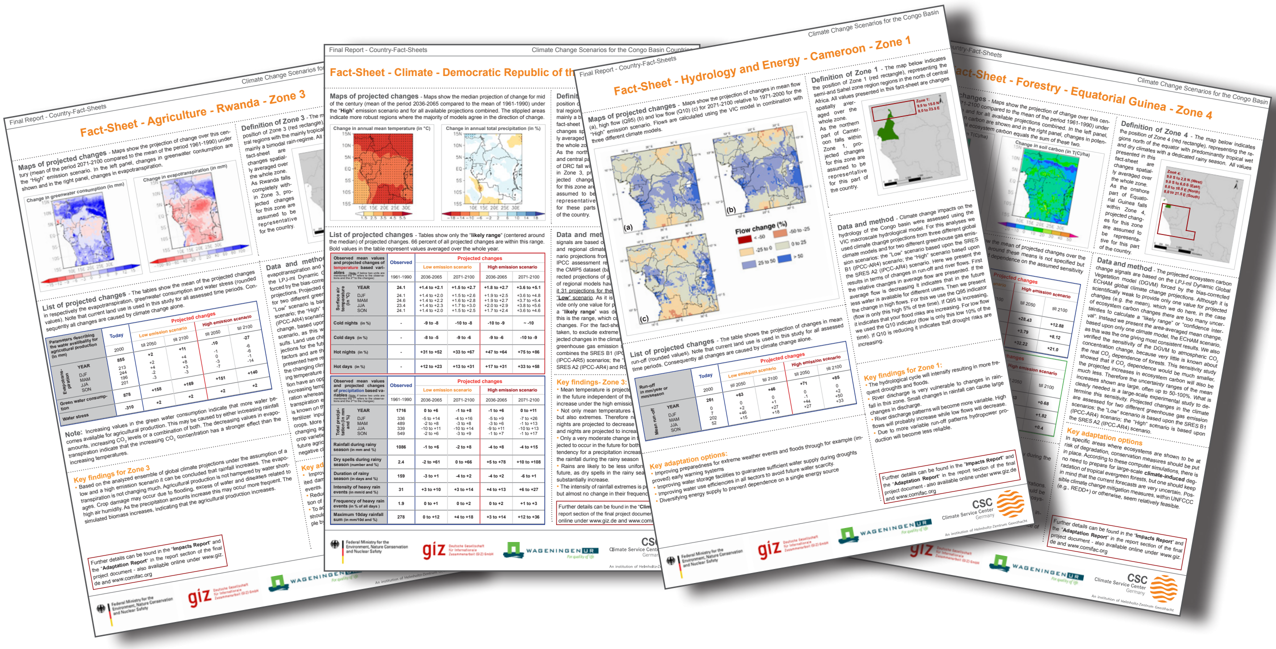
Climate Change Scenarios for the Congo Basin

interactive pdf-document of available

Country Fact-Sheets



How to use this document:

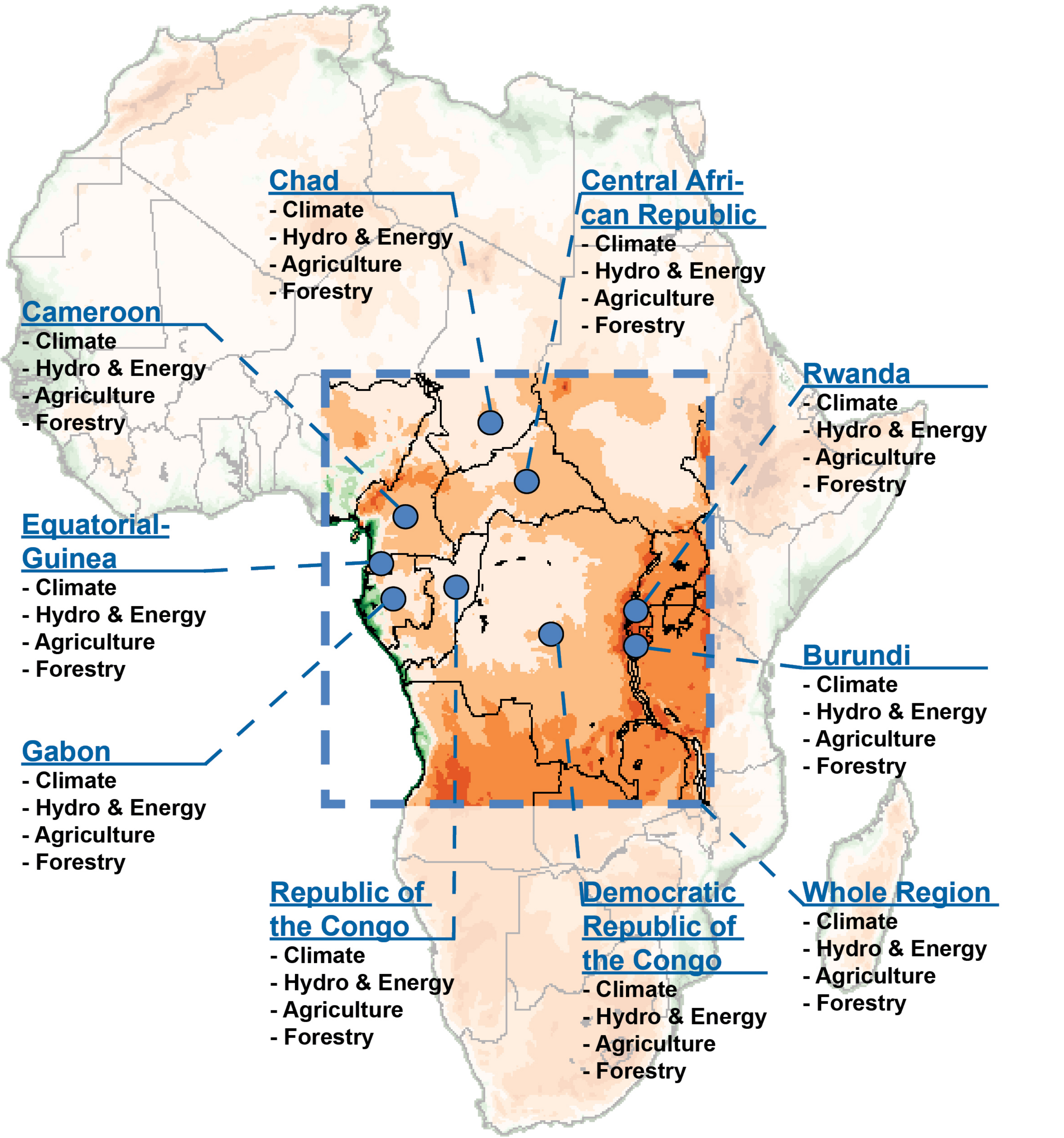
This document assembles fact-sheets summarizing the major findings of the project „Climate Change Scenarios for the Congo Basin“ for different sectors (climate, hydrology and energy, agriculture and forests) on a country level. The document is a click document - just click on this page to navigate to the overview page, where all available fact-sheets are listed. To select a fact-sheet, just click on the respective sector below the countries - then the chosen fact-sheet will open. You can zoom in using the standard tools of your pdf-viewer. If you click once more either you switch to the next page of the fact-sheet or, if you are already at the last page, you will jump back to the overview page.

Contact: andreas.haensler@hzg.de (climate fact-sheets) or fulco.ludwig@wur.nl (others)

On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Overview of available fact-sheets

To open a fact-sheet just click on one of the sectors listed below the respective countries



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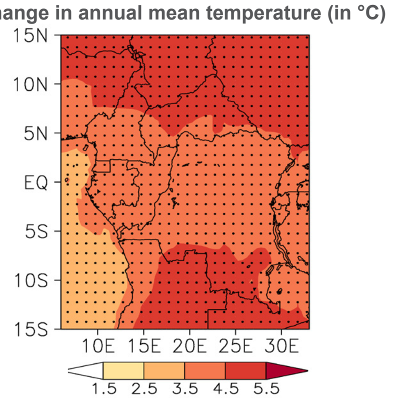
Fact-Sheet - Climate - Regional - Zone 1

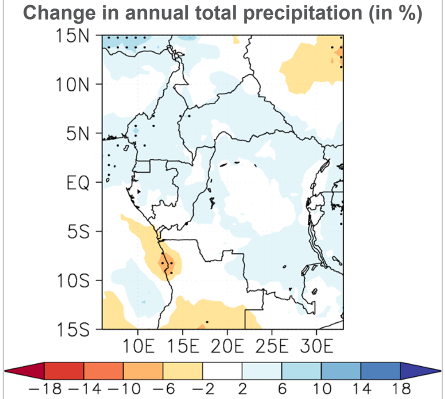
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

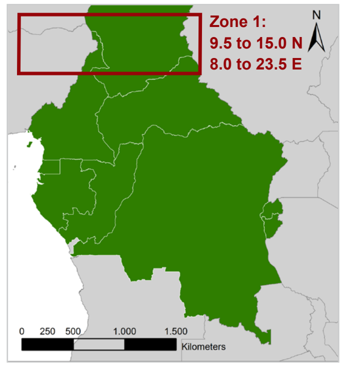


Change in annual total precipitation (in %)



Definition of Zone 1

- The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

- Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**27.2**	**+1.5 to +2.3**	**+1.9 to +3.1**	**+2.0 to +3.0**	**+3.8 to +5.7**
	DJF	23.5	+1.4 to +2.1	+1.7 to +2.9	+1.9 to +2.8	+3.7 to +5.2
	MAM	30.3	+1.7 to +2.4	+1.8 to +3.2	+2.1 to +3.1	+4.2 to +5.6
	JJA	28.2	+1.5 to +2.4	+2.0 to +3.3	+2.0 to +3.0	+3.6 to +6.0
	SON	26.8	+1.6 to +2.3	+2.0 to +3.1	+2.0 to +2.9	+4.0 to +6.0
Cold nights (in %)		-	**-8 to -6**	**-9 to -6**	**-8 to -7**	**-10 to -9**
Cold days (in %)		-	**-6 to -5**	**-8 to -6**	**-8 to -6**	**-9 to -9**
Hot nights (in %)		-	**+18 to +30**	**+19 to +38**	**+22 to +35**	**+47 to +54**
Hot days (in %)		-	**+10 to +17**	**+12 to +26**	**+13 to +23**	**+22 to +46**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**672**	**-9 to +17**	**-9 to +14**	**-4 to +14**	**-14 to +28**
	DJF	0.4	-19 to +165	-12 to +257	-40 to +133	-40 to +178
	MAM	54	-19 to +11	-16 to +11	-21 to +9	-26 to +11
	JJA	492	-10 to +18	-11 to +13	-6 to +16	-16 to +22
	SON	123	-13 to +34	-12 to +36	-7 to +29	-14 to +66
Rainfall during rainy season (in mm and %)		**621**	**-10 to +15**	**-10 to +14**	**-4 to +14**	**-14 to +27**
Dry spells during rainy season (number and %)		**2.6**	**-10 to +29**	**-5 to +36**	**-23 to +39**	**-19 to +67**
Duration of rainy season (in days and %)		**106**	**-3 to +2**	**-4 to +4**	**-3 to +2**	**-4 to +3**
Intensity of heavy rain events (in mm/d and %)		**39**	**-2 to +19**	**-5 to +19**	**-2 to +17**	**-8 to +32**
Frequency of heavy rain events (in % of all days)		**0.7**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +1**
Maximum 10day rainfall sum (in mm/10d and %)		**295**	**-7 to +22**	**-7 to +19**	**-5 to +26**	**-4 to +46**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 1:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- A moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season.
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

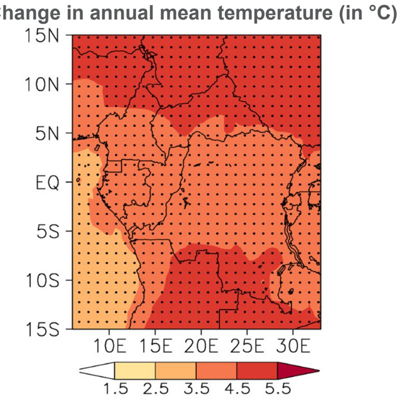
Further details can be found in the "**Climate Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Climate - Regional - Zone 2

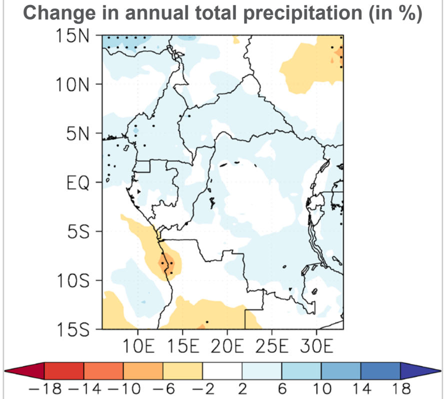
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

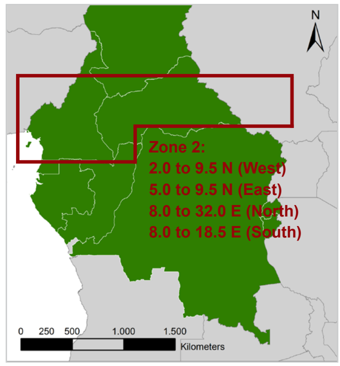


Change in annual total precipitation (in %)



Definition of Zone 2

- The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

- Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**25.6**	**+1.4 to +2.2**	**+1.6 to +2.8**	**+1.8 to +2.7**	**+3.7 to +5.1**
	DJF	24.8	+1.4 to +2.1	+1.6 to +2.9	+2.0 to +2.7	+3.8 to +5.1
	MAM	27.3	+1.4 to +2.2	+1.7 to +3.0	+1.9 to +2.9	+3.9 to +5.5
	JJA	25.0	+1.4 to +2.1	+1.7 to +2.8	+1.8 to +2.7	+3.5 to +5.2
	SON	25.1	+1.4 to +2.0	+1.6 to +2.6	+1.8 to +2.6	+3.7 to +4.9
Cold nights (in %)		-	**-8 to -6**	**-9 to -6**	**-9 to -8**	**-10 to -9**
Cold days (in%)		-	**-8 to -6**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)		-	**+27 to +43**	**+30 to +58**	**+39 to +54**	**+67 to +76**
Hot days (in %)		-	**+10 to +18**	**+11 to +23**	**+13 to +24**	**+26 to +48**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**1488**	**-2 to +7**	**-2 to +8**	**-3 to +7**	**-6 to +12**
	DJF	13	-12 to +54	-15 to +56	-17 to +47	-14 to +118
	MAM	336	-7 to +5	-5 to +6	-8 to +3	-10 to +12
	JJA	633	-5 to +6	-5 to +8	-4 to +9	-8 to +13
	SON	477	-1 to +10	-1 to +13	+1 to +10	+1 to +23
Rainfall during rainy season (in mm and %)		**1228**	**-5 to +6**	**-3 to +6**	**-4 to +6**	**-8 to +12**
Dry spells during rainy season (number and %)		**2.0**	**-11 to +57**	**-7 to +60**	**-3 to +88**	**+11 to +141**
Duration of rainy season (in days and %)		**164**	**-3 to +1**	**-3 to +1**	**-4 to +1**	**-7 to 0**
Intensity of heavy rain events (in mm/d and %)		**35**	**0 to +10**	**0 to +14**	**+2 to +14**	**+1 to +27**
Frequency of heavy rain events (in % of all days)		**1.5**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**277**	**-2 to +15**	**+1 to +17**	**+2 to +19**	**+13 to +38**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 2:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
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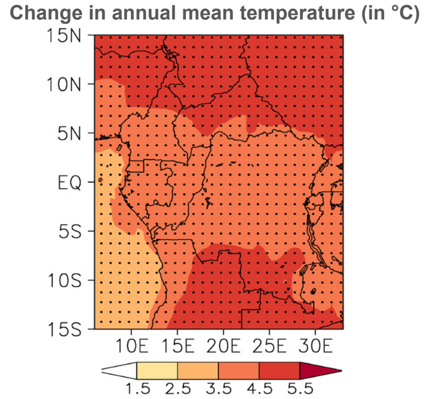
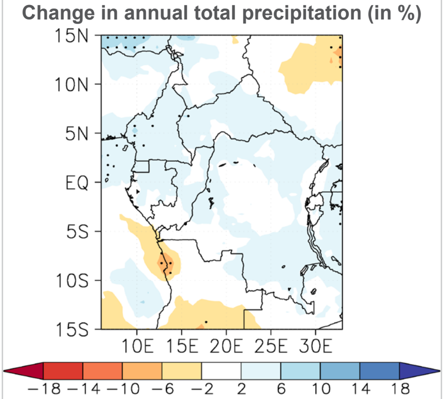
Fact-Sheet - Climate - Regional - Zone 3

Maps of projected changes

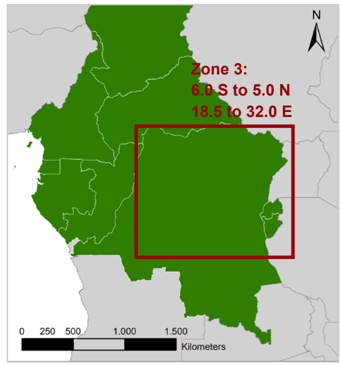
Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.





Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**24.1**	**+1.4 to +2.1**	**+1.5 to +2.7**	**+1.8 to +2.7**	**+3.6 to +5.1**
	DJF	24.1	+1.4 to +2.0	+1.5 to +2.6	+1.9 to +2.5	+3.6 to +4.8
	MAM	24.6	+1.4 to +2.2	+1.6 to +2.8	+1.9 to +2.7	+3.7 to +5.4
	JJA	23.4	+1.4 to +2.3	+1.7 to +3.0	+2.0 to +2.9	+3.8 to +5.6
	SON	24.1	+1.4 to +2.0	+1.5 to +2.5	+1.7 to +2.4	+3.6 to +4.6
Cold nights (in %)		-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)		-	**-8 to -5**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)		-	**+31 to +52**	**+33 to +67**	**+47 to +64**	**+75 to +86**
Hot days (in %)		-	**+12 to +23**	**+13 to +31**	**+17 to +31**	**+33 to +58**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**1716**	**0 to +6**	**-1 to +8**	**-1 to +6**	**0 to +11**
	DJF	336	-5 to +14	-4 to +16	-5 to +9	-7 to +26
	MAM	489	-2 to +8	-3 to +8	-3 to +6	-1 to +13
	JJA	339	-10 to +11	-10 to +14	-9 to +11	-10 to +13
	SON	549	-2 to +6	-3 to +9	-1 to +7	-1 to +17
Rainfall during rainy season (in mm and %)		**1086**	**-1 to +6**	**-2 to +8**	**-4 to +8**	**-4 to +15**
Dry spells during rainy season (number and %)		**2.4**	**-2 to +61**	**0 to +66**	**+5 to +78**	**+10 to +108**
Duration of rainy season (in days and %)		**159**	**-3 to +1**	**-4 to +2**	**-4 to +2**	**-6 to +1**
Intensity of heavy rain events (in mm/d and %)		**31**	**+3 to +10**	**+3 to +14**	**+4 to +13**	**+6 to +27**
Frequency of heavy rain events (in % of all days)		**1.9**	**0 to +1**	**0 to +2**	**0 to +2**	**+1 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**278**	**0 to +12**	**+4 to +18**	**+3 to +14**	**+12 to +36**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 3:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a clear tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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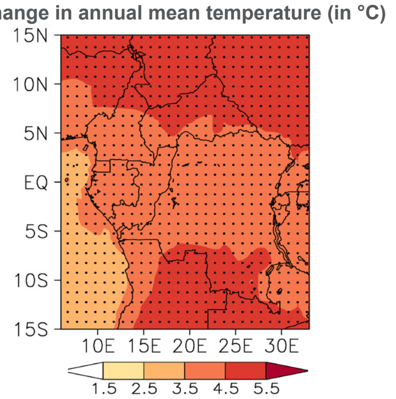
Fact-Sheet - Climate - Regional - Zone 4

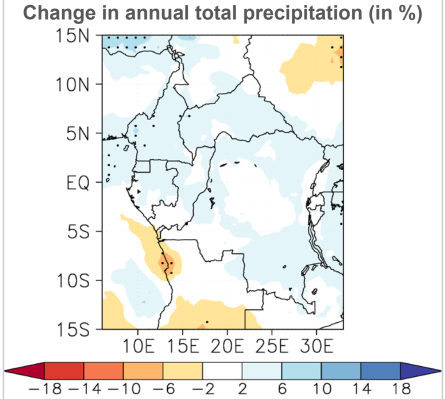
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

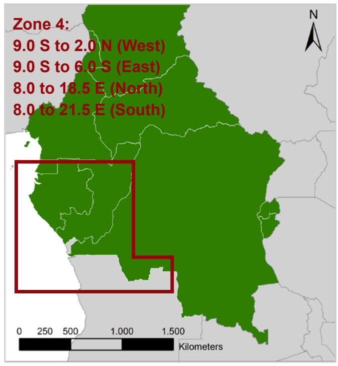


Change in annual total precipitation (in %)



Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**24.6**	**+1.4 to +2.0**	**+1.5 to +2.6**	**+1.8 to +2.5**	**+3.6 to +4.7**
	DJF	25.2	+1.3 to +1.9	+1.4 to +2.4	+1.8 to +2.3	+3.7 to +4.4
	MAM	25.5	+1.3 to +2.1	+1.5 to +2.7	+1.8 to +2.5	+3.5 to +4.7
	JJA	22.9	+1.5 to +2.1	+1.5 to +2.8	+1.9 to +2.6	+3.7 to +5.1
	SON	24.7	+1.4 to +2.1	+1.4 to +2.6	+1.8 to +2.5	+3.6 to +4.6
Cold nights (in %)		-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)		-	**-9 to -6**	**-9 to -6**	**-9 to -7**	**-10 to -9**
Hot nights (in %)		-	**+36 to +58**	**+40 to +69**	**+52 to +67**	**+78 to +87**
Hot days (in %)		-	**+17 to +31**	**+19 to +40**	**+24 to +39**	**+46 to +69**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**2100**	**-3 to +6**	**-3 to +6**	**-5 to +7**	**-8 to +10**
	DJF	567	-5 to +7	-6 to +11	-7 to +7	-9 to +15
	MAM	696	-2 to +5	-3 to +7	-3 to +8	-2 to +12
	JJA	114	-14 to +9	-14 to +8	-17 to +16	-27 to +3
	SON	720	-4 to +8	-4 to +6	-8 to +11	-10 to +12
Rainfall during rainy season (in mm and %)		**1507**	**-3 to +7**	**-3 to +10**	**-5 to +11**	**-9 to +17**
Dry spells during rainy season (number and %)		**3.3**	**0 to +71**	**+1 to +74**	**-6 to +77**	**0 to +126**
Duration of rainy season (in days and %)		**165**	**-2 to +2**	**-4 to +3**	**-4 to +3**	**-7 to +1**
Intensity of heavy rain events (in mm/d and %)		**46**	**+2 to +10**	**+4 to +14**	**+2 to +13**	**+5 to +25**
Frequency of heavy rain events (in % of all days)		**1.6**	**0 to +1**	**0 to +2**	**0 to +2**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**363**	**-2 to +14**	**+2 to +18**	**+1 to +17**	**+9 to +27**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 4:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

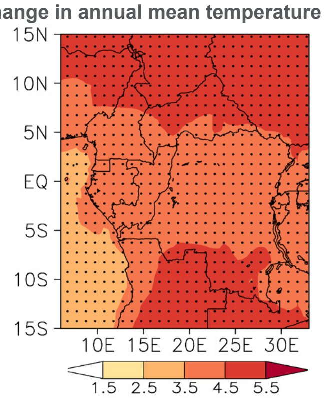
Further details can be found in the "**Climate Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Climate - Regional - Zone 5

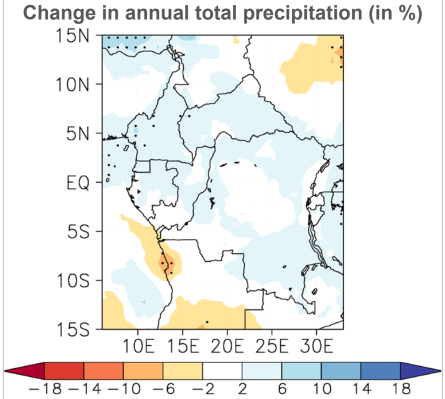
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

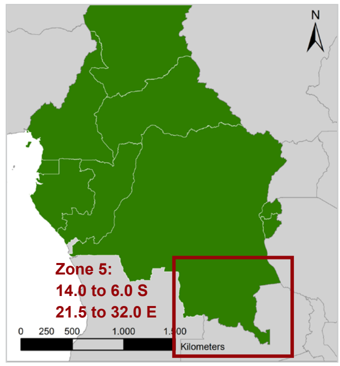


Change in annual total precipitation (in %)



Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**21.9**	**+1.5 to +2.2**	**+1.7 to +2.9**	**+1.9 to +2.7**	**+3.9 to +5.2**
	DJF	22.7	+1.3 to +1.9	+1.5 to +2.6	+1.7 to +2.5	+3.5 to +4.9
	MAM	22.1	+1.4 to +2.3	+1.6 to +2.9	+1.8 to +2.7	+3.7 to +5.3
	JJA	19.6	+1.6 to +2.4	+1.7 to +2.9	+2.1 to +2.9	+4.2 to +5.4
	SON	23.3	+1.7 to +2.3	+1.7 to +3.1	+2.1 to +3.0	+4.3 to +5.7
Cold nights (in %)		-	**-9 to -7**	**-10 to -8**	**-10 to -8**	**~ -10**
Cold days (in %)		-	**-8 to -5**	**-9 to -6**	**-8 to -6**	**-10 to -9**
Hot nights (in %)		-	**+23 to +36**	**+25 to +46**	**+29 to +46**	**+54 to +71**
Hot days (in %)		-	**+9 to +15**	**+10 to +23**	**+12 to +21**	**+27 to +51**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**1284**	**-4 to +5**	**-4 to +7**	**-3 to +7**	**-3 to +10**
	DJF	660	-1 to +6	0 to +7	+1 to +6	0 to +14
	MAM	333	-6 to +11	-7 to +15	-3 to +17	-1 to +27
	JJA	9	-36 to +20	-35 to +42	-29 to +20	-53 to +33
	SON	285	-12 to +2	-12 to -1	-11 to +2	-18 to +2
Rainfall during rainy season (in mm and %)		**1137**	**-4 to +3**	**-4 to +5**	**-3 to +5**	**-4 to +11**
Dry spells during rainy season (number and %)		**1.8**	**-11 to +64**	**-14 to +60**	**-19 to +68**	**-15 to +123**
Duration of rainy season (in days and %)		**154**	**-4 to -2**	**-5 to -1**	**-4 to 0**	**-6 to -1**
Intensity of heavy rain events (in mm/d and %)		**29**	**+3 to +10**	**+3 to +11**	**+5 to +12**	**+9 to +24**
Frequency of heavy rain events (in % of all days)		**1.5**	**0 to +1**	**0 to +1**	**0 to +1**	**+1 to +2**
Maximum 10day rainfall sum (in mm/10d and %)		**264**	**+1 to +11**	**+2 to +16**	**+3 to +17**	**+12 to +38**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 5:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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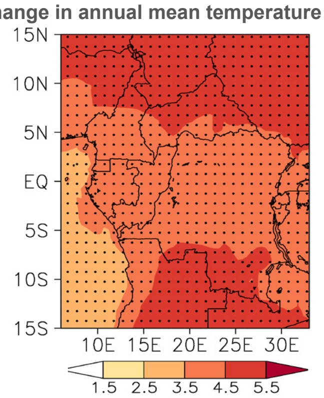
Fact-Sheet - Climate - Gabon - Zone 4

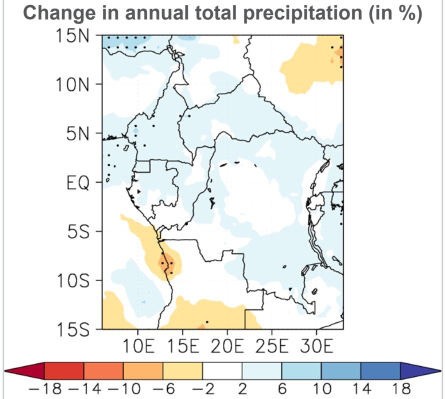
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

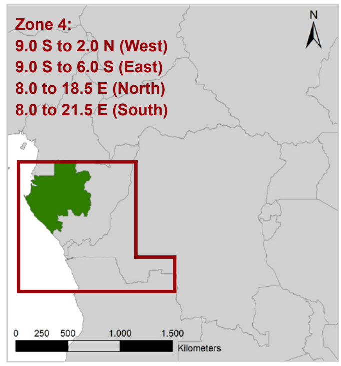


Change in annual total precipitation (in %)



Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Gabon falls completely within Zone 4, projected changes for this zone are assumed to be representative for the country.



List of projected changes

- Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**24.6**	**+1.4 to +2.0**	**+1.5 to +2.6**	**+1.8 to +2.5**	**+3.6 to +4.7**
	DJF	25.2	+1.3 to +1.9	+1.4 to +2.4	+1.8 to +2.3	+3.7 to +4.4
	MAM	25.5	+1.3 to +2.1	+1.5 to +2.7	+1.8 to +2.5	+3.5 to +4.7
	JJA	22.9	+1.5 to +2.1	+1.5 to +2.8	+1.9 to +2.6	+3.7 to +5.1
	SON	24.7	+1.4 to +2.1	+1.4 to +2.6	+1.8 to +2.5	+3.6 to +4.6
Cold nights (in %)		-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)		-	**-9 to -6**	**-9 to -6**	**-9 to -7**	**-10 to -9**
Hot nights (in %)		-	**+36 to +58**	**+40 to +69**	**+52 to +67**	**+78 to +87**
Hot days (in %)		-	**+17 to +31**	**+19 to +40**	**+24 to +39**	**+46 to +69**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**2100**	**-3 to +6**	**-3 to +6**	**-5 to +7**	**-8 to +10**
	DJF	567	-5 to +7	-6 to +11	-7 to +7	-9 to +15
	MAM	696	-2 to +5	-3 to +7	-3 to +8	-2 to +12
	JJA	114	-14 to +9	-14 to +8	-17 to +16	-27 to +3
	SON	720	-4 to +8	-4 to +6	-8 to +11	-10 to +12
Rainfall during rainy season (in mm and %)		**1507**	**-3 to +7**	**-3 to +10**	**-5 to +11**	**-9 to +17**
Dry spells during rainy season (number and %)		**3.3**	**0 to +71**	**+1 to +74**	**-6 to +77**	**0 to +126**
Duration of rainy season (in days and %)		**165**	**-2 to +2**	**-4 to +3**	**-4 to +3**	**-7 to +1**
Intensity of heavy rain events (in mm/d and %)		**46**	**+2 to +10**	**+4 to +14**	**+2 to +13**	**+5 to +25**
Frequency of heavy rain events (in % of all days)		**1.6**	**0 to +1**	**0 to +2**	**0 to +2**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**363**	**-2 to +14**	**+2 to +18**	**+1 to +17**	**+9 to +27**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 4:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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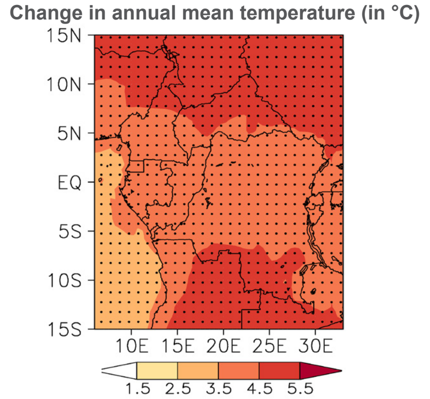
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Climate - Burundi - Zone 3

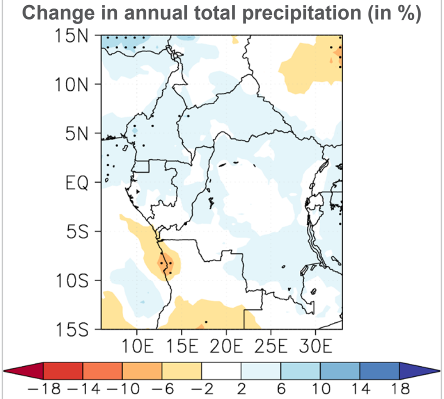
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

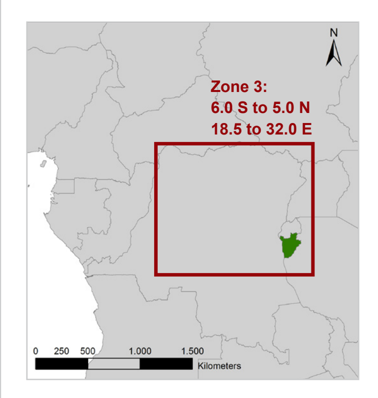


Change in annual total precipitation (in %)



Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Burundi falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**24.1**	**+1.4 to +2.1**	**+1.5 to +2.7**	**+1.8 to +2.7**	**+3.6 to +5.1**
	DJF	24.1	+1.4 to +2.0	+1.5 to +2.6	+1.9 to +2.5	+3.6 to +4.8
	MAM	24.6	+1.4 to +2.2	+1.6 to +2.8	+1.9 to +2.7	+3.7 to +5.4
	JJA	23.4	+1.4 to +2.3	+1.7 to +3.0	+2.0 to +2.9	+3.8 to +5.6
	SON	24.1	+1.4 to +2.0	+1.5 to +2.5	+1.7 to +2.4	+3.6 to +4.6
Cold nights (in %)		-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)		-	**-8 to -5**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)		-	**+31 to +52**	**+33 to +67**	**+47 to +64**	**+75 to +86**
Hot days (in %)		-	**+12 to +23**	**+13 to +31**	**+17 to +31**	**+33 to +58**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**1716**	**0 to +6**	**-1 to +8**	**-1 to +6**	**0 to +11**
	DJF	336	-5 to +14	-4 to +16	-5 to +9	-7 to +26
	MAM	489	-2 to +8	-3 to +8	-3 to +6	-1 to +13
	JJA	339	-10 to +11	-10 to +14	-9 to +11	-10 to +13
	SON	549	-2 to +6	-3 to +9	-1 to +7	-1 to +17
Rainfall during rainy season (in mm and %)		**1086**	**-1 to +6**	**-2 to +8**	**-4 to +8**	**-4 to +15**
Dry spells during rainy season (number and %)		**2.4**	**-2 to +61**	**0 to +66**	**+5 to +78**	**+10 to +108**
Duration of rainy season (in days and %)		**159**	**-3 to +1**	**-4 to +2**	**-4 to +2**	**-6 to +1**
Intensity of heavy rain events (in mm/d and %)		**31**	**+3 to +10**	**+3 to +14**	**+4 to +13**	**+6 to +27**
Frequency of heavy rain events (in % of all days)		**1.9**	**0 to +1**	**0 to +2**	**0 to +2**	**+1 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**278**	**0 to +12**	**+4 to +18**	**+3 to +14**	**+12 to +36**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 3:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a clear tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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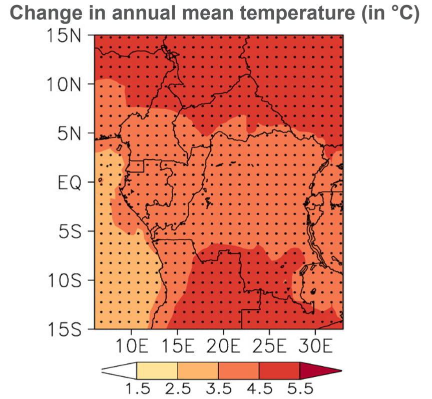
Fact-Sheet - Climate - Cameroon - Zone 1

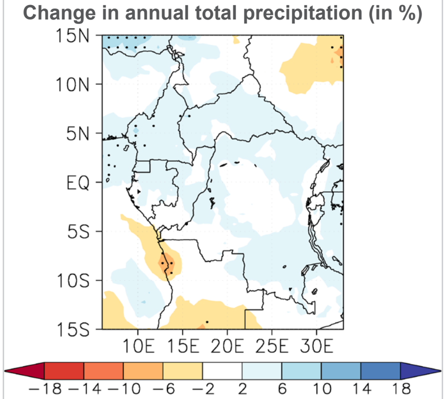
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)



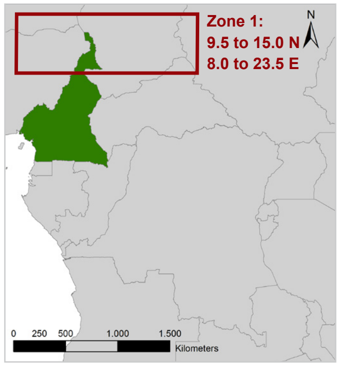
Change in annual total precipitation (in %)



Definition of Zone 1

- The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the northern part of Cameroon falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**27.2**	**+1.5 to +2.3**	**+1.9 to +3.1**	**+2.0 to +3.0**	**+3.8 to +5.7**
	DJF	23.5	+1.4 to +2.1	+1.7 to +2.9	+1.9 to +2.8	+3.7 to +5.2
	MAM	30.3	+1.7 to +2.4	+1.8 to +3.2	+2.1 to +3.1	+4.2 to +5.6
	JJA	28.2	+1.5 to +2.4	+2.0 to +3.3	+2.0 to +3.0	+3.6 to +6.0
	SON	26.8	+1.6 to +2.3	+2.0 to +3.1	+2.0 to +2.9	+4.0 to +6.0
Cold nights (in %)		-	**-8 to -6**	**-9 to -6**	**-8 to -7**	**-10 to -9**
Cold days (in %)		-	**-6 to -5**	**-8 to -6**	**-8 to -6**	**-9 to -9**
Hot nights (in %)		-	**+18 to +30**	**+19 to +38**	**+22 to +35**	**+47 to +54**
Hot days (in %)		-	**+10 to +17**	**+12 to +26**	**+13 to +23**	**+22 to +46**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**672**	**-9 to +17**	**-9 to +14**	**-4 to +14**	**-14 to +28**
	DJF	0.4	-19 to +165	-12 to +257	-40 to +133	-40 to +178
	MAM	54	-19 to +11	-16 to +11	-21 to +9	-26 to +11
	JJA	492	-10 to +18	-11 to +13	-6 to +16	-16 to +22
	SON	123	-13 to +34	-12 to +36	-7 to +29	-14 to +66
Rainfall during rainy season (in mm and %)		**621**	**-10 to +15**	**-10 to +14**	**-4 to +14**	**-14 to +27**
Dry spells during rainy season (number and %)		**2.6**	**-10 to +29**	**-5 to +36**	**-23 to +39**	**-19 to +67**
Duration of rainy season (in days and %)		**106**	**-3 to +2**	**-4 to +4**	**-3 to +2**	**-4 to +3**
Intensity of heavy rain events (in mm/d and %)		**39**	**-2 to +19**	**-5 to +19**	**-2 to +17**	**-8 to +32**
Frequency of heavy rain events (in % of all days)		**0.7**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +1**
Maximum 10day rainfall sum (in mm/10d and %)		**295**	**-7 to +22**	**-7 to +19**	**-5 to +26**	**-4 to +46**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 1:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- A moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season.
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

Further details can be found in the "**Climate Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

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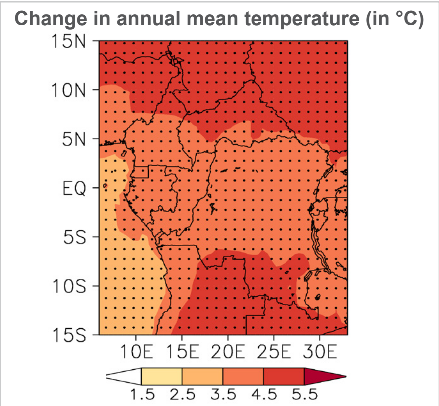
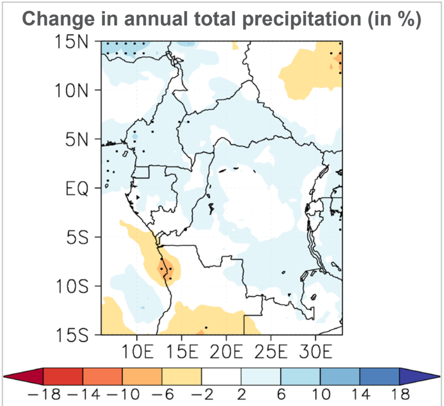
Fact-Sheet - Climate - Cameroon - Zone 2

Maps of projected changes

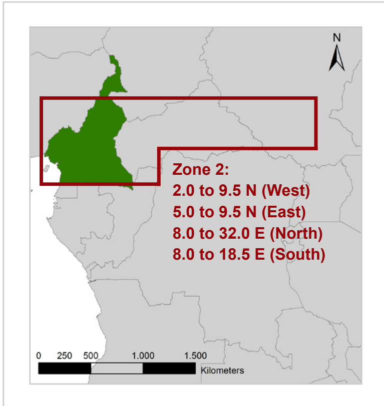
Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.





Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of Cameroon falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) **YEAR**	**25.6**	**+1.4 to +2.2**	**+1.6 to +2.8**	**+1.8 to +2.7**	**+3.7 to +5.1**
DJF	24.8	+1.4 to +2.1	+1.6 to +2.9	+2.0 to +2.7	+3.8 to +5.1
MAM	27.3	+1.4 to +2.2	+1.7 to +3.0	+1.9 to +2.9	+3.9 to +5.5
JJA	25.0	+1.4 to +2.1	+1.7 to +2.8	+1.8 to +2.7	+3.5 to +5.2
SON	25.1	+1.4 to +2.0	+1.6 to +2.6	+1.8 to +2.6	+3.7 to +4.9
Cold nights (in %)	-	**-8 to -6**	**-9 to -6**	**-9 to -8**	**-10 to -9**
Cold days (in%)	-	**-8 to -6**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)	-	**+27 to +43**	**+30 to +58**	**+39 to +54**	**+67 to +76**
Hot days (in %)	-	**+10 to +18**	**+11 to +23**	**+13 to +24**	**+26 to +48**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) **YEAR**	**1488**	**-2 to +7**	**-2 to +8**	**-3 to +7**	**-6 to +12**
DJF	13	-12 to +54	-15 to +56	-17 to +47	-14 to +118
MAM	336	-7 to +5	-5 to +6	-8 to +3	-10 to +12
JJA	633	-5 to +6	-5 to +8	-4 to +9	-8 to +13
SON	477	-1 to +10	-1 to +13	+1 to +10	+1 to +23
Rainfall during rainy season (in mm and %)	**1228**	**-5 to +6**	**-3 to +6**	**-4 to +6**	**-8 to +12**
Dry spells during rainy season (number and %)	**2.0**	**-11 to +57**	**-7 to +60**	**-3 to +88**	**+11 to +141**
Duration of rainy season (in days and %)	**164**	**-3 to +1**	**-3 to +1**	**-4 to +1**	**-7 to 0**
Intensity of heavy rain events (in mm/d and %)	**35**	**0 to +10**	**0 to +14**	**+2 to +14**	**+1 to +27**
Frequency of heavy rain events (in % of all days)	**1.5**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**277**	**-2 to +15**	**+1 to +17**	**+2 to +19**	**+13 to +38**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 2:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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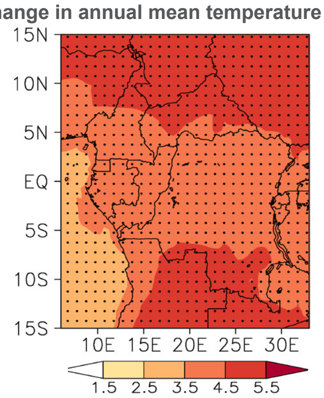
Fact-Sheet - Climate - Chad - Zone 1

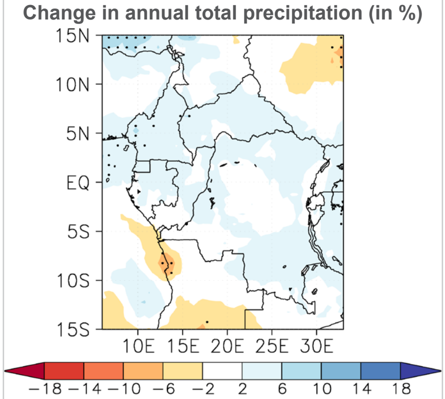
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

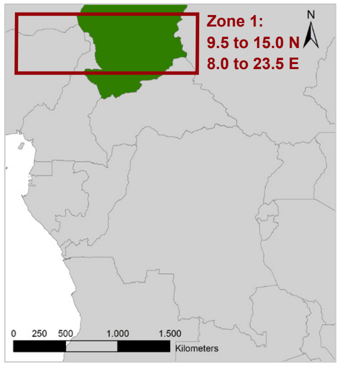


Change in annual total precipitation (in %)



Definition of Zone 1

- The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the central part of Chad falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) **YEAR**	**27.2**	**+1.5 to +2.3**	**+1.9 to +3.1**	**+2.0 to +3.0**	**+3.8 to +5.7**
DJF	23.5	+1.4 to +2.1	+1.7 to +2.9	+1.9 to +2.8	+3.7 to +5.2
MAM	30.3	+1.7 to +2.4	+1.8 to +3.2	+2.1 to +3.1	+4.2 to +5.6
JJA	28.2	+1.5 to +2.4	+2.0 to +3.3	+2.0 to +3.0	+3.6 to +6.0
SON	26.8	+1.6 to +2.3	+2.0 to +3.1	+2.0 to +2.9	+4.0 to +6.0
Cold nights (in %)	-	**-8 to -6**	**-9 to -6**	**-8 to -7**	**-10 to -9**
Cold days (in %)	-	**-6 to -5**	**-8 to -6**	**-8 to -6**	**-9 to -9**
Hot nights (in %)	-	**+18 to +30**	**+19 to +38**	**+22 to +35**	**+47 to +54**
Hot days (in %)	-	**+10 to +17**	**+12 to +26**	**+13 to +23**	**+22 to +46**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) **YEAR**	**672**	**-9 to +17**	**-9 to +14**	**-4 to +14**	**-14 to +28**
DJF	0.4	-19 to +165	-12 to +257	-40 to +133	-40 to +178
MAM	54	-19 to +11	-16 to +11	-21 to +9	-26 to +11
JJA	492	-10 to +18	-11 to +13	-6 to +16	-16 to +22
SON	123	-13 to +34	-12 to +36	-7 to +29	-14 to +66
Rainfall during rainy season (in mm and %)	**621**	**-10 to +15**	**-10 to +14**	**-4 to +14**	**-14 to +27**
Dry spells during rainy season (number and %)	**2.6**	**-10 to +29**	**-5 to +36**	**-23 to +39**	**-19 to +67**
Duration of rainy season (in days and %)	**106**	**-3 to +2**	**-4 to +4**	**-3 to +2**	**-4 to +3**
Intensity of heavy rain events (in mm/d and %)	**39**	**-2 to +19**	**-5 to +19**	**-2 to +17**	**-8 to +32**
Frequency of heavy rain events (in % of all days)	**0.7**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +1**
Maximum 10day rainfall sum (in mm/10d and %)	**295**	**-7 to +22**	**-7 to +19**	**-5 to +26**	**-4 to +46**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 1:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- A moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season.
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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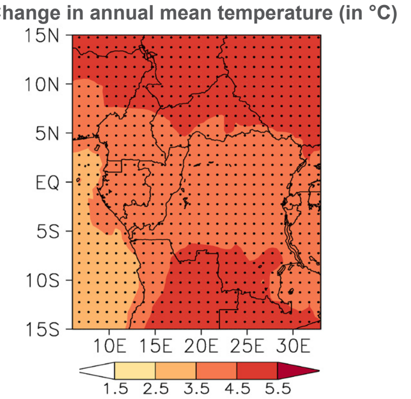
Fact-Sheet - Climate - Democratic Republic of the Congo (DRC)- Zone 3

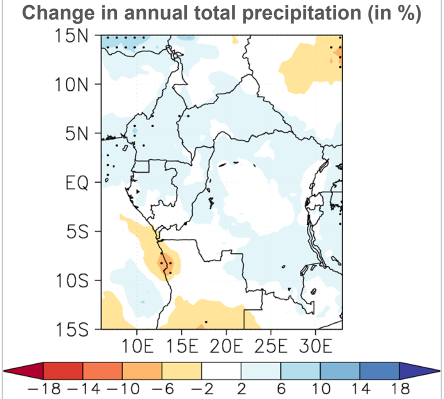
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

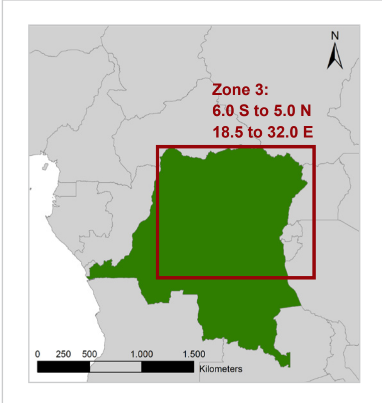


Change in annual total precipitation (in %)



Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the northern and central parts of DRC fall within Zone 3, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) **YEAR**	**24.1**	**+1.4 to +2.1**	**+1.5 to +2.7**	**+1.8 to +2.7**	**+3.6 to +5.1**
DJF	24.1	+1.4 to +2.0	+1.5 to +2.6	+1.9 to +2.5	+3.6 to +4.8
MAM	24.6	+1.4 to +2.2	+1.6 to +2.8	+1.9 to +2.7	+3.7 to +5.4
JJA	23.4	+1.4 to +2.3	+1.7 to +3.0	+2.0 to +2.9	+3.8 to +5.6
SON	24.1	+1.4 to +2.0	+1.5 to +2.5	+1.7 to +2.4	+3.6 to +4.6
Cold nights (in %)	-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)	-	**-8 to -5**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)	-	**+31 to +52**	**+33 to +67**	**+47 to +64**	**+75 to +86**
Hot days (in %)	-	**+12 to +23**	**+13 to +31**	**+17 to +31**	**+33 to +58**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) **YEAR**	**1716**	**0 to +6**	**-1 to +8**	**-1 to +6**	**0 to +11**
DJF	336	-5 to +14	-4 to +16	-5 to +9	-7 to +26
MAM	489	-2 to +8	-3 to +8	-3 to +6	-1 to +13
JJA	339	-10 to +11	-10 to +14	-9 to +11	-10 to +13
SON	549	-2 to +6	-3 to +9	-1 to +7	-1 to +17
Rainfall during rainy season (in mm and %)	**1086**	**-1 to +6**	**-2 to +8**	**-4 to +8**	**-4 to +15**
Dry spells during rainy season (number and %)	**2.4**	**-2 to +61**	**0 to +66**	**+5 to +78**	**+10 to +108**
Duration of rainy season (in days and %)	**159**	**-3 to +1**	**-4 to +2**	**-4 to +2**	**-6 to +1**
Intensity of heavy rain events (in mm/d and %)	**31**	**+3 to +10**	**+3 to +14**	**+4 to +13**	**+6 to +27**
Frequency of heavy rain events (in % of all days)	**1.9**	**0 to +1**	**0 to +2**	**0 to +2**	**+1 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**278**	**0 to +12**	**+4 to +18**	**+3 to +14**	**+12 to +36**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 3:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a clear tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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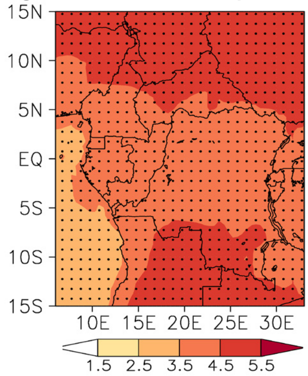
Fact-Sheet - Climate - Democratic Republic of the Congo (DRC)- Zone 4

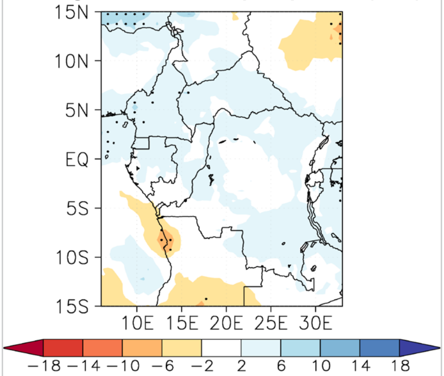
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the “**High**” emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

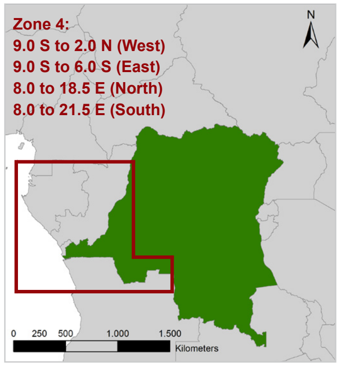


Change in annual total precipitation (in %)



Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the western part of DRC falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show only the “**likely range**“ (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) **YEAR**	**24.6**	**+1.4 to +2.0**	**+1.5 to +2.6**	**+1.8 to +2.5**	**+3.6 to +4.7**
DJF	25.2	+1.3 to +1.9	+1.4 to +2.4	+1.8 to +2.3	+3.7 to +4.4
MAM	25.5	+1.3 to +2.1	+1.5 to +2.7	+1.8 to +2.5	+3.5 to +4.7
JJA	22.9	+1.5 to +2.1	+1.5 to +2.8	+1.9 to +2.6	+3.7 to +5.1
SON	24.7	+1.4 to +2.1	+1.4 to +2.6	+1.8 to +2.5	+3.6 to +4.6
Cold nights (in %)	-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)	-	**-9 to -6**	**-9 to -6**	**-9 to -7**	**-10 to -9**
Hot nights (in %)	-	**+36 to +58**	**+40 to +69**	**+52 to +67**	**+78 to +87**
Hot days (in %)	-	**+17 to +31**	**+19 to +40**	**+24 to +39**	**+46 to +69**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) **YEAR**	**2100**	**-3 to +6**	**-3 to +6**	**-5 to +7**	**-8 to +10**
DJF	567	-5 to +7	-6 to +11	-7 to +7	-9 to +15
MAM	696	-2 to +5	-3 to +7	-3 to +8	-2 to +12
JJA	114	-14 to +9	-14 to +8	-17 to +16	-27 to +3
SON	720	-4 to +8	-4 to +6	-8 to +11	-10 to +12
Rainfall during rainy season (in mm and %)	**1507**	**-3 to +7**	**-3 to +10**	**-5 to +11**	**-9 to +17**
Dry spells during rainy season (number and %)	**3.3**	**0 to +71**	**+1 to +74**	**-6 to +77**	**0 to +126**
Duration of rainy season (in days and %)	**165**	**-2 to +2**	**-4 to +3**	**-4 to +3**	**-7 to +1**
Intensity of heavy rain events (in mm/d and %)	**46**	**+2 to +10**	**+4 to +14**	**+2 to +13**	**+5 to +25**
Frequency of heavy rain events (in % of all days)	**1.6**	**0 to +1**	**0 to +2**	**0 to +2**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**363**	**-2 to +14**	**+2 to +18**	**+1 to +17**	**+9 to +27**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the “**High**” and 46 projections for the “**Low**“ scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a “**likely range**” was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “**Low**“ scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the “**High**“ scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 4:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

Further details can be found in the “**Climate Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

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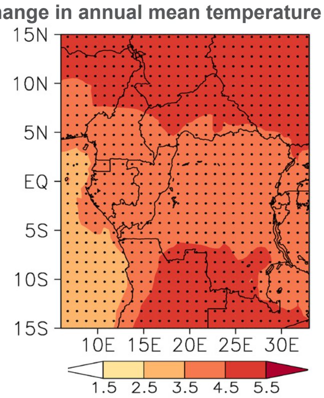
Fact-Sheet - Climate - Democratic Republic of the Congo (DRC)- Zone 5

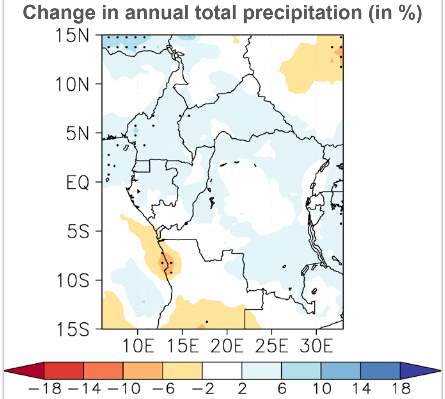
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)



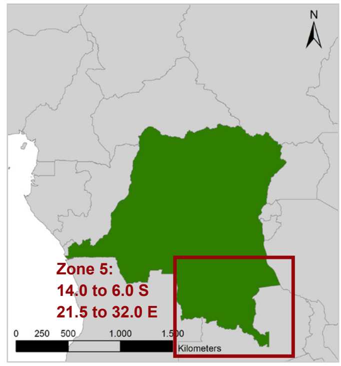
Change in annual total precipitation (in %)



Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the southern part of DRC falls within Zone 5, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) YEAR	**21.9**	**+1.5 to +2.2**	**+1.7 to +2.9**	**+1.9 to +2.7**	**+3.9 to +5.2**
DJF	22.7	+1.3 to +1.9	+1.5 to +2.6	+1.7 to +2.5	+3.5 to +4.9
MAM	22.1	+1.4 to +2.3	+1.6 to +2.9	+1.8 to +2.7	+3.7 to +5.3
JJA	19.6	+1.6 to +2.4	+1.7 to +2.9	+2.1 to +2.9	+4.2 to +5.4
SON	23.3	+1.7 to +2.3	+1.7 to +3.1	+2.1 to +3.0	+4.3 to +5.7
Cold nights (in %)	-	**-9 to -7**	**-10 to -8**	**-10 to -8**	**~ -10**
Cold days (in %)	-	**-8 to -5**	**-9 to -6**	**-8 to -6**	**-10 to -9**
Hot nights (in %)	-	**+23 to +36**	**+25 to +46**	**+29 to +46**	**+54 to +71**
Hot days (in %)	-	**+9 to +15**	**+10 to +23**	**+12 to +21**	**+27 to +51**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) YEAR	**1284**	**-4 to +5**	**-4 to +7**	**-3 to +7**	**-3 to +10**
DJF	660	-1 to +6	0 to +7	+1 to +6	0 to +14
MAM	333	-6 to +11	-7 to +15	-3 to +17	-1 to +27
JJA	9	-36 to +20	-35 to +42	-29 to +20	-53 to +33
SON	285	-12 to +2	-12 to -1	-11 to +2	-18 to +2
Rainfall during rainy season (in mm and %)	**1137**	**-4 to +3**	**-4 to +5**	**-3 to +5**	**-4 to +11**
Dry spells during rainy season (number and %)	**1.8**	**-11 to +64**	**-14 to +60**	**-19 to +68**	**-15 to +123**
Duration of rainy season (in days and %)	**154**	**-4 to -2**	**-5 to -1**	**-4 to 0**	**-6 to -1**
Intensity of heavy rain events (in mm/d and %)	**29**	**+3 to +10**	**+3 to +11**	**+5 to +12**	**+9 to +24**
Frequency of heavy rain events (in % of all days)	**1.5**	**0 to +1**	**0 to +1**	**0 to +1**	**+1 to +2**
Maximum 10day rainfall sum (in mm/10d and %)	**264**	**+1 to +11**	**+2 to +16**	**+3 to +17**	**+12 to +38**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 5:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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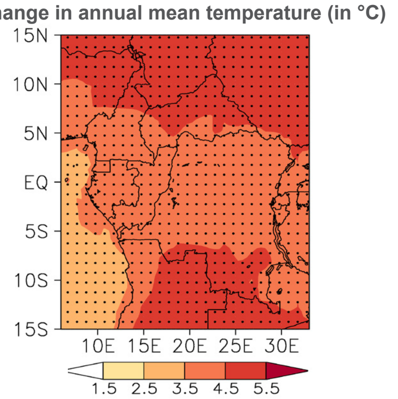
Fact-Sheet - Climate - Rwanda - Zone 3

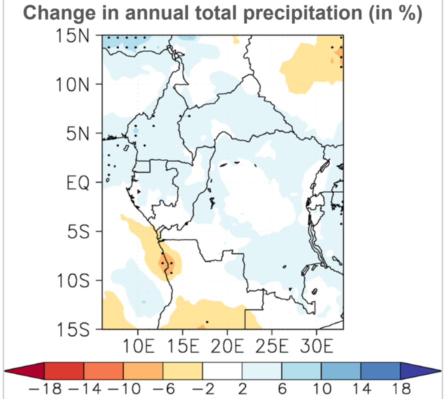
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

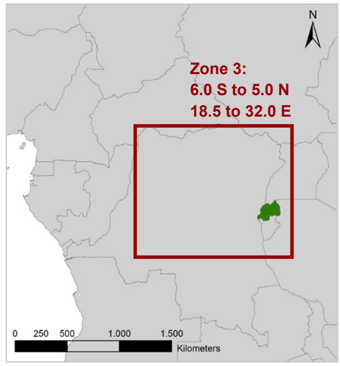


Change in annual total precipitation (in %)



Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Rwanda falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) YEAR	**24.1**	**+1.4 to +2.1**	**+1.5 to +2.7**	**+1.8 to +2.7**	**+3.6 to +5.1**
DJF	24.1	+1.4 to +2.0	+1.5 to +2.6	+1.9 to +2.5	+3.6 to +4.8
MAM	24.6	+1.4 to +2.2	+1.6 to +2.8	+1.9 to +2.7	+3.7 to +5.4
JJA	23.4	+1.4 to +2.3	+1.7 to +3.0	+2.0 to +2.9	+3.8 to +5.6
SON	24.1	+1.4 to +2.0	+1.5 to +2.5	+1.7 to +2.4	+3.6 to +4.6
Cold nights (in %)	-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)	-	**-8 to -5**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)	-	**+31 to +52**	**+33 to +67**	**+47 to +64**	**+75 to +86**
Hot days (in %)	-	**+12 to +23**	**+13 to +31**	**+17 to +31**	**+33 to +58**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) YEAR	**1716**	**0 to +6**	**-1 to +8**	**-1 to +6**	**0 to +11**
DJF	336	-5 to +14	-4 to +16	-5 to +9	-7 to +26
MAM	489	-2 to +8	-3 to +8	-3 to +6	-1 to +13
JJA	339	-10 to +11	-10 to +14	-9 to +11	-10 to +13
SON	549	-2 to +6	-3 to +9	-1 to +7	-1 to +17
Rainfall during rainy season (in mm and %)	**1086**	**-1 to +6**	**-2 to +8**	**-4 to +8**	**-4 to +15**
Dry spells during rainy season (number and %)	**2.4**	**-2 to +61**	**0 to +66**	**+5 to +78**	**+10 to +108**
Duration of rainy season (in days and %)	**159**	**-3 to +1**	**-4 to +2**	**-4 to +2**	**-6 to +1**
Intensity of heavy rain events (in mm/d and %)	**31**	**+3 to +10**	**+3 to +14**	**+4 to +13**	**+6 to +27**
Frequency of heavy rain events (in % of all days)	**1.9**	**0 to +1**	**0 to +2**	**0 to +2**	**+1 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**278**	**0 to +12**	**+4 to +18**	**+3 to +14**	**+12 to +36**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 3:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a clear tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

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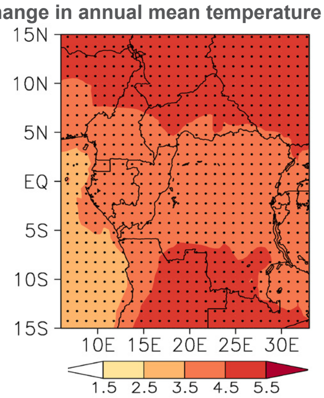
Fact-Sheet - Climate - Central African Republic - Zone 2

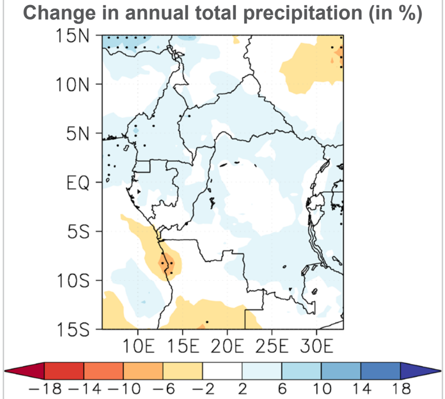
Maps of projected changes

Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

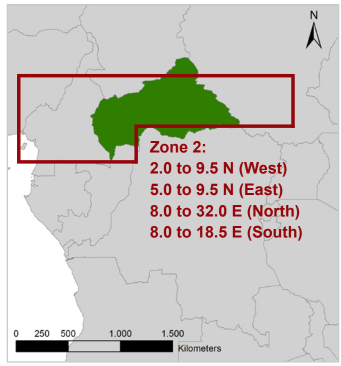


Change in annual total precipitation (in %)



Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of the Central African Republic falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) – **YEAR**	**25.6**	**+1.4 to +2.2**	**+1.6 to +2.8**	**+1.8 to +2.7**	**+3.7 to +5.1**
DJF	24.8	+1.4 to +2.1	+1.6 to +2.9	+2.0 to +2.7	+3.8 to +5.1
MAM	27.3	+1.4 to +2.2	+1.7 to +3.0	+1.9 to +2.9	+3.9 to +5.5
JJA	25.0	+1.4 to +2.1	+1.7 to +2.8	+1.8 to +2.7	+3.5 to +5.2
SON	25.1	+1.4 to +2.0	+1.6 to +2.6	+1.8 to +2.6	+3.7 to +4.9
Cold nights (in %)	-	**-8 to -6**	**-9 to -6**	**-9 to -8**	**-10 to -9**
Cold days (in%)	-	**-8 to -6**	**-9 to -6**	**-9 to -6**	**-10 to -9**
Hot nights (in %)	-	**+27 to +43**	**+30 to +58**	**+39 to +54**	**+67 to +76**
Hot days (in %)	-	**+10 to +18**	**+11 to +23**	**+13 to +24**	**+26 to +48**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes: Low emission scenario		Projected changes: High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) – **YEAR**	**1488**	**-2 to +7**	**-2 to +8**	**-3 to +7**	**-6 to +12**
DJF	13	-12 to +54	-15 to +56	-17 to +47	-14 to +118
MAM	336	-7 to +5	-5 to +6	-8 to +3	-10 to +12
JJA	633	-5 to +6	-5 to +8	-4 to +9	-8 to +13
SON	477	-1 to +10	-1 to +13	+1 to +10	+1 to +23
Rainfall during rainy season (in mm and %)	**1228**	**-5 to +6**	**-3 to +6**	**-4 to +6**	**-8 to +12**
Dry spells during rainy season (number and %)	**2.0**	**-11 to +57**	**-7 to +60**	**-3 to +88**	**+11 to +141**
Duration of rainy season (in days and %)	**164**	**-3 to +1**	**-3 to +1**	**-4 to +1**	**-7 to 0**
Intensity of heavy rain events (in mm/d and %)	**35**	**0 to +10**	**0 to +14**	**+2 to +14**	**+1 to +27**
Frequency of heavy rain events (in % of all days)	**1.5**	**0 to +1**	**0 to +1**	**0 to +1**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**277**	**-2 to +15**	**+1 to +17**	**+2 to +19**	**+13 to +38**

Data and method

The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 2:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

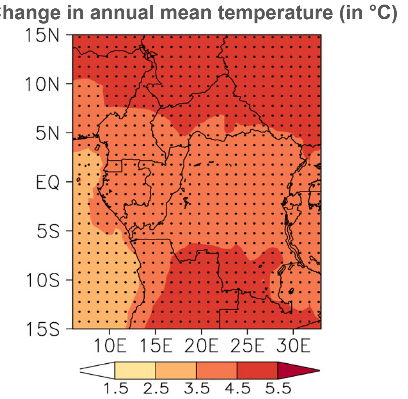
Further details can be found in the "**Climate Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Climate - Republic of the Congo - Zone 4

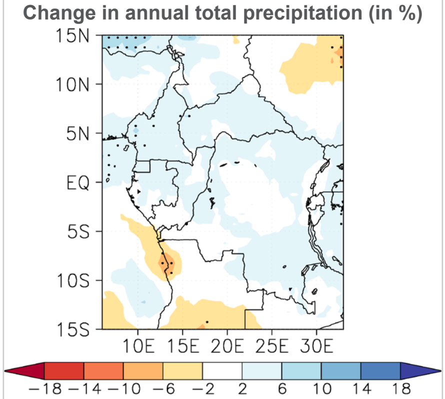
Maps of projected changes

- Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the “**High**” emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

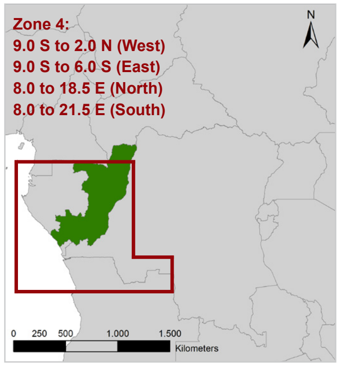


Change in annual total precipitation (in %)



Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major part of the Congo falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show only the “**likely range**“ (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C) **YEAR**	**24.6**	**+1.4 to +2.0**	**+1.5 to +2.6**	**+1.8 to +2.5**	**+3.6 to +4.7**
DJF	25.2	+1.3 to +1.9	+1.4 to +2.4	+1.8 to +2.3	+3.7 to +4.4
MAM	25.5	+1.3 to +2.1	+1.5 to +2.7	+1.8 to +2.5	+3.5 to +4.7
JJA	22.9	+1.5 to +2.1	+1.5 to +2.8	+1.9 to +2.6	+3.7 to +5.1
SON	24.7	+1.4 to +2.1	+1.4 to +2.6	+1.8 to +2.5	+3.6 to +4.6
Cold nights (in %)	-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)	-	**-9 to -6**	**-9 to -6**	**-9 to -7**	**-10 to -9**
Hot nights (in %)	-	**+36 to +58**	**+40 to +69**	**+52 to +67**	**+78 to +87**
Hot days (in %)	-	**+17 to +31**	**+19 to +40**	**+24 to +39**	**+46 to +69**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)	Observed	Projected changes			
		Low emission scenario		High emission scenario	
	1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %) **YEAR**	**2100**	**-3 to +6**	**-3 to +6**	**-5 to +7**	**-8 to +10**
DJF	567	-5 to +7	-6 to +11	-7 to +7	-9 to +15
MAM	696	-2 to +5	-3 to +7	-3 to +8	-2 to +12
JJA	114	-14 to +9	-14 to +8	-17 to +16	-27 to +3
SON	720	-4 to +8	-4 to +6	-8 to +11	-10 to +12
Rainfall during rainy season (in mm and %)	**1507**	**-3 to +7**	**-3 to +10**	**-5 to +11**	**-9 to +17**
Dry spells during rainy season (number and %)	**3.3**	**0 to +71**	**+1 to +74**	**-6 to +77**	**0 to +126**
Duration of rainy season (in days and %)	**165**	**-2 to +2**	**-4 to +3**	**-4 to +3**	**-7 to +1**
Intensity of heavy rain events (in mm/d and %)	**46**	**+2 to +10**	**+4 to +14**	**+2 to +13**	**+5 to +25**
Frequency of heavy rain events (in % of all days)	**1.6**	**0 to +1**	**0 to +2**	**0 to +2**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)	**363**	**-2 to +14**	**+2 to +18**	**+1 to +17**	**+9 to +27**

Data and method

- The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the “**High**” and 46 projections for the “**Low**“ scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a “**likely range**” was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “**Low**“ scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the “**High**“ scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 4:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

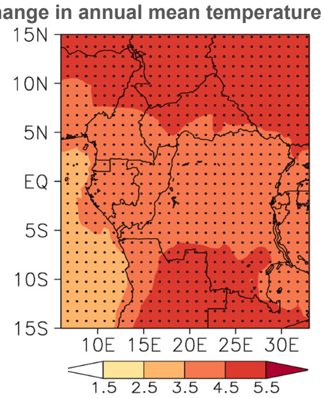
Further details can be found in the “**Climate Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Climate - Equatorial Guinea - Zone 4

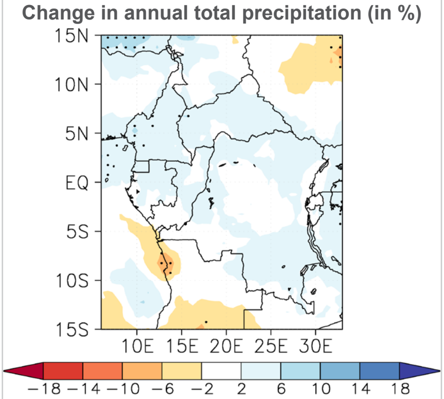
Maps of projected changes

Maps of projected changes - Maps show the median projection of change for mid of the century (mean of the period 2036-2065 compared to the mean of 1961-1990) under the "**High**" emission scenario and for all available projections combined. The stippled areas indicate more robust regions where the majority of models agree in the direction of change.

Change in annual mean temperature (in °C)

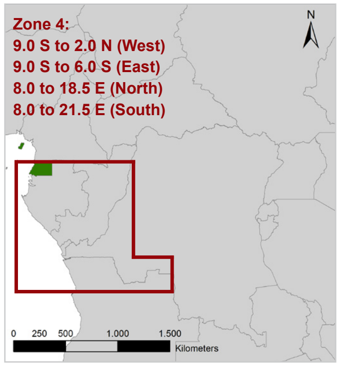


Change in annual total precipitation (in %)



Definition of Zone 4

Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the onshore part of Equatorial Guinea falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

List of projected changes - Tables show only the "**likely range**" (centered around the median) of projected changes. 66 percent of all projected changes are within this range. Bold values in the table represent values averaged over the whole year.

Observed mean values and projected changes of temperature based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Surface air temperature (in °C)	**YEAR**	**24.6**	**+1.4 to +2.0**	**+1.5 to +2.6**	**+1.8 to +2.5**	**+3.6 to +4.7**
	DJF	25.2	+1.3 to +1.9	+1.4 to +2.4	+1.8 to +2.3	+3.7 to +4.4
	MAM	25.5	+1.3 to +2.1	+1.5 to +2.7	+1.8 to +2.5	+3.5 to +4.7
	JJA	22.9	+1.5 to +2.1	+1.5 to +2.8	+1.9 to +2.6	+3.7 to +5.1
	SON	24.7	+1.4 to +2.1	+1.4 to +2.6	+1.8 to +2.5	+3.6 to +4.6
Cold nights (in %)		-	**-9 to -8**	**-10 to -8**	**-10 to -9**	**~ -10**
Cold days (in %)		-	**-9 to -6**	**-9 to -6**	**-9 to -7**	**-10 to -9**
Hot nights (in %)		-	**+36 to +58**	**+40 to +69**	**+52 to +67**	**+78 to +87**
Hot days (in %)		-	**+17 to +31**	**+19 to +40**	**+24 to +39**	**+46 to +69**

Observed mean values and projected changes of precipitation based variables (Note: if below two units are mentioned the 1st refers to the observations and the 2nd to the changes)		Observed	Projected changes			
			Low emission scenario		High emission scenario	
		1961-1990	2036-2065	2071-2100	2036-2065	2071-2100
Total precipitation (in mm and %)	**YEAR**	**2100**	**-3 to +6**	**-3 to +6**	**-5 to +7**	**-8 to +10**
	DJF	567	-5 to +7	-6 to +11	-7 to +7	-9 to +15
	MAM	696	-2 to +5	-3 to +7	-3 to +8	-2 to +12
	JJA	114	-14 to +9	-14 to +8	-17 to +16	-27 to +3
	SON	720	-4 to +8	-4 to +6	-8 to +11	-10 to +12
Rainfall during rainy season (in mm and %)		**1507**	**-3 to +7**	**-3 to +10**	**-5 to +11**	**-9 to +17**
Dry spells during rainy season (number and %)		**3.3**	**0 to +71**	**+1 to +74**	**-6 to +77**	**0 to +126**
Duration of rainy season (in days and %)		**165**	**-2 to +2**	**-4 to +3**	**-4 to +3**	**-7 to +1**
Intensity of heavy rain events (in mm/d and %)		**46**	**+2 to +10**	**+4 to +14**	**+2 to +13**	**+5 to +25**
Frequency of heavy rain events (in % of all days)		**1.6**	**0 to +1**	**0 to +2**	**0 to +2**	**0 to +3**
Maximum 10day rainfall sum (in mm/10d and %)		**363**	**-2 to +14**	**+2 to +18**	**+1 to +17**	**+9 to +27**

Data and method

Data and method - The projected climate change signals are based on a large ensemble of different global and regional climate change projections. For each scenario projections from the CMIP3 dataset (basis of the 4th IPCC assessment report - IPCC-AR4), projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together; making it 31 projections for the "**High**" and 46 projections for the "**Low**" scenario. As it is scientifically questionable to provide only one value for projected changes (e.g. the mean) a "**likely range**" was defined. According to IPCC-AR4, this is the range, which consist 66 percent of all projected changes. For the fact-sheet the central 66 percent were taken, to exclude extreme outliers from the analysis. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "**Low**" scenario combines the SRES B1 (IPCC-AR4) and RCP2.6 and 4.5 (IPCC-AR5) scenarios; the "**High**" scenario combines the SRES A2 (IPCC-AR4) and RCP8.5 (IPCC-AR5) scenarios.

Key findings- Zone 4:

- Mean temperature is projected to substantially increase in the future independent of the scenario, with a stronger increase under the high emission scenario.
- Not only mean temperatures are projected to increase but also extremes. Therefore number of cold days and nights are projected to decrease and number of hot days and nights are projected to increase,
- Only a very moderate change in total precipitation is projected to occur in the future for both scenarios, with a slight tendency for a precipitation increase. This is also true for the rainfall during the rainy season
- Rains are likely to be less uniformly distributed in the future, as dry spells in the rainy season are projected to substantially increase.
- The intensity of rainfall extremes is projected to increase, but almost no change in their frequency is projected.

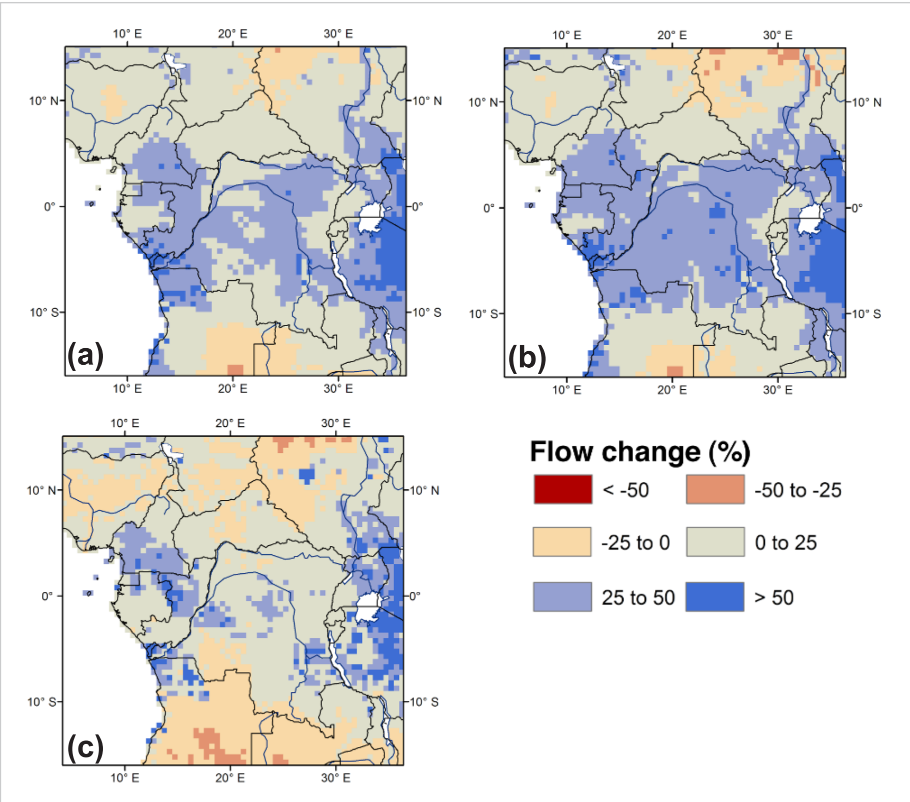
Further details can be found in the "**Climate Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Hydrology and Energy - Regional - Zone 1

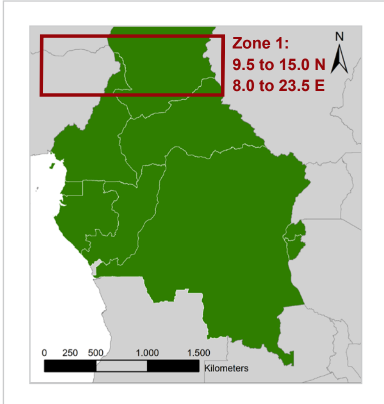
Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**261**	**+63**	**+46**	**+71**	**+85**
	DJF	0	0	0	0	0
	MAM	7	+2	+1	-1	+2
	JJA	202	+46	+27	+44	+50
	SON	52	+15	+18	+27	+33

Key findings for Zone 1:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge is very vulnerable to changes in rainfall in this zone. Small changes in rainfall can cause large changes in discharge.
- River discharge patterns will become more variable. High flows will probably increase while low flows will decrease.
- Due to more variable run-off patterns hydropower production will become less reliable.

Key adaptation options:

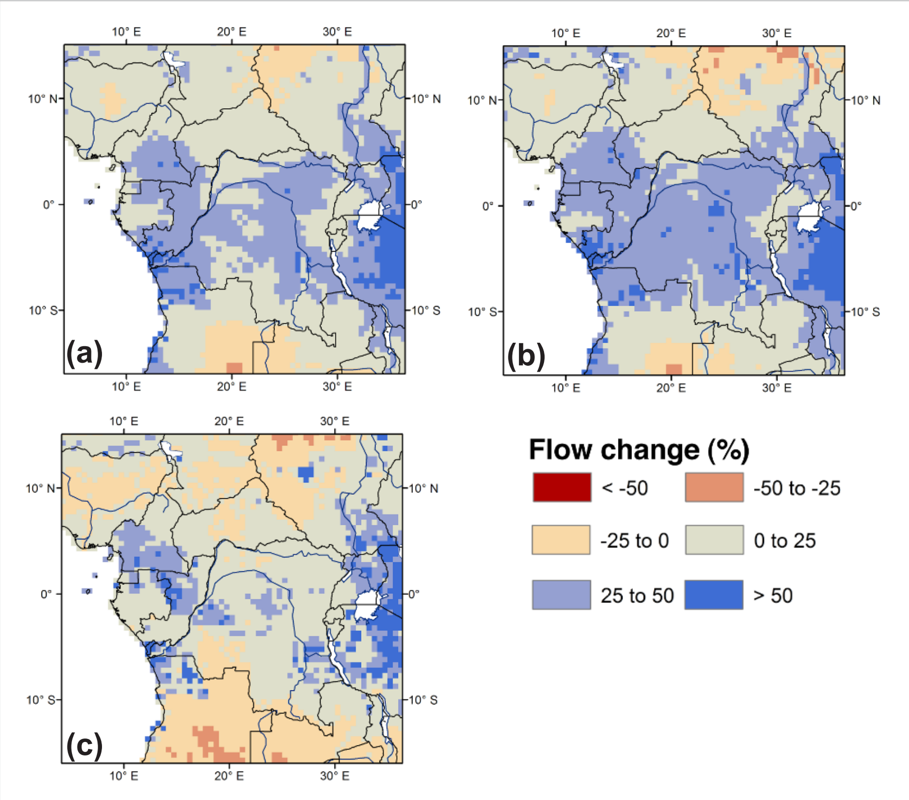
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Improving water use efficiencies in all sectors to avoid future water scarcity.
- Diversifying energy supply to prevent dependence on a single energy source

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Regional - Zone 2

Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

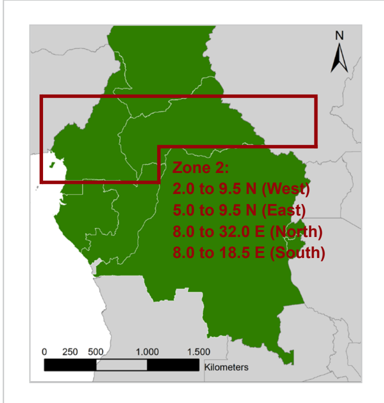
Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**795**	**+62**	**+117**	**+120**	**+281**
	DJF	8	0	-1	-1	+4
	MAM	103	-3	+9	-1	+23
	JJA	374	+24	+31	+52	+106
	SON	310	+41	+77	+70	+147

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

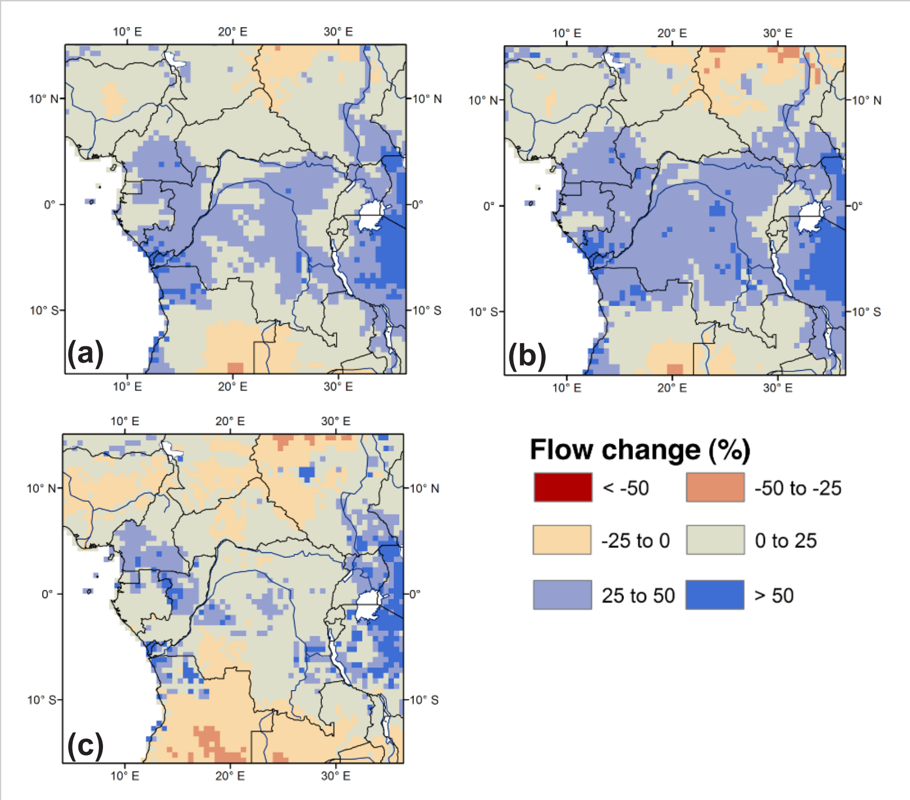
Key findings for Zone 2:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge patterns will become more variable. High flows will increase while low flows will decrease.
- Average flows are more likely to increase than decrease. Flows will especially increase during the wet season.
- On average hydropower potential will be probably increase but due to more variable run-off patterns hydropower production could become less reliable.

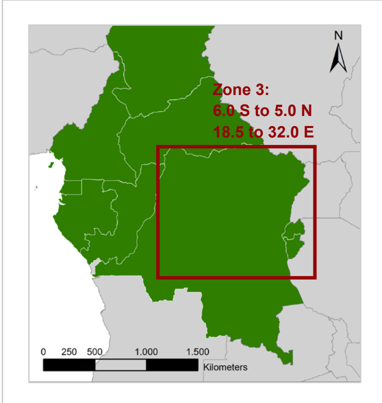
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Regional - Zone 3

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**766**	**+72**	**+124**	**+94**	**+309**
	DJF	146	+9	+18	-4	+43
	MAM	193	+4	+20	+3	+52
	JJA	156	+11	+20	+19	+60
	SON	270	+49	+67	+66	+145

Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

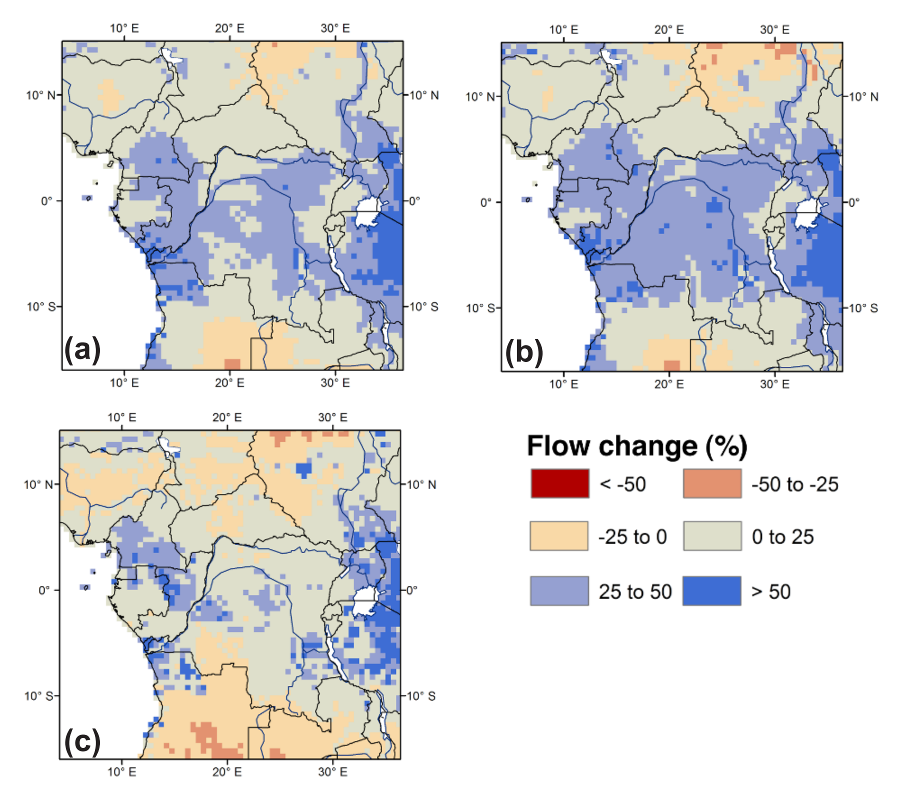
Key findings for Zone 3:

- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which could possible cause severe damages.

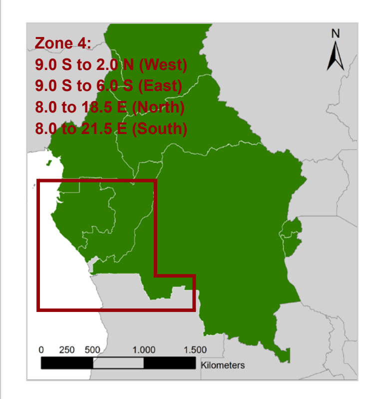
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Regional - Zone 4

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**1233**	**45**	**256**	**180**	**386**
	DJF	325	-3	76	32	115
	MAM	433	7	75	56	102
	JJA	45	3	8	14	22
	SON	429	39	98	79	148

Key findings for Zone 4:

- The hydrological cycle will intensify resulting in more frequent floods and possibly more droughts.
- Both average and peak flows could severely increase in this zone probably resulting in more frequent and more severe floods.
- Hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- In the future, hydropower facilities will be faced with more frequent and more severe high flow events this could potentially cause severe damages.

Key adaptation options:

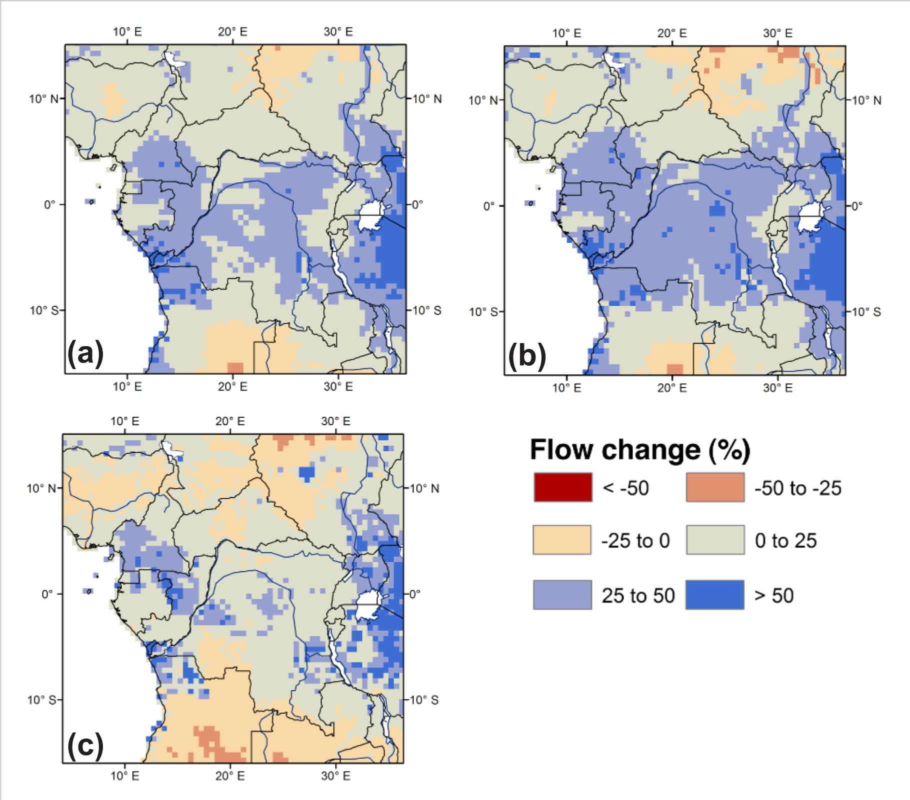
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Adaptation of river systems so they can manage much higher flows and more extremes.
- Diversifying energy supply to prevent dependence on a single energy source.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Regional - Zone 5

Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

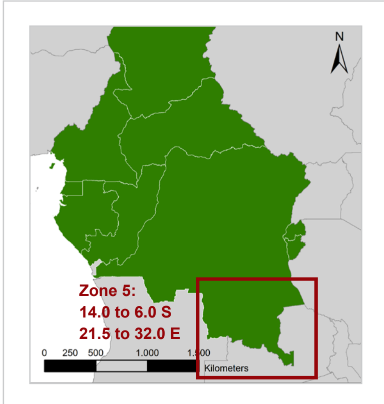
Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**531**	**24**	**52**	**60**	**140**
	DJF	327	15	29	32	84
	MAM	140	11	16	23	47
	JJA	1	0	0	0	0
	SON	64	-2	6	5	9

Key adaptation options:

- Improving preparedness for extreme weather events and floods through e.g. (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.
- Adaptation of river systems to manage higher flows and more extremes.
- Improving water storage facilities to guarantee sufficient water supply during droughts.

Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key findings for Zone 5:

- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which might cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

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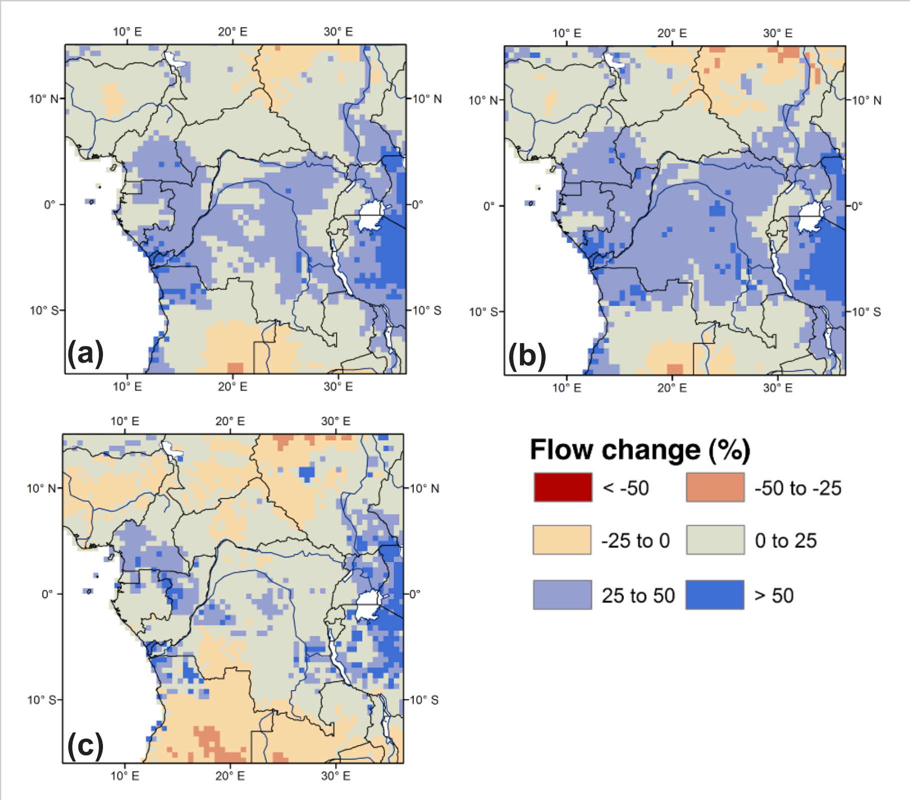
Fact-Sheet - Hydrology and Energy - Rwanda - Zone 3

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



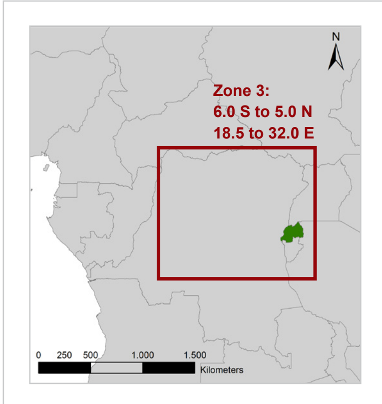
List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	YEAR	766	+72	+124	+94	+309
	DJF	146	+9	+18	-4	+43
	MAM	193	+4	+20	+3	+52
	JJA	156	+11	+20	+19	+60
	SON	270	+49	+67	+66	+145

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Rwanda falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

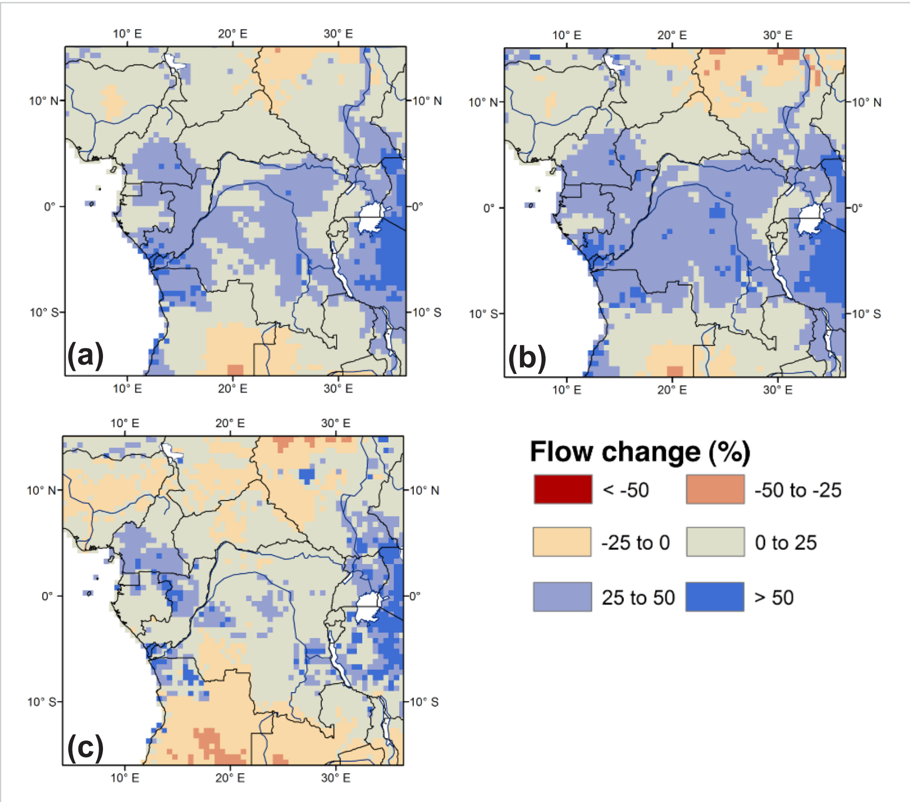
Key findings for Zone 3:

- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which could possible cause severe damages.

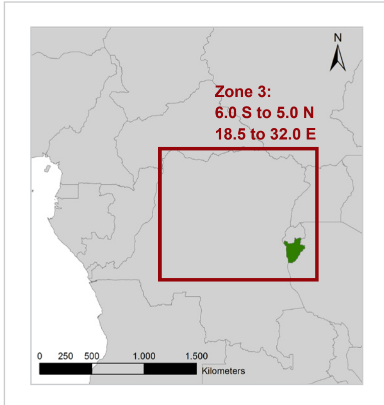
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Burundi - Zone 3

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Burundi falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**766**	**+72**	**+124**	**+94**	**+309**
	DJF	146	+9	+18	-4	+43
	MAM	193	+4	+20	+3	+52
	JJA	156	+11	+20	+19	+60
	SON	270	+49	+67	+66	+145

Key findings for Zone 3:

- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which could possible cause severe damages.

Key adaptation options:

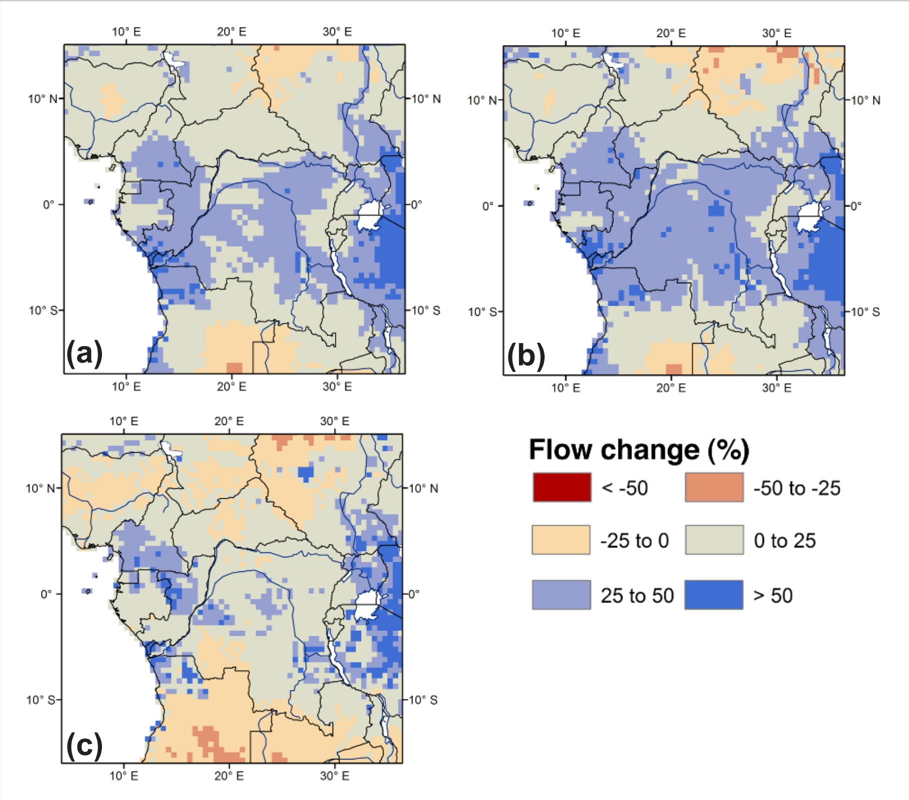
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Cameroon - Zone 1

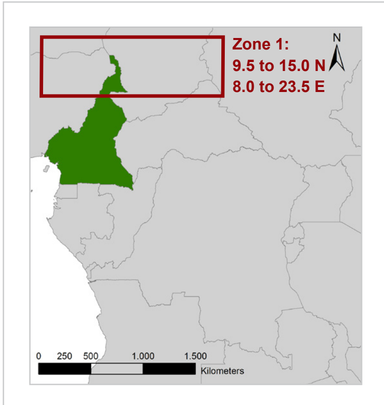
Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.



As the northern part of Cameroon falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.

Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**261**	**+63**	**+46**	**+71**	**+85**
	DJF	0	0	0	0	0
	MAM	7	+2	+1	-1	+2
	JJA	202	+46	+27	+44	+50
	SON	52	+15	+18	+27	+33

Key findings for Zone 1:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge is very vulnerable to changes in rainfall in this zone. Small changes in rainfall can cause large changes in discharge.
- River discharge patterns will become more variable. High flows will probably increase while low flows will decrease.
- Due to more variable run-off patterns hydropower production will become less reliable.

Key adaptation options:

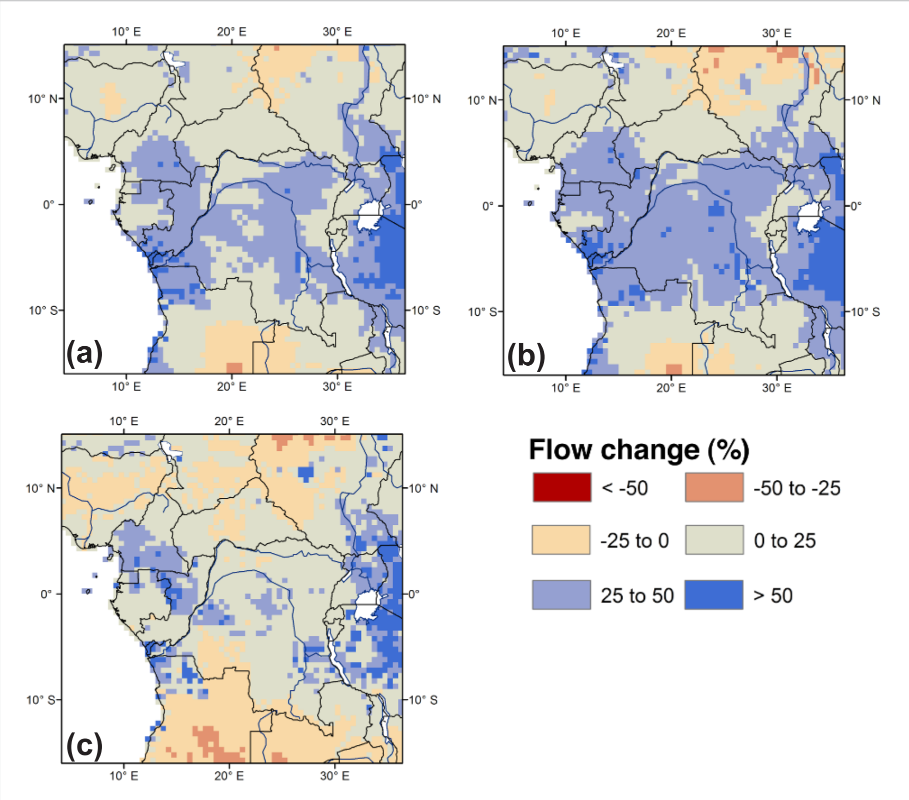
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Improving water use efficiencies in all sectors to avoid future water scarcity.
- Diversifying energy supply to prevent dependence on a single energy source

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Cameroon - Zone 2

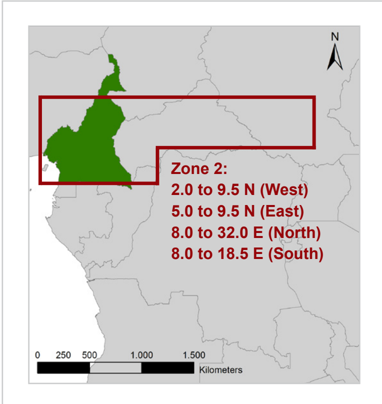
Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of Cameroon falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	YEAR	795	+62	+117	+120	+281
	DJF	8	0	-1	-1	+4
	MAM	103	-3	+9	-1	+23
	JJA	374	+24	+31	+52	+106
	SON	310	+41	+77	+70	+147

Key findings for Zone 2:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge patterns will become more variable. High flows will increase while low flows will decrease.
- Average flows are more likely to increase than decrease. Flows will especially increase during the wet season.
- On average hydropower potential will be probably increase but due to more variable run-off patterns hydropower production could become less reliable.

Key adaptation options:

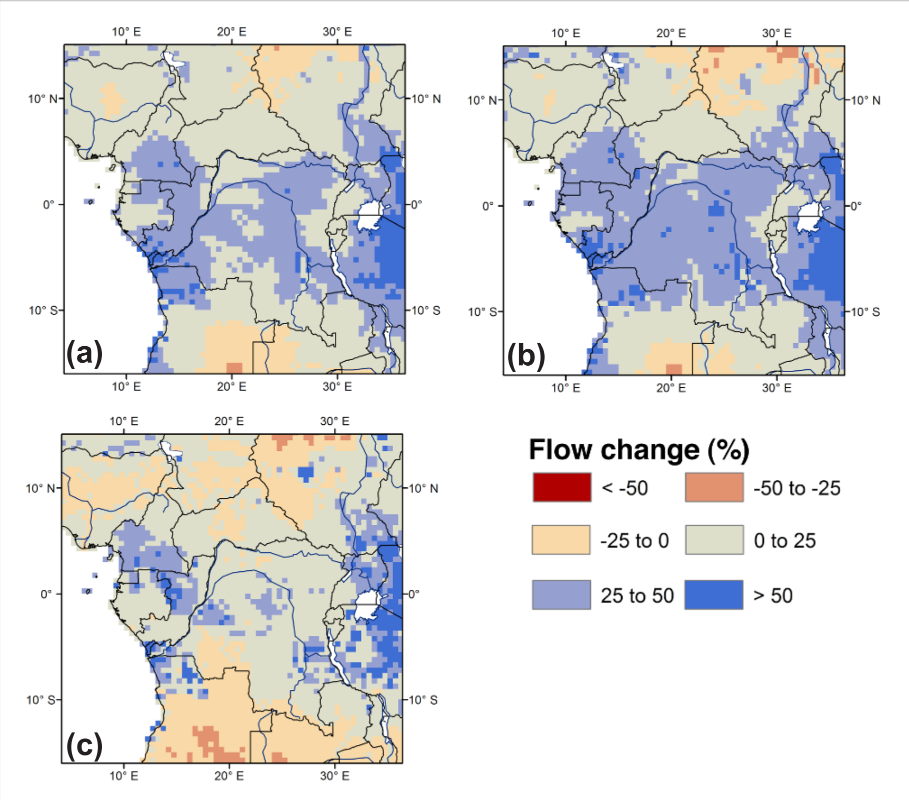
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Central African Republic - Zone 2

Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

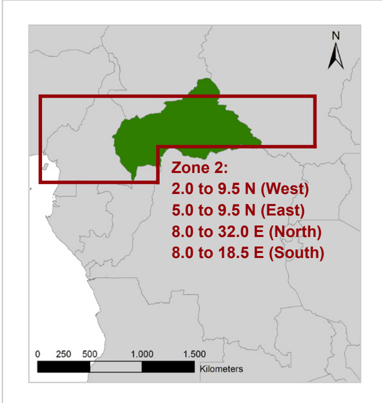
Run-off in mm/year or mm/season		Today	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**795**	**+62**	**+117**	**+120**	**+281**
	DJF	8	0	-1	-1	+4
	MAM	103	-3	+9	-1	+23
	JJA	374	+24	+31	+52	+106
	SON	310	+41	+77	+70	+147

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of the Central African Republic falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key findings for Zone 2:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge patterns will become more variable. High flows will increase while low flows will decrease.
- Average flows are more likely to increase than decrease. Flows will especially increase during the wet season.
- On average hydropower potential will be probably increase but due to more variable run-off patterns hydropower production could become less reliable.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

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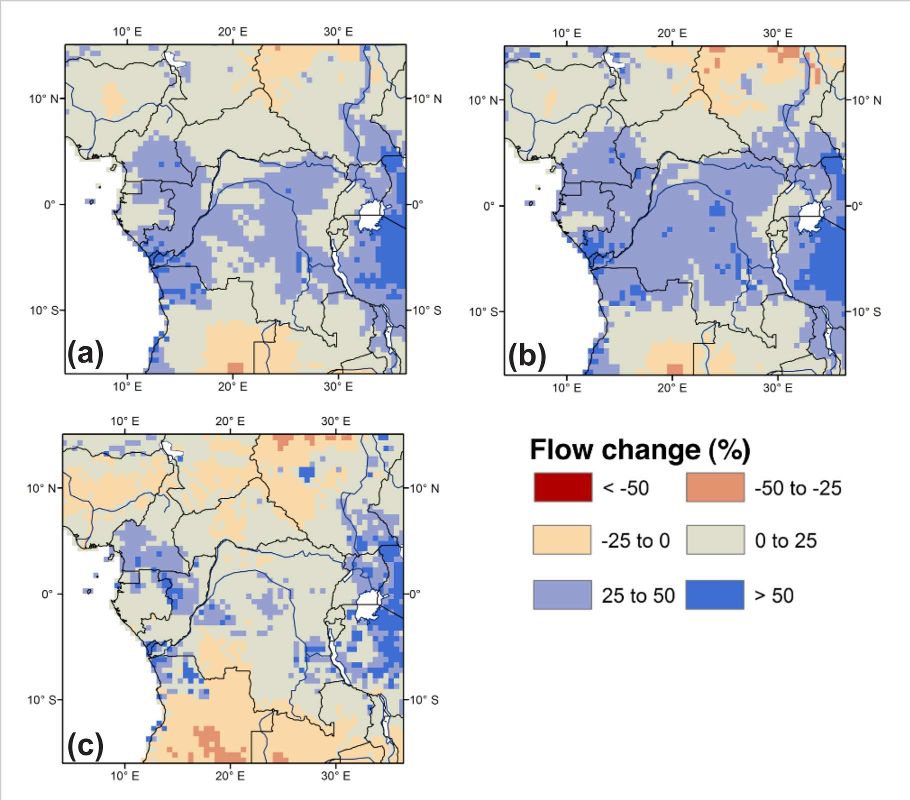
Fact-Sheet - Hydrology and Energy - Chad - Zone 1

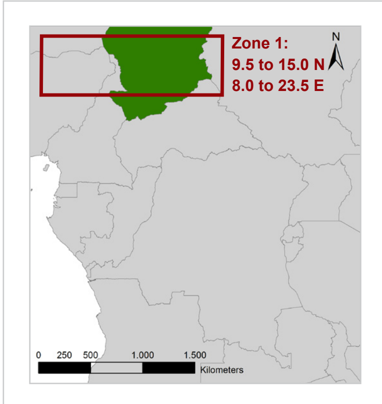
Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.



As the central part of Chad falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.

Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**261**	**+63**	**+46**	**+71**	**+85**
	DJF	0	0	0	0	0
	MAM	7	+2	+1	-1	+2
	JJA	202	+46	+27	+44	+50
	SON	52	+15	+18	+27	+33

Key findings for Zone 1:

- The hydrological cycle will intensify resulting in more frequent droughts and floods.
- River discharge is very vulnerable to changes in rainfall in this zone. Small changes in rainfall can cause large changes in discharge.
- River discharge patterns will become more variable. High flows will probably increase while low flows will decrease.
- Due to more variable run-off patterns hydropower production will become less reliable.

Key adaptation options:

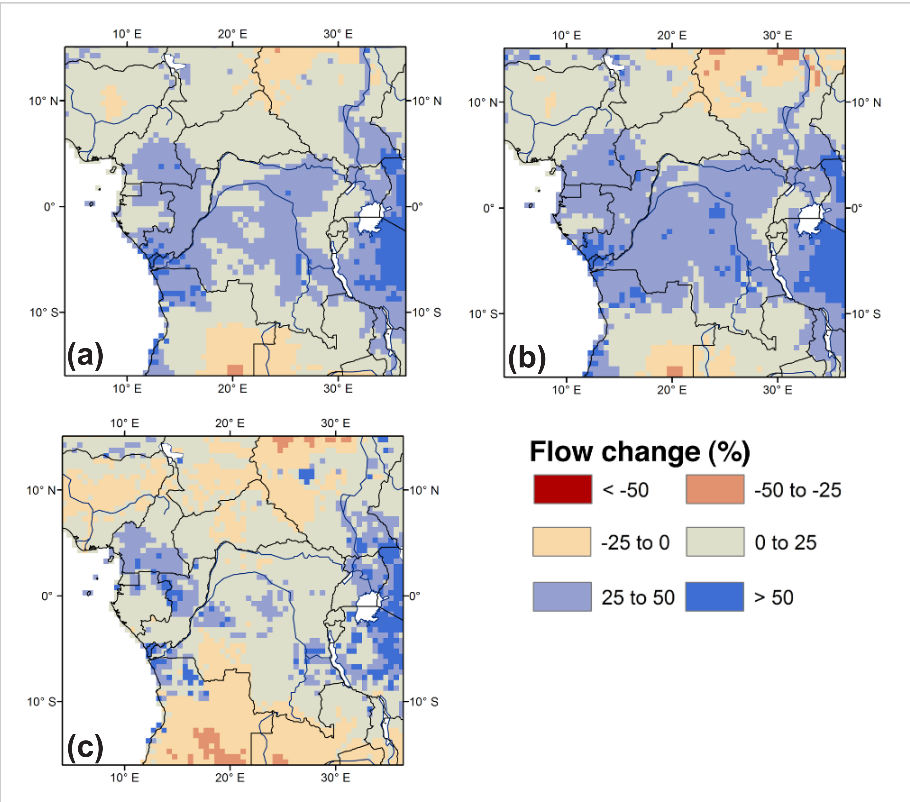
- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems
- Improving water storage facilities to guarantee sufficient water supply during droughts
- Improving water use efficiencies in all sectors to avoid future water scarcity.
- Diversifying energy supply to prevent dependence on a single energy source

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Republic of the Congo - Zone 4

Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

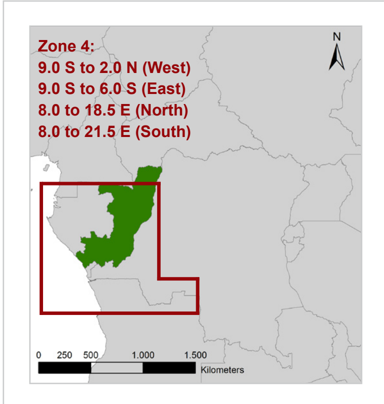
Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**1233**	**45**	**256**	**180**	**386**
	DJF	325	-3	76	32	115
	MAM	433	7	75	56	102
	JJA	45	3	8	14	22
	SON	429	39	98	79	148

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Adaptation of river systems so they can manage much higher flows and more extremes.
- Diversifying energy supply to prevent dependence on a single energy source.

Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major part of the Congo falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key findings for Zone 4:

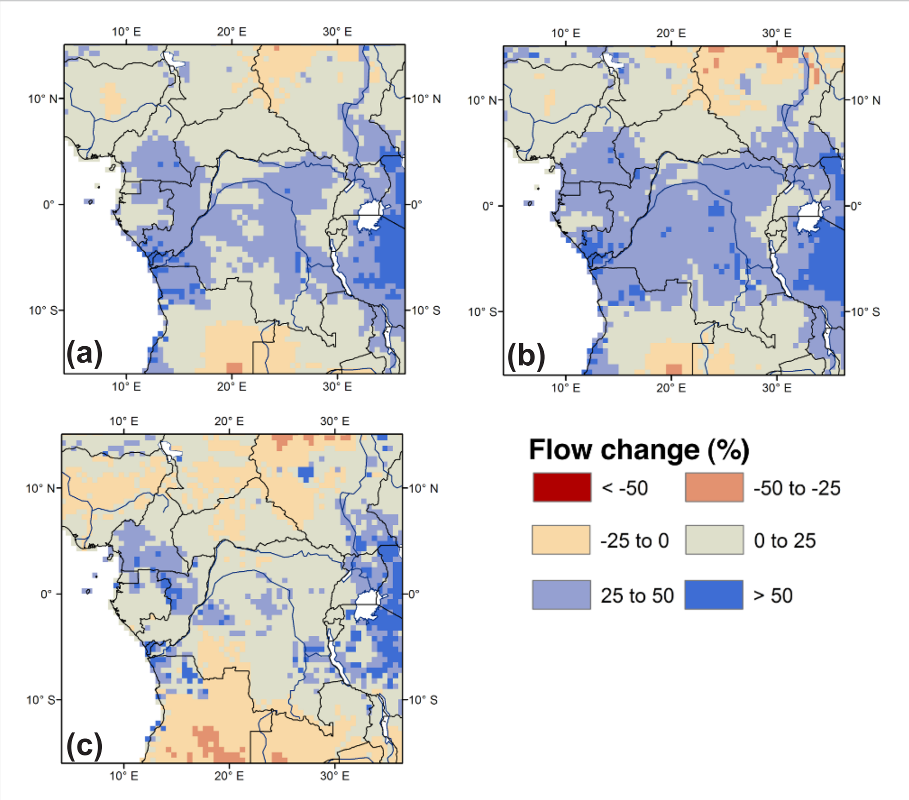
- The hydrological cycle will intensify resulting in more frequent floods and possibly more droughts.
- Both average and peak flows could severely increase in this zone probably resulting in more frequent and more severe floods.
- Hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- In the future, hydropower facilities will be faced with more frequent and more severe high flow events this could potentially cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Democratic Republic of the Congo (DRC)- Zone 3

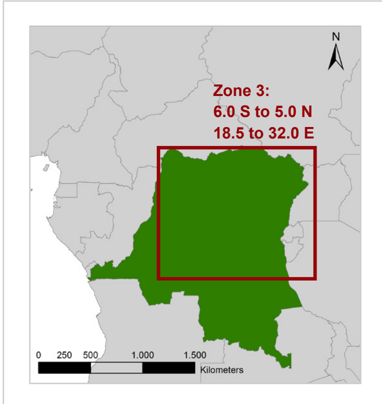
Maps of projected changes

Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the northern and central parts of DRC fall within Zone 3, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	YEAR	766	+72	+124	+94	+309
	DJF	146	+9	+18	-4	+43
	MAM	193	+4	+20	+3	+52
	JJA	156	+11	+20	+19	+60
	SON	270	+49	+67	+66	+145

Data and method

Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.

Key findings for Zone 3:

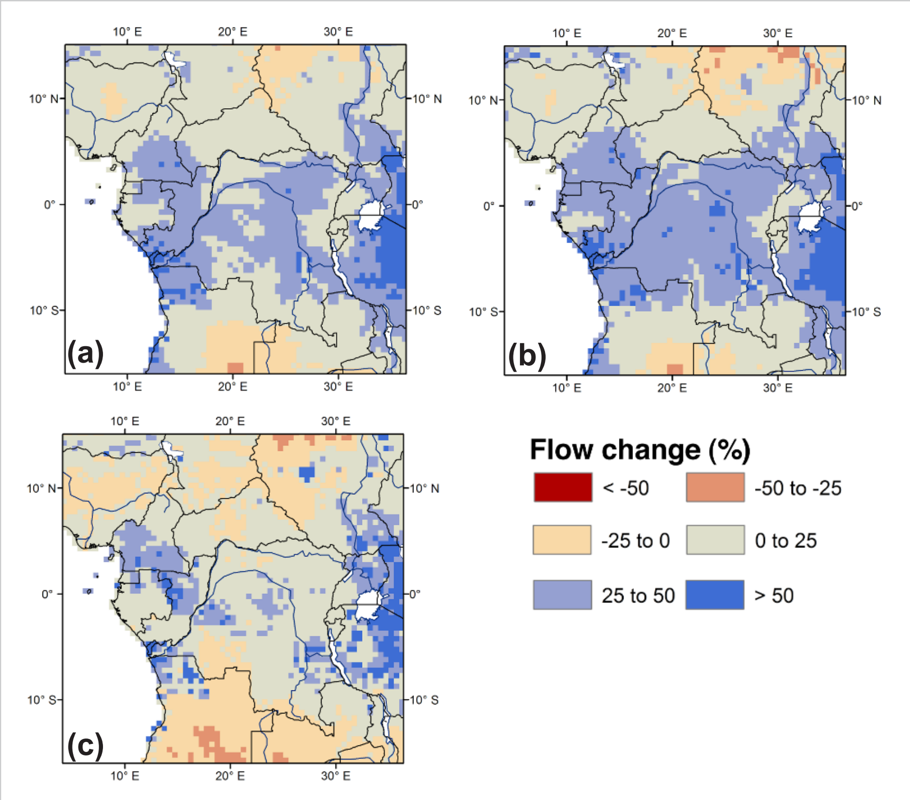
- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which could possible cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Democratic Republic of the Congo (DRC)- Zone 4

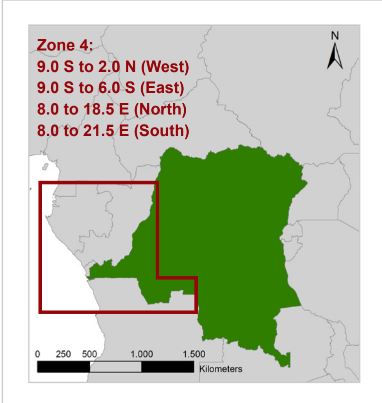
Maps of projected changes

- Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the western part of DRC falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**1233**	**45**	**256**	**180**	**386**
	DJF	325	-3	76	32	115
	MAM	433	7	75	56	102
	JJA	45	3	8	14	22
	SON	429	39	98	79	148

Data and method

- Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Adaptation of river systems so they can manage much higher flows and more extremes.
- Diversifying energy supply to prevent dependence on a single energy source.

Key findings for Zone 4:

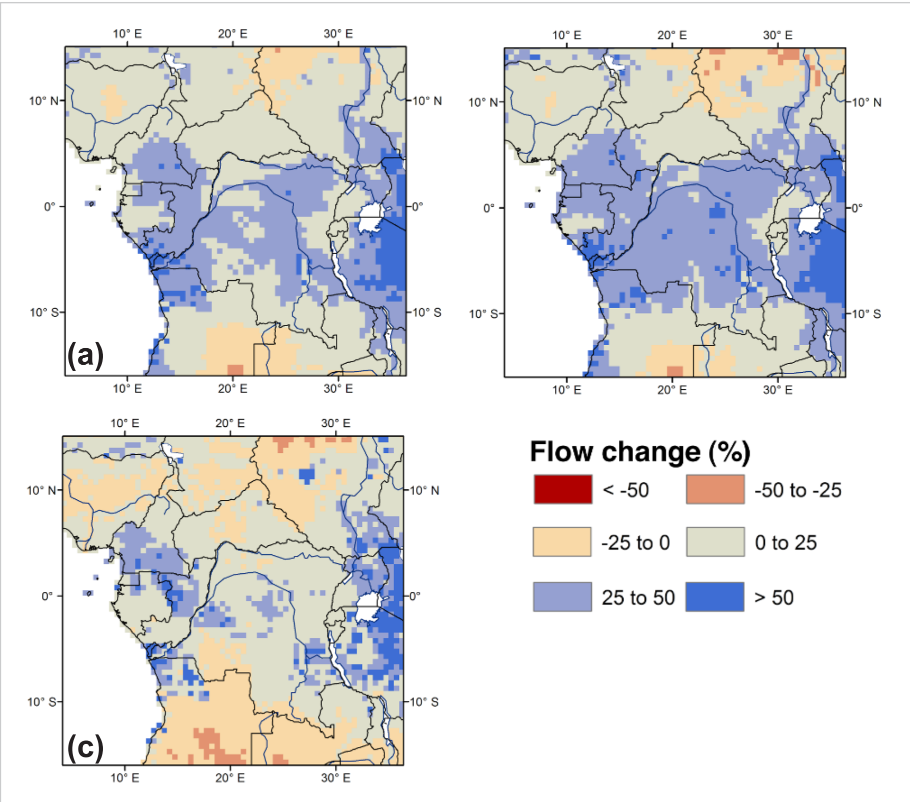
- The hydrological cycle will intensify resulting in more frequent floods and possibly more droughts.
- Both average and peak flows could severely increase in this zone probably resulting in more frequent and more severe floods.
- Hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- In the future, hydropower facilities will be faced with more frequent and more severe high flow events this could potentially cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Democratic Republic of the Congo (DRC)- Zone 5

Maps of projected changes

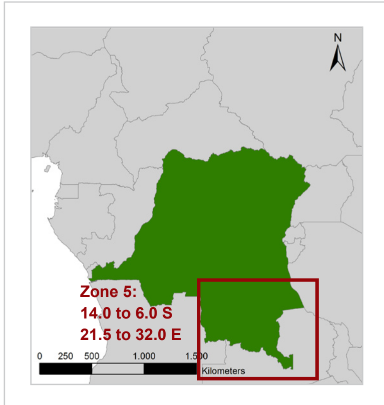
Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the “High” emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 5

Definition of Zone 5 - The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the southern part of DRC falls within Zone 5, projected changes for this zone are assumed to be representative for this part of the country.



Data and method

Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the “Low“ scenario based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

List of projected changes

List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**531**	**24**	**52**	**60**	**140**
	DJF	327	15	29	32	84
	MAM	140	11	16	23	47
	JJA	1	0	0	0	0
	SON	64	-2	6	5	9

Key findings for Zone 5:

- The hydrological cycle will intensify resulting in more frequent floods and maybe more droughts.
- Especially peak flows will increase in this zone probably resulting in more frequent and more severe floods.
- On average hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- Hydropower facilities should be aware of more frequent high flow events which might cause severe damages.

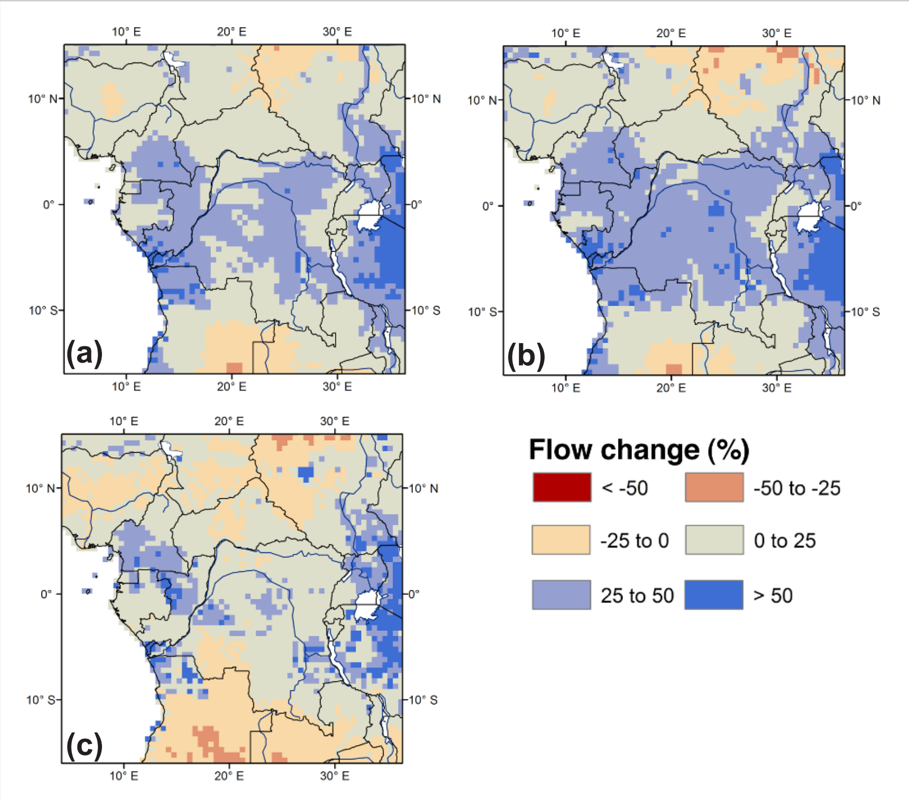
Key adaptation options:

- Improving preparedness for extreme weather events and floods through e.g. (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Diversifying energy supply to prevent dependence on a single energy source.
- Existing and future hydropower facilities should be developed and managed in such a way that they can cope with more variable flow patterns including more frequent and severe extremes.
- Adaptation of river systems to manage higher flows and more extremes.
- Improving water storage facilities to guarantee sufficient water supply during droughts.

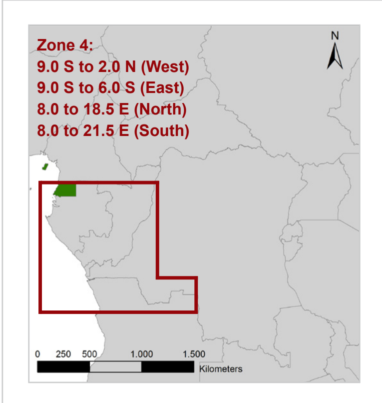
Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Hydrology and Energy - Equatorial Guinea - Zone 4

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the onshore part of Equatorial Guinea falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season	Today	Projected changes: Low emission scenario		Projected changes: High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Mean run-off: **YEAR**	**1233**	**45**	**256**	**180**	**386**
Mean run-off: DJF	325	-3	76	32	115
Mean run-off: MAM	433	7	75	56	102
Mean run-off: JJA	45	3	8	14	22
Mean run-off: SON	429	39	98	79	148

Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Adaptation of river systems so they can manage much higher flows and more extremes.
- Diversifying energy supply to prevent dependence on a single energy source.

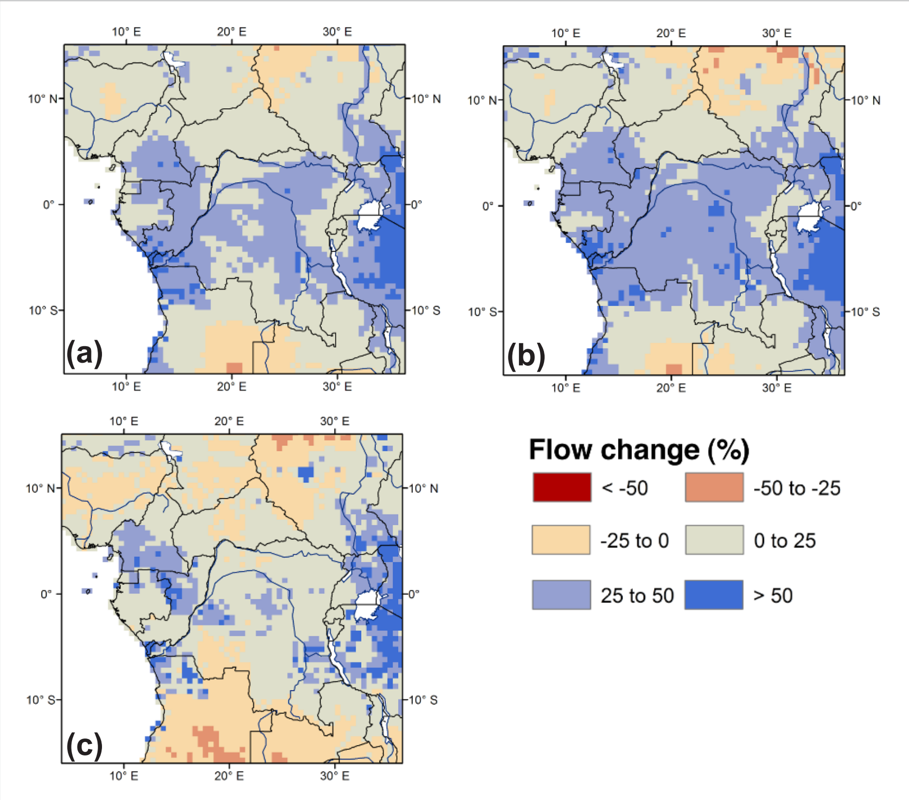
Key findings for Zone 4:

- The hydrological cycle will intensify resulting in more frequent floods and possibly more droughts.
- Both average and peak flows could severely increase in this zone probably resulting in more frequent and more severe floods.
- Hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- In the future, hydropower facilities will be faced with more frequent and more severe high flow events this could potentially cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

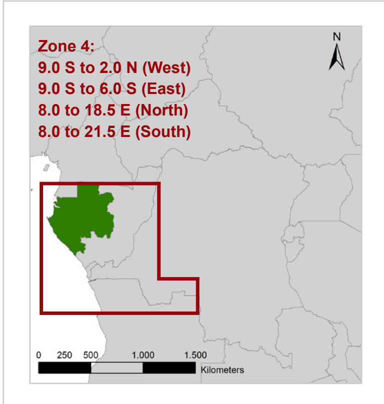
Fact-Sheet - Hydrology and Energy - Gabon - Zone 4

Maps of projected changes - Maps show the projection of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for the "High" emission scenario. Flows are calculated using the VIC model in combination with three different climate models.



Definition of Zone 4

Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Gabon falls completely within Zone 4, projected changes for this zone are assumed to be representative for the country.



List of projected changes - The table shows the projection of changes in mean run-off (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Run-off in mm/year or mm/season		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Mean run-off	**YEAR**	**1233**	**45**	**256**	**180**	**386**
	DJF	325	-3	76	32	115
	MAM	433	7	75	56	102
	JJA	45	3	8	14	22
	SON	429	39	98	79	148

Key adaptation options:

- Improving preparedness for extreme weather events and floods through for example (improved) early warning systems.
- Development of additional (micro)hydropower facilities where possible.
- Adaptation of river systems so they can manage much higher flows and more extremes.
- Diversifying energy supply to prevent dependence on a single energy source.

Data and method - Climate change impacts on the hydrology of the Congo basin were assessed using the VIC macroscale hydrological model. For this analyses we used climate change projections from three different global climate models and for two different greenhouse gas emission scenarios: the "Low" scenario based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario based upon the SRES A2 (IPCC-AR4) scenario. Here we present the results in terms of changes in run-off and river flows. First the relative changes in average flow are presented. If the average flow is decreasing it indicates that in the future less water is available for different users. Then we present the change in high flows. For this we use the Q95 indicator (flow is only this high 5% of the time). If Q95 is increasing, it indicates that your flood risks are increasing. For low flow we used the Q10 indicator (flow is only this low 10% of the time). If Q10 is reducing it indicates that drought risks are increasing.

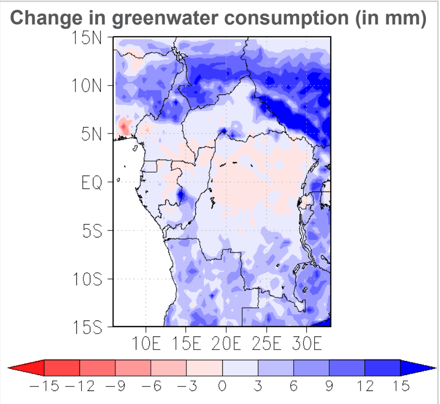
Key findings for Zone 4:

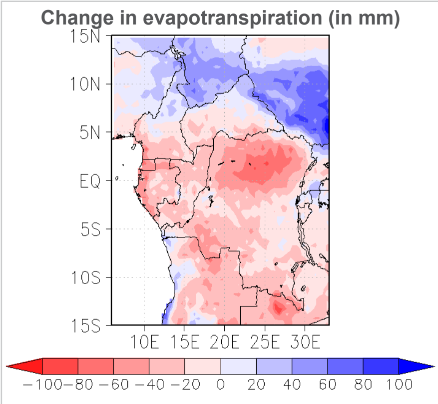
- The hydrological cycle will intensify resulting in more frequent floods and possibly more droughts.
- Both average and peak flows could severely increase in this zone probably resulting in more frequent and more severe floods.
- Hydropower potential will probably increase but due to more variable run-off patterns hydropower production could become less reliable.
- In the future, hydropower facilities will be faced with more frequent and more severe high flow events this could potentially cause severe damages.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

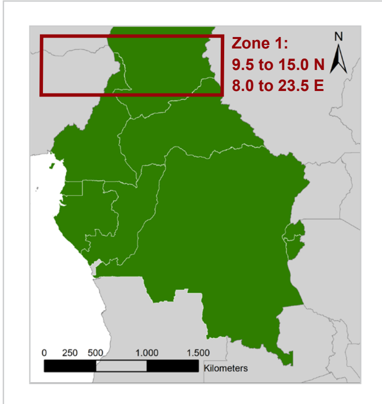
Fact-Sheet - Agriculture - Regional - Zone 1

Maps of projected changes
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 1
The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes
The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**438**	**+14**	**+18**	**+10**	**+27**
	DJF	26	+1	+1	+1	+2
	MAM	52	+2	+2	-1	+3
	JJA	218	+8	+9	+5	+10
	SON	142	+4	+7	+5	+13
Green water consumption		**2768**	**+608**	**+619**	**+578**	**+681**
Water stress		**-286**	**+1**	**+1**	**+1**	**+1**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 1
- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that the rainy season is extended and the rainfall amount increases. The greenwater consumption increases whereas the changes in the waterstress are limited, which indicates that the agricultural production is less hampered by droughts and may increase in the wetter regions in this zone. The simulated biomass increases as well, which confirms this finding. The dryer regions in the north will continue to experience occasional droughts.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

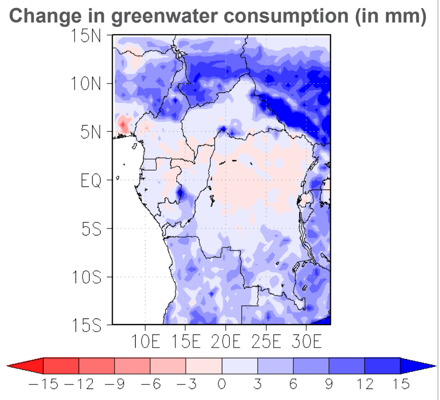
Data and method
The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

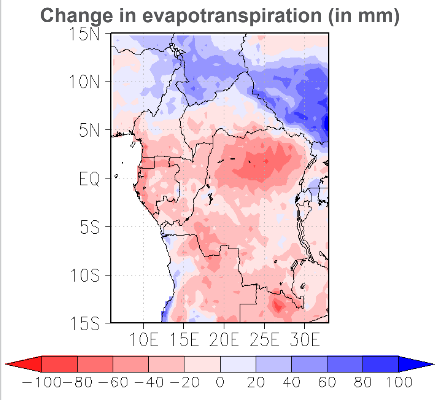
Key adaptation options
- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties.
- Improving drought management plans which prevent large scale food shortage during future droughts.

Fact-Sheet - Agriculture - Regional - Zone 2

Maps of projected changes

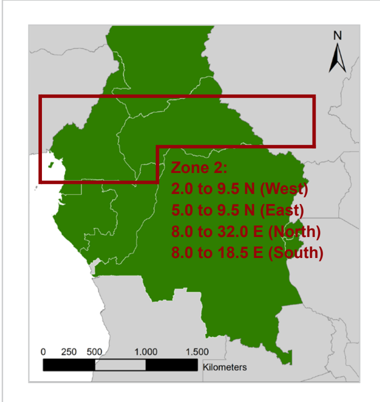
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	731	+13	+19	-3	+10
	DJF	97	+4	+4	+4	+16
	MAM	183	+3	+2	-4	-3
	JJA	229	+6	+11	0	+4
	SON	223	+0	+1	-3	-7
Green water consumption		2111	+503	+523	+469	+567
Water stress		-296	+2	+2	+2	+3

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 2

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases 12-20%, The evapotranspiration however, does not change very much. In combination with the increasing greenwater consumption (20-25%) this indicates that more water will be available suggesting that the agricultural production may slightly increase. The biomass (vegetation carbon) increases, which confirms the higher potential agricultural production.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall year and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- More agroforestry prevents erosion, improves soil fertility and makes farming systems more diverse.

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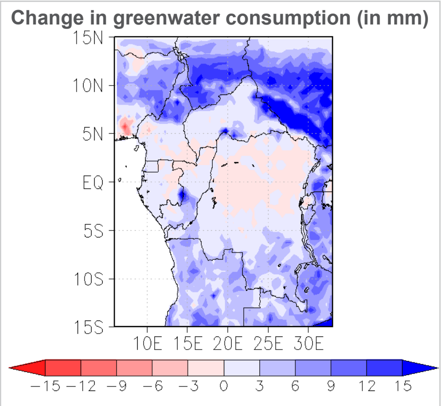
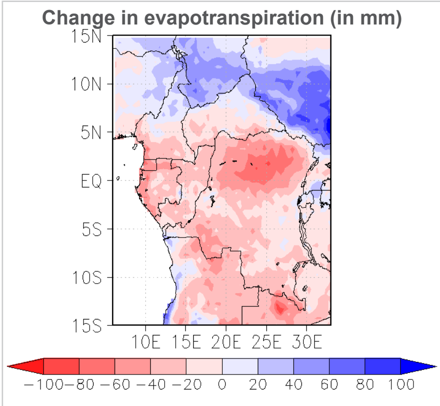
Fact-Sheet - Agriculture - Regional - Zone 3

Maps of projected changes

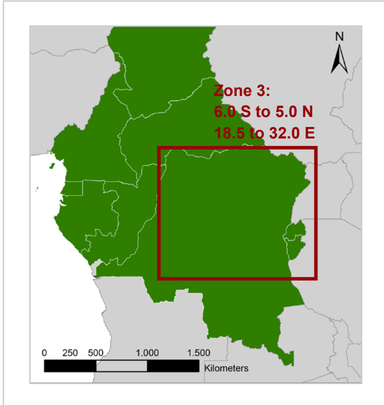
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availability for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotranspiration	**YEAR**	**855**	**+2**	**+11**	**-10**	**-27**
	DJF	213	+2	+4	-1	-6
	MAM	244	+4	+8	0	-6
	JJA	196	-2	+3	-3	-1
	SON	201	-3	-3	-7	-14
Green water consumption		**878**	**+158**	**+169**	**+151**	**+140**
Water stress		**-310**	**+2**	**+2**	**+2**	**+2**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 3

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases. The evapotranspiration is not changing much. Agricultural production is not hampered by water shortages. Crop damage may occur due to flooding, excess of water and diseases related to high air humidity. As the precipitation amounts increase this may occur more frequent. The simulated biomass increases, indicating that the agricultural production increases.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties

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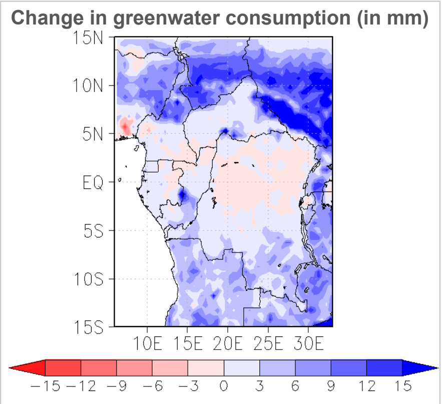
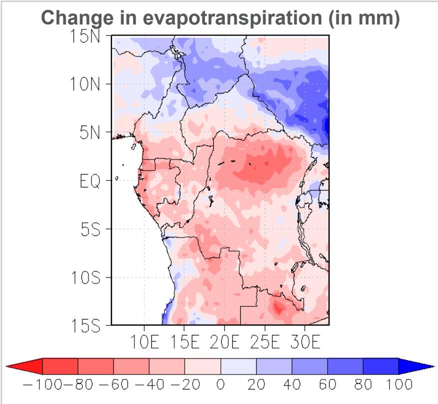
Fact-Sheet - Agriculture - Regional - Zone 4

Maps of projected changes

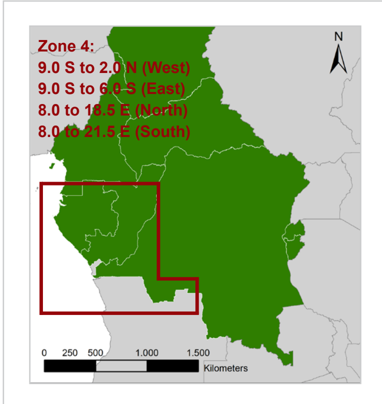
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 4

Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress(rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availability for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	**813**	**-1**	**+2**	**+2**	**-27**
	DJF	240	+3	+1	+2	-8
	MAM	239	+3	+3	-2	-6
	JJA	156	-3	+2	+3	+1
	SON	179	-4	-4	-2	-13
Green water consumption		**1257**	**+210**	**+258**	**+261**	**+205**
Water stress		**-301**	**+2**	**+2**	**+2**	**+2**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 4

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases (10-20%). The evapotranspiration is not changing much whereas the greenwater consumption initially is increasing, indicating that more water comes available for the agricultural production at the beginning of the century. Halfway the century it stagnates and the water availability does not change much. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. In the northern regions, agriculture may experience occasional crop damage due to an excess of rainfall. In the south occasional droughts will occur.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

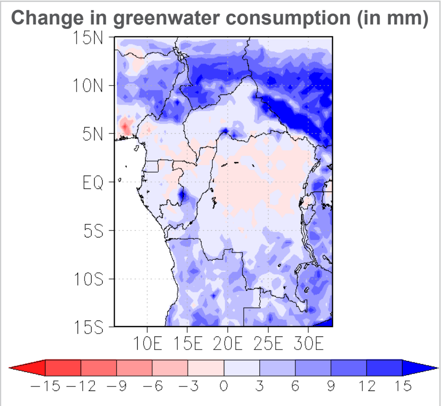
Key adaptation options

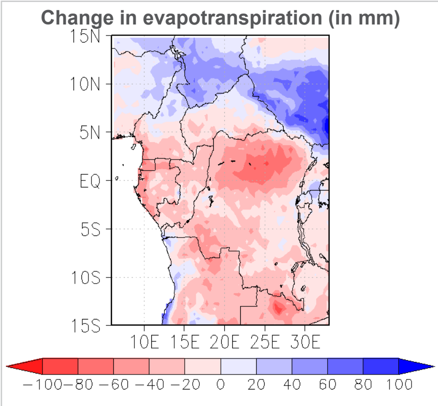
- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

Fact-Sheet - Agriculture - Regional - Zone 5

Maps of projected changes

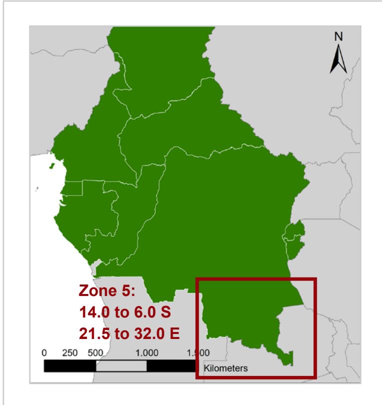
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the “High” emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 5

Definition of Zone 5 - The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	671	-9	-9	-12	-24
	DJF	229	0	-1	-9	-12
	MAM	251	0	-1	-2	-9
	JJA	45	-3	-1	0	+1
	SON	145	-5	-5	-1	-5
Green water consumption		2685	+508	+522	+500	+466
Water stress		-264	+5	+4	+5	+4

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 5

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall slightly increases (0-10%). The evapotranspiration decreases slightly. On the other hand the greenwater consumption initially increases (15-18%), however halfway the century this increase stop. This indicates that initially more water comes available for the agricultural production, however halfway the century available water remains stable. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. Note that the southern regions may experience droughts.

Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “Low“ scenario is based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

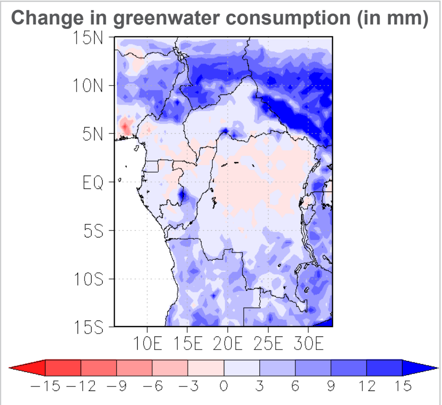
Key adaptation options

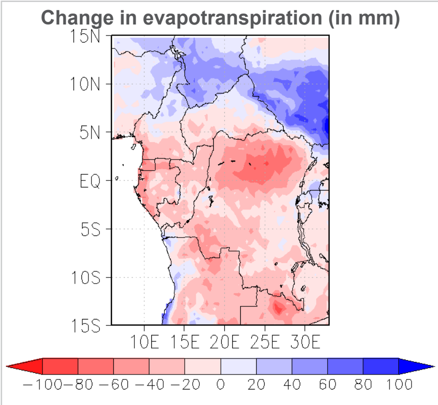
- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Introduction of new varieties which are adapted the higher temperatures, heat stress and dry periods during the growing season.
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

Fact-Sheet - Agriculture - Equatorial Guinea - Zone 4

Maps of projected changes

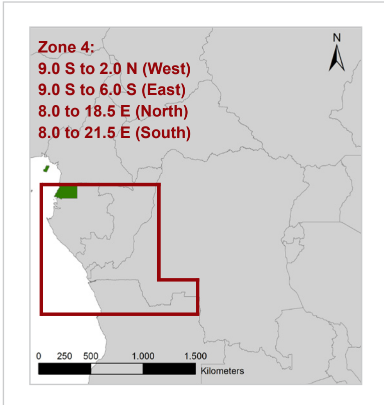
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 4

Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the onshore part of Equatorial Guinea falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress(rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes: Low emission scenario		Projected changes: High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	**813**	**-1**	**+2**	**+2**	**-27**
	DJF	240	+3	+1	+2	-8
	MAM	239	+3	+3	-2	-6
	JJA	156	-3	+2	+3	+1
	SON	179	-4	-4	-2	-13
Green water consumption		**1257**	**+210**	**+258**	**+261**	**+205**
Water stress		**-301**	**+2**	**+2**	**+2**	**+2**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 4

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases (10-20%). The evapotranspiration is not changing much whereas the greenwater consumption initially is increasing, indicating that more water comes available for the agricultural production at the beginning of the century. Halfway the century it stagnates and the water availability does not change much. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. In the northern regions, agriculture may experience occasional crop damage due to an excess of rainfall. In the south occasional droughts will occur.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

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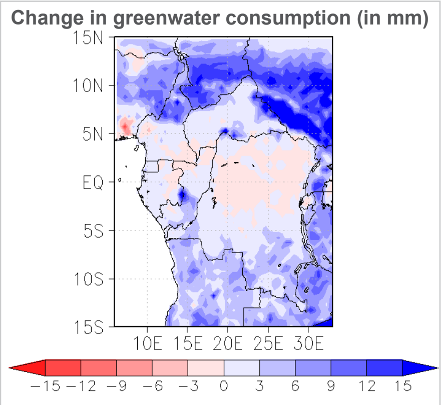
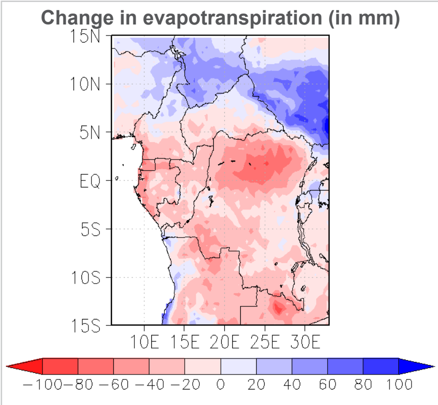
Fact-Sheet - Agriculture - Burundi - Zone 3

Maps of projected changes

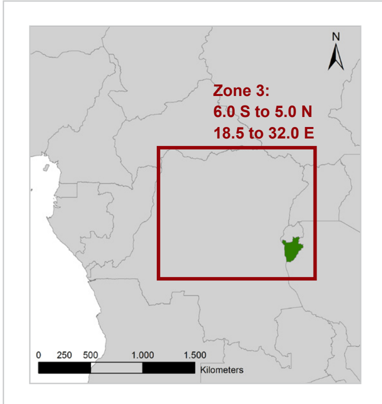
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 3

Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Burundi falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes

List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**855**	**+2**	**+11**	**-10**	**-27**
	DJF	213	+2	+4	-1	-6
	MAM	244	+4	+8	0	-6
	JJA	196	-2	+3	-3	-1
	SON	201	-3	-3	-7	-14
Green water consumption		**878**	**+158**	**+169**	**+151**	**+140**
Water stress		**-310**	**+2**	**+2**	**+2**	**+2**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Data and method

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key findings for Zone 3

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases. The evapotranspiration is not changing much. Agricultural production is not hampered by water shortages. Crop damage may occur due to flooding, excess of water and diseases related to high air humidity. As the precipitation amounts increase this may occur more frequent. The simulated biomass increases, indicating that the agricultural production increases.

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

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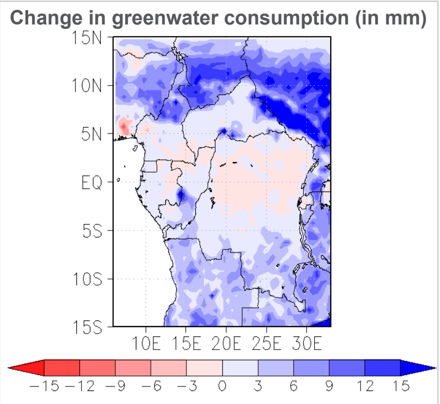
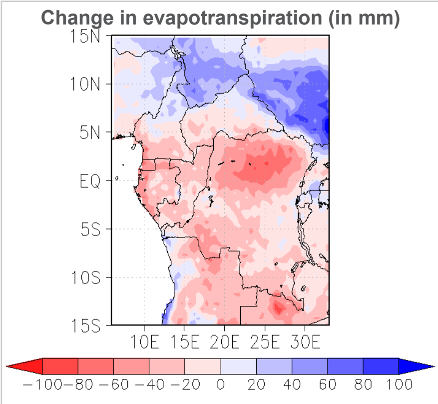
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Agriculture - Cameroon - Zone 1

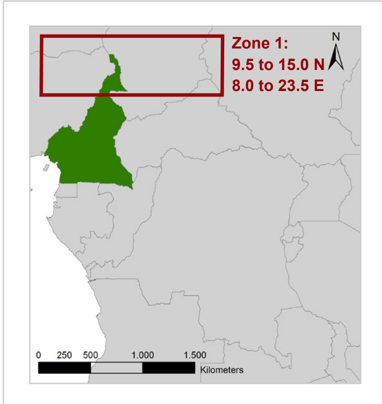
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 1 - The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the northern part of Cameroon falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**438**	**+14**	**+18**	**+10**	**+27**
	DJF	26	+1	+1	+1	+2
	MAM	52	+2	+2	-1	+3
	JJA	218	+8	+9	+5	+10
	SON	142	+4	+7	+5	+13
Green water consumption		**2768**	**+608**	**+619**	**+578**	**+681**
Water stress		**-286**	**+1**	**+1**	**+1**	**+1**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 1

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that the rainy season is extended and the rainfall amount increases. The greenwater consumption increases whereas the changes in the waterstress are limited, which indicates that the agricultural production is less hampered by droughts and may increase in the wetter regions in this zone. The simulated biomass increases as well, which confirms this finding. The dryer regions in the north will continue to experience occasional droughts.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

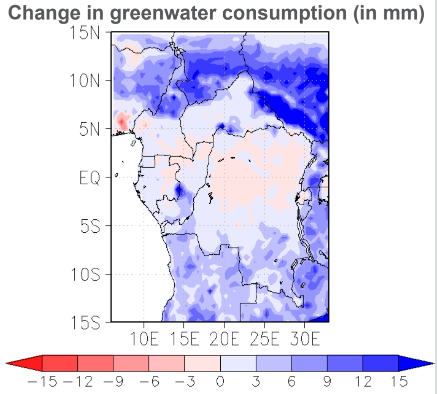
- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties.
- Improving drought management plans which prevent large scale food shortage during future droughts.

Fact-Sheet - Agriculture - Cameroon - Zone 2

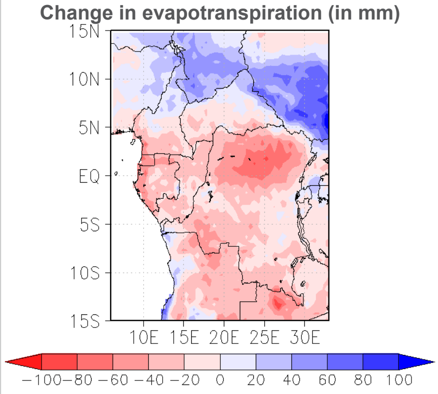
Maps of projected changes

- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.

Change in greenwater consumption (in mm)

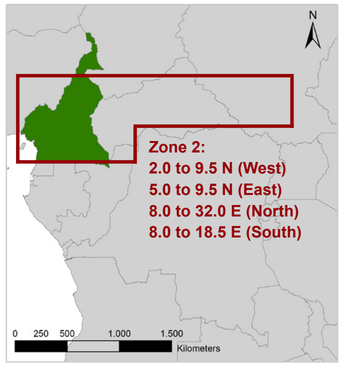


Change in evapotranspiration (in mm)



Definition of Zone 2

- The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of Cameroon falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

- The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	731	+13	+19	-3	+10
	DJF	97	+4	+4	+4	+16
	MAM	183	+3	+2	-4	-3
	JJA	229	+6	+11	0	+4
	SON	223	+0	+1	-3	-7
Green water consumption		2111	+503	+523	+469	+567
Water stress		-296	+2	+2	+2	+3

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 2

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases 12-20%, The evapotranspiration however, does not change very much. In combination with the increasing greenwater consumption (20-25%) this indicates that more water will be available suggesting that the agricultural production may slightly increase. The biomass (vegetation carbon) increases, which confirms the higher potential agricultural production.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

- The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

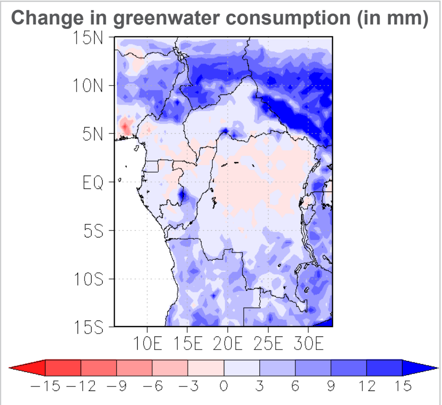
Key adaptation options

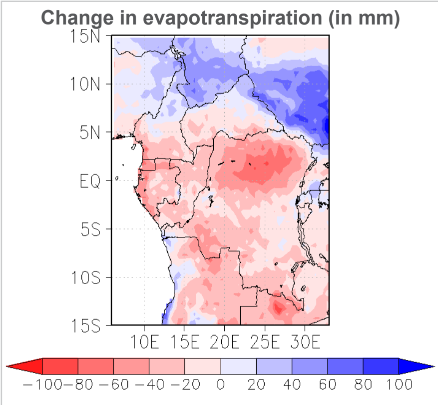
- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall year and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- More agroforestry prevents erosion, improves soil fertility and makes farming systems more diverse.

Fact-Sheet - Agriculture - Central African Republic - Zone 2

Maps of projected changes

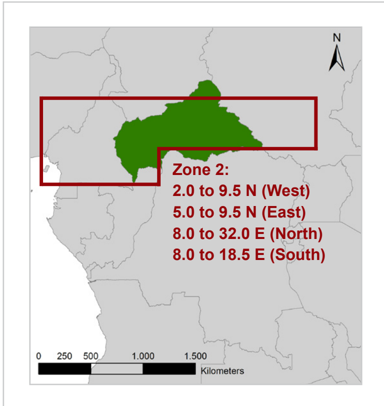
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of the Central African Republic falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**731**	**+13**	**+19**	**-3**	**+10**
	DJF	97	+4	+4	+4	+16
	MAM	183	+3	+2	-4	-3
	JJA	229	+6	+11	0	+4
	SON	223	+0	+1	-3	-7
Green water consumption		**2111**	**+503**	**+523**	**+469**	**+567**
Water stress		**-296**	**+2**	**+2**	**+2**	**+3**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 2

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases 12-20%, The evapotranspiration however, does not change very much. In combination with the increasing greenwater consumption (20-25%) this indicates that more water will be available suggesting that the agricultural production may slightly increase. The biomass (vegetation carbon) increases, which confirms the higher potential agricultural production.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

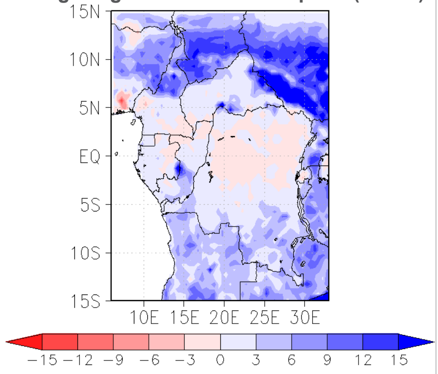
- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall year and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- More agroforestry prevents erosion, improves soil fertility and makes farming systems more diverse.

Fact-Sheet - Agriculture - Chad - Zone 1

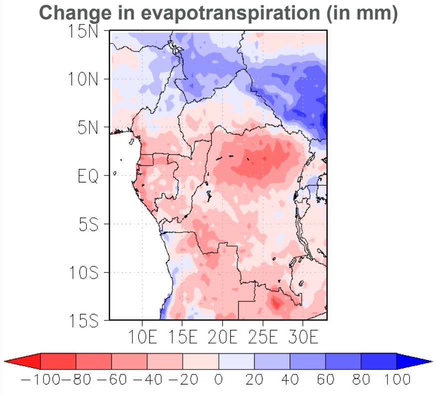
Maps of projected changes

- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.

Change in greenwater consumption (in mm)



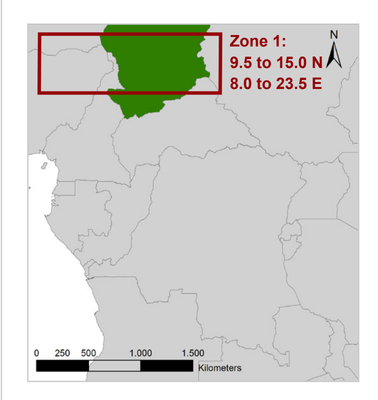
Change in evapotranspiration (in mm)



Definition of Zone 1

- The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the central part of Chad falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**438**	**+14**	**+18**	**+10**	**+27**
	DJF	26	+1	+1	+1	+2
	MAM	52	+2	+2	-1	+3
	JJA	218	+8	+9	+5	+10
	SON	142	+4	+7	+5	+13
Green water consumption		**2768**	**+608**	**+619**	**+578**	**+681**
Water stress		**-286**	**+1**	**+1**	**+1**	**+1**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 1

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that the rainy season is extended and the rainfall amount increases. The greenwater consumption increases whereas the changes in the waterstress are limited, which indicates that the agricultural production is less hampered by droughts and may increase in the wetter regions in this zone. The simulated biomass increases as well, which confirms this finding. The dryer regions in the north will continue to experience occasional droughts.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

- The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

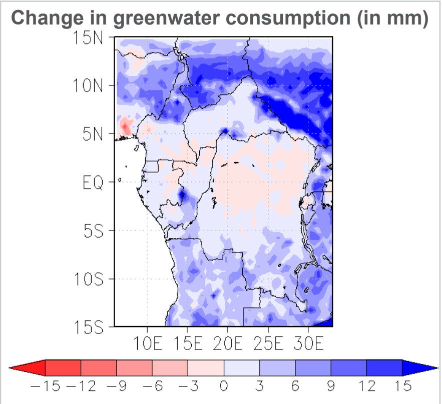
Key adaptation options

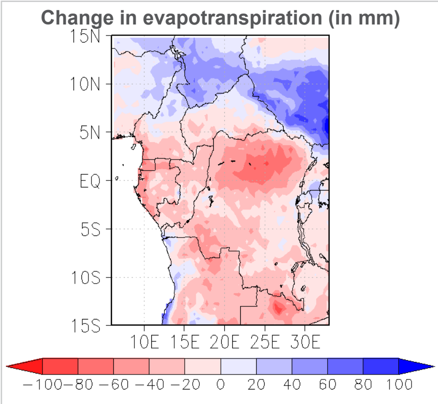
- Introduction of new varieties which are adapted the higher temperatures and heat stress
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties.
- Improving drought management plans which prevent large scale food shortage during future droughts.

Fact-Sheet - Agriculture - Republic of the Congo - Zone 4

Maps of projected changes

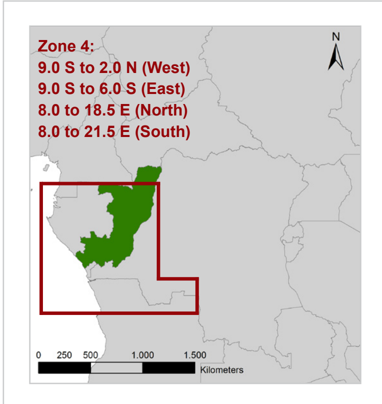
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the “High” emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major part of the Congo falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress(rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	813	-1	+2	+2	-27
	DJF	240	+3	+1	+2	-8
	MAM	239	+3	+3	-2	-6
	JJA	156	-3	+2	+3	+1
	SON	179	-4	-4	-2	-13
Green water consumption		1257	+210	+258	+261	+205
Water stress		-301	+2	+2	+2	+2

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 4

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases (10-20%). The evapotranspiration is not changing much whereas the greenwater consumption initially is increasing, indicating that more water comes available for the agricultural production at the beginning of the century. Halfway the century it stagnates and the water availability does not change much. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. In the northern regions, agriculture may experience occasional crop damage due to an excess of rainfall. In the south occasional droughts will occur.

Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

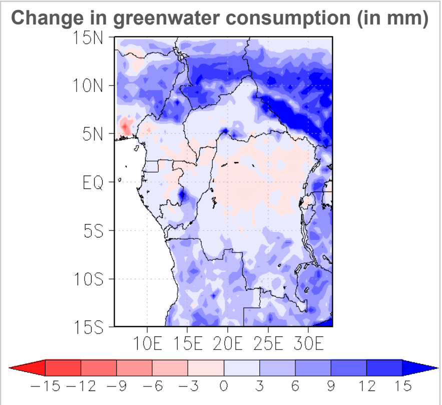
The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “Low“ scenario is based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

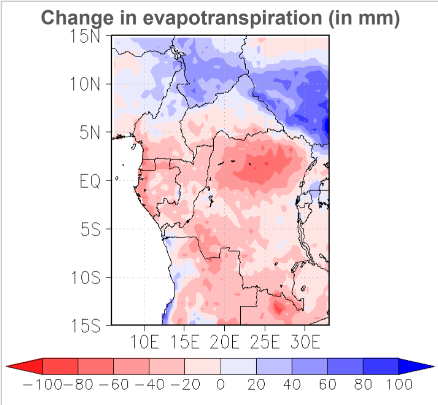
Key adaptation options:

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

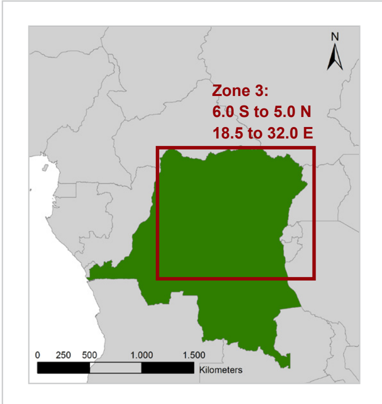
Fact-Sheet - Agriculture - Democratic Republic of the Congo (DRC)- Zone 3

Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the northern and central parts of DRC fall within Zone 3, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availability for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotranspiration	YEAR	855	+2	+11	-10	-27
	DJF	213	+2	+4	-1	-6
	MAM	244	+4	+8	0	-6
	JJA	196	-2	+3	-3	-1
	SON	201	-3	-3	-7	-14
Green water consumption		878	+158	+169	+151	+140
Water stress		-310	+2	+2	+2	+2

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 3

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases. The evapotranspiration is not changing much. Agricultural production is not hampered by water shortages. Crop damage may occur due to flooding, excess of water and diseases related to high air humidity. As the precipitation amounts increase this may occur more frequent. The simulated biomass increases, indicating that the agricultural production increases.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

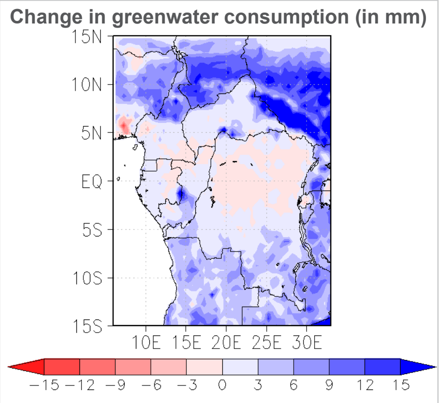
Key adaptation options

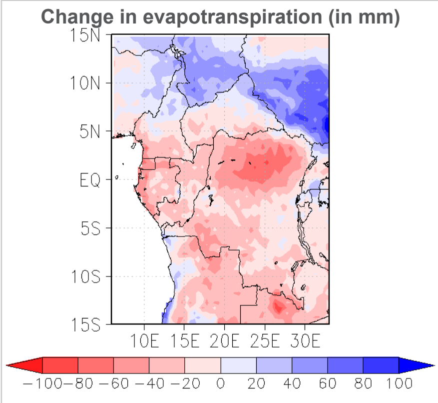
- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties

Fact-Sheet - Agriculture - Democratic Republic of the Congo (DRC)- Zone 4

Maps of projected changes

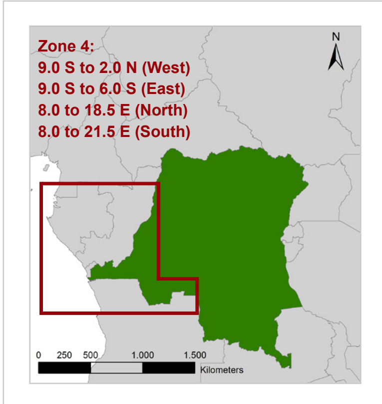
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the “High” emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 4

Definition of Zone 4 - The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the western part of DRC falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress(rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotranspiration	YEAR	813	-1	+2	+2	-27
	DJF	240	+3	+1	+2	-8
	MAM	239	+3	+3	-2	-6
	JJA	156	-3	+2	+3	+1
	SON	179	-4	-4	-2	-13
Green water consumption		1257	+210	+258	+261	+205
Water stress		-301	+2	+2	+2	+2

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 4

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases (10-20%). The evapotranspiration is not changing much whereas the greenwater consumption initially is increasing, indicating that more water comes available for the agricultural production at the beginning of the century. Halfway the century it stagnates and the water availability does not change much. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. In the northern regions, agriculture may experience occasional crop damage due to an excess of rainfall. In the south occasional droughts will occur.

Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “Low“ scenario is based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

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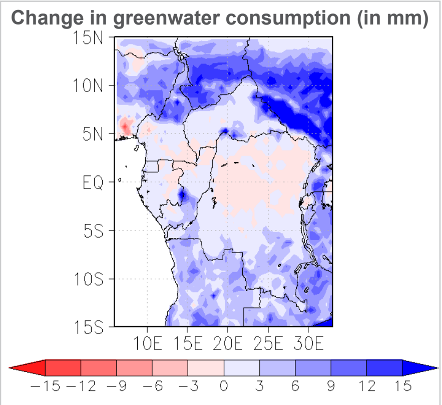
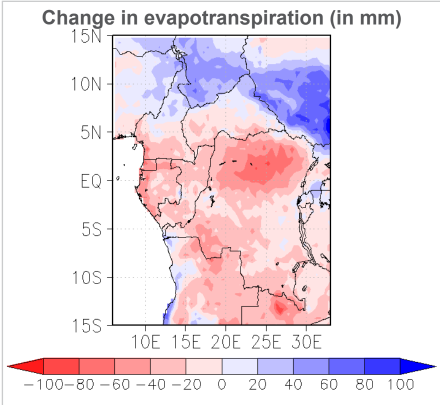
Fact-Sheet - Agriculture - Democratic Republic of the Congo (DRC)- Zone 5

Maps of projected changes

Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.

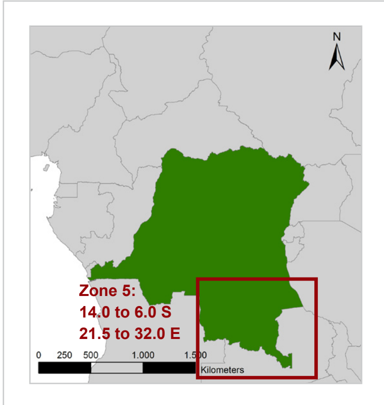




Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the southern part of DRC falls within Zone 5, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	671	-9	-9	-12	-24
	DJF	229	0	-1	-9	-12
	MAM	251	0	-1	-2	-9
	JJA	45	-3	-1	0	+1
	SON	145	-5	-5	-1	-5
Green water consumption		2685	+508	+522	+500	+466
Water stress		-264	+5	+4	+5	+4

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 5

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall slightly increases (0-10%). The evapotranspiration decreases slightly. On the other hand the greenwater consumption initially increases (15-18%), however halfway the century this increase stop. This indicates that initially more water comes available for the agricultural production, however halfway the century available water remains stable. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. Note that the southern regions may experience droughts.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method

The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

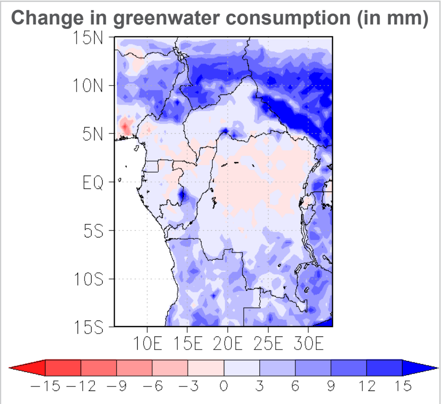
Key adaptation options

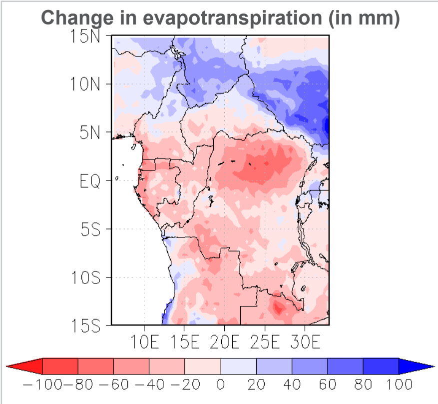
- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Introduction of new varieties which are adapted the higher temperatures, heat stress and dry periods during the growing season.
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

Fact-Sheet - Agriculture - Gabon - Zone 4

Maps of projected changes

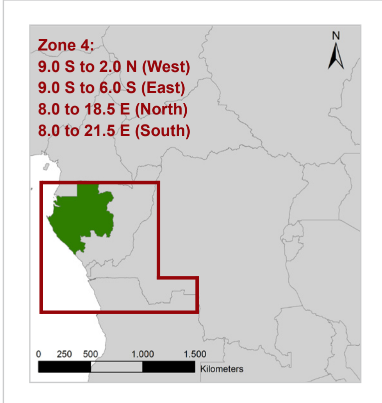
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Gabon falls completely within Zone 4, projected changes for this zone are assumed to be representative for the country.



List of projected changes

The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress(rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	YEAR	813	-1	+2	+2	-27
	DJF	240	+3	+1	+2	-8
	MAM	239	+3	+3	-2	-6
	JJA	156	-3	+2	+3	+1
	SON	179	-4	-4	-2	-13
Green water consumption		1257	+210	+258	+261	+205
Water stress		-301	+2	+2	+2	+2

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Data and method

The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key findings for Zone 4

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases (10-20%). The evapotranspiration is not changing much whereas the greenwater consumption initially is increasing, indicating that more water comes available for the agricultural production at the beginning of the century. Halfway the century it stagnates and the water availability does not change much. The biomass (vegetation carbon) is decreasing in this period which indicates that the agricultural production may decrease if the current farming systems and techniques are applied in this period. In the northern regions, agriculture may experience occasional crop damage due to an excess of rainfall. In the south occasional droughts will occur.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties
- Improved management of climate variability to ensure maximum yield during high rainfall years and minimum damage during dry years.

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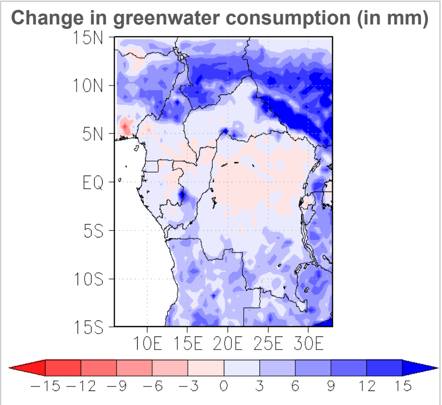
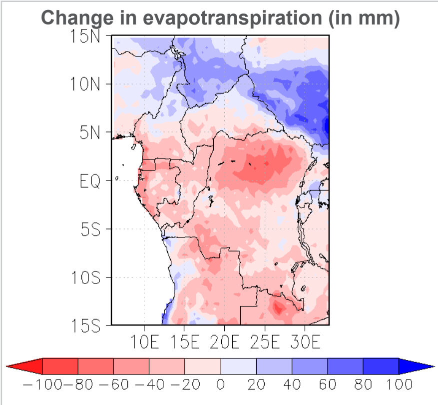
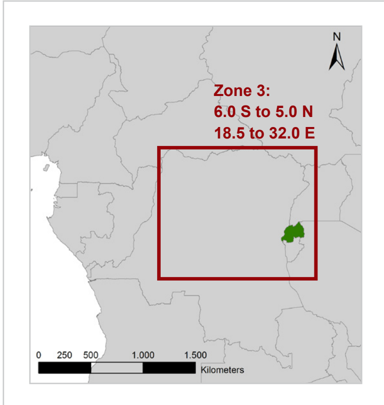
Fact-Sheet - Agriculture - Rwanda - Zone 3

Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario. In the left panel, changes in greenwater consumption are shown and in the right panel, changes in evapotranspiration.





Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Rwanda falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes - The tables show the mean of the projected changes in respectively the evapotranspiration, greenwater consumption and water stress (rounded values). Note that current land use is used in this study for all assessed time periods. Consequently all changes are caused by climate change alone.

Parameters describing the water availibility for agricultural production (in mm)		Today	Projected changes			
			Low emission scenario		High emission scenario	
		2000	till 2050	till 2100	till 2050	till 2100
Evapotrans-piration	**YEAR**	**855**	**+2**	**+11**	**-10**	**-27**
	DJF	213	+2	+4	-1	-6
	MAM	244	+4	+8	0	-6
	JJA	196	-2	+3	-3	-1
	SON	201	-3	-3	-7	-14
Green water consumption		**878**	**+158**	**+169**	**+151**	**+140**
Water stress		**-310**	**+2**	**+2**	**+2**	**+2**

Note: Increasing values in the green water consumption indicate that more water becomes available for agricultural production. This may be caused by either increasing rainfall amounts, increasing CO_2 levels or a combination of both. The decreasing values in evapotranspiration indicate that the increasing CO_2 concentration has a stronger effect than the increasing temperatures.

Key findings for Zone 3

- Based on the analyzed ensemble of global climate projections under the assumption of a low and a high emission scenario it can be concluded that rainfall increases. The evapotranspiration is not changing much. Agricultural production is not hampered by water shortages. Crop damage may occur due to flooding, excess of water and diseases related to high air humidity. As the precipitation amounts increase this may occur more frequent. The simulated biomass increases, indicating that the agricultural production increases.

Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Data and method - The projected greenwater, evapotranspiration and water stress signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario. We present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the only one giving acceptable results. Land use changes up to 2006 have been used. Projections for the future land use depend on many unknown factors and are therefore difficult to incorporate. The data presented here reflect the changes that are only caused by the changing climate i.e. land use is kept constant. Increasing temperature and the rising atmospheric CO_2 concentration have an opposite effect on agricultural production. The increasing temperature results in an increasing soil evaporation whereas the rising CO_2 concentration reduces plant transpiration especially in the C_4-crops. Unfortunately little is known on the interaction of the rising CO_2 concentration, fertilizer inputs and increasing temperatures for tropical crops. More research in this direction is needed. Note that changing agricultural practises such as more inputs, new crop varieties etc. may have a strong positive effect on the future agricultural production and may compensate for the negative climate change impacts.

Key adaptation options

- Improved flood management plans to ensure limited damages to agricultural systems during high rainfall events.
- Reducing erosion risk and nutrient leaching by introduction of agroforestry systems
- To adapt to increased climate variability farming systems should become more diverse. This can be done for example by planting multiple crops and using different varieties

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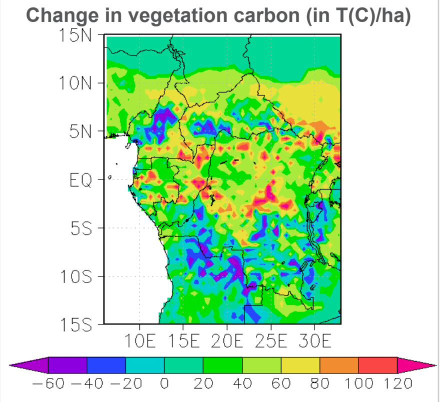
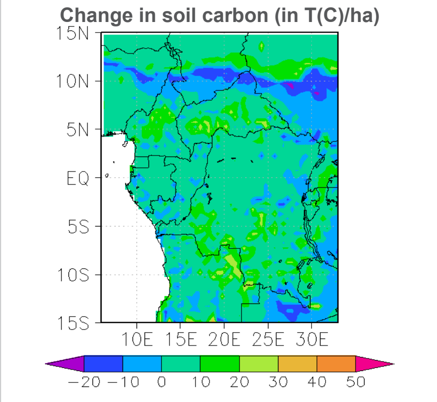
Fact-Sheet - Forestry - Regional - Zone 1

Maps of projected changes

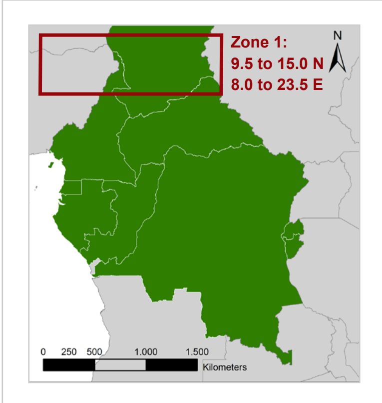
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	9.97	+7.18	+10.13	+8.61	+16.38
Soil carbon	45.84	+1.31	+1.56	+1.97	+1.67
Total carbon	55.81	+8.49	+11.69	+10.58	+18.05

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	0.07	+0.11	+0.16	+0.14	+0.22
Seasonal forest	0.87	+0.78	+0.99	+1.01	+1.74
Natural Grassland	2.53	-0.14	-0.23	-0.19	-0.3

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 1:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase slightly.
- It is likely that total ecosystem carbon in this zone will increase moderately.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase while the proportion natural grasslands will decrease.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

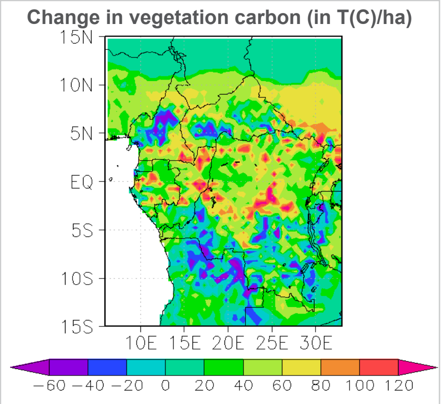
In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

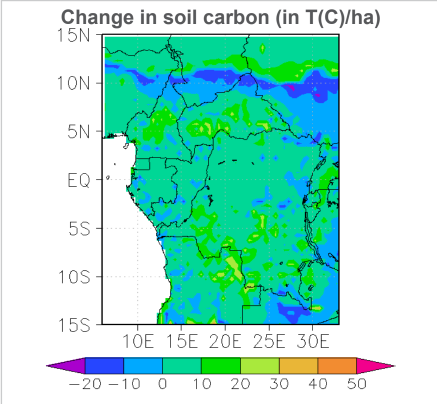
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Forestry - Regional - Zone 2

Maps of projected changes

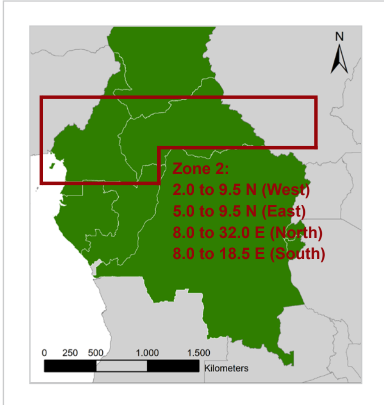
- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 2

- The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	91.98	+17.6	+16.51	+33.97	+43.21
Soil carbon	65.45	+2.65	+4.33	+1.35	+2.55
Total carbon	157.43	+20.25	+20.84	+35.32	+45.76

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	2.71	+0.63	+0.56	+0.64	+0.82
Seasonal forest	4.17	+1.26	+1.2	+1.62	+2.45
Natural Grassland	1.16	-0.21	+0.23	-0.32	-0.06

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 2:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase, although there is a distinct area (see map) where soil carbon will decrease.
- It is likely that total ecosystem carbon in this zone will increase slightly.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase slightly while the proportion natural grasslands will first decrease, then increase again.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

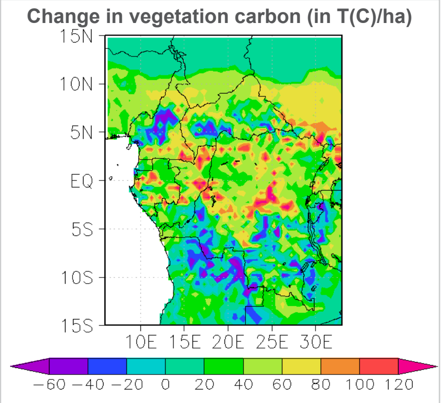
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

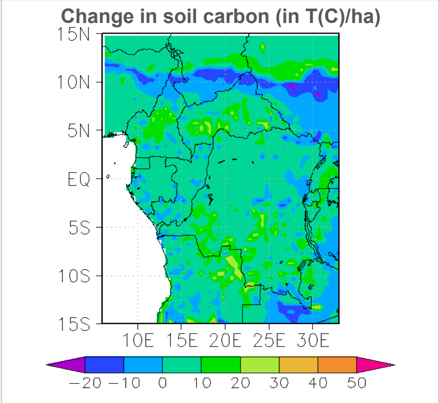
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Forestry - Regional - Zone 3

Maps of projected changes

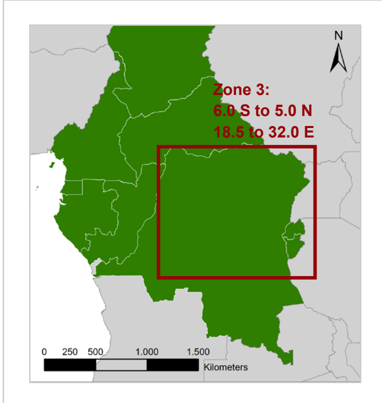
- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 3

- The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	148.26	+11.86	+18.64	+36.46	+43.52
Soil carbon	76.94	+6.18	+5.39	+4.7	+4.91
Total carbon	225.2	+18.04	+24.03	+41.16	+48.43

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	5.11	+0.47	+.06	+0.58	+0.9
Seasonal forest	4.62	+1.25	+1.71	+1.72	+2.66
Natural Grassland	1.07	+0.27	+0.16	+0.01	+0.1

Key findings for Zone 3:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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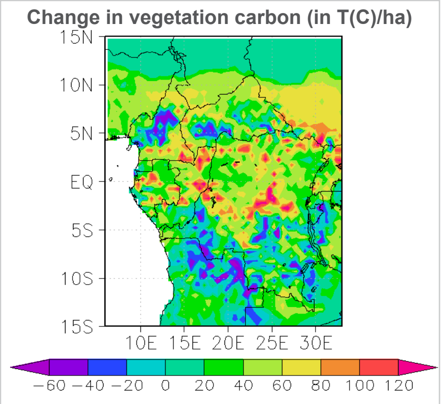
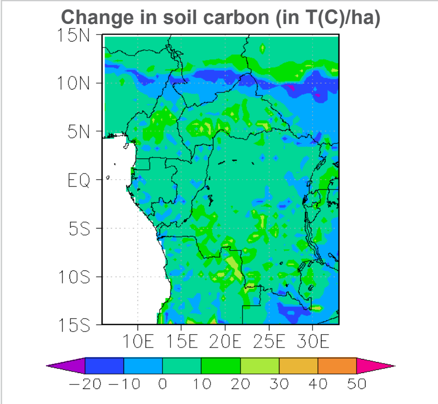
Fact-Sheet - Forestry - Regional - Zone 4

Maps of projected changes

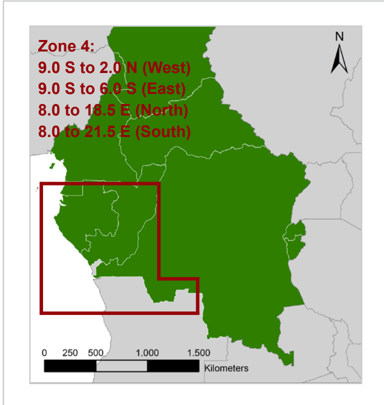
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**124.87**	**+3.26**	**-9.53**	**+28.43**	**+12.88**
Soil carbon	**71.85**	**+7.72**	**+8.01**	**+3.79**	**+8.12**
Total carbon	**196.72**	**+10.98**	**-1.52**	**+32.22**	**+21.0**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**4.0**	**+0.24**	**+0.42**	**+0.53**	**+0.68**
Seasonal forest	**4.49**	**+0.76**	**+1.19**	**+1.19**	**+1.82**
Natural Grassland	**1.0**	**+0.37**	**+0.22**	**+0.12**	**+0.4**

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 4:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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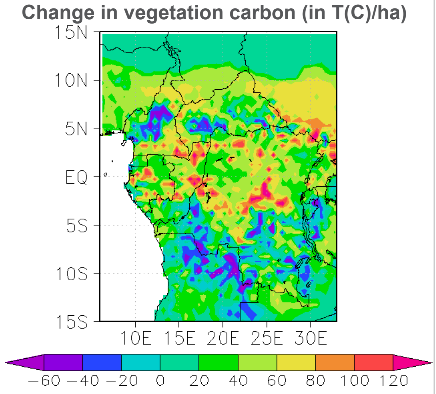
Fact-Sheet - Forestry - Regional - Zone 5

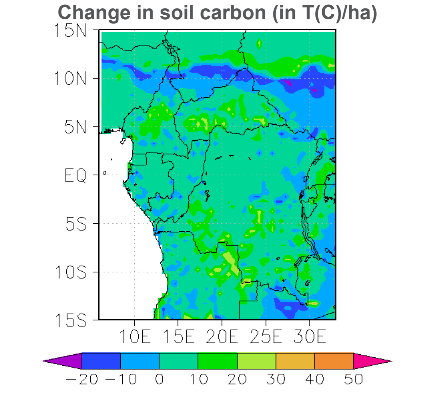
Maps of projected changes

Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

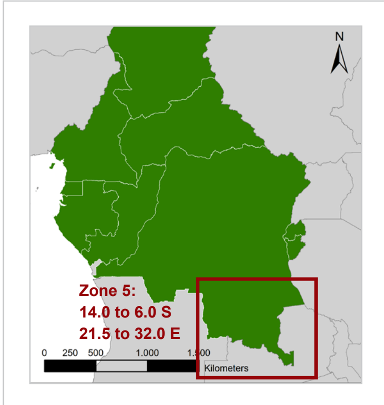


Change in soil carbon (in T(C)/ha)



Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. Projected changes for this zone are assumed to be representative for these parts of central Africa.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**93.23**	**+1.76**	**-8.87**	**+17.23**	**+14.3**
Soil carbon	**78.46**	**+5.0**	**+5.83**	**+3.11**	**+4.37**
Total carbon	**171.69**	**+6.76**	**-3.04**	**+20.34**	**+18.67**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**1.97**	**+0.22**	**+0.34**	**+0.38**	**+0.56**
Seasonal forest	**4.57**	**+0.82**	**+1.06**	**+1.27**	**+1.96**
Natural Grassland	**1.23**	**+0.13**	**+0.17**	**-0.12**	**-0.08**

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 5:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase slightly.
- It is likely that total ecosystem carbon in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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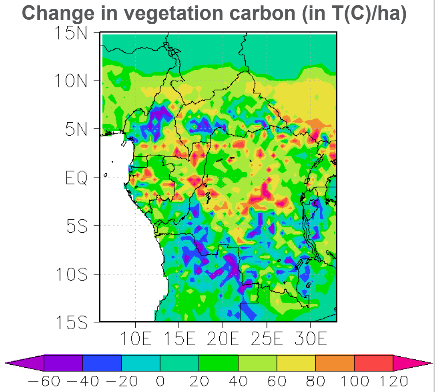
Fact-Sheet - Forestry - Rwanda - Zone 3

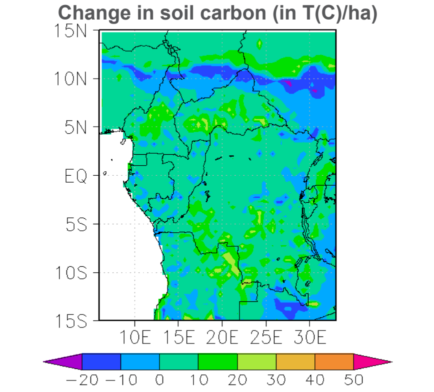
Maps of projected changes

- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

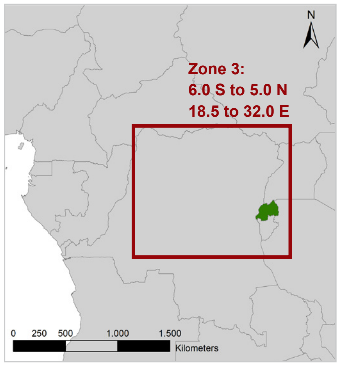


Change in soil carbon (in T(C)/ha)



Definition of Zone 3

- The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Rwanda falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	148.26	+11.86	+18.64	+36.46	+43.52
Soil carbon	76.94	+6.18	+5.39	+4.7	+4.91
Total carbon	225.2	+18.04	+24.03	+41.16	+48.43

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	5.11	+0.47	+.06	+0.58	+0.9
Seasonal forest	4.62	+1.25	+1.71	+1.72	+2.66
Natural Grassland	1.07	+0.27	+0.16	+0.01	+0.1

Key findings for Zone 3:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

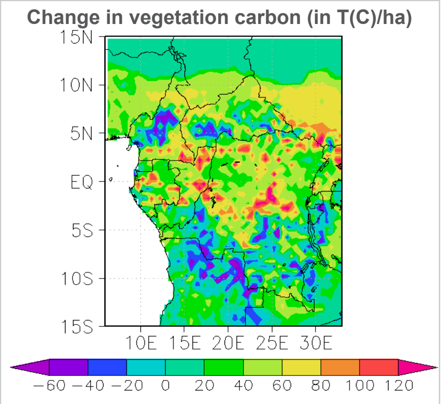
In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

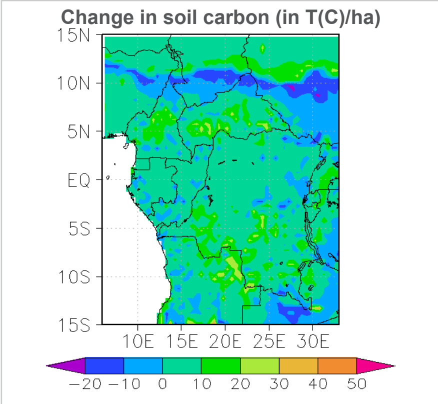
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Forestry - Burundi - Zone 3

Maps of projected changes

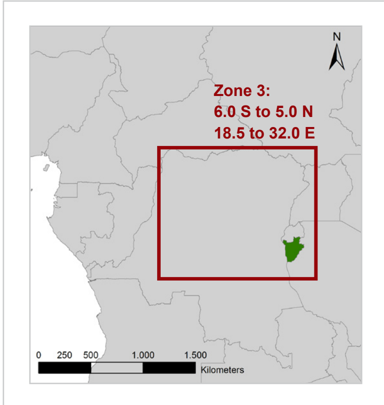
Maps of projected changes - Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 3

Definition of Zone 3 - The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Burundi falls completely within Zone 3, projected changes for this zone are assumed to be representative for the country.



List of projected changes

List of projected changes - Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**148.26**	**+11.86**	**+18.64**	**+36.46**	**+43.52**
Soil carbon	**76.94**	**+6.18**	**+5.39**	**+4.7**	**+4.91**
Total carbon	**225.2**	**+18.04**	**+24.03**	**+41.16**	**+48.43**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**5.11**	**+0.47**	**+.06**	**+0.58**	**+0.9**
Seasonal forest	**4.62**	**+1.25**	**+1.71**	**+1.72**	**+2.66**
Natural Grassland	**1.07**	**+0.27**	**+0.16**	**+0.01**	**+0.1**

Data and method

Data and method - The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 3:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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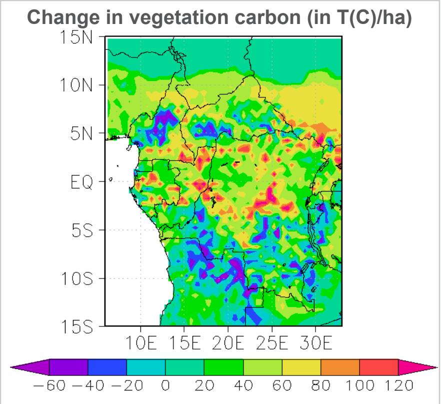
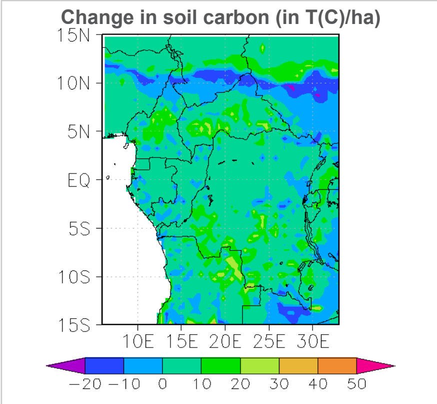
Fact-Sheet - Forestry - Cameroon - Zone 1

Maps of projected changes

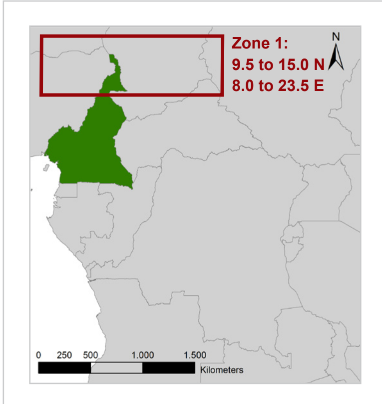
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the northern part of Cameroon falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	9.97	+7.18	+10.13	+8.61	+16.38
Soil carbon	45.84	+1.31	+1.56	+1.97	+1.67
Total carbon	55.81	+8.49	+11.69	+10.58	+18.05

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	0.07	+0.11	+0.16	+0.14	+0.22
Seasonal forest	0.87	+0.78	+0.99	+1.01	+1.74
Natural Grassland	2.53	-0.14	-0.23	-0.19	-0.3

Key findings for Zone 1:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase slightly.
- It is likely that total ecosystem carbon in this zone will increase moderately.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase while the proportion natural grasslands will decrease.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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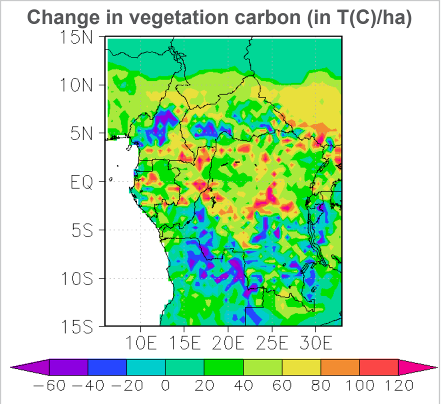
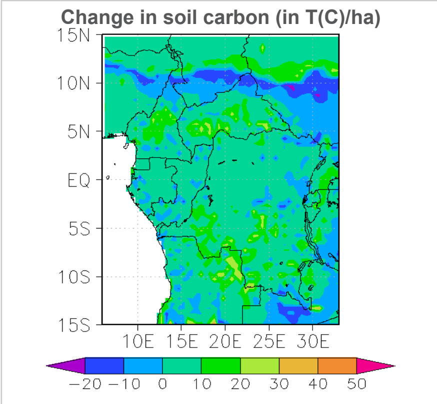
Fact-Sheet - Forestry - Cameroon - Zone 2

Maps of projected changes

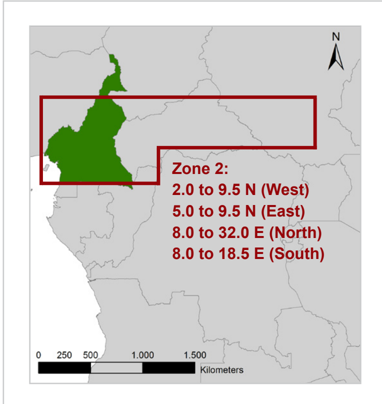
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 2

The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of Cameroon falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	91.98	+17.6	+16.51	+33.97	+43.21
Soil carbon	65.45	+2.65	+4.33	+1.35	+2.55
Total carbon	157.43	+20.25	+20.84	+35.32	+45.76

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	2.71	+0.63	+0.56	+0.64	+0.82
Seasonal forest	4.17	+1.26	+1.2	+1.62	+2.45
Natural Grassland	1.16	-0.21	+0.23	-0.32	-0.06

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 2:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase, although there is a distinct area (see map) where soil carbon will decrease.
- It is likely that total ecosystem carbon in this zone will increase slightly.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase slightly while the proportion natural grasslands will first decrease, then increase again.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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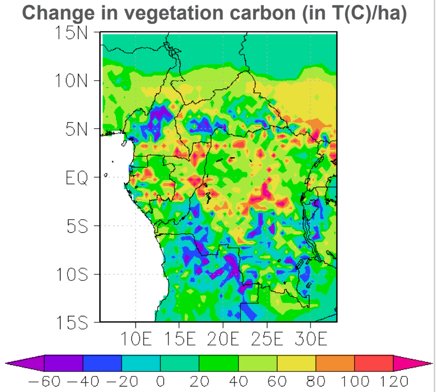
Fact-Sheet - Forestry - Central African Republic - Zone 2

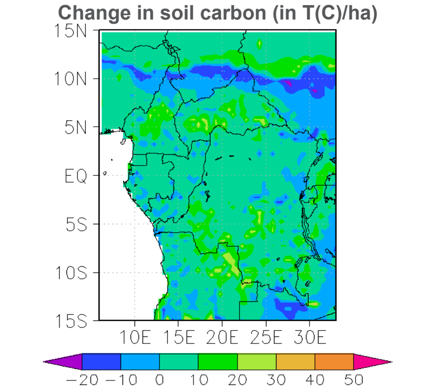
Maps of projected changes

- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

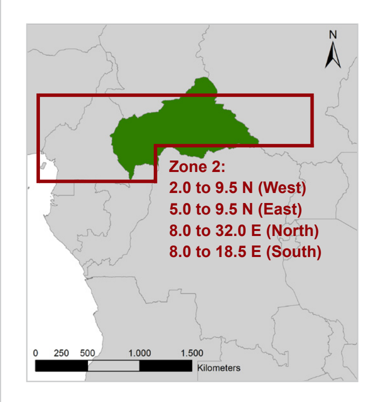


Change in soil carbon (in T(C)/ha)



Definition of Zone 2

- The map below indicates the position of Zone 2 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major parts of the Central African Republic falls within Zone 2, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	91.98	+17.6	+16.51	+33.97	+43.21
Soil carbon	65.45	+2.65	+4.33	+1.35	+2.55
Total carbon	157.43	+20.25	+20.84	+35.32	+45.76

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	2.71	+0.63	+0.56	+0.64	+0.82
Seasonal forest	4.17	+1.26	+1.2	+1.62	+2.45
Natural Grassland	1.16	-0.21	+0.23	-0.32	-0.06

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 2:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase, although there is a distinct area (see map) where soil carbon will decrease.
- It is likely that total ecosystem carbon in this zone will increase slightly.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase slightly while the proportion natural grasslands will first decrease, then increase again.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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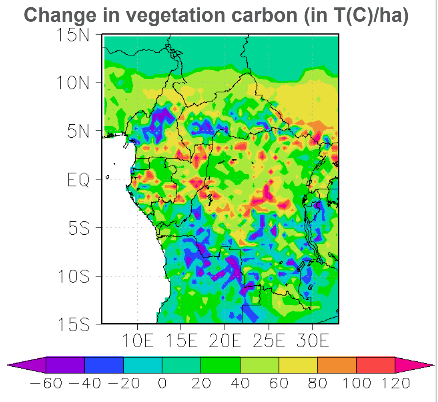
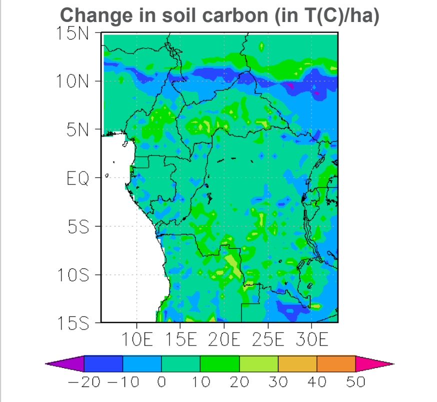
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Forestry - Chad - Zone 1

Maps of projected changes

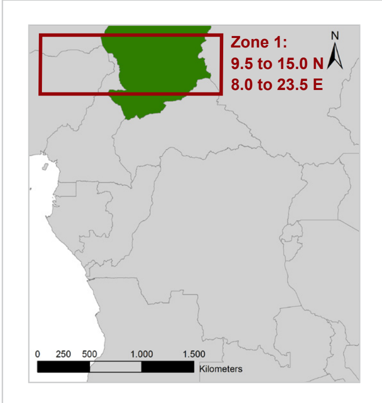
Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 1

The map below indicates the position of Zone 1 (red rectangle), representing the semi-arid Sahel zone region regions in the north of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the central part of Chad falls within Zone 1, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**9.97**	**+7.18**	**+10.13**	**+8.61**	**+16.38**
Soil carbon	**45.84**	**+1.31**	**+1.56**	**+1.97**	**+1.67**
Total carbon	**55.81**	**+8.49**	**+11.69**	**+10.58**	**+18.05**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**0.07**	**+0.11**	**+0.16**	**+0.14**	**+0.22**
Seasonal forest	**0.87**	**+0.78**	**+0.99**	**+1.01**	**+1.74**
Natural Grassland	**2.53**	**-0.14**	**-0.23**	**-0.19**	**-0.3**

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 1:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase slightly.
- It is likely that total ecosystem carbon in this zone will increase moderately.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests will increase while the proportion natural grasslands will decrease.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

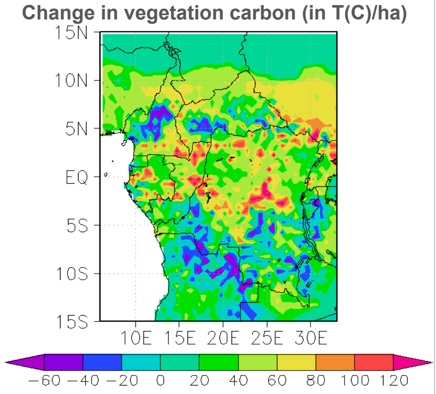
Further details can be found in the "**Impacts Report**" and the "**Adaptation Report**" in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Forestry - Republic of the Congo - Zone 4

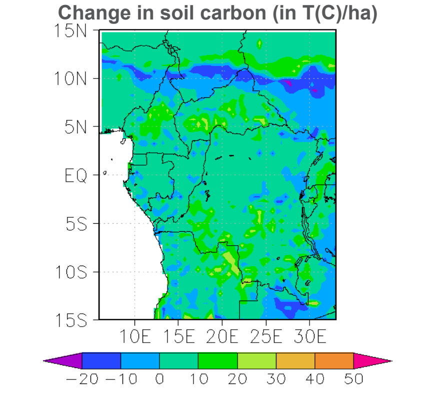
Maps of projected changes

- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the “High” emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

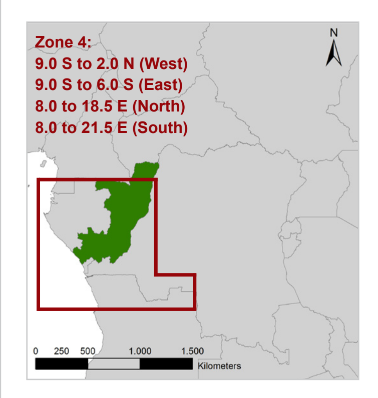


Change in soil carbon (in T(C)/ha)



Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the major part of the Congo falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	124.87	+3.26	-9.53	+28.43	+12.88
Soil carbon	71.85	+7.72	+8.01	+3.79	+8.12
Total carbon	196.72	+10.98	-1.52	+32.22	+21.0

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	4.0	+0.24	+0.42	+0.53	+0.68
Seasonal forest	4.49	+0.76	+1.19	+1.19	+1.82
Natural Grassland	1.0	+0.37	+0.22	+0.12	+0.4

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a “likely range” or ”confidence interval”. Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “Low“ scenario is based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 4:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

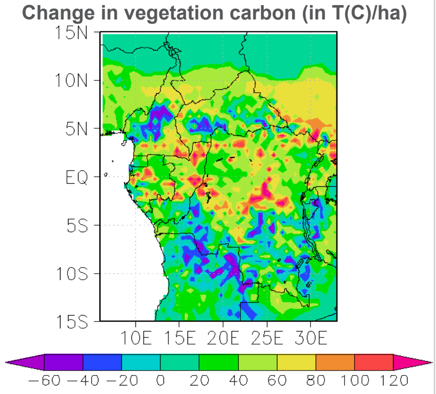
Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

Fact-Sheet - Forestry - Democratic Republic of the Congo (DRC)- Zone 3

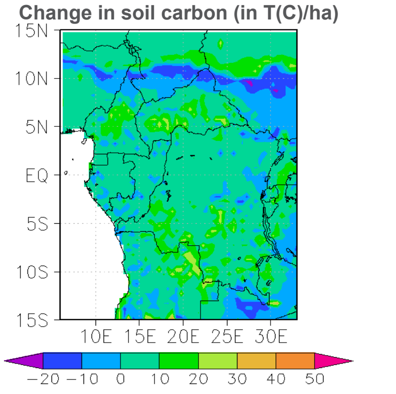
Maps of projected changes

Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

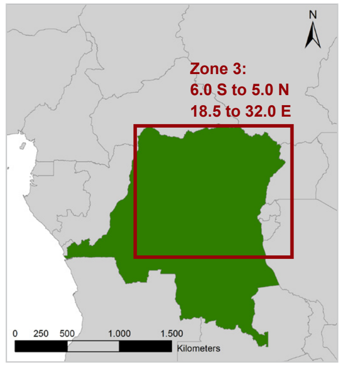


Change in soil carbon (in T(C)/ha)



Definition of Zone 3

The map below indicates the position of Zone 3 (red rectangle), representing the central regions with the mainly tropical rainforest climates and mainly a bimodal rain-regime. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the northern and central parts of DRC fall within Zone 3, projected changes for this zone are assumed to be representative for these parts of the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	148.26	+11.86	+18.64	+36.46	+43.52
Soil carbon	76.94	+6.18	+5.39	+4.7	+4.91
Total carbon	225.2	+18.04	+24.03	+41.16	+48.43

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	5.11	+0.47	+.06	+0.58	+0.9
Seasonal forest	4.62	+1.25	+1.71	+1.72	+2.66
Natural Grassland	1.07	+0.27	+0.16	+0.01	+0.1

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 3:

- It is likely that biomass (vegetation carbon) in this zone will increase.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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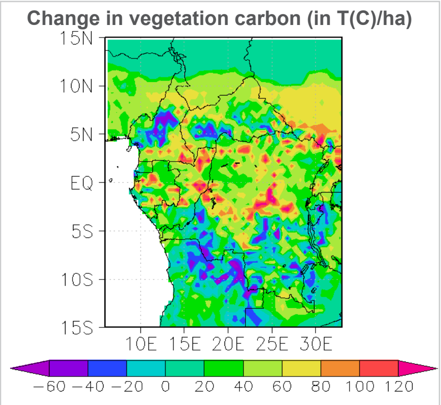
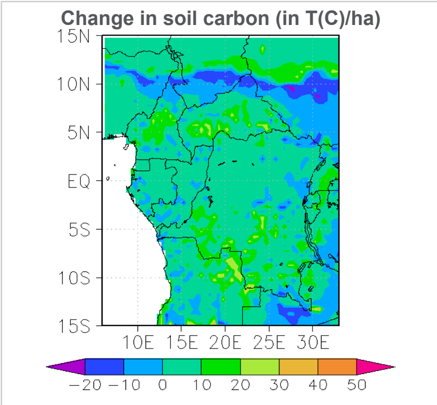
Fact-Sheet - Forestry - Democratic Republic of the Congo (DRC)- Zone 4

Maps of projected changes

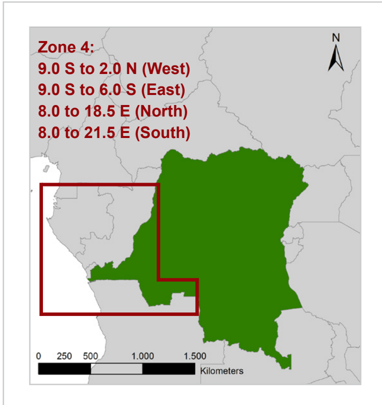
- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the western part of DRC falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**124.87**	**+3.26**	**-9.53**	**+28.43**	**+12.88**
Soil carbon	**71.85**	**+7.72**	**+8.01**	**+3.79**	**+8.12**
Total carbon	**196.72**	**+10.98**	**-1.52**	**+32.22**	**+21.0**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**4.0**	**+0.24**	**+0.42**	**+0.53**	**+0.68**
Seasonal forest	**4.49**	**+0.76**	**+1.19**	**+1.19**	**+1.82**
Natural Grassland	**1.0**	**+0.37**	**+0.22**	**+0.12**	**+0.4**

Key findings for Zone 4:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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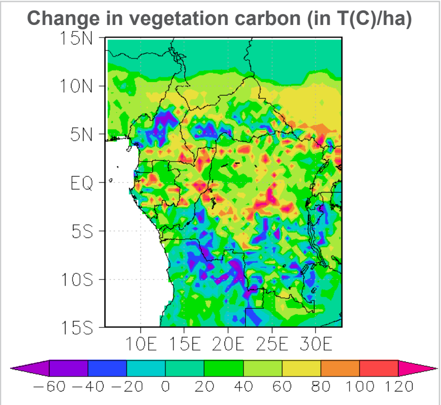
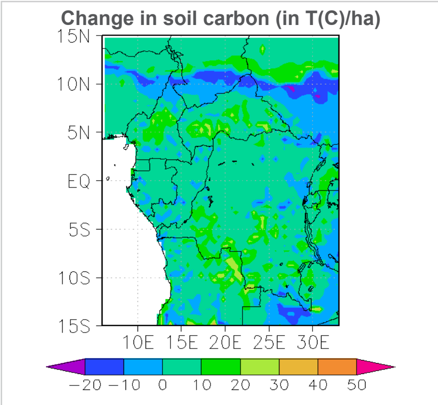
Fact-Sheet - Forestry - Democratic Republic of the Congo (DRC)- Zone 5

Maps of projected changes

Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

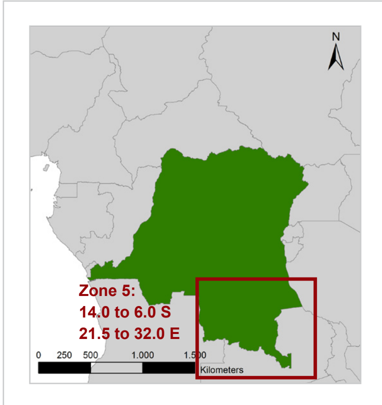




Definition of Zone 5

The map below indicates the position of Zone 5 (red rectangle), representing the subtropical regions in the south of central Africa. All values presented in this fact-sheet are changes spatially averaged over the whole zone.

As the southern part of DRC falls within Zone 5, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	93.23	+1.76	-8.87	+17.23	+14.3
Soil carbon	78.46	+5.0	+5.83	+3.11	+4.37
Total carbon	171.69	+6.76	-3.04	+20.34	+18.67

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	1.97	+0.22	+0.34	+0.38	+0.56
Seasonal forest	4.57	+0.82	+1.06	+1.27	+1.96
Natural Grassland	1.23	+0.13	+0.17	-0.12	-0.08

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key findings for Zone 5:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase slightly.
- It is likely that total ecosystem carbon in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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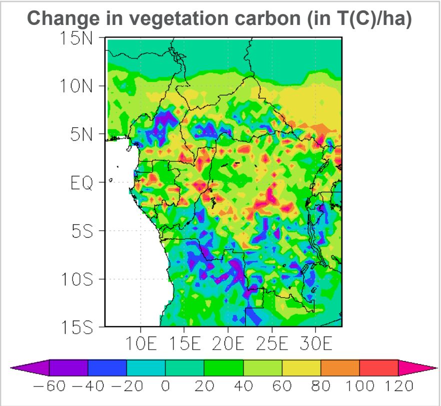
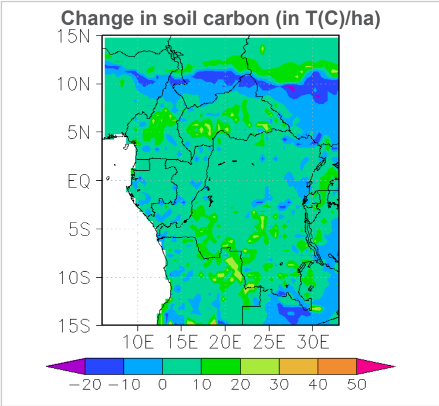
Fact-Sheet - Forestry - Equatorial Guinea - Zone 4

Maps of projected changes

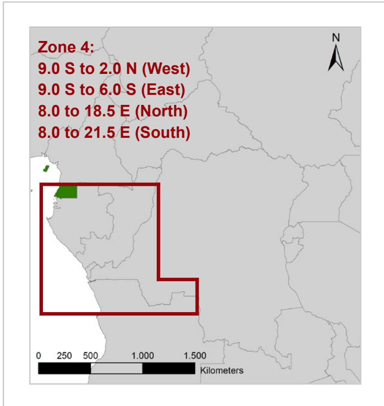
- Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the “High” emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.





Definition of Zone 4

- The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As the onshore part of Equatorial Guinea falls within Zone 4, projected changes for this zone are assumed to be representative for this part of the country.



List of projected changes

- Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	124.87	+3.26	-9.53	+28.43	+12.88
Soil carbon	71.85	+7.72	+8.01	+3.79	+8.12
Total carbon	196.72	+10.98	-1.52	+32.22	+21.0

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	4.0	+0.24	+0.42	+0.53	+0.68
Seasonal forest	4.49	+0.76	+1.19	+1.19	+1.82
Natural Grassland	1.0	+0.37	+0.22	+0.12	+0.4

Key findings for Zone 4:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

- The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a “likely range” or ”confidence interval”. Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the “Low“ scenario is based upon the SRES B1 (IPCC-AR4) scenario; the “High“ scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

Further details can be found in the “**Impacts Report**“ and the “**Adaptation Report**“ in the report section of the final project document - also available online under www.giz.de and www.comifac.org

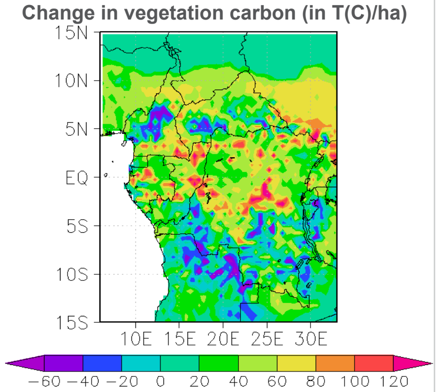
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
WAGENINGEN UR For quality of life
CSC Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Fact-Sheet - Forestry - Gabon - Zone 4

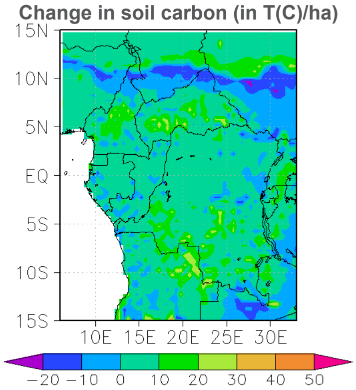
Maps of projected changes

Maps show the projection of change over this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under the "High" emission scenario and for all available projections combined. In the left panel, changes in potential vegetation carbon are shown and in the right panel, changes in potential soil carbon. Changes in total ecosystem carbon equals the sum of these two.

Change in vegetation carbon (in T(C)/ha)

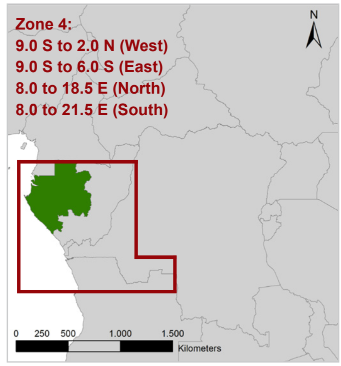


Change in soil carbon (in T(C)/ha)



Definition of Zone 4

The map below indicates the position of Zone 4 (red rectangle), representing the regions north of the equator with predominantly tropical wet and dry climates with a dedicated rainy season. All values presented in this fact-sheet are changes spatially averaged over the whole zone. As Gabon falls completely within Zone 4, projected changes for this zone are assumed to be representative for the country.



List of projected changes

Tables show the mean of projected changes over the first and second half of this century. Uncertainty around these means is not specified but variable, depending on the climate model used and dependence on the assumed sensitivity of vegetation growth to atmospheric CO_2.

Simulated potential ecosystem carbon (T(C)/ha) for the year 2000, and simulated total changes till 2050 and till 2100, respectively (T(C)/ha)	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Vegetation carbon	**124.87**	**+3.26**	**-9.53**	**+28.43**	**+12.88**
Soil carbon	**71.85**	**+7.72**	**+8.01**	**+3.79**	**+8.12**
Total carbon	**196.72**	**+10.98**	**-1.52**	**+32.22**	**+21.0**

Simulated potential Net Primary Production (NPP, T(C)/(ha*yr)) for the year 2000, and simulated changes till 2050 and till 2100, respectively (T(C)/(ha*yr))	Today	Projected changes			
		Low emission scenario		High emission scenario	
	2000	till 2050	till 2100	till 2050	till 2100
Tropical Evergreen forest	**4.0**	**+0.24**	**+0.42**	**+0.53**	**+0.68**
Seasonal forest	**4.49**	**+0.76**	**+1.19**	**+1.19**	**+1.82**
Natural Grassland	**1.0**	**+0.37**	**+0.22**	**+0.12**	**+0.4**

Key findings for Zone 4:

- It is likely that biomass (vegetation carbon) in this zone will decrease, mainly during the second half of the century - under a low emission scenario.
- It is likely that soil carbon in this zone will increase.
- It is likely that total ecosystem carbon in this zone will increase.
- The increase is mainly the consequence of increasing atmospheric CO_2 concentrations. If CO_2 increase would be less than expected OR if vegetation sensitivity to CO_2 would be less than assumed in the vegetation models, the increase in vegetation, soil and ecosystem carbon would also be less.
- The proportion evergreen and seasonal forests as well as of natural grasslands will increase slightly, in this case that means that productivity of all three will increase.
- According to the models and the predicted climate, it is unlikely that as a consequence of climate change, the natural vegetation in the region will strongly degrade.

Data and method

The projected ecosystem carbon change signals are based on the LPJ-ml Dynamic Global Vegetation model (DGVM) forced by the bias-corrected ECHAM global climate change projections. Although it is scientifically weak to provide only one value for projected changes (e.g. the mean), which we do here, in the case of ecosystem carbon changes there are too many uncertainties to calculate a "likely range" or "confidence interval". Instead we present the area-averaged mean change, based upon only one climate model, the ECHAM scenario, as this was the one giving most consistent results. We also verified the sensitivity of the DGVM to atmospheric CO_2 concentration change, because very little is known about the real CO_2 dependence of forests. This sensitivity study showed that if CO_2 dependence would be much smaller, the projected increases in ecosystem carbon will also be much less. Therefore the uncertainty ranges of the mean increases shown are large, often up to 50-100%. What is clearly needed is a large-scale experimental study to determine this sensitivity. Projected changes in the climate are assessed for two different greenhouse gas emission scenarios: the "Low" scenario is based upon the SRES B1 (IPCC-AR4) scenario; the "High" scenario is based upon the SRES A2 (IPCC-AR4) scenario.

Key adaptation options

In specific areas where ecosystems are shown to be at risk of degradation, conservation measures should be put in place. According to these computer simulations, there is no need to prepare for large-scale **climate-induced** degradation of tropical evergreen forests, but one should keep in mind that the current forecasts are very uncertain. Possible climate change mitigation measures, within UNFCCC (e.g., REDD+) or otherwise, seem relatively feasible.

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