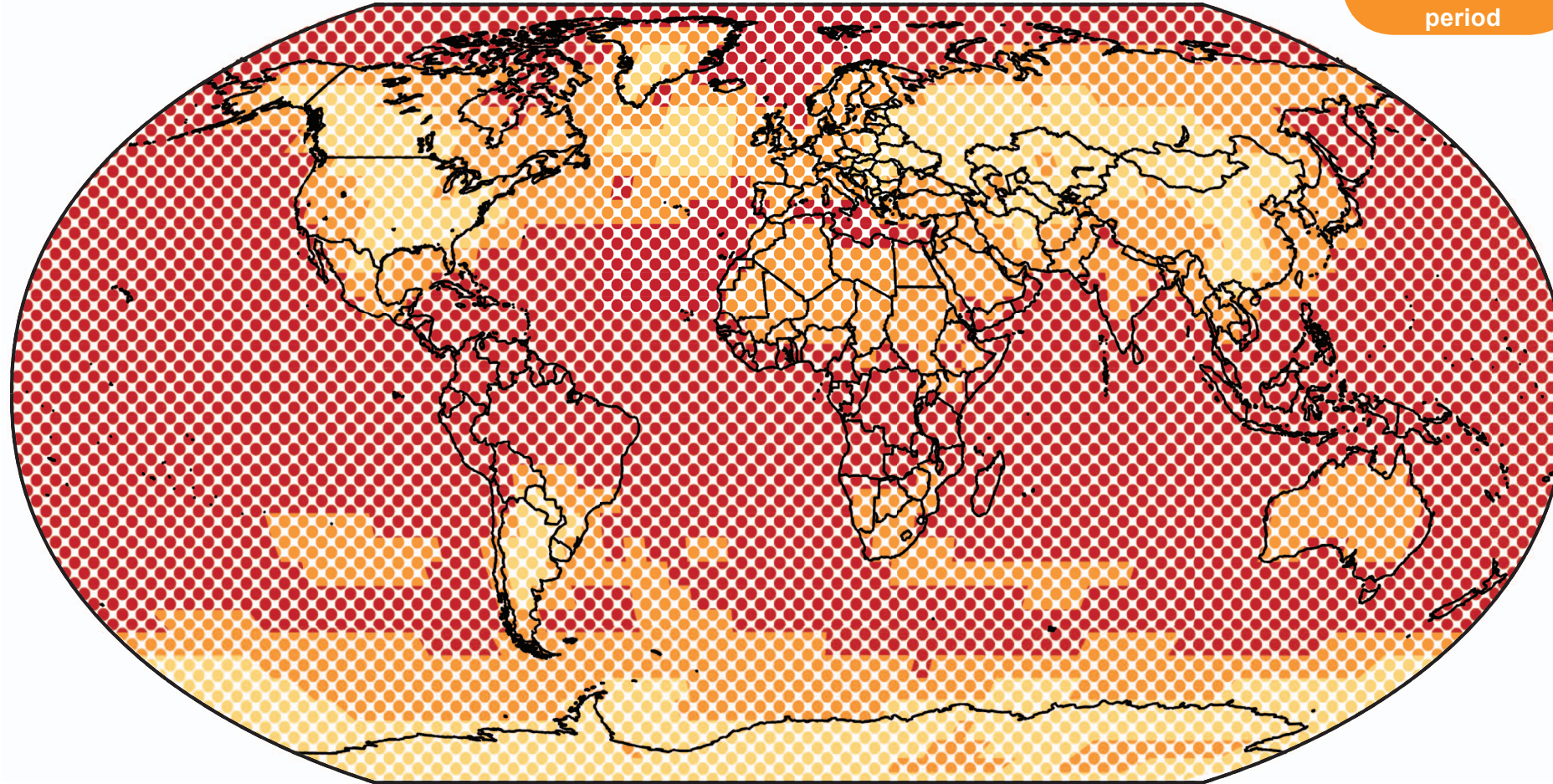


Climate-Signal-Map

Decrease in the occurrence of cold days per year

A cold day has a lower minimum temperature than 90 percent of all days of the 1971 to 2000 period



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Background information

A Climate-Signal-Map shows the mean projected change of a climate parameter averaged for the time period of 2036 to 2065 compared to the average for the time period of 1971 to 2000.

The map is based on a set of 66 climate change projections from a multitude of recent global climate models, resampled on a regular 5° x 5° grid. It combines simulations following three different emission scenarios.

Projected changes are regarded as robust, if at least 2/3 of all models project changes that are:






- in the same direction (decrease/increase), and
- statistically significant, and
- insensitive to small shifts of the reference and scenario time periods.

All areas with robust climate change signals are highlighted with color. All areas with non-robust changes are marked with grey.

White areas depict regions with a change in the opposite direction than indicated in the map.

More details on the method can be found under www.climate-service-center.de/climate-signal-maps

Legend

- Decrease** in the occurrence of cold days:
- more than 65 percent 
 - between 45 and 65 percent 
 - less than 45 percent 
 - projected decrease not robust 
- Increase** in the occurrence of cold days 

On behalf of



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Eine Einrichtung des Helmholtz-Zentrums Geesthacht

Zusammenfassung

Climate-Signal-Maps

- können strategischen Portfolioideen dienen.
- sind ein Tool zur schnellen und leicht verständlichen Überprüfung der Robustheit der verfügbaren Klimaänderungsinformationen.
- dienen zur Sensibilisierung im Umgang mit Klimainformationen.
- basieren auf state-of-the-art Klimainformationen und wissenschaftlichen Analysen.
- bieten als Ergänzung zu den Climate-Fact-Sheets auch regional aufgegliederte Informationen.
- können auch für weitere Klimaparameter erzeugt werden.

Was hinter den Climate-Signal-Maps steckt

Climate-Signal-Maps

- basieren auf 66 verschiedenen Klimaprojektionen aktueller globaler Klimamodelle (IPCC AR5) für 3 verschiedene Emissionsszenarien (RCP 2.6; RCP 4.5 und RCP8.5) mit der Periode 2036 bis 2065 als Projektions- und der Periode 1971 bis 2000 als Referenzzeitraum.
- sind für verschiedene Klimaparameter und Indikatoren verfügbar.
- haben (in den meisten Fällen) eine Richtung und zeigen die projizierte Zu-/ oder Abnahme eines Parameters, basierend auf dem damit verbundenen Gefährdungspotential.
- zeigen die Größe der projizierten Änderungen nur dann, wenn die Änderungen auch **robust** sind.

Robustheitstests:

Es werden für alle Klimaprojektionen drei verschiedene Robustheitsabfragen durchgeführt. Nur wenn mindestens 2/3 aller Klimaprojektionen den jeweiligen Test bestehen, werden die Änderungen farblich in der Karte dargestellt.

Test 1 – Übereinstimmung der Richtung der simulierten Änderungen

Basiert auf der "likely"- Annahme des IPCC AR4 (und auch AR5) und den Climate-Fact-Sheets.

Test 2 – Statistische Signifikanz der simulierten Änderungen

Dient der Unterscheidung zwischen Signal und Rauschen. Ein parameterfreier, verteilungsunabhängiger Signifikanztest wird verwendet.

Test 3 – Sensitivität gegenüber kleinen zeitlichen Änderungen

Hier wird der Einfluss von dekadischen Schwankungen auf das Klimaänderungssignal untersucht. Insgesamt wird die Referenz- und die Klimaänderungsperiode 10 mal um jeweils 1 Jahr verschoben und dann getestet, ob sich die Mittelwerte der projizierten Änderungen unterscheiden.

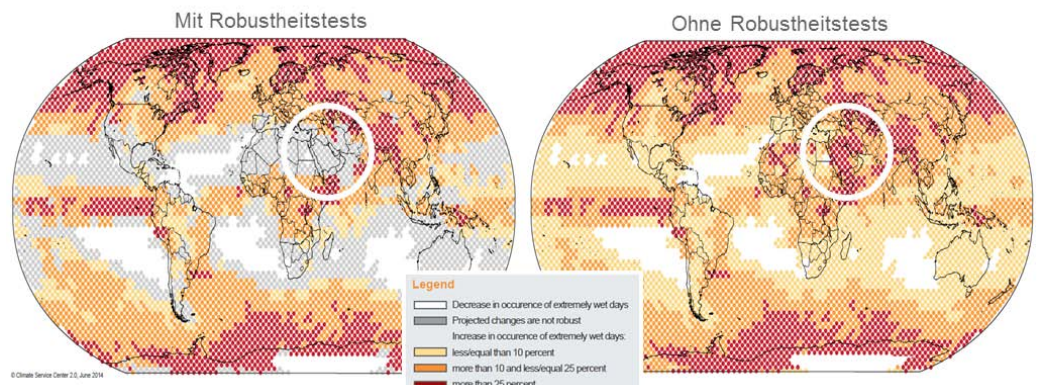
... 2035-2064 vs 1970-1999 ← 2036-2065 vs 1971-2000 → 2037-2066 vs 1972-2001 ...

Mehrwert der Climate-Signal-Maps

Climate-Signal-Maps zeigen auf einen Blick

- für welche Regionen basierend auf heutigem Wissen robuste ("verlässlichere") Klimaänderungsinformationen zur Verfügung stehen
- in welchen Regionen die projizierten robusten Änderungen am stärksten sind

Beispiel: Projizierte Änderungen im Auftreten von Tagen mit sehr starkem Niederschlag



What is shown in the maps?

- The maps show the possible decrease in the frequency of cold days under future climate conditions (averaged for the time period of 2036 to 2065 compared to the average of the time period from 1971 to 2000).
- White regions indicate an increase in the frequency of cold days (does not apply here).
- Grey regions indicate where the projected decrease in the frequency of cold days is not robust (does not apply here).

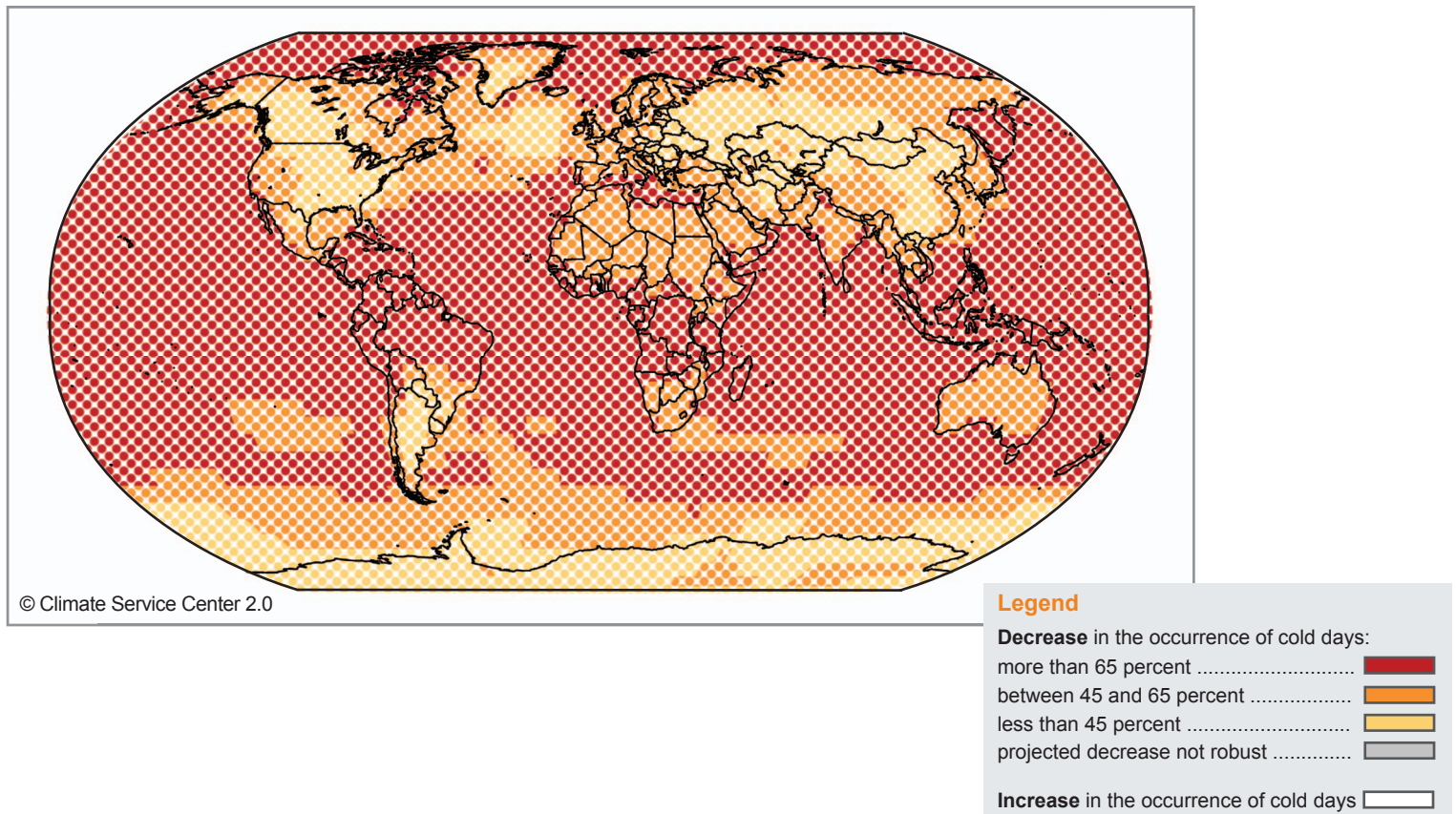
How is a cold day defined?

- A cold day is defined as a day having a daily minimum temperature lower than 90% of all days in the period of 1971-2000. It thus belongs to the 10% coolest days of present-day climate.
- It is a region specific index (as a cold day in polar regions differs from a cold day in temperate regions) which is calculated from today's temperature statistics.

Why is it interesting to know if cold days will occur less frequent in the future?

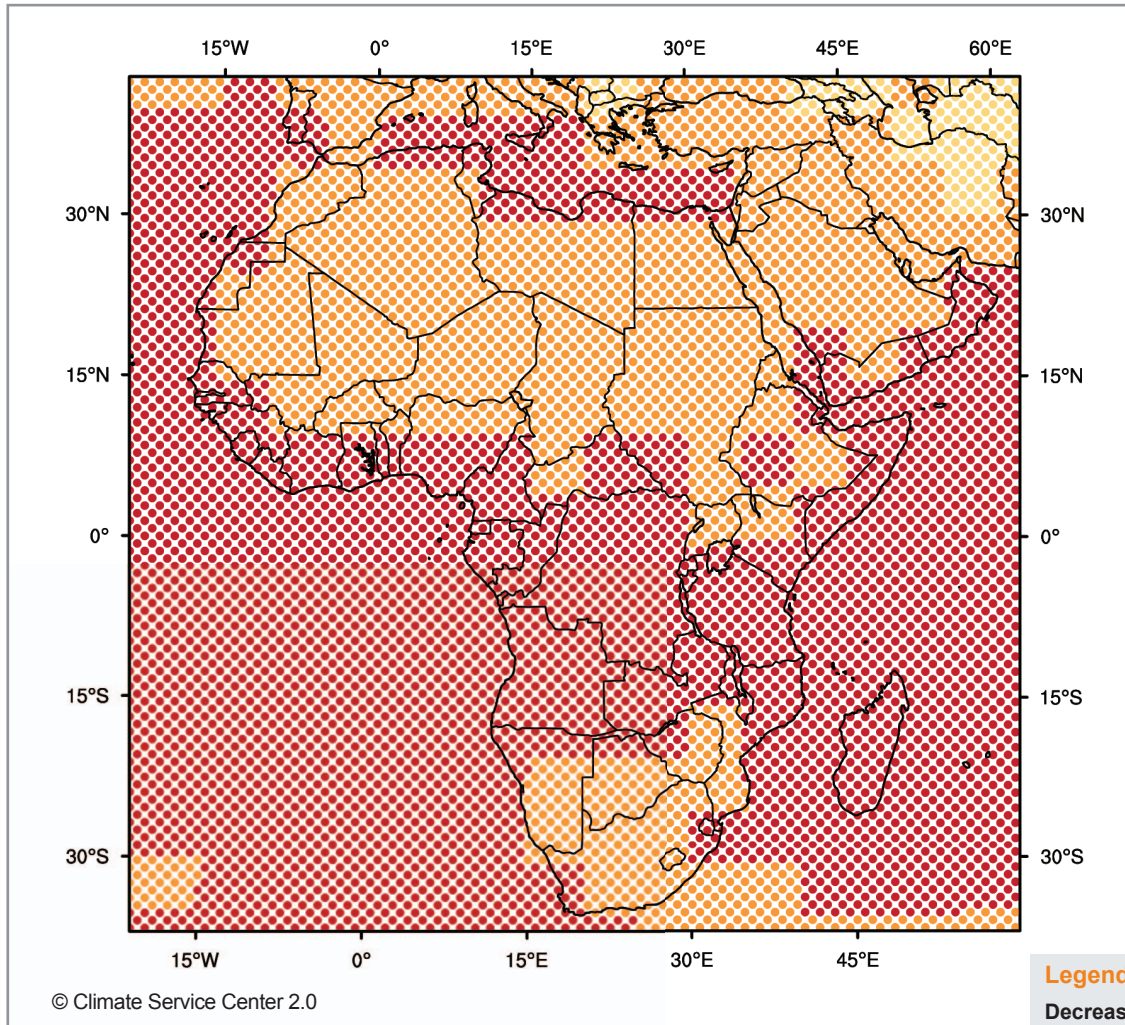
- The knowledge about the future frequency of cold days is important as less cold days could e. g.:
 - reduce the need for heating in households.
 - increase the need for cooling in transport (e. g. food), industries, stocking, etc.
 - cause need for adaptation for agriculture due to changes in the growing and dormant seasons.

Global distribution - Decrease in the occurrence of cold days per year








Regional distribution - Decrease in the occurrence of cold days per year

Africa



Legend

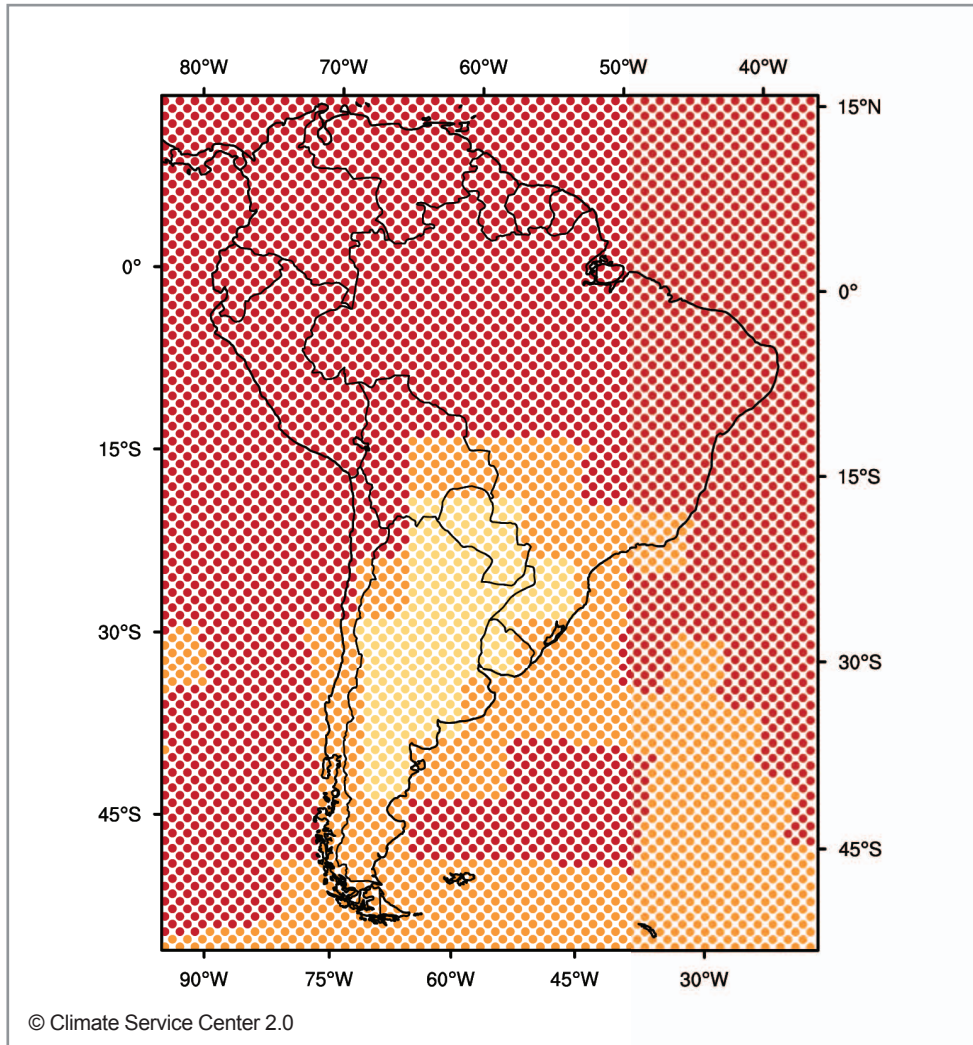
Decrease in the occurrence of cold days:	
more than 65 percent	
between 45 and 65 percent	
less than 45 percent	
projected decrease not robust	
Increase in the occurrence of cold days	
	

Short explanation of figure






- For the entire region of Africa, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- Highest decrease in the frequency of cold days is projected for the region between 15°S and 10°N with a reduction of the occurrence of cold days by more than 65%. Values between -45% and -65% are projected for the regions south of 15°S and north of about 10°N.

Regional distribution - Decrease in the occurrence of cold days per year

South America



Legend

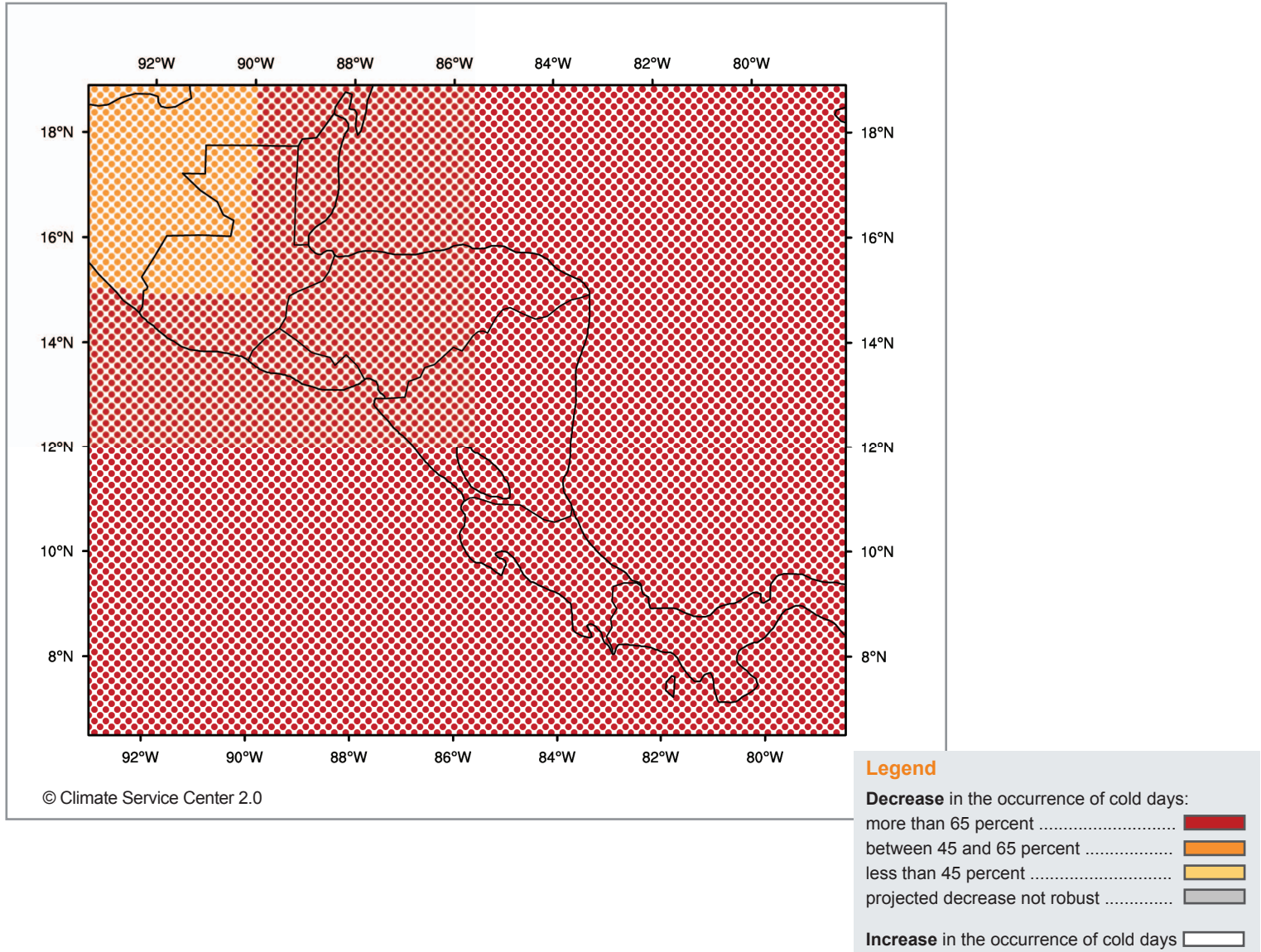
Decrease in the occurrence of cold days:	
more than 65 percent	
between 45 and 65 percent	
less than 45 percent	
projected decrease not robust	
Increase in the occurrence of cold days	
	

Short explanation of figure

- For the entire region of South America, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- Highest decrease in the frequency of cold days is projected for the region north of about 15°S with a reduction of the occurrence of cold days by more than 65%. Smaller values are projected for the regions south of 15°S.

Regional distribution - Decrease in the occurrence of cold days per year

Central America

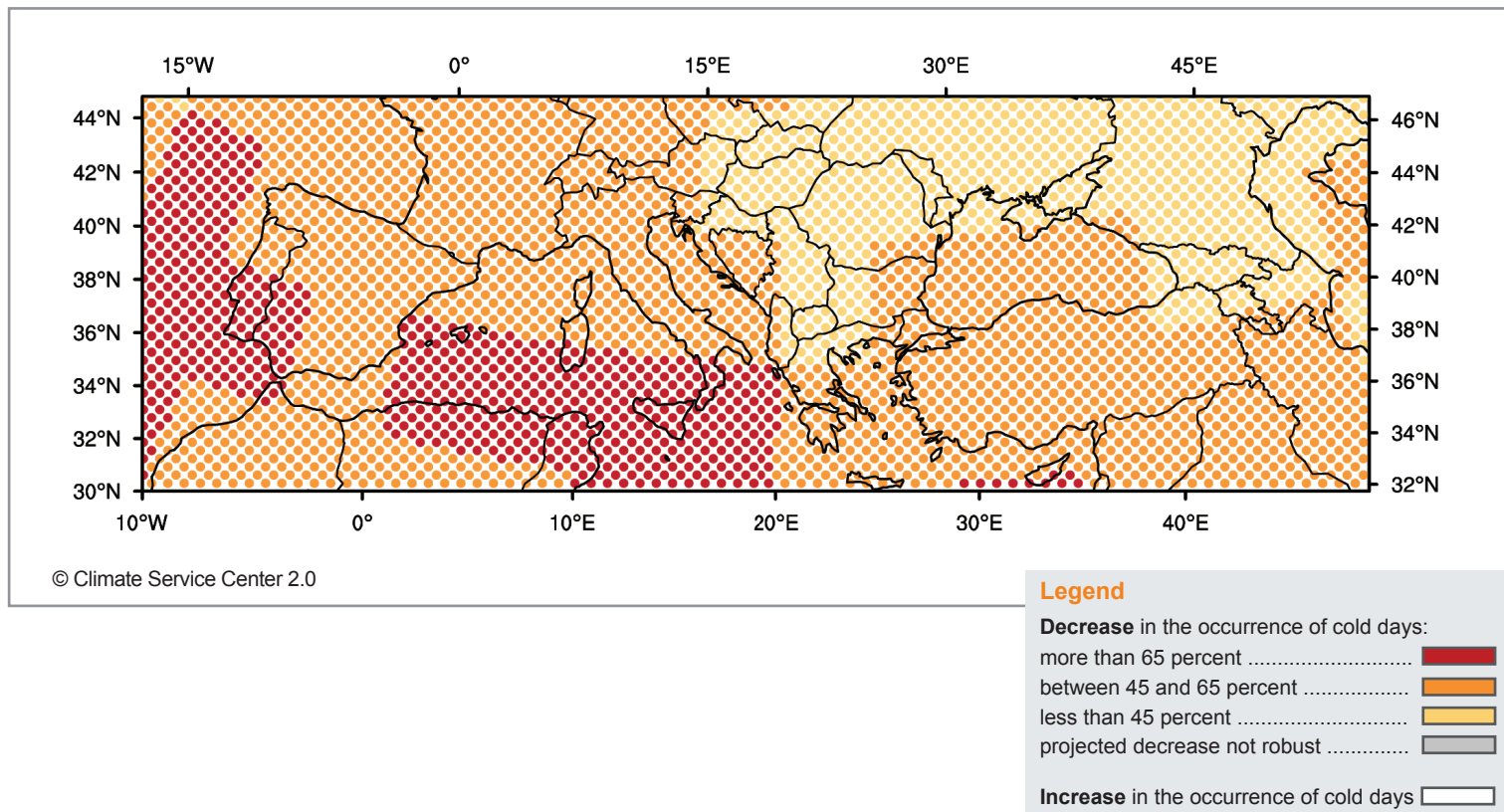


Short explanation of figure

- For the entire region of Central America, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- High decrease in the frequency of cold days is projected for the majority of the region with a reduction of the occurrence of cold days by more than 65%. Values between -45% and -65% are projected for north-western Guatemala and southern Mexico.
- Due to the small size of the land surface, and the comparably large grid boxes of the climate models, the model results have to be treated with extra caution in this region.

Regional distribution - Decrease in the occurrence of cold days per year

Southern Europe & Caucasus

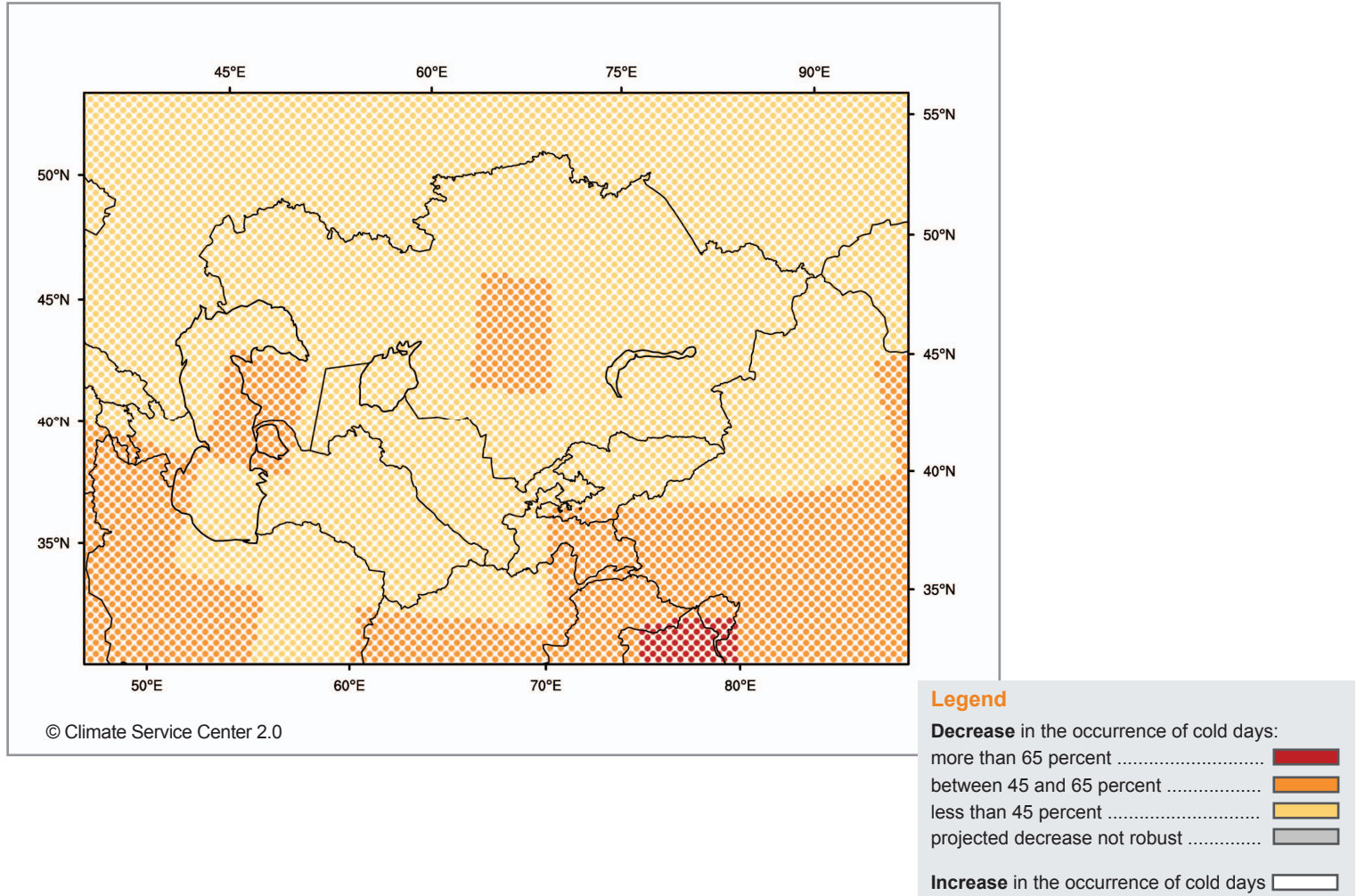


Short explanation of figure

- For the entire region of Southern Europe & Caucasus, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- Highest decrease in the frequency of cold days is projected for south-west Portugal and Spain and for the south-western Mediterranean with a reduction of the occurrence of cold days by more than 65%. Values between -45% and -65% are projected for western and southern Europe, values lower than -45% are projected for eastern Europe and the Caucasus.

Regional distribution - Decrease in the occurrence of cold days per year

Central Asia

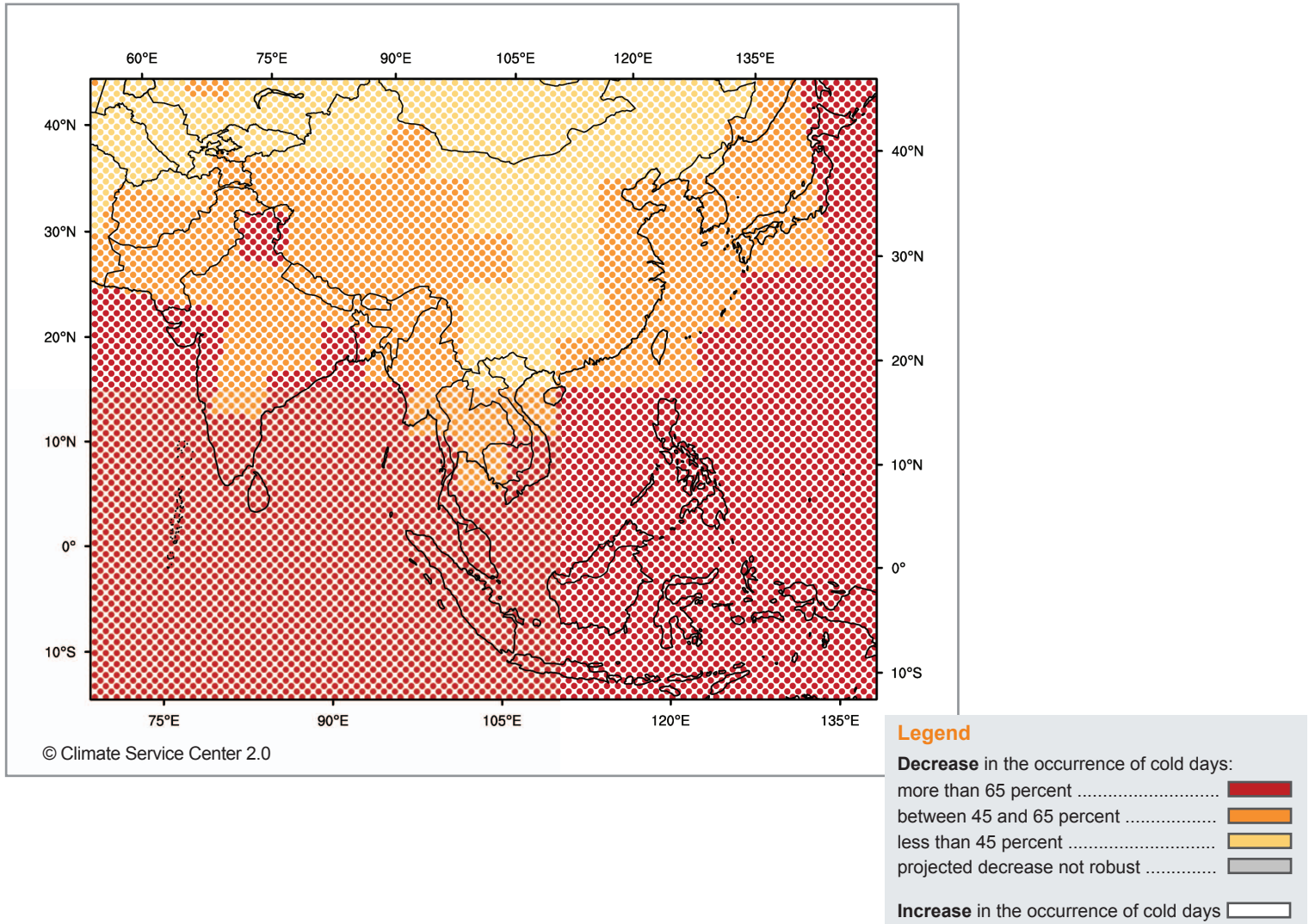


Short explanation of figure

- For the entire region of Central Asia, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- Comparably low values of less than 45% decrease of the frequency of cold days are projected for large parts of Central Asia, higher decrease is projected for the southern parts of the region.

Regional distribution - Decrease in the occurrence of cold days per year

South & East Asia



Short explanation of figure

- For the entire region of South & East Asia, the frequency of cold days is projected to decrease.
- The results are robust for the entire region.
- The region shows a sharp north-south gradient with higher decrease in the frequency of cold days in the south and moderate values in the north.