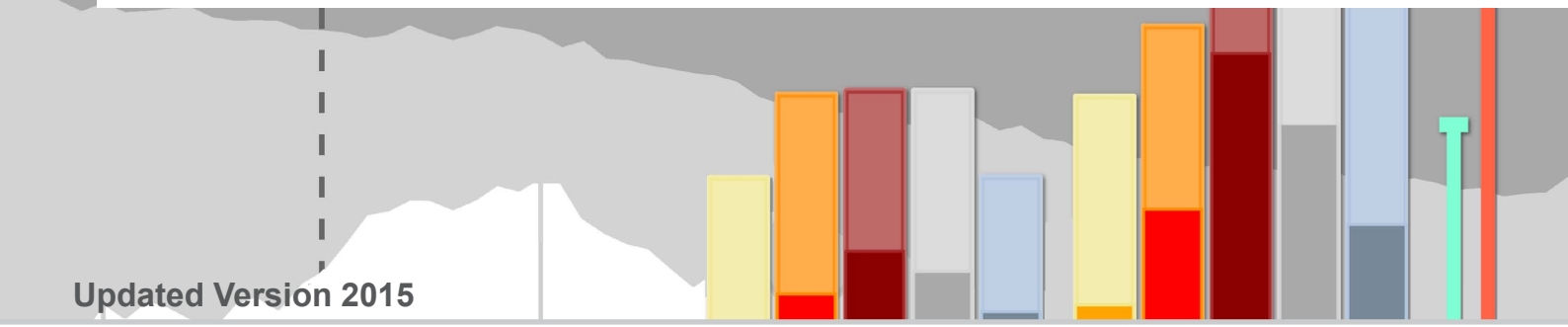
Climate-Fact-Sheet

Niger



Updated Version 2015

Abstract

The climate of Niger can be classified as semi-arid (BSh) in the south of the country to arid (BWh) in the central and northern parts. The southern regions are characterised by a unimodal rainfall regime, with a marked rainy and a marked dry season. The region receives rainfall mainly between June and September, when the Inter-Tropical Convergence Zone (ITCZ) is in its northern-most position. Maximum rainfall occurs in August. Annual rainfall is largest in the south and reaches up to 800 mm per year. Over the central and northern parts (77% of the country area), however, mean rainfall is below 150 mm per year, with almost no rain over vast areas. In the dry months between November and March, almost no rain falls at all. Wet season rainfall amounts show a remarkable inter-annual variability. Annual mean temperature ranges between 24°C in the north to about 30°C in the south. Seasonal variations are more pronounced in the north with temperatures ranging from about 15 to 35°C, while in the south temperatures are always above 25°C. The warmest month is generally shortly before the onset of the rainy season (May in the south).

Mean annual temperature has increased at a rate of 0.35°C per decade over the last 30 years. For the future, projections from global climate models suggest a medium-strong increase in temperature. For the end of the century, a warming in the range of 1.8 to 5.4°C (compared to the reference period from 1971 to 2000) is likely. Furthermore, a strong increase in the duration of heat waves as well as a strong reduction in cold spell length is projected.

For the annual total rainfall amounts a significant increase of 36% was observed over the last 30 years. For the future, climate models project a tendency towards an increase in precipitation. For the end of the century, a change in annual total precipitation in the range of -1 to +45% (compared to the reference period from 1971 to 2000) is likely. Furthermore, projections suggest a tendency towards more intense heavy rainfall events, however, no clear trend for the duration of dry spells is given.

Also for the climatic water balance no clear trend is projected for the future. Regarding, solar irradiance global climate model projections show a tendency towards a decrease, whereas for annual mean wind speed the projections suggest no clear trend over the 21st century. However, the skill of the global models in reproducing mean wind speed and solar irradiance is limited.

Zusammenfassung

Der Niger ist durch trockenes Klima geprägt, mit semi-aridem Steppenklima im Süden hin zu Wüstenklima in den nördlichen Regionen. Niederschläge treten vorwiegend im Süden des Landes im Zeitraum von Juni bis September auf, mit August als feuchtestem Monat. Außerhalb dieses Zeitraums sowie in den nördlichen Regionen regnet es eher selten. Die mittlere jährliche Niederschlagsmenge liegt im Süden bei etwa 800 mm und ist durch eine deutliche interanuelle Variabilität gekennzeichnet. In den zentralen und nördlichen Regionen des Landes fällt deutlich weniger Niederschlag (weniger als 150 mm/Jahr). Die Jahresmitteltemperatur liegt zwischen 24°C im Norden und 30°C im Süden. Saisonale Temperaturschwankungen sind im Norden stärker ausgeprägt und liegen im Bereich von 15 bis 35°C. Im Süden liegt dagegen kein Monat unter 25°C. Die wärmste Zeit des Jahres ist generell zu Beginn der Regenzeit.

Beobachtete Jahresmitteltemperaturen zeigten in den letzten 30 Jahren eine Zunahme um 0.35°C pro Dekade. Für die Zukunft projizieren Klimamodellrechnungen für die Region einen mittelstarken Temperaturanstieg. Zum Ende des Jahrhunderts kann eine Temperaturzunahme zwischen 1.8 und 5.4°C im Vergleich zum Basiszeitraum von 1971 bis 2000 als wahrscheinlich betrachtet werden. Einhergehend mit dem Temperaturanstieg sind eine starke zeitliche Ausdehnung von Hitzeperioden sowie eine deutliche Verkürzung von Kälteperioden.

Für den Jahresniederschlag wurde in den letzten 30 Jahren eine signifikante Zunahme um 36% beobachtet. Auch für die Zukunft projiziert die Mehrzahl der Klimamodellrechnungen einen positiven Niederschlagstrend. Zum Ende des 21. Jahrhunderts kann eine Niederschlagsveränderung zwischen -1 und +45% im Vergleich zum Basiszeitraum von 1971 bis 2000 als wahrscheinlich betrachtet werden. Weiterhin wird eine Tendenz zu intensiveren Starkniederschlägen, aber keine klare Änderung bei der Länge von Trockenperioden von den Modellen projiziert.

Für die klimatologische Wasserbilanz zeigt sich keine klare Tendenz in den Daten der Klimamodelle. Für die solare Einstrahlung wird eine Tendenz zur Abnahme aus den analysierten Globalmodelldaten ersichtlich. Für die mittlere Windgeschwindigkeit wird dagegen bis zum Ende des Jahrhunderts kein klarer Trend projiziert. Allerdings können diese Größen nur bedingt verlässlich von Klimamodellen wiedergegeben werden.

On behalf of KFW

BMZ Federal Ministry for Economic Cooperation and Development

GERICS Climate Service Center Germany

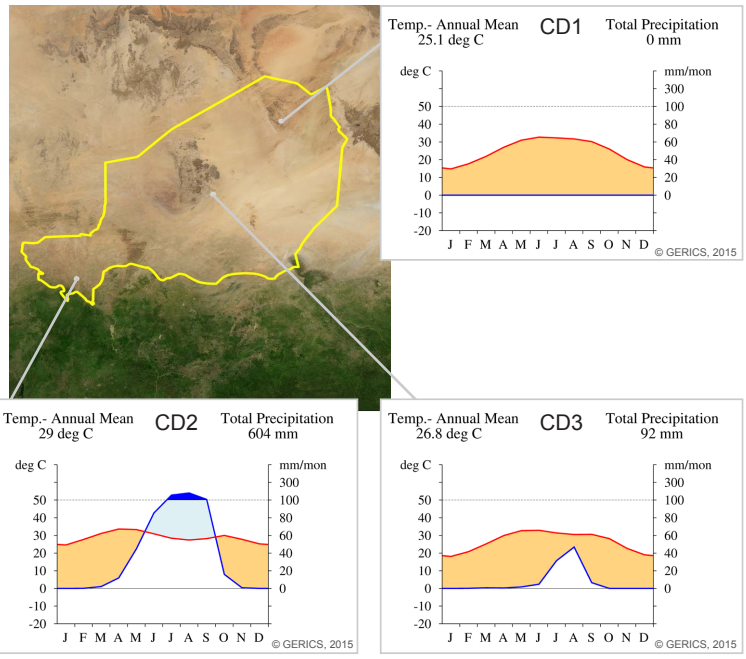
Current climate

Observed mean values are taken from literature and available global data sets (averaged over the whole country):

- Major climate zones (see also climate diagrams - CD1-3): Semi-arid (BSh - see CD2) in the south of the country to arid (BWh) in the central (see CD3) and northern (see CD1) parts
- Annual mean temperature: 27°C
- Annual total precipitation: 150 mm/yr
- Annual mean actual evaporation: 95 mm/yr
- Annual mean climatic water balance***: -39 mm/yr
- Intensity of heavy rain events*: 19 mm/day
- Mean duration of dry spells*: 716 days**
- Mean duration of heat waves*: 6 days
- Mean duration of cold spells*: 11 days
- Annual mean solar irradiance (surface): 2008 kWh/(m² yr)
- Annual mean wind speed (10 m above surface): 3.3 m/s

Reported recent extreme events:

- Serious flood events took place in 2012, 2013 and 2014.
- Niger is affected by frequent and severe drought events (e.g. 2001, 2005, 2009, 2011). In 2011 3 million people were affected by a drought.



The climate parameters marked with * are defined in the manual „How to read a Climate-Fact-Sheet“. Whenever mentioned in the fact-sheet, statistical significance is indicated at the 95% confidence level. The description of the climate zones is based on the Köppen-Geiger climate classification. ** A dry spell in the northern parts of the country can last several years. ***The climatic water balance is derived from a different data set than precipitation and evaporation, therefore it is possible that the values do not sum up.

Historical climate trends (based on the global CRU data set and literature sources)

Observations from globally available data (CRU) show:

- A small but significant temperature increase of +0.05°C per decade was observed between 1901 and 2013, which was substantially stronger over the last 30 years (+0.35°C per decade).
- Over the same 113-years period no significant change in precipitation was observed. However, over the last 30 years there was a large significant precipitation increase (+36%/30yrs).

Additional information from literature shows:

- An increase has been observed in the minimum temperatures, whereas no clear change was observed in maximum temperatures.
- In central and northern Niger an increase in the frequency of dust events has been observed.
- Droughts in the 1970s and 1980s were characterised primarily by a reduced frequency of heavy rainfall events rather than by a reduction in rainfall amount within heavy events.

Summary of projected future climate (for a 30-year period centred around 2085 and combined for all scenarios)

Temperature The likely range of projected change in annual mean temperature is from +1.8 to +5.4°C by 2085, and the very likely range is from +1.3 to +6.3°C. Confidence in these figures is medium. The change in temperature can be considered to be medium-strong. The likely range of projected change in maximum temperature is from +1.9 to +5.6°C by 2085 and in the minimum temperature from +1.6 to +5.0°C.

Heat waves The likely range of projected change in the duration of long-lasting heat waves is from +10 to +79 days by 2085, and the very likely range is from +6 to +130 days. Confidence in these figures is medium. The change in the duration of long-lasting heat waves can be considered to be strong.

Cold spells The likely range of projected change in the duration of long-lasting cold spells is from -11 to -5 days by 2085, and the very likely range is from -12 to -3 days. Confidence in these figures is medium. The change in the duration of long-lasting cold spells can be considered to be strong.

Precipitation The likely range of projected change in annual total precipitation is from -1 to +45% by 2085 and the very likely range is from -11 to +112%, with most projections showing an increase. In the dry season a tendency towards drier condition is projected. For the first half of the wet season no clear trend is shown, in the second half, mostly wetter conditions are projected. Confidence in these figures is low. The change in annual total precipitation can be considered to be medium-strong.

Dry spells The likely range of projected change in the duration of long-lasting dry spells is from -21 to +7 days by 2085 and the very likely range is from -31 to +43 days, with a some projections showing an increase and some a decrease. Confidence in these figures is low. The change in the duration of long-lasting dry spells can be considered to be weak.

Heavy rains The likely range of projected change in the intensity of heavy rain events is from -4 to +29% by 2085 and the very likely range is from -16 to +43%, with most projections showing an increase. For the frequency of heavy rain events almost no change is projected by 2085. Confidence in these figures is medium. The change in the intensity of heavy rain events can be considered to be medium-strong.

Evaporation The likely range of projected change in the annual mean actual evaporation is from -1 to +49% by 2085 and the very likely range is from -6 to +109%, with most projections showing an increase. Confidence in these figures is medium. The change in the annual mean actual evaporation can be considered to be medium-strong.

Water balance The likely range of projected change in the annual mean climatic water balance is from -8 to +11 mm/yr by 2085 and the very likely range is from -31 to +97 mm/yr, with some projections showing an increase and some a decrease. Confidence in these figures is low. The change in the annual mean climatic water balance can be considered to be medium-strong.

Solar irradiance The likely range of projected change in the annual mean solar irradiance is from -54 to -1 kWh/(m^2 yr) by 2085 and the very likely range is from -76 to +13 kWh/(m^2 yr), with only a few projections showing an increase. Confidence in these figures is medium.

Wind speed The likely range of projections for annual mean wind speed indicates almost no change by 2085. The very likely range is from -1 to +8%. Confidence in these figures is medium. The change in the annual mean wind speed can be considered to be weak.

Note: The Climate-Fact-Sheets provide an overview of projected possible changes for selected climate parameters at the national or regional level. The Climate-Fact-Sheets are generated on the basis of the best currently available multi-model ensembles of regional and/or global climate models. Accordingly, the Climate-Fact-Sheets provide a first impression of the magnitude of potential future climate change averaged over a given country/region. As such, the information presented in the Climate-Fact-Sheets does not contain information on the finer local scale changes that may occur, and which may be of more interest, in for example, impact or adaptation studies. The Climate-Fact-Sheets are not intended, nor were they designed, to provide this kind of information. If more local scale information is the nature of your interest, or requirement, then alternative methods or tools should be used. Finally, the description of the current climate of the country as well as the observed historical trends is kept to a minimum, as the focus of the Climate-Fact-Sheets is on projected future changes.

Data sources and references

Data sources:
All projections are based on the results of the global model climate and sea level change projections, which are the base of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5 - www.ipcc.ch). Additionally, the results of the global model climate projections, which are the base of the Fourth Assessment Report of IPCC are used for comparison.
Information on current climate and historical trends, as well as the climate diagrams, are based on the available global data set compiled by the Climatic Research Unit from the University of East Anglia. Also data from the so called WATCH forcing data (compiled within the EU-project WATCH - Water and Global Change) has been used. Data on evaporation and climatic water balance has been taken from reanalyses data (ERA40) compiled by the European Centre for Medium-Range Weather Forecasts (ECMWF).

References:
Information on recent extreme events and their impacts has been taken from:
http://www.preventionweb.net
The International Disaster Database: http://www.emdat.be/country_profile/index.html, last viewed 03/09/2015, 08:36.

Information on the classification of climate zones and of the current climate has been taken from the following literature:
Kottek, M., Grieser J., Beck C., Rudolf B. and Rubel F. (2006): World Map of the Köppen-Geiger climate classification updated. In: Meteorologische Zeitung, 15, 259-263.

Information on historic trends and for projected future changes (mainly for cross-checking) has been taken from the following literature (in alphabetical order):
Christensen, J.H. et al. (2007): Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
Climate Change (2007): Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry et al. Eds.,Cambridge University Press, Cambridge, UK, 469-506.
Dai, A. et al. (2004): The recent Sahel drought is real. International Journal of Climatology, 24(11), 1323-1331.
IPCC (2014): Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 688 pp.
Lebel, T., & Ali, A. (2009): Recent trends in the Central and Western Sahel rainfall regime (1990–2007). Journal of Hydrology, 375(1), 52-64.
Nicholson, S. E. (2001): Climatic and environmental change in Africa during the last two centuries. Climate Research, 17(2), 123-144.
Shinoda M et al. (1999): Diurnal variations of rainfall over Niger in the West African Sahel: A comparison between wet and drought years. Int J Climatol 19: 81–94.

Update of the Climate-Fact-Sheets in a nutshell

The Climate-Fact-Sheets have been developed in 2011 jointly by the KfW Development Bank and the Climate Service Center Germany (GERICS) to present projected climate change in a condensed manner. Now an update of the Climate-Fact-Sheets has been made.

What is new in the updated version?

- The data presented has been updated to the data basis of the 5th Assessment Report of the Intergovernmental Panel on Climate Change (AR5 IPCC). These climate change projections are based on the so-called Representative Concentration Pathways (RCPs). Projections for three different emission scenarios are analysed: RCP2.6 representing a low scenario; RCP4.5 representing a moderate scenario and RCP8.5 representing a high scenario. Altogether, many more climate change simulations are now included allowing a more robust identification of projected changes.
- Additionally, a range of projected changes under two different assumptions of a possible future global climate development is shown in the updated change figures: the political target of a world below two degree warming (2°C target; mitigation) and a world above 4°C warming at the end of this century is included (see below).
- Information on future sea level change on the basis of the information used in IPCC AR5 is included.

What is still the same?

- Climate change figures are still based on a large ensemble of projections from different global climate models for three different scenarios (low, medium, high).
- Climate change information is still provided for a large set of parameters.
- The range of projected changes of IPCC AR4 (database of the original Climate-Fact-Sheets) is still included in the figures.
- Expert judgement of signal strength and confidence in projected changes is still shown.
- A detailed (updated) manual on „How to read a Climate-Fact-Sheet“ is provided.

What exactly is presented in the updated climate change figures?

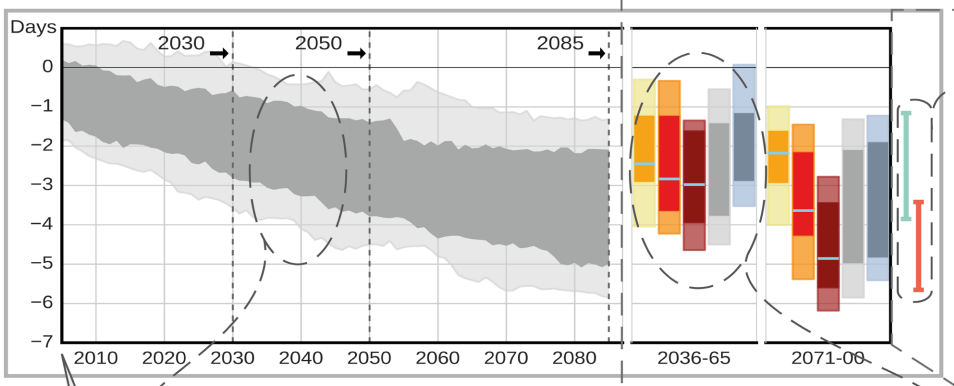
Left part of climate change figures

The bandwidth of projected changes (compared to the reference period from 1971 to 2000) combined for all scenarios over the 21st century (from 2006 to 2085) of data used in IPCC AR5 is shown:
- All values are smoothed in time by a 30 year running mean - so the bandwidth indicated for the year 2085 is actually the bandwidth of the period from 2071 to 2100.
- Three dedicated periods indicated with stippled lines (2030; 2050; 2085) represent the 30 year periods mentioned in the text and/or are presented in more detail on the right part of the diagram.
- Different colour shadings of the bandwidth are explained below the figure.

Note:
For more details on the different climate change projections, RCP scenarios, climate parameters and a more detailed description of the climate change figures, please have a look in the Climate-Fact-Sheet Manual.

Right part of climate change figures

A more detailed view on projected changes for two specific future 30 year periods centred around 2050 (period from 2036 to 2065) and around 2085 (period from 2071 to 2100) with respect to the reference period from 1971 to 2000 is given:
- The yellow, orange and red bars represent the projected changes for the different emission scenarios, represented by different RCPs. The yellow bar represents the low (RCP2.6) scenario; the orange bar the medium (RCP4.5) scenario and the red bar the high (RCP8.5) scenario.
- The grey bar represents the bandwidth of projected changes combined for all three scenarios (IPCC AR5 only) and reflects the information given on the left part of the figure at the same time periods (either 2050 or 2085; both indicated by the stippled lines).
- The blueish bar represents the bandwidth of projected changes from data used in the IPCC AR4 and reflects the information which was provided in the earlier version of the Climate-Fact-Sheets.
- Different colour shadings of the bars are explained below the figure.



Vertical axis: magnitude and unit of projected changes; Horizontal axis: time periods

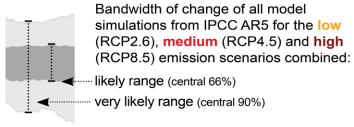
The two different grey shadings reflect different ranges of projected changes, which can be classified by different likelyhoods according to IPCC. A change is *likely* to occur if 66% of all model projections lie within this range. A change is *very likely* to occur if 90% of all projections are within this range. In order to exclude single outliers the *likely* and *very likely* ranges are defined around the median of the projected bandwidth.

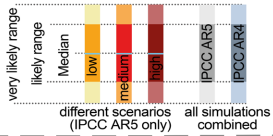
As indicated above, the different colours of the five bars reflect the different scenarios as well as different data sources from the IPCC AR4 and AR5 respectively. Additionally, the different colour shading within each bar reflects the *likely* range and *very likely* range of the projected changes as defined on the left. The blue line in the three bars for the different scenarios represents the median (50% value) of the projected changes. Please note that the grey bar (AR5) does not necessarily span the full range defined by the three coloured scenario bars.

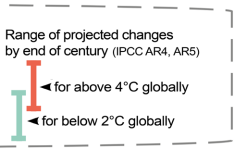
Additional information on the right edge of climate change figures

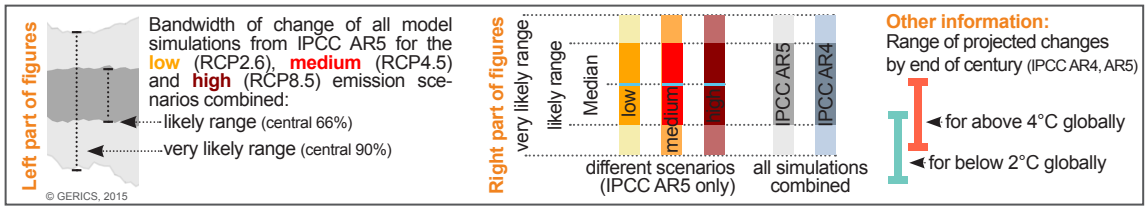
Here, information of projected changes under two different assumptions of the global climate development are given, in order to demonstrate the potential impact of climate change mitigation measures:
The turquoise bar represents the range of projected changes of all model simulations (IPCC AR4 & AR5) which project a global mean warming by the end of the century compared to preindustrial of below or equal 2°C (2°C target). Likewise the light red bar represents the range of projected changes of all model simulations which project a global mean warming by the end of the century compared to preindustrial equal or more than 4°C.
The information is based on the same data as depicted in the other parts of the diagramm (IPCC AR4 & AR5), but the sorting has been done according to projected global mean temperature change instead of emissions. It is important to note that the two bars sometimes overlap and sometimes do not.

This information is also given in the legends on top of each page









GERICS Climate Service Center Germany

Projections of possible development of temperature, heat waves and cold spells

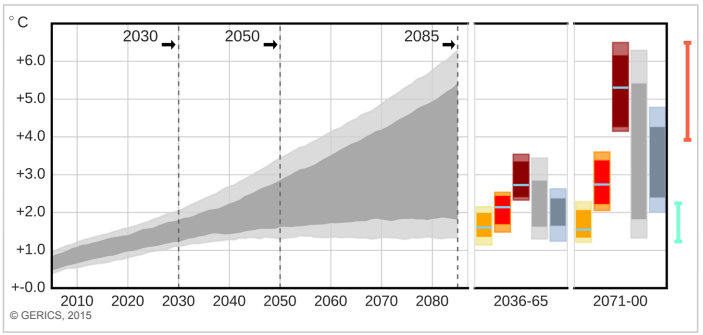
Annual mean temperature

- Likely range of projected change in annual mean temperature is from +1.2 to +1.8°C by 2030, from +1.6 to +2.9°C by 2050 and from +1.8 to +5.4°C by 2085.
- Very likely range: +1.1 to +2.1°C by 2030; +1.3 to +3.4°C by 2050; +1.3 to +6.3°C by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario:** Median +1.5°C
- **High-Scenario:** Median +5.3 °C

Comparison to projections of IPCC AR4:
- Latest AR5 projections show same magnitude of increase but with a substantially larger bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** +1.2 to +2.2°C
- **above 4°C-threshold:** +3.9 to +6.5°C



Maximum and minimum temperature

The trends of maximum and minimum temperature are consistent with the trend of annual mean temperature depicted above.

- Likely range of projected change in annual maximum temperature is from +1.3 to +1.9°C by 2030, from +1.8 to +3.0°C by 2050 and from +1.9 to +5.6°C by 2085.
- Likely range of projected change in annual minimum temperature is from +1.3 to +1.8°C by 2030, from +1.6 to +2.8°C by 2050 and from +1.6 to +5.0°C by 2085.

in °C	Scenario	Measure	Max-Temperature	Min-Temperature
Projected change by 2085	ALL	**likely** very likely	**+1.9 to +5.6** +1.4 to +6.4	**+1.6 to +5.0** +1.2 to +5.9
	Low	Median **likely** very likely	+1.6 **+1.3 to +2.4** +1.2 to +2.8	+1.5 **+1.2 to +1.9** +1.1 to +2.0
	Medium	Median **likely** very likely	+3.0 **+2.4 to +3.6** +2.2 to +4.3	+2.6 **+2.1 to +3.1** +1.8 to +3.4
	High	Median **likely** very likely	+5.3 **+4.4 to +6.2** +4.3 to +7.0	+4.9 **+4.1 to +5.8** +3.7 to +6.1
	Warming thresholds	below 2°C	+1.2 to +2.3	+1.1 to +2.4
		above 4°C	+4.7 to +6.7	+4.7 to +6.1

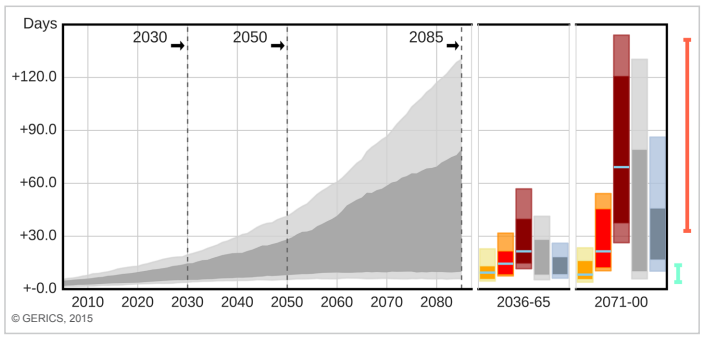
Heat waves

- Likely range of projected change in the duration of long-lasting heat waves is from +5 to +15 days by 2030, from +8 to +28 days by 2050 and from +10 to +79 days by 2085.
- Very likely range: +4 to +19 days by 2030; +5 to +41 days by 2050; +6 to +130 days by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario:** Median +8 days
- **High-Scenario:** Median +69 days

Comparison to projections of IPCC AR4:
- Latest AR5 projections show same magnitude of increase but with a substantially larger bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** +4 to +14 days
- **above 4°C-threshold:** +33 to +141 days



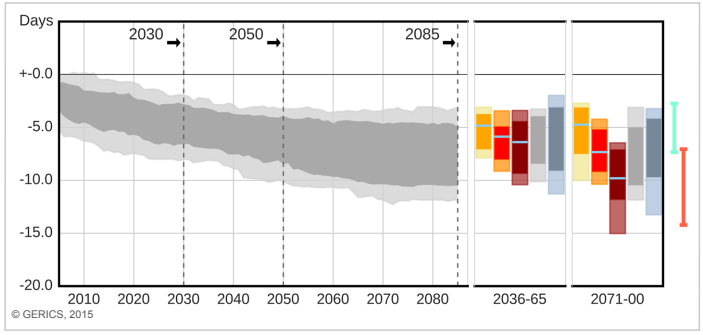
Cold spells

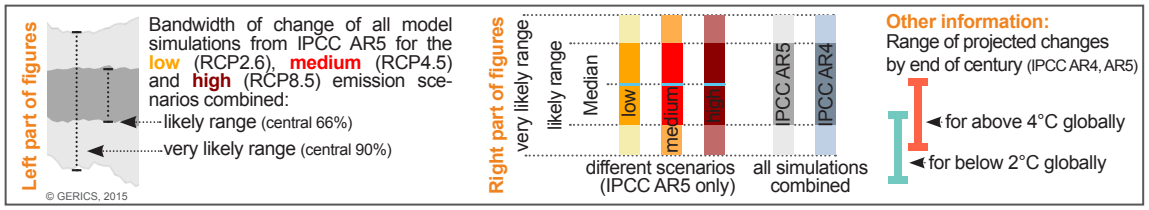
- Likely range of projected change in the duration of long-lasting cold spells is from -7 to -3 days by 2030, from -8 to -4 days by 2050 and from -11 to -5 days by 2085.
- Very likely range: -8 to -2 days by 2030; -10 to -3 days by 2050; -12 to -3 days by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario:** Median -5 days
- **High-Scenario:** Median -10 days

Comparison to projections of IPCC AR4:
- Latest AR5 projections show same magnitude of decrease with a similar bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** -7 to -3 days
- **above 4°C-threshold:** -14 to -7 days





GERICS Climate Service Center Germany

Projections of possible development of precipitation and water availability

Annual total precipitation

- Likely range of projected change in annual total precipitation is from +2 to +34% by 2030, from 0 to +38% by 2050 and from -1 to +45% by 2085.
- Very likely range: -2 to +55% by 2030; -8 to +70% by 2050; -11 to +112% by 2085.

Separate scenario examination (by 2085):

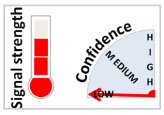
- **Low-Scenario:** Median +9%
- **High-Scenario:** Median +26%

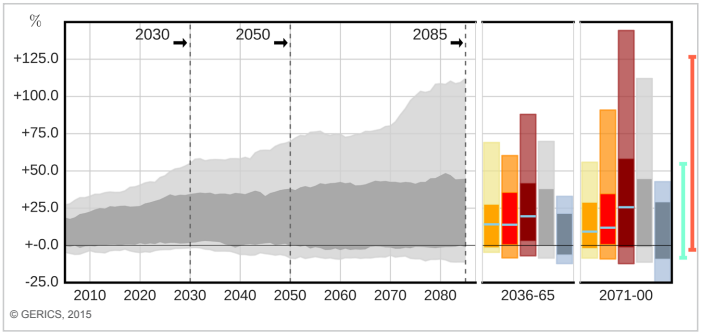
Comparison to projections of IPCC AR4:

- Latest AR5 projections show a tendency towards an increase but with a substantially larger bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):

- **below 2°C-target:** -8 to +55%
- **above 4°C-threshold:** -3 to +127%

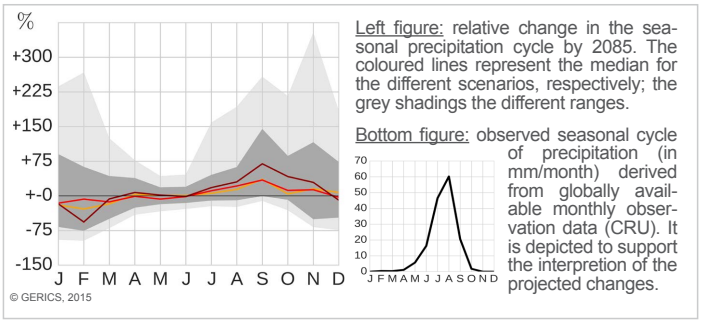




Precipitation seasonality (by 2085)

- Due to the rather dry conditions projected changes in precipitation seasonality span a rather large bandwidth, especially during the dry season (November to March). Here, the majority of the models show a tendency towards drier conditions. For the first half of the wet season (April to June) no clear trend in precipitation amounts is projected, , whereas for the second half of the wet season (July to October) most model projections indicate wetter conditions.
- Likely range of projected change in total precipitation is from -25 to +30% (April to June) and from -10 to +130% (July to October).
- Very likely range (wet season): -40 to +75% (April to June); -18 to +250% (July to October).

Under the **high** scenario the projected change in the precipitation seasonality is more pronounced than under the **low** scenario.



Dry spells

- Likely range of projected change in duration of long-lasting dry spells is from -18 to +1 days by 2030, from -16 to +4 days by 2050 and from -21 to +7 day by 2085.
- Very likely range: -78 to +41 days by 2030; -39 to +52 days by 2050; -31 to +43 days by 2085.

Separate scenario examination (by 2085):

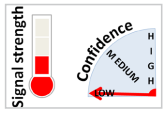
- **Low-Scenario:** Median -2 days
- **High-Scenario:** Median -9 days

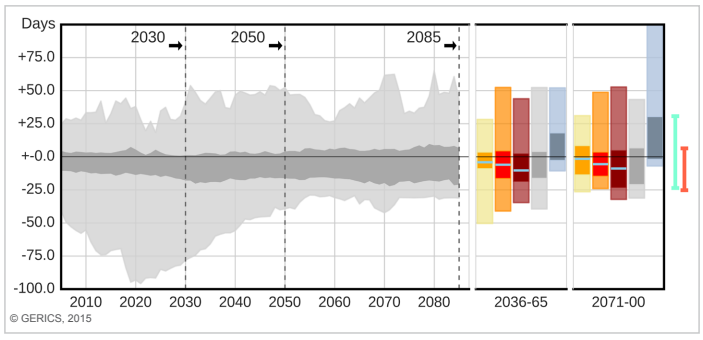
Comparison to projections of IPCC AR4:

- Latest AR5 projections show now clear trend for the future, whereas a tendency towards an increase is present in AR4 data.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):

- **below 2°C-target:** -24 to +31 days
- **above 4°C-threshold:** -25 to +6 days





Heavy rains

- Likely range of projected change in the intensity of heavy rainfall events is from 0 to +18% by 2030, from 0 to +21% by 2050 and from -4 to +29% by 2085.
- Very likely range: -13 to +28% by 2030; -9 to +34% by 2050; -16 to +43% by 2085.

Separate scenario examination (by 2085):

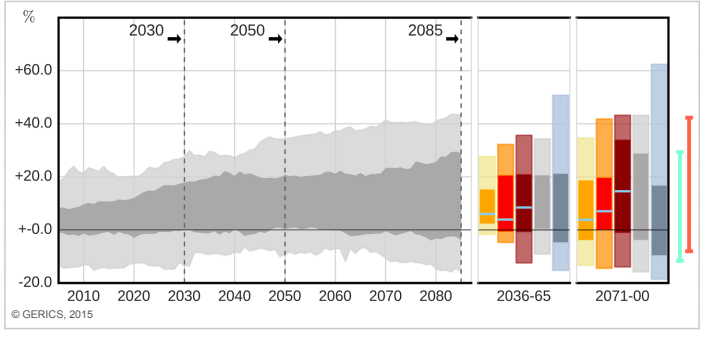
- **Low-Scenario:** Median +4%
- **High-Scenario:** Median +15%

Comparison to projections of IPCC AR4:

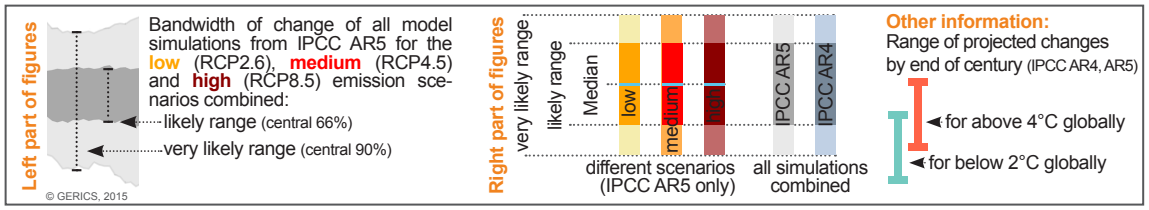
- Latest AR5 projections show a tendency towards an increase but with a comparable large bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):

- **below 2°C-target:** -12 to +29%
- **above 4°C-threshold:** -8 to +42%



Likely range of projected change in the frequency of a heavy rainfall event of today's intensity is from +12 to +75% by 2030, from +16 to +75% by 2050 and +13 to +97% by 2085.



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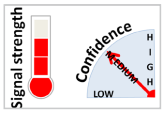
Actual evaporation

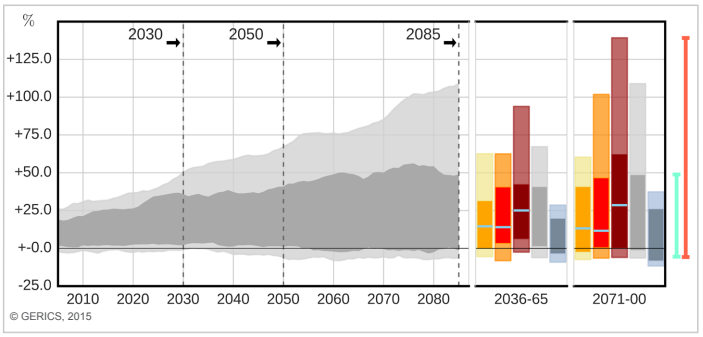
- Likely range of projected change in annual total actual evaporation is from +2 to +36% by 2030, from +1 to +41% by 2050 and from -1 to +49% by 2085.
- Very likely range: -1 to +50% by 2030; -6 to +67% by 2050; -6 to +109% by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario :** Median +13%
- **High-Scenario:** Median +29%

Comparison to projections of IPCC AR4:
- Latest AR5 projections show a tendency towards an increase but with a substantially larger bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** -6 to +49%
- **above 4°C-threshold:** -6 to +139%





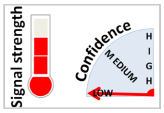
Climatic water balance (difference between annual mean precipitation and annual mean actual evaporation)*

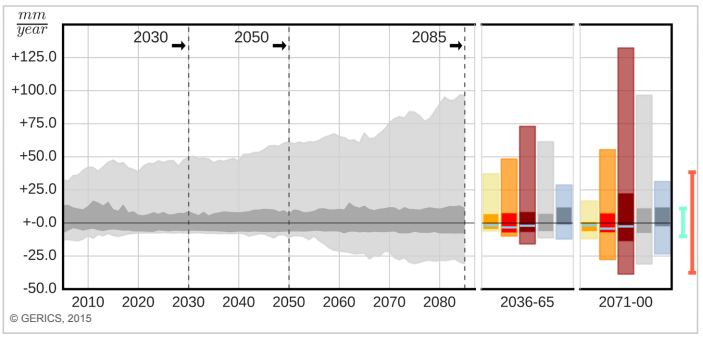
- Likely range of projected change in climatic water balance is from -6 to +9 mm/yr by 2030, from -6 to +7 mm/yr by 2050 and from -8 to +11 mm/yr by 2085.
- Very likely range: -8 to +50 mm/yr by 2030; -11 to +61 mm/yr by 2050; -31 to +97 mm/yr by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario :** Median -2 mm/yr
- **High-Scenario:** Median -3 mm/yr

Comparison to projections of IPCC AR4:
- Latest AR5 projections show the same outcome of no clear trend but with a substantially larger bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** -10 to +11 mm/yr
- **above 4°C-threshold:** -38 to +38 mm/yr





* The climatic water balance is derived from projected precipitation and projected actual evaporation amounts. Therefore the bandwidth of both parameters is accumulated in this parameter. Due to this, the climatic water balance shows a rather high bandwidth. Because the climatic water balance can have positive or negative values for today's or future conditions, the changes are given in mm/yr.

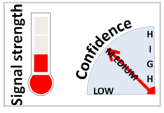
Projections of possible development of solar irradiance

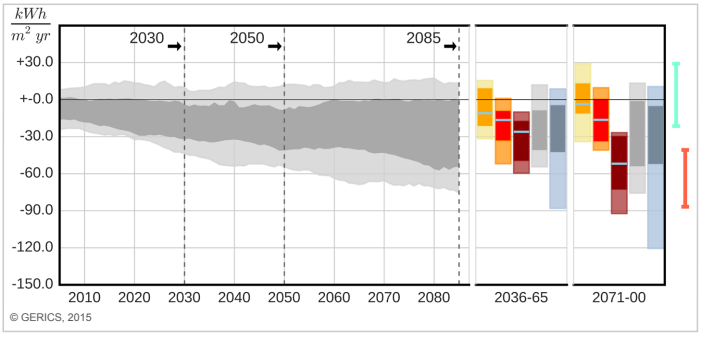
- Likely range of projected change in solar irradiance is from -32 to -4 kWh/(m² yr) by 2030, -41 to -8 kWh/(m² yr) by 2050 and from -54 to -1 kWh/(m² yr) by 2085.
- Very likely range: -44 to +10 kWh/(m² yr) by 2030; -54 to +12 kWh/(m² yr) by 2050; -76 to +13 kWh/(m² yr) by 2085.

Separate scenario examination (by 2085):
- **Low-Scenario :** Median -4 kWh/(m² yr)
- **High-Scenario:** Median -52 kWh/(m² yr)

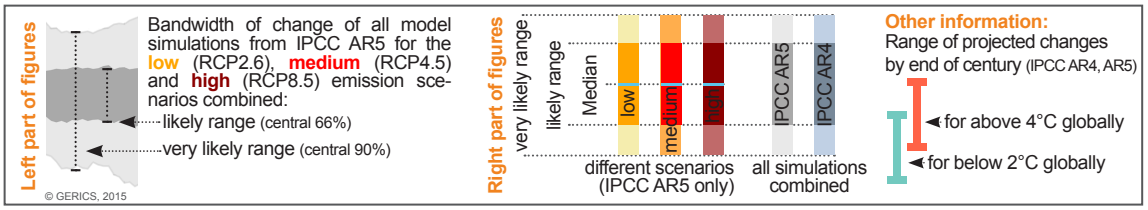
Comparison to projections of IPCC AR4:
- Latest AR5 projections show the same tendency towards a decrease but with a slightly smaller bandwidth.

Range of projected changes for all simulations with global mean warming below 2°C or above 4°C (by 2085):
- **below 2°C-target:** -21 to +29 kWh/(m² yr)
- **above 4°C-threshold:** -87 to -41 kWh/(m² yr)





All projected changes presented in the Climate-Fact-Sheet are with respect to the reference period from 1971 to 2000. Whenever a single year is referenced in the climate change section it refers to the 30 year period centred around this single year (e.g. by 2085 reflects the change for the period from 2071 to 2100). Exception to these periods are only the projections for sea level rise (if applicable).
The evaluation of the signal strength includes not only the actual climate change signal but also the statistical significance of the projected change. Signal strength is separated into weak, medium-strong or strong signal.
The assessment of the confidence in the climate model projections is based on the models' performance in simulating today's climate as well as on the bandwidth of projected climate change. This bandwidth results from the fact that every climate model projects a slightly different climate change signal. Confidence is separated into low, medium or high confidence.
For more details see „How to read a Climate-Fact-Sheet".



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Projections of possible development of wind speed

- Likely range of projected change in annual mean wind speed is from -1 to +2% by 2030, from 0 to +3% by 2050 and from -1 to +5% by 2085.
- Very likely range: -1 to +6% by 2030; -2 to +7% by 2050; -1 to +8% by 2085.

Separate scenario examination (by 2085):

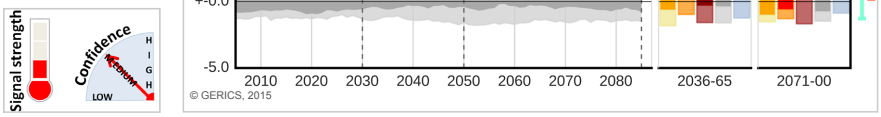
- **Low-Scenario :** Median 0%
- **High-Scenario:** Median +3%

Comparison to projections of IPCC AR4:

- Latest AR5 projections show no clear trend, whereas a tendency towards a slight increase is present in AR4 data.

Range of projections reaching the 2°C target or are above 4°C in the global mean (by 2085):

- **below 2°C target:** -1 to +4%
- **above 4°C-threshold:** 0 to +11%



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