

# Welcome to Germany and at Potsdam

Part 1

Climate Data & Diagnostic

RD1

## EARTH SYSTEM ANALYSIS

Atmosphere, Ocean, Ice Sheet & Vegetation



Multi-sector Impacts and Climate Extremes

CLIMATE IMPACTS AND VULNERABILITIES

RD2

RD3

## SUSTAINABLE SOLUTIONS

Global Adaption Strategies, Policy Assessment

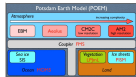


Complex Networks and Visualization

TRANSDISCIPLINARY CONCEPTS & METHODS

RD4

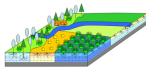
# Models/Tools:



Potsdam Earth Model



Parallel Ice Sheet Model



Lund-Potsdam-Jena managed Land



COSMO-ClimateLimited-areaModelling



Soil and Water Integrated Model



FORESt Ecosystems in a Changing Environment



# Outline:

## ① Climate Data

- ① from global to national: access ++ costs ++ handling

## ② Climate Diagnostic

- ① from global to local: circulation pattern ++ extremes

## ③ Climate Scenarios

- ① from global to regional: dynamical/statistical ++ access ++ bias correction

## ④ Weather in Climate Models

- ① objectivation of European circulation pattern
- ② assessment of climate models



# Climate Data:

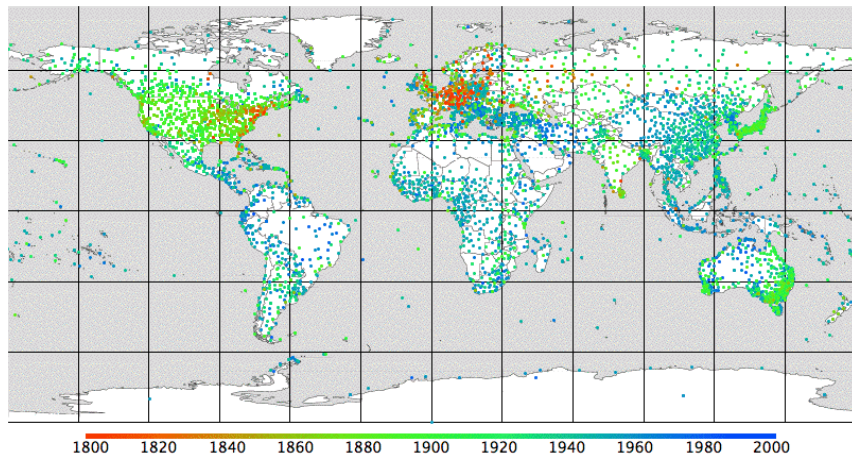
Scale	Dataset		Access	Costs	Usage
global	WATCH	daily	consortium	—	ISI-MIP
	CRU	monthly	consortium	—	Studies
	WDC	monthly	connection	5000 €/yr	Studies
regional	E-OBS	daily	free access	—	Monitoring
national	DWD	hourly/daily	limited access	250 €/yr	Swim-live
					downscaling
global	GFS/CFS	3 hourly	free access	—	forecasting

- Data handling:

- ▶ exchange via ftp
- ▶ interactive programming languages: R & Python



# Climate Data: global



GCHN Database, as used by CRU and NCDC

# Climate Data: monthly climate data

WDC, Obninsk

Ethiopia (Part B)( 63300- 63599)

6333120150208055199999902281089199999999999903101015010901

6340220150208367199999902001124105101691194103161008412121

6347120150208865199999902461125199900001017103231016912721

Kenya & Tanzania (United Republic of) & Uganda( 63600- 63979)

6375620150208858199999902401214104100361999902891999992401

6383220150208826199999902341215110100841999902981015912351

6396220150208950199999902261219112100751001102861015111731

6397120150209979110107102731295103100961999903091023712451

Zaire|( 64000- 64379)

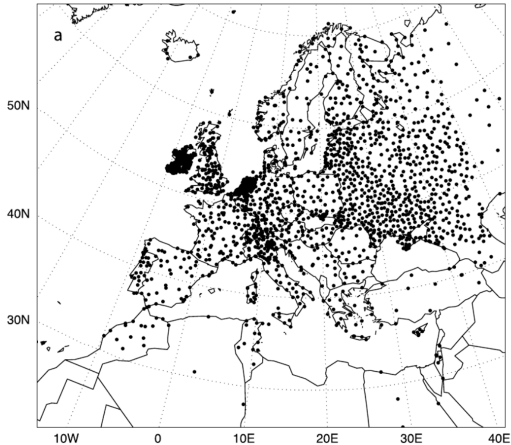
6421020150209753110101102631277110102411999903171022619999



Station\_list: 637560 HTMW MWANZA TN -0246 +03291 1140

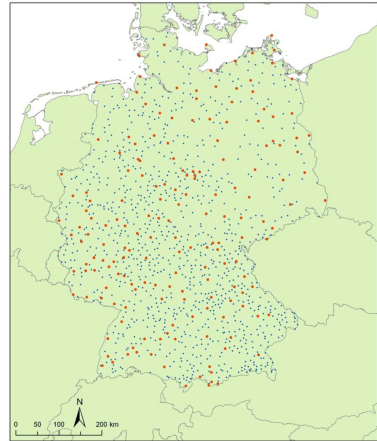
# Climate Data: global to national

Europe (E-OBS,  $0.25^\circ \times 0.25^\circ$ )



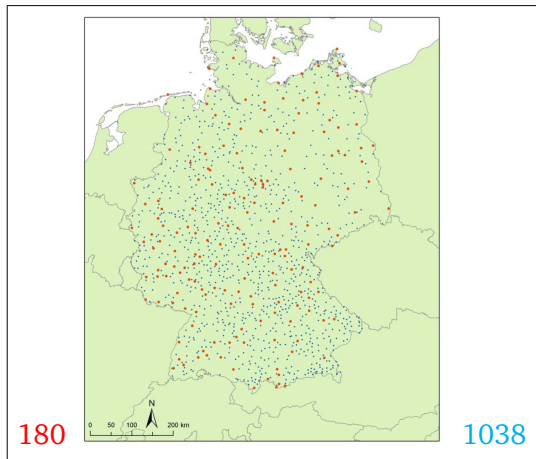
ca. 250 stations

Germany (DWD)



ca. 180 stations

# Climate Data: regional to national



## Observation Network

- synoptical stations
- climate stations
- free climate stations
- precipitation gauges
- full & half automatic
- Großwetterlagen (GWL)

# Climate Data: Access



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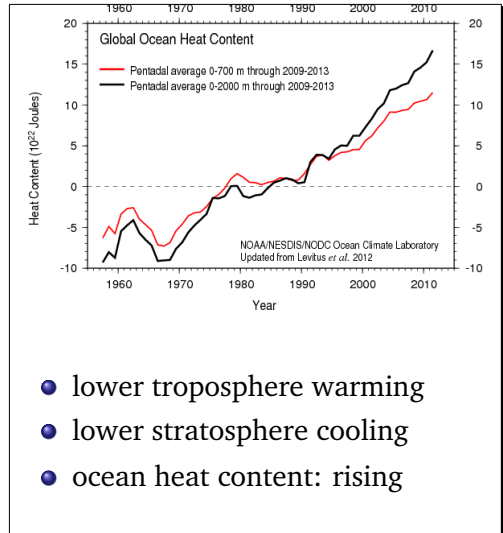
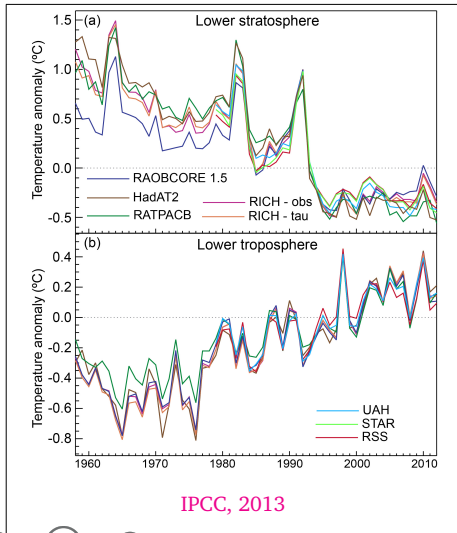
Matches: 59

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Product ID	Title	Product	Metadata	XML	Example
de.dwd.cpd.rcm	Regional Climate Projections				-
de.dwd.hydromet.owlk.climate	oWLK-GCM objective weather types derived from General Circulation Models (Reanalysis data and Global Climate Model Simulations)				-
de.dwd.nkdz.collections	Time series of different meteorological elements provided on files related to the federation states of Germany and some 1-km-grid fields for download				-
de.dwd.nkdz.DDHM	Climatological time serie: hourly means of wind direction (in degrees)				-
de.dwd.nkdz.FBDM	Climatological time serie: daily mean of windforce (in Bft)				-
de.dwd.nkdz.FFDM	Climatological time serie: daily mean of windspeed (in m/sec)				-
de.dwd.nkdz.FFDX	Climatological time serie: daily maximum of windspeed (in m/sec)				-
de.dwd.nkdz.FFHM	Climatological time serie: hourly means of wind speed (in m/sec)				-
de.dwd.nkdz.HRRMS	monthly sums of precipitation (homogeneous) (in mm)				-
de.dwd.nkdz.HTAMM	monthly means of air temperature (homogeneous) (in degree C)				-

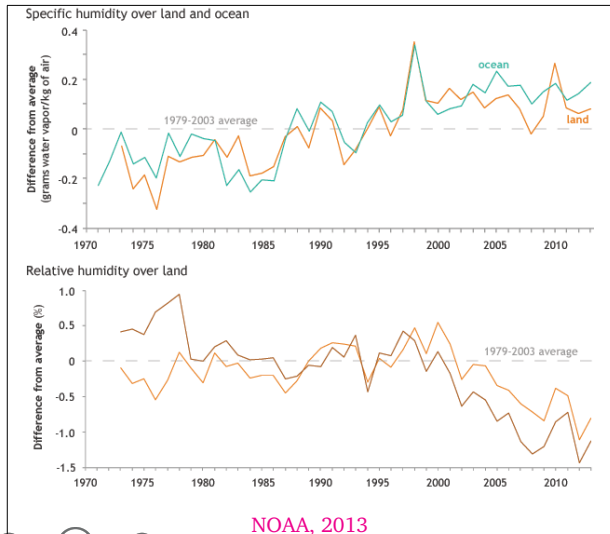


# Climate Diagnostic: Temperature (Atmos./Ocean)

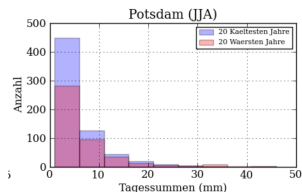


- lower troposphere warming
- lower stratosphere cooling
- ocean heat content: rising

# Climate Diagnostic: Humidity (global)



- specific humidity ( $g/km$ )
  - ▶ rising
  - ▶ more wv in atmosphere
- relative humidity (%)
  - ▶ falling
  - ▶ condensation level rises
- if its rain than more heavy
- shift of the precipitation spectrum



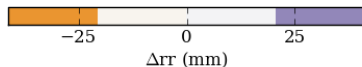
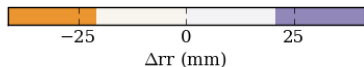
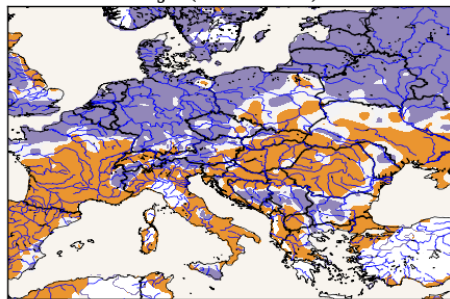
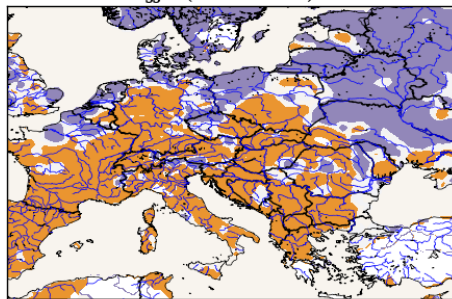


# Climate Diagnostic: Precipitation (Europe)

1984-2014 — 1951-1980

JJA (8413-5180)

DJF (8413-5180)

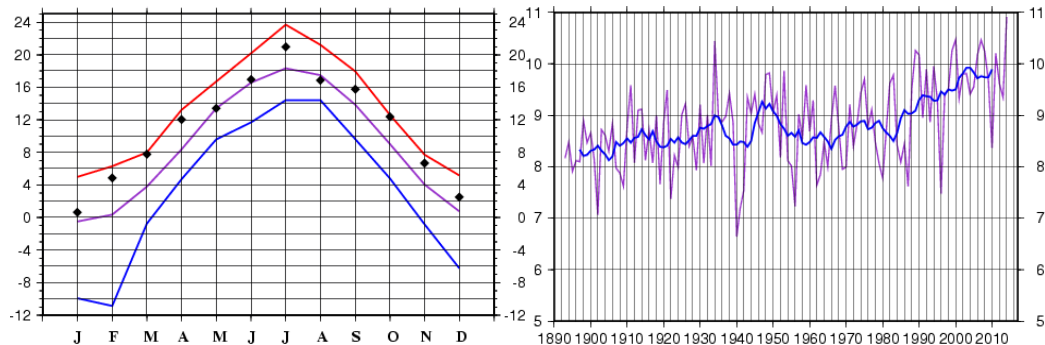


Summer

E-OBS

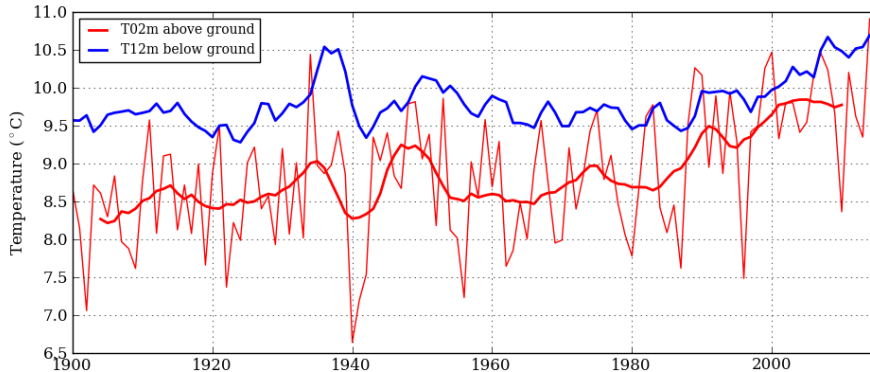
Winter

# Climate Diagnostic: Potsdam



**2014: the warmest year on record ( $10.91^{\circ}\text{C}$ )  
globally, in Europe and in Germany**

# Climate Diagnostic: Potsdam



annual mean Temperature  
2m-Temperature and 12m Temperature below ground

# Climate Diagnostic: Potsdam

• year	• Jan	• Feb	• Mar	• Apr	• May	• Jun
	• Jul	• Aug	• Sep	• Oct	• Nov	• Dec
show						
date	highest daily maximum of air temperature in year					
9. 8.1992	39.1 °C					
11. 7.1959	38.4 °C					
10. 7.1959	38.2 °C					
11. 7.2010	38.0 °C					
1. 8.1994	37.7 °C					

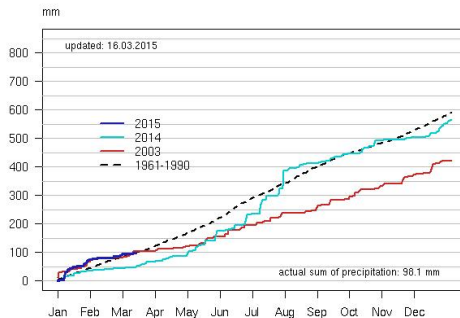
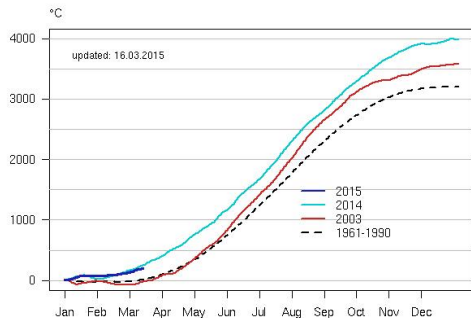
• year	• Jan	• Feb	• Mar	• Apr	• May	• Jun
	• Jul	• Aug	• Sep	• Oct	• Nov	• Dec
show						
date	lowest daily minimum of air temperature in year					
11. 2.1929	-26.8 °C					
10. 2.1929	-26.0 °C					
19. 1.1893	-25.7 °C					
21.12.1969	-24.5 °C					
18. 1.1893	-24.3 °C					

• year	• Jan	• Feb	• Mar	• Apr	• May	• Jun
	• Jul	• Aug	• Sep	• Oct	• Nov	• Dec
show						
date	highest daily total of precipitation in year					
8. 8.1978	105.7 mm					
12. 8.2002	83.9 mm					
9. 7.1927	83.1 mm					
29. 8.1969	79.2 mm					
25. 6.1940	69.2 mm					



Remarkable weather situations

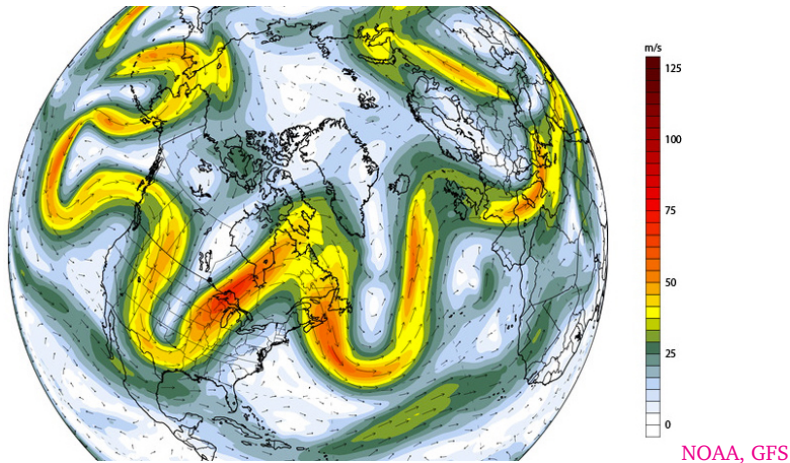
# Climate Diagnostic: Potsdam



2015: cumulative charts

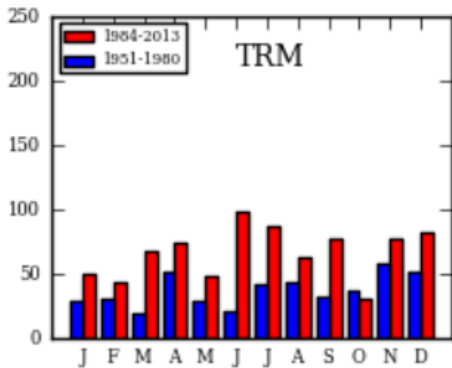
Temperature (left) and Precipitation (right)

# Climate Diagnostic: Jetstream



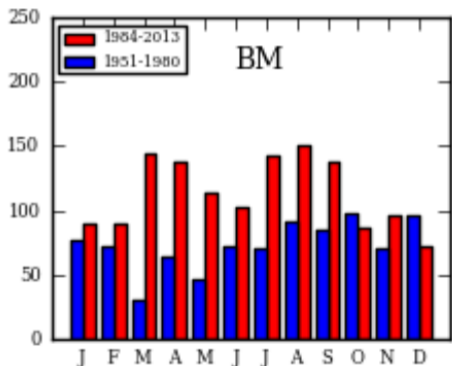
weather driver

# Climate Diagnostic: Weather Situations



”Trough over Central Europe”  
increasing

# Climate Diagnostic: Weather Situations



Hochdruckbrücke Mitteleuropa  
23. Januar 1981

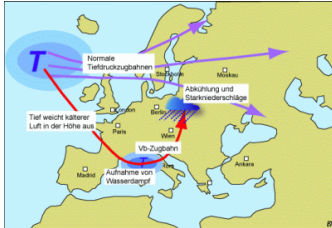


”High Bridge over Central Europe”  
increasing

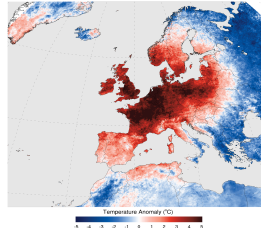


# Climate Diagnostic: Extreme Weather Events

## Floods



## Heatwaves



## Winter Storms



## Thunderstorms



## Black Ice



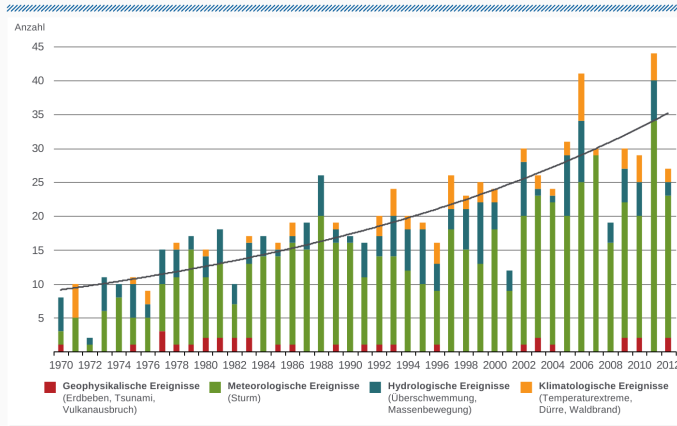
# Climate Diagnostic: Natural Disasters

NatCatSERVICE

## Naturkatastrophen in Deutschland 1970 – 2012

Anzahl der Ereignisse mit Trend

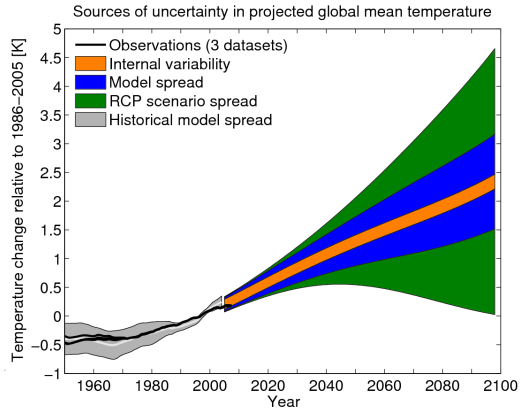
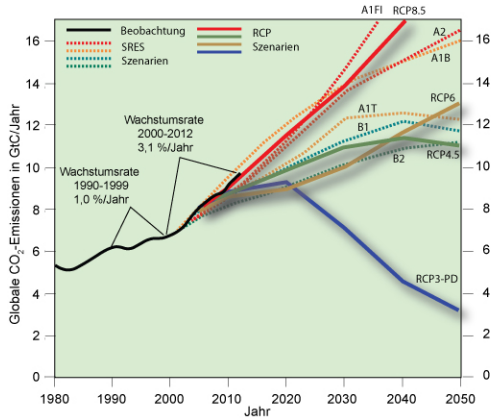
Munich RE 



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Munich RE, 2013

# Climate Scenarios: Emissions & Temperature



IPCC, 2013

# Climate Scenarios: ESGF



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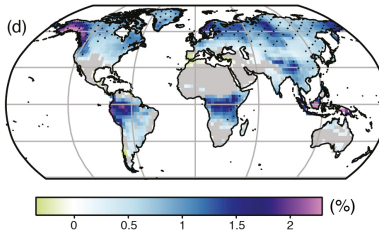
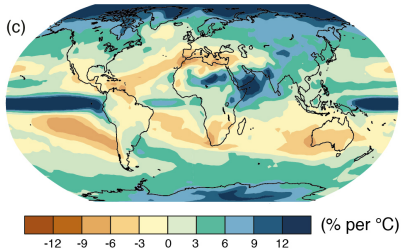
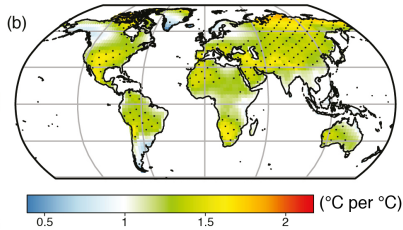
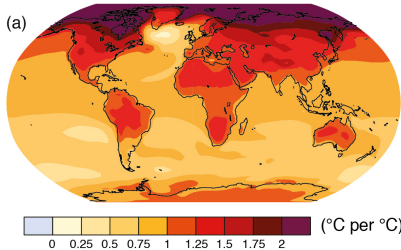
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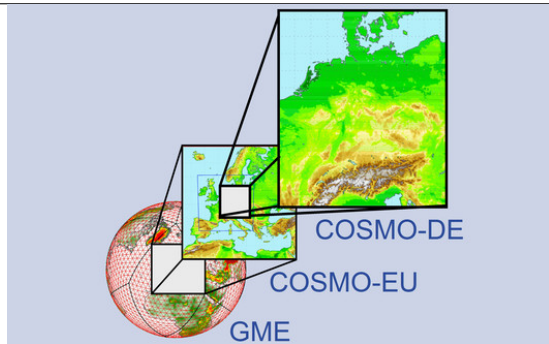
[cordex.output.EUR-11.CLMcom.MPI-M-MPI-ESM-LR.rcp85.r1i1p1.CCLM4-8-17.v1.day.tas](#)  
Data Node: carbon.dkrz.de  
**Version: 20140515**  
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# Climate Scenarios: global

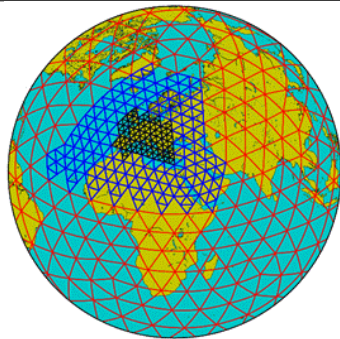


# Climate Scenarios: downscaling

**CMIP5 → Cordex**



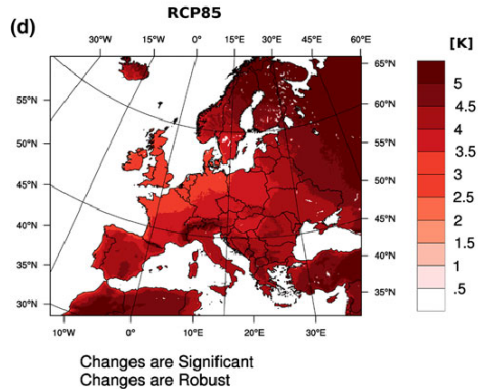
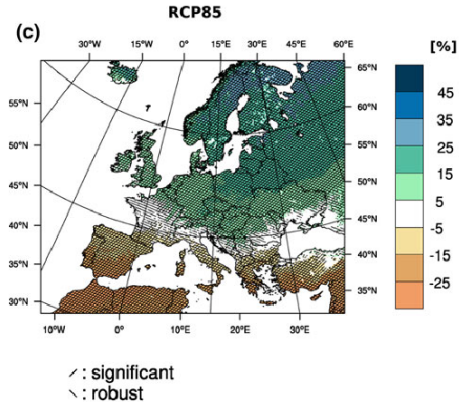
**ICON**



DWD

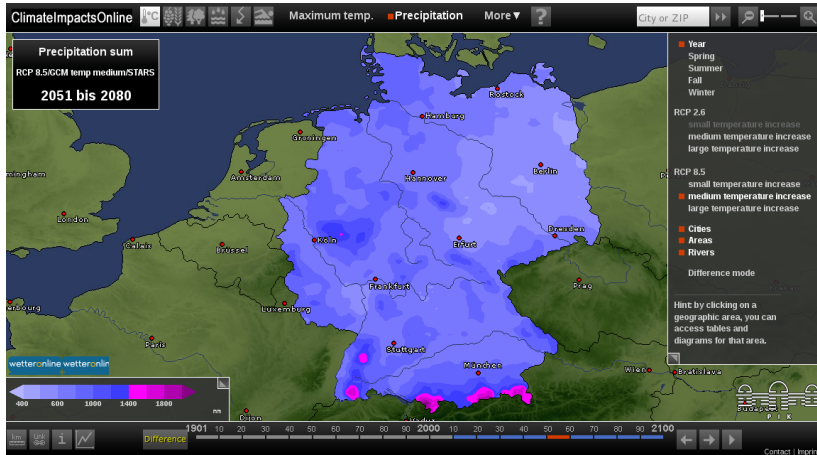
**dynamical downscaling**

# Climate Scenarios: regional



Jacob et al. 2013

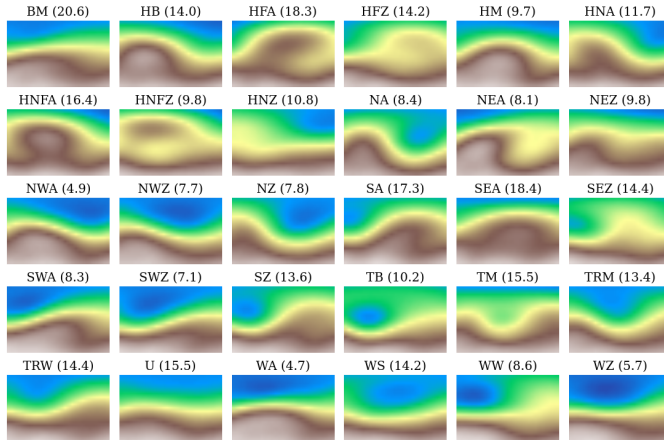
# Climate Scenarios: national



ClimateImpactsOnline



# Weather in Climate Models: Pattern in Reanalyses

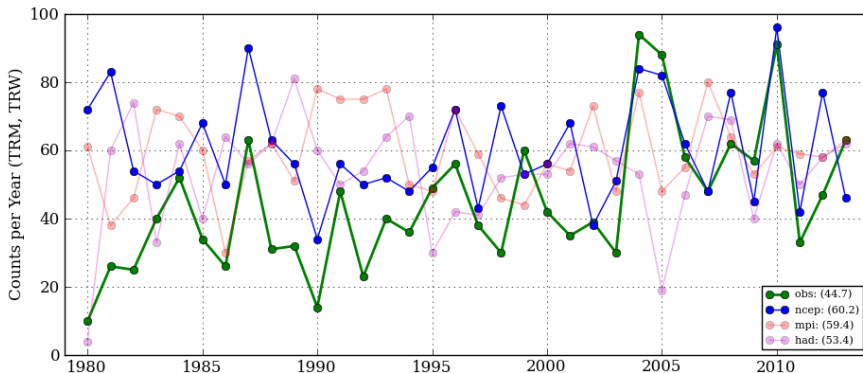


European circulation pattern at GPH500

**Climatology**

# Weather in Climate Models: long-term Trends

## Identification of European circulation pattern via image comparison “Trough over Europe”



observation/reanalyses



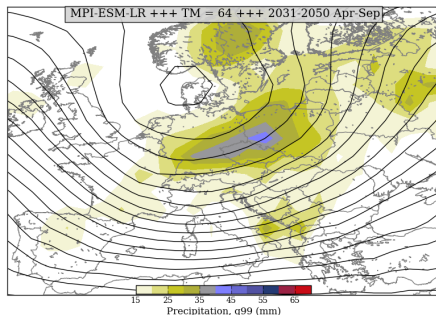
climate models



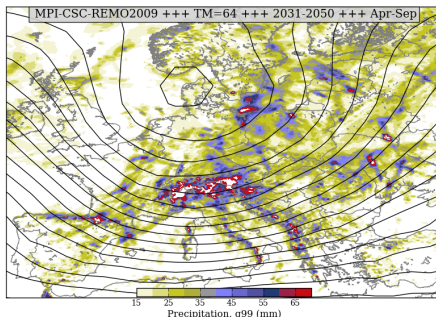
# Weather in Climate Models: Applications

## Low over Central Europe (TM)

GCM



RCM

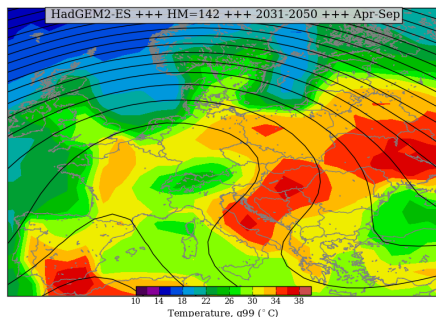


heavy precipitation

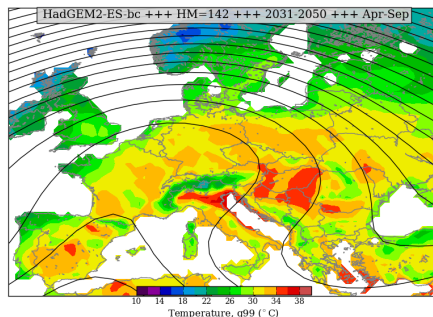
# Weather in Climate Models: Applications

## High over Central Europe (HM)

**GCM uncorrected**



**GCM corrected**



temperature extreme

# INVITATION TO VISIT



LONG-TERM  
METEOROLOGICAL STATION  
POTSDAM TELEGRAFENBERG



- 100 year without gaps (81m)
- unchanged measurement and boundary conditions
- recording of the most important meteorol. values
- jewel among the meteorol. long-term series worldwide
- first official weather observation: 1st Jan 1893
- Reinhard Süring: director from 1909 for 23+5 years
- record ballon ascend: 31st July 1901 (10.800m)
- Süring died in the age of 85 years (1951)
- 2020: DWD plans to say goodbye from visual observ.

The long-term station Potsdam is the only one worldwide measuring before 1900:

- soil temperature + snow cover + frost depth + T<sub>min</sub> near ground + cloud forms + sight + precip. kind

Measurement Programme:

- soil temperature: 2cm, 5cm, 10cm, 20cm, 50cm, 1m, 2m, 4m, 6m, 12m