World Meteorological Organization

Weather • Climate • Water

Observed State of the Global Climate

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WMO
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Observations of Changes of the physical state of the climate

ESSENTIAL CLIMATE VARIABLES

OCEANIC

Surface (10)

- Sea-surface temperature
- Sea-surface salinity
- Sea level
- Sea state
- Sea ice
- Surface current
- Ocean colour
- Carbon dioxide partial pressure
- Ocean acidity
- Phytoplankton

Sub-surface (8)

- Temperature
- Salinity
- Current
- Nutrients
- Carbon dioxide partial pressure
- Ocean acidity
- Oxygen
- Tracers

ATMOSPHERIC

Composition (3)

- Carbon dioxide
- Methane and other long-lived greenhouse gases
- Ozone and Aerosol supported by their precursors

Upper-air (5)

- Temperature
- Wind speed and direction
- Water Vapour
- Cloud properties
- Earth radiation budget (incl. solar irradiance)

Surface (6)

- Air temperature
- Wind speed and direction
- Water Vapour
- Pressure
- Precipitation
- Surface radiation budget

TERRESTRIAL

Biological/Ecological (6)

- Land cover
- FAPAR
- Leaf area index
- Above ground biomass
- Soil carbon
- Fire disturbance

Hydrological (5)

- River discharge
- Water use
- Ground water
- Lakes
- Soil moisture

Cryospheric (4)

- Snow cover
- Glaciers and ice caps
- Ice sheets
- Permafrost

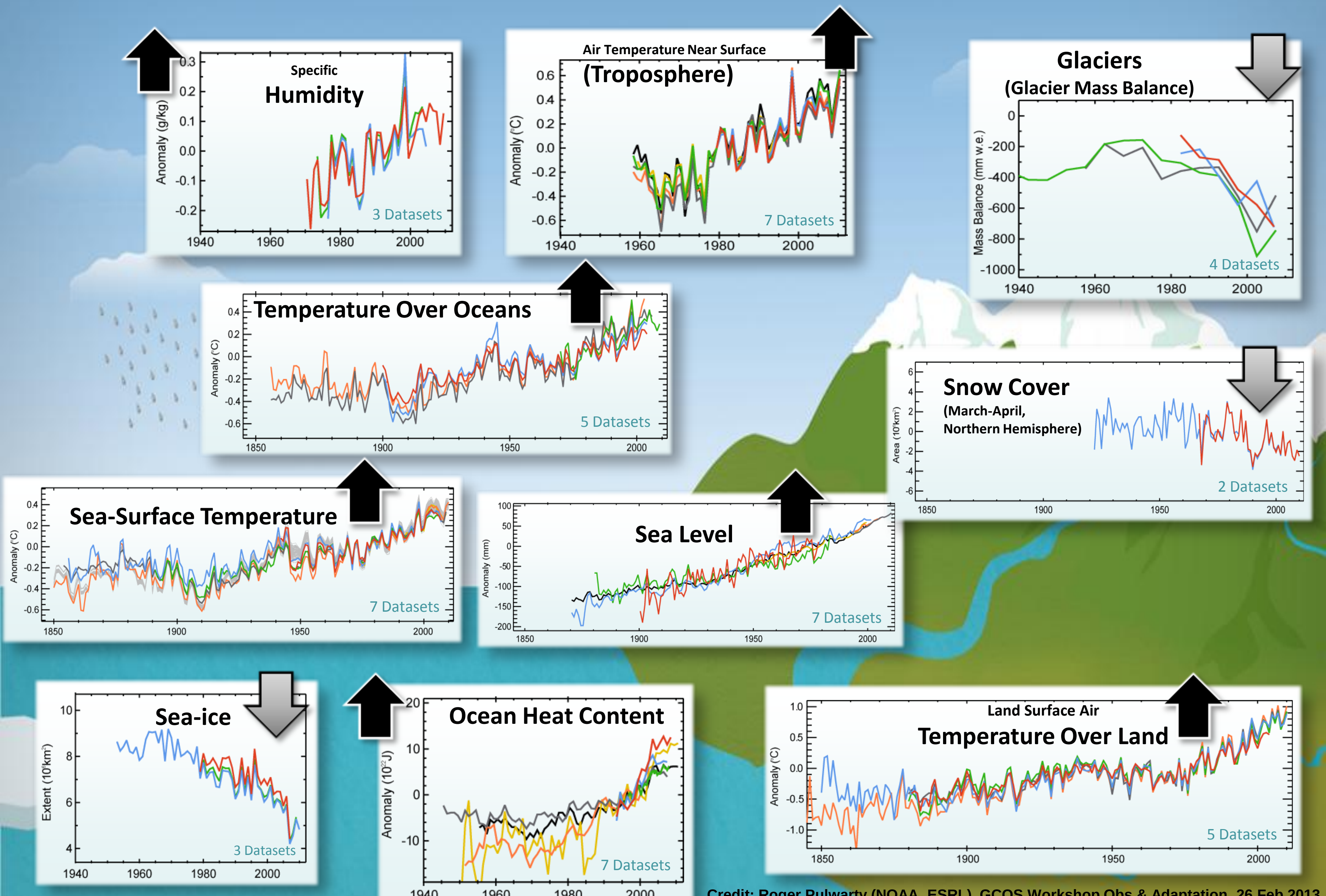
Other (1)

- Albedo

The GCOS Essential Climate Variables (ECVs) are required to support the work of the UNFCCC and the IPCC. All ECVs are technically and economically feasible for systematic observation. It is these variables for which international exchange is required for both current and historical observations.

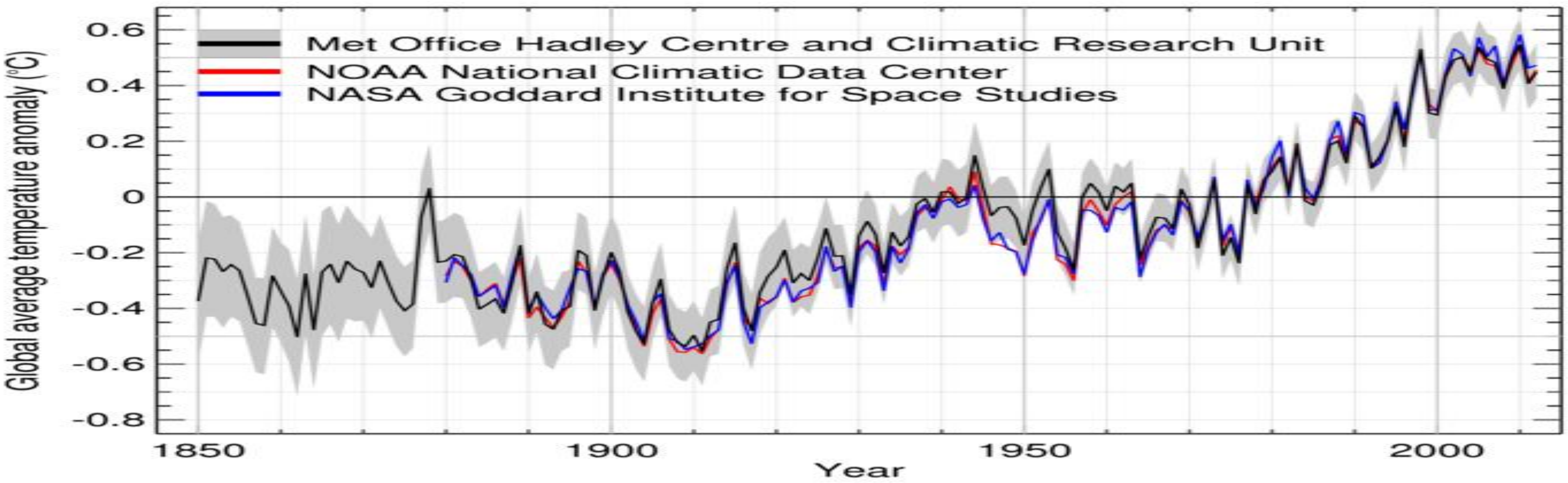
GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

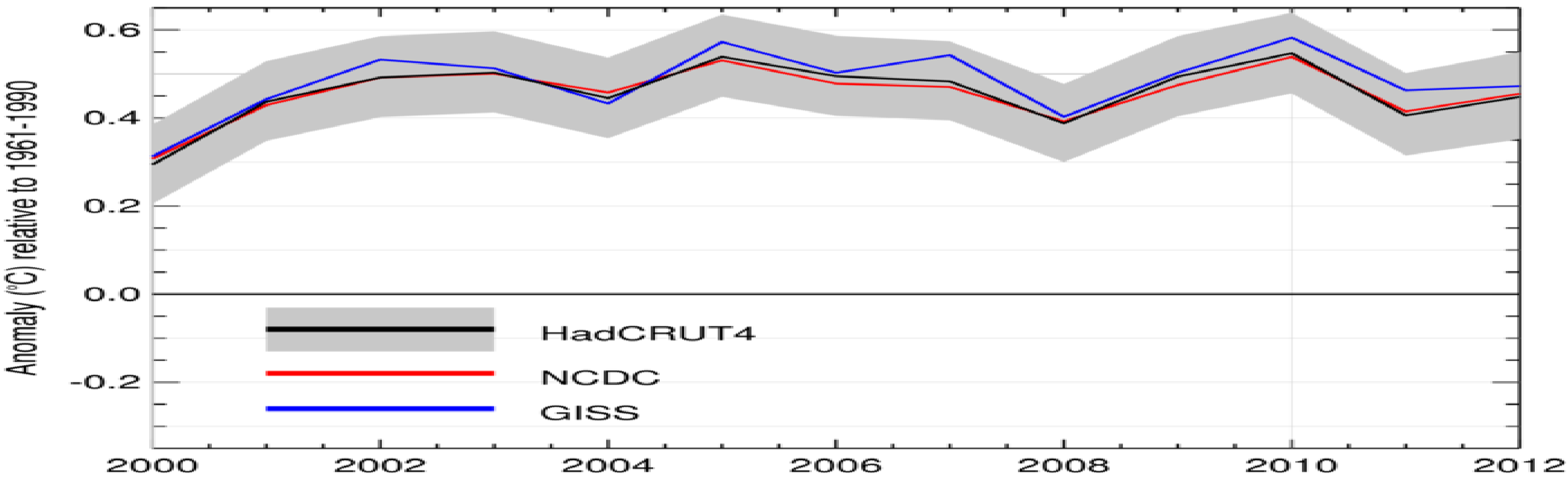
Observed Physical System Changes-What is in the data?

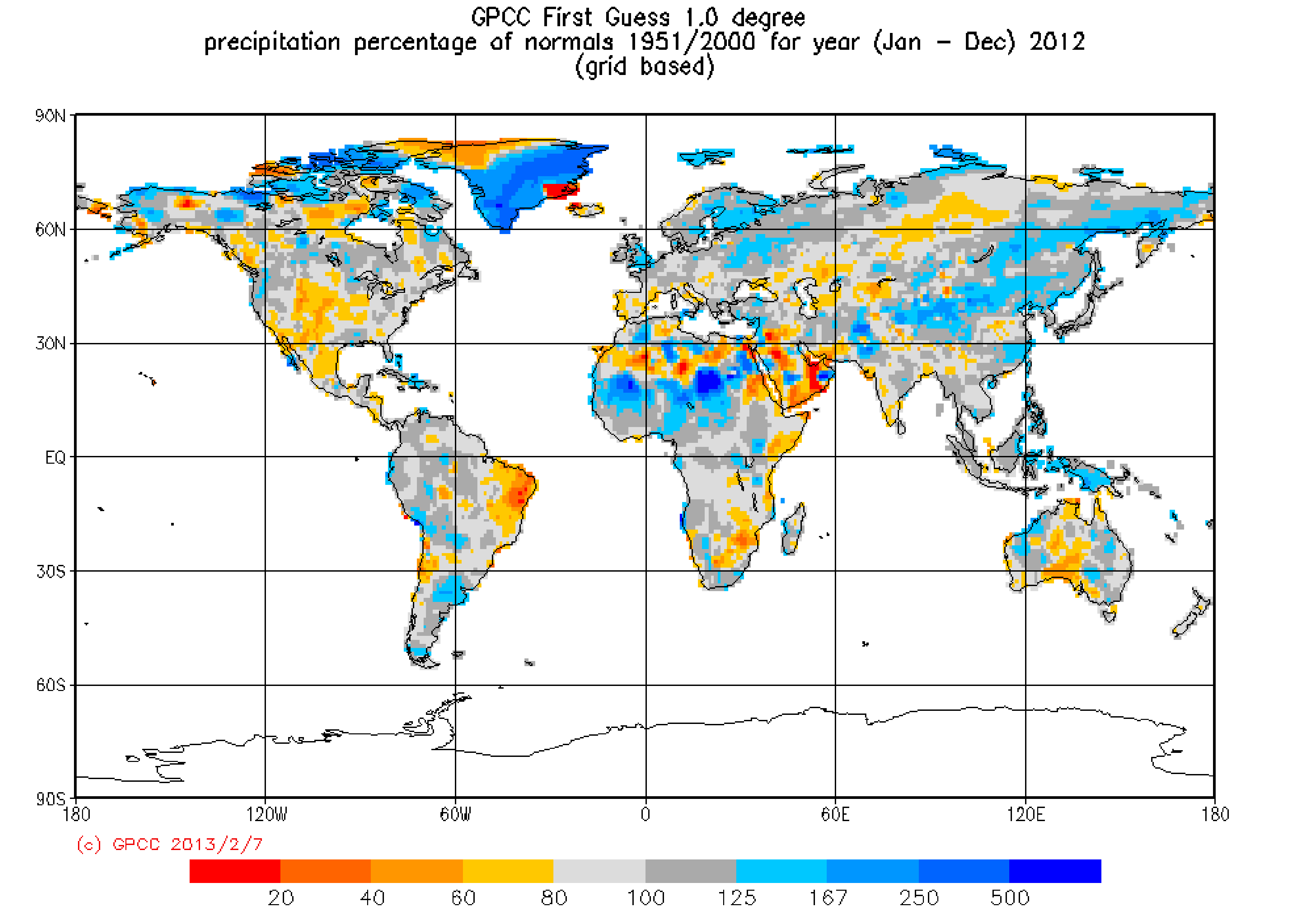


Credit: Roger Pulwarty (NOAA, ESRL), GCOS Workshop Obs & Adaptation, 26 Feb 2013

Annual Global Average Temp.



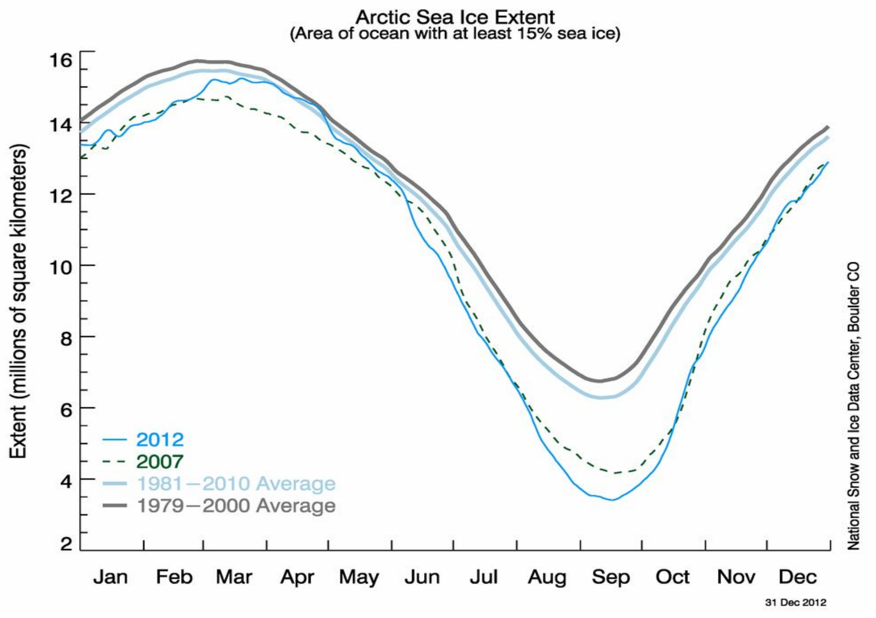




GPCC First Guess 1.0 degree
precipitation percentage of normals 1951/2000 for year (Jan - Dec) 2012
(grid based)
90N
60N
30N
EQ
30S
60S
90S
180
120W
60W
0
60E
120E
180
(c) GPCC 2013/2/7
20
40
60
80
100
125
167
250
500

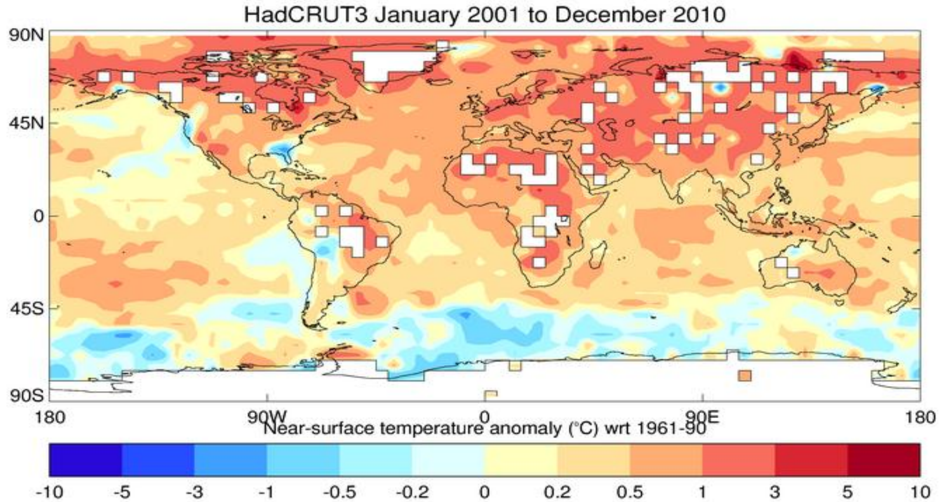
Sea Ice Extent- 2012

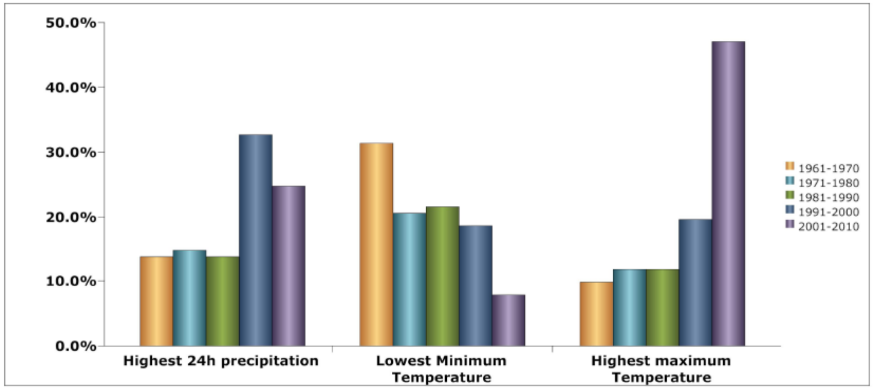
- 3.41 million square km on Sep 16th:
  - 18% below the previous record
  - 49% below the 1979–2000 average
- Difference between maximum extent and minimum extent was 11.83 million square km—**the largest seasonal sea ice extent loss on record**



2001-2010 CLIMATE - KEY FINDING

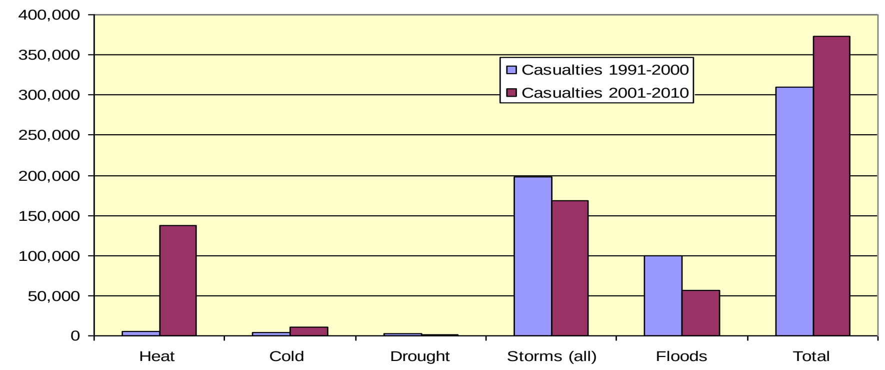
- For global land-surface temperatures as well as for ocean-surface temperatures the decade is currently estimated as the warmest on record
-
- The rate of temperature increase was particularly high in the northern hemisphere with temperature anomalies in the range of 1-1.5°C or higher
- A remarkable decline in the Arctic sea-ice continued throughout the decade. A historical low Arctic sea-ice extent at the melting period in September was recorded in 2007
- Substantial number of national climate records of Temperature and Precipitation were broken; in parallel major high impact Climate Extremes were recorded; heat waves , droughts and floods
- CO2 concentration reached a globally averaged value of 389 parts per million (ppm), the highest value ever recorded in the modern measurements



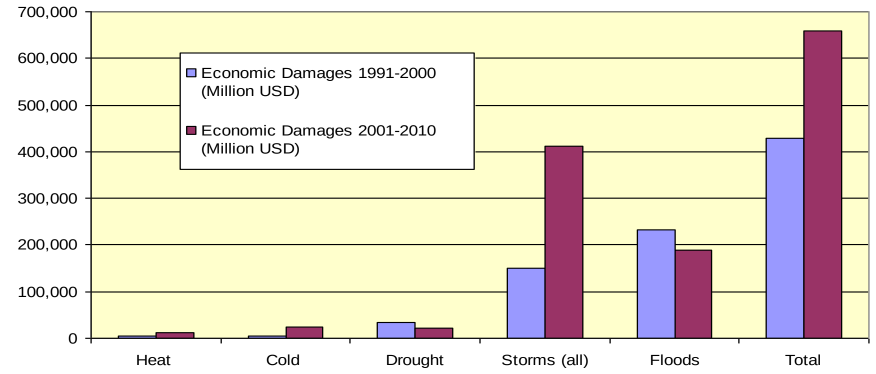


CLIMATE EXTREMES: IMPACTS

CASUALTIES 2001-2010 versus 1991-2000
→ Decreased for Storms and Floods
→ Dramatically increased for Heat, due to 2003 and 2010 extreme heat waves in Europe and Russia



ECONOMIC DAMAGES 2001-2010 versus 1991-2000
→ Substantial Increase due to Storms (mainly tropical storms)
→ Slight decrease of damages due to floods



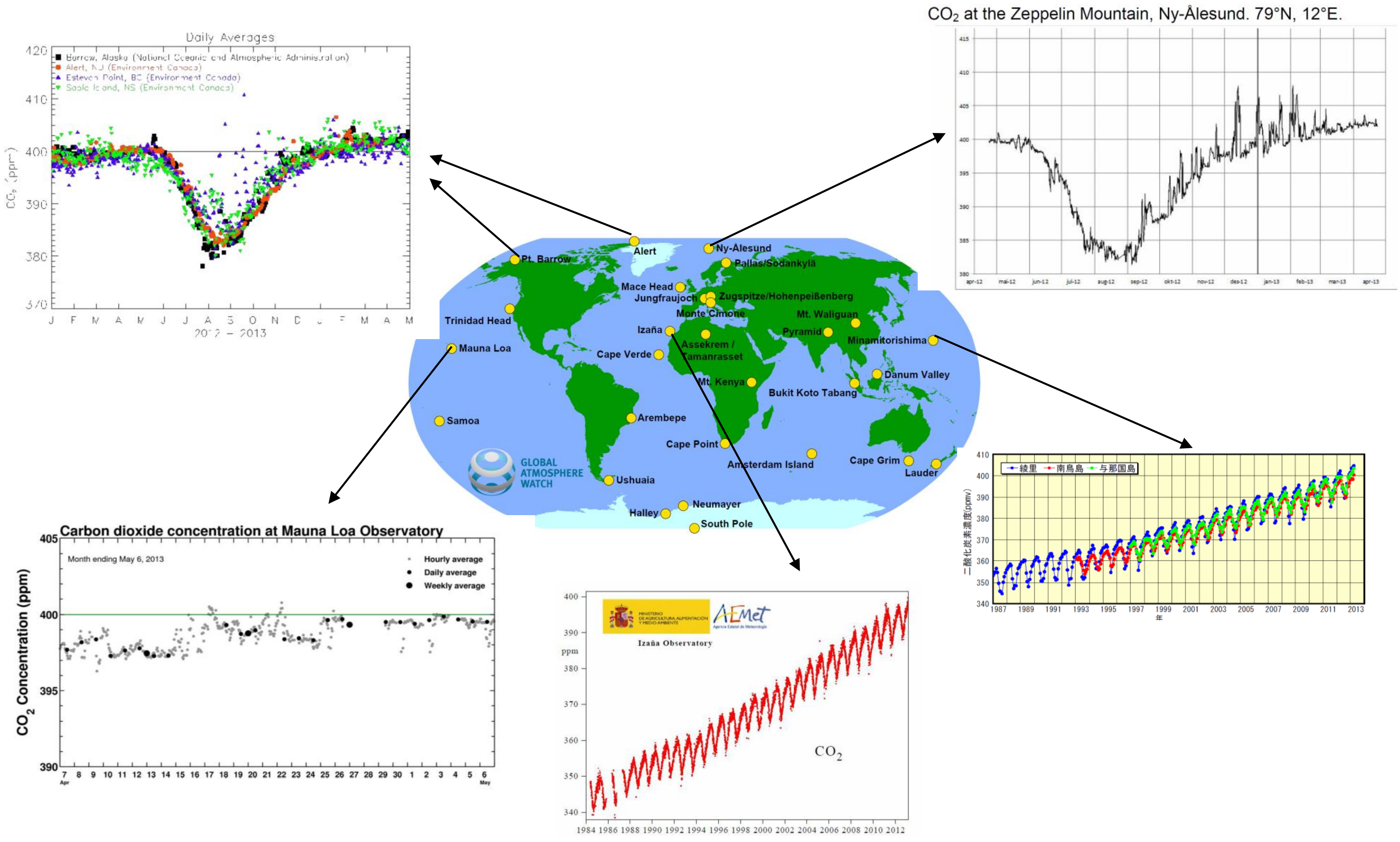
Data source: EM-DAT (CRED)

The 2003 European heat-wave is among those events for which human influence had probably substantially increased the likelihood of its occurrence;

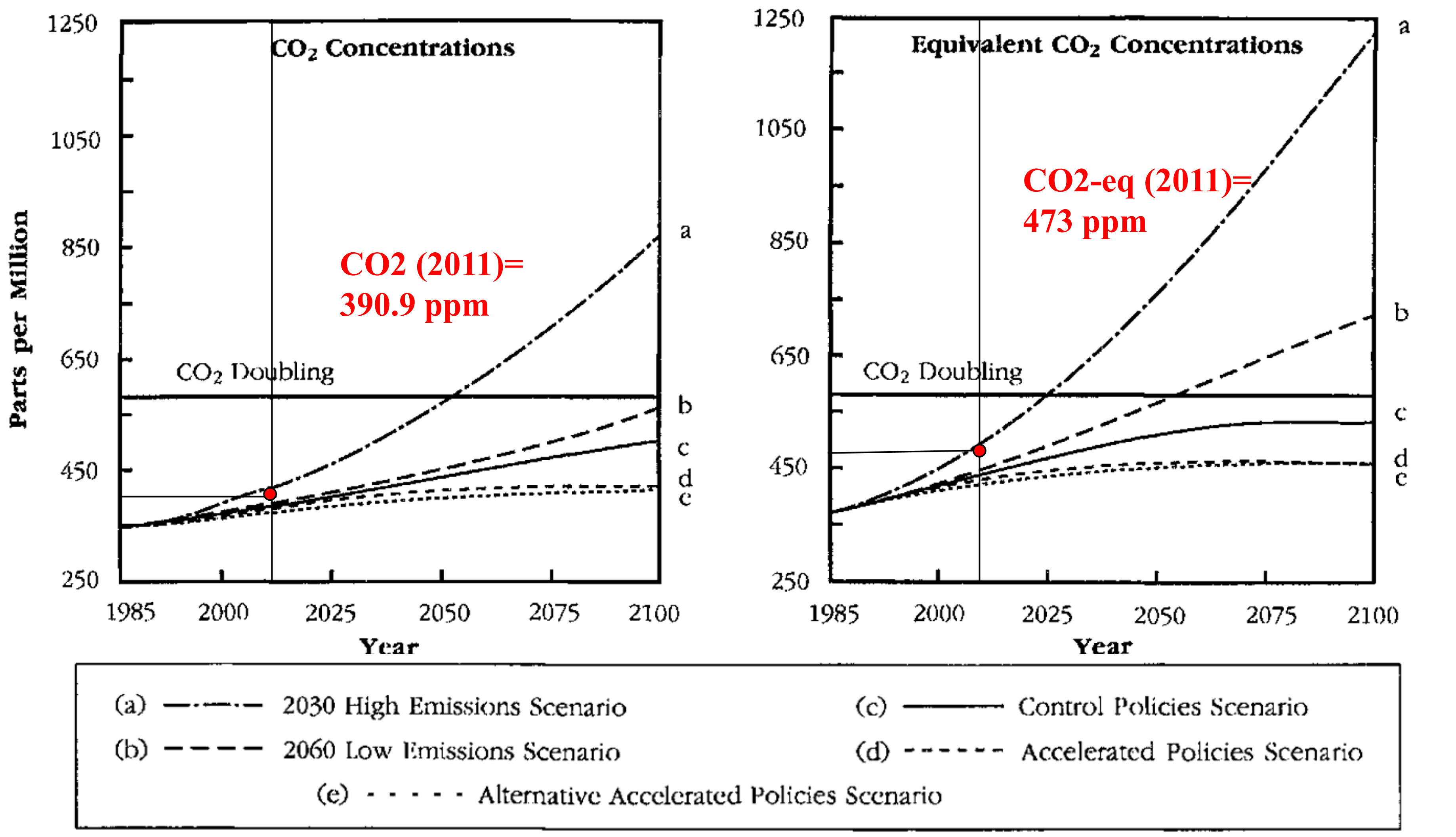
The 2010 Russian heat wave exhibits on the other hand the dominant natural variability aspect.

Reference WCRP Position Paper on Attribution of Climate Extremes, Peter Sttot et al, 2011

Observations above 400 ppm CO_2 at GAW Global Stations



Climate Change: The IPCC Response Strategies (1990)



AR4: Issues related to mitigation in the long-term context

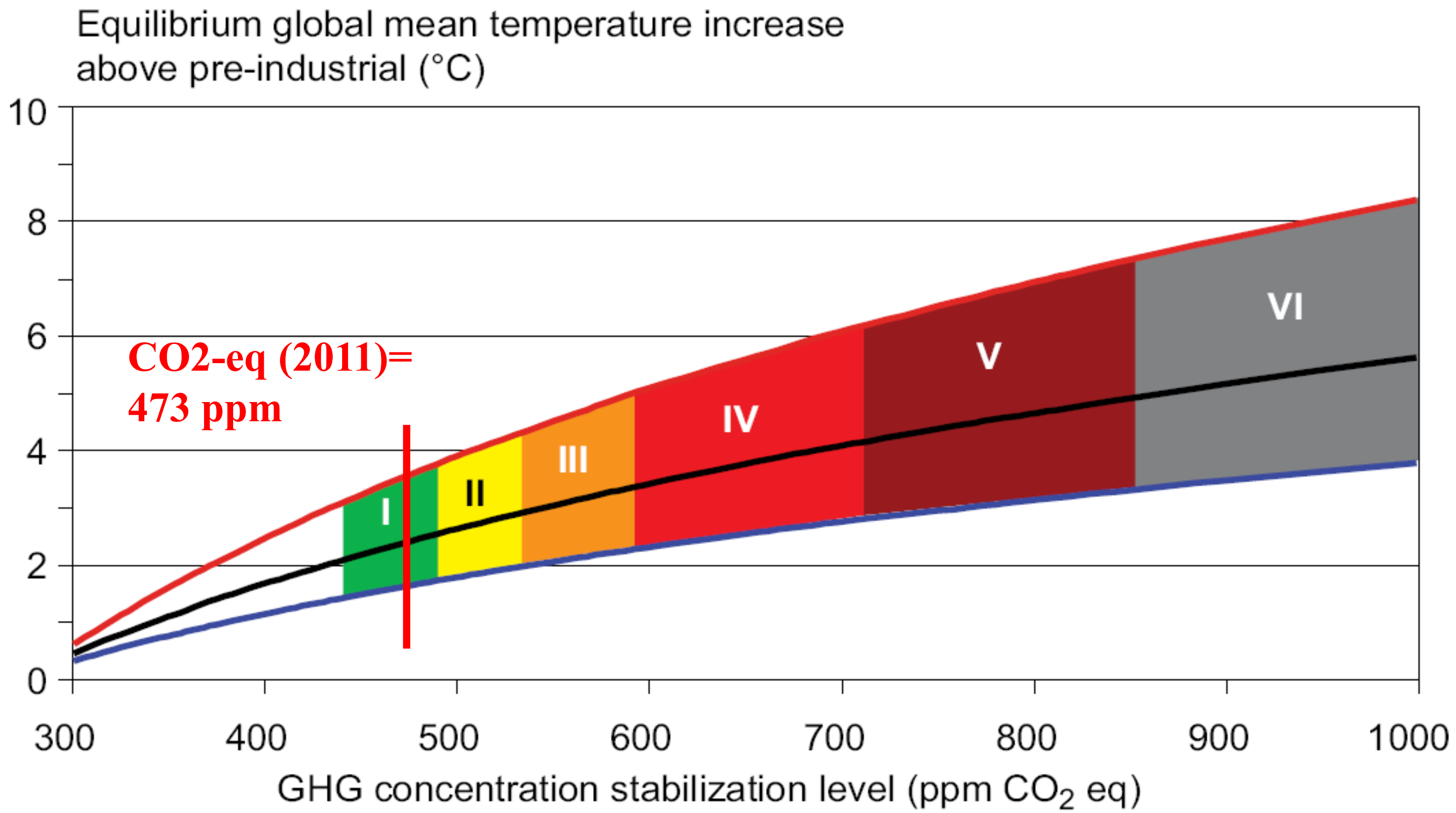
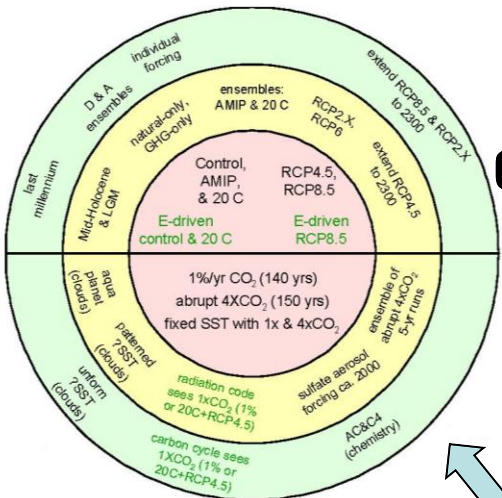


Figure 3.38: *Relationship between global mean equilibrium temperature change and stabilization concentration of greenhouse gases using: (i) 'best estimate' climate sensitivity of 3°C (black), (ii) upper boundary of likely range of climate sensitivity of 4.5°C (red), (iii) lower boundary of likely range of climate sensitivity of 2°C (blue) (see also Table 3.9).*

Major WCRP Climate Prediction & Projection Experiments

Coupled Model Intercomparison Experiment 5 – CMIP5 ⇨ IPCC AR5



decades,

centuries

Chemistry-Climate Model Validation

CCM Validation Activity for SPARC

CCMVal

http://www.pa.op.dlr.de/CCMVal

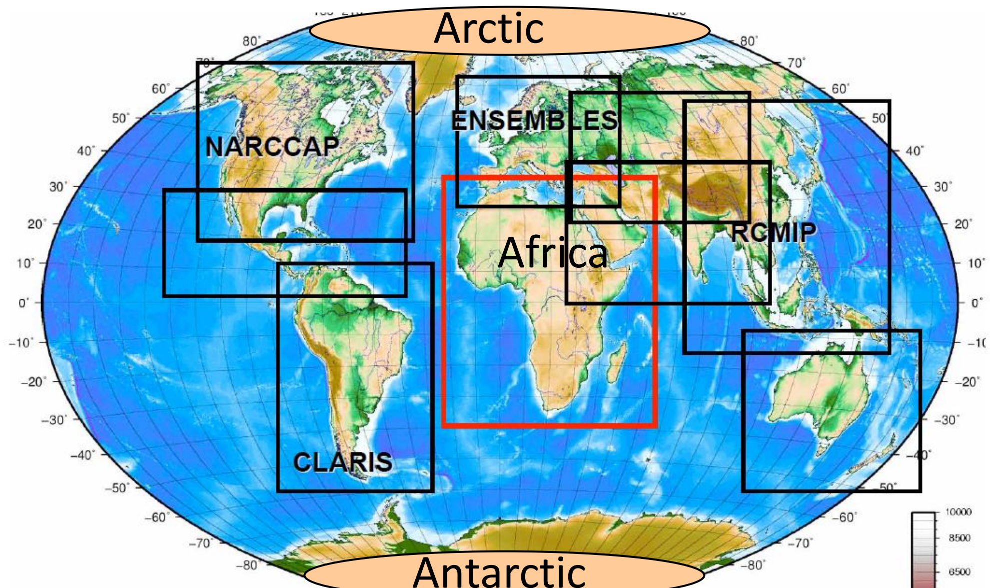
chemistry,

ozone

Climate-system Historical Forecast Project - CHFP

seasonal sea ice, stratosphere

Coordinated Regional Downscaling Experiment – CORDEX ⇨ IPCC AR5

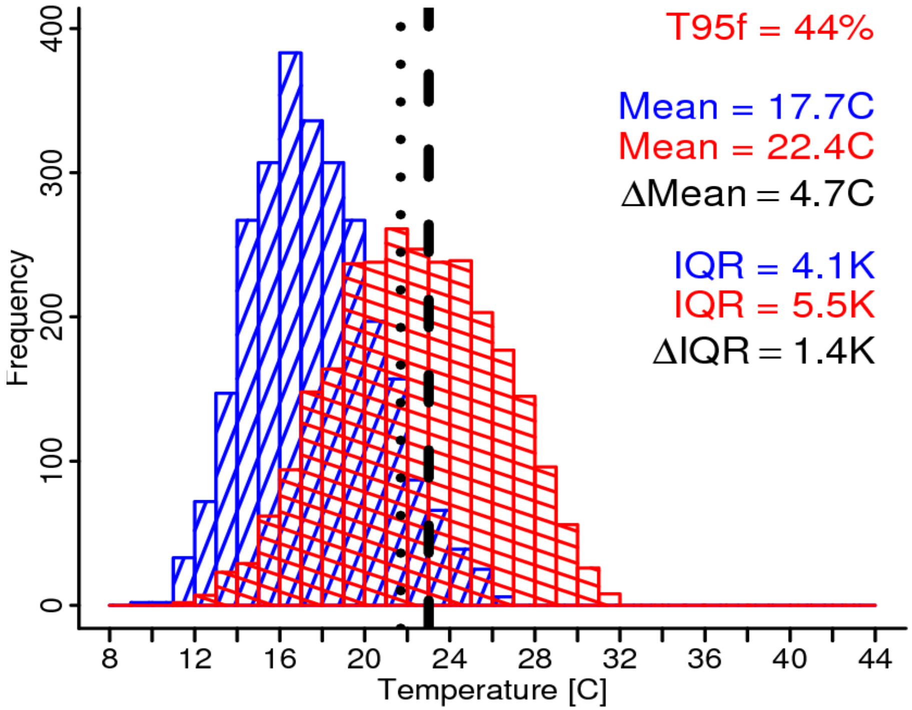


regional

Frequency of daily summer temperatures

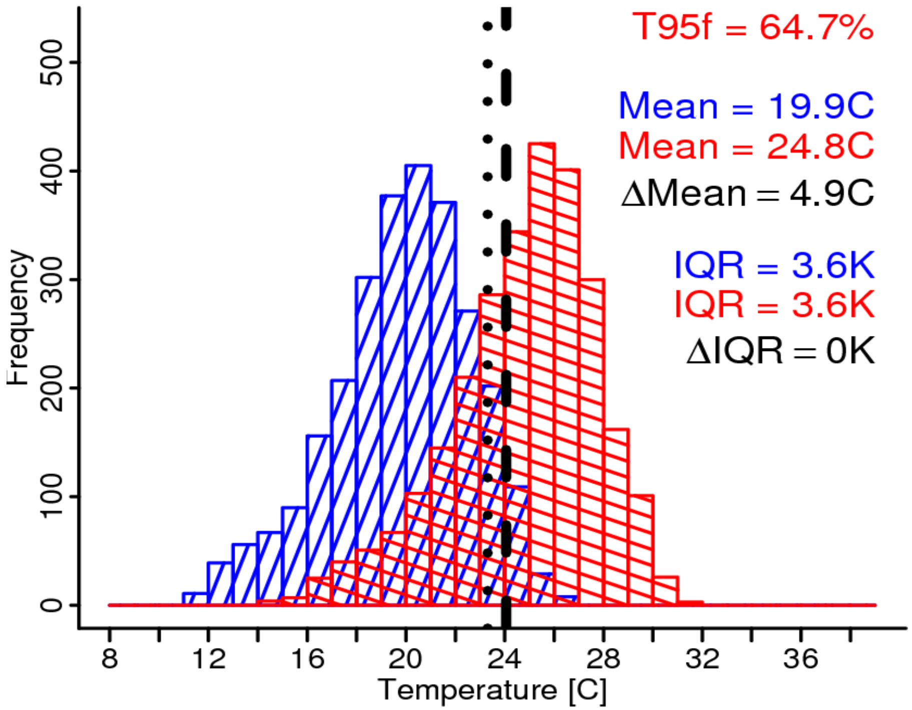
CTL: 1961-1990
SCN: 2071-2100

France



Increase in variance

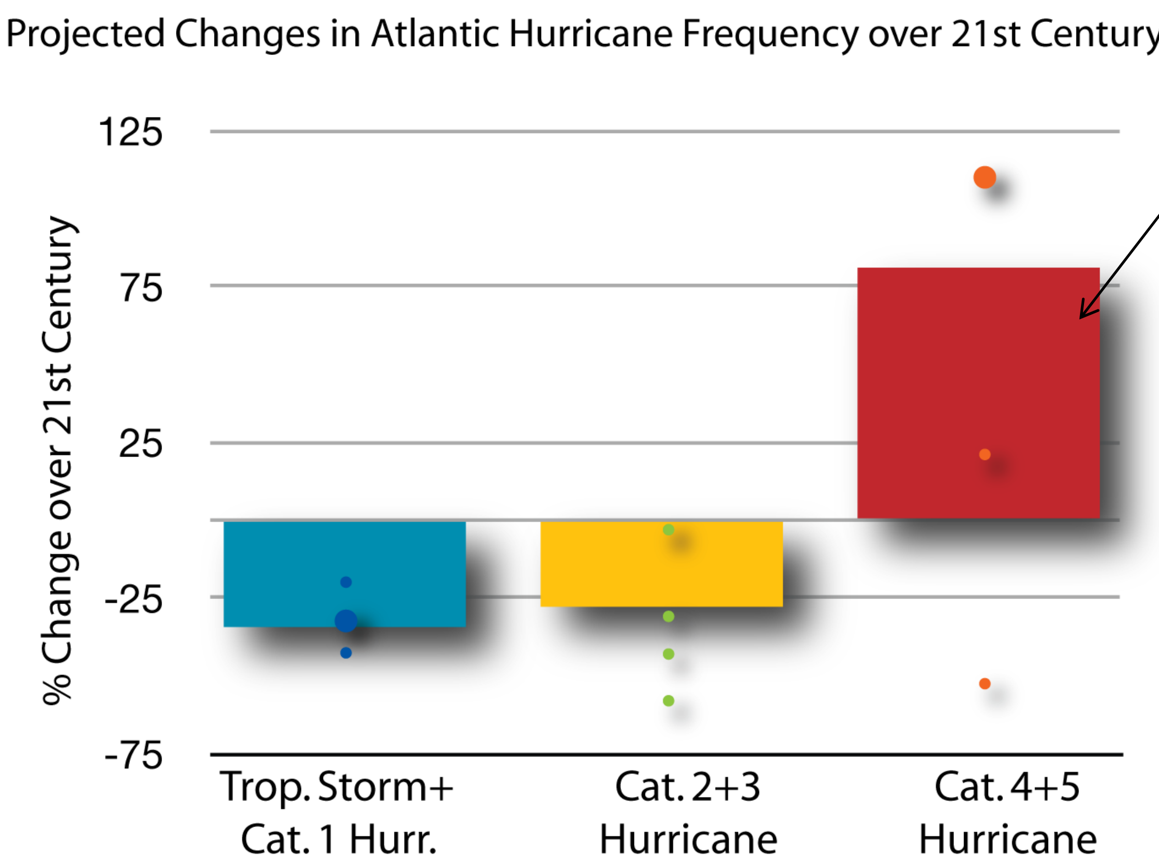
Iberian Peninsula



Increase in skewness

PRUDENCE, CHRM (ETH) model Fischer and Schär 2009; Clim. Dyn.

Atlantic Hurricanes



Cat 4+5 frequency: 81% increase, or 10% per decade

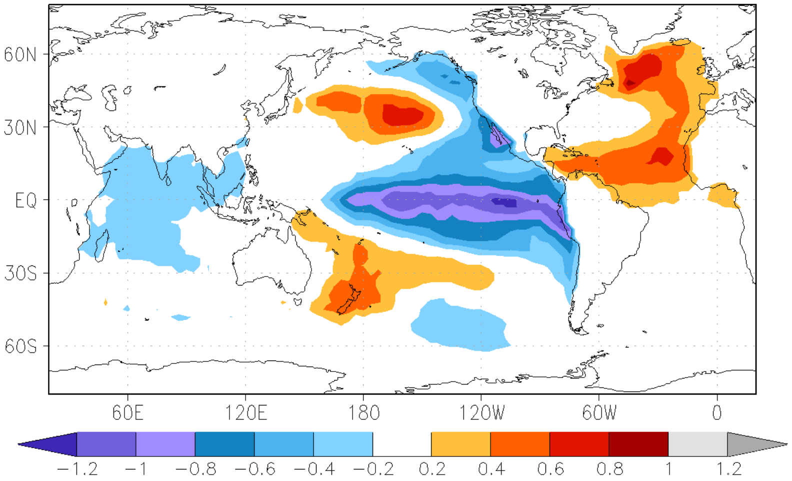
Estimated net impact of these changes on damage potential: **+28%**

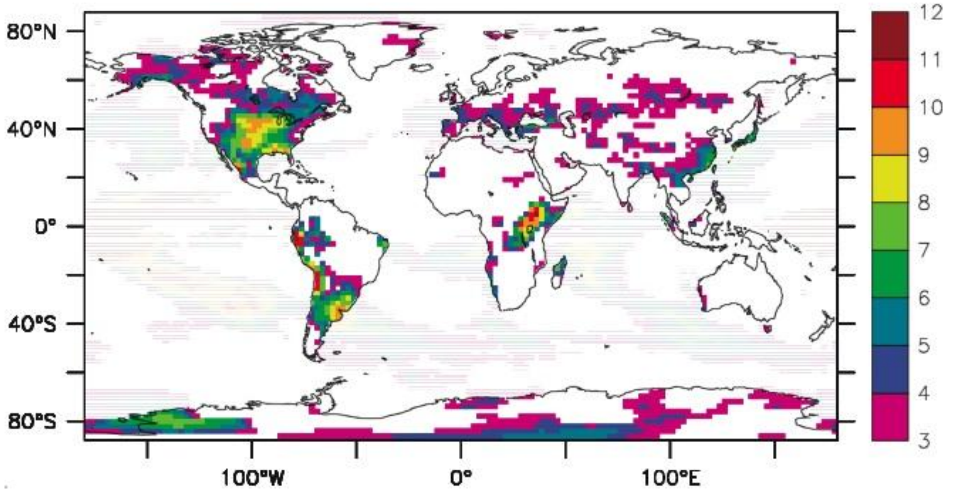
Bars show changes for the18 CMIP3 model ensemble (27 seasons); dots show range of change across 4 individual CMIP models (13 seasons).

Bender et al., *Science,* 2010

Droughts

- Climate Model Evaluation Project (DRICOMP)



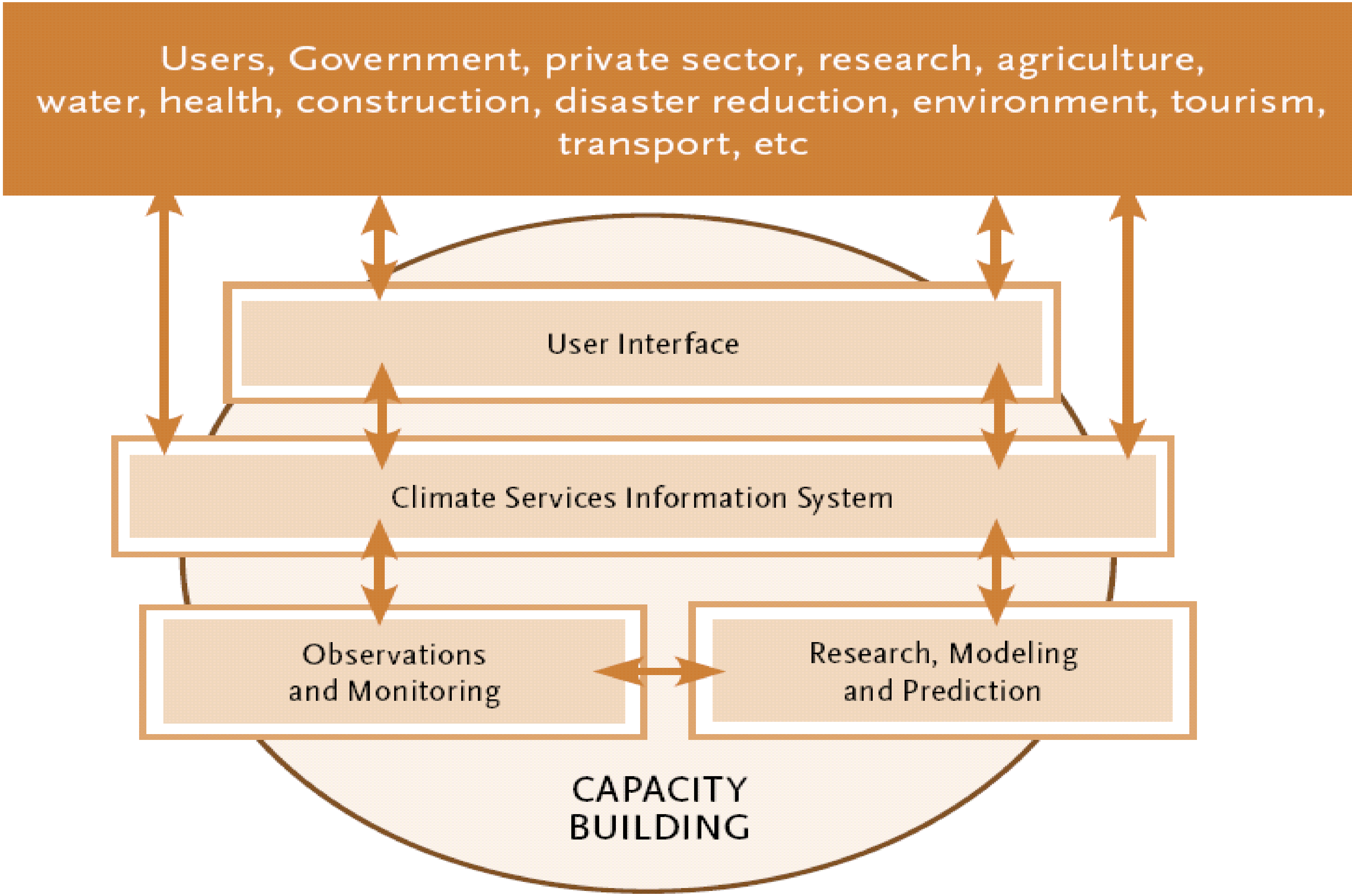


SSTA patterns

Implications for future global droughts!

Courtesy of Kirsten Findell (GFDL-NOAA-USA)

The pillars of the GFCS



Thank you for your attention

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