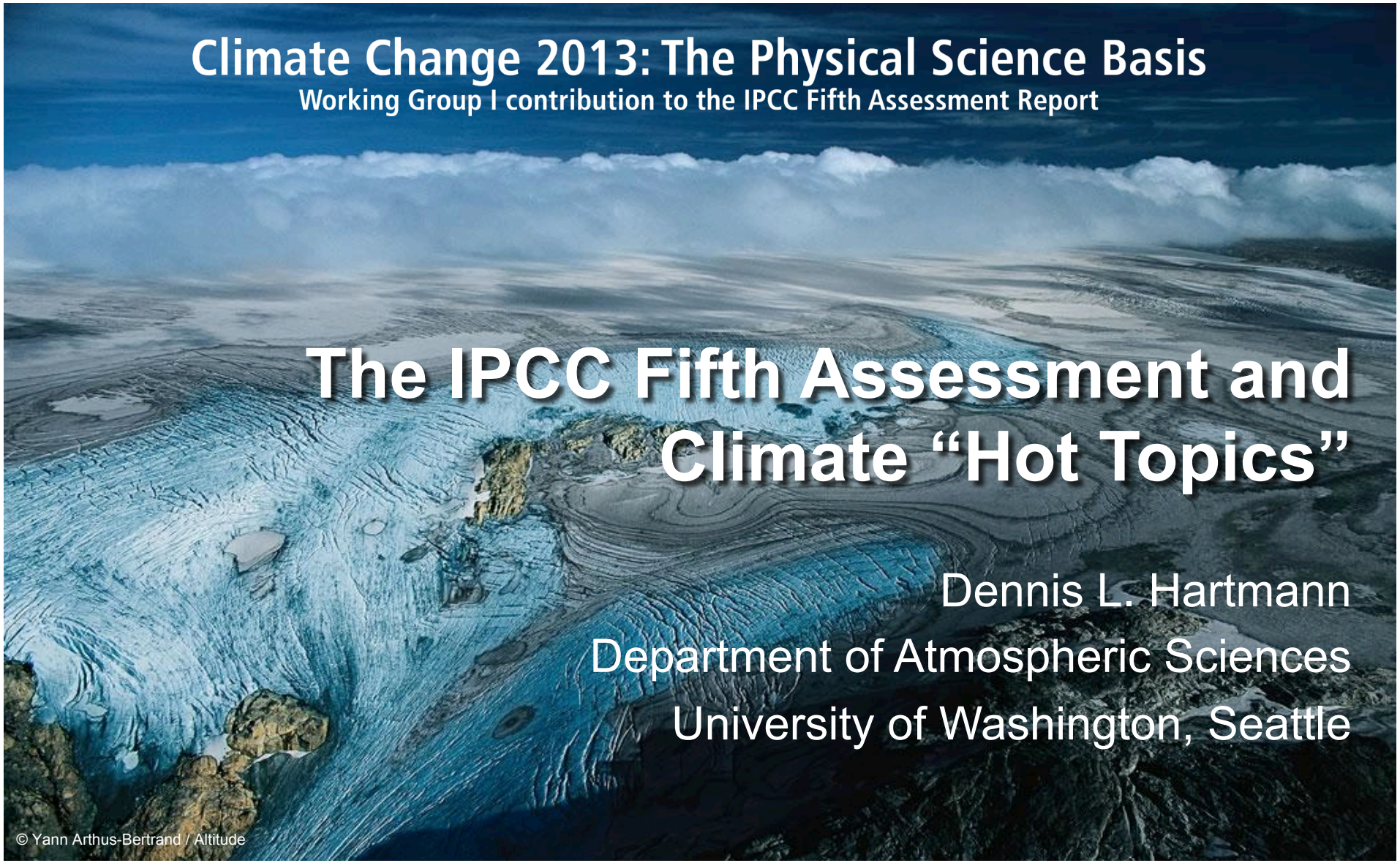


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Outline

- IPCC Introduction
- Salinity and Hydrologic Cycle Change
- CO2 release and warming relationship
- The Hiatus in Warming
- Impacts Assessment

What is IPCC?

- Intergovernmental Panel on Climate Change
- Established 1988 by UNEP and WMO.
- Task is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socioeconomic information relevant to understanding the
  - (1) scientific basis of risk of human-induced climate change,
  - (2) its potential impacts and
  - (3) options for adaptation and mitigation.

What is AR5?

- Assessment Report 5 (2014)
- FAR (1990) SAR (1995)
- TAR (2001) AR4 (2007)

Fifth Assessment Report (AR5)

The Working Group Reports and Synthesis Report will be completed in 2013/2014. The Fifth Assessment Report will be considered by the Panel according to the following timetable:

Working Group I (Stockholm, Sweden)	23-26 September 2013
Working Group II (Yokohama, Japan)	25-29 March 2014
Working Group III (Berlin, Germany)	7-11 April 2014
Synthesis Report (Copenhagen, Denmark)	27-31 October 2014

Key SPM Messages

19 Headlines

on less than 2 Pages

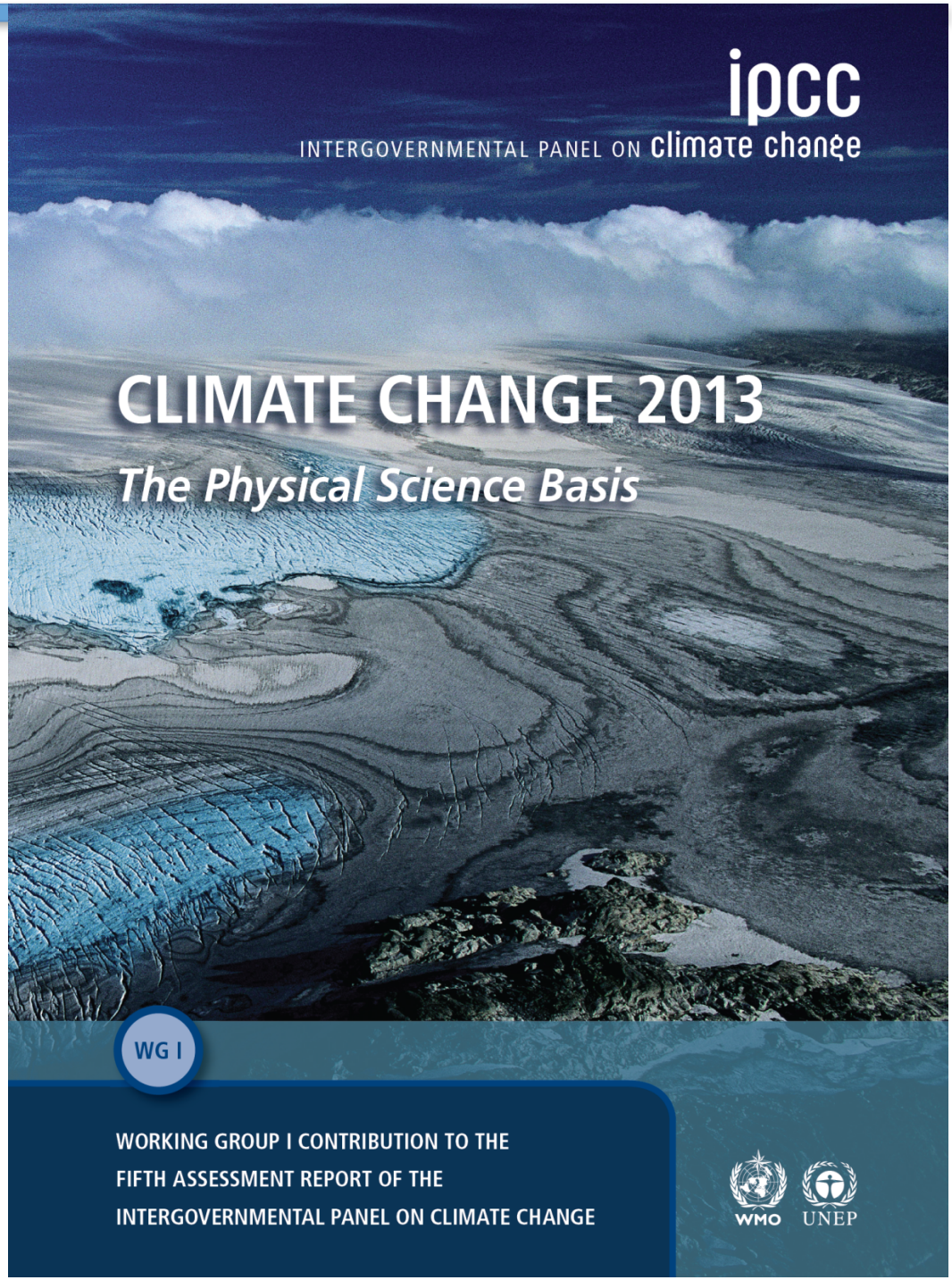
Summary for Policymakers
~14,000 Words

14 Chapters
Atlas of Regional Projections

54,677 Review Comments
by 1089 Experts

2010: 259 Authors Selected

2009: WGI Outline Approved



First Lead Author Meeting – November 2010
Kunming, China

12th Session of Working Group I of IPCC
36th Session of the Panel
Approval and Acceptance of AR5 WG I

Stockholm, Sweden 23-26 September 2013

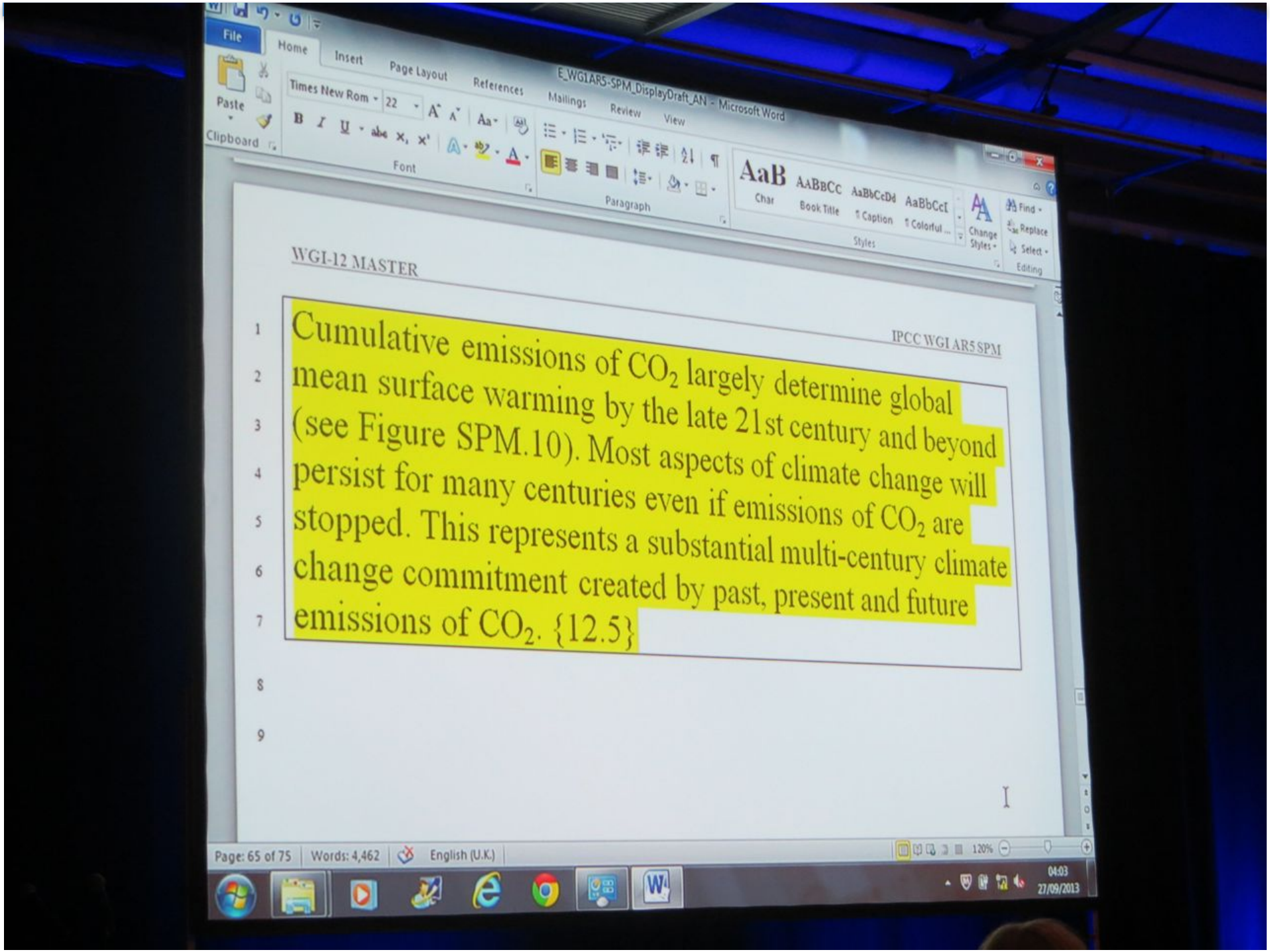
Munich Brewery, Stockholm


Main Hall: The Brewery


SOUTH AFRICA


SRI LANKA
SOUTH AFRICA

Co-Chairs, TSU and Authors


File
Home
Insert
Page Layout
References
Mailings
Review
View
E_WGIAR5-SPM_DisplayDraft_AN - Microsoft Word
Paste
Clipboard
Times New Rom
22
Font
Paragraph
Styles
Find
Replace
Select
Editing
WGI-12 MASTER
IPCC WGI AR5 SPM
Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond (see Figure SPM.10). Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped. This represents a substantial multi-century climate change commitment created by past, present and future emissions of CO_2. {12.5}
Page: 65 of 75
Words: 4,462
English (U.K.)
120%
04:03
27/09/2013


AUSTRALIA
ARMENIA


SAUDI ARABIA


CO-CHAIR WG I
CO-CHAIR WG I

Key SPM Messages

19 Headlines

on less than 2 Pages

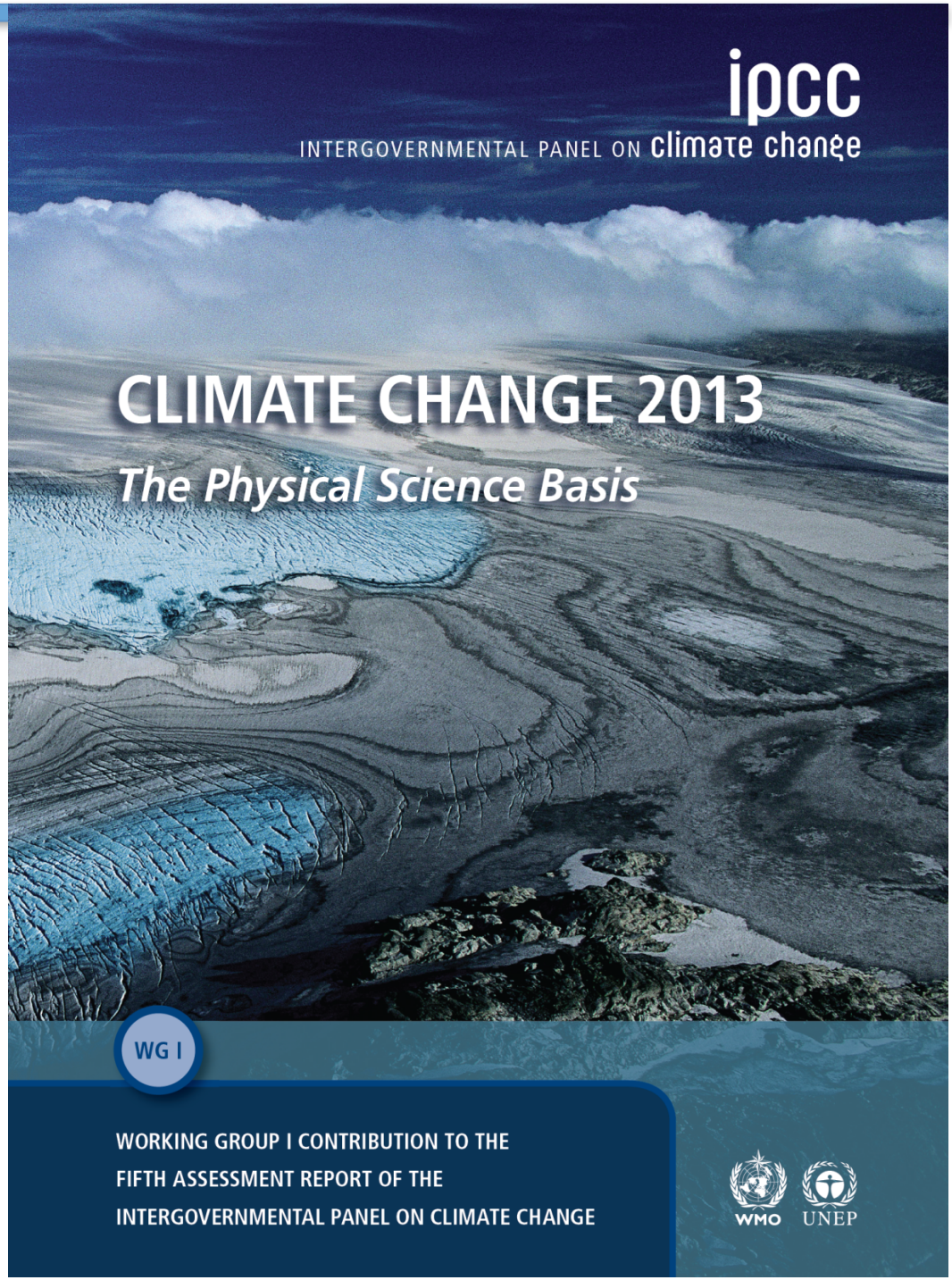
Summary for Policymakers
~14,000 Words

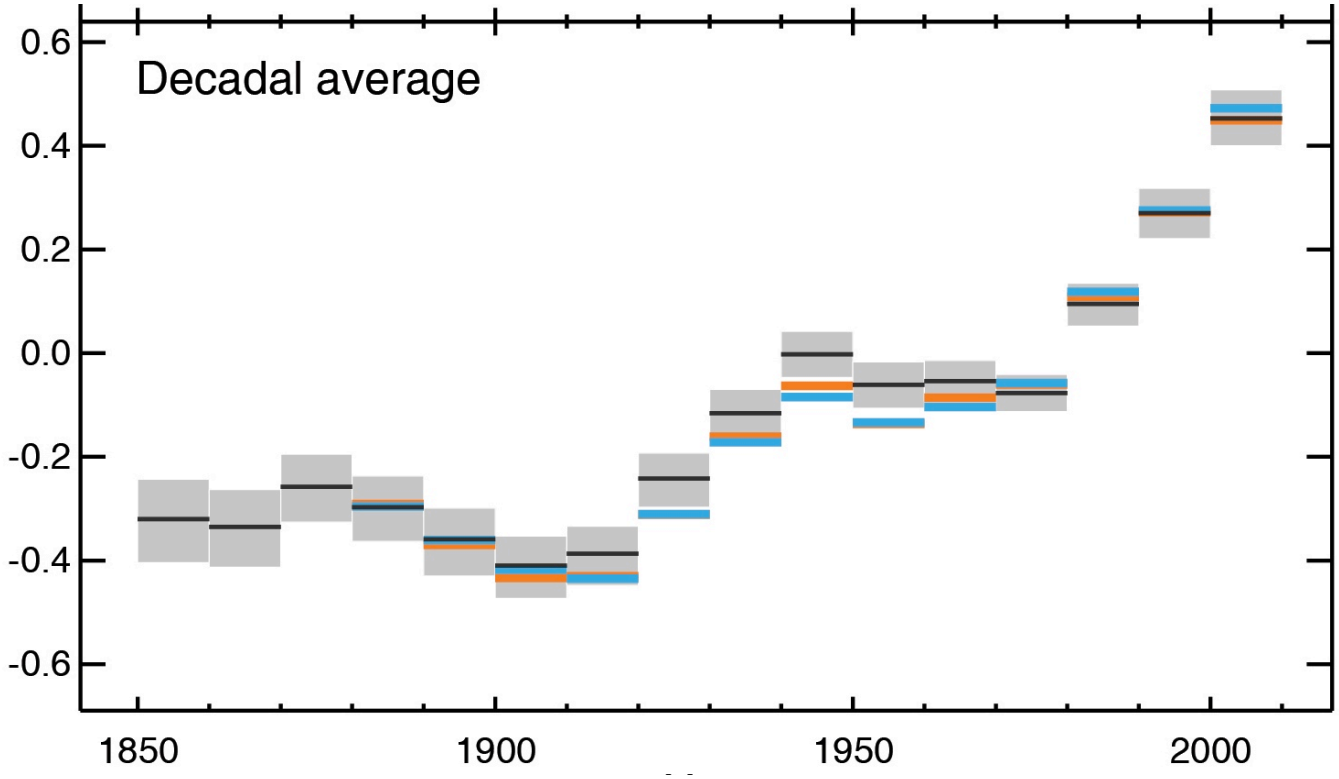
14 Chapters
Atlas of Regional Projections

54,677 Review Comments
by 1089 Experts

2010: 259 Authors Selected

2009: WGI Outline Approved

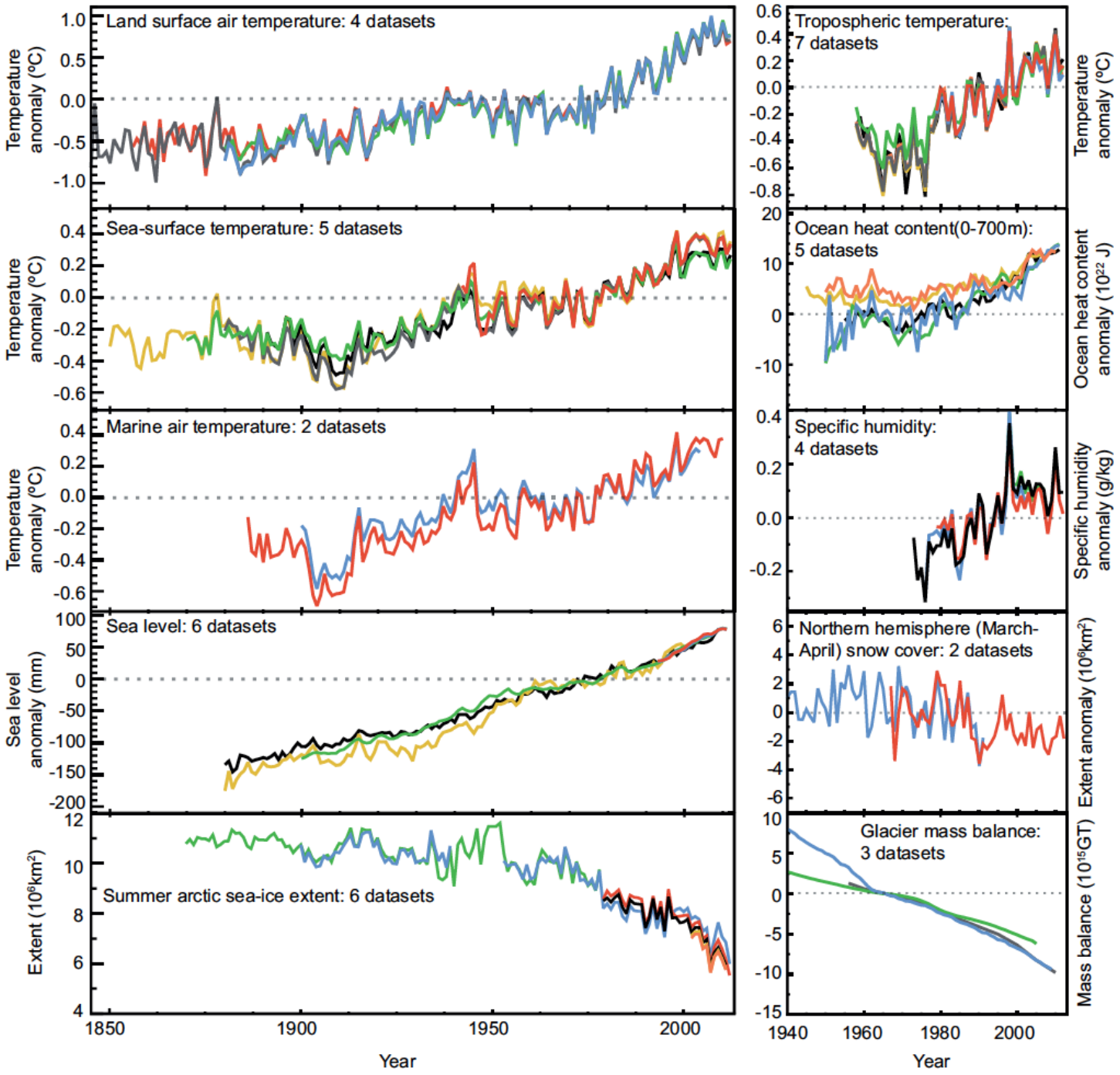




(IPCC 2013, Fig. SPM.1a)

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*).

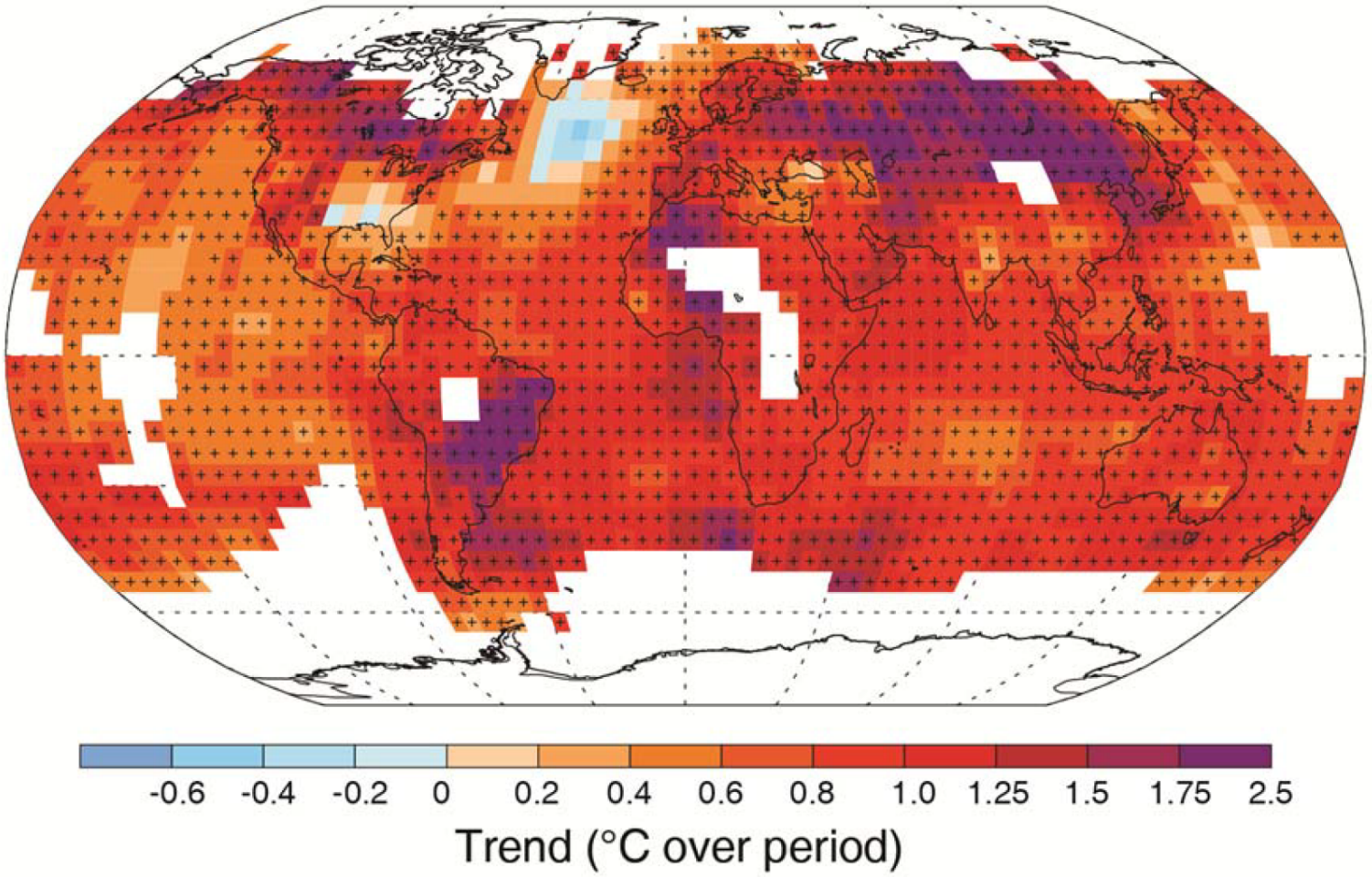


Evidence of warming is apparent in many independent data sources and analyses.

Fig TS-1

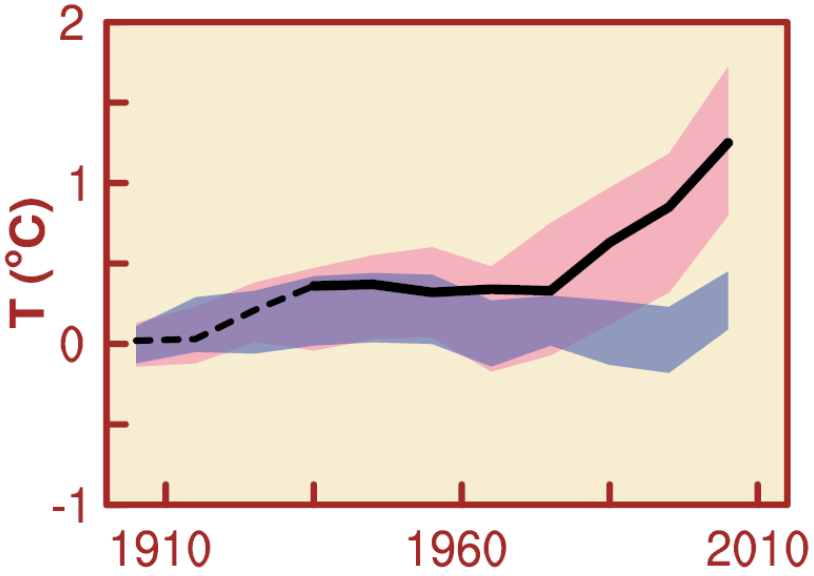
ipcc
te change

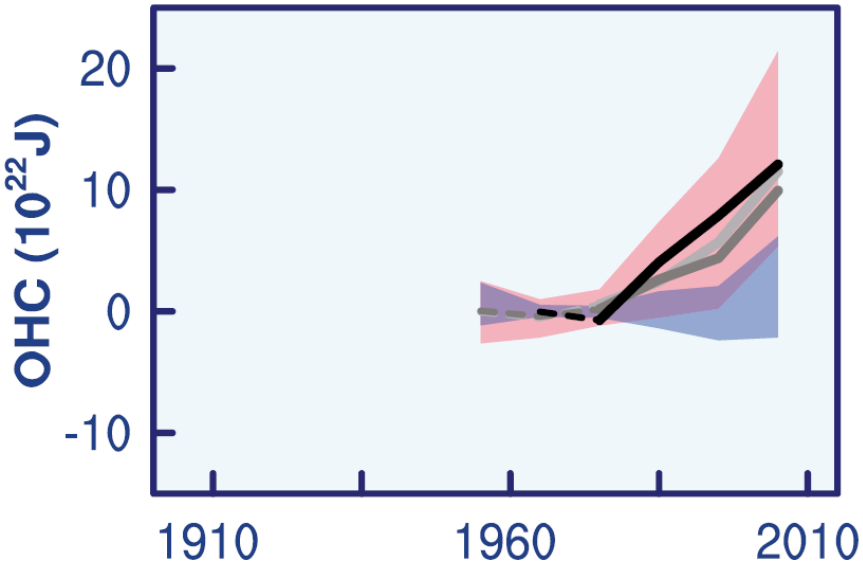
WMO UNEP



(IPCC 2013, Fig. SPM.1b)

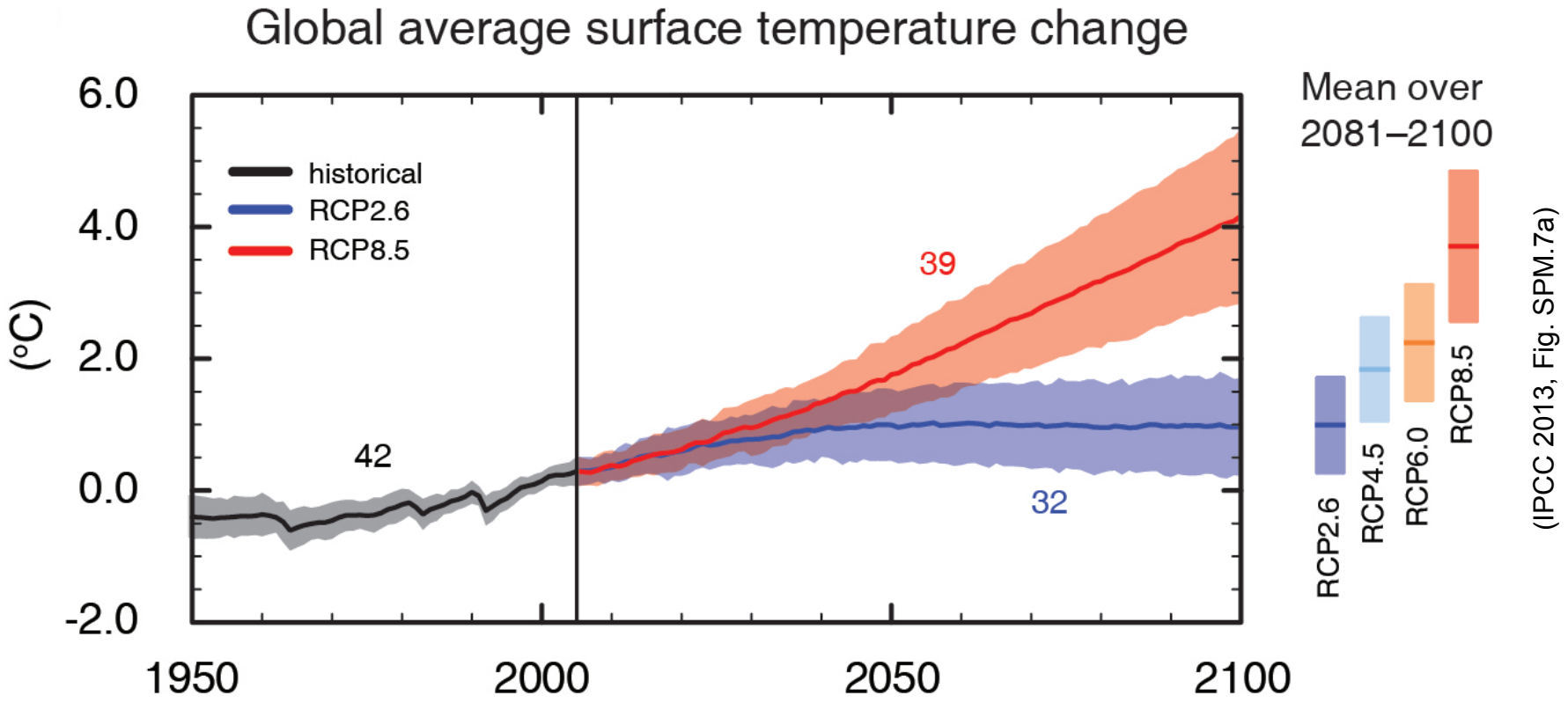
Warming in the climate system is unequivocal



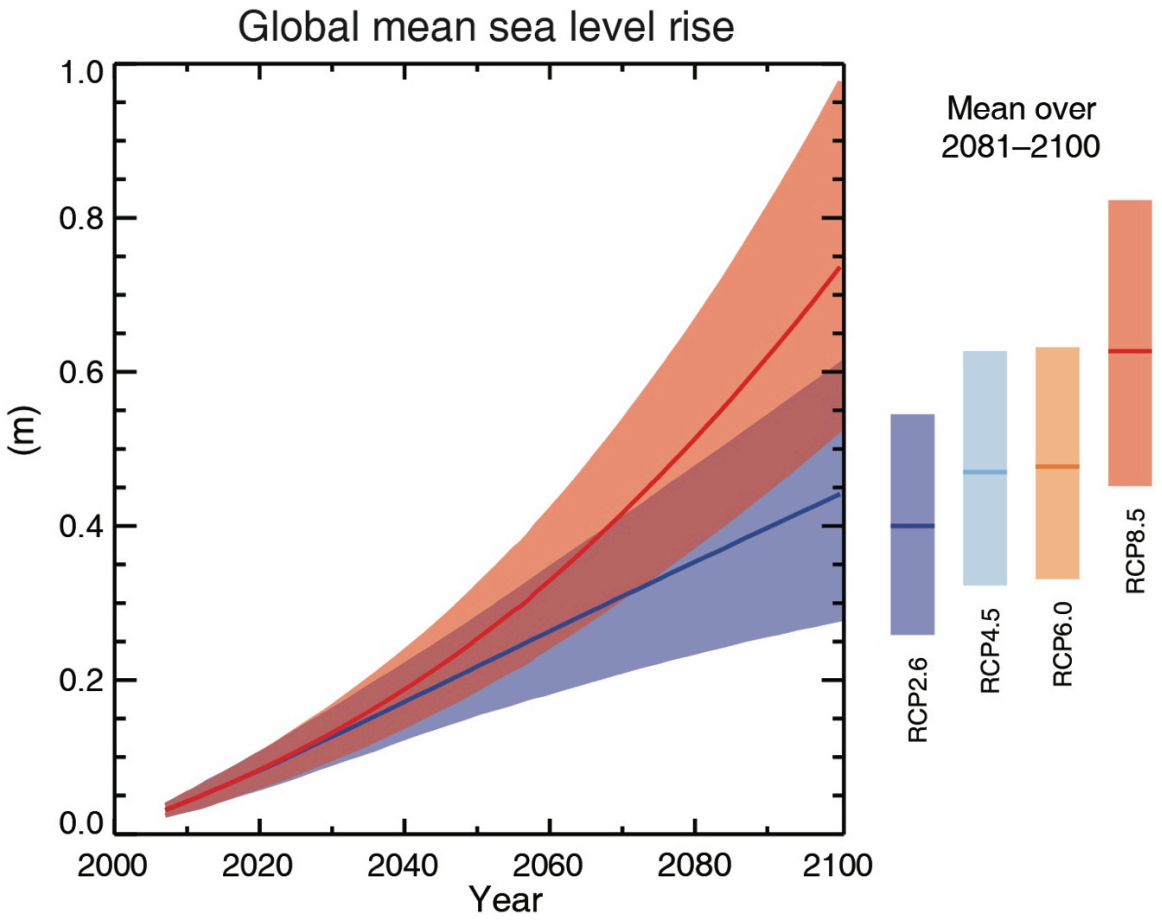


(IPCC 2013, Fig. SPM.6)

Human influence on the climate system is clear

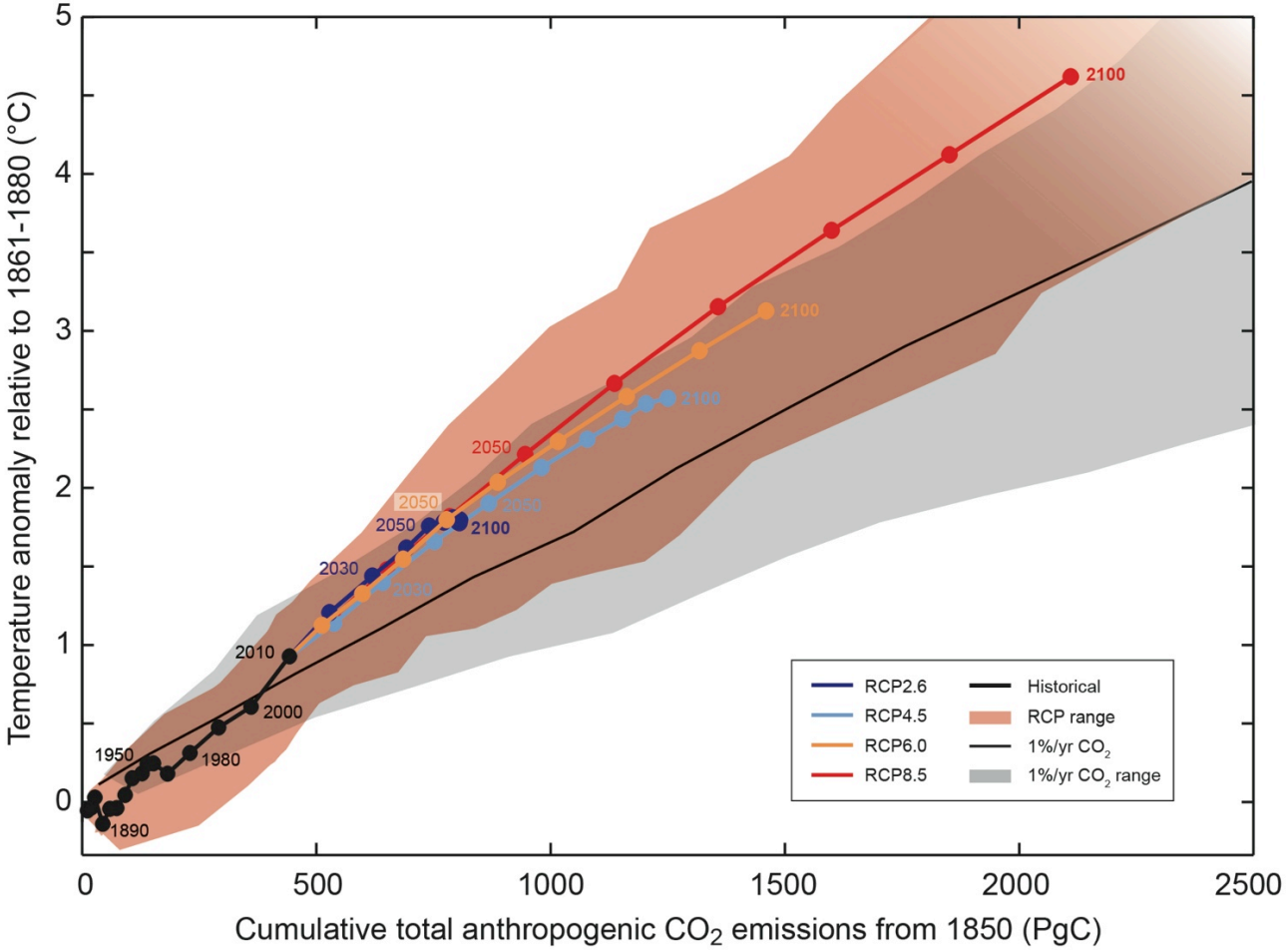


Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 for all scenarios



(IPCC 2013, Fig. SPM.9)

Global mean sea level will continue to rise during the 21st century

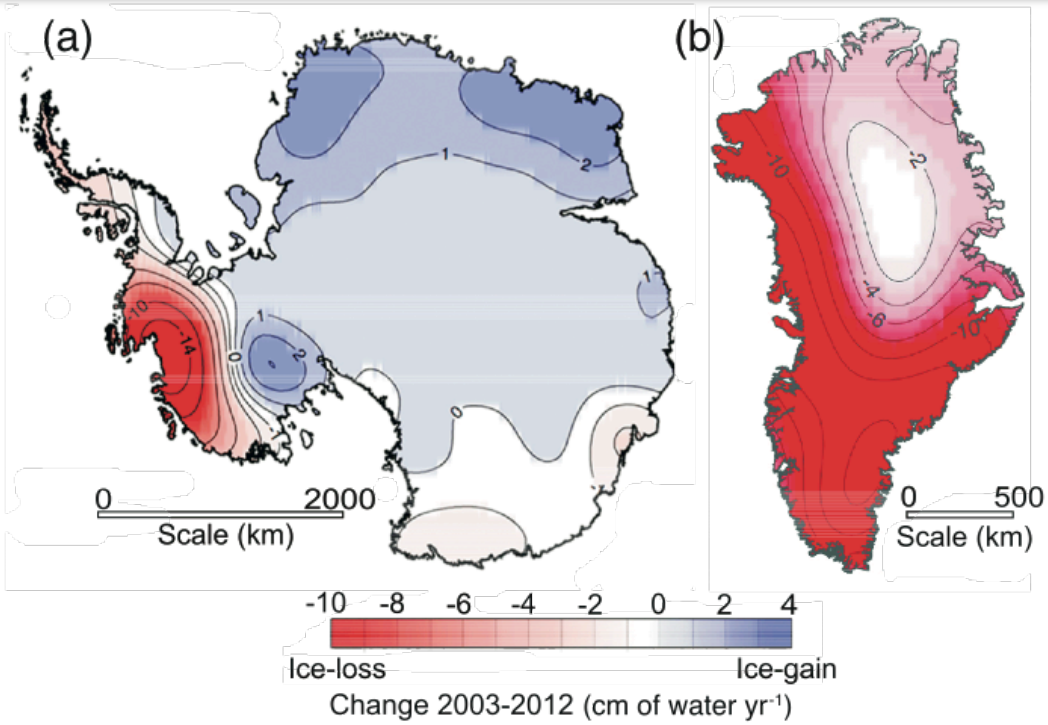


(IPCC 2013, Fig. SPM.10)

Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions

Sea level and Ice

Models and Paleo-data suggest that a warming of 2˚C will result in the eventual complete melting of the Greenland Ice Sheet - DLH



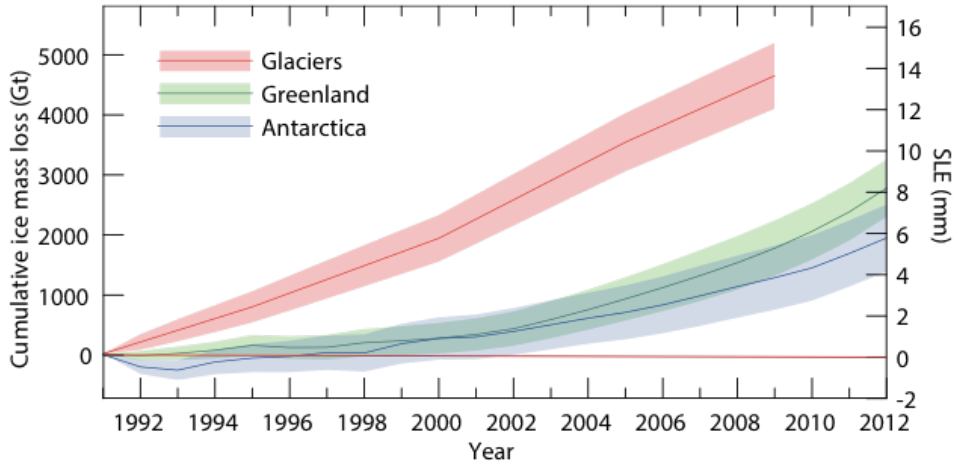


Fig TS-3

Salinity Trends

Trends in Salinity look similar to the mean salinity pattern.
Is this the first observational verification of the wet-gets-wetter, dry-gets-dryer prediction of climate models?

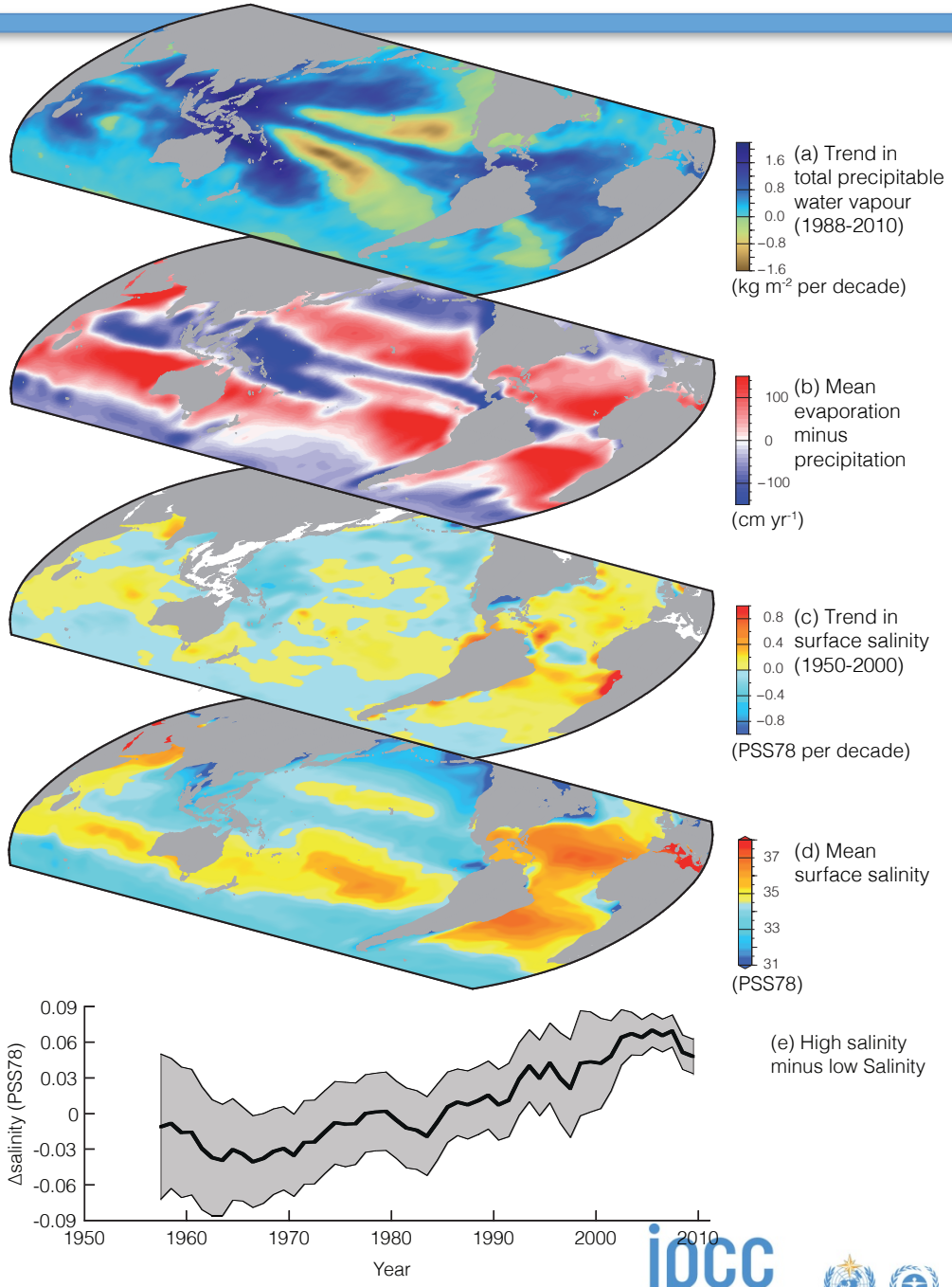


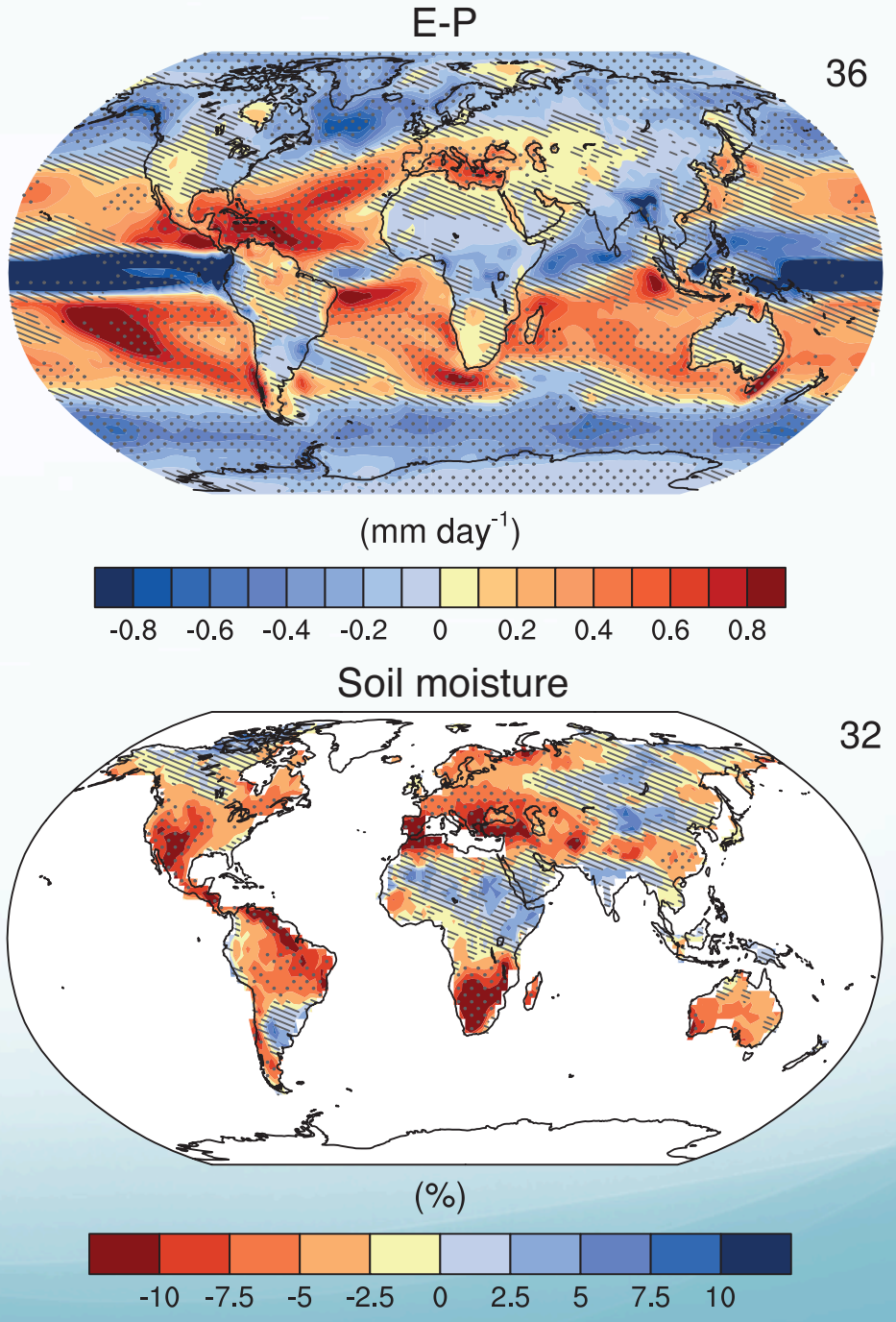
Fig TFE-1-1

Subtropics get more dry

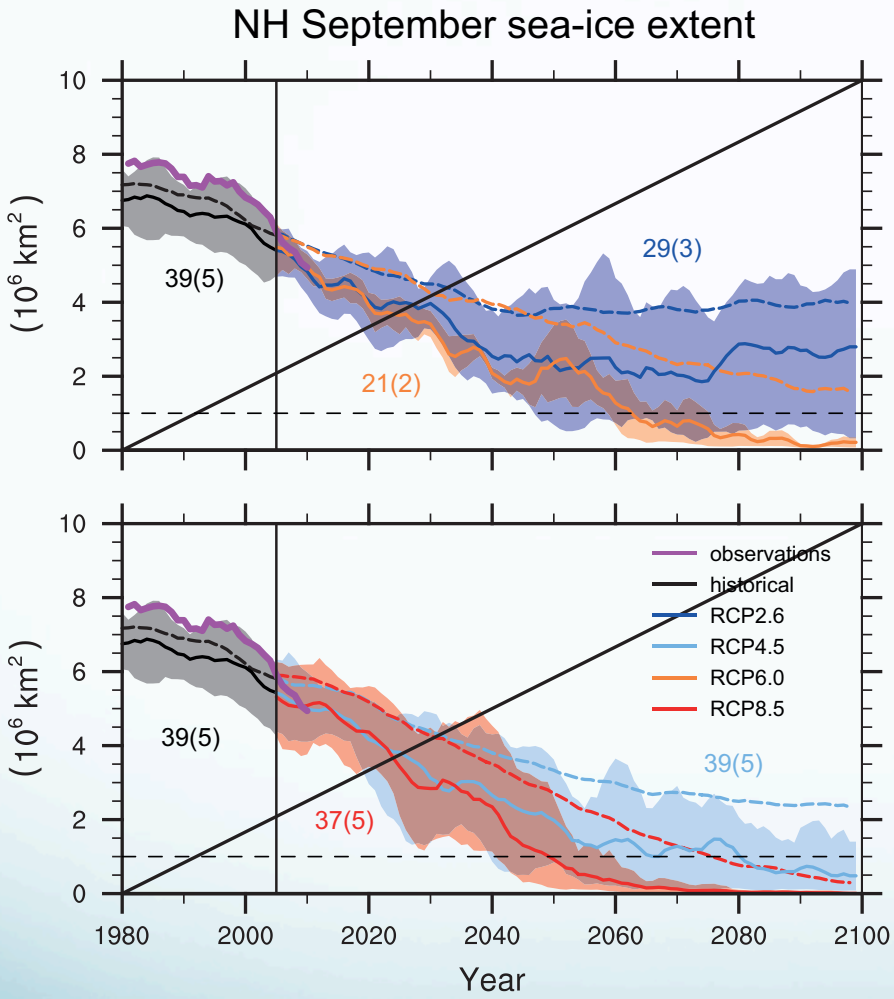
Equatorial and high latitudes get wetter

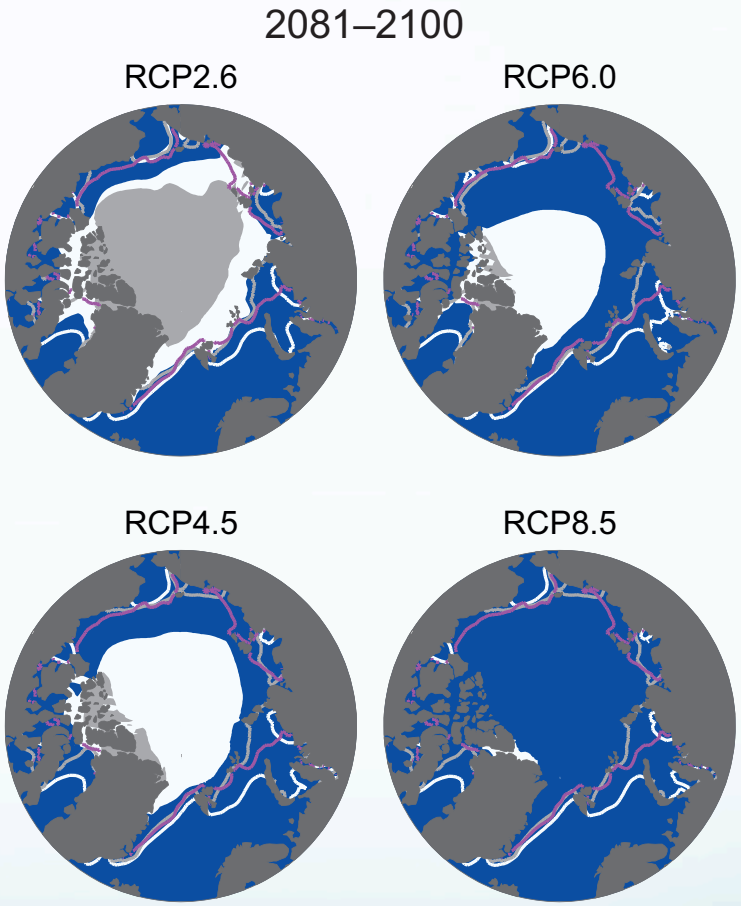
Projections for 2081-2100 RCP 8.5 minus present

Some land areas are projected to become significantly drier



Arctic Sea Ice

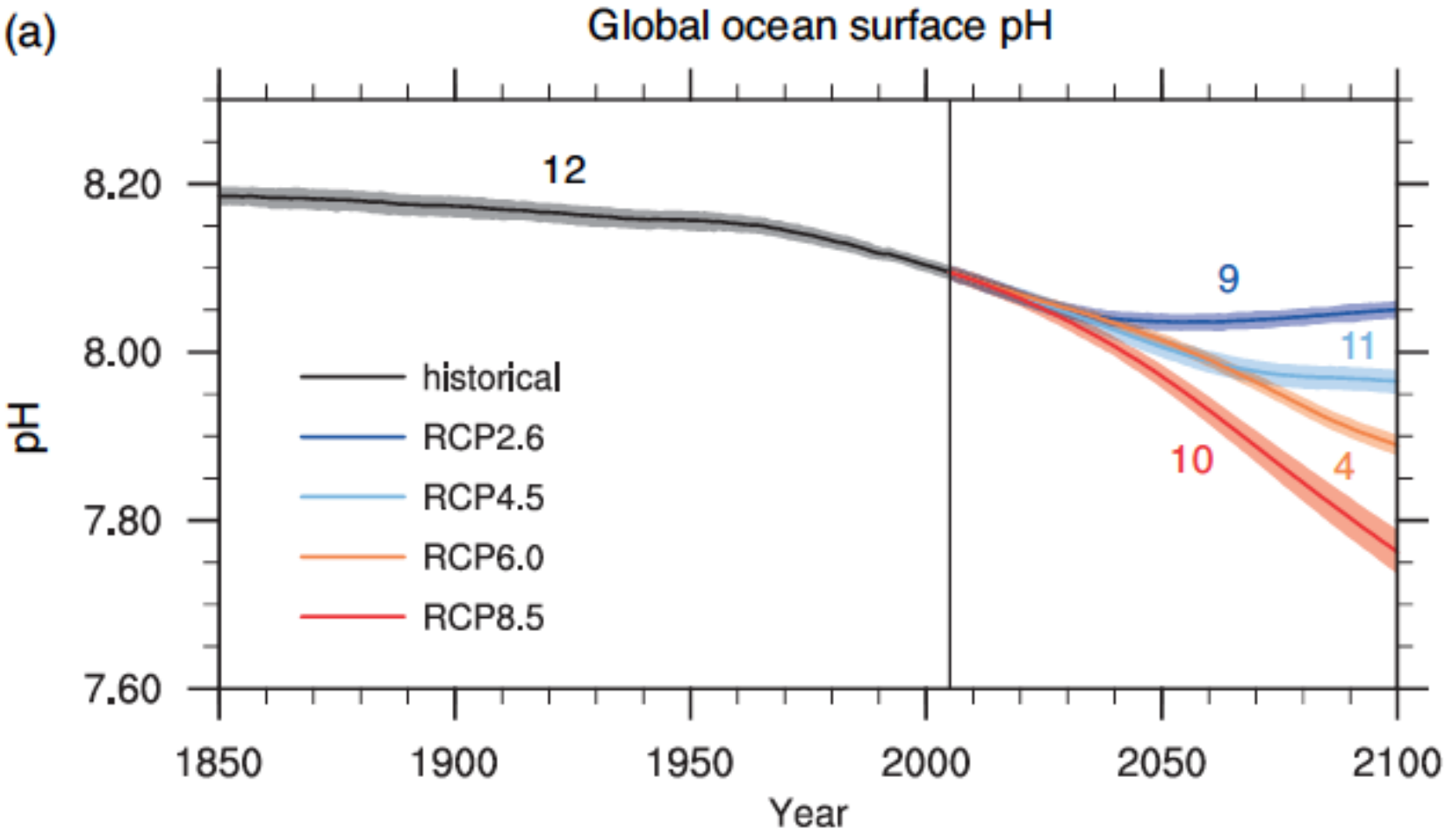




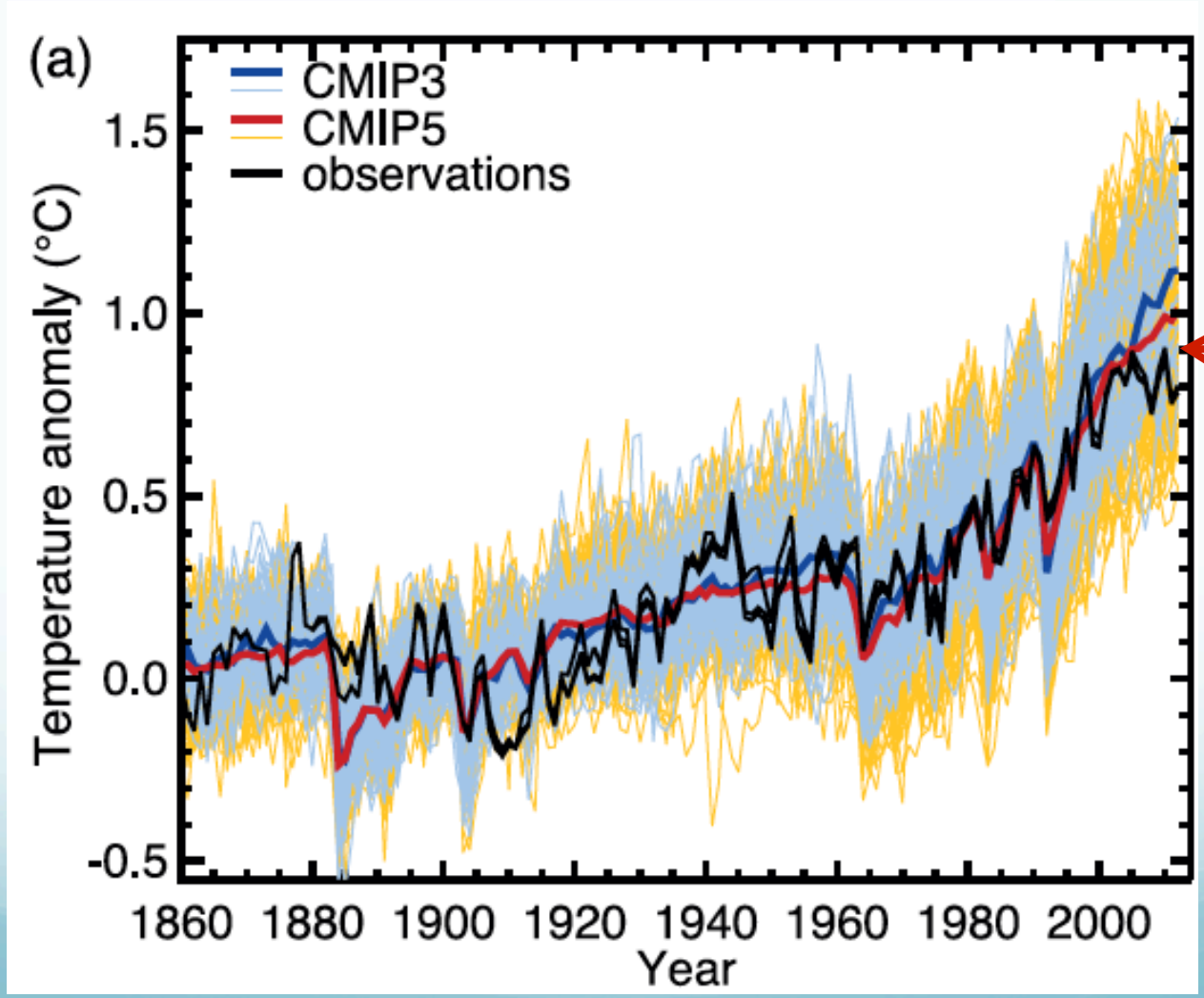
It is likely that the Arctic Ocean will be ice free by 2050 if we stay on current path toward greenhouse gas increases

IPCC AR5 TS-17

Ocean Acidification



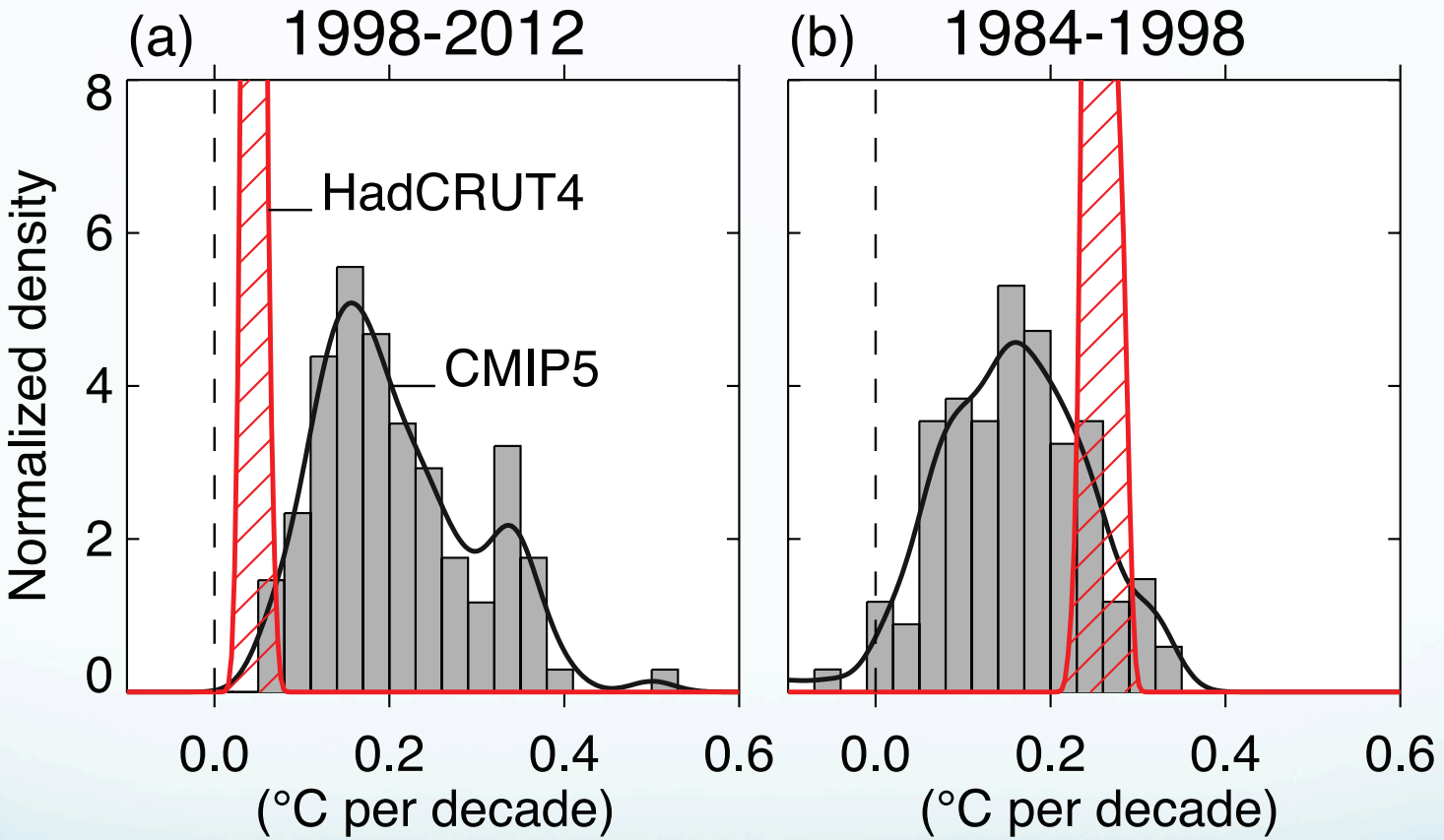
The “Hiatus”
Reduced warming since ~1998



The Hiatus Gap

IPCC AR5 WG I Fig. 10.1

Models suggest that the reduced trend is significant

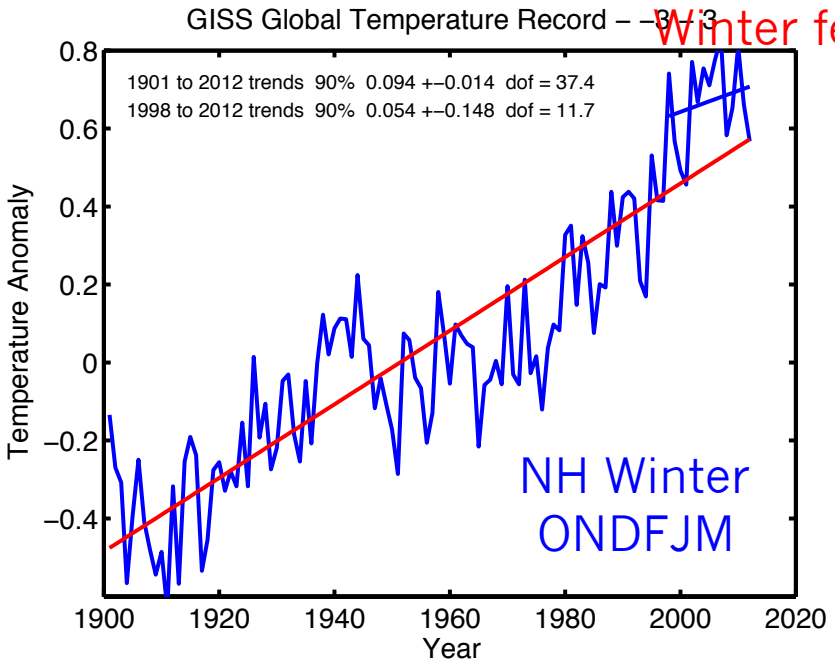


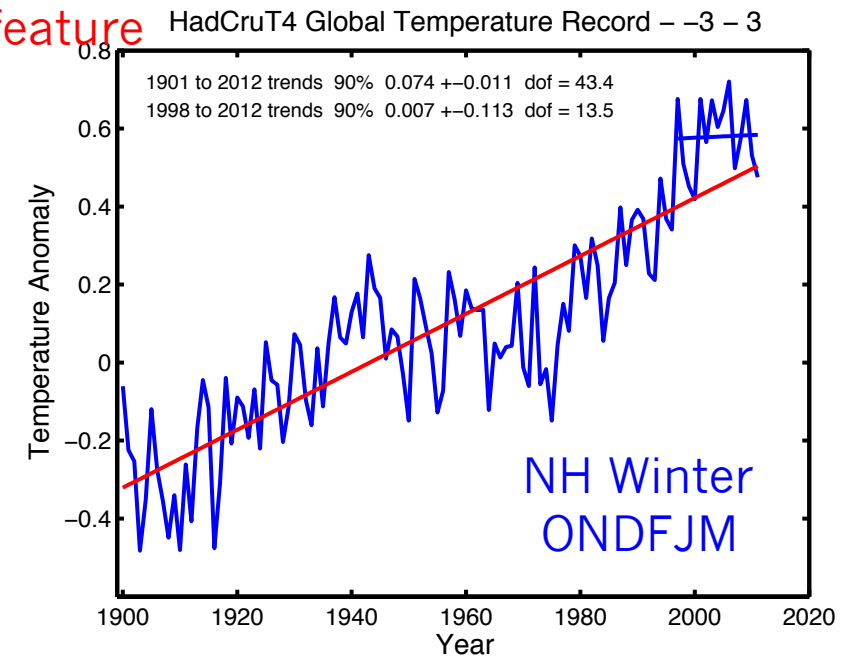
For 1998-2012, the observed trend (HadCRUT4) is nearly outside the range of trends produced by the CMIP5 model ensemble

GISSTEMP

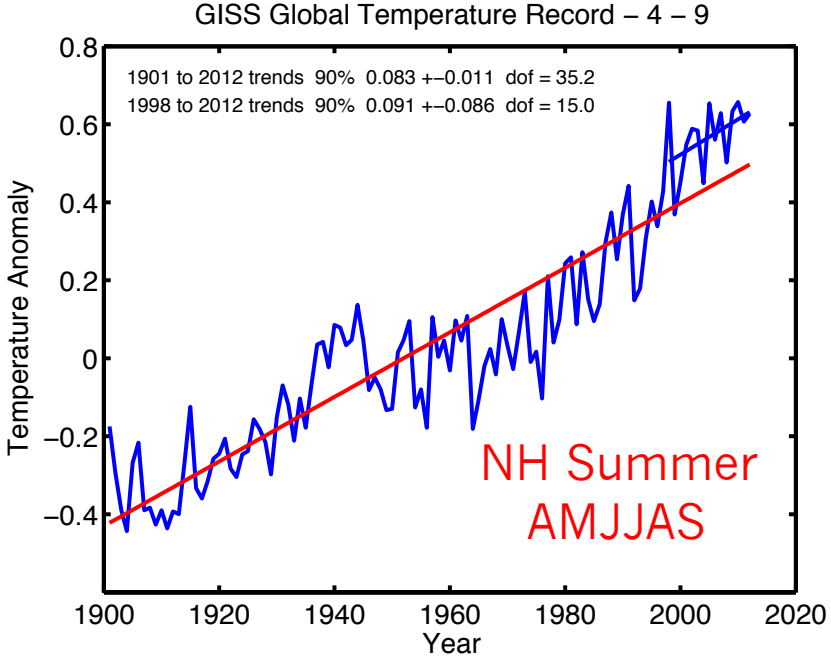
Hiatus is NH Winter feature

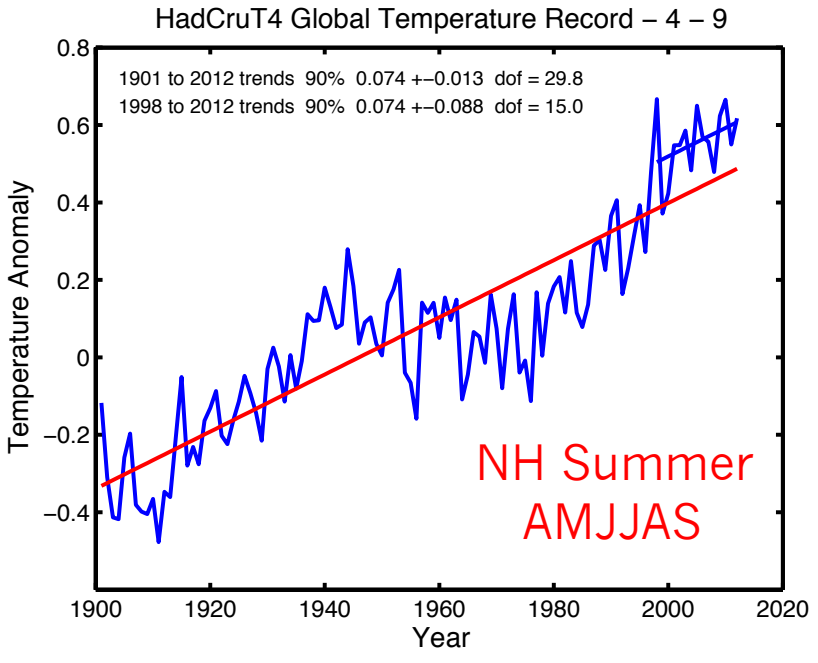
HadCRUT4





October to March

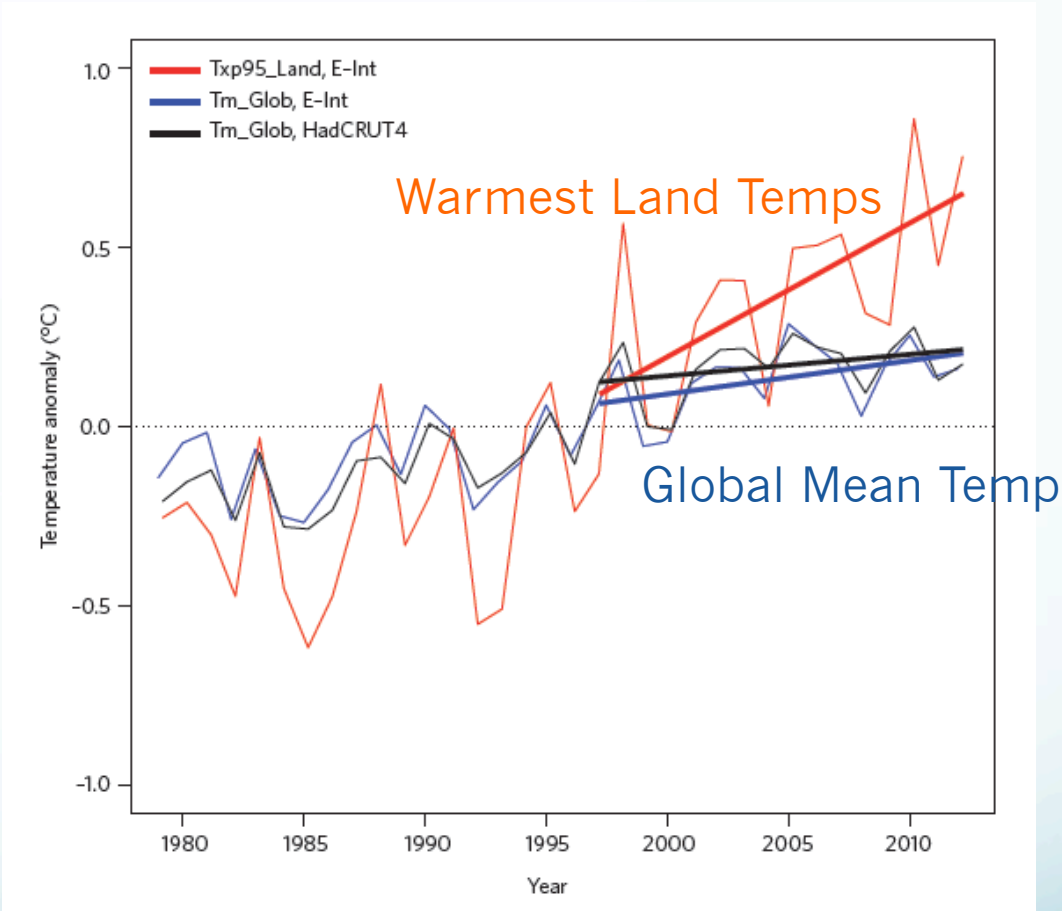




April to September

Warm Extremes over Land

The warmest 5% of land temperatures has continued to increase since 1998.



Seneviratne et al. 2014, Nature Climate Change

Figure 2 | Time series of temperature anomalies for hot extremes over land (red) and global mean temperature (black, blue). The anomalies are computed with respect to the 1979–2010 time period. The time series are based on the ERA-Interim 95th percentile of the maximum temperature over land (Txp95_Land, red) and the global (ocean + land) mean temperature (Tm_Glob) in ERA-Interim (blue) and HadCRUT4 (black). (See Supplementary Information for details.)

Proposed Explanations for 'The Hiatus'

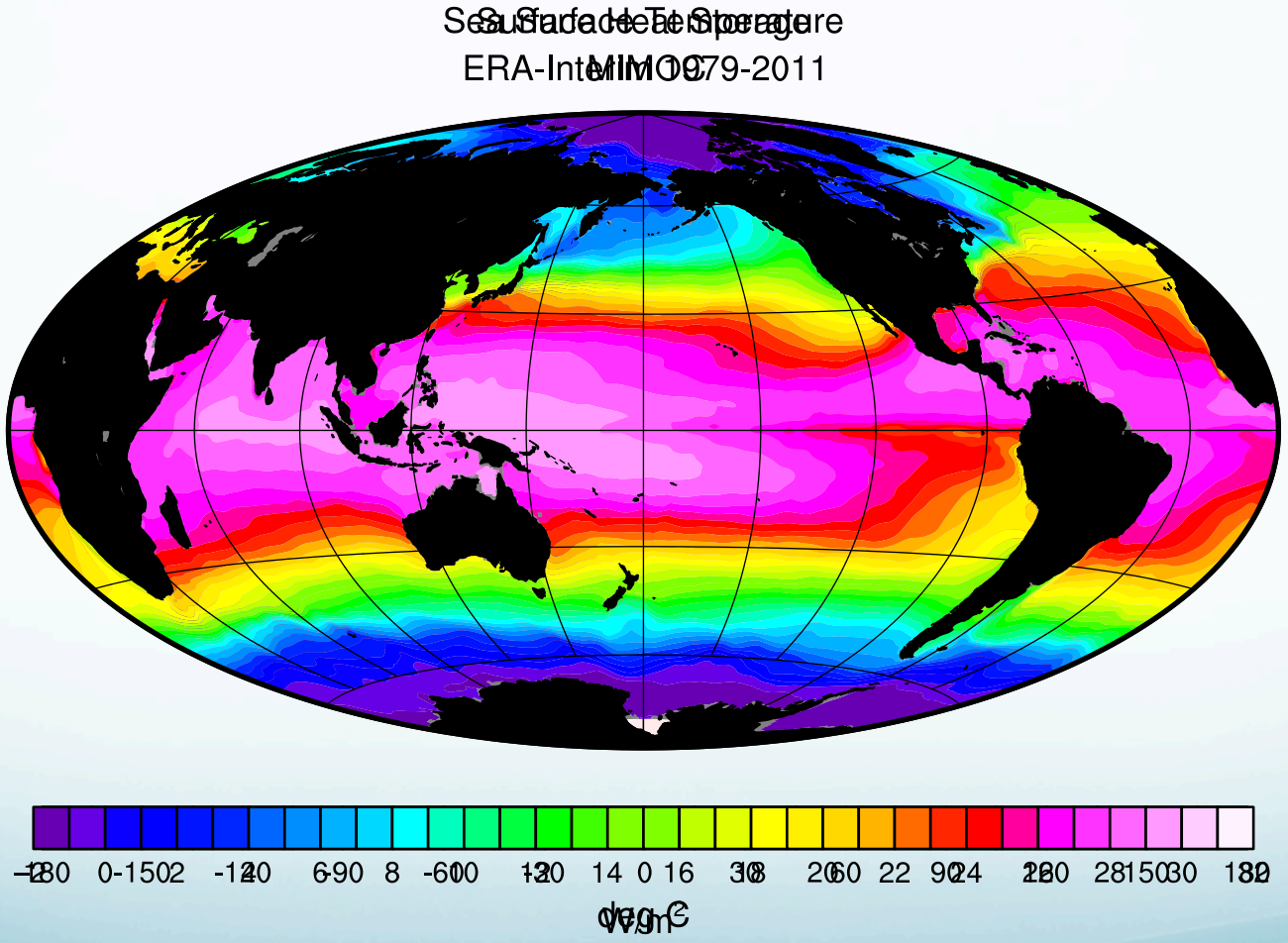
- Reduced Solar output
  - Solar cycle declined over 2000-2011 ~ -0.1 Wm^{-2}
- Increased volcanic activity
  - A few small volcanic eruptions occurred that were not in natural forcing used by models ~ -0.06 Wm^{-2}
- Less water vapor in Stratosphere
  - Reduced greenhouse effect of water very high in the atmosphere, argued to explain ~25% of Klimapause
- Natural Variations in the rate at which the ocean takes up heat
  - Equatorial Pacific – La Niña Trend
  - North Atlantic – Increased downward mixing of heat by the Atlantic Meridional Overturning Circulation.

What are we looking for?

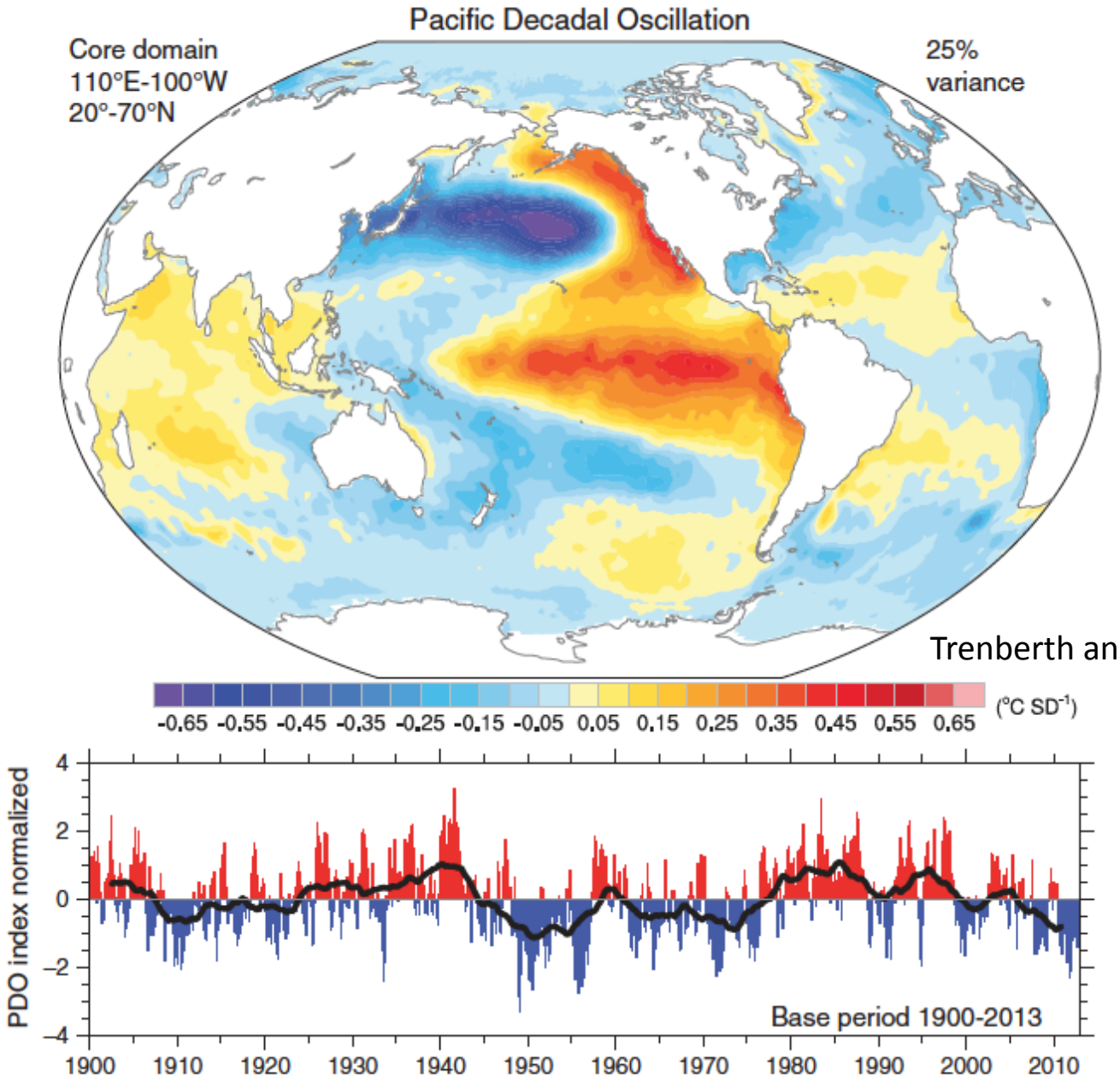
- The net imbalance at the top of the atmosphere that is causing the current warming, is estimated to be about 0.6 Wm^{-2} averaged over the surface of Earth.
- To stop the warming, we need to reduce the imbalance by about that much, either by reducing the top of atmosphere energy imbalance, or by increasing the rate of heat storage in the ocean.
- 'Found" forcing changes just discussed are too small to do the job, so we look to changes in the rate at which the ocean takes up heat

Heat uptake by Ocean

- Historical Averages



Red means the ocean is being heated, Blue that it is being cooled

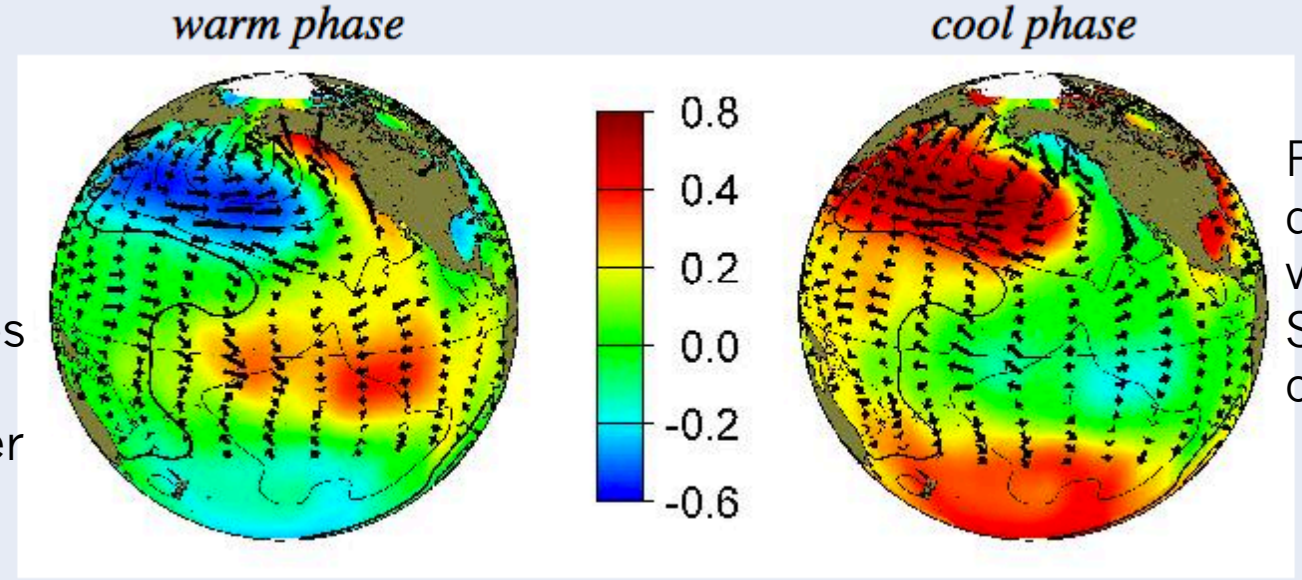


Trenberth and Fasullo, 2014

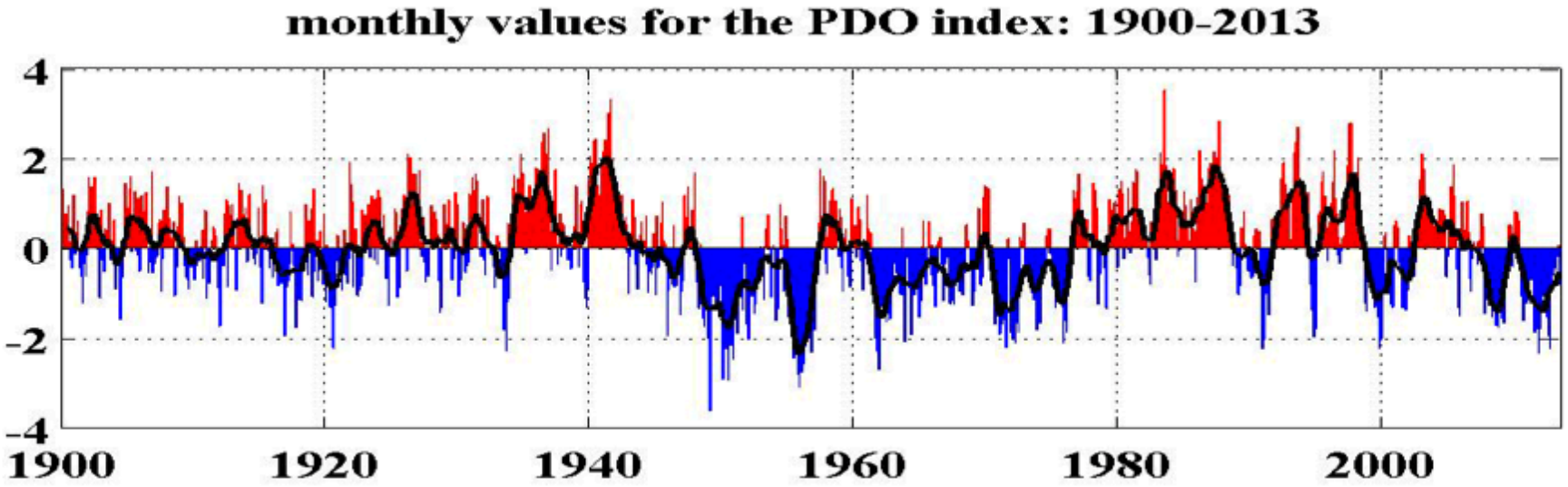
Figure 8. The Pacific Decadal Oscillation based on an EOF analysis of SST anomalies with the global mean removed from 1900 to May 2013 in the 20°N–70°N and 110°E–100°W region of the North Pacific, which explains 25% of the variance. The principal component time series, given below in normalized units, is regressed on global SSTs to give the map above. The black curve is a 61 month running average.

PDO – Pacific Decadal Oscillation in DJF

SST and Surface Wind Anomalies during NH Winter



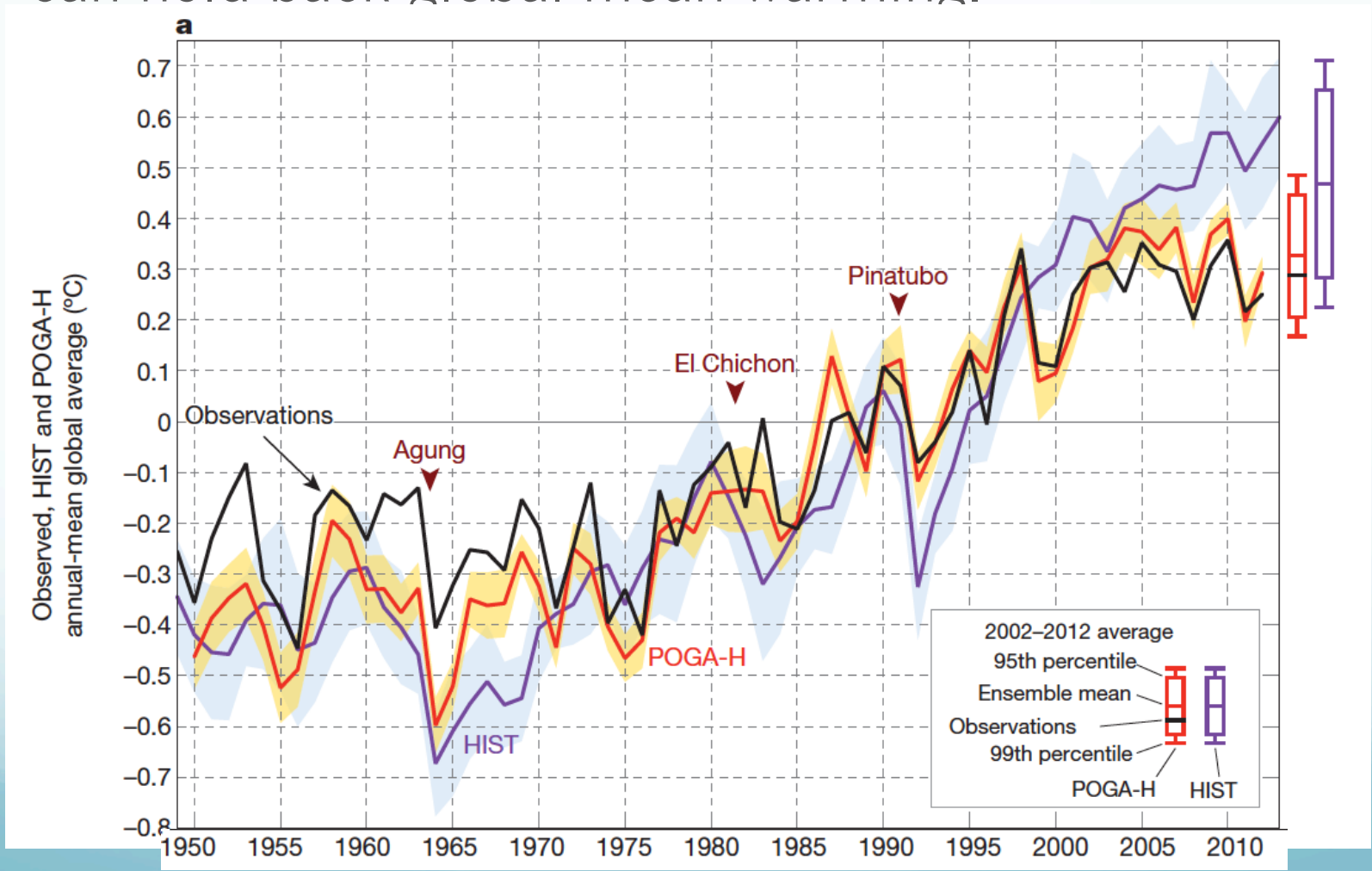
PDO is dominant variation of SST poleward of 20N



Recent trend toward cool phase of PDO

Global Mean Trends

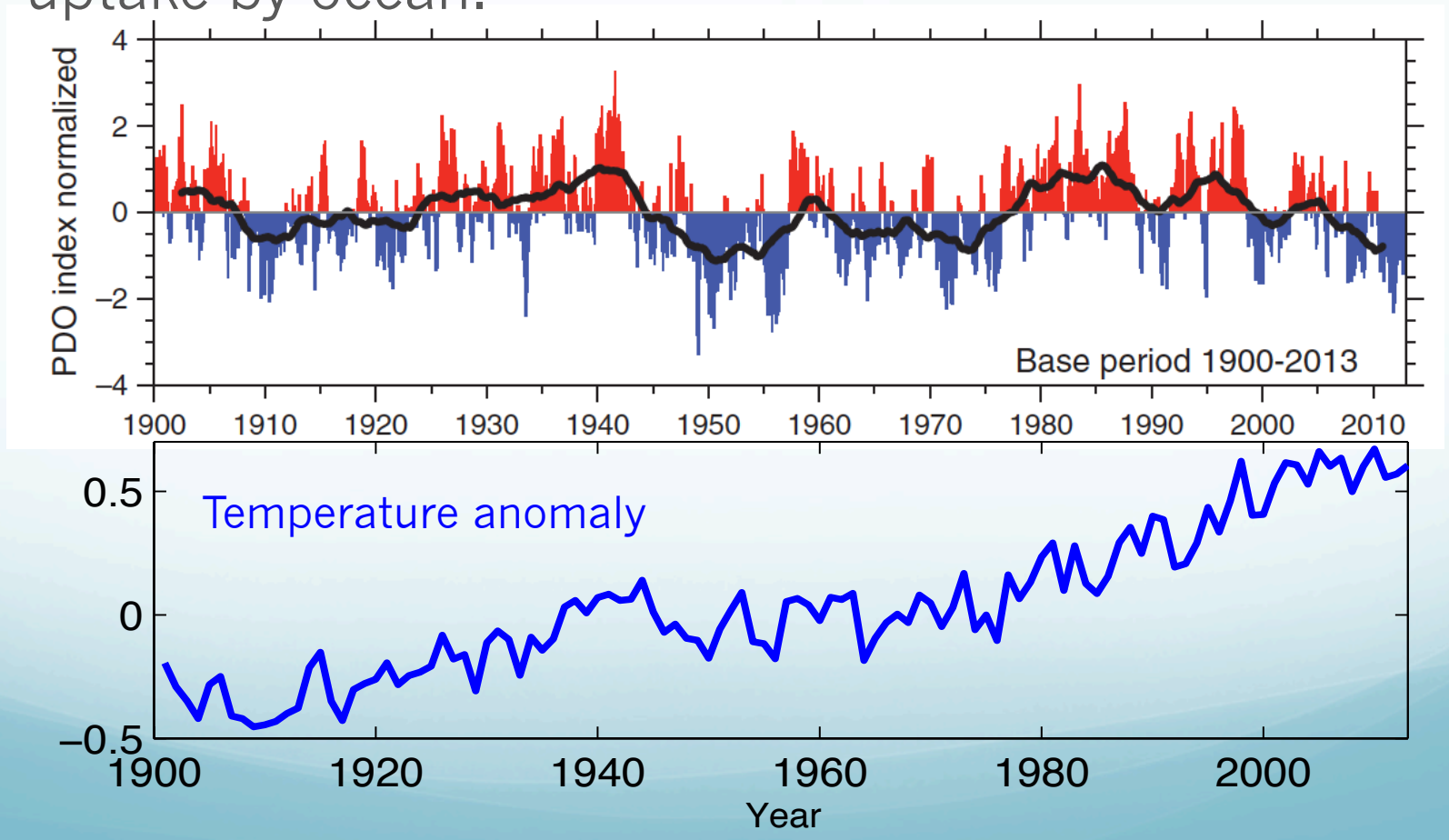
- Fixing Tropical East Pacific SST's to observations can hold back global mean warming.



Kosaka and Xie, 2013

PDO Assisted Warming

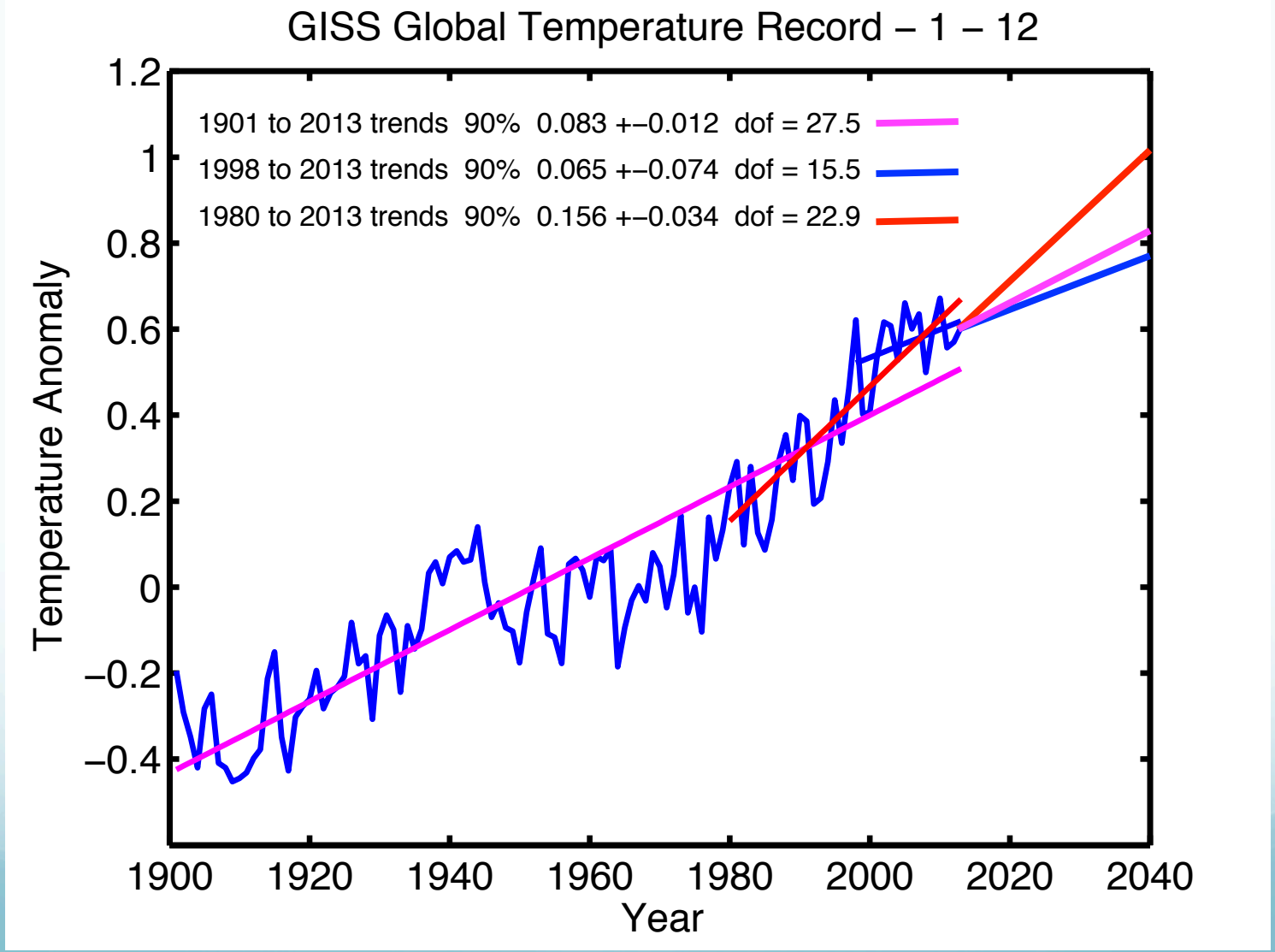
- IF PDO cool phase is responsible for part of current Klimapause, then warming from 1980 to 2000 was enhanced by Warm Phase PDO suppressing heat uptake by ocean.



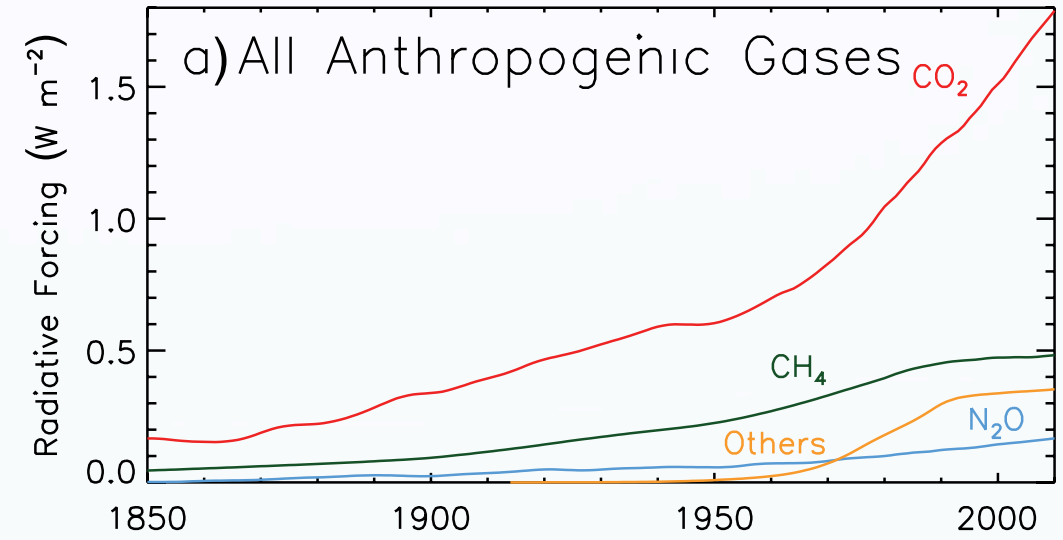
What Next?

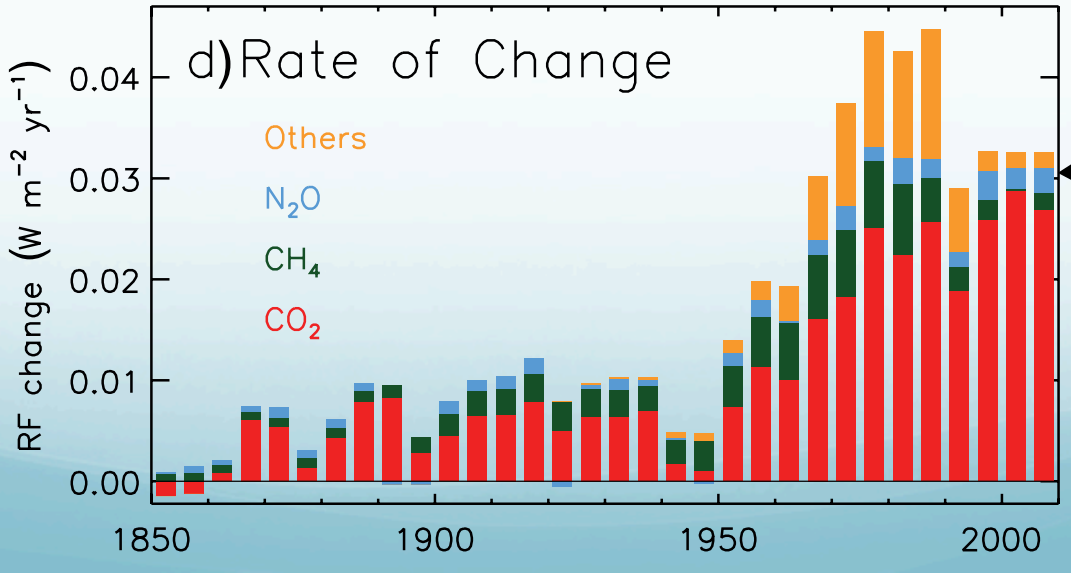
- There are two points of view in the scientific community.
- 1. A predicted El Niño for this winter will break the La Niña/Cool PDO grip on global climate and usher in a period of renewed enhanced warming like that between 1980 and 1998.
- 2. The current shift to more rapid ocean heat uptake will persist much longer, like the long period of cool PDO after 1940, so that the period of lowered warming rates will persist for another decade or more.

Extrapolation Prediction



We're sure that Human Climate Forcing is increasing





+0.3 Wm^{-2} per 10 years

WG II: Impacts, Adaptation and Vulnerability

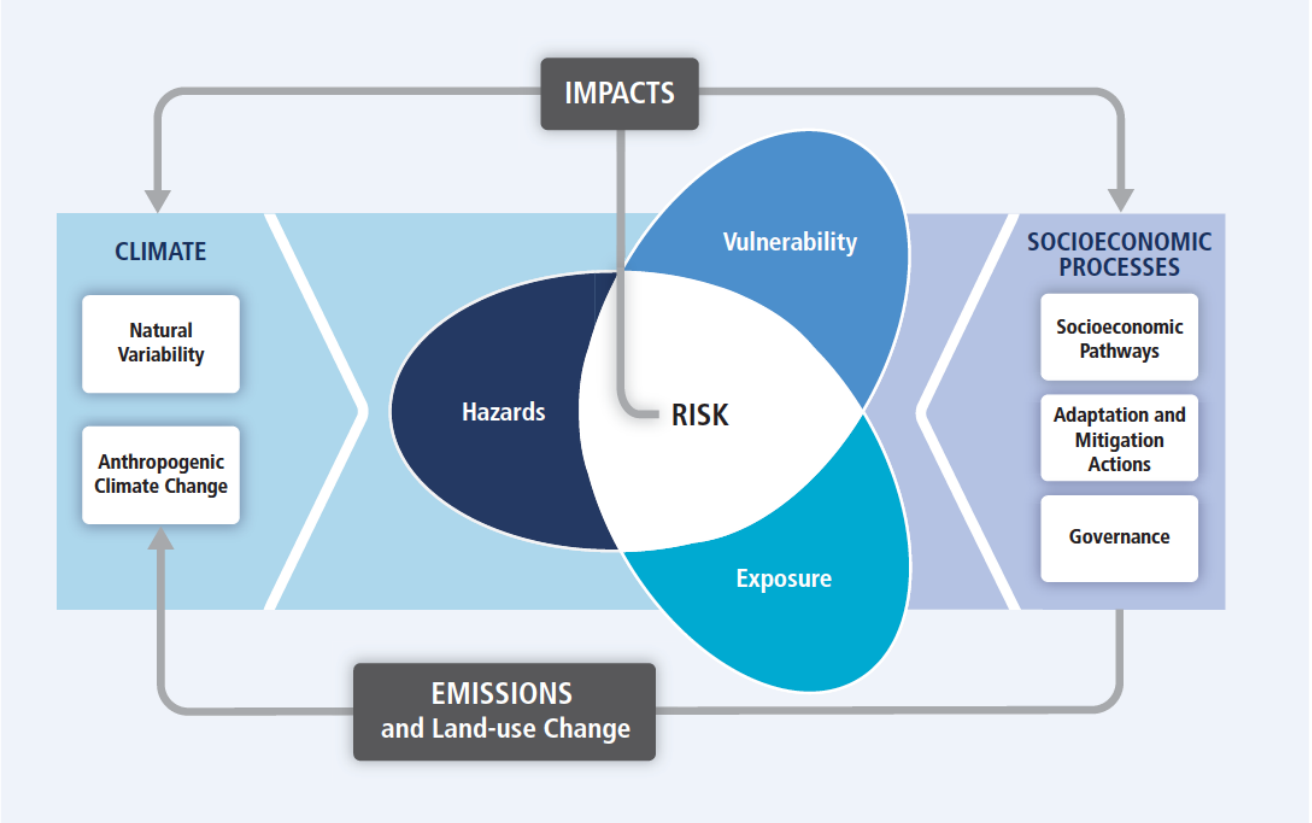
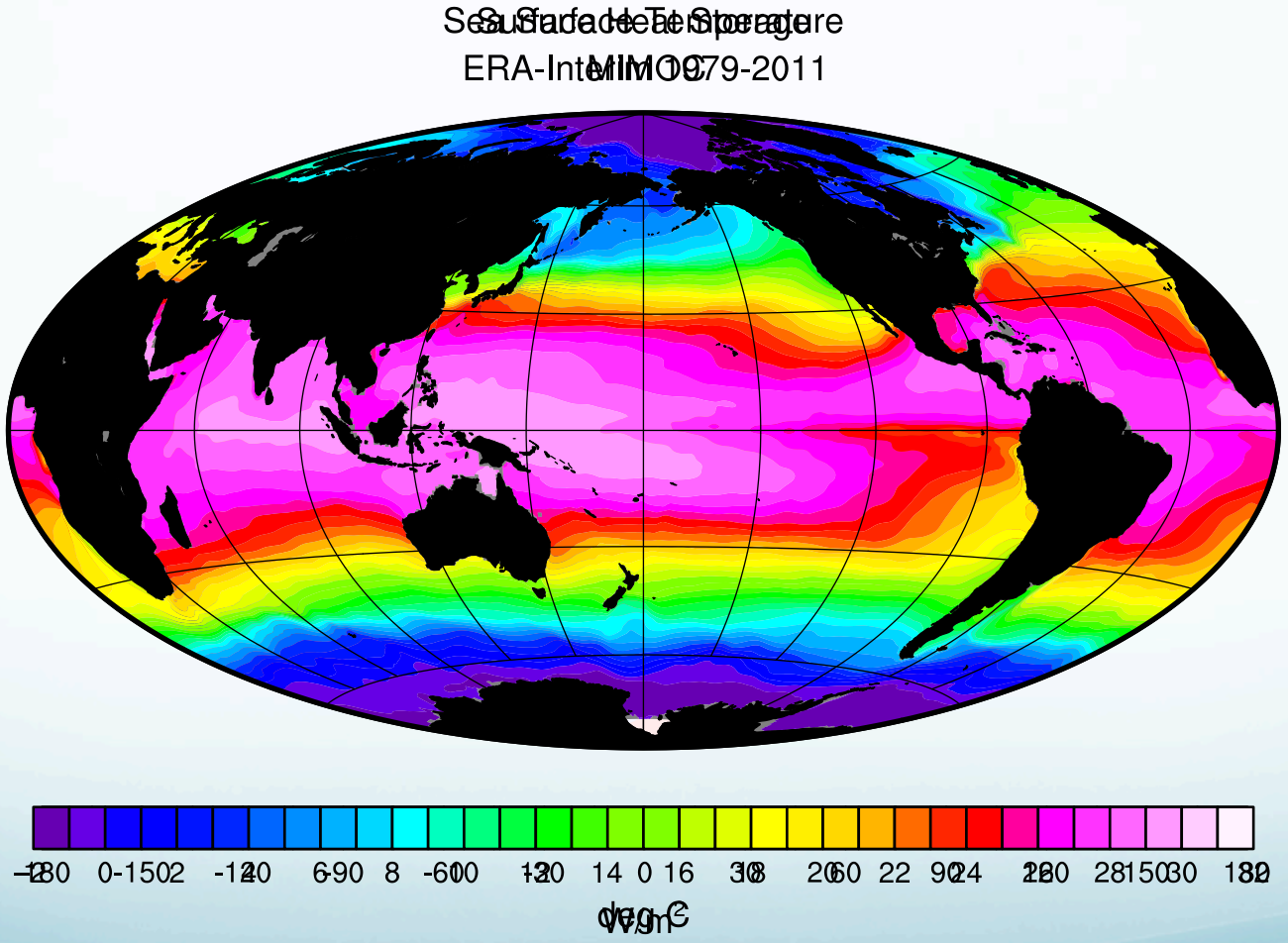


Figure SPM.1 | Illustration of the core concepts of the WGII AR5. Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability. [19.2, Figure 19-1]


Climate Change 2013: The Physical Science Basis
Working Group I contribution to the IPCC Fifth Assessment Report
Further Information
www.climatechange2013.org
For Impacts, Adaptation and Vulnerability
www.ipcc-wg2.gov
© Yann Arthus-Bertrand / Altitude

Thank You!

- Historical Averages



Red means the ocean is being heated, Blue that it is being cooled

Most Likely Explanation for Hiatus – La Niña

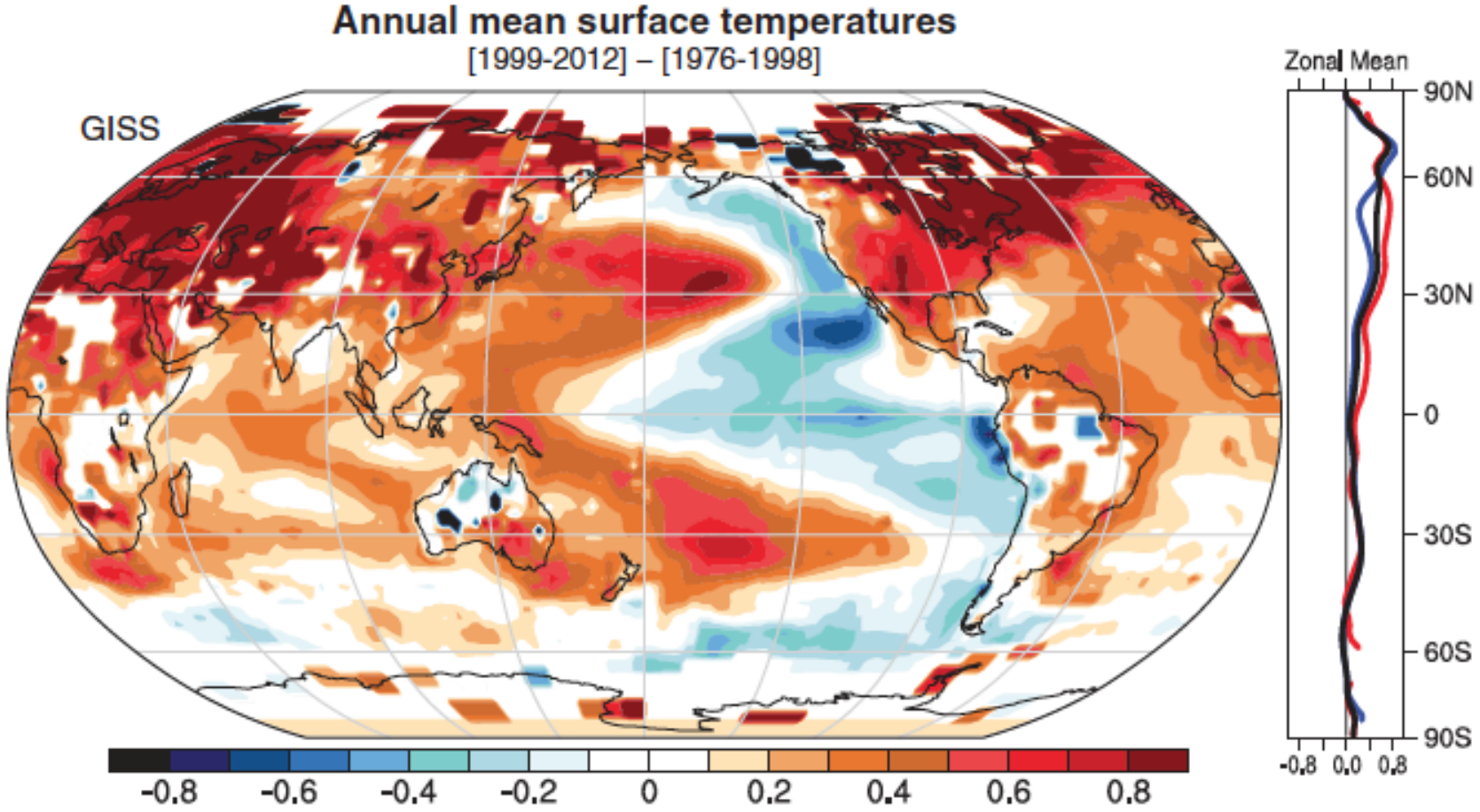
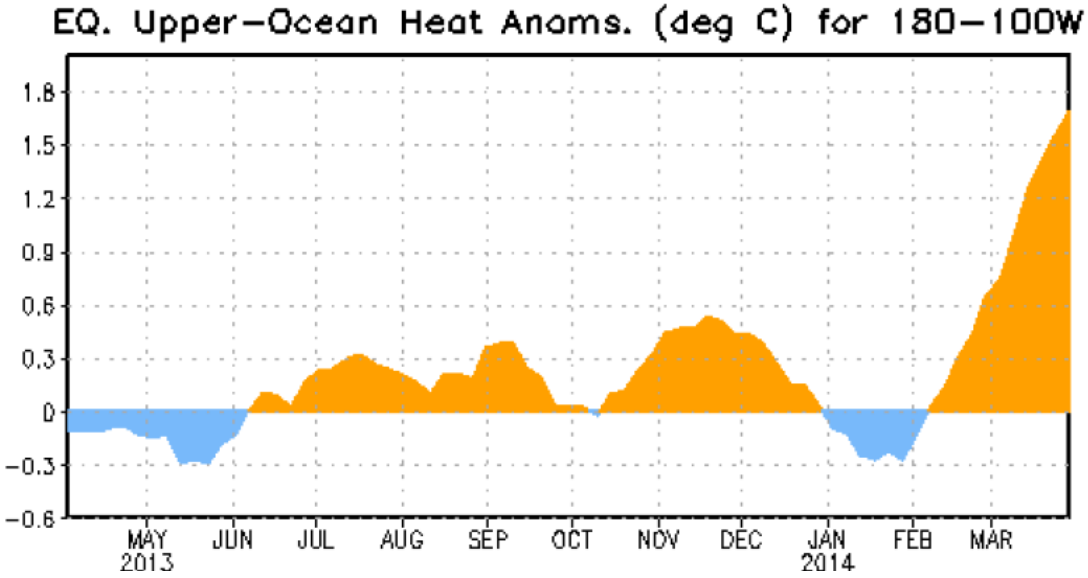


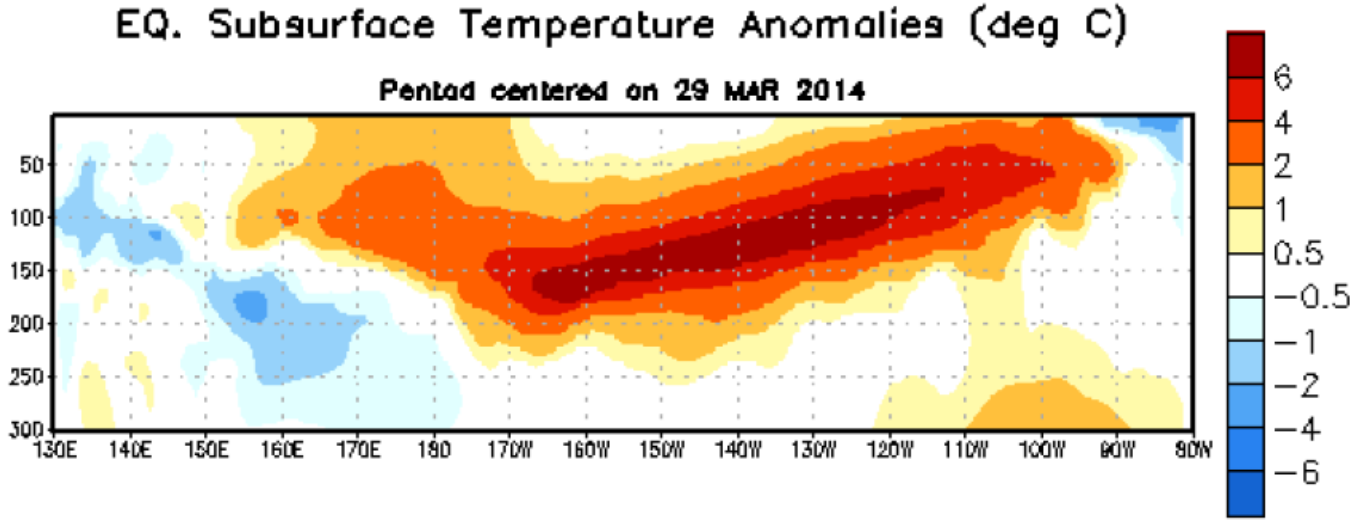
Figure 9. Mean annual surface temperature differences from GISS for 1999–2012 and 1976–1998 in °C, with zonal means at right for ocean (blue), land (red), and zonal mean (black).

Trenberth and Fasullo, 2014

ENSO Forecast: El Niño

- Equatorial Pacific Ocean heat content is very high.

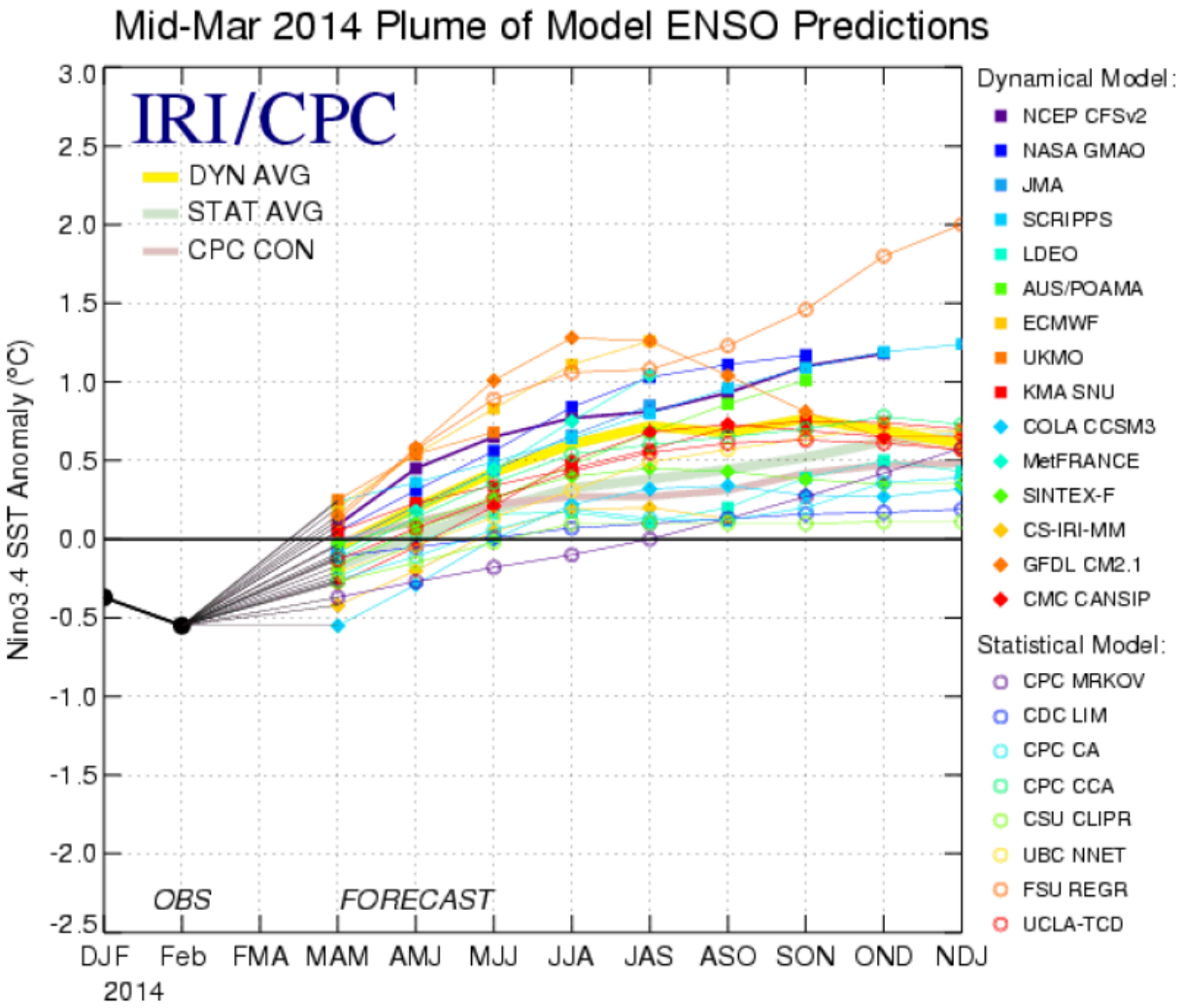




NOAA - CPC

ENSO Forecast: El Niño

- Most forecast groups indicate an el Niño in development.



NOAA - CPC