



ipcc

INTERGOVERNMENTAL PANEL ON climate change

CLIMATE CHANGE 2013

The Physical Science Basis

The Fifth Assessment: A Discussion of the IPCC Working Group 1 AR5 Report

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May 13, 2014

Washington Marriott at Metro Center

IPCC WG1 Summary

- **“The human influence on Earth’s climate is clear”**
 - **It’s still warming ... but with more observables.**
 - **More warming to come.**
 - **New lines of evidence**
 - **New concepts**

www.climatechange2013.org

The Report

- **1** Scoping Meeting to outline **14** Chapters ▪ Over **1000** nominations from **63** countries ▪ **209** Lead Authors and **50** Review Editors from **39** countries ▪ Over **600** Contributing Authors from **32** countries ▪ Over **2 million** gigabytes of numerical data from climate model simulations ▪ Over **9200** scientific publications cited ▪

The First Order Draft Expert Review

- Nearly **1500** individuals registered ▪ **21,400** comments from **659** Expert Reviewers from **47** countries ▪

The Second Order Draft Expert and Government Review

- Over **1500** individuals registered ▪ **31,422** comments from **800** Expert Reviewers from **46** countries and **26** Governments ▪

The Final Government Distribution

- **1855** comments from **32** Governments on the Final Draft Summary for Policymakers ▪

Total Reviews

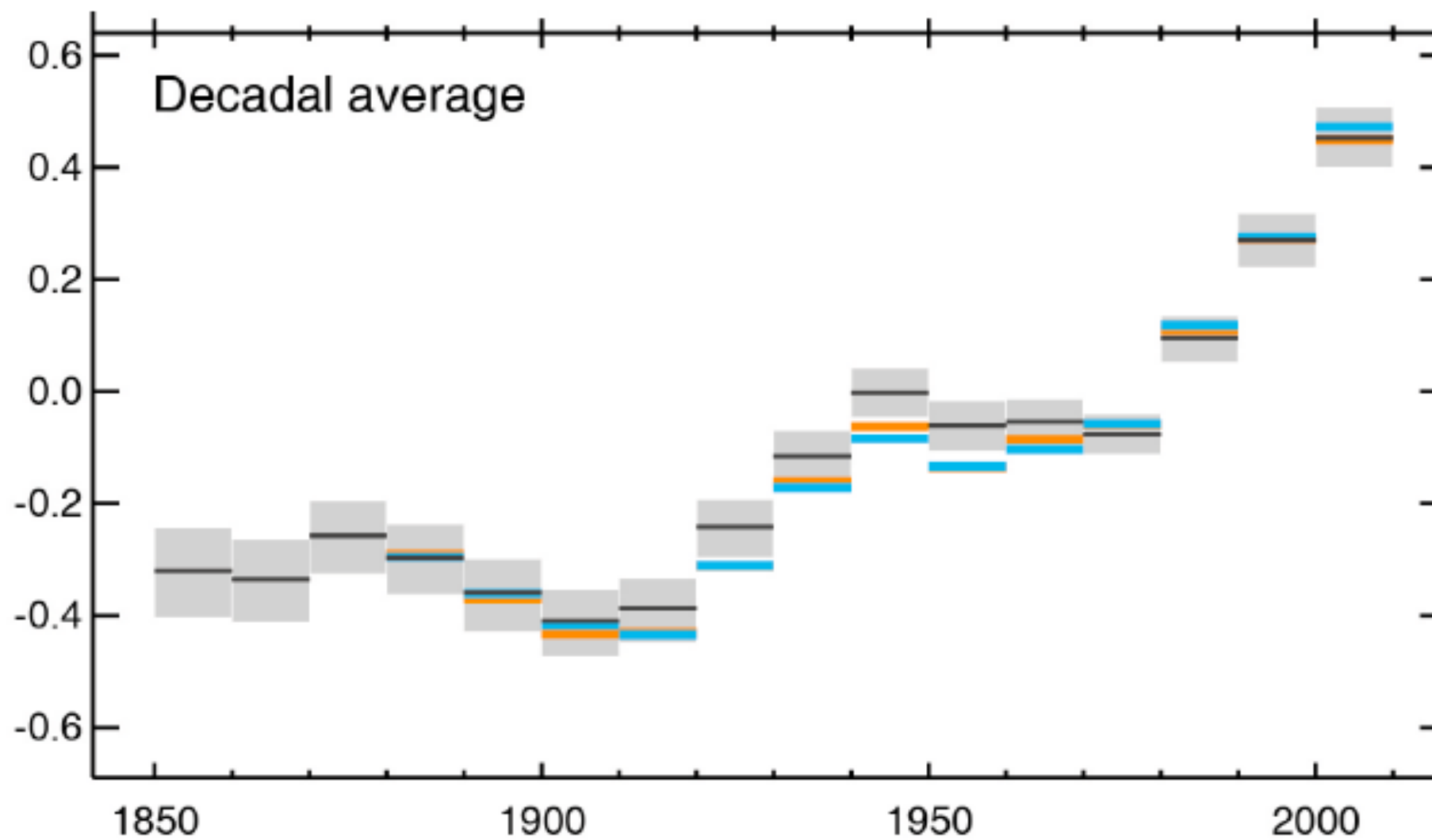
- **54,677** comments ▪ **1089** Expert Reviewers from **55** countries ▪ **38** Governments ▪

The WGI Approval Session

- 23-26 September 2013, Stockholm, Sweden ▪ The Summary for Policymakers will be approved line-by-line by up to **195** Governments ▪

The Timeline

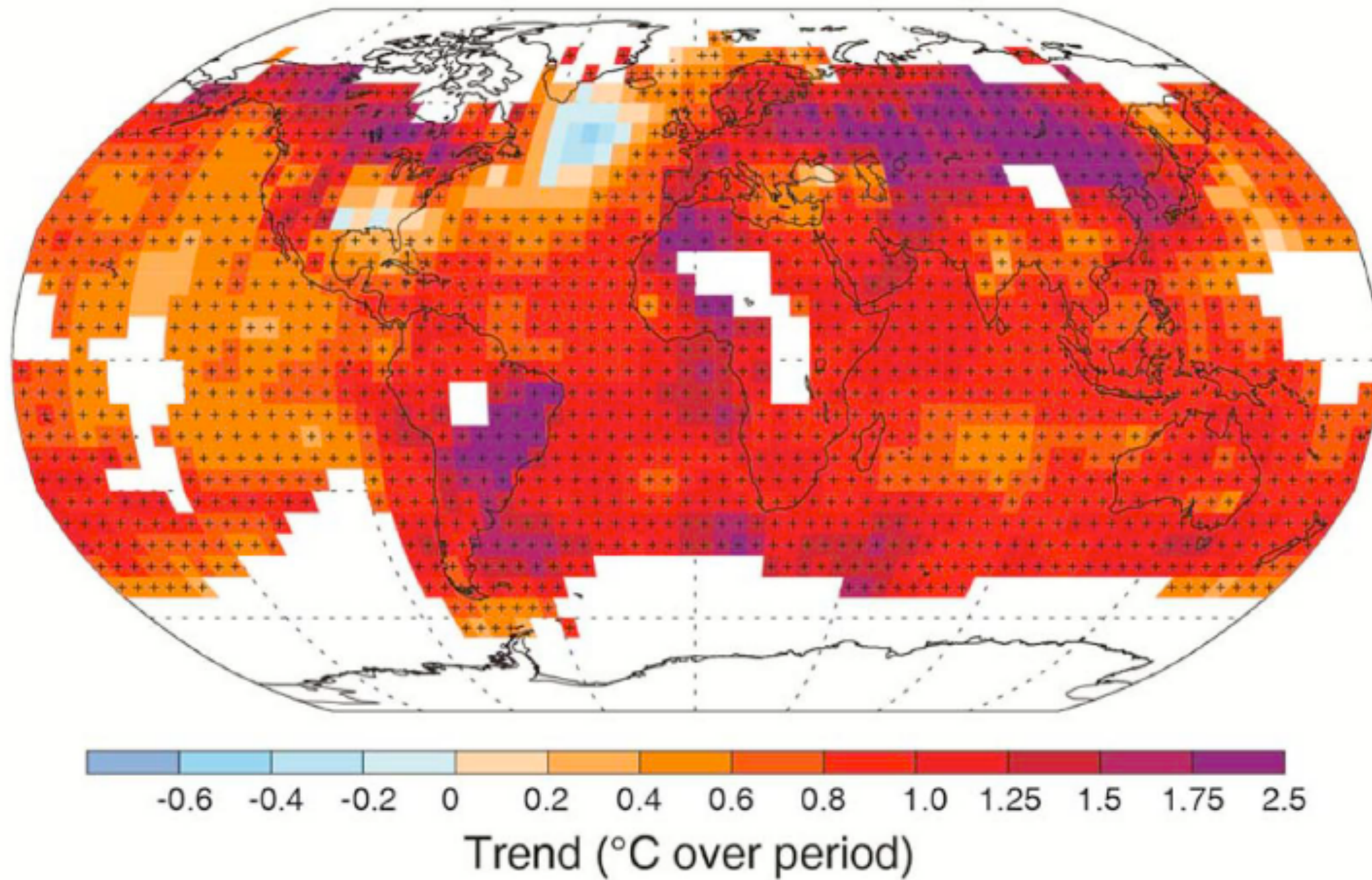
- 2010 MAY - IPCC WG1 Authors and Reviewers Selected
- 2010 NOVEMBER - First Lead Author Meeting - Kunming, China
- **2011 MARCH 18** - Zeroth Order Draft
- 2011 JULY - Second Lead Author Meeting - Brest, France
- **2011 NOVEMBER 18** - First Order Draft
- 2012 APRIL - Third Lead Author Meeting - Marrakech, Morocco
- **2012 AUGUST 10** - Second Order Draft
- 2013 JANUARY - Fourth Lead Author Meeting - Hobart, Australia
- **2013 MAY 13** - Final Draft
- **2013 SEPTEMBER 27** - IPCC Plenary Approval of SPM - Stockholm, Sweden



(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*).



(IPCC 2013, Fig. SPM.1b)

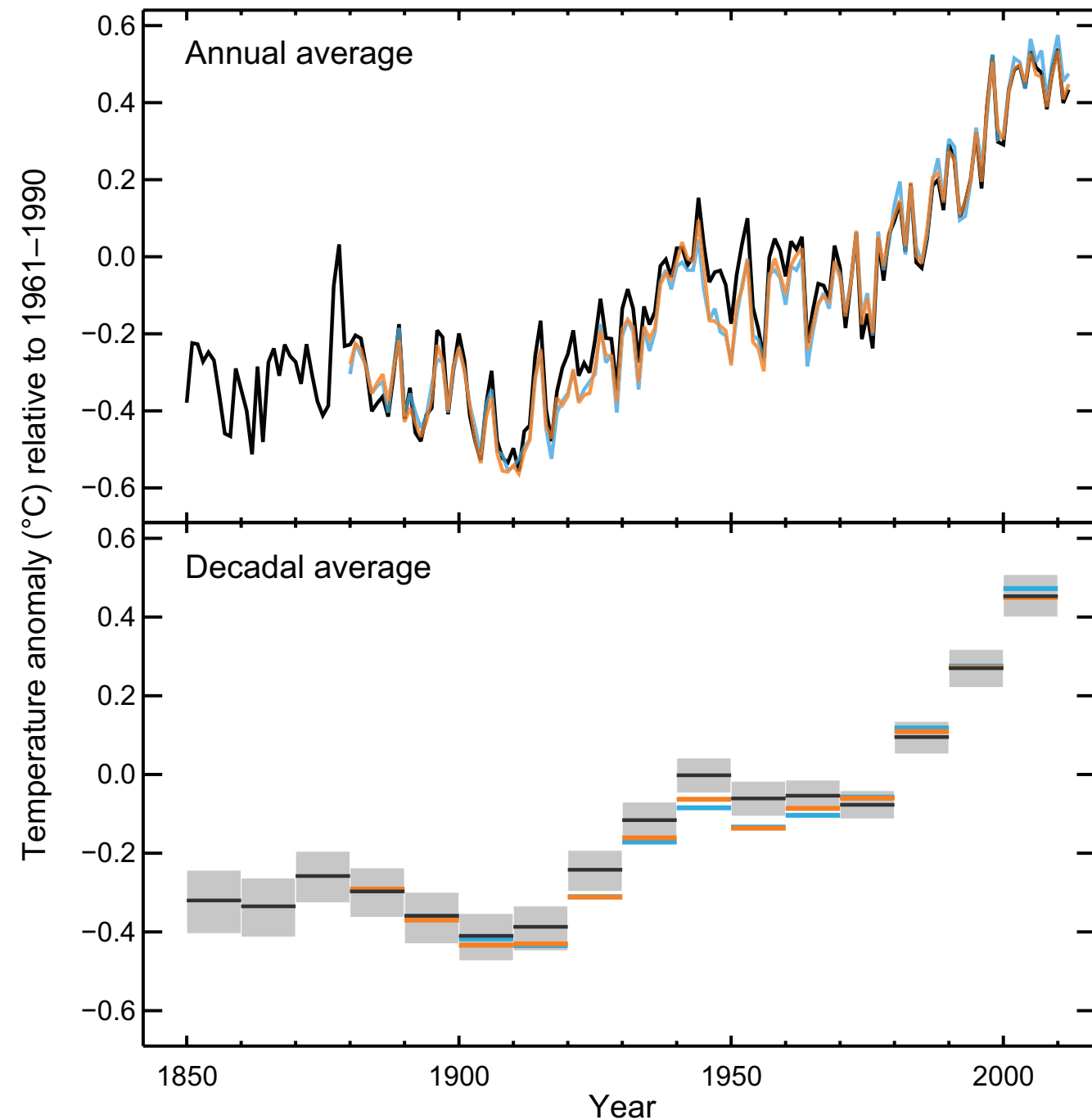
Warming in the climate system is unequivocal

Observed Surface Temperature Changes

Figure SPM.1a

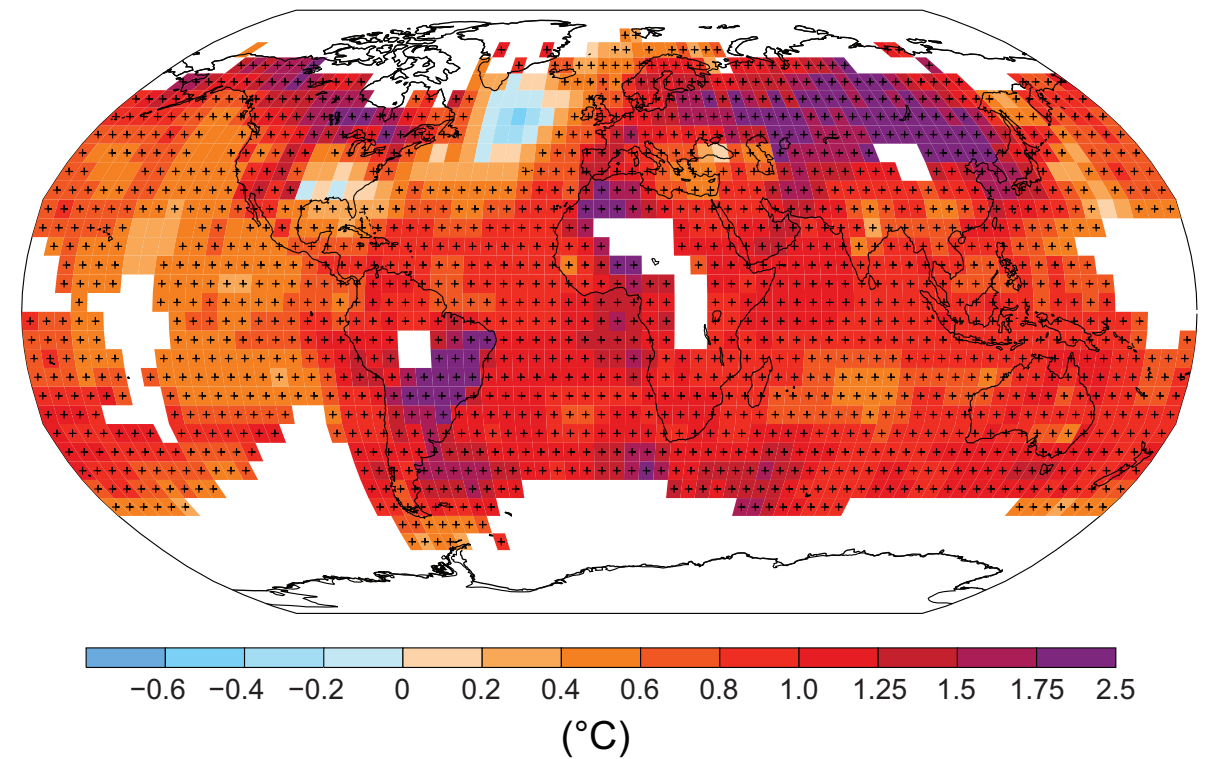
Observed globally averaged combined land and ocean surface temperature anomaly 1850–2012

(a)



(b)

Observed change in surface temperature 1901–2012

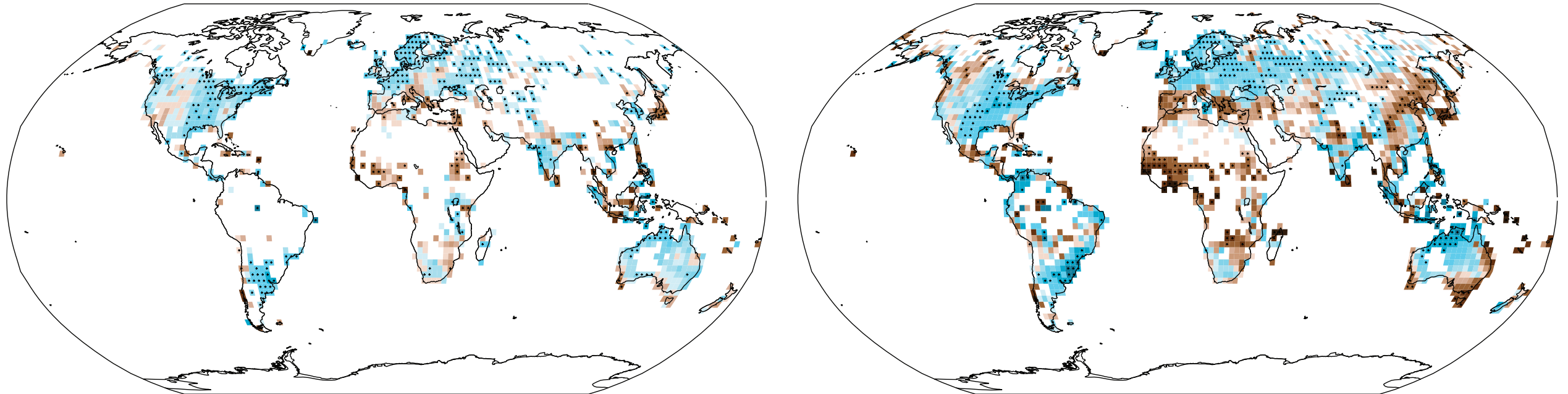


Increased focus on observed precipitation changes

Observed change in annual precipitation over land

1901–2010

1951–2010



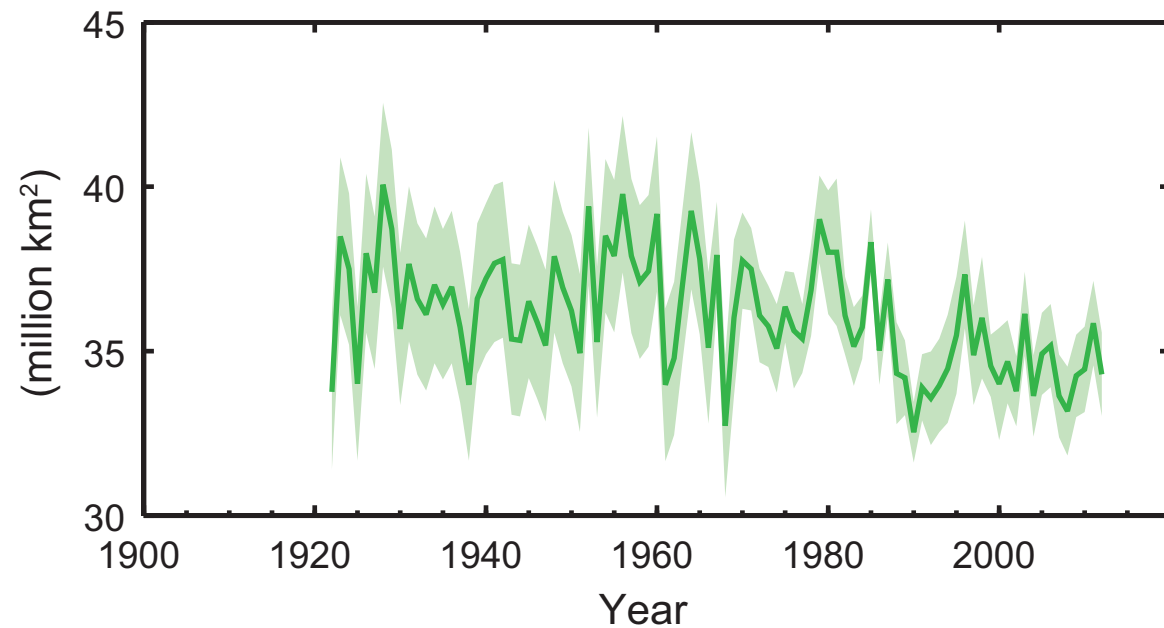
-100 -50 -25 -10 -5 -2.5 0 2.5 5 10 25 50 100

(mm yr⁻¹ per decade)

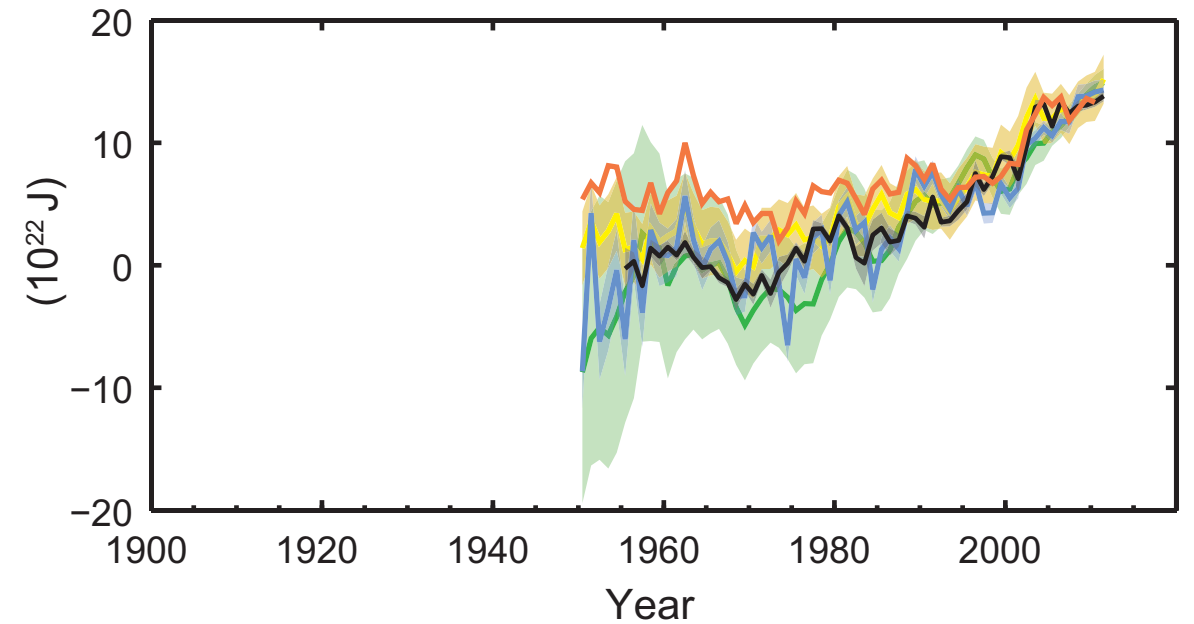
(IPCC WG1 AR5 Figure SPM.2)

Many additional observations are now used to assess historical climate change

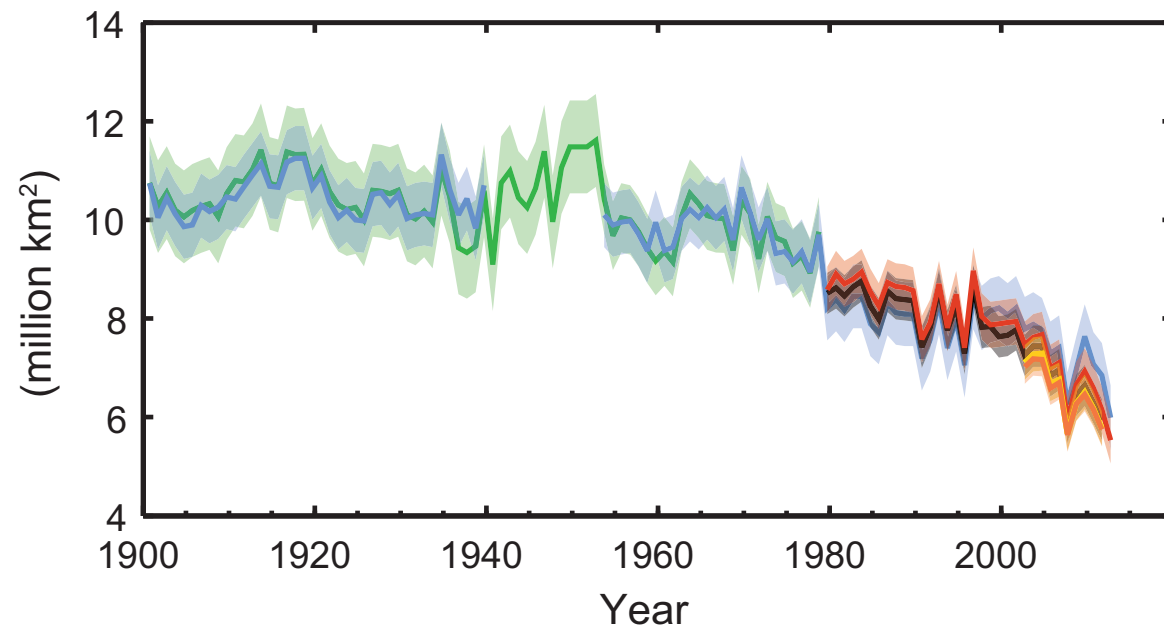
(a) Northern Hemisphere spring snow cover



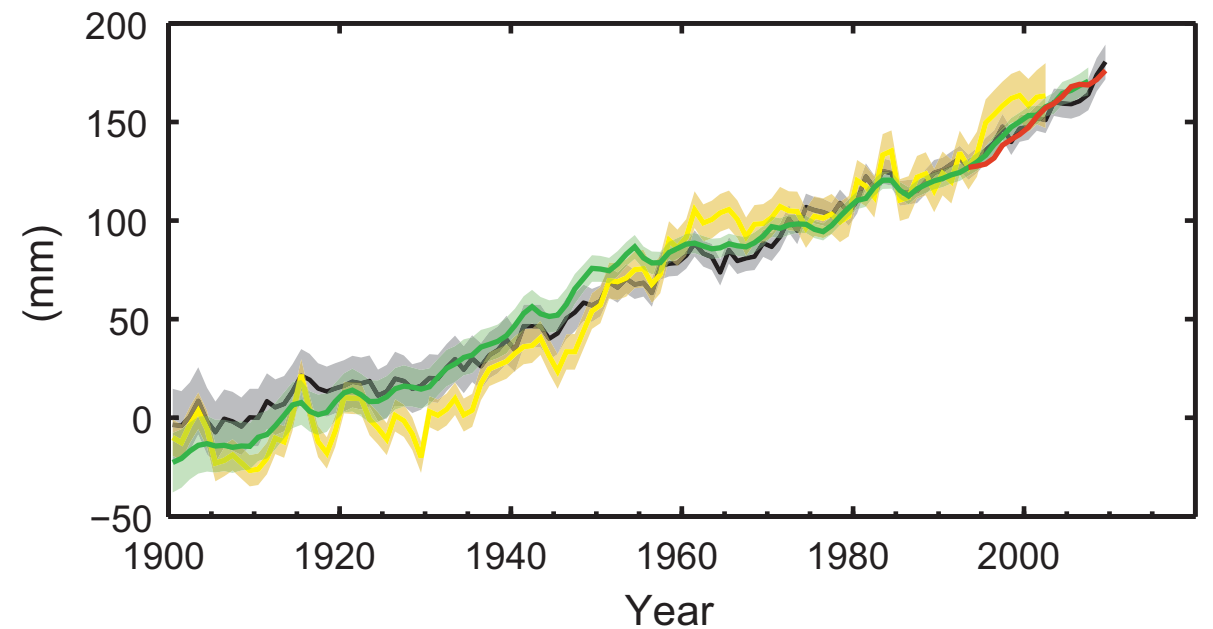
(c) Change in global average upper ocean heat content



(b) Arctic summer sea ice extent

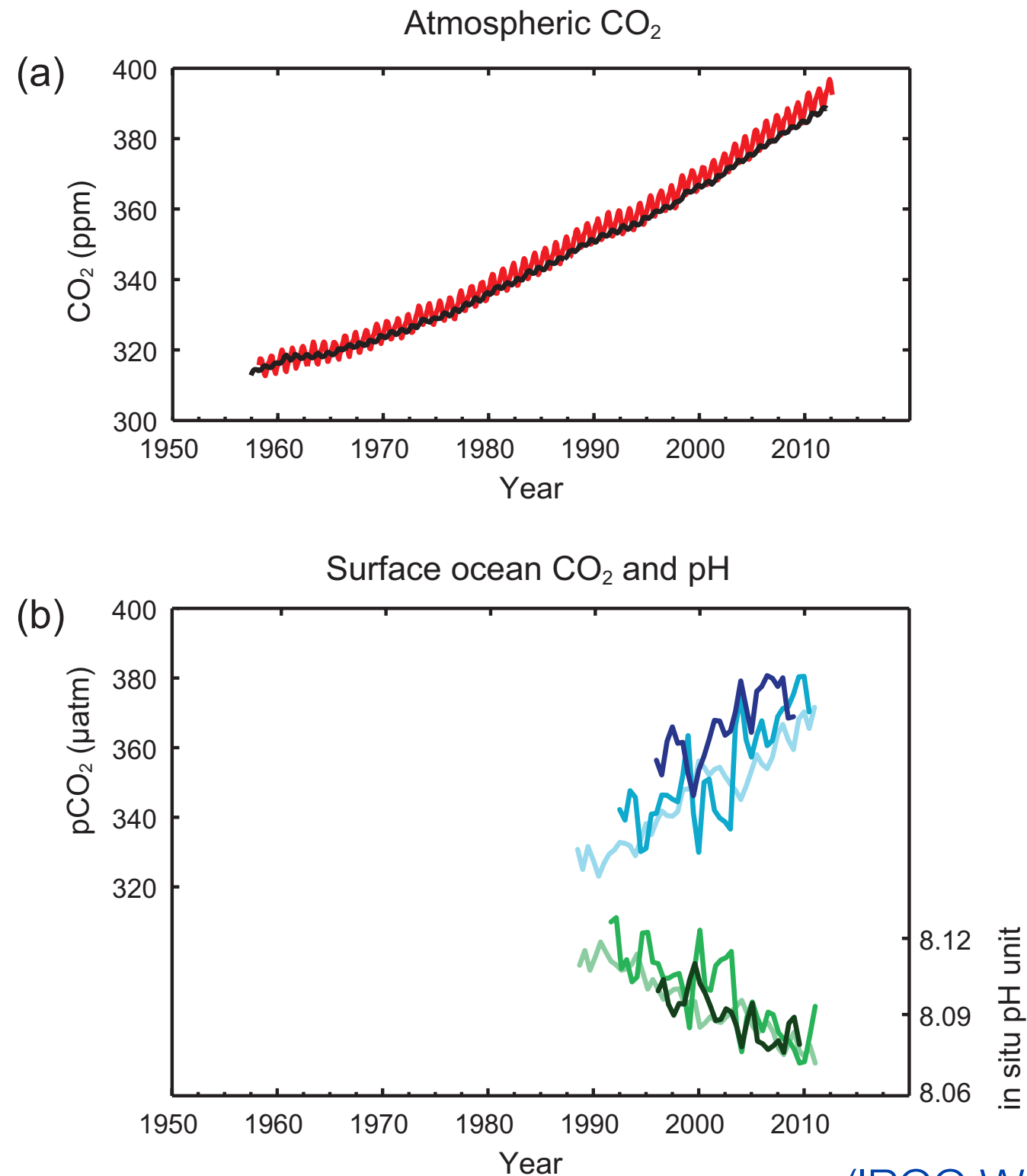


(d) Global average sea level change



(IPCC WG1 AR5 Figure SPM.3)

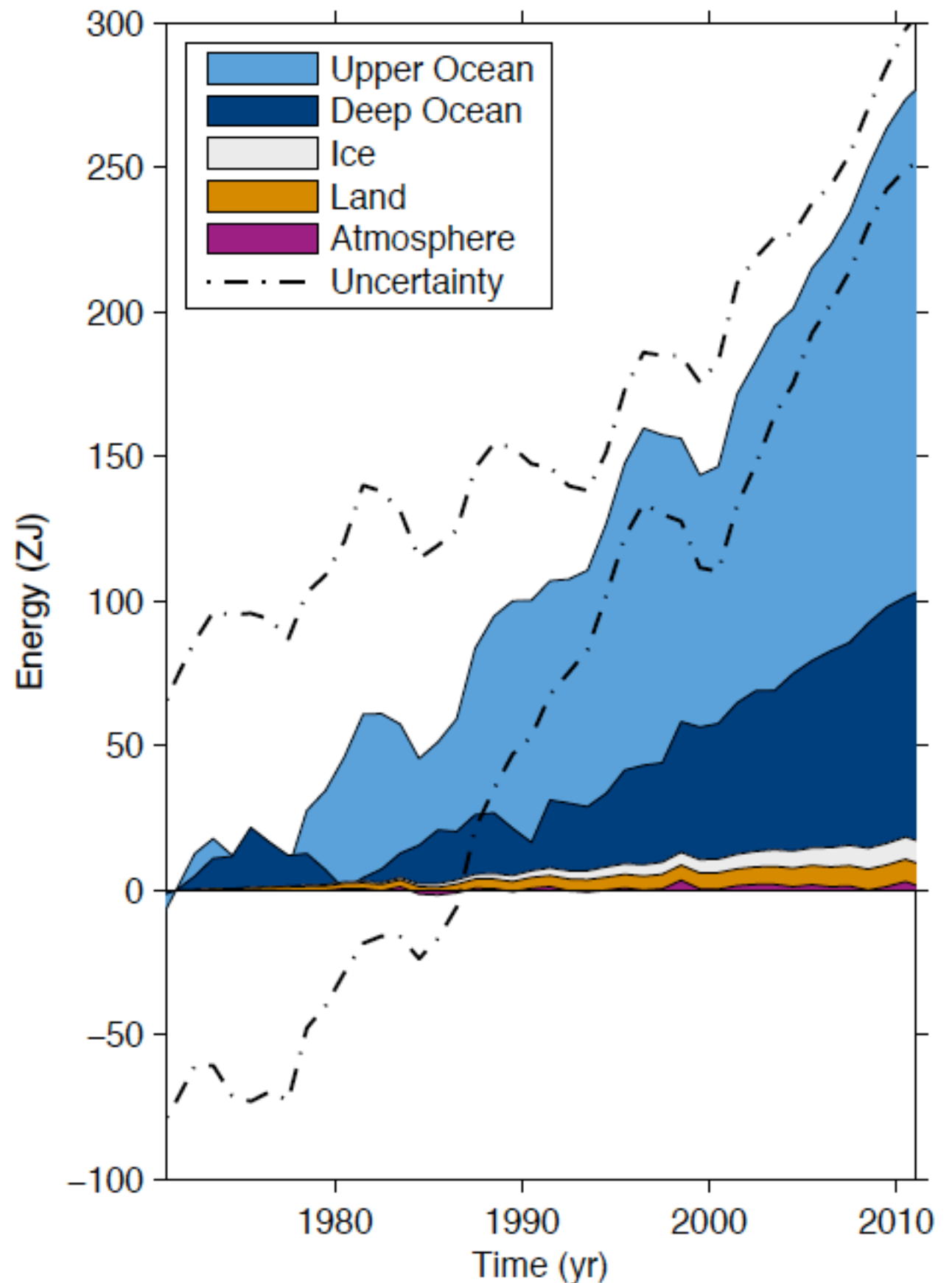
Including key Carbon Cycle observations



Anthropogenic warming has mainly occurred in the ocean.

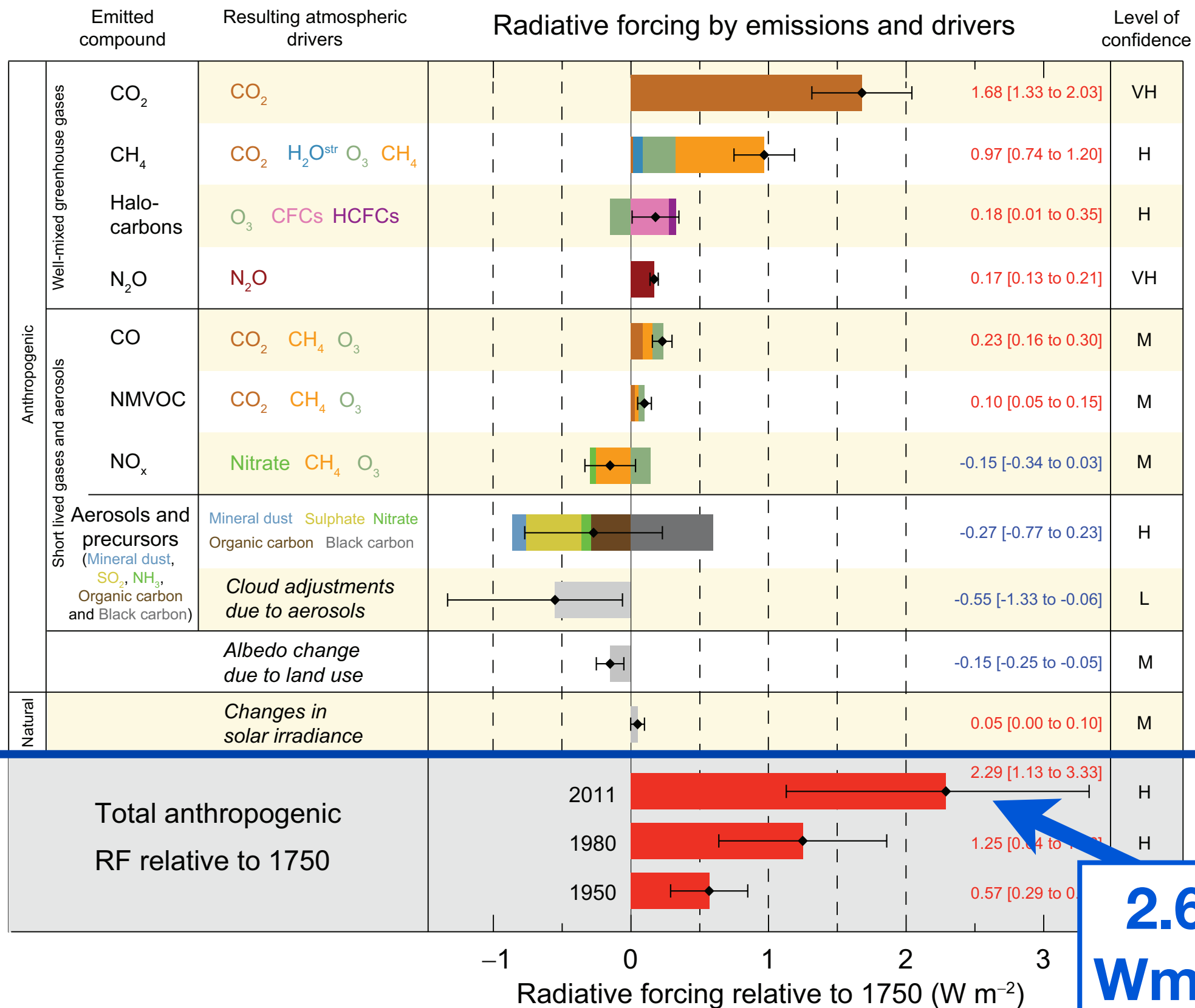
Evidence in the Global Energy Budget

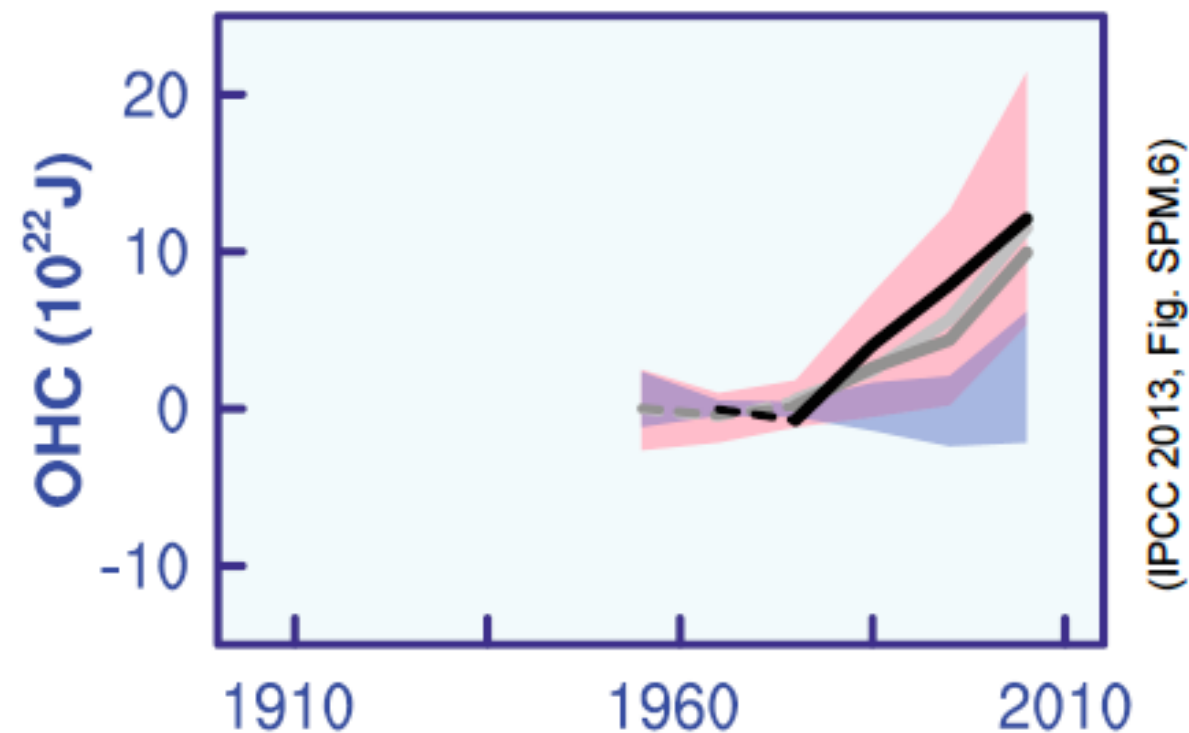
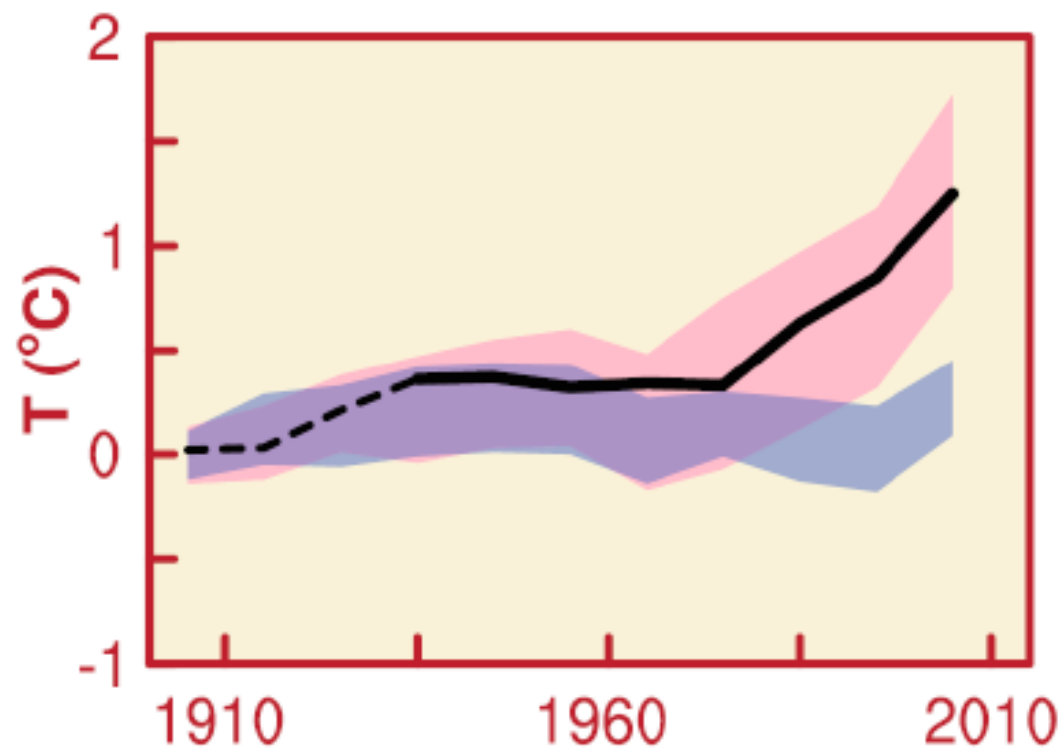
- Accumulated Energy Increase since 1970
- >90% of energy increase in ocean heat content
- ZJ = 10^{21} Joules



The Drivers of Climate Change

Radiative Forcing: Figure SPM.5





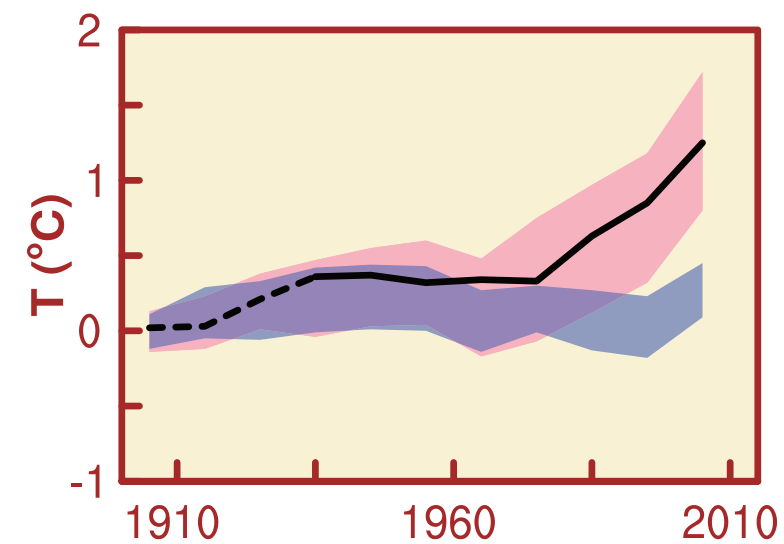
(IPCC 2013, Fig. SPM.6)

Human influence on the climate system is clear

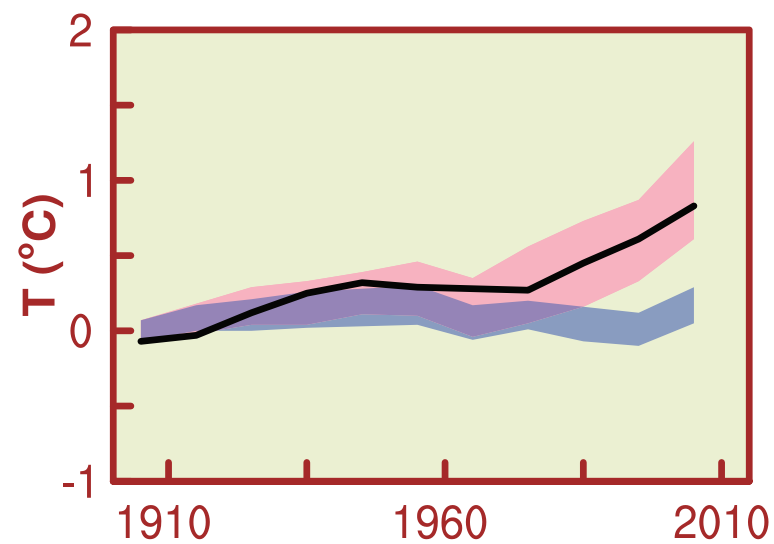
Can Climate Models capture the observed changes?

Global averages

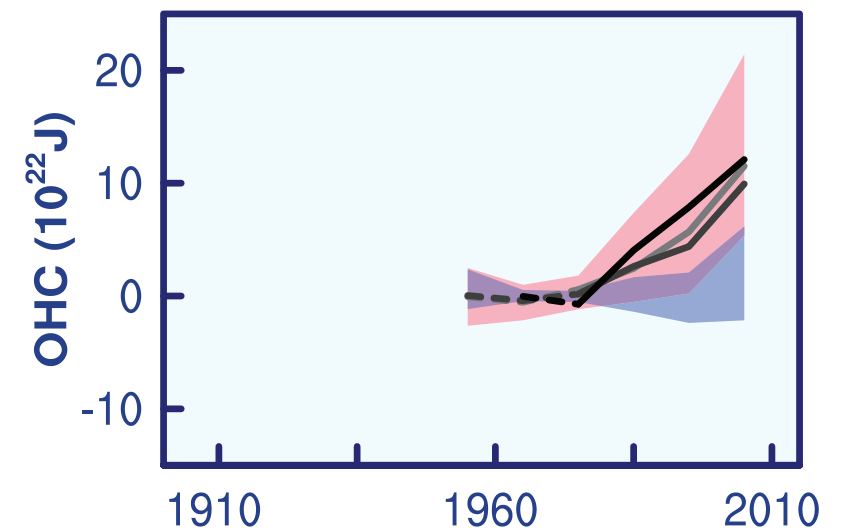
Land surface



Land and ocean surface



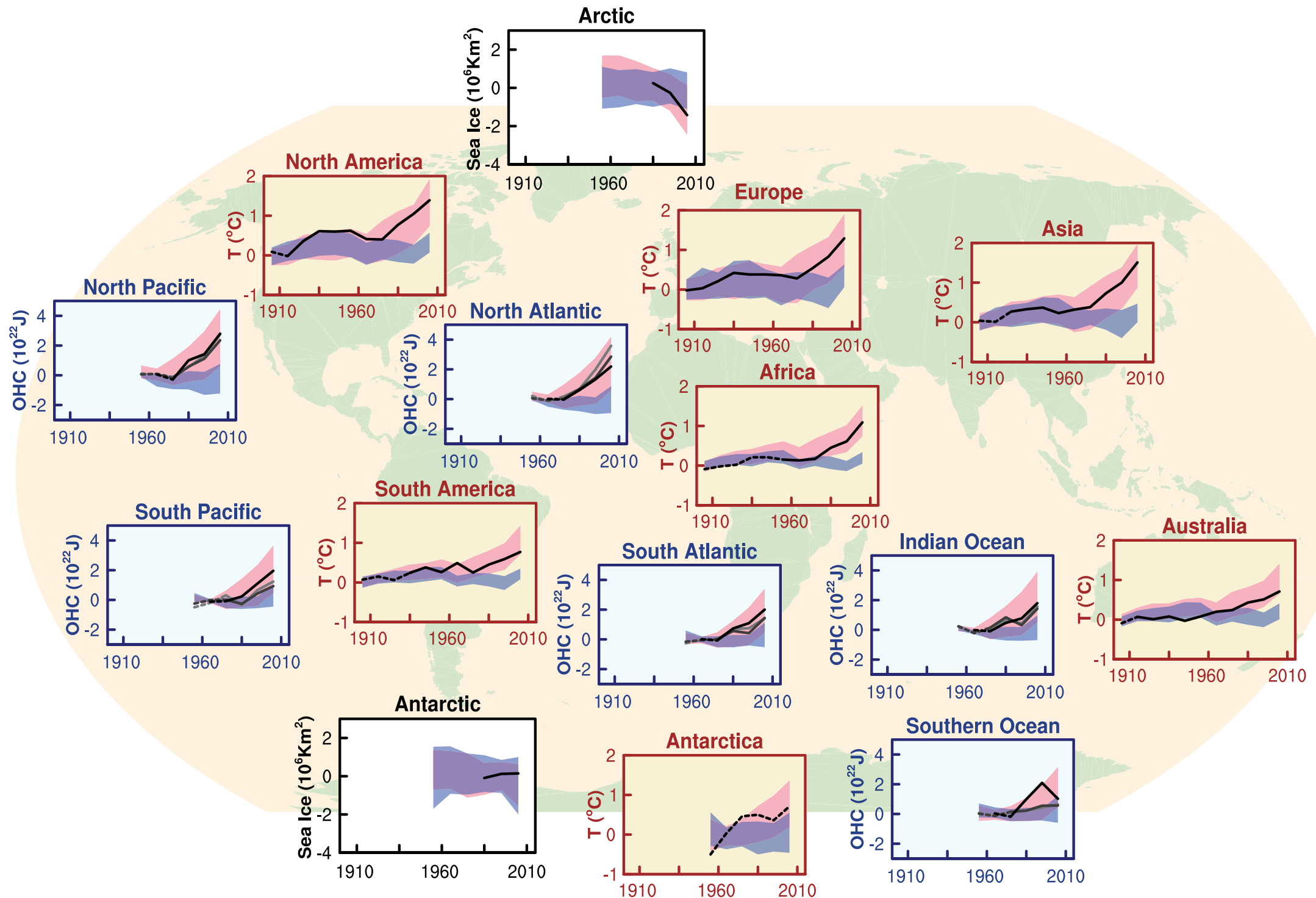
Ocean heat content



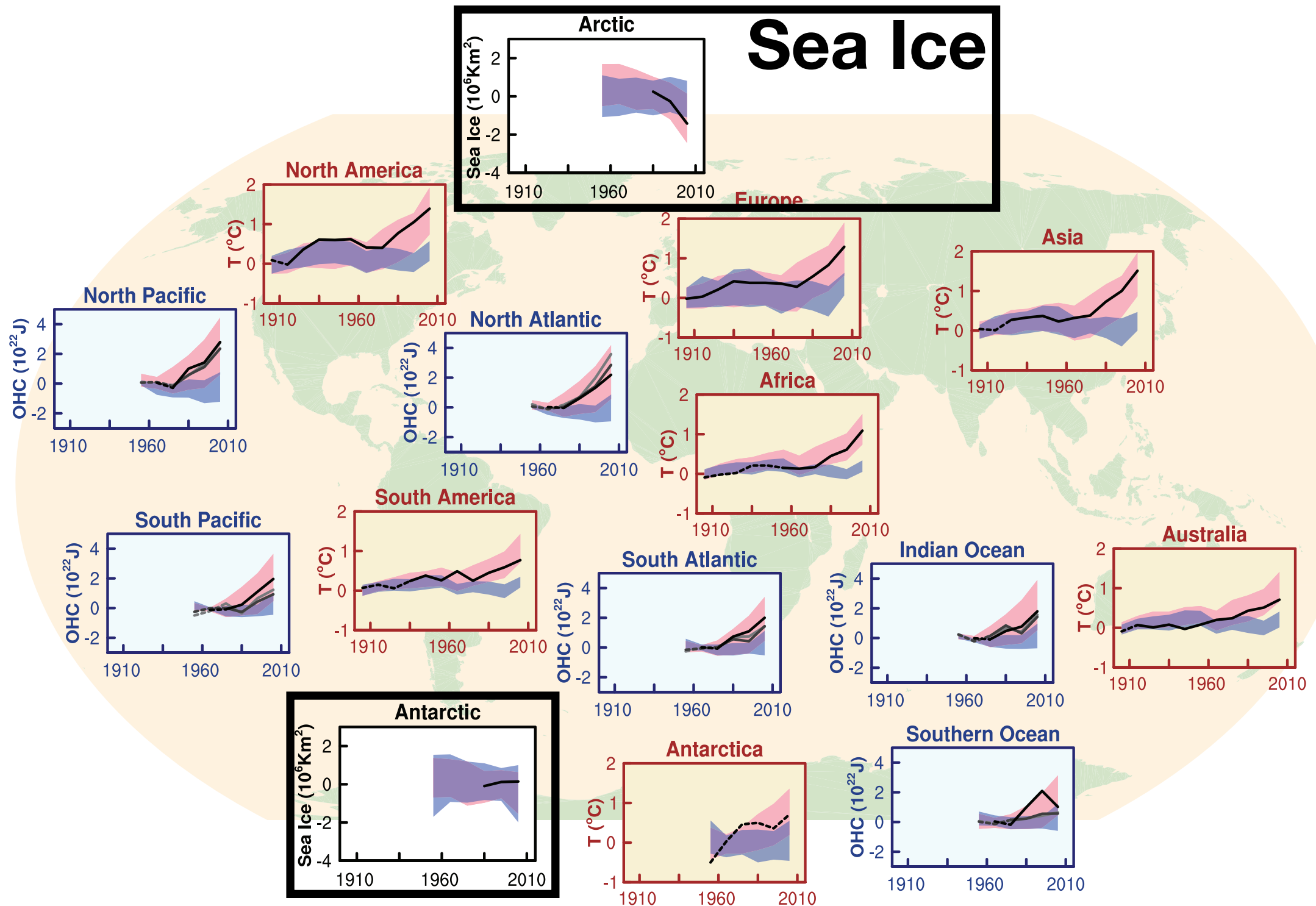
≡ Observations

■ Models using only natural forcings
■ Models using both natural and anthropogenic forcings

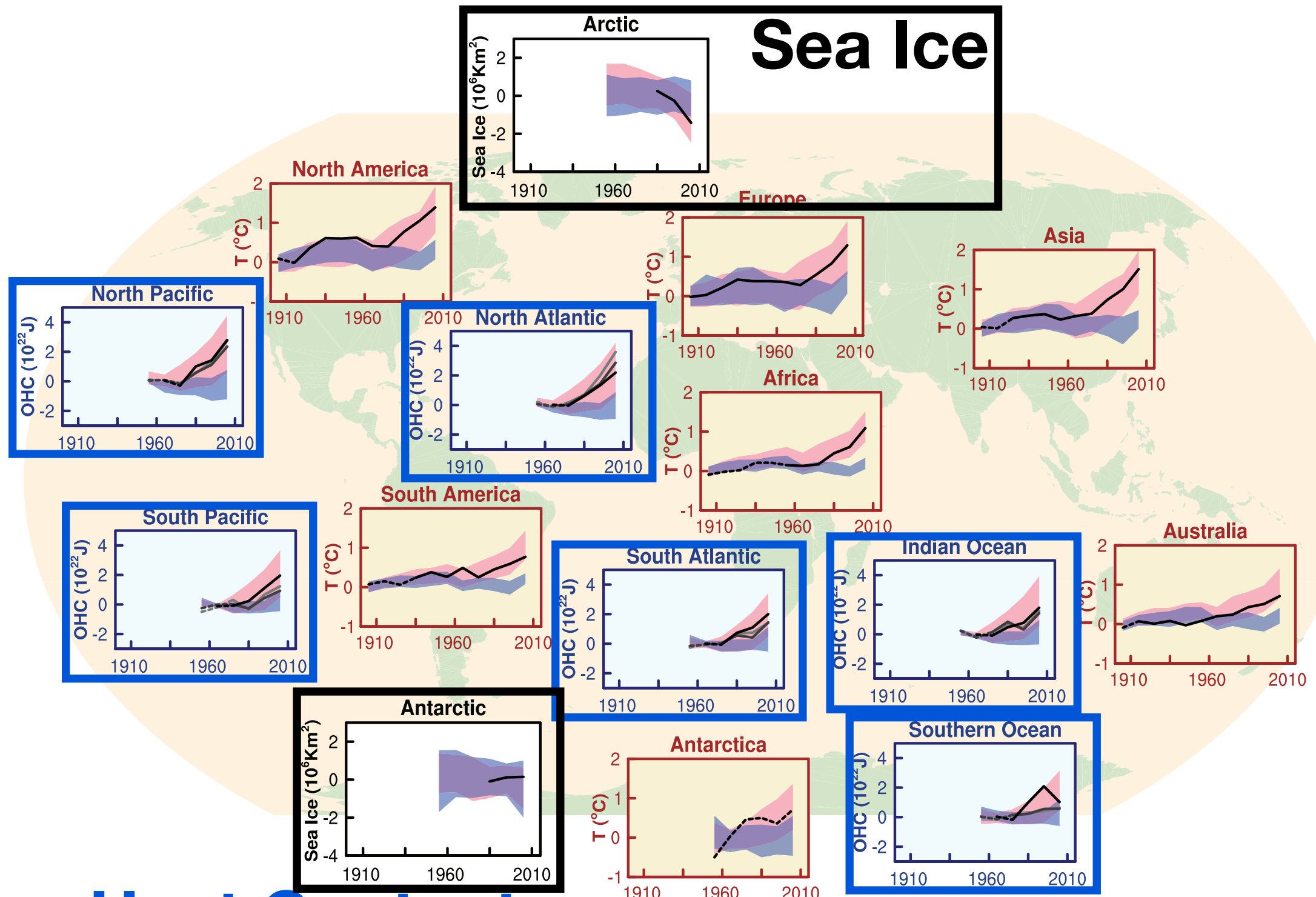
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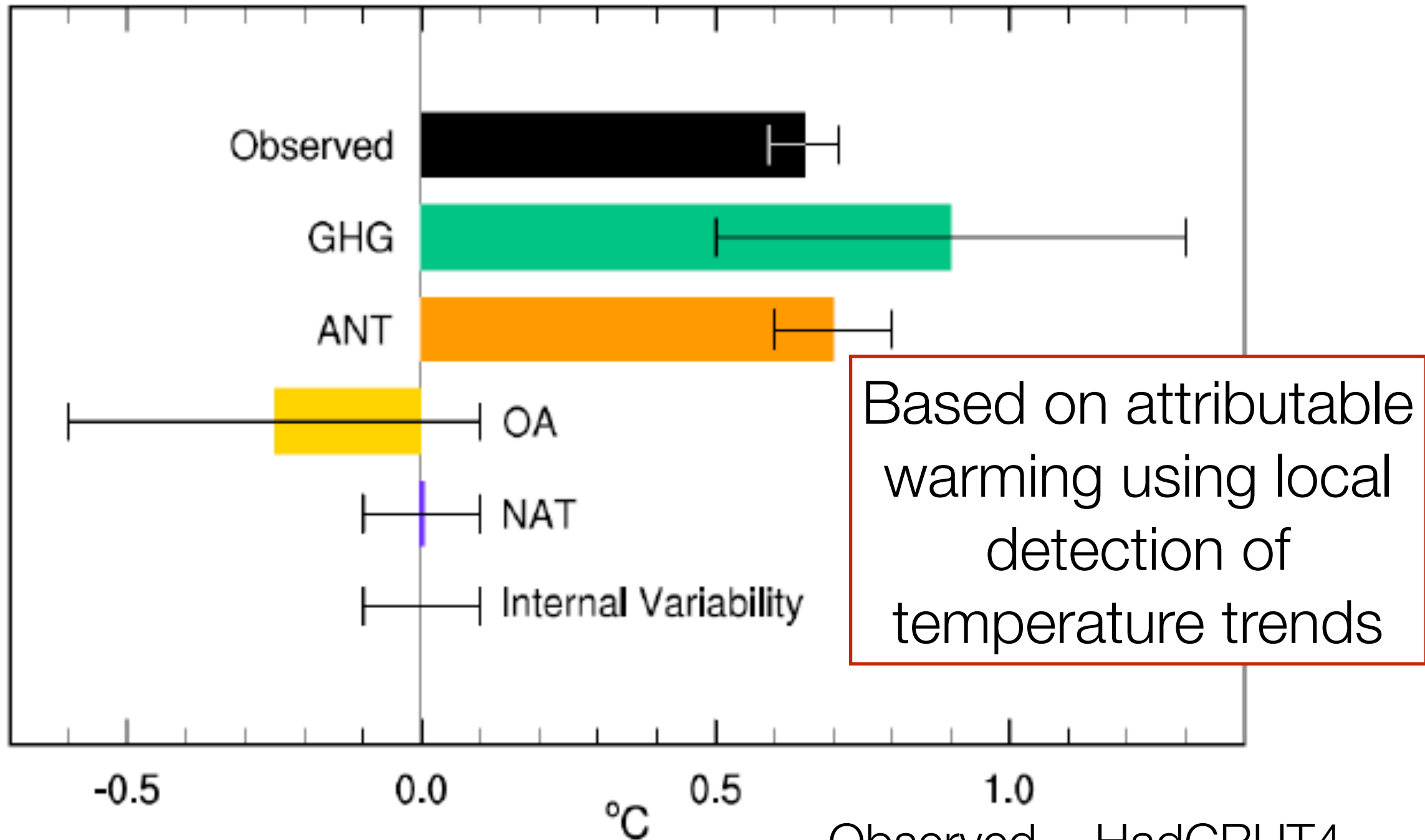
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Ocean Heat Content

IPCC WG1 AR5 Figure SPM.6

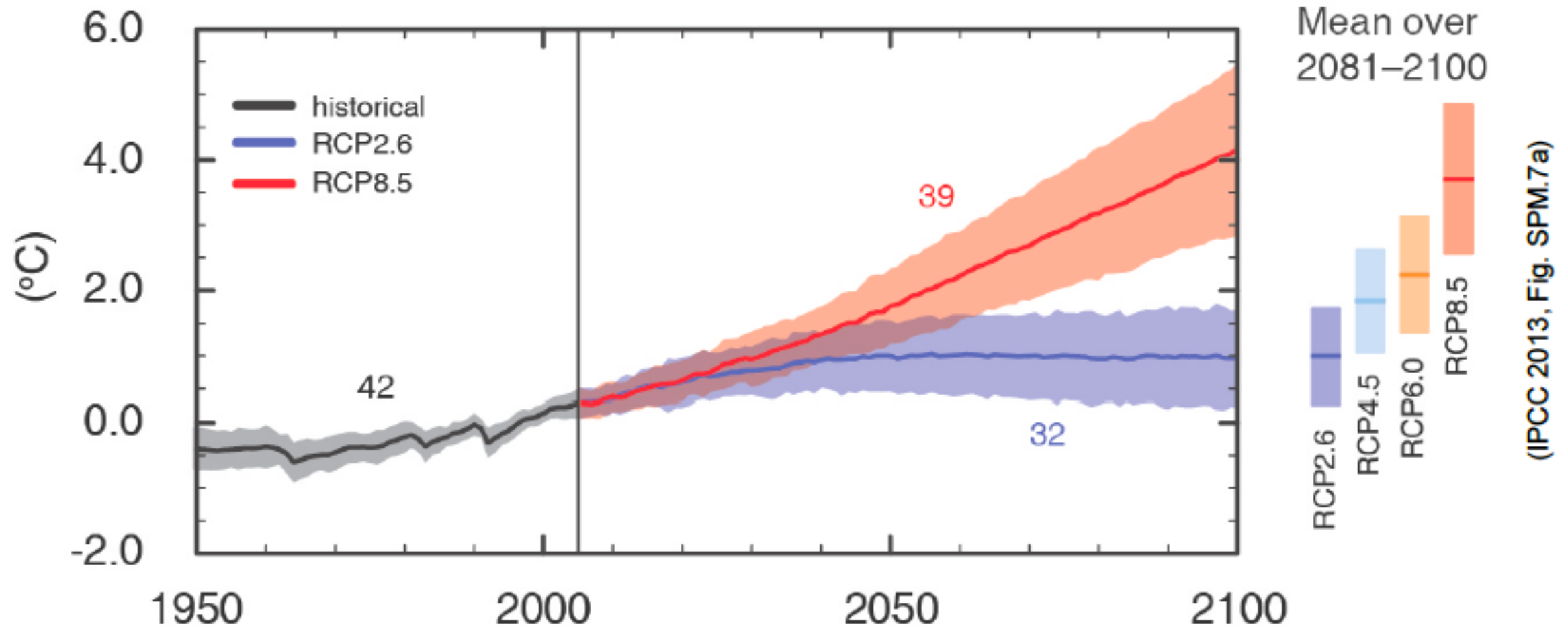
What are the causes of warming?



Observed = HadCRUT4

IPCC WG1 AR5 Figure 10.5

Global average surface temperature change



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

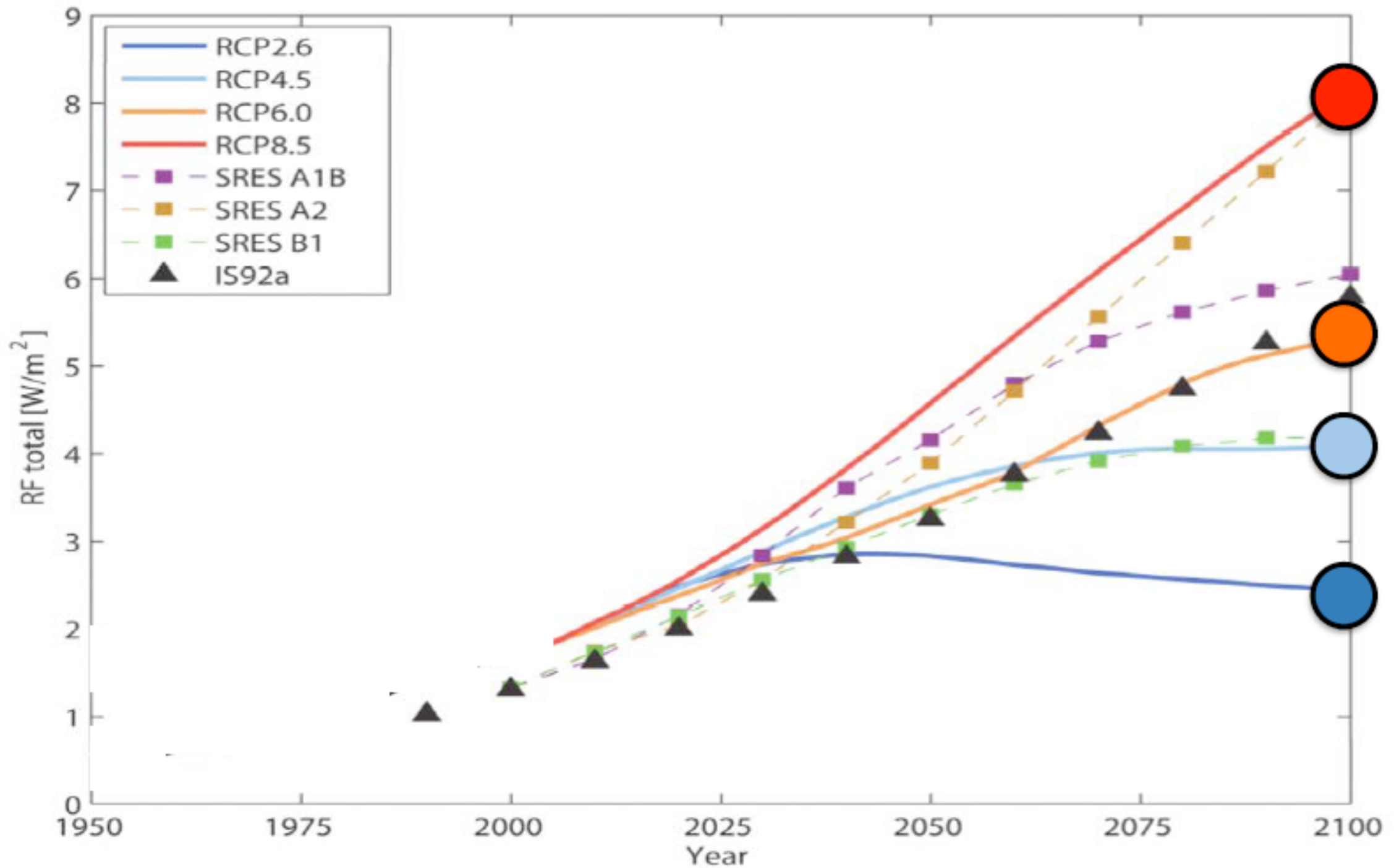
**RCP Scenarios have replaced
SRES Scenarios (which
replaced IS92 Scenarios**

**RCP := Representative
Concentration Pathways**

**2.6, 4.5, 6.0, & 8.5 := Radiative
Forcing at 2100**

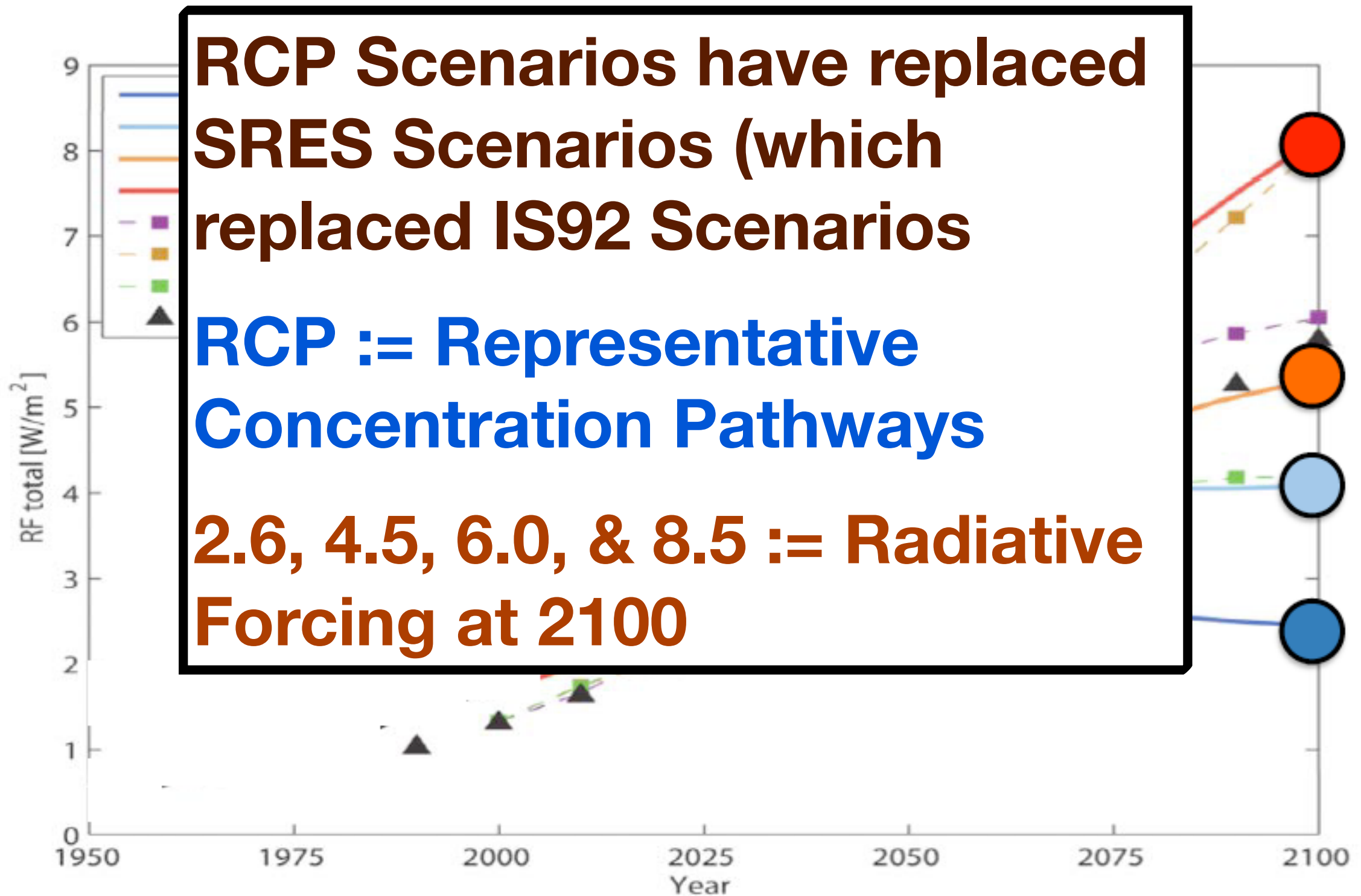
Total anthropogenic radiative forcing

IS92a (SAR), SRES (TAR/AR4), RCP (AR5)



See Fig.1.15

Total anthropogenic radiative forcing IS92a (SAR), SRES (TAR/AR4), RCP (AR5)



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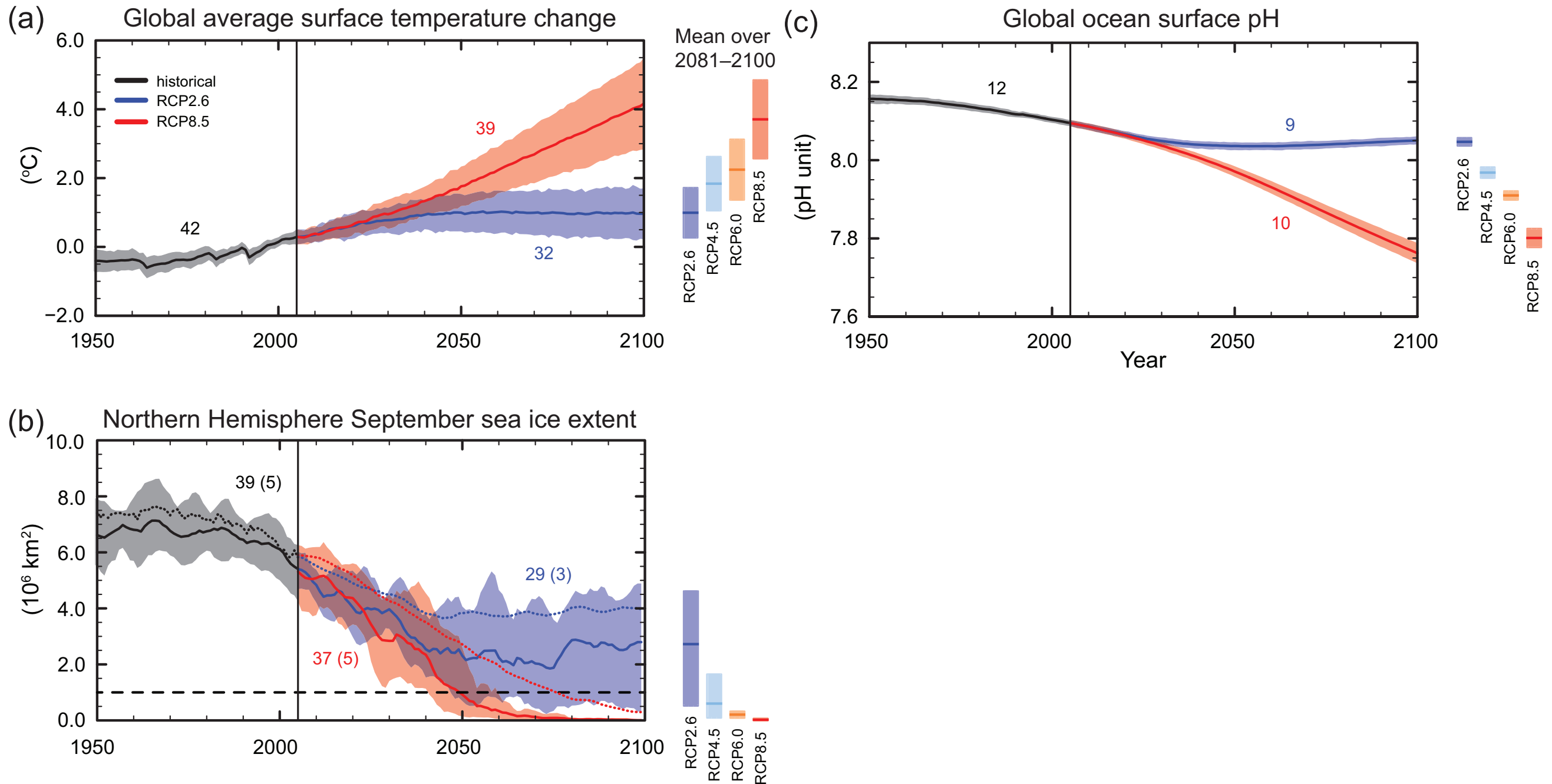
See Fig.1.15

Climate Projections using RCP Scenarios

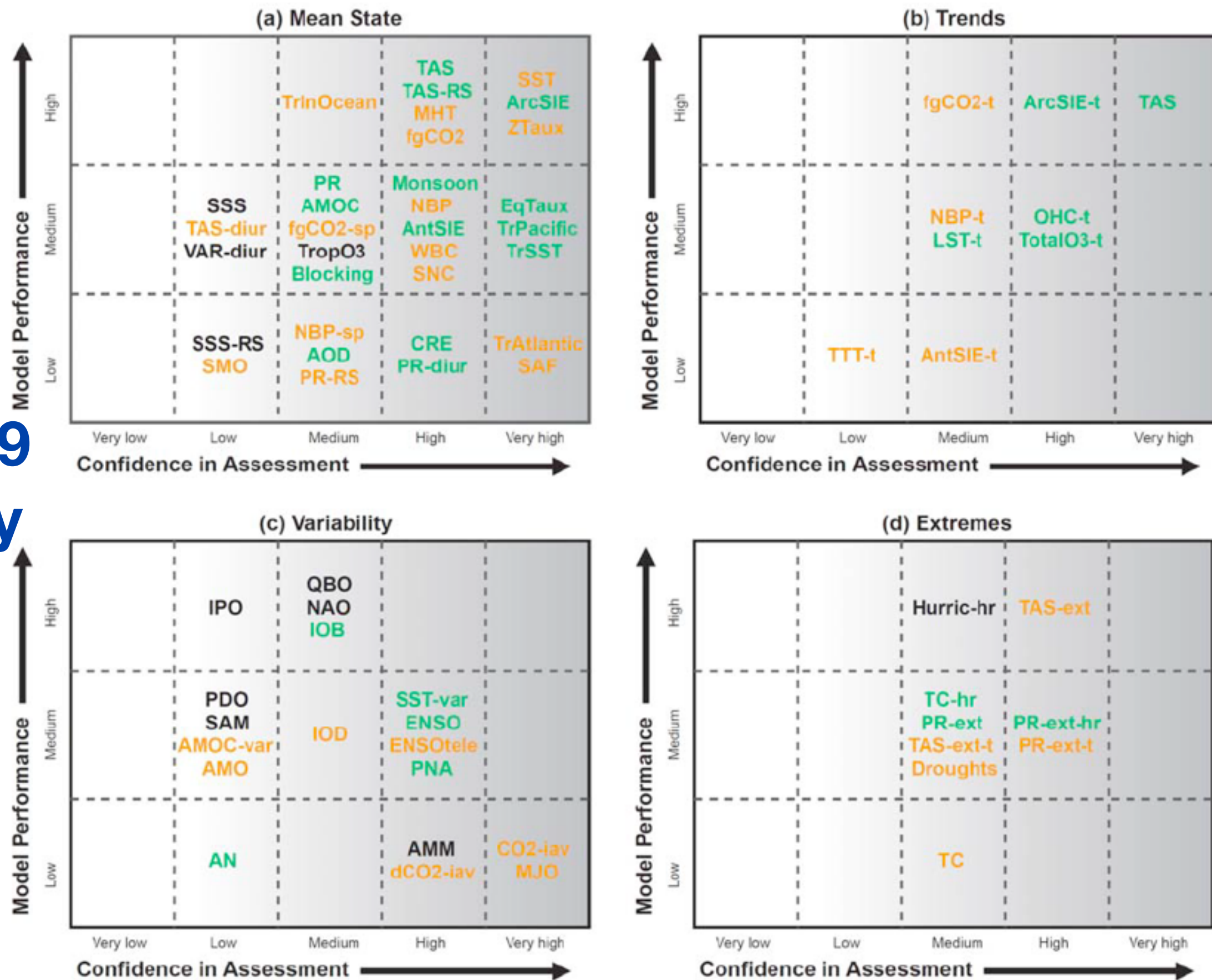
Temperature, NH Sea Ice, Ocean pH

Climate Projections using RCP Scenarios

Temperature, NH Sea Ice, Ocean pH



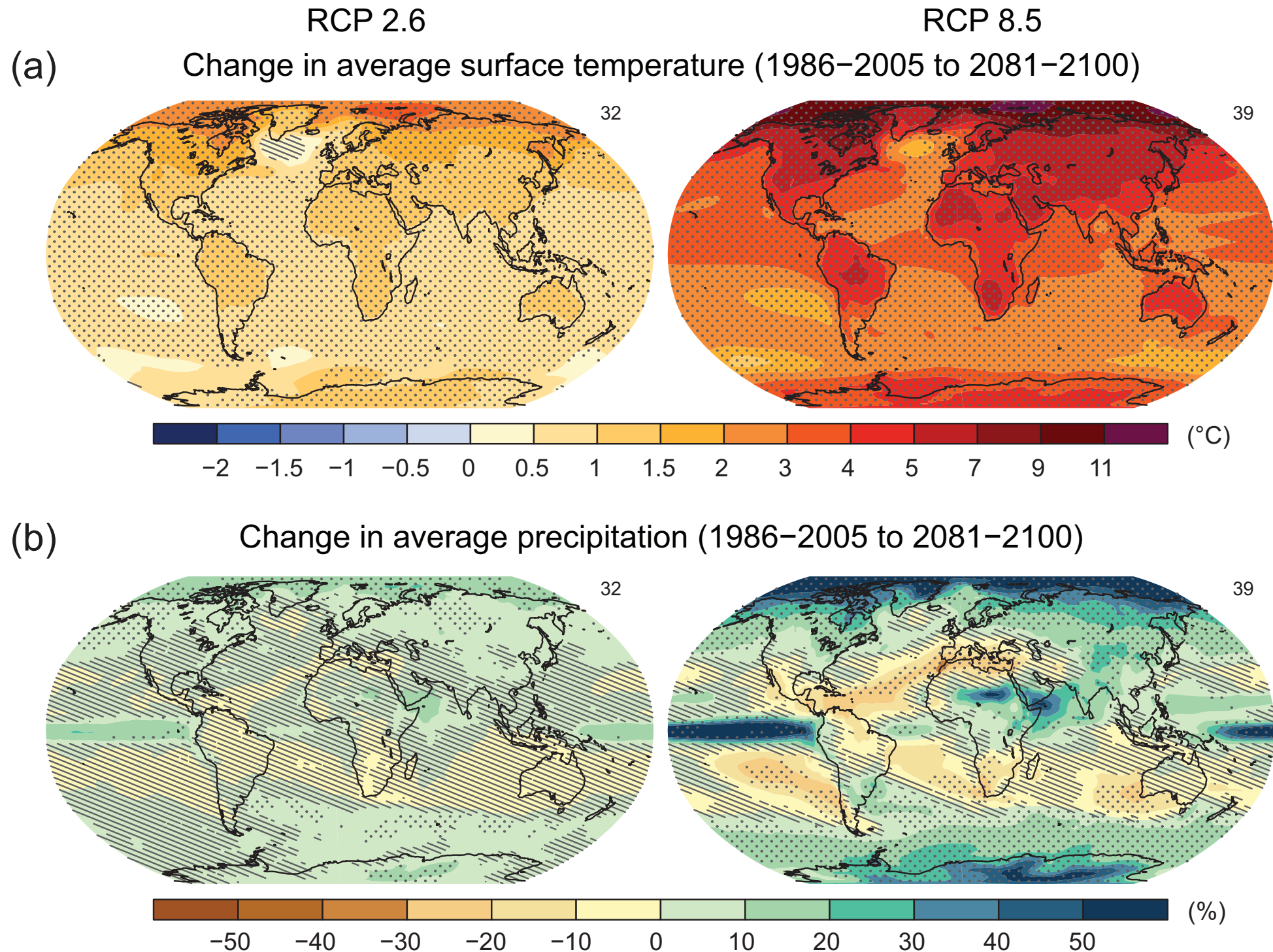
Chapter 9 Summary Figure

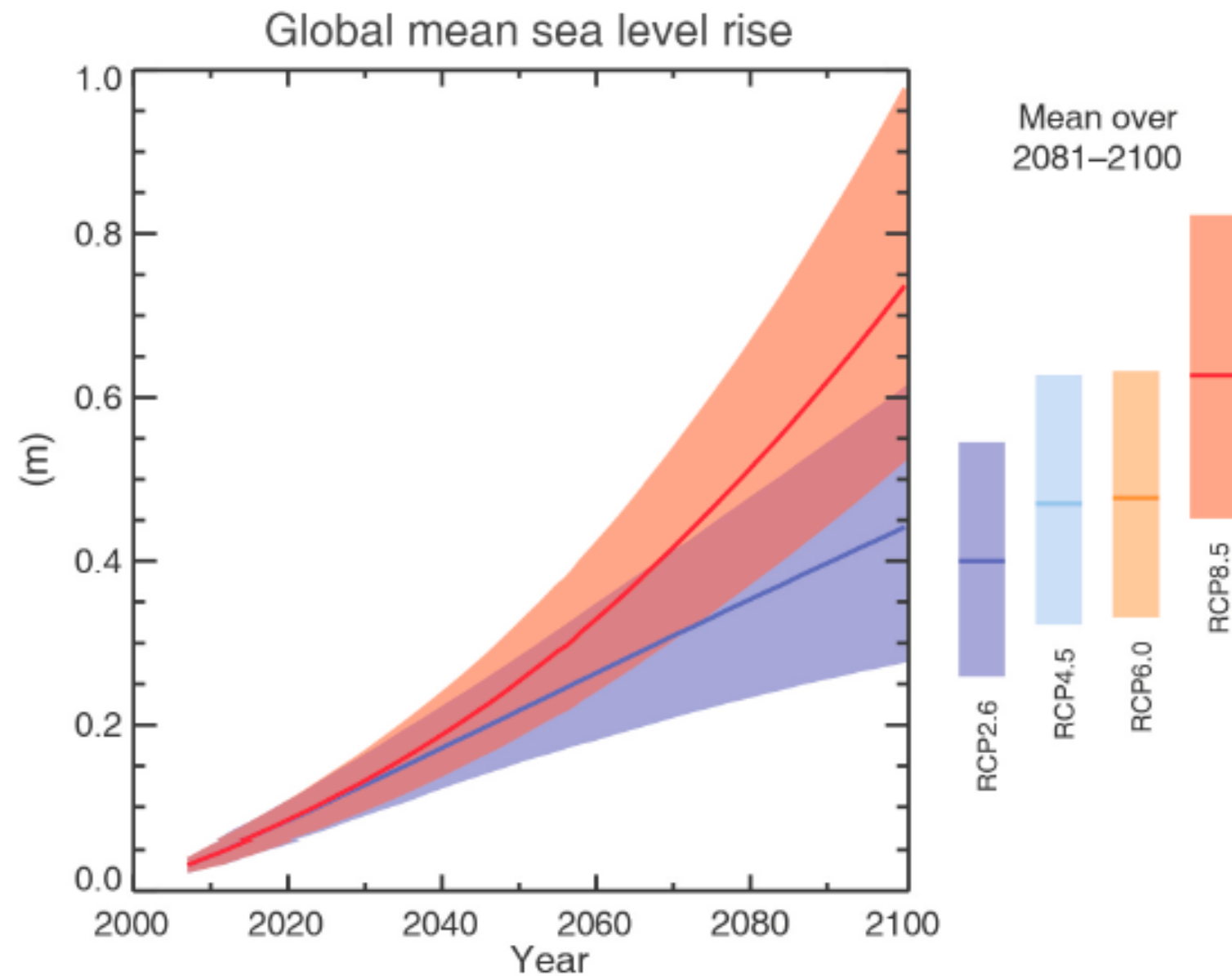


Degradation since CMIP3
 No changes since CMIP3
 Improvements since CMIP3
 No relative assessment CMIP3 vs. CMIP5

Climate Projections using RCP Scenarios

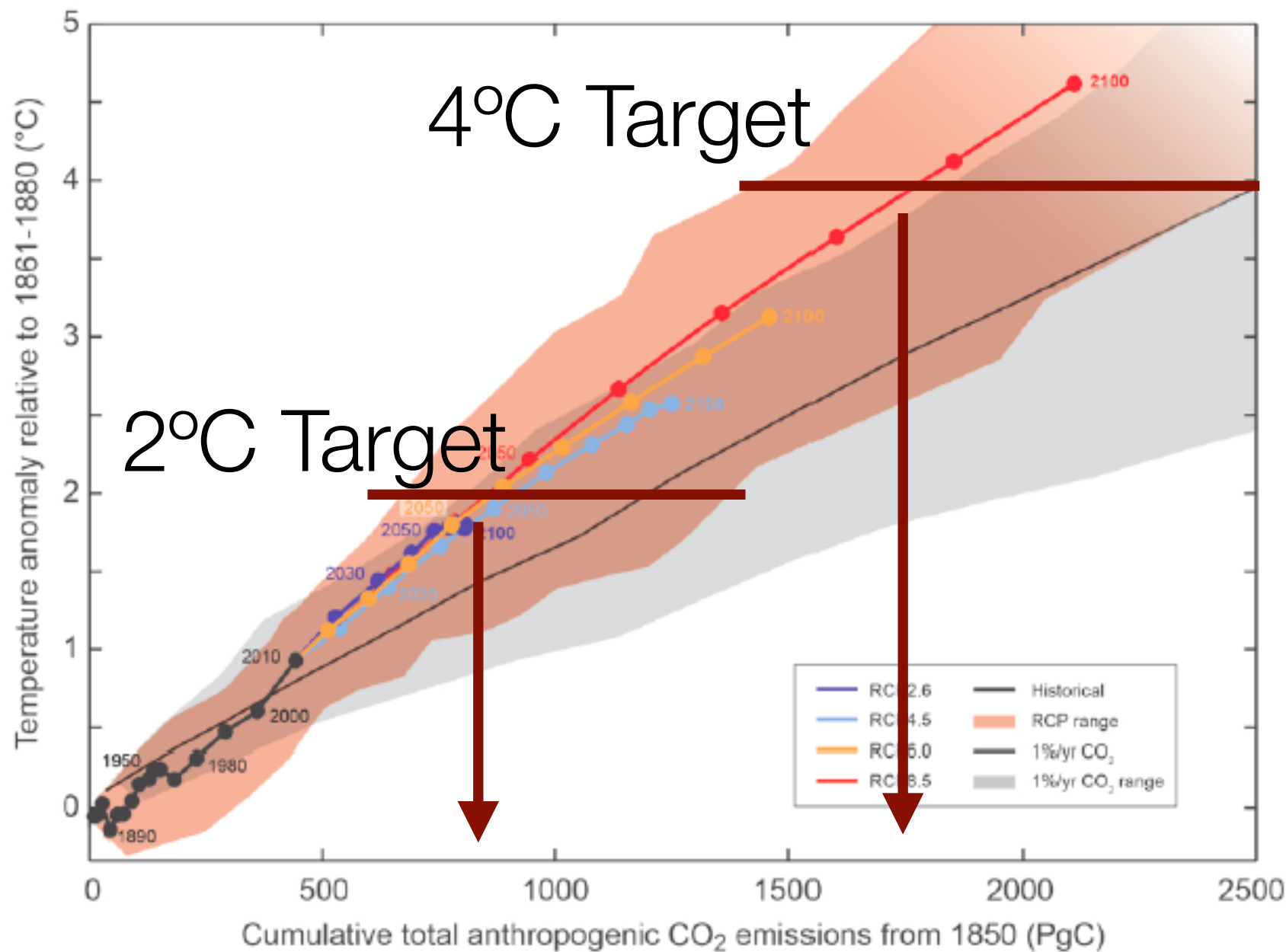
Low (RCP2.6) High (RCP8.5)





(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

Conclusions:

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- **Past: It’s still warming ... but with more observables.**
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- **New lines of evidence**
 - **Deep Ocean, Carbon-cycle, sea-ice, ocean pH**
- **New concepts**
 - **Aerosol-Cloud effective forcing**
 - **Earth System Models (emissions to response)**
 - **Cumulative Carbon Emissions → Temperature Target**