

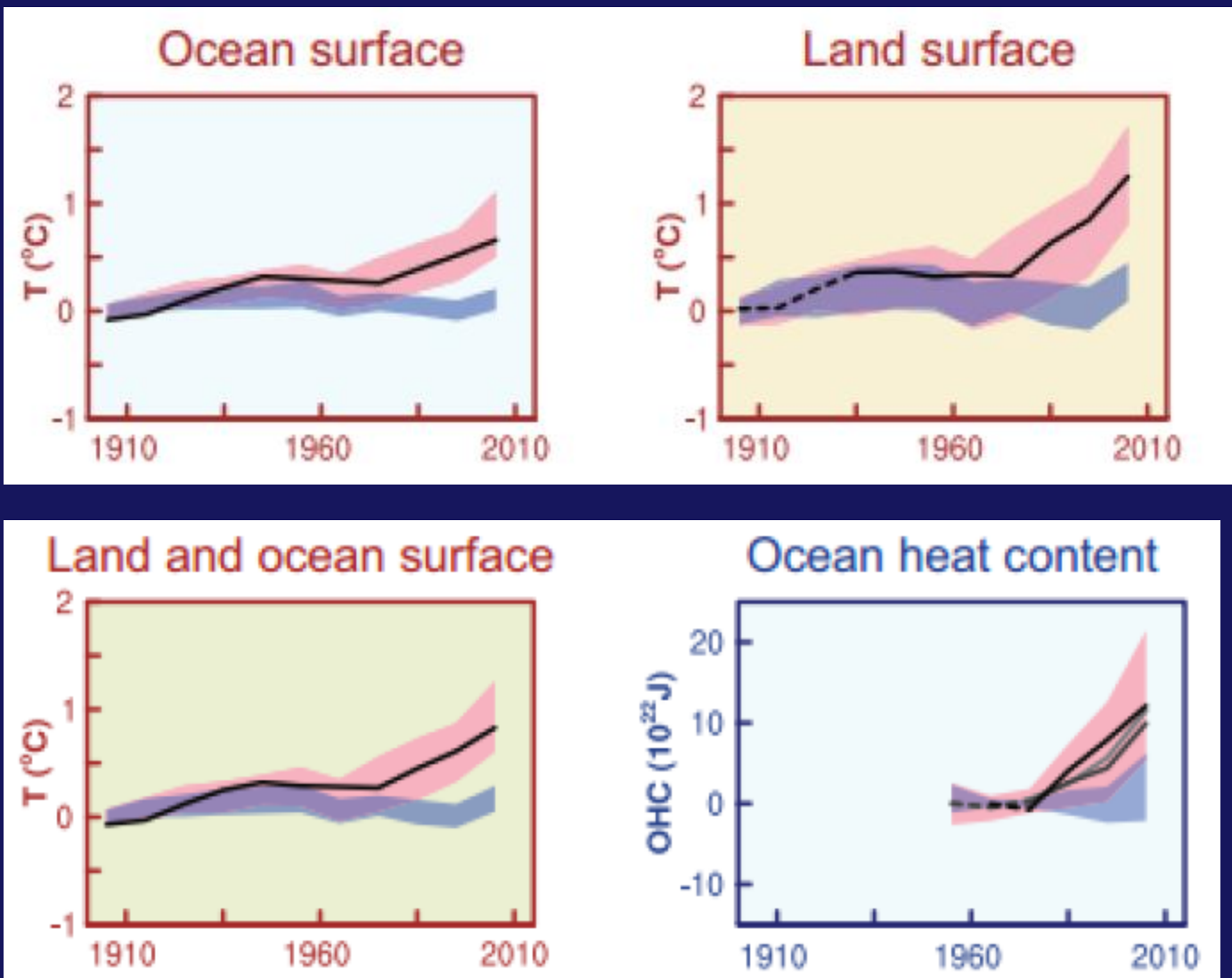
TOPIC # 13
GLOBAL WARMING &
ANTHROPOGENIC
FORCING

WRAP UP!

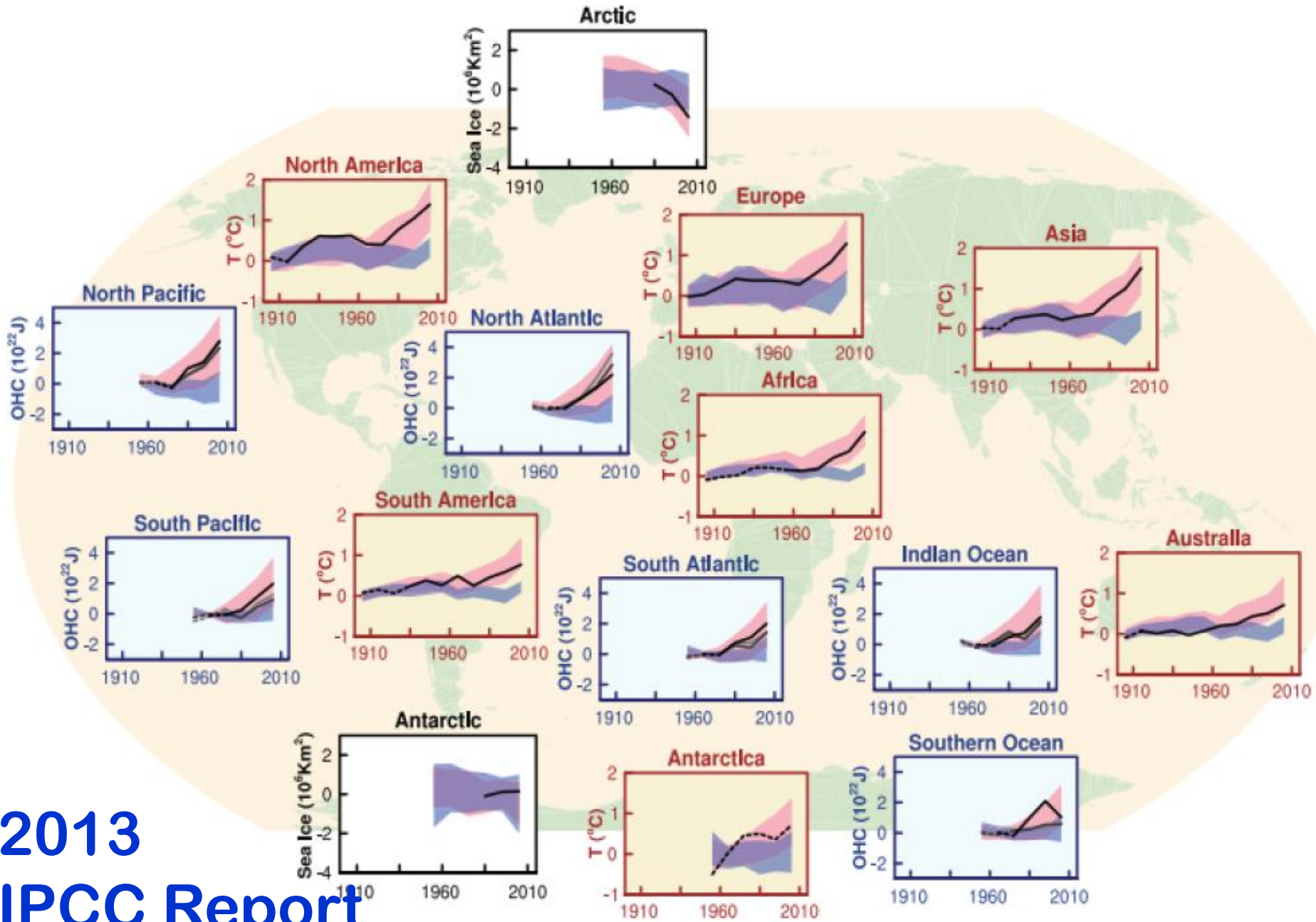
2013 IPCC Report

☰ Observations

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

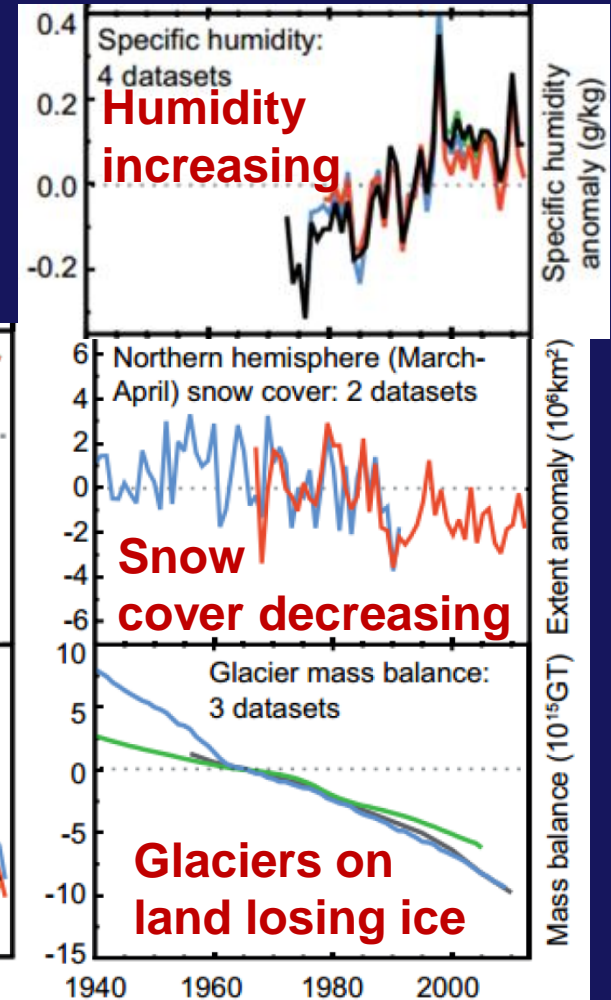
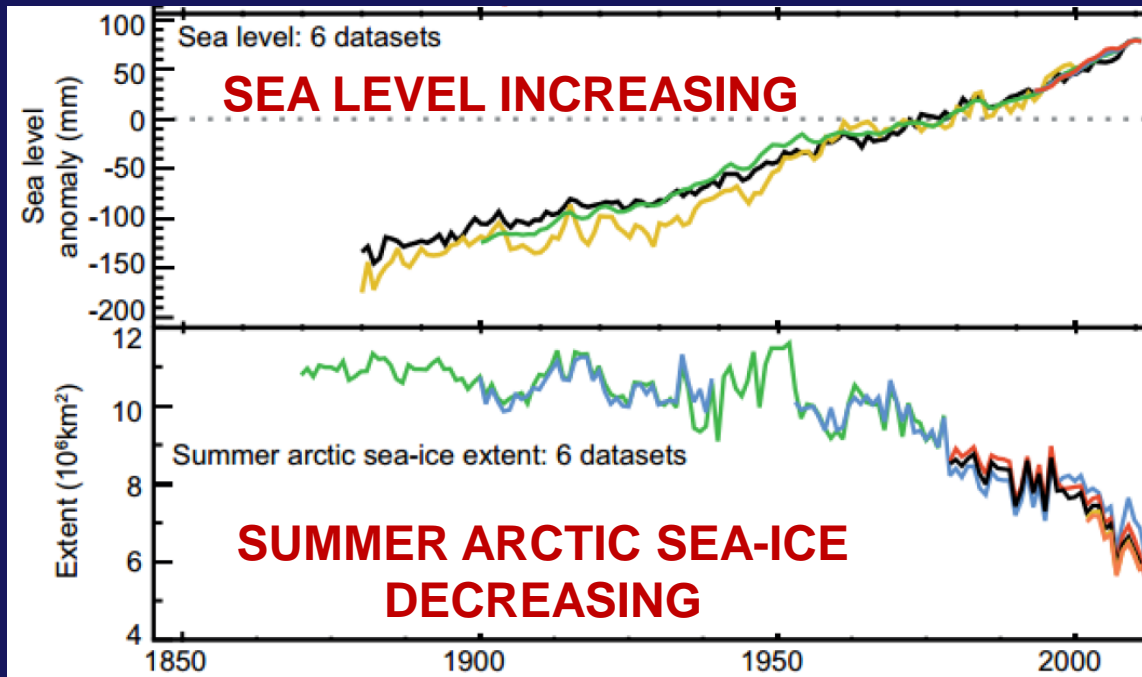


Model Comparisons of Natural vs. Anthropogenic Forcing on All Continents



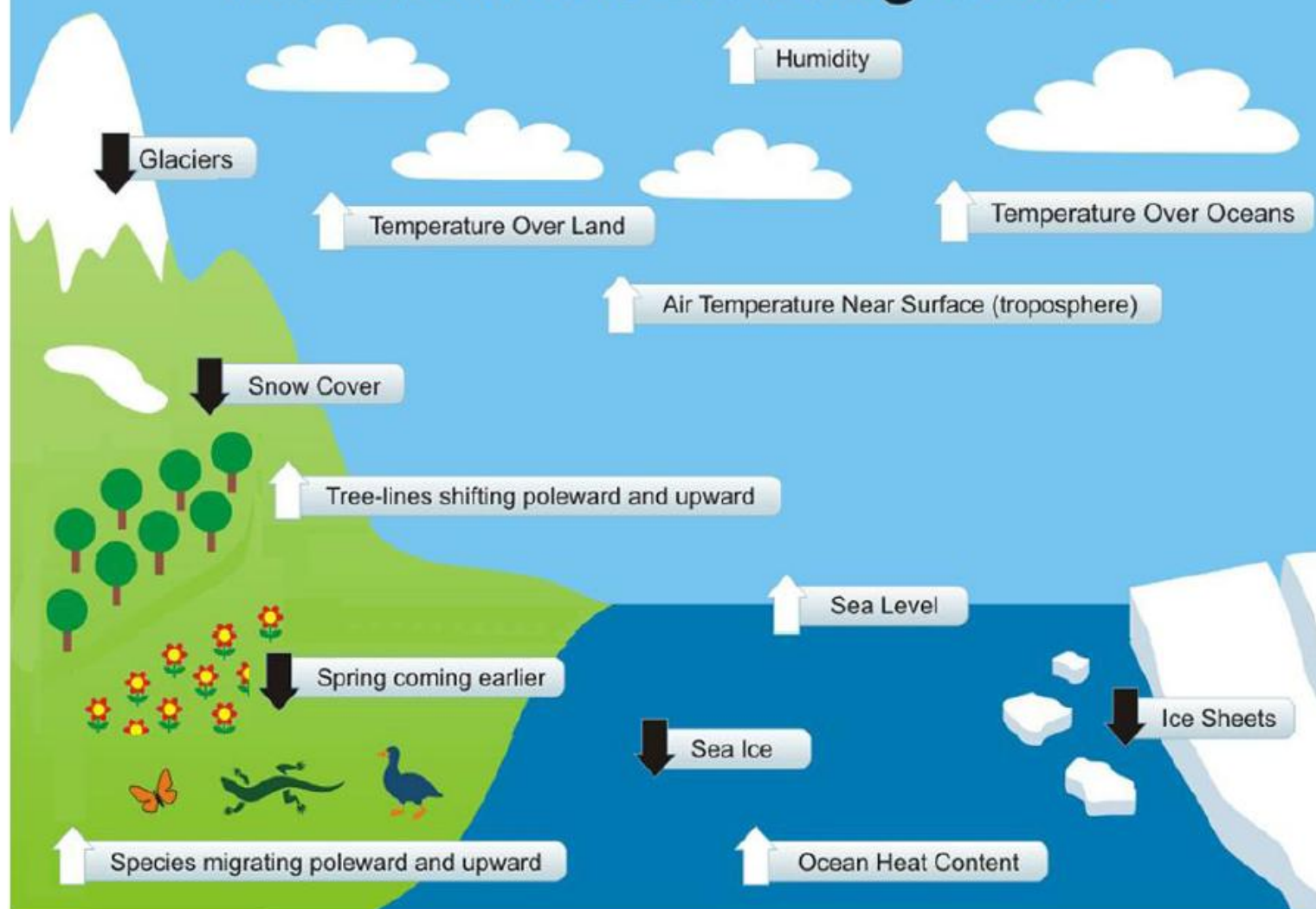
2013
IPCC Report

WHAT ELSE IS CHANGING?



THE SUMMARY: INDICATORS RECAP

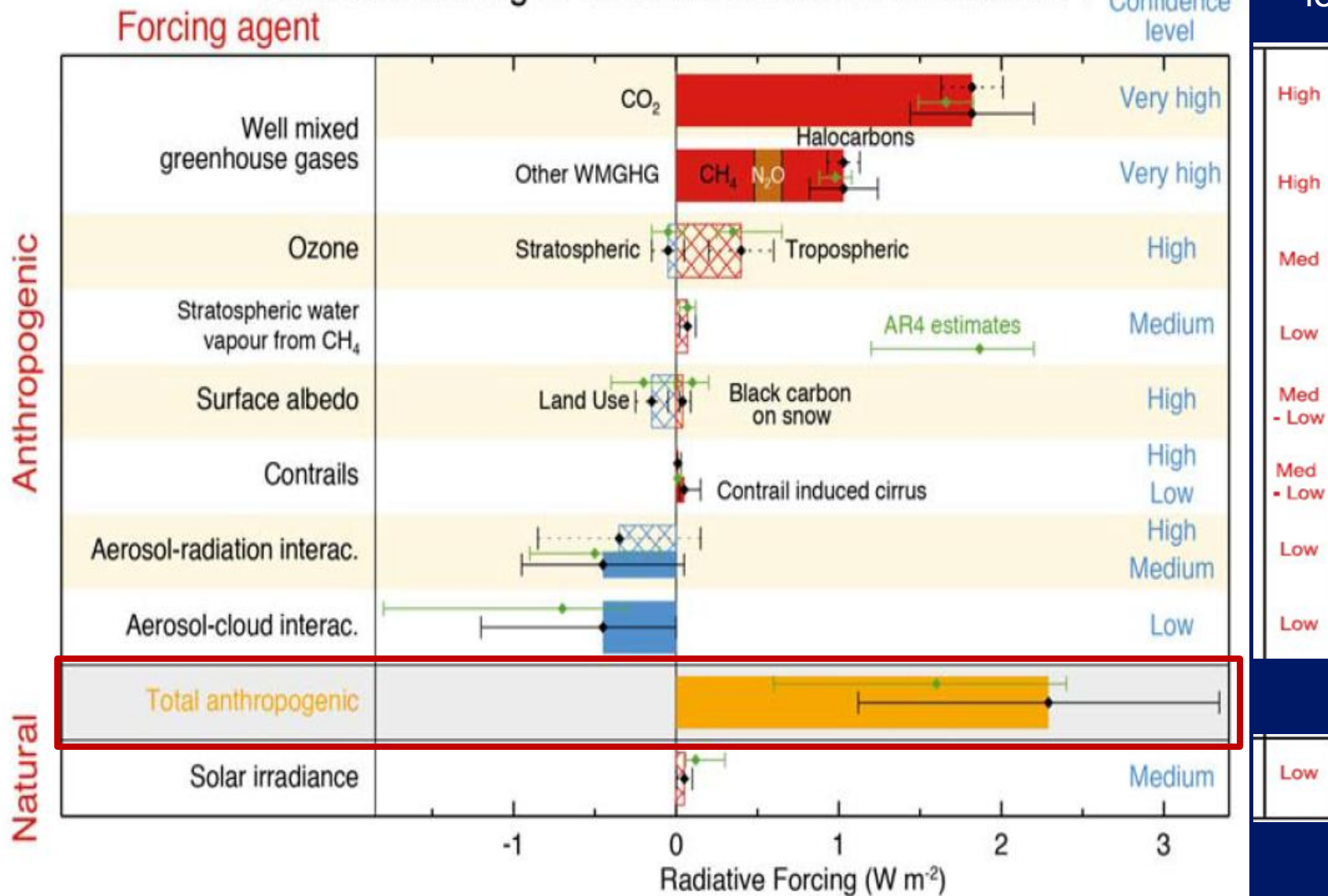
Indicators of a Warming World



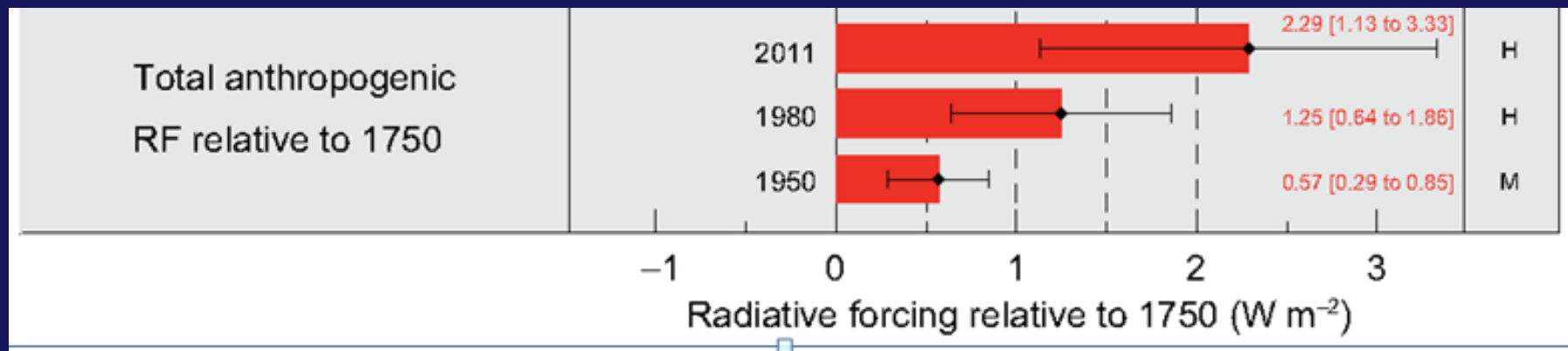
IPCC REPORTS 2007 vs 2013 in Confidence

2007
levels

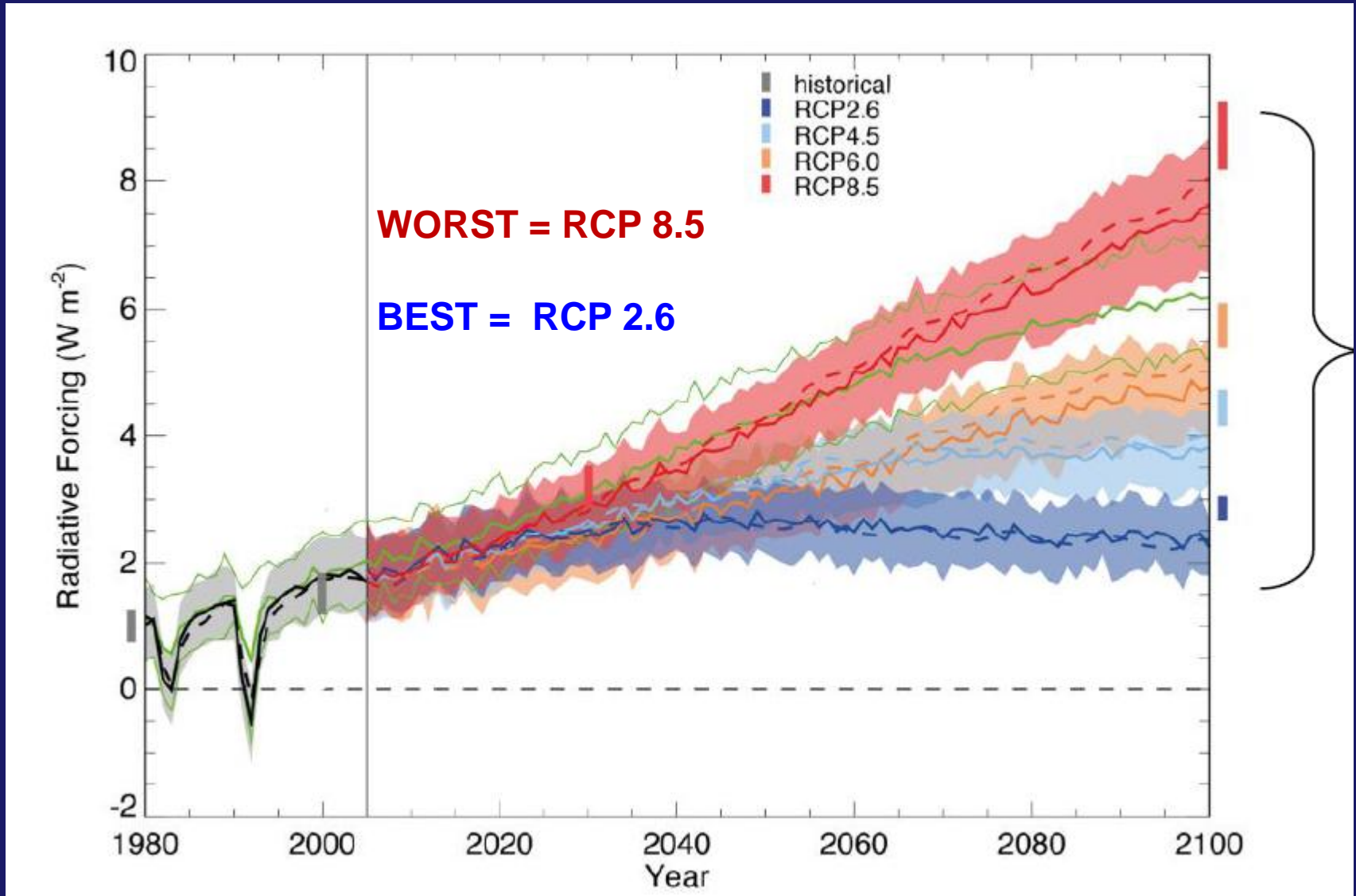
Radiative forcing of climate between 1750 and 2011



NEW: A time comparison of
**TOTAL ANTHROPOGENIC
FORCING!**



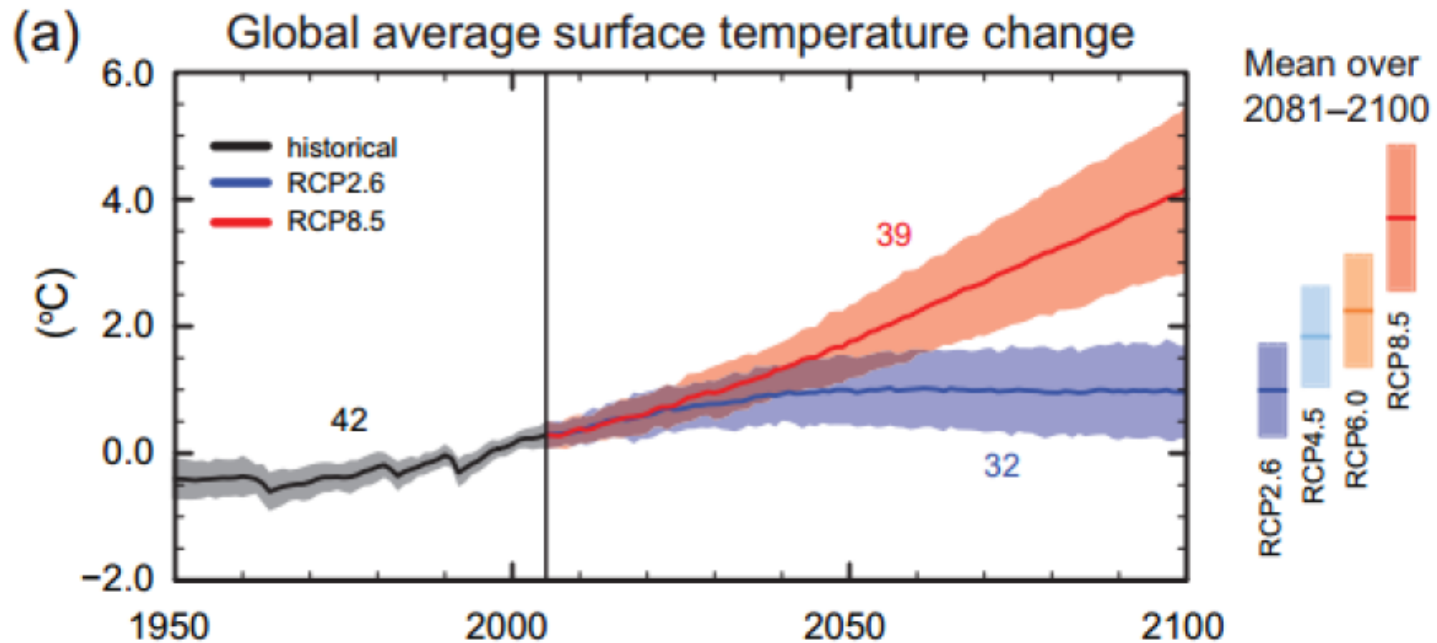
2013 REPORT: Projected RADIATIVE FORCING based on 4 NEW & DIFFFERENT Emissions Scenarios

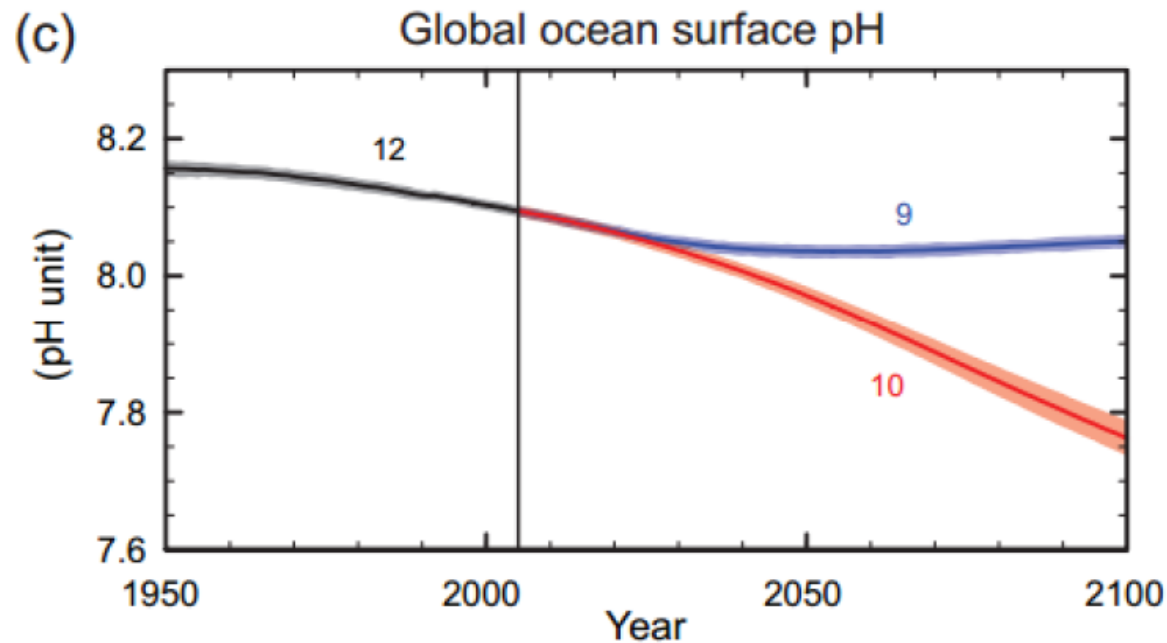
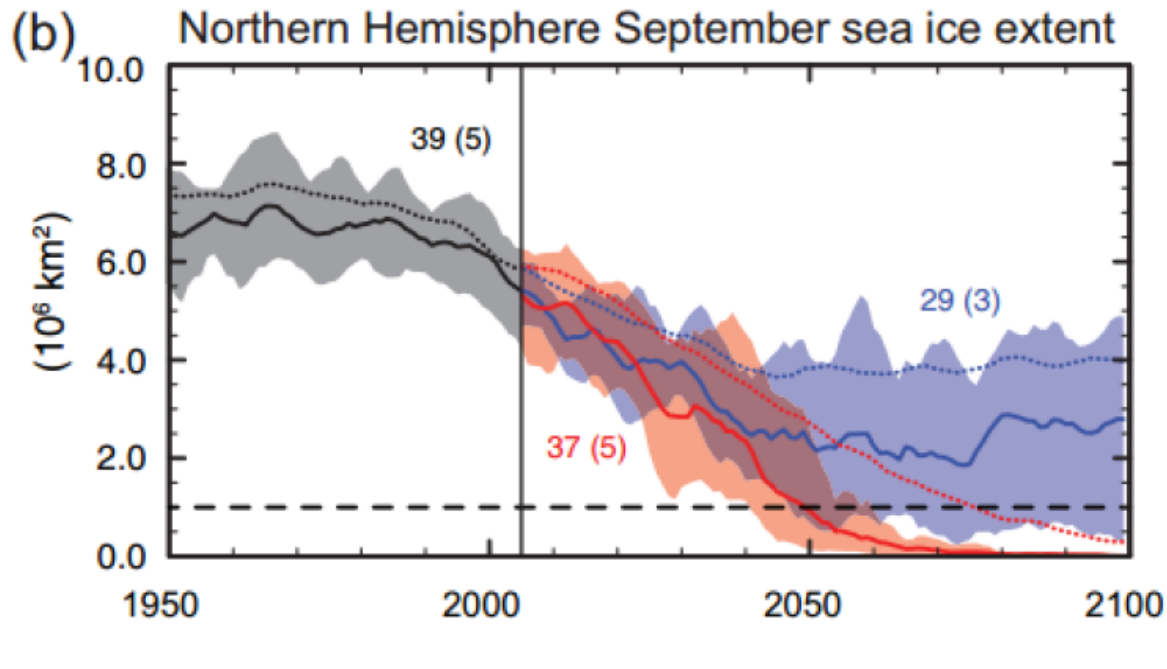


IPCC 2013 (AR5): Projected Climate Change for Different Emissions Scenarios

IPCC 2013 AR5 WG I Summary for Policy Makers Fig SPM.7

http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf





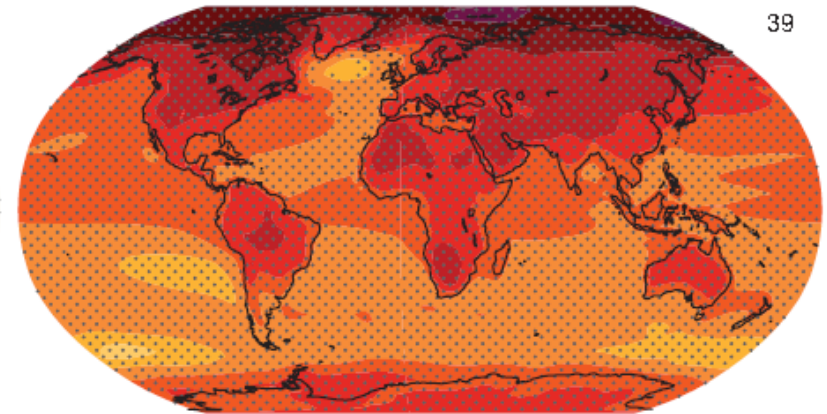
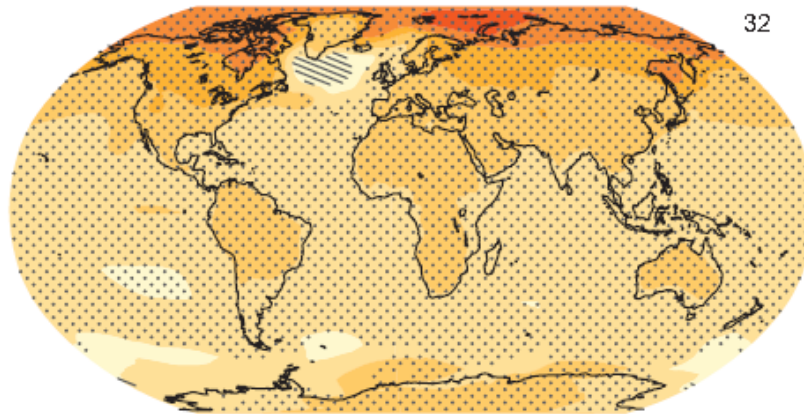
Two FUTURE SCENARIOS FROM THE 2013 REPORT:

very low forcing level

very high greenhouse gas emissions

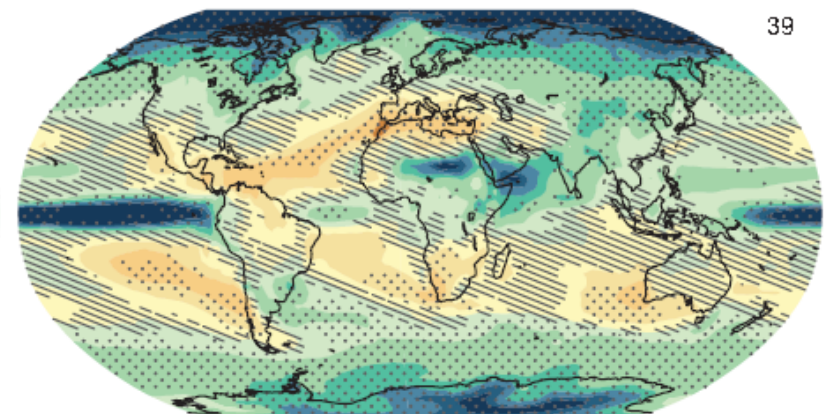
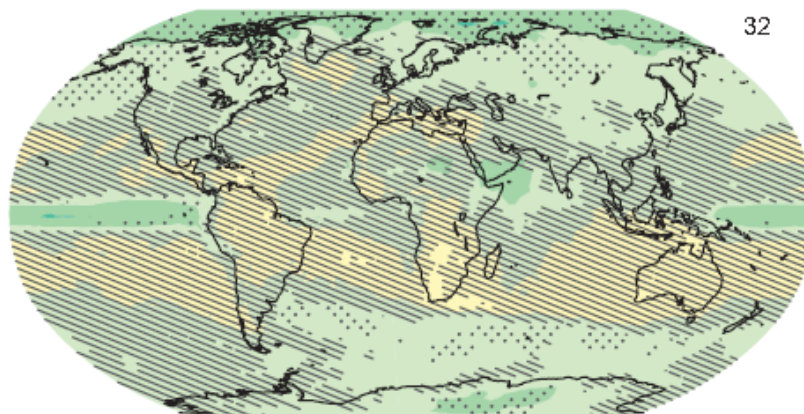
(a)

Change in average surface temperature (1986–2005 to 2081–2100)



(b)

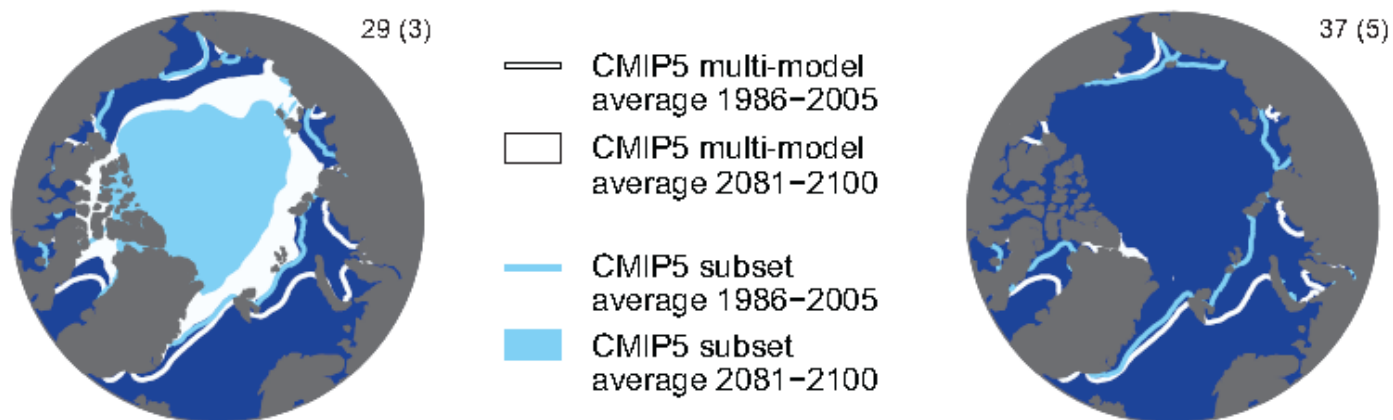
Change in average precipitation (1986–2005 to 2081–2100)



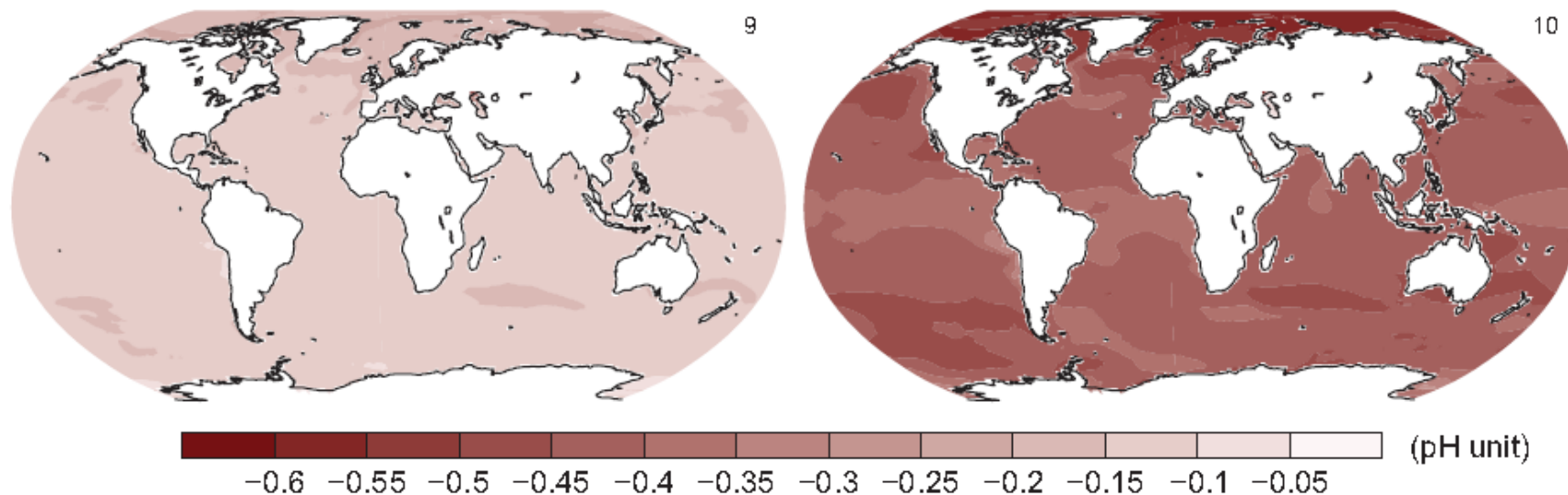
very low forcing level

very high greenhouse gas emissions

(c) Northern Hemisphere September sea ice extent (average 2081–2100)



(d) Change in ocean surface pH (1986–2005 to 2081–2100)



The most comprehensive source of information on Global Climate Change -- the IPCC



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



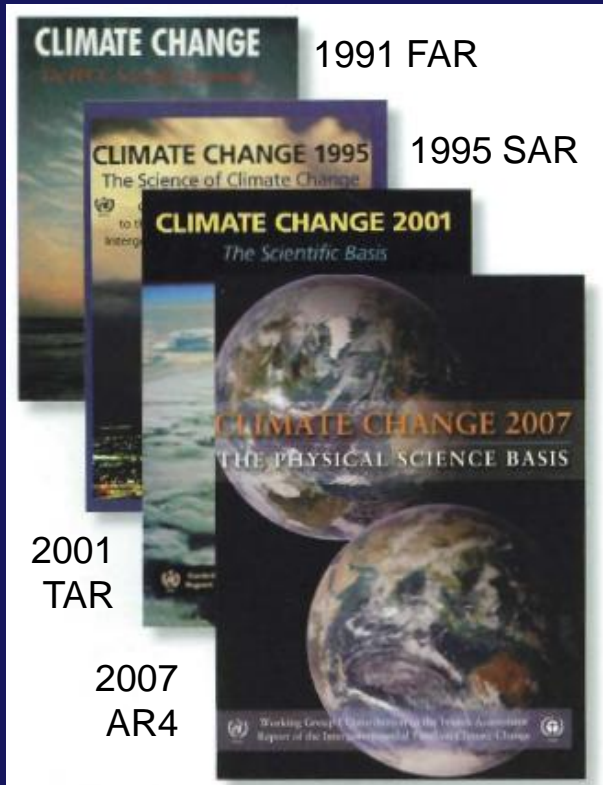
- Established by World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988 as **an objective source of information for decision-makers . . .**

“to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences” (IPCC 2007)

- The IPCC **does not conduct any research on its own**, nor does it monitor climate data or parameters.

Began with:

The “First Assessment Report” (FAR) in 1991



- Its role is **to assess on a comprehensive, objective, open and transparent basis** the latest scientific, technical and socio-economic literature to understand:

- the **risk** of human induced climate change

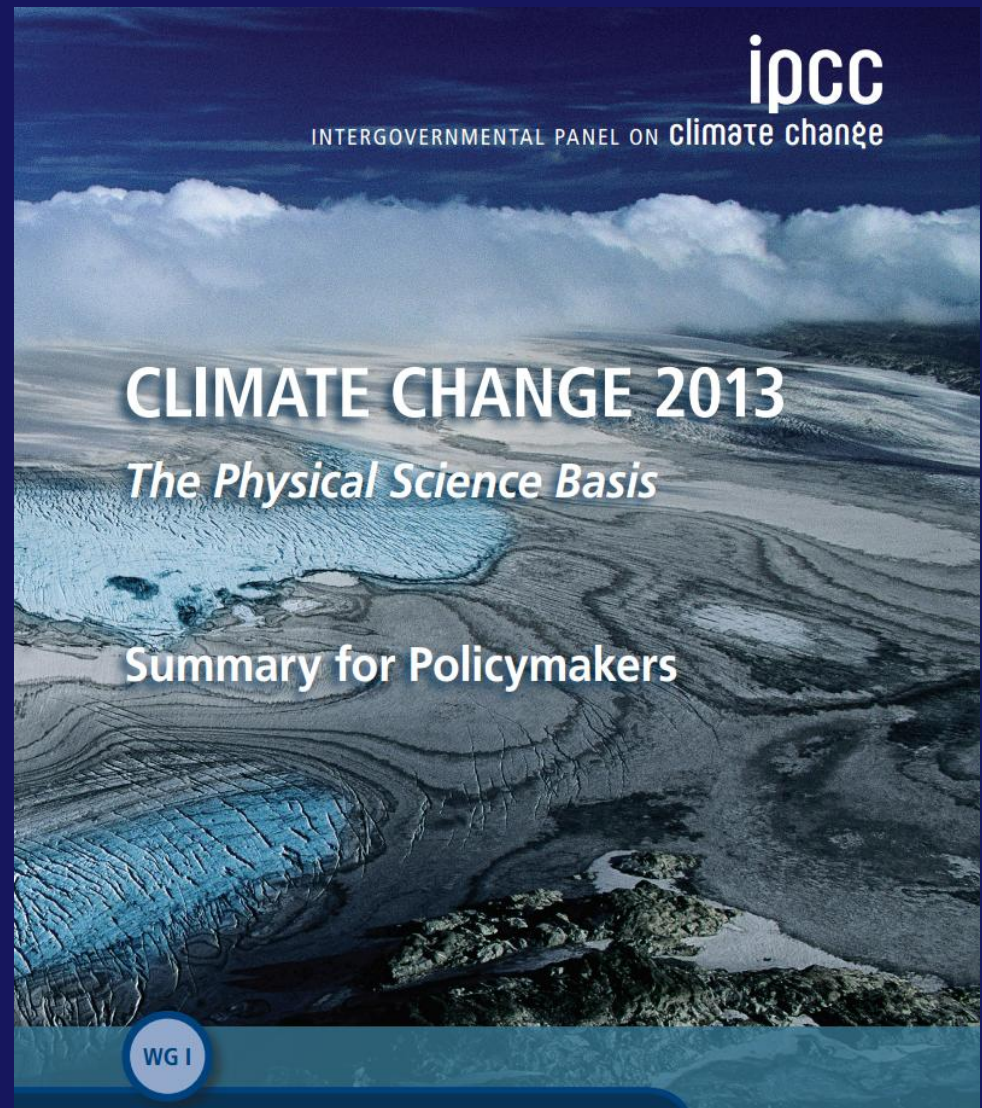
- its **observed and projected impacts** and

- options for **adaptation and mitigation.**

<http://www.ipcc.ch/>

**ASSESSMENT
REPORT 5
(AR5)**

September 2013



Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased

- The **IPCC** is a **scientific body**
- **Thousands of scientists** from all over the world contribute to the work of the IPCC on a voluntary basis.
- **PEER REVIEW** is an essential part of the IPCC process, to ensure an objective and complete assessment of current information.
- **Differing viewpoints** existing within the scientific community are reflected in the IPCC reports.

- The **IPCC** is an **intergovernmental body**, and it is open to all member countries of UN and WMO.
- Because of its scientific and intergovernmental nature, the IPCC embodies a **unique opportunity to provide rigorous and balanced scientific information to decision makers.**
- By endorsing the IPCC reports, **governments acknowledge the authority of their scientific content.**

What was NEW in the most recent reports:

Estimates of confidence in the report's results / conclusions:

- **virtually certain** (greater than 99% chance that a result is true)
- **very likely** (90-99% chance);
- **likely** (66-90% chance);
- **medium likelihood** (33-66% chance);
- **unlikely** (10-33% chance);
- **very unlikely** (1-10% chance);
- **exceptionally unlikely** (less than 1% chance).

IPCC PROJECTIONS FOR THE 21ST CENTURY

VIRTUALLY CERTAIN 99%

- Cold days and nights will be warmer and less frequent over most land areas
- Hot days and nights will be warmer and more frequent over most land areas

VIRTUALLY CERTAIN 99%

0 10 20 30 40 50 60 70 80 90

PROBABILITY (%)

- Over most land areas:

HOT DAYS & NIGHTS will be WARMER;
and MORE FREQUENT



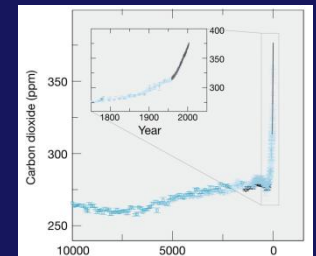
IPCC PROJECTIONS FOR THE 21ST CENTURY

VERY LIKELY 90%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by more than 1.5°C
- The warming over inhabited continents by 2030 will be about double the observed variability during the 20th century
- There will be an observed increase in methane concentration due to human activities
- The rate of increase in atmospheric CO₂, methane, and nitrous oxide will reach levels unprecedented in the last 10,000 years
- The frequency of warm spells and heat waves will increase
- The frequency of heavy precipitation events will increase
- Precipitation amounts will increase in high latitudes
- The ocean's conveyor-belt circulation will weaken or shut down abruptly

VERY LIKELY 90%

- the **RATE** of increase of **GHG's** will be **UNPRECEDENTED** in past 10,000 yrs
- Frequency of **HEAVY PRECIPITATION EVENTS** will INCREASE



IPCC PROJECTIONS FOR THE 21ST CENTURY

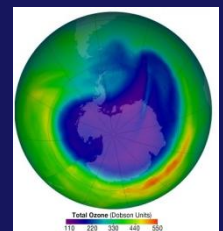
LIKELY 66%

- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by between 2°C and 4.5°C
- The future increase in global average surface temperature will be between -40% and +60% of the values predicted by climate models
- Areas affected by drought will increase
- The number of frost days will decrease, and growing seasons will lengthen
- Intense tropical cyclone activity will increase, with greater wind speeds and heavier precipitation
- Extreme high-sea-level events will increase, as will ocean wave heights of mid-latitude storms
- Precipitation amounts will decline in the subtropics
- The loss of glaciers will accelerate in the next few decades
- Climate change will promote ozone-hole expansion, despite an overall decline in ozone-destroying chemicals

LIKELY 66%



- Extreme **HIGH SEA LEVEL** events will increase
- **SUBTROPICS** (that's us!) will experience **PRECIPITATION DECLINE**
- Stratospheric cooling → **ozone hole persistence** even **WITH** ban of CFC's!



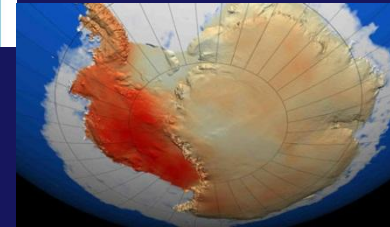
IPCC PROJECTIONS FOR THE 21ST CENTURY

AS LIKELY AS NOT 35 - 50%

- The West Antarctic ice sheet will pass the melting point if global warming exceeds 5°C

ABOUT AS LIKELY AS NOT 35-50%

- **W. ANTARCTIC ICE SHEET MELTING** (if Temp > 5° C)



UNLIKELY 35%

- Antarctic and Greenland ice sheets will collapse due to surface warming

UNLIKELY

- **ANTARCTIC & GREENLAND ICE SHEETS COLLAPSE**

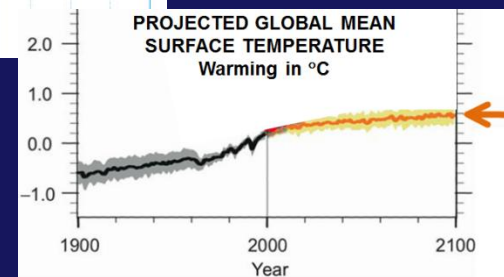


VERY UNLIKELY 10%

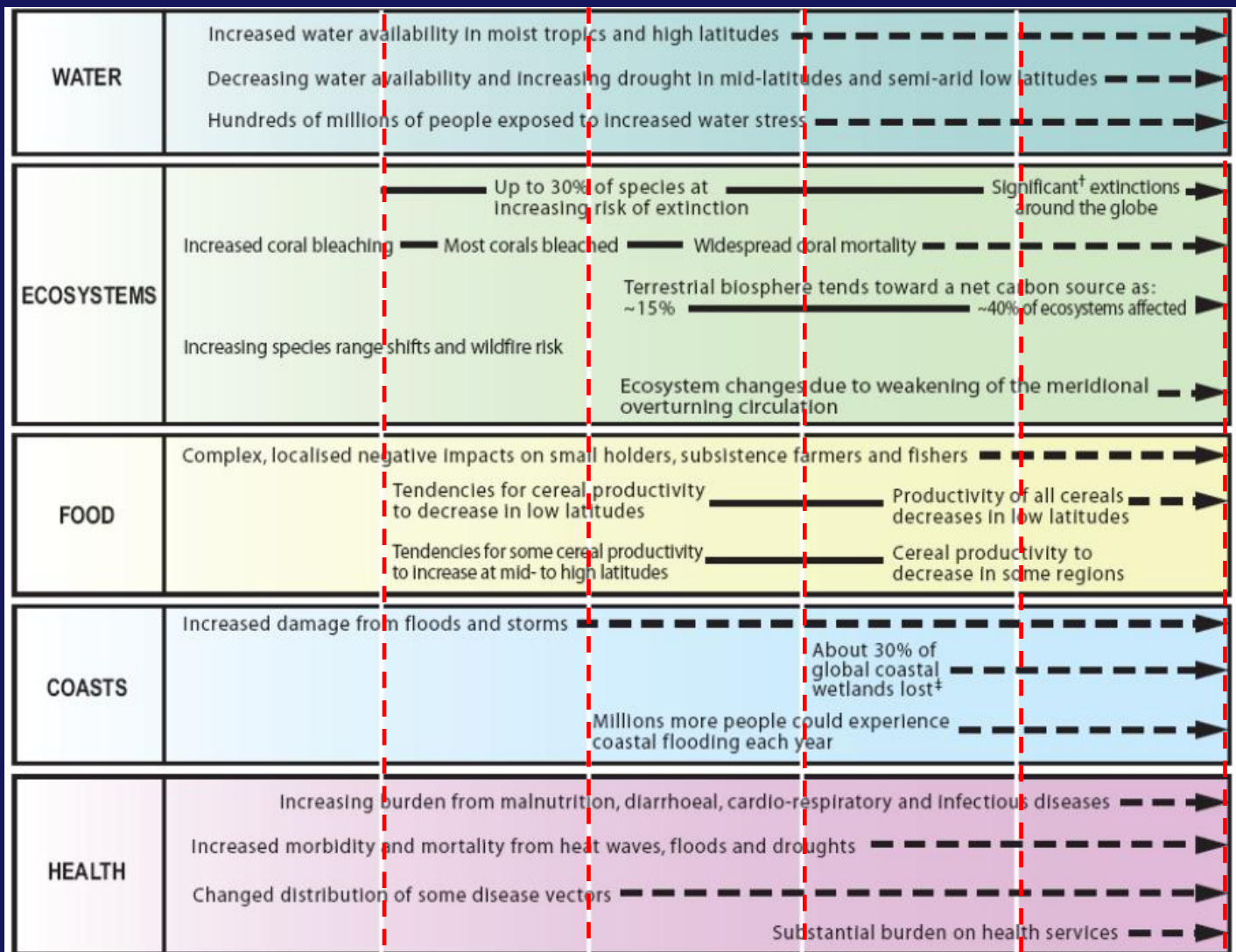
- The ocean's conveyer-belt circulation will suffer an abrupt transition
- If the atmospheric CO₂ level stabilizes at double the present level, global temperatures will rise by less than 1.5°C

VERY UNLIKELY 10%

- **GLOBAL TEMPERATURES** will rise by LESS than 1.5° C (if CO₂ stabilizes at 2x)



Examples of IMPACTS associated with global average annual temperature change (relative to 1980-1999 average temperature)



1°C 2°C 3°C 4°C 5°C

TOPIC #14

WHERE DO WE GO FROM
HERE?

p 89 in Class Notes

COP 21
PARIS TALKS
2015



**Small, low income, vulnerable people & nations:
They are least responsible,
yet likely to be impacted the most!**

G-7 Exploring the Data



GROUP ACTIVITY