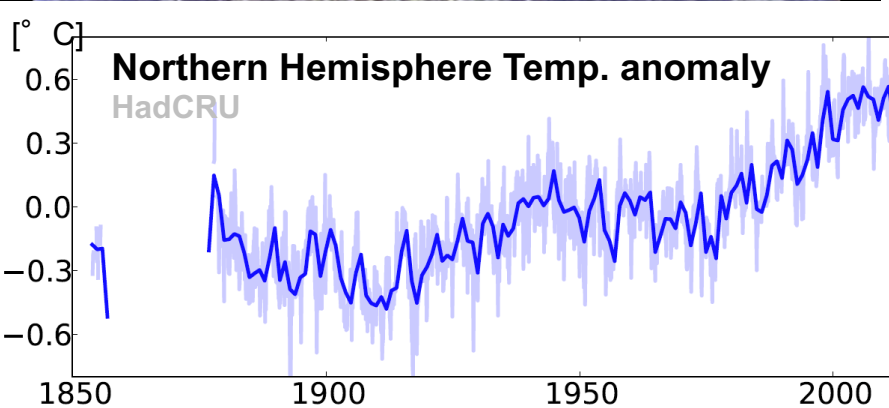


# Towards a global sustainable development of our Earth



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**Alfred Wegener Institut  
Helmholtz Zentrum für Polar-  
und Meeresforschung  
Bremerhaven**

**Universität Bremen**

LC Bremen Cosmopolitan  
Bremen May 22, 2010

## Bremerhaven 70 km north of Bremen



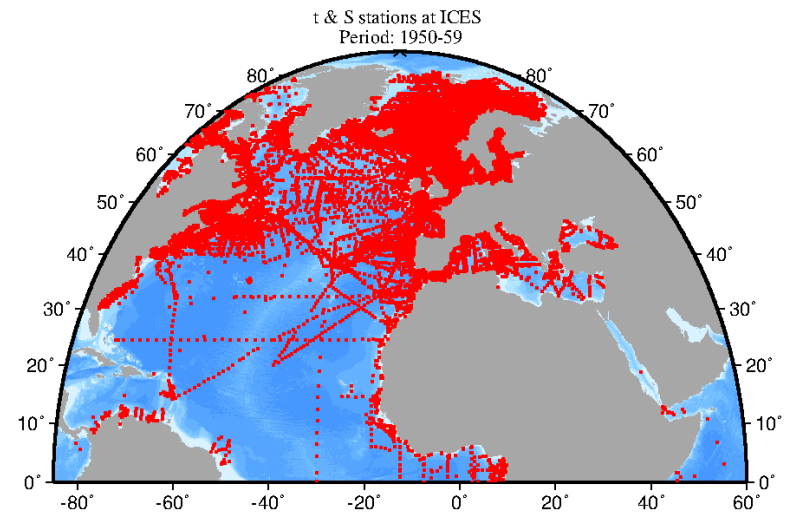
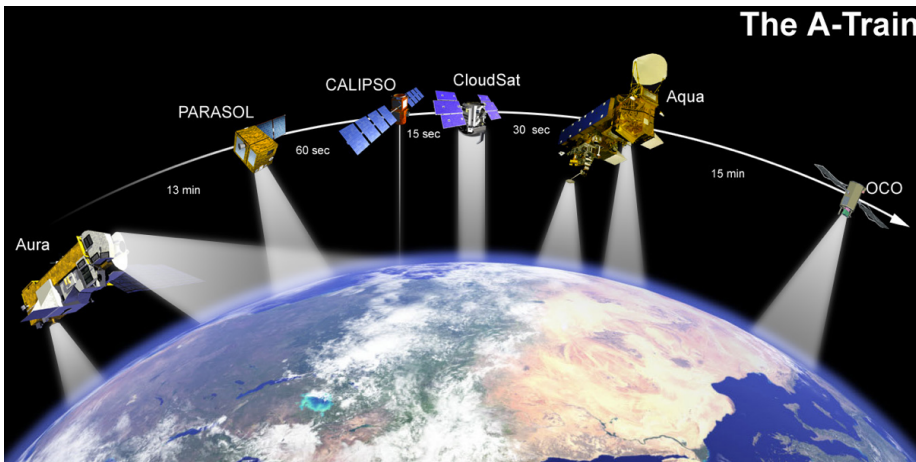
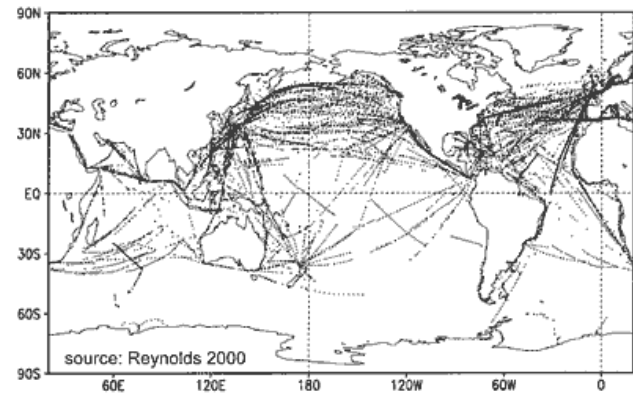
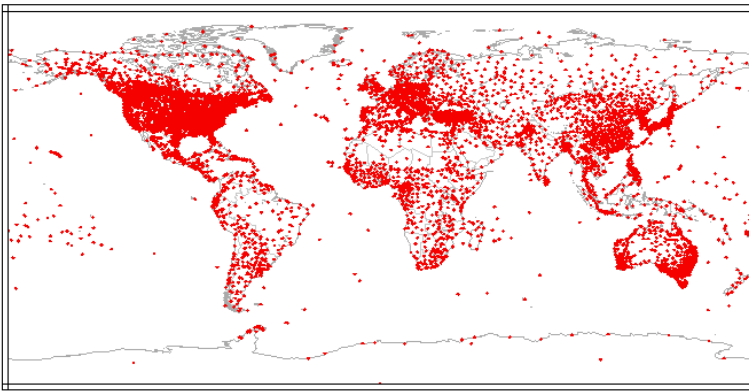
<https://mosaic-expedition.org>



# How do we *know* what's happening to the temperature on Earth?

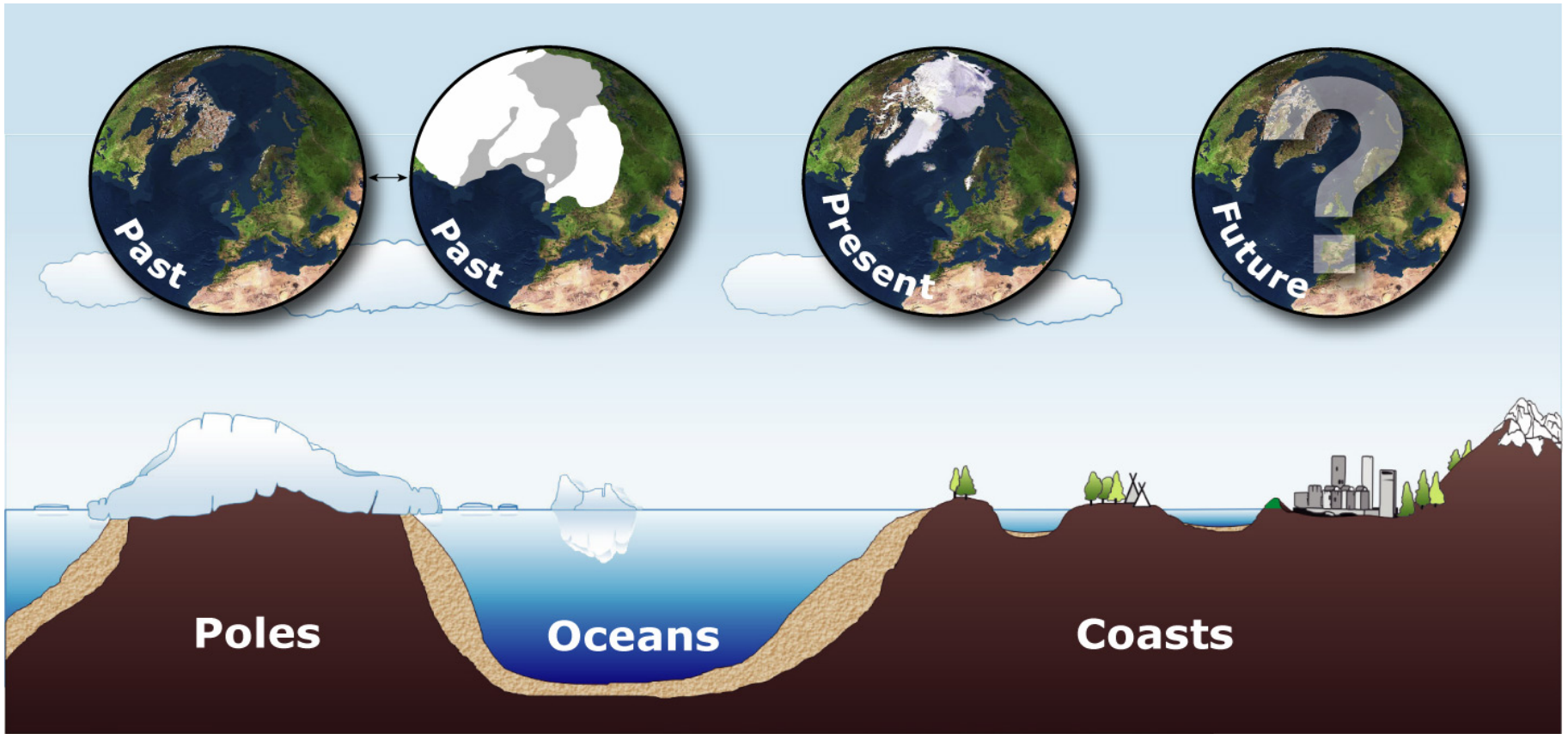
*The instrumental record: thermometers, barometers, etc*

GHCN v2.0 Mean Temperature Stations

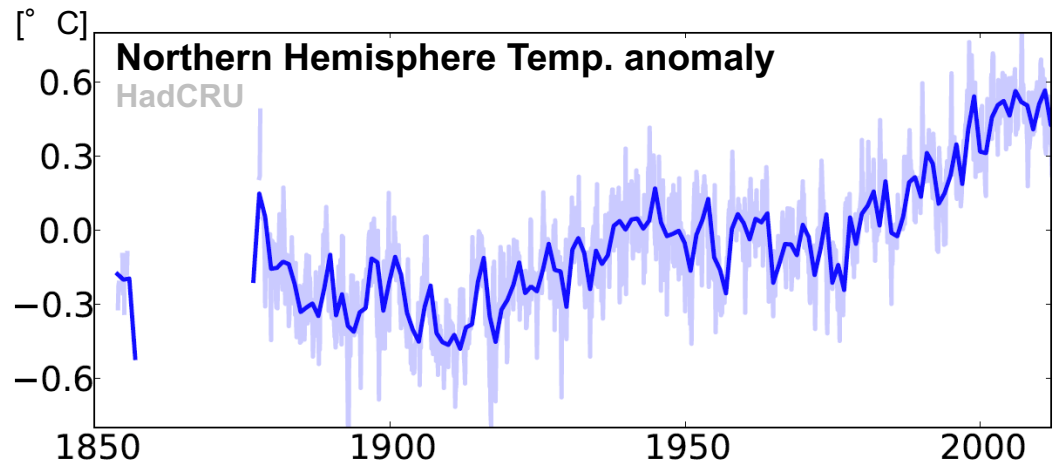


<http://www.weather.gov/timeline>

<http://www.ncdc.noaa.gov/img/climate/research/ghcn/ghcnv2.mean.gif>



**Is the warming and  
CO<sub>2</sub> rise  
unprecedented?**



# Earth System Analysis



Ice drilling camp, 2009



Polarstern, marine sediments



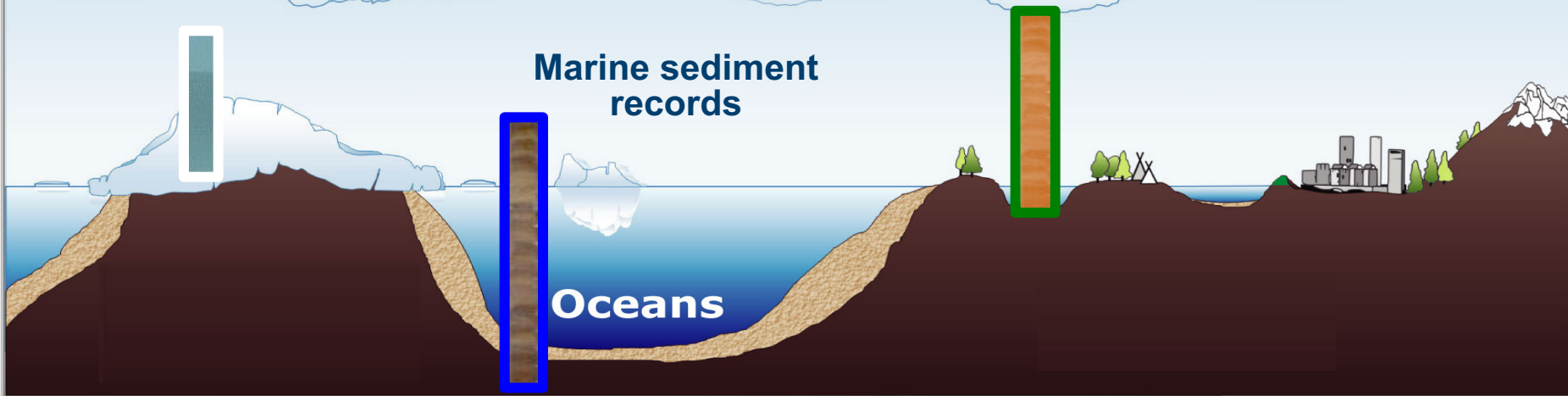
Lake/permafrost sediments

Climate records from  
ice cores

Lake/permafrost  
sediment records

Marine sediment  
records

Oceans



# Earth System Analysis



Ice drilling camp, 2009



Polarstern, marine sediments



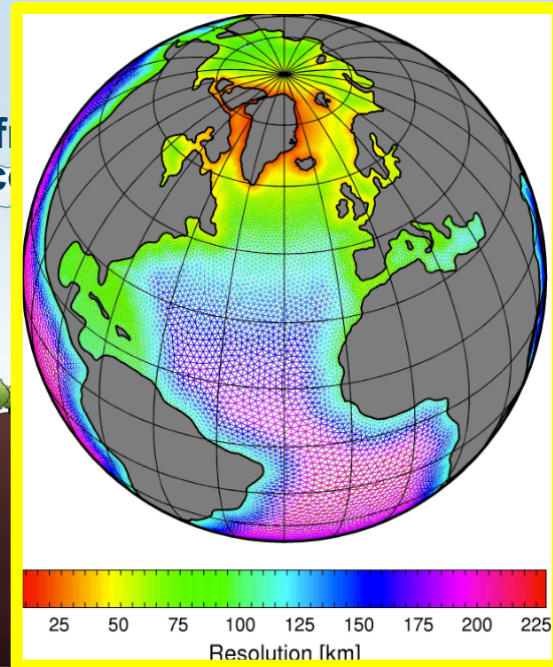
Lake/permafrost sediments

Climate records from  
ice cores

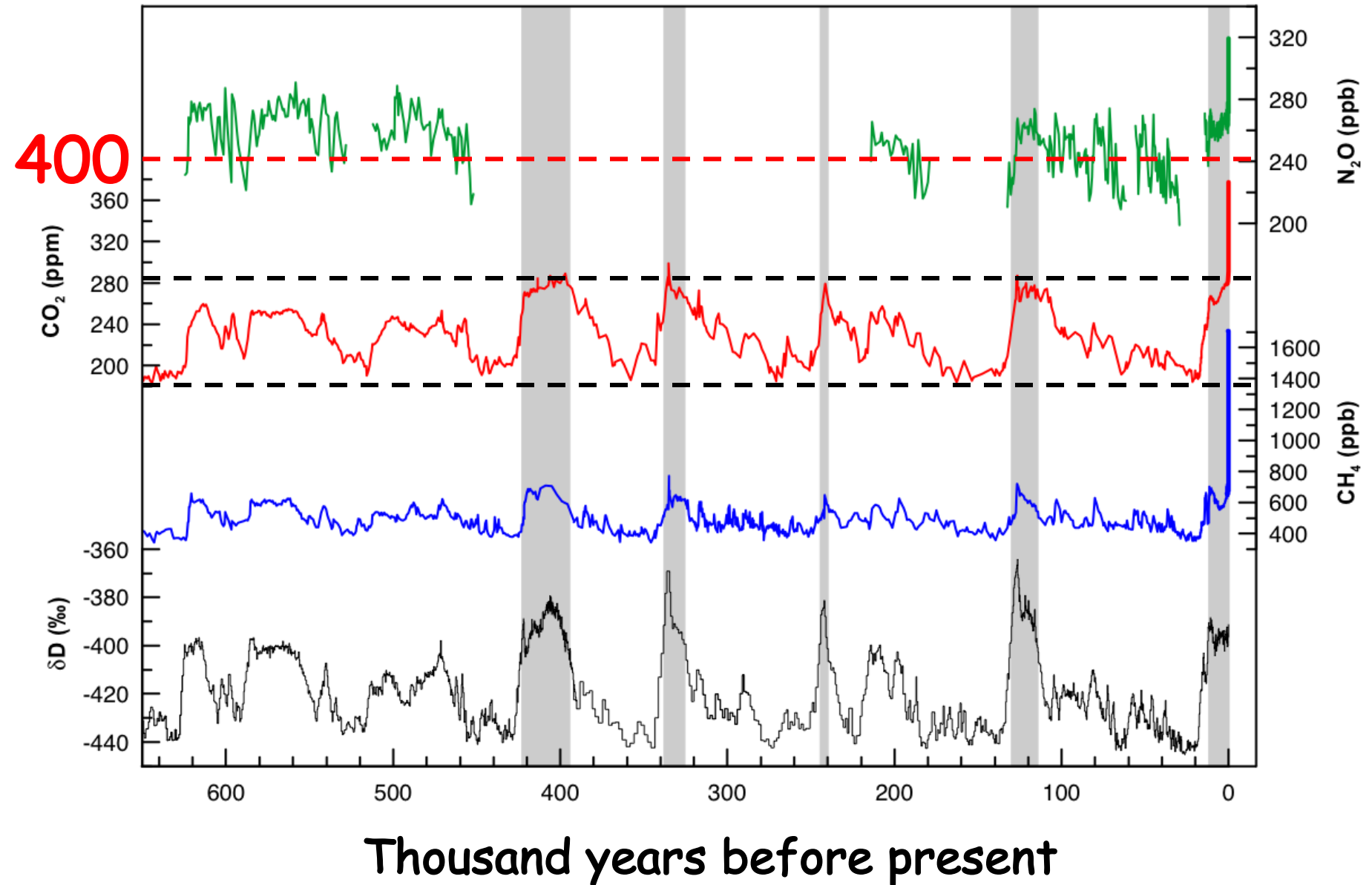
Lake/permafrost  
sediment records

Marine sediment  
records

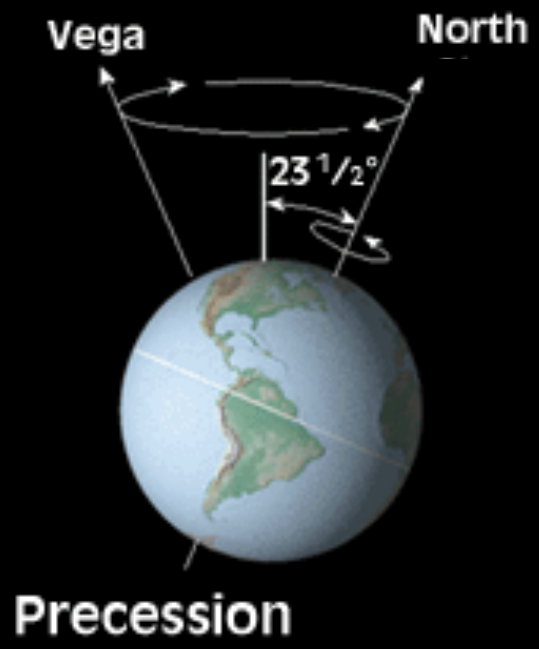
Oceans



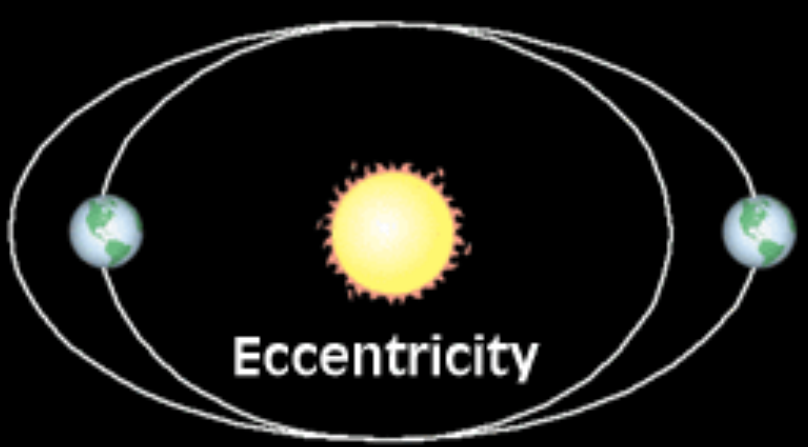
# Greenhouse gas concentrations: Ice cores





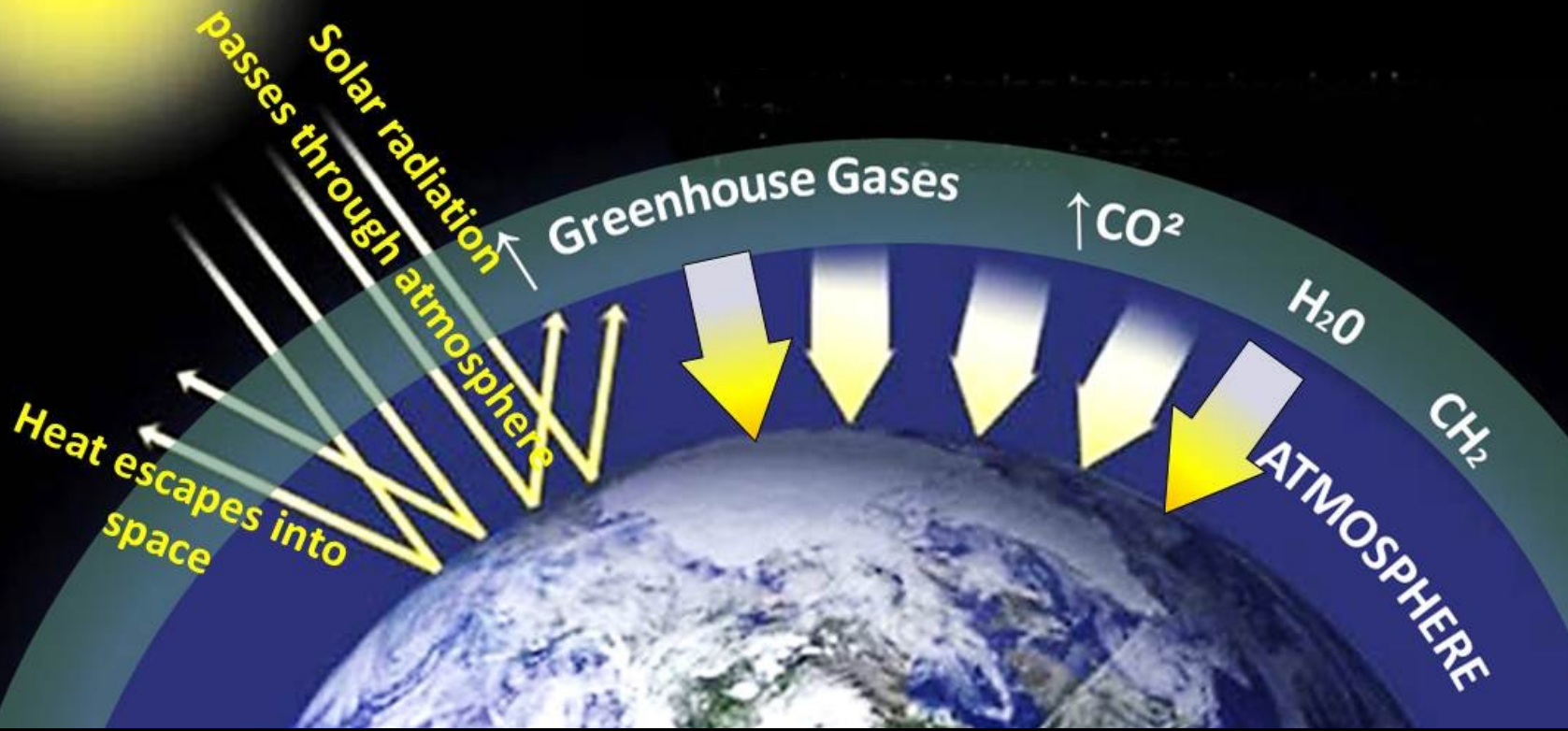


orbit

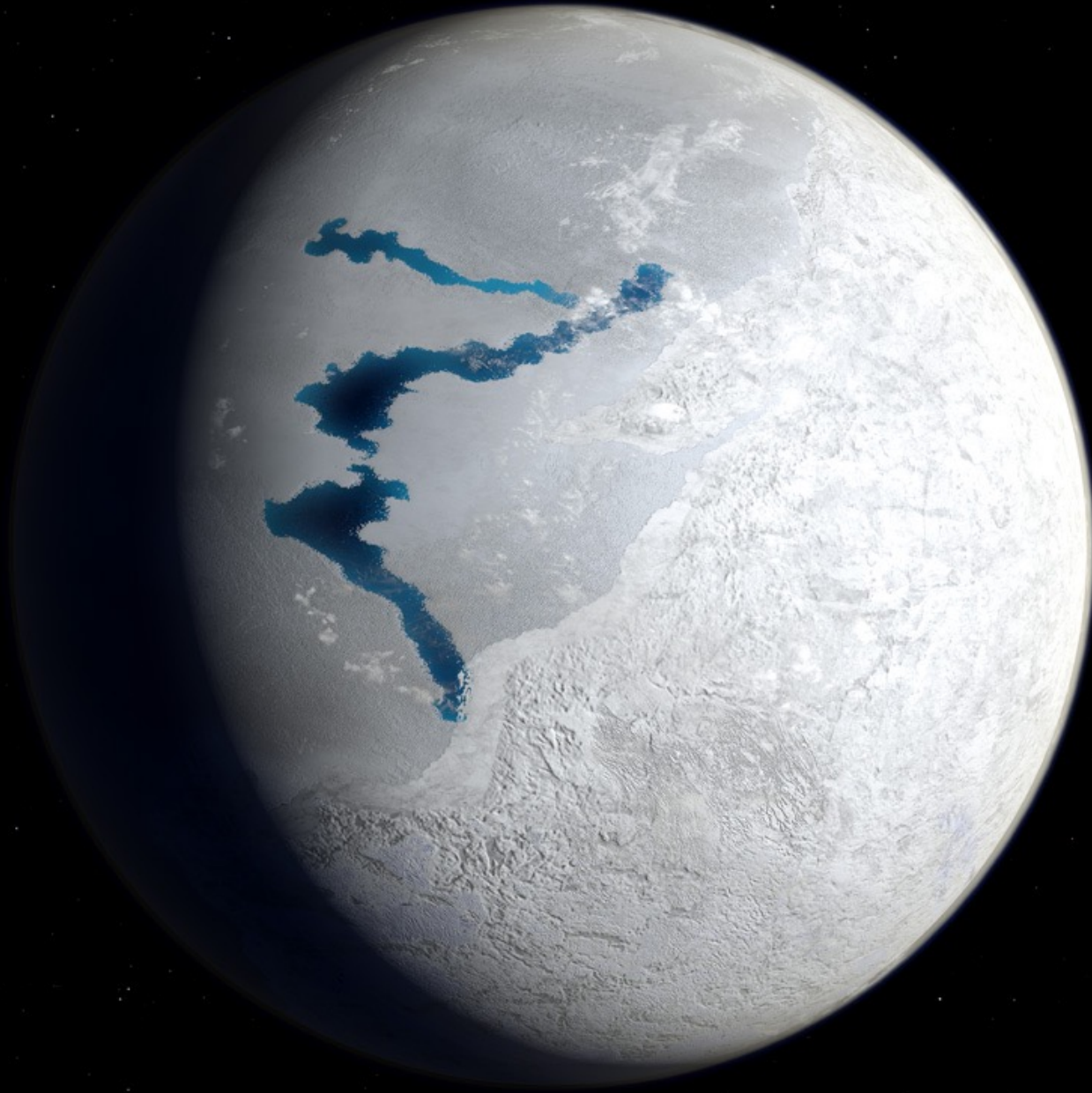


Greenhouse gases are trapping the longwave radiation

SUN

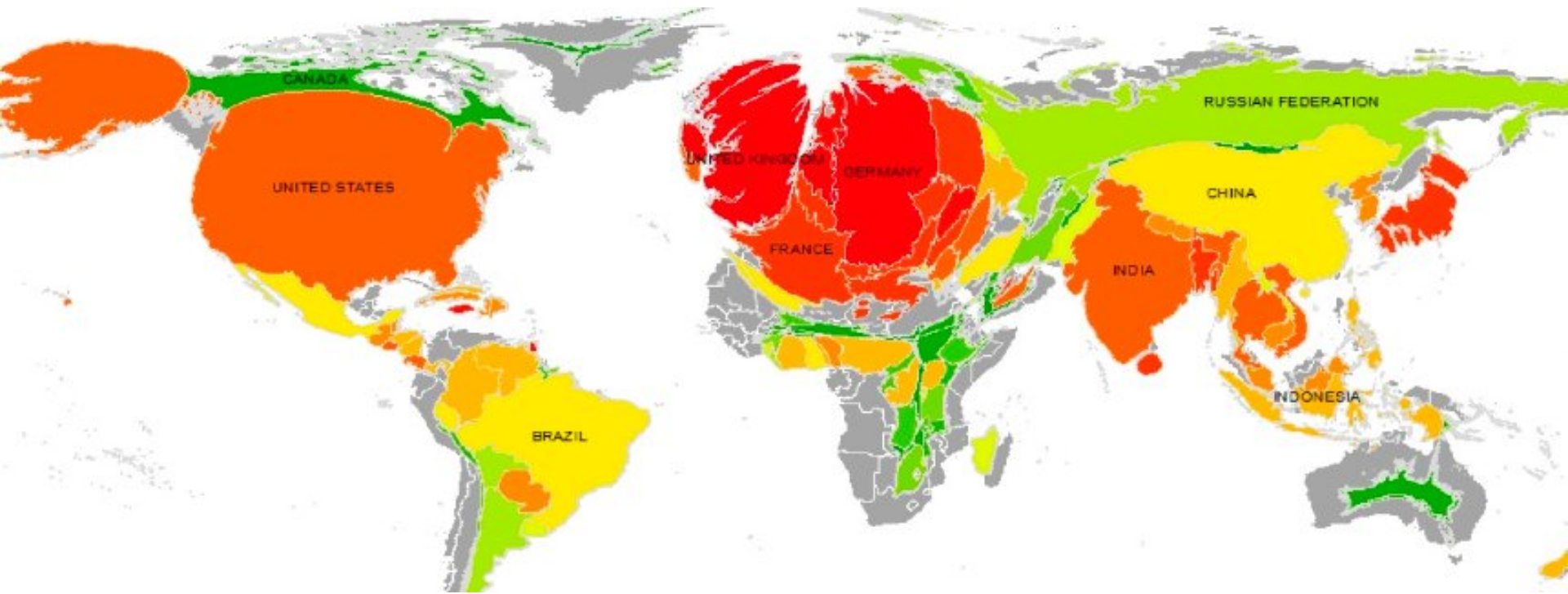


**If we didn't have an atmosphere, the earth would be a toasty -16C, 3F**



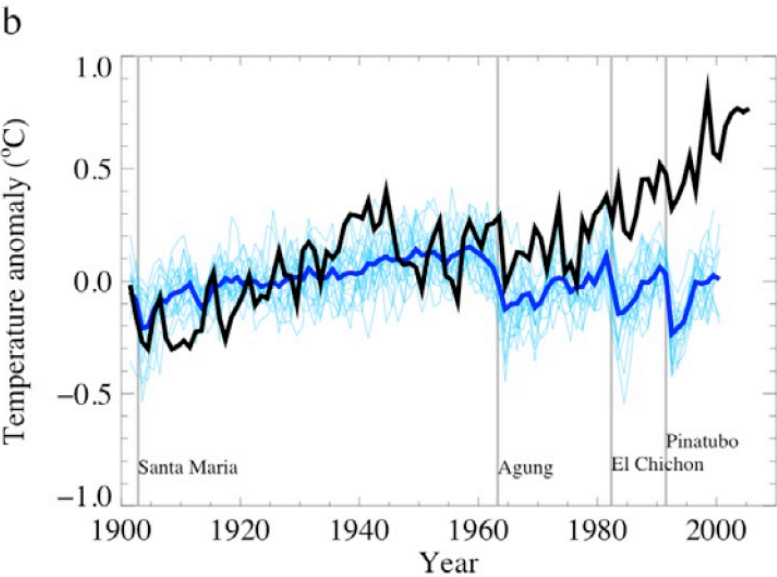
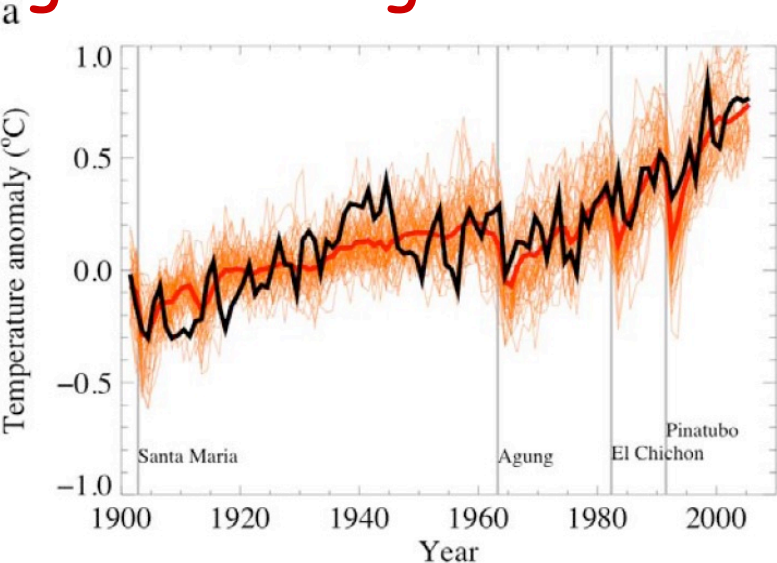
ALL RIGHTS RESERVED

# Contribution for global warming in the last 200 years



# Attribution

**greenhouse gas emissions**



**no greenhouse gas emissions**

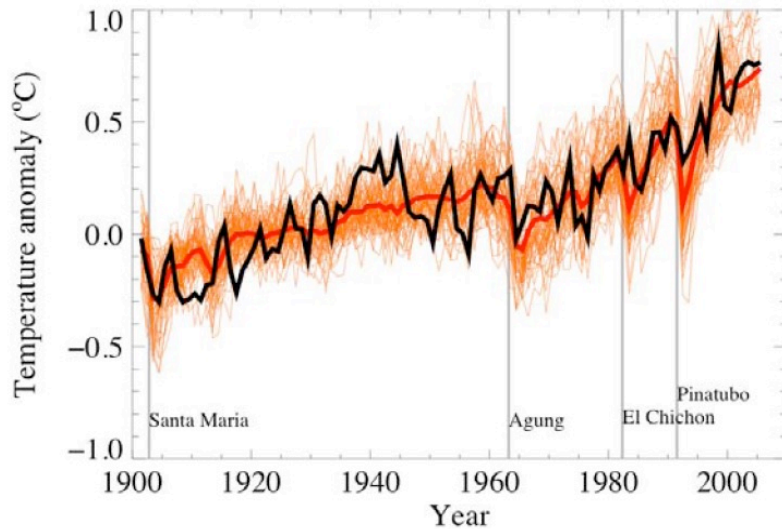
Asks whether observed changes are consistent with

expected responses to forcings

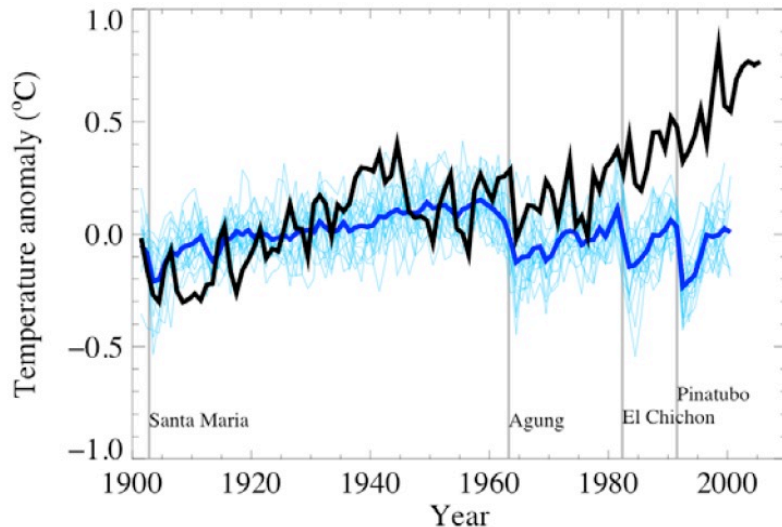
inconsistent with alternative explanations

# Attribution

a **greenhouse gas emissions**



b



**no greenhouse gas emissions**

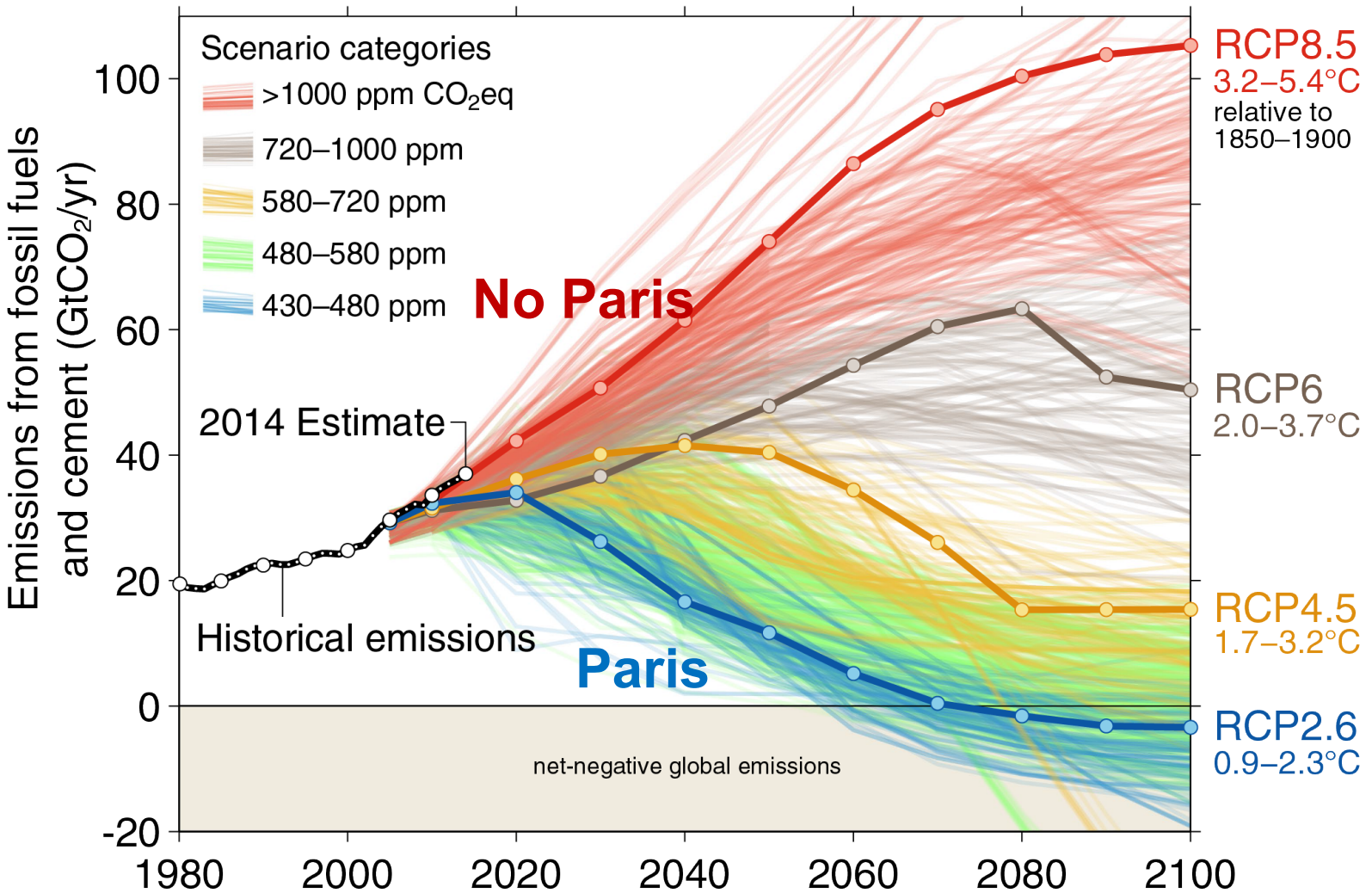
Asks whether observed changes are consistent with

expected responses to forcings

inconsistent with alternative explanations

**Warming of the past 50 years is caused by humans**

# Business-as-usual



World Meteorological Organization, 2014.

# Antarctica is huge

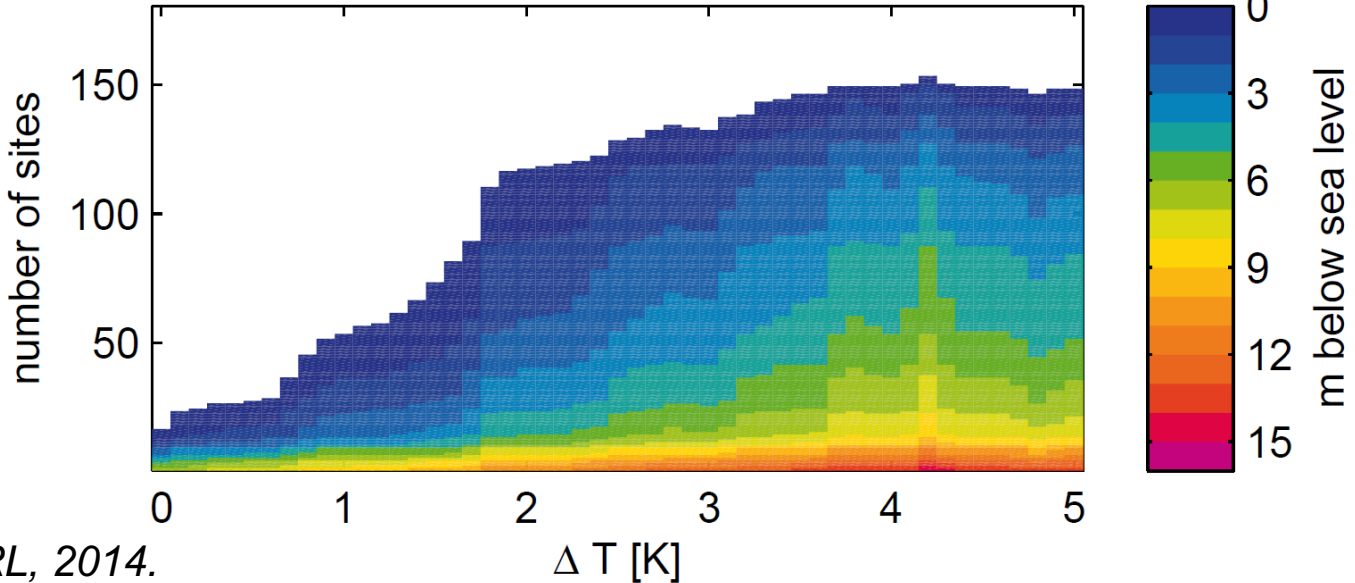
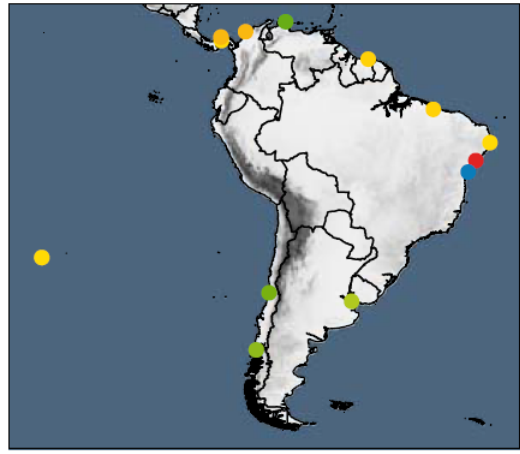
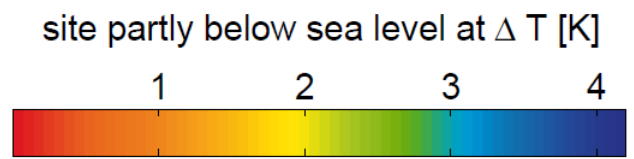
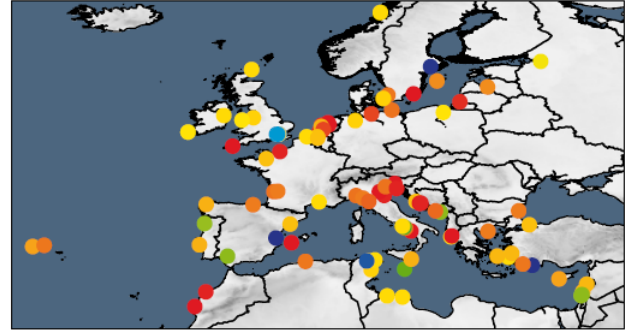
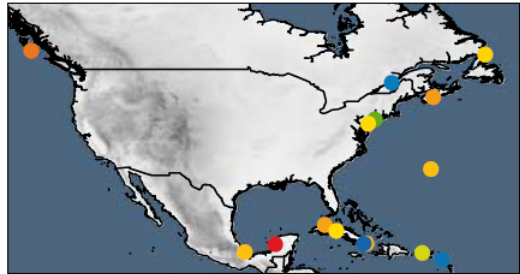
[www.thetruesize.com](http://www.thetruesize.com)



„a la Trump“

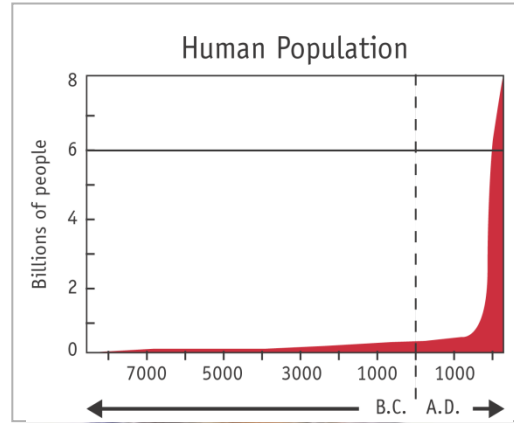


# world heritage



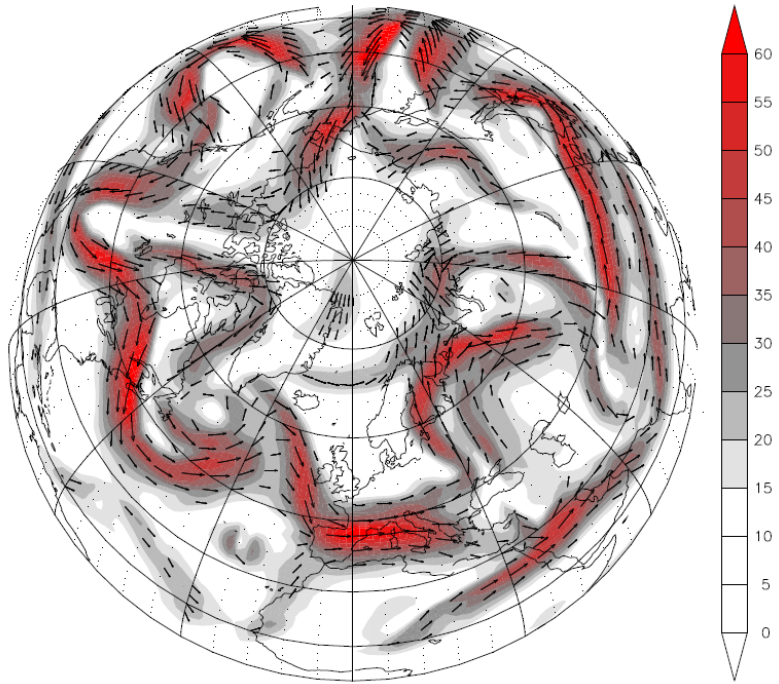
Marzeion & Levermann, ERL, 2014.

Human population > 7.700.000.000



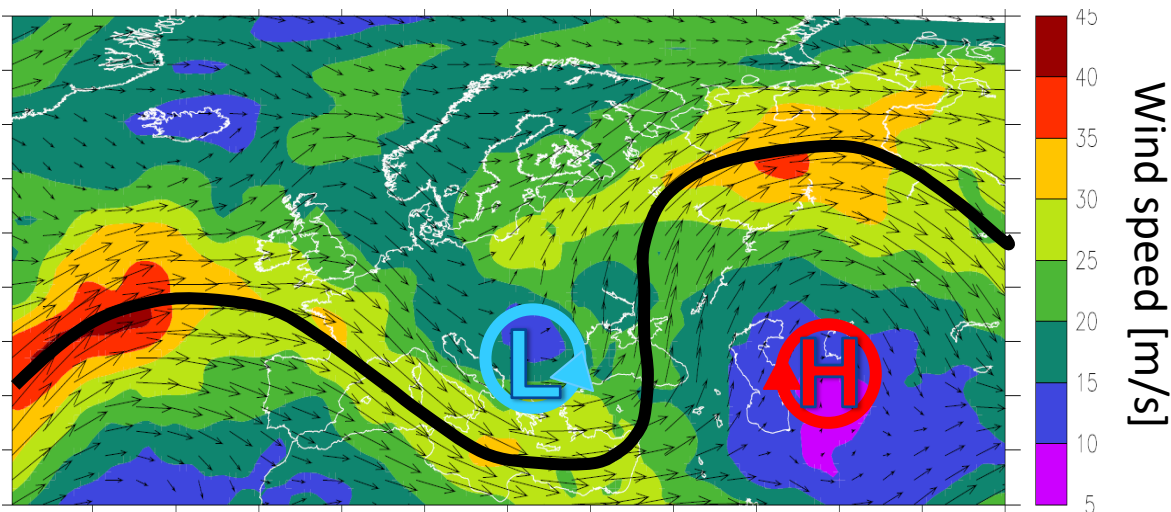
**Challenge: “a global sustainable development of our changing Earth”**

# Challenge: Extremes



## Balkan flood May 2014

Wavy Jetstream  
7<sup>th</sup> – 22<sup>nd</sup> of May 2014



# the habitability of our planet

**the number of consumers  
and the scale and nature of  
their consumption**



# **Lessons learned to make the future sustainable**

Awareness of the challenges of climate change

Reduce greenhouse gas emissions (e.g. CO<sub>2</sub>, CH<sub>4</sub>) !

# Lessons learned to make the future sustainable

Awareness of the challenges of climate change

Reduce greenhouse gas emissions (e.g. CO<sub>2</sub>, CH<sub>4</sub>) !

People living in high-income nations shall play the leading part.

Only when wealthier groups adopt low-carbon lifestyles, we will reduce the pressure on global climate, resource and waste issues.

Change in the core values of developed societies