

Climate 101

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Congaree National Park
Climate Friendly Parks Workshop
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Weather is what you get
Climate is what you expect – Mark Twain



Today: Progress in learning what to expect

Climate Change Means Changing...

Expectations based on current, historical, archaeological, and geologic records...

- Weather (Temp., Precip., storms, droughts)
- Water levels in rivers, oceans, and aquifers
- Melting snow, sea ice, permafrost, and glaciers
- Species ranges, communities, and life cycles
- Changes to human health, economy, security, natural hazards, agriculture, land use

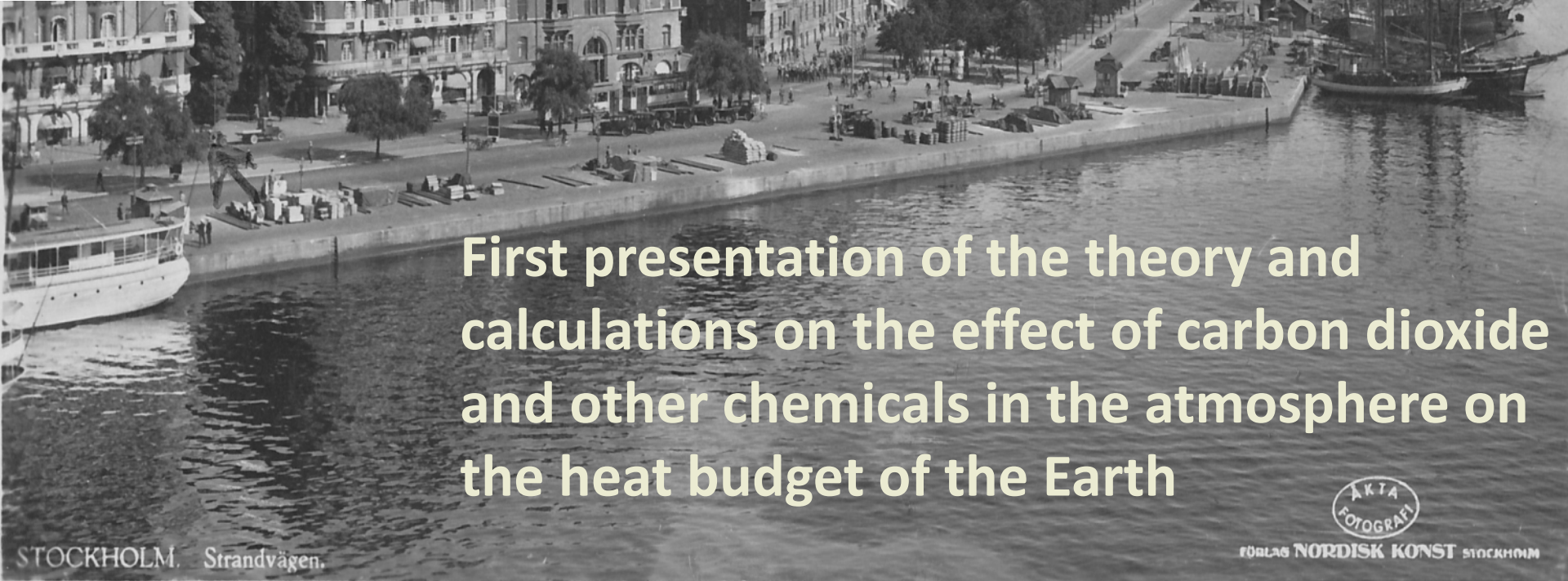


Svante Arrhenius
Fotografi. 1893.

Established Theory

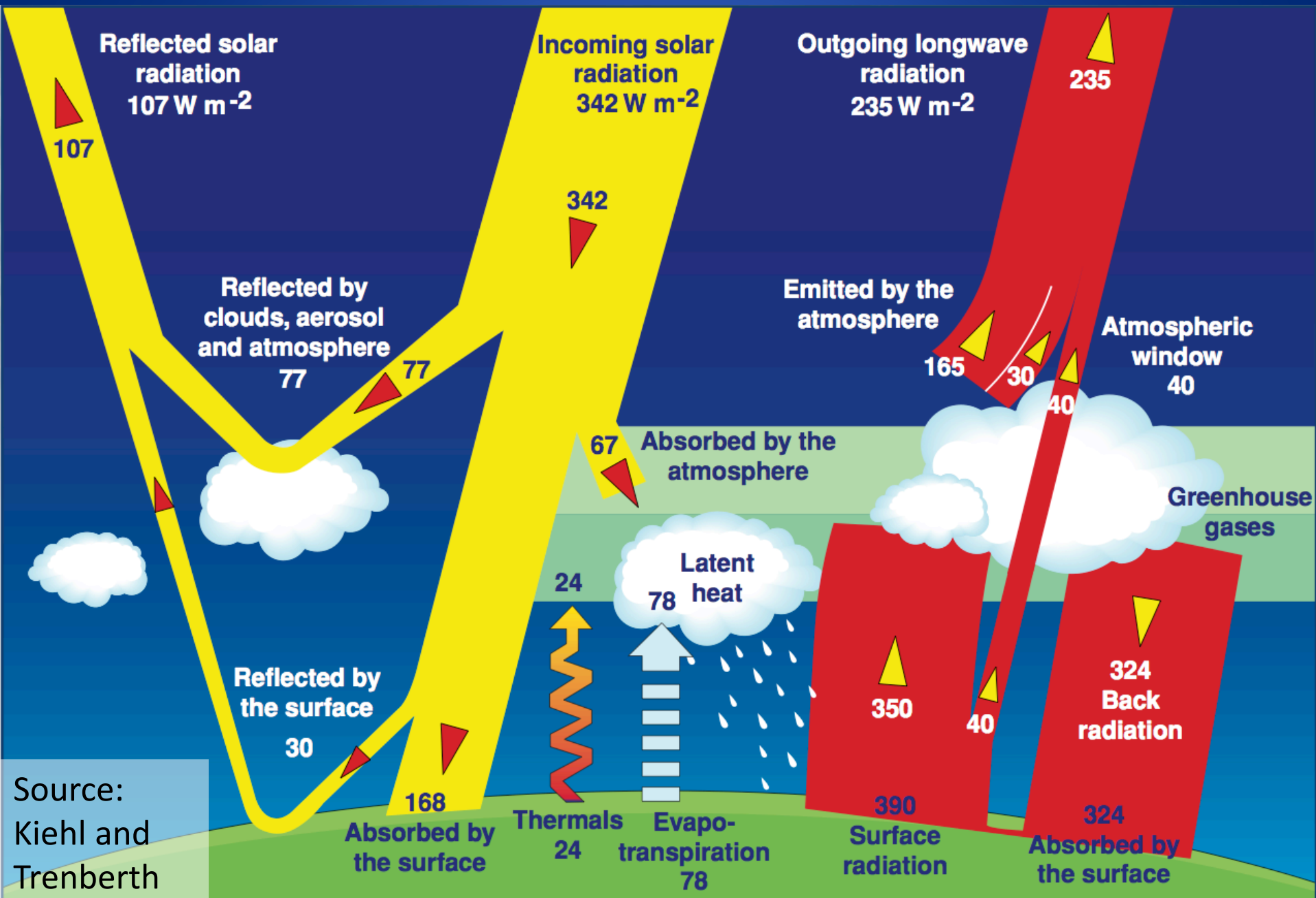
Svante Arrhenius, Swedish scientist (1859-1927), in 1895 presented “On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.”

First presentation of the theory and calculations on the effect of carbon dioxide and other chemicals in the atmosphere on the heat budget of the Earth

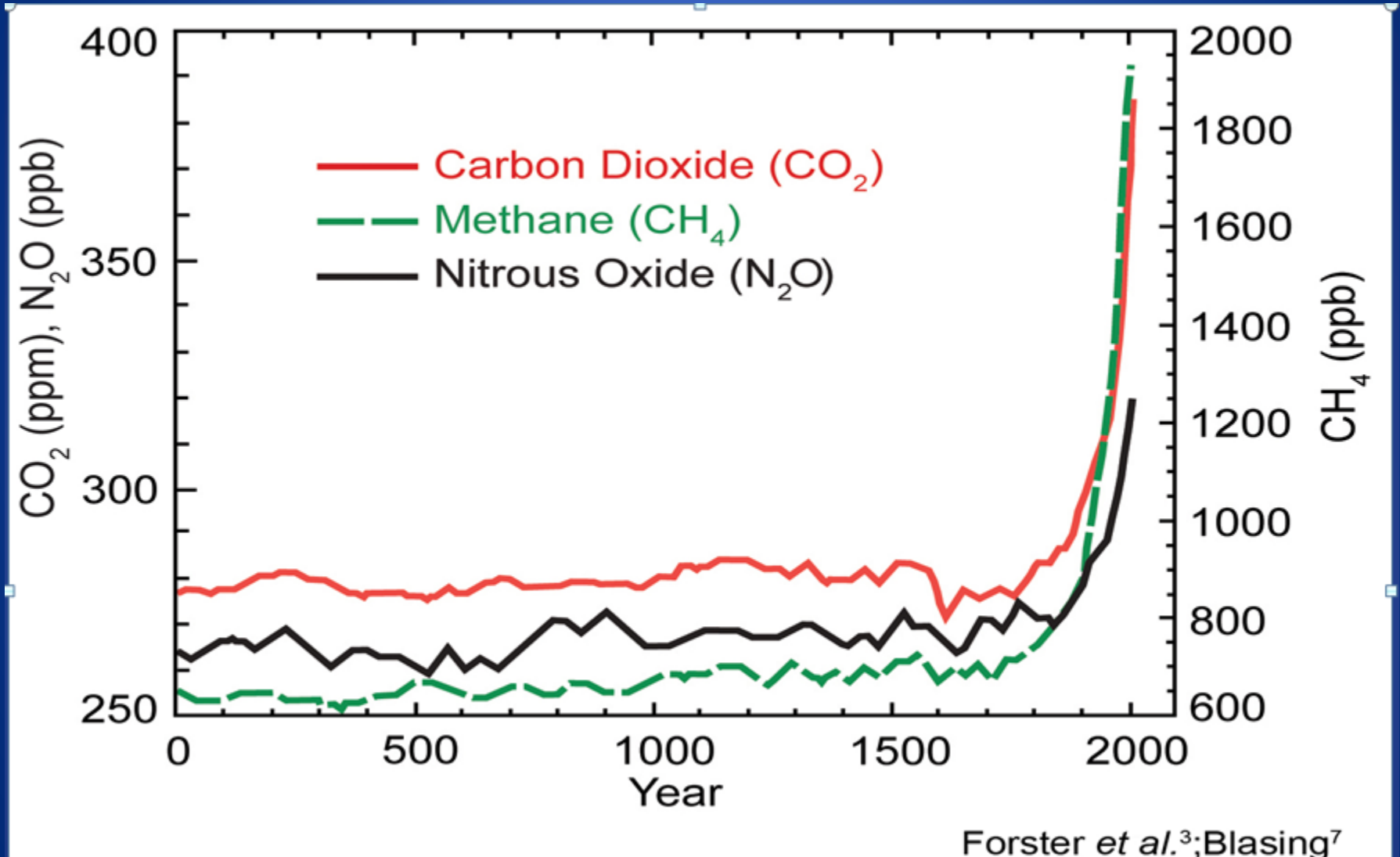


FÖRLAG NORDISK KONST STOCKHOLM

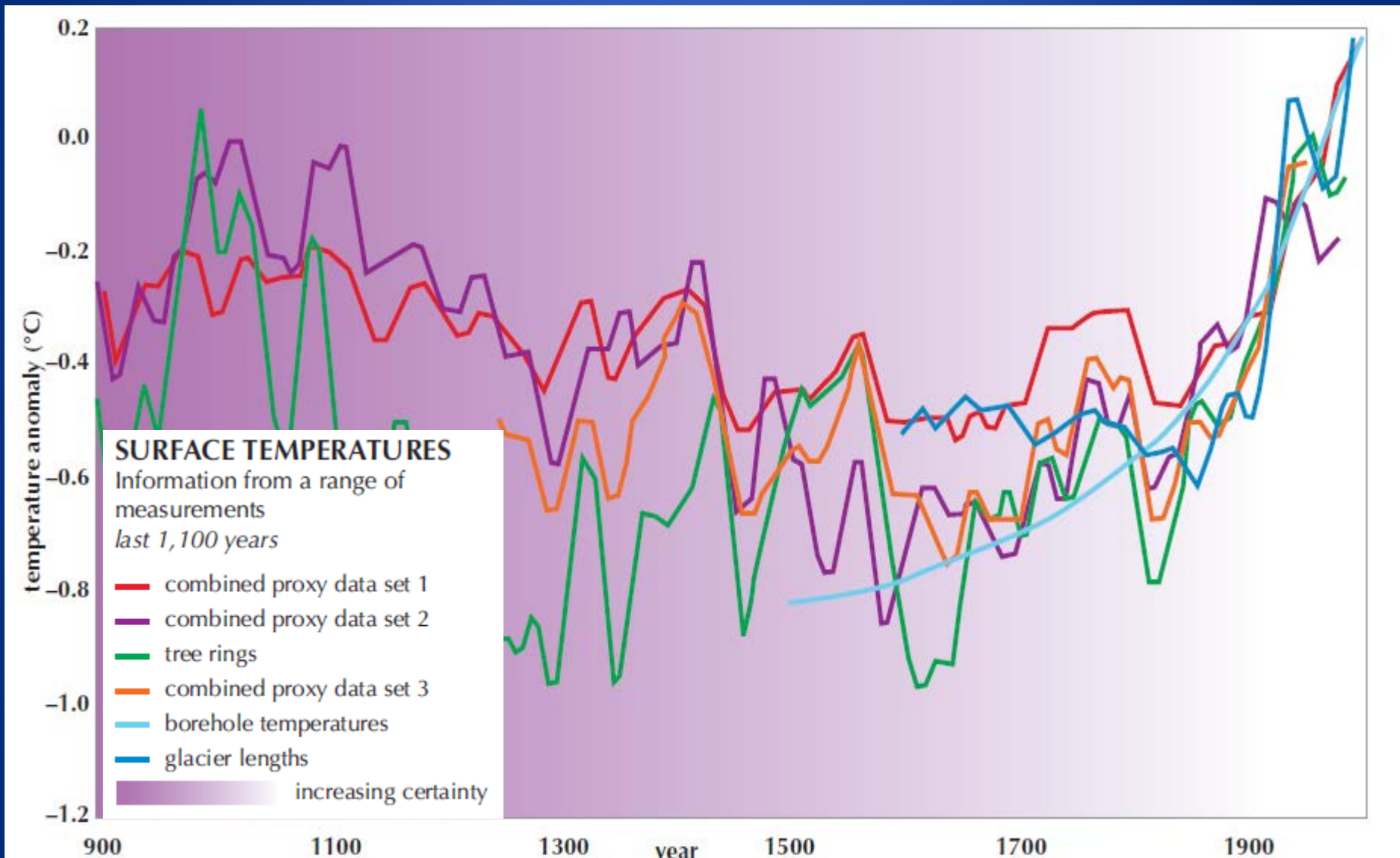
Measurements of the Earth's Radiation Budget



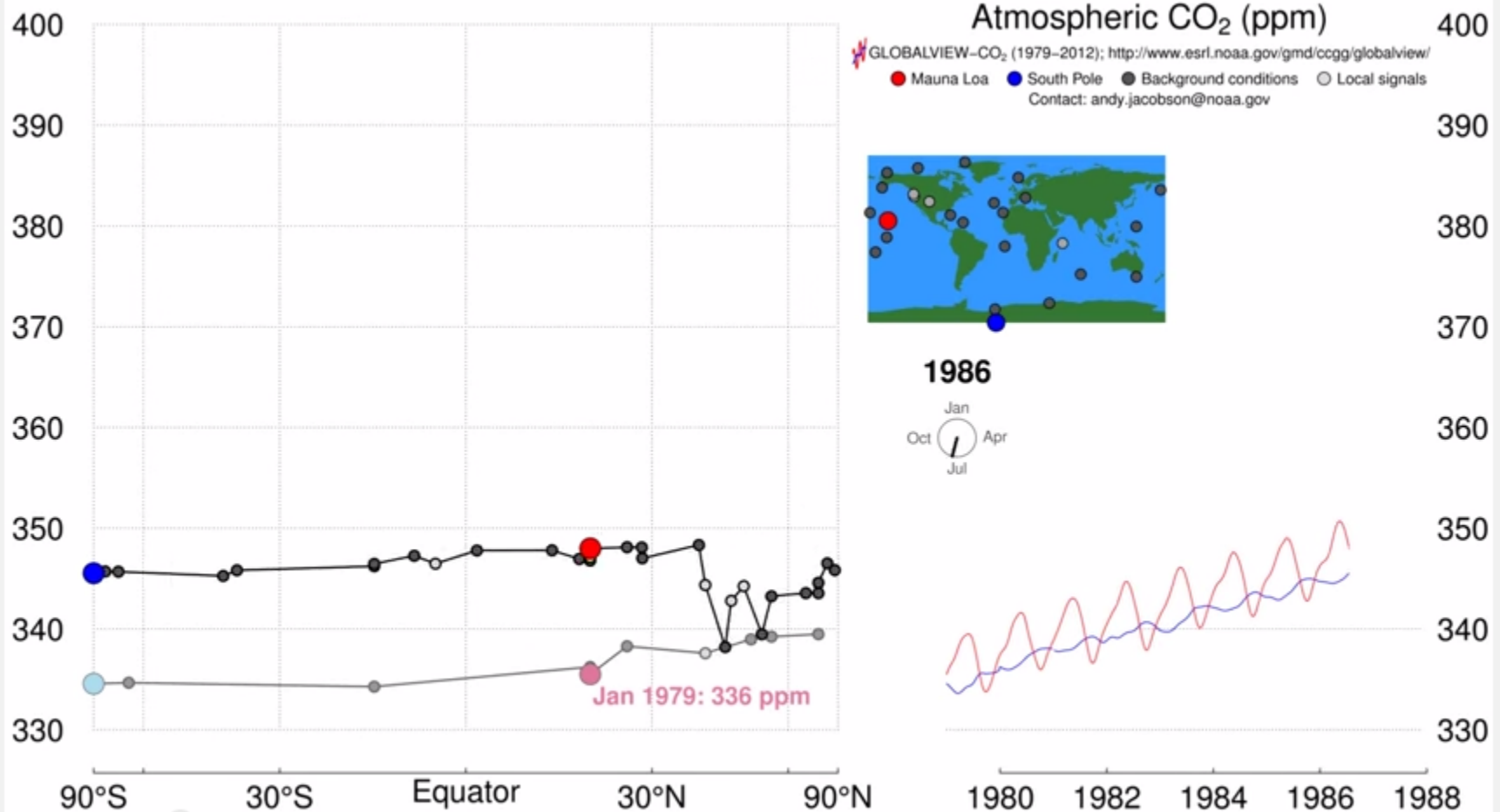
Measurements of Greenhouse Gases



Multiple sources of evidence on past temperatures



In the context of planetary and human history



Models require greenhouse gas inputs to replicate observed changes

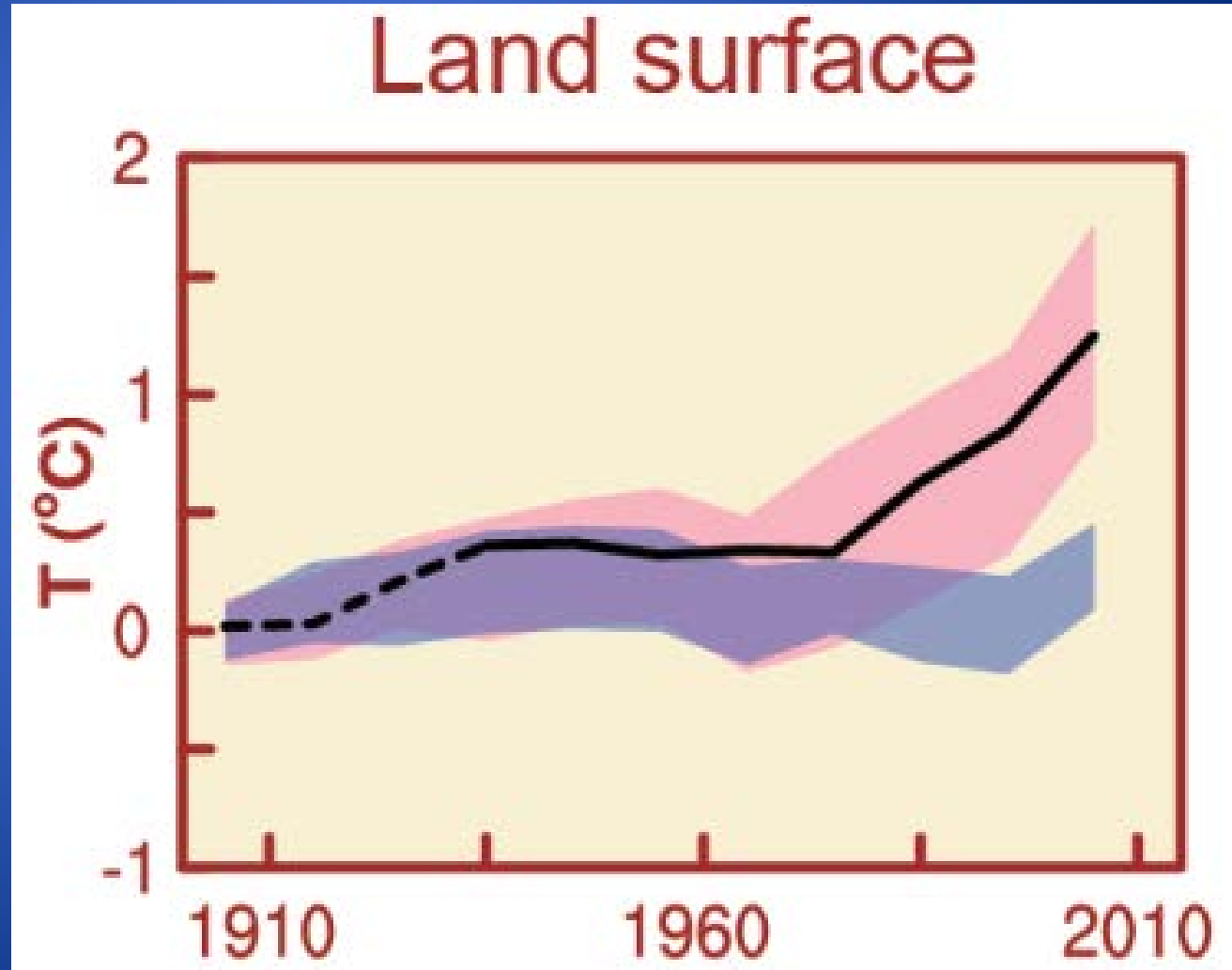
Temperature change relative to 1880-1919



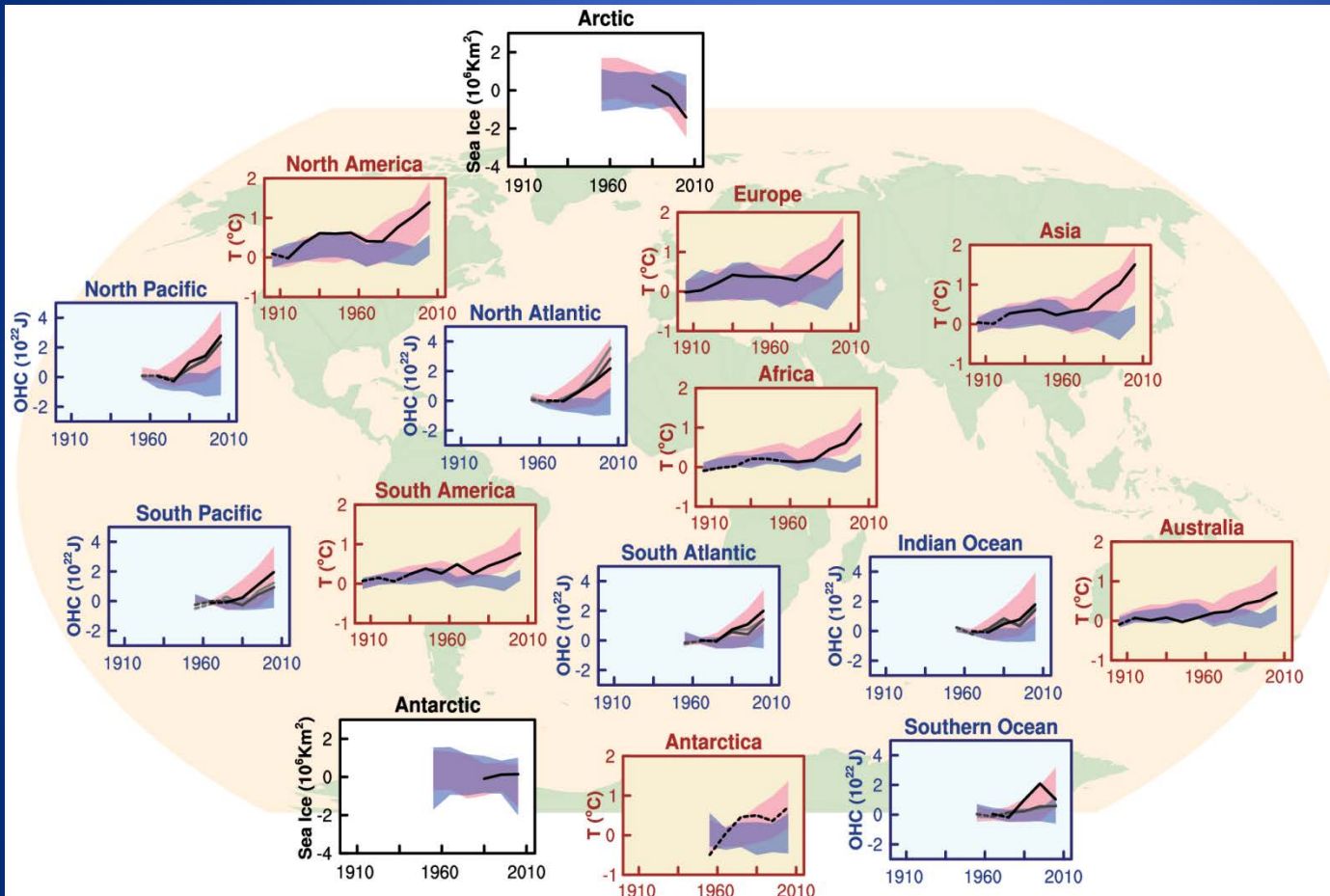
Models using Natural Forcings



Models using Natural & Human Forcings



Same relationship holds at the regional level Gives some confidence in the models



Temperature
change
(Arctic – sea ice area)



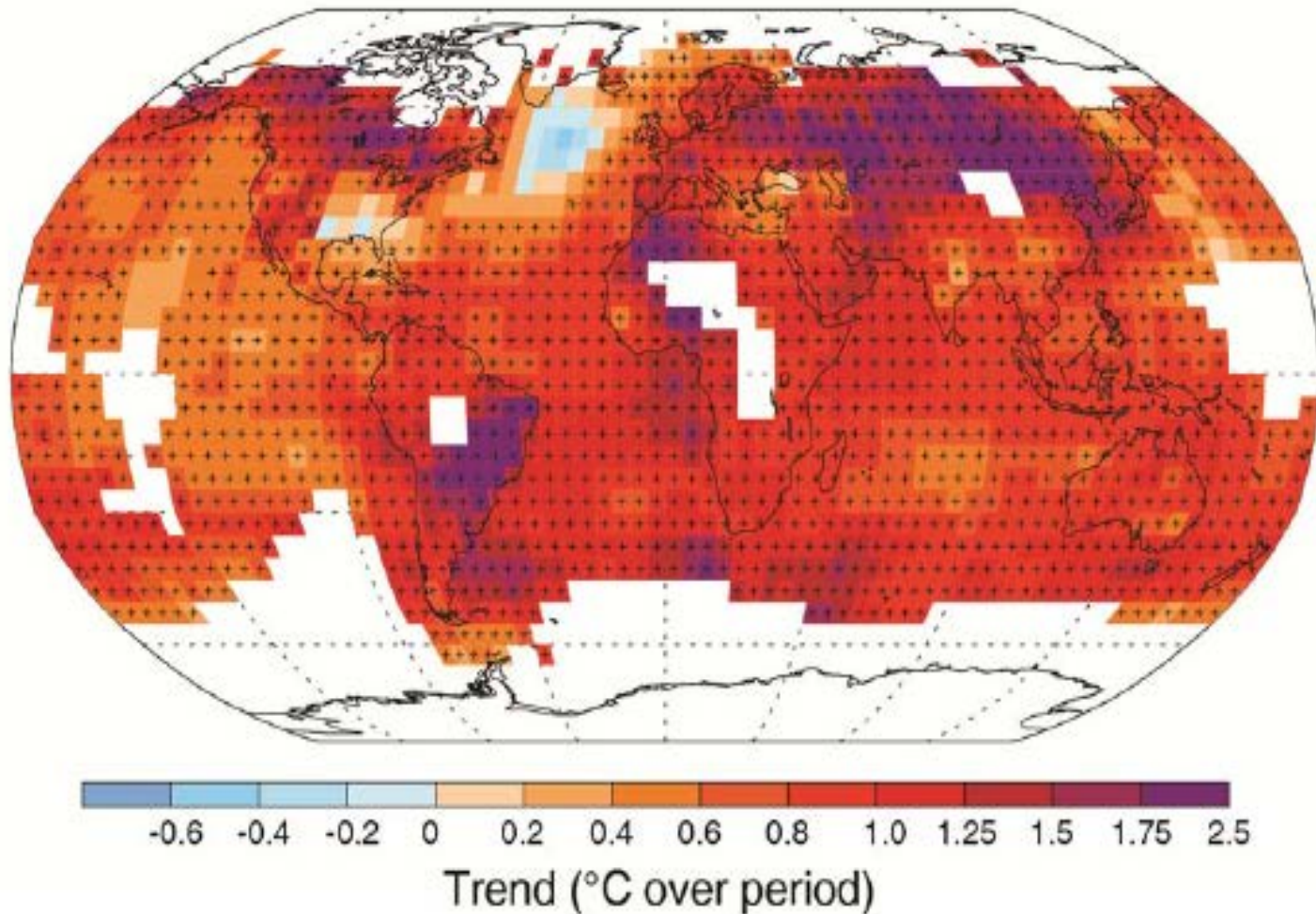
Models using
Natural Forcings



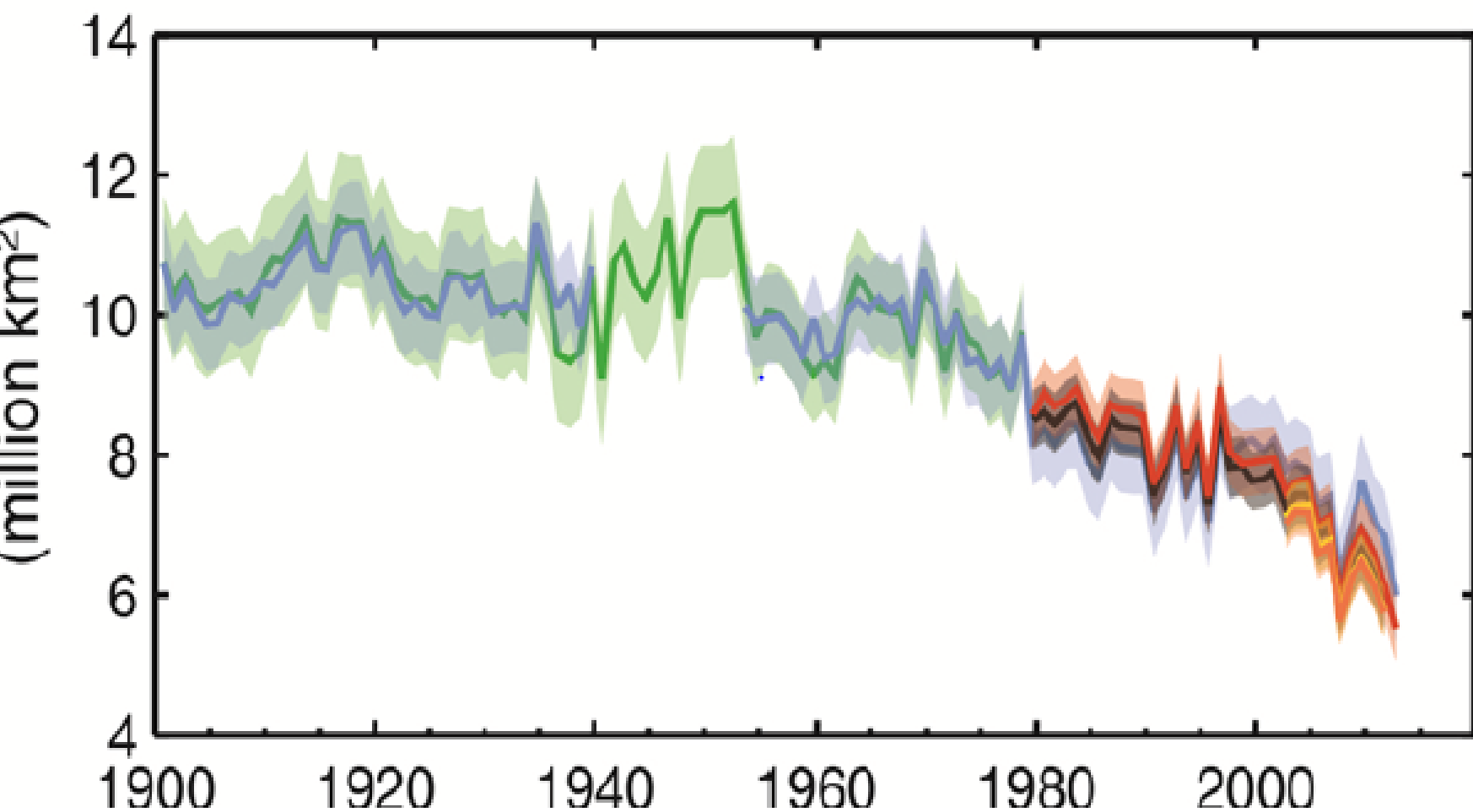
Models using
Natural &
Human Forcings

Observations are consistent with theory

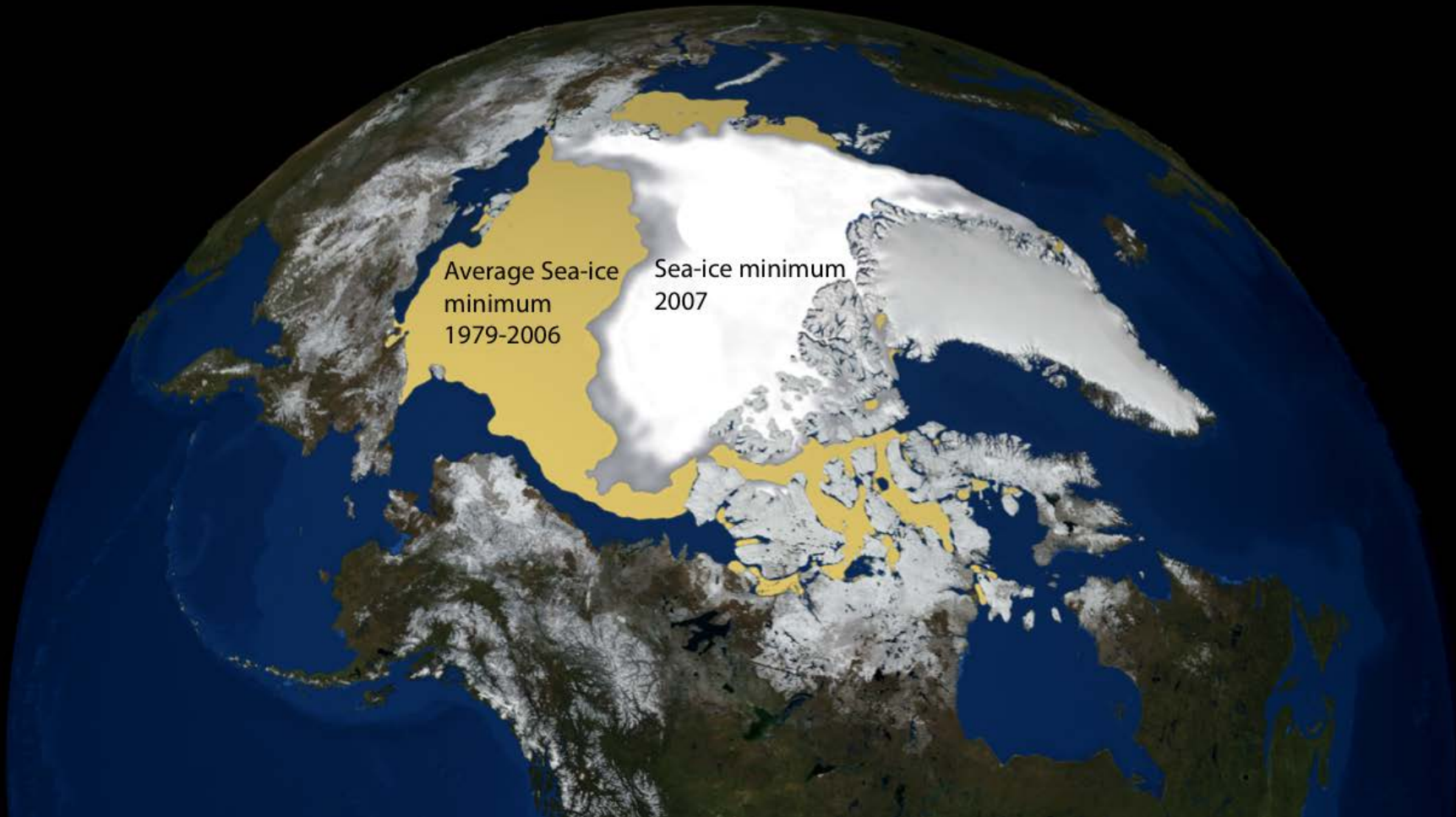
(b) Observed change in average surface temperature 1901–2012



Arctic summer sea ice extent



Arctic Sea Ice



Climate
change
being
observed

- Temperature

- Physical system

- Biological system

- Source: IPCC Working Group I Summary Makers

of signif.
observed
changes

% consistent
with
warming

% consistent
with
warming

Globally

Physical

Biological

765

28,671

94%

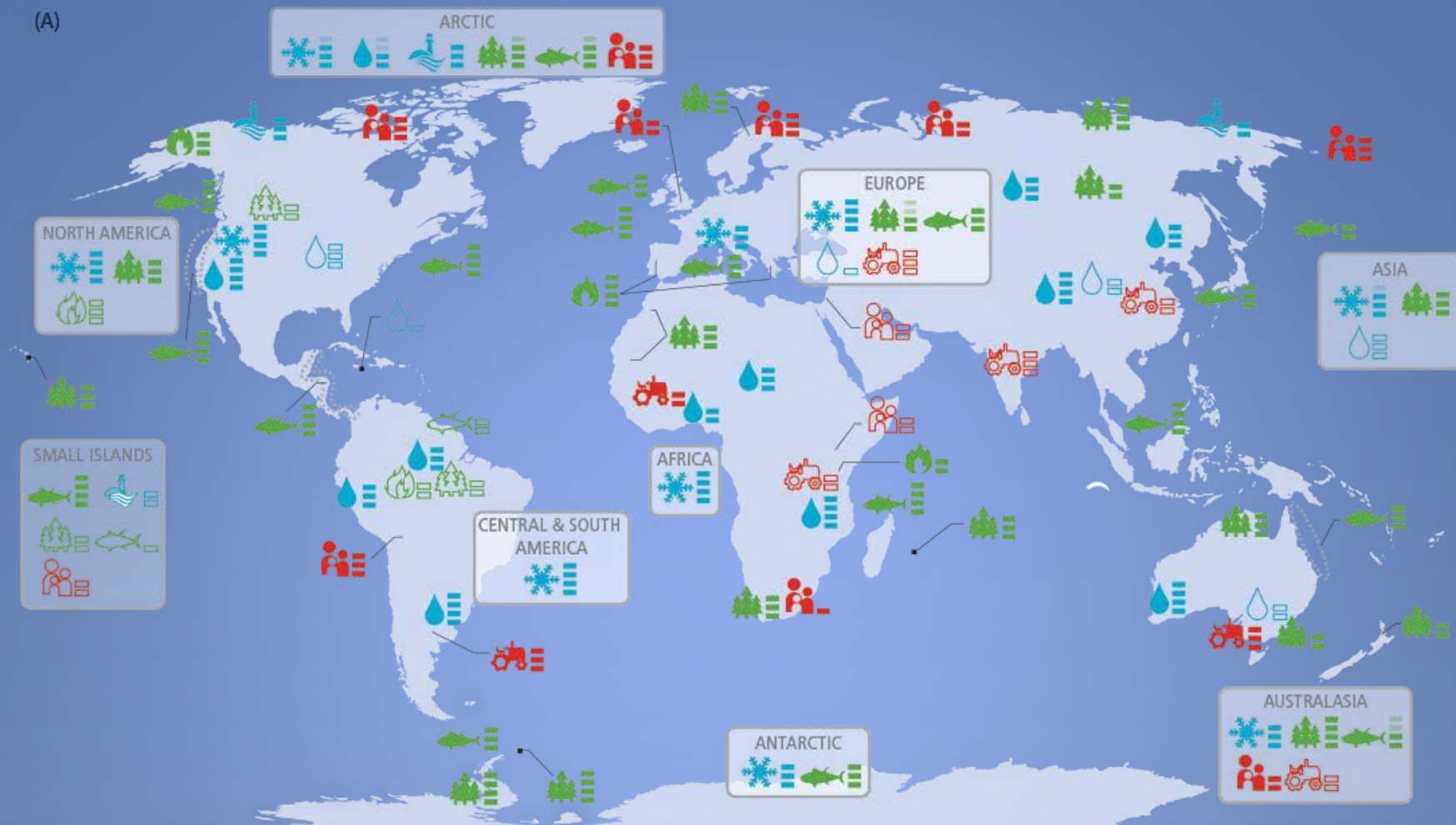
90%

94%

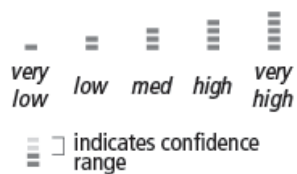
92%

represent 1 to 7,500 data series.

(A)



Confidence in attribution to climate change



Observed impacts attributed to climate change for

Physical systems



Biological systems



Human and managed systems



□ Regional-scale impacts

Outlined symbols = Minor contribution of climate change
Filled symbols = Major contribution of climate change

Increased flooding: \$200 million in flood control underway in C'ton



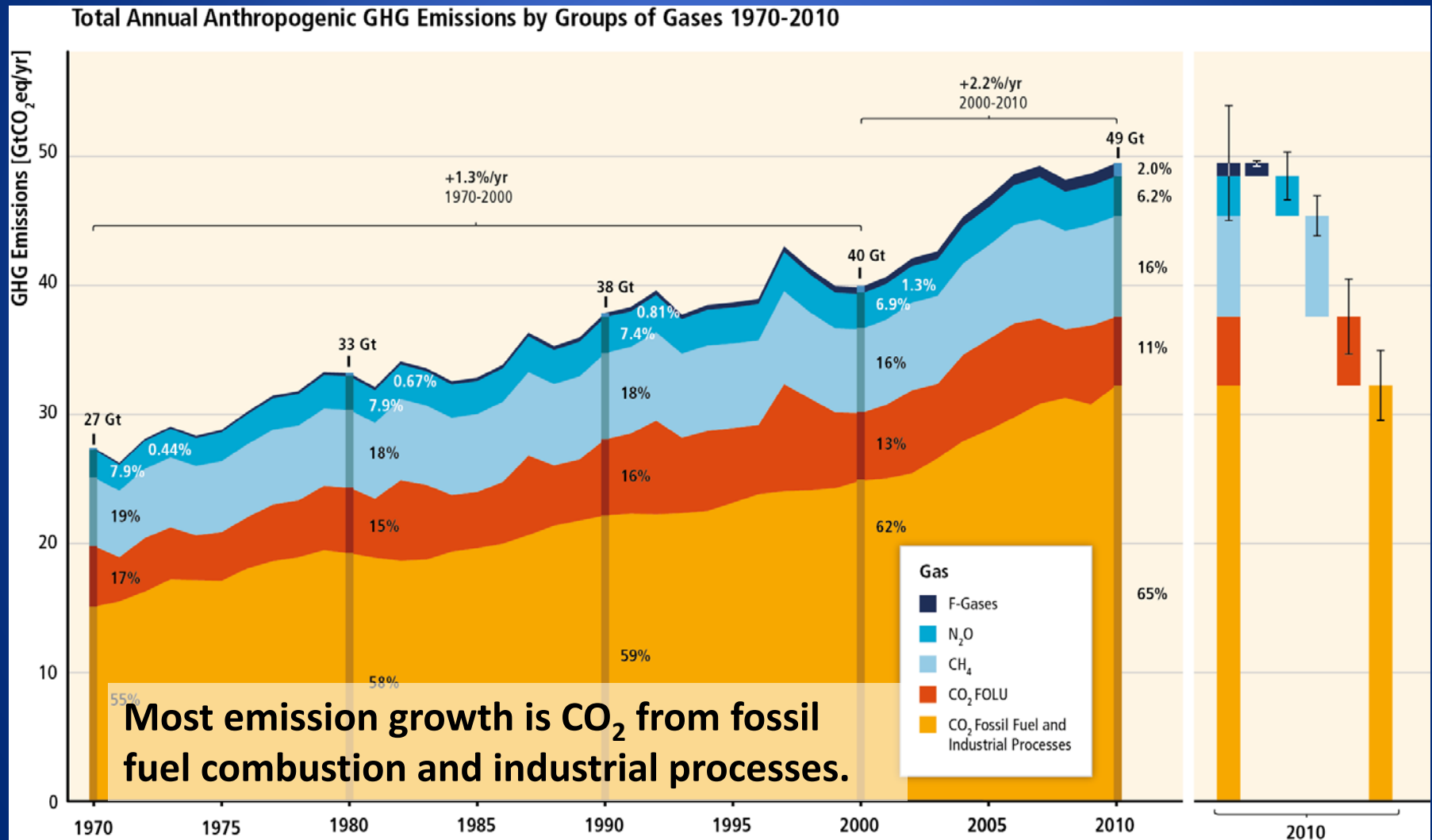
Source: www.holycitysinner.com

Kayaking through the Charleston City Market, August 28, 2012

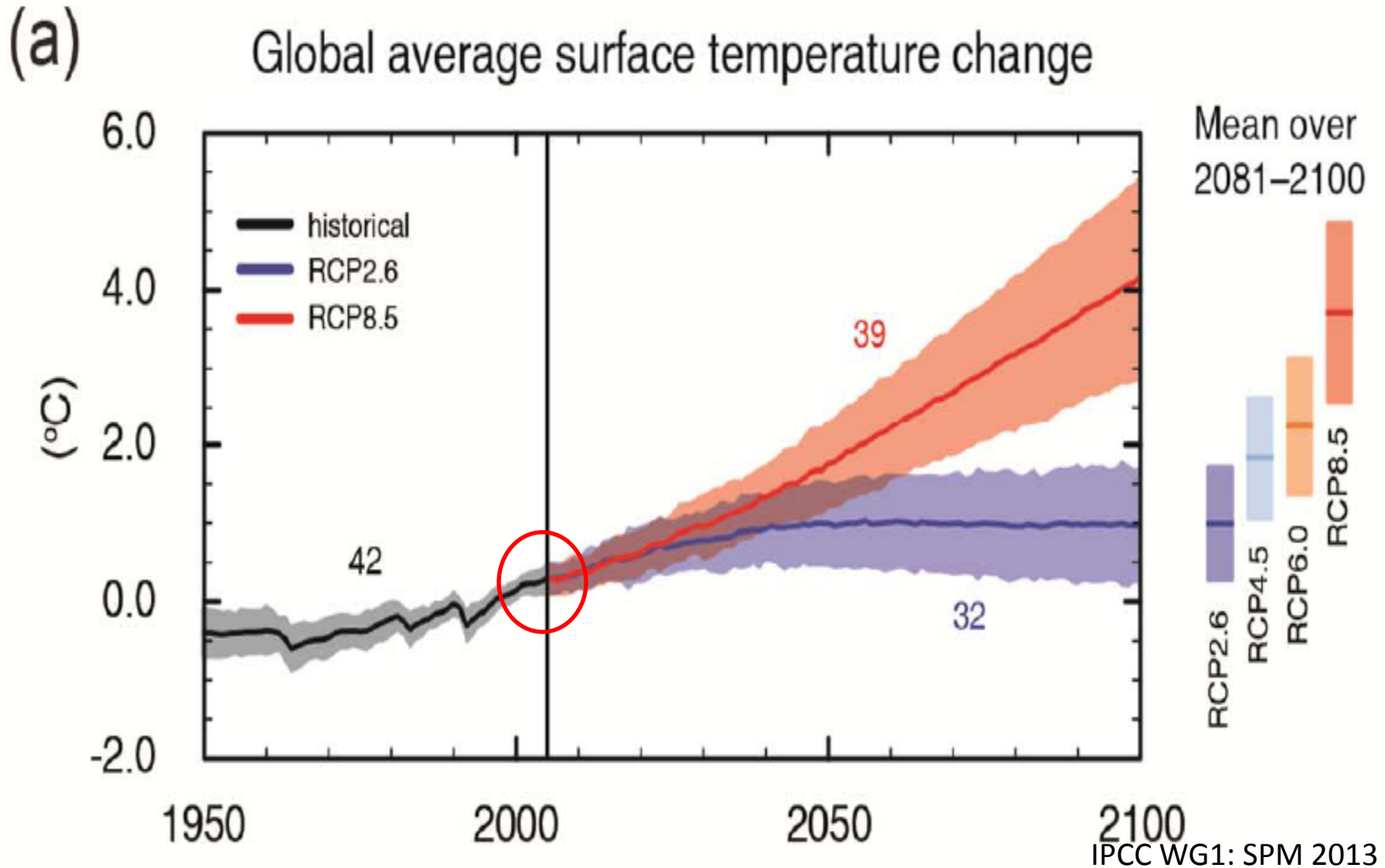
3 Lines of Evidence

- 1. The fundamental process is well established**
- 2. Climate models show some ability to replicate observations indicating they are capable of representing some processes**
- 3. Observations of many impacts are consistent with theory**

Currently, GHG emissions accelerate despite reduction efforts.



The choice of paths



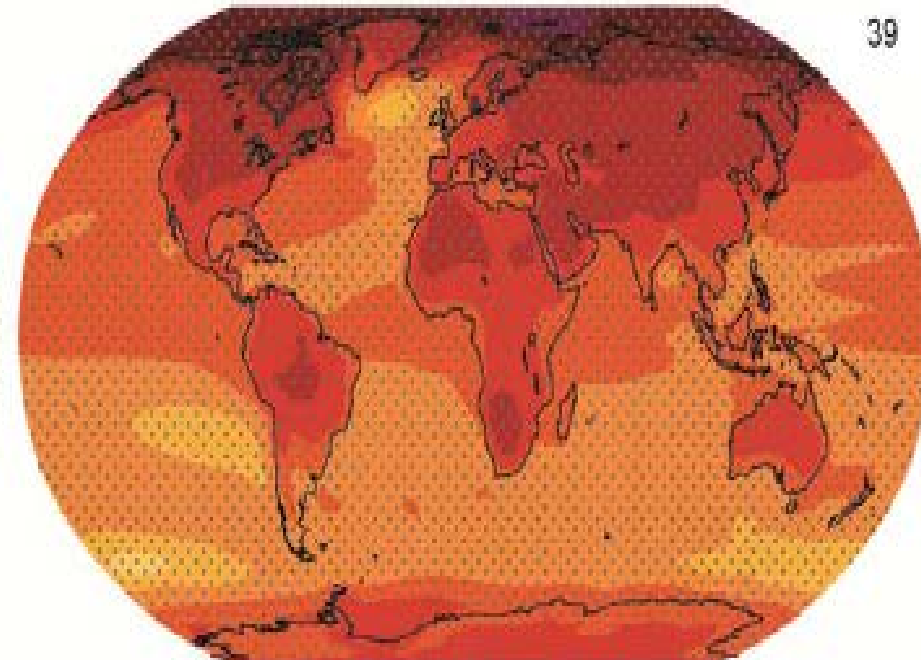
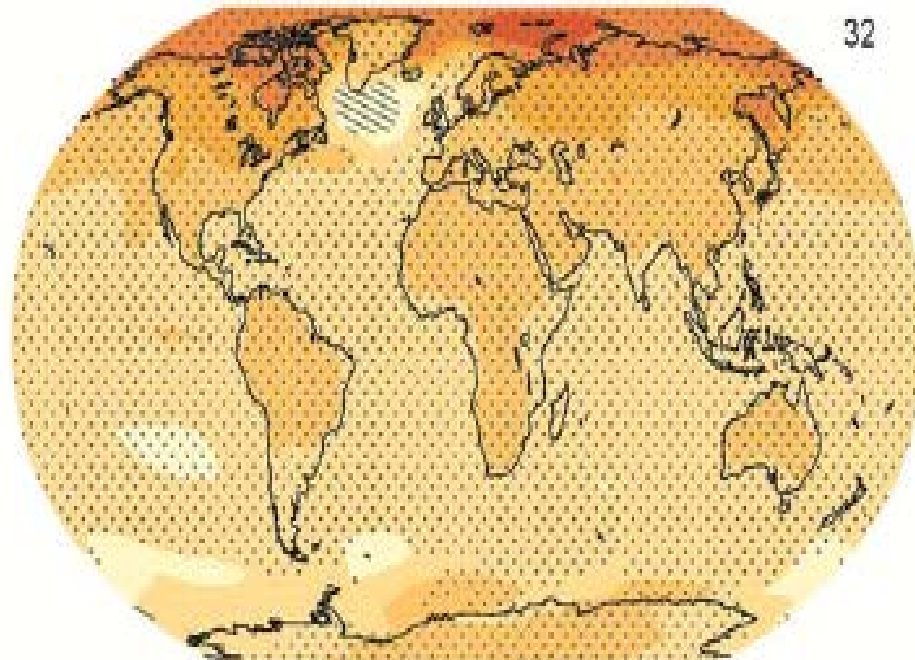
High and low projections for 2081-2100

RCP 2.6

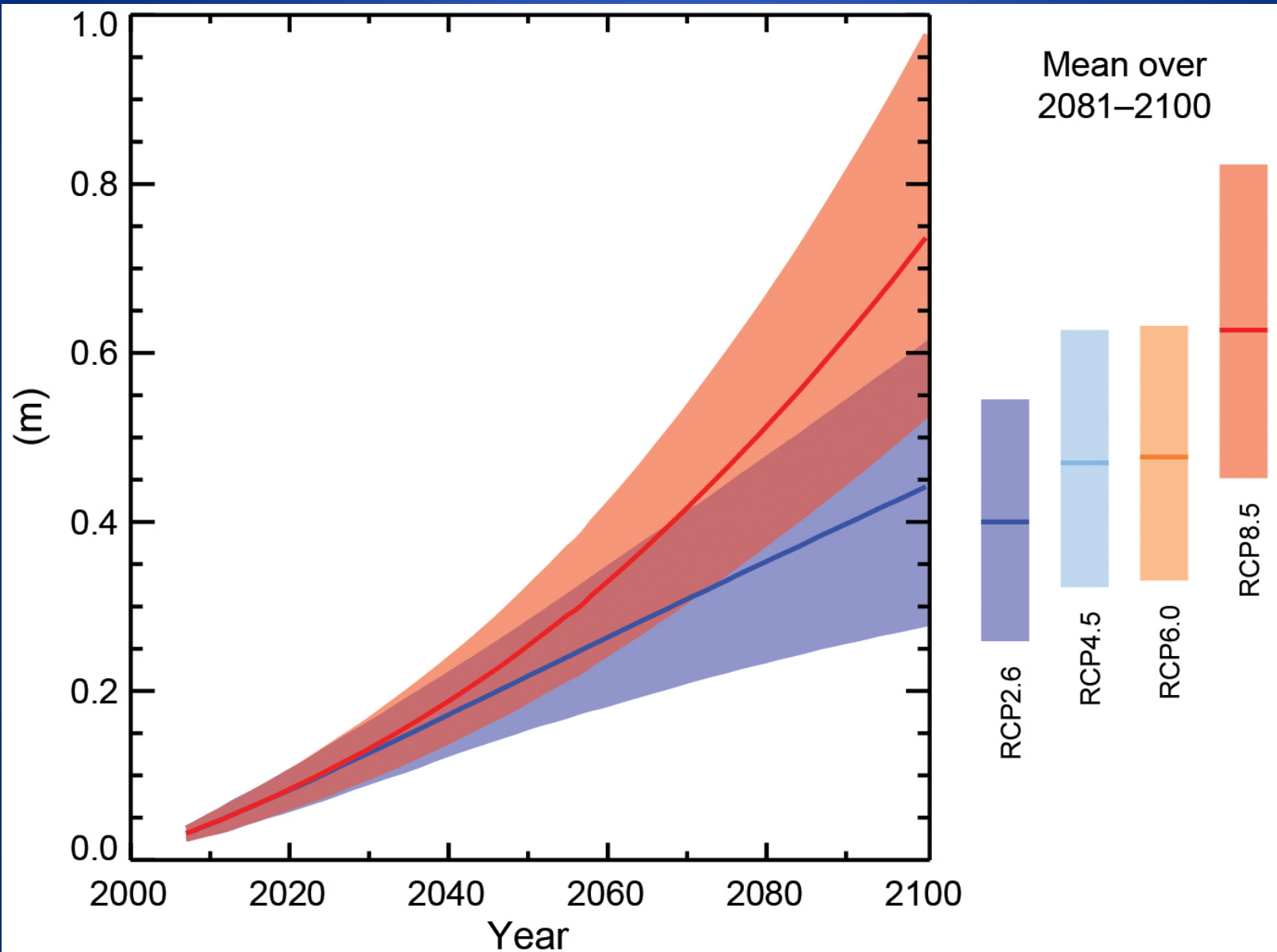
RCP 8.5

(a)

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

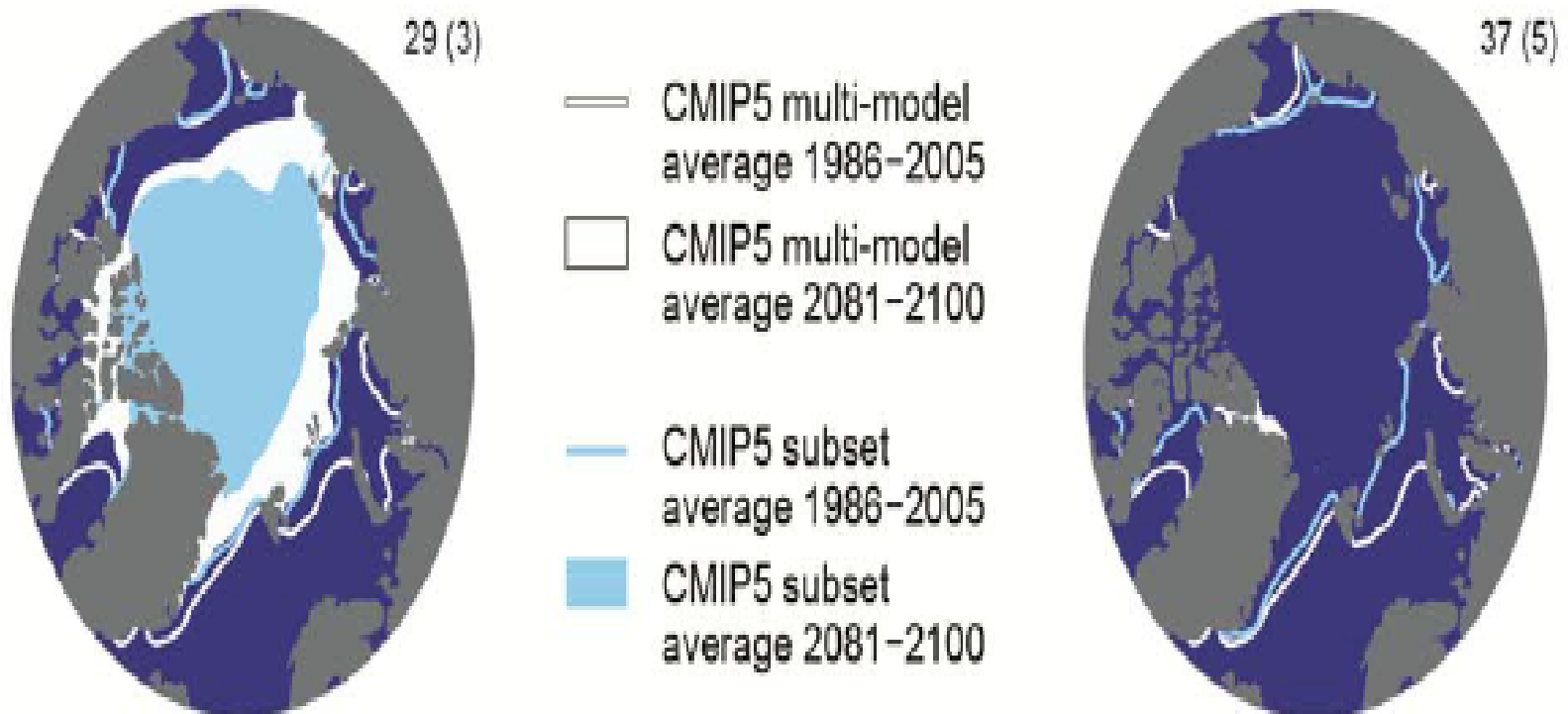


Projected Global Mean Sea Level Rise



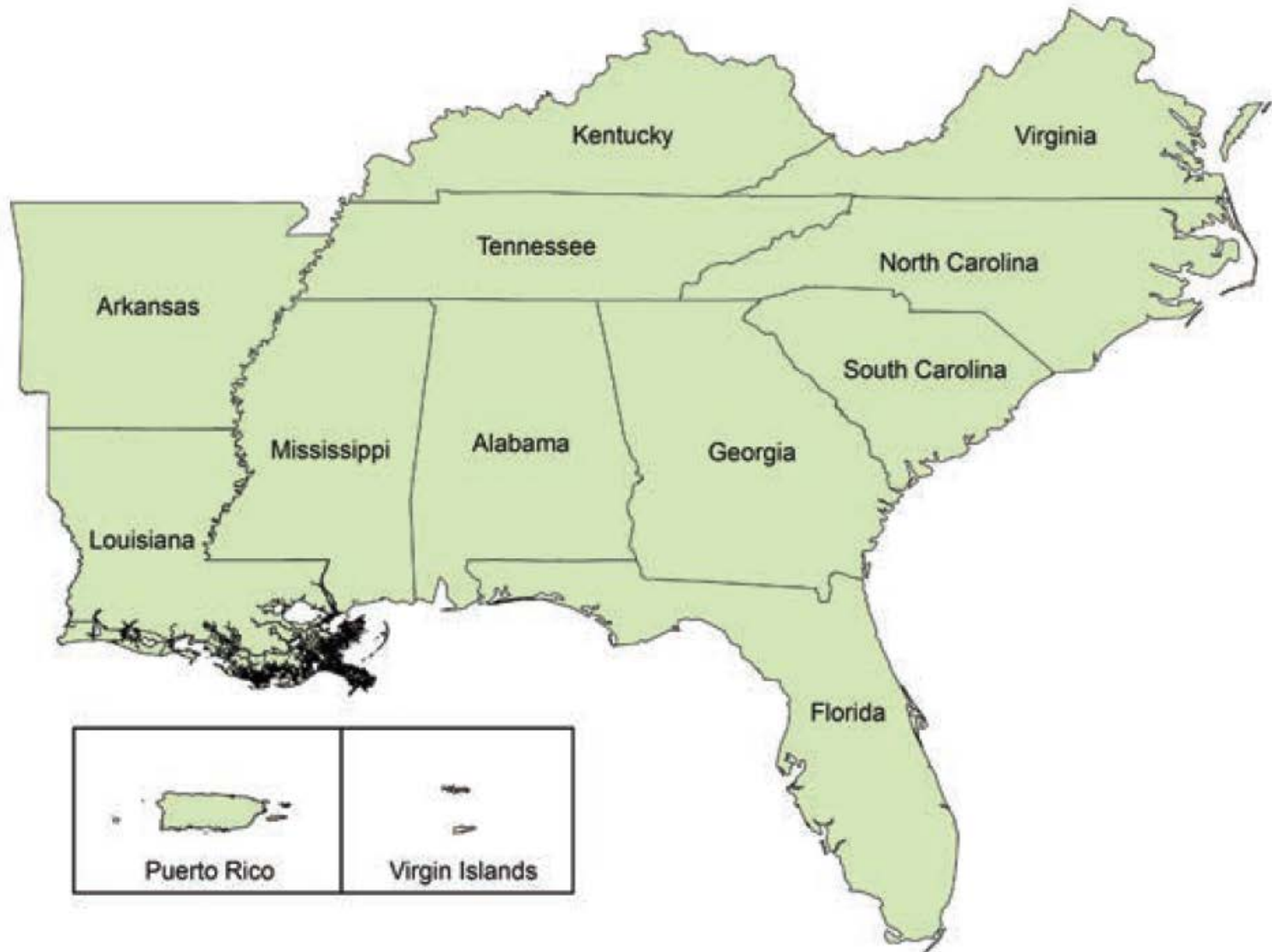
High and low projections: Arctic sea ice

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



US National Climate Assessment

Southeast Region



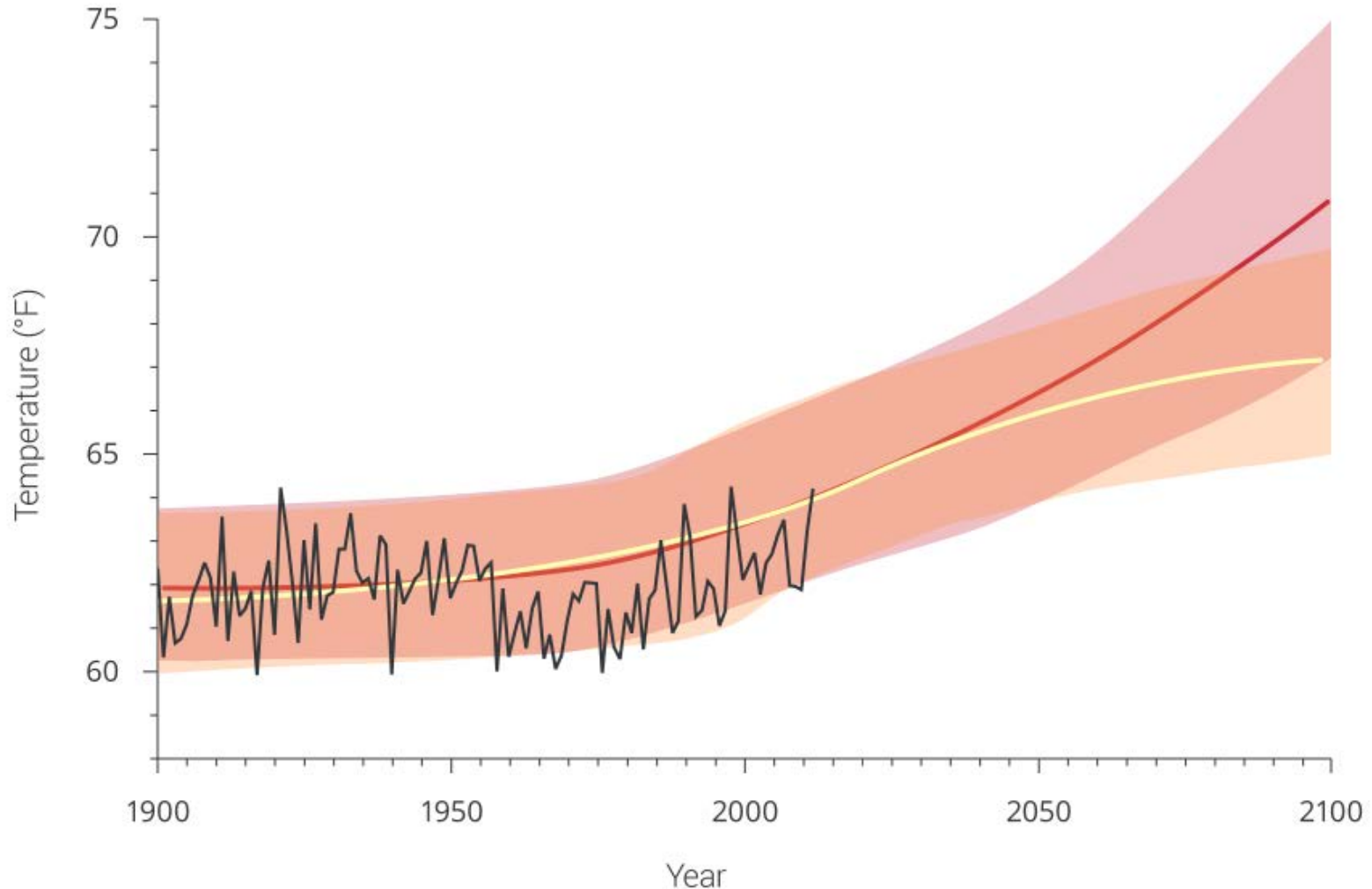
Southeast U.S. Temperature

Annual Average Temperature

OBSERVED

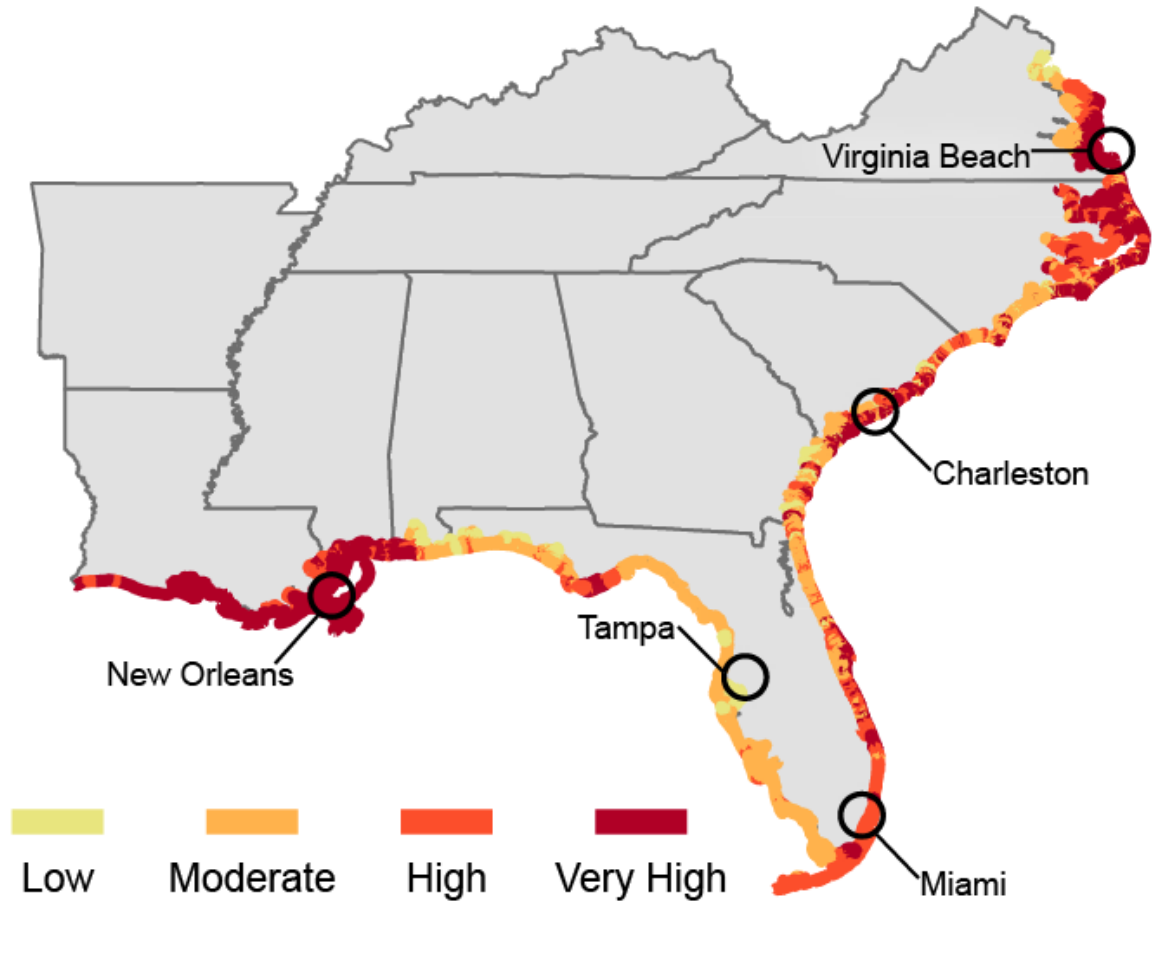
LOWER EMISSIONS (B1)

HIGHER EMISSIONS (A2)



Sea Level Rise: Differences in Vulnerability

Vulnerability to Sea Level Rise



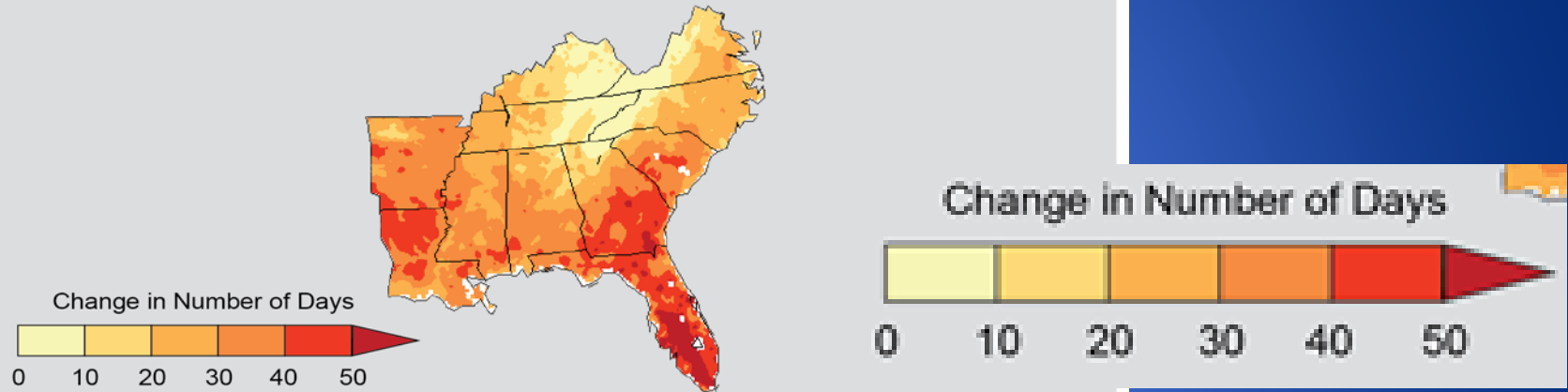
Causes of differences

- Tidal range
- Wave height
- Coastal slope
- Shoreline change, landforms, and processes
- Historical rate of sea level rise

Southeast U.S. Days over 95F

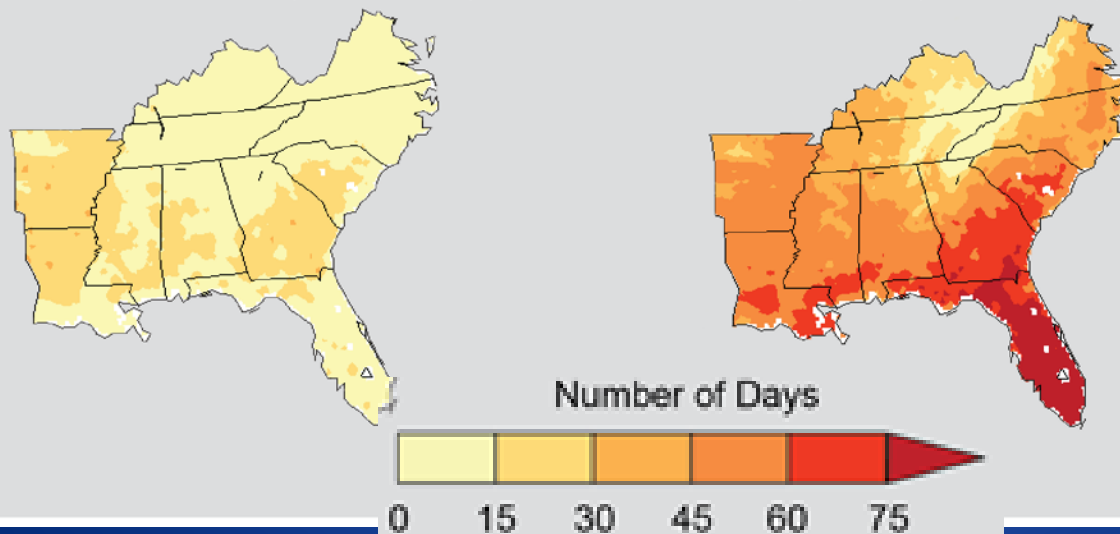
Projected Change in Number of Days Over 95°F

Projected Difference from Historical Climate

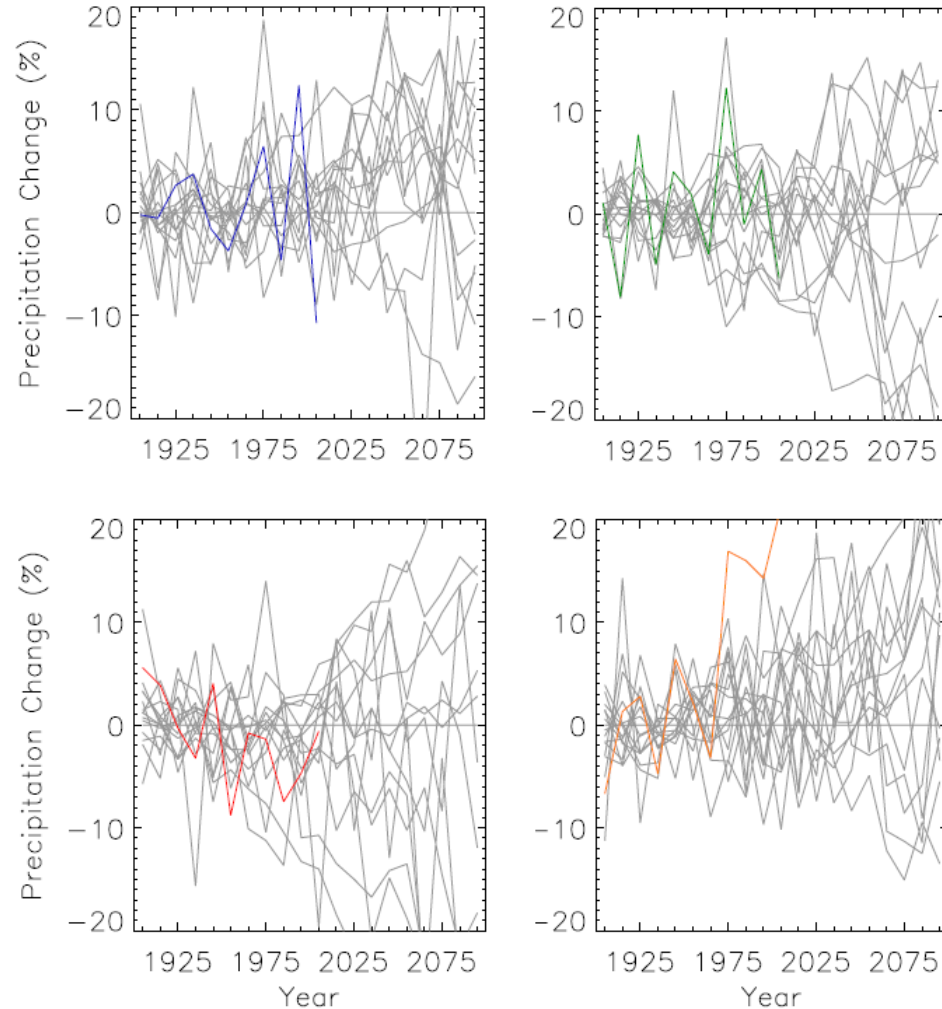


Historical Climate (1971-2000)

Projection (2041-2070)



Southeast U.S. Precipitation Projections



Black line – Observed decadal mean annual precipitation change
Colored lines – Observed decadal mean annual precipitation change

Gray lines – Model simulations from 15 CMIP3 models for the high (A2) emissions scenario.
Gray lines – Model simulations from 15 CMIP3 models for the high (A2) emissions scenario.

Other Connections

Protecting the
Lincoln
Reflection Pond

estimate
approximately
\$7 million

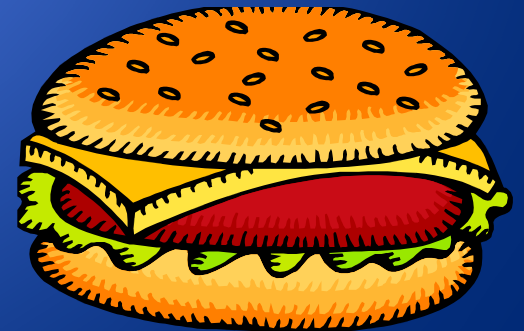


Western Drought and Beef Prices

“Beef prices hit all-time high in U.S.”

8 April 2014 LA Times

- October 2013 McDonald's Dollar Menu becomes a “Dollar Menu & More”
- January 2013 Wendy's “Dollar Menu” became the “right price, right size”



Vulnerability of global supply chains

“Thailand Flooding Cripples Hard-Drive Suppliers”

New York Times; 6 November 2011

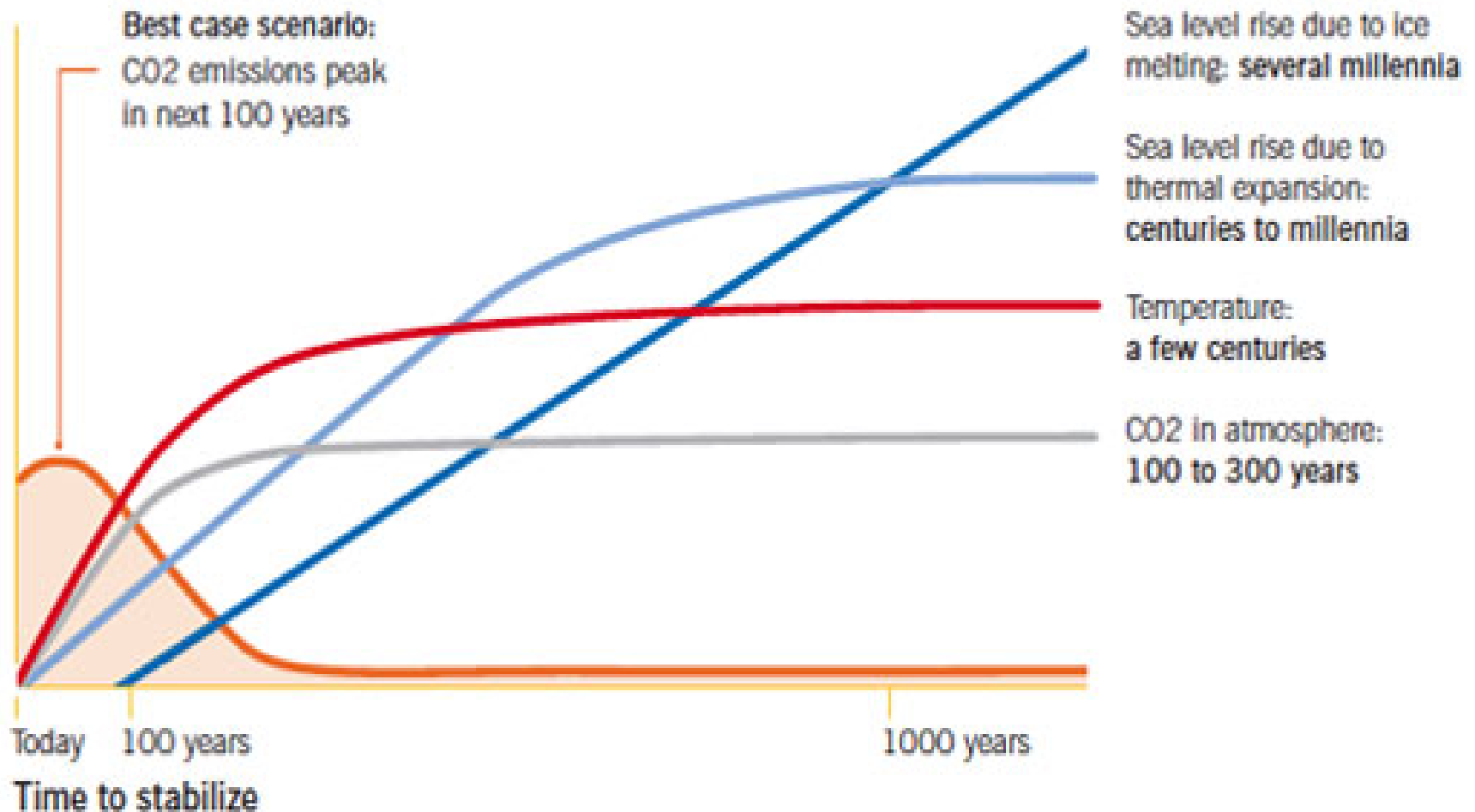


Anticipated 10% increase in consumer prices
Slow down in Honda and Toyota car production

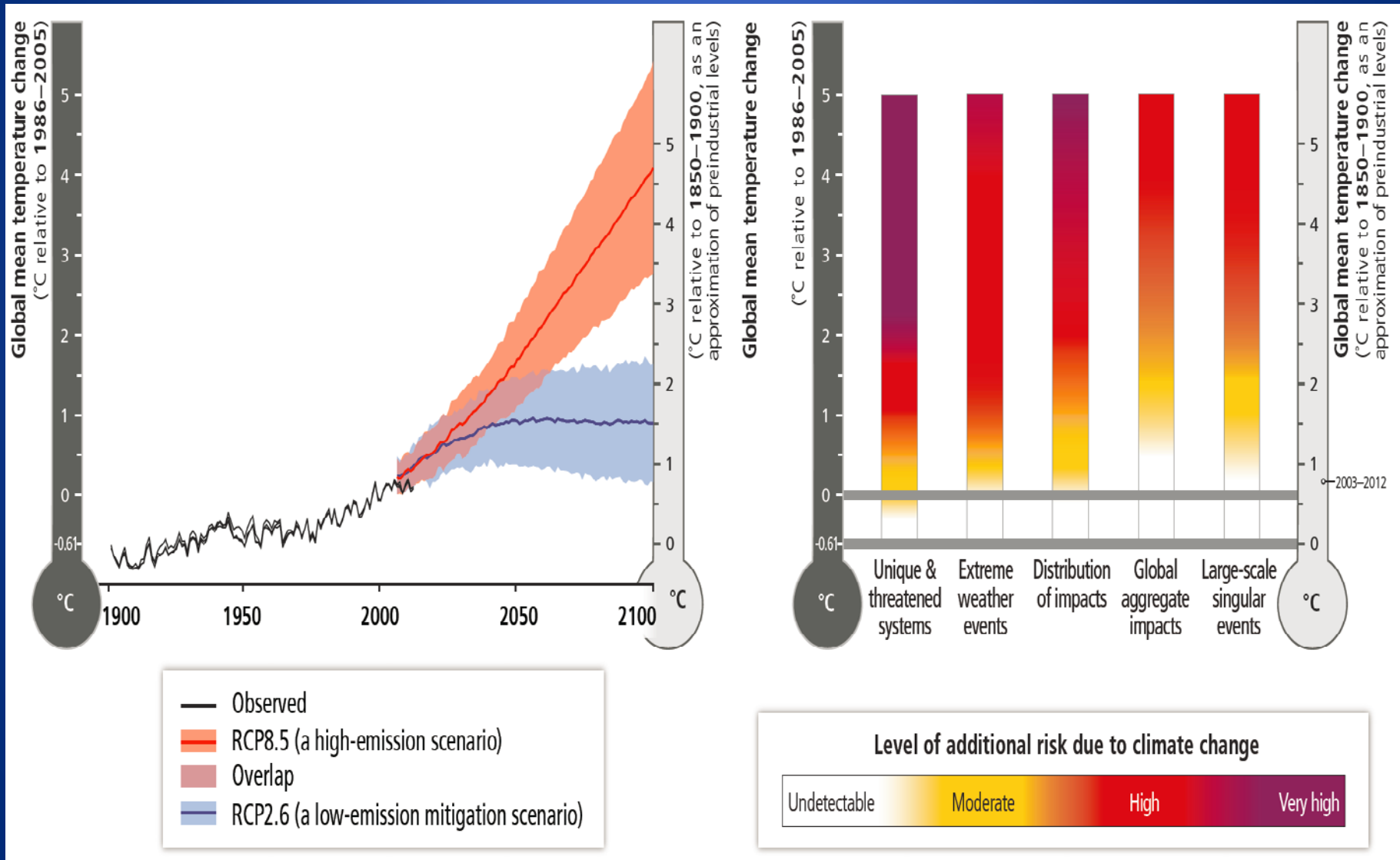
Figure 1: How long will it take our climate to stabilize?

Even if we succeed at reducing our emissions, it will take centuries for the climate—and the effects of global warming and sea level rise—to stabilize.

Magnitude



Climate Choices



Demonstrating and sharing information about empowering choices are effective



Thank you all for your Climate Friendly Park efforts