How do we know the world is warming?

An interactive presentation about climate from NOAA

Instructions:

In Slide Show mode, go to slide #2 and click any label to jump to a slide of additional information

•Return to the main slide by clicking “Back”

•Click “Data” to see a graph of datasets that support each statement

•If you have Internet access available, click “Interactive Version” to launch a browser and explore the data

How do we know the world is warming?

Click any label for information

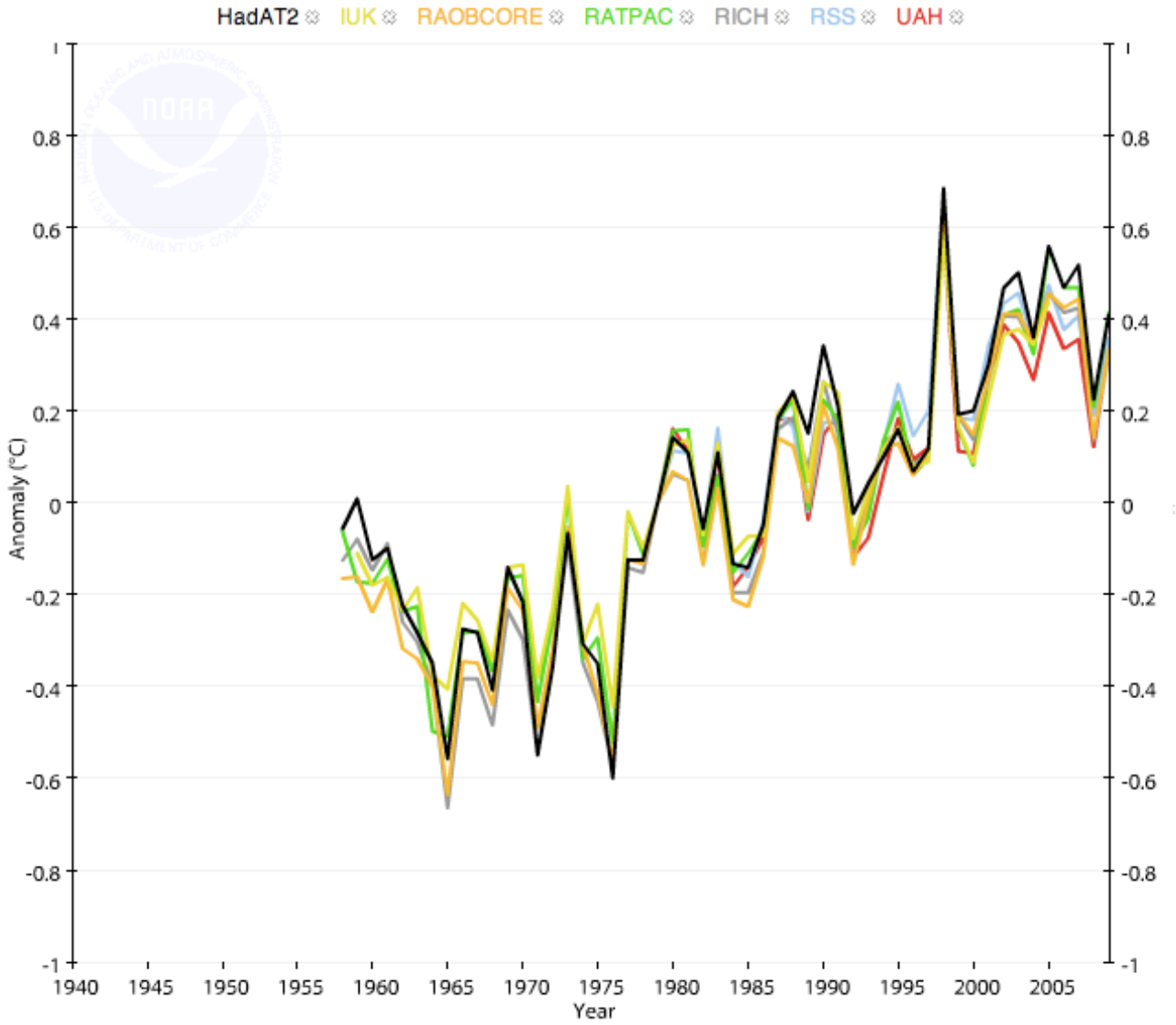
Credits and data sources

Temperature of the Lower Atmosphere

Measurements from satellites and weather balloons show that the lowest layer of the atmosphere—the layer where we live, airplanes fly, and weather occurs—is warming. Greenhouse gases are building up in this layer, trapping heat radiated from Earth's surface and raising the planet's temperature.

Tropospheric Temperature

Datasets



Explore more…

Access interactive graph, references, and data

(requires Internet)

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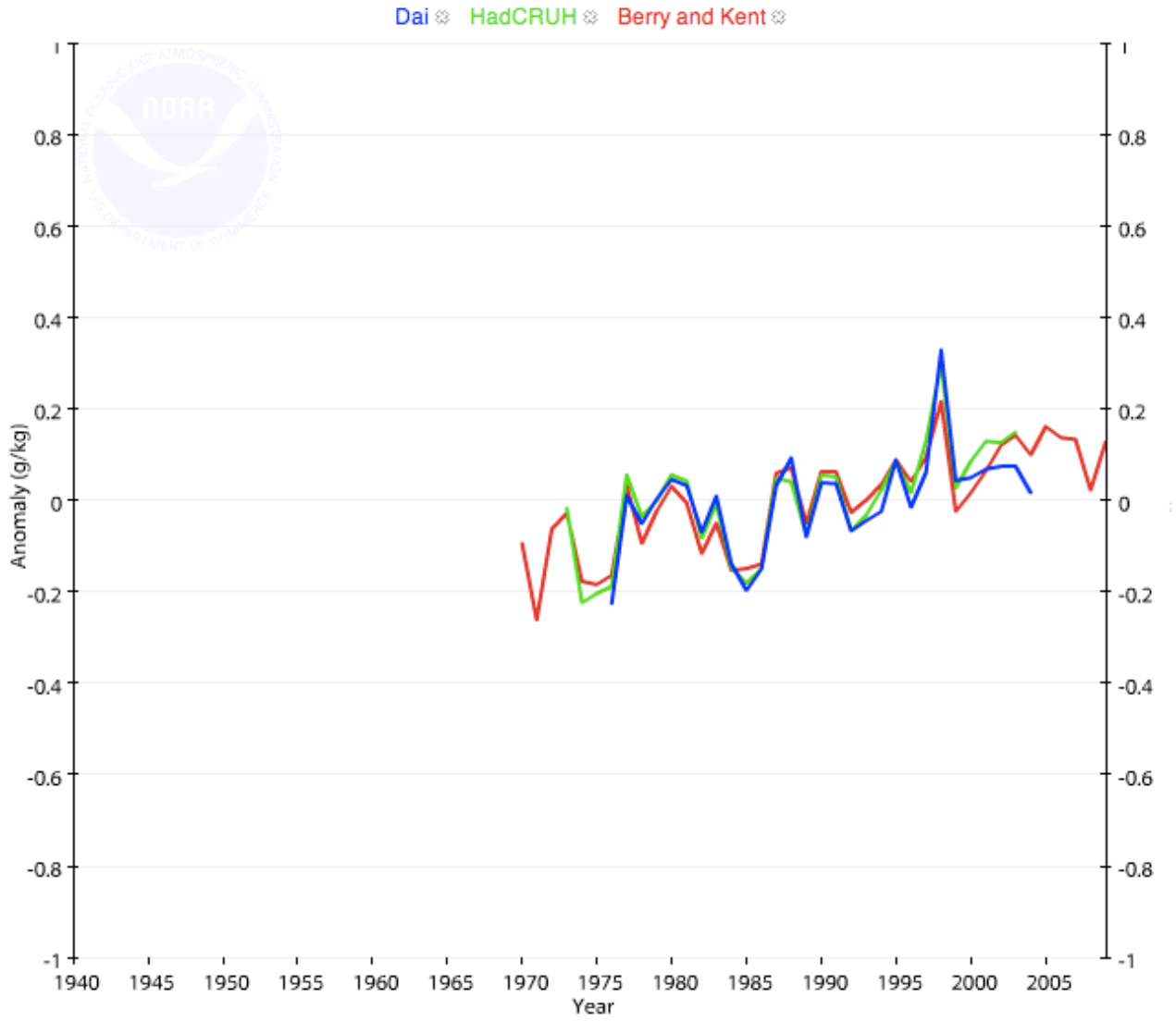
Humidity

Measurements over land and water show more water vapor in the air. The air feels stickier when it's hot, and air conditioners have to work harder for us to feel comfortable.

Specific Humidity

Datasets



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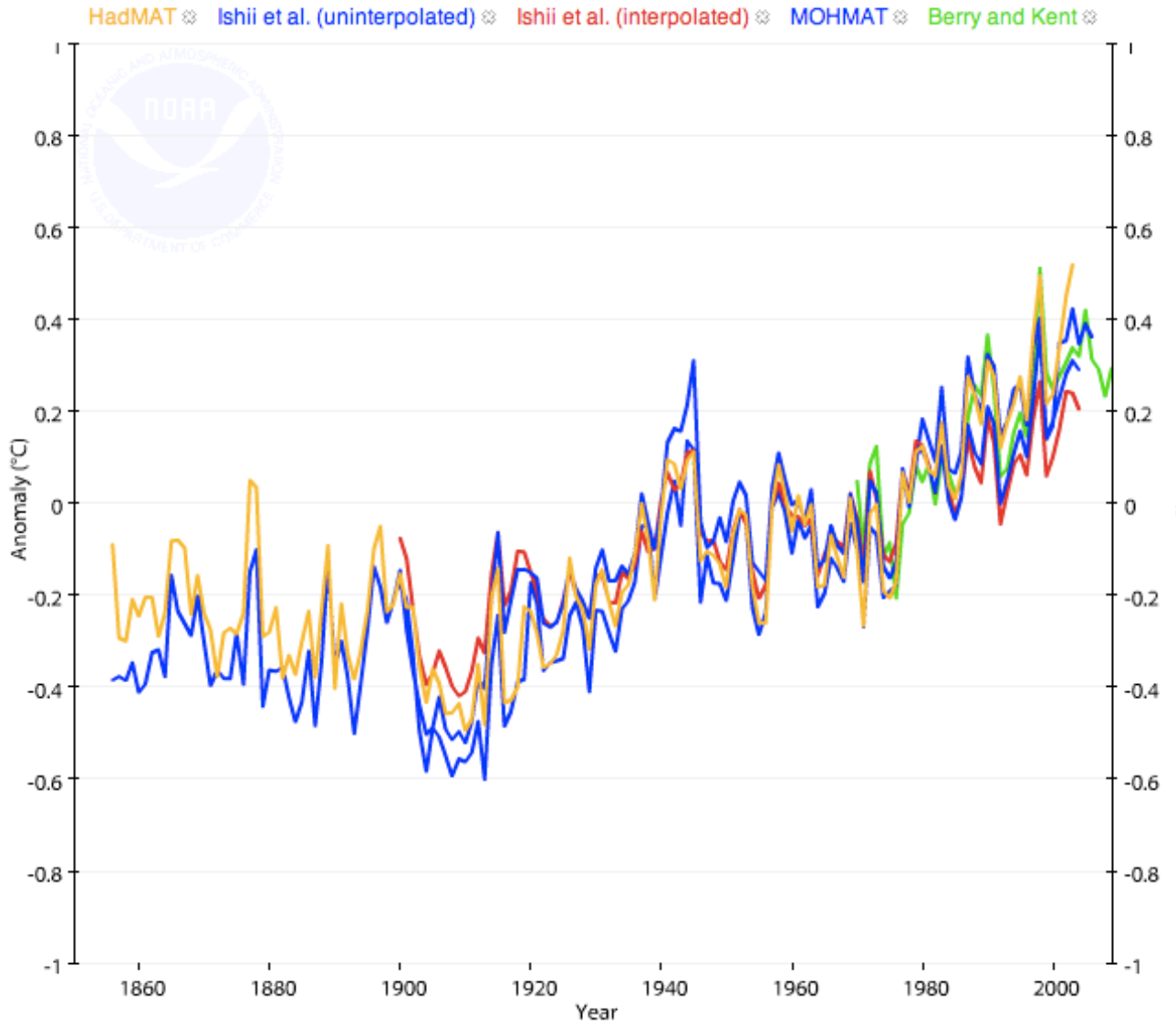
Air Temperature over Ocean

Thermometers on ships and floating buoys show that air near the ocean's surface is getting warmer, increasing its ability to evaporate water.

In turn, we see an increase in heavy precipitation events and flooding on land

Marine Air Temperature

Datasets



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Air Temperature over Land

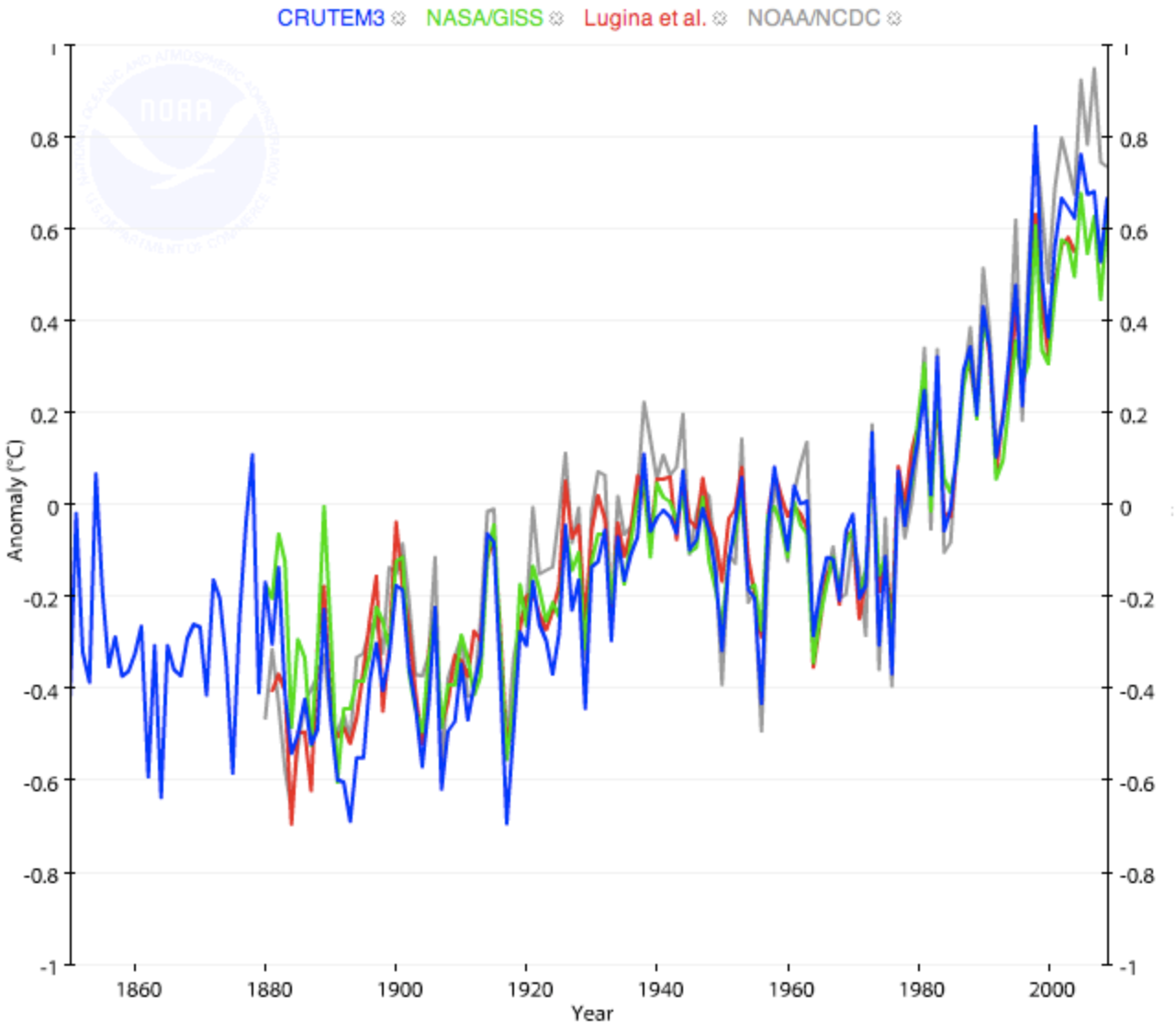
Satellites and weather stations on land show that average air temperature at the surface is going up.

Consequently, we see an increase in the number of heat wave events and the area affected by it.

This sign in Paris gave a phone number people could call to find out if their loved ones were among the victims who died during a heat wave there in 2003.

Land Surface Air Temperature

Datasets



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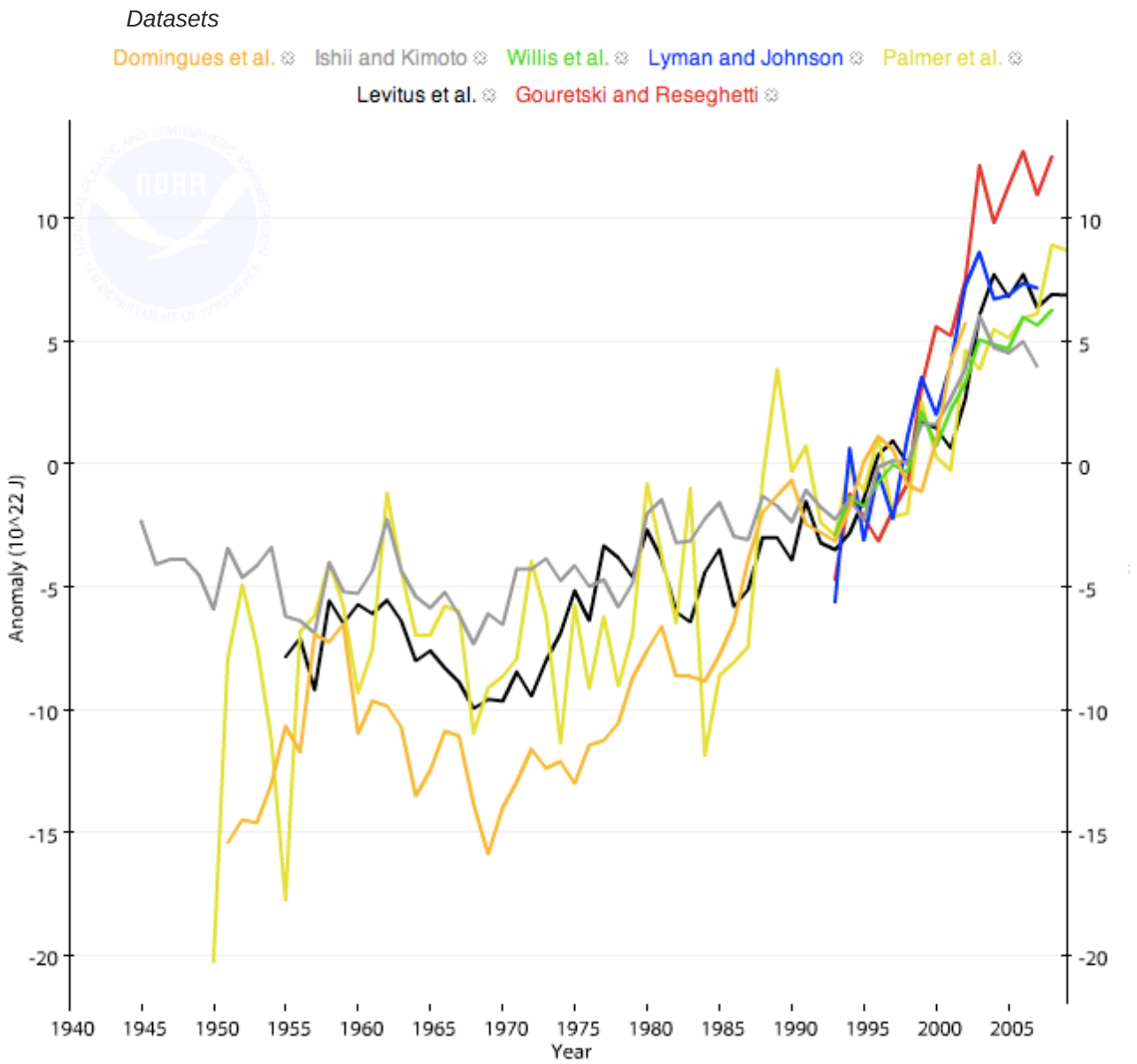
Ocean Heat Content

Temperature sensors on buoys and in “floats” that move up and down through the ocean show an increase in the heat energy stored in the top half-mile of ocean water.

Warming causes water to expand, raising global sea level. Higher water temperatures can also affect marine ecosystems, disrupting fisheries and the who depend ι

Ocean Heat Content (0-700m)



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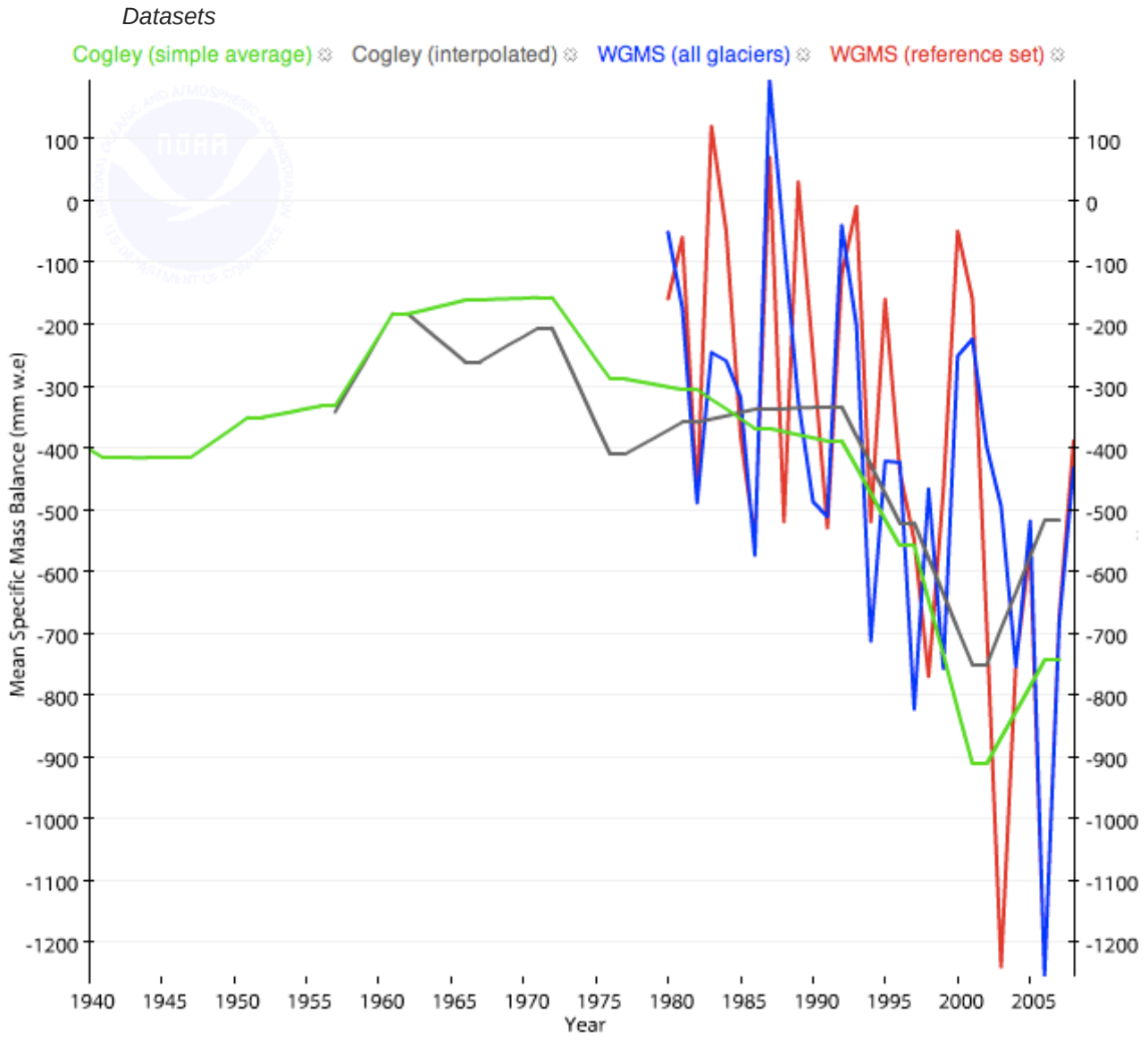
Glaciers

Historical paintings, photographs, and other long-term records show that most mountain glaciers are melting away.

People who depend on water from melting glaciers for their living needs, crops, and livestock are facing ial shorta

Glacier Mass Balance



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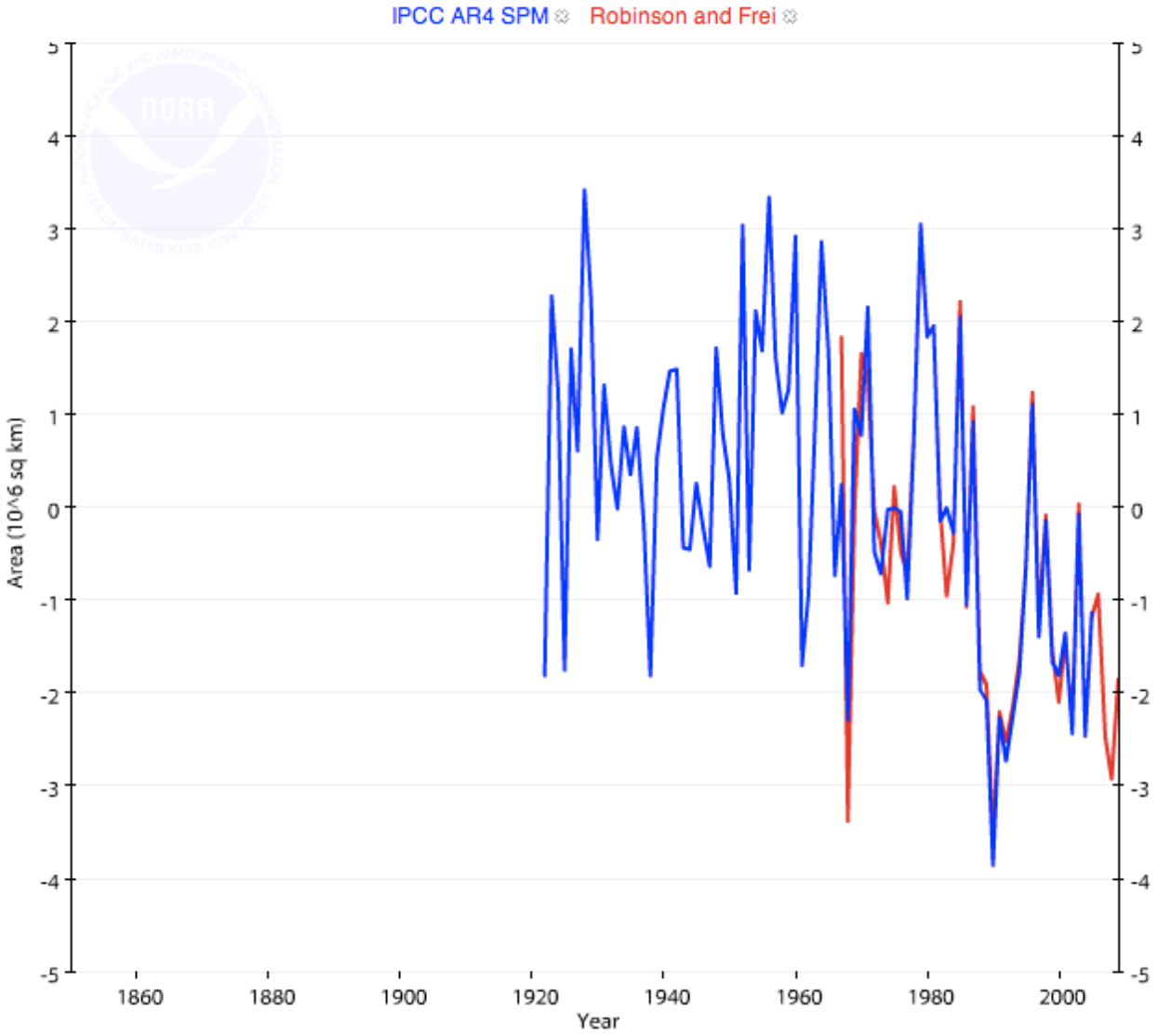
⬇ Snow

Satellite images show that the area of land covered by snow during spring in the Northern Hemisphere is getting smaller.

Snow is melting earlier, changing when and how much water is available for nature and people.

Northern Hemisphere (March-April) Snow Cover

Datasets



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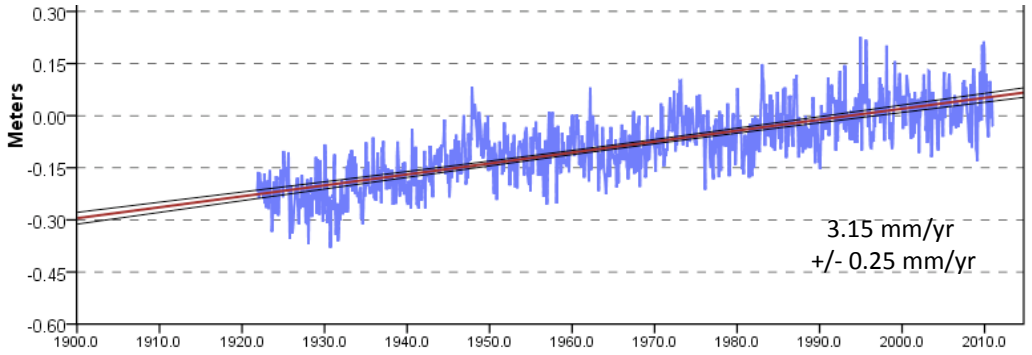
Global Sea Level

Tide gauges and satellites that measure the distance from their orbit to the ocean's surface both show that global sea level is getting higher.

Rising waters threaten ecosystems, freshwater supplies, and human developments along coasts.

Mean Sea Level Trend – Charleston, South Carolina



Data

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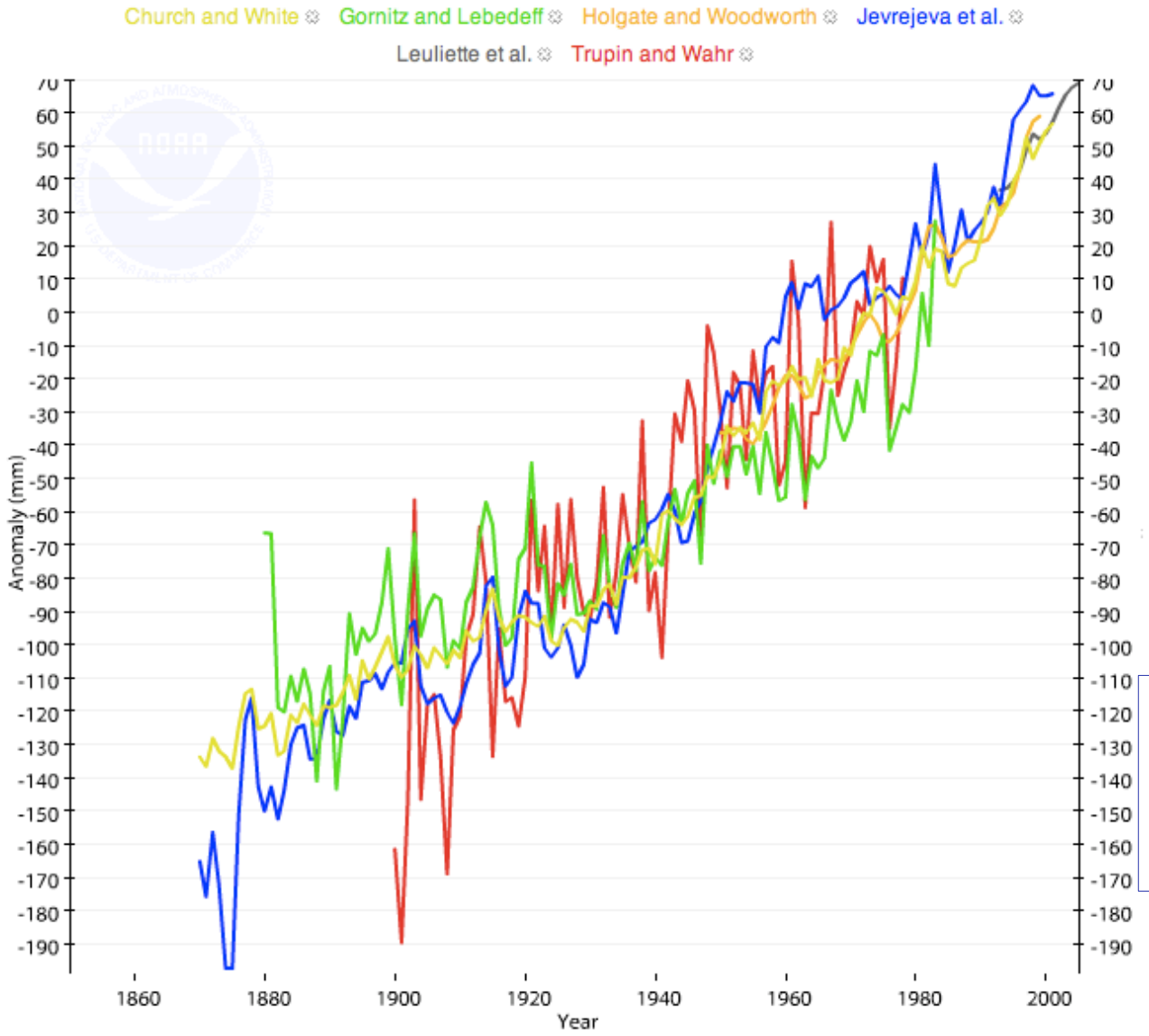
Sea Level

Datasets



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Sea Surface Temperatur e

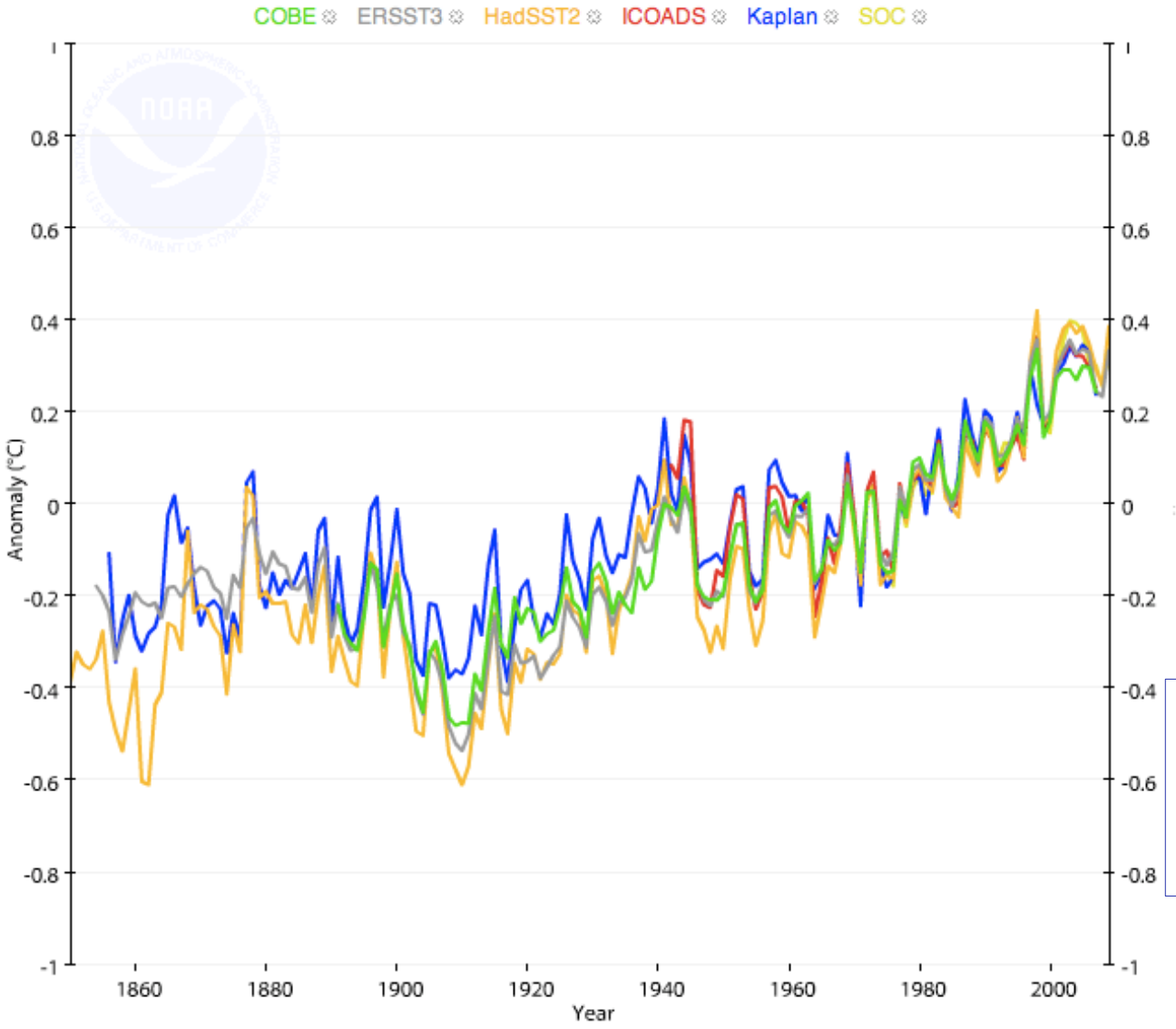
Satellite sensors and thermometers on ships and buoys show that the temperature of water at the ocean’s surface is rising.

Warm surface waters can damage coral reefs, reducing opportunities for fishing and tourism, and leave coasts vulnerable to storm surges and

ı.

Sea-surface Temperature

Datasets



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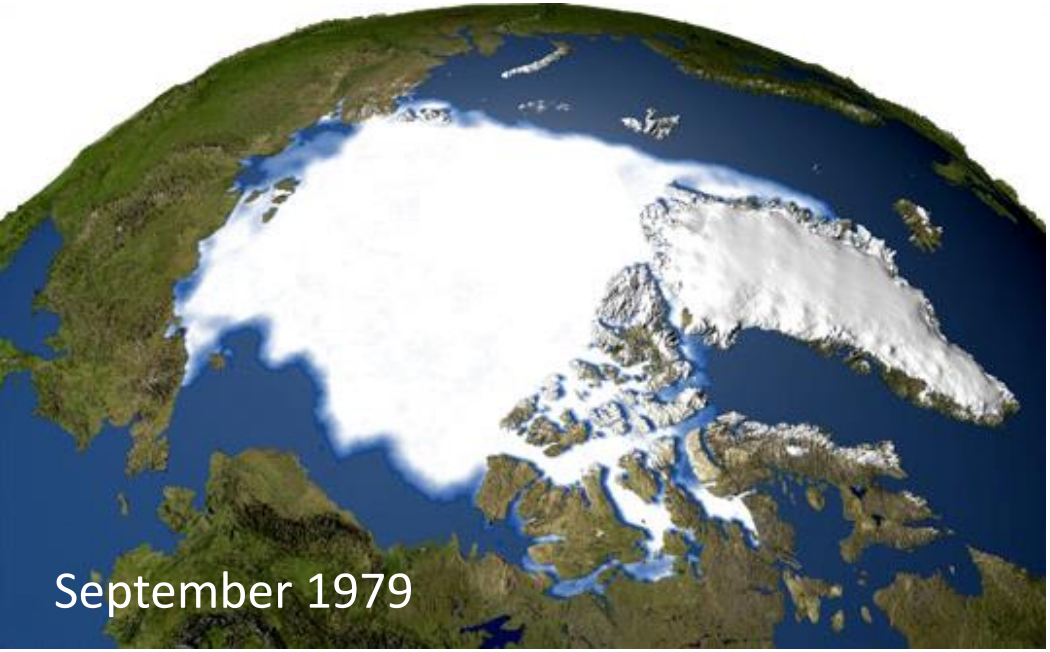
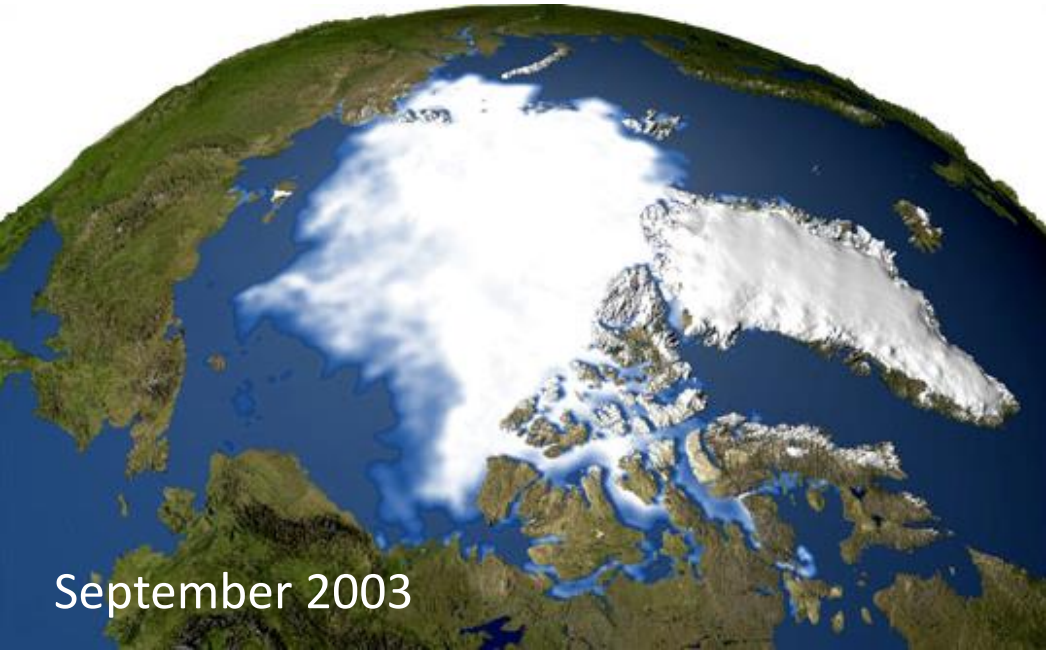




Arctic Sea Ice

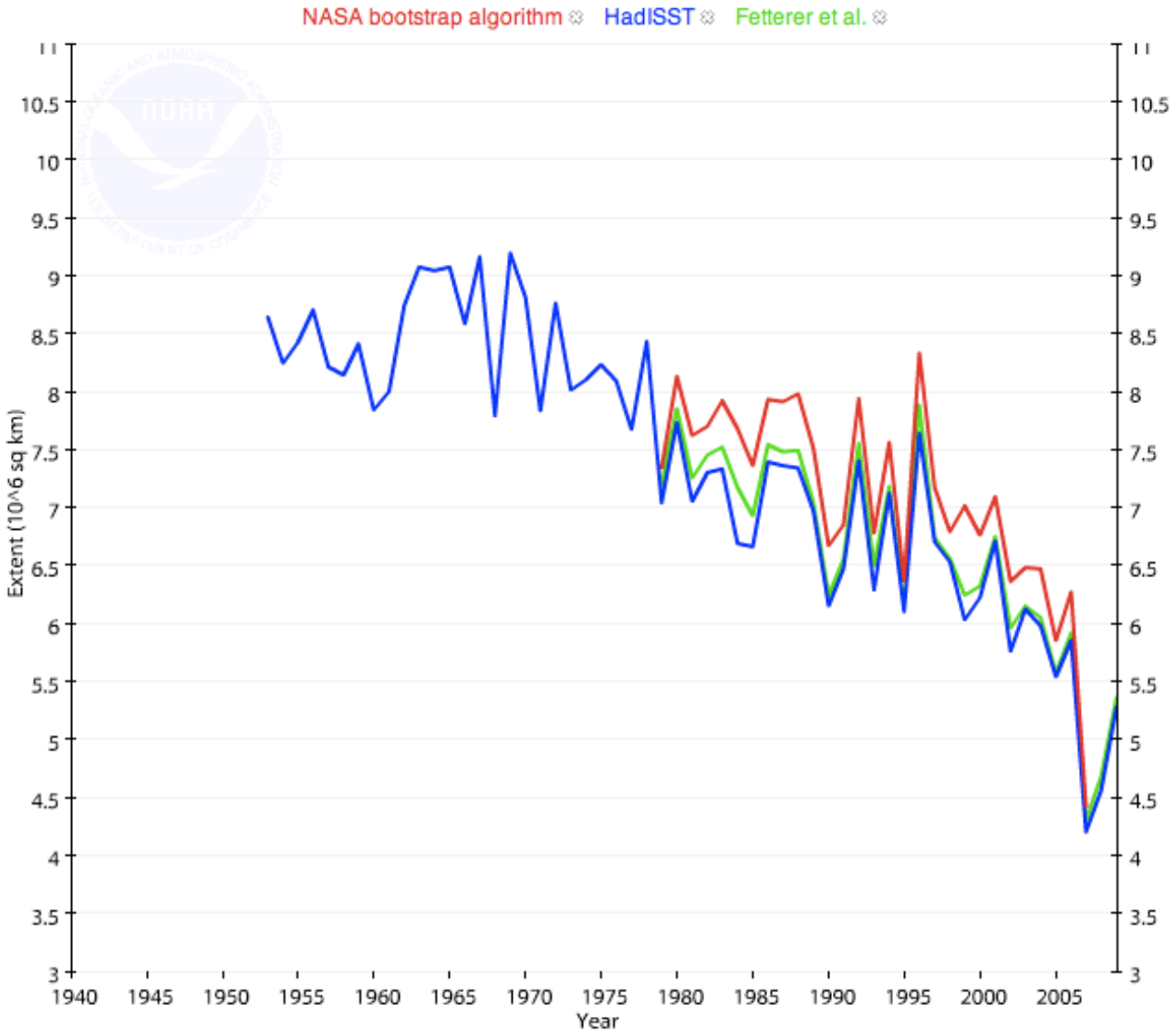
Satellite images show that the area covered by sea ice in the Arctic is getting smaller.

While a decrease in sea ice may open new shipping routes and provide easier access to natural resources, it may also introduce concerns related to national security and invasive species.

Data Back

September Arctic Sea-Ice Extent

Datasets



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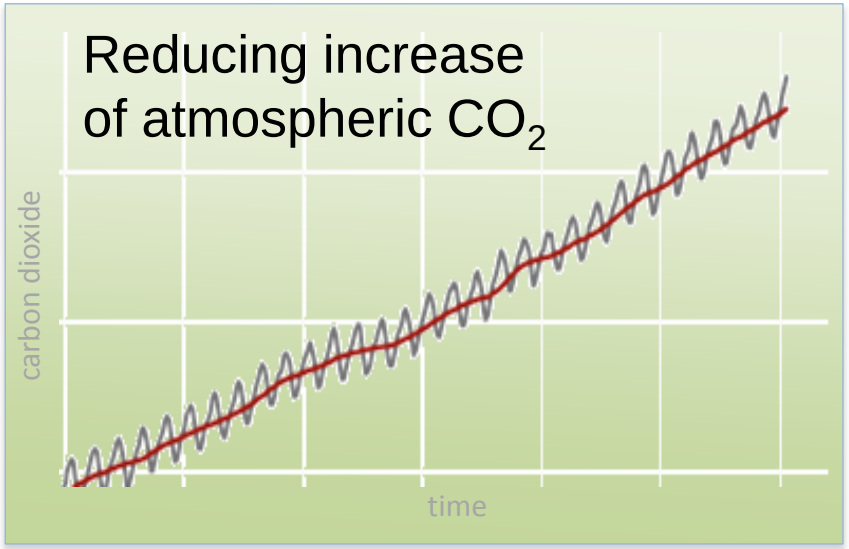
Mitigation

Reducing greenhouse gas emissions or removing carbon dioxide from the atmosphere can lessen the severity of climate change impacts



Click graph for examples

Adaptation

(also called Preparedness)

Taking action to minimize vulnerability to climate change impacts can smooth our transition to a warmer world

Click image for examples

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Mitigation – Reducing CO_2

- Develop new habits to eliminate wasted energy
- Switch to carbon-free energy sources such as solar and wind
- Plant new trees to increase the amount of CO_2 taken up by forests

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Assessing a region's ability to handle runoff from heavier precipitation

Adaptation –

Anticipating and adjusting to new conditions

What changes are coming?

What changes do we need to make?

- Protect habitat or structures threatened by sea level rise
- Develop plans to ensure adequate water supplies
- Plant different crops
- Develop new businesses

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Sources:

How do we know the world has warmed? by J. J. Kennedy, P. W. Thorne,
T. C. Peterson, R. A. Ruedy, P. A. Stott, D. E. Parker, S. A. Good, H. A. Titchner, and K. M. Willett, 2010: [in "State of the Climate in 2009"]. Bull. Amer. Meteor. Soc., 91 (7), S79-106.

Global Climate Change Impacts in the United States, U.S. Global Change Research Program. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Interactive PowerPoint Presentation prepared by NOAA Climate Program Office. Science review by Derek Arndt, National Climatic Data Center. Credits for images appear in the Notes section of each slide. All comparative statements in the presentation refer to trends measured over a minimum of 30 years.

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