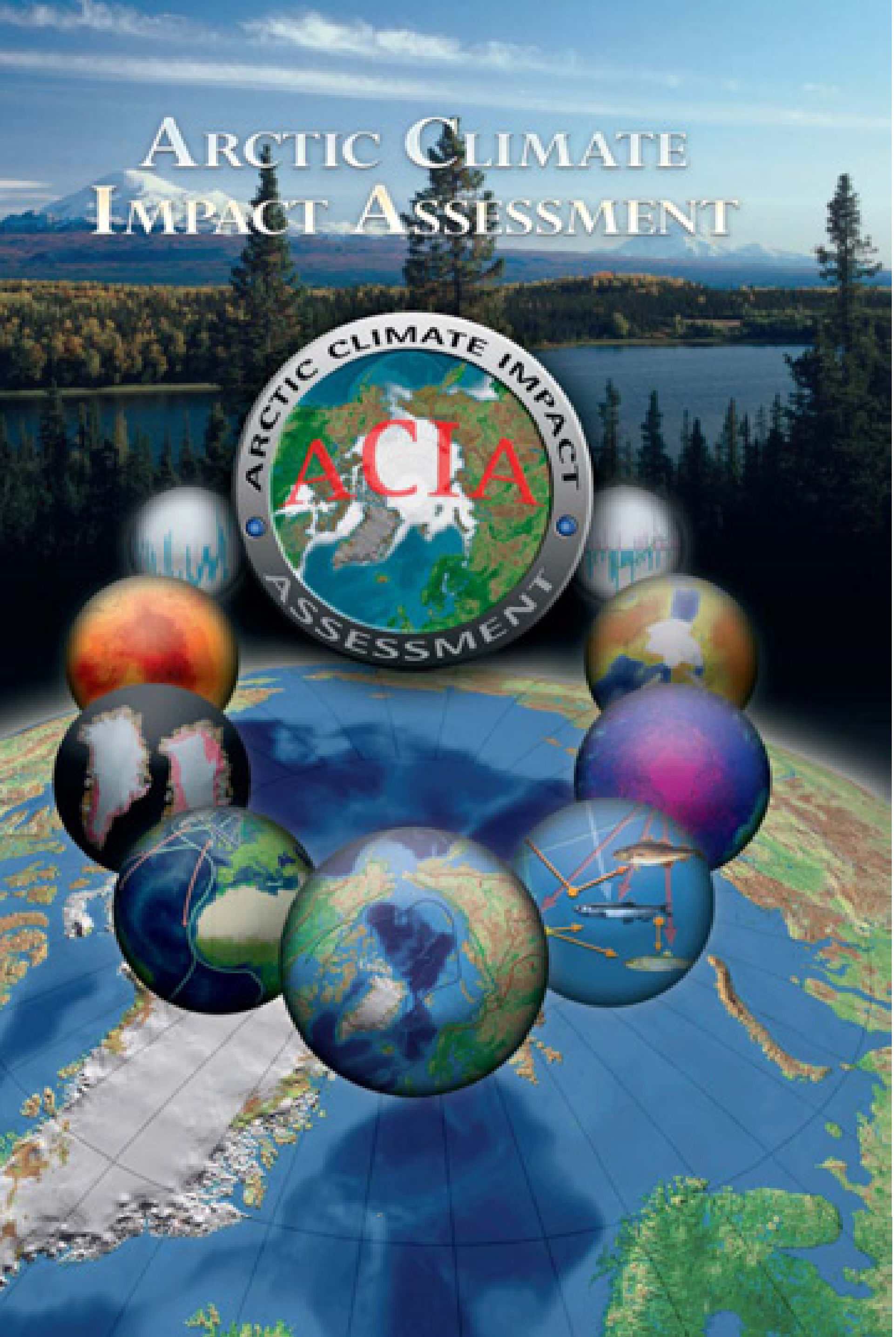
QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.

Good Morning



ACIA Arctic Climate Impact Assessment

Global Warming: Looking Beyond Kyoto

Session Two: Key Vulnerabilities in Climate Change

Yale University
Center for the Study of Globalization
October 21-22, 2005

www.acia.uaf.edu

"Right now the weather is unpredictable. In the older days, the edlers used to predict the weather and they were always right, but now, when they try to predict the weather, it's always something different….."

Z. Aqqiaruq, Igloolik 2000

The Presentation will Explore these Four Questions:

1. **What does science tell us, particularly recent findings that have implications across the Arctic Region and Globally?**

2. **What are some examples of strategies and scenarios towards emission reduction?**

3. **What issues of policies related to climate changes have the Ministers of the Arctic Council adopted in their Declaration of November, 2004**

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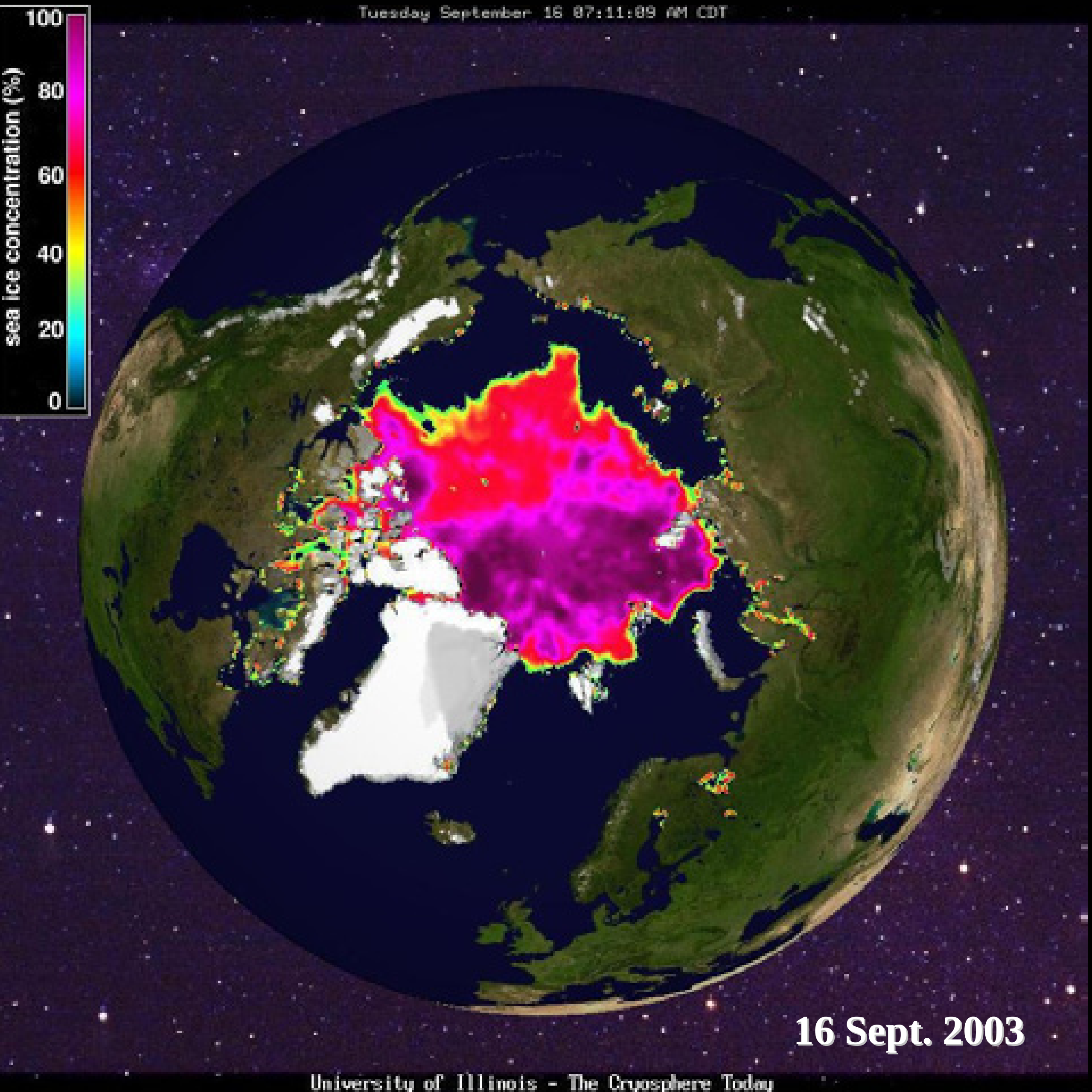
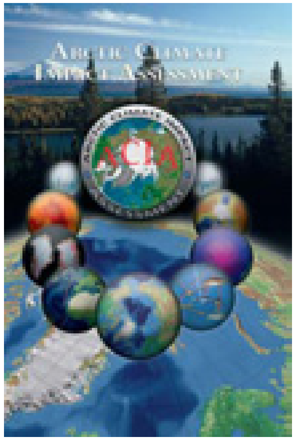
The Arctic Sea Ice is Rapidly Melting

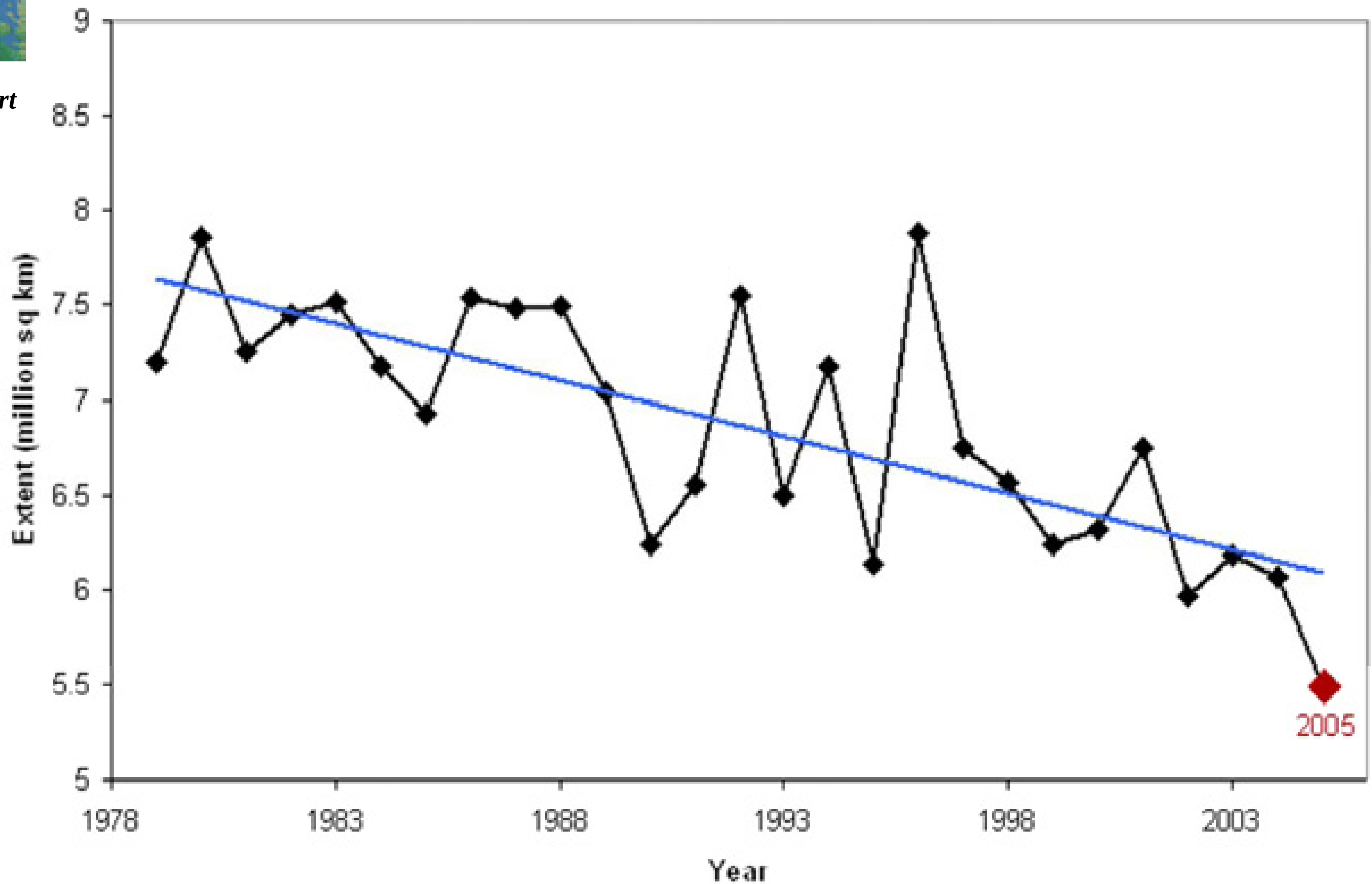


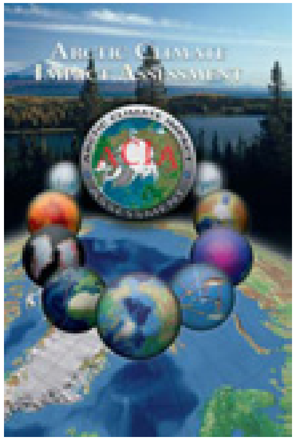
How Fast is it Melting and, How Important is that Fact for the Rest of the World?

Status of the Arctic Sea Ice. What happened in 2005?



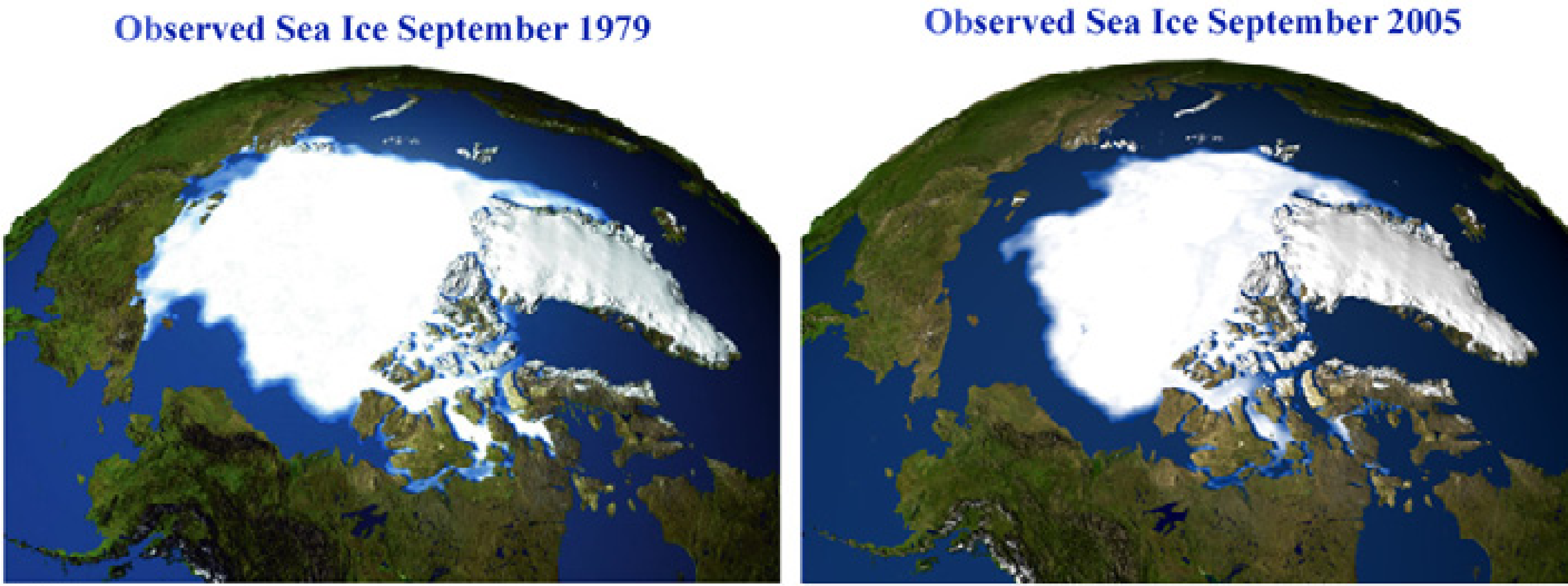
The Scientific Report



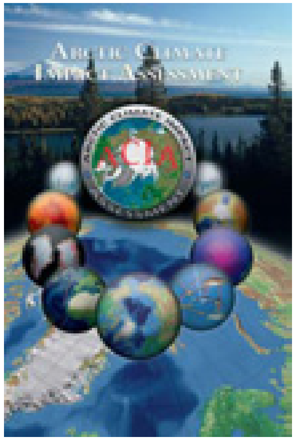


The Scientific Report

Status of the Arctic Sea Ice What happened in 2005?

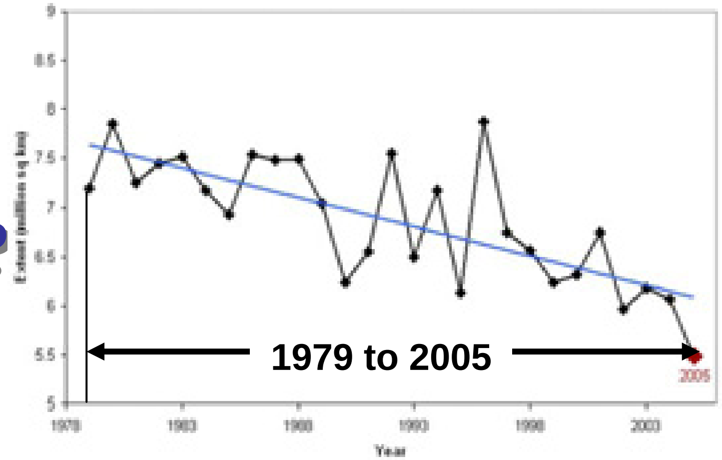


©NASA

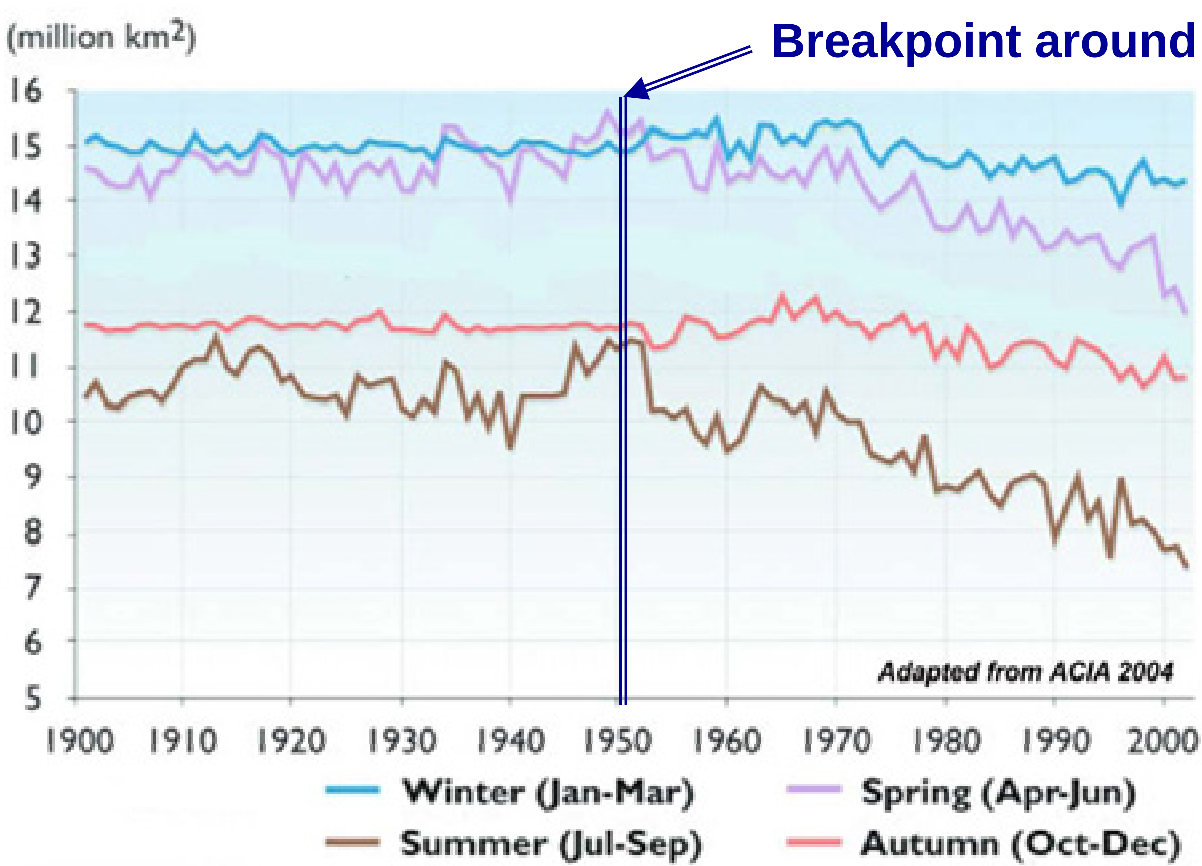


The Scientific Report

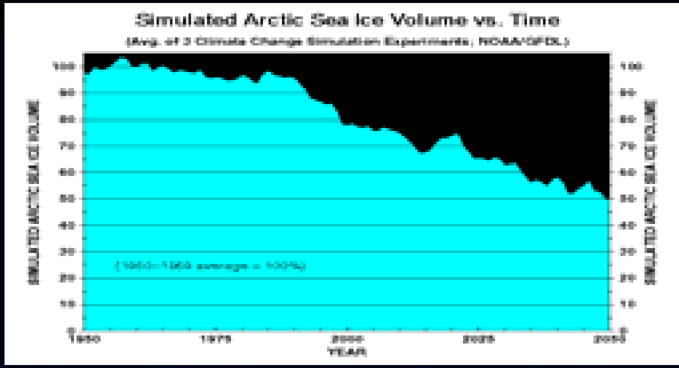
Arctic Sea Ice.
Is it a Short Term Process?



Observed seasonal Arctic sea-ice extent (1900-2003)

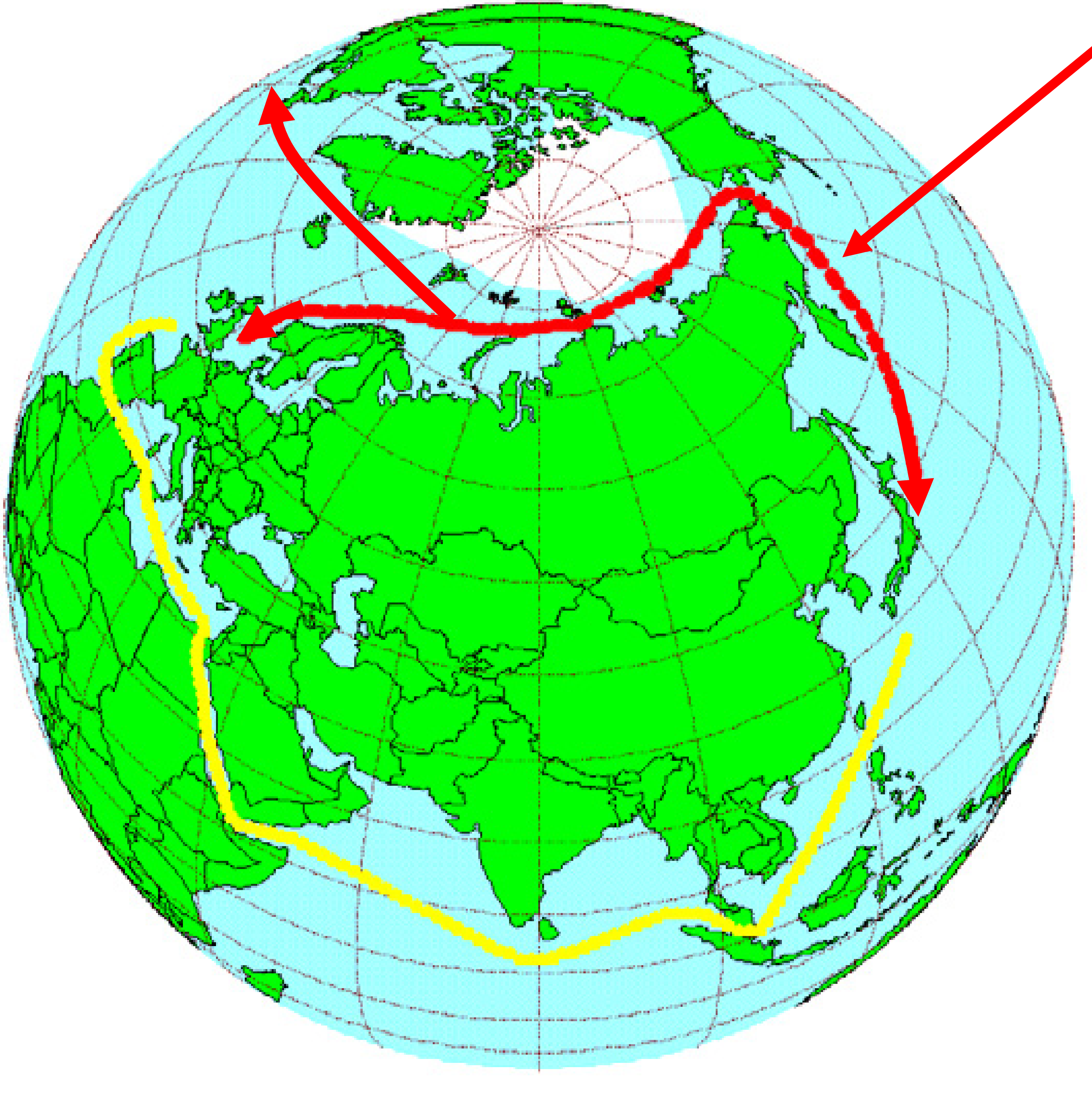


GFDL Simulation Projects 50% Reduction by 2050



(2010-2030) (2040 – 2060) (2070 – 2090)

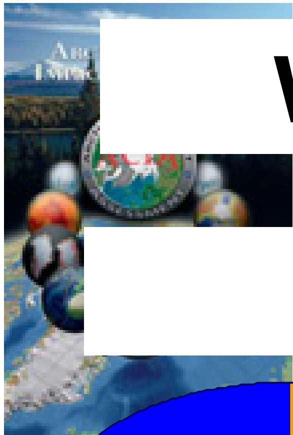
Five Models Project Sea Ice Extent for Mid-September



Northern Sea Route is 45% Shorter than through the Suez Canal

The ACIA models projects that the current navigation season of 20-30 days per year will increase to 3-6 months/yr by 2080, with one model indicating an ice-free summer by 2040

Worlds Petroleum Potential



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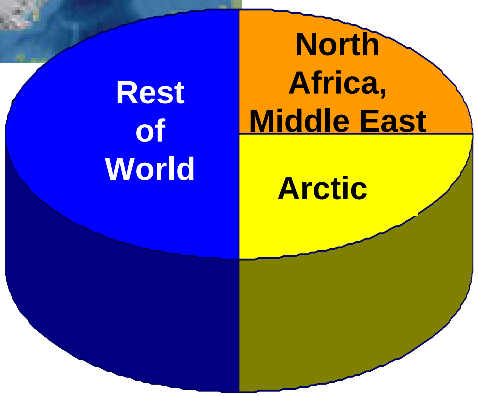
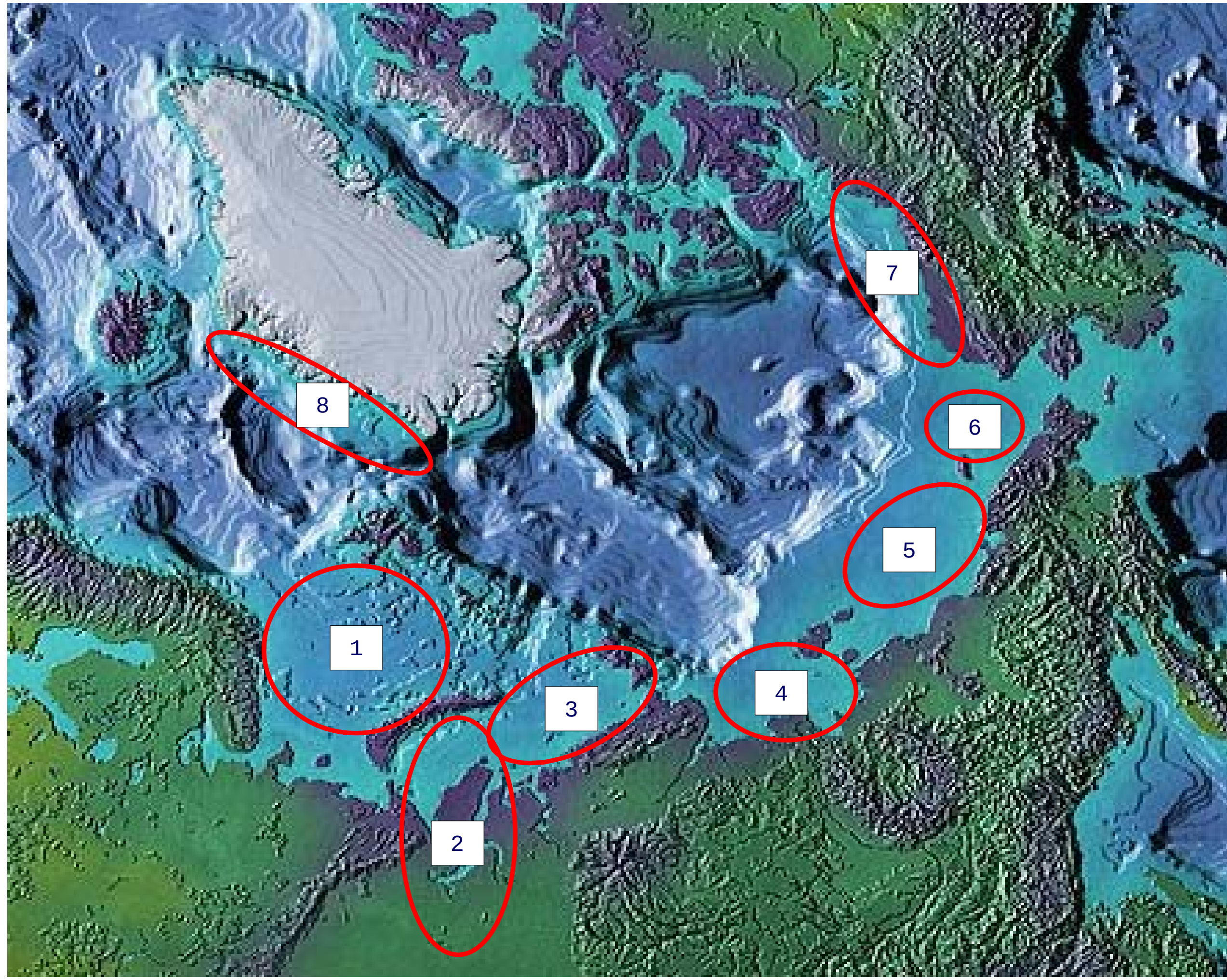
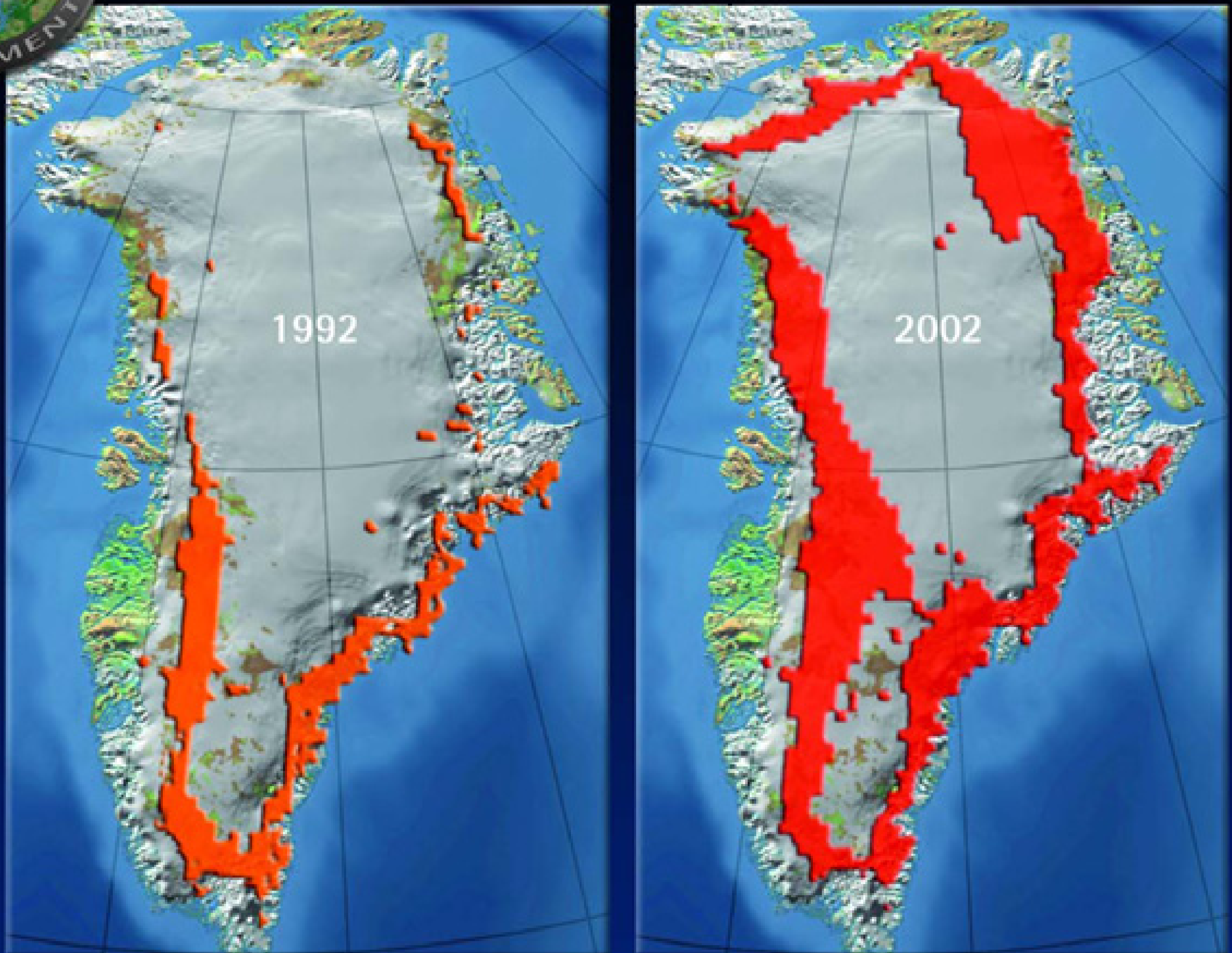




1. **Barents Sea**
2. **Southern Kara Sea and Western Siberia**
3. **Northern Kara Sea**
4. **Laptev Sea**
5. **East Siberian Sea**
6. **Chukchi Sea**
7. **Alaska North Slope**
8. **East Greenland**

IMPACTS OF A WARMING ARCTIC

Greenland Ice Sheet Melt Extent

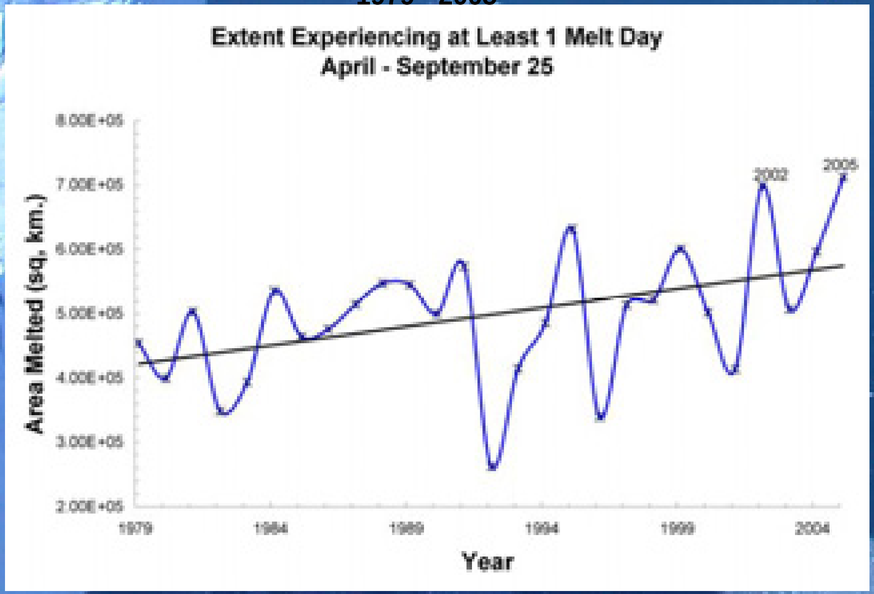


We expect a record total melt area for 2005 given the fact that the southern and western part of Greenland are still melting in late September, whereas 2002 and 1991 experienced almost no melt in late September and during October.

Source: Konrad Steffen and Russell Huff, Cooperative Institute for Research in Environmental Sciences (CIRES), Boulder, Colorado

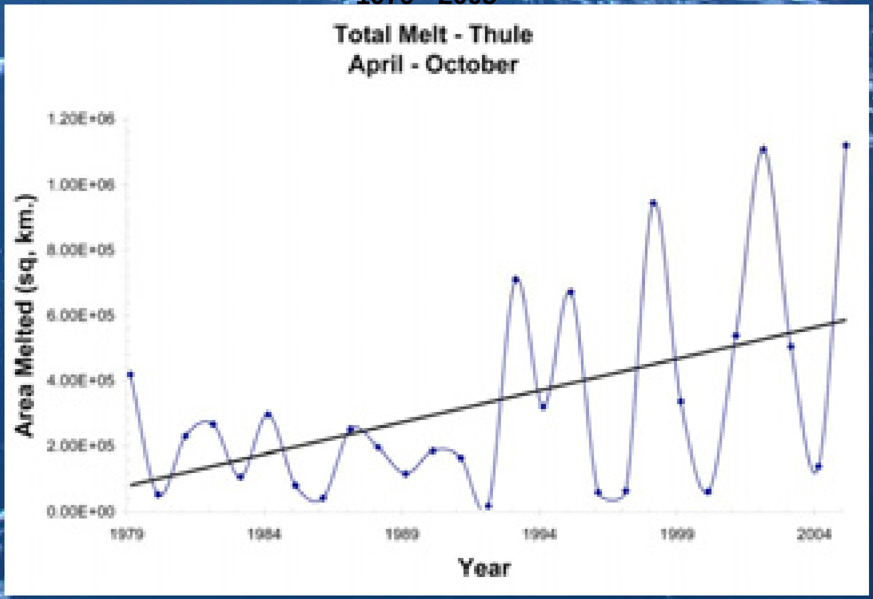
Melt Area for all of Greenland Melt

1979 - 2005



Area for NW Thule Area of Greenland

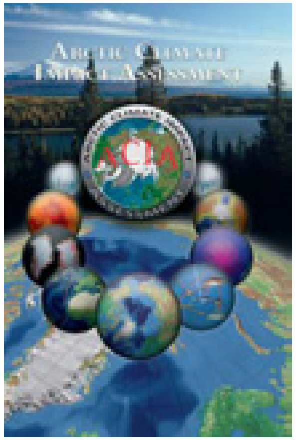
1979 - 2005



The Greenland Ice Sheet Dominates Land Ice in the Arctic

Over the past two decades, the melt area on the Greenland ice sheet has increased on average by about 0.7%/year (or about16% from 1979 to 2002).

Source: Business Week Aug. 2004



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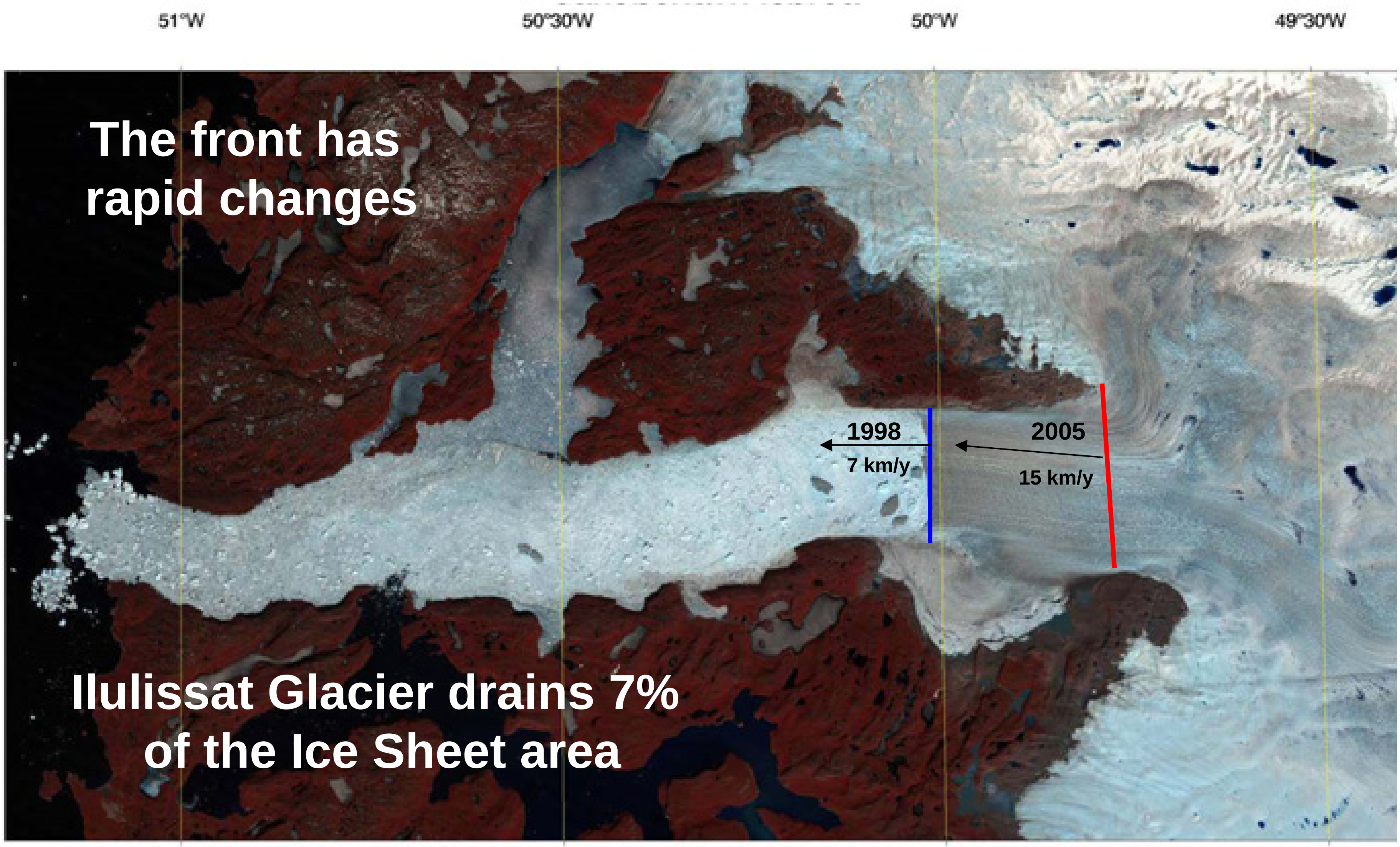
Changes in the Greenland Ice Sheet

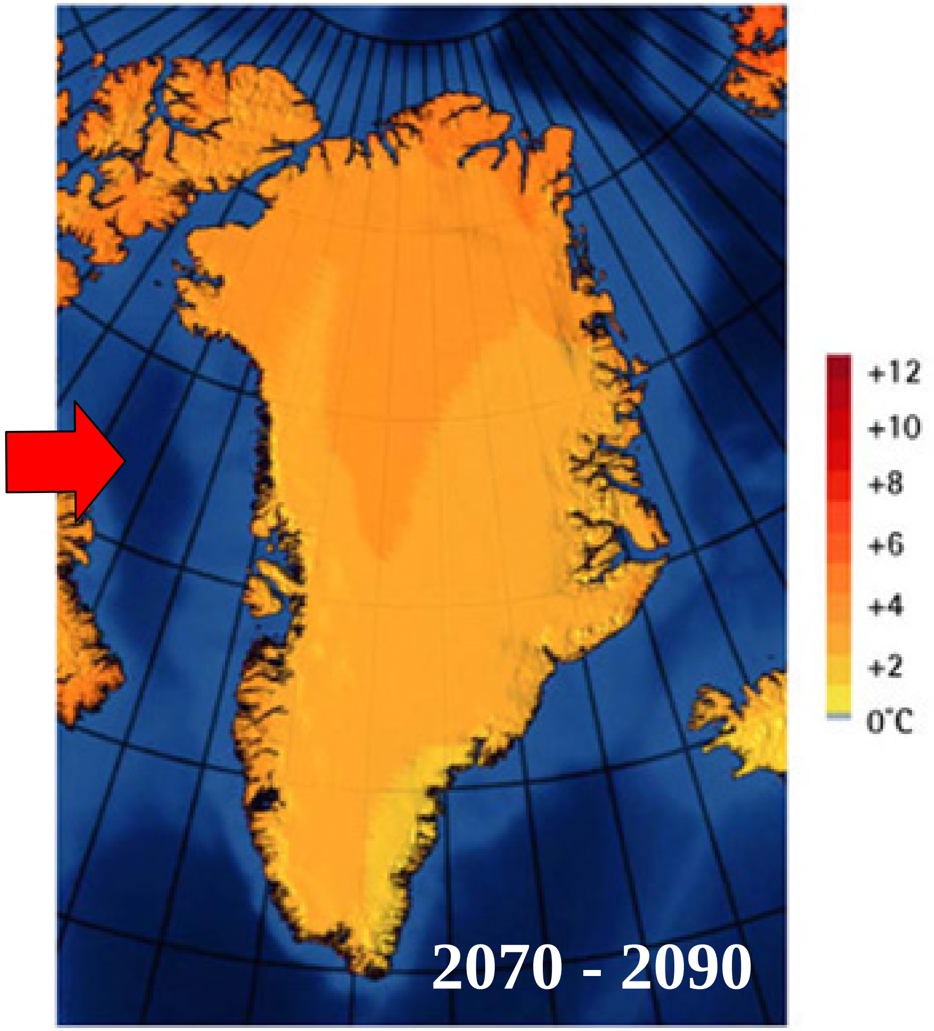
The glacier front retreated 8 km from 2001 to 2003, the Ice Velocity increased from 10 km/yr to 15 km/yr (1.7m/hr), and the ice is thinning 10 m per year



Ilulissat Glacier Retreat 1998-2005

Greenland's Annual Temperatures are Projected to Increase

Projected to be in the range of + 3^0 to 6^0 C



©2004, ACIA / Map ©Clifford Grabhorn

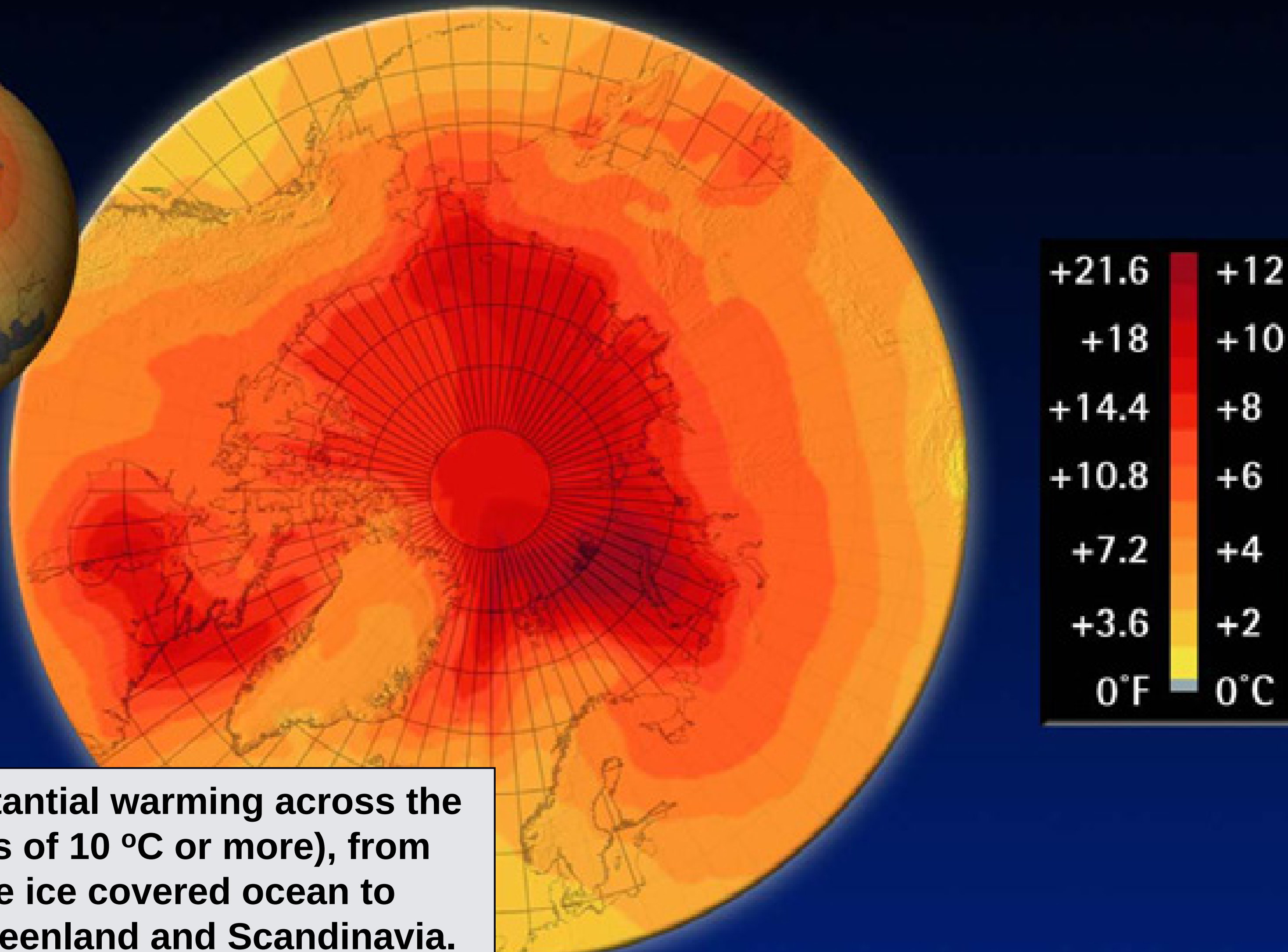
Climate models indicate that the local warming over Greenland is likely to be up to three times the global average.

IMPACTS OF A WARMING ARCTIC

Areas in Florida Subject to Inundation with 100 Centimeter Sea Level Rise

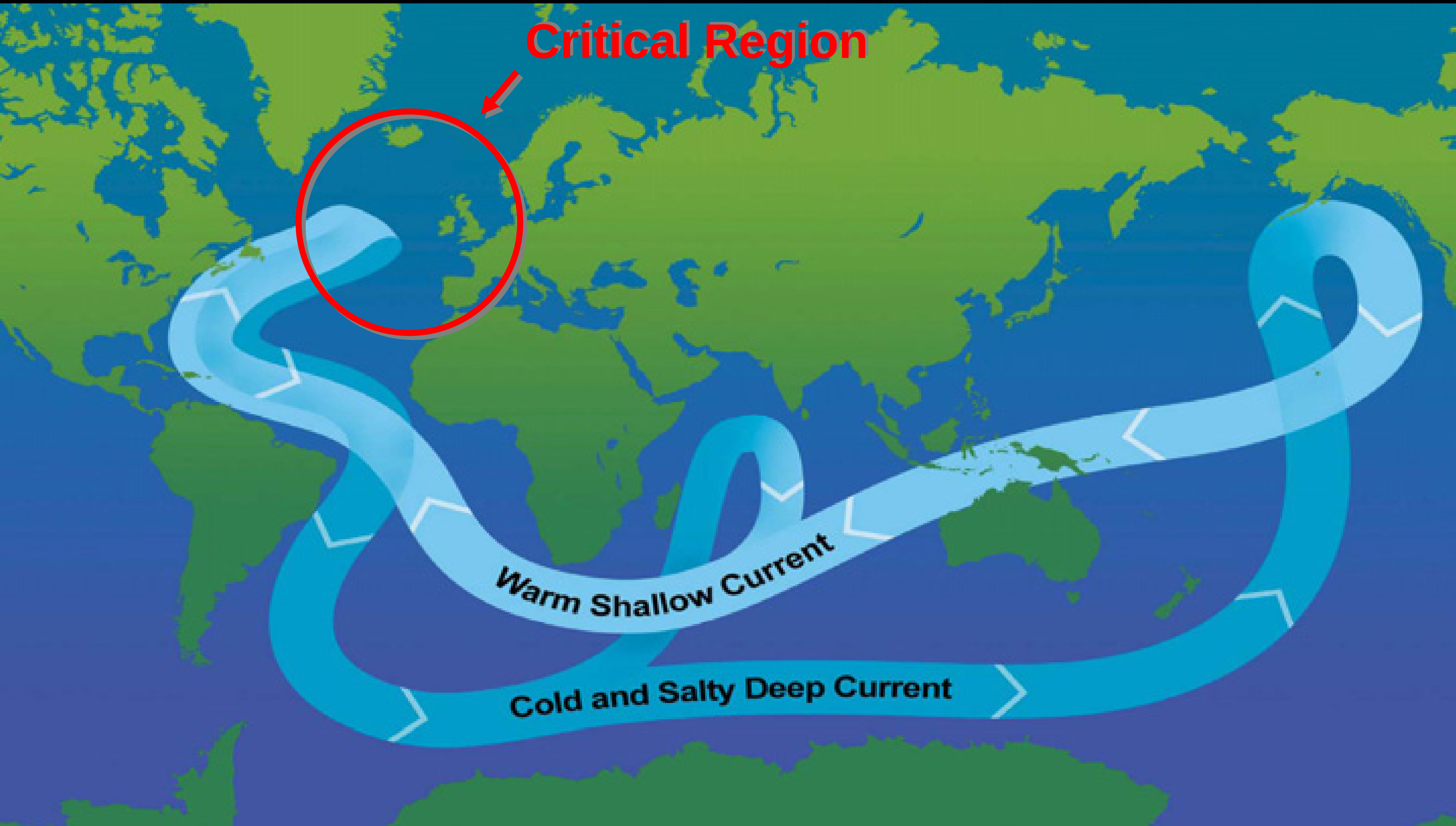
IMPACTS OF A WARMING ARCTIC

Projected Surface Air Temperature Change: 1990s-2090s (winter Dec-Feb)



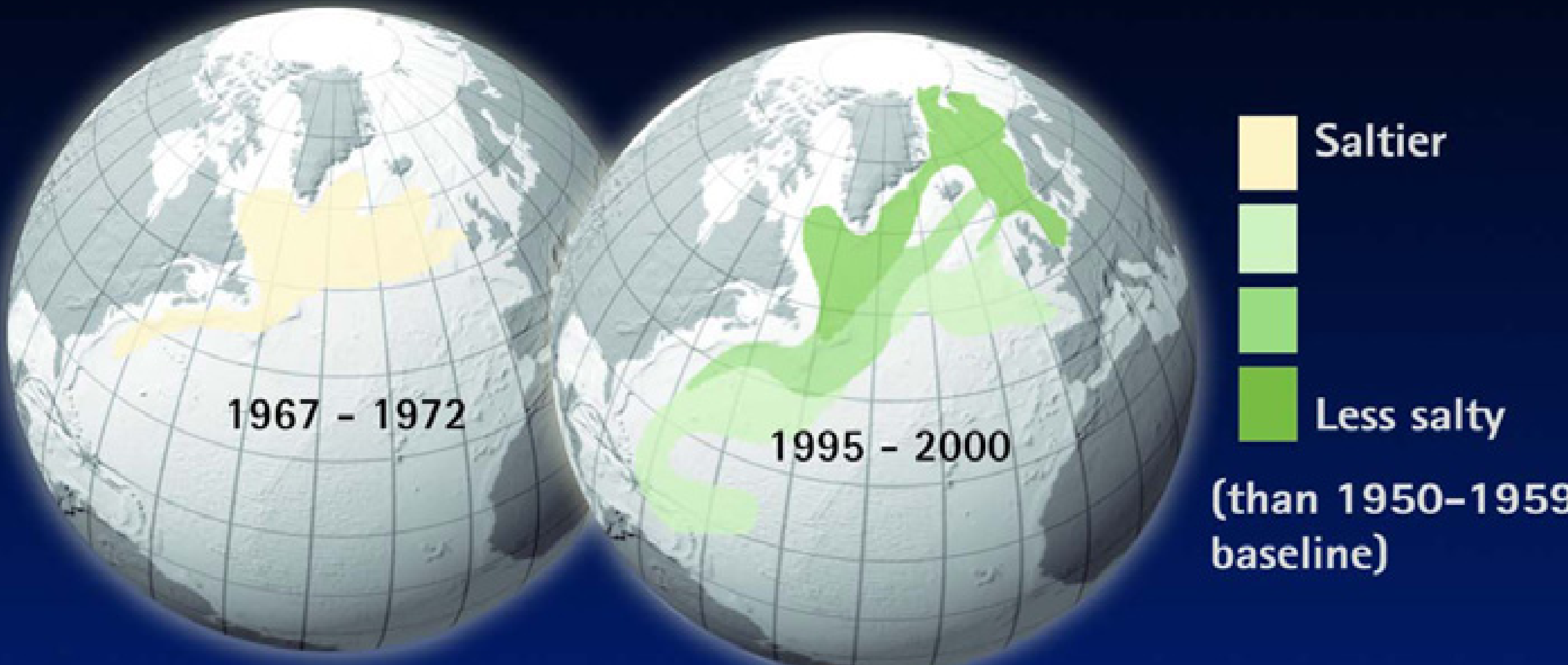
Note: The substantial warming across the Arctic, (upwards of 10 ºC or more), from very warm in the ice covered ocean to less warm in Greenland and Scandinavia.

Does this Melting of Sea Ice have other Effects, such as an Impacts on Oceanic Circulation?

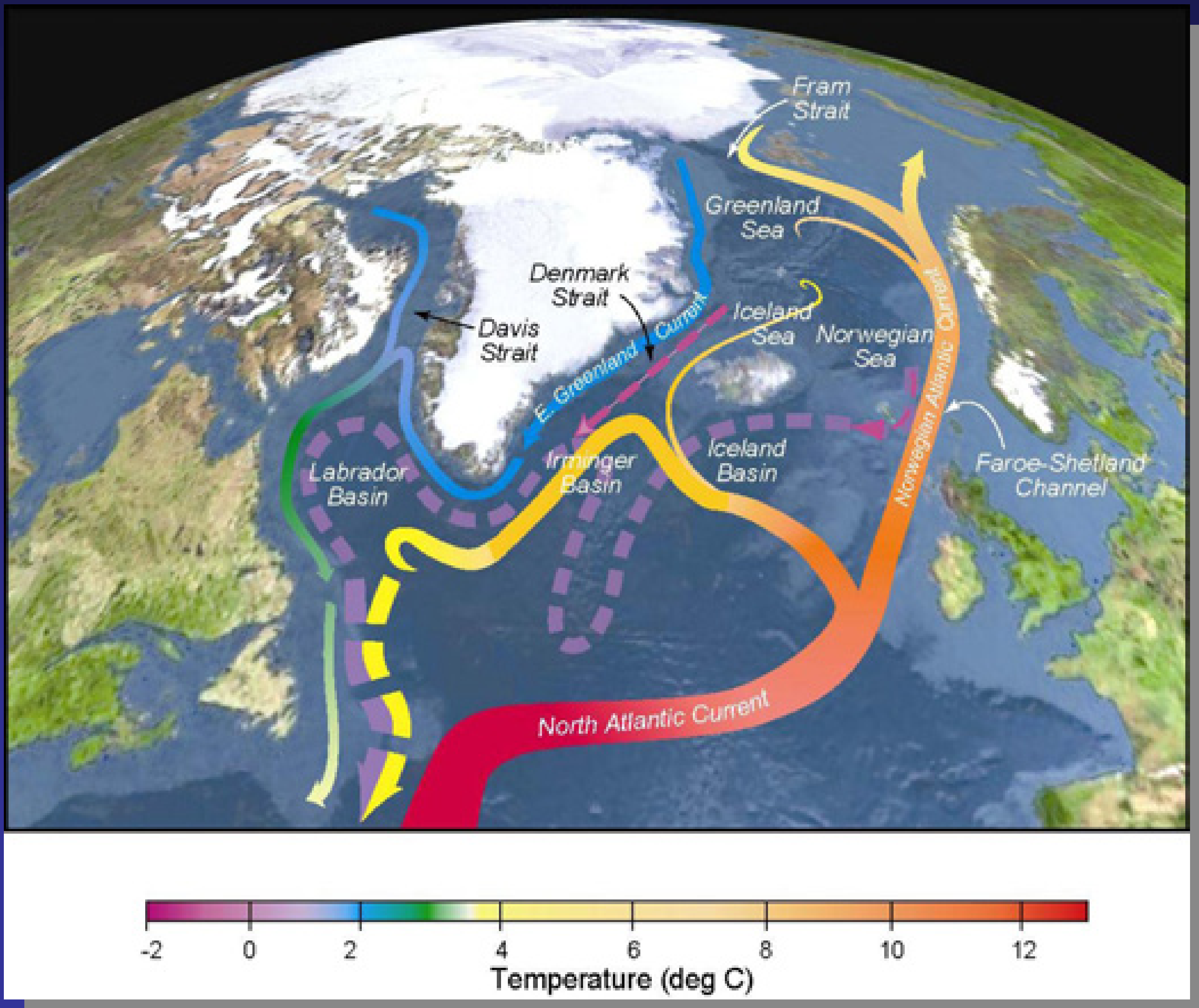


IMPACTS OF A WARMING ARCTIC

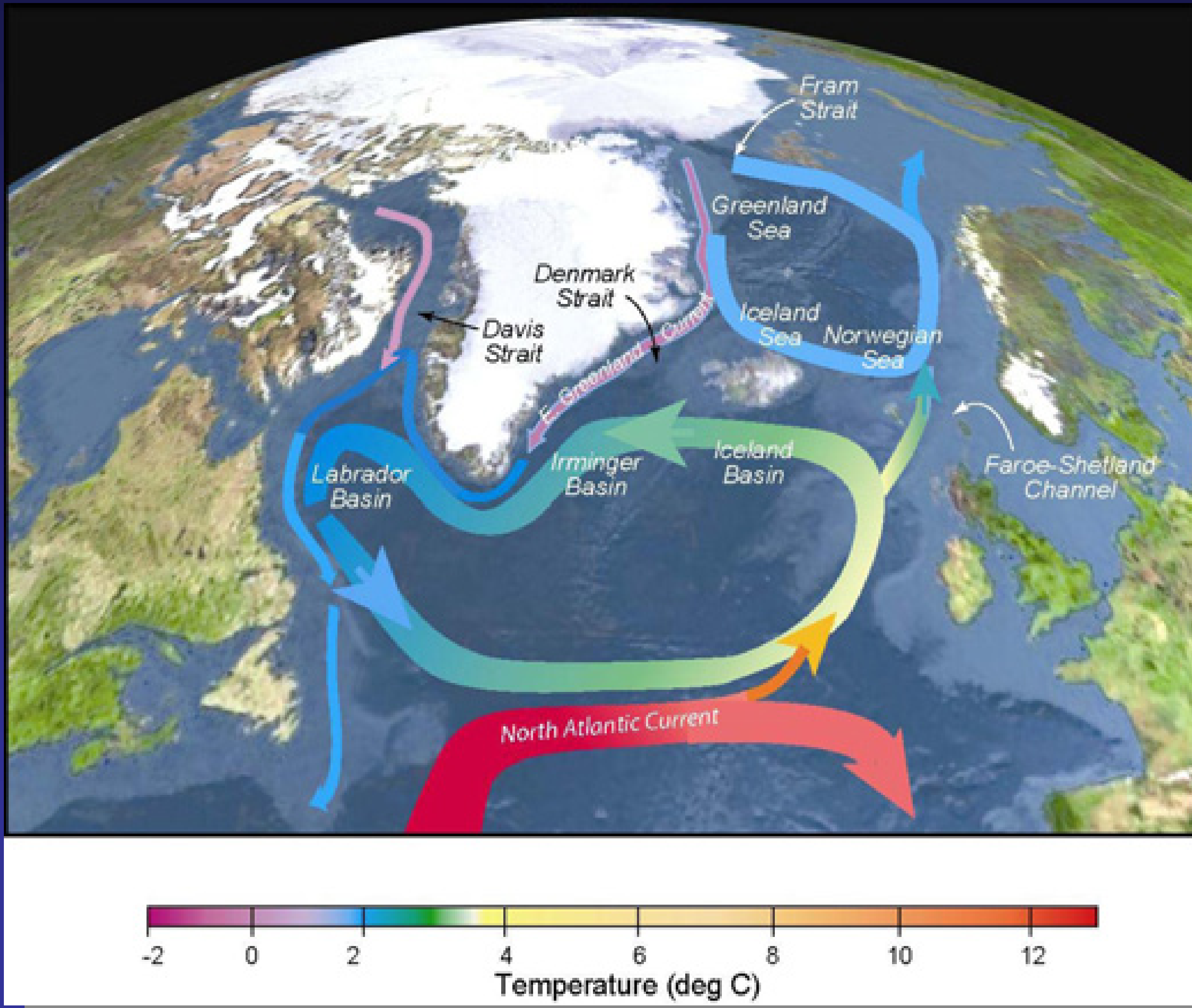
Reduced Salinity of North Atlantic Waters



Changes in Oceanic Temperatures of Importance.



Conveyor OFF



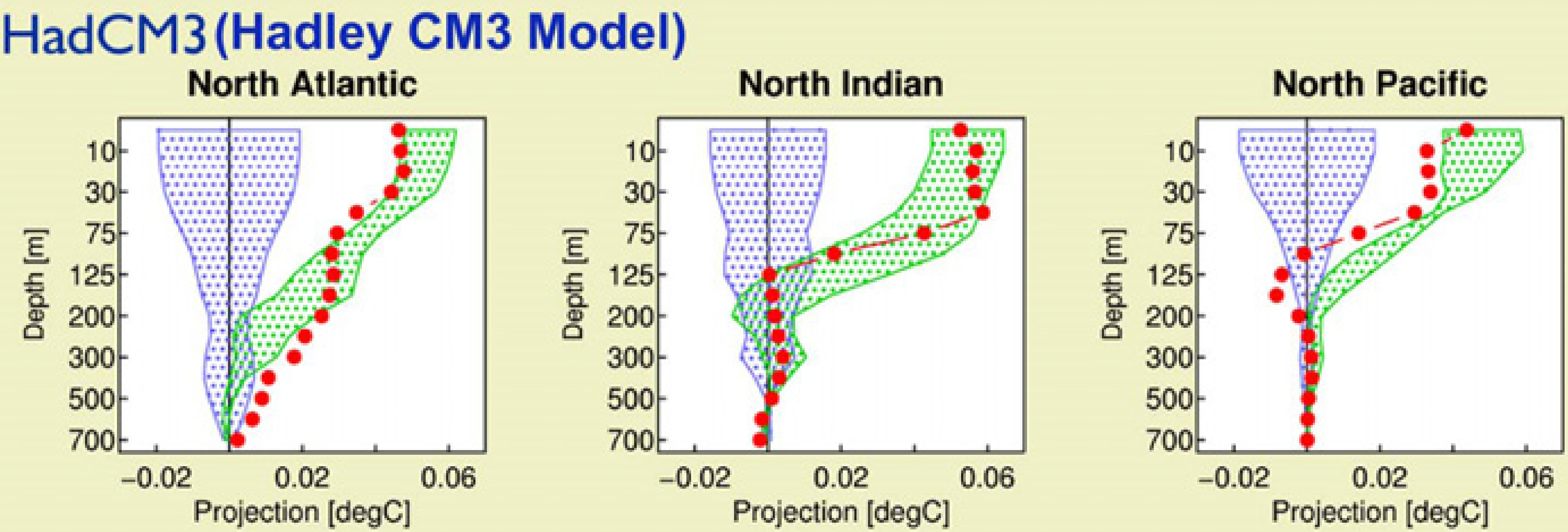
- **Strong cooling in North Atlantic**
- **Warming everywhere else**
- **No net global change**

Global Warming of the World's Oceans (T.P. Barnett, et al 2005)

No Anthropogenic Forcing (Blue)

With Anthropogenic Forcing (Green)

Observational Data (Red)



Key:

Blue: Temperature distribution with no anthropogenic forcing (the blue swath). Signal strength values falling within this region can be forced simply by 'natural variability'.

Green: Temperature distribution produced by five different climate-change model runs with anthropogenic forcing (greenhouse gasses and aerosols produced by human activity).

Red: The red dots show the signal strength estimated from the observations. The agreement between what is observed, and what is expected to arise from anthropogenic forcing, is excellent in all ocean basins.

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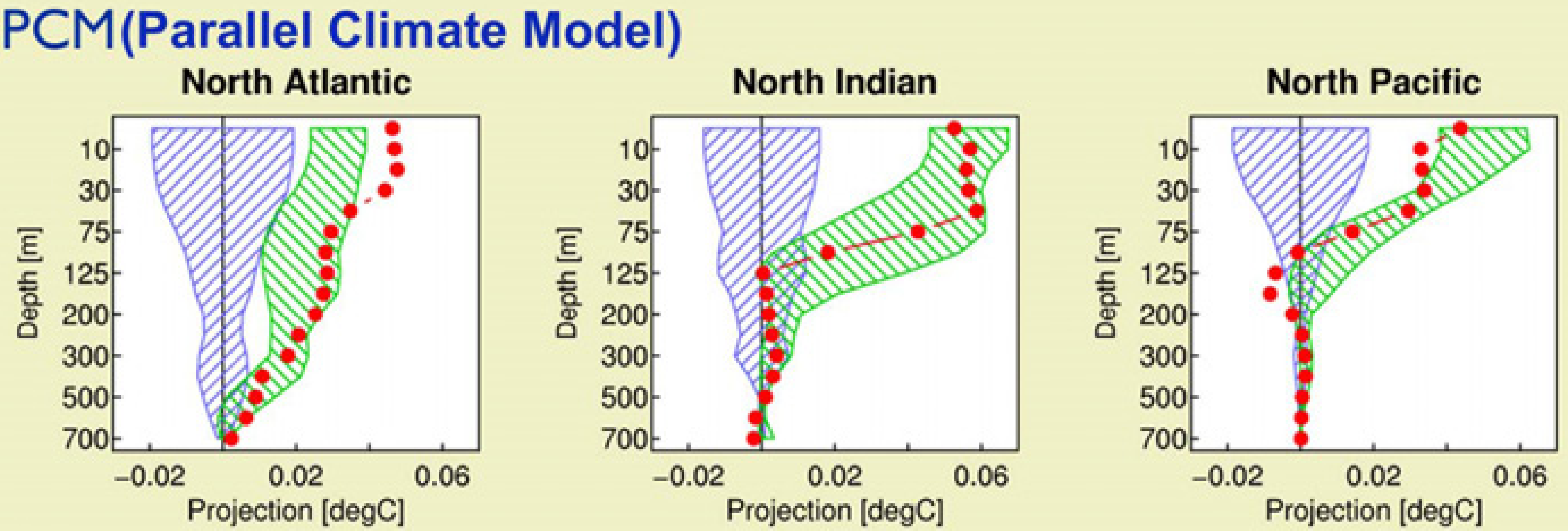

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Earth's Energy Imbalance: Confirmation and Implications

James Hansen, et al (*Science* 2005)

Significance of Hansen's *Science* Paper:

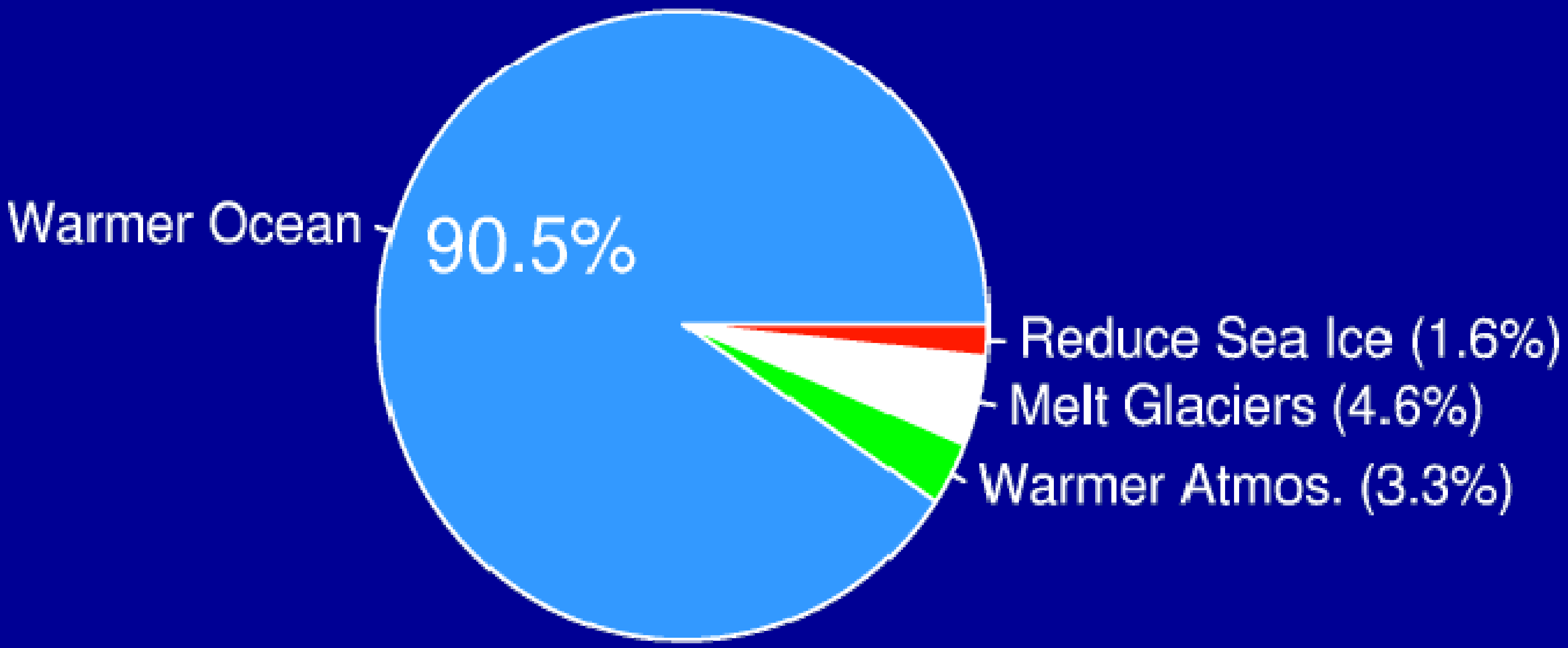
The Earth is now absorbing 0.85 +/- 0.15 W/m^2 more energy from the Sun than it is re-emitting back into space. This imbalance is confirmed by precise measurements of increasing ocean heat content over the past 10 years.

Major implications:

> ***"An expectation of additional global warming of about 0.6^{o}C without further change of atmospheric composition."***

Why are the oceans Important?

Because, that is where the heat goes !



Data from Levitus et al, *Science*, 2001

How will the Oceans Change as the Earth Warms?

- **As the oceans warm: sea level will rise, oceanic salinity balance will be altered, oceanic pH will change, and the ocean's ability to absorb CO_2 will change.**
- **It will impact atmospheric circulation, storm tracks, severe storms, and the frequency and distribution of droughts**

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Strategies can be thought of as measures or actions that can address the potential consequences of climate change. Here are a few examples for our discussions:

- **EU: The European Union, for example, declared in the late 1990's and continues to consider measures so that global average temperatures would not exceed 2 degrees Celsius above pre-industrial level.**
- **UK: Prime Ministry Tony Blair indicated that the UK should reduce greenhouse gas emission by 60% by 2050.**
- **In the US and Canada: The six New England states in the U.S. and the four maritime provinces of Canada have a climate action plan to address these goals:**

  A Short-term Goal: Reduce regional GHG emissions to 1990 emissions by 2010,
  A Mid-term Goal: Reduce regional GHG emissions by at least 10% below 1990 emissions by 2020, and establish an iterative five-year process, commencing in 2005, to adjust the goals if necessary and set future emissions reduction goals, and
  A Long-term Goal: Reduce regional GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions of 75–85% below current levels.

Strategies (another example for our discussions):

Portland, Oregon in the U.S. adopted a climate action plan in 1993, the first to do so, with a set targets and a timetable to:

- Reduce the City's emissions by 10% by 2010 (not just from Government).
- To purchase 100% of local government energy from renewable sources by 2010.
- Taking forward plans for a utility-scale wind power project to supply city facilities.
- Achieving 60% recycling rate by 2005.

Portland has made major progress and has achieve:

- 75% growth in public transit use since 1990.
- 13% reduction in per capita greenhouse gas emissions since 1990.
- 10% of local government's energy currently sourced from renewables.
- Construction of over 40 high-performance green buildings.
- With energy savings of over $300 million for businesses and residences, and over $11 million in energy costs to the city.

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Reykjavik Declaration:

- “**Recognize** that the Arctic climate is a critical component of the global climate system with worldwide implications,
- **Acknowledges** the need to consider the findings of the ACIA and other relevant studies in implementing their commitments under the UNFCCC and other agreements, including through adoption of climate change mitigation strategies across relevant sectors, and
- **Endorses** the ACIA policy recommendations for mitigation, adaptation, research, monitoring and outreach.“

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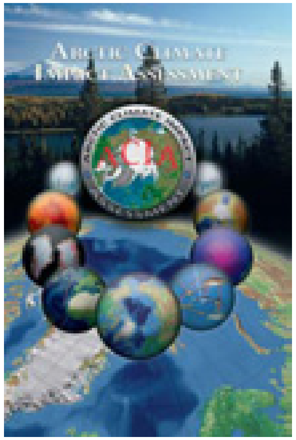
Major Geopolitical Issues are Unresolved across the Arctic Basin



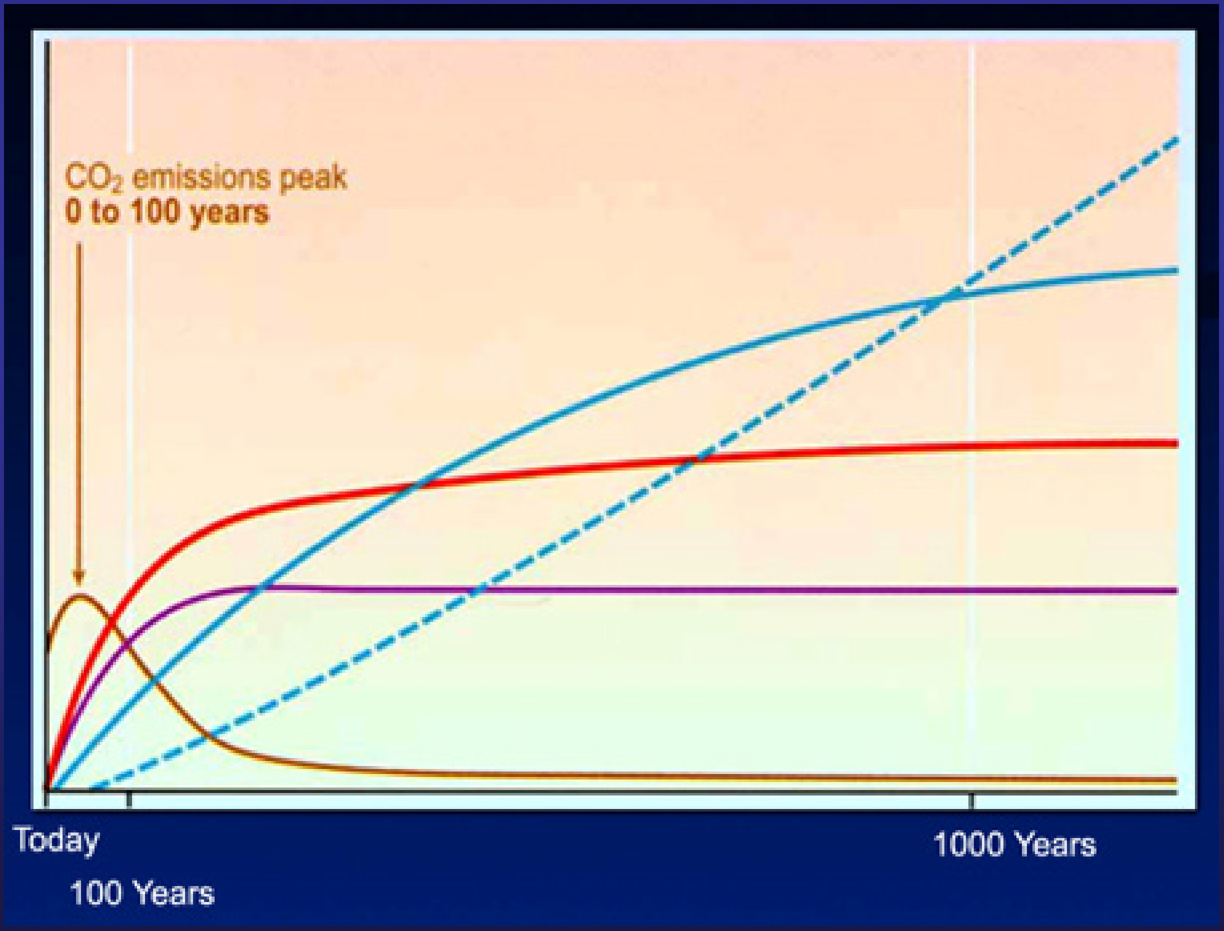
The Scientific Report

- **ACCESS:** Issues of Access and Rights of Passage through the Northern Sea Route (Russia) and the Northwest Passage (Canada)
- **SEAWARD CLAIMS**: Claims of seaward ownership within the Arctic oceanic basin. Median Line Method (i.e., Divide into areas proportional to the amount of coastline of a country), and the Sector Method (Divide into areas by essentially longitudinal line from the countries to the pole).
- **BOUNDARY DISPUTES:** Many boundary disputes still exist.
- **VENUE:** Is the Law of the Sea the venue to resolve these geopolitical issues, or other international frameworks required?

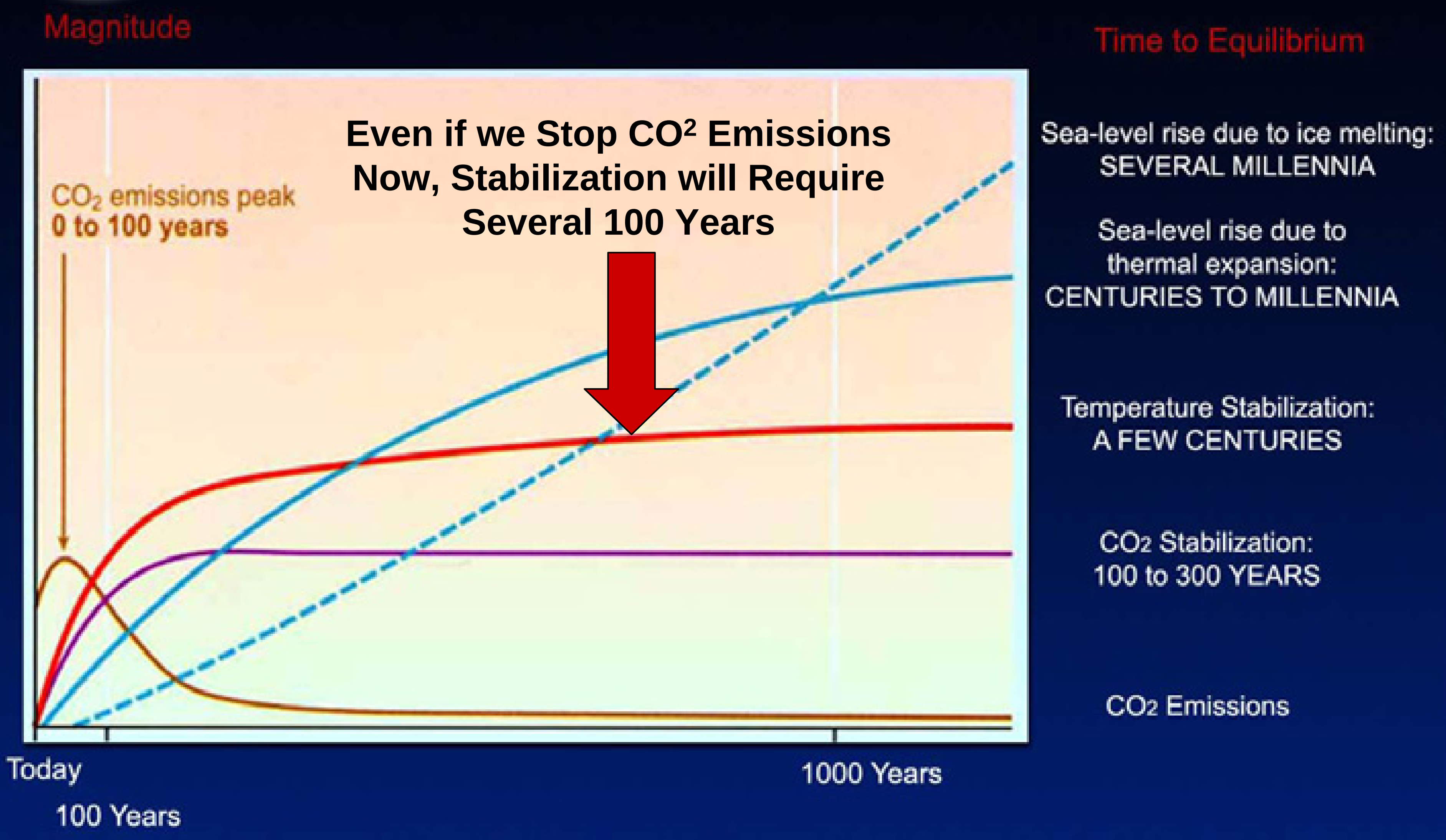
A Fundamental Asymmetry Exists

There is a fundamental asymmetry between the time scales that the climate system reacts to increases in greenhouse gases and the time scales to recover from such increases.

It takes roughly ten times as long as for the planet to recover from increases in greenhouse gases than it takes to increase these gases in the first place from anthropogenic sources.



CO_2 concentration, temperature, and sea level continue to rise long after emissions are reduced



Two Summary Thoughts

***First*, addressing the issues of moving knowledge to action in the interests of society, its people, its economic welfare, and its environmental stewardship, is complex, demanding, and challenging. Is it possible that series of "Climate Round Tables" or "Dialogues", conducted under "Chatham House Rules" among world leaders might aid in bridging these difficult challenges for societies?**

Two Summary Thoughts

***Second*, it is increasingly clear that even with the best of mitigation measures, the climate will continue change: temperatures will rise, sea level will increase, and other consequences of a warming planet will present challenges and opportunities of societies. The issue of adapting to these changes primarily occurs a local levels and among common sectors, e.g., water managers, farmers, health services, natural resources managers, city leaders, etc.. Is it time to work on adaptation strategies and practices at these local and sectoral levels such groupings as Farmer, Business and Industry, Workers and Trade Unions, Local Authorities, Non-Governmental Organizations, Children and Youth, Women, and Indigenous People, and the Science and Technology Communities?**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Thank You
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