

WHAT HAPPENS IN THE ARCTIC.....

Even if you don't live there, don't do business there, and will never travel there, the Arctic is closer than you think. Rapid climatic and other changes in the region are having profound effects, not only in the Arctic but on the rest of the planet.



Arctic Matters

THE GLOBAL CONNECTION TO CHANGES IN THE ARCTIC

..... DOESN'T STAY IN THE ARCTIC

Scientific study continues to illuminate the changes that are underway and their global connections.

Arctic Matters



Source: Stratus Consulting/University of Colorado; NOAA Climate.gov

PERMAFROST IS THAWING

Permafrost (a frozen layer of soil found in the Arctic) derives its name from the word "permanent," but it is becoming markedly less so. When permafrost thaws, it can have significant impacts on landscapes, ecosystems, hydrology, and infrastructure—for example, by causing the erosion of coastlines and the collapse of roads, bridges, runways, and buildings.

SEA ICE IS MELTING

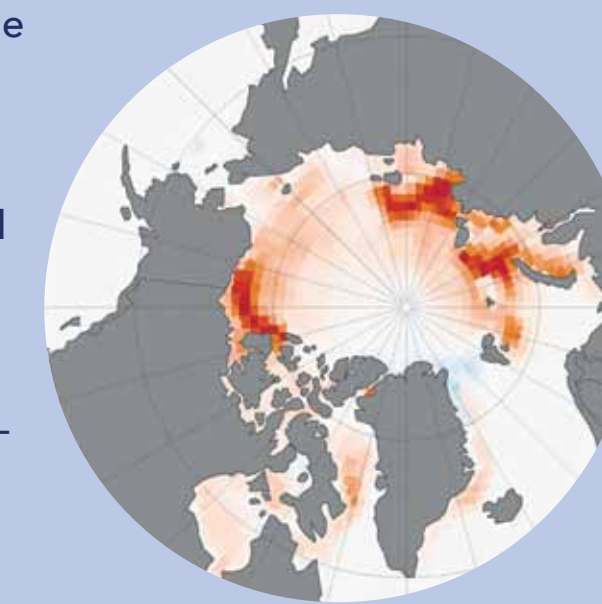


If you were to stand at the North Pole, the sea ice under your boots might extend as far as you could see. But over the past several decades, warmer temperatures have meant there is less sea ice left at the end of the summer.

These visualizations show the decrease in sea ice coverage, especially older "multi-year ice" (shown in bright white) from 1980 (left) to 2012 (right). Source: NASA Earth Observatory

GLOBAL CLIMATE GETS WARMER

Many of the shifts underway in the Arctic are likely to contribute to further climate changes, both in the Arctic and around the globe. For example, as the area covered by reflective, white Arctic snow and ice shrinks, darker surfaces like tundra and water—which absorb more of the Sun's energy—emerge. As a result, the reflectivity, or albedo, of the region decreases, causing temperatures to rise and more snow and ice to melt.



Sea Ice Fraction Trend, 2000-2014 (%)

The percentage change in sea ice cover from 2000 to 2014 shows a decrease (in red) in many areas. Source: NASA Earth Observatory.

FISHERIES MAY CHANGE

Ten percent of the world's fish catch comes from Arctic and subarctic waters, and about half of the United States fish catch comes from subarctic waters. Changes in the Arctic marine environment could have important implications for this global food source.



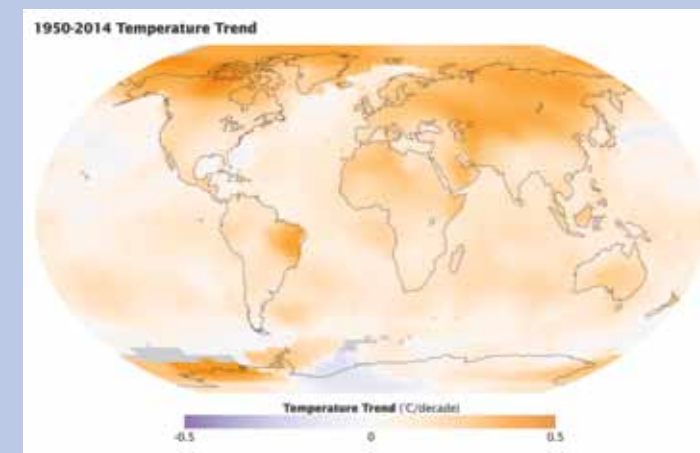
Norwegian fishing boat. Source: Cliff Hellis

ECOSYSTEMS ARE CHANGING

Many Arctic species are highly specialized, having evolved in response to the unique Arctic environment over millions of years. As ice melts and temperatures change, these species face mounting challenges—including the possibility of extinction.



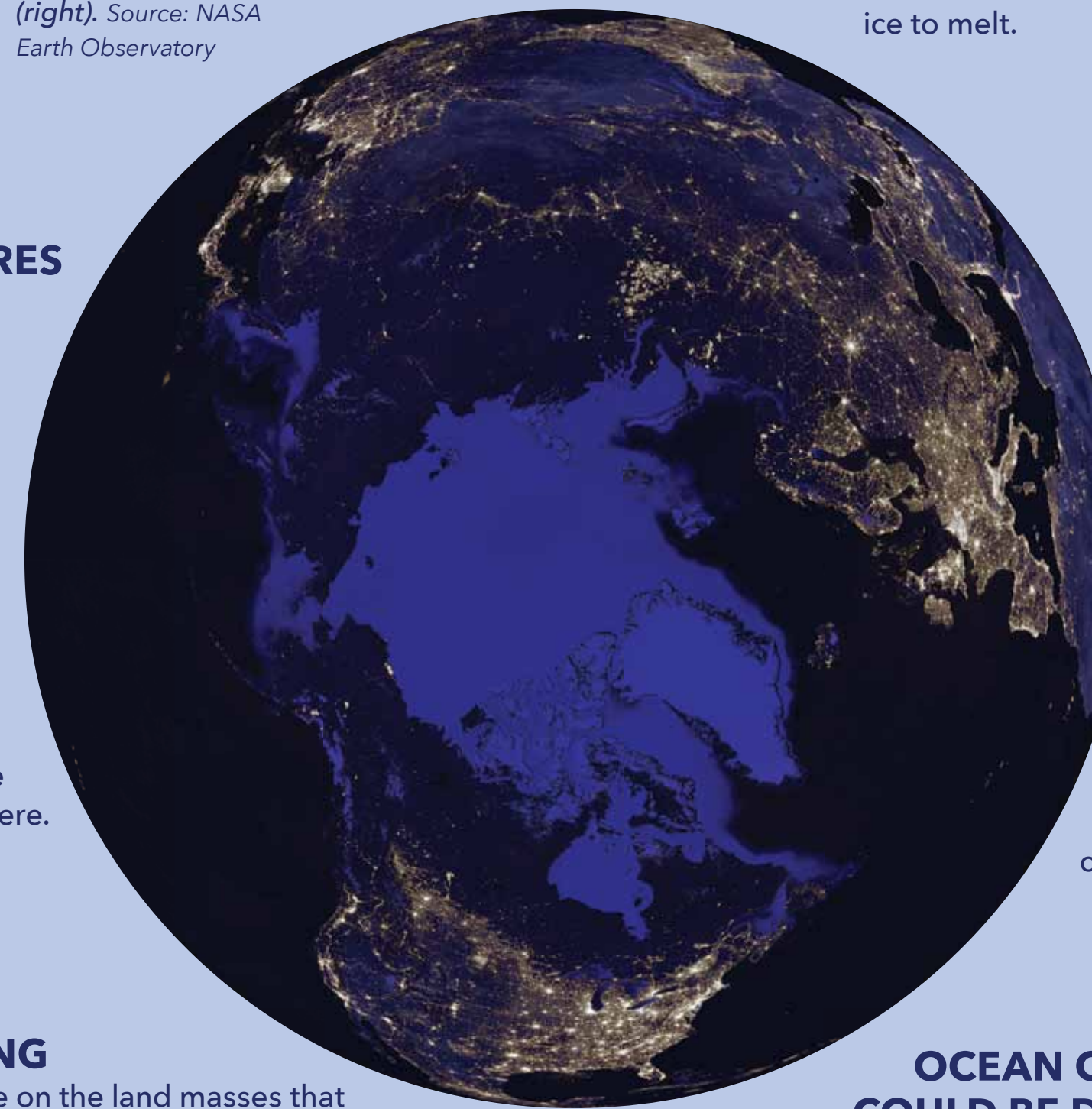
Source: US Fish and Wildlife Service/Dean Biggins



A much warmer Arctic is evident in this map of the temperature trend from 1950 to 2014. Source: NASA Earth Observatory/NASA Goddard Institute for Space Studies (GISS)/Kevin Ward

TEMPERATURES ARE RISING

Temperatures are rising twice as fast in the Arctic as compared to the average global temperature rise. Warming temperatures are a driver of Arctic change and also may be affecting weather patterns across the Northern Hemisphere.



GLOBAL SEA LEVEL RISES

Much of the Arctic's melting land ice and glaciers ultimately flows into the sea, adding volume to the world's oceans. Sea-level rise (and associated storm surges) poses significant threats to human lives and infrastructure, especially in vulnerable and densely populated coastal areas.



During Superstorm Sandy in 2012, storm surges brought water inland and flooded the coastline of New Jersey. Source: U.S. Air Force/Master Sgt. Mark C. Olsen.

SHIPPING & TOURISM INCREASE

In the past, few ships ventured into the perilous waters of the Arctic Ocean or its various straits and seas. Today, more and more ships are coming to the Arctic to explore for oil and gas, to conduct research missions, to transport oil and other commodities, and for tourism.



Source: Alain A Grenier

ARCTIC CHANGES

ARCTIC LIFE IS CHANGING

Changes in the Arctic environment—combined with broad political, economic, and cultural shifts—are putting new strains on ancient traditions. For example, melting snow and ice pose problems for subsistence hunters who typically rely on sleds or snow mobiles to reach seals, walruses, and caribou.



A family with a traditional qamutik (sled) in Cape Dorset, an Inuit hamlet in Nunavut, Canada. Source: Angsar Walk.

RESOURCES ARE BEING DEVELOPED

An estimated 30 billion barrels of undiscovered oil remain in the U.S. Arctic alone, and the Arctic also contains valuable mineral deposits, including some rare minerals critical to making electronics. Rising demand for these raw materials and the Arctic's increasing accessibility will likely increase development in the region as reserves are explored.



Source: Shutterstock/vitstudio

LAND ICE IS MELTING

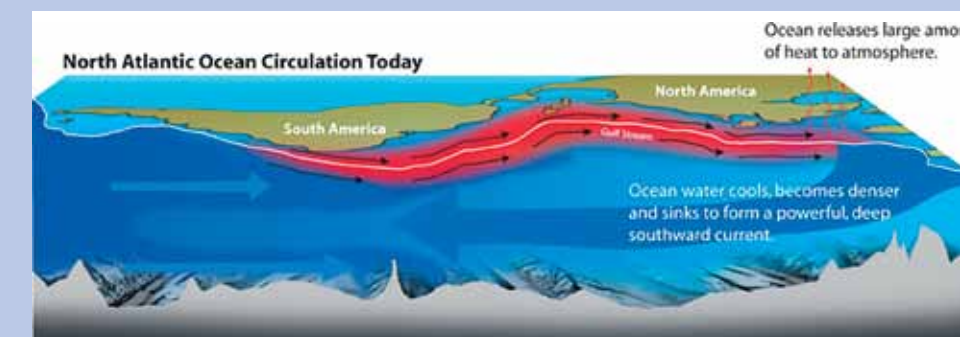
Ice is melting at a rapid pace on the land masses that encircle the Arctic Ocean. Glaciers, many of which have endured since the last Ice Age or longer, are becoming smaller. Those that border bodies of water are increasingly breaking off into icebergs that float away and gradually melt into the sea.



Photographs show how the Muir Glacier in Glacier Bay National Park and Preserve, Alaska, has changed from 1976 (top) to 2003 (bottom). Source: USGS/Bruce F. Molnia

OCEAN CIRCULATION COULD BE DISRUPTED

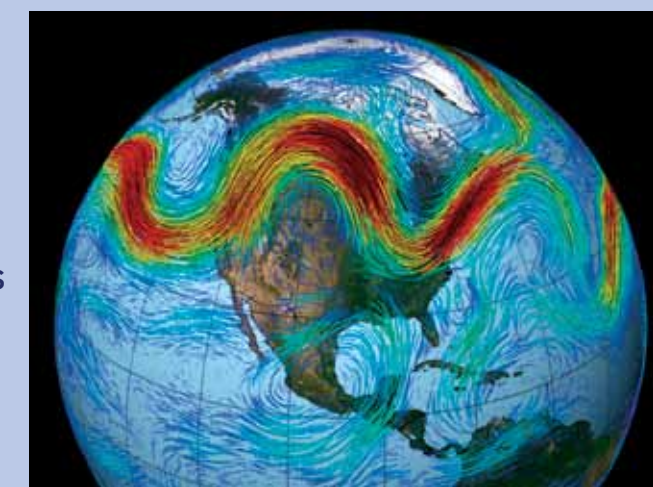
As Arctic ice melts, the Arctic Ocean is being flooded with fresh water. Because the circulation of ocean water is acutely affected by water temperature and salinity (saltiness), scientists believe this freshwater influx could have profound impacts on global ocean circulation, which, in turn, can alter weather patterns around the world.



North Atlantic Ocean circulation. Source: E. Paul Oberlander, Woods Hole Oceanographic Institution

NEW WEATHER PATTERNS EMERGE

Weather in the Northern Hemisphere is strongly influenced by the jet stream, an air current generated when colder air masses from the Arctic meet warmer air masses from the tropics. Because temperatures are rising faster in the Arctic than at the tropics, the forces that drive the jet stream are becoming less intense. This could result in longer droughts, heat waves, heavy rain events, and cold snaps in North America and Europe.



Weather and climate observations are used to model 30 days of the jet stream's journey over North America. Source: NASA's MERRA dataset

GEOPOLITICS SHIFT

Growing interest in the Arctic is bringing an influx of new people, cultures, ideas, and opportunities from all over the world. Many Arctic indigenous groups are experiencing greater political influence and are increasingly involved in decision making—for example, reviewing proposed developments such as mines or oil drilling operations.



Chief Kristina Kane speaks at an Arctic Council meeting. Source: Arctic Council



About Arctic Matters

Arctic Matters is an initiative by the Polar Research Board (PRB) of the National Academies of Sciences, Engineering, and Medicine to raise awareness of scientific findings on Arctic change and its impacts around the globe. Additional support was provided by the U.S. Arctic Research Commission. The National Academy of Sciences was established under President Lincoln to honor top scientists and provide scientific and technical advice to the nation.

