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**Abstract:** Discusses how global warming trends impact the rise of ocean temperatures, the rates in which ice melts, the rising sea levels, and turbulent weather systems. Rise in the carbon dioxide in the atmosphere over the past 140 years; How the runoff from glaciers on land contributes to a global rise in sea level; Speculation that some coastlines could spread for miles inland due to global warming in the next century, which would displace millions of people in places such as Siberia and northern Canada; Rise in the average surface temperature of the Northern Hemisphere in the 1990s.

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### One Degree of Change

#### [A big difference](#)

Climate fluctuates naturally between warm and cool periods. But the 20th century has seen the greatest warming in at least a thousand years, and natural forces can't account for it all. The rise of CO<sub>2</sub> and other heat-trapping gases in the atmosphere has contributed; both greenhouse gases and temperature are expected to continue rising.

#### [• Warming trends](#)

The concentration of carbon dioxide in the atmosphere helps determine Earth's surface temperature. Both CO<sub>2</sub> and temperature have risen sharply since 1950

- Over the past 140 years, forest clearing and fossil fuel burning have pushed up the atmosphere's CO<sub>2</sub> level by nearly 100 parts per million. The average surface temperature of the Northern Hemisphere has mirrored the rise in CO<sub>2</sub>. The 1990s was the warmest decade since the mid 1800s, and 1998 the warmest year.
- **Shrinking sea ice**

An image based on satellite data shows perennial ice cover in 1979, when the ice extended over the Arctic Ocean from edge to edge. Since then the area of coverage has decreased by 9 per cent per decade.

- A similar image from 2003 shows dramatically reduced perennial ice cover. Large areas of open ocean have appeared near Russia, Alaska, and Canada. Some climate models project that the ice will be gone in summer by the end of this century.

**Hot zone** The Arctic is warming several times faster than most of the planet; ice there is melting on land and at sea. The release of fresh water into the oceans could change the course of currents that play a vital role in climate. Runoff from glaciers on land is already contributing to a global rise in sea level.

#### • Coasts threatened

As ice melts and warmer seawater expands, the oceans will rise. How much depends largely on how much CO<sub>2</sub> and other greenhouse gases we continue to emit. This model projects rises of between a few inches and a few feet over the next century.

#### • Storm warnings

Higher global temperatures could fuel extreme weather. At right are computer-model projections of the chance that various weather events will be more frequent in a warmer world.

Uncertain scenarios In the next century some coastlines could migrate miles inland, displacing tens of millions of people. Siberia and northern Canada could experience a warmer, wetter climate. Other regions could suffer more frequent and severe droughts. Taking steps now to rein in greenhouse gas emissions could limit these impacts.

Thick smoke towers over a forest near Fairbanks, one more sign that Alaska is getting hotter. In three decades the average temperature rose 4.16°F in the northern city of Barrow. The capital, Juneau, saw a 3.54° increase, and Anchorage, the state's most populous city, is 2.26° warmer. Northern coniferous forests, which become fire prone in hot weather, could be hit hard. Computer models predict that CO<sub>2</sub>-induced warming could eventually raise the incidence of fires by more than half.

Climate warming hits hard in cold regions partly because of albedo feedback. Snow and ice have a high albedo--that is, they reflect a lot of solar energy. But as heat melts snow and ice, darker, less reflective land or water is exposed. More heat is absorbed, giving rise to further melting and warming.

Alaska's spectacular glaciers--among them Buckskin Glacier in Denali National Park and Preserve--are disappearing. An estimated 23 cubic miles of water now runs off each year, the largest glacial contribution to sea-level rise on Earth. The heat is also melting permafrost that supports roads, buildings, and other infrastructure across most of the state. It's a bumpy ride on a bike path near Fairbanks, where once frozen soil has softened and chunks of underground ice have melted. The result is sharp dips and rises in

what once was level ground. Even trees are susceptible to softening ground, leading to the phenomenon of the "drunken" forest. In Shishmaref waves undermine bluffs softened by permafrost melt. The early retreat of sea ice each year--in addition to making it harder for villagers to locate prey during traditional spring hunts-- magnifies sea swells, causing further erosion.

MAP: Ice melting

MAP:

DIAGRAM: Temperature rising

DIAGRAM: Sea level rising

DIAGRAM: Weather turning wild?

DIAGRAM

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