FACT SHEET 1:

What is happening to the Arctic climate?

Earth's climate is changing, with the global temperature now rising at a rate unprecedented in human experience. While some historical changes in climate have resulted from natural causes and variations, the strength of the trends and the patterns of change that have emerged in recent decades indicate that human influences, resulting primarily from increased emissions of carbon dioxide and other gases, have now become dominant.

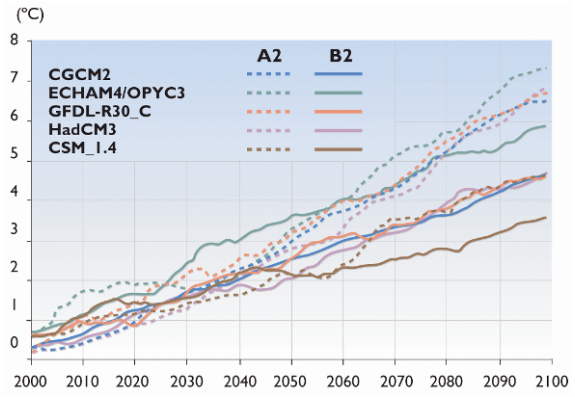
These climatic changes are being experienced earliest and most intensely in the Arctic region.
Arctic average temperature has risen by twice the global average rise in the past half-century, with some parts of the Arctic experiencing even greater increases, especially in the past few decades. Widespread melting of glaciers and sea ice and increasing permafrost temperatures present additional evidence of strong Arctic warming. These changes in the Arctic provide an early indication for the world of the environmental and societal significance of climate warming.

Ice cores and other evidence of climate conditions in the distant past provide evidence that rising atmospheric carbon dioxide levels are associated with rising global temperatures. Human activities, primarily the burning of fossil fuels (coal, oil, and natural gas), and secondarily the clearing of land, have increased the concentration of carbon dioxide, methane, and other heat-trapping ("greenhouse") gases in the atmosphere. Since the start of the industrial revolution, the atmospheric carbon dioxide concentration has increased by about 35% and the global average temperature has risen by about 0.6°C. There is an international scientific consensus that most of the warming observed over the last 50 years is attributable to human activities.

Why Does the Arctic Warm Faster than Lower Latitudes?

First, as Arctic snow and ice melt, the darker land and ocean surfaces that are revealed absorb more of the Sun's energy, increasing Arctic warming.

Second, in the Arctic, a greater fraction of the extra energy received at the surface due to increasing concentrations of greenhouse gases goes directly into warming the atmosphere, whereas in the tropics, a greater fraction goes into evaporation.
Third, the depth of the atmospheric layer that has to warm in order to cause warming of near-surface air is much shallower in the Arctic than in the tropics, resulting in a larger arctic temperature increase. Fourth, as warming reduces the extent of sea ice, solar heat absorbed by the oceans in the summer is more easily transferred to the atmosphere in the winter, making the air temperature warmer than it would be otherwise. Finally, because heat is transported to the Arctic by the atmosphere and oceans, alterations in their circulation patterns can also increase arctic warming.



The 10 lines show air temperatures for the region from 60°N to the pole as projected by each of the five ACIA global climate models using two different emissions scenarios. The projections remain similar through about 2040, showing about a 2°C temperature rise, but then diverge, showing increases from around 4° to over 7°C by 2100.

Rising temperatures
Temperatures have increased sharply in recent decades over most of the region, especially in winter. Winter increases in Alaska and western Canada have been around 3-4°C over the last half century. Larger increases are projected this century.

Rising river flows
River discharge to the ocean has increased over much of the Arctic during the past few decades, and springtime peak river flows are occurring earlier. These changes are projected to accelerate.

Thawing permafrost
Permafrost has warmed by up to 2°C in recent decades, and the depth of the layer that thaws each year is increasing in many areas. Permafrost's southern limit is projected to shift northward by several hundred kilometers during this century.

Rising sea level
Global and Arctic average sea level has risen 10-20 centimeters in the past 100 years. An additional 10 to 90 centimeters of sea-level rise is projected to occur in this century, with the greatest increases projected to be in the Arctic region.

Increasing precipitation
Precipitation has increased by about 8% on average, with much of the increase coming as rain, mostly in winter. Greater increases are projected for the coming 100 years.

Declining snow cover
Snow cover extent has declined about 10% over the past 30 years. Additional decreases of
10-20 % by 2070 are projected, with the greatest declines in spring.

Melting Greenland ice sheet
The area of the Greenland ice sheet that experiences some melting has increased about 16 % from 1979 to 2002. The area of melting in 2002 broke all previous records.

Retreating summer sea ice
The average extent of sea ice cover in summer has declined by 15-20% over the past 30 years. This decline is expected to accelerate, with the near total loss of sea ice in summer projected for late this century.

Melting glaciers
Glaciers throughout the Arctic are melting. The especially rapid retreat of Alaskan glaciers represents about half of the estimated loss of mass by glaciers worldwide, and the largest contribution by glacial melt to rising sea level yet measured.

UV Impact
Increased ultraviolet radiation reaching the surface as a result of ozone depletion and the reduction in springtime snow and ice cover will impact ecosystems on land and in water.

Diminishing lake and river ice
Later freeze up and earlier break up of river and lake ice have combined to reduce the ice season by one to three weeks in some areas. The strongest trend is over western Eurasia and North America.

Ocean salinity change
Reduced salinity and density have been observed in the North Atlantic Ocean as melting ice has added more freshwater to the ocean. If this trend persists, it could cause changes in ocean circulation patterns that strongly affect regional climate.

Wetland changes
Permafrost thawing will cause lakes and wetlands to drain in some areas, while creating new wetlands in other places. The balance of these changes is not known, but as freshwater habitats are thus modified, major species shifts are likely.

Vegetation shifts
Vegetation zones are projected to shift northward, with forests encroaching on tundra, and tundra encroaching on polar deserts. The resulting reduction in surface reflectivity will lead to further warming.

Increasing fires and insects
Forest fires, insect infestations, and other disturbances are projected to increase in frequency and intensity. Such events can subject habitats to invasion by non-native species.

Northward species shift
The ranges of many species of plants and animals are projected to shift northward, resulting in an increased number of species in the Arctic. Some currently widespread Arctic species are likely to suffer major declines.

Marine species at risk
Marine species dependent on sea ice, including polar bears, ice-living seals, walrus, and some marine birds, are very likely to decline, with some facing extinction.

Land species at risk
Species quite specifically adapted to the Arctic climate are especially at risk including many species of mosses and lichens, lemmings, voles, arctic fox, and snowy owl.

Carbon Cycle Changes
Over time, replacement of Arctic vegetation with more productive vegetation from the south is likely to increase net carbon storage, though methane emissions are likely to increase.