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State of the Arctic Climate

David Grimes

President, World Meteorological Organization Assistant Deputy Minister, Meteorological Service of Canada, Environment and Climate Change Canada

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The Arctic matters

- Shipping
- Transportation
- Tourism
- Hunting
- Economic development
- Resilient communities
- Climate adaptation
- Science





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Climate classification of the Arctic





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Arctic surface air temperature trends

- The Arctic is currently warming at more than twice the rate of global mean temperatures.
- Larger positive temperature trends north of 60 °N compared to other latitudes.



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Arctic sea ice extent



Decreasing minimum (Sept.) and maximum (March) sea ice extent relative to the mean values for the period 1981–2010.

Source: Perovich et al. (2017) [in Arctic Report Card 2017], https://www.arctic.noaa.gov/Report-Card



The age of sea ice has been decreasing between 1985 (left) and 2017 (right). Younger ice is thinner than older ice, and more vulnerable to melt in the summer.

Precipitation in the Arctic

- Annual precipitation ranges between 0.28 mm/day to 6.32 mm/day
- Precipitation in the Arctic is typically:
 - High over oceans
 - High in mountainous area
 - Low inland
 - Low over sea ice



GCPC combined precipitation dataset

 Low density of observation in the Arctic is especially challenging for the monitoring of precipitation

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Other components of the Arctic climate are changing as well

- Glacier, ice caps, and ice sheets are melting
 - Changed landscape; sea level rise
 - Affect surface energy budget (albedo)
- Terrestrial snow cover is decreasing
 - Affect surface energy budget (albedo)
 - Impact to freshwater storage
- Permafrost is thawing
 - Coastal and soil erosion
 - Release of trapped carbon and methane
 - Tundra is greening
 - Trees are pushed farther north
 - Shrinking caribou natural tundra habitat





Illustration by Chuck Carter, National Geographic





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The Arctic Oscillation



- The Arctic Oscillation (AO) is a climate index of the state of the atmospheric circulation over the Arctic.
 - Positive phase: strong winds circulate around the North Pole, confining cold air to polar regions.
 - Negative phase: weaker wind circulation, allowing colder, arctic air into the mid-latitudes.
 - The AO alternates between the positive and negative phase.
- The different phases of the Arctic atmospheric circulation influence mid-latitude weather and climate

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Future climate projections





2081–2100 projections:

- Pronounced increase in surface temperature
- Pronounced increase in precipitation
- Decrease in sea ice extent
- Increase of sea level







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Highlight examples for Winter 2017–2018

- Warmer than normal conditions
 - Above freezing temperatures at the North Pole in February 2018.
- The winter sea ice maximum was second smallest on record
 - Smallest sea ice extent in January and February since 1979, and record low sea ice extent in the Bering Strait.





Image by Joshua Stevens, NASA Earth Observatory. Data from the National Snow and Ice Data Centre.







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Social aspects and impacts of climate change in the Arctic

- Traditional lifestyle
 - Impact on traditional activities, culture, health
 - Impact on hunting, fishing, and foraging
 - Food security; potential relocation
- Health
 - Risks to infrastructures (e.g.: storm surge, permafrost thawing)
 - Spread of disease from changing climate
 - Exposure to storms: incident, injury, damage to infrastructure
- Transportation
 - Impact on traditional routes and knowledge of weather patterns
 - Expansion of marine shipping routes; Northwest passage
- Economic development •
 - Resource development

Environment and

Tourism







Photo by Clarence Irrigoo Jr., February

Concluding remarks



- The Arctic is characterized by different climate regimes.
- Observational records of temperature, precipitation, and the cryosphere are common indicators of changes in the Arctic.
- The different components of the Arctic climate system are interconnected and affect one another.
- Recent changes in the Arctic Climate are causing social and environmental impacts, regionally and globally.
- It is thus critical to develop regionally focused climate monitoring and prediction tools for the Arctic region.



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