

A visual summary is proposed in the form of a typical arctic landscape where the sea ice reflects much more radiation than do water or soil.

Slide #7: What's Going On?

Here are a few summary statements from the [United Nations' Intergovernmental Panel on Climate Change](#)'s most recent report on the state of climate change (2001). They point to dramatic changes in the Arctic environment, particularly to the sea ice cover.

- Since 1978, roughly 10-12% of the total summer sea ice extent has disappeared.
- This same extent has decreased by as much as 20% in the Atlantic waters.
- The last century has seen an increase of 5°C in Arctic air temperature.
- Sea ice has been freezing up later and melting sooner!

Slide #8: What's Next?

An exponential positive *feedback mechanism* is at play when sea ice melts to reveal water surface with a net loss in albedo of 75% thus absorbing more heat and causing more sea ice to melt...

Slides #9 to #13: CASES

[CASES](#) is the *Canadian Arctic Shelf Exchange Study*. Its goal is to study the effects of changing sea ice cover on the Arctic Environment. It was launched in 2003. Its area of study is the Mackenzie Shelf where a cutting edge Canadian icebreaker called the *Amundsen* (named after the Norwegian explorer who first crossed the Northwest Passage in 1905) will crisscross the icy waters to analyze surface and deep sea currents, ice depth and formation, perform water sampling and sea floor mapping (diagram).

Slide #14: Great Ocean Conveyor Belt

One of the key findings of the CASES project is that world climates could be further influenced by the loss of sea ice and albedo. This is because a "great ocean conveyor belt" drives the world's main ocean currents through the complex workings of *thermohaline circulation*. This circulation starts in the ice covered Arctic where dense (cold and salty) waters underlying the ice sink until they reach tropical and equatorial regions to resurface, carrying with them surface currents responsible for climate patterns such as the Western European warming from the Gulf stream. If enough sea ice disappears, arctic waters may not be dense enough to plunge and initiate this global mechanism...

Slide #15: Maximum and Minimum Ice

Here are depictions of current minimum and maximum extents of Arctic sea ice. Both are consistently receding farther North due to *global warming* and in doing so provoke further warming.

Slide #16: Present and Future Ice Cover

Here are depictions of current ice extents for March (maximum) and September (minimum) overlain by forecasted (by CASES) extents for the year 2050. The differences speak for themselves! The North Pole could be ice free for part of the year!

Slide #17: What's in Store for Nanook?

The polar bear's habitat is frozen water... Where there is less sea ice, bears become limited in their feeding time, they must travel greater distances to feed and must work harder to do so. Not good news for an animal that depends on large fat reserves to survive...

Slides #18 to #20: The Northwest Passage

The *Northwest Passage* is a fabled maritime shortcut from the Atlantic to the Pacific (or vice versa). The only problem is that it has long been at least partially frozen year-round. As sea ice retreats further north, what has long been a treacherous navigational route could soon become a very viable and reliable shipping lane. Those that have successfully traversed the Passage are highlighted, along with comparative navigational distances from the port of Oslo to the port of Tokyo. What are some of the consequences to the passage becoming open for the better part of the year?

Slides #21 and #22: Activity and Discussion

An optional activity whereby students can chart their own course across the Northwest Passage and compare their total distance traveled from the tip of Greenland to the Bering Strait (watch out for sectors permanently blocked by minimum sea ice)!

Materials required are listed below:

- A North Circumpolar Region Map with a scale of 1:10 000 000. (Copies of this map may be obtained from authorized map dealers. To find the nearest map dealer, contact the Canada Map Office at 1-800-465-6277 or visit their web site at <http://maps.nrcan.gc.ca/cmo/dealers.html> . Quote MCR 001);
- Metre long pieces of string (one per map);
- Adhesive (to secure the string to the map surface);
- Metre stick or tape measure (to measure length of course; convert to kilometers using map scale).
- Compare results with those of previous Passage Pioneers! Is your course realistic (blocked by ice)?