Shrinkage of the North Polar Ice Cap and Pole-to-Pole Teleconnections

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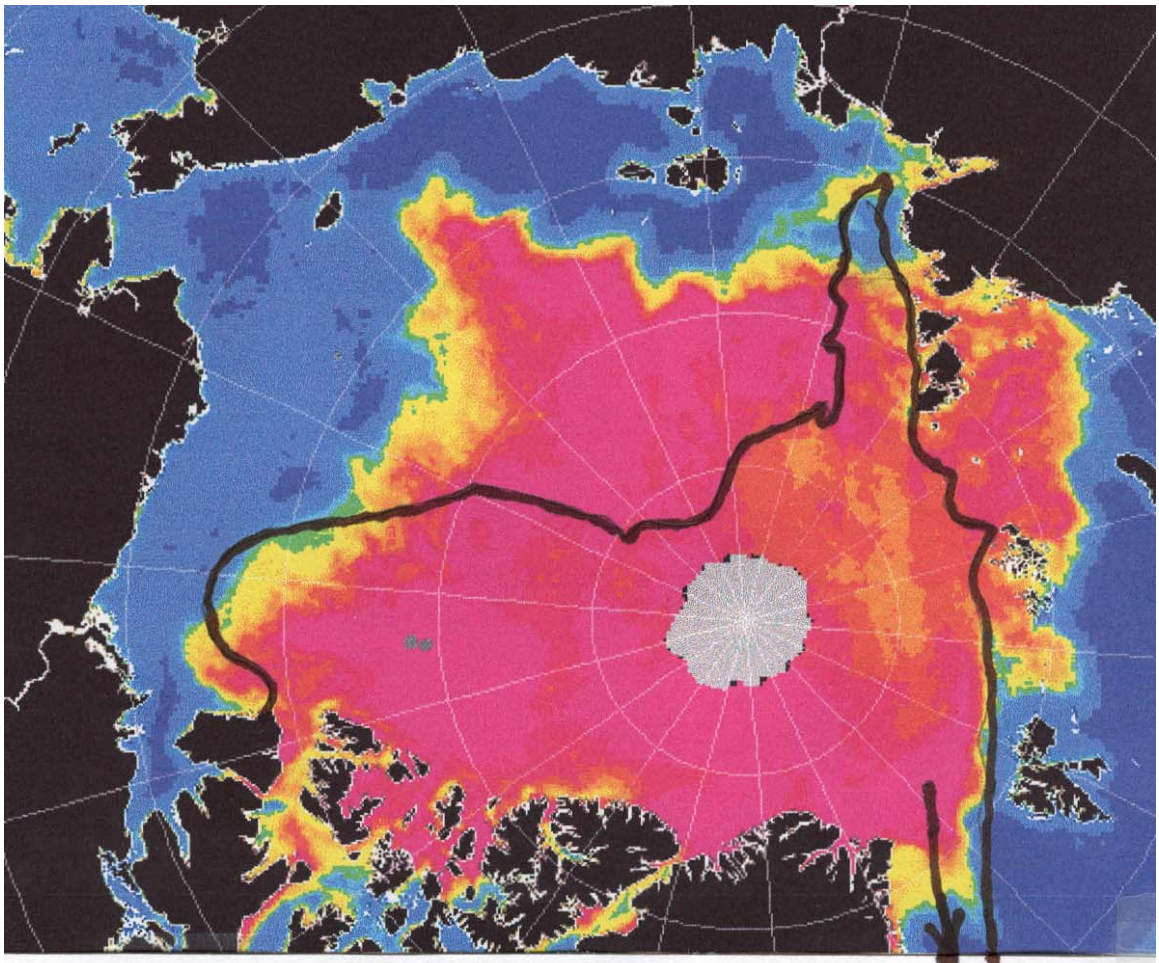
We now have a beautiful (but tricky) example how warming is affected the oceanic climate system. The rapid loss of North Polar perennial sea ice is now well documented. The figure below shows the false color image of the perennial ice on Sepember 29, 2002 (thanks to NASA and the Technical University of Denmark).



North Polar sea ice(red) on 9/29/2002, three weeks after the summer minimum. Heavy black outline is the coverage on 9/27/2007. Large areas in the Asian sectors are now free of perennial ice, but now the East Greenland outflow is much stronger and on this date the black outline (arrow) extends southward half-way down the Greenland coast.

The heavy brown outline that overlays the 2002 ice image is today's perennial ice as of September 27. Two large areas of ice have been lost in the east and west Asian sectors in the last five years. In addition, the main outflow of ice from the polar region in the East Greenland current (brown arrow) today extends half way down the coast of Greenland, whereas in 2002 the seasonal flow had hardly started. The increased outflow of ice and water is consistent with a recent Scandinavian report of increasing flow of the Norwegian current into the Arctic Ocean, and contrasts with the report of the Woods Hole oceanographers that the deep outflow from the Greenland Sea (that forms the conveyor belt) was slowing. But it all makes sense, what goes in must come out somewhere, and if less deepwater comes out while the Norwegian Current is increasing, much more water must come out on the surface, and that water contains the meltwater from annual net loss of perennial ice. And the larger flow of low salinity water of the Greenland Current inhibits deepwater formation and the deep outflow that normally results.

But there is more. The deep outflow is the northern end of the "conveyor belt" flow that extends to the Southern Ocean around Antarctica and the outflow is slightly warmer and saltier than most water around the South Pole. It takes a while for deepwater to transit from the north end of the belt to the south, but if the flow slows at the north end, a slowing at the south end will appear very soon. But this slightly warmer northern water tends to upwell around Antarctica, and, as explained by P.K. Weyl in 1968, its presence limits the sea ice that forms in the winter around Antarctica. If the supply of northern warmer water is reduced, the Antarctic Sea ice thickens and expands northward as it is indeed doing, according to Ohio State researcher David Bromwich. And that is cooling the heart of the continent down there because its temperatures, particularly the winter temperatures, depend on warmer air circulating from the warmer areas of open ocean that border the continent, and the thickening and northward extension of the sea ice would make the source of warmth more distant. But not to worry - or maybe worry a lot - because when the North Polar ice is gone in another 20 years, or less, the conveyor belt will speed up and Antarctica will warm - will really warm. And also then the Arctic Ocean may remain open much longer, and the resulting heavy snows in Canada may kickstart a lot of new glaciation despite the rising CO2 content in the atmosphere. Stay tuned.