About the science.

Why study the climate system at the poles?
Why should teachers introduce regions that are literally "off the map"—outside of our students' everyday experience and have no apparent connection to their lives? The answer is twofold:

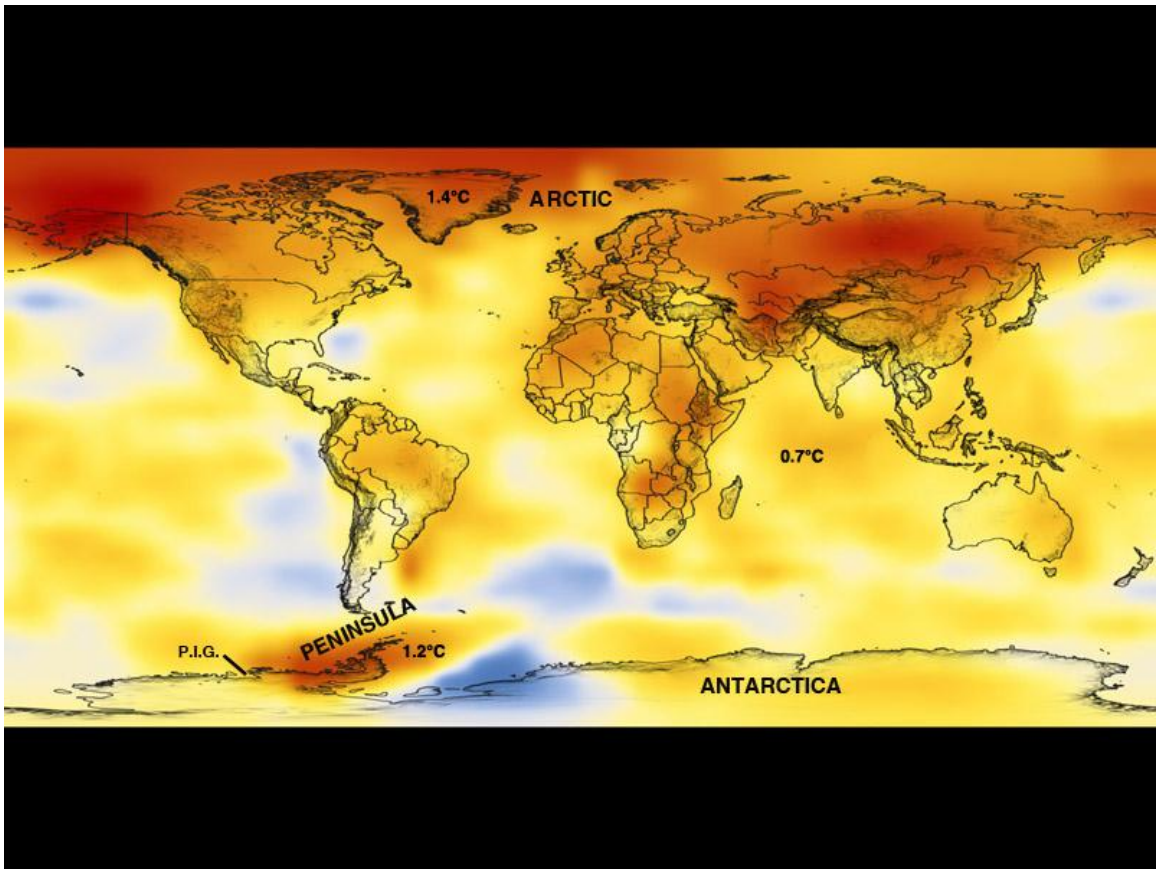
1. The Arctic and Antarctic show the most visible evidence of our climate system at work; their warming outpaces the rest of the globe (Figure 1). The Intergovernmental Panel on Climate Change (2007) noted a global mean warming of 0.7°C over the last 50 years, yet Antarctic data shows a warming of 1.2°C (Vaughan et al. 2001), and Greenland shows overall temperature increases greater than 1.4°C in that time period, with some sections showing an astounding 2–4°C increase (Arctic Monitoring and Assessment Programme 2009). This temperature magnification at high latitudes is an important piece in Earth's climate system, affecting us all.

2. The polar regions are a significant player in the entire global climate system. On a map. the poles may appear disconnected from the rest of the world, however, they do not operate in isolation. Tightly connected through the great ocean conveyor belt and atmospheric circulation patterns, they cool both Earth's oceans and atmosphere.

Figure 1

Global surface temperatures from 1880 to 2005.

The dark red represents the greatest warming and the dark blue the greatest cooling. This data clearly illustrates that the Arctic and the Antarctic Peninsula lead global temperature increases, outpacing the rest of the globe—a climate system response called polar amplification.



(Credit: NASA, edited)

Why are the poles changing faster?

The polar regions are warming much faster than the lower latitudes because of interactions in two other Earth systems: hydrologic and atmospheric. These changes are linked to a series of "feedbacks" in the climate system that amplifies the warming. The National Center for Atmospheric Research (NCAR) has for decades been producing models that that show that the polar regions would feel the most effect from even modest global warming. Reasons for the rapid change include (Arctic Council and International Arctic Science Committee 2004):

- *Loss of reflectivity (albedo):* Snow and ice, over both land and water, are highly reflective (50–90%). As snow and ice melt, more solar energy is absorbed by the darker less reflective (6%) open ocean and land surfaces (NSIDC 2012). This energy moves back to the atmosphere as warming.

- *Cooler climate has less evaporation:* The polar regions are cold and dry. Because little energy is used in evaporation, more energy goes directly into heating the atmosphere.

- *Altered circulation patterns cause warming:* The poles are connected to the mid-latitudes. Heat moves between the mid-latitudes and the polar regions by two

main patterns of circulation: global atmospheric and ocean circulation. Even small alterations in exchange patterns for either of these systems have a large effect on the polar regions.

References

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