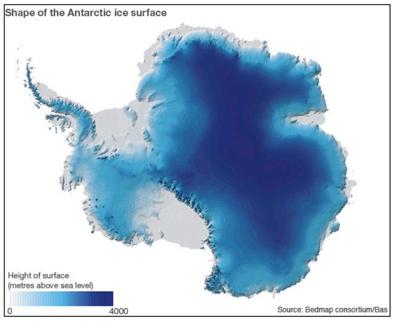
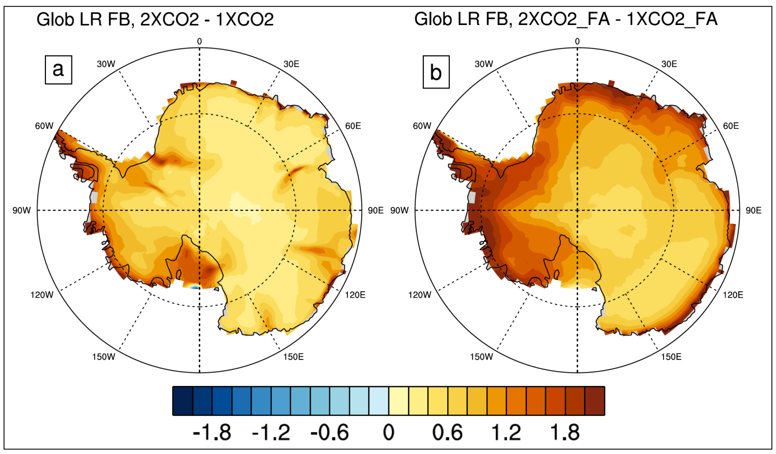
For Polar Climates, Orography Matters

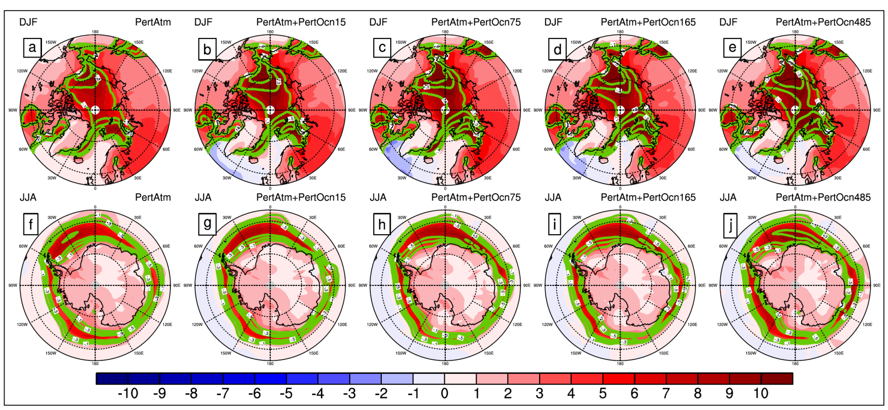


(Top) Surface elevation of the Antarctic continent (in m above sea level).

(Middle) Lapse rate feedback (winter season; in $W/m^2/K$) with CO_2-doubling over the Antarctic ice sheet with present-day orography (left) and 90% reduced orography (right).

(Bottom) Lapse rate feedback (colors; winter season; in $W/m^2/K$) over the Arctic and Antarctic in a series of CESM-SOM experiments where CO_2 is doubled. Contours show sea ice fraction loss relative to the pre-industrial control.





How does the orography of the Antarctic and Greenland ice sheets contribute to their general resistance to greenhouse warming?

Over these high-elevation polar regions, the lapse rate feedback is significantly weaker than over lower-elevation land and ocean at similar latitudes. Furthermore, lowering Antarctic orography increases the lapse rate feedback over the continent.

Ice sheet surface height alters atmospheric vertical structure, coupling to the surrounding ocean and sea ice surface, and overall polar climate sensitivity. And we haven't even mentioned the effects of meltwater and albedo yet!

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