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Hemispheric Bias in Earth's response to orbital forcing

Rajarshi Roychowdhury and Rob DeConto
University of Massachusetts, Amherst, United States

Today, there is an unequal distribution of land and water between the two hemispheres. The Northern Hemisphere has about 68% of the total landmass on earth, while the Southern hemisphere has less than half of the northern hemisphere land (∼32%). It is observed that the Southern Hemisphere climates tend to be slightly milder than those in the Northern Hemisphere at similar latitudes, except in the Antarctic which is colder than the Arctic. This variance in climate can be attributed to two reasons: the current precessional configuration of the earth; and the fact that the Southern Hemisphere has significantly more ocean and much less land. The objective of this paper is to determine a hemispheric bias in climate due to unequal land distribution in the Northern and Southern Hemispheres.

In this study, we use physically based climate models to gain insights into the role of Northern Hemisphere landmass distribution affecting the Southern Hemisphere climate and vice versa. We use hypothetical symmetric earth models in which landmass distribution is mirrored along the equator. We use these hypothetical landmass distributions to run a control simulation to provide the boundary conditions for a number of branched runs with a range of modified orbital parameters. The aim is to isolate the effects of the modified landmass distribution from the usual effects of orbital forcing. Using a Northern-Hemisphere symmetric earth model and a Southern-Hemisphere symmetric earth model, we are able to draw conclusions regarding the Northern influence on Southern Hemisphere and vice versa. With this information, a hemispheric bias map is constructed which has the potential to reveal useful insights into many unsolved climate problems. Precession and Obliquity effects are also studied in isolation on the calculated hemispheric bias. An improved understanding of the hemispheric bias caused by continental distribution will help associate past climates to paleocontinental reconstructions with greater accuracy.