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Consistency of regional climate projections with the global conditions that stimulated them

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ABSTRACT

Policy decisions related to climate impacts would benefit from robust regional projections if such information was reliable. Regional climate models can be used to add local detail to projections of global climate models. The regional models are usually driven by a global model in a one way fashion: no information from the regional model feeds back into the evolution of the global model which drives it.

This research contrasts regional climate variables from a regional climate model with projections for the same region made by the global model driving it. Simulations from the North American Regional Climate Change Assessment Program (NARCCAP) provide a valuable test bed for this type of study. A number of global/regional model pairs are considered with the aim of testing the space and time scales on which the regional model projections remain consistent with the corresponding global model projections. A range of climate variables are considered, to determine criteria for when regional and global models deviate to such an extent that the reliability of both is in question. Differences in quantities like the net surface radiation balance can be related to the size of the climate change drivers expected to generate the signal of interest. For example, comparing the size of the anthropogenic direct radiative forcing with the size of the divergence between net surface radiation balance in the two models provides a useful estimate of the lead time at which the divergence of the two models will have likely swamped any anthropogenic signal.

At a lead time of decades, annual averages of important atmospheric variables sometimes reveal a significant divergence between a given regional model and its driving global model. This implies a dynamical noise term that will cloud any physical interpretation of either model. The wider aim of this research is to assess the quality and reliability of climate simulations and the effectiveness of various downscaling methods, in order to better understand the relationship between climate model output, downscaled output, and the climate system itself. It is hoped that improving our understanding of these relationships will (i) allow a more informed measure of fidelity of climate model simulations, (ii) assist in the development of more accurate models, and (iii) aid scientific support for decision-making and policy.

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