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A framework for estimation of uncertainty in regional climate change

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In this study we focus on four sources of uncertainties in climate projections: anthropogenic greenhouse gas emission scenarios, climate system response to external forcing, natural variability and inter-model differences in the patterns of regional climate change.
The contributions of the first three sources are evaluated using the MIT IGSM-CAM framework, which links the MIT Integrated Global System Model to the NCAR Community Atmospheric Model. The MIT IGSM couples a model of world economy (Emission Prediction and Policy Analysis model, EPPA) with the MIT Earth System Model of intermediate complexity (MESM). The version of the MESM used in this study consists of a two-dimensional (zonaly averaged) atmospheric model with interactive chemistry, an ocean global circulation model and a land system model that simulates both physical and biogeochemical processes.
The uncertainties associated with the inter-model differences in the patterns of regional climate change are evaluated using a pattern scaling approach. Namely, regional changes in surface air temperature and precipitation are obtained by scaling changes in the zonal mean simulated by the IGSM using regional patterns from simulations with different AR4 AOGCMs.
We present results for two different regions, namely the contiguous United States and Northern Eurasia. Our results show that on short time scales uncertainty in surface warming are primarily caused by uncertainty in climate system response and natural variability. In contrast uncertainties in the changes in surface temperature on a century scale are mainly associated with different emissions scenarios. Different sources play more equal roles in the uncertainties in projected precipitations. In particular, natural variability and inter-model differences have a much large effect on changes in precipitation than on simulated surface warming.