ATS/CIRA Colloquium

Isla Simpson

Scientist at NCAR

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ATS 101
Hosted by Jim Hurrell

Improvements in wintertime surface temperature variability in the Community Earth System Model version 2 (CESM2) related to the representation of snow density

The Community Earth System Model (CESM) is widely used for the prediction and understanding of climate variability and change. Accurate simulation of the behavior of near surface air temperature (T2m) is critical in such a model for addressing societally relevant problems. However, previous versions of CESM suffered from an overestimation of wintertime T2m variability in Northern Hemisphere (NH) land regions. Here, it is shown that the latest version of CESM (CESM2) exhibits a much improved representation of wintertime T2m variability compared to its predecessor and it now compares well with observations. A series of targeted experiments reveal that this improvement has primarily arisen through the local effects of changes to the representation of snow density within the land surface component. Increased snow densities in CESM2 lead to enhanced conductance of the snow layer. As a result, larger heat fluxes across the snow layer are induced in the presence of T2m anomalies, leading to a greater dampening of surface and near surface atmospheric temperature anomalies. The implications for future projections with CESM2 will also be considerd through comparison of the CESM1 and CESM2 large ensembles. Aligned with the reduction in surface temperature variability, compared to CESM1, CESM2 exhibits reduced ensemble spread in future projections of NH winter mean temperature and a smaller decline in daily wintertime T2m variability under climate change. Overall, this improvement has increased the accuracy of CESM as a tool for the study of wintertime T2m variability and change.

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