**Impacts of new atmospheric forcing downscaling methods and topography-based subgrid structure on E3SM simulations**

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**Abstract**

Topography has major control on land surface processes; however, the effects of its subgrid heterogeneity are not well represented in current Earth System Models (ESMs). Recently, a new topography-based subgrid structure has been implemented within the hierarchical subgrid spatial structure of the Energy Exascale Earth System Model (E3SM) Land Model (ELM) with new methods of downscaling of atmospheric forcing from grid cell mean to the corresponding subgrids to improve representation of land surface processes. The new subgrid structure discretizes grids into variable number of subgrids depending on their topographic heterogeneity improving the ability to capture spatial heterogeneity of atmospheric forcing and land cover influenced by topography with minimal increase in computational demand. This study focuses on evaluation of the impacts of the downscaling methods and the topography-based subgrid structure on simulations of land surface processes. More specifically, ELM simulations with subgrid topography driven by grid cell mean atmospheric forcing, using single and multiple subgrids per grid model configurations, will be compared against ELM simulations using multiple subgrids per grid model configuration driven by atmospheric forcing downscaled following topographic variability. Furthermore, to evaluate the impacts of the spatial downscaling of atmospheric forcing on land surface modeling results will be compared against observations in topographically heterogeneous regions.