**Performance of hydrostatic and nonhydrostatic dynamical cores in a forecast diagnostic package**

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In order to understand the impact of the choice of dynamical core on the climatology of the Simple Cloud-Resolving E3SM Atmosphere (SCREAM), we present the results of parallel simulations using both hydrostatic and nonhydrostatic dynamical cores at resolutions ranging from ne30 to ne256. This study has three purposes: first, to identify at which resolutions the differences between hydrostatic and nonhydrostatic dynamical cores can be observed; second, to find regions that exhibit significant differences in the simulated climatology between hydrostatic and nonhydrostatic dynamical cores (here focusing on precipitation); and third, to understand the physical mechanisms causing these differences. Hourly ERA5 atmospheric fields and SSTs are used as the initial conditions of the simulations. The analysis is conducted both globally and over various regions including tropical oceans and mountainous areas. Ensembles initialized on successive days are used in the analysis to assess statistical significance of the results.

Simulation quality is evaluated using a Python-based forecast diagnostic package, which is designed to compute diagnostics of targeted forecast simulations and to generate plots for comparing the model simulation with ERA5 reanalysis. The evaluated metrics include precipitation, temperature, humidity, cloud, total column water vapor, vertical velocity, and geopotential height. To compare the hydrostatic and non-hydrostatic dynamical, horizontal transport of vertical velocity is also computed in this package. Two forecast skill scores (i.e., root-mean-squared error and anomaly correlation coefficient) are computed to assess the performance of the simulation. The diagnostic package shows that E3SM shows notable skill in forecast mode when compared against reanalysis.