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Impact of Resolution Aware Moist Physics on Constituent Transport

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The current version of the Goddard Earth Observing System Atmospheric General Circulation Model (GEOS-5 AGCM) of the Global Modeling and Assimilation Office (GMAO) at NASA Goddard Space Flight Center was designed to function seamlessly across many different resolutions and applications. The GEOS-5 AGCM moist physics parameterizations include "resolution aware" parameters that resulted in improved behavior of the GEOS-5 AGCM high resolution simulations and more uniformity of model mean state across resolutions and applications. The two governing parameters that are specified a priori as a function of horizontal resolution are the critical relative humidity used for large scale condensation, and a parameter which governs the minimum allowable entrainment used for the "stochastic Tokioka trigger" of the convective parameterization.

The overarching motivation for the implementation of the resolution aware behavior was the expectation that as resolution increases, subgrid scale variability decreases and the AGCM dynamics resolves some of the convective motions. At high resolution, therefore, the convective mass flux is partially inhibited, and more of the AGCMs precipitation is due to grid scale processes. Results will be shown to demonstrate that these two changes at high resolution have a profound impact on the behavior of the GEOS-5 Chemistry Climate Model (GEOS-5 CCM). Convective transport of passive tracers, gases and aerosols is inhibited, and the hydrostatic dynamical transport does not completely compensate. In addition, the rates of aerosol scavenging are currently different for convective and grid scale sources of precipitation, and so the total scavenging rates at high resolution were affected. These results demonstrate the need for the implementation of extensions of the resolution aware behavior to constituent transport.