Evaluation of MERRA-2-based Ozone Profile Simulations with the Global Ozonesonde Network

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Chemical transport model (CTM) hindcasts of ozone (O_3) are useful for filling in observational gaps and providing context for observed O_3 variability and trends. We use global networks of ozonesonde stations to evaluate the O_3 profiles in two simulations running versions of the NASA Global Modeling Initiative (GMI) chemical mechanism. Both simulations are tied to the NASA Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) meteorological reanalysis: 1) The GMI CTM, and 2) The MERRA-2 GMI Replay (M2 GMI). Both simulations start in 1980, and are compared against >50,000 ozonesonde profiles from 37 global stations from the tropics to the poles. The comparisons allow us to evaluate how the Replay technique affects modeled O_3 distribution, how an updated chemical mechanism in the GMI CTM affects simulated tropospheric O_3 amounts, and how observed O_3 distributions compare to the full set of model output. In general, M2 GMI O_3 is ~10% higher than in the GMI CTM, and shows global near-surface and tropical upper troposphere/lower stratosphere (UT/LS) high biases. The updated chemical mechanism in the GMI CTM reduces these high biases. Both simulations show similar negative biases in tropical free-tropospheric O_3, especially during typical biomass burning seasons. The simulations are highly-correlated with ozonesonde measurements, particularly in the UT/LS ($r > 0.8$), showing the ability of MERRA-2 to capture tropopause height variations. Both simulations show improved correlations with ozonesonde data and smaller O_3 biases in recent years. We expect to use the sonde/model comparisons to diagnose causes of disagreement and to gauge the feasibility of calculating multidecadal O_3 trends from the model output.

Key words: Ozonesonde, Chemical Transport Model, Reanalysis, UT/LS