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Assimilation of Earth Rotation Parameters into NCAR's Community Atmosphere Model

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It has been found in recent years that the atmosphere excites changes in the rotation of the Earth, i.e. the wobble of the rotational pole (polar motion) and the rate of rotation of the Earth (i.e. changes in the length-of-day, or LOD), by the exchange of angular momentum between the atmosphere and solid Earth. These changes range from subdaily to decadal timescales, and while very small, can be observed at high precision by space geodetic techniques. Observations of polar motion and LOD reflect the atmosphere's total angular momentum, and thus represent an integral measure of the atmospheric state. They can therefore be used to observationally constrain atmospheric models. Here we present the application of this constraint to simulations of NCAR's Community Climate Model 5 (CAM5) using an Ensemble Square Root Filter, implemented within the Data Assimilation Research Testbed (DART). We present a set of perfect-model experiments wherein observations of thee Earth rotation parameters are assimilated daily. Since the observations represent spatial integrals, each set of observations does not correspond to a unique state-space solution, which means that the three parameters are unable to fully constrain the state. However, the spread of the ensemble around the true state is significantly reduced as the assimilation progresses, showing that the application of a spatial-integral observations can constrain the modeled dynamics in a way that is complementary to standard meteorological observations.