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Assimilation of stratospheric and mesospheric temperatures from MLS and SABER into a global NWP model

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Abstract. The forecast model and three-dimensional variational data assimilation components of the Navy Operational Global Atmospheric Prediction System (NOGAPS) have each been extended into the upper stratosphere and mesosphere to form an Advanced Level Physics High Altitude (ALPHA) version of NOGAPS extending to ~100 km. This NOGAPS-ALPHA NWP prototype is used to assimilate stratospheric and mesospheric temperature data from the Microwave Limb Sounder (MLS) and the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instruments. A 60-day analysis period in January and February 2006, was chosen that includes a well documented stratospheric sudden warming. SABER and MLS temperatures indicate that the SSW caused the polar winter stratopause at ~40 km to disappear, then reform at ~80 km altitude and slowly descend during February. The NOGAPS-ALPHA analysis reproduces this observed stratospheric and mesospheric temperature structure, as well as realistic evolution of zonal winds, residual velocities, and Eliassen-Palm fluxes that aid interpretation of the vertically deep circulation and eddy flux anomalies that developed in response to this wave-breaking event. The observation minus forecast (O-F) standard deviations for MLS and SABER are ~2 K in the mid-stratosphere and increase monotonically to about 6 K in the upper mesosphere. Increasing O-F standard deviations in the mesosphere are expected due to increasing instrument error and increasing geophysical variance at small spatial scales in the forecast model. In the mid/high latitude winter regions, 10-day