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Title: High Altitude Data Assimilation at the Naval Research Laboratory: Recent Results and Future Directions

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To improve the observational characterization of middle atmosphere dynamics, the Naval Research Laboratory (NRL) has developed a high-altitude atmospheric data assimilation system (DAS) capable of generating global synoptic meteorological analyses every 6 hours from the ground to the lower thermosphere (~90 km altitude). This DAS is based on the existing high-altitude version of the Navy Operational Global Atmospheric Prediction System (NOGAPS), known as NOGAPS-ALPHA (Advanced Level Physics-High Altitude). In addition to assimilating operational meteorological observations in the 0-50 km altitude range, the NOGAPS-ALPHA DAS also assimilates temperature and constituent measurements from instruments on NASA research satellites such as Aura MLS and TIMED SABER using a three-dimensional variational (3DVAR) approach. This unique data set provides a global description of middle atmospheric dynamics that we have used to investigate nonlinear interactions between planetary waves and tides in the mesosphere and lower thermosphere (MLT). We present recent DAS results describing the morphology of the quasi-two day wave, five day wave, and migrating diurnal and semidiurnal tides during summer in both Northern and Southern Hemispheres over the 2005-2010 period. We also investigate the possible link between the occurrence of major stratospheric sudden warmings (SSW's) during Northern winter and tidal motions in the equatorial MLT region, which has been proposed to explain unusually large ionospheric disturbances observed following SSW's in January 2009 and 2010. Preliminary results from a new high-altitude 4DVAR DAS based on the Navy Global Environmental Model (NAVGEM) will also be presented.