

A Data assimilation model for determining the mean state and migrating tide structures in the mesosphere and lower thermosphere using satellite measurements of wind and temperature

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Brief Abstract:

Satellite measurements provide a global but asynoptic view of the atmosphere. In the mesosphere and lower thermosphere the dominant dynamical features in the wind and temperature fields consist of the mean flow and migrating tidal structures. These flow components are almost perfectly aliased in satellite measurements, making it a difficult challenge to determine the separate mean, diurnal and semidiurnal tide contributions. The standard approach to tidal analysis employs harmonic fitting to the local time sampling that occurs as the satellite precesses, but this method is often produces unsatisfactory results because of incomplete sampling or transience of the fields during the long precession cycle.

We have developed an approach to analyzing satellite data that utilizes the dynamical relationships that must hold between the mean and tidal components of the wind and temperature fields by assimilating the data into a model of the tides and mean flow. The migrating tides are forced oscillations whose structure is determined by the heat sources that drive the tide as well as by dissipation mechanisms such as radiative damping and eddy and molecular diffusion, and by the interaction with gravity waves. The assimilation model is fit to the measurements by tuning a relatively small set of parameters that are designed to characterize these forcing mechanisms.

We will present some details of the assimilation model and show examples of results of the model applied to UARS and TIMED data. The assimilation model is able to determine estimates of the mean flow and tidal structures from data for a single day, and does not require data over a full precession cycle. Results show conclusively that gravity wave interaction plays an important role in affecting the structure of the migrating diurnal tide. They also provide an estimate of the turbulent eddy diffusion in the upper mesosphere and lower thermosphere.