MAPING THE GLOBAL STRUCTURE OF NEUTRAL COMPOSITION AND MASS DENSITY USING DATA ASSIMILATION TECHNIQUES

Fuller-Rowell Tim, Cliff Minter and Mihail Codrescu
University of Colorado and NOAA, 325 Broadway, Boulder, Colorado, USA

Abstract:

Physical models have been used extensively to investigate the neutral upper atmosphere, and to understand its response to solar, geomagnetic, and lower atmosphere forcing. Thermospheric numerical models are based on the so-called “primitive” equations that are used routinely in lower atmosphere general circulation models for conventional weather forecasting. For the upper atmosphere, these equations are combined with the generalized diffusion equations in order to predict the total neutral mass density for satellite drag applications, and the relative proportion of the major neutral species such as O and N2. The latter are used in ionospheric model to estimate the plasma loss rate through recombination, which is controlled by the ratio of atomic to molecular neutral species. Recently, the physical models have been combined with observations using data assimilation techniques in order to improve specification of density and composition for space weather applications. The assimilation techniques, such as the Kalman filter, are well established but the challenge in the use of the physical model is in specifying the solar and geomagnetic driver. During the propagation step in the filter, incorrect drivers can push the state away from that observed. The non-linear nature of the response renders the conventional linear methods inappropriate for deriving the drivers. More sophisticated tools are required including the Ensemble Kalman filter.