Comparison of methods for estimating planetary boundary layer height from radiosonde temperature, humidity and refractivity profiles and implications for GPS RO methods

Dian Seidel, NOAA Air Resources Laboratory
Chi Ao, Jet Propulsion Laboratory, California Institute of Technology

Several methods have been proposed for obtaining planetary boundary layer (PBL) height from GPS RO observations. These may prove useful for developing long-term global PBL height climatologies and for analysis of local PBL structure and variability, particularly in regions where conventional meteorological profile observations are sparse. To interpret PBL heights derived from GPS RO, they should be compared with more traditional PBL height information. We have used ten years of radiosonde temperature and humidity data from a global network of over 700 stations to simulate GPS RO refractivity profiles and to derive PBL height using seven different methods. These include four traditional methods (based on temperature, potential temperature, and virtual potential temperature profiles) and three methods proposed for use with GPS RO data (based on specific humidity, relative humidity, and refractivity). We compared the resulting climatologies using statistical tests and find significant differences among the methods, including biases and differences in seasonal and diurnal variations. The traditional "mixing height", which is based on virtual potential temperature profiles and is sensitive to atmospheric stability, is systematically lower than other PBL height estimates and exhibits stronger seasonal and diurnal variability. The frequent occurrence of surface-based temperature inversions, with tops generally below 500 m, in some locations also poses challenges for GPS RO.