Exploring the Application of Radio Occultation Data in Improving Analyses of Temperature and Moisture over Traditional Data Void Regions with the WRF/DART Ensemble Data Assimilation System

Hui Liu, Jeffrey Anderson, Ying-Hua Kuo, Chris Snyder, and Alain Caya

National Center for Atmospheric Research
Boulder, CO 80305

Abstract

Over traditional data void regions, like remote oceans, the current analyses of temperature and moisture rely heavily on nadir-viewing satellite microwave and infrared radiance measurements. Over these regions, however, there usually exist a large amount of clouds. In cloudy situations, retrievals of temperature and moisture from the satellite radiance measurements are subject to significant errors and uncertainties. In those situations, the satellite cloud motion derived wind observations are the major data resource. In this preliminary study, we explore application of Global Positioning System (GPS) radio occultation (RO) measurements in improving the analyses of temperature and moisture over the data void regions. The impact of the CHAMP (CHAllenging Minisatellite Payload) GPS RO refractivity on improving the regional analyses of temperature and moisture over the continental US (CONUS) domain in the presence of only satellite cloud derived wind observations during January 1-31, 2003 is examined. The GPS RO refractivity and the satellite wind observations are assimilated using the WRF/DART (NCAR's Data Assimilation Research Test-bed) ensemble data assimilation system at 50 km horizontal resolution. The analyses with and without the assimilation of RO refractivity are verified against nearby radiosonde observations (<200km and +/- 3 hour of the RO data) that are withheld from the assimilations. A newly developed RO non-local refractivity operator is used in the assimilation of the RO refractivity.

The results show that the assimilation of the CHAMP RO refractivity significantly improves the analyses of temperature and moisture in the troposphere in the presence of only satellite cloud derived wind observations. This suggests that RO measurements may significantly improve current analyses of temperature and moisture over the traditional observation void regions. This may benefit forecasts of hurricanes as well as weather and climate studies related to the remote oceans. Further study of the impact of GPS RO data in improving the analyses over remote tropical oceans, where there is little traditional observations, is under way.