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The COSMIC/FORMOSAT-3 mission: Early results for weather prediction and climate

R. Anthes, Y.-H. Kuo and C. Rocken

University Corporation for Atmospheric Research, United States of America

anthes@ucar.edu / Fax: 303 497 1652 / Phone: 303 497 1652

The radio occultation (RO) technique, which makes use of radio signals transmitted by the Global Position System (GPS) satellites, has emerged as a powerful and relatively inexpensive approach for sounding the global atmosphere in all weather and over both land and ocean. As demonstrated by the proof-of-concept GPS/Meteorology (GPS/MET) experiment and more recently by the CHAMP (CHAllenging Minisatellite Payload) and SAC-C (Satellite de Aplicaciones Cientificas-C) missions, GPS RO data are shown to be of high precision, accuracy and vertical resolution. At 0140 UTC on 15 April 2006, the joint Taiwan-U.S. COSMIC/FORMOSAT-3 (Constellation Observing System for Meteorology, Ionosphere, and Climate and Formosa Satellite mission #3; hereafter COSMIC) mission, a constellation of six microsatellites, was launched into a 512-km orbit from Vandenberg Air Force Base in California. Using on-board propulsion these satellites are being deployed to their final orbits at 800 km with 30 degrees of separation. This process will take about 17 months following the launch. During the early weeks of the deployment, the satellites were spaced closely, offering a unique opportunity to verify the high precision of RO measurements. Since 28 July 2006, COSMIC has been providing over a thousand RO soundings each day to support the research and operational communities. The number of soundings is expected to increase to about 2,500 per day by mid 2007 as the satellites are further separated and reach their final orbits.

Preliminary assessments have shown that the GPS RO data from COSMIC are of better quality than those from the previous missions and penetrate much farther down into the troposphere; from 70 to 90 percent of the soundings reach to within 1 km of the

surface on a global basis. COSMIC data are making a positive impact on operational global weather forecast models. At present (May 25, 2007), the European Centre for Medium-Range Weather Forecasts, the National Centers for Environmental Prediction, and the UK Meteorological Office are using COSMIC data operationally.

COSMIC data are shown to be useful in improving the skill of weather prediction models. With the ability to penetrate deep into the lower troposphere using an advanced open loop tracking technique, the COSMIC RO instruments have shown the capability to observe the structure of the tropical atmospheric boundary layer, providing valuable information on low level atmospheric water vapor. The information on water vapor had a positive impact on modeling the genesis of Tropical Storm Ernesto (2006). The value of RO for climate monitoring and research is demonstrated by comparing observations from COSMIC and other RO missions and showing that the RO observations are mission-independent. We also show that COSMIC observations are capable of inter-calibrating microwave measurements from the Advanced Microwave Sounding Unit (AMSU) on different satellites.

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