JPL/USC GAIM: New Developments in Using COSMIC and Ground-Based GPS Data to Estimate High Precision Ionospheric Products Including VTEC

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Data assimilation techniques for space weather are finding increasing success in ionospheric remote sensing due to the growing abundance of data from ground and space-based sensors and new GPS ionosphere-enabled satellites. The COSMIC satellite constellation, launched in April 2006, now provides unprecedented global coverage from GPS occultation measurements (~1700 per day as of June 2007), each of which yields electron density information with up to ~1 km vertical resolution. Calibrated measurements of electron density (total electron content or TEC) from COSMIC suitable for input into assimilation models are currently made available in near real-time (NRT) with latencies between 30 and 120 minutes.

In this research, we discuss the impact of assimilating COSMIC occultation and ground-based TEC measurements into the JPL/USC Global Assimilative Ionospheric Model (GAIM). Electron density profiles from GAIM are compared to radar measurements obtained from the Baseline Scatter Radars (ISR) at Arecibo, Jicamarca and Millstone Hill.

**Figures and Tables**
- **GAIM Input Data Files:**
- **Kalman Assimilation Runs: Three Case Studies**
- **Summary and Conclusions:**
  - JPL now routinely generates calibrated TEC and Abel electron density retrievals using COSMIC data.
  - Ground-only, ground+COSMIC and climate GAIM runs performed.
  - GAIM profiles are validated using Arecibo, Jicamarca, Millstone Hill ISR, Jason VTEC and Abel profiles.
  - ISR validation results show that assimilating COSMIC data improves VTEC, NmF2 and Hmf2: i.e., resulting in improved profile shapes. Assimilating COSMIC data seem to improve TEC accuracy potentially leading to more accurate IGS ionospheric products.

**Promise of Global Ionospheric Data Assimilation (GAIM) is near.**