Assessment of the impact of FORMOSAT-7/COSMIC-2 GNSS RO observations on mid- and low-latitude ionosphere specification and forecasting: Observing system experiments by ensemble square root filtering

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Motivations and Goals
The Formosa Satellite-7/Constellation Observation System for Meteorology, Ionosphere and Climate-2 (FORMOSAT-7/Constellation-2) GNSS Radio Occultation (RO) payload can provide global observations of slant Total Electron Content (sTEC) with unprecedentedly high spatial and temporal resolution.

This presentation will demonstrate (A) how the Ensemble Square Root Filter (EnSRF) [Whitaker and Hamill, 2001] can be used to assimilate sTEC observations effectively and (B) impacts of FORMOSAT-7/Constellation-2 GNSS RO data on low- and mid-latitude ionospheric specification and forecasting.

Data assimilation system
Synthetic RO sTEC data are assimilated into a coupled model of thermosphere, ionosphere, and plasmasphere by using EnSRF.

Model – GIP/TIEGCM
Global-Ionosphere-Plasmasphere-Thermosphere–Ionosphere Electrodynamic General Circulation Model (GIP/TIEGCM) [Pedatella et al., 2011] is made of following two models.

GIP – thermosphere ~ 400 - 800 km

TIEGCM – thermosphere ~ 400 - 800 km

GIP – ionosphere and plasmasphere ~ 19000 km

EnSRF

- Assimilates other observations (10000 km).

- Use data assimilation with a localization.

- Incorporates proper localization.

- No localization.

Results

1. Overall, data assimilation of FORMOSAT-7/COSMIC-2 RO data can improve the mid- and low-latitude ionospheric specification.

2. For a given localization length scale, EnSRF with a larger ensemble size (~70) generally performs better for assimilation of RO sTEC. Considering the computational demand, we decide to use EnSRF with 70 ensemble members for GIP/TIE-GCM RO sTEC data assimilation.

3. The covariance localization with GC function with a length scale of 5000-10000km in horizontal direction helps the quality of sTEC data assimilation. On the other hand, the vertical localization appears to have a mixed effect.

4. Our future work includes: a) applying an empirical localization function that designed specifically for sTEC data assimilation. b) updating thermospheric variables during analysis step of EnSRF.