Impact of COSMIC data on a synoptic-scale cyclone over the west Antarctica
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1. Introduction
Precipitation accompanied by synoptic-scale cyclones is one of the major sources of water mass over Antarctica. However, the structure and developing mechanism of the synoptic-scale cyclones over the West Antarctic Ice Sheet (WAIS) (Bromwich et al. 1996) are little known compared to other areas on the globe. In this study, we investigate a synoptic-scale storm, with a rapidly enhancement to 923 hPa during three days, by assimilating GPS radio occultation (RO) data. Although the benefit of GPS RO data over data sparse areas has been statistically fairly well demonstrated (Wee et al. 2008), practical data assimilation towards optimal use of the data is not straightforward. Our exhaustive tests (including model resolution, initial time, and assimilation strategies etc.) show a large sensitivity of impact to the system parameters, implying that not only the true quality of the data but also the way the data are used in a particular data assimilation system is essential to properly assess the data's value (e.g., Fig. 1).

2. Model settings and Experimental designs
We pick up the best assimilating parameters for GPS RO data and assess the impact of GPS RO data by data denial experiment.

- **Model**
  - WRF v3.1.1 and WRFDA v3.1.1
  - Domain: 401x401x55 grid points with 30 km horizontal resolution

- **Observation**
  - Conventional data (GTS)
  - GPS RO (COSMIC, CHAMP, SAC-C, GRACE)

- **Physics**
  - Microphysics: WSM-5 class scheme
  - Longwave radiation: rrtmg scheme
  - Shortwave radiation: Goddard short wave
  - Surface layer: Monin-Obukhov (Janjić) scheme
  - Boundary layer: Mellor-Yamada-Janjić (Eta) scheme
  - Cumulus: Kain-Fritsch (new Eta scheme)

- **Experiments**
  - Initial condition: NCEP FNL analysis at 00 UTC 9th Dec. 2007-7-h forecast as the first guess for DA
  - NG: assimilated with GTS data
  - WG: assimilated with GPS and GPS RO data
  - Both experiments are executed under three updated cycling then forecast 72 cycles

3. Results
There are total 240 GPS RO soundings (Fig. 2) adopted during the three updated cycling assimilation. Both simulated tracks (NG and WG) are close to those in ECWMF in NCEP before cycling (Fig. 3a)

- NG and WG have opposite behavior on bias of temperature during the cyclonic development, but WG presents a smaller deviation with ECWMF in temperature.
- The effect of moisture on this cyclonic development is quite limited. The maximum errors against ECWMF are less than 0.5 g kg\(^{-1}\) before 2007/12/12 18 UTC.
- It does not make a significant different, even the moisture in NG is derived from WG, (Fig. 3b)

4. Summary
Both experiments present similar track prediction as the global analyses, but assimilated with GPS RO data can further improve the prediction of cyclonic intensity.

- From verifications and sensitivity tests, temperature is a more important factor than moisture.
- Assimilating with GPS RO provide a warmer initial condition which can affect the cyclonic development.
- More detailed investigation of how the GPS RO data affecting the cyclonic development will be carried on.

References