Impact of assimilating COSMIC refractivity profiles on Polar WRF forecasts of synoptic-scale cyclones over West Antarctica

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In support of the United States Antarctic Program (USAP), Polar WRF, developed by the Polar Meteorology Group at The Ohio State University, is currently used in real-time numerical weather prediction in Antarctica. While the code is optimized for applications in the high latitudes, its application in Antarctica faces significant challenges. Compared to the Arctic, Antarctica lacks the numerous observations needed for accurate initial and lateral boundary conditions for the high resolution simulations. In order to fill the gaps, numerous Automatic Weather Stations (AWS) have been installed. AWS distribution remains uneven with most located on the Ross Ice Shelf. Furthermore AWS can only provide measurements at the instrument level (~2 m) and cannot profile the atmosphere above. In March 2006 a constellation of satellites was launched under the FORMOSAT-3/COSMIC (F3C) project. Just after launch, the six spacecraft each with a GPS Radio Occultation (RO) receiver provided high vertical resolution measurements of the atmosphere using a limb sounding technique which was developed by the Jet Propulsion Laboratory (JPL). The release of WRFDA version 3.1.1, a data assimilation package, by the Mesoscale and Micro-scale Meteorology Division of NCAR allows the assimilation of RO refractivity indices into the initial fields for Polar WRF forecasts.

On October 4, 2007 a synoptic scale cyclone moved into the Ross Ice Shelf and crossed West Antarctic Ice Sheet (WAIS). As it crossed WAIS a smaller cyclone developed near the main hub of USAP operations at McMurdo on October 8, 2007. Improving the ability of Polar WRF to predict such cyclogenesis is a major objective of this NASA funded project (NASA Grant NNX08AN57G). Strong winds associated with these cyclones affect the safety of aircraft taking part in USAP operations. In this study, we assess whether the use of COSMIC profiles in simulations of this representative cyclone can improve the skill of Polar WRF in simulating cyclogeneis over WAIS.

First the cyclone is simulated using standard initialization and boundary forcing as is currently performed in the AMPS forecasts used by USAP. The cyclone is then simulated again but this time RO refractive indices from the mesoscale array of soundings from the COSMIC microsatellites are assimilated into Polar WRF initial conditions using WRFDA. The impact of COSMIC profiles on the model skill is then assessed by comparing the two simulations.