Assessing the impact of RO refractivity on the analysis and prediction of Typhoon Morakot (2009) with a new data assimilation strategy

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Refractive features and the atmospheric temperature and moisture profiles can be retrieved from the raw measurements of radio occultation (RO) remote-sensing technique. With its uniform global distribution, RO data emerges to be an important observation source over the data-sparse open sea, and thus has great potential to improve typhoon forecast. However, the assimilation of RO refractivity, which is a non-traditional atmospheric measurement, into regional numerical weather prediction model is still very challenging.

In this study, we developed a new strategy to assimilate RO refractivity on thinned exact height levels. Advantages of this strategy include: assimilating RO refractivity at thinned exact height levels rather than random arbitrary heights; determining and tuning the thinned exact height levels mainly according to the general vertical resolution of RO refractivity and referring to the model vertical resolution; extracting RO refractivity data through proper interpolations from the supplied high vertical sampling resolution profiles; minimizing the observational error correlation through an effective data thinning scheme; performing (assuming) latitude-dependant observational error statistics on fine (thinned) exact height levels, and avoiding any kinds of interpolation or fitting of observational errors; only performing quality control (QC) against background via more Gaussian and more accurate assumed observational errors; easily being applied in both variational and ensemble-based data assimilation systems.

This new strategy was successfully implemented in the ensemble-based data assimilation system, WRF/DART. Using this new strategy, a case study was performed to assess the impact of data assimilation of RO refractivity on the analysis and prediction of Typhoon Morakot (2009). The advantages in data preprocessing, implementation details of observation operators, and assumption of observational errors as a result of using this new strategy will be discussed.