Assimilation of GPS RO data using a nonlocal excess phase operator and its impact on typhoon prediction

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Abstract

Many previous studies have demonstrated that GPS radio occultation (RO) data have positive impacts on global operational numerical weather prediction as well as the forecasting of severe weather events such as atmospheric rivers and hurricanes. The assimilation of GPS RO data can be performed with different observation operators, including: local refractivity, local bending angle, nonlocal excess phase, and two-dimensional bending angle. The nonlocal excess phase (EPH), developed by Sokolovskiy et al (2005), is an attractive approach, as it takes into consideration the effects of the horizontal gradients of the atmosphere refractivity (which can be quite significant for severe weather events) with only a modest increase in computational cost. Recently, we have implemented a parallelized version of this nonlocal excess phase operator into the WRF 3D-Var data assimilation system, which offers great promises for potential operational implementation.

In this study, we test the nonlocal excess phase operator with the WRF 3D-Var system and assess the impact of GPS RO data on the analysis and prediction of Typhoon Morakot (2009). The assimilation with the local refractivity, which is the most commonly used in the community, is also performed. Our results show that use of the nonlocal excess phase operator gives superior performance to the local refractivity operator. In the presentation, we will provide additional diagnosis on how nonlocal excess phase improves the results of GPS RO assimilation. In particular, we will examine how observation operator affects the analysis of temperature and moisture in the vicinity of Typhoon Morakot. We will also discuss the implementation strategies with regards to the nonlocal excess phase operator.