OBSERVATIONAL ERROR ESTIMATION OF FORMOSAT-3/COSMIC GPS RADIO OCCULTATION DATA

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The Global Positioning System (GPS) radio occultation (RO) technique is becoming a robust global observing system. GPS RO refractivity is typically modeled as local refractivity observable at the ray perigee point in a data assimilation system. Such an observable does not take into account the horizontal gradients that affect the GPS RO refractivity. A new observable (linear excess phase), defined as an integral of the refractivity along some fixed ray path within the model domain, has been developed in earlier studies to account for the effect of horizontal gradients. In this study, we estimate the error statistics of both observables (refractivity and linear excess phase) using the GPS RO data from the FORMOSA Satellite #3 / Constellation Observing System for Meteorology, Ionosphere and Climate (FORMOSAT-3/COSMIC) mission. The National Meteorological Center (NMC) method, which is based on lagged forecast differences, is applied for evaluation of the model forecast errors that are used for estimation of the GPS RO observational errors. We use the Weather Research and Forecasting (WRF) model forecasts in the East Asia region at 45-km resolution for one winter month (mid-January to mid-February) and one summer month (mid-August to mid-September) in 2007. Fractional standard deviations of the observational errors of refractivity and linear excess phase both show an approximately linear decrease with height in the troposphere and a slight increase above the tropopause; their maximum magnitude is about 2.2% (2.5%) for refractivity and 1.1% (1.3%) for linear excess phase in the lowest 2-km for the winter (summer) month. An increase of both fractional observational errors near the surface in the summer month is attributed mainly to a larger amount of water vapor. The results indicate that the fractional observational error of refractivity is about twice as large as that of linear excess phase, regardless of winter or summer time. The observational errors of both linear excess phase and refractivity are much less latitude dependent for the summer month than for the winter month. This difference is attributed to larger latitudinal variations of the specific humidity in the winter month. The latitudinal dependences of observational errors have been considered in WRF 3DVAR. Some comparisons by using the estimated observational errors are also shown in this study.