Assimilation of GNSS zenith total delay into a regional weather research and forecast model

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The Global Navigation Satellite System (GNSS) zenith total delay (ZTD) observations can provide moisture-related information with high spatial and temporal resolution and have been an important data source of assimilation and forecast system. In this study, the impact of assimilating ZTD observations within the weather research forecast (WRF) model is evaluated. The ZTD observations from 75 stations of Hubei CORS in central China are obtained during the period of Feb. 28 to Mar. 2, 2018 which precipitation event occurs. Different experiments are implemented including a reference experiment with no data assimilated, a GNSS experiment with only ZTD data assimilated and a multi-source data experiment with ZTD and other meteorological observations assimilated simultaneously. The result demonstrates a positive impact on short-range precipitation forecasts when GNSS ZTD observations are assimilated and the most significant improvement in forecast is obtained when GNSS ZTD data are assimilated together with other meteorological observations into the WRF model. In addition, we have applied the ZTDs derived from WRF forecast products into the real-time precise point positioning (RT-PPP) as a constrained condition. The accuracy of WRF-derived ZTDs is assessed against with the post-processed GNSS-derived ZTDs. The result shows that the WRF-derived ZTDs agree well with the GNSS-derived ZTDs. The convergence time of RT-PPP is also discussed, and result indicates that an improvement in convergence time is achieved by comparison with the standard PPP solution.