New Insights on Residual Ionospheric Effects (RIEs) from High-Top MetOp-A and Spire GNSS-RO Profiles

Wu, Dong L.

NASA Goddard Space Flight Center, United States of America

Keywords *residual ionospheric error, GNSS radio occultation, bending angle, climate monitoring, upper stratosphere, long-term variation*

Abstract

GNSS-RO observations play an increasingly important role in monitoring climate changes in the upper stratosphere. Because the bending angle is small at these altitudes, the impacts of residual ionospheric errors (RIEs) become critical to derive a reliable climate signal in the geophysical retrievals. RIEs remain poorly understood since multi-path propagation, high-order (other than f-2) dependence, and receiver clock errors can all induce the RIEs at these altitudes. Leveraging a recent study for the D/E-region electron density retrieval, we gained more insights on the RIE problem. We found that the impact of RIEs on bending angle is proportional, of the first order, to the vertical gradient of iono-free excess phase profile (exL), or d(exL)/dz. Thus, we propose a new RIE correction method, called the exL-gradient method, using d(exL)/dz derived from the exL data at z>65km. The exL-gradient method, allowing both positive and negative RIE corrections, shows different climatology and interannual variations, compared to the results derived by the □-method [Healy and Culverwell, 2015]. Although the exL-gradient method can be applied to the RO profiles with a top at least 85 km, a higher RO top (e.g., MetOp-A and Spire) would significantly improve the RIE correction. It is recommended to extend the high-rate RO acquisition up to z =220 km for all future GNSS-RO operations.