EGU21-16243
https://doi.org/10.5194/egusphere-egu21-16243
EGU General Assembly 2021

Multi-GNSS Slant Wet Delay Retrieval Using Multipath Mitigation Maps

Addisu Hunegnaw[1], Yohannes Getachew Ejigu[2], Felix Norman Teferle[1], and Gunnar Elgered[3]
[1]University of Luxembourg, Luxembourg, Luxembourg (ahunegnaw@gmail.com)
[2]Department of Space Science and Application Research Development, Ethiopian Space Science and Technology Institute, Ethiopia
[3]Department of Space, Earth and Environment, Chalmers University of Technology, Onsala Space Observatory, Onsala, Sweden

The conventional Global Navigation Satellite System (GNSS) processing is typically contaminated with errors due to atmospheric variabilities, such as those associated with the mesoscale phenomena. These errors are manifested in the parameter estimates, including station coordinates and atmospheric products. To enhance the accuracy of these GNSS products further, a better understanding of the local-scale atmospheric variability is necessary. As part of multi-GNSS processing, station coordinates, carrier phase ambiguities, orbits, zenith total delay (ZTD) and horizontal gradients are the main parameters of interest. Here, ZTD is estimated as the average zenith delay along the line-of-sight to every observed GNSS satellite mapped to the vertical while the horizontal gradients are estimated in NS and EW directions and provide a means to partly account for the azimuthally inhomogeneous atmosphere. However, a better atmospheric description is possible by evaluating the slant path delay (SPD) or slant wet delay (SWD) along GNSS ray paths, which are not resolved by ordinary ZTD and gradient analysis. SWD is expected to provide better information about the inhomogeneous distribution of water vapour that is disregarded when retrieving ZTD and horizontal gradients. Usually, SWD cannot be estimated directly from GNSS processing as the number of unknown parameters exceeds the number of observations. Thus, SWD is generally calculated from ZTD for each satellite and may be dominated by un-modelled atmospheric delays, clock errors, unresolved carrier-phase ambiguities and near-surface multipath scattering.

In this work, we have computed multipath maps by stacking individual post-fit carrier residuals incorporating the signals from four GNSS constellations, i.e. BeiDou, Galileo, Glonass and GPS. We have selected a subset of global International GNSS Service (IGS) stations capable of multi-GNSS observables located in different climatic zones. The multipath effects are reduced by subtracting the stacked multipath maps from the raw post-fit carrier phase residuals. We demonstrate that the multipath stacking technique results in significantly reduced variations in the one-way post-fit carrier phase residuals. This is particularly evident for lower elevation angles, thus, producing a retrieval method for SWD that is less affected by site-specific multipath effects. We show a positive

impact on SWD estimation using our multipath maps during increased atmospheric inhomogeneity as induced by severe weather events.