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Evaluation of Virtual Reference Station constraints for GNSS Tropospheric Tomography in Austria

Robert Weber (1), Zohre Adavi (1,2), and Masoud Mashhadi Hossainali (2)

(1) Department of Geodesy&Geoinformation, TU-Vienna, Advanced Geodesy / E120-4, Vienna, Austria (robert.weber@tuwien.ac.at), (2) Department of Geodesy and Geomatics Engineering, K. N.Toosi University of Technology, No. 1346, Vali_Asr Ave., Mirdamad Cr., Tehran, Iran.

One of the most important and applicable methods of GNSS meteorology in recent decades is GNSS Tomography. This method can be used for determining water vapor distribution as the most active component of the atmosphere among GNSS measurements, which improves the accuracy of weather forecasting and early warning of severe weather. Therefore, it is a valuable source of information for meteorological and climatological studies and weather forecasting. The system of equations of this problem is mixed-determined because propagated signals do not pass through some of the model elements within the area of interest. Consequently, the normal matrix is close to singular without any unique solution. To avoid singularity and achieve a unique solution for the tomography model, additional sources or horizontal and/or vertical constraints are usually applied. Here, two schemes were considered for remedying the rank deficiency of the problem. In the first scheme, minimum horizontal constraints are imposed on the system of observation equation, where each refractivity is the weighted mean of the refractivities of the neighboring voxels. In the second scheme, Virtual Reference Stations (VRS) are used to reduce the elements of the model null space to the trivial ones. These schemes have been analyzed in a network of GPS reference stations in Austria for DoYs 244-257 in 2017 . Radiosonde profiles available in the study area were used to evaluate the tomography solutions.