Investigation of Height-Dependent Systematic Component of Ztds Using Spherical Harmonic Functions (SHF) and Empirical Orthogonal Functions (eof)

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Key words: GNSS/GPS; Positioning; Tropospheric zenith delay; spherical harmonic, empirical orthogonal functions

SUMMARY

Spherical harmonic (SH) is one of the tools used in modelling scalar fields on the spherical surface. Employing SH doesn't cause a problem in the matrix calculations of global and regional areas. However, the (weighted) normal equations' matrix of the least squares solution becomes ill-conditioned in local areas of several degrees. Apart from the density and distribution of data, noise and blunders affect the results of SH modeling. For unique and stable solutions, it is recommended to use the smoothed or filtered data.

Empirical Orthogonal Function (EOF) analysis is a statistical tool utilized in the determination of spatial and temporal variation in a physical field, the separation of the signal from the noise, the prediction and filtering of data.

Tropospheric Zenith Delay (ZTD) time series derived from continuous GNSS stations (CORS) depends on the topography of the field (position) and the meteorological parameters. Location-dependent systematic effects in ZTDs, and especially the effect of station heights, can be determined by EOF analysis with high precision.

In this study, hourly ZTD time series are derived at 16 TUSAGA-Active (Turkish CORS) stations (at distances of 80-100 km) for 20 days in a test area limited to 30°–34° northern latitudes and 39°–42° eastern longitudes. The precision of the least squares SHF modelling and the SHF modelling of the results obtained from EOF analysis (the height-dependent systematic components (PCs) and the reconstructed data (RFs) from these PCs) are investigated.

SHF modelling was carried out using 16 stations for every hour. SHF modelling was employed to these stations for the arithmetic mean of standard deviation of total of 456 models Mavg, different radius vectors, PC1 (first Principal Component) and RF13 (the constructed data from 13 PC). Whether the ZTDs contain a height-dependent systematic component and their effects on the precision of 3D SHF modelling are verified by the values of Mavg. For unique and stable solutions, the radius of the Earth is taken as r=6374,5 km+hkm and the arithmetic average of standard deviation is found to be Mavg=±9.93 mm.