Determination of the Most Applicable Precipitable Water Vapour Model for Turkey Using GNSS

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SUMMARY

Water vapor is a key component for modelling atmosphere and climate studies. Moreover, long-term water vapor changes can be an independent source for detecting climate changes. Since Global Navigation Satellite Systems (GNSS) use microwaves passing through the atmosphere, the atmospheric effects should be modeled with high accuracy. Tropospheric effects on GNSS signals are estimated with the total zenith delay parameter (ZTD) which is the sum of the hydrostatic (ZHD) and wet zenith delay (ZWD). The first component can be obtained from meteorological observations with high accuracy; the second component, however, can be computed by subtracting ZHD from ZTD (ZWD=ZTD-ZHD). Then, the weighted mean temperature (Tm) or the conversion factor (Q) is used for the conversion between the precipitable water vapor (PWV) and ZWD.

The parameters Tm and Q are derived from the analysis of radiosonde stations' profile observations. A number of Q and Tm models have been developed for each radiosonde station, radiosonde station group, countries and global fields such as Bevis Tm model and Emardson and Derks' Q models. In previous studies, an algorithm has been developed using Matlab to compute Tm, Q, ZWD, and the PWV from the parameters of radiosonde profile data such as height (h), temperature (T), dew point temperature (Td), pressure (p) and relative humidity (H). By applying least squares method to the results obtained from the devised algorithm, the PWV models (Tm and Q models) applied for Turkey have been derived using a year of radiosonde data (2011) from 4,103 radiosonde profile observations of Istanbul, Ankara, Samsun, Erzurum, Diyarbakir, Adana, Isparta and Izmir radiosonde stations. These models depend on different combinations of parameters such as the station temperature, the station latitude, the station height and day of year. In this study, the models developed are tested by comparing PWV_GNSS computed applying Tm and Q models to the ZTD estimates derived by Bernese and GAMIT/GLOBK software at GNSS stations established at Istanbul and Ankara with those from the co-located radiosonde stations (PWV_RS) from October

2013 to December 2014. The GNSS and meteorological data are obtained from a project (no 112Y350) supported by the Scientific and Technological Research Council of Turkey (TUBITAK). The comparison results show that PWV_GNSS and PWV_RS are in high correlation (86 % for Ankara and 90% for Istanbul). Thus, the most applicable model for Turkey and the accuracy of GNSS meteorology are investigated.