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Q Conversion Factor Models for Estimating Precipitable Water Vapor for Turkey

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Global Navigation Satellite Systems (GNSS) have recently proved to be one of the crucial tools for determining continuous and precise precipitable water vapor (GNSS-MET networks). GNSS, especially CORS networks such as CORS-TR (the Turkish Network-RTK), provide high temporal and spatial accuracy for the wet tropospheric zenith delays which are then converted to the precipitable water vapor due to the fact that they can operate in all weather conditions continuously and economically.

The accuracy of wet tropospheric zenith delay highly depends on the accuracy of precipitable water vapor content in the troposphere. Therefore, the precipitable water vapor is an important element of the tropospheric zenith delay. A number of studies can be found in the literature on the determination of the precipitable water vapor from the tropospheric zenith delay. Studies of Hogg showed that when the precipitable water vapor is known, the tropospheric zenith delay can be computed. Askne and Nodius have developed fundamental equations between the wet tropospheric zenith delay and the precipitable water vapor from the equation of the index of refraction in the troposphere. Furthermore, Bevis have developed a linear regression model to determine the weighted mean temperature (T_m) depending on the surface temperature (T_s) in Askne and Nodius studies. For this reason, nearly 9000 radiosonde profiles in USA were analyzed and the coefficients calculated. Similarly, there are other studies on the calculation of those coefficients for different regions: Solbrig for Germany, Liou for Taiwan, Jihyun for South Korea, Dongseob for North Korea, Suresh Raju for India, Boutiouta and Lahcene for Algeria, Bokoye for Canada, Baltink for Netherlands and Baltic, Bock for Africa. It is stated that the weighted mean temperature can be found with a root mean square error of ±2-5 K. In addition, there are studies on the calculation of the coefficients globally.

Another model for the determination of precipitable water vapor is the conversion factor Q which is shown in Emardson and Derks' studies and also Jade and Vijayan's. Developing a regional model using either T_m-T_s equation or the conversion factor Q will provide a basis for GNSS Meteorology in Turkey which depends on the analysis of the radiosonde profile data. For this purpose, the radiosonde profiles from Istanbul, Ankara, Diyarbakı r, Samsun, Erzurum, Izmir, Isparta and Adana stations are analyzed with the radiosonde analysis algorithm in the context of the "The Estimation of Atmospheric Water Vapour with GPS" Project which is funded by the Scientific and Technological Research Council of Turkey (TUBITAK). The Project is also in the COST Action ES1206: Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate (GNSS4SWEC).

In this study, regional models using the conversion factor Q are used for the determination of precipitable water vapor, and applied to the GNSS derived wet tropospheric zenith delays. Henceforth, the estimated precipitable water vapor and the precipitable water vapor obtained from the radiosonde station are compared. The average of the differences between RS and models for Istanbul and Ankara stations are obtained as 2.0±1.6 mm, 1.6±1.6 mm, respectively.