# Modelling of Geodetic Refraction Coefficient Using GNSS Data

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**SUMMARY**

Refraction is a complex parameter that affects terrestrial optical measurements and is regarded as a major source of systematic error in the precise determination of height differences using trigonometric heighting. Due to the intricate process required to calculate an exact value for the refraction coefficient in every surveying task, it has been suggested, for simplicity, that specific values that approximate the average state of the atmosphere be applied. Such values include the global k=0.13 for all seasons whereas in Greece the value of k=0.16 is routinely used. However, these values are not always representative and the determination of k remains a long-term topic of research in engineering geodesy. Studies use various approaches such as reciprocal sights, vertical temperature gradient measurements to focus on the short-term variations of the refraction coefficient or one-sided zenith angle and distance measurements, combined with meteorological data.

This work aims to study the use of Global Navigation Satellite System (GNSS) data in the estimation of the refraction coefficient. As GNSS signals travel through the troposphere, they are delayed due to changes in the refractive index of the medium. Based on this, GNSS data can be used in the remote sensing of the atmosphere, such as to measure physical variables (atmospheric temperature, pressure and troposphere heights) needed for weather and climate change monitoring. Additionally, it can estimate the amount of precipitable water from the amount of water vapor in the atmosphere, which is proportional to the Zenith Wet Delay (ZWD) and is relevant to weather forecasting. The Zenith Tropospheric Delay (ZTD) is estimated alongside with the unknown positions in GNSS solutions and can be very useful for meteorological applications regarding the estimation of water vapor content in the atmosphere.

In this work, GNSS observations of over three and a half years from a continuously operated station

(TEIA), collocated with a meteorological station are used. Data from a Leica GRX1200 Pro receiver are processed using the PPP technique. The ZTD estimates are then related with meteorological data of high reliability, collected by a DAVIS Vantage Vue meteorological station on site. These datasets are augmented by terrestrial geodetic measurements to determine the actual value of k at specific times. Combined analysis of all data will allow to estimate the quantitative effect of the atmosphere on the refraction coefficient, that will reflect the actual atmospheric conditions for the area and time of interest.