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Exploitation of the signal to noise ratio of GNSS receivers for improving the accuracy of position and tropospheric delay estimation

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The Tropospheric delay (TD) introduces a bias in the measurement of the ranges between the GNSS satellite and the receiver on Earth. Troposphere is not a dispersive media at microwave bands. Thus TD suffered by the GNSS signal collected from ground stations, cannot be removed as done for the ionospheric one. So it is modeled in terms of a zenith tropospheric delay (ZTD) unless of a slant factor, or mapping function (MF), depending on the sine of the elevation angles (E). Marini-Murrray (MM) suggested a mathematical formulation of the MF in terms of nested function of the following fashion: an-1/(Sin(E)+an), truncated at third stage. Niell in 1996 used atmospheric profiles retrieved with balloon observations (RAOB) to compute the coefficients of his MF (NMF). Profiles could also be provided by climate and/or Numerical Weather Prediction (NWP) models as in Vienna MFs; or by observations coming from GNSS-Radio Occultation missions. In this work we have estimated the MF using a new unexpected source of data: the GNSS signal to noise ratio (SNR) usually recorded in the RINEX files. The rationale of this approach is that the weakening of the signal mainly depends on the extinction effects due to the atmosphere. The fading of the signal through the atmosphere is ruled by the product of an extinction coefficient, depending on the chemical and physical properties of the atmosphere, times the number of air masses crossed by the signal. The relationship between the elevation angle and the number of air masses (NAM) crossed by signals is simply another way to define the MF. This approach is widely applied in astronomical photometry to remove atmospheric fading from the flux measurements (magnitude) of a celestial body. We have used the same approach for each of geodetic techniques: SLR, VLBI and GNSS; with the reverse goal to estimate the MF knowing the relationship between the elevation, azimuth and the SNR of the signals caught by the receivers. For this investigation we have used the super-site of Matera where all the aforementioned geodetic techniques are co-located together with an astro-metric station devoted to space debris monitoring.