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HOW IMPROVE TROPOSPHERIC DELAY ESTIMATION FROM GNSS RECEIVERS SIGNAL TO NOISE RATIO

Abstract

The Tropospheric delay (TD) introduces a bias in the measurement of the ranges between the GNSS satellite and the receiver on Earth. As Troposphere is not a dispersive media at microwave bands the TD that affects the GNSS signal collected from ground stations cannot be deleted using the benefits of the double frequencies combinations as done for the ionospheric one. GNSS measurements caught from receivers will be always affected by range bias. The only way to deal with it is to use a modeling in terms of a zenith tropospheric delay (ZTD) unless of a slant factor (namely mapping function, MF) that depends on the sine of the satellites elevation angles (E). The most used mathematical formulation for the MF was the Marini-Murray (MM) nested function of the form: an-1/(Sin(E)+an), truncated at third stage. To retrieve its coefficients from atmospheric profiles many type of data have been used: balloon observations (RAOB) as done by Niell in 1996 (NMF); climate and/or Numerical Weather Prediction (NWP) models as in Vienna MFs or observations from GNSS-Radio Occultation missions. In this work we present a new source of data to compute the MF: the GNSS signal to noise ratio (SNR) usually recorded in the RINEX files. SNR quantifies the weakening of the signal suffered from the GNSS receivers and it mainly depends on the extinction effects due to the atmosphere. We can express the fading of the signal using the product of an extinction coefficient, depending on the chemical and physical properties of the atmosphere, times the number of the crossed air masses. The new MF will be the relationship between the elevation angle and the number of air masses (NAM) crossed by signals as done in astronomical photometry to remove atmospheric fading from the flux measurements (magnitude) of a celestial body. In this work we apply the same approach to the 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. The geodetic core site of Matera co-locates all the aforementiones techniques together with an astro-metric station devoted to space debris monitoring.