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Tropospheric Parameters Derived From Co-located Instrumentation at the Onsala Space Observatory

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Observations performed with ground-based space geodetic and remote sensing techniques are sensitive to the amount of water vapour in the neutral atmosphere. Corresponding parameters that describe the signal delay in the troposphere can be derived for example from the analysis of data collected from geodetic Very Long Baseline Interferometry (VLBI), Global Navigation Satellite System (GNSS), as well as microwave radiometers. The latter instruments are often referred to as water vapour radiometers (WVR).

The Onsala Space Observatory (OSO) operates a number of such instruments for VLBI, GNSS and WVR measurements, all co-located within about 600 m. Among these are the Onsala twin telescopes (OTT), two modern 13.2~m diameter radio telescopes performing observations in the VLBI Global Observing System (VGOS) of the International VLBI Service for Geodesy and Astrometry (IVS). The OTT are the first operational VGOS twin telescopes worldwide and are contributing with observations to the IVS since 2019. OSO also operates eight permanently installed GNSS stations, of which two are official stations in the International GNSS Service (IGS) network. Furthermore, OSO operates ground-based microwave radiometers, which are used for atmospheric research and perform continuous observations of the water vapour content in the neutral atmosphere. Data analysis of all three techniques, VLBI, GNSS and WVR, allows to derive information on the temporal and spatial variations of water vapour in the neutral atmosphere. Using co-located instrumentation within a few hundred metres distance thus offers a perfect opportunity for comparisons and assessments of the results.

We focus on data recorded at OSO during 2022 and compare the parameters describing the signal delay in the neutral atmosphere, i.e. the so-called equivalent zenith total delays and the linear horizontal delay gradients. The temporal resolution of the derived parameters is 15 min or less. Out of more than 40 VGOS experiments in 2022, each of a duration of 24 h, we have WVR data covering at least half of the session in all except one. We have examples where the equivalent zenith wet delay only varies by 2--3 cm over an experiment during rather stable atmospheres. When the atmosphere is more variable the zenith wet delay can vary by more than 10 cm over 24 h.