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Assessment of the zenith wet delay and horizontal delay gradients derived from collocate techniques

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Radio signals are refracted when passing through the Earth's neutral atmosphere. The refraction introduces an additional delay to the primary observable, the signal propagation time, for microwave space geodetic techniques, i.e. the Global Positioning System (GPS) and Very Long Baseline Interferometry (VLBI). In order to achieve high accuracy, the propagation delay is estimated in the data processing along with other unknown parameters. The delay is usually separated into two parts: the dry and the wet path delay. The dry part is often known a priori. It can be modeled with high accuracy using measured ground pressure. The estimated wet part is correlated to the errors in the estimated coordinates, e.g. a relative Zenith Wet Delay (ZWD) error of 0.03 mm will approximately correspond to a relative vertical position error of 0.1 mm, depending on observing geometry. Due to the fact that the wet delay is dependent on the amount of water vapour in the air through which the signal passes, the large variability of the estimated wet delay is caused by inhomogeneity in the water vapour distribution. Therefore, careful investigation on the horizontal delay gradients, which represent the spatial and temporal variation of the wet delay is useful in order to improve the estimation of the wet delay, and in turn improve the repeatability of the estimated site coordinates.

At the Onsala Space Observatory in Sweden, a VLBI site is collocated with a permanent GPS site (ONSA), and a Water Vapour Radiometer (WVR). The WVR has full movability in both the azimuth and the elevation angle and is operated continuously in a so called "sky-mapping" mode, making about 6000–8000 measurements per day. This makes the WVR capable of providing an independent data set for comparisons with the wet delay and the horizontal delay gradients inferred from the GPS and the VLBI data. The GPS data were analyzed using the GIPSY 5.0 software to solve for the atmospheric wet delay and its horizontal gradients as random walk parameters with a temporal resolution of 5 minutes while the ZWD and gradients from the VLBI data were estimated using piecewise linear functions for with 1 hour and 3 hours temporal resolution, respectively.

Using 54 days of observation, *Gradinarsky et al.* (2000) showed that the ZWD are highly correlated between the same three techniques with the best agreement between the VLBI and the GPS data. The results for the estimated gradients show much lower correlation, but again the best agreement is between the VLBI and the GPS data. In this work, we present comparisons of the estimated ZWD and horizontal delay gradients inferred from the same three techniques, but using observations covering a much longer time period: from 1997 to 2008.

Gradinarsky et al., Earth Planets Space, *Vol. 52, No. 10, pp. 695–698.*