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On the assimilation of GNSS horizontal delay gradients

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Radio signals which are transmitted by GNSS satellites and received by a ground-based station allow the estimation of the Zenith Total Delay (ZTD) and the so-called horizontal delay gradients. Recently we developed a rapid and accurate algorithm to compute slant total delays, i.e. the atmospheric induced signal travel time delays between the station and the GNSS satellites in view, utilizing the refractivity field of a Numerical Weather Model (NWM). Due to the simple relation between slant total delays and horizontal delay gradients we immediately obtain a forward operator for horizontal delay gradients. In a simulation (assimilation) study we analyse how the horizontal delay gradients on top of the ZTD affect the background refractivity field in the vicinity of a single station. The background refractivity field can be obtained from a NWM or it can be assembled from a GPS radio occultation refractivity profile (the refractivity field is spherically layered). In the latter case, we obtain a synergy of ground-based and space-based GNSS atmospheric data.