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Asymmetry of ground-based GPS slant delay data

R. Eresmaa, H. Järvinen, S. Niemelä, and K. Salonen

Finnish Meteorological Institute, Erik Palménin aukio 1, 00100 Helsinki, Finland

Abstract. The ground-based measurements of the Global Positioning System (GPS) allow estimation of the tropospheric delay along the slanted signal paths through the atmosphere. The meteorological exploitation of such slant delay (SD) observations relies on the hypothesis of azimuthal asymmetry of the information content. This article addresses the validity of the hypothesis.

A new concept of asymmetry is introduced for studying the SD observations and their model counterparts. The asymmetry is defined as the ratio of the absolute asymmetric delay component to total SD. The model counterparts are determined from 3-h forecasts of a numerical weather prediction (NWP) model, run with four different horizontal resolutions. The SD observations are compared with their model counterparts with emphasis on cases of high asymmetry in order to see whether the observed asymmetry is a real atmospheric signature.

The asymmetry is found to be of the order of a few parts per thousand. Thus, the asymmetric delay component barely exceeds the assumed standard deviation of the SD observation error. However, the observed asymmetric delay components show a statistically significant meteorological signal. Benefit of the asymmetric SD observations is therefore expected to be taken in future, when NWP systems will explicitly represent the small-scale atmospheric features revealed by the SD observations.

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