Geophysical Research Abstracts
Vol. 12, EGU2010-8066, 2010
EGU General Assembly 2010

Validation of slant delays derived from single and dual frequency GPS data

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Improved knowledge of the humidity distribution is very important for a variety of atmospheric research applications. During the last years the potential of GPS derived tropospheric products, e.g. zenith total delays (ZTD), slant total delays (STD), with high temporal resolution have been demonstrated. The spatial resolution depends on the network density, which needs to be improved for such meteorological applications, as high resolution numerical forecast models. Another application is the water vapor tomography, which can be used to resolve the spatial structure and temporal variations of the tropospheric water vapor. The GPS derived STDs are used here as input data. To reconstruct reliable vertical profiles, a large number of STD observations covering the complete region from a wide range of angels is required. Due to economic reasons, the network densification is recommended with single frequency (SF) receivers.

The Satellite-specific Epoch-differenced Ionospheric Delay model (SEID) has been developed at the Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences to estimate ionospheric corrections for SF receivers embedded in networks of dual-frequency (DF) receivers. With these corrections the SF GPS data can be processed in the same way as the DF data. It has been proved, that the SEID model is sufficient for estimating tropospheric products as well as station coordinates from SF data. The easy implementation and the accuracy of the SEID may speed up the densification of existing networks with SF receivers. After introducing the SEID model, the validation results of SF and DF derived tropospheric products will be presented.

Currently the very sparse character of independent observations makes it difficult to assess the anticipated high quality of DF & SF STD data processed for a large network of continuously operating receivers. Therefore monitoring of GPS derived STD data against weather analysis is an alternative. To compare STDs with their model equivalents we perform ray-tracing through the European Centre for Medium Range Weather Forecasts (ECMWF) analysis. A first statistical inter-comparison of simulated and observed STDs retrieved from DF GPS data for the large network of continuously operating ground-based receivers in Germany indicates a good agreement over the entire elevation range. Similar validation efforts for STDs retrieved from SF GPS receivers is work in progress.