Geophysical Research Abstracts
Vol. 16, EGU2014-13163, 2014
EGU General Assembly 2014

Improved modelling of tropospheric wet delay and its vertical approximation

Jan Dousa and Michal Elias
Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecny, Czech Republic
(jan.dousa@pecny.cz)

The troposphere modelling is a limiting factor in GNSS positioning, in particular when kinematic application suffers from a high correlation between estimated height and tropospheric path delay parameters. The path delay reaches up to 2.5 meters in the zenith above the antenna and up to a few tens of meters in low elevations. The main difficulty, however, resists in the modelling of 10 per cent of the total path delay, so called wet path delay, due to temporally and spatially variable moisture in the atmosphere. It can not be precisely modelled from in situ observations and additional information about the vertical profile is important, at least. Until recently, external meteorological data were not considered as helpful for the wet delay modelling in positioning. However, with recent improvements in quality and temporal and spatial resolution of numerical weather models, these might be suitable for a future support of kinematic GNSS positioning including airborne applications. In such cases, the accuracy is expected at the level from centimetres to decimetres and external tropospheric data could be helpful for eliminating (or decorrelating) the troposphere from the height.

In past decades, various models for zenith wet delay (ZWD) were derived, but the most commonly used one was developed 25 years ago by Askne and Nordius (1987). Their analytical formula is highly suitable for designing a tropospheric correcting model for geodetic positioning. The approach was thus originally used at the University of New Brunswick and later adopted in the Minimum Operational Performance Standards (MOPS) for the Wide Area Augmentation Systems (WAAS) like EGNOS in Europe. Recently, we have studied an optimal vertical approximation of ZWD and we defined an independent lapse rate this parameter. Using new formulation supporting more flexible parametrization, we demonstrated actually the best results in vertical approximation when compared with other existing approaches. Additionally, the new defined lapse rate was used for a significant improvement in the calculation of ZWD by the modification of the model by Askne and Nordius. Our method thus consists of two important enhancements - a) ZWD calculation itself by analytical formula and b) ZWD vertical reduction. We expect that the new ZWD model, in particular for its high flexibility with respect to meteorological input parameters (and also a legacy to MOPS or other models based on Askne and Nordius formula), is well suited for developing future tropospheric augmentation models in support of positioning or various other related applications.

The presentation describes the background of the new lapse rate definition and formula derivation. We demonstrate its flexible usage and a significantly improved performance compared to any existing approximation model, i.e. with exception of numerical integration through the vertical profile. The evaluation was carried out carefully for different seasons and locations with support of radiosonde profiles from the British Atmospheric Data Centre (BADC) and meteorological data from the ERA-Interim reanalysis model provided by the European Centre for Medium-Range Weather Forecasts (ECMWF).