Sensitivity of Long-term GNSS to Vertical Land Motion: Effects of Geophysical Loading Corrections

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Keywords *Long-term GNSS, Sensitivity analysis, Vertical land motion, Trajectory models, Climate change detection*

Abstract

In this contribution we are addressing the question of how sensitive noisy GNSS data is to vertical ground motions (e.g., uplift rates), which is a vital question for climate change detection. We use daily-sampled data from 244 European GNSS stations, processed and provided by the Nevada Geodetic Laboratory (NGL), with observation intervals up to 27 years. The data is reduced by the effects of atmospheric, oceanic and hydrological non-tidal loading. With Hector software linear trajectory models and stochastic models are fitted station-wise. Based on the obtained uncertainty intervals we compute the sensitivity of the model parameters -- i.e., a linear trend, the amplitudes of annual and semi-annual periodic signals, offset and bias terms and compare both the case with and without loading corrections. It is shown that by applying loading corrections, the sensitivity can be significantly improved, e.g., from 1.3 mm/year to 0.6 mm/year for the median of the trend component. Power-law-white-nose (PLWN) stochastic noise models are the primary choice in this case; model choices are based on the Bayesian Information Criterion (BIC). The sensitivity analysis can be carried out for periodic signals with time-varying amplitude as well.

The proposed algorithm for the sensitivity analysis cannot only be applied to GNSS data, but also to many other geodetic and geophysical time series data, especially in view of climate change monitoring and detection.