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On atmospheric induced correlations between GPS phase observations

S. Schön and F. Brunner

Engineering Geodesy and Measurement Systems TU Graz, Austria

(steffen.schoen@tugraz.at / Fax: 43 316-8736820 / Phone: 43 316-8736325)

For precise GPS point positioning, the incomplete knowledge of the atmospheric composition along the signal path is still an accuracy limitation. The dynamic processes in the atmosphere induce correlated wave propagation effects on GPS signals. However, these correlations are usually not modelled in the variance-covariance matrix of the observations. Hence, too optimistic uncertainty measures are obtained for GPS derived parameters like point positions. Turbulence theory forms the basis to describe the atmospherically induced random fluctuations of the GPS phase observations in terms of structure functions.

In this contribution, we investigate the atmospherically induced correlations between GPS phase observations. Based on the structure function of refractivity, the GPS phase fluctuations as well as their correlations are derived. As a result, the correlation patterns for double differenced GPS phase observations can be computed. They depend on changes in the satellite-receiver geometry expressed by baseline lengths, azimuth and elevations of the satellites. Incorporating these correlations in the classical GPS error model, more realistic uncertainty measures in terms of variances and covariances are obtained. Finally, a specific GPS network with distinct varying baseline lengths is used to test the theoretical results