

ATMOSPHERIC PLANETARY WAVES IMPACT ON IONOSPHERIC CORRECTION IN GPS

Andrey Lyakhov⁽¹⁾, Alexey Chermenin⁽²⁾

(1) Institute of geospheres dynamics, Moscow, Russia

(2) Moscow Institute of Physics and Technology, Moscow, Russia

The observations of position error are evaluated at Mikhnevo geophysical observatory of the Institute of geospheres dynamics (54.94N, 37.73E) since November 1 2014. We use Javad Sigma 3 receiver with 1 Hz sampling rate and RTKLib software. The exploratory data analysis has shown new intriguing features of errors.

First of all, the spatial distribution of the “measured” points very rarely follows the Gaussian distribution. More frequently, the distribution of 1-hour data can be best fitted by an ellipse. Moreover, there are periods when the distribution is clearly the superposition of two ellipses. The probability distributions differ significantly from theoretical normal as well as from simulated red noise processes.

The evidence allows us to proceed with the determination of the scattering ellipse parameters using principal component analysis technique. Thus the time series of coordinates have been transformed into the time series of the ratio R of ellipse major axis to the minor one.

An attempt to analyze the R temporal behavior using Lomb technique failed, as far as we see no statistically significant spectral peaks. Meanwhile, the exploratory analysis of the $R(t)$ series allows to hypothesize that sometimes events with large R occur more frequently. Then, under an expert estimation of critical R value equals 10 the original data have been reduced to the temporal point process. Finally the aforementioned data have been passed through the Lyubushin’s method for seeking periodicities in point processes.

Integral spectrum shows clear quasi-2-days, 14 and 21 days periods in the appearance of large R , hence extreme errors in coordinates. Moreover, the spectrogram demonstrates that these periods have been observed at different time periods. As far as these periods are known to be the periods of planetary atmospheric waves the following two opportunities can be hypothesized: either GPS navigation signal suffers from ionospheric disturbances due to the wave activity or the ionospheric correction algorithms suffers from such processes. In order to check these hypotheses we repeat the data processing with the ionospheric correction switched off. There were no periodicities in coordinate scattering without ionospheric correction.

Our results allow to make the conclusion that existing ionospheric correction (broadcast) algorithms suffer from the planetary wave activity, which would be included in future generation of correction algorithms.