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Correction of multipath effect for precise point positioning high-rate GNSS data processing in seismic phenomena analysis

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The main high-rate GNSS processing strategy for dynamic co-seismic motions detection is Precise Point Positioning (PPP). This technique does not require any reference stations, which may be displaced during the earthquake. In contrast to relative approach, where systematic errors are reduced with double differences, in PPP they are reduced with models and corrections. Within short period of time this technique can reach millimeter-level of precision, similar to relative positioning.
The major source of error in high-rate GNSS is considered to be multipath, which is site-dependent and influenced by the satellites geometry. In standard processing strategies of data with smaller sampling rate, multipath error is considered to be reduced with antenna model and is neglected during processing. In case of high-rate GNSS analysis this error is usually being reduced with sidereal filtering in observation or position domain. Another approach in high-precision applications is to use multipath hemispherical maps to reduce the noise level and increase the precision of obtained time series. Assuming the repeatability of satellite spatial distribution, 3-51 day long permanent observations enable to create reliable multipath map that represents systematic error values. As it is possible nowadays to obtain PPP-derived phase post-fit residuals in L1 and L2 frequencies separately, we have created multipath hemispherical maps for GNSS stations co-located with seismometers. Multipath maps were created using stacking of phase post-fit residuals in hemisphere bins. The data sampling used for this calculation is 30 seconds and the period of observations was 15 days. Created multipath maps were implemented in PPP high-rate 10-Hz GNSS data processing to reduce the phase observables and obtain corrected position time series of these stations during the magnitude 4-6 earthquakes. Position results were then compared to the outcome of standard PPP approach and with reference seismological data.
Paper presents the impact of multipath effect correction separately for L1 and L2 frequencies on precision of PPP-derived GNSS time series and its influence on discrepancy of high-rate GNSS and seismological positioning data during the earthquake.