Geophysical Research Abstracts
Vol. 16, EGU2014-3995, 2014
EGU General Assembly 2014

Annual variability of GPS and GLONASS multipath ground reflections related to changes in local environment of the GNSS antenna

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Analyses of multipath effect caused by signal reflections from horizontal surface at permanently observing GNSS sites allow to deduce some characteristics of the environment of the receiver antenna. We investigated the annual variability of period, amplitude and phase of the reflected signals for rising or setting satellites in specified azimuthal sectors. The multipath parameters are inferred from daily analyses of signal-to-noise ratio (SNR) observations of GPS and GLONASS satellites. The GPS data from specific satellite allow to form time series with daily spacing for each parameter of interest (e.g. the amplitude of periodic multipath variation of satellite observed close above the horizon). For GLONASS the time series related to one satellite rise or setting in specified azimuthal sector are with 8-days spacing due to GLONASS constellation ground repeat. Information gained from signal strength of L1 and L2 phase observations (SNR1 and SNR2) caused by multipath obtained independently from GPS and GLONASS are mutually compared. The relations of the monitored SNR parameter changes with the GNSS antenna environment changes (like heavy rainfall or snow depth variations) are documented for some selected GNSS permanent sites situated in Central Europe.