

Effect of elongated radio source structure on the estimated geodetic VLBI parameters

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Current work presents a simulation study on the sensitivity of geodetic parameters estimated with Geodetic Very Long Baseline Interferometry (GeoVLBI) technique to the observed radio sources that have elongated internal structure. In GeoVLBI the radio sources are used as reference points and their coordinates form Celestial Reference Frame (CRF). Position and orientation of the Earth in space are defined relative to the coordinates of the radio sources. Analyzing time delay of radio signals arrived to different radio antennas of global VLBI network, it is possible to estimate various geodetic parameters, such as Earth orientation parameters, station coordinates, troposphere density, etc. Many of radio sources from CRF are not point-like, furthermore the structure of the radio sources have temporary variations. These effects have noticeable influence on the accuracy of VLBI technique. If a radio source has elongated structure, the effect of the time delay calculated for different radio telescope's baselines will depend on the orientation of the baseline relative to the source structure elongation. The simulations are used to investigate this effect on the geodetic parameters estimated from VLBI observations. Several scenarios to mitigate or correct this effect are considered and proposed in this work.

The modern VLBI Global Observing System (VGOS) is currently becoming operational. In the VGOS observations the largest error source, caused by troposphere, will be considerably reduced. However, the radio source structure effect becomes very prominent in the VGOS observations and development of mitigation methods is required. In our simulation we use real observation schedules of CONT17 campaign, where both legacy and VGOS networks have performed continuous VLBI observations over a time period of about two weeks. The aim of the CONT17 campaign was to investigate possible network biases and to demonstrate state of the art VLBI and VGOS capabilities.