EGU2020-5922
https://doi.org/10.5194/egusphere-egu2020-5922
EGU General Assembly 2020

Satellite geodesy with VLBI in the GGOS era: observation concepts, geodetic products and the technical feasibility

Grzegorz Klopotek[1], Rüdiger Haas[1], Thomas Hobiger[2], and Toshimichi Otsubo[3]
[1]Department of Space, Earth and Environment, Chalmers Univeristy of Technology, Gothenburg, Sweden
[2]Institute of Navigation, University of Stuttgart, Stuttgart, Germany (thomas.hobiger@nav.uni-stuttgart.de)
[3]Graduate School of Social Sciences, Hitotsubashi University, Tokyo, Japan (t.otsubo@r.hit-u.ac.jp)

The demanding requirements of the global geodetic observing system (GGOS) necessitate appropriate changes to be made also in the field of geodetic/astrometric very long baseline interferometry (VLBI). The VLBI global observing system (VGOS) is the milestone step towards reaching the GGOS goals. This next-generation VLBI system has already reached an operationally stable international network and it continuously evolves into a truly global infrastructure, with the aim of delivering geodetic products and frame parameters with an unprecedented quality. Thanks to the enhanced measurement precision, increased observation density and improved tracking capabilities, VGOS provides also a great opportunity for extending the current VLBI research with new applications such as observations of geodetic satellites with VLBI. This requires also that a geodetic satellite transmits signals that can be observed by VLBI telescopes, and such ideas have been proposed over the last years. Although a variety of simulation studies have already been performed with the aim of addressing the usefulness of this concept for geodesy and few interesting aspects have been discussed, this topic has not been fully exploited, especially in connection with VGOS. Observations of natural radio sources (quasars) and dedicated geodetic satellites with the same instruments (radio telescopes) bring several benefits as well as new challenges related to the observing strategy and the technical feasibility of this concept. When observing satellites, VLBI gains an access to the set of geodetic parameters that are usually out of scope for conventional VLBI, e.g., satellite orbits or geocenter motion (observed directly). Besides the co-location in space and on the ground, the combined quasar-satellite solutions could also potentially result in an enhanced quality of common geodetic products such as Earth Rotation Parameters (ERP) or station positions. Lastly, the goal of a consistent determination of the terrestrial and celestial reference frames, Earth Orientation Parameters and satellite orbits could be also met in this case.
The following contribution provides a holistic view concerning the prospective VLBI observations of geodetic satellites in the era of GGOS and their impact on various geodetic products. The aspect of VGOS-type satellite observations in the GGOS era is investigated with the use of Monte-Carlo simulations carried out with the c5++ analysis software. The basis of our study form three-day VGOS schedules, which include both quasar and satellite observations. The latter are realized with the use of several Galileo satellites, which are located on different orbital planes. Both observation types are used to derive satellite orbits and estimate common station-based and global geodetic

parameters. The impact on classical geodetic parameters (station positions, ERP), caused by additional satellite observations and the orbit determination process, is investigated with the use of different satellite observation precision levels. We also provide insights concerning the quality of the determined satellite orbits and geocenter estimates. In addition, the scheduling aspects and the technical feasibility of the presented approach are also discussed.