REFAG 2022 THESSALONIKI - GREECE
17-20 October 2022

On how multi-technique co-location in space can contribute to the Global Geodetic Observing System goals

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Abstract. Accurate global terrestrial reference frames (TRF) are the backbone of Earth system studies. Therefor requirements on the TRF accuracy have been defined by the Global Geodetic Observing System (GGOS), which have not yet been reached. This in view, the German Research Centre for Geosciences (GFZ) realized in collaboration with the Technische Universitaet Berlin (TUB) the project GGOS-SIM-2. One focus of this project is to investigate the potential of co-location of different observation techniques on dedicated satellites. These satellites are a frequently recurring concept, which has nevertheless not yet been realized, but currently been revived by f.i. ESA. Therefore, we performed simulations for the four main space geodetic techniques, namely DORIS, GNSS, SLR and VLBI towards co-location in space on a single satellite. For most realistic simulations firstly, Precise Orbit Determination (POD) to a range of prominent satellite missions launched and operated during the last thirty years was performed. The analysis of the real observations and the POD derived information provide the basis for the simulation environment in highest coincidence with reality. Adapting this simulation environment, we performed multi-technique simulations to existing satellites and quasars currently used for TRF determination and also to a future dedicated space-tie satellite in overall six different orbit scenarios. Following the simulations, single-technique and combined TRF solutions were generated based on existing infrastructure and in addition with the space-tie satellite. The effect on the TRF is quantified in terms of the reference frame defining parameters and the formal errors of adjusted parameters. Based on all the scenarios, we aspire to answer the question if and how TRFs can be improved by co-location in space towards the important GGOS goals.