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Correlations between parameters estimated by space geodetic techniques

D. Thaller (1), M. Kruegel (2), R. Schmid (1), V. Tesmer (2), M. Rothacher (3), D. Angermann (2)

(1) Forschungseinrichtung Satellitengeodäsie , TU Munich, (2) Deutsches Geodätisches Forschungsinstitut, Munich, (3) GeoForschungsZentrum Potsdam
(daniela.thaller@bv.tum.de/+49-89-289-23178)

The space geodetic techniques VLBI, GPS, SLR and DORIS can determine a broad spectrum of parameters, e.g., site positions and velocities, Earth orientation parameters (EOPs), and, except for SLR, site-specific troposphere parameters (i.e. zenith delays and horizontal gradients). In addition, VLBI is able to determine quasar coordinates whereas the satellite techniques have access to the Earth's center of mass and, obviously, the orbits of the satellites. All these parameters are far away from being independent of each other and the characteristics of the correlations differ considerably between techniques.

In this contribution we first study some of these correlations for each individual technique, namely (1) the correlations between station coordinates and troposphere zenith delays and gradients and (2) the correlations between EOPs. Secondly, we assess how an inter-technique combination helps to decorrelate these parameter groups.

It is well known that, when estimating troposphere parameters, strong correlations exist between station heights and troposphere zenith delays on one hand, and horizontal positions and troposphere gradients on the other hand. As a consequence, modeling deficiencies in station coordinates (antenna phase center variations, remaining tidal signals, ...) will show up in tropospheric parameters and vice versa. We discuss the size of the correlations and those adverse effects for each of the techniques and the combination based on simulated and real data from the continuous VLBI Campaign CONT02. As, for SLR, tropospheric refraction can be modeled with sufficient precision, we analyze to what extent the inclusion of SLR into a (combined) microwave solution can help to reduce these correlations.

Between EOPs several types of correlations are important. We show that correlations between pole coordinates, UT1-UTC, nutation and their time derivatives heavily depend on the time resolution chosen for each of these components. In the "extreme" case of sub-daily estimation of pole coordinates, a diurnal retrograde polar motion term corresponds one-to-one to a nutation offset (and to a rotation of all orbital planes). This singularity can be avoided by blocking diurnal retrograde polar motion. We investigate the effect of this blocking mechanism using simulated as well as real observations for the CONT02 campaign period. In this context, the temporal resolution of the sub-daily pole coordinates and differences between VLBI and the satellite techniques have to be considered.