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Improved geodetic datum realization based on simulation studies for co-located SLR-VLBI stations

Joanna Najder¹, Alexander Kehm², Mathis Bloßfeld², Krzysztof Sośnica¹, and Matthias Glomsda²

¹Wrocław University of Environmental and Life Sciences, Institute of Geodesy and Geoinformatics, Poland

²Deutsches Geodätisches Forschungsinstitut (DGFI-TUM), Technical University of Munich, Germany

The International Terrestrial Reference System is realised in the form of multi-year reference frames such as the International Terrestrial Reference Frame (ITRF) or in the form of epoch reference frames relying on short observation time spans up to several weeks. The realisation is based on the combination of space-geodetic techniques, namely the global navigation satellite systems (GNSS), satellite laser ranging (SLR), very long baseline interferometry (VLBI) and Doppler orbitography and radiopositioning integrated by satellite (DORIS). In some ITRF and epoch reference frame solutions, SLR and VLBI are responsible for realising the datum parameters origin (only by SLR) and the scale, while the orientation of the network with respect to the Earth's body is maintained by a mathematical constraint. The integration of the techniques is achieved by introduction of local ties (LTs) at co-located sites, i.e., by ground-based measurements of difference vectors between the technique-specific reference points. High accuracy of current LTs between techniques and the establishment of new co-location sites are necessary to provide (and further improve) a reliable realisation of the geodetic datum. Co-location sites with the SLR technique are of particular significance as this is the only technique that enables the realisation of a terrestrial reference frame origin with a high level of accuracy. As previous studies demonstrate, the performance of the observational networks has a significant impact on the accuracy and stability of the corresponding datum realisation, especially for epoch reference frames.

This study aims to examine how improving the performance of the existing network of co-located SLR stations could affect the quality of determined datum parameters. The considered simulation scenarios study the performance of SLR stations co-located with the VLBI technique and improve the performance of those that do not meet the standards set by the International Laser Ranging Service (ILRS). Moreover, it is examined how significant the improvement of the datum parameters is in the case of extending the SLR network with stations located nearby existing VLBI telescopes (due to a 'better' datum transfer via a higher number of local ties).