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Combining the Observations from Different GNSS

Rolf Dach (1), Simon Lutz (1), Michael Meindl (1), Stefan Schaer (2), Peter Steigenberger (3), and Gerhard Beutler (1)

(1) Astronomical Institute, University of Bern, Bern, Switzerland (rolf.dach@aiub.unibe.ch), (2) Federal Office of Topography swisstopo, Wabern, Switzerland, (3) Institut für Astronomische und Physikalische Geodäsie, Technische Universität München, Munich, Germany

Since many years precise applications for Global Navigation Satellite Systems (GNSS) have exclusively used the American Global Positioning System (GPS). With the highly improved stability of the Russian counterpart GLONASS (Global Navigation Satellite System) and the development of alternative systems in Europe (Galileo) or China (Compass) we are confronted more and more with a multi-GNSS situation.

The Center for Orbit Determination in Europe (CODE) acting as a global analysis center of the International GNSS Service (IGS) has a long tradition in the combined analysis of the data from different GNSS since all CODE contributions to the IGS are generated in fact from a rigorously combined analysis of GPS and GLONASS data — apart from the clock products.

When the procedure for deriving the multi–GNSS clocks has been developed the question about the modeling of the inter–system bias in the receivers was reviewed. Traditionally, a constant offset between the internal GPS and GLONASS receiver clocks is assumed in the data processing. When analyzing the data in more detail a number of indicators have been found that this might not be sufficient. However, is seems to be overshooting to introduce fully independent receiver clock parameters for each GNSS — an approach that dramatically reduces the benefit from the combined processing of observations from different GNSS with respect to analyzing the measurements of only one GNSS.

In particular real–time and near–real–time applications do typically highly benefit from the bigger number of satellites in a multi–GNSS scenario. In this context the results from our study on the behavior of the inter–system bias for different receiver types is highly relevant — in particular as the results are derived from the GLONASS extension of the CODE reprocessing to increase the basis of receiver types.