The CODE consortium

Four institutions compose the CODE consortium: the Astronomische Institute der Universität Bern (AIUB), Switzerland; swisstopo: the Federal Office of Topography of Switzerland; the German Federal Agency for Cartography and Geodesy (BKG) and the Institut für Astronomische und Physikalische Geodäsie (IAPG), Munich, Germany.

Rigorously combined processing of GPS and GLONASS observations has been performed since mid of 2003 as an essential step towards multiconstellation analysis (see Figures 1 and 2). Two consistent solution series, a clean one-day (COF) and a three-day long-arc (COD) solution, are generated in parallel.

Regular contribution to IGS-MGEX since 2012 with a five-system solution: GPS + GLONASS + Galileo + BeiDou + QZSS (see presentation of Prange et al. in plenary session 01).

Continuous parameterization, particularly for Earth orientation parameters (EOP, Figure 3), troposphere zenith path delays (ZPD) and horizontal gradients, as well as for ionosphere parameters (Figure 4), allows the connection of the parameters at day boundaries. Completeness of GNSS orbit products with respect to all transmitting GPS and GLONASS satellites without exception with reliable accuracy code information. Generation of uninterrupted orbit information for the satellites being repositioned (Figure 5). Corresponding events are identified with a maneuver flag in the RINEX orbit files. An orbit initialization procedure is implemented for easy inclusion of brand new GNSS satellites, even if they do not provide broadcast navigation messages.

Atmospheric verification of IGSS14 fiducial sites for consistent datum definition in the final, rapid, and ultra-rapid analysis chains.

Comprehensive CODE analysis summaries with extended orbit validation information and datum verification results. Independent GNSS orbit validation on the basis of SLR data including MGEX (see poster of Graslhal et al. in session “PS06: Orbit Modelling”). GNSS ambiguity resolution: ambiguities are resolved for GPS and GLONASS observations with a self-calibrating procedure for handling of GLONASS-DOPD ambiguities. Monitoring parameters are set up in the final solutions for internal use:

- Satellite-specific antenna offsets and patterns.
- GLONASS GPS bias parameters with respect to station coordinates and troposphere ZPD and (from day 185/2016) gradients.
- Scaling factors for higher-order ionosphere (HOI) and non-tidal atmospheric pressure loading (APL) corrections.
- Geocenter coordinates (GCC).
- Plane-specific ERP and satellite-specific GCC.

Note: These parameters are contained in the daily NEQs that are archived. For efficiency reasons the monitoring parameters are stacked or removed from the NEQs before generating the final solution.

Observeable-specific code bias estimation for all GNSS signals (see Figure 6) based on the combination of clock and ionosphere analysis results. GLONASS frequency numbers are verified on a regular basis.

SINEX result files are generated in all processing lines: final, rapid and even ultra-rapid.

Fully automated GNSS data processing with the latest development version of the Bernese GNSS Software (Dach et al., 2015). The processing is embedded in a hierarchy of Perl modules. This includes instant alerting in case of processing and technical failures, general data flow problems, changes in the GNSS constellation.

For more details on recent developments at the CODE AC are available in the IGS Technical Report 2016.

Reprocessing activities at CODE

Repro15 - GNSS orbits and clock corrections in IG08/IG08.atx reference frame. Orbits for GPS (since 1994) and GLONASS (since 2002), 3D satellite clock corrections in IG08/IG08.atx reference frame. Orbits for GLONASS-DOPD ambiguity parameters were collected for long-term code bias combination and subsequent realignment of the daily code bias estimates. A consistent time series of IGMS with a 1-hour resolution is an important output of this extra reprocessing effort.

Most important new developments and model changes

- A refined GNSS bias handling (see presentation by Schauer et al. in plenary session 003) to cope with all available GNSS systems and signals has been implemented and activated (in May 2016) in all IGS analysis lines. Bias of CODE orbit and ionosphere analyses are combined at NEQ level. Coherent long-term code bias solutions are also computed and provided in Bias-SINEX V1.00.
- On day 206/2016 satellite attitude modelling according to Kouba (2009) for GPS and Dilssner et al. (2011) for GLONASS satellites was activated. The use of the aforementioned models improves quality of the CODE products for eclipsing satellites.
- In agreement with IGSNMAIL-7299, the CODE routine processing was switched from IG08 to IG14 reference frame together with the respective phase center corrections and station post-seismic deformation (PSD) models on day 030/2017. The switch was combined with addition of new mainly multi-GNSS stations to the CODE processing network.

- GPS and GLONASS final clock corrections starting from day 030/2017 (now based on newly designed SLR Quick-Look validation for ILRS extended (fr GR) to GREJ2 satellite constellations.
- Preference is now given to RINEX3 data.

- The CODE IGS-MGEX processing is now part of the routine analysis.

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Reference coding products

The products from CODE (ultra-rapid, rapid, final, MGEX and Repro15 series) are referable as:


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