Activities at the CODE Analysis Center

International GNSS Service
Workshop 2012
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THE CODE CONSORTIUM

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BASICS

Since mid-2003, CODE's products for the IGS have been generated from a rigorous combination of GPS and GLONASS observations (Fig.2 and 3). In this way, best possible consistency of the orbit products is guaranteed. This may be considered as an essential step towards the analysis of multi navigation satellite constellations, specifically in view of the upcoming European Galileo system.

HIGHLIGHTS

Continuous parameterization, particularly for Earth orientation parameters (EOP, Fig.3), troposphere zenith path delays (ZPD) and horizontal gradients, as well as for ionosphere parameters (Fig.4), allows the connection of the parameters at day boundaries.

Completion of GNSS orbit products with respect to all transmitting GPS+GLONASS satellites without exception. Reliable accuracy code information is provided.

Generation of uninterrupted orbits for the satellites being repositioned (Fig.5). Corresponding events are identified with a maneuver flag in the SP3c orbit files. Orbit initialization procedure is implemented for easy inclusion of brand new GNSS satellites, even if they do not provide broadcast navigation messages.

Automatic verification of IGS08 fiducial sites for consistent datum definition.

Comprehensive CODE analysis summaries with extended orbit validation information.

Fully automated GNSS data processing with the latest development version of the Bernese GNSS Software including BPE (Bernese Processing Engine). The processing is embedded in a system of Perl modules. This includes instant alerting in case of BPE processing and technical failures, general data flow problems, changes in the GNSS satellites or tracking stations constellations.

External GNSS orbit validation on the basis of SLR data.

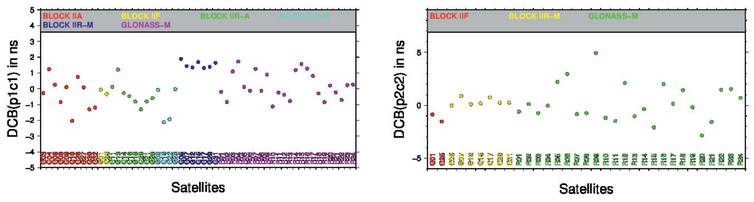
Refinement of the **GLONASS ambiguity resolution** strategy.

Introduction of a **GLONASS-GPS bias parameters** with respect to station coordinates and troposphere ZPD.

Direct DCB estimation and reprocessing of the old data to update the historic files.

Phase pre-processing for shortest and short baselines: The test criteria for checking the geometry-free LC is a function of the baseline length. This ensures that the original L1 and L2 observations are clean for shortest baselines (less than 20km).

P2-C2 code bias retrieval on an operational basis: Corresponding results are produced for satellites and receivers for each GNSS (GPS and GLONASS). A corresponding DCB GNSS product is also generated for P1-C1 differences.



Poster compiled by S.Lutz, July 2012
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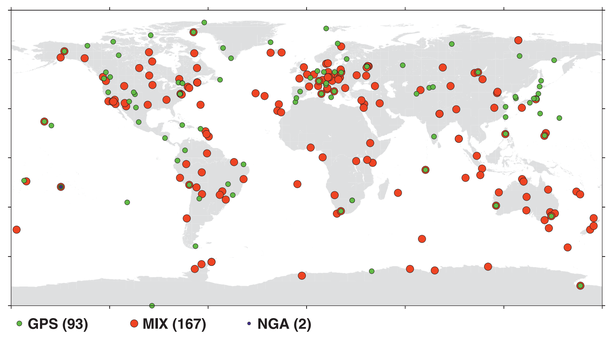

Fig.1: Tracking network as considered in CODE's final GNSS analysis for GPS week 1691.

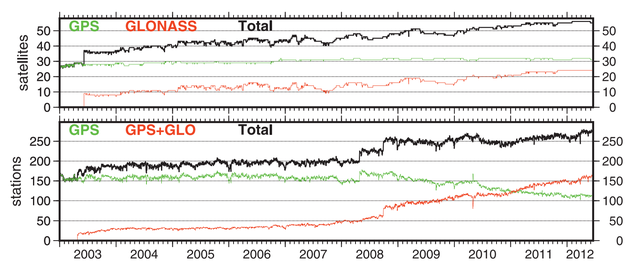

Fig.2: Number of GNSS satellites and tracking stations since 2003 as considered in CODE's analysis. With a total of 56 operational GPS+GLONASS satellites two full constellations were reached on 02-Feb-2012 (IGSMail 6538).

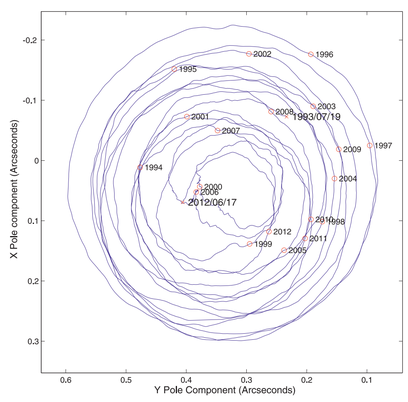

Fig.3: Polar motion from 19-Jul-1993 to 17-Jun-2012 as monitored by CODE.

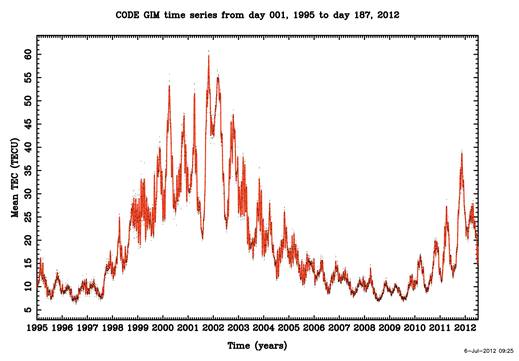

Fig.4: Global mean TEC extracted from the Global Ionosphere Maps produced by CODE covering more than one solar cycle. The red curve shows the interpolated mean TEC based on a least-squares collocation. The daily averaged mean TEC values, namely the zero-degree coefficients of the spherical harmonic expansion used to represent the global TEC, are indicated by black dots.

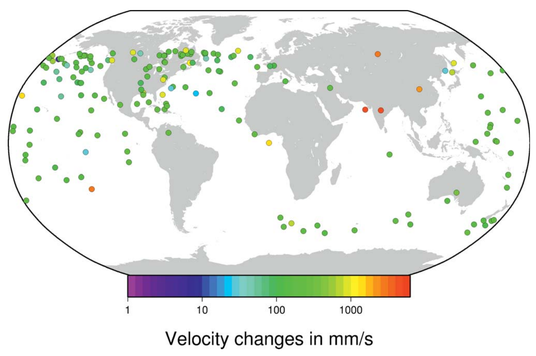

Fig.5: Geographical locations (subprints) of repositioning events of GPS satellites since 2004 determined by CODE.

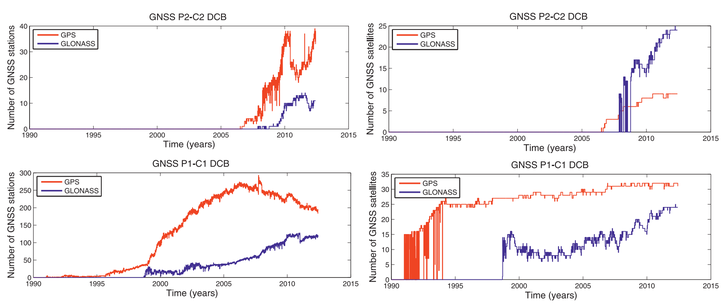

Fig.6: Time evolution of contributing number of GPS and GLONASS satellites (top) and corresponding receiver components (bottom), for P1-C1 (left) and P2-C2 (right) GNSS DCB reprocessing, carried out at CODE on the basis of 1990 to 2011 RINEX data.

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MOST IMPORTANT NEW DEVELOPMENTS AND MODEL CHANGES

GPS week 1591

- Upload of predicted IONEX to CDDIS; complete time series as of day 001 of year 2008

GPS week 1602

- Do not resolve ambiguities between block IIR-M and other satellites for LEICA and NOV receivers (due to L2C quarter-cyle issue).
- AMBVER sequence activated for IGS final analysis in order to cope with quarter-cycle issue.
- Consideration of higher-order ionosphere (HOI) correction terms for second and third order effects as well as ray path bending using the CODE GNSS ionosphere maps. Dedicated scaling parameters allow a variety of HOI-related operations on NEQ level.

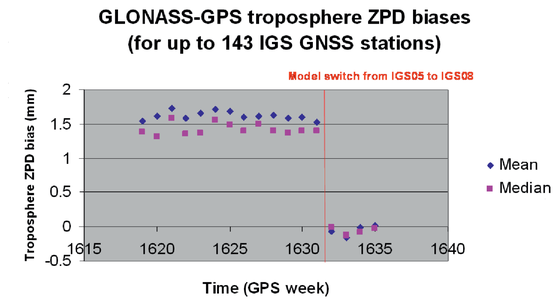
GPS week 1604

- Use of VMF1 instead of GMF as troposphere mapping model. The ECMWF based hydrostatic part of the troposphere delay is mapped using dry-VMF1 coefficients, the wet part is estimated using wet-VMF1 coefficients. The VMF1 information is interpolated on the basis of 6-hourly global grids. (See also IGS Mail 6287.)

GPS week 1619/1625

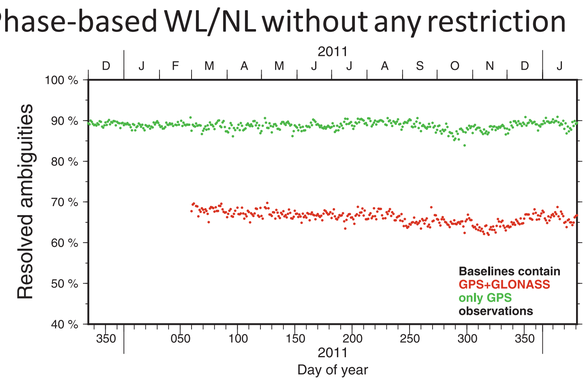
- Starting with this week an extra set of 3+1 parameters is set up for each GPS+GLONASS observing station to characterize
  GLONASS-GPS receiver antenna offset vector and
  GLONASS-GPS ZPD troposphere bias.

  These GLONASS-GPS bias parameters are kept in the NEQ results for later retrieval.



GPS week 1625

- *Self-calibrating* GLONASS ambiguity resolution enabled:
  Direct L1/L2 without any restriction
  QIF restricted to same frequency channels
  Phase-based WL/NL without any restriction



GPS week 1632

- Switch from IGS05 to IGS08

IGS08 REPROCESSING

The release of the IGS08 reference frame and the corresponding antenna phase center corrections for the receivers and satellites led to a new reprocessing of the data since January 1996 following the latest IERS 2010 conventions. The processing until May 2003 started from RINEX, until end of 2008 an existing set of pre-processed GPS/GLONASS observation files was used. Starting with 2009 the screened observation files from the operational CODE processing were taken. The new GLONASS ambiguity resolution scheme was applied.

The results are available at ftp://ftp.unibe.ch/aiub/REPRO_2011.

There are plans to extend the list of reprocessing products by clock corrections (starting with 2008 also for GLONASS).