Activities at the CODE Analysis Center

IGS Workshop
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University of Berne

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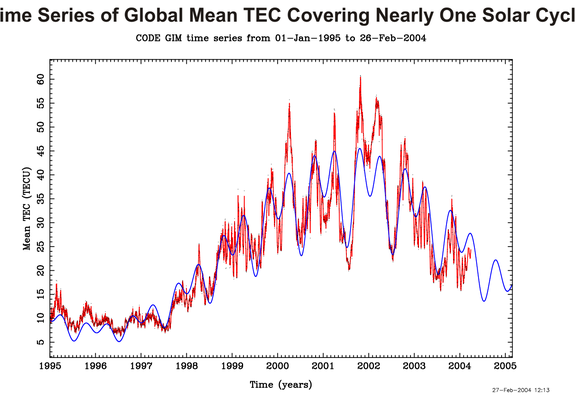
Overview, New Developments, and Highlights

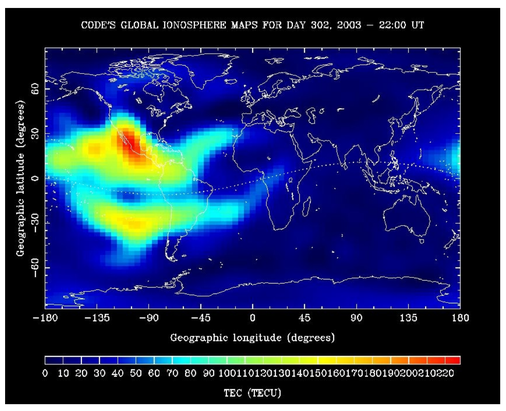
A number of important developments were made at the CODE analysis center of the IGS in the course of the last year:

- Since the beginning of May 2003, CODE has been computing a rapid orbit product for both the GPS and the GLONASS satellite constellation. GPS and GLONASS orbits are generated at the same time in a rigorous GNSS analysis. This may be considered as essential step towards the analysis of multi navigation satellite systems, specifically in view of the upcoming European GALILEO system.
- Rapid as well as final ionosphere analysis in GNSS mode starting with April 27, 2003 (GPS week 1216). Retrieval of GLONASS group delay (GD), or P1-P2 DCB values established. Ambiguity-fixed GPS P1-C1 bias values are computed.
- Detailed monitoring concerning completeness and availability of IGS/IGLOS GNSS tracking data, with a main focus on combined GPS/GLONASS data. Corresponding charts are regularly posted to `http://www.aiub.unibe.ch/download/igsdata/`. A significant number of e-mails sent to achieve improvement in terms of both completeness and availability of GNSS data.
- Final analysis extended to GNSS on June 8, 2003 (GPS week 1222) for all products, apart from the clock product. Automatic verification of IGS00 fiducial sites for consistent datum definition.
- Production of ultra-rapid orbits commenced officially on July 30, 2003, now considering IGS/IGLOS NRT tracking data. This product also includes orbits for the GLONASS satellites. It is complete with respect to all transmitting GNSS satellites and has been available without exception since the beginning. Reliable accuracy code information is provided.
- Uninterrupted orbit generation for GPS satellites being repositioned. Corresponding events are identified with a maneuver flag in the SP3c orbit files.
- Orbit initialization procedure implemented for easy inclusion of brand new GNSS satellites, which do not provide broadcast navigation messages.
- External GNSS orbit validation on the basis of SLR data.
- Regular estimation of GNSS satellite antenna phase center patterns for GPS-II, GPS-IIA, GPS-IIR, GLONASS and GLONASS-M satellite types starting with GPS week 1254. Corresponding patterns are not only available for the ionosphere-free linear combination but also for the geometry-free (L1-L2) linear combination.
- Continuous parameterization, particularly for EOP, troposphere ZPD and horizontal gradient parameters, ionosphere parameters, allowing for connection of the parameters at day boundaries.
- Generation of final as well as rapid high-rate (30-sec) clock products.
- Use of new, powerful BPE (Bernese Processing Engine) V5.0 for automated and efficient GNSS data processing.
- Implementation of alerting via e-mail, computer terminal, and SMS messages in case of BPE processing failures, computer, or disk problems, ftp connection problems, general IGS/IGLOS data flow problems, GNSS satellite constellation changes, IGS/IGLOS tracking stations becoming active or inactive (concerning both hourly and daily data flow).

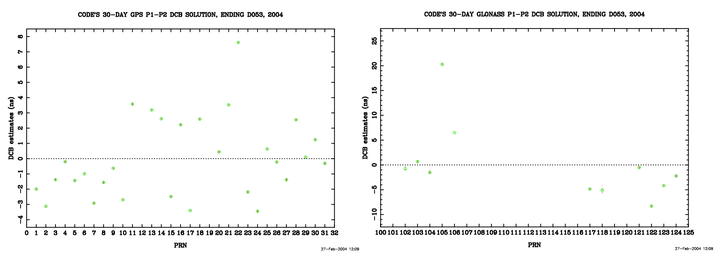
Time Series of Global Mean TEC Covering Nearly One Solar Cycle



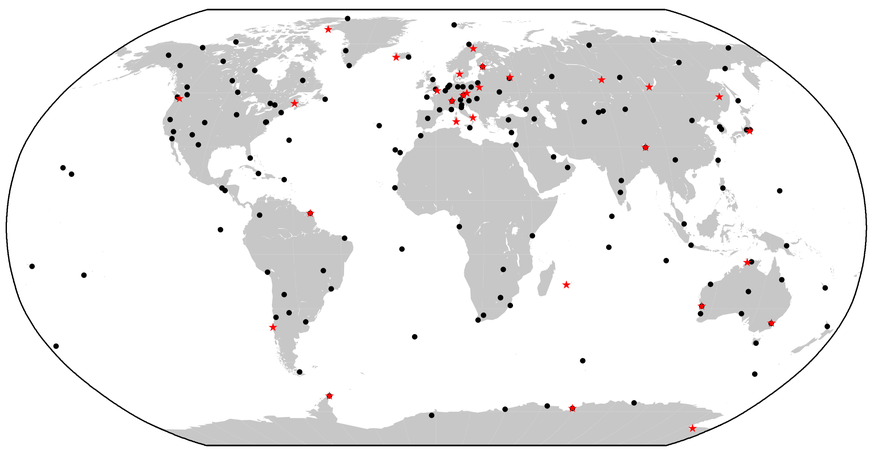
Exceptionally High TEC Levels due to X17.2 Solar Flare (CME)



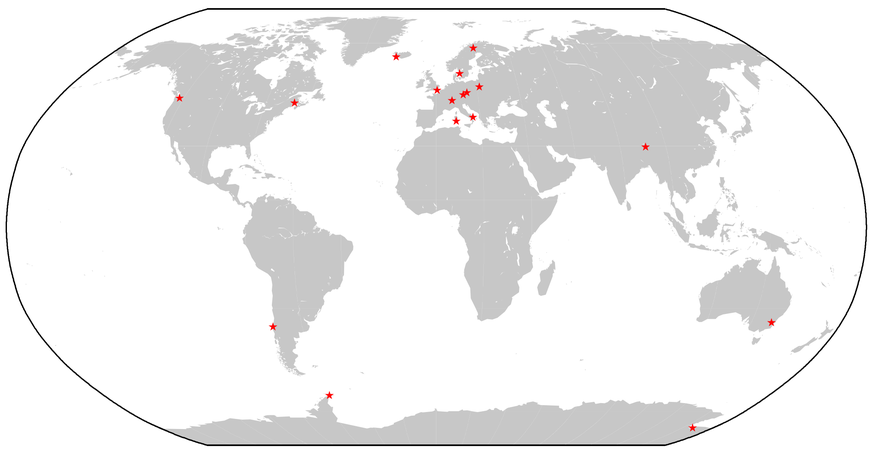
Group Delay (GD) Values Computed for Both GPS and GLONASS



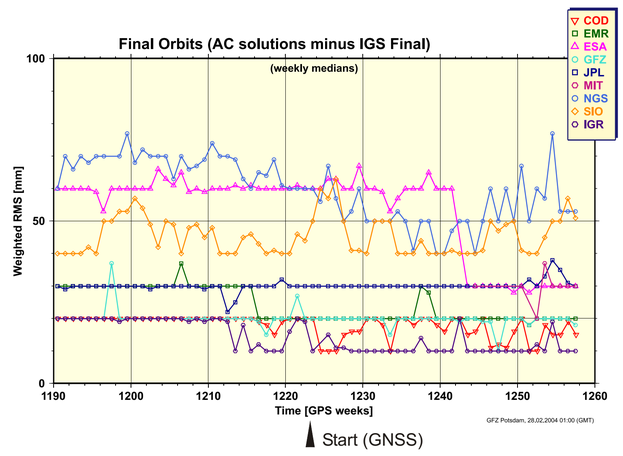
IGS/IGLOS Tracking Network as Considered in CODE's Final GNSS Analysis



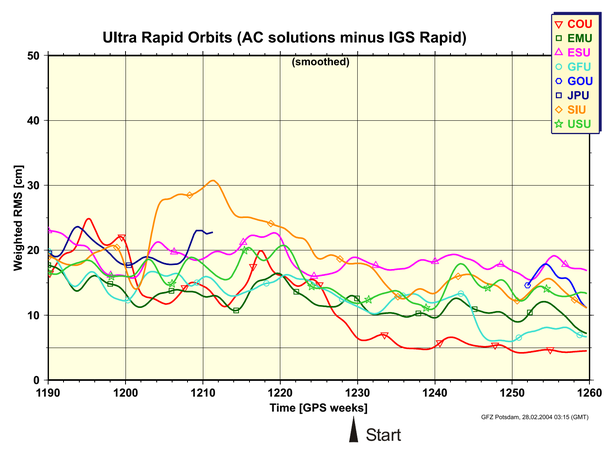
IGLOS Tracking Network as Considered in CODE's NRT GNSS Analysis



Final Orbits (AC solutions minus IGS Final)

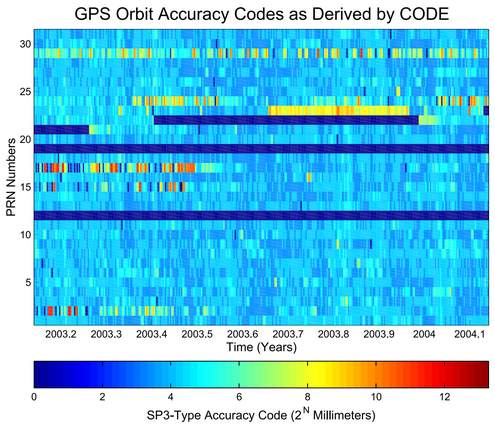


Ultra Rapid Orbits (AC solutions minus IGS Rapid)

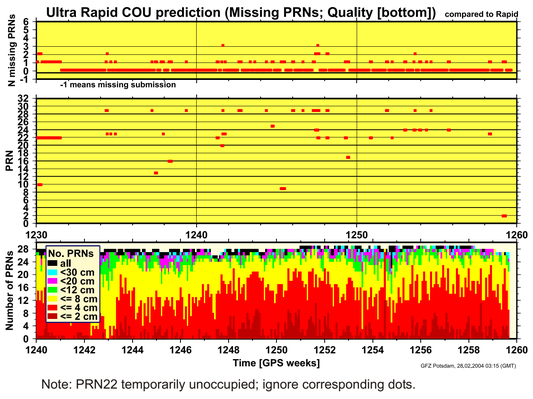


Identification of Misbehaving GPS Satellites

GPS Orbit Accuracy Codes as Derived by CODE

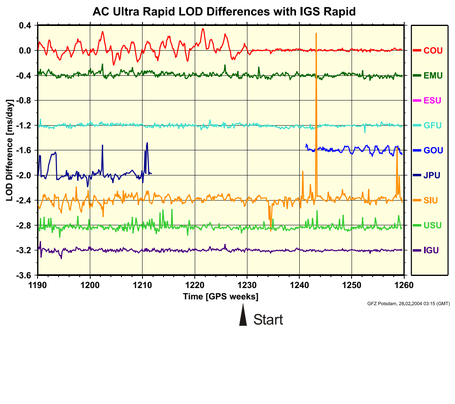


100% Availability of CODE Ultra-Rapid GNSS Orbits



Note: PRN22 temporarily unoccupied; ignore corresponding dots.

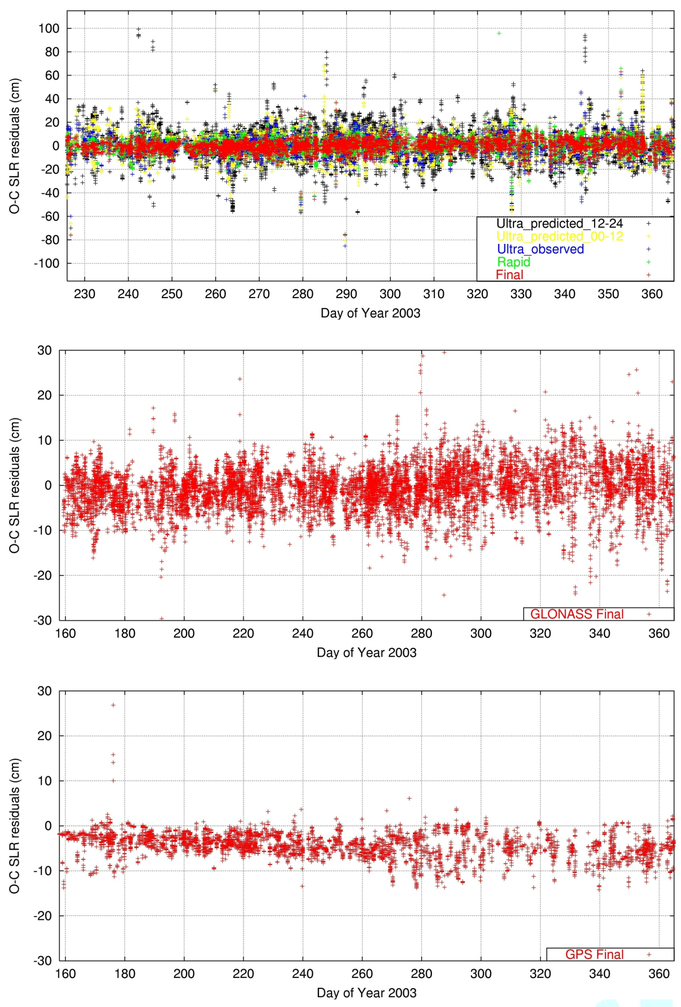
AC Ultra Rapid LOD Differences with IGS Rapid



IGS AC graphics by courtesy of G. Gendt, GFZ, Potsdam, Germany

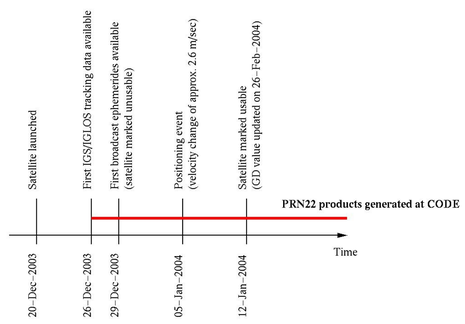
GNSS Orbit Validation Using SLR Data

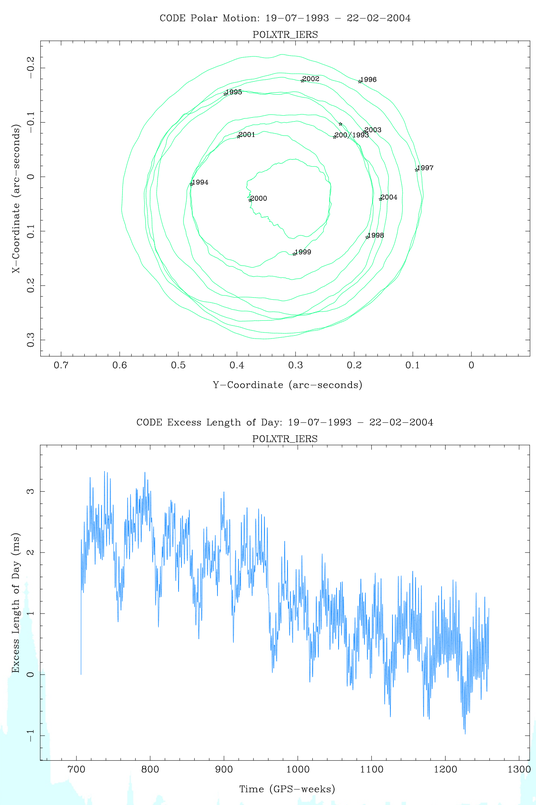
Independent orbit validation is performed based on the difference between observed ranges (SLR measurements) and computed ranges (relying on orbital information derived from microwave data). The top figure shows O-C range residuals for the GLONASS satellites R03, R22, and R24 using CODE orbit products (Final, Rapid, Ultra-Rapid) and SLR data from about 25 globally distributed tracking sites. Residuals do not indicate a systematic offset. Because we considered a new, corrected reflector offset value of 1542 mm, instead of 1510 mm, the commonly known mean bias of -5 cm could no longer be confirmed. The two following figures show the range residuals separately for GLONASS and GPS CODE Final orbits, specifically for the three GLONASS satellites and the two GPS satellites, G05 and G06.



System	Orbit solution	RMS (cm)	STD (cm)	Mean (cm)	#NP	Doy of 2003
GLONASS	CODE Final	4.87	4.87	-0.18	4722	226-365
GLONASS	CODE Rapid	5.64	5.64	0.28	4723	226-365
GLONASS	CODE Ultra, observed	6.90	6.90	0.24	4563	226-365
GLONASS	CODE Ultra, predicted, 00-12	9.32	9.31	0.62	4528	226-365
GLONASS	CODE Ultra, predicted, 12-24	13.48	13.41	1.37	4506	226-365
GLONASS	CODE Final	4.61	4.58	-0.54	7033	158-365
GPS	CODE Final	4.92	3.18	-3.76	2768	158-365
GPS	IGS Final	3.87	2.85	-2.61	2768	158-365

Chronology of the Most Recent GPS Block-IIR Satellite Launch (PRN22)





Poster compiled by M. Meindl and S. Schaer, February 2004
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