IGS 2010 Workshop

Newcastle upon Tyne
June 28-July 1

Summary Recommendations

Session Recommendations

1. Combining GNSS Signals - Van der Marel
2. Issues in Network Infrastructure - Bruyninx & Romero
3. Real Ttime analysis products - L Agrotis, K MacLeod, G Weber
4. Reprocessing Round 1 - R Ferland and G Gendt
5. SV modeling (orbit and attitude) - M Ziebart
6. Loading and tides: models and products - N Penna
7. Troposphere: models and products - Y Bar-Sever
8. Ionosphere: models and products - A Krankowski and M Hernandez-Pajares

Splinter Session Recommendations

9. Data Center WG - C Noll
10. LEO and Smart Receiver – H Boomkamp
11. Antenna WG – R Schmid
12. Analysis Center Splinter Session – Agenda and Issues from IGS-AC email

IGS Workshop 2010
Newcastle upon Tyne
Session Summary and Recommendations

Session Title/Date**: COMBINING GNSS SIGNALS (All bias and Calibration issues)**

Chair (& Co-Chair): **Hans van der Marel**

Rapporteur: Tim Springer

Key Issues, Session Highlights:
Please briefly summarize key issues or reports, ~ one paragraph each.

Due to new GNSS systems and new GNSS signals an increasing number of types of biases are expected. At present, only P1-C1, P2-C2, and P1-P2 differential code biases (DCB) for GPS and Glonass are considered. However, the increase in number of possible signals (from 4 to 11) and the resulting complexity of the biases is bewildering, in particular if also carrier phases biases and code carrier biases need to be considered. Also it may be necessary to change to an absolute delay scale rather than use a zero mean datum. Another important question is should we change from referencing to P1&P2 observations (considering the new GPS policy on civil use, upcoming L5 signals, and L2 not being available on Galileo)? For instance, the IGS clock is now a iono-free l.c. based on L1-P1/L2-P2 data. Do we have to maintain a "second" clock with L5, or differences with the main clock? Do we have to give this every epoch, or can we model with a bias, of low order polynomial? Or give it as a wide-lane L2-L1 bias?

Stefan Schaer showed that when combining GNSS (currently GPS and GLONASS), careful consideration of intersystem biases is a must, in particular when an adequate combination of individual GLONASS clock correction results is intended. The successful combination of GPS and GLONASS also showed the way to go for other systems. For the calibration of code biases Stefan Schaer proposed a change from DCB (Differential Code Biases) to CB (Code Biases). Also he proposed that the quarter-cycle biases between different phase observables (specifically L2P and L2C) should be solved by the receiver manufacturers in a similar way as was done for L1-P and L1-CA. During the discussion it was proposed to organize a special workshop to deal with these matters.

Flavien Mercier addressed the issue of code – carrier biases and the use of – so-called – carrier phase clocks to facilitate ambiguity resolution for PPP. The CNES group uses a special method to solve the raw carrier phase clocks (which have rank-defects and modulo narrow lane wavelength biases) that preserves the integer nature of the underlying single difference ambiguities. This makes it possible, in combination with estimates for the wide-lane biases, to do ambiguity resolution for PPP. This procedure could also result in a reduction of the clock discrepancies at the day boundaries, whereas, variations in the observed ionosphere free phase biases for different AC solutions could reach the narrowlane wavelength.

Oliver Montenbruck presented the Cooperative Network for GIOVE Observations (CONGO) . CONGO is a global network of GIOVE capable GNSS receivers established jointly by DLR , TUM

and BKG. Other than in ESA's network of GIOVE Experimental Sensor Stations, the CONGO network employs a variety of different antennas and receivers that have become available for public use over the last two years. The presentation showed the GPS/GIOVE tracking performance, characterization of antenna gain patterns, receiver noise and multipath errors, as well as the presence of intersystem biases (described as a Pandora's Box).

Mathias Becker presented the antenna calibrations done in the anechoic chamber in Bonn. Unlike robot calibrations, anechoic chamber calibrations can be used to calibrate all possible frequencies, including L5, E5a/b, E6 and Glonass). Comparisons with robot calibrations for the GPS frequencies did show that there are no significant differences between the two methods. This facility provides IGS with the opportunity to calibrate GNSS antenna that are capable of the new frequencies before they are installed on new or existing stations, before the actual signals are available from space.

Other issues that were briefly mentioned, but not addressed in detail during the sessions, were should we consider separate PCO/PCVs for code and phase, effect of satellite PCV (L2-L1) on ionosphere determination, satellite antenna calibrations on the ground prior to launch, resolution of problem with different quarter-cycle phase offsets by receivers.

Recommendations :
Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.

Modernized GNSS Signals Demonstration Project
In order to prepare for upcoming new signals and systems it is essential that IGS gathers experience with tracking the new signals and systems, new receiver and antenna types, inter system biases, and analysis of the new signals. In order to facilitate these studies we propose to set up a network of GNSS receivers capable of tracking the new signals and systems, including experimental satellites, as soon as possible. The specific goals of the pilot are

- To set up an experimental tracking network for GPS, Galileo (GIOVE/IOV), Compass and QZSS to track as many signals as possible using available receiver and antenna technology,
- To provide orbit and clock data for the new satellites,
- Use the data for studies in tracking performance, biases and analysis of the impact on contemporary IGS products,
- Involve receiver manufactures and set up a test bed for various receiver and antenna types as a prototype receiver validation facility

The demonstration project should be started as soon as possible by issuing a **call for participation** (this autumn). The official kick off of the demonstration project could coincide with the **GNSS Signals and Biases workshop** in 2011. The feasibility of this activity has already been clearly demonstrated by the CONGO network which was set up by DLR, BKG and TUM. The demonstration project or activity will have to collaborate closely with the CONGO network and participate in the Asia-Pacific Multi GNSS demonstration campaign. If the recommendation is approved by the IGS CB the organization could be handed over to the GNSS working group.

GNSS Signals and Biases Workshop
Considering the increasing number of GNSS systems and signals and the increasing number of types and complexity of biases, a dedicated workshop on these issues, with IGS representatives,

external experts and receiver manufacturers, should be organized. The workshop should result in clear recommendations on:

- Set of required observations to be tracked as a bare minimum by new multi GNSS IGS sites, and to set a guideline for receiver manufacturers for IGS qualified receivers.
- Strategy for handling code and carrier phase biases, intersystem biases and reference observation type changes (P1/P2 currently) within the IGS analysis.
- Necessary modifications to existing formats

The workshop will be linked to the proposed **Modernized GNSS Signals Demonstration project**. The proposed date for the workshop is 2011 and could possibly coincide with the kick-off of the Modernized GNSS Signals Pilot project. The symposium will be convened by the **bias working group** and **Modernized GNSS Signals Demonstration project.**

Code-carrier phase biases and phase clocks

In order to facilitate ambiguity resolution for PPP and to investigate the possible improvements of a clock product that does respect the integer nature of the underlying single difference ambiguities, as shown by the CNES group and several others, we propose that a **subset of the IGS analysis centers** carry out a test for a two month period, and compare the results from different analysis. In particular suitability of possible new or improved clock products for ambiguity resolution with PPP and the effect on day boundary jumps should be investigated. Special attention should be given to code carrier phase and wide-lane biases. If this recommendation is approved **CNES** is prepared to take the lead of this action.

Antenna calibrations for the new frequencies

Considering the availability of facilities for calibrating GNSS antenna for the new frequencies, such as the anechoic chamber in Bonn, we recommend that **station operators** install GNSS antenna that are capable of tracking the new signals (in particular L5) whenever a new site is set up or existing antenna is replaced, and that **station operators** ensure that this antenna has been calibrated for the full frequency range of GNSS signals.

Also we recommend that more research is done by **antenna specialists** and **manufacturers** on antenna calibrations, in particular for the new signals and frequencies, code versus carrier phase delay patterns, antenna attenuation patterns for different polarizations, effects of RF absorbing material on multipath reduction and antenna PCO and PCV variations, and that clear recommendations should be given to station operators.

The lead of this action, if approved, should be taken by the **antenna working group**.

IGS Workshop 2010
Newcastle upon Tyne
Session Summary and Recommendations (Revised Nov 2010)

Session Title/Date**: IGS INFRASTRUCTURE**

Chair (& Co-Chair): **C. Bruyninx & I. Romero**

Rapporteur**: I. Romero**

Recommendations on Network Infrastructure

Recommendation 1
The IGS should send out a clear statement to GNSS receiver vendors on requiring phase offset normalization.
Responsibilities and deadlines:
IC: Preparation of statement by IC (end July 2010)
UNAVCO: Provision of vendors email list (end July 2010)
EC: Distribution of IGS statement by email (start of August 2010)

Recommendation 2
The IC should ensure parallel GNSS data from IGS sites performing an equipment upgrade following the station upgrade guidelines is available to researchers together with all the relevant metadata, change logs, etc.
The IC shall ensure the IGS has the procedures and mechanisms to compile and hold the results and procedures used by different researchers processing the parallel data so that it is available to all IGS stakeholders.

Responsibilities and deadlines:
IC+DCWG+IGSCB: Agree on parallel data locations over station upgrades (end of Dec. 2010)
IC+IGSCB: Develop data storage procedures over station upgrade periods (end of Feb. 2011)

Recommendation 3
The IGS tracking network should keep pace with evolving RF needs and GNSS signals in order to continue providing the highest quality products. For that purpose it is recommended to set up the roadmap towards the next generation IGS tracking network.

Responsibilities and deadlines:
IC & UNAVCO: First draft of specifications of next generation IGS station and the implementation roadmap (end of 2010)
IC: Iteration of first draft site specifications and roadmap amongst IC and external experts, (end of Feb. 2011)
IGS GB: Discussion/feedback on specifications & roadmap, (end of Mar. 2011)

Recommendation 4
Considering the increasing number of global and regional GNSS stations and the increasing potential for naming conflicts, the IC shall investigate together with others (SOPAC, IGN, etc) the

issue of unique GNSS station identification (4 char ID codes, etc) and propose a possible way forward for the IGS.

Responsibilities and deadlines:
IC: Study and document the current GNSS station ID process (Jan. 2011)
IC: Develop recommendations with broad support (SOPAC, IGN, etc) (May 2011)

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date: REALTIME INFRASTRUCTURE, ANALYSIS AND APPLICATIONS

Chair (& Co-Chair): **L. Agrotis, K. MacLeod, G. Weber**

Rapporteur**: L. Agrotis**

Summary and Session Highlights:
The presentation session had a strong focus on uses and applications of the Real Time data and products with presentations on how to use the RT infrastructure (Weber), disaster monitoring (Blewitt, Ramatchi, Colombo), weather monitoring (Marquardt), multi-GNSS (Hauschild, Tegedor) and PPP processing (Takasu, Geng). The description of analysis techniques was dealt with in several poster presentations.

The splinters were structured so that the first splinter was focused on the users, the second splinter on RTPP AC issues and how to meet user requirements and the third (held jointly with the IC) on data formats and protocols.

The first splinter concluded that:
1. User requirements are in tune with current performances
   0.1 ns sigma, 4-5 cm orbit 1-D RMS, latencies of 10-30 sec, update rate of 10 sec
2. Reliability/availability are the more important concerns
3. There is a need to improve the communication between infrastructure groups (e.g. the tropo group were not aware of the RTPP activities)

The second splinter was split into two parts. The first part was held jointly with the AC meeting and concluded with the following recommendations:
1. Identify and resolve issues with orbit predictions in the ultras
2. RT combination could include detection of inconsistent orbits and suppress the relevant s/c
3. Agreed to endeavour to prioritise AC processing of RT stations

The second part of the RTPP AC splinter addressed RTPP AC issues.
1. Product Enhancements
   a. All ACs to reduce latency to < 10 s
   b. Ambiguity fixing support
      i. Reduce PPP convergence time / increase accuracies
      ii. Working group to define requirements for PP (M. Ge)
2. Improvements to reliability and availability
   a. Develop/implement policy, including:
      i. Redundant station streams
      ii. Multiple broadcasters
      iii. Diversely located redundant combination centres
      iv. Monitoring and alarms

The IC/RT splinter agreed to continue work with the RTCM to reach agreement on the RTCM-HP messages and to convey to the RTCM the IGS requirement for phase alignment on all signals.

The main workshop recommendations are listed below and were collected during the discussions at the various splinters.

Recommendations:

Focus on User Requirements and in particular on:

Recommendation 1. Roadmap and schedule to transition to full IGS product line

What needs to be done:

1. Robust data distribution
    a. Commitment from operators
    b. Critical stations sending data to two casters
2. Combination to be performed in several places
3. Alarms and internal checks
4. Disclaimer on usage (best efforts)
5. Approval of RTCM formats
6. To be incorporated in the RTPP
    a. Possible Schedule 1.5-2 years

Recommendation 2. Work towards GLONASS and Galileo processing

1. GLONASS processing possible now
    a. Some GLONASS streams available
        i. More stations needed
    b. Needs development of AC infrastructure
        i. BKG/TUP already available
        ii. Others have plans for imminent development
    c. GLONASS in ultras will help
2. Galileo
    a. Lack of stations/data is main issue
    b. Regarded as a longer-term objective

Recommendation 3. Promote development and use of freely available positioning software and standards

1. Continue to work through RTCM
    a. Close to reaching agreement on SSR and RTCM HP
2. Promote Positioning Software
    a. Ambiguity fixing support
        i. Reduce PPP convergence time / increase accuracies
        ii. Working group to define requirements for PP (M. Ge)
    b. Software Packages
        i. RTKLIB, BNC, NRCAN

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date: **REPROCESSING 1**

Chair (& Co-Chair): **R. Ferland & G. Gendt**

- All ACs should contribute the entire time
- All parameter types should be contributed
- All parameters should be unconstrained or un-constrainable with the information provided in the solution

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date: **SV ORBIT MODELLING (ORBIT AND ATTITUDE)**

Chair (& Co-Chair): **M. Ziebart**

Summary

•Outstanding problems remain in GNSS precise orbit determination and prediction
•Several promising approaches are in the pipeline to attack problems
•Earth radiation pressure and antenna thrust modeling reduce SLR residuals from 4 cm to 2 cm, and has a positive impact on the terrestrial reference frame
•GLONASS spacecraft show previously unknown deterministic attitude behavior in eclipse
•Initial analysis of the GIOVE-B space hydrogen maser shows great promise for future POD analysis

Recommendations

All analysis centers should implement earth radiation pressure and antenna thrust modeling in orbit determination and prediction

All analysis centers should implement the Dilssner et al. GLONASS attitude model

A working group will be formed to progress IGS research in SV orbit dynamics and attitude to: (a) develop better physical models of solar and thermal radiation forcing effects; (b) expand our understanding and modeling of earth radiation effects; (c) revisit the role of empirical and stochastic models to capture effects we do not understand; (d) develop a dialogue with spacecraft manufacturers and (e) provide a repository of models and documentation for the community

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date**: LOADING AND TIDES: MODELS AND PRODUCTS**

Chair (& Co-Chair): **N. Penna**

Key Issues, Session Highlights:

Session included five talks on different aspects of loading and tides, which helped to cover the status of current models used in IGS analyses and some effects not currently modeled, with a view to indicating whether modeling should or can start.

Atmospheric pressure loading (van Dam et al)
S1/S2 issues were discussed, such as how representing the signals is problematic due to model deficiencies, data noise and 6 hour temporal resolution, although the Ponte and Ray (2002) tidal model has been shown to reduce the residuals in VLBI and SLR. Hence it is recommended that S1/S2 is also incorporated at the observation level in GPS analyses. Un-modeled topography effects were also highlighted, i.e. how the input surface pressure has a minimum grid size that does not always adequately capture high topographic variability within the cell and affects the modeled loading displacements. Height variations on a day-to-day basis can be around 2 mm in regions of high topographic variability but are elsewhere small. Annual height signals of around 2 mm amplitude can also occur from ignoring topography effects.

Ocean tide loading (Bos et al)
The typically used FES2004 model was shown to have some problems around Hudson Bay, based on comparisons with EOT08a, GOT00.2, GOT4.7 and TPXO7.2. M2 OTL height displacements can differ depending on the (recent) model used by around 0.2 mm inland but by around 3 mm in some coastal places. The recently implemented hardisp routine was shown to eliminate Nu2 and L2 tides at Newlyn in south-west England and also how it includes the 18.6 year tide (thus failing to model OTL can result in vertical rate errors of up to about 0.2 mm/yr for time series less than 9 years). Anomalous OTL values in south-west England have been observed – the most likely explanation is the influence of tidal dissipation due to loading in the upper mantle.

Non-tidal ocean loading (Williams and Penna)
GPS height measurements for sites close to the North Sea shown to be susceptible to non-tidal ocean loading (NTOL), with displacements comparable in size to those from atmospheric loading (ATML). For 1 year of data from 17 sites, together NTOL and ATML reduce the height variance by 15-30 mm^2 (reduction in RMS of 20-30% compared to ~15% for ATML only). The global ECCO model can provide a useful first order approach, but over predicts in North Sea region, and high resolution models such as POLSSM are required if the highest GPS height precisions are to be obtained. However, at present there is no readily available global model product.

Earth's dynamic oblateness observed by GPS (Lavallee et al)

GPS can be used to estimate precise measurements of non-secular J2 (Earth's oblateness) variations. The GPS J2 annual signal is in agreement with that from SLR but on the long term there are some intriguing differences, possibly related to the 18.6 year solid Earth tide model. Subtraction of a J2 load model (land, atmosphere & ocean mass) removes all significant GPS J2 semi-annual but residual annual remains along with a GPS specific periodic term of 1.24 years.

High frequency tidal EOP from space geodesy and ocean modeling (Gipson and Ray)
The three tidal models (IERS2003, TPX71, and GOT47) give very similar predictions for UT1. For PM the agreement is also very good, but the newer models differ from IERS2003. The empirical models based on VLBI and GPS also agree with each other, but differ from the tidal models. Including the effects of libration in UT1 and PM improves the agreement between the tidal models and the empirical models. The libration term in PM has been part of the standards since 2003, but was called by something else. The UT1 libration term was added in 2010.

Once libration is included, the agreement between all three tidal models and the two empirical models is about the same. It is difficult to use this comparison to choose the best tidal models. However, there is clear evidence that the TPX71 and GOT47 are better at ocean tides, so from this point of view they should be preferred. In any case, everyone should be using both PM and UT1 libration.

Recommendations :
Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.

To model S1/S2 atmospheric tides are modeled at the observation level, with the Ponte and Ray (2002) model suggested.

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date: **TROPOSPHERE**

Chair (& Co-Chair): **Y. Bar-Sever**

Highlights:

- Re-processed IGS trop products now offers 16 years of consistent, high quality ZTD records
- Weather modeling applications require data from dense regional networks (i.e., do not directly benefit operationally from the the IGS trop product). Rather, they require RT/NRT orbit and clock states
- A priori gradients may improve overall quality of estimated gradient (and other estimated parameters)
- ZTD is a high quality, mature product displaying ~6 mm accuracy on a global scale

Recommendations:

1. IGS should continue producing a high quality trop product as a reference for comparisons (external and internal) and for climatology.
2. There is no compelling reason to keep a formal trop Working Group
3. The production of the IGS Trop product could be:
    a. added to responsibilities of existing coordinators, or,
    b. performed by an "Associated AC", such a weather bureau, after a solicitation process

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date**: IONOSPHERE: MODELS AND PRODUCTS**

Chair (& Co-Chair): **A Krankowski and M Hernandez-Pajares**

Rapporteur: P. Wielgosz

Key Issues, Session Highlights:

This session has been a forum for discussing sources of systematic errors that limit the accuracy of GNSS-derived ionosphere models and product. Session topics included dealing with possible improvements of the IGS ionospheric products, methods to correct for higher-order ionospheric delays in GNSS, occultation measurements, inter-frequency bias calibrations, etc. The session has also included a summary of the activities of the IGS Ionosphere Working Group

Recommendations :
Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.

1. Higher temporal resolution of IGS GIMs - 1 hour – this is due to many signals from the community (responsible UWM, September/October 2010).
2. Starting a new official product - predicted IGS GIMs – 1 and 2 days ahead, combination of ESA, UPC and CODE maps carried out by UWM to be started as official/routine product after performance evaluation period (2011).
3. Cooperation with National Central University (Taiwan) on evaluating the application of COSMIC occultation data for additional IGS GIM validation (responsible UWM/UPC, 2011).

Splinter Session Summaries

IGS Workshop 2010
Newcastle upon Tyne
Session Summary and Recommendations

Session Title/Date: **DATA CENTER WORKING GROUP**

Chair (& Co-Chair): **C. Noll**

Rapporteur: Carey Noll

Key Issues, Session Highlights:
Please briefly summarize key issues or reports, ~ one paragraph each.

- Working group viability – Attendees believe there continues to be a requirement for the working group and recommend its continuation
- Membership – New members were added based on attendance
- Data center harmonization and data flow
    - GDCs have agreed to archive data from all IGS network sites
    - GDCs have agreed to accept push of data from ODCs/stations
        - Need to review data flow for all IGS sites
        - Need to contact ODCs/stations to implement
        - GDCs still need to do some coordination to ensure harmonization/equalization
- Compression
    - zip vs. bzip2
    - Coordinate through IC and develop implementation schedule

Recommendations :
Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.

- •GDC archive content and data flow: All GDCs archive data from all IGS stations as identified on the IGS network website; ODCs push data, and any subsequent resubmissions, from their stations to ALL GDCs and ODCs issues advisory for ALL resubmissions (Who: all DCs, By: 10/2010)
- •Compression: Develop plan for introduction of new compression scheme into the IGS infrastructure (Who: DCWG/IC, By: 06/2011)
- RINEX construction: Define/develop 1) tool for comparison of RINEX files from various construction approaches, 2) minimum requirements for acceptance of an accumulated data stream of observations as a RINEX file in IGS data archives, 3) mandatory/optional observation types to be included, 4) procedures to fill the gaps in the case data streams have been interrupted (Who: RTPP/DCWG/DCs/IC/ACs, By: 06/2011)

IGS Workshop 2010
Newcastle upon Tyne
Session Summary and Recommendations

Session Title/Date**: SPLINTER IGS LEO / SMART RECEIVER PROJECT**

Chair (& Co-Chair): **H. Boomkamp**

Rapporteur: HB

Key Issues, Session Highlights:

The main blocking problems in IGS LEO have always been

(1) a need to analyze combined solutions with LEO at a far higher data rate than AC can handle

(2) the fact that LEO data is not available to IGS AC at short latency.

Both problems have so far prevented inclusion of LEO data in IGS product generation. The problems are being solved by allowing LEO missions to process their own GPS data, which removes the need to release the data immediately. This is achieved by splitting a conventional least squares solution in sub-processes per receiver that communicate with each other over the internet (Dancer project). Because this approach also works for normal (ground) receivers, and then forms a scalable grid computing method on the internet, the Dancer approach allows much larger GPS network solutions than can be handled by current AC (thousands of receivers in a single rigorous LSQ adjustment). What started as an IGS LEO concept is therefore growing into a much larger, IAG-level project.

Recommendations :

1 Reconsider the need for continuation of the IGS LEO WG. The processing of LEO GPS data does not appear to be a practical option for the IGS AC, for known problems that will not go away. At the same time, alternatives are being implemented that will allow proper inclusion of e.g. JASON GPS data in routine reference frame realizations.

2 Find a way to keep IGS involved in the further development and operational deployment of the Dancer system. It is likely that a form of "pilot project" will be called by IAG WG 1, in which IGS sites can / should participate.

3 Continue IGS efforts to extend the IGS network to a size of several thousands of stations rather than just a few hundred, and to move to a high processing rate of 30 seconds at the same time. This may one day allow combination of IGS solutions with Dancer solutions.

IGS Workshop 2010
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Session Summary and Recommendations

Session Title/Date: **ANTENNA WORKING GROUP**

Chair (& Co-Chair): **R. Schmid**

Recommendations :
Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.

1. The Antenna Working Group will work with the ACs able to process LEO data to provide GPS satellite antenna PCVs for nadir angles > 14°.
2. The Antenna Working Group should provide an updated set of GPS satellite antenna PCV values (including azimuthal variations?) to be applied for the repro2 campaign. For the time being it is not necessary to include PCV parameters into the SINEX format.
3. The anechoic chamber in Bonn is accepted to provide phase center calibrations to the IGS.
4. L5 calibrations from the chamber in Bonn will be accepted and merged with L1/L2 calibrations from Geo++ in a best-possible consistent manner.
5. The maintenance of igs_01.atx will be discontinued.

IGS ANALYSIS CENTER SPLINTER MEETING AGENDA

Wednesday, 30 June 2010

16:30 - 18:30

Newcastle Upon Tyne

ACC: J. Ray
Agenda Items:

*** common issues with RTPP analysis (till no later than 17:00)**
+ RTPP: preliminary real-time clock products in test phase
+ IGU orbits & their use by RTPP ACs
+ reporting of comparisons statistics
+ RTPP AC issues
+ if IGU products still needed, are some RTPP ACs willing to contribute to IGUs also ?
+ evolution of RTPP products -- consider views of users

- -

*** IGS08/igs08.atx definition & realizations**
+ definition of IGS08 -- updated draft circulated by IGN/RFWG
+ selection & maintenance of "core" subnetwork of IGS08 RF sites (RFWG)
+ any other final comments ?

+ estimation of new SV antenna offsets using repro1 AC SINEX files (AWG with Xavier Collilieux)
+ SV PCOs must be consistent with ITRF2008/IGS08 frame
+ GLONASS updates from CODE/ESOC
+ what about applying azimuthal satellite calibration patterns -- not this time
+ add any other PCV updates
+ to be ready by ???

+ test impact of changed antenna cals in igs08.atx on IGS2008 coordinates (IGN)
+ will use PPP comparisons between igs05.axt & preliminary igs08.atx (from Ralf)
+ will need to decide how to use results: apply corrections or exclude sites ?

+ notification of users in July/August ?
+ implementation by ACs by end of August/September ?

+ DECIDE: official IGS adoption: mid-September or later ?

* any remaining ITRF2008 issues ?

+ any ACs to study IGN/DGFI differences ?
+ rough target date for next ITRF update (for repro2 planning) ?

*** completion & publication of repro1 products**

+ final SINEX/orbit/clock combinations of all repro1 AC solutions now finished, files posted at CDDIS in repro1 subdirectories
+ users notified via IGS Mail 6136
+ only remaining step is to run new timescale algorithm for clocks, then update IG1 product files -- any news from Ken ?
+ finally, IG1 product files to be linked upward to replace original operational files
+ DECIDE: publication of a special journal issue on results ?

*** status of ACs & core products**

+ IGL: other new GLONASS ACs ?
  - GFZ started GPS+GLO products from wk 1579

  - prospects to develop conventions for GLONASS channel biases ?
  - needed to implement real IGL clock combination

+ IGU: need more, better IGU ACs to improve quality & reliability
  - SGU (from IGN) is under evaluation as possible candidate
  - need more clock ACs to produce robust combination

+ IGS: GRGS now integrated into Finals (except clocks & LOD)

*** infrastructure issues**

+ L2C, L5, & other new signals
+ should we reconsider use of unhealthy SVs ?
  - often seem to cause more troubles than any possible benefit
  - esp problematic in IGUs & IGRs
+ other general issues ?

*** future ACC developments**

+ ACC2.0: is a more rigorous Final combination feasible ?
+ ACC2.0: proposals for development work on new combo system ?
+ candidates for next ACC starting January 2012 ?

* pending product issues & analysis improvements

+ orbit modeling improvements
 - albedo model -- scale (1 - 2 cm) & translation effects
 - but do we fully understand all the impacts (e.g., on TRF) ?

 - rotational errors seem to dominate all product errors
 - probably due to limitations of once-per-rev empirical parameterization
 - leads to aliased orbit errors at draconitic harmonics
 - also have strong fortnightly errors, probably due to O1 subdaily EOP
   tide model errors
 - subdaily EOP tide errors at 12h probably map directly into orbits

 - improved attitude modeling should be implemented by all ACs (e.g., at
   least Jan Kouba's model)
 - any other changes suggest ?

 - what about adding UT1-acceleration parameter for poor aprioris ?

+ how to reduce draconitic harmonics in all parameters ???

+ prospects for updated subdaily EOP tidal model from the IERS
 - very important for improved IGS products (esp all rate estimates)
   but highly uncertain
 - libration effect due to triaxiality of Earth's figure recently added
   to IERS Conventions for UT1

+ AC apriori constraints
 - try to remove as many as possible
 - at least try to better understand effects
 - can we agree to limitations on use of constraint ?
 - is there a need to standardize EOP apriori modeling & UT1 fixation ?
   (esp for Rapids & Ultra-rapids)
 - how to proceed ?

+ adoption of model for higher-order iono effects
 - DECIDE: should common implementation date be coordinated ?

+ should a model for thermal expansion of monuments & nearby bedrock be
 considered ?
 - see paper by H. Yan et al., GRL, 36, L13301, 2009
 - annual amps for bedrock reach level of 1.3 mm

+ updates for obs bias calibrations & conventions
 - work on P2-C2 biases by Stefan
 - should the IGS change from referencing to P1/P2 obs ?
 - should the IGS change to an absolute delay scale rather than
   use a zero-mean datum ?
 - what about adding receiver-based effects ?
 - is there a need to track phase biases too ?

- how to proceed with common strategy for GLONASS channel biases ?

+ new edition of IERS Conventions
  - new mean pole model adopted -- when to implement by IGS ?
  - EGM2008 & updated time-variations for low-degree terms -- when to implement by IGS ?
  - new model planned for ocean tide effects on geopotential
  - model for S1/S2 atm pressure loading tides
  - maybe new apriori model for static tropo gradients
  - implement model for oceanic pole tide (loading & geopotential) ?

+ various procedural changes
  - possible reductions in product latencies ?

*** preparations for repro2**

+ all analysis improvements above
+ GPS + GLONASS ?
+ need ACC2.0 if multi-GNSS data to be used
+ when will ACs complete s/w updates ?
+ treatment of non-tidal loading displacements ?
+ should SINEX integrations be reduced from 7 d to 1 d ?
+ more consistent and rigorous methods for AC product combinations ?
+ see: http://acc.igs.org/repro1/repro2_agu-f09_poster.pdf