SUMMARY RECOMMENDATIONS
IGS 2012 WORKSHOP

OLSZTYN, POLAND
23-27 JULY 2012

Session Recommendations

Session Rapporteur Reports

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **ANALYSIS CENTER AND REFERENCE FRAME WORKING GROUP**
Chair: J. Griffiths

Recommendation 1
Resolve pending reference frames issues
- Consider two-step combination planned for repro2
- Prepare final IGb08 and update igs08.atx by September
- Quantify (if possible) impact of including .24h orbits by Wk 1702

Responsibilities and deadlines:

Recommendation 2
Continue testing low-degree geopotential terms, with an aim to adopt a "conventional model" (if available) for repro2
- Further testing of low-degree geopotential terms from CSR by other ACs
  - Need longer spans of results and further comparisons
- Possible adoption for repro2
  - If preliminary NGS results confirmed, IGS should consider adopting a conventional model for annual geopotential variations for Repro2
- Must coordinate with GRACE, SLR, and IERS group
- Srinivas Bettadpur working on GRACE fit to degree 15

Responsibilities and deadlines:

Recommendation 3
Finalize and implement set of minimum repro2 analysis standards
- All recommended standards available at http://acc.igs.org/reprocess2.html
  - Minimum standards settled (in black)
  - Additional proposed standards for each AC to implement as desired (in red)
- In addition: for all analysis centres, implement and test physical models developed by UCL:
  - SRP/TRR – using grid files for the bus, and modeling thermal gradients across solar panels using solar and earth radiation fluxes
  - Will update for all GPS and GLO satellite types

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: DATA CENTER WORKING GROUP**
Chair & Co-Chair: H. Habrich, C. Noll

Recommendation 1
The DCs recommend to continue the efforts by the Infrastructure Committee and the RINEX WG to agree on new file names

Recommendation 2
Until the RINEX version 3 file-name convention is finalized, separate directories for distinguishing between files created from streams and by receivers will be established by all DCs.

Recommendation 3
All DCs explore transition options for follow on compression scheme to replace UNIX "compress" as early as possible.

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: INFRASTRUCTURE COMMITTEE**
Chair: I. Romero

Recommendation 1
That **MGEX shall remove the Rinex 2 data requirement and work only with Rinex 3 data** , and that the MGEX requests to the DCs that other past Rinex 3 data appeals be stored together with the MGEX data moving forward.

Responsibilities and deadlines:

Recommendation 2
That the IC fully **supports and encourages the new fulltime NC at the CB** and its support staff to continue to monitor the network and correct all issues as they arise as promptly as possible with special attention to header/log issues, antennas, dormant stations and proposed stations.

Responsibilities and deadlines:

Recommendation 3
The IC and NC will work to **strengthen ties with regional networks to promote the "Network of Networks"** from the IGS, to promote the new site guidelines and to make available to RFWG and ACs more stations with long time and stable time series especially ahead of the next repro effort.

Responsibilities and deadlines:

Recommendation 4
Considering the increasing number of global and regional GNSS stations and the increasing potential for naming conflicts, the IC/RINEX WG shall investigate together with others the issue of **unique GNSS station identification** (4 char ID codes, etc) and propose a possible way forward for the IGS.

Responsibilities and deadlines:

Recommendation 5
That the RINEX WG shall continue to iterate in the proposed direction for **new RINEX 3 data filenames**.

Responsibilities and deadlines:

Recommendation 6
That the RINEX WG shall keep the **RINEX 3 format open at all times as a "working draft" and to publish "formats"** as needed. The working draft shall be an open document as well so that manufacturers and users can request additions and changes and new signal conventions can be added quickly for experimentation to avoid conflicts afterwards.

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: REAL-TIME WORKING GROUP**
Chair: M. Caissy

Recommendation 1
Identify a core set of stations for use by all RTAC's in the generation of real-time clocks.

> *Responsibilities and deadlines*: RTACC and RTAC's; time frame – start process immediately.

Recommendation 2
Monitor the stability of the core set of stations on a daily basis.

> *Responsibilities and deadlines:* TBD – will be discussed further within the pilot project; time frame – ASAP with recognition it is needed before launch of the Real-Time Service

Recommendation 3
Analysis Centre Coordinator work towards more frequent updates to the IGU product. Ideally the current cycle of six hours would become one hour.

> *Responsibilities and deadlines:* ACC with cooperation from ACs; time frame - TBD

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **GNSS WORKING GROUP**
Chair: R. Weber

Recommendation 1
Adopt RINEX Format V3.02 (including QZSS) as soon as possible.

Responsibilities and deadlines: RINEX WG; time frame – 3 months

Recommendation 2
Establish an open source software for RTCM-MSM to RINEX V3.0x conversion.

Responsibilities and deadlines: IGS community; time frame – 6 months

Recommendation 3
Encourage the setup of further MGEX tracking sites with focus on global distribution and tracking of the complete suite of available signals. Zero-baseline testbeds are very welcome to study receiver dependent calibration biases.

Responsibilities and deadlines: GNSS WG, IGS Community; time frame – 6 months.

Recommendation 4
Encourage analysis of the collected MGEX data to establish initial orbit and clock data sets.

Responsibilities and deadlines: GNSS WG, IGS ACs; time frame – 6 months

Recommendation 5
Immediate efforts to harmonize the MGEX data archives and to provide an up-to-date and complete picture of the data inventory to the user community.

Responsibilities and deadlines: GNSS WG, MGEX DC, IGS CB; time frame – 1 month

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: CLOCK PRODUCT WORKING GROUP**
Chair: K. Senior

Recommendation 1
Where possible provide UTC(k) bias offsets of IGS stations collocated at timing laboratories, possibly using pending bias format. This will support utilization of UTC(k) in new v2.0 algorithm.

Responsibilities and deadlines:

Recommendation 2
Provide updated list of timing important stations to support clock densifications.

Responsibilities and deadlines:

Recommendation 3
Provide v2.0 timescale realignment for other GNSS combined products when available and sufficient clocks are included.

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: BIAS AND CALIBRATION WORKING GROUP**
Chair: R. Dach (for S. Schaer)

Recommendation 1
Recommendations already covered by other working groups.

Responsibilities and deadlines: NA

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **IONOSPHERE WORKING GROUP**
Chair: A. Krankowski

Recommendation 1
Higher temporal and spatial resolution of IGS combined GIMs – the IAACs (UPC and JPL) agreed on providing their maps in IONEX format, with a resolution of 15 min., 1 degrees and 1 degrees in time, longitude and latitude respectively

Responsibilities and deadlines:

Recommendation 2
Starting a new official/operational product – TEC fluctuation changes over North Pole to study the dynamic of oval irregularities (carried out by UWM to be started as official/routine product after performance evaluation period (end of 2012)

Responsibilities and deadlines:

Recommendation 3
The new IAAC from GNSS Research Center (GRC), Wuhan University, China (Hongping Zhang, end of 2012)

Responsibilities and deadlines:

Recommendation 4
Cooperation with IRI COSPAR group

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title**: TROPOSPHERE WORKING GROUP**
Chair: C. Hackman

Recommendation 1
Establish automated on-going comparisons of IGS final troposphere estimates (FTEs) with results from other techniques/ACs, with the goal of establishing accuracy of IGS FTEs.

Responsibilities and deadlines: time frame – next IGS workshop

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **ANTENNA WORKING GROUP**
Chair: R. Schmid

Recommendation 1
NGS robot calibrations are generally accepted for the IGS antenna phase center model. Biases w.r.t. other calibration institutions have to be further investigated.

Responsibilities and deadlines:

Recommendation 2
Consistent calibration values for multiple GNSS (at least GPS and GLONASS) from a single source are requested for the IGS antenna phase center model. The AWG decides on exceptions (e.g., for antenna types installed at NGA or GSS stations)

Responsibilities and deadlines:

Recommendation 3
Conventional phase center offset values for the new GNSS are added to igs08.atx.

Responsibilities and deadlines:

Recommendation 4
GPS satellite antenna phase center variations contained in igs08.atx are extended with estimation results from CODE for nadir angles > 14^{o}.

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **SPACE VEHICLE ORBIT DYNAMICS WORKING GROUP**
Chair: M. Ziebart

Recommendation 1
See recommendations of Analysis Center (AC) and Reference Frame (RF) working group

Responsibilities and deadlines:

Recommendation 2
Repro2 standards agreed:
1. All ACs to implement Earth radiation pressure routines
2. All ACs to implement antenna thrust models
3. All ACs to implement new GPS and GLONASS yaw behavior models (Dillsner and Weiss)

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
SESSION SUMMARY AND RECOMMENDATIONS

Session Title: **IGS TIGA WORKING GROUP**
Chair: T. Schöne

Recommendation 1
IGS should not forget about coordinates

Responsibilities and deadlines:

Recommendation 2
REPRO2 should start asap

Responsibilities and deadlines:

Recommendation 3
Non-IGS TIGA stations should be handled with care and marked in the final IGS-repro2 solution

Responsibilities and deadlines:

Recommendation 4
TIGA repro will follow repro2 as close as possible (3 participating centers)

Responsibilities and deadlines:

Recommendation 5
Interlink IGS repositories for IGS log files with SONEL for TIGA.

Responsibilities and deadlines:

IGS WORKSHOP 2012
OLSZTYN, POLAND
PLENARY SESSION / WG SPLINTER MEETING SUMMARY AND RECOMMENDATIONS

Session/Splinter Meeting Title**: COMBINED SPLINTER MEETING OF THE ANALYSIS CENTER & REFERENCE FRAME WG, TIDE GAUGE WG AND CLOCK PRODUCTS WG**
Date: 26 July 2012
Chair: Jake Griffiths
Rapporteur: Jake Griffiths

Key Issues, Session / Discussion Highlights:

1. Reference Frame Issues
    a. inter-AC discrepancies
        i. periodic signals small compared to IGS-load residuals
        ii. why such large offsets/discontinuities?
    b. IGb08 and igs08.atx
        i. recover IGS08 stations w/ static positional offsets
        ii. solve issues with misidentified antennas
        iii. update igs08.atx w/ new satellite PCOs
    c. switch to products based on 1d TRF integrations
        i. all ACs have switched to daily SNX
        ii. some ACs still have >24h orbital arcs
2. Impact of ignoring low-degree geopotential terms
    a. annual geopotential variations have small but non-negligible impacts for IGS products
        i. DZ component of orbit & terrestrial frames shifted by ~1 mm
        ii. LOD is biased by few μs
        iii. subdaily orbit residuals differ up to ~4 mm WRMS
        iv. station positions shift by up to ~0.7 mm horizontal, ~3 mm vertical, probably seasonally
        v. systematic geographic shifts may significantly alias inferred GPS load signatures
        vi. however, annual geopotential effect generally appears to be smaller than annual (GPS – load) residuals, esp for dN & dE
3. Advances for repro2 (IG2)
    a. orbit dynamics, minimum standards for IG2:
        i. include an *a priori* Earth Radiation Pressure model, modelling both short wave (albedo) and long wave (thermal) effects
        ii. include *a priori* antenna thrust
        iii. update yaw behaviour models based on work of Florian Dillsner (ESOC) and Jan Weiss (JPL)

Recommendations :

1. Resolve pending reference frame issues
    a. consider two-step combination planned for repro2
    b. prepare final IGb08 and update igs08.atx by September
    c. quantify (if possible) impact of including >24h orbits by Wk 1702
2. Continue testing low-degree geopotential terms, with an aim to adopt a "conventional model" (if available) for repro2

    a. further testing of low-degree geopotential terms from CSR by other ACs
        i. need longer spans of results & further comparisons
    b. possible adoption for repro2
        i. if preliminary NGS results confirmed, IGS should consider adopting a conventional model for annual geopotential variations for Repro2
        ii. must coordinate with GRACE, SLR, & IERS groups
        iii. Srinivas Bettadpur working on GRACE fit to degree 15
3. Finalize and implement set of minimum repro2 analysis standards
    a. all recommended standards available at http://acc.igs.org/reprocess2.html
        i. minimum standards settled (in black)
        ii. additional proposed standards for each AC to implement as desire (in red)
    b. in addition
        i. for all analysis centres, implement and test physical models developed by UCL:
            1. SRP/TRR – using grid files for the bus, and modelling thermal gradients across solar panels using solar and earth radiation fluxes
            2. will update for all GPS & GLO satellite types

IGS WORKSHOP 2012
OLSZTYN, POLAND
PLENARY SESSION / WG SPLINTER MEETING SUMMARY AND RECOMMENDATIONS

Session/Splinter Meeting Title: **IGS DATA CENTER SPLINTER MEETING**
Date: July 25, 2012
Chair: Carey Noll
Rapporteur: Heinz Habrich

Procedure:

- Provide the filled form until Thursday evening (for sessions before Friday) electronically to urs.hugentobler@bv.tum.de and igscb@jpl.nasa.gov.
- The rapporteur will have 5 minutes for presenting the Recommendations in the Splinter Working Group Reports and Recommendations session of Friday.

Key Issues, Session / Discussion Highlights:

AGENDA:

- Proposed changes to the RINEX file-naming convention
- Handling multiple version of files
- Archiving RINEX V2 vs. V3 at DCs

The IGS DCs recognize that a changed file name convention will allow to better organize RINEX files, when the unique identification of the station name, file creation approach and file content becomes visible from the file name. File name changes directly affect DC operations.

(Note: Significant workload for DCs to change to new file names, and
new file names will remove some difficulties for DCs in handling RINEX files, but also induce new problems, e.g., possible "zombie" files in case of re-submission, if first version holds 8h and updated version holds 24 h of data)

Intermediate solutions for the period from today until the introduction of new RINEX file names are needed.

a. RINEX v2 and v3 files: Separate directories for the two versions
b. Identification of files from streams vs. files from receivers:
c. Proposal: Separate "incoming" and "archive" directories for the two versions
d. File synchronization between DCs: Only files from "receivers" will be synchronized. Files from streams are considered "optional" and need not be synchronized between DCs. DC may decide individually to apply this scheme.

Continued evaluation:

The DCs ask the question, whether the definition of a "primary" and a "secondary" DC for those RINEX files accumulated from streams is needed, e.g., in the site log files.

IGS users reported to DCs that decompression tools for ".Z" compressed files may no longer run on newest generation of computers, e.g., 64 bit processors. DCs recommend to change the standard compression format as early as possible.

Long term DC synchronization efforts, such as common URLs, common file structure still need to be addressed.

Please briefly summarize key issues or reports, ~ one paragraph each.
Address in particular issues related to IGS Infrastructure, M-GEX and Real-Time if appropriate.

Recommendations :

- The DCs recommend to continue the efforts by the Infrastructure Committee and the RINEX WG to agree on new file names.
- Until the RINEX version 3 file-name convention is finalized, separate directories for distinguishing between files created from streams and by receivers will be established by all DCs.
- All DCs explore transition options for follow on compression scheme to replace UNIX "compress" as early as possible.

Please prioritize top three recommendations, and if recommendations are adopted, please suggest who is responsible to implement, and what timeframe is needed to accomplish.
Where appropriate attempt to harmonize your recommendations with those of other WGs.

IGS WORKSHOP 2012
OLSZTYN, POLAND
PLENARY SESSION / WG SPLINTER MEETING SUMMARY AND RECOMMENDATIONS

Session/Splinter Meeting Title: **GNSS SPLINTER MEETING**
Date: July, 23rd , 15.30-17.00
Chair: Robert Weber
Rapporteur: Robert Weber

Procedure:

- Provide the filled form until Thursday evening (for sessions before Friday) electronically to urs.hugentobler@bv.tum.de and igscb@jpl.nasa.gov.
- The rapporteur will have 5 minutes for presenting the Recommendations in the Splinter Working Group Reports and Recommendations session of Friday.

Key Issues, Session / Discussion Highlights:

Please briefly summarize key issues or reports, ~ one paragraph each.
Address in particular issues related to IGS Infrastructure, M-GEX and Real-Time if appropriate.

Key Issues:

- MGEX Webpage
- Overall and up to date picture of available MGEX-tracking data
- RINEX 3.02 (Stop accepting RINEX 2.11 data)
- RTCM-MSM Converter to RINEX 3.0x
- Approach Manufacturers (add receivers to testbed)
- Initiate first Analysis : Orbit and clocks test data sets
- Enforce ANTEX extensions
- Change of Chairman

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.
Where appropriate attempt to harmonize your recommendations with those of other WGs.

The GNSS WG recommends:

- To adopt RINEX Format V3.02 (including QZSS) as soon as possible.
- Responsible: RINEX WG; Time Frame: 3 months?
- To establish an open source software for RTCM-MSM to RINEX V3.0x conversion.
- Responsible: IGS community; Time Frame: 6 months
- To encourage the setup of further MGEX tracking sites with focus on global distribution and tracking of the complete suite of available signals. Zero-baseline testbeds are very welcome to study receiver dependent calibration biases.
- Responsible: GNSS WG, IGS community; Time Frame: 6 months
- To encourage analysis of the collected MGEX data to establish initial orbit and clock test data sets.
- Responsible: GNSS WG, IGS ACs; Time Frame: 6 months

- Immediate efforts to harmonize the MGEX data archives and to provide an up-to-date and complete picture of the data inventory to the user community.
- Responsible: GNSS WG, MGEX DC, IGS CB; Time Frame: 1 month

IGS WORKSHOP 2012
OLSZTYN, POLAND
JULY 23-27
PLENARY SESSION / WG SPLINTER MEETING SUMMARY AND RECOMMENDATIONS

Session/Splinter Meeting Title**: REAL-TIME SPLINTER MEETING**
Date: Wednesday
Chair: Mark Caissy
Rapporteur: Mark Caissy

Discussion Highlights:

The objective of the meeting was to identify key action items to be included in a plan of action. The action items are to be completed before the real-time service is launched at the end of 2012. The target start date is November 2012.

The high level plan of action will be presented to the IGS Governing Board at the close of the workshop.

In addition to the key recommendations below the following topics are also considered important recommendations for consideration:

- Web pages related to the IGS Real-Time Service should be hosted at the Central Bureau. A web content management system should be used to allow this content to be managed by members of the pilot project and real-time working group.
- The work being done within the Real-Time Ambiguity Resolution Working Group is acknowledged. As such it is recommended that this work be discussed among real-time analysis centres.
- The ultra rapid GLONASS orbit product is considered essential if the Real-Time Service is to reach full operating capability. It is therefore recommended that all Analysis Centres work towards generating ultra rapid GLONASS orbits for inclusion in a robust combined ultra rapid GLONASS product.

Further to recommendation #3 below it is recognized that this is a contentious issue due to the limited resources of the ACC and AC's. It is never the less maintained as a recommendation because of the utility of one hour ultra rapid orbits for the purpose of identifying problematic satellites that occasionally appear in the current 6-hour ultra rapid product. This has been shown to be the case by the real-time analysis centre coordinator in a number of presentations. Alternatives to the implementation of recommendation #3 are to be identified and considered.

Recommendations:

1. Identify a core set of stations for use by all RTAC's in the generation of real-time clocks.
    a. Responsible – RTACC and RTAC's
    b. Timeframe – start process immediately
2. Monitor the stability of the core set of stations on a daily basis
    a. Responsible – TBD – will be discussed further within the pilot project

   b. Timeframe – ASAP with recognition it is needed before launch of the Real-Time Service
3. Analysis Centre Coordinator work towards more frequent updates to the IGU product. Ideally the current cycle of six hours would become one hour.
   a. Responsible – Analysis Centre Coordinator with cooperation from Analysis Centres.
   b. Timeframe – TBD

IGS WORKSHOP 2012
OLSZTYN, POLAND
PLENARY SESSION / WG SPLINTER MEETING SUMMARY AND RECOMMENDATIONS

Session/Splinter Meeting Title: **IGS TROPOSPHERE SPLINTER MEETING**
Date: 24 July 2012
Chair/Rapporteur: Christine Hackman

Topics presented/discussed:

- Update on computation of IGS Final Troposphere Estimates (FTEs)
    - Summarized turnover from JPL to USNO and future plans (mostly Repro 2, which USNO will execute in PPP mode using Repro 2 orbits/clocks/EOPs, and possible inclusion of GLONASS data into IGS FTEs).
- WG 2011-2 activities: re-establishment of WG, charter
- Survey results
    - Chair designed/distributed survey to WG members in Jan 2012 with goal of assessing their major interests/concerns, plus usage of IGS FTEs. Summarized survey results, which led to:
- Establishing accuracy of IGS FTEs: how? (Most of meeting time spent here.)
    - Establishing on-going automated comparisons with other techniques/numerical weather models/GNSS results seemed the obvious choice. The WG discussed execution of this strategy at length. Some groups already do this, e.g., J Dousa (GOP), R Heinkelmann (DGFI); would be good to leverage their efforts. Also, former WG chair Y Bar-Sever has software to compare AC ZTD solutions.
    - The WG decided to focus on comparisons at "super-sites," i.e., IGS sites where several means of estimating ZTD co-exist, e.g., VLBI, WVR, etc. L Sanchez (DGFI) reported that according to DGFI's work, only six sites exist having GPS, GLONASS, VLBI, WVR and radiosonde measurements[1]. Also, VLBI measurements are not necessarily taken every day. Therefore, the WG began to create a prioritized wish-list for co-located techniques: GPS, then VLBI, then ***calibrated*** WVRs. Still unsorted: radiosondes, known height, calibrated barometer, GLONASS measurements.
- Finally, comparisons to post-processed GNSS-independent numerical weather model estimates will be made as well.

[1] I could be remembering the number of co-located techniques that go with "6" incorrectly. My fault, not Dr. Sanchez's.

- The group agreed to a paraphrased version of the recommendation below. The chair will develop a task list and start hunting down volunteers.

- ~~How to vote/make decisions?~~ << This was on the agenda, but tabled, as the chair wished to end the meeting at 1700.

So ended the meeting. The chair will be in touch with the members via the WG email list.

Recommendation:

By the next IGS workshop,

- establish automated, on-going comparisons of IGS final troposphere estimates (FTEs) with results from other techniques/ACs,
- with the goal of establishing accuracy of IGS FTEs.