

3 Reports of IERS components

3.1 Directing Board

The IERS Directing Board (DB) met twice in the course of the year 2015. Summaries of these meetings are given below.

Meeting No. 60 April 12, 2015, Technical University of Vienna, Gusshausstr. 27, Vienna, Austria

Introduction and approval of agenda The agenda was accepted. Brian Luzum welcomed the guests and the members of the IERS Directing Board.

Formalities The minutes of IERS DB Meeting #59 were distributed together with the agenda of DB Meeting #60.

Re-election of AC Tom Herring was re-elected as IERS Analysis Coordinator for one additional term (4 years).

Changes in IERS Terms of Reference The email voting on the IERS Terms of Reference (ToR) regarding the IERS Chair was successfully finished in March. The proposed change was accepted. The ToR on the website were updated accordingly.

The list of IERS Associate Members will be updated every year and distributed to the DB members for review/confirmation at the December DB meeting.

DB members may send one proxy, but the current ToR are not clear whether this person has the right to vote. A proposal for changing the ToR will be sent out after the DB meeting.

New Action Item:

#60.01 Set up voting for change in ToR regarding proxies.

Reports from the Technique Centres
International DORIS Service (IDS)

Jean-Michel summarized IDS activities:

- DORIS constellation status: SPOT-5 changed to lower orbit; future missions: Jason-3 launch postponed to July 2015, Sentinel-3A/-3B in 2015/2017; network evolution: new stations in Owenga (New Zealand) and Goldstone, reconnaissance at Wettzell (Germany).
- Analysis Update:
 - 6 active ACs (5 different software packages).
 - Contribution to ITRF2014: extension of DORIS data until September 6, 2014 (no more data for 2014 due to data and models latencies); combined solution delivered on February 27, 2015.

- IDS ACs process the DORIS data in the RINEX format.
- DORIS Special Issue (Adv. Space Research) in preparation.
- Scale offset increase w.r.t. ITRF2008 starting mid 2012 (will be investigated).
- Next meetings: IDS AWG May 28-29, 2015, Toulouse, IDS AWG in October 2015 probably in the US.

International GNSS Service (IGS)

Urs Hugentobler reported on IGS activities:

- New Governing Board chair is Gary Johnston, currently no ACC, probably no combination in the future, but AC solutions.
- Network of >120 stations, 6 ACs; transition to RINEX 3.
- ITRF2014 contribution:
 - Contributions from 7 operational ACs + 2 TIGA ACs; combined SINEX files delivered on February 27, 2015.
 - AC-specific features in station position residuals noticed.
 - Offsets and rates in the combined geocentre time series w.r.t. IGB08 found.
- Workshop on geodetic metadata planned for August this year.
- Next IGS Workshop in February 2016 in Sydney, Australia.

International Laser Ranging Service (ILRS)

Cinzia Luceri gave a report about the ILRS activities:

- Network: new Russian station Irkutsk validated; Mendeleev 2 re-validated; new Wettzell SLR system will undergo validation soon. Still few stations in the southern hemisphere.
- Missions: 4th Indian GNSS s/c IRNSS-1D successfully launched on March 28, 2015.
- Space Debris study group has been established.
- Main LLR activities: IfE LLR solution for ITRF2013 submitted (for testing purposes only); Simulation of new LLR sites in progress; Studies on combined use of LLR, GRAIL and LRO data continue.
- Analysis: 8 operational AC/CCs; 8 ACs and 2 CCs contributed to ITRF2014; AC weighting factor peculiarities found (2 groups of factors); discontinuity in scale found around the year 2011.
- ILRSA v61 official ILRS contribution delivered in late February 2015 (another solution of the backup CC).
- Recent meetings: 19th Int. Laser Workshop and AWG meeting in Annapolis in October 2014.
- Future meetings:
 - Technical Workshop in Matera, Italy, October 25–30, 2015.
 - 20th Int. Workshop on Laser Ranging in 2016 in Potsdam, Germany.

- Next AWG meeting scheduled Saturday before the Matera Workshop week.

International VLBI Service for Geodesy and Astrometry (IVS)

Chopo Ma reported on the latest IVS activities:

- IVS ITRF2014 input: 11 ACs submitted a contribution, 9 ACs finally included in combined solution; Inconsistencies in variance factors found and corrected; Combined solution submitted in February 2015.
- VGOS (VLBI Global Observing System): small and agile telescopes with large bandwidth (2–14 GHz), allowing a denser sampling of the atmosphere.
- Network: multiple new stations with new receiver technology; new station Ishioka, Japan, RAEGE project: RAEGYEB in Ye-bes, Spain, already working and RAEGSMAR in Santa Maria, Azores, inauguration in May 2015. TIGO in Chile was closed in April and will be moved to Argentina, becoming AGGO.
- Next meetings: EVGA on the Azores in May 2015; Technical workshop in June in Robledo, Spain; 4th Int. VLBI Technology Workshop in November 2015 in Auckland, New Zealand.

ITRS/ITRF

Report from ITRS Combination Center at DGFI

Detlef Angermann presented the status of the DGFI CC.

- DGFI is now an institute of the TU Munich.
- ITRF2014:
 - First combined solution foreseen for IUGG in Prague; VLBI, SLR and DORIS input data analysed.
 - Very good agreement of SLR and VLBI TRF2014 solution w.r.t. DTRF2008.
 - DORIS scale: jump around 2011 found.
 - GNSS discontinuities still under investigation.

Report from ITRS Combination Center at JPL

Richard Gross reported on recent activities at the JPL CC:

- Quality comparisons for IVS, ILRS and IDS w.r.t. the ITRF2008 contributions.
- Discontinuity files: discontinuities were identified without station or service input. An inclusion of a discontinuity file by the Services with their data submissions is suggested.
- Solution will be weekly SINEX files for station positions.

Report from ITRS Center

Zuheir Altamimi reported on the activities of the ITRS Centre.

- New ITRF website to be ready by end of 2015.
- Local survey: 1st draft of a document for local survey guidelines; prepare an IERS Technical note; operational entity should be recognized by the IERS as a fundamental component of the ITRS Center (change the ToR?).

- Status of ITRF2014:
 - All TC contributions available; all SINEX files are archived at the IERS CB server; Work on local tie SINEX files in progress.
 - Origin and Scale: SLR: offset in TY and jump in scale starting in 2010; VLBI: large scale scatter due to changing networks from one session to another.
 - Post-seismic deformations: linear function vs. parametric model.
 - Seasonal signal vs applying NATML model? Proposal: remove periodic signals (at least annual and semiannual); do not apply NATML model.
 - Provide amplitude and relaxation time for stations with post seismic deformation.
 - Schedule: end June – beginning July: first ITRF2014P solution for evaluation by the TCs; final solution in September-October (evaluated by the four Techniques Centres within one month).

The United Nations GA adopted a resolution on a Global Geodetic Reference Frame. For the first time geodesy and the global geodetic reference frame are acknowledged at the UN level. A workshop on the roadmap will take place at UN in Vienna.

In the discussion, Zuheir Altamimi pointed out that only use IGS stations with more than 2.5 years of observations are used. DOMES numbers have currently been assigned by IGN. Time series may be provided to users upon request. Richard Gross requested that discontinuity files should come along with the technique solution, and Detlef Angermann proposed to compare discontinuities between the three Combinations Centres.

New Action Items:

#60.02 Provide full loading model to the ITRS Combination Centres.

#60.03 Provide routine for the model with amplitude and relaxation time.

#60.04 Prepare an IERS Technical Note on local survey guidelines.

Unified Analysis Workshop (UAW) 2014

Tom Herring presented the recommendations and the topics from the UAW concerning the IERS.

The recommendations cover many Services and Centres of the IERS, e.g. for the following issues:

- Resolving the VLBI/SLR/DORIS scale differences:
 - Re-assessment of the relativistic formulations for VLBI and satellite based systems → Conventions Centre.

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- Explore possible systematic height errors from radio telescope deformations → IVS.
- Explore impact of range biases on SLR height estimates and of blue sky → ILRS.
- Explore antenna phase centre model for satellite receiving antennas for DORIS → IDS.
- Geophysical Fluids: deficiencies in the model of the annual and semiannual EOP variations.
- Analysis methods: time variable gravity models; solid-Earth pole tide model; impact of ocean pole tide; monument stability: list of monument site issues from the operator

Monument stability: Develop a list of monument site issues from the operators → ITRS Combination Centres.

Decision: DB members representing the Services should take back the recommendations to the Services.

ICRS/ICRF and IAU Working Group

Bryan Dorland presented the ICRF-3 status:

- ICRF-3 goals: competitive in precision with Gaia and uniform precision for all sources; extend to higher frequencies, improve southern coverage. Complete ICRF-3 by 2018.
- Status: EGSG meeting in Dec. 2014; work underway to assess radio/optical tie issues; observing underway for 100–200 strong sources using southern CRF network @ S/X bands, weaker sources to be observed from 2015 to 2017.
- VLBA Cal Survey-II underway to re-observe VCS sources.
- K-band (24 GHz) southern hemisphere observations approved for 2015.
- Comparisons of VLBI frames from various analysis groups underway.

Report on GGOS

Brian Luzum reported on the IERS/GGOS Meeting:

- Meeting in San Francisco as an attempt to create a better working relationship between GGOS and IERS.
- Summary:
 - Successful attempt to create a better working relationship between GGOS and IERS.
 - No duplication or redundancy in the work of GGOS regarding IERS (and other services).
 - Improve communication and coordination between these two entities.

- IERS representatives are asked to actively contribute to the revised structure of GGOS for better support, operation and promotion.

Discussion:

- Richard Gross: IERS does not feel any advantage/no value added in branding their products with the GGOS logo. A discussion with GGOS and all IERS contributing parties is needed.
- The “GGOS2020” book helped a lot to get funding.
- How to take advantage of the UN-GGIM resolution?
- IERS and GGOS are partners; but this relationship is not practiced at the moment.
- IERS is “coordinating” geometric services, GGOS should coordinate with gravity services.
- Would it help to co-organize sessions at meetings (EGU, AGU, etc.)?
- Richard Gross: UAW will be in future co-organized between IERS and GGOS (head of science panel).
- Open question: How can GGOS add some value to the already existing IERS products?

Earth orientation products *Report from Earth Orientation Centre*

Daniel Gambis reported on the activities of the Earth Orientation Centre:

- Conventional Mean Pole:
 - Need to adopt a mean pole for geodynamic applications.
 - A conventional mean pole (CMP) model is provided by the IERS Conventions.
 - Preparation of IERS Conventions 2013: list of mean pole values; modelling is an open question.
- IAU Working Group recommendations: 4 developments
 1. ASCII “Leap second file” available.
 2. EOP data available in XML format, [ftp hpiers.obspm.fr](ftp://hpiers.obspm.fr).
 3. Leap second Web service.
 4. Secure protocol (via NTP) to give information on leap second announcements for server synchronization: Need of authoritative source for leap second announcement for NTP servers synchronization.

Inform (via IERS message) users about the existence of the file. Modify specificities of the NTP protocol to indicate that the file is available at the Earth Orientation Centre and no longer at NIST.

Daniel Gambis reported that he would retire in September 2015; Christian Bizouard will take over his position.

Report from Rapid Service/ Prediction Centre

Christine Hackman reported:

- Products 2014: values downloaded to 18025 unique IP addresses.
- e-VLBI from KPGO unavailable since June 2014 → 40% accuracy reduction in one-day UT1–UTC prediction.
- Access issues to USNO EOP servers: http access mostly restored; ftp access restoration TBD. Long-term plan: migrate services to cloud.
- Test NTP UT1 service set up at NIST.

IERS Conventions

Brian Luzum summarized the activities on updating the IERS Conventions:

- Additional personnel: USNO Conventions personnel now include Nick Stamatakos, Maria Davis and Dennis McCarthy.
- Open topics: Chapter 7 (conventional mean pole), Chapter 9 (models for atmospheric propagation delays), Chapter 11 (general relativistic models for propagation).
- Leap second will occur on 30 June 2015.
- Need of feedback from the community.

Reports from the Working Groups

IERS Working Group on on Site Survey and Co-location

Sten Bergstrand reported on the current activities of the WG.

- Meetings: open meeting at REFAG, closed meeting at EGU.
- The WG's main focus will be on definitions.
- An IGN guideline document will be circulated for review in 2015.
- POCs have been established with IDS, ILRS, IVS and IGS + surveyors.
- How to support/implement UAW recommendations?
- How to get local tie numbers to be published?

He presented also examples for thermal deformations of telescopes. For this height measurements using invar rod and temperature sensors in the telescope's foundation were carried out.

IERS Working Group on Combination at the Observation Level (COL)

Richard Biancale reported on the COL activities.

- 6 years of COL activities.
- End the activities of COL and start a new WG COL 2 with new goals and participants.
- Proposal to focus combination efforts to satellite data only (DORIS, GNSS, SLR) and to check the impact of multi-technique platforms.
- Proposal to renew the COL-WG in preparation to new projects such as GRASP.
- A final WG meeting is expected after the ITRF2014 will be ready.

***IERS Working Group on
SINEX Format***

Daniela Thaller reported on the activities of the WG on SINEX Format.

- VLBI: A. Nothnagel and Z. Malkin are working on a block to specify the quality of the radio source positions.
- Multi-GNSS: Galileo activities requested satellite antenna PCO with multi-frequencies, clearly defining the offsets.

***IERS Working Group on Time
Series Format***

A splinter meeting will take place on Wednesday evening for discussing the next steps.

Annual Reports

Daniela Thaller gave an overview on the status of the Annual Report 2014. The deadline was end of March, as of now 6 contributions have been received.

Next DB Meeting

The next DB meeting will take place before the AGU meeting on Sunday, December 14, 2014 in San Francisco.

New Action Item:

#58.05 Prepare DB meeting #61.

Meeting No. 61	December 13, 2015, Hotel Marriott Marquis, 780 Mission Street, San Francisco, USA
Introduction and approval of agenda	The agenda was accepted. Daniela Thaller welcomed the guests and the members of the IERS Directing Board and informed the IERS DB that Brian Luzum cannot participate in the meeting.
Action Items of previous DB meetings	59.01 The successor of R. Gaume as representative for the ICRS Centre is appointed: Bryan Dorland 59.03 Study S1/S2 issues: J.-P. Boy reported that studies are done; a report will come up soon. 60.01 Voting for changes in ToR has been done. 60.02 Full loading model for the ITRF2014 station list has been provided by T. van Dam to the ITRS Combination Centers. 60.03 Z. Altamimi has provided a routine for the model with amplitude and relaxation time for non-linear station motions. 60.06 Prepare DB meeting #61: done
Changes in IERS Directing Board	The new IAG/IUGG representative is Axel Nothnagel, replacing C. Wilson. The new IERS DB member representing the Earth Orientation Centre is Christian Bizouard, replacing D. Gambis. The new IERS DB member representing the ICRS Centre is Bryan Dorland, replacing R. Gaume.
Associate Members	A list of IERS Associate Members has been distributed by the CB in advance. The DB discussed the list of Associates and their rights regarding access to the minutes of IERS DB meetings. <i>Decisions:</i> More people working within IERS components should be added as IERS Associate Members. The minutes of each DB meeting first have to be approved by the IERS DB members before the IERS Associate Members will get access to them. <i>New Action Item:</i> 61.01 Add persons from IERS components to list of IERS Associate Members
Report on GGOS and GGOS Days	Daniela Thaller gave the report prepared by Hansjörg Kutterer on the GGOS Days: • The designation process for GGOS Consortium has been completed: IERS Representatives are T. Herring and D. Thaller. • The GGOS Coordinating Office is still vacant; applications are possible until the end of January.

- GGOS Days were held in Frankfurt am Main on October 21–23 with a review of implementation plans and the initiation of an IAG position paper on GGRF (Global Geodetic Reference Frame).

The IERS DB discussed that with the new functionaries within GGOS, the relation between GGOS and the IERS seems to be weaker than before. Now, the gravity community is stronger involved in order to fulfill the GGOS goal to improve the connection with gravity.

Status of ICRS/ICRF and IAU Working Group

Axel Nothnagel reported about the developments in the ICRF-3 Working Group:

- Patrick Charlot took over the working group chair in July 2015.
- The WG seems to be only an IAU activity at the moment.

The IERS DB discussed that it will be important to establish a connection between IAU and IAG/IERS in order to be sure that radio wavelengths are considered in ICRF-3. Axel Nothnagel will discuss with P. Charlot the possibility to establish a joint IAG/IAU working group (as in the past).

New Action Item:

61.02 Work for a joint IAG/IAU Working Group on ICRF-3

ITRF2014 including update of EOP series

Report from ITRS Center

Zuheir Altamimi presented the status:

- Main issue: implementation of PSD function for non-linear station motions; the PSD model was estimated from GNSS time series and then applied to co-located VLBI, SLR and DORIS sites; no PSD model for non-GNSS sites if no co-location.
- A minor but important impact is seen on polar motion (1–3 mm): requires a re-iteration of the solution.
- Estimating seasonal signals performs better than applying atmospheric loading (see discussion in Vienna 2015); but not estimated for most of VLBI/SLR sites due to sparse time series.
- Estimated seasonal signals can be provided to interested users (but only on request).
- Final solution will be ready by January 2016.

Report from ITRS Combination Center at DGFI

Mathis Blossfeld reported on the status of the ITRS CC at DGFI.

- First solution ready and distributed to Technique Centres for validation.
- Loading is corrected for atmosphere and hydrology (no oceans due to short time series).

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- LOD is combined (different to the IGN approach where LOD is VLBI-only).
- A 13.65-day signal is visible in LOD when comparing to C04 (reason in C04 series?)
- The inter-comparison with the IGN solution is foreseen after publication of ITRF.

Report from ITRS Combination Center at JPL

Richard Gross gave an overview on the CC work at JPL:

- VLBI regional sessions are removed, as well as stations shorter than 2.5y.
- All local ties are used, but with different weighting.
- Combined scale is closer to VLBI than to SLR.
- Result: Time series of 1838 weekly SINEX files; backward prediction is included (based on linear + seasonal model).
- Few refinements are needed; final solution to be ready by end of January 2016.
- Operational updates are foreseen, depending on users' demand.

Report from Earth Orientation Center on updating C04

Christian Bizouard presented this report.

- Updates of C04 are available as soon as ITRF2014 is officially available.
 - Discussion: coordinate update with Bulletin A and Technique Centres.
- Nutation is now directly combined for dX / dY (not dEps / dPsi).
- Increase of formal uncertainties of Nutation and UT since 2005 visible.
 - Discussion: Are similar effects seen in IVS solutions?
- Question: Are dEps / dPsi still needed?
 - Discussion: Yes, they are needed (old flight missions; geophysical interpretation).

Decisions:

Two IERS Technical Notes have to be prepared:

- ITRF solutions (IGN, DGFI, JPL)
- Contributions and validations by the techniques (to be coordinated by the Technique Analysis Coordinators)

Nutation series dEps / dPsi should be maintained.

New Action Items:

61.03 Prepare two IERS Technical Notes on ITRF2014

61.04 Coordinate update of EOP series C04 and Bulletin A

Reports from the Technique Centres	
<i>International DORIS Service (IDS)</i>	Hugues Capdeville presented the IDS report: • Altogether 7 DORIS sites with post-seismic model in ITRF2014. • Proposal to provide PSD corrections in XYZ and NEU.
<i>International GNSS Service (IGS)</i>	Paul Rebischung reported on IGS activities: • Residuals for station positions increased in recent years due to antenna phase centers of new GNSS satellites. • JPL and GFZ were the only ACs answering the request of validating the preliminary ITRF2014 solution; none of both ACs saw any major problems.
<i>International Laser Ranging Service (ILRS)</i>	Erricos Pavlis presented the ILRS report: • A technical workshop was held in Matera, Italy in October 2015. • Intensive discussions at the Matera workshop on the preliminary ITRF2014 solution; several issues were discovered and a re-iteration for the discontinuities had to be done. • Arequipa does not fit well from the ITRF2014 series with the ILRS series, but better than ITRF2008. • The evaluation of ITRF is still going on, with a 2009–2014 re-analysis by all ACs. • Next AWG meeting is scheduled during the EGU 2016 week.
<i>International VLBI Service for Geodesy and Astrometry (IVS)</i>	Chopo Ma reported on the latest IVS activities: • 4 groups submitted validations for ITRF2014P (GFZ, Uni Bonn, GSFC, SHAO). • ITRF2014P does not exhibit any significant errors relative to ITRF2008. • The new PSD model generally shows good agreement with VLBI position time series. • There are EOP rate differences between solutions applying ITRF2014P and ITRF2008 that need further work to understand.
Optimal strategy for TRF	Tom Herring presented some thoughts on non-linear modelling of station positions: • Exponential function will approach linear model within few years, but logarithmic function will take several 100 years to approach linear model. • Sites in regions of earthquakes do not all have parameterizations in ITRF2014P – something to be careful of as sites are added.

- Remaining issues with annual terms not provided with ITRF2014: they are propagating into EOPs (as seen from DGF1 presentation, approx. 10 micro-arcsec).

Decision: Keep annual signals only “on request”.

IERS Annual Reports

Daniela Thaller informed about the status of IERS Annual Report 2014: The IGS contribution is still missing, all other have been received.

Decision: Publish IERS AR 2014 after DB meeting, independent of availability of IGS contribution.

IAG Service Assessment

Daniela Thaller reported that IAG sent back comments on the IERS spreadsheet. It is not clear how the IERS should continue.

Due to a lack of time, the discussion was postponed to the next IERS DB meeting in Vienna. The CB will distribute the assessment summary to all DB members.

New Action Item:

61.05 Distribute summary of IAG Service Assessment to DB

UN-GGIM GGRF resolution (Global Geodetic Reference Frame)

Zuheir Altamimi reported on the UN-GGIM Resolution on the Global Geodetic Reference Frame (GGRF):

- Key points are development and sustainability of the GGRF, enhancement of global cooperation, sharing of geodetic data, standards and conventions, outreach programs, and commitments to improve and maintain national geodetic infrastructure.
- A roadmap is currently developed.
- The GGRF contains not only the terrestrial reference frame (like ITRF) but also the geodetic networks, data holdings, analysis / combination centres, gravimetric products, height systems, the ICRF and EOPs.

Discussion: The IERS with its products are highly involved by the GGRF. Therefore, the roadmap should be distributed as soon as it is finalized.

New Action Item:

61.06 Distribute GGRF Roadmap within IERS DB

Symposium on Earth Rotation 2016

Richard Gross provided information on the joint IAU / IAG / IERS Symposium:

- July 18 – 23, 2016 in Wuhan / China
- A website is available:
<<http://main.sgg.whu.edu.cn/gager2016/>>
- Abstract deadline is April 30, 2016

Richard Gross also proposed to held a special conference for the centennial anniversary of IAU and IAU Commission A2 (Rotation of the Earth) on July 28, 2019. The IERS DB agrees with this proposal.

Other reports
GGFC

Jean-Paul Boy reported that a half-day meeting of the GGFC was held in Vienna during EGU 2015. After this meeting, all models became “official”.

***IERS Working Group on
Combination at the Observation
Level***

Daniela Thaller reported on behalf of Richard Biancale the idea that the COL working group (enlarged with other persons) should prepare a proposal for ESA’s call on Earth Explorer 9 missions, with a European GRASP-like mission. The Letter of Intent need to be submitted by February 1st, 2016, the proposal in June 2016.

The IERS DB underlines the importance of having a GRASP-like mission.

Decision: The WG COL should work for proposing a European GRASP mission.

Next IERS DB Meeting

The next DB meeting will be an all-day meeting and will take place on Sunday, April 17, 2016 before the EGU meeting.

New Action Item:

#61.07 Prepare next DB meeting in Vienna.

Daniela Thaller, Sabine Bachmann, Wolfgang R. Dick