

IVS Newsletter

Issue 55, December 2019



Unified Analysis Workshop in Paris

– Dan MacMillan and John Gipson, NVI, Inc./NASA GSFC



Mathis Bloßfeld giving a presentation about preparatory work for ITRF2020.



Institut de Physique du Globe de Paris was the venue in Paris for the sixth IAG/GGOS/IERS Unified Analysis Workshop held 2–4 October 2019. The purpose of this meeting was to meet with colleagues representing the different techniques (VLBI, SLR, GNSS, DORIS, Gravity) to discuss the latest developments and analysis issues that each technique is facing. It is a forum where es-

timation of common parameters and common a priori models can be discussed. In addition, there are often modeling approaches used by one technique that can be helpful in addressing problems in a different technique. There were 76 attendees. IVS was represented by James Anderson, Cornelia Eschelbach, John Gipson, Robert Heinkelmann, Dan MacMillan, and Oleg Titov.

The general session outline of the workshop was: DORIS/GNSS/VLBI/SLR sessions on Systematic Errors and Biases, Gravity Models for POD, Space Geodesy Infrastructure, Standards, Geodetic data set DOIs, Global Unified Height System, Reference Systems/Frames, and Site Surveys/Co-location.

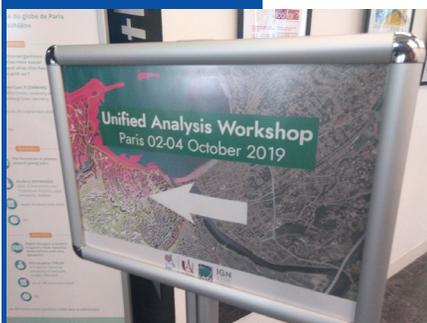
Each of the techniques was given a session in which to discuss systematic errors and biases specific to the technique. Dan MacMillan gave a presentation entitled, “Galactic Aberration and its Effects on the CRF, the TRF, and EOP.” He discussed the results from the IVS aberration working group (WG8), which was formed to investigate Galactic aberration drift and provide an a priori model for the ICRF3 solution as well as for VLBI solutions in general. James Anderson discussed his work with Minghui Xu on source structure effects and how to model them in analysis. A difficult problem will be how to handle source structure in future VGOS broadband observing. Oleg Titov presented his method for estimation of the Earth’s instantaneous angular velocity using phase delay rates.

There was a presentation by Cornelia Eschelbach on photogrammetric measurement of the Onsala VLBI antenna ONSA13NE using drones. This is a very promising technique requiring only a day to make measurements. It could be used to measure the gravitational deformation models of other VLBI antennas. John Gipson gave a presentation on the current status of the measurement of antenna gravitational deformation modeling, where only six antennas have been measured. IVS was urged to make efforts to measure more antennas primarily because of the impact on reference frame scale. There was a lot of discussion at the meeting and later on using the drone photogrammetric technique of Eschelbach et al. or Axel Nothnagel’s methods to measure more antennas.

John Gipson gave a talk in the Standards session on results from the IERS high frequency EOP working group that he chaired. The results of the working group investigation led to the adoption by the IERS of the model derived by Desai & Sibois (Egbert) based on the tidal model TPX0.8. This HF-EOP model along with Galactic aberration and the gravitational antenna deformation models will be applied in upcoming IVS ITRF2020 solutions.

As in the UAW in 2017, reference frame scale was a big topic of discussion. Based on a test solution from Cinzia Luceri (ASI), new SLR range biases have changed the SLR scale with respect to ITRF2014 from -0.69 to $+0.46$ ppb at 2010 (and a rate change from -0.013 ppb/yr to $+0.025$ ppb/yr). The scale bias between VLBI and SLR in ITRF2014 was 1.37 ppb and ITRF2014 weighted the VLBI and SLR scale contributions equally. With the new range biases, the VLBI-SLR scale bias was reduced to only 0.23 ppb. It is likely that the remaining bias is caused by unmodeled VLBI antenna gravitational deformation. There were several presentations on reference frame scale and discussion about allowing techniques other than VLBI and SLR to contribute to the ITRF2020 scale. However, relative to ITRF2014, the DORIS and GNSS scale contribution are about $+1.2$ ppb greater than ITRF2014.

The workshop was well organized and allowed the participants to interact productively. Discussion of common issues was good since next year all of the services will be preparing contributions to ITRF2020. We thank the IGN and the Institut de Physique du Globe de Paris for hosting the workshop.



Information sign to the Unified Analysis Workshop at the Institut de Physique du Globe de Paris.



Feature

Himwich on the Move

— John Gipson, NVI, Inc./NASA GSFC; Brian Corey, MIT Haystack Observatory

[From the Editor: You probably already heard it through the grapevine, Ed Himwich is leaving the Goddard VLBI group and stepping down from his position as IVS Network Coordinator. With two decades of service (the longest-running coordination officer in the IVS), it is in order to celebrate Ed's many contributions and accomplishments

and to honor him as a person—also with some personal tidbits and anecdotes. For that, I'm very glad to be able to present to you a brief biographical sketch that John Gipson and Brian Corey were so kind to put together.]



Ed Himwich at a station visit to Ny-Ålesund in 2009.

William Edwin Himwich (Ed to his friends—which includes the entire IVS community) grew up in the mid-west United States. He attended Swarthmore College in Pennsylvania where he earned a B.S. in Physics, graduating in 1982. Immediately after college he joined the Goddard VLBI group, where he worked with such VLBI legends as Tom Clark, Chopo Ma, Nancy Vandenberg, and David Shaffer, all of whom have since retired.

Ed's initial responsibilities included helping develop *solve*—the VLBI analysis program widely used in the VLBI community—and conducting VLBI observations at geodetic stations. When Ed began working on *solve*, it could only process a single day of data; so, you could only estimate things that you could derive from a single day of data, such as station position at an epoch. An early important contribution of Ed's was to modify *solve* so that it could process many

VLBI sessions simultaneously. If you do this in a simple and naive way, the number of parameters in the normal equation increases arithmetically with the number of sessions. Now, the time required to invert the normal equations grows like N^3 ; so, if a single session takes 1 minute, then 10 sessions would take 1000 minutes (or almost a day) and 20 sessions would take 8000 minutes (or 5.5 days). This problem can be solved by doing arc-parameter elimination, a technique borrowed from solving for satellite orbits. In this technique the normal equations are divided into arc parameters—that is, parameters which depend only on the data for a single day—and global parameters which depend on the data from many days. The arc parameters are 'squeezed out' of the normal equations on a day-by-day basis, leaving only the global parameters. This technique, revolutionary at the time, is now widely used in VLBI and other applications.

Starting in autumn 1982, Ed made frequent trips to VLBI stations to set up and run the equipment during geodetic sessions. (In those early years of the MkIII data acquisition system, most sites did not have the local manpower or expertise for these tasks.) Both authors had the pleasure of sharing set-up and observation duties with Ed during multiple sessions at Owens Valley Radio Observatory in California. Ed impressed both of us with his eagerness to learn and his quickness of intellect and of wit—characteristics that have stood him in good stead ever since. He was also good company during the occasional down time. On a free weekend between sessions, Ed and one of us (J.G.) went hiking, and Ed introduced me to bristlecone pines, the oldest living plant in the world.

Ed's extensive exposure to site operations early in his career prepared him well for one of his major contributions to the IVS and the general VLBI community, namely, the maintenance and development of the Field System (FS). The FS is used to control the VLBI antenna and equipment, and is used at VLBI sites around the world. The original version of the FS was written for HP workstations, long before the advent of Linux PCs. The HP workstations were expensive (compared to PCs) and used a proprietary operating system.



Ed giving a class at TOW2009.

An early project of Ed's was to port the FS to run on Linux PCs, making it more accessible. In subsequent years Ed has had primary responsibility for adapting the FS to keep up with the ever-changing landscape of VLBI hardware, as we moved from recording data on tapes to recording on disks, and as we moved from analog to digital equipment, and from physically recording data to e-transferring.

For 30 years Ed has been a frequent and very popular guest at geodetic VLBI stations around the world, where he has trained local staff in observational techniques, equipment operation, and FS usage, and helped them *solve* site-specific problems. While a stickler for detail and for doing things right (essential qualities for successful VLBI), Ed's easy-going manner, patience, and thorough knowledge of all things VLBI made him an effective instructor,

always in demand. When it comes to questions about RF electronics, Ed tends to defer to others to answer, but he knows more than he lets on. In a conversation once with VLBI god Alan Rogers about Alan's cable cal system design, Ed saw better than Alan how it worked and then explained it to him.

Most often Ed traveled solo to the stations, but occasionally he was a member of a small team sent to sites such as Matera, Crimea, Urumqi, Svetloe, and Ny-Ålesund to help bring a new station on line or to deal with multiple station issues. These trips also yielded memorable extra-curricular experiences. At Nanshan station near Urumqi, Ed and companions rode horses up the mountain to the beautifully furnished yurt of Kazakh herders, who served us fermented mare's milk. And who knew that Ed has a lovely singing voice? All it took to reveal this was (too) many rounds of vodka toasts at a dacha near Svetloe and a karaoke machine.

Ed was instrumental in the founding of the IVS, and has been on the IVS Directing Board from the very beginning. He is one of the few permanent members of the Board, being the IVS Network Coordinator. In this position he is the person stations go to when they have problems. Many station personnel know Ed from the biennial Technical Operations Workshops where Ed is a regular teacher on the FS.

Ed has wide-ranging interests outside VLBI, and conversations with him are invariably stimulating, thanks in part to his voracious book reading (and now podcast listening). He has a ham radio license (Amateur Extra class, call sign K3PN) and has participated in many major ham radio contests. When Ed was a little younger, he was a devoted runner, and ran in several marathons. Nowadays Ed gets his daily exercise by waking up early to swim laps. That may also help explain why many of us are accustomed to

receiving emails that he sent at 3:00 AM his time. Ed enjoys good food and loves sushi. If it is Monday at Goddard, we are guaranteed to go to Osaka, a Japanese restaurant across the street.

Although Ed is leaving the Goddard VLBI group, he is not disappearing from VLBI completely. He has promised to be available to provide support and guidance on the Field System and other aspects of VLBI observing.



A growler a day, keeps the FS at bay.



In 1983, Ed visited Goldstone in the Mojave Desert. Look for the guy in shorts.



Ed (right) in conversation at the TOW2015 icebreaker.



Ed and John during a company outing on the Chesapeake Bay in 2007.

Board Meets on Axel's Former Stomping Ground

– Dirk Behrend, NVI, Inc./NASA GSFC

On September 30, 2019, the IVS Directing Board (DB) came together for its 41st meeting in the former capital of the Federal Republic of Germany. IVS Chair Axel Nothnagel entertained his guests at the Institute of Geodesy and Geoinformation of the University of Bonn, his stomping ground for the last several decades. The day coincided with his last working day at this university—we were allowed to witness history in the making. It also marks the end of an era: with Axel retiring from the university, also the long-active VLBI group there ceased to exist. Since October, Axel is affiliated with the TU Vienna spending time between Bonn and Vienna.

At the meeting itself, the Board honored Jim Long, who had just passed away, by a minute of silence. A Center of Excellence for Geodesy in the UN-GGIM frame will be established at a yet to be determined location (a sponsoring country needs to be identified); this will be similar to a Coordinating Office with a personnel strength of 10–12 people. The Center of Excellence for Geodesy may fund a correlation center or remote observing sites in the future.

The IAG accepted the changes to the IVS Terms of Reference that were discussed at the 40th DB meeting. Gino Tuccari reported that the Ventspils International Radio Astronomy Center in Irbene, Latvia is interested in joining the VGOS network with a 16-m antenna that will be equipped with a BRAND receiver (which includes VGOS); personnel from the site will attend the upcoming IVS General Meeting (GM2020) in Annapolis, MD.

Ed Himwich gave notice that he would relinquish his position as IVS Network Coordinator without a final target date yet. The IVS will issue a Call for Proposals to refill the position. Students of the last VLBI Training School asked to organize a school more often; the Board felt that the amount of effort involved in organizing and teaching likely does not allow for a higher cadence. The Board was discussing the possibility of establishing the position of a frequency manager; however, the member organizations do not have the funding to employ a frequency manager. A stakeholder meeting will be organized in conjunction with the GM2020 to raise awareness of this issue, but also to address a number of other items concerning the future of the IVS service.

The meeting was closed out with a social gathering at the Gasthaus im Stiefel. This tavern is a stone's throw away from the birthplace and dwelling of the famous composer Ludwig van Beethoven ("Beethoven-Haus Bonn"), which nowadays is hosting a museum. As a side note, there will be celebrations of the 250th anniversary of Beethoven's birth in 2020. It only remains to thank Axel for his being an excellent host and for continuing to steer the IVS boat, now from a different home base.



IVS Directing Board 2019.

Upcoming Meetings...

IVS General Meeting Annapolis, MD, USA March 22-28, 2020	JpGU-AGU Joint Mtg 2020 Chiba, Japan May 24-28, 2020
IVS Analysis Workshop Annapolis, MD, USA March 27, 2020	AGN Workshop 2020 Paris, France June 15-19, 2020
EGU General Assembly Vienna, Austria May 3-8, 2020	AGU Fall Meeting San Francisco, CA, USA December 7-11, 2020

<https://ivsc.gsfc.nasa.gov/meetings>

The IVS Newsletter is published three times annually, in April, December, and December. Contributed articles, pictures, cartoons, and feedback are welcome at any time.

Please send contributions to the General Editors (see below).

The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

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The newsletter is published in color with live links on the IVS web site at

<https://ivsc.gsfc.nasa.gov/>.

News from the IVS Office of Outreach and Communications

– Nancy Kotary, MIT Haystack Observatory

Just in time for the upcoming IVS 2020 General Meeting in Annapolis, a new outreach program for the IVS is officially underway! As promised earlier, the IVS now has:

- A new outreach Web site online at <http://vlbi.org> (which still hosts the standards page, for those of you who consult this).
- A fledgling Twitter account, https://twitter.com/IVS_OOC, that even has a few followers already—hello to IVS folks online!
- An Instagram site: please send pictures for this to ivs@mit.edu or tag in your feed.
- A new IVS logo, with files for you to download and start using!

You'll likely notice that these new online outreach components are new and still a bit minimalistic at this early stage. However, now that they're being officially launched, they will all grow substantially over time as major IVS events are held and the various accounts are more widely publicized online. They are intended for people who don't know what VLBI is or what the IVS does, so there is not a lot of technical documentation to start with. More will be added once the basics are fully established online.

So far, several helpful people within the IVS have provided excellent ideas for the next stage of communications and outreach: thank you all very much. Lots of help is needed, along with feedback, ideas, and reports and photos from IVS and related conferences to fill out these new sites and social media accounts. Please email ivs@mit.edu with suggestions, feedback, and photographs of IVS meetings, people, daily tasks at sites or centers, and other ways to show off the hard work going on behind the scenes.

GM2020: Deadlines for Registration and Abstract Submission Coming

The 11th IVS General Meeting will be held in Annapolis, MD, USA during the week of March 22–28, 2020. In addition to the GM itself, a slew of splinter meetings is anticipated. An overview of the meeting week is provided on the meeting Web site at <https://ivsgm2020.com/#schedule>. Please note that the deadlines for registration and abstract submission are approaching fast. Abstracts should be submitted by January 1, 2020. Registration will close on February 1, 2020.

– Dirk Behrend



What's next? More information will be posted on a regular basis, explaining VLBI and related science and technology, and describing the various components of the IVS, plus information on the important work of all IVS members. I'll be reaching out to people at various IVS sites for help showcasing one location at a time; if you're interested in having your site highlighted online, please get in touch if you haven't heard from me already. We'll have posters talking about VLBI and the IVS and other print materials to download and hand out. (If you already have excellent VLBI outreach materials, we should talk.)

Another way to help: if you have a personal or workplace Twitter or Instagram account, please follow the new IVS accounts and tag us online when appropriate. Mention the IVS account when you post your presentation or anything else online for the upcoming IVS General Meeting. We don't expect to have a follower count in the millions immediately, but making sure we're all connected online will be one of the best ways to ensure that new content is interesting and useful.

It's time to retire the old IVS logo. The new logo has been designed to be usable in grayscale, to be visible at small sizes, to be editable for future customizations, to be reproducible in any file format needed, and to be clear against both light and dark backgrounds. The new logo files will be available at vlbi.org. Please discontinue use of the old logo at this point. If you need a customized version, a certain resolution or aspect ratio or file format, please email ivs@mit.edu. Let your colleagues know if they don't see the newsletter; an email will be sent out as well. Thanks in advance for your help making the switch, along with any feedback and input going forward!



Updated Guidelines to Handle R&D Proposals

– Dirk Behrend, NVI, Inc./NASA GSFC (for the OPC)

Since the introduction of the observing program for the legacy S/X system (see WG2 Report, https://ivsc.gsfc.nasa.gov/publications/ar2001/wg2_report_2.pdf) in 2002, the IVS has organized up to ten R&D sessions per calendar year based on proposals from the community. The main goal of these R&D sessions was the improvement of the VLBI technique in accordance with the mandate of the IVS providing a service which supports geodetic and astrometric work on reference systems, Earth science research, and operational activities. Proposals going beyond the covered fields were considered on a case-by-case basis and only after consultation with the IVS components.

The R&D experiments were mostly aimed at improving the quality of the S/X observing, while a few were dedicated to pursue targets of opportunity (e.g., observing the lunar beacon of the Chang'E mission). It was not intended to establish new observing series. The observing networks were mostly limited to eight stations; the number of sessions dedicated to a particular proposal was at the 1–2 sessions level with some being given 4–6 sessions.

While the VLBI Global Observing System (VGOS) is being developed and rolled out into the field, it has not yet reached the state where it is useful to open it up for R&D work. This may change, when the processing chain is fully established and operationally used, or when VGOS has replaced legacy S/X as the production system of the IVS.

Hence, at this point in time the Observing Program Committee (OPC) can only consider proposals that adhere to the following guidelines:

- observing system: legacy S/X only;
- maximum network size: 8–10 stations;
- maximum number of sessions: 3–4.

Any proposal exceeding these requirements are subject to being rejected or referred to the IVS Directing Board for further evaluation. The general procedures for observing proposals are provided on the IVS Web site at <https://ivsc.gsfc.nasa.gov/program/obsprop-policy.txt>.

Peter McGregor Prize Awarded to the DiFX Collaboration

On July 11, 2019 the Astronomical Society of Australia (ASA) awarded the Peter McGregor Prize to the DiFX Collaboration. This prize is bestowed on an individual or team for the design, invention, or improvement of astronomical instrumentation and associated software techniques; it is normally awarded every three years.

The DiFX Collaboration consists of a larger group led by Adam Deller; the contributors, some of which are also active in the IVS, include: Adam Deller (leader), Walter Alef, James Anderson, Matthias Bark, Matthew Bailes, Walter Brisken, Roger Cappallo, Geoff Crew, Richard Dodson, David Gordon, Zheng Meyer-Zhao, John Morgan, Chris Phillips, Cormac Reynolds, Jon Romney, Helge Rottman, John Spitzak, Matteo Stagni, Steven Tingay, Jan Wagner, Mark Wainright, and Randall Wayth.



ASA President Cath Trott (left) presenting the award to Adam Deller (right).

The assessment committee based their decision on the following evaluation: “The Distributed FX Correlator (DiFX) is a software package that contains tools necessary to turn an array of radio telescope signals into a functioning radio interferometer. The DiFX has contributed significantly to reducing the barrier to entry and play a major role in radio astronomy research internationally. The system has enabled a wide range of science, as testified by the very high number of references to the key technical papers. The open-access nature of the software has put a new tool in the hands of astronomers, with demonstrated positive results. Its scalability and adaptability have and continue to enable researchers to tailor its behavior and pursue what would otherwise be difficult science goals.”

Most of the IVS correlators use the DiFX software for their daily work. This is likely to continue into the foreseeable future. It only remains to congratulate the successful team on their great achievement.

– Dirk Behrend



“The only reason for time is so that everything doesn't happen at once.”

–Albert Einstein

Implementation of the GGRF in Latin America

– Dirk Behrend, NVI, Inc./NASA GSFC

From September 16 to 20, 2019 the IUGG Workshop “Implementation of the UN Resolution on the Global Geodetic Reference Frame (UN-GGRF) for Sustainable Development in Latin America” was held in Buenos Aires, Argentina as a capacity building activity. The workshop took place at the HQ premises of the Argentine Instituto Geográfico Nacional (IGN) in Palermo, Buenos Aires and some 130 participants from twenty countries were in attendance. While most of the attendees hailed from Latin America, about 25% came from other corners of the world (e.g., Europe, United States, Australia). Some 34 colleagues from Latin American countries received travel grants in order to be able to attend the workshop.

The various IAG services were represented by either their chairs or their central bureau directors. It was one of the most complete representations of the services that I have ever witnessed. The workshop provided a more or less complete overview of the different international organizations contributing to and supporting the implementation of the Global Geodetic Reference Frame (GGRF). One of the goals of the workshop was to promote a more active participation of the Latin American countries in global or regional initiatives including the possible improvement of infrastructure. I would regard this goal as having been accomplished. A summary and further information is provided on the SIRGAS (Sistema de Referencia Geocéntrico para las Américas) Web site at <http://www.sirgas.org/en/ggrf/>.

The logistics of the meeting was handled superbly by the IGN and the Argentinean-German Geodetic Observatory (AGGO). On the final day, the international guests were invited to visit AGGO station near La Plata about an hour's drive east of Buenos Aires. AGGO is a geodetic fundamental station that includes a 6-m S/X VLBI antenna, an SLR system, GNSS antennas, an absolute gravimeter, and a superconducting gravimeter. There are two hydrogen maser and three cesium clocks on site. It is planned to install a tide gauge at the Río de la Plata some 20 km away in the not too distant future.



Attendants of the GGRF workshop.

I was very impressed by the enthusiasm of the station personnel about their site and the individual techniques. It bodes well for the future of geodetic activities in La Plata. The cooperation between the German Federal mapping authority BKG and the Argentine Science Council CONICET demonstrates how the Global Geodetic Observing System (GGOS) can be densified at remote locations. Due to the global interest of having more fundamental stations for GGOS and complying with UN Resolution 69/266, BKG and CONICET currently discuss the continuation of its cooperation over the next decade. This period seems adequate to continue with the modernization of the instruments, bring up the SLR system, and make the observatory permanent. In the weeks following the IUGG Workshop, the IVS Directing Board approved a proposal of the IGN to become an Associated Analysis Center (AC)—making it the first IVS AC in Latin America.



Workshop visitors at the AGGO site with the 6-m VLBI antenna in the back.

VieVS Days 2019

– Elena Martínez Sánchez, OAN Yebes Observatory

From October 15 to 17, 2019 the “VieVS Days” (formerly called VieVS User Workshop) were held in Vienna, Austria to present the “Vienna VLBI



Participants of the VieVS Days 2019 in Vienna, Austria.

and Satellite Software” version 3.1 to new users. Participants from China, Germany, and Spain attended the three days of the workshop and learned how to use

the software. Several lectures combined with various exercises gave all attendees a solid knowledge in the VLBI analysis.

The first day focused on analyzing geodetic VLBI sessions, and we saw the possibilities of analyzing VLBI observations by ourselves. We learned how to detect clock breaks or how to diagnose other problems in the analysis of individual sessions. We also acquired knowledge in how to deal with Intensive sessions, do multiple session processing, and determine global solutions. On the second day, we could create a schedule with the VieSched++ software, which is an independent tool of VieVS that allows the creation of high-quality geodetic sessions. The final day focused on the analysis of VGOS sessions and the baseband simulator.

In general, the VieVS Days were very useful and provided us with an overview of all aspects that need to be considered in the analysis of different types of sessions. Coffee and lunch breaks were an opportunity to talk with other participants and share different experiences from our daily work. Every day, after the meeting, we had free time to visit Vienna and its historical buildings, such as the Vienna State Opera, the St. Charles Church, or the Schönbrunn Palace (where we attended an opera show). On the last day we had the opportunity to try one of Vienna’s most popular dishes—the Wiener Schnitzel.

We wish to thank all the lecturers and the Department of Geodesy and Geoinformation of TU Wien for their efforts, time, and kindness. It was a great experience and what we learned will be immensely valuable for our future work.



Matthias Schartner giving a lecture during the VieVS Days 2019.

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