



Non-GM2020: The General Meeting that Wasn't

– Dirk Behrend, NVI, Inc./NASA GSFC

While some people may consider non-GMO a good thing, a non-GM2020 is a different beast altogether. In particular, when you are on the side of organizing the event, it is a draining feeling that all your efforts and sweat were basically in vain. And I'm sure that on the attendee side there is also a lot of frustration. However, let's not lament too much and just have a look at how we got there and how to move on.

Whoa event app. The latter was intended to have a paperless meeting by having the meeting program readily available on your mobile device. About three weeks before the meeting start, we had final preparation meetings with the meeting venue and banquet place.

By mid-January there was an increasing amount of news about a novel coronavirus spreading in China. We saw it as a distinct possibility that this could impact our meeting. This was confirmed, when the U.S. government implemented a travel ban for travelers from China, basically making the participation of our Chinese colleagues an impossibility. This was especially unfortunate, as we started very early with them to ensure that they would get a travel visa for the U.S. and we were mostly successful.

As the coronavirus spread further around the world, we received messages from several countries first stating that their participation was doubtful, followed by several cancellations. We reached a critical mass when we were informed by NASA leadership that we would not be able to attend our own meeting if there were international participants. Thus, two weeks prior to the meeting start, we officially canceled GM2020 and its splinter meetings. Discussions are under way to see if at least some of the planned meetings could be held in a virtual setting; however, this is challenging as the IVS community covers a large range of time zones. Hence, it appears likely that only select meetings will be held in this fashion.

So, unfortunately, there will be no GM2020 (that is, neither replacement nor postponement). And we may continue with the next GM, which is planned to be held in Helsinki in 2022. Will the next GM then be the 12th General Meeting? We hope so. Although GM2020 is the GM that wasn't, we would like our efforts to be counted.

Venue of 12th General Meeting

The 12th IVS General Meeting will be organized by the Finnish Geospatial Research Institute (FGI, National Land Survey of Finland) and is likely to be held in late March 2022 in the greater Helsinki area. With GM2022 we will also celebrate the completion of the geodetic core station at Metsähovi.



A still-life with the giveaway collection.



The logo of GM2020.



The story began a few weeks before the General Meeting in Longyearbyen, that is, sometime in the spring of 2018. The Goddard VLBI Group and some other contenders submitted proposals for holding the 11th IVS General Meeting in 2020. The Directing Board evaluated the proposals and eventually awarded the event to the U.S. group. We decided early on to hold the meeting in Annapolis, MD, which is some 20 miles east of Goddard, and made arrangements for the hotel and meeting venue. At the GM in Longyearbyen we presented a short video introducing the planned meeting as we saw it then.

With the initial steps made, the local host of NVI, Inc. then started to put the pieces together trying to make GM2020 a memorable event. Well, we mostly laid low for the remainder of 2018 and early 2019, before we ramped up activities about a year before the actual event. Early activities included scouting venues for the meeting banquet and the excursion and looking into added fixtures for these events. Have you heard of Dem Raider Boyz?

By the summer of 2019, the Program Committee and Directing Board had agreed on the keynote theme for the meeting (“VGOS – 20/20 Acuity for VLBI”) and the initial Web site and logo were set up. With the Web site we introduced the color theme for the meeting—we went for the primary colors (red and gold) of the Maryland flag (while black and white are accent colors). We continued with the color scheme for the giveaway and eventually also used it with the

The Korean Geodetic VLBI Station at Sejong

Sejong Station is the first geodetic VLBI station in the Republic of Korea, its main purpose being to support geodetic VLBI observations. To this end, the station (known within the IVS by its two-letter code 'Kv') sports a 22-m diameter telescope. The site has been an IVS Network Station since April 2012. Newsletter Editor Hayo Hase checked in with Sang-oh Yi to learn more about the station and its people. The following is what Hayo found out in an e-mail interview.



Aerial view of Sejong Station taken using a drone.

Sang-oh, can you give us an introduction to your VLBI station.

The Sejong VLBI Station is operated by a Korean national agency called the National Geographic Information Institute (NGII). It is located about 120 km south of Seoul, the capital of Korea. The VLBI Observation Station is situated at the peak of a small mountain located in a new city called Sejong. Sejong is a new city that will be developed in multiple phases until the year 2030. The area around the observation station is yet to be developed, so thanks to the pristine environment, we have opportunities to see wildlife such as water deer, pheasants, and snakes from time to time.

What was the purpose of establishing the Sejong VLBI Station and what is the composition of the personnel?

NGII, which runs the Sejong VLBI Station, is a national agency operating under the legal framework for producing and managing spatial information such as maps and the national geospatial standards. VLBI is one of the various technologies applied to manage the national geospatial standards. NGII is well-aware of the importance of scientific equipment such as VLBI to ensure accurate geospatial standards, and this is why it established the Space Geodetic Observation Center

in March 2012 and the VLBI station here. It is staffed with four regular employees, including myself, carrying out VLBI-related job duties. On the other hand, equipment maintenance and local surveying, which are performed regularly, are carried out by private companies that we have signed contracts with. Considering VLBI observations, data analysis, maintenance, and surveying among other tasks, I believe there are around twenty people involved in the operations of the Sejong VLBI Station.

What are the job duties of the Sejong VLBI Station staff?

The Sejong VLBI Station is one of the departments under the Geodesy Division of NGII. Therefore, our fundamental job duties include administrative and clerical tasks associated with NGII and our supervising division. We carry out VLBI observations, correlational analyses, and baseline analyses in parallel. We compile the results of the VLBI observations and provide the technical support necessary for the results to be reflected in the national surveying system. Our partners providing equipment maintenance services visit our center on a regular basis to inspect and maintain the equipment. We also provide tours to visitors including students. We welcome approximately 1,400 visitors a year, and providing visitor services is part of our staff members' job duties.

What are your priorities for the station and what do you do to attain the related goals?

The priority of the Sejong VLBI Observation Station is to continually generate important data for decision-making and management of the global geospatial standard systems such as the UN-GGIM, GGRF, and IAG GGOS. This ultimately strengthens the national administrative and technical capacities related to geospatial standards. The space-geodetic techniques applied at the Sejong VLBI Station encompass VLBI, GNSS, and SLR. We are preparing to contribute fundamental observation station data to ITRF2020 by using these different types of equipment in combination for surveying. We are doing research to determine the optimal surveying techniques for linking different technologies and preparing to put them into application. To this end, we are currently working together with surveying engineers and academic experts.



Station staff in front of the telescope (from the left): Sang-won Lee, Sang-oh Yi, and Sang-chul Han.

Are there any operational challenges? If so, what do you do to overcome them?

The Sejong VLBI Observation Station is affiliated with NGII; hence, our work is closely linked together. And there are significant challenges associated with this. In order to enhance the convenience of applying observation techniques, we have developed and applied a graphical user interface as well as a program for automating routine tasks such as data conversion and correlation analysis. This has been considerably helpful, time-wise, as it has allowed us to focus on new or urgent assignments. More recently, we have developed Python-based field software for VLBI observations (Field System), which we are currently using on a trial basis. This is also intended to provide improved convenience when it comes to equipment maintenance and upgrades.

What services do you provide to the general public?

A radio telescope in an urban setting is a great structure that triggers people's curiosity. People want to come to the observation center to take a look around and go near the antenna. They are ultimately curious about what this massive antenna does. At the observation center, we have set up a small public relations (PR) hall to help people gain a better understanding of VLBI. Of course, we do not charge admission. In addition to a VLBI observation simulation device, there are VLBI videos and information panels for students. The information is provided to introduce our center and the IVS member states to our visitors and inform them of what kind of work we do.

What do you do in your free time, and is there a message you would like to convey?

I enjoy fishing in the quiet at a tranquil river or doing weight training for my health. However, I have three sons: my oldest is six years old and loves insects and animals, then I have four-year-old twins who are indescribably adorable. So, I think, I will spend all my free time with my family until they grow up. That aside, I would like to extend my gratitude to everyone in the field of VLBI at home and abroad, as without them I would not be able to do this peaceful and amazing work. The Sejong VLBI Station and I have received technical assistance from VLBI experts from a number of different countries. I would like to especially thank the Kashima VLBI Group (particularly Dr. Kondo) and the members of the NASA/GSFC Group (John, David, Sergei, and others).

Thank you very much for the interview.



Inside the observation control room of Sejong VLBI Observatory showcasing the installed monitoring and control systems.



Visitors, young and old, can learn a thing or two in the Sejong Center for Public Relations.

IVS Outreach Corner

The IVS outreach program continues to grow! In the works: poster and handouts explaining the IVS and VLBI. The outreach website, <https://vlbi.org>, is up and running, including updates on events, locations, and milestones. We have a small and growing following on Twitter (@IVS_OOC), and will be adding photos to Instagram over time.

Please send any updates, changes, and especially photos of your sites and anything IVS-related to ivs@mit.edu. We'll be in touch over the coming months to profile various locations. Suggestions are welcome, as always.

Please see the IVS outreach website for the new logo file.

**** Letter from the Board **** **** Letter from the Board ****

Re: Continuation of operational readiness of IVS components for maintenance of globally critical infrastructure

Dear colleagues,

The COVID-19 pandemic has changed our daily life in a dramatic way which we never imagined could happen in our civilization. We, the IVS Directing Board, very much hope that all of you and your families will safely live through this extraordinary challenge.

In view of the operational readiness of the IVS in these hard times, it is more important than ever that we remind ourselves of the fact that the products delivered by the IVS are essential for a large number of subsequent applications. As you all know, the IVS performs regular, globally organized VLBI observations for—to a large extent—the determination and dissemination of Earth orientation parameters. In particular, the phase of rotation, UT1–UTC, is essential—beyond space navigation applications—for orbit computations of Global Navigation Satellite Systems (GNSS) such as GPS, Galileo, GLONASS, Beidou, QZSS, and IRNSS. The lack of UT1–UTC information on a daily basis would lead to a degradation of the navigation

capabilities of any of these GNSS. And this will impact the ability to not only navigate your personal car safely but also to conduct those many search-and-rescue operations and other emergency applications. For this reason, observatories and correlators as well as analysis, combination, and data centers together with the IVS coordination components must secure the infrastructure to sustainably maintain delivery of the necessary UT1–UTC product and subsequently of the reliability of all GNSS.

In the times of the novel coronavirus COVID-19 pandemic, we count on you so that all operational components of the IVS as outlined above keep performing their duties for EOP determinations as set forth in the IVS master observing plans, such as the Intensive series and the R1, R4, and VGOS sessions, as best as you can. Of course, we make this request under the assumption that you take utmost care of your own health and avoid risking an infection.

Yours sincerely,

Directing Board of the IVS

The IVS Newsletter is published three times annually, in April, August 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.

General Editors: Dirk Behrend (Dirk.Behrend@nasa.gov),
Kyla Armstrong (Kyla.L.Armstrong@nasa.gov)
Feature Editor: Hayo Hase (hayo.hase@bkg.bund.de)
Layout Editor: Heidi Johnson (heidij@mit.edu)

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

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

A Salute to the IVS Components

As the COVID-19 outbreak expanded into a global pandemic in the month of March, numerous countries started to impose drastic measures to curb the spread. Plenty of stay-at-home orders were issued, forcing a significant number of people to telework. This included many of the staff of the various IVS member organizations—otherwise working at observatories, correlation centers, the coordinating center, analysis centers, or what have you. A logical consequence might have been a discontinuation or a reduction of the IVS operations. This, however, is not the case. By and large, the IVS observational program continues as planned.

This clearly deserves a salute to the IVS components, who found resourceful ways to continue their work successfully. Several stations transitioned to remote operations, albeit with limited technical support on site. The current status of the various sites is summarized in a table available at the outreach office under the URL <https://vlbi.org/site-status/>. The plan is to keep this table current for the duration of the coronavirus crisis. A survey of the IVS correlators has assured us that the processing of the station data will continue to work for the foreseeable future. And, looking at the email traffic in the various IVS exploder lists, analysis results are made available at the normal pace. For that, we would like to commend each and every single one of you for your devotion and dedication. We very much appreciate all your efforts. Stay safe and healthy.

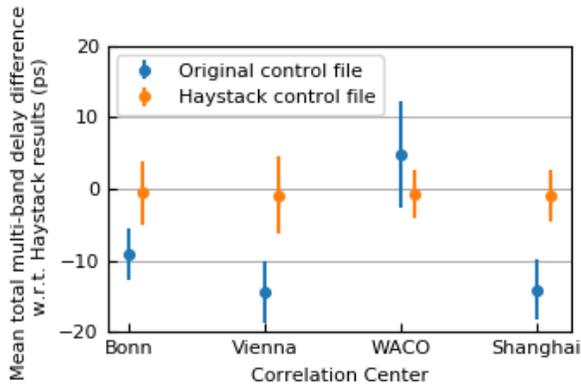
– Dirk Behrend

FROM THE VGOS WORLD...

Blind Test Advances VGOS Correlation and Post-processing

– John Barrett, MIT Haystack Observatory

What is the current state of VGOS correlation? There has been continual progress in bringing online correlation capacity to the VGOS community since the VGOS Correlation workshop held at Haystack in May 2019 following the last TOW.



The mean difference in the total multi-band delay over all scans in session VI9290 of each correlation center with respect to the value estimated at the Haystack correlator. The error bars are the root-mean-square scatter of the difference. Initially, (blue markers) systematic offsets of several picoseconds were seen between each correlation center, but these (orange markers) were largely eliminated when correlators reprocessed the data using the same (Haystack) control file.

As part of this process, an exercise serving as a “blind test” was performed in late 2019 that involved five correlation centers—Haystack, Bonn, Washington, Vienna, and Shanghai—whereby each correlator would independently process the exact same VGOS data, and results would be compared. The purpose of this test was twofold: (1) to evaluate the individual correlator readiness to process VGOS data and (2) to validate the process described at the VGOS Correlation workshop.

The test was carried out in a “blind” way to tease out discrepancies in the way the processing might be done at each correlation center. Ostensibly, because the data, processing software, and methods were to be the same among all correlators, it was expected that geodetic products such as station position and UT1–UTC estimates would also be identical, or close to it (i.e., within the estimated errors). Surprise! This was found not to be the case, as Sergei Bolotin communicated to us in December.

The test involved realistic yet data-manageable observations: a one-hour VGOS Intensive session between KPGO and Wettzell was run on 17 October 2019 (aka VI9290). Although one might view the scope of this 3-terabyte data test as somewhat limited, it does duly exercise all VGOS correlation and post-processing steps while eschewing the gargantuan data volumes of a typical 24-hour, multi-station VGOS session, or about 180 terabytes. Efforts

for a 24-hour VGOS session study are currently underway.

In order to compare the data as processed by each correlation center, the results of several intermediate steps from correlation through geodetic processing were examined. Primarily, items of interest included how the correlator setup was done (e.g., software version, clock model, Earth orientation parameters), the construction of the fringe-fitting control file, the application of various delay calibrations, the resulting signal-to-noise ratio of scans, and the differences in multi-band delay (the VGOS broadband delay synthesized over the four observing bands and two polarizations) for each scan relative to Haystack, the reference correlator (see figure for some results). The gory details can be found in the following Haystack memo: https://www.haystack.mit.edu/geo/vlbi_td/BB/051.pdf.

In short, it is concluded that broader inter-correlator coordination and further refinement of the data processing procedures will be required to improve on the repeatability of VGOS results, which is deemed highly desirable. This study has already identified some improvements to the post-processing software, and a new automation feature has been added. However, not all discrepancies found can be eliminated solely by software improvements, some such as the establishment of a uniform procedure for setting station clocks will require attention from the general community.

The VGOS correlation study is at a juncture where correlation centers will now receive data from a typical 24-hour, multi-station session in various forms. A successful comparison will then move VGOS correlation to the next level, one where all correlators will process VGOS data consistently and validated quality products will be generated.



Author John Barrett (right) in discussion with Harro Verkoeter during a break of the VGOS Correlation workshop at Haystack

FROM THE VGOS WORLD...

Towards VGOS Correlation in Vienna

– Jakob Gruber, TU Vienna

The Vienna Correlator has been part of the VLBI processing chain for two years in order to provide correlator and fringe-fitting products for the IVS community. Most sessions use the AuScope antenna network to observe sources in the southern sky and improve their position accuracy. For the correlation of these S/X band sessions, the third realization of the Vienna Scientific Cluster (VSC-3) has been used.



With the VSC-4, the supercomputer family in Vienna recently got a new member. We are very happy that we have gained access to this high-performance computing infrastructure. We use 480 private cores as well as private storage of 1 PByte dedicated for VLBI correlation and fringe-fitting. The VSC-4 is connected via 10-Gbps e-transfer links to the world. Initial VGOS raw data processing performance tests with the Distributed FX software correlator (DiFX) show very promising results in terms of data throughput and scalability. At the moment we do a comparison with the MIT Haystack correlator to evaluate the quality of our VGOS data products. Once these readiness tests are completed, we are looking forward to seeing how the new correlation infrastructure can handle the immense data load of a full 24-h VGOS session.

Inspection of the Vienna Scientific Cluster 4 by Johannes Böhm (front), Jamie McCallum (back right), and Jakob Gruber (back left). More info at <https://www.vlbi.at>.

Status of VGOS at Metsähovi

– Nataliya Zubko and Joonas Eskelinen, Finnish Geospatial Research Institute (FGI)

The VGOS telescope at FGI's Metsähovi Geodetic Research Station was recently equipped with a new 2.1–14 GHz broadband receiver. The receiver was manufactured by the IGN Yebes Technology Development Center and arrived at the station in the middle of November. After successful on-site laboratory tests, the receiver was lifted onto the telescope and installed in the cone (see figure). All the commissioning and installation work was done together with the IGN Yebes staff; everything went well and FGI would like to thank Yebes for their efforts. First light with the Metsähovi VGOS telescope was obtained soon after the commissioning by observing the bright radio source Cassiopeia A. Work on the determination of a pointing model for the telescope has begun.

Initial receiver tests showed that several RFI sources could disturb the VGOS observation band. Work to monitor and to alleviate the RFI conditions continues at the station. Work on monitoring the telescope's reference point stability has also started. For this purpose, two GNSS antennas were installed on the sides of the telescope dish in March. A series of local tie measurements, including the telescope reference point, are planned for this year. Testing is under way of the telescope system including the receiver as well as the integration of the signal chain components.



Installing the broadband receiver on the VGOS telescope on 22 November 2019 (Photo: Nataliya Zubko).

Don't Cry for Me, Compressor!

– Alex Burns, MIT Haystack Observatory

Spring has not quite sprung in the northeast United States, but already some days have reached 20°C. During this time of the year we always experience some warming in the cryogenic system, as the ambient temperatures and sun loads increase from winter. With the older Model 22 refrigerator, it may be the time to change the cold head. But with the new Model 350, we can see 18, 24, or even a bit more months of use before failure. So, in the springtime we purge contaminants from the system. This involves starting with a cold system, turning off the cryo compressor, and immediately disconnecting the supply and return lines from the back of the compressor. We connect these lines to a helium maintenance manifold, which allows us to fill the cold head from a supply bottle of Ultra High Purity helium, and also allows us to purge to atmosphere. We then warm the system to ambient and flush the cold head by first purging the helium from the supply and return lines and the cold head, filling the manifold, lines, and cold head from the supply bottle, and then operating the cold head at between 195 and 205 PSI for 10–30 seconds. This process is repeated five times in total. The procedure clears the formerly frozen contamination from the cold head, hopefully giving you a worry-free summer of operations!



Picture of a helium maintenance manifold. The fill from the helium bottle is on the right, the purge to atmosphere is on the left, and the supply and the return helium lines attach to the two large connectors on the top side.

**** IVS Raffle ****

Celebrating 20 Years of IVS: You can win a prize!

On the occasion of the 20th anniversary of the IVS, Zinovy Malkin looked into the evolution of the data and products of the service and compiled an extensive article that he recently published in the journal *Astronomy Reports* (Vol. 64, No. 2, pp. 168–188, 2020). The paper is also available via arXiv under the URL <https://arxiv.org/abs/2003.03364>.

We would like to compliment Zinovy on this work and use it to celebrate our first 20 years with an IVS raffle:

- Explore this remarkable paper on your work and our IVS history! Select your favorite table or graphic and tell us why!
- Send an e-mail with the subject “IVS raffle” to the Office for Outreach and Communications <ivs@mit.edu>. In the main body of the e-mail describe your favorite in the following style: “I like table/figure X most, because of ...”
- Submit your entry to the raffle by June 30, 2020. Your submission is subject to be published in the next issue of the IVS Newsletter.

We will select the best entry among the submissions and award the winner with a commemorative MLB Washington Nationals Bam Vino bottle holder. Good luck!



Upcoming Meetings

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

A consequence of the COVID-19 pandemic is that larger gatherings of people have been disallowed in many countries in the foreseeable future. Social distancing rules are simply impossible to implement in a regular conference setting. Hence, we refrain from listing the upcoming meetings that would be of interest to the IVS community. We would like to point out, though, that both the EGU General Assembly and the JpGU-AGU Joint Meeting plan on implementing virtual meetings instead. The AGN Workshop 2020 has been cancelled. The AGU Fall Meeting is still scheduled to be held as usual.

CSIRO Hosts IVTW in Sydney

– *Jamie McCallum, University of Tasmania*

The 8th International VLBI Technology Workshop (IVTW) was held in Sydney at the CSIRO's Marsfield Centre over three days in November. This followed on from the DiFX developer's meeting held in Melbourne the week before.



Participants of the 8th International VLBI Technology Workshop in Sydney.

With the number of attendees at approximately 40, this was one of the smaller IVTW meetings but it still included contributions from around the world. Along with reports from observatories and networks,

there were new results from spacecraft and asteroid tracking experiments, ICRF surveys, and novel observing techniques to improve phase referencing.

There was a particular focus on developments in receivers and high-speed samplers, with presentations of the recent developments for the Australian telescopes operated by the ATNF. Notably, wideband receivers for the Parkes radio telescope have been

built with the Ultra-wideband Low (UWL) receiver operating between 0.7 and 4 GHz having been constructed, with a second receiver operating between 4–16 GHz planned. The great benefit for these receivers at Parkes is in removing the necessity of labor-intensive receiver changes.

The IVTW meetings are notable for inviting contributions from industry groups as well as scientific organizations. Of particular interest locally were the presentations from Intel dealing with the next generation of memory technologies, and AARNET (the Australian Research Network) on the continuing roll out of high-speed networking infrastructure connecting Australia to the world.

As usual, the coffee breaks provided excellent opportunities for discussions and in-person meetings, and good use was made of this.

While the bushfires made their presence felt with red skies and a remarkable blanket of smoke one morning, there was no effect beyond this. The conference dinner was conducted on an evening cruise around Sydney Harbour.

The meeting concluded on the Wednesday with plans being made for the next meeting, with Haystack Observatory volunteering to host this. Details are yet to be announced.

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

ivscc@lists.nasa.gov

phone: 301-614-5939

fax: 301-286-0239

IVS Coordinating Center

NASA GSFC

Code 61A.1

Greenbelt, MD 20771

