DACH Operation Center Report

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Abstract OC DACH plays a central role in the operations of the International VLBI Service for Geodesy and Astrometry (IVS), supporting 21 out of 38 IVS observing programs listed in the master schedule, making it the largest operation center in terms of supported programs. Between 2023 and 2024, OC DACH was responsible for 859 out of 2374 Intensive sessions and 107 out of 493 24-hour sessions. In addition to routine operations, OC DACH actively contributes to research and development, particularly in VGOS, and continuously improves scheduling automation, robustness, and data quality control. Future efforts will focus on advancing scheduling software, enhancing source selection, and further developing VGOS scheduling strategies.

1 General Information

The Operation Center (OC) DACH is a joint endeavor of ETH Zurich (Switzerland), the Federal Agency for Cartography and Geodesy in Germany (BKG; Germany), and formerly TU Wien (Austria). The motivation behind the OC DACH is to combine expertise in VLBI scheduling with expertise in VLBI operations. Furthermore, with the help of this cooperation, the longevity of the Operation Center can be ensured.

1. ETH Zurich
2. Federal Agency for Cartography and Geodesy

2 Component Description

The operational scheduling part of OC DACH is centered around the scheduling software VieSched++ [1], as well as the automated operational framework VieSched++ AUTO. The software is regularly updated with new developments based on community needs and scientific discoveries.

The software is hosted at a dedicated server infrastructure at the Geodetic Observatory Wettzell, including backup facilities.

3 Staff

Matthias Schartner is currently leading the operational scheduling aspect of OC DACH. He is further responsible for improving the scheduling software development. Benedikt Soja is leading the research group at ETH Zurich. The Federal Agency for Cartography and Geodesy staff members supervise and support the technical facilities running the OC.

4 Current Status and Activities

OC DACH is responsible for a significant portion of the operational IVS sessions and plays a key role in R&D activities focused on VGOS. It supports 21 out of the 38 observing programs listed in the IVS master schedule—10 out of 17 for Intensive sessions and 11 out of 21 for 24-hour sessions—making it the largest operation center in terms of the number of supported

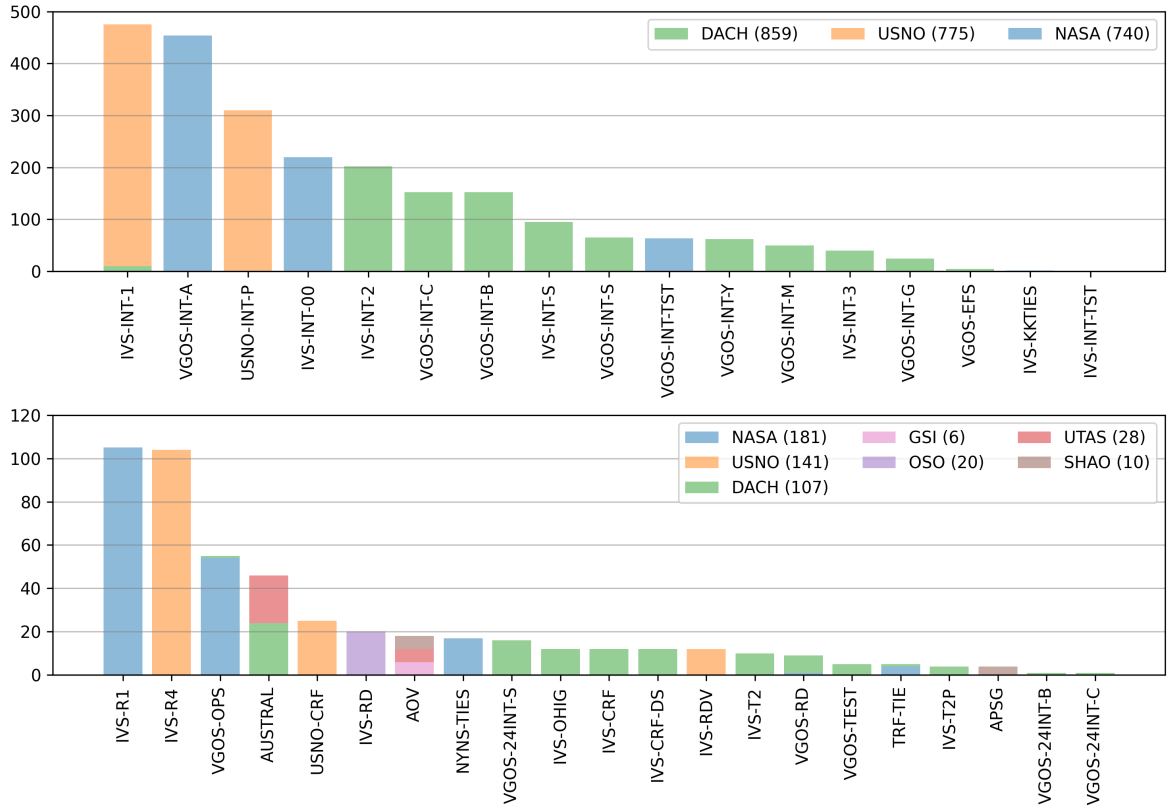

Fig. 1 List of observing programs listed in the IVS master schedule, color-coded by operation center. The number next to the OC name indicates the total number of sessions.

observing programs. Figure 1 lists all IVS observing programs and the corresponding operation center.

Below is a brief overview of the observing programs. While individual sessions may deviate from the descriptions provided, this summary offers a general perspective.

Figure 2 depicts the distribution of sessions scheduled at OC DACH. Only observing programs with ≥ 4 sessions are listed. Figure 3 depicts stations explicitly mentioned in the following text.

4.1 Intensive Sessions

Intensive sessions are a cornerstone of IVS operations, providing one of the core geodetic VLBI products: the rapid determination of the Earth's phase of rotation, expressed via the UT1–UTC parameter. Between 2023 and 2024, OC DACH was responsible for 859 out of 2374 Intensive sessions, making it the largest operation center for Intensives.

4.1.1 S/X Intensive Sessions

- **IVS-INT-2**: Weekend Intensive sessions initially observed between Is, Mk, and Wz, later primarily between Mk and Wz. These sessions use a 256 Mbps observing mode. A detailed program description can be found in [2].
- **IVS-INT-3**: Monday Intensive sessions observed using a 1 Gbps observing mode. The network varies based on antenna availability but typically involves Ns, Wz, Ny, and either Is or Sh. A detailed description can be found in [2].
- **IVS-INT-S**: Southern Hemisphere Intensive sessions observed on Mondays between Hb and Ht, with Yg added in February 2024. These sessions

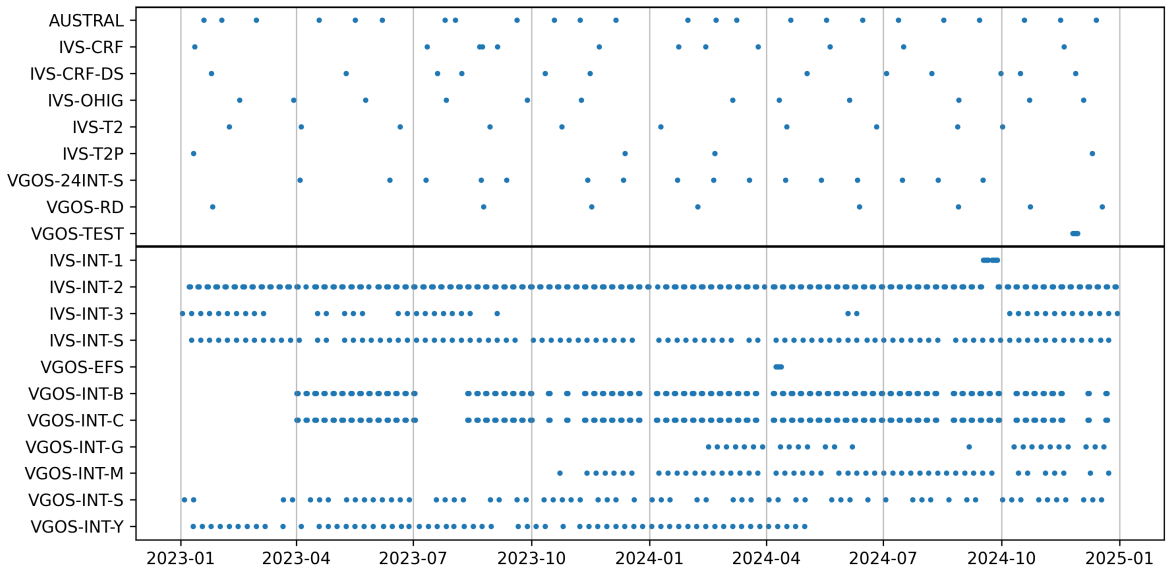

Fig. 2 Temporal distribution of sessions scheduled at OC DACH: (top) 24-hour sessions, (bottom) Intensives. Only observing programs with ≥ 4 sessions are listed.

Fig. 3 List of stations explicitly mentioned in the text in alphabetic order: Gs (GGAO12M); Hb (HOBART12); Ht (HART15M); Is (ISHIOKA); Mg (MACGO12M); Mk (MK-VLBA); Nn (NYALE13N); Ns (NYALE13S); Ny (NYALES20); Oe (ONSA13NE); Oh (OHIGGINS); Ow (ONSA13SW); Sa (RAEGSMAR); S6 (SESHAN13); Sh (SESHAN25); Ws (WETTZ13S); Wz (WETTZELL); Yg (YARRA12M); Yj (RAEGYEB).

use a 1 Gbps observing mode. A detailed description can be found in [3].

4.1.2 VGOS Intensive Sessions

- **VGOS-INT-B**: Weekend Intensive sessions observed between Is, Oe, and Ow using the standard 8 Gbps VGOS observing mode. A detailed program description and performance evaluation can be found in [4].
- **VGOS-INT-C**: Weekend Intensive sessions observed between Is, Oe, and Ow, running consecutively with VGOS-INT-B and using the standard 8 Gbps VGOS observing mode. This program began in April 2024 and differs from VGOS-INT-B by employing a novel scheduling approach that considers the source jet angle relative to the projected baseline orientation. An evaluation of the performance gain compared to VGOS-INT-B is underway.
- **VGOS-INT-G**: Thursday Intensive sessions observed between Is, Sa, Yj, and S6 using the standard 8 Gbps VGOS observing mode, with plans to test alternative observing modes. This program started in February 2024.
- **VGOS-INT-M**: Monday Intensive sessions observed between Is, Ws, and Nn using the standard 8 Gbps VGOS observing mode. This program started in October 2023.
- **VGOS-INT-S**: Tuesday Intensive sessions observed between Mg and Ws using the standard 8 Gbps VGOS observing mode. These sessions test a novel scheduling strategy that alternates rapidly between high- and low-elevation scans

to improve atmospheric delay determination. A detailed program description can be found in [5].
- **VGOS-INT-Y**: Tuesday Intensive sessions primarily observed between Sa, Yj, and either Mg or Gs. The sessions are using the standard 8 Gbps VGOS observing mode.

4.2 24-hour Sessions

Beyond Intensive sessions, OC DACH is responsible for a variety of 24-hour sessions, which typically involve a global network of telescopes. Between 2023 and 2024, OC DACH was responsible for 107 out of 493 24-hour sessions, making it the third-largest operation center for these sessions.

4.2.1 S/X Sessions

- **AUSTRAL**: These are regional sessions observed in Australia. Only the so-called AUA sessions are scheduled by OC DACH, while the AUM sessions are managed by UTAS. Typically, one AUA session is conducted per month, using a 1 Gbps observing mode. A detailed description of this observing program can be found in [6].
- **IVS-CRF**: These sessions aim to improve the celestial reference frame, focusing on sources located between $\pm 30^\circ$ declination. Six sessions are conducted per year using a 1 Gbps observing mode. A detailed description of this observing program can be found in [7].
- **IVS-CRF-DS**: Similar to the IVS-CRF sessions, these sessions focus on improving the celestial reference frame but target sources located below -15° declination. Six sessions are conducted per year using a 1 Gbps observing mode. A detailed description of this observing program can be found in [7].
- **IVS-OHIG**: These sessions aim to improve the terrestrial reference frame, with a special focus on incorporating station Oh, located in Antarctica, into the network. Six sessions are conducted per year using a 128 Mbps observing mode.
- **IVS-T2**: Dedicated to enhancing the terrestrial reference frame, these sessions involve a global network of telescopes, including stations from the NASA Deep Space Network. Five sessions are conducted per year, using a 128 Mbps observing mode.
- **IVS-T2P**: These sessions are essentially the same as IVS-T2, with the exception that they utilize a 512 Mbps observing mode. Two sessions are conducted per year.

4.2.2 VGOS Sessions

- **VGOS-24INT-B**: These are 24-hour Intensive sessions observed consecutively using the VGOS-INT-B scheduling strategy. The purpose is to increase the sample size of the sessions and enable more sophisticated analyses. Regular operation of this program is not currently planned.
- **VGOS-24INT-C**: Similar to the VGOS-24INT-B sessions, these are 24-hour Intensive sessions observed consecutively using the VGOS-INT-C scheduling strategy. The aim is to increase the sample size and support advanced analyses. Regular operation of this program is not currently planned.
- **VGOS-24INT-S**: These sessions are scheduled as 24 consecutive one-hour Intensive sessions, alternating between using the VGOS-INT-S scheduling strategy and a standard Intensive scheduling strategy. Unlike the VGOS-24INT-B and VGOS-24INT-C sessions, these sessions have been conducted regularly for a period of time and may continue in the future.
- **VGOS-RD**: These sessions represent global VGOS research and development (R&D) efforts. Each session is uniquely designed based on specific objectives, ranging from source surveys to testing frequency sequences and calibration approaches. A detailed discussion of some VGOS-R&D activities can be found in [8].
- **VGOS-TEST** and **VGOS-EFS**: These are six-hour long extended frequency tests for VGOS stations. Five sessions have been observed on five consecutive days using the same schedules but different observing modes, allowing for a rigorous comparison of different frequency sequences. The results of these sessions will be presented soon.

5 Future Plans

Looking ahead, OC DACH aims to further enhance its operational efficiency, automation, and support for research and development. The following key areas will be the focus of our future efforts:

We will continue to refine and automate the scheduling processes to improve operational efficiency and reliability. This includes the development of more robust algorithms to handle unforeseen issues, ensuring smooth and uninterrupted session planning.

Strengthening quality control measures will be a priority. This involves improving real-time and post-session data validation, refining error detection mechanisms, and ensuring that scheduled sessions meet the highest performance standards.

Significant improvements are required for VGOS scheduling, particularly regarding the handling of input catalog files, which are currently insufficient. Further advancements in source modeling and observational strategies will be pursued to optimize VGOS operations.

Efforts will be made to enhance the selection and monitoring of observed sources. This includes optimizing source catalogs, improving tracking of source stability and astrometric quality, and incorporating new observational strategies to maximize data reliability.

OC DACH will continue its active involvement in R&D activities, particularly in advancing VGOS capabilities. Research will focus on refining observational strategies.

Future developments in scheduling software will address evolving needs, particularly for satellite observations. Additionally, methodologies from neighboring disciplines, such as astronomy and astrometry, will be explored and integrated to enhance scheduling accuracy and flexibility.

To ensure sustainable operations and workload distribution, training initiatives will be expanded. The goal is to distribute scheduling expertise across a broader team, fostering knowledge transfer and ensuring that scheduling tasks can be handled efficiently by multiple operators.

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