Ny-Ålesund Geodetic Observatory

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Abstract In 2019/2020 the 20-m Ny telescope in Ny-Ålesund, Svalbard, operated by the Norwegian Mapping Authority (NMA), continued regular contributions to the IVS observation schedule as the northernmost VLBI station. The Ns 13-m telescope at the new geodetic observatory (officially inaugurated in 2018) became a tag-along station and is contributing regularly to R1 and R4 sessions.

1 General Information

The Geodetic Observatory of the Norwegian Mapping Authority (NMA) is situated at 78.9° N and 11.9° E in Ny-Ålesund, Kings Fjord, on the west side of the island of Spitsbergen. This is the biggest island in the Svalbard archipelago. The Geodetic Observatory features a 20-meter Legacy VLBI radio telescope at the Rabben site (see Figure 1), as well as fast-slewing VGOS (VLBI Global Observing System) twin telescopes at the new facility at Brandal (see Figure 2). In 2019/2020, the 20-m Ny telescope at Ny-Ålesund was scheduled for 241 24-hour VLBI sessions, including R1, R4, EURO, RD, T2, and RDV sessions. But, due to the failure of the elevation encoder in November 2020, only 96 sessions were analyzed in 2020. The Ny telescope was also scheduled for 101 one-hour sessions within the Intensives program during this period. Meanwhile, the 13-m Ns telescope was scheduled in tag-along mode in 67 sessions in 2019/2020.

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Fig. 1 The geodetic observatory's Rabben site with the Ny 20-m telescope.

Fig. 2 The geodetic observatory's Brandal site with 13-m twin telescopes (Image: Bjorn-Owe Holmberg).

In addition to the 20-m VLBI telescope and the 13-m twin telescopes, the geodetic observatory has two GNSS receivers in the IGS system and a Super Conducting Gravimeter which is part of the International Geodynamics and Earth Tide Service. A second SCG is installed at the Brandal site, approximately 1.5 km away. A solar radio burst monitor is set up at Rabben,

and a tide gauge is in operation at the harbor. The observatory also hosts an accelerograph from the Instituto Geográfico Nacional in Spain and a GISTM (GPS Ionospheric Scintillation and TEC Monitor) receiver which is operated in the frame of ISACCO, an Italian research project on ionospheric scintillation observations, led by the Italian Institute of Volcanology and Geophysics (INGV). Another Real-Time Ionospheric Scintillation (RTIS) Monitor has been set up and operated by the NMA since November 2012. A DORIS station is located approximately 350 m from the new geodetic observatory at Brandal and is hosted by the French-German AWIPEV research base.

2 Component Description

The radio telescope with a 20-m diameter is intended for geodetic use and receives in S- and X-band. Its design and construction are similar to those at Green Bank and Kokee Park. A DBBC2 streams the data to a Mark 5B+ recorder. Another Mark 5B+ unit is used to transfer data via network to the correlators. Timing and frequency is provided by a NASA NR maser, which is monitored by a CNS system.

The fast-slewing VGOS twin telescopes at Brandal (designated as Nn and Ns) are 13.2 m in diameter. A tri-band feed is currently installed at the Ns telescope with a DBBC2 and Flexbuff forming the backend system. At the Nn telescope a broadband receiver (2—14 GHz) is installed, with a DBBC3 and Flexbuff as the backend. A T4Science iMaser 3000 provides the frequency signal at Brandal.

3 Staff

The staff at Ny-Ålesund consists of five people employed at 75 %, with 3.75 full-time positions currently covered (see Figure 3 for an overview). Station staff are part of the Global Geodesy group at the Geodetic Institute of the Norwegian Mapping Authority, which has its main office in Hønefoss (near Oslo).

Axel Meldahl has been working as an operations engineer at the observatory since 2015, while Susana Garcia-Espada and Rubén Bolaño González joined the operations team in April 2020. Piotr Kupiszewski has been with the observatory since 2018 and is the station leader. Simon L'orange (an operations engineer since 2018) will leave Ny-Ålesund in February 2021. A new operations engineer will join the team in May 2021.

The staff at Ny-Ålesund work closely with colleagues located on the mainland at NMA's Hønefoss and Oslo offices: Ann-Silje Kirkvik (VLBI data analyst), Leif Morten Tangen (VLBI instrument responsible person), Robin Kleiven (VLBI engineer), Gro Grinde (project leader for the new geodetic observatory), and Hans Christian Munthe-Kaas (head of department) (see Table 1 for an overview).

Fig. 3 Core team: Rubén Bolaño González, Susana Garcia-Espada, Piotr Kupiszewski, Simon L'orange, Axel Meldahl (Image: Helge Markussen).

Table 1 Staff related to VLBI operations at Ny-Ålesund.

Head of department	Hans Christian Munthe-Kaas
Station Leader	Piotr Kupiszewski
Project leader (new observatory)	Gro Grinde
Operations engineer	Axel Meldahl
Operations engineer	Rubén Bolaño González
Operations engineer	Susana Garcia-Espada
Operations engineer	Simon L'orange (until February 2021)
VLBI instrument responsibility	Leif Morten Tangen
VLBI engineer	Robin Kleiven
VLBI data analyst	Ann-Silje Kirkvik

4 Current Status and Activities

A broadband receiver (2–14 GHz) was installed in September 2019 in the northern telescope (Nn) at the new geodetic observatory at Brandal, adding to the tri-band receiver already installed in the southern telescope (Ns). During the course of 2019 and 2020, work continued to run observations with the tri-band receiver and DBBC3 at the Ns antenna. Unfortunately, multiple issues were encountered with the DBBC3, and reaching stable operations proved difficult. The problems were partly caused by using the DBBC3 together with a tri-band receiver, which was not an optimal combination. A DBBC2 replaced the DBBC3 in November 2020, greatly improving the stability of operations. Ns is currently operating as a tag-along station in R1 and R4 sessions and has also contributed to RV and T2 sessions.

Work to operationalize Nn is ongoing with the aim of having Nn be able to join the IVS observation schedule as a VGOS telescope in mid-2021. The backend system for the Nn telescope was completed with the delivery of a Flexbuff in October 2020. The storage capacity of the new Flexbuff is 553 TB (72 disks of 7.68 TB each), while the expected recording rate is $\geq$ 16 Gbps.

The Legacy 20-m telescope at Rabben (Ny) was operative for most of 2019 and 2020. But, in October 2020, Ny suffered a major setback when the elevation encoder failed. The 20-m telescope has been out of operation since then, as Ny-Ålesund awaits the return of the spare BEI encoder which was sent for repair to the US in August 2020. Delivery of the repaired spare encoder is expected in March 2021. In August 2020, prior to the encoder failure, laser scanning of the gravitational deformation of the 20-m telescope at Rabben was performed together with colleagues from the RISE research institute in Sweden.

Local tie measurements were carried out at Brandal in 2019 and 2020 and, in August 2019, two new control points were set up for line-of-sight local tie measurements between the VLBI telescopes at Brandal and the DORIS beacon. In the summer of 2020 a cable duct (approximately 350 m) was dug down between Brandal and the DORIS beacon. The duct will house an RF cable providing a 5 MHz reference signal from the hydrogen maser at Brandal to the DORIS beacon and will ensure that all space geodetic techniques at Brandal use a common frequency standard.

Furthermore, several new instruments have been installed at the observatory. A solar radio burst monitor was installed at Rabben in 2019. The instrument is a passive receiver with a directional antenna and measures radio waves in the range 1.0 to 1.6 GHz. The solar radio burst monitor tracks the Sun (as long as the Sun is above the horizon) and monitors radio noise at frequencies which are relevant for aviation and GNSS systems.

In preparation for installation of the Satellite Laser Ranging (SLR) instrument an ADS-B (Automatic Dependent Surveillance–Broadcast) antenna was installed at Brandal, and subsequently a second antenna was set up at Rabben. The ADS-B instruments are used to collect information about air traffic over Ny-Ålesund and will be part of the SLR safety system.

Other activities include maintenance of the superconducting gravimeters, energy optimization work, and installation of an electronic access control system at Brandal. For both the superconducting gravimeters at Kongepunktet and Brandal, cold heads were exchanged in March 2020. At Brandal, the heating and ventilation systems were improved, e.g. by adding an outdoor cooling system to the existing ventilation system in the Data Center. A new 28-m telescopic boom lift (Manitou 280TJ) was acquired in November 2019, greatly facilitating maintenance of the VLBI telescopes.

Finally, the Internet site for the geodetic observatory received a new graphic design (see https://www.kartverket.no/en/about-kartverket/geodetic-earth-observatory).

5 Future Plans

Fully operationalizing the twin-telescopes at the new geodetic observatory remains the focus of the station staff. The Ns telescope is expected to join the IVS schedule as a fully operational station in March 2021. The Ns telescope is planned to run with the tri-band receiver, DBBC2, and Flexbuff at least until the end of 2022, when the 1.5 years of parallel observations with the 20-m Ny telescope should be completed. Subsequently, a broadband receiver and DBBC3 will be installed. Delivery of the second broadband receiver from

the Instituto Geográfico Nacional is scheduled for August 2022.

Testing and configuration of the DBBC3 at the Nn telescope continues in parallel, with the aim of having the Nn telescope join the IVS schedule in mid-2021. The old 20-m telescope will undergo repair work in spring 2021. The elevation encoder will be re-installed, troubleshooting of the vacuum system will be carried out, and the leak in the helium system will be fixed. Overall, focus will increasingly shift to operations at the new geodetic observatory, and the 20-m telescope will be phased out and taken down once the period of parallel observations with Ns is completed.

Installation of the first components of the SLR is planned for 2021 with setup of the dome on the roof at Brandal and installation of the riser. The gimbal and telescope assembly will follow in 2022, and the laser system will be installed in 2024. The SLR is planned to be fully operational by 2025. The geodetic observatory is thus planned to become a fundamental station with all space geodetic techniques co-located in 2025.