

Ny-Ålesund Geodetic Observatory

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Abstract During 2021/2022 Ny-Ålesund Geodetic Observatory in Svalbard (Norway), operated by the Norwegian Mapping Authority (NMA), continued contributing to the VLBI network as the northernmost VLBI station. The old 20-m telescope (Ny) and the new Ny-Ålesund South (Ns) 13-m telescope at the new geodetic observatory (officially inaugurated in 2018) continued their regular contributions to the IVS observation schedule by running parallel sessions in the legacy IVS network. Ns started contributing as a core station in the legacy network in November 2021. The new Ny-Ålesund North (Nn) 13-m VGOS (VLBI Global Observing System) telescope at the new geodetic observatory started 24-hour operations as a core VGOS station for scheduled VGOS sessions correlated at Haystack from November 2022. Currently it is in the process of fully contributing to the VGOS VLBI network.

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 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 twin

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telescopes at the new facility at the Brandal geodetic observatory (see Figure 2).



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. From left to right: Ny-Ålesund 13-m North antenna (Nn), SLR dome, operations building, and Ny-Ålesund 13-m South antenna (Ns). (Image: Bjorn-Owe Holmberg)

In addition to the 20-m VLBI telescope and the 13-m twin telescopes, the geodetic observatory has three GNSS receivers in the IGS system and two Super Conducting Gravimeters which are part of the International Geodynamics and Earth Tide Service. One SCG is installed at the Rabben site, and the second SCG is installed at the Brandal site; they are approximately 1.5 km away from each other. A fourth GNSS receiver from the German Research Centre for Geosciences (GFZ) is hosted in the Rabben site. A solar radio burst monitor is set up at Rabben, and a tide gauge is in operation at the harbor in Ny-Ålesund.

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 is set up and has been 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.

The NMA is working on a Satellite Laser Ranging (SLR) installation in the new geodetic observatory. The SLR dome was installed in April 2022 (see Figure 2). Gimbal and telescope assembly are planned during 2023. Laser installation is planned during 2024. The SLR technique will be operational by 2025.

2 Component Description

The radio telescope with a 20-m diameter is intended for geodetic use and receivers 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 Mark5B+ recorder. Another Mark5B+ 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 back-end system. At the Nn telescope a broadband receiver

(2–14 GHz) is installed, with a DBBC3 and Flexbuff as the back-end. 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 Geodesy division at the Geodetic Institute of the NMA, which has its main office in Hønefoss (near Oslo).



Fig. 3 Core team from left to right: Rubén Bolaño González, Susana Garcia Espada (station leader), Axel Meldahl, Silje Wennesland, and Thomas Gasmoe. (Image: Bjorn-Owe Holmberg)

Axel Meldahl has been working as an operations engineer at the observatory since 2015. Susana Garcia-Espada and Rubén Bolaño González joined the operations team in April 2020. Susana has been the station leader since November 2021. Thomas Gasmoe has been an operations engineer since May 2021. Silje Wennesland joined the team in November 2021.

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

Head of department	Per Erik Opseth
Project leader (new observatory)	Gro Grinde
Station Leader	Susana Garcia Espada
Operations engineer	Axel Meldahl
Operations engineer	Rubén Bolaño González
Operations engineer	Thomas Gasmoe
Operations engineer	Silje Wennesland
VLBI instrument responsible	Leif Morten Tangen
VLBI data analyst	Ann-Silje Kirkvik

The staff in 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), Gro Grinde (project leader for the new geodetic observatory), and Per Erik Opseth (head of the Geodesy department) (see Table 1 for an overview).

4 Current Status and Activities

In 2021/2022 the 20-m Ny telescope in Ny-Ålesund was scheduled for 243 24-hour VLBI observations, including R1, R4, EURO, RD, T2, and RDV sessions, and for 64 one-hour observations within the Intensive program. During this period the Ny telescope had a five-month down period from June 2021 until October 2021 due to problems with the NASA NR2 maser used as the frequency standard.

Meanwhile, the 13-m Ns telescope was scheduled tagged-along for 247 24-hour VLBI sessions, including R1, R4, EURO, RD, T2, and RDV sessions, and for 57 one-hour VLBI sessions within the Intensive program.

The Ns telescope joined the legacy VLBI network as a core station in November 2021. Most of the scheduled sessions were run in parallel at both the Ny and Ns telescopes (see Figure 4).



Fig. 4 The distance from the Ny telescope at Rabben to the Ns and Nn telescopes is about 1.5 km.

In order to get the best possible estimations and results for the parallel time series between Ns–Ny, 14 24-hour VLBI local-tie short baseline sessions between the Ny and Ns telescopes (NYTIE) were observed from August 2022 until mid October. The plans are to correlate the NYTIE sessions locally. Work is in progress.

The legacy 20-m telescope at Rabben (Ny) was operative for most of 2021 and 2022. Unfortunately, from the end of June 2021 to mid October 2021, Ny suffered a major setback when the NASA NR maser failed. After investigations, spare parts sent to Ny-Ålesund, and the correspondent maintenance, the maser was fixed correctly again, making it possible to resume VLBI

operations with Ny. New problems were noticed since October–November 2022 and the Ny antenna started having a lower performance than usual. It is currently under investigation, and suspicions are on a failure of the DBBC2. Currently, a DBBC2 borrowed from the Instituto Geográfico Nacional (Spain) is being shipped from the Santa Maria station (Azores) to Ny-Ålesund observatory. At the end of December 2022, the structure of the winch that is used to install and take down the receiver in the 20-m telescope collapsed over the receiver and smashed/cut a few cables, the S-band and X-band IFs and the 5 MHz to the receiver being among them. Cables were repaired. Ny is currently waiting for the DBBC2 to be delivered in Ny-Ålesund in order to resume operations again as soon as possible before it is dismantled at the end of summer 2023.

In the last years, it has been challenging to keep the 20-m Ny telescope operational, and more efforts are being put into the new Ns and Nn antennas at Brandal. The Ns flexbuff was updated in June 2022 to increase capacity and recording performance.

The 13-m Nn telescope started operations in August 2022. Nn was scheduled tagged-along in three 24-hour VGOS sessions processed at the Haystack correlator. Since November 2022, Nn has been scheduled as a core station in the VGOS VLBI network. During this period it has observed two 24-hour VGOS sessions correlated at Haystack.

On the other hand, the VGOS receiver (installed in November 2021 in the Nn telescope) was upgraded during mid 2021 at the Yebes Observatory (Instituto Geográfico Nacional, Spain). Its LNA configuration was upgraded from single-ended to balanced configuration. The installation of the upgraded VGOS receiver in the Nn telescope was done in November 2021.

Local tie measurements were carried out at Brandal in the summers of 2021 and 2022, continuing with the stability measurement time series.

The DORIS beacon has been connected to the common frequency standard at the Brandal new geodetic observatory since July 2022. The duct cable from Brandal to DORIS houses an RF cable providing a 5 MHz reference signal from the hydrogen maser at Brandal to the DORIS beacon. It ensures that all space geodetic techniques at Brandal use a common frequency standard.

The installation of the first SLR components started in April 2022 with the installation of the SLR dome on the roof at Brandal geodetic observatory (see Figure 2).

Calibration of both SCGs at Brandal and Rabben was performed using an FG5 absolute gravimeter during October 2021. The calibration was performed with support by colleagues from Strasbourg University (France).

5 Future Plans

Fully operationalizing the twin-telescopes (Ns and Nn) at the new geodetic observatory remains the focus of the station staff.

The Nn telescope will contribute to the VGOS VLBI network, and hopefully it will begin operations as a full core station during 2023.

The Ns and Ny telescopes will continue observing parallel measurements, official IVS sessions, and local NYTIE VLBI local-tie sessions, as soon as the Ny telescope is back in operation again.

The legacy 20-m telescope at Rabben (Ny) will be dismantled at the end of summer 2023 giving an end to its VLBI operations after more than 30 years of observations and after more than three years of parallel observations together with the Ns telescope. Overall, focus will increasingly shift to operations at the new geodetic observatory when the 20-m telescope will be phased out and taken down.

The Ns telescope will continue observing at least during 2023 as part of the legacy VLBI network. A second VGOS receiver (to be installed in Ns) is planned to be upgraded at the end of 2023 at Yebes Observatory (Instituto Geográfico Nacional, Spain). Its LNA con-

figuration will be upgraded from single ended to balanced configuration, making it equal to the VGOS receiver installed in the Nn telescope. It is not decided when the Ns will be upgraded with the VGOS receiver and when it will start operations in the VGOS VLBI network. Investigations and simulations are on-going to find the best timing for the upgrade in order to have the best contributions possible for the VLBI community and ITRF. Together with the upgraded broadband receiver, a DBBC3 will be installed. In the meantime, Ns will continue observing in the VLBI legacy network through 2023.

Local tie measurements at Brandal and between Brandal and Rabben will be carried out in summer 2023 before the 20-m Ny telescope is dismantled.

Gimbal and telescope assembly for the SLR are planned to be installed after summer 2023, 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.

References

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