

Ny-Ålesund: New SLR Site in the Arctic at 79° North

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Abstract

Ny-Ålesund is a new Satellite Laser Ranging (SLR) site located in the Arctic at 79° north. The first SLR subsystems have already been installed, and the gimbal and telescope arrive in 2023. The complete SLR is planned for on-site test in late 2024, with start of SLR operations in early 2025. Ny-Ålesund will be the first of an initial three SLR stations developed by NASA as part of the Space Geodesy Satellite Laser Ranging (SGSLR) project, and NASA plans to further develop five or more similar stations in the coming decade. After SLR operations start, Ny-Ålesund geodetic observatory owned by the Norwegian Mapping Authority (NMA), becomes a GGOS core site that co-locates the four space geodetic measurement techniques; SLR, VLBI, GNSS and DORIS. This gives valuable contributions to the international terrestrial reference frame. We present status and plans for the Ny-Ålesund site, with emphasis on opportunities and challenges related to SLR operations at this very remote location.

1. Introduction

Satellite Laser Ranging (SLR) stations operate as a part of a global network. Ny-Ålesund, Norway, is a new SLR site under development. It is the first of an initial three SLR stations developed by NASA as part of the Space Geodesy Satellite Laser Ranging (SGSLR) project [1]. The Norwegian Mapping Authority (NMA) owns and operates a geodetic observatory in Ny-Ålesund, and the SLR station will be co-located at site, as shown in Figure 1. The new SLR station, located in the Arctic at 79° north, will contribute to an enhanced global network distribution. This work discusses characteristics related to SLR operations at the remote Ny-Ålesund location.

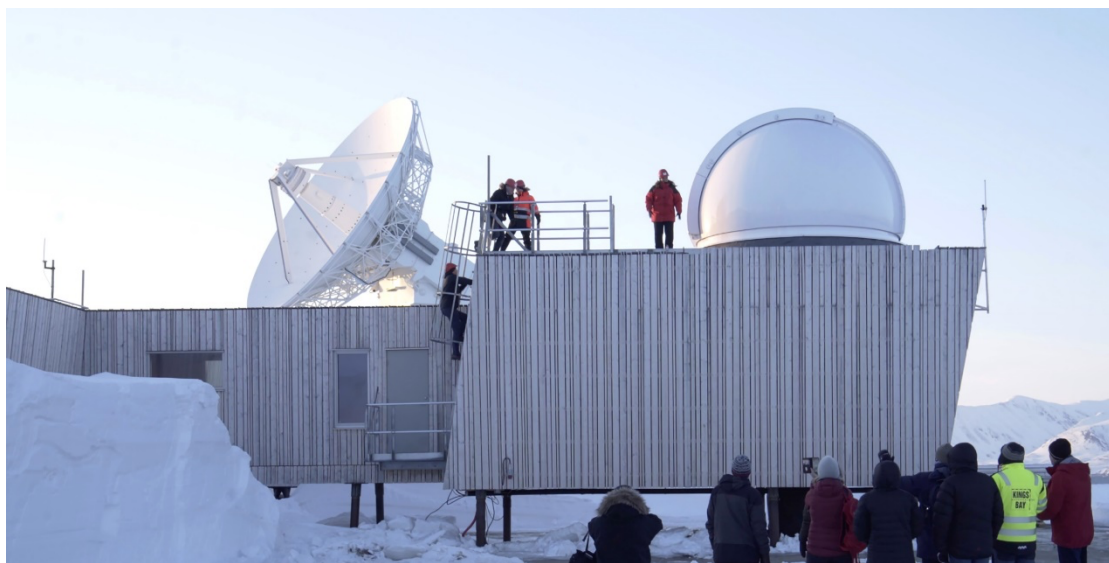


Figure 1. The Ny-Ålesund Satellite Laser Ranging (SLR) station at 79° north. One co-located VLBI antennas is visible in the background. Photo: Bjørn-Owe Holmberg

2. Ny-Ålesund geodetic observatory

Ny-Ålesund has a long history with three space geodetic measurement techniques present: VLBI, GNSS and DORIS. When the SLR station is finished, the Ny-Ålesund geodetic observatory will become one of few sites globally with all four space geodetic measurement techniques co-located. This makes it possible to benefit from the techniques complementarity when developing the international terrestrial reference frame (ITRF). Figure 2 shows pictures of current measurement equipment.



Figure 2. When the SLR is finished, four space geodetic measurement techniques will be co-located at the Ny-Ålesund geodetic observatory: Two VLBI antennas, GNSS receivers, DORIS ground station and SLR station. Photo: Bjørn-Owe Holmberg

The Global Geodetic Observing System (GGOS) sets stringent accuracy requirements for the reference frame. Oceanographers require 1 mm accuracy in the origin and 0.1 mm/year stability over time to address sea level rise issues with confidence. Previous studies indicate that 24 – 32 sites with co-located SLR and VLBI are needed to implement and maintain the reference frame to the required level of accuracy [2, 3].

The number of sites with co-located space geodetic measurement techniques is increasing, and many sites have upgraded or are in the process of upgrading to the latest technology. There are about 12-15 sites with SLR/VLBI/GNSS co-located, and about 8 so-called core sites with SLR/VLBI/GNSS/DORIS.

However, this is still far from the about 30 core sites required by GGOS. Hence, when the SLR station is complete, the Ny-Ålesund core site at its unique location will make an important contribution to meet the reference frame requirements.

3. Location

Ny-Ålesund is located at the Norwegian archipelago Svalbard in the Arctic Ocean. The archipelago is marked by a circle in Figure 3. Special laws apply on Svalbard, regulated by the Svalbard Treaty. The administration center on Svalbard is Longyearbyen, with about 2000 inhabitants, school, shops, hospital and daily flights to the Norwegian mainland.

Ny-Ålesund is a small town located on the east side of the archipelago. This is the world’s northernmost permanent settlement, with an international community with about 25 inhabitants from several countries that have ratified the Svalbard Treaty. There are weekly flights connecting Ny-Ålesund to Longyearbyen.

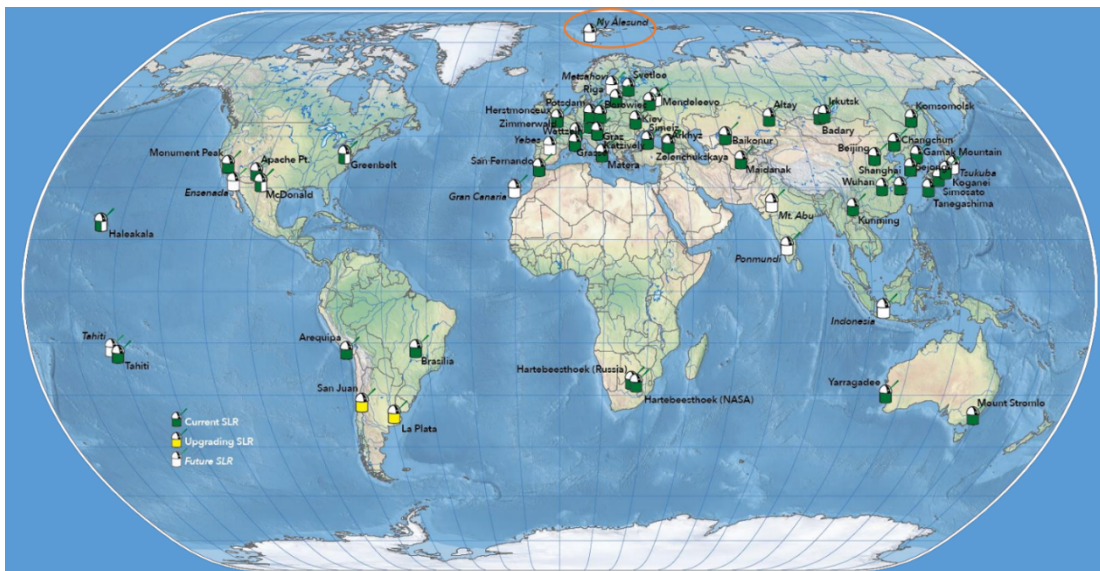


Figure 3. Ny-Ålesund is located at the Norwegian archipelago Svalbard in the Arctic Ocean, marked by an orange circle in the figure. Source: ILRS

4. Wildlife

Wildlife at Svalbard differs greatly in winter and summertime. The “King of the Arctic”, the polar bear shown to the left in Figure 4, is one of five marine mammals that stay in the area year-round. In the breeding season migratory birds return and there is intense bird activity. The Ny-Ålesund geodetic observatory lies in an important bird area, and the Governor of Svalbard requires that potential effects on bird life are to be monitored and evaluated. The Governor also puts restrictions on human presence at the observatory.



Figure 4. Svalbard wildlife includes polar bears (left) year-round, and intense bird activity e.g., the Atlantic puffin (right), during breeding season. Photos: Rolf Stange

5. Remote operations and aircraft laser safety

Figure 5 shows a Ny-Ålesund overview, and how the geodetic observatory is located relative to the town, the airport, and the Norway Mapping Authorities (NMA) offices.

Due to the Governors restrictions, daily presence is not allowed at the geodetic observatory, which implies remote SLR operations are required. Thus, after an initial commissioning phase with local operations at the observatory, the SLR will be operated remotely, first from the NMA office approximately 1500 meters from the observatory, and at a later stage from the Norwegian mainland.

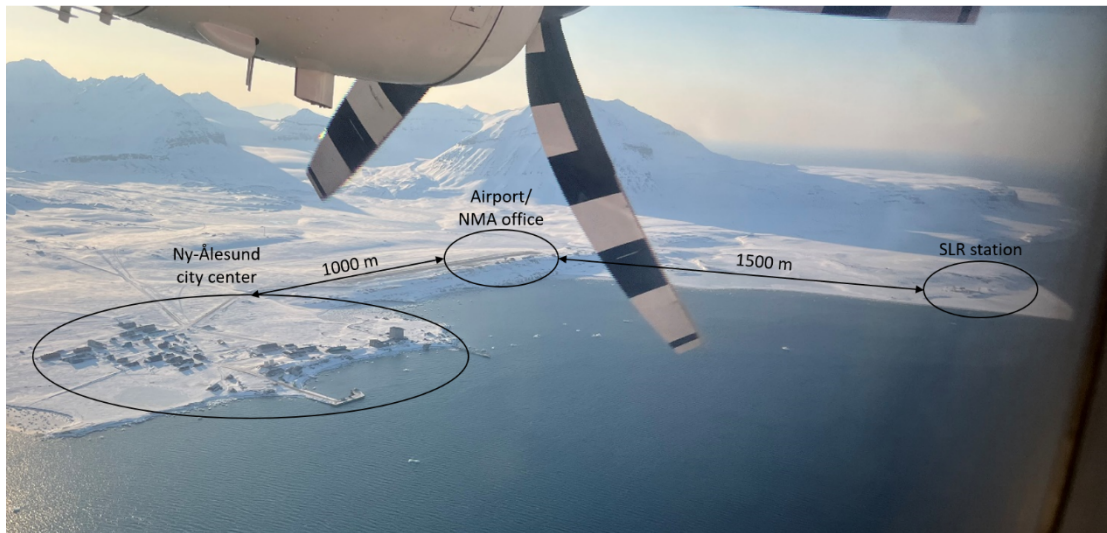


Figure 5. Ny-Ålesund town to the left, the airport and the Norwegian Mapping Authorities (NMA) office in the middle, and the SLR at the geodetic observatory to the right. Distances are about 1000-1500 meters. Photo: Gøril M. Breivik

Radio wave transmission e.g., radars, are prohibited in Ny-Ålesund due to the sensitivity of the VLBI antennas. This, combined with the proximity of the SLR station to the local airport, and the need for remote control of the SLR, puts great demands on laser safety to protect aircrafts. NMA currently develops an Aircraft Avoidance System that satisfies all these requirements [4] and that interfaces with the SLR laser safety system developed by NASA [5].

6. Daylight and climate

At 79° latitude, the sun never sets during summer, and never shows during winter. That is, in Ny-Ålesund there is daylight around the clock from 16 April to 25 August and a never-ending night from 24 October to 18 February. For SLR operations this means good tracking conditions during winter, and poorer during summer. However, the SGSLR technology delivered by NASA handles daylight tracking.

The temperatures in Ny-Ålesund are mild due to the North Atlantic Current. Precipitation varies throughout the year, as shown in Figure 6. Cloud coverage has not been accurately calculated; however, the site is cloudier than more tropical SLR sites.

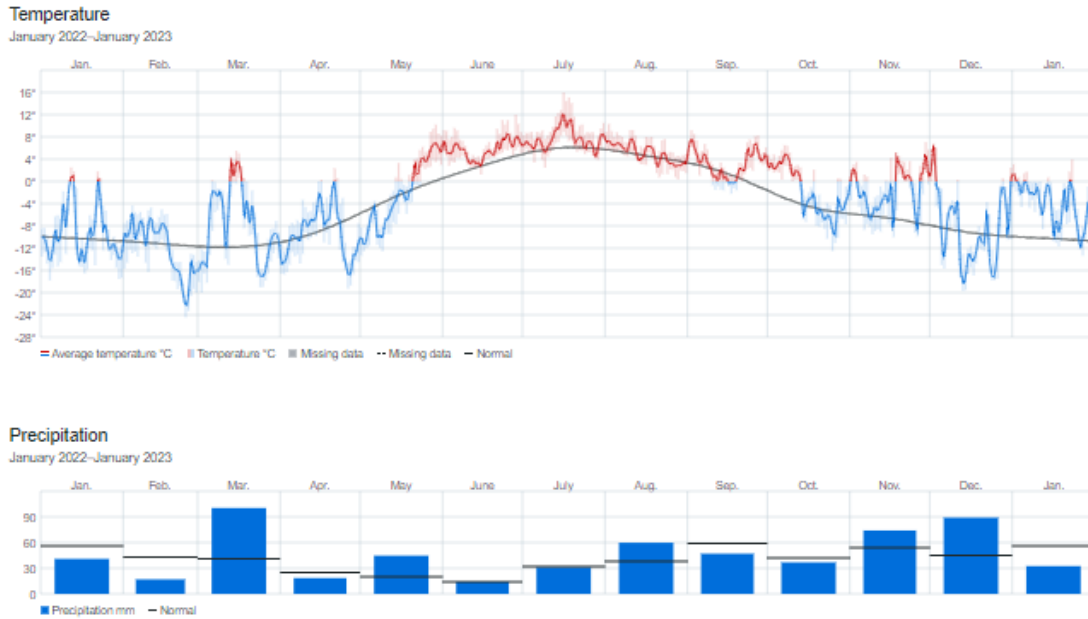


Figure 6. Temperature and precipitation data for Ny-Ålesund throughout one year. Source: yr.no

7. SLR status and timeline

In March 2022, the dome and riser were installed in the SLR shelter in Ny-Ålesund, as shown in Figure 7. The optical bench support structure was attached to the pier in the laser room, and the site is ready to receive and install the gimbal and telescope as scheduled in 2023.



Figure 7. The dome (left) and riser and optical bench support structure (right) was installed in the Ny-Ålesund SLR shelter in March 2022. Photos: Gøril M. Breivik

In 2023 system integration and testing of the remaining components will be done at Goddard Geophysical and Astronomical Observatory (GGAO), and co-location tests with MOBLAS-7 are planned for spring 2024.

During fall 2024 the complete SLR-system will be shipped from GGAO to Ny-Ålesund, and SLR ranging in Ny-Ålesund is scheduled to start in January 2025. An upgrade for nearby remote operations is planned finished by December 2025.

8. Conclusions

Ny-Ålesund is a very characteristic site with respect to location, wildlife, daylight, and climate. This puts requirements to aircraft laser safety and the need for remote SLR operations.

When the SLR station is finished, the Ny-Ålesund geodetic observatory owned by the Norwegian Mapping Authority (NMA) will become a core station with all four space geodetic measurement techniques. It will make an important contribution towards the 1 mm accuracy and 0.1 mm/year stability requirements for the international terrestrial reference frame.

The Ny-Ålesund SLR station is developed as part of NASA's SGSLR project. Deployment started with the dome and riser in 2022. Development and installation continue in 2023 and 2024. SLR ranging from Ny-Ålesund is expected to start in 2025.

Acknowledgements

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