

## **2.6 TOPIC 6: Large scale facilities**

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### **Mission**

Serving science

#### **2.6.1 Challenges**

To operate large scale facilities for all compartments of marine and terrestrial research in both the Arctic and Antarctic for the wider scientific community with maximum efficiency and to provide state-of-the-art mobile and stationary facilities for access to and deep field operations in the remote polar regions.

#### **2.6.2 Contents and goals**

Next to carrying out original research in various fields, which requires long-term commitment and large infrastructures, it has been one of the principal tasks of Helmholtz-Centres to provide large science infrastructures for use by the national and international scientific community.

With the changeover to programme oriented funding this task has become the responsibility of appropriate programmes. This has the additional advantage that, by coordinating the use of large-scale infrastructures within programmes, most efficient usage can be achieved. At the same time this facilitates the development of joint research programs between the Helmholtz-Programmes and those designed by scientists at universities and other institutions thereby

enlarging the overall scope and scientific effectiveness.

AWI was founded in 1980. Since then AWI has operated the infrastructure for polar marine and terrestrial research for the German and international scientific community. As the polar program developed and widened in scope to include the Arctic as well, demands on infrastructure grew and over the years it developed to its present status, which is described further below and in the Annex. In order to meet the scientific challenges ahead as described in this programme, the available infrastructure must be kept in top condition, adapted to ever changing requirements posed by new scientific experiments and field observations. Furthermore as new technologies emerge and can be brought into use for research, the existing infrastructure must be widened in scope with new units added.

Keeping large-scale facilities in top condition and efficient use is a major and not only financial challenge. Next to financial resources it requires dedicated and experienced staff able to understand science requirements and merge them with technical possibilities. This is particularly important for research in the polar and ocean regions, which impose very special and sometimes very harsh environmental conditions, where not only issues of remote operations but also issues of personal safety have to be considered.

### 2.6.3 The units

#### **Research and supply vessel RSV "Polarstern"**

The research and supply vessel RSV "Polarstern" commissioned in 1982 is the major research tool of the German polar research programme. She provides ideal working conditions for almost all compartments of marine sciences and atmospheric as well as glaciological research. "Polarstern" is a unique research tool even in the international context. She can break ice up to 2 m continuously, can operate up to 90 days at sea and thus is ideally suited for the often long cruise legs to the remote regions.

By the possibility to host 55 scientists and a variable laboratory space "Polarstern" is a most effective interdisciplinary research platform. "Polarstern" was designed to staying winter over in the pack-ice and therefore can operate even during polar winters, which already has led to three year round deployments to the Antarctic and late winter expeditions to the Arctic. This provided the first clues on sea ice related processes, which drive the seasonal evolution of sea ice covered areas including the effects on marine biota. "Polarstern" has pioneered 2 ship expeditions to the deep interior of the Arctic Ocean and the first 2 ship marine geophysical experiment in the Antarctic

Due to its unique combination of ice breaking capability and design for research use research time on "Polarstern" is always heavily overbooked with applications for ship time coming from AWI and to a higher degree from other national and international research groups. A panel of experts from the wider community reviews applications for ship time; allocation is made on the basis of scientific merit and occurs in cooperation and according to standards accepted by all larger units of the German research fleet.

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#### **RV "Heinke"**

RV "Heinke" is a medium sized multipurpose research vessel and can be used for a broad range of biological, hydrographic, and smaller scale geoscientific research activities. In addition to serving as a research platform RV "Heinke" is used for University courses having a mixture of class and fieldwork.

RV Heinke is operational for different marine sciences mainly in the North Sea during 170 days per year. Ship time allocation is managed by the steering group for medium sized German research vessels.

The challenge in the management of Heinke stems from the comparatively short durations of the cruises between days and maximum 4 weeks with port stays of only one or two days. During the last five years considerable funds have been used to improve the infrastructure of the vessel in the bridge and engine area and the conservation of the ship's hull.

In 2007 a mid-life conversion of the vessel has been started during which the vessel will be

improved to serve present scientific requirements and to extend the useful lifetime of the vessel for a total sum of 6 Mio €. In this context a technical commission has collected the scientific and technical requirements and as the result a workplan has been formulated in collaboration with the ship's operator.

### **Polar Research aircraft**

Until 2005 AWI operated 2 Dornier 228/100 ski equipped research aircraft in both polar regions. Due to a landing accident, luckily without lasting injury to the crew, POLAR 4 was so heavily damaged that repair after retrieval on board of Polarstern did not seem advisable. As a replacement a BASLER BT-67 aircraft was purchased in 2007 and is on its first Antarctic mission during the 2007/2008 season. This aircraft is based on a completely refurbished DC3 and was built to our specifications for scientific missions allowing the attachment of a variety of sensors packages. It is also specially adapted to missions in the polar regions

The combined wheel and ski gear enables take-off and landing at gravel strips and even unprepared snow surfaces. The relatively slow flight speed makes it an effective tool for survey missions, especially since it has about three times the range of the Dornier 228. For financial reasons it is unclear at present whether we shall be able to continue to operate the POLAR 2, which still is in good condition and has a few thousand hours of operational life ahead. An outside panel of experts allocates flight campaigns based on scientific merit; the logistic support flights are allocated by AWI.

During the last years major missions were focussed within the European EPICA program reconnaissance over Dronning Maud Land, logistics for Kohnen Station as well as aeromagnetic, aero-gravimetric and glaciological radar surveys in the Antarctic and Arctic. Additionally some missions were dedicated to tropospheric aerosol studies and sun-photometer measurements, as well as meteorological (e. g. catabatic wind) studies over Greenland, Fram Strait and Svalbard.

### **Polar Research Stations**

#### **Neumayer Station (70°39'S, 08°15'W, 40 m a.s.l.)**

The Neumayer Station is the permanently occupied German research station located at the Eckstrøm ice-shelf close to Atka Bay. The station was commissioned in 1992 and replaced the former Georg von Neumayer station established in 1981.

The station operates scientific observatories for Meteorology, Atmospheric Chemistry, Geomagnetism and Seismology. Due to their location in the Southern Hemisphere data from all observatories close important gaps in global coverage and are routinely fed into the respective international networks. At the same time they allow research of a more regional nature by providing high quality datasets for regional circulation studies, aerosol transport modelling or local seismicity and hence investigations of present day tectonic regime. The designs and operational characteristics of the observatories have served as models for similar installations in Antarctica.

Furthermore Neumayer Station serves as the operational base for all AWI aircraft missions and deep field traverses with the polar vehicle fleet during the summer season. Beyond these programme tasks the logistic facilities of the station are open to other national programmes. A major contribution to aircraft operations is a regular flight weather forecast service covering the whole Dronning Maud Land region. Since the establishment of Dronning Maud Land Air Network in 2003 (DROMLAN details see annex) the station can be used for more than 120 days for summer season only programs.

By 2009 the present station, which is now buried about 12m below the snow surface will be replaced by a new station, NEUMAYER STATION III. In contrary to the current, so-called "tube design", where the station facilities are accommodated in adequately sized steel tubes, the novel design features above-ground and below-ground facilities combined in one large structure. It can be raised hydraulically to compensate the snow accumulation. Therefore a significant longer service lifetime can be envisaged, and NEUMAYER III will provide better working conditions and advanced technical facilities for science and logistics.

**Kohnen Station (75 S, 00° E, 2892 m a.s.l.)**

Kohnen station is a summer base on the inland ice plateau of Dronning Maud Land. It was established in 2000 primarily as base for the deep ice core drilling within the EPICA program, but has already been used for EPICA associated programs. This base will serve at least for the next decade for EPICA related studies in the borehole but also allow a number of summer only investigations, respectively facilitate automatic observatories augmenting the one at Neumayer and thus extending the scope of the ongoing regional studies.

Kohnen Station is regularly maintained by the summer staff at Neumayer Station. Using aircraft transport, which is coordinated within DROMLAN, it can be used for about 70 to 90 days during summer seasons. Supply with heavy material and consumables is performed by the polar vehicle fleet available at Neumayer Station.

**Dallmann Laboratory (62°14'S, 58°14'W, 15 m a.s.l.)**

The Dallmann Laboratory is located at the Argentinean Jubany station on King George Island. It was established as an international laboratory funded by the Instituto Antartico Argentino (IAA), the Netherlands Council of Earth and Life Sciences (NWO) and AWI in 1994. Since then it has been occupied each year during the Antarctic summer season. About 12 to 15 scientists from Germany, Argentina and the Netherlands are working in the laboratory each season. Research is focussed on marine and terrestrial biological studies, solar UV and ecophysiological investigations as well as geological fieldwork. German research projects include investigations, which are in parallel carried out at AWIPEV Arctic Research Base (Koldewey Station) in the Arctic.

**AWIPEV Arctic Research Base (Koldewey Station) (79°N, 12°E, 50 m a.s.l.)**

The AWIPEV Arctic Research Base in Ny-Ålesund (Svalbard) is the French-German Arctic research station, located on the west coast of Spitsbergen. The joint research base emerged from the individual stations "Koldewey" and "Rabot" in 2003 and since then is run with a joint over wintering staff. Projects at the base are managed by a joint French-German Advisory Board, which prioritises joint applications.

The base is part of the Kongsfjorden International Research Base, which comprises all bases and stations in Ny-Ålesund. Additionally, the AWIPEV Arctic Research Base contributes to European and international programmes and networks like ARCFAC, GeoMon, NDACC, GAW etc. The main two tasks of the base are to serve as a multi-disciplinary platform for a wide range of atmospheric, marine-biological and geophysical science projects and additionally to serve as an observatory for long-term measurements, particularly for climate, atmospheric, and permafrost research. Balloon-borne observations and ground-based remote sensing techniques are applied to study dynamical and chemical processes from the surface into the stratosphere and are a crucial reference for validation of remote sensing instrumentation e.g. on satellites or airborne platforms. The atmospheric observatory programme is run in close co-operation with the IUP of University of Bremen. Two permafrost observatory sites are maintained continuously and monitor the heat and water fluxes between the soil and the atmosphere.

The base has a total capacity for 16 guests at any time of the year. The facilities include various laboratories, boats, vehicles and outdoor equipment. Three over wintering personnel of which two persons are employed by AWI and one by IPEV, run the base all year round.

AWI is a member of the consortium, which runs the International Arctic Marine Laboratory in Ny-Ålesund. This laboratory was inaugurated in 2005 as a dedicated facility for marine biology and oceanography. It comprises several wet and chemical lab rooms, including a toxic lab, and has a large number of tanks for storage of and experiments with living marine organisms under natural and modified natural conditions (light, temperature, salinity). German research teams are among the largest user groups of the marine laboratory. In particular the AWI scientific scuba diving group uses the marine lab facilities for sample collection and under water operations in the Kongsfjorden.

## Programme TOPICS

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The scientific programmes at the AWIPEV Arctic Research Base will contribute in the coming years to at least two big “Flagship” science projects in the Kongsfjorden International Research Base, namely to the “Atmosphere and Climate” and the “Kongsfjorden Ecosystem” studies.

### **2.6.4 Expected results, milestones**

We expect continued operation of the units to serve the needs of scientific projects, long-term observations, education and national as well as international cooperation.