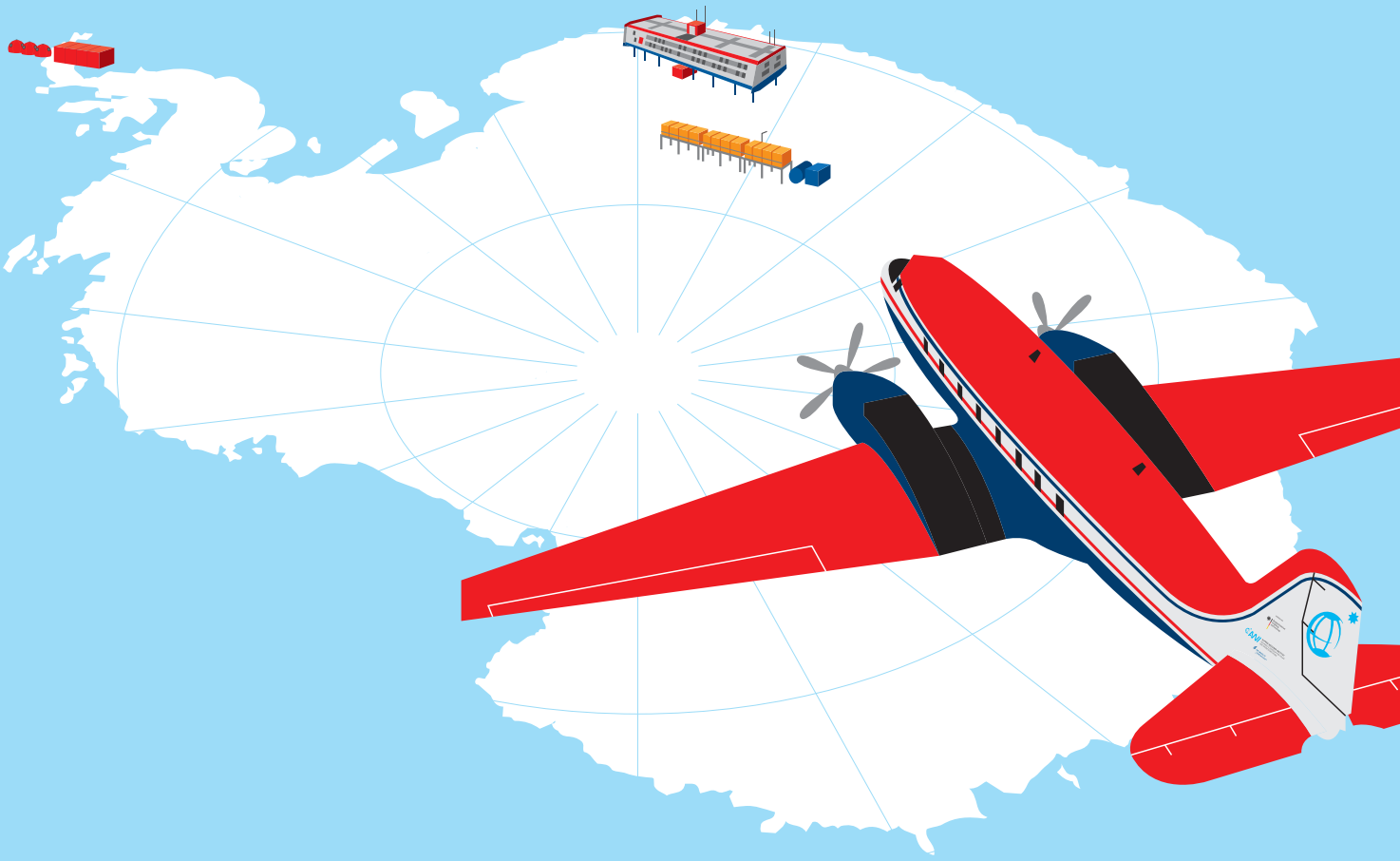
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Expedition Program

ANTARCTICA

(ANT - Land 2019/20)
Land activities & flight missions



HELMHOLTZ

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1. ANT-LAND 2019/20

1.1 Summary

1.2 Schedule of the season

The season is scheduled as shown in Figure 1.

1.3 Scientific projects at NEUMAYER STATION III

The maintenance of the observatories will be done by the supervisors. The yearly routine covers the lifting of the instruments due to snow accumulation during the year and maintenance of the instruments to ensure the continuity of the measurement series.

Meteorological Observatory – Holger Schmithüsen (AWI)

Air chemistry Observatory – Rolf Weller (AWI)

Geophysical Observatory – Tanja Fromm (AWI)

CTBTO – I27DE – Matthias Hoffmann, Torsten Grasse (BGR, Germany)

Wintering Projects:

AFIN

PI: Stefanie Arndt (AWI)

Continuous observations of sea ice fastened to coasts, icebergs and ice shelves is of crucial importance for understanding key processes and predicting changes in the climate- and ecosystem in the polar regions. Near Antarctic ice shelves, this landfast sea ice exhibits two unique characteristics that distinguish it from most other sea ice: On the one hand, ice platelets form and grow in super-cooled water, which originates from ice shelf cavities. The crystals accumulate beneath the solid sea-ice cover and are incorporated into the sea-ice fabric, contributing between 10 and 60% to the mass of the land-fast sea ice around Antarctica. On the other hand, a thick and partly multi-year snow cover accumulates on the fast ice, altering the sea-ice surface and affecting the sea-ice energy and mass balance. In order to investigate the role and the spatial and temporal variability of platelet ice and snow for Antarctic fast ice, we perform regular field measurements on the land-fast sea ice of Atka Bay since 2010 as part of the international Antarctic Fast Ice Network (AFIN).

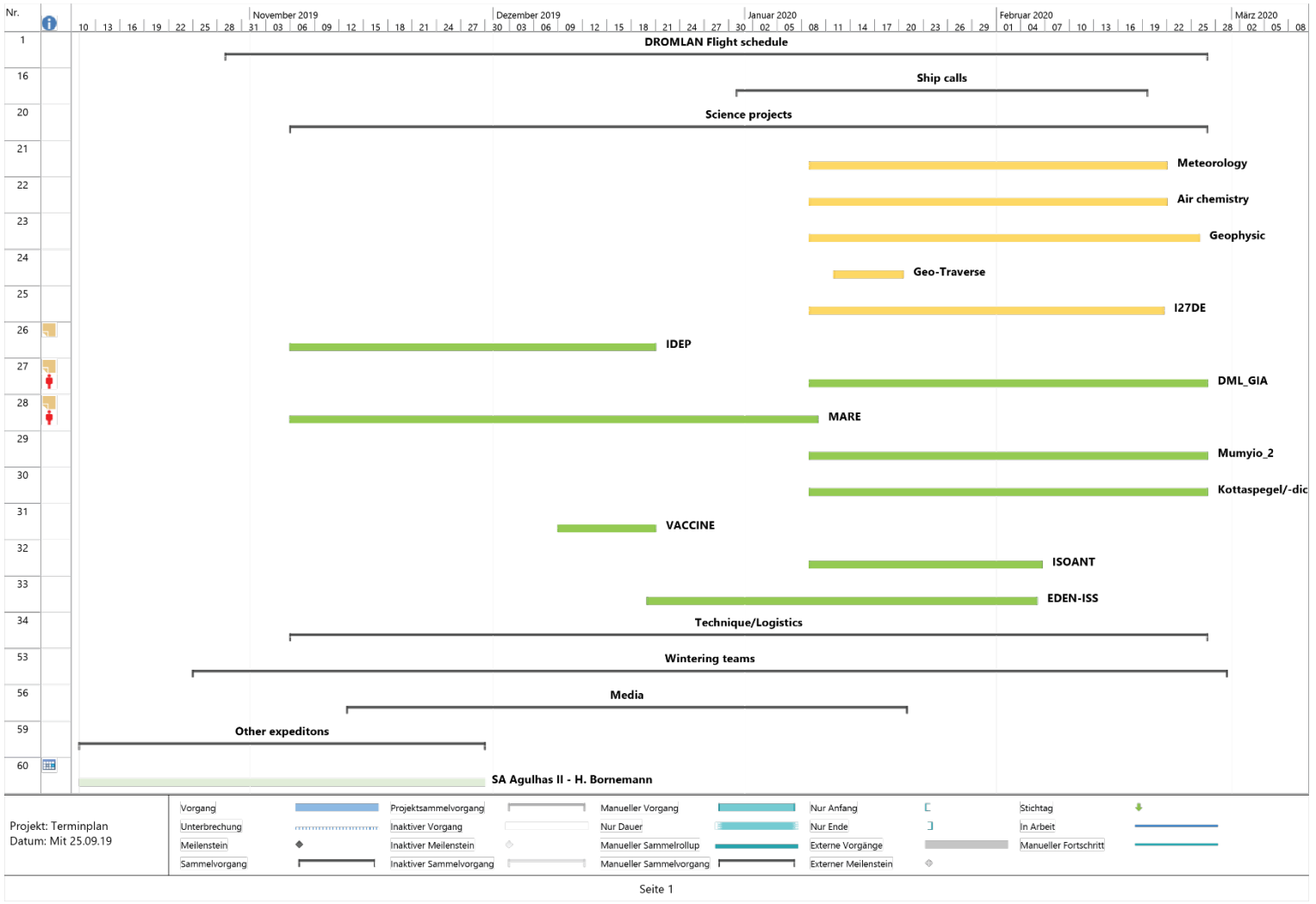

Figure 1 Schedule for season 2019/20

EDEN-ISS

PI: Daniel Schubert (DLR, Germany)

The EDEN ISS project was funded by the European Union Horizon 2020 project (reference number: 636501) supported via the COMPET-07-2014 - Space exploration – Life support subprogramme. The project has developed and has subsequently deployed an advanced plant production system to the NEUMAYER STATION III Antarctic station in the summer season 2017/18. The EDEN ISS greenhouse container was operated for a full winter season at the analogue test site in Antarctica (NEUMAYER STATION III). The production of fresh food for the overwintering crew was successful and more than 140 kg of lettuce, cucumber, radish, tomatoes, and herbs have been harvested until end of the winter season. Scientific investigations on microbial behaviour within the grow chamber, biomass quality examinations, and operation procedure testing were also performed. In the season 2018/19 several systems in the container will be upgraded and repaired. The greenhouse will be operated by the overwintering team of the NEUMAYER STATION III and supported by the EDEN team in the mission control room at DLR Bremen. In addition to the production of fresh food for the crew on site several scientific questions regarding remote operations of a greenhouse in extreme environments will be investigated.

ISOAnt

PI: Martin Werner (AWI)

This proposal is linked to the REKLIM-Project „Iso-Ant“, which will improve our knowledge and understanding of the hydrological cycle and its isotopic composition in Antarctica. Here, we apply for using the facilities at NEUMAYER STATION III to perform maintenance work on a laser-based spectrometer for isotope analyses.

MICA-S

PI: Khan-Hyuk Kim (Kyung Hee University, South Korea)

The goal of this project is to develop and install an induction-coil magnetometer at NEUMAYER STATION III for the studies of ultra low frequency (ULF) waves associated with solar wind coupling to the magnetosphere and ionosphere. Observation of geomagnetic fields is critical in understanding the physical link between the Sun and the Earth’s magnetosphere and ionosphere.

Neuromayer

PI: Alexander Stahn (Charité Berlin, Germany), Alexander Choukér (LUM Munich, Germany)

We will investigate both immediate and long-term benefits of *Hybrid Training*. Our primary outcomes are neurostructural and neurofunctional changes assessed with magnetic resonance imaging (MRI), and cognitive performance assessed with classical paradigms, but also operationally relevant tasks (i.e. virtual ISS robotic arm docking task). We will also assess biochemical markers of stress and neuroplasticity, objective measures of sleep-wake rhythmicity and sleep structure, subjective symptom

reports, and group cohesion with unobtrusive measurements as additional outcomes that will provide insights into mechanisms and consequences of the observed structural and functional brain changes, and their reversibility by *Hybrid Training*. These data will be compared to historic controls from NEUMAYER STATION III and other Antarctic stations (Concordia, Halley), space analog environments and the ISS. At the end of the project, we will have a much clearer understanding whether and to what extent the detrimental effects of ICE environments on neuroplasticity and behavioral health can be mitigated by *Hybrid Training*.

PALAOA

PI: Olaf Boebel (AWI)

Recording the underwater calls of marine mammals is one of the most promising methods to study distribution and seasonal migration of these animals in the ice-covered Antarctic. Visual sightings of marine mammals in Antarctic waters are rare since human access is limited and animals only occasionally surface to breathe. Acoustic recordings, on the other hand, can be made year round. By means of the PALAOA observatory, ocean acoustics experts from the Alfred Wegener Institute for Polar and Marine Research in the Helmholtz Association have discovered that leopard and Ross seals populate Antarctic waters near NEUMAYER STATION III.

SPOT

PI: Daniel Zitterbart (WHIO, USA & University of Erlangen, Germany), Ben Fabry (university of Erlangen, Germany)

This project aims to understand the reorganization process in penguin huddles and the implications for social thermoregulation. We will install a remote-operated penguin observatory including hard- and software for fast image acquisition and real-time processing. The observatory will be capable of detecting the whole huddle, as well as tracking the movements of thousands of individual penguins throughout the winter. An accurate count of animals within the colony and the size of individual animals will also be recorded, and together our data will help to estimate how the increasing environmental strain such as ongoing climate changes, thinning sea ice and reduced krill availability, is affecting Emperor penguins.

WSPR

PI: Ulrich Walter (TU Munich, Germany), Michael Hartje (HS Bremen, Germany)

Using a permanent radio beacon at NEUMAYER STATION III, in order to investigate the state of the D- E- and F-layers of the terrestrial ionosphere and their influence on radio wave propagation throughout the communication spectrum.

This refers to terrestrial paths on shortwave as well as to satellite communication, where radio signals have to penetrate the ionospheric layers in order to reach ground stations.

Seasonal Projects:

MARE/MARGEO

PI: Daniel Zitterbart (WHOI, USA & University of Erlangen, Germany), Celine LeBohec (CNRS-CSM-IPEV, France), Olaf Eisen (AWI)

MARE will assess the vulnerability of Antarctic ecosystems using the Emperor penguin as sentinel species. To date, our information about demographic and life-history traits were predominantly based on monitoring a single colony in Adélie Land. To evaluate the overall trend of a species and its adaptive capacities, it is crucial to long-term monitor more than one population, breeding in different ecosystems, and under consideration of high risk of extinction in a near future according to climatic scenarii. This second-worldwide Life Observatory of emperor penguins (since 2017) aims to predict the species' adaptive potential to climate change and associated fluctuations in prey abundance and distribution. Life-long monitoring of the birds is performed using Passive Integrated Transponders and Radio-Frequency Identification systems. As umbrella species, seabirds can play an important role in determining the size for Marine Protected Areas (MPAs), and help to map marine biological hotspots. Knowledge of the distribution at sea and foraging strategies of emperor penguins is extremely scarce. We aim to fill this gap 1) by biologging of birds from Atka Bay colony (TDR/GPS/Argos) at different stages of their life cycle, and over regular intervals (e.g. 5 years), and 2) through collection of guano and stomach content (dead chicks) to determine the geologic provenance of the gastroliths gathered on the sea floor, the diet and trophic level (and its variability) on which they are foraging. Reciprocally, geological contents (pebbles) collected in these samples will improve the geologic characterization of the foraging grounds.

VACCINE (Variation in Antarctic cloud condensation nuclei (CCN) and ice nucleating particle (INP) concentrations at Neumayer Station

PI: Silvia Henning, Frank Stratmann (TROPOS, Leipzig, Germany)

It is a great challenge to assign exact numbers to the human influence on climate change. While we know the effect of carbon dioxide emissions quite well, there are anthropogenic emissions of other substances that effect climate through complex chains of interactions with atmospheric processes, that are not yet well characterized (IPCC,2013). This lack of knowledge causes uncertainties in the quantification of how human activities influence weather and climate (Carslaw et al. 2013). To identify the anthropogenic effects, we need to characterize the atmosphere as it was before industrialization. The fact that Antarctica is geographically isolated from anthropogenic emissions makes it a perfect place to study pristine conditions (Hamilton et al., 2014). In this project we, i.e., TROPOS suggests to extend the existing aerosol measurements at Neumayer station by in-situ cloud condensation (CCN) and ice nucleating particles (INP) measurements. These data will be linked with meteorological information (e.g. back trajectories) and information on the chemical composition of the sampled aerosol particles for identifying sources of INP and CCN. The quantitative information on Antarctic

Pristine CCN and INP will be made availed on the PANGAEA Database and thereby be useable to evaluate and constrain global models and satellite retrieval methods.

IDEP – Impact of Drones on Emperor Penguins

PI: Osama Mustafa (ThINK, Jena, Germany)

The impact of drones (UAVs), of which numerous applications in different scientific and commercial fields have led to an enormous increase in numbers in recent years worldwide as well as in Polar Regions, currently is a highly discussed topic. The protection of the pristine wildlife of the Antarctic from such impact seems particularly important and calls for detailed knowledge about the magnitude of disturbances by UAVs. Due to the novelty of the technology only few studies have been done to investigate the impact UAVs have on Antarctic species, and those are focused on species of the Sub-Antarctic or the Antarctic Peninsula. So far, no knowledge has been gathered about the sensitivity of emperor penguins to fly-overs by UAVs. In the harsh conditions of the Antarctic continent, energy expenditure becomes an extremely limiting factor to survival and reproduction and thus every disturbance associated with a change in physiology or behavior and thus energy loss becomes crucial. Detailed information about the magnitude of the impact is needed to formulate international guidelines to protect the animals. This project aims to gather the necessary data to address the issue of UAV impact on emperor penguins and to compare the disturbance by UAVs and visitors. Disturbance experiments in different designs will be conducted to measure the impact of UAV operations to emperor penguins.

Mumiyo_2

PI: Sonja Berg (University of Cologne, Germany)

Within the proposed project we want to study the temporal and spacial distribution of snow petrel (Pagodroma nivea) breeding colonies in the interior of the Antarctic continent. The timing of colonisation can be inferred by radiocarbon dating of so-called mumiyo deposits, which form in front of snow petrel nesting cavities and consits of guano and stomach oil. Distribution of snow petrel colonies in un-glaciated in-land sites provides important information on local glaciation and enviromental histories but also on the oceanic foraging grounds of the birds. We would like to continue sampling of mumyio deposits from un-glaciated nunataks in Dronning Maud Land (East Antarctica) to extent the known record of snow petrel occupation, in particular during the last glacial period. We suggest that these deposits provide a unique archive of environmental variability for this remote region of Antarctica.

DML_GIA – GNSS measurements in Dronning Maud Land to investigate glacial-isostatic adjustment (GIA)

PI: Mirko Scheinert (TU Dresden, Germany)

We aim to determine the deformation of the Earth's crust in Dronning Maud Land (DML) resulting from the instantaneous elastic response and glacial-isostatic adjustment (GIA) of the solid Earth to present and past ice-mass changes. GIA still exerts the greatest uncertainty when determining the mass balance of the Antarctic Ice Sheet by satellite gravimetry. The only direct measurement of GIA can be obtained by realizing geodetic GNSS measurements on bedrock. DML is one of the areas where comparably small deformation signals are expected but measured so far by only a few geodetic GNSS sites. We already started in 1995 to perform campaign-style GNSS measurements in DML, and continued them mostly between 2001 and 2005. Most of the sites are situated in the mountain ranges that run parallel to the coast in a distance of 100 to 200 km between 13°W to 14°E. Repeating these measurements we aim to determine the deformation pattern with an improved spatial resolution and over a long time span of partly more than 20 years. The inferred vertical deformation rates will serve as constraints for an improved GIA estimation, which will be done in two ways: Firstly, satellite altimetry and gravimetry will be combined to empirically estimate ice-mass balance and GIA. Secondly, the 3D rheological structure of the Earth will be revised and, subsequently, introduced to predict the GIA effect.

1.4 Scientific projects at KOHNEN STATION

Kohnen Station will be closed during season 2019/20.

1.5 Scientific projects at DALLMANN LABORATORY

Mercury contamination and plastic debris residues in Antarctic petrel species

PI: Petra Quillfeldt

Global industrial production and consumer behavior lead to increasing contamination of the oceans. Therefore, there is a growing need to understand the prevalence and risk associated with exposure of wildlife to sources of contamination such as plastics and mercury, especially in remote areas such as the Southern Ocean. To compare the exposure to plastics among petrels sampled at different Antarctic and subantarctic sites and times of the season, the presence of three common plasticizers will be determined in the waxy preen oil using a recently established GC-MS protocol. In addition, mercury will be measured from the same birds using feather samples which integrate the exposure to mercury between two successive moults and blood samples which are representative of the present exposure. We will focus on small petrels (storm-petrels, prions and blue petrels) and will also analyse samples from storm-petrels breeding in the North-east Pacific to enable a comparison to an area known to have

high plastic exposure. We will test for differences in the level of contamination associated with breeding and inter-breeding distribution and trophic level (determined using compound-specific stable isotope analyses). We will further compare samples collected during the early and late Antarctic breeding season (e.g. November versus March) to quantify carry-over effects of the exposure in the inter-breeding season. To determine diet, regurgitates will be collected opportunistically during nest checks and mistnet captures. Furthermore, a pilot project will assess the feasibility of GPS tracking.

Biodiversity and adaptation of polar algae and their interactions with symbionts and parasites in a changing environment

PI: Thomas Wichard, Fatemeh Ghaderiardakani (University of Jena, Germany), Hans-Peter Grossart (Leibniz Institute of Feshwater Ecology and Inland Fisheries, Neuglobssow, Germany), Joas Zimmermann (Botanic Garden and Botanical Museum Berlin-Dahlem, Germany)

Antarctic marine biodiversity has been considered for a long time as species-poor constrained by a harsh environment. Particularly Antarctic microorganisms are still not explored and hence the impacts of on-going global environmental change, pose challenges to the present and future understanding of Antarctic biodiversity and related ecological functions. Our projects deal with biodiversity and adaptation processes of polar algae and focus on the following two main research lines including three three sub projects (A, B, C):

(1) How do cross-kingdom interactions contribute cooperatively to the cold-stress adaptation of macroalgae? (**Project A**) The green macroalga *Ulva* (or *Monostroma*) reacts adequately to cold stress if its microbiome can also adapt to environmental changes to provide the necessary algal growth-promoting factors. The project addresses the adaptation of *Ulva* to cold temperature (i) by intrinsic changes in the algal metabolism due to differential gene expression and metabolite production and (ii) by extrinsic changes due to the associated microbiome maintaining providing algal growth factors.

(2) How do parasitic interactions with diatoms shape the polar benthic habitats? (Projects B, C) Diatoms can be affected by parasites (e.g., chytrids). The project will focus on benthic diatoms collected from many marine soft-bottom regions in the Potter Cove. We plan to evaluate benthic diatom biodiversity in fine-grained taxonomic depth and infection rates through parasites using a combination of field, culture, and culture-independent methods for phenotypic and genotypic identification and parasite quantification.

1.6 Scientific flight campaigns POLAR 6

No scientific flights campaigns are planned for season 2019/20

1.7 Other scientific projects with AWI participation

Foraging ecology of Ross seals in the NORTHERN Weddell Sea

PI: Marthán N. Bester[1], Wiam Haddad[1], Nico Lubcker[1], Horst Bornemann[2], Mia Wege[1] (not on board – [1]MRI, [2]AWI)

During the SA Agulhas II Southern oCean seAsonaL Experiment (SCALE) Spring cruise (Oct – Nov 2019) a scientist of the Alfred Wegener Institute will be part of a seal research team led by scientists of the Mammal Research Institute (MRI) at the University of Pretoria. The forthcoming spring cruise extends previous summer expeditions carried out by MRI-AWI-scientists along the east coast of the Weddell Sea, i.e. off Princess Martha Coast, Dronning Maud Land (SA Agulhas II SANAE 55 expedition 2016), and in the south-western Weddell Sea, i.e. Filchner Outflow System (RV Polarstern PS82 and PS111 expeditions 2013/14 and 2018). Ross seals will be instrumented with satellite-linked position-temperature tags to investigate their ranging behaviour and, through the use of stable isotope analyses on sampled blood, fur and whiskers, and opportunistic scat and vomitus samples, their diet. Ship-board census strips shall be carried out for post-hoc reconciliation of locations of seals spotted on ice with those identified on satellite images to improve abundance estimates.

Beyond EPICA high radar survey at Little Dome C

PI: Daniel Steinhage (AWI), Ryan Taylor (U Alabama), Olaf Eisen (AWI, not on site), David Armond Lilien (U Copenhagen), Heinrich Miller (AWI, not on site), not on site), Stephen Yan (U Alabama, no on site), Charles O'Neill (U Alabama, not on site), Prasad Gogineni (U Alabama, not on site), Dorthe Dahl-Jensen (U Copenhagen)

In support of Beyond EPICA – Oldest Ice a ground-based radar survey at Little Dome C is planned for mapping the internal structure in the bottom 20% of the ice sheet. Based on glaciological fieldwork carried out in previous years and modelling studies three sites have been identified as suitable for a drill site for recovering ice older than 1.2 million years, see also slide 6 in https://cdn.egu.eu/media/gamedia/documents/2019/98/be-oi_press-conference.pdf. The now scheduled survey, deploying an especially for this occasion by the University of Alabama designed 8-channel VHF radar, is aiming to reveal the internal layering in the bottom part of the ice sheet in the 3 target sites as well as between them and Dome C. The latter will allow to transfer the age-depth scale of the EPICA DC core to the three investigated areas while the mapping of three region contributes to the data base on which the Beyond EPICA steering committee will finally determine the drill site.

2. LOGISTICAL OPERATIONS

2.1 Dronning Maud Land Air Network (DROMLAN)

The aim of DROMLAN is to provide an intercontinental air-link from Cape Town to destinations within Dronning Maud Land (DML) to any member country of COMNAP and SCAR in science related activities, including logistics. This regularly operated air-link improves the accessibility and extends the time period for summer season activities. DROMLAN has been established as an international project by Belgium, Finland, Germany, India, Japan, Norway, Russia, South Africa, Sweden, The Netherlands, and UK. In Figure 3, the DROMLAN partners are presented.

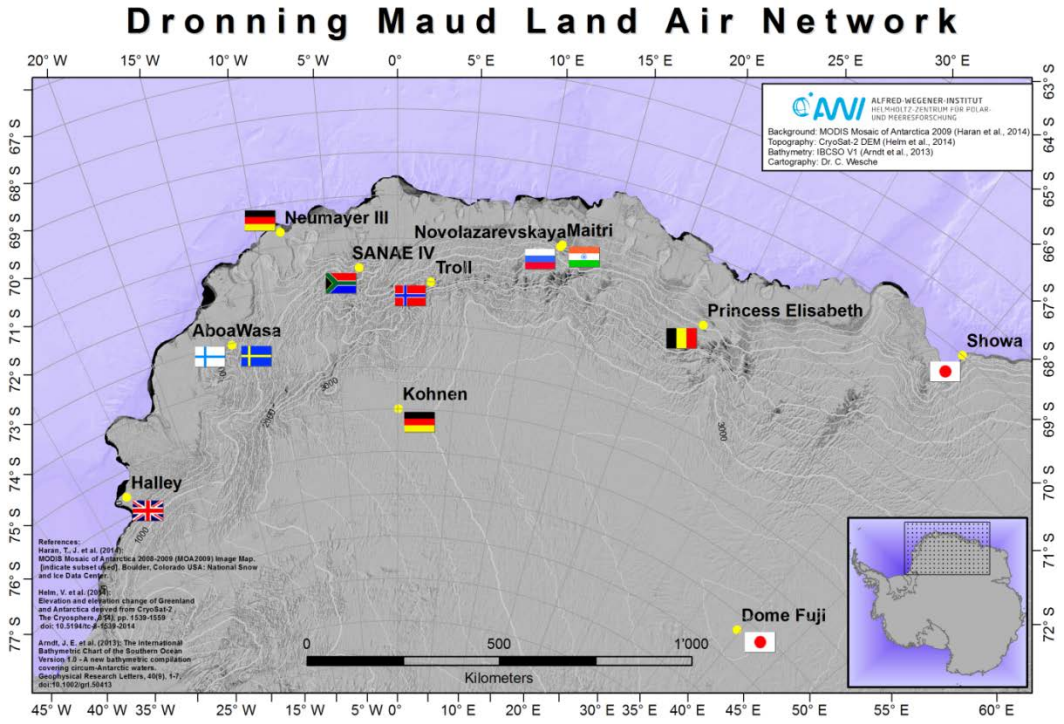

Figure 2 Overview of the DROMLAN partners

Each summer season runways are prepared at NOVO RUNWAY close to the Russian station NOVOLAZAREVSKAYA and at the Norwegian station TROLL for landing of heavy aircraft. The runway at NOVO Airbase consists of compacted snow and is elevated about 500 m a.s.l. The runway at TROLL STATION consists of blue ice at an elevation of about 1300 m a.s.l.

The weather forecast for intercontinental and internal flight operations is organized at NEUMAYER STATION III (AWI, DWD). This service covers the region between HALLEY and SYOWA for all intercontinental and internal flights in the scope of DROMLAN.

Internal feeder flights are performed with ski-equipped aircraft Basler (BT-67) and Twin Otter. DROMLAN members coordinate the feeder flights with the operator ALCI (Antarcric Logistics Center International) and provide necessary services, fuel and facilities at their stations.

The number of flight missions depends on logistic and scientific requirements of the national programs. Every season DROMLAN generally aims to perform 10-13 intercontinental flights with connecting flights to various destinations.
In season 2019/20, for DROMLAN altogether 13 intercontinental flights to NOVO RUNWAY are planned.

2.2 Ship calls

Due to the absence of RV POLARSTERN in season 2019/20, the supply of NEUMAYER STATION III will be done in strong collaboration with the South African National Antarctic Program (SANAP). Their vessel SA AGULHAS II will call at Atka Bay in total three times to supply the station with scientific and technical equipment, fuel and provision to ensure a smooth summer season and wintering period. The first and the second call will be for supplying the station whereas the third call will be used for disposal of waste and back freight of equipment.

3. NATIONAL AND INTERNATIONAL VISITS

In season 2019/20, two media teams from German broadcasting services (ARD and ZDF) will visit NEUMAYER STATION III.

4. PARTICIPANTS

Name	First name	Destination	Project
Bähler	Stefanie	Neumayer III	Technical team
Bagheri Dastgerdi	Saeid	Neumayer III	ISOAnt
Bornemann	Horst	SA Agulhas II	SCALE
Brändli	Monika	Neumayer III	Housekeeping
Brawand	Urs	Neumayer III	Traverse team DML_GIA
Briese	Wilfried	Neumayer III	Siemens/Maintenance
Brodbeck	Boris	Neumayer III	Buchele/Maintenance
Buchta	Eric	Neumayer III	DML_GIA
Christian	Boris	Neumayer III	Technical team
Czart	Thorsten	Neumayer III	ZDF
Denecke	Mirko	Neumayer III	Technical inspection
Ebert	Matthias	Neumayer III	ARD
Eberlein	Lutz	Neumayer III	DML_GIA
Eder	Pitt	Neumayer III	Technical team
Fromm	Tanja	Neumayer III	Geophysical

			observatory
Geis	Peter	Neumayer III	Pistenbully maintenance
Grasse	Torsten	Neumayer III	I27DE
Henning	Silvia	Neumayer III	VACCINE
Heuck	Hinnerk	Neumayer III	Technical coordinator
Hoffmann	Mathias	Neumayer III	I27DE
Krams	Ralf	Neumayer III	Pistenbully maintenance
Loose	Bernd	Neumayer III	Meteorology observatory
Matz	Thomas	Neumayer III	Expedetion leader
Mitteregger	Christian	Neumayer III	Technical team/Traverse team DML_GIA
Mondini	Juan Pablo	Neumayer III	ARD
Mustafa	Osama	Neumayer III	IDEP
Pennucci	Daniel	Neumayer III	Technical team
Riess	Felix	Neumayer III	Technical inspection
Roetz	Oliver	Neumayer III	ZDF
Rotthäuser	Siegfried	Neumayer III	IgH
Rümmler	Marie-Charlott	Neumayer III	IDEP
Schubert	Holger	Neumayer III	Sub-EIS-Obs/Technical team
Steffens	Dirk Peter Jörg	Neumayer III	ZDF
Steinhage	Daniel	Dome C	BE-IO
Vallas	Benoit	Neumayer III	MARE
Vogel	Lutz	Neumayer III	Technical team
Weller	Rolf	Neumayer III	Airchemistry observatory
Wesche	Christine	Neumayer III	Expedition leader
Winterl	Alexander	Neumayer III	MARE
Zabel	Paul	Neumayer III	EDEN-ISS
Zeidler	Conrad	Neumayer III	EDEN-ISS
Zink	Iris Else	Neumayer III	ZDF

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