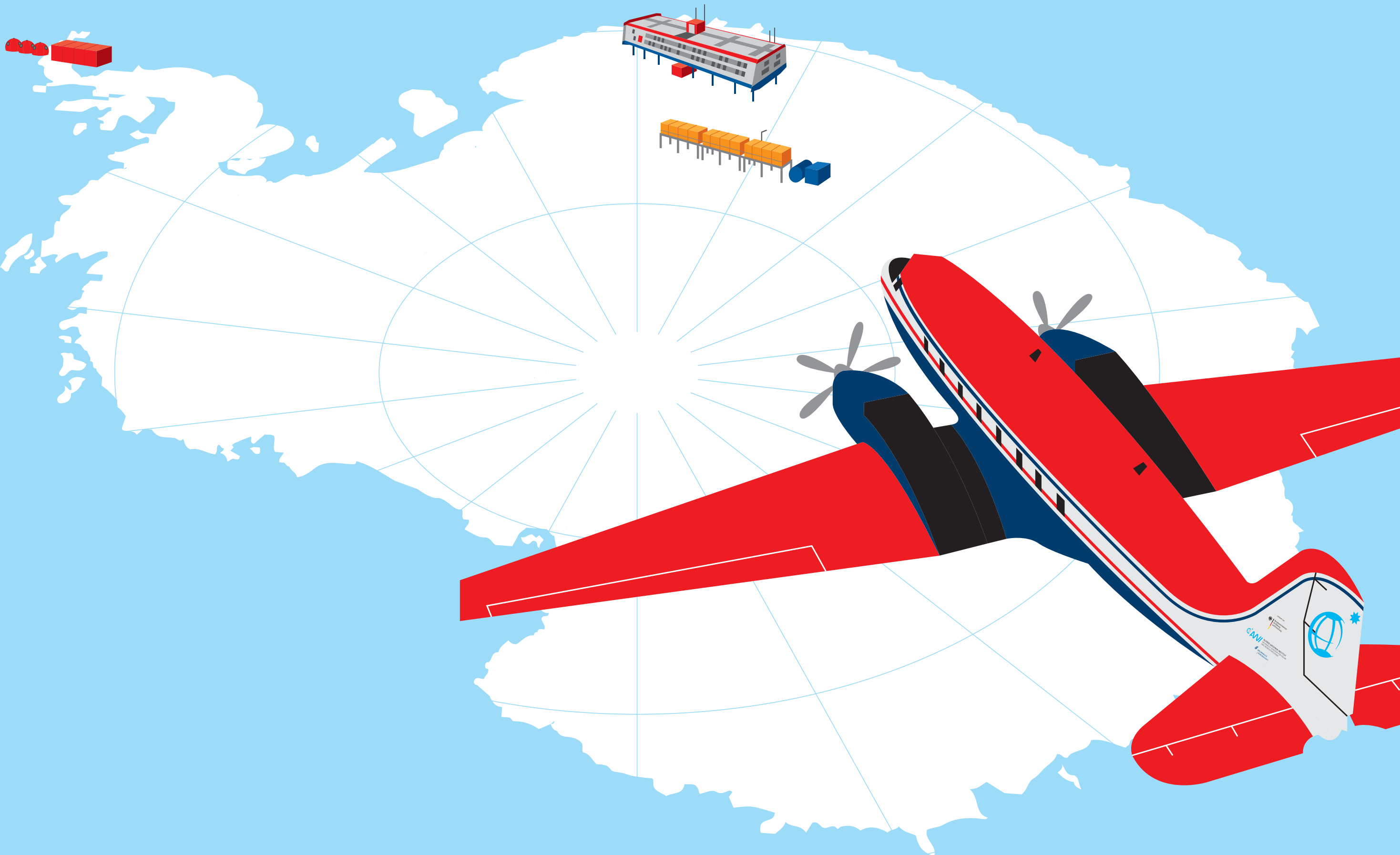
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Expedition Program

ANTARCTICA

(ANT - Land 2020/21)

Land activities & flight missions



HELMHOLTZ

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1. ANT-LAND 2020/21

1.1 Summary

1.2 Schedule of the season

Due to the COVID-19 pandemic, the season activities will be extremely reduced, focused on the maintenance of the station, the observatories and multiple year projects. All participants will arrive and depart at/from Neumayer Station III with R/V Polarstern with a minimal duration of stay at the station. The wintering team will be exchanged.
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 – not on site this season)

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).

CHOICE

PI: Alexander Choukér (University of Munich)

Knowledge achieved from CHOICE I&II (Antarctica) and from more “technical” isolation environments (such as MARS500) as well as from the International Space Station (ISS), has helped to elucidate the link between an exposure and a potential disorder in the area of immune dysfunctions. This provides insights and tentative interactions into the interconnected mechanisms of intrinsic and extrinsic regulatory effects of the immune system. The first results have provided i) first clinical observations showing initial higher rate of infections, ii) genetic transcriptome pattern to be systematically affected, iii) delayed but continuously increased in vitro hypersensitivity especially to fungal antigens as well as iv) viral reactivation altogether in a microbiologically changing environment.
This altogether is leading to the questions of their interactions and the leading impact. Especially since case reports from the medical staff and from overwintering crew members in Antarctic bases report of emerging allergies and the occurrence of anaphylactic incidences, exploring how sensitivity reactions are triggered during isolation is required. Furthermore the interlinkage to the environmental load, its extrinsic and intrinsic dynamics (e.g. the Microbiome) and to viral activity and the hormonal control in the overwintering crew has to be elucidated. Moreover, the factor of exposition time seems also a strong variable and needs to be addressed in a controlled way in the same environment, resulting in a summer campaign element and an overwintering crew element. This especially since our observations and assumptions are complimentary to data from ISS in Space and returning crew. Biologicial specimen will be collected and complimentary to the protocol at Concordia Station Dome C (DC), pre, at early arrival, at start of confinement, twice during confinement (April and July), post-winter opening, before leaving station, at arrival in South Africa (Tbd) and after longer “re-exposition” in Europe. Samples are collected along the approved ethical board protocol and will included blood, usine, salvia, stool and hair and are complemented by questionnaires/tests addressing well-being and emotional memories.

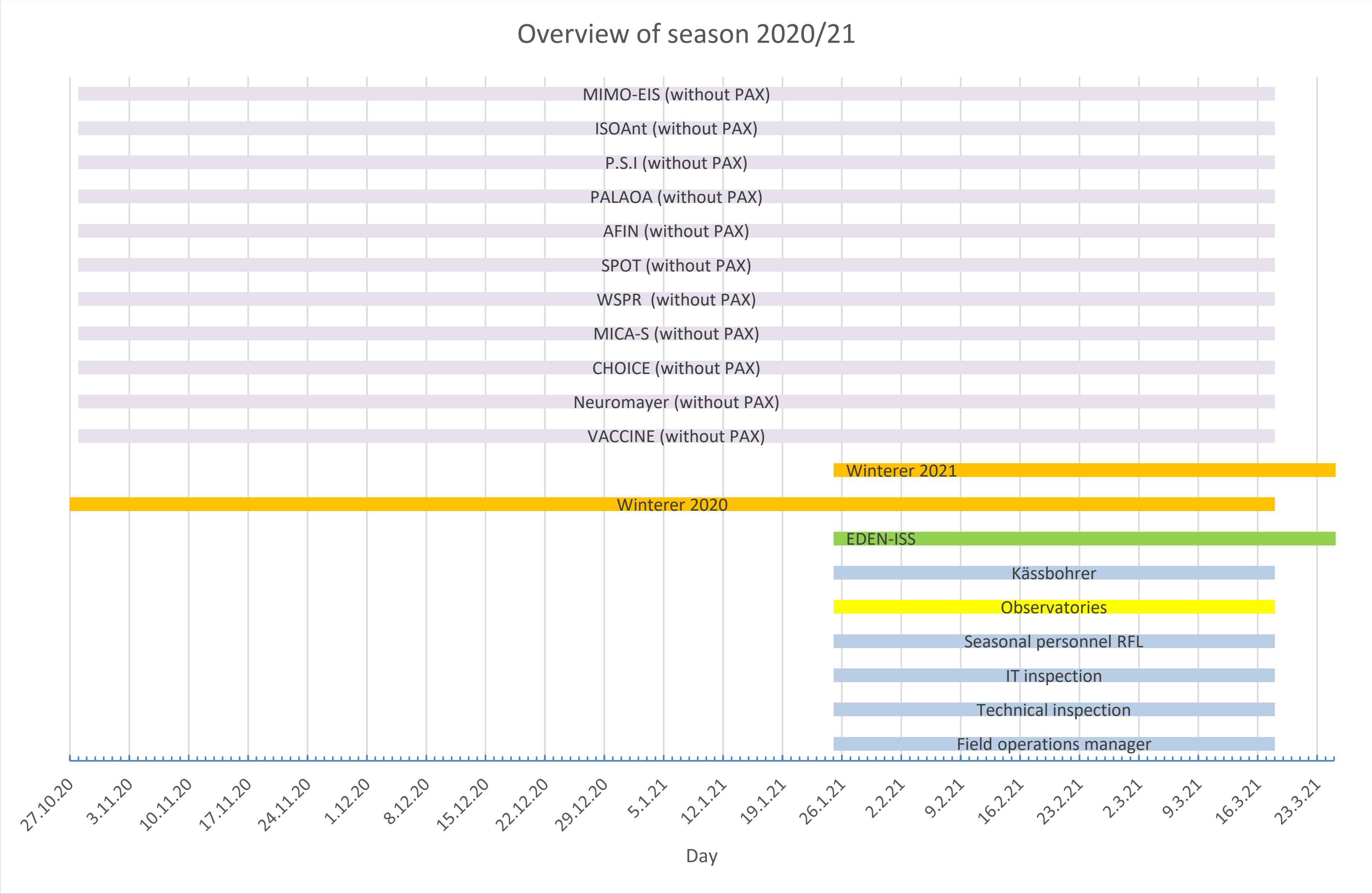

Figure 1 Schedule for season 2020/21

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.

MIMO-EIS

PI: Olaf Eisen (AWI)

The interaction of ice shelves with the ocean water underneath is one of the key processes for the future development of ice masses. Especially for the Antarctic ice sheet, mass loss through ice shelves is the dominant component of loss in the mass budget. Water masses entering the Filchner-Ronne Ice Shelf system are partly pre-conditioned in the coastal current of Dronning Maud Land, Antarctia. This project aims at establishing a continuous monitoring system on the Ekström Ice Shelf (EIS) to determine the interannual (and potentially seasonal) variability of basal melt rates to improve our understanding of the processes of ice-ocean interaction along the DML coast. To this end, an Autonomous phase-sensitive Radio-Echo Sonding (ApRES) system will deployed in the center of EIS, at the flank of the main bathymetric trough. Data will be retrieved half-annually and will be used as validating constraints in numerical ocean-modelling runs as well as satellite-based analyses. The project will extend a chain of already available and ongoing ApRES observations on other ice shelves in the Dronning Maud Land Region, like Roi Baudouin and Fimbul, and thus increase our observational and potentially monitoring capabilities in this region.

The interaction of ice shelves with the ocean water underneath is one of the key processes for the future development of ice masses ice sheets. Especially for the Antarctic ice sheet, mass loss through ice shelves is the dominant component of loss in the mass budget. Under steady-state conditions, this mass loss is balanced by an equal amount of mass deposition on the ice sheet. Although mass loss from ice shelves does not directly contribute to a change in sea level (as they are already floating), their socalled buttressing effect is of important for the dynamic behaviour of the ice streams and sheet upstream of the grounding line. Over the last decade it turned out that the presence of warmer waters at and underneath ice shelves and tidewater glaciers can lead to a massive increase in basal melt rates (e.g. Milillo et al., 2019). Subsequently, the ice shelf can react dynamically, and with reduced buttressing the mass flux across the grounding line will increase – providing a net mass gain to the ocean.

Based on numerical modelling under warming climate scenarios, it is likely that the Filchner-Ronne ice shelf, one of the three largest ice shelf systems on Earth, will potentially be subject to a considerable increase in basal melt rates in the second half of this century, induced by warmer ocean water entering the ice shelf cavity (Hellmer et al., 2012). For this process, the pre-conditioning of water masses in the coastal current of Dronning Maud Land, Antarctica, is potentially important. Previous studies investigated the ocean process in the cavity of other ice shelves along the DML coast (e.g. Hattermann et al., 2012) and also their effect on and interaction with ice-shelf basal melting.

Dedicated observations of basal melt rates are nowadays routinely facilitated by application of phase sensitive Radio-Echo Sonding (pRES). Deploying pRES repeatedly at the same position over longer periods (weeks, months) provides integrated observations, from which the mean basal melt rate can be reproduced. The pRES system can also operate in an unattended mode, basically autonomously, as so-called ApRES. In that case, the observations take place on the order of minutes to hours. This provides a time series of basal processes, which enables the resolution of ice-ocean interaction on the temporal scale relevant for tidal action as well as seasonal changes. Lindbäck et al. (2019) deployed ApRES on Nivlisen and observed strong variations of basal melt rates over days and weeks, related to the overall atmospheric circulation and sea-ice pattern, which changed ocean properties in the cavity. Previous results from the Roi Baudoin ice shelf based on satellite measurements (Berger et al., 2017) and complemented by ground-based pRES observations (Sun et al., in review) likewise indicate spatial as well as temporal variations in basal melting.

The results obtained on the Roi Baudouin ice shelf led to the initiation of the Belgian MIMO (Monitoring melt where ice meets ocean) project, in which AWI Glaciology acts as an international collaborator. The satellite-based techniques applied by Berger et al., 2017 were extended to all other ice shelves in the DML region, including Ekströmisen.

All these available studies indicate that the relevant processes at the ice-ocean boundary vary on various temporal and spatial scales. They are driven by a highly-coupled interaction of atmospheric (e.g. strom system), cryospheric (e.g. sea-ice cover), oceanographic (e.g. currents) as well as topographic (bathymetry) conditions. Despite of all the efforts made, the number of observations of basal melt available so far is still too limited (spatially and temporarily) to reduce uncertainties to a degree where we could reliably determine the current state and sensitivity of the ice-ocean system in the DML region at present to improve out predictions in the mid-term future on the order of decades, neither from numerical ocean models nor satellite-based analyses of ice-shelf melting. This emphasizes the need for further observations.

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.

P.S.I. (Performance and Stress in Isolation)

PI: Alessandro Alcibiade (University of Pisa)

In order to increase our database we propose performing at the Neumayer station the same research we are performing at Concordia Station in agreement with the ESA Human and Robotic Exploration Directorate (P.O.C Dr. Ngo Ann and Dr. Harrods).

<u>Background:</u> A large variety of studies in the scientific literature suggest the existence of a correlation between changes in the amplitude and frequency of the words spectrum, and the stress levels perceived in the test subjects.

<u>Objectives:</u> This study aims to quantify the correlation between the change in length and variation in the structur of a written text and the psychological and perceived stress levels in the writer, determined through a Psychological questionnaire and through the analysis of the peculiar chanches in the complexity and variety of the writtend composition.

<u>Experimental design:</u> The experiment will be performed by subjects experiencing voluntary isolation during the winter-over period at Neumayer Antactic Station. The experiment consists of two tasks.

1st task: *Text.*

The written texts will be acquired analyzing the periodical reports that key crew-members (ex. Station Leader, MD, etc.) will have to provide timely to their mainland agency during the whole winter over period.

2nd Task: *Short psychological questionnaire*, to be completed at the end of the winter-over isolation from that key crew-members involved.

Ethic: The content of the text will not be considered but only the structure, all the data will be reported anonymized. This experiment has the ethic approval from Universitá di Pisa and the scientific commission of Concordia, and need to be extended to Neumayer III to gain key comparison data.

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:

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.

This project was extended for one year and will be conducted without personnel on site.

1.4 Scientific projects at KOHNEN STATION

Kohnen Station will be closed during season 2019/20.

1.5 Scientific projects at DALLMANN LABORATORY

No activities at Dallmann Laboratory.

1.6 Scientific flight campaigns POLAR 6

No flight activities in Antarctica.

1.7 Other scientific projects with AWI participation

None.

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.

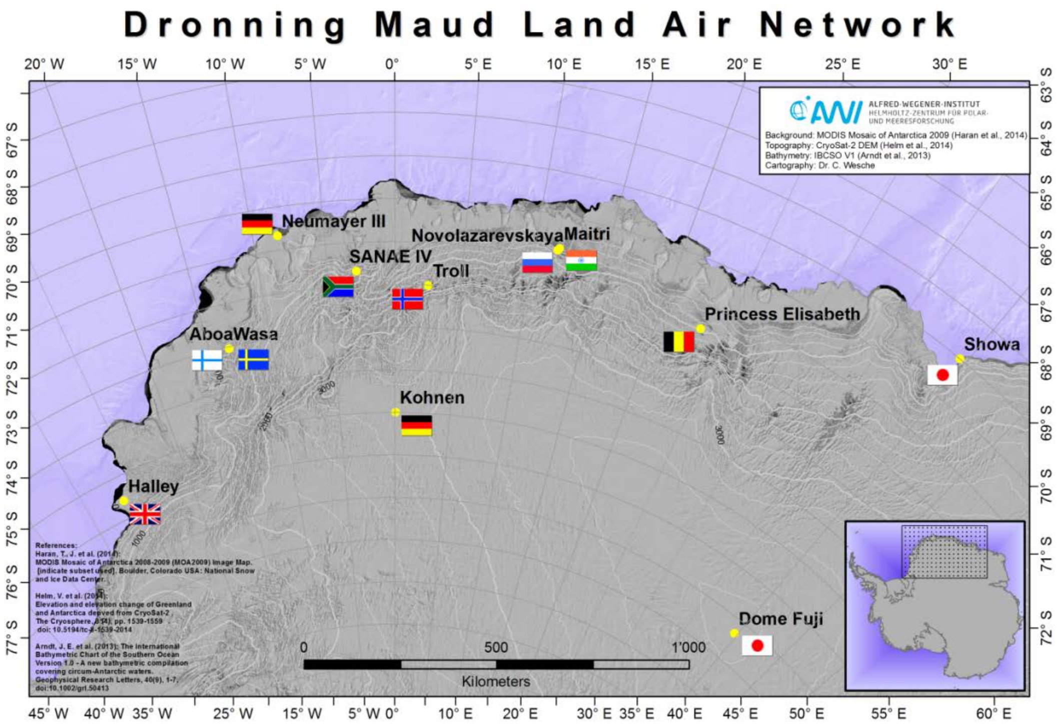

Figure 2 Overview of the DROMLAN partners

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). DROMLAN members coordinate the feeder flights with the operator ALCI (Antarctic 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. Usually, DROMLAN aims to perform 10-13 intercontinental flights with connecting flights to various destinations. Though, the pandemic caused a reduction of activities for all DROMLAN nations, the number of intercontinental flights to NOVO RUNWAY is reduced to five. This results in a short Antarctic season starting mid November 2020 until mid February 2021. AWI will not use the DROMLAN facilities in season 2020/21.

2.2 Ship calls

Personnel and cargo will be transported to/from Neumayer Station III with RV POLARSTERN. The first ship call at ATKA BAY is planned for mid January 2021. On this first call, the new wintering team, the maintenance team and the complete supply with provision, fuel and equipment will be delivered. The complete discharge and the dismission of personnel (old wintering team, maintenance team) will be performed on the second ship call in mid March 2021.

3. NATIONAL AND INTERNATIONAL VISITS

No visits are planned in season 2020/21.

4. PARTICIPANTS

Name	**First name**	**Destination**	**Project**
Ackle	Roman		40. Wintering team
Baden	Markus	Neumayer III	41. Wintering team
Bähler	Stefanie	Neumayer III	Technical inspection
Beyer	Mario		40. Wintering team
Buchek	Jess	Neumayer III	41. Wintering team
De Almeida Santos	Wanderson		40. Wintering team
Dornhöfer	Timo	Neumayer III	41. Wintering team
Doron	Tanguy	Neumayer III	41. Wintering team
Eder	Pitt	Neumayer III	Technical team

Fromm	Tanja	Neumayer III	Geophysical observatory
Geis	Peter	Neumayer III	Pistenbully maintenance
Guba	Klaus		40. Wintering team
Heitland	Tim	Neumayer III	Expedition leader
Jonczyk	Peter	Neumayer III	41. Wintering team
Koch	Florian	Neumayer III	41. Wintering team
Jörss	Anna-Marie		40. Wintering team
Laubach	Hannes	Neumayer III	Technical team
Lemm	René	Neumayer III	Housekeeping
Loftfield	Julia		40. Wintering team
Marten	Lorenz	Neumayer III	41. Wintering team
Oblender	Andreas		40. Wintering team
Ockenfuß	Paul	Neumayer III	41. Wintering team
Ort	Linda	Neumayer III	41. Wintering team
Preis	Loretta	Neumayer III	Meteorological observatory
Riess	Felix	Neumayer III	IT inspection
Schmithüsen	Holger	Neumayer III	Meteorological observatory
Schubert	Holger	Neumayer III	Technical team
Schütt	Philipp	Neumayer III	Technical team
Sterbenz	Thomas	Neumayer III	Technical team
Thoma	Theresa	Neumayer III	41. Wintering team
Trumpik	Noah		40. Wintering team
Vrakking	Vincent	Neumayer III	EDEN-ISS
Wehner	Ina		40. Wintering team
Weller	Rolf	Neumayer III	Airchemistry observatory

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