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INSTITUTE
PAUL-ÉMILE VICTOR

ANNUAL
REPORT

SUMMER CAMPAIGN

2018
2019





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of the activity report
is shorter than
the French version.

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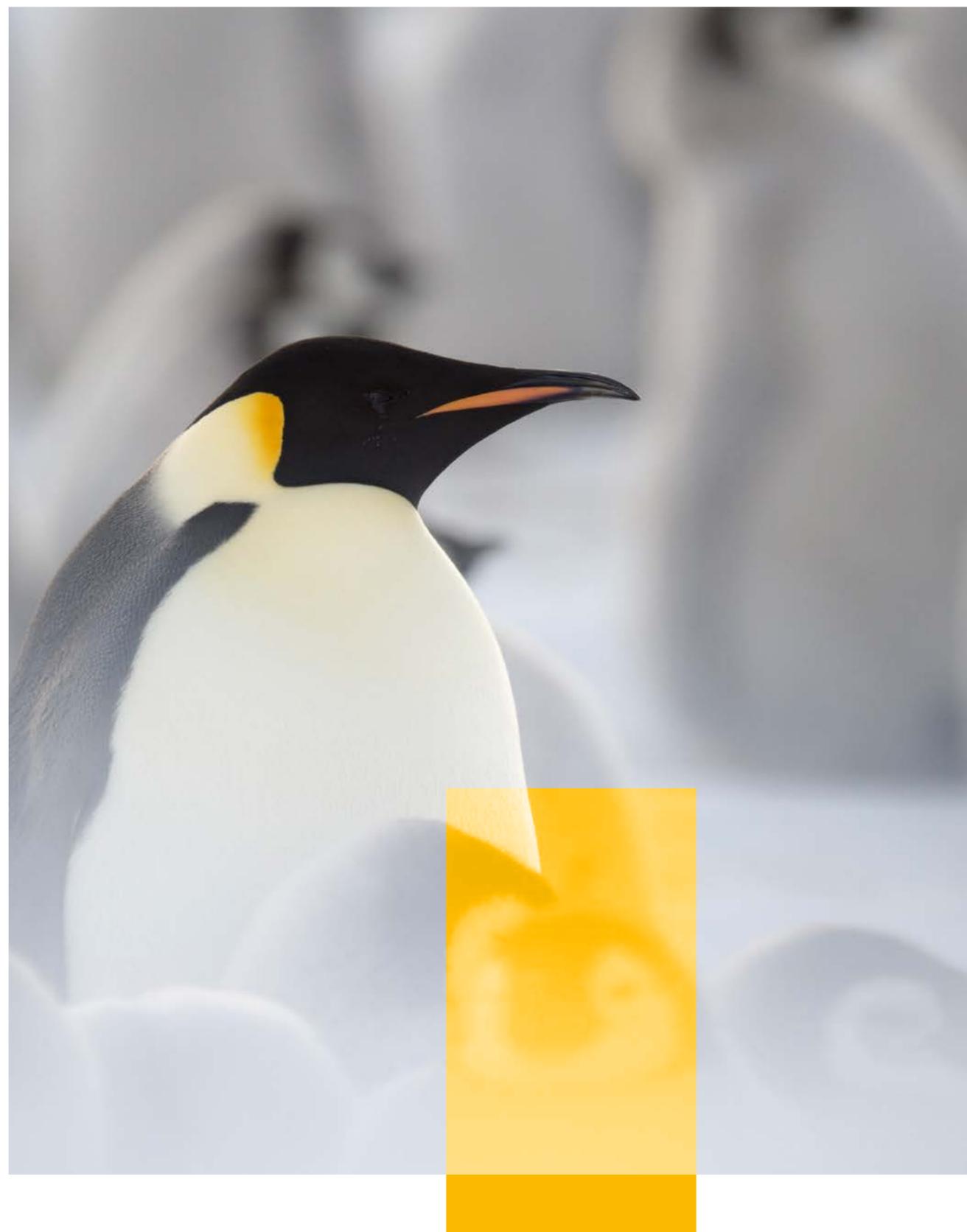
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Editorial

2018

A fully active year

Marie-Hélène Tusseau-Vuillemin

Ministry of Higher Education,
Research and Innovation

After eight years at the head of the French Polar Institute, Yves Frenot has crossed the Atlantic to take up his post as Science and Technology Advisor at the French embassy in the United States. His successor is a glaciologist from the CNRS, Jerome Chappellaz, experienced in the field and polar exploration with the French Polar Institute throughout his career. With him, the Institute will bring its support to the diverse scientific community in the human and social sciences, life and earth and planetary science. This will be achieved by accomplishing technically difficult missions in environments with harsh, dangerous conditions. The handover at the top gives the opportunity to celebrate the achievements of Yves Frenot and the successes of the whole French Polar team, whose strong commitment, criteria for excellence and the common good are an emblem of pride for the governing ministry.

A change of management is also a chance to introduce new ideas, a new overall perspective on the Institute. In this spirit several measures were initiated to improve and rationalise the Institute's internal organisation and procedures, also to define a new strategic plan. What will be the key polar sciences for the future, what resources will we need to apply? The French Polar Institute on its own or otherwise what kind of strategic partnerships should be brought in? Some of the questions the Institute and the scientific community as a whole will be investigating in the near future. The European project H2020 Beyond EPICA is particularly emblematic. As its name shows, the aim is to reach further than the already outstanding results yielded by EPICA. The new objective is a continuous stratigraphic sequence recording the climate conditions and going back 1.5 million years. The French Polar Institute, the Italian National Antarctic Research Programme (PNRA) and the CNRS are working together on this six-year project.



As well as these activities, 2018 has seen the second Antarctic logistic support mission conducted with the new supply ship *Astrolabe*. Owned by the TAAF, fitted out by the French Navy, the French Polar Institute takes command for its missions over periods totalling 120 days per year. The ship's capabilities and performance were tested out and verified in 2017-18. Sailings during the 2018-19 season then confirmed the vessel to be fully functional and operational. Favourable weather conditions helped *Astrolabe* successfully deliver supplies close by the

research teams, with no need for helicopter backup or transport over the sea-ice. The overall fuel consumption was however higher than expected. Testing of the ship's technical and operational characteristics and performance is required. All specifications must be optimised to bring *Astrolabe* into compliance with the Institute's vital commitment to implement sustainably-run missions!

The French Polar Institute supported 75 projects in 2018 in Arctic and during the 2018-2019 summer campaign in the other polar areas: 24 in the Arctic, 33 in Adelie Land and the Subantarctic islands and 18 in Concordia

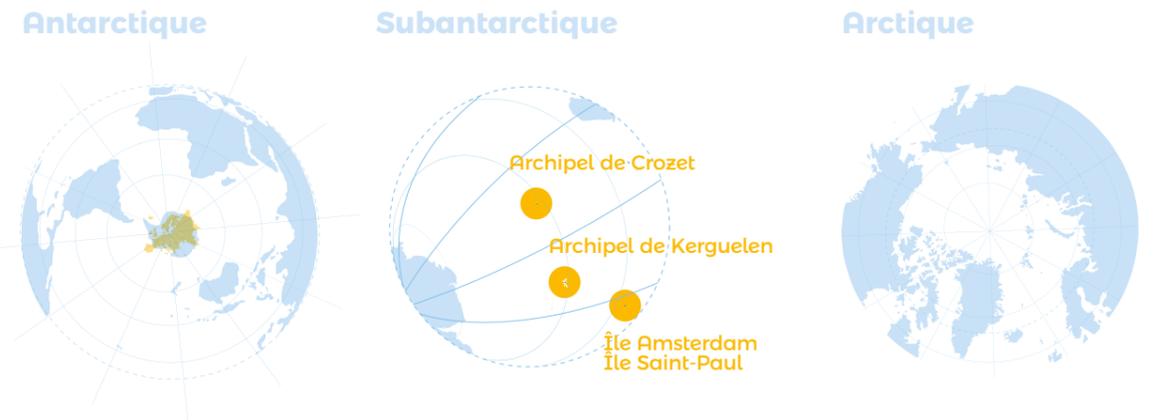




Antarctique Subantarctique



Europe
Antarctique



Arctique



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A year in the field

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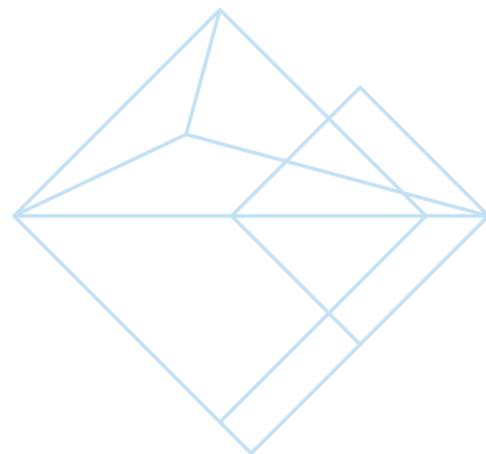
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A year in the field





AWIPEV

Station Ny-Ålesund

This year, 10 scientific projects in marine biology, ornithology, glaciology and physics and chemistry of the atmosphere have been launched.

The grand operations for **logistics**

Reinstallation of the hydraulic crane of the autopilot of the Jean Floc'h after refit at Brest for coastal oceanographic operations with the vessel.



Installation of a hydraulic table in the scooter and snowbike workshop.

Reinstalling the outboard motors of Fun Yak boats: After refitting of the 100CV engine of the 5.4m Fun Yak at Brest, the vessel's stern plate has also been changed. The 40CV engine of the 4.5m craft was replaced by a new one as the petrol feed system had become irreparable.



Installation of a positional tracking system on the boats Jean Floc'h and Luciole: to improve the safety of people travelling aboard. An AIS ship intelligence tracking system is fitted. This identification system uses automated VHF radio message exchange between boats allowing them and traffic watch networks to recognise the identity, status and position of vessels and their routes taken when located in the navigation zone.



The AIS on Jean Floc'h

Corbel station

Maintenance of the energy generator unit and battery replacement

In 2018, the station was open from the beginning of April to the end of October. Outside this period, access is very difficult and it is run in winter mode. In preparation, the water circuits are emptied, the ventilators are blocked to avoid snow getting in and the shutters are fitted.

In 2016 and 2017, batteries of the energy generator system had expired and eventually froze up. The whole set of batteries was replaced in 2018 and the insulation of the battery storage room was improved to restrict the fall in temperature. The total capacity in Ampage per hour (Ah) of the array was also reinforced in order to improve the overall energy production. The battery system now consists of 2 blocks of 24 2-volt units each of 1695 Ah and 90 kg, in all 4320 kg of lead gel batteries transported by showbikes.



Replacement of the battery set



There were no openings on the south side of the building's bedrooms. These were therefore never warmed by the sun. Strongly insulated windows of about 1m² were fitted to obtain solar heating of around 1000W per room on sunny days.

The wind turbine AWP 1.6 KW installed in 2007 stopped working during winter 2017 and was replaced by a more powerful one. The existing mast was kept to limit the mobilisation of logistical resources otherwise needed for a model of 2.5 KW (ANTARIS 2.5) that was installed, reaching nominal power of 2500 W.

The new wind turbine in place



The new scientific projects in the Arctic 2019-2020

Imob-Ed

Survey of migrant-status students from Greenland, their possibilities and means of access to university education and their level of success outside the Arctic.

Alpaca

Study on aerosols from local Arctic pollution sources, their formation processes and distribution systems in winter and early spring.

Extremevent

Study of the changes in coastal morphology of Reykjanes Peninsula (south-west Iceland) by following trends in successive cliff-top deposits in selected accumulation zones, the aim being to check the hypothesis whereby climate change would increase the frequency and/or intensity of storms in the mid- and high latitudes.

PalethnoAK

Excavation of an encampment dating 9600 years BP, which itself abits traces of occupation dating back 11 150 years BP. The aim is to record human activities in the Pleistocene-Holocene period in Nenana Valley (Alaska).

HyperGesse

After a 22-year period, survey of the same field site in the Canadian Arctic to assess the extent of increased browsing by geese and climate changes and their effects on its environment and overall fauna.

Icewaveguide

Application of new methods of measuring the Arctic sea ice: thickness of deterioration and its elasticity. Techniques based on the propagation of elastic waves through the ice.

MPC 2

Collection and analysis of data on low cloud in the mixed phase to study the impact of their microphysical properties on the energy budget at the surface and for a better understanding of the life-cycle of clouds.

PIM

Involvement of IAOOS platforms in the international campaign MOSAIC aiming to follow atmospheric and oceanic processes that affect the sea ice during the first year of its formation and until its decline.

Dumont d'Urville

Each season has its highlight event. Last year was marked by a change of ship and the entry of the French Navy into the fleet. The arrangements for deploying the supply ship for transport between Hobart and the research station Dumont d'Urville have altered considerably following the first season of operations after the maiden voyage of *Astrolabe*, the new vessel. Further work was needed to guarantee that the new season would run successfully. Preparations for that season were being made while major changes were happening in the Institute with the arrival of a new team in the Directorate who took office on March 1st 2018.

The many major objectives of season 2018-2019

- Complete replenishment of diesel fuel stocks, taking into account the needs for a forthcoming scientific traverse, departing from Concordia and heading for the South Pole in the 2019-2020 season
- Restocking of kerosene, ensuring supplies for research flights in the ICECAP project in the context of the convention with the Institut de géosciences de l'environnement (IGE) (project of the Agence nationale pour la recherche (ANR))
- Resupplying of bases with food requiring temperature restrictions (+4°C and frozen at -20°C), also with dry foodstuffs as wintering provisions, also delivery of the required number of pre-prepared meals for the traverses, scientific and logistic, planned for the next campaign
- Resolve the delay in transfer of materials and equipment from Hobart. Much of this has stayed there for several years owing to problems of access to the Dumont d'Urville station where there is no ice break-up
- Ship two vehicles over to Dumont d'Urville, one adapted for haulage over the sea-ice, the other a snowgroomer with wide snow-cutter acquired from the Italian partners, which has to be transferred to Concordia at the beginning of season 2019-2020
- Run three supply traverses with provisions for the scientific expedition East Antarctic International Ice Sheet Traverse (EAIIST) and also the transportation of goods and equipment for late-running work (general store for instance)
- Undertake priority building work on Dumont d'Urville station. This entails sealing the whole roof of the energy generating plant and freshwater production system which have been suffering for many years. A new roof support structure delivered at the start of the season and insulation cladding will be fitted on the existing structure of the building
- Implement the logistic operations for the scientific activities at the coast. January's R2 crossing should have allowed work to proceed at Port-Martin (geology and ornithology) but also a quick visit to Cape Denison to pick up equipment left several years ago, GPS and tide-gauge data. On this occasion a specialist heritage mission at Mawson's Hutt on behalf of AAD was carried out and also the dismantling of an automatic AWS
- The media and communications officers came to film the event and produced sound recordings at Dumont d'Urville and Robert Guillard on the Cape Prud'homme site
- The visit by Mme Decorps, new Prefect of the TAAF, with the Director of the French Polar Institute Jérôme Chappellaz was programmed on crossing R3





Concerning the human resources aspects, on sites, as well as contract personnel mostly already well used to summer campaigns, this season especially saw the arrival of permanent staff of the Polar Institute Gaëlle Sellin came to assist with the logistics and as main agent for scientific coordination on the stations Dumont d'Urville and Robert Guillard.

Patrice Bretel is involved as head of operations for this season. The scientific coordination was directed at Concordia by Doris Thuillier. Also, Anthony Vendé coordinated the traverse-related activities and on-site mechanical operations. Jean-Gabriel Coll was in charge of the alarm systems, their distribution and the electrical circuitry. A thorough survey of the site's buildings, their layout and installations was conducted by Nathalie Auffret. The technical and administrative liaison was performed by staff remaining at the Institute's HQ. A large proportion of the regular contract personnel fulfilled their functions as summer campaigners and some new people have been recruited this year (notably a cladding technician and a bosco).

The supply services of *Astrolabe*



The ice conditions were exceptional this season. The pack was only weakly developed with low density straight in front of Dumont d'Urville station it was diminishing steadily as the season progressed. The sea crossing times were very short. The ship was able to arrive alongside Lion quay from the first voyage. The sea-ice melt directly in front of Dumont d'Urville expanded to all the adjacent areas. This made manoeuvring the boat quite easy, even though this meant skirting round areas of open water but as-yet not studied by hydrographic survey.

For crossing R2 access to Port-Martin made easier by that ice-melt as for approaching Cape Denison. However, access to the Lion for the new ship *Astrolabe* is still a difficult exercise. The addition of daymarkers as physical points of alignment is an effective aid but the operation still brings risks as the avoidance zone is reduced, a critical situation if winds exceeding 20 knots occur. The weather window available for access to Lion dock during this crossing service did not allow the boat to dock. A detailed plan of such a scenario could however have made helicopter delivery for all transfers possible and highly effective in one day.

The planes



Basler Chinare, from the Chinese National programme, team for the ICECAP programme

The air operations began early in the season with the arrival of 18 passengers, including 3 scientists, on 29 October 2018. Such an early start was necessary in order to prepare for the departure of the first traverse without having to wait for the first boat crossing. The restriction with the new calendar allowing 120 consecutive days' availability, instead of a period of 140 days, makes it difficult to accomplish three traverses in a season without bringing personnel over early by air. Moreover, good forward planning of the mechanical maintenance and preparation of the machines at the end of the previous season is essential.

A freight transfer with one passenger to Concordia was conducted on 20 November 2018. Next, as part of the ICECAP project, a series of scientific flights from Robert Guillard using the lairstrip of D10 was run between 22 November 2018 and 6 December 2018.

Services for passengers and scientific equipment were provided by 6 flights on Twin Otter between Concordia, Mario Zuchelli and Robert Guillard, in the period from 14 December 2018 to 11 January 2019.

At the end of the season, 2 transfer flights from Basler took personnel returning from Concordia and scientific equipment. The return flight to Concordia took the last batch of fresh food before the beginning of the wintering period.

CROSSINGS	HOBART		DUMONT D'URVILLE	
	Arrival	Departure	Arrival	Departure
R0	31/10/2018	06/11/2018	13/11/2018	19/11/2018
R1	26/11/2018	03/12/2018	09/12/2018	16/12/2018
R2	21/12/2018	27/12/2018	31/12/2018	11/01/2019
R3	16/01/2019	21/01/2019	27/01/2019	03/02/2019
R4	08/02/2019	12/02/2019	18/02/2019	21/02/2019

09/11/2018 : Passage to Macquarie
27/02 - 01/03 : Arrival - Handover Hobart

The contract fixing the availability of the ship for a defined period of 120 days for the whole schedule of crossings was respected.

During this season, two helicopters were loaded on to the first service. Favourable ice conditions however, meant that one of them could be sent back on the first return trip to Hobart with a pilot. Two pilots stayed on the station until R3, the 3rd service. The potential for running flights was strengthened by the availability on site of two pilots or a single helicopter in mid-season. This allows efficient transport of diesel fuel from Dumont d'Urville station to the Antarctic continent, as the melting sea-ice completely prevented the usual transfer by traverse operations over the sea-ice.

The operations and activities on the station

The 2018-2019 season was highlighted by the visit from the Prefect of the TAAF Evelyne Decorps, along with Jérôme Chappellaz, during crossing R3. It was an intensive visit, taking in Dumont d'Urville and Robert Guillard, and gave the Prefect the opportunity to see Port Martin. Several major topics were raised at the end of this on-site meeting, including:

- Problems concerning the hospital
- Renewable energy systems
- Lion aerodrome
- The garage at Robert Guillard
- Water treatment
- The heritage sites at Port Martin and the Cabane Marret

The season at the coast generally fulfilled its objectives, greatly helped by the exceptional sea-ice conditions. These facilitated the logistical operations. With the weather also favourable, the key building work scheduled for the season, extensive roof repairs on the energy generator house at Dumont d'Urville, could be accomplished.

The first stage involved setting up safety and security arrangements around the site, stripping and reinforcement of many outside structures of the old roofing framework. Essential waterproofing and protection to ensure dry conditions are kept everywhere in case the project schedule cannot be completely finished. The team of three cladding technicians, a welder along with support from multi-trade technicians and personnel of the electricity generating plant, quickly made good progress. The works were then finished right at the end of the season, with the final checks to ensure all was watertight.

The objective of a second repair operation was again to resolve problems of water infiltration and waterproofing, but also one of condensation. This concerned building 75 (storage, sports room and waste management). The next summer season should indicate how effective the repairs have been. If successful, the same procedures could potentially be repeated on other buildings suffering from the same problems.

External work on the boilerhouse was mainly concerned the installations for delivery or dispatch of diesel fuel. Various other less extensive, though time-consuming, maintenance and repair jobs were undertaken as the season progressed. These included piping supports, mending duckboarding, repairs to work-site equipment, container maintenance, or upkeep and installation of navigation or day-markers. Progress was also made this year on a final operation, awaiting attention for several years, with the laying of a new section of concrete platform on the floor of the aeroplane hangar.

Finally, two vehicles were delivered: a snowgroom adapted for transportation over sea-ice, and a snowgroom with a cabin destined for Concordia. A second snowgroom also for use on the sea-ice, which will stay on site in the winter, was returned to Hobart for modifications, in particular for fixing additional tanks



Transferring a vehicle over pontoons pushed by a Sea Truck



The storage space capacity at Hobart for equipment and materials is at its lowest level for many years.

A load with 14.8 m³ of Specific Antarctic Blended (SAB) diesel fuel has been delivered, thereby saturating the storage space, also 600 tons of cargo delivered, 100 tons of cargo returned including a traverse machine brought in for a refit and 100 tons of returned waste to be shipped to France. Good preparation and the season's favourable conditions for logistics gave the chance to conduct activities and especially to assess the logistical potential of the new *Astrolabe*. This was also a season to make adjustments and successfully test and practise the working methods between the French Polar Institute and the French Navy.



Operations on the Franco-Italian annex station Robert Guillard at Cap Prudhomme

Traverses from Robert Guillard Dumont d'Urville to Concordia

three logistics traverses were conducted between Robert Guillard and Concordia.

A total of 360m³ of SAB were delivered to Concordia and 220 tons of freight

It must be emphasised that the addition of a new -20° container to the convoy this year made it possible to return with improved storage conditions for the ice cores. This new unit will be extremely useful for the future projects and especially for Beyond EPICA. This drilling operation will be located 50 km from Concordia on the Little Dome C site.



Visit of the Navy on site at the start of the first traverse

Scientific traverse

The regular scientific traverse SAMBA was conducted between 20 and 27 December 2018. The configuration for this year was rather different with the addition of greater resources in order to bring in two extra people. Therefore 5 personnel in all were included in the activities. An additional caravan module and tank were used. The traverse went well without a problem.

At the beginning of the season, an Australian consultant, a longstanding partner visited the station to conduct an audit both on the work done at the site and the operational work on the logistics traverse. This external viewpoint, provided from an Anglo-Saxon perspective that uses different practices from a different culture, put particular emphasis on many of the procedures followed. It is valuable for taking a long look at various habits and current practices of the personnel of the Institute, permanent staff or people on contract. Following the production of the consultant's report, several points for improvement will be worked on, including notably working conditions and safety.

In parallel with the recurrent logistic activities, convoy preparation and the machines, plus the air traffic control and management of transport services between Robert Guillard and Dumont d'Urville, several pieces of work have been accomplished on the station annexe:

- The diesel fuel transfer using a pipe from the arrival point to the foot of the slope to the storage tanks on the base has finished. This method reduces transportation using tanks, sometimes difficult owing to the steep slope
- The electricity generator of the energy module of the science caravan has been changed.
- Construction of a sledge for the 20 foot -20°C container with a new refrigeration unit
- Replacement of the garage door
- Construction of a duckboard pathway between the station and the general store
- Stock organisation work in the container storeroom and preparation to plan a renewed shelving system which will be supplied during next season
- Change of navigation system on the tractors used on the traverse with the aim of simplification
- Making the fleet completely reliable and more homogeneous



Completion of fitting and positioning the diesel-oil pipe



Traverses

DEPARTURE Robert Guillard

- LOG. 64/1 17/11/2018
- LOG. 65/2 19/12/2018
- LOG. 66/3 16/01/2019

ARRIVAL Concordia

- LOG. 64/1 29/11/2018
- LOG. 65/2 28/12/2018
- LOG. 66/3 25/01/2019

DEPARTURE Concordia

- LOG. 64/1 02/12/2018
- LOG. 65/2 31/12/2018
- LOG. 66/3 28/01/2019

ARRIVAL Robert Guillard

- LOG. 64/1 10/12/2018
- LOG. 65/2 07/01/2019
- LOG. 66/3 04/02/2019

Fanco-Italian station **Concordia**

The summer campaign at Concordia was run between 7 November 2018 and 12 February 2019. The average number of people involved was 60, with an occupation of more than 65 for over 2 months and some periods with 90. Use of the site was made difficult by this excessive occupation rate.

The station was supplied by 3 logistic traverses which kept up the entire fuel reserves for the site (fuel delivered = 360m³) and the transport of almost all equipment and materials on stand-by at Dumont d'Urville and Hobart for the past 2 years. The air services were highly active, with 38 flights and fuel consumption totalling 31m³ of kerosene.

The most extensive maintenance tasks carried out included: cleaning out of the water storage tanks, disinfecting the recycled-water, network, cleaning cogeneration systems on the electricity generators and, checking of all the external electric cables, maintenance work on all doors and windows of every building on the site. Snow clearance, becoming a heavier task each year, requires one person and a vehicle for the whole season.

A considerable amount of new work has also been accomplished. Such operations included the installation and start-up of a recycled-water production system using ion-exchange resins; on the electrical generator set, replacement of the last Caterpillar 3306 engine by a Caterpillar 3406; the commissioning of a humidification unit on the ventilation system. Renovation of the foundation station of the quiet building was finished. For the noisy building the same operation was postponed until the next summer campaign. Training sessions for overwinterers at their work stations and for operating groups on safety were completed, in parallel with a heavy workload.

Support for science

The greatest commitments and most intense efforts of the technical team in support of scientific activities needing substantial human resources and material means for the project have been:

- SUPERDARN with the objectives of implementation of the 2nd radar zone at the end of the summer campaign, involving completion of the shelter and mounting of the unit on stilts, also installation of associated aerial and underground cables
- Construction of the future SISMO shelter
- Assistance to the team of BEOI Subglacior in the phases of setup and removal of tubing

The team's service's have been frequently called upon for setting up numerous Italian and French programmes, with not such broad scope but needing assistance. This can be highly diverse, although an example concerns adaptations to the climatic conditions of sites, by getting insulated boxes made, or deployment operations into specific places.

The technical project of an underground cellar has been successful. The challenge was to create a stable underground cavity using an inflated balloon which is then covered over with snow. The project is continuing and the visit to the cellar after wintering will give valuable information for pursuing it further.



Positioning of the SUPERDARN shelter on stilts

New SISMO shelter on stilts

Subantarctic islands

The summer campaign in the Subantarctic Islands began on 3 November 2018 and came to a close on 3 April 2019.

During the OP3, a delegation from UNESCO, accompanied by Cedric Marteau, Director of the TAAF Nature Reserve, visited the area to assess the TAAF National Nature

Reserve's candidature to become a UNESCO World Heritage site. Jérôme Chappellaz also took part in this voyage for the first time as Director of the Institute.

The campaign's schedule was highlighted during OP1 by a tour to the Sparse Islands, which cut down the time for visiting *Marion Dufresne* at Crozet and Kerguelen and therefore the distribution for operations on the more remote sites.

The 22 scientific projects selected by the CPST have been accomplished in part with the aid of the strong support of the transfer boat *La Curieuse*, very well prepared by the teams of the Indian Ocean naval dockyard. The French Polar teams conducted the resupplying for the refuges, taken charge of on-site operations. In key roles apart from their daily tasks, they participated in the scientific projects, planned missions, issued information concerning refuges, managed relations with partners and gave training for the winterers.

These scientific projects require that participants stay for lengthier periods in refuges. This means providing better energy autonomy. Also needed are means for water collection, more substantial restocking of supplies and comfort.

In 2018, supply deliveries by helicopter were made at the time of the supply services by *Marion Dufresne* in November and December. The logistics team of the Institut polaire ran the food-supply operations, but also deliveries of energy-related products, and scientific equipment and materials for 31 refuges: 17 at Kerguelen, 4 at Crozet and 2 at Amsterdam:

CROZET : La Pérouse, Baie américaine, Pointe basse, Les Moines.

KERGUELEN : Pointe Suzanne, Ratmanoff, Pointe Morne, Val Studer, Baie Charrier, Cap Noir, Cap Cotter, Cataractes, Sourcils noirs, Phonolite, Bossière, Port Elisabeth, La Mouche, Les Deux Frères, Gazelle, Port Couvreur.

AMSTERDAM : Entrecasteaux et Del Cano.

Concerning the needs of the Cycleleph project, the refuge Estacade which was a site officially regulated by TAAF has been taken on directly by the Institute. Completely renovated, this refuge can now house 4 persons over longer periods.





Resupplying of refuges and projects on remote sites

CROZET

Refuge Baie Américaine :

Structural repairs to the power unit housing after damage to closing devices in winter and change of external door frames of the refuge.

Refuge Lapérouse :

Repairs to the shutters on the refuge, deteriorated owing to winter storms

AMSTERDAM

Refuge d'Entrecasteaux :

Maintenance and repairs on the photovoltaic network

On St Paul island,

classified as an Integral Nature Reserve Scientific equipment and apparatus deployed at the site is still in place after many years for projects monitoring sea levels (Nivmer) and recording local seismic activity. So that this system can operate autonomously and to ensure the continuity of these measurements over the long term, the installation of a photovoltaic system was finalised in 2018. This last stage entailed connecting the whole array of equipment to the power network which had already been working under trial for one year.



KERGUELEN

Gazelle refuge :

During winter 2018, the Gazelle site suffered damage to the cladding and the surrounding terracing which were repaired.

Studer refuge :

An historic research site, dating back to the 1980s, on Kerguelen geared to tracking studies on species of interest to fishing. All the structures at the refuge needed thorough and extensive renovation work. In line with the aim to reduce the impact of the presence of anthropogenic waste on the territory of Subantarctic National Nature Reserve, 3 structures have been demolished and evacuated out of the 6 that were on that location. The site has been cleared of pollution and metallic waste removed. For the more recent structures, large-scale building operations have brought the photovoltaic energy system back into working order.

A wooden terrace was built between the storage/ kitchen and living space modules.

Refuge at Pointe Suzanne Haut :

In the 1960s-70s, buildings were erected on the Pointe Suzanne Peninsula for launching Russian rockets for scientific research. Out of the group of original installations the only building to be conserved and which served as a refuge for scientific missions has been completely renovated thanks to extensive operations.

Australia Nord and Cochon refuge :

The various rehabilitation operations on these refuges have brought clear improvements to the conditions for hosting personnel, with enlarged living areas, comfortable for 3 persons. Living conditions are also helped by the addition of a new kitchen area or kitchen/table or again improvement of the overall waterproofing.

Activities

On the base at Port aux Français

The major activity during the summer season remains the logistical support to scientific issue equipment, information on the organisation and procedures regarding the refuges, assist with projects, radio time for emailing to laboratories and location of navigation markers, management of relations with international partners, the Navy, TAAF, the Nature Reserve and so on, also organisation of logistics services by *Marion Dufresne* (arranging for the return of waste materials and equipment from refuges). Specific operations are also carried out for structural upkeep and running the scientific research on the station.



Of the transfer boat *La Curieuse*

The 25m ship *La Curieuse* has been working for several years, serving the implementation up of scientific projects. But it has also supported the distribution and various removals of activities over the whole district of Kerguelen. In particular the vessel ensures the more urgent restocking and maintenance needs of isolated coastal sites.

This year, *La Curieuse* was operating in the first few weeks, from 1 January until 15 February, then later from 23 November to 31 December 2018. The principal missions were:

- Implementation of an autonomous 18-day mission on the St Paul site as part of an observation exercise to record the recolonisation of areas by fauna following rat extermination on the island at the end of the 1990s.
- Installation of acoustic sensors in the framework of an international scientific partnership to track the colonisation zone of trout at Kerguelen.
- Monitoring the oceanic environment with the project Proteker around Kerguelen and in the Golfe du Morbihan.
- Implementation of a geological mission the Rallier zone of Baty around the Deux Frères site.

The new scientific projects in the Subantarctic Islands 2019-2020

EnviKer

Setting up of a tool for characterising environmental changes recorded in the Subantarctic Islands, based on observation of testate amoebae.

Palas 2

Study of climate fluctuations from analyses of sedimentological and geochemical markers sampled in lakes in the south and north of Kerguelen.

Adelise

Installation of a measuring instrument on the Island of Amsterdam for a comparative study of the results obtained from Dumont d'Urville on modifications to isotopes in water along its route from the regions of evaporation, in the Indian Ocean and as far as the areas of precipitation in the Antarctic in the Island of Amsterdam for comparative studies with results obtained at Dumont d'Urville, on the modifications to isotopes in water along its route from the regions of evaporation, in the Indian Ocean and as far as areas of precipitation in the Antarctic.

A history of traverses



Patrice Godon

Manager of the Antarctic activity until 2017 at the Institut polaire français, arrived at EPF in 1979

The term traverse (raid for the French Polar Institute) is used to signify the expeditions crossing the ice caps. Applied to the project under way at the scientific research station Concordia, they are the final link in a chain of transport services to Dôme C, the point where Concordia and its installations are located.

The first of these traverses was an exploratory trek setting off from Dumont d'Urville station, Cap Prud'homme. It took place between November and December 1993. Now, the launch of this season 2019 has seen the 67th transport traverse arrive successfully at its destination. The personnel have always proved their ability to resolve the day-to-day difficulties that crop up. Organisation of the operations between the field and HQ has ensured that any reoccurrence of problems has been avoided. New advances in methods such as technical improvements are always arriving. The traverse is now a field of activity in itself, built up piece by piece right from the start.



The origins

Until the start of the 1990s no other country except the USSR, which supplied Vostok by convoy, organised such transport on the Antarctic continent. The other continental station, the American base Pôle Sud, being supplied by plane. Concordia was to be the third station sited on the continent: the first intentions were to work with a solution for surface transport, without at all following the Soviet example which used outdated machines.

The Institut polaire was not starting off from a blank page because the Expéditions polaires françaises had acquired a reputation for excellence in organising traverses for scientific purposes. The programme at Concordia however called for a change of both methods and scale :

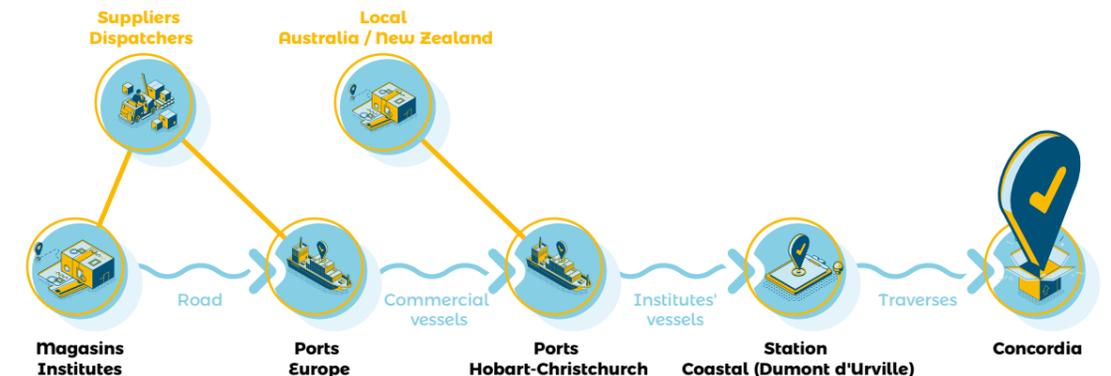
The project for the station and the associated EPICA deep drilling scheme involved the initial transportation of around 3600 tons of equipment and fuel.

The operations and running of Concordia on its own require annually the haulage of at least 400 tons.

Rationalisation

The project for a special system of transport between the coastal station Dumont d'Urville and Dôme C, the site of construction of Concordia, follows the recognition of the need for continuity in the existing logistics chains.

The French Polar Institute had to become the Antarctic transporter, to professional standards, making deliveries beyond the ice cap, on-time and with goods in perfect condition; all for the best cost levels. Reaching this objective demanded an extensive review of all aspects and all the phases of the transport system.



First decision

choose the mode of transport:



Transport on the platform of a truck or tow trailers

That's the solution: Pulling the loads is the winner ! Goods trucks with a specific size, this solution seemed the most economic straight away: mutualise, keeping the hauled elements easy to handle, reduce the number of combustion engines, increase the load per driver etc ...

Define the phases of the study

Planning a convoy is like preparing a ship:

The first phases were the study and design of the equipment, then the finalisation of the methods. These two are interdependent. In the Antarctic, the expeditions move around in complete isolation for several weeks, The traverse is on its own track has to be created, its subsistence planned for.



2.



- Accommodation for the personnel must be incorporated, the fuel is taken on board, food and also spare parts; the team must include someone able to solve technical problems and capable of driving the convoy, navigate, find the route during bad weather.
- The ground consists of a material, névé, that has no well-defined mechanical characteristics. Therefore team members have to go back and amend any deformations, and prepare the passages.
- The personnel must be able to rest in comfort and have good conditions of health and hygiene.
- The food must be well adapted and appetising.

The equipment must be reliable, effective, without need for heavy maintenance:

- The tractors must be adapted for the terrain, with fuel consumption as low as possible in relation to the towing effort expended, and must be comfortable.
- Loads must be easy to tow such that the traction effort is used to optimum effect. Any deformation of the terrain they must be kept to a minimum to limit the need for levelling of the track followed.

First voyages

Taken from a standard schema combining tractors, loads and levelling machines, several pieces of equipment for testing had been bought from 1991 onwards :

- A farming tractor on Caterpillar Challenger crawlers: this first towing unit was itself an innovation and had improved capabilities compared with the bulldozers of the same make already used as a traction unit in a scientific convoy by other operators.
- Two Kassbor mountain snowgoose levellee.
- Sledges from the manufacturers Otaco and Aalener for the loads
- Sledges designed by the Institut polaire français for the loads and for the fuel.
- A set of caravans designed on the Institute's plans and built by the body builder Lamberet comprising a life caravan intended for meals and rest, and an energy caravan housing an electric generator, the sanitary facilities, a workshop and a snow-melting set for the service water supply.

The full-scale test took place at the end of 1993. Leaving with all the new machines and equipment, including two snow groomers and the tractor, this expedition was useful for getting to know the terrain along the whole distance between the coast and the site and gave the chance to test all the machines and other equipment acquired for the project. This first convoy to Concordia was an initiation, because it was confronted by all the problems of the strongly uneven ground with different geometric forms and uneven surfaces. Navigation had to be highly accurate, as the convoy sledges of the time were not robust, experiences with preparation of vehicles, tracing and making the route to follow, matching difficulties between snow groomers and tractors and so on.

After two new traverses devoted to exploration of the site at Dôme C (search for the summit, survey to locate the rock base, establish the deep-drilling point) the first transport convoy was prepared on the same model as the one in 1993. It ran in January-February 1996. This does not leave only good memories: the site was reached only after two weeks of driving 18 hrs per day shared between 2 teams of 9 hrs. The cause was a whole series of breakdowns involving the sledges and difficulties with the terrain. The first summer convoy, of 1996-1997, encountered the same problems: the outward journey alone taking three weeks, the plane had to be called to bring replacement parts for the snow groomers, also sledge axles broke. An upturn finally came in the second season with the possibility of keeping a track levelled and the development of improved methods for towing and starting off hitched trailers, allowing them to move along without the risk of large loads getting stuck.

We finally moved on from the two traverses of that campaign, in 1997-1998 to three envisaged within the Concordia project.

On the whole, the successive gains in reliability and efficiency (optimisation of carrying equipment, improvement of progress possible in bad weather, levelling etc.) have been obtained, by the continual toing and froing between the experimental phases in the field and the deliberation phase, on the organisation, and the study phase. The amount of breakdowns arising from equipment that has been towed is now one of the lowest, bad weather only marginally disturbs the progress of convoys now that the net load of the coupled trailers is increasing. With passing years, the tractors dating back to the project's have been replaced by the new generation, and, if the benefits are evident, some deficiencies of new systems remain to be corrected.



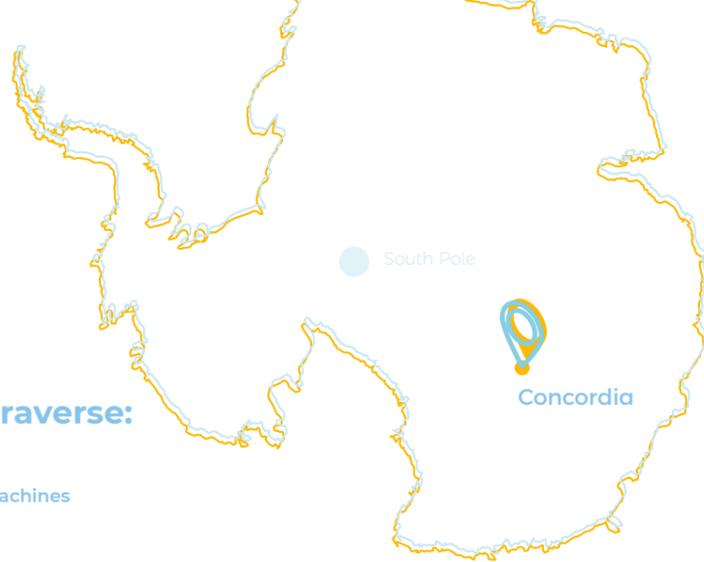
3.

The equipment

Equipment composing the traverse:

4.

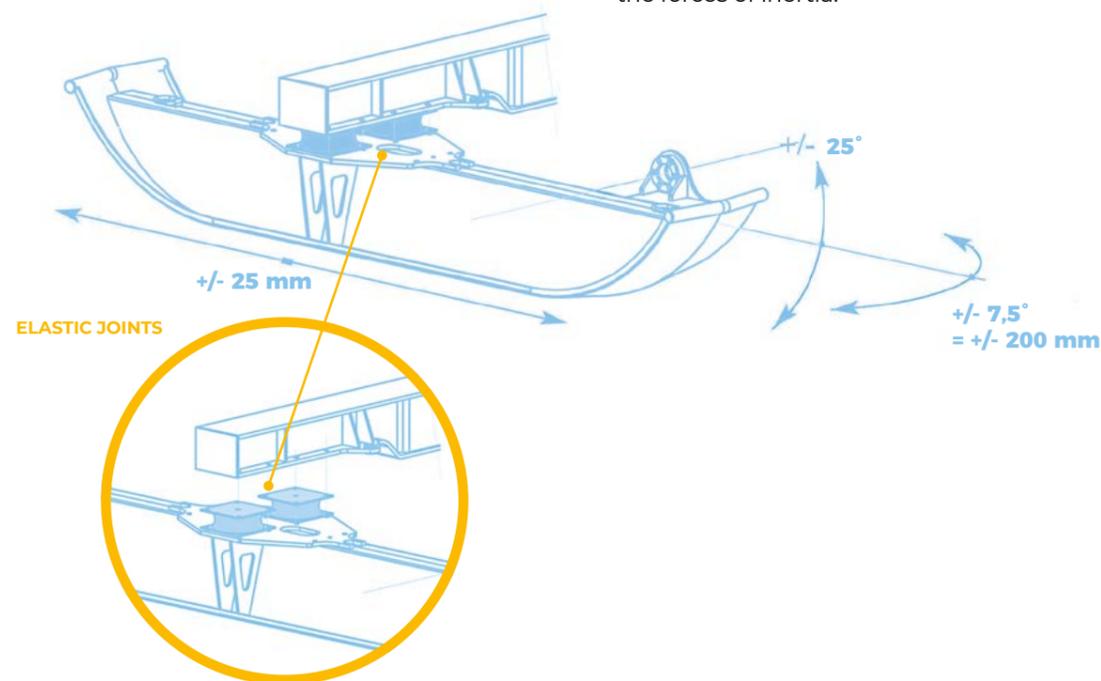
-  Tractors and levelling machines
-  Cargo sledges
-  Specialised transport unit: cold rooms, heated units, stores
-  Fuel trains convoys and site
-  Caravans for personnel: accommodation and facilities
-  Principal accessories: cranes, winch, bad-weather spot lamps



Major technological innovations

The development of this equipment is as much the fruit of calculated solutions as the result of logical processes of intuition. However, it is often the latter that initiate important innovation. A proportion of chance is in there and also creation in the final moments of developing a piece of equipment.

One of the important innovations concerned the new sledges: to replace the sets of mechanical links/connections, for which maintenance was difficult, by elastic articulations requiring no particular upkeep. This is a major innovation because it resolves a crucial technical point of the design of sledge. These articulations take the concentrated forces due to the load, those due to traction movements, but also to the forces of inertia.



Organisation

Configuration of convoys

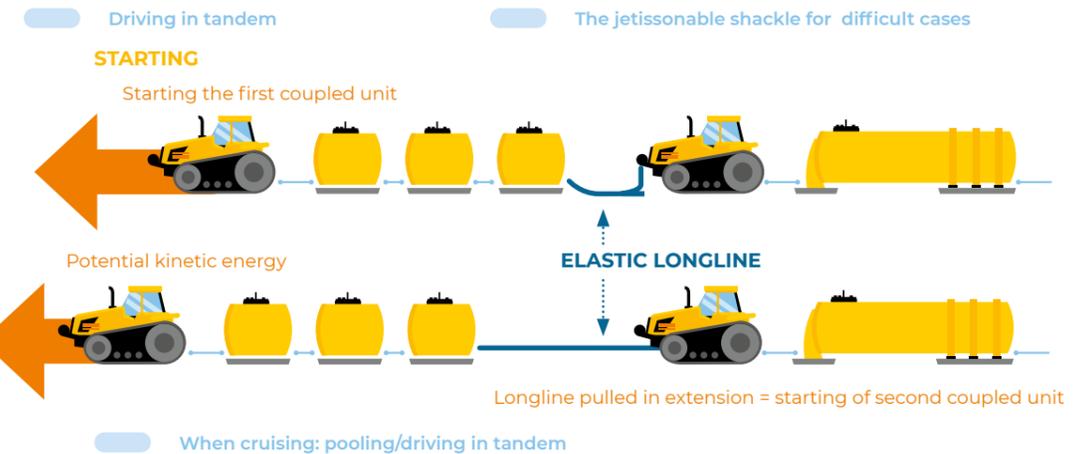
5.

The quality and performances of the equipment are important but so is the quality of the organisation. The ways in which the elements of a convoy train are assembled and coupled up, and loads are distributed within it are the savoir-faire gained from practice. Such experience brings efficiency to the system.

The objective is to pull as much as possible at the cruising phase and use all the forces available: towing to the slip threshold of the tractor. This economic objective is not compatible with the train's starting-up procedure.

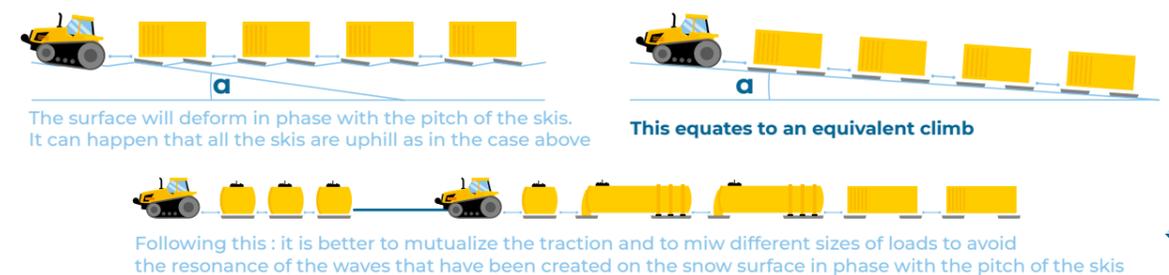
In any case that demands a much greater pulling force than for the cruising speed. It is possible to limit the length of the train at the starting without risk of staying stuck on the site, but running at half-load is not the objective. Therefore even if the skis are not stuck and have the right form, appropriate methods and complementary systems, must be available to overcome the convoy train's inertia and simplify departures.

Two major types of system have been devised by the Concordia project groups:



This method of traction is maintained while cruising because the elastic sling allows also for the whole to free itself from an additional tensile stress which could be required in certain field situations, with the bungee cord playing then the role of compensator between the two couplings.

As shown in the following illustration, a train consisting of a tractor and 4 loads of the same nature deforms the surface with a wave corresponding to the pitch of the skis. Fatally, there comes a time when everyone is on an uphill climb and the train is in a situation similar to the ascent of an equivalent slope and will have to stop by skidding of the tractor. Driving in pairs makes it possible to overcome this difficulty. In addition, a mix of different length charges reduces this risk by reducing the car's self digging.





6.

Mutualization allows traction of more loads than with one single coupled unit. In the order of ideas, it is interesting to observe that a train with three units operates better than a train with two. The limit for grouping such units together was fixed by the need for re-leveling the snow on the roadway after a certain number of loads has passed.

Starting off a convoy with a detachable clevis consists of using it to hitch an extra tractor up to the front of a convoy, stuck after unsuccessful attempts to set off, with the aid of the inertial kinetic energy of its partner. The extra tractor coupled to a non-elastic longline, applies the additional pulling force demanded to get the train on its way. Once the convoy is moving the detachable clevis is opened and the extra tractor goes free without stopping the rescued train from moving on its way.

Circulation of the convoy

Organisation of a convoy in a line depends on the state and topography of the ground encountered. The névé surface is very hard in the first part of the route taken (or the coastal zone - 400 km between Cap Prud'homme and Dôme C). This hardened zone is shaped and etched in Sastrugi by the slope winds or catabatic winds which come and reinforce bouts of bad weather that pass over. Even at the local scale, the catabatic wind occurs where there is a bit of a slope.

By looking at the ground, this currents of air can be seen, loaded with snow in suspension, still visible even in fine weather. Further inland towards the site at this local wind subsides gradually as the slope weakens, before petering out almost completely.

The zones with only very low wind will determine those of very light snow where it is difficult to obtain a satisfactory compaction of the snow. The coupled units of a convoy having driven only once should not be put in line one after another but arranged to move in parallel because the surfaces have very little density, owing to the lack of particle cohesion in the névé. This makes driving on a recently used track difficult.

However, the névé, extremely loose immediately after the passage of convoy units, hardens after 2 to 3 days. It then becomes load-bearing and the tractors benefit from this new compaction of the ground; their caterpillars can transmit a better traction force. Although there is no benefit in this same track, already used, the same tracks of exploration (on virgin terrain) it is thus the converse that happens when driving is done on the same place. The surface snow of a track used several times becomes even harder than the in the coastal zone. There is a double advantage: the tractor crawlers can grip more effectively and the skis of the sledge loads are held back to a lesser extent.

Sastrugi
Irregularity topographic sharp on a surface of snow resulting from erosion wind-induced

Organisation of the work

7.

The work of the traverse personnel is distributed between the various phases of the running part and the periods when stopped. Generally, the traverse is moving for 11 hours per day, from 8h30 until 13h30 for the morning driving post and from 14h30 to 20h30 for the afternoon post. The driving day is shifted voluntarily into the evening in order to leave the overnight stopping zone when temperature conditions are milder than those of the morning.

It is generally the doctor, who is responsible for the meals and the one taken at midday is kept simple. In the evening, the person on duty to prepare the food takes advantage of the hour and a half for equipment maintenance to make a more substantial meal. This is presented ready-made in a cardboard box, also comprising disposable cutlery (wooden), cardboard plate and glasses. It is preferable to use the disposable tableware, which will be sent back to Australia or France to limit washing-up and emissions of effluent.



A typical traverse is made up of 6 tractors and 3 snow groomers, caters for 10 persons including 4 diesel and specialist tractor drivers; 2 snow groomer drivers, 1 electronics specialist, 1 doctor and 1 or 2 additional mechanics or observers or scientists having presented a project to accomplish during the journey of the traverse.

During the travelling phase, some of the personnel drive the tractors, while another group operates the snow grooming machines. The stopping phase is more intense. It certainly enables them to take refreshment and have, a rest, but the stop made in the evening is also the time to prepare the machines, check the loads and refuel all ready for the next day.



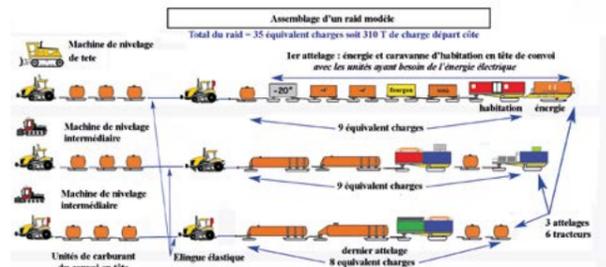
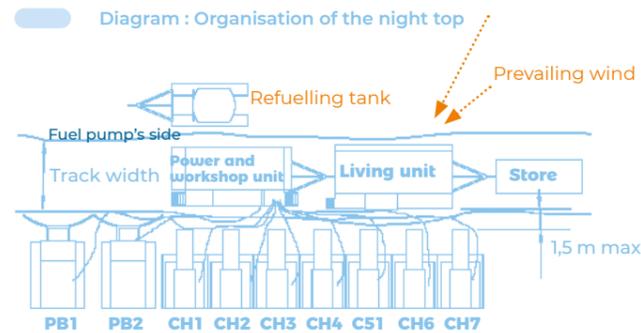
Organisation of the convoy

8.

The tractors drive hitched up in twos. The first one tows a maximum of three to four loads. The second is an additional one for achieving full use of combined pulling force to reach a real figure of 12 loads for a couple.

Life on the convoy is centred on the accommodation units. These consist of the workshop, the store, the electricity generator which provides energy for heating vehicles and the pumps necessary for fuel transfer. The diagram given below-right depicts the overnight stop. The loads are stopped on the roadway while the accommodation units are positioned so as to leave the wind to their left side with an angle ideally of 90°. The vehicles are parked leeward of the units (hence the right-hand side) and are connected up to the generator.

The base floor of the load-bearing frame is either situated 1.5 m from the ground letting the wind pass under the unit, while still attenuating it limits the formation of congères in case of bad weather, being pushed away backwards tractor. Corridor of about 1.5 m is also created allowing the personnel in case there is a stop owing to visibly problems lead to cancel circulation.



With the circulation in-line convoy, keeping a watch on the speed of each particular coupled assemblage unit is necessary. Experience has shown that even with one good estimation of the loads, it is complicated to organise a sets of units that would ensure a journey that is completely in synchrony with one of these coupled units. Furthermore it would be penalising to install the slowest group at the head of the convoy.

Moreover, in the same concern for efficiency, it is the convoy of housing units that must arrive first at the scheduled stops. A convoy of equipment cannot logically be installed at the head of the convoy because, if conditions allow it and it arrives half an hour early, the staff of this team would wait without activity for the arrival of the housing units.

The housing units are thus positioned at the head of the convoy. Whether at lunch break or at the evening stop, their early arrival at the port of call allows the meal officer to prepare lunch and dinner in «masked» time.

The navigation

The environment

In the first expedition on to the continent, navigation was achieved by the stars, including the sun, using a theodolite. This method was complemented by physical reference points installed at regular intervals. In all cases it was only possible to move around in fine weather and perfect visibility because the way markers implanted, metallic tubes, were spaced out at 10 km.

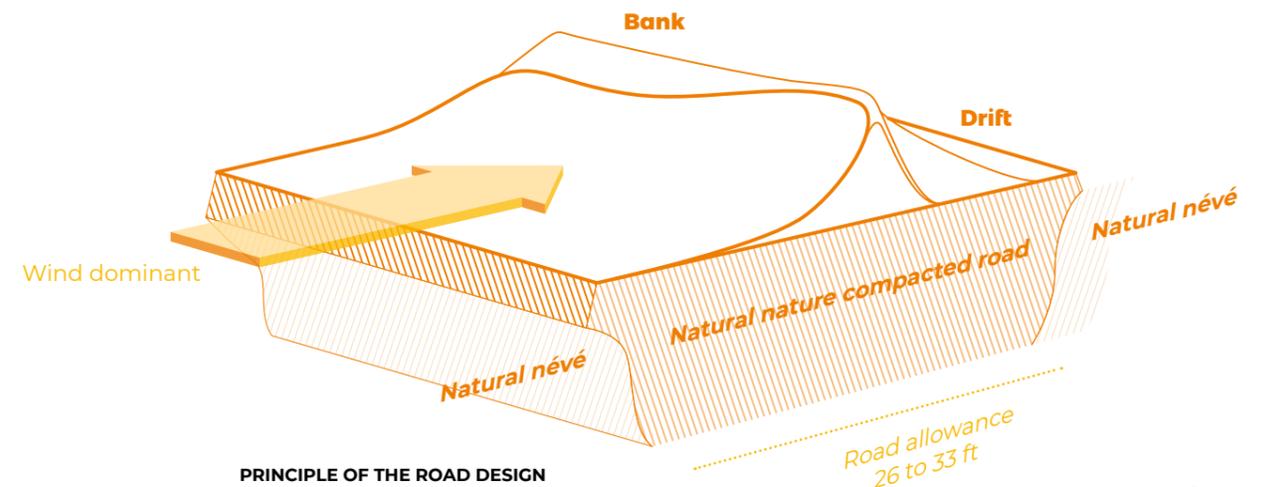
Navigation by satellite then arrived. It offered a real technological breakthrough. It is certain that the traverse of the coastal zone would not be as easy without it, because it has freed us from dependence on physical references.

9.

Types of terrain encountered

The coastal zone ends where the altitude ceases to rise at about 400 km from the sea. From there the plateau and the zone of low-density snow begins. At this distance less blowing snow is seen, but also less precipitation. This combination of factors means they can be left as they are, so the area can be found again year after year.

In summary, in the area termed the coastal zone, it is difficult to find again the traces of previous visits from one year to the next, but the hardness of the névé, aided by the wind, conserves traction marks if the has not driven on an old route. In the interior zone, or the plateau, the low-density snow does not allow work to be done correctly during the first passages but the possibility for finding traces each year which, with time enables the creation of an effective road compacted artificially.



Summaries & conclusions



Positioning equipment

The navigation GPS currently used are multi-constellation receivers. The satellites Navstar, Glonass and Galiléo are also linked, and the devices can process simultaneous data from 40 different satellites. The accuracy obtained is about 2 meters without differential corrections. These receivers give the position and the direction to follow (the heading). Combined with a computer processing program, the user can register the positions, find them and locate them on a map.

Improving vision under **white out**

The white out is phenomenon of light stemming from the white color of the snow. If there is cloud cover and the resulting absence of any shadows, the surface (sastrugis, bumps, banks) become invisible. It is common to hear people saying that the vertical visibility is zero whereas the horizontal is good.

The idea was to use artificial lighting to bring back elements of relief to the surface. However, make the ground stand out well this additional lighting must have a higher efficiency than natural light, meaning more than 120 000 Lumen. The model of flood light used (Philips Arena 2 KW / 220 000 Lumen) is perfectly suitable for the Challenger tractors. Its effectiveness is reinforced by using yellow filtering glasses which take out the blue components of the natural light. However, this solution is not appropriate for Kassbohrer vehicles, with a fragile design: the set of head 5 kwmps have a mass of 2 x 100 kg which cannot be installed on the cabin roof of powered by a 15 kw electricity generator and 1 which given its volume is also incompatible with the organisation of the machine.

New equipment for loads

A new piece of loading equipment is currently under test: a platform carried by a pneumatic mattress. The mattress is pushed down against the ground by 1 thickness of an intermediary sheet of polythene. The ensemble exerts a very light contact pressure on the ground giving the capacity to bear heavy loads which could not be transport by a standard sledge unit on skis.

Moreover, this sledge is a very good tool for snow grooming and leaves a track behind it a perfectly flat track.

Finally, beyond the types of tractor, the types of sledge, of instrumentation, beyond all the equipment which depend on the logical processes of design, the traverse operates efficiently owing to the following creations of technical ingenuity:

The elastic longline allows two machines and their loads to start off even if the inertia of the whole train is very high and the skis are stuck strongly in the ground. With this they can also mutualise the combined traction force so that the convoy so formed can move along with the maximum load permitted by the tractor slip threshold.

The detachable clevis allows, with the help of the tractor of another convoy, to take off a hitch that would not have been able to start on its own, without breaking any material and without having to uncouple and move everything individually. Once the convoy to be assisted is moving, the towing shackle is opened, the towing tractor is released, leaving the convoy started in motion.

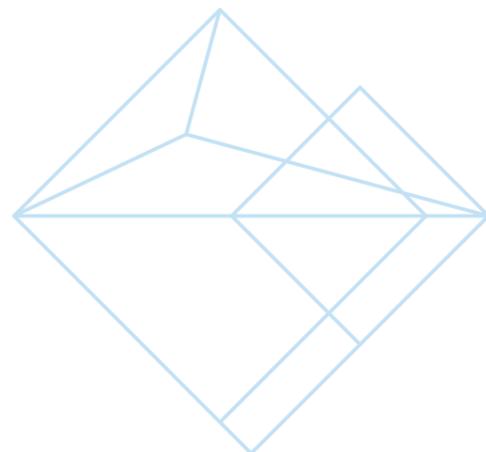
The elastic linkage is used to link up a ski with an axle (or cross-piece) for it to be flexible and show several degrees of controlled freedom.

Navigation The embankment at the edge of the road is the physical element for marking way the which, combined with sophisticated electronic instrumentation, enables driving with confidence on the compacted road in the plateau zone.

Also in navigaton additional lighting with simple equipment (even if the installation is less simple) allows drivers to maintain visual contact with the embankment and stay on the road while pushing back the visibility li-mite below which it is no longer possible to drive. It is necessary to point out that even with an accuracy of 2 m, the best GPS systems do not allow to stay on the compacted road with reduced visibility.

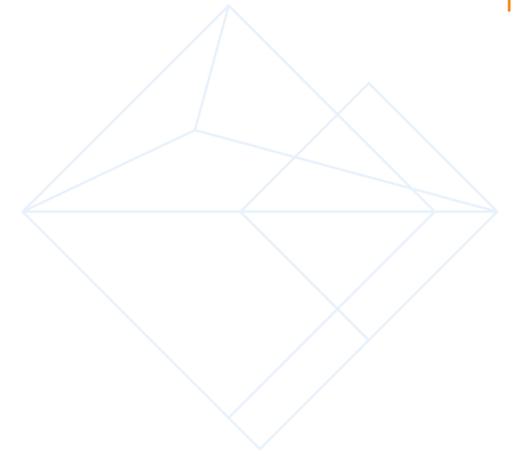
10.

French Polar Institute





French Polar Institute



The French Polar Institute is a public interest group responsible for the implementation of French research in the polar regions.

With the difficulty of access to these regions and their harsh living conditions, the Polar Institute mobilises substantial leading-edge technical resources, fully adapted

to polar environments. The Institute employs people with the specialist technological knowledge and skills to help scientists accomplish top-level research in such extreme conditions.

MISSIONS

From its headquarters at Brest, French Polar Institute:

- **Selects** scientific projects with the guidance of a committee of specialists, provides finance for the field operations and organises the expeditions.
- **Implements** maintenance of research stations.
- **Recruits** the personnel required to take on the maintenance of these stations and also continuity of the scientific work during the Southern Polar winter.
- **Provides** training and ensures the safety and security of all.
- **Provides** the infrastructure needed for living in these polar environments.
- **Transports** freight and personnel between mainland France and their destinations.
- **Organises** and plans the technical operations and scientific research activities.
- **Develops** new technological solutions for logistics management and polar infrastructure installations.
- **Communicates** scientific news and information on these polar regions.

The French Polar Institute is fully involved in the related international scientific and logistic and consultations and is often present in its representative role for France

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From March to 2018 to March 2019

PARTICIPATION OF THE INSTITUTE'S MANAGEMENT IN EUROPEAN OR INTERNATIONAL MEETINGS

- | | |
|--|---|
| <p>Jérôme CHAPPELLAZ</p> <ul style="list-style-type: none"> Member of the French delegation to meetings of the Antarctic Treaty (RCTA) and Committee for the Protection of the Environment (CPE) French delegate to the Council of Management of National Antarctic Programs (COMNAP) Permanent Participant member of the European Polar Board (EPB) French representative on the Scientific Operators at Ny-Alesund (NySMAC) French representative at the Forum of Arctic Research Operators (FARO) French representative on the International Arctic Science Committee (IASC) Member of the Steering Committee of TGIR Concordia Participant in the European PolarNet project | <p>Christine DAVID-BEAUSIRE</p> <ul style="list-style-type: none"> Member-substitute of the European Polar Board (EPB) French Representative on the Ny-Alesund Scientific Operators Committee (NySMAC) French representative in the Forum of Arctic Research Operators (FARO) |
| <p>Patrice BRETEL</p> <ul style="list-style-type: none"> French delegate to the Council of Managers of National Antarctic Programs (COMNAP) | |

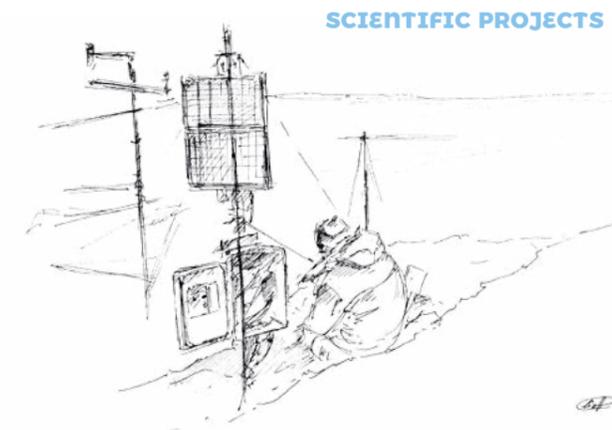
- Beyond Epica-Oldest Ice Steering Committee · March 2018
- EU-PolarNet General Assembly at Tallinn · March 2018
- Official visit of the Director of AWI and the President of Helmholtz to Ny-Alesund · April 2018
- EU-PolarNet Retreat to Santpoort-Noord · May 2018
- Environmental Protection Committee and Consultative meeting on the Antarctic Treaty in Buenos-Aires · May 2018
- COMNAP Annual General Meetings and Symposium at Garmisch-Partenkirchen · June 2018
- International Arctic Science Committee Council at Davos · June 2018
- Forum of Arctic Research Operators (FARO) Meeting at Davos · June 2018
- Ny-Alesund Science Managers Committee (NySMAC) at Davos · June 2018
- European Polar Board - Plenary Meeting at Davos · June 2018
- Steering Committee Concordia at Paris · July 2018
- EU-PolarNet Policy Briefing at Bruxelles · September 2018
- Information meeting on the development of research activities at Ny-Alesund · September 2018
- Second Arctic Science Ministerial Meeting at Berlin · September 2018
- Malta Meeting (Beyond Epica-Oldest Ice) at Göttingen · September 2018
- NySMAC Meeting at Ny-Alesund · November 2018
- EU-PolarNet General Assembly and Symposium at Lisbonne · March 2019

Scientific projects

50 Supported in the Arctic

Supported in the Antarctic and Subantarctic **108**

142 Scientific projects ESA



Project supervisor

Project supervisor	project n°	page
Alemany Olivier	1202	99
Armbrrecht Gabriele	991102	105
Baroni Mélanie	1145	95
Bascou Jérôme	1003	89
Bernard Eric	1108	66
Betoulle Stéphane	409	75
Blangy Sylvie	1208	68
Bollache Loic	1036	53
Bonadonna Francesco	354	74
Bost Charles André	394	75
Boulinier Thierry	333	51 1151 78
Chambodut Aude	139	83
Charrassin Jean-Benoît	1182	79
Chastel Olivier	330	51
Crubezy Eric	1038	64
Decaulne Armelle	1148	67
Delmotte Marc	416	87
Domine Florent	1042	58
Dommergue Aurelien	1028	90
Dimitri Zigone	133	82
Duprat Jean	1120	93
Enck Paul	991308	105
Favier Vincent	411	86 1048 90 1154 96
Gattuso Jean-Pierre	1141	61
Gaudin Philippe	1041	76
Genthon Christophe	1013	89 1143 94
Gilbert Caroline	1201	80
Gillet-Chaulet Fabien	1180	61
Glenn Yannic	1210	55
Goloub Philippe	1165	97
Gremillet David	388	52
Guillot Tristan	1066	92 1179 98
Hennion Françoise	1116	77
Houssais Marie-Noëlle	1206	62
Hubert Guillaume	1112	93
Jacobi Hans-Werner	1126	59
Jumelet Julien	209	83
Klein Karl-Ludwig	227	84
Larose Catherine	1192	54
Lavrillier Alexandra	1127	66
Landais Amaelle	1205	101
Le Bohec Céline	137	72
Le Meur Emmanuel	1053	91
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Arctic

Life sciences



330

ORNITHO ENDOCRINO

Hormones and reproductive effort in arctic seabirds

In the frame work of the ORNITHO-ENDOCRINO research program, we will study the physiological and fitness effects of poly- and perfluorinated alkyl substances (PFASs) exposure in Svalbard Black-legged kittiwakes. PFASs are surface-active agents used in a multitude of manufactured and consumer products and are nowadays the most abundant contaminants in many Arctic seabirds, but their effects remain poorly known. We will 1) Investigate in deep the influence of PFASs on key endocrine mechanisms underlying reproductive decisions and parental effort (corticosterone, LH, prolactin); 2) Explore via the study of telomeres dynamics the impact of PFASs contamination on the rate of ageing of individuals; 3) Assess the consequences of PFASs exposure on fitness traits like reproductive success and survival.



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333

PARASITO ARCTIQUE

Host-parasite interactions in space: dispersal and local interactions in arctic seabirds



The aim of this research program is to examine the response of animal populations to environmental variability at different spatial scales. The study system is a host-parasite system at three levels, involving arctic seabirds as hosts, the tick *Ixodes uriae* as their ectoparasite and microparasites such as Lyme disease agent *Borrelia burgdorferi* and arboviruses. The role of the variability in host phenotypic responses (immunology and behaviour) and of the coevolution between the hosts and the vector tick for the ecology and evolution of such interactions at different scales will be studied. In addition to laboratory analyses, the approach combines field experiment to the analyses of data recorded in a spatialised context.



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388

ADACLIM

Responses of Arctic marine birds to environmental constraints in the context of climate change

It is essential to reach a better understanding of ecological processes in the Arctic, as this ecoregion is hit severely by the consequences of global change. In this context, we study the ecophysiology of little auks (*Alle alle*), which are the most abundant seabirds of the Arctic, and acknowledged ecological indicators of changing marine ecosystems in this polar region. Via a long-term study of little auks breeding in East Greenland (Liverpool Land), in place since 2005, but also through specific experimental and modelling approaches, as well as through a panarctic network of collaborations, we test the following hypotheses:

- ▶ Arctic climate change is impacting the trophic status, the foraging ecology, the reproductive output, the body condition and the multi-annual survival of adult little auks during the breeding season.
- ▶ Ongoing climate change impacts the migratory ecophysiology of little auks in the North Atlantic.
- ▶ Flight and diving energetics condition the functional ecology of little auks - among the world's smallest diving marine homeotherms.

- ▶ Climate change is generating thermal stress for arctic seabirds, with impacts on their reproductive performances.
- ▶ Environmental contamination impacts little auk ecophysiology, behaviour and breeding success, with long-term population effects.
- ▶ The pan-arctic seabird community functions as a natural monitoring network for both legacy and emerging contaminants. All of our work participates in the Circumpolar Biodiversity Monitoring Programme (CBMP) of the working group Conservation of Arctic Flora and Fauna (CAFF) of the Arctic Council, and therefore corresponds to the expectations of arctic peoples in terms of environmental research.



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1036

INTERACTIONS 2

Directs and indirect impacts of predator-prey interactions on the non linear dynamics of arctic vertebrate communities facing climate changes

Lemmings and their predators are deeply structuring the terrestrial vertebrate communities in the Arctic. Their local densities and dynamics are, directly and indirectly, both impacted by and impacting the population dynamics of most other vertebrate species. But today, the main predator-prey interaction leading to their high-amplitude cyclic population dynamics are increasingly disturbed by climate-driven changes in NE Greenland and in the Arctic in general. Comparing the differences found between distinct study areas and at different geographical scale (regional and circumpolar) will allow us to better understand and assess the respective contributions of the different interactions in the functioning and dynamic of this emblematic Arctic terrestrial vertebrate community. Expected results from our renewed program will allow us to better predict the different paths Arctic terrestrial ecosystems are expected to follow under various climate change scenarios and the implications of such changes on Arctic biodiversity in general.



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1162

SexCoMonArc2

Behavioral strategies in a monogamous arctic bird during reproduction.

Recent studies have revealed surprising role for bacteria in the ecology and evolution of animals. Although bacteria are of vital importance for animal fitness, we have however just made the first steps in discovering their complexity, diversity and function. In the SexCoMonArc2 program, we will study the interactions between bacteria and bird behavior at different stages of reproduction. We will focus on the ultimate and proximate mechanisms of several behaviors that are potential strategies against bacteria. We will study an Alaskan population of black-legged kittiwakes nesting on an abandoned tower that enables us to easily capture and monitor breeders and chicks. Based on the knowledge and skills acquired from our previous IPEV projects, we will also develop new approaches to study offspring sex-ratio adjustments.



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1192

MICROLIFE

Microorganisms living in the Arctic

The Arctic plays a key role in the Earth's climate system and is an area of growing strategic importance for European policy. With MicroLife, we will deliver information about the role of external inputs (e.g., atmospheric) of nutrients and microorganisms that drive biogeochemical processes in relation to annual variation in Arctic microbial activity and biogeochemical processes. The first step in understanding the role of biotic and abiotic inputs on ecosystem functioning in Arctic terrestrial ecosystems is determining the sources of these inputs, how they vary seasonally and how they interact. As part of this research, we will need to improve our database with respect to seasonality. We would like to improve our data regarding snow and rain deposition throughout the winter, and starting in October 2017, we would like to ask for the support of IPEV logistics to collect and store samples for the project. This would require changing atmospheric filters, collecting freshly fallen precipitation and also snow and some soil samples. In the spring of 2018, we will send researchers to Ny-Alesund in order to carry out more specific experiments and to prepare and handle the collected samples. With this project, we will be able to a) assess the role of the atmosphere as a source of microorganisms and nutrients to terrestrial ecosystems (supraglacial environments, snow and soils), b) identify factors involved in colonization of these terrestrial systems by studying interfaces and transition zones, c) determine seasonal changes in nutrient and contaminant budgets, and d) identify key organisms involved in regulating biogeochemical cycling of nutrients and contaminants. Additionally, process kinetics, community DNA and transcripts will be studied in response to a range of perturbations related to external inputs.



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1210

IVORY

In search of Ivory Gull: a sentinel species of climate change in the most threatened and remote areas of Greenland.

Species living in the Arctic are facing strong environmental changes. Forecasting impacts of such changes on endemic Arctic species require a full understanding of their ecology and habitat requirement. A limited number of sea ice associated Arctic species act as sentinel species, whose ecological responses to the consequences of environmental modifications deserve special attention. This is the case of the Ivory Gull (*Pagophila eburnea*), a species that entirely completes its life-cycle in the Arctic and is thus directly facing impacts of the Arctic alteration. Here, we propose to use complementary approaches to investigate the demographic trend, change of space use and contaminant load of Arctic species under climate change and other environmental modifications (i.e. an increase of bird exposure to contaminants), with Ivory Gull as case study species. We will combine a genomic approach (high-throughput sequencing) to infer population dynamics and population genomic structure with GPS tracking used to infer movements and habitat selection of Ivory Gull throughout its distribution range. In addition, we will assess the contaminant loads of ivory gulls in its last Greenlandic breeding strongholds. Our complementary approach will produce fundamental biological information for the conservation of the Ivory Gull in the context of climate change and of the planned exploitation of its offshore feeding grounds.



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316 IPCROCI-3 JOKER

Interactions between Hotspot, Rift and Cryosphere : Jökulhlaup Economic Risks

The IPCROCI-3 JOKER project is the continuation of the former IPCROCI-2 program (2009-2012). The major results of the previous program lead to ask new scientific questions. We envisage now to study in a greater detail the impacts of large-scale glacial outbursts floods (jökulhlaups) issued from the ice cap. We will analyze the morpho-sedimentary effects of the jökulhlaups in the large periglacial fluvial systems around Vatnajökull, date the major flood events, and understand the structural control of the trigger events and on their flow.



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1015

OPTIMISM-bio

Observing Processes impacting. The sea Ice Mass balance from In Situ Measurements : from physics to its impacts on biology

The OPTIMISM (2009-2013) project brought together a consortium of researchers and engineers from 5 French laboratories to document and study the evolution of sea ice thickness together with processes governing exchanges at the ocean-ice-atmosphere interface from in situ observations, a prerequisite to improve models' parameterizations. The project was based on the development of an autonomous instrument (Ice-T buoy and Bear meteo mast) aimed at measuring the different parameters impacting the thermodynamical sea ice mass balance (sea ice thickness evolution, heat content and fluxes at its interfaces). The Ice-T buoy was deployed for 4 consecutive years at the North Pole, in the frame of the international NPEO observatory, allowing to collect a valuable data set not only for process studies, but also to validate models and satellite observations. This project also aimed at investigating factors impacting the activity of polynya, which, as dense water formation regions ventilating the deep ocean, play a key role in the climate machinery. We have in particular collected an uninterrupted 2-year time series of measurements in the heart of the Storfjorden polynya, Svalbard. This effort fostered the development of a new multidisciplinary, international, observation program, involving paleo-oceanographers and biogeochemists in addition to physicists, based on a series of oceanographic cruises (STeP program, Storfjorden Polynya multidisciplinary study). This renewed OPTIMISM project, opening to a broader scientific community (including polar regions biogeochemists), envisions new technological developments on the one hand, enabling in particular to measure biological activity within and at the base of sea ice, in addition to physical parameters provided by the instrument ("green" Ice-T) or snow measurements based on miniaturized millimetric radar. Such technological



developments require to be tested in arctic conditions before reaching an operational stage. The project aims, on the other hand, at pursuing the collection of data at the North Pole within the NPEO international consortium, which is highly motivated in the frame of an Arctic in rapid transition, as well as measuring greenhouse gases within the sea ice in Storfjorden, in relationship with the STeP campaigns.



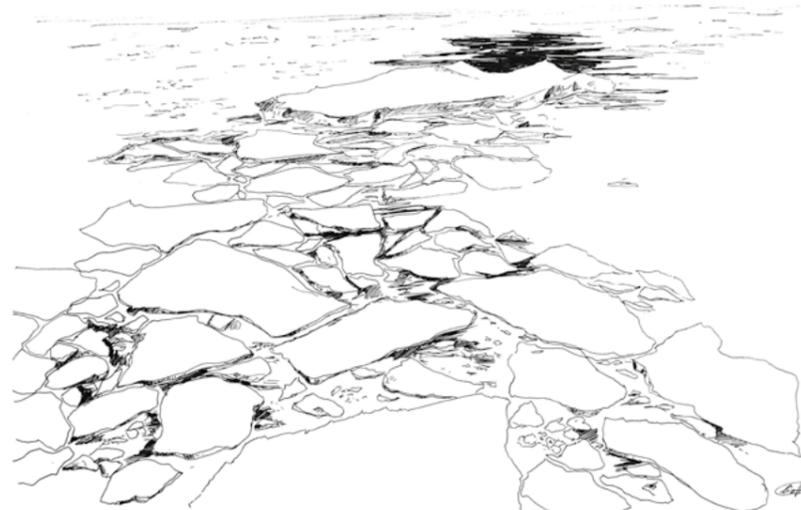
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1026 **POLARLIS3**

**POLARisation of the
thermospheric Red Line
In Svalbard**

This proposal is an extension of the proposal 1026. After a series of discoveries and a first wintering at Ny Alesund, it is now desirable to perform long term measurements of the red line polarisation. Long term means at least over ½ a solar cycle (about 6 years) from the same observation position. The goal is to link the polarisation to the solar activity to make it a new space weather window on our space environment. We already have a few months from Hornsund, and a few months from Ny Alesund. We propose here to complete this series of observations for the next 4 winters at Ny Alesund.



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1042 **ESCAPE-Arctic**

**Ecosystems, Snow, Climate,
Permafrost feedbacks**

Permafrost covers over 20% of land masses in the Northern hemisphere. Its thawing due to global warming could release tens of Pg of carbon in the form of CO₂ and CH₄ to the atmosphere, representing a major positive feedback to warming. Permafrost thawing also impacts Northern communities and on the development of the Arctic. This project aims at improving (1) our prediction of the evolution of the thermal regime of permafrost; (2) our understanding of the exchanges of carbon between the permafrost and the atmosphere. Regarding the first question, the emphasis will be placed on snow-vegetation interactions, and in particular on the physical processes induced by vegetation growth and which modify snow thermal conductivity, in order to pursue and complement the breakthroughs of the past 4 years. Regarding the second question, the emphasis will first be placed on the Umiujaq site, where the ground in carbon-poor and where vegetation growth has allowed recent carbon uptake. Subsequently, the carbon-rich Bylot site will be studied.



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1111 **GRAAL**

**GroundWater - Rivers -
Active-layer relationship
in the AustreLovenbreen
catchment**

The project GRAAL (Groundwater – Rivers - Active-layer relationship in the Austre Lovénbreen catchment - Spistbergen) aims to study the impacts of groundwater and permafrost (active layer) upon the hydrology and geochemistry of rivers at the outlet of a small glaciated catchment, ideal for hydrology, close to Ny Alesund (Austre Lovén glacier catchment, 10.5 km²). The long-term monitoring of flow discharge (started in 2008) is helpful to discuss the impact of climate change on the fluxes of water toward the fjord. Using a network of piezometers set up in the proglacial area, the direction of groundwater/river exchanges and the groundwater dynamics of the supra-permafrost water-table are studied. The geochemical characteristics of the interstitial water of the active layer (2 to 2.5 m deep) and that of warming-up permafrost significantly impacts the geochemistry of rivers, especially concerning fluxes of carbon and sulfates.



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1126 **ARCSNOW**

**Long-term interactions
between snow and
the atmosphere in the Arctic**

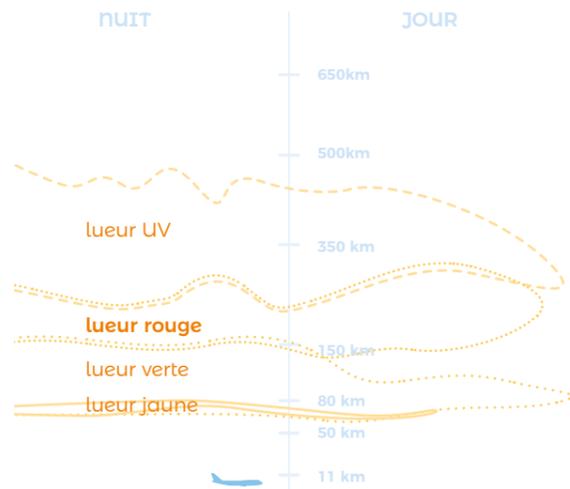
Climate assessments consistently reproduce zonal mean surface temperature warming in Arctic latitudes exceeding the global average. This Arctic Amplification was initially attributed to snow/ice albedo feedbacks, but progressing climate modeling revealed several other feedbacks playing a role as well. These include effects due to modified thermal properties of sea ice or changes in poleward energy transport and associated shifts in storm tracks, vapor and clouds. These findings are mostly based on climate modeling, but their validation by observations as well as the assessment of the relative importance of inherent processes remains difficult and is still quite controversially discussed. Based on this background, this project seeks to investigate the role of long-term snow developments and of inherent feedbacks due to e.g. changes in snow structure and snow albedo in Arctic Amplification in more detail. Albedo changes are at least partly related to the incorporation of light absorbing impurities and, thus, the chemical composition of the snow. Therefore, a second objective is related to a better understanding about chemical interactions between the atmosphere and the snow including pollutant wet/dry deposition and pollutant recycling at the snow/ice-atmosphere interface.



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1134 **ARCTISO**

Monitoring surface water vapour isotopic composition at Ny Alesund

Following the successful deployment of an instrument in June 2014, the ARCTISO-2 project aims at continuing and exploiting measurements of precipitation and water vapour isotopic composition at Ny Alesund (Svalbard). The isotopic composition of water vapour reflects the history of air mass trajectories, in relationship with evaporation conditions and distillation occurring along transportation, itself affected by cloud microphysical processes. Measurements in Ny Alesund are related to studies performed in different sites located in the North Atlantic (Bermuda, Iceland, south and north-west Greenland), in the Arctic (Ural, Siberia) complemented by transects (ACTIV ship from Denmark to Greenland, PolarStern). These measurements will allow

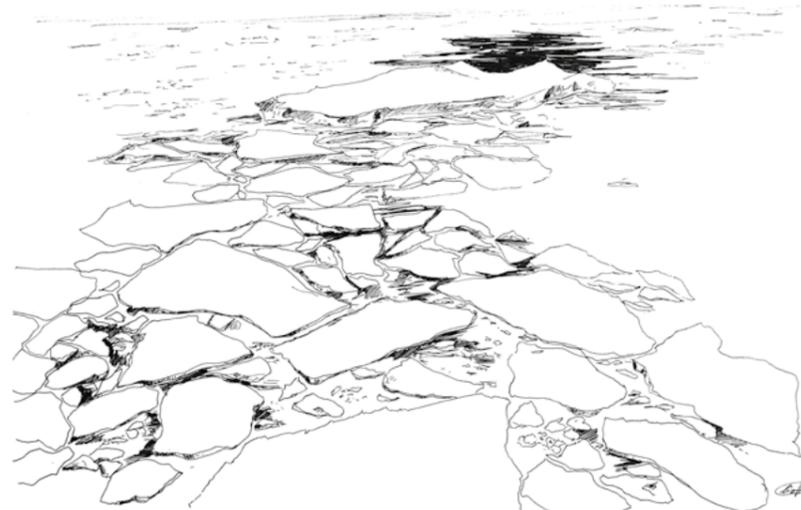
us to better understand the processes controlling water vapour isotopic composition, especially near the sea ice margin, to assess the ability of atmospheric models to resolve these processes, especially for deuterium excess. Together with backtrajectory and moisture transport calculations, these measurements will allow to estimate the fraction of moisture of local (Arctic) origin and the fraction of moisture which has been transported over long distance. In the context of an intensification of the Arctic water cycle, this fraction remains an important source of uncertainty. Finally, better understanding the processes controlling the water vapor isotopic composition will improve the interpretation of paleoclimate records such as those obtained from ice cores.



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1141 **AWIPEV-CO2**

Monitoring of the carbonate chemistry at the AWIPEV underwater observatory,5

The AWIPEV-CO2 project aims to establish time-series measurements of the carbonate chemistry at Ny-Ålesund. It would be the first time-series of this kind in the coastal Arctic. These data are needed to estimate the rate at which the coastal Arctic acidifies and to plan new perturbation experiments following the first ones carried out as part of AWIPEV in 2009 and 2010. It is proposed to add two instruments to the already existing AWIPEV Underwater Observatory to measure the partial pressure of CO2 (continuously) as well as total alkalinity (once a day). Additionally, discrete sea water samples will be collected weekly for measurement of dissolved inorganic carbon and total alkalinity. This will be used to calibrate and validate the sensor data.



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1180 **EGRIP-France**

Ice drilling in Greenland EGRIP-FRANCE

This project represents the French contribution to the international deep drilling project EGRIP (East Greenland Ice core Project) with the target of studying the dynamics of the large North East Greenland Ice Stream (NEGIS) and recover a high resolution climatic archive of the last 50.000 years: access to the drilling site, to the ice samples and contribution to the deep drilling operation.



Greenland (EGRIP drilling camp)
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1206

INTAROS-SVALBARD

Contributing to an INTegrated ARctic Observation System around SVALBARD

The Arctic is undergoing the most rapid changes among all regions on the Earth. These changes, including the rapid sea ice decrease and air temperature warming, are affecting the Arctic ecosystems in terms of functioning, geographical distribution and communities. They are also suspected to influence the Northern Hemisphere atmospheric circulation and the European Climate. Increasing the in-situ observing capacity in the Arctic has become a major challenge owing to the current lack of data, mostly due to the difficulty in accessing these remote and harsh environments. The INTAROS-Svalbard aims at strengthening the observing capacity in a very important region of the Arctic with regards to on-going changes, the Svalbard region. This initiative is part of a wider one that is currently set-up within the EU-H2020 INTAROS (INTegrated Arctic Observation System) project. The ocean around Svalbard is a key-region for the Arctic climate, as it is a major pathway for the warm Atlantic water entering the Arctic Ocean, an area of intense ocean-ice-atmosphere interactions and a transition region between two very distinct Atlantic and Arctic biogeographic provinces.

The main objectives of the INTAROS-Svalbard project are (i) to better understand and monitor the environmental conditions which control the redistribution of the heat content of the Atlantic water inflow to the Arctic Ocean through Fram Strait, its links to sea ice and the thermohaline structure of the upper ocean in the region west and north of Svalbard, (ii) to better understand and monitor the interactions between waves and sea ice in the coastal zones of west Spitsbergen focusing on a major fjord, Kongsfjorden, (iii) to characterize the response of the biology and behavior of zoobenthic populations to sea ice evolution



and hydrographic conditions in Kongsfjorden. To achieve these objectives, gliders will be deployed in summer in Fram Strait and north of Svalbard. These high resolution measurements will provide a detailed characterization of the summer hydrography, hydrodynamical properties and mesoscale activity associated with the Atlantic inflow in the region extending across the western Spitsbergen slope and beyond. Mooring lines deployed on the northern slope of Svalbard will provide multi-year time series of current and water properties, helping to understand the link between the sea ice distribution, the upper ocean properties, the current dynamics and the cross slope exchanges. In Kongsfjorden, passive acoustic signals recorded by hydrophones and measurements by accelerometers which will be installed on benthic bivalves will be used to monitor the biological activity. The separation of the acoustic signals between its biological and abiotic origins will allow to understand the biological activity in relation to the sea ice evolution and other environmental parameters. Wave-sea ice interactions will be investigated from the acoustic records and high resolution SAR imagery.



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1207

MESSI

Mercury stable isotopes in the Arctic atmosphere

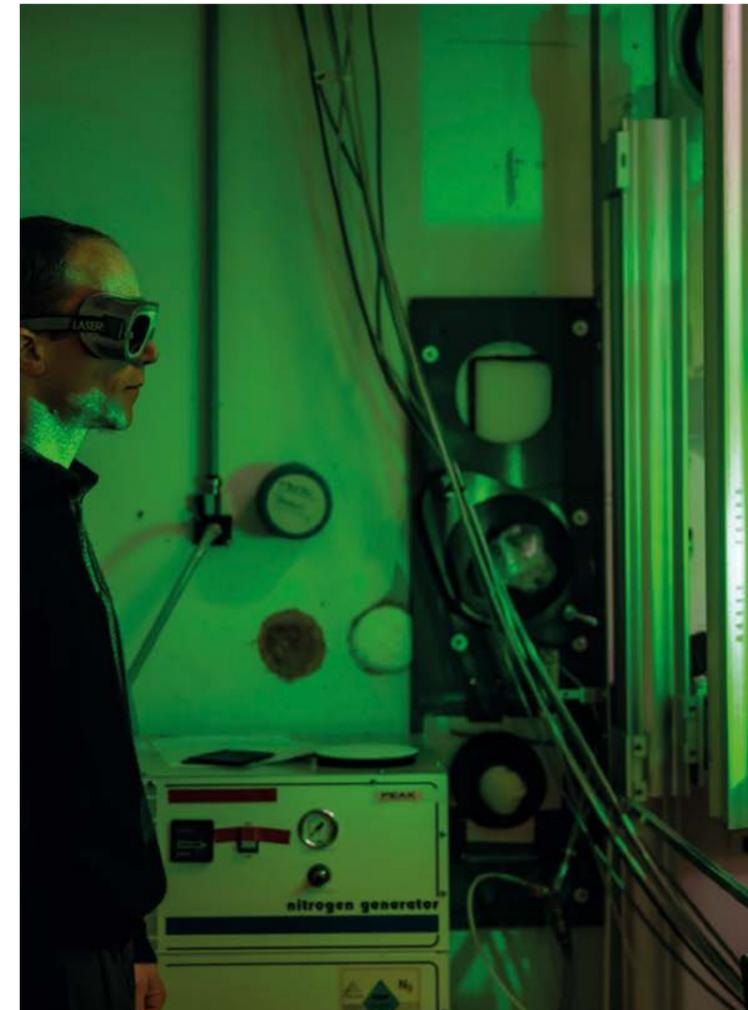
Mercury is toxic to both wildlife and humans and is transported to arctic ecosystems via air, rivers and oceans. During recent ERC, CAF, and H2020 projects we have made new and critical observations on arctic mercury cycling, including the first seasonal observation on russian river inputs, on open Arctic Ocean mercury speciation and distribution and on tundra uptake of atmospheric mercury. These results are stimulating a rethink of arctic mercury cycling and the development of a new generation of numerical models that help understand how arctic warming affects mercury cycling and exposure. One key observation, the elevated summertime atmospheric elemental Hg levels, remains ill-understood. The main objective of the MESSI project is to make novel observations of the mercury isotope signatures of the summertime peak, in order to understand its origin (terrestrial, marine, sea ice?). In addition we will revisit seasonal atmospheric reactive mercury (HgII) dynamics by intercomparing novel sampling methods to current mercury monitoring instruments. The new observations should help better parameterize coupled 3D models of the arctic mercury cycle.



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1038 HUMAD-MAFSO

Human-Environment coevolution in Indigirka (Russian Federation): frozen graves in present-day autochthonous populations

The MAFSO-HUMAD programme focuses on the settlement history of Yakutia (Sakha Republic in Eastern Siberia) and on human adaptation in one of the coldest areas of the world between the Arctic Circle and the Arctic Ocean. Yakut population settlement and the coevolution of humans and infectious-parasitic diseases will be investigated through archaeological (excavation of frozen graves in exceptional states of preservation), historical, cultural and biological data. The history of population settlement will be evaluated by comparing ancient and contemporary populations using the same genetic markers. A particular focus is on ancient DNA ; human subjects, bacteria and viruses can be investigated and their genetic codes sequenced. Studies on emerging diseases, diseases already identified by our team, will be conducted during the epidemiological missions on targeted contemporary populations. Following the settlement study in the Verkhoyansk area (2010-2012), this new programme continues to study Yakut settlement but in new ecological regions: the basin of the Indigirka and Kolyma rivers, the region of Olenek (west Lena un-



der the Arctic circle) and with news genomic technologies: complete sequences of ancient virus and bacteria. This research (field and laboratory) will be conducted through a bilateral French-Russian collaboration, officialised in the International Associated Laboratory COSIE Human-Environment Coevolution in Eastern Siberia.



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1080

ENCHAINEC

Environmental Changes and Human Activity In North Eastern Canada (Nunavik and Labrador) during the Last Millenium

The ENCHAINEC project is focused on vulnerability, resilience and adaptation of northern societies facing global change. The rapid current warming of Arctic climates has already created many changes in the social, economic and cultural behavior of the populations inhabiting these regions and more changes are expected to come. These changes disturb the fragile balance between human and the environment. Populations of these areas have to face these challenges, and in this context, looking at the past provides the opportunity to explore the complex relationships between climate, ecology and human societies, which may help to suggest scenarios about some situations according to the forecasts. The chronological frame of the project encompasses the last millennium, a pretty well documented period. The study area concerns North-Eastern Canada (Nunavik, and Labrador-Nunatsiavut). Around 1000 years cal. AD, hunters/gatherers/fishers lived by the Nunavik and Labrador coasts. Within these study areas, our aim is to document 1000 years of interactions between Thule/Inuit (last Dorset pro parte) people, and their environment, through an interdisciplinary approach exploiting different kinds of natural archives. The use of pedo-sedimentary archives (lake and peat deposits, cryosols, anthrosols) and palaeo-environmental multiproxy analyses will give useful information about landscape evolution, climatic and anthropogenic forcings upon ecological processes. Archaeological sites, and more specifically archaeological soils, ecofacts and artefacts, will give precious information about the nature of these interactions. In parallel when possible, an anthropological/cultural approach through open interviews will focus on human memory of Inuit elders, perception and prospects of environmental and social changes.



Several modes of communication have already been identified, adapted to the different audiences and partners involved in the project: academics (presentations at conferences and publications in international journals), local communities and local authorities. It is a priority for us to circulate the results of our field work and analyses to a non-specialist audience, especially youths of the Inuit communities, by a website featuring the innovative interactive platform and the Facebook page.



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1108 **PRISM**

Permafrost Rock Ice and Snow Monitoring in the Austre Lovén glacier basin (Svalbard)

Prism project is focused on 2 main objectives. First, using drones and a terrestrial laser scanner to derive high resolution surface models. Second to maintain a long term observation network in a small Svalbard glacier basin. Combined use of drone and photogrammetry on one hand, and of lidar technology on the other hand do allow for a fine resolution approach of highly variable processes such as snow cover settling, moraine icings, permafrost related surface morphology changes and glacier ice changes. These dynamical processes do have an important role in the physical and hydrological behaviour of polar glaciers and on the cryosphere at large. The second major aspect of Prism will consist in continuing recurrent measurements in the framework of the Austre Lovénbreen basin as a glacier observatory. Mass balance and surface temperature measurements will be the principal component of data that will continue the work that has been undertaken over the last few years.



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1127 **BRISK's**

Observatories of the project "bridging indigenous and scientific knowledge about global change in the Arctic: adaptation, and vulnerability of society ; environment"

Based on case studies in Lapland (Norway, Sweden) and Siberia (Yakoutia, Amour, Kamchatka, Tuva Republic), BRISK develops innovative methodologies that facilitates knowledge co-production. It documents the state of the art with respect to scientific and indigenous methods and observations of global change. BRISK juxtaposes and makes comparisons at several levels. Firstly, it examines in different but nonetheless coherent contexts, the intimate relationship between people and their environments through the comparison of two types of reindeer herding in Eurasia. Secondly, it considers the notion of extreme meteorological events from the differing viewpoints of climate scientists and indigenous peoples. Thirdly, in order to bring together indigenous and scientific knowledge for the observation of global change (climatic, environmental, industrial, social), community-based observing systems are jointly conceived by scientists (natural and social) and indigenous peoples.



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1148 **DESIGN**

Dynamic Slope Geomorphology and vulnerability in Nunavik, Canada

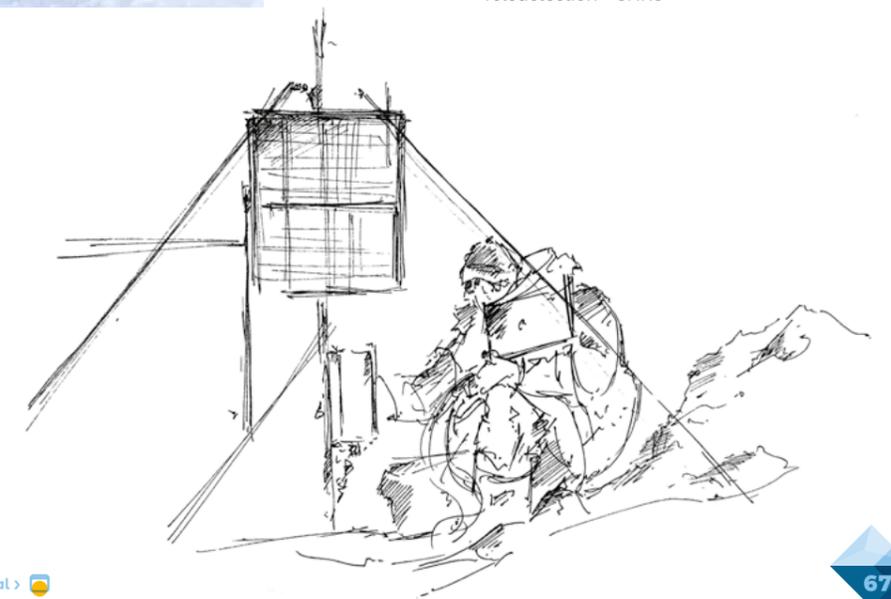
Several of the villages and parks in Nunavik (northern Quebec, Canada) are located close to high reliefs where slope record frequent gravity movements. In such setting, providing data regarding landforms, their dynamics and induced risk for a growing local population and even more numerous tourists years after years within the parks are requested. The first objective of project DeSiGN is to improve the slope dynamic knowledge over long-term and mid to short-term periods in a global warming context. The second objective is to characterize both hazard and vulnerability, to define and quantify risk due to slope dynamics. To reach these objectives, we privilege a methodology based on field techniques offered by geomorphology and stratigraphy, and lab analyses (dating, sedimentology, dendrochronology).



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1208

BOAZU

A Sameby-driven research project investigating the cumulative impacts of environmental and social change on reindeer herding and the future for Saami youth

Reindeer herders today face many challenges, including climate change (resulting in later springs and colder summers), high rates of predation on young calves, and restricted access to land due to increased encroachment (by mining, wind farms, hydroelectric dams and tourism). Given these concerns about their future, they wish to better understand how the cumulative effects of these changes are currently affecting the reindeer-herding economy and lifestyle, the land, as well as their future impact on Saami reindeer-herder culture and language.

When they finish school, young Saami students have to make choices based on what they believe the future holds. Would their best prospects be in mining, tourism, or other jobs combined with reindeer herding? To address these issues, a proposal for an initial research project was drafted in July 2017 during a series of workshops with the Jåkkåkaska Sameby at the reindeer-marking camp in Arasluokta. The project, aimed at exploring options and possible future scenarios, will be led by Sameby members and students at the Saami school in Jokkmok, working with a team of researchers from universities in Sweden, Norway, Finland and France. In this way, Saami schools, Sameby members and academics will join forces to develop an integrated, interdisciplinary, collaborative participatory-action research program to explore the issues and priorities and develop an action plan. This approach will bring together local expertise and scientific



knowledge in order to better understand the magnitude of changes, to analyze their impacts, and to envision the scenarios for the future. The Saami of Sapmi seek an overall view of the changes taking place rather than dealing with one question at a time. BOAZU stands for "reindeer" in Saami.



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Antarctic Subantarctic

Life sciences

Supported science PROJECTS



109

ORNITHOECO

Seabirds and marine mammals as sentinels of global changes in the Southern Ocean

The program uses seabirds and marine mammals as indicators of global changes in the marine ecosystems of the southern ocean. Through a network of 4 observatories from the Antarctic to sub-tropical biomes, the populations of 25 species of marine top predators and their distribution at sea are monitored since 50 years. These individually based long term information, combined with shorter term studies carried out on an annual base, especially on the foraging ecology of the species, are used to understand the processes through which climate affects marine ecosystems, and to make predictions on the effects of future changes in these ecosystems, as well as to propose conservation measures to limit the impact of fisheries on populations.



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PROJECTS : in progress

119

ECONERGIE

Mediators of individual quality : proximate aspects and fitness consequences

Our research program ECONERGY is devoted to the study of the physiological, energetic and evolutive aspects of the so-particular adaptations exhibited by adults and king penguin chicks (*Aptenodytes patagonicus*) to their ashore living stages. These are characterized either in chicks by their extraordinary long growth period and the irregular feeding rates during the winter or in adults by their long-term fast during reproduction or molting. To answer our questions we realized studies via the study of the animal in his environnement with an ecophysiological approach.



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136

SUBANTECO

Subantarctic biodiversity, effects of climate change and biological invasions on terrestrial biota

The subantarctic islands are amongst the most isolated islands from any continental landmass and contain a number of the limited terrestrial habitats present at these latitudes. Interestingly, our knowledge of the subantarctic biodiversity, autoecology and effects of climate changes and biological invasions still contain many gaps. In parallel, accurate assessments of the sensitivity and vulnerability of polar organisms must be achieved in order to reliably predict species and community trajectories. In addition to climate changes, alien insects and plants can represent significant drivers of community structure and functional diversity in general. Changes in plant communities have strong bottom-up effects on multitrophic interaction networks with subsequent effects on above-ground animal communities in terms of abundance, taxonomic and functional diversity. In this project, we are investigating the spatio-temporal patterns of the subantarctic biodiversity, biological invasion processes, the effects of changing environments and multi-stress on species physiological ecology and the perception of the biodiversity in a non-market context.



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137

ECOPHY

Adaptive strategies and population dynamics of penguins under environmental constraints

Assessing the ongoing and future adaptive capacities of populations to cope with global changes is a major challenge. Relying on multi- and trans-disciplinary expertise, P137 has selected three main animal models (and phylogenetically-related top-predators): king penguins *Aptenodytes patagonicus*, Adélie penguins *Pygoscelis adeliae*, and emperor penguins *Aptenodytes forsteri*, to investigate the impact of climate on Southern Ocean ecosystems. Our unique database, without the biasing effects of flipper bands, allows us to study two contrasting, but nonexclusive, mechanisms that can explain their population responses to environmental variability (natural and anthropic): (i) phenotypic plasticity responses and (ii) microevolutionary processes. In addition to determine and monitor the flexibility and plasticity of numerous phenotypic traits (morphological, physiological, phenological and behavioural; accounting for sex, age, experience, condition, etc.), we also study the spatial structuration of the colonies according to different constraints (social structure, parasitism, predation, local meteorological conditions, etc., but also phylogenetic constraints). We also aim to evaluate the genetic basis of phenotypic traits and their plasticity, and assess genetic diversity and gene flow between colonies within and between archipelagos to gauge their adaptive capacities. The development of new predictive models of population



responses to ecosystem changes (models integrating individual-based models within demographic-selection modelling framework, based on scenarios forecast by the IPCC 2014) will be precious tools for population conservation measures and ecosystem management. As never done before, we also propose to develop cutting edge technological innovations to minimize experimental disturbances and resulting scientific bias, such as mobile Radio Frequency Identification antennas on remote-operated vehicles (ROVs), automatic weighing and camera-tracking systems, or networked implanted micro-loggers. In return, it will open new opportunities for science, bringing new research questions that could not have been addressed without these innovations.



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354

ETHOTAAF

Behavioural ecology of subantarctic birds

Individuals are programmed to survive, mate, and optimise their fitness. To accomplish these tasks they interact with conspecifics, other organisms, and other elements of their environment. Behaviour thus is the baseline of all animal activities and is continuously modified by cues and clues coming from their environment. Our project, merges animal behaviour and sensory ecology, and aims at studying those cues and clues influencing seabirds' behaviour. Signals coming from other individuals broadcast important information for communication. We are particularly interested in the process of mate choice. This behavioural process in petrels passes through acoustic and olfactory signals giving information on direct or indirect (respectively) benefits that a potential partner may bear to the progeny. Signals coming from the surrounding animals may also influence animal behaviour without an actual communication between individuals. For instance, king penguins may use for their orientation an acoustic landscape formed by all individuals calling in the colony. In this case, what is used by an individual it is not the information directly broadcasted between two individuals, but the constant noise that all the information broadcasted forms in the environment. To test this hypothesis, we aim to study how this acoustic landscape is formed and whether it is actually used to orient. However, in penguins not only cues coming from other individuals



may be important for orientation and positioning. Positioning in the colony and thus survival depend also from predators and other environmental features (waves, temperature, rain, flooding etc). Ultimately the colony structure may reflect how the birds respond to all the inputs coming from their surroundings. We therefore also need to understand colony formation and dynamics to understand movements of individuals in crowded environments.



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394

OISEAUX PLONGEURS

Foraging Ecology and Energetic of Southern Diving Predators in Relation to Climatic Variability.

The objectives of this proposal are to study the foraging strategies and energetics of the main diving birds of the Southern Ocean (especially penguins) that play in major role in food webs through a pluri-disciplinary study involving ecologists, physiologist and oceanographers and using bio-logging developments. We want to determine i) their foraging strategies ii) their at-sea energetics, from the individuals to the population to iii) evaluate the consequences of environmental changes on diving birds ecology. The applied issues concerns the determination of important at-sea birds areas and the use of penguins as indicators of the impact of climatic variability, at short and long term, on some poorly known food webs of the South Indian ocean.



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409

IMMUNOTOXKER

Aquatic Ecotoxicology and Immunotoxicology of aquatic organisms in Kerguelen Islands

Aquatic ecosystems in Kerguelen islands are a natural laboratory for the study of ecotoxicological effects related to Global Change.

In this context, our objective is to contribute to:

- ▶ A better understanding of the sensitivity of model organisms (Mytilidae / salmonidae) and the vulnerability of their populations to changes in environmental factors induced by global change;
- ▶ Set up an observatory in ecotoxicological risk assessment for freshwater-marine continuum in Kerguelen Islands.



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1041 SALMEVOL

Evolutionary ecology of salmonids colonization of the Kerguelen Island.

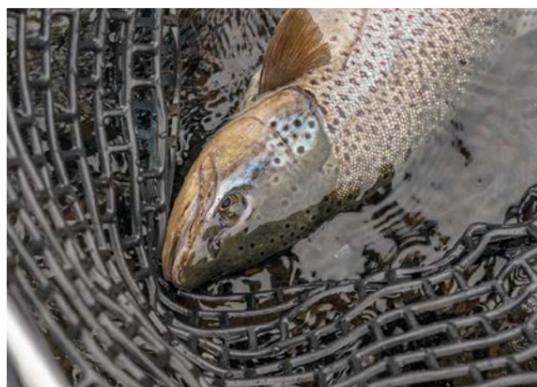
Research conducted in the SALMEVOL project focuses on the evolutionary ecology of salmonids in the specific context of the successful colonization of the Kerguelen Is by some of the species that have been introduced 60 years ago. Trout is the only species that has successfully colonize almost all watersheds of the eastern half of the main island. The large-scale experiment that was initiated by these introductions is of major interest in the context of global warming and very fast glacier retreat in the sub-Antarctic region. The tremendous database and samples collected from 1954 to the present, together with our multidisciplinary expertise, allow us to explore some of the major issues concerning the success of biological invasions, the evolution and adaptation of species and their relationships with the rapid change in their environment.



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1044 PROTEKER

Effects of global change on coastal marine life in Kerguelen Islands. Establishment of a base line for ecological and genetic monitoring, protection and conservation

The PROTEKER project is a pilot program that aims to establish a base line for assessing the impact of climate change in coastal marine ecosystems of Kerguelen islands by ecological and genetic monitoring at reference sites. The rich biodiversity of coastal marine ecosystems is usually strongly impacted by environmental changes over the planet. In Kerguelen, such environments were little investigated compared to open sea areas, and are still poorly known. The project should provide stake holders and decision makers with scientific criteria for protection and conservation of Kerguelen coastal marine ecosystems. The PROTEKER first phase (2011-2014) aimed at assembling together and merging all available data from previous programs, selecting, and setting up monitoring stations for completion of the present proposal required for 2015-2018. During this second, operational phase, scientific investigations will integrate all levels of marine biodiversity, from species to community levels and will consist in a pluri-disciplinary approach including monitoring of abiotic parameters, habitat mapping, population genetics, genomics, functional ecology (physiological/trophic analyses), and macroecological analyses (ecological niche modelling). Expected results should provide with integrative models of Kerguelen coastal marine life distribution and sensitivity to environmental changes.



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1091 L'AMMER

Adelie penguins as Monitor of the Marine EnviRonment.

This program proposal proceeds from the recent international efforts towards long-term monitoring of breeding and at-sea foraging performances of key species serving as eco-indicators of environmental changes. Here, foraging success of these species is linked to physical parameters of their environment and to resource availability. The data collected will consist in identifying the preferred foraging zones of Adélie penguins in Dumont d'Urville, Adélie Land and quantifying the hunting effort according to i) the availability of their main prey, ii) their own ability to find and capture prey, which depends on their individual quality. In partnership with the WWF, these data will be included in the databases of international programs of eco-regionalization (Census of Antarctic Marine Life, SCAR, CCAMLR). Comparisons with Adélie penguins' performance in other regions of the East Antarctic sector will be conducted, in collaboration with colleagues from Australian and Japanese polar institutes. Following the recommendations of the aforementioned international institutions, the program will put a special emphasis on the examination of the impact of human activities on penguins' performances through dedicated ecophysiological and behavioural monitoring.



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1116 PlantEvol

Plant biodiversity in subantarctic islands: evolution, past, and future, in changing environments.

Contemporary climate change is already having a marked impact on sub-Antarctic environments. If we are to conserve the unique plants of this region we need to better understand their potential to respond to these long-term changes. Our program takes a two-part approach combining macro- and micro-evolutionary studies to examine the origins and evolution of sub-Antarctic island plants and floras as well as how contemporary species interact with their environment. We propose interdisciplinary studies involving phylogenetics, cytogenetics, transcriptomics and analyses of trait variation across abiotic and biotic gradients. Combining insights into the history and current status of these plants will provide an unparalleled perspective on the potential for environmental change to shape plant diversity across a range of temporal and geographic scales.



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1151 **ECOPATH**

Circulation of directly transmitted and tick-borne infectious agents in sub-Antarctic and Antarctic colonial vertebrate populations

Describing and understanding factors affecting the distribution and circulation of infectious agents in animal populations is important for basic and applied reasons. Populations of wild vertebrates living in southern polar areas are increasingly the subject of threats from infectious diseases, which can add to other environmental threats, and it is becoming critical to establish baseline data and sound understanding of the dynamics of host-parasite interactions in these systems. In some instances, such information can have clear potential management implications. Populations of vertebrates breeding in colonies are especially important to study in those respects because they are distributed in very discrete units among and within which the transmission of infectious agents can be affected by various processes and can lead to disease outbreaks that can affect hundreds to thousands of individuals at the same time. In this project, we plan to explore how large scale dispersal processes and more local interactions between hosts and parasites can affect the dynamics of circulation of infectious agents and the occurrence of possible outbreaks. In order to do so, we will combine complementary methodological approaches from different fields, involving notably laboratory analyses of biological samples gathered in the field on identified individuals, the implementation of specific field experiments and the parallel development of a modelling approach. Modern molecular techniques as well as tracking devices will be used to address specific questions. The project will also rely on the existing set of long-term IPEV research programs conducted on various key sites. The work will be conducted in tight



coordination with the TAAF Nature Reserve. A specific focus will be developed on infectious agents potentially responsible for large outbreaks, such as avian cholera, as well as on seabird ticks and tick-borne disease agents. Field work is planned to be conducted on the three districts of the French sub-Antarctic islands (Amsterdam, Kerguelen and Crozet) in order to address issues at local but also broad spatial scales.



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1182 **ASSET**

Antarctic Seals and the Sea-ice Environment



Given the sensitivity of the sea-ice zone to global warming (IPCC 2013), there is an urgent need for determining how top predators use their physical and biological environment, in order to understand and predict their response to climate change in the different Antarctic regions. Events such as calving of large icebergs provide a framework for natural experiments to study the consequences of habitat variations on higher trophic level populations. Because the occurrence of such extreme events around

Antarctica is predicted to increase due to global warming, it is now timely to study the ecological response of higher trophic levels to calving of large icebergs and their oceanographic consequences. We propose to take advantage of the unique opportunity offered by the recent Mertz Glacier Tongue calving in Adélie Land (Feb. 2010) to continue an unprecedented time-series on the winter foraging movements and in-situ oceanographic conditions of a ice-dependent top predator, the Weddell seal, spanning over 13 years and encompassing this significant climate event. Using vertical T/S/chlorophyll profiles collected by the seals during their dives in winter, we will link their foraging behaviour to in situ hydrographic conditions before and after the Mertz Glacier calving, and assess impact of the Mertz Glacier calving on ocean/sea ice interactions and primary production in the Dumont d'Urville region, and their potential consequences on the seals foraging behaviour. We will also complete our time-series on the foraging ecology of Weddell seals during summer (post breeding), during which ice retreat stimulates primary production. Finally, we propose to develop new seal-borne sensors to measure otherwise poorly sampled key sea-ice parameters such as sea-ice thickness and sea-ice algae biomass. By so doing, we will simultaneously address urgent questions on upper trophic levels ecology, primary production processes in and below sea-ice, and sea-ice/ocean interactions in an innovative and cost-efficient way.



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1201

CYCLELEPH

Links between personality and energetic and behavioural adjustments of Southern elephant seals in response to environmental condition variations during their life cycle



Climate and environmental changes influence the dynamics and structure of marine ecosystems, which affect the distribution and the abundance of marine species. Southern elephant seals (*Mirounga leonina*) may be particularly affected by such spatiotemporal variability, since they alternate between foraging periods at sea and fasting time on land. Different foraging strategies at sea may impact the efficiency with which animals forage, which is the key to their reproduction and moult on land. This work aims to 1) link natural conditions and energetic constraints of a marine predator during its life cycle, alternating foraging and fasting periods; 2) explore whether individual strategies related to personality traits would impact on foraging success, moult speed, and ultimately on energetic and fitness components and 3) extend the environmental and seal behaviour data set through the SO-MEMO program.

By exploring both proximate parameters (i.e. physiological, behavioural, energetic strategies) and ultimate (i.e. foraging success, reproductive success, moult speed) of individuals, this work will substantially increase our understanding of how environmental stressors such as ocean warming may influence energy expenditure, energy intake and therefore energy balance of this deep diving predator and how this could be mediated by personality traits.



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Earth and space sciences

133 SISMOLOGIE/OBS Geoscope - EOST

The main objective of the "SEISMOLOGY/OBS" program is the continuous, broad-band, high-resolution observation of ground motion, especially high latitudes of the southern hemisphere, which are still insufficiently sampled despite the improvements of the past few years. Recorded and quality controlled data are freely distributed to the international scientific community both in real- and delayed-time. Our data contribute equally to global and regional tomographic studies, to seismicity studies, and to studies of microseismic noise. Real-time data from our sub-Antarctic stations are used for tsunami warning alerts in the Indian Ocean, for which they are particularly valuable. Our goals are to maintain or improve the quality of the data, to improve the robustness of the data recording and distribution procedures, and to increase their national and international utilization.



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Sismologie
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139 GEOMAGNETIC OBS

Five French permanent magnetic observatories in Southern territories

The 5 permanent magnetic observatories of Amsterdam, Crozet, DomeC/Concordia, Dumont d'Urville and Kerguelen are fulfilling the Intermagnet (INTERNational Real-time MAGnetic observatory NETWORK, <http://www.intermagnet.org/>) standards. In these observatories, the Earth's magnetic field is continuously recorded with sampling rates of 1 second. Absolute measurements of the magnetic field components are also performed every day along the year. The data processing and dissemination, to the world Data Centers (W.D.C. for Geomagnetism) across the Intermagnet network, are quasi real-time thanks to the recent acquisition system integrating daily shipment protocols. The continuity, quality, stability and homogeneity of those observations are of the utmost importance for their continued usefulness for the whole scientific community. The observatories are localized in remote places that do not allow to fully use usual French observatories protocols (BCMT <http://www.bcmf.fr/> protocol usually used: permanent internet connection, permanent observer, larger site and shelters, ...) and have led necessarily to logistical and technological adaptations. We plan (i) to continue the consolidation of our equipment and (ii) to establish, with the IPEV collaboration, the settlement of real-time transmission of the data.



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1- www.intermagnet.org
2- www.bcmf.fr

209 NDACC-Antarctica

Long-term UTLS and stratospheric ozone monitoring, stratosphere-climate interactions

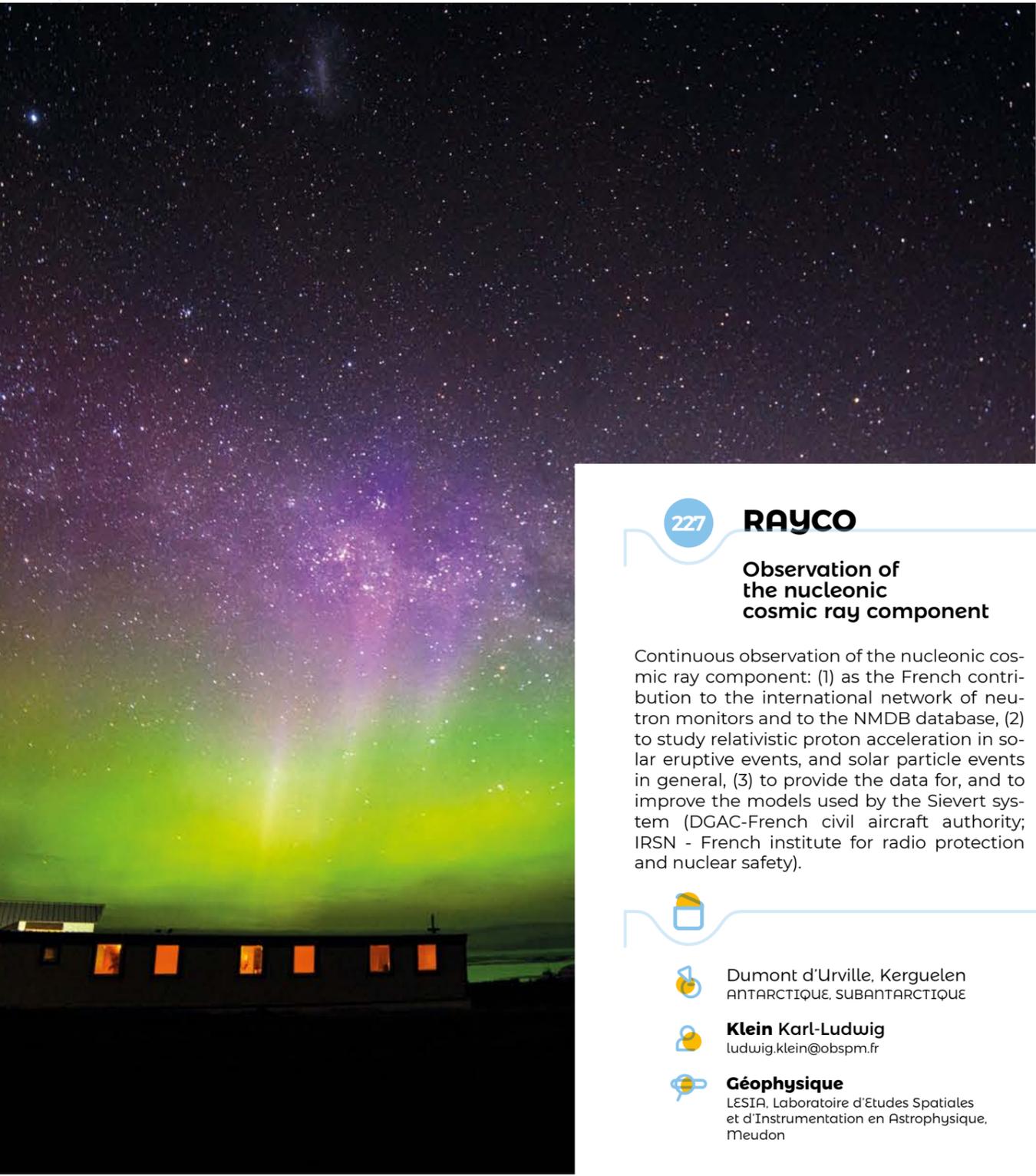
The objectives of the 209 program NDACC Antarctic consist in long term monitoring associated to process and climatological studies on both the particle population (aerosols, Polar Stratospheric Clouds - PSC) and chemical composition (including stratospheric ozone) of the Upper Troposphere / Lower Stratosphere. The global thematic is the stratospheric ozone chemistry and depletion, in a changing climate context. Consequences on UV-B radiation on ground, as well as ozone interactions with climate, especially concerning the impact of green house gases increases are also investigated. A set of instruments dedicated to the measurements of clouds occurrence and physical characterization, and ozone, along with the parameters involved in its chemical equilibrium is currently implemented on the French stations Dumont d'Urville and Kerguelen. These instruments are: UV-Visible spectrometers, UV-B broad-band detector, balloon ozone soundings and lidar (Rayleigh/Mie/Raman). The observed variables are ozone, total column and vertical profiles, aerosols and PSC profiles, temperature, nitrogen dioxide and erythemal UV-B. This observatory program is part, at the French level, of the Observing Service NDACC-France.



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227

RAYCO

Observation of the nucleonic cosmic ray component

Continuous observation of the nucleonic cosmic ray component: (1) as the French contribution to the international network of neutron monitors and to the NMDB database, (2) to study relativistic proton acceleration in solar eruptive events, and solar particle events in general, (3) to provide the data for, and to improve the models used by the Sievert system (DGAC-French civil aircraft authority; IRSN - French institute for radio protection and nuclear safety).



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312

SUPERDARN KER

SuperDARN Kerguelen

The SuperDARN network of coherent High-Frequency (HF) radars is dedicated to global observations of the convection of the ionospheric plasma in the high-latitude regions: auroral zones and polar cap. The french SuperDARN Kerguelen radar is conjugate with the english Hankasalmi radar and with the incoherent scatter radars, ESR and EISCAT, all located in Scandinavia. This configuration greatly enhances the capabilities of the whole SuperDARN project on most of the scientific objectives, but more particularly on those centred on magnetic conjugacy between hemispheres. It will allow to understand the nature and the limits of magnetic conjugacy. Moreover, the SuperDARN network gives also complementary measurements to experiments onboard satellites, bringing a better understanding of the whole solar wind-magnetosphere-ionosphere system, particularly its evolution with time.



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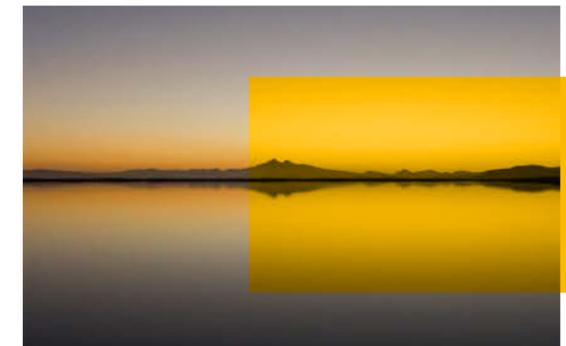
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337

GRAVITE

Gravity variations in polar and sub-Antarctic regions - Constraints on post-glacial rebound and present-day ice melting

The observation of pluriannual gravity variations in the polar and subantarctic regions thanks to the repeat of ground absolute gravity measurements is instrumental in constraining present-day ice mass changes and post-glacial rebound. We plan to repeat the following campaigns. In the Arctic, absolute gravity will be measured at Ny-Alesund, Svalbard, in 2017 and 2020, previous measurements dating back to 2001, 2004, 2007, 2010, 2012, and 2014. In the southern hemisphere, absolute gravity observations will be made at Dumont d'Urville station, Antarctica, in 2018 (previous measurements in 2000 and 2006), and on the French sub-Antarctic islands Crozet, Kerguelen and New Amsterdam in 2019 (previous measurements in 2001, 2003 and 2005).



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411

GLACIOCLIM -SAMBA

The glaciers,
an observatory of climate,
Antarctic component

This project is the renewal of GLACIOCLIM SAMBA program, which was initiated in 2004. GLACIOCLIM SAMBA is the Antarctic component of the GLACIOCLIM SO/ORE, in order to detect, monitor and understand climate and mass balance variability and change in the glacial environment. The program proposes surveying and maintaining the surface mass balance networks at Cap Prud'homme (CP, summer and winter surveys), along a 156 km transect (1 survey/yr), and at Concordia (1 survey/year or more) and the meteorological instruments deployed near CP. Special meteorological and glaciological observing periods are also planned in order to analyze particular meteorological processes.



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414

CESOA

Atmospheric Sulfur Cycle
in relation with climate
at mid and high Southern
latitudes

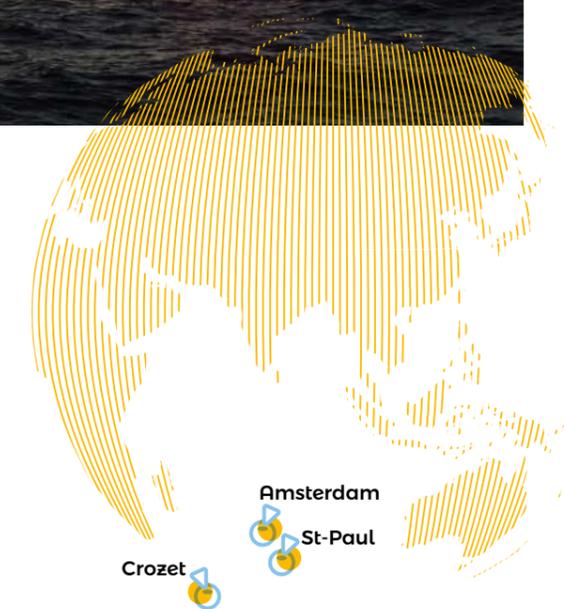
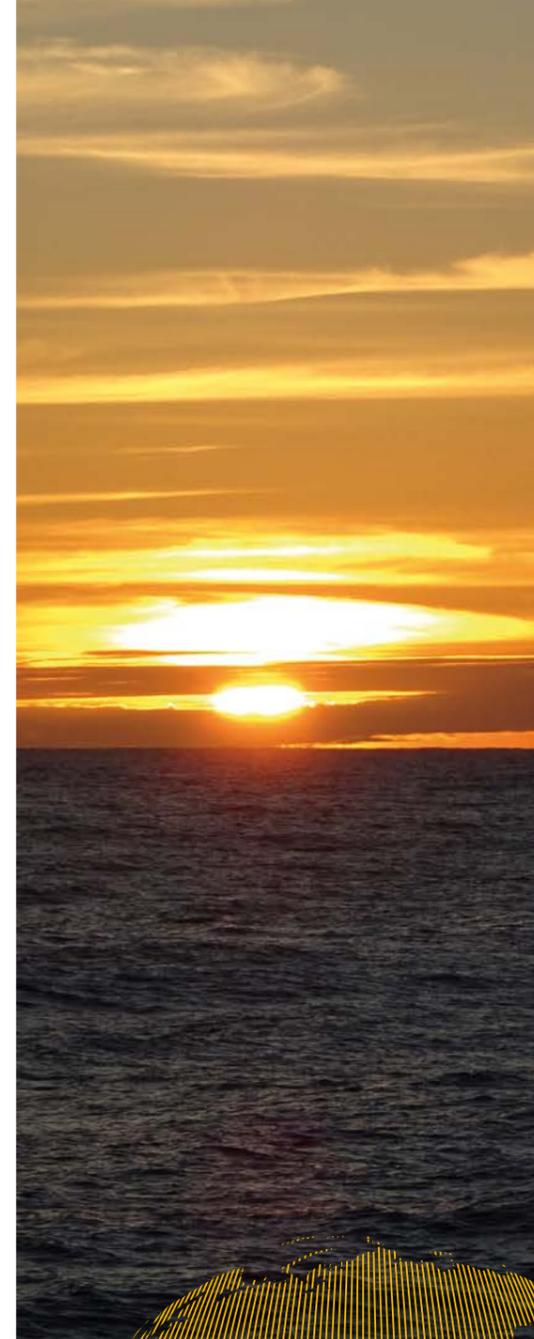
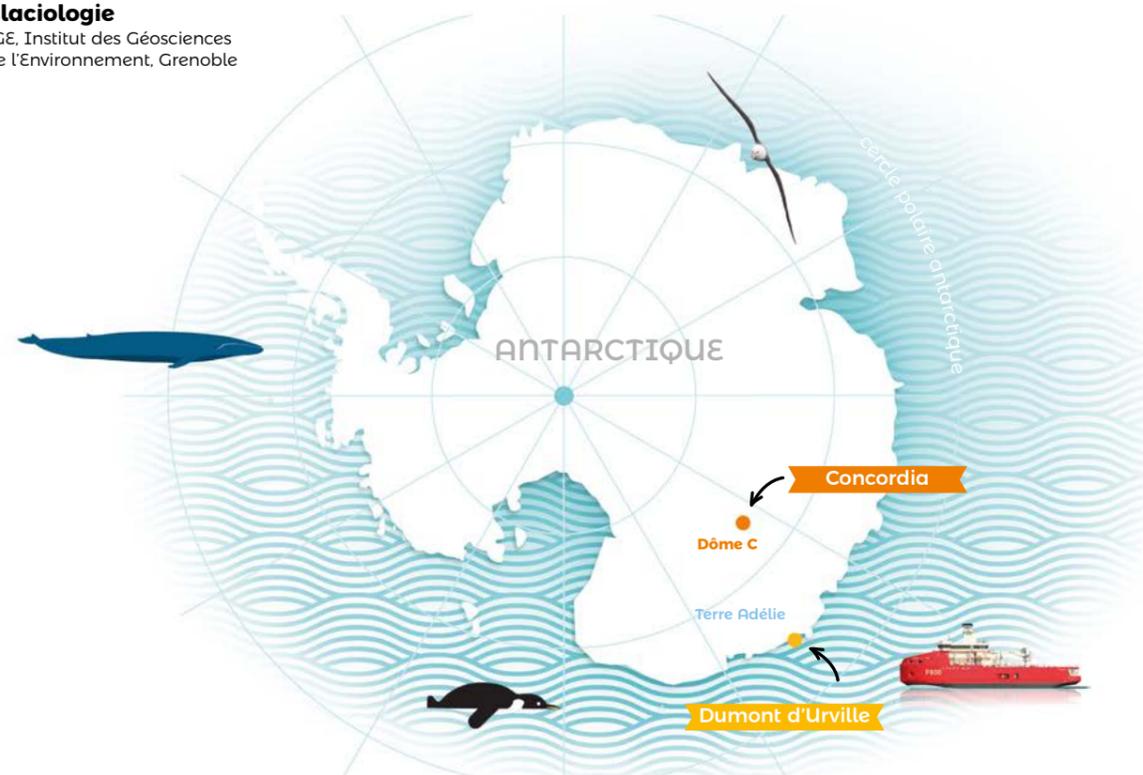
The atmospheric Sulfur cycle at mid and high southern latitudes: interannual variability of marine DMS emissions (sea-ice, ocean temperature, oceanic DMS content, chlorophyll a, short-term climatic event such as ENSO) and future response to global climate change. That includes a year-record study of DMS and sulfur aerosol at DDU, Amsterdam and Concordia Station, DMS in seawater occasionally collected during ship traverses between different stations.



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416

SNO-AMS/ICOS-France

Greenhouse gas monitoring
at Amsterdam Island

The goal of the greenhouse gases measurement program at Amsterdam Island is to contribute to long term atmospheric monitoring within the framework of the ICOS-France National Observation Service and the international GAW (Global Atmospheric Watch) network from World Meteorological Organization. Amsterdam Island is a reference site for atmospheric watch (clean site), and measurements conducted in-situ enable us to better estimate the austral ocean impact as a carbon sink and better understand the associated mechanisms. This location is also well suited to trace emission transport coming from South Africa. In addition to continuous CO₂ and CH₄ measurements and weekly flask sampling (CO, H₂, N₂O, CO₂ isotopes) conducted since several years, we propose to set up continuous CO and N₂O measurements and to restart the O₃ monitoring over the next 4 years. The 222-Radon measurements as well as meteorological parameters which enable an accurate air mass origin characterization will be continued. In order to further increase our knowledge about the Austral Ocean carbon sink, we think about setting up a continuous and high precision atmospheric oxygen analyzer.



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688

NIVMER

NIVMER

The NIVMER program aims to maintain and develop the ROSAME tide gauges network as part of the SONEL french observatory and in the frame of the international GLOSS program. This program is complementing several research and monitoring, national and international, programs using in situ sea level observations in the Indian sector of the Southern Ocean (Long term sea level change, tsunami warning system, satellite calibration, ...). This tide gauges network is the french contribution in this part of the ocean to the GLOSS core network.



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910

HAMSTRAD

H2O Antarctica Microwave Stratospheric and Tropospheric Radiometers

The HAMSTRAD radiometer is a genuine state-of-the-art microwave instrument dedicated for the detection of 1) the 60-GHz oxygen line to measure tropospheric temperature profile, and 2) the 183-GHz water vapour line to get tropospheric H2O (profile and precipitable water). It has been installed at Dome C in 2009 and is running normally since 2010. The initial aim of the HAMSTRAD project was to measure the trends in water vapour and temperature profiles from the lower part of the troposphere to the lower part of the stratosphere and their links with climate change. Coupled with other instruments operating at Dome C (e.g. aerosol Lidar), the HAMSTRAD project also intends to study the genesis of thick clouds and diamond dust (ice particles) above the Dome C station by using the information coming from measurements (in situ and remote sensing at the station, satellites) and meteorological analyses of different parameters: temperature, water vapour, ice, precipitation, AOD, radiation, particles, etc. To date, the project has produced 12 peer-reviewed papers.



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1003

ARLITA

Architecture of the East Antarctic lithosphere-Terre Adélie

The main goal of the ArLiTA project is to characterize the architecture and the deformation structures of the Neoproterozoic and the Paleoproterozoic lithosphere of the Terre Adélie and George Vth Land (East Antarctica: 135 to 145°E). The project integrates various complementary approaches: mapping from seismological data, systematic mapping of the structures by tectonic analysis, petrophysics (textural analyses, Anisotropy of Magnetic Susceptibility (AMS), seismic properties modeling...), characterization of materials and paleofluids (petrology, geochemistry, datations) and thermomechanics (thermobarometry).



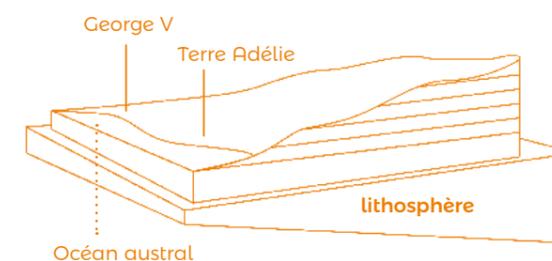
Terre Adélie
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UMR6524 - Magmas et Volcans - Equipe Transferts Lithosphériques, St Etienne



PROJECTS : · in progress · renewal ·

1013

CALVA

Calibration, validation of meteorological and climate models and satellite retrieval, Antarctic coast to Dome C

The aim of CALVA is to gather series of in-situ observations in Adélie Land and at the Dome C, which are needed to better evaluate and improve Antarctic meteorological models and global climate models over Antarctica. The observations also aim to contribute to improve remote sensing of precipitation. In Adélie Land, CALVA focuses on precipitation, extreme dynamic atmospheric boundary layer (catabatic winds) and drifting and blowing snow. At Dome C, CALVA also focuses on the boundary layer, which is extreme here in terms of temperature and inversions, and on precipitation. These are poorly known aspects of the Antarctic meteorology and climate, which are consequently poorly represented or simply ignored (blowing snow) in the models used for IPCC climate change predictions. The observation thus aim to improve those prediction, in particular those of the surface mass balance of the ice sheet and impact on sea-level.



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1028

GMOstrat

Global Mercury Observation system in austral and antarctic lands

The GMOstrat is initiated by a European project GMOS (Global Mercury Observation System), which is developing a coordinated global observation system for the global pollutant, atmospheric mercury (Hg). Through a cyber-infrastructure it provides with high quality data for the validation and application of regional and global scale atmospheric models, to give a firm basis for future policy development and implementation. In this context we have implemented three Hg monitoring stations in sub-Antarctic and Antarctic sites (AMS, DDU and DMC) in order to document and monitor the atmospheric Hg trends in remote places of the southern hemisphere and to study the almost unknown reactivity of Hg in those regions, in particular diurnal cycling, deposition, and reemission trends in Antarctica. After 4 years of successful measurements, we propose to extend these monitoring activities on 2 sites (AMS and DMC) in order to provide with high quality data of atmospheric Hg that are freely accessible in the frame of an international convention (Minamata convention) and a global monitoring network acquire longer data set (up to 8 years of continuous data) in order to document the seasonality of Hg compounds and short term variation. Are the international regulations leading to decreasing atmospheric trend in the Southern Hemisphere or are the trends offset by increasing natural emission (from oceans or biomass burning) ? improve our knowledge on the transport and reaction pathways of mercury using GEOSCHEM 3D model.



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1048

KESAACO

Kerguelen Surface Ablation, Accumulation and Climate Observation

During the last six years, in the framework of the GLACIOCLIM-KESAACO and KCRuMBLE programs, we implemented key glaciological and meteorological networks on Kerguelen Archipelago. 5 AWS and 1 hydrological station (a pressure gauge installed in la Diosaz river) were set up, and the data collected on the islands offered crucial informations to understand the glaciers retreat in this region. This new field campaign will offer additional glaciological measurements on the Ampère glacier (DGPS, GPR) and new data from the 5 AWS and from the pressure gauge. Moreover, additional rock samples will be collected in the Bontemps lake valley, along the flanks of nunataks and on summits around Cook Ice cap to go a step further in the understanding of the glacier retreat chronology since the last glacial maximum. The analysis of rock samples is funded by a new French INSU LEFE project Glacepreker (2016-2019). The sensors installed in the vicinity of the Ampère glacier will be removed at the end of the field campaign, meaning that this field campaign will be the last of the GLACIOCLIM-KESAACO program.



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1053

DACOTA

Dynamics of coastal outlet glaciers and implications on the overall mass balance of the East Antarctic ice sheet

The Astrolabe glacier serves as a test zone for measuring and understanding the dynamics of East Antarctic outlet glaciers. It is part of the more general observatory CRYOBS-CLIM (<https://cryobsclim.osug.fr/>) which aims at understanding the links between the environment (essentially climate forcing) and resulting glacier changes. These links operate at two principal levels : (i) climate changes induce surface mass balance changes which indirectly impact the environment and (ii) surface mass balance changes constitute the principal boundary conditions in the dynamic evolution of ice masses.

If the first aspect is principally covered by the GLACIOCLIM Observatory (IPEV program 411), the aim of the present proposal is to tackle these ice dynamics mainly driven by surface mass balance changes and, to a lesser degree, by direct climatic inputs (essentially temperature) and as such, appears fully complementary to the GLACIOCLIM one. Since the ice discharge in Antarctica is by more than 80 % drained by outlet glaciers from the eastern ice sheet, understanding their dynamics and being able to model their present and future behaviour is crucial when addressing the sea level issue.

The proposed approach is double by first proposing a comprehensive survey of the selected test glacier in order to capture the specific dynamics of marine outlet glaciers and feed relevant ice flow models. Corresponding results will then in a second time be applied to the modeling of the large outlet glaciers of the Wilkes-Terre Adelie land sector of east Antarctica whose contribution to sea level is major and needs to be constrained. The core of the activities detailed in the proposed program concerns the first task implying field work on the Astrolabe glacier. As for the second part,



it is carried out through an international collaboration of our program with the University of Texas under the form of several airborne geophysical campaigns. These measurements allow for assessing the environment settings of these large glaciers (bedrock and surface topographies, outlining of respective grounded and floating parts..) necessary for conducting the modeling of their future behaviour.



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1066

ASTEP+

Antarctic SouThErn Photometry telescope

Exoplanets are now discovered on a daily basis thanks to many astronomical surveys. These surveys require additional follow-up observations for validation or for joint observations at different wavelengths. This need will become even more important with the launch of TESS and JWST. In this domain, the potential of robotic medium size (30-80 cm) telescopes has been demonstrated by TRAPPIST in Chile with its successful confirmation and characterization of more than 90 exoplanetary systems. In parallel, recent results obtained on the characterization of the delta Scuti oscillations of beta Pictoris, with ASTEP-400, a photometric 40cm telescope, have demonstrated that a very accurate photometry can be obtained with an automated telescope operated from the Concordia station with minimal human interventions.



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1110

NIVOLOGIE

Snow properties evolution in a changing climate in Antarctica

The NIVO program is interested in the evolution of snow at and near the surface from time scales of hours to a few years. The aim is to understand the role of snow in the climate. The snow surface exchanges momentum, energy, water vapor (for different isotopes) with the atmosphere which gives rise to numerous feedback loops involving many processes (radiative, aerodynamic, turbulent, ...). To understand and parametrize these processes and feedbacks in snow and climate models, NIVO operates a set of automated instruments and collect manual measurements in order to characterize snow in the shallow sub-surface and in depth up to tens of meters. The goal of the next four years is to investigate inter-annual variations of grain size, density, albedo, temperature and the isotopic composition, to understand the evolution of the surface roughness, to advance on the exchange of vapor for stable water isotopes, and to progress on metamorphism laws at low temperature. NIVO also aims at providing essential data on snow microstructure and ice electromagnetic properties for the calibration/validation of satellite data which in turn helps to generalize the findings from Dome C to the whole Antarctic continent.



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1112

CHINSTRAP

Continuous High-altitude Investigation of Neutron Spectra for Terrestrial Radiation Antarctic Project

The CHINSTRAP project aims at installing a high-energy extended neutron spectrometer at the Concordia station in Antarctica. The particularities of this location are unique (high altitude and proximity to the geomagnetic pole) and allow long-term measurements dedicated to the study of the atmospheric natural radiative environment dynamics for Space Weather applications. These data will complete the ones already obtained at the Pic-du-Midi in France and in the Pico dos Dias in Brazil, near the South Atlantic Anomaly.

The project includes two phases:

- ▶ The first consists in installing and operating the HERMEIS in the station;
- ▶ The second consists in investigating the data then in combining their analyses to those from other measurement sites.



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1120

MICROMETEORITES

Micrométéorites at Concordia

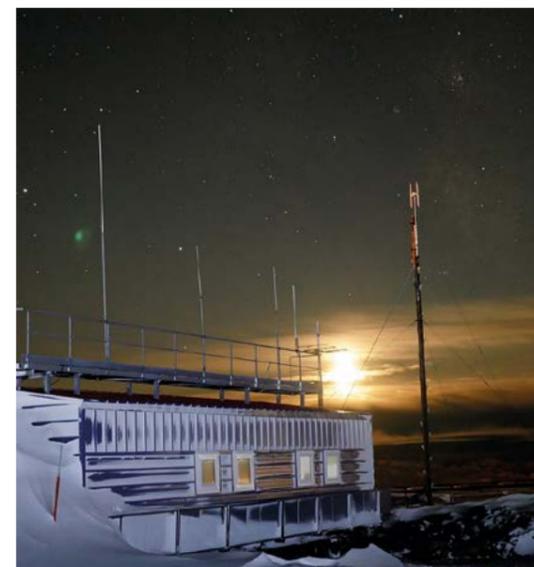
The general framework of the present project is the astrophysical context of the solar system formation and its evolution during the first millions of years after the gravitational collapse of the proto-Sun. Cometary matter is expected to contain the most primitive solar system components, including mineral phases and organic matter. Cosmic dust originates from both asteroids and comets, although the proportion of each source is still poorly constrained. This project aims at performing a new collection of cometary and asteroidal particles at the vicinity of Concordia Station. In previous collections, we identified a new type of interplanetary dust in the Concordia Collection: ultra-carbonaceous micrometeorites (UCAMMs), that are rare among the collected particles (~ 1%), but are of uttermost importance, as they are, along with samples returned by space missions, the only particles giving access to the most remote regions of the early solar system. They could also have played an important role for the input of prebiotic molecules on the early Earth. Dome C has crucial advantages to collect these rare particles that are most probably of cometary origin. The objectives of this program are to perform a large collection of micrometeorites in order to identify a significant number of UCAMMs (about 50), to obtain a new constraint on the currently debated value of micrometeorite flux on Earth and, possibly, identify new types of interplanetary dust.



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1143

APRES3

Antarctic Precipitation : Remote Sensing from Surface and Space

The antarctic region is still Terra Incognita in the global precipitation databases. The 1st climatology which does not heavily relies on models was recently published (2014). It is obtained from satellite-born radar data. The project is to deploy 1 or 2 summer campaigns at Dumont d'Urville to study the variability and microphysics of Antarctic precipitation in the coastal regions, as well as to calibrate and validate those data. The Ecole Polytechnique Fédérale de Lausanne meteorological radars, hydrometeor detecting lidars (Swiss and Italian), and the 70-m vertical profiling system from the CALVA program will be used during the field campaigns. It will be particularly interesting to operate the surface radars looking upward while the space radar overpasses, in order to directly cross the output from both sides of the atmosphere.



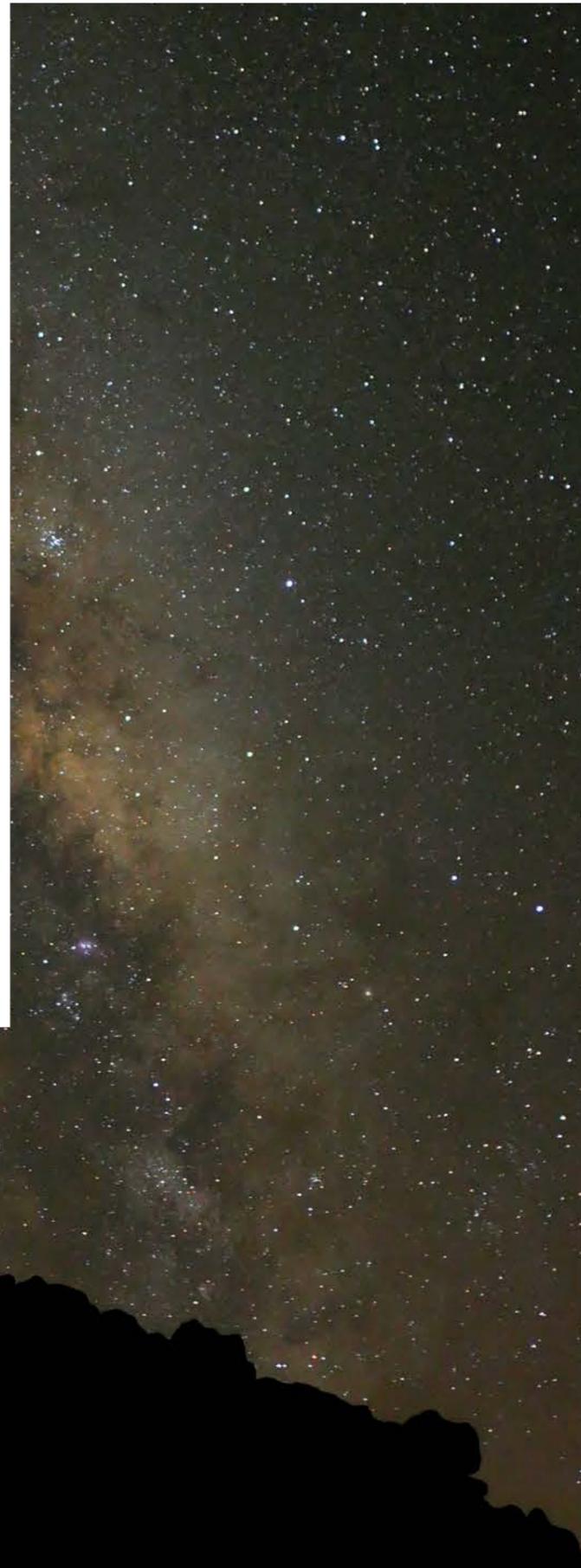
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1145

SolarIce

Study of the Solar Forcing over the Holocene from a new Dome C Ice Core

Solar forcing is one of the main natural climate forcings with greenhouse gas emissions, insolation or volcanic forcing. During the last millennium, solar minima often coincide with periods of enhanced volcanic forcing, making the attribution of climate variations to one or the other cause ambiguous (IPCC, 2013) ; this should not be the case for earlier millenia and it has to be tested on expanded records. In addition, the information collected on the variation of solar forcing in the past until today, can be used in climate models and allow to better constrain the part of the current climate change that is of natural origin and that of anthropogenic origin. There are various indicators of solar activity such as irradiance values measured by satellite for 30 years, sunspots observed on the Sun's surface since the early 17th century but for longer timescales, only cosmogenic isotopes such as beryllium-10 (10Be) can provide information on past solar activity. The objective of this project is to propose a new reconstruction of solar activity during the Holocene, our current interglacial. This reconstruction will be based on a 10Be record at high resolution obtained from a new 350 m ice core drilled on the Concordia-Dome C site. In order to make a reference of this record, we will implement a multiproxy approach at a resolution rarely achieved in the past. Many data will be collected to characterize the evolution of the past atmospheric composition (carbon monoxide and methane), the variation of local temperature, humidity sources, volcanic forcing, biomass burning, the dust sources and the origin of air masses that reach Concordia-Dome C. The teams that have an expertise in each of these areas will be involved in the project through a Franco-Italian collaboration involving three French laboratories

(CEREGE, LGGE, LSCE) and four Italian research institutions (Trieste, Milan, Venice, Rome). The project will constitute an important contribution to the IPICS priorities (past 2k), the Antarctic 2k (within PAGES 2K). It will also provide elements on two of the six priorities for Antarctic science as recently stated by the Scientific committee on Antarctic Research (question 1 : define the global reach of the Antarctic atmosphere and Southern Ocean and question 3 : reveal Antarctica's history). The IPEV Solarice project will take place over two seasons. The drilling of the 350m ice core is planned for the season 2015/2016. The ice core will be left for a year in the EPICA buffer to relax, the processing would happen the season after, in 2016/2017, and the samples will be back to Europe during the spring 2017.



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1154 ASUMA-ITASE

Improving the Accuracy of the Surface Mass balance of Antarctica. International Trans-Antarctic Scientific Expeditions

The present IPEV ASUMA-ITASE project, aims to define the logistical needs and requests in the framework of the ANR-ASUMA project (funded for 2014-2018). In this ANR project, we proposed to assess the integrated SMB value over Antarctica, by filling the gap that exists in the coast to central plateau transition zone, where large variations of SMB are observed within small distances. For this task, we will a) collect firn cores which will be dated using radiochemistry analyses and accurately analyzed for water isotopes and chemistry studies b) Interpolate SMB data with ground penetrating radar and satellite data, c) perform original field measurements of SMB and snow physics and robustly link them to satellite data. The present IPEV ASUMA-ITASE project will define the needs for three field trips planned during successive austral summers. Two small scale field trips are planned in the first 50 km from the coast to study melting areas in 2015-16 and 2017-18, and a long distance traverse is proposed for the 2016-17 summer. The main demand will address the long distance traverse, for which the use of IPEV's logistical supply for scientific expeditions acquired during the ANR-VANISH program (tractors and caravans) and by the EQUIPEX CLIMCOR program is required. The request also concerns the transport of snow and firn and ice samples collected in the field for their analysis in France and at Dome C.



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1165 AERONET

Aerosol Monitoring using sun photometer at Amsterdam Island (AERONET/PHOTONS station)

This project aims to maintain the AERONET measurements at Amsterdam Island. These measurements provide optical and microphysical properties of aerosols in the atmospheric column. Very few "clean marine" stations are currently in operation in the AERONET network. Observations initiated since 2002 at Amsterdam Island thus represent an important component of AERONET and will continue in this new IPEV project. Most of the work on site concerns for the installation (once / year) and monitoring (maintenance, data) of the measurements provided by a sunphotometer CIMEL. Data is shared and publicly accessible in near real time in the AERONET database.

This project was previously managed by the IPEV program AEROTRACE (415) led by Jean Sciare (LSCE).



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1169 EAIIST

East Antarctic International Ice Sheet Traverse

Italian, French and US scientists unite their knowledge and capability to study the interior of the Antarctic plateau between the French-Italian Concordia station (75°S, 123° E), and the US South Pole station (90°S). The scientific objectives of EAIIST are to study the icy terrain of the Antarctic continent in its driest places. These areas are largely unexplored and unknowns and offer unique and extraordinary morphological characteristics : presence of mega-dunes, glazed ice surface, and thermal cracks, structure probable analog to glacial age on deep drilling sites such as Dome C or Vostok . A consortium of scientists from three nations, Italy, France and US is built around the idea to explore and study the geophysical (snow physics, surface mass balance, density, temperature, seismicity, etc.), geochemical (impurities, aerosols, air-snow transfer, water isotopes, etc.) and meteorological dimensions (AWS, atmospheric dynamic, air mass transport, etc.) of these most inhospitable, remote and unknowns regions of the planet by the means of a scientific traverse.



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1177 CAPOXI 35-75

Oxidative capacity of Atmosphere 35-75 ° S

The CAPOXI 35-75 project aims to document the oxidative capacity of the southern hemisphere following a North-South latitudinal gradient, from the Amsterdam Island (37° S) to the Concordia station (75° S), including the Dumont d'Urville coast station (67° S). The program will specifically be dedicated to solve few inconsistencies observed these past few years in Antarctica. If the high oxidative capacity of the Antarctic plateau atmosphere is a well established phenomena, induced by the snow emission of nitrogen oxides, it is however difficult to reconcile our current knowledge of the oxidation schemes with the ground observations. Such discrepancies strongly limit our capacity to understand to ice core records. In this program, we propose to revisit some of the key parameters governing of the oxidation state of the atmosphere. By managing scientific stations from 37 to 75° C, IPEV offers the unique opportunity to study the oxidative capacity in very contrasting environments that will ease to reveal the different interaction between reactive species. The project will focus on the nitrogen oxides and halogen species in direct link with the ozone budget and will benefit from international collaboration to access specific instrumentation and modeling tools not available in our group.



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1179 Beta Pic

Characterization of Beta Pic from Concordia

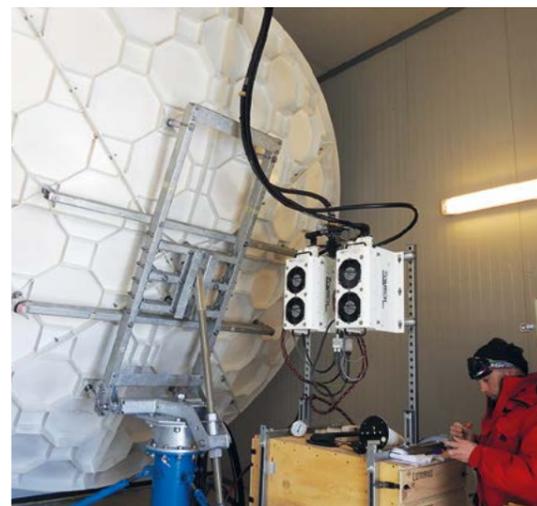
The star BETA Pic is famous: it is the first star for which it was possible to image a protoplanetary disk in 1984. It is also around this star that we deduced for the first time the presence of "exocomètes". In 2008, a planet was discovered about 8 at its star (roughly the distance from Saturn to the Sun). The study of this planet, Beta Pic b, and the dust disk around the star, is a unique source of information to understand these very young systems and the formation of planets. As in 1981, the planet will go back in front of its star between April 2017 and January 2018. This opportunity will not recur before 18 or 36 years. The detection of a transit (the planet passing exactly in front of the star) would be a revolution in the field because it would allow for the first time to have all the physical characteristics of an exoplanet. It would also allow to observe rings, a disc around the star and / or moons, which has never been done before!



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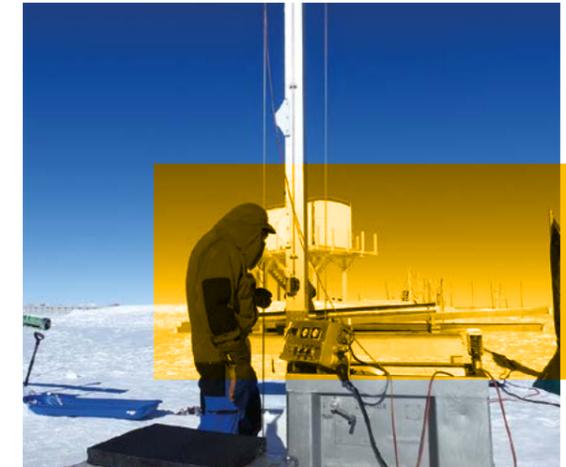
1202 Beyond Epica

Oldest Ice

BE-OI is a H2020 European project (Coordination and Support Action, IPEV, PNRA and CNRS being official contractants) to locate in Antarctica optimal sites where a deep drilling operation could be conducted during the decade 2020. The aim is to recover a stratigraphically-ordered sequence of climate and atmospheric/environmental conditions going back to 1.5 million years before present, overlapping the so-called mid-Pleistocene transition when the pacing of glacial-interglacial cycles dramatically changed from 40 to 100 kyr periodicities. Ultimately, the main question lies in the role played by greenhouse gases in this major change.

On the French and Italian side, the focus reconnaissance work of BE-OI takes place at Concordia and its vicinity. In 2016/2017, the site of "Little Dome C", located about 40 km west from Concordia along the ridge toward Vostok station, has seen extensive radar survey, a first series of phase radar measurements, GPS positioning as well as a first test drilling with the British RAID rapid access drill. At Concordia itself, the first test campaign of the highly innovative SUBGLACIOR reconnaissance probe was conducted. 2017/2018 will see a second test season for SUBGLACIOR (if logistics permits it), a second deployment of RAID, as well as GPS and phase radar measurements.

The BE-OI component presented here covers the follow-up of the 2018/2019 and 2019/2020 field seasons: the SUBGLACIOR deployment at the optimal site of Little Dome C, a site defined during the field season 2017/2018, as well as additional deformation measurements and the first field deployment of the Swiss rapid



access tool RADIX. 2019/2020 will either see a reiteration of the above activities, or the start of camp buildup anticipated for the following deep drilling operation. In addition, tests of new logging tools (notably a sonic logger) in the EPICA borehole are anticipated during these two seasons, before their deployment in the BE-OI reconnaissance boreholes.

The IPEV project BE-OI therefore represents most of the French and Italian declination (+ part of the Swiss contribution) of the European project BE-OI. For the field seasons 2016/2017 and 2017/2018, the latter was incorporated into two projects: SUBGLACIOR-1119 and part of GLACIOLOGIE-CONCORDIA-902. At the request of IPEV and for ease of follow-up by the CPST, the following two field seasons see the merging of these two projects (in part for 902) into a single one, named BE-OI.



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1203 ARCHIVE EPICA

Management of the EPICA-DC ice core stored at Concordia

The EPICA ice core, drilled at Dome C is 3260 m long and allows to record climatic changes over the last 800,000 years. It is therefore a particularly valuable archive. A quarter of the ice core (over the entire length) has been kept in an ice cave dug into the snow, where the average annual temperature is -55°C. The reason for this on-site storage is indeed to keep the ice at very low temperatures as required by certain measures. The rest of the ice core was either distributed to EPICA's various partners or kept in cold rooms at -25°C, near Grenoble. The objective of this project concerns the management of the archive remaining in Concordia. The tasks are:

- ▶ Respond to sampling requests from various national or international groups (once endorsed by EPICA's Steering Committee)
- ▶ Finish the repacking of the bags (if it is not finished in 2017-2018)
- ▶ Prepare the specifications for the future EPICA cave, taking into account the interactions with the "ice memory" storage project.

This project is thus a service to the ice core community more than a scientific proposal by itself.



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1205 ADELISE

Better constrain the origin of surface accumulation and recent climate change in the Adélie Earth through the supply of water isotopes

Quantification of fluxes of snow and water vapor at the Antarctic surface as well as links with climatic variations is a major challenge for projections of climate and water cycle organization in this region. Still, large uncertainties prevent such quantification. On the one hand, precipitation amount is difficult to estimate because of the influence of wind, a process particularly important on the coastal areas because of the strong katabatic winds. On the other hand, it is particularly difficult to quantify the direct snow exchanges with atmosphere (sublimation / condensation) because of badly constrained processes within the boundary layer (blowing snow, supersaturation, turbulence influence, ...). Finally, climatic variations over the last decades to centuries are often bad documented because of a lack of instrumentation in this region.

Water isotopic measurements on shallow ice or snow cores in Antarctica is currently one of the best tools to reconstruct the climatic variability (temperature, accumulation) in the absence of weather station instrumentation. Indeed, because of isotopic distillation from low to high latitudes, it is possible to link temperature to the snow isotopic composition at the seasonal and interannual scale. However, the snow isotopic composition is also sensitive to other effects during snow formation and deposition (e.g. kinetic fractionation, re-evaporation of falling or blowing snow) and after deposition (diffusion, sublimation and hoar deposition). These effects increase the complexity for direct interpretation of snow isotopic composition in term of temperature but also permit to retrieve other information on the snow deposition conditions and water fluxes at the ice sheet surface.

Within the ADELISE project, we propose to perform continuous isotopic measurements on the water vapor, precipitation, blowing snow and surface snow at Dumont d'Urville over 2 consecutive years. The isotopic measurements will complement the measurements performed on the LIDAR, RADAR and pluviometers already in place at this station in order to characterize water cycle processes in the atmospheric column and at the snow surface. The isotopic measurements will be combined with



long-term chemistry measurements on aerosol filters within the CESOA program (and following program from 2020) and will permit to better interpret the isotopic and chemistry records obtained on shallow cores drilled recently in Adélie Land within the ASUMA project. Finally, a parallel system of continuous measurements of water vapor isotopic composition will be installed over the same period at Dome C within the NIVO2 project. Combination of the two records with back-trajectories will permit to better understand the isotopic transfer function between the coast and East Antarctica hence improving our interpretation of water isotopes in the Dome C deep ice core. This project also includes a significant part of modeling through the atmospheric regional model MAR already largely applied for Adélie Land. MAR is also currently being equipped with water isotopes. This project will thus permit the validation of the MARiso model as well as its use for interpretation of shallow ice cores recently drilled in Adélie Land.



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1170

ERISI

Study on the Evolution of individuals' Relation with their Close Spaciality during a stay in extreme and unusual and/or isolated and confined environment from the perspective of a take into account of adaptive stress

The sensory perception assessment protocol ERSI, Year 2 – known as « Per-Sens » part, aims to study the possible sensory perception changes that might experiment individuals during long stay/missions in extreme & unusual environments (EUE - eg. [sub]antarctic stations – up to 14 months in the field) or isolated & confined environments (ICE - eg. Submarines SSBN – board from 70 to 90 days). If, literature indicates that sense, considered independently of each other, might be modified by such experiences, no holistic research has yet measured what is the very impact of a long stay/mission in EUE/ICE on the sensory perception of individuals and, consequently, the impact of possible changes of perception on their mood, stress level and/or performance.

This study will focus on the evaluation of (1) visual, (2) olfactory, (3) gustatory, (4) tactile, (5) auditory individuals' perceptions and (6) proprioception and body scheme, on a triple investigative pattern "at the beginning", "during" "at the end" of the stay/mission in ICE/EUE.



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Scientific PROJECTS

ESA

European Spatial Agency



991102 BONE HEALTH

Impact of an extended stay in Antarctica on bone health

It is known that bone loss can occur during a prolonged stay in Antarctica. It is assumed that this results from changes in vitamin D metabolism due to low sunlight exposure with subsequent changes in bone metabolism. A number of factors that are important for bone metabolism have not been considered in work to date in Antarctica, however. For example, are individuals less physically active during a prolonged stay in Antarctica? Does deterioration in neuromuscular function occur? Are there other changes in hormonal and energy metabolism status that may impact upon bone metabolism? Closing this gap in our knowledge will not only extend our understanding of bone physiology, it is also a critical step in developing countermeasures to counteract the negative effects of a prolonged stay in Antarctica.



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991308 ICELAND

Immune and Microbiome Changes in Environments with Limited Antigen Diversity

Commensal microbiota depends strongly on the environment and the immunosurveillance. On the other hand the immune system is under constant challenge of the commensal microbiota maintaining its fitness and possibly basal low-inflammatory status. The project ICELAND will investigate the effect of a prolonged stay in an environment with limited antigen diversity on the human cognitive immunity and the gut microbiota. Similarly to long-term space travel, a prolonged stay in a confined (antigen exposure restricted, overclean) environment such as the Antarctica station CONCORDIA could have health effects on the volunteers' gut microbiota and their basal immune status during confinement with possible permanent scars on immune memory. We propose to assess these effects during two successive upcoming seasons and to compare them to people living in a natural, very diversified environment with regular exchange and communication with a large population. If confirmed, prolonged stay in a confined environment effect and its potential health consequences may be prevented by a nutritional strategy, e.g. a probiotic supplementation. This may be tested in a further step during future seasons. This study will also bring precious information on the effect of environment conditions on population health with possible prevention strategy for immune disorders associated with air conditioning, industrial food, and over clean environment as observed in industrialised countries.



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991316 SIMSKILL

Use of a spaceflight simulator for investigations on piloting skill maintenance in long-term confinement under isolation

As stated by the recent Theseus report, skill maintenance for tasks that are carried out infrequently and yet are crucial for space mission success or even survival of astronauts has been underestimated so far. However, there is no adequate and validated prediction theory on how these skills degrade over time, not to mention countermeasures for the decrement. The SMISKILL experiment approaches the problem by measuring performance in an ecologically valid environment and with a task set embracing its multimodal nature. A spacecraft simulator with an attached data logging and performance evaluation tool shall be placed within the Concordia Station. By measuring performance during the overwinter stay and comparing the results against a non-isolated reference group, the degradation rate "half-life" of typically required piloting skills will be determined. One half of the overwinter participants will train on a regular basis, giving additional information whether simulator training is a valid countermeasure or not. All participating test subjects will be trained to the task before the first measurement; the piloting task complexity and realism has been balanced against the Concordia research analogue limitations. The results are expected to provide direct input for ongoing space mission and systems developments, in particular human behaviour and performance, and will emanate into more profane fields.

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991327 EFIA

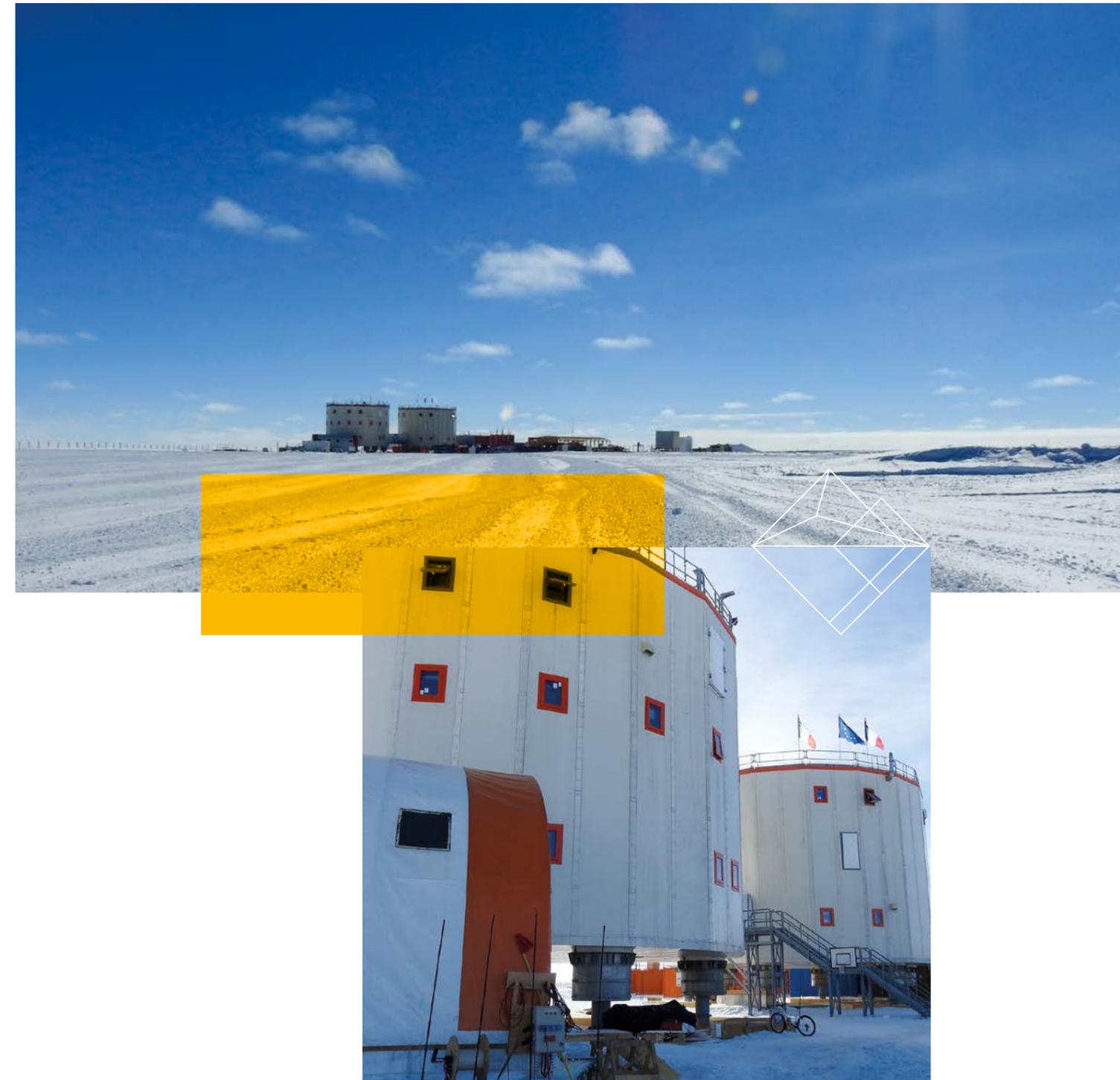
**Learning from Antarctica for Advance Medical Care on Earth and in Space :
Effects of Hypobaric Hypoxia and Antarctic Winter - Confinement on Interactions of the Vascular Barrier, the Cardiopulmonary, and the body fluids System.**

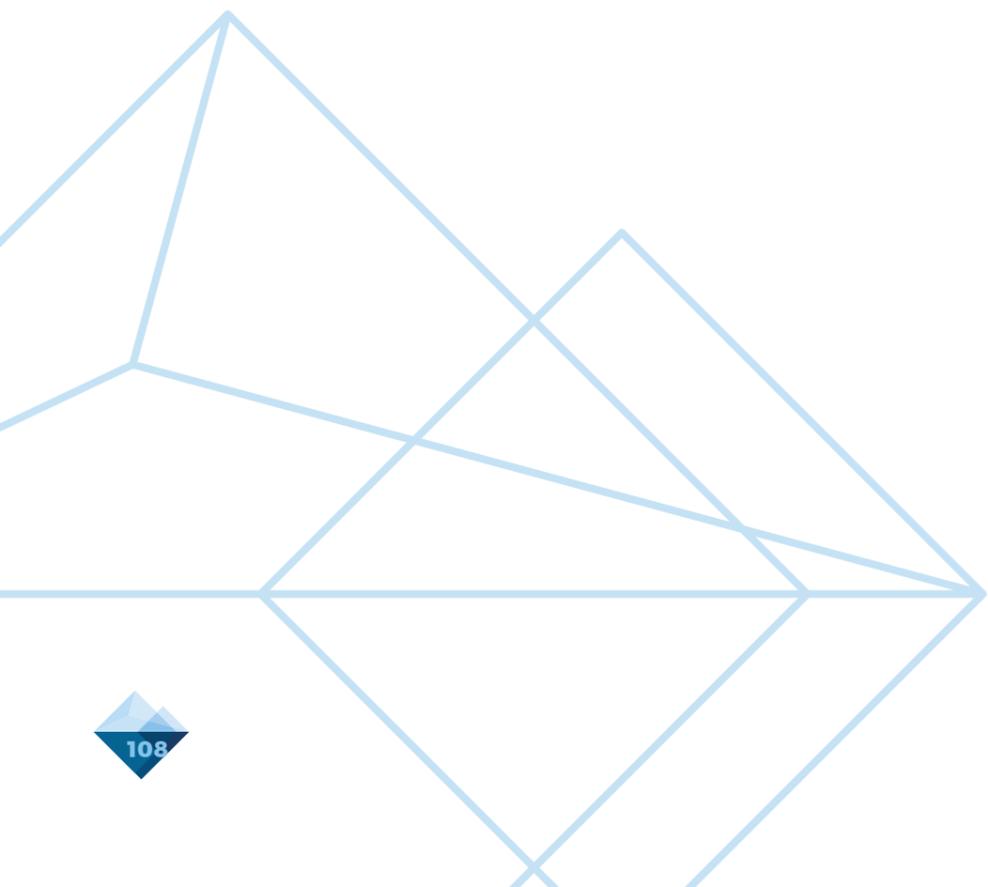
Putting our project in a nutshell, we are highly interested in forming a new concept of human vessel-fluids interactions in 1) space flight, 2) high altitude adaptation and 3) advanced medical care. We hypothesize a common mechanism based on break down of the so called glycocalyx [1] of the vascular endothelial cells by hypoxia, fluid overloading and inflammation, leading to edema formation in humans in all of these conditions. Diseasebased endothelial glycocalyx degradation is characterized by the triad: increased microvascular permeability (edema), albuminuria and release of glycocalyx fragments into the blood. To discover this triad in the Concordia inhabitants, we plan to use inert gas rebreathing and bio-bio-impedance techniques, as well as biochemical urine and blood analyses.

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