Thank you for these four years that have been full of novelty and excitement although not without some difficulties, as always happens in new adventures.

Dear Director, our best wishes for the future, trusting in your continuing support!

UNDER THE SPOTLIGHT

Farewell to Director Carlo Barbante

WG-Communication

We would like to say goodbye to our first Director, Carlo Barbante who, after four years, bids us farewell and returns to serve at Ca’ Foscari University of Venice.
REPORT

CNR-ISP 2° Workshop of Institute

Thematic Area 1:
“Contaminants and Ecosystems“ - a look at the present and future perspectives

Elena Barbaro, Maria Papale, Luisa Patrolecco, Francesca Spataro

The thematic area (TA) "Contaminants and Ecosystems" aims to study the sources, transport dynamics, dispersion, and fate of regulated and emerging contaminants, including micro/nano plastics and trace elements, in polar ecosystems.

In this context, the multidisciplinarity of the skills converging in this TA constitutes an indispensable requirement to understand the effects of anthropogenic impact and climate change on polar ecosystems, following a One Health approach and aiming for sustainable management of these vulnerable environments in the next future. It is divided into five closely related sub-themes: 1) sources, transport, and environmental dynamics, 2) from the development of analytical methods to the study of environmental processes, 3) plastic pollution - distribution and impact on the environment and biota, 4) underwater noise and impact on polar organisms, 5) ecosystemic responses and adaptations.

The TA sees the participation of researchers from all the Institute's locations, particularly Messina (40%) and Venice (36%), being the most represented compared to Rome and Bologna (12% each). There are also active fruitful collaborations with external partners from doctoral students and personnel from Ca' Foscari University, to other entities such as ISPRA. The most represented skills are in the field of Analytical and Environmental Chemistry (35%), Microbiology (31%), followed by Acoustics (11%), Ecology (12%), and Chemistry applied to Ecology (11%).
The strengths of this TA are primarily the synergies, and complementarities between the activities carried out by its members, as well as the presence of important research infrastructures (i.e., polar bases) including analytical laboratories equipped with high-performance instrumentation. During the workshop the needs and gaps identified were the need to create greater interconnections between research groups, optimization of the available scientific resources and expertise within the institute, as well as the lack of personnel working on models applied to the interpretation of data collected during monitoring campaigns. These are important gaps that should be addressed in the future.

The evaluation of the impact and visibility of the "Contaminants and Ecosystems" shows high productivity of the involved researchers, with numerous publications in high-level scientific journals and strong international collaborations with major polar institutes outside Italy, as well as numerous Italian universities and research institutions.

**Thematic Area 2: Paleoclimate and Paleoenvironments**

*AT2 - Paleoclimate and Paleoenvironments afferents*

The Anthropocene is a new geological time unit, albeit unofficially, describing the most recent period in Earth's history, characterized by significant human impacts on climate and global ecosystems. This era is marked by unprecedented technological advancements, enabling the measurement of crucial Essential Climate Variables (ECVs) with high temporal resolution tools like satellites and the prediction of future climate scenarios using climate models. However, instrumental measurements only date back to the mid-20th century, and climate simulations cover only a few centuries, making it uncertain if observed climate changes are part of natural variability. Climate archives such as ice cores, marine/lacustrine sediments, corals, speleothems, and tree rings offer the opportunity to extend observations over time and provide valuable insight into future climate evolution.

The Paleoclimate and Paleoenvironments thematic area actively explores these natural climate history archives, using them as authentic 'time machines'. In particular, ISP researchers utilize them to trace past events, using biological, geochemical, and sedimentary indicators known as proxies, to better understand past climate and environmental conditions.

Integrating various archive types allows for a more comprehensive and interdisciplinary understanding of the climate system. During the Institute Workshop, the complementarity of different archives and ISP researchers' interest in ice cores, sediment cores, corals, speleothems, and glacial geomorphology became evident. The period of interest spans from a few centuries during the "Common Era" to the Miocene, encompassing abrupt variations like the
Dansgaard–Oeschger events (decades/few hundred years). Additionally, among the 55 Essential Climate Variables (ECVs) defined by the Global Climate Observing System for climate study, ISP researchers monitor various ocean, atmosphere, and continental cryosphere ECVs, such as atmospheric and oceanic temperature, sea ice distribution, fire frequency, physical, chemical, and biological properties of the atmosphere and oceans, and terrestrial cryosphere dynamics like permafrost, glaciers, and snow cover. Finally, the workshop highlighted the high level of international collaboration with major foreign research centers in strategic paleoclimate areas.

Thematic Area 3:
“Changes in Polar Systems” - a look at the present and future perspectives

Nicoletta Ademollo, Maurizio Azzaro, Fabiana Corami, Federico Giglio e Stefania Gilardoni

Polar areas are extremely sensitive hotspots for observing the alterations and transformations that are happening at different scales all over the planet. The astonishing rapidity with which these changes are taking place makes these issues increasingly present in the public domain, leaving the niche to which they have been confined for decades together with the geopolitical and economic as well as scientific implications they pose. Through multidisciplinary research, the thematic area “Changes in Polar Systems” seeks to improve knowledge of the processes and interactions among the different components of the Earth system (Atmosphere, Biosphere, Cryosphere, Hydrosphere and Lithosphere) and to assess their responses to global changes.

The complexity of the area, reflected by the broad adhesion of ISP researchers featuring numerous cross-cutting expertise, is matched by an inherent multidisciplinary approach in the complexity of the different components of the Earth system and their relative interrelationships. Although at present we are still in the early days of a real successful implementation of the activities that ISP’s different research groups carry out in this thematic area, a beneficial path has nevertheless been pursued to create more synergies among the different researchers belonging to it. Many
research infrastructures that are used by ISP researchers both in the polar field (Arctic, Antarctic and third pole) and on the national territory are of outstanding relevance, as are the collaborations and synergies at the national and international level. The extensive, cross-cutting and remarkable science outputs falling within the thematic area and the remarkable projects represented therein hold out hope for important future growth prospects.

Thematic Area 4: “Earth Observation and Models” - a look at the present and future perspectives

Francesco De Biasio, Francesco Filiciotto, Emiliana Valentini, Matteo Zucchetta

The “Earth Observation (OT) and Polar Ecosystem Modeling” thematic area brings together around thirty researchers and contributes to the training of numerous doctoral and graduate students, and research fellows. The area embraces numerous disciplinary fields of natural sciences, ranging from ecology, physics, chemistry to earth sciences.

The activity focuses on three methodological pillars and their integration: remote and in situ observations, information organization, and representation by numerical and conceptual models.

Researchers in this thematic area mainly deal with the definition, description and study of the processes that occur in the terrestrial, aquatic, and atmospheric spheres, publishing their research in a vast selection of international scientific journals, mainly dedicated to remote sensing (fig. 1).

The different groups make use of a variety of instruments either fixed or portable for the observation of the Earth, ranging from both active and passive sensors to electromagnetic detection. These are mounted on satellites, fixed to oceanographic buoys and moorings, which are also equipped with acoustic recorders or (fig. 2a), to the climate tower for atmospheric detection and (fig. 2b), to autonomous anemometric stations.

The scientific investigation focuses on the dynamics of polar ecosystems, also paying attention to climate zones at different latitudes for comparison. Among the topics of greatest climatic impact, variations in air and sea temperature, sea level rise, changes in polar ice caps, characteristics of snow cover and ice (fig. 3), permafrost evolution and oceanic water masses, erosion and coastal growth processes, release and segregation of greenhouse gases, biogeochemical cycles, and biodiversity are analyzed.

In this thematic area, data-driven and process-based algorithms for geospatial and statistical analysis are developed and applied, with particular attention dedicated to organizing knowledge in terms of thesauri and metadata.
Fig. 3. Image captured by the Sentinel-2 satellite of ESA: some supraglacial lakes in Greenland are visible. The rapid evolution of these lakes contributes to accelerating glacier melting.

Continuous comparison allows for the integration of spatial and ecological models with observational data.

**Thematic Area 5: “Biosciences” - a look at the present and future perspectives**

*Warren Cairns, Mario La Mesa, Angelina Lo Giudice*

Main themes of the Biosciences Thematic Area at CNR-ISP are:

- The structural and functional organization of polar ecosystems and dynamics of populations and communities.
- The response of individuals, populations, and communities to external influences of climatic and anthropic origin.
- Biotechnological implications resulting from adaptation to low temperatures and/or other physico-chemical factors.

These are then split into the following research objectives:

- The study of structural and functional diversity and the eco-physiology of polar organisms, shedding light on the limits of adaptation.
- The study of biogeochemistry and ecology in marine and terrestrial habitats in the Polar Regions, including environmental factors that control biological interactions.
- Estimation of the biotechnological potential of organisms adapted to life at low temperatures and/or other physico-chemical factors.
- Understanding the behavior and evolution of polar ecosystems through spatio-temporal analysis of ecological processes.
- Management and conservation of polar marine resources.
- Comparison of observed trends in polar areas and mid-latitudes.

The number of people working in this thematic area are 29 permanent staff, 10 temporary staff made up of PhD students, post-Docs and associated personnel from other research institutes and institutions. Over half work in Messina and the rest are distributed between Venice, Rome and Bologna.

Research activity in the 5 years since the Institute was founded has been supported by 32 projects from the PNRA, PNRR, and PRA national calls and
the INTERACT, ARICE and Horizon 2020 international calls. This has allowed us to build an excellent infrastructure to support our work with applied analytical chemistry being the strong points of the Rome and Venice labs, while the biological expertise is supported in Messina with labs specialised in ecology, biotechnology, microbial biogeochemistry and environmental microbiology.

These resources are backed up by observatories for sample collection such as the LTER moorings in Antarctica, the PNRA cryo-ecosystem observatory, the SIOS coastal oceanographic buoy for biodiversity monitoring, the PRA arctic lakes observatory and the MICR(Y)O - Culture Collection of Microorganisms from cryo-environments.

The strong points of our thematic area are the ability to attract funding, the interdisciplinary nature of our work and our presence in many international working groups such as SCAR and those of the Arctic Council. Our weak points are a lack of large instrumentation open to use by all, and a skills shortage in modelling, characterisation of biomolecules and in zoo and phytoplankton taxonomy.

During preparations for the workshop, we identified many points of potential future collaboration and expansion in fields such as epigenetics, the ecology and physiology of Archaea and micro-archaea in extreme environments, interactions of pollutants with biota and the assessment of the pollutant degradative capabilities of extremophile microbiota.

Book of Abstract and Gallery of the ISP workshop
The 2024 field season has officially begun at the Arctic Station Dirigibile Italia. As in recent years, the station will host researchers and technicians for a total of over 1500 person-days, with an average daily presence of around 6 people between February and September. The number of projects for 2024 remains around 30, and also this year the station will also welcome international colleagues through access programs.

Among the projects, two are of particular note, both funded by the PRIN program of the Italian Ministry of University and Research (MUR). The first is the PHOTOPLANT project, led by the University of Rome 3, which aims to explore the combined influence of photoperiod and global warming on the flora and vegetation of Arctic and alpine environments. Through a series of targeted experiments, the project will assess the adaptability and plasticity of plants in response to these two key factors.

The second is SEDNA-Pp, led by the Institute for the Study of Human Impacts and Sustainability in the Marine Environment (IAS) of CNR. The project aims to understand how current changes in the oceans are affecting common minke whales in Kongsfjorden (migration and feeding) and to develop models to understand how the whales might respond in the short term. This area represents an extreme case study, given its sensitivity to climate change.

Since the beginning of April, we have a new station leader, Veronica Coppolaro, who will coordinate the local activities of the base in the coming months together with Tessa. Veronica recently completed her PhD at the University of Manitoba, with a thesis on the effects of climate change and human impacts on Arctic marine mammals using bioacoustic techniques. We wish her all the best in her new role at Ny-Ålesund!
RESEARCH HIGHLIGHTS

Project TEMPLE LIFE: Scientific Mission in Antarctica aboard the icebreaker ship "Le Commandant Charcot"

Francesco Filiciotto and Maurizio Azzaro

The Institute of Polar Sciences has recently achieved a new milestone in its research mission, with the conclusion of an exciting expedition to Antarctica as part of the TEMPLE LIFE project (Template Habitat, Microbial Signatures and Iconic Life in the Antarctic Ocean), funded by the Antarctic Research Icebreaker Collaboration for Europe (ARICE) program.

The expedition aboard the icebreaker ship "Le Commandant Charcot" began on January 8 from Ushuaia in Argentina and concluded in Lyttelton, New Zealand, on February 5. During the mission, the two ISP researchers on board, Maurizio Azzaro (Principal Investigator) and Francesco Filiciotto, conducted various scientific activities, including the investigation of marine habitat through hydrological and oceanographic surveys and the visual sampling of marine mammal species. The main objective of the TEMPLE LIFE project was to explore the Southern Ocean using multidisciplinary approaches to gain a synoptic view of this unique and rapidly changing ecosystem.

The TEMPLE LIFE team (to left M. Azzaro, to right F. Filiciotto)

The project focused on understanding biogeochemical processes and microbial ecology with particular attention to carbon remineralization and the role of microorganisms.

On-board presentation of the project activity

Hydrological sampling
The latter play a key role in the marine carbon cycle, influencing primary production, carbon dioxide sequestration, and nutrient availability. The project also extended to monitoring Antarctic marine mammal populations to assess their conservation status, thus integrating the ecological project context.

The ISP researchers, with a strong multidisciplinary spirit, collaborated with other research groups on board from numerous International Scientific Institutions: including the Australian Centre for Whale Research, the Alfred Wegener Institute, University of Colorado, and Universidad Católica de Chile.
2 - Study of microbial signatures in the water masses of the Ross Sea

Filippo Azzaro and Alessandro Ciro Rappazzo

After two months of navigation in the Ross Sea aboard the icebreaker "Laura Bassi", on 5 March 2024, the 39th Italian Expedition to Antarctica ended for the CNR-ISP personnel.

During this expedition, activities were carried out as part of the PNRA-MUR project 'SIGNATURE' (PhysIcal and bioGeochemical traciNg of wATer masses at source areas and export gates in the Ross Sea and impact on the SoUtheRn OcEan), coordinated by Prof. Pierpaolo Falco of the Polytechnic University of the Marche.

The research objective was to characterize the main water masses of the Ross Sea from a physical, chemical, and biological perspective. The Ross Sea is one of the main sites for the formation of Dense Shelf Water that contributes to the formation of Antarctic Bottom Water, present in the deepest zone of the Antarctic Ocean, which provides about 40% of the deep waters to the oceans and is considered one of the main cold drivers of the planet. In particular, the CNR-ISP operational unit was responsible for the collection and initial treatment of seawater samples for the direct and indirect estimation of microbial abundance and biomass, their vitality, the estimation of respiratory and enzymatic activity, and the determination of the isotopic ratio $^{18}\text{O}/^{16}\text{O}$ and $^2\text{H}/\text{H}$ (with the collaboration of IGG-CNR of Pisa) in the Ross Sea, including the Ross Ice Shelf, to obtain a detailed picture of the microbial signatures in the main water masses present there.
2nd Institute Workshop
Bologna, April 23-24, 2024: the 2nd Workshop of the Institute of Polar Sciences (CNR-ISP) entitled “Polar research: current issues and future prospects” was held at the CNR Research Area in Bologna. The workshop opened with greetings from our Director Carlo Barbante. The various representatives then gave an overview of the research activities taking place within the 5 Thematic Areas into which ISP is divided. Then, the activities involving ISP researchers and administrative staff in many different areas were presented, from the PNRR Projects, the Working Groups supporting the Institute, access and management of the Base Dirigibile Italia, the establishment of the Polar Hub and, finally, to the administrative management. The poster session was an important moment of to meet and informally exchange ideas while presenting the results of various scientific activities carried out by our ISP researchers.

2nd Institute Workshop
Bologna, April 23-24, 2024

More than a year has passed but it is still not easy to say goodbye to our colleague and friend Angelo Viola. Too many things bind the institute and all of us to Angelo and that is why we wanted him to be with us in our thoughts at this second institute workshop... so we could all say goodbye to him one last time.

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UPCOMING EVENTS

- **Working groups di SCOR**: A call for Working Group proposals is now open. The proposals are due 17 May 2024 on particularly current and relevant topics with the aim of defining new research lines or innovative solutions.

- **XI Convegno Nazionale sul Particolato Atmosferico - PM2024**: Torino 28-31 maggio 2024. Il convegno metterà a confronto per alcuni giorni le più autorevoli comunità scientifiche sui temi legati al particolato atmosferico, che spaziano dalla composizione chimica alle dinamiche di trasformazione e di trasporto in atmosfera, dal monitoraggio ai modelli di diffusione e di caratterizzazione delle sorgenti, dalla tossicità agli effetti sulla salute e, in generale, dalle strategie di intervento alla gestione delle problematiche in materia.

- **Arctic Congress Bodø 2024**: 29 May - 2 June 2024. The themes of Arctic Congress Bodø 2024 has followed those of Norway’s Arctic Council chairship priorities in partnership with the Norwegian Ministry for Foreign Affairs. Norway’s chairship of the Arctic Council focus on several core issues, including the impacts of climate change, sustainable development, and efforts to enhance the well-being of people living in the region.

- The Italian Aerosol Society in collaboration with Ca’ Foscari University and the Institute of Polar Sciences-CNR is organizing the International IAS summer school "**Aerosol in polar and mountain areas: theoretical and practical aspects**". The events will be held in Venice-Mestre at the Ca’ Foscari Science Campus from June 16-21, 2024.

- 'School and Workshop on Polar Climates: Theoretical, Observational and Modelling Advances' will take place on 22-31 July 2024 at @ictpnewsin Trieste, Italy. The call for applications is open until 1 April 2024. More information: https://indico.ictp.it/event/10498/

- The 2024 Annual Meeting of the European Meteorological Society will take place as a hybrid event at the Historical University of Barcelona & online from 2 to 6 September 2024. **UP2.6 - The cryosphere and cold region processes in the climate system.** Conveners: Renato R. Colucci (CNR-ISP), Bianca Mezzina, Andrea Securo (CNR-ISP), Andrea Fischer.