



12th PORTUGUESE CONFERENCE ON POLAR SCIENCES
ONLINE CONFERENCE

26 - 27 NOVEMBER 2020

PROGRAM &
ABSTRACT BOOK





The Portuguese Conference on Polar Sciences is a unique forum where the most recent advances on the Portuguese Polar research are presented and debated. Due to the ongoing Covid-19 epidemic, the XII Portuguese Polar Sciences Conference is organised virtually. In spite of this situation, the conference has received an exceptionally high number of registrations. This highlights the advantage of fully virtual conferences' great potential to increase access and diversify meeting attendance to the benefit of all participants, besides the indisputable advantage of reducing the conference carbon footprint. In fact, it is estimated that the total carbon emissions of fully virtual conferences can be less than 1 percent of a traditional "fly-in" event. In the spirit of inclusion and open science, the virtual XII Portuguese Polar Sciences Conference will be free of charge.

The conference is yearly boosted by the Portuguese Polar Programme (PROPOLAR) as a forum where researchers working both in the Arctic and Antarctica share their most recent research results and activities. The conference traditionally provides an opportunity for discussion and to promote networking and access of information to all stakeholders, essential to consolidate the Portuguese research in polar regions, and to maximize the participation of Portugal in international polar organizations. The main objective of these conferences is to review the most important research results, particularly of the research papers, published during the past year, related to science, policy making, education and capacity building, as well as preliminary results from last field season.

The first Portuguese Conference on Polar Sciences was held in 2008 aiming to promote a dynamic interface for debate to support the Portuguese research community, enriched with the knowledge and experience of invited international researchers working in the Polar Regions. The Portuguese Polar research community has been increasing ever since with the support of the Portuguese Polar Programme (PROPOLAR) and the Portuguese Foundation for Science and Technology (FCT). The conference attendance has also been increasing year after year, gathering national and international Polar researchers, early career scientists, students and teachers, as well as the wider community with an interest in Polar research and related issues of global importance to help society adapt to an ever-changing world.

This year, the XII Portuguese Conference on Polar Sciences welcomes three renowned researchers as keynote speakers. Pedro Duarte from the Norsk Polarinstitut (Norway) will give a presentation on "Nutrients in the water masses of the European sector of the Arctic Ocean". Carlos Schaefer from the Soil Science Department of the Federal University of Viçosa (Brazil) will speak about "The state of permafrost at Andean High Mountains and Antarctica under a global warming scenario". Pedro Marques-Quinteiro from the William James Center for Research of Instituto Universitário de Ciências Psicológicas, Sociais e da Vida (Portugal) will give a talk on "Team Adaptation in Antarctica: The Moderating Role of Adaptation Triggers". The Portuguese Association of Polar Early Career Scientists (APECS - Portugal) Workshop, traditionally linked to the Conference, will be focused on the theme "ART&SCIENCE: Your research through images".

The Conference comprises one institutional talk about the Portuguese Polar Program (PROPOLAR), three invited keynote lectures, 16 oral communications and 22 posters, organized in three different sessions dedicated to Biological Sciences, Earth and Environmental Sciences and Social Sciences. The speakers are both national and international researchers that will cover a wide range of topics concerning the Arctic and Antarctica.

This virtual Conference is organized by the Portuguese Polar Program, with the institutional support of the Institute of Geography and Spatial Planning (IGOT) from the University of Lisbon (Portugal). We are honoured to host such a dynamic, committed and multidisciplinary community of polar researchers that have been helping to move the Portuguese Polar science forward.

We would like to welcome you all to the XII Portuguese Polar Sciences Conference and wish that this virtual conference will provide a fruitful space for debate and also contribute to create opportunities to develop new synergies for the Portuguese Polar research and even help identify new career opportunities.

The Organizing Committee,
Maria Teresa Cabrita, Ana Salomé David and Catarina Magalhães

ORGANIZING COMMITTEE

Ana Salomé David, CEG/IGOT-ULISBOA
Catarina Magalhães, CIIMAR-U.PORTO
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ORGANIZATION

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Centro de Estudos Geográficos (CEG)
Instituto de Geografia e Ordenamento do Território (IGOT)
Universidade de Lisboa

<https://conferenciapolar2020.wixsite.com/cpcp2020> | conferencia.polar@propolar.org



Instituto de Geografia
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CEG
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Fundação
para a Ciência
e a Tecnologia



Química Estrutural

26 November 2020

09h20 **Participants Log in**

09h30 **Opening Session**

Gonçalo Vieira, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
Germana Santos (Fundação para a Ciência e a Tecnologia (FCT))

09h45 **The Portuguese Polar Program**

Maria Teresa Cabrita, Programa Polar Português (PROPOLAR)

10h00 **New scientific results on BIOLOGICAL Sciences**

Chair: José Xavier, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal; British Antarctic Survey, United Kingdom

10h00 **Nutrients in the water masses of the European sector of the Arctic Ocean**

KEYNOTE SPEAKER: Pedro Duarte, Norsk Polarinstitutt, Norway

10h30 **Biosynthetic diversity of Arctic Ocean microbiomes**

Adriana Rego, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal; Institute of Biomedical Sciences Abel Salazar

10h45 **WHY Antarctica 2020 - Wastewater for Hydroponics in Antarctica**

Tânia Correia, Polytechnic Institute of Beja, Portugal

11h00 **VIRTUAL Coffee-break**

11h20 **Biogeographic structure and connectivity of two kelp ecosystem engineers**

Susana C. Almeida, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal; Pontificia Universidad Católica de Chile, Departamento de Ecología, Chile

11h35 **Mercury levels in Antarctic toothfish from the Southwest Pacific Sector of the Southern Ocean**

José P. Queirós, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal

11h50 **Adélie Penguins and the presence of microplastics from Antarctic Peninsula**

Joana Fragão, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal

12h05 **Annual schedule adjustment in a sub-arctic breeding wader: the Icelandic whimbrel**

Camilo Carneiro, Department of Biology and CESAM, University of Aveiro, Portugal

- 12h20 **Demographic responses to environmental change of the black-browed albatross, sentinel of the Patagonian Shelf Large Marine Ecosystem**
Francesco Ventura, CESAM, University of Aveiro, Portugal; Departamento de Biologia Animal, Faculdade de Ciências, University of Lisboa, Portugal
- 12h35 **FLASH INTRODUCTION TO POSTERS on BIOLOGICAL Sciences**
- 12h50 **VIRTUAL LUNCH**
- 13h50 **New scientific results on Earth and Environmental Sciences**
Chair: Pedro Pina, Centre for Natural Resources and the Environment (CERENA), Instituto Superior Técnico (IST), University of Lisbon, Portugal
- 13h50 **The state of permafrost at Andean High Mountains and Antarctica under a global warming scenario**
KEYNOTE SPEAKER: Carlos Schaefer, Soil Science Department, Federal University of Viçosa (UFV), Brazil
- 14h20 **Precipitation over the Southern Ocean: comparison of two snowfall events around Mertz Glacier**
Diogo Luís, Department of Physics, University of Aveiro, Portugal
- 14h35 **Estimation of air temperature in the Hurd Peninsula of Livingston Island between 2000 and 2016 from MODIS LST data**
Carmen Recondo, RSApps Research Group, Department of Mining Exploitation and Prospecting, University of Oviedo, Spain; Institute of Natural Resources and Territorial Planning (INDUROT), University of Oviedo, Spain
- 14h50 **Environmental controls on permafrost and ground temperature regimes and distribution in Barton Peninsula (King George Island, Antarctic)**
Joana Baptista, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h05 **LATA2019 – Tides at Primavera Station**
Pedro Almeida, GeoBioTec Research Centre, University of Beira Interior, Portugal
- 15h20 **Constraining the chronology of ice thinning and glacier dynamics in the Hurd Peninsula (Livingston Island, South Shetland Islands, Antarctic Peninsula) following the Last Glacial Maximum**
José M. Fernández-Fernández, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h35 **Ultra-high resolution assessment of the impacts of vegetation shadows on satellite-derived spectral signals from small thermokarst lakes (subarctic Canada)**
Pedro Freitas, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h50 **Mercury Methylation and Monomethylmercury Demethylation in Sediments from Permafrost Thaw Lakes**

Martin Jusek, Centro de Química Estrutural (CQE), Instituto Superior Técnico (IST), Universidade de Lisboa

16h05 **FLASH INTRODUCTION TO POSTERS on Earth and Environmental Sciences, on video**

16h20 **VIRTUAL Coffee-break**

16h55 **New scientific results on social Sciences**

Chair: Maria Teresa Cabrita, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal

16h55 **Team Adaptation in Antarctica: The Moderating Role of Adaptation Triggers**

KEYNOTE SPEAKER: Pedro Marques-Quinteiro, William James Center for Research, ISPA – Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Portugal

17h25 **How do you feel today? On the group effect dynamics of a two-week expedition to Antarctica**

Jan B. Schmutz, Department of Management, Technology and Economics, ETH Zurich, Switzerland

17h40 **APP Prototype to health and safety management in Polar regions**

Paola Barros Delben, Federal University of Santa Catarina, Brazil

17h55 **FLASH INTRODUCTION TO POSTERS on SOCIAL Sciences, on video**

18h00 **Conference closing and INTRODUCTION OF APECS Workshop**

Catarina Magalhães, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal
Hugo Guímaro, APECS Portugal

27 November 2020

APECS Workshop - Art&Science: your research through images

09h00 **Sessão de Abertura | Opening Session**

09h15 **W1 – Synthesizing Evidences in Scientific Research**

João Carvalho, CESAM and Department of Biology, University of Aveiro, Portugal

10h45 **Coffee-break**

11h00 **W2 – Visual Storytelling for Science**

Fiammetta Ghedini, RIVA Illustrations

13h00 **Almoço | Lunch**

14H15 **AFTERNOON INTRODUCTION**

14h30 **W3 – Fieldwork Drawing Techniques – Introduction to Scientific Illustration**

Davina Falcão, freelance illustrator and Department of Biology, University of Aveiro

16h30 **Coffee-break**

17h00 **W4 – Talking with Pictures: Visual Communication with Vector Graphics**

Kamar Thomas, <https://kamarthomas.com/>

20h00 **Fim do Workshop APECS | End of APECS Workshop**

Pedro Duarte conducted his PhD research at the New University of Lisbon and worked as Assistant and Associate Professor at University Fernando Pessoa (Portugal), between 2005 and 2013. He got his "Agregação" in 2012. Since 2013, he has worked as a Senior Research Scientist at the Norwegian Polar Institute. His current research is focused on Arctic Ocean ecosystem change resulting from global warming, with an emphasis on primary production changes and implementation and usage of coupled ocean and sea-ice physicalbiogeochemical models. Since 2018, he has been responsible for the Modelling work package of the Kongsfjorden Ecosystem Flagship Research Program on Svalbard3. His curriculum vitae contains approximately 100 peer-reviewed publications.



Carlos Schaefer is Full Professor of Pedology and Geomorphology at the Federal University of Viçosa (Brazil). He holds a MSc in Soils and Plant Nutrition, from Federal University of Viçosa (Brazil) in 1990. He received his PhD in Soil Science from University of Reading (United Kingdom) in 1994. He has been the Research Leader of the TERRANTAR Network between 2002 and 2020. He is also Project Coordinator of the Brazilian Antarctic Program since 2002. He has coordinated more than 50 research projects since 1994, in particular for the CNPq Network, focused on Archaeological soils, between 2001 and 2004. He was considered one of the top 100.000 Global Leading scientists (Plos, 2020). He participates in the Antarctic Treaty System, and is the national representative at the Committee for Environmental Protection (Antarctic Treaty System), at the Council of Managers of National Antarctic Programs (COMNAP) and at the International Arctic Science Committee (IASC) council. In 2019, he was awarded the Medal of Merit in Research P.H. ROLFS, by the Federal University of Viçosa (Brazil).



Pedro Marques-Quinteiro holds a PhD in Human Resources Management and Development from ISCTE - Instituto Universitário de Lisboa (Portugal), and he works as an Assistant Professor at ISPA - Instituto Universitário de Ciências Psicológicas, Sociais e da Vida (Portugal), and is a Research Fellow at the WJCR - William James Center for Research (Portugal). He has focused his research around the topic of teams and team adaptation. His research combines prevalent models of team adaptation with the theory of teams as complex adaptive systems to investigate the temporal and multilevel dynamics that define the process of adaptation in isolated, confined, and extreme workplaces. The studied environments include polar expeditions, urban disasters, and healthcare. In these unique contexts, he examines how individuals and teams change their cognitions and behaviours to solve unexpected events that threaten team members well-being and mission success. Currently, Pedro Marques-Quinteiro is involved in several research projects in the Polar regions, supported by the Portuguese Polar Program (PROPOLAR), the European Space Agency, the INGRoup-NTR consortium, and SAGA Space Architects.



PROGRAMME ON BIOLOGICAL SCIENCES

- 10h00 **New scientific results on BIOLOGICAL Sciences**
Chair: José Xavier, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal; British Antarctic Survey, United Kingdom
- 10h00 **Nutrients in the water masses of the European sector of the Arctic Ocean**
KEYNOTE SPEAKER: Pedro Duarte, Norsk Polarinstitut, Norway
- 10h30 **Biosynthetic diversity of Arctic Ocean microbiomes**
Adriana Rego, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal; Institute of Biomedical Sciences Abel Salazar
- 10h45 **WHY Antarctica 2020 - Wastewater for Hydroponics in Antarctica**
Tânia Correia, Polytechnic Institute of Beja, Portugal
- 11h20 **Biogeographic structure and connectivity of two kelp ecosystem engineers**
Susana C. Almeida, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal; Pontificia Universidad Católica de Chile, Departamento de Ecología, Chile
- 11h35 **Mercury levels in Antarctic toothfish from the Southwest Pacific Sector of the Southern Ocean**
José P. Queirós, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal
- 11h50 **Adélie Penguins and the presence of microplastics from Antarctic Peninsula**
Joana Fragão, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal
- 12h05 **Annual schedule adjustment in a sub-arctic breeding wader: the Icelandic whimbrel**
Camilo Carneiro, Department of Biology and CESAM, University of Aveiro, Portugal
- 12h20 **Demographic responses to environmental change of the black-browed albatross, sentinel of the Patagonian Shelf Large Marine Ecosystem**
Francesco Ventura, CESAM, University of Aveiro, Portugal; Departamento de Biología Animal, Faculdade de Ciências, University of Lisboa, Portugal
- 12h35 **FLASH INTRODUCTION TO POSTERS on BIOLOGICAL Sciences**
- The prokaryotic rare biosphere is sensible to environmental heterogeneity in the Arctic Ocean**
Francisco Pascoal, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal

Biogeography of Arctic Eukaryotic Microbiome: A comparative approach between 18S rRNA gene metabarcoding and microscopic analysis

Marta Sousa, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Faculdade de Ciências, University of Porto, Portugal

Functional traits of the Antarctic vegetation as potential biodiversity-based ecological indicators

Bernardo Rocha, Centre for Ecology, Evolution and Environmental Changes (cE3c), Faculdade de Ciências, University of Lisboa, Portugal

Trans-Arctic dispersal and connectivity in amphiboreal seaweeds

João Neiva, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal

Impact of Arctic environmental conditions on the reproduction and recruitment of *Alaria esculenta* and *Laminaria digitata*

Cláudio Silva, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal

Continuous light disrupts recruitment success in the Arctic kelp species *Alaria esculenta*

Neusa Martins, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal

Crustacean guide for predator studies in the Southern Ocean

José C. Xavier, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal; British Antarctic Survey, United Kingdom

Antarctic octopod beaks as proxy for mercury concentrations in soft tissues

Ricardo S. Matias, Marine and Environmental Sciences Centre (MARE), Department of Life Sciences, University of Coimbra, Portugal

Evolution of innate immunity genes in *Notothenioidei* fish

Cármén Sousa, Centre of Marine Sciences (CCMAR), University of Algarve, Portugal

The role of Antarctic penguin colonies in promoting recruitment sites for bacterial populations colonisation of inland ecosystems

Mafalda S. Baptista, International Centre for Terrestrial Antarctic Research, University of Waikato, New Zealand; Interdisciplinary Centre of Marine and Environmental Research (CIIMAR) and Faculdade de Ciências, University of Porto, Portugal;

Biosynthetic diversity of Arctic Ocean microbiomes

Adriana Rego (a,b), António G. G. Sousa (a), Pedro N. Leão (a), Catarina Magalhães (a,c)

(a) Interdisciplinary centre of marine and environmental research (CIIMAR)

(b) Institute of Biomedical Sciences Abel Salazar

(c) Faculty of Sciences, Porto University

Polyketide synthase (PKSs) and Non-ribosomal peptides synthetase (NRPSs) are two mega enzymes responsible for the biosynthesis of a large fraction of natural products (NPs). Molecular markers targeting biosynthetic genes, such as ketosynthase (KS) domain of PKSs have been used to assess the diversity and distribution of biosynthetic genes of bacterial isolates and complex microbial communities. More recently, metagenomic studies have complemented this approach by allowing the recovery of complete biosynthetic gene clusters (BGCs) from environmental DNA. In this study, the distribution and diversity of biosynthetic genes and clusters from six Arctic Ocean samples (NICE-2015 expedition), was assessed using PCR-based strategies couple with high-throughput sequencing and metagenomic analysis. This is the first report of biosynthetic diversity assessed through metagenomes in the Arctic Ocean. In total 149 KS domain OTU sequences were recovered, 36% of which were not possible to confidently assign to any known MiBiG database BGC. A promising sample had over of 75% of its relative abundance not matching the database. In total, were recovered 74 bacterial metagenome-assembled genomes (MAGs), from which it was possible to extract 179 BGCs using anti-SMASH. A network analysis performed using BiG-SCAPE identified potential new NP families, including non-ribosomal peptides and polyketides. The approach employed allowed the recovery of complete or near-complete BGCs, including good candidates for heterologous expression. Results obtained in this study have highlighted the potential of Arctic Ocean for the discovery of novel secondary metabolites. Furthermore, the approach presented revealed to be a good starting point for bioprospection studies, since it allows to direct efforts for promising samples as well as for heterologous expression of novel BGCs.

FCT - Ph.D. scholarship to AR and a grant to CM.

EuroMarine – EuroMarine individual fellowship to AR.

WHY Antarctica 2020 - Wastewater for Hydroponics in Antarctica

Tânia Correia (a), Nuno Sidónio (a), Luis Madeira (a,c), Mariana Regato (a), Rui Anastácio (a), Fátima Carvalho (a,b)

(a) Polytechnic Institute of Beja, Street Pedro Soares – IPB Campus, 7800-295 Beja, Portugal

(b) FibEnTech – Fiber Materials and Environmental Technologies, Street Marques de Avila e Bolama, 6201-001, Covilhã, Portugal

(c) CENSE, Center for Environmental and Sustainability Research, FCT-Nova, Quinta da Torre, 2829-516, Caparica, Portugal

This communication gives an overview of WHY ANTARCTICA and preceding projects (PROPOLAR/FCT). During the February 2020 campaign, experimental activities were conducted at Great Wall Station (GWS), Antarctica. The team implemented a system for plant cultivation in hydroponics, using lettuce plants and pretreated wastewater as the nutrient solution. The station's domestic wastewater was pretreated through a single step lime chemical precipitation process, performed manually, that incorporated CO₂ capture and that produced water suitable for agricultural reuse applications. The system was the upgrade of a prototype already tested in the 2019 campaign (ESTeEM Antarctica PROPOLAR/FCT), at the Bulgarian Antarctic Base (BAB). For this campaign we had four main objectives: (1) increase the size of the system to improve the statistical significance of results; (2) test different operational parameters of the hydroponic system; (3) test the application of the pretreatment to wastewater with different characteristics (source and population) (4) collect wastewater and lettuce samples at the end of the campaign to assess the efficiency of the pretreatment and the quality of the plants. During both campaigns, the system was monitored through pH, electrical conductivity (EC), temperature (water and atmospheric), humidity, solar irradiation and barometric pressure. Reagent consumption, sludge (solid waste) production and neutralization (CO₂ capture) during pretreatment and lettuce plant growth in the hydroponic system were accessed in situ. So far these studies allowed us to conclude that the domestic wastewater from both stations has different characteristics that demand different reagent amounts for pretreatment (0,50 and 0,28 g L⁻¹, BAB and GWS respectively) and that the amount of sludge produced also significantly differ (22,0 and 1,9 ml L⁻¹, BAB and GWS respectively). Lettuce plants survived during both hydroponic experiments. The wastewater, sludge and plant characterization are ongoing.

Project with financial support of FCT, I.P./MCTES through national funds (PIDDAC) and the Portuguese Polar Program (PROPOLAR)

Biogeographic structure and connectivity of two kelp ecosystem engineers

Susana C. Almeida (a,e), Logan Couraud (a), Leiv Poncet (b), João Neiva (a), Jorge Assis (a), Luca Caminiti (a), Cristina Paulino (a), Gareth A. Pearson (a), Paul Brickle (c), Andrés Mansilla (d), Sylvain Faugeron (e), Ester A. Serrão (a)

(a) Centro de Ciências do Mar (CCMAR), Universidade do Algarve, Faro, Portugal

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(c) South Atlantic Environmental Research Institute (SAERI), Stanley, Falkland Islands

(d) Universidad de Magallanes, Departamento de Ciencias y Recursos Naturales, Punta Arenas, Chile

(e) Pontificia Universidad Católica de Chile, Departamento de Ecología, Santiago, Chile

In the Southern Ocean, unique oceanographic features in combination with distantly separated land masses create an exceptional system to test hypothesis regarding connectivity between populations. While extensive ice sheets during glacial periods have determined long-term geographic isolation between the sub-Antarctic and neighbouring regions for most taxa, subsequent recurrent postglacial recolonizations have dynamically shaped species' distribution ranges. Importantly, heterogeneity of glacial histories among distinct land masses in the Southern Ocean determined different population trajectories, while dispersal potential may play an important role in connectivity and long-term persistence. Macroalgal assemblages in sub-Antarctic regions are characterised by high levels of endemism compared with cold-temperate latitudes. However, biodiversity, source populations for postglacial recolonizations and dispersal pathways are still poorly understood for most species. The aim of this work is to assess the genetic diversity and regional-scale connectivity of two groups of kelp species (Laminariales, Phaeophyceae) and understand their biogeographic history in the Falkland Islands and Magellan region (south Patagonia). Kelp forests are among the most ecologically important marine ecosystems, promoting species richness and contributing to the resilience of their associated communities. We used mitochondrial and microsatellite markers in a comparative analysis of genetic diversity, population structure and phylogeography. Ocean transport models were used to infer the potential for present-day regional connectivity. Results show strong genetic differentiation of the Falklands, suggesting independent refugia and limited connectivity with South American continent. They also reveal that within the Falklands there are sectors of the coastline with distinct genetic groups that can be explained by ocean currents and colonization effects.

Mercury levels in Antarctic toothfish from the Southwest Pacific Sector of the Southern Ocean

José P. Queirós (a), Simeon Hill (b), Matt Pinkerton (c), Marino Vacchi (d), João P. Coelho (e), Eduarda Pereira (f), Jaime A. Ramos (a), José Seco (f,g), Darren W. Stevens (c), José C. Xavier (a,b)

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(b) British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, CB3 0ET, Cambridge, UK

(c) NIWA – National Institute for Water and Atmospheric Research, 301 Evans Bay Parade, Hataitai, Wellington 6021, New Zealand

(d) IAS - Institute for the study of the anthropic impacts and the sustainability of the marine environment, CNR, Via de Marini 6, 16149 Genoa, Italy ISMAR

(e) Departamento de Biologia & CESAM, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

(f) Departamento de Química & REQUIMTE, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

(g) School of Biology, University of St Andrews KY16 9ST, Scotland UK

Mercury is a toxic pollutant that bioaccumulates throughout the life of organisms and can reach the top of the food webs through the consumption of contaminated food. Although the Southern Ocean is often portrayed as a pristine ecosystem, substantial levels of mercury are already present in many Antarctic predators. We analysed mercury concentrations (organic and inorganic forms) in the muscle of Antarctic toothfish, *Dissostichus mawsoni*, a long-lived top predator which supports a highly profitable fishery. Our samples were collected in three fishing areas (one seamount and two on the continental slope) in the Southwest Pacific Sector of the Southern Ocean during the 2016/2017 fishing season. Mercury levels and the size range of fish varied between fishing areas, with the highest levels (0.68 ± 0.45 mg kg⁻¹ ww) occurring on the Amundsen Sea seamount where catches were dominated by larger, older fish. The most parsimonious model of mercury concentration included both age and habitat (seamount versus continental slope) as explanatory variables. Mean mercury levels for each fishing area were higher than those in all previous studies of *D. mawsoni*, with mean values for the Amundsen Sea seamount exceeding the 0.5 mg kg⁻¹ food safety threshold for the first time. It might therefore be appropriate to add *D. mawsoni* to the list of taxa, such as swordfish and sharks, which are known to exceed this threshold. This apparent increase in mercury levels suggests a recent contamination event which affected much of the Southwest Pacific sector, including both the Amundsen and Dumont D'Urville seas.

NHK Japan by the financial support. JQ was supported by FCT/MCTES through national funds (PIDDAC) and PROPOLAR and by a travel grant of SCAR Ant-ERA.

Adélie Penguins and the presence of microplastics from Antarctic Peninsula

Joana Fragão (a), Filipa Bessa (a), Hugo R. Guímaro (a), Andrés Barbosa (b), José C. Xavier (a,c)

(a) Marine and Environmental Sciences Centre, Department of Life Sciences, University of Coimbra, Coimbra, Portugal

(b) Departamento de Ecología Evolutiva, Museo Nacional de Ciencias Naturales, CSIC, 28006 Madrid, Spain

(e) Marine and Environmental Sciences Centre, Department of Life Sciences, University of Coimbra, Coimbra, Portugal

(c) British Antarctic Survey, Natural Environment Research Council, Cambridge, UK

Anthropogenic pressures, such as marine pollution in the form of microplastics (< 5mm in size), are known to possibly cause cumulative toxicity and/or increase mortality and decline in wild biodiversity, but they are still poorly studied in Antarctic seabirds, such as penguins. This group of seabirds have a widely distribution around Antarctica, and as microplastics could come via ingestion of preys, penguins can be used as an Antarctic biological sampler for this type of contamination in Antarctic marine food webs. Adélie penguins (*Pygoscelis adeliae*) from Antarctic Peninsula area, at Yalour breeding colony, were used as bioindicators to assess the levels of microplastics and to identify their prey (e.g. Antarctic krill - *Euphausia superba*) as a potential source of microplastics. Data collection was carried out in 2008 and 20 scats were analysed (as a proxy of ingestion), in which every Antarctic Krill was counted and measured to determine Adélie penguins diet. In addition, after digestion of samples, potential microplastics were looked under a microscope for identification and for further chemical analysis (polymer type) to infer its origin. The results showed that 85% frequency of occurrence of Antarctic Krill (n = 71) and a 20% frequency of occurrence of potential microplastics (n = 4). The chemical analysis of the potential microplastics identified them as microfibrils of natural fabricated cellulose, important fibres in the production of textiles that can contain synthetic contaminants. This study shows for the first time the presence of microplastics in Adélie penguins and demonstrate the suitability of the use of this species as bioindicator of microplastic pollution in the Antarctic Peninsula.

Andrés Barbosa (CSIC), Norman Ratcliffe/Claire Waluda (BAS), the study benefited from the strategic program of MARE, financed by FCT (UIDB/04292/2020)

Annual schedule adjustment in a sub-arctic breeding wader: the Icelandic whimbrel

Camilo Carneiro (a,b), Tómas G. Gunnarsson (b) & José A. Alves (a,b)

(a) Dep. Biology & CESAM, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal

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The timing for performing specific tasks of the annual cycle can be crucial for animals to maximize their fitness, but it may be dependent on previously experienced conditions, particularly in highly seasonal environments. The arctic and sub-arctic present a high proportion of migratory animals that often occupy the region during the short summer months to breed. To avoid negative consequences of delays on the onset of breeding, migrants can use stationary periods to adjust their schedule, a behaviour that may help explain the counter-intuitive absence of carry-over effects in extreme long-distance migratory waders.

The Icelandic whimbrel *Numenius phaeopus islandicus* typically migrates in non-stop flights of up to ca. 6000km and uses up to two stationary locations outside the breeding grounds: winter site in W. Africa and stop-over site during northward migration in Europe. Hence, providing an opportunity to assess possible bottlenecks at different annual stages, and their potential implications to individual fitness. Using full annual cycle individual level data, we investigated relationships between timing of annual stages, duration of stationary periods, and their fitness consequences in that population.

Icelandic whimbrels compensated for delays at the wintering sites, which were mostly due to successful breeding (in the preceding breeding season). A domino effect was observed from spring departure to laying date, which has the potential to affect breeding output, since fledging success declines with laying date. However, the total time saved during all stationary periods seems enough to avoid interannual effects between breeding seasons. These findings show the importance of the non-breeding sites for adjustment of the annual schedule and to prevent carry-over effects.

Demographic responses to environmental change of the black-browed albatross, sentinel of the Patagonian Shelf Large Marine Ecosystem

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Owing to their role as sentinels and biodiversity indicators, top-predator populations offer crucial insight into the processes shaping their supporting ecosystems. As the oceans undergo dramatic change and our understanding of the marine domain remains limited, investigating the demographic responses of marine top-predators to environmental variability is key for a process-based understanding of climate change. In this study, we analyse the most extensive dataset for the Falklands' black-browed albatross (*Thalassarche melanophris*), a top-predator present year-round in the Patagonian Shelf Large Marine Ecosystem (PSLME) biodiversity hotspot. Using a powerful integrated population modelling framework, which outperforms conventional modelling methodologies and is widely applicable to other study systems, we quantified the population demographic parameters and established a mechanistic link between albatross demography and the PSLME environmental variability. High survival and breeding rates sustained by the rich waters of the PSLME underpin population growth, making this globally important population the only increasing albatross population in the South Atlantic, with over 70% of the species' global abundance. Environmental fluctuations affected the population's breeding parameters through bottom-up processes modulating resources availability/accessibility, with a strong negative effect of higher sea surface temperatures and a positive effect of wind intensity. The variability in adult survival was influenced by deeper ecosystem changes, captured by large-scale indices (Southern Annular Mode) and the sharpest drop in albatross survival co-occurred with widespread penguin mortality and extremely low fishery catches. The changes in the Southern Ocean circulation and ocean warming brought by climate change are therefore of conservation concern and economic relevance.

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The prokaryotic rare biosphere is sensible to environmental heterogeneity in the Arctic Ocean

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The prokaryotic rare biosphere represents the low abundance populations of prokaryotes and is important for ecosystem resistance and resilience. The few previous studies on the prokaryotic rare biosphere of the Arctic Ocean assert that water masses harbor specific microbial ecotypes and most prokaryotic taxa remain rare across biogeography and seasons. Our study uncovers different types of rare populations in the Arctic Ocean and reveals their dynamics during a winter to spring transition. For that purpose, we used seawater samples from the Norwegian Young Sea Ice Expedition (2015), which used a vessel fixed on drifting ice to take under-ice seawater samples, from epipelagic and mesopelagic layers, in March, April and June, capturing microbiomes from distinct water masses. To determine the structure of the prokaryotic rare biosphere, we used both 16S rRNA gene and total metagenome sequencing. Our results indicate that water masses are indeed the major driver of the structure of the prokaryotic rare biosphere in which the constituent populations tend to remain rare across seasons and sites. We also found that most of the rare taxa were transiently rare, meaning that they appear and disappear in different samples, probably as a result of dispersal limitation caused by the different water masses. Furthermore, we suggest that conditional rarity, which represents taxa that vary between abundant and rare across time/space, are more prevalent at epipelagic layers, where seasonal variation in light availability occurs. Thus, rare prokaryotes tend to maintain low abundance within specific Arctic Ocean water masses, but they can become abundant or disappear across seasonal variation and different water masses. The response of the rare biosphere to the conditions surveyed suggests that it is sensitive to environmental heterogeneity. Future work should tackle how the rare biosphere responds to climate change and which are the consequences of this response for ecosystem functioning.

Equipa da expedição do "Norwegian Young Sea Ice Expedition" de 2015, responsável pela recolha de amostras e processamento do DNA para sequenciação.

Biogeography of Arctic Eukaryotic Microbiome: A comparative approach between 18S rRNA gene metabarcoding and microscopic analysis

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Climate change is affecting the Arctic Ocean through the decrease of the sea ice extent and thickness.

This study aimed to investigate the biogeographic patterns of Arctic microplankton diversity and distribution along two oceanographic transects in the Marginal Ice Zone (MIZ) around Svalbard by combining the 18S metabarcoding approach, using next generation sequencing techniques (NGS), and the classic microscope cell identification. During MOSJ-ICE2016 expedition (Environmental Monitoring of Svalbard and Jan Mayen), led by Norwegian Polar Institute (NPI), seawater was collected, at surface (2m-5m), chlorophyll maximum (17m-50m) and bottom depth (50m-1035m). Phytoplankton counts and identification were performed by NPI while metabarcoding analysis were performed at CIIMAR (Porto, Portugal), through the analysis of the massive sequencing of the hypervariable V4 region of the small subunit ribosomal RNA gene.

Results from metabarcoding revealed that the eukaryotic dataset comprises highly complex and diverse protists community structure, with a marked biogeographic pattern of the protists communities along the MIZ with clear trends of depth-dependency along the water column and water masses variations. As for the methodological comparison, results showed that the identification and characterization of the phytoplankton groups were quite different when using both methods. Also, metabarcoding was able to detect higher phytoplankton diversity but with lower abundance recovery, as for microscopy, this method detected fewer taxonomic groups but with higher abundance recovery.

Despite the discrepancies of both methods, this is the first step to improve a methodological comparison for the protists community in the Arctic region and could serve as a baseline for further studies and relevant to apply effective methodologies in long-term phytoplankton monitoring programs, essential to anticipate future Arctic warming trends.

Logistics were supported by PROPOLAR and NPI. The Portuguese Science and Technology Foundation that funded this study through NITROLIMIT project

Functional traits of the Antarctic vegetation as potential biodiversity-based ecological indicators

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Polar terrestrial ecosystems are within the most susceptible to climate change, with its early impacts becoming evident. Thus, developing standard, non-invasive and easy-to-use tools to monitor climate change effects for these regions and the effectiveness of the actions taken for its protection, is fundamental.

Our objective was to build a biodiversity-based ecological indicator of the effects of climate change in Antarctica, based on the functional traits of lichens, bryophytes and plants identifiable by photographic sampling. Life form and colour can be easily identified in image analysis, without species identification, and are expected to be related to the environmental drivers. We analysed the frequency of these traits in 150 photographs from 30 sampling sites distributed along an altitudinal gradient across 4 locations in two islands of the Shetlands Islands Archipelago. We tested the hypothesis that traits were related with the climate gradient, measured as distance to the coast and altitude, among others. Other environmental factors were also tested, such as natural pollution (distance to animal colonies). Vegetation functional composition was primarily related to the altitudinal gradient, which reflected a climatic gradient. All traits responded to this gradient, with some functional groups giving contrasting responses, highlighting that large shifts in vegetation functional composition occur in a climate gradient. Some functional groups also showed a response to the presence of animal colonies. Our results reveal that it is possible to focus on easily identifiable traits as a new non-invasive tool to be used as ecological indicator for the effect of climate change in polar regions.

LICHEN EARLY METER 1 and 2, VEGETANTAR 2, PERMANTAR (PROPOLAR-FCT); Comité Polar Español; Czech Antarctic Programme; Oleg Vassilev.

Trans-Arctic dispersal and connectivity in amphiboreal seaweeds

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For most organisms and for most of the time, the Arctic represents a formidable dispersal barrier. Trans-Arctic dispersal requires seasonally ice-free routes that exist only during short interglacial windows, since glacial advances and lowered sea levels routinely close oceanographic connections. Unsurprisingly, most amphiboreal taxa are composed by vicariant phylogroups and sister species whose systematic and biogeographic affinities reflect these vicariance/dispersal dynamics. Along trans-Arctic routes, sweepstake founder effects are predicted to involve important genetic and functional bottlenecks in low-dispersal species, but these have seldom been assessed. This study focuses on the macroalga *Fucus distichus* to compare 1) patterns of genetic diversity and phylogeographic structure throughout its Pacific and Atlantic ranges and 2) inter-oceanic niche conservatism using Species Distribution Models. We reveal phylogeographic diversity unprecedented among fucacean relatives, but extremely skewed towards the Pacific, where model projections imply a larger and more stable range across the most recent glacial/interglacial transition. Furthermore, haplogroups were not shared between oceans. These data support a Pacific diversification centre and a late colonization of the Arctic/Atlantic, and reveal no ongoing inter-oceanic gene-flow. Niche differences were apparent between ocean basins, with noticeable unfilled niches in the temperate NE Atlantic. The eco-geographic differences among Pacific vs Arctic/Atlantic are discussed in light of putative functional bottlenecks associated with the historical trans-Arctic migration (contraction of fundamental niche), or increased competition in the Atlantic where fucoid communities are more diverse (contraction of realized niche). Finally, we highlight historical idiosyncrasies by comparing with another amphi-boreal seaweed where genetic signatures of post-glacial trans-Arctic dispersal are evident.

People contributing with samples and FCT through UIDB/04326/2019, DL57/2016/CP1361/CT0010, EXCL/AAG-GLO/0661/2012 and Biodiversa/0004/2015.

Impact of Arctic environmental conditions on the reproduction and recruitment of *Alaria esculenta* and *Laminaria digitata*

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Kelp forests are important habitats along rocky coasts in Arctic regions. Although most of the kelp species in the Arctic are adapted to the pronounced environmental seasonal variations from this region, there is a critical lack of knowledge about how different seasonal Arctic conditions affect the survival and reproduction of kelp early life stages. Therefore, we compared the performance and the reproductive success of microscopic life stages of two sympatric kelp species, *Alaria esculenta* and *Laminaria digitata* from Kongsfjorden, Spitsbergen under simulated Arctic environmental conditions to better understand the regulation of kelp life cycle processes in this harsh environment. The gametophyte growth and survival during simulated Arctic winter period and subsequent sporophyte recruitment under spring conditions were investigated. During winter conditions (2°C, complete darkness) the gametophyte growth was hampered in both species. Despite low survival rates of both species, particularly for *L. digitata*, the capacity to recover and become reproductive was greater than in *A. esculenta*. During summer conditions, the influence of current and projected Arctic seawater temperatures (5°C and 9°C), nutrient levels and parental kelp canopy shading was also studied in both species. *A. esculenta* had a greater survival and reproductive success than *L. digitata*, except under very dense canopy conditions. Parental kelp canopy shading was important for *L. digitata* reproductive success. Predicted summer temperatures of 9°C lead to a negative effect on reproduction, particularly in *A. esculenta*. The species-specific interactions with environmental drivers are evident in patterns of survival and reproduction. Our results demonstrate that kelp communities can be shaped by seasonality and natural shading, and suggest that climate change could alter recruitment patterns in the Arctic. These results can be used to improve future forecasts and management actions.

This work was supported by a Pew Marine Fellowship and FCT through UID/04326/2020, BIODIVERSA/0004/2015, SFRH/BPD/122567/2016 (DL 57/2016/CP1361/CT0039).

Continuous light disrupts recruitment success in the Arctic kelp species *Alaria esculenta*

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Many organisms have endogenous clocks that synchronize the biological events with environmental changes leading to optimized development and reproduction. Laminariales possess circadian rhythms to control the release of eggs from female gametophytes, with release occurring within 30 min of darkness after 8-10 days under long-day conditions. Kelp forests are important habitats along rocky coasts in Arctic regions and most species seem to be well adapted to the variable environmental conditions characteristic of this region. However, the Arctic environment poses a special challenge to circadian clocks particularly due to the extreme seasonal changes in daylength, ranging from permanent sunlight in mid-summer to several months of complete darkness in winter. Using *Alaria esculenta* as a model species, we investigated how different light conditions (daylength and light intensity) affect gametogenesis and the recruitment success of a summer reproducing kelp species that inhabits the Arctic and thus experiences perpetual day for several months of the year. The thermal resilience of the sporophytes developed under different daylengths was also investigated. We discovered that although continuous daylight, characteristic of Arctic summers, enhanced gametogenesis and increased gametophyte vegetative growth and thereby the number of potential reproductive gametophyte cells, the recruitment of sporophytes was higher under long days of 16:8h daylength. Previous exposure to different daylengths during early life stages influences the sporophyte growth under different temperatures; overall the sporophytes previously developed under continuous daylight grew less compared to the sporophytes developed under shorter daylengths. However, no major differences were observed regarding the thermal tolerance limits between the sporophytes from different daylengths. This study showed that the synchronization of fertilization in *A. esculenta* is disrupted in continuous light leading to hampered recruitment.

This work was supported by a Pew Marine Fellowship and FCT through UID/04326/2020, BIODIVERSA/0004/2015, SFRH/BPD/122567/2016 (DL 57/2016/CP1361/CT0039).

Crustacean guide for predator studies in the Southern Ocean

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Crustaceans are an important component in the diet of numerous predators of the Southern Ocean (water masses located south of the Subtropical Front). As identifying crustaceans from food samples using conventional methods is not easy, a crustacean guide was written to aid scientists working on trophic relationships within the Southern Ocean. Having the needs of the scientists in mind, we gathered information from > 100 species from 53 families of the most relevant crustaceans in the diet of subantarctic and Antarctic meso- and top predators, including information on distribution, their relevance in predator diets, sizes, availability of allometric equations and practical procedures to differentiate crustacean species within each family. Additional information of bibliography is added if families possess more than the species mentioned in this book. It is noted that a large number of species still has no allometric equations and taxonomic status of some species has to be (or remains to be) clarified.

Antarctic octopod beaks as proxy for mercury concentrations in soft tissues

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As the role of mercury is poorly known in Southern Ocean biota, the total mercury (T-Hg) concentrations were evaluated in upper and lower beaks, digestive gland, gills and mantle muscle of *Adelieledone polymorpha* and *Pareledone turqueti*, two of the most abundant octopod species around South Georgia. Beaks had the lowest T-Hg concentrations (*A. polymorpha*: [T-Hg]_{Upper}= 27.2±12.9 ng·g⁻¹ and [T-Hg]_{Lower}= 27.5±20.0 ng·g⁻¹; *P. turqueti*: [T-Hg]_{Upper}= 34.6±13.9 ng·g⁻¹ and [T-Hg]_{Lower}= 56.8±42.0 ng·g⁻¹), followed by gills and muscle. The highest values were recorded in the digestive glands (*A. polymorpha*: 251.6±69.7 ng·g⁻¹; *P. turqueti*: 347.0±177.0 ng·g⁻¹). Significant relationships were found between the concentrations of T-Hg in the beaks and muscle of *A. polymorpha* (T-Hg in muscle is 10 times higher than in beaks). This study shows that beaks can be used as proxy for T-Hg in muscle for some octopod species, and beco a helpful tool for estimating total Hg body burden from beaks.

We thank British Antarctic Survey for the logistical support on sample collection. This study was financed by FCT-Portugal (UID/MAR/04292/2019).

EVOLUTION OF INNATE IMMUNITY GENES IN NOTOTHENIOIDEI FISH

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Have cold-stable environments shaped fish immunity? Notothenioidei fish inhabit the cold-stable environment of Antarctic and sub-Antarctic regions. The Antarctic Nototheniid fish acquired specific physiological adaptations but changes on immunity are poorly studied. Here we focused on the characterization of pathogen pattern-recognition Toll like Receptors (TLRs) that are key elements of vertebrate innate immunity vertebrates. Genomes of Antarctic fish and other teleosts were explored and TLRs compared and in silico analysis revealed that species-specific gene deletions, duplication and mutations occurred during their emergence from a single ancestor. This study contributes for understanding fish immunity and the impact of environment on gene evolution and function.

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The role of antarctic penguin colonies in promoting recruitment sites for bacterial populations colonisation of inland ecosystems

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Antarctic penguins play important roles in nutrient transfer between the eutrophic soils of their colonies and the highly oligotrophic soils of inland terrestrial ecosystems. To understand if the most abundant and prevalent bacterial populations at the ornithogenic soils of penguin colonies could colonise inland, mineral soils we carried out a comprehensive survey at the Adare Peninsula, Northern Victoria Land, a 77-km long landform extending from Cape Adare, in the north, to the Transantarctic Mountains range, in the south. Microbial community was analysed by high throughput sequencing of 16S ribosomal RNA (rRNA) gene amplicons and subsequent amplicon sequence variant (ASV) analysis. Differentially abundant ASVs were then identified in the ornithogenic and mineral soils of the Adare Peninsula.

The analysis of the spatial distribution of the bacteria populations indicative of a penguin lifestyle was congruent with the view that penguin colonies can assist in bacterial populations colonisation in inland terrestrial habitats. Bacterial populations affiliated with ornithogenic soils (e.g. *Psychrobacter* sp.) and marine-affiliated populations (*Aequorivita capsosiphonis*), considered an exemplar model of penguins lifestyle which feed on sea and breed at land, were good indicators of the extent of the penguin footprint. Unlike these, bacterial populations associated with faecal flora were not a good indicator, probably because their lifestyles do not enable them to survive on the oligotrophic terrestrial environments of Antarctica. These results open new perspectives concerning the mechanisms that drive microbial biogeography in Antarctica terrestrial ecosystems.

PROGRAMME ON EARTH AND ENVIRONMENTAL SCIENCES

- 13h50 **New scientific results on Earth and Environmental Sciences**
Chair: Pedro Pina, Centre for Natural Resources and the Environment (CERENA), Instituto Superior Técnico (IST), University of Lisbon, Portugal
- 13h50 **The state of permafrost at Andean High Mountains and Antarctica under a global warming scenario**
KEYNOTE SPEAKER: Carlos Schaefer, Soil Science Department, Federal University of Viçosa (UFV), Brazil
- 14h20 **Precipitation over the Southern Ocean: comparison of two snowfall events around Mertz Glacier**
Diogo Luís, Department of Physics, University of Aveiro, Portugal
- 14h35 **Estimation of air temperature in the Hurd Peninsula of Livingston Island between 2000 and 2016 from MODIS LST data**
Carmen Recondo, RSApps Research Group, Department of Mining Exploitation and Prospecting, University of Oviedo, Spain; Institute of Natural Resources and Territorial Planning (INDUROT), University of Oviedo, Spain
- 14h50 **Environmental controls on permafrost and ground temperature regimes and distribution in Barton Peninsula (King George Island, Antarctic)**
Joana Baptista, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h05 **LATA2019 – Tides at Primavera Station**
Pedro Almeida, GeoBioTec Research Centre, University of Beira Interior, Portugal
- 15h20 **Constraining the chronology of ice thinning and glacier dynamics in the Hurd Peninsula (Livingston Island, South Shetland Islands, Antarctic Peninsula) following the Last Glacial Maximum**
José M. Fernández-Fernández, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h35 **Ultra-high resolution assessment of the impacts of vegetation shadows on satellite-derived spectral signals from small thermokarst lakes (subarctic Canada)**
Pedro Freitas, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 15h50 **Mercury Methylation and Monomethylmercury Demethylation in Sediments from Permafrost Thaw Lakes**
Martin Jusek, Centro de Química Estrutural (CQE), Instituto Superior Técnico (IST), Universidade de Lisboa
- 16h05 **FLASH INTRODUCTION TO POSTERS on Earth and Environmental Sciences, on video**
Atmospheric rivers in the Arctic: from case studies to long-term analysis
Carolina Viceto, CESAM and Department of Physics, University of Aveiro, Portugal

Atmospheric rivers at the Antarctic Peninsula and their impacts on temperature and precipitation using the Year of Polar Prediction observations

Irina V. Gorodetskaya, CESAM and Department of Physics, University of Aveiro, Portugal

Assessing the dynamics of active layer using an automated electrical resistivity tomography system

Mohammad Farzamian, Instituto D. Luiz and Faculty of Sciences, University of Lisboa, Portugal

Effect of summer snow cover on the variability of active layer thermal regime and thickness on CALM-S JGM, James Ross Island

Filip Hrbacek, Department of Geography, Faculty of Science, Masaryk University, Czech Republic

Variability of the permafrost temperature on James Ross Island, Antarctic Peninsula, in the period 2004-2017

Lucia Pastirikova, Department of Geography, Faculty of Science, Masaryk University, Czech Republic

Coastal flooding vulnerability mapping in Tuktoyaktuk – static and hydrodynamic approaches

Daniel Pinheiro, Centre of Geographical Studies, Institute of Geography and Spatial Planning, University of Lisbon, Portugal

Characterization of sorted stone circles and their relationship with vegetation in the Barton Peninsula in Antarctica using UAV data

Marta Almeida, Centre for Natural Resources and the Environment (CERENA), Instituto Superior Técnico (IST), University of Lisbon, Portugal

VEGETANTAR field survey during the 2019-20 Austral summer season

Gabriel Goyanes, Centre for Natural Resources and the Environment (CERENA), Instituto Superior Técnico (IST), University of Lisbon, Portugal; Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal

Monitoring vegetation in Barton Peninsula, King George Island, Antarctica

Vasco Miranda, Centre for Natural Resources and the Environment (CERENA), Instituto Superior Técnico (IST), University of Lisbon, Portugal

Precipitation over the Southern Ocean: comparison of two snowfall events around Mertz Glacier

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Mertz Glacier is located in George V Land, East Antarctica, in a region with a polynya system, which has an important contribution to the Antarctic Bottom Water formation. This water mass plays a major role in the global ocean overturning circulation, and thus in the global climate regulation. It is highly sensitive to freshwater input, where key contributions are from melting of the ice shelves, sea ice and precipitation. Increased precipitation over the Southern Ocean as part of the enhanced global hydrological cycle is expected to have a greater impact on the freshening of the ocean and is still highly uncertain. Precipitation is a poorly known variable in the region due to the lack of measurements. Unique precipitation measurements were carried out during the Swiss Polar Institute's Antarctic Circumnavigation Expedition (ACE) (December 2016 - March 2017). High temporal resolution measurements of precipitation were performed by a Snow Particle Counter and by a micro rain radar. Radiosondes were launched periodically to observe the vertical structure of the atmosphere. We also use precipitation and radiosonde measurements from Dumont D'Urville station (DDU). ECMWF's ERA5 reanalysis product is evaluated using ACE and DDU observations and is further applied to analyse temporal and spatial evolution of precipitation events, synoptic situation and moisture transport. Two snowfall events that occurred around Mertz Glacier during ACE campaign are analysed in detail. The first event on 2 February 2017 was associated with an extratropical cyclone east of Adélie Land and a moderate along shore moisture transport. The second event on 8-10 February 2017 was associated with a cyclone west of Mertz blocked by a high-pressure ridge, directing an intense moisture transport and precipitation to the Mertz Glacier and DDU. We verify if reanalysis is able to simulate these different types of precipitation events and examine associated large-scale atmospheric circulation.

Estimation of air temperature in the Hurd Peninsula of Livingston Island between 2000 and 2016 from MODIS LST data.

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The use of remote sensing data in the polar areas study is very important, due to the difficulty in maintaining a wide network of meteorological stations. Therefore, with data from the PERMASNOW project and AEMET stations, we analyzed the air temperature (T_a) variation in six points of the Hurd peninsula in Livingston Island (Antarctica) with daytime and nighttime data of the land surface temperature (LST) from the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor, on board the TERRA (MOD11A1) and AQUA (MYD11A1) satellites, between the years 2000 and 2016. We used daily mean T_a data obtained from the Juan Carlos I (JCI), Johnson Glacier (GJ) and Hurd Glacier (GH) (AEMET stations), and Incinerador (INC), Reina Sofia (RS) and Collado Ramos (CR), from PERMASNOW project. We applied locally weighted regression (LOESS) to determine the T_a behavior in the study period: a decrease between -2.3 and -3.0 °C decade⁻¹ is observed at the JCI station, closest to the coast, while in the stations furthest from the coast and of higher altitude an increase between $+0.2$ and $+0.8$ °C decade⁻¹ is observed. Regarding the comparison between LST MODIS and T_a , except GJ, where LST variable is not significant, we obtained the best T_a models estimation using daytime Terra LST data, with R^2 between 0.5 and 0.7, and 0.5 - 0.6, in the analysis and cross validation respectively. In both cases, the RMSE does not exceed 2.6 °C. Therefore, we conclude that MODIS LST data are useful to estimate T_a in the study area.

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Environmental controls on permafrost and ground temperature regimes and distribution in Barton Peninsula (King George Island, Antarctic)

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Permafrost temperatures have been shown to be close to 0 °C at the South Shetlands, which indicates a sensitive area to permafrost degradation. Until 2019 the deepest borehole in King George Island was at Bellingshausen station in Fildes Peninsula, with 8 m depth and mean annual ground temperature of -0.35 °C (Vieira et al. 2010). With the aim to better characterize the permafrost conditions in King George Island a new borehole was drilled in 2019 in Barton Peninsula at 128 m asl reaching a depth of 13.2 m (KSSB). The borehole is integrated in the PERMANTAR network and in GTN-P and is equipped with 15 temperature sensors at different depths, recording at an 1-hour interval. The first full-year data set was collected in March 2020. To analyze the ground surface temperature (GST) regimes and their geographical controls, 20 miniloggers were installed in different terrain settings recording at an interval of 3 hours. In this presentation, we discuss the thermal regime of KSSB and of the 20 GST monitoring sites and their implications for understanding the spatial distribution of permafrost and periglacial dynamics in Barton Peninsula. KSSB showed a mean permafrost temperature at 13 m of -1.5 °C, an active layer depth of c. 2 m in 2019 and a thaw depth of 3 m in March 2020, a value which was possibly surpassed. One-Way ANOVA showed a prevailing control of elevation and concavity of the terrain in GST distribution in Barton Peninsula, with significant spatial differences. The Freezing Degree Days varied from 438 to 1041 °C during winter, with n-factors showing values between 0.6 and 1, reflecting the influence of snow cover. The results show that permafrost is warm in Barton Peninsula, with temperatures in agreement with those measured in similar setting in the South Shetlands. The comparison of this results with the regional ground temperature models by Obu et al (2020) show a difference of about -0.8 °C, which indicates a good proximity between recorded and estimated MAGT.

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LATA2019 – Tides at Primavera Station

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The third LATA mission (Loadings and Tectonics of Antarctic peninsula), to Base Primavera in Antarctica from 25 to 30 January 2019 had the objective to measure the ocean tides in front of the station. The weight of the ocean tides deforms the Earth's surface by several mm's, and this is observed by the GNSS station at Base Primavera that was installed during the first LATA mission back in 2016 and which has been collecting data since then. Global tide models are used to predict this loading, contribution of tides within a range of 500 km are needed for an accurate estimate, but to improve the loading due to nearby waters, in-situ tide observations are essential. The sea level was measured with a Ruskin TGR-2050 pressure sensor.

Ocean tides also cause variations in the Earth's gravity field which were observed with a SCINTREX CG3M gravimeter. In this presentation we show the time series observed and compare them with various global ocean tide models to assess their accuracy in this area.

Although the main objective of bringing the gravimeter to Base Primavera was to measure the tidal variations, we also determined the absolute gravity value at this station. On the way to Antarctica, gravity measurements were made at two points in Ushuaia, Argentina. After returning from Antarctica, a measurement was made in Punta Arenas. This provided sufficient information to compute the absolute gravity value for Base Primavera. Results and details of the computation will be presented.

We are thankful to Luísa Bastos for lending us her pressure sensor and to Instituto Antártico Argentino (DNA-IAA) for allowing us to use their facilities.

Constraining the chronology of ice thinning and glacier dynamics in the Hurd Peninsula (Livingston Island, South Shetland Islands, Antarctic Peninsula) following the Last Glacial Maximum

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Nunataks are key spots in the understanding of the environmental evolution of deglaciated areas. They offer the opportunity of studying biological processes such as vegetal and animal colonization, but also to track the deglacial history and reconstruct past ice losses using Cosmic-Ray Exposure (CRE) dating. Here, we present the application of cosmogenic ^{10}Be CRE dating to glacially polished surfaces in two palaeonunataks (Reina Sofía Peak, Moores Peak) and one nunatak (Napier Peak) distributed across the ice-cap covering part of the Hurd Peninsula, SW Livingston Island, South Shetland Islands. Most of the exposure age results show a logical chronological sequence, and allowed us to reconstruct past vertical changes of the ice surface. The uppermost surfaces of the Moores and Reina Sofía peaks became exposed during the Last Glacial Maximum (LGM), between ~ 24 ka and ~ 20 ka. However, most of the ice thinning in the Sofía Peak occurred afterwards, during Termination-1, between ~ 20 and ~ 14 ka. A period of massive thinning occurred at around ~ 14 ka that also triggered the onset of the deglaciation at the Napier nunatak, coeval with the so-called melt-water pulse 1a. According with our results, ice shrinking during the Holocene must have been very small compared to the post-LGM period. However, some of the ages from the summit of the Reina Sofía and Moores peaks and the base of the Napier nunatak were anomalous, either too old or not following the general exposure age vs elevation pattern. These artifacts reveal the occurrence of nuclide inheritance with the conservation of previously exposed surfaces due to the inefficient subglacial erosion typical of the cold-based glaciers. Nevertheless, the spatial pattern of ages within the whole dataset also evidences the polythermal character of the Hurd Peninsula ice cap.

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Ultra-high resolution assessment of the impacts of vegetation shadows on satellite-derived spectral signals from small thermokarst lakes (subarctic Canada)

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Warming of the circumpolar north is accelerating permafrost thaw, with implications for landscapes, hydrology, ecosystems and the global carbon cycle. In subarctic Canada, rapid permafrost degradation is creating widespread thermokarst lakes. Little attention has been given to small waterbodies less than 10000 m² in area, yet these are likely to be biogeochemically more active than larger lakes. Additionally, the landscapes where they develop are experiencing intense shrubification and terrestrialization processes, with increases in area and height of shrub and tree communities. Tall vegetation that is colonizing waterbody margins can project shadows that impact productivity, thermal regime, and the water-leaving spectral signal, which in satellite data generates pixels with mixed signatures between sunlit and shaded surfaces. We undertook UAV observations using optical and multispectral sensors at long-term monitoring sites of the Center for Northern Studies (CEN) in subarctic Canada, from sporadic (SAS/KWAK) to discontinuous (BGR) permafrost zones. These ultra-high resolution data enabled spectral characterization and 3D reconstruction of the study areas. Here we use ultra-high resolution digital surface models of the tundra-forest produced by UAV data to model shadow effects at the overpass time of very high (WV, PlanetScope) and high-resolution satellites (Sentinel-2, Landsat). We then analyzed the impacts of vegetation shadows on lake surface spectral reflectance derived from satellite imagery. Ultra-high resolution UAV imagery shows that it provides accurate shadow models in the tundra-forest zone and can be used to improve the assessment of errors and accuracy of satellite data analysis. This research is funded by the Portuguese Foundation for Science (FCT) and Technology under the project THAWPOND (PROPOLAR), by the Centro de Estudos Geogrficos (UID/GEO/00295/2019), with additional support from ArcticNet (NCE), Sentinel North (CFREF) and CEN.

*T-MOSAiC (Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections).
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Mercury Methylation and Monomethylmercury Demethylation in Sediments from Permafrost Thaw Lakes

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In the Arctic, mercury and monomethylmercury are being mobilized via permafrost degradation, being the formation of thaw lakes one of the most important features. Thus, the study of the mercury cycle in these systems is crucial to better understand the consequences and impacts to the arctic ecosystems. Sediments and bottom water from two permafrost thaw lakes (SAS-1A and SAS-2A) were sampled in the sub-arctic region of Nunavik (Canada) in a sporadic permafrost area. Mercury and monomethylmercury levels and Hg methylation and monomethylmercury demethylation rates were determined using Hg stable isotope techniques. Three different enrichments: iron(III) chloride, sodium molybdate and sodium 2-bromoethanesulfonate were used to increase or inhibit the activity of iron-reducing bacteria, sulphate-reducing bacteria and methanogens respectively, which are well known as Hg methylators.

Results showed that the concentrations of both Hg species were higher in lake SAS-1A (SAS-1A_{up} 346 ng/g), than in SAS-2A (SAS-2A_{up} 53 ng/g). Sediment mercury methylation rates appear to be influenced by the Hg content and by organic matter content and quality. Microbial diversity plays a major role in mercury methylation, however, their influence in monomethylmercury demethylation was not clear. Concerning Hg methylation, sulfate-reducing bacteria and methanogens were shown to be largely involved in methylation processes, nevertheless our results clearly point differences between lakes.

In conclusion, permafrost thaw lakes are important freshwater systems not only due to their increasing area in the arctic but also because they are a source of Hg previously retained on permafrost.

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Atmospheric rivers in the Arctic: from case studies to long-term analysis

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Recently, significant increase in the atmospheric moisture content has been documented over the Arctic region, which might be explained by the enhanced poleward moisture flux that is expected to continuously increase in the future. This might be caused by several factors, including increased moisture transport intensity. Here we focus on the anomalous moisture transport events confined to long, narrow and transient corridors, known as atmospheric rivers (ARs), which are expected to have a strong influence on Arctic mass and energy budget.

This study started with the analysis of case studies with anomalous moisture transport identified as ARs reaching Ny-Ålesund, during the ALOUD campaign that took place in Svalbard from May to June 2017. We explored the spatiotemporal evolution of these events by means of two tracking algorithms and multireanalysis products in synergy with regional climate model simulations. To assess their performance, we analysed measurements from Ny-Ålesund, combined with spatial fields from satellite products.

Results indicate that three events were identified as ARs by one or both tracking algorithms. These were associated with different precipitation patterns (mixed-phase precipitation, dominated by rainfall and no precipitation) and moisture sources (Western Siberia and Northern Scandinavia). Overall, reanalysis and model at Ny-Ålesund show good agreement, despite some differences that suggest the need for high temporal/spatial resolution and adequate physics description.

Building on the detailed case studies analysis, this work is now being extended to longer time periods from the recent past and into the future. Preliminary results from the recent past show a higher frequency of ARs over the Norwegian and Barents Sea, mainly during autumn and winter, although during May and June there is a high frequency of ARs over Western Siberia and Barents Sea.

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Atmospheric rivers at the Antarctic Peninsula and their impacts on temperature and precipitation using the Year of Polar Prediction observations

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Antarctic Peninsula (AP) has been experiencing a much stronger recent warming compared to the rest of the ice sheet and other land areas in the Southern Hemisphere. This warming and associated surface melt have been related in the recent past to the major ice shelf collapse around AP and is projected to increase in the future. Major surface melt events at the AP and adjacent ice shelves have been related to atmospheric rivers (ARs) – long corridors of intense moisture transport from subtropical and mid-latitude regions poleward (Wille et al 2019, <https://doi.org/10.1038/s41561-019-0460-1>). ARs are also known for prominent signatures in moisture and wind profiles (Gorodetskaya et al, 2020, <https://doi.org/10.1007/s00376-020-9221-8>) and for their role in intense precipitation (Gorodetskaya et al 2014, <https://doi.org/10.1002/2014GL060881>). In this study, we explore the ARs double role, as carriers of both heat and moisture, in their impacts on both precipitation (rain and snow), cloud radiative forcing and air temperature at the AP. Observations from the Year of Polar Prediction (YOPP, Bromwich et al 2020, <https://doi.org/10.1175/BAMS-D-19-0255.1>) endorsed sites/projects are used - Escudero (CAALC project) and King Sejong stations on King George Island, as well as Punta Arenas (southern Chile) site with project DACAPO-PESO. These projects employed a set of ground-based remote sensing instrumentation for water vapor, cloud and precipitation observations, as well as frequent radiosonde launches during the YOPP Special Observing Period in austral summer 2018/2019. We present case studies characterizing the temporal evolution of ARs, focusing on thermodynamic and dynamic conditions accompanying the transition between snowfall and rain. We also show the added value of increased frequency in radiosonde observations in improving the forecast of weather conditions during ARs, including precipitation, which have important consequences for air, ship and station operations in Antarctica.

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Assessing the dynamics of active layer using an automated electrical resistivity tomography system

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The last overview of the thermal state in the Western Antarctic Peninsula shows that permafrost is close to 0°C in the region suggesting that the region is near its climatic boundary. This fact reinforces the importance to study the evolution of permafrost and active layer in the region.

In this context, we installed an automated electrical resistivity tomography (A-ERT) systems in Antarctica at Deception Island under project ANTERMON, supported by the Portuguese Polar Program (PROPOLAR-FCT). we report on results of two complete year-round of A-ERT data, collected in 2010 and 2019, and show that the A-ERT can provide valuable subsurface information to improve the spatio-temporal understanding of active layer and permafrost dynamics with very high resolution and minimal environmental disturbance in Antarctica. Detailed investigation of the A-ERT data and obtained models reveals that the A-ERT system can detect the seasonal active-layer freezing and thawing events with very high resolution. In addition, the brief surficial refreezing and thawing of the active layer during summer and winter respectively were well resolved by A-ERT data, highlighting the significance of the continuous A-ERT monitoring setup which enables detecting fast changes in the active layer during short-lived extreme meteorological events. A comparison of the A-ERT models obtained from 2010 to 2019 shows an increase of resistivity mainly at depth over 40 cm and within the permafrost zone suggesting a decrease in unfrozen pore water and an increase in ice content.

The deployed A-ERT system is very robust for continuous monitoring under the harsh environment of Antarctica with limited access and the set-up is very flexible and can be used with different configurations to investigate different depth ranges for site-specific detailed investigation.

This research was conducted under projects ANTERMON and PERMANTAR-2, supported by the Portuguese Polar Program (PROPOLAR-FCT).

Effect of summer snow cover on the variability of active layer thermal regime and thickness on CALM-S JGM, James Ross Island

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The seasonal occurrence of snow cover, its thickness and spatial distribution affect significantly ground thermal regime as well as active layer thickness. In the Antarctic Peninsula region (AP), snow cover was found a very effective factor affecting ground thermal regime mainly in the South Shetlands in the western AP. On the contrary, observations from the eastern AP pointed on generally lower snow accumulation and consequently it has only little effect on the ground thermal regime or active layer thickness.

This case study brings observation of the short-term occurrence of snow cover during high summer 2018 and assesses its effects on the ground temperatures and active layer depth in the CALM-S JGM on James Ross Island, eastern AP. The area of 80 to 70 m is equipped by two reference ground temperature monitoring sites, automatic weather station and snow depth sensor. Thaw depth measurements were done three times per season using GPR survey along 70m long parallel lines. The transmission velocity used for time-depth conversion was calibrated based on the thaw depth probing taken each 10 m.

Snowfall and snow accumulation were recorded at the CALM-S site between 13 and 24 January. The distribution of snow at the site was determined from photographs taken by UAV three days after the snowfall and the depth of snow pack was obtained from GPR data measured with 850 MHz antenna. The snow pack covered >60 % of the CALM-S area and the maximum snow depths was >30 cm. Snow fully covered one of the reference ground temperature monitoring station whereas the second remained snow-free. Decreasing of Thawing Degree Days by ca. 10% and active layer thaw depth reduction by ca. 5-10 cm in parts covered by snow compared to previous snow-free seasons was observed. This study showed that even short-term occurrence of the snow cover during high summer could significantly affect active layer thermal regime and thawing propagation.

Variability of the permafrost temperature on James Ross Island, Antarctic Peninsula, in the period 2004-2017

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Changes in permafrost over time in the periglacial regions of the world are important indicators of climate variability. These changes (e.g. melting of permafrost, increasing active layer) can have significant impact on terrestrial ecosystems in the environment of Antarctica. The study area is Johann Gregor Mendel station, James Ross Island, north-eastern part of the Antarctic Peninsula. The meteorological station is located on the Ulu Peninsula, which is one of the largest deglaciated areas of the Antarctic Peninsula that provides suitable conditions for the study of permafrost. The soil temperature at a depth of 75 cm has been measured at the station since 2011 through the air temperature monitoring began in 2004. The main objective of the study is to reconstruct the permafrost temperature in the period 2004/05-2016/17 using the TTOP model. This model has been applied and validated in several parts of the world, including Antarctica. In addition to the thermal and physical properties of the soil, the input parameters are the air temperature data. The reference period 2011/12-2016/17 provided a time series of measured soil temperature for TTOP model verification. It showed strong correlation ($R^2 = 0.96$) and RMSE (0.64) between modelled and measured permafrost temperatures. The absolute error of modelled temperatures rose with increasing observed temperature. The reconstructed permafrost temperature was -5.4 °C in the period 2004/05-2016/17, with a trend of -0.06 °C/decade, whereas the air temperature was -6.6 °C, with a trend of 0.03 °C/decade. The temperatures ranged from -3.8 °C (air) and -2.1 °C (permafrost) in 2016/17 to -9.1 °C (air) and -8.5 °C (permafrost) in 2009/10. This study found TTOP model a suitable approach for air-temperature based reconstruction on James Ross Island. The model can importantly extend the permafrost temperature datasets necessary for better understanding of its long-term variability in Antarctica.

Coastal flooding vulnerability mapping in Tuktoyaktuk – static and hydrodynamic approaches

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Arctic warming is leading to an increased reduction in sea ice, with models for the year 2100 indicating a reduction in the Arctic sea ice area from 43 to 94% in September and from 8 to 34% in February (IPCC, 2014). The increase of the sea-ice free season duration will result in more exposure of the coasts to wave action, with changing climate also modifying the contribution of terrestrial erosion processes (Fritz et al., 2015, Ramage et al 2018, Irrgang et al 2018). Coastal erosion can also be increased by warmer seawaters and sea-level rise, with more frequent storms and associated surge events leading to the increase in flooding.

During the short open water season (June to October) there has been an increase coastal storms (wind speeds > 36 km/hr and surges level > 1m), this has led to an increment in coastal erosion and flooding.

This work focusses on the Hamlet of Tuktoyaktuk (Northwest Territories, Canada), where extensive ultra-high-resolution surveys with unmanned aerial vehicles (UAVs) have been conducted, allowing to generate orthophoto mosaics, digital surface models (DSM), derived land use, geomorphological and socio-economic activity maps. The DSM, digital elevation model (DEM), bathymetry, meteorological data, and soil subsidence rates are used as inputs for flood modelling in MOHID Water software. Validation is conducted using tide gauge and DGPS data from 2019, with the boundary conditions obtained from the FES2014 tide model (Finite Element Solution). Both approaches run on LiDAR data from 2004 and the UAV DSMs for direct comparison. This research is done in cooperation with the Hamlet, with the results being provided as a tool for strategical spatial planning, culminating in more resilient mitigation and adaptation measures to climate change. This research is funded by the European Commission H2020 project NUNATARYUK and by the Climate Change Preparedness in the North Program (CCPN).

Characterization of sorted stone circles and their relationship with vegetation in the Barton Peninsula in Antarctica using UAV data

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The knowledge underlying the formation of sorted stone circles has been increasing consistently over the past few years. The more detailed and spatially extensive characterization of the circles will allow us to deepen the geomorphological and morphodynamic knowledge of the ice-free regions of Antarctica.

The sorted stone circles covered in this work are patterns with a well-defined circular shape formed in soils of permafrost zones, whose interior zone is essentially constituted by soil (s.l) and the periphery by the accumulation of rock fragments (crown). In this work 2927 circles were studied through images acquired via UAV (unmanned aerial vehicle) in the main regions of occurrence of the Barton Peninsula, on the island of King George, Antarctica (62°S). The high number of circles studied makes the statistics performed much more representative than in previous works.

After the delimitation of each of the circles, the parameters of size and shape (2D) and the volume of the crown (3D) were extracted. The crown volume was obtained by applying the "visual method" and the "minimum method", which was developed and tested in this work. The classification of the images was performed using the Support Vector Machines method, using the Green leaf index, which allowed to obtain the percentage values of each class used in the inner region and in the crown of the circle.

Through the analysis of the trends of the characterization parameters and the classification carried out, it was found that the circles of the lower elevated areas present larger dimensions, thicker, voluminous crowns, and a lower percentage of usnea than at higher altitudes. In general, the inner region of the circle did not show great variations with increasing altitude.

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VEGETANTAR FIELD SURVEY DURING THE 2019-2020 AUSTRAL SUMMER SEASON

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The main goal of the VEGETANTAR project is to create a multitemporal vegetation map of the Antarctic Peninsula through remote sensing. Different satellite images are analysed in order to achieve this objective. In most locations in Antarctica the vegetation cover occurs in small and sparse patches, for this reason is necessary to apply a very high-resolution based methodology, the UAV's surveys. With its information is possible then to make a downscaling from UAVs to satellite images.

In the last Antarctic summer season, our team conducted field works in Byers and Hurd peninsula in Livingston island, South Shetlands, collaborating with LICHEN EARLY METER, PERMANTAR, ANTERMON and NUNANTAR Portuguese projects.

32 automatic flights were made with a DJI Phantom 4 Pro collecting more than 10.000 images. The flight altitude was 70 m.a.g.l. using the terrain following mode obtaining a resolution up to 2 centimetres. Ground control points were taken at each site using a DGPS in order to improve the geolocation of the final models.

The areas surveyed were Juan Carlos I basin, Rock glacier and Caleta Argentina in Hurd peninsula and Sealer hill, Nunatak Clark and CALM Limnopolar in Byers peninsula.

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Monitoring vegetation in Barton Peninsula, King George Island, Antarctica

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Vegetation spatial distribution in the Antarctic can be used as a proxy of climate change. Through remote sensing, large scale mapping and monitoring of the Antarctic Peninsula's vegetation is being performed. For this purpose, a test area has been chosen to refine the methodology by which this task will be accomplished, Barton Peninsula (King George Island). It constitutes the best training ground for this stage of the methodology due to availability of orthomosaics from unmanned Aerial Vehicles (UAV) surveys, acquired in 2 campaigns (2018 and 2019), and also the existence of previous works on this subject on the region [1]. The UAV images, with a spatial resolution of 2 cm/pixel, will be considered as ground truth for the subsequent classification of satellite images. Moreover, several satellite images have been retrieved from this area, both high resolution (HR) and very high resolution (VHR). The multispectral satellite imagery is of varying spatial scales: WorldView2, QuickBird, Sentinel2 and LANDSAT with 2, 2.4, 10 and 30 m/pixel, respectively. The accurate classification of vegetation through the increasing pixel sizes of these images will prove crucial to perform temporal change detection, which may only rely on the LANDSAT imagery due to its historic availability (since the late 1970s).

Presently, all aspects of the classification procedure are being tested, from the adequate preprocessing of the images to the classification techniques. The latter is being built upon a similar work developed for the neighboring Fildes Peninsula in King George Island [2].

[1] Shin JI, Kim HC, Lim, SI, Hong, S.G, 2014. Vegetation abundance on the Barton Peninsula, Antarctica: estimation from high-resolution satellite images. *PolarBiol* 37 1579–1588.

[2] Miranda V, Pina P, Heleno S, Vieira G, Mora C, Schaefer C E (2020). Monitoring recent changes of vegetation in Fildes Peninsula (King George Island, Antarctica) through satellite imagery guided by UAV surveys. *The SciTotal Env* 704 135295.

PROGRAMME ON SOCIAL SCIENCES

- 16h55 **New scientific results on social Sciences**
Chair: Maria Teresa Cabrita, Centre of Geographical Studies (CEG), Institute of Geography and Spatial Planning (IGOT), University of Lisbon, Portugal
- 16h55 **Team Adaptation in Antarctica: The Moderating Role of Adaptation Triggers**
KEYNOTE SPEAKER: Pedro Marques-Quinteiro, William James Center for Research, ISPA – Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Portugal
- 17h25 **How do you feel today? On the group effect dynamics of a two-week expedition to Antarctica**
Jan B. Schmutz, Department of Management, Technology and Economics, ETH Zurich, Switzerland
- 17h40 **APP Prototype to health and safety management in Polar regions**
Paola Barros Delben, Federal University of Santa Catarina, Brazil
- 17h55 **FLASH INTRODUCTION TO POSTERS on SOCIAL Sciences, on video**
- Teamwork challenges during a 3-month space analogue mission in the Arctic**
João Henriques, William James Center for Research, ISPA – Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Portugal
- Emotional Regulation on ICE Teams**
Fernanda Filha, William James Center for Research, ISPA – Instituto Universitário de Ciências Psicológicas, Sociais e da Vida, Portugal

How do you feel today? On the group affect dynamics of a two-week expedition to Antarctica

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One of the major threats to human performance and wellbeing in isolated, confined and extreme environments regards changes in the individual and collective affective experience of people over time. Also during shorter summer expeditions, individuals and teams can experience strong mood swings due to isolation and lack of privacy that in extreme cases can lead to depression. Such emotional distress can have a negative impact on the as well as mission success. Often, members of Antarctica teams are interdependent on each other working towards a common goal but also spend a considerable amount of time together besides work. Team interactions might be a powerful lever to counteract negative mood during Antarctica missions that teams need to be aware of. Therefore the goal of this paper is a) to explore situations that lead to extreme mood (positive and negative) on an individual level and b) to investigate strategies how individuals and teams can cope with negative mood. To answer this question we used a mixed methods. A two-person team completed a mood survey (PANAS) three times a day including notes about significant events during an Antarctica summer mission. This data was complemented by daily diary entries. The research team applied a collaborative ethnographic approach and explored the 25% most positive and negative events in terms of individual mood experience. Based on this approach we also identified strategies how individuals and teams can cope with extreme mood experiences. This manuscript sheds light on the influencing factors of mood in Antarctica and how teams are able to counteract, especially negative mood experiences caused by stressors.

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APP PROTOTYPE TO HEALTH AND SAFETY MANAGEMENT IN POLAR REGIONS

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Applications (apps) for mobile devices are promising technologies to provide optimization of selection, monitoring and intervention processes regarding health and safety in polar regions, in view of the steadily growing human presence in these places. Objective: To describe the development of an app prototype for expeditionaries' health and safety management in polar missions Method: Descriptive study based on the safe behavior model and the Prototyping Model, divided into the following stages: (1) situational diagnosis, (2) empirical research in Antarctica (2016-2019), (3) interviews with experts in order to analyze functionality and usability of the app, and (4) prototype development, including functional and non-functional requirements' definitions. Results: 5 app screens were defined (1. login/register, 2. menu and profile, 3. monitoring protocols, resource evaluation, diaries, and safe behavior assessment, 4. training, and 5. results) guiding the user according to the pre, during (in-mission) and post-expedition phases, personalizing the experience with notifications support. A multiplatform programming framework was chosen and the gamification concept was implemented to achieve greater participant engagement. The app also incorporates systems, equipment and installations' management, avoiding fragmentation into several tools. Conclusion: The technology helps to reduce the use of instruments in printed versions, to overcome methodological barriers in studies with human beings in polar regions. Also, in regions with difficult to access, especially at certain times of the year, when the possibility of evacuation is decreased, the app can promote self-care and autonomous behaviors in polar expeditionaries, minimizing risks of accidents and illnesses.

Marinha do Brasil, Força Aérea Brasileira, SINOVA, PROANTAR

Teamwork challenges during a 3-month space analogue mission in the Arctic

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The LUNARK Moon Analog habitat (MAh) located in the Arctic region represents a unique opportunity to study what are the challenges that the teams working in the Arctic circle might face during their campaigns. The harshness of the environment and the lack of sound studies addressing how humans perform in remote sites such as the North Pole during long periods of isolation and confinement leverage the importance of identifying which task, human, and environmental factors might challenge the human capacity to collaborate. This research proposes to investigate what are the challenges that teams face during long duration Arctic missions, thus looking at the frequency of these challenges across the full duration of the mission.

Participants in this research are two male volunteers, enrolled in the MAh simulation experiment in Greenland over 3 months. Data collection is ongoing. Preliminary results obtained from daily messages sent by the participants via a satellite phone suggest that there is a greater incidence of logistical, resource, and atmospheric challenges in the first stage of the mission (construction of the habitat) than on the second stage of the mission (living in habitat). On the other hand, the psychological and physical problems (i.e. tiredness, monotony, physical illness) present a greater incidence in the second stage. Although these data are preliminary, we understand the practical importance of the present study in the future of teams working in extreme environments marked by isolation and confinement. This project allows us to understand the challenges that these teams face in the different phases of their projects as well as to understand how they adapt to them. The lessons learned from this project can also be transferred to other similar environments on Earth, namely, Antarctica, off-shore platforms and submarines.

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Emotional Regulation on ICE Teams

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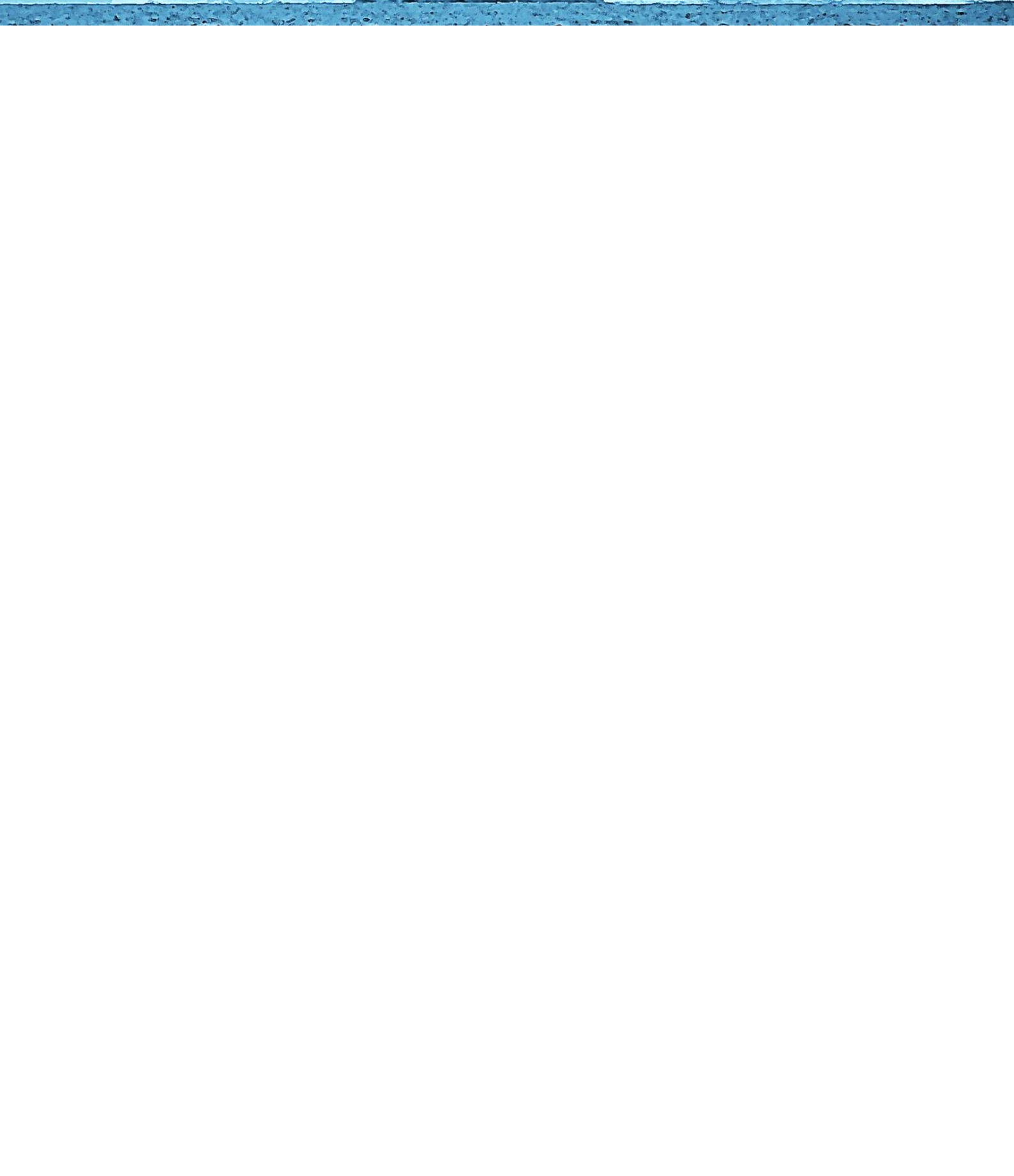
Over the years, we have increasingly valued scientific research in isolated, extreme and confined places such as space or Antarctica. However, although the functioning of teams is a widely studied topic in areas such as Psychology and Sociology, there is not much research on how teams work in ICE environments where there are such specific conditions, with very difficult working conditions, dangers and a variety of stressors, making it so that research previously done for teams does not apply exactly in this context. It is essential to have more studies focus in these teams so that they are not only more efficient and functional, but also to avoid psychological consequences for individuals within those teams.

In order to contribute to these researches, this thesis sought to understand how Emotional Regulation was carried out, both individually and as a team with eight individuals who have already participated in missions in Antarctica. The method used was qualitative, with interviews carried out by zoom and analysis of them using the MAXQDA program and tables to compare the contents of the interviews.

The data found were diverse between individuals, but there are also concordances in some aspects. At the group level, there may be ways to improve and worsen affects. In terms of improving, one of the most used is to communicate and collaborate with others. On the side of worsening, criticizing in a confrontational way is the most common. At an individual level, some of the strategies used to regulate emotions were talking with colleagues, listening to music, rationalizing emotions and being able to be a bit alone.

Despite being interesting data to contribute to the research, it is essential to have more in-depth and longer-term studies to be able to understand how teams in these environments work and improve their performance.

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BOOK OF ABSTRACTS



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