

Report for the year 2022 and future activities

SOLAS ‘Portugal’

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This report has two parts:

- **Part 1:** reporting of activities in the period of January 2022 - Jan/Feb 2023
- **Part 2:** reporting on ongoing/concluded/planned activities for 2023 and 2024.

Introduction

The present document reports on the first assessment of science-related activities by Portuguese researchers working in Themes and Cross-Cutting Themes within the SOLAS 2015-2025 Science Plan, only a few months following the invitation for Portugal to be part of the SOLAS international community. The SOLAS-Portugal introduced here is composed by a multidisciplinary group of researchers from various universities, institutes, and research centres from all over the country, including MARE/ARNET-University of Lisbon, CIIMAR/LOAI-University of Porto, IPMA (Marine Geology and Geo-resources Division), CIMA/ARNET-University of Algarve, IITAA-University of the Azores, OOM/ARDITI-University of Madeira, and IDL-University of Lisbon (affiliations provided in the “Comments” section). The alphabetical list of SOLAS-relevant projects (n=22) in which Portuguese researchers participate as PI’s, co-PI’s and/or research collaborators, as well as the list of publications (n=11) and conference presentations (n=30) for the period of January 2022 – February 2023 with Portuguese authors and/or co-authors, are based on researchers’ voluntary input. SOLAS-relevant activities developed in Portugal were/are mostly focused on: investigating the biogeochemical effects of atmospheric deposition; studying air-sea interfaces and fluxes of mass and energy; using Earth Observations and modelling approaches to explore climate-related environmental variability; laboratory studies; paleo-reconstructions; integrated studies of high sensitivity systems, with focus on polar regions; outreach activities linking science and society.

PART 1 - Activities from January 2022 to Jan/Feb 2023

1. Scientific highlight

The year 2022 was marked by the occurrence of at least **two events** of major relevance for the SOLAS Portuguese community:

(1) Fátima Abrantes (IPMA/CIIMAR) was Co-Chief Scientist of the first IODP (International Ocean Discovery Program) expedition entirely centered in the continental margin SW off Portugal, a region with rapidly accumulating sediments, and where previous studies have demonstrated a precise correlation between the surface and deep-water climate signals to the polar ice cores in both hemispheres, turning it in a prime target for ocean drilling. Expedition IODP 397 Iberian Margin Paleoclimate (*Hodell et al., 2022*) took place on RV JOIDES Resolution (11 October – 11 December) with the main objective of extending the climate record below the existing 1.45 Ma to the late Miocene (8 Ma), reconstruct the sea-ice-land connections and recover a bathymetric transect between 4691 and 1339 meters below sea level. This was the first IODP that ever managed to recover Miocene sediments in the open ocean offshore of Portugal.

The location of Portugal on the western extreme of the European continent results in very specific and markedly seasonal surface circulation which in recent times is linked to shifts in the position of the Azores high and Iceland low pressure systems (e.g., *Relvas et al., 2007*). During Spring-Summer, wind-forced coastal upwelling of nutrient-enriched ENACW (Eastern North Atlantic Central Water) generates a transition zone between the oligotrophic waters offshore and the highly productive area near the coast. During Autumn-Winter, the dominant wind regime becomes southerly along the western Portuguese margin, inducing onshore Ekman transport and downwelling conditions over the shelf (e.g., *Vitorino et al., 2002*). Expedition 397 was especially designed to study the past variability of all the water masses that fill the NE Atlantic Basin inferred from sediments drilled from the depth of occurrence of the main north Atlantic water masses in this key-region. The climate signals from these sediments are now in the process of being analyzed by all the scientific parties, expected to provide the greatest possible potential to reconstruct the natural variability of the North Atlantic climate (before human impact) at unprecedented temporal resolution back through the Miocene (last 8 million years). Results are likely to contribute to address several SOLAS-relevant questions: e.g. what was the behavior of the deeper water masses, their role in carbon storage, and its effect on atmospheric CO₂? How did the marine ecosystem respond to rapid climatic changes? Is there a coupling between planktonic and benthic biological communities that we can identify from the sediment record? How was the upwelling system modulated by changing glacial boundary conditions in the Pliocene–Pleistocene, and what was the impact of enhanced atmospheric dust deposition in the ocean during glacial periods? (SOLAS *Themes 1, 2 and 5*)

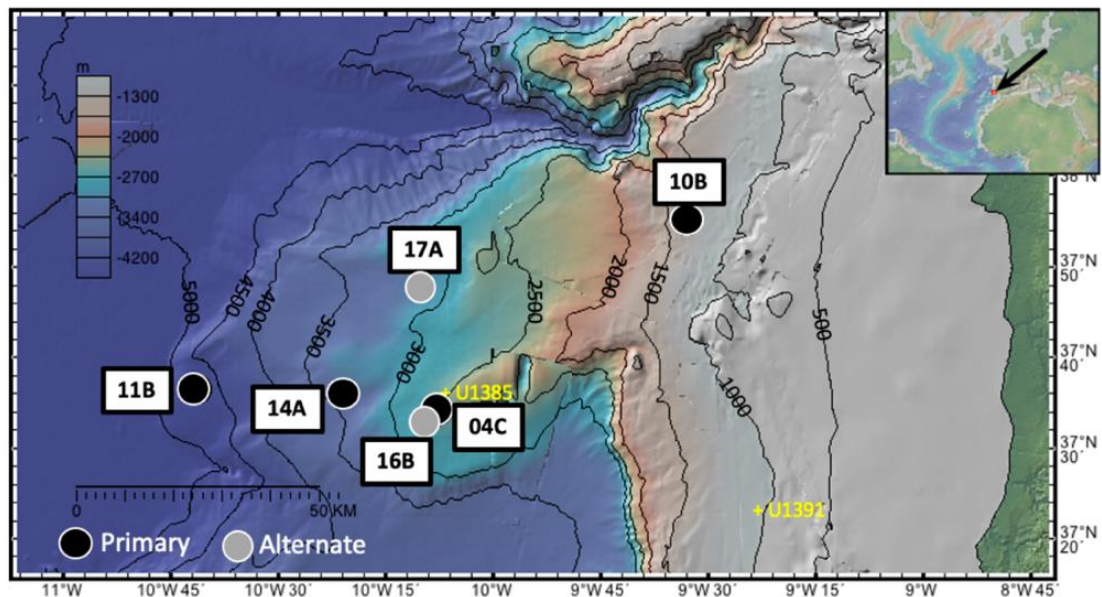


Figure: Bathymetry of the Promontório dos Príncipes de Avis showing the locations of the four sites (U1586, U1587, U1385, and U1588) drilled during Expedition 397, Marion Dufrenoy (MD) piston cores, and IODP Site U1391. Site U1385 was occupied previously during Expedition 339, as was Site U1391 (Fig. Credits: Hodell et al., 2023).

References:

- Hodell, D.A., Abrantes, F., and Alvarez Zarikian, C.A., and Expedition 397 Scientists, 2023. Expedition 397 Preliminary Report: Iberian Margin Paleoclimate. International Ocean Discovery Program. http://publications.iodp.org/preliminary_report/397/
- Relvas, P., Barton, E.D., Dubert, J., Oliveira, P.B., Peliz, A., da Silva, J.C.B., Santos, A.M.P., 2007. Physical oceanography of the western Iberia ecosystem: Latest views and challenges. *Progress in Oceanography* 74, 149–173.
- Vitorino, J., Oliveira, A., Jouanneau, J.M., Drago, T., 2002. Winter dynamics on the northern Portuguese shelf. Part 1: physical processes. *Progress in Oceanography* 52, 129–153.

(2) Portugal was stage of the UN Ocean Conference in Lisbon (27 June – 1 July), co-hosted by the Governments of Kenya and Portugal, under the motto "Our oceans, our future: partnering for the implementation of Sustainable Development Goal 14". Several researchers of the Portuguese SOLAS community participated in this conference aimed at "scaling up ocean action based on science and innovation for the implementation of Goal 14 of the UN Agenda 2030: stocktaking, partnerships and solutions" (SOLAS *Theme Science and Society*).

2. Activities/main accomplishments in 2022 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

PROJECTS (n=22)

1. **(AC)3** (Arctic Amplification: Climate Relevant Atmospheric and Surface Processes and Feedback Mechanisms). TR172 Trans-regional German project funded by DFG (Germany). LOAI/CIIMAR participates as Mercator fellow and external collaborator, student co-supervisor (2017-current).
2. **APMAR** (Antarctic Peninsula precipitation and surface Mass balance: what is the role of Atmospheric Rivers?). Fieldwork project in Antarctica funded by FCT-PROPOLAR (in collaboration with Korea Polar Research Institute). Meteorological observations at the Professor Julio Escudero station, King George Island. PI LOAI/CIIMAR (2020-2022).
3. **APMAR2** (Antarctic Peninsula precipitation and surface Mass and energy balance: what is the role of Atmospheric Rivers?). Fieldwork project in Antarctica funded by FCT-PROPOLAR (in collaboration with Korea Polar Research Institute). Radiosonde profiling, precipitation remote sensing, precipitation sampling at King Sejong station, King George Island. PI LOAI/CIIMAR (2022-2023).
4. **ARCA** (Atmospheric rivers climatology in Antarctica), funded by ANR (France). LOAI/CIIMAR participates as external collaborator (2020-2023).
5. **ATLACE** (ATLantic interactions via atmospheric water cycle: exploiting a unique dataset from the Antarctic Circumnavigation Expedition for better understanding of clouds and precipitation), funded by FCT (Portugal), PI LOAI/CIIMAR (2020-2023).
6. **ATLANTIDA** (Platform for the monitoring of the North Atlantic Ocean and tools for the sustainable exploitation of the marine resource), funded by CCDR-N (Portugal). Researchers and task leaders LOAI/CIIMAR (2020-2023).
7. **CHASE** (CHASing the environmental Effects of dust deposition across the Atlantic and Southern Ocean: a coccolithophore perspective), funded by CEECIND-FCT (Portugal). PI MARE/ARNET (2020-current).
8. **EsCo-Ensembles** (Estuarine and coastal numerical modeling ensembles for anthropogenic, extreme events and climate change scenarios), funded by FCT (Portugal). Researcher LOAI/CIIMAR (2018-2022).
9. **GPD4CCI** (GPD + Wet Tropospheric Corrections for use in the Sea level), CCI project funded by ESA. LOAI/CIIMAR participates as researcher (2022-2023).
10. **GPD4CRYOSAT** (Wet Tropospheric Correction), funded by ESA. Task leader LOAI/CIIMAR (2016-2024).
11. **GPD4S3** (S3 Altimetry GPD + Wet Tropospheric Correction), funded by EUMETSAT. Task leader LOAI/CIIMAR (2021-2024).
12. **HALO-(AC)3** (Arctic Air-Mass Transformations During Warm Air Intrusions and Marine Cold Air Outbreaks), funded by DFG (Germany). LOAI/CIIMAR participates as external collaborator and co-PI (2020-2023).
13. **HYDROCOASTAL** (Sentinel-3 and Cryosat SAR/Sarin Radar Altimetry for Coastal Zone and Inland Water), funded by ESA. Researcher LOAI/CIIMAR (2019-2023).
14. **HYDROSHIFTS** (Understanding the abrupt hydroclimate variations in the North Atlantic Middle Latitudes), funded by FCT (Portugal). PI IPMA (2022-2024).
15. **MAELSTROM** (Smart technology for MArinE Litter SusTainable RemOval and Management), funded by EU-H2020. Task leader LOAI/CIIMAR (2021-2024).
16. **Magal Constellation** (Setting the cornerstone of a future ocean and climate change monitoring constellation, based on radar altimeter data combined with gravity and ocean temperature and salinity), funded by Programme UTAustin Portugal. PI LOAI/CIIMAR (2020-2023).
17. **Med-Trap** (Unravelling seasonal dust-induced productivity changes in the Mediterranean Sea). Funded by UU-NIOZ (Netherlands). PI Royal Netherlands Institute for Sea Research, MARE/ARNET participates as team- and PhD commission member MARE/ARNET (2021-2025).

18. **MODEL RISK** (Ecosystem models to support Environmental Risk Assessment of marine ecosystems under HNS spills), funded by ITOPF (UK). Researchers and task leaders LOAI/CIIMAR (2021-2023).
19. **Ocean3R** (Reduce pressures, restore, and regenerate the NW-Portuguese ocean and waters), funded by CCDR-N (Portugal). Researchers LOAI/CIIMAR (2021-2023).
20. **PRIMUS** (PRIMary-productivity in Upwelling Systems), Earth Science Case "Comparison of sediment trap data in the Canary upwelling system using standard and Lagrangian approaches to primary production", funded by ESA. PI Plymouth Marine Laboratory, WP lead MARE/ARNET (2021-2023).
21. **S6-JTEX** (Sentinel-6 Michael Freilich and Jason-3 Tandem Flight Exploitation). Funded by CLS (UK). Researchers LOAI/CIIMAR (2021-2023).
22. **TULIP** (Towards a better Understanding of the Link between cloud microphysics and precipitation during warm air Intrusions north of the Antarctic Peninsula). Meteorological observations at the Professor Julio Escudero station, King George Island. PI LOAI/CIIMAR (2021-2022).

MAJOR INTERNATIONAL INITIATIVES

1. ARTMIP – Atmospheric Rivers Tracking methods Intercomparison Project (2017-ongoing):
Irina Gorodetskaya (LOAI/CIIMAR): active member contributing with her AR own algorithm (Gorodetskaya et al., 2014; 2020 - Antarctica; Viceto, Gorodetskaya et al., 2022 - Arctic) and Algorithm Intercomparison (Wille et al., 2019, 2022; Viceto et al 2022)
<https://www.cgd.ucar.edu/projects/artmip>
2. SCAR – Scientific Committee on Antarctic Research (2020-2028):
Scientific Research Programme AntClimNow - Near Term Variability and Prediction of the Antarctic Climate System; Irina Gorodetskaya (LOAI/CIIMAR): member of the Scientific Steering Committee <https://www.scar.org/science/antclimnow/members/>
3. YOPP – The Polar Prediction Project / The Year of Polar Prediction; and YOPP site Model Intercomparison and Improvement Project (YOPPsiteMIIP)
- YOPP-SH (2013-2023): Irina Gorodetskaya (LOAI/CIIMAR) as co-coordinator of the winter YOPP-SH targeted observing periods over the Antarctic Peninsula and leading the AP TOP forecasting team.
Polar Prediction newsletter: <https://www.polarprediction.net/news/polarpredictnews/>
IG&CDA: TOP forecasts for the winter YOPP-SH TOPs; radiosonde and precipitation measurements on King George Island
- YOPPsiteMIIP (2015-ongoing): Irina Gorodetskaya (LOAI/CIIMAR) as co-coordinator of the YOPPsiteMIIP over Antarctica and applications over the AP.
4. Members of the validation teams of the Sentinel 3, Sentinel 6 and SWOT missions
Clara Lázaro and Joana Fernandes (LOAI/CIIMAR): Members of the validation teams of the satellite altimetry measurements of the three missions: Sentinel 3, Sentinel 6 and SWOT.
Sentinel 3: 2013-current; Sentinel 6: 2021-current; SWOT: 2020-2024.

ORGANIZATION OF CONFERENCES/EVENTS

- Open Science Conference on EBUS: Past, Present and Future & Second International Conference on the Humboldt Current System, Session "Understanding the driving factors of marine productivity in EBUS", Lima, Peru, September 19-23, 2022. Primary chair MARE/ARNET.
- EGU General Assembly 2022 session "Clouds, moisture and precipitation in polar regions: Sources, Processes and Impacts". Session convener LOAI/CIIMAR.
- Atmospheric rivers and Polar Meteorology and Climate, International Atmospheric River Conference 2022, Santiago, Chile, 10-14 October 2022. Session organizer LOAI/CIIMAR.
- The role of the ocean in the climate system, CIIMAR, Matosinhos, Portugal, 18 May 2022. International course organized by LOAI/CIIMAR.
- Discussions on coastal and ocean monitoring and dynamics by ODCWS graduate and undergraduate students, CIIMAR, Matosinhos, Portugal, 22 July 2022. International workshop (LOAI/CIIMAR).

SCIENTIFIC CONFERENCES (n=30)

1. Aguiar, P., Vieira, T., Lázaro, C., Fernandes, M.J. (2022): Synergistic use of the Sentinel-3A SRAL/MWR and SLSTR Sensors for the Wet Tropospheric Correction Retrieval. 2022 Ocean Surface Topography Science Team (OSTST), Venice, Italy.
2. Alves JMR, Caldeira R, Miranda P (2022) Influência da orografia, orientação de linha de costa e temperatura de superfície do mar na estrutura do vento junto à costa 7as Jornadas de Engenharia Hidrográfica, Lisboa, Portugal.
3. Amorim, F., Morlet, O., Bastos, L., Lázaro, C. (2022): Eddy kinetic energy as a trigger for the Azores Current intensification at depth: a perspective based on ocean model reanalysis and Satellite Altimetry. Oceans from Space, Scuola Grande di San Marco, Venezia.
4. Barcelos e Ramos, J., Ribeiro, S.C., Schulz, K.G., Coelho, F. J. R. C., Oliveira, V., Cunha, A., Gomes, N., Brownlee, C., Passow, U., Azevedo, E.B., 2022. *Emiliana huxleyi* – bacteria interactions in a changing ocean (Poster at: 5th International Symposium on the Ocean in a High CO2 World, 13-16 September 2022, Peru, (online).
5. Barcelos e Ramos, J., Ribeiro, S.C., Schulz, K.G., Coelho, F. J. R. C., Oliveira, V., Cunha, A., Gomes, N., Brownlee, C., Passow, U., Azevedo, E.B., 2022. Phytoplankton - bacteria interactions in a changing ocean (Poster at: Marine microbes in a changing climate, Royal Society, 12-13 September 2022, Whittlebury, Towcester, United Kingdom).
6. Barcelos e Ramos, J., Ribeiro, S.C., Schulz, K.G., Coelho, F. J. R. C., Oliveira, V., Cunha, A., Gomes, N., Brownlee, C., Passow, U., Azevedo, E.B., 2022. Phytoplankton - bacteria interactions in a changing ocean (Presentation at: Frontiers in E3, 8th Annual Meeting, From islands to the world: interconnecting science, 8-9 September 2022, Angra do Heroísmo).
7. Bio, A., Iglesias, I. (2022): EsCo-Ensembles project. CIIMAR annual meeting, Matosinhos, Portugal.
8. Claudio Durán-Alarcón; Gorodetskaya, Irina V; Luís, Diogo; Alexis Berne; Michael Lehning; Katherine C. Leonard (2022) "Using microphysical information to constrain snowfall rate estimates from micro rain radar during the Antarctic Circumnavigation Expedition". Paper presented in Cryosphere 2022, 21-26 August, Reikjavik.
9. Fernandes, M.J., Lázaro, C., Vieira, T. (2022): Enhanced GPD+ wet tropospheric corrections for the Copernicus Sentinel-3 missions. 2022 Ocean Surface Topography Science Team (OSTST) Meeting, Venice, Italy
10. Fernandes, M.J., Lázaro, C., Vieira, T. (2022): GPD+ wet tropospheric corrections for the Sentinel-3 SRAL/MWR BC 004 and BC 005 collections. 7th Sentinel-3 Validation Team (S3VT) meeting 2022, Frascati, Italy
11. Gorodetskaya, Irina V; Claudio Duran-Alarcon; Xun Zou; Penny M. Rowe; Sergi Gonzalez-Herrero; Niels Dutrievoz; Paola Rodriguez Imazio; et al. (2022). "New record high temperatures on the Antarctic Peninsula in February 2022 during an atmospheric river event". Paper presented in Antarctic Atmospheric River Workshop 2022, Grenoble.
12. Gorodetskaya, Irina V; Durán-Alarcón, Claudio; Christophe Leroy-Dos Santos; et al. (2022). "February 2022 heatwave at the Antarctic Peninsula: subtropical moisture sources, atmospheric river and foehn". Paper presented in XIV Portuguese Conference on Polar Sciences, CCMAR, U. Algarve, Faro, Portugal 18-19 November.
13. Gorodetskaya, Irina V; et al. (2022). "Enhanced observations during the Year of Polar Prediction special observing periods for improving weather forecasting and climate projections in Antarctica". Paper presented in AntClimNow workshop on Connecting Models and Observations of the Antarctic Climate System Across Timescales, Cambridge, UK, 28-30 September.
14. Gorodetskaya, Irina V; Penny M. Rowe; Xun Zou; Anastasia Chyhareva; Claudio Duran-Alarcon; et al. (2022). "Heatwaves and rainfall at the Antarctic Peninsula associated with atmospheric rivers from Year of Polar Prediction enhanced observations and regional climate modeling". Paper presented in Cryosphere 2022, August 21–26, Reikjavik.
15. Gorodetskaya, Irina V; Penny M. Rowe; Xun Zou; Anastasia Chyhareva; Svitlana Krakovska; Cordero, Raul R. (2022). "Antarctic Peninsula warming and precipitation phase transition during atmospheric river events". Paper presented in The D-A-CH Meteorology Conference (DACH-2022), Leipzig.
16. Gorodetskaya, Irina V; Xun Zou; Durán-Alarcón, Claudio; Rowe, Penny; Kyle Clem; Sergi Gonzalez-Herrero; et al. (2022). "Summer 2022 temperature extremes at the Antarctic Peninsula triggered by a strong atmospheric river and foehn". Paper presented in International Atmospheric River Conference 2022, Santiago, Chile, 10-14 October.

17. Guerreiro, C.V., Baumann, K-H., Brummer, G-J., Valente, A., Ziveri, P., Brotas, V., Stuut, J-B., 2022. Drivers of coccolithophore CaCO₃ export production between NW Africa and the Caribbean: implications for the biological carbon pump. Open Science Conference on EBUS: Past, Present and Future & Second International Conference on the Humboldt Current System, Session 7: Understanding the driving factors of marine productivity in EBUS. Lima, Peru, September 19-23.
18. Hodell, D.A., Abrantes, F., and Alvarez Zarikian, C.A. (2022). Expedition 397 Scientific Prospectus: Iberian Margin Paleoclimate. International Ocean Discovery Program. <https://doi.org/10.14379/iodp.sp.397.2022>
19. Iglesias, I. (2022): EsCo-Ensembles project: objectives and methodologies. Estuaries: Challenges for present and future management, Final Workshop of the EsCo–Ensembles project, Estuarine and coastal numerical modelling ensembles for anthropogenic, extreme events and climate change scenarios. Leça da Palmeira, Portugal.
20. Iglesias, I., Bio, A. (2022): Coastal and Ocean Dynamics, Monitoring and Management. Workshop CIIMAR – The Reef Company, CIIMAR, Terminal de Cruzeiros do Porto de Leixões, Portugal
21. Iglesias, I., Pinho, J.L., Bio, A., Avilez-Valente, P., Melo, W., Gomes, A., Vieira, J.M., Bastos, L., Veloso-Gomes, F. (2022): EsCo-Ensembles: Ensembles de modelos hidrodinâmicos aplicados en áreas estuarinas y costeras. AEC 2022, Santiago de Compostela, Spain.
22. Jonathan D. Wille; Favier, V.; Kittel, Christoph; Pohl, Benjamin; Cavallo, S.; Christophe Leroy-Dos Santos; Gorodetskaya, Irina V. (2022). "Antarctic Atmospheric River Life Cycles". Paper presented in EGU General Assembly 2022, Vienna.
23. Martins, I., Amorim, F. (2022): Numerical tools to support Environmental Risk Assessment (ERA) in the ocean. One Sustainable Ocean UNOC, Ocean Science and Business2Sea, a joint initiative organized by Lisbon City Council, Fórum Oceano, Science and Technology Foundation, University of Lisbon.
24. Melo, W., Pinho, J.L., Iglesias, I. (2023): Desenvolvimento de um emulador de modelos numéricos para redução do tempo de cálculo em simulações da morfodinâmica estuarina e costeira. 16 Congresso da Água, Lisbon, Portugal.
25. Pedro Aguiar, Telmo Vieira, Clara Lázaro, M. Joana Fernandes (2022): Sentinel-3 SRAL/MWR and SLSTR Sensors Synergy for the Retrieval of the Wet Tropospheric Correction. 7th Sentinel-3 Validation Team Meeting 2022 (hybrid).
26. Penny M. Rowe; Gorodetskaya, Irina V; Anastasia Chyhareva; Cordero, Raul R.; Xun Zou (2022). "Characterization of Atmospheric River and Foehn Events over the Antarctic Peninsula". Paper presented in ICSHMO 2022 - 13th International Conference on Southern Hemisphere Meteorology and Oceanography.
27. Penny M. Rowe; Xun Zou; Gorodetskaya, Irina V; et al. (2022). "Foehn Warming over the Antarctic Peninsula Amplified by Strong Atmospheric Rivers". Paper presented in 17th Workshop on Antarctic Meteorology and Climate (WAMC), August 4-6, Madison, WI.
28. Stuut, J-B., Guerreiro, C.V., Brummer, G-J., van der Does, M., 2022. Monitoring present-day Saharan dust above and below the ocean surface. EGU General Assembly 2023, Session AS3.10 "Aeolian dust: initiator, player, and recorder of environmental change, 23–28 April, Viena, Austria.
29. Stuut, J-B., Guerreiro, C.V., Brummer, G-J., van der Does, M., 2022. Monitoring present-day Saharan dust above and below the ocean surface. Open Science Conference on EBUS: Past, Present and Future & Second International Conference on the Humboldt Current System, Session 7: Understanding the driving factors of marine productivity in EBUS. Lima, Peru, September 19-23.
30. Stuut, J.-B., Guerreiro, C., Brummer, G.-J., and van der Does, M., 2022. Monitoring present-day Saharan dust at sea. EGU General Assembly 2022, Session AS3.10 "Aeolian dust: initiator, player, and recorder of environmental change (online)

OUTREACH ACTIVITIES & PARTICIPATION AT MAJOR EVENTS:

UN Ocean Conference, Lisbon (27 Jun – 1 Jul 2022); participation at several events (e.g.):

- Episode of radio Show "90 seconds of Science" of Antena 1 titled "Antarctic, microplastics and conservation photography: How Portuguese researchers are leading international marine research and public engagement in ocean protection", 28 June 2022. Invited researchers: Nuno V. Rodrigues, Paula Sobral and José Xavier (MARE/ARNET).

- “One Sustainable Ocean - Ocean Science & Business2Sea”, ARNET Exhibition (June 27 to July 1).
- Virtual event “From the Southern Ocean to the Arctic - a Call to Action via the UN Ocean Decade”, 26 June. Invited member of the discussion panel: José Xavier (MARE/ARNET).
- Symposium “Talking about Ocean Conservation in Portuguese”, 27 June. Invited speaker: Rui Rosa (MARE/ARNET).
- Event titled “Marine Protected Areas, Source-to-sea Concepts and Multi-use of Marine Space”, on the 30 June, Pavilion of Knowledge - Ciência Viva, in Lisbon.
- Side-event titled “Ocean Research: the future for science collaboration”, hosted by the Faculty of Sciences of the University of Lisbon, co-organized by the British Embassy in Lisbon and Innovation Network, 28 June. Invited speakers: Xavier, J. and Brotas, V. (MARE/ARNET)
- Side-event titled “MAGAL, Ocean Radar Altimetry, a New Space Approach”, 30 June 2022, Lisbon, Portugal (LOAI/CIIMAR).

All-Atlantic Ocean Research Alliance 2022 Forum 12-14 July, National Academy of Sciences, Washington DC, USA, [including Side Event on “Research Cooperation from Pole to Pole”, hosted by the Portuguese Embassy in Washington DC]. Invited participant researcher: Guerreiro, C.V. (MARE/ARNET).

NANNOTALKS - International Association of Nannoplankton, June 2022 (online event). Invited speaker: Guerreiro, C.V. (MARE/ARNET) “Influence of dust on the export production of calcifying phytoplankton (coccolithophores) between NW Africa and the Caribbean: implications for the biological carbon pump”.

PaleoForum - Instituto do Mar e da Atmosfera, June 2022 (online event). Invited speaker: Guerreiro, C.V. (MARE/ARNET): “Influence of dust on the export production of calcifying phytoplankton (coccolithophores) between NW Africa and the Caribbean: implications for the biological carbon pump”.

IMPECAF & ROADMAP Projects Workshop on “Extreme events in the atmosphere and the ocean”, March 2022, Instituto Dom Luiz, University of Lisbon (hybrid event). Invited speaker: Guerreiro, C.V. (MARE/ARNET): “Influence of dust on the export production of calcifying phytoplankton (coccolithophores) between NW Africa and the Caribbean: implications for the biological carbon pump”.

Solid Earth Seminars, Instituto Dom Luiz, January 2022 (online event). Invited speaker: Guerreiro, C.V. (MARE/ARNET): “Influence of dust on the export production of calcifying phytoplankton (coccolithophores) between NW Africa and the Caribbean: implications for the biological carbon pump”.

Website/interactive blogs of projects CHASE (www.chase-dust.com) and PRIMUS (www.primus-atlantic.org) (creation and coordination MARE/ARNET).

FIELDWORK

EUROFLEETS+ EXPEDITION CARBO-ACID (SEA02-10-Carbo-Acid), on board RV Ramon Margalef, 2–11 August 2022, aimed at collecting high-resolution data towards investigating the potential effects of ocean acidification on carbonated marine organisms (coccolithophores, pteropods, planktonic and benthic foraminifera, and corals) along the Iberian coastal upwelling system. PI CIMAR/IPMA.

EUROFLEETS+ EXPEDITION SINES (Climate Change Impact on Ocean Fronts Ecosystems: the case of the Iberian Upwelling System), on board RV Sarmiento de Gamboa, 10–20 September 2022, to collect high-resolution data from a broad range of environmental parameters across an upwelling front offshore the SW coast of Portugal. The multi-proxy collected material will contribute to develop new calibration biological and biogeochemical proxies to be used as a baseline for the identification, quantification, and validation of modern ecosystem changes with respect to pre-industrial status. PI CIMAR/IPMA

EXPEDITION IODP 397 Iberian Margin Paleoclimate, on board of RV JOIDES Resolution during 11 October–11 December 2022, aimed at studying the role that millennial-scale climate change played in the waxing and waning of the great Northern Hemisphere ice sheets, as well as in land-ocean interactions, back to 3–5 million years ago through the geologic periods Quaternary and Pliocene. PI CIMAR/IPMA.

3. List SOLAS-related publications published between 2022 and April 2023 (only PUBLISHED articles) and if any, web links to models, datasets, products, etc.

1. Aguiar, P., Vieira, T., Lázaro, C., Fernandes, M.J. (2022). Synergistic Use of the SRAL/MWR and SLSTR Sensors on Board Sentinel-3 for the Wet Tropospheric Correction Retrieval. *Remote Sensing*, 14(13), 3231 <https://doi.org/10.3390/rs14133231>
2. Barcelos e Ramos, J., Ribeiro, S.C., Schulz, K.G., Coelho, F. J. R. C., Oliveira, V., Cunha, A., Gomes, N. C. M., Brownlee, C., Passow, U., Azevedo, E. B. (2022). *Emiliania huxleyi* – Bacteria interactions under increasing CO₂ concentrations, *Microorganisms*, 10 (12), 2461. <http://dx.doi.org/10.3390/microorganisms10122461>
3. Bresson, H., Rinke, A., Mech, M., Reinert, D., Schemann, V., Ebell, K., Maturilli, M. et al. (2022). Case study of a moisture intrusion over the Arctic with the ICOSahedral Non-hydrostatic (ICON) model: resolution dependence of its representation. *Atmospheric Chemistry and Physics* <https://doi.org/10.5194/acp-22-173-2022>
4. Collow, A. B. M., Shields, C. A., Guan, B., Kim, S., Lora, J. M., McClenny, E. E., Nardi, K., et al. (2022). An Overview of ARTMIP's Tier 2 Reanalysis Intercomparison: Uncertainty in the Detection of Atmospheric Rivers and Their Associated Precipitation. *Journal of Geophysical Research: Atmospheres* 127 (8), <http://dx.doi.org/10.1029/2021jd036155>
5. Melo, W., Pinho, J.L., Iglesias, I. (2023). Coastal morphodynamic emulator for early warning short-term forecasts. *Environmental Modelling and Software*, 165, 105729 <https://doi.org/10.1016/j.envsoft.2023.105729>
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4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2022? If yes, who? How did you engage?

N/A

PART 2 - Planned activities for 2023 and 2024

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).

FIELDWORK

DUST 2023 EXPEDITION (64PE514): took place from 6– 27 March 2023 on board RV *Pelagia*, sailing from Mindelo (Cape Verde) to Malaga (Spain), led by the Royal Netherlands Institute for Sea Research, and including MARE/ARNET participant Catarina V. Guerreiro. The goal was to investigate the biogeochemical effects of Saharan dust deposition on the biological carbon pump, focusing on the calcifying phytoplankton communities. Outcomes from this

international collaboration will contribute to projects FCT-CHASE (www.chase-dust.com) and ESA-PRIMUS (www.primus-atlantic.org) ongoing at MARE/ARNET. Part of the collected material will provide the basis for the soon to be started MSc thesis in Marine Sciences at the Faculty of Sciences of the University of Lisbon (supervision: Catarina V. Guerreiro).

ATLANTIC MERIDIONAL TRANSECT (AMT30–DY157): took place from 21 February to 30 March 2023 on board RRS *Discovery*, sailing from the Falkland Islands to Southampton (UK), led by Plymouth Marine Laboratory (PML) and including MARE/ARNET participants (Andreia Tracana and Federico Ienna). The goal was to collect material for the study of the phytoplankton communities across the Atlantic in relation to carbon chemistry, nutrient distribution, nitrogen fixation, optical properties, oxygen status, air-sea gas exchange, atmospheric deposition, and particle export. Outcomes from this international collaboration will contribute to ongoing collaborations between MARE/ARNET and PML, in the context of the AMT program.

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).

OUTREACH EVENTS:

Webinar “Ocean Changes: a plankton story, from open waters to the lab” organized by HIPÁCIA (Association of Portugal-residing Italian Researchers), in collaboration with the Embassy of Italy in Lisbon, SCIAENA, and Italian Culture Institute, 14 April 2023 (online). Invited speaker: Guerreiro, C.V. (MARE/ARNET) “Chasing the effects of dust across the Atlantic Ocean: a coccolithophore perspective”.

Conference “An ocean of opportunities” organized by the City Hall of Torres Vedras (Portugal) in celebration of the Ocean’s International Day at the Environmental Interpretation Center of the Local Nature Reserve Foz Azul, 8 June 2023. Invited speaker: Guerreiro, C.V. (MARE/ARNET) “How marine phytoplankton contributes to sequester atmospheric CO₂”.

EDITORIAL ACTIVITIES:

Research Topic at Frontiers in Marine Science: “Aerosol Deposition in the Ocean: Drivers and Biogeochemical Effects” (section: Ocean Observation), IF 5.247, CiteScore 5.2. Deadline: 30 November 2023. <https://www.frontiersin.org/research-topics/52367/aerosol-deposition-in-the-ocean-drivers-and-biogeochemical-effects> Guest Editorial Team: Guerreiro, C.V. (MARE/ARNET), Guieu, C. (LOV); Stuet, J-B. (NIOZ); Jickells, T. (EAU)

Special Issue at Deep-Sea Research Part II: “Eastern Boundary Upwelling Systems (EBUS): Past, Present and Future”, IF 2.887, CiteScore 6.9. Deadline: 31 January 2024. <https://www.sciencedirect.com/journal/deep-sea-research-part-ii-topical-studies-in-oceanography/about/call-for-papers#eastern-boundary-upwelling-systems-ebus-past-present-and-future> Guest Editorial Team (e.g.): Guerreiro, C.V. (MARE/ARNET)

ORGANIZATION OF CONFERENCES/EVENTS:

SOLAS Session at the Ocean Sciences Meeting (OSM): “The Biogeochemistry of Air-Sea Exchange Processes”, February 2024, New Orleans, Louisiana, USA. Primary chair: Catarina V. Guerreiro (MARE/ARNET); Co-chairs: Andrew S. Wozniak, University of Delaware; Amanda A. Frossard, University of Georgia; Jan-Berend W. Stuet, NIOZ and Vrije Universiteit Amsterdam.

Discussions on research topics developed by LOAI and MEMO graduate and undergraduate students, CIIMAR, Matosinhos, Portugal, 13 July 2023. International workshop organized by LOAI/CIIMAR.

CONFERENCE PRESENTATIONS:

Stuet, J-B., Guerreiro, C.V., van der Does, M. (2023). Monitoring present-day Saharan dust above and below the ocean surface. XXI INQUA Congress 2023, Session 35 on “Dust dynamics through the Quaternary: terrestrial records of climatic and environmental impacts”, 13 - 20 July 2023, Rome, Italy.

Gorodetskaya, I. V. et al. (2023). YOPPsiteMIIP applications over the Antarctic Peninsula. Paper presented in Workshop on Model Intercomparison and Improvement Projects for the polar regions and beyond, Stockholm University, Sweden, 17-20 April.

Melo, W., Pinho, J.L., Iglesias, I. (2023): Desenvolvimento de um emulador de modelos numéricos para redução do tempo de cálculo em simulações da morfodinâmica estuarina e costeira. 16 Congresso da Água, Lisbon, Portugal.

SUBMITTED PAPERS:

Sierra A., Correia C., Ortega. T., Forja. J., Rodrigues, M. and Cravo A. Dynamics of CO₂, CH₄, and N₂O in Ria Formosa coastal lagoon (Southwestern Iberia) and export to the Gulf of Cadiz. Submitted to Science of the Total Environment (April 2023).

3. Funded national and international projects/activities underway.

In addition to most of the Projects and Major International Initiatives indicated in PART 1.2:

2023-2024: MAPS (Measurements and modelling of the atmospheric and oceanic boundary layers at the northern Antarctic Peninsula during the Year of Polar Prediction Special observing periods). Funded by FCT (Portugal). PI and co-PI LOAI/CIIMAR.

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).

SCOR Working Group “Towards best practices for Measuring and Archiving Stable Isotopes in Seawater (MASIS)”. Proposal submitted to SCOR in May 2023, aimed at remedying existing issues of data collection, quality control, and compilation of stable isotopes in seawater, through e.g., assessing the validation stage of the available stable isotopic datasets; reporting on the best practices from sample collection to measurement and quality control; and reviewing current methods of bias adjustment in archives towards providing recommendations for the future to standardize these bias adjustments. Co-PI Antje Voelker, IPMA (Portugal).

5. Engagements with other international projects, organisations, programmes, etc.

N/A

Comments

The Portuguese SOLAS community reported here is very active on a personal/research group basis and/or by being involved in SOLAS-related studies in the context of national/international projects, but without being organised as SOLAS-Portugal. This report represents a valuable first step in that direction while providing a first assessment of the SOLAS-related activity developed in Portugal and by disclosing it to both the national and the international communities. This will surely contribute to stimulate scientific networks both inside of Portugal and within the international SOLAS community, likely to result in more interdisciplinary, robust, and evidence-based SOLAS-related science.

ARDITI - Regional Agency for the Development of Research, Technology and Innovation

ARNET – Aquatic Research Network

CIIMAR - Interdisciplinary Centre of Marine and Environmental Research

CIMA – Marine and Environmental Research Center

IDL – Instituto Dom Luiz

IITAA – Instituto of Agricultural and Environmental Research and Technology

IPMA - Portuguese Institute for Sea and Atmosphere,

LOAI - Land Ocean and Atmosphere Interactions

MARE – Marine and Environmental Sciences Center

OOM - Madeira Ocean Observatory