



**ULPGC**  
Universidad de  
Las Palmas de  
Gran Canaria

# OCEANOGRAFÍA Y CAMBIO GLOBAL: PERSPECTIVAS PARA LA FORMACIÓN DE FUTUROS INVESTIGADORES

Líneas de investigación del programa de doctorado del IOCAG



**ULPGC**

Instituto Universitario de  
Oceanografía y Cambio Global





Mesocosms (GEOMAR) at Gran Canaria

**Research Interests:**

Our group studies how Climate Change shapes pelagic ecosystems, in terms of productivity, plankton community structure, and carbon fluxes and sequestration in the dark ocean. Our work includes field studies of plankton ecology and ecophysiology, microbial oceanography and biogeochemistry, spanning from the submesoscale to the large scale in the ocean. We also address experimental studies with microcosms and mesocosms to look at the effects of climate change on planktonic communities, and to evaluate nature-based solutions to remove carbon dioxide.

The group has concentrated most of its efforts in the Canary Current and NW Africa coastal upwelling regions that surround us, although we collaborate closely with other national and international groups to engage in many international cruises and field studies around the world.

We are particularly committed to the social dissemination of our activities at science fairs, media, public conferences and schools.

**NEWS**



**Ocean Alkalinity Enhancement**  
Using slaked lime to fight climate change



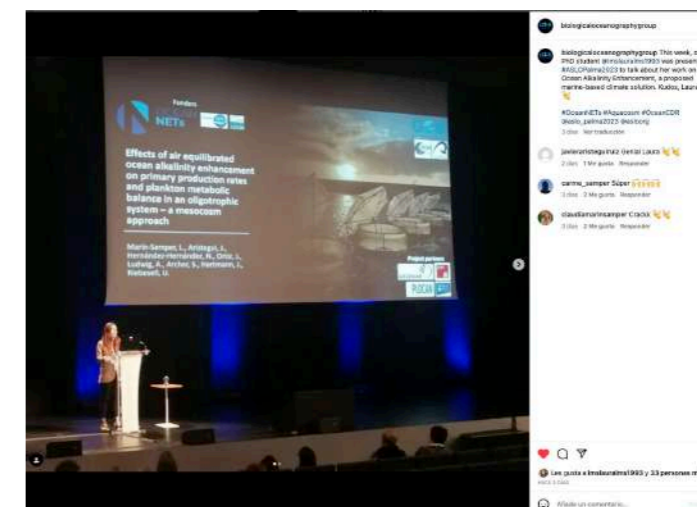
**International Training Course on Mesopelagic Respiration takes place!**  
Early career researchers learn about the latest methods used to measure mesopelagic respiration in the ocean



# Grupo de Investigación: Oceanografía Biológica



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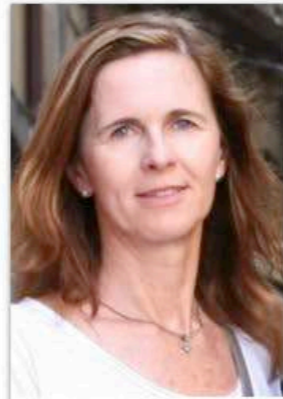




## People



**Javier Arístegui**  
*Professor*



**María F. Monte...**  
*Lecturer*



**Nauzet Hernán...**  
*Postdoc*



**Beatriz Fernán...**  
*Postdoc*



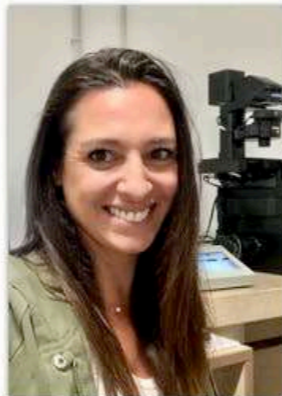
**Joaquín Ortiz**  
*Postdoc*



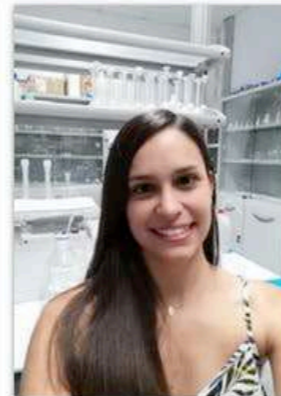
**Aja Trebec**  
*Ph.D. Student*



**Laura Marín-Sa...**  
*Ph.D. Student*



**Minerva Espino**  
*Lab Technician*



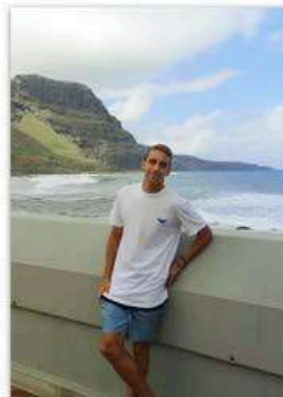
**Acorayda Gonz...**  
*Lab Technician*



**Claudia de la G...**  
*Lab Technician*



**Ianna Francine...**  
*Outreach  
Manager*



**Álvaro Delgado**  
*Student Intern*

## GRUPO DE INVESTIGACIÓN

# GRUPO DE INVESTIGACIÓN

## Alumni

**Markel Gómez Letona** (ULPGC, Ph.D. 2018-2023)

**Lucía Palacios** (Research Assistant, 2021-2023)

**Isabel Baños** (ULPGC, Ph.D. 2017-2022)

**Asier Furundarena** (Research Assistant, 2016-2021)

**Javier Berdún** (ULPGC, Ph.D. 2020 \*)

**Marta Sebastián** (PostDoc 2018 – 2020) - <https://emm.icm.csic.es/member/marta-sebastian/>

**Yeray Santana (ULPGC, Ph.D. 2010 – 2017)** - <https://www.researchgate.net/profile/Yeray-Santana-Falcon>

**Ignacio Pérez Mazuecos** (University of Granada, Ph.D. 2010 – 2015, co-directed by I. Reche & J. M. Gasol)

**Valeria Anabalón** (ULPGC & UnC (Chile), Ph.D. 2010 – 2019, co-directed by C. Morales)

**Mar Benavides** (ULPGC, Ph.D. 2008 – 2012, co-directed by N. Agawin) - [www.oceanbridges.net](http://www.oceanbridges.net)

**Federico Baltar** (ULPGC, Ph.D. 2006 – 2010, co-directed by G. Herndl and J. M. Gasol) - <https://fiskote.wixsite.com/website>

**Iván Alonso** (ULPGC, Ph.D. 2006 – 2010, co-directed by A. Calafat) - <http://www.oceomic.com>

**Ana Mendonca** (University of Azores, Ph.D. 2005 – 2011, co-directed by A. Martins)

**Juan Carlos Vilas** (ULPGC, Ph.D. 2002 \*)

**Mercedes García Muñoz** (ULPGC, Ph.D. 2000 – 2006)

**Kornelis van Lenning** (ULPGC, Ph.D. 1995 – 2000, co-directed by M. Zapata)

**Alicia Ojeda** (ULPGC, Ph.D. 1994 – 1998)

**Javier Almunia** (ULPGC, Ph.D. 1994 – 1998)

**Salomé Ballesteros** (ULPGC, Ph.D. 1989 – 1994)

**Gotzon Basterretxea** (ULPGC, Ph.D. 1990 – 1994)

**Rienko H. J. Vanderschuur** (University of Groningen, M.Sc. 1990 – 1991, co-directed by W.W.C. Gieskes)



# LINEAS DE INVESTIGACIÓN

- La Bomba Biológica de Carbono en el océano
- Monitorización de la calidad del agua
- Impacto de multi-estresores climáticos
- Soluciones basadas en el océano para remover CO<sub>2</sub>

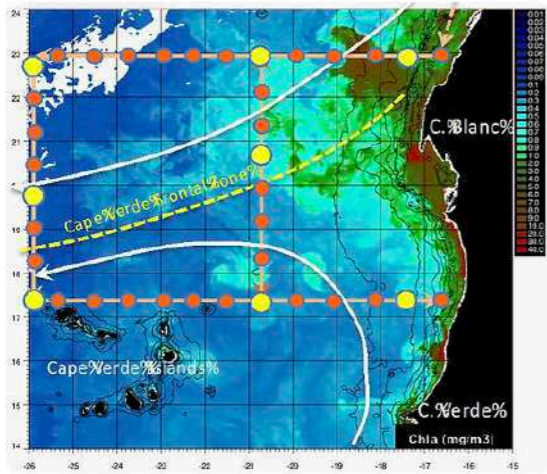


# LA BOMBA BIOLÓGICA DE CARBONO EN EL OCÉANO

- Producción primaria/ respiración comunitaria, estructura, función y biodiversidad de comunidades planctónicas.
- Influencia de procesos físicos (submesoescala) sobre la biogeoquímica marina y el transporte y secuestro de carbono disuelto y particulado
- Balance biogeoquímico entre fuentes (flujos de carbono) y sumideros (respiración en la columna de agua)
- Regiones de Afloramiento -Corrientes de Frontera

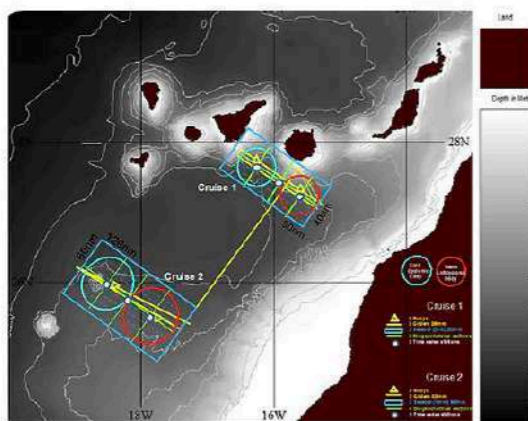


# LA BOMBA BIOLÓGICA DE CARBONO: PROYECTOS



## **FLUXES (2016-2019): Constraining organic carbon fluxes in an eastern boundary upwelling ecosystem (NW Africa): the role of non-sinking carbon in the context of the "biological pump" (CTM2015-69392-C3)**

The main goal of FLUXES is to quantify the relevance of labile and semi-labile dissolved (DOC) and suspended (POCs) organic carbon (i.e. non-sinking organic carbon) in the context of the biological pump (BP), in Eastern Boundary Upwelling Ecosystems (EBUE). The Cape Blanc region (NW Africa), characterized by a rich mesoscale variability resulting from the interaction of the upwelling system and the Cape Verde Frontal Zone that built up the Giant Filament, will be used as a case study. We want to test the hypothesis that offshore lateral advection of POCs, as well as secondary circulation at the submesoscale range and vertical mixing of DOC and POCs, contribute significantly to the export of organic carbon in EBUE.

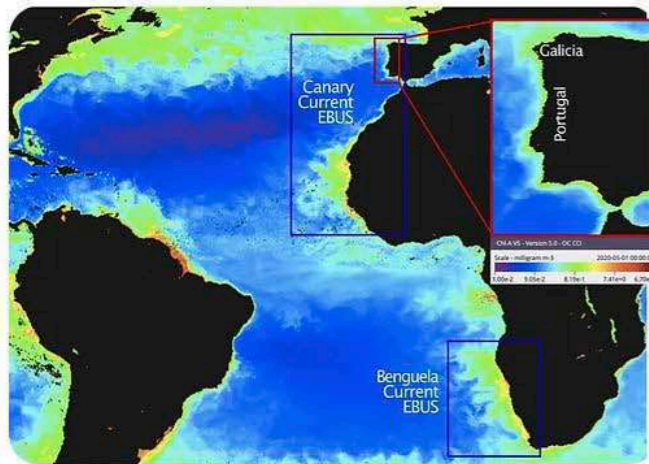


## **e-IMPACT (2020-2023): Biogeochemical impact of mesoscale and sub-mesoscale processes along the life history of cyclonic and anticyclonic eddies: plankton variability and productivity (PID2019-109084RB-C21)**

This project aims to assess the relevance of oceanic subtropical cyclonic (C) and anticyclonic (A) mesoscale eddies in the context of the Biological Pump (i.e. the production of organic matter and its transport to the deep ocean). To achieve this goal, we will study the linkage in the dynamics of mesoscale (O~100 km) and sub-mesoscale (O~10 km) physical processes and their biological and biogeochemical impacts, along the life history of C and A eddies (from their generation to a mature stage), in the Canary Current Corridor. The project will combine traditional oceanographic sampling with novel instrumentation (e.g. buoys and gliders) to sample down to the sub-mesoscale.



# LA BOMBA BIOLÓGICA DE CARBONO: PROYECTOS



## **PRIMUS - PRIMary-productivity in Upwelling Systems**

PRIMUS is an international multidisciplinary project funded by ESA that aims to substantially advance our existing understanding on the link between net primary production (NPP) and wind-forced upwelling in Atlantic Eastern Boundary Upwelling Systems (EBUS), through combining Earth Observation (EO) data obtained from satellite remote sensing, with upwelling and climate indices, data collected in-situ, and ocean circulation modelling.



## **OceanICU (2022-2027): Improving Carbon Understanding (HORIZON-CL6-2022-CLIMATE-01, 101083922)**

The Ocean plays a crucial role in the global C cycle, acting as a sink and thus slowing the rate of climate change. Ocean ICU will measure key biological processes within the biological C pump and evaluate their overall significance, transferring those that are important into models that inform the IPCC process and, in this way, contribute to resolving the observed model data mismatch of Ocean C sink estimates. They will use the acquired fundamental knowledge around biological systems to evaluate the ability of human interventions in the ocean to alter the carbon cycle and produce management tools that allow the tension between resource extraction and C storage to be addressed.





# LA BOMBA BIOLÓGICA DE CARBONO: PROYECTOS



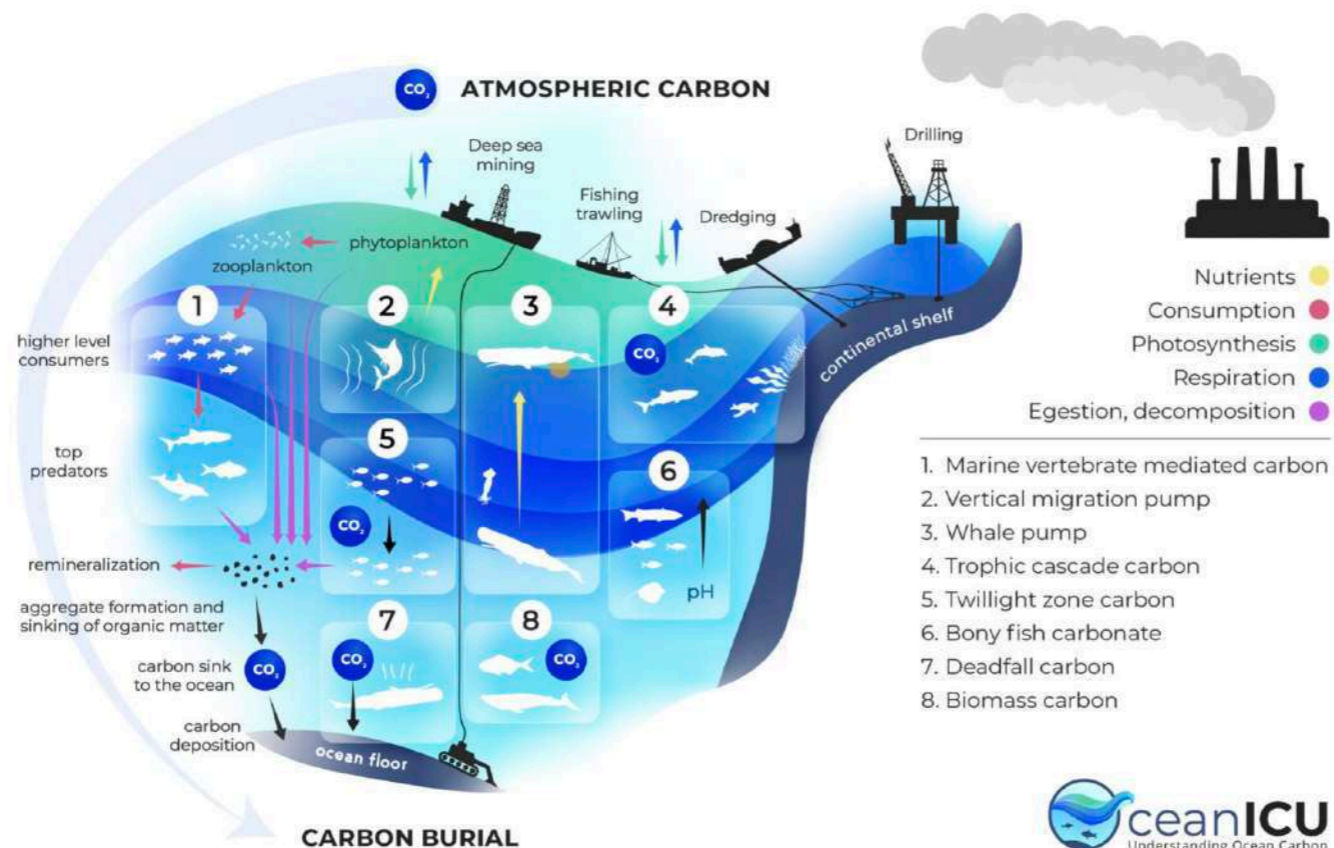
## WP4 | Ecosystem controls on carbon sequestration

**WP4 Leaders:** Stephanie Henson (NOC) and Javier Arístegui (ULPGC)

**Contributors:** DTU-Aqua, AMU, AWI, University of Azores, PML, IIM-CSIC, IMR

This WP4 group will measure and quantify key ecological processes within the biological carbon pump related to the ecosystem structure. This activity will involve data synthesis and fieldwork across the whole Atlantic and in the Arctic to generate a new understanding of these processes and define parameterisations to model higher trophic level behaviour, active transport by vertical migrants, and dark carbon fixation/respiration.

### ► Work package objectives



# MONITORIZACIÓN DE LA CALIDAD DEL AGUA

- Monitorización del estado de salud de las aguas costeras de Canarias (e.g. Playa de Las Canteras)
- Desarrollo de índices biológicos / microbianos de contaminación ambiental (citometría de flujo, análisis de imágenes, diversidad molecular)
- Estudio de floraciones de cianobacterias, mucílago marinos y comunidades microbianas (fitoplancton, bacterias y protozoos) asociadas

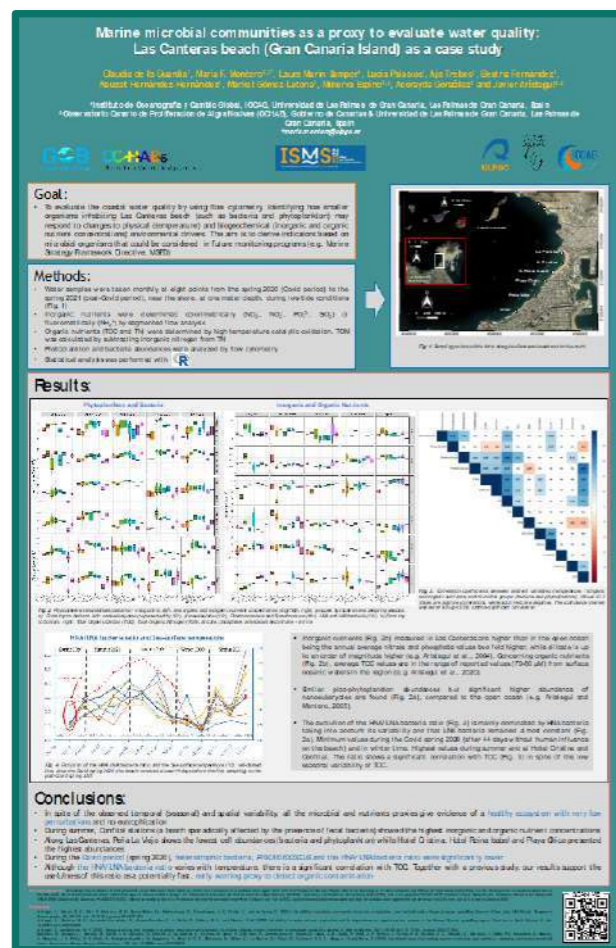


# MONITORIZACIÓN DE LA CALIDAD DEL AGUA: PROYECTOS



## TRICHODESMIUM (2021-2023) (Gobierno de Canarias)

The focus of this project is to monitor *Trichodesmium* blooms in the Canary Islands, consolidate the predictive model developed in the previous *Trichodesmium* project, control the possible beneficial or adverse effects of the blooms and, in the last place, control pathogens associated to *Trichodesmium* mucilages dragged to the coasts.



INVESTIGA EN LAS CANTERAS (2020-2023). Convenio de colaboración entre el Ayuntamiento de Las Palmas de Gran Canaria y la ULPGC para desarrollar acciones y actividades de investigación en la costa de la Bahía del Confital-Las Canteras



# MULTI-ESTRESORES CLIMÁTICOS

- Impacto de multi-estresores climáticos sobre comunidades planctónicas marinas
- Simulación de escenarios futuros: calentamiento + acidificación + fertilización de macro y micronutrientes + deposición de polvo
- Experimentos en microcosmos y mesocosmos

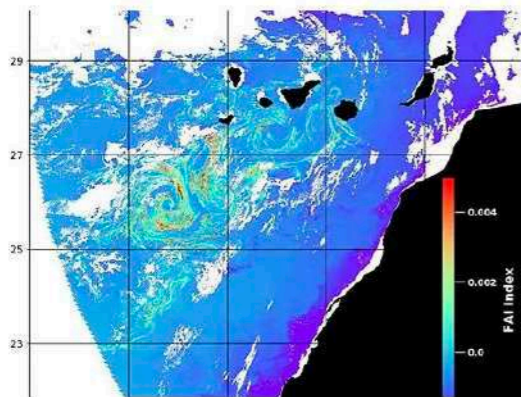


# MULTI-ESTRESORES CLIMÁTICOS: PROYECTOS



## **FONIAC (2020-2022): Natural Ocean Fertilization: Upwelling and Aerosol Impacts on Marine Production (Caja Canarias/La Caixa; 2019SP12)**

The hypothesis and general objective of this project is to verify if the sea surface temperature increase, together with the micro- and macronutrient fertilization that may result from natural upwelling (due to an increase in mesoscale process' occurrence) and/or atmospheric deposition (caused by the potential aerosol intensification), have a combined effect on primary production and phytoplankton community structure. The temperature increase and intensified fertilization rates may be causing a shift in phytoplankton populations, which may become dominated by larger species. Thus, potentially posing alterations in higher trophic levels (fish). The study will be conducted through controlled experiments in which the covariation between fertilization rates and temperature will be analysed.

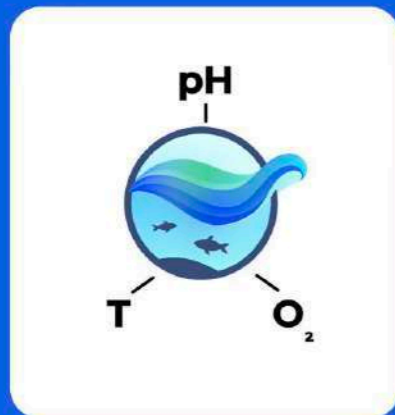


## **TRICOFER (2021 - 2023) Trichodesmium Fertilization of Primary Production in the Canary Islands**

The aim of this project is to study the fertilization effect of *Trichodesmium* spp blooms on the Canary Islands waters, which could lead to an increase in primary production. The progressive temperature increase and water column stratification occurring in the Canary Islands region has resulted into recurrent *Trichodesmium* blooms in the last few years. When colonies aggregate in the surface, they collapse and die, liberating high inorganic nutrient and organic matter concentrations to the water column (before sinking), which favour the exuberating growth of other planktonic organisms, acting as a fertilizer in the marine food web. If our hypothesis is correct, the increasing occurrence of *Trichodesmium* blooms in the near future could partially palliate the reduction in primary productivity in the Canary region as predicted by climatic models, due to the sea surface progressive warming.



# MULTI-ESTRESORES CLIMÁTICOS: PROYECTOS



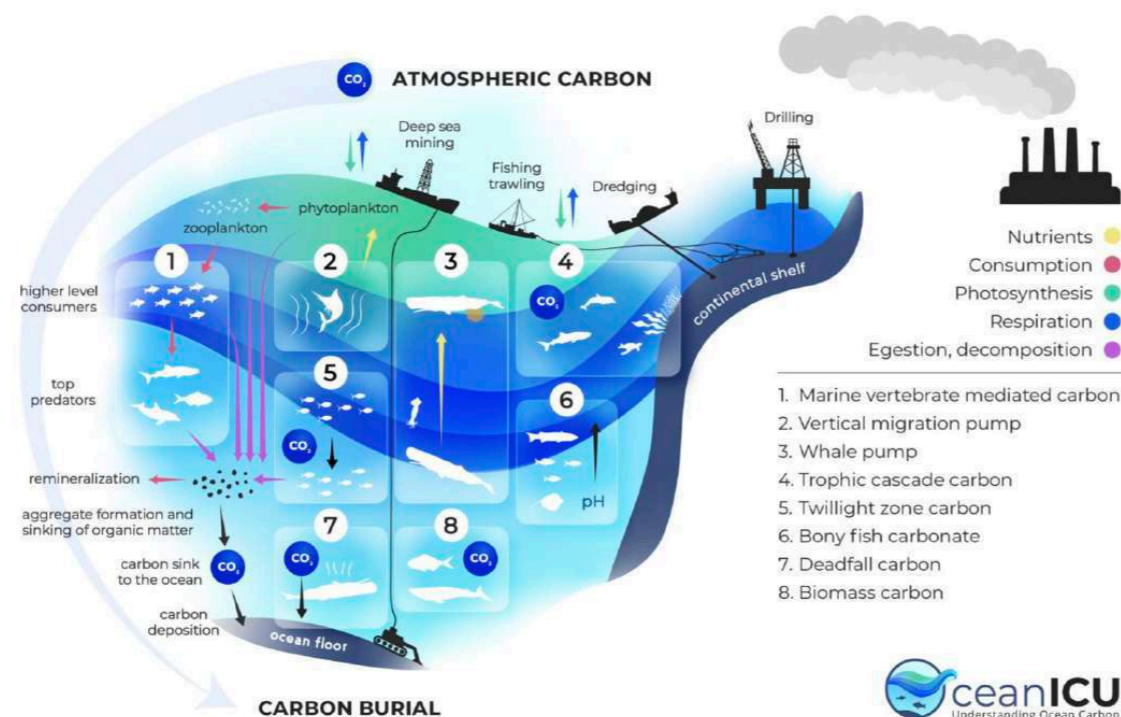
## WP3 | Impacts of Abiotic Climate Stressors (pH, O<sub>2</sub> & T) on the Biological Carbon Pump (BCP)

**WP3 Leader:** Jan Taucher (GEOMAR), Heriot Watt (Poulton)

**Contributors:** GEOMAR, Heriot Watt, Liverpool, NUI Galway, ULPGC, Exeter, LSCE

The key focus for WP3 is to undergo research activities to investigate the impact of ocean climate (temperature, T), acidification (pH) and deoxygenation (O<sub>2</sub>), and in light of recent increases in fire intensity, ash deposition on the biological carbon pump functioning. This will involve data synthesis, fieldwork in the Canaries and Southern Ocean, habitat and resilience model development to generate new understanding and parameterizations of the impact of climate multi-stressors (T, pH, O<sub>2</sub>, Aerosol) in the biological carbon pump. Key results will be introduced to models in collaboration with the partners in WP5.

### ► Work package objectives

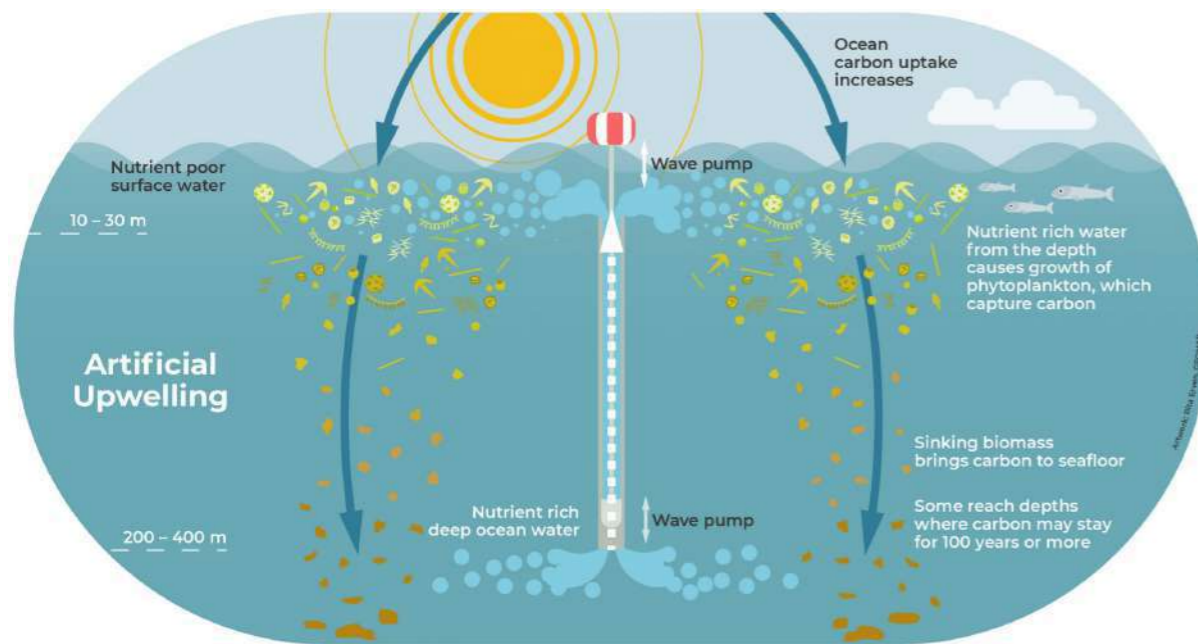


# SOLUCIONES BASADAS EN EL OCÉANO

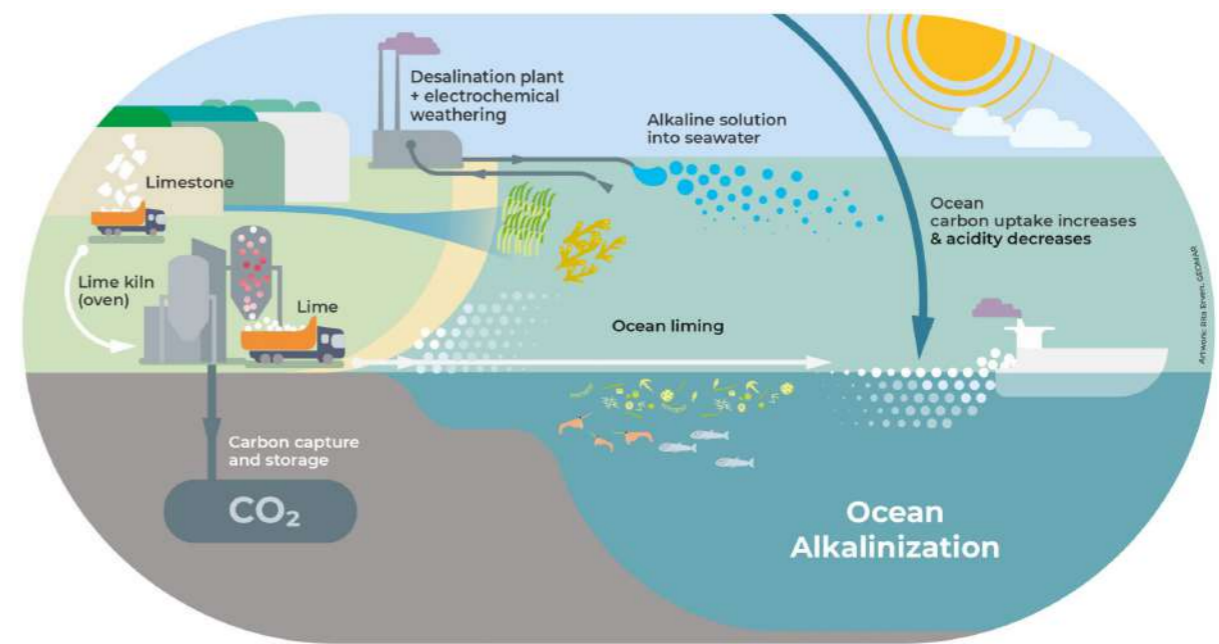
- Soluciones basadas en el océano para remover  $\text{CO}_2$  : impactos sobre ecosistemas

Negative Emission Technologies (NETs) – Carbon Dioxide Removal technologies (CDRs)

## Afloramiento artificial



## Alcalinización oceánica



# SOLUCIONES BASADAS EN EL OCÉANO: PROYECTOS

## Research

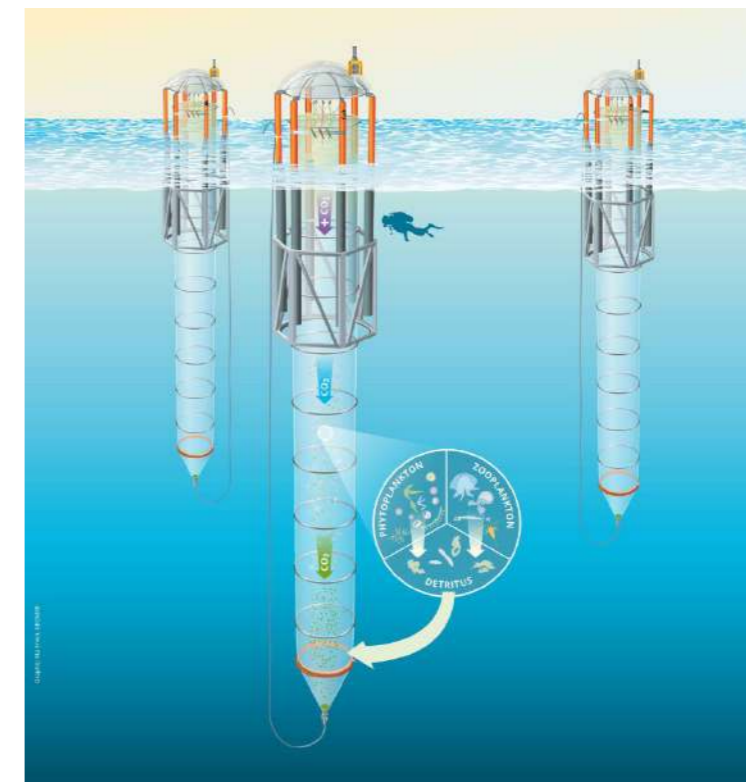


**OceanNETs (2020-2024): Ocean Negative Emission Technologies - analysing the feasibility, risks, and co-benefits of oceanbased negative emission technologies for stabilizing the climate (H2020, 869357).**

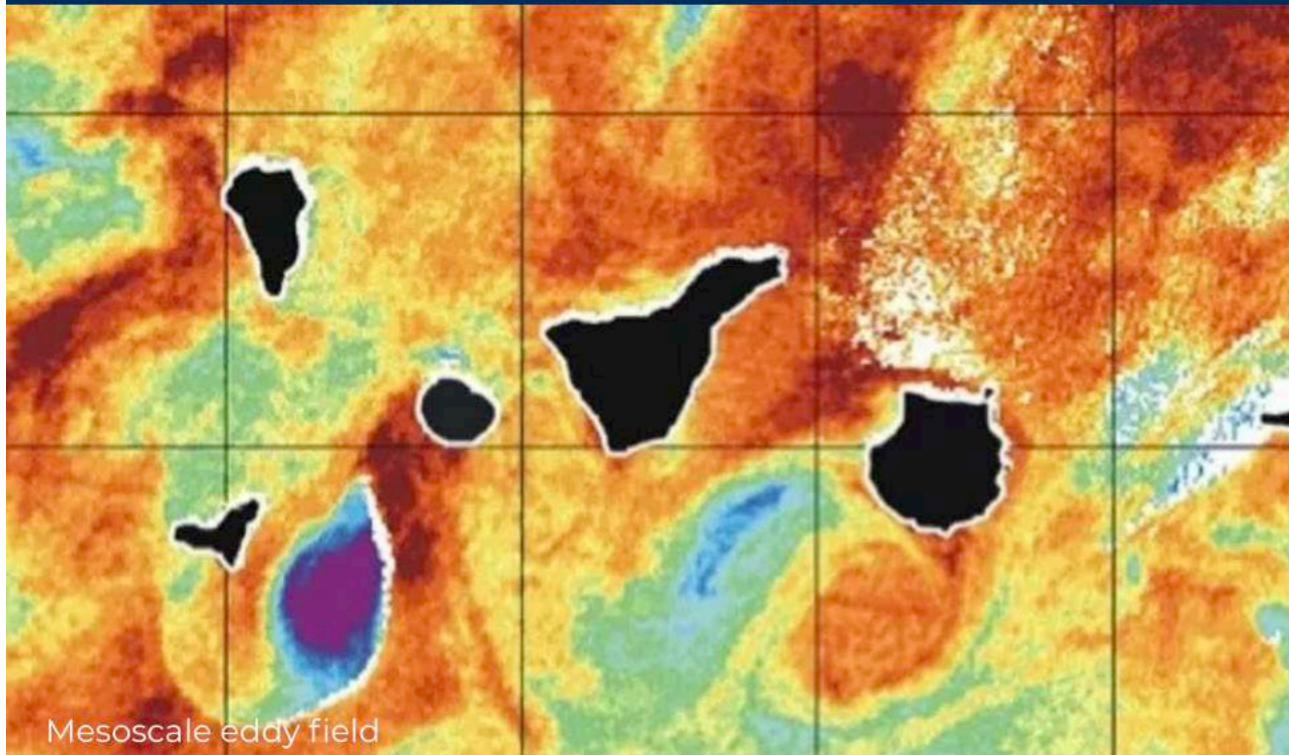
OceanNETs will investigate the feasibility and impacts of emerging ocean-based NETs through a transdisciplinary research approach. We will establish if ocean-based NETs can play a substantial and sustainable role in medium-to-long term pathways that achieve climate neutrality from the perspective of reaching the Paris Agreement goals. The impacts of ocean-based NETs on society and the Earth system will also be determined. Analyses will account for both risks and co-benefits, as well as any feedbacks these may have on NET efficacy and feasibility. The project will contribute to major international, national, and EU assessments of possible climate mitigation options.



Photo: Uli Kunz







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