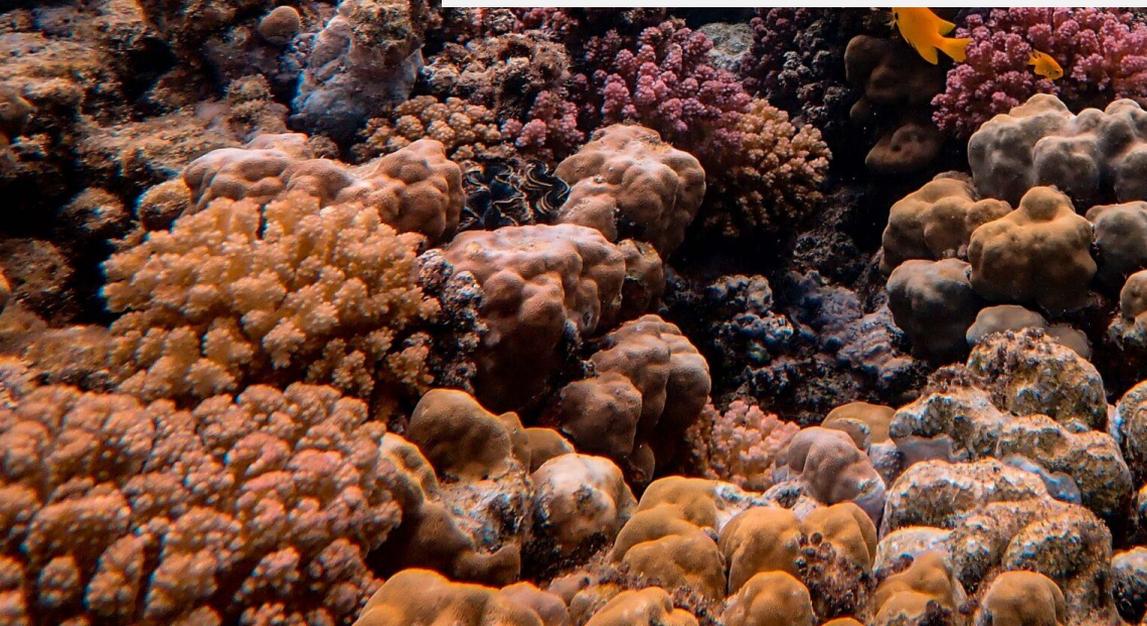
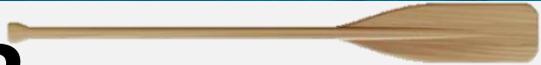


Radiotracers for the study of **M**arine and **O**ceanic **E**cosystems

Berta Rubio for the REMO project
IFIC
Santiago de Compostela 2022





Radiotracers for the study of **M**arine and **O**ceanic **E**cosystems

Berta Rubio for the REMO project
IFIC
Santiago de Compostela 2022

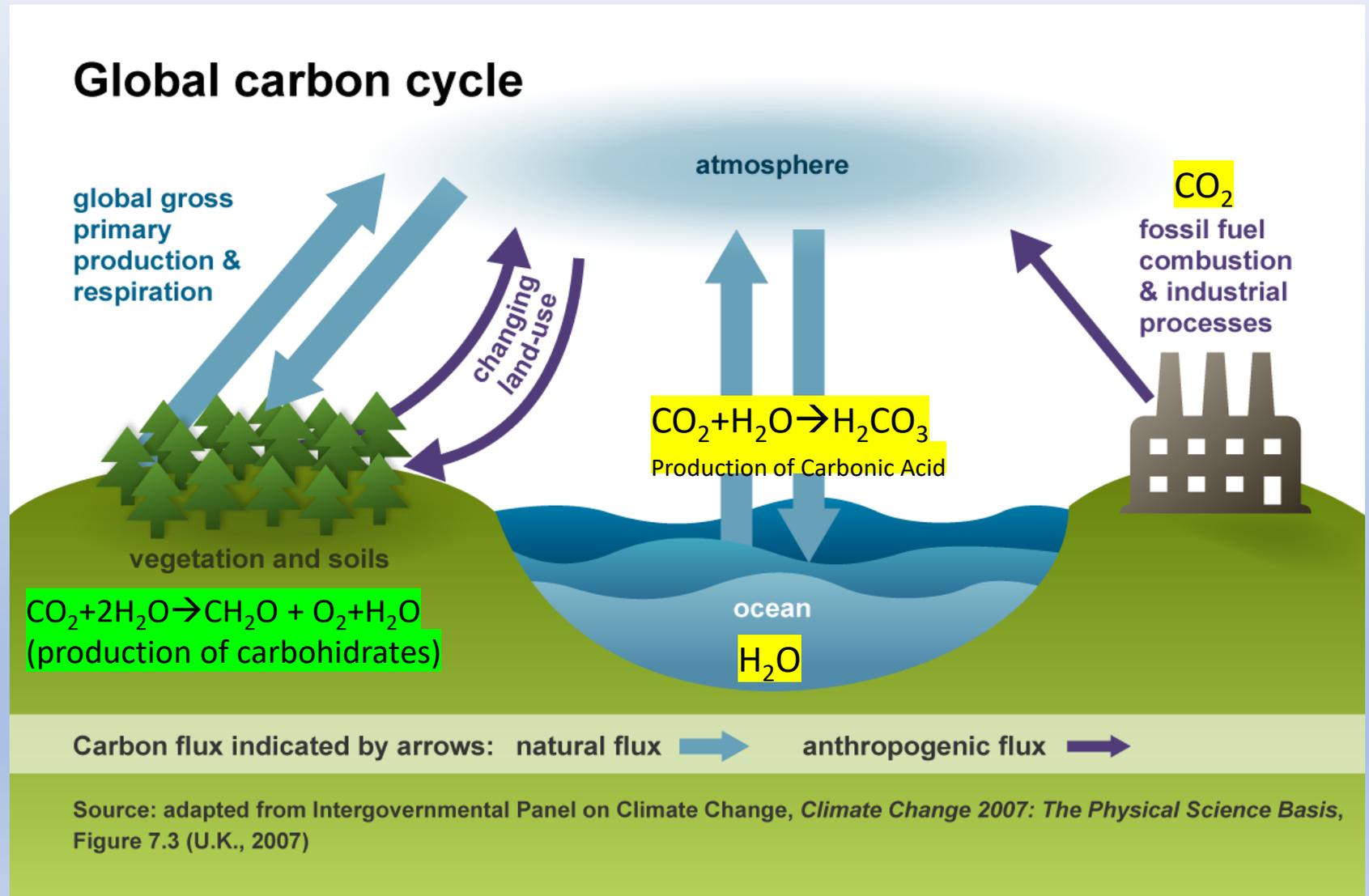


Enrique Nácher
en Costa Rica

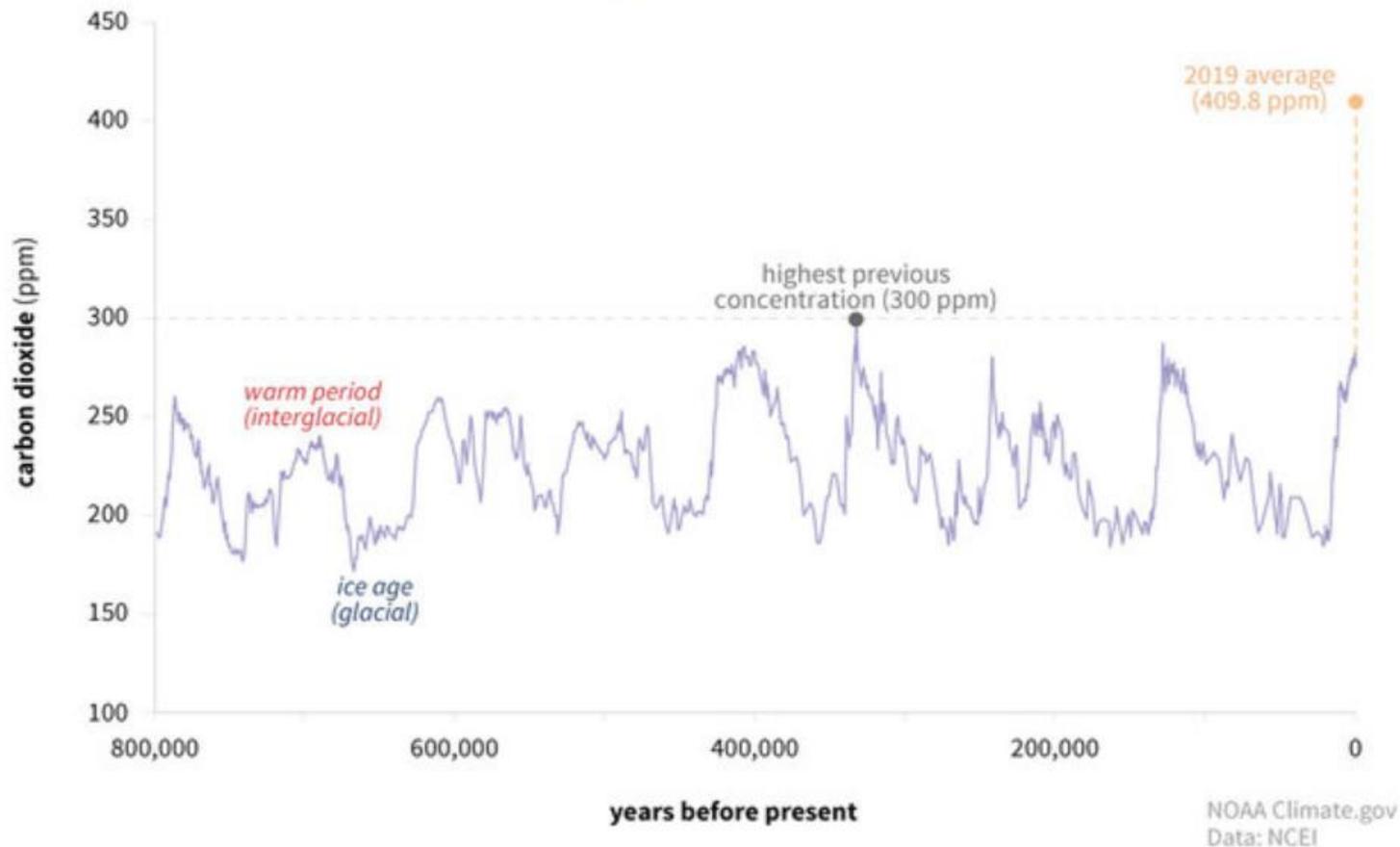
An underwater photograph of a vibrant coral reef. The water is clear and blue, with sunlight filtering through from the surface, creating shimmering patterns. The reef is composed of various types of coral, including large, rounded, brownish-orange structures and smaller, more delicate pink and purple corals. Several small, bright yellow fish are scattered throughout the scene, swimming near the coral. A semi-transparent yellow rectangular box is centered in the upper-middle part of the image, containing the word "Motivation" in a clean, black, sans-serif font.

Motivation

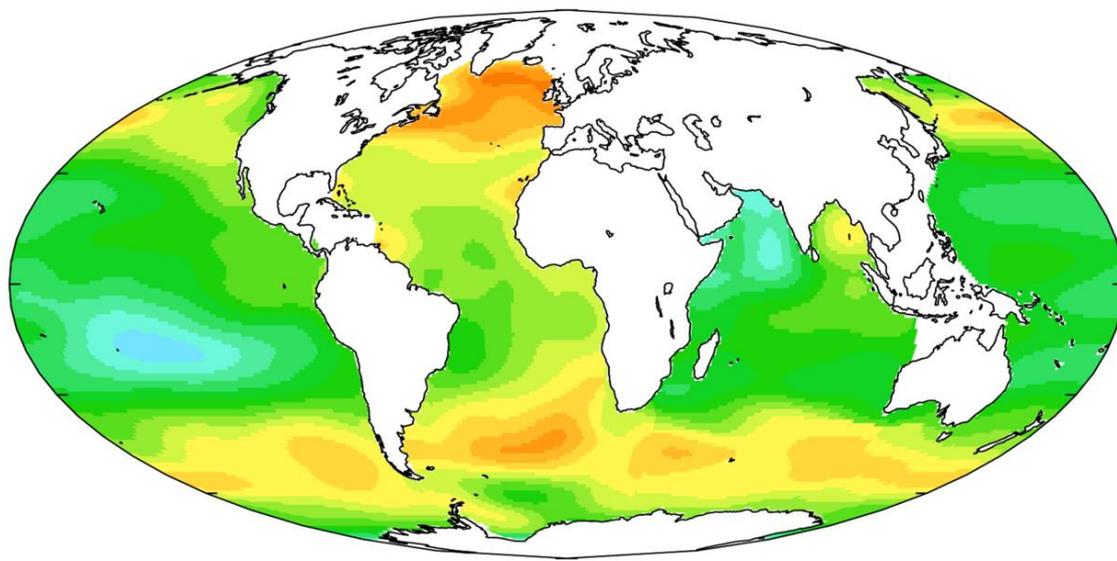
Since the beginning of the industrial revolution, oceans and seas have absorbed about one third of the carbon dioxide (CO₂) released by human activities. This release results in ocean acidification, often referred to as "the other CO₂ problem", along with global warming.



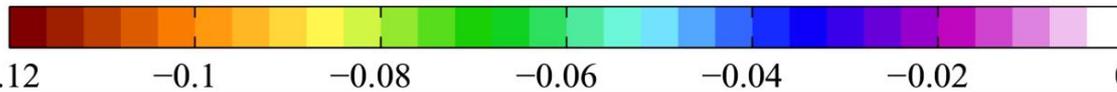
CARBON DIOXIDE OVER 800,000 YEARS



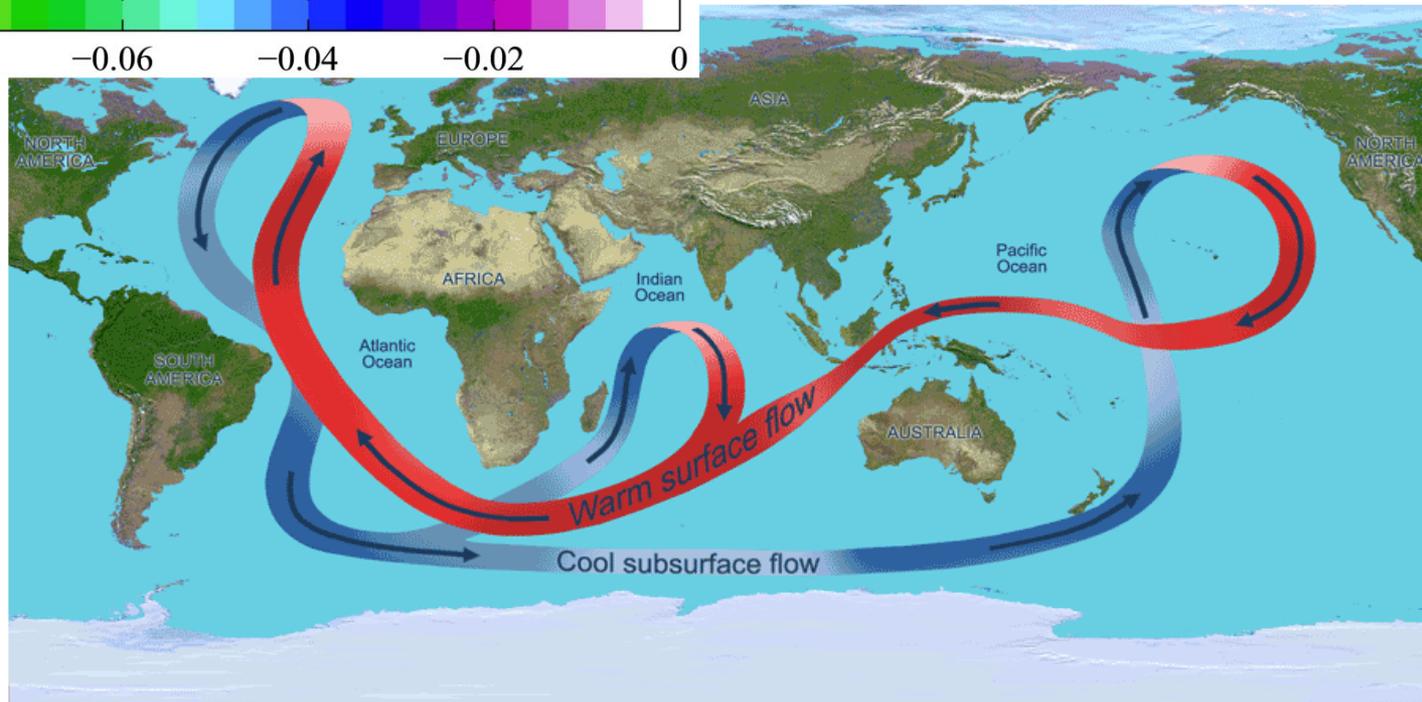
Global atmospheric carbon dioxide concentrations (CO_2) in parts per million (ppm) for the past 800,000 years. The peaks and valleys track ice ages (low CO_2) and warmer interglacials (higher CO_2). During these cycles, CO_2 was never higher than 300 ppm. On the geologic time scale, the increase (orange dashed line) looks virtually instantaneous. Graph by NOAA Climate.gov based on data from Lüthi et al., 2008, provided by the NOAA NCEI Paleoclimatology Program.



Δ sea-surface pH [-]



Due to the Oceanic currents, The increment in acidity affects, not only the industrialised coasts but also very remote places such as the Coral Reefs



Motivation

Change in acidity:

The increases in acidity can reach **170%** compared with pre-industrial times

Velocity of the change:

10 times more than any time before

How this affects the Marine Ecosystem

The **REMO** project is a tool for **diagnosys**, it tries to evaluate how this change in acidity affects the growing of the marine species

REMO Project

Radiotracers for the study of **M**arine and **O**ceanic **E**cosystems
(**R**adiotrazadores para el estudio de **E**cosistemas **M**arinos y **O**ceánicos)

More specifically: we wanted to study the **growing** of the **marine species** and the **evolution** in time for different **acidification conditions** of the water using **radiotracers**

Starting point: **Which species are important and “accessible”** to measurements?

- Important for food production(economy) or for enviroment
- The growing of the species should be adequated to the technique and the time length of the project (three years)
- The spieces should “survive” the measuring procedure (no destruction, no stress)

Which species are **important and “accessible”** to measurements?

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- (no destruction, no stress)

Which species are **important** and **“accessible”** to measurements?

Bivalve mollusc are very important for the Economy of Mediterranean and Atlantic Countries like Spain: we eat them, export them.



Coral reefs support more species per unit area than any other marine environment, including about 4,000 species of fish.

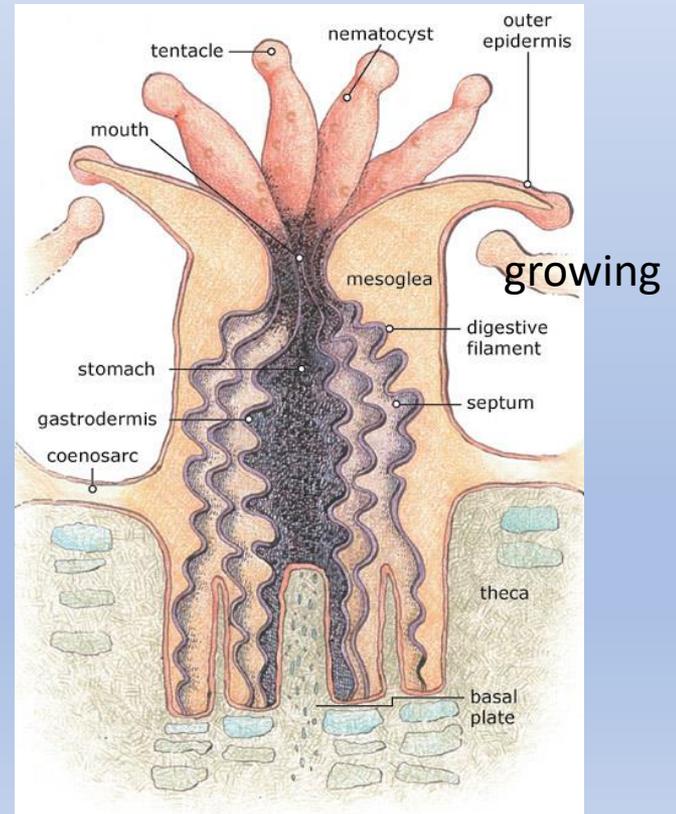
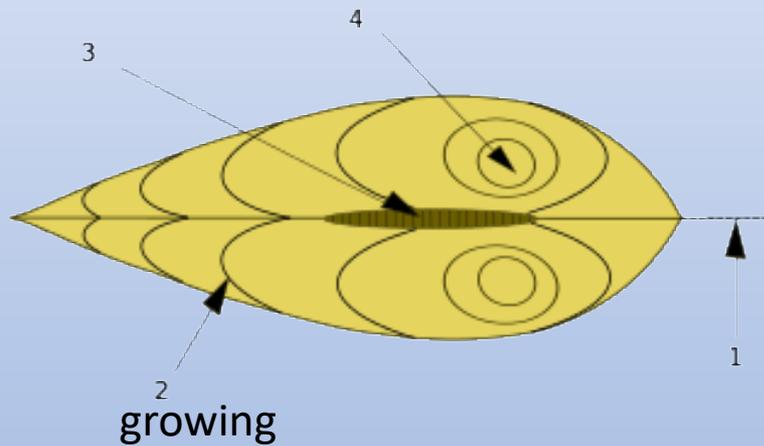


The **growing** is always incorporating **Calcium Carbonate**, CaCO_3 , to their skeletons, in both cases is an **exoskeleton**

How much Calcium they incorporate tell us how much they are growing

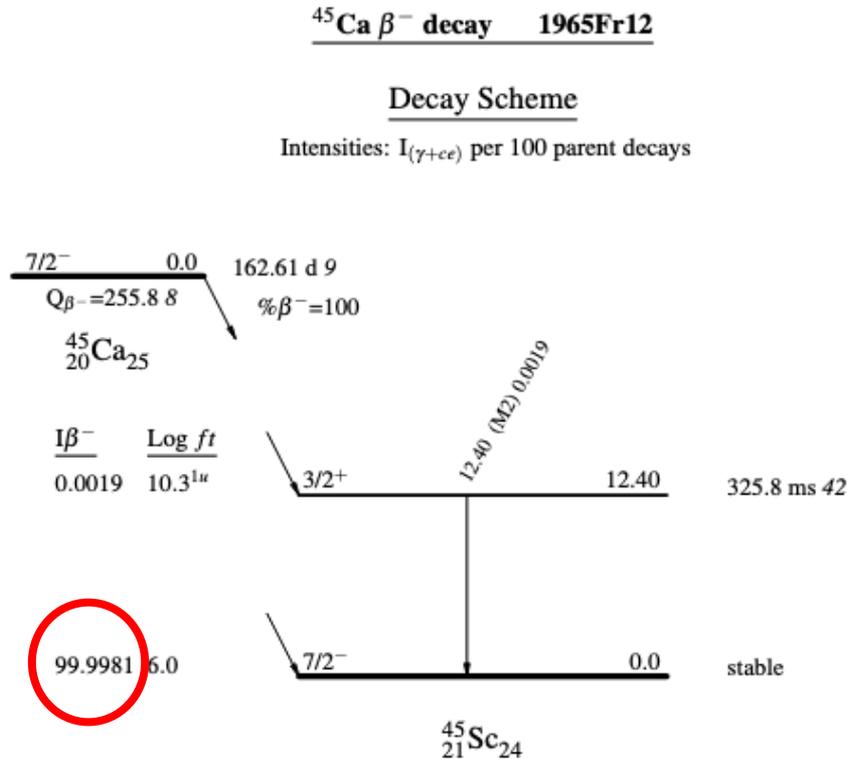
The incorporation of calcium is strongly affected by the acidification

The grow goes in the Surface (molusks), or near the Surface (corals)



Radiotracer: ^{45}Ca

^{45}Ca (half-life 163 days) \rightarrow ^{45}Sc (stable) + β particle (electron, up to 256 keV)



The idea is to develop **nuclear instrumentation** Capable to measure **β -particles** of approximately 150 keV located near the surface of mollusc and corals in a **non-destructive way**, and to study the growing **along the time** (1-2 years)

How?

The aquarium Ecosystems will be installed at **Oceanographic** In Valencia



PH 8,1(present)



Mediterranean

PH 7,5 (year 2100, if we do nothing!!)



PH 8,1(present)



Tropical

PH 7,5 (year 2100, if we do nothing!!)

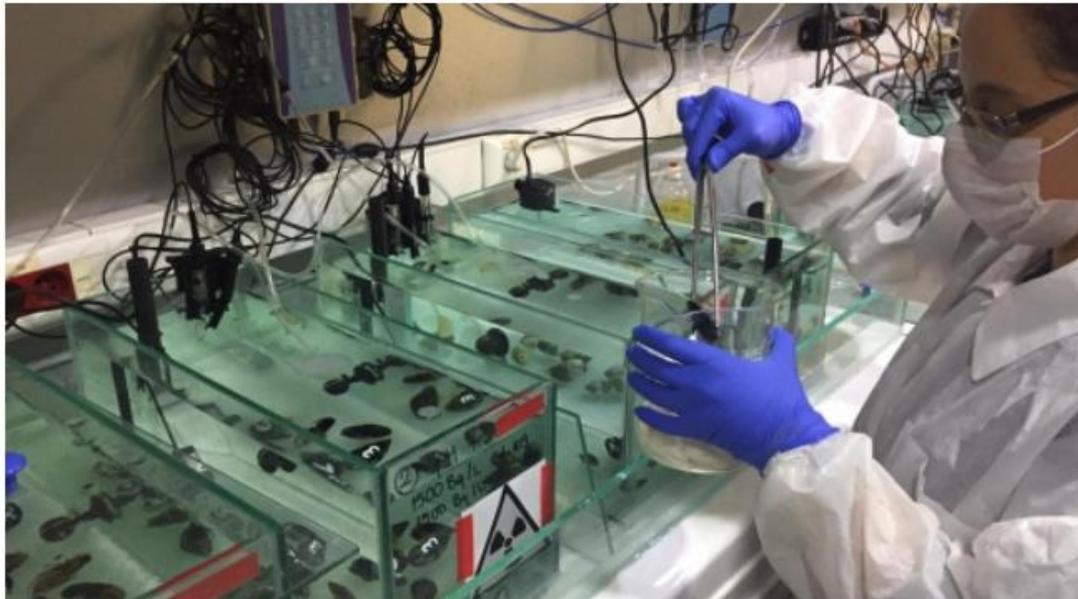


Jeopardy at Sea: What Atoms in Clams Tell us about Ocean Acidification

From the IAEA Bulletin

Laura Gil, IAEA Office of Public Information and Communication

NOV
27
2018



Related stories



World Oceans Day: Protecting Our Oceans, Our Future with Nuclear Science



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Ocean Acidification: The Little-known Impact of CO₂ Emissions

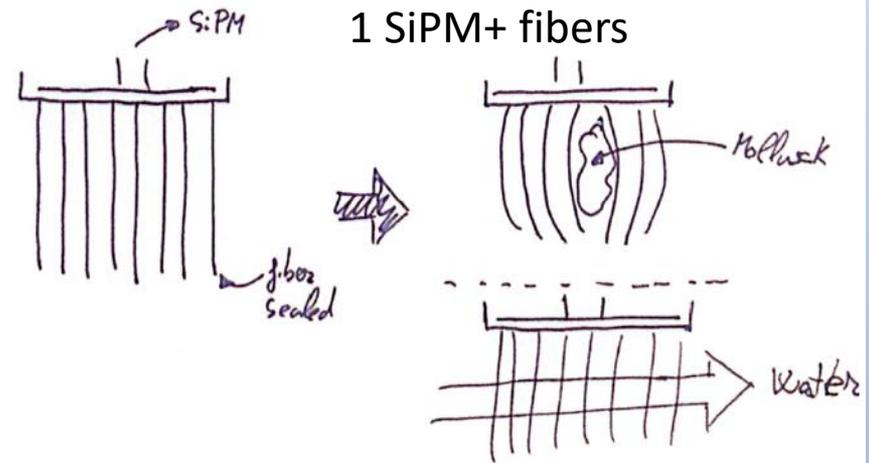
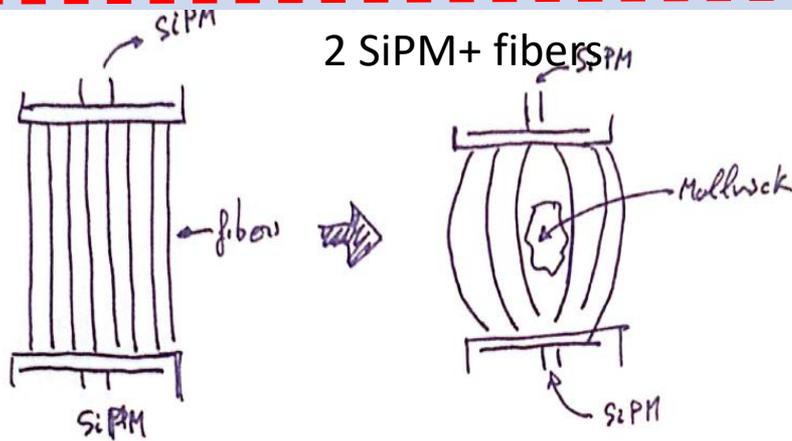
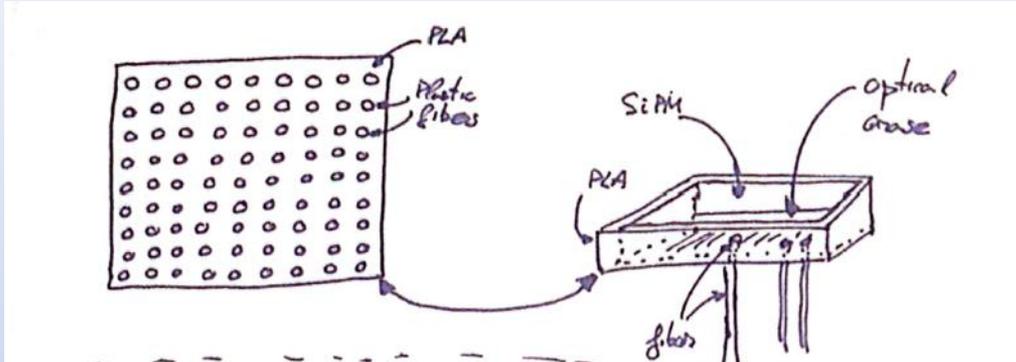
Related resources

Yes, but the technique I destructive

Our way to measure

Should not destroy the animal

Detector 1: scintillating fibers

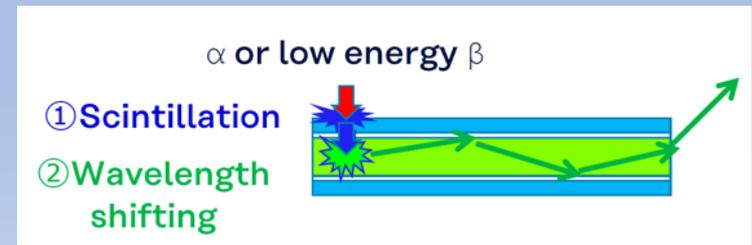
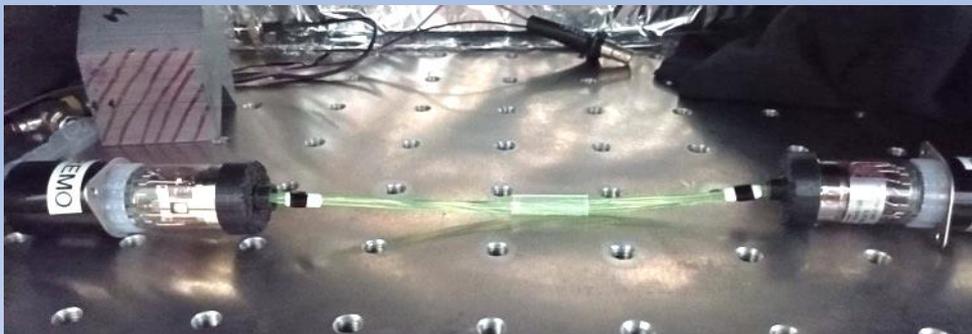


Detector 1: Scintillating optical fibers

- Direct coupling to a PM or



- We have acquired 3 types of fibers of Kuraray: SCFS de 0.5 y 1.0 mm, OLS de 1.0 mm (non commercial)
- Tests with radioactive sources of ^{45}Ca at IFIC, and with electrons at CIEMAT

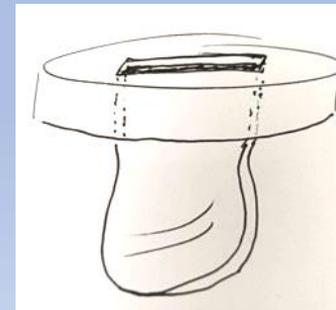


Detector 2: Vessel with liquid scintillator



Coktail
de centelleo

- Same idea as standard Liquid Scintillation Counter, but “custom made” to keep the animal alive.
 - Bigger vessel
 - Protection for the animal



Cross check with standard (destructive) techniques available at LARAMM (Uni. Valencia)



Opportunity



EU Resilience funds in Spain:

- (1) Biotecnología aplicada a la salud,
- (2) **Ciencias Marinas,**
- (3) Comunicación cuántica,
- (4) Energía e hidrógeno renovable,
- (5) Agroalimentación,
- (6) Astrofísica y física de altas energías,
- (7) Materiales avanzados y
- (8) Biodiversidad.

RESOLUCIÓN EL DIRECTOR GENERAL DE CIENCIA E INVESTIGACIÓN POR LA QUE SE TOMA EN CONSIDERACIÓN LAS SOLICITUDES PRESENTADAS AL AMPARO DE LA CONVOCATORIA DE 22/07/2021, DE EXPRESIONES DE INTERÉS DE PROYECTOS DE INVESTIGACIÓN ALINEADOS CON *THINKINAZUL*.



GVA-THINKINAZUL/2021/023	Fidel Toldrá Vilardell	74.970	61.880	45.759	27.391	210.000
GVA-THINKINAZUL/2021/030	Yolanda Pico García	107.100	18.445	57.064	27.391	210.000
GVA-THINKINAZUL/2021/036	Enrique Nacher González	88.655	77.945	16.009	27.391	210.000
GVA-THINKINAZUL/2021/005	Miguel Rodilla Alamá	53.550	3.570	125.489	27.391	210.000
GVA-THINKINAZUL/2021/008	Victoria Vivancos Ramón	133.875	14.280	34.454	27.391	210.000
GVA-THINKINAZUL/2021/013	Valentín Pérez Herranz	107.100	35.700	39.809	27.391	210.000
GVA-THINKINAZUL/2021/025	José Miguel Cerdá Reverter	71.400	20.825	62.992	23.283	178.500
GVA-THINKINAZUL/2021/037	Pedro Sanz Valero	124.950	44.625	13.034	27.391	210.000



WP1- Monitorización ambiental

Enviroment monitoring



F. Giménez / J. Tena



This study forms part of the ThinkInAzul programme and was supported by MCIN with funding from European Union NextGenerationEU (PRTR-C17.11) and by *Generalitat Valenciana*



C. Azorín y V. Nieves



E. Nacher/B. Rubio



A.A. Ramos



C. Bordehore



J. E. Tent



V. Pérez



J. Lloret y S. Sendra



J. Pardo



Y. Picó

Objetivos

- **Objetivo 1.1** (L A 1.5) **Diagnóstico** y planteamiento de plataformas de observación

1. Diagnosis

- **Objetivo 1.2** (L A 1.9) Desarrollo, validación e implementación de **nuevas herramientas** y/o tecnologías para la mejora del **seguimiento** y **monitorización** del ecosistema marino

2. New instrumentation for monitoring

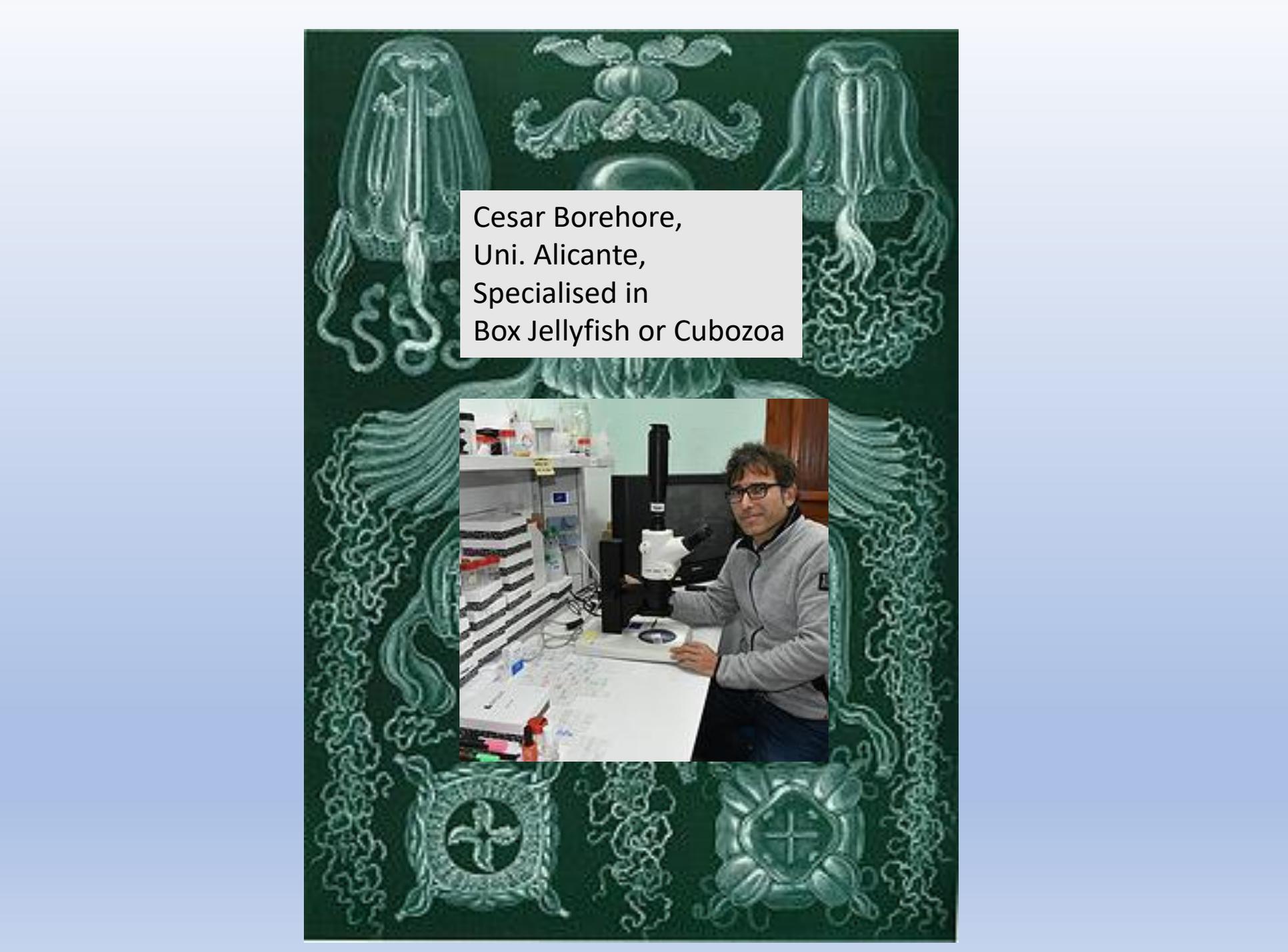
- **Objetivo 1.3.** (L A 1.10) **Red** de estaciones de **seguimiento** continuo del litoral y realización de campañas de investigación 'ad hoc'

3. Coast vigilance: networking



This study forms part of the ThinkInAzul programme and was supported by MCIN with funding from European Union NextGenerationEU (PRTR-C17.1) and by *Generalitat Valenciana*

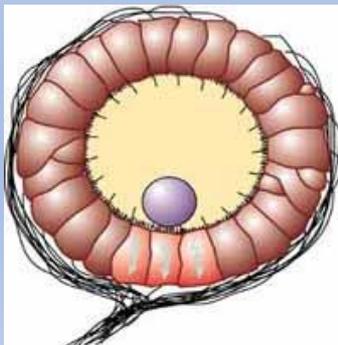
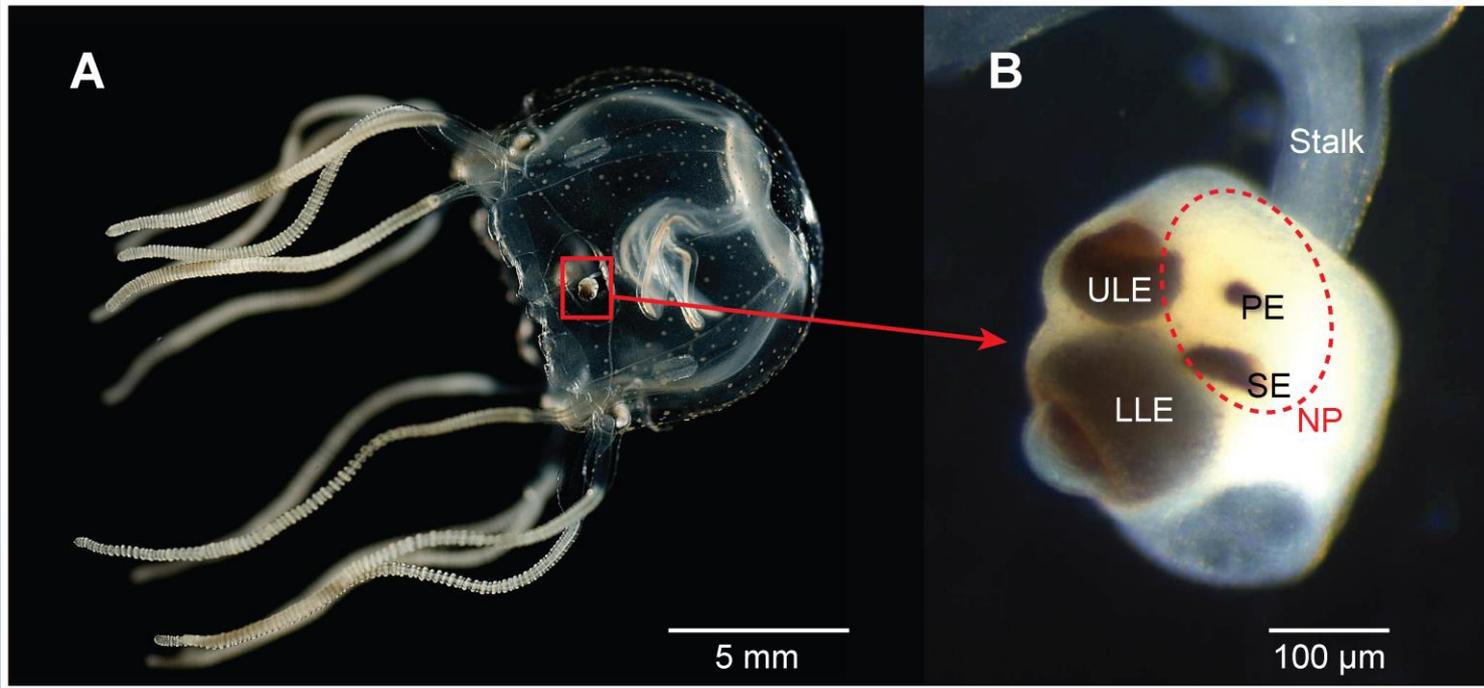




Cesar Borehore,
Uni. Alicante,
Specialised in
Box Jellyfish or Cubozoa



Cube jellyfish have 24 eyes, 4 of them true eyes, looking up, down and to the interior.



Near each true eye there is a **statocyst**, a balance and Accelerometer sensor based on gravity.

The **statocyst** is formed of Calcium Sulfate, CaSO_4

polychaete



They help keeping the soil in good condition, by filtering the water And fixing Ca at an incredible speed.

They are part of the food chain, and can even be bioindicators of environmental disturbances.

It is important to study the fixing of Ca under different environmental conditions



Conclusion:

REMO is a fruitful Interdisciplinary collaborative project

At present is a financed proof of concept

If successful, it could be extended to other marine ecosystems

Perhaps to a vigilance networking along the coast

To have this knowhow in Spain will be very useful



Daniel García
José Luis Crespo,
Mario Roche
Roi Lata
Andrea Spinelli



Enrique Nácher
Berta Rubio
Javier Balibrea
Jorge Lerendegui
Ion Ladarescu



Giacomo de Angelis
Luisa Conte
Giovanna Montagnoli
(Uni. Padova)



Carlos Saavedra
David Cordero





Thank you for your attention