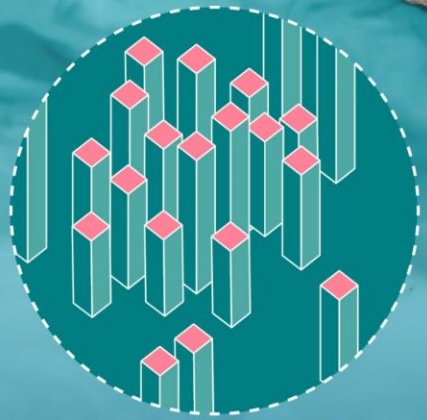
DATAVIZ

WEBINAR SERIES

#2 EXPLAIN OCEAN DATA

6 March 2025

14:00 CET



PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

Copernicus Marine Service

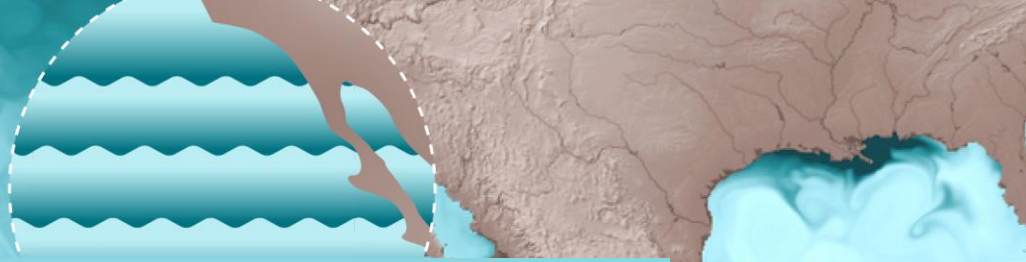
implemented by MERCATOR OCEAN INTERNATIONAL

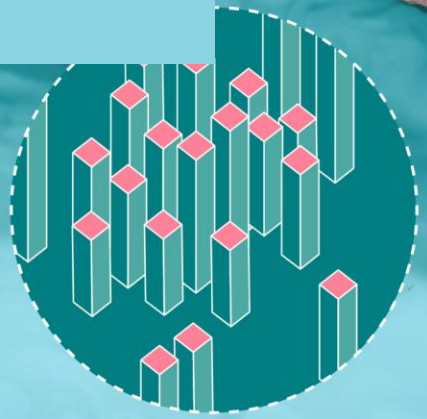
Elodie Gutknecht

Mercator Ocean International

Marine biogeochemistry
Numerical modelling

Phytoplankton blooms in the ocean

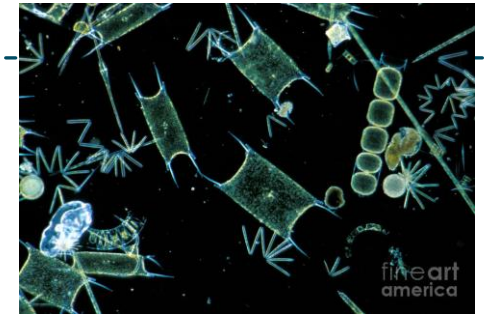


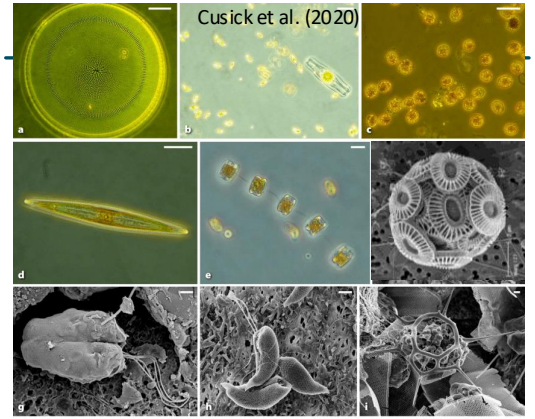


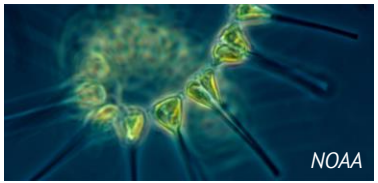
Phytoplankton

Phytoplankton are **microscopic, floating and drifting alga.** They form the **base of the oceanic food web**.

Under a microscope, phytoplankton exhibit a remarkable **diversity of morphologies, pigmentation, and structural patterns.**





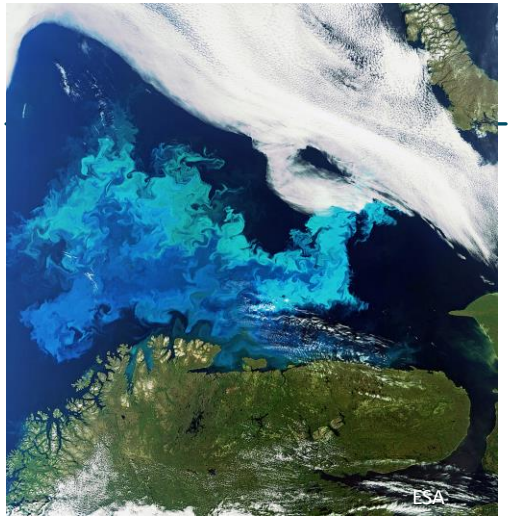


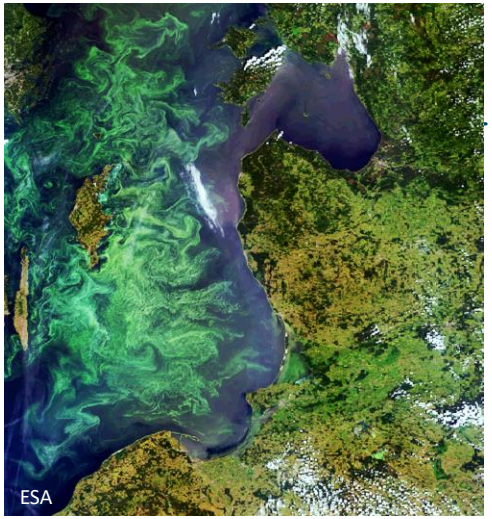
Phytoplankton

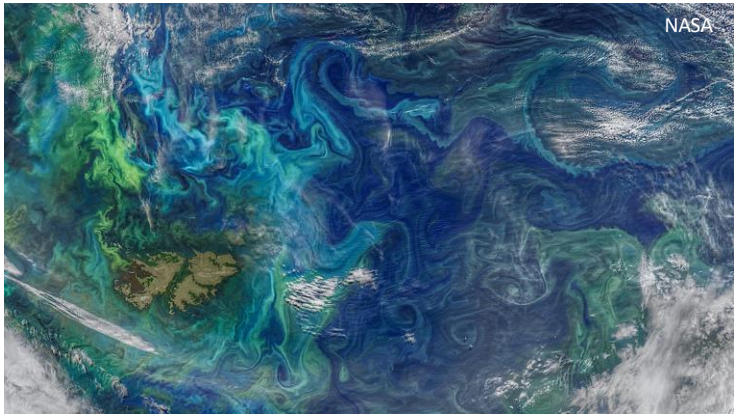
Phytoplankton are **microscopic, floating and drifting alga.** They form the **base of the oceanic food web**.

From space, phytoplankton create **extensive patterns, forming eddies and wave-like structures, that span vast oceanic areas.**

The blooms can take a **large range of colors**, creating **contrasts** with the deep blue of the sea water.





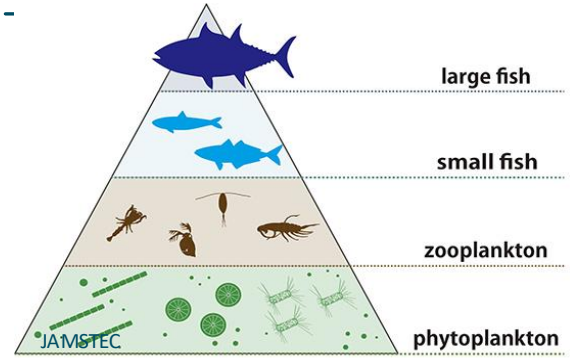


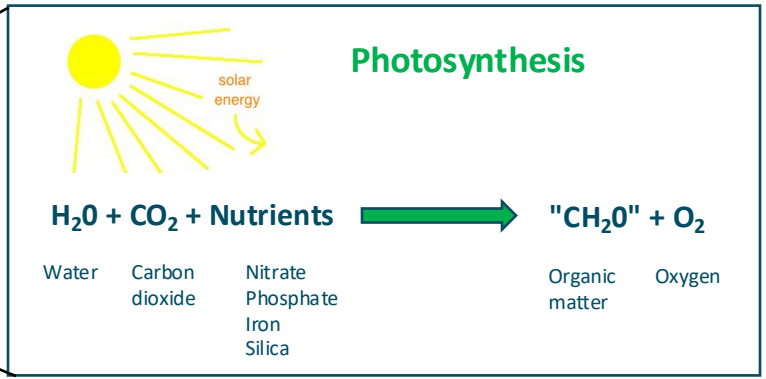
Phytoplankton

Phytoplankton are **microscopic, floating and drifting alga.** They form the **base of the oceanic food web**.

Phytoplankton are **photosynthetic organisms:** they use **sunlight, carbon dioxide (CO_2), and nutrients** to produce energy through **photosynthesis**, releasing **oxygen** in the process.

Foundation of the Marine food web





Why is Phytoplankton important ?

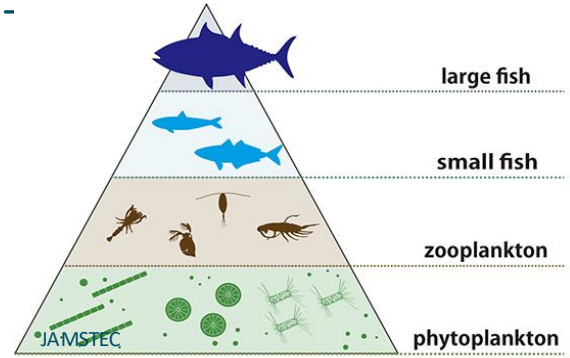
Global Carbon Cycle & Climate Regulation :

- **Absorbs CO_2** from the atmosphere, fixate it to produce organic matter
- **Exports and traps Carbon** to the deep ocean for hundreds or even thousands of years (thanks to dead organisms sinking to the depths of the ocean)

Oxygen Production :

- **Produces 50%** of Earth's oxygen (so every second breath you take comes from phytoplankton)

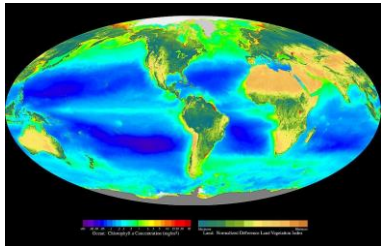
Foundation of the Marine food web



Marine Food Web & global fisheries

- Eaten by zooplankton, which feed small fish, in turn are consumed by larger fish and top predators
- **Supports higher trophic levels** and **sustain global fisheries**.

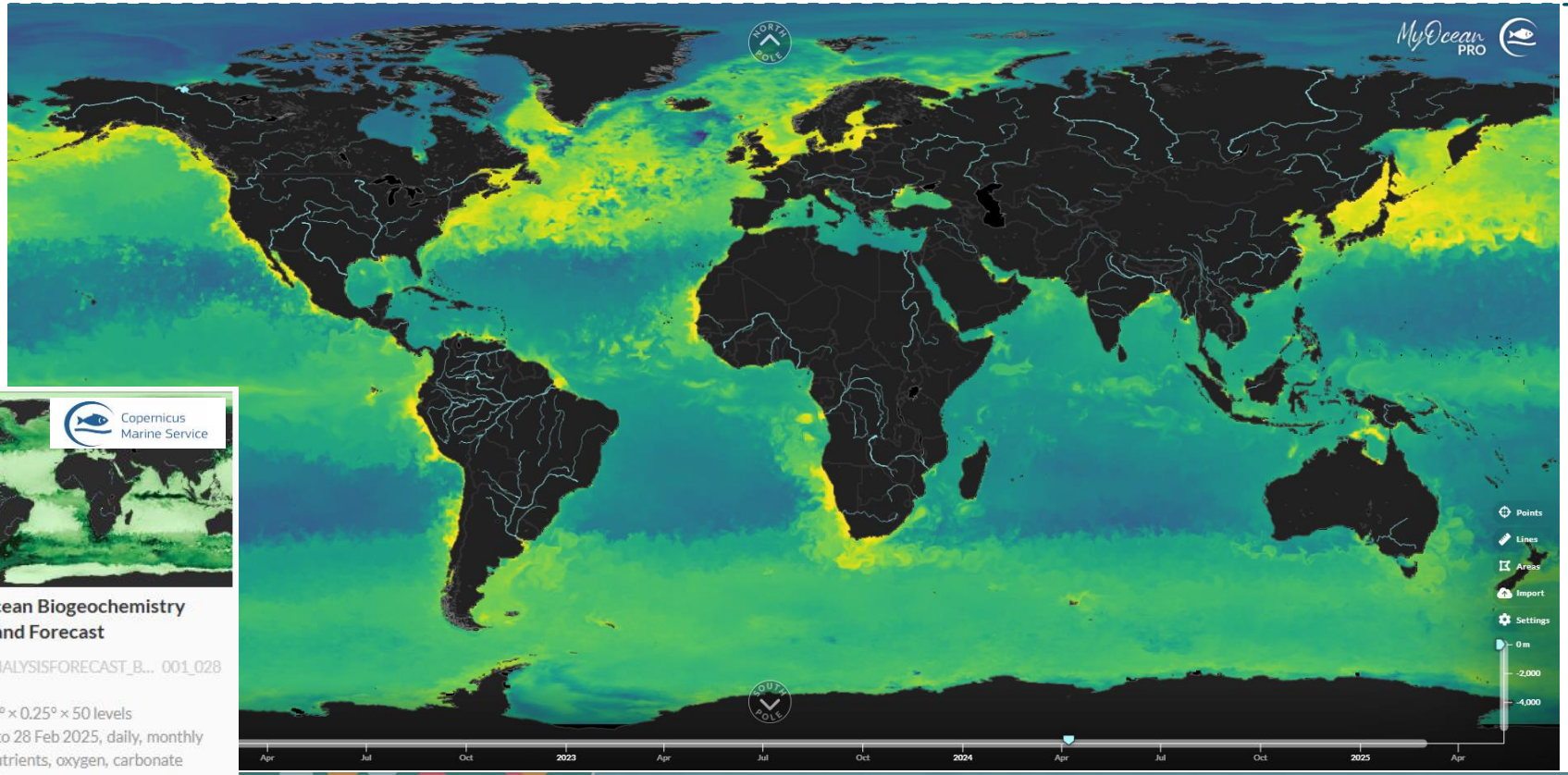
50% Primary Production

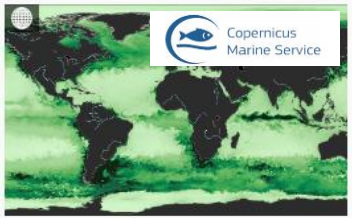


50% O_2 Production

CO_2 sequestration

Global distribution of Phytoplankton





Global Ocean Biogeochemistry Analysis and Forecast

GLOBAL_ANALYSISFORECAST_B... 001_028

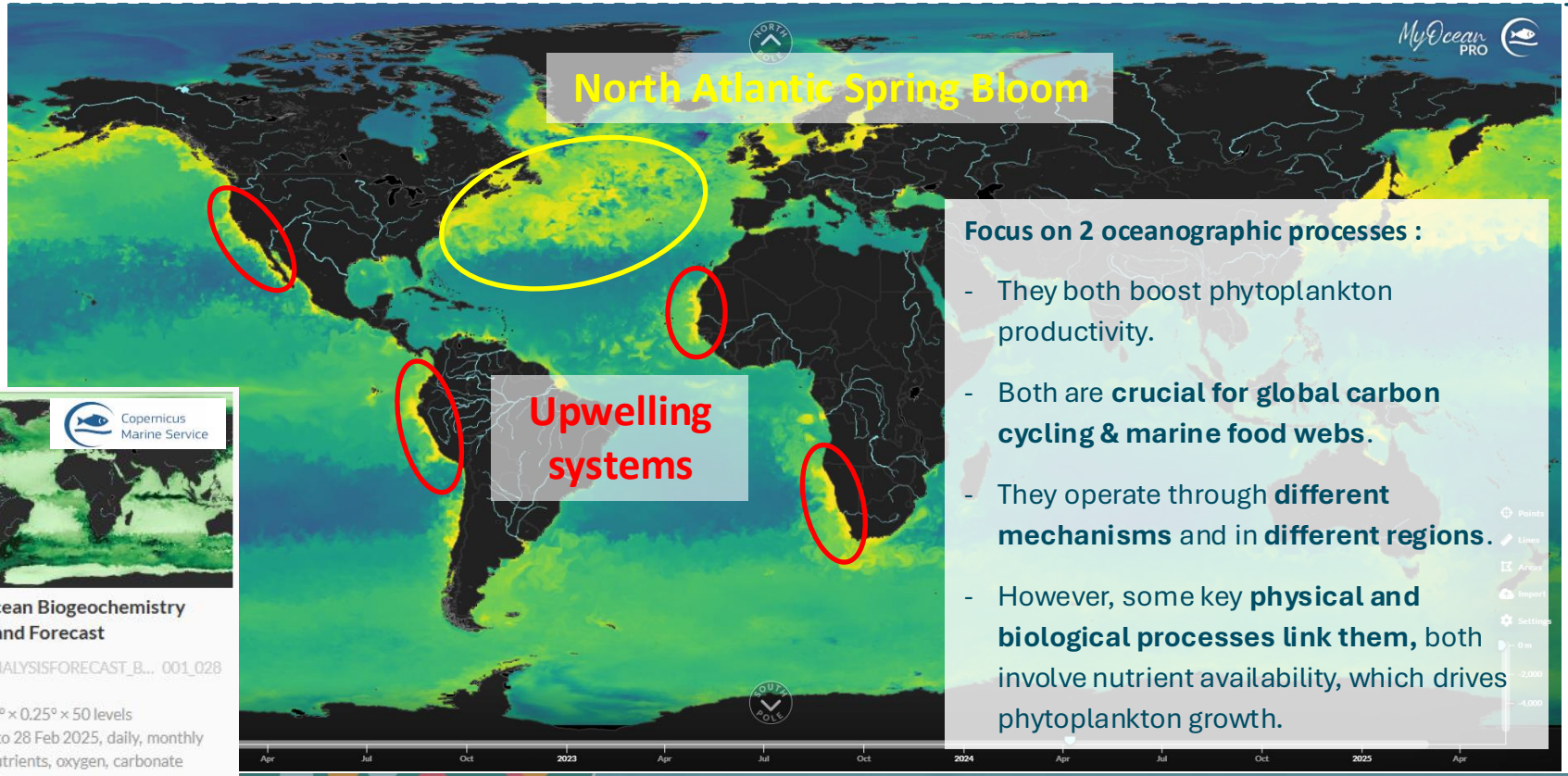
Models

Global, 0.25° × 0.25° × 50 levels

1 Oct 2021 to 28 Feb 2025, daily, monthly

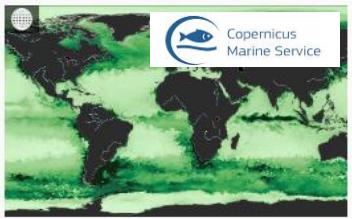
Plankton, nutrients, oxygen, carbonate system, optics

Key oceanographic processes



Focus on 2 oceanographic processes :

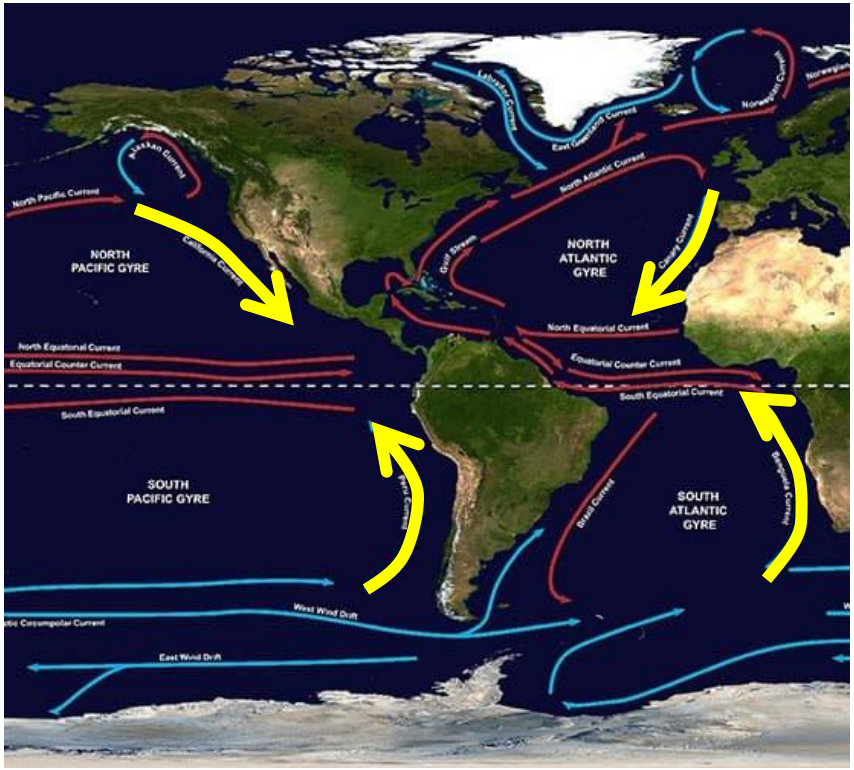
- They both boost phytoplankton productivity.
- Both are **crucial for global carbon cycling & marine food webs**.
- They operate through **different mechanisms** and in **different regions**.
- However, some key **physical and biological processes link them,** both involve nutrient availability, which drives phytoplankton growth.

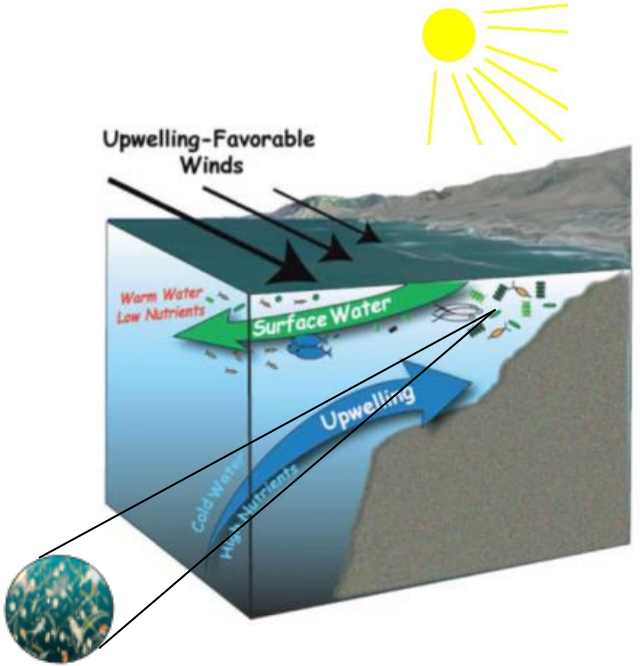


Global Ocean Biogeochemistry Analysis and Forecast

GLOBAL_ANALYSISFORECAST_B... 001_028
Models
Global, 0.25° × 0.25° × 50 levels
1 Oct 2021 to 28 Feb 2025, daily, monthly
Plankton, nutrients, oxygen, carbonate system, optics

Upwelling systems



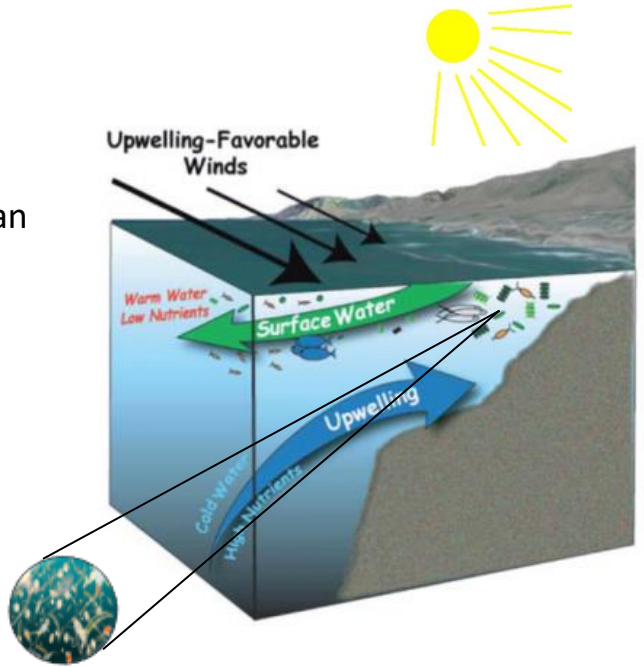


Upwelling systems

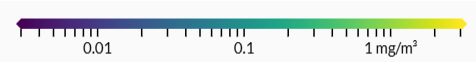
→among the most biologically productive regions of the ocean

→support the world's most important fisheries, sardines, anchovies and mackerel are the most abundant fishes

→contribute to 25% to global fisheries, while occupying less than 1% of global ocean area.



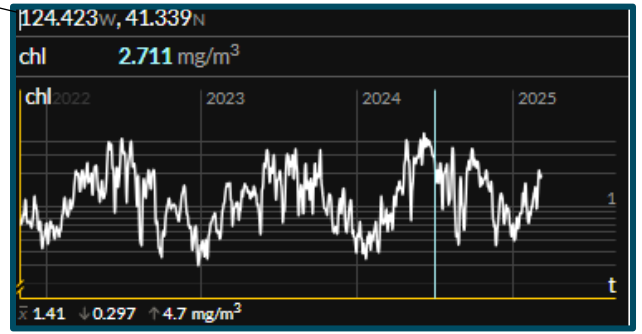
Upwelling systems



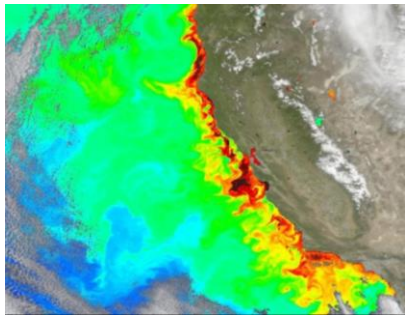
The California Upwelling System:
→ driven by northerly winds
→ strongly seasonal

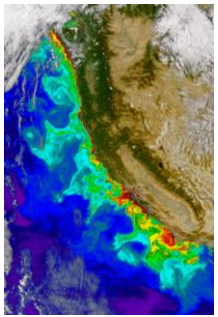
Winter: weak upwelling, low biological productivity

Spring and summer : intense upwelling, high biological productivity, rich ecosystems

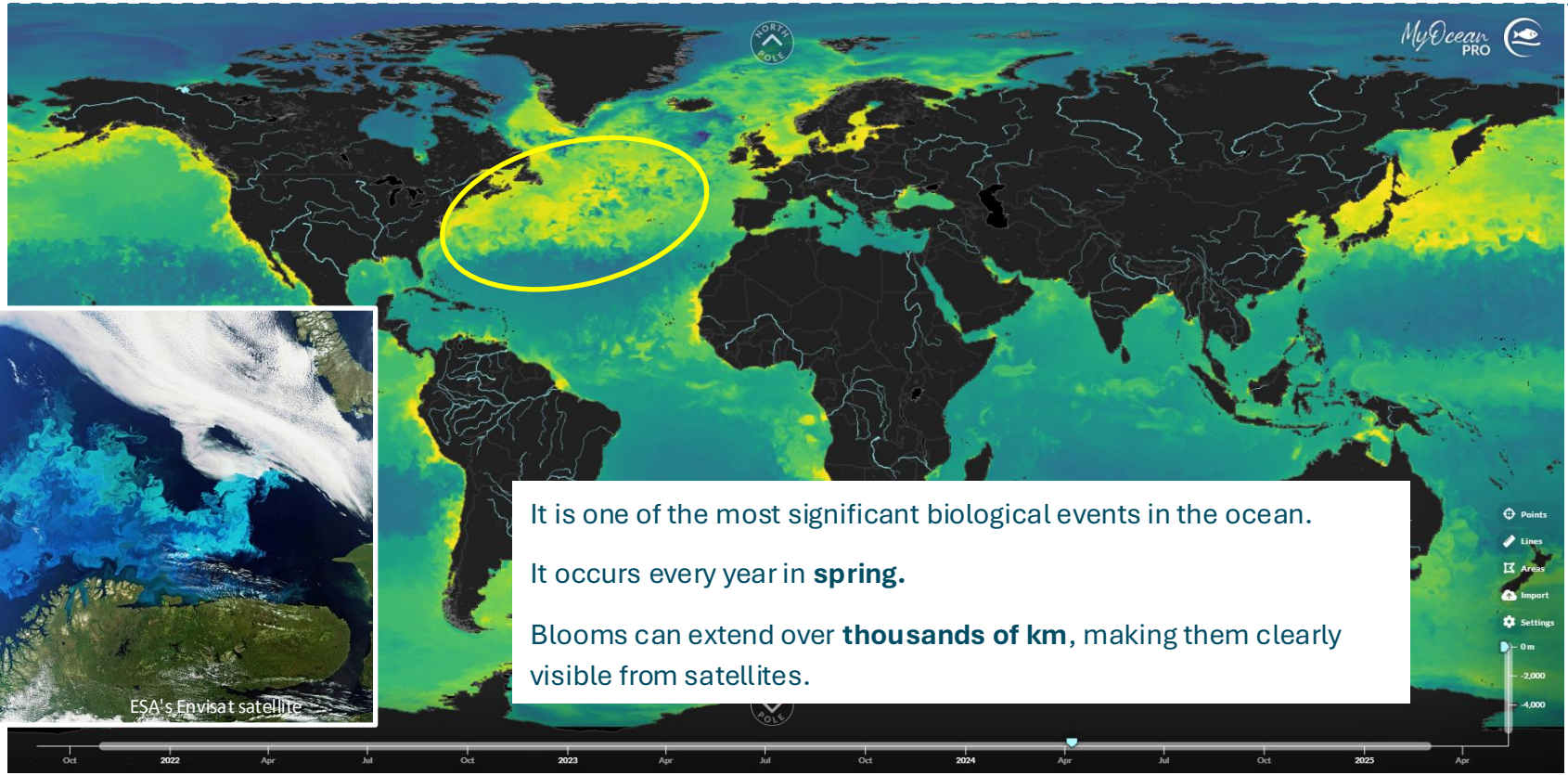


Upwelled water spreads towards offshore, forming **pigment-rich filaments** :





North Atlantic Spring Bloom



It is one of the most significant biological events in the ocean.

It occurs every year in **spring.**

Blooms can extend over **thousands of km**, making them clearly visible from satellites.

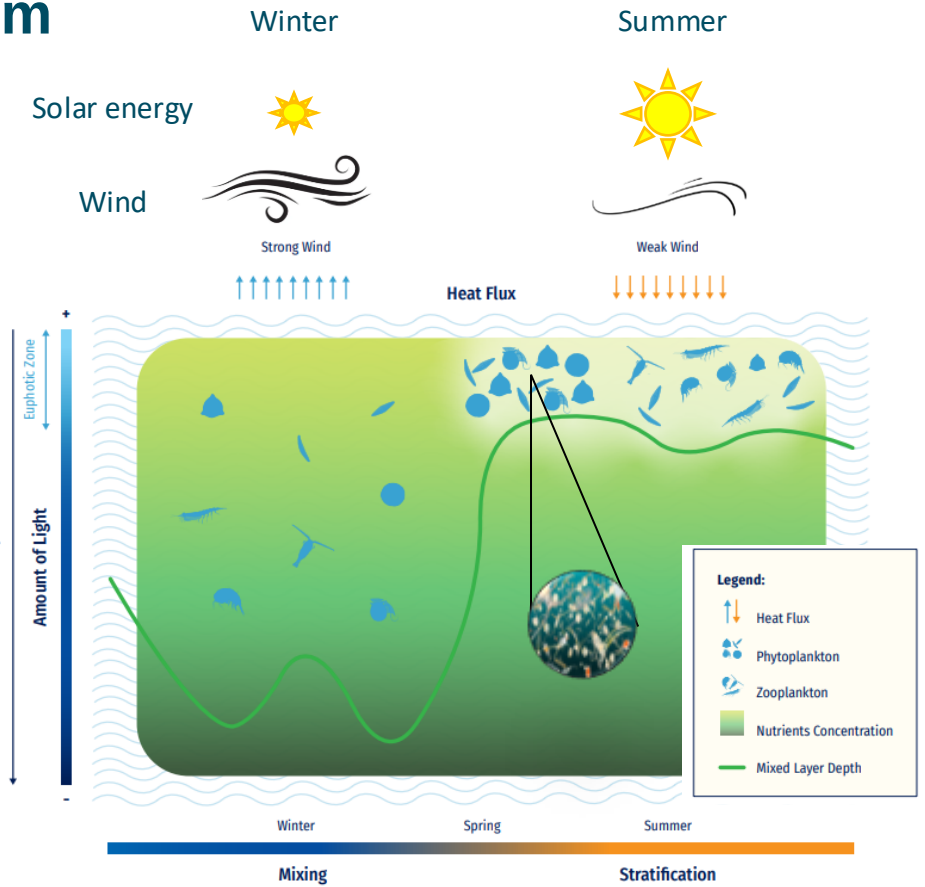
North Atlantic Spring Bloom

Winter: low sunlight + storms
→ mix surface waters with deep and nutrient-rich waters
→ surface waters replenished in nutrients

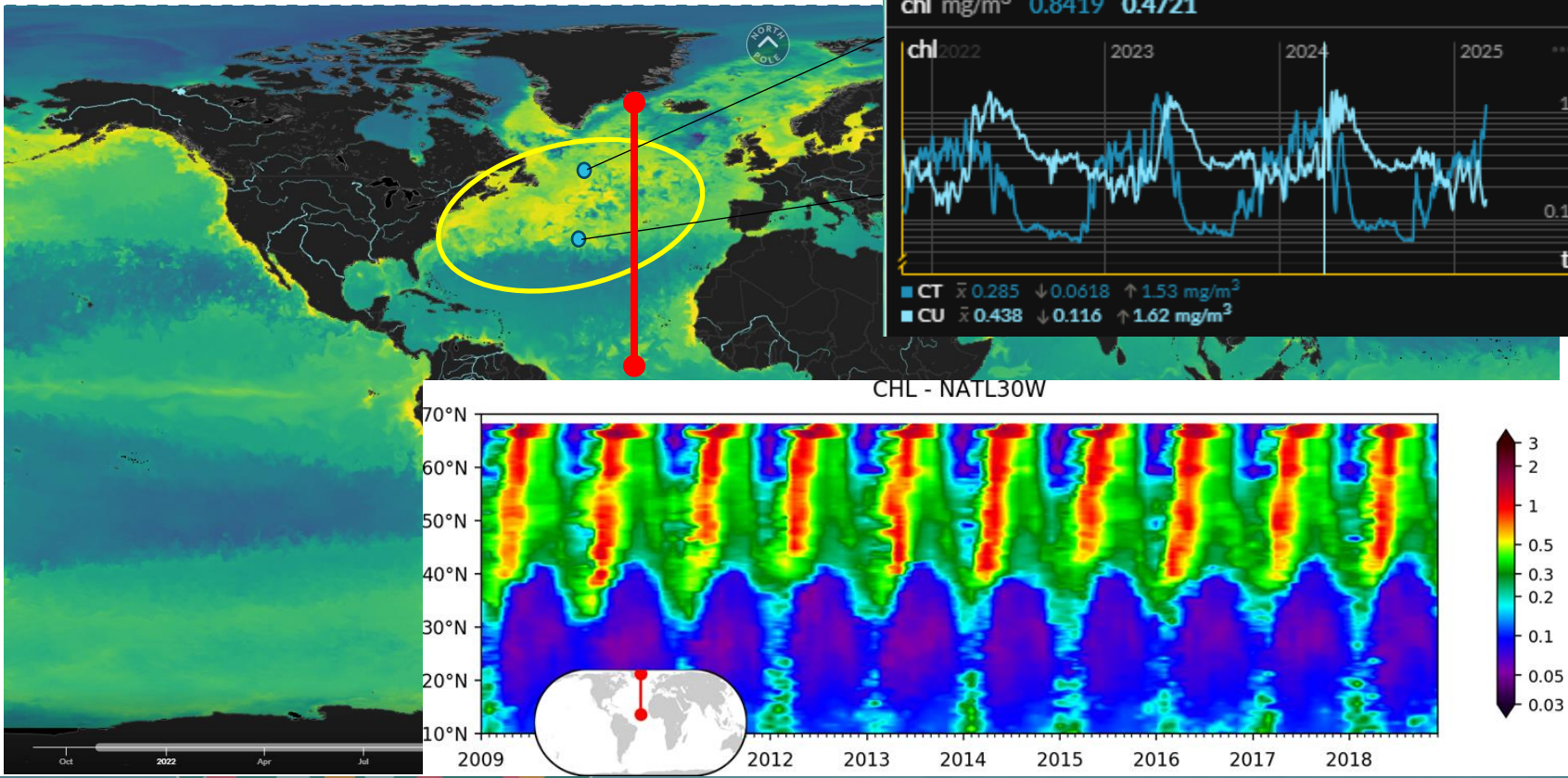
Spring: sunlight increases + winds decrease
→ stable upper layer

Perfect conditions to phytoplankton to growth rapidly
Blooms over vast areas of the North Atlantic

Summer:
- phyto triggers a zooplankton bloom, which feeds fish larvae, and larger fish
- nutrients decline; phyto decrease



North Atlantic Spring Bloom



Thank you !