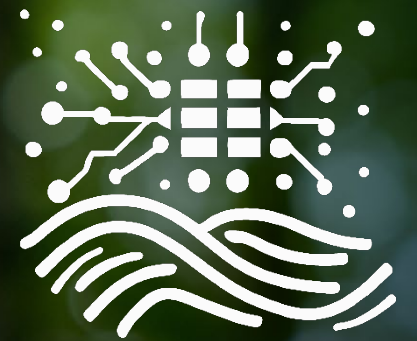


BioSpace25 - Biodiversity insight from Space
10 - 14 February 2025 | ESA-ESRIN | Frascati - Italy

Mediterranean 4D seascape based on phytoplankton phenology detected from satellite observations: patterns and drivers

4DMED-sea

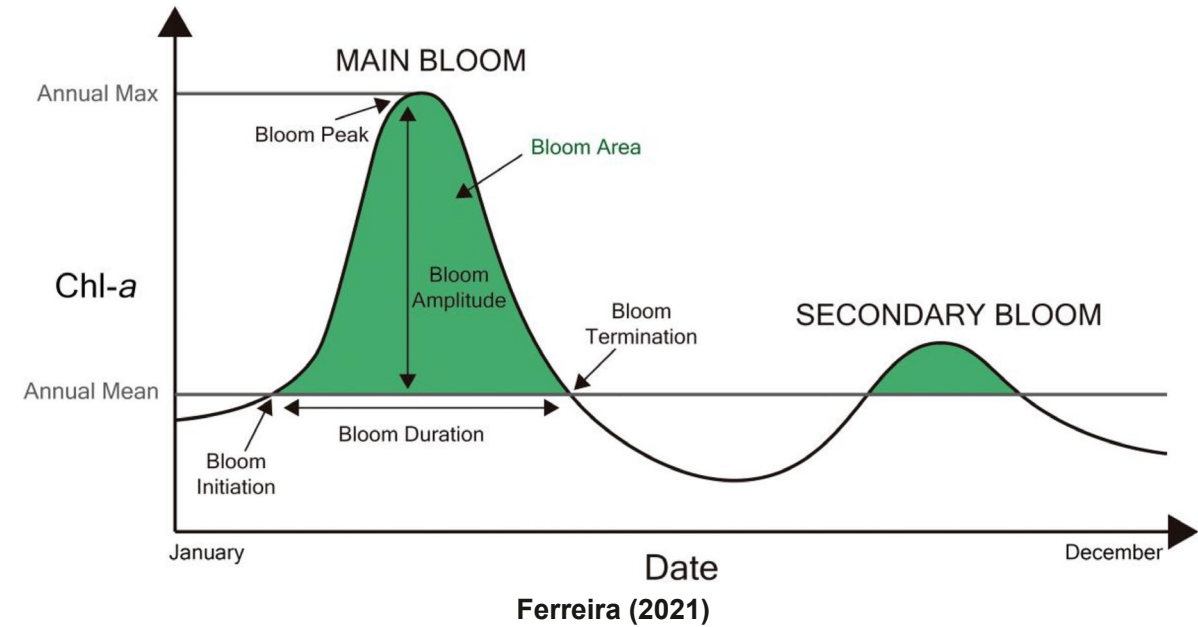
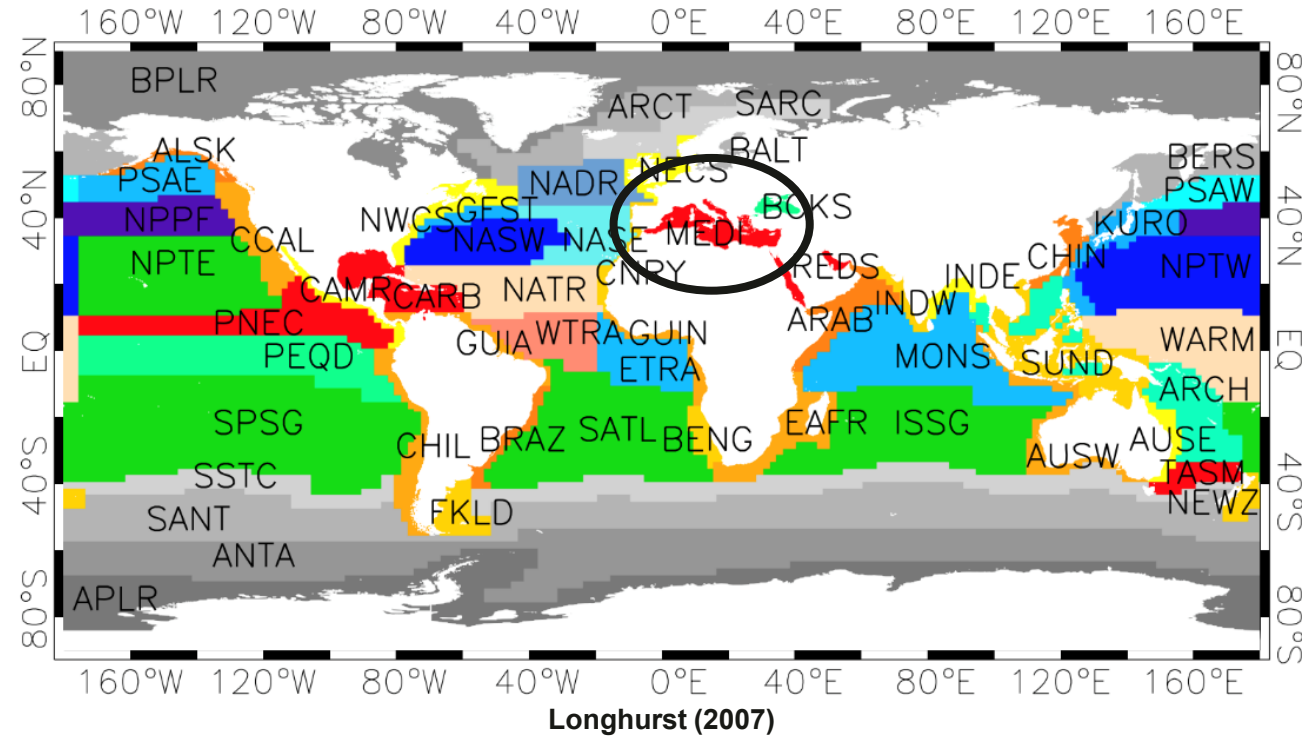


ESA Contract No. 4000141547/23/I-DT

Riccardo Nanni^{1,2}, Emanuele Organelli¹, Christian Marchese¹, Michela Sammartino², Simone Colella¹, Bruno Buongiorno Nardelli²

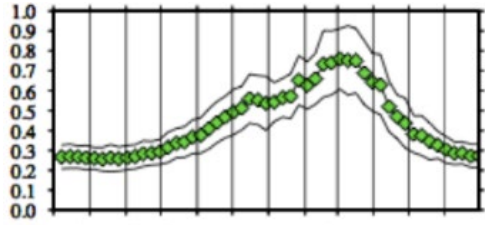
¹Istituto di Scienze Marine (ISMAR), Consiglio Nazionale delle Ricerche (CNR), Roma; ²Istituto di Scienze Marine (ISMAR), Consiglio Nazionale delle Ricerche (CNR), Napoli

Worldwide ocean regionalization



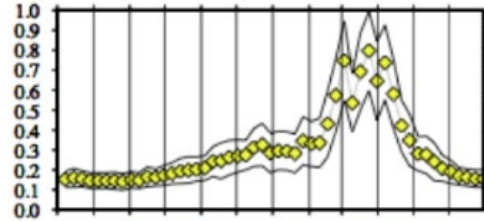
- Regions are areas with similar properties.
- Phytoplankton phenology is a key method for bioregionalization.
- Phytoplankton plays a crucial role in understanding climate change.
- Provides valuable insights for fisheries management.

Mediterranean sea bioregionalization



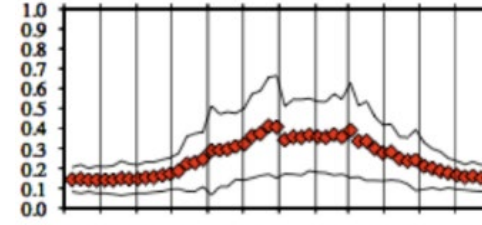
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

Intermittent



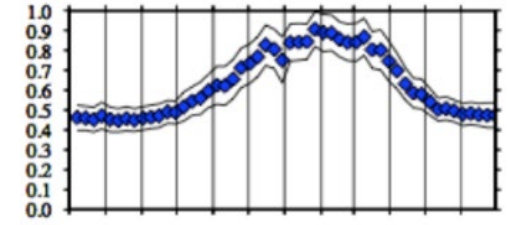
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

Bloom



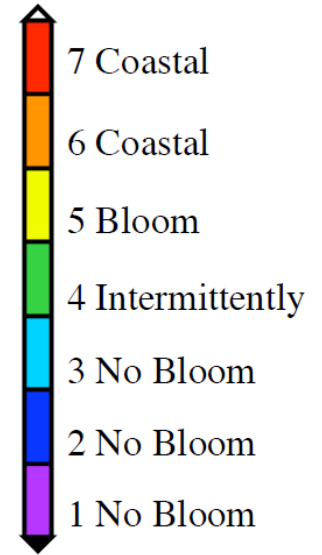
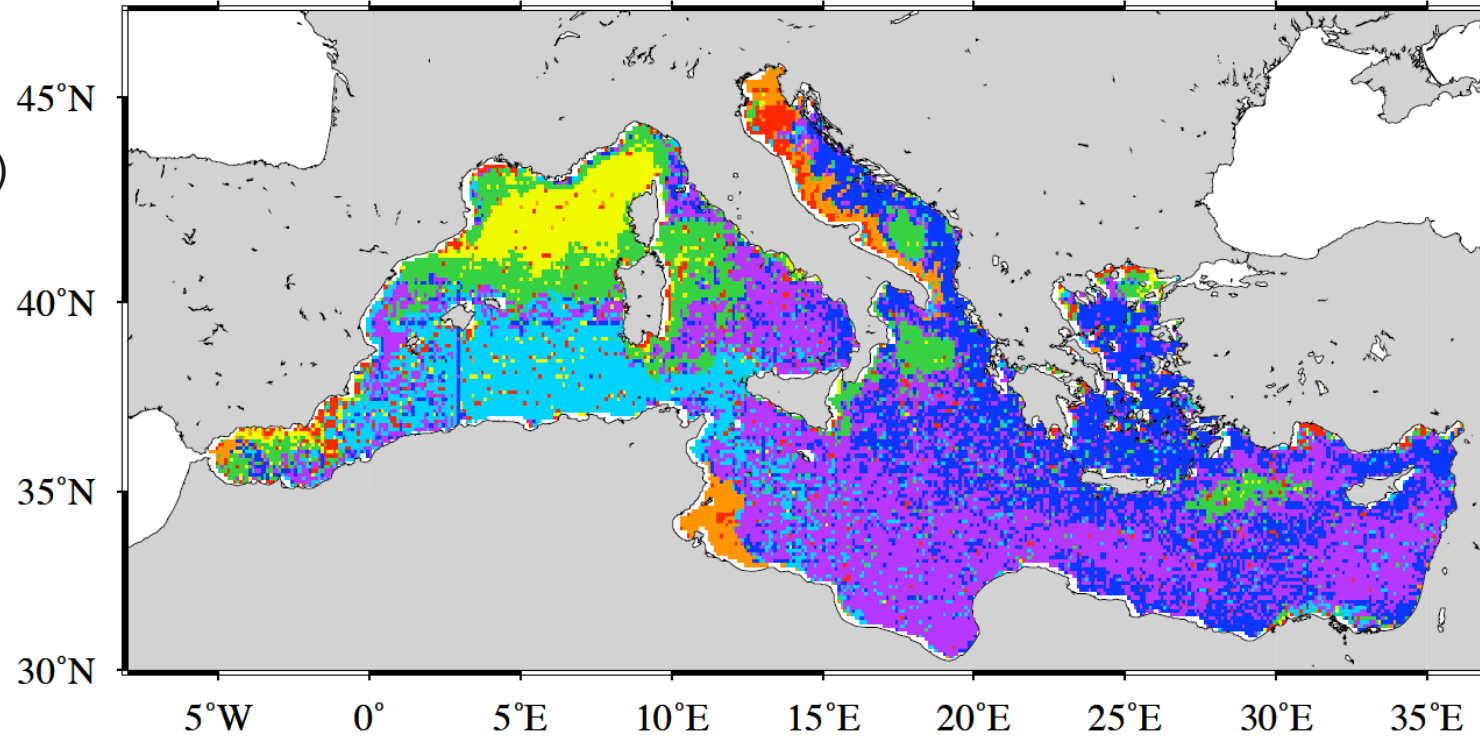
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

Coastal



Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

- 10 years dataset (1997-2007)
- 18 km resolution
- SeaWiFS satellite only
- High noise level
- Exclusion of coastal areas



D'Ortenzio and Ribera d'Alcalà (2009)



1. Revisit Mediterranean bioregionalization and phytoplankton phenology

26 Years of Ocean Colour chlorophyll (Copernicus; 1998-2023), 5 days, 4km resolution, k-means

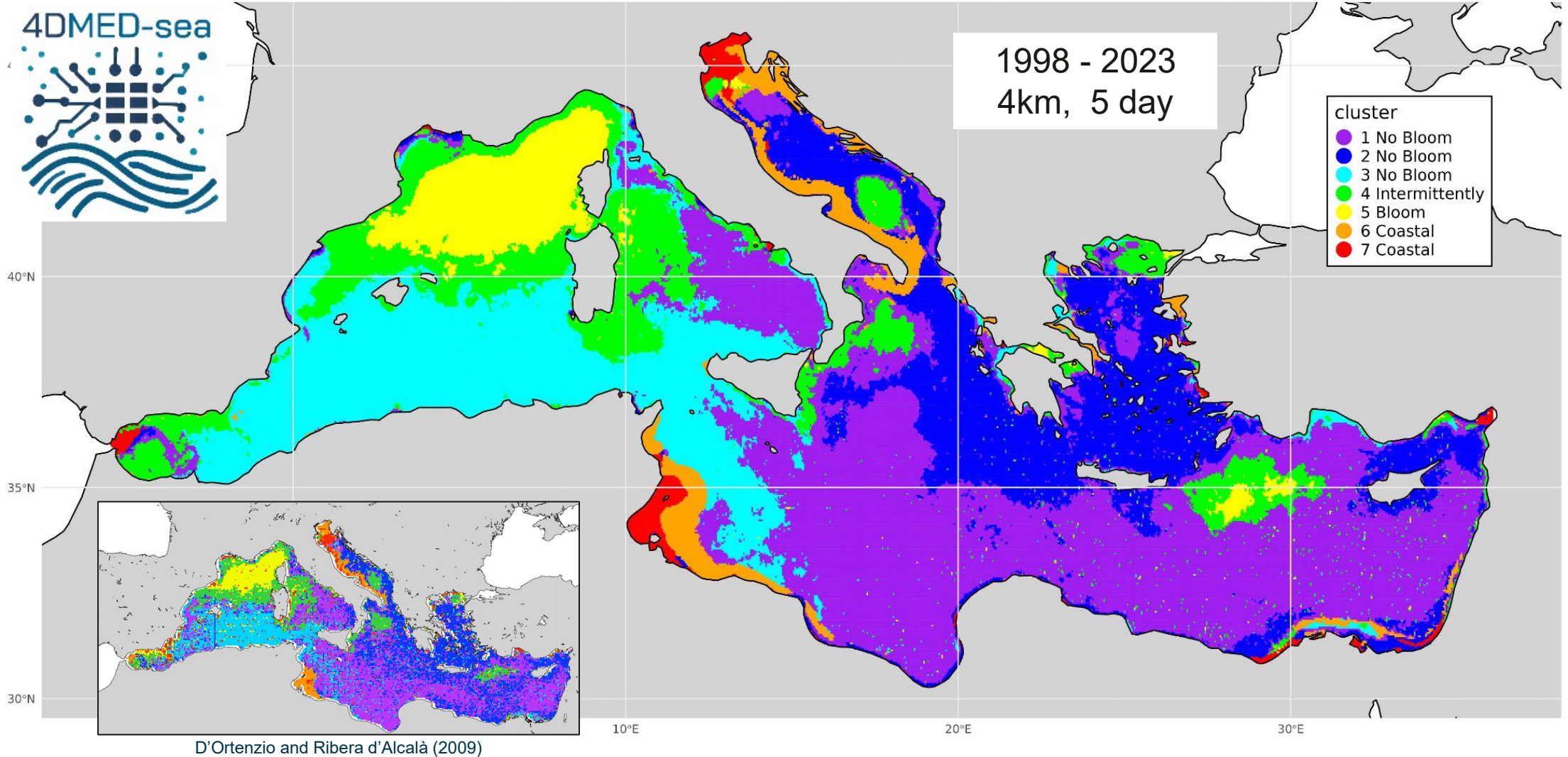
2. Explore interannual variability of bioregions and drivers of change

26 yearly clusterizations using climatological centroids, preliminar correlation with sea surface height

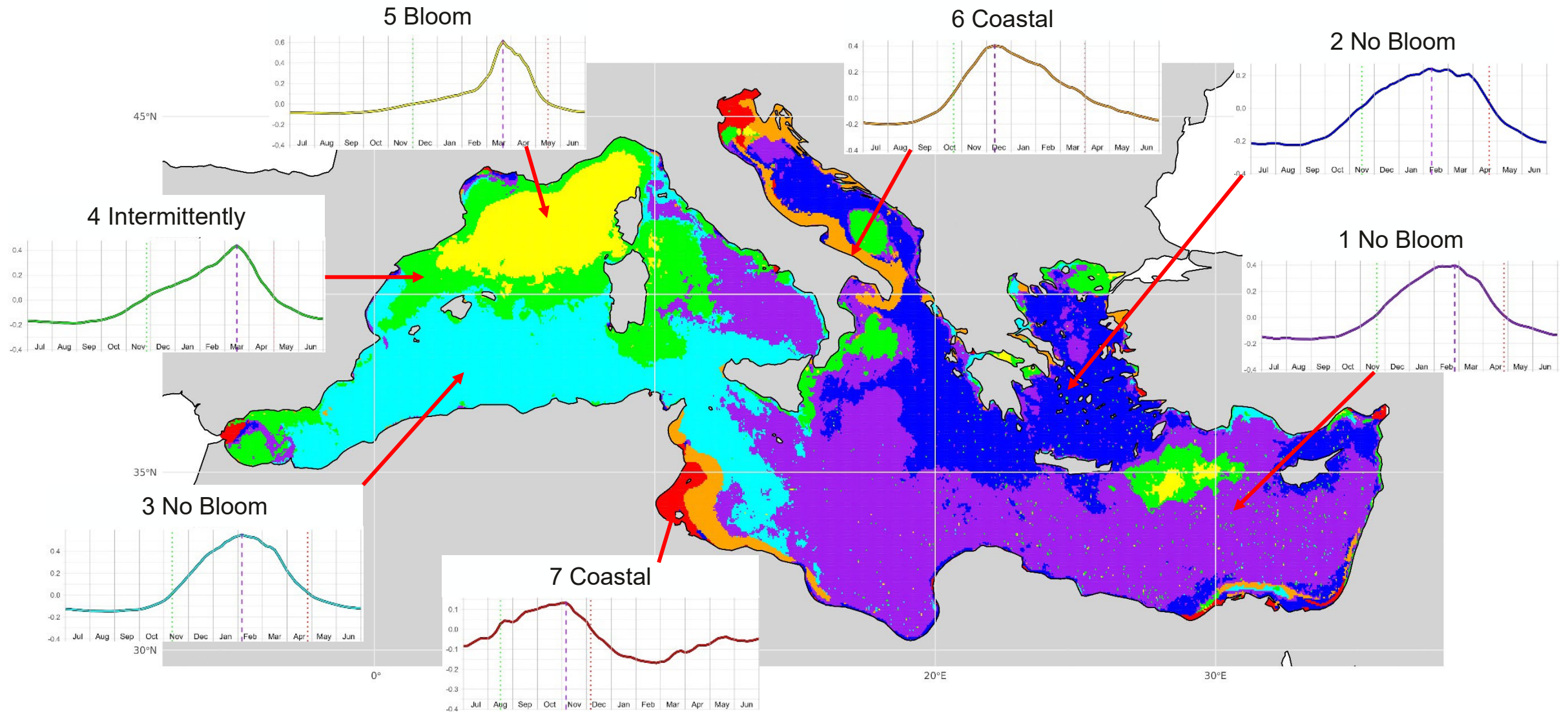
3. Link surface phenology with deeper layers

4D profiles of chlorophyll (4MED-Sea; 2016-2021) integrated between 3 and 150 m, 4km resolution, k-means

Updated Med bioregionalization



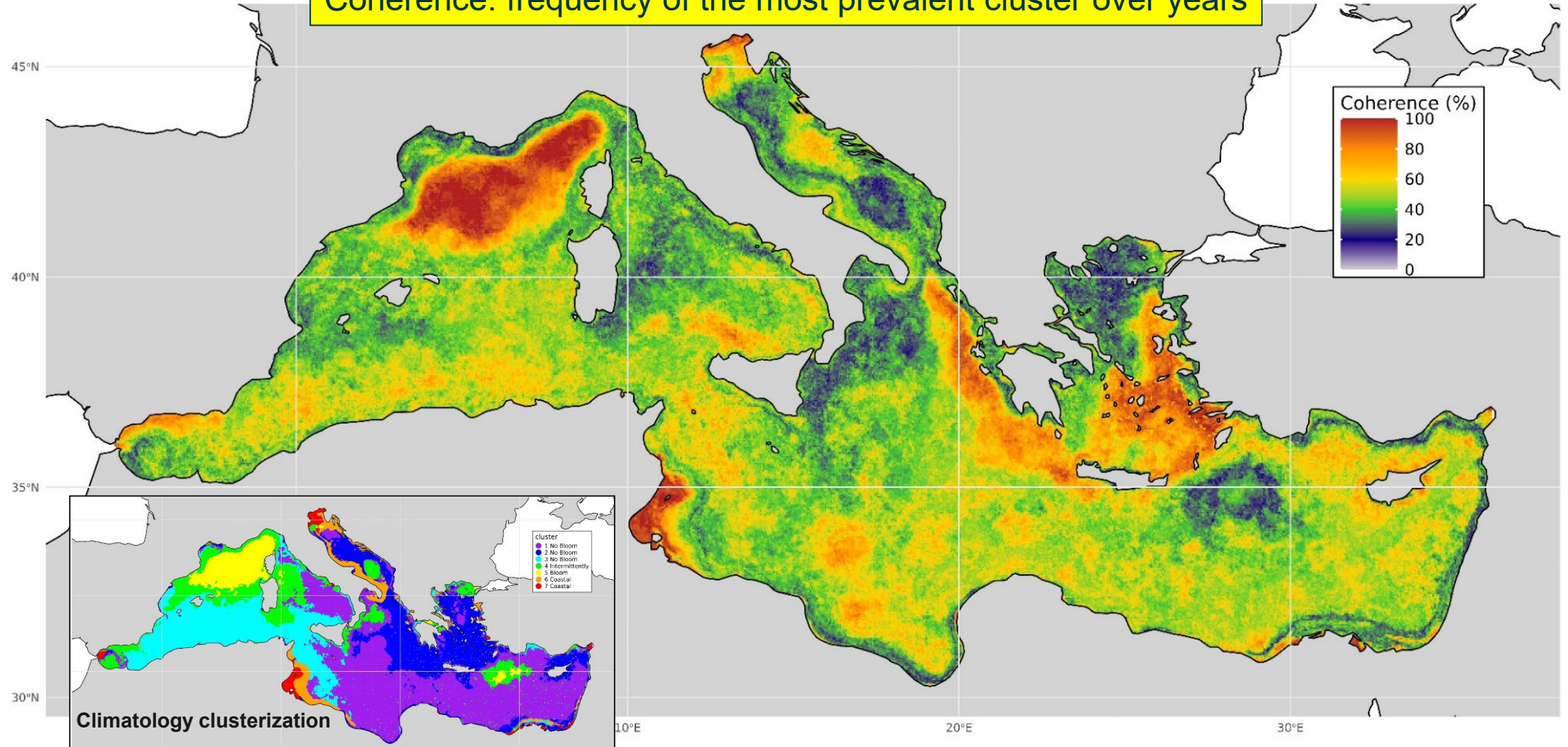
Clusters phenology



Interannual variability



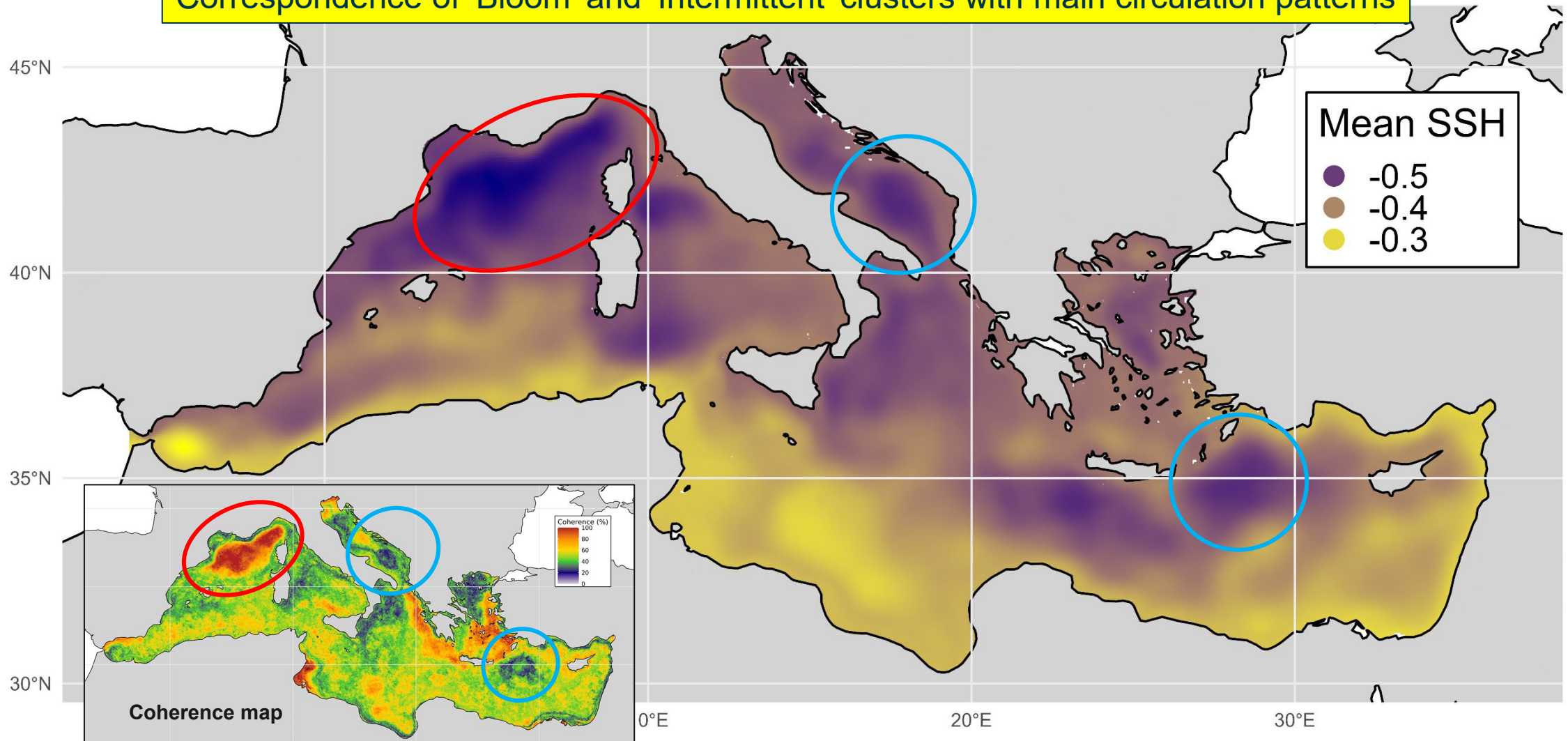
Coherence: frequency of the most prevalent cluster over years



Drivers of change

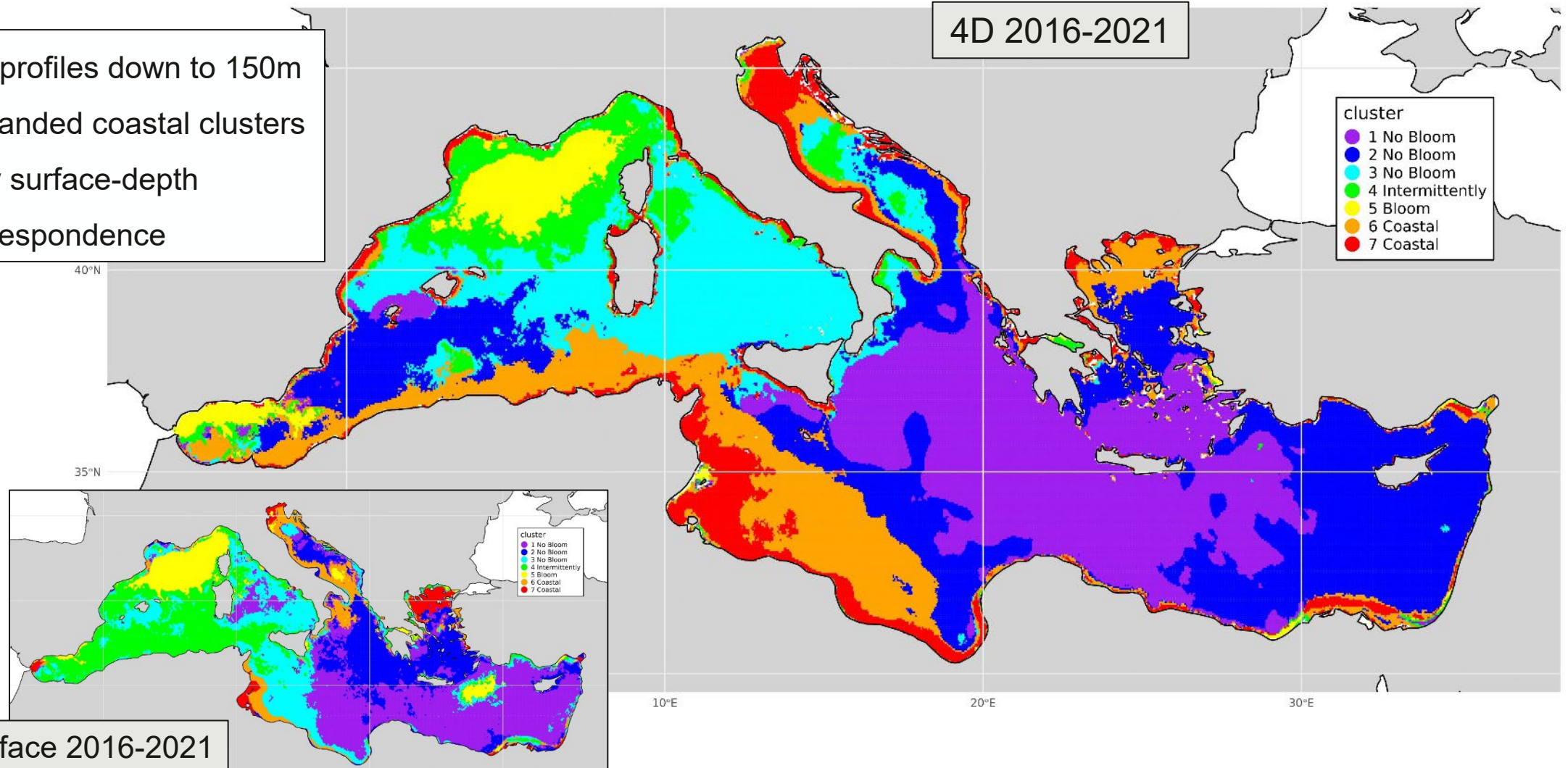


Correspondence of 'Bloom' and 'Intermittent' clusters with main circulation patterns



Depth clusterization

- Chl profiles down to 150m
- Expanded coastal clusters
- Low surface-depth correspondence



Conclusions



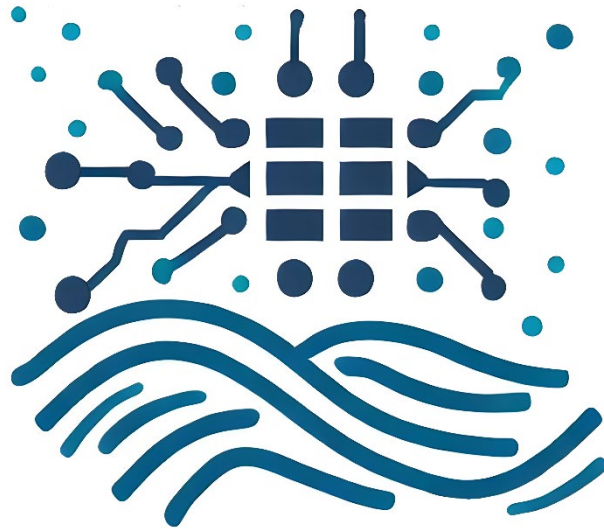
GEOBON

CEOS



- Consistence with D'Ortenzio's bioregionalization, with key differences in cluster definition and coastal region inclusion.
- Coherence analysis identified distinct stable and variable areas.
- Circulation patterns and gyres likely drive interannual variability.
- Depth-based clustering showed significant differences from surface clustering, except in specific areas.
- Further research is needed to explore bio-physical surface interactions beyond chlorophyll and link phenology with deeper layers, improving marine resource management.

4DMED-sea



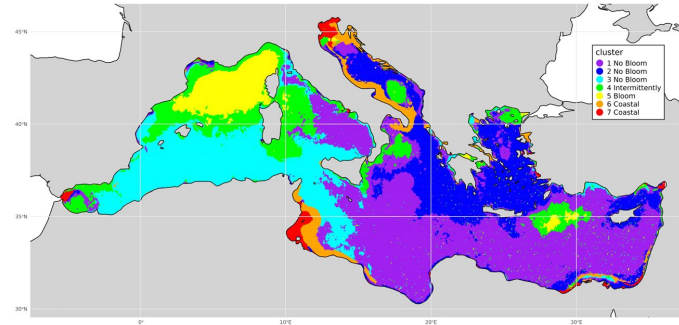
Thanks for your attention!

ESA Contract No. 4000141547/23/I-DT

riccardo.nanni@artov.ismar.cnr.it

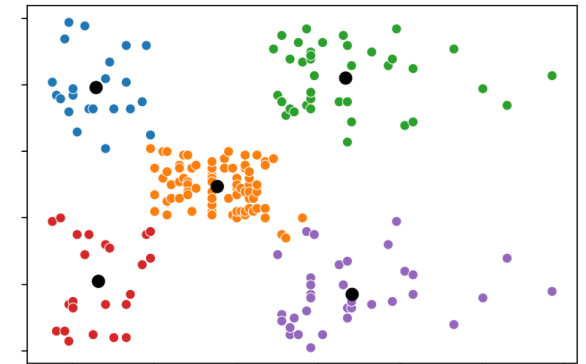
Supplementary material

Climatological clusterization



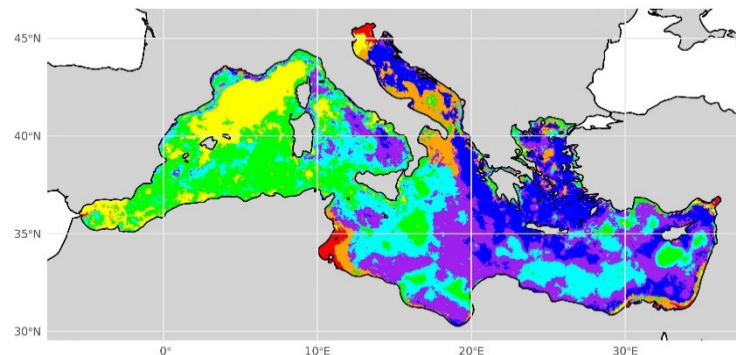
Centroids extraction

Climatological centroids



- Clusterization of yearly dataset
- 15-day smoothing applied
- Clustering based on climatological centroids

Yearly clusterization



Applied on yearly dataset

Yearly clusterization

