

Interannual variability of the Mediterranean seascape based on phytoplankton phenology detected from satellite observations

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INTRODUCTION

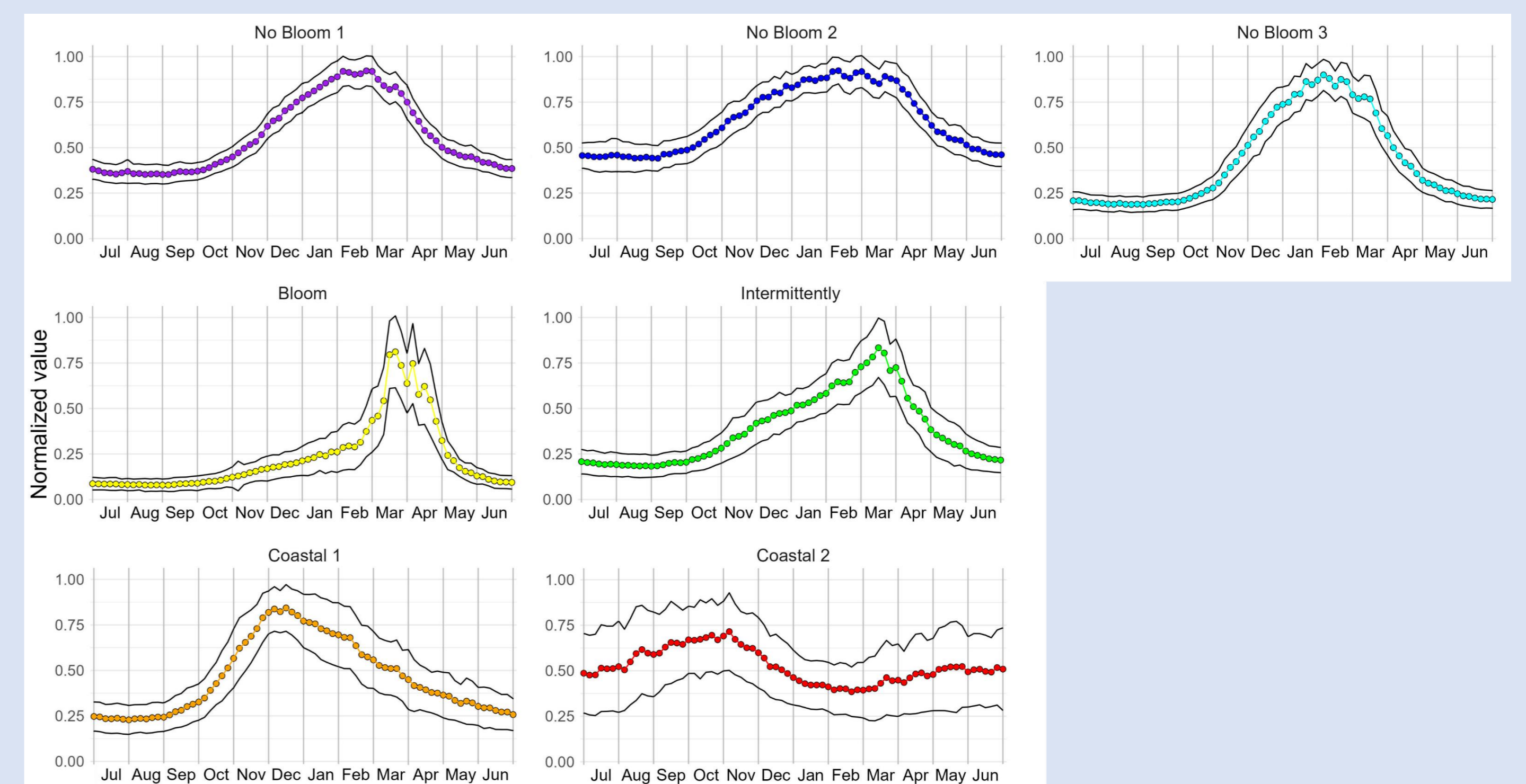
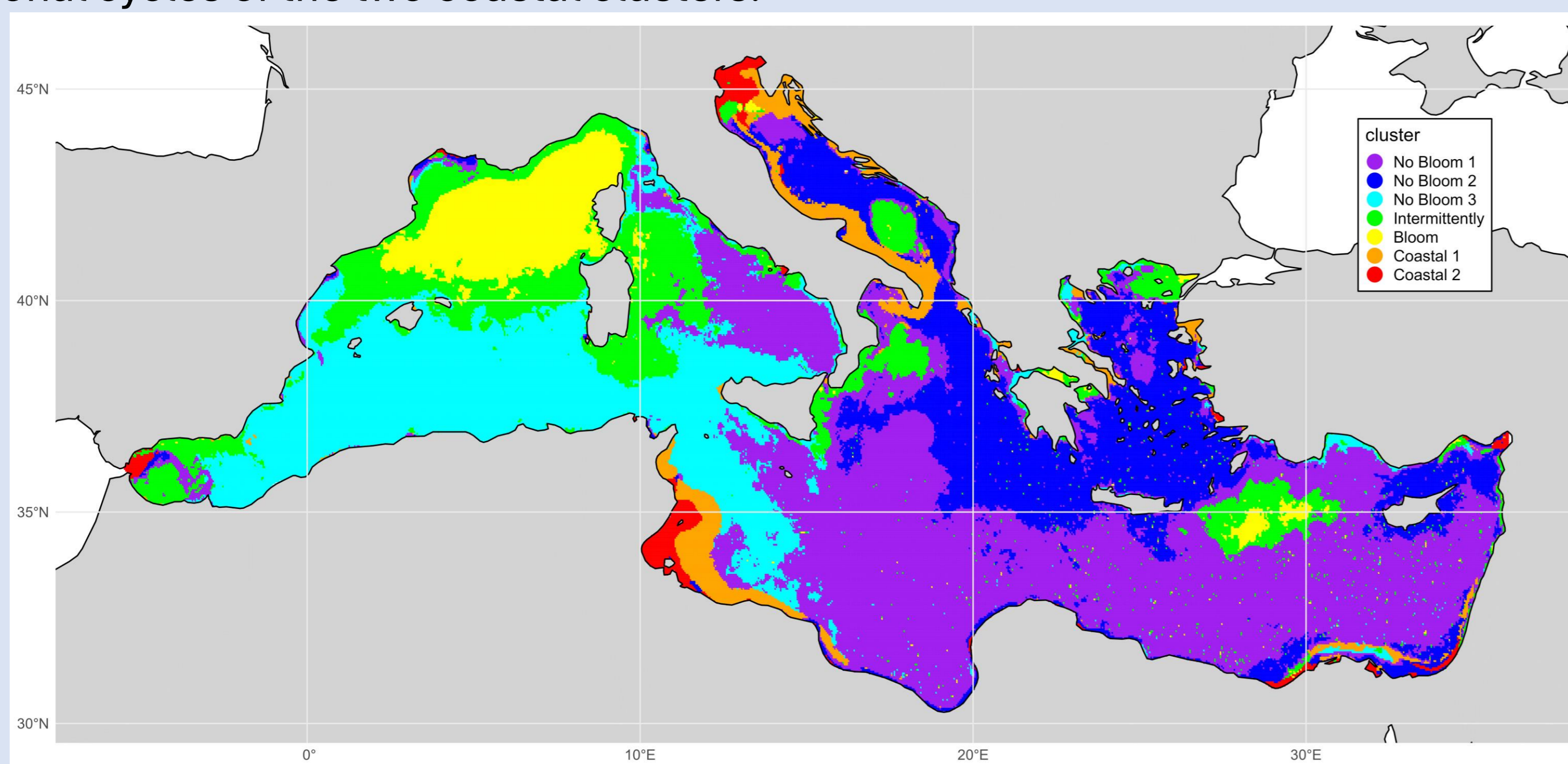
Mediterranean marine ecosystems are tremendously impacted by climate change, leading to profound consequences on the structure and services provided by living communities, starting from primary producers and circulation patterns. Various studies have attempted to define the Mediterranean seascape objectively using satellite-derived surface chlorophyll-a concentration (as a proxy for phytoplankton; e.g., D'Ortenzio & Ribera d'Alcalà, 2009) or other methods, such as circulation patterns described by hydrological models (see Ayata et al., 2018 and references therein). Yet, the inter-annual variability of the resulting regionalizations has not been fully addressed, much less the link with climate. Here, we explored 26 years (1998-2023) of daily satellite-derived chlorophyll-a images at 4 km of spatial resolution from which the interannual variability of the Mediterranean pelagic seascape was assessed.

MATERIAL & METHODS

- Copernicus chlorophyll *a* concentration: L4 gap-free daily products, 1Km, 1998-2023
- Regrid at 4 Km and filtering
- Creation of a 26-year climatology
- Cluster k-means analysis on climatology
- Cluster k-means analysis yearly using centers from the 26-year climatology as in Kheireddine et al. (2021)

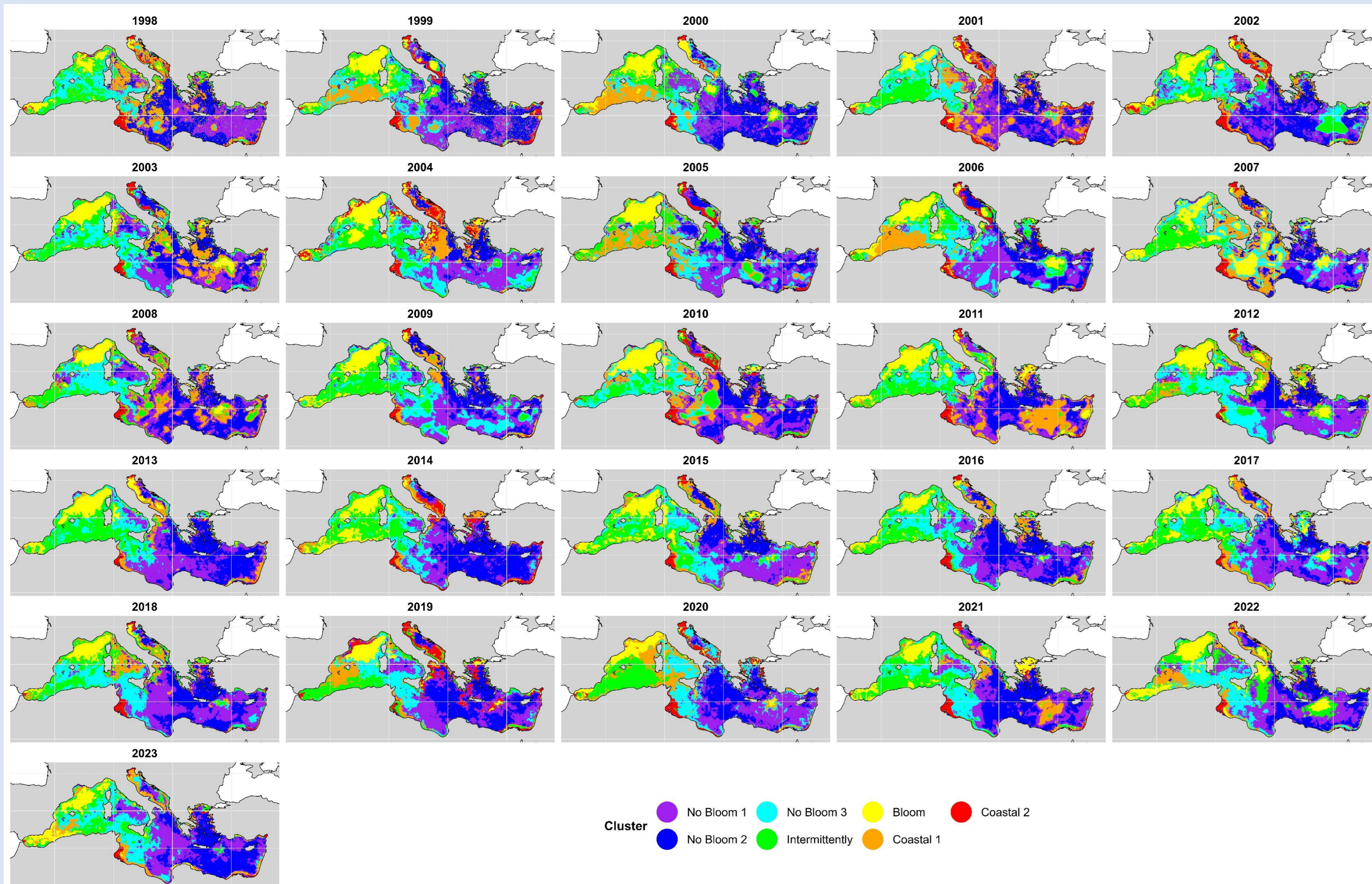
CLIMATOLOGICAL DISTRIBUTION OF CLUSTERS (1998-2023) & AVERAGE SEASONAL CYCLES OF CHLOROPHYLL

The analysis of 26 years of satellite data confirmed the occurrence of 7 significant clusters based on phytoplankton chlorophyll phenological cycles across the Mediterranean Sea, as found by D'Ortenzio and Ribera d'Alcalà (2009) from 1998 to 2007. However, the higher spatial and temporal resolutions revealed different chlorophyll distribution and seasonal cycles of the two coastal clusters.



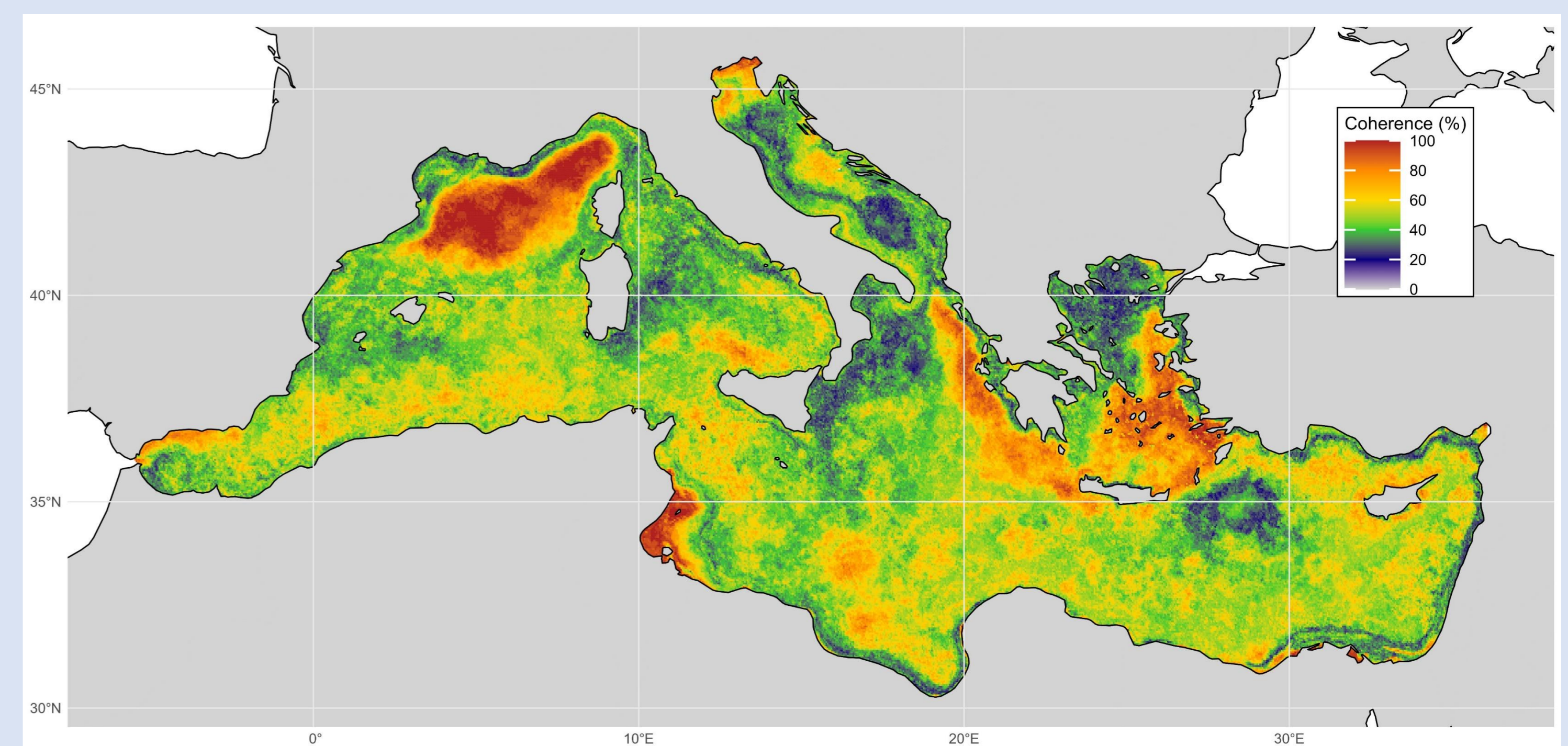
INTERANNUAL VARIABILITY OF THE 7 CLUSTERS OVER 26 YEARS OF OBSERVATIONS

The spatial distribution of all clusters showed high interannual variability. For example, cluster "Coastal 1" was also revealed to be distributed in offshore waters.

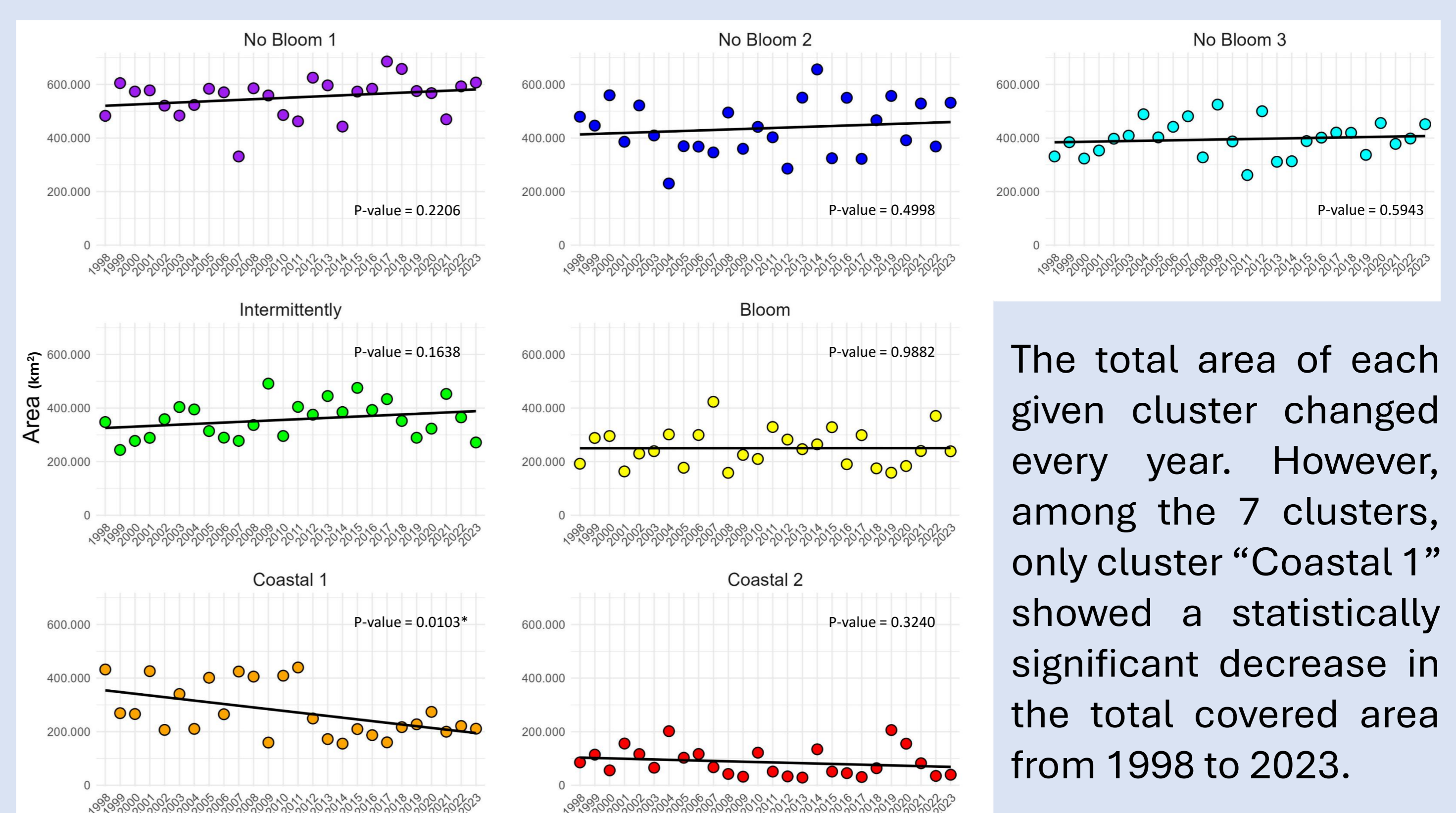


COHERENCE DISTRIBUTION MAP

A degree of coherence was calculated for each pixel (i.e., pixel assigned to the same cluster or not year after year). The map here below shows the highest level of coherence (>60%) corresponding to clusters "Bloom", "Coastal 2" and "No Bloom" clusters. In comparison, the lowest level of coherence (<40%) is found for clusters "Intermittently" and "Coastal 1".



TRENDS IN THE AREAL COVERAGE OF THE 7 CLUSTERS



CONCLUSIONS & PERSPECTIVES

- Confirmed the climatological pattern related to phytoplankton phenology as observed in previous studies over shorter time scales
- High interannual consistency of "Bloom", "Coastal 2" and "No Bloom" clusters
- The total area of Cluster "Coastal 1" has been significantly reduced since 1998
- Further analysis will aim to correlate interannual variability with climate indices and surface circulation patterns

REFERENCES

D'Ortenzio, F. and Ribera d'Alcalà, M. (2009), <https://doi.org/10.5194/bg-6-139-2009>.
Ayata, S.-D., Irissou, J.-O., Aubert, A., Berline, L., Dutay, J.-C., Mayot, N., Nieblas, A.-E., D'Ortenzio, F., Palmiéri, J., Reygondeau, G., Rossi, V., Guieu, C., (2018), <https://doi.org/10.1016/j.pocean.2017.09.016>.
Kheireddine, M., Mayot, N., Ouhssain, M., and Jones, B.-H., (2021), <https://doi.org/10.1029/2021JC017486>, 2021.

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The total area of each given cluster changed every year. However, among the 7 clusters, only cluster "Coastal 1" showed a statistically significant decrease in the total covered area from 1998 to 2023.