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Ocean colour as a valuable tool for assessing phytoplankton bloom phenology patterns in upwelling-influenced regions

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Abstract

Phytoplankton bloom phenology (i.e. the study of the annual timing and intensity of phytoplankton blooms) is key for the understanding of marine ecosystems. Changes in bloom timing and intensity can have harmful consequences for the pelagic ecosystem, such as mismatches between phytoplankton blooms and fish spawning, which may have severe impacts on pelagic fish communities and, consequently, on fisheries. Because of its role, its sensibility to exogenous forcing and specificity to different oceanographic regimes, phytoplankton phenology has been suggested a major indicator of changes in the pelagic ecosystem. This study aimed to assess phytoplankton bloom phenology in the Western Iberian Coast (WIC), a complex coastal region located in SW Europe, using a state-of-the-art long-term ocean colour dataset with daily resolution. Satellite-derived Chl *a* was used as a proxy of phytoplankton biomass. To account for the spatial heterogeneity of WIC, the region was partitioned into phenoregions (i.e. coherent regions according to selected phenology metrics). Random forest (RF) models (Breiman, 2001; Breiman and Cutler, 2004) were used to identify and evaluate the main drivers of each metric of bloom phenology. Bloom phenology off WIC was seen to be complex, matching its oceanography. Five phenoregions were identified, characterised and their drivers identified. Overall, oceanic phytoplankton communities were seen to form typically long, low-biomass spring blooms, mainly influenced by atmospheric phenomena and the conditions of the water column. Coastal phytoplankton, however, was characterised by short, high-biomass highly heterogeneous blooms, as nutrients, sea surface height, temperature and water flow had a major role in shaping phenology. Wind-driven upwelling and riverine input were seen to be major factors in influencing bloom phenology. This work is expected to contribute with relevant information for managing WIC and other upwelling regions, particularly under the current the threat of climate change.

Keywords

phytoplankton, bloom phenology, ocean colour remote sensing, Western Iberian Coast