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Automated techniques to follow the spatial distribution of Phaeocystis globosa and diatoms spring blooms in the Channel and North Sea

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Abstract: The eastern Channel and southern North Sea are continuously influenced by the Atlantic waters and freshwaters inputs, as well as by tidal fronts. At the French coast, flows from local estuaries are driven from the Channel to the North Sea by the residual tidal current creating a "coastal flow" separated from Channel central waters by a tidal front. It leads to a series of different brackish water systems from the Bay of Seine to the Scheldt and Rhine estuaries, supplementing and maintaining high nutrient concentrations along the French, Belgian and Dutch coast. During spring, phytoplankton blooms are mainly dominated by a haptophyte harmful algal species, *Phaeocystis globosa,* preceded and succeeded by diatom blooms including potentially harmful genera (i.e. *Pseudo-nitzschia* spp.). Moreover, in the English coastal area, the Thames river plume provides a local area of important continental influence. Semi-automated techniques are being applied in this area recently, at high resolution to highlight spatio-temporal patterns in phytoplankton successions and outbursts. They provide rapid estimates of abundance and/or chlorophyll *a* content for the whole community and/or at the single-cell level for small picoeukaryotes up to large colonies of microphytoplankton.

The study was performed during a series of three consecutive spring cruises 2017 (PHYCO, CNRS, "Côtes de la Manche" R/V; Lifewatch, VLIZ, "Simon Stevin" R/V; RWS, "Zirfaea" R/V) in the frame of monitoring or research projects, as well as of the European JERICO-Next H2020 European research infrastructure. The cruises started after the onset of spring blooms in the Channel and followed their development along the eastern Channel towards the southern North Sea. Multi-spectral fluorometers and automated flow cytometers were deployed in continuous and profiling mode. They highlighted patchiness in abundance and fluorescence per group as well as some inshore-offshore gradients and contrasts when considering the distance to main estuaries in the area. The deployment of these automated techniques made it possible to discriminate the optical signatures of *P. globosa and Pseudo-nitzschia* spp., mainly found in the brackish waters and to point out their substantial contribution to total phytoplankton abundance and biomass during the progression of the spring bloom. Multivariate analysis were applied to show relations between phytoplankton communities and hydrological and biogeochemical features in the system considered. Automated flow cytometry analysis suggested that *Pseudo-nitzschia* spp. were mostly found in the Scheldt and Rhine estuaries whereas *P. globosa* was widely spread in the system. In brackish waters, the application of a haptophyte signature by multispectral fluorescence showed that this species would have represented more than 75% of the total pigmentary biomass.

Keywords: Automated flow cytometry, Phaeocystis globosa, Pseudo-nitzschia spp