Modelling the relationship between phytoplankton biomass and environmental parameters in the Scheldt Estuary

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Microalgae are the main primary producers in aquatic ecosystems. Due to their short generation time, they show a quick response in function of changing environmental conditions. Therefore it is of great importance to include phytoplankton dynamics in monitoring programs to evaluate water quality and develop efficient management strategies. From 1996 onwards, the Scheldt Estuary has been monitored monthly in the framework of the OMES-project (Onderzoek Milieu-Effecten Sigmaplan). Phytoplankton communities and several (a)biotic parameters (chlorophyll a, other pigments, temperature, conductivity, chlorides, discharges, pH, O_2, BOD-N, PO_4-P, total phosphorus, NH_4, NO_3, NO_2, SO_4, dissolved silica, SPM, $Z_m.Z_{eu}^{-1}$, Kd, DOC, POC and zooplankton) are measured and analysed. The aim of this study is to investigate the spatial-temporal changes in the phytoplankton communities and to link these patterns to variations in (a)biotic parameters. For this purpose a general additive mixed model (GAMM) will be developed based on this large dataset to explore the relationship between chlorophyll a, an indicator for phytoplankton biomass, and above mentioned environmental parameters (Zuur *et al.,* 2009). As many ecological interdependencies are non-linear, traditional regression methods, for instance, general linear models, are shortcoming and new statistical methods have been developed for these kind of analyses. Additive models are able to deal with non-linear relationships between predictor and response variables by smoothing functions and do not require previous knowledge of functional relations. Another advantage when they are combined with mixed models, is the ability to deal with both temporal and spatial autocorrelations between samples, which is a common difficulty in analysing monitoring datasets (Zuur *et al*., 2007). Prior to fitting the model, correlations and variance inflation factors between the variables were checked to avoid problems of collinearity. Different models have already been fitted using the R package 'mgcv' (Wood, 2014). More complex GAMMs will be tested in order to improve model fitting and will be selected based on the Akaika information criteria (AIC). The final model should have the lowest AIC value, containing only significant variables and residuals should be normally distributed showing no visible patterns. This model will help to understand spatial-temporal changes in phytoplankton biomass and how these patterns are linked with bottom-up (hydrology and abiotic parameters) and top-down (zooplankton) control mechanisms.

References

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