Probabilistic models for harmful algae: application to the Norwegian coast

Some algae produce toxins that contaminate shellfish, posing significant health risks to humans who consume them. These algae also affect the aquaculture industry because contaminated shellfish cannot be sold and are likely to remain unsold even after being depurated. Assessing the risk of toxic algae occurring in shellfish farms can help farmers make better decisions and reduce economic losses, such as harvesting before contamination events and planning the market supply to periods with reduced risks. We have developed probabilistic models to estimate the likelihood of harmful algae presence and outbreaks along the Norwegian coast. We use support vector machines to calibrate these models for estimating the presence and harmful abundance (HA) of eight toxic algae species found in this region, including Alexandrium spp., Alexandrium tamarense, Dinophysis acuta, Dinophysis acuminata, Dinophysis norvegica, Pseudo-nitzschia spp., Protoceratium reticulatum, and Azadinium spinosum. The inputs for our models are sea surface temperature, photosynthetically active radiation, mixed layer depth, and sea surface salinity. The presence models show good statistical performance for all taxa, with correlations (observed presence frequency vs. predicted probability) ranging from 0.69 to 0.98 and root mean squared error ranging from 0.84% to 7.84%. Predicting the probability of HA is more challenging, and the HA models only achieve reliable results for four taxa (Alexandrium spp., A. tamarense, D. acuta, and A. spinosum). The models can estimate regions and seasonal periods with elevated risks of toxic species detection as well as safe zones and seasons. Public agencies and farmers can use this information to implement mitigation actions against toxic algae. Furthermore, the method can be extended to other regions as it relies only on data from remote sensing and models combined with national programs of toxic algae monitoring.

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