

## **How to measure the breadth of the coastal zone using bio-optics**

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The breadth of the coastal zone is a value of practical importance in relation to its management and to the legislation of many states. Such legislation is exemplified in the EU Water Framework Directive, which defines coastal waters as being 1 nautical mile wide. In order to investigate the true width of the coastal zone in the Baltic Sea, we analysed variations in bio-optical constituents and submarine optical properties along a transect from the nutrient-enriched Himmer fjord (local Swedish name: Himmerfjärden) to the open Baltic. The optical variables provide a convenient suite of indicators of ecosystem state. CDOM (coloured dissolved organic matter) relates to mostly terrestrial inputs of freshwater, inorganic SPM (suspended particulate matter) to land drainage and to wind-stirring in shallow waters, and phytoplankton pigments to the productive status of the pelagic ecosystem influenced by anthropogenic nutrients from sources on land. Multiple regression analysis was used to describe the contribution of each optical component to the spectral attenuation coefficient,  $K_d(490)$ , which thus provides an overall measure of ecosystem state. The transect was worked on a number of occasions under two different weather conditions – in June of 2001 and August of 2002. The transect data were used to define the breadth of the coastal zone and to analyze the interaction between coastal waters and the open sea. The analysis was made by using a model that assumes diffusion as the driving force for the distribution of bio-optical variables, and therefore describes a polynomial decline of each optical component from a source close to land to a sink in the open sea. Results obtained by fitting the model to the observations suggest that the breadth of the coastal zone in this region is of order 10 kilometres and that sampling must extend beyond this distance in order to describe the boundary or reference conditions for coastal waters. Finally, this approach is useful for interpreting Level-2 ocean colour data of the Baltic Sea.