Nutrient enrichment

What is the issue?

OSPAR assessments of the waterborne and atmospheric inputs of nutrients highlight a number of key variables affecting eutrophication that are associated with climate (OSPAR Commission, 2009a and 2009b). Rainfall patterns affect the level nutrients enter rivers and are subsequently discharged to the sea. Sea temperature directly impacts upon phytoplankton and seasonal stratification with consequential changes to the availability of nutrients in the summer, extent of growth and types of phytoplankton expected. Increasing storminess would affect turbidity and mixing of the sea, which also influences the light climate to which phytoplankton are exposed, and may decrease overall growth in shallow areas. These factors may also affect the growth of macrophytes and toxic algae. It is important to be able to distinguish between changes due to climate and changes induced by anthropogenic nutrient inputs to the sea (OSPAR Commission, 2009a and 2009b).

What has happened and how confident?

Drier summers may already be contributing to a decrease in nutrient inputs in European seas although it is difficult to distinguish between changes due to the effects of human inputs (e.g. agricultural run-off) and those that may be due to climate change through rainfall and ocean transport.

In the 1990s, OSPAR Contracting Parties were reporting climate-related effects on eutrophication. The Netherlands noted a large increase in the toxic species *Dinophysis* following an unusually wet year, and Denmark noted a significant decrease in nutrient inputs and chlorophyll levels caused by a number of uncharacteristically dry years.

What might happen?

Overall impacts of climate warming upon coastal and marine ecosystems are likely to intensify the problems of eutrophication (IPCC, 2007b).

In the future, drier summers may decrease nutrient inputs, although sudden storms may deliver pulses with consequences that are difficult to predict. More intense winter storms would raise concentrations of nutrients at the ocean surface and may increase transfer of nutrients into shelf seas. If summer stratification (reduced mixing) becomes stronger, nutrient supply from deeper waters to surface waters will reduce during the productive season (Hydes *et al.,* 2008).

Are there any OSPAR regional differences?

The main impacts appear to add a further pressure to those areas susceptible to eutrophication as such this is of primary importance to particular areas within OSPAR regions. Suggestions of potential regional climate impacts are discussed in (OSPAR Commission, 2008).

Winter rainfall has substantially increased over Northern Europe, increasing flooding along river basins and increasing run-off into the North Sea (Struyf *et al.*, 2004). Nutrients in Region II (Greater North Sea) may now be transferred to the coastal environment more quickly.

➥ *Go to the full QSR assessment report on impacts of climate change (publication number 463/2009)*

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