

Do UK riverine inputs of nitrogen to the North Sea significantly impact on EU states sea areas?

Marine Theme Objective: Human pressures and impact on the marine environment

What's the problem?

Eutrophication is a process that may occur when nutrients are added to marine waters. Although it can occur naturally it can also result from enrichment with riverine nutrients derived from human activities. Under some circumstances enrichment with riverine nutrients can lead to eutrophication that result in increased growth of plants and an undesirable disturbance to the balance of organisms, for example, nuisance blooms of algae. Consequently, detection and diagnosis of eutrophication is required for a range of European Union (EU) legislation and by the Oslo-Paris international convention (OSPAR). Following the first assessment of eutrophication for OSPAR the Netherlands and Germany diagnosed eutrophication in their maritime areas and alleged that riverine inputs of nitrogen from the UK caused a significant contribution to eutrophication problems in their waters. This project set out to calculate the extent of transboundary transport of nutrients in order to provide partners in OSPAR with the information required to develop sound management strategies to eliminate eutrophication.

What are the aims of the project?

The aim of the project was to provide Defra with the best possible advice on the extent of transboundary nutrient transport by making best use of UK expertise particularly with regard to the use of modelling tools. The objectives of this work included supporting the contractor (Cefas) in its lead role convening an international working group on eutrophication modeling on behalf of OSPAR.

Specific objectives requiring the use of models were to carry out an investigation of the effect of reducing the level of riverine nutrient inputs on eutrophication in the North Sea and to calculate the amount of transboundary nutrient transport in the North Sea (i.e. crossing international maritime boundaries).

Additional objectives included reviewing the scientific knowledge and capability of modeling tools, identifying gaps and proposing new work. The programme also set out to consider how to enhance UK eutrophication monitoring.

The completion date of the project was 31 March 2010.

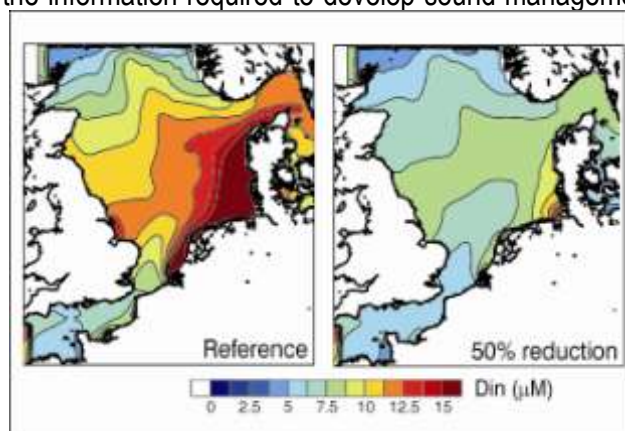


Fig 1: Maps showing effects of reducing riverine inputs of dissolved inorganic nitrogen (Din) on distribution and concentration in the North Sea. The reference condition on the left is the result of a model simulation without nutrient reduction. The picture on the right shows model results after reducing riverine Din by 50% compared to nutrients levels entering the North Sea in 1985.

Which policy areas will the research inform?

The work is directly relevant to policies requiring assessment of eutrophication including the OSPAR Convention, Urban Waste Water Treatment Directive, Nitrates Directive, Water Framework Directive and the Marine Strategy Framework Directive. The work provides evidence to inform management strategies to eliminate eutrophication as well as recommendations as to the use of models in conjunction with data from monitoring programmes in assessing eutrophication.



Do UK riverine inputs of nitrogen to the North Sea significantly impact on EU states sea areas?

What are the results from the project and how will they be used?

Work to evaluate the effects of riverine nutrient reductions on eutrophication in the North Sea have shown that:

- A 50% reduction in nutrients (Nitrogen) may not result in elimination of eutrophication ,
- Reducing nutrient inputs from the UK rivers to 0% has a minimal impact on the levels of dissolved oxygen a key indicator used by the Netherlands to diagnose eutrophication in oyster grounds region of the North Sea,
- Coastal areas were found to be more sensitive to nutrient reductions than offshore areas,
- Problem areas (i.e. those classified as eutrophic) in continental coastal waters receive by far the largest proportion of their nutrients from continental rivers and not from UK sources.

Work to calculate the extent of transboundary transport of nutrients has shown that:

- Management of nutrient inputs to specific water bodies requires information from this study on the relative contribution of the sources that varies from place to place over the North Sea,
- The largest UK contribution to other maritime areas occurs in the central North Sea where nutrient enrichment does not exceed locally set thresholds i.e. the receiving waters are not 'enriched' with nutrients according to the OSPAR Comprehensive Procedure,
- For specific Problem Areas the main nutrient sources can be identified and the extent of their contribution leading to this classification can be determined,
- It is possible to further refine the identification of nutrient sources to the level of individual rivers/treatment plants instead of groups of rivers allowing identification of specific management measures that can be taken to achieve non-problem area status in a cost effective manner.

Overall this work has shown that:

- More robust and effective strategies for eliminating eutrophication can be developed by using models,

- Confidence in the assessment of eutrophication can be improved through the use of models,
- Collaborative model applications drawing in models and expertise from more than one group increase confidence in the resulting advice.

The results of this work will be used in various ways. OSPAR has amended its strategy to combat eutrophication based on the knowledge derived from this work that a 50% reduction in nutrient inputs (compared to 1985) may not be sufficient to eliminate eutrophication. Knowledge of the extent of transboundary transport of nutrient will be used to inform cost-effective and targeted management measures that may be required to eliminate eutrophication in specific water bodies.

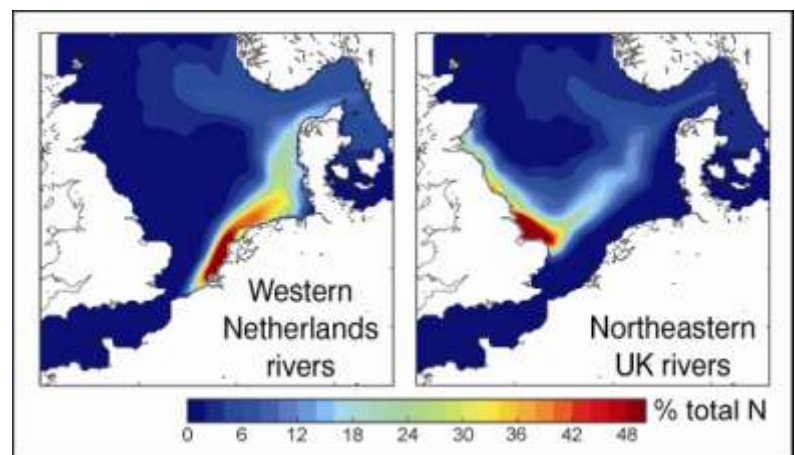


Figure 2: Map of North Sea showing the results from modeling Transboundary Nutrient Transport. The figure shows the percentage of the total nitrogen (organic and inorganic) originating from rivers along the UK northeast coast and from the Rhine. The results are the average for a 1 year model simulation and show that the highest concentration of nitrogen is found close to the riverine sources. They also show that nutrients can travel some distance from the source but are diluted as they travel by being mixed with waters containing nutrients from natural and human influenced sources.

Where can I find further information about this and related research?

Information on the workshops and reports on the results can be found on the Cefas web site www.cefas.co.uk/publications/miscellaneous-publications

Alternatively, please contact Defra's Marine and Fisheries Science Unit: marinescience@defra.gsi.gov.uk

Defra Science – did you know?

At any one time Defra manages over 2000 research projects covering a wide range of topics. For more information on current research see <http://randd.defra.gov.uk> and to find out about future research proposals see the Defra Research and Analysis page at: www.defra.gov.uk/evidence/index/htm