European Commission

Science for Environment Policy

Air pollution modelling could help predict algal blooms

Models that predict how nitrogen from the air is deposited in the sea could be useful in predicting algal blooms. Based on the knowledge that excess nitrogen increases algal growth rates, researchers simulated nitrogen deposition in the North Sea and suggested that, using predicted weather data, it might be possible to adapt this approach to predict algal blooms.

Algae populations are kept under control by various factors that affect their growth. Certain nutrients, for example, are not always available at concentrations that would allow unrestrained growth.

In the marine environment, the main limiting factor for algal growth is thought to be nitrogen. Therefore, when nitrogen levels in seawater increase, algae populations grow rapidly and can sometimes result in algal blooms. As the algae die and decay, broken down by microbes, large quantities of oxygen are consumed. This process of eutrophication is harmful to other marine organisms because it deprives them of oxygen.

The main route for excess nitrogen to reach the sea may be through the flow of groundwater containing nitrogen, for example, from fertilisers used in farming, but nitrogen can also be deposited from the air. Studies suggest that 6–16% of nitrogen that enters the North Sea comes from the atmosphere, through the burning of fossil fuels, for instance.

The study's authors wanted to develop a model that would be capable of predicting the levels of nitrogen that enter the sea from airborne sources. They show how weather and emissions data, and computer simulations, can be combined to estimate nitrogen inputs.

For the simulations, they used publically available software that can simulate the movements of pollutants based on the weather conditions. They used weather data from reports for the English Channel and southern North Sea region, along with data on emissions of nitrogen oxides and ammonia.

In this way, the researchers were able to model the quantities of nitrogen deposited in the sea from the air during 2009 and 2011. To test the effects of higher and lower levels of emissions, they combined weather data for these years with emissions data from either 2000 (higher emissions) and 2009 (lower emissions).

When the results were plotted on a map, they showed that the levels of nitrogen oxides deposited in the sea were visibly higher when the 2000 (higher emissions) data were used. There was a less obvious difference in levels of ammonia deposition, which were much higher than the levels predicted for nitrogen oxides in both 2009 and 2011. This may be because ammonia is more hydrophilic, meaning it has a natural affinity for water.

Most ammonia comes from agricultural sources but shipping was another important source of nitrogen, with the researchers' maps showing that high levels were deposited around the busiest shipping routes.

To test the effects of different weather conditions, the researchers compared the results for 2009 and 2011, using the same emissions data. The drier weather in 2011 resulted in lower nitrogen deposits, particularly in the case of nitrogen dioxides.

According to the researchers, their model could be used to help predict effects on algae populations. Weather predictions could be combined with emissions data from previous years to simulate nitrogen deposition levels and thereby predict when harmful algal blooms might occur. The model could also be improved by using weather data recorded at more frequent time intervals and emissions data recorded at higher spatial resolution, which will be available in the near future.

19 March 2015
Issue 408

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Source: Djambazov, G. & Pericleous, K. (2015). Modelled atmospheric contribution to nitrogen eutrophication in the English Channel and the southern North Sea. *Atmospheric Environment* 102 (2015) 191-199. DOI: 10.1016/j.atmosenv.2014.11.071.

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