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Waters acidified by air pollution have recovered as predicted

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Back in 1999, a group of scientists predicted how changing air pollution levels would affect the acidity of lakes and rivers in Europe in 2010 using a computer model. A follow up study has now gathered actual measurements of these waters to see if the predictions came true. The observations show that most of the rivers and lakes did recover from acidification, as forecast by the model, and demonstrate the model's value in predicting future water chemistry, the authors say.

For much of the 20th century, large areas of Europe suffered from the effects of the atmospheric pollutants sulphur and nitrogen oxides. These pollutants travel long distances, acidifying distant lakes and rivers, severely damaging freshwater biodiversity and killing fish.

The research team behind the earlier study had made forecasts in 1999 for how 202 acidified rivers and lakes across 10 study regions of Europe would recover as a result of emission reductions agreed under the 1999 Gothenburg Protocol. This protocol is designed to cut emissions of sulphur and nitrogen oxides throughout Europe and is implemented through the National Emission Ceilings (NEC) Directive in the EU.

In particular, the study estimated the quantity of sulphur and nitrogen compounds that would be deposited from the atmosphere in 2010, and considered how this deposition would affect concentrations of sulphate and nitrate in water, the main reason for increased freshwater acidity. They also assessed the acid-neutralising capacity (ANC) of waters, which is a measure for the overall buffering capacity against acidification.

This 1999 research was carried out under a major European project, RECOVER: 2010[1]. It used MAGIC (Model of Acidification of Groundwater In Catchments) to make the predictions.

For the new study, researchers compared the earlier predictions with actual measurements of deposition for 1995–2010 from the 10 regions, collected as part of the European Monitoring and Evaluation Programme (EMEP). They also collated measurements of surface water chemistry taken from national monitoring programmes, also for 1995–2010.

The predictions of sulphur deposition and water sulphate concentrations were close to the actual measurements. The correlation score between predicted and measured deposition data was 0.92 (where 1 is total correlation and 0 is no correlation at all). The correlation was 0.89 for surface water concentration data.

The two sets of ANC results also mirrored each other, with correlation scored at 0.96. Both sets of data showed a general increase in ANC over the study period.

The results did not match as well for nitrogen compounds. The correlations score between predicted and actual measurements for nitrogen deposition was just 0.42, and 0.73 for the surface water results. There are several possible explanations for differences between the predictions and measurements. For instance, unpredicted changes in forests, including pest and disease damage, or changes in catchment processes as a result of extreme climate conditions, will affect the availability of nitrogen nutrient compounds in the environment.

However, it is sulphur, and not nitrogen compounds, that have largely driven the recovery of ANC in these lakes and rivers. The study's authors therefore say that they have proven MAGIC can predict recovery from acidification, particularly at sites where changes are mainly driven by sulphur. It could be useful in supporting new policies to manage long-range pollution, they suggest.

1. RECOVER:2010 (Predicting recovery in acidified freshwaters by the year 2010, and beyond) was supported by the European Commission. See: www.macaulay.ac.uk/recover/