Hydrology and Earth System Sciences
An Interactive Open Access Journal of the European Geosciences Union

Hydrol. Earth Syst. Sci., 7, 447-455, 2003
www.hydrol-earth-syst-sci.net/7/447/2003/

A modelling assessment of acidification and recovery of European surface waters

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Abstract. The increase in emission of sulphur oxides and nitrogen (both oxidised and reduced forms) since the mid-1800s caused a severe decline in pH and ANC in acid-sensitive surface waters across Europe. Since c.1980, these emissions have declined and trends towards recovery from acidification have been widely observed in time-series of water chemistry data. In this paper, the MAGIC model was applied to 10 regions (the SMART model to one) in Europe to address the question of future recovery under the most recently agreed emission protocols (the 1999 Gothenburg Protocol). The models were calibrated using best available data and driven using S and N deposition sequences for Europe derived from EMEP data. The wide extent and the severity of water acidification in 1980 in many regions were illustrated by model simulations which showed significant deterioration in ANC away from the pre-acidification conditions. The simulations also captured the recovery to 2000 in response to the existing emission reductions. Predictions to 2016 indicated further significant recovery towards pre-acidification chemistry in all regions except Central England (S Pennines), S Alps, S Norway and S Sweden. In these areas it is clear that further emission reductions will be required and that the recovery of surface waters will take several decades as soils slowly replenish their depleted base cation pools. Chemical recovery may not, however, ensure biological recovery and further reductions may also be required to enable these waters to achieve the "good ecological status" as required by the EU Water Framework Directive.

Keywords: Europe, acid-sensitive, waters, predictions, recovery, protocols

Final Revised Paper (PDF, 804 KB)

Citation: Jenkins, A., Camarero, L., Cosby, B. J., Ferrier, R. C., Forsius, M., Helliwell, R. C., Kopácek, J., Majer, V., Moldan, F., Posch, M., Rogora, M., Schöpp, W., and Wright, R. F.: A modelling assessment of acidification and recovery of European surface waters, Hydrol. Earth Syst. Sci., 7, 447-455, 2003. Bibtex EndNote Reference Manager