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Modelling sulphate stream concentrations in the Black Forest catchments Schluchsee and Villingen

A. Prechtel¹, M. Armbruster², and E. Matzner¹

¹Department of Soil Ecology, BITÖK, University of Bayreuth, D-95440 Bayreuth, Germany

²Institute of Soil Science, Technical University of Dresden, D-01735 Tharandt, Germany

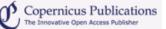
Abstract. The sulphate (SO_4) released by mineralisation and desorption from soil can play an important role in determining concentrations of SO₄ in streams. The MAGIC model was calibrated for two catchments in the Black Forest, Germany (Schluchsee and Villingen) and SO_4 concentrations in the streams for the years 2016 and 2030 were predicted. Special emphasis was placed on the dynamics of soil sulphur (S) pools. At Schluchsee, 90% of soil S is stored in the organic S (S $_{\rm org}$) pool, whereas at Villingen, 54% is in the inorganic (S_{inorg}) pool. The Villingen stream chemistry was modelled successfully by measured Langmuir isotherm parameters (LIPs) for Sinora. Schluchsee data could not be modelled satisfactorily using measured or freely adapted LIPs only, as the S_{inorg} pool would have to be more than five times larger than what was measured. With 60.5 mmol_c SO₄ m⁻² yr⁻¹ as internal soil source by mineralisation and the measured LIPs, stream data was modelled successfully. The modelling shows that in these two catchments pre-industrial concentrations of SO_4 in runoff can be reached in the next two decades if S deposition decreases as intended under currently agreed national and international legislation. S_{org} is the most likely dominant source of SO_4 released at Schluchsee. Mineralization from the S_{ora} pool must be included when modelling SO₄ concentrations in the stream. As the dynamics and the controlling factors of S release by mineralisation are not yet clear, this process remains a source of uncertainty for predictions of SO_4 concentrations in streams. Future research should concentrate on dynamics of S mineralisation in the field, such that mathematical descriptions of long-term S-mineralisation can be incorporated into biogeochemical models.

Keywords: sulphate release, organic S, mineralisation, acidification, recovery, modelling, MAGIC, catchments, predictions, Germany, forest

Final Revised Paper (PDF, 599 KB)

Citation: Prechtel, A., Armbruster, M., and Matzner, E.: Modelling sulphate stream concentrations in the Black Forest catchments Schluchsee and Villingen, Hydrol. Earth Syst. Sci., 7, 552-560, 2003. Bibtex EndNote Reference Manager

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