Modelling and Mapping the Impacts of Atmospheric Deposition of Nitrogen and Sulphur

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J. Slootweg (author) RIVM
M. Posch (author) RIVM
J.-P. Hettelingh (author) RIVM

Contact:
Jaap Slootweg
DMG/RIVM
jaap.slootweg@rivm.nl

The Coordination Centre for Effects (CCE: www.wge-cce.org), located at RIVM, is the Programme Centre of the International Cooperative Programme on Modelling and Mapping (ICP M&M: www.icpmapping.org) of Critical Loads and Levels and Air Pollution Effects, Risks and Trends under the Working Group on Effects (WGE) of the Convention on Long-range Transboundary Air Pollution (LRTAP Convention: www.unece.org/env/lrtap/welcome.html).

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The Netherlands
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Publiekssamenvatting

De effecten van atmosferische depositie van stikstof- en zwavelverbindingen gemodelleerd en in kaart gebracht

Als stikstof vanuit de lucht op de bodem terechtkomt, werkt dat als een voedingsstof. Door te veel stikstof kunnen bepaalde plantensoorten verdwijnen of juist gaan overheersen. In internationale politieke gremia is daarom de vraag gesteld bij welke hoeveelheden stikstof (stikstofoxides en ammoniak) in de lucht natuurgebieden intact blijven. Het internationale Coordination Centre for Effects (CCE) helpt deze vraag te beantwoorden door een Europese database te beheren en te analyseren waarin de limieten ('kritische belastingsgrenzen') per type natuurgebied staan weergegeven. Landen uit het CCE-netwerk leveren hiervoor informatie.

Er zijn meerdere methoden om de kritische belastingsgrenzen te bepalen: op basis van de stikstofconcentratie in het bodemvocht (in de bodemlaag waar de wortels zitten) en op basis van de direct waargenomen effecten van stikstofdepositie op de natuur. Een aanvulling hierop is de relatief nieuwe methode die is gebaseerd op het gemodelleerde verlies aan biodiversiteit. Hierbij wordt een relatie gelegd tussen de planten die een bepaald soort vegetatie typeren en de omstandigheden in de bodem waaronder deze planten optimaal gedijen.

Dit jaar is voor het eerst aan de landen data gevraagd over belastingsgrenzen die zijn gebaseerd op het verlies van biodiversiteit. Duitsland en in beperkte mate het Verenigd Koningrijk hebben hieraan een bijdrage geleverd. Vijf andere landen hebben aangegeven in een volgende ronde deze methode ook te gaan passen.

Het CCE informeert beleidsmakers over de effecten van luchtverontreiniging op verschillende ecosystemen, wat de gevolgen daarvan zijn en wat het rendement van maatregelen is. De concentratie stikstof neemt al jaren af, maar is nog steeds hoog. Dit is ook als fundamenteel onderzoeksthema ingebracht in het 7th Framework-project ECLAIRE ('Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems') van de EU.

Kernwoorden: Biodiversiteit, CCE, ecosysteem effecten, luchtverontreiniging, kritische depositie waarde

Summary

Modelling and Mapping the Impacts of Atmospheric Deposition of Nitrogen and Sulphur

This report consists of three parts. The two chapters in Part 1 contain contributions to the update of the European critical loads database in 2015 based on the Call for Data issued in 2014 and the data submissions by 13 Parties to the LRTAP Convention.

In Chapter 1, the changes are described in comparison with the previous version of the critical loads database (2012), while the exceedances for the year 2010 are addressed using both the previous and current version of the critical loads databases for acidification and eutrophication. The exceedance by total nitrogen deposition of critical loads from the database of 2015 is higher than the same from the 2012 database. Overall, the European ecosystem area at risk of excessive nitrogen deposition is 61 %, compared with 55 % for the 2012 database.

Chapter 2 gives a detailed analysis of the results of the 2014/15 Call for Data, leading to the update of the critical loads database, with a focus on comparing the national submissions with the European 'background database'. This is relevant because this background dataset is used for countries that did not submit national data. The critical loads for nitrogen in the background database are generally lower than country submissions. Preliminary results of the regional application of biodiversity-based critical loads are discussed as well. Finally, the critical load for eutrophication (CLeutN) is introduced and compared with the empirical (CLempN) and the modelled critical load for nitrogen (CLnutN). The most striking changes since the 2011/2012 submissions can be noted with respect to the critical loads for acidification in Germany, the coastal regions of France and in Switzerland.

Part 2 consists of Chapters 3 and 4, which address progress made with the modelling and assessment of critical loads for biodiversity. In Chapter 3 an updated version of the PROPS model (described in Chapter 4) is used, in conjunction with the simple mass balance model, to compute the biodiversity response to nitrogen and sulphur deposition in a number of habitats on a regional scale. This response is quantified by the habitat suitability index (HSI), an indicator agreed upon by the Task Force on Modelling & Mapping in 2014 to facilitate transboundary comparisons of critical loads for biodiversity. Furthermore, methods to derive critical loads of nitrogen and sulphur from HSI calculations are described. European data and maps of biodiversity critical loads are presented and discussed. In particular, they are compared with the 'classical' acidity critical loads of N and S (see Part 1). Finally, open issues are listed that need to be resolved before biodiversity critical loads can be used in integrated assessment.

Chapter 4 describes the PROPS model used to compute the occurrence probabilities of about 4,000 European plant species as a function of pH, N and climate parameters. The underlying data (relevés) and the statistical methods used to derive the model parameters are discussed.

Furthermore, the BioScore European habitat map and database are introduced. These are used to assign plant species to habitat-EUNIS class combinations over Europe and thus enable the computation of the HSI and biodiversity critical loads for a European background database. Finally, in Part 3 the National Focal Centre reports are reproduced, describing the methods and data used for their submission to the 2014/15 Call for Data.

Keywords: Air pollution, biodiversity, CCE, critical load, eutrophication, ecosystem effects