

Atmospheric Nitrogen Deposition on Swiss Forests: Comparing measurement and modelling

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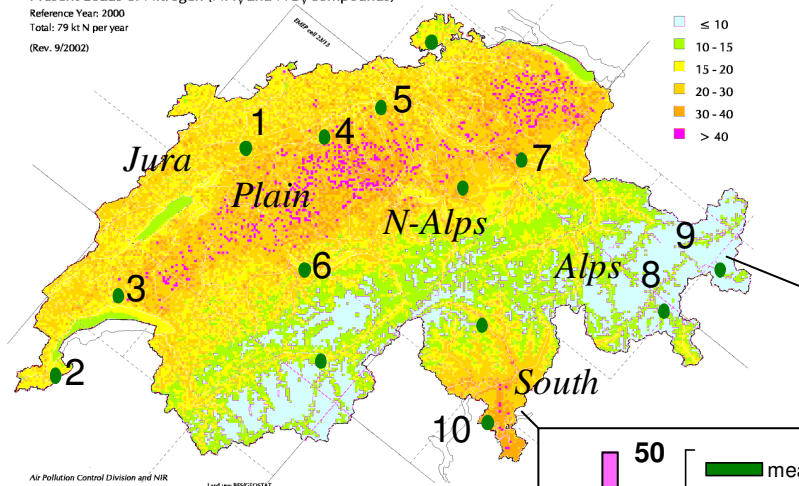
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Introduction: Why attend to deposition of nitrogen?

Increased nitrogen deposition has often been mentioned as a potential risk for the functioning of forest ecosystem. Getting a better understanding of the ecosystem and the determining of critical loads has been the subject of numerous field experiments. In order to assess the risks the experimental results have been applied within programmes to measure and model the emission, long-range transport and atmospheric deposition of nitrogen.

Methods

MAPPING CRITICAL LEVELS AND LOADS FOR SWITZERLAND:
Present Loads of Nitrogen (NH₃ and NO_x compounds)
Reference Year: 2000
Total: 79 kt N per year
(Rev. 9/2002)



i) Modelling, spatial, 1x1 km

Wet and dry deposition for Switzerland has been simulated with the empirical composite model of Rihm (1996) based on annual values of the following terms:

Wet Deposition

- **concentration in precipitation** (compound, x, y, z): various Swiss wet deposition measurements
- **precipitation amount**: map derived from long-term meteorological measurement

Dry Deposition

- **concentration in the air of gaseous compounds and aerosols**: emission inventories, air concentration measurements, transport models
- **specific deposition velocity** (compound, broadleaf/coniferous, x, y, z)

ii) Measurements, LWF



Fig. 1: Snow sampler on open field



Fig. 1: Rain collector in the forest

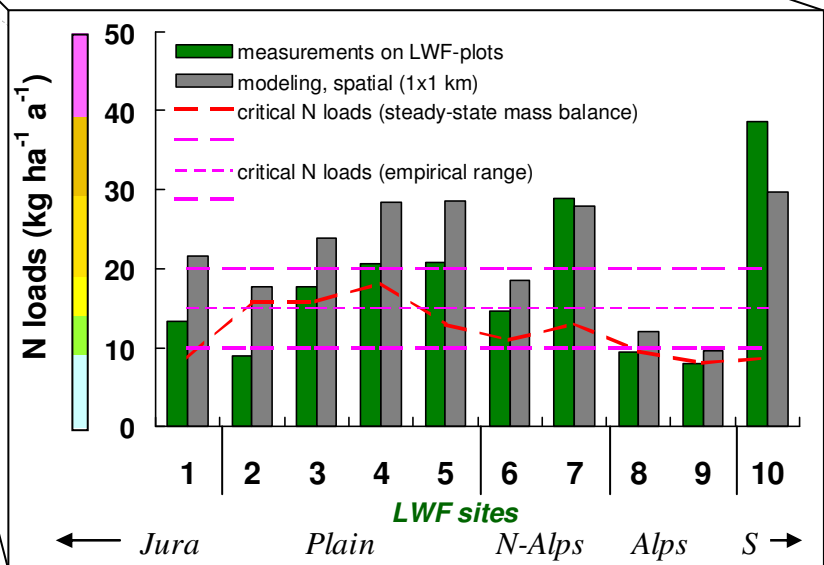
Wet and dry deposition have been derived from chemically analysed two-weekly deposition samples of long-term forest ecosystem research (LWF) sites:

Wet Deposition

- **bulk deposition** sampling on open field, corrected (Draaijers et al, 1998)

Dry Deposition

- **bulk deposition** sampling on open field
- **throughfall** sampling in the forest
- **canopy budget model** (Ulrich, 1983)



Results and Interpretation

There is a good agreement between the LWF measurement and spatially modelled values of N Deposition for the year 2000 ($R^2=0.90$, see also chart), which is in the magnitude of the year to year variability. On average, wet deposition is overestimated by 1.3 and dry deposition by 3.6 $\text{kg ha}^{-1} \text{a}^{-1}$. Because the functions used in the model are based on data from similar measurements as presented here, model adjustment can be recommended. For dry deposition both independent estimation methods include substantial uncertainties: (i) on-site concentrations in the air, especially of aerosols, deposition velocities, (ii) assumptions about the cation exchange and about the N uptake within the tree canopies. Hence, there is a need for on-site air concentration measurements and for experiments aiming on developing and apply new dry deposition measurements methods (e.g. washing or inferential methods).

References

- Draaijers, G. P. J., Erisman, J. W., Lövblad, G., Spranger, T., and Vel, E.: 1998. TNO-MEP Report R98/093.
Rihm, B.: 1996. Environmental Series, Vol. 275, FOEFL, Bern, 74 p.
Ulrich, B.: 1983. In: B. Ulrich, J. Pankrath (eds.). Reidel, Dordrecht, p. 33-45.