A comparison of bulk and wet-only deposition in Flanders (Belgium)

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Acidifying deposition in Flanders, in the north of Belgium, is known to be among the highest in Europe (UNECE and EC, 2003). Although wet deposition is best measured using wet-only samplers, continuously open funnels or bulk collectors are often used in ecological studies. For example, at many sites of the Pan-European Intensive Monitoring Programme of EU/ICP Forest, bulk precipitation is measured in the vicinity of a studied forest stand. Bulk deposition data are then used in combination with throughfall measurements to quantify dry deposition of acidifying compounds onto forests.

To our knowledge, no comparison between bulk and wet-only deposition has been made for Flanders. The aims of the study were therefore: (i) to assess the systematic bias on precipitation chemistry measured by using continuously open funnel collectors, (ii) to compare the precipitation chemistry measured at different heights at two adjacent sites, and (iii) to assess the effect of using bulk deposition measurements on the quantification of atmospheric deposition onto forest ecosystems.

During nine months, the weekly bulk and wet-only precipitation depositions in an urbanized region of Flanders were compared at two sites with a different height and separated by 1 km (Staelens et al. 2005). The amount of rainfall at the two sites was similar, and the difference in ion deposition between the two sites was generally less than 5%. While the amount of rainfall measured was almost the same for both collector types, bulk deposition was significantly ($p < 0.02$) higher than the wet deposition of all ions other than H^+ and NH_4^+. Averaged for both sites, bulk deposition was 129% (K^+), 84% (Ca^{2+}), 51% (Cl^-), 50% (Mg^{2+}), 46% (Na^+), 32% (SO_4^{2-}), 27% (NO_3^-), 17% (F^-), and 11% (NH_4^+) higher than wet-only deposition. The acidity of bulk samples was significantly ($p < 0.06$) lower than the acidity of wet-only samples. Bulk NH_4^+ concentrations were only significantly ($p < 0.002$) higher than wet-only concentrations at one site because of the sensor-related, delayed closing of the wet-only lid at the second site.

The canopy budget model proposed by Ulrich (1983) and adapted by De Vries et al. (1998) was used to quantify the total atmospheric deposition onto a deciduous beech (*Fagus sylvatica* L.) stand. Using bulk deposition instead of wet-only deposition data, the canopy budget model underestimated dry deposition of the measured ions onto the forest canopy by 6-20%. The total atmospheric deposition to the forest stand was overestimated by 10-15% for K^+, Ca^{2+}, and Mg^{2+}, and was underestimated by 5% for NO_3^- and NH_4^+.

Bulk deposition exceeded the wet acidifying deposition of NO_3^-, NH_4^+, and SO_4^{2-} by almost 25%. Therefore, wet-only samplers are preferred for accurately determining wet deposition fluxes. Alternatively, site-specific bulk over wet-only factors could be used to correct for dry deposition onto bulk funnels. However, the effect of using bulk deposition instead of wet-only deposition data on the quantification of the total atmospheric deposition onto a forest stand was small compared with overall model uncertainties.

References

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