

Contribution of rime to atmospheric sulfur and nitrogen deposition in Central Europe

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Rime is an underexploited pathway of atmospheric deposition of ecological and environmental relevance, in particular in montane regions. The industrial part of Central Europe, especially the so-called “Black Triangle” near the borders between Czech Republic, Poland and Germany, was affected by massive spruce die-back due to acid rain during the 1970-1995 period. Sulfur (S) emissions, originating mostly from soft-coal burning power plants, peaked in 1987, and decreased dramatically thereafter, while high reactive nitrogen (N_r, mostly nitrate, NO₃⁻, and ammonium, NH₄⁺) emissions exhibited less pronounced temporal changes. We quantified the contribution of rime (ice accretions) to total atmospheric deposition of acidifying compounds of these two elements at 10 mountain-top sites during three consecutive winters. All study sites were located at an altitude of about 1000 m a.s.l in the Czech Republic. We used replicated custom-made rime collectors with high surface roughness, placed 1.5 m above snow surface. Average intervals between rime and snow samplings were 7 to 8 days, respectively. Sulfur and nitrate-N concentrations in rime were up to 10 times higher, compared to those in snow. Between-site differences in SO₄²⁻-S and NO₃⁻-N were larger for rime than for snow. At nine sites, winter-time deposition of S *via* rime corresponded to 5-13 % of annual wet S deposition. At the most polluted 10th site situated close to the Czech–Polish border (Tetrevce, Eagle Mts.), S rime deposition reached 25 % of annual wet S deposition. Winter-time deposition of NO₃⁻-N corresponded to 6-25 % of annual wet NO₃⁻-N deposition. Large inter-annual differences in rime deposition rates were recorded for both S and N. While total atmospheric deposition of S and N was dominated by vertical deposition (snow), the contribution of horizontal deposition (rime) to the budget was far from negligible even in the era of easing air pollution. Funding by the Czech Technological Agency, Grant no. SS 02030031 ARAMIS.