Impact of dust deposition on forest ecosystems

M-P. TURPAULT[1*], E. LEQUY[1] AND S. CONIL[2]

[1]BEF-INRA, Centre de Nancy, 54280 Champenoux, France (*correspondence : turpault@nancy.inra.fr)
[2]Andra- Centre de Meuse Haute Marne 55290 Bure, France

As forest ecosystems generally grow on nutrient-poor soils, the challenge for forest management and wood production is to maintain a sustainable level of nutrients. Nutrient budgets are a diagnostic tool that assesses forest sustainability by adding up nutrient inputs (atmospheric dissolved deposition and soil weathering) and outputs (losses in drainage water and by wood harvesting). Whereas Aeolian dust deposition (ADD) is recognized as a significant nutrient input in various ecosystems (eg. oceans and tropical forests), it is still not taken into acount in usual nutrient budgets of European forests. The aim of this study was to quantify ADD every four weeks and estimate its nutrient lability for four forest ecosystems in the northern part of France during two years. The supplementary interception of ADD by forest canopy was evaluated from throughfall samples in two sites. The samples were subdivided into two samples to obtain (i) the total ADD and (ii) only the mineral part of ADD.We quantified (i) the total ADD, its mineral fraction and hardly soluble mineral fraction, and (ii) the fluxes of each nutrients (Ca, Mg, K, P) from their chemical composition.

ADD in open field was equally composed of mineral and organic matter. Mineralogical analyses revealed a common basis of silicates (quartz, phyllosilicates, feldspars,...) for all the sites, associated with a set of various site-dependent minerals that appeared less frequently with lesser proportion (Fe-oxide, gypsum, amphibole, talc, gibbsite, calcite). These minerals likely indicate a regional origin of ADD. ADD rate in open field showed a seasonal pattern with high deposition from spring to autumn and low deposition in winter. The total dust deposition in open field was around 50 $kg.ha^{-1}.yr^{-1}$ including ~5 $kg.ha^{-1}.yr^{-1}$ of labile mineral and 19 ± 3 $kg.ha^{-1}.yr^{-1}$ of hardly soluble mineral. Forest canopy induced a supplementary deposition of ~8 $kg.ha^{-1}.yr^{-1}$ of labile minreral.

The nutrient deposition from ADD was less than 1 $kg.ha^{-1}.yr^{-1}$ for each nutrient. It is the same magnitude as nutrient inputs by soil weathering and could be important especially for phosphorus, which is the limiting nutrient in most of terrestrial ecosystems. Indeed, at one site, P input from ADD was of 0.3 kg $P.ha^{-1}.yr^{-1}$, whereas dissolved deposition and weathering flux were of 0.1 and 0.2 kg $P.ha^{-1}.yr^{-1}$, respectively.