Geophysical Research Abstracts
Vol. 18, EGU2016-6133-1, 2016
EGU General Assembly 2016

Influence of Plants on Chlorine Cycling in Terrestrial Environments

Malin Montelius (1), Yves Thiry (2), Laura Marang (3), Jacques Ranger (4), Jean-Thomas Cornelis (5), Teresia Svensson (1), and David Bastviken (1)

(1) Department of Thematic Studies - Environmental Change, Linköping university, Sweden (malin.montelius@liu.se), (2) Andra, Research and Development Division, Parc de la Croix Blanche, 1/7 rue Jean Monnet, 92298 Châtenay-Malabry Cedex, France, (3) EDF, Laboratoire National d'Hydraulique et Environnement, 78401 Chatou, France, (4) Biogéochimie des écosystèmes forestiers, INRA Centre de Nancy, 54280 Champenoux, France, (5) Soil Science Lab, Earth and Life Institute - Environmental Sciences, Université Catholique de Louvain, Croix du Sud 2/10, 1348 Louvain-la-Neuve, Belgium

Chlorine (Cl), one of the 20 most abundant elements on Earth, is crucial for life as a regulator of cellular ionic strength and an essential co-factor in photosynthesis. Chlorinated organic compounds (Clorg) molecules are surprisingly abundant in soils, in fact many studies during the last decades show that Clorg typically account for more than 60% of the total soil Cl pool in boreal and temperate forest soils and frequently exceed chloride (Cl-) levels. The natural and primarily biotic formation of this Clorg pool has been confirmed experimentally but the detailed content of the Clorg pool and the reasons for its high abundance remains puzzling and there is a lack of Cl budgets for different ecosystems.
Recently, the radioisotope 36Cl has caused concerns because of presence in radioactive waste, a long half-life (301 000 years), potential high mobility, and limited knowledge about Cl residence times, speciation and uptake by organisms in terrestrial environments. The chlorination of organic molecules may influence the pool of available Cl- to organisms and thereby the Cl cycling dynamics. This will prolong residence times of total Cl in the soil-vegetation system, which affects exposure times in radioactive 36Cl isotope risk assessments.
We tested to what extent the dominating tree species influences the overall terrestrial Cl cycling and the balance between Cl- and Clorg. Total Cl and Clorg were measured in different tree compartments and soil horizons in the Breuil experimental forest, Bourgogne, established in 1976 and located at Breuil-Chenue in Eastern France. The results from this field experiment show how the dominating tree species affected Cl cycling and accumulation over a time period of 30 years. Cl uptake by trees as well as content of both total Cl and Clorg in soil humus was much higher in experimental plots with coniferous forests compared to deciduous forests. The amounts of Clorg found in plant tissue indicate significant Clorg production inside trees in addition to substantial soil production of Clorg. A large and tree species dependent "luxury" Cl uptake, rapidly released through the leaves and returned to the soil as throughfall, was indicated for some tree species. The physiology of dominating tree species, along with tree-related soil microbial communities, thus appears more important for the local Cl levels and cycling than atmospheric Cl deposition.