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Radionuclide deposition during fog events

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Fog deposition has been assumed to significantly contribute to the deposition of radionuclides in Japan during the Fukushima accident . Until recently, very little attention had been paid to such meteorological conditions with regard to radioactive contamination. It comes from 1) the lack of relevant field observation since rain gauge network are not able to properly quantify the amount of fogwater, 2) the lack of information about the capability of fog droplets to washout efficiently the atmosphere compare to rain drops, and 3) because of the scarcity of validated modeling scheme for operational models used in emergency situation . It is expected that for a pulse of airborne contaminant, fog deposition could deposit a non-negligible amount of pollutant. Fog contribution to radionuclide deposition on terrestrial ecosystem is thus legitimate, both on a regular basis i.e. during routine situations or after an accident release. This study focuses on radionuclide deposition by fog on different plants. An analysis of the fog water radioactivity levels and a quantification of the fog water deposition have been performed in the north east region of France. In order to quantify the deposition of cloud water, plants are exposed to fog and weighted with a precision balance every ten to twenty minutes. Three main plant species: a small conifer with 3D shape; grasses and leaf-vegetable (cabbage). Results show that the mass of water deposited (0.15 to 4 mL.min-1.m-2 of vegetation cover) is greater on small conifers than on other plants or bare soil. This is consistent with what was expected due to the larger impaction surface of the small conifers and turbulent induced droplet impaction. We also tested different plant densities. As expected high density of plant will compete deposition and lead to an edge (or comb) effect with higher deposition on edge while the deposition is less abundant inside the plant canopy.

During the fog season in continental temperate climate fog water deposition can represent 1 to 2 % of total water deposition (mostly by rain and snow) but corresponds up to 12% of 137Cs or 210Pb deposited amount (in Bq/m2). Apparent deposition velocity are at least those induced by sedimentation for 10 to 20 μm aerosols and at most those assuming and additional contribution by turbulent impaction and deposition. The liquid water content (LWC) can be used to derive the sedimentation deposition velocity (Tav et al. 2018) The LWC is linked to the visibility which can easily be provided by usual sensor even if the use of visibility to derive the LWC leads to a higher uncertainty. An additional simple modelling scheme based on appropriate deposition velocities could partly sort out the problem and improved deposition assessment.

1) Hososhima & Kaneyasu, 2014

2) Katata 2014, 2015