Determination of fog droplet deposition velocity based on weighing method

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Fog water deposition can represent an important part of the hydrological, nutrients, pollutants inputs in specific areas such as mountainous or coastal regions (Shimadera et al., 2011). However there has only been few studies on deposition of radionuclides by fog droplets (Hososhima and Kaneyasu, 2015). In order to determine the radiological input linked to fog water deposition on plants, a quantification of the fog water deposition has been performed at the ANDRA OPE atmospheric platform in the north east region of France. One of the aims of this study is to determine fog droplets deposition velocity on different types of plants to improve models and make them prone to accurately reproduce all kinds of wet deposition.

Based on the fact that deposition velocity is defined as the density flux divided by the concentration at a reference height, we have measured the flux of water deposited by exposing plants to fog and weighing them with a precision balance every twenty minutes.
We have studied three main plants species (small conifer, grass, cabbage) and a bare soil surface. The Particulate Volume Monitor (PVM, Gerber Scientific Inc.) and the Fog Monitor (FM-120, DMT) respectively provide the liquid water content in the air (LWC) to calculate fog droplets deposition velocities and the droplets size distribution.

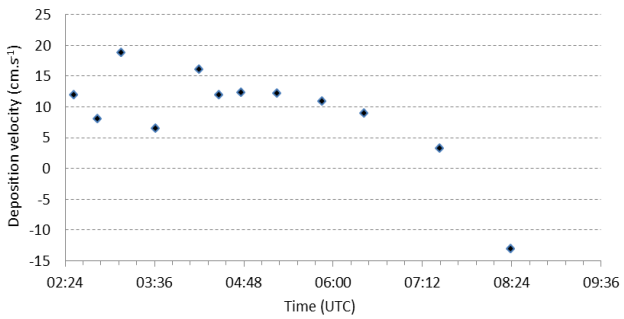

Figure 1. Deposition velocity of fog droplets on bare soil during fog event on November 1, 2015

Deposition velocities for fog droplets on bare soil ranged from -13 (evaporation process) to 18 $cm.s^{-1}$ (Fig.1). This is much higher than sedimentation velocities that have been calculated based on the size distribution of droplets during this event. This probably shows the influence of impaction as a deposition mechanism even for a relatively smooth surface such as bare soil. Fog deposition velocities on plants will be determined for the three main species and compared with observation data from previous studies. Deposition velocities measured by throughfall or canopy water balance (Lovett, 1984) and eddy covariance method (Beswick et al., 1991) ranged from 2.1 to 8 $cm.s^{-1}$ for short vegetation and from 7.7 to 92 $cm.s^{-1}$ for forests, cited by Katata (2014).

This important variability of deposition velocities on plants especially for forests is due to uncertainties in measurement method. Contrary to the eddy covariance method, the weighing method is a simple and direct way that can be implemented even for complex terrain. However uncertainties caused by assessment of plants leaf area and the complexity of their foliar structure can be quite important.

Beswick, K.M., Hargreaves, K.J., Gallagher, M.W., Choularton, T.W. and Fowler, D. (1991) *Quarterly Journal of the Royal Meteorological Society*. **117**, 623-645.

Hososhima, M. and Kaneyasu, N. (2015) *Environmental Science & Technology*. **49**, 3341-3348.

Katata, G. (2014) *Journal of Geophysical Research: Atmospheres*. **119**, 2014JD021669.

Lovett, G.M. (1984) *Atmospheric Environment*. **18**, 361-371.

Shimadera, H., Kondo, A., Shrestha, K.L., Kaga, A. and Inoue, Y. (2011) *Atmospheric Environment*. **45**, 6299-6308.