Aerosol particle dry deposition velocities above environmental substrates: deposition vs emission.

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Nuclear facilities introduce different types of radionuclides into the atmosphere in the form of gases and aerosols during chronic or accidental releases. These particles may be submitted to atmospheric dispersion, dry and wet deposition. The study of dry deposition based on the dry deposition velocity (dry deposition flux divided by an atmospheric concentration above the substrates) concept is a major issue concerning the impact of radionuclides on the population and the environment. Uncertainties on the dry deposition velocity values of submicronic particles are up to several orders of magnitude discrepancies according to the model used (Petroff *et al.*, 2008). Moreover there is no data for particle diameter under 10 nm. So, the aim of this study is to quantify dry deposition velocity for particles sizes between 2.5 nm and 1 µm.

Dry deposition flux can be calculated from the covariance between fluctuations of the vertical wind velocity and fluctuations of the atmospheric aerosol particle concentration during 30-minutes periods at high frequency. The aerosol particle concentration was measured by an Electrical Low Pressure Impactor (ELPI, Dekati, Inc.) for particle sizes between 7 nm and 1 µm, and coupling two Condensation Particles Counters (CPC 3788, TSI, Inc.) for particle sizes between 2.5 and 14 nm (Twin CPC method). The wind 3-component velocity was measured by an ultrasonic anemometer (Young 81000, Inc.). Different tests to validate measurements (stationarity, integral characteristic of turbulence) and then spectral analysis and the calculation of fluxes were done (Damay *et al.*, 2009).

Two experimental campaigns were conducted on grassland in western France (near Poitiers) in April and September 2015.The results of these sampling campaigns have been compared with the results obtained by Damay (2010) above different substrates: bare soil, maize and grassland, and with another campaign led during the NEEDS REMORA project above a forest.

Results show a significant increase of the emissive events when the particle diameter is above 0.2 µm and greater for campaigns on grass in 2015 and maize (Figure 1). This increase may be due to the magnification of the accumulation mode particles size, by condensation/coagulation reactions of fine particles.

Furthermore, for neutral and stable atmospheric conditions, the normalized dry deposition velocities according to the particles diameter are the same order of magnitude discrepancies for all the environmental substrates studied (Figure 2). Moreover, during 2015 campaigns, measurements of dry deposition velocities of ultrafine particles (2.5—14 nm) have been carried out and results are coherent with the rest of the results (Figure 1 and 2). This result is a first at International level.

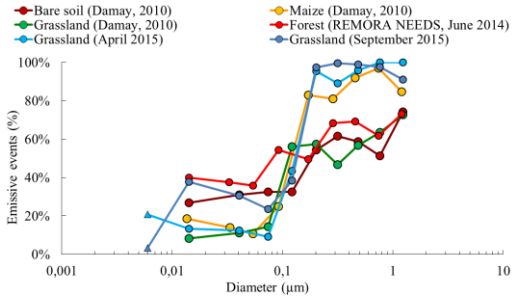

Figure 1: Percentage of emissive events above environmental substrates according to the particles diameter, triangles are Twin CPC results and circles are ELPI results

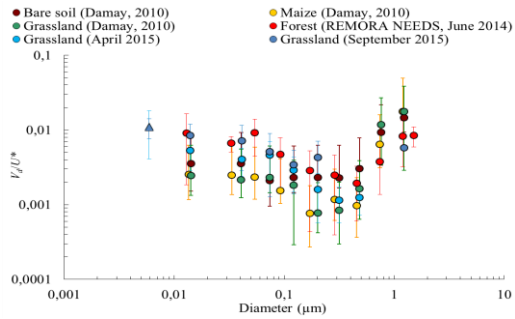

Figure 2: Dry deposition velocities *Vd* above environmental substrates normalized by friction velocities *U** according to the particles diameter; error bar represent two standard deviations; triangles are Twin CPC results and circles are ELPI results

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