Aerosol Particle Dry Deposition Velocities above Grassland According to the Diameter and the Micrometeorological Parameters: The "V" Curve between 1.5 nm and 1 µm with Three Different Methods

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Abstract
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 according the particles diameter and the atmospheric stability.

Dry deposition flux can be determinate with different devices. We used 3 different methods to quantify the dry deposition velocities according the particles diameter. (1): For particles around 1.5 nm we studied the dry deposition of free faction of alpha particles of Rn222 decay products by the gradient method (2) For particles between 2.5 nm and 1.2 µm we used the eddy correlation method with a cospectral analysis (Pellerin et al., 2017): the dry deposition flux is determinate thanks to 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 coupling two Condensation Particles Counters (CPC 3788, TSI, Inc.) for particle sizes between 2.5 and 14 nm (Twin CPC method) and for particle sizes between 7 nm and 1 µm, an Electrical Low Pressure Impactor (ELPI, Dekati, Inc.) was used. The wind 3-component velocity was measured by an ultrasonic anemometer (Young 81000, Inc.). (3) The last method used is the direct deposition of fluorescein particles of 0.6 µm on synthetic grass and the measurement are carrying on by a fluorimeter.

Four experimental campaigns were conducted above a grassland in western France (near Poitiers) april 2015 and September 2016.

The first results of these campaigns show that the particles under 10 nm are influenced only by the mechanical turbulence (link with the friction velocity u*), while the particles over 10 nm are influenced by the mechanical turbulence and the thermic turbulence (link with the sensible heat flux H).

The different results of dry deposition velocities with the three different methods allowed to obtain a “V” curve between 1.5 nm and 1.2 µm. In fact, if we look the curve of dry deposition velocities normalized by friction velocities according to particles diameter and for the four sampling campaign, even if the used different technics, all of the point are consistent. Moreover we can find the theoretical curve shape of dry deposition velocity with the effects of the three dry deposition mechanisms: Brownian diffusion, interception and impaction.

We propose to present the all used methods and devices and then, to describe the results.