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Atmospheric Measurement Techniques Discussions

Interactive comment on "Dry deposition of NaCl aerosols: theory and method for a modified leaf-washing technique" *by* A. Reinap et al.

Anonymous Referee #2

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Reinap et al. present the methodology of a leaf-washing technique and apply it to a wind tunnel experiment of NaCl particle deposition on oak leaves. Oak leaves were exposed for 4 hours to NaCl particles generated by a bubble-bursting process in a wind tunnel experiment under different conditions regarding wind speed and aerosol concentration. In the next step, the exposed leaves were transferred into Milli-Q water, and the solute was analyzed for sodium and chloride ions after 5, 10, and 20 min. Finally, the wash-off dynamics were fitted to the measured ion concentrations based on first-order kinetics.

The title and introduction of the manuscript suggest a study on dry deposition of NaCl aerosol to vegetation. The main results and the corresponding discussion, however,

focus on the wash-off dynamics of sodium and chloride ions from oak leaves. There is no attempt to link these experimental results to the controlling factors of aerosol dry deposition in a wind tunnel experiment or in the atmosphere. The turbulence conditions in the wind tunnel are not characterized, and it is not clear if and how the experimental results can be used under atmospheric conditions. In addition to the reference given for the wind tunnel experiment, some basic information about the setup (e.g. arrangement, size) and the flow conditions (e.g. Reynolds number) would be absolutely necessary in the manuscript.

The main idea of the manuscript is to exploit data on the wash-off dynamics of sodium and chloride ions for a better estimate of the total deposition of these ions. In section 2.1, the authors introduce a model of the wash-off dynamics based on first-order kinetics including the amount of aerosol deposited on the leaves during exposure, the amount of aerosol residing on the leaves prior to exposure, and the amount of retained/absorbed and leached ions. The explanations in this section are hard to follow and should be simplified. In particular, the definitions of the used variables are not consistent (e.g. is q_r equal to q_ro? Is m_o = m(0)?).

It seems that the selected time steps for ion concentration measurements are not adequate for the curve fitting presented in Fig. 2 and 3. For most experiment runs, especially at high aerosol concentrations (Fig. 3), the solute concentration is more or less constant for the three different measurements. The authors themselves acknowledge that 90% (low exposure) and 96 % (high exposure) of the chloride on the leaves is washed off during the first wash-off step. Thus, the model fit is poorly constrained with regard to dynamics, i.e. the reaction constant k. For example, if additional ion concentration measurements had been made after 2 min, the initial slopes of the presented fit curves might look very different. Therefore, I disagree with the author's statement that the "wash-off methodology presented here gives important insights into the wash-off dynamics, for instance, in terms of reaction constants" (p. 3862). Is there a physical explanation for the assumption of first-order wash-off dynamics?

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Apart from poorly constrained wash-off dynamics, what is the advantage of the model fit over the ion concentration measurement after 20 min? In order to obtain an estimate of the washed-off ion concentration, is there a significant difference if the ion concentrations measured directly after 20 min (as presented in Figs. 2 and 3) are compared with the corresponding m(0) values in Tab. 1 and 2?

Overall, the presented approach should be tested with sampling times more adequate for characterizing the wash-off dynamics. Clearly, for NaCl aerosol most of the deposited material is washed off within 5 - 10 min. The observed retention of sodium is well-known but additional insight could be gained, e.g. if the authors followed up on the studies of Neinhuis and Barthlott (1998) discussed on p. 3863. Finally, it is absolutely essential to clarify the added benefit of the presented modified leaf-washing technique with regard to aerosol/forest interactions (p. 3852), aerosol deposition to plant material (p. 3864), and aerosol deposition modeling (p. 3865). In the present form, the manuscript does not help to simplify investigations of aerosol dry deposition and vegetative surface morphology.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3851, 2010.