Geophysical Research Abstracts, Vol. 8, 08105, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08105

Dry deposition of small particles to ocean surfaces. Reanalysis of a laboratory experiments

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Dry deposition of atmospheric particles mainly depends on wind speed and particle diameter. The dry deposition velocity, v_d, is found to vary a factor 100-1000 with diameter in a likely diameter range, adding uncertainty to deposition estimates, because the diameter distribution for many particulate species is not well known.

Experimental studies of v_d over both water and solid surfaces largely confirm the above cited huge variations with diameter. However, a number of studies over natural waters report both much less diameter variation and overall larger deposition velocities.

The authors have tested the hypothesis that the larger deposition velocities were associated with the spray and bubble activities characterizing natural water surfaces for moderate to high winds. The influence of these phenomenon on dry deposition is fairly easily modeled, and we here present models used to study the possible impact of the different processes on the deposition velocity. However, it has proven difficult to verify the models due to the difficulties of measuring the relatively small deposition rates under spray condition over the natural waters.

Here, is presented data on this subject obtained in the wind/water tunnel in Marseille, where the bubble and spray process were modeled by use of 2600 submerged aquarium frits. We summarize the experiments. The Experiments showed that the tunnel

spray and bubble process described the natural bubble and spray distributions satisfactorily, in the sense that it was shown that the bubble and spray production spectra could be related to the white cap cover in a way similar to the expressions over the ocean.

The results of the experiments, reported here, were that the bubbling and spray processes have no significant influence on the deposition rate of the particles. However, in the experiments the loss of particles from the tunnel to the surrounding laboratory space was not well estimated, and hence the results could not be properly statistically constrained. In a later experiment aimed at gas-exchange, this tunnel lab-exchange was measured. Using these measurements to a proper mass balance for the aerosols in the air-space of the tunnel could be estimated and earlier results on particle deposition could be confirmed with statistical bounds.