G.J. Heij and J.W. Erisman (Editors). Acid Rain Research: Do we have enough answers?

Fog deposition on Douglas Fir Forest

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Abstract

In December 1992 and February 1993 two periods in which fog occurred were monitored at the location Speulderbos in The Netherlands. The occult deposition during these periods was 3.4 and 2.0 mg/(m^2.s) respectively. The contribution of occult deposition to the total acid deposition to forests in The Netherlands is estimated to be about 5%. High correlation between the friction velocity u_* and turbulent deposition velocity v_t of fog droplets could be derived.

1. INTRODUCTION

Occult deposition is the downward transport of atmospheric pollutants by direct transfer of fog or cloud droplets to a receptor surface [1]. The turbulent deposition of fog droplets or other large particles can be measured directly or indirectly with micrometeorological methods. In order to infer deposition rates from simple routine measurements it is necessary to relate these measurements to more direct but expensive measurement techniques.

2. MEASUREMENTS

The measurements were carried out at Speulderbos, one of the research sites of the Dutch Priority Programme on Acidification in the centre of the Netherlands [2]. Direct measurements of the turbulent deposition of the fog droplets were made with the eddy correlation technique. Gravitational settling was calculated from the measured droplet size distribution. The eddy-correlation

measurements were carried out using a Solent 3D symmetric head sonic anemometer. The Liquid Water Content (LWC) was measured with a Gerber PVM-100 sensor. Samples of the fog water were drawn with a CWP string collector operated by KEMA. The size of the fog droplets was measured with a Forward Scattering Spectrometer Probe (FSSP) of Particle Measurements Systems.

3. RESULTS

The measured throughfall flux was a factor two higher than the measured occult deposition flux. The concentrations of acidifying ions in fog water were a factor 2 to 3 higher than in throughfall water. The occult deposition velocity v_t showed a high correlation with the squared friction velocity (u_*^2, r=0.83) and with the deposition velocity for momentum (v_m, r=0.75). The measured turbulent deposition velocity for fog is half the deposition velocity for impulse.

Table 1.
Calculated turbulent and gravitational fog water fluxes in mg/(m^2.s) for data selected from two periods (n=537). Data within brackets concerns all data.

Period	F_{turb}	F_{grav}	F_{total}	n	$F_{throughfall}$
December '92	1.47 (1.81)	1.97 (1.74)	3.44 (2.55)	77	5.1
February '93	1.76 (1.52)	0.26 (0.30)	2.02 (1.82)	460	5.3
Total	1.72 (1.57)	0.51 (0.38)	2.23 (1.95)	537	5.2

Table 2.
Estimated annual contribution of acidic components of deposited fog water compared with the total deposition (wet+dry) for Speulderbos in 1989 [3] usizng measured concentrations in mist in 1989 [4].

Component	Fog dep. (Mol/ha)	Total Dep. (Mol/ha)	Relative (%)
NO_y	47	940	5
SO_x	46	910	5
NH_x	134	2880	5

4. REFERENCES

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