Vertical Particle Fluxes Over A Coniferous Forest

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BITÖK

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a guest contribution

INTRODUCTION

Turbulent exchange of gases (e.g. CO_2, H_2O) between biosphere and atmosphere is routinely measured through eddy covariance (EC).

The application of EC to estimate **particulate** deposition fluxes (e.g. Buzorius et al., 2000; Gallagher et al., 1997) is still focus of fundamental research rather than a routine method.

METHODS

We applied an eddy covariance system (Fig. 1) combining a YOUNG 81000 ultrasonic anemometer and 2 condensation particle counters (TSI CPC 3760A and TSI UCPC 3025). These two particle counters exhibit different minimum detectable particle sizes (50 % cut off at **11 nm** and **3 nm** particle diameter, respectively). The system was mounted at 22 m above ground level in the SE corner of a 30 m research tower. Data were collected with a time resolution of 10 Hz.

Fig. 1

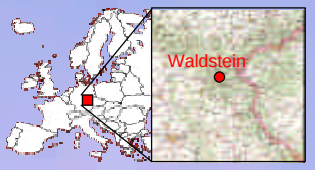

Fig. 2: "Waldstein" site in NE-Bavaria, Germany

The EC system was operated during the first four-week **BEWA2000** field campaign at the "Waldstein" ecosystem research site (Fig. 2) of the Bayreuth Institute for Terrestrial Ecosystem Research (BITÖK) in the "Fichtelgebirge" mountain range (NE-Bavaria, Germany) in July and August 2001. The tower is surrounded by coniferous forest consisting mainly of Norway spruce (Picea abies (L.) Karst.) with a maximum canopy height of 19 m.

RESULTS AND DISCUSSION

Sampling line **time lags** were determined using a cross-correlation analysis (Fig. 3a). However, the interpretation of the cross-correlations proved to be difficult in many cases when a pronounced maximum could not be identified (Fig. 3b). The application of detrending algorithms yields a more consistent pattern of the cross-correlation functions.

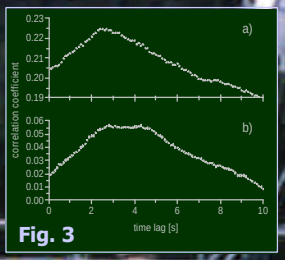

Fig. 3

Spectral analysis (Fig. 4) of particle concentration time series yield –2/3 slopes for nondimensional frequencies $0.1 < n < 3$. For higher frequencies, the **power spectra** of the UCPC 3025 are still of high quality, whereas the CPC spectra are distorted as a result of the slower response of this particle counter.

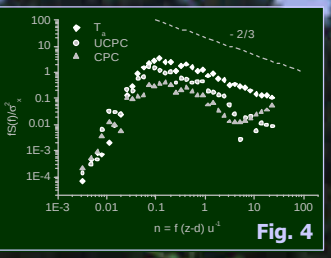

Fig. 4

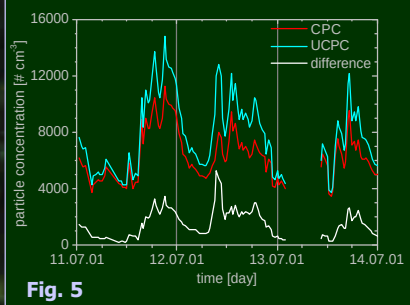

Fig. 5

When operated in parallel, the differential concentration of both particle counters should correspond to the concentration of particles in the ultrafine size range.

In Fig. 5, we clearly find a diurnal pattern of both the total and the ultrafine **particle concentrations**. Typical concentrations of 6000 to 8000 particles per cm^3 are sufficient to yield robust counting statistics for 10 Hz sampling .

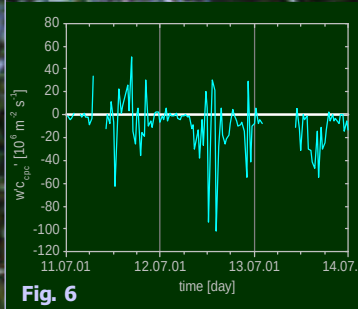

Fig. 6

Our preliminary results indicate the need to apply detrending and correction algorithms to obtain reliable flux estimates. Therefore, the presented covariances (Fig. 6) have to be interpreted with care. **Covariance** values for nighttime data are close to zero, whereas daytime data are clearly different from zero. Negative covariances prevail, indicating more particle deposition than emission.

CONCLUSIONS

- Our preliminary results endorse the general applicability of this system to determine vertical particle fluxes at our site.
- Typical ambient particle concentrations are sufficient to yield robust counting statistics for EC.
- Detrending algorithms for particle time series as well as corrections accounting for the shortcomings of the setup have yet to be optimized.
- Primarily, we find negative covariance values, indicating particle deposition into the forest ecosystem.

REFERENCES

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