CO_2 and water vapour fluxes at a subtropical montane cloud forest ecosystem in north-eastern Taiwan

E. Beiderwieden[1*], K. Mildenberger[1], Y.J. Hsia[2], and O. Klemm[1]

[1]University of Münster, Institute for Landscape Ecology, Germany
[2]National Dong Hwa University, Institute of Natural Resources, Taiwan

*corresponding author: beiderwieden@uni-muenster.de

Objective

From 04 August through 27 September 2006, an eddy covariance setup was installed to study the turbulent vertical fluxes of CO_2 and water vapour. Fog affects the physiologically conditions of trees through high air humidity and strong reduction of available incoming shortwave solar radiation, affecting the leaf metabolism and development of reproductive organs. Particular emphasis of this study is set on the influence of fog on the microclimate of the endemic cypress forest.

Study Site

The experiment was carried out within a cloud forest ecosystem in Chilan/Taiwan. It is part of Taiwan's Long Term Ecological Research sites. The study site is located at 1650 m a.s.l. within a partly managed plantation of *Chamaecyparis obtusa var. formosana* and *Chamaecyparis formosensis*. The tree canopy is virtually closed and uniform, the average height is 13.7 m. The meteorological tower is situated within a valley on a relatively flat section which slopes with an inclination of 15° towards south east.
Fog occurrence (visibility < 1000 m) is frequent with an average duration of 4.7 to 11 hours per day. The presence of fog is related with to valley winds from SE and S.

View from meteorological tower towards SE direction

The study site is located at 24°35'27.4" N and 121°29'56.3"E

Experimental Setup

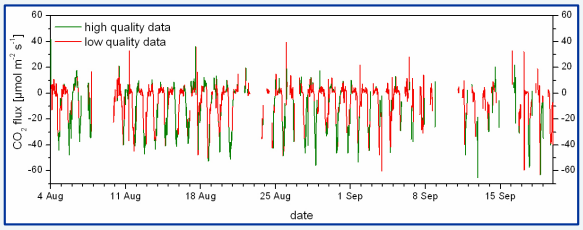
The eddy covariance setup consisted of a Young 81000 sonic anemometer and a LI-COR 7500 combined infrared CO_2/H_2O analyzer. The sample frequency was 12.5 Hz. The instruments were installed at the uppermost platform of the meteorological tower, at 23.4 m.

Meteorological tower

Experimental setup

Results

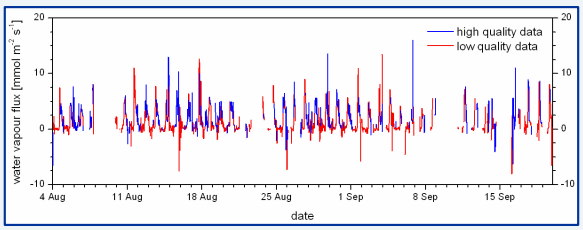
Special effort was employed on quality assurance of the flux data. Only data during steady-state condition during 30-min averaging intervals, simultaneously exhibiting a developed turbulence regime, were used for calculation of fluxes.



CO_2 fluxes classified according to data quality

The CO_2 fluxes ranged between -52.5 µmol m^{-2} s^{-1} and +18.1 µmol m^{-2} s^{-1} (respiration) with a median of +2.6 µmol m^{-2} s^{-1}. The fluxes exhibited a pronounced diurnal cycle with negative values for the fluxes during daytime representing deposition or CO_2 uptake by plants. At night, the CO_2 fluxes were positive, e.g. directed upward. During foggy conditions, the CO_2 fluxes were considerably lower than at times without fog.

The water vapour fluxes show an opposite diurnal cycle and ranged between -3.2 mmol m^{-2} s^{-1} and +6.7 mmol m^{-2} s^{-1} with a median flux of +0.9 mmol m^{-2} s^{-1}.



Water vapour fluxes classified according to data quality

A footprint analysis was applied to evaluate the fluxes and data quality regarding the changing topography and fetch properties depending on wind direction. The footprint calculations showed excellent fetch conditions for flux measurements for winds from south easterly direction.

Conclusions

During nighttime, when atmospheric layering was stabile and turbulence regime was poorly developed, the measured fluxes were small. The examination of friction velocity u* lead to the hypothesis that advective downhill fluxes occurred at night.

The study was supported by the Deutsche Forschungsgemeinschaft (DFG, KI 623/06) and National Science Council (NSC)

For further information please vistit our homepage **http://kli.uni-muenster.de**