The comparison of eddy covariance and Bowen ratio energy balance method for measuring the latent and sensible heat fluxes above high density poplar stand

Milan Fischer[1,2], Miroslav Trnka[1,2], Jiří Kučera[3], Matěj Orság[1,2],AbhishekMani Tripathi[2], Gabriela Pozníková[1,2], Zdeněk Žalud[1,2]

1) Institute of Agrosystems and Bioclimatology, Mendel University, Zemědělská 1, 613 00 Brno, Czech Republic, fischer.milan@gmail.com, mirek_trnka@yahoo.com, orsag.matej@gmail.com, zalud@mendelu.cz
2) Global Change Research Center AS CR, v.v.i., Bělidla 986/4a, 603 00, Brno, Czech Republicmailto:
3) Environmental Measuring Systems, Turistická 5, 621 00 Brno, Czech Republic, kucera@emsbrno.cz

Eddy covariance (EC) is considered as the most defendable and the only direct method for measuring the fluxes of energy and matter in the turbulent surface boundary layer. Despite the recent progress, the method has still remained relatively expansive and alternative indirect techniques like Bowen ratio energy balance (BREB), surface renewal analysis, temperature variance or aerodynamic method are used by researchers, mainly if only the latent (LE) and sensible heat (H) fluxes are the primary interest. The presented study will describe one season of simultaneous measurement of LE and H by EC and BREB above high density poplar stand at the locality Domanínek (Czech Republic, 49° 31´ N, 16° 14´ E and altitude 530 m a.s.l.). Apart from the main question what is the overall agreement between these two methods, the issue of inequality of eddy diffusivity for heat and water vapour (the main assumption of the BREB method) as well as the energy balance disclosure will be discussed.

Improvement of CO_2 eddy fluxes modelling in topographically complex terrain

LadislavŠIGUT[1,2], Eva DAŘENOVÁ[2], RadekPOKORNÝ[2], PavelSEDLÁK[3]

[1] Department of Physics, Faculty of Science, Ostrava University, 30. dubna 22, CZ-701 03 Ostrava 1, Czech Republic

[2]CzechGlobe – Global Change Research Centre AS CR, v.v.i., Bělidla 986/4a CZ-603 00 Brno, Czech Republic

[3]Institute of Atmospheric Physics AS CR, v.v.i., Boční II 1401, CZ-141 31 Praha 4, Czech Republic

Abstract

Annual sums of net ecosystem exchange (NEE) estimated by eddy covariance method (EC) are often used for comparisons among sites. But application of EC in topographically complex terrainrestrains application of standard methods for their estimation due to the presence of advection. Analysis of friction air velocity response of night-time CO_2 fluxes and estimation of mean daily ecosystem respiration from daytime NEE showed that night-time data and fluxes measured early after sunrise or late before sunset are not sufficiently reliable for computation of accurate annual sums of NEE. Therefore presented method takes into account auxiliary soil chamber measurements and applies correction factor in ecosystem respiration model calibrated to biomass inventory results. This correction factor can be interpreted as value of ecosystem respiration to soil respiration ratio. Uncertainty of annual sums of NEE estimation based on this approach is studied using theoretically acceptable correction factors. Automated algorithm for computation of light response curve parameters in constrained range was established. Also assessment of biomass inventory and eddy covariance uncertainties is presented. Proposed method produced defensible annual sums of NEE that were only slightly higher than values determined by biomass inventory method.

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Boundary layer structure during sea breeze conditions at Ahtopol, Bulgaria

D. Barantiev (1), E. Batchvarova (1), and M. A. Novitzky (2)

(1) National Inst of Meteorology and Hydrology, Physiscs of the Atmosphere and Ecology, Sofia, Bulgaria, (2) Research and Production Association 'Typhoon' - Obninsk, Russian Federal Service on Hydrometeorology and Environmental Monitoring, Moscow, Russia

Continuous sodar (Scintec MFAS) and ultrasonic anemometer (Typhoon – Obninsk make) measurements were initiated in summer 2008 at the meteorological observatory of Ahtopol at the Black Sea coast (south-east Bulgaria) under a Bulgarian-Russian collaborative rogramme. These observations of high resolution form the basis for studies of the atmospheric boundary layer turbulence and vertical structure at a coastal site. This sodar is unique in Bulgaria and provides the first continuous high resolution data on the wind profile up to 400 – 500 m above the ground. In addition, the continuous turbulence parameters monitoring allows atmospheric boundary studies needed for different applications.

The meteorological observatory at Ahtopol is under development as a background tmospheric composition station in coastal area and the wind data are essential for the studies of gases exchange under breeze conditions. The measurements revealed quite different sea breeze seasons during the years 2008 to 2011 and within the individual seasons, a number of different sea breeze types were identified depending on the interaction of local and larger-scale forcing.

In this study we investigate the turbulence parameters and the vertical structure of the boundary layer related to only to sea breeze conditions. We also study the wind profile within the first 400 - 500 m above the ground. For the surface layer, we test the free convection theory against the sodar observations.

Fluxes of Volatile Organic Compounds over Boreal Forest

T. M. Ruuskanen, Simon Schallhart, Maija Kajos, Pekka Rantala, Markku Kulmala

Department of Physics, University of Helsinki, Finland

Volatile organic compounds (VOCs) take part in atmospheric processes from formation of atmospheric oxidants, such as ozone and OH, to secondary organic aerosol (SOA) particle formation. Plants emit various VOCs, including oxygen containing compounds such as methanol, acetone and acetaldehyde as well as isoprene, mono- and sesquiter-penes. Determining simultaneous EC fluxes of a wide range of organic compounds has become possible with a combination of PTR with a time-of-flight mass-spectrometer (PTR-ToF) (Graus et al., 2010). The novel PTR-ToF method opens up a new possibility to look at fluxes of a wide range of organic compounds allowing the determination of their fate in the atmosphere, e.g. screening of VOCs emission from various ecosystems and observation of deposition fluxes. A PTR-TOF was used to measure at 10 Hz fre-quency full mass spectra up to m/z 315 over a boreal forest at SMEAR II, Hyytiälä Fin-land. In a previous study above temperate mountain grassland 481 ion mass peaks (Mül-ler et al., 2010) were determined from ambient air concentration and eddy covariance fluxes were calculated for all of the ion mass peaks (Ruuskanen et al., 2010). Ruuskanen et al. (2010) found during harvesting of grass significant fluxes of 18 compounds dis-tributed over 43 ions, including protonated parent compounds, as well as their isotopes and fragments and VOC-H+-water clusters. Processing of the PTR-ToF dataset and screening for fluxes over hundreds of compounds is laborious and consistent methods for determination of fluxes are much needed. We will present the measurement setup used for the flux measurements above a boreal forest and apply EddyUH to the flux calculation and analysis of the VOC data.

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