Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03871, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03871
EGU General Assembly 2008

The surface flux measurements over a complex urban terrain in Helsinki, Finland

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The turbulent fluxes of momentum, sensible and latent heat, and CO_2 have been measured in urban measurement station SMEAR III in Helsinki, Finland, since Dec 2005. The measurements are made on top of a 31 metres high measurement tower located on a rocky hill (26 meters above sea level) about five kilometres from the centre of Helsinki. The surrounding area is very heterogeneous consisting of different sized of buildings, paved areas including roads and parking lots, and vegetation. The surroundings have been divided into three land use sectors each representing different surface cover (urban, road and vegetation). The urban sector is mainly covered with paved area and University of Helsinki buildings with a mean height of 20 meters. One of the main roads leading to downtown of Helsinki is passing the road sector approximately 150 meters away from the tower. The space between is covered with a belt of deciduous forest. The vegetation sector is mainly covered with greenspace including grasses, deciduous forest and garden cultivation in the allotment garden and University of Botanical Garden. The main purpose of this study was to investigate the seasonal behaviour of heat and CO_2 fluxes, and their dependencies from the surface cover in urban environment.

The measurement system included a Metek ultrasonic anemometer (USA-1, Metek GmbH, Germany) and an open-path infrared gas analyzer (LI-7500, Li-Cor, Lincoln, Nebraska, USA). The turbulent fluxes were calculated according to the eddy covariance (EC) technique and before the flux calculations a linear trend removal and 2-

dimensional coordinate rotation were applied. Data between Dec 2005 and Jun 2007 was analyzed.

The sensible heat flux (H) always exceeded the latent heat flux (*LE*) reaching 340 W m^{-2} in the urban sector in summer. H was lowest in the vegetation sector through the year due to the enhanced anthropogenic heat production in other sectors, and heat consumed in transpiration in the vegetation sector. In spring and summer, H got negative values in all sectors at nigh indicating a stable stratification. During winter and fall nights, the urban and road sectors remained unstable stratified while the stratification was slightly stable in the vegetation sector. *LE* was close to zero in winter but in summer it reached a value of 150 W m^{-2} in the vegetation sector due to the increased transpiration. Traffic as a source of CO_2 was evident as the highest CO_2 fluxes (F_c) were measured in the road sector where the fluxes reached 20 μmol $m^{-2}s^{-1}$ through the year. In the vegetation sector, F_c remained below 8 μmol $m^{-2}s^{-1}$ and in summer the CO_2 uptake of vegetation exceeded the emission from anthropogenic sources and a downward flux of 7 μmol $m^{-2}s^{-1}$ was observed. F_c correlated with the traffic density and a background non-vehicle flux was 1 μmol $m^{-2}s^{-1}$.