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Flux measurements at the SMEAR III station

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Introduction

- The SMEAR III station measurements started in Helsinki in fall 2004

- One measurement site is the 31 m high tower at Kumpula where the vertical flux measurements are made including
  - Momentum flux
  - Sensible and latent heat fluxes
  - Carbon dioxide flux

Measurements

- Flux is the transfer of some substance/area/time
- Fluxes are calculated by the eddy covariance technique

$$F = \overline{w's'}$$

- The high-frequency (10 Hz) measurement system includes a Metek ultrasonic anemometer (USA-1) and an open path infrared gas analyzer (LI-7500)

Methods

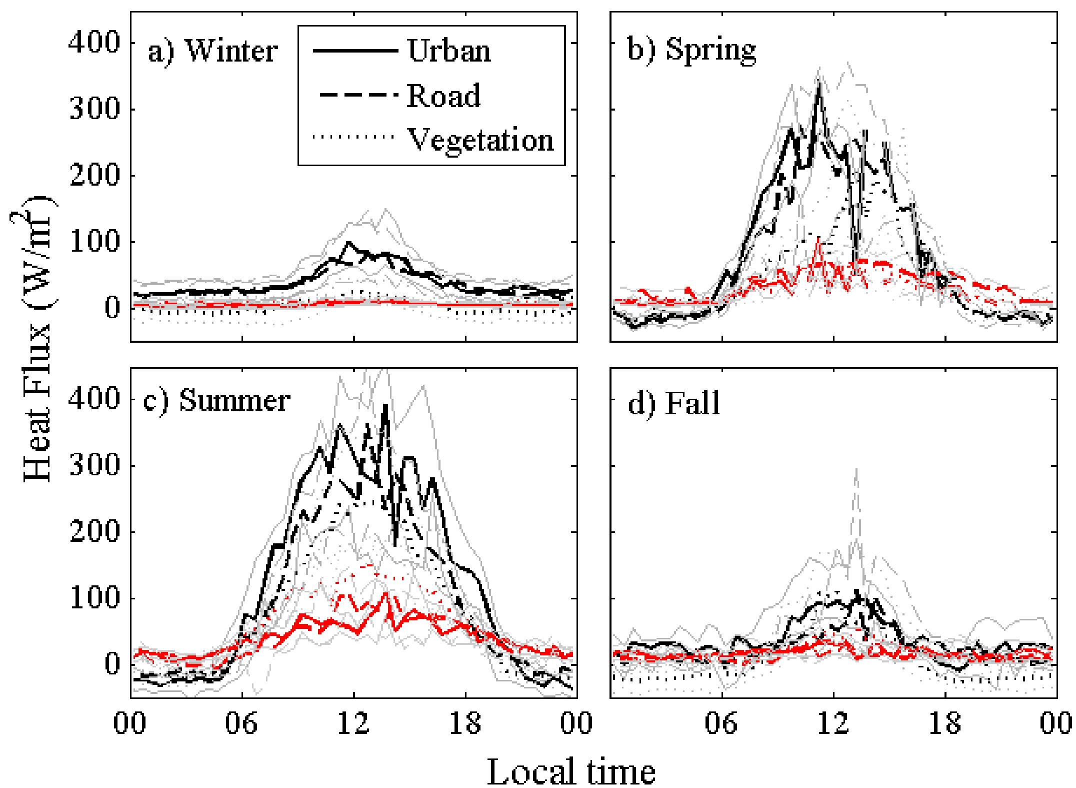
- The surroundings of the tower are very heterogeneous and measurements are divided into three land use sectors: Urban, road and vegetation

- Data between 12/2005 and 2/2007 was analyzed and data was divided according to season

Table 1. The land use fractions around the measuring tower within a circle of radius 250 m separately for all three sectors.

	Land use type	Building fraction (λ_p)	Road fraction (λ_r)	Vegetation fraction (λ_v)
320 - 40°	Urban	0.42	0.51	0.07
40 - 180°	Road	0.10	0.60	0.30
180 - 320°	Vegetation	0.02	0.13	0.85
Full circle		0.14	0.40	0.46

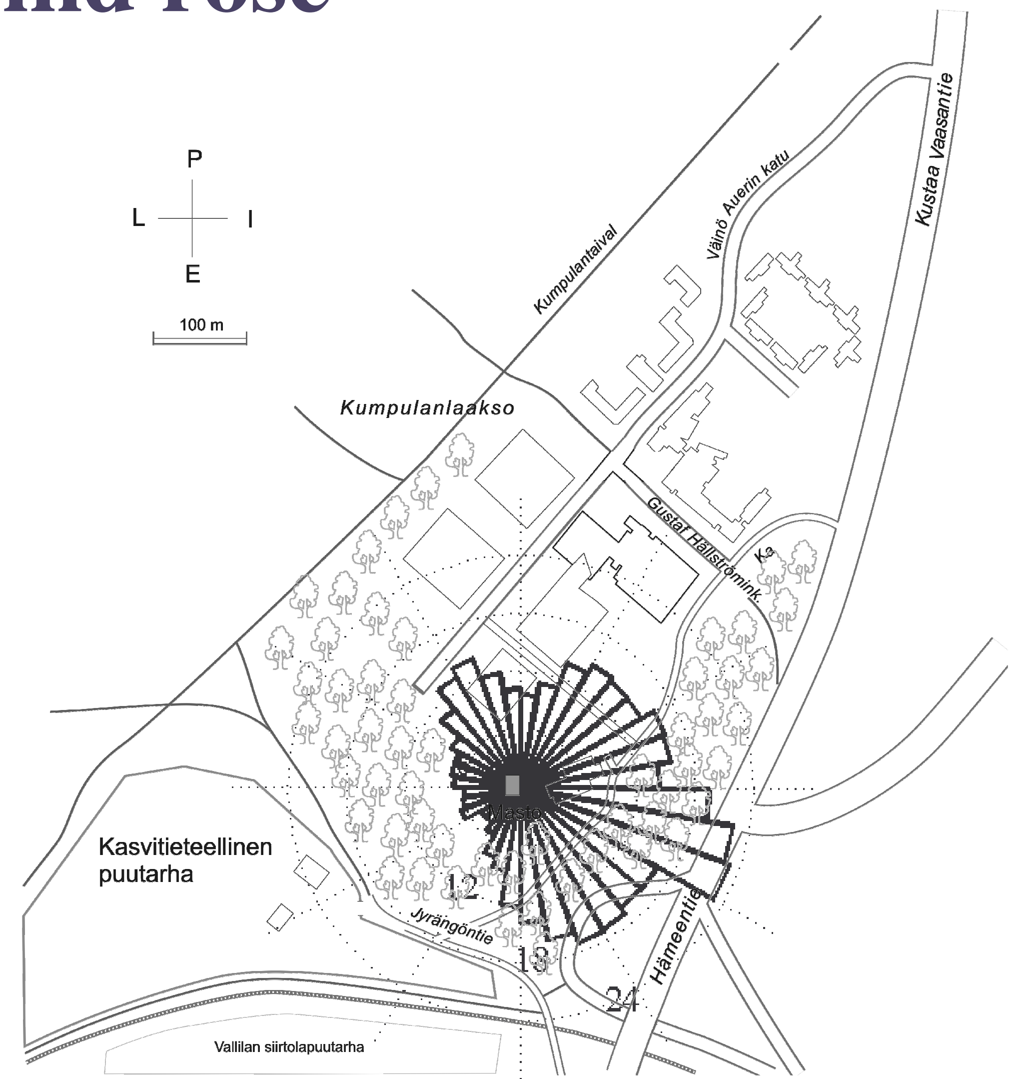
Results:
The diurnal cycle of sensible heat (black) and latent heat (red) fluxes



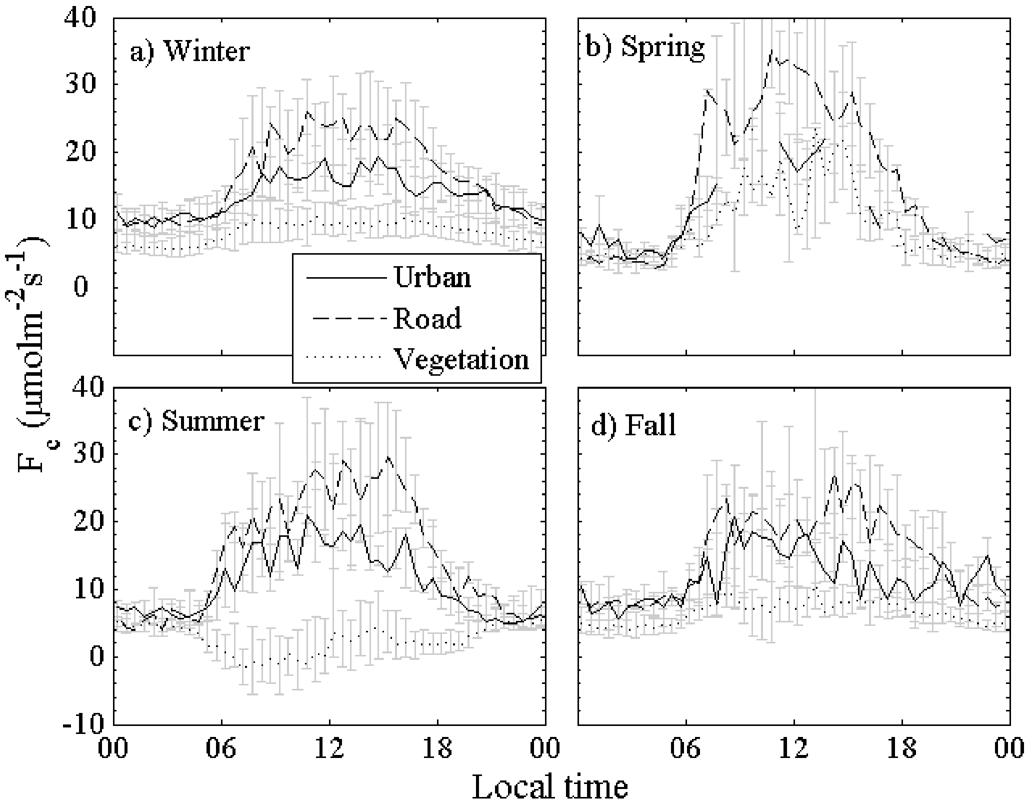
- Sensible heat flux was nearly always lower over vegetation
- Highest latent heat fluxes were measured over the vegetation at summertime due to evapotranspiration

Results: CO_2-flux wind rose

- CO_2-fluxes have a clear WD dependent pattern
- Highest fluxes are measured in the road sector
- Lowest fluxes in the vegetation sector



Results: Diurnal cycle of CO_2 fluxes at different sectors and seasons



- On average, the surroundings of the tower acted as a source for CO_2
- At summer days, the vegetation uptake on averagely exceeded the anthropogenic sources

Conclusions

- The sensible heat flux had highest daytime values in urban and road sector
- The latent heat flux was systematically lower that sensible heat flux with highest values at vegetation sector at summer
- CO_2 exchange was affected by the traffic
- On average, the surface acted as a source for CO_2
- At summer mornings, the uptake of vegetation exceeded the anthropogenic sources resulting negative fluxes