Two EC sites on one urban tower: what can we learn?

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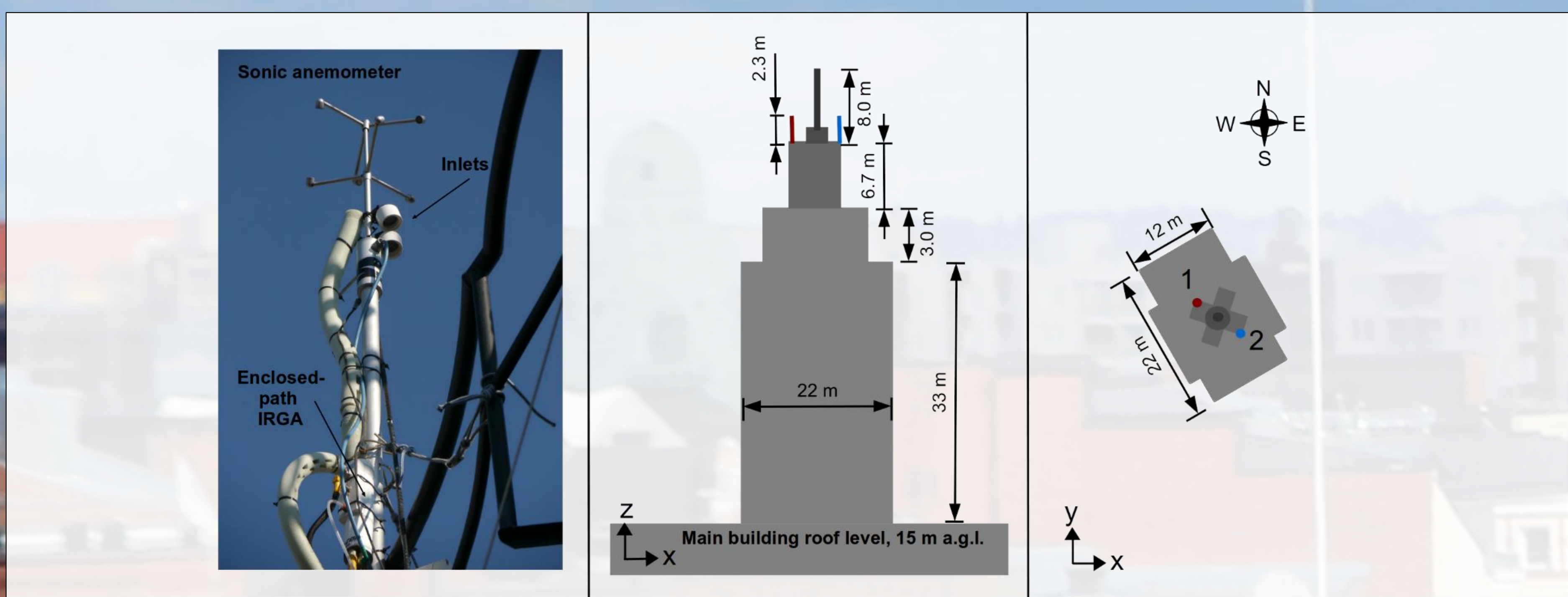
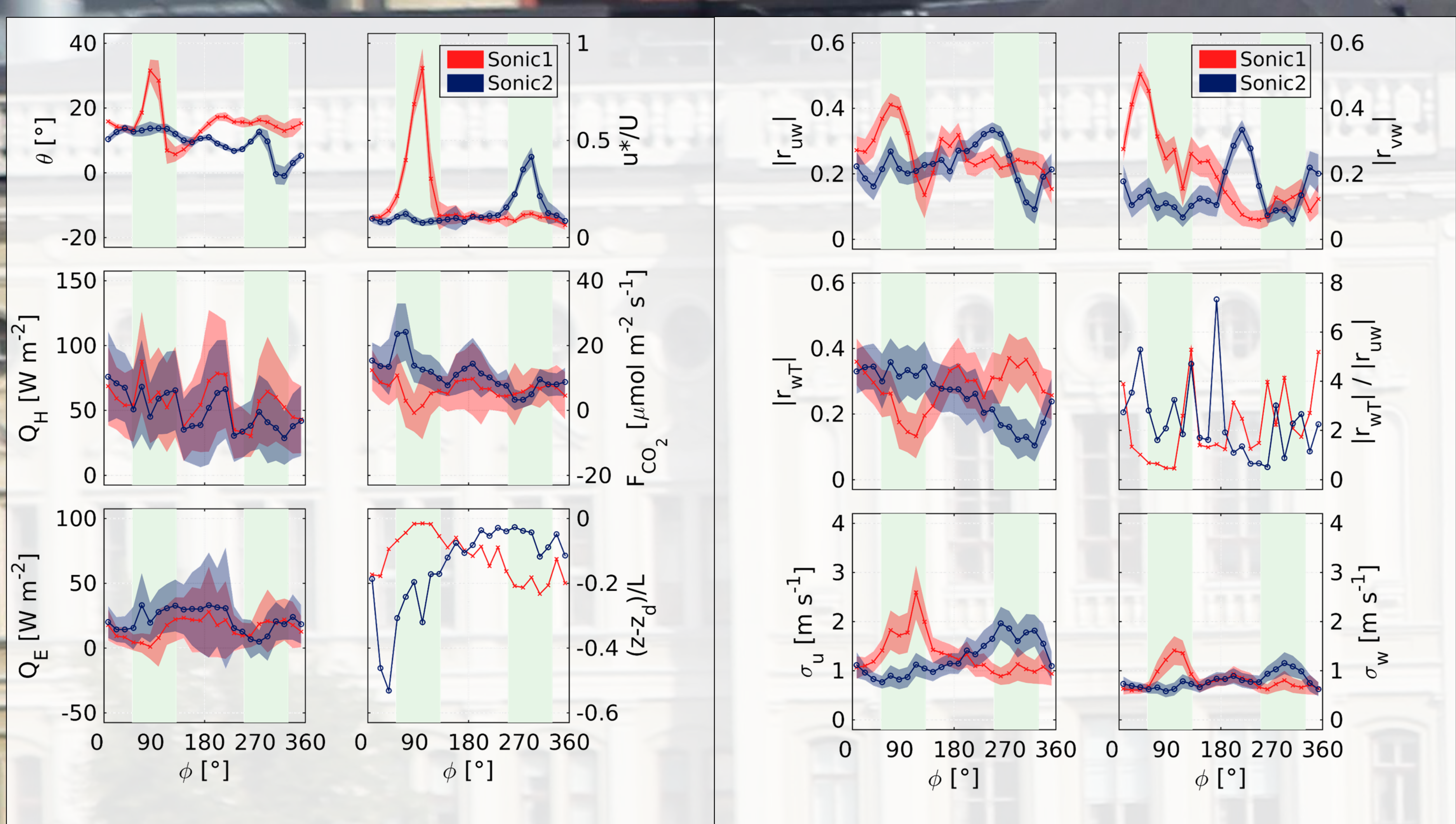
Questions

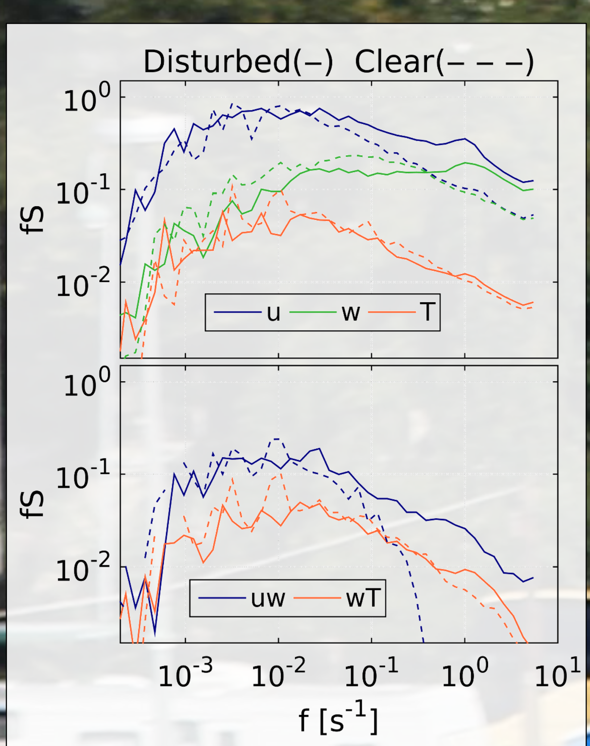
- ✓ How do we detect the flow-disturbed directions?
- ✓ How badly are the fluxes affected?



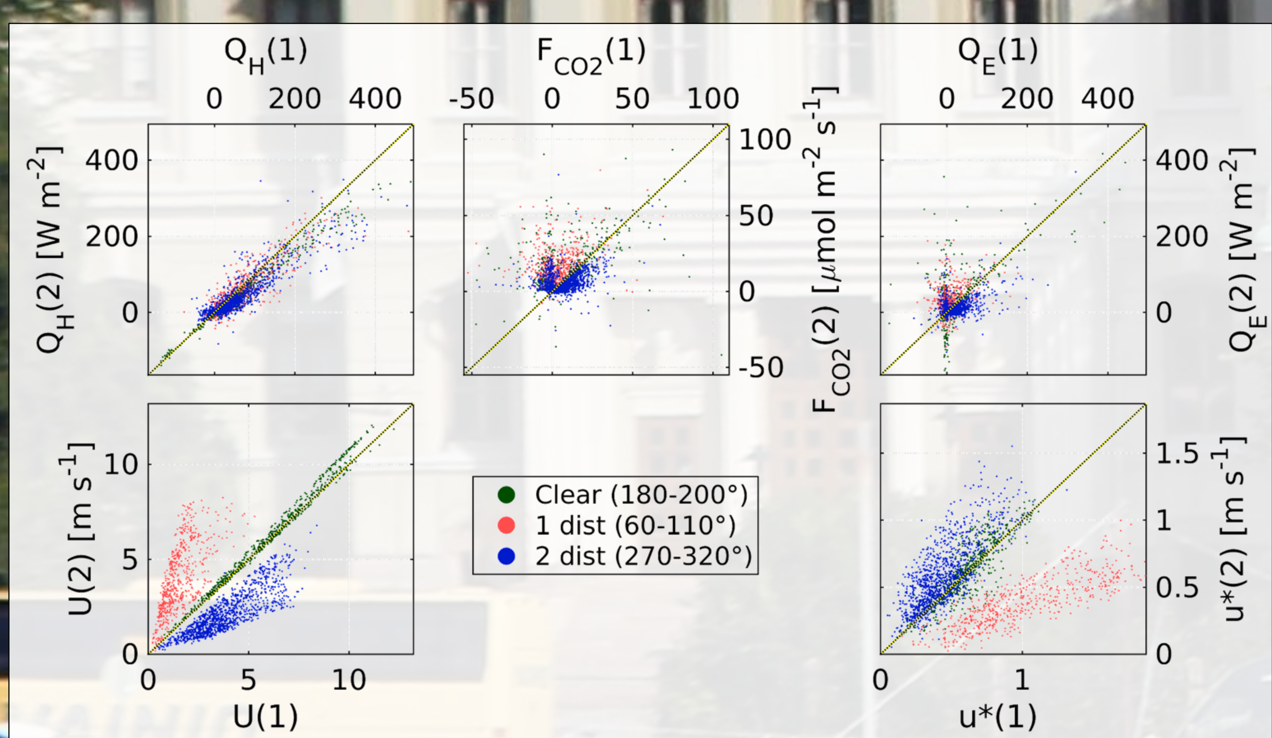
Site setup (Nordbo et al. 2012). The sonics are at 60m above ground on a Hotel tower in central Helsinki. Average neighbourhood values are z_H=24.1m, z_d=14.9m, z_0=1.4m; and land-cover is 55% built, 42% paved, 3% vegetation (Nordbo et al. 2015). Figures below use data from Jun'13-Jan'14



Average fluxes and turbulence statistics as a function of wind direction. Shading around average is $\pm 1\sigma$. (Data have undergone standard procedures such as double rotation; see Nordbo et al. 2012 for details.)



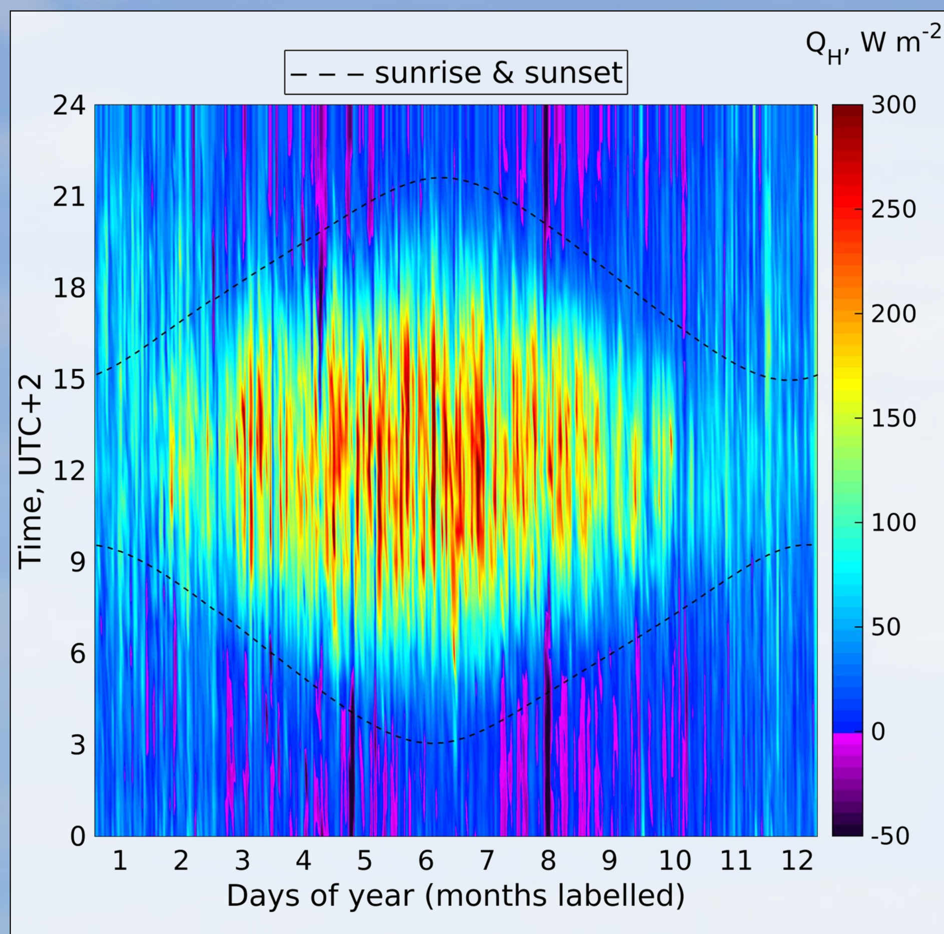
Spectra on 2011-09-04. Note the extra energy at about 1s



Scatterplots comparing the two EC sub-sites. These data are purposely not yet corrected (e.g. for spectral corrections)

30-min statistics between the two EC sub-sites for disturbed flow 1,2 (and clear flow in brackets). N = 598,1777 (629)

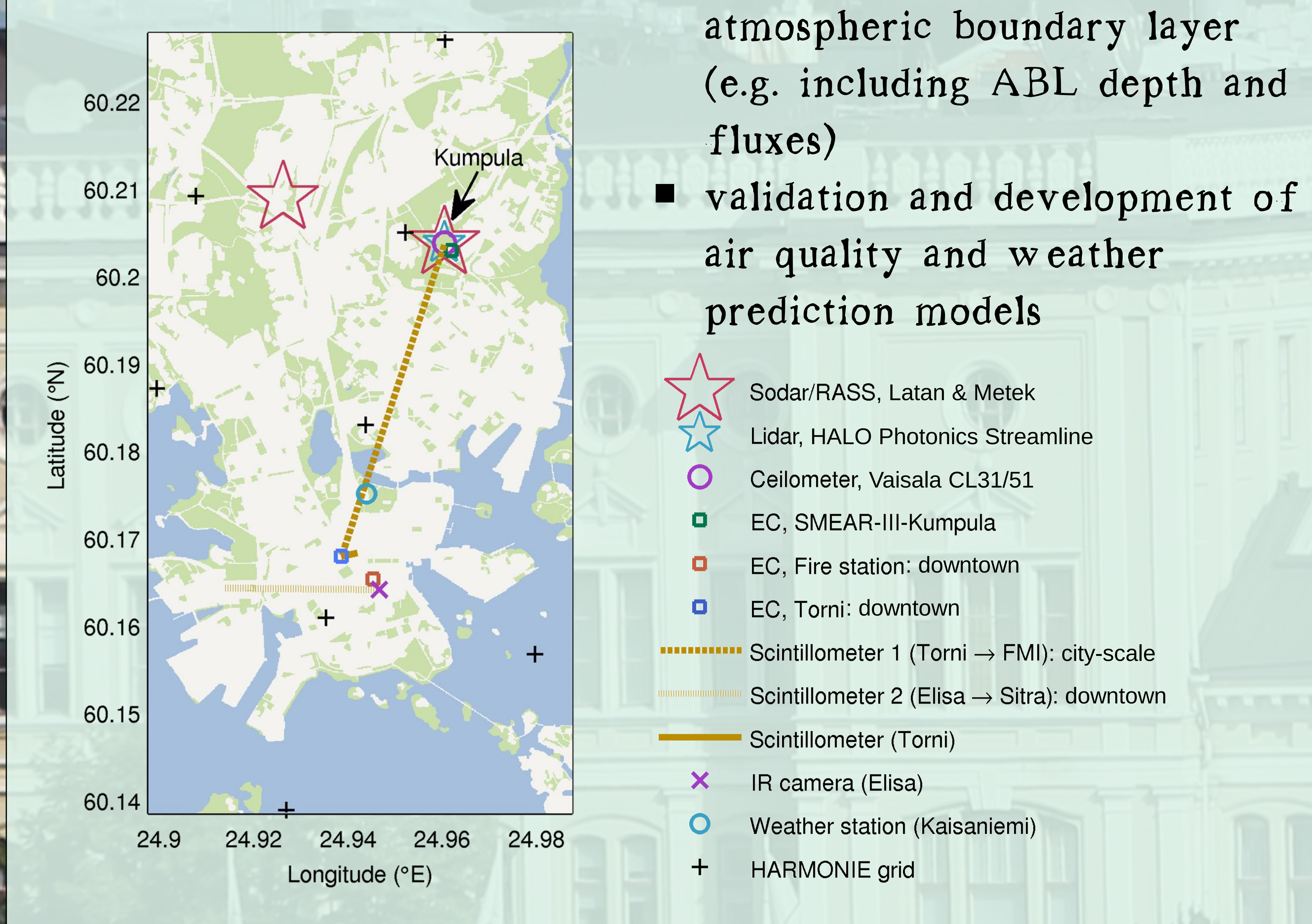
	Q_H	Q_E	F_{CO2}	u*	U
rmse	36,39 (30)	45,31 (52)	25,10 (24)	0.7,0.2 (0.1)	2.8,1.9 (0.3)
mbe, dist – clear (or 1–2)	9,17 (20)	-20,9 (-8)	-14,1 (-5)	0.6,-0.1 (-0.02)	-2.5,1.7 (-0.2)
r	0.87, 0.89 (0.99)	0.37,0.63 (0.68)	-0.01,0.34 (0.39)	0.84,0.73 (0.86)	0.69,0.84 (0.99)



Median sensible heat flux (Torni, central Helsinki), 2011/09 –2015/04

Helsinki UrBAN (Urban Boundary-layer Atmosphere Network, Wood et al. 2013a,b, http://urban.fmi.fi) is a research-grade observation network for:

- the study of Helsinki's urban atmospheric boundary layer (e.g. including ABL depth and fluxes)
- validation and development of air quality and weather prediction models



Discussion

- ✓Fluxes **can** be obtained from urban towers (see also Wood et al. 2011), and especially interesting would be advanced corrections such as from wind-tunnel modelling (Barlow et al. 2011) or LES (Griessbaum and Schmidt 2009)
- ✓Wind and momentum flux are clearly badly affected for flow-disturbed directions
- ✓Those directions' power spectra clearly have extra energy, particularly at around 1 second
- ✓The power and co-spectra are not **very** badly affected; so under cases of flow disturbance, a correction/estimation of fluxes and turbulent statistics seems possible
- ✓Future work: evaluate the effect of gap filling, e.g. CO_2 fluxes; useful for cases with only one EC site on a mast

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