The 'FluxSAP 2010' hydroclimatological experimental campaign over an heterogeneous urban area

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The FluxSAP team


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The context

- VegDUD: the role of vegetation in sustainable urban development
- Funded by the French National Research Agency (2010-2013)
- Understanding and quantitatively assessing the impact of vegetation in present and future urban development projects
- Mixed urban areas (built, unbuilt, green surfaces)
- Climatology, hydrology, energy control, environment
- Location: city of Nantes, around the permanent observation site of IRSTV ('Pin Sec' district)
- Two ground and airborne measurement 'FluxSAP' campaigns: 2010, 2012
The objectives

- FluxSAP objective: obtain reference data
  - for evaluating urban hydrology and microclimate models
  - for assessing quantitatively the role of vegetation on urban climate

- FluxSAP 2010 objective: test the methods allowing
  - to measure sensible heat and water vapour fluxes over a heterogeneous urban district
  - to spatialize the measurements, taking into account land use heterogeneity
  - to test footprint models over an urban area
Loire river

Erdre river

Loire river

Nantes region
'Pin Sec' measurement area
10 eddy covariance sensor systems
5 LAS, 1 SAS

Wind Rose GOSS Mast 21m

Halveque

Industry
Sports Grounds
Buildings > 46m
Buildings > 28m
Buildings > 14m
Buildings < 14m
Vegetation

Turbulence & meteo mast

Average height: 22.3m
Average building height: 7m
14 T-RH sensors at $z = 2-3$ m
10 piezometers, 8 T-θ profiles
Ground-based measurements

Set-up summary

- T-RH (2 m)
- EC mast
- Scintillo
- Sodar
- GIS limits
TIR measurements

Airborne (13 flights) and handheld (140 refs) TIR
Hyperspectral airborne measurements

**Hyspex sensor and inertial platform**

- **VNIR (400-1000 nm)**
  - 160 bands (4 nm)
  - 0.6 m resolution

- **SWIR (1000-2500 nm)**
  - 256 bands (6 nm)
  - 1.2 m resolution

- **95 ground measurements portable spectrometer**
30 passive tracer dispersion experiments
The meteorology (26 April - 7 June)
Temperature and humidity gradients from T-RH and surface sensors

- Temperature air
- Surface
- - 5 cm
- - 35 cm
- - 1 m

- Taupe 3

- 4 K
- 18 %
Heat flux measurements with EC turbulent sensors

- 150 Wm$^{-2}$
Heat flux measurements with LAS scintillometers

Sensible Heat Flux during FluxSAP 2010

300 Wm$^{-2}$
Preliminary conclusions

- Differences between measurement techniques but good coherence between sites

- Differences between sites linked with different distributions of land cover (buildings, pavement, bare soil, high and low vegetation)

- Footprint analysis should allow us to identify the various flux contributions and quantify the influence of vegetation

Further analysis: the footprint issue

turbulent flux sensor

wind $U$

source area or footprint
Further analysis: the footprint issue

\[ L \text{ and } D = f(z, z_0, U, z/L,...) \]
Wind
Preparation for May-June 2012 campaign

- More variable land cover within footprint
- More EC masts over vegetated urban areas
- More $\text{H}_2\text{O}$ turbulent sensors (Li-Cor)
- More differentiated LAS paths (mineral, vegetal, mixed)
- 1 or 2 water vapour scintillometers?
- Measure PTUV profile (0-150 m) with tethered balloon
- Monitor water table (soil moisture profile)
Thank you