FluxSAP 2010 experimental campaign over an heterogeneous urban zone, part 1: heat and vapour flux assessment

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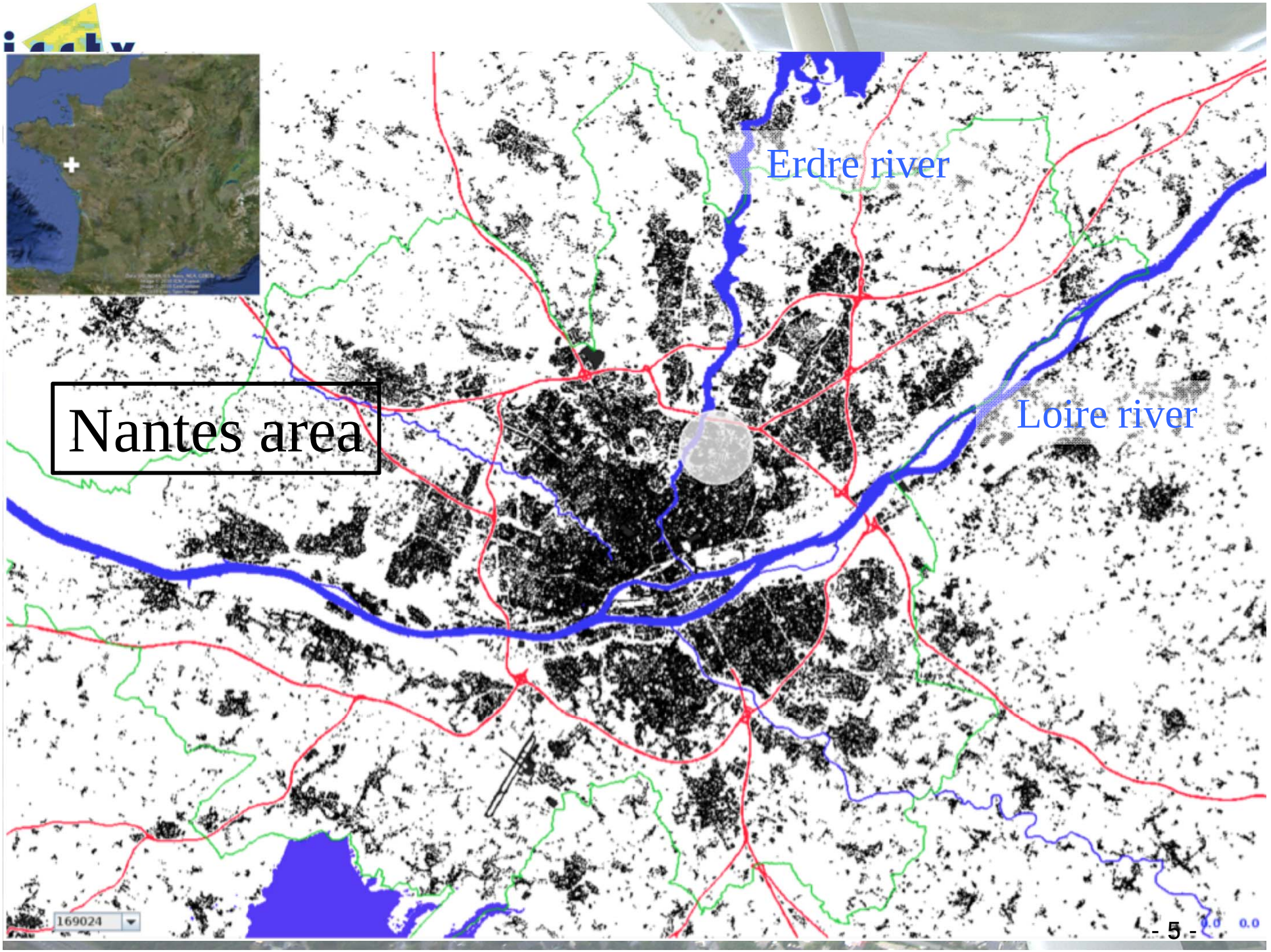
The context

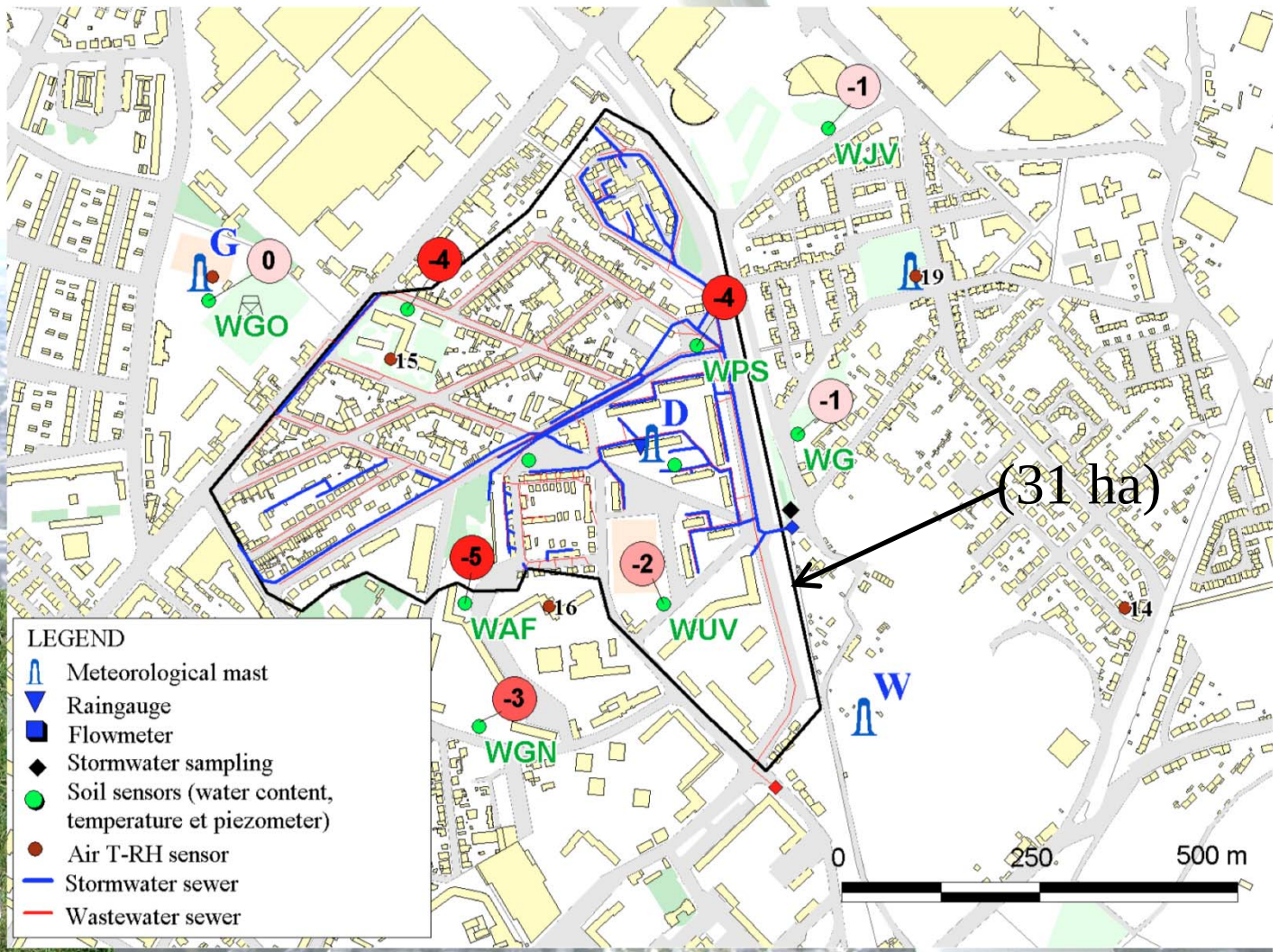
- **VegDUD, The role of vegetation in the sustainable urban development; an approach by the stakes linked to climatology, hydrology, energy control, and environment,**
- **a cooperative program based on a systemic approach, with some 15 partners aiming at understanding and quantitatively assessing the vegetation impact in the present and future urban development projects**
- **funded by the French National Research Agency (ANR) during 4 years (2010-2013).**
- **within this framework two campaigns of at-ground and airborne measurements are organized, the first one in 2010 and the second one in 2012**
- **around the permanent observation site of IRSTV (Pin Sec district)**

The objectives

- **<u>FluxSAP's objective</u> : to obtain reference data for assessing quantitatively the role of vegetation in urban climate,**
- **and for evaluating urban hydrology and climatology models**
- **<u>FluxSAP2010's objective</u> : to test the methods allowing**
- **to measure the sensible heat and water vapour fluxes over a heterogeneous urban district,**
- **to spatialize the measurements taking into account the heterogeneous land surface cover modes,**
- **and to test the footprint models for a urban area.**

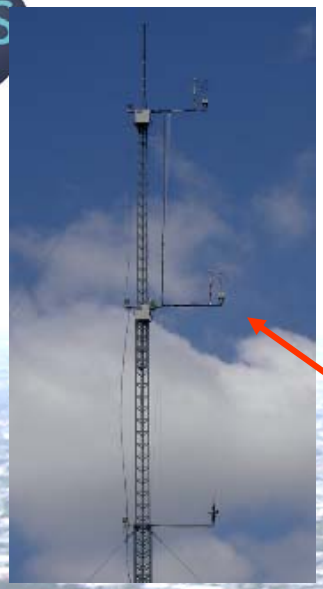

Erdre river
Loire river
Nantes area
169024

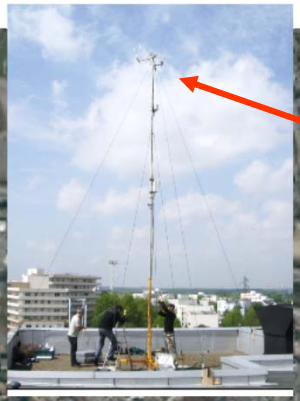
In the soil (permanent) : 10 piezometers
8 temperature profiles and water content



In the air : 14 T-RH sensors at z = 2-3 m agl

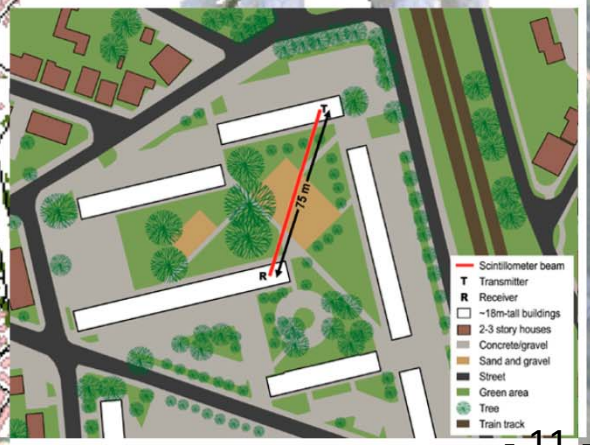
10 Eddy Covariance sensor systems

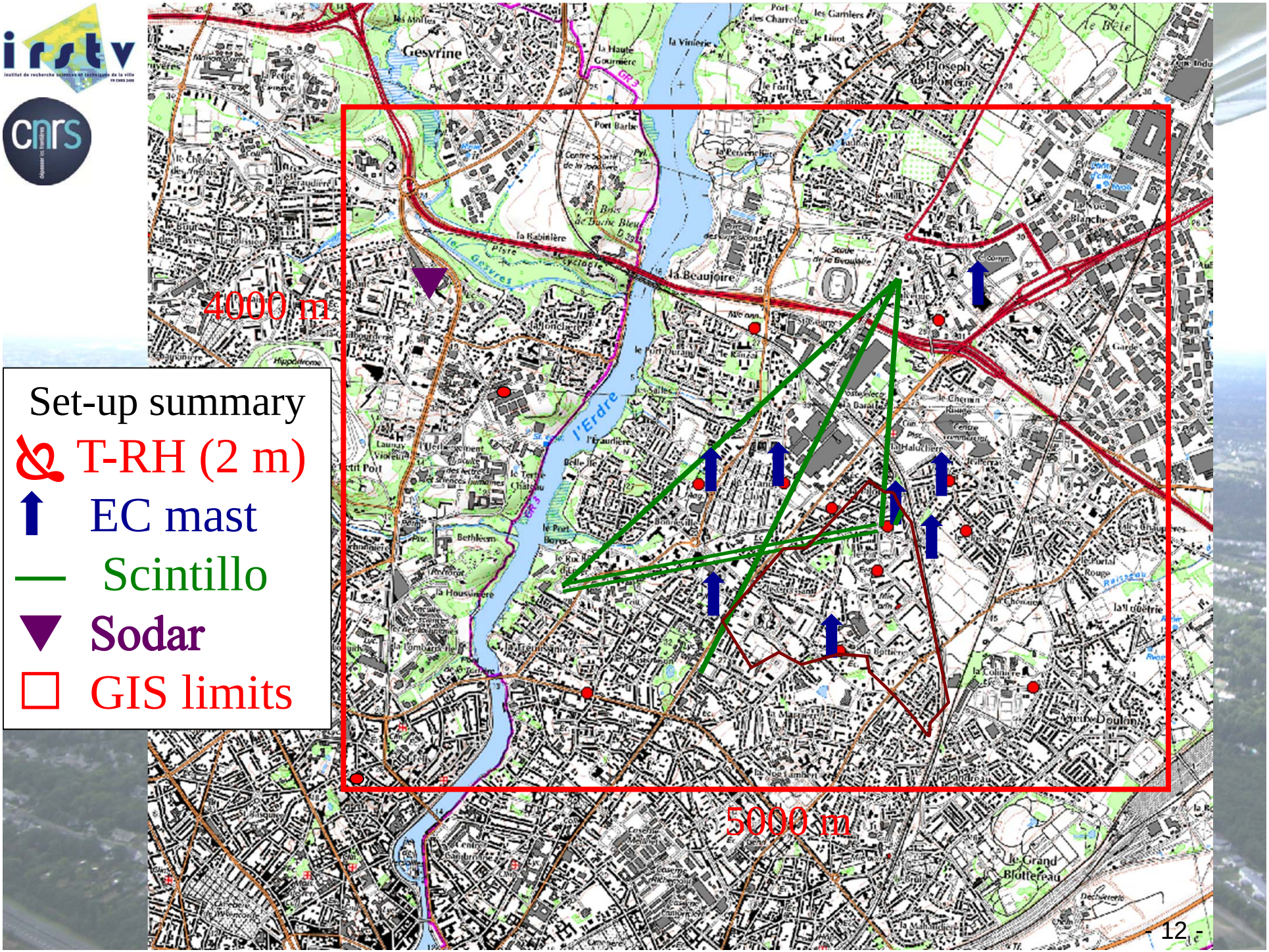




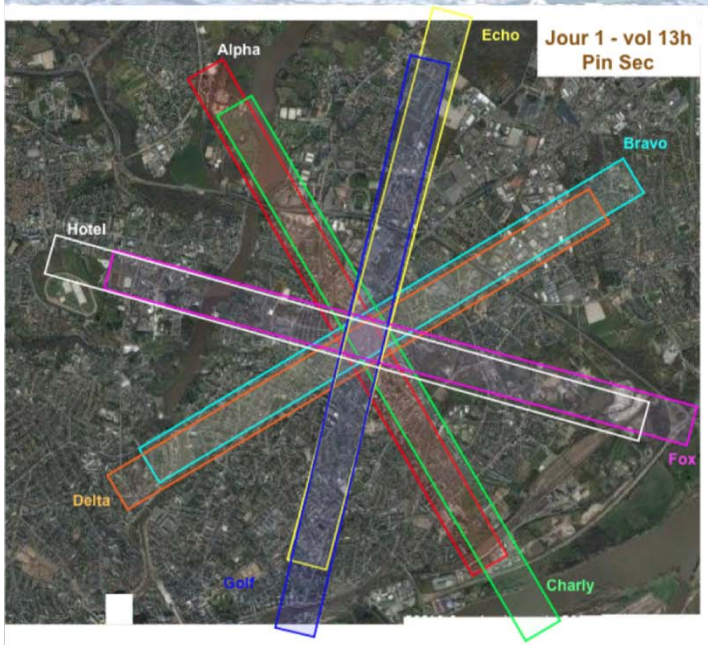
5 Large Aperture Scintillometers (LAS)

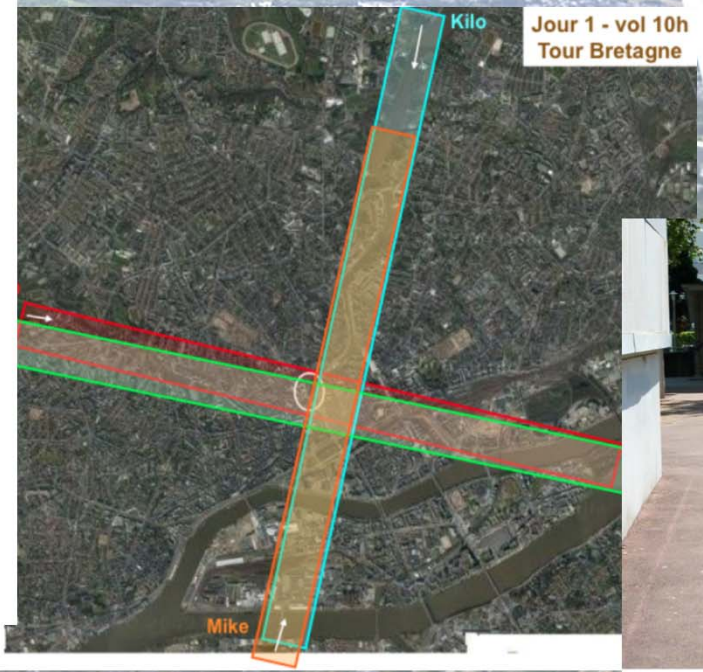
5 LAS and 1 SAS




Set-up summary
T-RH (2 m)
EC mast
Scintillo
Sodar
GIS limits
4000 m
5000 m

Airborne (13 flights) and handheld (140 refs) thermal infrared measurem^{ts}





Hyperspectral (Hyspex) airborne measurements

Flight scheme :
20 flight lines

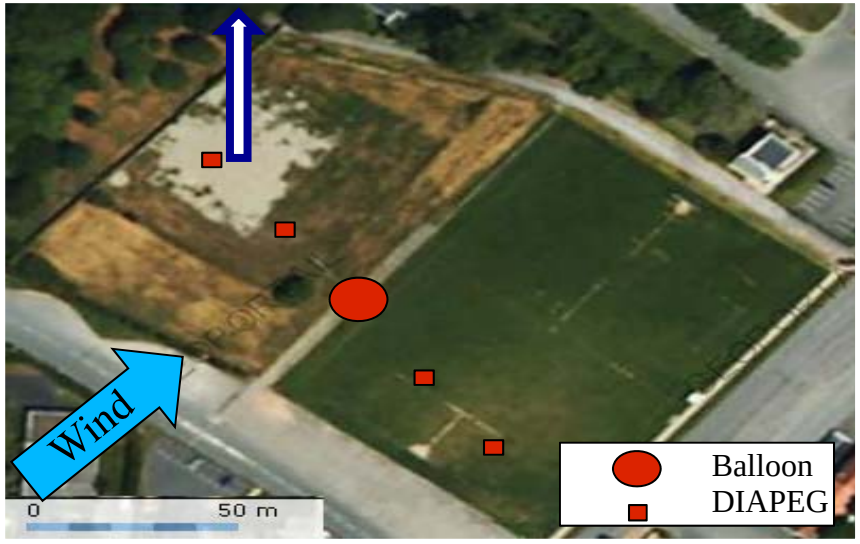
Hyspex sensor and inertial plateform

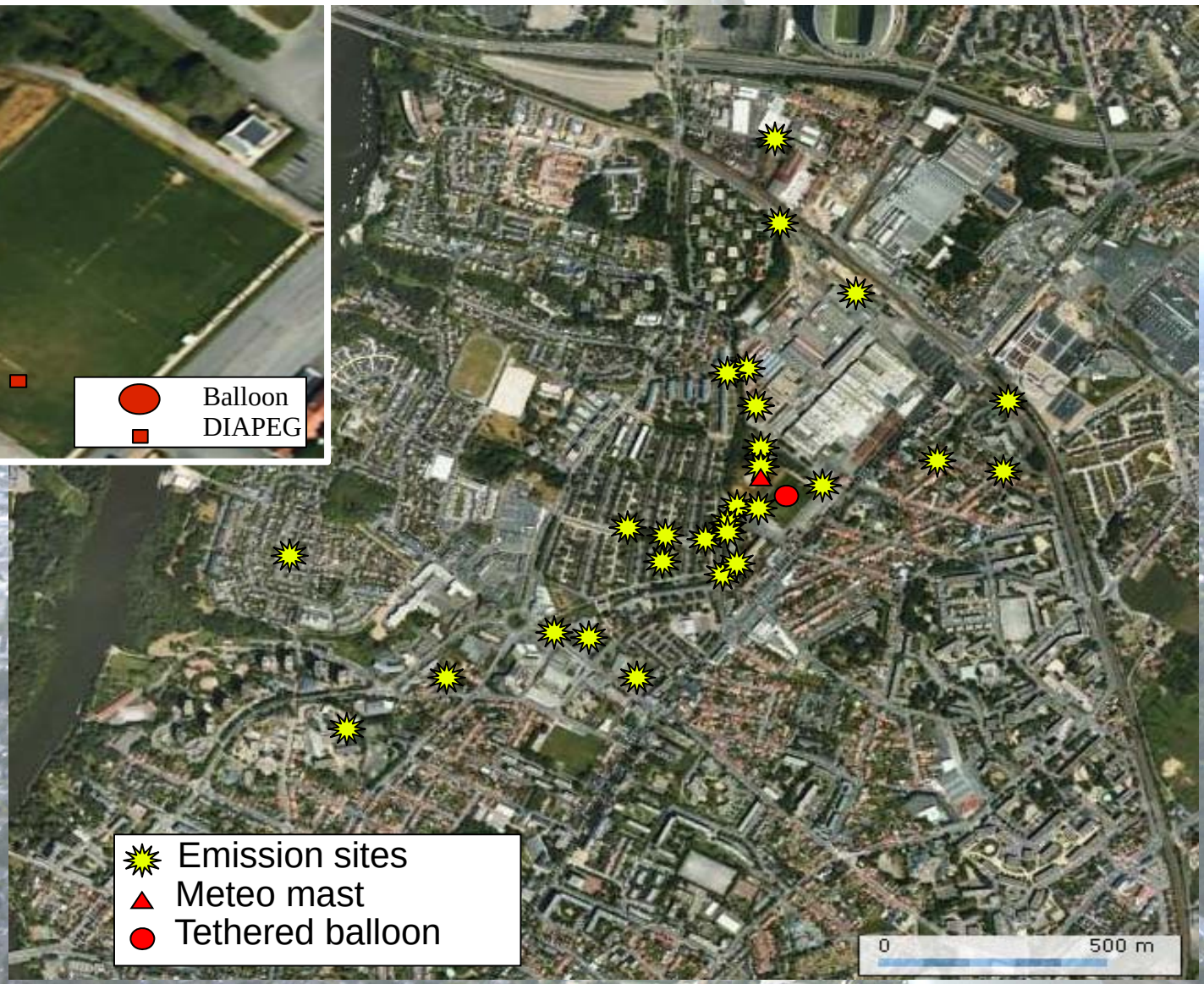
VNIR (400-1000 nm) :
160 bands (4nm),
0.6 m resolution

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

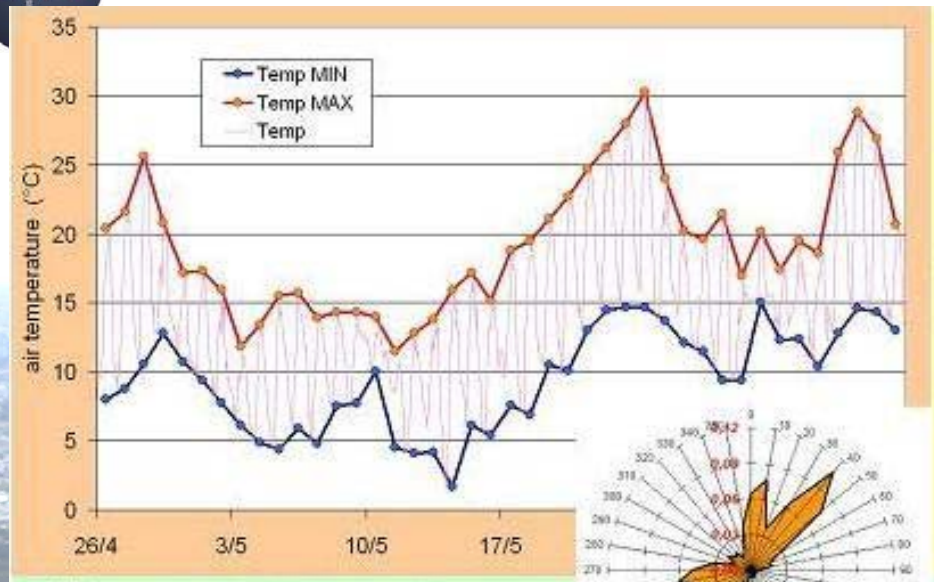
95 meas^{ts} at ground w. portable spectrometer

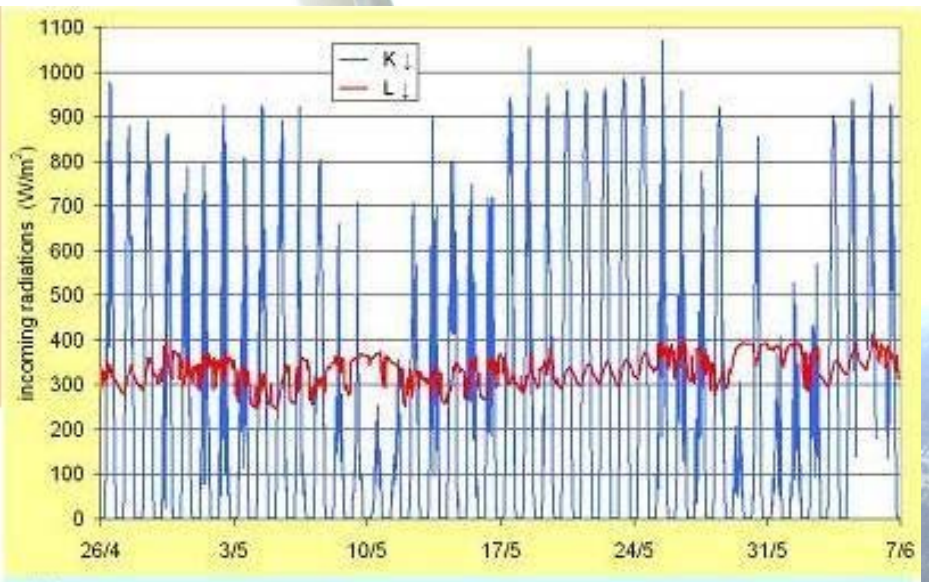
30 passive tracer dispersion exercises see Part 2 (Maro et al.)

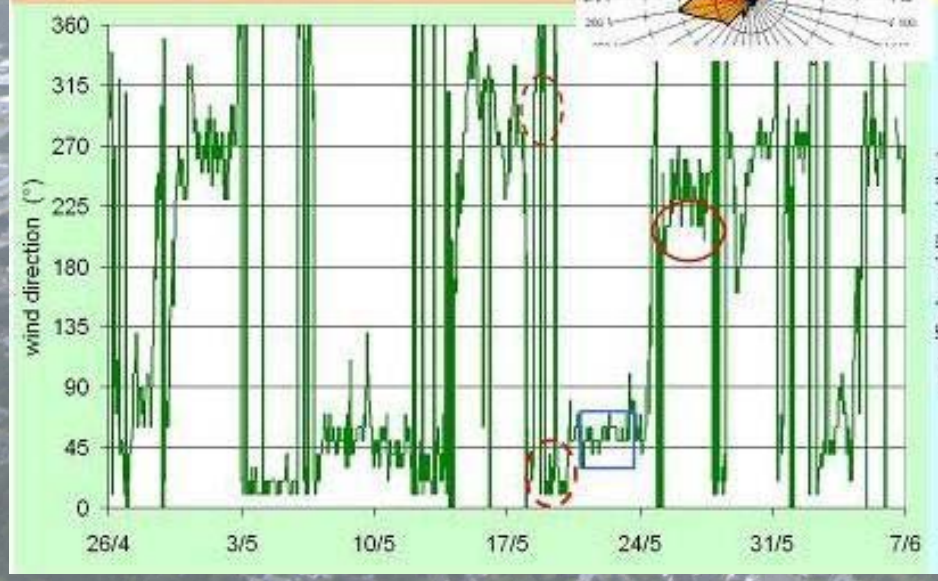


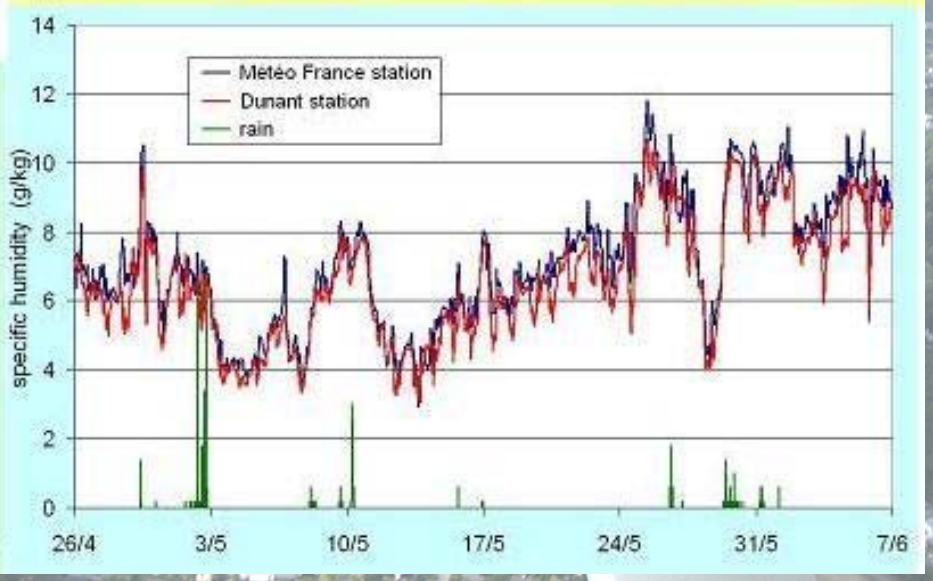


The meteorology (26 April – 7 june)

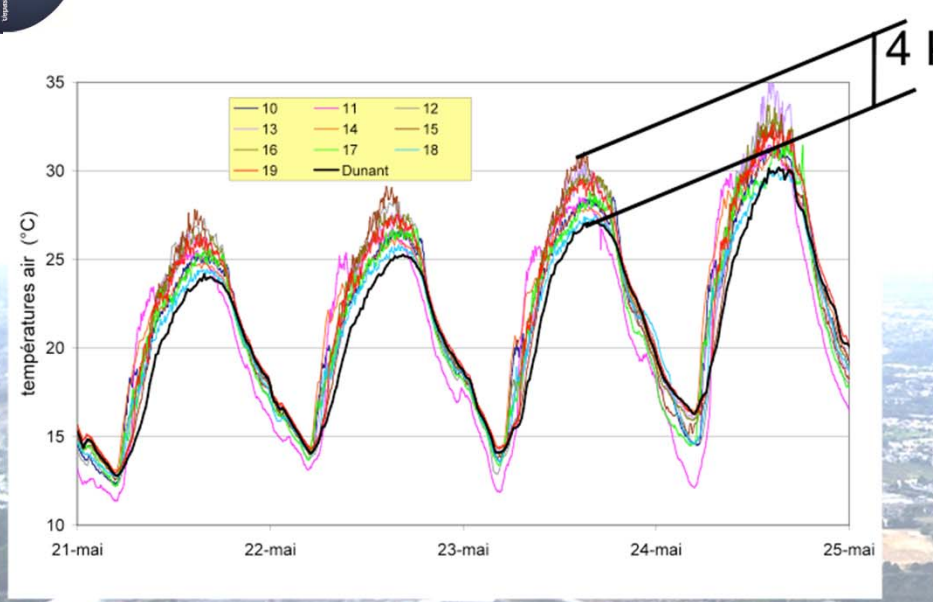


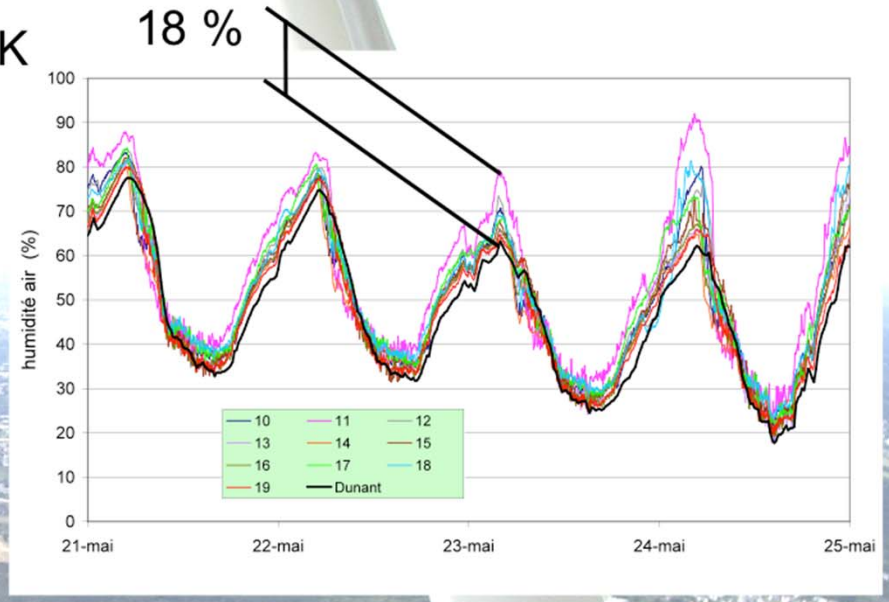


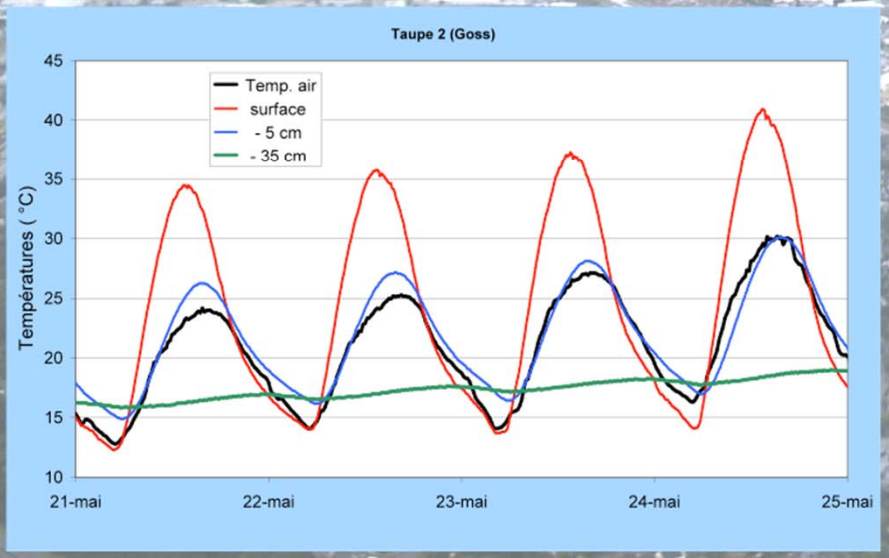


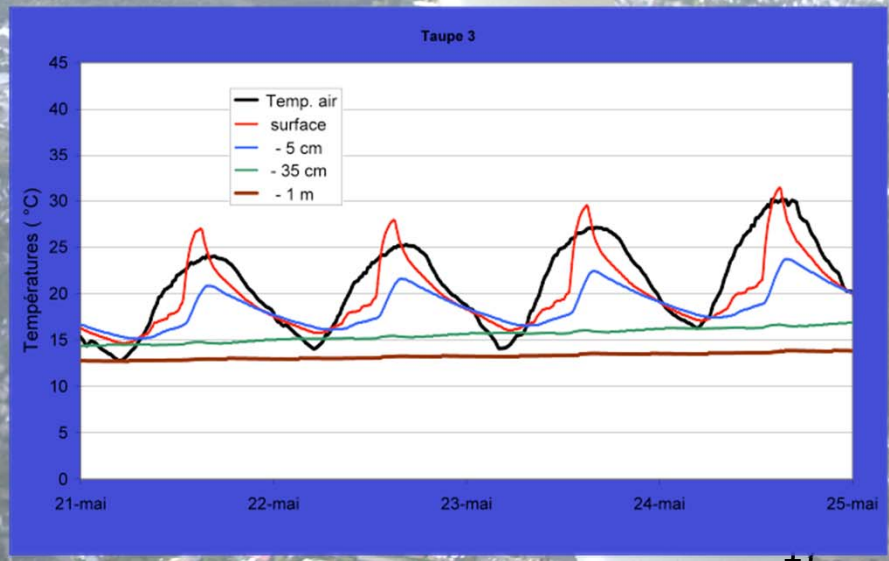


First results : temperature and humidity gradients from T-RH and surface sensors

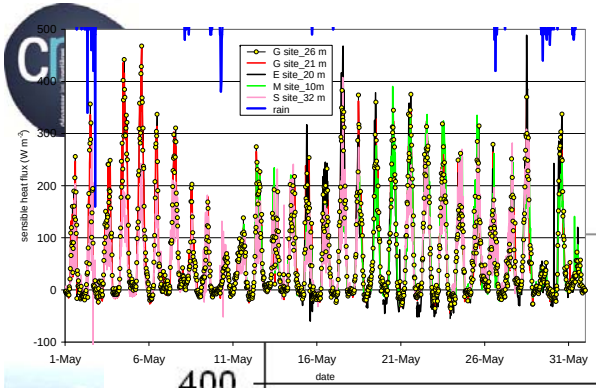


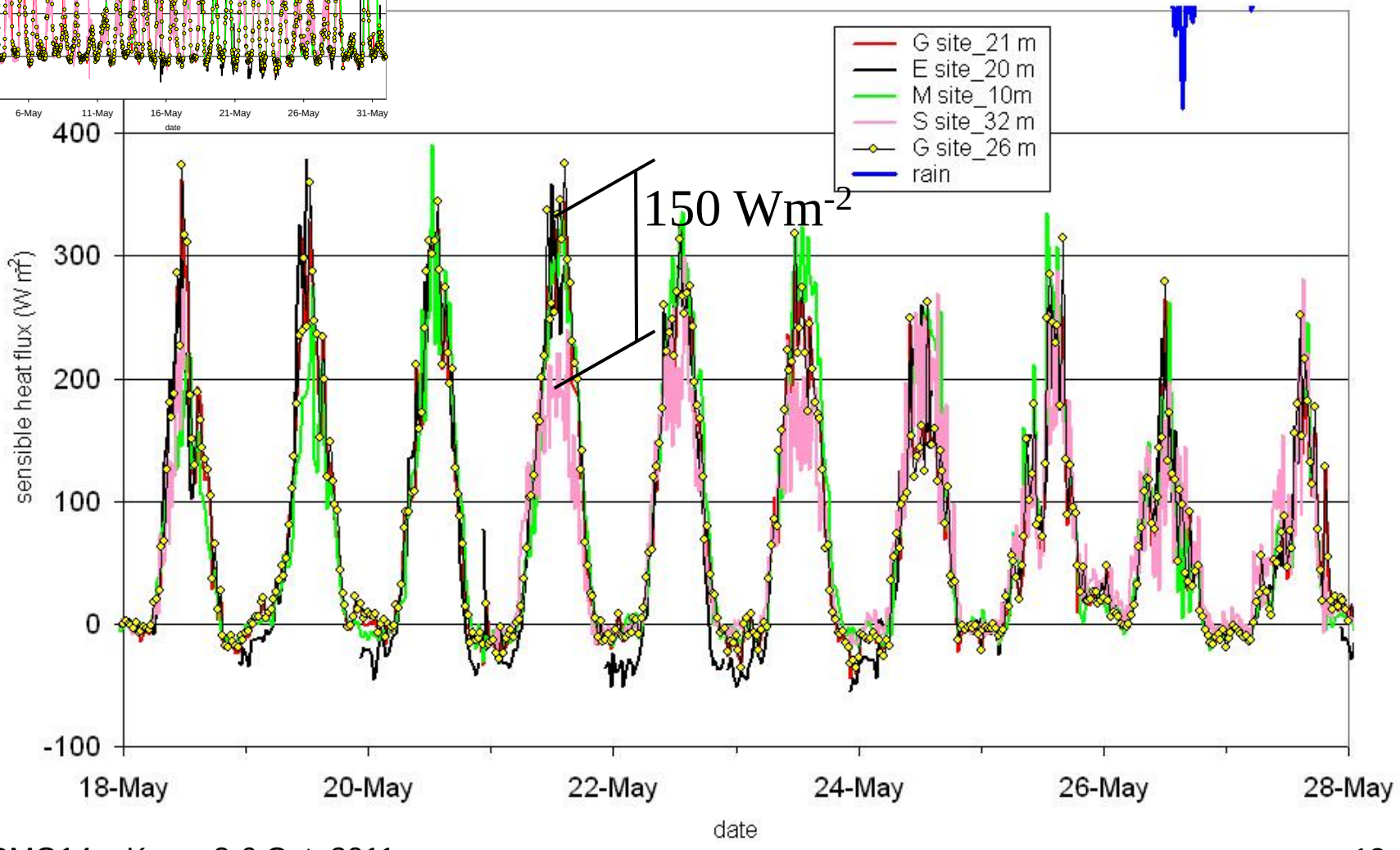




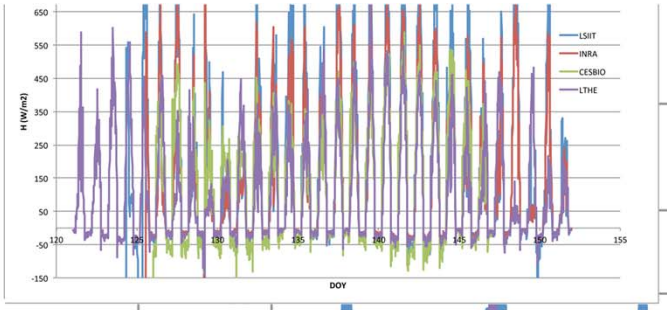


First results : heat flux measurements with EC turbulent sensors





First results : heat flux measurements with LAS scintillometers



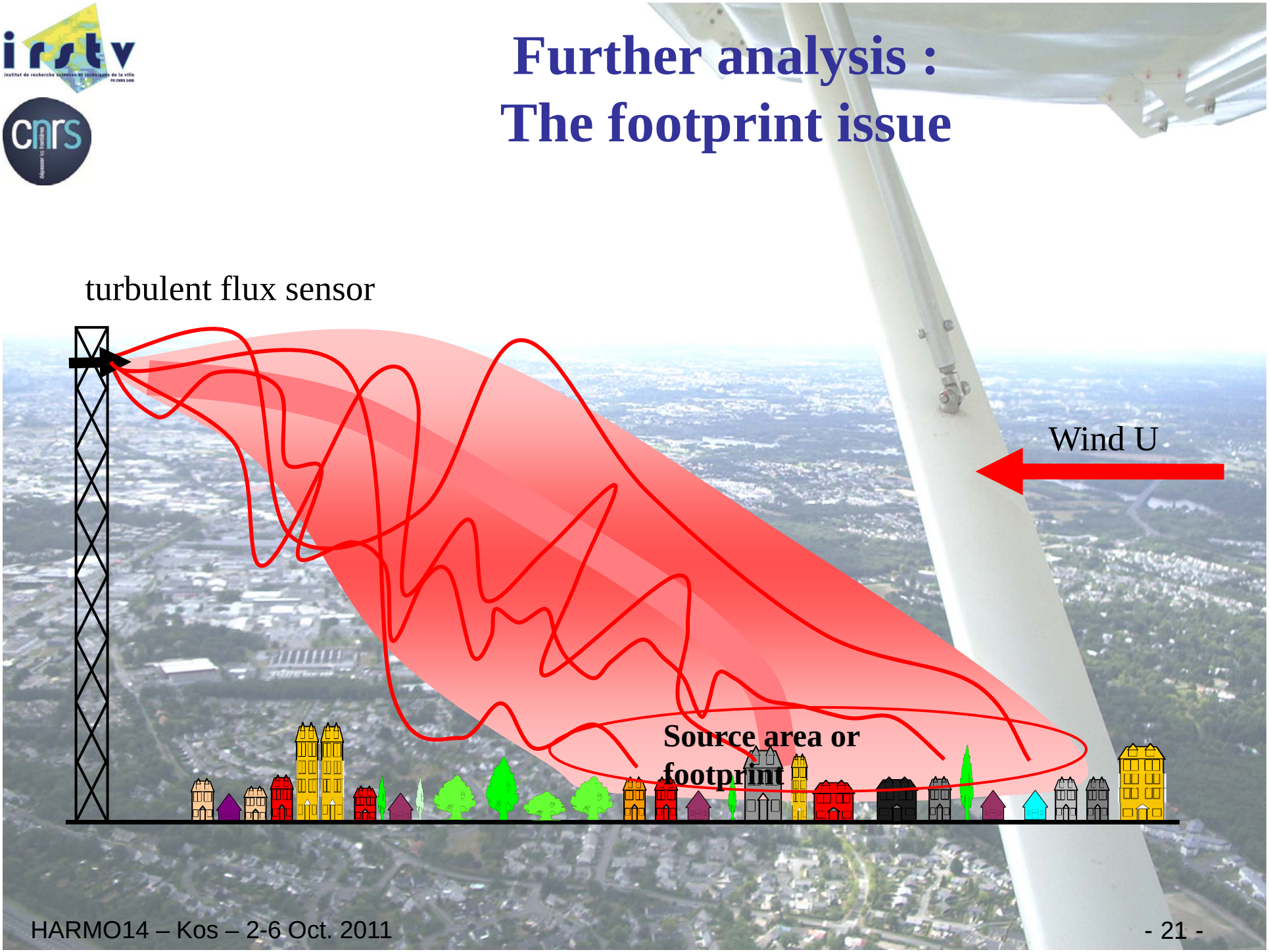
Preliminary conclusions

- **Good coherency between sites but differences between measurement methods (sensors + algorithms).**
- **Differences between sites linked with different distributions of land cover modes (buildings, pavement, bare grounds, high and low vegetation).**

Mestayer et al. (2011), *Urban Climate News*, **40**, 22-30 (www.urban-climate.org)
" " " (in French) *La Météorologie*, **73** (mai 2011), 33-43 (www.smf.asso.fr)

- **Footprint analysis should allow to separate the various contributions to fluxes and to quantify the influence of vegetation.**

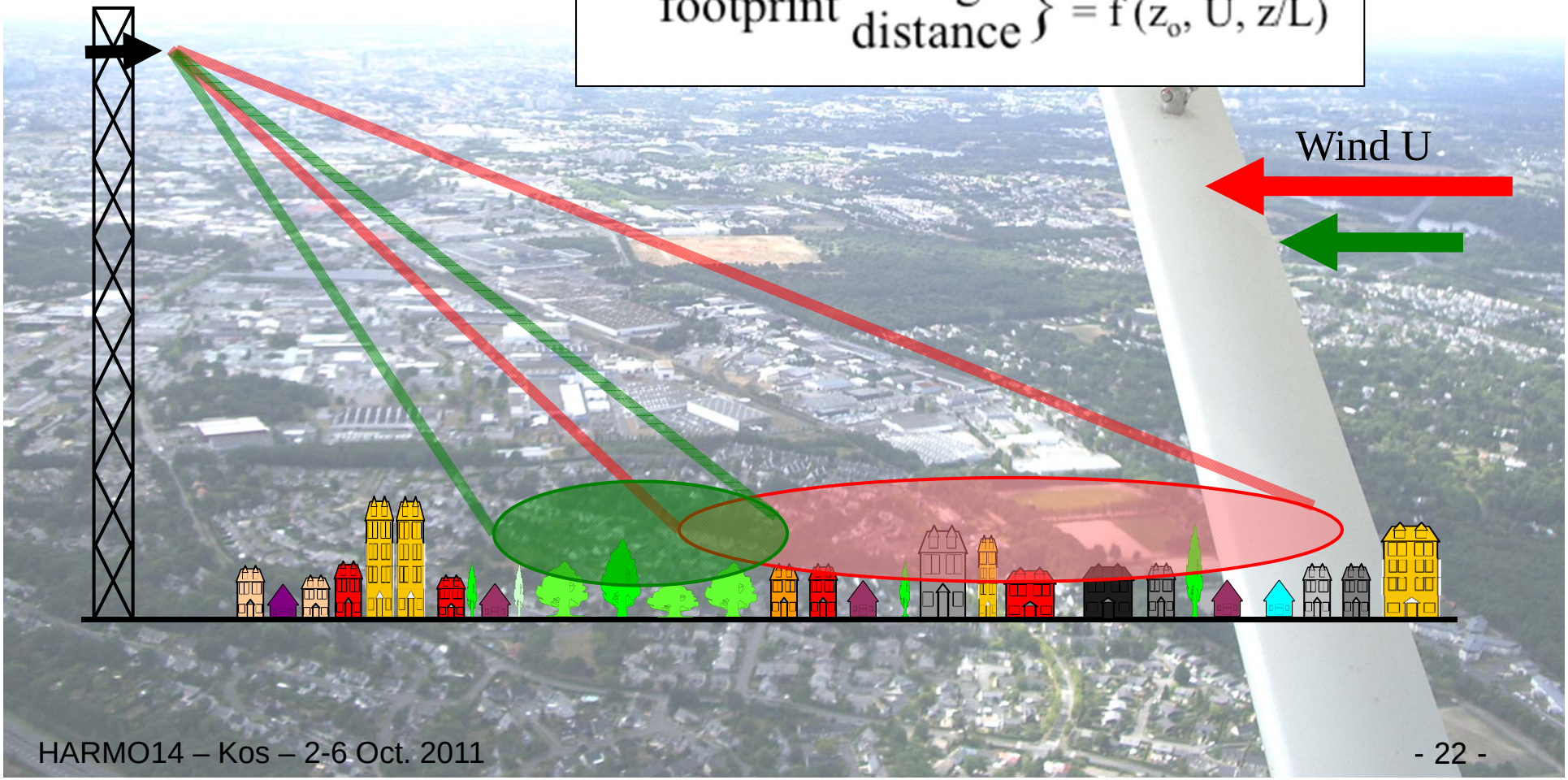
Further analysis : The footprint issue

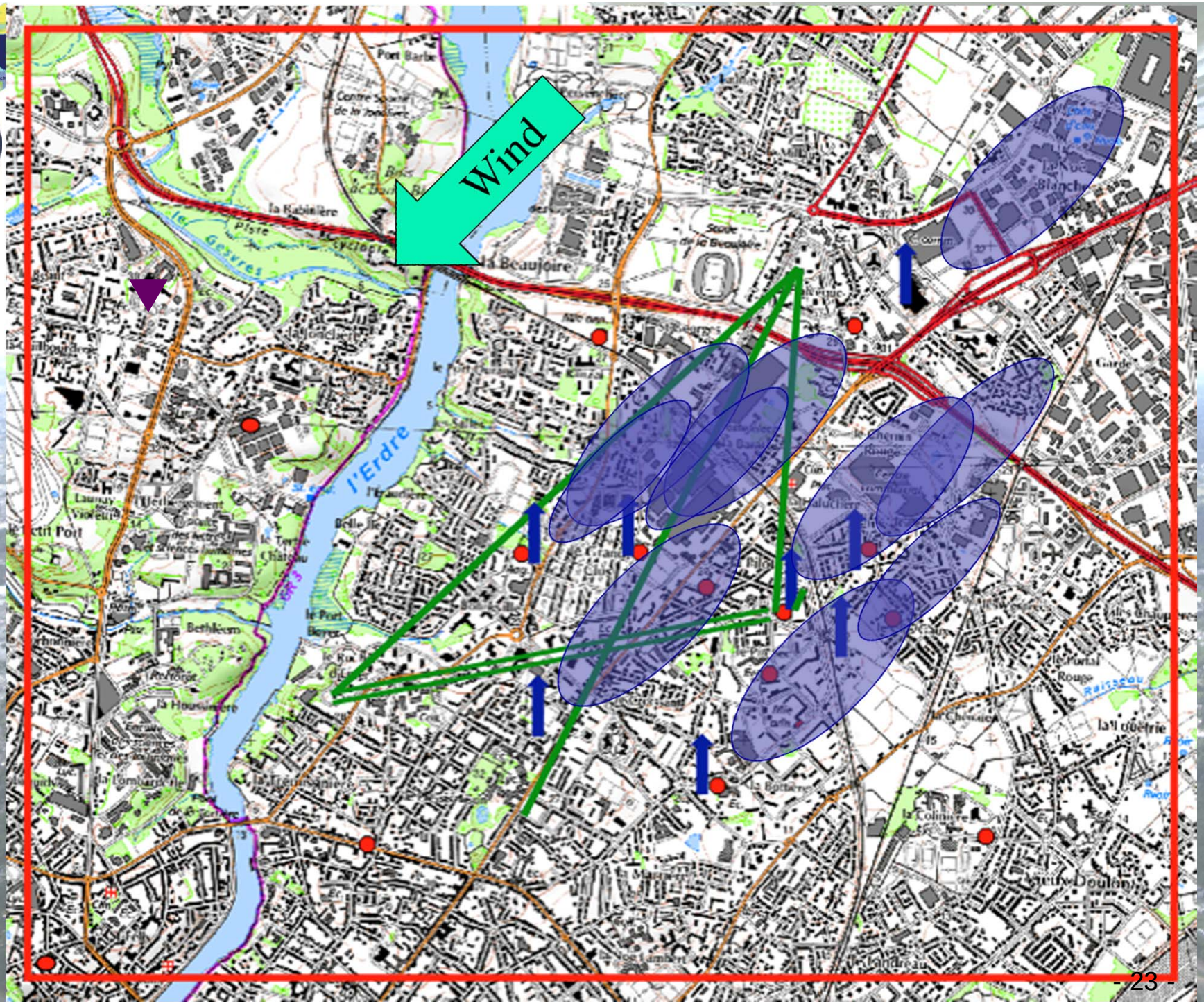


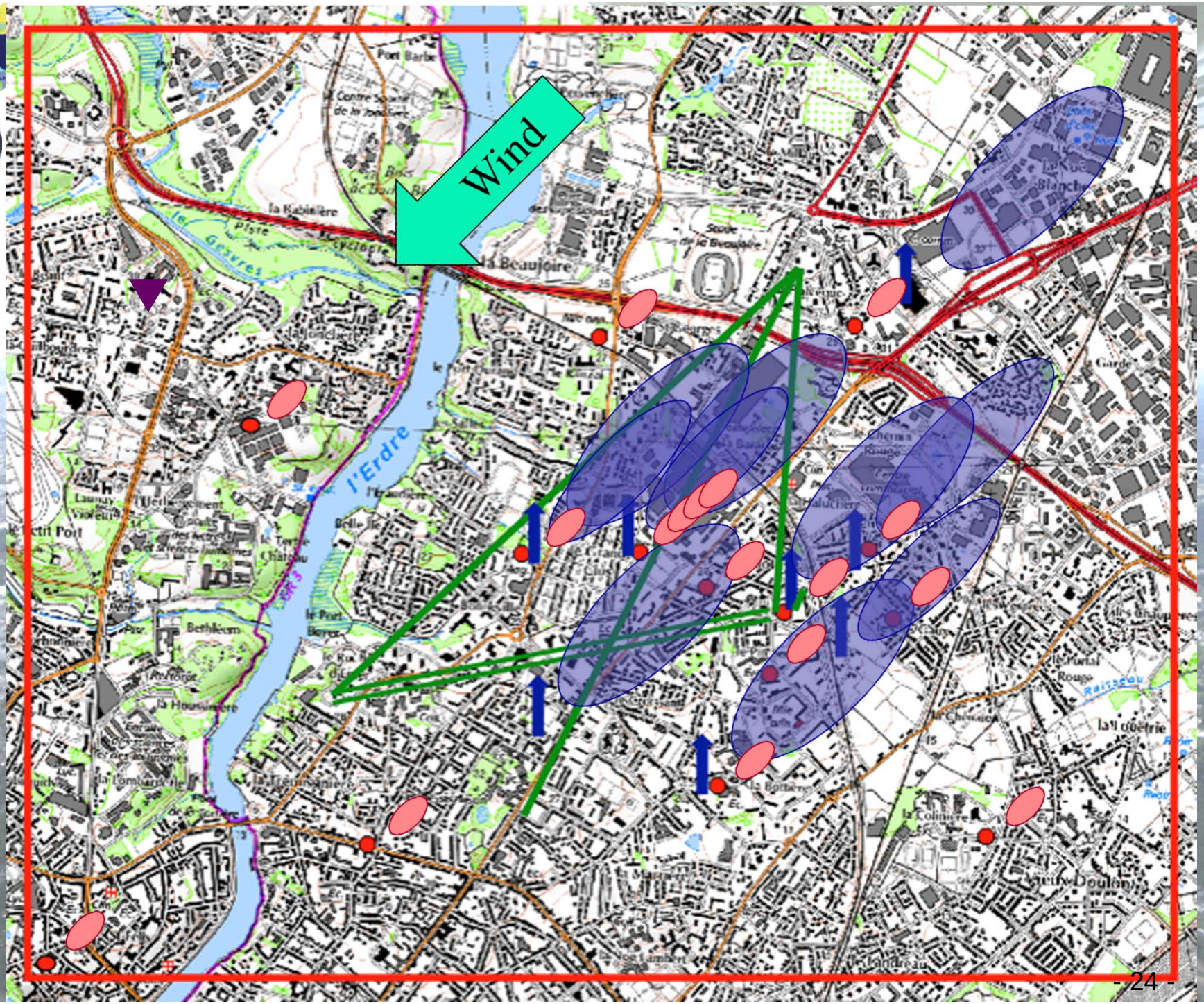
The footprint issue

turbulent flux sensor

$$\text{footprint} \begin{Bmatrix} \text{length} \\ \text{distance} \end{Bmatrix} = f(z_o, U, z/L)$$




Wind
l'Erdre
la Rabinière
la Beaujoire
le Petit Port
Bethléem
la Houssinière
la Colinière


Wind
l'Erdre
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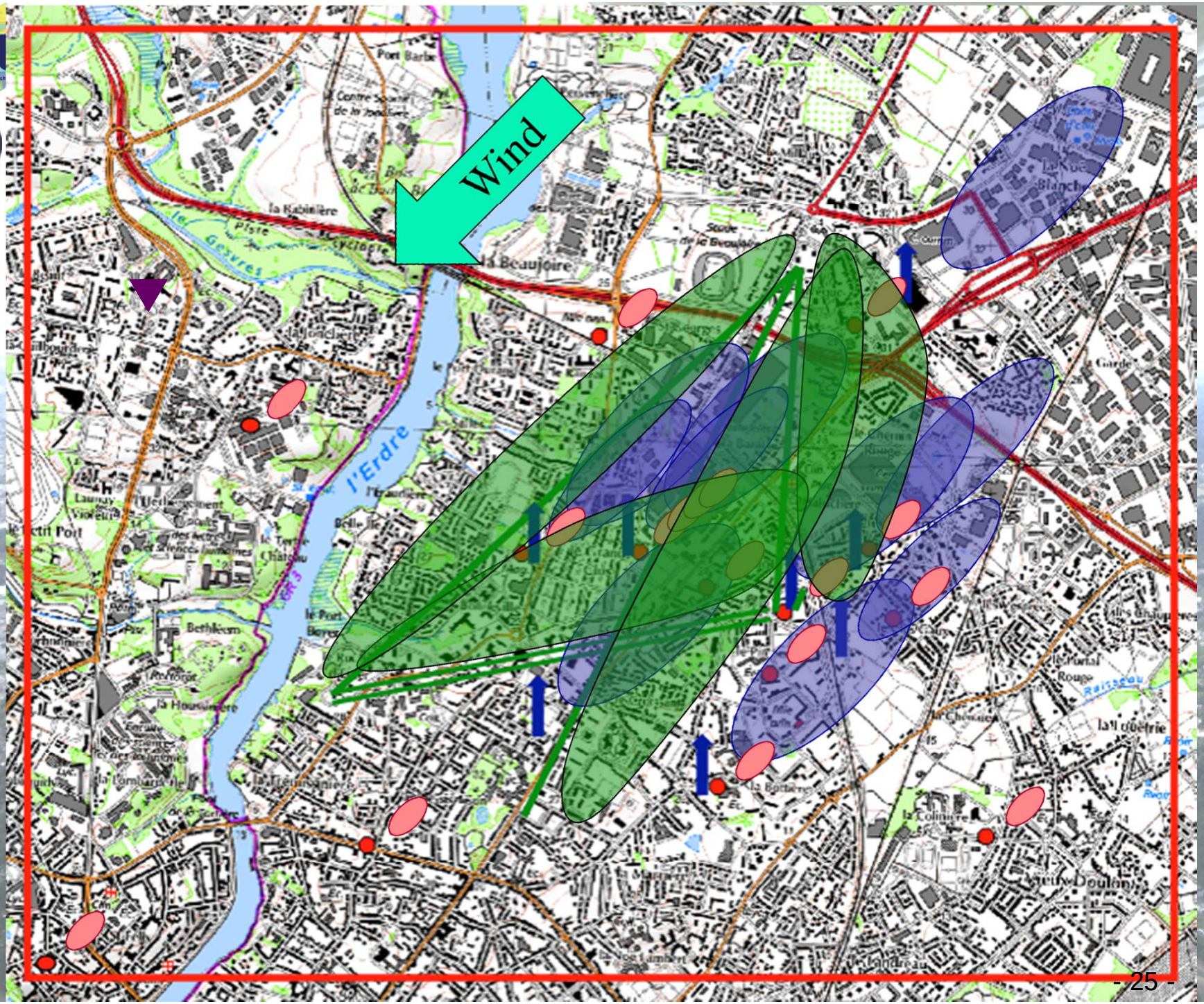
la Colinière


Wind
l'Erdre
la Beaujoire
la Rabinière
le Petit Port
Bethléem
la Colinière

Preparation for second campaign, May-June 2012

- Look for more differences between footprint land cover modes.
- Look for more differentiated LAS paths (mineral, vegetal, mixed).
- Look for more EC masts over vegetated eco-districts.
- Look for more H_2O turbulent sensors (Li-Cor).
- Look for building influence on vegetation.
- Monitor water table in the ground (soil moisture profile)
- Measure PTUV profile (0-150 m) with tethered balloon.
- Hope to have 1 or 2 water vapour scintillometers.

Thank you for your attention