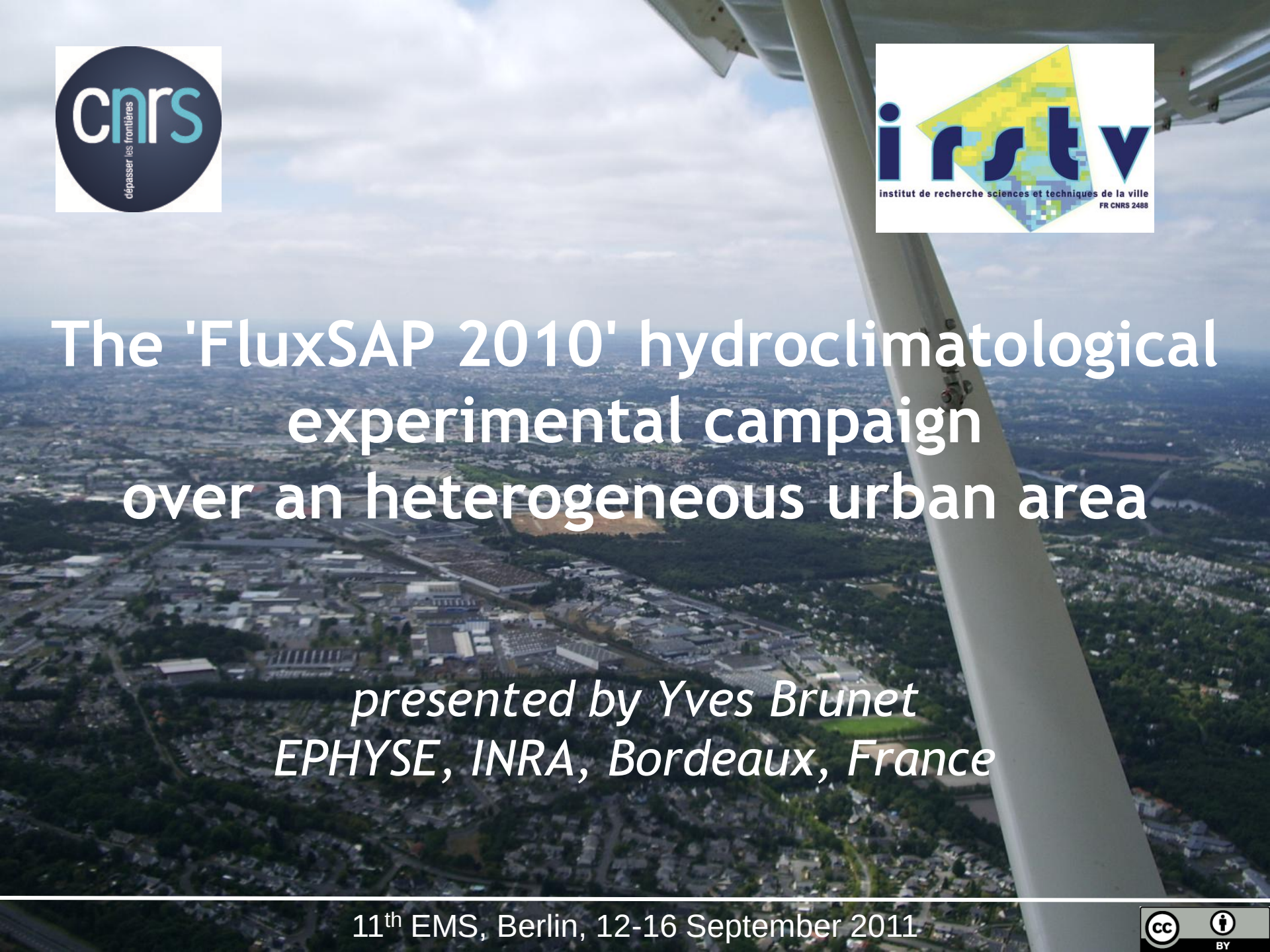

The 'FluxSAP 2010' hydroclimatological experimental campaign over an heterogeneous urban area

presented by Yves Brunet
EPHYSE, INRA, Bordeaux, France

11th EMS, Berlin, 12-16 September 2011

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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

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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 landuse heterogeneity
  - to test footprint models over an urban area

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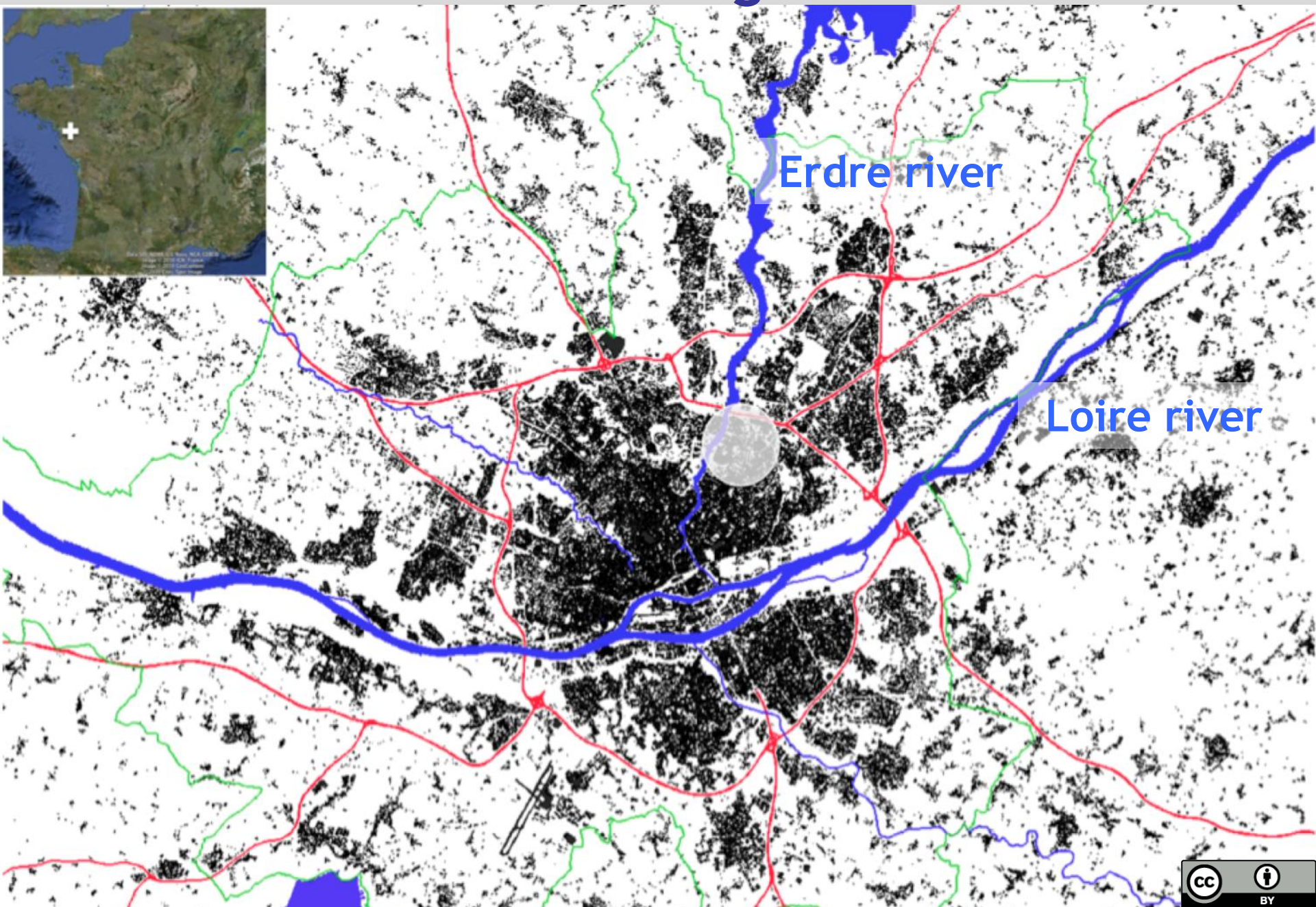
Nantes region



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'Pin Sec' measurement area

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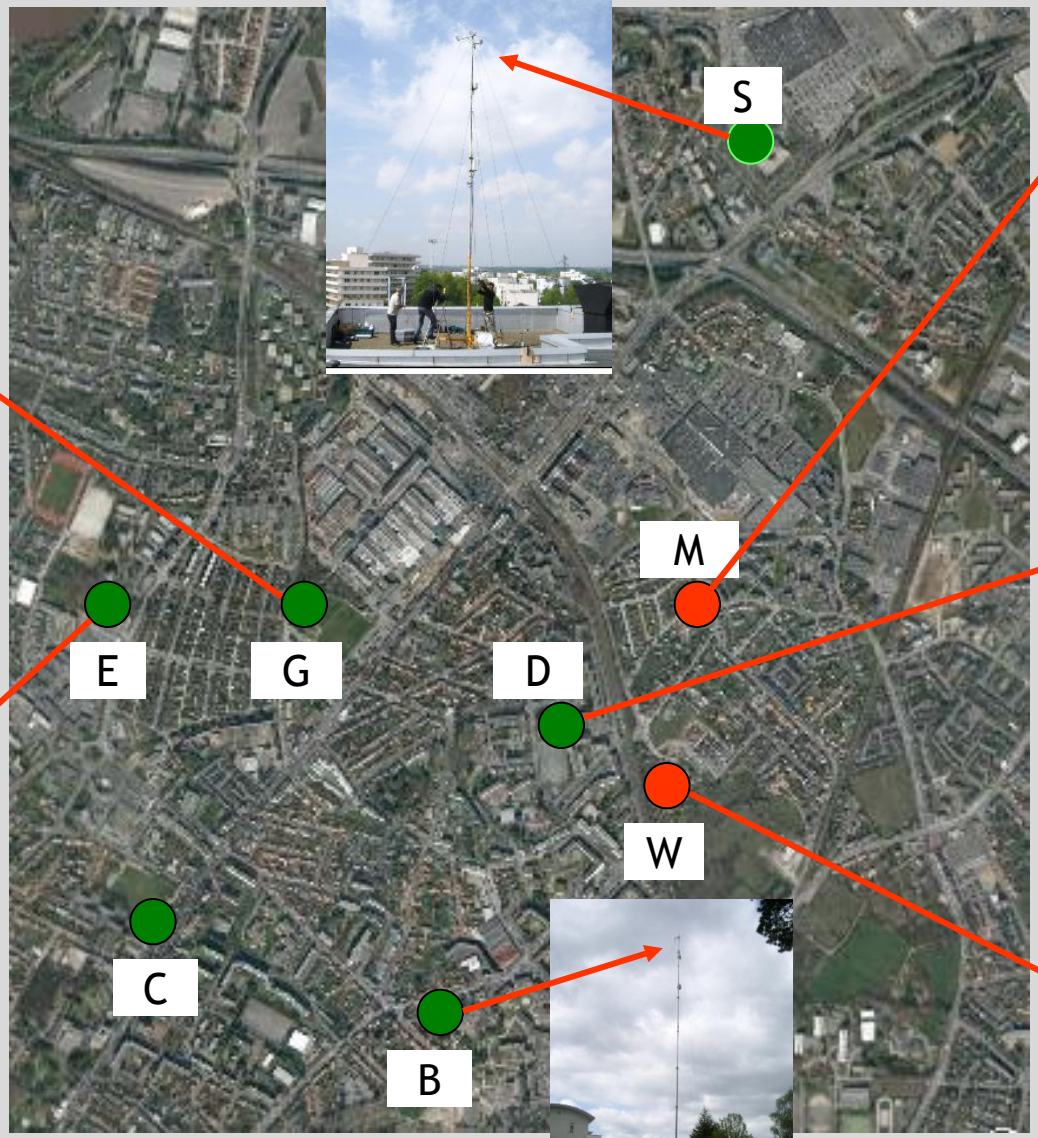
10 eddy covariance sensor systems



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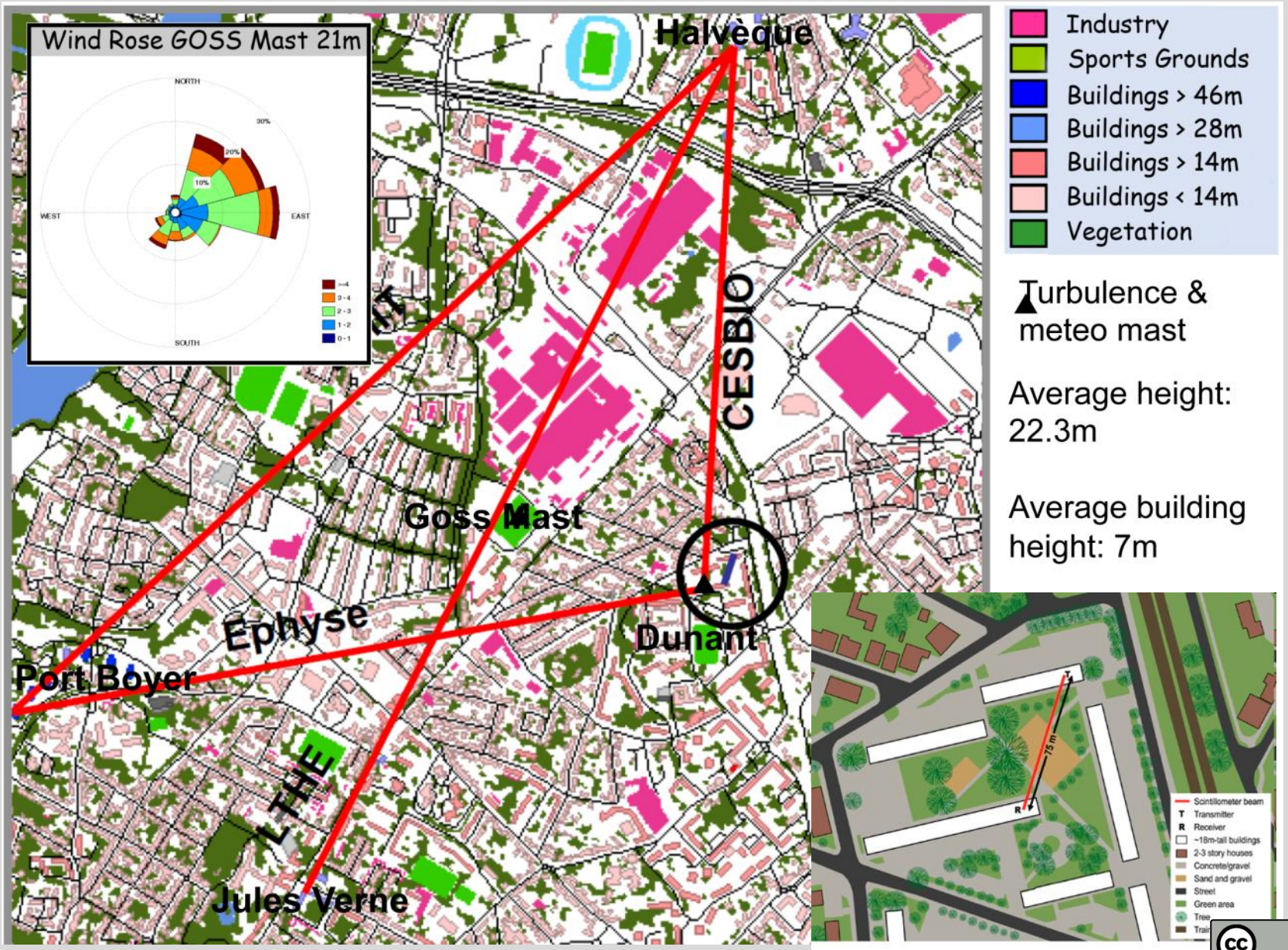
5 LAS, 1 SAS


Wind Rose GOSS Mast 21m
NORTH
EAST
SOUTH
WEST
Halvèque
CESBIO
Goss Mast
Ephyse
Port Boyer
Dunant
THE
Jules Verne
Industry
Sports Grounds
Buildings > 46m
Buildings > 28m
Buildings > 14m
Buildings < 14m
Vegetation
Turbulence & meteo mast
Average height: 22.3m
Average building height: 7m
75 m
Scintillometer beam
Transmitter
Receiver
~18m-tall buildings
2-3 story houses
Concrete/gravel
Sand and gravel
Street
Green area
Tree

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14 T-RH sensors at z = 2-3 m

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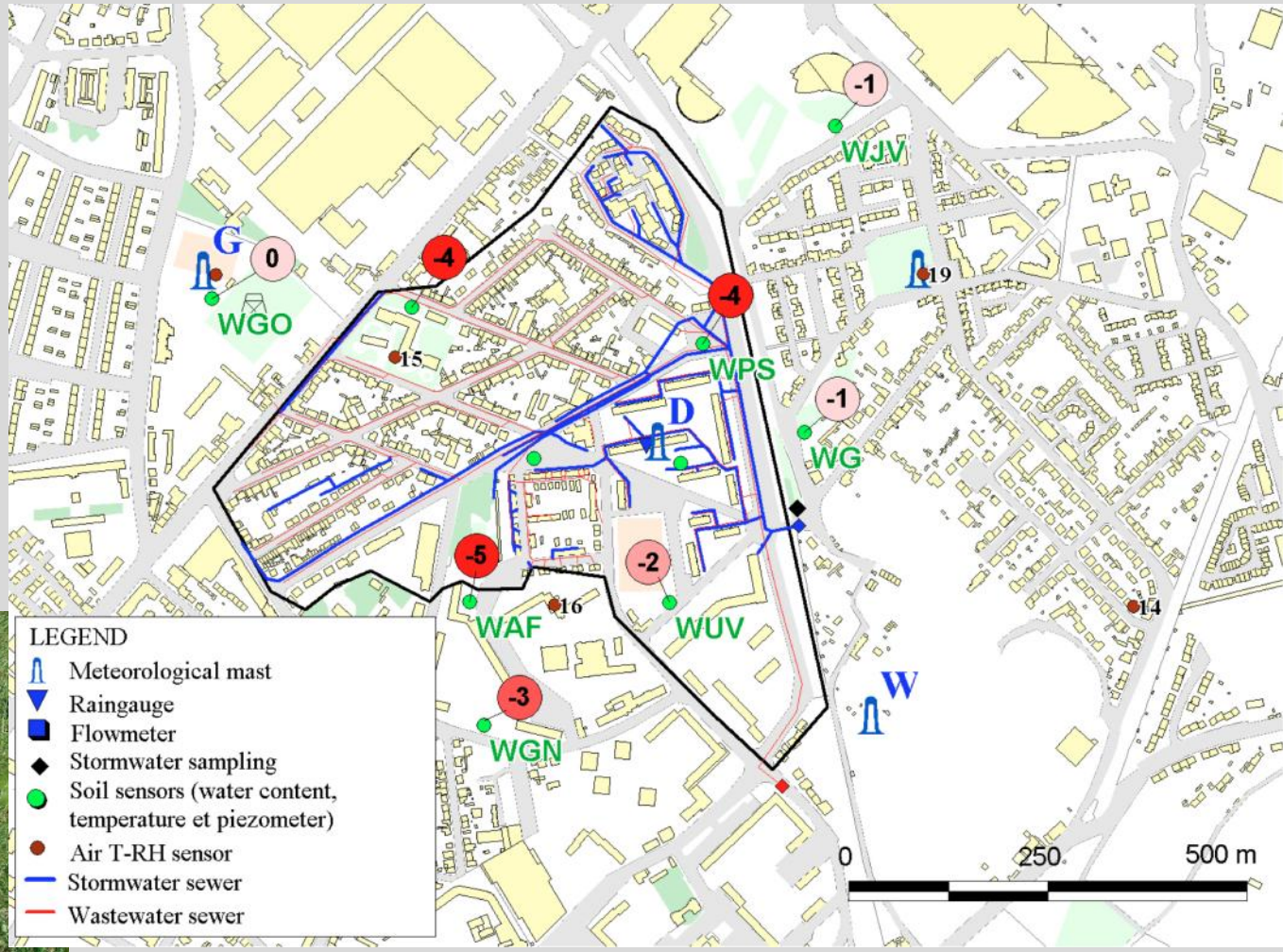
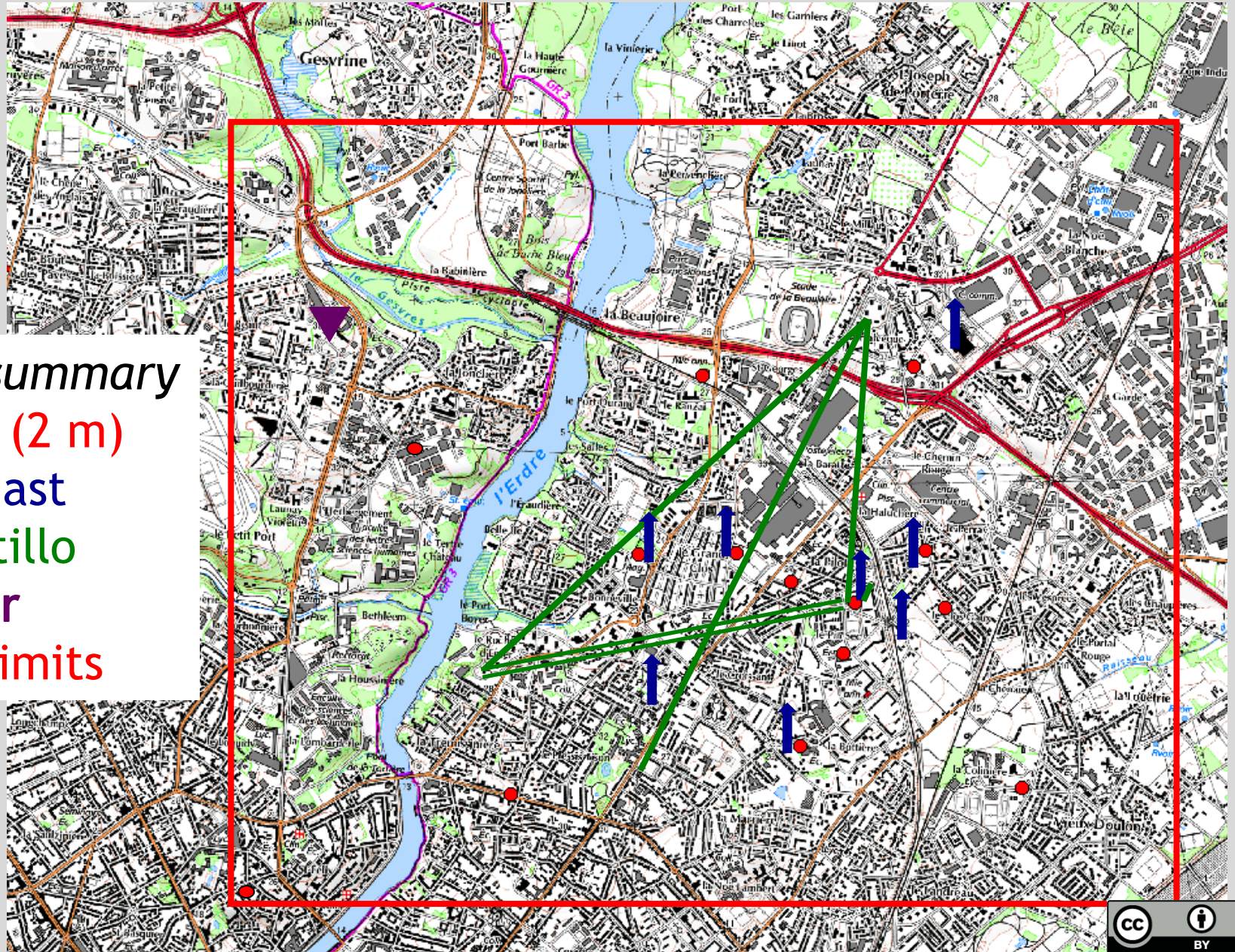
10 piezometers, 8 T-θ profiles

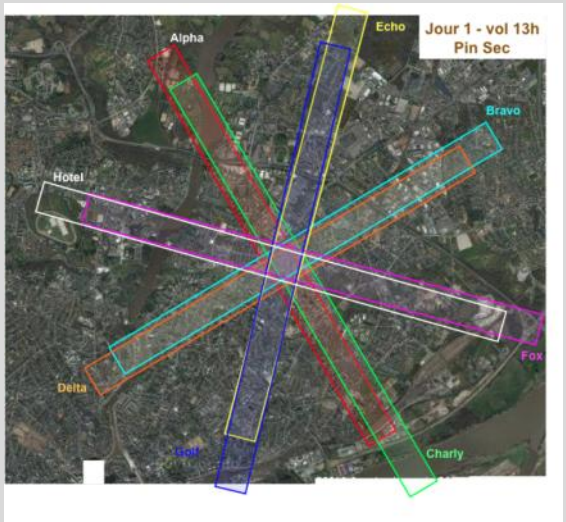


Ground-based measurements


Set-up summary
T-RH (2 m)
EC mast
Scintillo
Sodar
GIS limits
Gesvrine
la Babinière
la Beaujoire
l'Erdre
le Port Boyer
Bethléem
la Haussinière
la Tremblaie
la Bottière
la Colinière
la Noë Lambert
le Landreau
le Portal
la Haluchère
le Chemin Rouge
la Garde
la Blanche
la Vinetterie
Port Barbe
le Port Durand
le Rocher
le Grand Clos
la Bouteillerie
la Maurière
la Gaudrière
le Petit Port
le Terrier Château
Parc des Expositions
Stade de la Beaujoire
Bois de Bache Bleu
Piste cyclable
la Haute Gournière
les Garniers
le Tillot
le Four
la Petite Gaudrière
le Chêne des Anglais
les Malles
les Tavers
la Fonclière
la Périvinelière
Ae Bele
Ecole des sciences humaines
Ecole des sciences de la nature
Ecole des sciences économiques
Ecole des sciences et des techniques
Ecole des sciences juridiques
Ecole des sciences et des techniques
Ecole des sciences économiques
Ecole des sciences humaines
Ecole des sciences de la nature

TIR measurements

Airborne (13 flights) and handheld (140 refs) TIR



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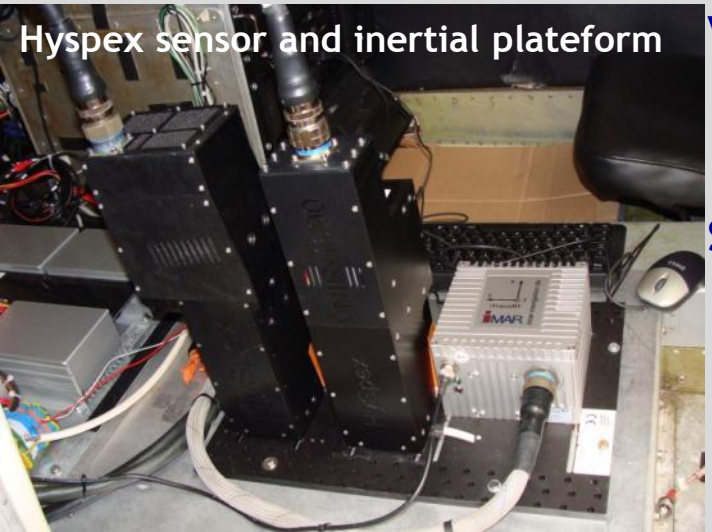
Hyperspectral airborne measurements

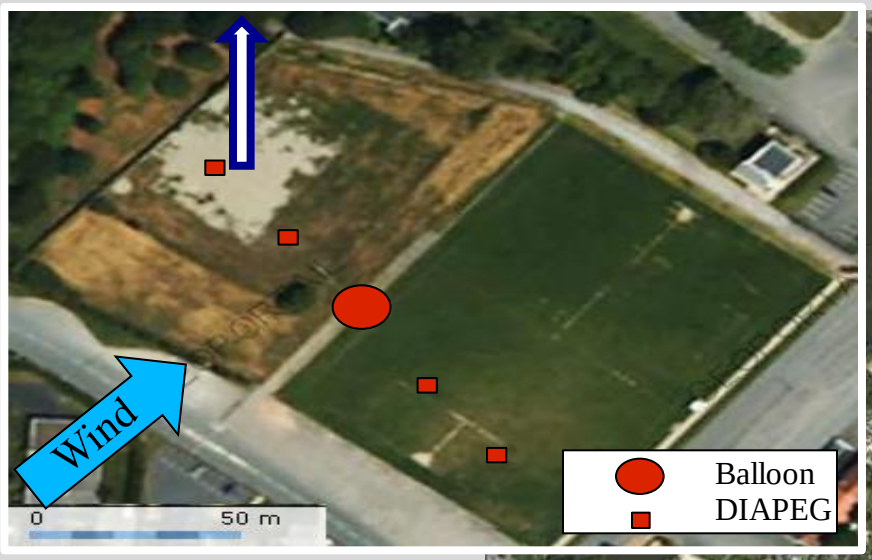


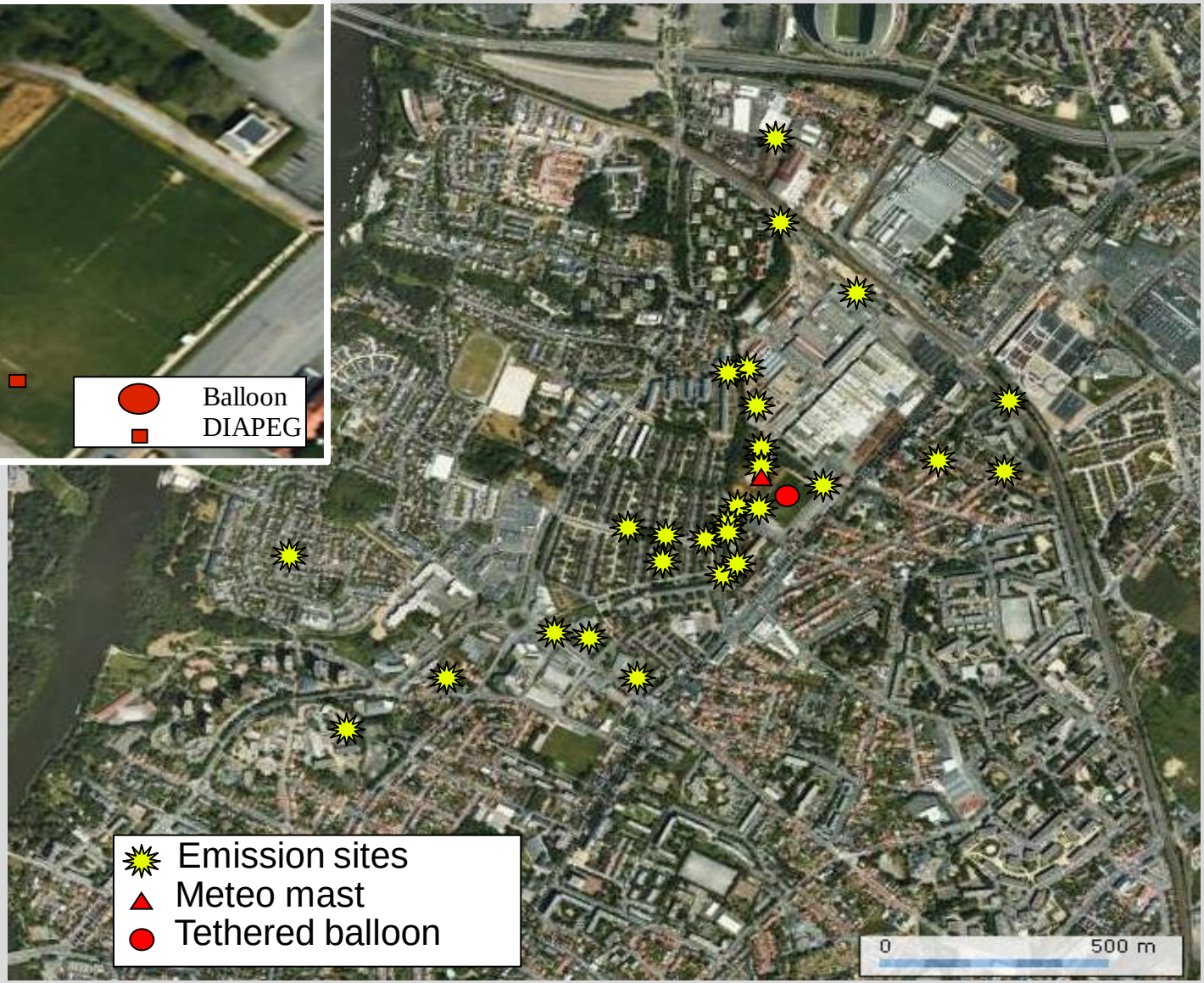
VNIR (400-1000 nm)
160 bands (4 nm)
0.6 m resolution

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

95 ground measts portable spectrometer

30 passive tracer dispersion experiments





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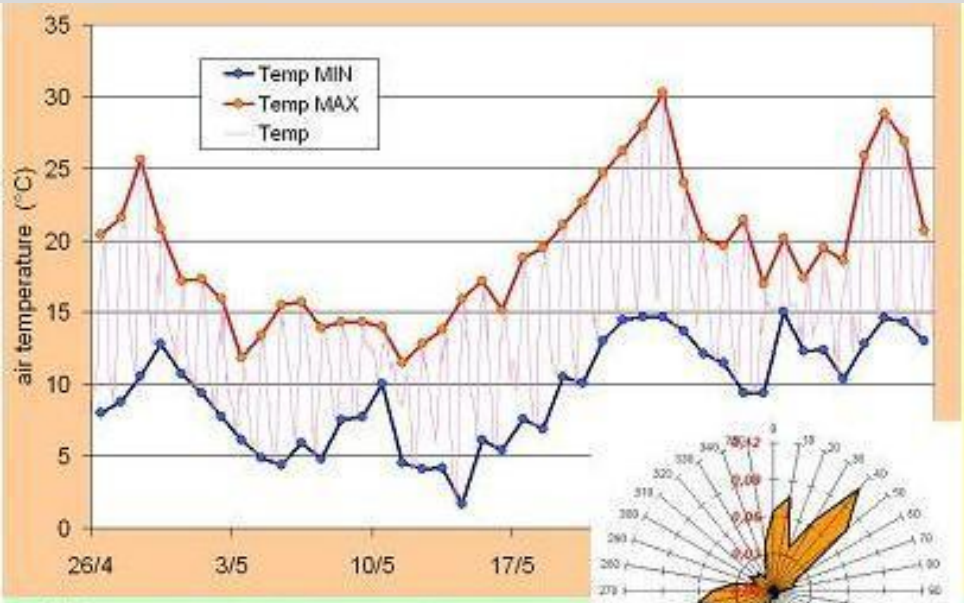
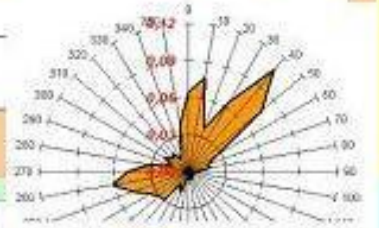
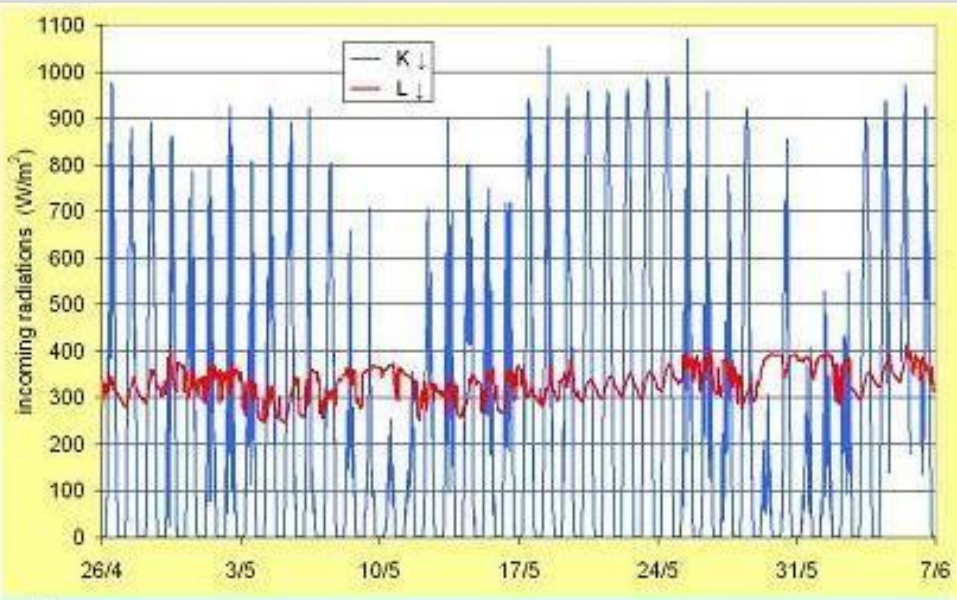
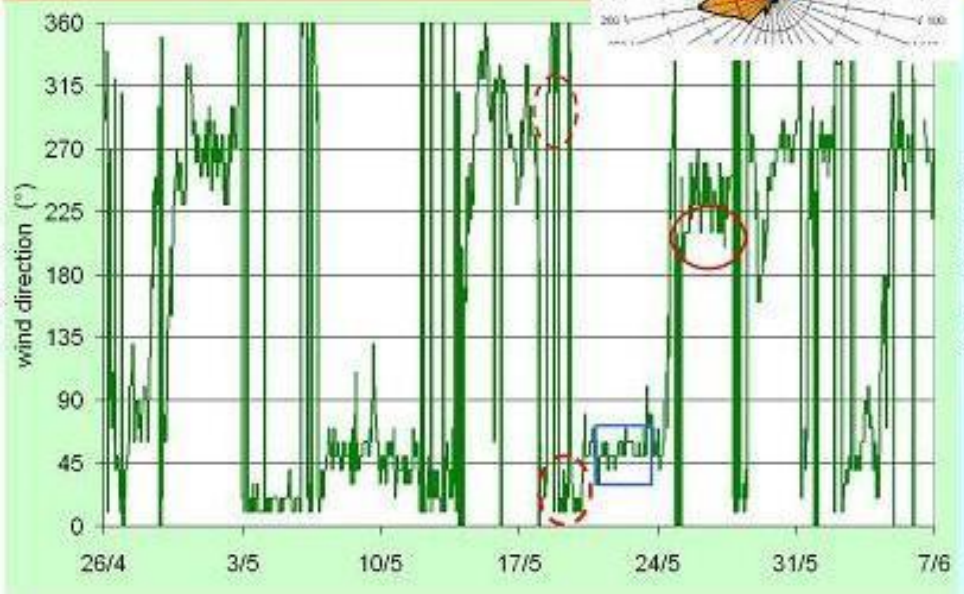
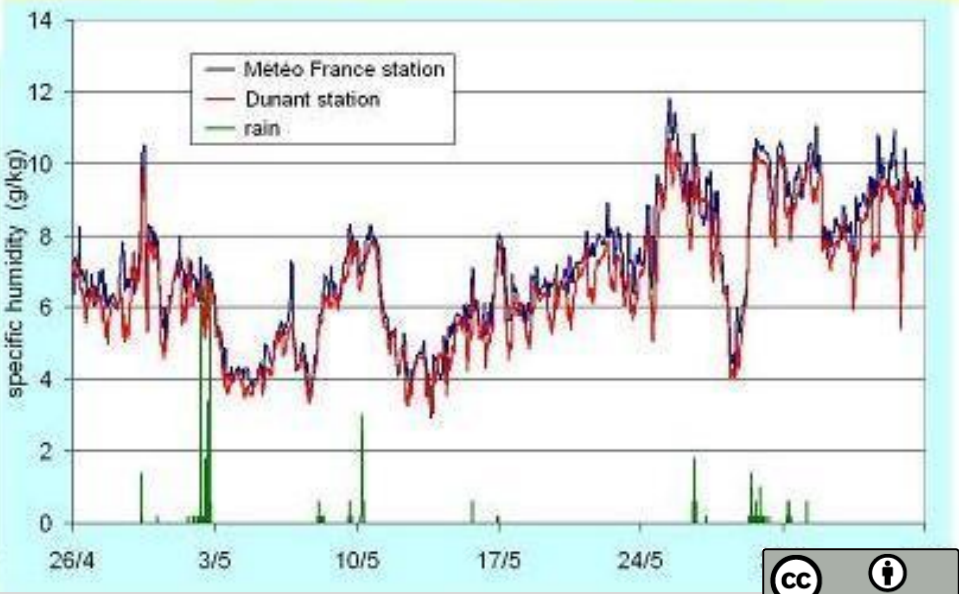
The meteorology (26 April - 7 june)











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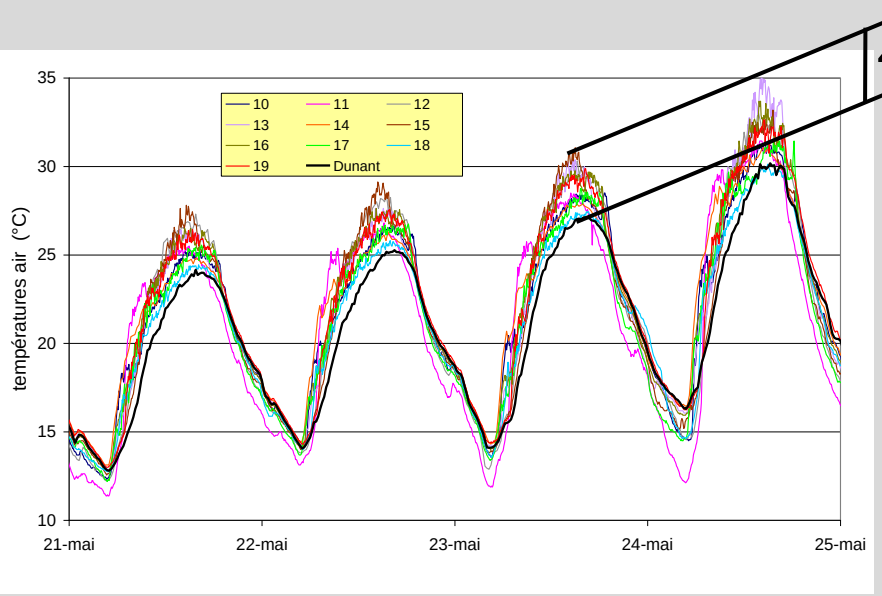
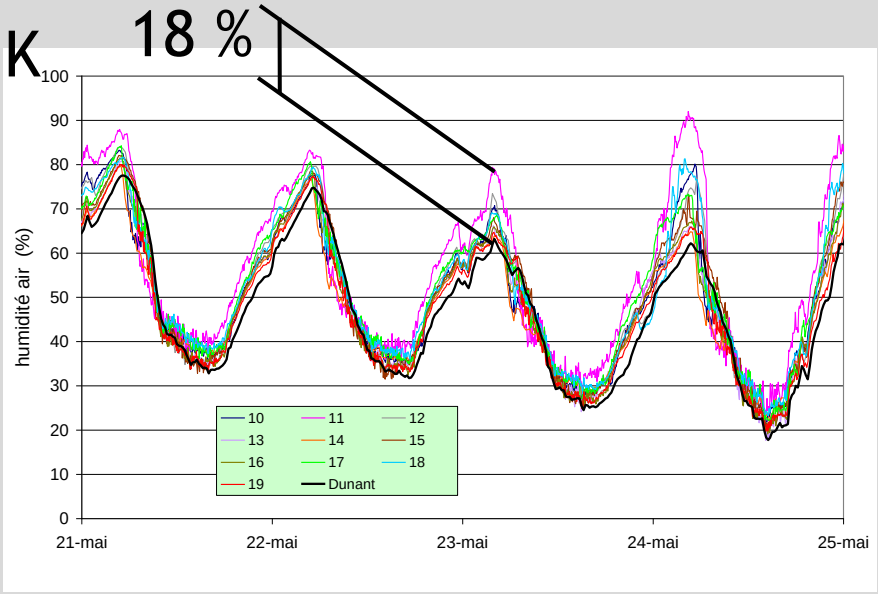
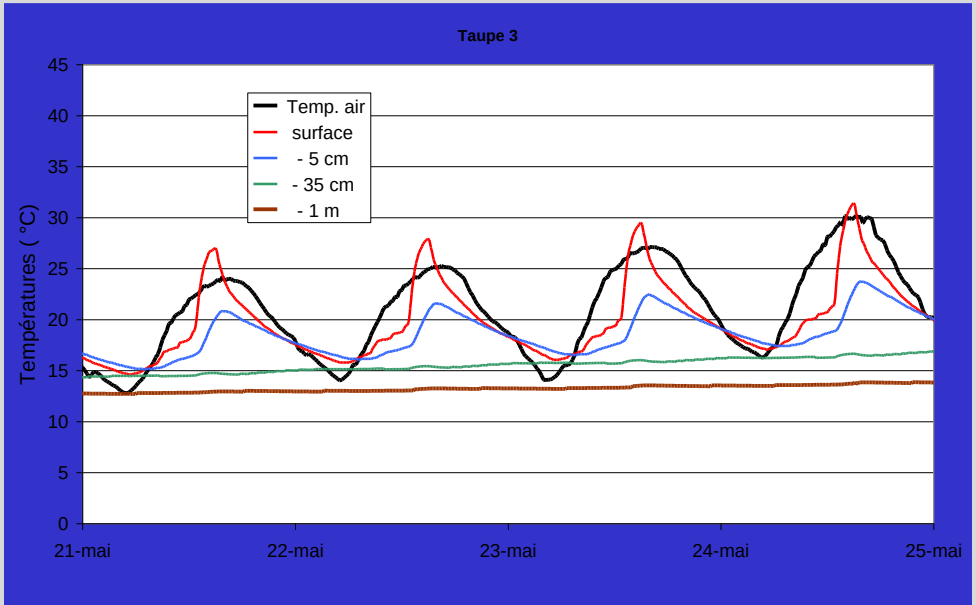
Temperature and humidity gradients from T-RH and surface sensors







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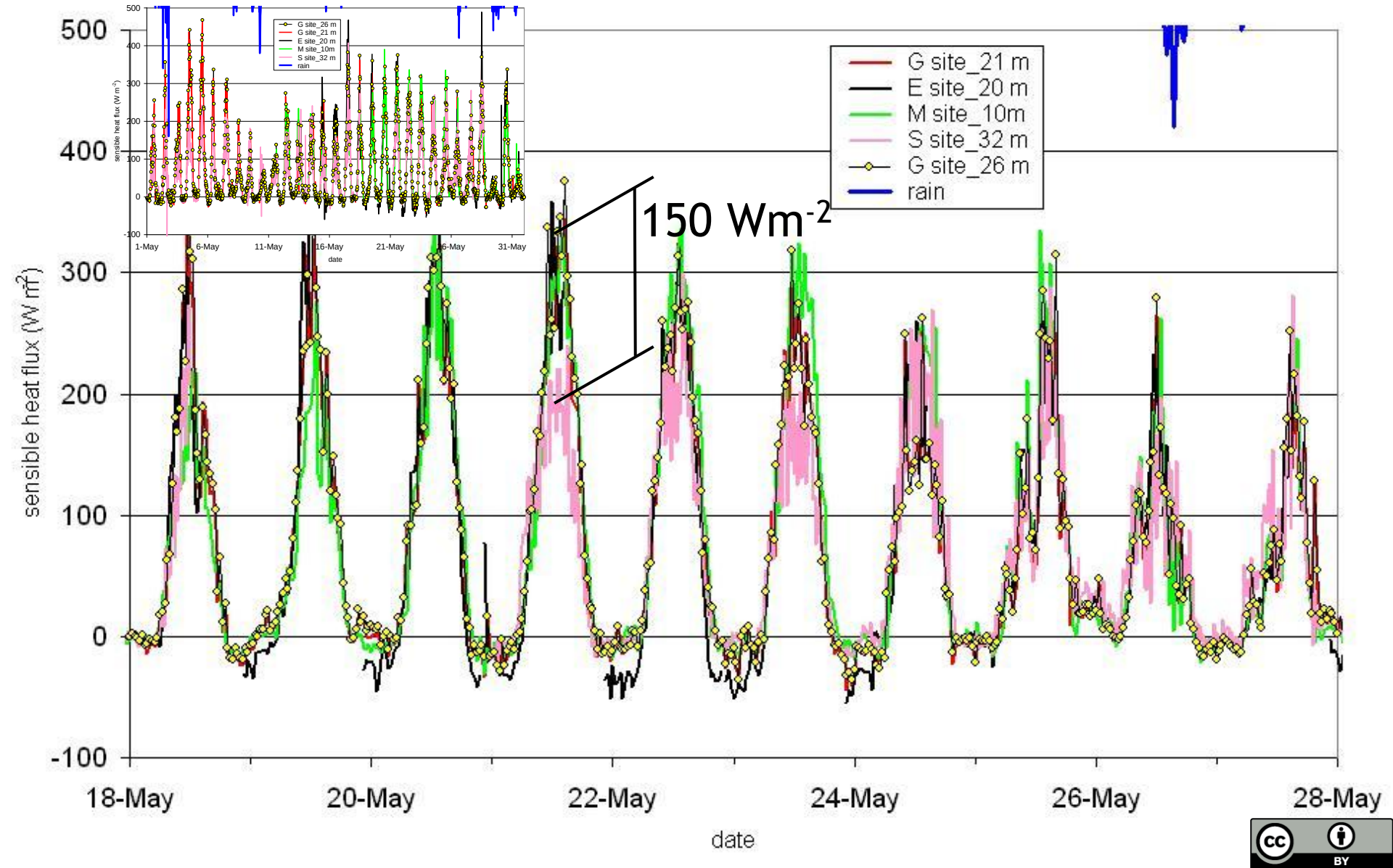
Heat flux measurements with EC turbulent sensors



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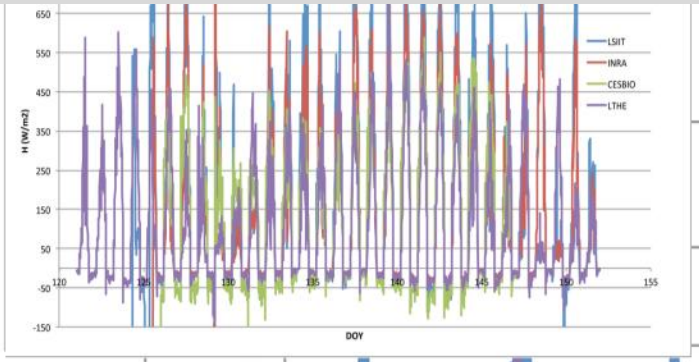
Heat flux measurements with LAS scintillometers



Sensible Heat Flux during FluxSAP 2010

300 Wm^{-2}

LSIIT
INRA
CESBIO
LTHE

H (W/m2)

650
550
450
350
250
150
50
-50

138 139 140 141 142 143 144 145 146

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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)**

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

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

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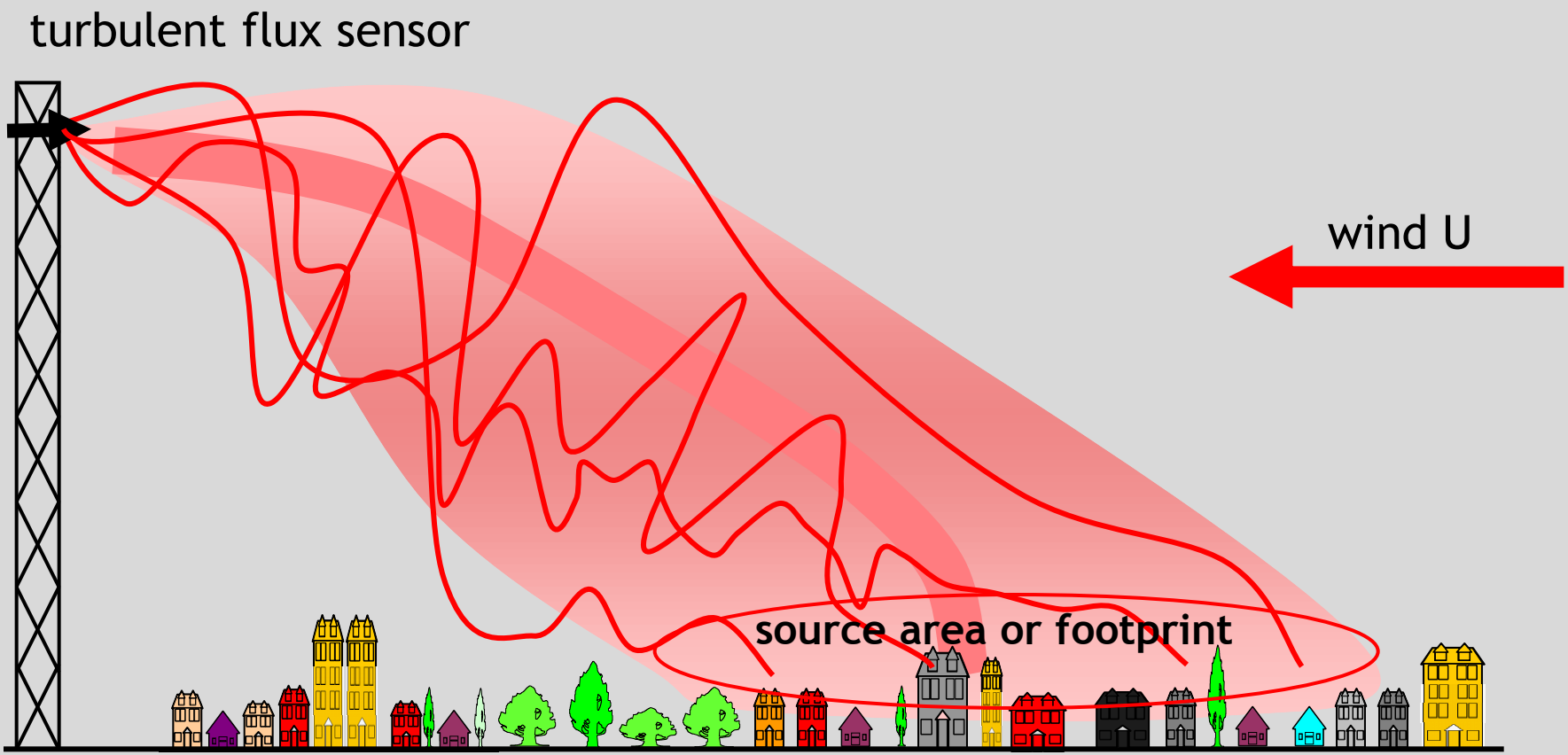
Further analysis : the footprint issue



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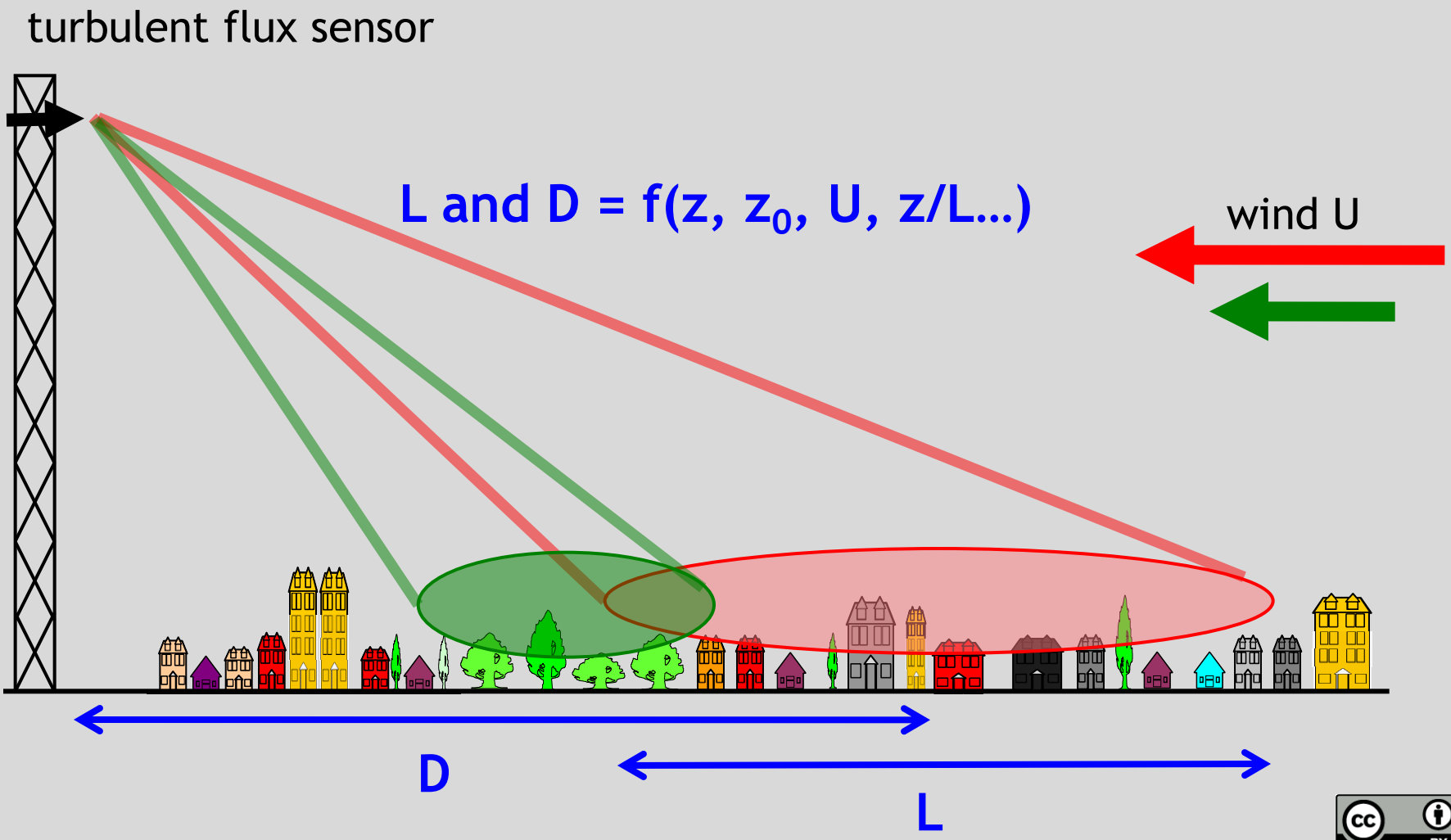
Further analysis : the footprint issue



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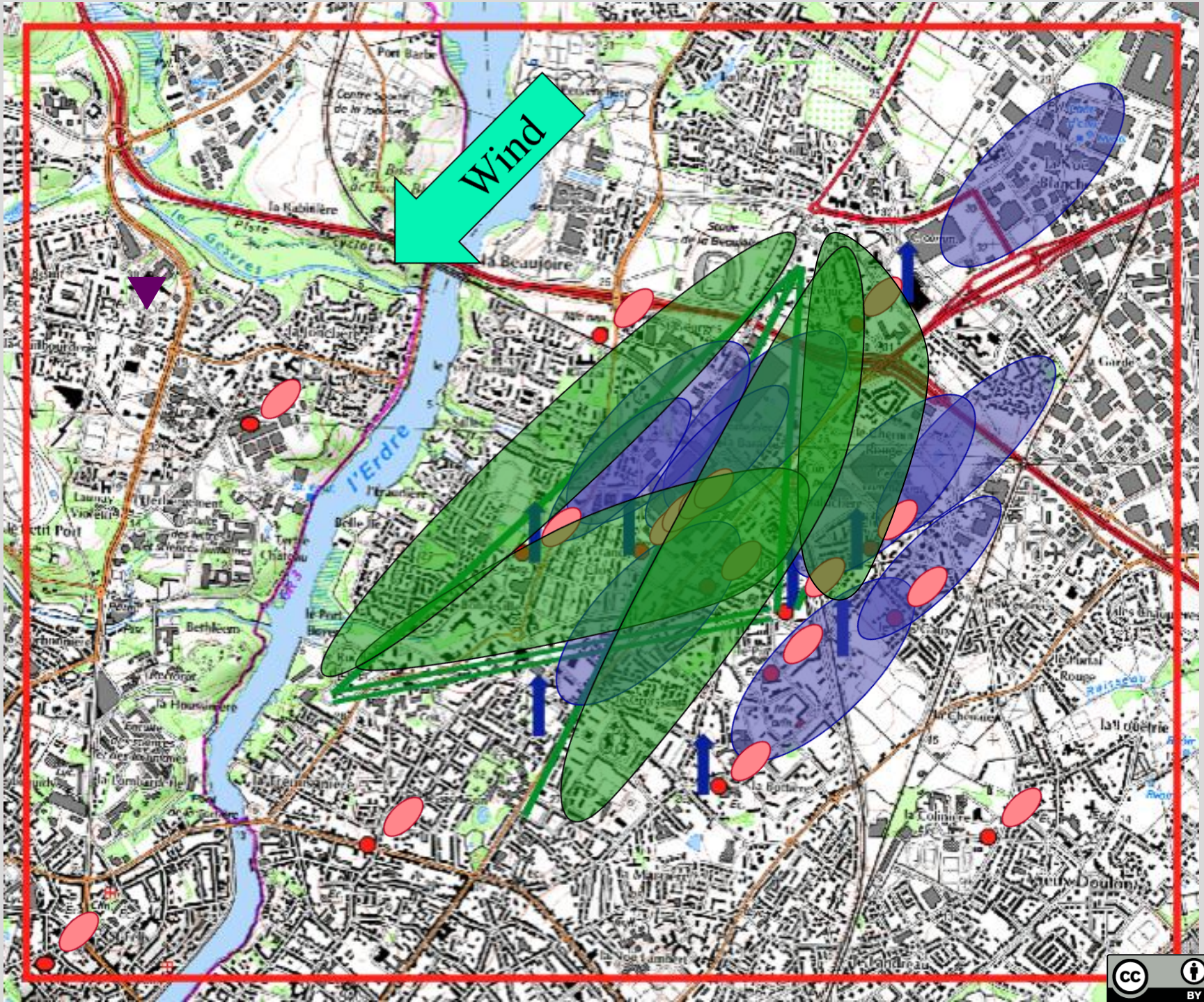
Wind
la Beaujoire
l'Erdre
la Rabinière
Port Barbe
Bethléem
la Housinière
la Colinière
la Louetrie
Vieux Doulon

Preparation for May-June 2012 campaign

- More variable land cover within footprint
- More EC masts over vegetated urban areas
- More H_2O 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)

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Thank you