FluxSAP 2010 experimental campaign over an heterogeneous urban zone
Part 2: quantification of plume vertical dispersion during a gas tracer experiment using a mast and a small tethered balloon

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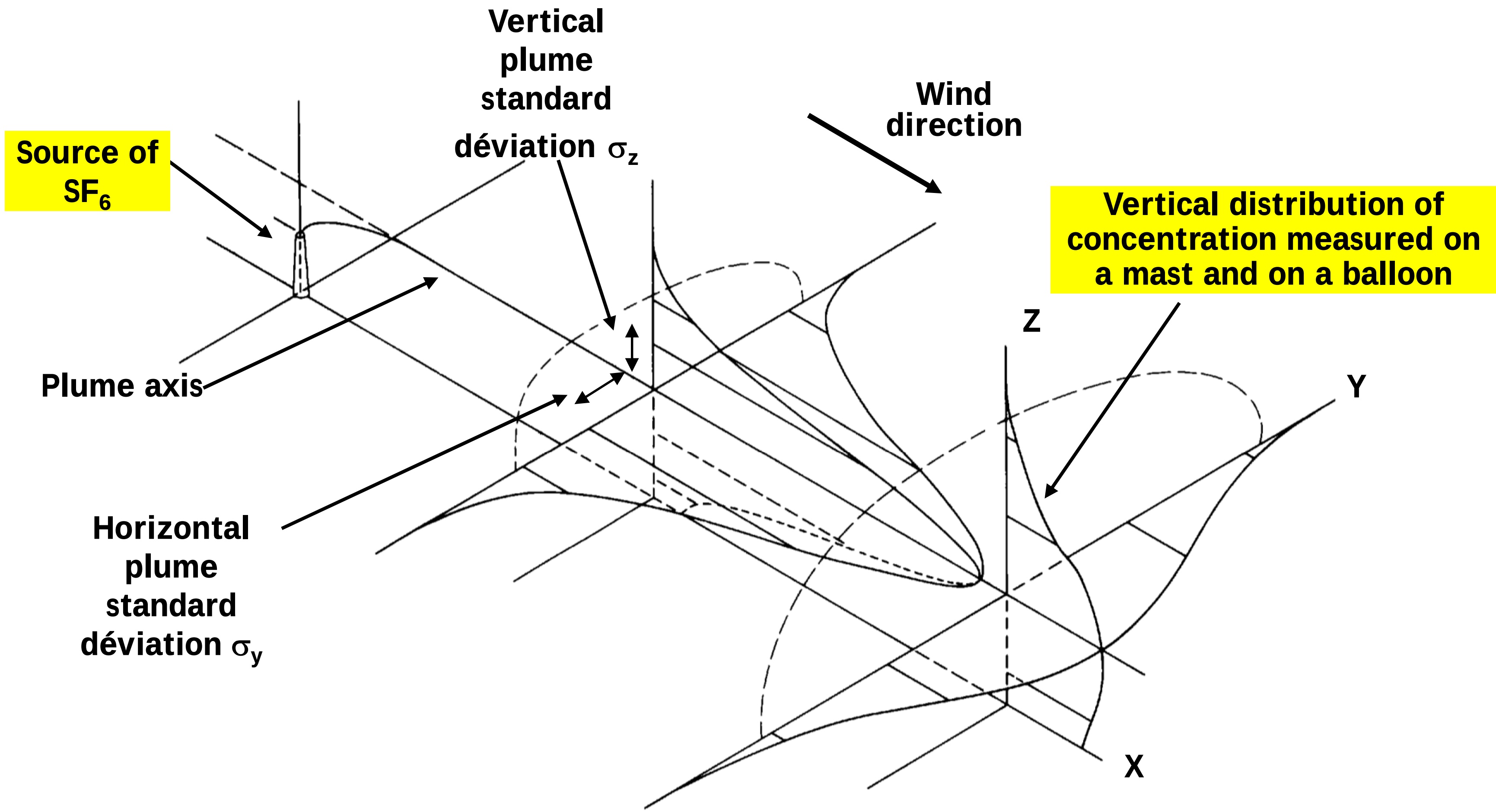
¤ Context & Objectives

- **Need of experimental campaign due to a lack of available field data on vertical plume dispersion in urban environment.**

  - The first objective of this experiment is to better understand and quantify the vertical dispersion of the plume in an urban area as a function of the atmospheric turbulence.
  - The second objective is to assess atmospheric dispersion models and footprint models in urban area.

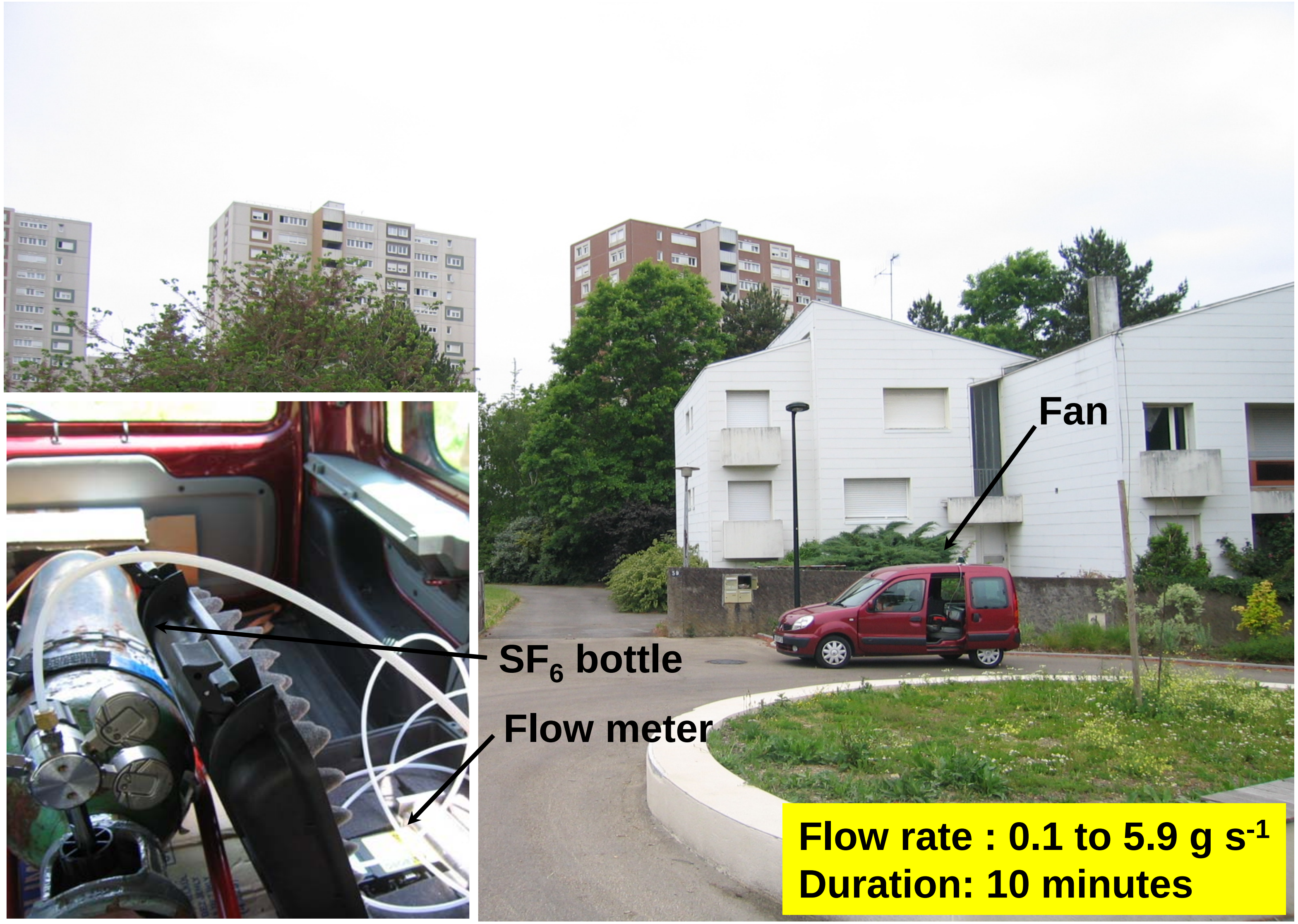
- **Here we report the original methodology used and an intercomparison with three Gaussian models, two from the first generation (Briggs-urban; Doury) and one from the second generation, ADMS 4.0.**

⌑ Methodology : experimental setup

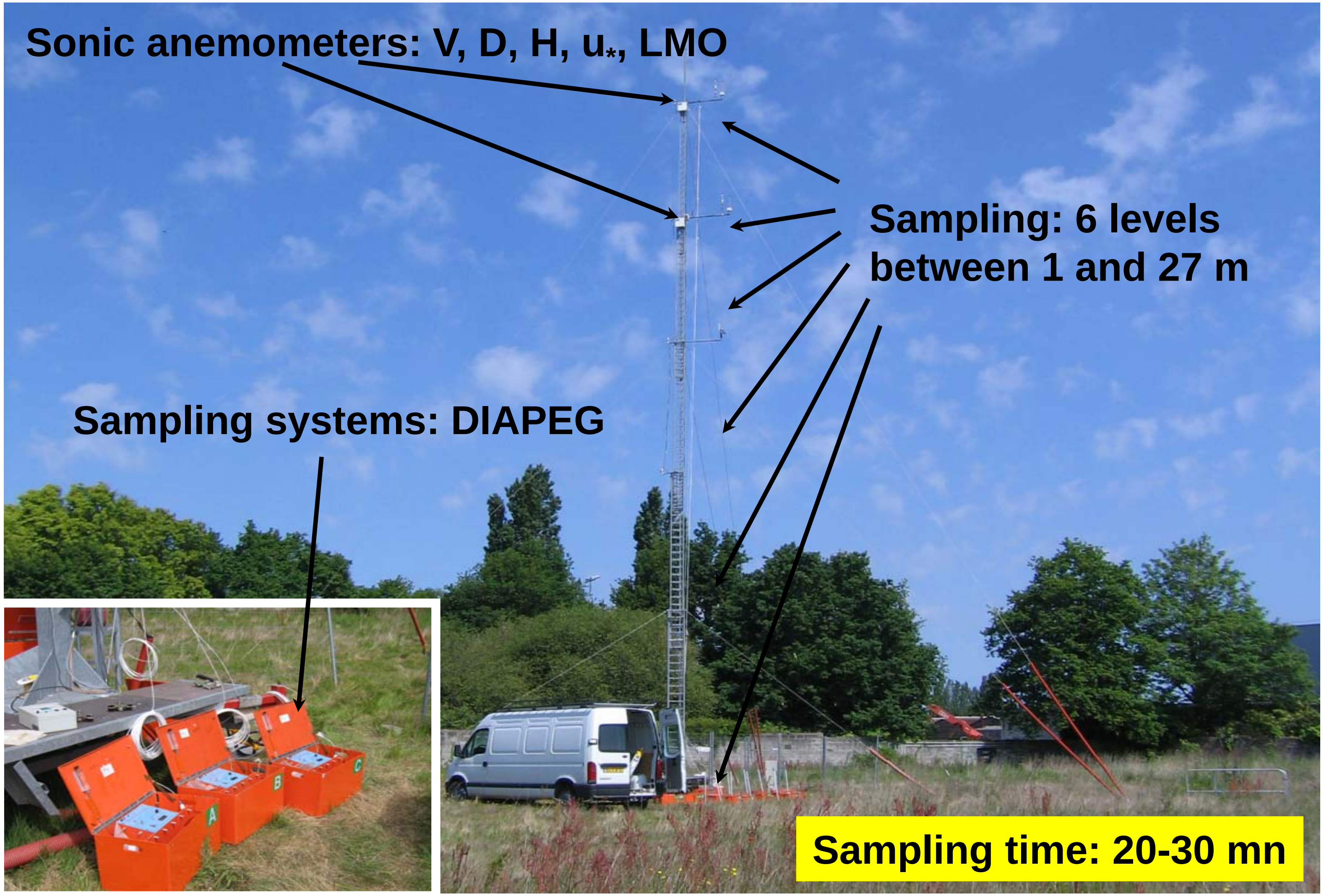


- Field tracer experiments using SF_6: 30 emissions and measurements between May 18 and 27, 2010, in the city of Nantes.
- Distance from the source to the sampling systems: 20 to 1150 m.

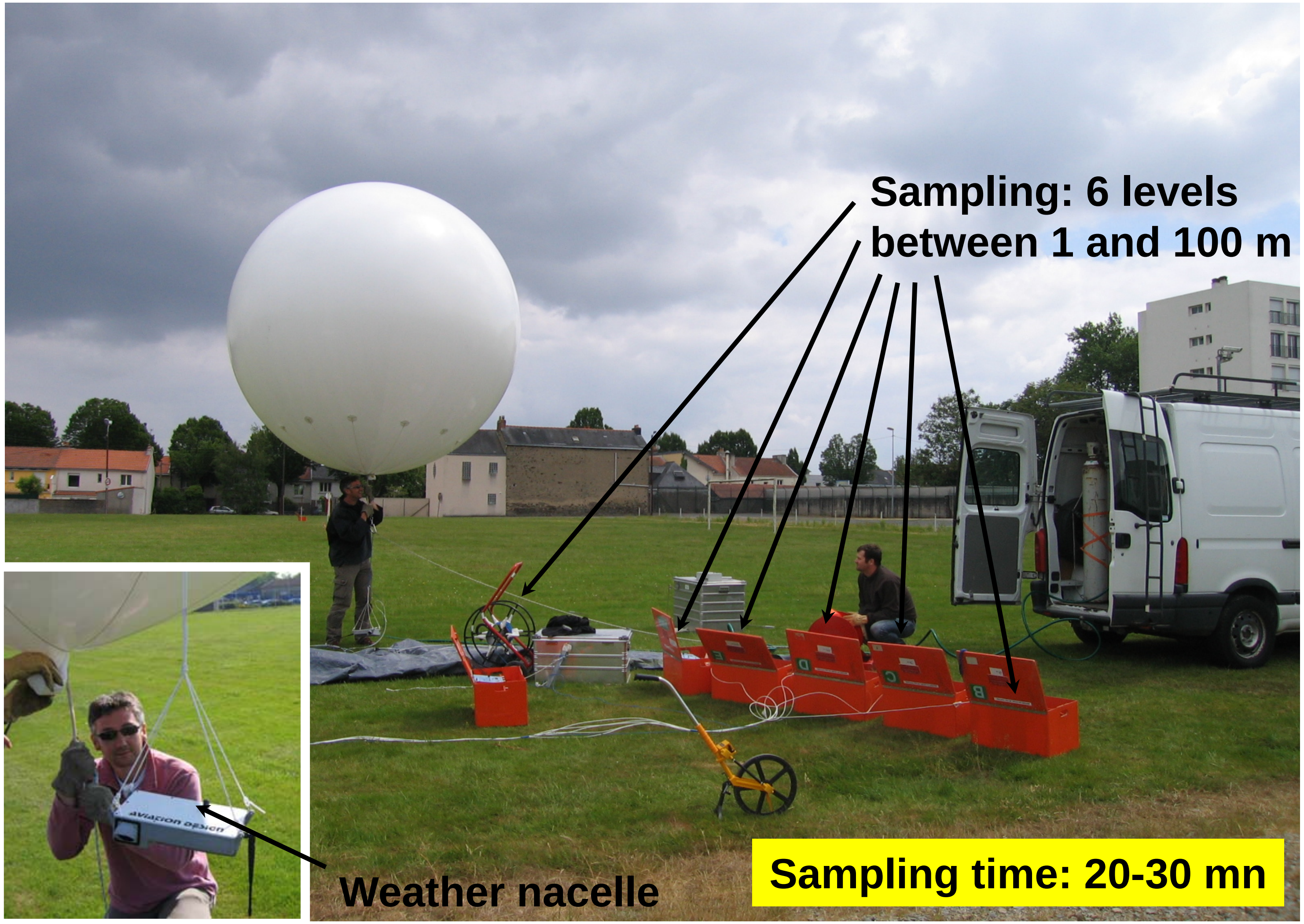
¤ Methodology : source of SF_6



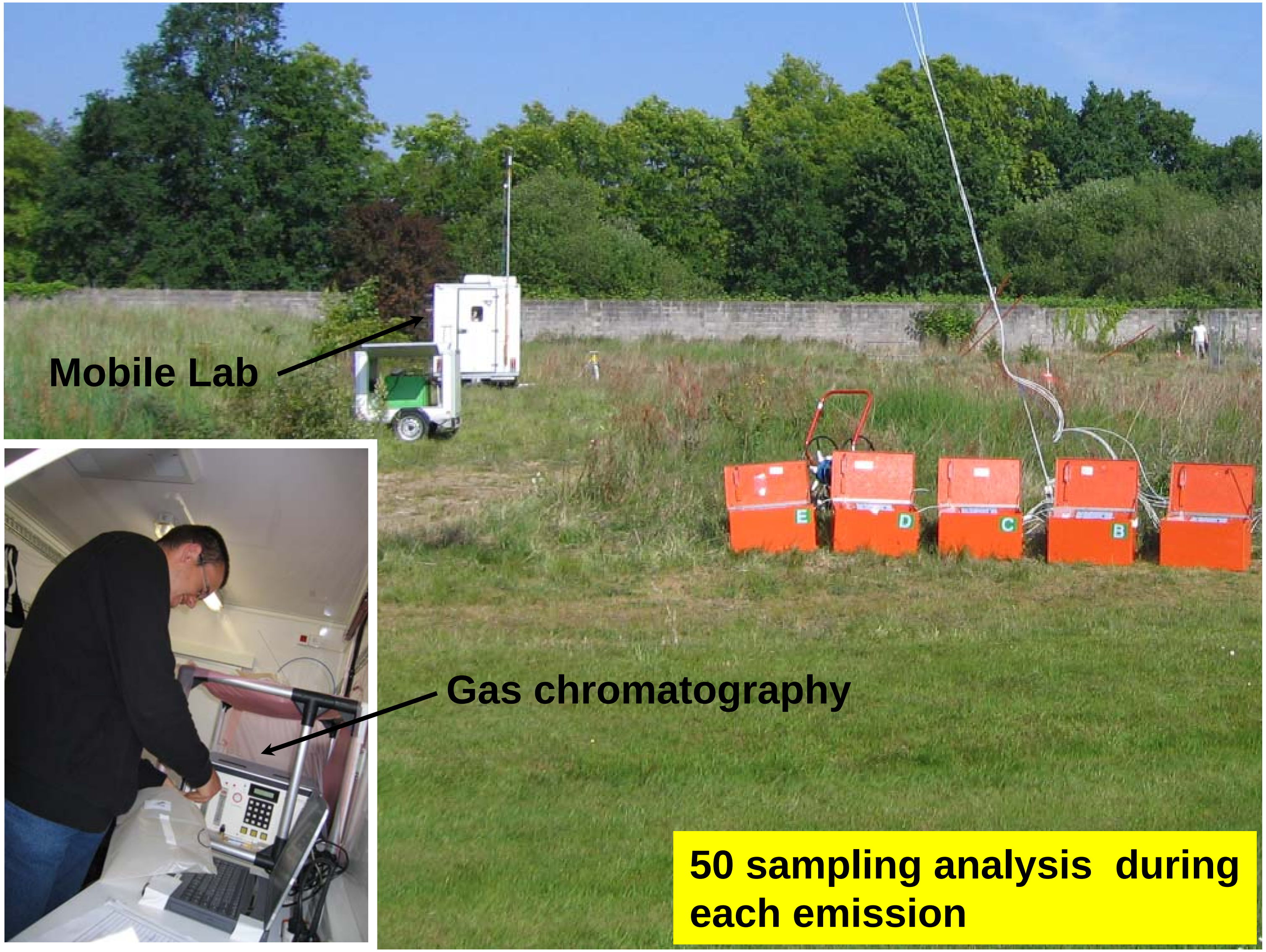
¤ Methodology : sampling on mast for the short distances



¤ Methodology : sampling under captive balloon for the long distances

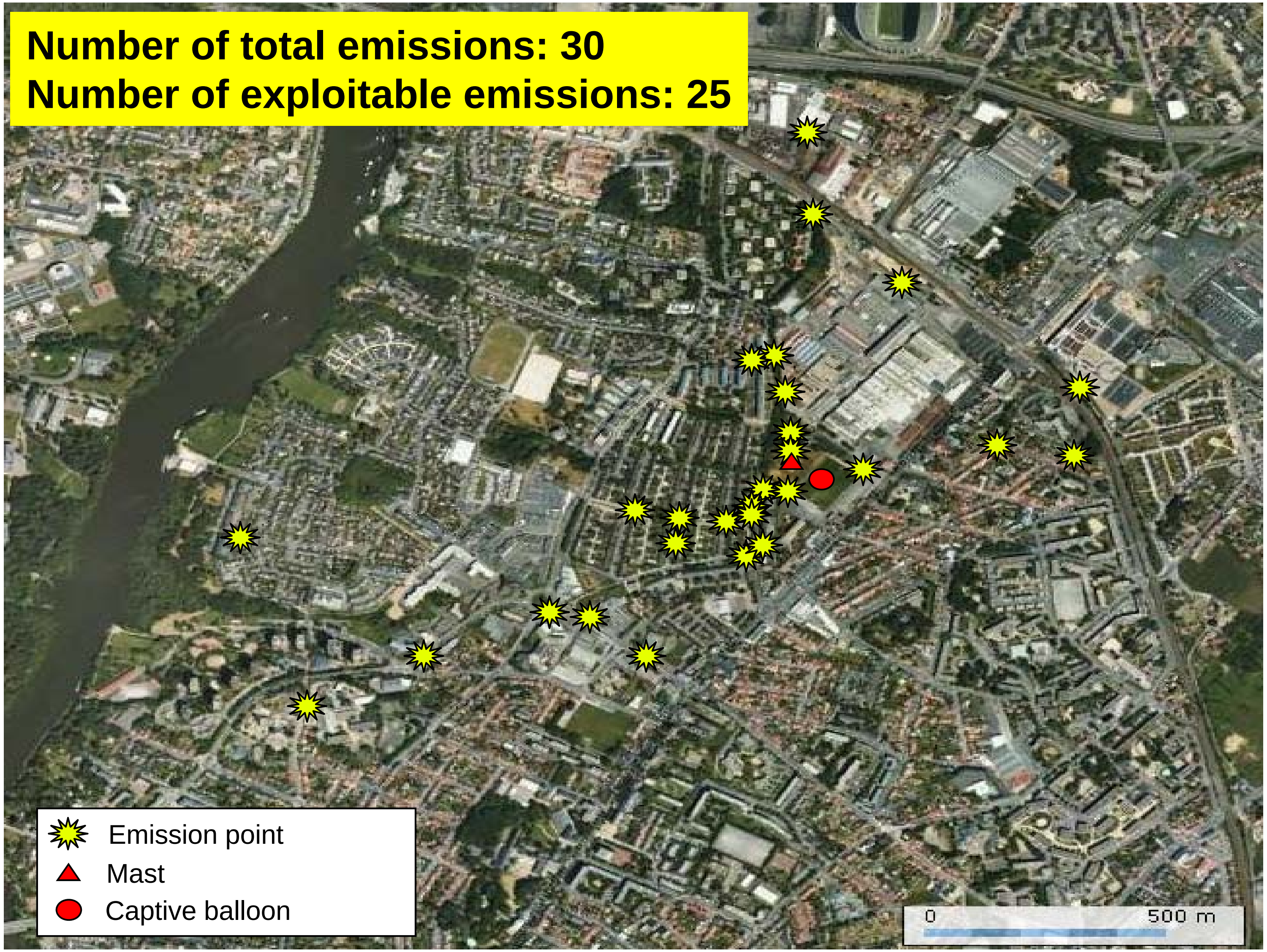


¤ Methodology : measurement in mobile lab



50 sampling analysis during each emission

¤ Results and discussion: affected area (Nantes)



¤ Results and discussion: meteorological conditions

Distance from emission (m) (min/ave/max)	U (m s^{-1}) (min/ave/max)	u_* (m s^{-1}) (min/ave/max)	H (W m^{-2}) (min/ave/max)	Pasquill stability class (number of occurrence)
20/356/1150	2.3/3.5/5.2	0.3/0.6/0.9	17/154/299	B(9), C(9), D(7)

- **The campaign started with anticyclonic conditions (May 18) and ended with a depression system (May 27).**
- **Started with unstable atmospheric stability (B) and ended with neutral atmospheric stability (D) .**

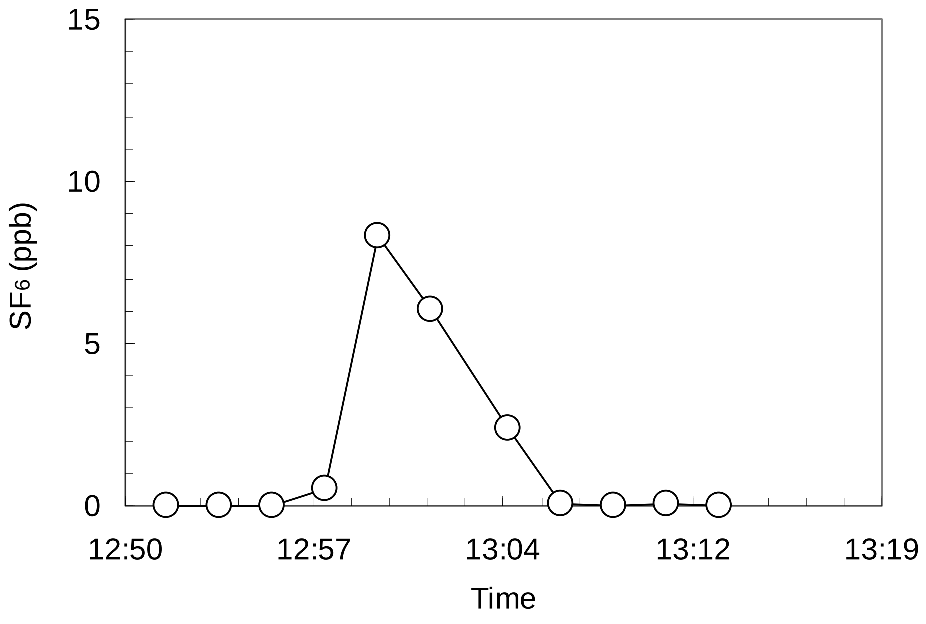
¤ Results and discussion: comparison between model predictions and measurements

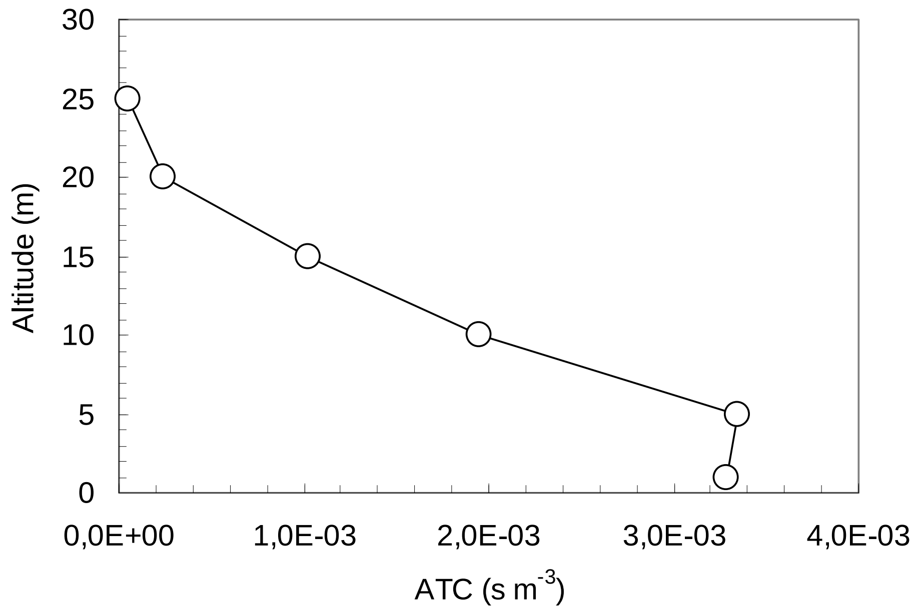
- Intercomparison with three Gaussian models, two from the first generation (Briggs-urban; Doury) and one from the second generation, ADMS 4.0.

$$ATC = \frac{\int_{t0}^{t1} X(M,t).dt}{\int_{t'0}^{t'1} q(t).dt}$$

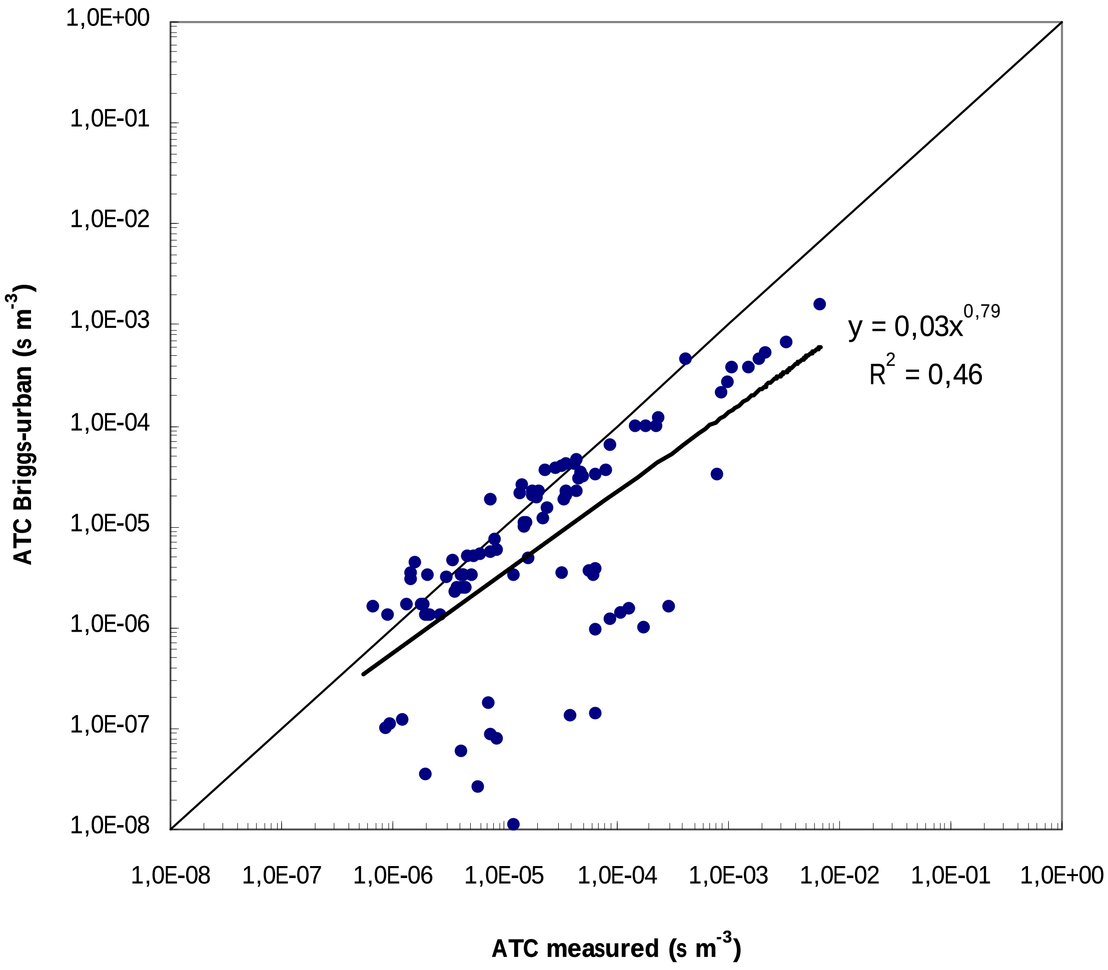
- $X(M,t)$: SF_6 concentration ($m^3\ m^{-3}$), at point M;
- $q(t)$: SF_6 release rate ($m^3\ s^{-1}$);
- t'_0, t'_1: time of beginning and end of source emission;
- t_0, t_1: time of beginning and end of measurement at M.

¤ Results and discussion: typical evolution of the concentrations on the site and typical vertical profile of the ATCs over the terrain

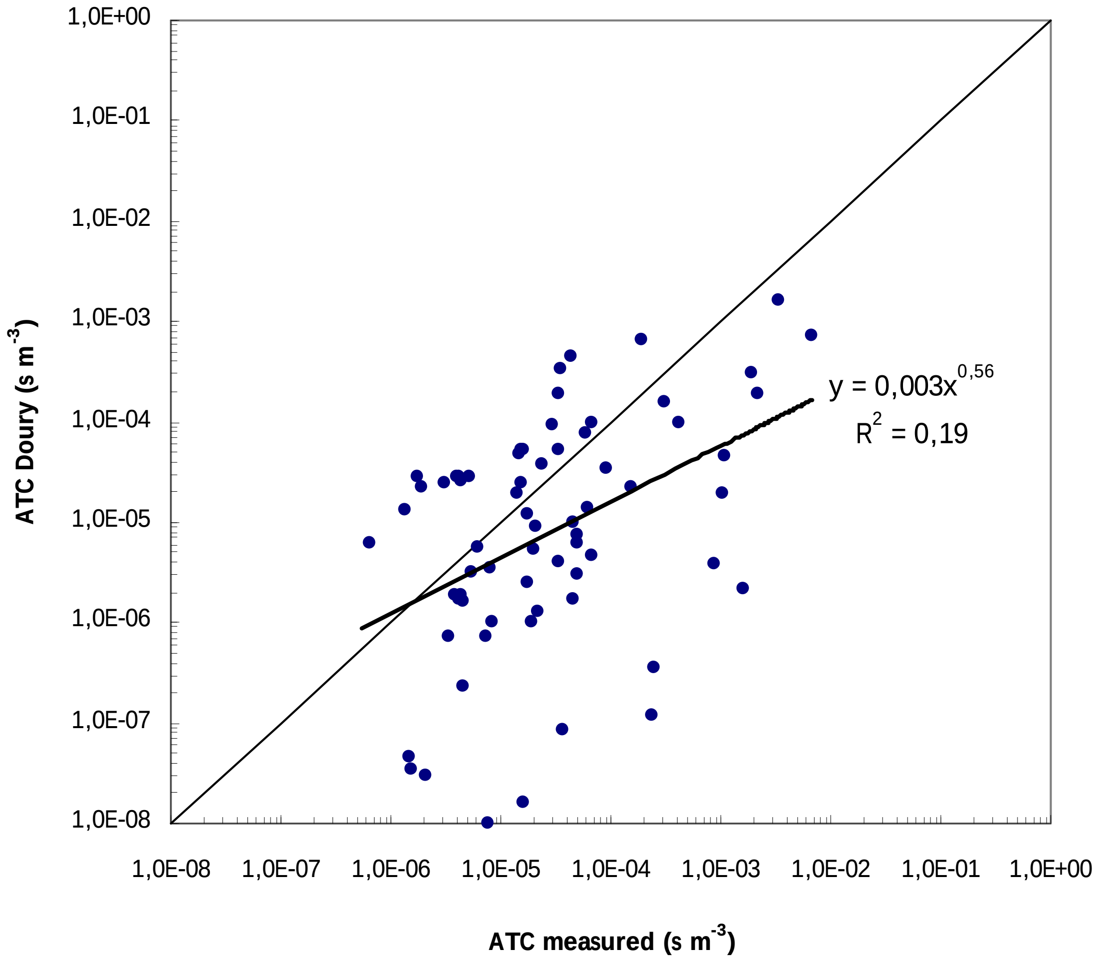




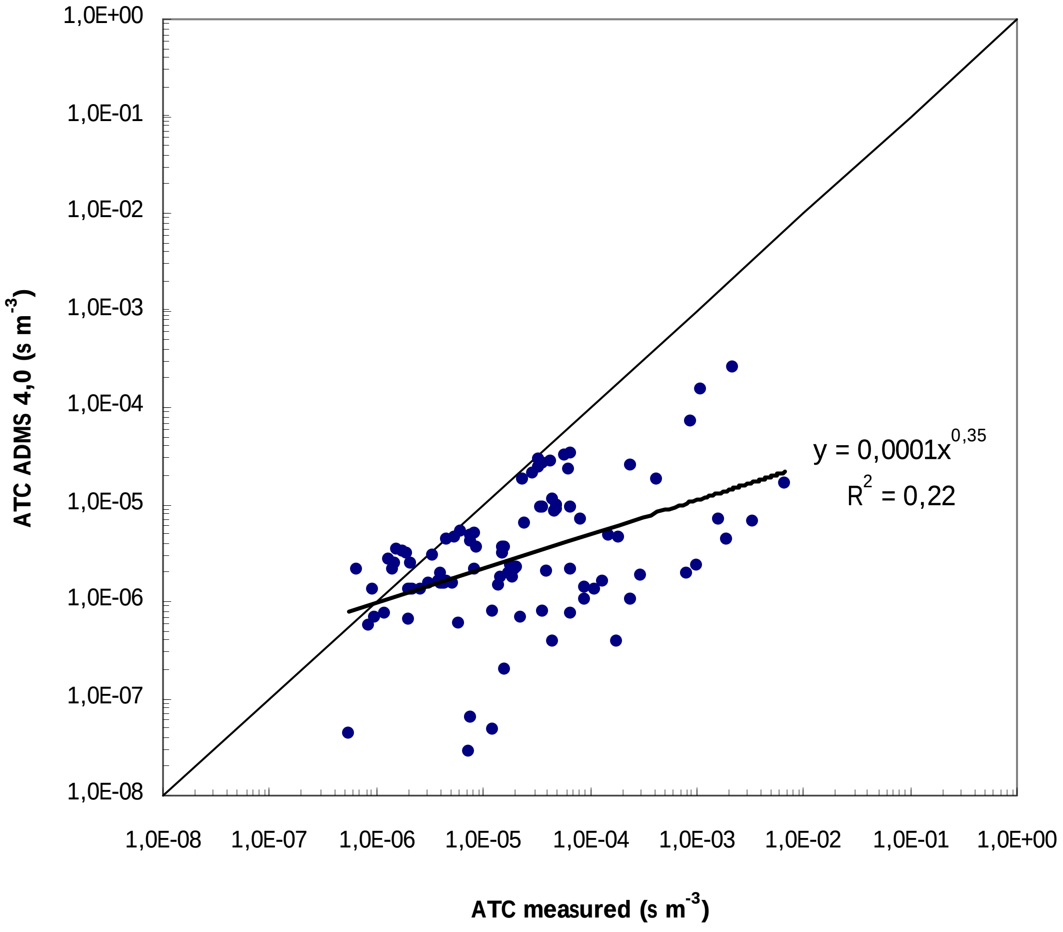
¤ Results and discussion: comparison using Briggs-urban model



¤ Results and discussion: comparison using Doury model



¤ Results and discussion: comparison using ADMS 4.0 model



Results and discussion: benchmarking models

Model	Number of ATC values above 10^{-8} s m^{-3} (total: 107)	Average ratio (measurement / prediction)	FAC 2 (%)	FAC 5 (%)
Briggs-urban	99	35	57	77
Doury	69	91	16	43
ADMS 4.0	99	51	29	55

$$FAC2 : \frac{1}{2} \leq \frac{C_p}{C_0} \leq 2$$

$$FAC5 : \frac{1}{5} \leq \frac{C_p}{C_0} \leq 5$$

- C_p: ATC predicted.
- C_o : ATC observed.

• **In our case the best predictions are with Briggs-urban, then ADMS 4.0 and Doury.**

¤ Conclusion

- A new methodology has been developed to quantify the plume vertical dispersion in a complex urban area: SF_6 emission, sampling on a mast or tethered balloon.

- The results has been compared with three Gaussian models, two from the first generation (Briggs-urban; Doury) and one from the second generation, ADMS 4.0: Briggs-urban best fitted the data.

- In the next future, a Large Eddy Simulation model ARPS (Advanced Regional Prediction System) will be used to estimate the concentration and the scalar fluxes of pollutants.

- To quantify the scalar fluxes and assess footprint models, Relaxed Eddy Accumulation (REA) will be developed and used during the next experimental campaign (FluxSap2012).

Thank you for your attention