

Wind tunnel simulation of mean flow and turbulence characteristics during the Urbcap Nantes '99 campaign

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During the Urbcap Nantes'99 field campaign measurements of wind velocities and concentration values were taken at Rue de Strasbourg in the city-center of Nantes (France). All sensors were installed in one cross-section and at a roof mast 7 m above roof level.

The idea of the wind-tunnel studies was to compare the wind-tunnel results with full scale data and to increase the sampling point density. The wind-tunnel data sets deliver information on the spatial variability of the flow field in Rue de Strasbourg, the vertical structure above roof level and the boundary layer development in the modeled area. They will be also used for comparison and evaluation of numerical model simulations. Furthermore parameterizations for urban flow regimes will be tested against the data sets.

The velocity measurements in the wind tunnel were done with a LDA probe installed inside the tunnel. It was possible to measure two velocity components simultaneously. To obtain data for all three velocity components two series (u, v plus u, w) with different probe orientation had to be taken for each sampling location. The sampling frequency was 20 Hz and the sampling time was 100 s. The approach flow velocity in boundary layer height was 6 m/s. The influence of traffic motion was not considered, but a special technique (Fig. 5) with metal plates (not moving) was installed during all the experiments. A limited number of concentration field measurements with variable traffic velocities were done in a separate study.

Rue de Strasbourg can be considered as street canyon with a great homogeneity of building shapes on both sides. It is approximately 15 m wide and the average building height is about 22 m. Traffic moves in one direction on three lanes. The location of the experimental site during the Urbcap Nantes '99 campaign and the area modeled in wind tunnel is shown in Fig. 1. The wind-tunnel flow measurements were taken for two wind directions. The wind direction 10° was typical for the field campaign. In the wind tunnel vertical profiles (in total 31) of the horizontal (u, v) velocity components inside and above Rue de Strasbourg were measured for wind direction 10° . Statistics of all three velocity components and the turbulent fluxes $\overline{u'w'}$ and $\overline{u'v'}$ are available for wind direction 243° (perpendicular to Rue de Strasbourg) at the positions shown in Fig. 2. This data set is of particular interest also for comparison with idealized street canyon studies.

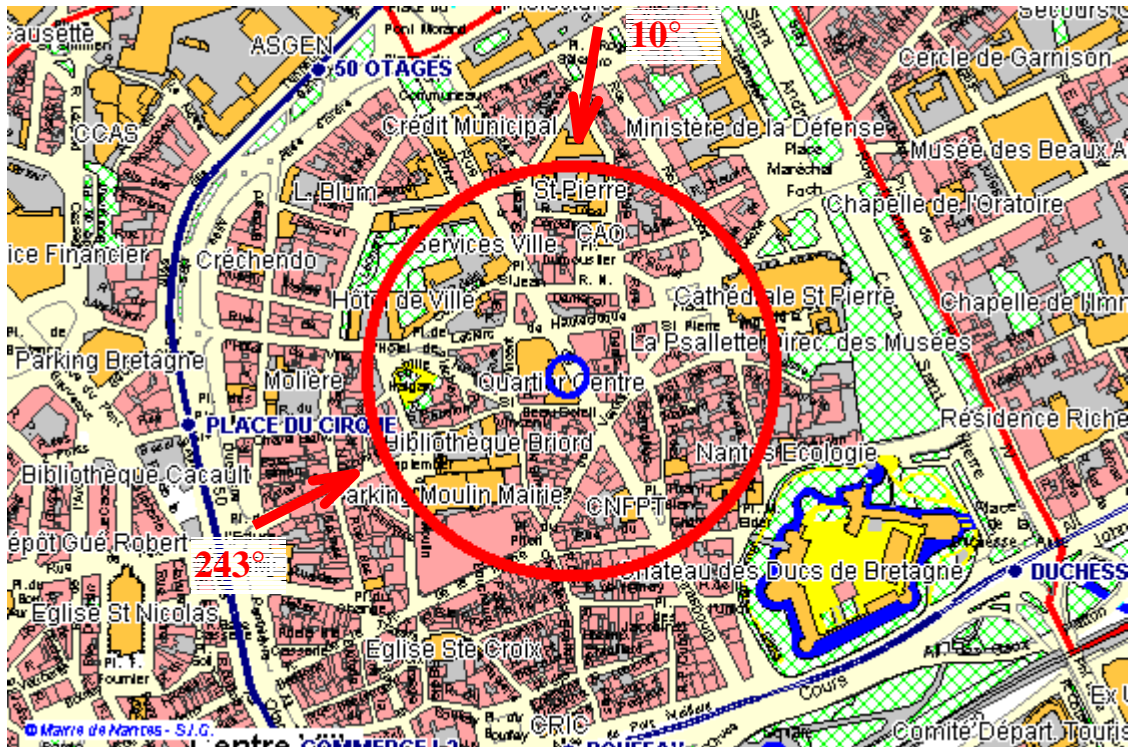


Fig. 1: Map of the area around Rue de Strasbourg, Nantes. The blue circle corresponds to the location of sampling points during the Urbcap Nantes '99 field campaign. The red circle shows the area modeled in detail in the wind tunnel at the University of Karlsruhe. Red arrows indicate the two wind directions studied in the wind tunnel.



Fig. 3: View of the central part of the wind-tunnel model.



Fig. 4: View of the wind-tunnel model installed at the boundary-layer wind tunnel at the University of Karlsruhe. The situation corresponds to wind direction 243° and the photo was taken upwind the model.

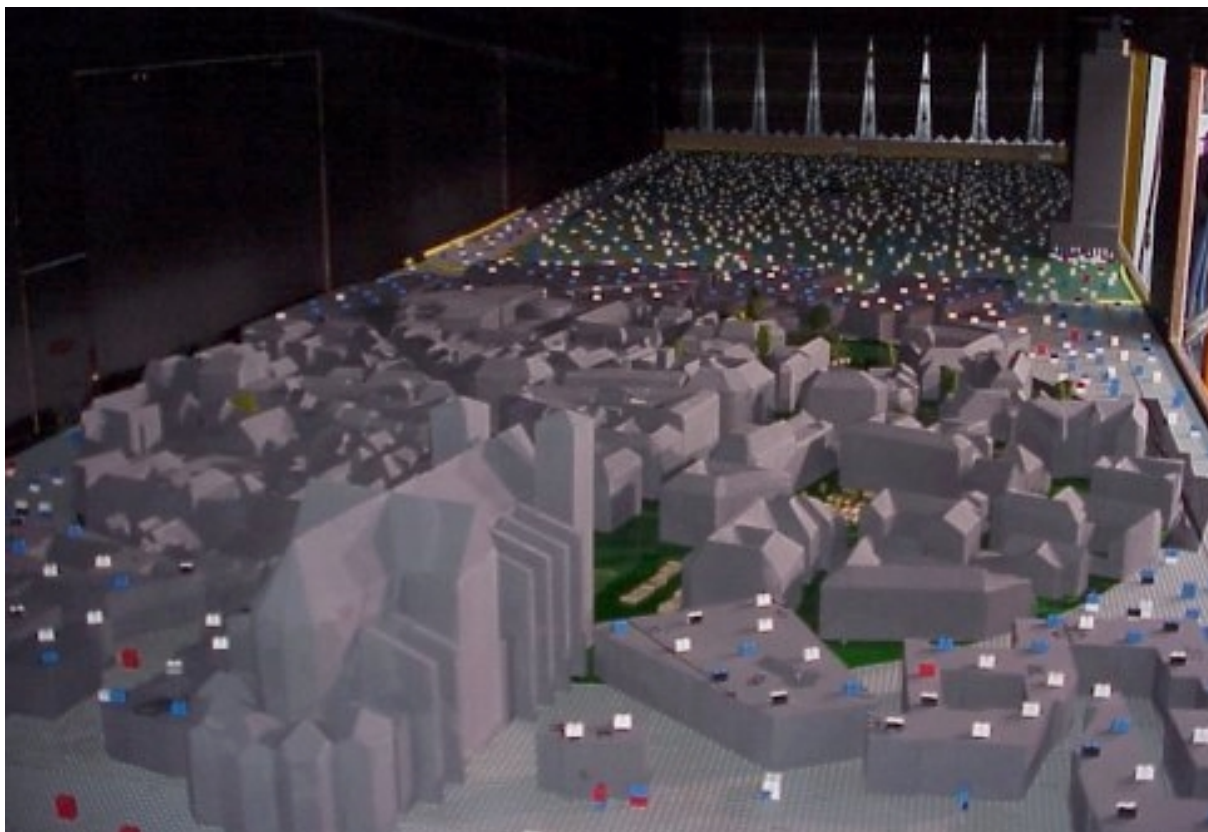


Fig. 5: View of the wind-tunnel model and inflow section with vortex generators and Lego-roughness elements.



Fig. 5: View on Rue de Strasbourg in the wind-tunnel model.