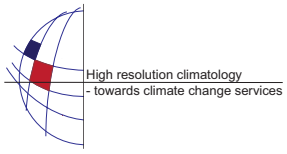
EMS Annual Meeting Abstracts
Vol. 7, EMS2010-341, 2010
10th EMS / 8th ECAC



Analysis of urban boundary layer flow and turbulence parameters on the basis of an experimental campaign in Turin city

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The flow and turbulence structure of the atmospheric boundary layer above urban areas is significantly perturbed by the density and distribution of buildings and other obstacles, by the thermal effect of the so-called 'urban heat island' and by the possible presence of topographical inhomogeneities. A thorough investigation of the characteristics of the flow and turbulence in urban canopy was pursued both with an experimental approach, carrying out an intensive observational field campaign and analysing the observed data, and evaluating the boundary layer and turbulence parameterisations, which are used in the numerical meteorological and air pollution models.
The experimental activity was carried out along a continuous 15-months observational period at four measurement sites, located in the city of Turin. Here we analyse the data gathered at a 25 m mast, displaced at one of the measuring stations and equipped with sonic anemometers at 5 m, 9 m, 25 m height. Close to the mast, a station measuring solar radiation, humidity and temperature at ground level was also active. Since Turin is characterised both by a complex urban fabric and by a very frequent low wind regime, the dataset allows also investigating and estimating the boundary layer parameters in the peculiar conditions of low wind speed.
With regard to the dataset, a stationary test singled out that each anemometer recorded about 25-30% of stationary data, but only the 9% of data were simultaneously stationary at the three anemometers. Concerning the stability for the whole dataset, a neutral stratification developed in only the 3% of the cases, while the percentages raise to the 47% and 50% respectively for the stable and the unstable cases. In some cases different stability conditions occurred at different levels, this peculiarity was investigated. At the three levels the distributions of the observed horizontal turbulent velocity fluctuations do not present remarkable differences, whereas the vertical component assumes rather different values. Considering the whole observed data set, low wind speeds, here defined as speed values less than 1.5 m/s, occurred in more than 90% of the cases. A comprehensive analysis of the observed wind velocity and turbulent velocity fluctuations, of the calculated stability parameters, surface layer parameters and boundary layer height is illustrated and discussed. A comparison of the measured wind standard deviation profiles as a function of stability with the values predicted by literature parameterisations for flat undisturbed terrain is also presented.