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Derivation of wind velocity standard deviation values in the urban inertial sublayer from observations in the roughness sublayer

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The atmospheric turbulence in the surface layer over urban and suburban areas is affected by the presence of roughness elements. The roughness sublayer (RSL) extends from the ground up to about two to five times the mean building height of the area. Within RSL, turbulence is inhomogeneous and heat and momentum turbulent fluxes are not constant with height, therefore the Monin-Obukhov Similarity Theory (MOST) is not suitable and the surface-layer parameters (friction velocity, stability parameter) are not well defined. Instead, in the inertial sublayer (ISL) above the RSL, the turbulent fluxes are constant and the MOST is still considered valid.
In air pollution models, observed surface-layer parameters available from data collected at urban or suburban stations might be used as inputs. Therefore, often RSL values are used in the parameterizations of the turbulence variables, such as the wind velocity standard deviations, as they were representative of the ISL, possibly leading to a not appropriate application of the MOST.
We investigate whether it is possible to derive suitable values of the wind velocity standard deviations in the ISL using RLS observed parameters, through the analysis of a sonic anemometer dataset collected in a suburban site at three levels, two in the RSL and one in the ISL.
The ISL wind velocity standard deviation are evaluated as similarity-like analytical functions of the RSL friction velocity and stability parameter. The RSL surface parameters are found to be satisfying scaling parameters and the empirical coefficients in the analytical formulation are estimated from the experimental data. Then the new analytical functions for wind velocity standard deviation are tested and verified against data collected during experiments in both homogeneous and heterogeneous conditions. Such approach could be useful in air pollution modeling over urban/suburban areas when ISL data are not available.