Lagrangian-Stochastic Modeling of pollutant dispersion in the urban boundary layer over complex terrain, and comparison to the Haifa 2009 tracer campaign

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Lagrangian stochastic particle models provide a well-established theoretical framework for the description of pollutant dispersion in different atmospheric boundary layer scenarios. Such modeling depends on an adequate description of the turbulent processes. The IIBR Lagrangian stochastic model presented here was tested for various cases in the Israeli coastal urban boundary layer, including the Haifa area. We present here simulations of passive scalar dispersion, carried out in the Haifa 2009 tracer campaign. The model is based on the well mixed principle, suggested by Thomson (1987). It utilizes the full Reynold stress tensor in near neutral conditions and a skewed velocity probability density function in convective conditions.

Turbulence parametrizations were adopted based on their consistency with measurements of the Haifa 2009 tracer campaign. It is shown that in conditions of developed stationary turbulence, in most areas of Haifa, there is agreement of measured turbulence with local MOST predictions. In contrast, in very low wind conditions, the turbulent nocturnal boundary layer is not necessarily stationary and is spatially non-homogeneous, as manifested in the pollutant pattern. Comparison of the experimental results and model simulations were analyzed based on statistical acceptance criteria. The ground concentration results met acceptance criteria which are used for such comparison in planar urban areas. These criteria are difficult to meet in complex terrain. The model shows in accordance with measurements that the hazard distances in day convective conditions are much shorter than for night neutral conditions. In addition it is shown that at night in very stable conditions the dispersion pattern is much more complex.

In order to further investigate and statistically validate the turbulence characteristics in Haifa, an additional measurement campaign was carried out during 2014-2015. Some of the results will be presented.

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