Multiscale Modelling Tools for Flow and Dispersion Calculations in Urban Areas

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Interactions between different spatial and temporal scales play a major role in determining the flow structure and pollutant dispersion in the urban canopy over densely built agglomerations. The intense surface inhomogeneities result in the generation of additional terms in the turbulent transport within the urban atmospheric boundary layer (ABL), which in effect generate equally intense temporal inhomogeneities. Aiming to address the limitations which arise because of these physical differentials between the different scales, schemes for the two-way coupling between mesoscale and the microscale have been applied which utilise collections of multi-dimensional interpolating metamodels. The application of such "proxy" schemes relies on a suitable classification of urban morphologies and land use patterns, including building heights and the orientation of major roads. Application examples include the study of small-sale flows in the cities of Athens and Paris.

In the same context, Large-Eddy Simulation (LES) of the ABL has nowadays become an important research method in accounting for the impact of multiscale interactions in flow and dispersion problems in urban areas mainly because via this method processes across the entire ABL can be resolved. It has recently become possible to include detailed structures, such as buildings in ABL LES, but the modelled areas are still limited in terms of the resolved spatial and time scales. One of the main problems encountered if that the ABL LES domain should cover a large area leading to a need for large computational resources. To account for these problems a two-way nesting was implemented in the parallelized LES model PALM to concentrate resolution to the primary area of interest. In this paper the latest developments in the two-way nesting which are implemented in the parallelized PALM LES model are presented.