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Implementation of an improved urban parametrisation into the mesoscale meteorology model METRAS and application to London, UK

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Urban areas have well documented effects on thermal and dynamic properties of the air as well as its chemical composition. E.g. increased heat storage, anthropogenic heat sources and radiative trapping can cause increased temperatures in the urban canopy, leading to an urban heat island with potentially adverse effects on human health and comfort. A nocturnal heat island may exacerbate the impact of summer heat waves. With growing urbanisation and in a changing climate it can be expected that these effects will increase.

In order to mitigate adverse effects of the urban heat island, the strength of the heat island needs to be assessed for current levels of urbanisation, as well as for prospective urbanisation scenarios. For this purpose, the mesoscale meteorology model METRAS (Schlünzen, 2003) has been extended by the urban canopy model BEP (Martilli et al., 2002), which has previously been validated and implemented in other mesoscale meteorology models. BEP parameterises the effects of the urban canopy walls and surfaces on momentum, heat and turbulent kinetic energy and takes into account very detailed specifications of building parameters, such as building height distributions and street axis orientations. The implementation of BEP in METRAS allows the use of a separate numerical grid for BEP, so that for the model simulations presented in this study a very fine vertical grid with 5m cell height (compared to 20m in the METRAS grid) could be used.

Greater London forms the largest urban area within the UK and has therefore been selected as the focus area for the validation of results from the improved model and for selected case studies. A domain covering 100km x 100km around London has been set up with a horizontal grid resolution of 1km x 1km. Results of the validation show that the inclusion of BEP improves the performance of METRAS for most cases when compared with measurements in the urban area. This improvement can ultimately be used to provide better assessments of urban air quality based on METRAS.

References

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