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The Urban Wind Island Effect

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Though the Urban Heat Island has been extensively studied, relatively little has been documented about differences in wind between the city as a whole and the countryside. Urban winds are difficult to capture in both observations and modelling, due to the complex urban canyon and neighbourhood geometry. This study uses a straightforward mixed-layer model (Tennekes & Driedonks, 1981) to investigate the contrast between the diurnal cycle of wind in the urban and the rural environment. The model contains one urban and one rural column, to identify differences in wind patterns between city and countryside under equal geostrophic forcing. The model has been evaluated against observations taken at the Cabauw research tower (the Netherlands), and urban observations from the BUBBLE campaign (Basel, Rotach et al., 2005). The influence of the urban fabric on the wind is investigated by varying the surface underneath the column model using the 10 urban Local Climate Zones, thereby altering building height, fraction of impervious surface, and initial boundary-layer depth.
First results show that for higher initial urban boundary-layer depths compared to the rural boundary-layer depth, the urban column can much windier than its rural counterpart (up to 1 m/s): the urban Wind Island Effect. The magnitude and onset of the Wind Island Effect is highly dependent on the initial wind profile, the geostrophic forcing, and the boundary layer evolution.