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Evaluating WRF in highly complex terrain – a city surrounded by mountains

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Accurate prediction of meteorological conditions is particularly important for cities in mountainous terrain, where populations are frequently exposed to extreme weather and poor air quality. However, the wide range of processes that interact across different scales and considerable spatiotemporal variability in these regions present challenges to measurement and modelling. Analysis of turbulence observations in and around Innsbruck reveals similarities and differences in the climate of this alpine city compared to previously-studied urban sites. In particular, the effect of the wind regime (e.g. thermally-driven circulation, foehn) on the timing and magnitude of the surface energy budget is explored. These observations are then used in a detailed assessment of the performance of the Weather Research and Forecasting (WRF) model (at 1-km grid spacing) including the multi-level urban surface scheme. It is found that WRF captures the valley-wind circulation reasonably well, although underestimates the turbulent kinetic energy both inside and outside the city. Even in this complex mountainous setting, the multi-level urban scheme is able to improve model performance.