Using data assimilation in WRF to model the urban climate of Amsterdam: technical challenges

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Climate change and ongoing urbanization stress the need to understand urban hydrometeorology and its implications for human thermal comfort and water management. As they progress towards higher resolutions, weather and climate models can capture more detailed characteristics of local and regional weather processes, which helps to improve our understanding of these issues. At these higher resolutions, a correct representation of the complex structures of cities becomes more and more important, requiring a different modeling approach compared to the rural surroundings. The current urban canopy layer schemes account for these city specific characteristics, but differ substantially among each other due to uncertainty in land use parameters and incomplete physical understanding. Therefore, meteorological forecasting and hindcasting of the urban environment requires improvement.

In this study, we demonstrate the set-up and results of a data assimilation and nudging study using the WRF (Weather Research and Forecasting) mesoscale model at a 100m horizontal resolution for Amsterdam, as well as the technical challenges we encountered. We incorporate observations from of a variety of sources using data assimilation and nudging techniques. Sources include synoptic weather observations, records by hobby meteorologists in cities, and volume radar data. Including each of these data sources improves the model skill. The final goal of the project is to create a 15 year climatological urban re-analysis data archive of (hydro)meteorological variables. This will enable us to detect trends in thermal comfort and extreme precipitation.