5.8 USING WEATHER RADAR OBSERVATIONS FOR DATA ASSIMILATION TO MODEL THE AMSTERDAM URBAN CLIMATE

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Ongoing world-wide climate change and urbanization illustrate the need to understand urban hydrometeorology and its implications for human thermal comfort and water management. Weather forecasting and climate models can assist to understand these issues, as they progress increasingly towards finer scales. With high model resolutions (grid spacing of 100m), effective representation of cities becomes crucial. The complex structures of cities, configuration of buildings, streets and scattered vegetation, require a different modelling approach than the homogeneous rural surroundings. The current urban canopy-layer schemes account for these city specific characteristics, but differ substantially amongst 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 create a 15-year high resolution climatological urban re-analysis data archive of (hydro)meteorological variables for Amsterdam. The rest of the Netherlands will be archived on a slightly lower resolution. This will enable us to trace trends in thermal comfort and extreme precipitation.

Model simulations are performed with the WRF (Weather Research and Forecasting) mesoscale model, which uses nested domains to bridge the resolution of ECMWF re-analysis data on the boundaries towards the finer resolutions in the inner domain. We attempt to improve the WRF (Weather Research and Forecasting) mesoscale model performance by incorporating observations of a variety of sources using data assimilation and nudging techniques. Data assimilation aims to accurately describe the most probable atmospheric state by steering the model fields in the direction of the observations. Data assimilation has been conducted every 2 hours and consists of WMO synoptic weather observations, volume radar data and urban weather observations recorded by hobby meteorologists.

The volume radar data is retrieved from one of the C-Band Doppler weather radar from the Royal Netherlands Meteorological Institute (KNMI). We use both the reflectivity and radial wind from the elevation scans. The reflectivity is converted to rain water mixing ratio before assimilation takes place. This leads to a lower conversion error compared to direct assimilation of reflectivity. For our study this is crucial to get an improved analysis field.

Different data assimilation methods are evaluated for hindcasts of July 2014 for the Netherlands. That month is characterized by both a warm dry period and two days with extreme precipitation (more than 100mm in two days). The largest improvement is made by assimilating the air temperature, dew point temperature and

pressure from WMO synoptic stations. Applying additional radar data assimilation, slightly improves the location of the precipitation indicated by the fraction skill score. The data assimilation of urban weather stations, lastly, reduces the cold biases within the canopy which appeared in WRF.