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Precipitation intensity - temperature relation in urban areas

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Alterations in land-surface characteristics due to extensive urbanization can influence atmospheric variables that effect precipitation. Both present day weather forecasting and future projections will advance from a better understanding of the impact of growing cities on local weather. The city size and surface morphology can modify the surface temperature and energy balance. Typically the Bowen ratio is enhanced in cities compared to the countryside, and heat is efficiently stored in the urban fabric. Moreover, the aerosol composition and wind speed and direction can be altered. These characteristics can influence moisture availability, atmospheric instability, and thereby convection and precipitation. The maximum impact on precipitation is expected over cities with an approximate $>$20 km radius (Schmid and Niyogi 2013). However even in smaller cities, such as in the Netherlands, precipitation modifications are still seen (Daniels et al., 2014).

Precipitation is known to increase with increasing (dew point) temperatures, with an observed rate that in the Netherlands is shown to exceed the expected theoretical Clausius-Clapeyron scaling (Lenderinκ and Van Meijgaard 2008) In this study, we analyze the relation between the temperature and precipitation intensities for Amsterdam to investigate how the urbanization influences the precipitation for different temperature ranges, seasons and wind directions, separating the precipitation intensities into different percentiles. We utilize hourly precipitation observations from KNMI's gauge-adjusted weather radar rainfall product with a 1 km resolution and hourly (dew-point) temperatures from the KNMI weather stations in the Netherlands. The comparison of the observed temperature-precipitation scaling between urban and surrounding rural areas will reveal the influence of urbanization on precipitation for the different temperatures.

References

Daniels, E.E., Lenderink, G., Hutjes, R.W.A. and Holtslag, A.A.M., 2014. Spatial precipitation patterns and trends in The Netherlands during 1951–2009. International Journal of Climatology, 34(6), pp.1773-1784.

Lenderink, G. and Van Meijgaard, E., 2008. Increase in hourly precipitation extremes beyond expectations from temperature changes. Nature Geoscience, 1(8), pp.511-514.

Schmid, P.E. and Niyogi, D., 2013. Impact of city size on precipitation modifying potential. Geophysical Research Letters, 40(19), pp.5263-5267.