Rainfall maps from networks of citizen weather stations for urban rainfall information

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Opportunities of citizen observations for urban hydrometeorology:

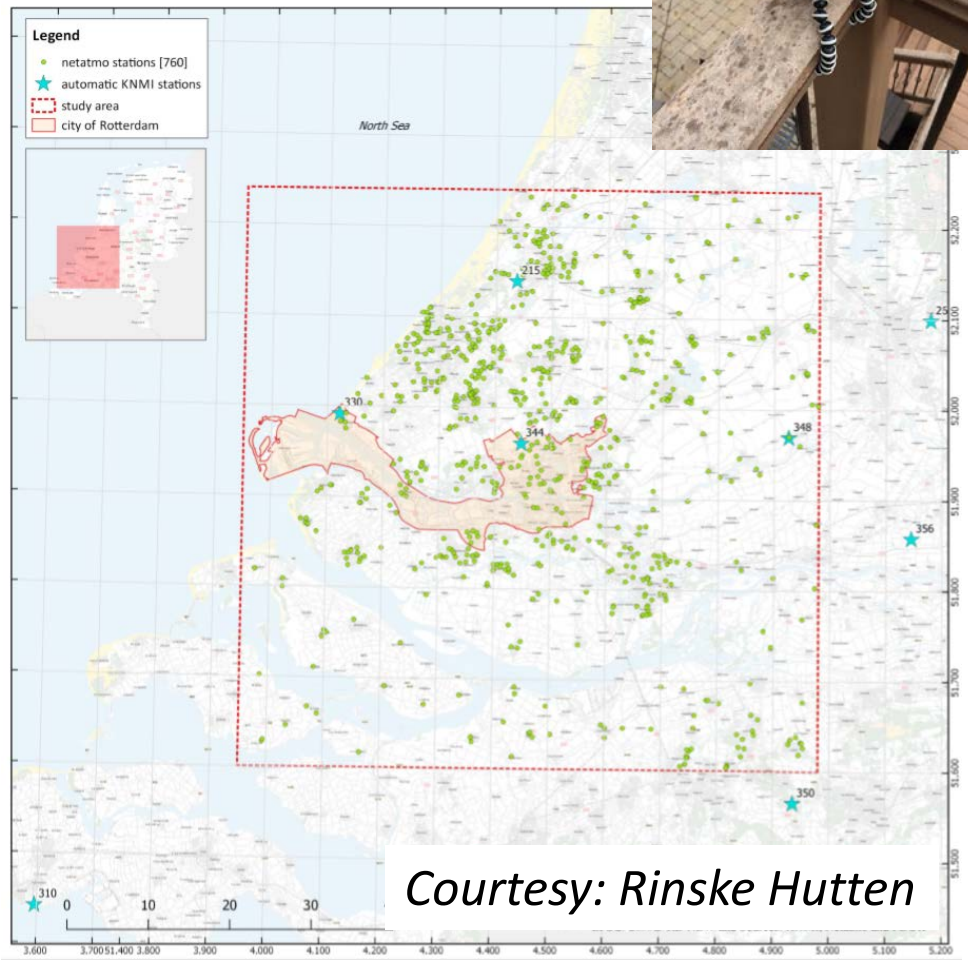
”What can we learn from potentially ubiquitous, but intrinsically noisy data generated from citizen observations?”

Citizen Weather Stations

760 CWS in 70x700 km^2 window around Rdam:

1 station every 6.6 km^2

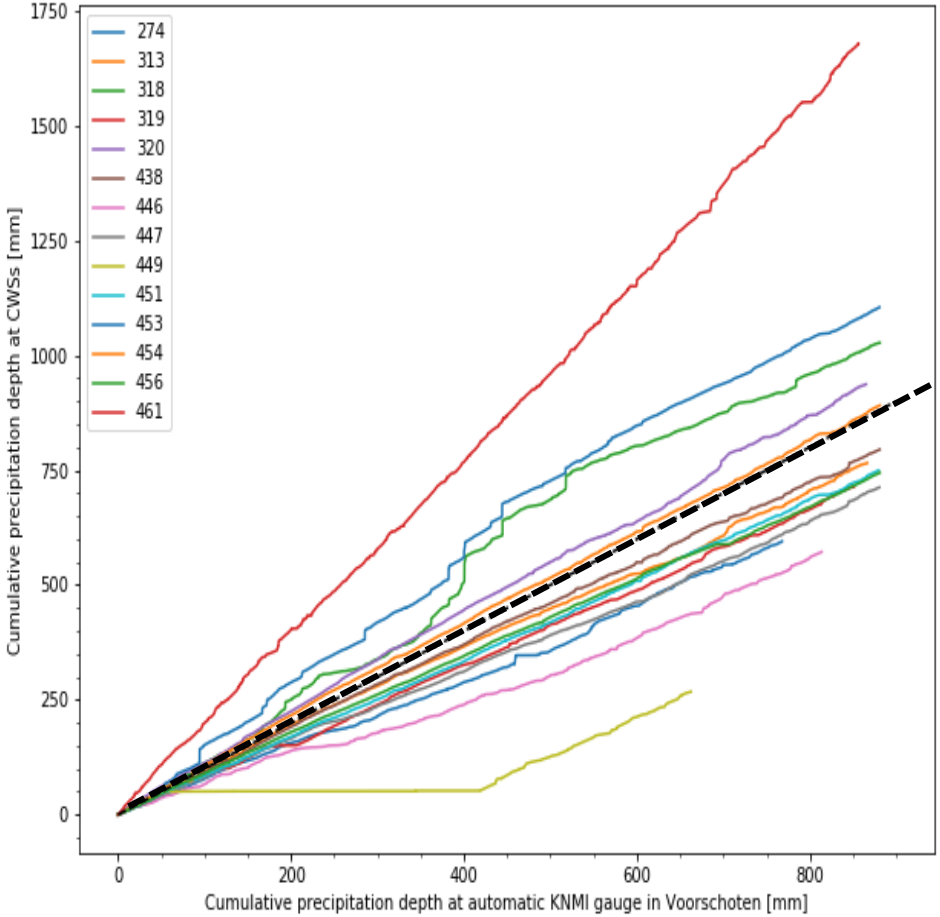
KNMI (Nat.W.Service):
~ 1 every 1000 km^2 (automatic weather stations)
~ 1 every 100 km^2 (manual gauges)



Courtesy: Rinske Hutten

Citizen Weather Stations Data Quality

- Most stations underestimate compared to professional gauge
- Consistent overestimation: due to incorrect TB volume
- Hard to detect: missed rainfall



Courtesy: Rinske Hutten

QC filter to detect undetected rain

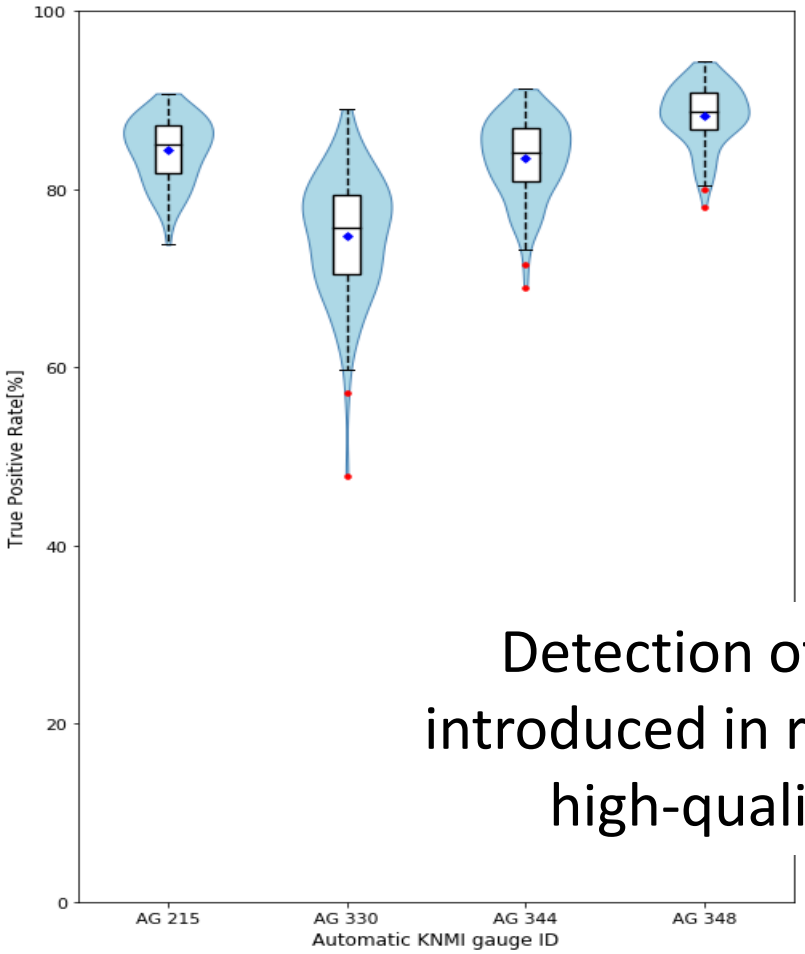
CWS filter

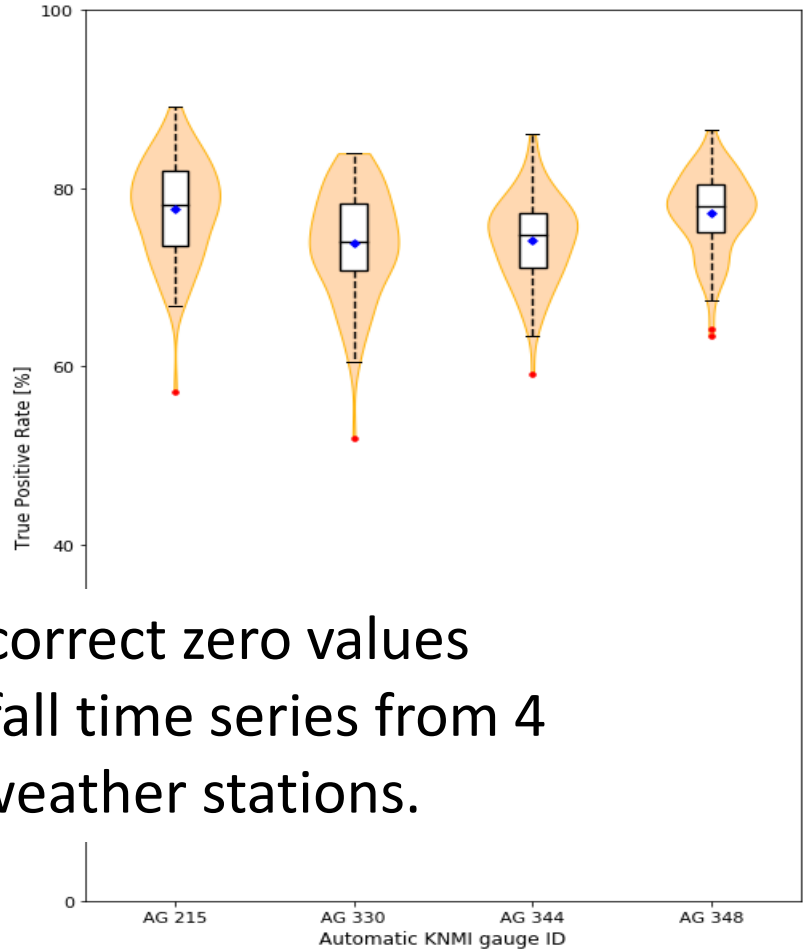
- Median precipitation depth of neighbouring stations (min. 3) within 8-km radius:
  $P_{med,n}(t) > 0$ & $P_{CWS}(t) = 0$
- *Benefit:* No other rainfall data sources are required than CWS network
- *Assumptions:* majority of neighbouring CWSs have correct recording
- *Limitations:* Filter requires at least 3 neighbouring CWSs

Radar filter

- Overlying radar pixel :
  $P_{rad}(t) > 0.06$ mm & $P_{CWS}(t) = 0$
- *Benefit:* Continuous availability of required information to perform filter, therefore better suitable for areas with sparse CWS network
- *Limitations:*
  - Requires additional rainfall data source
  - Disagreement between radar and gauges on rainfall occurrence
  - Susceptible to radar artefacts

QC filter to detect undetected rain - control case -

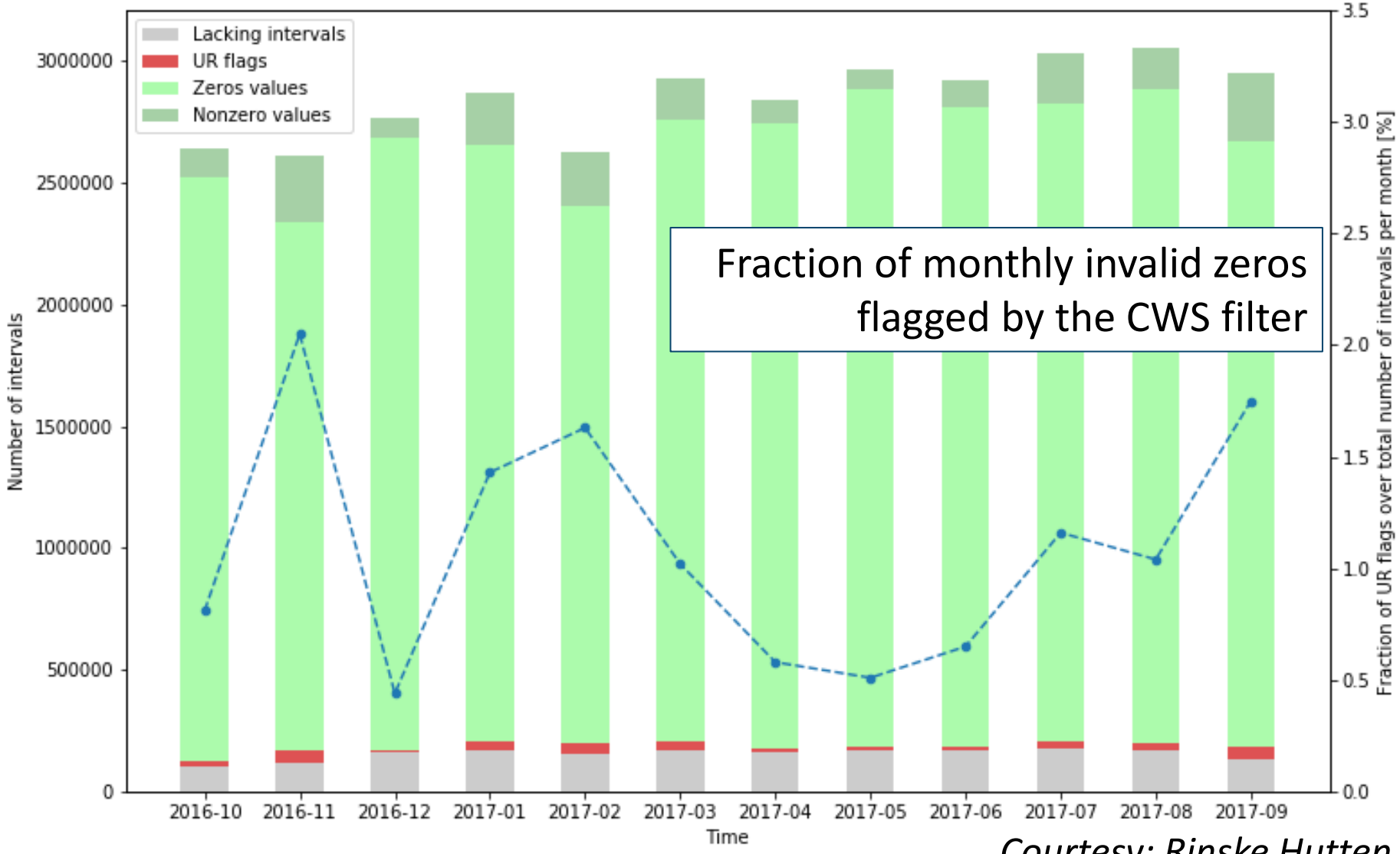




Detection of incorrect zero values introduced in rainfall time series from 4 high-quality weather stations.

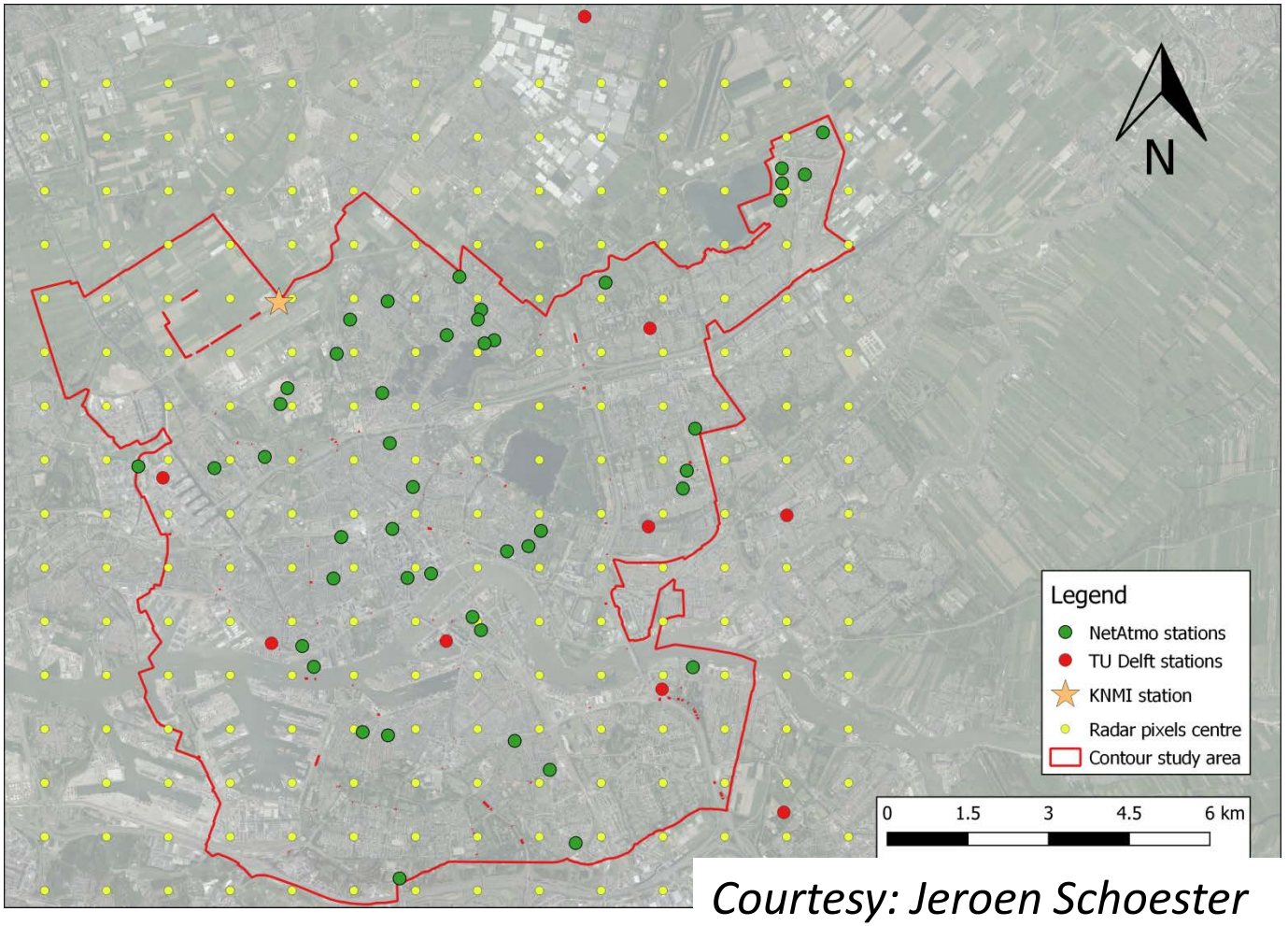
Courtesy: Rinske Hutten

OC filter for undetected rain



Courtesy: Rinske Hutten

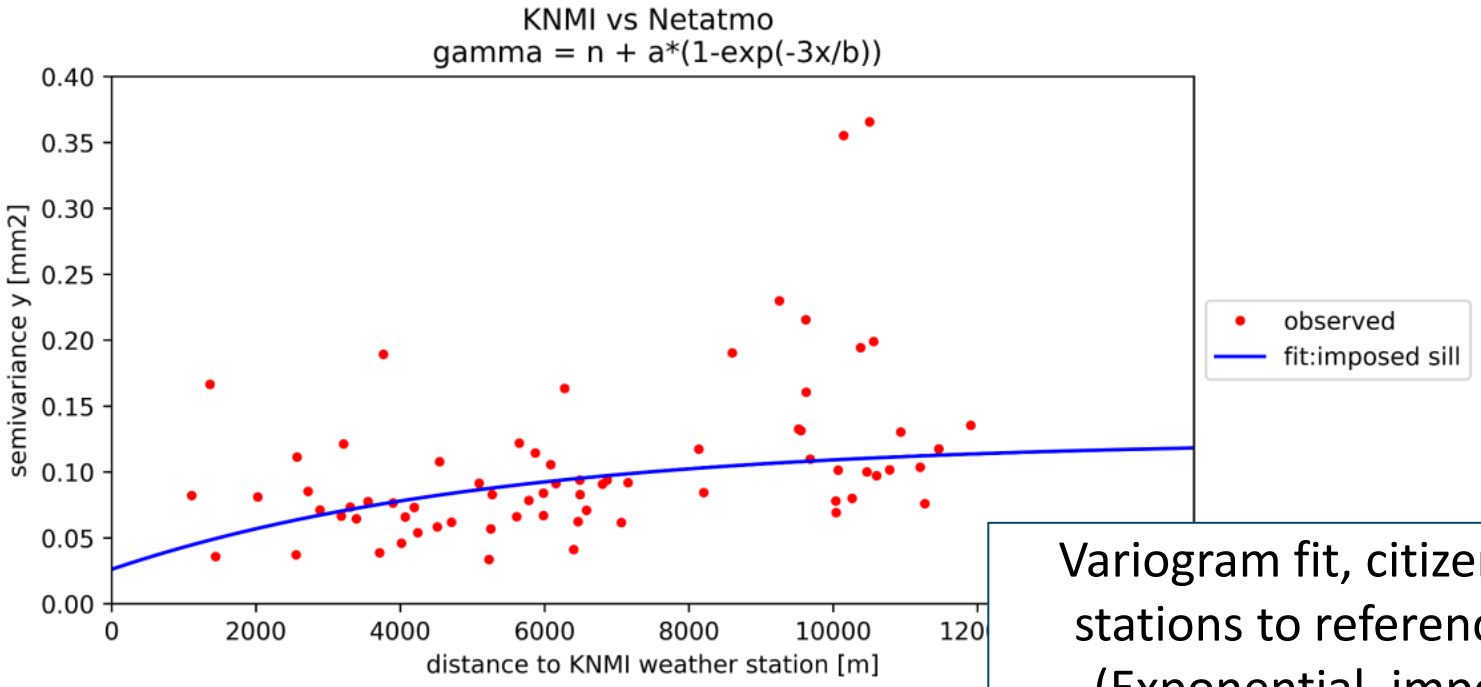
Rainfall information from citizen rain gauges



Courtesy: Jeroen Schoester

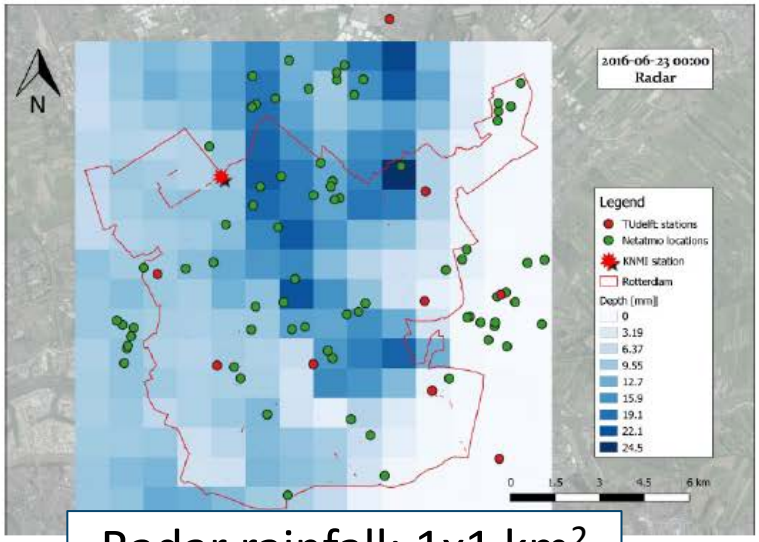
Rainfall information from citizen rain gauges

Interpolation method: weighted distance interpolation
- weights depending on distance (Variogram) and type of station

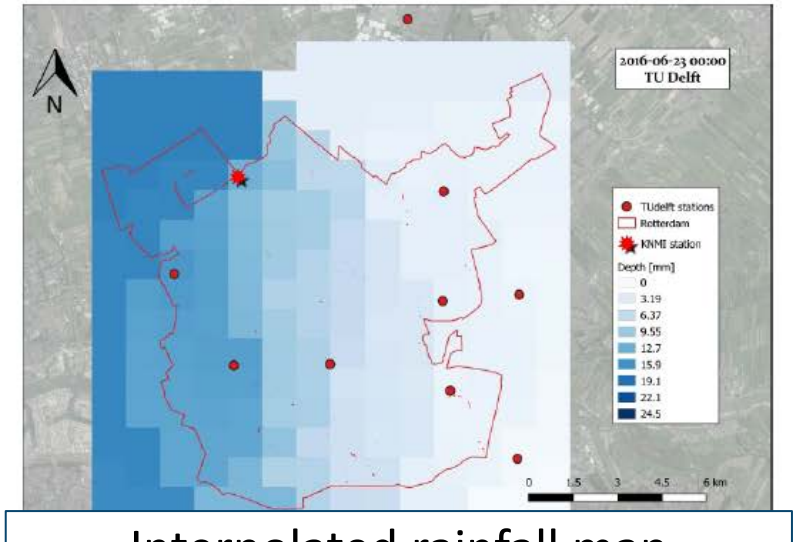


Variogram fit, citizen weather stations to reference station (Exponential, imposed sill)

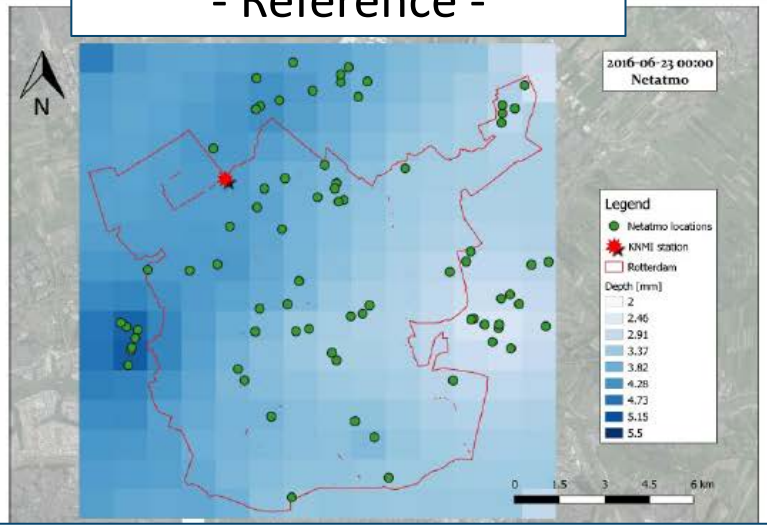
Interpolated rainfall maps



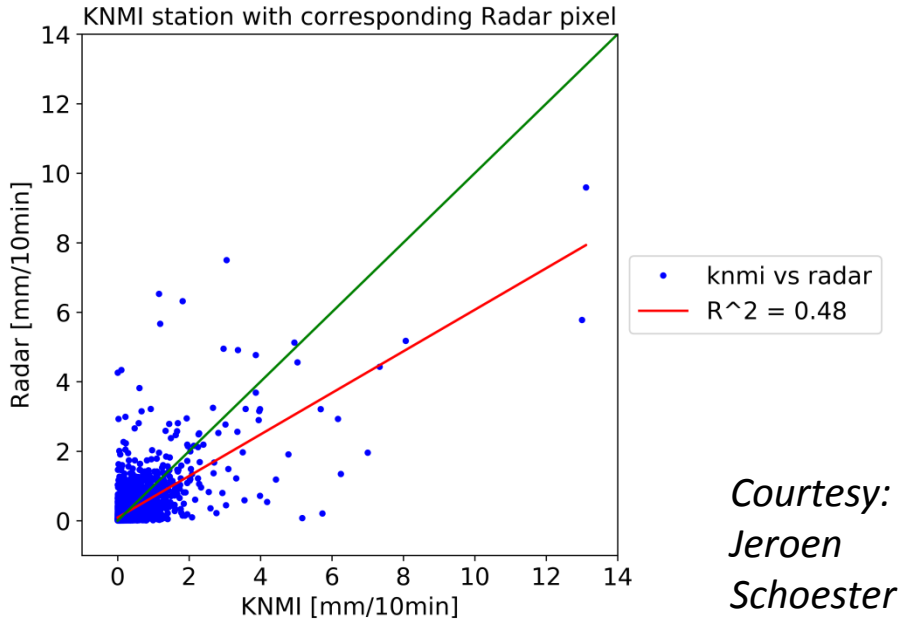
Radar rainfall: 1x1 km^2
- Reference -



Interpolated rainfall map
Low-density, high quality stations

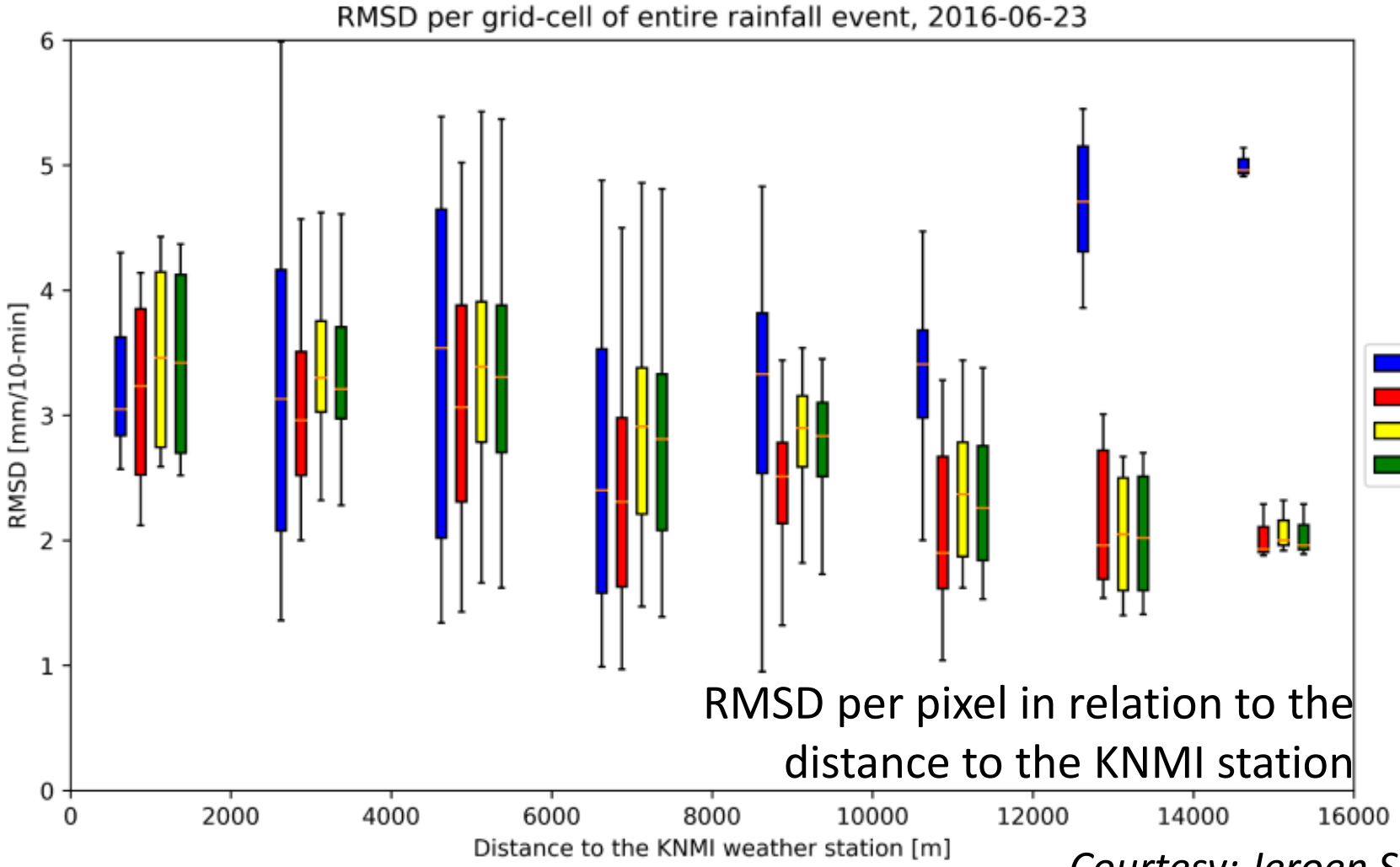


Interpolated rainfall map
High-density, citizen weather stations



Courtesy: Jeroen Schoester

Interpolated rainfall maps



RMSD per pixel in relation to the distance to the KNMI station

Courtesy: Jeroen Schoester

Citizens sensing rain:

Knowledge, Empowerment, Bottom-up data collection

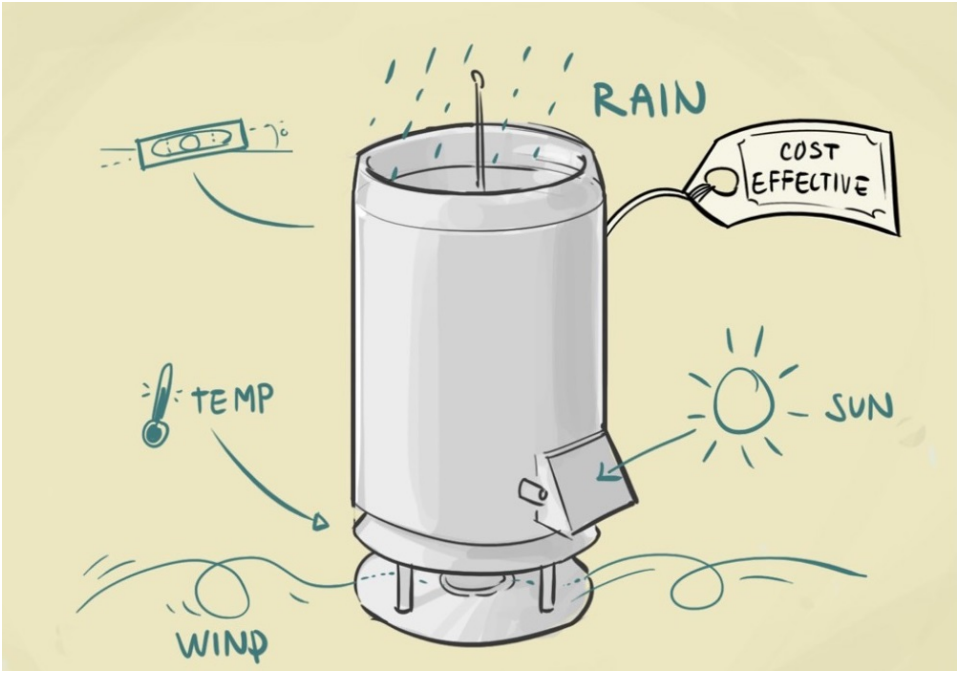
Data-> Information:
Huge challenges ahead to achieve sufficient density and quality

Back-up slides

Citizen science: examples from the global south

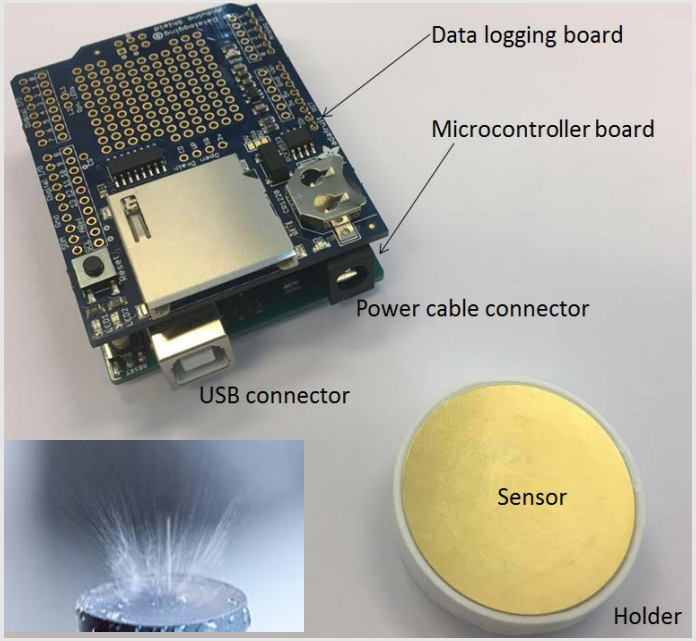
TAHMO

Trans-African Hydro-Meteorological Observatory



Citizen Science

Raindrop counter



Ongoing tests: Tanzania (rain season)

Courtesy: Di
MSc stude

Citizen science:

Knowledge, Empowerment, Bottom-up data collection

Data-> Information: Huge challenges ahead to achieve sufficient density and quality