OPTIMAL TEMPORAL RESOLUTION OF MERGED RADAR – GAUGE RAINFALL FOR URBAN APPLICATIONS

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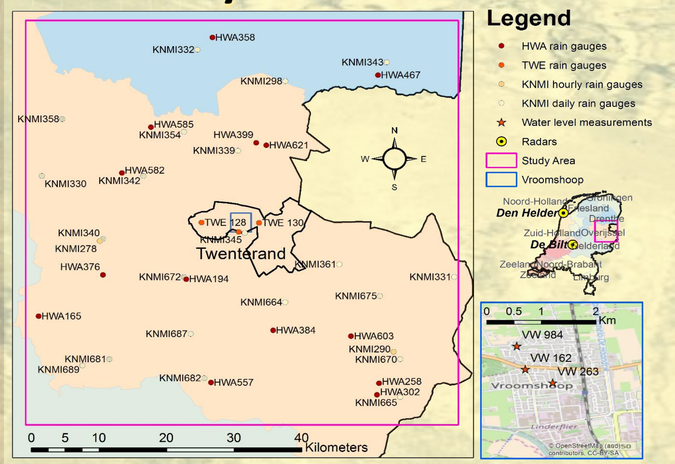
Problem

- Accumulating rainfall time series over time reduces the uncertainty, but fine temporal resolution is usually required in urban models.
- Radar has high resolution, but is not accurate.

Solution

- Rain gauge and radar data can be merged at coarse temporal resolution.
- The merged product can then be downscaled at finer resolution, using the radar data to reconstruct the temporal pattern.

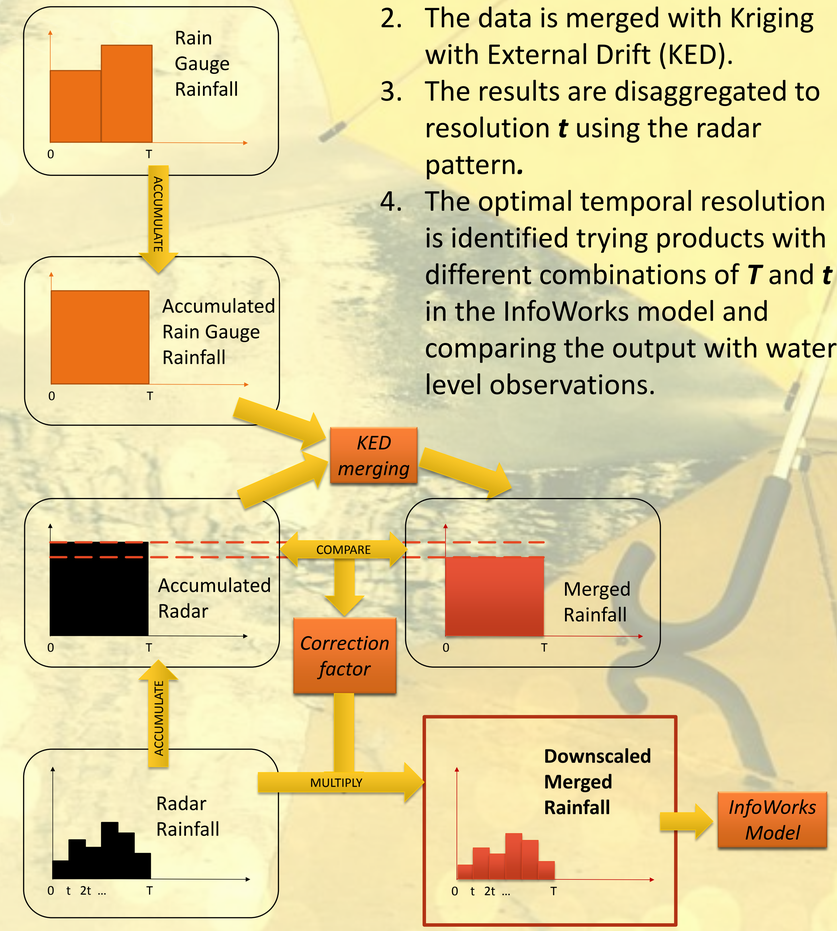
Case Study



- Radar data from the Koninklijk Nederlands Meteorologisch Instituut (KNMI) at 5-minutes;
- Rain gauge data from the KNMI, the municipality of Twenterand, and from amateur networks at variable temporal resolutions;
- Event from the 13th to the 17th of June 2016 that caused floods in Vroomshoop;
- InfoWorks model of the drainage in Vroomshoop.

Process

1D simplification of the 3D process:



1. All rain gauge and radar data are aggregated at the same coarse resolution ***T***.
2. The data is merged with Kriging with External Drift (KED).
3. The results are disaggregated to resolution ***t*** using the radar pattern.
4. The optimal temporal resolution is identified trying products with different combinations of ***T*** and ***t*** in the InfoWorks model and comparing the output with water level observations.

References

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- *Cressie, N.A.C., 1993. Statistics for Spatial Data.*
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- *Overeem et al., 2009. Derivation of a 10-Year Radar-Based Climatology of Rainfall. J. Appl. Meteorol. Climatol. 48.*

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Results

The process has been applied to the case study with different resolutions ***T*** and ***t***. The different products were tested in the InfoWorks model.
The optimal combination of ***T*** and ***t*** was identified comparing the modelled water level to the one measured in the sewer system. Although different sources of uncertainty affect the model, for this case study an accumulation resolution of 3 hours and a downscaling resolution of 30 minutes were found optimal. The results may be different for other case studies and models, but the same method can be applied.

Accumulation	Downscaling	*BIAS*	*MRTE*	*NSE*
24 hours	5 minutes	0.146	0.218	0.579
24 hours	15 minutes	0.147	0.213	0.577
24 hours	30 minutes	0.146	0.212	0.577
12 hours	5 minutes	0.159	0.289	0.580
12 hours	15 minutes	0.159	0.303	0.580
12 hours	30 minutes	0.158	0.336	0.580
3 hours	5 minutes	0.178	0.078	0.731
3 hours	15 minutes	0.178	0.075	0.732
3 hours	30 minutes	0.178	0.068	0.742
1 hour	5 minutes	0.183	0.092	0.730
1 hour	15 minutes	0.183	0.086	0.734
1 hour	30 minutes	0.182	0.072	0.743
15 minutes	-	0.184	0.128	0.579
5 minutes		0.184	0.134	0.578

MRTE = Mean Root Transformed Error NSE = Nash-Sutcliffe Efficiency

Conclusions

The proposed approach is able to improve radar –rain gauge merging, by optimising rainfall temporal resolution. The final rainfall estimate has the accuracy of a well merged product, but a fine temporal resolution, suitable for urban applications. Although the numeric results are specific for the case study, the methodology is flexible and can be applied to different data, and models. Additionally, the kriging based merging method allows to consider the uncertainty as well, in the form of the kriging variance.