



Application of Artificial Intelligence in Rainfall Nowcasting and Flash Floods Forecast in an urban catchment: First results from Research Project KIWaSuS in Germany Application de l'intelligence artificielle dans la prévision à court terme des précipitations et de crues torrentielles dans une zone du réseau d'assainissement urbain : Les premiers résultats du projet de recherche KIWaSuS en Allemagne

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Introduction



Source: Christoph Reichwein, published at www.rp-online.de

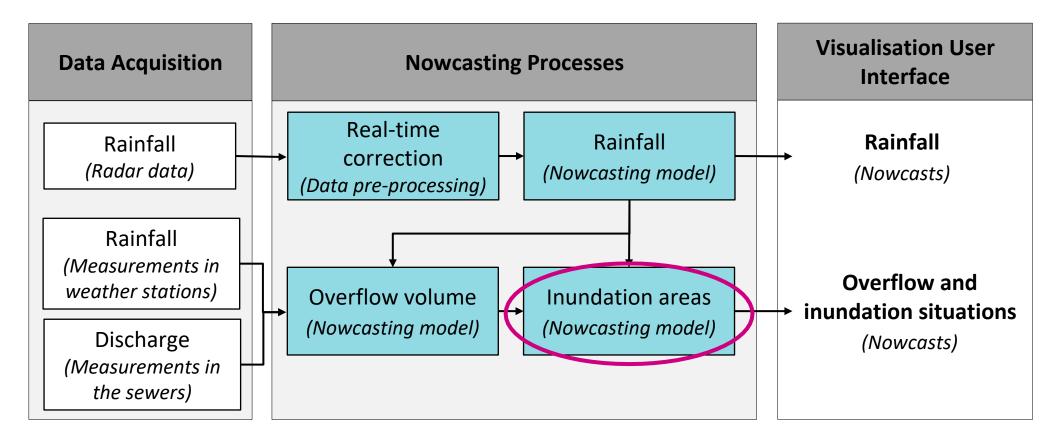
Real-time warning system with application of AI models

novo

- To better localise inundation areas
- To provide more detailed information to the crisis management team
- To increase warning times

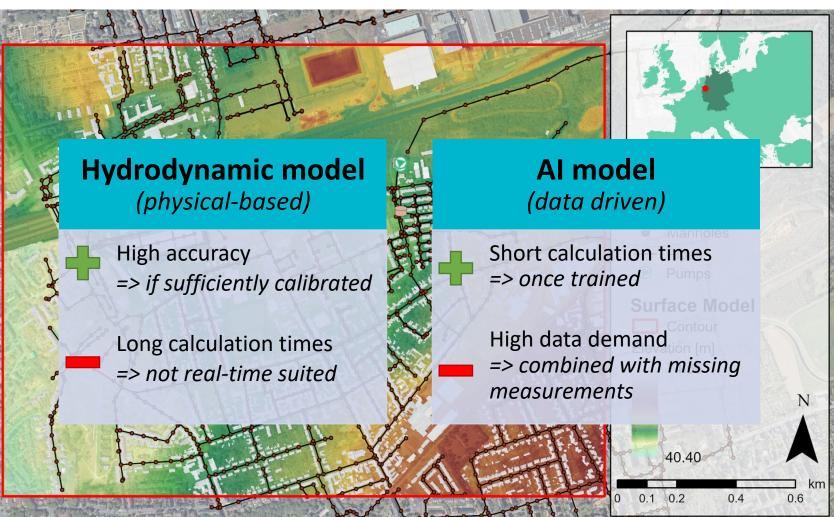
KIWaSuS Research Project

• Development of a chain of AI-models to predict a spatio-temporal sequence of inundation areas for the study area during a heavy rainfall event





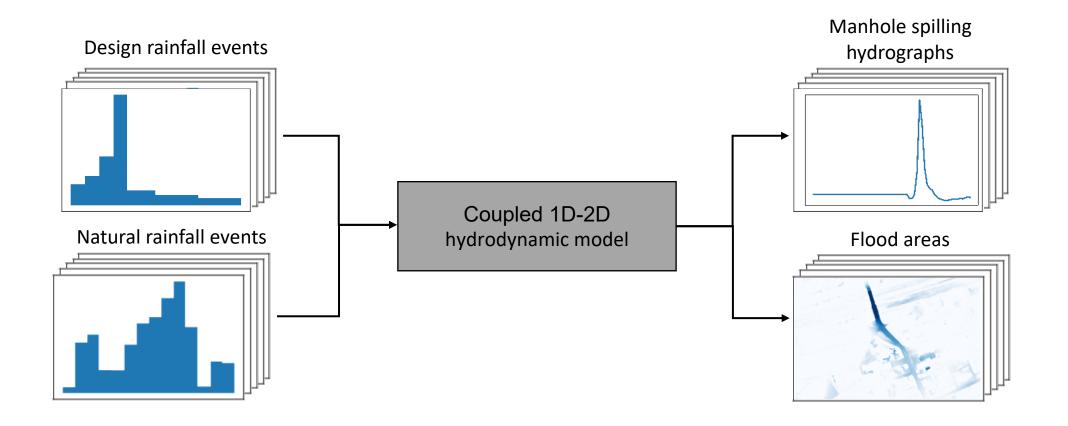
Flash-Flood Nowcasting Study area



Flash-Flood Nowcasting

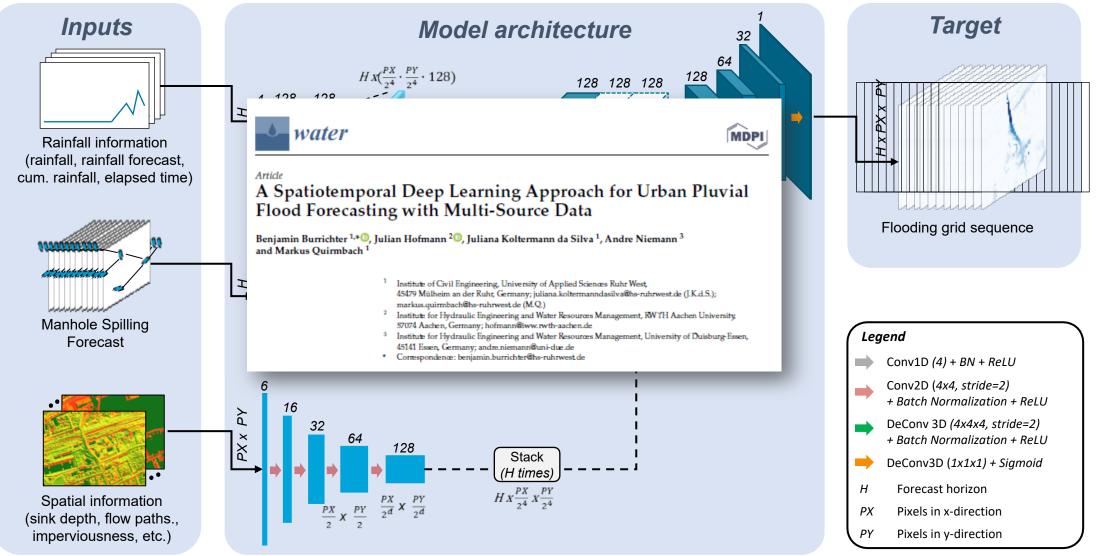


Data generation process



Flash-Flood Nowcasting

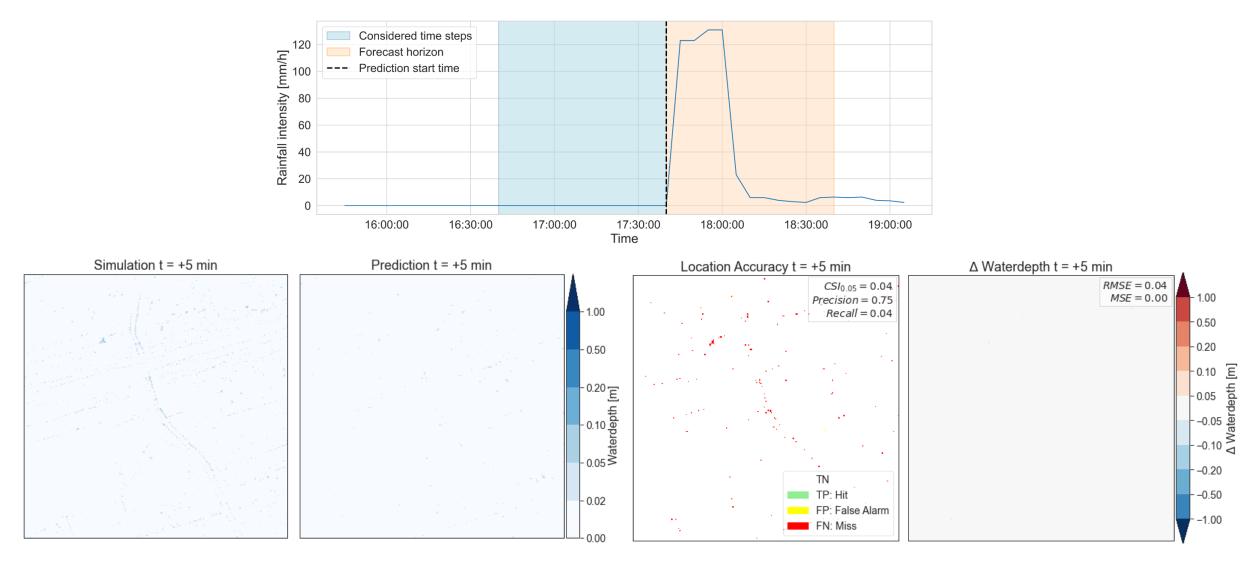
Model architecture





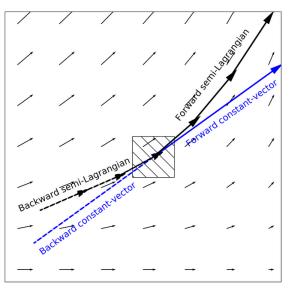
Flash-Flood Nowcasting

Preliminary results: Extreme Event Forecast (T > 200 a)

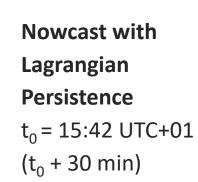


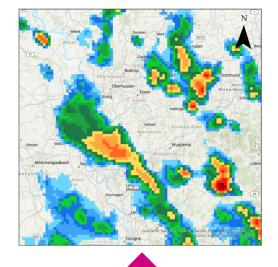
Current practice

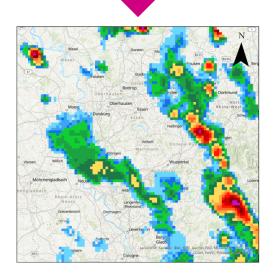
- Lagrangian Persistence:
 - Determination of motion field
 - Advection of the latest radar image according to this motion field
- Growth and decay of rainfall cells not considered



(Ayzel, G., Heistermann, M., and Winterrath, T.: Optical flow models as an open benchmark for radar-based precipitation nowcasting (rainymotion v0.1), Geosci. Model Dev., 12, 1387-1402, https://doi.org/10.5194/gmd-12-1387-2019, 2019.)







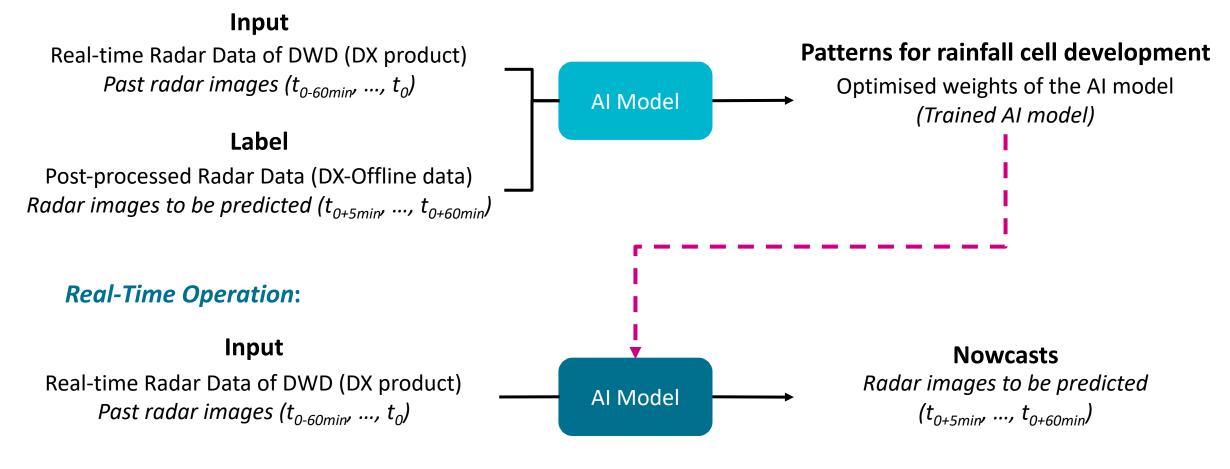


Radar measurement 16:12 UTC+01



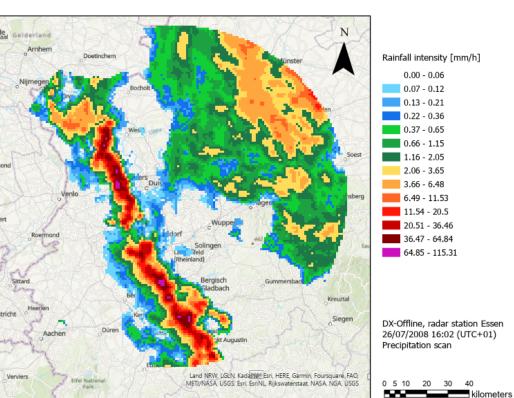
Rainfall Nowcasting AI-based approach

Training:



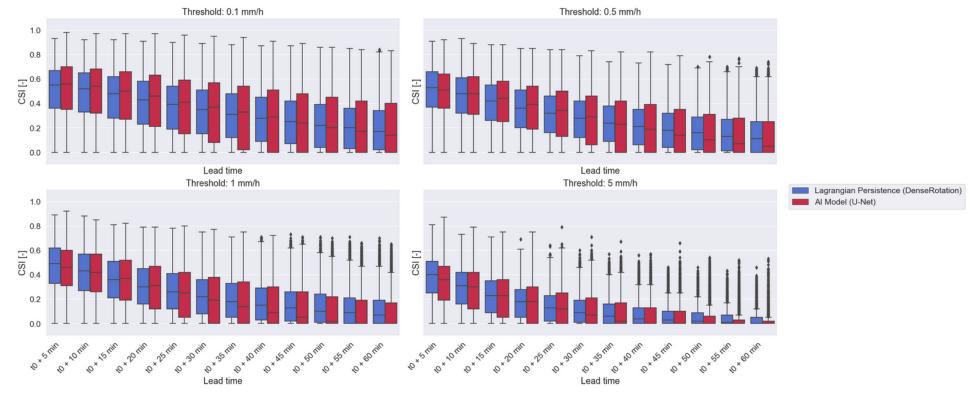
Data description and selection

- Radar data from one radar station
 - Precipitation Scan
 - Radius = 80 km
- Two qualities of data
 - Input = Raw corrected to clutter and attenuation
 - Label = Extensively corrected with adjustment to rainfall measurements from WS
- Selection of relevant rainfall events
 - T≥3a
 - 15 ≤ D ≤ 240 min



Preliminary results

- Similar performance to Lagrangian Persistence: lower rainfall intensity values are relatively well predicted for short lead times
- Extreme imbalanced dataset: circa 7% of the rainfall intensity values greater than 0.5 mm/h
- This result is not adequate for the nowcasting of heavy rainfall events



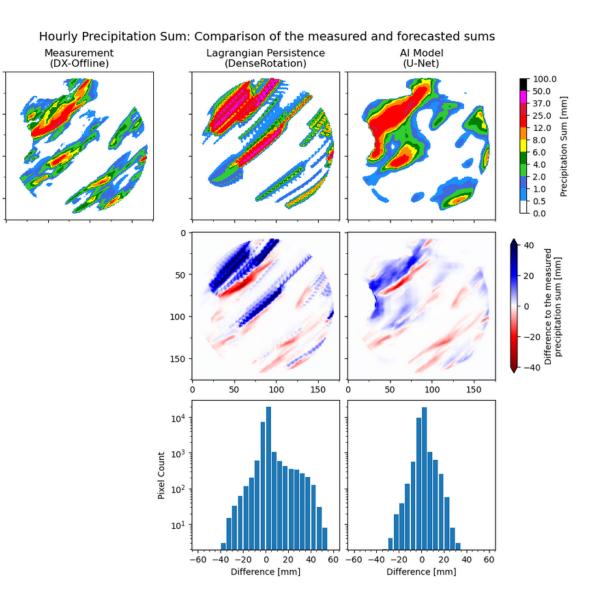


Preliminary results

 Hourly precipitation sums show already promising results, but further optimisations are required

20/07/2019 14:00 -20/07/2019 15:00 (UTC00) 00 00 05

 Improvement needed of the classical architectures to better predict the higher rainfall intensities and heavy rainfall events



Conclusions



Flood Nowcasting

- ML-Models are potentially able to predict inundation areas within a few seconds
- The quality of the output depends mainly on the accuracy of the rainfall nowcasting and the hydrodynamic model used for the data generation

Rainfall Nowcasting

- Rainfall nowcasting model needs to be further optimised to improve the performance on relevant rainfall intensity thresholds
- Classical model architectures and loss functions seem to be inadequate to deal with the complex high-spatio temporal interdependencies and the imbalanced dataset, respectively



NÔVATECH L'eau dans la ville Urban water

STAIL POLE ERU & TERRITOIRES

Thank you very much for the attention!

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Merci beaucoup pour votre attention!

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Über uns v Projektbeschreibung v Aktuelles Dokumente v Kontakt

KIWaSuS – KI-basiertes Warnsystem vor Starkregen und urbanen Sturzfluten

https://kiwasus.de/

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