GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

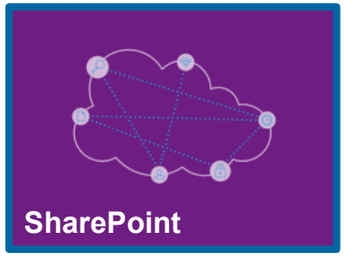
KIWASUS

AI-based early warning system against heavy rainfall and urban flash flooding

(KI-basiertes Frühwarnsystem vor Starkregen und urbanen Sturzfluten)

neusta analytics & insights

Competence extract of neusta



Experts for Artificial Intelligence

We are the experts for Artificial Intelligence at team neusta.

As a service provider with a focus on software development, we realize intelligent solutions for our customers.

Close to science and research

Close cooperation with universities

Sponsorship projects

Knowledge4Retail
Innovationswettbewerb *„KI als Treiber für volkswirtschaftlich relevante Ökosysteme“*

Bundesministerium für Wirtschaft und Energie

KIWaSuS
Förderrichtlinie *„Künstliche Intelligenz in der zivilen Sicherheitsforschung“*

Bundesministerium für Bildung und Forschung

SmaLeTax
Förderrichtlinie *„Zukunftsfähige Unternehmen und Verwaltungen im digitalen Wandel“*

Bundesministerium für Arbeit und Soziales

Issues to solve

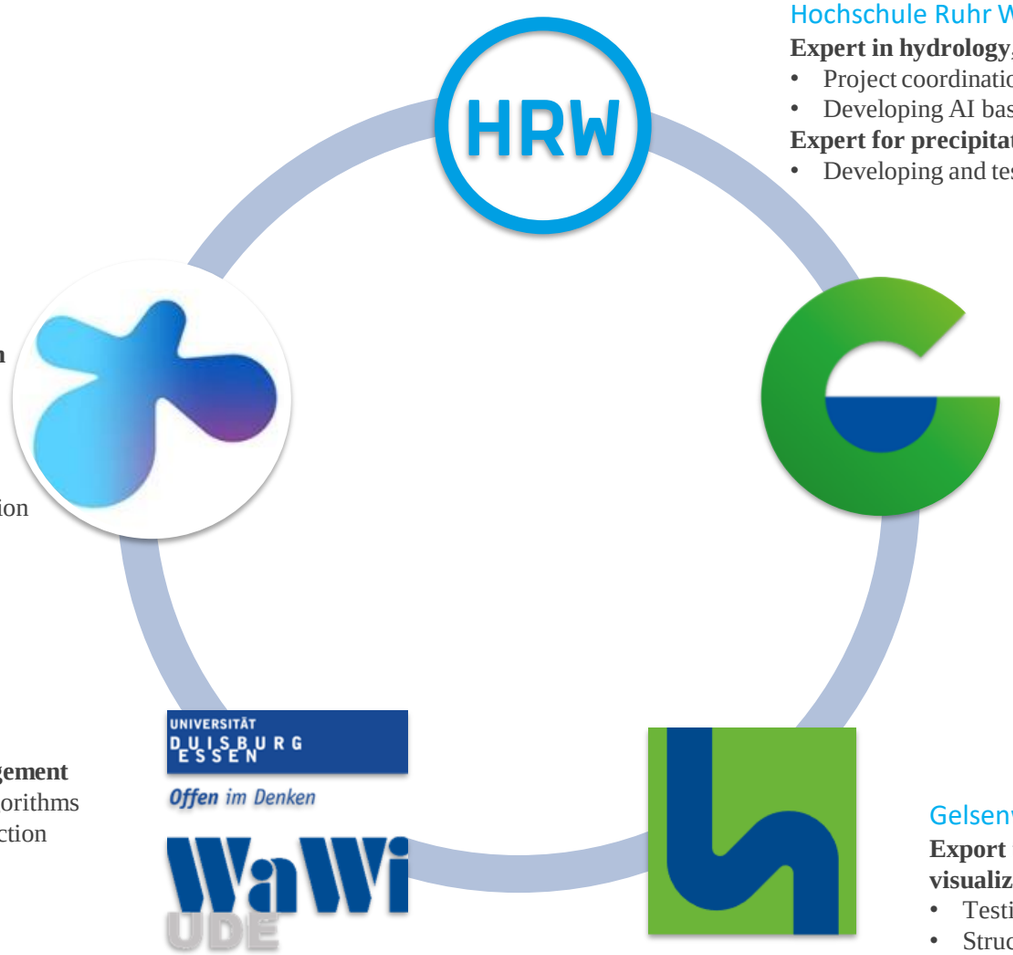
- Weather warnings are large-scale and inaccurate
  - Frequent false alarms lead to indifference among the population
- Lack of prediction of concrete flooding situations
  - Targeted warning of the population only insufficiently possible
  - No proactive action is possible in the event of an incident
  - Limited ability to act on the part of all stakeholders
- Increased security risk
  - Flooded / blocked escape routes (especially underpasses)
  - Citizens are caught by surprise and stay in places at risk of flooding

Solution approach

- Real time warning and management system für urban flash floods based on AI models
  - Providing detailed information for communal crisis management
  - Better localization of precipitation amounts and floodings
  - Increasing advance warning time significantly

KIWaSuS Consortium (Homepage: www.kiwasus.de)

Project partners



Hochschule Ruhr West

Expert in hydrology, urban drainage (HRW BI)
- Project coordination
- Developing AI based prediction models

Expert for precipitation sensors (HRW MST)
- Developing and testing low-cost rain sensors

neusta analytics & insights

Expert for AI, data platforms and specialist application development
- Developing the data platform
- Supporting the development of AI based algorithms
- Developing an intuitive visualization interface

Abwassergesellschaft Gelsenkirchen mbh

End users (network experts)
- Provisioning data
- Defining requirements
- Workshops and practical tests
- Implementation in the municipal warning and action concept for crisis situations

Universität Duisburg Essen

Expert for data quality management
- Developing AI based test algorithms
- Developing automated correction procedures

Gelsenwasser AG

Export for drainage sensors, data transmission and visualization interfaces
- Testing a low-cost drainage sensor
- Structuring a low-cost measuring network (Sensors+LoWaWAN)
- Developing an intuitive visualization interface

Data

Requirements

Associated project partners

LANUV Kompetenz für ein lebenswertes Land

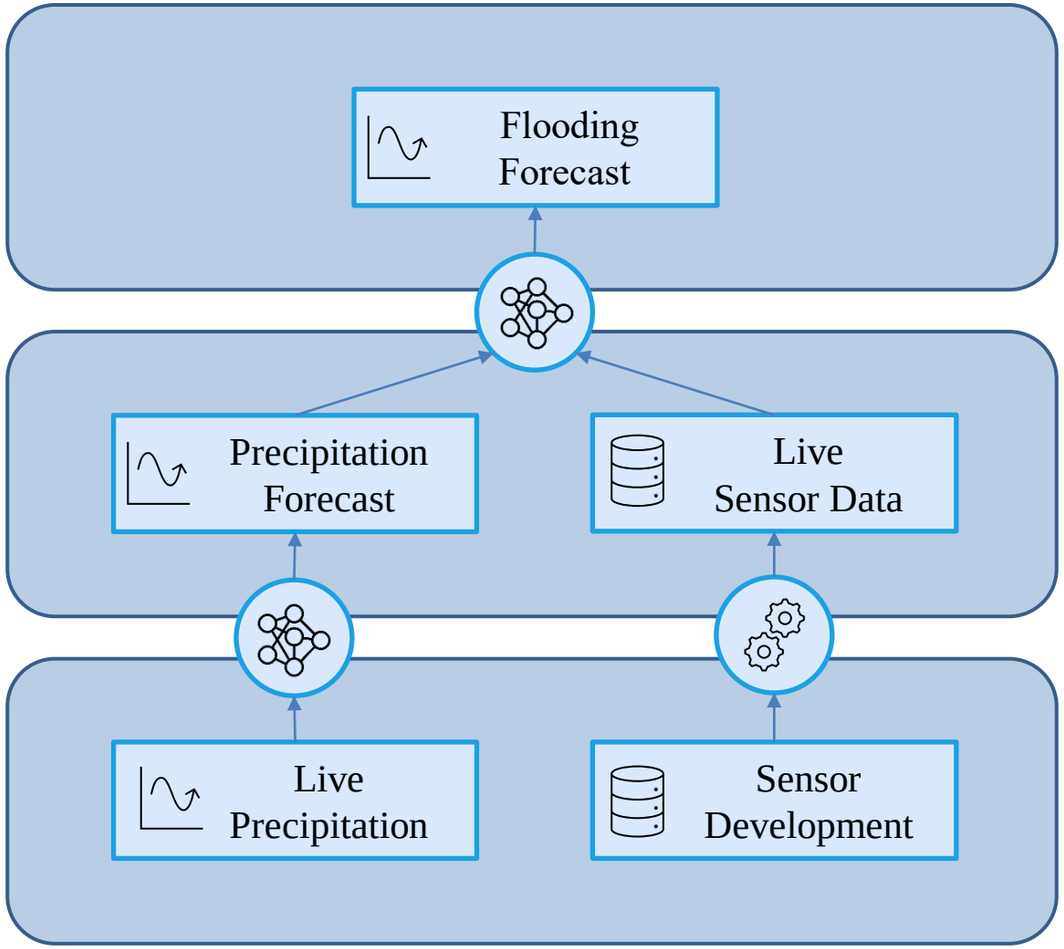
EMSCHER LIPPE GENOSSENSCHAFT EGLV VERBAND

LAMBRECHT meteo

Feuerwehr/Rettungsdienst

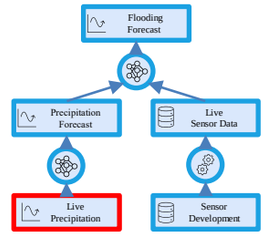
Stadt Gelsenkirchen

Modeling problem

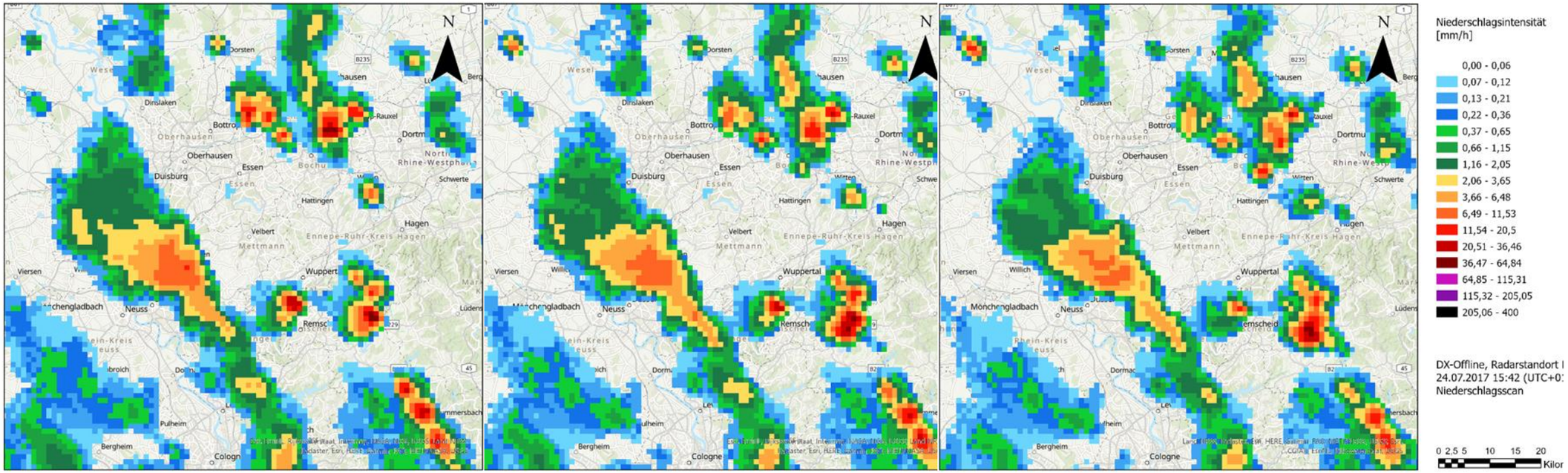


Precipitation forecast

Understanding radar data



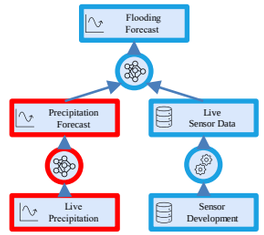
03:32 p.m. 03:37 p.m. 03:42 p.m.



Raster images with a resolution of 1 km x 1 km and a value for each cell and timestamp

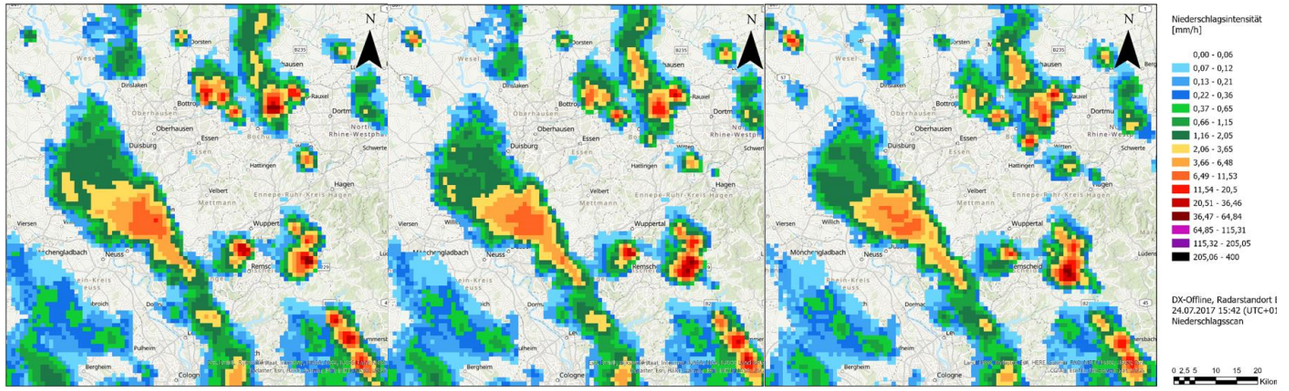
Precipitation forecast

Understanding the prediction problem

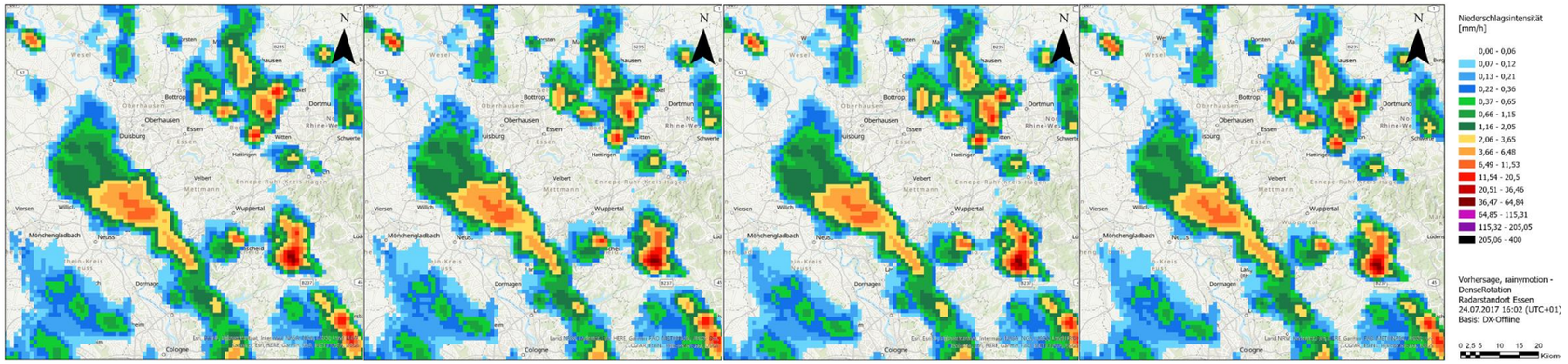


03:32 p.m. 03:37 p.m. 03:42 p.m.

Real Data



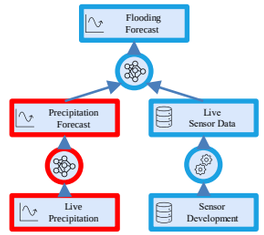
Predictions



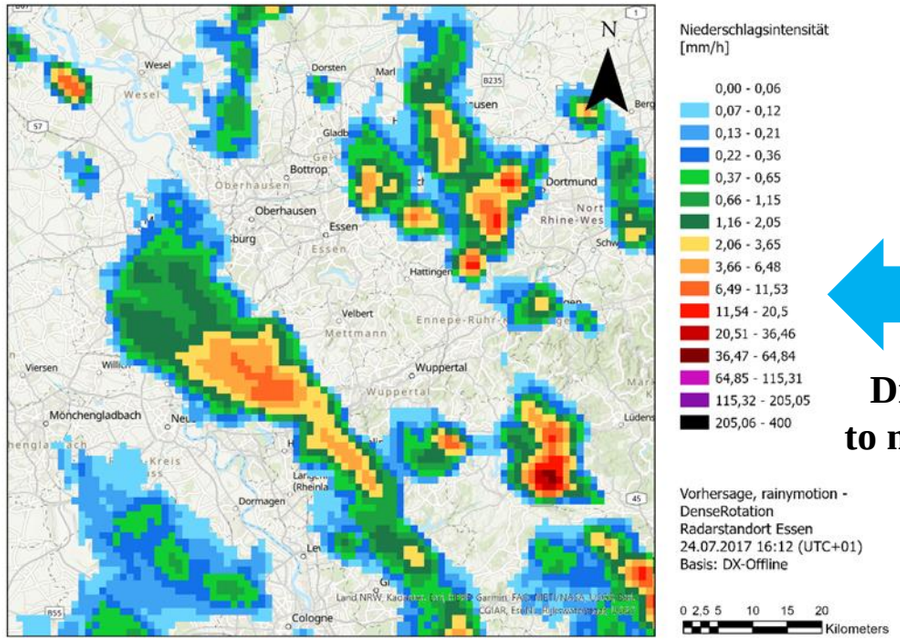
03:47 p.m. **(+ 05 min)** 03:52 p.m. **(+ 10 min)** 03:57 p.m. **(+ 15 min)** 04:02 p.m. **(+ 20 min)**

Precipitation forecast

Understanding the prediction problem

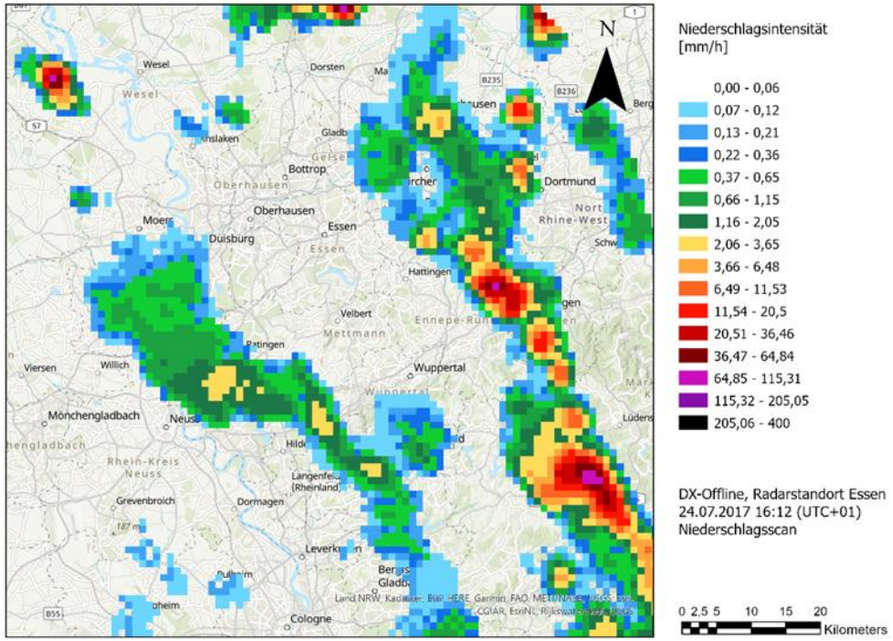


Prediction for 04:12 p.m.
Based on radar images of 03:42 p.m.



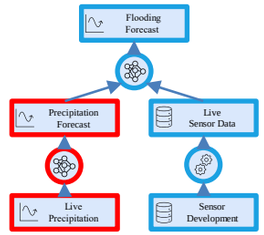
Difference to minimalize

Real radar image for 04:12 p.m.



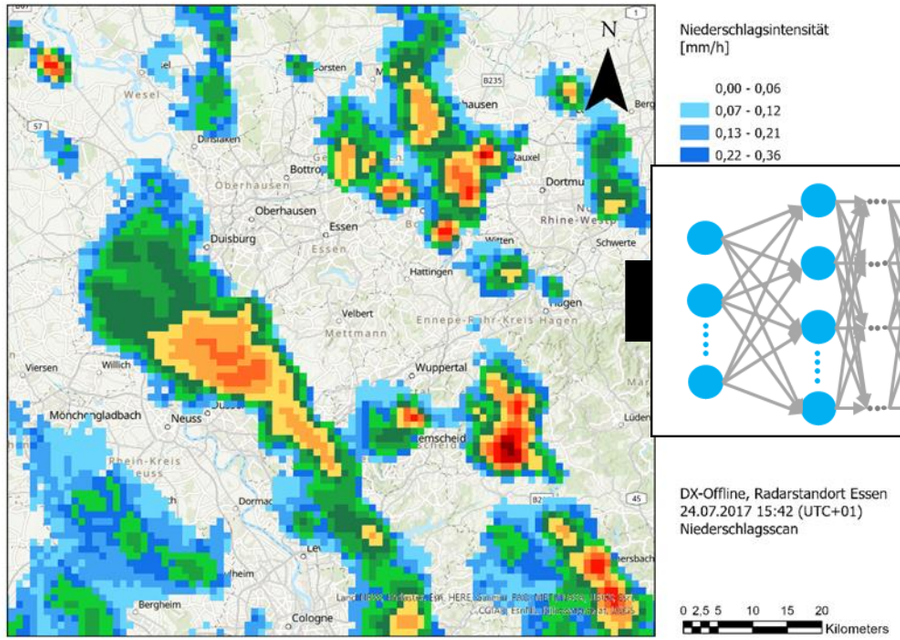
Precipitation forecast

Understanding the prediction problem



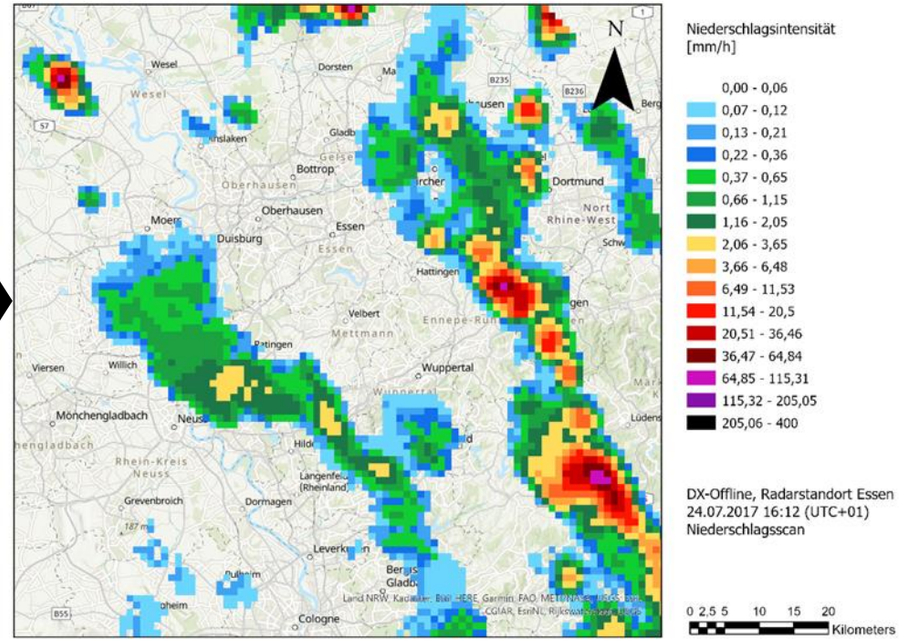
Current radar image

(Timestamp t_0)



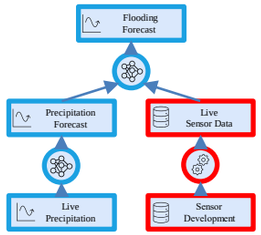
Prediction

(Timestamp $t_{+n\ min}$)

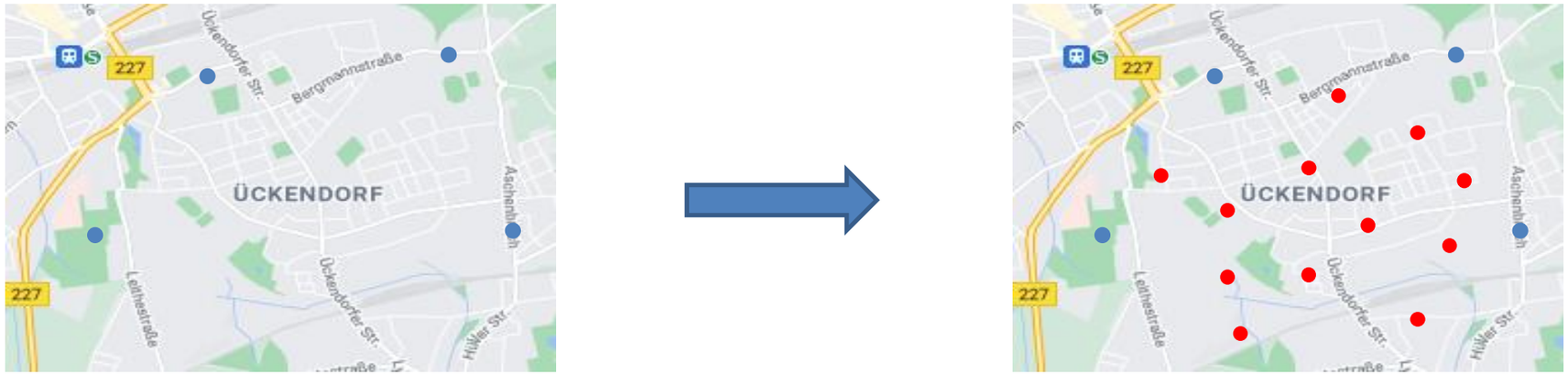


Creating additional data

Increasing the spatial coverage of the data

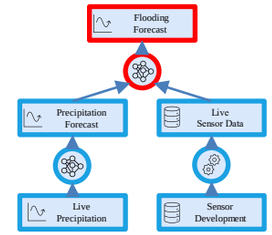


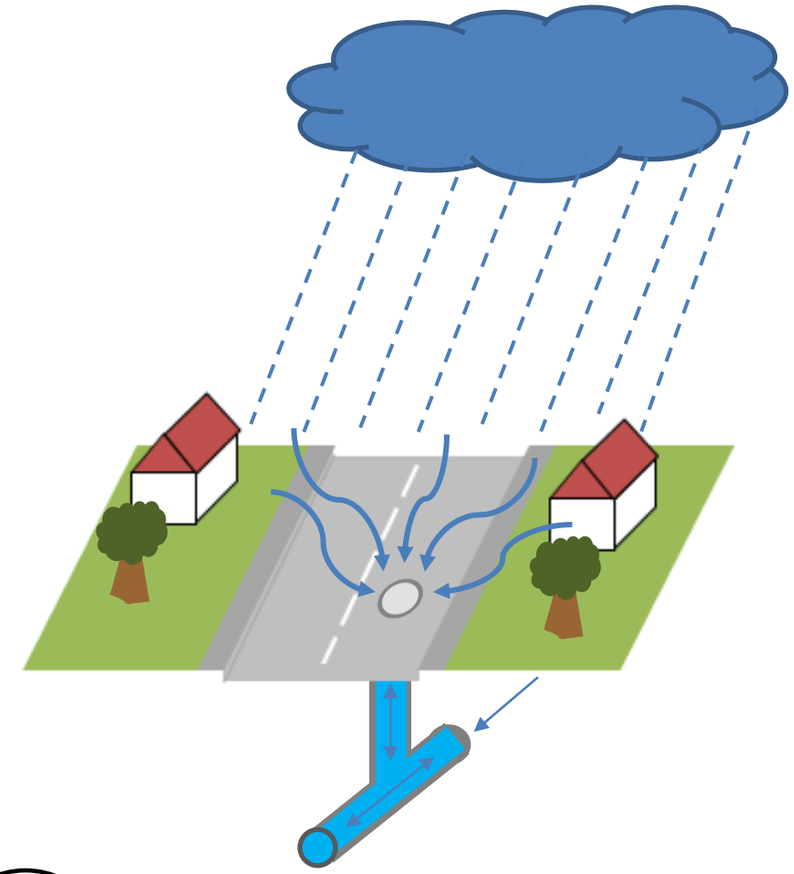
- Sensor density is low
  - ➢ New sensors need to be installed
- Conventional sensors are too expensive to be spread throughout a large area
  - ➢ Low-cost sensors are developed and installed
- Measurements of high-cost sensors can be used to calibrate and validate the measurements of low-cost sensors

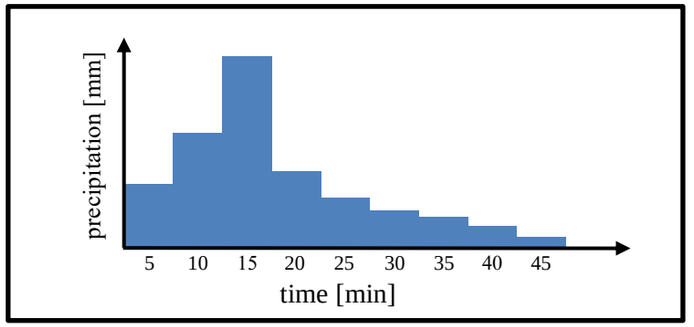


Discharge and flooding forecast

Physically based approach (sewage network model)





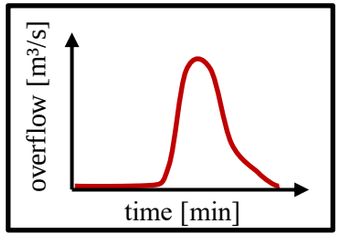


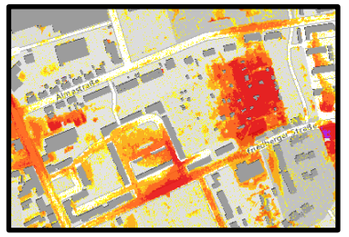
runoff formation process

runoff concentration process

runoff transformation process

runoff division and storage





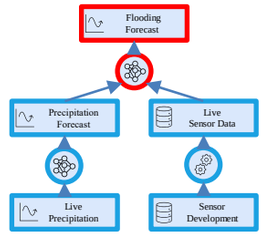
system load

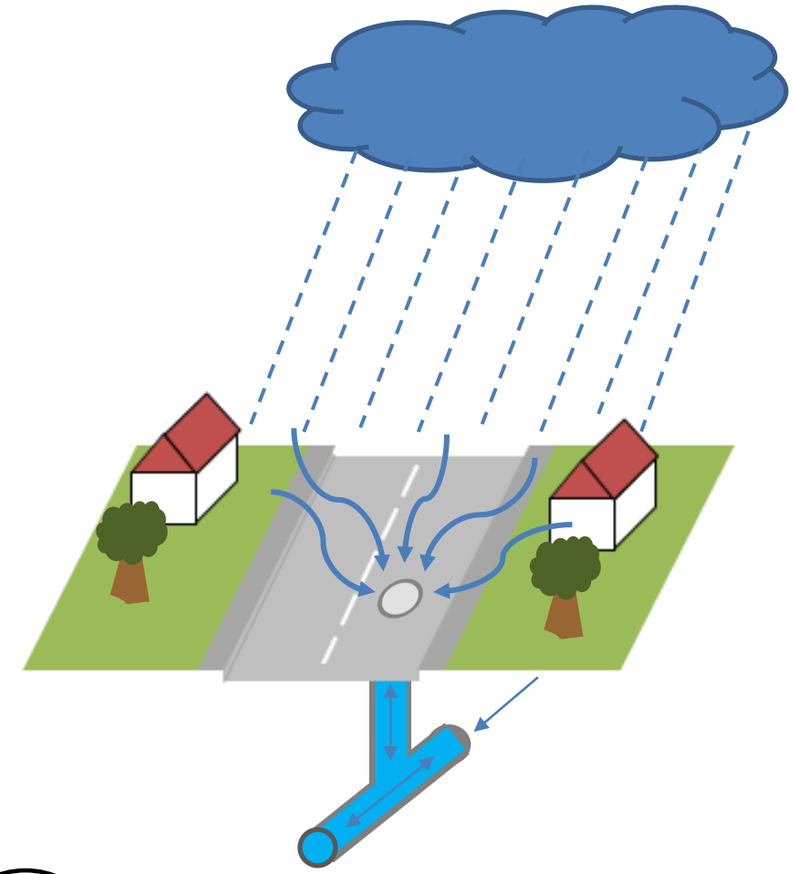
processes to be mapped

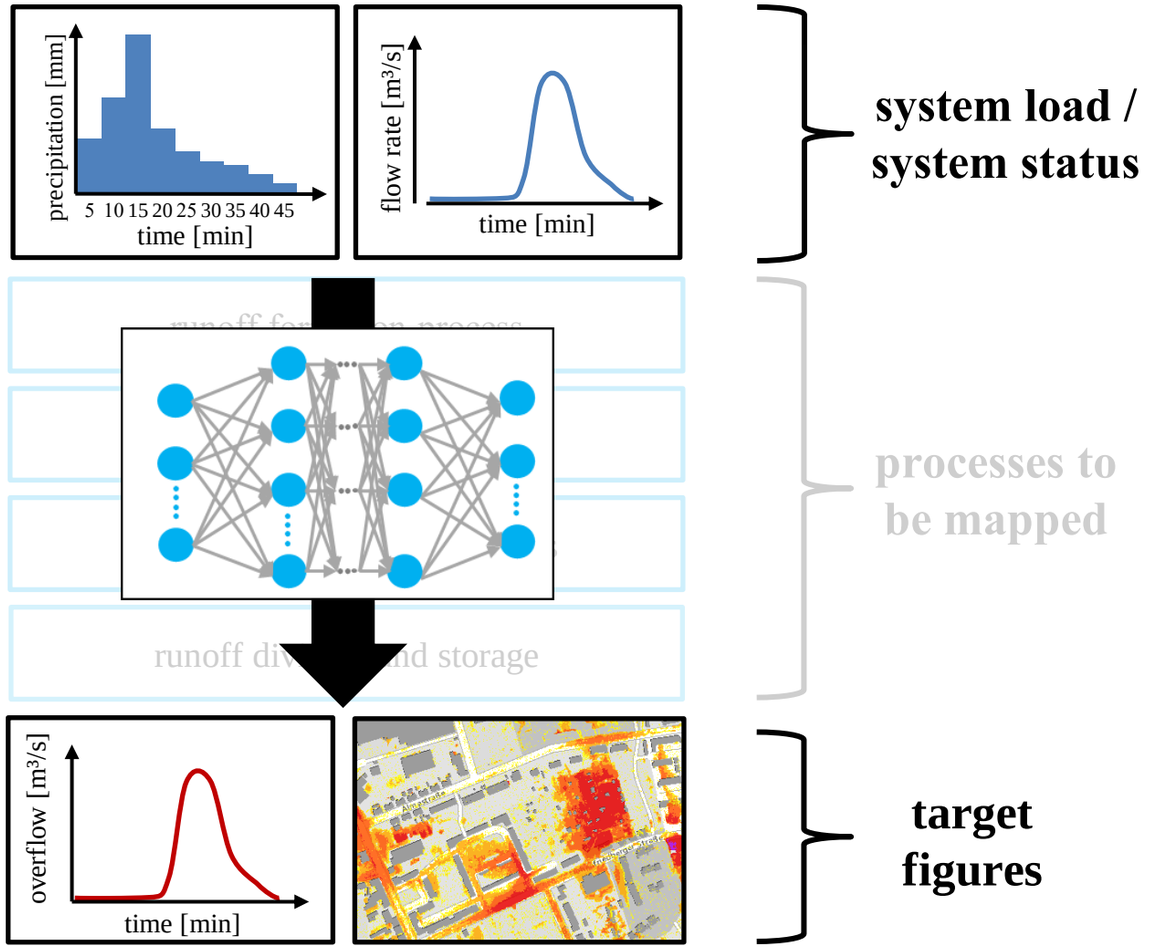
target figures

Discharge and flooding forecast

Use of machine learning techniques for runoff and flood forecasting







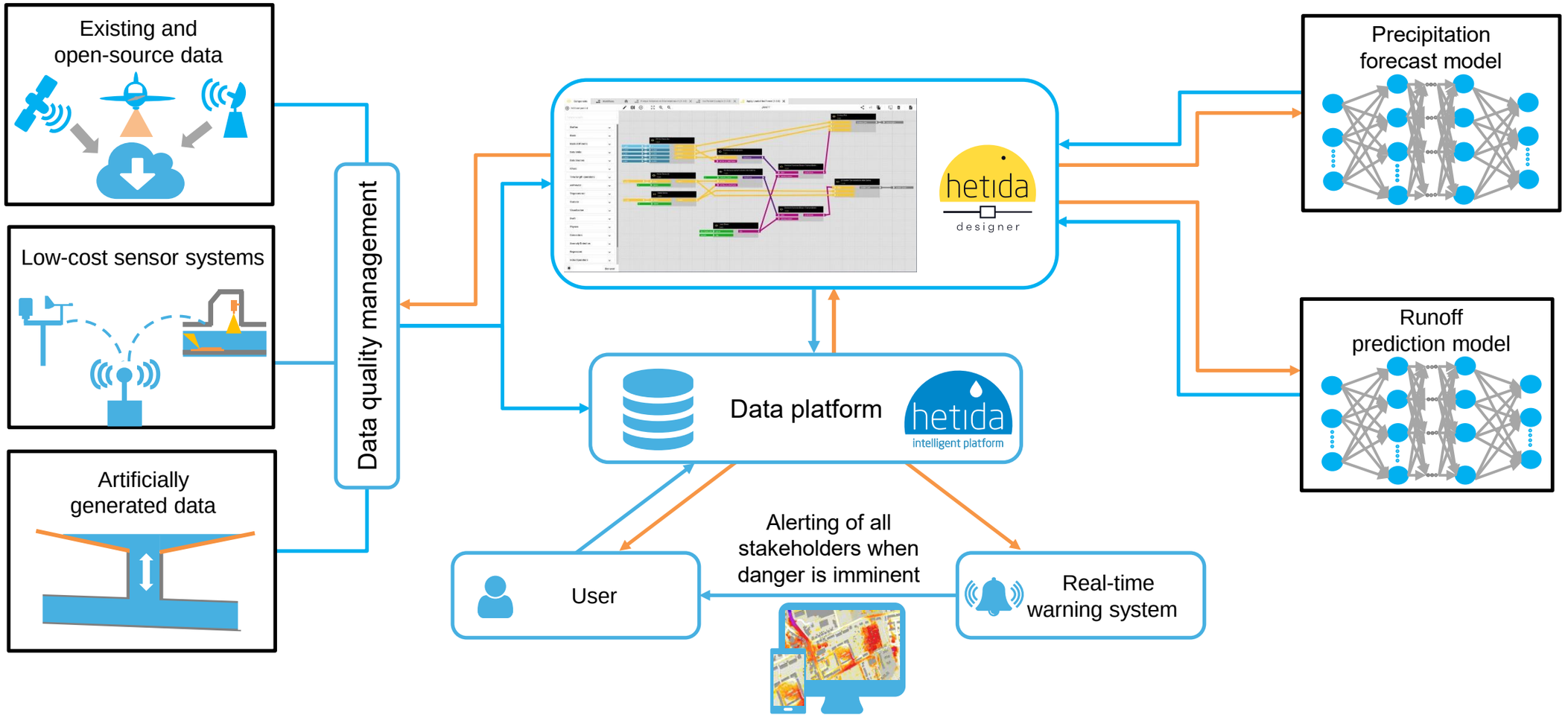
Data platform

Data challenges

- Big Data
  - 50+ measuring devices (rain gauges, flow sensors, etc.), every minute
  - Radar data from DWD (17,000 data points for 2 million timestamps), 5-minutely
  - Forecasts: 5-minutely for 2-hour forecasts
  - Master data
  - Simulation data
- Data management
  - IoT connection
  - Persistence and organization
  - Spatial and temporal reference between data
- Real time analysis and visualization

Composition real-time warning system

Integration of all data and results into a central data platform



Thank you for your attention!