



**Figures have been removed from this presentation for publication**

# KI**WA**SUS

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



FH MÜNSTER  
University of Applied Sciences



Universität Bremen



Deutsches  
Forschungszentrum  
für Künstliche  
Intelligenz GmbH



HOCHSCHULE RUHR WEST  
UNIVERSITY OF APPLIED SCIENCES



LPS LERN- UND  
FORSCHUNGSFABRIK



Technische  
Hochschule  
Georg Agricola



Forschungsinstitut für  
Wasser- und Abfallwirtschaft  
an der RWTH Aachen e.V.



Fraunhofer

### 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



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## 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](http://www.kiwasus.de))

## Project partners

### 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

### Universität Duisburg Essen

**Expert for data quality management**

- Developing AI based test algorithms
- Developing automated correction procedures

### 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

### 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

### Gelsenwasser AG

**Expert 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

## Associated project partners



### Feuerwehr/Rettungsdienst



Data

Requirements

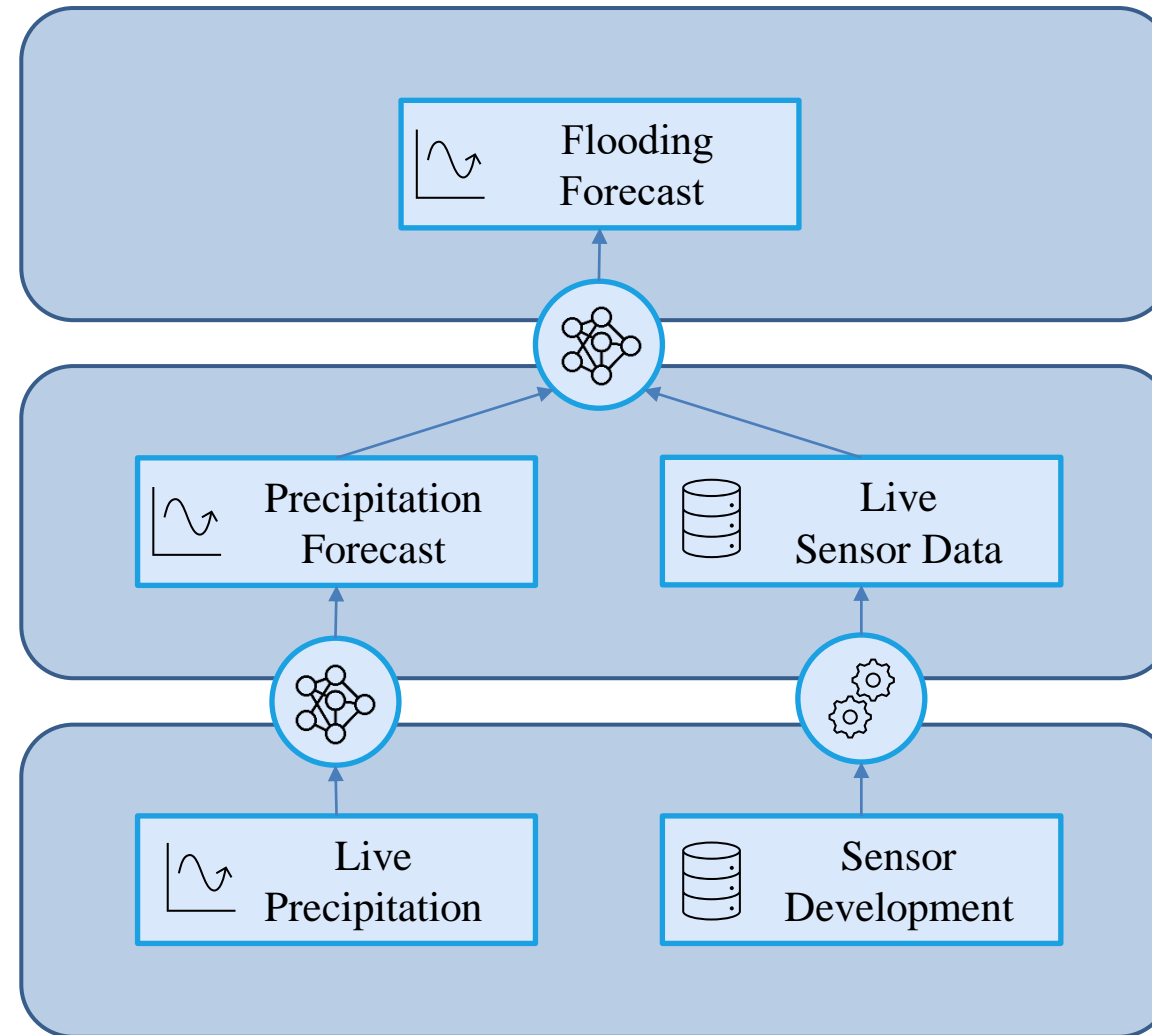


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# Modeling problem

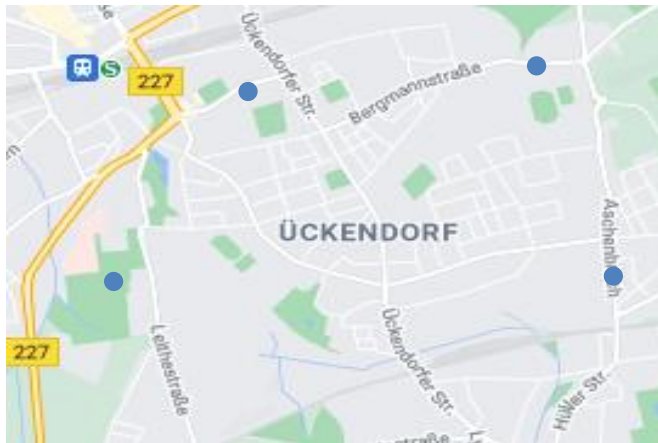
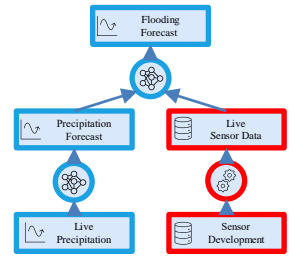




# Creating additional data

Increasing the spatial coverage of the data

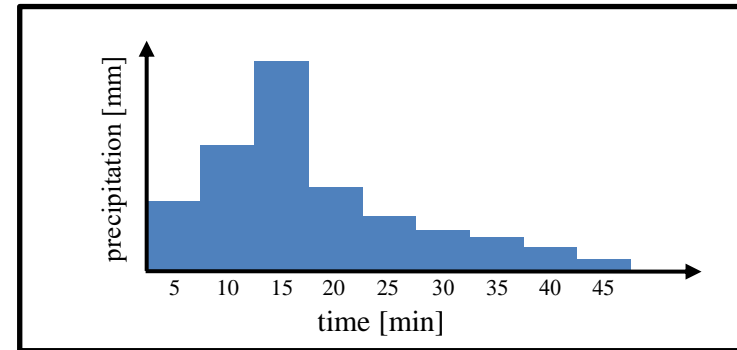
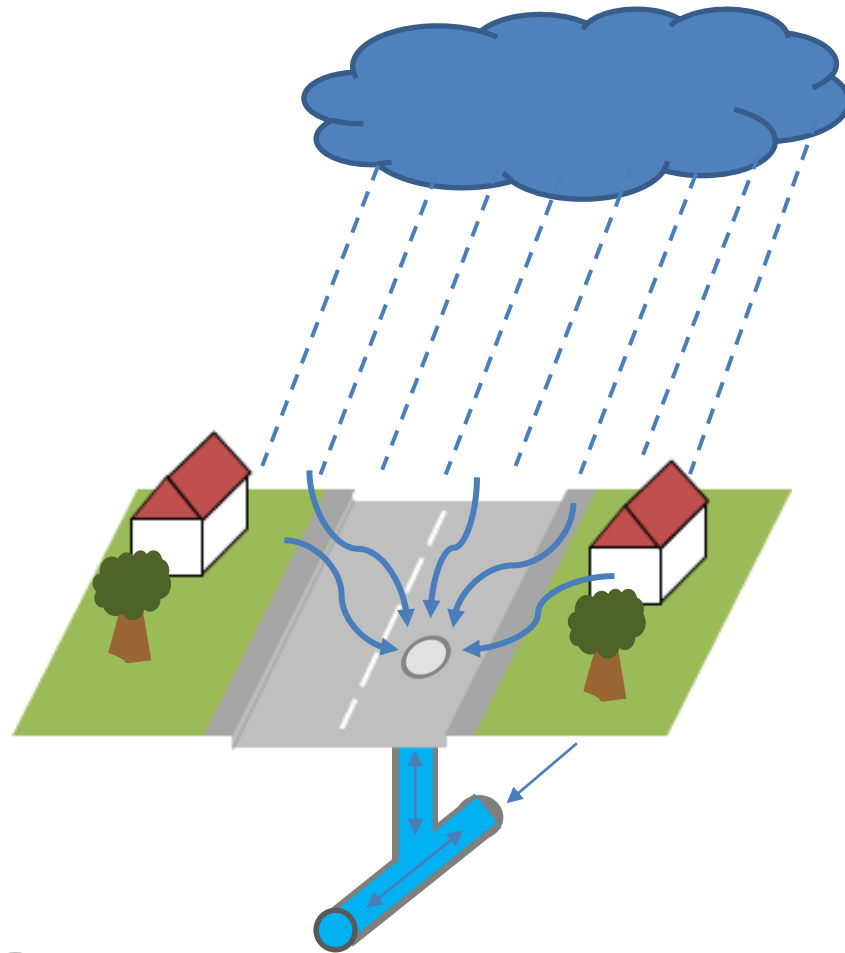
- Sensor density is low
  - New sensors need to be installed
- Conventional sensors are too expensive to be spread throughout a large area
  - Low-cost sensors are developed and installed
- Measurements of high-cost sensors can be used to calibrate and validate the measurements of low-cost sensors





# Discharge and flooding forecast

Physically based approach (sewage network model)

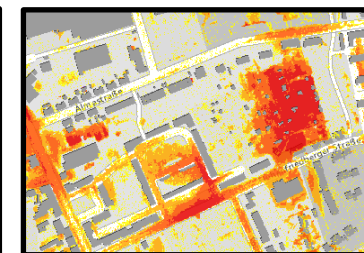
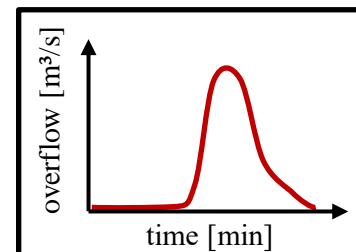


runoff formation process

runoff concentration process

runoff transformation process

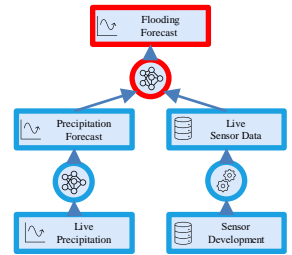
runoff division and storage



system  
load

processes to  
be mapped

target  
figures

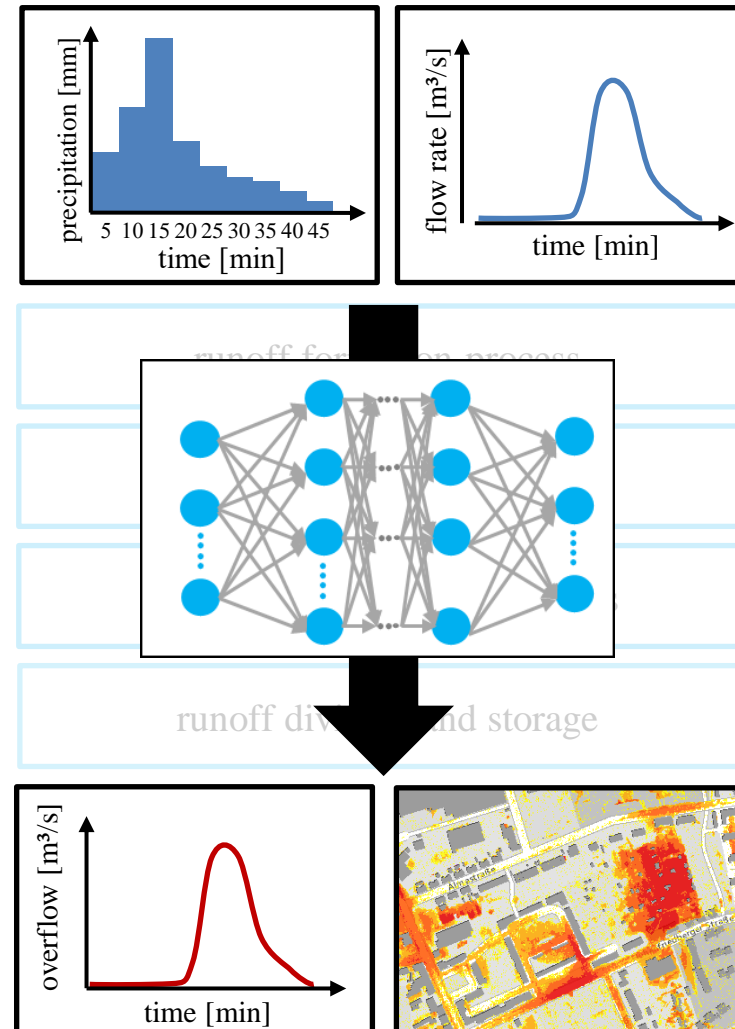
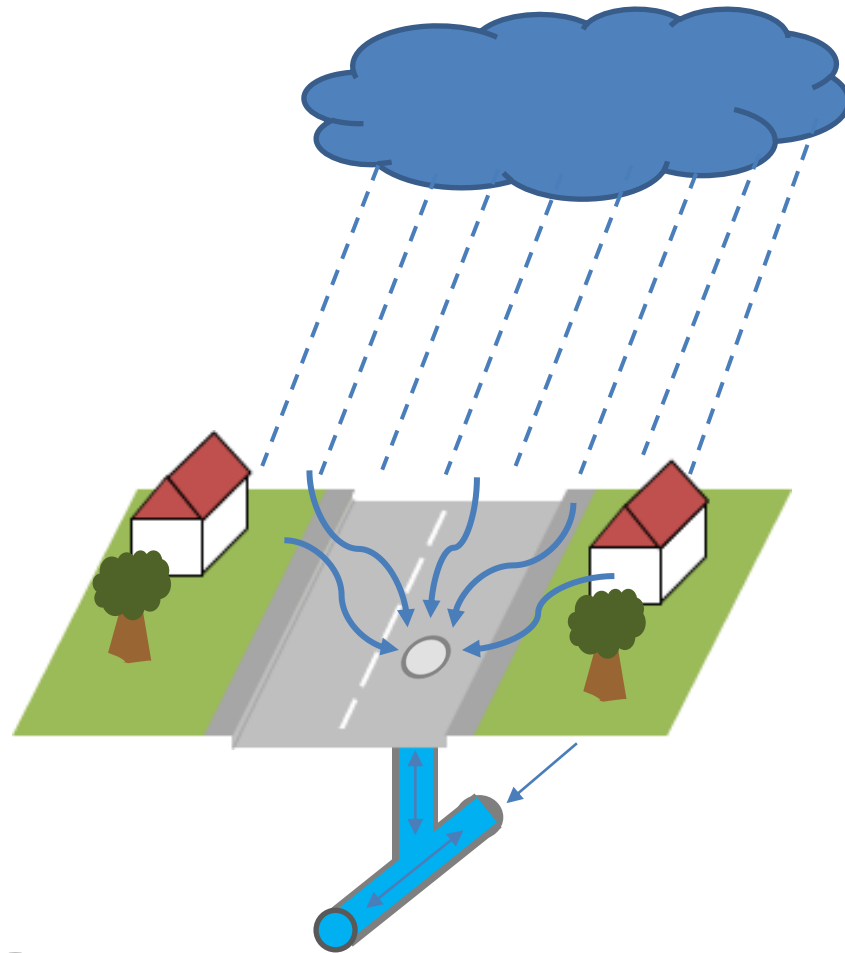
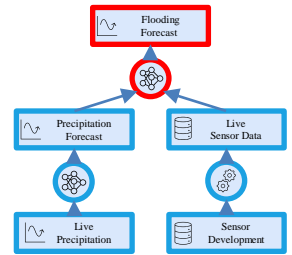






# Discharge and flooding forecast

Use of machine learning techniques for runoff and flood forecasting



system load /  
system status

processes to  
be mapped

target  
figures



# 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

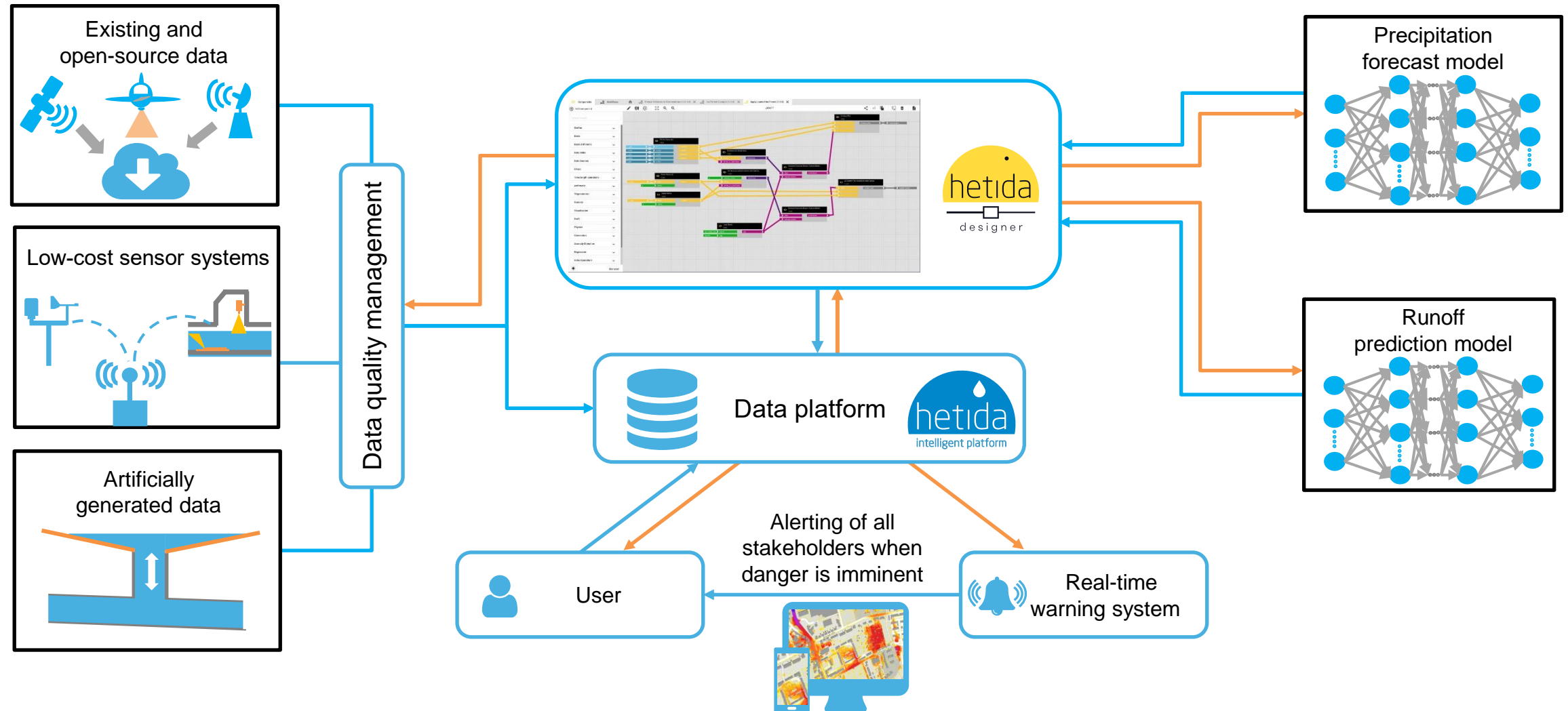
- IoT connection
- Persistence and organization
- Spatial and temporal reference between data

### ➤ 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!



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