Hind casting of the Rur-river flooding for the event 2021

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enabling delta life

Contents of today

- Hind casting of the Rur-river flooding for the event 2021

  - Characteristics of the catchment
  - Experiences from July 2021
  - My research
  - Preliminary results

Rur river: catchment

Lower catchment

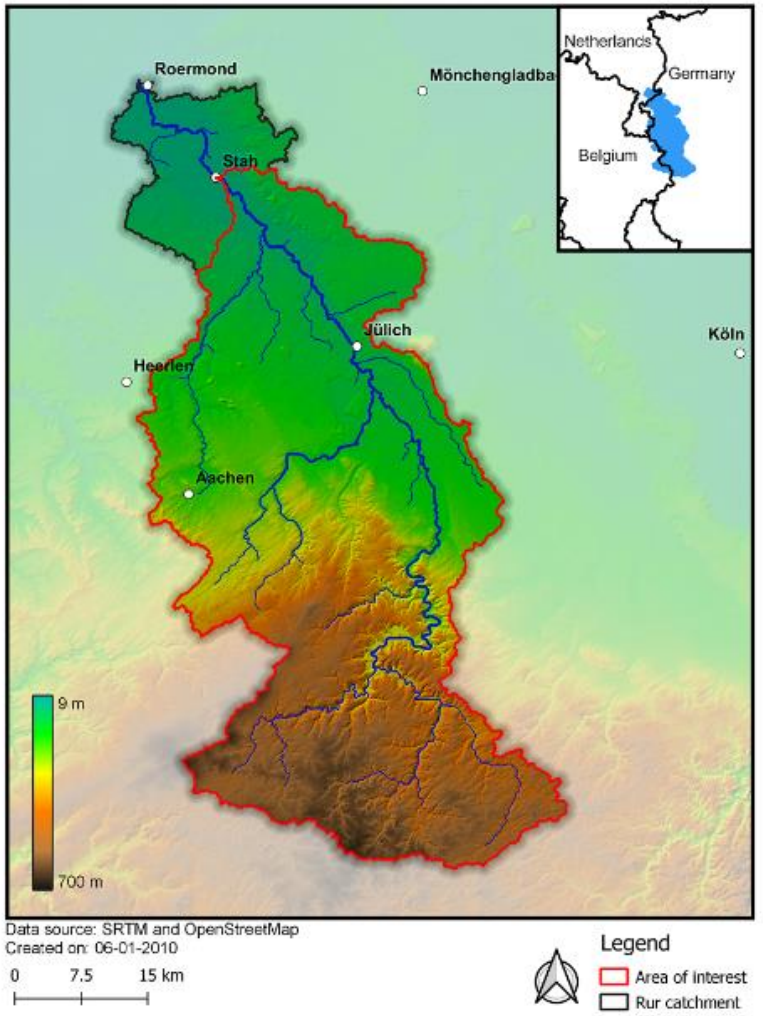
→ slow response, river flooding

- Flat urban, agricultural and industrial areas
- Eolian deposits (permeable soil)
- Presence of mining pits affecting groundwater level
- Varying precipitation and wide floodplains

Upper catchment

→ fast response, ‘flash flood’

- Eifel region with forest on steep slopes
- Solid rocks (impermeable underground)
- Presence of reservoirs
- Uniform precipitation

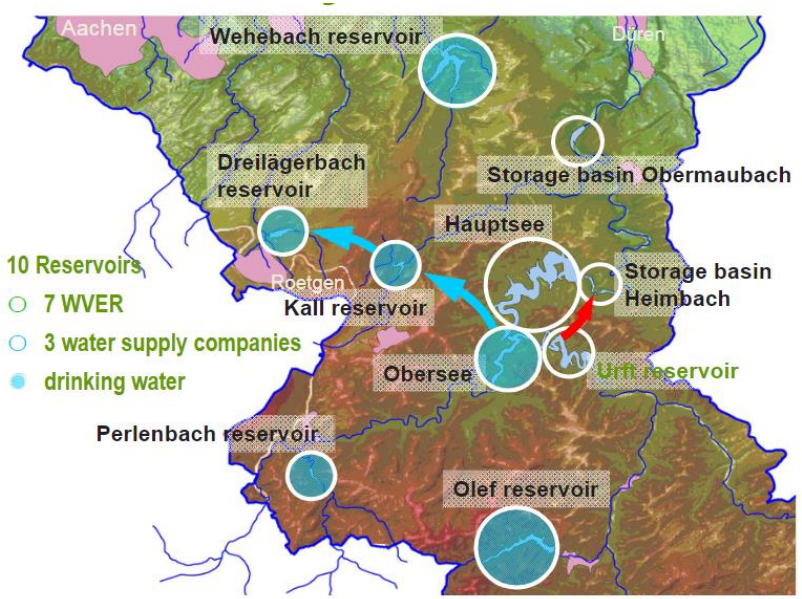


Source: Van den Munckhof (2020)

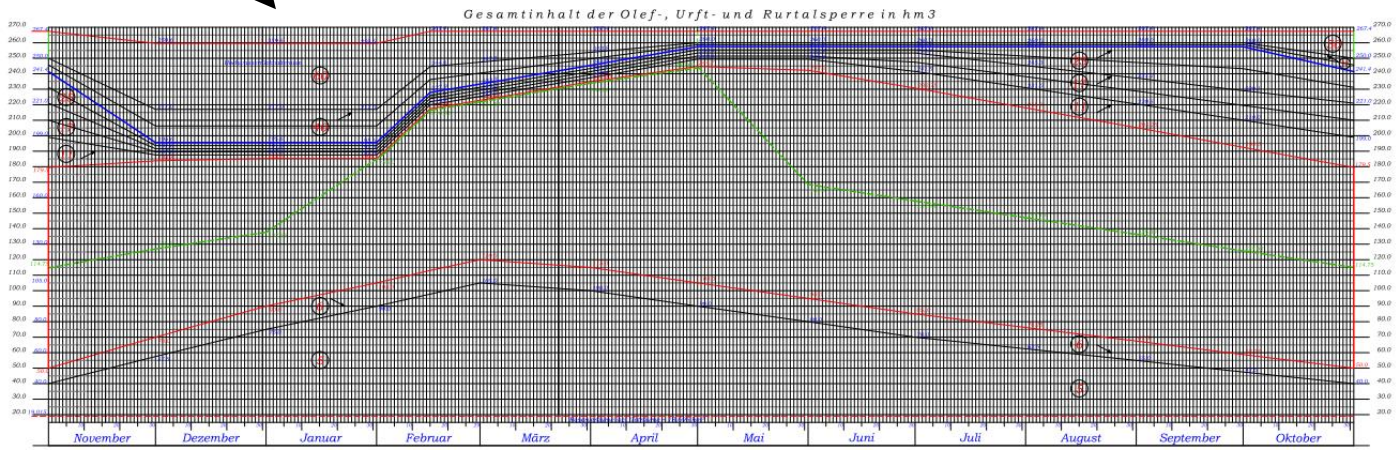
Rur river: reservoirs

Reservoirs managed by Wasserverband Eifel-Rur (WVER)

- Flood risk management (main function)
- Hydro-power and drinking water supply
- Reservoir rules based on Lamellenplan



Source: Homann (2011)



Experiences from the Limburg 2021 floods

Challenges in inundation modelling

- Dependence on measurement stations
- Accuracy of meteorological predictions

Interpretation of predictions

- Comparison to floodmaps (e.g. T100)
- Visualization of floodmaps
- Reliability / confidence intervals

Realtime radar measurements versus manual corrections afterwards
→ Challenges in meteorological predictions

Challenges in inundation modelling

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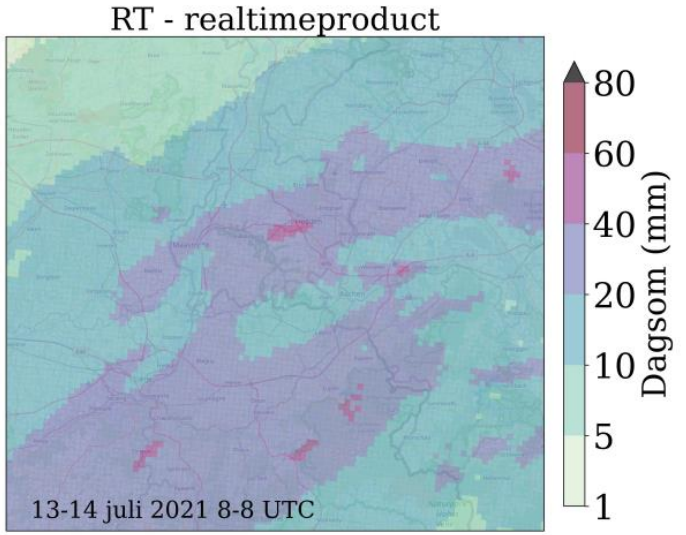

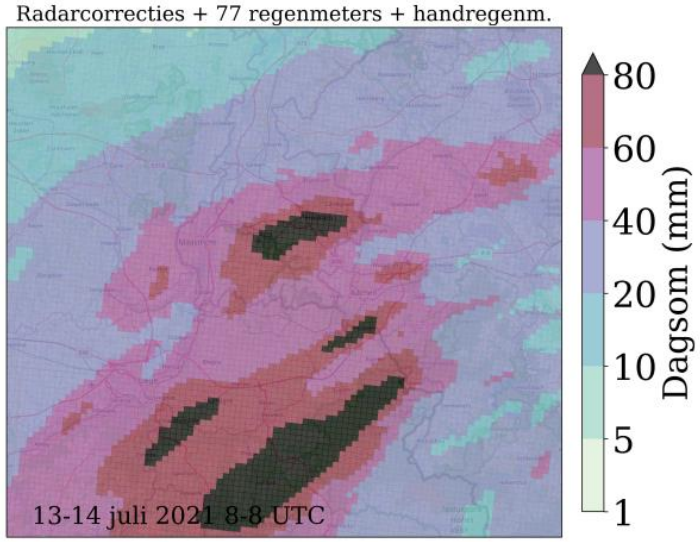

Source: A. Overeem & H. Leijense (KNMI 2021)

Challenges in inundation modelling

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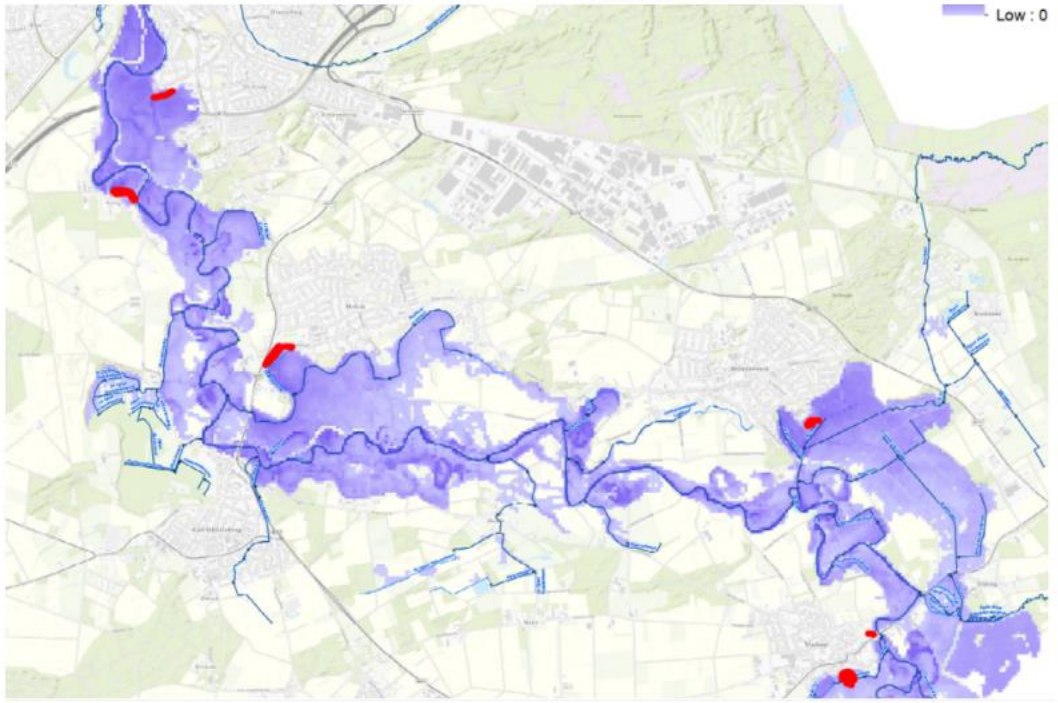

Source: https://www.limburger.nl/ - Veiligheidsregio Limburg Noord

My research

Hind casting of the Rur-river flooding for the event 2021

- Why? → Investigate which lessons we can learn from 2021 in flood forecasting
- How? → Setup an extended flood forecasting model of the Rur catchment for extreme floods

Comparison of meteorological data (forecasts + hindcasts)

Implementation of reservoir rules for discharge prediction in model

Result visualization and interpretation

My research

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Result visualization and interpretation

→ **Improve forecasting, from meteorological input to impact-based output**

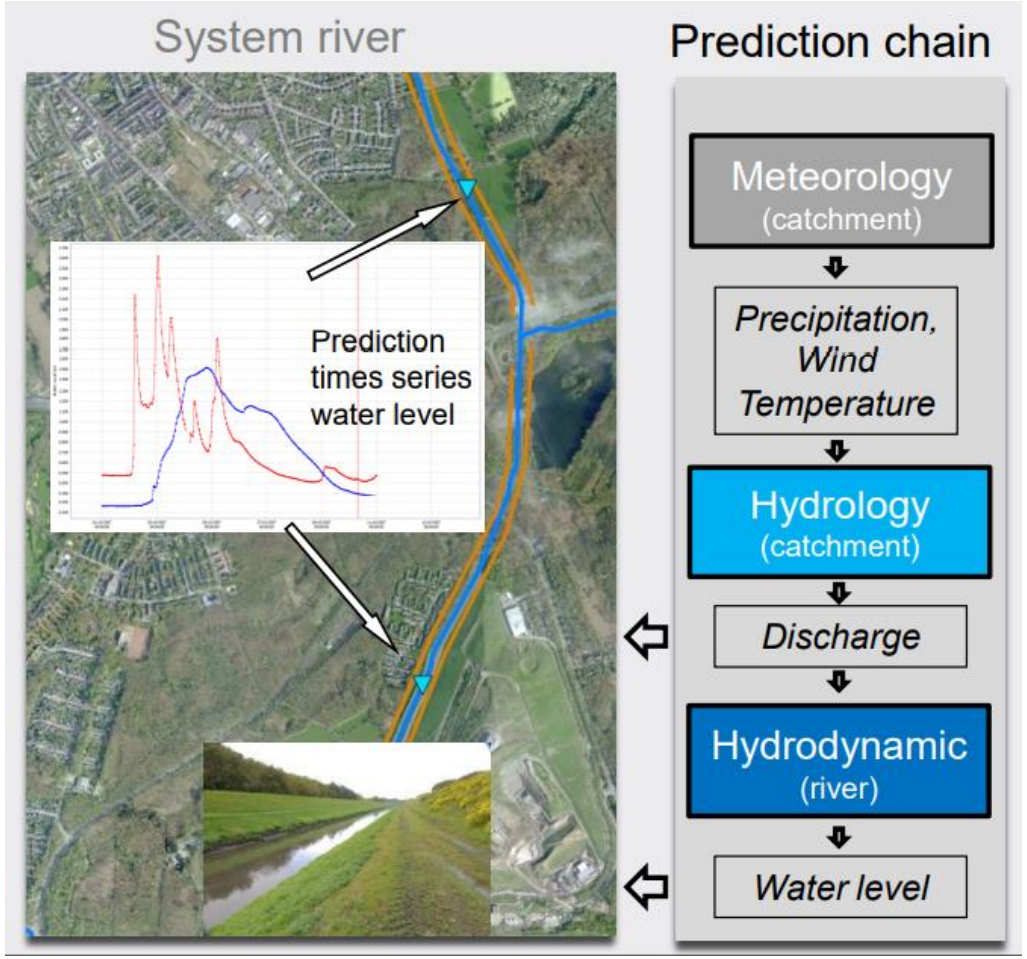
→ **Are the results different, and would we have made different choices with this knowledge?**

Collaboration between Delft University of Technology, Deltares and Hochschule Magdeburg-Stendal

Impact-based flood forecasting

Usability of the results:

- Graphs → impact-maps
- Decisions based on same forecasts (alarm-bells, risk assessment, evacuations)



Source: Bachmann (2021)

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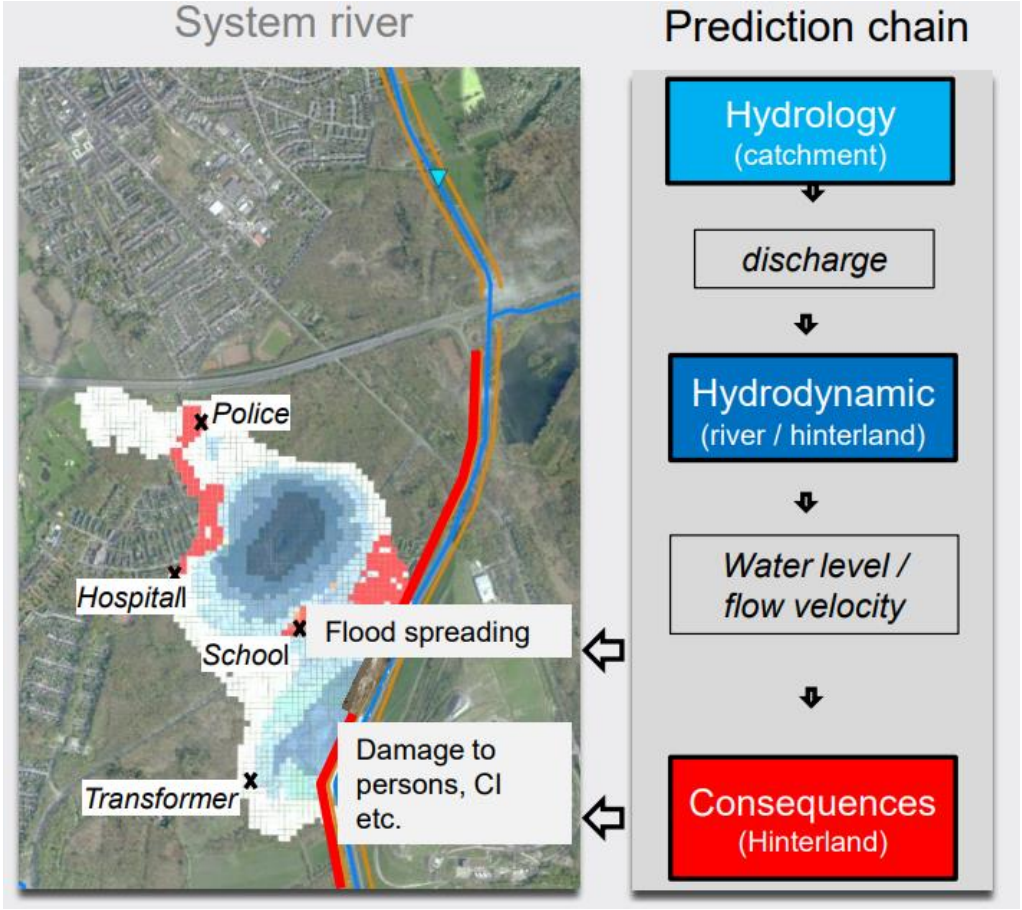


Source: Bachmann (2021)

Impact-based flood forecasting

Usability of the results:

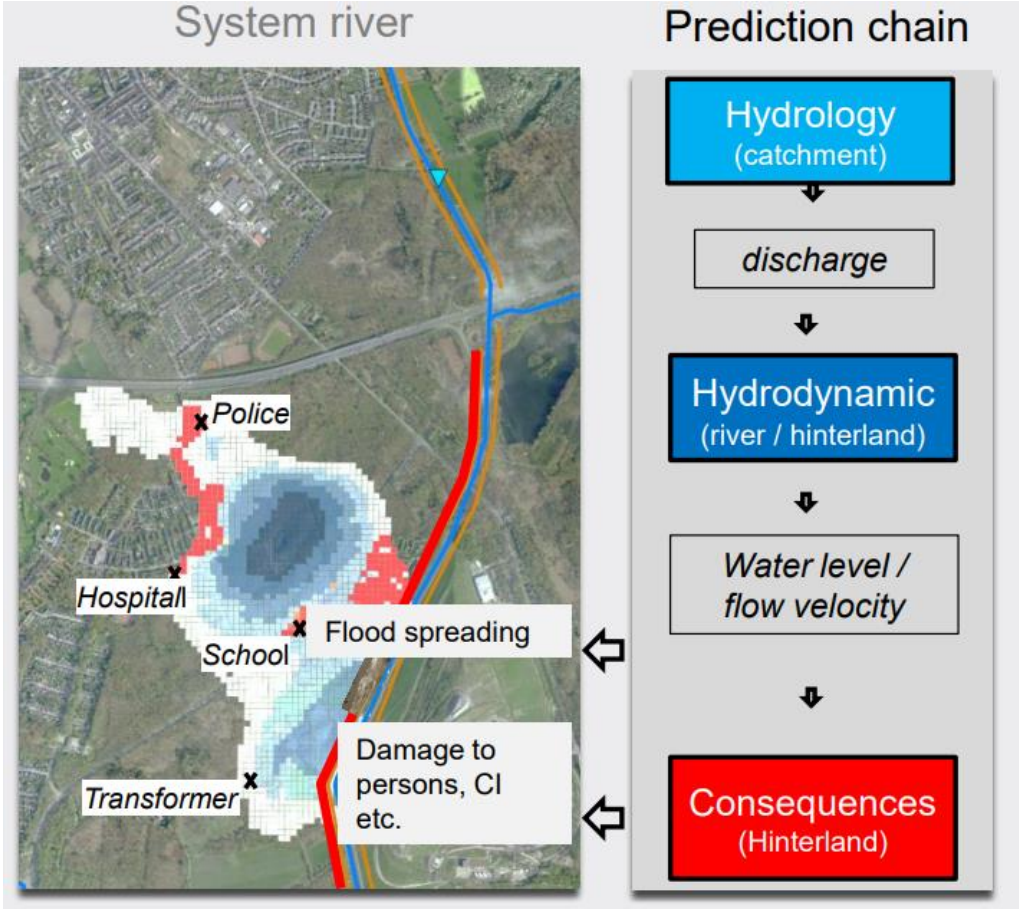
- Graphs → impact-maps
- Decisions based on same forecasts (alarm-bells, risk assessment, evacuations)

Include variability in the model:

- Traditional flood maps (TXXX)→ flood maps based on meteorological scenarios
- Communication of scenarios and probabilities

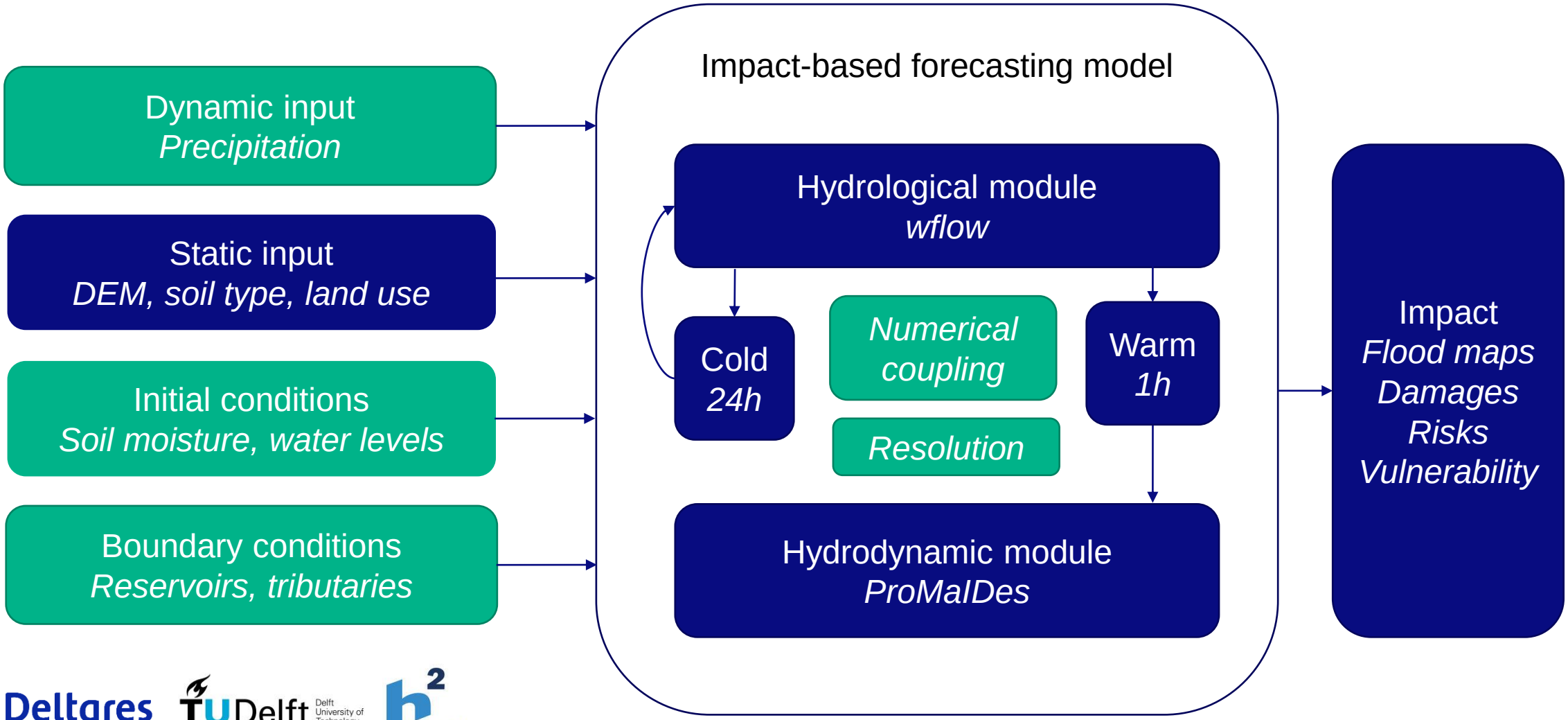
Forecasting based on real-time predictions:

- Determining factors in forecasting, “what drives the model?”
- Meteorological predictions but also hydrological responses (reservoir management)



Source: Bachmann (2021)

Model setup



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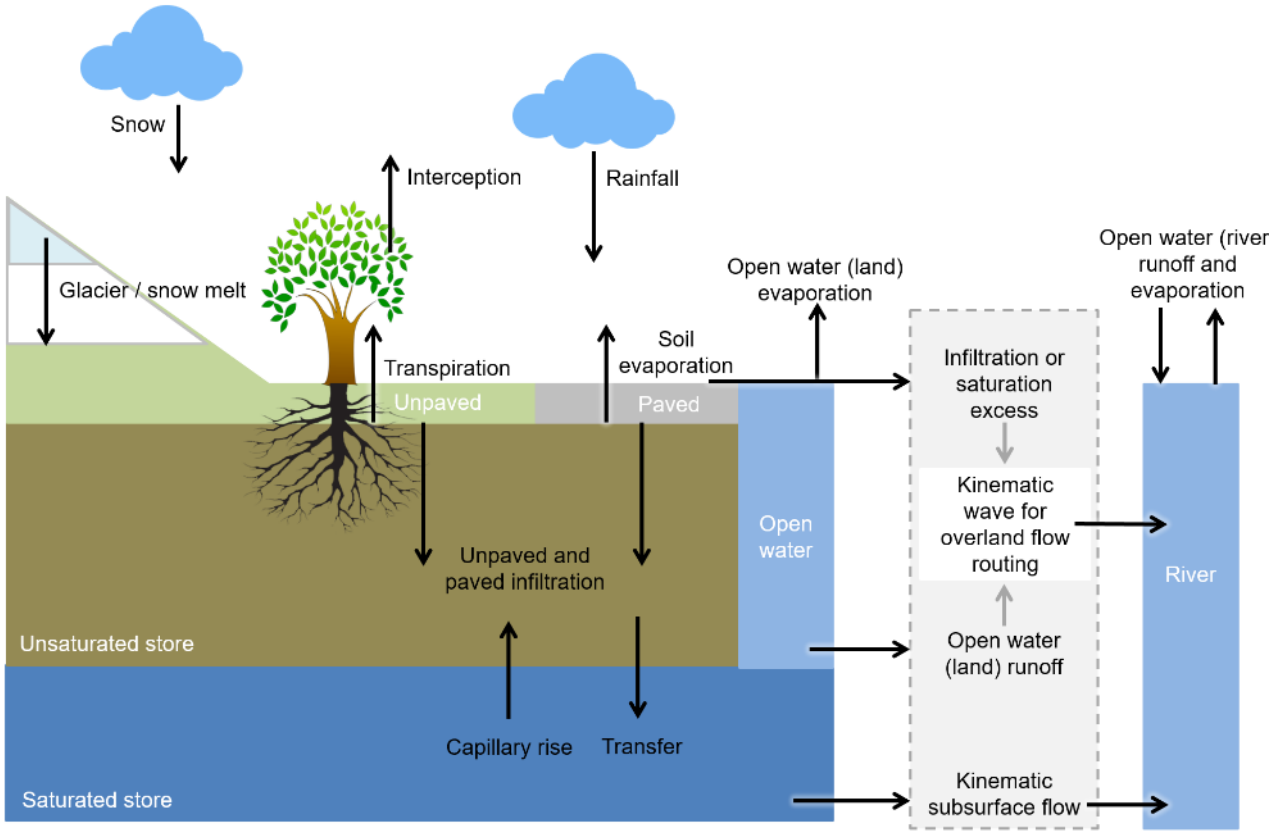
Model setup

Wflow

- Distributed hydrological model
- Based on SBM for vertical processes and D8 network routing for lateral processes
- Using HydroMT for model setup (data catalog)
- Implementing reservoir modules
- Developed by Deltares

→ Calculate inflows (boundary conditions) of Rur river using meteorological predictions



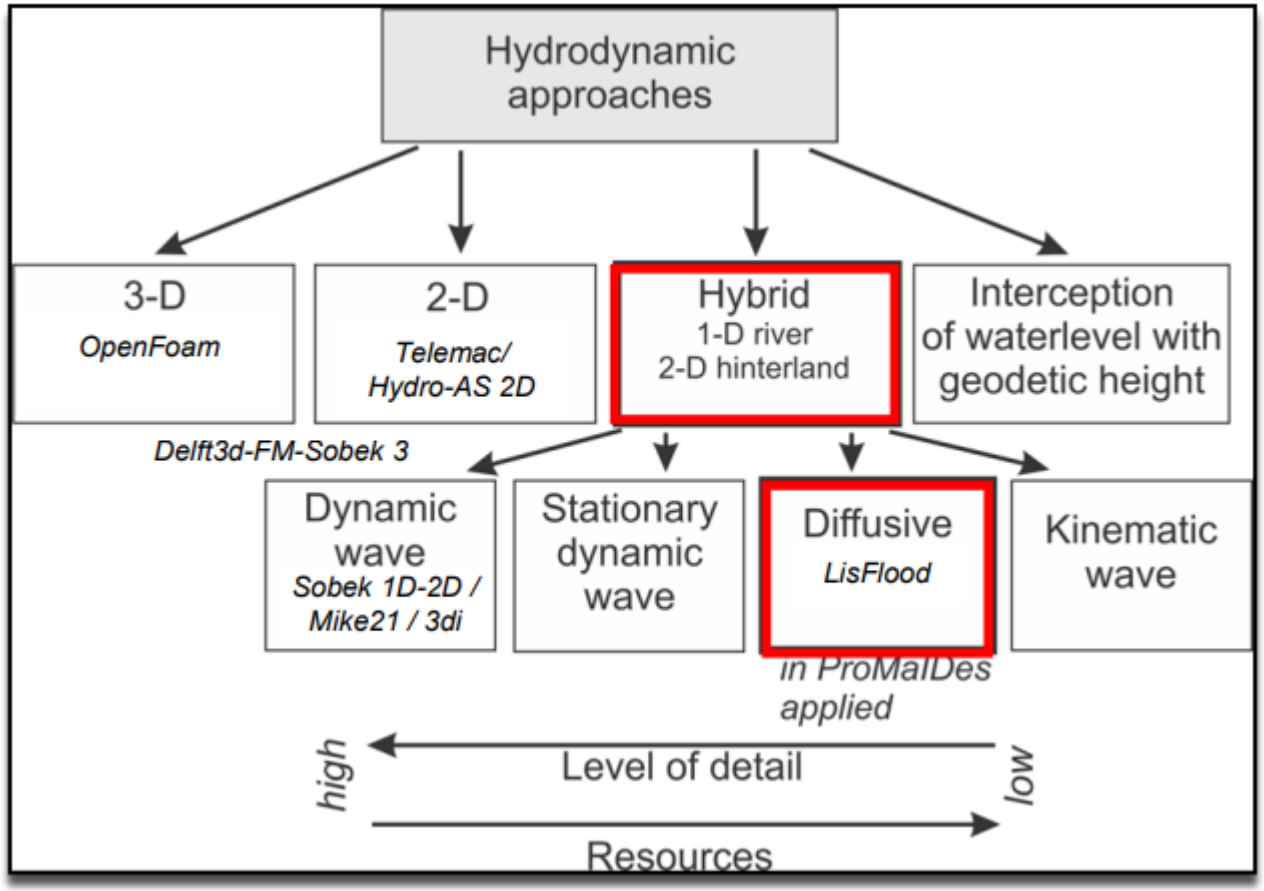
Source: Deltares (2022)

Model setup

ProMalDes

- Tool for supporting flood risk management
- Using HYD module for hydrodynamic calculations
- 1D-2D model, coupling between river and floodplain
- Diffusive wave approach
- University of applied sciences Magdeburg-Stendal and RWTH Aachen University

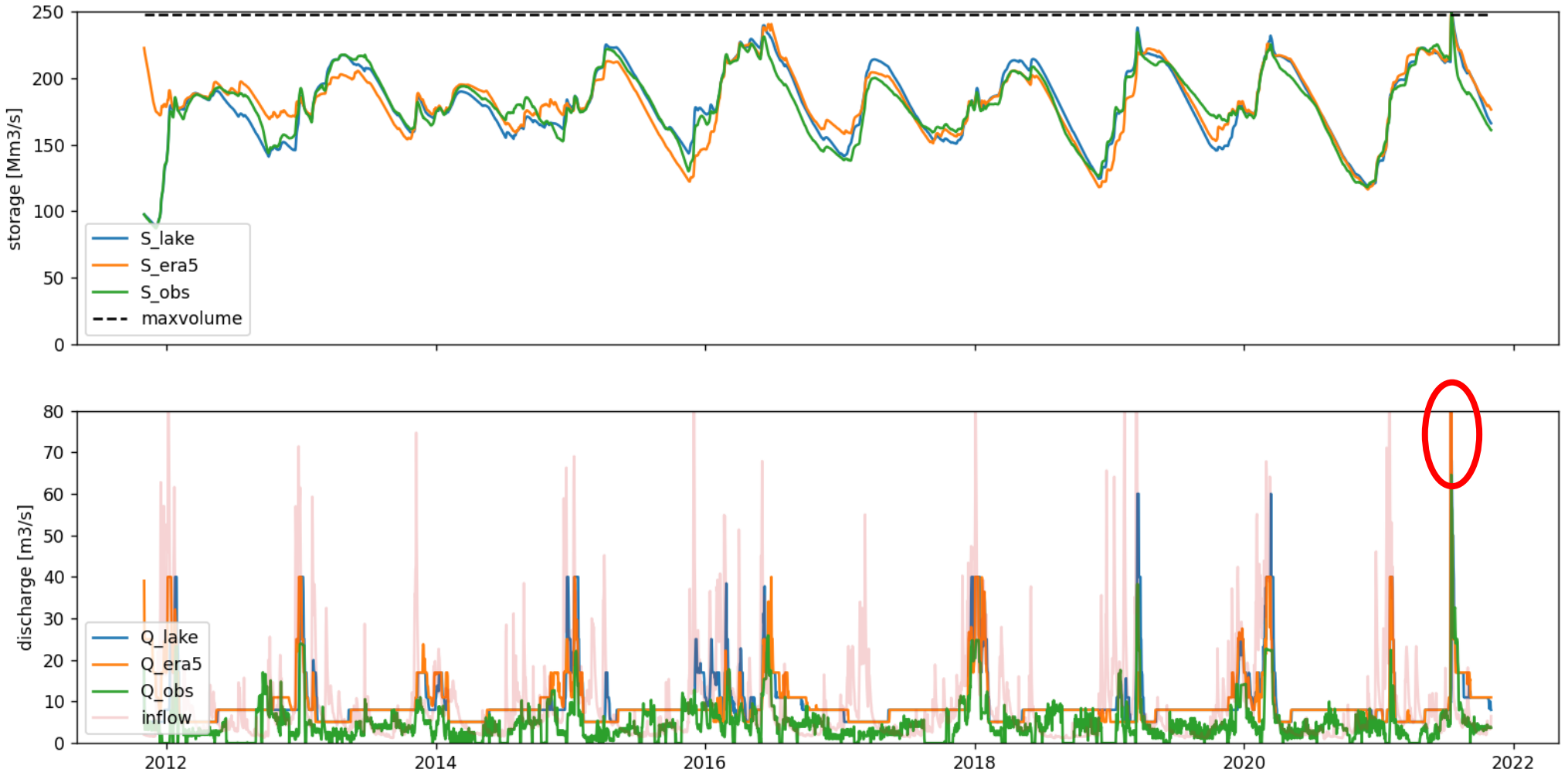
→ Calculate flooding of Rur river and floodplains



Source: Bachmann (2016)

Preliminary results (uncalibrated!)

Preliminary results: reservoir behaviour (Rur+Urft)

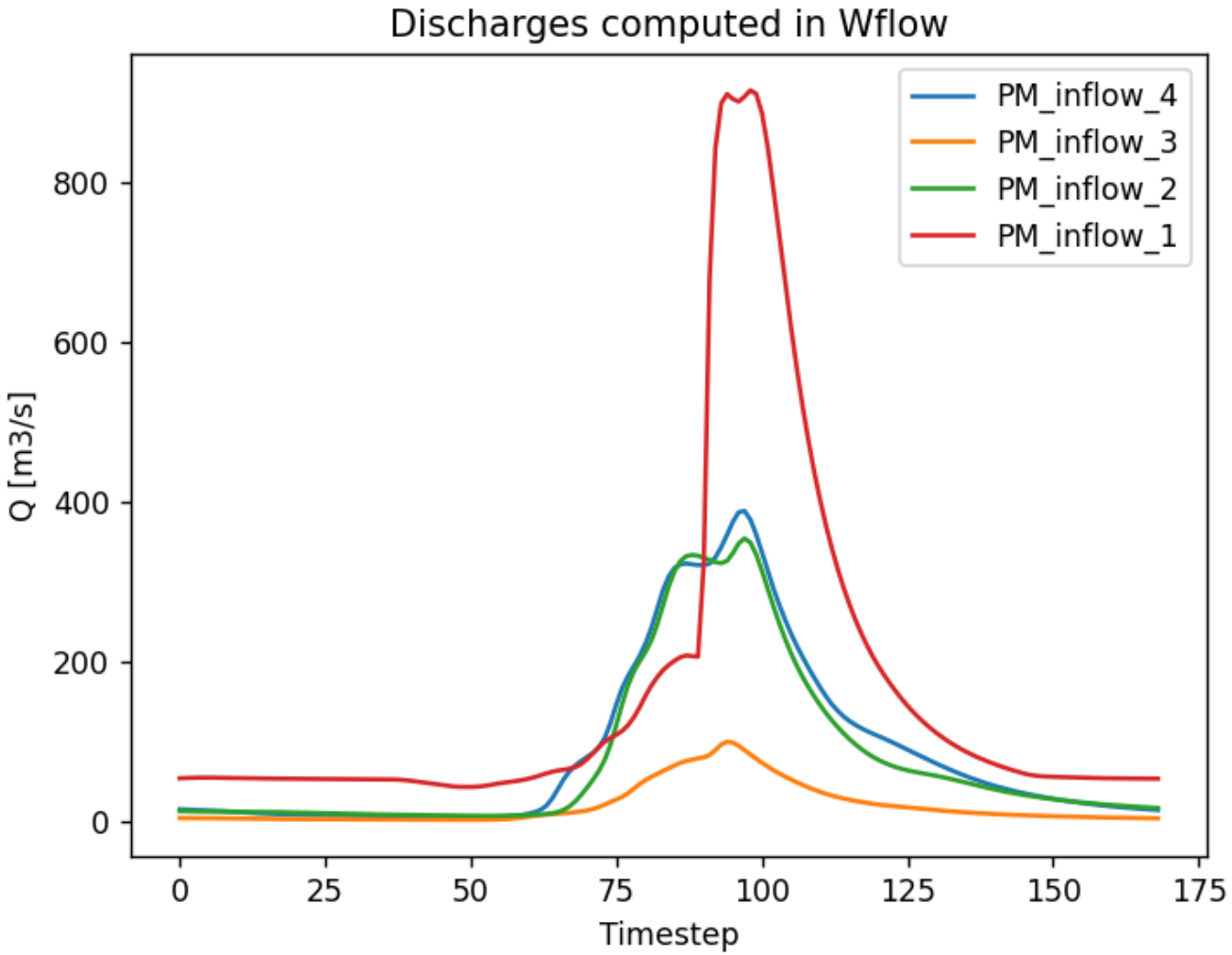


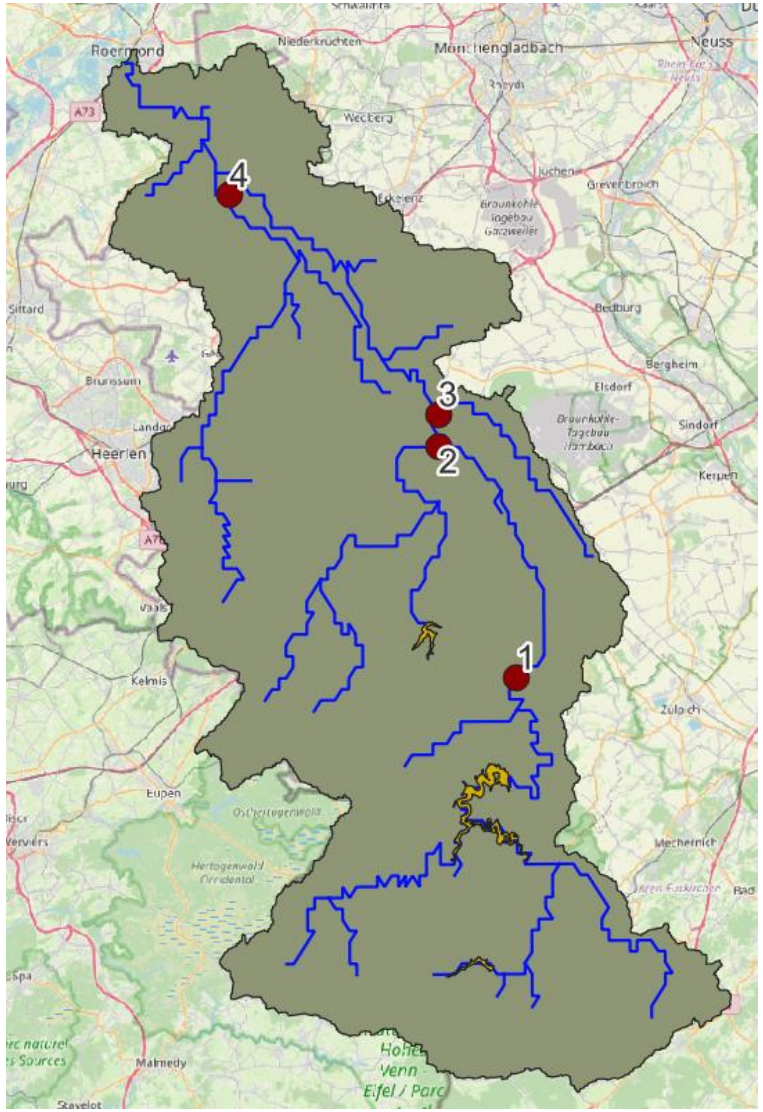
Timestep: 24h

Preliminary results: reservoir behaviour (Rur+Urft)

Timestep: 24h

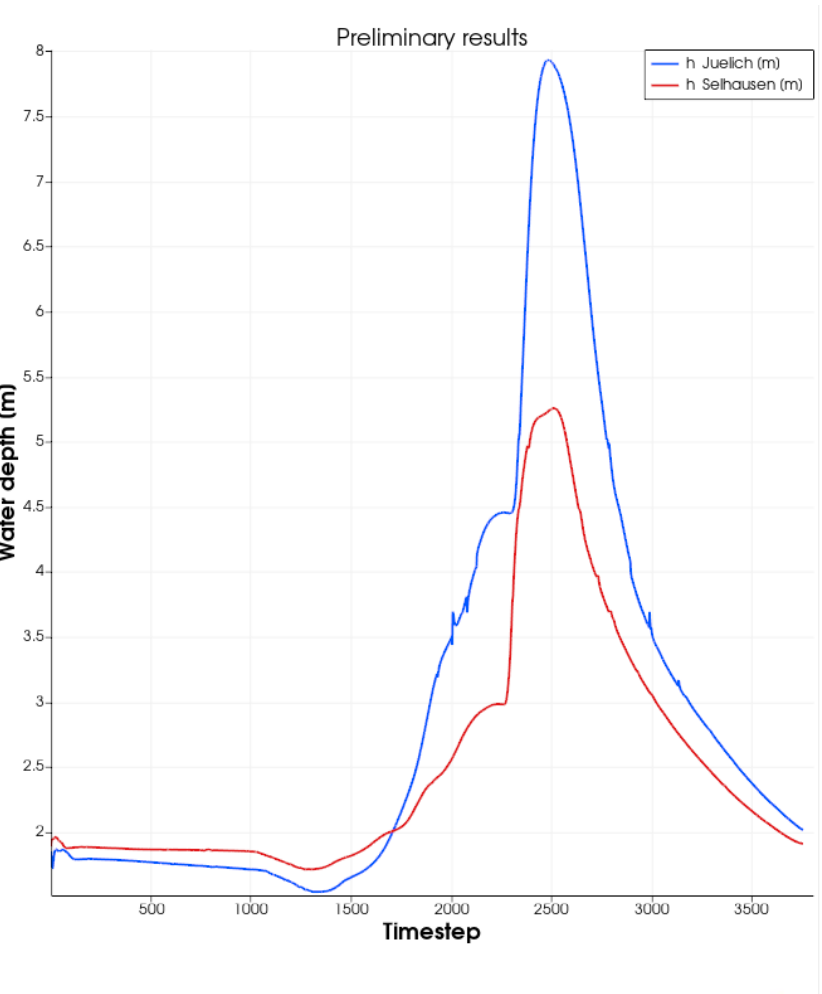
Preliminary results: hydrology

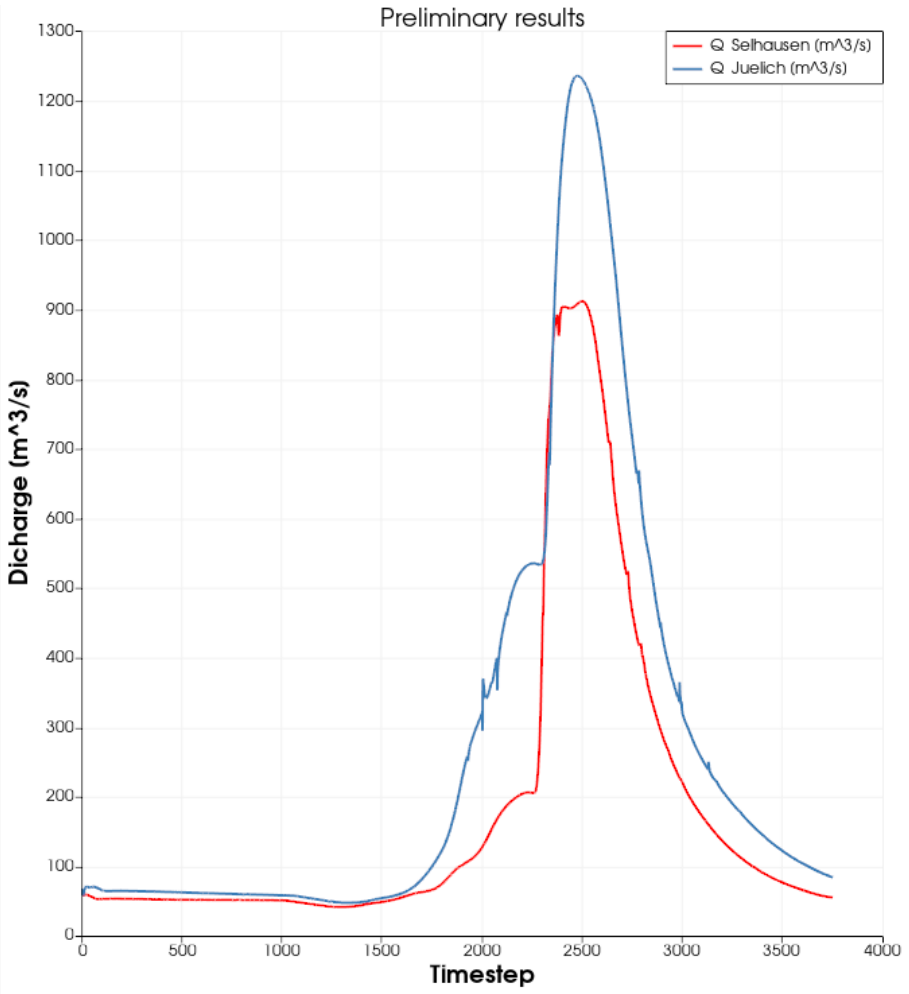


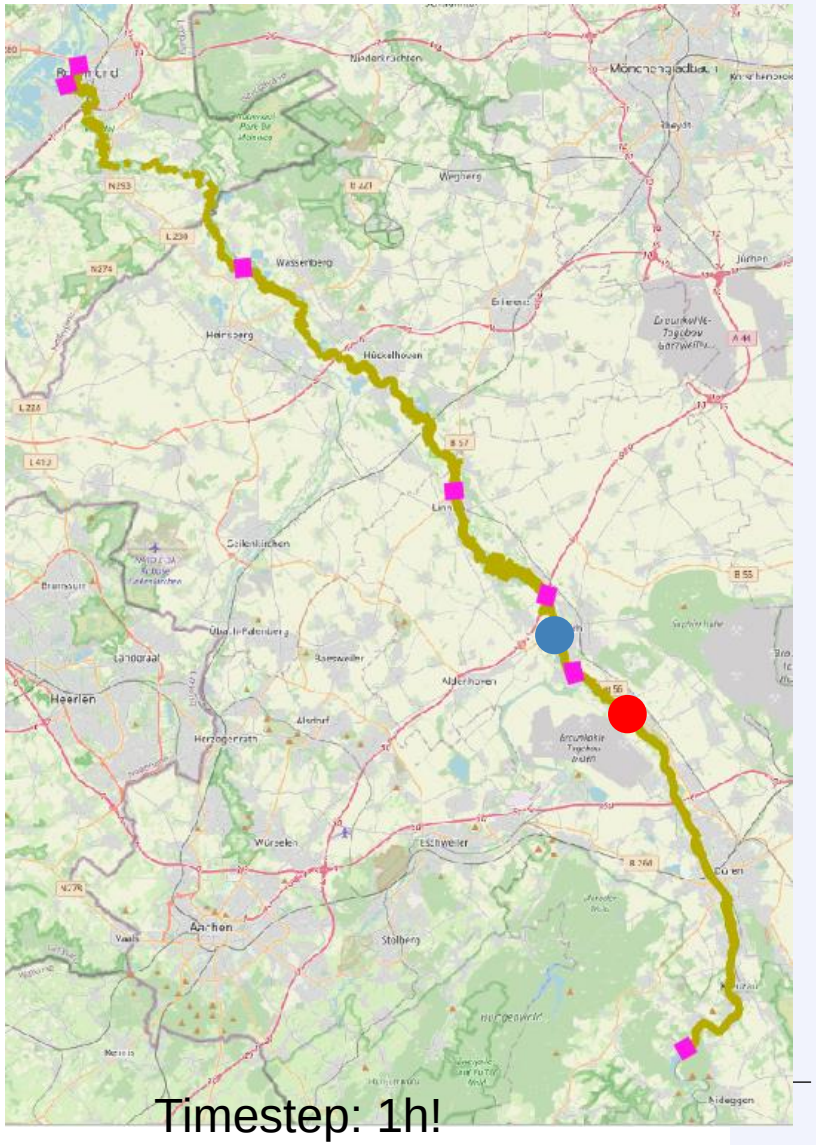


Timestep: 1h!

Preliminary results: hydrodynamics







Timestep: 1h!

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Challenges

- Reliability of meteorological data, especially for ‘filling’ the reservoir
- Run-times of the hydrodynamic model with respect to forecast window
- Modelling hydrological response for a distinct catchment (upstream vs. downstream)
- Validation of July 2021 event with limited observations

Challenges / prospects

- Reliability of meteorological data, especially for ‘filling’ the reservoir
- Run-times of the hydrodynamic model with respect to forecast window
- Modelling hydrological response for a distinct catchment (upstream vs. downstream)
- Validation of July 2021 event with limited observations

- Develop an efficient model to use meteorological forecasts (X ensembles) for advanced forecasting
- Create reliable and understandable results based on impact-based modelling
- Predict catchment response (including reservoirs) to extend forecasting window

Thank you for your attention!

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