PROTOTYPES OF RISK-BASED FLOOD FORECASTING SYSTEMS IN THE NETHERLANDS AND ITALY

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FloodRisk conference, Lyon

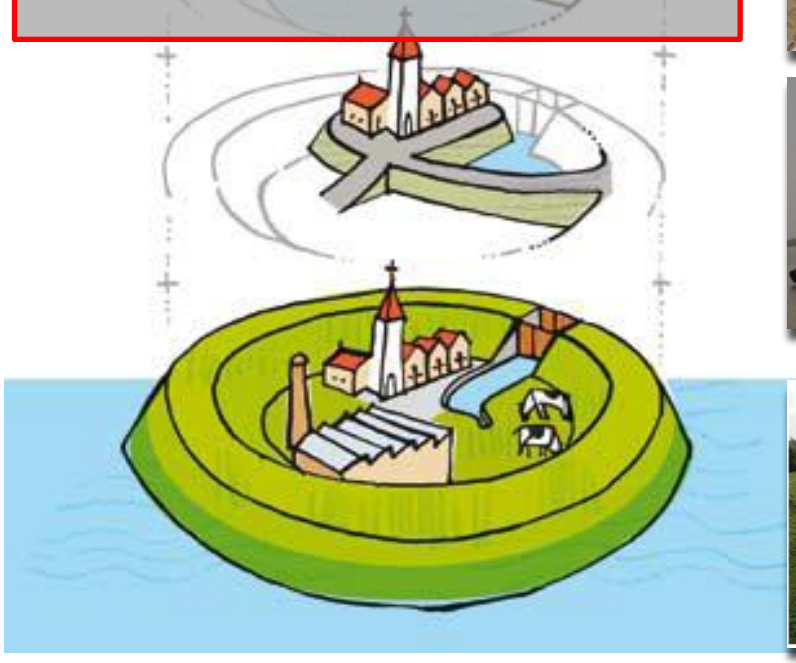
19th October 2016

Multi-layer approach to water safety

Emergency management

Flood forecasting

Sustainable, flood proof spatial planning and building



Prevention of flooding

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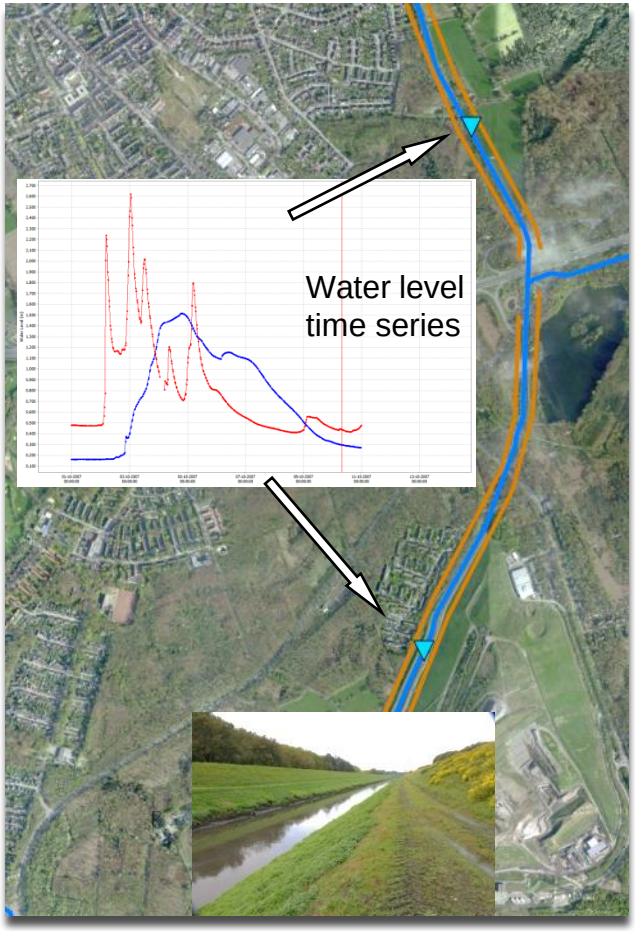
Common practice in operational flood forecast

System river



Forecasted process chain

Meteorology (catchments)

Precipitation, temperature, wind etc.

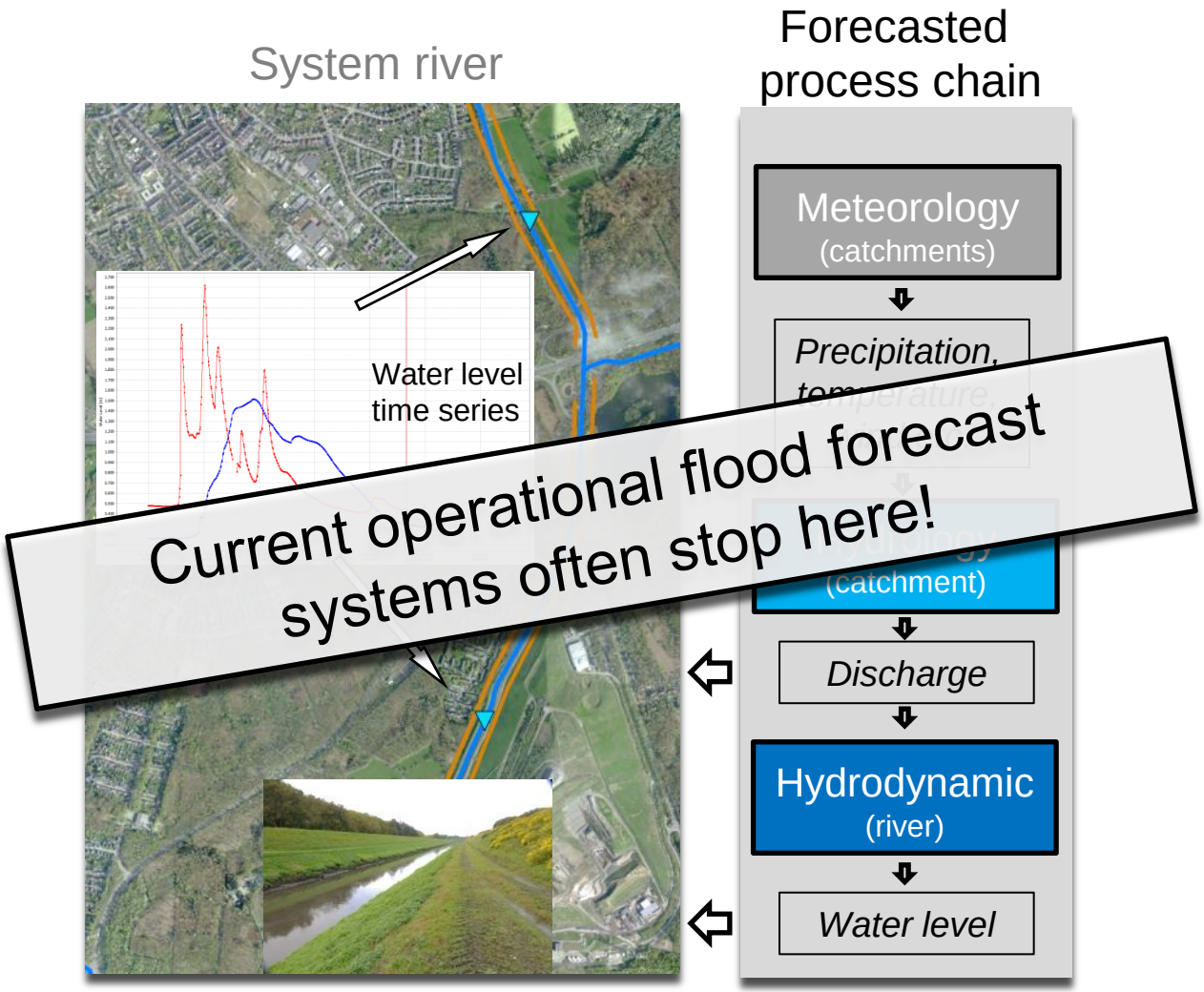
Hydrology (catchment)

Discharge

Hydrodynamic (river)

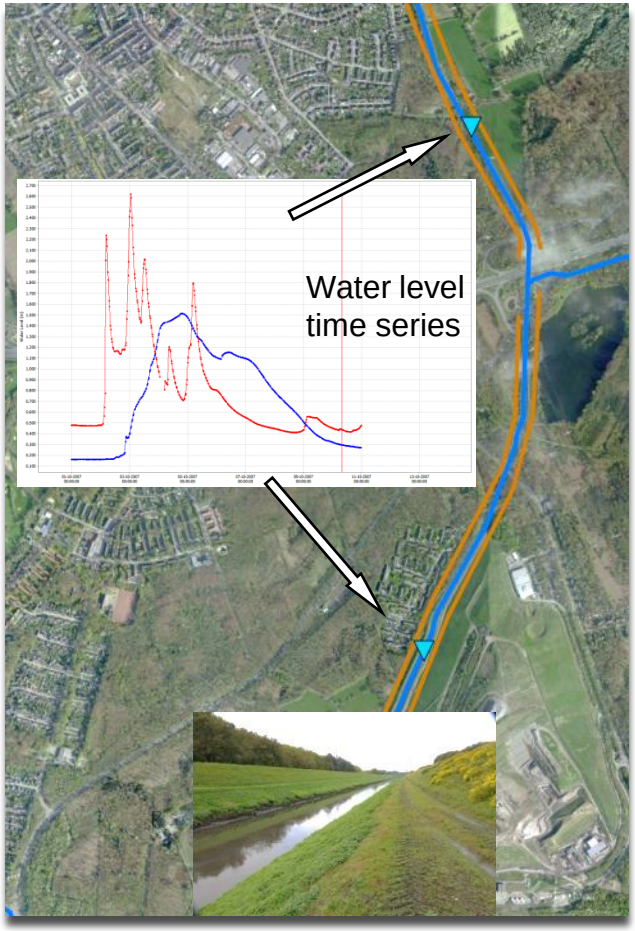
Water level

Common practice in operational flood forecast



How to make a decision based on water levels?

System river



Crisis manager

- How will my flood defence line perform?

- What will be the impacts of flooding?

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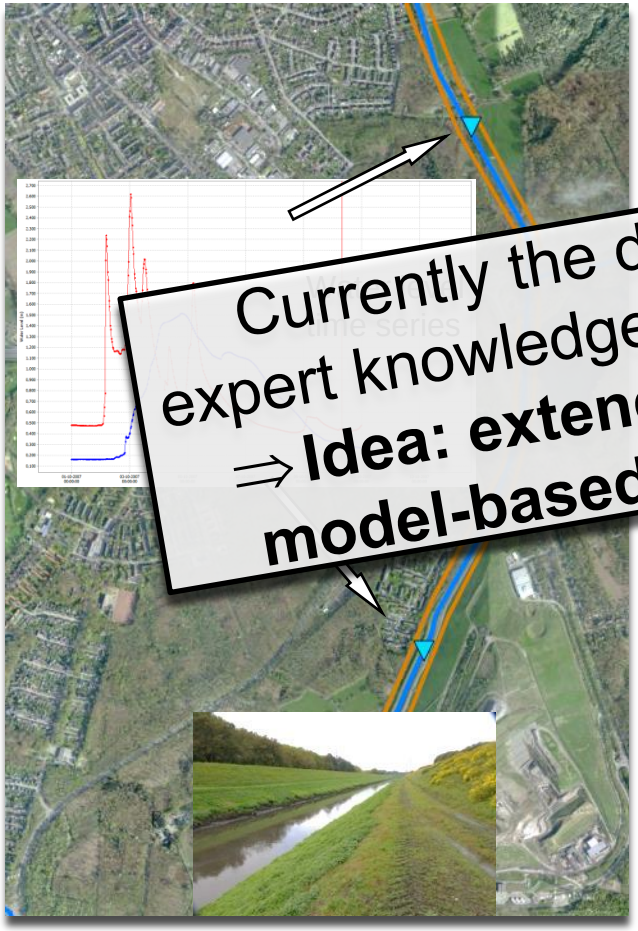
How to make a decision based on water levels?

System river

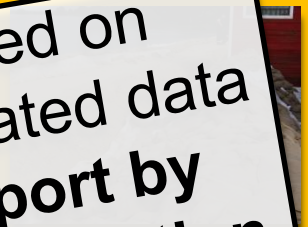


Currently the decision are based on expert knowledge and pre-calculated data

⇒ **Idea: extend decision support by model-based forecasted information**

Crisis manager

- How will my flood defence line perform?



- What will be the impacts of flooding?

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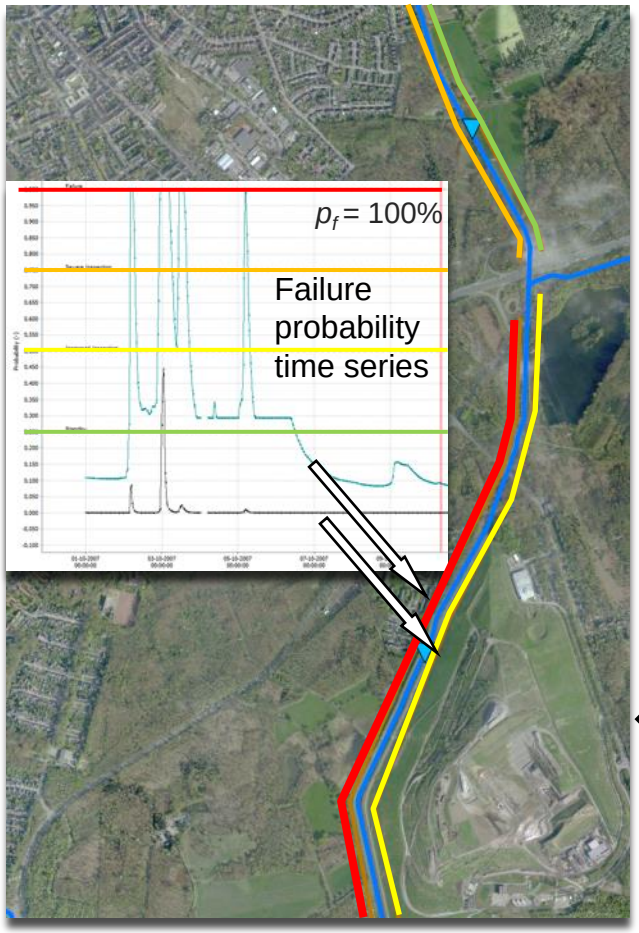
Extension: workflow 1

System river and flood defence line



Forecasted process chain

Meteorology (catchments)

Hydrology (catchment)

Hydrodynamic (river)

Water level

Reliability transformation

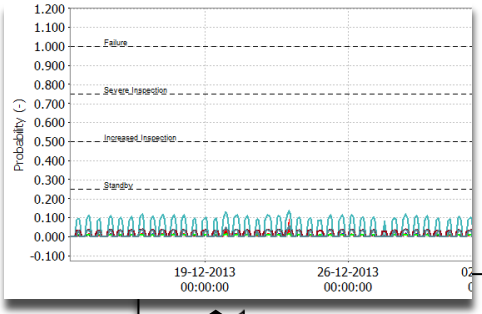
Fragility curve

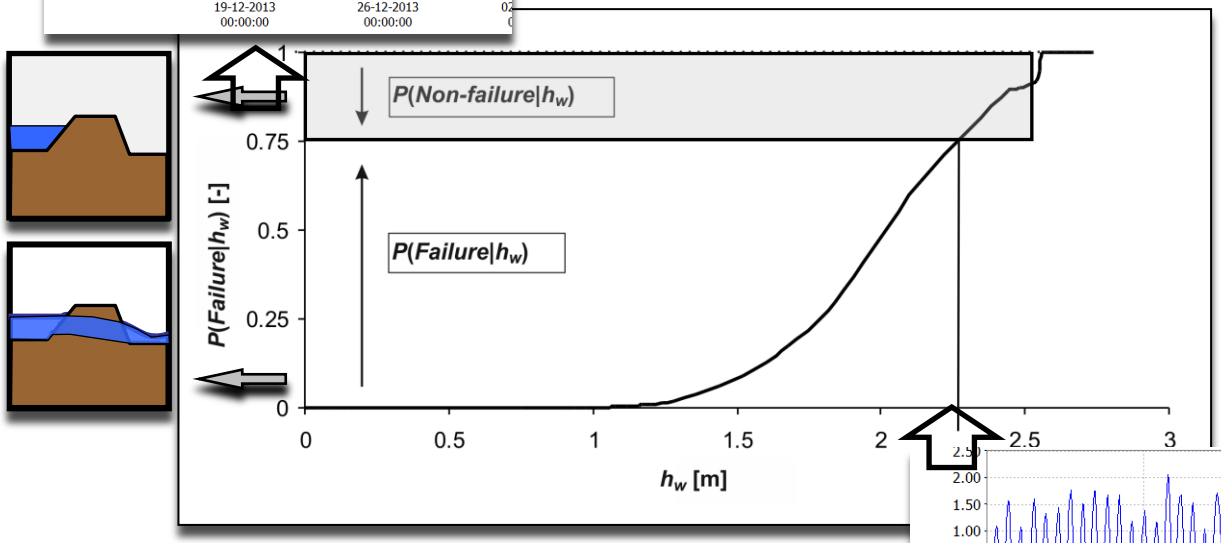
In advance

Failure analysis (flood defence line)

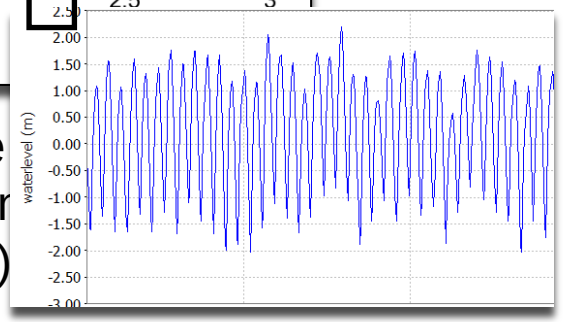
Fragility curve (FRC)/Reliability transformation

Failure probability time series





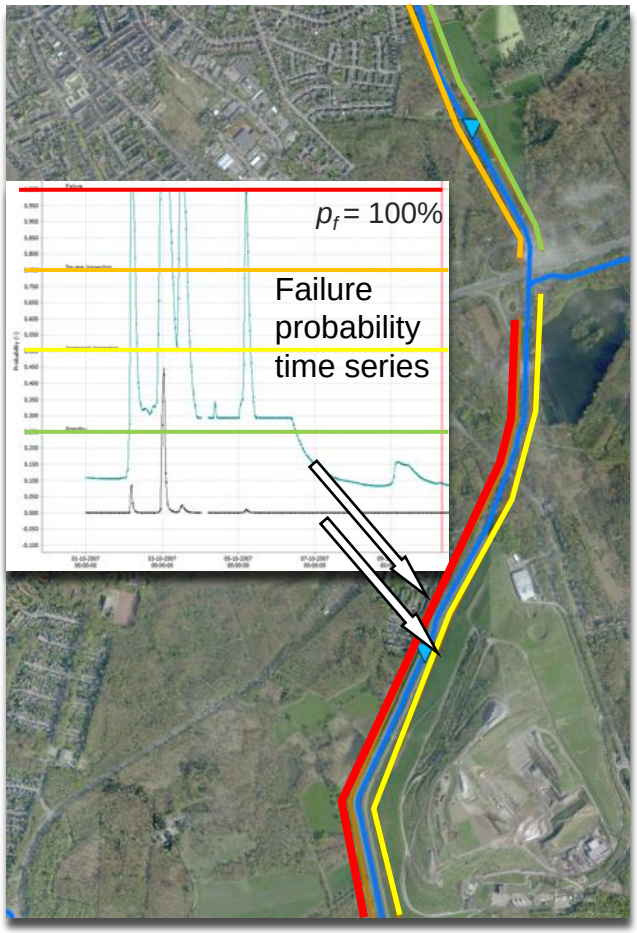
Summary of the performance
probability of a structure dependi
(e.g. water level [m])



Water level time series

Decision support: workflow 1

System river and flood defence line



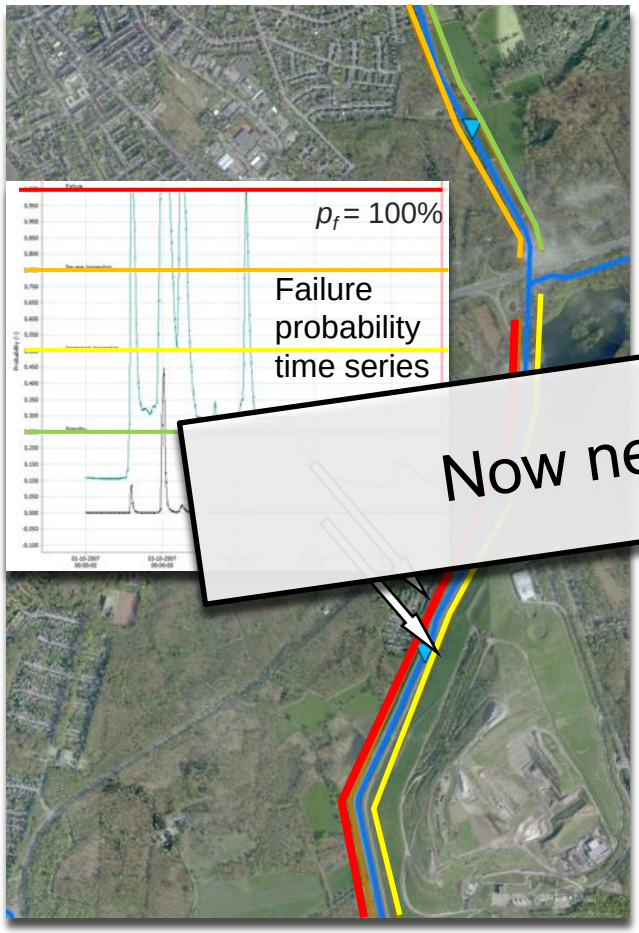
- Where is my weak section given the hydraulic load?

- Where and when inspection should increased or emergency measures should be taken?

- Where and when a breach is probable?

Decision support: workflow 1

System river and flood defence line



- Where is my weak section given the hydraulic load?

- Where and when inspection should increase / emergency measures should be taken?

Now new questions arise!

- Where and when a breach is probable?

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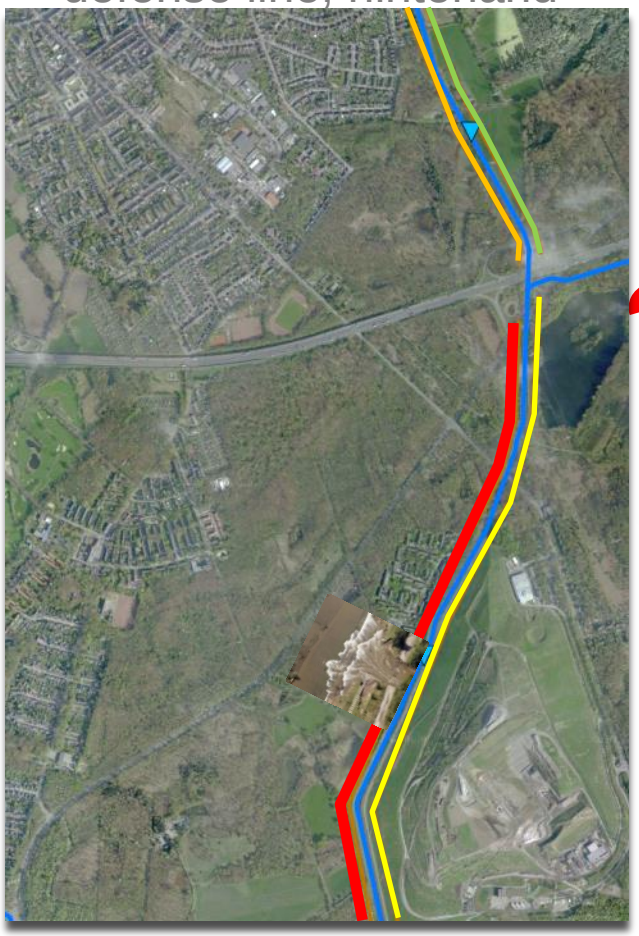
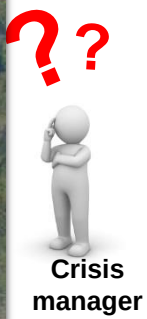
What happens if a breach occurs?

System river, flood defense line, hinterland





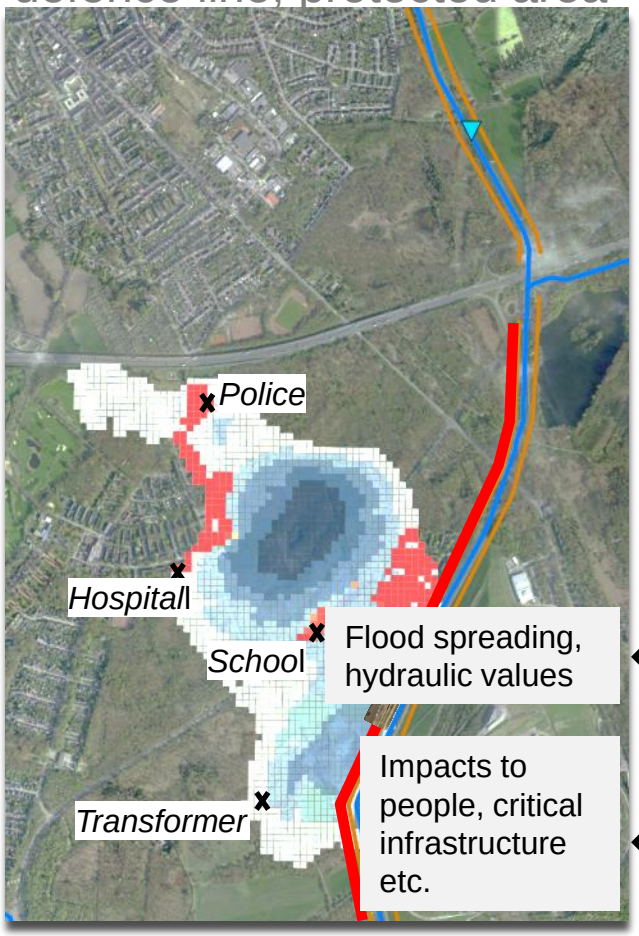
- How fast, how much and where the water will flow?

- How relevant is the protection task of this section?

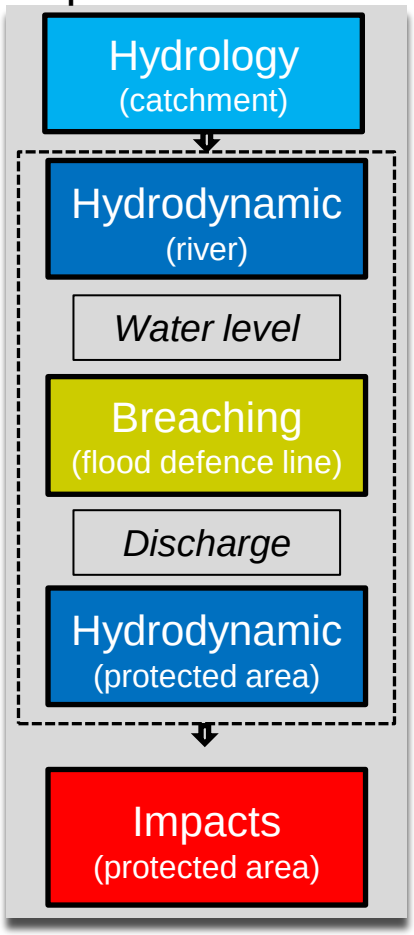
- When and which emergency measures should be triggered?

Extension: workflow 2

System river, flood defence line, protected area

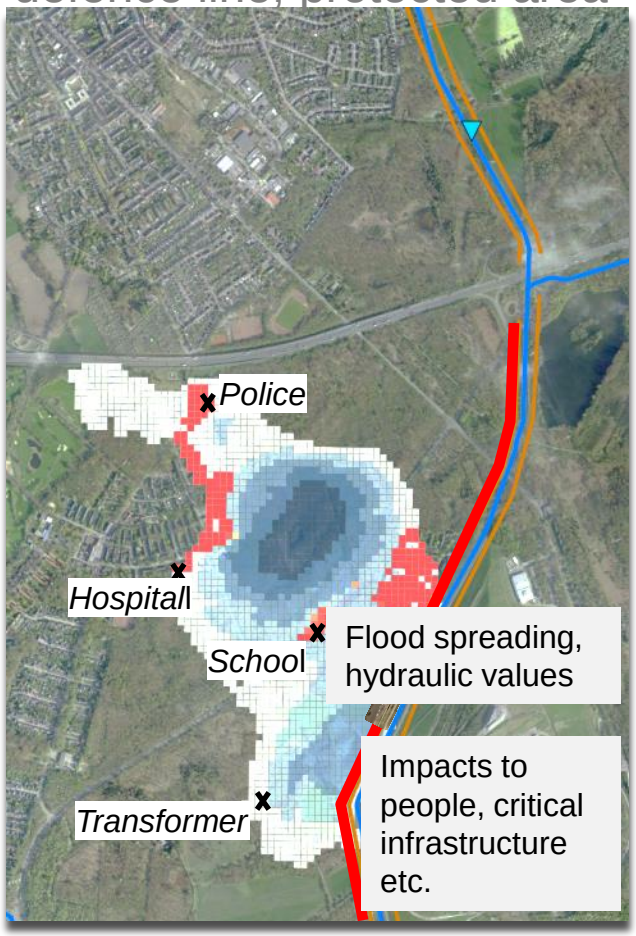


Forecasted process chain



Decision support: workflow 2

System river, flood defence line, protected area



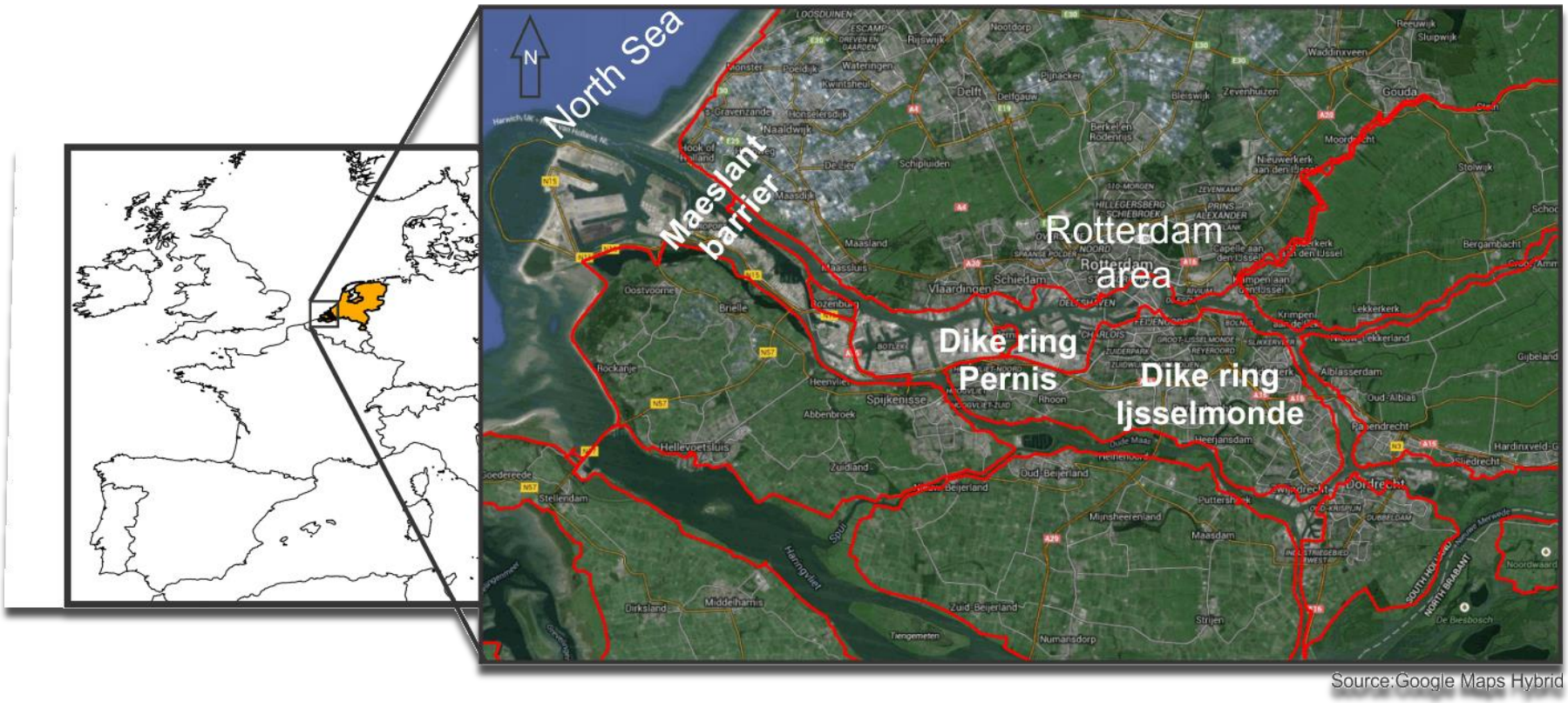
Crisis manager

- How fast, how much and where the water will flow?

How relevant is the protection task of this section?

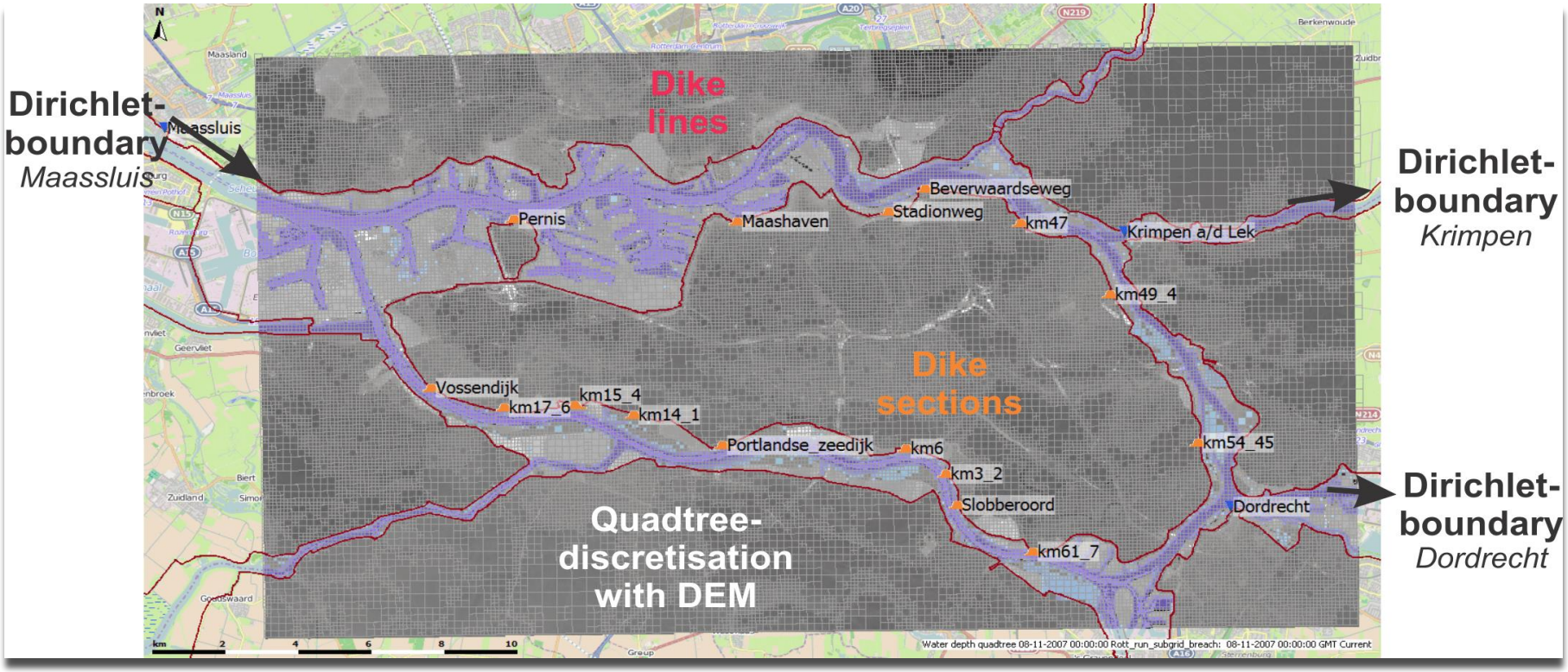
- When and which emergency measures should be triggered?

The Rotterdam area



- Western part of the Netherland at the delta of Rhine and Maas rivers to the North Sea
- Highly populated area (ca. 1.3 million people)
- High flood protection standards

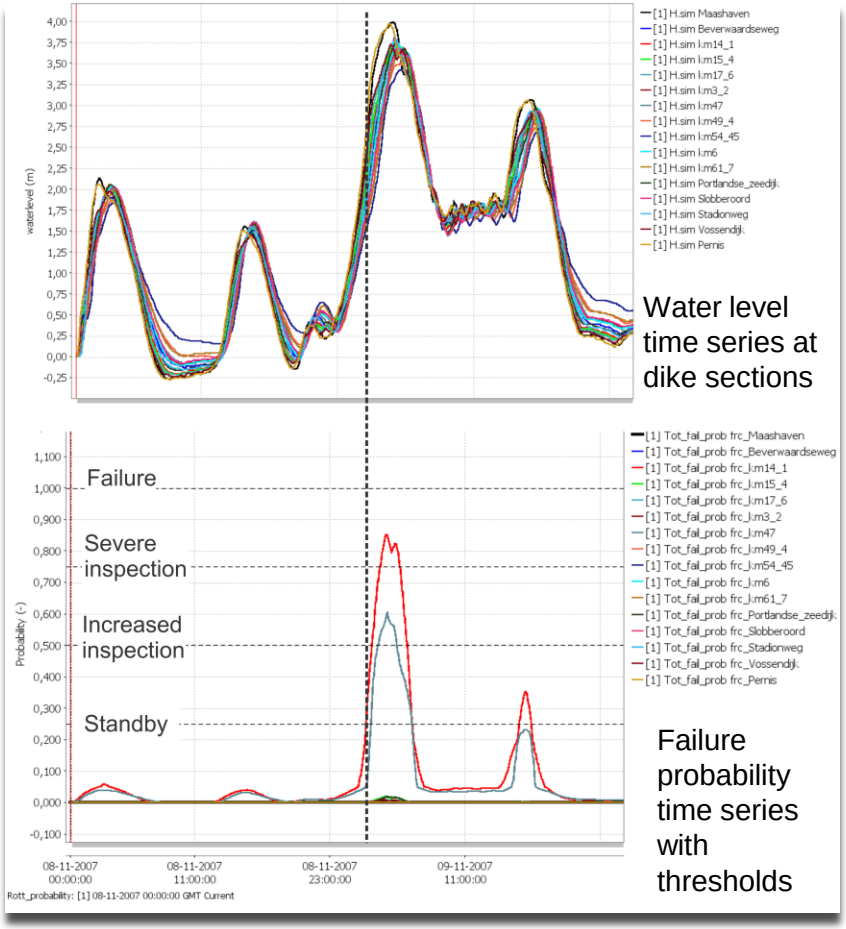
Test case Rotterdam (with manipulated input data)



- Dike ring Pernis and Ijsselmode
- **Reliability analysis**: 15 dike section with fragility curve
- **2d-Hydrodynamic analysis**: Subgrid/3di-model

Forecast Workflow 1: Where and when failure?

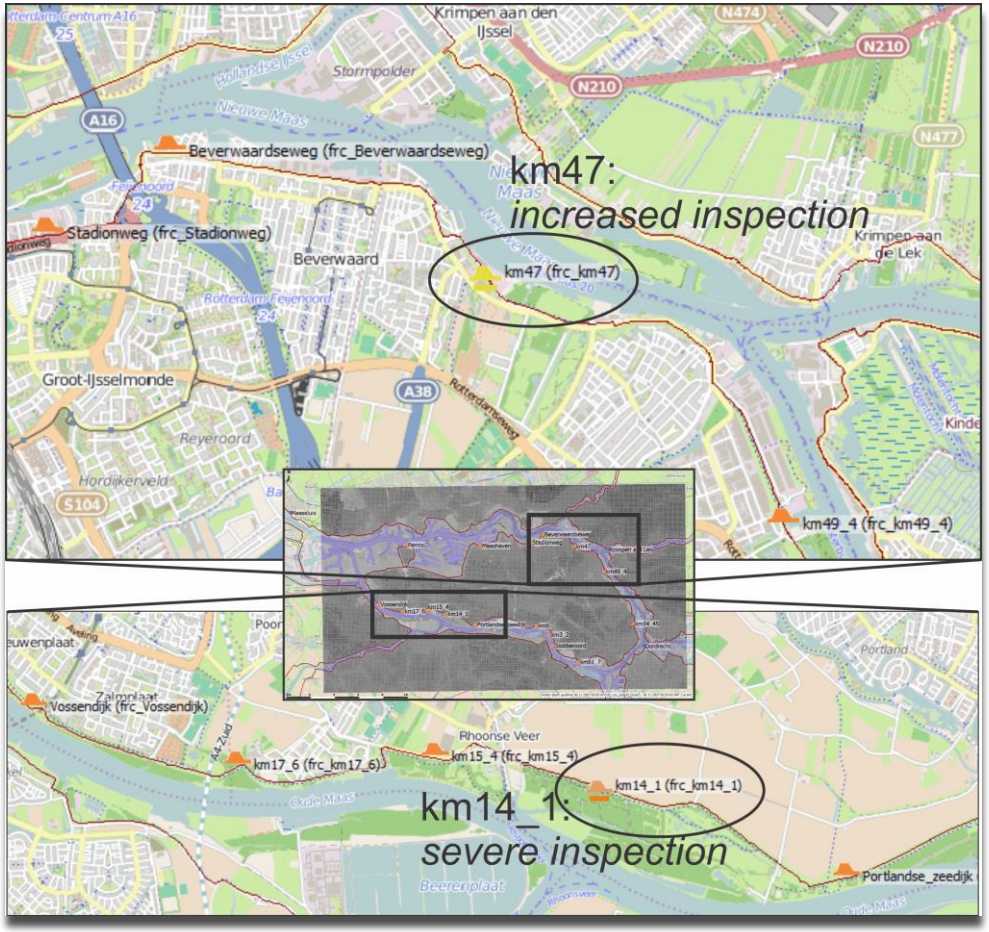
When?



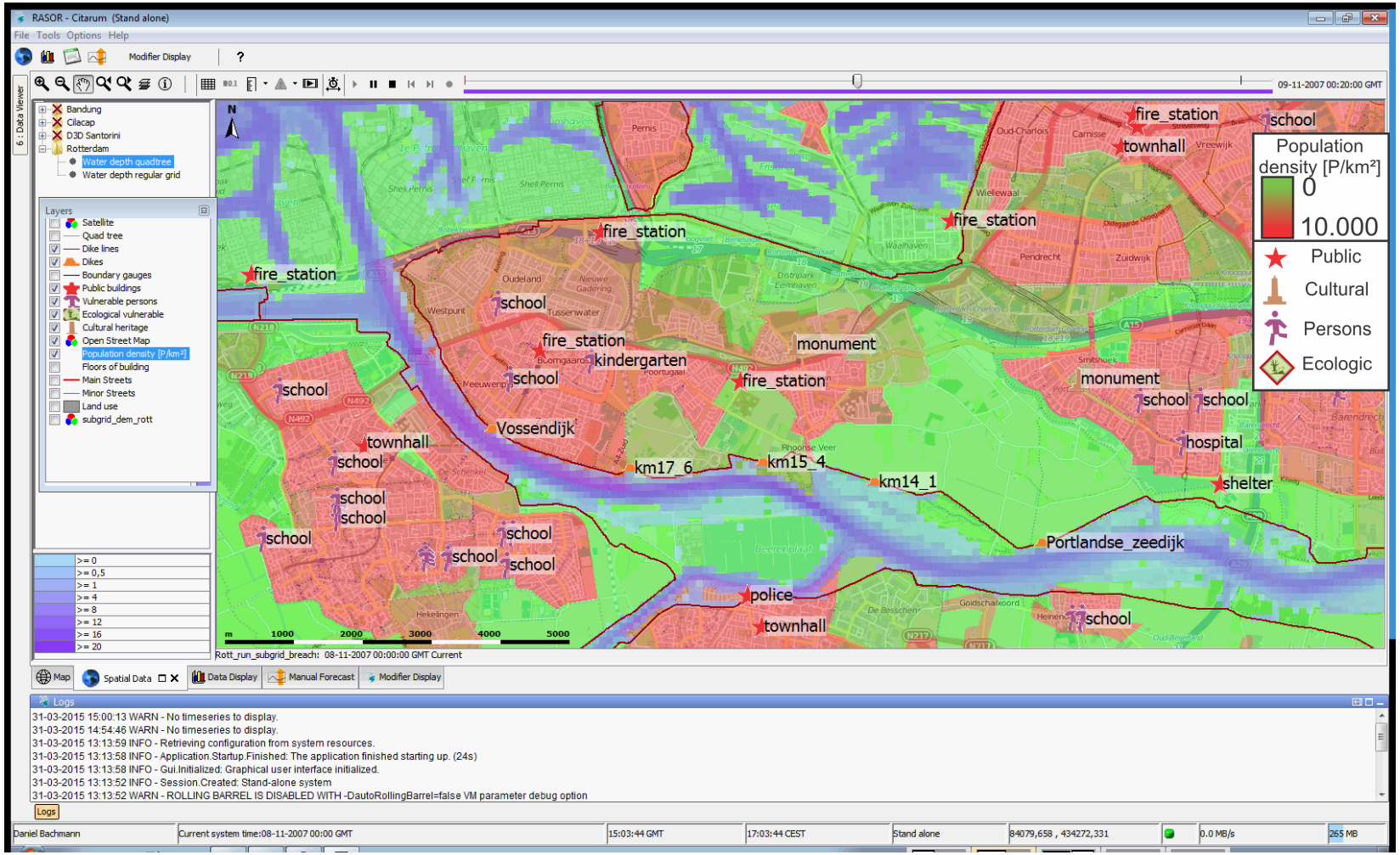
Water level time series at dike sections

Failure probability time series with thresholds

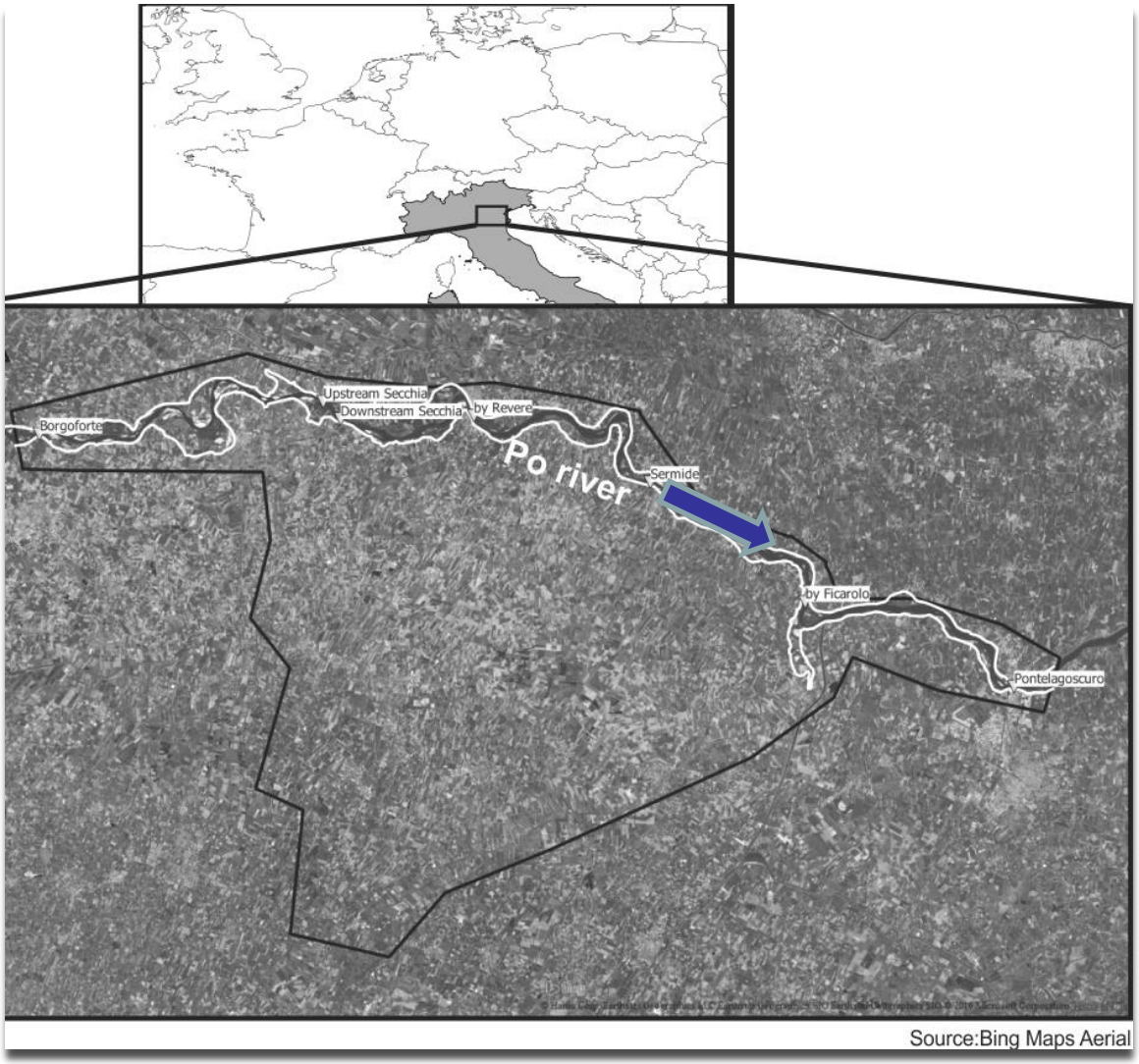
Where?



Forecast Workflow 2: What happens when?

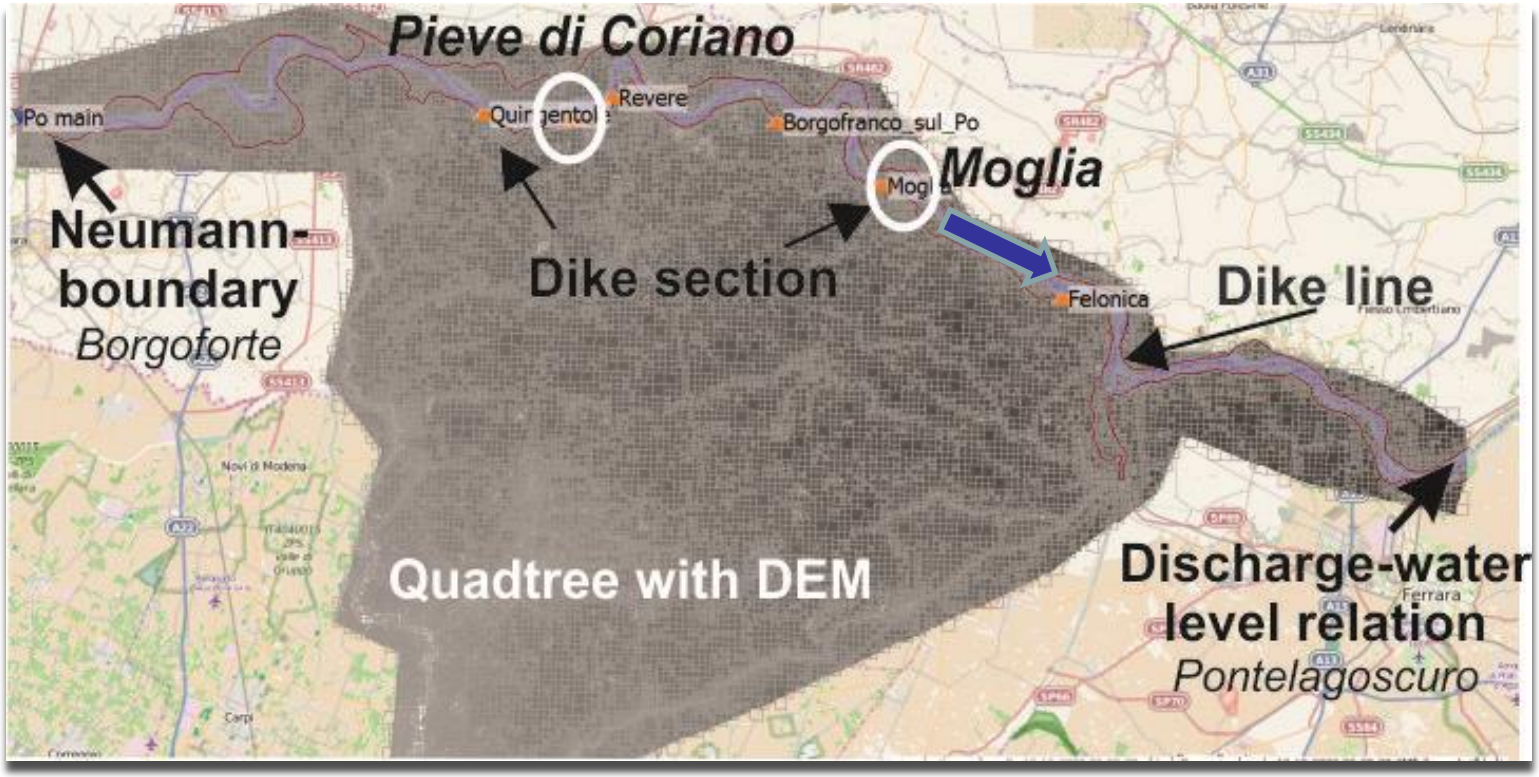


The Po area



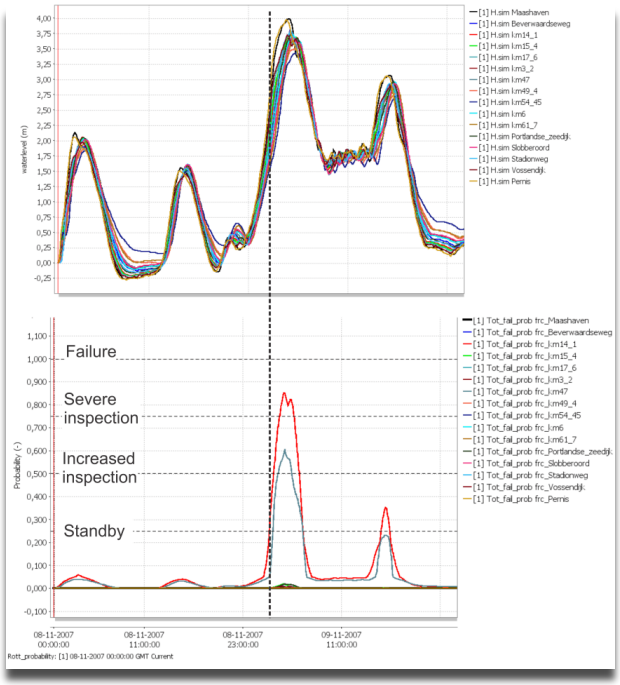
- North eastern part of Italy
- Agricultural land use is predominant
- Flood protection by dikes

Test case Po area

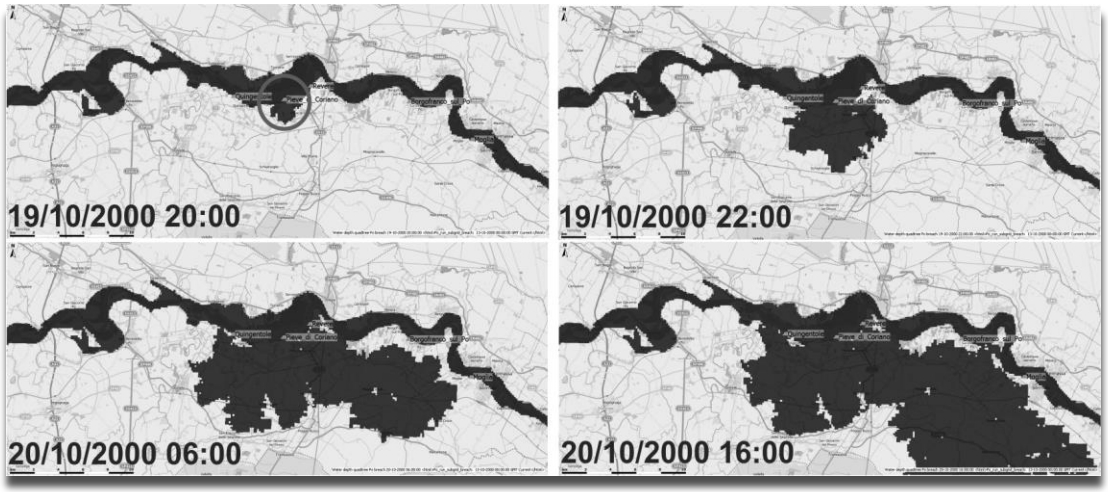


- **Reliability analysis** (expert judgement): 6 dike section with fragility curve
- **2d-Hydrodynamic analysis**: Subgrid/3di-model

Forecasted results of workflow 1 and 2



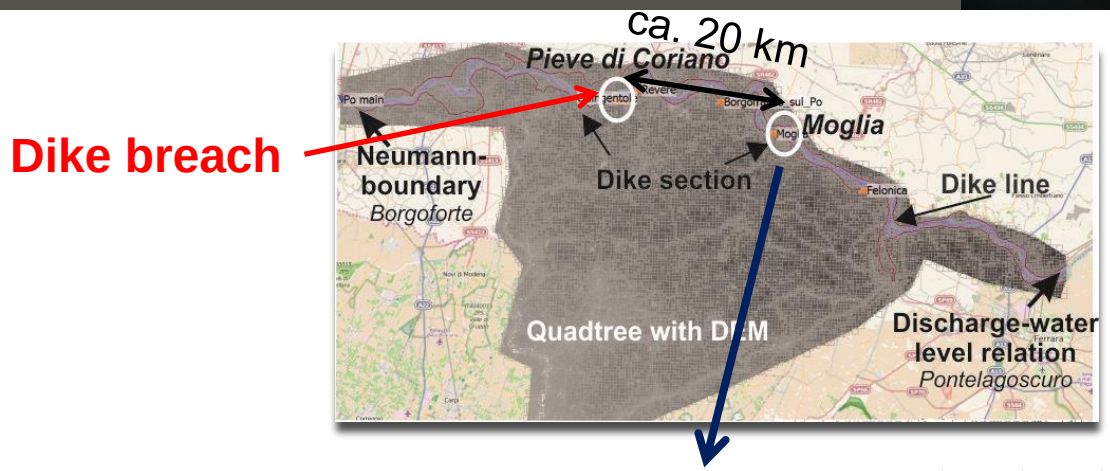
Forecasted failure probability of dike sections

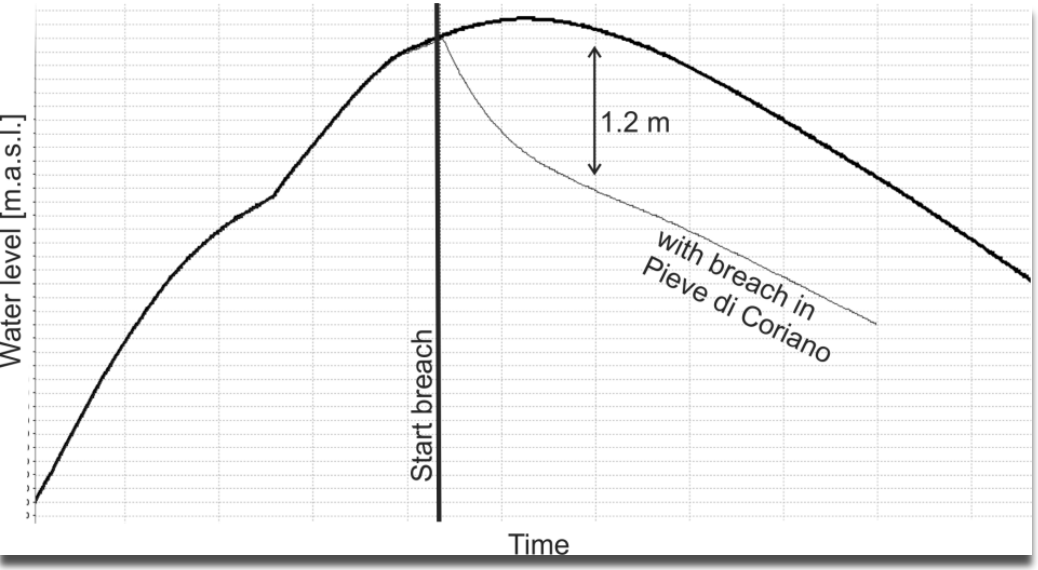


Forecasted flood spreading

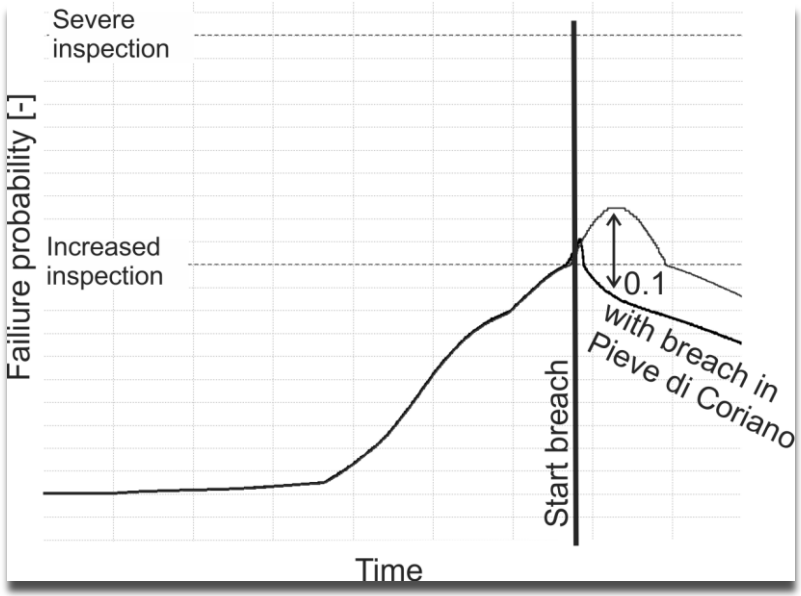
=> Results similar to the Rotterdam test case

Forecast: Water level and failure probability reduction





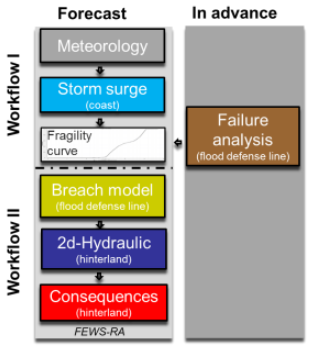
Water level reduction due to dike failure



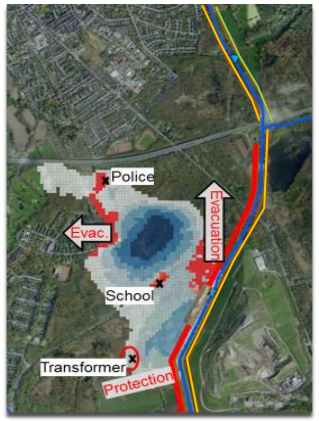
Failure probability reduction due to dike failure

Conclusion

- **Technical point of view:** it is possible to provide information beyond water levels or discharges in flood forecasting systems like:
  - Weak spots in the flood defense section
  - Flood spreading
  - Impacts



- **Added value**: Supports the development and adaptation of **emergency measures** in real-time



- **Organizational point of view:** Major challenge is bringing different organization together (e.g. forecasters and crisis managers)

HR Wallingford
Working with water

Deltares
Enabling Delta Life

RASOR

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Thank you for your attention!
Welcome at our stand!

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