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Modelling microbial water quality in drinking water sources

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Modelling

- We use hydrodynamic modelling
- To describe how contamination spreads in the water source
  - Transport with water
  - Inactivation/decay of microorganisms
- Hydrodynamic modelling requires
  - Input data
  - Software (license)
  - Time-consuming computations

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Using modelling, we can:

- Assess the influence of contamination sources
  - Calculate how much different contamination sources contribute to the contamination at the water intake
  - Identify the main contamination sources

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Using modelling, we can:

- Identify the processes that influence the fate and transport of faecal contamination
  - Identify which factors influence the spread of contamination
  - Identify the periods of increased risks

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Using modelling, we can:

- Describe the microbial water quality at the water intake
  - if we cannot measure due to fast variations or concentrations below the detection limit
  - this information is needed to dimension the drinking water treatment

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Using modelling, we can:

- Predict the microbial water quality at the water intake
  - Under different conditions by testing various scenarios, e.g.
    - future situations (climate change)
    - results/consequences of mitigation measures or emergency situations

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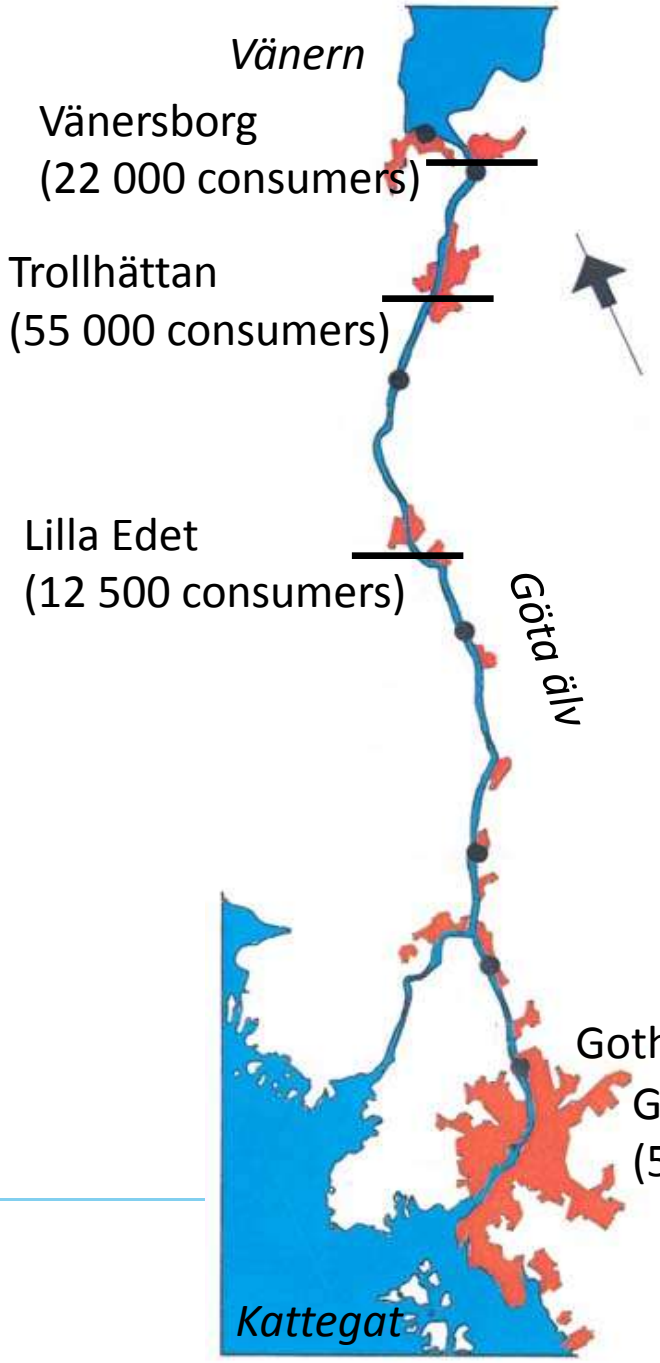
Study area
the river Göta älv



Length: 93 km
Average flow: 550 m^3/s
Max flow: 1000 m^3/s

Water source for approx.
700 000 consumers

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Methods

- Hydrodynamic 3D model (MIKE 3 by DHI):
  - Water flow and water level
  - Wind and precipitation
  - Discharge from contamination sources

- Microbial water quality module (ECO Lab by DHI):
  - Concentrations of pathogens and faecal indicators in wastewater
  - Inactivation of pathogens and faecal indicators

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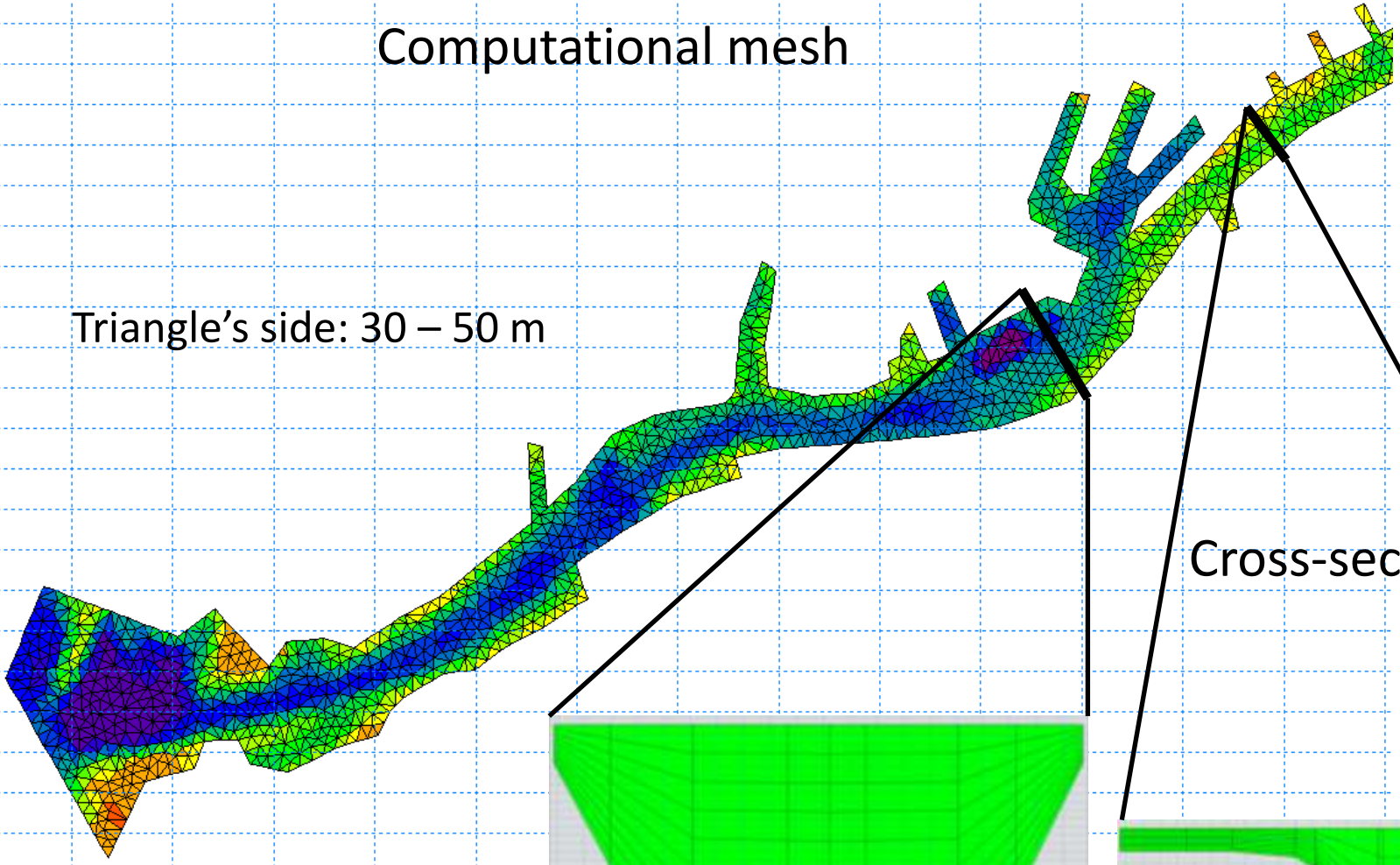
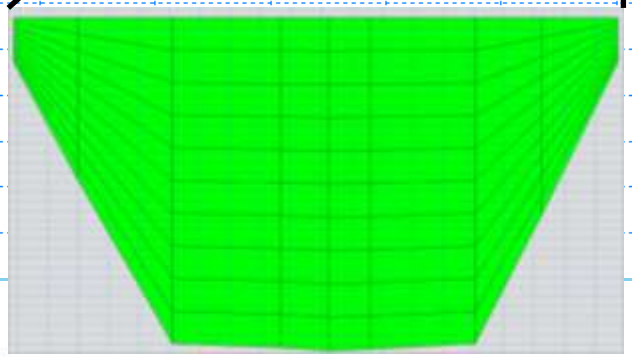
3D Modelling

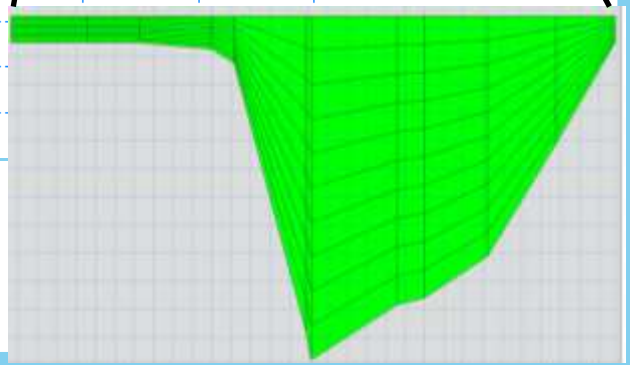
Computational mesh

Triangle's side: 30 – 50 m

Cross-section







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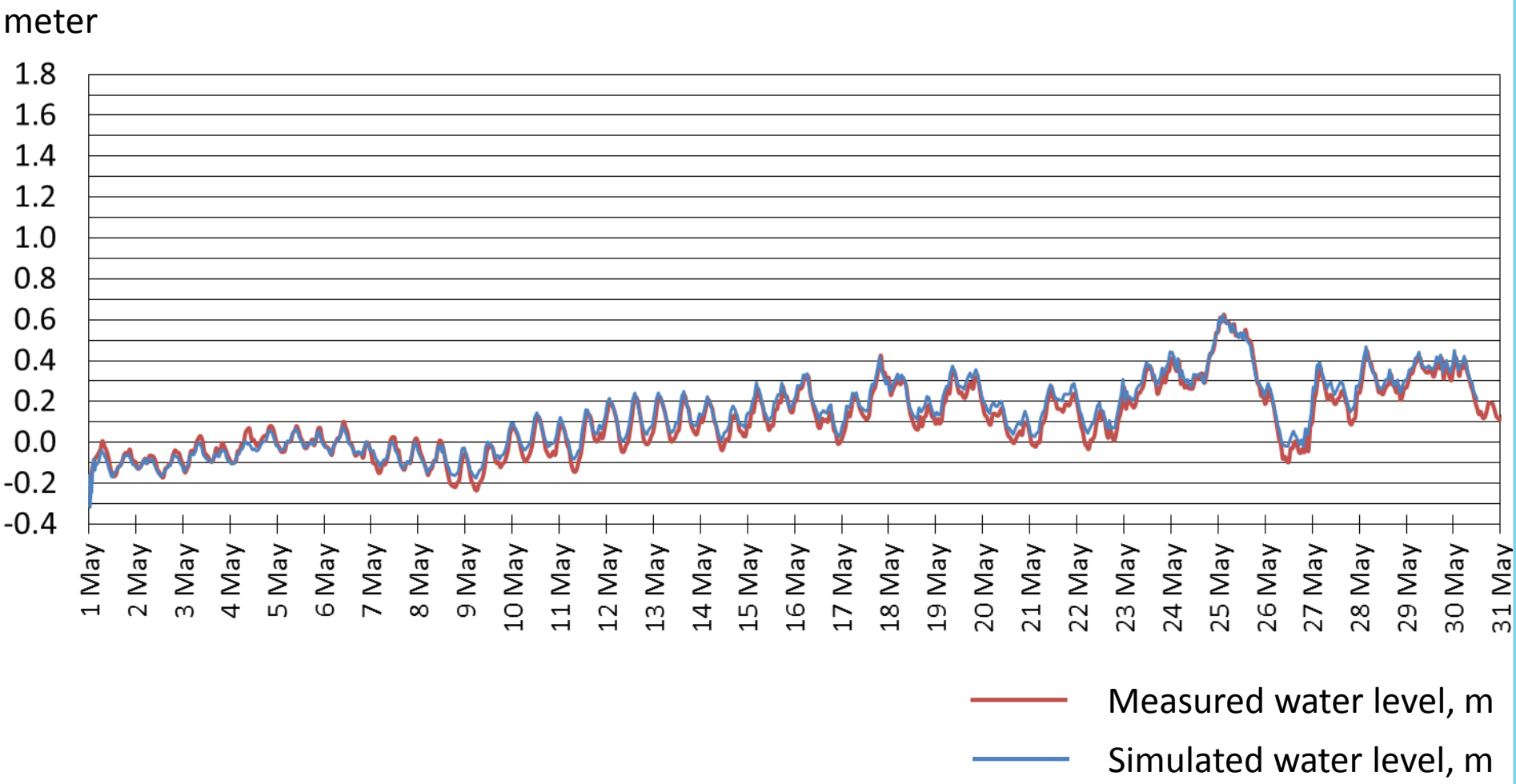
Validation

Water level at Gothenburg water intake in May 2011



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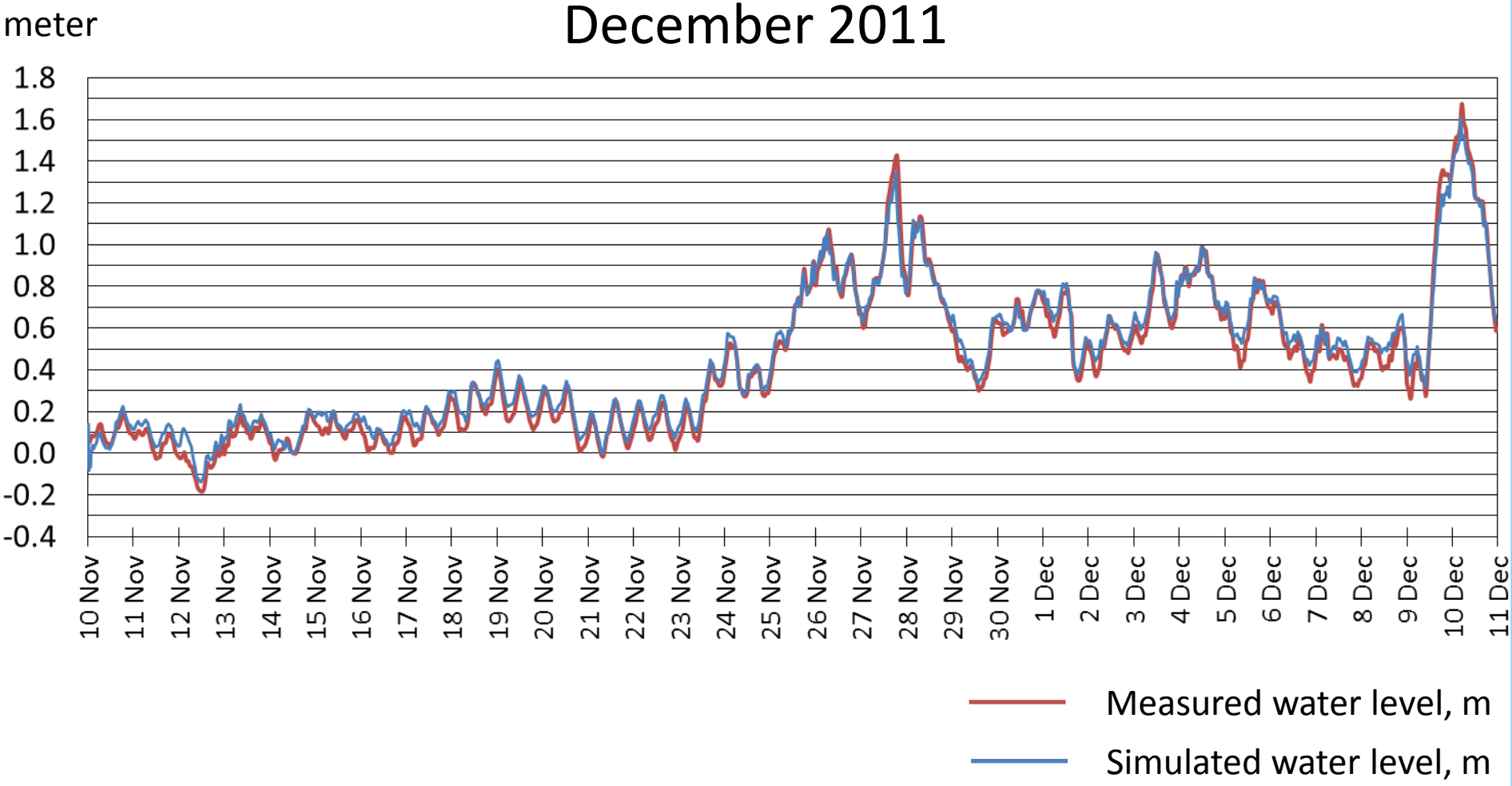
Validation

Water level at Gothenburg water intake in November – December 2011



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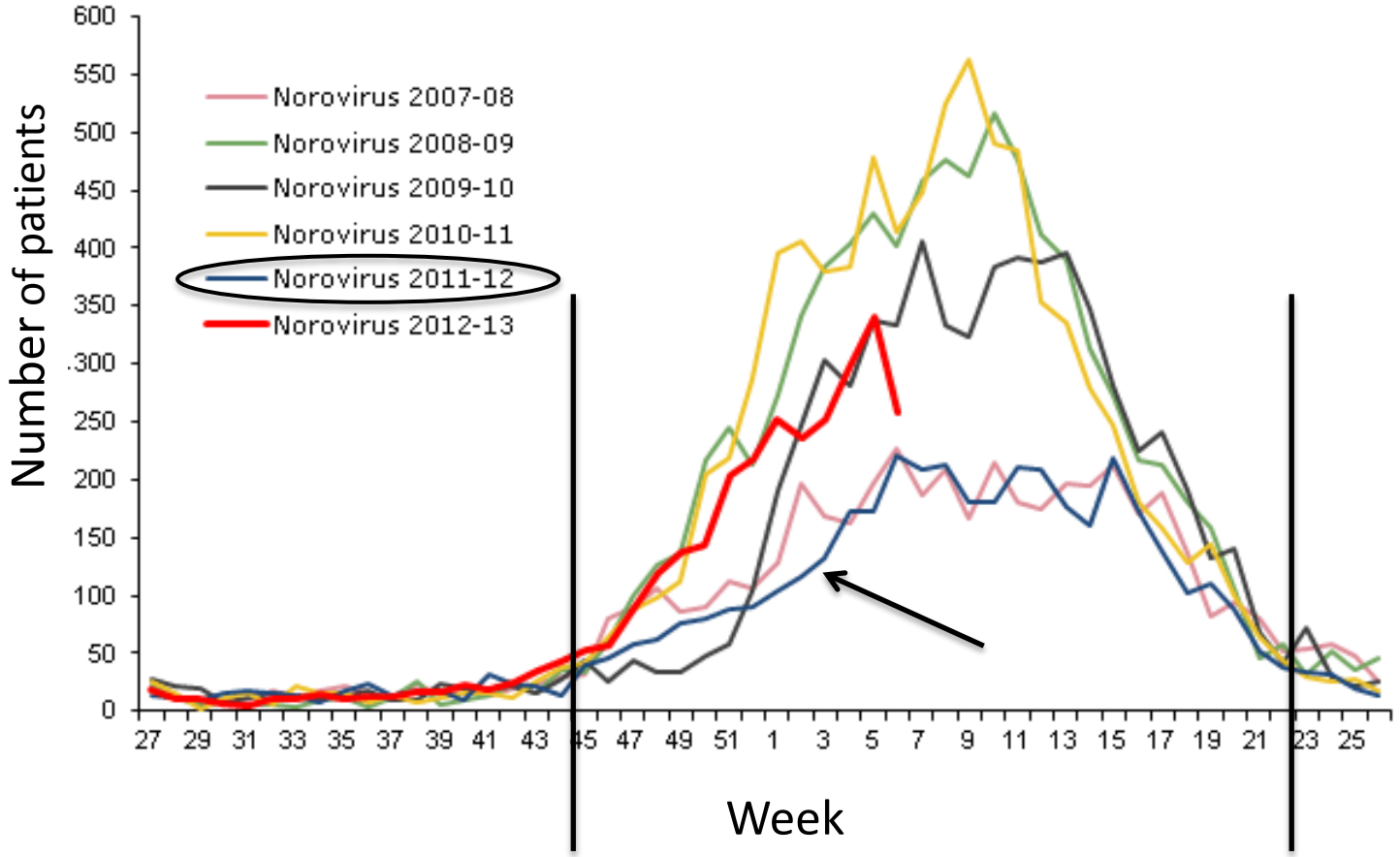
Norovirus cases during the year

Smittskyddsinstitutet: the total number of diagnosed cases at the laboratories that participate in the voluntary reporting

Cases of norovirus per week



Smittskyddsinstitutet, Calicivirusrapport

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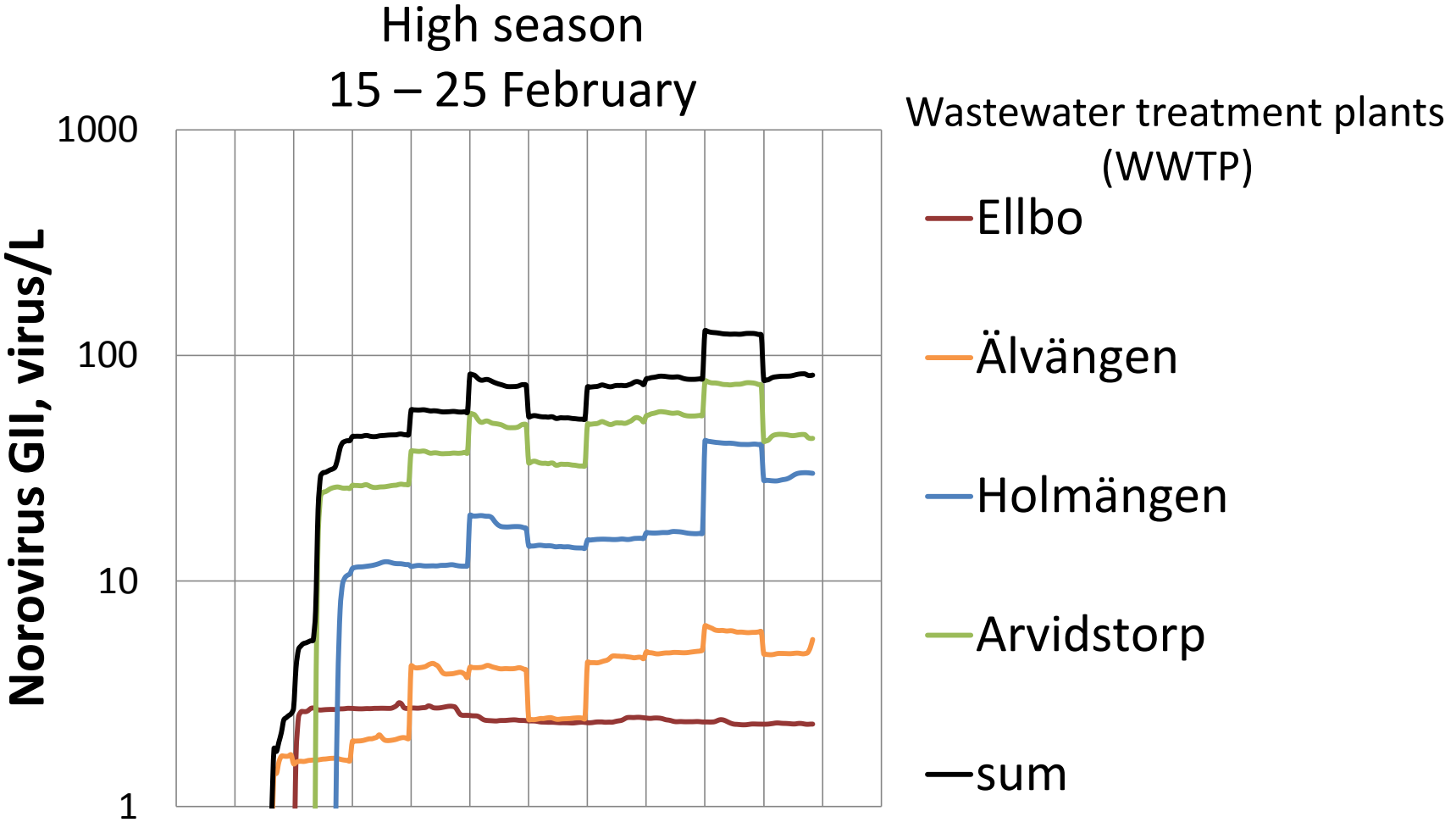
Contribution from the different sources to the contamination at the Gothenburg water intake



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Modelling results

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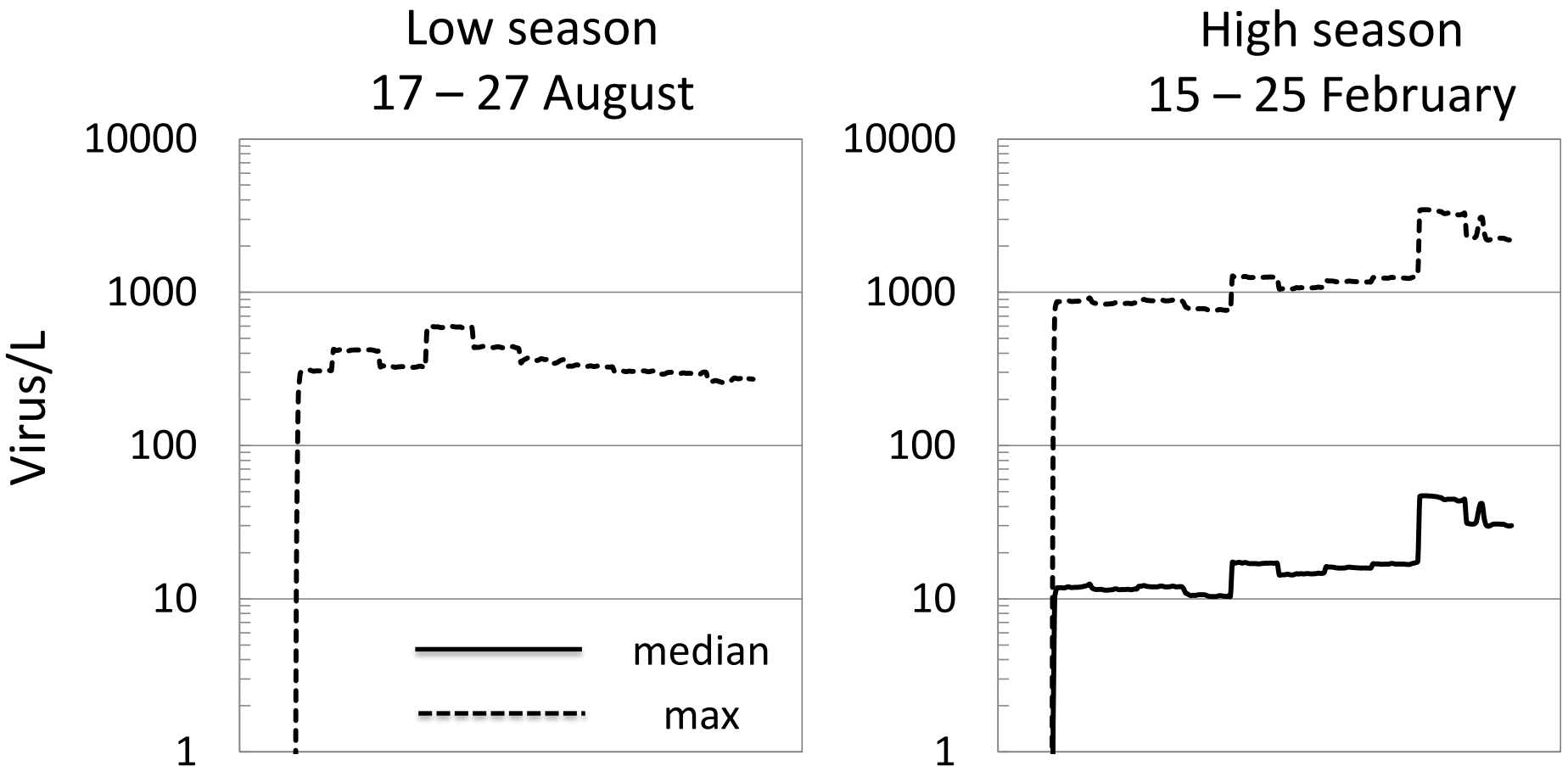
Norovirus GII concentration (virus/L) at the **Trollhättan** water intake



Modelling results

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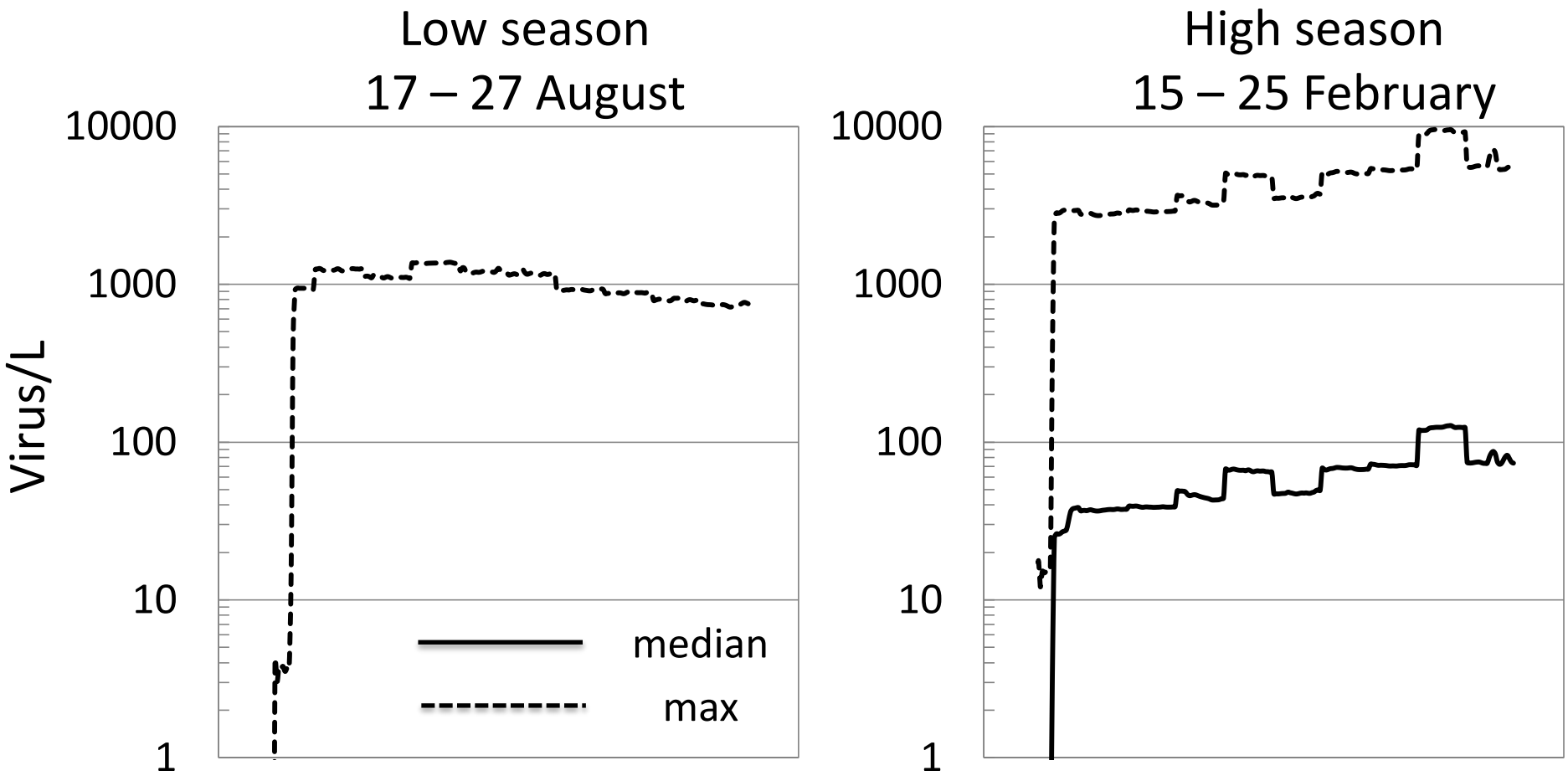
Norovirus GII concentration (virus/L) at the **Lilla Edet** water intake



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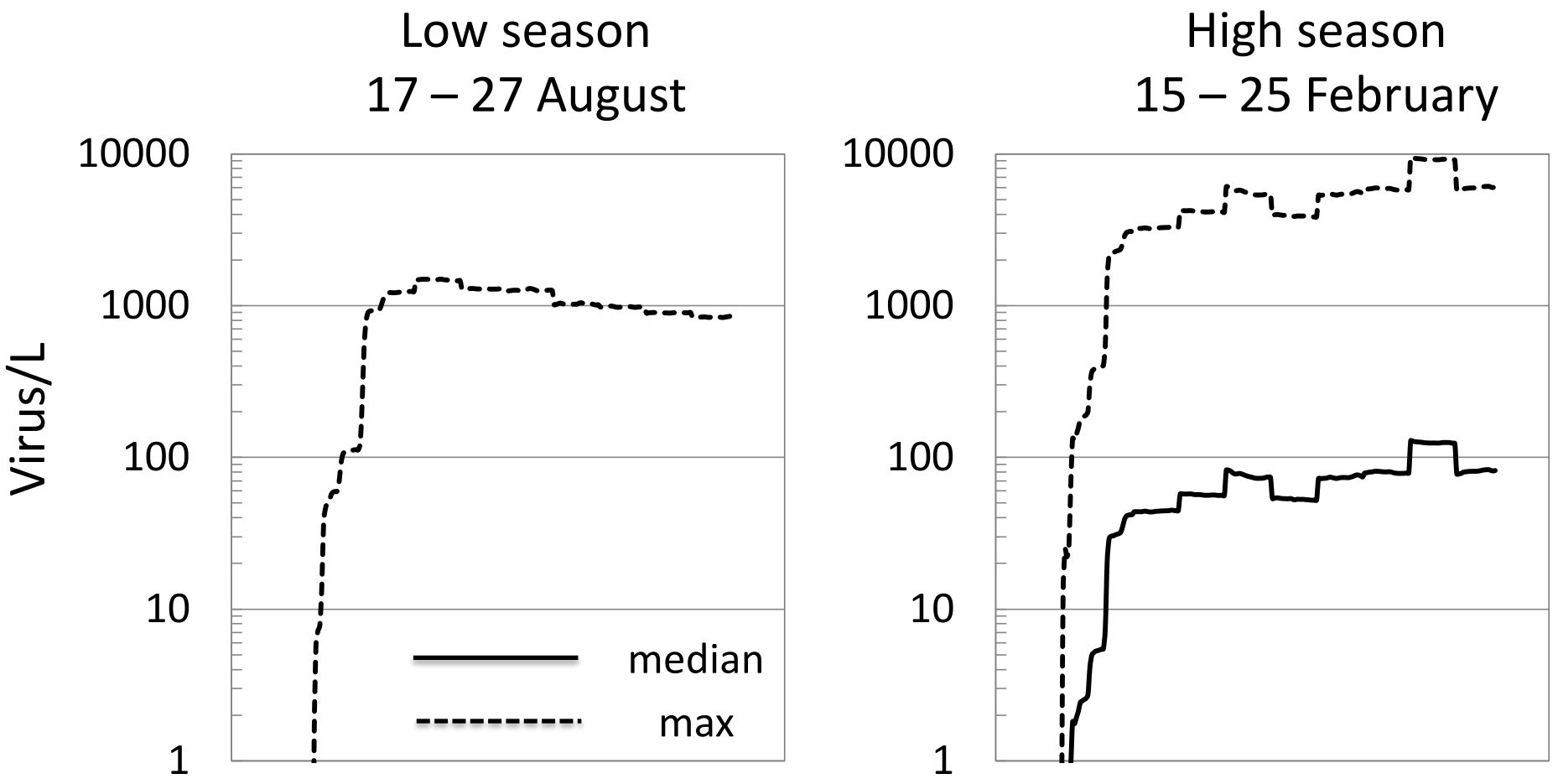
Norovirus GII concentration (virus/L) at the **Gothenburg** water intake



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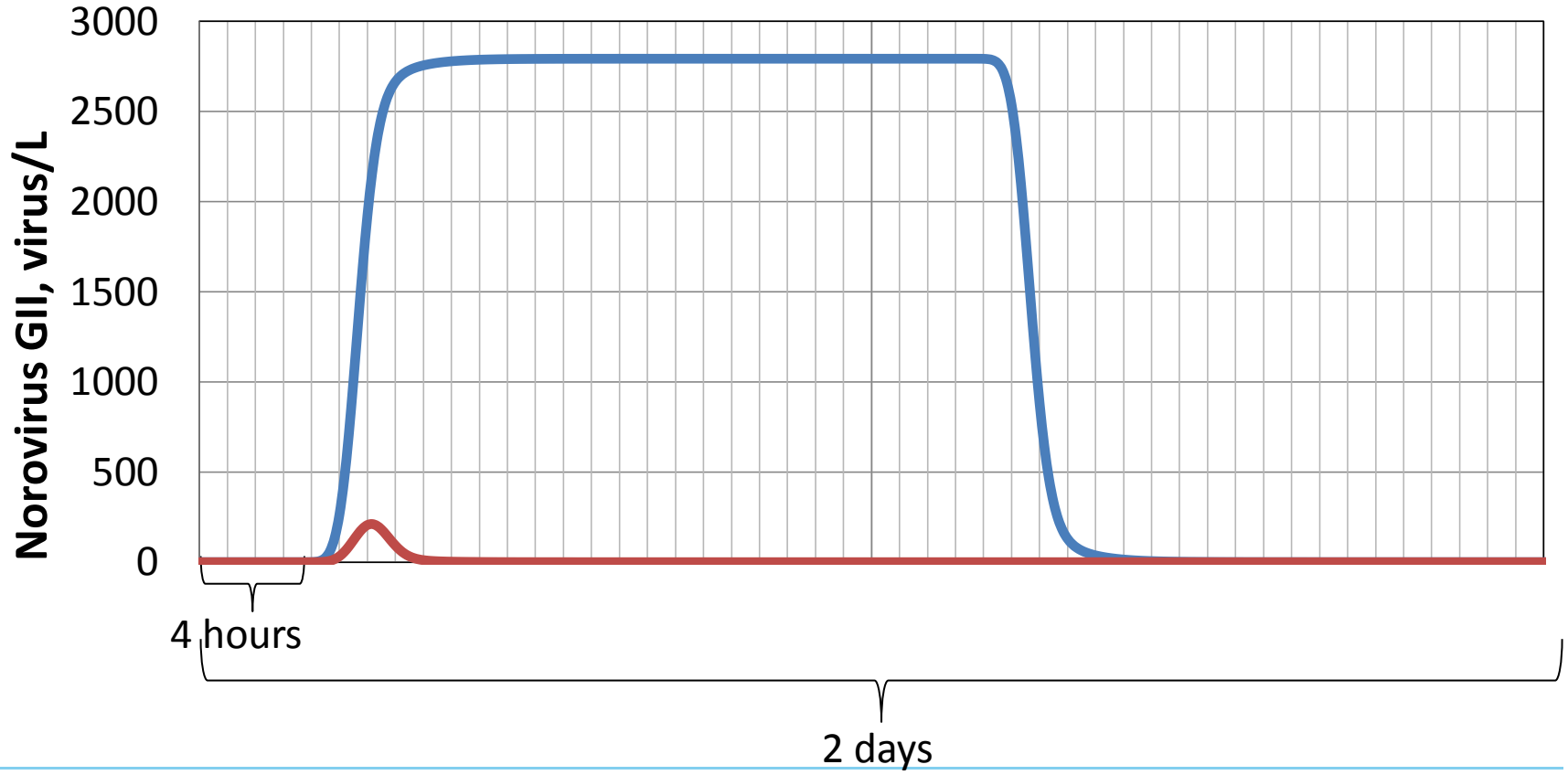
Scenario: emergency discharge from a WWTP

Influence of Holmängen WWTP on the raw water quality at Trollhättan

Scenario: discharge **during 1 day and 1 hour**,
average flow in Göta älv, maximum norovirus GII concentration, high season



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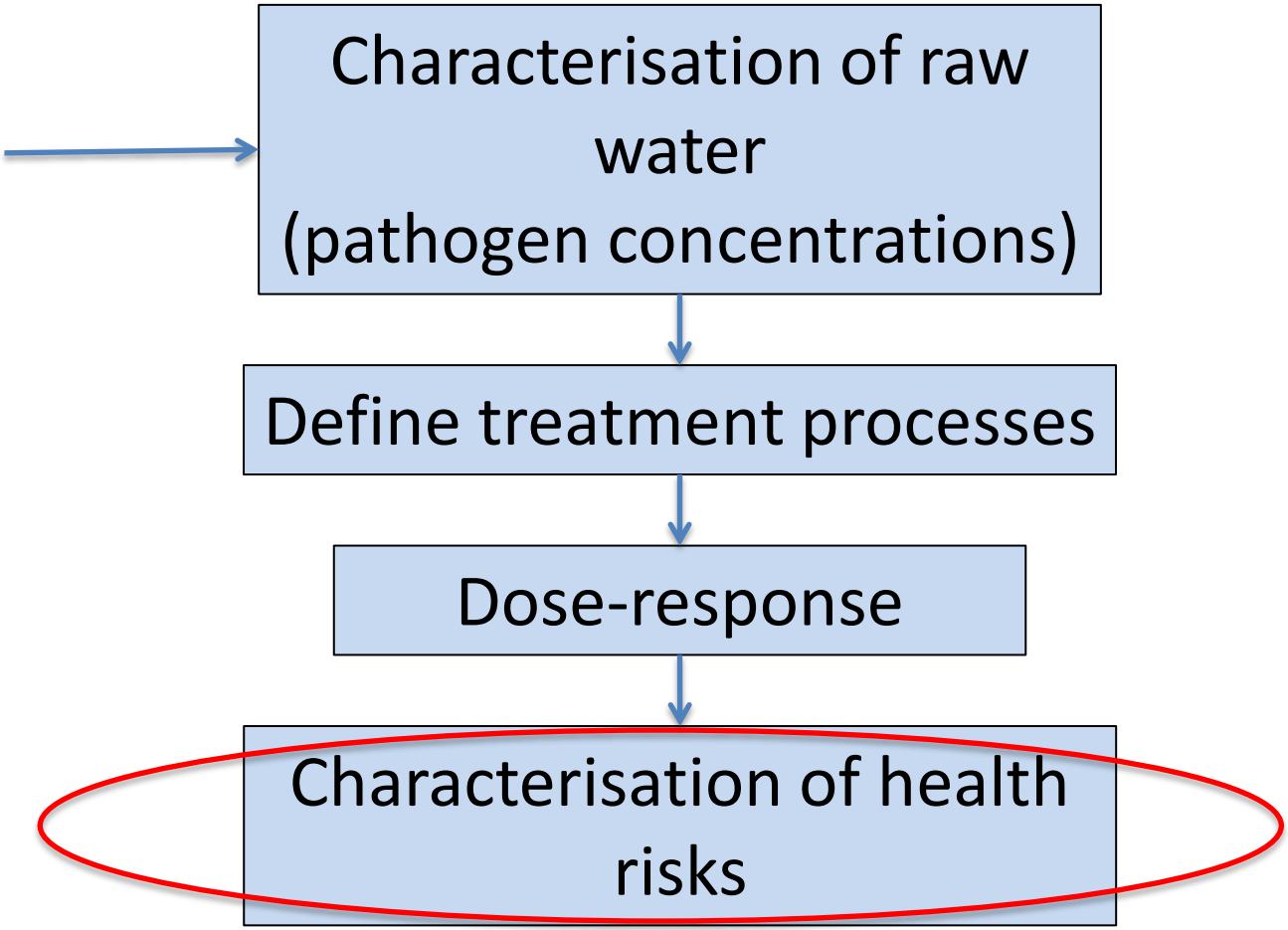
Quantitative microbial risk assessment (QMRA/MRA)

Measured data
Modelling results



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- Colleagues within the VISK project
- Graduate School on Environment and Health

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