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CLUSTER OF EXCELLENCE
CLIMATE, CLIMATIC CHANGE, AND SOCIETY (CLICCS)

Development of a high-resolution model system for assessing an urban flood event in past and future climate

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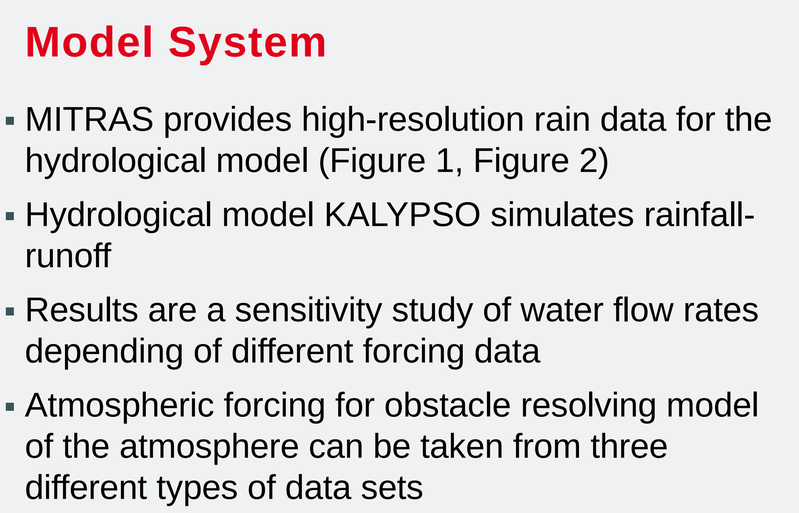
Introduction

- One aim of the project CLICCS-C1 is the high-resolution simulation of the “Lohbrügge event” in past and future climate
- A coupled high-resolution model was developed to represented precipitation and run-off in urban areas
- The coupled model system includes an atmospheric and a hydrological/hydrodynamical model
- Different model configurations were investigated for a suburb in Hamburg, Germany
- Lohbrügge is a city quarter in the eastern part of Hamburg, Germany
- On May 10th, 2018, Lohbrügge was hit by a local heavy rainfall event
- The sewer system was overloaded and parts of Lohbrügge were flooded

Model System

- MITRAS provides high-resolution rain data for the hydrological model (Figure 1, Figure 2)
- Hydrological model KALYPSO simulates rainfall-runoff
- Results are a sensitivity study of water flow rates depending of different forcing data
- Atmospheric forcing for obstacle resolving model of the atmosphere can be taken from three different types of data sets
- Forcing can be taken from two different types of rain radar data or full meteorological forcing from COSMO-D2 can be applied



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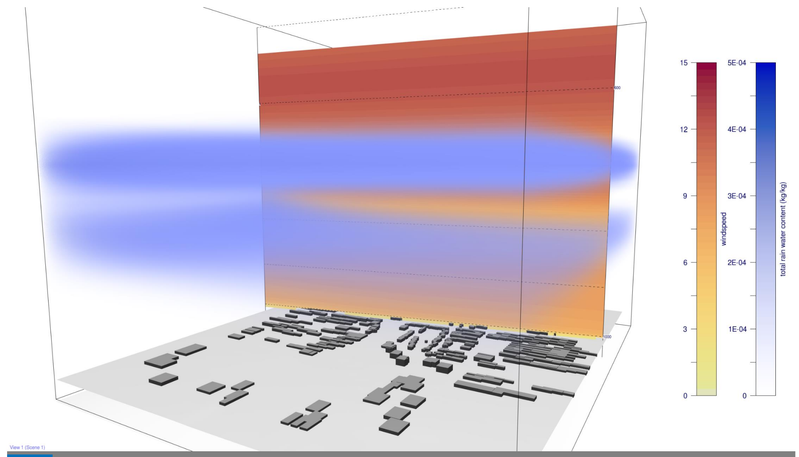
1) Model chain from atmospheric forcing to quantitative results as used for sensitivity study.



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2) 3D result of the atmospheric model MITRAS

Climate Projections

- Following Clausius-Clapeyron-Equation precipitation increase of 7% per 1 K temperature increase, median of 50-member model ensemble in the same range
- Measurements and interquartile range of 50-member model ensemble show precipitation increase of 11% per 1 K temperature increase
- Temperature increase for Lohbrügge: 1K to 1.5 K from 2018 to 2050
- Climate Future for Lohbrügge: moderate increase scenario (MIS) with 7% (7%/1 K) and high increase scenario (HIS) with 16.5% (11%/1 K) until 2025 (Figure 3)

Adaptation Scenarios

- Three future state scenarios for the city of Hamburg in 2050: coping (present state), incremental and transformative adaptation
- Scenario narratives are “water defensive city”, “water resilient city” and “water aware city”
- Combination of present climate and two climate projections with the future state scenarios leads to a matrix of nine model simulations (Figure 3)

	Present State 1 Water defensive city	Future State 2 Water resilient city	Future State 3 Water aware city
Present Climate			
Climate Future 1 (MIS)			
Climate Future 2 (HIS)			

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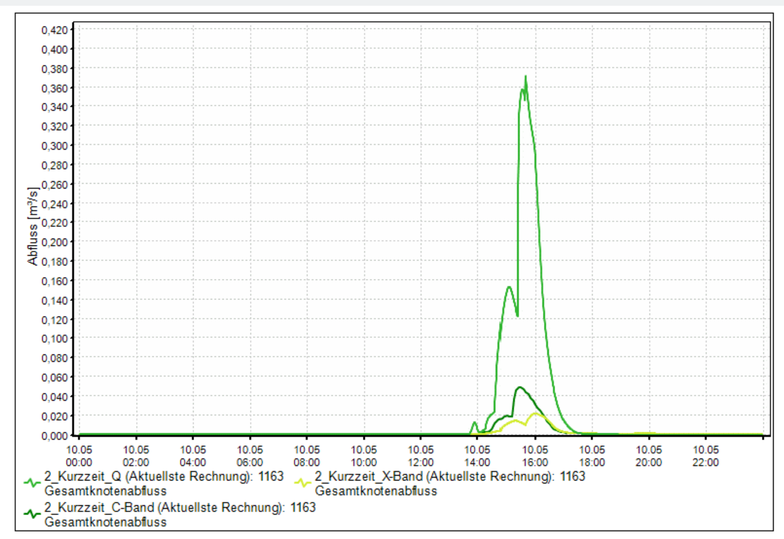
3) Matrix for model simulations, spanned by climate projections and adaptation scenarios.

Results

- Magnitude of the water flow rate depends substantial on the type of forcing data used for the model system (Figure 4)
- High-resolution modelling shows higher increase in water flow rate than in precipitation increase (Figure 5)



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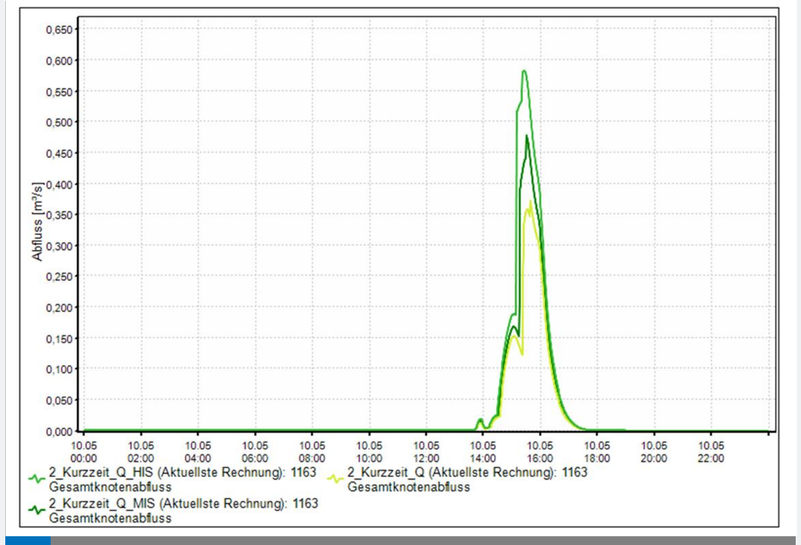
4) Water flow rate at draining point of the catchment area for simulations forced with two different rain radar data sets and COSMO-D2



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5) Water flow rate at draining point of the catchment area for present climate and MIS and HIS

Conclusion

- The model system is very sensitive on forcing data sets
- A model of the atmosphere is important to bring radar data from measurement height to surface

High quality, high resolution rain input data are important

References

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