



# 3RD NATIONAL PARTICIPATION DAY - AUSTRIA

Panel 1: Extreme Hazards & Climate Change

09.04.2024 | 09.00 -18.00 CET

BOKU River Lab (BOKU Wasserbaulabor)  
Am Brigittenauer Sporn 3, 1200 Vienna



**foster europe**  
Foundation for strong  
European Regions



**WAU**  
Department of  
Water, Atmosphere  
and Environment

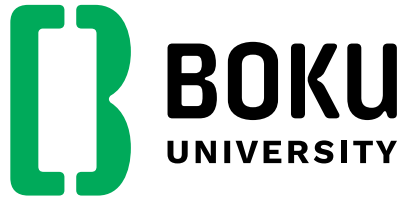


**Austrian Presidency**  
of the EU Strategy  
for the Danube Region

**Danube Strategy**  
Civil Society  
Forum



**DANUBE REGION**  
strategy  
Institutional Capacity



# Extreme Hazards & Climate Change

Panel 1

Gregor Laaha  
Lena Junger  
Adriane Hövel  
BOKU University

Science  
for a  
[cooler  
future]

# Water-related Global challenges



**Freshwater biodiversity loss rate of 83% since 1970 (WWF, 2022)**

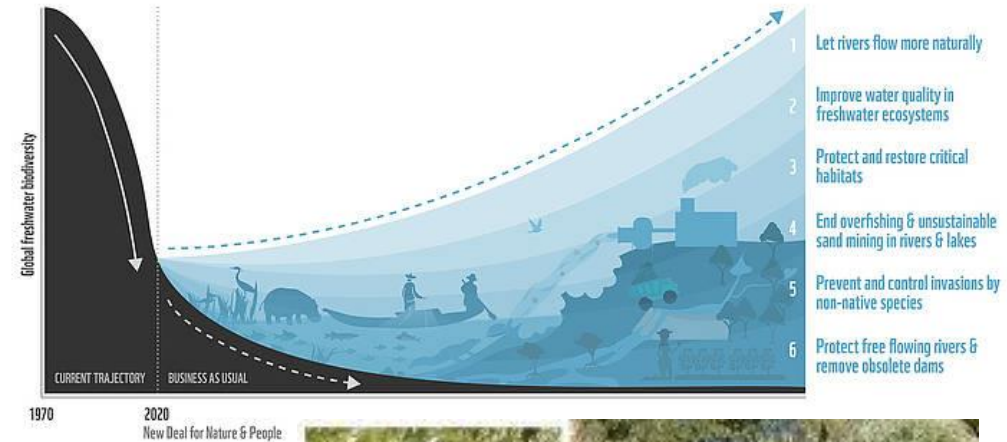


River Po 2022. Photograph: Pierpaolo Ferreri/EPA



## Water-related disasters

- **deaths doubled**
- > 90% infrastructure damage over past 10 years (Sendai Framework Monitor)



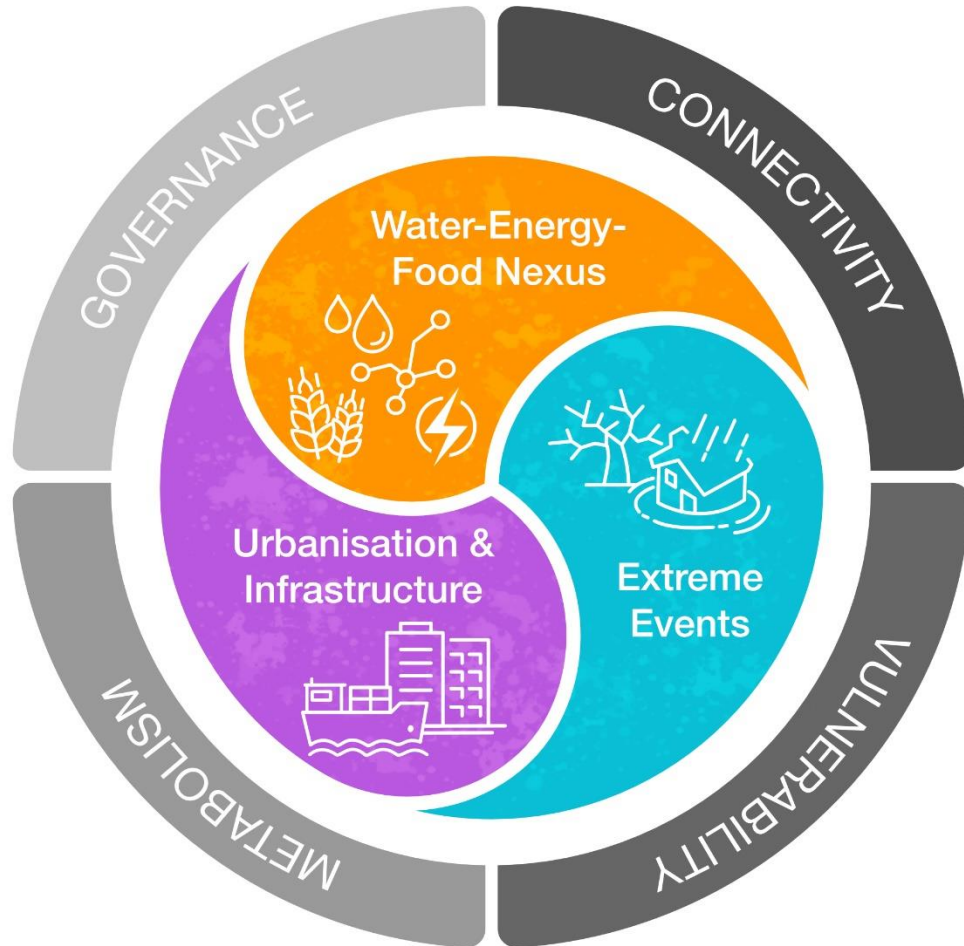
## Droughts and floods

**3 billion people affected** between 2000 and 2019 (World Bank, 2021)



© 2003 Marc Brehm, iStockphoto.com

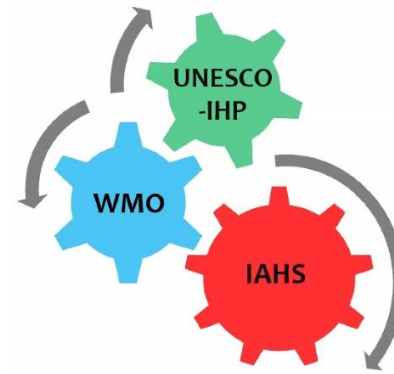
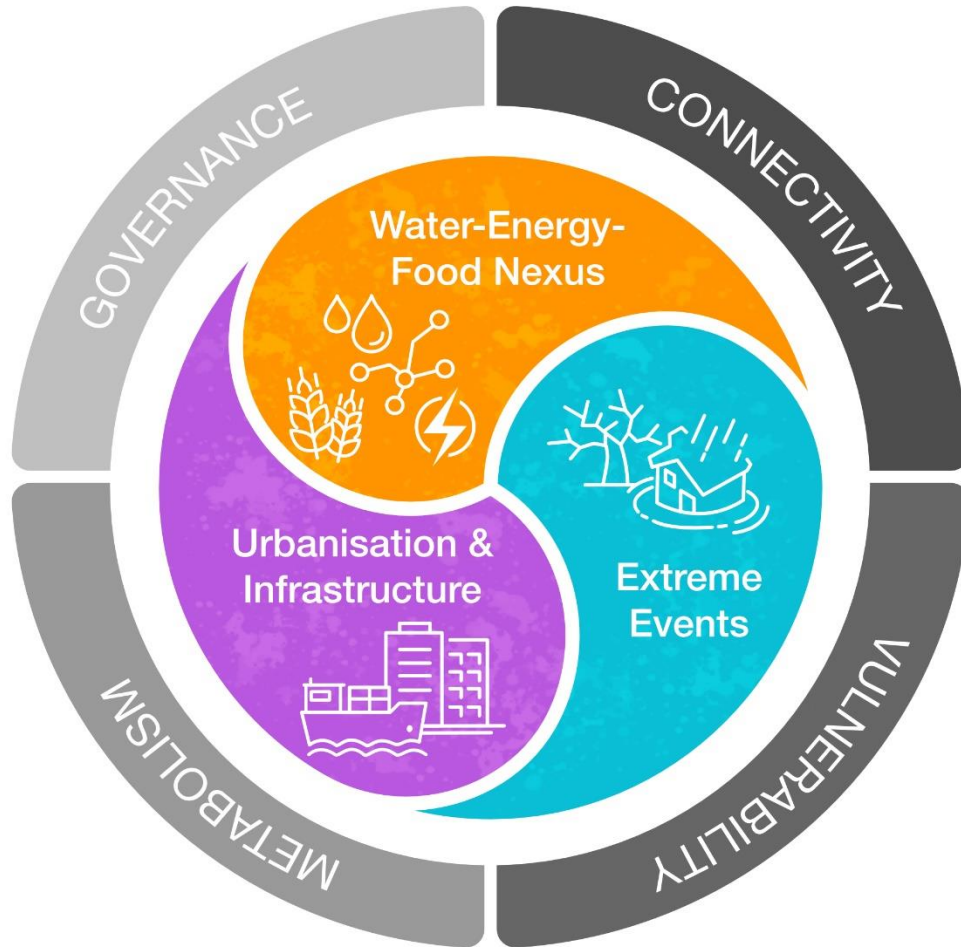
# Doc-School: Human River Systems (HR21)



- **Interdisciplinary Educational Program**
- **Structured in 4 Research Clusters**
- **PhD Topics related to 3 Research Fields**



# Socio-ecohydrological systems approach



<https://iahs.info/>

## Theme 1: Global and local interactions

**1.04 Urban water**

**1.05 Human-water dynamics**

**1.07 Water for biodiversity**

**1.08 Soil moisture dynamics**

**1.10 Aquifer governance**

**1.11 Hydrological design, hydrostochastic models**

**1.12 Water quality under global change**

**1.15 Droughts in mountain regions**

## Theme 2: Holistic solutions for water security

**2.01 Drought in the Anthropocene**

**2.03 Nature-based solutions**

**2.04 The water-energy-food-ecosystem nexus**

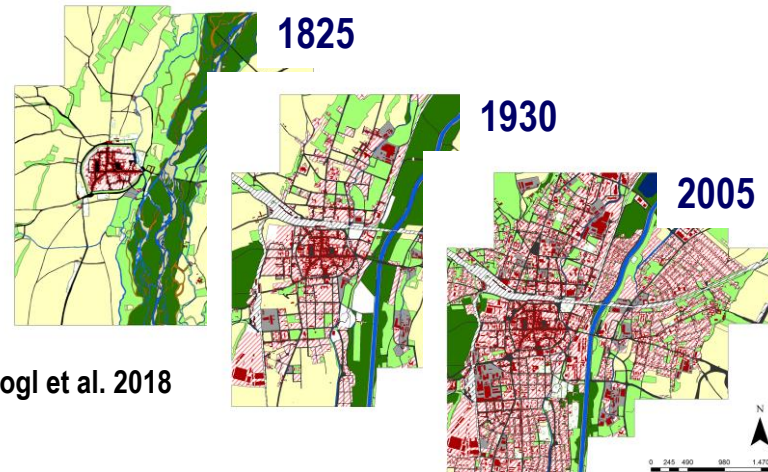
**2.05 Green infrastructure for flood protection**

**2.06 Water systems analysis for integrated planning**

**2.07 Stepwise ecological restoration of watersheds**

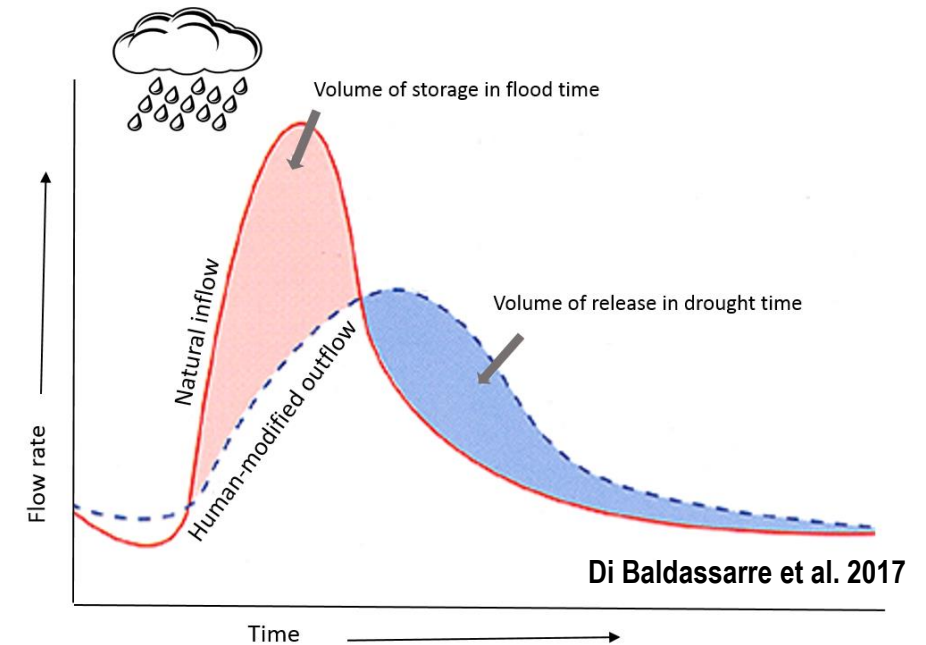


**Extreme events** – understanding impact chains and feedback processes of hydrological extremes on SEHS



Haidvogel et al. 2018

Material flows for flood protection & societal feedback loops



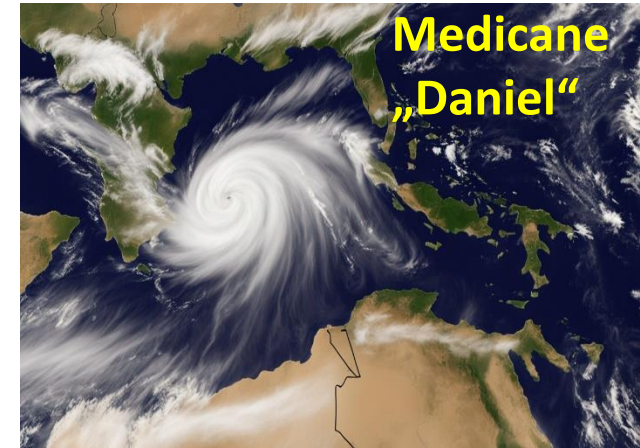
Human impact on hydrological extremes

# Libya dam collapse: engineering expert raises questions about management

Published: September 15, 2023 9.21pm CEST • Updated: September 16, 2023 11.17am CEST



Satellite imagery after the catastrophic flooding that struck the city of Derna. Satellite image (c) 2023 Maxar Technologies/Getty Images



[www.bnn.network.org](http://www.bnn.network.org)



Whaley bridge Dam, Danny Lawson/PA 2019

# Low Flows – one manifestation of drought



... affecting a range of water related sectors



Impacts of droughts in Europe  
Figure by A.J. Teuling, Wageningen,  
from Van Loon (2015, *WIREs*)



# Extreme Hazards and Climate Change

3<sup>rd</sup> NATIONAL PARTICIPATION DAY – AUSTRIA

**Waters 2040:** Climate Change and Resilient Water Management

in the Danube Catchment

09 April 2024

# PhD Students



PA 2

Sustainable Energy



PA 4

Water Quality



PA 5

Environmental Risks



PA 10

Institutional Capacity & Cooperation

Adriane Hövel



*Rainfall-Runoff Process*



Eva Kaminsky



*Groundwater Temperature*



Philipp Stern



*Climate Change Adaptation*



Katharina Kearney



*Urban Stormwater Management*



Lena Junger



*Spatial Planning*



## PA 2: Sustainable Energy



- Sustainable use of biomass, solar, geothermal, hydropower, and wind power
- New and innovative subsurface energy storage solutions

## PA 4: Water Quality



- Environmental restoration and protection in the Danube River Basin
- Reduction of nutrient levels and restoration of ecosystems

## PA 5: Environmental Risk



- Flood risk management and climate change adaptation
- Impact assessment of water scarcity and droughts
- Promote disaster resilience, preparedness and response activities

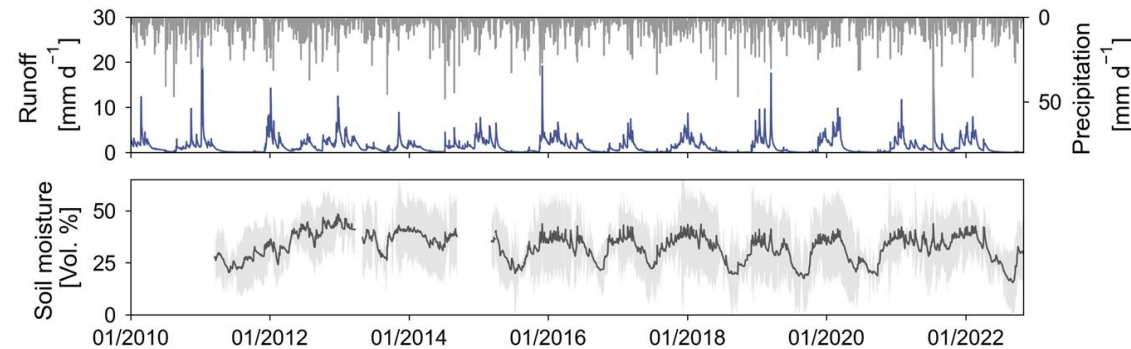
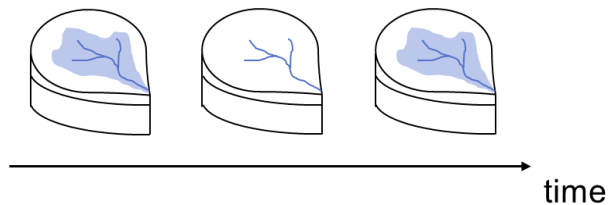
## PA 10: Institutional Capacity & Cooperation



- Strengthening institutional capacity to improve decision-making
- Involving society and local actors for effective policy-making and implementation

# Hydrological Processes: Development & Application of New Methods

- Investigate the rainfall-runoff process in the same catchment **at different time points** to identify temporal **patterns**
- Use of high-resolution observation data



Adriane Hövel



PA 5

Environmental Risks

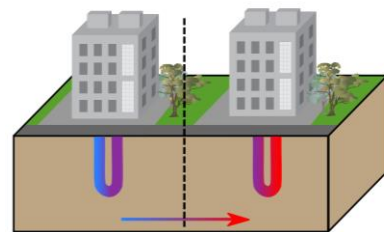
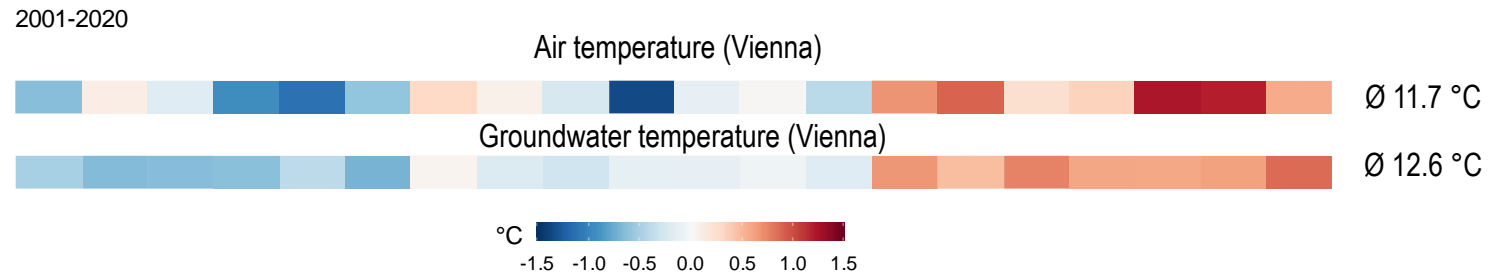
➤ **Improved process-understanding** can lead to enhanced management strategies

# Climate change and temperature extremes: effect on urban groundwater quality

- Investigation of increasing urban groundwater temperature and its impact

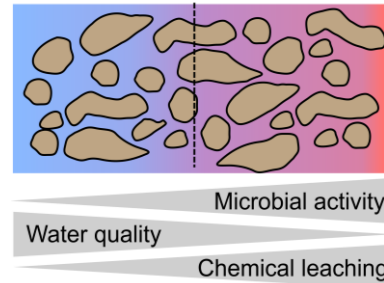


Eva Kaminsky

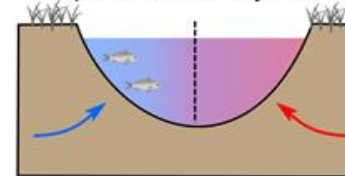


**c** Enhanced geothermal energy opportunities

**d** Impacts on groundwater chemistry and microbiology



**e** Impacts on groundwater dependent ecosystems



Benz et al. (2022)

- Optimizing the utilization of rising temperatures can enhance both energy provision and ecological well-being



PA 2

Sustainable Energy

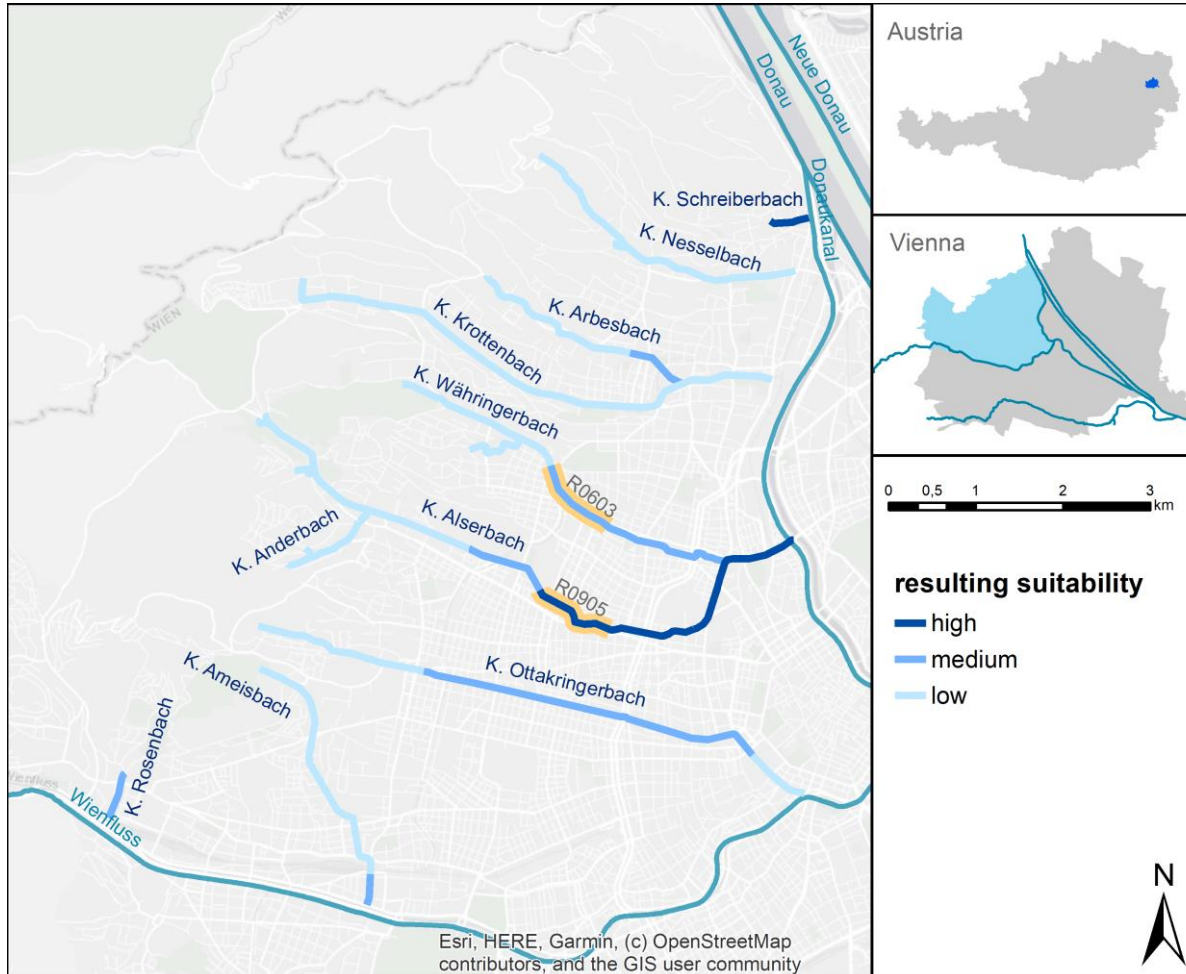


PA 4

Water Quality



# Potential of Urban Streams for Heat Mitigation – Case Study Vienna



Suitability pre-assessment for decoupling in-sewer captured streams (Prenner et al. 2022)

- Rising Temperatures aggravated by Urban Heat Island effect (UHI) in urban settlements
- Water from urban streams for blue-green climate change adaptation measures
- Investigation of **local water resources** and potential of **blue green infrastructures** helps to develop strategies to alleviate effects



Philipp Stern



PA 5

Environmental Risks

# Urbanized Areas

Sealed surfaces

Heterogeneous infrastructures

Densely built-up area – high damage potential



Competing interests for limited space

Sectoral responsibilities and conflicting objectives

Socio-ecological system – complex interplays



Katharina Kearney



Lena Junger



PA 5

Environmental Risks

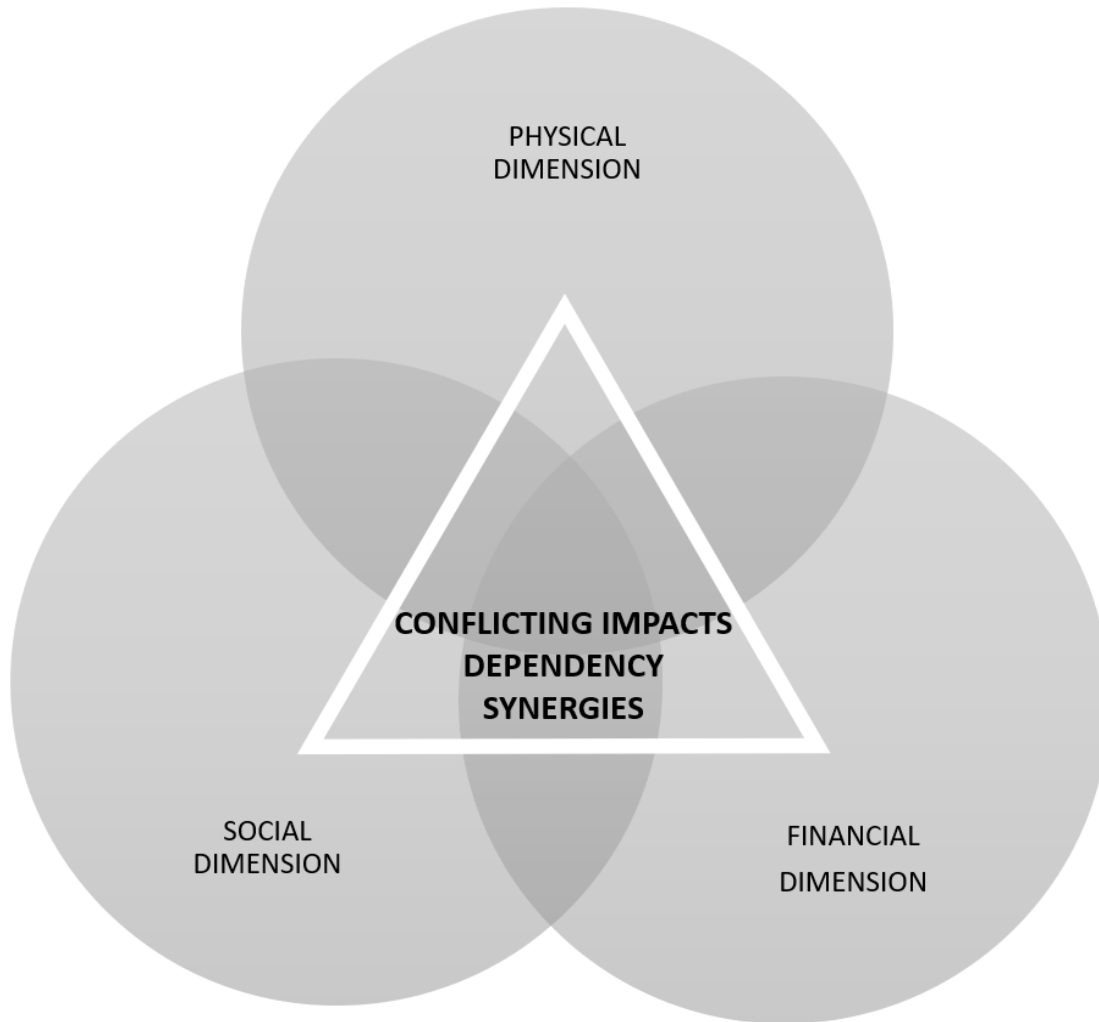


PA 10

Institutional Capacity & Cooperation



# Resilience



Katharina Kearney



Lena Junger



PA 5

Environmental Risks



PA 10

Institutional Capacity & Cooperation

Multidimensional Resilience,  
Junger et al. 2023

# Case Studies

- Participatory modelling and co-creation for transformation and resilience

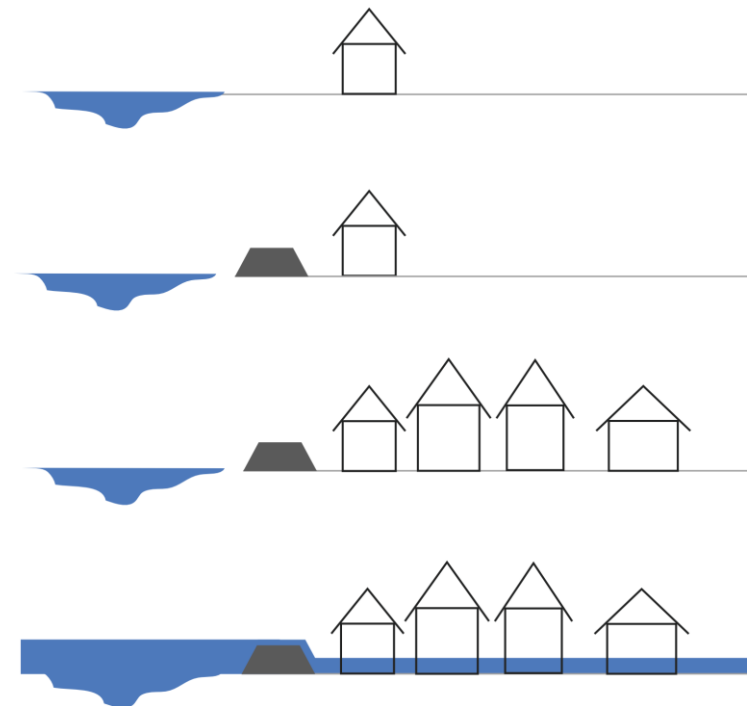
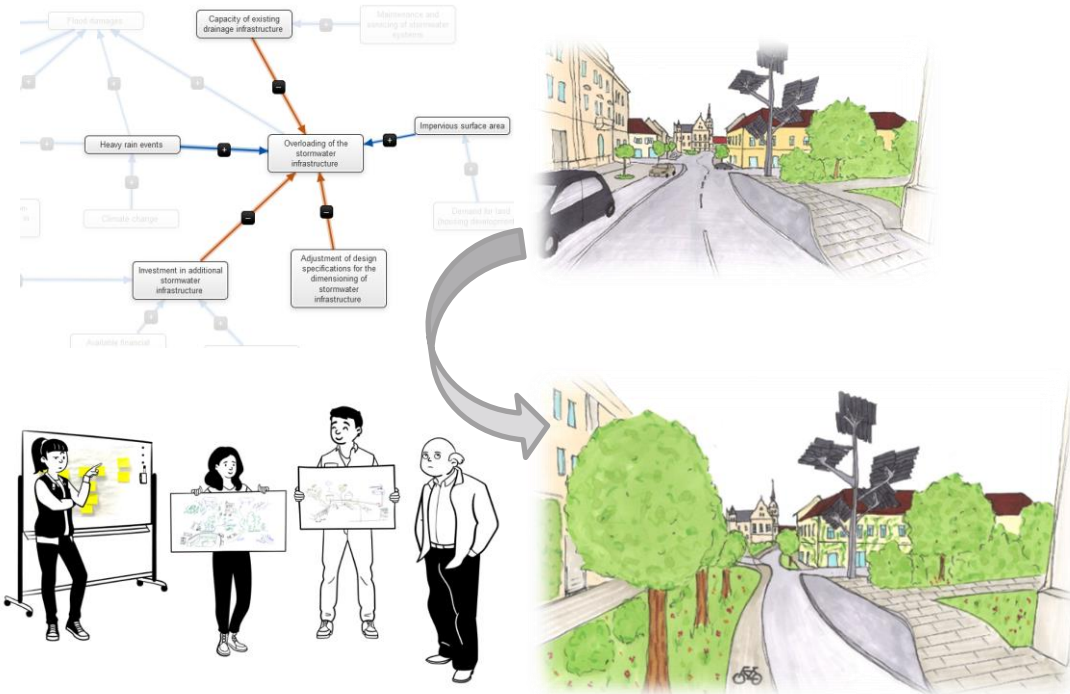
- Spatial planning and the levee effect



Katharina Kearney



Lena Junger



PA 5

Environmental Risks



PA 10

Institutional Capacity & Cooperation

## Concluding Statements

>> Due to uncertainties, new challenges and changing conditions caused by climate change, the **continuous monitoring of data** and the use of **new methods** are needed.

>> Changing conditions and existing **potentials** should be better utilized to **create synergies** (e.g.: local water resources for blue-green infrastructures, increased temperatures for energy generation in the city)

>> **System-thinking** and risk-oriented **planning decisions** are required to enable the use of potentials and adapt to climate change.

PA 2 Sustainable Energy  
PA 4 Water Quality  
PA 5 Environmental Risks  
PA 10 Institutional Capacity  
& Cooperation

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