



Network of Experts

Knowledge Ability Action

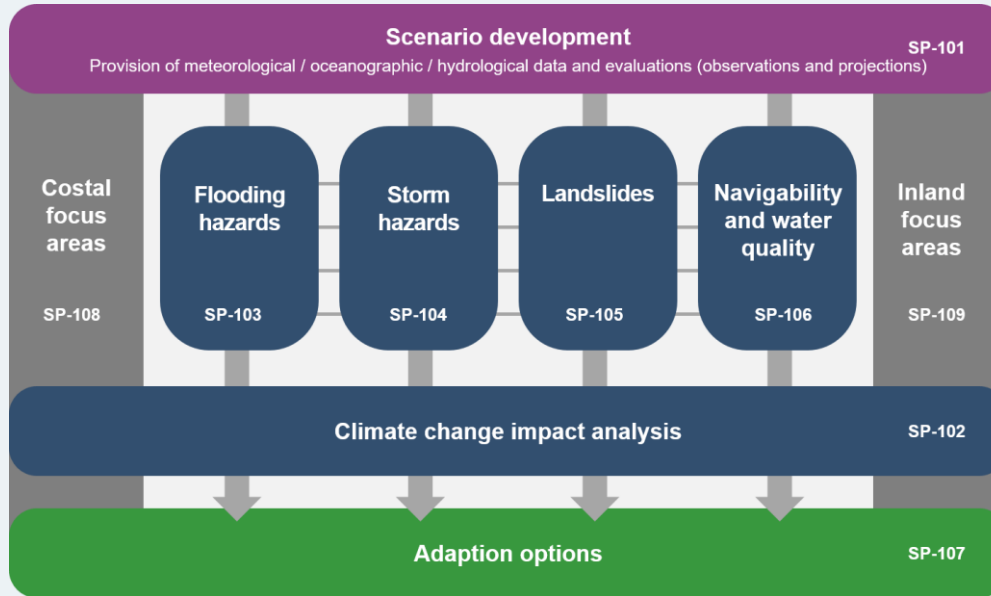
Stephanie Hänsel, Lara Klippel and the project-team

**Adapting the German transport system to
climate change and extreme weather events:
Results of research phase 1 (2016-2019) and
outlook on phase 2 (2020-2025)**

The path ahead ...



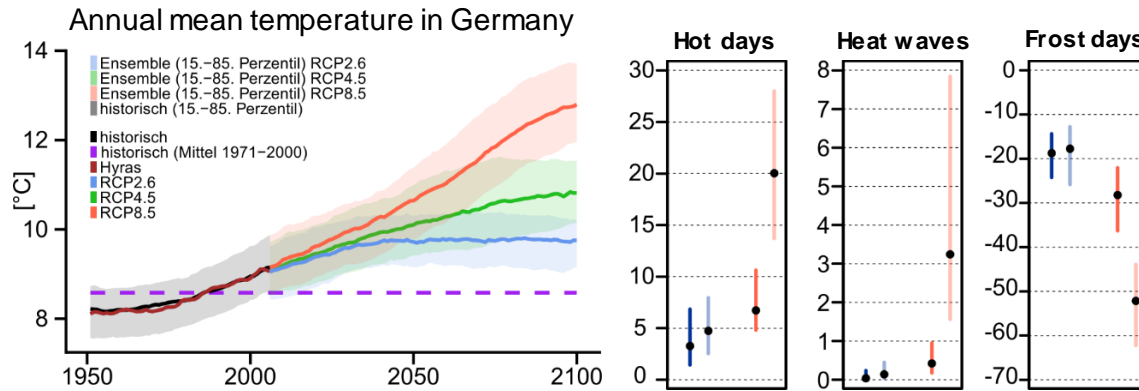
1st Research Phase (2016-2019)



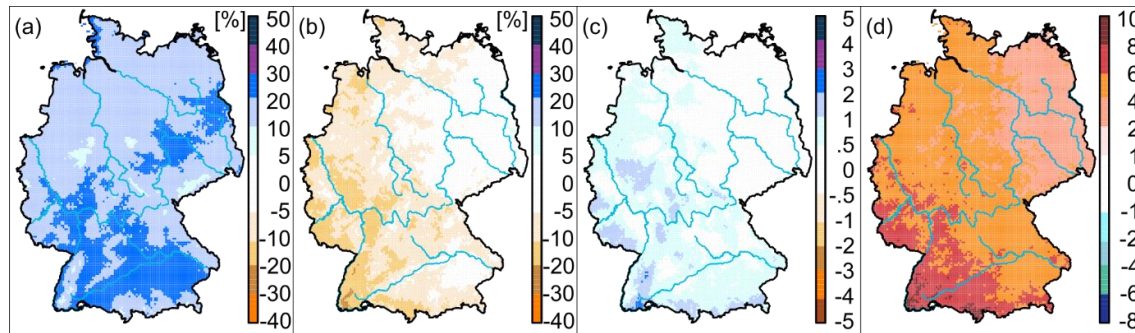
- Consistent assessment across the three modes of transport
- Coordinated datasets and methods
- Diverse output (data, methods, maps, reports)

- How severe, where and with which mechanisms climatic changes and extreme weather events impair the German transport system?
- Which adaptation options are already available or can be generated in future?

Climate change – Atmosphere



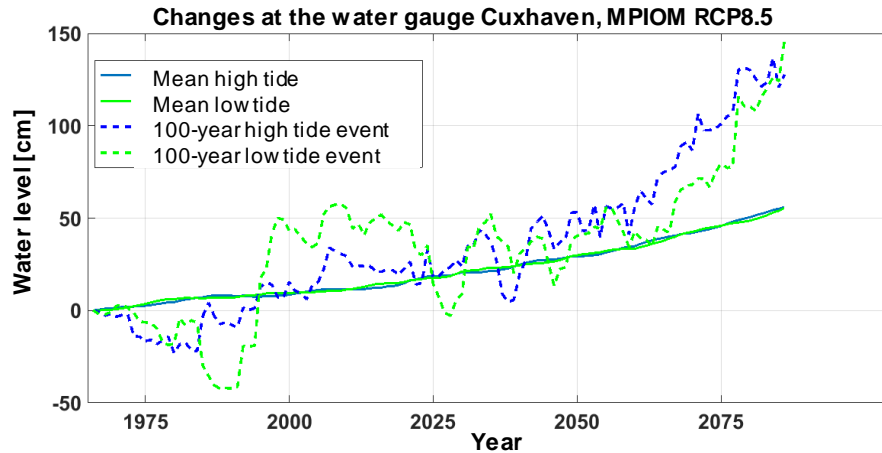
- air and water temperature ↑
- heat ↑
- frost ↓



Changes in [2071-2100 vs. 1971-2000; median RCP8.5] precipitation sum in (a) winter, (b) summer and number of (c) days with heavy precipitation [winter] and (d) dry days [summer]

- seasonal precipitation changes
- days with heavy precipitation ↑
- dry days ↑

Climate change – Hydrosphere

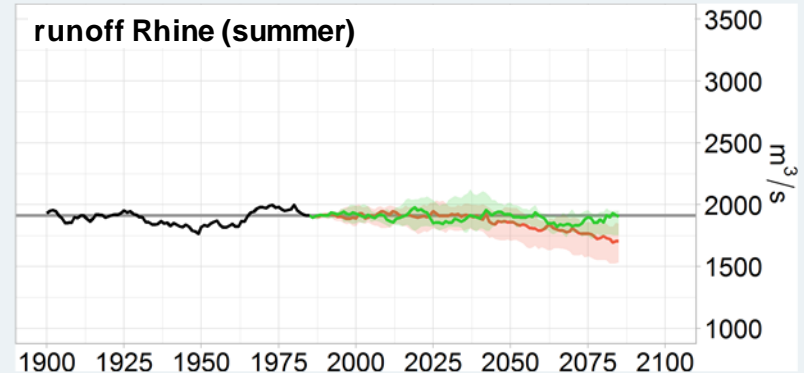
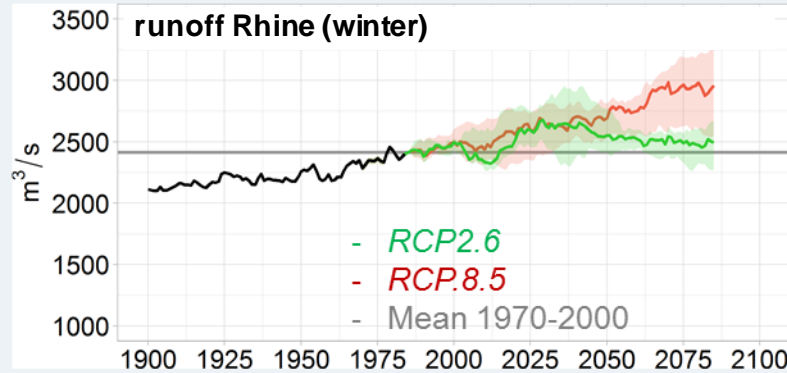


Coast

- sea level ↑
- tidal changes

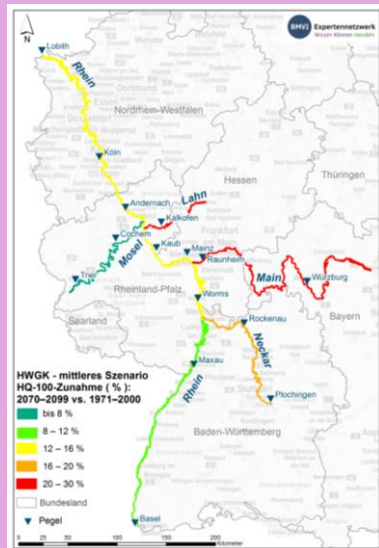
Inland

- seasonal changes in runoff



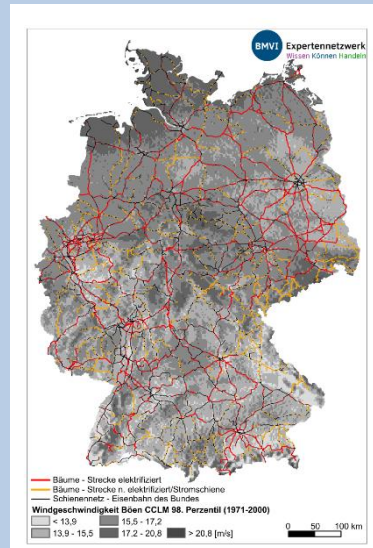
Impacts of climate

Changes of HQ₁₀₀ at the Rhine and its tributaries



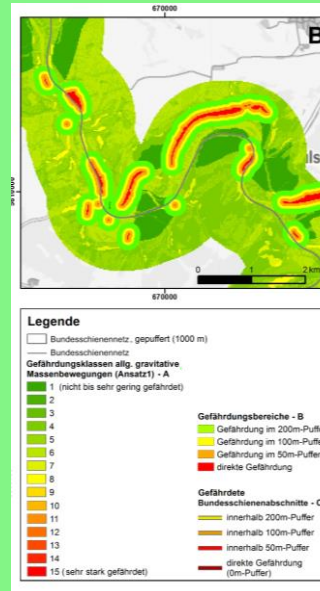
■ Floods ↑

Exposition and sensitivity of the Federal railway system against wind throw



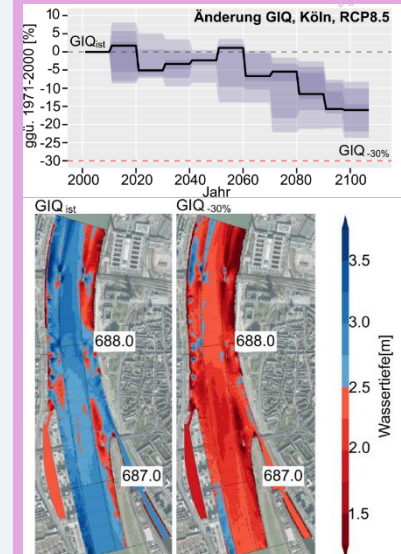
■ Wind throw →

Maps about the risk of gravitational mass movement



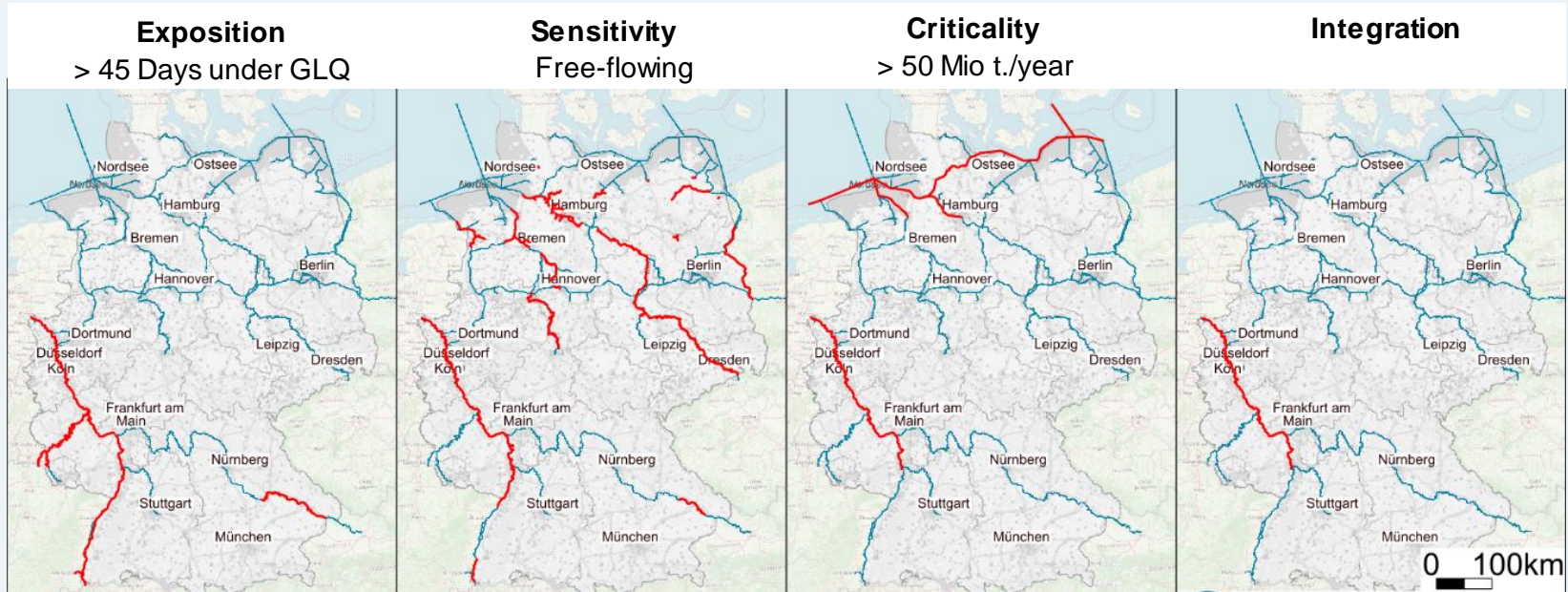
■ Landslides ↑

Changes in low water discharge (parameter GIQ)



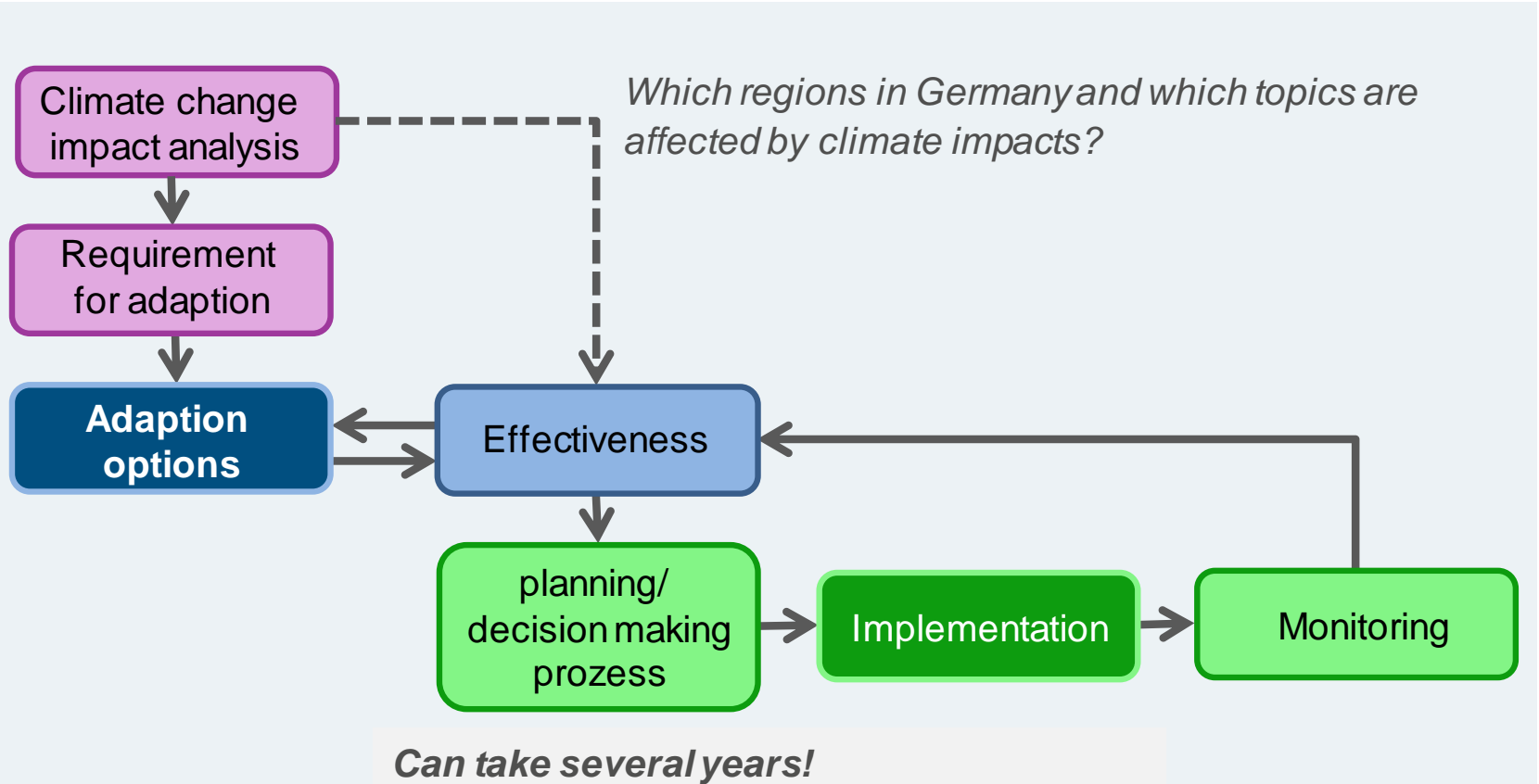
■ Low water ↑

Climate impact – integrated approach

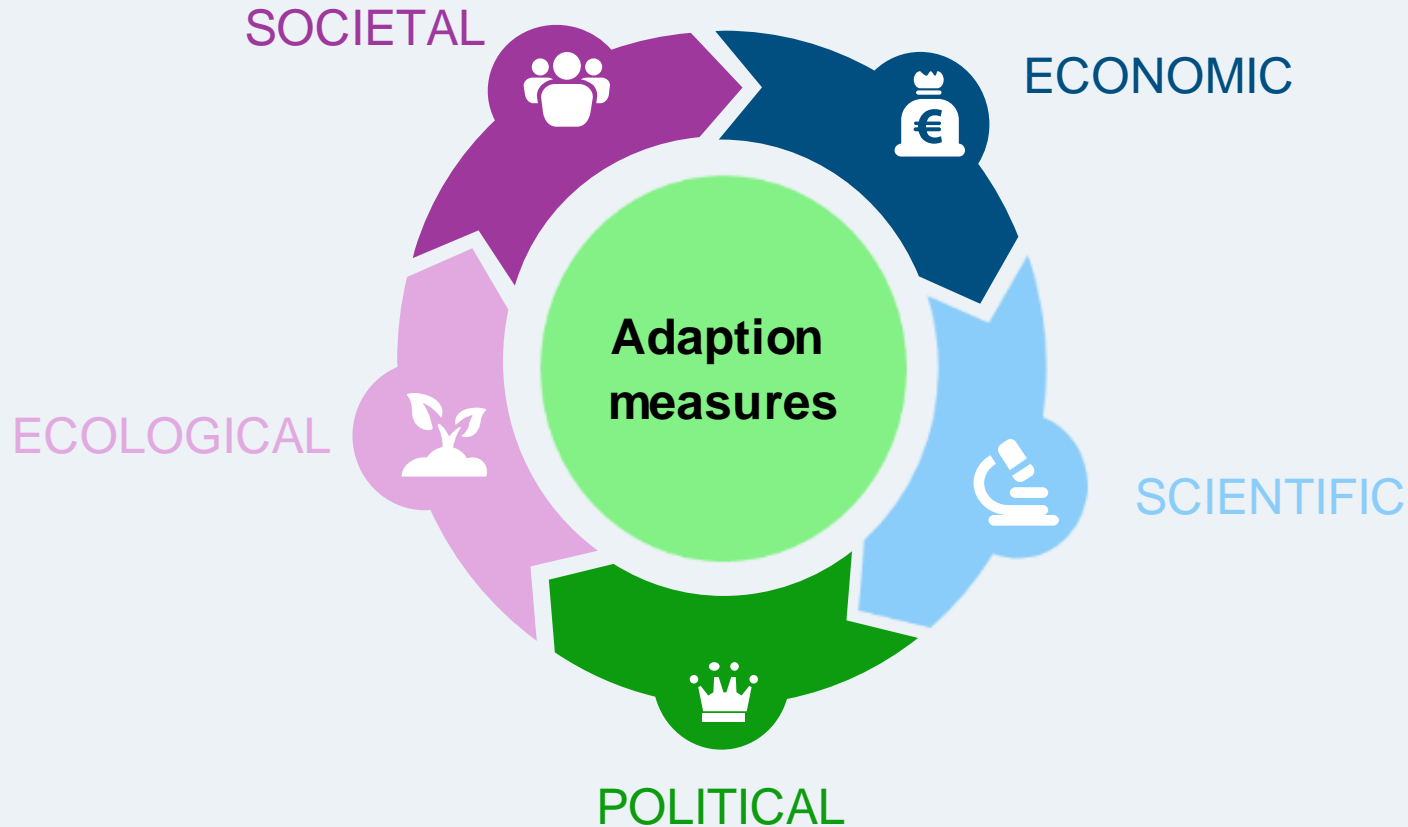


- Climate change impact analysis as a basis to assess need for adaption

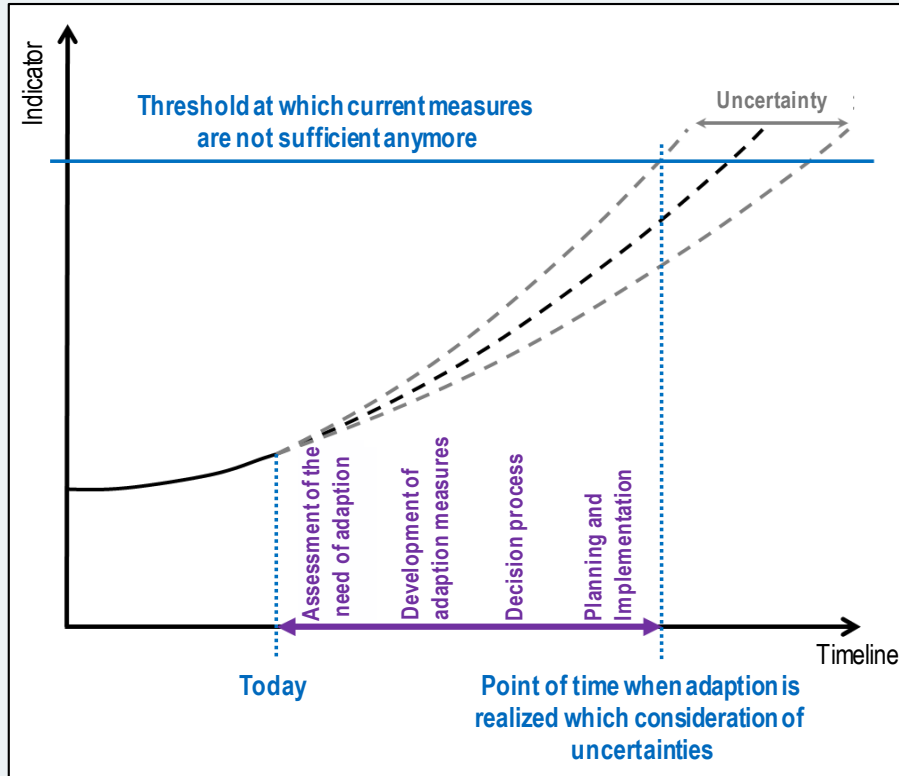
Adaption options – development



Adaption options – boundary conditions



Handling of uncertainties



Changed according to Lowe et al. (2009)

Adaptation strategies need to consider:

- Handling of uncertainties in projections
 - Duration of the single steps in the planning and implementation process
- An early start of the adaptation process is recommended

Types of Adaption options

informational → services

- Development of a sustainable base of data and procedures which are adapted to the needs of the operators

regulatory

- Technical standards and basis of assessment
- Systematical inspection (and if necessary revision) of technical standards on possible climate change impacts

technical

- Adapt or if necessary, replace structures
- New structures to compensate for negative effects of climate change

operative – transport infrastructure

- Adapted Management (e.g., sediment management of the tidal Elbe)

operative – traffic system

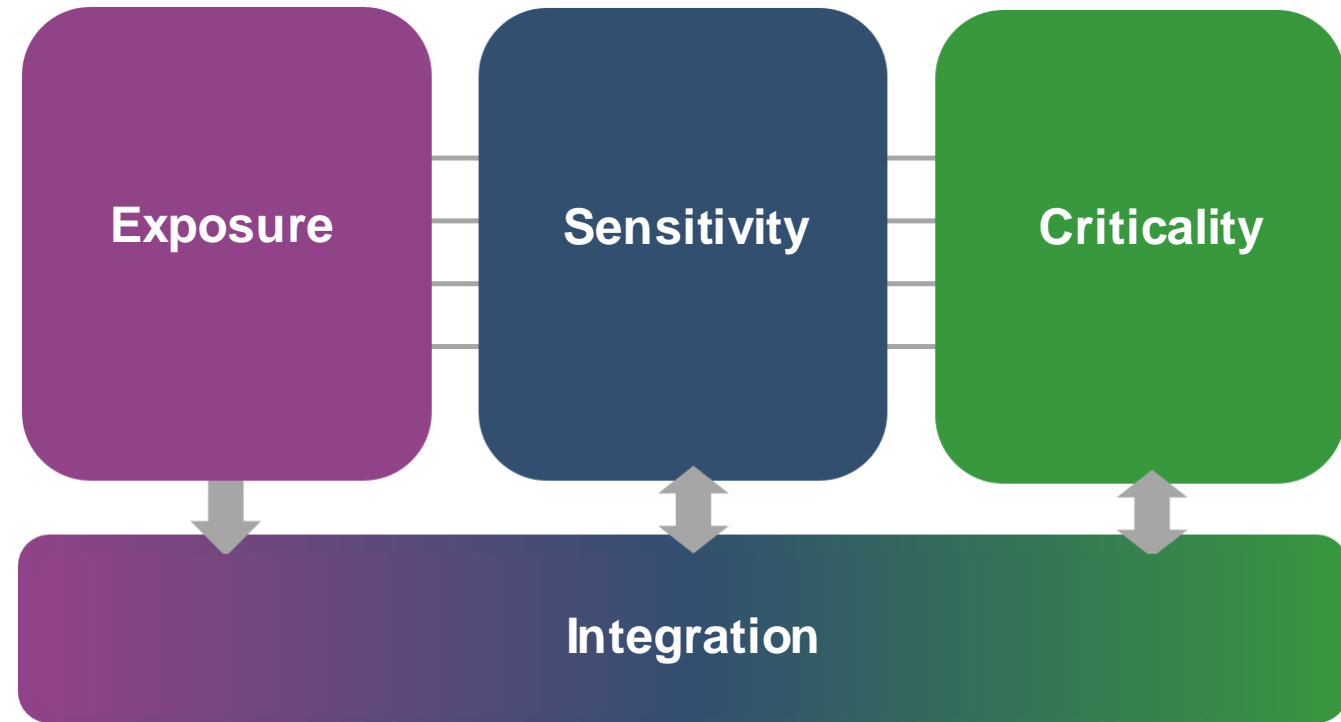
- Short-term modal shifts when an incident occurs and if necessary long-term re-routing due to a higher reliability of other transport modes

Achievements of the 1st research phase

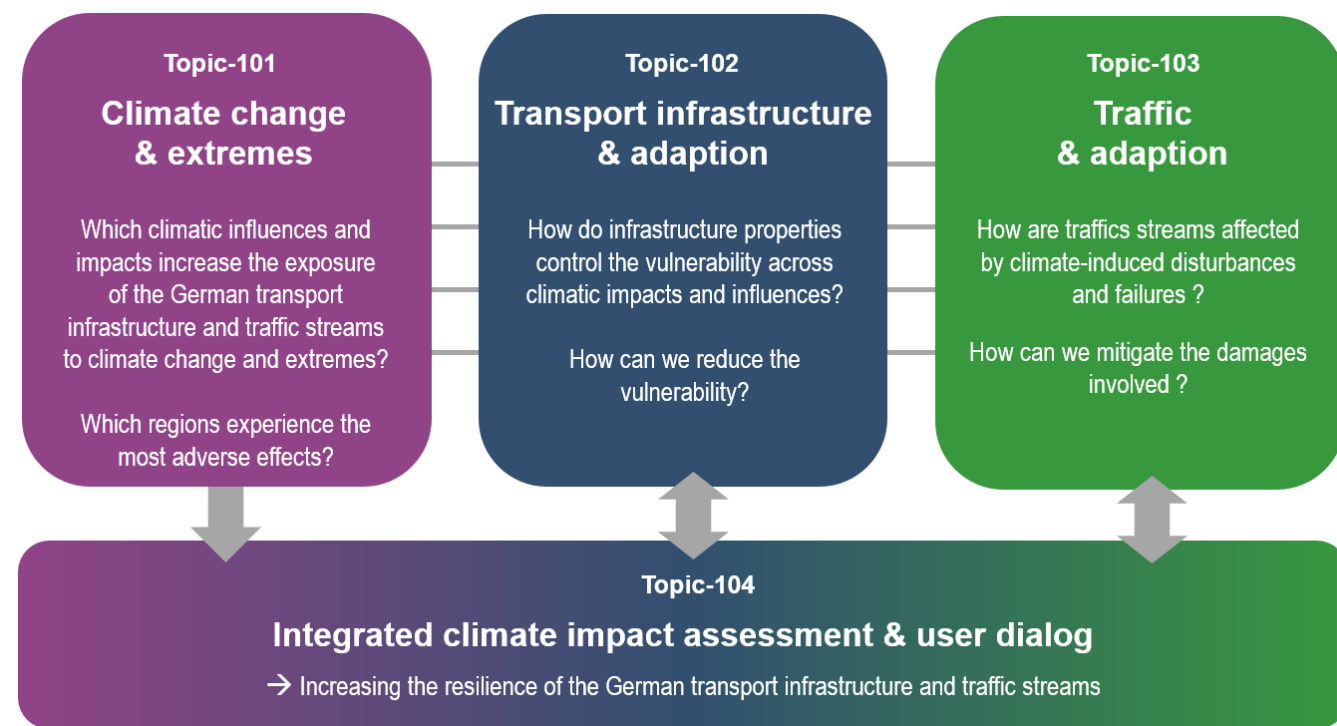
- ✓ Information about the current and projected climatic influences and impacts on the Federal transport system are provided across the three modes of transport.
- ✓ Analysis and assessment of potential adaption options.
- ✓ Establishment of a decision-making basis to adapt the Federal transport system to climate change.

What is new in the 2nd research phase?

Re-organisation of the work flows



Re-organisation of the work flows



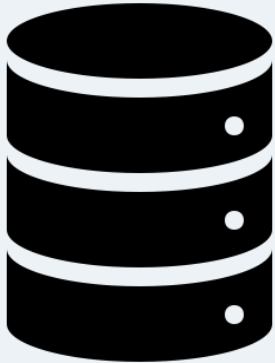
Intensification of the user-dialog

A broad concept how to integrate the exposure, sensitivity and criticality analysis has not been developed yet. This will be done in cooperation with the user to assurance a practicability.

An strengthened dialog with the users eases the provision of data, the exchange of ideas, and the development of exemplary adaption options.



Fill data gaps with respect to the sensitivity – Example 1



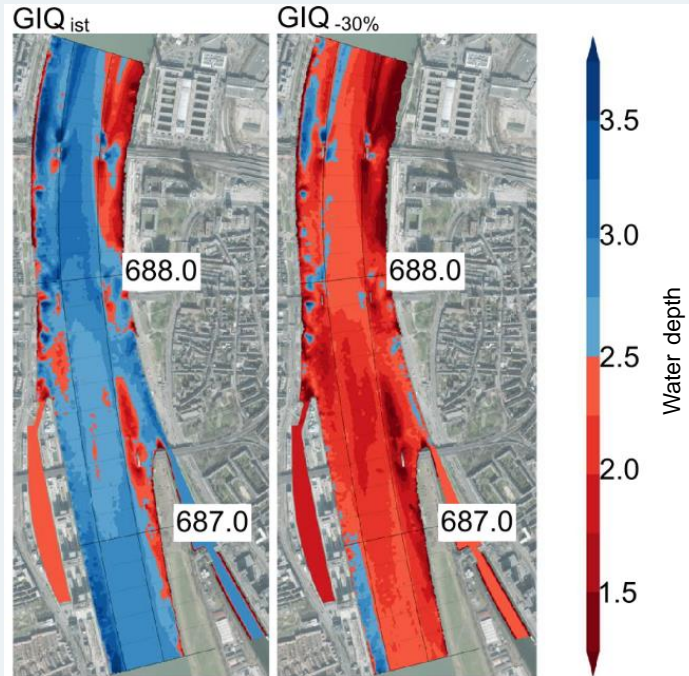
Gathering of new data that capture information on the sensitivity of a system.

Height of streets and rails

Development of database on damages from climate-induced events

Identification of passages in guidelines (street) which may be adapted to climate change

Fill data gaps with respect to the sensitivity – Example 2



Phase 1: Case study

Sensitivity was assessed at a single site at the Rhine in Cologne.

Changes in the parameter GLQ were translated into changes of the water depth.

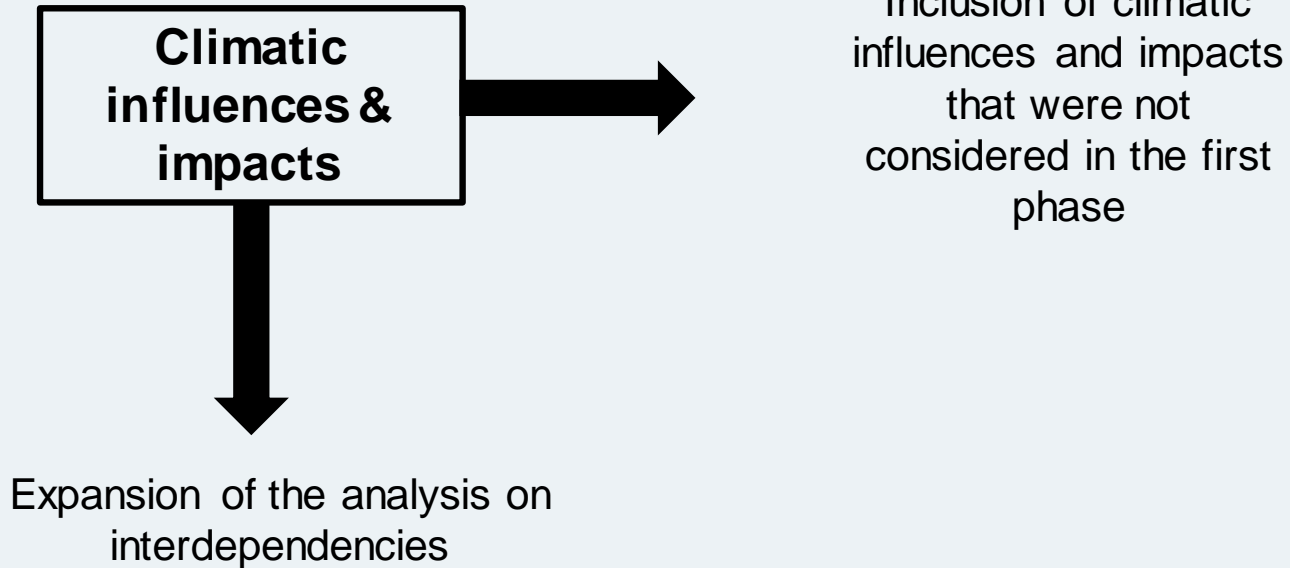
Fill data gaps with respect to the sensitivity – Example 2



Phase 2: Network-wide picture

Qualitative synopsis which parameters can be used to capture the sensitivity of waterways with respect to climate change at coarser, but network wide resolution.

Enlarge the scope of exposure analysis



Contact details

Project coordinators TF-1:

Expertennetzwerk.TF1@dwd.de

- Dr. Stephanie Hänsel (DWD), stephanie.haensel@dwd.de
- Dr. Lara Klippel (DWD), lara.klippel@dwd.de



Contact persons transport modes:

- roads: Farina Lohrengel (BASt), lohrengel@bast.de
- waterways: Dr. Enno Nilson (BfG), nilson@bafg.de
- railways: Frederick Bott (EBA/DZSF), bottf@dzsf.bund.de