Increasing the resilience of the German transport system to climate change and extreme weather events

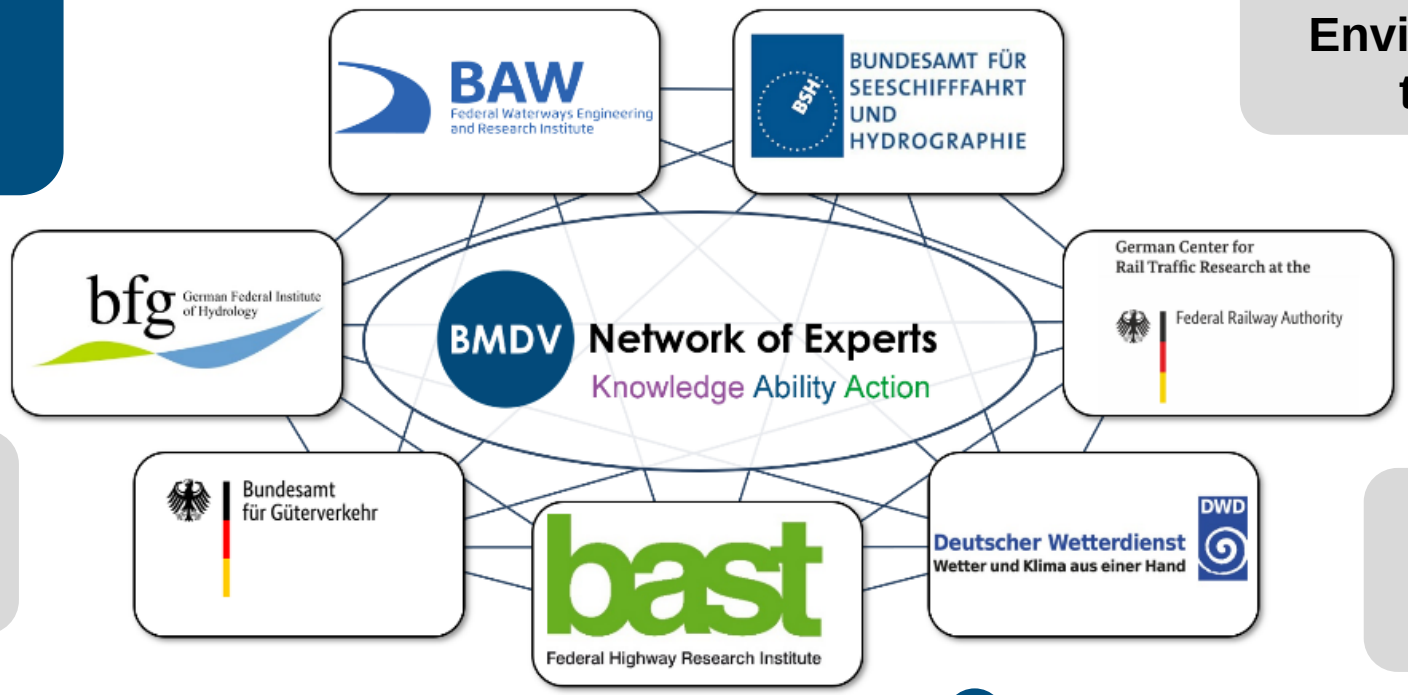
BMDV Expertennetzwerk
Wissen Können Handeln

Stephanie Hänsel, Lara Klippel, Christoph Brendel, Enno Nilson, Nils Schade, Lennart Meine, Carina Herrmann, Ingo Hache and many more …

The BMDV Network of Experts

TF-1
Climate change impacts and adaptation

TF-2
Environment and transport



TF-6
Transport economic analysis

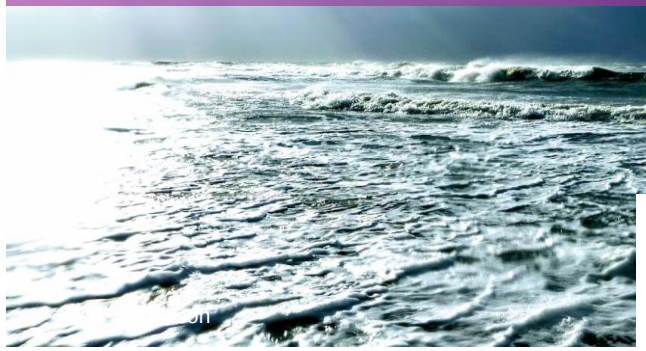
TF-3
Reliable transport infrastructure

TF-5
Renewable energies

TF-4
Digital technologies

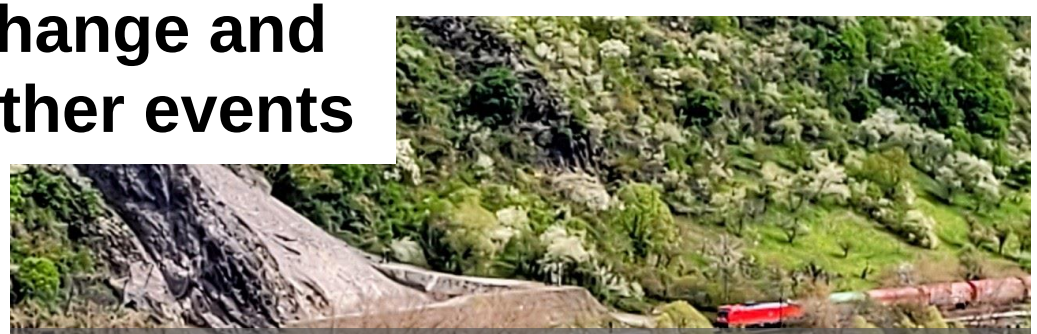
Adapting transport infrastructure and traffic to climate change and extreme weather events

Climatic Changes



Impact of climate change and extreme weather on transportation (exposure)

Sensitivity and criticality of infrastructures and traffic streams

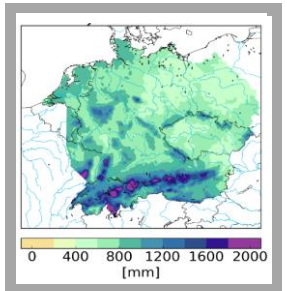


Development of climate change adaptation options

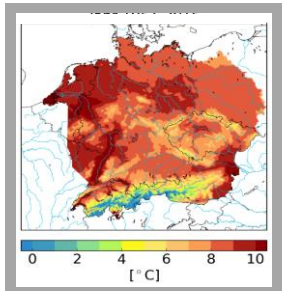
Improved reference datasets

Example: HYRAS global radiation 1951-2015, 5 km x 5 km grid

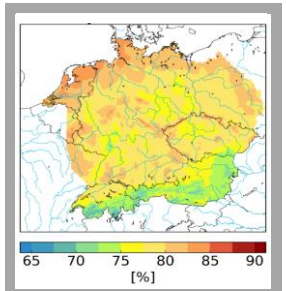
Phase 1



precipitation

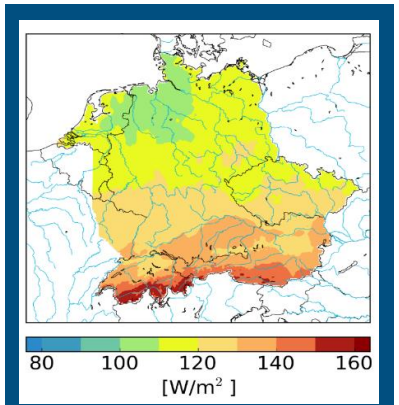


Temperature
(Mean, Max, Min)



Relative humidity

Phase 2.1



Global radiation

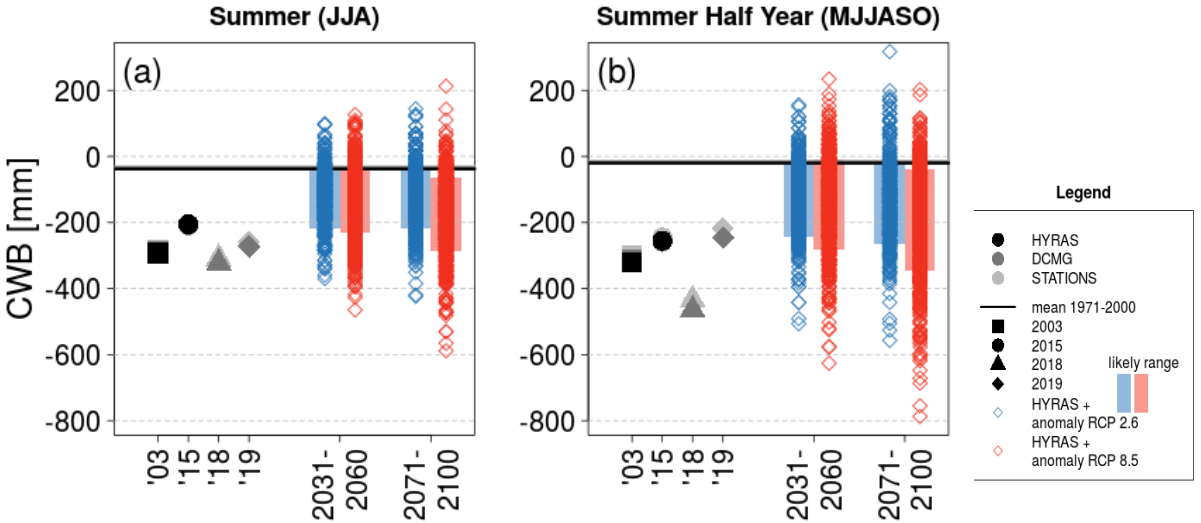
DWD, Brendel (2021): Jahresmittel Niederschlag Mitteltemperatur, relative Feuchte, Globalstrahlung 1951-2015

- Important for calculation of evapotranspiration, estimating soil moisture and hydrological modelling

→ Improving the database for climate change analyses (spatial and temporal resolution; more parameters)

Studying future climatic changes

Changes in mean conditions and extremes; use of climate indices



Plots of the German mean surface area climatological water balance (CWB) values for observation datasets compared to all model summer indicator values

Kelly Stanley

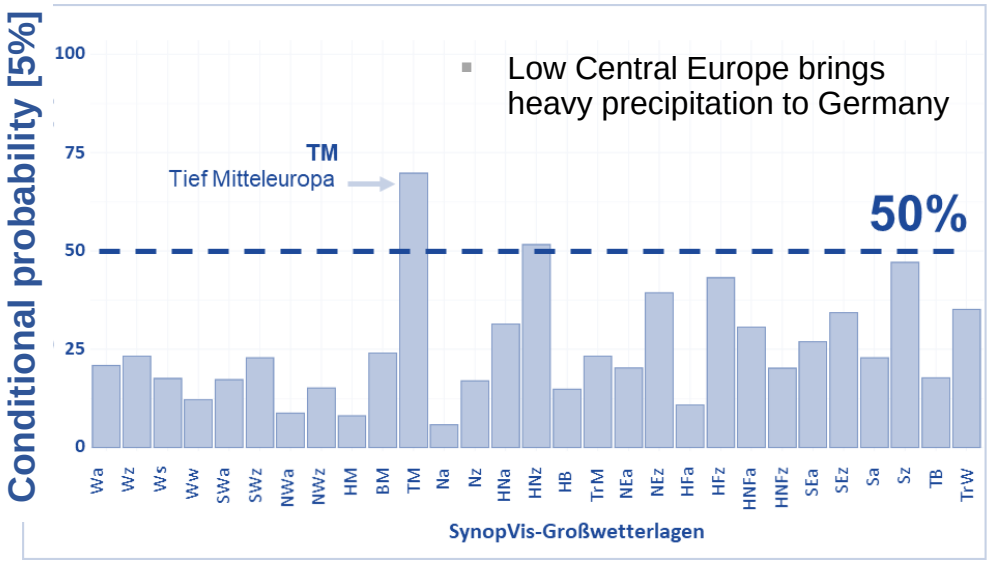
Session UP3.1
07.09.22 | 9:00

Recent hot and dry summers in Germany in comparison to climate projections

→ Development of new/tailored indices that can be used by the transport modes and the DAS core service „Climate and Water“

Circulation pattern and heavy precipitation

SynopVis GWL



Angelika Palarz

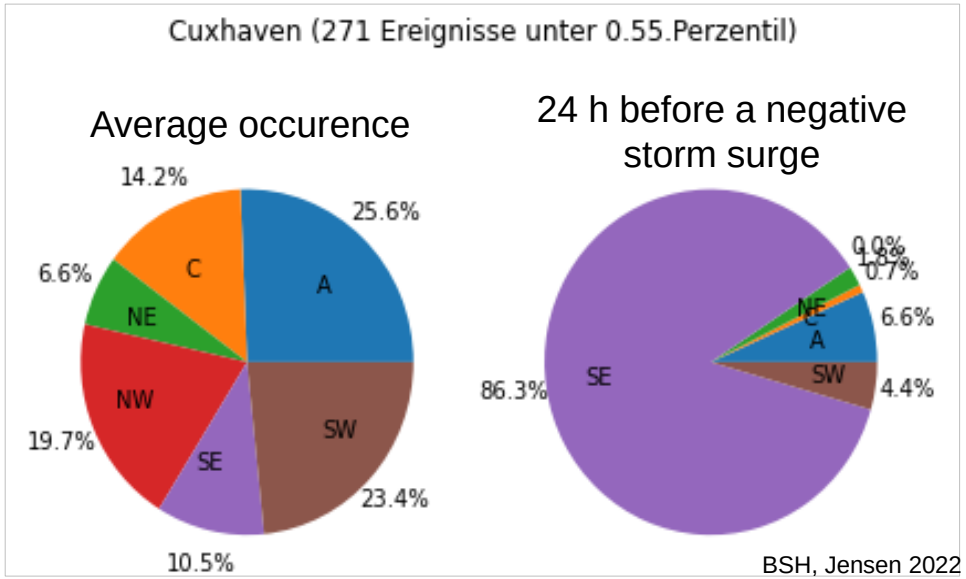
Session UP1.6
08.09.22 | 14:45

Short-duration precipitation extremes detected by the DWD radar network and associated circulation patterns

→ Analyses are the basis for integrating damage information
→ Improving process understanding of flood-generation

Circulation pattern and tidal dynamics

LAMB circulation



BSH, Jensen (2022): Average occurence of LAMB circulation pattern using daily mean sea level pressure from ERA5

- Negative storm surges occur mainly under South-Eastern circulation with strong offshore winds

→ Basis for the analysis of shipping restrictions due to negative storm surges

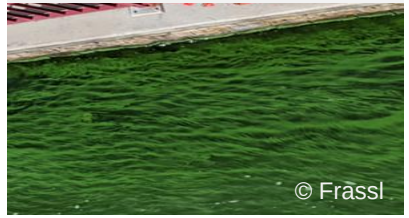
Exposure

Assessment of future climate changes and their impact on transport infrastructures

Mass movements

Low water levels

Water quality



Storm surges

Windthrow

High water levels

Erosion

Extreme low tides

Flash floods

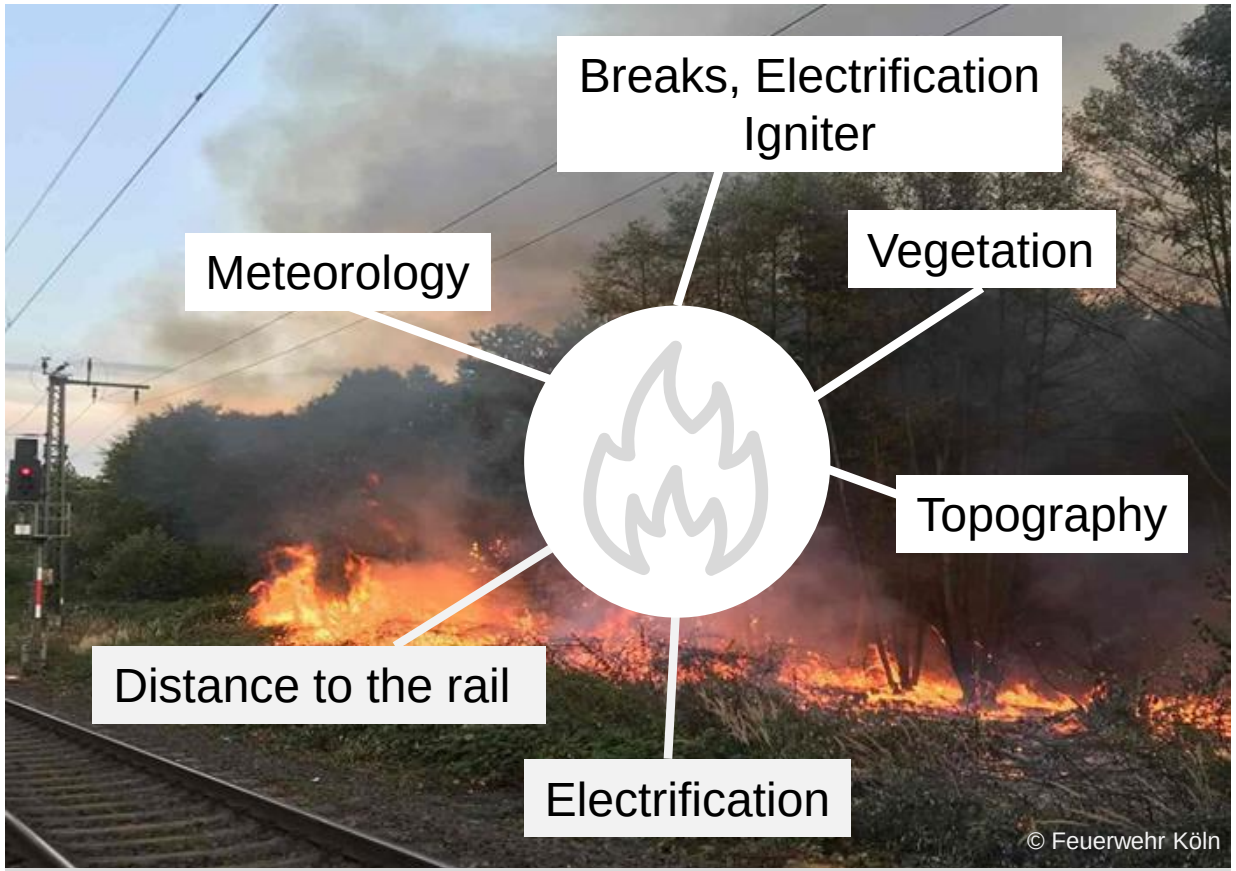
Embarkment fires

Sea level rise

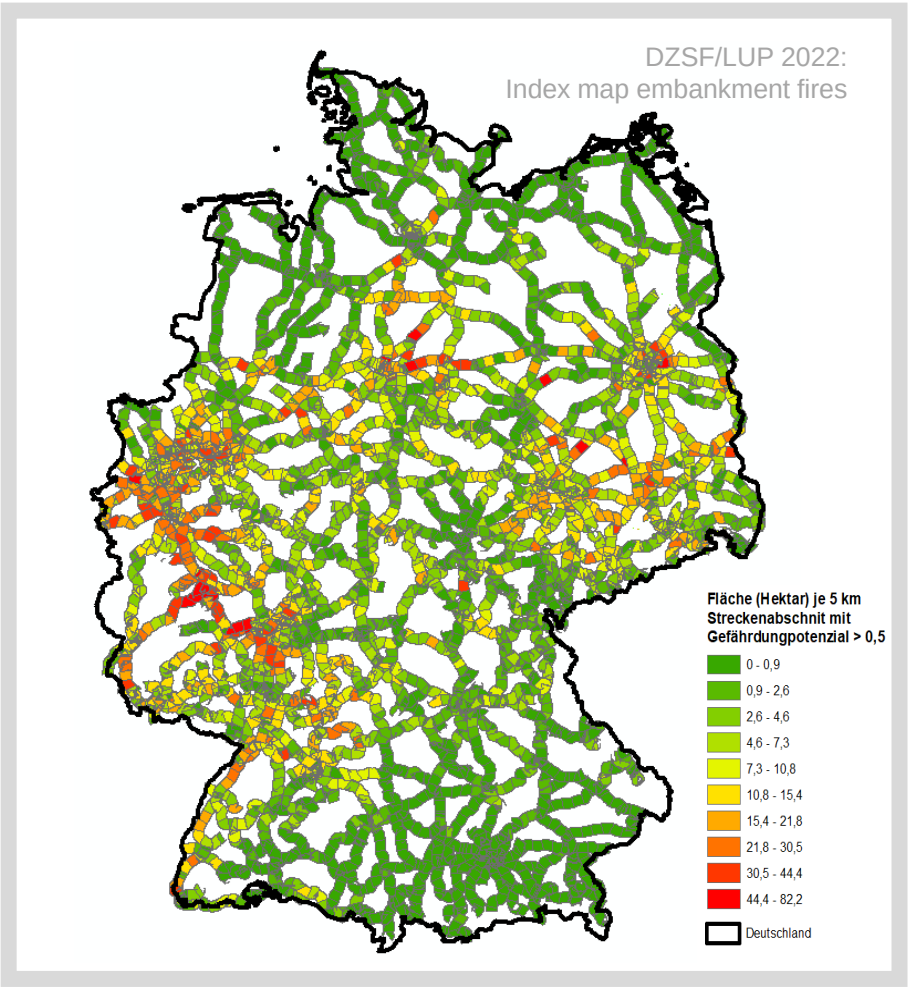
Extreme waves

- Development of impact models
- Studying spatial and temporal changes in the occurence of specific climate impacts on transportation

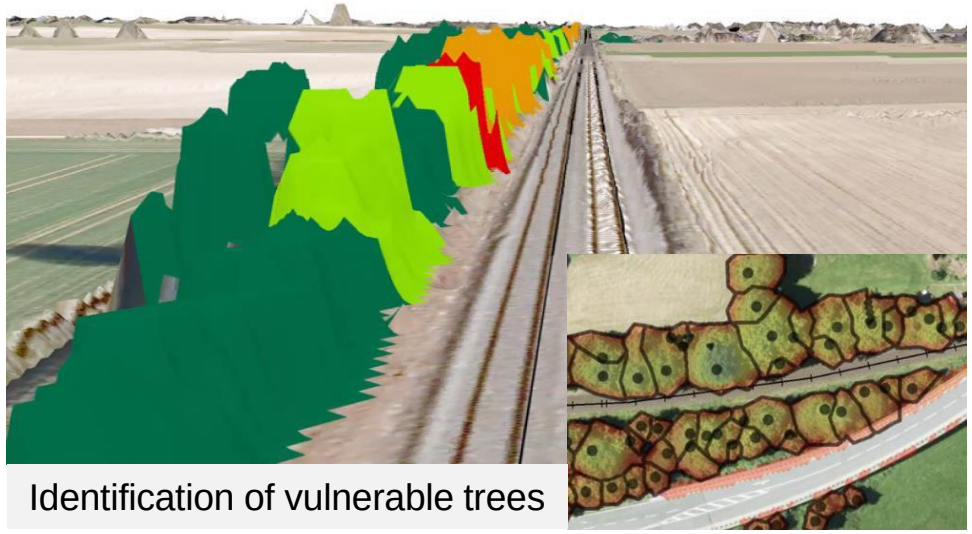
Assessment of the exposure towards embankment fires (rail)



Embankment fires cause infrastructure damages and traffic interruptions

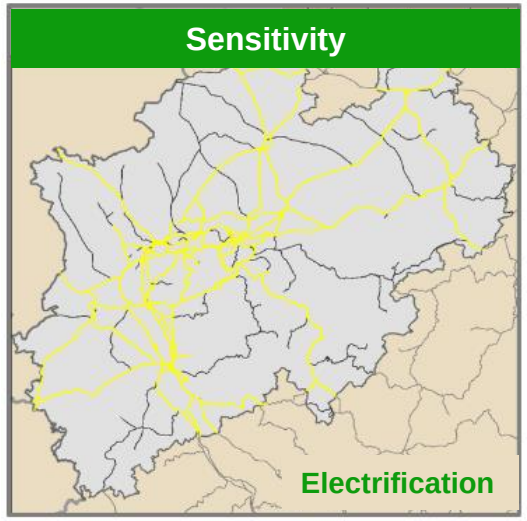


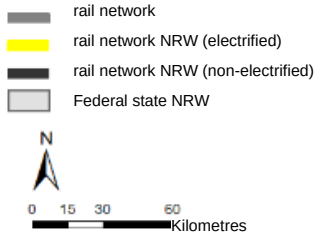
Exposure and sensitivity to windthrow along railways



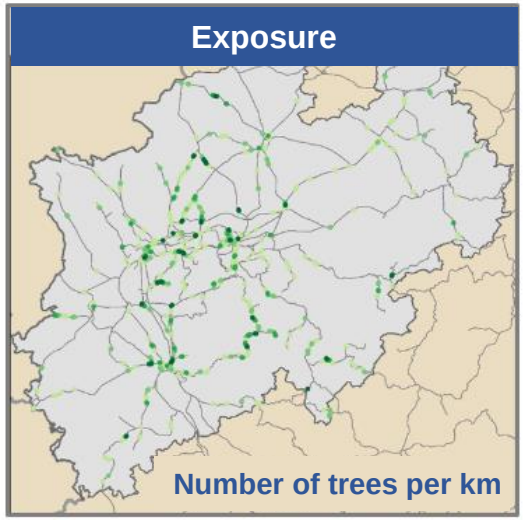
Identification of vulnerable trees

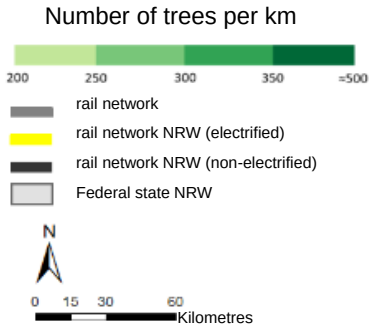
Frick et al. (2021)



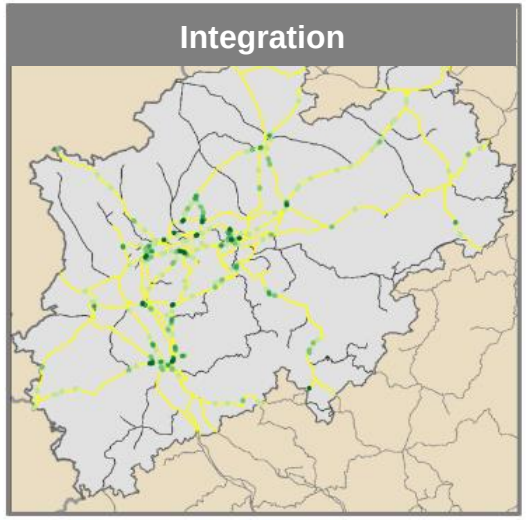


69.6% of the railway network with electrification





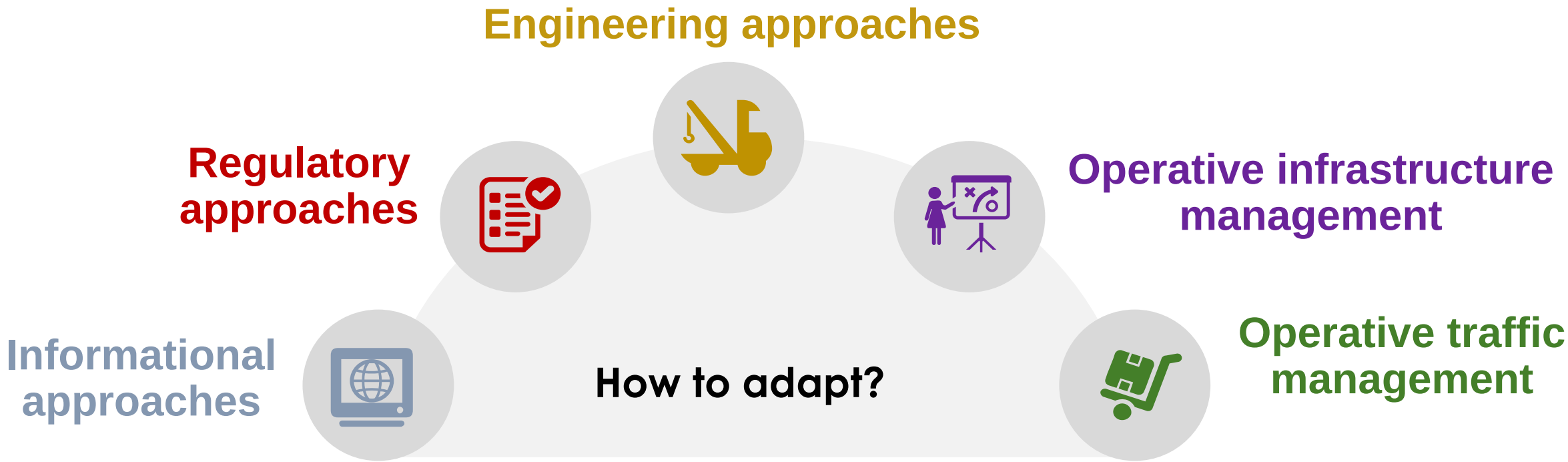
7% of the railway network with >350 trees per km



4.7% high exposure **and** sensitivity

DZSF/EBA (2022)

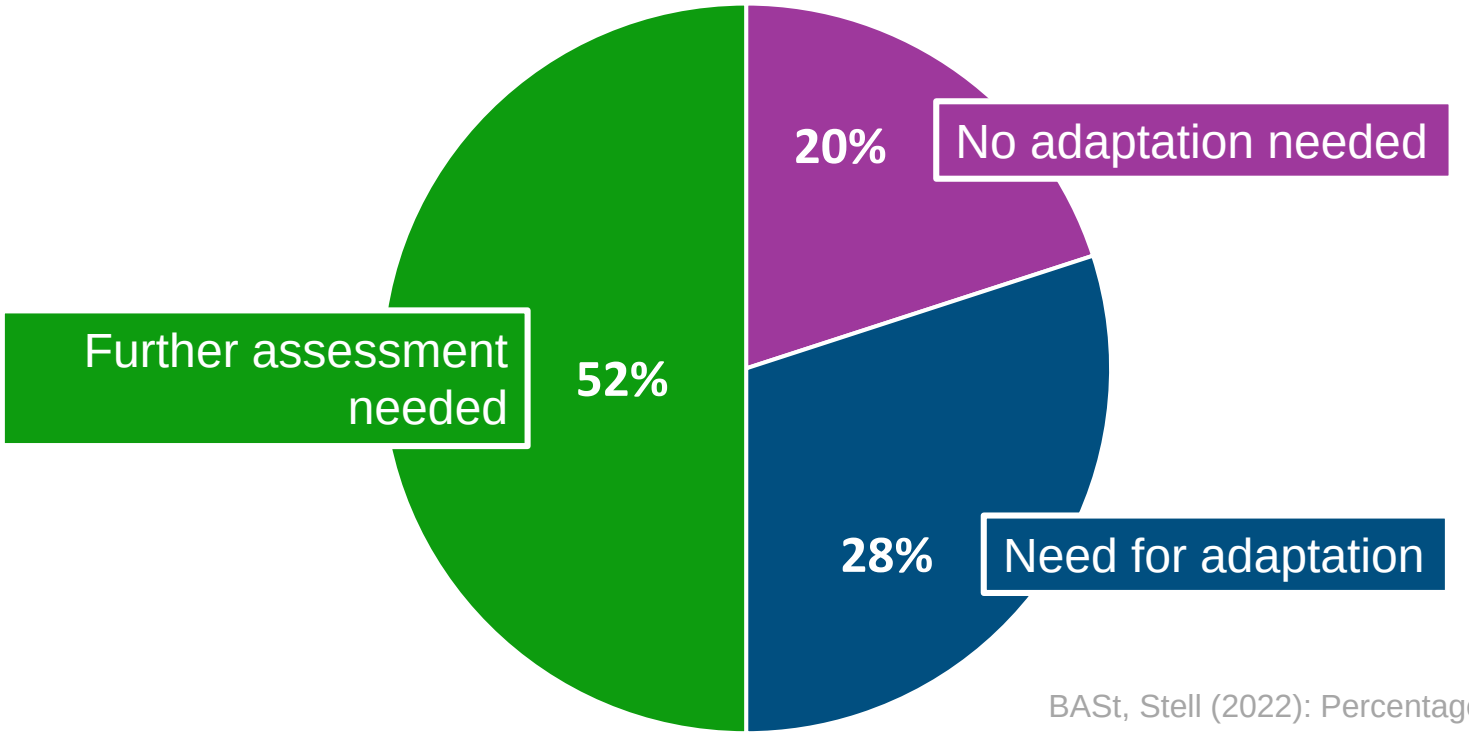
Developing adaptation options



Developing operational climate services	Adaptation of rules, regulations and design values	Structural measures	Adapted management of transport infrastructures	Traffic shifts, modelling traffic flows

Norpoth et al. 2020: Scheme for the classification of adaptation options

Regulatory Approach



- Example: Adaptation need of regulations for federal roads
- About 900 regulations and rules have been studied with respect to the adaptation needs to climate change

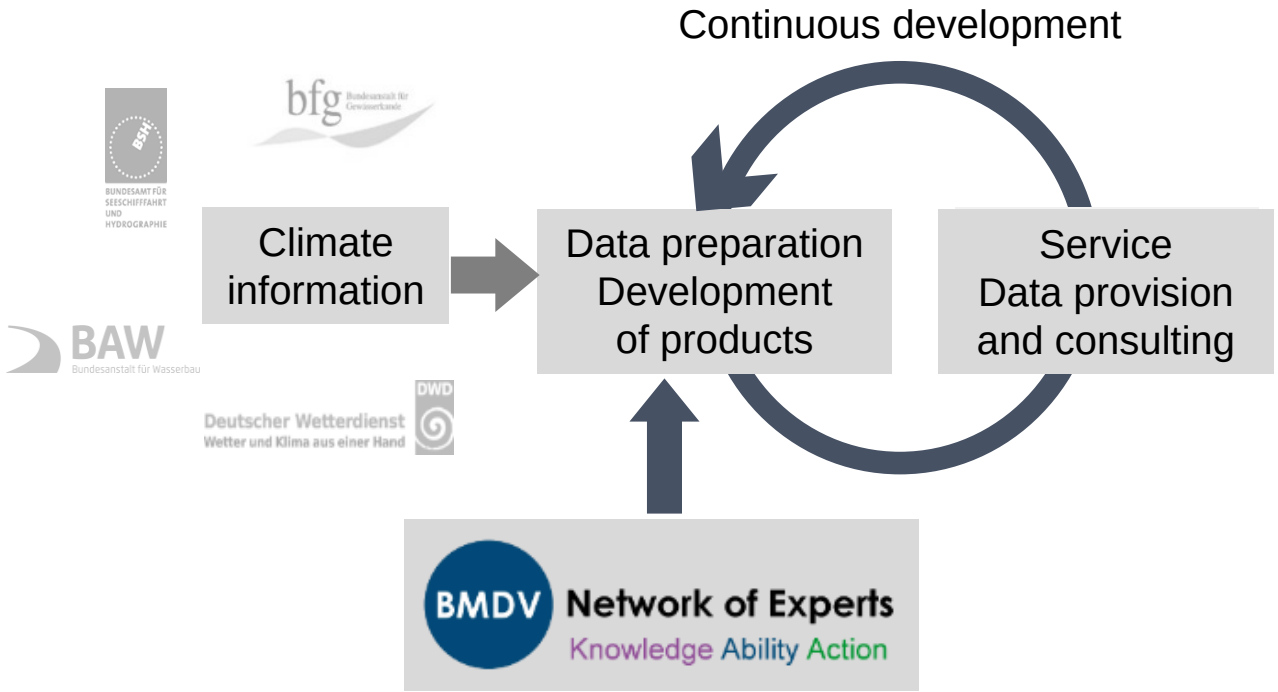
BASt, Stell (2022): Percentage of regulations with need for adaptating to climate change

→ The adaptation of rules, regulations and design values is the basis for the systematic integration of climate change aspects into infrastructure planning

Informatory approach

DAS core service “climate and water”

- Provision of knowledge on climate change (data, consultation, education) to infrastructure planners, e.g. the Federal water and shipping administration.
- Information is a available in a routine process | operational service



www.das-basisdienst.de

DAS Basisdienst
Klima und Wasser

Summary

Studying climate change

Development of new datasets and methods;
Analysis of changes in the climate average and extreme events

Analysing climate change impacts on transportation

Study cause-and-effect relationships;
Development of hazard maps

Assessing sensitivity and criticality of infrastrutures & traffic

Collection of event and damage data;
Development of data bases and information portals

Developing adaptation options

Exemplarily study different types of adaptation measures

Further information …

… may be found at our website
www.bmdv-expertennetzwerk.info.de

- general information
- Scientific and synthesis reports
- Scientific publications
- Past and future events; e.g. German Climate Adaptation week
- ….and more !!!

More information at 12 September 2022

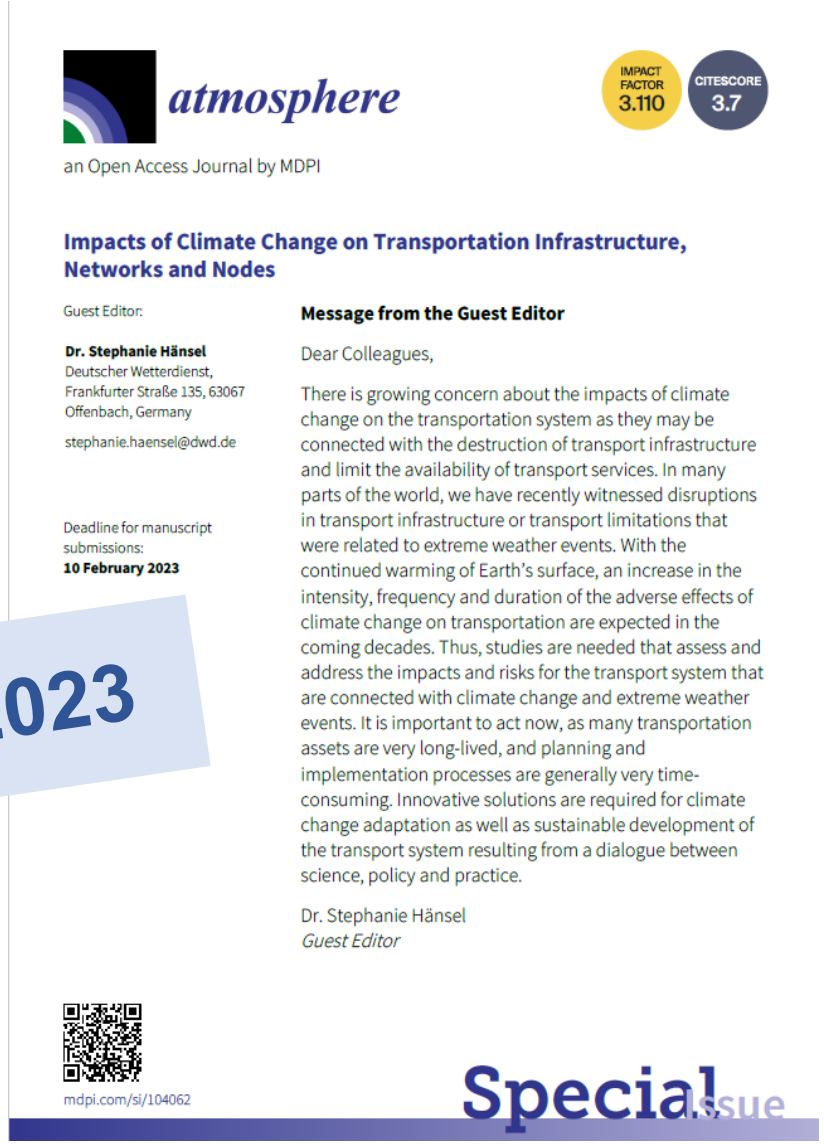
Special Issue "Impacts of Climate Change on Transportation Infrastructure, Networks and Nodes"

- Szymczak et al (2022) Impacts of Heavy and Persistent Precipitation on Railroad Infrastructure in July 2021: A Case Study from the Ahr Valley, Rhineland-Palatinate, Germany

Under review:

- Uber et al. (2022) Climate Change Impacts on Soil Erosion and Sediment Delivery to German Federal Waterways: A Case Study of the Elbe Basin
- Jensen et al. (2022) N… – L… … climate … et al. (2022) Implementing hydrological forecasting services supporting waterway management and transportation logistics relating to hydroclimatic impacts

Submit your manuscript till 10 February 2023



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Homepage BMDV Network of Experts