German Centre for
Rail Traffic Research at the

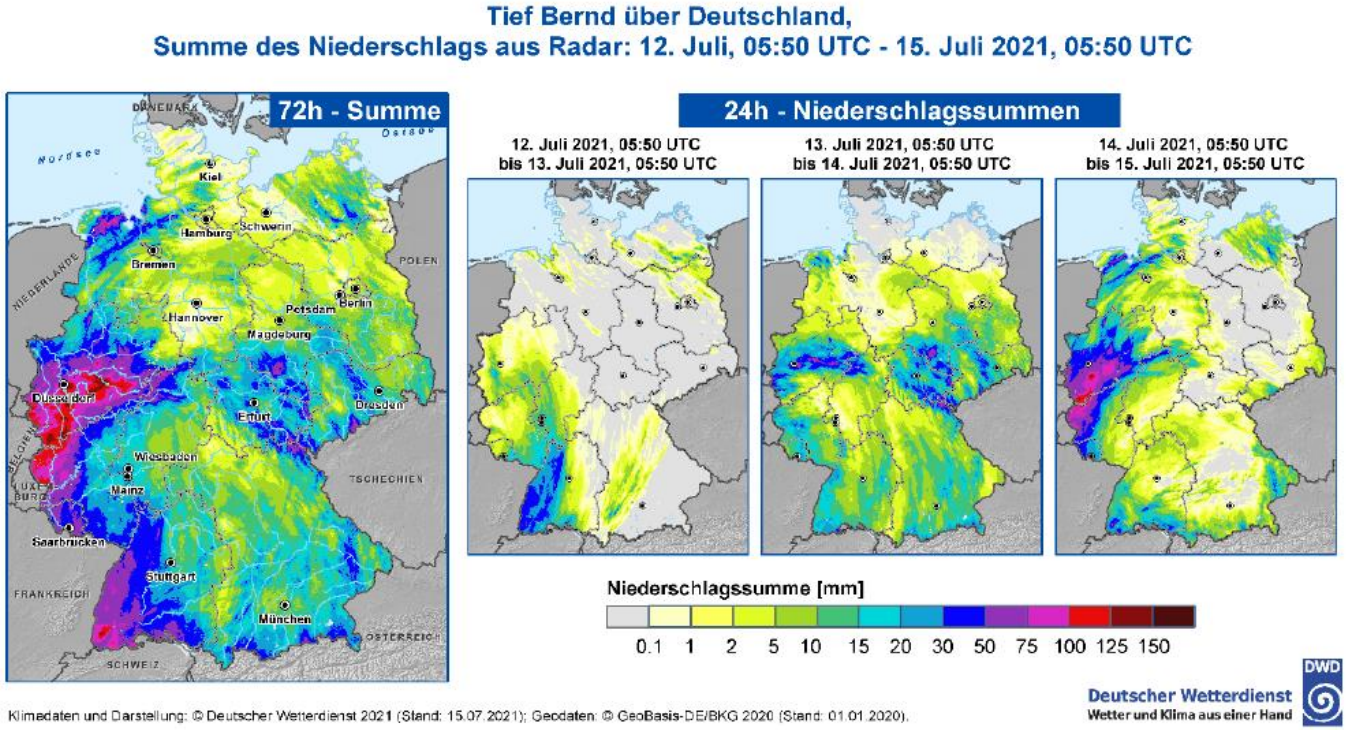
Federal Railway Authority

Impacts of heavy and persistent precipitation on railway infrastructure – insights from the Ahr valley, Germany July 2021

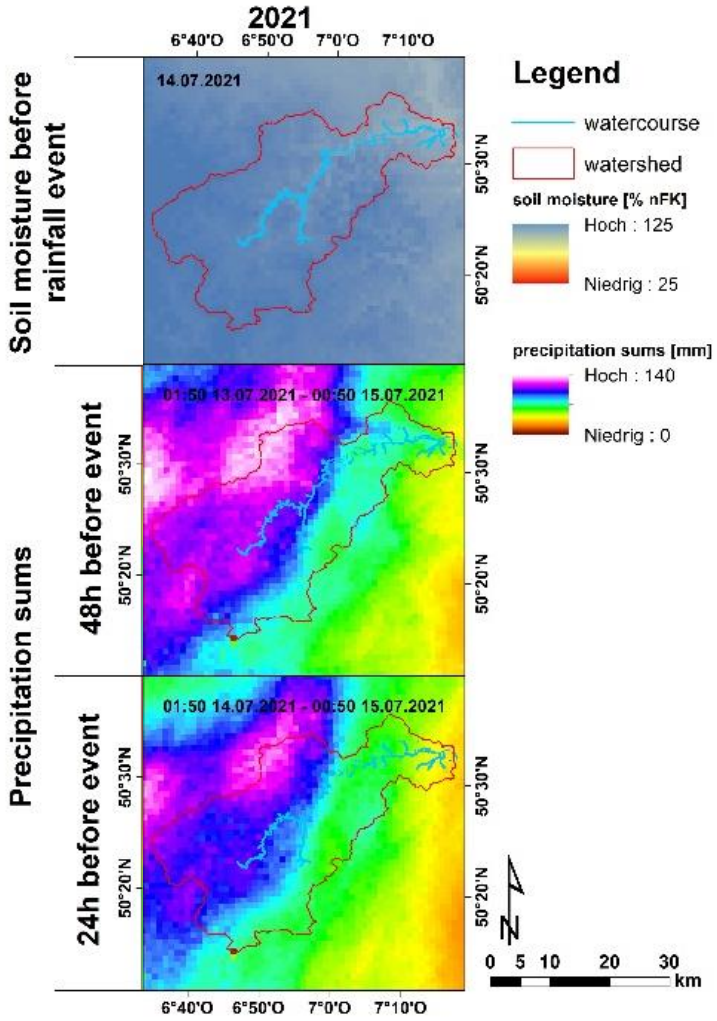
Sonja Szymczak, Fabia Backendorf, Veit Blauhut, Frederick Bott, Katharina Fricke, Thomas Junghänel, Ewelina Walawender

Presentation at EGU General Assembly 2022, 27.05.2022

Triggering event



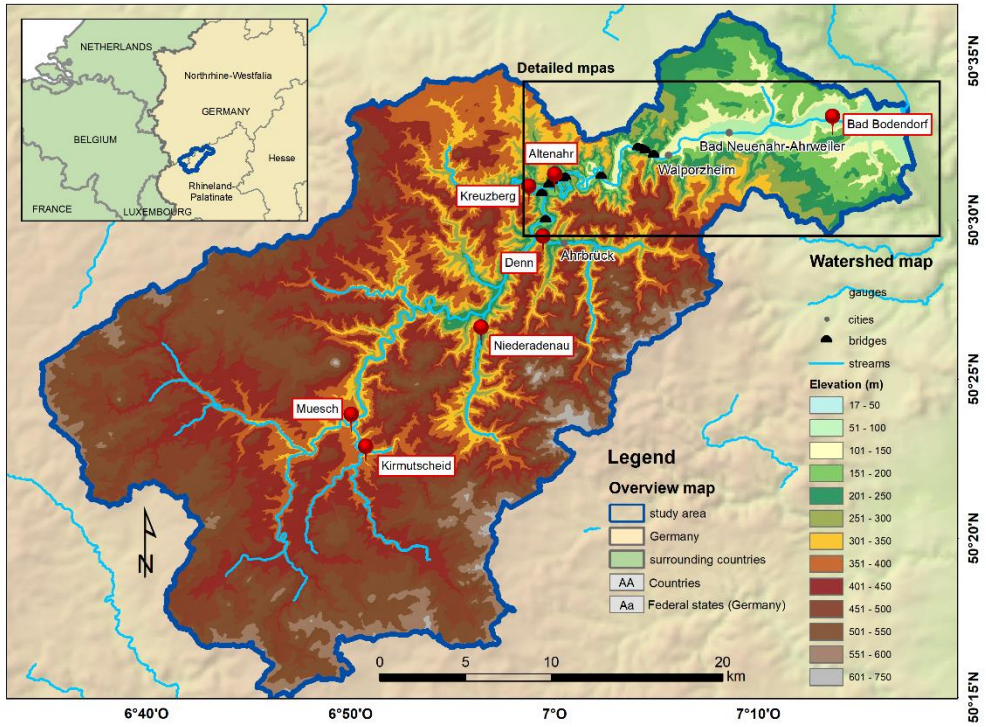
Junghänel et al. 2021

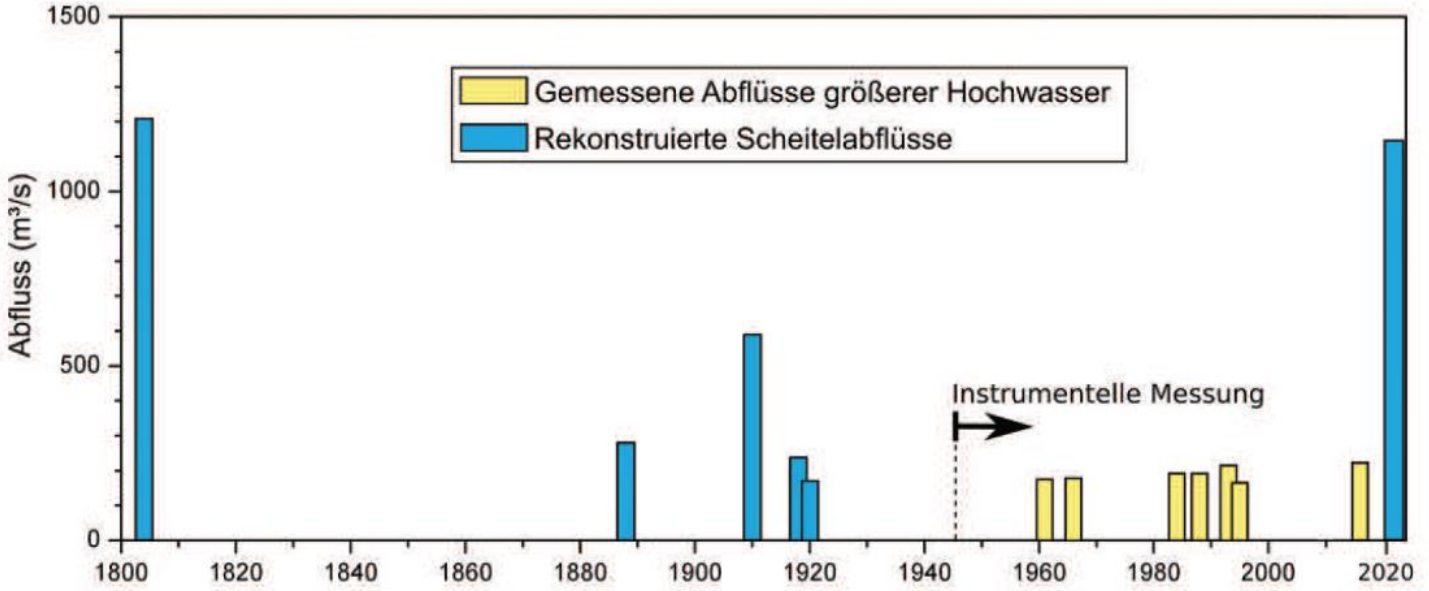


Ahr valley:

- persistent precipitation (3-day sums approx. 165% of usual monthly precipitation)
- high saturation of soils
- unfavorable topographical conditions

Ahr valley





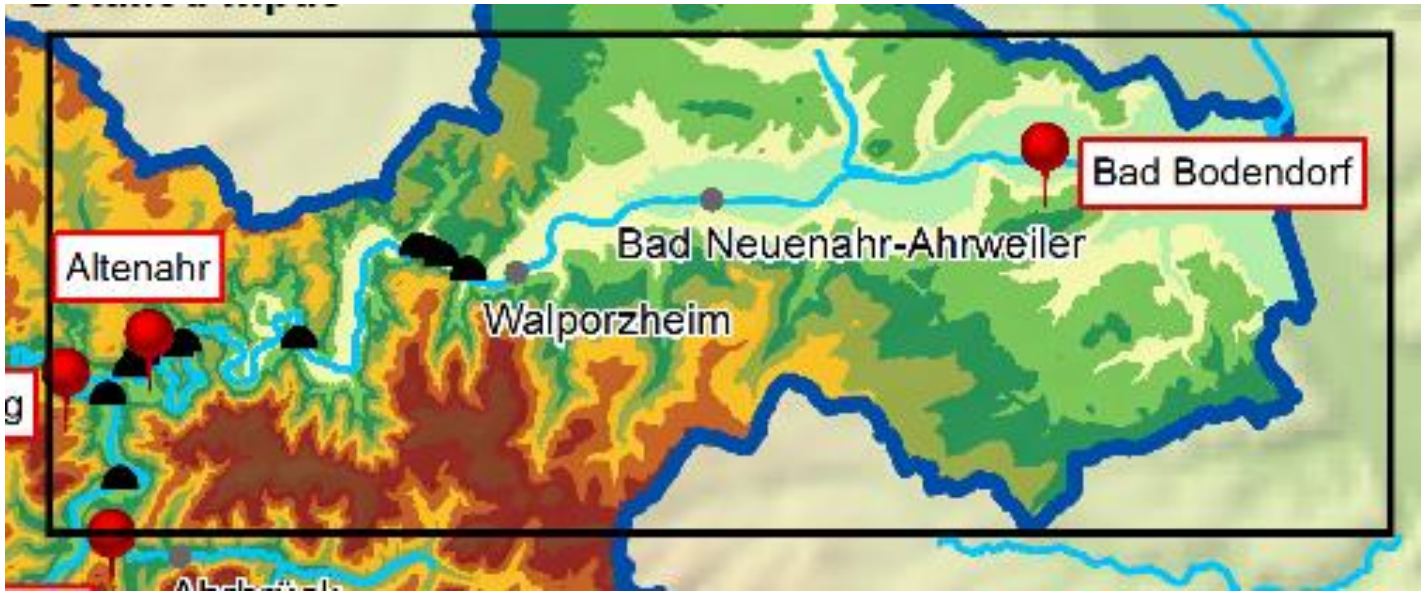
Roggenkamp & Herget 2022

Ahr valley railroad

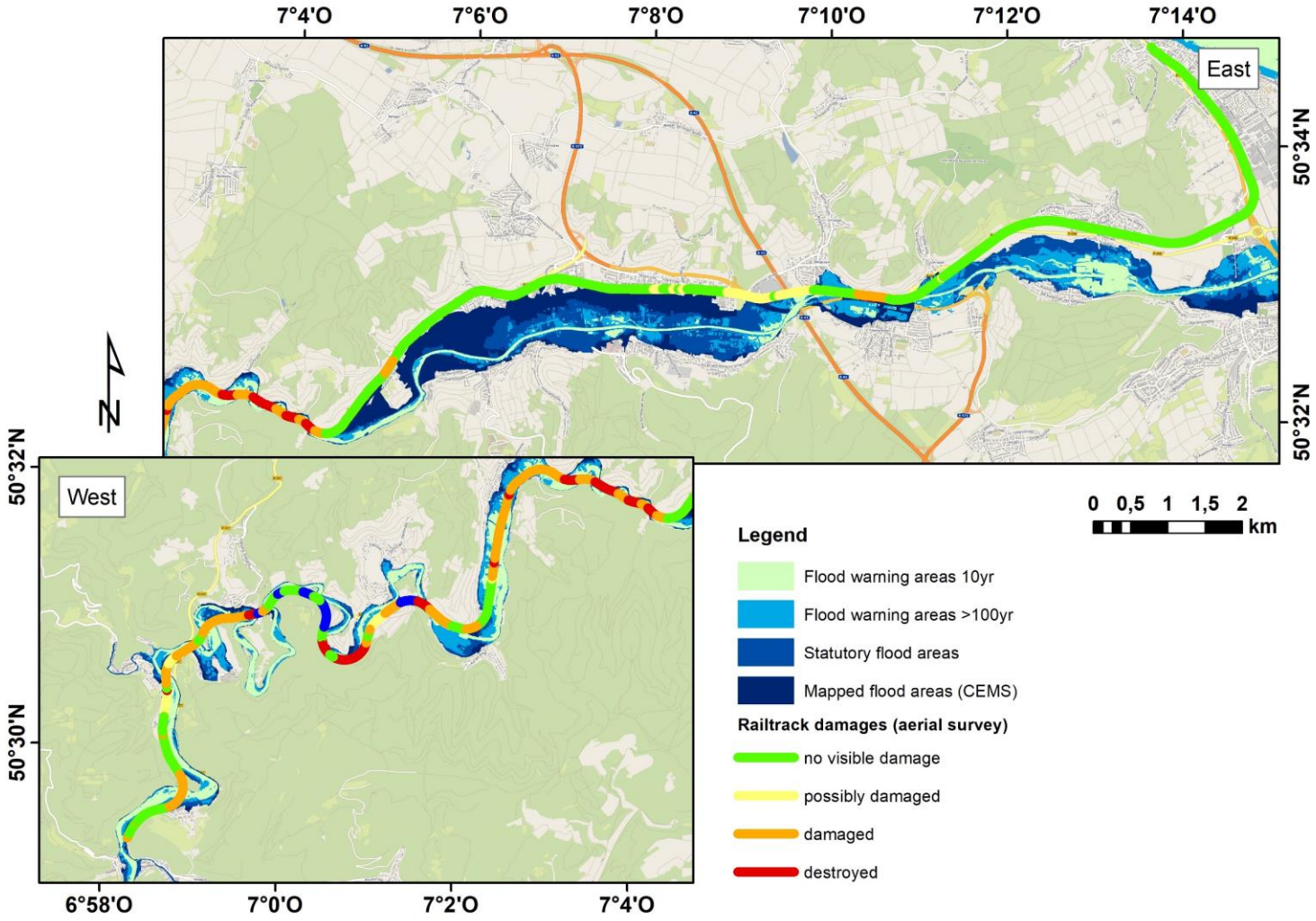
- opening: 17.09.1880
- route length: 29 km
- mainly single-tracked, not electrified
- 5 tunnel
- 11 bridges crossing the Ahr river

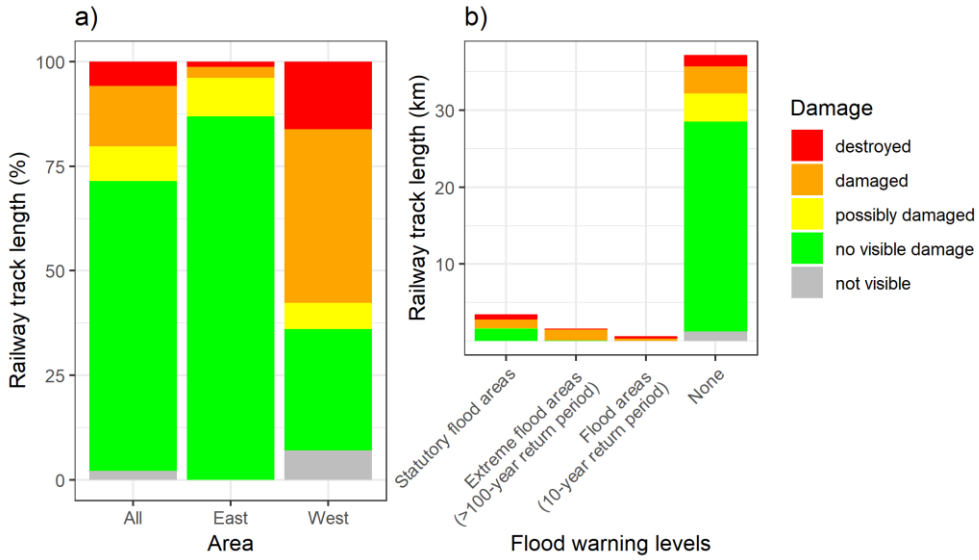
© Axel Hindemith (https://commons.wikimedia.org/w/index.php?curid=75493461)

- Reopening of route section Remagen – Walporzheim: 11.12.2021
- Prognosis for the route section Walporzheim – Ahrbrück: approx. 5 years



Damage mapping on the railroad line





Damage on the railroad bridges

- Bridge failures mainly in peripheral areas
- Backwater of material mainly at upstream bridges

© Adobe Stock | #468618924

Aerial photograph from German Aerospace Center, 16.07.2021

Damage on the railroad bridges

- Seven bridges in meandering river sections
  → greatest damage mainly on slip-off slope
- widening of the river bed at five bridges visible during the time of field survey

© Adobe Stock | #468642157

Aerial photographs from State Office for Surveying and Geographic Information Rheinland-Pfalz, 24.7.2021

Conclusions

Challenges

- summer floods are a common phenomen in the Ahr valley
- railroad infrastructure, especially bridges, are at risk, but also contribute to flood wave modification (backwater effect, new flow paths during the event)
- heavy precipitation events can occur anywhere in Germany

To be better prepared

- inclusion of historical water levels in the preparation of flood hazard maps
- build railroad bridges more resilient to flood events
  - slimmer bridge structures
  - Piers outside the riverbed
- adapt dimensions of culverts and railroad embankments to climate change

further reading:

Szymczak, S., Backendorf, F. Bott, F., Fricke, K., Junghänel, T., Walawender, E. (in prep): Impacts of heavy and persistent precipitation on railway infrastructure in July 2021 – A case study from the Ahr valley, Rhineland-Palatinate, Germany. In preparation for submission in the Special Issue from Atmosphere: „Impacts of Climate Change on Transportation Infrastructure, Networks and Nodes“

Deutsches Zentrum für
Schienenverkehrsforschung beim

Eisenbahn-Bundesamt

Dresden | Bonn

Contact

Dr. Sonja Szymczak

+49 (0)351 47931 - 0
forschung@dzsf.bund.de
www.dzsf.bund.de