Reconstruction of the July 2021 European floods footprint
From field measurements to hydraulic model calibration

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EVENT OVERVIEW

HISTORICAL PERSPECTIVE

EVENT RESPONSE & FIELD RECON

FOOTPRINT RECONSTRUCTION

Event Overview

Meteorological Overview

- Transport of moist air from the Mediterranean

- Interaction with cooler air mass drawn in from the north

- Pattern resulted in intense and prolonged rainfall across western and central Europe

Precipitable Water in the Atmosphere on July 14, 2021
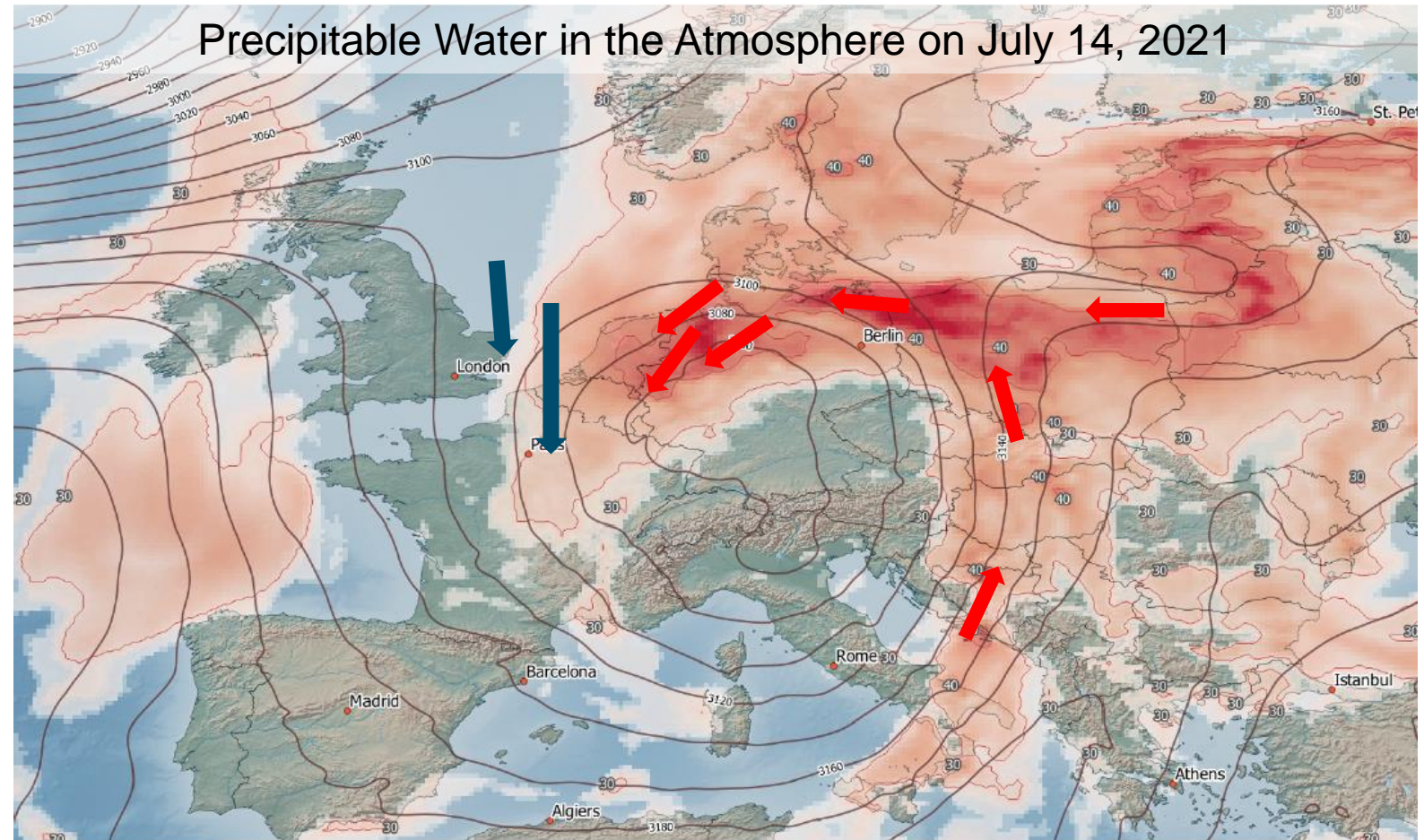
Source: CEDIM FDA Report No.1, 21 July 2021
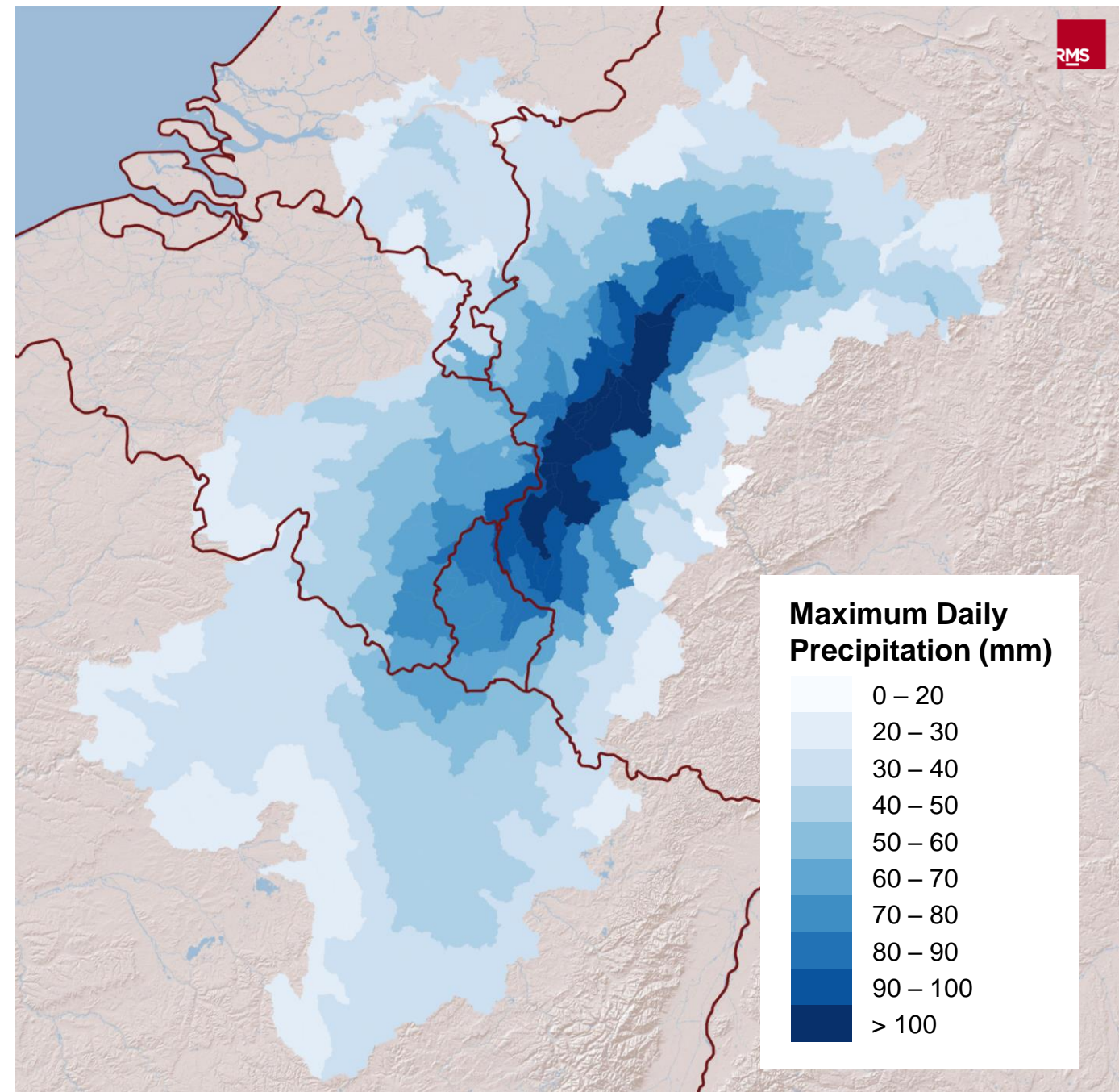
Resulting Precipitation

- Daily observed precipitation between July 11–19 2021, from E-OBS data

- Intense and prolonged precipitation, mainly over western Germany, eastern Belgium, Luxembourg, northeastern France

11 July 2021

Cumulated Precipitation (mm / day)
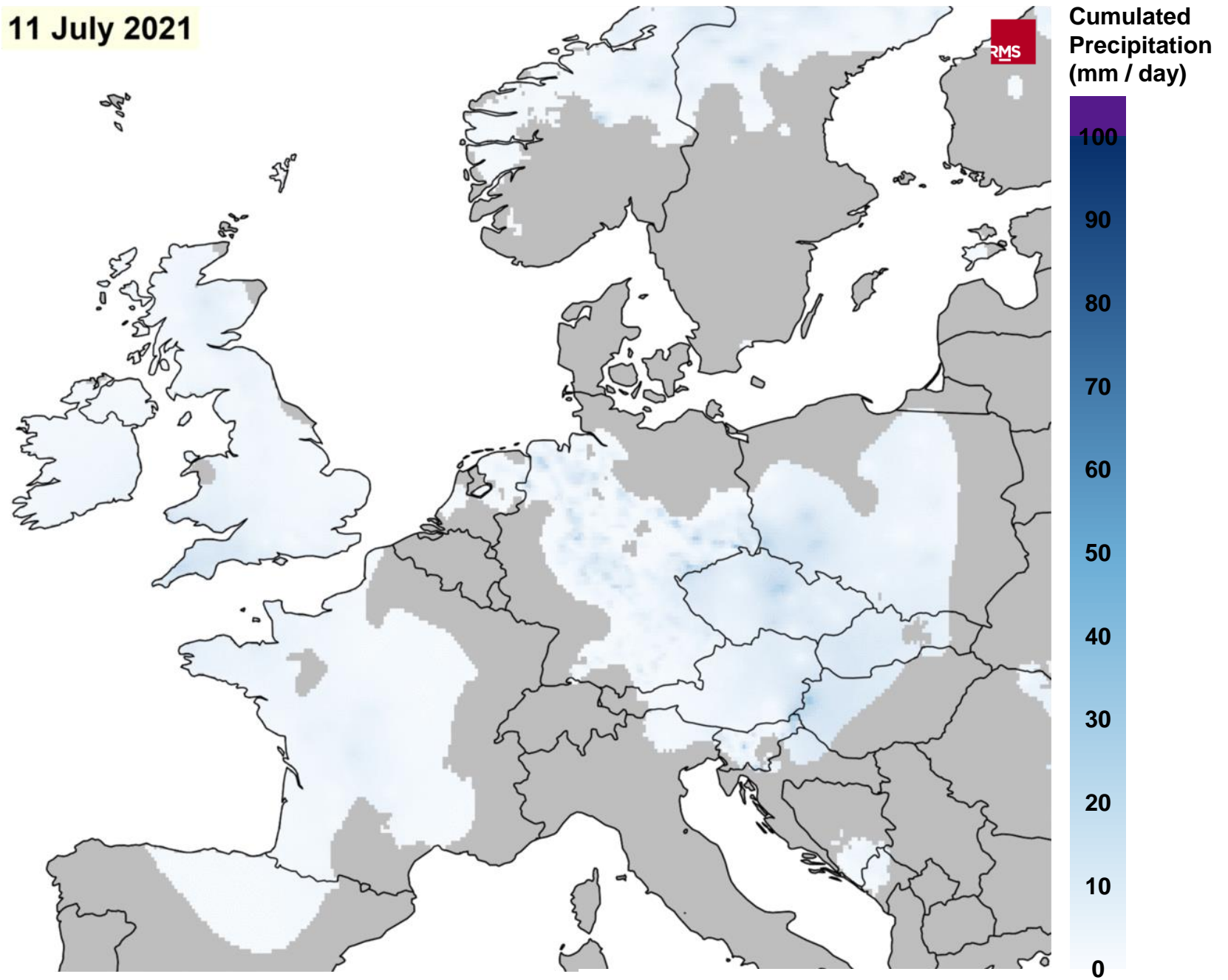
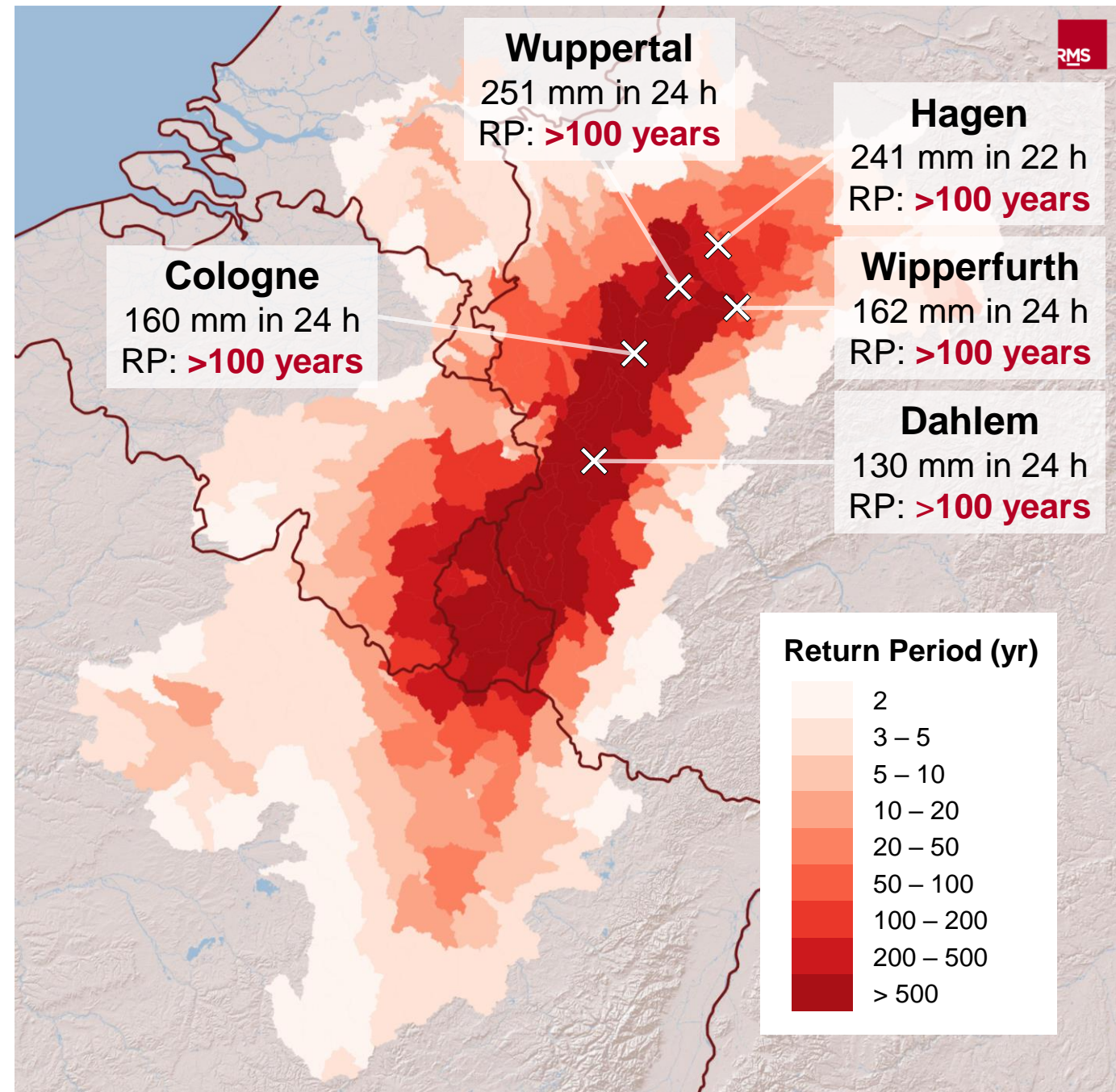Data Source: E-OBS gridded dataset, daily resolution

Precipitation per Catchment

- E-OBS precipitation sums aggregated to the catchments of the RMS® Europe Inland Flood HD Models

- Maximum daily observed precipitation between July 13–15, 2021

- Data used as input for the full event reconstruction

Maximum Daily Precipitation (mm)
- 0 – 20
- 20 – 30
- 30 – 40
- 40 – 50
- 50 – 60
- 60 – 70
- 70 – 80
- 80 – 90
- 90 – 100
- > 100

Source: E-OBS gridded dataset data

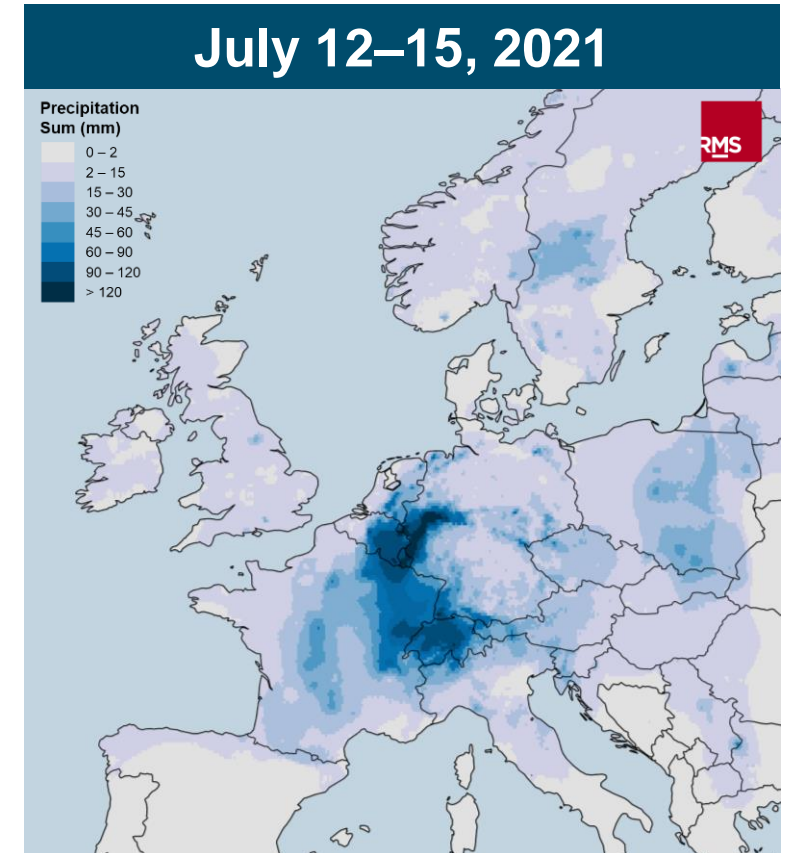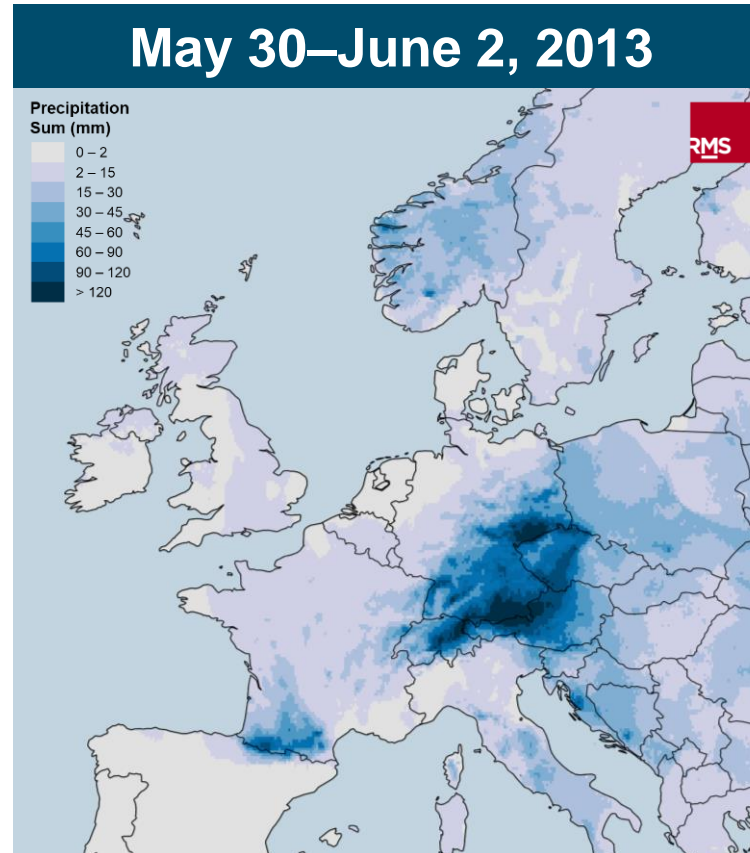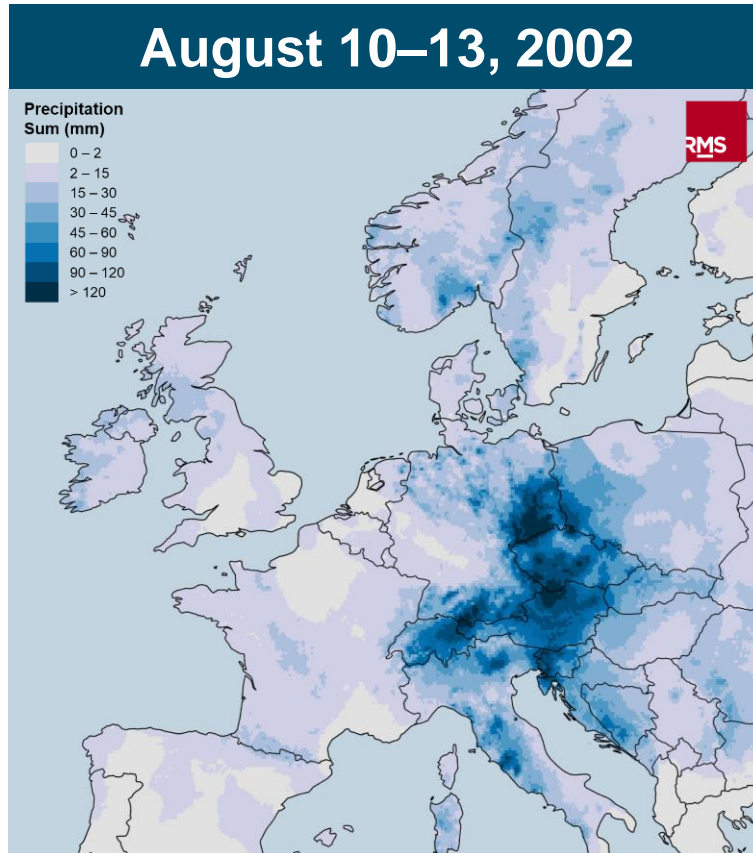# Precipitation per Catchment: Return Period

- Compare observed precipitation against precipitation sums from stochastic event set of RMS Europe Inland Flood HD Models

- Observed maximum daily precipitation can be associated with a return period (RP)

- Validation of return periods against empirical return period estimates at various stations by the German Meteorological Service DWD

Wuppertal
251 mm in 24 h
RP: **>100 years**

Hagen
241 mm in 22 h
RP: **>100 years**

Cologne
160 mm in 24 h
RP: **>100 years**

Wipperfurth
162 mm in 24 h
RP: **>100 years**

Dahlem
130 mm in 24 h
RP: **>100 years**

Return Period (yr)

- 2
- 3 – 5
- 5 – 10
- 10 – 20
- 20 – 50
- 50 – 100
- 100 – 200
- 200 – 500
- > 500

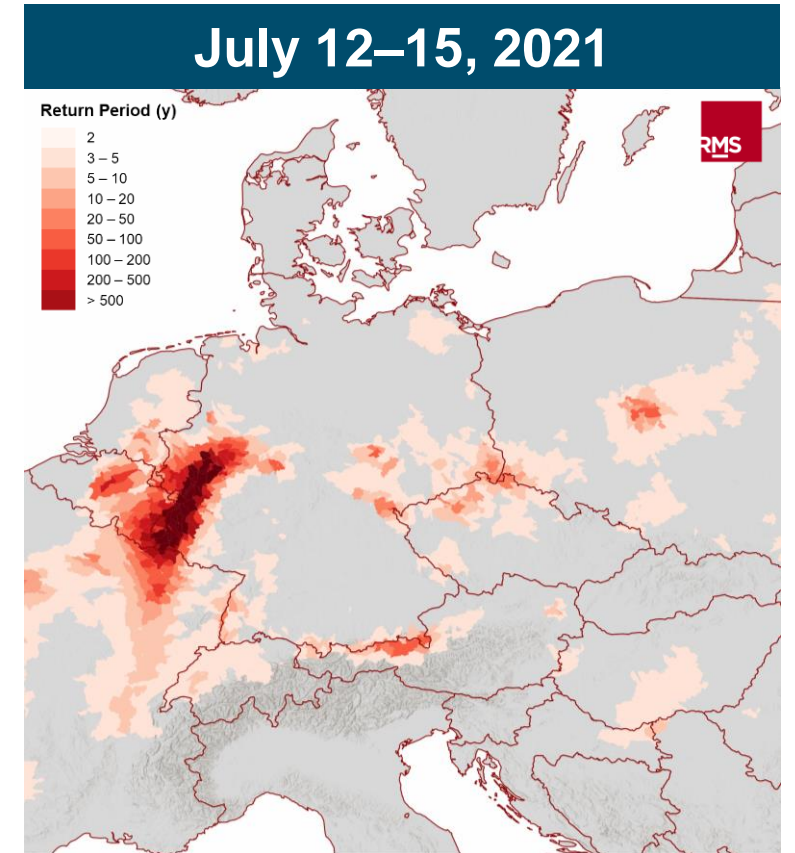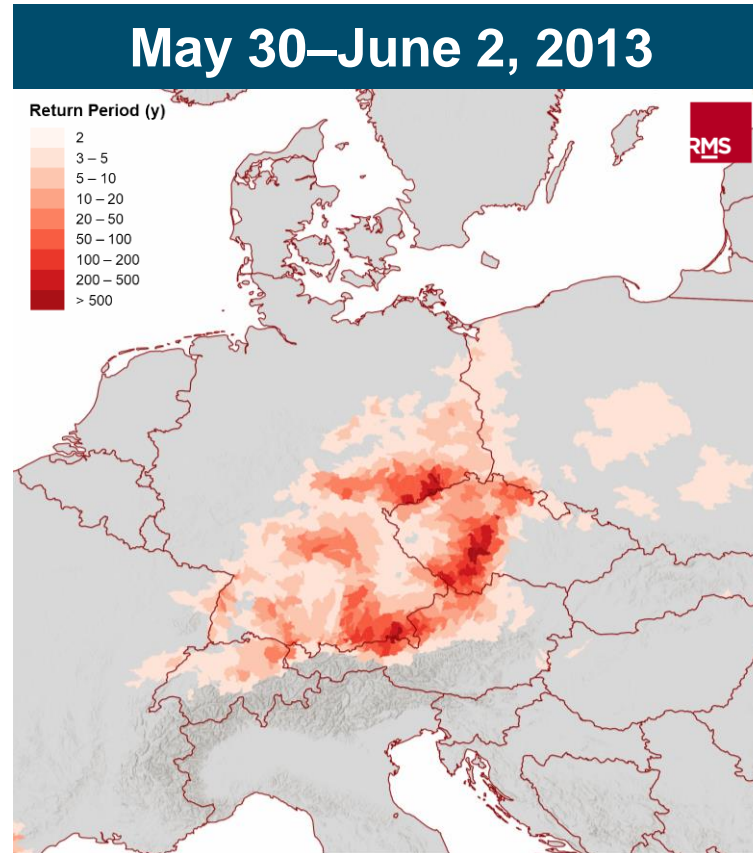# Historical Perspective
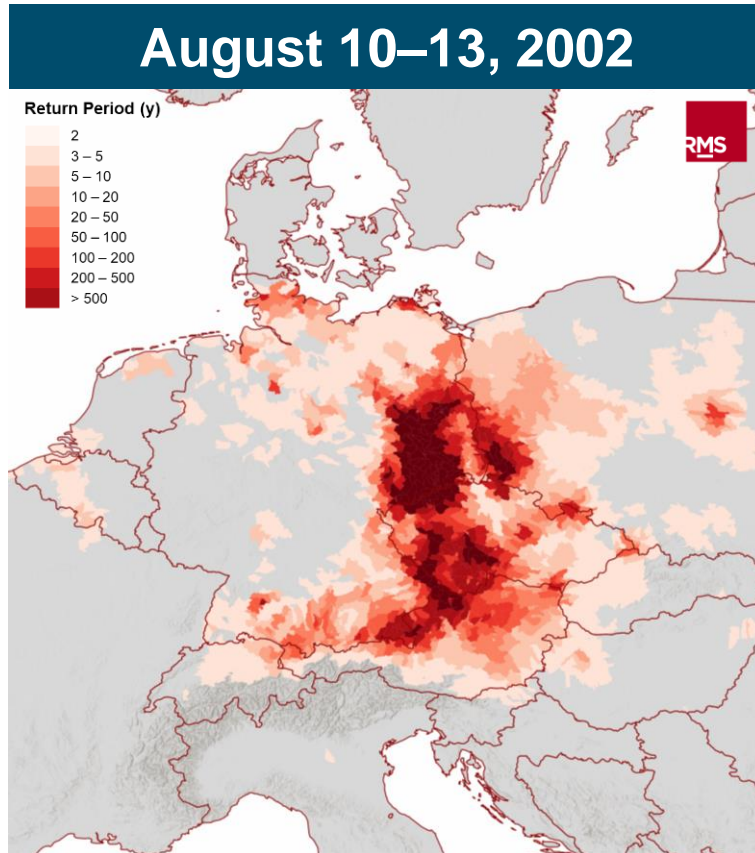
Event Precipitation

Four-Day Precipitation Sum of Major European Flood Events

Source: E-OBS gridded dataset data
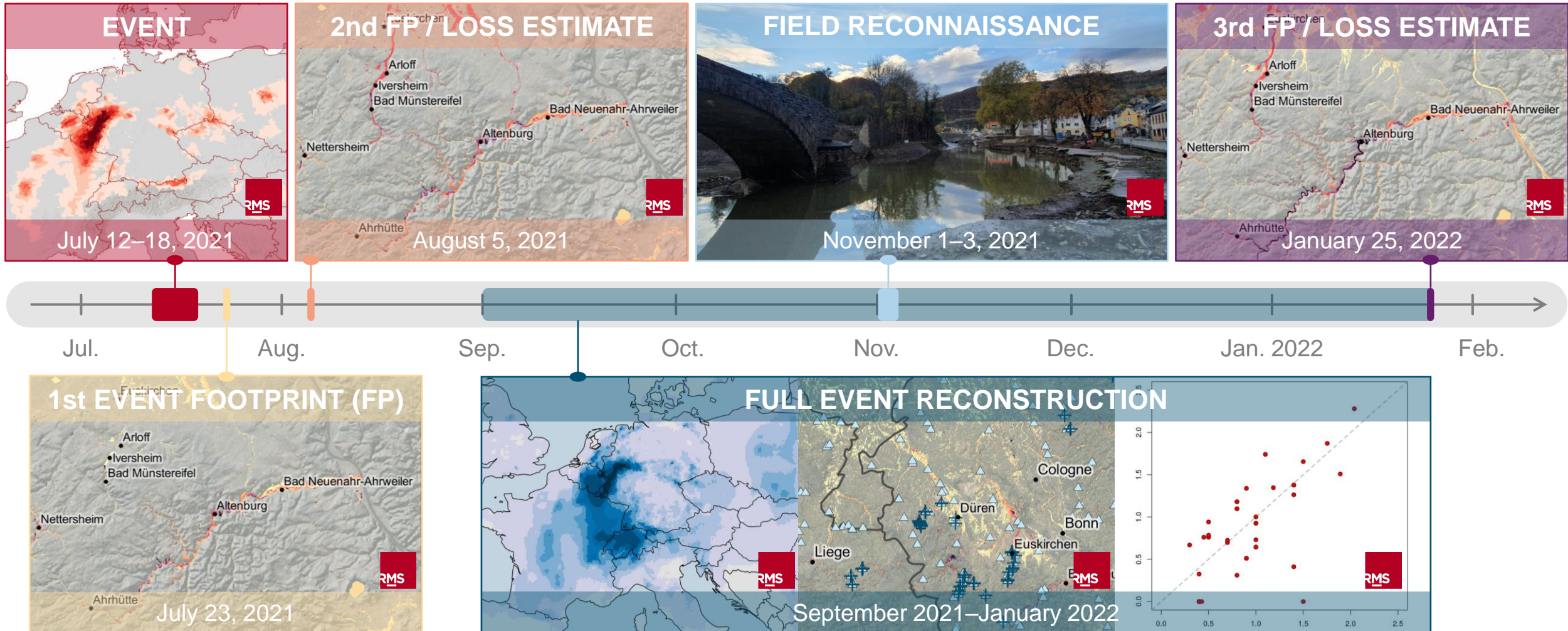
Event Precipitation: Return Period

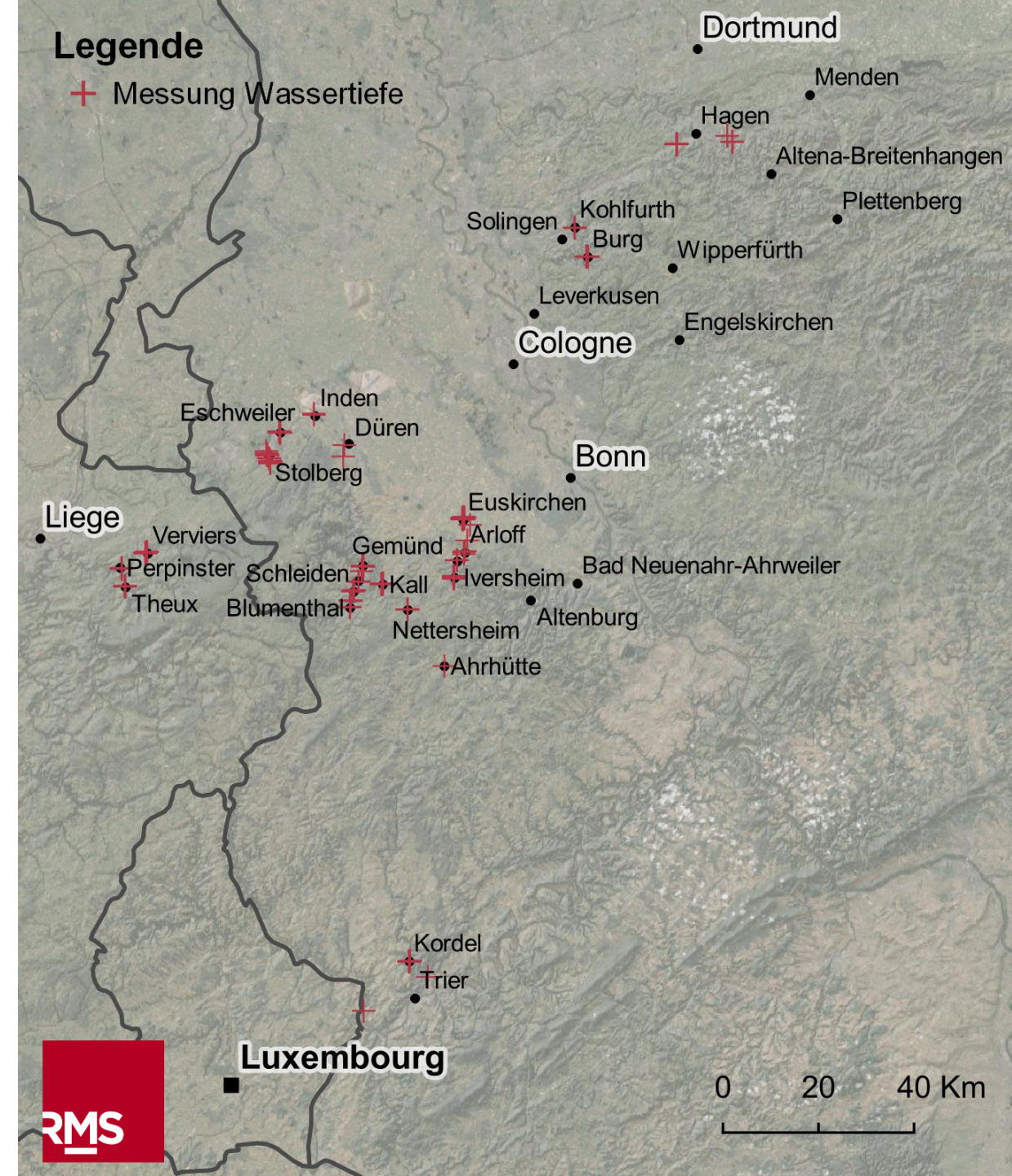## Return Period of Maximum Daily Precipitation of Major European Flood Events

Event Response and Field Reconnaissance

Timeline

EVENT — July 12–18, 2021

2nd FP / LOSS ESTIMATE — August 5, 2021

FIELD RECONNAISSANCE — November 1–3, 2021

3rd FP / LOSS ESTIMATE — January 25, 2022

Jul. — Aug. — Sep. — Oct. — Nov. — Dec. — Jan. 2022 — Feb.

1st EVENT FOOTPRINT (FP) — July 23, 2021

FULL EVENT RECONSTRUCTION — September 2021–January 2022

Field Reconnaissance

- Two teams dispatched

- Large area covered (North Rhine-Westphalia, Rhineland Palatinate, Eastern Belgium, and small part of Luxembourg)

- Compare flood footprint with observations in the field

- Collect independent observations, e.g., flood depth measurements derived from flood marks

- Validate assumptions including vulnerability, business interruption (BI) …

- Enhance understanding of the processes
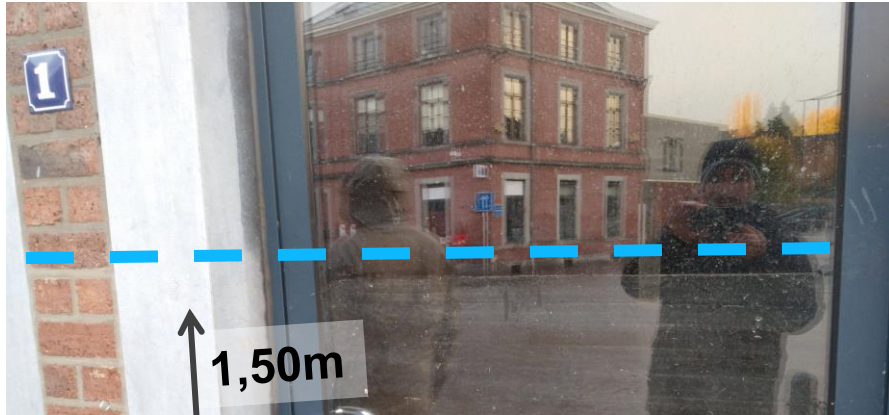
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Source: RMS recon

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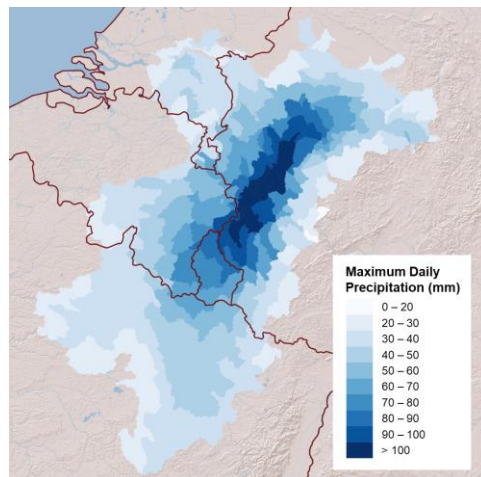- Enhance understanding of the processes

Source: RMS recon

Field Reconnaissance

1,50m

2,90m

2,60m

Footprint Reconstruction

Full Event Reconstruction

- Focus on most affacted areas (e.g., Bavaria, Saxony excluded)

- Maximum precipitation from E-OBS dataset between July 13–15, 2021

- Leveraging components of the Europe Inland Flood HD Models

- Inclusion of data from roughly 700 gauge stations, mainly along small and medium rivers

- Incorporation of own ~200 flood depth measurements inferred from observed flood marks
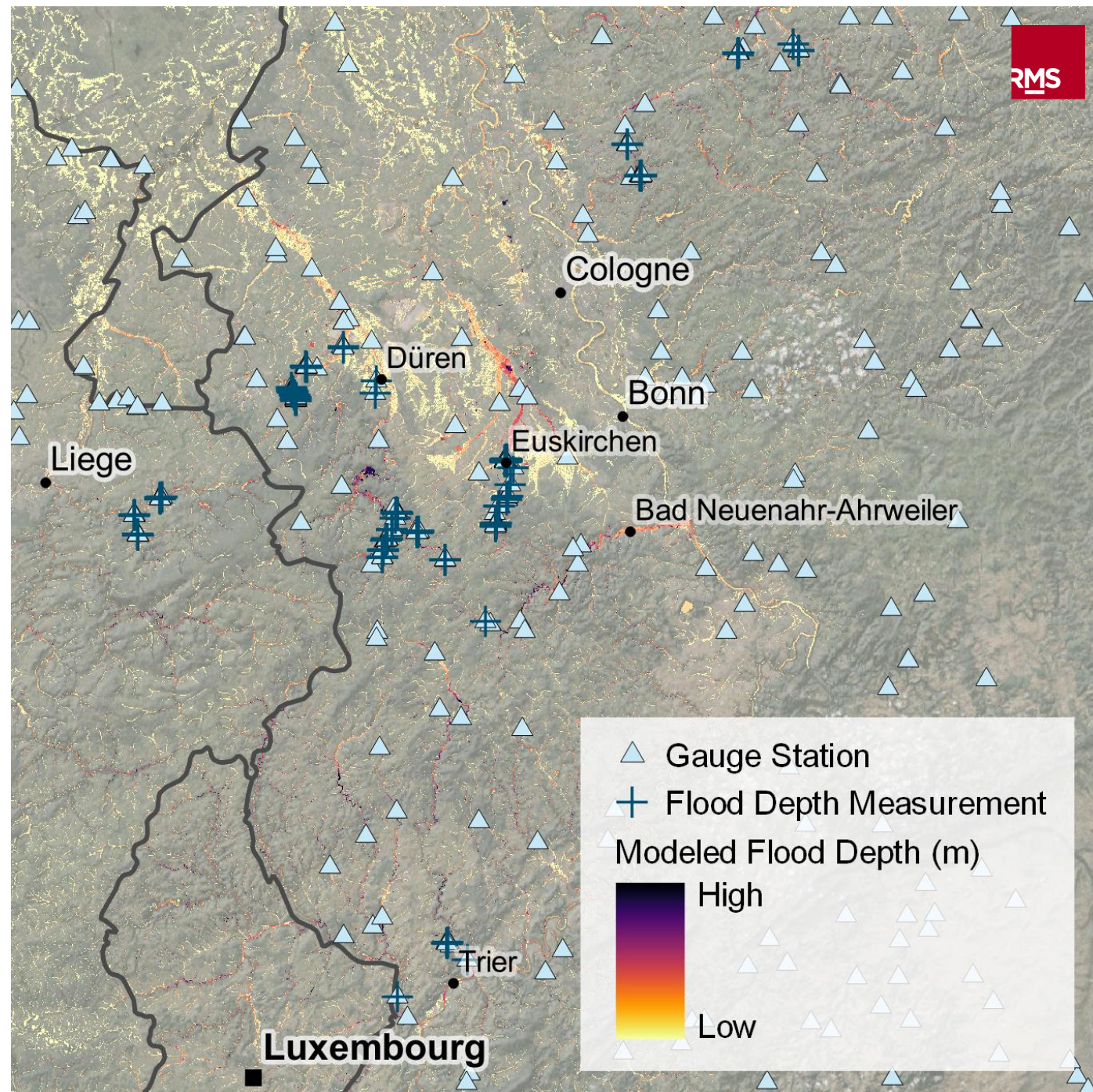
Footprint update – leveraging additional information

- Calibration of 2 parameters
  - Catchment-level event runoff coefficient
  - Saturation area threshold

- Basin level calibration as first step

- Local (group of catchments) fine calibration where field measurements are available

- For these catchments, the simulated vs observed water depths for the **recon locations** ● present an ***excellent fit,*** while the gages in smaller streams show a much larger degree of uncertainty, but are still more or less unbiased
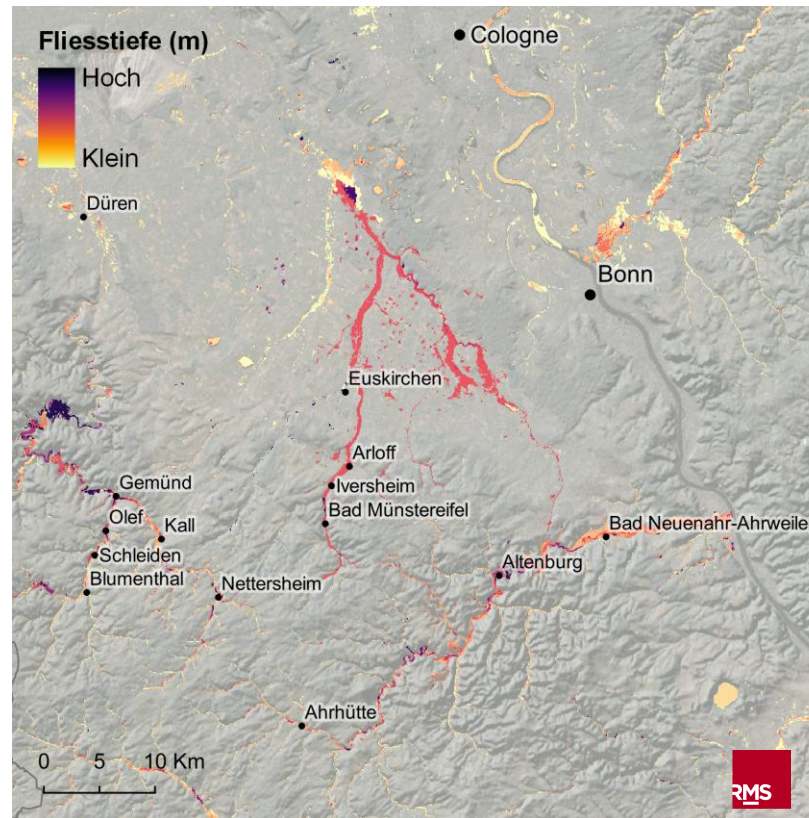

Observed water depth [in m]
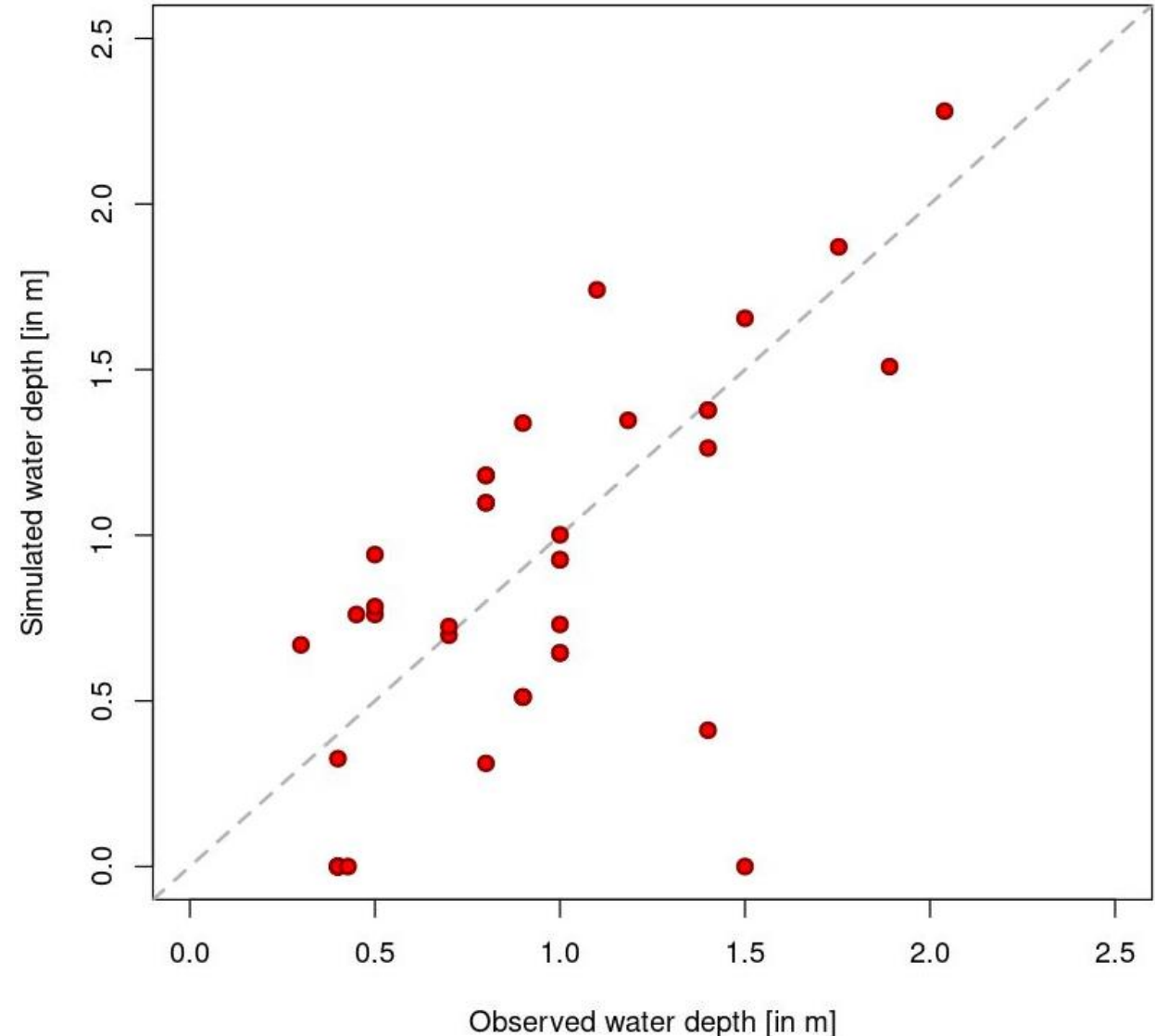
Comparison of flood footprints released

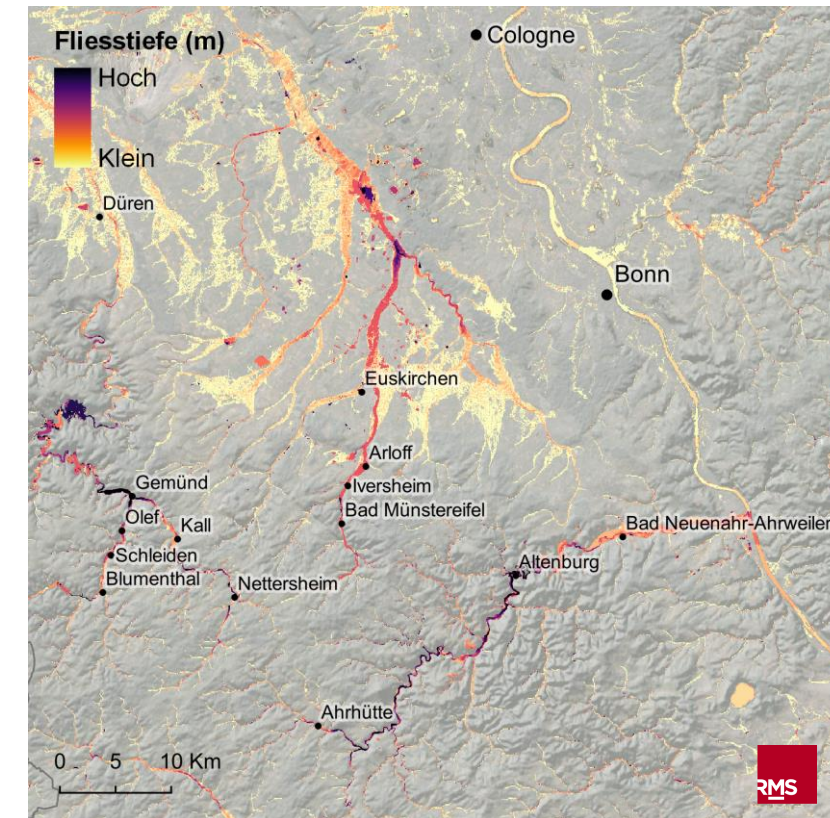**Version 23 July 2021**
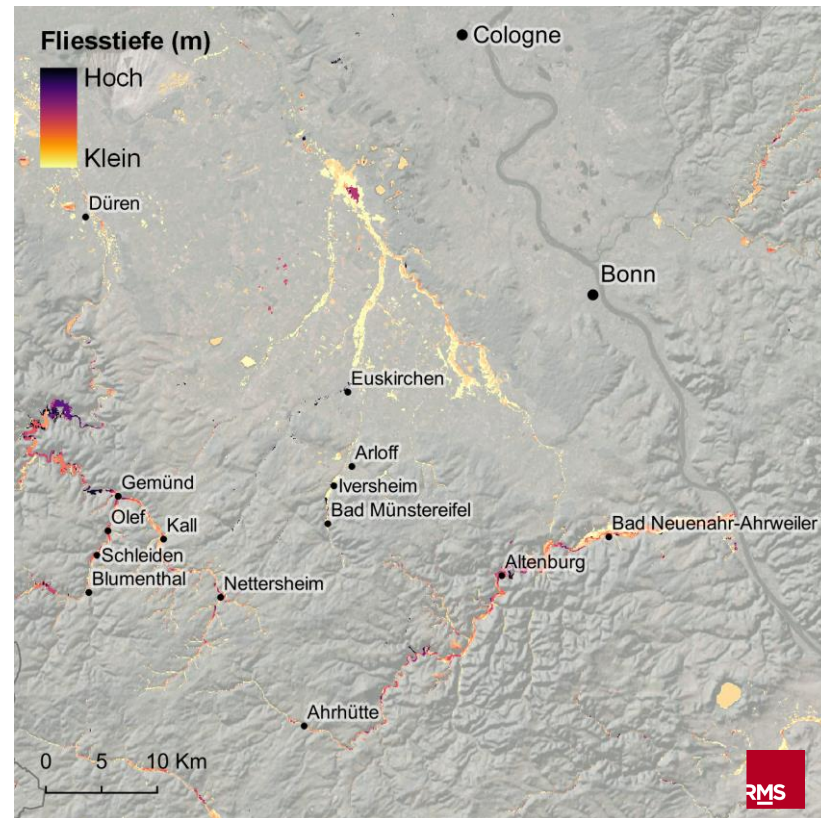
Version 5 August 2021

Version 25 January 2022

Thank you