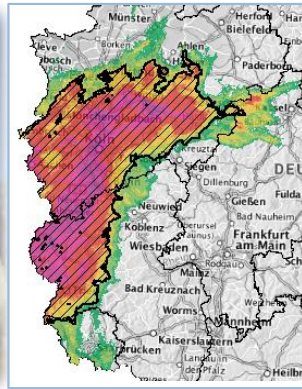


Evaluation of the **extreme rainfall event of July 2021** in **Western Germany** and its impact based on the **Catalogue of Radar-based Heavy Rainfall Events (CatRaRE)**



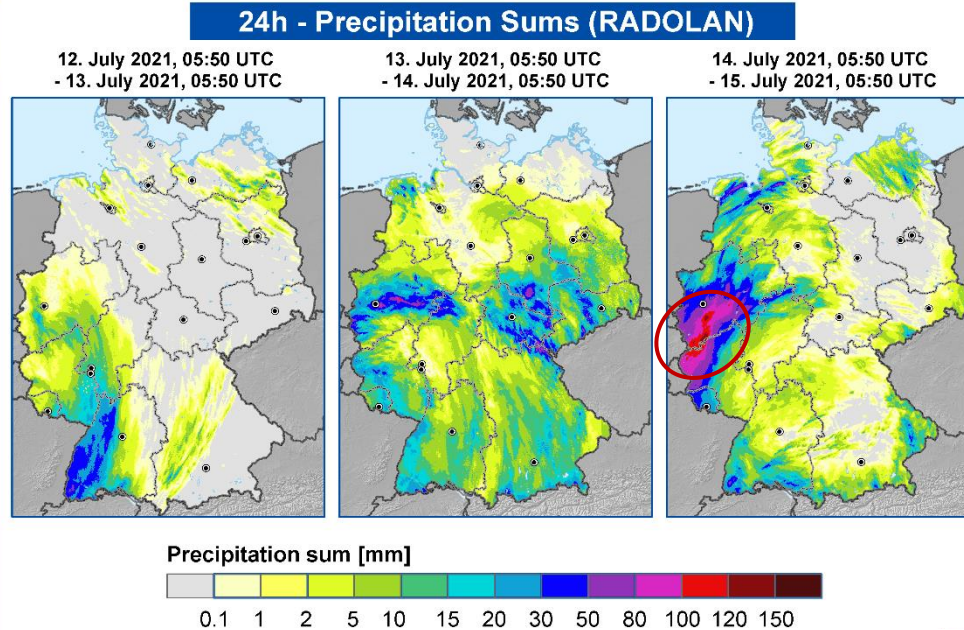
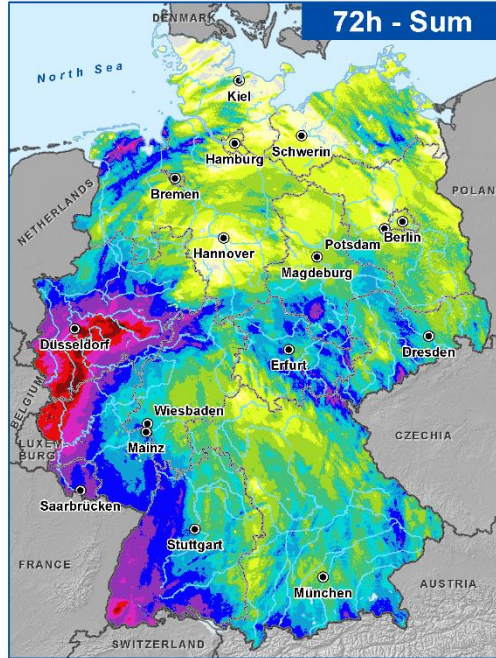
Ewelina Walawender, Dr. Katharina Lengfeld, Dr. Tanja Winterrath, Elmar Weigl

Deutscher Wetterdienst, Hydrometeorology, Offenbach am Main, Germany



13 – 15 July 2021: Low Bernd

Low Bernd over Germany, Precipitation Sums (Radar): 12. July, 05:50 UTC - 15. July 2021, 05:50 UTC



(!) Regionally
>> 150 mm of
precipitation in
24 hours

Precipitation data and graphic credits: © Deutscher Wetterdienst 2021 (Last Update: 23.05.2022); Geodata: © GeoBasis-DE/BKG 2020 (Last Update: 01.01.2020).



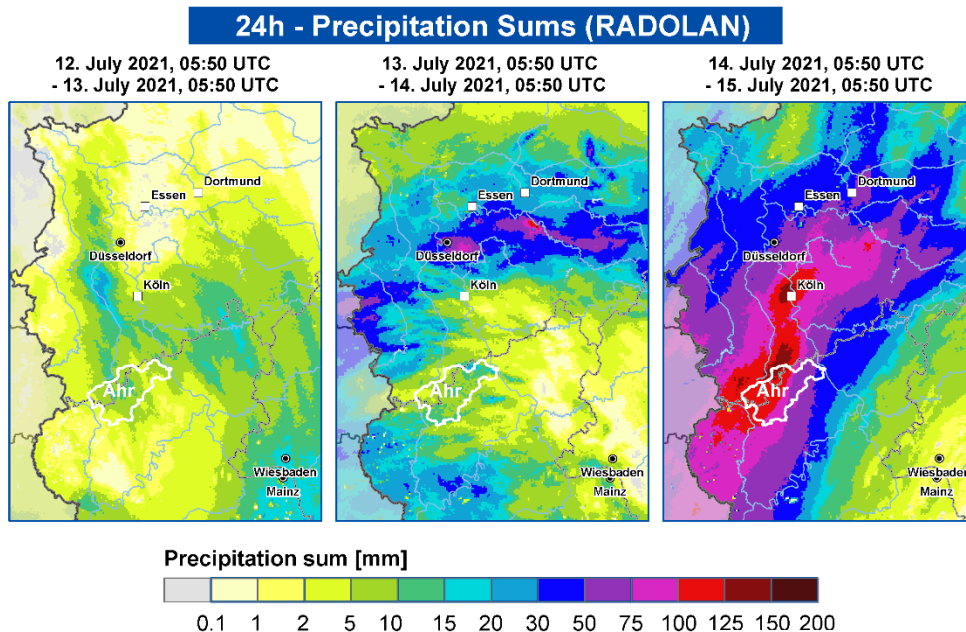
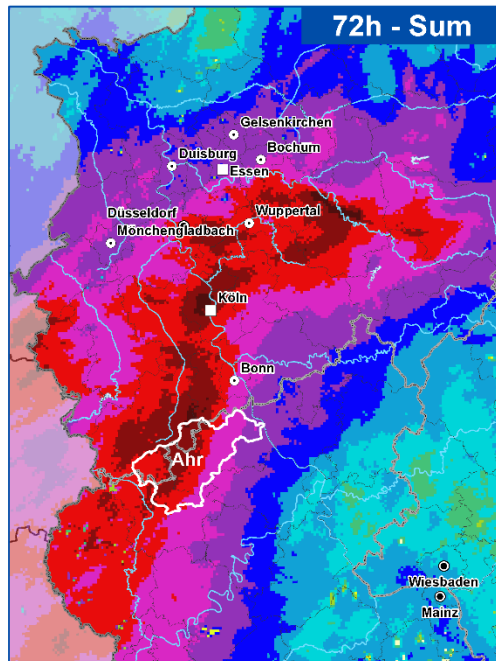
 RADOLAN hourly





13 – 15 July 2021: Low Bernd

Extreme Rainfall over Western Germany, Precipitation Sums from Radar: 12. July, 05:50 UTC - 15. July 2021, 05:50 UTC



- The long lasting low caused more and more rain
- North Rhine-Westphalia and Rhineland-Palatinate most affected
- Extreme Flood in the Ahr valley...



→ RADOLAN hourly



“CatRaRE” → Catalogue of Radar-based heavy Rainfall Events

→ Contains all short-term and long-term heavy rain events in Germany from 2001 onwards,

→ Two variants: **W3**: Events with **Precipitation Sum $\geq$ Warning Level 3**

T5: Events with **Return Period $\geq$ 5 Years**

→ Event identification for various durations:

1, 2, 3, 4, 6, 9, 12, 18, 24, 48 and 72h

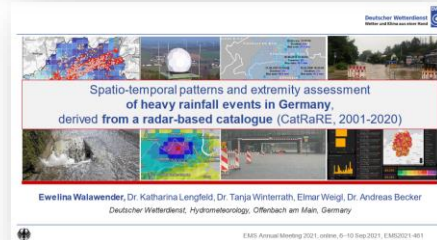
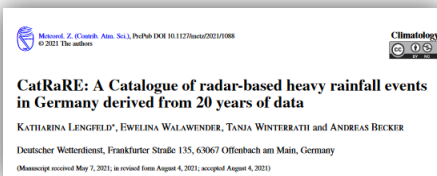
→ No overlap in space and time

→ Based on Radar Climatology Dataset **RADKLIM**
(currently 2001-2020, 2021 very soon);

BUT Operational monitoring based on RADOLAN Data
(Radar Online Calibration)

Event choice based on the
highest **Extremity***

*** EXTREMITY ($E_{T,A}$)** - combination
of Event Area and its Return Period
based on concept of Weather
Extremity Index (WEI) by Müller and
Kaspar (☞ [Source Paper](#))



CatRaRE PAPER:

Lengfeld, K., Walawender, E., Winterrath, T., Becker, A., 2021, *CatRaRE: A Catalogue of radar-based heavy rainfall events in Germany derived from 20 years of data*, Meteorologische Zeitschrift, DOI: [10.1127/metz/2021/1088](https://doi.org/10.1127/metz/2021/1088).

EMS2021 TALK:

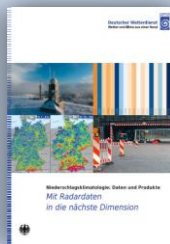
Walawender, E., Lengfeld, K., Winterrath, T., Weigl, E., and Becker, A.: *Spatio-temporal patterns and extremity assessment of heavy rainfall events in Germany, derived from a radar-based catalogue (CatRaRE, 2001-2020)*, EMS Annual Meeting 2021, online, 6–10 Sep 2021, EMS2021-461, <https://doi.org/10.5194/ems2021-461>, 2021

https://presentations.copernicus.org/EMS2021/EMS2021-461_presentation.pdf

In German?



click on the
miniature to open
the publication

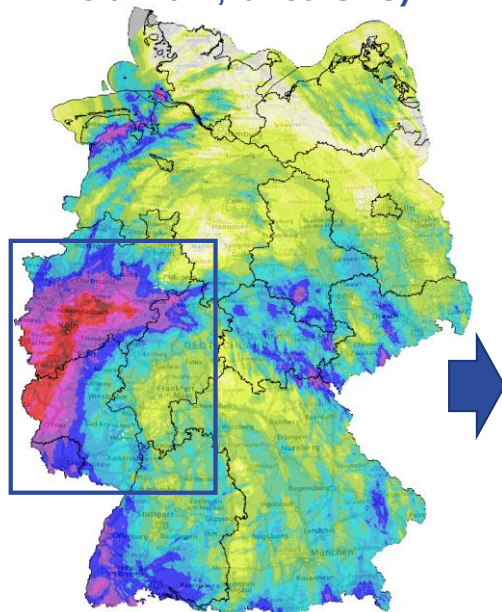


Or simply... ➔ dwd.de/catrare



Low Bernd as CatRaRE Event – Operationally

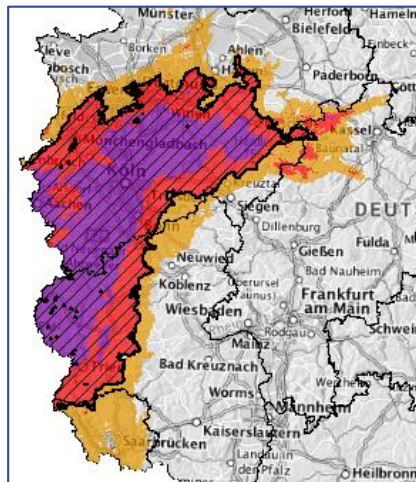
Duration = 48h
(13.07.2021, 02:50 UTC
- 15.07.2021, 02:50 UTC)



Precipitation sum [mm]



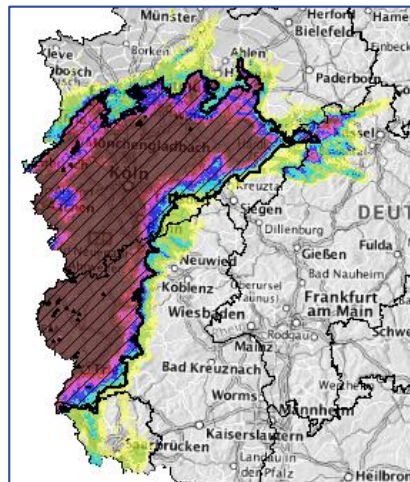
**Level of DWD
Warning**



Warning Level



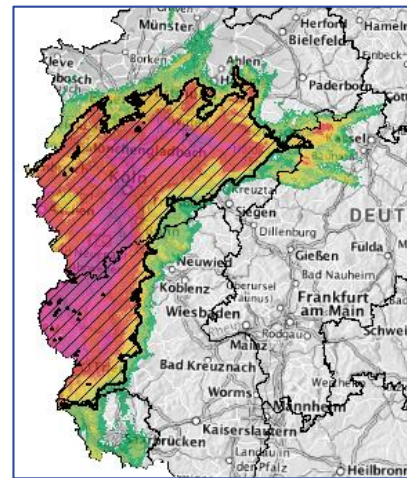
**Return Period
(based on RADKLIM)**



Return Period [Years]



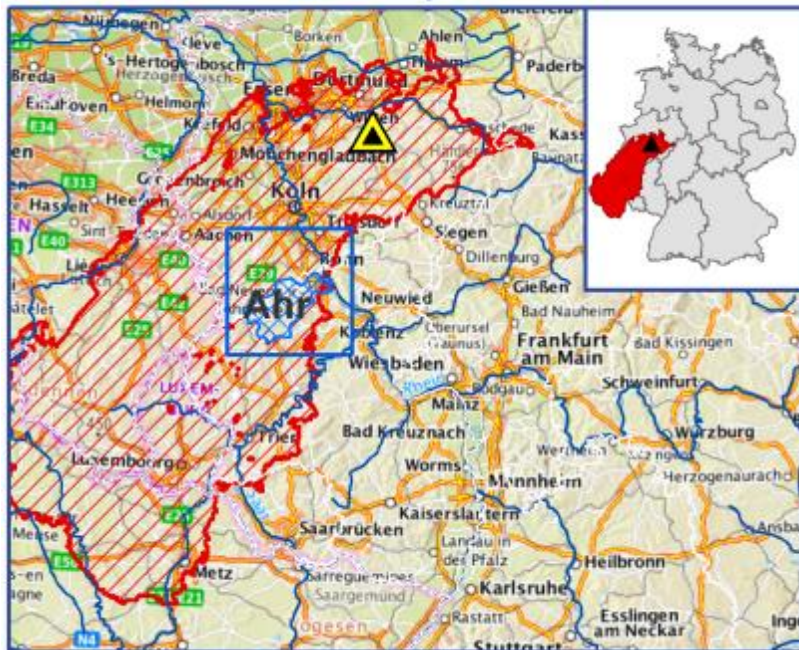
**Heavy Rainfall Index
(SRI, based on Schmitt)**





Low Bernd as CatRaRE Event – Operationally

Event Zone and Precipitation Maximum



Start Time: 13.07.2021 02:50:00
Duration: 48 h
Area (only DE): 43418 km² (20788 km²)
RRmax / RRmean: 201.6 mm / 91.8 mm
SRI_{max} / SRI_{mean}: 10 / 7
T_{max} / T_{mean}: >> 100 Years / 93 Years
Eta: 231.67

Location of the DE - Maximum (181,7 mm):

Bundesland: Nordrhein-Westfalen
Landkreis: Märkischer Kreis
County/City: Nachrodt-Wiblingwerde
Catchment: Lenne (Ruhr)

Population: 15.4 Mill. (in DE: 11.8 Mill.)
Populated Area: 4.4 % (in DE: 6.5 %)
Sealed Areas: 5.5% (in DE: 8.1%)

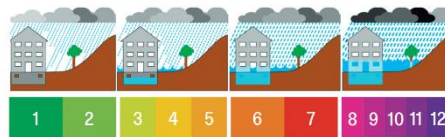
Elevation Range: 840 m

Weather Type (oWLK DWD): XXZZF



Low Bernd as CatRaRE Event – Operationally

- ➔ TOP 1 Extremity in comparison with all Events from 2001-2020 Catalogue (TOP2: Elbe Flood 08.2002)
- ➔ Mean Heavy Rainfall Index (SRI) over the Event Area = 7 (!)



Low Bernd Event and the TOP 10 (Extremity) CatRaRE 2001-2020

RANK	Ereignisbeginn [UTC]	D [h]	Area [RADKLIM Pixel]	Extremität		RRmax [mm]	RRmean [mm]	SRImax [1-12]	SRImean [1-12]	Land / Kreis / Gemeinde des Niederschlagsmaximums
				Absolut	Relativ					
X	13.07.2021 02:50	48	43418	231.67	100.0	201.6	91.8	10	7	Frankreich (DE: NRW /Märkischer Kreis)
1	12.08.2002 02:50	24	48420	207.99	89.8	283.1	86.89	11	5	SN /Sächsische Schweiz-Osterzgebirge /Altenberg
2	24.07.2017 07:50	48	54898	188.96	81.6	255.8	85.04	9	5	NI /Goslar /Bad Harzburg
3	17.07.2002 01:50	48	45053	176.29	76.1	187.2	85.26	10	5	NI /Hildesheim /Sibbesse
4	29.06.2017 10:50	24	33927	166.19	71.7	161.9	71.62	9	5	BE /Berlin /Berlin
5	21.07.2011 05:50	48	37879	145.14	62.6	187.2	82.44	8	5	Tschechien
6	25.09.2010 21:50	48	45655	132.87	57.4	154.5	79.38	8	4	SN /Bautzen /Wachau
7	26.08.2010 04:50	24	14519	132.38	57.1	163.9	86.16	10	6	NW /Borken /Schöppingen
8	30.05.2013 17:50	72	32937	127.18	54.9	319.5	131.95	8	4	BY /Rosenheim /Aschau i. Chiemgau
9	27.09.2007 12:50	48	26330	114.07	49.2	189.5	78.56	8	4	ST /Harz /Wernigerode
10	20.05.2019 12:50	18	22325	109.71	47.4	106.7	60.21	9	5	HE /Main-Kinzig-Kreis /Steinau an der Straße

FELDERBESCHREIBUNG:

D - Signifikante Dauerstufe [h] des Ereignisses; Area - Gesamtfläche [km²] des Ereignisses (nach RADKLIM-Daten Projektion); RRmax/RRmean - Maximaler/Mittlerer Niederschlag [mm]; SRImax/SRImean - Maximaler/Mittlerer Starkregenindex nach Schmitt (Wertebereich [0, 12]).

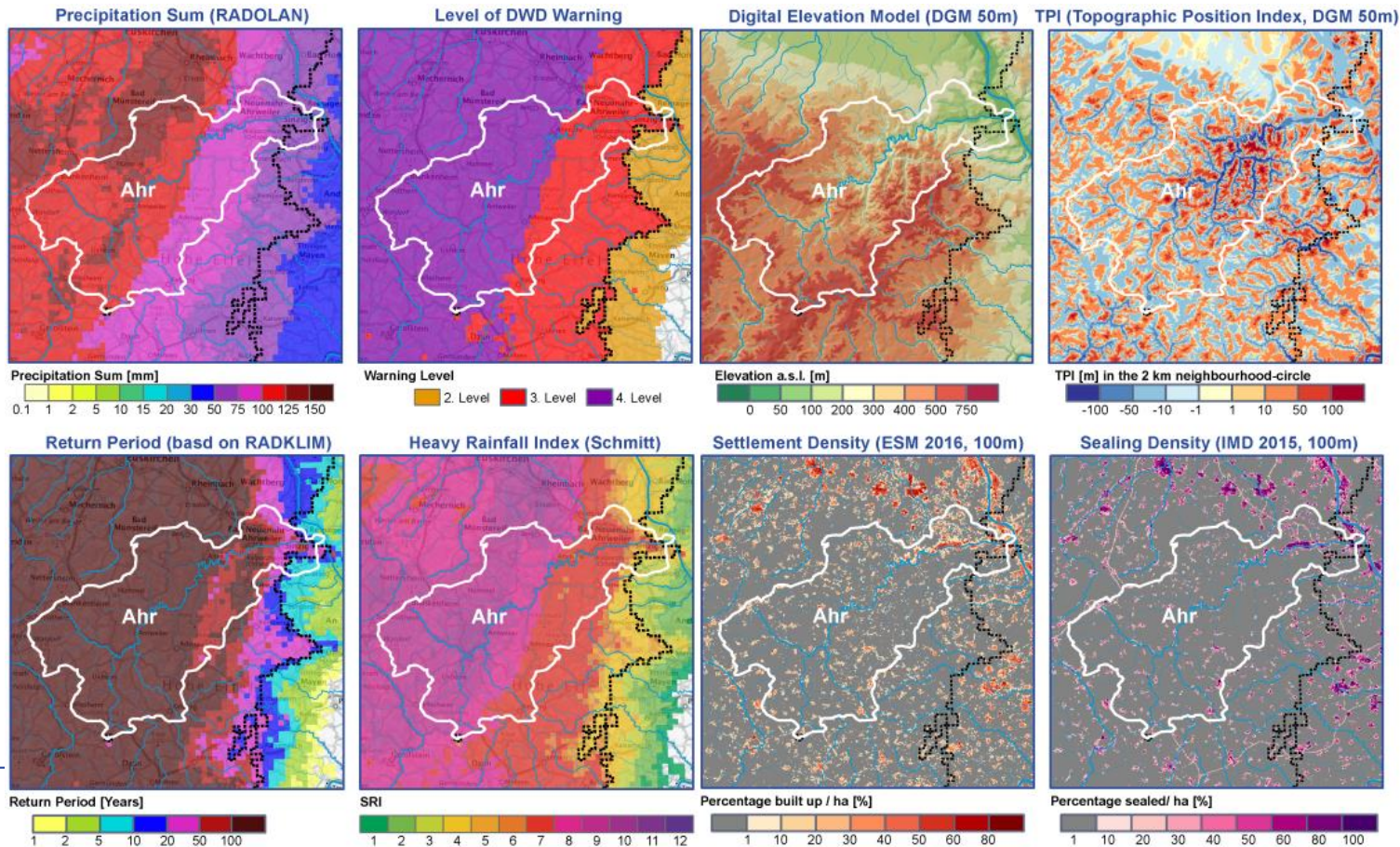
Datenbasis: © DWD 2021 (CatRaRE, DOI: https://doi.org/10.5676/DWD/CatRaRE_W3_ETA_V2021.01); Geodaten: © GeoBasis-DE/BKG 2020 (Stand: 01.01.2020).





Ahr Valley: Unfavorable Geographical Variables

→ Due to the **orographic conditions**, the water was channelled in the narrow river valleys

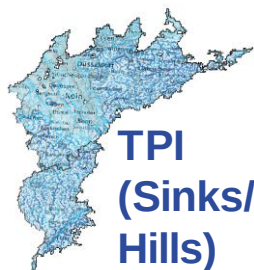




Future Application of CatRaRE – Impact Analysis ?

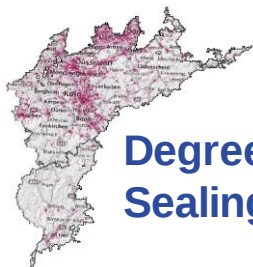
Identification of areas of enhanced risk

~ Endangering

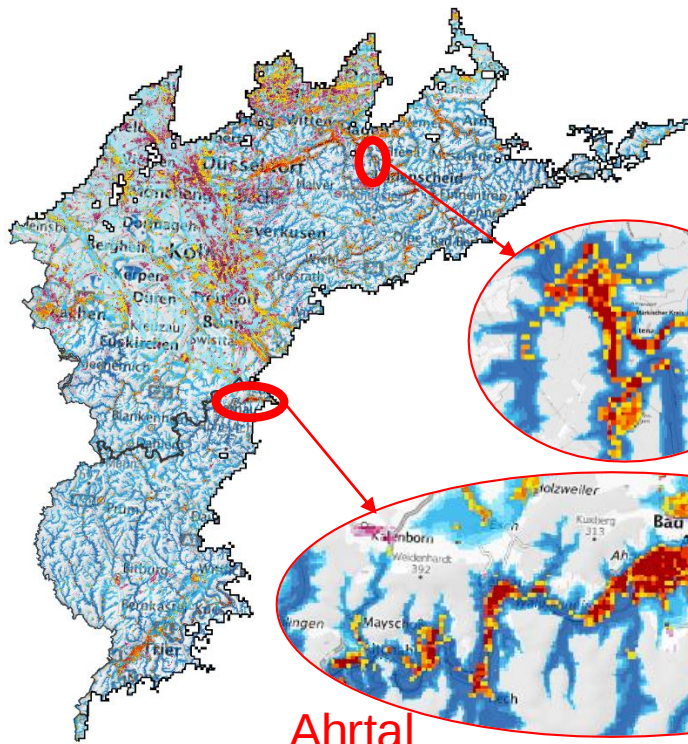


TPI
(Sinks/
Hills)

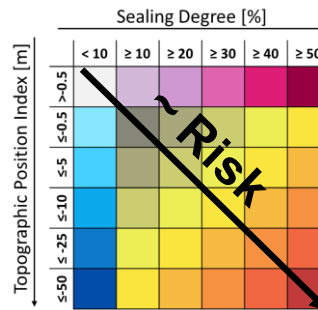
~ Damage potential



Degree of
Sealing

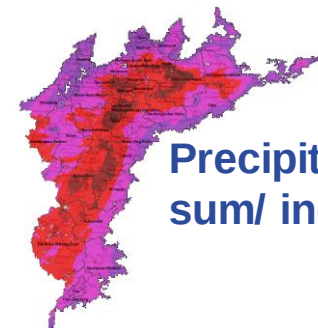


Ahrtal



Alena

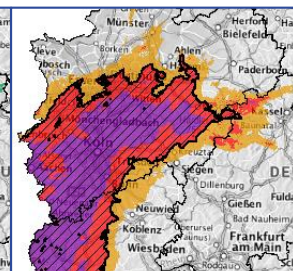
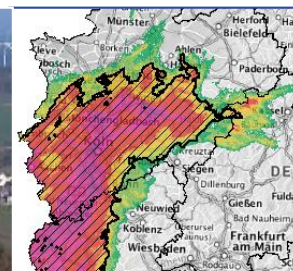
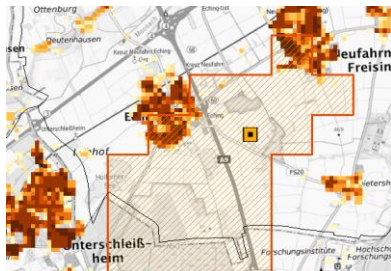
+



Precipitation
sum/ indices

+

Soil Moisture,
antecedent rain index,
population
characteristics ...



Thank You for your attention!



- CatRaRE Events Catalogues : <https://www.dwd.de/catrare>
- Radar Climatology Dataset - RADKLIM: <https://www.dwd.de/radklm>

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