



EMS 2022 – 7 September 2022 – Bonn

A new hydro-meteorological precipitation and flood forecasting system for small catchments

7 September 2022

Tanja Winterrath et al., EMS 2022, Bonn



Tanja Winterrath¹,
Christian Chwala²,
Jens Grundmann³,
Andy Philipp⁴,
and Achim Six⁴

¹ Department of Hydrometeorology
Deutscher Wetterdienst



Project overview

(funded by the
German Federal Ministry
of Education and research)



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4 LANDESAMT FÜR UMWELT,
LANDWIRTSCHAFT
UND GEOLOGIE

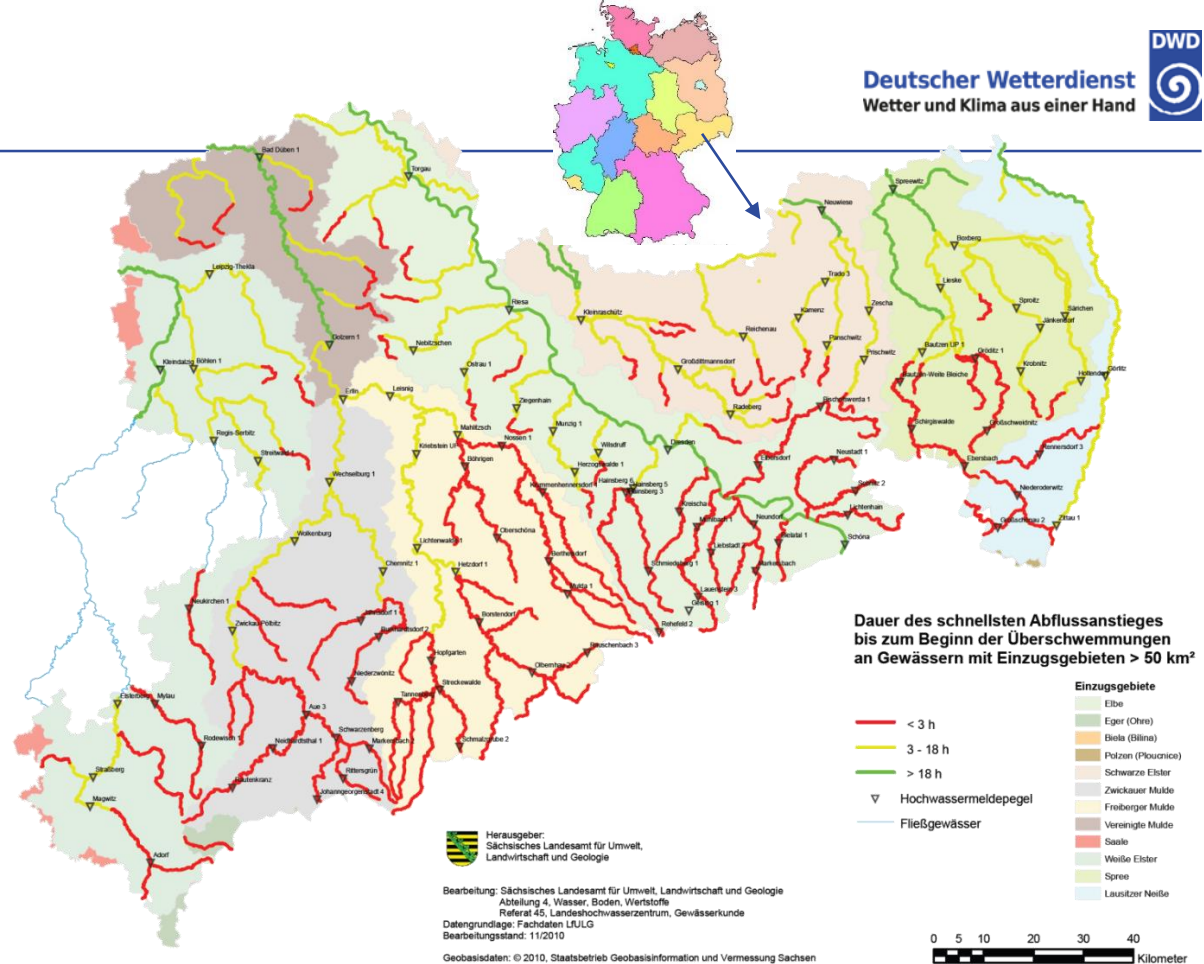


2 **UNIA**
Universität
Augsburg
University

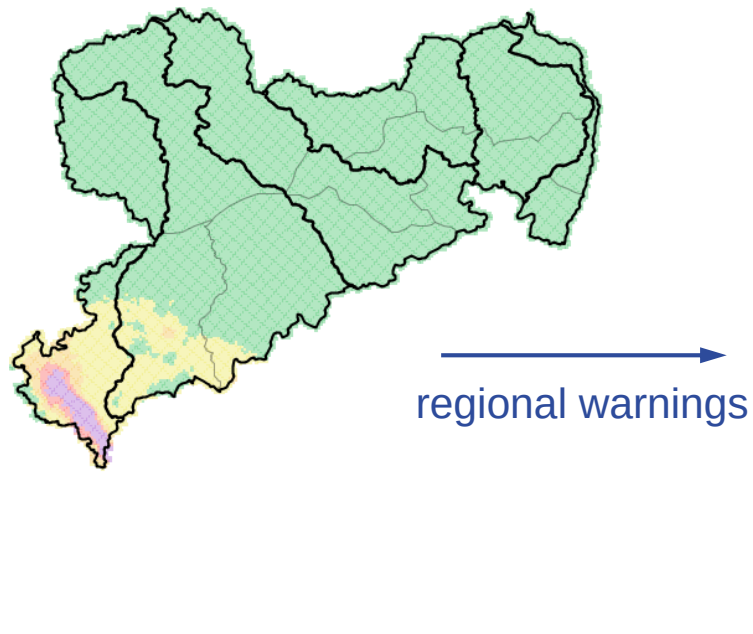
3  **TECHNISCHE
UNIVERSITÄT
DRESDEN**

Study area Saxony

- ➔ many catchments show fast hydrological responses to precipitation
- ➔ especially pronounced in the Ore Mountain Area (red color: < 3 h)
- ➔ need for timely (flash) flood warnings

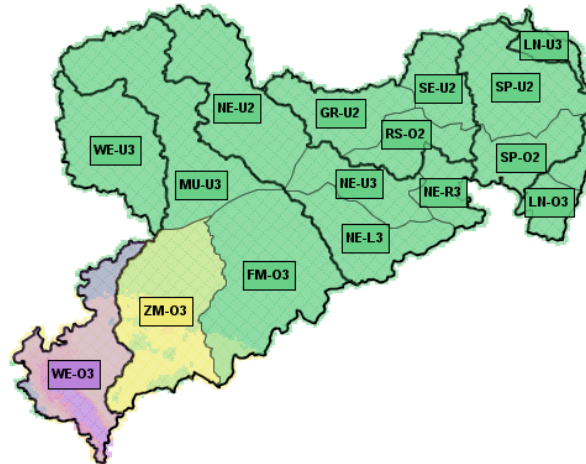


Operational flood early warning system



Hazard information
(based on intensity
and affected area)

- very high
- high
- medium
- moderate
- low
- no information



Link to method description:
<http://bit.do/HWFWsRep>

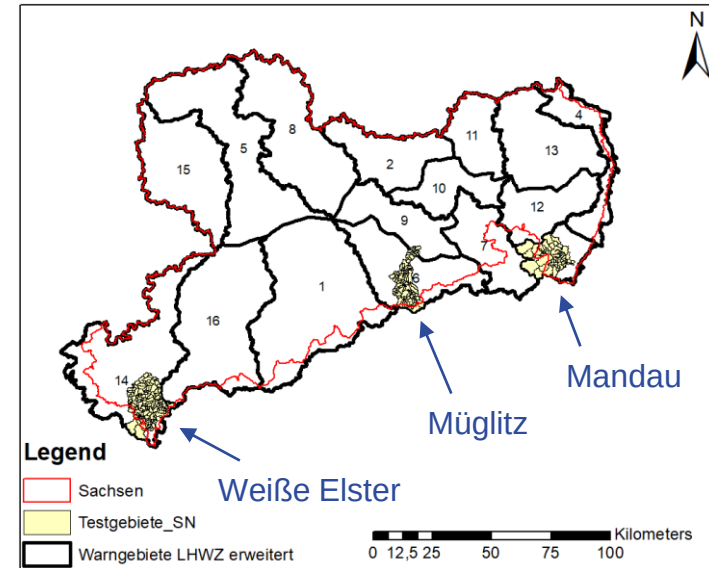
Towards warnings on higher spatial resolution

➔ Current spatial reference



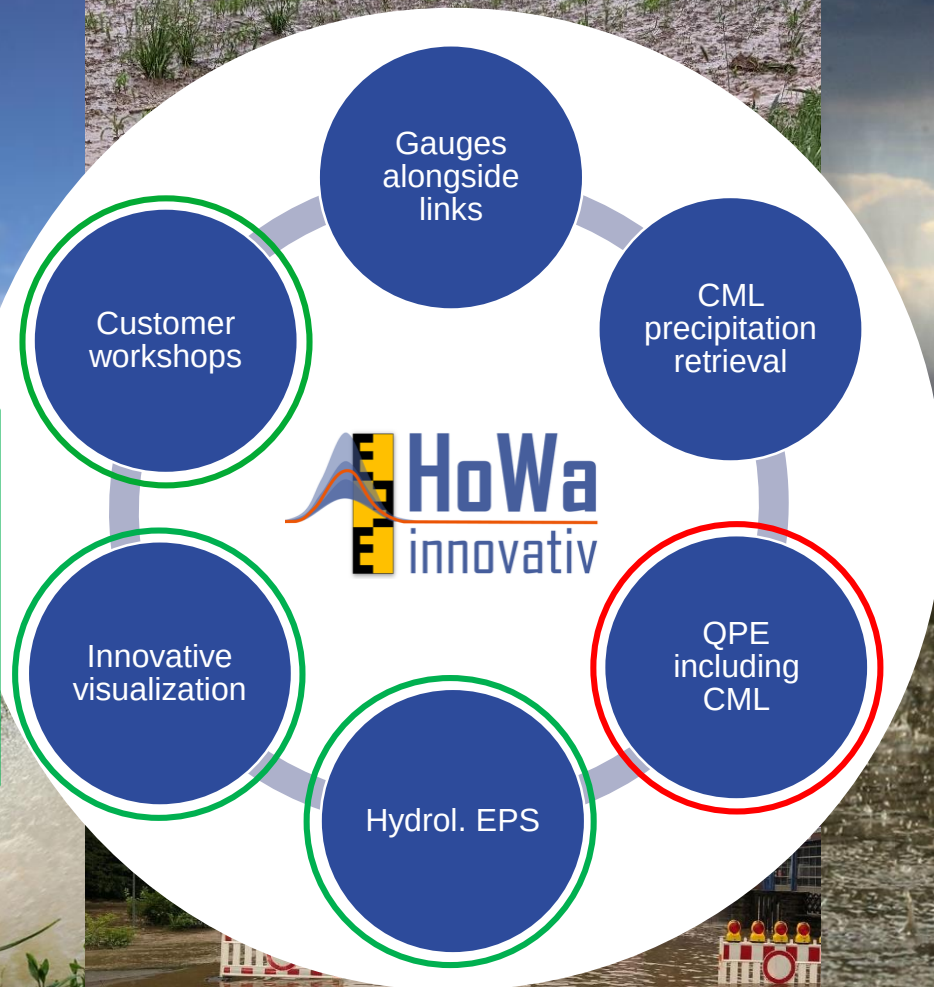
Need for precise
QPE and QPF input

➔ Aim: Small (sub-)catchments



EMS2022-679 | Orals | [ES2.3](#)
Communicating uncertainties
for flood warning in small
catchments using ensemble
hydrological forecasting

Jens Grundmann, Achim Six,
and Andy Philipp
Mon, 05 Sep, 14:35–14:55 |
Room HS 7



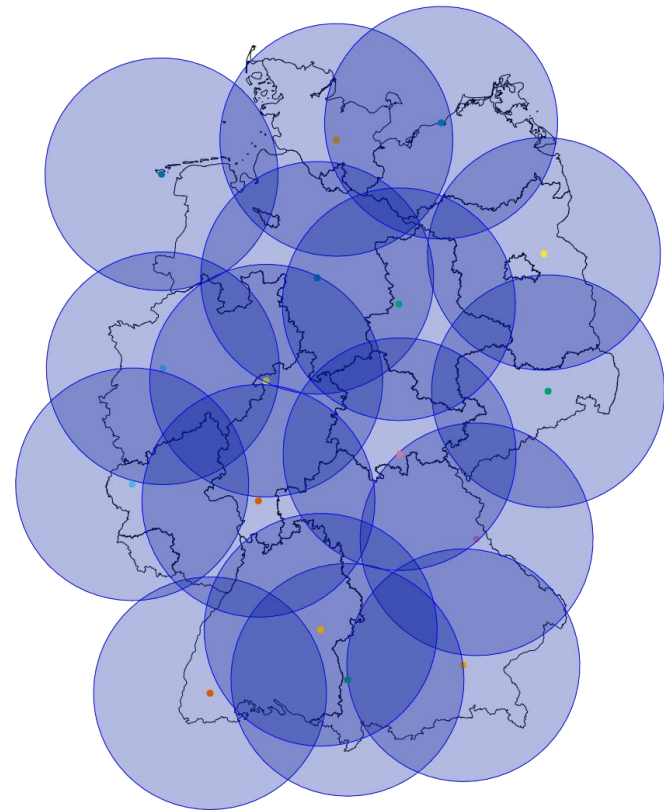
Sources:
DWD-WarnWetterApp,
Christina Nikogosian,
Christian Chwala



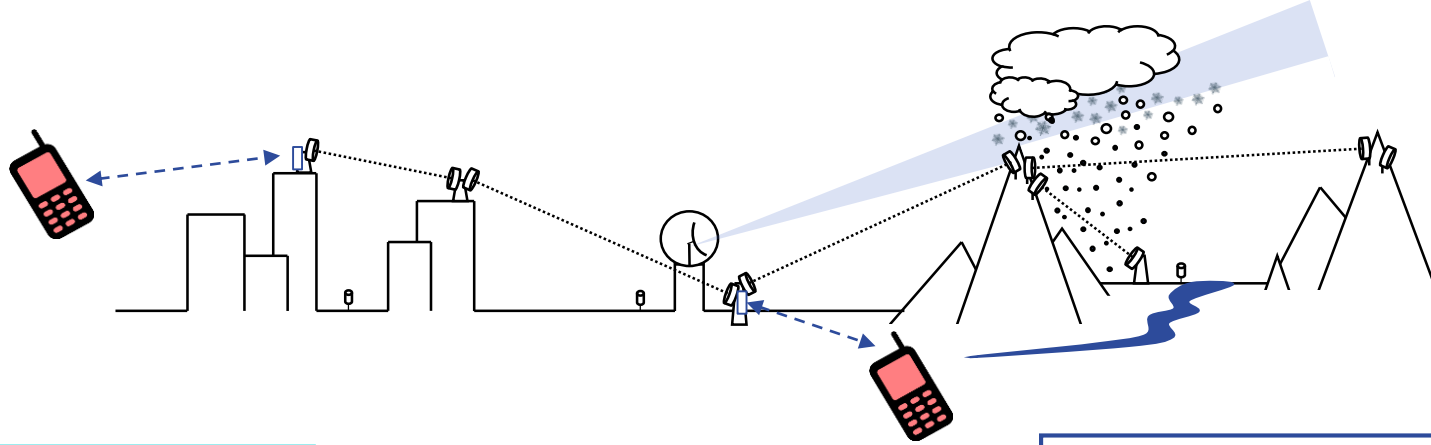
Multi-sensor QPE – Radar + Gauges + CML

Radar-based precipitation analysis

- Operational online adjustment RADOLAN
 - Germany composite with 1 km² spatial resolution
 - Combination of radar and gauges
 - aggregation over 1 hour
 - latency of ~ 25 min
- Methodology
 - Application of interpolated additive and multiplicative radar-gauge differences to unadjusted precipitation estimates
- operational since June 2005



CML = Commercial Microwave Links

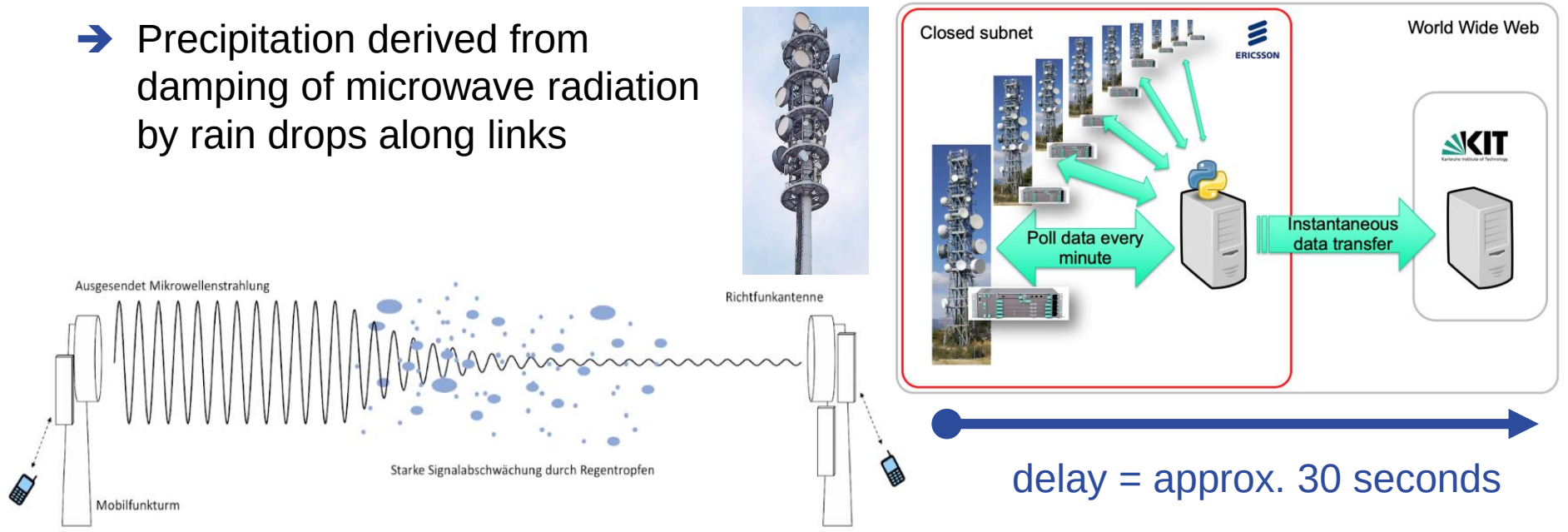


- 👍 ~ linear AR relationship
- 👍 near-ground line integral
- 👍 big data (currently) for free

 **OpenSense**
Cost Action on
opportunistic sensing
⇒ **You're welcome to join!**

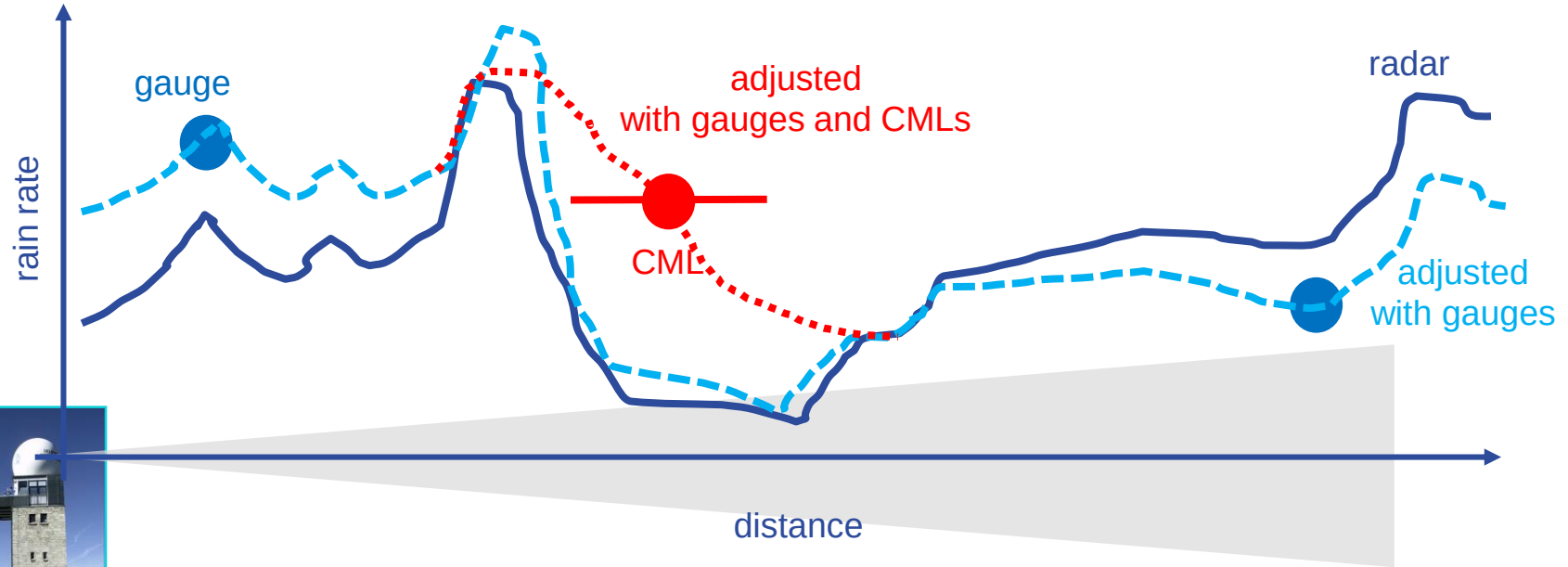
Precipitation retrieval from CML data

➔ Precipitation derived from damping of microwave radiation by rain drops along links



delay = approx. 30 seconds

Multi-sensor adjustment of radar data





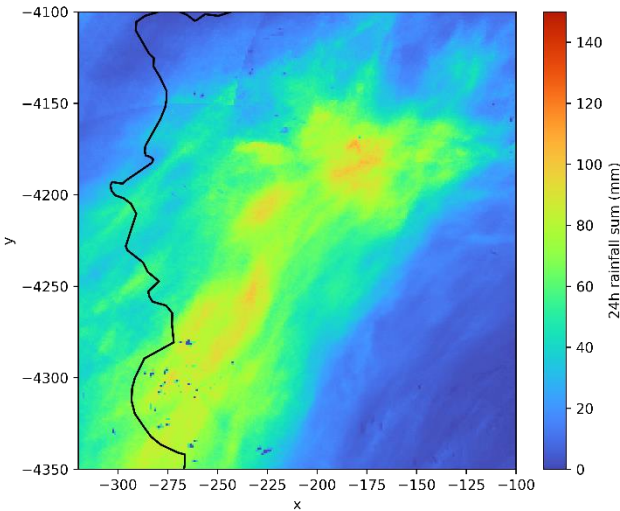
Quelle: DWD-WarnWetterApp

Case study Ahr valley flooding in July 2021

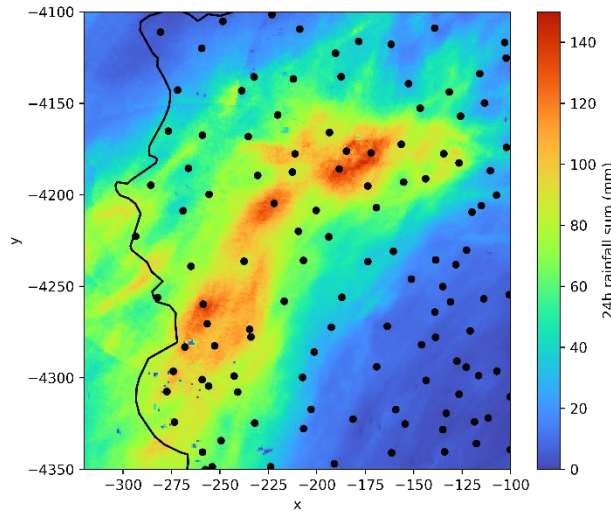
Adjustment: Radar + Gauges

➔ Better capturing of high precipitation levels including gauges

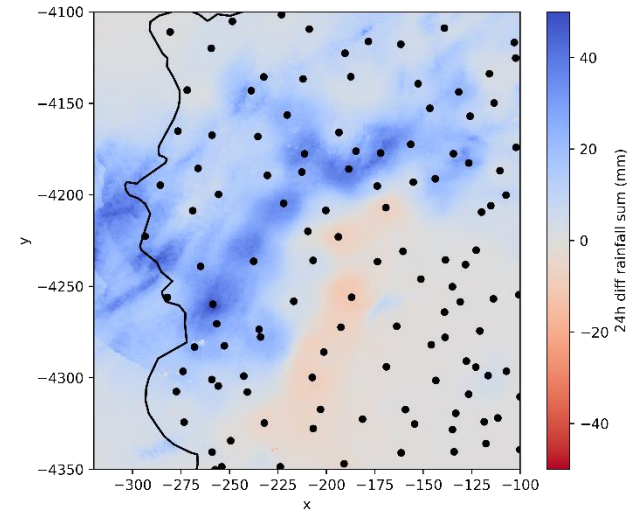
Pure radar (RH)



Gauge-adjusted (RW)



RW - RH



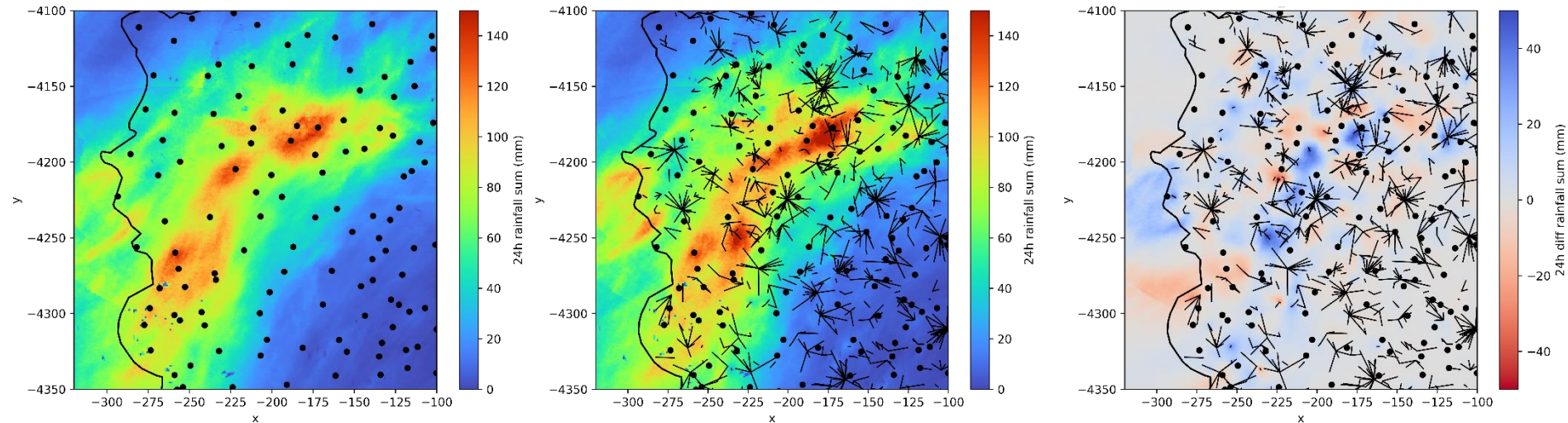
Adjustment: Radar + Gauges + CML

➔ Additional improvement including CML-based precipitation retrieval

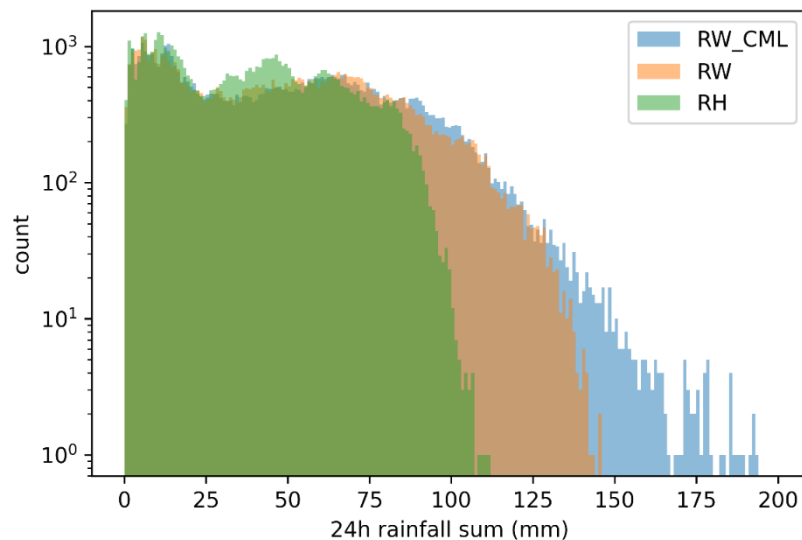
Gauge-adjusted (RW)

+ CML (RW_cml)

RW_cml - RW



High precipitation values better represented by RW_cml



Precipitation TOP 5			
RR Sum [mm]	Location	Duration	Date
241	Hagen-Holthausen (LANUV)	22 h	14/07/2021
162	Wipperfürth-Gardeweg	24 h	14/07/2021
152	Kall-Sistig	24 h	14/07/2021
151	Wuppertal-Buchenhofen	24 h	14/07/2021
125	Schneifelforsthaus (LfU RP)	24 h	14/07/2021

- ➔ Adjustment by gauges improves capturing high precipitation values
- ➔ Additional adjustment with CML data allows better representation of very high precipitation sums in accordance with observed station data



Outlook

What to do next at DWD?

- Increasing temporal frequency of multi-sensor adjustment including CML to 5 min
- Developing new adjustment procedures to handle high temporal frequency and spatial heterogeneity
- Adding deep learning methods to adjustment system
- Performing comprehensive verification studies
- Establishing operational QPE at DWD performing high-frequency adjustment including CML data
- **Project HoWa-PRO has just started this September**



Contact

Dr. Tanja Winterrath
Deutscher Wetterdienst
Department of Hydrometeorology
Frankfurter Straße 135
63067 Offenbach am Main

Email: tanja.winterrath@dwd.de
hydromet@dwd.de

URL: www.dwd.de/radolan
<https://www.howa-innovativ.sachsen.de/>
<https://opensenseaction.eu/>

Twitter: https://twitter.com/DWD_klima



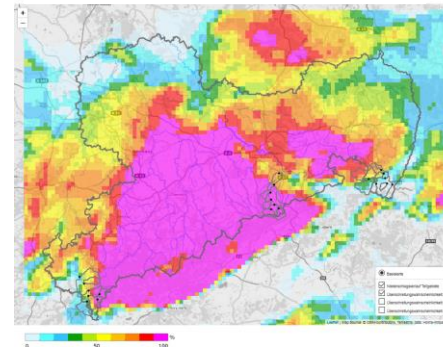


Communicating hazard – the demonstrator

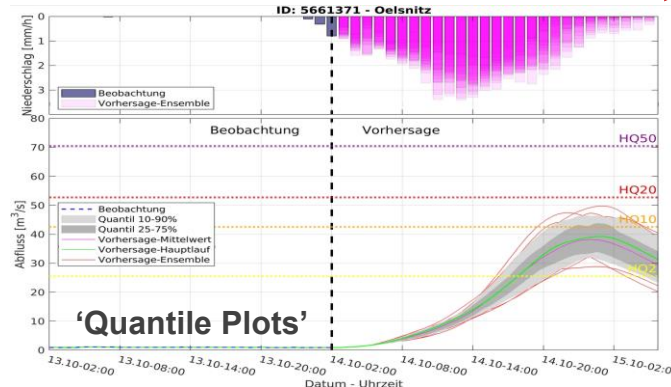
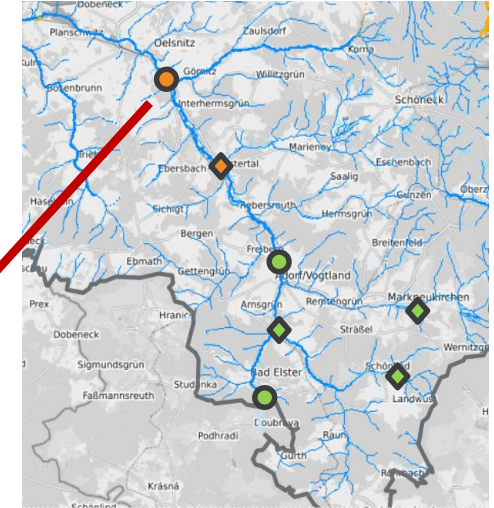
Demonstrator

- Extreme precipitation warning in Saxony
- Discharge forecast for 3 pilot regions
- 24 h history - 27 h forecast
- Hourly update
- Live modus:
<http://howa-innovativ.hydro.tu-dresden.de/WebDemoLive/>
- Historic event:
<http://howa-innovativ.hydro.tu-dresden.de/WebDemo/>

Exceedance Probability



'Traffic Lights'



'Quantile Plots'

Precipitation

Discharge

