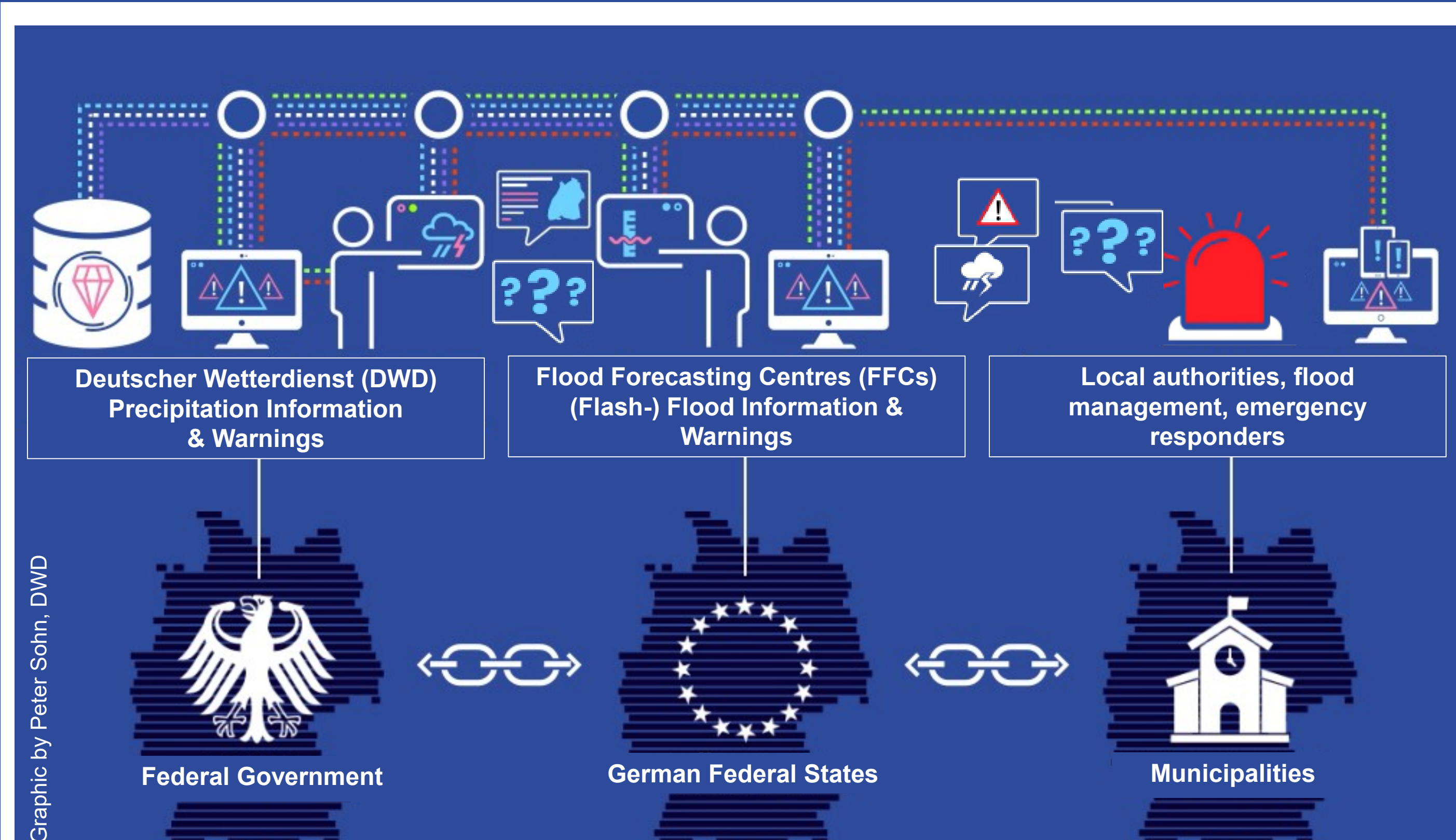# Tailoring SINFONY forecasts and other DWD products to flood forecasting applications following a co-design approach

Julia H. Keller, Christian Berndt, Ulrich Blahak, Jan Bondy, Vanessa Fundel, Malte Schmidt and Peter Sohn

Heavy precipitation associated with severe convective storms may result in small-scale flooding events with high societal impacts. In order to improve the prediction of such events, Deutscher Wetterdienst (DWD) is strengthening its collaboration with Germany's flood forecasting authorities in a co-design approach.

Flood-Forecast Warning Chain in Germany

Graphic by Peter Sohn, DWD

Deutscher Wetterdienst (DWD) Precipitation Information & Warnings — **Federal Government**

Flood Forecasting Centres (FFCs) (Flash-) Flood Information & Warnings — **German Federal States**

Local authorities, flood management, emergency responders — **Municipalities**

Modelling Perspective

➔ DWD provides e.g. precipitation forecast data and products to customers, like German flood forecasting centres, local authorities and emergency responders

➔ Flood forecasting centres, based in regions, run their flood forecasting models, using DWD and other data as input, and provide flood forecasts to customers

Warning Perspective

➔ DWD issues warnings for precipitation and other meteorological variables

➔ Flood forecasting centres issue flood warnings for their respective regions
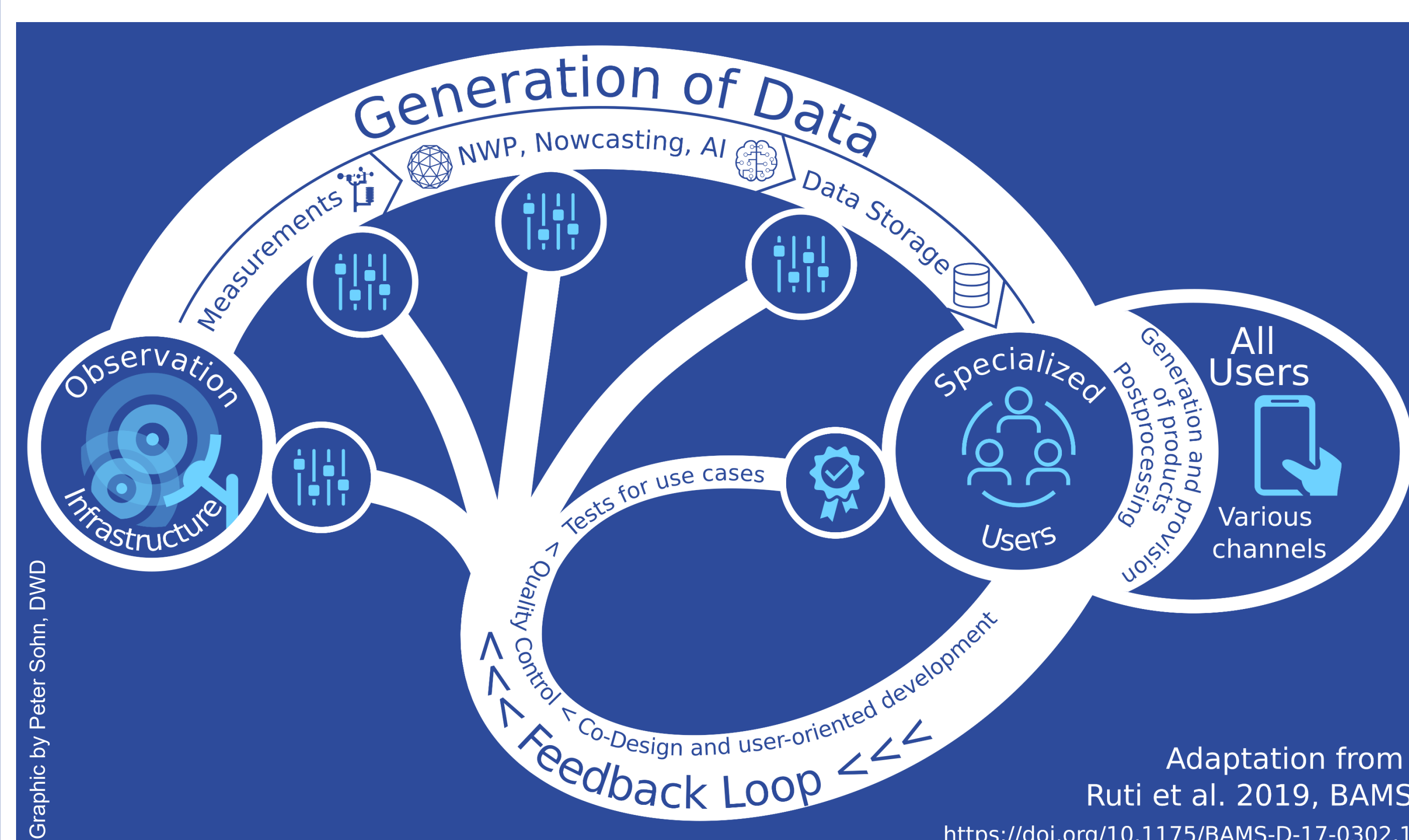
Implementing a Co-Design approach

Product development tailored to user needs

➔ Through a continuous dialogue, identify user requirements for targeted development of forecast products

➔ Provision of test data to identify potential for improvement in a feedback loop

Collaboration on research & development

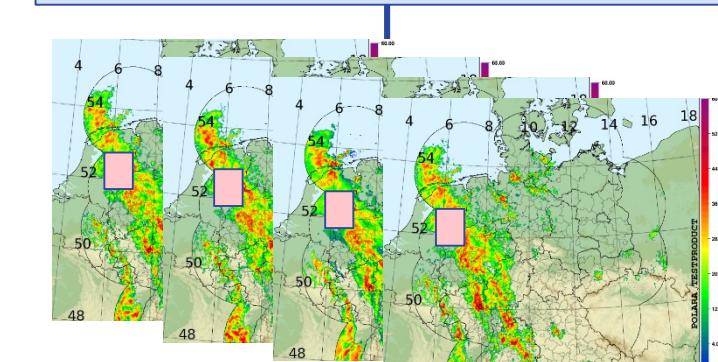➔ Joint research projects for improvements along flood forecasting warning chain

Graphic by Peter Sohn, DWD

Adaptation from Ruti et al. 2019, BAMS
https://doi.org/10.1175/BAMS-D-17-0302.1

Ongoing and commencing activities

SINFONY

Define tiles in each member

Run clustering for each tile

Sort cluster by number of members

Few members / Many members

Probability of occurrence
Low — High

Ensemble Reduction

➔ SINFONY will produce huge amounts of ensemble data – exceeding the processing capacities of some German flood forecasting centres

➔ Condense precipitation information into a member-reduced ensemble that maintains a large part of the probability distribution of the forecast

➔ Find the locally most probable precipitation forecasts, as well as alternate scenarios

Catchment-based precipitation forecasts

➔ Postprocessing of SINFONY data for individual catchments ($10 < A < 500$ km²)

➔ Derive meteorological potential for floods, based on observed precipitation + SINFONY seamless ensemble forecasts
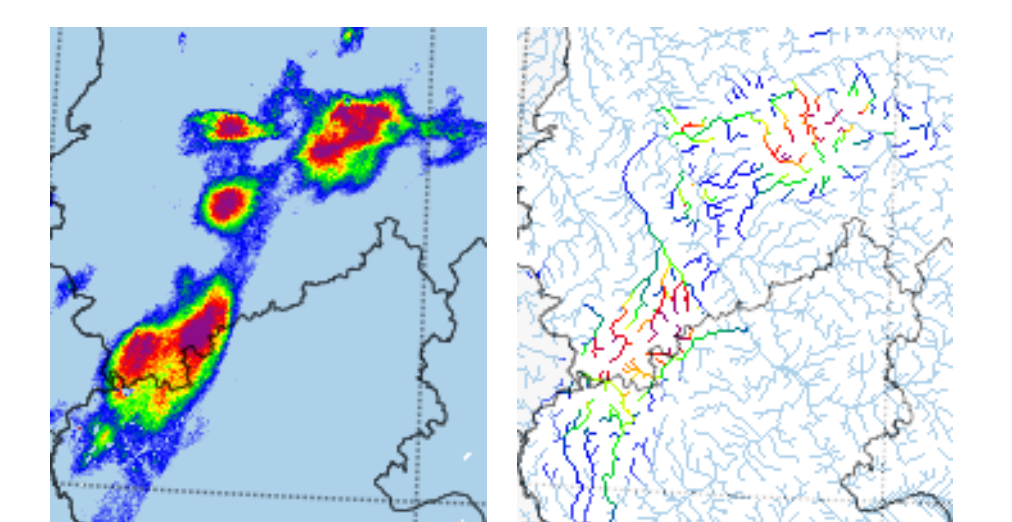
24h precipitation amount (left) and catchment-based precipitation obs + forecast (→ flood potential)

Estimate extremity of predicted catchment rainfall

➔ Derive return periods for each catchment by extreme value statistics (Radar + station-based statistics) and calculate return interval of catchment-based precipitation amounts to inform about severity of event

Continuous dialogue with flood forecasting centres and provision of test data are key components of the SINFONY journey

Co-Design Project

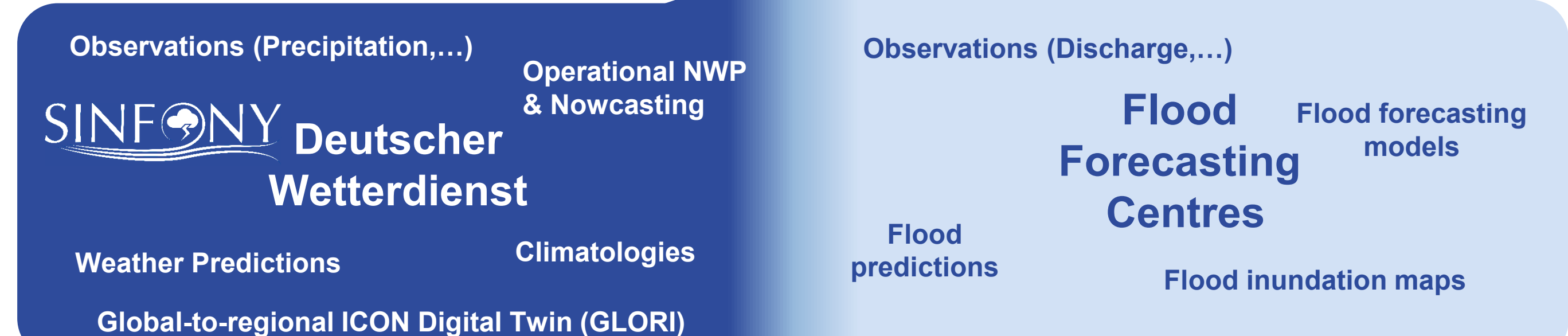**Augmenting the hydrometeorological value chain through co-design**

User-oriented evaluation & optimization of DWD's precipitation forecasts

Adaptation of DWD's new warning system to needs of flood forecast

Testing DWD's data and products in applications of for flood forecasting

Improving communication of forecasts and warnings

Decision makers, civil protection, emergency management

Observations (Precipitation,…)

Operational NWP & Nowcasting

SINFONY Deutscher Wetterdienst

Weather Predictions

Climatologies

Global-to-regional ICON Digital Twin (GLORI)

Observations (Discharge,…)

Flood Forecasting Centres

Flood forecasting models

Flood predictions

Flood inundation maps

Part of Italia – Deutschland science-4-services network in weather and climate (IDEA-S4S) new joint research network for improving seamless weather and climate forecasts for floods and drouths