

# Catchment-based verification of precipitation forecasts for flood forecasting centres

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The cooperation between the German flood forecasting centres and the German Weather Service (DWD) is being improved through the IDEA-S4S Co-Design project. Here, the precipitation forecasts are checked in an overview display for their accuracy on the scale of catchment areas.

## Objective

An approach to a retrospective analysis of rainfall in the catchment areas is presented here. It can shed a light on when critical events can be foreseen and potentially which models work better than others. The steps to this first investigation include:

- choice of
  - an observation date, time and duration
  - a catchment area
  - forecast models (deterministic and ensemble from the ICON chain)
- calculation of average observed precipitation in the time interval from RADOLAN-RW radar date
- calculation of forecast average precipitation in the different models
- visual analysis

## Background

Within the DWD SINFONY project, based on Germany's surface topography, 10000 catchments have been defined in 6 size classes ranging from 10 to 500 km<sup>2</sup> (Fig. 1). Furthermore, statistical analyses of the catchments have been performed and the resulting precipitation heights for return periods of 2, 5, 10, 20, 30, 50, and 100 years will be applied in the Co-Design verification.

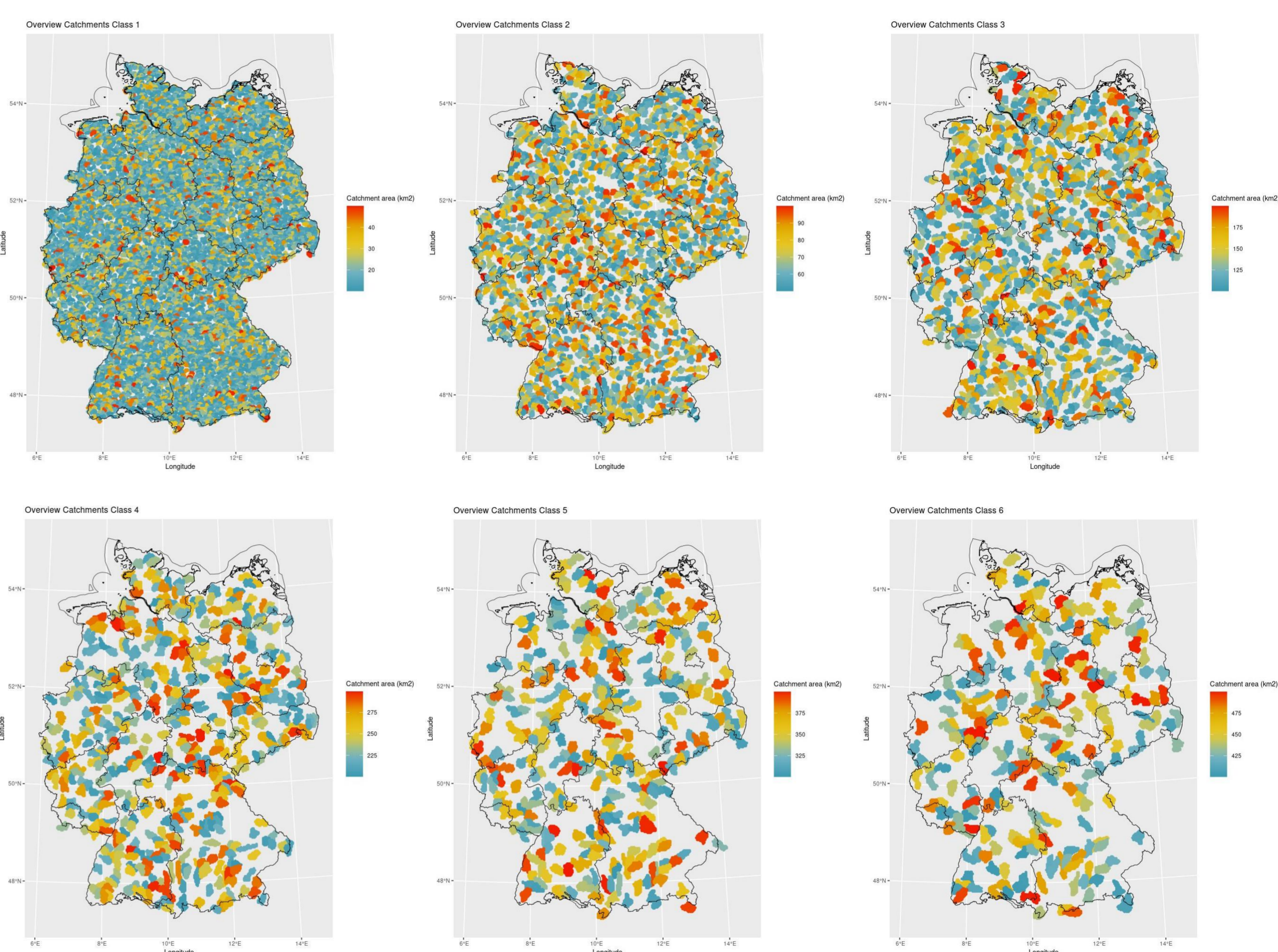


Fig. 1: Overview of the catchment areas for 6 defined area size classes

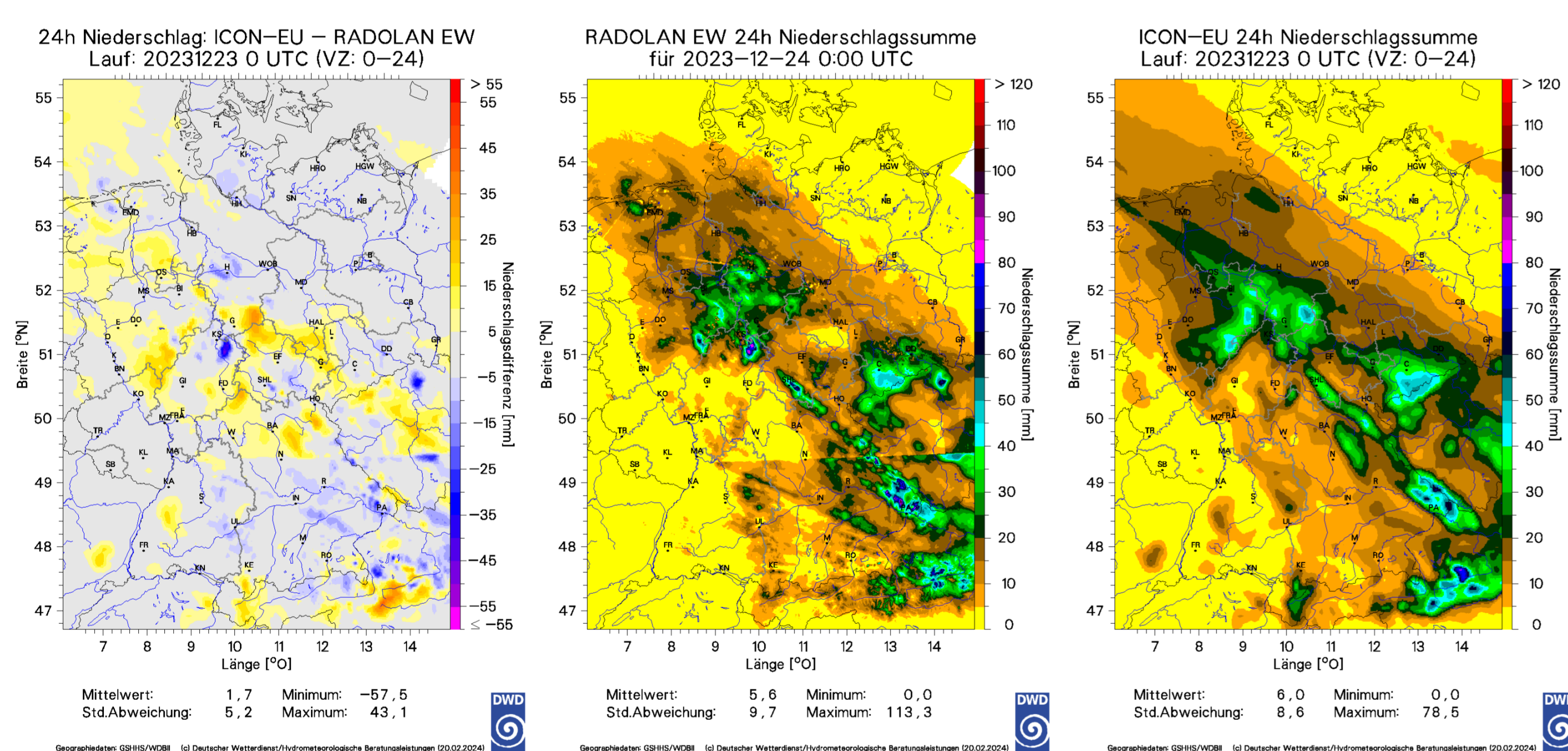


Fig. 2: Visual comparison between forecast (middle) and observed (right) precipitation heights accumulated during 24 hours and their absolute difference (left)

## Next Steps

In the future, it will be allowed to select multiple catchments and/or larger (catchment) areas. The choice of the catchment(s) needs to be made user-friendly and will be in accordance with user interests. Further forecast models will be implemented:

- ECMWF IFS
- MeteoFrance AROME-HD
- DWD SINFONY ICON-RUC & INTENSE

and the calculation will be converted into a Shiny app to be made available to the flood forecasting centres.

In the verification process, the aforementioned statistics for extreme events will be used for identification of relevant events that then will be chosen to analyse the quality of the forecasts. The members of the ensemble forecasts will be examined individually to later be able to allow for a best member selection.

## Example: December 24th 2023, northern Germany

In December 2023, a prevailing westerly current continuously brought low-pressure systems and humid air masses from the Atlantic to Central Europe, resulting in repeated heavy precipitation over a long period from 19 December 2023 to 5 January 2024 with few interruptions. As the ground was already mostly saturated, this caused extensive flooding especially in central and northern Germany.

Precipitation heights that were forecast in the ICON-EU model and observed by RADOLAN-EW and the difference between the both are shown in Fig. 2 for the example of a 24 hour period ending December 24th 00:00 UTC.

It can be observed for a catchment in the Harz mountains how the spread of the forecast values decreases towards the date (Fig. 3) and that in the last 24 hours the forecast precipitation heights exceeded the observed values.

In this example, the overall weather conditions with the intense rainfall had little uncertainty while the spatial pattern on the smaller scale could not be matched as well.

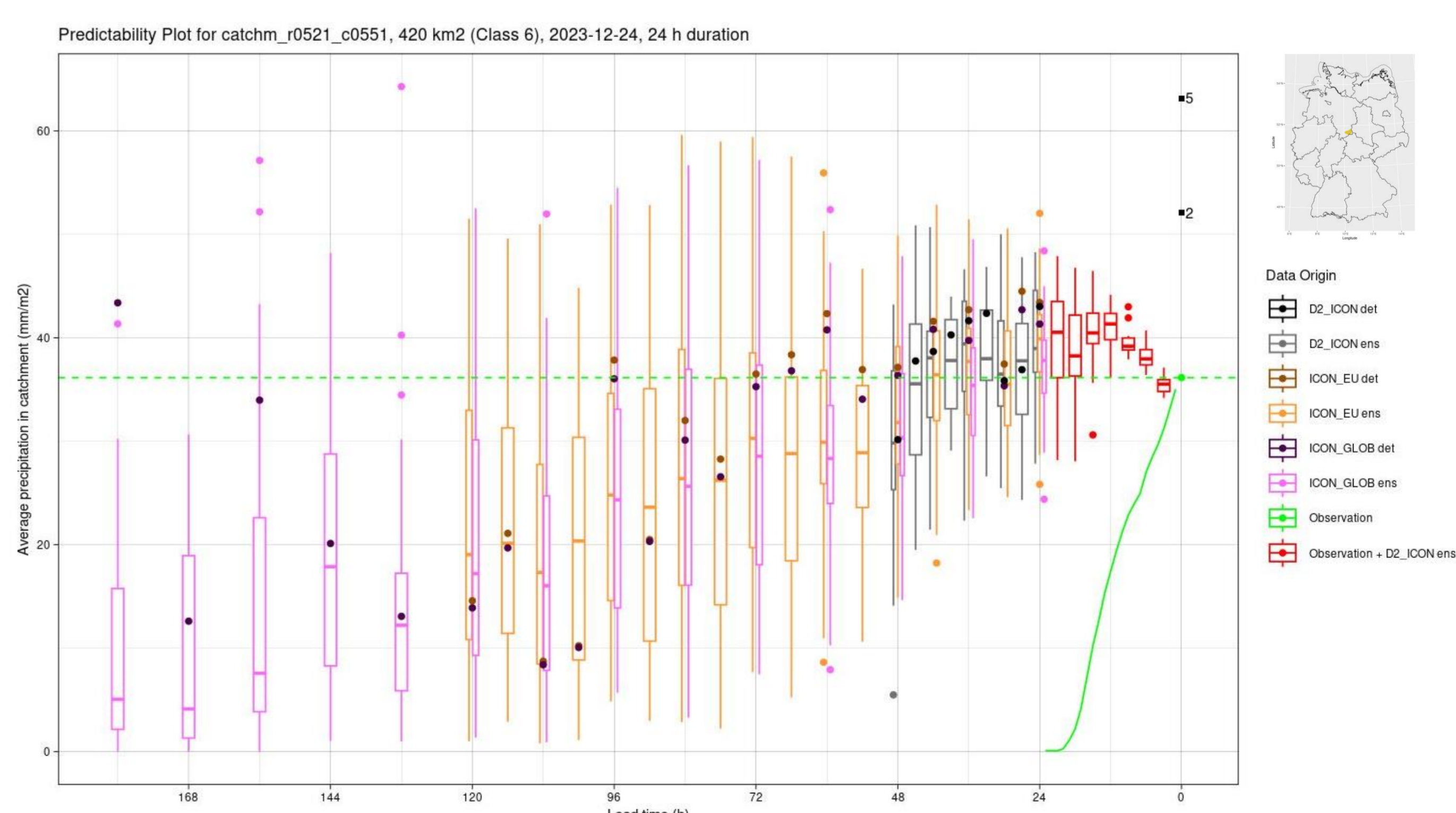


Fig. 3: Predictability plot showing an observed (green) average precipitation within a catchment and the evolution of the forecasts with their according lead times; the red line/dots are cumulated forecast precipitation heights in the last 24 hours before the date; black numbers refer to the return periods (in years)