Climate Digital Twin (DE340)

# The HydroMet Use Case: Extreme rain event analysis and catalogization

C. Steger, S. Sayed, M. Juchem

DESTINATION EARTH

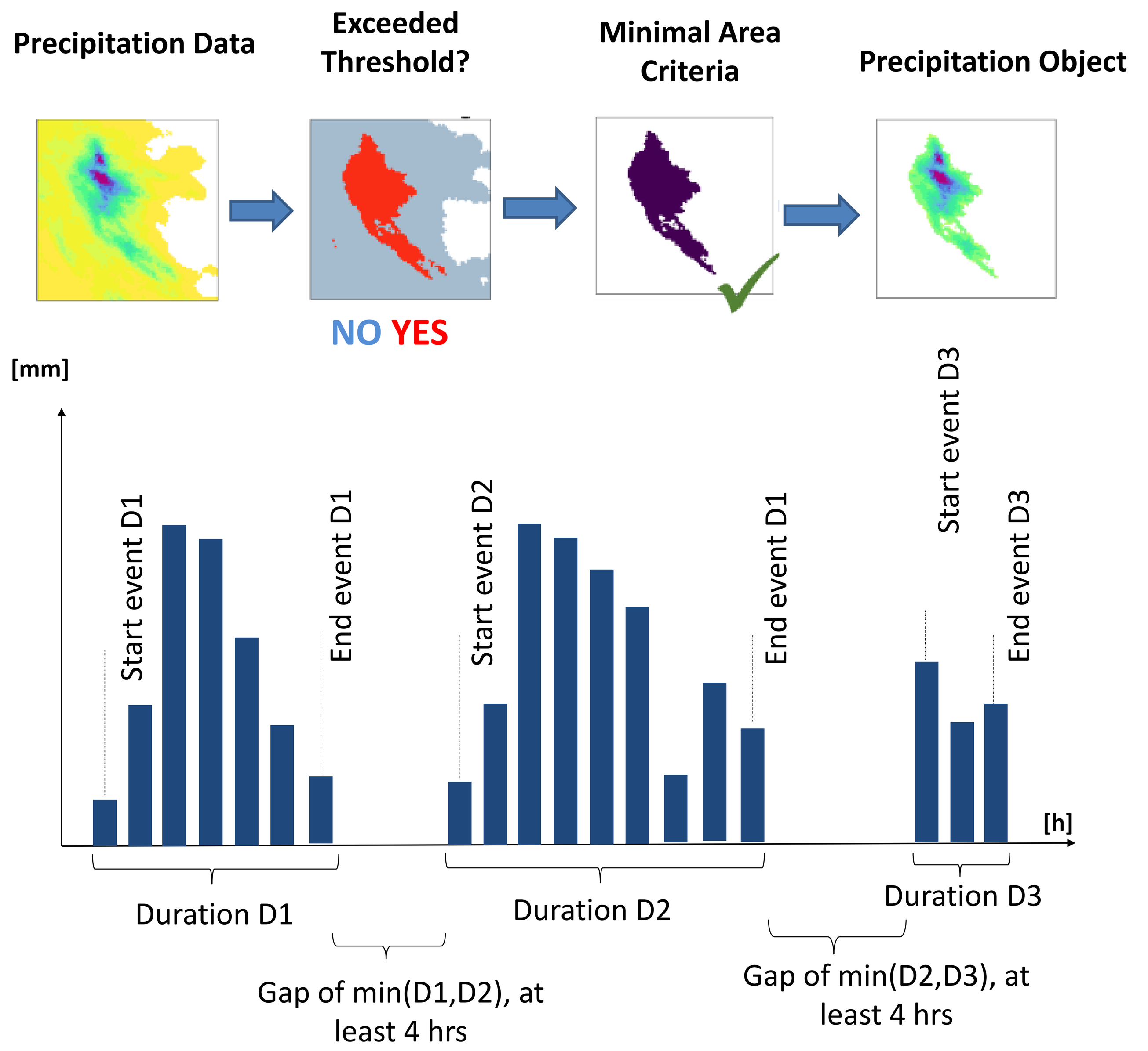
Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

## INTRODUCTION

The impact of climate change is often experienced through extreme events. The Eifel floods (12 - 15 July 2021 in Western Europe) specifically led to considerable loss of life and an estimated €50 bn in property losses. The HydroMet use case scopes to detect and identify extreme rainfall events in the ClimateDT data stream. The summarized data and information will be listed within an event catalogue. The main software components and packages for this application are adapted versions of DWD (Deutscher Wetterdienst) internal developed codes, KOSTRA2020 and CatRaRE. The application is being implemented by closely interacting with the German Adaptation Strategy to Climate Change (DAS) Core Service “Climate and Water”, which provides data and information about climate change for adaptation management. The use case will use the streamed data from the ClimateDT with unprecedented temporal and spatial resolution and create beyond state of the art statistics and information on rainfall extremes.

## IMPLEMENTATION IN THE WORKFLOW

The HydroMet use case will be working with the streamed and bias-corrected total precipitation variable (tp) data, which will be processed in several steps by different software packages deriving from the KOSTRA2020 and CatRaRE codes. The pre-processing script is implemented into the One-pass layer to compute and accumulate historical data, which is needed for the computations following in the KOSTRA2020 package component. The CatRaRE software defines precipitation objects according to exceeded thresholds, whilst accounting for temporal and spatial independencies for each object. It uses the statistical output delivered by the KOSTRA2020 package while also reading directly from the GSV. In order to select events whilst regarding their spatial and temporal indecencies, two criteria apply:




**1. Spatial independency**
Events must not spatially overlap in case a time step includes objects of several duration windows.

**2. Temporal independency**
Between two events covering the same or similar area has to be a time gap the length of the duration window of the shorter event, but at least 4 hours.

**Fig. 1** The two criteria of a rain event selection.

### How can the initiative help to improve the state of the art methods in the hydrology sector?

For this we can identify the user needs and requirements that the ClimateDT will be able to address:

| Needs | Requirements |
|---|---|
| Estimate likelihood of extreme precipitation events. | Observe and analyse return time of extreme rain events, cover extreme value statistics for sub-hourly durations to several days. |
| Detect and observe areas of high risk. | Deal with regionality of rain events. Ability to detect convective weather patterns (<10 km). |
| Observe and estimate temporal trends of extreme precipitation. | Deal with transient behaviour of rain events, especially extreme rain e.g. Thunderstorms (<30 minutes). |
| Observe and estimate spatial trends of extreme precipitation. | Analyse spatial distribution of heavy rain in Germany, determine small scale/regional patterns (<10 km) and trends. |

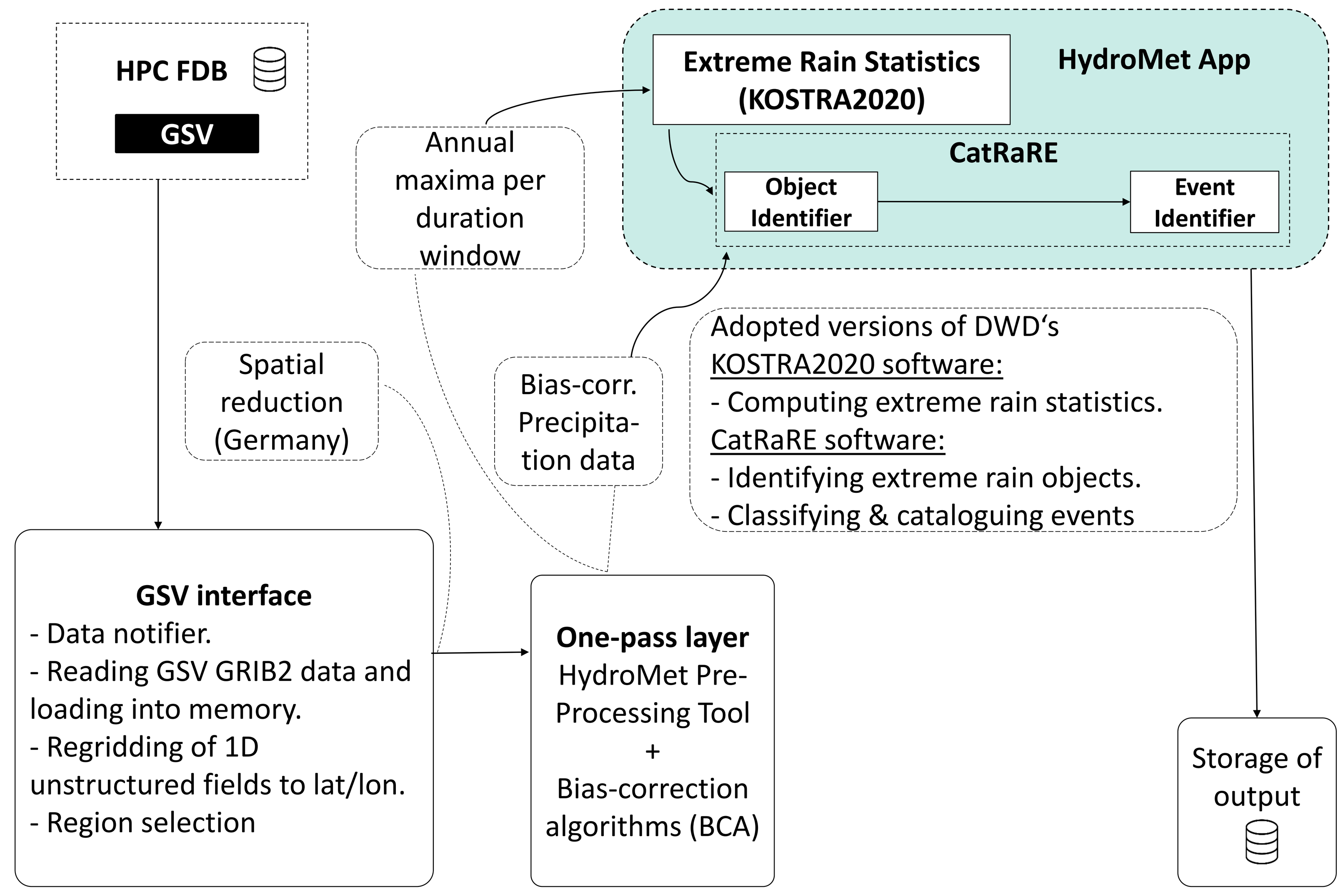



**Fig. 2** Preliminary architecture of the HydroMet application and its implementation to the DestinE workflow.

## RESULTS

Figures 3 and 4 show an example analysis of the HoKliSim COSMO CLM data. The KOSTRA2020 software computes extreme rain statistics that enable threshold identification for the different return periods and durations in the projected time range from 2031 to 2060 (RCP8.5). Figure 5 displays the annual Germany-wide distribution of extreme events based on the CatRaRE_W3_Eta_v2021.01 catalogue.

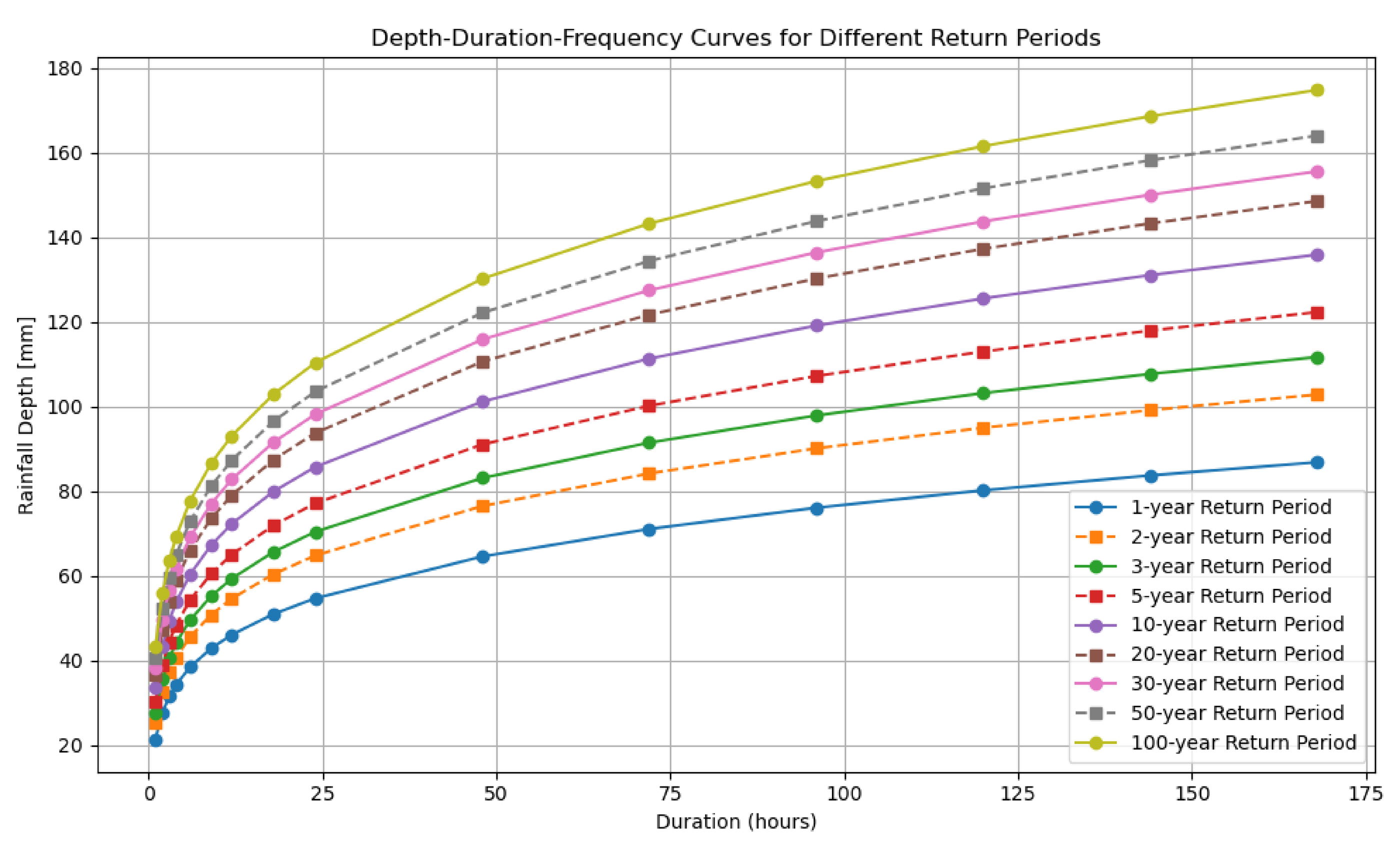



**Fig. 3** DDF curves for different return periods.

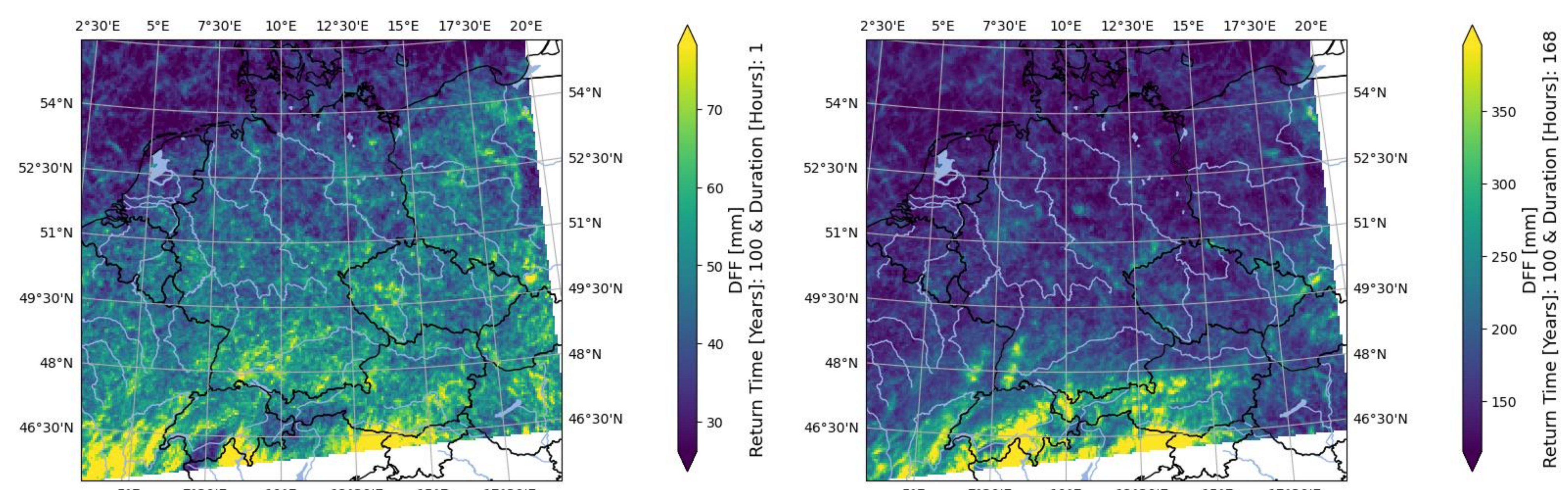



**Fig. 4** DDF over Germany for the duration windows 1 hour (left) and 7 days (right) for the return period of 100 years.

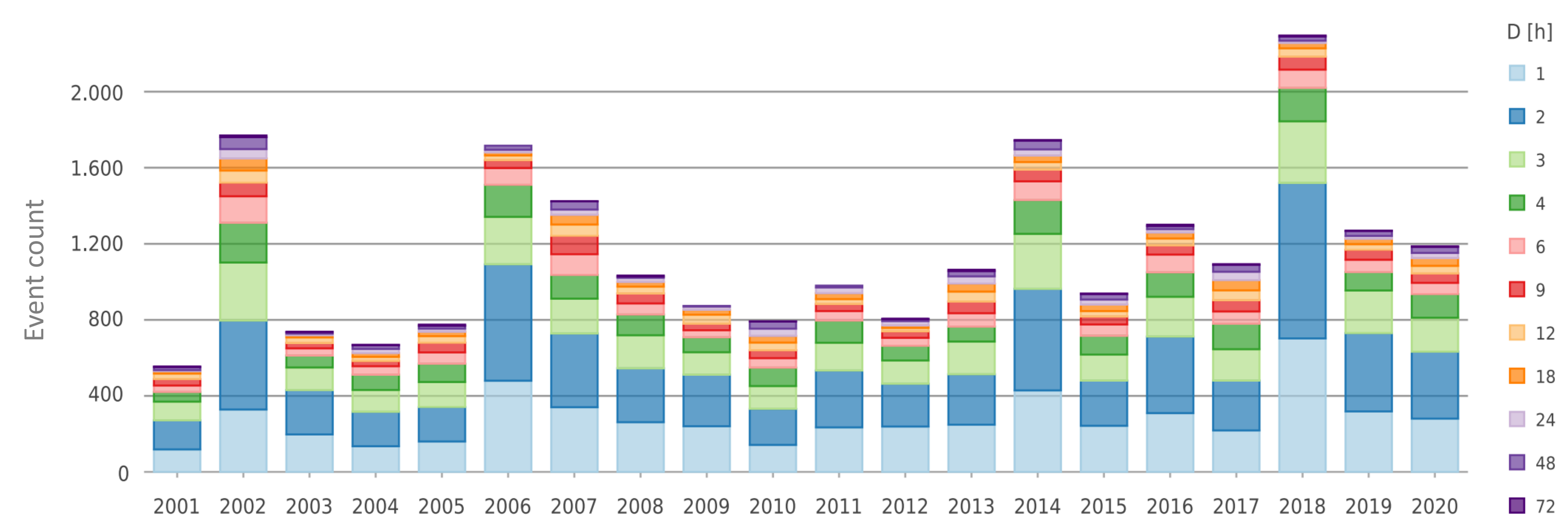



**Fig. 5** Timeline of yearly event distribution for every duration window (Catalogue: CatRaRE_W3_Eta_v2021.01)

Funded by the European Union
Destination Earth
implemented by ECMWF esa EUMETSAT