
Interreg Euregio Meuse-Rhine

EM Flood Resilience

EUROPEAN UNION
European Regional Development Fund

Deltares

# Estimation of discharge extremes in the Meuse basin

## Application of high-resolution climate and hydrological models


**Interreg Euregio Meuse-Rhine**

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# Interreg project – Euregio Meuse-Rhine

*Short-term actions to strengthen, among other things, weather data, flow data, early signalling, mapping hazards and risks, measures for flora and fauna management*

July 2022 – December 2023

Waterboard Limburg in the lead with 11 partners

WP 5 D.T5.4.1 - KNMI - Meteorological information on extreme precipitation events from synthetic climate data

WP 5 D.T5.4.2 - RWS - Floodrouting of extreme precipitation events from synthetic climate data

Partners

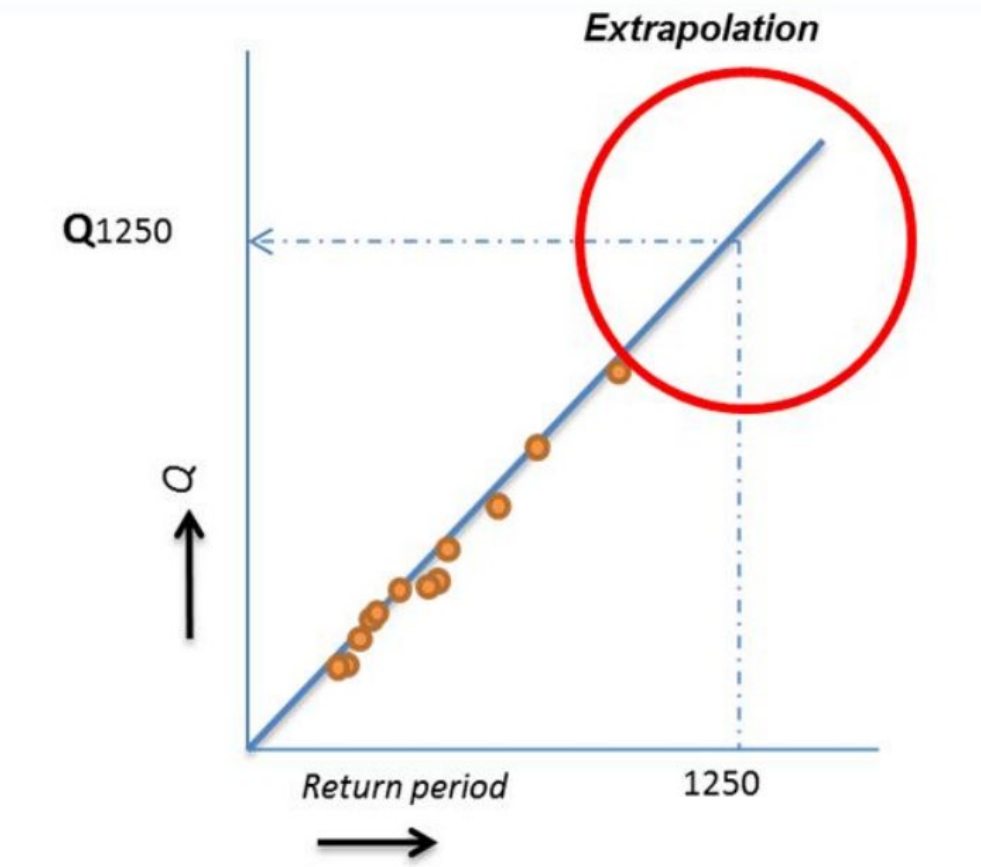
Lead partner:

Other partners:

# Intro: Estimation of discharge extremes

Typically:

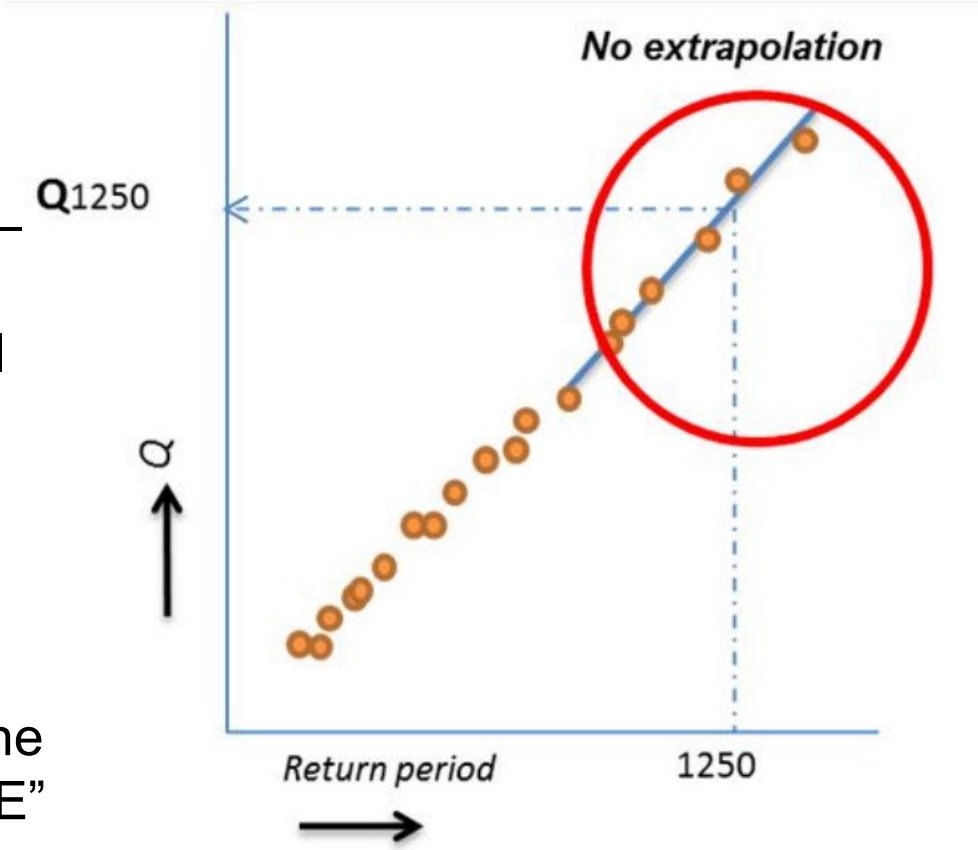
- **Observed** historical time series of hydrometeorological data of limited length (30 – 100 years)
- Extrapolation to higher return periods based on extreme value statistics (GEV, Gumbel...)



# Intro: Estimation of discharge extremes

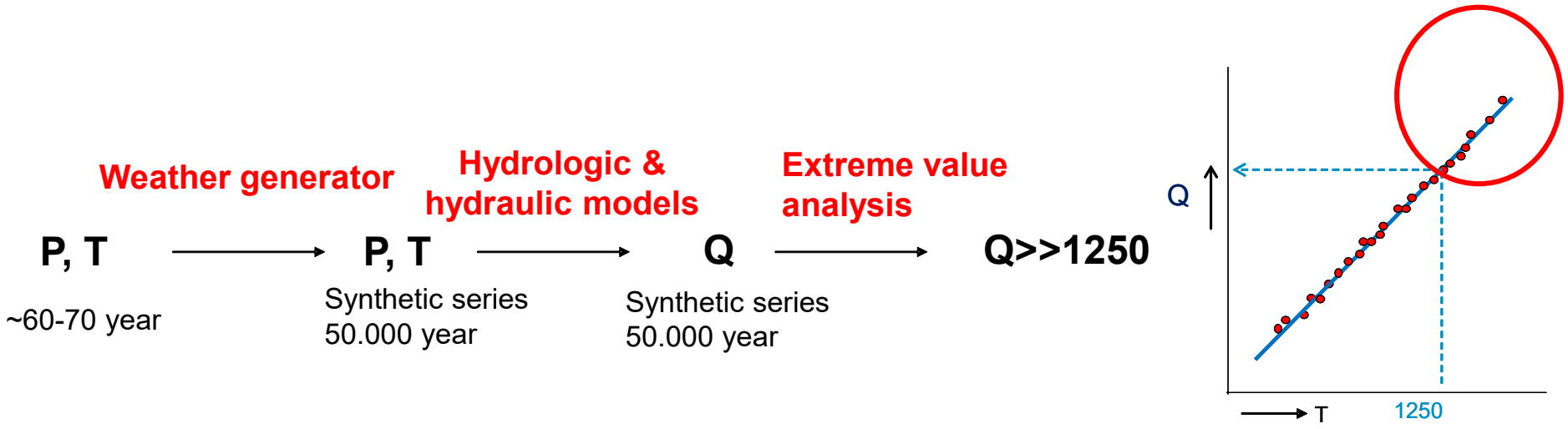
Alternatively:

- **Synthetic** meteo time series of very long length (1000 – 50000 years) based on shorter time series of observed historical meteo data in combination with a hydrological model
- No extrapolation required to estimate higher return periods
- Ongoing research and application for the Meuse & Rhine by RWS, KNMI and Deltares since many years “GRADE”



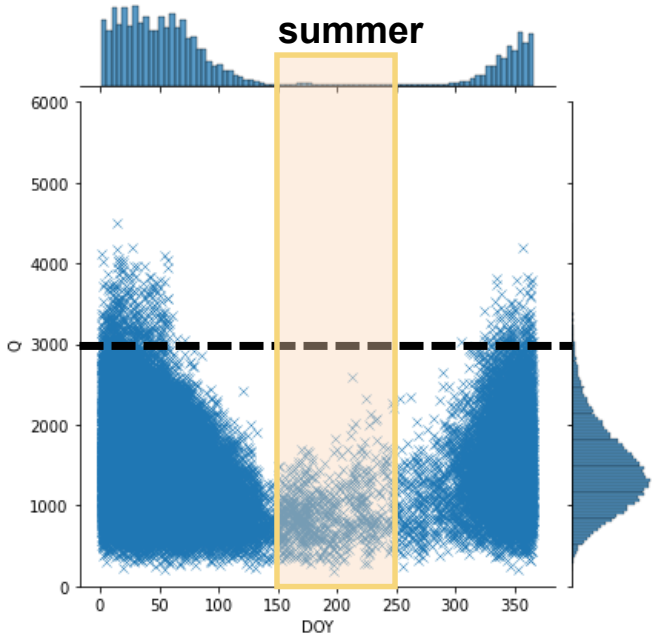
# GRADE
# **G**enerator of **R**ainfall **A**nd **D**ischarge **E**xtremes

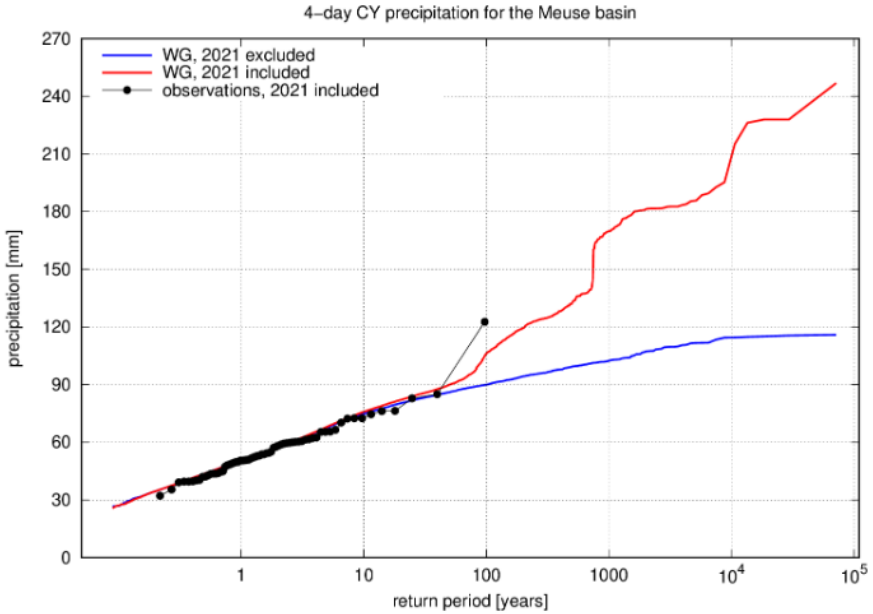
Modeling chain to generate long meteorological and discharge time series (50.000 year) for the Meuse at Borgharen



# Drawbacks

- Climate is changing
- In the 50000 years, no summer event reached the level of July 2021
- Including July 2021 in the weather generator leads to unrealistic patterns in the 4-days extreme precipitation



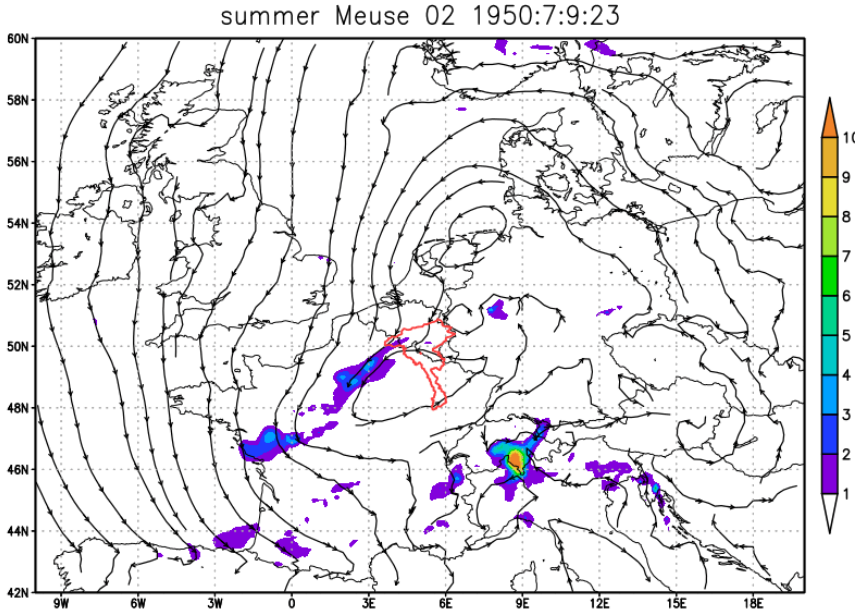



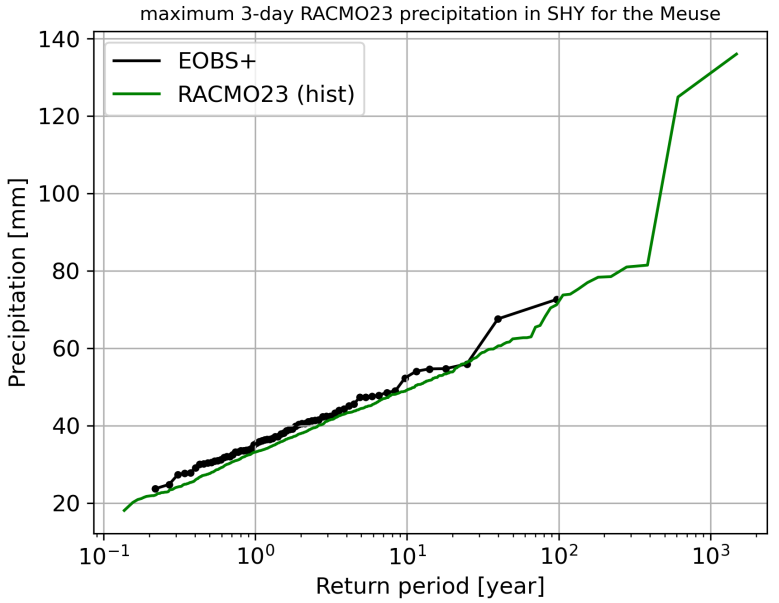

L. van Voorst & H. van den Brink, 2022

- What if…..
  - we would have thousand(s) of years of meteorological data every 10km for every hour which include more extreme events than have been observed..
- Then:
  - we could use a hydrological model to calculate the extreme discharges for the Meuse and all its subbasins.

# We have!

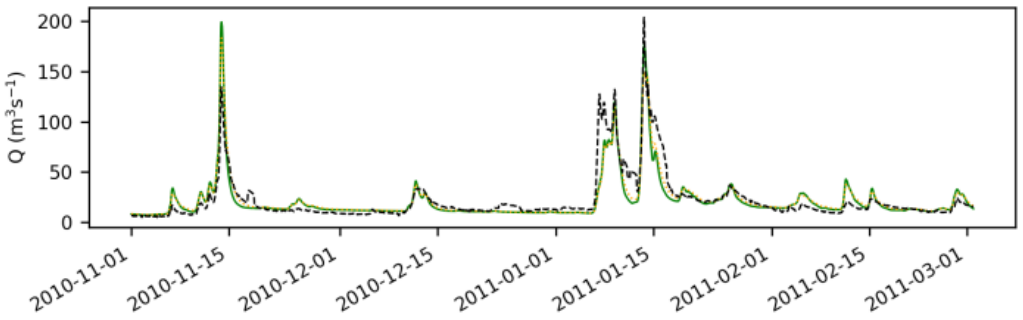
- RACMO is regional climate model
- Main use is derivation of the climate scenarios for the Netherlands.
- Complete meteorological dataset (precipitation/temperature/evaporation)
- Simulate more extreme events than ever observed – 16 members, 72 years = 1152 years of data
- Applicable to current and future climate

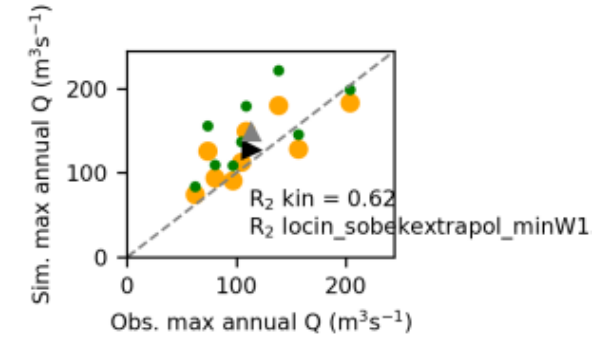


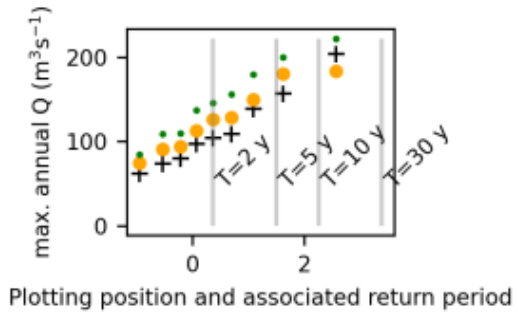



# We have!

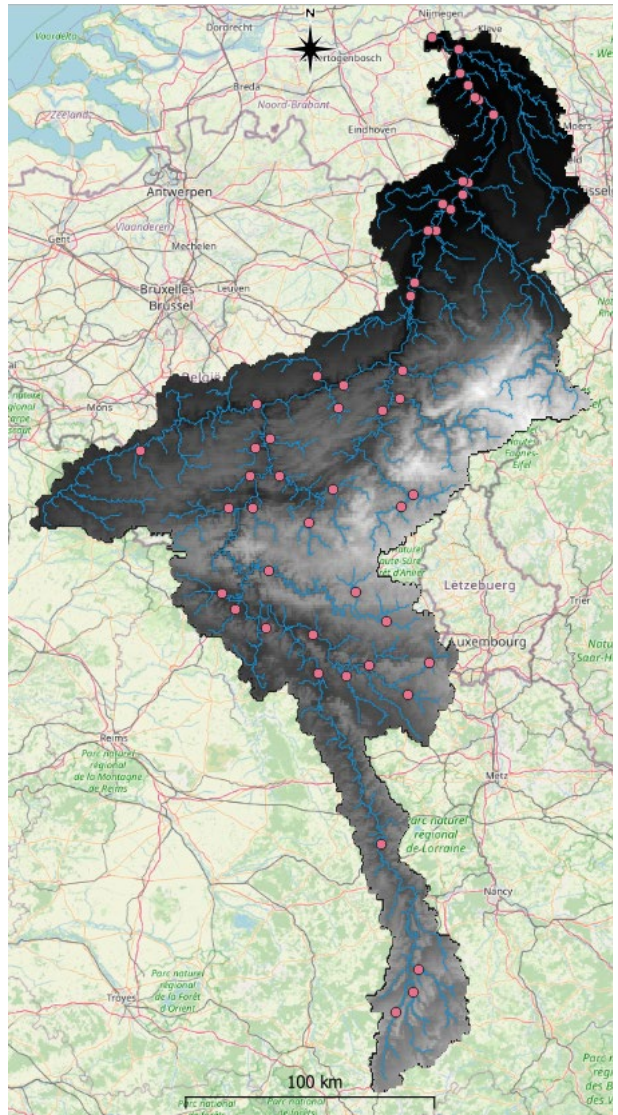
- Wflow sbm is distributed hydrological model
- It has been set-up and evaluated (hydrographs, signatures) for the entire Meuse basin including many tributaries
- With a large focus on improving the process representation (e.g. including overbank flow and floodplain routing)



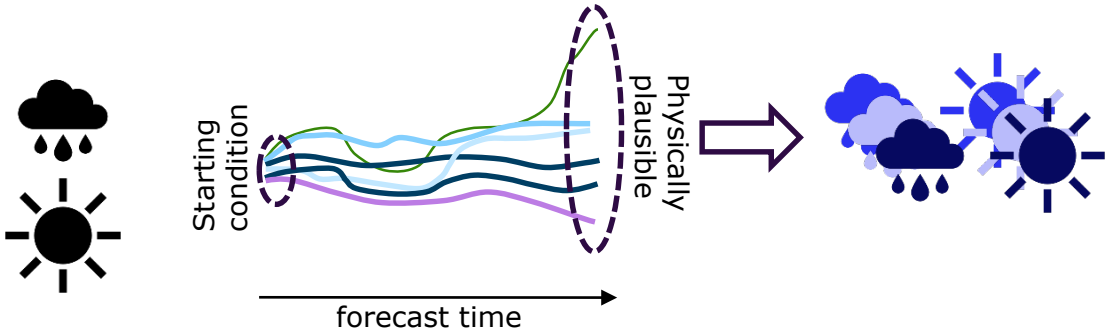

Meuse model extent



# Main goals of the project

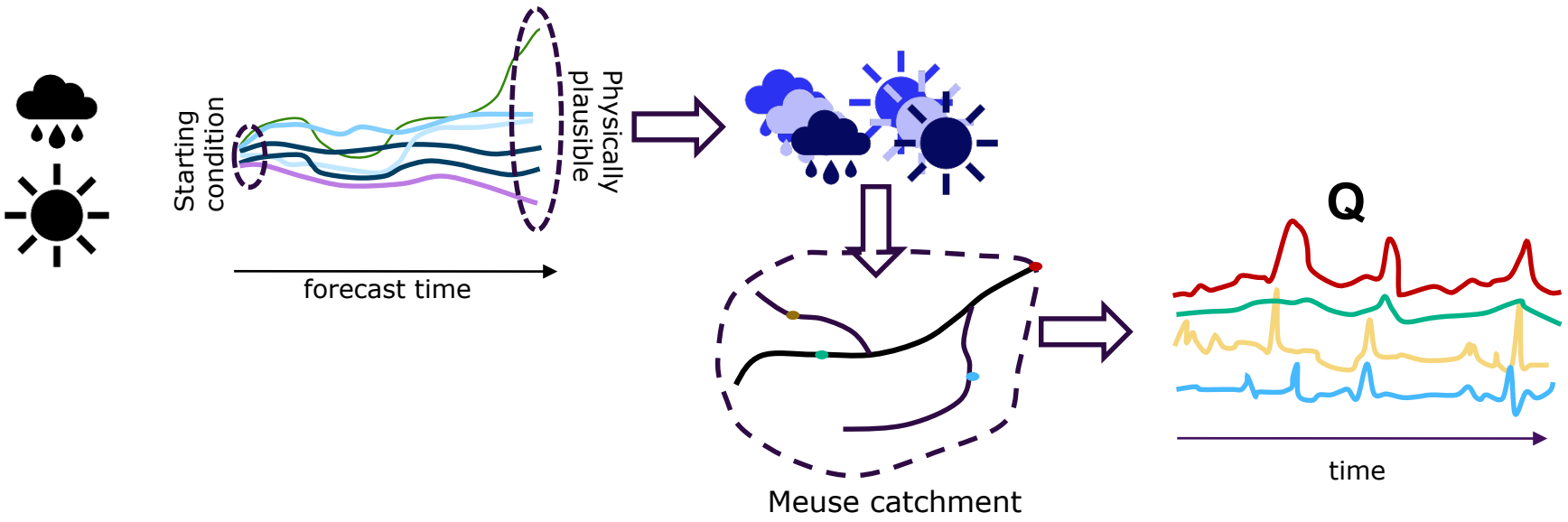
- Evaluate the use of synthetic data sets from climate models to calculate statistics in extreme discharge frequencies
- Evaluate the use of a 6-hourly time step instead of daily on extreme discharge frequencies
- Estimate discharge statistics for the main tributaries of the Meuse
- Understanding the interaction of tributaries with the main river
- Improve the model based on feedback and information of water managers in the basin

# Suggested Approach



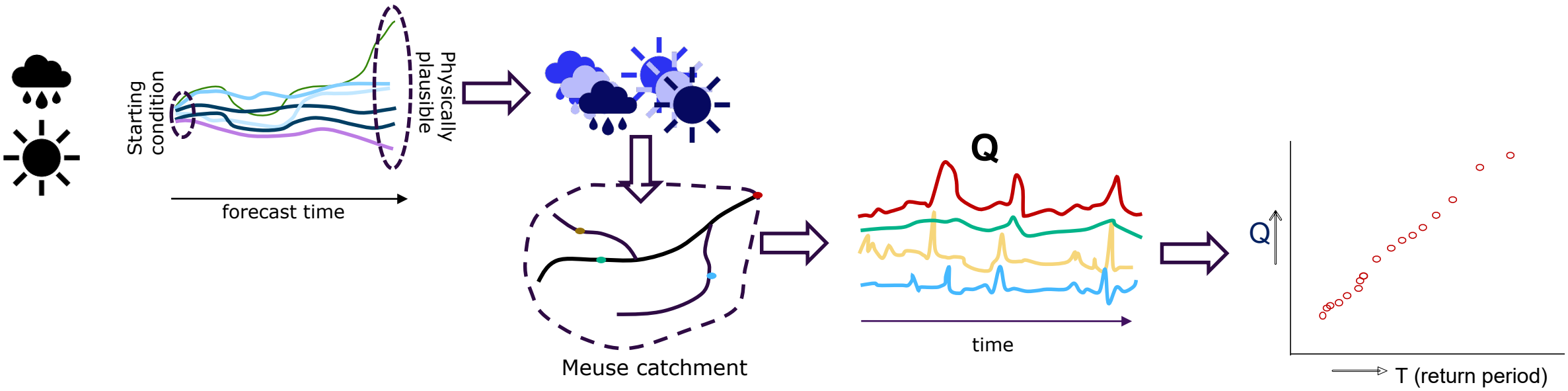

**Datasets from KNMI**

# Suggested Approach




**Datasets from KNMI** → **Hydrological and hydraulic model** → **Datasets of discharges across the whole Meuse catchment**

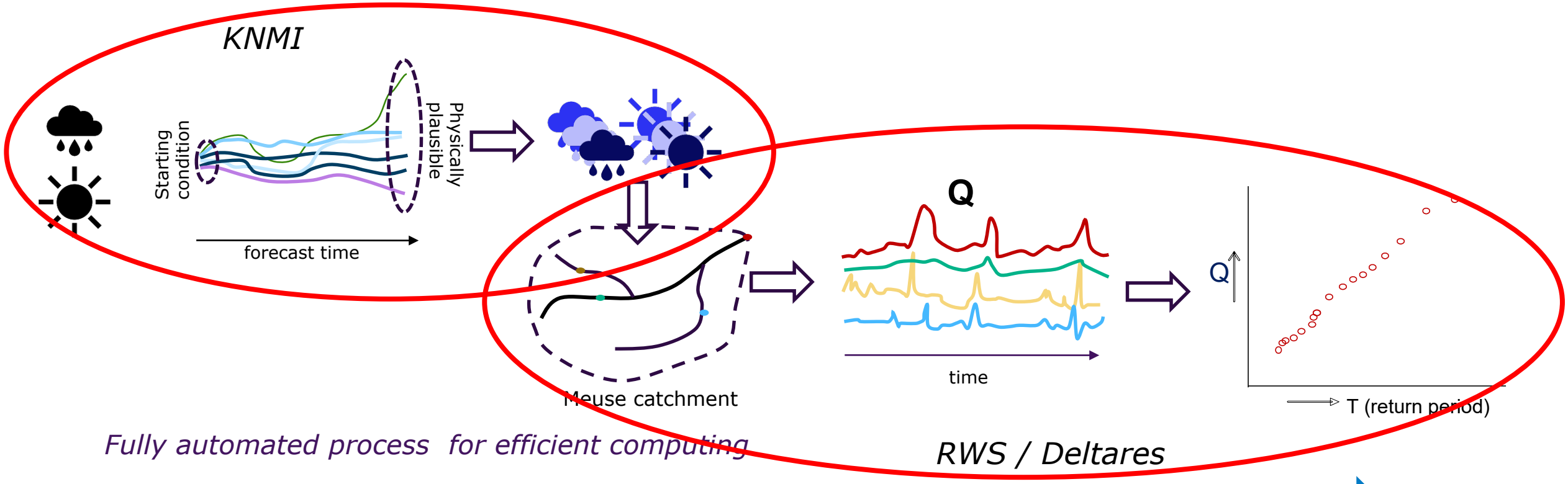
# Suggested Approach




*Fully automated process  for efficient computing*

**Datasets from KNMI** → **Hydrological and hydraulic model** → **Datasets of discharges across the whole Meuse catchment** → **Postprocessing**

# Suggested Approach

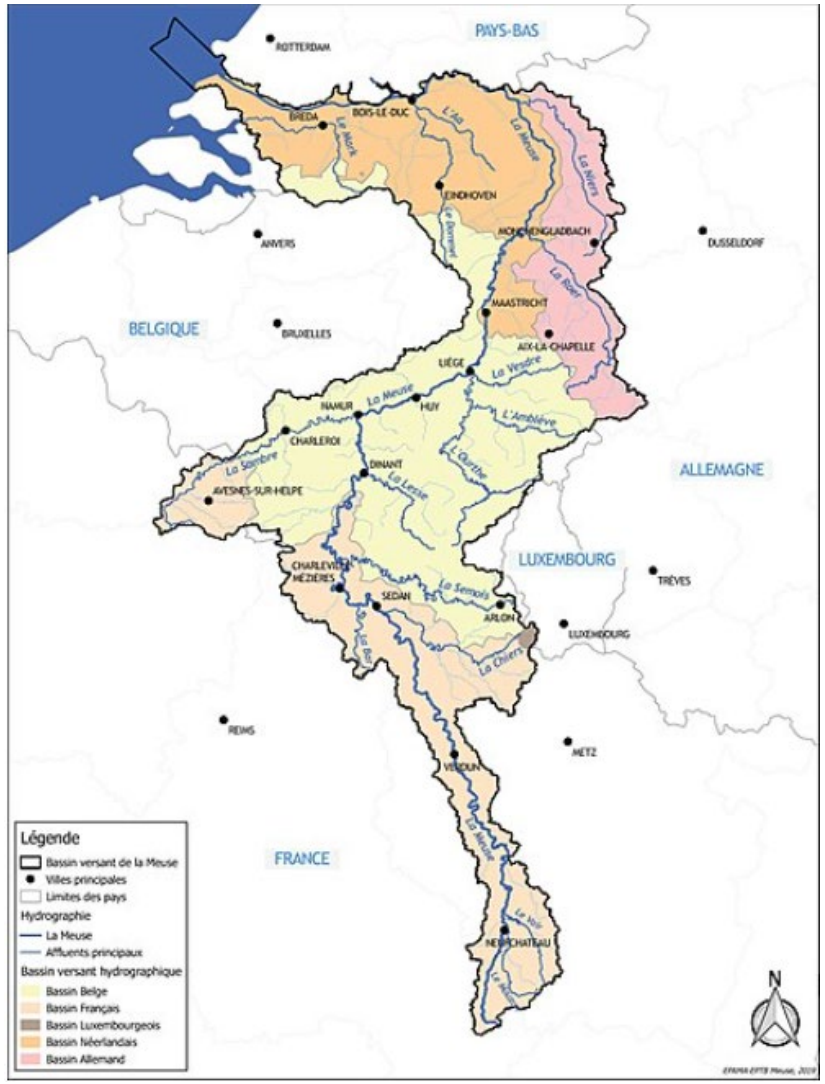



**Datasets from KNMI** → **Hydrological and hydraulic model** → **Datasets of discharges across the whole Meuse catchment** → **Postprocessing**

# Requirements

- Cooperation with researcher and water manager partners
  - Workshop ~ **1 Dec 2022 Maastricht** to present methodology, gather data and select focus areas
  - Workshop ~ May 2023 to present results and gather feedback to improve modeling chain
- Data requirements
  - Hourly discharge data (for model validation) at gauge locations
  - Locations of gauges / reservoirs / other relevant data (GIS)
  - Local relevant information / system understanding (e.g., **bathymetry / floodplains**)
  - Information on current methodologies for derivation of extreme discharge statistics
  - **Reservoir operation rules (adapted after 2021?)**
  - **Current official discharge statistics for selected locations / tributaries (for e.g., 1/10, 1/100, 1/1000)**

# Expected outcome




- A set of high impact low probability extreme rainfall and discharge events, across all seasons (such as the last summer rainfall events)
- Comparison with local discharge statistics for better understanding and improving the model performance

Following the suggested approach, we will derive:

- Synthetic discharge times series (daily and 6-hourly) across the whole catchment
- Discharge frequency curves for selected locations in the catchment, including the main tributaries