

Deloitte Quantum Climate Challenge 2024 – Data description

In this document, an overview of the data is provided. Some suggestions are offered for potential utilization of the data. However, you are not required to follow these suggestions. Strive to follow your unique ideas towards developing a convincing solution.

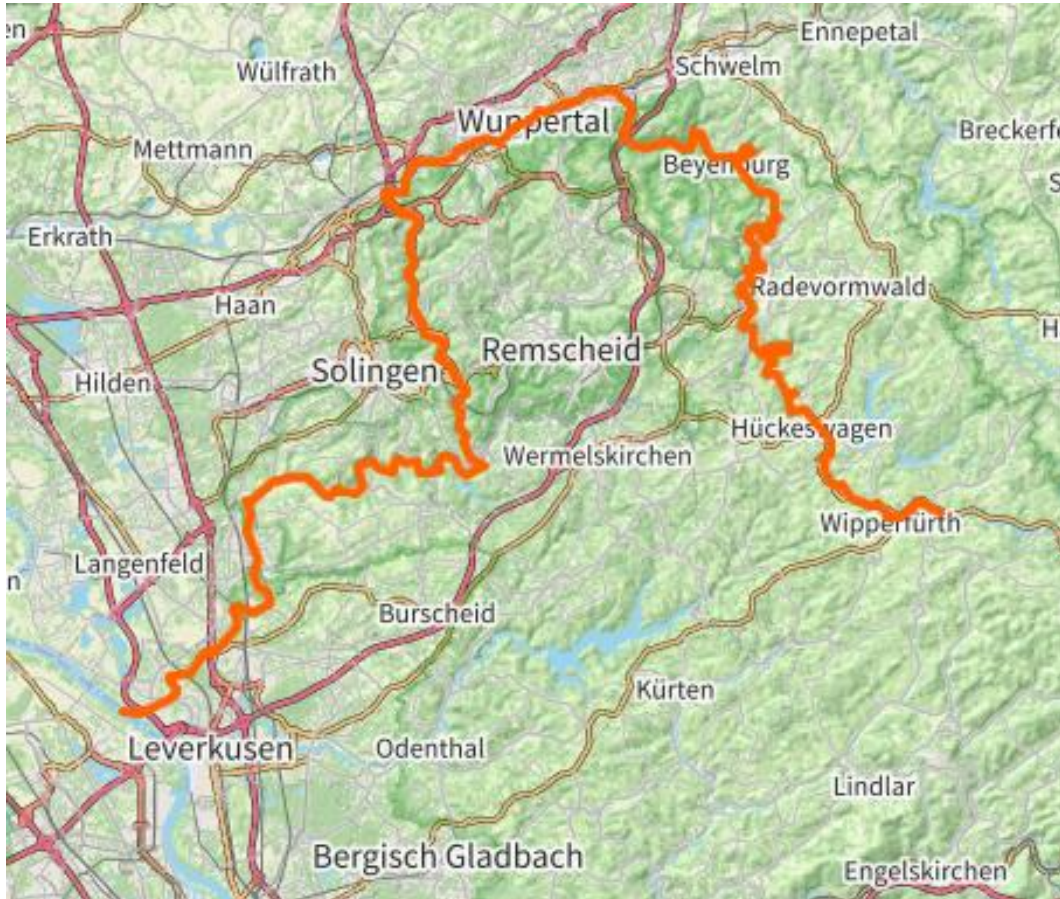


Figure 1: Course of the river Wupper (in orange)¹

Data

The data you should use to build a model consists of timeseries data containing several parameters for different locations along the river Wupper. A pre-curated dataset has been assembled that will be described in detail below. The region under study is situated in Germany in proximity to the cities Wuppertal, Solingen, and Remscheid.

¹ Overview map from Open Street Map

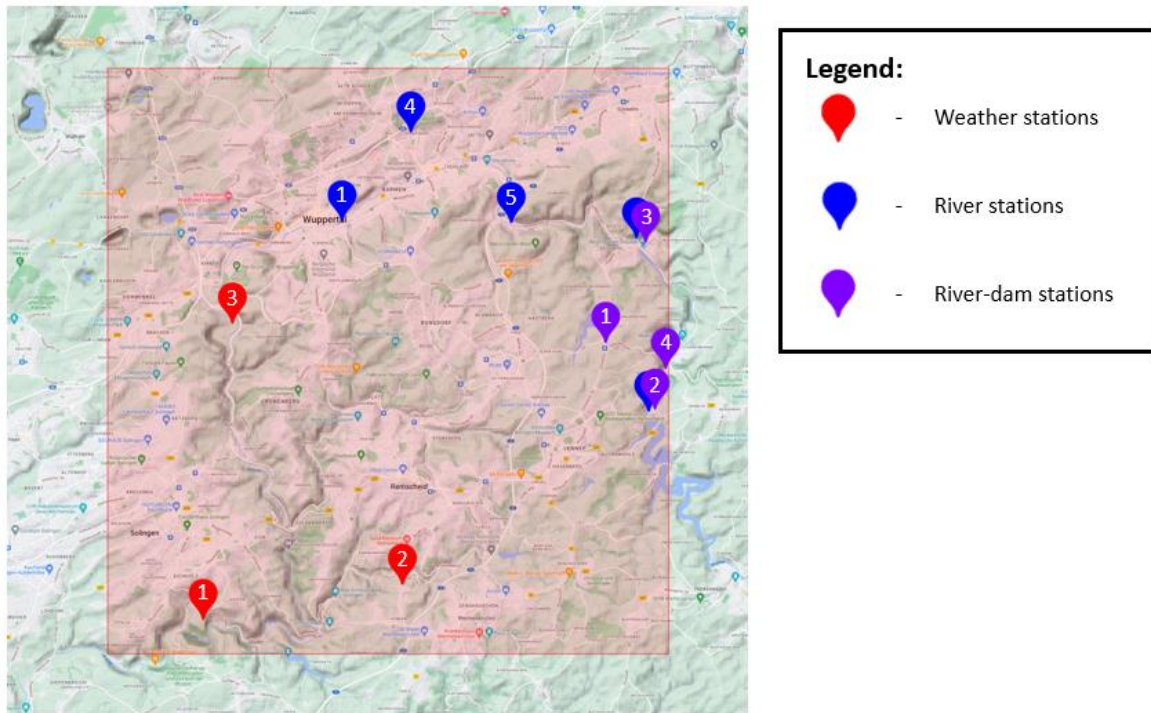


Figure 2: 51°06'N 7°00'E to 51°18'N 7°18'E²

² Generated via Google Maps API

Station	Type	ID
Kluserbrücke	River station	1
Krebsöge	River station	2
Stausee Beyenburg Ablaufpegel	River station	3
Leimbach	River station	4
Laaken	River station	5
Herbringhauser Talsperre	River-dam station	1
Wupper-Talsperre	River-dam station	2
Stausee Beyenburg	River-dam station	3
Stauanlage Dahlhausen	River-dam station	4
Solingen-Hohenscheid	Weather station	1
Wermelskirchen	Weather station	2
Wuppertal-Buchenhofen	Weather station	3

Goal of the QML-Model

In this region, we have identified several different measurement points. The most important point is the “Kluserbrücke”³, a bridge located in the heart of Wuppertal. This location is intended for the Quantum Machine Learning Model’s evaluation point of the river’s water level. To facilitate a classification model, you can set a specific threshold. As shown in the figures above, all other river-based measurement stations are situated further upstream the river.

³ More information for the measure station Kluserbrücke:
<https://hochwasserportal.wupperverband.de/Pegel/Kluserbr%C3%BCcke/> (German)

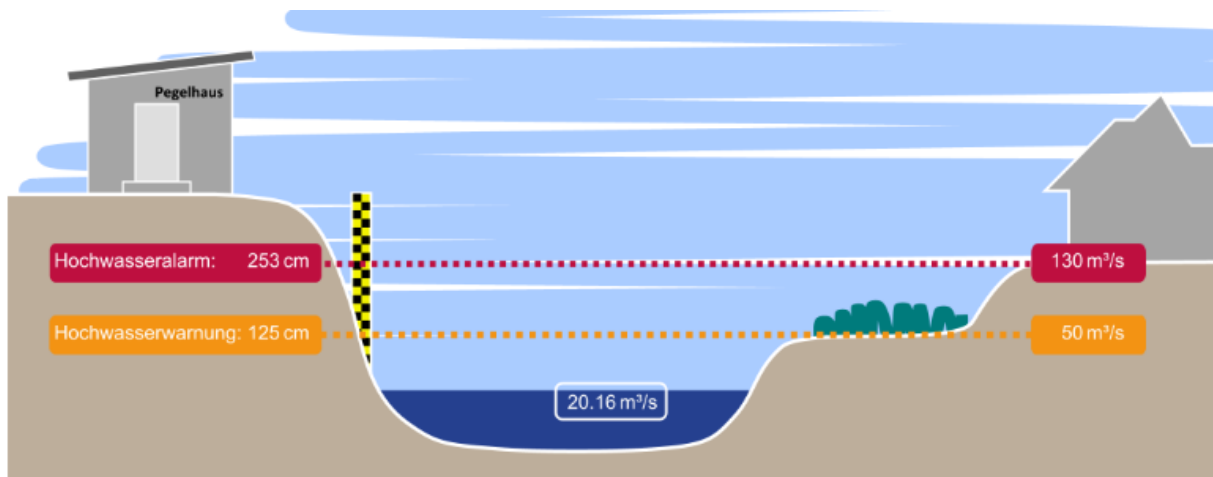


Figure 3: Evaluation of the water level and discharge at the Kluserbrücke.⁴

The Wupperverband has set a water level of 125cm (equivalent to a discharge of 50m³/s) as the flood warning point. A water level of 253cm (equivalent to a discharge of 130m³/s) activates a flood alarm. To derive a classification model that provides more data points for a flood warning, you may consider lowering the flood warning threshold to 90cm. The primary objective is to forecast the highest water level for a specified day.

Further Data by the Wupperverband

We provide data from eight additional measurement stations. Four of these are other gauge stations: Krebsböge⁵, Beyenburg Ablauf⁶, Laaken, and Leimbach⁷. These stations monitor the water level and discharge at various points along the Wupper. A suggestion to consider is to calculate the daily maximum of these stations for subsequent computations.

Furthermore, we provide the data from four water reservoirs: Wupper-Talsperre⁸, Stausee-Beyenburg⁹, Stauanlage Dahlhausen¹⁰, and Herbringhauser Talsperre¹¹. These reservoirs can prevent floods by retaining large amounts of water. The Wupper-Talsperre is by far the largest of these reservoirs with 25 Mio. m³. Substantial reductions in the amount of water stored there can lead to higher water levels in the Wupper, even when there are only small amounts of precipitation. On the other hand, water reservoirs can take in large amounts of water when there are large amounts of precipitation and even prevent floods this way.

⁴ Picture taken from <https://hochwasserportal.wupperverband.de/Pegel/Kluserbr%C3%BCcke/> (20.02.2024 13:00)

⁵ More information for Krebsböge: <https://hochwasserportal.wupperverband.de/Pegel/Krebs%C3%B6ge/> (German)

⁶ More information for Beyenburg Ablauf: <https://hochwasserportal.wupperverband.de/Pegel/Beyenburg%20Ablauf/> (German)

⁷ More information for Leimbach: <https://hochwasserportal.wupperverband.de/Pegel/Leimbach/> (German)

⁸ More information for Wupper-Talsperre: <https://hochwasserportal.wupperverband.de/Talsperren/Wupper-Talsperre/> (German)

⁹ More information for Stausee-Beyenburg: <https://hochwasserportal.wupperverband.de/Talsperren/Stausee%20Beyenburg/> (German)

¹⁰ More information for Stauanlage Dahlhausen: <https://hochwasserportal.wupperverband.de/Talsperren/Stauanlage%20Dahlhausen/> (German)

¹¹ More information for Herbringhauser Talsperre: <https://hochwasserportal.wupperverband.de/Talsperren/Herbringhauser%20Talsperre/> (German)

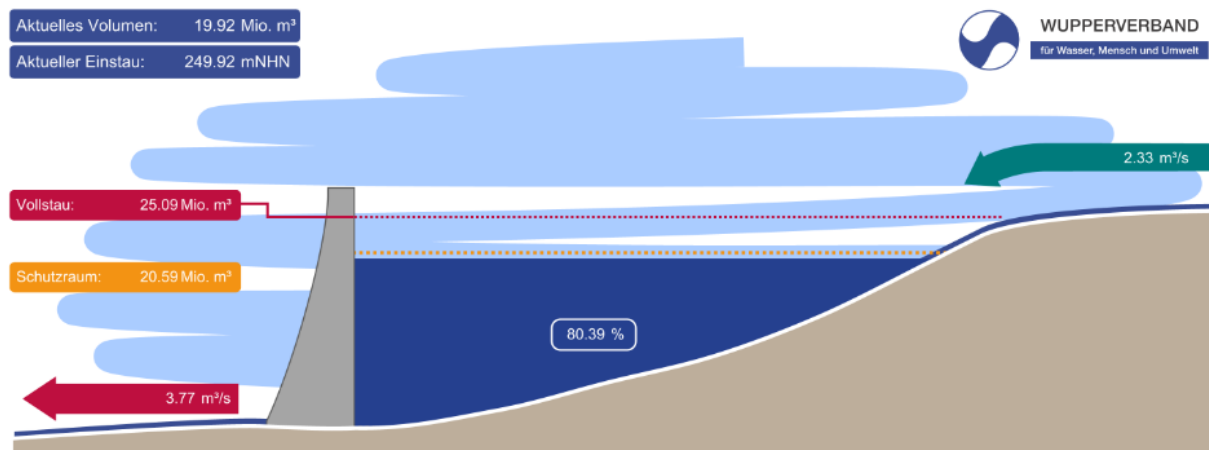


Figure 4: Evaluation of the water level and discharge at the Wupper-Talsperre.¹²

The Wupperverband has its own website with data: <https://fluggs.wupperverband.de/> (German). All data curated here is taken from this website.

Weather Data

We collected weather data from the DWD (Deutscher Wetterdienst, German Weather Service). Historical precipitation data from 3 weather stations across the area are provided to you. We also artificially created prediction data to enable you to incorporate predicted values for the subsequent day within your model.

DWD-ID	Name	Geo. North	Geo. East	Geo. Height
4741	Solingen-Hohenscheid	7.092982	51.140040	152.0
5483	Wermelskirchen	7.186723	51.149817	255.0
5717	Wuppertal-Buchenhofen	7.105176	51.225598	134.0

The data provided consists of values for the three stations listed. The timeframe considered ranges from 01-01-1990 to 31-12-2023. We provide you with the accumulated precipitation data for every single day (RS) and additionally forecast values for 1-day (RS+1), 2-days (RS+2), 3-days (RS+3), 7-days (RS+7) and 14-days (RS+14) in the future. Furthermore, there is a remark on the form of precipitation (RSF) which can hold the following values:

- 0: no precipitation
- 4: unknown form of precipitation
- 6: only rain
- 7: only snow
- 8: rain and snow
- 9: missing value or no form identifiable

¹² Picture taken from <https://hochwasserportal.wupperverband.de/Talsperren/Wupper-Talsperre/> (28.02.2024 13:00)

General Remarks

Expand the Forecast

The task only mandates a 1-day forecast. However, in disaster prevention early detection is extremely valuable. For example, knowing a flood is likely 14 days in advance allows for proactive measures such as preemptively draining the water reservoirs so that these can collect water when the flood is looming. Thus, we encourage you to extend your model to a 3-day, 7-day, or even 14-day forecast.

Further data

We tried to curate data that are valuable to you. Nevertheless, should you require more or different data, feel free to gather data as you see fit. Please note that since the Wupper-Talsperre was completed in 1987, data from before this year may not yield meaningful insights.

An option for further data would be topographic data. An exemplary dataset for the topographic data can be accessed via NASA-Earthdata after signing up for NASA Earth Explorer on the following websites:

- Hillshading map of described area
- Dataset: NASA SRTM3 SRTMGL1
- Downloadable from <https://urs.earthdata.nasa.gov/home>
- Searched at <https://earthexplorer.usgs.gov/>
- Metadata:
 - e4ftl01.cr.usgs.gov/DP109/SRTM/SRTMGL1.003/2000.02.11/N51E007.SRTMGL1.hgt.zip.xml
 - e4ftl01.cr.usgs.gov/ASTER_B/OTHR/QA.001/2015.02.23/N51E006.SRTMGL1.num.zip.xml

.csv-overview

Name	Contains
river-meta_data.csv	Meta information about all considered river-stations including station name, latitude, longitude, ID, measured phenomenon (including start and end date of the measure) and the respective file name
2024_02_23__SBEY__ABF__2024-02-27.CSV	Water-Level data for station Beyenburg (Ablaufpegel)
2024_02_23__SBEY__WST__2024-02-27.CSV	Discharge data for station Beyenburg (Ablaufpegel)
2024_02_26__SHT\$__SPI__2024-02-27.CSV	Volume data for station Herbringhauser Talsperre
2024_02_26__SHT\$__SPF__2024-02-27.CSV	Fill-level data for station Herbringhauser Talsperre
2024_02_23__SKLU__WST__2024-02-27.CSV	Discharge data for station Kluserbrücke
2024_02_23__SKLU__ABF__2024-02-27.CSV	Water-Level data for station Kluserbrücke
2024_02_23__SKRE__WST__2024-02-27.CSV	Discharge data for station Krebsöge
2024_02_23__SKRE__ABF__2024-02-27.CSV	Water-Level data for station Krebsöge
2024_02_23__SLAA__WST__2024-02-27.CSV	Discharge data for station Laaken
2024_02_23__SLAA__ABF__2024-02-27.CSV	Water-Level data for station Laaken
2024_02_23__SLEI__WST__2024-02-27.CSV	Discharge data for station Leimbach
2024_02_23__SLEI__ABF__2024-02-27.CSV	Water-Level data for station Leimbach
2024_02_26__SDAL__SPI__2024-02-27.CSV	Volume data for station Stauanlage Dahlhausen
2024_02_26__SDAL__SPF__2024-02-27.CSV	Fill-level for station Stauanlage Dahlhausen
2024_02_26__SBY\$__SPI__2024-02-27.CSV	Volume data for station (Stausee) Beyenburg
2024_02_26__SBY\$__SPF__2024-02-27.CSV	Fill-level for station (Stausee) Beyenburg
2024_02_26__SWU\$__SPI__2024-02-27.CSV	Volume data for station Wupper-Talsperre
2024_02_26__SWU\$__SPF__2024-02-27.CSV	Fill-level for station Wupper-Talsperre
weather_data.csv	Containing weather data for listed stations, including station name, date, latitude, longitude and precipitation data as described above