TECHNISCHE UNIVERSITÄT DRESDEN

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EGU General Assembly 2022

Flood Forecasting With LSTM Networks: Enhancing Input Data With Statistical Precipitation Information

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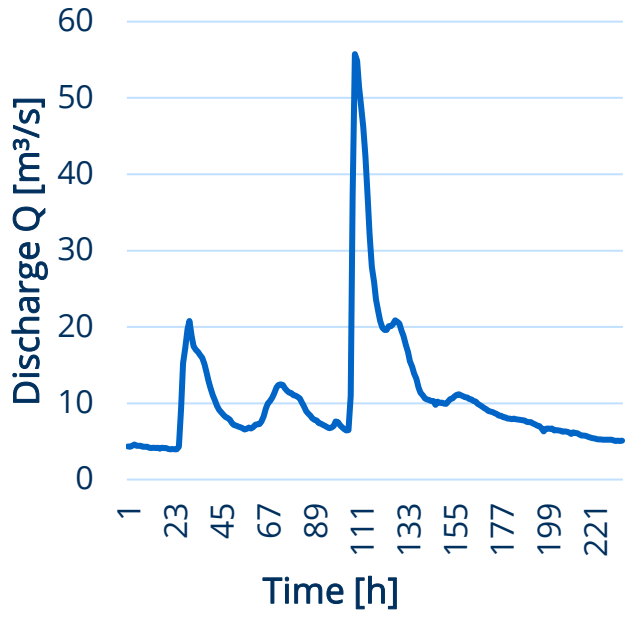
Dr. Jens Grundmann
Prof. Niels Schütze

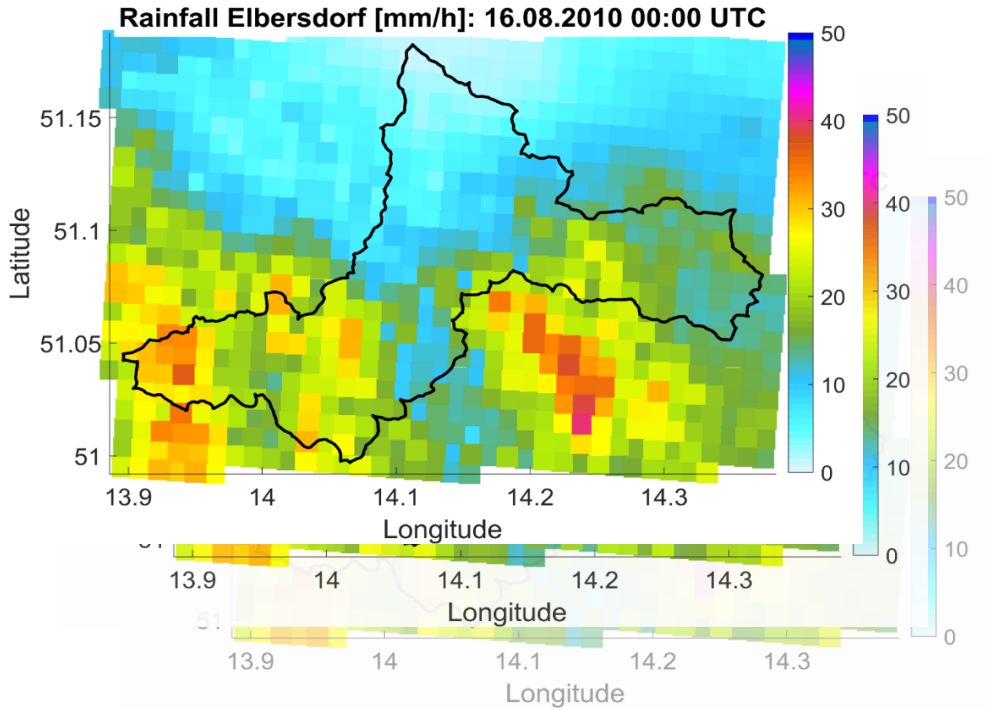
Vienna 25.05.2022

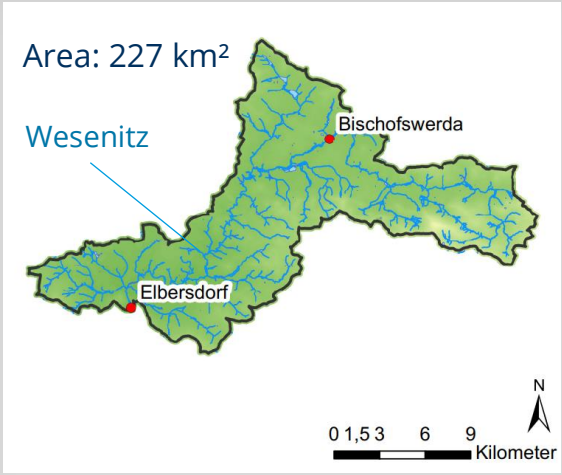
Data
The Basis

Hourly discharge observation
(representative of catchment state)



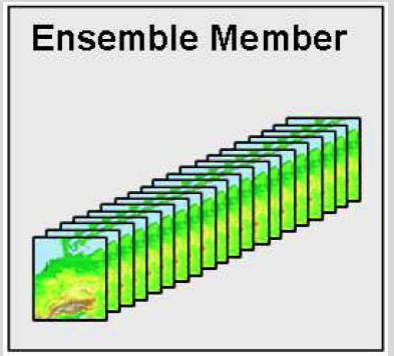
Hourly precipitation observation from RADOLAN RW product
(driving force)



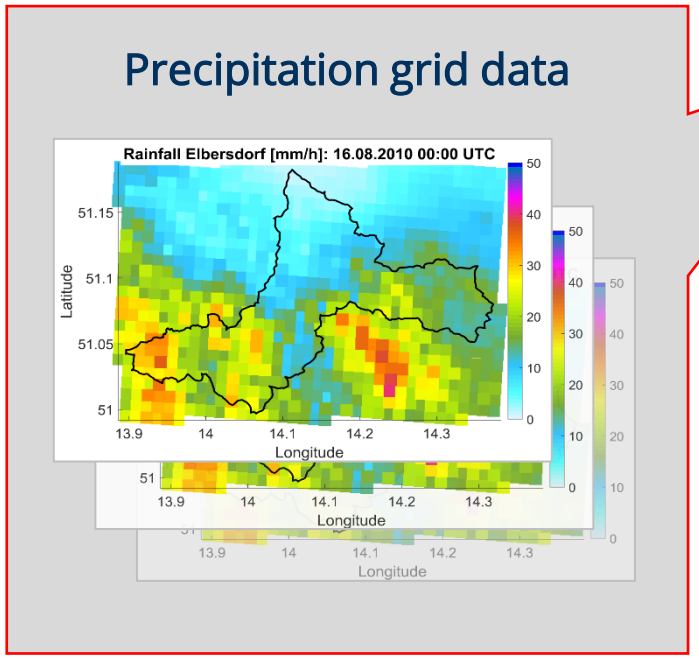


Later used as well:
meteorological forecast ensembles

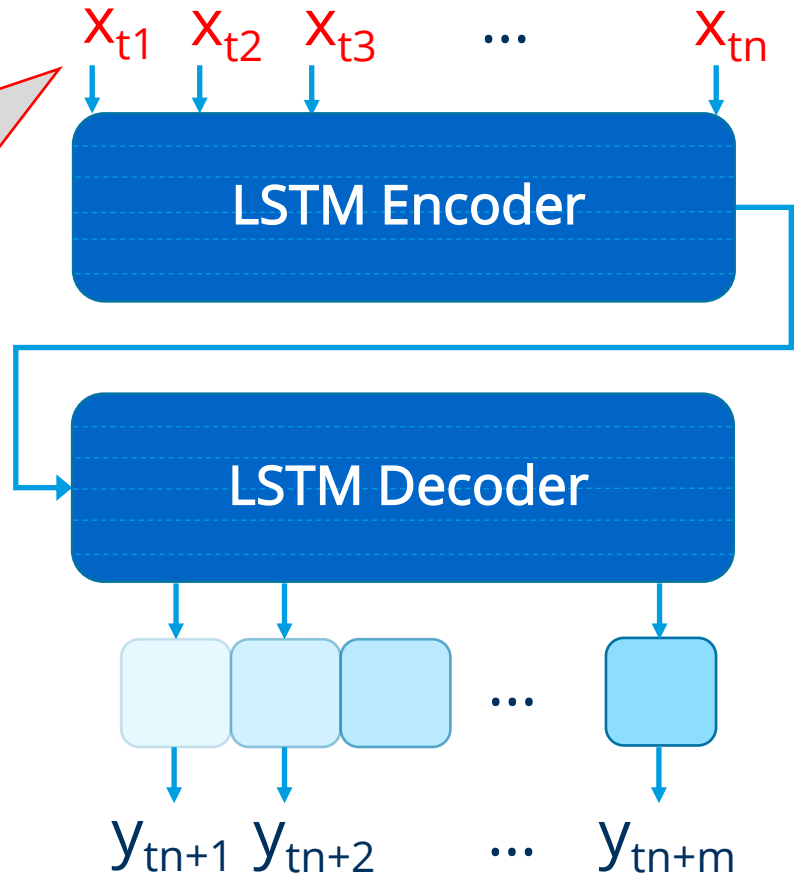
DWD: COSMO/Icon-D2-EPS



Methods
The Deep Learning Network



?



Hidden units: 35

Optimizer: Adam

Loss function: RMSE

Trained Networks per variation: 20

Event based training:
8 train events
(containing largest event)
4 validation events
8 test events

Moving-window-like samples in batches (events):
Window length n = 60 h

Data
Statistical precipitation characteristics

Reference: **discharge + area averaged precipitation**

\+ Precipitation intensity **minimum & maximum**

\+ **Standard deviation** over area

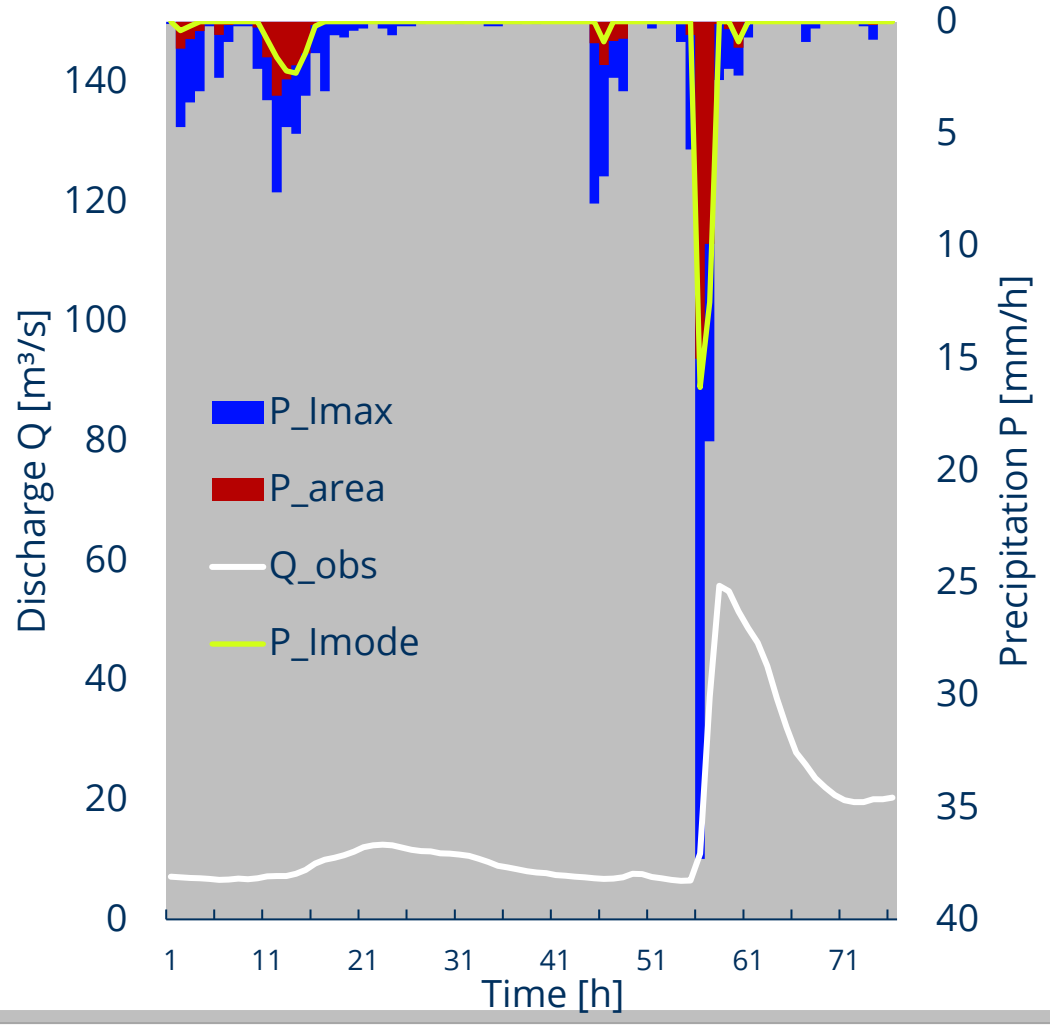
\+ **Area percentage** exceeding threshold of 10, 15, 25, 40 mm/h

\+ **Coefficient of variation** over area

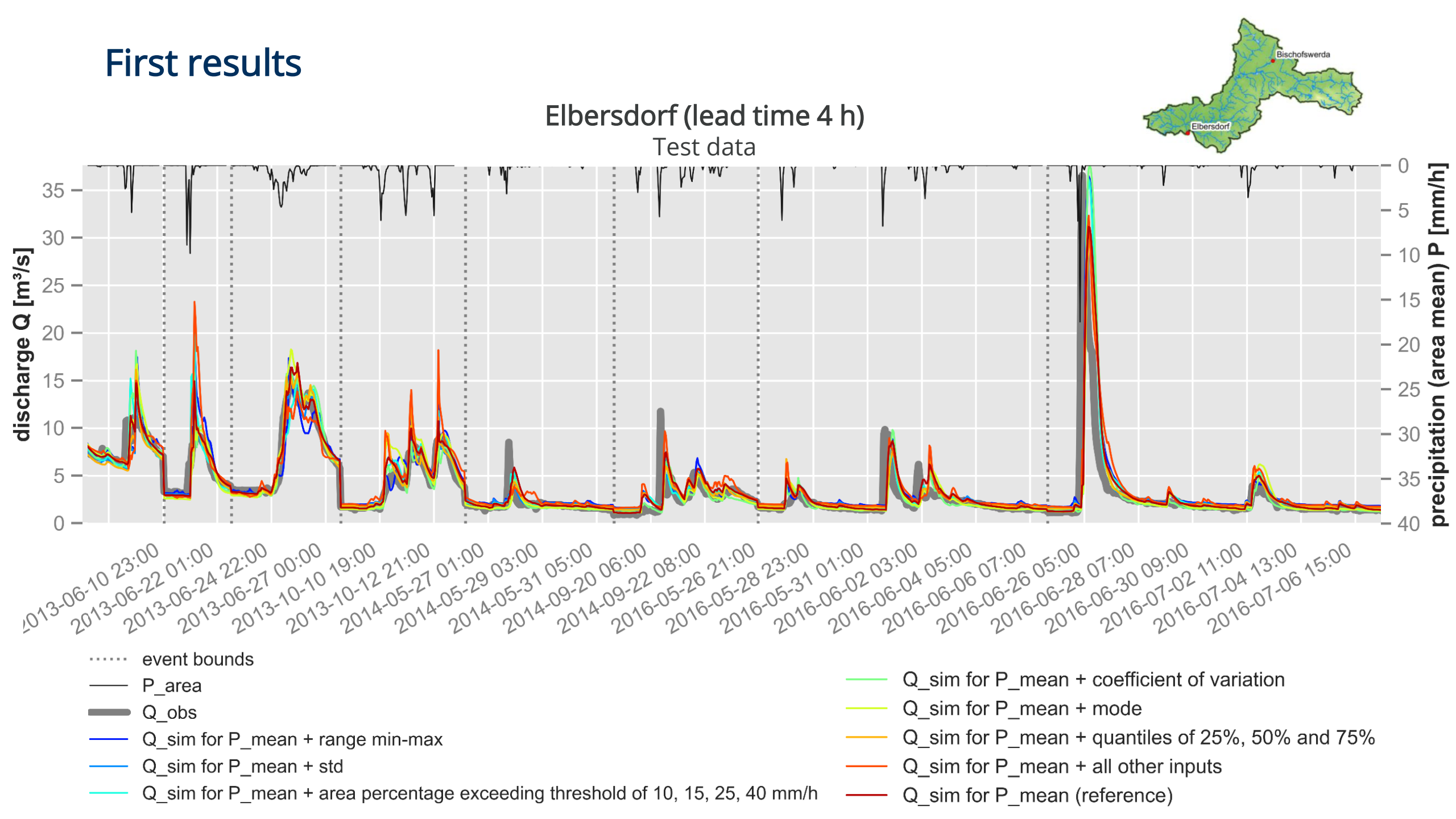
\+ **Mode value** over area

\+ Precipitation **quantiles** of 25%, 50% and 75% over area

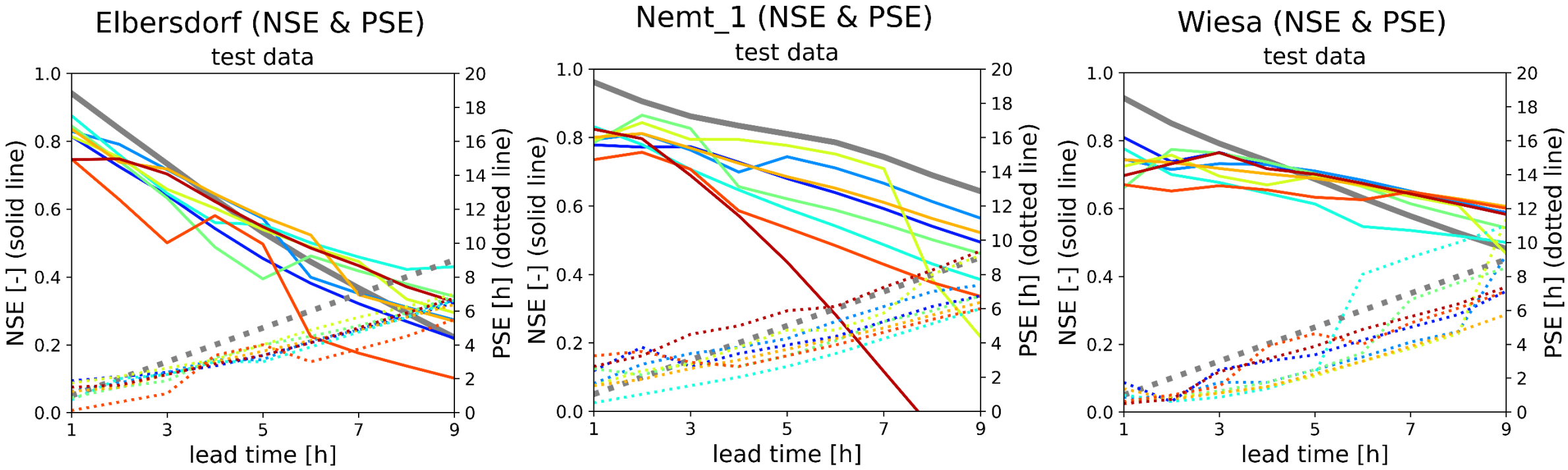
\+ **All** precipitation information



First results



First results



NSE ... Nash Sutcliffe Efficiency
PSE ... Phase shift error

- Baseline out of Q_obs
- P_mean + range min-max
- P_mean + std
- P_mean + area percentage exceeding threshold of 10, 15, 25, 40 mm/
- P_mean + coefficient of variation
- P_mean + mode
- P_mean + quantiles of 25%, 50% and 75%
- P_mean + all other inputs
- P_mean (reference)

Prospective investigations

Input represents whole catchment

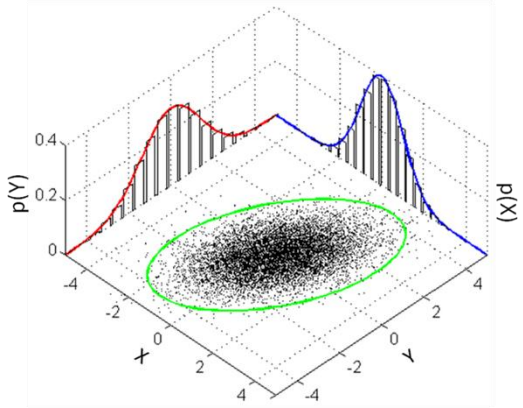
- **correlation** between best suitable statistical quantity and **precipitation patterns**?
- Precipitation characteristics containing **spatial** information (e.g. distance peak – gauging station, bivariate gaussian distribution as approximated spatial precipitation distribution)

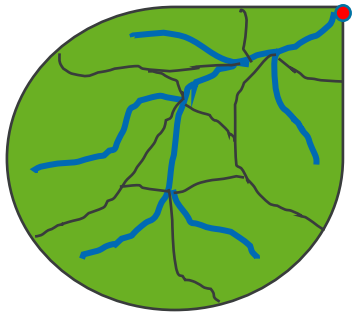
Input represents catchment sections

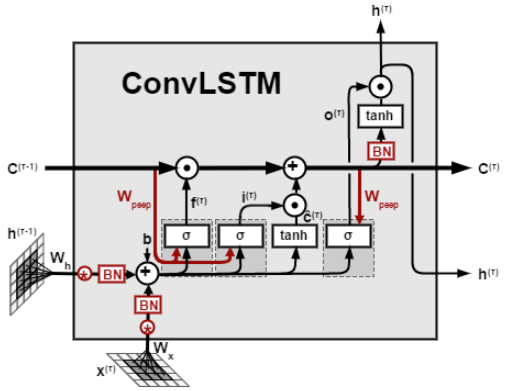
- symmetrical **grid aggregation**
- **isochrones**
- **subcatchments**

Input represents catchment grid

- LSTM networks with internal processing adapted to 3D (spatio-temporal) input (e.g. **ConvLSTM**)







https://upload.wikimedia.org/wikipedia/commons/8/8e/MultivariateNormal.png

https://miro.medium.com/max/942/1*u8neecA4w6b_F1NgnyPP0Q.png

Thank you for your attention!

Contact: tanja.morgenstern@tu-dresden.de

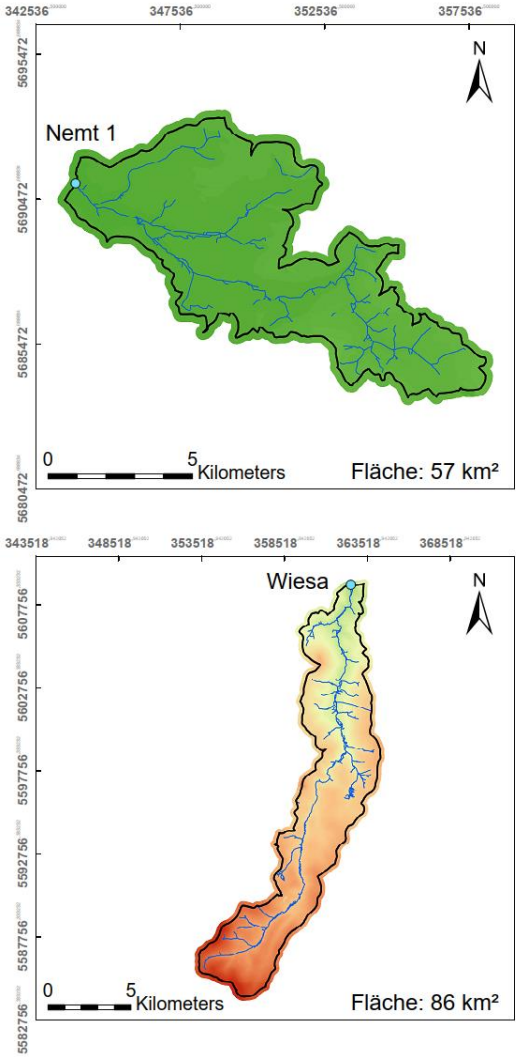
Abstract:

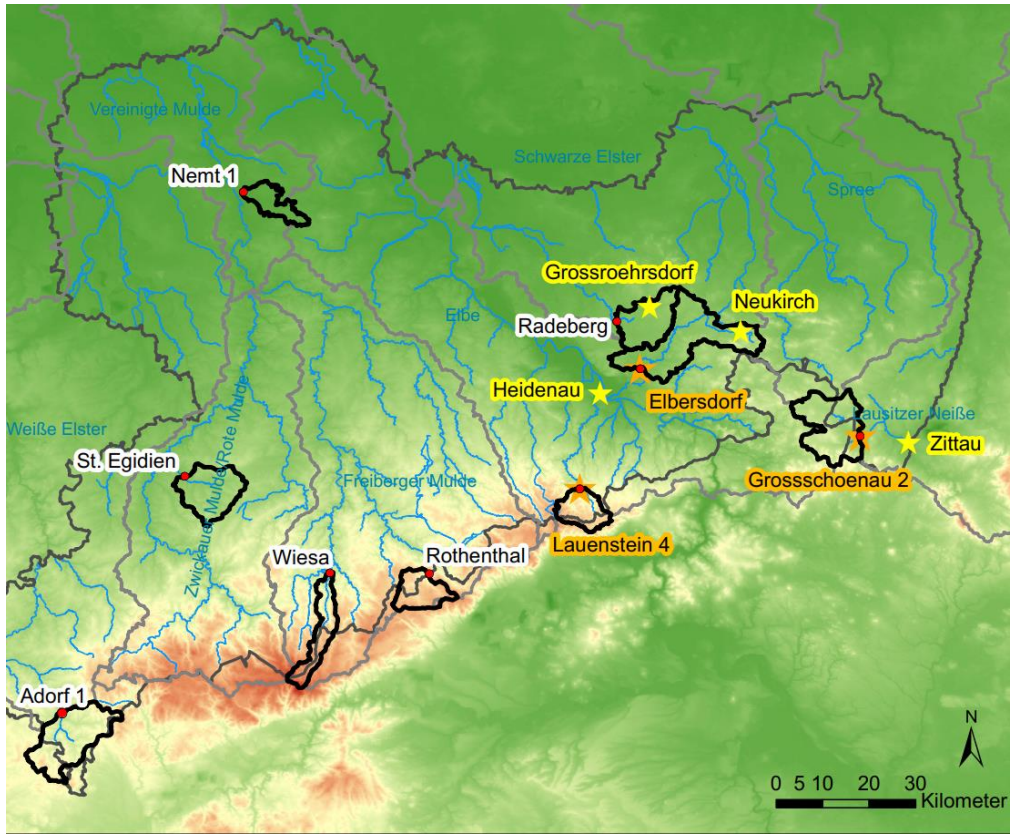
Thu 26th May – Session **HS1.2.2:**

Towards automatic real-time water level estimation using surveillance cameras
Xabier Blanch
17:03 – 17:10

Determination of continuous discharge time series based on the optical Particle Tracking Velocity (PTV)
André Kutscher
17:31 – 17:38

The other catchments





Legende

- Pegel
- Messstellen Typ A
- Messstellen Typ B
- Haupteinzugsgebiete
- Einzugsgebietsgrenze
- Landesgrenze
- Fließgewässer Übersicht

Geländehöhe (DGM5)

1242 m

0 m

Datengrundlage:
DGM5: © GeoBasis-DE / **BKG**
Pegel, EZG & Gewässer:
Landesamt für Umwelt,
Landwirtschaft und Geologie
Sachsen