BURGER

A Bottom-Up Regionalised Global Extreme Rainfall dataset

Why BURGER

- Intensity-Duration-Frequency (IDF) data is essential for flood risk management and as input to (pluvial) flood models
- Spatially-varying IDF data at global scale sets are scarce, and their methodologies differ strongly

- At Fathom, we wanted a
  - Globally consistent data set
  - Capture the accuracy of local rainfall observations

BURGER in context

SMEV = Simplified Meta-statistical Extreme Value approach (Marra et al., 2019)

All IDF data sets have their merit!

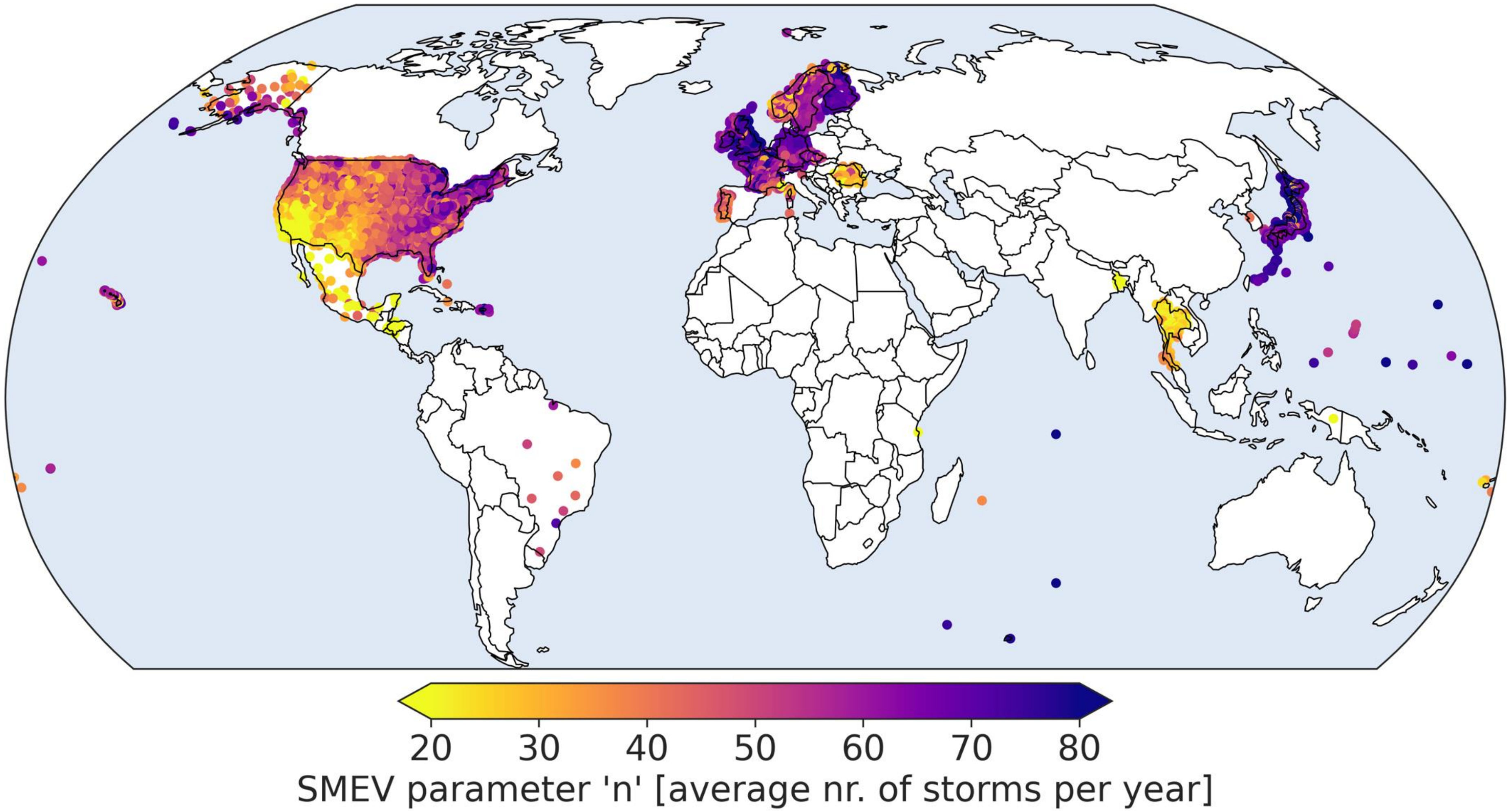
Other IDF datasets

- Derive EVD parameters from remotely sensed P-data
- Limited by biases/constraints in P-data, e.g. spatial resolution, accuracy
- Often apply GEV
- Sub-daily to multi-day duration

BURGER

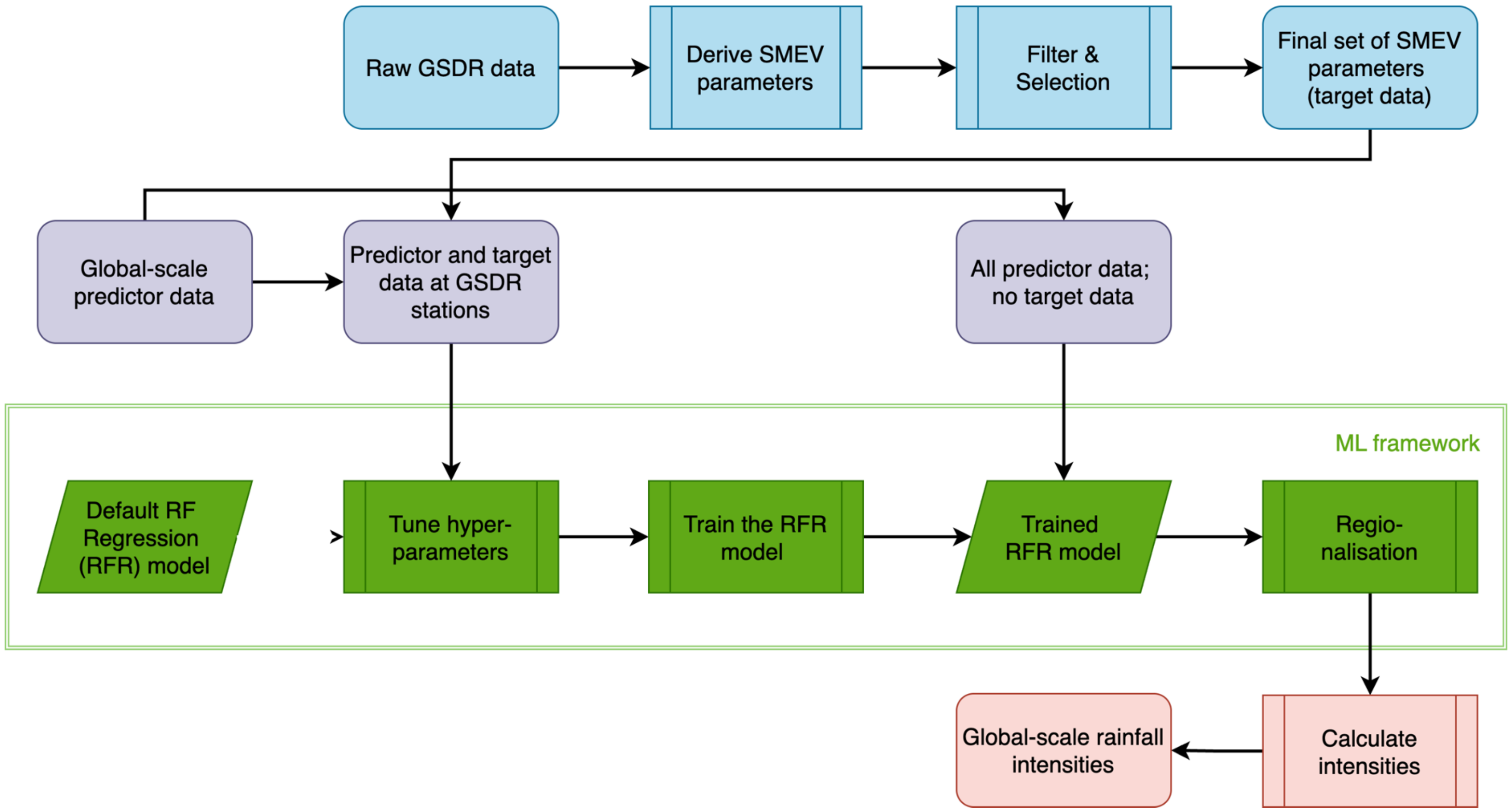
- Derive SMEV parameters from local observations (GSDR)
- Limited by accuracy of regionalisation approach
- Applies SMEV, better for sub-daily rainfall extremes
- Sub-daily duration only

The problem: Spatial distribution of available GSDR stations

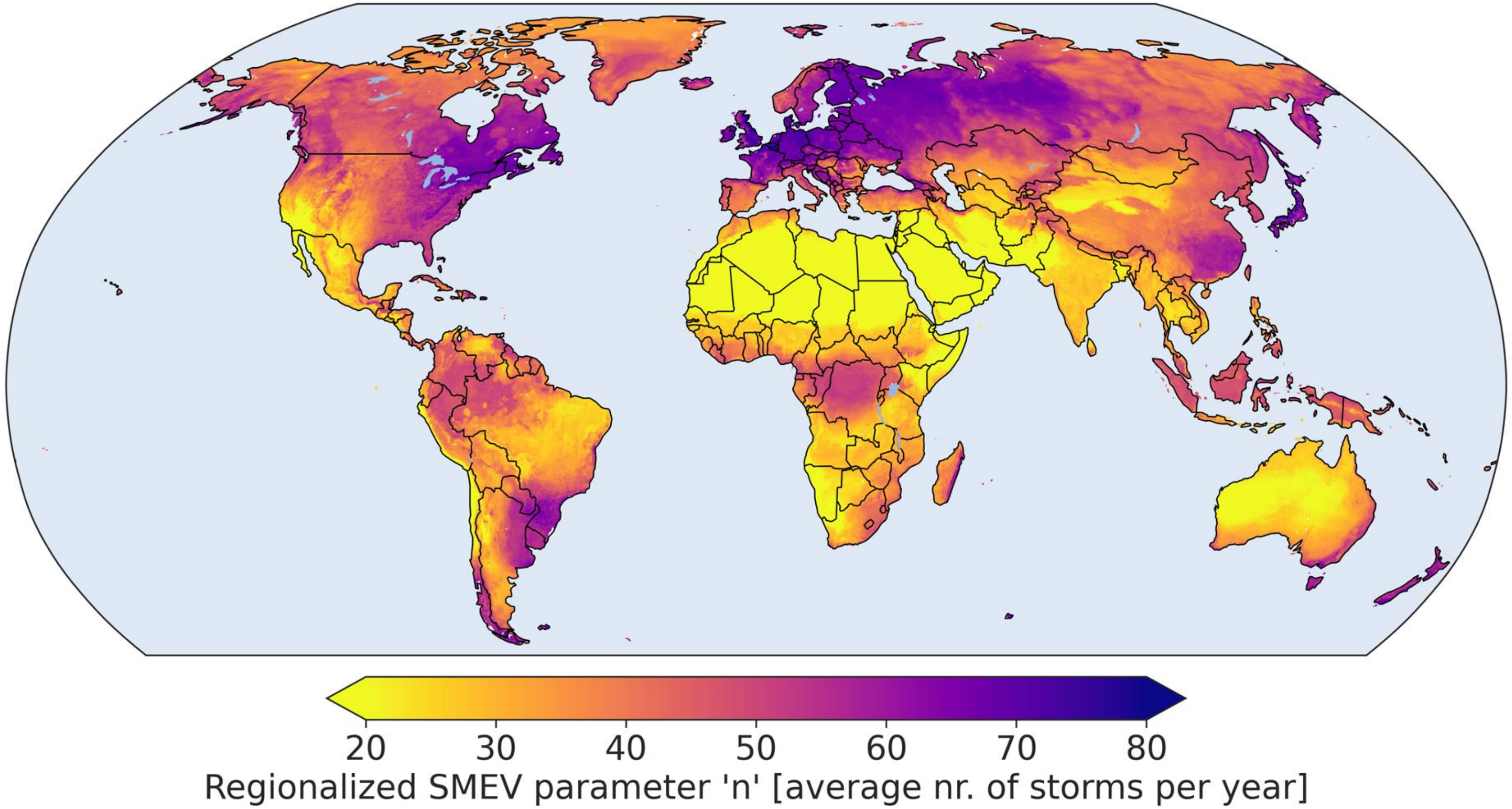


Methods

Using global scale predictor data to regionalise SMEV parameters from GSDR stations using multivariate regression.



Example of regionalised SMEV parameter



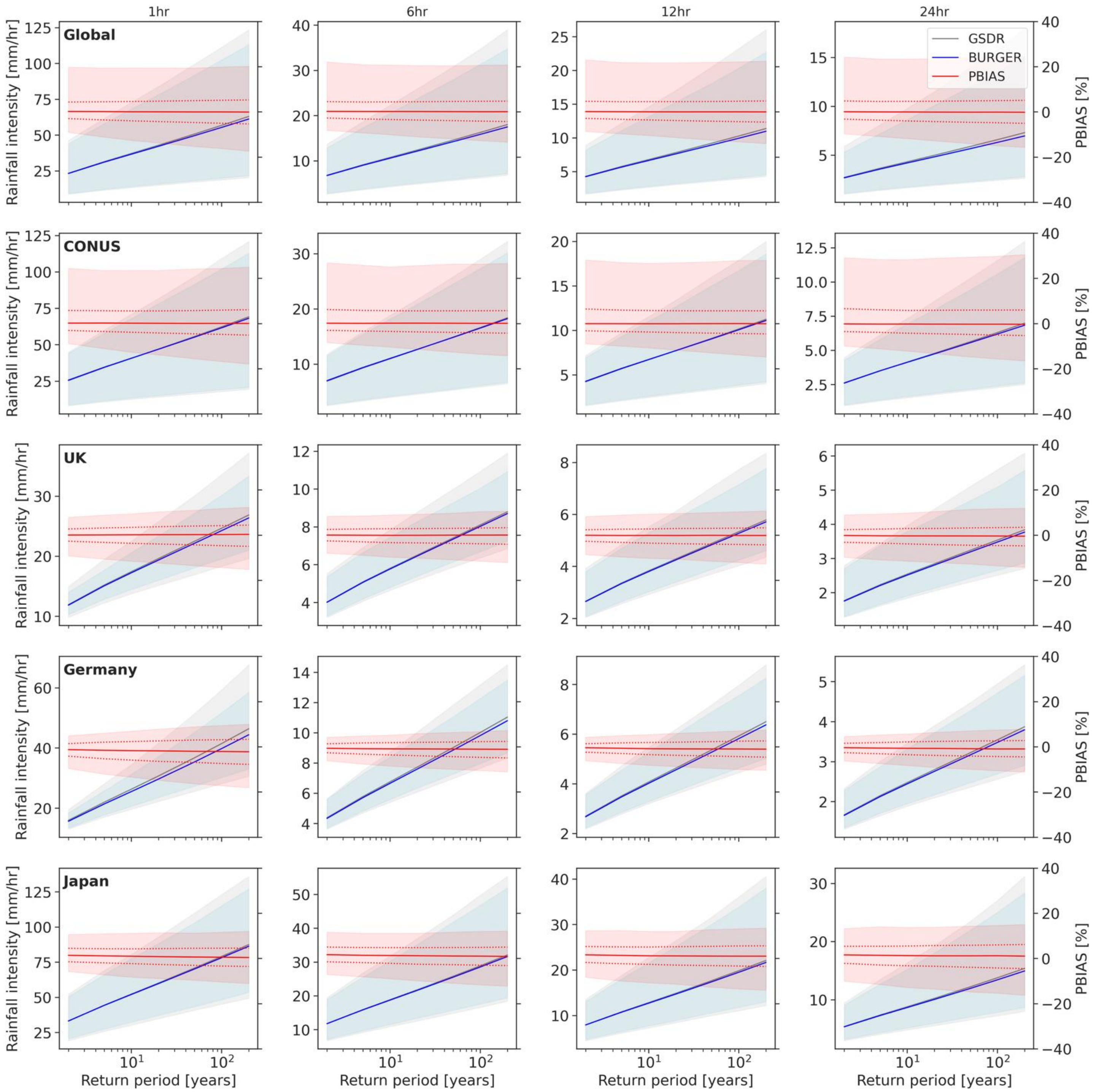
Some results

At large, distributions of observed parameter values are resembled well by ML predictions.

	Scale initial	Scale power	Shape initial	Shape power	n
R^2 [-]	0.77	0.68	0.57	0.48	0.71
MAE [-]	0.72	0.05	0.08	0.03	6.25
RMSE [-]	1.16	0.09	0.11	0.04	9.07

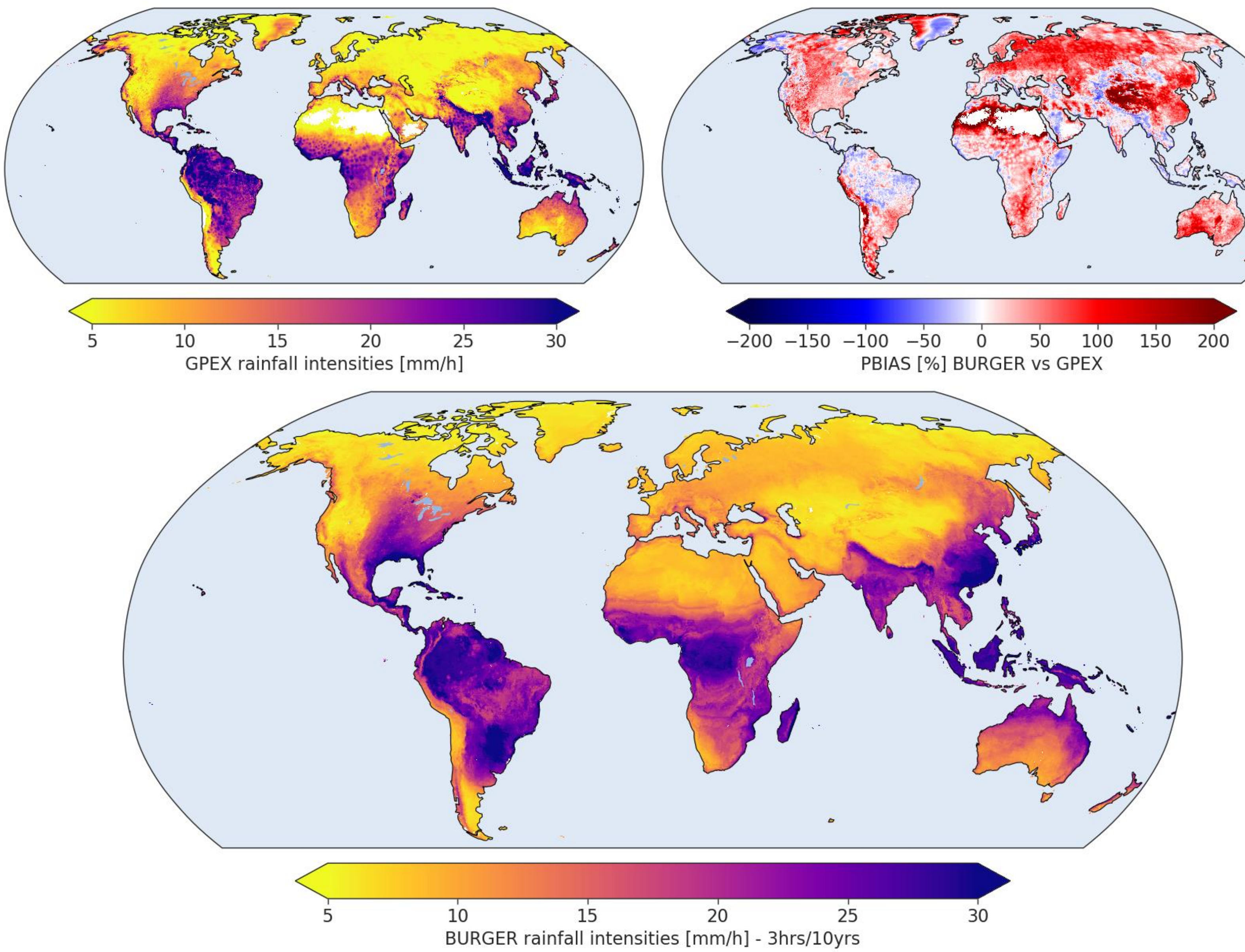
Some results

- *GSDR intensities:* obtained by fitted SMEV equation at station level
- *BURGER intensities:* obtained with ML regionalisation
- *PBIAS:* (BURGER – GSDR) / GSDR * 100



Some results

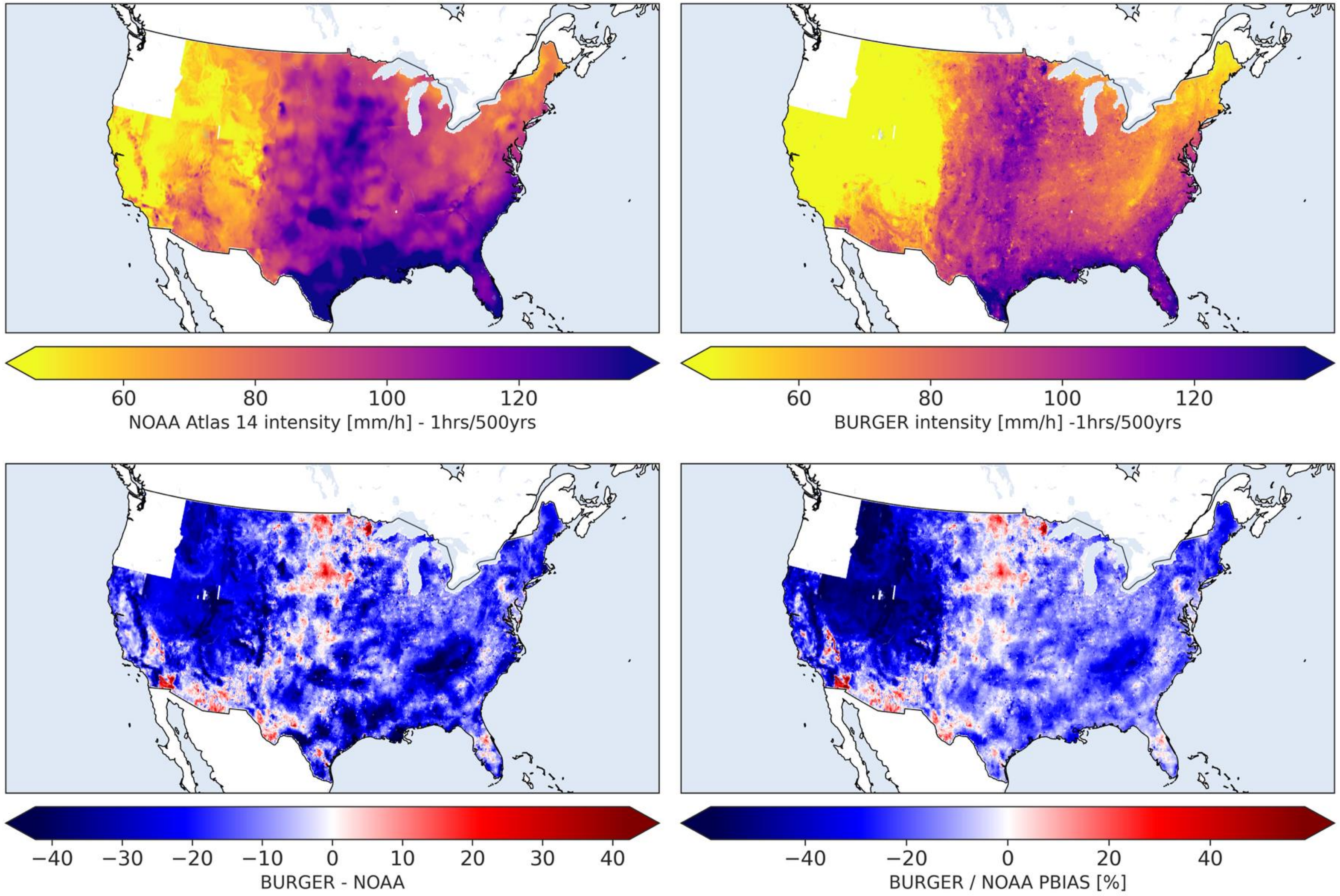
Comparison between BURGER and GPEX (Gründemann et al, 2023).



Some results

Comparison between BURGER and NOAA Atlas 14 data.

Note: there are massive methodological differences!



From IDF to Floods

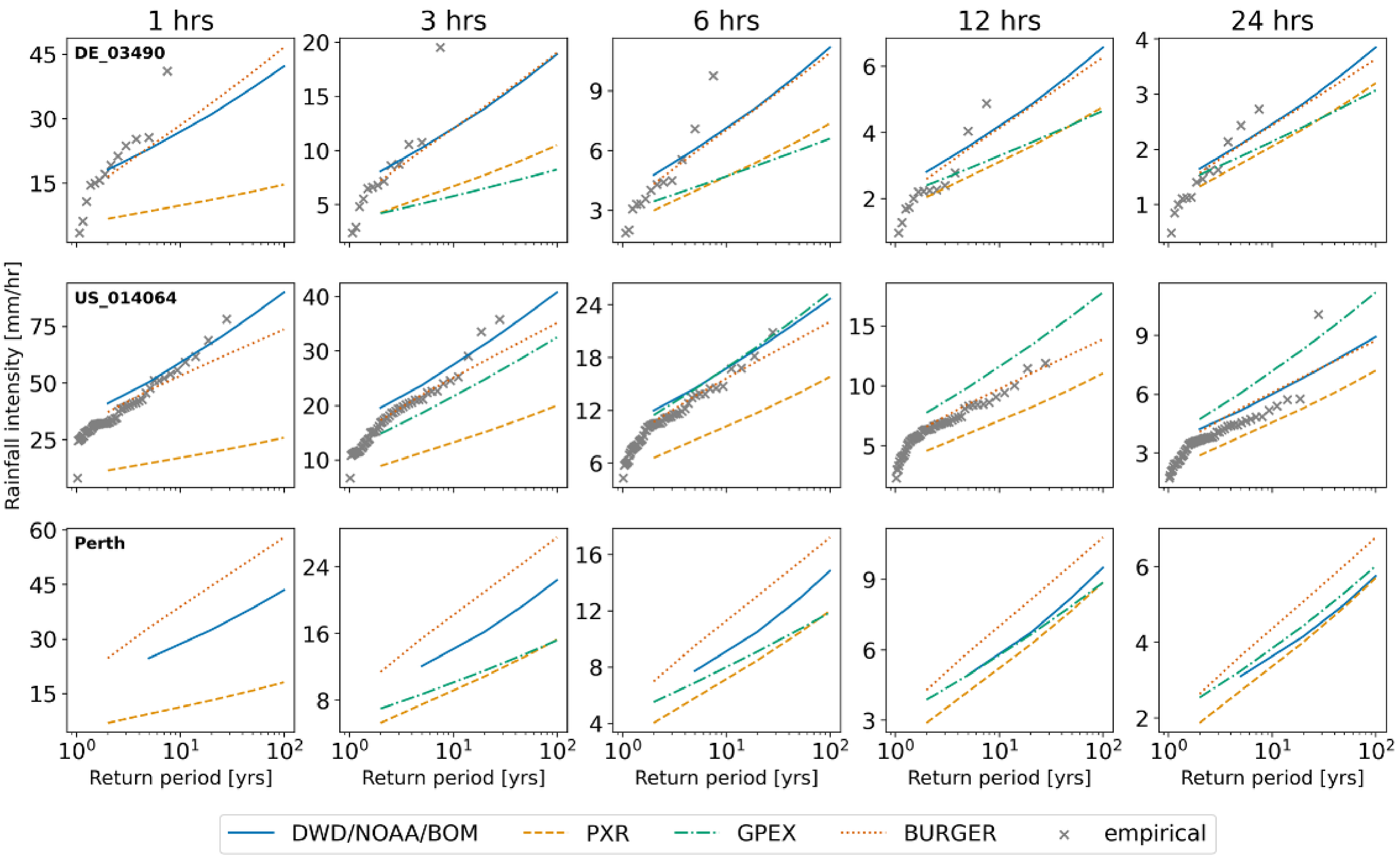
Compare global-scale to national-scale IDF data.

- Test locations
  - Ahrweiler (Germany)
  - Huntsville (USA)
  - Perth (Australia) – no GSDR data available there!
- Run LISFLOOD-FP with several IDF data sets
  - Global: GPEX, PXR-2, BURGER
  - National: KOSTRA-DWD, NOAA Atlas 14, BOM ARR14
- Compute Critical Succes Index (CSI) for all global IDF data sets. National data sets are the benchmark.

Some results

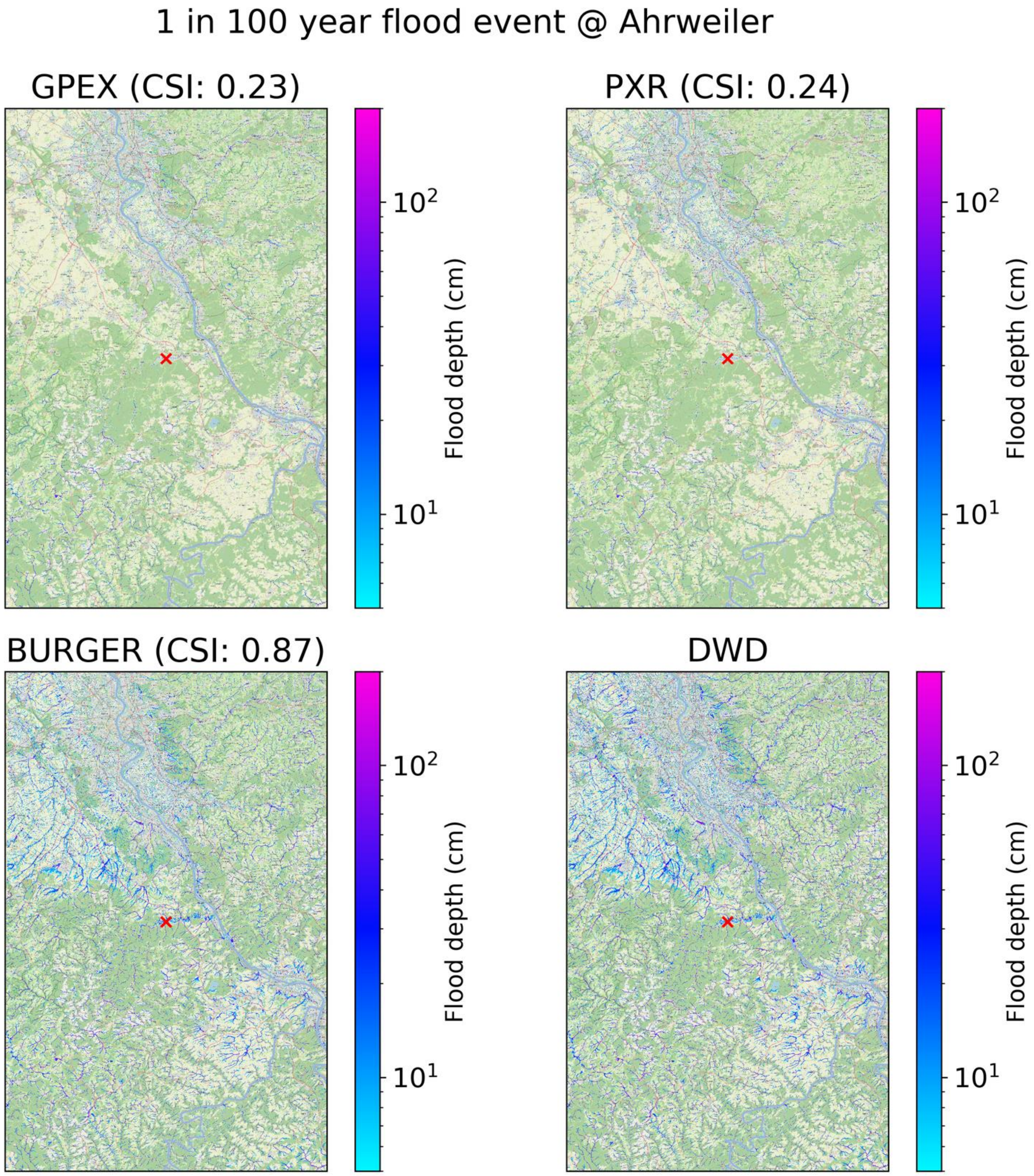
Comparison of rainfall intensities at closest GSDR stations.

Note: no GSDR in Australia available!



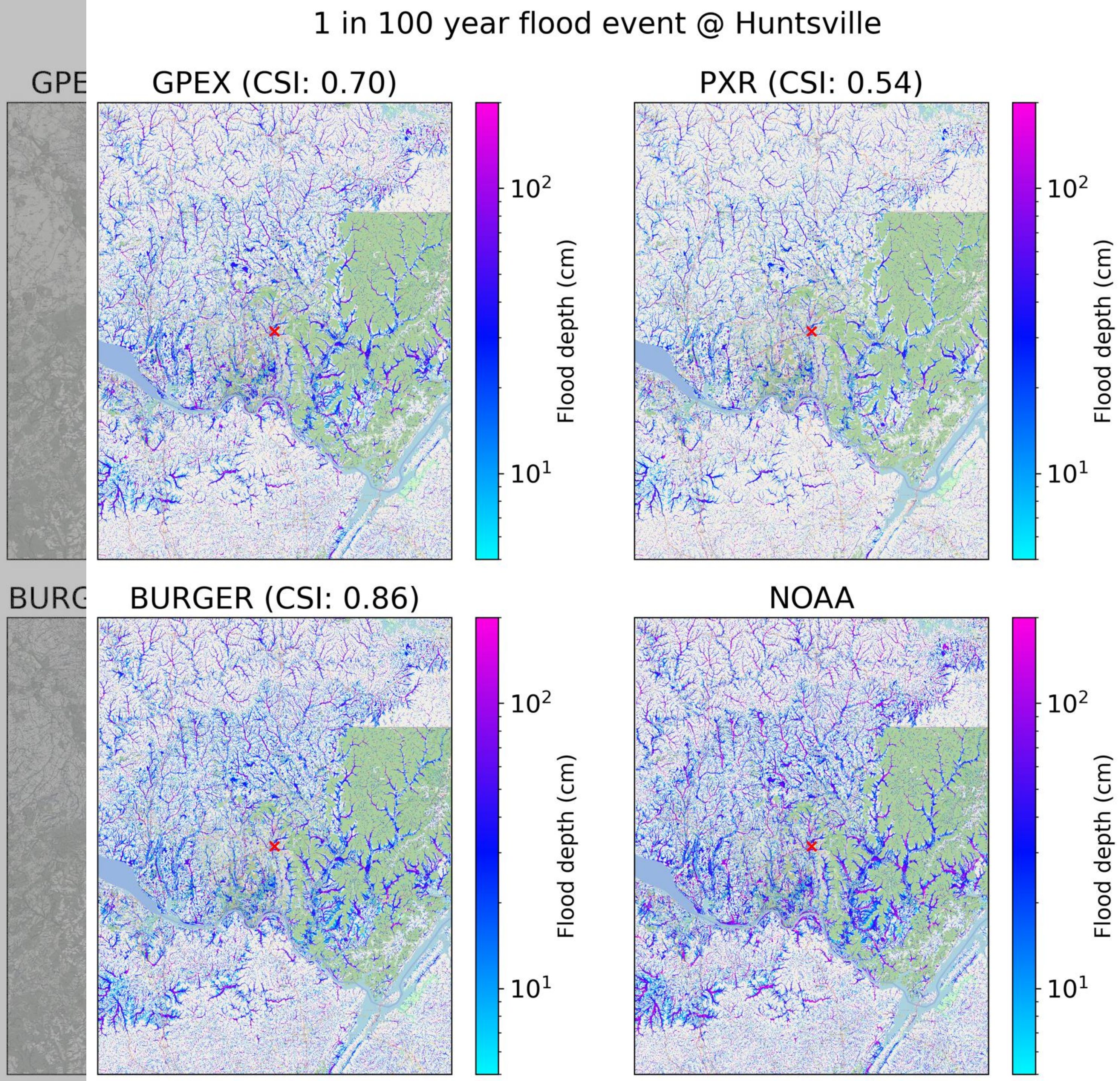
Some results

National reference IDF dataset: KOSTRA-DWD



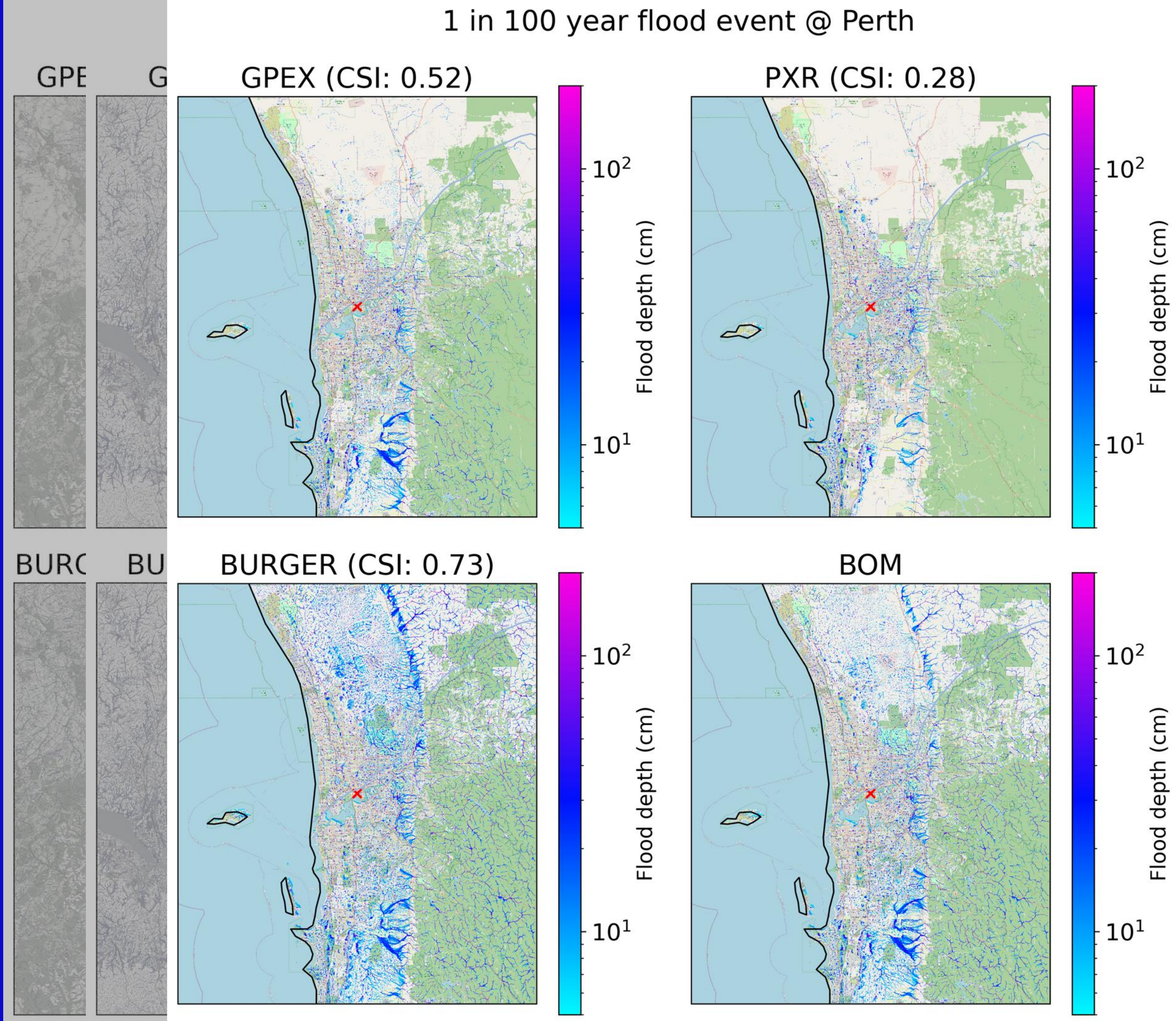
Some results

National reference IDF dataset: NOAA Atlas 14



Some results

National reference IDF dataset: Bureau of Meteorology (BOM) Australian Rainfall ???



Conclusions

- BURGER regionalises SMEV parameters well (within ML-model capabilities)
- At large, BURGER intensities agree well with expected intensities, especially outside CONUS
- Clustering of GSDR stations hampers simulation and evaluation in many areas
- Resulting flood maps agree with with those obtained with national-scale IDF data sets, even where no station data is available
- Methodological difference between IDF datasets make benchmark challenging
- All global IDF data sets have their merit but use national ones where available

Next steps

For any ideas to improve BURGER or interesting test cases, please get in touch!

- BURGER will be used as input to Fathom's upcoming 4th generation of Global Flood Maps
- Include a Regional Frequency Analysis
- More elaborated ML methods to be tested while testing feature engineering for contextual information
- Integration with TENAX model which would allow scaling rainfall intensities with temperature change

→ Credits to my colleagues at Fathom as well as

→ Francesco Marra (Univserity of Padova)

→ Hayley Fowler (Newcastle University)

→ Elizabeth Lewis (The University of Manchester)

→ Preprint @ ESSOAR

→ Manuscript accepted @ WRR (yay!)