



## 2025 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

### PART A

**Title of the project:**

Probabilistic runoff projections based on an LSTM-based runoff model

**Helmholtz Centre and/or institute:**

Helmholtz Centre for Environmental Research - UFZ

**Project leader:**

Jakob Zscheischler

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**Description of the project:**

Projections of droughts and floods typically rely on hydrological model simulations driven by climate model output. However, rainfall-runoff models based on Long Short-Term Memory (LSTM) models largely outperform traditional hydrological models in the simulation of runoff dynamics in ungauged basins, suggesting that they might also be better suited to simulate runoff dynamics under future climate conditions compared to process-based models. Yet so far, such machine learning-based models have not been used to generate runoff projections for the future.

Using a recently trained and validated LSTM model for Europe, which has already been used to reconstruct daily runoff in >14,000 catchments over the last 70 years (<https://essd.copernicus.org/preprints/essd-2024-450/>), this project aims to generate robust runoff projections under different climate scenarios.

Tasks will include: 1) Extract, bias adjust and downscale climate forcing data from the most recent set of climate model simulations (CMIP6). 2) Run the European-wide LSTM to generate future runoff at the catchment level for >14,000 catchments. 3) Analyse the resulting simulations with respect to changes in droughts and floods. 4) Compare the LSTM-based runoff projections with other runoff projections based on traditional hydrological models, for instance as collected in ISIMIP.



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The project will provide a better understanding of value of machine learning-based runoff projections for drought and flood risk analysis under future climate conditions.

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**Description of existing or sought Chinese collaboration partner institute:**

We would be interested in expanding our collaboration in this area, for instance the Department of Hydraulic Engineering at Tsinghua University. However, we are also open for other partners as we do not have any strong collaborations yet in this domain.

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**Required qualification of the postdoc:**

- PhD in Climate Science, Hydrology, Environmental Sciences, or similar
- Experience with large data analysis and machine learning models
- Language requirement: fluent in English (spoken and written)