Wenyue Zou

- Final-year Ph.D. student Email: wenyue.zou@unil.ch
Google Scholar and Personal website
Expertise of Centre for Climate Extremes (ECCE)
Faculty of Geosciences and Environment, University of Lausanne
- Visiting researcher Email: zouwen@eth.ch
Chair of Hydrology and Resources Management
Institute of Environmental Engineering, ETH Zurich

RESEARCH INTERESTS

- Storm and flood hazards and risk assessment
- Statistical/ML and dynamic modelling of extreme rainfall
- Climate extremes impact

PROFESSIONAL SKILLS

- Proficient in **predicting future changes in storm events and their effect on flood response**
- Proficient in **extreme rainfall frequency analysis** and **storm stochastic modelling**
- Proficient in **geostatistical downscaling and interpolation**
- Proficient in MATLAB, Python and ArcGIS for mapping and data analysis
- Skillful in literature review and data management

PUBLICATIONS

[5] Zou, W et al., 2025. A process-based framework linking temperature-rainfall projections and urban flood modeling. (Manuscript)

[4] Zou, W., Wright, B., Peleg, N. 2025. Morphing sub-daily rainfall fields based on temperature shifts to project future changes in rainfall extremes. Water Resources Research, accepted.

[3] Zou, W et al., 2024. Multiple-point geostatistics-based spatial downscaling of heavy rainfall fields. Journal of Hydrology. https://doi.org/10.1016/j.jhydrol.2024.130899.

[2] Zou, W et al., 2021. Spatial interpolation of the extreme hourly precipitation at different return levels in the Haihe River basin. Journal of Hydrology 598, 126273. https://doi.org/10.1016/j.jhydrol.2021.126273.

[1] Li, Q., Zhou, J., **Zou, W.**, et al., 2020. A tributary-comparison method to quantify the human influence on hydrological drought. Journal of Hydrology. https://doi.org/10.1016/j.jhydrol.2020.125652.

Main achievements

Generating high-resolution rainfall datasets and extreme value analysis

During my master's and the first year of my PhD, I co-led two projects to generate high-resolution rainfall extreme datasets from gauged observations and coarse satellite data, with all datasets and methods open-sourced for the research community.

Context and challenge: High-resolution spatial rainfall extremes (e.g. 1-km, hourly) are required for hydrological applications in mountainous and urban catchments. However, most basins rely on sparse gauge networks, requiring robust spatial interpolation to fill ungauged locations. Satellite products can provide spatial rainfall, but their resolution (10 km) is too coarse to use and needs to be downscaled not only in rainfall intensity but also in spatial structure.

To meet this challenge, I evaluated six different interpolation methods and found that the Kriging with external drift (KED) method outperformed the others for interpolating hourly station extreme rainfall, generating 2- to 100-year return level maps across a major Chinese basin. This method contributes to more accurate estimation of spatial rainfall extremes and can also be applied in other regions [2].

The second way to meet this challenge is downscaling satellite products: I designed a Multiple-point geostatistics-based spatial (MPS) downscaling model, which learns storm patterns from a few years of radar data, to downscale long-term satellite rainfall into high-resolution. I applied it to successfully downscale 22 years of CMORPH satellite rainfall from 8 to 1 km over Beijing city. The results indicate that the model downscales well in both rainfall intensity and spatial structure. The proposed approach can be applied to other rainfall datasets and regions, enhancing the availability of fine-scale rainfall datasets for diverse hydrometeorological applications [1,3].

Projecting future changes in storms and urban flood hazards under climate warming

During my PhD, I led projects on future changes in rainfall extremes and urban flooding under climate warming, developing and coupling a temperature-rainfall projection method, a stochastic storm transposition (SST), and a hydrodynamic model.

Context and challenge: Predicting future shifts in storms and urban pluvial floods is vital for disaster planning. The rapid hydrological response and highly variable storm fields demand refined rainfall data and flood simulation for robust scenario analysis. However, future sub-daily rainfall is not readily available globally due to the high computational cost of climate models.

To meet this challenge, I introduced a Gamma-based spatial quantile mapping (GSQM) method that uses temperature as a covariate to project an archive of future rainfall fields. By integrating it with SST, I efficiently reconstructed future rainfall extremes spatially. I demonstrated the efficiency of the GSQM-SST approach by projecting changes in Beijing's hourly rainfall extremes under multiple regional warming levels [4].

I subsequently simulated the GSQM-SST-derived storms into a high-resolution hydrodynamic flood model AutoShed, to generate future urban flood depth, velocity and inundation. My analysis revealed a non-linear increase in flood hazard with intensified local storms. The proposed GSQM-SST-AutoShed framework offers a data-driven, physically grounded approach for assessing future urban storm and flood risk under climate warming, relying only on readily available rainfall and temperature observations [5].

Supporting the research community and broader society

I've been involved in activities that benefit the research community and broader society through peer review, government and community projects, and teaching:

- I reviewed manuscripts for the Journal of Earth System Science Data and Earth Surface Processes and Landforms, providing detailed feedback to enhance rigor and clarity. Besides, I served on the committee of UNIL's Expertise Center for Climate Extremes and UNIL-EPFL Center for Climate Impact and Action, helping organize workshops to expand awareness of climate-change impacts and foster cross-institutional cooperation.

- I worked as a teaching assistant in Meteorological Field Measurement and Climate Change Impact Assessment, and Watershed Modeling courses, mentoring students in hands-on hydrometeorological analysis and modelling.

- I led the literature review work in a governmental insurance project of ECAB Fribourg, analyzing the historical trends and future projections of extreme weather events in Fribourg, Switzerland, and assessing their impacts on local building damages and informing resilience planning.

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EDUCATION BACKGROUND

- **2021 - present** — **Ph.D. in Environmental Science,** Faculty of Geosciences and Environment, University of Lausanne

  *Thesis: **Future changes in rainfall properties and their effect on urban flooding***
  Supervisor: Nadav Peleg

- **2018 - 2021** — **M.sc in Physical Geography,** Faculty of Geographic Science, Beijing Normal University — GPA:3.75/4 (10%)

  Thesis： Spatiotemporal characteristics of rainfall events based on a highly dense rain-gauge network. *Supervisor: Shuiqing Yin*

- **2014 - 2018** — **B.sc in Geography,** Faculty of Geographic Science, Northwest Normal University — GPA:3.84/4 (1%)

  Thesis： Spatial and temporal variation characteristics of hourly precipitation during the Warm season 1961-2012 in the Haihe River basin.
  Supervisor: Junju Zhou

SERVICES

- 2024 — **Committee of Expertise Center for Climate Extremes, University of Lausanne**
- 2022 — **Teaching assistant,** Faculty of Geosciences and Environment, University of Lausanne
  - Watershed and river network modelling
- 2020 — **Teaching assistant,** Faculty of Geographical Science, Beijing Normal University
  - Meteorology and Climate Practice course
  - Assessment of climate change and its impacts
- 2023 — Student committee of CliMACT between UNIL and EPFL university
- 2021 — Student committee in Association du Corps Intermédiare, FGSE, UNIL

AWARDS AND SCHOLARSHIPS

- 2021 Excellent Graduation Thesis in Beijing Normal University
- 2018, 2019 Academic Scholarship in Beijing Normal University (first class, twice)
- 2017 First prize in Scientific Research Challenge Cup at Northwest Normal University (5%)
- 2016 First prize in National College Students Mathematic Modeling Competition (10%)
- 2015 National Endeavor Scholarship (10%)