PhD Position announcement – 09/11/2020. Hiring date: Mar. 2021

Mission: Estimating Extreme Flood Hazard Anywhere in Switzerland. Part 1: Development of a stochastic weather generator for small river basins.

Context

Hazard assessment of extreme floods is a major issue worldwide. Such assessments require very long time series of data but such data are typically not available, because river basins are often ungauged or because discharge observations, when available, cover a couple of decades only. A powerful approach is hydrometeorological simulation, which consists in feeding an ad-hoc hydrological model with long synthetic series of weather scenarios. Long time series of discharges can thus be generated for the considered location.

Such an approach has been developed and used by a consortium of academic and industrial partners in the recent EXAR research project for the Aare River basin and its different sub-basins (Central Switzerland) (**https://www.wsl.ch/en/projects/exar.html**). Two advanced stochastic weather generators have been developed by the Institute of Geosciences and Environment (IGE Grenoble) and applied to generate 30 weather scenarios of 10'000's years each. Discharge scenarios have then been simulated at many places of the river network using HBV, a high-resolution hydrological model developed by the University of Zurich (UZH).

The IGE and UZH partners of EXAR have been asked to extend and consolidate this approach for the specific case of small catchments. This requires the development of specific cross-scaling models and approaches that will make possible the generation of weather scenarios anywhere in Switzerland for a wide range of catchment size (10 km^2 - 1000 km^2). These developments will be done within 2 twin PhDs supervised by IGE. The first PhD will consist in modelling the spatial/temporal scaling behaviour of statistics of precipitation extremes. The second PhD will provide a high-resolution weather generator to be fed in with regionalized outputs of the first PhD.

Objectives

The PhD thesis will be dedicated to the development and the comparison of 2 weather generators (WGENs) able to generate long time series of hourly mean areal precipitation/temperature scenarios for small catchments, with an area ranging from 10 to 1000 km^2. A key scientific challenge here is to find WGENs that can generate time series of mean areal scenarios for the whole spectra of surface areas considered. WGENs have to be applicable for any small catchment of Switzerland, from alpine to lowland ones. The WGENs will have to comply with the probability distributions of intensities provided by regional Intensity-Duration-Area-Frequency curves (IDAFs) for different temporal scales.

The main objectives of the PhD thesis will be to:

- Review existing subdaily conceptual stochastic generators, and select the most appropriate.
- Adapt this generator and GWEX for small and mountainous catchments.
- Determine how both WGENs can be adapted to various spatial scales (10 to 1000 km^2) and how they can account for the spatial/altitudinal heterogeneity issues.

- For test catchments covering a variety of size and hydrological regimes, evaluate and compare both WGENs for a large range of performance criteria, focusing on extreme events.

Geographical Location

IGE - Bât OSUG-B
460 rue de la piscine, Domaine universitaire
38 400 St Martin d'Hères
FRANCE

Supervision / Contacts

Guillaume Evin, researcher, INRAE, ETNA: guillaume.evin@inrae.fr

Benoit Hingray, researcher, CNRS, IGE: benoit.hingray@univ-grenoble-alpes.fr

Required skills

Master 2 or Engineer Diploma in Applied Statistics, or in Earth or Climate sciences with a good knowledge of statistics. A good knowledge of the software R (or equivalent) and strong interest in developing scripts is also required. Ability to work with spatial data would be appreciated.

Ability and interest to work in a team. Good knowledge of English for interactions with Swiss partners.

Funding / Language

PhD funded by the Swiss Confederation.

The research can be conducted in French or English. Non-French speaking candidates are expected to learn French basics to facilitate communication and get integrated in the lab.

Working environment

The ETNA research unit (https://www6.ara.inrae.fr/grenoble-etna_eng/) of INRAE carries out research projects on the prevention of natural hazards in mountainous areas (avalanches, blowing snow, torrential erosion, debris flows, rock falls, hazards relating to glaciers). IGE (http://www.ige-grenoble.fr/) is one of the main French laboratories in Geosciences. ETNA and IGE are part of the Observatoire des Sciences de l'Univers de Grenoble. This PhD will also benefit of the international consortium (Switzerland, France and Germany) of the EXAR project composed of renowned experts in this research field. To validate the hydrological relevance of generated scenarios, the PhD student will be in regular interaction with the Hydrological Team from Zurich.

Other Information

Type of contract: fixed-term – 3 years
Section: 19
Expected hiring date: 01/03/2021 (flexible)
Work quota: Full-time
Desired level of study: Master of Engineer Diploma in Earth / climate sciences, Applied Mathematics or Statistics
Desired experience: beginner to 4 years
Gross salary: between 1500 € and 2000 € (depending on experience)

Submission of applications:

Please send the following documents to guillaume.evin@inrae.fr **in support of your application:**

- Motivation letter in English (max. 2 pages)
- Curriculum Vitae
- Degrees and transcripts
- One academic writing sample in English or German (e.g. Master thesis or another single-authored piece of written work)

Note that only complete applications will be considered, with the exception of formal documents that cannot be obtained for factual reasons.

Application deadline: **31/12/2021**

Related literature

Evin, G., A.-C. Favre, and B. Hingray. 2018. "Stochastic Generation of Multi-Site Daily Precipitation Focusing on Extreme Events." *Hydrol. Earth Syst. Sci.* 22 (1): 655–72. https://doi.org/10.5194/hess-22-655-2018.

Evin, Guillaume, Anne-Catherine Favre, and Benoit Hingray. 2019. "Stochastic Generators of Multi-Site Daily Temperature: Comparison of Performances in Various Applications." *Theoretical and Applied Climatology* 135 (3): 811–24. https://doi.org/10.1007/s00704-018-2404-x.

Onof, Christian, and Li-Pen Wang. 2020. "Modelling Rainfall with a Bartlett–Lewis Process: New Developments." *Hydrology and Earth System Sciences* 24 (5): 2791–2815. https://doi.org/10.5194/hess-24-2791-2020.