



**i d i l**  
UNIVERSITÉ DE MONTPELLIER

**INTER-DISCIPLINARY & IN-LAB GRADUATE PROGRAM**

PhD offer in Statistics

## **Stochastic rainfall generators and impact studies on flood risk in Montpellier**

**Laboratory:** IMAG, Université de Montpellier and Inria LEMON, Montpellier

**Supervision team:** Gwladys Toulemonde (IMAG, Université de Montpellier and Inria LEMON), Nicolas Meyer (IMAG, Université de Montpellier and Inria LEMON), Carole Delenne (HSM, Université de Montpellier and Inria LEMON)

**Skills required :** Statistics/Probability; R and/or Python

**Keywords :** extreme values, spatio-temporal statistics, sensitivity analysis, climate hazards

**Period:** October 2024-September 2027

**Contact:** To express your interest, please contact Gwladys Toulemonde ([gwladys.toulemonde@umontpellier.fr](mailto:gwladys.toulemonde@umontpellier.fr)) and Nicolas Meyer ([nicolas.meyer@umontpellier.fr](mailto:nicolas.meyer@umontpellier.fr)).

**When to apply?** Before April 15, 2024

**Application procedure:** See below

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### **Scientific context**

Climate change contributes to a sharp rise in natural risks linked to environmental hazards. These phenomena are even more present in areas at the interface of different environments, often exposed to several hazards, such as coastal areas affected by flooding due to river flooding, urban runoff or tidal waves. Statistical analysis of precipitation data, when available and usable, is therefore essential for proposing appropriate modeling of environmental hazards.

Observation catalogs containing extreme precipitation data are by definition few in number and therefore difficult to use from a statistical point of view. To obtain a more comprehensive database, one method is to simulate rainfall data using stochastic generators. These generators are numerical tools designed to correctly reproduce the statistical properties of observed rainfall events.

### **Objectives**

The first objective of the thesis will be to develop a spatio-temporal stochastic rainfall generator, to be implemented for the study of the Montpellier region, in southern France associated with a specific climate. This tool will simulate extreme and moderate rainfall, as well as dry periods. The originality of the proposed approach will consist in combining two

crucial aspects in a single model: (i) stochastic modeling of rainfall events similar to those actually observed; (ii) high spatial resolution on a fine pixel grid and high temporal resolution.

The simulated data can then be used to feed a numerical model of urban runoff. The second objective of the thesis will then be to conduct correlative studies between the inputs and outputs of the numerical model, developing new methodological tools for sensitivity analysis and risk measurement in the context of spatial extremes.

From a methodological point of view, this thesis will draw heavily on extreme value theory, spatio-temporal statistics, risk statistics and graphical models. It will exploit and extend the tools of probabilistic machine learning and risk analysis, such as generalized additive models, trans-Gaussian random fields, the SPDE approach, risk measures and sensitivity analysis.

### **Context of the PhD offer**

This PhD is part of the Eau-PI-UM project funded by the [IDIL program](#). The general objective of the project is to propose mathematical and physical models to better understand urban flooding and contribute to a decision support system. This PhD offer, which covers the statistical part of the project, is coupled with another PhD, which addresses the physical issues. The successful candidate will therefore be required to collaborate with researchers from other disciplines.

## Application procedure

**Application deadline: April 15, 2024, 23H CET**

To apply for IDIL mirror doctoral contracts, student candidates must complete their applications and send them by the deadline to the following email address: [idil-team@umontpellier.fr](mailto:idil-team@umontpellier.fr), and fill in the Microsoft Forms application form at the same time.

**Important: in order to be taken into consideration, the format of the subject of the application email must strictly comply with the following methodology:**

**[IDIL PhD Application: Subject n° 3 – Doctoral school A – Surname – Name]**

Please copy and paste this and simply put your Surname and Name

Details of the application form can be found at the following link (in French):

<https://idil.edu.umontpellier.fr/inscrivez-vous-dans-un-doctorat-interdisciplinaire/>

**Items that must be included in the application for evaluation (don't forget to fill in the application form as well):**

- Covering letter, signed and dated
- CV
- Transcripts of grades from L3, M1 and M2 (or all years of equivalent study, e.g. engineering degree) with ranking

**The link to the application form to be sent in parallel for all student applicants:**

<https://forms.office.com/e/w97RmAL6RU>