

Master trainee and/or PhD position

Computing climate extreme events using machine learning and rare events algorithms

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Scientific description: We have recently demonstrated that rare event algorithms can lead to a gain of a factor 100 to 1000 in the computational cost required to compute extreme events in climate models, for instance extreme heat waves over Europe [1]. This technique will probably have a huge impact in the future for the study of climate extremes. We demonstrated that this technique is effective for persistent extremes, and can be used with IPCC class models.

Making similar advances for other classes of extremes, with a more complex dynamics, requires new theoretical and methodological developments. We need to learn effective dynamics of the large scales of the turbulent flow related to extreme simulations, and from these effective dynamics learn optimal score functions for the rare event algorithms, called committor functions [2].

The aim of the project will be to develop and implement the methodology to learn committor functions from already produced climate model outputs, using machine learning. The machine learning approach will be developed in an interdisciplinary team that gathers specialists of computer science, machine learning, climate dynamics, data sciences and statistical physics within the ACADEMICS project.

[1] F. Ragone, J. Wouters and F. Boucheta, Computation of extreme heat waves in climate models using a large deviation algorithm, [PNAS, vol 115, no 1, pages 24-29, \(2018\)](#).

[2] D. Lucente, S. Duffner, C. Herbert, J. Rolland and F. Bouchet, Machine learning of committor functions for predicting high impact climate events, *Climate Informatics C12019 proceedings*, (2019).

This project is part of the project ACADEMICS, funded by IDEX/Université de Lyon. This project gathers Lyon/Saint Etienne groups in physics (LPENSL), computer sciences (LIP/ENSL and LIRIS/INSA) and mathematics (LabHC). The student will participate to the project interdisciplinary discussions and meetings.

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