Post-doc position

Computing climate extreme events using machine learning and rare events algorithms

Supervised by *Freddy BOUCHET* in collaboration with Pascal Yiou (LSCE, IPSL, Saclay, Paris).
Where: École Normale Supérieure de Lyon - Laboratoire de physique (ENSL-CNRS, Lyon, France).
When: Starting in 2021 or 2022 (any time after March 2021).
Duration: A two-year contract.

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 this post-doc will be to develop and implement the methodology to learn committor functions from already produced climate model outputs, using machine learning and stochastic weather generators [3]. 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.

[1] F. Ragone, J. Wouters and F. Bouchet, 2018, Computation of extreme heat waves in climate models using a large deviation algorithm, Proceedings of the National Academy of Sciences, vol 115, no 1, pages 24-29, [pdf].
[2] D. Lucente, S. Duffner, C. Herbert, J. Rolland and F. Bouchet, 2019, Machine learning of committor functions for predicting high impact climate events, *Climate Informatics CI2019 proceedings*, *arXiv:1910.11736*, [pdf].
[3] P. Yiou, 2014, AnaWEGE: a weather generator based on analogues of atmospheric circulation, Geosci. Model Dev., 7(2), 531–543, doi:10.5194/gmd-7-531-2014.

This position is part of the project SAMPRACE, funded by ANR, a collaboration between LSCE, IPSL, Saclay, Paris (Pascal Yiou and Davide Faranda) and ENS de Lyon and CNRS (Freddy Bouchet and Corentin Herbert). The research project gathers groups in physics and statistical physics (LPENSL), computer sciences (LIP/ENSL), and statistics and climate sciences (LSCE, IPSL). The post-doc will participate to the project interdisciplinary discussions and meetings.

- PhD. in machine learning, computer science, climate dynamics, physics or in mathematics is required.
- The position can start any time after March 2021.
- Applicants should send a CV with two recommendation letters to Freddy.Bouchet@ens-lyon.fr
- Web: http://perso.ens-lyon.fr/freddy.bouchet/