Postdoctoral Research Associate position
"Laboratoire des Sciences du Climat et de l'Environnement"
(LSCE, Gif-sur-Yvette, France)
funded by CEA on

Event Attribution of Climate Changes with dynamically driven-Stochastic Weather Generators

Expected starting date: Spring 2018.
Duration: 16 months

Context of the position:

There is an increasing interest worldwide in assessing the extent to which recent extreme weather and climate events can be solely linked to natural climate variability or be significantly altered in frequency or intensity by human-induced climate change (Stott, 2016). Examples are numerous: Paris flood in June 2016, drought in Central Europe in Summer 2015, or the extremely cold European winter of 2009/10. The usual question is to know to what extent such extremes are linked to climate change, and if they are becoming (or will become) more or less frequent. Therefore, the science of "**event attribution**" is evolving rapidly.

This postdoctoral position is part of the European ERA4CS "EUPHEME" project, whose one of the main objectives is to develop state-of-the-art event attribution methods for a range of timescales, and new techniques for evaluating their reliability. The vision of the EUPHEME project is to place extreme weather events in the context of climate variability and change, thereby helping European citizens adapt to a changing climate and mitigate its worst effects.

Scientific context:

Event attribution relies on comparisons of various statistics of extreme events between a "factual world" (i.e., the world as we observe it or at least with the real physical forcings) and a "counter-factual world" (i.e., the world as it would be without one or several given forcings, as human-induced greenhouse gas emissions). Those comparisons are usually performed based on a very high number (1000s of runs) of climate model simulations. One issue is that General circulation models are generally too expensive to be run as long as needed to compute such statistics and at the demanded resolution. Stochastic weather generators (SWGs) are therefore a valid alternative: they are statistical models calibrated on past observations to simulate as many datasets as desired with the same statistical properties [Wilks, 2010, 2012].

Moreover, the dynamics of atmospheric motions depends on the observed atmospheric states. Recently, a technique to measure such state-dependent dynamical properties have been found [Faranda et al., 2017] by the computation of the so-called local dimensions (a measure of the state disorder) and the local persistence. Preliminary studies have shown that such information can be lumped with the statistical model to obtain "conditional SWGs" (e.g., Carreau & Vrac, 2011) providing simulations with a realistic dynamics.

Main goals:

The goal of the postdoctoral research is to provide both a theoretical framework and a numerical tool to build conditional SWGs driven by dynamical systems properties.

- The first step will be to introduce such properties and indicators in simple autoregressive models to mimic the dynamical properties of univariate time series of climate variables and simple dynamical systems.
- Those state-dependent indicators will then be used to condition progressively more sophisticated SWGs (e.g., Vrac et al., 2007), up to spatial models (i.e., simulating fields) for climate variables as wind, temperature or precipitation.

- At each stage, the different conditional SWGs developed will be applied in an event attribution purpose to evaluate the improvements achieved or still needed, depending on the extreme events of interest.

Skills & diploma requested:

The successful candidate should possess:

- A PhD in Statistics, Applied Mathematics, Statistical Physics, Climate sciences or related field;
- Strong bases on stochastic models including their statistical inference;
- A basic knowledge of climate dynamics;
- An excellent knowledge of R (recommended) or Python (second choice) programming languages;
- A basic knowledge of dynamical systems framework will be a plus but is not mandatory;
- English proficiency and attitude to work in an international research environment.

Geographical location & scientific team:

This postdoctoral position will be located at Gif-sur-Yvette (France), in the "Extremes – Statistics – Impacts – Regionalization" (ESTIMR) scientific research team of the "Laboratoire des Sciences du Climat et de l'Environnement" (LSCE). The ESTIMR team develops a methodological research aiming to better understand the climate data: statistical analyses of observations and simulations in order to investigate the variability and identify the trends, modelling of extreme events, detection and attribution of their changes, downscaling, bias adjustment of simulations, uncertainty modelling of climate projections, etc. The ESTIMR team leads and participates to international projects, from pure to more applied science project. The main activity of the team relies on the use and development of advanced statistical models via a strong multidisciplinary interaction among climatology, modelling and statistics.

How to apply: Applications **will be open until January 31, 2018** (or until the position is filled) and have to be submitted by e-mail to M. Vrac (mathieu.vrac[at]lsce.ipsl.fr) and D. Faranda (davide.faranda[at]lsce.ipsl.fr) as soon as possible and must include:

- a CV (max 2 pages + Publication list),
- A statement of research interests describing why the candidate fits the position (max 2 pages),
- The names of at least two references including e-mail addresses and telephone numbers.

More information on the "Extremes – Statistics – Impacts – Regionalization" (ESTIMR) team:
http://www.lsce.ipsl.fr/en/Phocea/Vie_des_labos/Ast/ast_groupe.php?id_groupe=56

More information on the "Laboratoire des Sciences du Climat et de l'Environnement" (LSCE):
http://www.lsce.ipsl.fr/

References:

Carreau, J., Vrac, M. (2011) "Stochastic downscaling of precipitation with neural network conditional mixture models". Water Resources Research, 47, W10502, doi:10.1029/2010WR010128

Davide Faranda, Gabriele Messori and Pascal Yiou. Dynamical proxies of North Atlantic predictability and extremes. Scientific Reports, 7-41278, 2017

Vrac, M., M. Stein, K. Hayhoe. Statistical downscaling of precipitation through nonhomogeneous stochastic weather typing. Climate Research, 2007, 34: 169-184, doi: 10.3354/cr00696

Wilks DS. Use of stochastic weather generators for precipitation downscaling. *WIRES Clim Change* 2010, 1(6):898–907

Wilks, D. S. (2012), Stochastic weather generators for climate-change downscaling, part II: multivariable and spatially coherent multisite downscaling. WIREs Clim Change, 3: 267–278. doi:10.1002/wcc.167