



Editorial to the special issue on Stochastic Weather Generators

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How can we reliably predict climate-related risks ? Many environmental, ecological or agricultural impact studies need daily climate variables, such as temperature, precipitation, total radiation and wind speed as inputs. Modelling coherently the variability of several climatic variables together allows to capture complex interactions that form high-impact weather events and consequently, it is of primary importance for impact studies at fine spatial scales. This could be done with the use of recorded, reanalyzed or global climatic models downscaled series but in many situations they are too short for a proper assessment of the probability of these kinds of events, even for the not so extreme ones. Weather generators (WG) are statistical simulators that produce daily time series of atmospheric variables (Temperatures, Precipitation, Wind speed, etc) with properties resembling those of observed ones, including the dependence structure among the variables as well as their temporal persistence. They have been adopted in impact studies as a computationally inexpensive tool to generate synthetic climatic time series of climatic variables, also known as 'daily weather scenarios', which are required by process-based models (e.g. crop models, electricity demand models).

The four papers presented in this special issue are based on talks given during the first workshop on Stochastic Weather Generators that was held in Roscoff in 2012. This workshop aimed at bringing together a wide range of researchers, practitioners, and graduate students whose work is related to the stochastic modelling of meteorological variables and stochastic weather generators. Topics of interest within this broad framework include : non-linear time series, multivariate time series, non-stationary time series, multiscale models, space-time models, model validation, rainfall, wind, wave, temperature, solar radiation, renewable energy, agriculture, air quality, hydrology, insurance, offshore and coastal engineering,... A second edition of the workshop took place in Avignon in 2014 and the next one is planned in Vannes in mai 2016.

The first paper written by Pierre Ailliot, Denis Allard, Valérie Monbet and Philippe Naveau gives an overview of stochastic weather generators based on weather type models. Weather types classically represent daily characteristics of the relevant atmospheric information at hand. There are many ways to build such weather states, either hidden or observed, and to infer their

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properties. This paper should help statisticians as well as meteorologists and climate product users to understand the probabilistic concepts and models behind weather type WGs, and to identify their advantages and limits.

The second paper written by Jan Bulla, Francesco Lagona, Antonello Maruotti and Marco Picone is an example of weather type model for multiple time series. It deals with the detection of time-stable environmental conditions from air-sea interactions. In each weather type, the wind and wave directions are linked by a multivariate circular von Mises distribution whereas the wind speed and wave height are linked by a multivariate log-Normal distribution. Besides, the transition between the different latent states is modelled by a hidden Markov chain.

In their article, Didier Dacunha-Castelle, Thi Thu Hoang and Sylvie Parey propose a complete methodology to simulate univariate daily air temperature time series. They give a particular attention to extreme values in order to reproduce the extremely cold and warm events observed in real data. The model is based on a non parametric approximation of the seasonality and a discretized time continuous diffusion for the remaining stochastic part of the signal. An adaptative truncation of the innovation process allows to reproduce the specific tails of the stationary distribution of temperature time series.

Finally the article from Anne Cuzol, Jean-Louis Marchand and Etienne Mémin deals with stochastic filtering methods for image data assimilation issues. Data assimilation techniques are widely used in meteorology and they aim at coupling a system state dynamics with partially observed measurements of this system. Such a procedure is essential for instance in forecasting applications to estimate from observed data a good initial state of the system's variables or to calibrate dynamical parameters. In this article, the authors combine the advantage of two well known filters (particle filter and ensemble Kalman filter) and they obtain convincing results for a problem based on a Navier-Stokes dynamic.

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