Réunion MULTIRISK
Projet LEFE/MANU 2014-2016

Conservatoire National des Arts et Métiers (CNAM)

Accès 37 - 1er étage - Salle 37.1.43

2 rue Conté, 75003 PARIS

20 - 21 Novembre 2014

Jeudi 20 Novembre après-midi :

- 14h30 (40' + 5' questions) Gwladys **Toulemonde** (Université Montpellier 2)

  Titre : A flexible dependence model for spatial extremes

  Résumé : In the last decade there has been a major effort to model extremes of spatially dependent data and max-stable processes appeared as natural models for processes of maxima. Max-stable processes arise as an infinite dimensional generalization of multivariate max-stable distributions. The multivariate extreme value theory offers various notions to capture the main characteristics of the underlying dependence structure. A particular one is asymptotic independence. Roughly speaking, the components of a random vector are asymptotically independent if an increasing number of independent copies of it tends to have their rescaled componentwise maxima independent. It is well known that Gaussian vectors are asymptotically independent. Extremal dependence related to max-stable processes is restricted to the notions of asymptotic dependence and exact independence. Some recent studies showed that environmental processes such as rainfalls or waves height exhibit asymptotic independence. Here we propose an hybrid spatial model for extremes allowing to model asymptotic dependence at short distance, asymptotic independence at intermediate distance and possibly exact independence at greater distance. An application to extreme rainfalls data will be given.

- 15h15 (40' + 5' questions) Liliane **Bel** (AgroParisTech)

  Titre : Downscaling of extremes : empirical and theoretical issues. Application to severe precipitation.

  Résumé : General Climate Models (GCM) that are widely used for projections from scenarios usually have a very coarse resolution (up to 250 km grid cells) and cannot reproduce local behaviours such as extreme events. Downscaling techniques have to be used to produce features at a lower scale. In these works we focus on downsclaling techniques that provide simulations on extremes at a local scale according to some information given by GCMs. An empirical approch based on well known downscaling methods and conditional simulations of max-stable processes will be presented together with some theoretical considerations.

16h00 - 16h20 **Pause**

- 16h20 (40' + 5' questions) Julie **Carreau** (HydroSciences Montpellier)

  Titre : Assessing the impacts of the choice of spatial dependence structure for flood-risk rainfall

  Résumé : The Cévennes mountain range lies at the North of the Mediterranean coast in France and peaks at 1699 m. The combination of both the complex orography and the Mediterranean sea influences explain the high variability of rainfall in the region and the occurrence of intense rainfall events which may trigger floods and landslide with dramatic human and material consequences. Hence, the analysis of extreme rainfall is a critical step in the design of civil engineering structures (e.g. dams, reservoirs and bridges) or for urban and landscape planning. Flood risk is measured in terms of high return levels of river runoff. These return levels may be estimated empirically from long series of river runoff. Since these are rarely available, hydrologists often rely on the following procedure : a stochastic rainfall generator simulates long series of pseudo-rainfall observations which are fed to a rainfall-runoff model from which a long series of pseudo-river runoff is obtained.

When using spatially-distributed rainfall-runoff models, spatially- distributed rainfall generators are required. Our goal is to study the impact of the choice of spatial dependence structure of the rainfall generator on (1) spatial features of the rainfall fields such as the spatial average of the simulated rainfall field and on (2) the runoff high return levels. We work in a multivariate framework where each random variable is the rainfall at one site. We focus on the class of rainfall whose spatial average is greater than 50 mm since this might lead to flooding. The Gaussian copula has been often used in stochastic rainfall generators and is taken as our benchmark model. We compare several multivariate dependence structures against the Gaussian copula such as the Student t copula, the Skew Normal and Skew t multivariate distributions and the Heffernan and Tawn conditional model for extremes. When the model does not specify the margins, we used either Gamma or semi-parametric margins with a Generalized Pareto in the upper tail of the distribution. Preliminary results comparing the spatial average of rainfall simulated by the different generators show the following : symmetric dependence structures such as the Gaussian and Student t copulas are not able to reproduce the shape of the distribution of the observed spatial average of rainfall whereas asymmetric dependence structures such as the skew Normal or the Heffernan and Tawn model seem more appropriate. Only the latter model seems to be able to reproduce the upper tail of the distribution, that is the occurrence of heavy spatial rainfall with large spatial average. The evaluation in terms of impacts on flood return levels will be performed at a later stage.

- 17h05 (40' + 5' questions) Davide **Faranda** (CEA)

  Titre : How to understand Atmospheric Dynamics by using the Poincaré recurrences and an Extreme value Theory of Dynamical Systems

  Résumé : We analyze several instrumental time series (temperature data and atmospheric blocking indexes) by using techniques originally developed for the analysis of extreme values of dynamical systems. By assuming that atmospheric dynamics is chaotic, we show how such datasets can be treated as the output of dynamical systems perturbed with noise and by instrument errors. The techniques provides a criterion to discriminate whether the recurrence of a certain event belongs to the normal variability or can be considered as rare events with respect to a specific timescale fixed as parameter. The analysis of temperature data allows for building a map of expected and unexpected temperature ranges that can be adapted according to the desired time window. The analysis of blocking indexes suggests that the transition between zonal and meridional circulations in the northern hemisphere could be linked to the presence of an unstable fixed point of the atmospheric dynamics, rather than the often invoked bistability. Such a behavior is observed by comparing the dynamics of blocking indexes with the one of toy systems (Lorenz equations, Henon attractor) and even with experimental datasets produced in a Von Karman Swirling flow experiment.

- 17h50 (40' + 5' questions) Philippe **Naveau** (LSCE)

  Titre : Simulating non-parametrically multi-variate max-stable random vectors

  Résumé : Multivariate Extreme Value Theory tells us that, under mild conditions, the dependence among multivariate block maxima should be modelled by a non-parametric structure that has to satisfy a few constraints. Currently, a popular approach to simulate multi-variate max-stable processes is to arbitrarily impose a parametric family that is based on a well-chosen Gaussian (or elliptical) seed, e.g. Brown-Resnick max-stable models. Although computationally and mathematically elegant, the drawback of such simulation approaches is that they force parametric dependence structures. In this talk, we will explore other avenues to simulate non-parametrically multi-variate max-stable random vectors. In particular, we will discuss a simulation approach based on a non-parametric estimator of the Pickands functions.

19h30 **Diner**

Vendredi 21 Novembre matin :

- 09h30 (40' + 5' questions) Elena **Di Bernardino** (CNAM)

  Titre : Estimation of extreme Multivariate Conditional-Tail-Expectation

  Résumé : This paper deals with the problem of estimating the Multivariate version of the *Conditional-Tail-Expectation*, proposed by Di Bernardino et al. (2011), Cousin and Di Bernardino (2013). We propose a new extreme estimator for this multivariate risk-measure, which is essentially based on an extreme extrapolation technic. Using the central limit theorem proposed in Cai *et al.* (2014) we provide a central limit theorem for our estimator. We illustrate the practical properties of our non-parametric estimator on simulations. A real

case in environmental framework is also analyzed. The performances of our new estimator are compared to the ones of the Kendall's process based estimator, previously proposed in Di Bernardino and Prieur (2014).

- 10h15 (40' + 5' questions) Anne-Laure **Fougères** (Université Lyon 1)

  Titre : Multivariate Archimax Copulas

  Résumé : A multivariate extension of the bivariate class of Archimax copulas was recently proposed by Mesiar and Jágr (2013), who asked under which conditions it holds. In a joint paper with A. Charpentier, C. Genest and J.G. Nešlehová, we answer their question and provide a stochastic representation of multivariate Archimax copulas. The aim of my talk will be to present this family and explore some nice properties of these copulas. Several examples will also be provided.

11h00-11h20 **Pause**

- 11h20 (40' + 5' questions) Ivan **Kojadinovic** (Université de Pau et des Pays de l'Adour)

  Titre : Tests d'appartenance à la famille des copules de valeurs extrêmes

  Résumé : An overview of existing nonparametric tests of extreme-value dependence is presented. Given an i.i.d. sample of random vectors from a continuous distribution, such tests aim at assessing whether the underlying unknown copula is of the *extreme-value* type or not. The existing approaches available in the literature are summarized according to how departure from extreme-value dependence is assessed. Related statistical procedures useful when modeling data with this type of dependence are briefly described next. Two illustrations on real data sets are then carried out using some of the statistical procedures under consideration implemented in the R package `copula`. Finally, the related problem of testing for the *maximum domain of attraction* condition is discussed.

12h30 **Dejeuner**

Vendredi 21 Novembre Après-midi :

- Discussions internes aux membres du projet LEFE (14h30-16h30)