# Extended extreme-value models with spatial dependence

Lorenzo Dell'oro*[1], Carlo Gaetan[2], and Thomas Opitz[3]

[1]Università di Padova – Italy
[2]Università Ca' Foscari di Venezia – Italy
[3]BioSP-INRAE – INRAE – France

**Abstract**

The spatial modeling of extreme values allows studying the risk of joint occurrence of extreme events at different locations and is of significant interest in climatic and other environmental sciences.
A popular class of models, due to its flexibility and its importance for asymptotic representations, is that of random location-scale mixtures, in which a spatial "baseline" process is multiplied or shifted by a random variable, potentially altering its extremal dependence behavior. Gaussian location-scale mixtures retain benefits of their Gaussian baseline processes while overcoming some of their limitations, such as symmetry, light tails and weak tail dependence.
We review properties of Gaussian location-scale mixtures and develop several novel constructions with interesting features. We leverage their flexibility to propose extended extreme-value models, that allow for appropriately modeling not only the tails but also the bulk of the data. This avoids the uncertainty brought by the need to select an artificial threshold to define extreme values and separate the bulk from the tail.
We propose new solutions for likelihood inference in parametric models of Gaussian location-scale mixtures, in order to avoid the numerical bottleneck given by the latent location and scale variables that lead to high computational cost of standard likelihood evaluations.
The effectiveness of the models and of the inference methods is confirmed with simulated data examples, and we present an application to wildfire-related weather variables.
We also develop an algorithm for conditional simulation from these models, exploiting the Gaussianity of the latent process and making use of a Metropolis-Hastings sampling scheme. This allows for the construction of a stochastic wildfire generator, in which the simulated wildfire risk is used as input.

**Keywords:** Spatial extremes, Gaussian scale mixtures, EGPD, wildfire risk

*Speaker