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Two probabilistic Assimilation Models for Precipitation Maxima

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A very active research field in atmospheric sciences is centered around the modeling of weather extremes. This is mainly due to the large economic and human impacts of such extreme events. In this talk, we focus on the statistical temporal modeling of precipitation maxima because daily and monthly maxima have been recorded for many decades and at various sites.

Our goal is to propose two new statistical assimilation models whose distributional foundations lie in Extreme Value Theory (EVT). Our first model takes advantage of max-stable processes, previously studied by Davis and Resnick (1989), among others. It can be viewed as a "translation" of the Gaussian linear Kalman filter into a Fréchet-type world in which the classical addition $a + b$ has been replaced by the max operator $a \vee b = \max(a, b)$ and the noise component is from a heavy-tailed distribution instead of being Gaussian. Our second statistical assimilation model is built from the mixture extremes framework proposed by Fougères et al. (2007). Its strong points are its flexibility and richness with respect to applications. In addition to addressing the theoretical questions brought by our models, the main benefit of introducing them is to propose simple and powerful connections between EVT and data assimilation communities. Hence, improving our knowledge about the representation of extremes within a mathematically-sound model framework is of strong interest from a data assimilation point of view.