On the guarantees derived from a possibilistic interpretation of ensemble predictions and their operational use

N. Le Carrer

Institute for Risk and Uncertainty, School of Engineering,
University of Liverpool, Liverpool L7 7BD, United-Kingdom

noemie.lecarrer@unive.it

Keywords: *Possibility theory; Decision-making under uncertainty; Reliability; Statistical post-processing; Extreme event prediction; Imprecise probabilities; Risk-averse decision-making*

Abstract

Ensemble forecasting has become popular in weather prediction to reflect the uncertainty about high-dimensional, nonlinear systems with extreme sensitivity to initial conditions. By means of small strategical perturbations of the initial conditions, sometimes accompanied with stochastic parameterisation schemes of the atmosphere-ocean dynamical equations, ensemble forecasting aims at sampling possible future scenarii and ideally at interpreting them in a Monte-Carlo-like approximation. Traditional probabilistic interpretations of ensemble forecasts do not take epistemic uncertainty into account, nor the fact that ensemble predictions cannot always be interpreted in a density-based manner due to the strongly nonlinear dynamics of the atmospheric system. As a result, probabilistic predictions are not always reliable, especially in the case of extreme events. In this work, we investigate whether relying on possibility theory can circumvent these limitations. We show how it can be used to compute confidence intervals with guaranteed reliability, when a classical probabilistic postprocessing technique fails to do so in the case of extreme events. We empirically illustrate our approach with an imperfect version of the Lorenz 96 model, and demonstrate that it is promising for risk-averse decision-making.