PhD position opening at Hydrology Meteorology and Complexity laboratory (HM&Co), École des ponts ParisTech

"Extreme variability of the velocity vector field, high resolution measurements and precipitation/pollution monitoring"

Since its creation in 1747, the oldest engineering school École des ponts ParisTech (ENPC, http://www.enpc.fr) is dedicated to the initial and continuous training of high-level engineers. It strives to be at the forefront of innovation, in permanent liaison with research of a recognised level of excellence, particularly in the domains of planning, construction, transportation, industry, economy and environment.

The Hydrology Meteorology and Complexity laboratory (HM&Co, http://www.enpc.fr/hydrologie-meteorologie-et-complexite) of École des ponts ParisTech develops multiscale observation, analysis and modelling methods adapted to the natural and built environments perceived as complex systems, with a focus on the high variability of climatic, meteorological and hydrological fields over a wide range of scales.

The fast development and deployment of low-cost and more accurate measurement devices — particularly, small polarimetric radars (X-, Ku-band radars) and lidars— have paved the way to high resolution precipitation/pollution monitoring, in particular nowcasting, which would respond to a strong social demand. But at the same time, these devices have underlined the scientific deadlock to break: the vector nature of the wind, a long lasting obstacle to take into account at its full extent the extreme wind variability over a wide range of scales. Indeed, the conventional observables used so far for statistical data analysis, as well as for stochastic modelling, have been scalar ones (e.g., the ubiquitous "structure functions"). They are based on isotropic considerations that are not so much relevant in the atmosphere. Furthermore, they are unable to give insights on the key interactions between the velocity components, but only between scales.

There had been recent developments on multifractal vectors based on the stochastic algebra of their generators that theoretically overcome the aforementioned limitations. However, even for what seems to be the simplest case, i.e., Levy-Clifford algebra, there a large number of parameters, therefore of theoretical choices to be done. This thesis will therefore first investigate the extension to the vector case of analysis techniques to assess multifractal parameters and apply them to various data sets to get some empirically based choices among various candidates. This will enable to proceed to simulations and possibly stochastic forecasts.

This project offers opportunities for fruitful collaborations with the Centre d'Enseignement et de Recherche en Environnement Atmosphérique (CEREA, http://www.enpc.fr/centre-denseignement-et-de-recherche-en-environnement-atmospherique) of École des ponts ParisTech and inside of our collaborative network, in particular with respect to the preparation of the hydro-meteorological monitoring of the 2014 Olympic Games that will be taken as a case study.

Interested candidates with a background in Meteorology, Hydrology, Hydrodynamics and/or Statistical Physics, are encouraged to apply. The contract is for three years. Further details and submission (CV and a letter of motivation): Daniel.Schertezr@enpc.fr