Modelling turbulent dispersion with extreme-value statistics

Context

- Laboratory/location: Team Mistis/Inria Grenoble Rhône-Alpes (Montbonnot).
- Supervisors: Stéphane Girard (Mistis), `Stephane.Girard@inria.fr` and Nicolas Mordant `Nicolas.Mordant@univ-grenoble-alpes.fr` (LEGI)
- Length: 5 months.
- Gross salary: about 500 euros a month.

Objectives

Characterizing the spread of a pollutant released in the atmosphere by an industrial accident such as the nuclear accident in Fukushima appears as a major issue for safety concern of populations. Statistical models of turbulent transport rely to a large extent to the prediction of the average concentration and at best the concentration standard deviation but the distribution of the concentration is strongly non Gaussian so that such information does not accurately predicts the probability of occurrence of exposure to large concentrations. We developed an experimental setup to model the turbulent dispersion of a passive scalar (heat) released by a localized source. An homogeneous turbulent flow is generated in a wind tunnel using an active grid. The source of scalar is a thin heated wire positioned downstream the grid. The time resolved temperature fluctuations have been recorded over long times by a cold wire probe at a collection of positions downstream the source providing a database of the evolution of statistics on a 2D map. This database will be analyzed in the framework of extreme-value theory.

Extreme-value theory is a branch of statistics dealing with the extreme deviations from the bulk of probability distributions. More specifically, it focuses on the limiting distributions for the minimum or the maximum of a large collection of random observations from the same arbitrary (unknown) distribution. Extreme-value theory thus provides a well defined mathematical framework for the modelling of the distribution tails.

In this work we shall use extreme-value theory to model the tails of the temperature fluctuations recorded in the database. In particular, we shall investigate to what extent the tail heaviness depends on the position on the 2D map.

Competences required

The candidate should have a strong knowledge on statistics (extreme-value theory and/or non-parametric statistics would be a plus). Good programming skills in `Matlab` or `R` are also required.