Proposition de stage M2 2016-2017

Numerical simulation of heavy gases dispersion in a turbulent boundary layer

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Illustration 1: Experimental study of dense gas releases at the Nevada Spill Test facility.

The atmospheric dispersion of heavy gases is an active research topic, since industrial hazards related to toxic or inflammable accidental gas releases can have catastrophic consequences for human population in urban areas. Many studies have been led, both experimentally or in field measurements, to measure and predict mean concentration at a given distance from the source, in idealized or complex terrains [Britter & Griffiths 1982, Briggs *et al.* 2001]. However, risk assessment requires limitations on the maximum exposure values of gas concentration. There is now a now a need for the prediction of concentration distribution at a given distance from the source, with a statistical model for extreme values.

Such a prediction relies on a precise determination of concentration gradients in the turbulent core of the gravity current. In this context, series of measurements will be performed at LMFA starting in 2017, by means of CO2-ethane mixture releases in a wind tunnel, in which simultaneous measurements of concentration by FID and velocity by LDA will be performed. Doing so, spatial distribution of the concentration PDF, as well as turbulent velocities in the dense gas phase will be obtained.

The objective of the present proposal is to set-up a numerical benchmark that will be compared to the coming experimental results. First, the dispersion of passive scalars, already measured in H. Gamel PhD [Gamel 2015], will be studied. In this case, the scalar source consists of an horizontal line, a vertical line or a point injection, located at the entrance of the wind tunnel major facilities at LMFA. In the following of H. Gamel's PhD thesis, RANS k-ε simulation (with Code-Saturne and Fluent) will be performed on scaled configurations, and compared to the experimental results. Then, buoyancy terms will be included in the simulation, in order to prepare the comparison with the new results.

At the same time, the candidate will run unstationary simulation using a 2D Lattice Boltzmann C++ scheme developed in the lab, in a first step for the passive scalar, and in a second step with a buoyancy term included in the Boussinesq approximation [He *et al.* 1998, Succi 2001]. This second set of numerical experiment will give access to the spatial distribution of the statistics of concentration values, that will later be compared with the experimental results. First comparison will also be made with the results found in the literature [Briggs *et al.* 2001, Snyder 2001]. If possible, some three-dimensional runs will be tried, and a comparison will be made with the results of the lattice Boltzmann code developped at LMFA.

Références Bibliographiques

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