

Computational Fluid Dynamicsfd Simulations of Air Pollutant Dispersion: Validation of Fire Dynamic Simulator Against the Cute Experiments of the Cost ES1006 Action

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Abstract : Following in-house objectives, Central laboratory of Paris police Prefecture conducted a general review on models and Computational Fluid Dynamics (CFD) codes used to simulate pollutant dispersion in the atmosphere. Starting from that review and considering main features of Large Eddy Simulation, Central Laboratory Of Paris Police Prefecture (LCPP) postulates that the Fire Dynamics Simulator (FDS) model, from National Institute of Standards and Technology (NIST), should be well suited for air pollutant dispersion modeling. This paper focuses on the implementation and the evaluation of FDS in the frame of the European COST ES1006 Action. This action aimed at quantifying the performance of modeling approaches. In this paper, the CUTE dataset carried out in the city of Hamburg, and its mock-up has been used. We have performed a comparison of FDS results with wind tunnel measurements from CUTE trials on the one hand, and, on the other, with the models results involved in the COST Action. The most time-consuming part of creating input data for simulations is the transfer of obstacle geometry information to the format required by SDS. Thus, we have developed Python codes to convert automatically building and topographic data to the FDS input file. In order to evaluate the predictions of FDS with observations, statistical performance measures have been used. These metrics include the fractional bias (FB), the normalized mean square error (NMSE) and the fraction of predictions within a factor of two of observations (FAC2). As well as the CFD models tested in the COST Action, FDS results demonstrate a good agreement with measured concentrations. Furthermore, the metrics assessment indicate that FB and NMSE meet the tolerance acceptable.

Keywords : numerical simulations, atmospheric dispersion, cost ES1006 action, CFD model, cute experiments, wind tunnel data, numerical results

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