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Sensitivity study of OpenFOAM model for local scale atmospheric dispersion simulations

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Computational Fluid Dynamics softwares are becoming more and more popular in environmental modelling, especially for the local scale simulations of the atmospheric dispersion of dangerous materials. However, successful application of a multi-purpose CFD application for atmospheric studies depends largely on the correct model setup. Selection of the appropriate grid, boundary conditions, solvers and turbulence models for atmospheric simulations must be based on detailed sensitivity studies and model verification data. We carried out a sensitivity study of the open-source CFD code OpenFOAM for local scale atmospheric dispersion simulations. Regarding geometry of a few blocks, model sensitivity on flow and scalar dispersion patterns were analysed in several cases with perturbed input meteorology and atmospheric boundary layer parameters. Model error due to limited grid resolution and CPU time was estimated based on several model runs that provide data for the optimization of computational costs. In order to enable the multiple model runs with little or no user interaction, we developed a simple package that enables OpenFOAM to run atmospheric simulations online using continuously provided meteorological data. This investigation forms a basis for further application of OpenFOAM in atmospheric studies. Based on our results, we can optimize computational costs and give a quantitative estimation of the model error due to the uncertainty of input parameters and limited computational capacities. These are the first steps to obtain reliable OpenFOAM model results for complex atmospheric flows.