Abstract Submitted
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Large eddy simulation of a high speed train geometry under cross-wind with an adaptive lattice Boltzmann method RALF DEITERDING, University of Southampton - Aerodynamics and Flight Mechanics Group, MORITZ M. FRAGNER, German Aerospace Center (DLR) - Institute of Aerodynamics and Flow Technology — Numerical investigations in order to determine the forces induced by side wind onto a train geometry are generally not sufficiently accurate to be used as a predictive tool for regulatory safety assessment. Especially for larger yaw angles, the turbulent cross-wind flow is characterized by highly instationary behavior, driven primarily by vortex shedding on the roof and underside geometric details, i.e., the bogie and wheel systems. While industry-typical Reynolds-averaged turbulence models are not well suited for this scenario, better results are obtained when large eddy simulation (LES) techniques are applied. Here, we employ a recently self-developed weakly compressible lattice Boltzmann method (LBM) with Smagorinsky LES model on hierarchically adaptive block-structured Cartesian meshes. Using a train front-car of 1:25 scale at yaw angle 30° and $\mathrm{Re} = 250,000$ as main test case, we compare the LBM results with incompressible large eddy and detached eddy simulations on unstructured boundary-layer type meshes using the OpenFOAM package. It is found that time averaged force and moment predictions from our LBM code compare better to available wind tunnel data, while mesh adaptation and explicit nature of the LBM approach reduce the computational costs considerably.

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