Abstract Submitted
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Nek5000 LES of realistic urban geometries initialized from weather models[1] ALEKSANDR OBABKO, GKHAN SEVER, RAJEEV JAIN, YU-HSIANG LAN, Argonne National Laboratory, PAUL FISCHER, University of Illinois at Urbana-Champaign, HAOMIN YUAN, ROBERT JACOB, CHARLIE CATLETT, MISUN MIN, Argonne National Laboratory — In the atmospheric modelling community, urban boundary layers have been generally treated using mesoscale models where a presence of obstacles are taken into account by paramaterizations of the urban (or vegetation) canopy. There are not enough CFD-quality observations to validate the momentum and heat transfer in these models for all cases of interest. We seek to improve parametrization and complement observations with CFD reference solutions using an open-source CFD solver Nek5000. High scalability combined with high-order discretization and low count of degrees of freedom per processor allows an efficient exploitation of high-fidelity approaches like large-eddy simulation (LES) in complex geometries. With initial and boundary conditions derived from a High-Resolution Rapid Refresh (HRRR) initialized WRF-urban model, we have performed wall-resolved Nek5000 LES of realistic urban geometries including Lake Point Tower and Goose Island regions of Chicago. These preliminary simulations suggest we have the capability to start modelling the flow in any city geometry assuming a proper mesh can be built. Extending these reference simulations to larger domains will be possible with upcoming exascale supercomputers while longer simulation times may still remain a challenge.

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