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Effects of time-dependent inflow perturbations on urban flow

Keith Ngan, Guangdong Duan, and Ghar Ek Lau
School of Energy and Environment, City University of Hong Kong, Kowloon, Hong Kong

Although urban flow and turbulence are driven by unsteady mesoscale winds, building-resolving urban-scale models typically employ steady Dirichlet boundary conditions or forcing. Hence their accuracy could be limited by the neglect of perturbations. This work investigates the effects of time-dependent inflow perturbations on flow in idealised and realistic domains. Using large-eddy simulation and a single street canyon, it is shown that the response of the velocity field (namely the error kinetic energy) is maximised for perturbation periods comparable to the timescale of the mean circulation. It is argued that the behaviour arises from a resonance between the inflow forcing and the mean motion around closed streamlines. The robustness of the results is verified using perturbations derived from measurements of roof-level winds. The extension to regular building arrays and realistic urban geometry is described.