

A New Single-Layer Urban Canopy Model for Use in Mesoscale Atmospheric Models

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Abstract

A new single-layer urban canopy model is developed and its performance is evaluated. The urban canopy model developed is different from other models in that (1) two walls are separately considered and (2) a computational fluid dynamics (CFD) model is used to estimate street canyon-averaged wind speed. By treating two walls separately, sunlit and shaded walls are determined by street canyon direction and local time. Since the amount of solar energy arriving at each wall is different, wall temperatures are not identical. These different wall temperatures affect sensible heat fluxes as well as longwave radiation, and thus energy balance in the street canyon. Through extensive CFD model simulations of street canyon flows with different canyon aspect ratios and ambient wind directions, the ratio of street canyon-averaged wind speed to ambient wind speed is regressed as a function of canyon aspect ratio and angle between ambient wind direction and street canyon direction. The urban canopy model is validated using two field measurement datasets (Marseille, France and Basel, Switzerland). Simulation results are in good agreement with observations.