Evaluation of shortwave radiation fluxes in the multi-layer SPARTACUS-Urban scheme using DART

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The heterogenous structure of cities impacts radiative exchanges (e.g. albedo and heat storage). Numerical weather prediction (NWP) models often characterise the urban structure with an infinite street canyon - but this does not capture the three-dimensional urban form. SPARTACUS-Urban (SU) - a fast, multi-layer radiative transfer model designed for NWP - is evaluated using the explicit Discrete Anisotropic Radiative Transfer (DART) model for shortwave fluxes across several model domains – from a regular array of cubes to real cities.

SU agrees with DART (errors < 5.5% for all variables) when the SU assumptions of building distribution are fulfilled (e.g. randomly distribution). For real-world areas with pitched roofs, SU underestimates the albedo (< 10%) and shortwave transmission to the surface (< 15%), and overestimates wall-plus-roof absorption (9-27%), with errors increasing with solar zenith angle. SU should be beneficial to weather and climate models, as it allows more realistic urban form (cf. most schemes) without large increases in computational cost.