A LES-benchmark case for surface solar irradiance variability under shallow cumulus

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Shallow cumulus clouds drive strong variability in space and time in surface solar irradiance, with shadows and bright spots due to reflection of light off cloud edges. Due to the tight coupling of the land surface, boundary-layer turbulence, cloud processes, and cloud-radiation interactions, our understanding of surface irradiance variability is still incomplete. Hence, our capacity to forecast it is limited. With large-eddy simulations we can very well simulate shallow cumulus convection, but producing realistic patterns of surface solar irradiance remains a challenge. We present here a LES-benchmark case for irradiance variability based on observations of a shallow cumulus day in August 2018 in Cabauw, The Netherlands. We compare the ability of the MicroHH model with the new 1D RTE+RRTMGP radiation code and the DALES model with the 3D TenStream solver in reproducing 1 Hz-observations of direct and diffuse radiation, near-surface meteorology, and cloud macrophysical properties.