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# MEASURED AND (SURFEX) MODELLED ENERGY BUDGETS IN A SEMI-URBAN ENVIRONMENT IN HELSINKI OVER ONE YEAR


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Abstract :

Conditions at the SMEARIII tower in Helsinki during the year of 2010 were simulated using SURFEX version 7.1 in an off-line mode, with atmospheric forcing taken from measurements in the tower. The tower is located on a small hill, with a busy road and large buildings to the north and east, and the University botanical gardens to the west. The complexity was simulated by running the model for three different scenes, having physiographic characteristics corresponding to local land use in three different sectors around the tower. The model output to be compared with the observations was then determined by choosing the appropriate sector according to the direction of the wind.

Forced with local atmospheric data, the model yields realistic annual cycles of radiative and turbulent surface fluxes, featuring (for the nature tile) a nearly closed surface energy budget, with only a small negative net annual residual. While the sum of sensible and latent heat fluxes matches the observations closely, larger discrepancies are present in the individual fluxes, leading to a significantly overestimation of the summer time Bowen ratio.

The winter of 2010 was characterised by a heavy snow cover, greatly influencing the surface energy budget, as can be seen in the daily evolution of the surface sensible heat flux (black and red) at the time of snow melt, displayed in the adjacent figure together with the snow water equivalent (blue). The disappearance of the snow cover is associated with a dramatic increase in the day-time sensible heat flux, well captured by the model.

As with the annual cycles, realistic mean diurnal cycles of radiative and turbulent fluxes are obtained for the summer time, although the overestimated Bowen ration noted earlier is clearly evident in the day-time fluxes. Another feature of the model, not matched by the observations is the total vanishing of turbulent heat fluxes at night.

A similar night-time quiescence is seen in the turbulent momentum flux, which is also significantly underestimated in the model (red). Things are improved at day time in a parallel experiment not making use of the surface layer parametrization (CANOPY), but the night-time difference remains.

The parametrization of space heating and inside temperature were found to yield too cool inside temperatures both summer and winter, and a modification to the evolution equation of the inside-temperature is proposed.



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