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The influence of thermal soil and vegetation characteristics on the ground heat flux and temperature

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Land surface processes have a significant impact on near-surface atmospheric phenomena. They determine, among others, near-surface sensible and latent heat fluxes and the radiation budget, and thus influence atmosphere and land characteristics, such as temperature and humidity, cloud formation, and the structure of the planetary boundary layer. It is therefore important to simulate the land surface processes in atmospheric models as realistically as possible.

Verifications have shown that the ground heat flux computed by the land surface scheme of the COSMO Numerical Weather Prediction model of the German Weather Service (DWD) tends to be systematically overestimated. Since this flux is part of the surface energy balance it affects the other components like the turbulent heat fluxes and the surface temperature. This means, an overestimation of the ground heat flux during daytime leads to an underestimation of the other surface fluxes and a reduced surface warming. During afternoon and night the opposite behaviour is obtained.

Data from the DWD Meteorological Observatory Lindenberg were used to analyse this model behaviour. In sensitivity experiments it turned out that the simulated ground heat flux is particularly influenced by the thermal conductivity of the soil and its dependence on the soil moisture, but also by the shading effect of the incoming solar radiation due to the vegetation cover.