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Model simulations of air temperature and humidity above forest stands

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The presented paper aims to quantify the influence of the underlying surface created by forest stand on air temperature and humidity conditions in the surface layer of the atmosphere above the canopy. For this purpose an experimentally verified mathematical model was designed, verified and applied to simulate daily courses of air temperature and vapour pressure deficit above a homogeneous spruce forest. The used methodical approach simplifies the basic scheme of the soil-vegetation-atmosphere system incorporating the relationships between energy fluxes and vertical profiles of air temperature and humidity in the fully developed convective boundary layer of the atmosphere into considerations. The model combines and extends the previous works creating a modification of the classical scheme of SVAT models to a microclimatic model being quite realistic in outputs and simple enough to be applied in various conditions. The verification of the model has been carried out on the basis of the profile microclimatic measurements performed in and above a spruce monoculture. This experimental verification has revealed that the model is able to explain the major part of daily variability in air temperature and saturation deficit in the lowest air layers above the forest. Consequently, the model appeared to be a suitable tool for a quantitative analysis of air temperature dynamics above homogeneous forest stands. Based on the model simulations, the surface and atmospheric effects on air temperature and humidity were separated that enabled to express the partial dependences of individual plant characteristics and soil moisture in the root zone on temperature and humidity conditions above the forest stand. Obtained results indicate that the stomatal resistance and physiological control of transpiration has a great importance for time variability of air temperature and the saturation deficit above dense vegetation. Besides other plant

characteristics, also the degree of the root system development turned out to be an important factor affecting primarily the transpiration and finally air temperature and humidity above extended vegetated surfaces. It was shown that soil moisture in the root zone had a potential to make a critical impact on the energy balance structure of vegetated surfaces and consequently on the air temperature and humidity near the evaporative surface.