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A sensitivity of CO_2 and H_2O exchange of forest ecosystems in South-European taiga to climate changes

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A sensitivity of CO_2 and H_2O exchange of spruce forest ecosystems of European part of Russia to projected future climate changes was provided using results of modeling experiments. A process-based model Mixfor-SVAT was used to derive energy, water and CO_2 fluxes between spatially uniform and vertically structured mono- and multi-species forest stands and the atmosphere (Olchev et al. 2002, 2008, 2009). To describe possible climate changes in the study area for the period up to 2100, the modeling results provided by the ECHAM5 global model (MPI Hamburg, Germany) were used (Roeckner et al. 2003). ECHAM5 reanalysis dataset (Roeckner 2004) was used to quantify present climate conditions. To generate the future meteorological conditions the moderate A1B emission scenario (IPCC 2007) was selected. To describe possible dynamics of the vegetation cover paleoenvironmental reconstructions of the past epochs were used as analogies for future projections (Olchev et al 2011).

Results show that projected climate changes (SRES scenario A1B) and changes of forest species composition at the end of 21 century can lead to insignificant increase of annual evapotranspiration as well as to growth of net ecosystem exchange of CO_2 of the forests in case if the projected increase in temperature and CO_2 in the atmosphere will be strictly balanced with growth of available amounts of soil nutrients and water. Reduction of available nitrogen in soil and above-ground biomass in the future can result in decrease of net ecosystem exchange of CO_2 and evapotranspiration of forest ecosystems. Minor changes of evapotranspiration of spruce forests in comparison with projected growth of precipitation amount in the area (SRES scenario A1B) can lead to increase in soil moistening and for waterlogged areas with peaty soils even to intensification of paludification processes.

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