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Dynamics of the carbon cycle functioning in Russian peatlands under the climate change

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A series of dynamic compartment models of carbon cycle functioning with elements of nitrogen cycle is designed and verified based on data for several bog ecosystems in the European part of Russia. Flow dependencies account for saturation functions and recipient flows. Possible steady states with elements of nitrogen cycle allow one to distinguish different types of bogs (raised, mesotrphic etc.) and some forest states. Stability and bifurcation analysis, as well as numerical modeling of transient non-equilibrium dynamic regimes, is carried out in the space of three parameters corresponding to intensities of atmospheric carbon assimilation by vegetation, output runoff from soils and litter, decay of dead organic matter by animals and microorganisms. Atmospheric CO_2 concentration increase leads to appearance of oscillations in system compartments or transition to another equilibrium states depending on two other parameter values. Numerical simulations allow to estimate stability boundaries of bog types and to calculate critical values of external carbon fluxes for which stable functioning of carbon cycle is provided. Change in climatic parameters initiates a model shift in parametric space corresponding to evolution of the carbon cycle functioning in the ecosystem. Using estimations for peatland areas of different types in some regions of Russia, estimations of flow coefficients, critical values of external carbon fluxes are calculated, and future dynamics of carbon emission from peatland surfaces under the climate change is studied.

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