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ECOMAG: a distributed model of runoff formation and pollution transformation in river basins

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Abstract The ECOMAG model consists of hydrological and water quality submodels, which operate at a daily time step. The hydrological submodel describes the main processes of the terrestrial hydrological cycle: snow accumulation and melting, soil freezing and thawing, water infiltration into unfrozen and frozen soil, evapotranspiration, the thermal and water regime of soil, and the lateral surface, subsurface, groundwater and channel flow. The water quality submodel describes the processes of pollutant accumulation on the surface, dissolution of pollutants by rain or snowmelt waters, penetration of soluble pollutants into soil, interaction with the soil solution and soil matrix, and biochemical degradation of pollutants. The transfer and transformation of pollutants in the river system are described, taking into account the lateral diffusive inflow of pollutants by surface, subsurface and groundwater flows, the load from point sources of pollutants discharged to the rivers, the exchange of pollutants between the river water and river bed. An application of the hydrological and water quality submodels is shown for simulating water quality dynamics in river basins of the Kola Peninsula which is exposed to intensive pollution from the Pechenganickel Industrial Complex. Simulated nickel concentrations in river water are compared with the corresponding observed data. Results of modelling experiments are presented to illustrate the impact of Pechenganickel on water quality in river channels.

Key words ECOMAG model; river basin; runoff formation; nickel; pollution transformation; water quality; Russia