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WATER RESOURCES AND THE REGIME OF WATER BODIES

Scenario Prediction of Changes in Water Balance Components in the Lena Basin in the Context of Possible Climate Changes

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Abstract—The dynamics of meteorological elements in the Lena R. Basin is predicted for the XXI century under four IPCC global scenarios of SRES family, corresponding to specified scenarios of the economic, technological, political, and demographic development of the civilization. The obtained predictions are used to simulate variants of possible changes in water balance components in the Lena Basin up to the mid-XXI century. The calculation procedure is based on the use of land-surface model SWAP and a climate scenario generator MAGICC/SCENGEN.

Keywords: water balance components, climate change scenarios, interaction between land surface and the atmosphere, physically based simulation, global databases, Lena R. basin

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INTRODUCTION

The polar region, which largely governs the hydrological processes and water resources of the Northern Hemisphere, will suffer the earliest and deepest changes caused by climate changes [14]. The Arctic causes especial concern in the context of the effect of climate changes on water resources of the polar regions. The Pan-Arctic basin shows a huge diversity of water resources, including many world's largest rivers. At the same time, IPCC reports [16–18] predict the temperature and precipitation in the Northern Hemisphere to increase by the late XXI century by ~3–5°C and 15%, respectively.

In this context, a problem to be solved is the prediction of changes in water balance components of northern rivers under possible climate changes in the region. The focus of this study is to assess the changes in water balance components in the basin of the Lena, the largest river in East Siberia, up to the mid-2060s. A detail physiographic description of the Lena R. is given in [9].

THE MAIN PRINCIPLES IN THE METHOD OF SCENARIO PREDICTION OF CHANGES IN WATER BALANCE COMPONENTS OF NORTHERN RIVER BASINS UNDER POSSIBLE CLIMATE CHANGES

The problem formulated in this study was solved with the use of the method of scenario prediction of changes in water balance components of northern river basins under possible climate change, developed in [2, 3]. The method is based on the land surface model Soil Water – Atmosphere – Plants (SWAP) [5, 6, 21], global datasets on land surface characteristics and scenario predictions of changes in the meteorological characteristics in the region of the basin under consideration in the XXI century. The predictions are based on climate scenarios constructed with the use of the changes in the emission rates of greenhouse gases and aerosols into the atmosphere under chosen scenarios of the socioeconomic development of the civilization. The IPCC climate scenarios used in this study are the same as those used in [11], i.e., SRES family scenarios (Special Report on Emissions Scenarios): A1, A2, B1, B2 [26]. These scenarios were used to develop the Third IPCC Assessment Report at the Seventh Conference of the Sides of the United Nations Framework Convention on Climate Change (Marrakesh, Morocco, November 7, 2001). The scenarios incorporate a wide range of assumptions regarding the changes in greenhouse emission rates, depending on whether certain types of special policy will be implemented by the humankind in the sphere of impact on climate.

Prognostic series of meteorological forcing data with a three-hour step for period 2000–2063 were prepared for each climate scenario. These data were based on the results of calculating climate characteristics, averaged over an ensemble of 16 general atmospheric circulation models [24]. The obtained three-hour prognostic meteorological forcing data, as well as sim-