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Investigations and modelling of flow dynamics in the microtidal delta of the Pechora River

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Abstract

The Pechora is the greatest river of the Russian European Arctic flowing into the South-Eastern part of the Barents Sea named 'the Pechora Sea'. The mouth area of the Pechora River includes vast delta with anastomosing distributary network and extensive lowlands subject to inundation by excessive river runoff as well as to flooding by tidal and surge water level oscillations. During low water season tidal waves, wind surges and reversed currents can progress along the main delta channels toward the delta top (120 km) and even further upstream.

The annual runoff of the Pechora is about 151 km^3 with the maximum in spring snow melting when the peak discharge can achieved 39,200 m^3/s. The low-flow runoff is about 2,500 m^3/s in summer and 500 m^3/s in winter. The tidal regime of the Pechora Sea semi-diurnal, the tidal range is about 1 m for spring tides and 0.5 m for neap tides.

The computer model for research of inundating regime was developed, and hydrological risk for the city of Naryan-Mar and minor settlements in the delta was assessed for floods of various genesis. The model also allows to trace a pollution dissemination amidst the delta branches. The model is developed using STREAM_2D software. The calibration and verification of the model is executed on the basis of field data secured mainly in August 2020, regime data of state gauging stations also was used. The complex use of the modern hydrological and geodetic equipment made it possible to reveal previously unknown features of the cyclical changes in hydraulic parameters of the delta branches caused by tidal fluctuations in the sea level.

The model can be used both for the retrospective analysis of floods and pollution impacts, and for scenario simulations and hydrological forecast.

Keywords

runoff distribution, delta branches, flood risk, tidal cycle