Sediment flow at the river mouths of the permafrost zone (limited to 2 lines)

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Introduction: Climate changes influence all factors which determine the hydrological regime of the river mouth areas. Climate conditions of the arctic region are characterized by extremely irregular input of solar radiation over the year and intensive cyclonic action. At present search of shelf deposit results in active lands development of coastal regions of Arctic Ocean, which are located in permafrost zone. In the permafrost zone icy base of landscapes is the stabilizing factor during the natural evolution and it becomes an aggravating factor promoting destruction of natural landscapes under man-caused loading. Thaw of grounds in the river mouths would provoke a change of the factors determining their hydrological regime, abrasion of banks at coastal zone of Arctic Seas, floods, etc. Climate changes in the areas of the upper reaches of the rivers also influence the regime of river mouths as they cause changes of water and sediment flows, of ice thickness, ice phenomena duration.

In this work we discuss water and sediment flows of the rivers (W_w km^3/year, W_s mln tons/year), flowing into the Arctic Seas of Russia, the mouths of which are located in permafrost zone: Pechora (Barents Sea), Ob, Pur, Taz, Yenisei, (Kara Sea), Khatanga, Olenyek, Lena, Yana (Laptev Sea), Indigirka, Kolyma (East-Siberian Sea). We compare magnitudes of W_w and W_s with those for the rivers Mackenzie (Beaufort Sea, Canada), Colville and Yukon (Alaska, USA).

Methods: Several factors have an effect on volume of sediment flow of a river, the main of which are the following: watershed area, river discharge, streamflow regulation, geological structure of a river basin. Comparative analysis of dependency $W_s \sim f(W_w)$ for rivers, mentioned above, is used in the paper. We consider the role of magnitudes of the river watersheds and presence of dams and reservoirs at the upstream reach of the rivers. The sources of data are the following: on Russian rivers [1, 2], Mackenzie [3], Colville [4, 5], Yukon [6]. We also discuss different types of frozen grounds at the upper and lower reaches of the rivers.

Results: During the period 2001–2005 climate warming in the North of Russia is estimated on average as very low – about +0.1°C, which occurs mainly in the cold season [1]. Ice free period fluctuations at the coastal of the Arctic Seas are synchronous with those of the average annual air temperatures. Under the warming the mean annual discharge of a middle river (Olenek) increases, while the discharge of the large regulated River Yenisei is practically stable. Average values of water and sediment flows, which are presented in Table 1, were carefully analyzed.

Table 1. Annual runoff and sediment flow of the rivers under consideration.

River	W_w, km^3/year	$W_s \cdot 10^6$ tons/year
Pechora	130	8.5
Ob	402	13.0
Pur	32.3	0.6
Taz	43.4	0.9
Yenisei	597	4.9
Khatanga	105	5.2
Olenyek	36.1	1.2
Lena	528	22.7
Yana	31.9	4.2
Indigirka	54.0	11.9
Kolyma	118	12.3
Mackenzie	350	**130**
Colville	15.8	5.8
Yukon	205	**20**

Discussion: The dependence of W_s of the rivers, located in cryosphere, on different factors is considered. The origin of the extremely large sediment flow of the Mackenzie River is examined.

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