# Changes of sediment flux of secondary branches at pan-Arctic deltas

**Elena Dolgopolova[1], Maria Isupova[1]**

[1]Water Problem Institute, Russian Academy of Sciences, Gubkina str. 3, 119333 Moscow, Country

Phone: +00-(7)-0499-1357201

E-mail: dolgopolova@gmail.com

**Introduction:** Modern climate warming provokes increase trends of annual water discharge <*Q*> of the rivers flowing in permafrost and emptying into the Arctic Ocean. Growth of active layer depth assisted by increase of surface temperature [1] contribute to water and sediment river fluxes. Arctic deltas are forming under competitive influence of growing water discharge and sea ice retreat due to air temperature increase. These changes affect river mouths formation at the Arctic coast. The impact of growing water discharge, permafrost melting and sea ice retreatment on sediment transport flux $W_S$ and delta morphology is not well understood. Our investigations of water flow *W* distribution among delta branches of the rivers Lena and Mackenzie show redistribution of the flow into the secondary channels as water flow at the delta head increases [2]. This study presents change of <*Q*> for the rivers listed in Table 1; distribution of water flow among delta branches as water discharge *Q* at delta head increases; varying *Q* and $W_S$ impact delta morphology.

**Table 1**. Change of <*Q*> and sediment flux of the rivers under consideration.

| River | <*Q*>, $m^3/s$ | $\Delta Q/<Q>$, %/yr | $W_s \cdot 10^6$ tons/yr |
|---|---|---|---|
| Pechora | 4231 | 0.24 | 8.5 |
| Lena | 17178 | 0.21 | 22.7 |
| Yana | 1063 | 0.61 | 4.2 |
| Indigirka | 1603 | 0.18 | 11.9 |
| Kolyma | 3162 | – 1.7 | 12.3 |
| Mackenzie | 9261 | 0.21 | 128 |
| Sagavanirktok | 48.3 | 1.19 | 1.0 |

**Methods:** Mean annual river discharges <*Q*> were calculated using data on the daily from [3, 4]. Changes of water discharges for branches of Mackenzie delta were estimated by the data of [5, 6], for Sag River of [7], for Russian rivers of [8]. From trend lines for <*Q*> we estimated increase of *Q* for secondary branches and then using approximate dependence of sediment discharge *R* on *Q*. Further analysis of sediment transport to the sea edge of river deltas enables one to estimate contribution of secondary channels to the sediment flux of a delta into the sea.

**Results:** All rivers mentioned in Table 1 show increasing <*Q*> excluding strongly regulated Kolyma River. The tendency of redistribution of water flow into secondary branches as *Q* grows noted earlier [2] is confirmed for the rivers under consideration (Fig. 1).

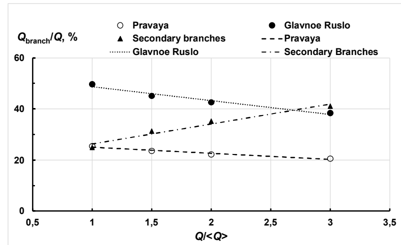


**Fig. 1:** Distribution of *Q* (%) among branches of the Yana Delta.

**Discussion:** Assuming approximate proportion dependence $W_S \sim W$ we analyze sea edge of deltas at the mouths of secondary branches by cosmic photos [2, 9, 10]. All secondary channels take part in forming of mouth bars (Pechora, Lena, Yana, Indigirka, Sagavanirktok [Google Earth]) or filling narrow bays (Kugmallit Bay, Mackenzie; Kolymsky Bay, Indigirka). It is necessary to note the role of retreating sea ices at the Arctic coast which releases more area for wave forming, strengthen of erosion of frozen grounds and limit protruding deltas into the sea.

**Acknowledgment:** The work is supported by state program № 0147-2019-0001, registration AAAA-A18-118022090056-0

**References:** [1] Hansen et al. (2017) *Global temperature*: 1–5; [2] Dolgopolova, Isupova (2020) *Proc. IV Vinogradov conf.* **I:** 440–444; [3] http://www.arctic.noaa.gov; [4] https://waterdata.usgs.gov; [5] Carson et al. (1998) Arctic **51**: 116–124.; [6] https://wateroffice.ec.gc.ca; [7] Hodel (1986) *USA Geological Survey*:1–28. DOI: 10.3133/ofr86267; [8] Magritsky et al. (2013) *Proc. of HP1, IAHS-IAPSO-IASPEL Assembly, Sweden, IAHS Press*: 67–79; [9] Kravtsova, Mit'kinykh (2013) *Atlas of space pictures*: M: Science World: 124; [10] Korotaev et al. (2017) *Atlas: Arctic mouths of Russia* M: APR: 148.