Trace metal and nutrient fluxes into Arctic ocean by largest Siberian rivers (ArcticFlux)

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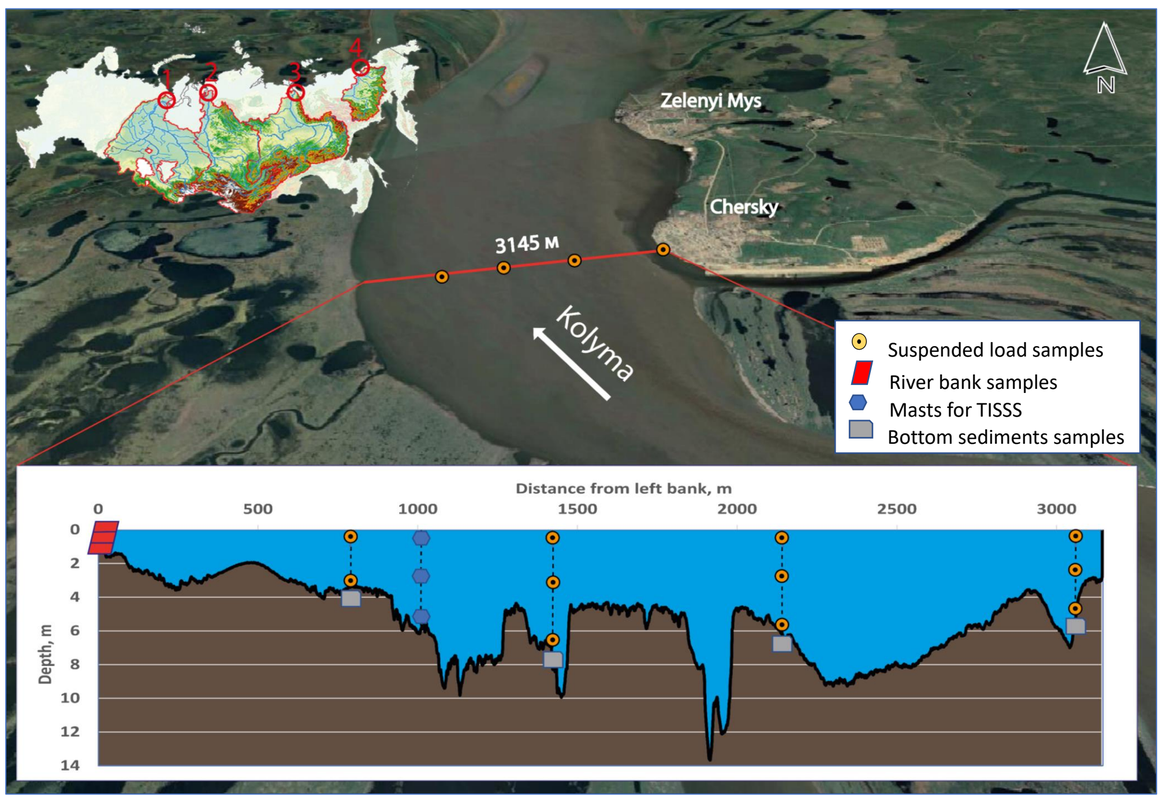


Introduction

The aim of the study (**ArcticFLUX** project) is an **assessment of water, chemical and sediment runoff**, as well as the **determination of the main sources of suspended solids and pollutants at the river mouth of largest Siberian rivers (Ob(1), Yenisei(2), Lena(3), Kolyma(4)**.

The objectives are:

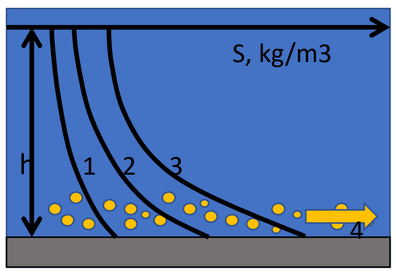
- Generalization of existing databases on water, chemical and sediment runoff.
- Assessment and estimation of the water runoff and sediment runoff using a new measurement methods. Measuring total (bed and suspended) sediment flux in large rivers using ADCP and Rouse model. Obtaining high-resolution grid distribution of sediment concentrations over crossection – Constructing annual flux
- Identification of processes affecting sediment runoff and transformation in deltaic zones
- Assessment of particulate metal transport into the Arctic seas.
- Creation of a database of hydrological data on the largest rivers of the Russian Arctic.

Methods

For this research a new sampling technique throughout the river section was used. The modern Acoustic Doppler Current Profiler (ADCP) acquisitions with sediment depth profile sampling methods provide a unique detailed view of the flow of particulate matter.

The use of the Rose model helps to determine the flow rate of sediments in the bottom layers. The calibration of the model could be made with the use of field turbidity data.

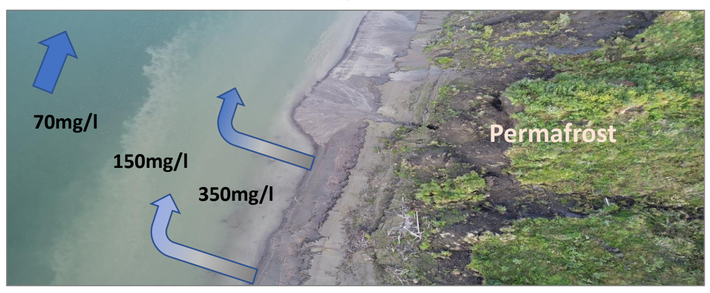
Modeling of total sedimentary load based on ADCP data using the Rouse approach and than calculation of sediment flows and trace metal flows for the entire crossection (taking into account local factors) make it possible to assess particulate metal transport into the Arctic seas.



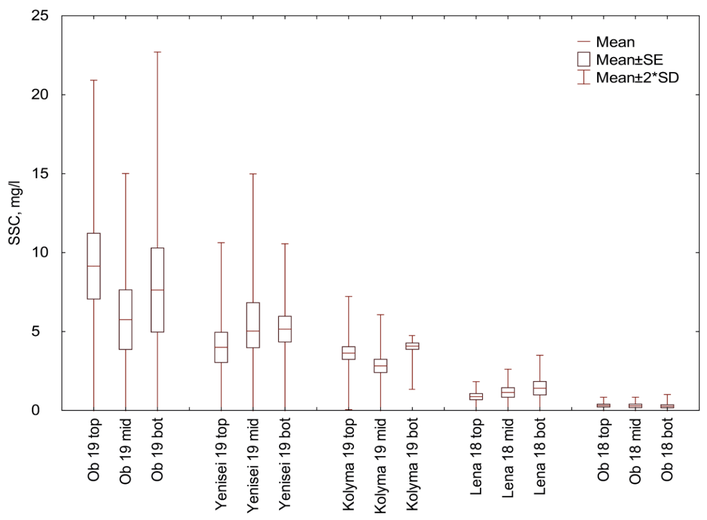
General scheme of distribution of suspended sediment in the stream

The main reasons for the variability of suspended sediment concentrations in river crossection:

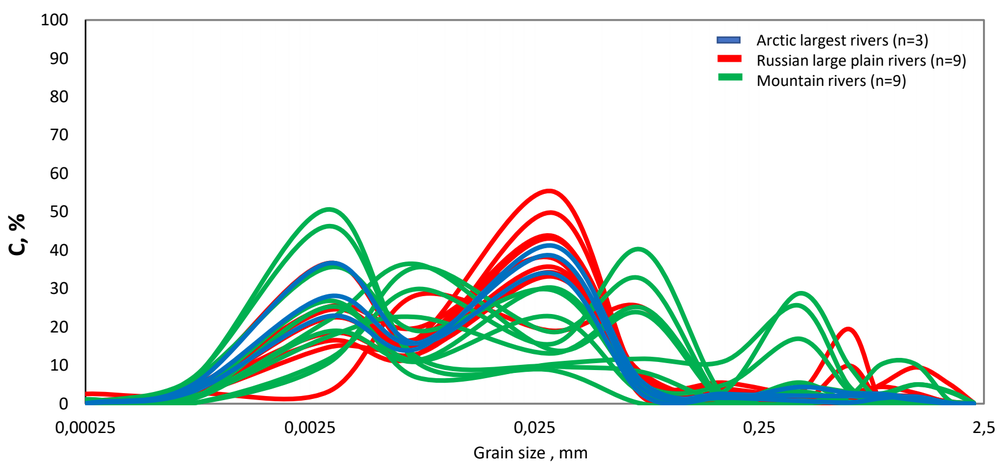
- **tributary confluence**
- **wind influence**
- **permafrost thawing**



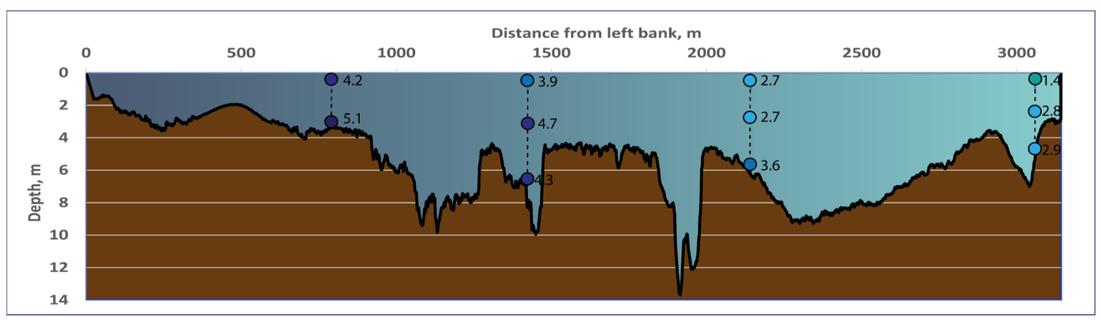
Sediment flow along the Kolyma river bank in permafrost melting area



SSD concentrations in Arctic rivers according to field data



Comparison of grain size distribution from large Arctic rivers to small mountain rivers

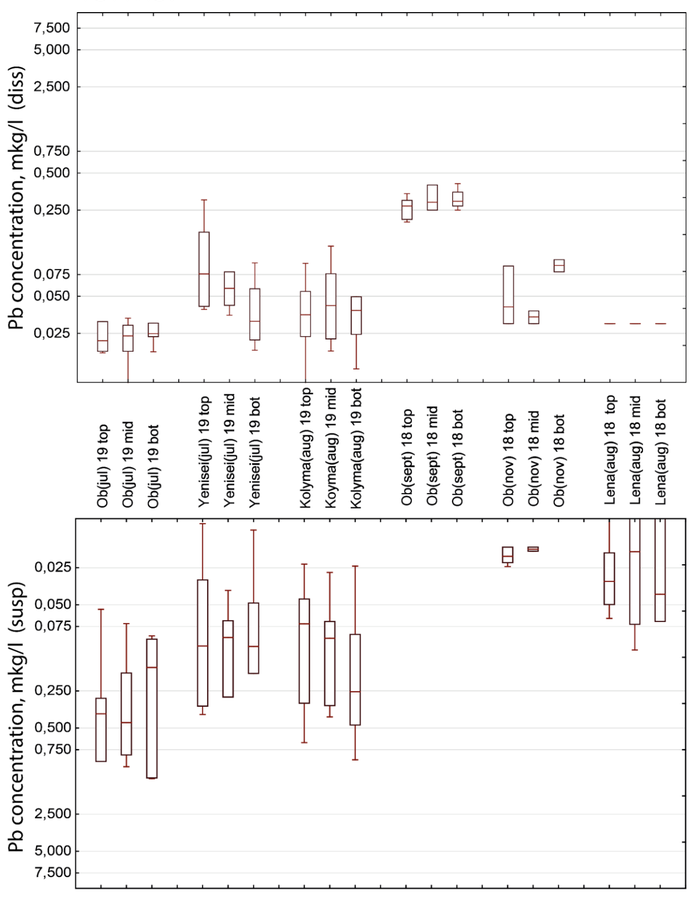


Distribution of suspended sediments in the Kolyma river section.
(Reduced turbidity at the right Bank is associated with the confluence of large right tributaries upstream (Omolon, Anui river). On the left Bank there is an intensive melting of permafrost)

Trace metal and sediments sampling campaigns

Observations were made for high and low water regime periods on the regular basis, and the total number of samples today exceeds **210**.

- For each sample analyses were made for trace metals (**68 elements**) (by ICP-MS), nutrients and dissolved and suspended organic carbon matter content both in dissolved and particulate (suspended and bed loads) forms.



Example of trace metal concentrations (Pb) distribution in dissolved and suspended form for the studied basins

The influence to trace metal concentrations

Concentrations of trace metals are strongly dependent on the horizon in the water stream. All metals in suspension shows correlation (0,53-0,69) with grain size fraction 0,005-0,05 and with average sediments diameter (0,61-0,76). This fraction accounts for about 40% of the sediment contained in the waters of Arctic rivers. The strong relationship between the particle size and the concentration of heavy metals in the suspension allows us to consider concentrations as a function of the granularity of sediment.

- As a result of combining data on the chemical composition of sediments, as well as the granulometric composition, it will be possible to obtain values of the annual flow of trace metals in Arctic rivers.
- The use of ADCF method and the Rouse model will help to reduce errors in the determination of chemical fluxes.
- The contribution of vertical and transverse variations to runoff estimations, including requirements for sampling strategies, will be determined.

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