



## **Grand Siberian Rivers and estuaries: nowadays evolution of dangerous ice phenomena resulted in changeability of fresh water discharge**

(1) **V. Melentyev**, (1) L. Bobylev, (2) O. Johannessen, (2) L. Pettersson, (2) S. Sandven, (2) K. Kloster

(1) Nansen International Environmental and Remote Sensing Centre, St Petersburg, Russia, (2) Nansen Environmental and Remote Sensing Centre (NERSC), Bergen, Norway,  
(vladimir.melentyev@niersc.spb.ru / Phone: + 7 812 234 39 24)

Dangerous ice phenomena and ice cover parameters in the Ob-Yenisey region are studied by using satellite ERS/RADARSAT/Envisat SAR images, obtained in 1993-2003. NERSC/NIERSC archive of SAR data contains the observations of ice freezing, ice development and destruction of ice as well it fixes the processes of ice and water exchange between the rivers and the Ob-Yenisey recurring polynya. The reconstructions of the history of ice formation are provided with comprehensive using optical and radio-physical satellite observations. For that satellite "Resourse" visual and IR images of the Grand Siberian Rivers and contiguous parts of the Kara Sea that were received in Salekhard satellite station were attracted.

The Ob Bay and Yenisey Gulf are the vast expanded zones of saline and fresh water mixture. As the giant water intake for the most part of the Siberia these estuaries are integrated sub-continental water flows from the Altai and Sayan Mountains at the south till the Ural Mountains and Lake Baikal at the west and east, correspondingly. Overall result that water parameters and ice feature here has resulted from sub-continental humidification. Global warming resulted in modification of the precipitation, PF and soil moisture change-over, increase the wind-driven circulation and storminess during the fall-winter season. Some of these processes induce changeability of fresh water discharge, some - the evolution and intensification of dangerous ice phenomena in lowers of the Siberian Rivers and estuaries. Notify that a most part of Yenisey river floor consist of PF embedded structure, and climate change resulted here especially

unsafe environment and natural hazard.

Our approach assumes SAR data use as instrument for sub-surface sounding and revealing the different ice processes and ice phenomena. Its regional as well seasonal and inter-annual modification is evaluated as a tracer of the modification of the water catchments resulted in changeability of the large-scale atmospheric processes. In frame of the presented study some of the NERSC/NIERSC archives SAR images were analyzed and interpreted. As result the ice regime features and dangerous ice phenomena in this part of Siberian Arctic were investigated. The different type of natural hazard was revealed, its nowadays evolution and modification was assessed. . Sub-satellite validation programs were organized onboard icebreakers in the Kara Sea and shallow waters of the bays and estuaries. In situ observations of the ice in the Ob Bay and Yenisey Gulf as well in the Ob-Yenisey recurring polynya has been accomplished, water samples and ice cores were gathered and had been analyzed in laboratory. The following ice parameters are investigated (some of them represents a danger and were assessed indirectly): ice development (age), type of ice (fast ice, drift and moving ice), ice arrangement and its connection with the type of winter severity, color and origin of ice (sea ice, fresh-water and brackish-water ice), rafting and ridging of ice, hummocking, rotating of ice floes and forced ice drift, formation of ice jam and barrier zones, ice blocking, accelerated ice drift (including ice river originating and developing), polynyas and cracks formation and closing, tide cracks (opening and closing, transformation of the parameters), ice stick and ice coverage of the ships, the ice compression and the nip, revealing the stages of ice channel "ageing" and degradation, flooding (in fall and spring time, as well its differences in the Ob and Yenisey, formation and destruction of ice dams). Based on the multi-temporal optical and radar survey, the suggestions for further development of methodology of SAR support of safe navigation and offshore ice operations in the Siberian Arctic were formulated. Many examples of climatic study and charting of the regional features of the natural hazard will be presented and discussed.