Satellite information application to ice season detection over the eastern coast of the Dvinskaya Bay (White Sea)

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Ice season start and end dates and duration are investigated in the White Sea region using modern historical (from 1978 to 2016) and high-resolution (10-km) satellite sea ice products.

This work was carried out with the purpose of primary collection of ice cover state information (ice season duration) on the Winter coast of the White Sea to substantiate the construction of the port near the place Kuya (about 50 - 60 km to the north from Arkhangelsk). The main question of the research is "Are the ice conditions near the Kuya settlement more favorable for navigation if compared to Arkhangelsk port in terms of ice period duration and how much?" As far as sea ice observation data are scarce and expensive in this region, satellite products give a nice opportunity to set sea ice investigation.

Reprocessed global sea ice concentration data records, distributed by OSI SAF [1], were used as input data for the analysis. This dataset covers period from 1978 to 2015 with spatial resolution of 10 km. The long period coverage and relatively high resolution sets apart this product from the others which might have higher resolution but short time-series (usually from 2000s) or long series but coarse resolution (about 30-40 km).

Long-term and annual values of sea ice season duration with start/end dates were determined for three sites over the Dvinskaya Bay «Zimnegorskiy» (north), «Kuiskiy» (middle) and «Mudiug» (south and close to Arkhangelsk).
Considering the limitations of sea ice satellite information usage in near-shore zones the original algorithm for sea ice season start/end dates detection was developed. It allows to determine three key time points: start of ice period (sea ice manifestation), start of severe ice period (sea ice with 70-90% concentration) and end of sea ice season.

Mean sea ice season duration in northern point «Zimnegorskiy» is about 150±4 days, in southern point «Mudiug» 178±3 days. The latest is about 15 days longer than in «Kuiskiy» point, where ice period duration amounts 163±3. Severe ice period lasts for 129±4 days in «Kuisky», by 5 days shorter in «Zimnegorsky» and by 14 days longer in «Mudiug» point (143±3 days). Statistically significant (α=0.05) negative trends were detected over the 1979-2015 period by about 20 days in «Mudiug» and «Kuiskiy» and by about 40 days in «Zimnegorskiy». Severe ice period has decreased by about a month at all sites.

Summarizing, it is revealed basing on the OSISAF data product, that ice period duration near Kuya is by at least 14 days shorter than in the Severnaya Dvina river mouth and is decreasing by 20-30 days (10-20%) since 1978.

Reference:
[1]. EUMETSAT Ocean and Sea Ice Satellite Application Facility. Global sea ice concentration reprocessing dataset 1978-2015, (v1.2). (2015). Norwegian and Danish Meteorological Institutes. [online] Available at: http://osisaf.met.no [Accessed 20 October 2016].