

ARCTIC SEA ICE SATELLITE MONITORING

Summary and purpose of the WP

The results are submitted of SRC Planeta long-term works on satellite radar monitoring of ice conditions in Arctic Region on the basis of the archival and operative information from Ocean satellites.

Action proposed: no action required.

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Satellite monitoring of ice conditions in Arctic Region is carried out by SRC Planeta since the moment of launch in 1983 of the "Okean-1500" satellite with side looking radar-tracking instrument (RLSBO). This satellite has put a beginning of functioning of first operational satellite radar-tracking system "Ocean". Till now 9 satellites of the "Ocean" series have been operated.

On the basis of "Ocean" satellites data (using also NOAA data) SRC Planeta in 1983-2001 carries out satellite radar monitoring of ice conditions in Arctic Region on a regular basis. Annually SRC Planeta generates more than 400 thematic maps of ice conditions, which are used in operative practice for an information safety of navigation and other economic activity in the Arctic seas of Russia.

Long term archive of OKEAN satellite radar data available at SRC Planeta allows to perform a number of research and application tasks that require long term sets of observation data, in particular, for climate change researches.

Arctic region marine ice cover plays an important role in Earth climate generation. At least two factors related to marine ice cover influence to climate are of great importance in multicomponent climate system. At first, Arctic ice represents a source of fresh water that is supplied to the North Atlantic basin. Intensity of ice melting may strongly affects the changes in World Ocean water masses circulation. Second factor is macro scale marine ice dynamics in polar regions that leads to global albedo variations. That affects on the conditions of ocean-atmosphere system energy flows formation and, finally, quantity of energy. Received by the Earth atmosphere. Both factors are in considerable dependence of marine ice characteristics and, in the first turn, of the ice extent in seas and oceans.

Since 1983 on the basis of satellite radar observation data works are carried out by SRC Planeta on investigation of marine ice fields extent and first year and multiyear ice borders location in the western sector of Arctic in winter.

For delimitation both areas of multiyear and first year ice using satellite radar data special technology of these data processing was developed. The technology includes the following elements:

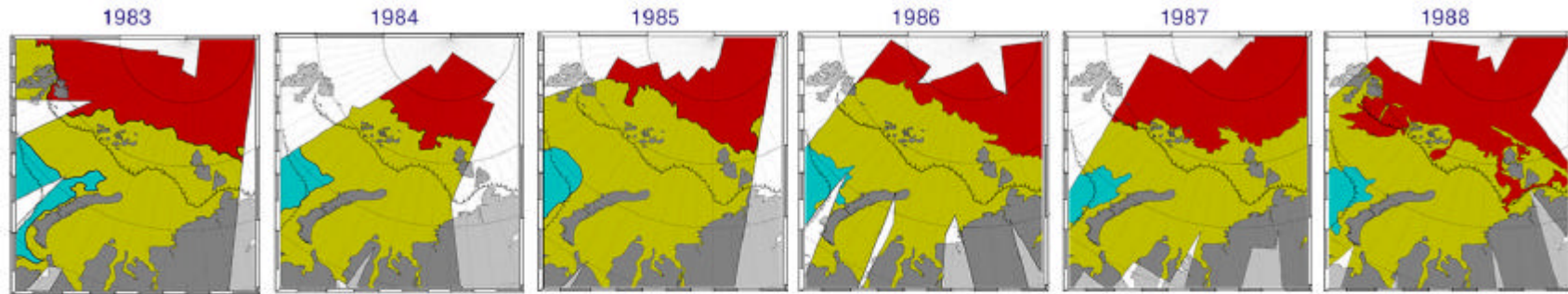
- Radiometric correction of the radar images;
- Absolute calibration of the radar images;
- Digital composition of radar maps from the separate radar images;
- Classification of sea ice of Arctic Region using of methods of recognition with training developed in SRC Planeta.

Within the framework of creation of the technology researches were carried out on characteristics of radar backscatter of various types of sea ice. Their seasonal variability was investigated.

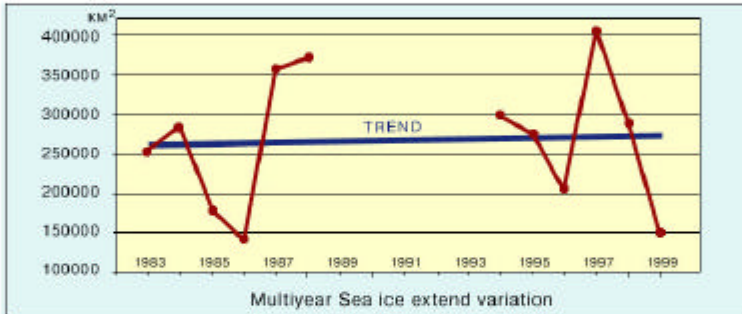
On the basis of this technology, the composition of radar mosaics of western sector of Arctic Region (east part of Barents sea and Kara sea) using Okean radar data were generated for the winter period of the years of 1983-2000. Then the processing of radar mosaics was carried out and multiyear and first year ice distribution maps were generated. For comparison of multiyear and first year ice borders location the borders of maximal and minimal floating ice distribution obtained from geographical maps were superimposed on the satellite derived thematic maps.

As a result of satellite radar maps processing in SRC Planeta the thematic maps of multiyear and first year distribution in the winter periods of 1983-2000 are generated (Fig. 1). Resulted thematic maps have been validated using aviation observations and ships measurements. Mean square deviation of ice boundary estimation is 8-12 km. The analysis of the data has shown increase of the area of multiyear ice per 90th years (in comparison with 80th years) on 10%.

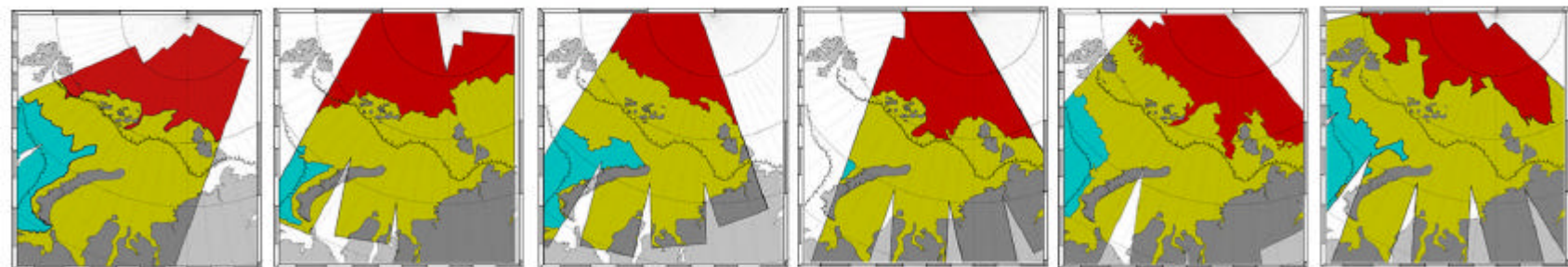
Satellite radar data application to Western Arctic sea ice cover climatological studies



Multiyear sea ice cover extent is estimated within the area between southern multiyear ice boundary and 85°N and between 40°E-105°E



Multiyear sea ice in Western Arctics covered in 1990th 10% more then in 1980th



Dynamics of Western Arctic floating ice distribution in 1983 - 1999 using OKEAN-O1 SLR data

- Earth surface
 - Multiyear ice
 - First year ice
 - Open water

- Borders of minimal (a) and maximal (b) zone of floating ice distribution (on the base of cartographic data)