The Arctic portal as an instrument for polar low operational detection and forecast of their evolution

Khvorostovsky K.S., Kortikova K.G., Zabolotskikh E.V., Balashova E.A., Yarusov K.I., Chapron B.
Russian State Hydrometeorological University, Satellite Oceanography Laboratory, St.Petersburg, Russia

Introduction

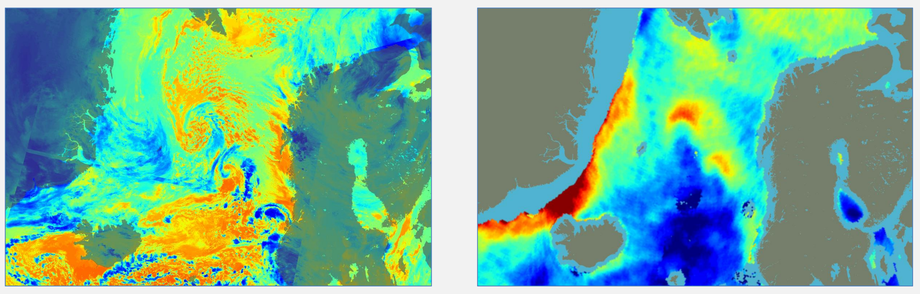
A growing activity in the Arctic occurs under extreme environmental conditions, and a complete and reliable knowledge about the current and future environmental state is of extreme importance, particularly regarding the dangerous events and their intensity, spatial distribution and frequency. This work presents a database of the Polar lows (PL) and less intensive mesocyclones (MC) observed over the entire Arctic region for the period of 2017-2018 and created with operational geographic information system – Arctic portal – developed at the Satellite Oceanography Laboratory (SOLab) of the Russian State Hydrometeorological University (RSHU).

Data

- Optical and infrared MODIS images from the Terra and Aqua satellites
- Surface wind speed (SWS) product from Advanced Scatterometer (ASCAT) onboard Metop-A satellite
- Advanced Scanning Microwave Radiometer (AMSR2) water vapor content and SWS fields retrievals

Method

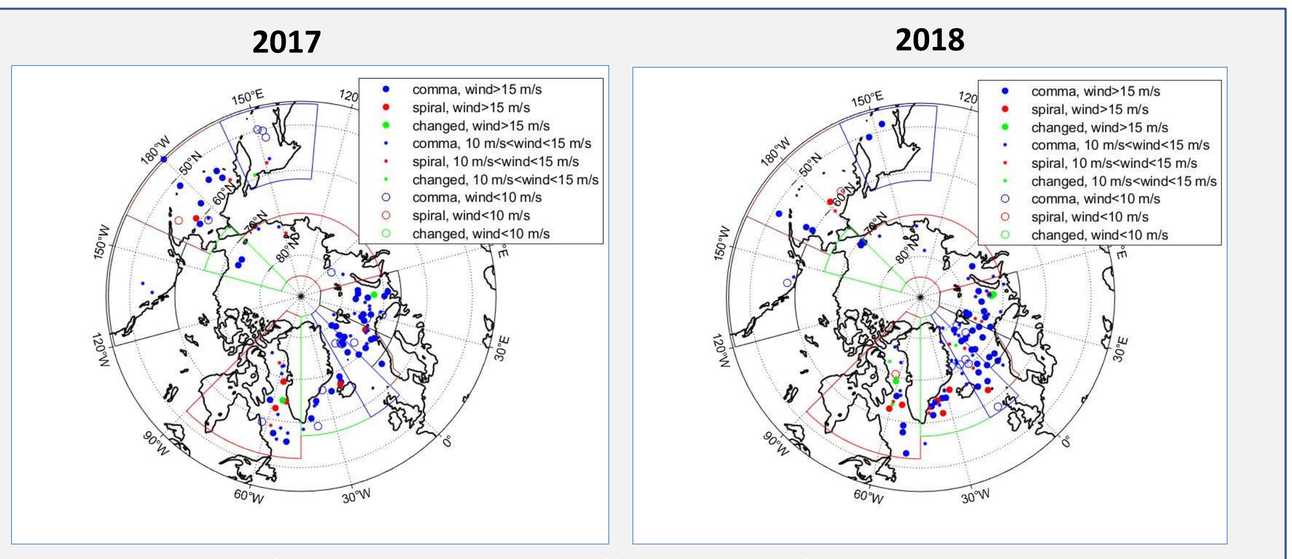
- The PL and MC database is created with the operational geographic information system – Arctic portal – developed at the SOLab of the RSHU
- The Arctic portal displays the fields of the atmosphere, ocean and sea ice parameters, as well as satellite radar, optical and infrared images
- The Arctic portal provides functional for working with satellite data of different spatial and temporal resolution required for monitoring and forecasting PLs, compiling databases, and analyzing the parameters associated with the PL development



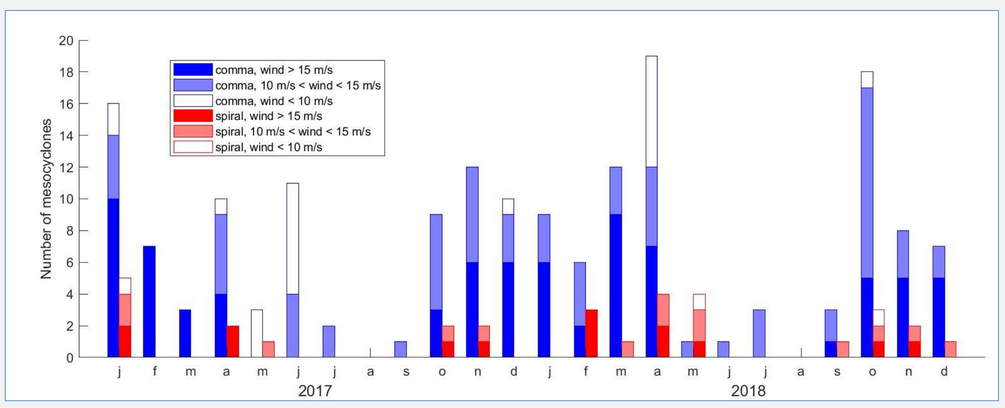
Polar lows on January 19, 2018 developed as the end-product of an occluded synoptic-scale cyclone, identified with the Arctic portal capabilities: Terra MODIS image at 03:20 UTC (left); AMSR2 derived SWS field at 03:13 UTC (right).

Results

We detected 211 MCs in the Arctic regions over two-year period: 99 in 2017 and 112 in 2018.
Data on the SWS are available for 205 of MCs, and 86 of them are the intense vortices with the maximum SWS > 15 m/s that can be classified as PLs.
MC and PL characteristics, such as shapes of cloud signature, sizes of vortex, duration and total distance travelled and area of formation, have been analysed.

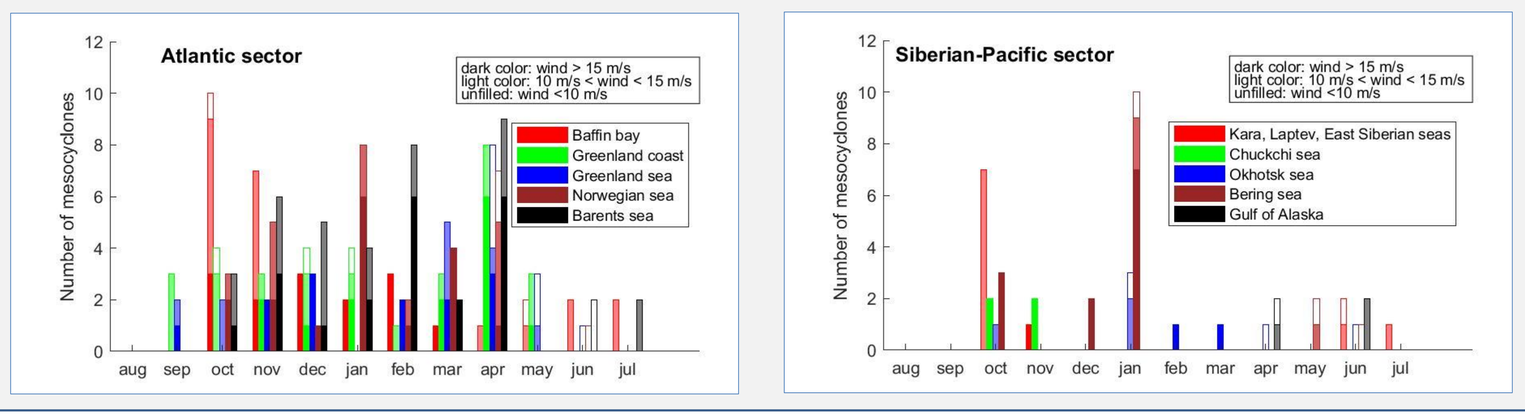


Spatial distribution of the PLs and MCs with different shape of cloud signatures and maximum SWS. About half of the MCs are observed in the areas of Greenland, Norwegian and Barents seas.



Monthly distribution of the PLs and MCs with comma and spiral shaped cloud signatures and with different maximum SWS.

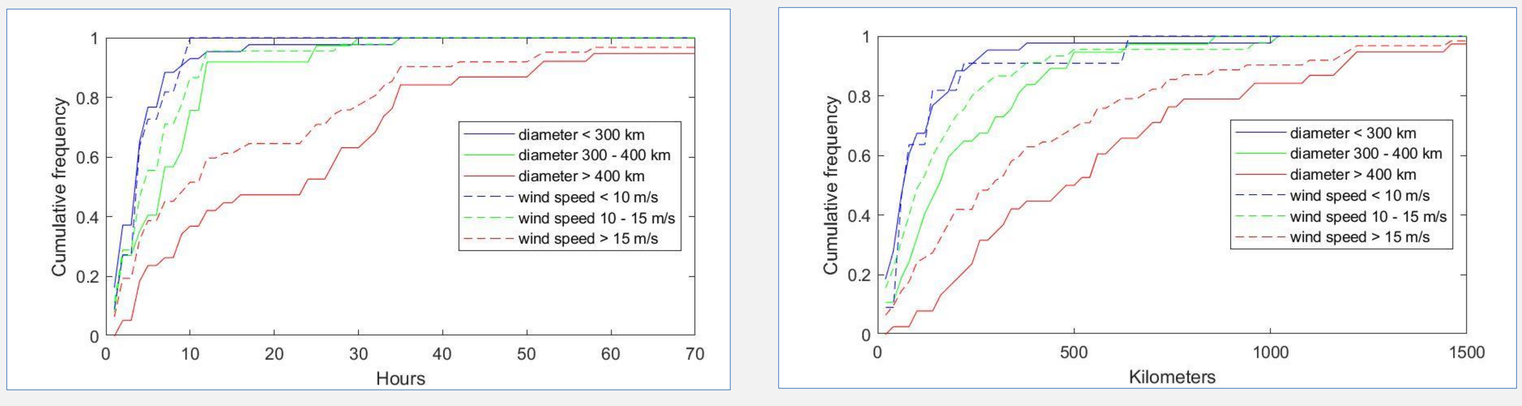
About 80% of the MCs and PLs have comma shaped cloud signatures.



Seasonal distribution of the PLs and MCs with different maximum SWS within 10 zones depicted on the figures with maps above.

In the east areas of the Atlantic sector a shift of the maximum PL and MC activity to April is revealed.

In the Eastern sector of the Russian Arctic (Kara, Laptev and East Siberian seas) the MCs form mostly in October with the maximum SWS of 10-15 m/s.



Cumulative frequency distribution of the PL and MC duration (left) and total distance travelled (right) according to maximum SWS and size at the mature phase.

PL and MC duration and total distance travelled depend on both size and intensity (maximum SWS) of the vortex.

Conclusions

The Arctic Portal, created in the RSHU SOLab and aimed at monitoring the Arctic environment, was used to produce a comprehensive database of the PLs and MCs for the period of 2017-2018. This database presents a number of the PL and MC parameters for the whole period of their lifetime.
In the Atlantic sector a tendency for shifting the maximum of PL activity from March to April is detected. Due to an recent sea ice retreat in the Eastern sector of the Russian Arctic an intermittent MC activity with the maximum in October is observed.