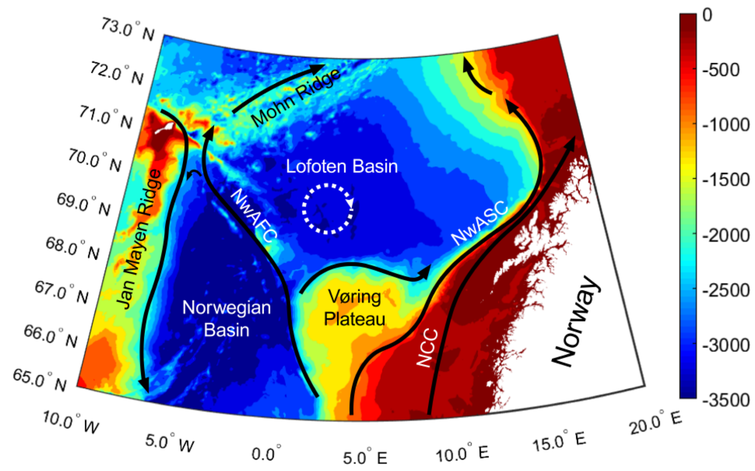
Study of seasonal variability of amount and thermohaline features of mesoscale eddies in the Lofoten Basin

Vladimir S. Travkin*, Tatyana V. Belonenko
Saint Petersburg State University, Universitetskaya nab. 7-9, St. Petersberg, 199034, Russian Federation
*e-mail: st055372@student.spbu.ru

The object of our research was a study of seasonal variability of amount and thermohaline features of mesoscale eddies in the Lofoten Basin for the period 1993-2017, using satellite altimetry data and GLORYS reanalysis.

•We use the "Mesoscale Eddy Trajectory Atlas Product". This method of eddy identification and tracking using sea surface height (SSH). This Atlas is based on a gridded altimetry dataset where eddies are isolated on each daily map. The algorithm identifies eddies as clusters of pixels that satisfy a specific set of criteria.

•We also use the GLORYS12V1 product of the Global Ocean Physics Reanalysis available at CMEMS. It is the global ocean eddy-resolving (1/12° horizontal resolution and 50 vertical levels) reanalysis covering the altimetry era. It is based largely on the current real-time global forecasting CMEMS system. The global ocean output files are displayed on a standard regular grid at 1/12° (approximatively 8 km) and on 50 standard levels.



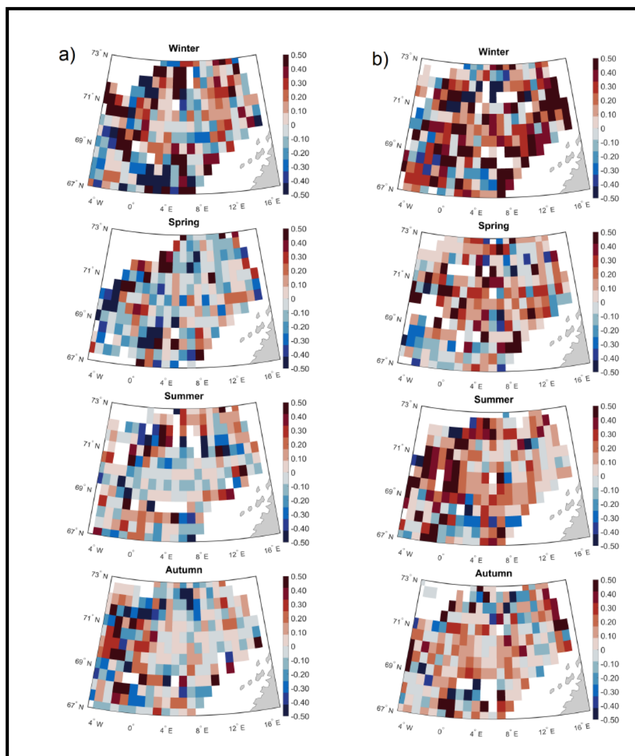
Bottom topography (color) and general circulation (arrows) of the study region. The white circle marks the Lofoten Vortex location. The black lines indicate the main currents.
Abbreviations: NCC – Norwegian Coastal Current, NwASC – Norwegian Atlantic Slope Current, NwAFC – Norwegian Atlantic Frontal Current.

Seasonal variability of mean mesoscale eddy characteristics in the LB for 1993–2017 based on satellite altimetry

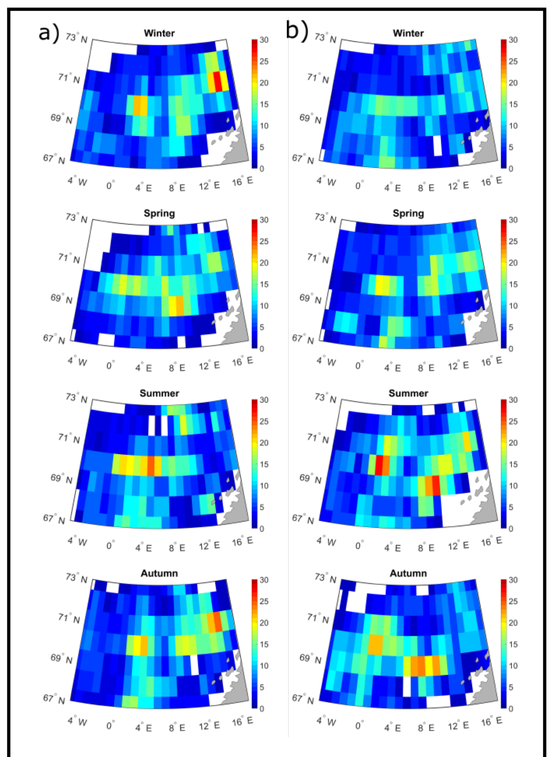
Characteristics \ Season	Winter		Spring		Summer		Autumn	
	CEs	ACEs	CEs	ACEs	CEs	ACEs	CEs	ACEs
Amount	238	269	232	262	279	275	277	273
Orbital speed (cm/s)	10.4	10.6	10.9	11.1	8.5	10.4	8.7	9.6
Amplitude (cm)	4.8	4.9	5.0	5.4	3.8	5.1	3.9	4.7
Lifetime period (days)	26.6	24.3	26.2	27.9	27.0	30.4	27.1	27.6
Radius (km)	56.8	54.5	53.1	54.8	54.6	53.9	56.0	55.8

Seasonal variability of time-space averaged thermohaline characteristics of mesoscale eddies in the LB at 450 m of depth based on the Global Ocean Physics Reanalysis (GLORYS12V1) for 1993–2017

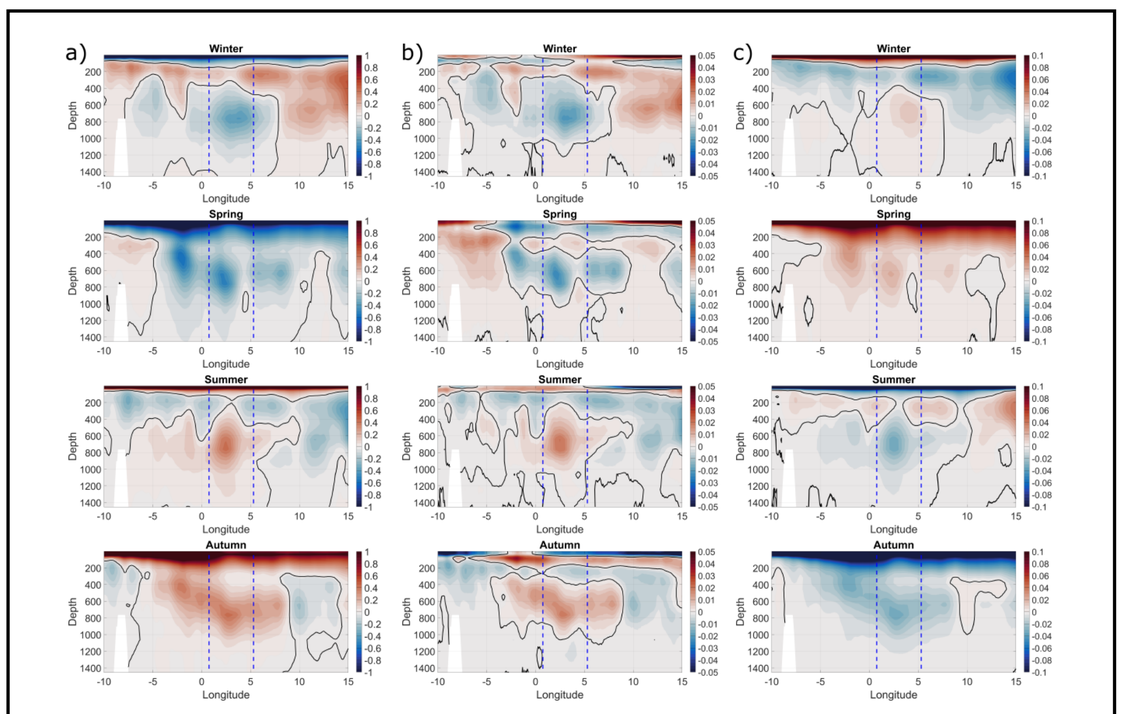
Characteristics \ Season	Winter		Spring		Summer		Autumn	
	CEs	ACEs	CEs	ACEs	CEs	ACEs	CEs	ACEs
T (° C)	3.56	3.98	3.58	4.08	3.77	4.20	4.17	4.30
S	35.06	35.07	35.05	35.08	35.06	35.08	35.08	35.09
σ (kg/m^3)	27.75	27.71	27.74	27.71	27.73	27.70	27.70	27.69



Seasonal temperature (° C) anomalies in the LB for the period 1993–2017 at depth 450 m in every 1.0° longitude and 0.5° latitude bins for CEs (a) and ACEs (b).



Amount of cyclonic (a) and anticyclonic (b) eddies in the LB in different seasons; eddies in every 1° longitude and latitude bins.



Longitude sections of temperature (° C) (a), salinity (b), and potential density (kg m-3) (c) anomalies along the 69.8 ° N in different seasons for 1993-2017.
The black lines show zero values. The blue dashed lines indicate the area of the LV.

Summary

Seasonal variability of mesoscale vortexes of the LV is manifested both in the seasonal change in their number and in the corresponding change of their thermohaline characteristics. A number of ACEs in winter and spring is more than number of CEs while there is almost no difference between them in summer and in autumn (even CEs dominate a bit). In summer and autumn, the average orbital speed and the amplitude are a bit less for CEs than for ACEs in the LB. Maximum number of CEs and ACEs it is shown in the central and eastern part of the LB, where their number can reach 30 eddies per grid unit for all seasons, while the western and north-western part of the LB is characterized by less number of eddies (less than 15 eddies per season).

T-S profiles of GLORYS12V1 data located inside the identified mesoscale eddies at 450 m of depth provide the quick look at seasonal variability in the center of eddy cores. They demonstrate that the greatest differences in eddy characteristics are manifested in temperature anomalies and much less in salinity and density. The greatest temperature anomalies in eddy cores are observed in winter, and the smallest in the autumn. The largest negative anomalies of temperature and salinity in CEs are noticed on the southern periphery of the LV. There is predominance of vertical gradients of thermohaline characteristics in the upper part of the LV.

References:

Belonenko T.V., D.L. Volkov, V.K. Ozhigin, Yu. E.. Norden (2014), Circulation of waters in the Lofoten Basin of the Norwegian Sea [In Russian], *Vestn. S. Petersbur. Un-ta*, 7(2):108-121.

Volkov D.L., T.V. Belonenko, V.R. Foux (2013), Puzzling over the dynamics of the Lofoten Basin - a sub-Arctic hot spot of ocean variability, *Geophys. Res. Lett.*, 40 (4): 738-743. doi:10.1002/grl.50126.

Acknowledgements

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