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Mesoscale dynamics of Antarctic waters of the Atlantic as a factor for formation of Antarctic krill agglomerations in conventional fishing grounds in the Scotia Sea

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Summary
The analysis of dynamics of mesoscale vortexes occurring in the Scotia Sea due to specific features of bottom relief and hydrodynamic instability of currents was carried out on the basis of ocean surface level measurements (Project AVISO, 2012, Chelton et al., 2012) as well as on the basis of trajectories of drifting buoys (Global Drifter Program, NOAA, 2012) over the period of 1992-2012. A typological classification of hydrodynamic conditions occurring in the Scotia Sea in different years was compiled. Complex data on the mesoscale dynamic of water mass based on altimetry data including kinematic characteristics of eddies and flow velocity were analyzed. Based on the hypothesis that the largest and densest agglomerations of krill are formed in the zones of mesoscale vortexes and are transported with them, the results obtained can contribute to deeper understanding of krill drift in order to improve krill resource management.

Introduction
Antarctic krill (Euphausia superba) is important object of fishery and key element of Antarctic ecosystem. Its distribution as a representative of the Antarctic plankton, are mainly determined by oceanographic factors (Kasatkina et al. 2005). The authors analyzed dynamics of mesoscale vortexes occurring in the Scotia Sea where the traditional areas of historical and current krill fishery are located.

Material and Methods
Altimetry measurements (absolute dynamic topography, flow velocity components) provided by the center AVISO (Archiving, Validation and Interpretation of Satellite Oceanographic data) as well as available data on the mesoscale eddies from satellite altimetry and data on trajectories of drifting buoys (Global Drifter Program, NOAA, 2012) over the period of 1992-2012 were used (Chelton et al, 2011). The cluster analysis based on the Ward's method was applied to subdivide the study area into the strata as areas with a similar fluctuation of dynamic topography.

Results and discussion.
Two main areas with different variability of dynamic processes corresponded to the northern and southern parts of the Scotia Sea were revealed from cluster analysis (Figure 1). These areas are related to the main circulation systems: the Antarctic Circumpolar Current and the Weddell Gyre. The boundary between these two systems is in good agreement with the ACC Southern Front separating ACC water from the sub-polar water. In each of the above described circulation systems several subdistricts are figured out. The ACC has three subdistricts: subantarctic surface water mass (IIa), the southern polar frontal zone (IIb) and the Antarctic surface water mass (IIb). In WG – there are two of them: secondary frontal zone (Ib), and the water of the Weddell Sea (Ia). Additional evidence on the complex nature of the ACC including the flows heterogeneity of Sub-Antarctic waters in the Scotia Sea was obtained.
Classification of dynamic topography allowed to define the eddies formed in secondary frontal zone, describe their nature and trace drift trajectory with special attention to the area of krill fleet operation. Radius of these eddies is ranged from 52 to 67 km. The angular velocity of rotation (10cm/sec) is

higher than speed of its movement (7cm/sec). Amplitudes of these eddies are significantly smaller then for the eddies in Southern Polar Zone. It was shown that the direction of the buoys drift is in line with the directions of currents calculated from the satellite altimetry data (Figure 2). The revealed dynamics of mesoscale vortexes occurring in the Scotia Sea provide additional information for understanding krill distribution variability.

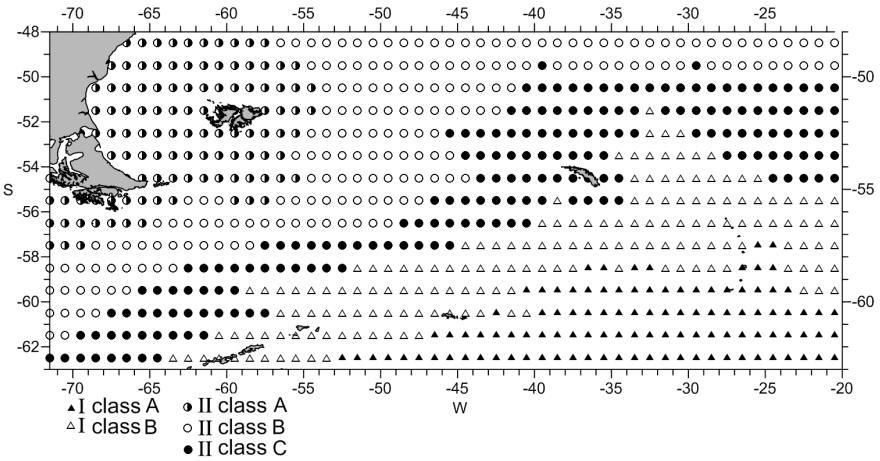

Figure 1. The spatial distribution of classes.

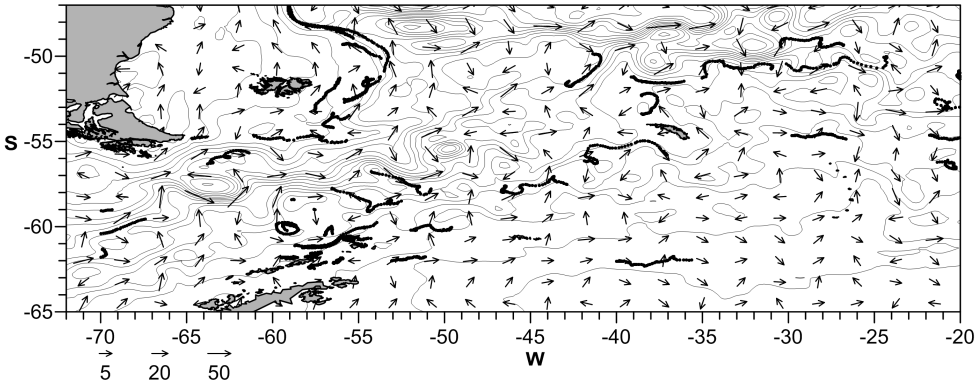

Figure 2. Assimilation ma, 16.02.2011: the arrows show the direction and velocity currents (cm/sec), ADT (contour lines drawn through the 10 cm), drifter tracks (accumulated distance for 16 days).

References

Chelton, D. B., M. G. Schlax, and R. M Samelson, 2011: Global observations of nonlinear mesoscale eddies. Prog. Oceanogr., 91, 167-216.

Kasatkina S.M, Shnar, V.N., Berezhinsky, O.V., Some characteristics of krill transport in the Scotia Sea based on the Russian survey data. CCAMLR document WG-EMM-05/41