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Lagrangian analysis of formation, structure, evolution and splitting of anticyclonic Kuril eddies

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Abstract

We studied in detail a mesoscale anticylonic eddy that has been sampled in the R/V *Professor Gagarinskiy* cruise (June – July 2012) in the area east of the Kuril Islands in the northwestern subarctic Pacific. Lagrangian approach was applied to study formation, structure and evolution of this feature called the eddy A and of its parent eddy B using a simulation with synthetic tracers advected by the AVISO velocity field. We used different Lagrangian methods and techniques to identify those eddies and their boundaries, to know their structure and to document their deformation, metamorphoses and splitting. It has been found that the eddy A was born as a result of splitting of the eddy B with the core water to be borrowed from the eddy B which, in turn, was influenced by the Okhotsk Sea water flowing into the ocean through the Kuril straits. The periphery of the eddy A was formed mainly by Eastern Kamchatka Current water in the process of its winding onto the eddy A core by portions. All these processes have been documented in detail with the help of drift and tracking Lagrangian maps computed forward and backward in time with a large number of synthetic tracers distributed over the studied area. We have found a Lagrangian structure of those eddies and the ways how they have gained and released water. Simulated and measured locations of the center of the eddy A and its boundary have been be estimated to coincide with the accuracy of ≈ 7–10 and ≈ 15–20 km, respectively. Our simulations were validated in part by tracks of available surface drifters and Argo floats. We presented CTD hydrographic observations of the Kuril eddy A from the surface to deep waters and compared observed and simulated results in order to establish origin and properties of water masses constituting that eddy.

Keywords: Lagrangian simulation, mesoscale eddies, Kuril Islands, hydrographic survey

1. Introduction

Mesoscale anticyclonic eddies have been regularly observed on the oceanic side of the Kuril Islands near the Bussol' Strait (Bulatov and Lobanov, 1983; Lobanov et al., 1991; Bulatov and Lobanov, 1992; Rogachev et al., 1996; Rogachev, 2000a,b; Yasuda et al., 2000; Rogachev and Carmack, 2002; Rabinovich et al., 2002). It is the deepest Kuril strait through which water inflows to the Okhotsk Sea and outflows from it (Talley and Nagata, 1995; Qiu, 2001). Such eddies are observed in this area every year by sea surface height anomaly maps and infrared satellite images. They are one of the most energetic and prominent features in the western subarctic gyre in the North Pacific which require detailed study of their hydrographic structure and understanding the processes of their origin, dynamics, transformation and decay. They are supposed to significantly control transport of the East Kamchatka and Oyashio currents and modify the properties of these source waters of North Pacific Intermediate Water (Yasuda et al., 2000).

Extensive hydrographic observations of these eddies (Lobanov et al., 1991; Bulatov and Lobanov, 1992; Rogachev et al., 1996; Rogachev, 2000a,b; Yasuda et al., 2000; Rogachev and Carmack, 2002; Rabinovich et al., 2002), especially in the last decade of the twentieth century, allowed to find

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