Surface and subsurface dynamics of two vortex patches

Mikhail Sokolovskiy*[1,2], Jacques Verron[3], and Xavier Carton[4]

[1]Institute of Water Problems of RAS (IWP RAS) – 3, Gubkina Street, 119333, Moscow, Russia
[2]P. P. Shirshov Institute of Oceanology of RAS (IO RAS) – 36, Nakhimovski prospect, 117997, Moscow, Russia
[3]Laboratoire de glaciologie et géophysique de l'environnement (LGGE) – CNRS : UMR5183, OSUG, INSU, Université Joseph Fourier - Grenoble I – Domaine Universitaire 54 Rue Molière - BP 96 38402 ST MARTIN D HERES CEDEX, France
[4]Université de Bretagne Occidentale [Brest] (UBO) – Université de Bretagne Occidentale (UBO) – 3 rue des Archives - CS 93837 - F29238 Brest cedex 3, France

Abstract

Mesoscale and sub-mesoscale processes in the surface ocean layers, on the one hand, play a crucial role in the formation of the basic properties of the water column, and, on the other hand, reflect many dynamic characteristics in the intermediate and deep levels. Thus, the study of the vortex interactions in the surface layers are curious both in themselves, and they are of general theoretical and applied interest.

In this paper, we study the features of the interaction mechanism of two initially circular vortex patches located in the upper layer, basing on a two-layer quasi-geostrophic model. Contour dynamics method allows obtaining numerically diagrams of various states of vortex structures, depending on the upper layer thickness and the Froude number. In particular, in the space of external parameters, we obtained existence domains for a new quasi-stationary state. Its formation scenario is as follows: after a brief merging stage of two vortex patches, a structure of three vortices is formed; further these vortices re-merge, and split again in a cascade way. A final triplet behaves as a stable structure.

We suggest that this kind of vortex triplets is one of an essential attribute of subsurface dynamics of the open ocean.

*Speaker