Dynamic Study of Ocean Striations From Perspective of Satellite Altimetry

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1. Abstract

A compilation of large, high-quality satellite and in situ data led to significant improvements in the description of the most dynamic ocean topography (MDOT) of the Pacific Ocean. The new models of MDOT, developed to 20-10 km resolution, have not only revealed important details on the complex mesoscale structure of circulation systems such as the Gulf Stream, Kuroshio, and its extension, but also discovered periodic striation-like features in ocean circulation in different ocean contexts.

While the long-term study of ocean circulation fronts and eddies, particularly those associated with the current systems, is complicated by a number of factors, including the temporal variability and the tendency of the fluid motion to change over time, the most immediate question is: are the striations of ocean circulation fronts and eddies related to the stability of the ocean motion? The study outlined in this article is an attempt to answer this question.

The paper outlines the main changes of the striation study project that is part of the new OST Science Team work. The project is focused on the study of stationary and periodic striations in the ocean. The project aims to provide a comprehensive description of the mean dynamic ocean topography (MDOT) and to investigate the role of these striations in the ocean circulation. The study will help to understand the complex interactions between the ocean circulation and the Earth's climate system.

2. Time-variant (propagating) striations

Systems of band-like structures and eddies propagating in time toward the equator are found in the satellite altimeter data.

2.1. Stationary striations

Stationary striations are reproduced in models. Results of preliminary runs of the OFES (OGCM for Earth Simulator) model show similar diagram for the surface vorticity in the ROMS (note changes in the longitude range 146.5-147.5 W). Green and black dashed lines indicate the crest and trough of a propagating eddy, respectively. The dashed lines are zero-velocity contours. Partial color (red) corresponds to eastward current associated with the striations.

3. Dynamics of stationary striations

An important list of mechanisms that can induce striations compiled at the 2007 IPFC workshop on jets and fronts includes:

- PV instability (Hakkinen et al., 2007)
- Rossby waves with meridional stratification of flow (e.g., Di Lorenzo et al., 2003)
- Recirculating flow, thermal creep, and the barotropic instability
- Flow interaction with bottom topography: Mixing over the ridge

While the understanding of striations is still limited, the study of the influence of the basin-scale dynamics on the formation of these features is a topic of ongoing research.

4. Are striations an artifact of moving eddies smeared by time averaging?

Recent findings by H. H. Lee, H. H. Lee et al. revealed that the striations are more clearly visible using the Earth Simulator. This technique is effective in reducing the noise, allowing for a clearer view of the striations. The study shows that the striations are not an artifact of time averaging and that they are a real feature of the ocean circulation.

5. Implications for climate system

The study of striations is significant for understanding the climate system, as they provide insights into the ocean circulation patterns and their potential impact on the Earth's climate.

6. Tasks on the Team for 2008-2012:

- Use satellite and in situ data to study periodic striations in the ocean
- Develop new techniques for the study of striations
- Investigate the role of striations in the climate system

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