Observing the Ocean's Interior from the Space

Xiao-Hai YAN

Mary A. S. Lighthipe Chair Professor, College of Earth, Ocean and Environment, University of Delaware, Newark, DE 19716, U. S. A.

Also a Distinguished Scholar, Joint-Institute of CRM, State Key Lab of Marine Environmental Science, Xiamen University, Xiamen, China

Recent ocean remote sensing missions and techniques have produced remarkable data sets of high accuracy measurements of sea surface height, surface wind, surface roughness, temperature, pigment concentration, etc. One can now study, on a truly global basis, the fluid ocean and its variability at all periods between years and days, on all spatial scales from the global to about a few meters. The accuracy and precision of the measurements are so good, that, with the help of the newly developed various remote sensing data processing techniques, a huge variety of phenomena can now be addressed. However, most remotely sensed oceanographic observations are confined to either the sea surface or to the upper mixed layer due to the limitations of the sensors. In the past 20 years some of the attempts to break the ocean's surface have already made the headlines. Yan et al. (1990, 1991a, b), and Yan and Okubo (1992) developed methods to infer the upper ocean mixed layer depths from multi-sensor satellite data. Furthermore, Yan et al (2006) developed method to study the variability of the Meddy (Mediterranean Outflow and Eddy) which is at about 1000m depth. Although these methods break the ocean's surface from the space successfully, still many important ocean processes in ocean interior need to be observed and studied from the space but not yet successful due to the limitations of the sensors and difficulties in the methodologies. Such deeper ocean processes include MOC (Meridional Overturning Circulation), DOC (Deep Ocean Convection), bottom topography, internal waves, some bio-geo-chemical deep ocean processes, etc, which relate and impact greatly to the global climate changes. This lecture will review the background and status of the research on breaking the ocean's surface from the space, and report some of the recent attempts to combine satellite altimetry, scatterometry, infrared, ocean color, and SAR with other observations and techniques, and with general circulation models to infer the three-dimensional, time varying ocean circulation, air-sea interactions, and global and regional oceanographic processes at ocean's interior such as MOC and DOC, which identified by the recent US National Academy of Sciences' Decadal Survey Report as one of urgent and most important research topic.

References:

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