DENSE WATER OVERFLOW OFF CONTINENTAL SHELVES

G.I. Shapiro (1,2), V.V. Ivanov (1), J.M. Huthnance (3), D.L. Aleinik (2)

(1) University of Plymouth, UK, (2) Institute of Oceanology, Moscow, Russia, (3) Proudman Oceanographic Laboratory, UK, g.shapiro@plymouth.ac.uk

This paper presents a world-wide inventory of confirmed events of dense water cascades over the shelf break, provides synergetic analysis of observational data, compares and contrasts the identified cases. The data were used to check theoretical models of cascading and infer the parameters of dense plume evolution. The study is focused on mesoscale plumes of dense water, which are formed by cooling, evaporation or freezing in the surface layer. Dense water is produced more effectively in shallow areas of the continental shelf and eventually spills over the shelf edge onto the steeper continental slope. A dense water cascade propagates generally both along- and across-slope under the influence of gravity, Earth rotation, friction and entrainment (mixing). When the sources of dense water are variable in space and time, the resulting dense water masses are likely to take the form of either mesoscale isolated lenses (cold or salt pools) or dense plumes with significant 3-dimensional structure. The cascading events were identified and collated using both scientific publications and raw T-S data bases. Two alternative techniques were used to trawl the raw data. The first focuses on previously reported locations, mostly at high latitudes, the second technique exploits the idea of a surface signature of the dense water on the shelf. The areas of higher surface density were identified and examined using an adaptive grid algorithm. More than 50 individual mesoscale cascading events were identified and analysed over the World Ocean, with the majority in the Arctic Ocean. Various theoretical formulations were used to estimate the down-flow fluxes and hence the rate of loss of dense water in the summer. Three cascading events cases were studied in depth: (i) West of Novaya Zemlia (Arctic), (ii) Rockall Bank (Atlantic), and (iii) Strait of Skagerrak (Atlantic). The model by Shapiro and Hill (1997) gave the time scale for the summer loss from 2 months (case iii) to 6-7 months (cases i, ii), similar to the values expected from oceanographic analysis of observations. The calculated scales support the idea that in the Arctic the remnants of winter cascades can be observed as late as August. This study was supported by INTAS grant 99-1600.