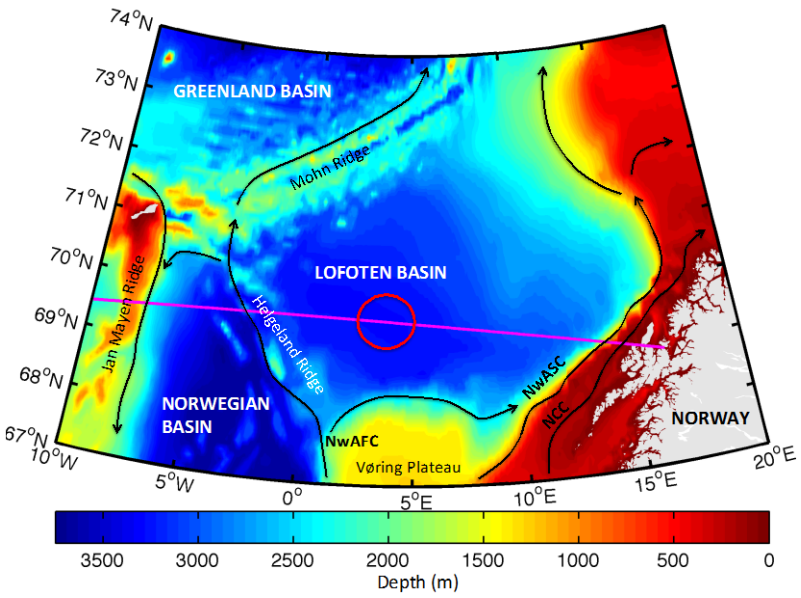
Formation and Variability of the Lofoten Vortex in the Norwegian Sea

Denis Volkov

The Lofoten Basin (LB) is a well defined topographic depression of about 3250 m depth situated in the northern part of the Norwegian Sea. The Norwegian Atlantic Current – a direct extension of the North Atlantic Current – dominates the upper-ocean circulation in the Norwegian Sea. The LB is the major heat reservoir in the Nordic Seas (common name for the Norwegian, Greenland, and Iceland Seas together), characterized by large ocean–atmosphere interactions. It has attracted much scientific attention because of its peculiar thermodynamical characteristics and possible importance in the global climate system. Being a transit region for the warm and saline Atlantic Water (AW), which occupies the upper 800 m, on its way to the Arctic Ocean, the LB is likely to play an important role in sustaining the Atlantic Meridional Overturning Circulation. Here, the AW loses heat to the atmosphere, mixes with ambient water masses, and thus undergoes a transformation that ultimately facilitates deep-water formation. Satellite altimetry observations show a local maximum of sea surface height (SSH) variability and eddy kinetic energy. The LB eddies are mainly generated through the instability of the Norwegian Atlantic Slope Current, propagate cyclonically around the center of the LB, and they are found to play an important role in heat exchanges and dense water formation. We addressed the problem of the Lofoten Vortex formation using three numerical experiments at different eddy-permitting horizontal resolutions(average grid spacing of 18, 9, and 4 km). By initializing the experiments with climatological fields of temperature and salinity we monitored the evolution of the eddy field in the LB and the generation of the vortex. The main focus of this study was to investigate the role of eddies in the dynamics of the vortex. Benefiting from a high-resolution model run we also estimated the kinematic properties of the Lofoten Vortex and other eddies in the LB. In addition, we investigated what processes drive the variability of the vortex strength. This study was part of the project "*Investigating the variability of sea level in the Arctic and sub-Arctic seas*" funded by NASA Physical Oceanography program.



Bottom topography (color) and general circulation (arrows) of the study region. The red circle marks the approximate Lofoten Vortex location. The magenta line indicates the transect along which the vertical profiles of temperature, salinity, and velocity are analyzed. Abbreviations: NCC – Norwegian Coastal Current, NwASC – Norwe- gian Atlantic Slope Current, NwAFC – Norwegian Atlantic Frontal Current. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)