Generation mechanism of an observed submesoscale eddy in the Chukchi Sea

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A submesoscale eddy was detected by satellite in the summer Chukchi Sea, which was generated by the salinity front slump. Multiple reanalysis data suggested that the front was generated as a result of denser water transport northward. The whole story can be separated into two stages: front genesis and eddy genesis (front slump). The front genesis event started with denser water located in southern of the Chukchi Sea. Wind-driven Ekman pumping lifted the salty water upward and increased the salinity in the upper layers. Later, the current transported the denser water northward until it arrived in the northeastern Chukchi Sea, where the fronts and submesoscale eddy were detected. The denser (lighter) water was located in the south (north) of the front, covering over 100 km and 80 m in the horizontal and vertical directions, respectively. The first stage was completed in 15 days. The front contained a great amount of mean available potential energy (MAPE), which was converted into eddy available potential energy (EAPE) via the EAPE production term when the salinity front slumped. EAPE was in turn converted into eddy kinetic energy (EKE) via the buoyancy flux work, and submesoscale eddies appeared. As the salinity front diminished, the salinity field became more homogenous in both the horizontal and vertical directions. The second stage was completed in 18 days. Numerical simulations suggested that the eddy activity was determined by the total depth of the fronts instead of the mixed layer depth. However, if a strong pycnocline was added between the fronts, the vertical buoyancy gradient largely increased there, which reduced the growth rate of unstable energy and produced weaker eddy activities on the denser side of the front.

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