Geophysical Research Abstracts
Vol. 21, EGU2019-5563, 2019
EGU General Assembly 2019

Evolution of Denmark Strait Overflow Features

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About half of the dense overflow across the Greenland-Iceland-Scotland ridge is supplied by the Denmark Strait Overflow (DSO), making the strait a critical gateway between the Arctic and the subpolar North Atlantic. In a changing climate, understanding the DSO high-frequency variability is of key importance to correctly interpret its observational estimates, and to predict the properties of the water masses that feed the Atlantic Meridional Overturning Circulation. Mesoscale features that cross the Denmark Strait during high-overflow transport events (known as boluses and pulses) occur with the same frequency as the DSO cyclones observed downstream. However, the connection between these features is not well established. To investigate this connection, we applied an automated vortex detection algorithm to a realistic, high-resolution numerical model solution. Our goal is threefold: (i) To better understand the dynamics associated with stretching of the water column; (ii) To assess the instabilities controlling the transfer of buoyancy between the overflow and the surrounding water; (iii) To determine how the hydrographic properties of DSO mesoscale features evolve in space and time. We found that cyclones form south of Denmark Strait, following two separate pathways consistent with the mean direction of boluses and pulses in the strait. Their vorticity signal quickly grows as they move south, until they encounter a rapid steepening of the bathymetric slope and start to decay. The rate of decay is slower than the earlier growth rate. The mean stratification of cyclones decreases during their life cycle, while their initial increase in relative vorticity is followed by a decrease; as a result, potential vorticity is only conserved during the growth phase. Last, composites of the deep cyclones show that they are preceded by downwelling and followed by upwelling.