STATISTICS OF DENSE WATER CASCADES AROUND THE WORLD OCEAN

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This study provides statistical analysis of 60 confirmed occurrences of dense water cascades from shelf areas of the World Ocean, 18 of which were not reported earlier. The cascade sites have been found in 28 locations around the World Ocean. In 40 cases, available observational data were full enough to carry out statistical analysis. In 48% of all identified cases, the lateral contrasts of both temperature and salinity facilitated cascading. In 45% of cases cascades were driven by temperature contrasts against hindering salinity gradients, in 7% of cases it was high salinity that made the shelf water denser despite it was warmer. Temperature contribution is predominant in mid-latitudes while it compares with salinity input in tropics and sub-tropics. The situation is more complicated at high latitudes. In the Arctic seas with permanent ice cover, salinity may act as a solo driver, creating extremely strong (more than 2 kg/m3) horizontal density contrasts in shallow areas beneath quasi-steady polynyas. Over deeper Arctic shelves, salinity contrasts decrease and change sign, allowing temperature to prevail and solely drive the cascade. The contribution of temperature variations to the density contrast is greatest in tropics and subtropics, where its typical value is 0.39(kg/m3) and occasionally is as high as 1.3 (kg/m3). The overall average values of density, temperature and salinity contrasts are 0.37 (kg/m3), 1.6 (deg C), and 0.26 (psu) respectively. Scale analysis showed that in non-dimensional variables the data from all climate zones fit well to a unique curve, which describes a relationship between the forcing of a cascade and its internal structure. In 70% of considered cases, cascades delivered colder and fresher water to the deep ocean. Among the remaining 30% of cases, only one half includes the ones driven by salinity excess. The other half includes cascades, which pass through a warmer and saltier environment thus becoming warmer and saltier than the water at the neutral density level. The study was
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