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On-shelf transport of slope water lenses within the seasonal pycnocline: A new cross–shelf edge exchange mechanism

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We present evidence of a shelf edge exchange process, not previously identified, that is of importance for the transport of salt and biogeochemical properties onto the continental shelf. Discrete lenses of anomalously high-salinity water, originating from the shelf edge and trapped within the seasonal pycnocline, are advected 100 km or more onto the Celtic Sea continental shelf. We propose that the lenses are created by increased diapycnal mixing at the shelf edge associated with breaking high-frequency internal wave packets that form in the trough of the internal tide. Hydrographic sections from a towed CTD package show the lenses to be $3-5$ km wide and consistent with being in near-geostrophic balance. Their temporal persistence is confirmed by moored instrumentation and a series of CTD casts. We estimate the advection speed of these features by calculating the approximate rate of salt loss from a lens assumed to be propagating on-shelf. These estimates of a few centimetres a second are in agreement with the observed residual currents of 0.01-0.06 m s^{-1}. Based on an analysis of the theoretical and empirical baroclinic modes of current variability, we propose that the on-shelf flux of water within the pycnocline is principally driven by non-linear mode two internal wave generated currents.