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Energetics of deep-water mixing in a stratified basin without tides

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The seasonal variability of deep-water mixing processes in the central Baltic Sea (Gotland Basin) is investigated using data from an extensive field campaign, including long-term moored instrumentation, ship-born turbulence microstructure measurements, and observations of the spreading of an inert tracer (SF_5CF_3) injected into the deeper part of the Gotland Basin in September 2007. A distinct variability of the deep-water kinetic energy correlates with seasonal changes in the surface momentum flux during intermittent wind events. Budgets of heat, salt, and potential energy show strongly enhanced mixing during the winter season, consistent with increased dissipation rates inferred from shear-microstructure observations. The latter suggest that boundary mixing may play a key role for basin-scale vertical mixing. Diffusivities obtained from vertical tracer spreading rates, and from budgets of heat and salt in the deep water are of similar order of magnitude. Spectral analysis of the kinetic and potential energies reveals two pronounced peaks that are the main energy sources for deep-water mixing: the first around the inertial frequency and a second broadband peak in the sub-inertial range that is interpreted as the signal of basin-scale topographic waves. The vertical energy flux from the near-inertial waves is strongly correlated with the occurrence of wind pulses with a clear dominance of downward propagating energy. The inferred dissipation rates are compared to the observed turbulence levels, as well as to the near-bottom energy dissipation associated with the topographic wave motions.