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Deep Mixing Driven By The Shoaling Internal Tide On The East Tasman Slope: Observations from TTIDE Leg II

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There are relatively few observations of ocean mixing at depths below 1 km. Of particular interest is the sequence of events that lead to the development of turbulence: the energy pathway from large to small scales. The challenge is to field instrument systems that resolve a broad range of space and time scales deep within the sea. In 2014-5, the NSF TTIDE Experiment attempted such measurements on the eastern slopes of Tasmania. Here, a ~5 GW, 1-2 KW/m semidiurnal tidal beam shoals after propagating across the Tasman Sea from its generation site south of New Zealand. Numerical studies suggest and measurements confirm that large areas of the Tasman Slope are reflective to the incoming tide. Only 10-30% of the incoming flux drives mixing on the slope. Much of the mixing is associated with two specific sites, a gullied super-critical region in the south and a ~10 km long seamount cresting at 1900 m in the north.

Using SIO's FAST CTD, multiday series of repeated density profiles have been obtained in the vicinity of the northern seamount. An altimeter on the CTD enabled profiling to within 15 m of the sea-floor. Intense mixing is associated with the breaking of the fundamental tide and the instability of a lee wave at the seamount crest, as well as with along-seafloor bores. Repeated tow-yos across the seamount can be converted into movies that are instructive in separating spatial and temporal scales. The primary and first- harmonic waves, both incoming and reflected, work together to establish the dominant space-time patterns. Extensive T-S variability is seen in the slope-waters 300-600 m above the seafloor. These filament-like features are perhaps formed at distant mixing sites and advected into the observational domain. In the active mixing regions just above the seafloor T-S variability is markedly reduced. The depth-along slope distribution of mixing seen in TTIDE can be compared with numerical output to refine our models of intense mixing in the deep sea.