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Tidally driven mixing: breaking lee waves, hydraulic jumps and the influence of subinertial internal tides

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We present observations of tidally driven turbulence that were obtained in a small channel that transects the crest of the Mendocino Ridge, a site of mixed (diurnal and semidiurnal) tides. At this latitude the diurnal tide is subinertial and evanescent away from the topography, in contrast to the semidiurnal tide which is superinertial and radiating. During the larger of the daily tides, strong turbulence (10 W/m^2) is observed, and using a high resolution, two-dimensional, nonhydrostatic simulation, we interpret observed flow features and concomitant turbulent dissipation to arise from both breaking internal lee waves (above the crest of the topography), and turbulent hydraulic jumps (on the flanks of the topography). To understand the nature of the regional scale flows we employ a three-dimensional tidally forced model, which illustrates the presence of diurnal bottom-trapped internal waves. These energetic waves are of leading order importance in determining the timing of the dissipative processes, alternately enhancing and canceling near bottom flows that are of critical importance to near-topographic turbulence.