Geophysical Research Abstracts
Vol. 21, EGU2019-1797, 2019
EGU General Assembly 2019
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Vortex Generation Due to Internal Solitary Wave Propagation Past Side Wall Variations

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Internal Solitary Waves in the coastal ocean propagate in a complex environment, with variations in background currents, stratification and both bottom (e.g. sills) and side (e.g. fjord walls) topography. While bottom topography has been treated in a number of studies, side topography has not received as much attention. We present direct numerical simulations of internal solitary wave propagation past isolated side wall topography on the laboratory scale. We find that for waves of depression, the wave–induced currents generate a strong separation region above the wave–deformed pycnocline. This vortex undergoes further instability and three-dimensionalization, but remains coherent long enough to yield significant tracer exchange between the near–wall and channel–interior. Below the pycnocline, the weaker wave–induced currents also induce a vortex. This vortex remains coherent far longer than the one above the pycnocline, again with clear implications for material transport. We contrast these findings with literature on isolated bottom topography, focusing on the inherently three-dimensional nature of the instability in the side-wall case.