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Pressure drag of two-layer shallow-water flow at an inclined oceanic ridge, independent of velocity

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The drag in geophysical flows over topography is commonly modeled by a quadratic law. For a rotating fluid, we show that in the two-layer shallow-water approach, the pressure drag of a sub-critical flow around an inclined ridge is in good approximation independent of the flow speed. Numerical simulations results confirm this for a large range of Rossby numbers for both, barotropic and baroclinic flows approaching the ridge. The behavior is explained by the observation that for larger speeds the flow crosses the ridge at lower depth leading to a shorter path-length. As the frictional head loss is a product of the velocity and the path length, both compensate.