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# Nonlinear internal waves at interfaces

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Recent experiments near interfaces of differing stability, such as the tropopause, have shown complicated internal wave behavior, including excessive wave amplitudes and wave breaking at the interfaces. Furthermore, recent statistical analysis of aircraft turbulence encounters indicates higher levels of turbulence at the tropopause than other altitudes. The reason for this bad behavior at the tropopause is likely due to nonlinear wave behavior, treated here with an idealized two-layer model. The layers are continuously stratified with different values of the Brunt-Vaisala frequency, assumed constant in each layer. The mean density profile is continuous, but its first derivative is discontinuous at the interface of the two layers. The solution is an expansion in the wave amplitude. Results with waves of permanent form show that higher harmonics are scattered by the interface, but still accumulate at the interface, resulting in higher wave steepness at the interface. Numerical results with a wave packet show that a mean flow is generated at the interface primarily by the wave packet. This mean flow may grow in strength, finally resulting in wave overturning beneath the interface. Weakly nonlinear theory with a wave packet will also be discussed.