Numerical simulations and theoretical predictions of nonlinear internal tide generation and dissipation

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The process by which the barotropic tide, flowing over bottom topography, ultimately leads to diapycnal mixing in the abyssal ocean is a complicated one. First the barotropic tides generate internal tides, the form of these internal tides being strongly modified by the height and steepness of the topography. Secondly, the internal tides may break through nonlinear processes, and hence lead to mixing. Here the generation and local breaking processes are examined, through the use of theory and numerical simulations. Two specific and contrasting scenarios are described in detail: the nonlinear transient lee-waves generated by tidal flow over very tall steep isolated topography, and the nonlinear wave-wave interactions above small-scale rough topography. Finally, parameterizations of diapycnal mixing which incorporate our current understanding of these processes are outlined, and results from global climate models in which these parameterizations are implemented are described.

Lecture 1. Generation of internal tides: linear theory
- Review of internal waves, linear theory of internal tide generation at small amplitude topography, acoustic and lee-wave limits. Bell's theory for internal tide generation. The limits of linear theory - controlling parameters. Comparison between linear theory and numerical simulations.

Lecture 2. Generation of internal tides at supercritical topography: theory and numerical simulation.
- Analytical theory for internal tide generation at supercritical and knife-edge topography, comparison between theory and numerical simulations.

Lecture 3. Nonlinear internal tides and overturning at tall steep topography.
- Numerical simulations of nonlinear transient internal lee-waves at tall steep topography, theoretical interpretation, implications for energy dissipation, parameterization of dissipation at tall steep topography.

Lecture 4. Dissipation of internal tides generated at rough topography.
- Numerical simulations of internal tides generated at small-scale rough topography, theoretical interpretation in terms of nonlinear wave-wave interactions, implications for energy dissipation, parameterization of dissipation at rough topography.