

Influence of Gravity Waves on the Ocean Circulation

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The ocean circulation is the result of a balance between forcing at large scales and dissipation at small scales. This balance occurs through a continuous transfer of energy from large to small scales. In the first lecture, I will review the global energy balance of the oceans with the goal of identifying the major source of energy that power the ocean circulation. In the second lecture, I will discuss the turbulent cascade that transfers energy from large down to dissipation scales. The discussion will emphasize both the aspects of the problem that are well understood and the many questions that remain to be answered. In lecture three, I will show that topographic generation of internal waves is a crucial step in the oceanic turbulent cascade, because it allows rapid conversion of energy from large to small scales. These three lectures will lay the case that a full theory of the ocean circulation and its role on climate relies on a theory of the transfer of energy from large to dissipation scales. The implications of these results for modeling the ocean circulation with computer models will also be addressed.

The last lecture will focus on a different aspect of internal waves. I anticipate that most lecturers will discuss the vertical mixing induced by gravity waves. Internal waves mix tracers in the horizontal as well. In this lecture I will present recent work on lateral mixing of tracers by internal waves in the ocean.

Lecture 1:

Energetics of the ocean circulation.

Lecture 2:

The turbulent cascade in the ocean.

Lecture 3:

Generation and dissipation of gravity waves in the Southern Ocean.

Lecture 4:

Lateral dispersion by internal waves.