JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

Weekly CEAFM Seminar: Fall 2012

Date: **Friday, November 30, 2012**

Time: 11:00 AM

Location: Gilman 50 (Marjorie M. Fisher Hall)

Speaker: **Dr. Nicolas Grisouard** (Courant Institute of Mathematical Sciences-NYU)

Title: *"Generation of Internal Solitary Waves by Internal Wave Beams"*

Abstract

Internal gravity waves are waves propagating in stratified fluids, which play an important part in ocean mixing. Regions near coasts and continental shelves exhibit two types of internal waves: focused internal wave beams (IWBs), which are able to propagate over the entire ocean column and nonlinear internal solitary waves (ISWs), which propagate horizontally along the thermocline (namely the temperature or density jump between the mixed layer, heated by the sun, and the cold abyss). These two types of internal waves are usually generated by the tide, inducing back-and-forth sloshing of the ocean over topographies, and usually propagate without interacting. On the contrary, observations from Western Europe and the South-Western Indian Ocean have provided evidence of the generation of ISWs due to an IWB impinging on the thermocline from below.

Besides in-situ observations, the problem of the generation of ISWs by IWBs has only been studied analytically and in very specific parameter regimes. Here we present the first direct numerical simulations of such a generation process with a fully nonlinear, non-hydrostatic model for an idealized configuration. We show that, depending on the parameters, different modes can be excited and we provide examples of ISWs as 1st, 2nd and 3rd modes, trapped in the thermocline. A criterion for the selection of a particular mode is put forward, in terms of phase speeds. In addition, another simpler geometrical criterion is presented to explain the selection of modes in a more intuitive way.

Next, we present numerical simulations of situations that are relevant for the Bay of Biscay (between France and Spain) in summer, where local generation is observed. We show that a beam impinging on a thermocline initially at rest can induce a displacement of the isopycnals, large enough for ISWs to be generated. These ISWs however differ from those observed in the Bay of Biscay through their amplitude and distance between wave trains. We then show that the latter feature is recovered when the background flow around the thermocline as found in the Bay of Biscay is included in the forcing, thereby yielding a more accurate view on the local generation mechanism.