Geophysical Research Abstracts
Vol. 12, EGU2010-13816, 2010
EGU General Assembly 2010

Internal Hydraulic Effects: From Fjords to mid-Ocean Ridges

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Direct observational studies of small scale processes have largely been pioneered in coastal and shelf seas systems. This is due in no small part to the relative ease of undertaking high temporal and spatial resolution observational campaigns in relatively shallow water close to land.

Another perceived advantage of visiting coastal and shelf sea systems to study small scale processes is the larger signal to noise ratio, due to the presence of enhanced barotropic tidal currents, strong stratification, intricate coastlines and steep topography.

In this paper we demonstrate that intense small scale internal hydraulic processes and associated diapycnal mixing are to be found all the way from fjords to the flanks of mid-ocean ridges. We do so firstly by an examination of the non-dimensional parameters relevant to the problem of oscillating stratified flow over topography, and secondly by reference to recent direct observations of small scale mixing processes made in a diverse range of locations. Examples are drawn from three case studies: a fjord on the west coast of Scotland (Loch Etive); an ocean margin ridge (the Wyville Thomson Ridge); a mid-ocean ridge (Northern MAR). In all three cases direct observations of highly non-linear internal wave processes will be presented, accompanied in each case with two-dimensional non-hydrostatic numerical simulations of the phenomena relevant to diapycnal mixing.