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The ocean's salinity and therefore its density increase with depth. This stratification supports subsurface waves, driven by tides. Periodic fluid motion over a shelf edge, or underwater mountain forces these internal gravity waves that appear as obliquely oriented, internal wave beams. Internal waves are of interest because they might explain observed strong mixing in the deep sea, one of the greatest unexplained mysteries of present-day oceanography. Experimentally, internal waves can be generated by periodically shaking a tank that is filled with a uniformly (salt) stratified fluid. Successive reflections of internal wave beams against inclined tank walls force the wave energy to collapse onto a closed orbit, the wave attractor. The wave attractor pattern depends on the precise shape of the tank and on wave frequency in combination with the stability frequency characterizing the stratification (Figures 1 and 2).

The long-term effects of wave attractors on stratification, current patterns and mixing, as well as their subsequent feed-back on these attractor patterns, are presently being studied. For this, a combination of theory and experiments is used. Initial investigations indicate that the wave attractors drive a net particle and fluid transport: first horizontally, towards the nearest attractor branch, and subsequently obliquely, along the attractor branches, in a direction opposite to the wave energy propagation direction. It turns out this can indeed provide an explanation for the elevated 'deep mixing'. The results described here were obtained under a FOM - 'dynamics of patterns' PhD grant. The work is a joint project between CWI (Amsterdam), DAMTP (Cambridge) and NIOZ (Texel).

Internal waves can also be trapped to density jumps. Such interfaces are regularly present in the ocean. The waves then appear as interfacial waves. Their interaction with the internal waves in the stratified layers adjacent to the interface may be responsible for sudden bursts of interfacial waves observed in the ocean and is currently being studied.

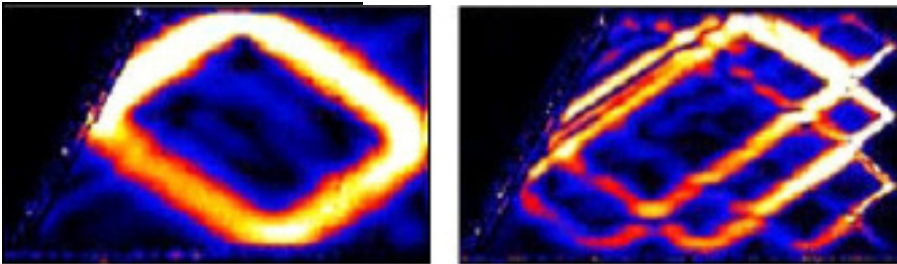


Figure 1 Side view of the stationary internal wave energy distribution due to periodic, horizontal shaking of a trapezoidal tank having a vertical/sawtooth shaped right wall in the left/right image. Internal waves are focused and defocused by the sloping walls, but focusing dominates and energy propagates clockwise in the focusing direction. Colors indicate strong (white) or weak (blue) motion.

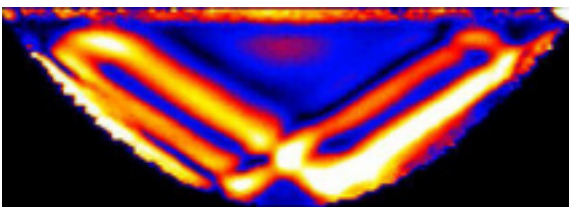


Figure 2 Internal wave energy distribution in a parabolic channel.