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Internal wave structures in abyssal cataract flows

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We discuss some theoretical approaches, experimental results and field data concerning wave phenomena in ocean near-bottom stratified flows. Such strong flows of cold water form everywhere in the Atlantic abyssal channels, and these currents play significant role in the global water exchange. Most interesting wave structures arise in a powerful cataract flows near orographic obstacles which disturb gravity currents by forced lee waves, attached hydraulic jumps, mixing layers etc. All these effects were observed by the authors in the Romanche and Chain fracture zones of Atlantic Ocean during recent cruises of the R/V Akademik Ioffe and R/V Akademik Sergei Vavilov (Morozov et al., Dokl. Earth Sci., 2012, 446(2)). In a general way, deep-water cataract flows down the slope are similar to the stratified flows examined in laboratory experiments. Strong mixing in the sill region leads to the splitting of the gravity current into the layers having the fluids with different densities. Another peculiarity is the presence of critical layers in shear flows sustained over the sill. In the case under consideration, this critical level separates the flow of near-bottom cold water from opposite overflow. In accordance with known theoretical models and laboratory measurements, the critical layer can absorb and reflect internal waves generated by the topography, so the upward propagation of these perturbations is blocked from above. High velocity gradients were registered downstream in the vicinity of cataract and it indicates the existence of developed wave structures beyond the sill formed by intense internal waves. This work was supported by RFBR (grants No 12-01-00671-a, 12-08-10001-k and 13-08-10001-k).