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Observations of internal solitary wave reflection at a step-like submarine bank and strong oblique interaction at Race Point Channel, (Cape Cod).

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A recent study revealed that Race Point Channel (in Cape Cod, Massachusetts) is a hotspot of internal solitary wave generation. SAR images suggest that the waves are generated within the channel (which has a flat bottom) during the ebb phase of the tide (flowing offshore) and propagate upstream during the initial stages of their formation. Some of these waves propagate into Massachusetts Bay (further North) and interact with the well known Stellwagen Bank internal waves that are generated on the lee-side of the Bank. The southern flank of Stellwagen Bank has very sharp bathymetric gradients and can be considered as a vertical step. Here we discuss the results of analysis of 25 TerraSAR-X radar images (in very high spatial resolution, 3 meters) and a collection of ENVISAT/ERS tandem mission acquisitions (separated in time by approximately 30 minutes) that reveal details about internal wave reflection at the southern flank of Stellwagen Bank. The SAR data also show transmission of internal waves over the Bank and subsequent interaction with lee-waves generated at the eastern side of Stellwagen Bank. The radar backscatter profiles are compared with theory of the transformation of a weakly nonlinear interfacial solitary wave in a two-layer model over a step. The coefficients of wave reflection and transmission are calculated based on typical stratification of the region and assuming linear theory of long interfacial waves. In addition, collision of reflected waves from the Bank with internal waves generated at the Race Point channel (one tidal cycle after) has been occasionally observed. The radar backscatter profiles suggest that the total wave amplitude during the interaction is greater than that obtained by simply adding the individual solitary wave amplitudes, which is in agreement with the theory of obliquely interacting solitary waves at a near critical angle (150°). This may imply localized turbulent mixing as a result of internal solitary wave interaction at Cape Cod Bay.