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The evolution of mode-2 internal solitary waves modulated by background shear currents

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The evolution of mode-2 internal solitary waves (ISWs) modulated by background shear currents was investigated numerically. The mode-2 ISW was generated by the"lock-release" method, and the background shear current was initialized after the mode-2 ISW became stable. Five sets of experiments were conducted to assess the sensitivity of the modulation process to the direction, polarity, magnitude, shear layer thickness and offset extent of the background shear current. Three distinctly different shear-induced waves were identified as a forward-propagating long wave, oscillating tail and amplitude-modulated wave packet in the presence of a shear current. The amplitudes of the forward-propagating long wave and the amplitude-modulated wave packet are proportional to the magnitude of the shear but inversely proportional to the thickness of the shear layer, as well as the energy loss of the mode-2 ISW during modulation. The oscillating tail and amplitude-modulated wave packet show symmetric variation when the background shear current is offset upward or downward, while the forward-propagating long wave was insensitive to it. For comparison, one control experiment was configured according to the observations of Shroyer et al. (2010); in the first 30 periods, $\sim$36% of total energy was lost at an average rate of 9W/m in the presence of the shear current; it would deplete the energy of initial mode-2 ISWs in $\sim$4.5 h, corresponding to a propagation distance of $\sim$5 km, which is consistent with in situ data.