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Solitary waves generated by flow over a step

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It is now well-known that trans-critical flow over an isolated obstacle generates upstream and downstream solitary waves. The situation is modelled by the forced Korteweg de-Vries (fKdV) equation, which can be solved either numerically, or by asymptotic techniques based on a combination of hydraulic theory and the Whitham modulation theory. In this work, we consider transcritical flow over a step, using both the forced Korteweg-de Vries equation, and simulations of the full Euler equation for free-surface flow. We show that a step of elevation generates primarily upstream solitary waves, and a step of depression generates primarily downsteam solitary waves. The numerical results are supported by some asymptotic anaylsis. Since an isolated obstacle can be viewed as a combination of steps of elevation and depression, the present results can be used to provide a novel interpretation of transcritical flow over an obstacle.