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Reflectionless wave dynamics in channels of variable depth and width

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In this work we discuss long wave dynamics in rectangular channels of variable depth and width. Demonstrated, that for conditions of "self-consistent channel" when Bc = const (B is a channel width, and c is a celerity), the wave propagates without inner reflection from the channel bottom and walls even if the function c(x) is arbitrary. It is shown, in the framework of the linear shallow-water theory, that the temporal shape of the travelling wave does not change with the distance; its amplitude and duration are constant. However, the spatial shape of the wave varies due to the change in celerity along the channel. In the framework of the nonlinear shallow-water theory, it is shown that the travelling wave deforms while the inner reflection from the channel bottom and walls is still absent. In this case dispersive effects lead to a disintegration of the initial wave into solitons. This process is studied in detail. Such unusual waves may propagate over long distances without loss of energy.