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Boussinesq model for shallow water waves over a rapidly varying topography

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We consider the propagation of water waves in a long-wave asymptotic regime, when the bottom topography is periodic on a short length scale. We perform a multiscale asymptotic analysis of the full potential theory model and of a family of reduced Boussinesq systems parameterized by a free parameter that is the depth at which the velocity is evaluated. We obtain explicit expressions for the coefficients of the resulting effective KdV equations. We discuss the compatibility of the potential model and the effective reduced models. We also discuss the impact of the rough bottom on the effective wave propagation. In particular nonlinearity is enhanced and we can distinguish two regimes depending on the period of the bottom where the dispersion is either enhanced or reduced compared to the flat bottom case.