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On weakly nonlinear gravity-capillary solitary waves BOGUK KIM — As a weakly nonlinear model equations system for gravity-capillary solitary waves on the surface of a potential flow, a cubic-order truncation model is presented, which is derived from the Taylor series expansion of the Dirichlet-Neumann operator (DNO) for the free boundary conditions of the Euler equations in terms of Zakharov's canonical variables. In deep water, the cubic-order truncation model allows gravity-capillary solitary wavepackets in the weakly nonlinear and narrow bandwidth regime where the classical nonlinear Schrödinger (NLS) equation governs. Since this model is consistent to the original full Euler equations in the order of nonlinearity up to the third order, the properties of the gravity-capillary solitary waves of this model precisely agree with the counterparts of the Euler equations. From this cubic order truncation model, the leading-order initial long-wave transverse instability growth rate of the gravity-capillary solitary waves is estimated to be identical, in the weakly nonlinear limit, to the earlier result by Kim and Akylas (J. Eng. Math. 58:167-175, 2007), through an equivalent perturbation procedure. Based on these analytical and numerical observations, the cubic-order truncation model equations system is regarded as the optimal reduced model for the dynamics of weakly nonlinear gravity-capillary solitary waves.

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