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Modelling dispersive meteotsunamis using the mild-slope equation

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We consider the generation and evolution of meteotsunamis around coastal areas. Meteotsunamis are tsunamis generated by pressure perturbations in the atmosphere, either by an impulse like increase or decrease in pressure or by Proudman resonance whereby a traveling pressure perturbation adds energy to a wave moving in the same trajectory.

Ocean waves are often composed of many different frequency waves which travel at different phase speeds. This mechanism causes dispersion of the frequencies. This means to accurately describe ocean waves composed of a wide band of frequencies we require a dispersive model. The mild-slope equation (derived from the Euler equation using appropriate assumptions) is a dispersive hyperbolic equation that models wave propagation over shallow slopes (slopes with gradients between zero and a third).

We deveop a novel meteotsunami model based on the mild-slope equation which, unlike previous models, is able to correctly reproduce dispersion and refraction of meteotsunamis. We compare our results for an impulsive two-dimensional atmospheric pressure perturbation with a flat bottom to analytic results by Renzi & Dias (2014). We also present our results for traveling three-dimensional atmospheric pressure perturbation over a plane beach.

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