Geophysical Research Abstracts
Vol. 19, EGU2017-8028, 2017
EGU General Assembly 2017

Wave attenuation by a model of vegetation in a flume

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The quantification of wave attenuation by vegetation is important for understanding shore protection and modeling coastal hydrodynamics. We investigate experimentally how different devices can modify the dynamics of irregular waves propagated in a flume. In particular we focus on a model of vegetation represented by flexible propylene stems with a modulus of elasticity E = 1200 MPa, a height l = 0.28 m and a diameter $2a$ = 0.025 m. The vegetation-like surface density is N = 720 stems/m^2. The flume is 80 m long, 1.5 m wide and 1.2 m deep with 20 capacitance-type wave probes distributed over 20 meters. A flap type paddle generated waves using the JONSWAP spectrum. Experiments are for 500 wave cycles for water depth w_d varying between 0.30 and 0.83 m and several significant wave heights H_s and wave periods T_p. We measure the wave height attenuation compared to flat-bed experiments and we apply a spectral analysis for post-processing. The loss of energy due to the stems is quantified and depends strongly on wave characteristics and geometrical parameters, in particular on the ratio l/w_d. From these experiments we can estimate a drag coefficient C_D by using a model of wave energy dissipation developed by Méndez and Losada (2004) which takes into account both wave and vegetation parameters.