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The standing biomass of saltmarshes as a key variable for estimating their wave energy damping capacity

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The estimation of wave energy dissipation produced by saltmarshes has traditionally been obtained in terms of a drag or friction force. The estimation of these forces is made taking into account the characteristics of the saltmarsh (i.e. biomechanical properties, morphology, density) and a hydrodynamic coefficient (i.e. the drag or friction coefficient). The characterization of a vegetated ecosystem by measuring leaf traits, the biomechanical properties of the plants and the number of individuals per unit area involves a lot of effort and is case-specific. In addition, hydrodynamic coefficients are selected on the basis of simplified geometry parameterizations or on calibrations performed in ad hoc studies and accurate estimates rely on their validation under real conditions.

Although for a very limited number of species, previous studies have shown that wave damping positively correlates with standing biomass. Therefore, standing biomass can be a unique variable that defines the wave energy attenuation capacity of the ecosystem. In addition, this variable has already been already characterized for many ecosystems by means of traditional plant harvesting or more recently using aerial images. Then, to further explore its relationship with the induced flow energy attenuation, a new set of experiments is proposed using real vegetation, with contrasting morphology and biomechanical properties, and subjected to different incident flow conditions. The experiments are carried out considering four species of vegetation, with contrasting biomechanical properties and morphology, and including two densities per species. Three water depths, wave heights from 0.08 to 0.18 m and wave periods from 1.5 to 4 s are tested. Capacitive free surface gauges and Acoustic Doppler Velocimeters (ADVs) are used to measure wave damping plant capacity along the meadow.

A direct relationship between the standing biomass of the meadow and plant induced wave attenuation is found for the eight vegetated conditions. In addition, a single relationship is obtained for the resultant wave damping and the eight standing biomass values. This relationship provides the basis for the use of standing biomass as a key parameter to estimate the coastal protection service provided by different saltmarsh species using a single variable that can be easily quantified from the field.