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MULTISCALE NUMERICAL EVALUATION FOR DISASTER MITIGATION EFFECTS AND LIMITATIONS OF COASTAL VEGETATION

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The presence of coastal vegetation contributes to dissipate tsunami flow energies [1]. While such disaster mitigation roles are widely recognized, its limitations caused by washout or breakage of trees still have a lot of ambiguity. Hence, there remains a need for an efficient method that can comprehensively assess both the effectiveness and the limitations of coastal vegetation.

This study presents a novel procedure for multiscale numerical evaluation of the effectiveness and the limitations of coastal vegetation. A key stategy in the proposed method is layering the whole structure of a coastal vegetation to two spatial scales; micro- and macro-scale. Each scale model accounts for the macro-scale structure or the micro-scale substructure composed several trees. With this idea such that the characteristics of the vegetation depends on the microscopic geometry and flow conditions, the macro-model is regarded as a set of surrogate surfaces that represent the micro-scale characteristics against the flow.

Firstly, several numerical experiments are conducted on the micro-model under the different inflow conditions. Then, after the macroscopic flow characteristics are transformed to the corresponding surrogate models, macroscopic simulations are performed. The stabilized finite element method [2] is employed to describe flows involving the vegetation. Assessment for the effectiveness and limitations are made by evaluating flow energy dissipation, growth of permeability and advection of the equivalent mass density. The validity of proposed framework is verified in comparison with laboratory experiments as well as classical equivalent roughness model (e.g. [3]).

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