



## **Cutting the costs of coastal protection: how vegetation reduces global flood hazard**

Vincent T. M. van Zelst (1), Jasper T. Dijkstra (1), Bregje K. van Wesenbeeck (1,2), Dirk Eilander (1,3), Edward P. Morris (4,5), Hessel C. Winsemius (1,2), Philip J. Ward (3), and Mindert B. de Vries (1)

(1) Deltares, P.O. Box 177, 2600 MH Delft, The Netherlands, (2) Delft University of Technology, Faculty of Civil Engineering and Geosciences, P.O. Box 5048, 2600 GA Delft, The Netherlands, (3) Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, 1081 HV Amsterdam, The Netherlands, (4) Instituto Universitario de Investigación Marina (INMAR), University of Cádiz, 11510 Puerto Real, Cádiz, Spain, (5) EO4 Data Science, 11500 El Puerto de Santa Maria, Cadiz, Spain

Exposure to coastal flood events is increasing due to growing population and economic activities in delta areas. These developments go hand-in-hand with the loss and deterioration of ecosystems as well as increasing sea levels and subsiding lands. Ironically, these same ecosystems can play a buffering role in reducing flood hazard and mitigating the resulting impacts. The ability of ecosystems to reduce coastal flood risk has been emphasized in multiple studies, but their contribution at a global scale has never been quantified. Here, we evaluate the role of currently present coastal vegetation, both of mangroves and marshes, in mitigating coastal hazards through wave reduction. We do this by combining earth observation (EO) data with an assessment method for wave reduction based on numerical models. We show that 31% of the total global coastline is covered with vegetation. For about 5.5% of the total global coastlines, vegetation can provide a meaningful contribution to flood risk reduction, by lowering required levee crest height with at least 50 centimetres, while maintaining the same flood protection level. We calculated that, if levees were established along all coastlines susceptible to flooding, vegetation could considerably lower required levee crest height, with a resulting saving of 194 billion USD in investments, of which 37 billion USD in urban areas.