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Coastal vegetation and its influence on the 2004 tsunami event

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A tsunami event has several effects once it reaches the shore. Infrastructure damage and casualties are two of its most dire consequences. The intensity of these damages is related to the wave force, which in turn is mostly determined by seaquake intensity and offshore properties. Nevertheless, once on land, the energy of the wave is attenuated by gravity (elevation) and friction (land cover). Despite being promoted as 'bio-shields' against wave impact, tree-belts lack quantitative evidence of their performance in such extreme events, and have been criticized for creating a false sense of security. We have studied some of the land uses in sites affected by the 2004 tsunami event, especially in coastal areas close to the coast of Indonesia, more specifically in the west coast of Aceh, Sumatra. Using transects perpendicular to the coast we analyzed the influence of coastal vegetation, particularly cultivated trees, on the impact of the 2004 tsunami. We developed a spatial statistical model that uses a land cover roughness coefficient to account for the resistance offered by different land uses to the wave advance. The coefficient was built using satellite imagery, land cover maps, land use characteristics such as stem diameter, height, and planting density, as well as a literature review. The spatial generalized linear mixed models used determined that while distance to coast was the dominant determinant of impact (casualties and infrastructure damage), the existing coastal vegetation in front of settlements also significantly reduced casualties by an average of 5%. Despite this positive effect of coastal vegetation in front of a settlement, we also found out that dense vegetation behind villages endangered human lives and increased structural damage. We believe that possibly debris carried by the backwash may have contributed to these dissimilar effects of land cover. The models developed in Indonesia are currently being adapted and tested for the effects that the same tsunami event caused in the Seychelles, where the intensity of the wave was a tenth of that in Aceh. On the Seychelles, our current work suggests that no direct effect of coastal vegetation existed. At the same time, our results indicate that vegetation maintained dunes seemed to offer a decrease of the probability of structural damage. We believe that instead of advocating for or against tree belts, a sustainable and effective coastal risk management should be promoted. This should include smart planning for the location (relative to the sea) of settlements but also consider the possible roles of coastal vegetation, as determined by its spatial arrangement. Overall, for any of these planning measures to be sustainable, coastal vegetation must be regarded as an important livelihood provider rather than just as a bio-shield. Consequently, it should be adapted to local customs as well as provide tangible short and mid-term benefits for local communities.