Mangroves as a coastal defense strategy: Using drones and smartphone LiDAR sensors to quantify mangrove-induced friction in flood models

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Mangroves play an important role in coastal protection in tropical deltas by exerting friction on incoming water flow and as such attenuating incoming extreme sea levels (e.g. storm surges, tsunamis). In order for models to realistically predict this attenuation of flood propagation by mangroves, we need to drastically improve the quantification of mangrove-induced friction on the water flow. Mangrove-induced friction is largely determined by the projected frontal area of the mangrove vegetation structure. That is, the structure of roots, stems, and branches which the water flow hits when flowing in and through a mangrove forest. Current methods represent a mangrove forest as arrays of regularly distributed cylinders which does not take into account the complex nature of the network of aerial roots typical for mangroves. Nowadays, LiDAR sensors on smartphones offer researchers an inexpensive and user-friendly method to build 3D models of terrestrial vegetation, opening up opportunities for a more comprehensive quantification of mangrove-induced friction. We demonstrate that a LiDAR-carrying smartphone can indeed be used to obtain an accurate 3D model of the complex aerial root system of mangrove trees. The light and user-friendly nature of such handheld smartphone offers an important advantage in challenging terrain such as an intertidal mangrove forest. Therefore, the method we present does not only contribute to quantifying vegetation-induced friction for hydrodynamic models but could be applied to other research efforts in order to effeciently and accuretaly obtain 3D models of objects.

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Mangroves; Hydrodynamic Modelling; LiDAR; iPhone