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Potential of WorldDEM™ to estimate forest canopy height and aboveground biomass in a tropical peat swamp forest

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ABSTRACT:

Forests can store a significant amount of carbon in the aboveground tree biomass and thus, are an important parameter in climate change models and global warming mitigation strategies. An approved method to estimate tree height and related biomass via remote sensing is the subtraction of a digital surface model (DSM) and digital terrain model (DTM) resulting in a canopy height model (CHM). This CHM represents the average vegetation height which is then used for biomass estimation. A global digital elevation model has been created by the TanDEM-X mission via SAR interferometry. The resulting WorldDEM™ can be considered as a DSM due to the low penetration of the X-Band into the canopy. A WorldDEM intermediate DEM (iDEM) available for the test site in Central Kalimantan and a corresponding DTM was derived. As a reference, high accurate DSM and DTM were produced from a LiDAR acquisition. The accuracy of iDEM models was assessed by comparison with respective LiDAR models. CHMs were calculated, which were used for biomass estimation via correlation of statistical values from the models to field measured biomass. The accuracy of iDEM DSM was high (RMSE = 0.8 m). The iDEM DTM achieved high accuracies as well (RMSE = 1.4 m) representing the terrain topography generally well, with minor overestimations where taller trees and underestimations where smaller trees were present. Errors from both iDEM models propagated to the CHM. Investigating the iDEM CHM to estimate aboveground biomass resulted in a RMSE of 50.8 t/ha (~17 % of actual mean biomass). The results show the high potential of WorldDEM™ for canopy height estimation. However, the accuracy of the WorldDEM DTM depends on the ground visibility in closed forests and the complexity of the terrain. Nevertheless, the globally available WorldDEM™ allows cost-efficient and consistent estimations compared to LiDAR, applicable on worldwide scale.

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