Correlations between forest biomass and full polarimetric parameters derived from Pi-SAR-L2 data for a site in Riau Province, Indonesia

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Abstract: Development of a forest biomass estimation algorithm is important from the perspective of understanding global warming. This is because the amount of forest biomass is one of the key parameters for estimating the carbon stock. One of the prospective parameters for estimating the global forest biomass is radar backscattering coefficient, σ^0_{HV} in L-band, which is known to be correlated with above ground biomass (AG-biomass). However, the relationship is valid only so long as the AG-biomass is less than 100 tons/ha, and thus, other parameters or methods must be employed to estimate larger quantities of forest biomass. In this work, correlations between forest biomass and full polarimetric parameters, including σ^0, four-component decomposition, eigenvalue decomposition (entropy/alpha/anisotropy), coherence value between polarization were analyzed. Polarimetric and Interferometric Airborne Synthetic Aperture Radar L2 (Pi-SAR-L2) data were examined to identify prospective full polarimetric parameters for estimating the AG-biomass of a dense forest. Five Pi-SAR-L2 repeat observations (observation ID: L201101, L201102, L201103, L201104, and L201105) were carried out on August 6, 2012, for study site in Riau Province of Indonesia, and these data were used in this analysis.

The σ^0–AG-biomass curve for the L201101 data shows saturation by around 100 tons/ha. On the other hand, correlation is observed up to 200 tons/ha for several full polarimetric parameters. The largest coefficient of determination (R^2) was observed when AG-biomass exceeded 100 tons/ha in the relation between AG-biomass and entropy; $R^2 = 0.2348$ was achieved with a window size of 7 for 1-look processed data. Anisotropy shows a weaker correlation with $R^2 = 0.1259$. In addition to these two parameters, σ^0 with a circular basis, the four-component decomposition parameters, and the HH-VV coherence all showed weaker or no correlation when AG-biomass exceeded 100 tons/ha. The cause of the dispersion observed between AG-biomass and entropy for the larger biomass areas were also examined by using L201101, L201102, L201103, L201104, and L201105 data, and these causes are discussed in the paper.

Keyword: L-band SAR, REDD+