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Novel model for Leaf Area Index estimation in semiarid environments using remote sensing data

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The Leaf Area Index (LAI) is a widely adopted index in environmental sciences used to represent the density of canopy that covers a specific surface area. LAI is used to estimate vegetation photosynthesis, transpiration, and energy balance of terrestrial surfaces, many climatological and hydrological attributes, such as atmospheric aerosols and water infiltration, and biogeochemical processes (Bonan, 1995), being one of the main parameters of both global and regional biosphere models (Arnold et al., 1998; Bieger et al., 2017). In particular, LAI models for the dry forest Caatinga in Brazil have not been duly calibrated by field measurements. The equations currently used to estimate LAI in the Caatinga show satisfactory covariance when compared to in situ data (Galvíncio et al., 2013; Machado, 2014), but they might lack accuracy in the whole spectra of possible values, because they were often calibrated with (i) spatial data from a single day, neglecting temporal variations due to phenology; and (ii) the Plant Area Index (PAI) instead of LAI, thus not taking into account the variable contribution of the Wood Area Index (WAI) in their measurements. These methodological flaws plus the fact that continuously efforts have focused same target areas in Brazil, i.e. the Brazilian Amazon and Rainforest, make the Caatinga an ecosystem in need for better models, and regional estimates. It is unquestionable the importance that Caatinga has in regional and global studies despite its poor environmental understanding. In this context, our objective was to create and test new empirical models using reflectance data. The study was based on measurements of photosynthetic photon flux density (PPFD) from above and below the canopy during the period of 2011–2016. These estimates were compared with Landsat-derived LAI products. The models proposed here present a better adjustment to the Caatinga vegetation in Brazil, while abstracting all complex process-based calculations involved in LAI data from radiative transfer models.
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