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Spectral vegetation dynamic on a fire-disturbed tropical peat swamp forest

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In Southeast Asia, a huge amount of peat has accumulated under peat swamp forest over millennia (∼ about 12% of global peat). However, these peatlands have been rapidly devastated by a repeatable large-scale fire as a result of land clearing, and a lower ground water levels in the late dry season, especially when the strong El Nino droughts arise. To investigate the effects of disturbance due to fires on the regional and global carbon balances, it is crucial to monitor vegetation regrowth after fire disturbance in tropical peat swamp forest. Analyses of land surface characteristic of satellite data relevant to Vegetation Indies (VI), which are affected by the plant canopy reflectance, have been widely used to monitor forest growth. However, accessing the seasonal variation of forest regrowth in this ecosystem-scale fire impact is quite limited and difficult, because the availability of noise-free data without clouds and aerosols over this region is low (∼0-1 day month-1). Therefore, we investigated vegetation recovery at a drained burnt ex-tropical peat swamp forest in Central Kalimantan, Indonesia (2.34ºS, 114.04ºE) for 11 years, since April 2004. The site was burnt four times during El Nino years in 1997, 2002, 2009, and 2014. We used reflectance indices obtained from micrometeorological tower to estimate vegetation regrowth. Results indicated that the seasonal variation of the tower-derived VIs varied with its minimum in the transition between the wet and dry seasons, and its maximum in the late dry season. This pattern is associated with a seasonal variation of diffuse solar radiation on tropical peatland. However, these VIs do not entirely explain the plant canopy reflectance on this ecosystem. Higher ground water level, and higher soil water content lowered canopy reflectance, while peat subsidence due to the peat fires increased canopy reflectance. Consequently, the tower-derived VIs failed to provide a longer period of monitoring vegetation recovery on this ecosystem. Modified visible reflectance – diffuse solar radiation response model and lower soil water content (SWC < 0.62 m3 m-3) improved the VIs model performance significantly. Our models show the strong relationship between MODIS data and tower-based VIs data (namely, the NDVI-Normalize Difference Vegetation Index, and the EVI2 – Enhanced Vegetation Index 2; p-value < 0.05).