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Satellite solar-induced chlorophyll fluorescence captured the vegetation drought during the 2015 El Niño event in Southeast Asia

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The year of 2015/16 has experienced one of the strongest El Niño events since 1950s, and led to historic warm and dry climate anomalies over the tropical land. Large-scale observations of plant stress due to drought are needed to improve modelling of global ecosystem transpiration and the implications of vegetation stress for the global carbon and water cycles. Southeast Asia experienced extreme drought which significantly affect the local human life and agricultural production during the 2015 El Niño event. The response of tropical forests to drought is uncertain and few studies have focused on the Southeast Asia. Here, we used the satellite-observed solar-induced chlorophyll fluorescence (SIF) from the Global Ozone Monitoring Experiment 2 (GOME-2), a proxy of actual photosynthesis, to investigate the variability of vegetation to the drought. We also used Palmer Drought Severity Index (PDSI), one of the most widely used drought index, and total water storage from GRACE to indicate the drought severity in the study region. We found that SIF was more sensitive to the drought event than traditional vegetation indices Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) to monitor drought for both evergreen broadleaf forest and croplands areas in Southeast Asia. We also found that the drought significantly reduced SIFyield, suggesting that the drought has caused the reduction in photosynthetic processes of vegetation. The comparison of retrieved column-average dry-air mole fraction of atmospheric carbon dioxide (XCO_2) with SIF was investigated to show carbon uptake responding to drought events. We conclude that satellite-based SIF is more beneficial to be an indicator to characterize and monitor the dynamics of drought in tropical vegetated regions.