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Remote sensing of temporal and spatial variations of litterfall in a subtropical forest

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Litterfall is important for returning nutrients and carbon to the forest floor, and will be released carbon dioxide into the atmosphere by microbes decomposition. Nutrients transferred from live aboveground biomass into forest floor is a pivotal component of the biogeochemical cycle in forest ecosystems as well. In this study, we utilized time-series (2001–2011) climate (the Moderate Resolution Imaging Spectroradiometer [MODIS] land surface temperature [LST] and Tropical Rainfall Measuring Mission [TRMM] precipitation) and green vegetation (MODIS photosynthetically active vegetation cover [PV]) variables to estimate regional litterfall in tropical and subtropical forests in Taiwan (23˚N, 121˚E). Excluding TRMM precipitation, we found that time-series annual accumulated MODIS LST and coefficient of variation of PV were salient variables to estimate the annual litterfall ($r^2 = 0.548, p < 0.001$). The mean ($\pm$ standard deviation) annual litterfall was 5.1 $\pm$ 1.2 Mg ha^{-1} yr^{-1} during the observation period. The temporal dynamics of the litterfall revealed that tropical cyclones and consecutive drought events might be determinants to affect inter-annual variations of litterfall. The annual amounts of litterfall decreased along the elevation gradient (r^2 = 0.284, $p < 0.05$) may reflect a shift of vegetation types. The northeast and northwest facing slopes yielded the highest amount of annual litterfall ($\geq$ 5.9 Mg ha^{-1} yr^{-1}) compared to lowest one in southern facing slope (5.1 Mg ha^{-1} yr^{-1}). This variation may be associated with the dryness of the microclimate, which is influenced by solar radiation. This study demonstrates the feasibility of utilizing time-series MODIS LST and PV data to predict regional litterfall may facilitate large-scale monitoring of biogeochemical cycles and disturbances in forest ecosystems.