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Discrepancy and linkage of Satellite-derived Land Surface Phenology with in-situ Observations from National Phenology Networks and PhenoCam Networks

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Land surface phenology (LSP) has been increasingly retrieved from satellite observations over past two decades. It plays an important role in understanding atmosphere-vegetation carbon and energy exchanges. Although LSP has been frequently compared with in-situ observations in a simple way, their difference and comparability are poorly understood. We in this study investigated the scalability, consistency, and representativeness of in-situ observations of species-specific phenology from national phenology networks and PhenoCam networks and compared them with LSP from Visible Infrared Imaging Radiometer Suite (VIIRS) at 500m pixels. Specifically, we investigated four methods (mean, median, 30th percentile, and minimum bias) to upscale in-situ observations collected from the Pan European Phenological database (PEP725, 9664 site-years) and the USA National Phenology Network (USA-NPN, 3144 site-years) spanning 2013–2020. The up-scaled in-situ observations were compared with the VIIRS LSP to address the optimal method of upscaling. The comparison differences were analyzed by associating with land cover and land surface heterogeneity to reveal the fundamental impact factors. Further, interannual variations and long-term trends in the species-specific phenological timing in the PEP725 and USA-NPN observations were correlated to VIIRS LSP, which was to expose the similarity of phenological variations under the same or similar weather conditions. Moreover, the daily variations in species-specific plant development were extracted from PhenoCam observations in the USA. The daily PhenoCam observations were fused with temporal trajectories obtained from harmonized Landsat and Sentienal-2 (HLS) at 30m pixels, which bridged field observations with satellite time series. The fused HLS-PhenoCam time series were applied to identify the phenometrics at 30m pixels, which were then linked to VIIRS LSP. Finally, we discussed the scalability and comparability of in-situ phenology observations to the LPS from moderate satellite pixels.