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Combining Observations of a Digital Camera Network, Satellite Remote Sensing, and Micrometeorology for Improved Understanding of Forest Phenology

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The observed phenological behavior of terrestrial ecosystems is a result of the seasonality of climatic forcing superposed with physical and biological responses of the plant-soil system. Biogeochemical models that represent rapid time scale phenomena well tend to simulate interannual variability and trends in productivity more accurately when phenology is prescribed, suggesting a gap in our understanding of the underlying processes or a generic means to represent their emergent behavior. Specifically, questions surround environmental triggers of leaf turnover, the relative importance of internal nutrient cycling, and the potential for generalization across broadly defined biome types. Satellite observations provide a spatially comprehensive record of the seasonality of land vegetation characteristics, but are most valuable when combined with direct measurements of ecosystem state. Time series of meteorology and fluxes (e.g. from eddy covariance tower sites) are one such data source, providing a valuable means to estimate productivity, but not a view of the state of the vegetation canopy. We have begun to assemble a network of digital cameras ('webcams') by deploying camera systems at existing research sites, and by harvesting imagery from collaborating sites and institutions. There are currently 80 cameras in the network, 17 of which are 'core' locations that are located at flux towers or field stations. We process and analyze the camera imagery as remote sensing data, utilizing the red, green, and blue, channels as a means to stratify the scenes and quantify relative vegetation 'greenness'. Our initial analyses have shown that these images do yield hourly-to-daily information about the seasonal cycle of vegetation state as compared both to fluxes and satellite indices. This presentation will summarize the current findings of the project, specifically focusing on (a) insights into controls on interannual variability at sites with long records (2000-present), and (b) a more detailed look at two core sites (Howland Forest, USA; and Bartlett Forest USA), which have concurrent flux and automated canopy radiometric observations.