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Assessing annual forest phenology: A comparison of Unmanned Aerial Vehicle (UAV) and Phenocamera Datasets

Earth observation satellites, handheld camera as well as human eyes, all are capable of capturing the timing of when plants grow buds, leaf out, flower, fruits and die back, the science known as plant *phenology*. These annual plant cycle events are known as *phenophase* which are often affected by the change in the amount of rainfall and temperature. An impact on phenophase timing by such change ultimately affects humans, animals and plants.

Imagine a situation where we want to measure the change in canopy greenness for a small experimental forest. Satellite images cannot offer the details at such scale. Hence, we can use cameras that are designed for tracking phenology known as phenocameras. Another example of such cameras is Unmanned Aerial Vehicle (UAVs), which has the capability to tackle some of the problems of satellite based measurements. They are capable of taking pictures of entire section of forest which allows us to estimate the phenophase events. They record the amount of increase or decrease in brightness of green during spring and fall respectively in the image. The plot showing amount of green can tell timing of increase, peak and decrease in greenness in the fall. This research focusses on deriving the annual change in canopy greenness over spruce forest from both platforms, computing and comparing the phenophase events against visually assessed data.

The study revealed a good agreement between the UAV and phenocamera based phenophase transition dates compared against visually assessed phenological events from phenocamera images. The seasonality events were consistently more closely associated with the visual assessments at an accuracy of less than a week. The research also observed significant amount of change in the occurrence of phenophase events over the years. Phenocamera data provided more flexibility in estimating date of important seasonality events. UAV provided the quality tree canopy level information with large spatial coverage and high temporal resolution. The agreement between UAV and phenocamera for studying evergreen spruce forest reveals the adequacy of these platforms for monitoring of tree dynamics.

Keywords: Geography, Ecosystem Analysis, Near-surface Remote Sensing, UAV, Phenocamera, Forest Phenology, Phenophase, Seasonality, NDVI, GCC

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