e-phenology: monitoring leaf phenology and tracking climate changes in the tropics

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The e-phenology is a multidisciplinary project combining research in Computer Science and Phenology. Its goal is to attack theoretical and practical problems involving the use of new technologies for remote phenological observation aiming to detect local environmental changes. It is geared towards three objectives: (a) the use of new technologies of environmental monitoring based on remote phenology monitoring systems; (b) creation of a protocol for a Brazilian long term phenology monitoring program and for the integration across disciplines, advancing our knowledge of seasonal responses within tropics to climate change; and (c) provide models, methods and algorithms to support management, integration and analysis of data of remote phenology systems. The research team is composed by computer scientists and biology researchers in Phenology. Our first results include: Phenology towers - We set up the first phenology tower in our core cerrado-savanna 1 study site at Itirapina, São Paulo, Brazil. The tower received a complete climatic station and a digital camera. The digital camera is set up to take daily sequence of images (five images per hour, from 6:00 to 18:00 h). We set up similar phenology towers with climatic station and cameras in five more sites: cerrado-savanna 2 (Pé de Gigante, SP), cerrado grassland 3 (Itirapina, SP), rupestrian fields 4 (Serra do Cipo, MG), seasonal forest 5 (Angatuba, SP) and Atlantic raiforest 6 (Santa Virginia, SP). Phenology database - We finished modeling and validation of a phenology database that stores ground phenology and near-remote phenology, and we are carrying out the implementation with data ingestion. Remote phenology and image processing - We performed the first analyses of the cerrado sites 1 to 4 phenology derived from digital images. Analysis were conducted by extracting color information (RGB Red, Green and Blue color channels) from selected parts of the image named regions of interest (ROI). using the green color channel. We analyzed a daily sequence of images (6:00 to 18:00 h). Our results are innovative and indicate the great variation in color change response for tropical trees. We validate the camera phenology with our on the ground direct observation in the core cerrado site 1. We are developing a Image processing software to authomatic process the digital images and to generate the time series for further analyses. New techniques and image features have been used to extract seasonal features from data and for data processing, such as machine learning and visual rhythms. Machine learning was successful applied to identify similar species within the image. Visual rhythms show up as a new analytic tool for phenological interpretation. Next research steps include the analyses of longer data series, correlation with local climatic data, analyses and comparison of patterns among different vegetation sites, prepare a compressive protocol for digital camera phenology and develop new technologies to access vegetation changes using digital cameras.