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Phenology and global warming research in Brazil

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A recent review on South American phenology research has shown an increase in phenology papers over the last two decades, especially in this new 21st century. Nevertheless, there is a lack of long term data sets or monitoring systems, or of papers addressing plant phenology and global warming. The IPCC AR4 report from 2007 has offered indisputable evidence of regional to global-scale change in seasonality, but it is supported by plant and animal phenological data from North Hemisphere and temperate species. Information from tropical regions in general and South America in particular are sparse or lacking. Here I summarize the recent outcomes of our ongoing tropical phenology research in Brazil and its potential contribution to integrate fields and understand the effects of global warming within the tropics. The Phenology Laboratory (UNESP) is located at Rio Claro, São Paulo State, Southeastern Brazil. We are looking for trends and shifts on tropical vegetation phenology, and are exploring different methods for collecting and analyzing phenology data. The phenological studies are developed in collaboration with graduate and undergraduate students, post-docs and researchers from Brazil and around the world. We established three long term monitoring programs on Southeastern Brazil from 2000 onwards: trees from an urban garden, semideciduous forest trees, and savanna cerrado woody vegetation, all based on direct weekly to monthly observation of marked plants. We have collected some discontinuous data from Atlantic rain forest trees ranging from 5 to 8 years long. I collaborate with the longest tropical wet forest phenology monitoring system in Central Amazon, and with another long term monitoring system on semi deciduous forest from South Brazil. All research programs aim, in the long run, to monitor and detect shifts on tropical plant phenology related to climatic changes. Our first preliminary findings suggest that: (i) flowering and leafing are more affected by changes on dry season length and severity, shifting on time and synchrony; (ii) shifts on fruiting are more subtle and related to seed dispersal mechanisms (animal, wind or others); (iii) forest edges and gaps, and distance from urban centers may influence tree phenology, stressing the synergic effect of fragmentation (among others) to global warming on tropical phenology; (iv) ground and satellite generated phenology patterns may not agree, deserving further and detailed research; (v) in situ environmental monitoring systems help to track changes on climate and correlate to ground phenology. Some important steps forward are: (i) to build a Brazilian Phenology Network, first based on a selection of national wide distributed species; (ii) to recover historical phenology data series from our herbarium collections and other sources; (iii) to integrate phenology to remote sensing; (iv) to stimulate more phenology long term monitoring programs and the integration across disciplines, advancing our knowledge of seasonal responses within tropics to long-term climate change.