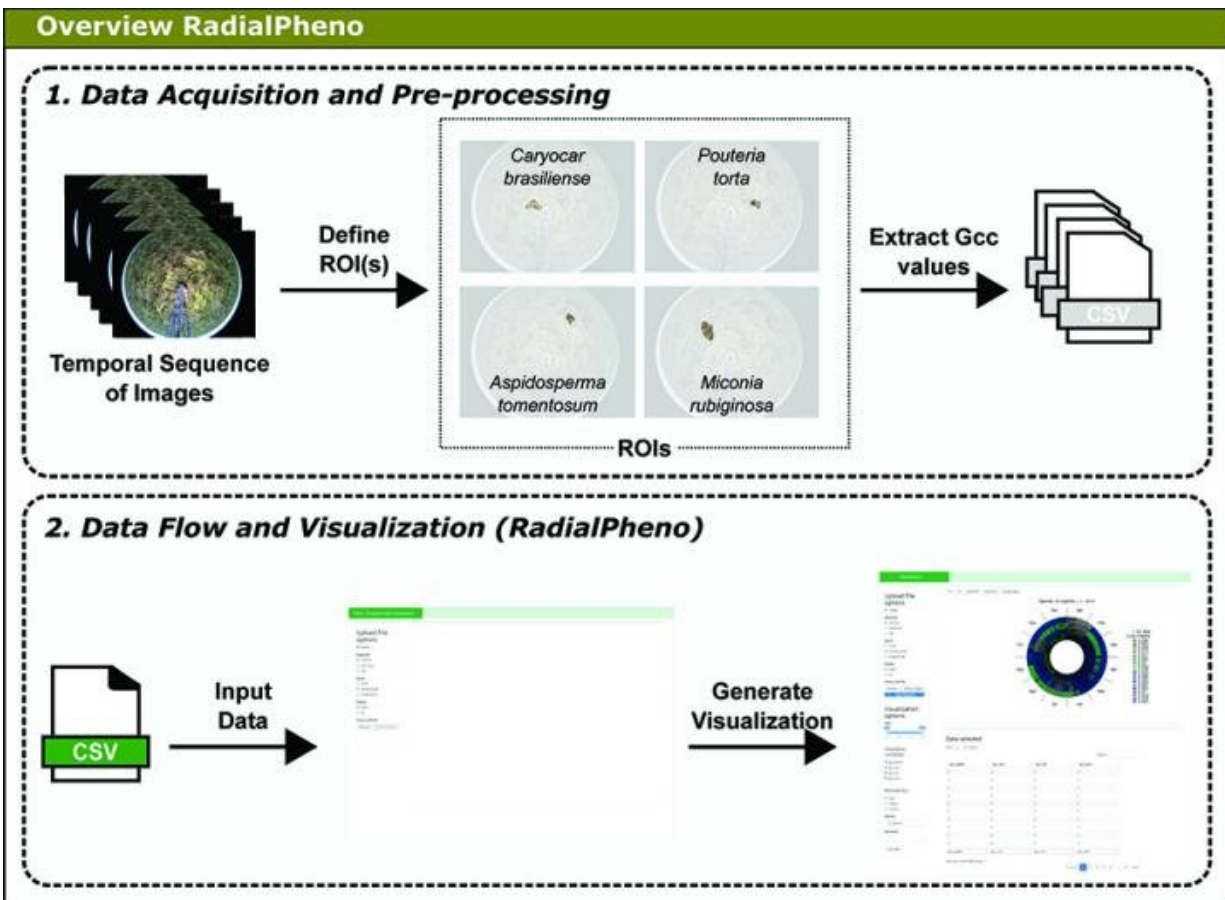


# Making sense of remote sensing data

August 9 2019



Example of RadialPheno workflow starting with a set of images from a fisheye phenocam and four regions of interest (ROIs); each ROI represents one individual species' crown. From the image processing, indices including the daily green chromatic coordinate (Gcc) values representing the leaf flushing phenophases for each species are obtained and saved as a CSV file, which is used as a data input in RadialPheno. Credit: Mariano, G. C., B. Alberton, L. P. C. Morellato, and R. da S. Torres. 2019. RadialPheno: A tool for near-surface phenology analysis through radial layouts. *Applications in Plant Sciences* 7(6):

e1253. <https://doi.org/10.1002/aps3.1253>

Remote sensor technologies like cameras, GPS trackers, and weather stations have revolutionized biological data collection in the field. Now researchers can capture continuous datasets in difficult terrain, at a scale unimaginable before these technologies became available. But as this flood of data has rolled into laboratory computers around the world, researchers have found themselves without well-developed analytical tools to make sense of it all. In research presented in a recent issue of *Applications in Plant Sciences*, Dr. Greice Mariano and colleagues introduce a tool called RadialPheno to analyze leafing patterns of plants based on remote camera data.

Before the widespread use of remote sensing equipment for field data collection, manual observation by scientists was a laborious, monotonous, and error-prone task, yielding much smaller and more dubious datasets. This is perhaps particularly true of phenology—the study of the timing of developmental events like leafing, flowering, and fruiting—because solid phenological observation requires being in the right place at the right time.

"On-the-ground phenological observations are accomplished periodically, require much more labor, and rely on the people that perform the observations," explains Dr. Mariano, corresponding author on the article and currently a post-doctoral research fellow at OCAD University, Toronto, Canada. "On top of that, results are stored in spreadsheets, which does not allow interoperability between data, making it difficult to analyze the data."

The ability to obtain rich sets of observations by setting up relatively inexpensive remote cameras has changed all that. But these observations

don't mean much unless they can be translated into integrated, tractable datasets that can yield meaningful insights. "Since remote monitoring is something new to phenology studies, there is a need to develop and improve methods for detecting changes in phenological series and data images, setting up standards," says Dr. Mariano, who conducted this research during her Ph.D. at the Institute of Computing, University of Campinas, Brazil. "Thus, in this research we introduced RadialPheno as a tool to support phenology experts in their analyses."

To identify the needs of these phenology experts, Dr. Mariano and her team worked with researchers at the Phenology Laboratory at São Paulo State University (UNESP). Dr. Mariano investigated what they wanted to see from data visualization tools and the issues they experience with existing software. Based on this investigation, they "developed a tool focused on the visualization of temporal data, where the identification of recurrent events is the most important task. We also thought about the integration of the visualization with the common statistical methods used by the experts," explains Dr. Mariano. "We choose radial representation because those structures are useful for understanding cyclical events, such as phenological ones."

The team tested their new tool by measuring leafing patterns in the Brazilian *cerrado*, a vast savanna ecosystem dominated by a wet and dry season. "Many plant phenology studies in Brazil have been conducted on a *cerrado* savanna area, and a digital camera for near-surface monitoring was installed in that area," says Dr. Mariano. "Thus, we also have phenological data based on on-the-ground observations, which allowed us to validate our tool with both on-the-ground data and [camera-derived] data." The camera network they set up is part of a set of cameras installed in different areas called the [Phenocam Network](#), which is available online.

Solid data about phenological patterns are more urgently needed than

ever, as climate change alters the timing of events in ecosystems around the world with possibly dire consequences for ecological interactions. Fortunately, remote sensing technologies have made collecting these datasets possible; tools like RadialPheno can now make them more meaningful.

**More information:** Greice C. Mariano et al, RadialPheno: A tool for near-surface phenology analysis through radial layouts, *Applications in Plant Sciences* (2019). [DOI: 10.1002/aps3.1253](https://doi.org/10.1002/aps3.1253)

Provided by Botanical Society of America

Citation: Making sense of remote sensing data (2019, August 9) retrieved 2 May 2024 from <https://phys.org/news/2019-08-remote.html>

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