SeasonWatch

Community Showcase

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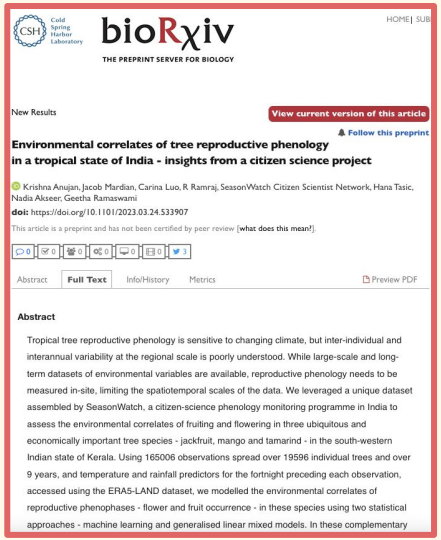
Authored Papers
about tree phenology in India



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Environmental correlates of tree reproductive phenology in a tropical state of India - insights from a citizen science project

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Abstract

Tropical tree reproductive phenology is sensitive to changing climate, but inter-individual and interannual variability at the regional scale is poorly understood. While large-scale and long-term datasets of environmental variables are available, reproductive phenology needs to be measured in-site, limiting the spatiotemporal scales of the data. We leveraged a unique dataset assembled by SeasonWatch, a citizen-science phenology monitoring programme in India to assess the environmental correlates of fruiting and flowering in three ubiquitous and economically important tree species - jackfruit, mango and tamarind - in the south-western Indian state of Kerala. Using 165006 observations spread over 19596 individual trees and over 9 years, and temperature and rainfall predictors for the fortnight preceding each observation, accessed using the ERA5-LAND dataset, we modelled the environmental correlates of reproductive phenophases - flower and fruit occurrence - in these species using two statistical approaches - machine learning and generalised linear mixed models. In these complementary

RESEARCH ARTICLES

Using citizen science to build baseline data on tropical tree phenology

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Large-scale and long-term baselines on climate-sensitive phenology of widespread tree species are lacking in the Indian subcontinent. Citizen scientists can help bridge this information gap by contributing simple, technology-based data. Here we describe an India-wide initiative called SeasonWatch, with preliminary insights into contributor behaviour and species phenology. Between 2011 and 2019, cumulative contributor numbers have increased every year, although consistent contribution remains constant and low. We describe seasonal and spatial phenological patterns in most-observed species based on repeated monitoring and one-time 'bioblitz' events. We study in detail the flowering phenology of one particular species, Cassia fistula, which appears to show aberrant phenology, reflecting a potential shift away from culturally known flowering dates. We conclude that citizen science-contributed information can be a valuable reference database to compare future changes in tree phenology.

Keywords: Baseline data, citizen science, climate change, seasonality, tree phenology.

CYCLIC patterns of growth and reproduction – or phenology – of living organisms are seasonal and highly sensitive to the environment[1]. Discernible changes outside of the known variability in the phenology of organisms are often indicative of underlying changes in large-scale climate patterns. In temperate regions, higher temperatures are related to the onset of spring phenophases, such as flowering and leaf unfolding[2]. Increasingly, dates of bud-burst have been demonstrated to advance when compared with long-term averages due to advancement in the warm season, increase in winter and spring temperatures, and effects of urbanization such as pavements and light at night-time[3–5]. In the tropics, recent long-term phenological studies have

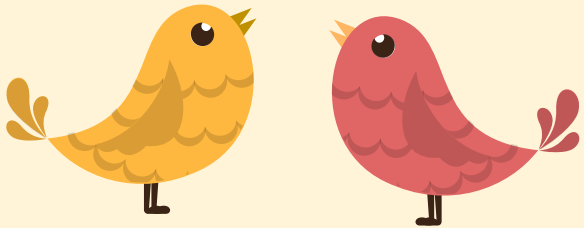
Europe and North America[11]. Apart from contemporary studies, this understanding is supplemented by a number of historical datasets collected by hobbyists and naturalists, that serve as baselines for comparing current phenological patterns (e.g. Marsham phenological record[1]). Some of the largest historical datasets on phenology are from temperate regions, including the Kyoto cherry blossom dataset which is over 1300 years old[12]. Most contemporary phenology monitoring networks are also situated in temperate latitudes[13]. Information on tropical phenology is lacking both in contemporary as well as historical studies, and large-scale or generalizable responses to climate are not known[14].

Arriving at generalizable trends for phenological responses to climate requires data collected over large spatial scales and over multiple years, and integrating different datasets[15]. Intensive research efforts at such scales are often not possible due to resource and personnel limitations. Large-scale, long-term observations, however, can be facilitated by citizen scientists[16]. Citizen science involves members of the public in scientific studies to collectively generate information around issues of larger public concern. The term, initially coined by the Cornell Lab of Ornithology, USA, in 1995, has since been used to include a multitude of projects such as mapping and documenting biodiversity (iNaturalist, Project Noah, PlantWatch, eBird) population dynamics (StreamWatch), bird migration (North American Bird Phenology Program) and plant phenology (Nature's Calendar, SeasonWatch). Citizen science projects are designed such that interested people, with or without a formal training in science, volunteer their time and collect information required to build and co-create datasets of interest[17,18].

Worldwide, citizen science initiatives have contributed to the large-scale understanding of phenology, including quantification of climate change impacts on plant pheno-

What is SeasonWatch?

SeasonWatch is a citizen science project based in India that employs nature enthusiasts and students (grades 6-10) to collect data on plant characteristics.



Citizen Observations Example

Date of Observation	Species	Flower Buds	Open Flowers	Unripe Fruit	Ripe Fruit
June 27th, 2024	Apple	Many	Many	None	Many
May 4th, 2019	Mango	Few	Many	Few	Few
April 20th, 2015	Jackfruit	Few	Many	Few	None

Problem Description

Finding Shifts In Plant Life Cycles

Climate change shifts plant phases (i.e flowering, fruiting)

We want to detect these shifts with SeasonWatch's citizen science data

Flowering

Fruiting

Research Question

How can we estimate start and end times of plant phases using SeasonWatch's citizen science data?

Results

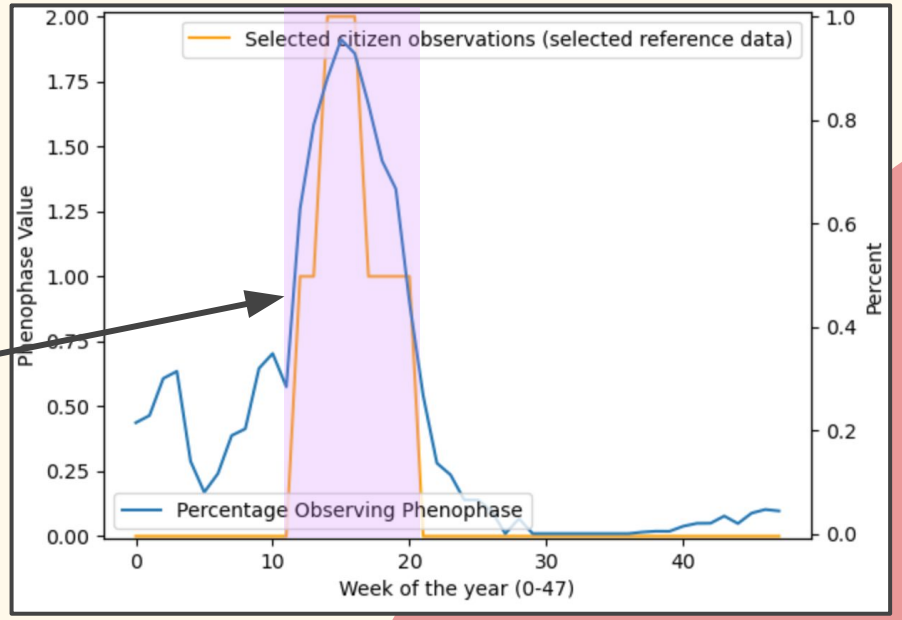
Estimating Plant Phases

We designed **two** different ways to estimate start and end times of plant phases, using SeasonWatch's citizen science data

Method 1: Identifying Weeks Where Phase is Present

For each year, we construct the plant phase as weeks where most observations tend to observe that phase.

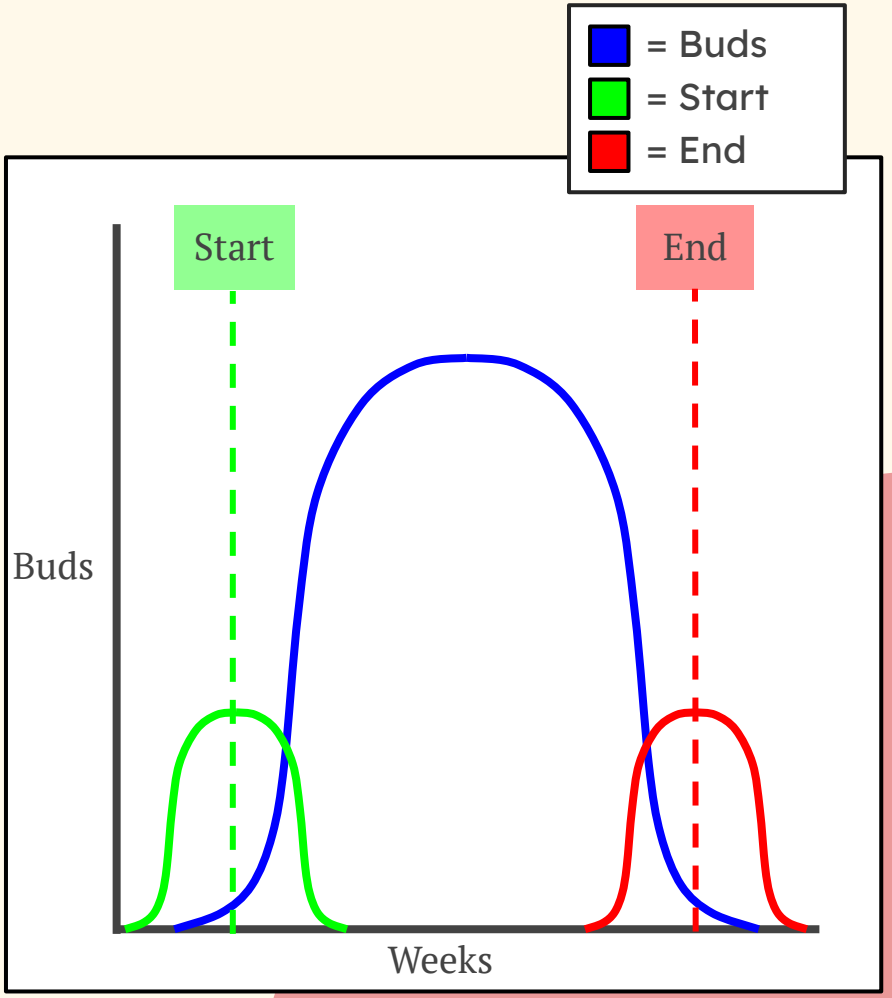
Weeks 11 to 21 capture the ripe fruits plant phase as shown by the spike.



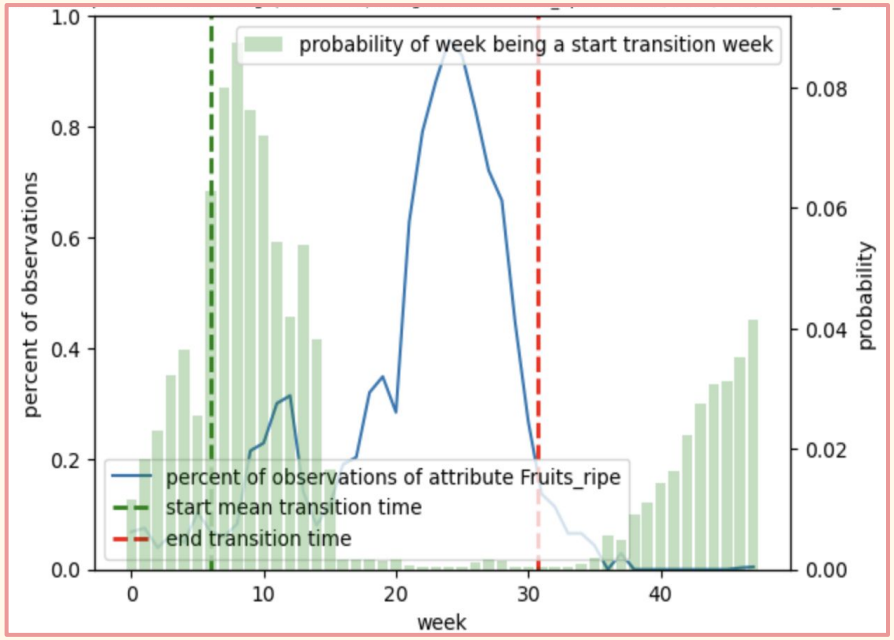
Method 2: Distribution-based

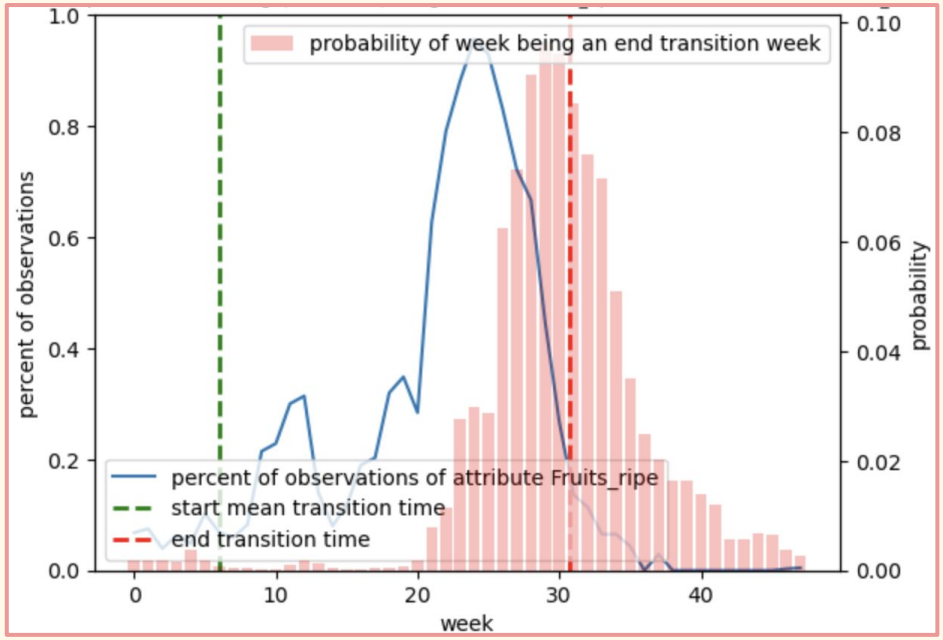
We quantify a plant phase with a distribution for the start week of the phase, and a distribution for the end week of the phase.

These distributions are computed from the citizen science data using statistics.



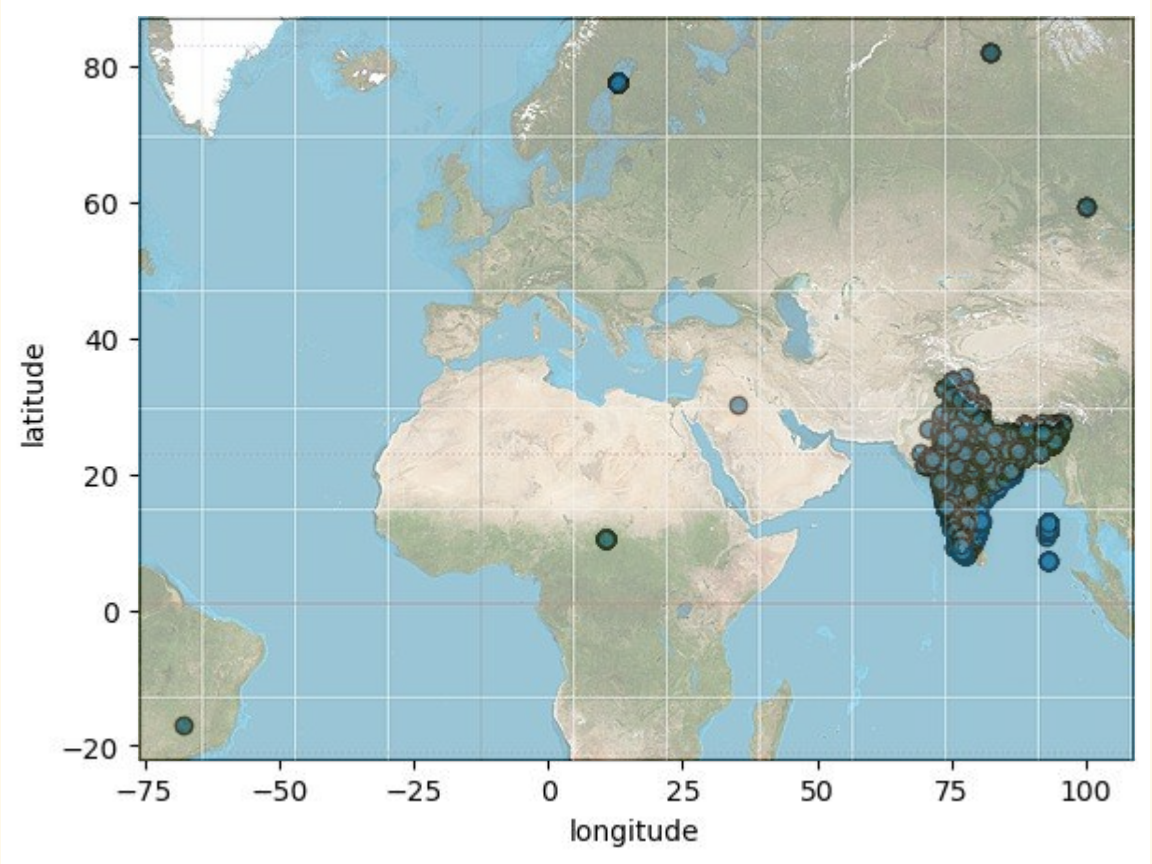
Method 2: Real Examples





Challenges

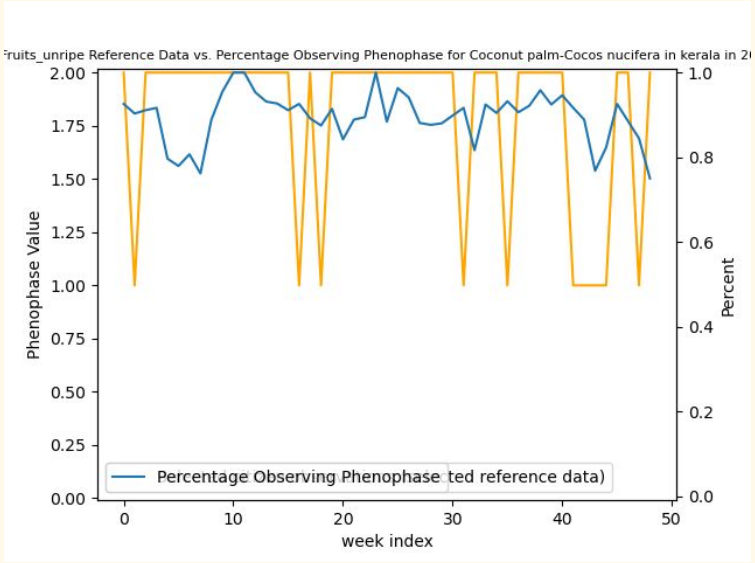
Challenge 1: Data Can Be Messy



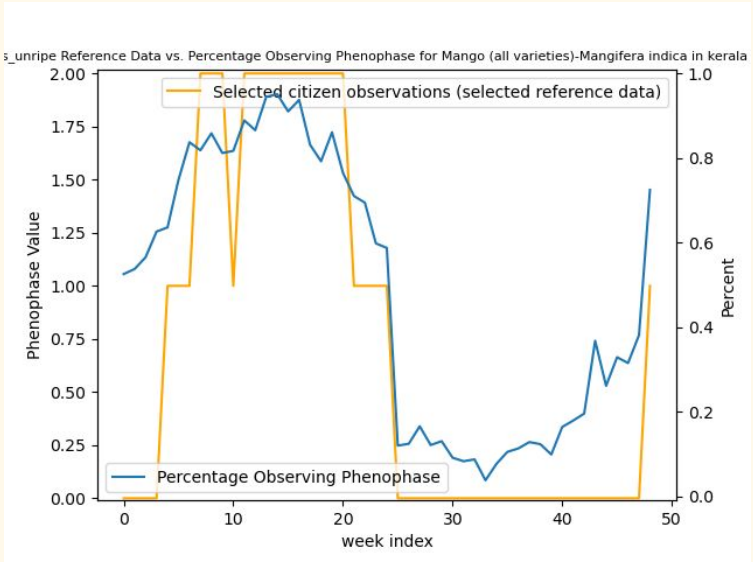
Challenge 2: Plant phases vary across species

Plant phases can differ in length and timing for different species.

Species: 

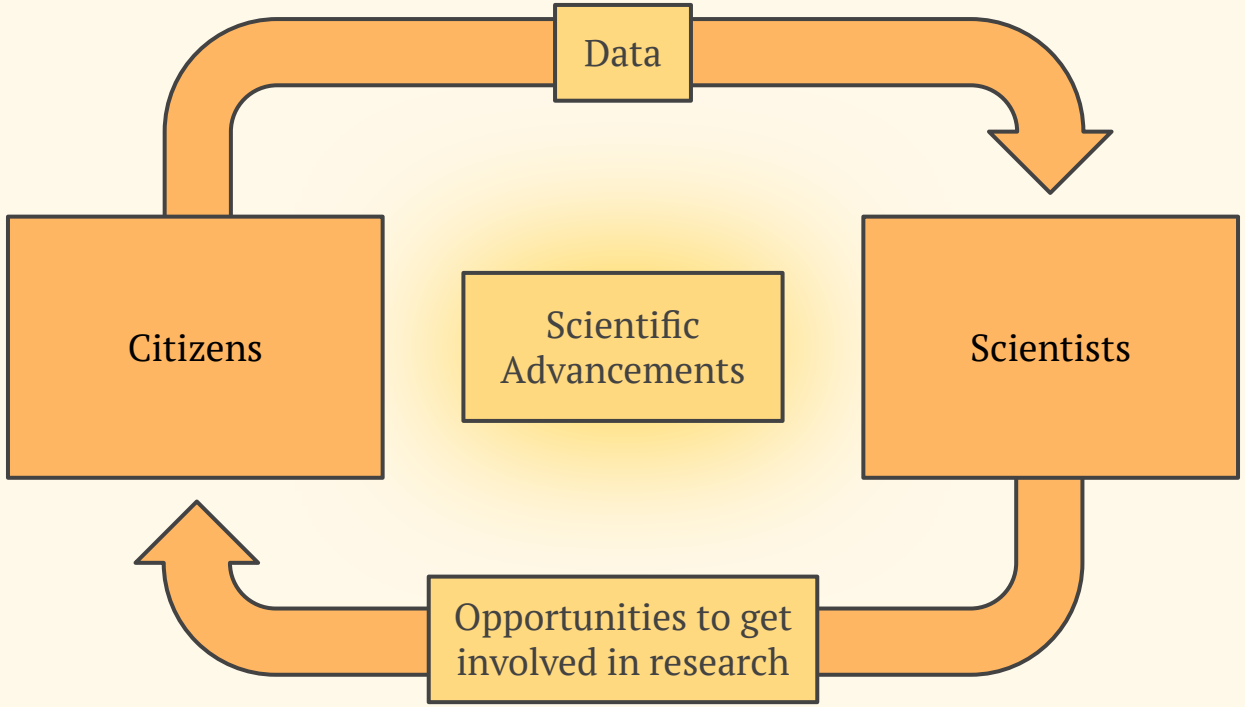


Species: 

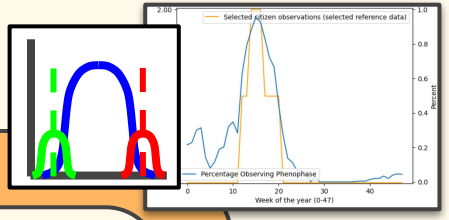


Project Impact

The Mutualistic Relationship of Citizen Science



Data



SeasonWatch Users

Scientific Advancements

Seasonwatch

seasonwatch

Opportunities to get involved in research

Resources

SeasonWatch Project Description Article:
https://images.assettype.com/ncfindia/2022-03/93582111-a405-42e4-958b-01d66fa4c2c3/Using_citizen_science_to_build_baseline_data_on_tree_phenology.pdf

Climate Change Research Utilizing SeasonWatch Data:
https://www.biorxiv.org/content/10.1101/2023.03.24.533907v1

SeasonWatch Tree Phenology Guide:
https://www.seasonwatch.in/wp-content/uploads/2023/11/SW-phenophases-guide-compressed.pdf

Register to SeasonWatch Here