Graphical representation of real time phenological information for the purpose of quality control, Citizen Science participation, media and climate impact monitoring

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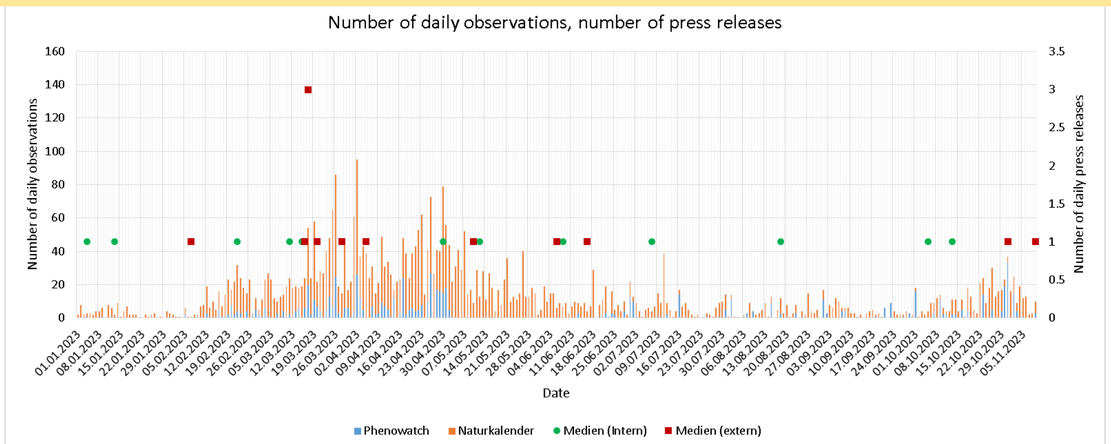
Real time pheno observations

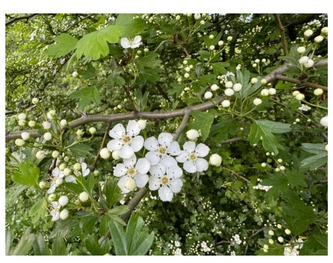
Via electronic media like smart phone apps volunteer observers of phenological networks are able to immediately transmit their eye observations and photographs to the data base. Based on such real time observations some phenological network operators provide graphical displays of the current phenological development on their respective home pages. The graphical representation of near real time phenological observations allow a number of interesting and useful applications. During the last couple of years a few such graphs have been developed at GeoSphere Austria, which will be presented here.

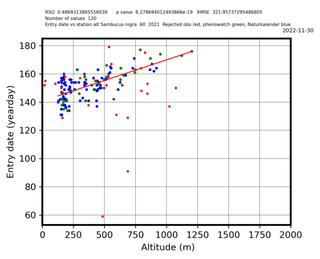
Pheno – Network - Metadata



Pheno – network – metadata displayed: the numbers of phenological observations (here from 2023, blue bars from phenowatch browser, orange bars from Naturkalender App) and of reporting observers (not displayed) can be monitored in real time. They typically reflect the seasonal variation of the frequency of phenological events with a strong spring maximum and a lesser autumn maximum. The effect of phenology related media releases (red dots: public media, blue dots: push messages to our Naturkalender observers) on observation numbers can be assessed. The long term trend of active observer and observation numbers helps to evaluate the measures for recruiting and encouraging volunteer observers.

QC Methods





Another application is the quality control of phenological observations. Photographs of plants and their phases might be checked by the network operator and in case of species or phase misidentification the observer might be contacted for feedback from the operator. Those two species were correctly identified, *Sambucus nigra*/black elder (left photograph), *Crataegus monogyna*/common hawthorn (medium image). Many phenological phases display a distinct regression with station elevation, which helps to detect outliers via scatter plots. Displayed is the regression entry date of black elder beginning of flowering from 2021 as function of station elevation, green dots from the browser interface, blue dots from the Naturkalender App, red dots observations rejected from the preliminary QC procedure, outliers, observations from outside Austria etc. .

Monthly Phenology Reports

Phänorückblick März 2024

Fast täglich gibt es phänologische Neuigkeiten zu beobachten, die Meldungen unserer freiwilligen Beobachter strömen mit 100 und mehr Beobachtungen pro Tag in die Datenbank. Der Rekordfebruar und recht warme März beschleunigten die phänologische Entwicklung sehr.

Der heurige und bereits hinter uns liegende Vorfrühling fällt in der 75 jährigen Reihe (1950 – 2024) unter die frühesten 5 Vorfrühlinge.

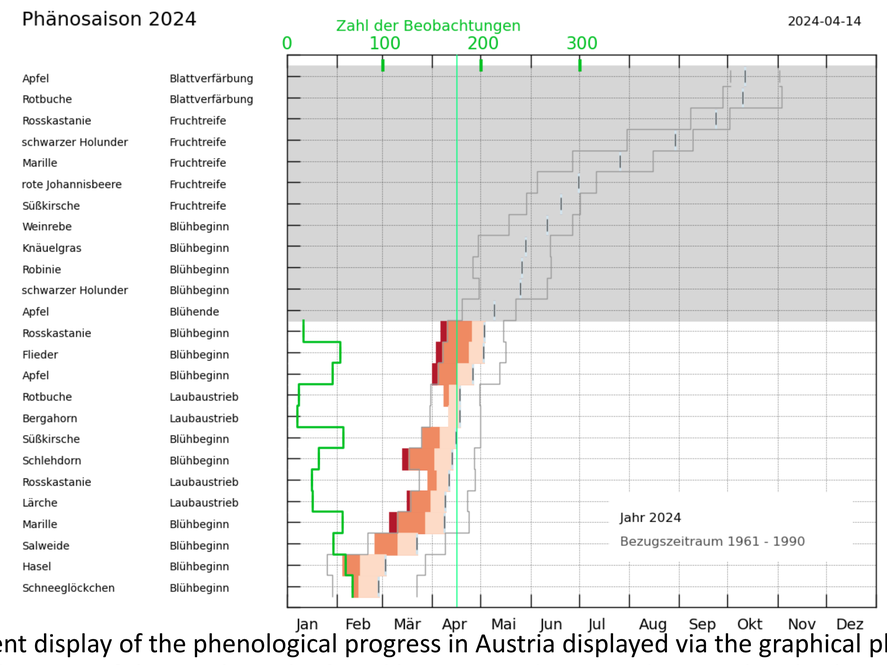
Der Blühbeginn von Kornelkirsche, Forsythie, Frühlingsknotenblume und Marille können als abgeschlossen betrachtet werden. Die Marillenblüte beispielsweise war die früheste der gesamten Beobachtungsperiode von 1946 bis 2024 (4. März) mit einem Vorsprung von etwa 3 Wochen gegenüber dem Mittel von 1991- 2020 und 4 Wochen gegenüber dem Mittel von 1961 – 1990.

Die ersten Hängebirken schütten ihre Pollen aus und treiben ihr Laub, Lärchen beginnen ihre Nadeln auszutreiben und Birnen zu blühen.

Durch den frühen Vegetationsbeginn ist die phänologische Entwicklung bereits weit fortgeschritten. Daher wäre ein Kaltlufteinbruch, der mindestens bis Ende April möglich ist, für die Landwirtschaft mit großen Schäden verbunden.

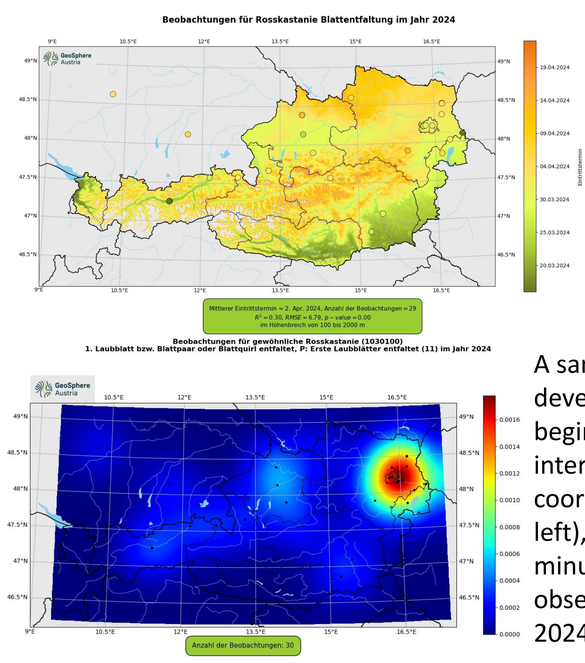
Phenological real time observations are the basis for monthly phenology reports, which are published for instance on the phenowatch home page during the phenologically active season (www.phenowatch.at). In mid- to higher latitudes the sequence of cold/warm events are well reflected by the variations of the phenological progress.

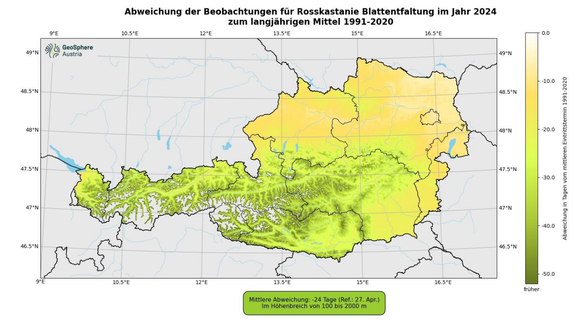
Graphical Pheno Review



A fairly current display of the phenological progress in Austria displayed via the graphical pheno review. A detailed explanation of the graph can be found here www.phenowatch.at. Dark red colouring indicates record phenological earliness of the spring 2024, most of the time series start in 1946.

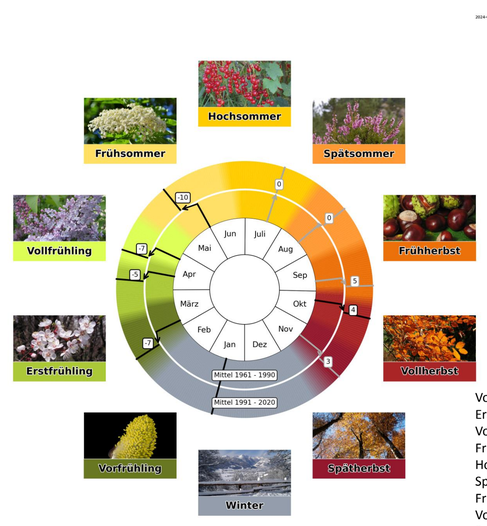
Phenological Maps



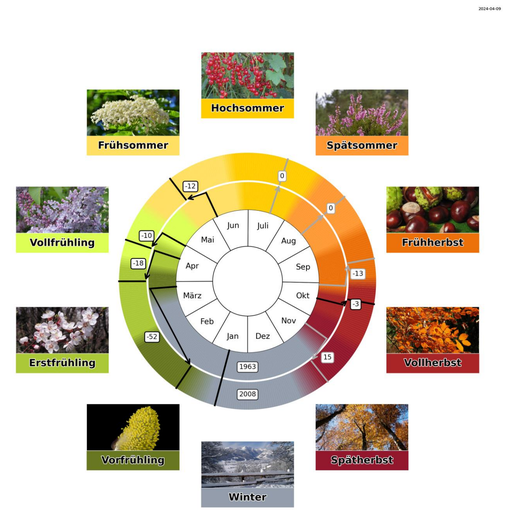


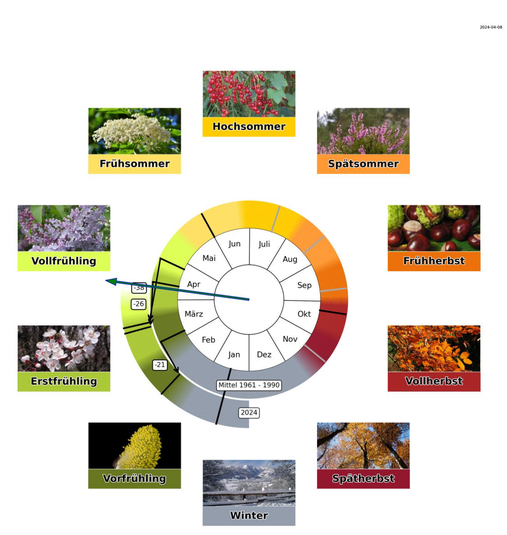
A sample of maps displaying the current phenological development of *Aesculus hippocastanum*/horse chestnut beginning of leaf unfolding: point observations and interpolated entry dates via multiple regression (station coordinates and elevation as independent coordinates)(top left), difference long term average entry dates 1991 – 2020 minus entry dates 2024 interpolated field (top right) and observation density or heat map for the same phase in 2024 (bottom left).

The Pheno Watch



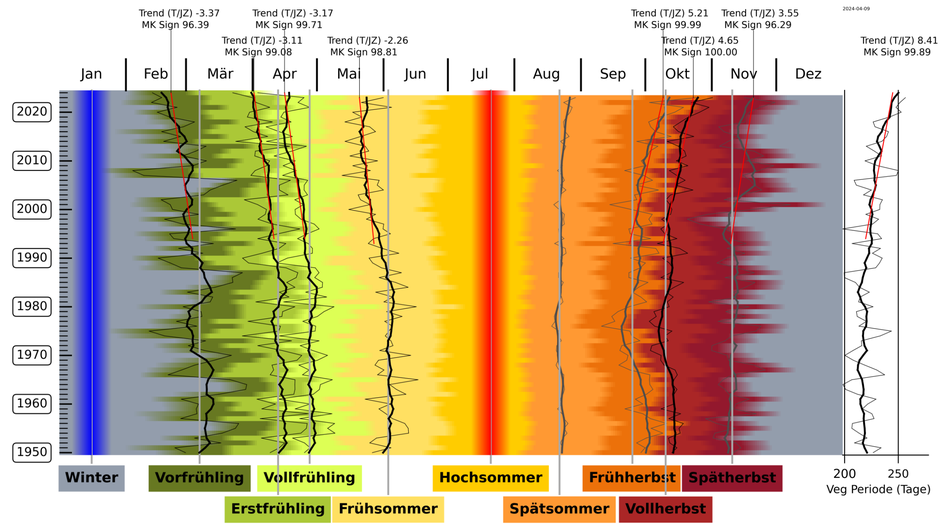
Vorfrühling – early spring
Erstfrühling – full spring
Vollfrühling – late spring
Frühsommer – early summer
Hochsommer – full summer
Spätsommer – late summer
Frühherbst – early autumn
Vollherbst – full autumn
Spätherbst – late autumn





The phenological watch constitutes a well suited instrument, to quickly and easily confer the idea of shifts in phenological entry dates. It is easier to read than curves on xy plots. There are many ways to compare two time periods or individual years.

The averaged position of the 10 seasons (see season list above), winter and full summer at a fixed date (15th January and 21st July), spring seasons, early summer and full autumn have been calculated from a selected set of phenological phases (black lines), late summer, early autumn and late autumn have been interpolated (grey lines). Numbers in the white boxes indicate the amount of shift in days. Climatological normals in comparison, 1961 – 1990 versus 1991 – 2020 (top left), extreme years in comparison, inner ring 1963 versus 2008 (top right), the current year 2024 versus 1961 – 1990 (bottom left).



If the rings of the phenological watches are cut at the top, bent straight and stacked upon each other year by year, an informative time series is created, demonstrating the shift of the seasons from 1950 to 2024 (as far as yet available): season averages (thin black lines), Gaussian low pass filtered season averages (thick black lines), 1961 – 1990 averages (thick grey lines connected to the season description boxes at the bottom, winter (blue line) and full summer (red line) are fixed at 15th January and 21st July respectively. For spring seasons, early summer and the autumn phases trend values are depicted at the top. The curve of the vegetation period has been added at the right hand of the figure, calculated as full autumn – early spring.