HR-VPP Monitoring

Hochaufgelöste Parameter der Pflanzenphänologie und Produktivität der Vegetation aus der Fernerkundung

Helfried Scheifinger

ZAMG


HOCHSOMMER
HOCHSOMMER
SPÄTSOMMER
SPÄTSOMMER

Themenübersicht

- Phänologie an der ZAMG
- HR-VPP **H**igh **R**esolution **V**egetation **P**henology and **P**roductivity
- Abstecher in die Phänologie, Klimawirkungsforschung
- HR-VPP, phänologische Beobachtungssysteme, Kalibrierung+Validierung
- HR-VPP Produkte und Zugang
- Anwendungsbeispiel FFG Projekt PhenObserve

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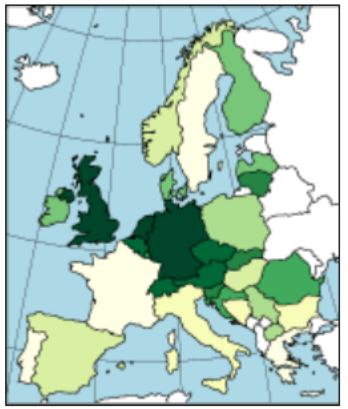
Pan European PEP725 Phenology DB



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Phenology Weekly

Living Almanac: Phenology Weekly - a US based **phenology newspaper!** You can access it on paper.li or linked within PEP725 Living Almanac: Phenology Weekly

Remark: We think it's worth reading but PEP725 does not have any influence to the content of this newspaper!

Our annual meeting will take place on
April 9, 2019, 10:00 - 13:00 at the ZAMG / Vienna.

The **public Phenological Symposium** is on the same day in the afternoon
April 9, 2019, 14:00 - 18:00 also at the ZAMG

on the following day,
April 10, 2019 the EGU phenology session will be held at the Austria Center Vienna
Orals 8:30-12:30 Room 0.49 | Poster Attendance 14:00-15:45

Details for this event can be found on the conference webpage Phenology and seasonality in climate change

Pan European PEP725 Phenology DB Management Meeting

EGU General Assembly 2019

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PEP725 News

New PEP725 reference publication

Management Meeting & Symposium

New records from Spain online

Dataset update

End of Year report 2015

more

Note: Phenology

Phenology is the study of the timing of recurring biological events in the animal and plant world. Leaf unfolding and flowering of plants in spring, fruit ripening, colour changing and leaf fall in autumn, as well as the appearance and departure of migrating birds and the timing of animal breeding are all examples.

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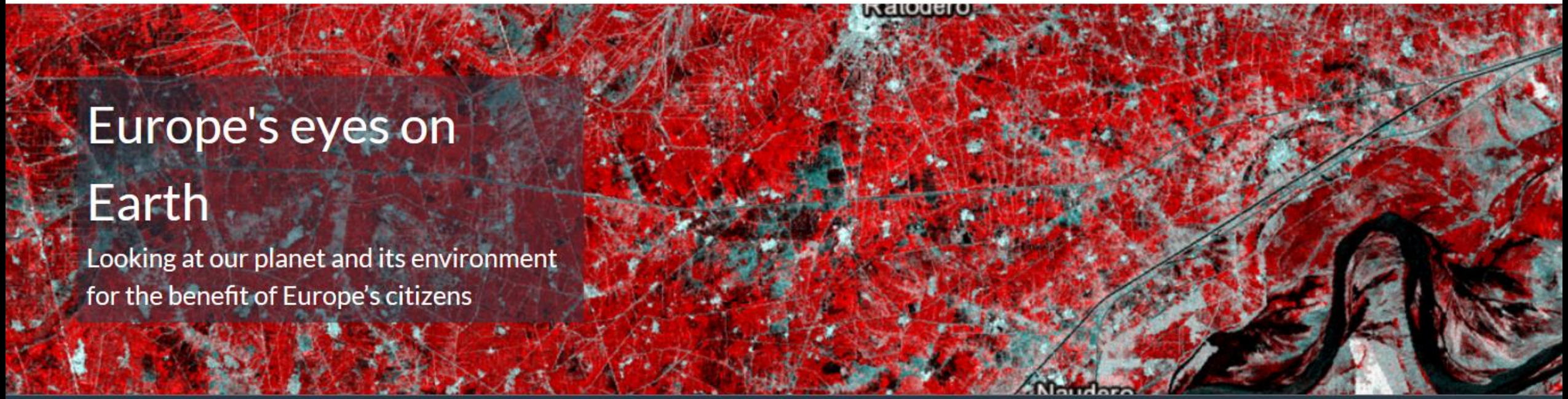

ision awards €5 million to winning project
OBSERVER: Climate data driven Use Cases shine at C3S Ga
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Atmosphere | Marine | Land | Climate Change | Security | Emergency

The Copernicus Land Monitoring Service (CLMS) provides geographical information on land cover and its changes, land use, **vegetation state**, water cycle …

Supports applications … spatial and urban planning, forest management, water management, agriculture and food security, ….

CLMS is jointly implemented by the European Environment Agency and **the European Commission DG Joint Research Centre (JRC)** and has been operational since 2012.

CLMS consists of five main components:

1. The systematic monitoring of biophysical parameters … … the products are used to **monitor vegetation, crops**, water cycle, energy budget and terrestrial cryosphere variables …

European Environment Agency

The European Environment Agency provides sound, independent information on the environment for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. In close collaboration with the European Environmental Information and Observation Network (Eionet) and its 32 member countries, the EEA gathers data and produces assessments on a wide range of topics related to the environment. Learn more

Air and climate

- Air pollution
- Climate change adaptation
- Climate change mitigation

Nature

- Biodiversity — Ecosystems
- Land use
- Soil
- Water and marine environment

Sustainability and well-being

- Environment and health
- Policy instruments
- Resource efficiency and waste
- Sustainability transitions

Economic sectors

- Agriculture
- Energy
- Industry
- Transport

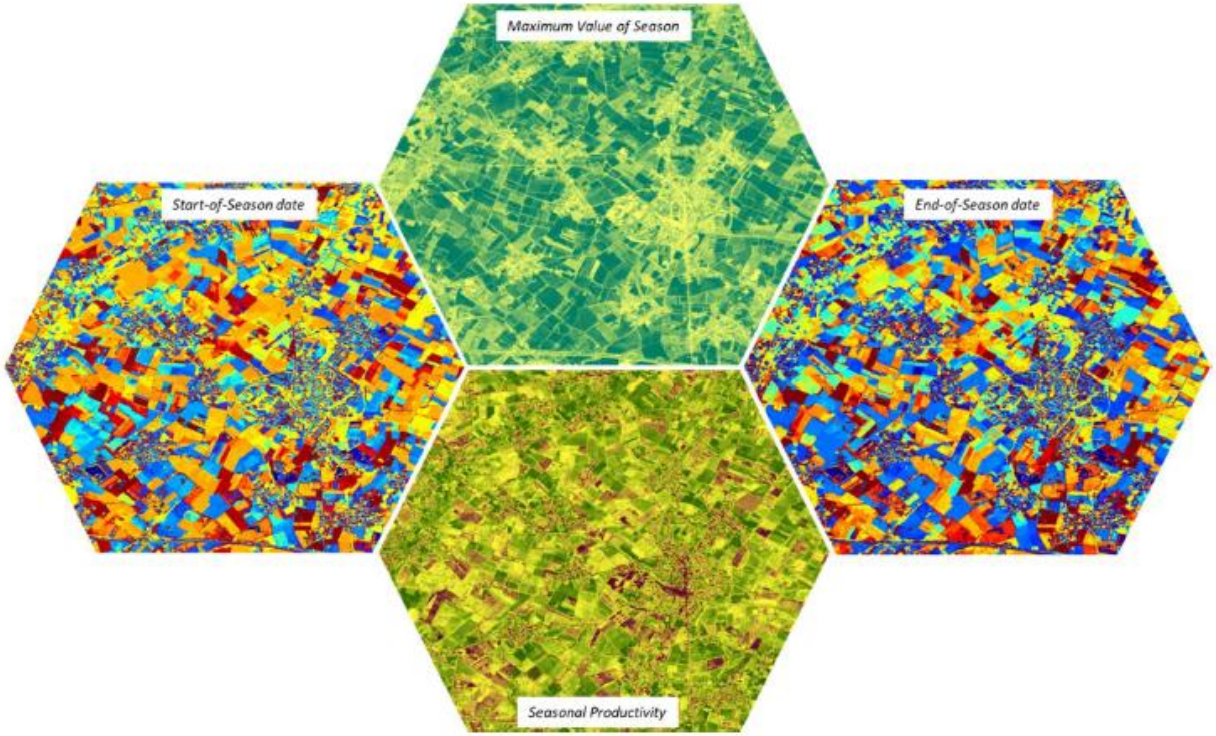
vito

REMOTE SENSING

End-to-end Earth observation support

Copernicus Land Monitoring Services

High Resolution Vegetation Phenology and Productivity Monitoring (HR-VPP)



SUBMITTED BY: **VITO (BELGIUM)**

IN COLLABORATION WITH:

LUND UNIVERSITY (SWEDEN)	EOLAB (SPAIN)	ZAMG (AUSTRIA)
LUND UNIVERSITY	EOLAB	ZAMG

WITH SUPPORT OF: **MALMÖ UNIVERSITY, KHUFKENS CONSULTING**

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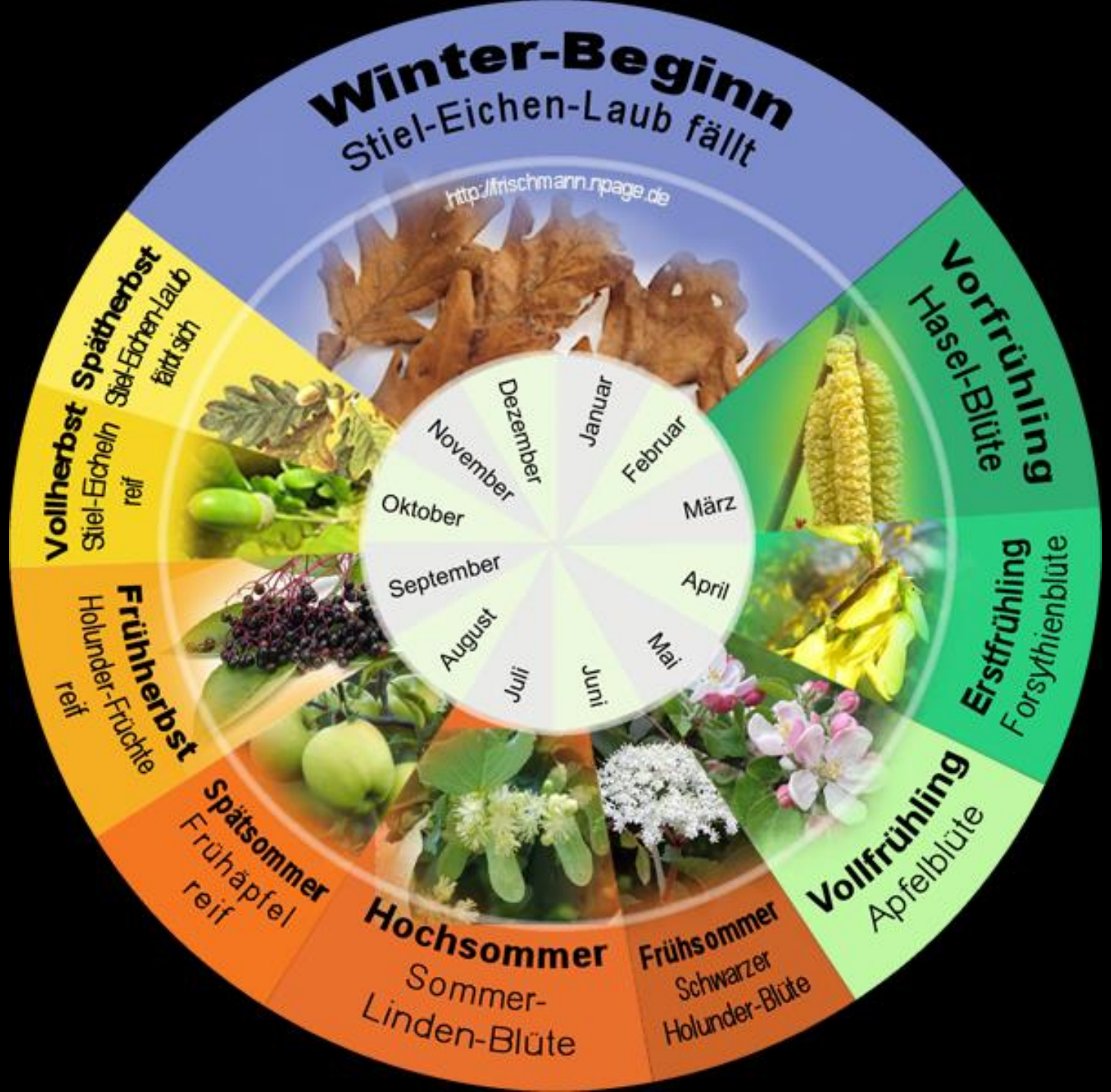
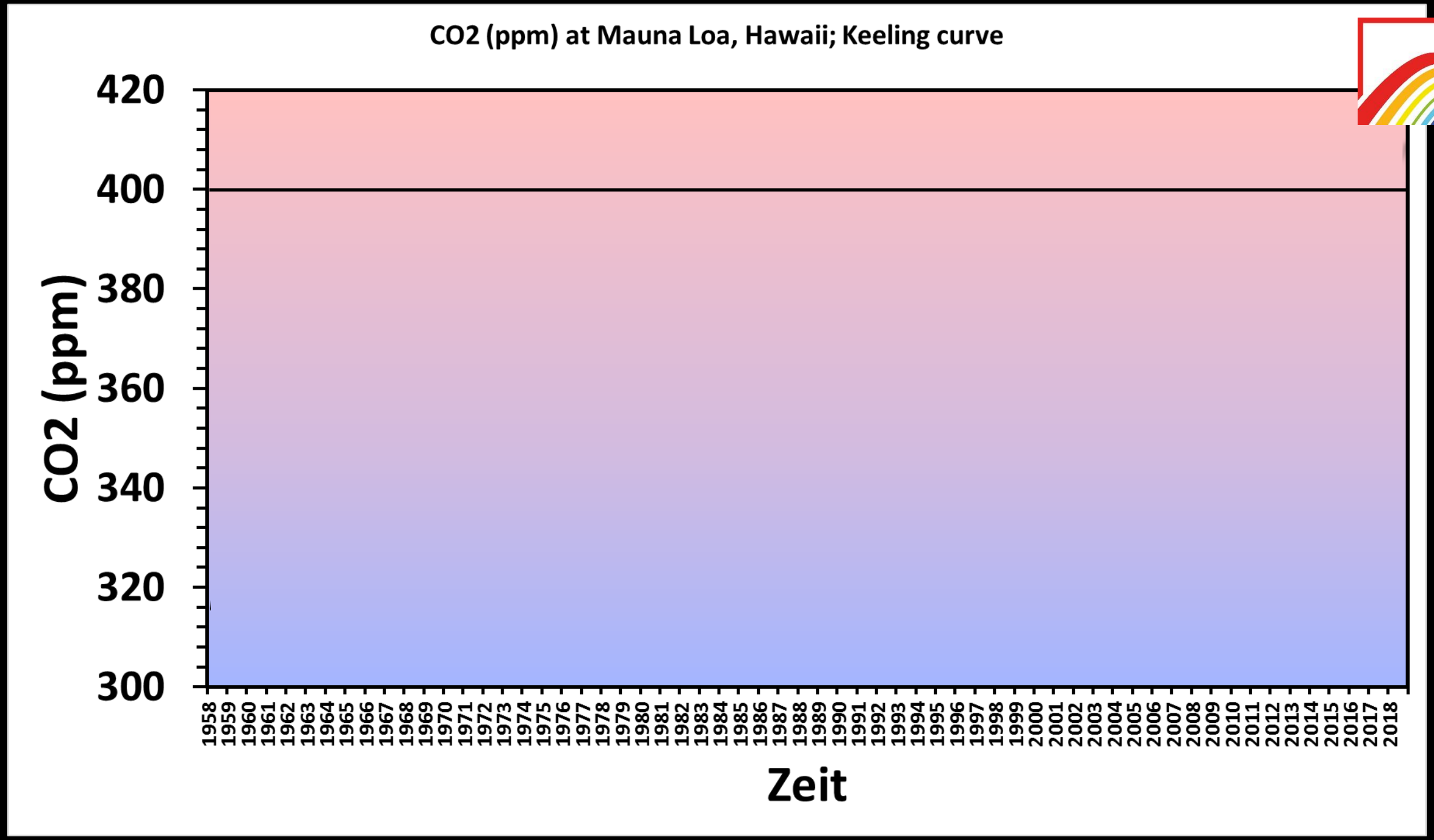
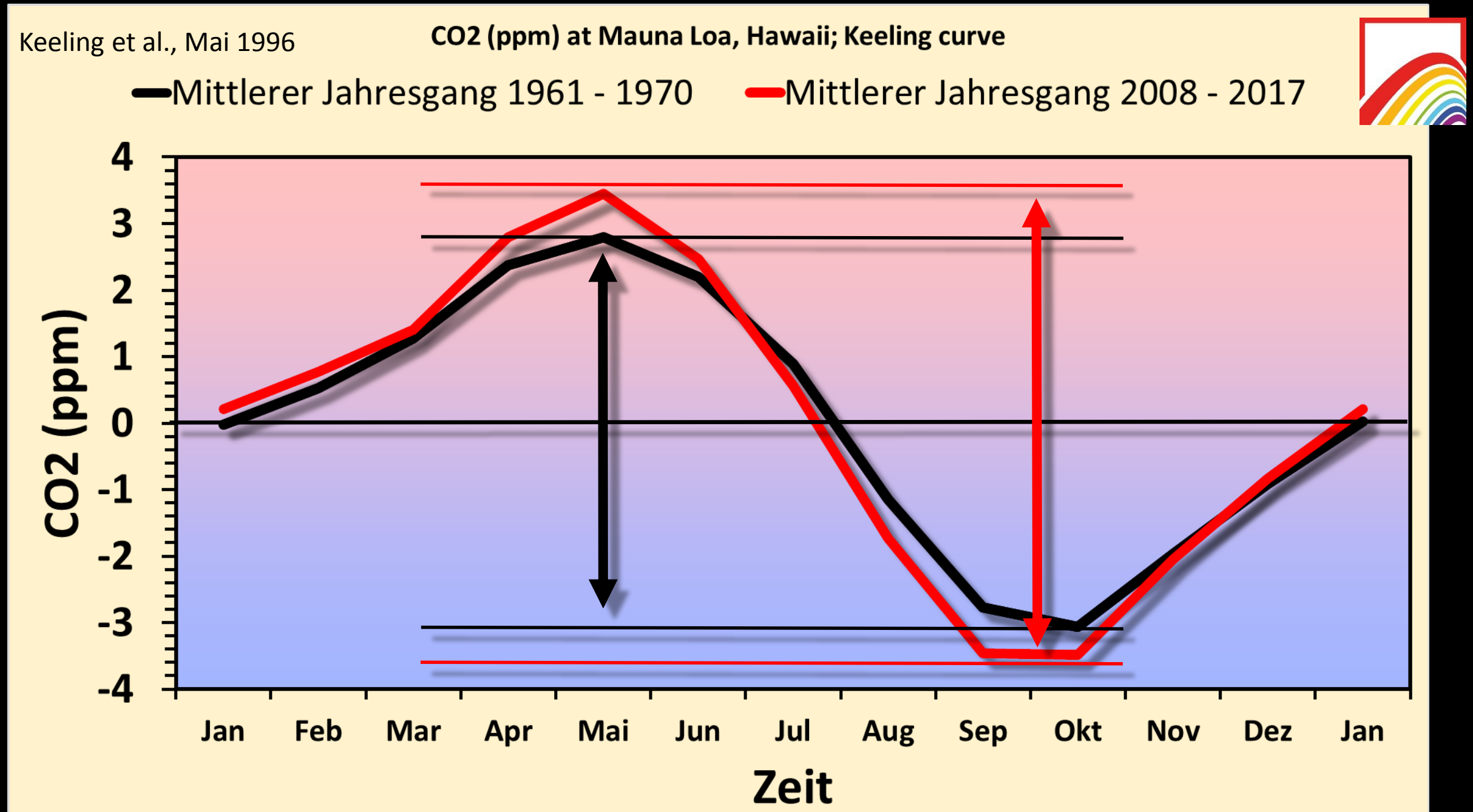


Die Phänologie beschäftigt sich mit den im Jahresablauf periodisch wiederkehrenden Wachstums- und Entwicklungserscheinungen in der Tier- und Pflanzenwelt und untersucht deren Ursachen in Hinblick auf biotische und abiotische Einflüsse (LIETH, 1971).

Charles Keeling (1928 – 2005)

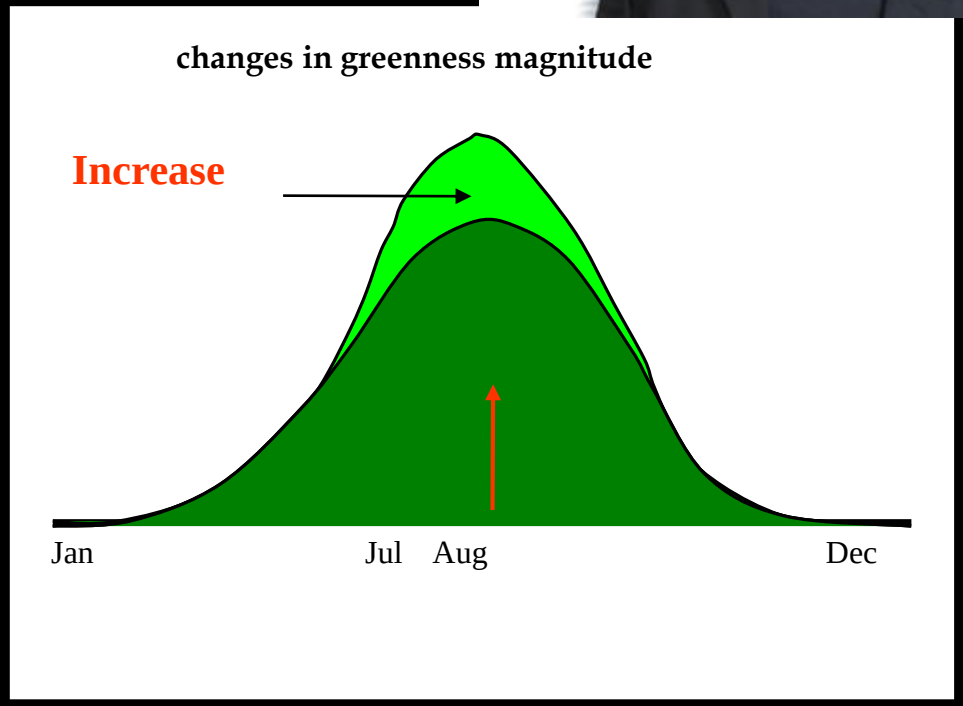

CO2 (ppm) at Mauna Loa, Hawaii; Keeling curve
CO2 (ppm)
420
400
380
360
340
320
300
1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Zeit

Keeling et al., Mai 1996

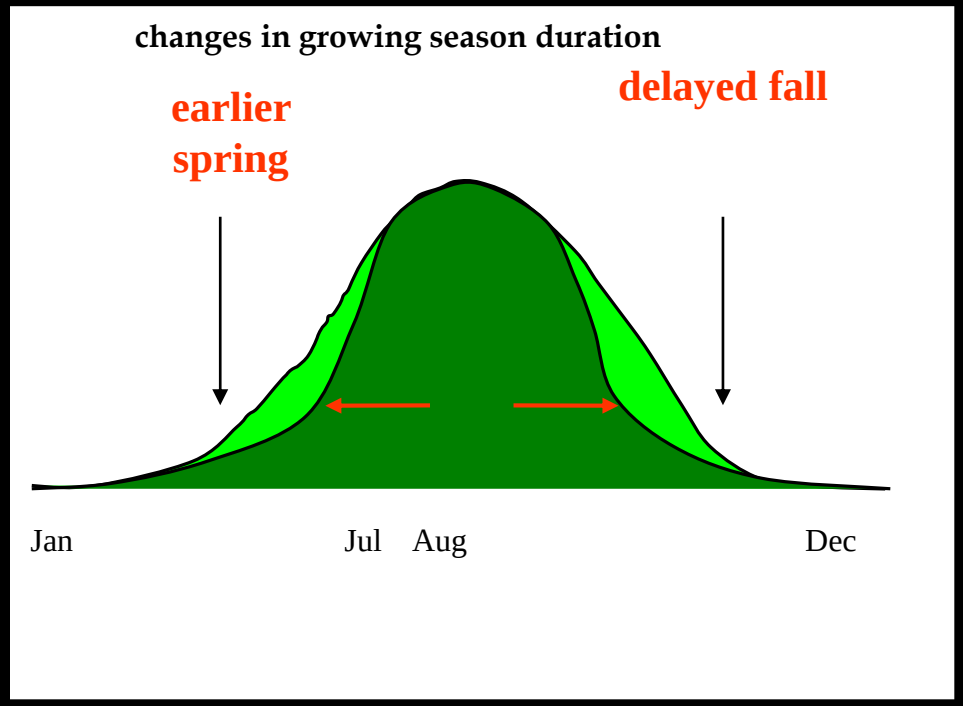


Myneni et al. April 1997

Ranga Myneni



Assess changes in peak seasonal greenness from July and August average NDVI



Use NDVI threshold to assess changes in dates of spring green-up and autumn green- down (assess sensitivity to threshold value)

Vernetztes System der Geosphäre, vielfache Rückkoppelungen

Strahlungsbilanz positiv

Trend: Erhöhung CO2 Konzentration

Erhöhung der Temperatur

Anthropogene CO2 Emissionen

Amplitude und Verschiebung: Verändert CO2 Jahresgang

Phänologie, Verlängerung der Vegetationsperiode
Intensivierung der Photosynthese

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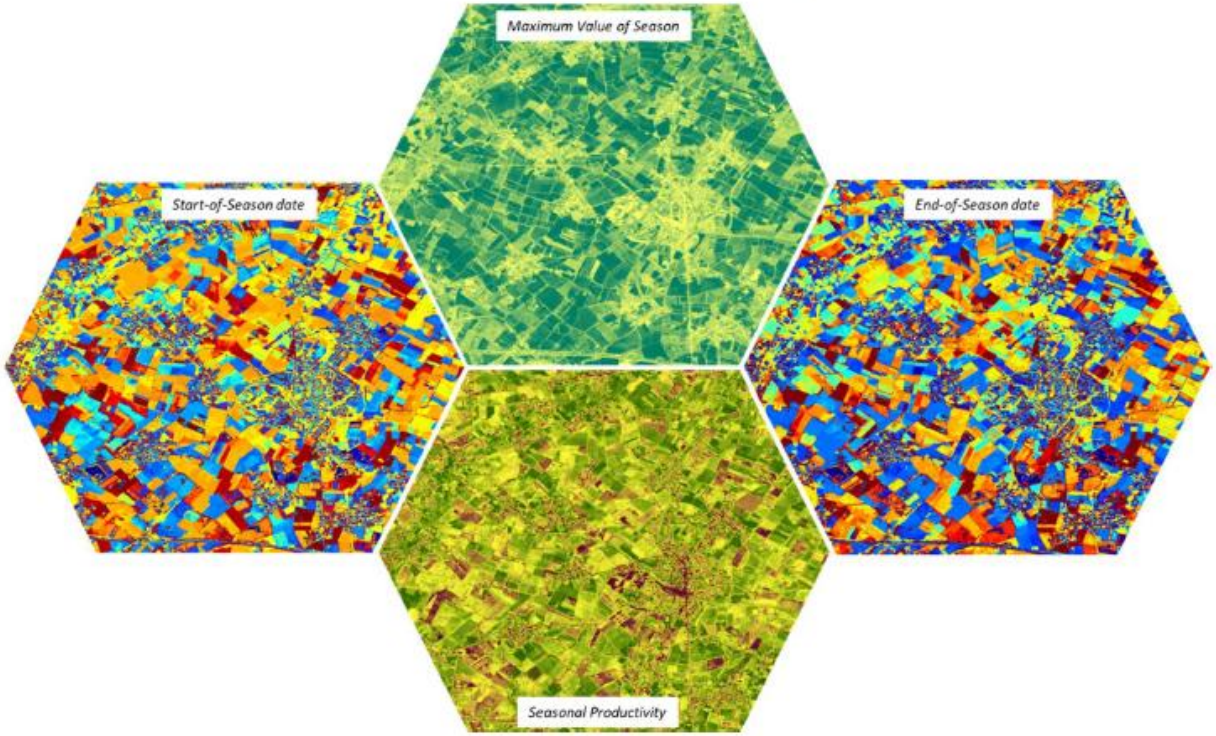
Copernicus Land Monitoring Services

High Resolution Vegetation Phenology and Productivity Monitoring (HR-VPP)



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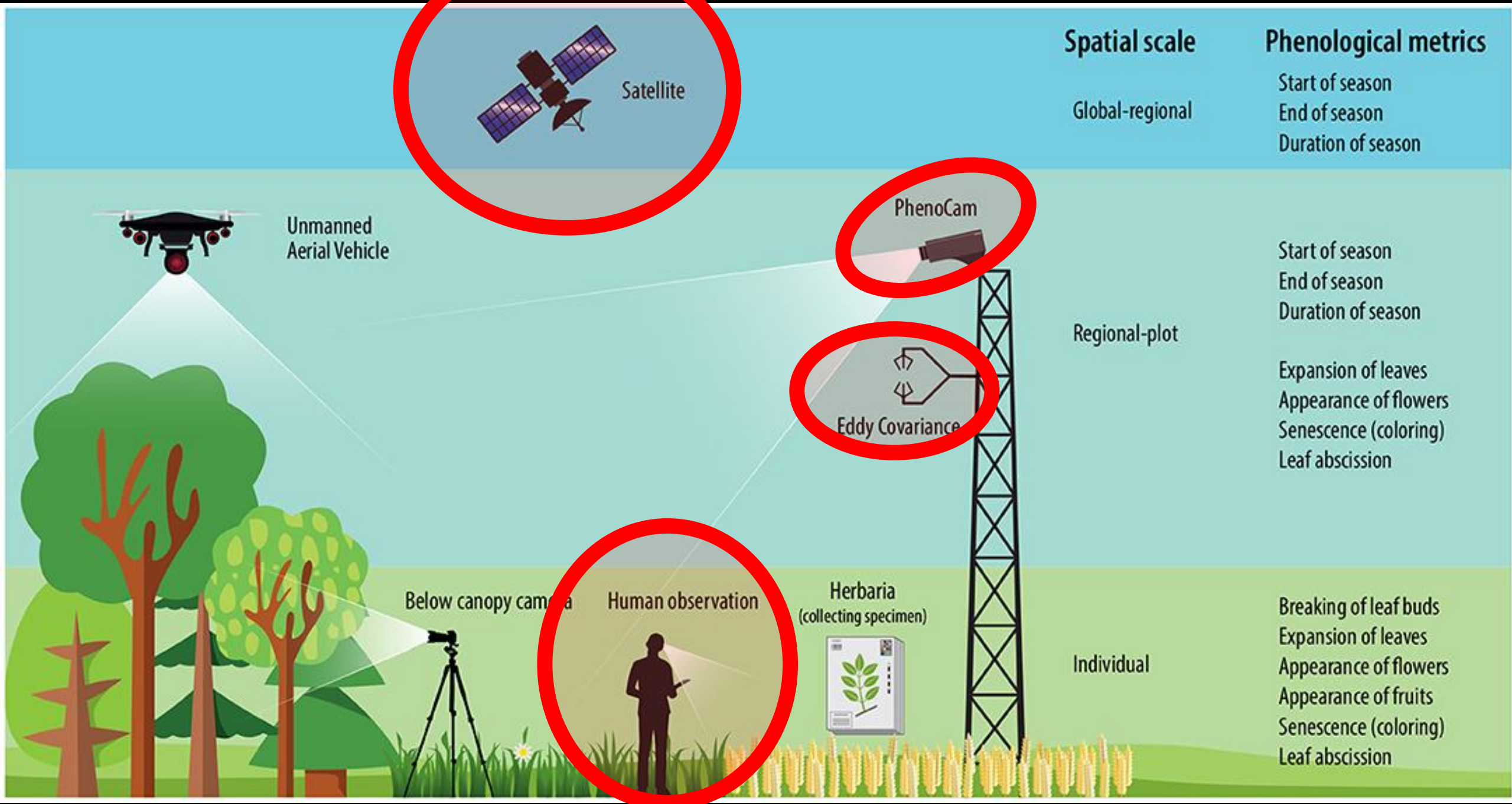
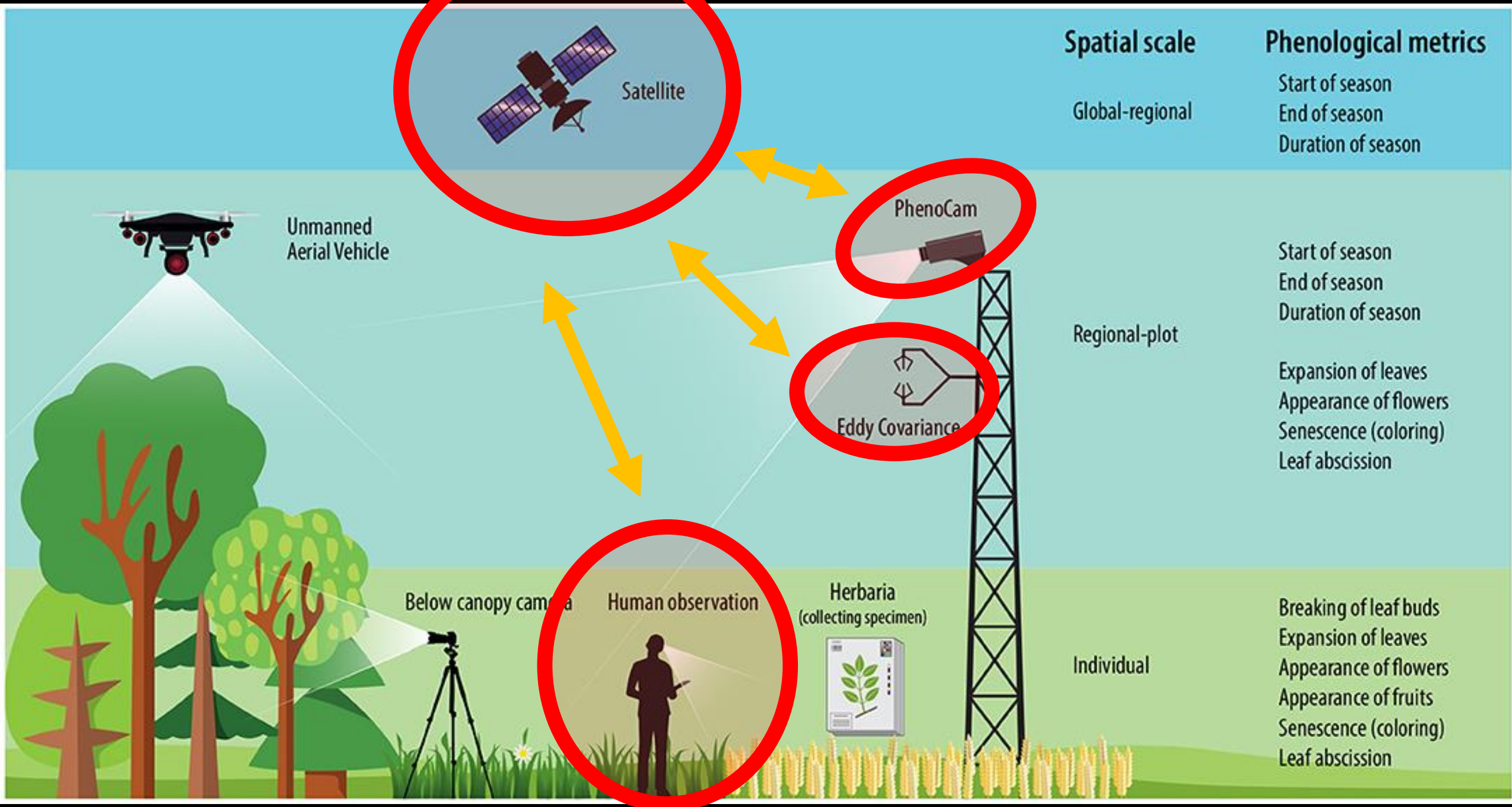

Spatial scale
Phenological metrics
Satellite
Global-regional
Start of season
End of season
Duration of season
Unmanned
Aerial Vehicle
PhenoCam
Regional-plot
Start of season
End of season
Duration of season
Eddy Covariance
Expansion of leaves
Appearance of flowers
Senescence (coloring)
Leaf abscission
Below canopy cam a
Human observation
Herbaria
(collecting specimen)
Individual
Breaking of leaf buds
Expansion of leaves
Appearance of flowers
Appearance of fruits
Senescence (coloring)
Leaf abscission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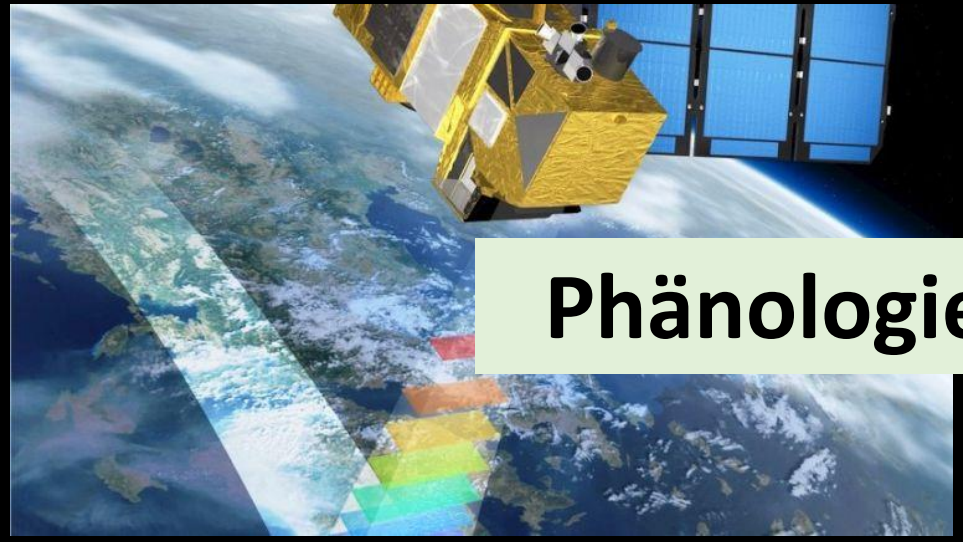
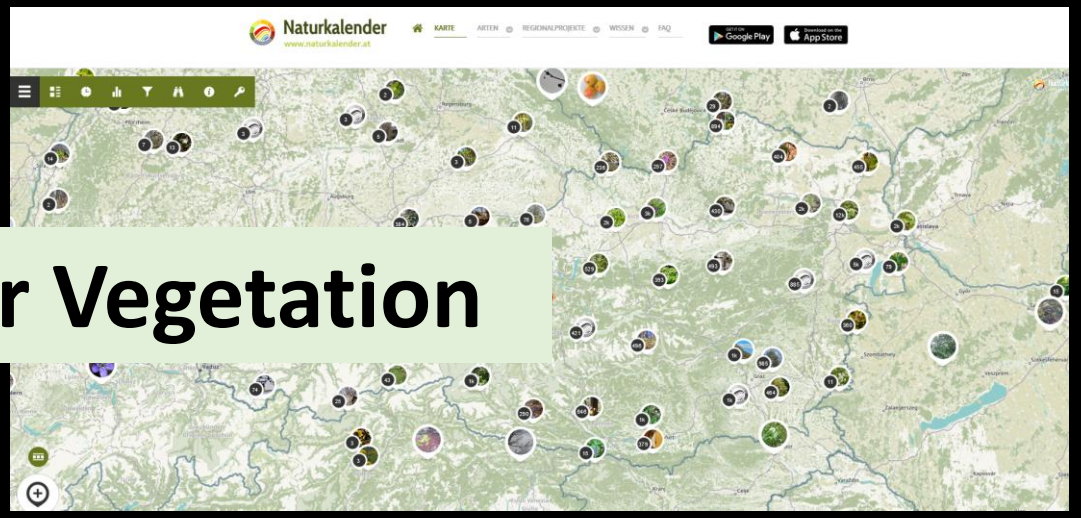


Phänologie der Vegetation



Fernerkundung

+ Je nach Bewölkung, eine komplette räumliche Abdeckung mit hoher räumlicher Auflösung möglich, zeitliche Auflösung 5 Tage

+ S2 10 m Auflösung, z.B. MODIS 350 m

+ Kleinstrukturierte landwirtschaftliche Flächen in Österreich

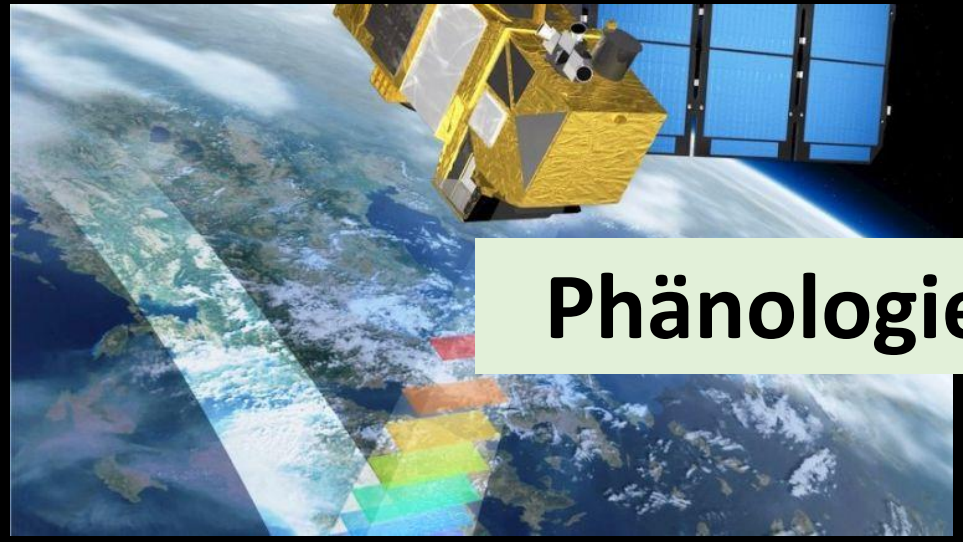
+ Mixed pixel Effekt reduziert

…

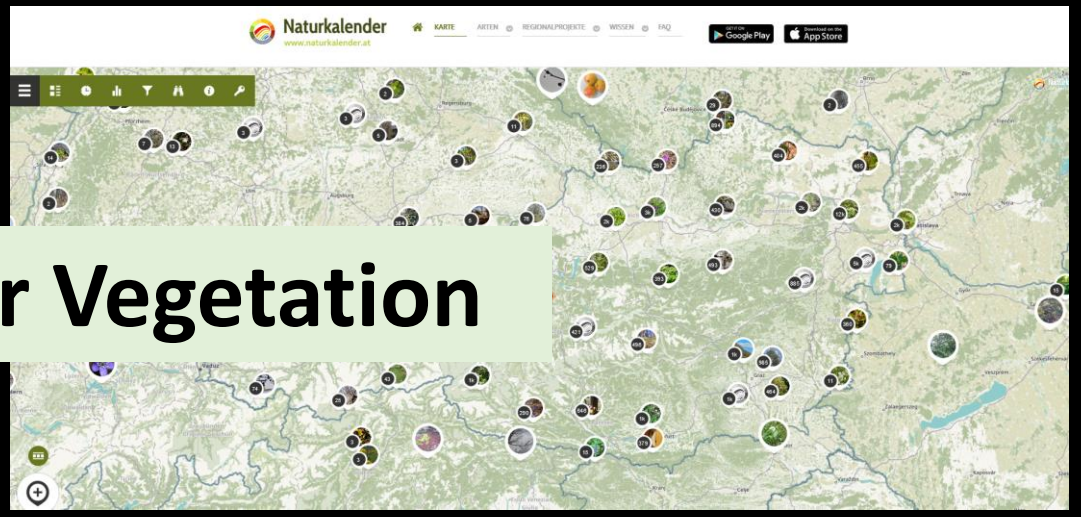
Bodenbeobachtungen

+ Spezifisch, nach Pflanzenarten und –phasen

- Phänologie, Bodenbeobachtungen punktuell eine Phase einmal/Jahr



Phänologie der Vegetation



Fernerkundung

- Sieht die Vegetation pauschal, unspezifisch

- LSP – GP Problem nach wie vor ungelöst, Kalibrierung und Validierung

Bodenbeobachtungen

+ Spezifisch, nach Pflanzenarten und –phasen

- Phänologie, Bodenbeobachtungen punktuell eine Phase einmal/Jahr

PhenoCam

AN ECOSYSTEM PHENOLOGY CAMERA NETWORK

Site Name: rosalia (show RGB view)
Location: Rosalia demonstration forest, Austrian
Lat: 47.7027 **Lon:** 16.3015 **Elev(m):** 678
Image Count: 43051 **Start Date:** 2019-07-05 **Last Date:** 2022-08-28

Site Metadata

Base Layer
- Google Satellite
- Google Hybrid
- Google Physical

Overlays
- MCD12Q1 2016
- NLCD Land Cover 2016

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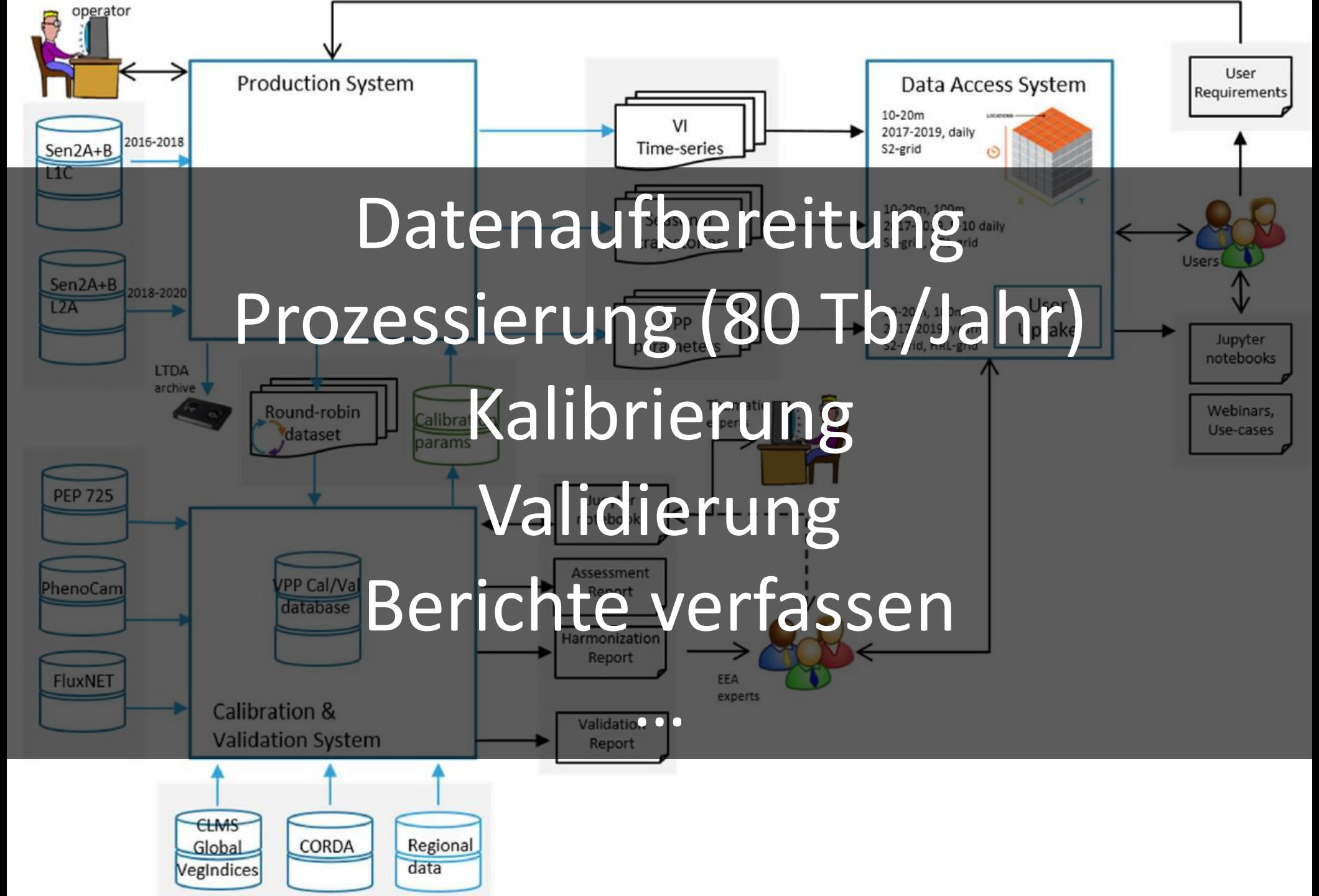

Datenaufbereitung
Prozessierung (80 Tb/Jahr)
Kalibrierung
Validierung
Berichte verfassen
...

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Sehr ausführliche Webseite:
Alle wichtigen Berichte publiziert
2 vierminütige Videos
pdfs von Vorträgen

High Resolution Vegetation Phenology and Productivity

Print


Vegetation Indices


Seasonal Trajectories


Vegetation Phenology and Productivity Parameters

...


Data access

User corner

- How to access our data
- Technical library
- Factsheets
- Use cases
- Looking for National projection & Expert products?

HRVPP Product Suite

Land Monitoring

	Sentinel-2 UTM Tile grid 10m	*EPSG:3035 HRL LAEA grid 10m*	*EPSG:3035 HRL LAEA grid 100m*		*Temporal frequency*	*Delivery*
	Sentinel 2 A/B Level 1C					
1.	Basic Vegetation Indices (NDVI, FAPAR, PPI, LAI)				'daily'	< 12hrs
2.	Seasonal Trajectories (PPI)	Seasonal Trajectories (PPI)	Seasonal Trajectories (PPI)		10-daily	March
3.	Phenological and Productivity Parameters (2 seasons)	Phenological and Productivity Parameters (2 seasons)	Phenological and Productivity Parameters (2 seasons)		Yearly	March

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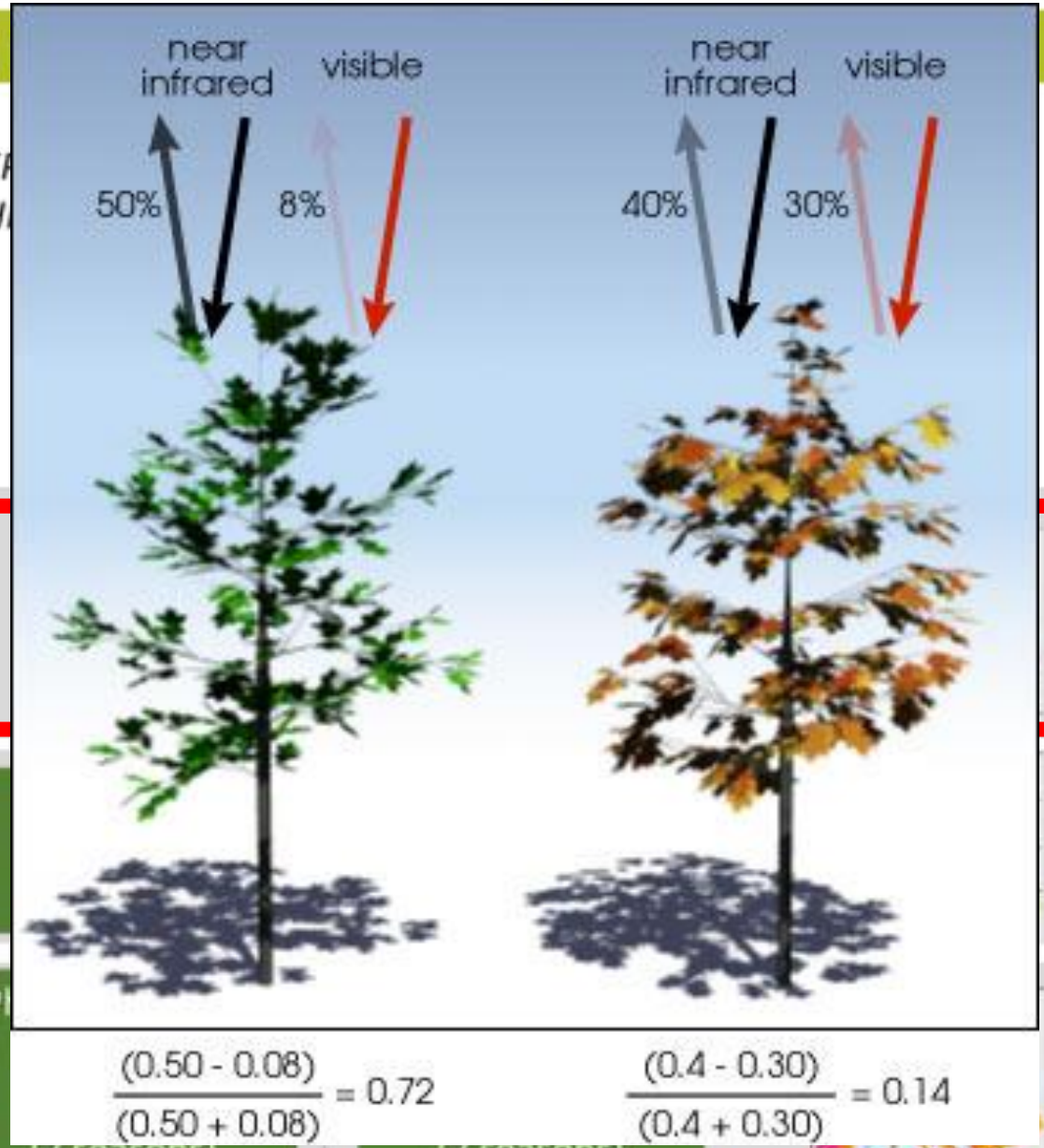
HRVPP P

Land Monitoring

Sentinel-2 UTM Tile grid 10m

Sentinel 2 A/B Level 1C



		Temporal frequency	*Delivery*
1.	Basic Vegetation Indices (NDVI, FAPAR, PPI, LAI)	'daily'	< 12hrs
2.	Seasonal Trajectories (PPI)	10-daily	March
3.	Phenological and Productivity Parameters (2 seasons)	Yearly	March

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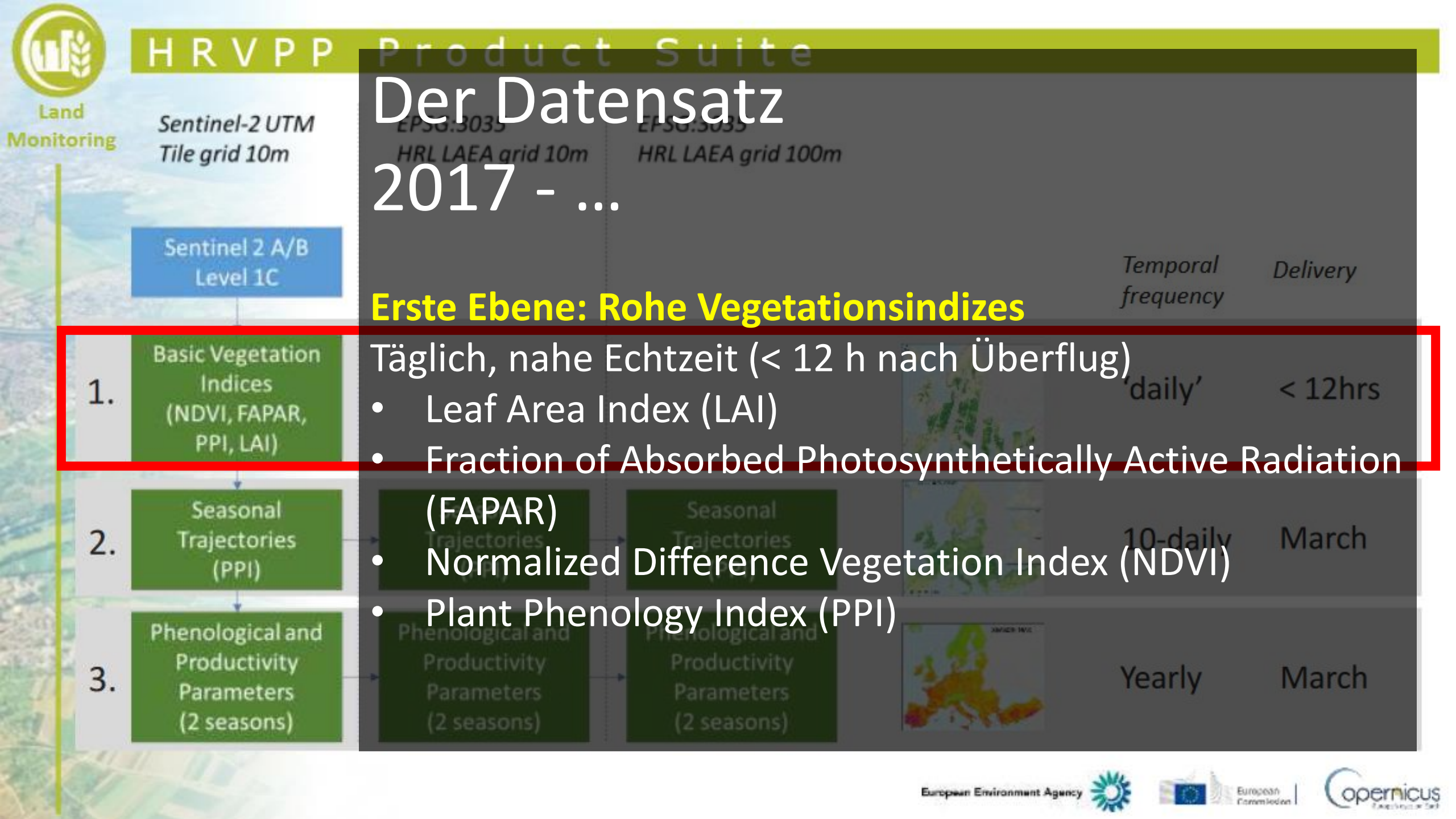
Der Datensatz 2017 - …

Erste Ebene: Rohe Vegetationsindizes

Täglich, nahe Echtzeit (< 12 h nach Überflug)

- Leaf Area Index (LAI)
- Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)
- Normalized Difference Vegetation Index (NDVI)
- Plant Phenology Index (PPI)



HRVPP Product Suite

Land Monitoring

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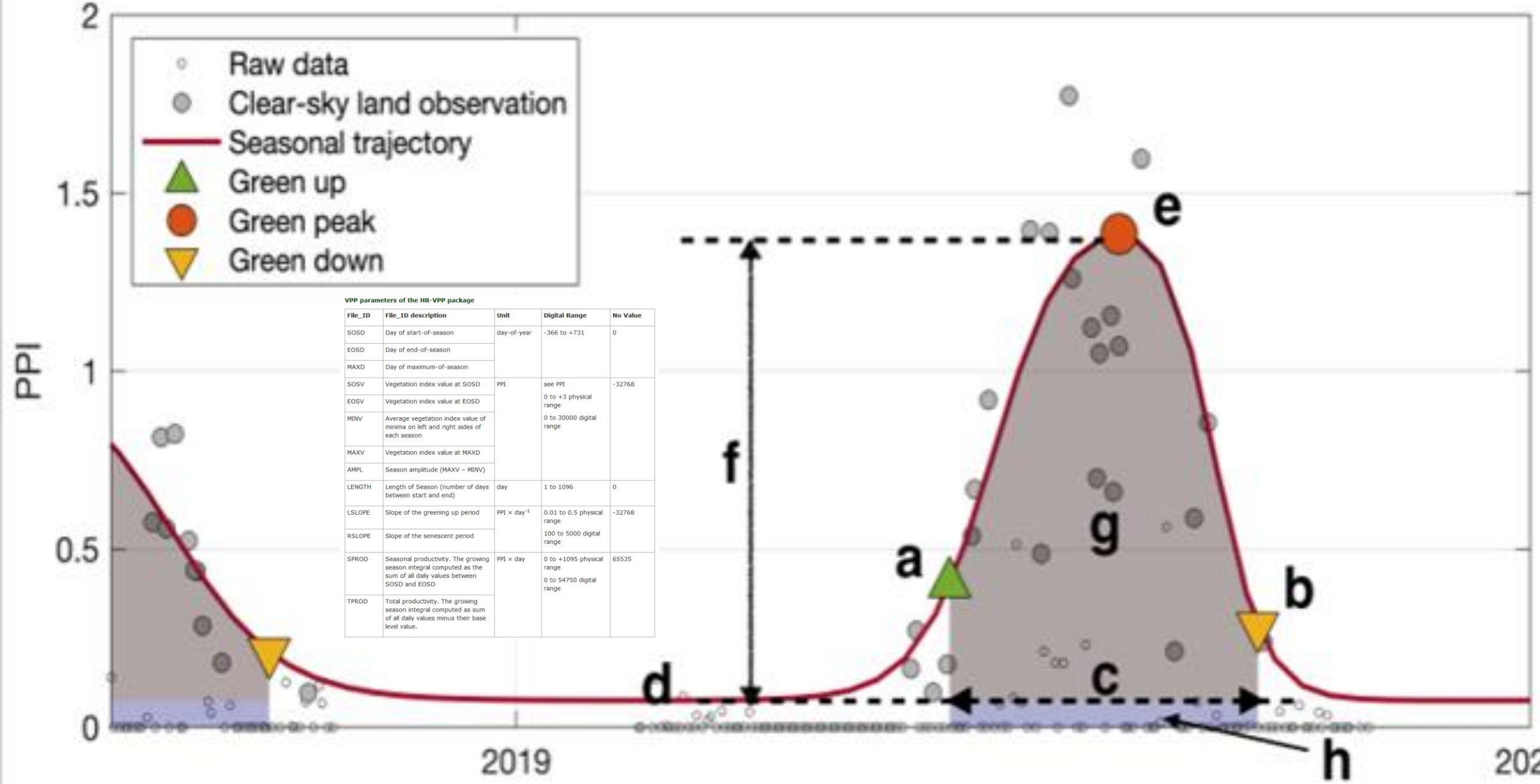
European Environment Agency | European Commission | Copernicus

Der Datensatz 2017 - ...

Zweite Ebene: Saisonale Trajektorien

Jährlich, bis Ende März im Folgejahr

- Saisonale PPI Trajektorien



VPP parameters of the HR-VPP package

File_ID	File_ID description	Unit	Digital Range	No Value
SOSD	Day of start-of-season	day-of-year	-366 to +731	0
EOSD	Day of end-of-season			
MAXD	Day of maximum-of-season			
SOSV	Vegetation index value at SOSD	PPI	see PPI 0 to +3 physical range 0 to 30000 digital range	-32768
EOSV	Vegetation index value at EOSD			
MINV	Average vegetation index value of minima on left and right sides of each season			
MAXV	Vegetation index value at MAXD			
AMPL	Season amplitude (MAXV – MINV)			
LENGTH	Length of Season (number of days between start and end)	day	1 to 1096	0
LSLOPE	Slope of the greening up period	PPI × day^{-1}	0.01 to 0.5 physical range 100 to 5000 digital range	-32768
RSLOPE	Slope of the senescent period			
SPROD	Seasonal productivity. The growing season integral computed as the sum of all daily values between SOSD and EOSD	PPI × day	0 to +1095 physical range 0 to 54750 digital range	65535
TPROD	Total productivity. The growing season integral computed as sum of all daily values minus their base level value.			

HRVPP Product Suite

Land Monitoring

	Sentinel-2 UTM Tile grid 10m	*EPSG:3035 HRL LAEA grid 10m*	*EPSG:3035 HRL LAEA grid 100m*		*Temporal frequency*	*Delivery*
	Sentinel 2 A/B Level 1C					
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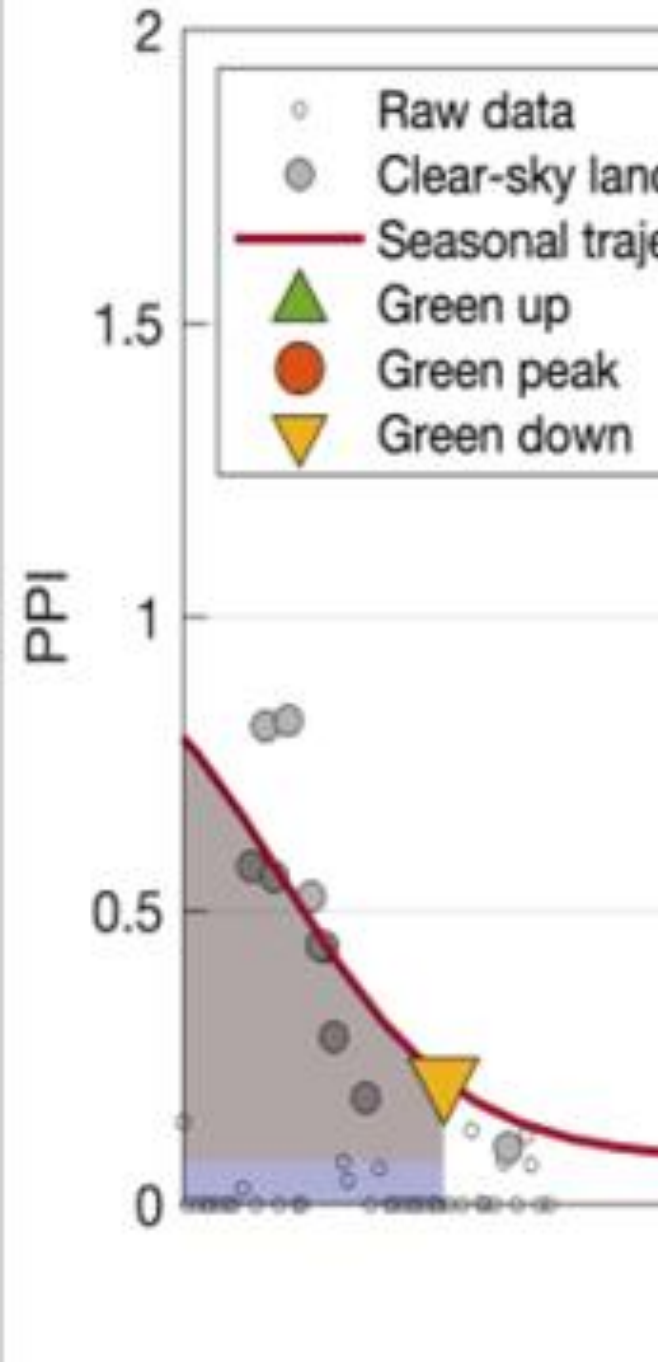
European Environment Agency | European Commission | Copernicus

Der Datensatz 2017 - ...

Dritte Ebene: Vegetationsphänologische Parameter:

Jährlich, bis Ende März im Folgejahr

- Liste von 13 Parametern, welche die Vegetationsperiode beschreiben



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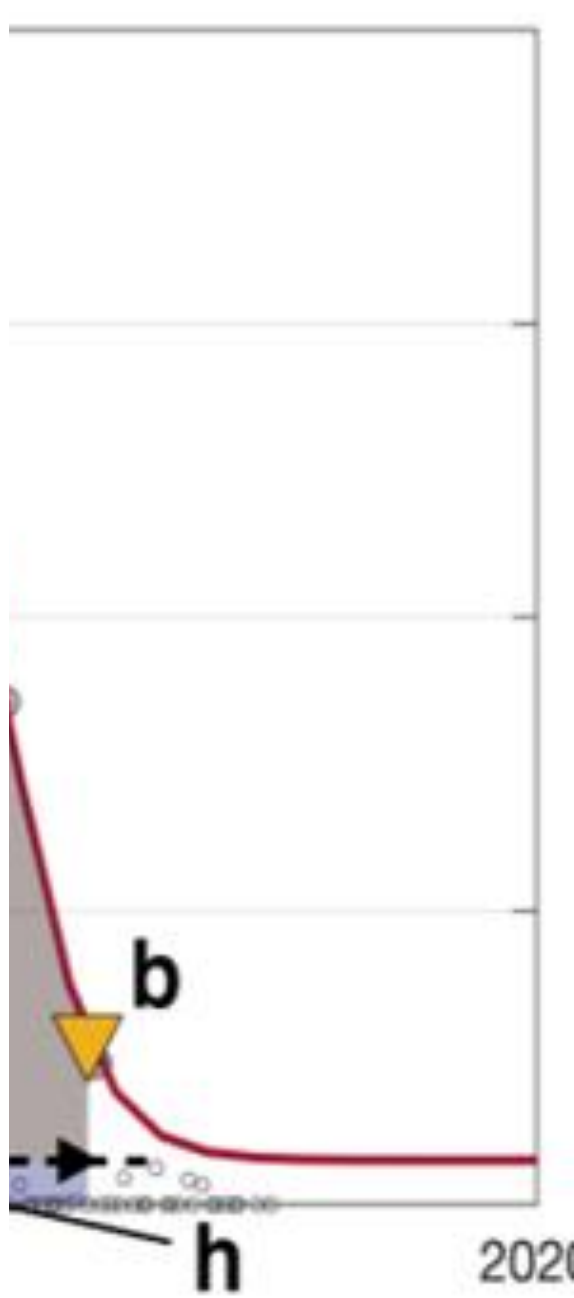

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Größere Datenmengen über eine virtuelle Maschine, bei VITO um einen user ansuchen, python/Jupyter

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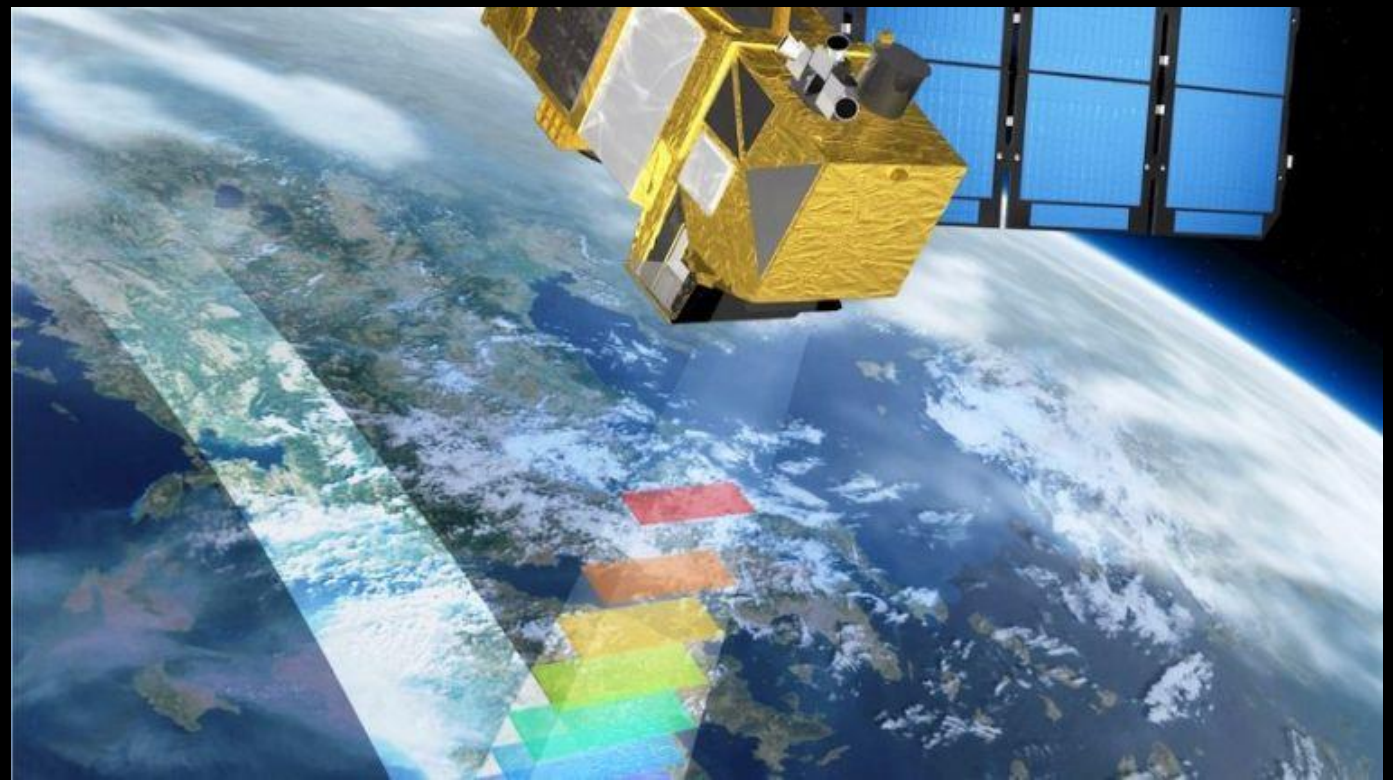
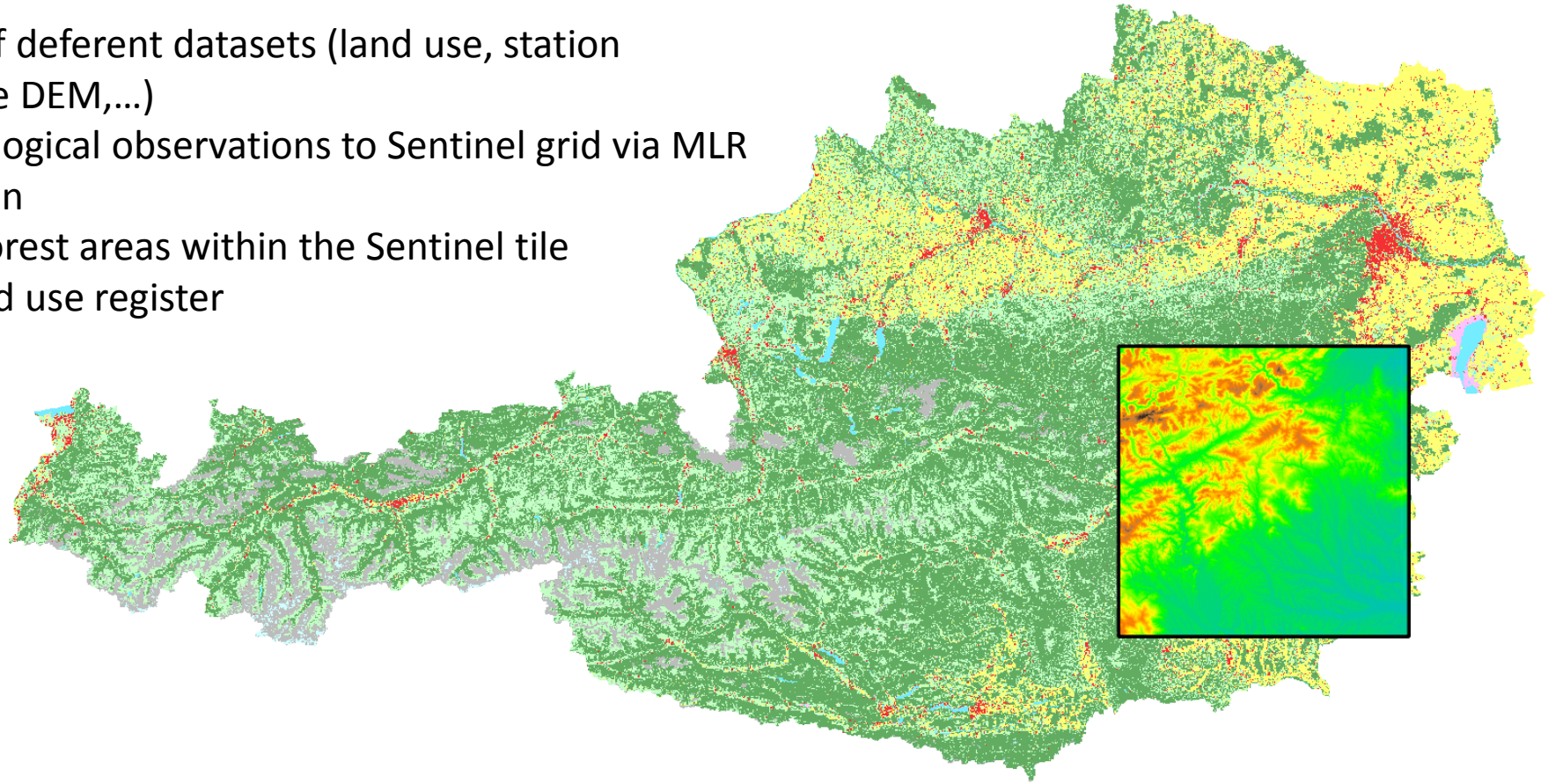
PhenObserve

How efficient monitoring can improve the assessment of the severity and extent of damages due to weather events.



Procedure for LSP – GP relationship: first steps

- Reprojection and cut of deferent datasets (land use, station coordinates, alternative DEM,…)
- Interpolation of phenological observations to Sentinel grid via MLR and elevation regression
- Designate deciduous forest areas within the Sentinel tile
- Comparison of two land use register



the deviation from the expected (modelled) usual behaviour. For the year 2018, Kalman innovations of the near infrared (NIR) band decrease to negative value ranges from the beginning of August, indicating drought period. In Figure 4, the sum of negative Kalman innovations between May and end of August and the SPEI values are plotted. It can be seen that the time of the decrease of Kalman innovations coincides with the decrease of the SPEI value and therefore, also supporting the theory that negative Kalman innovations are an indicator for drought damage. Since we are only interested in extreme drought and not extremely wet periods, we consider Kalman innovations in one direction only (negative values in case of NIR band).

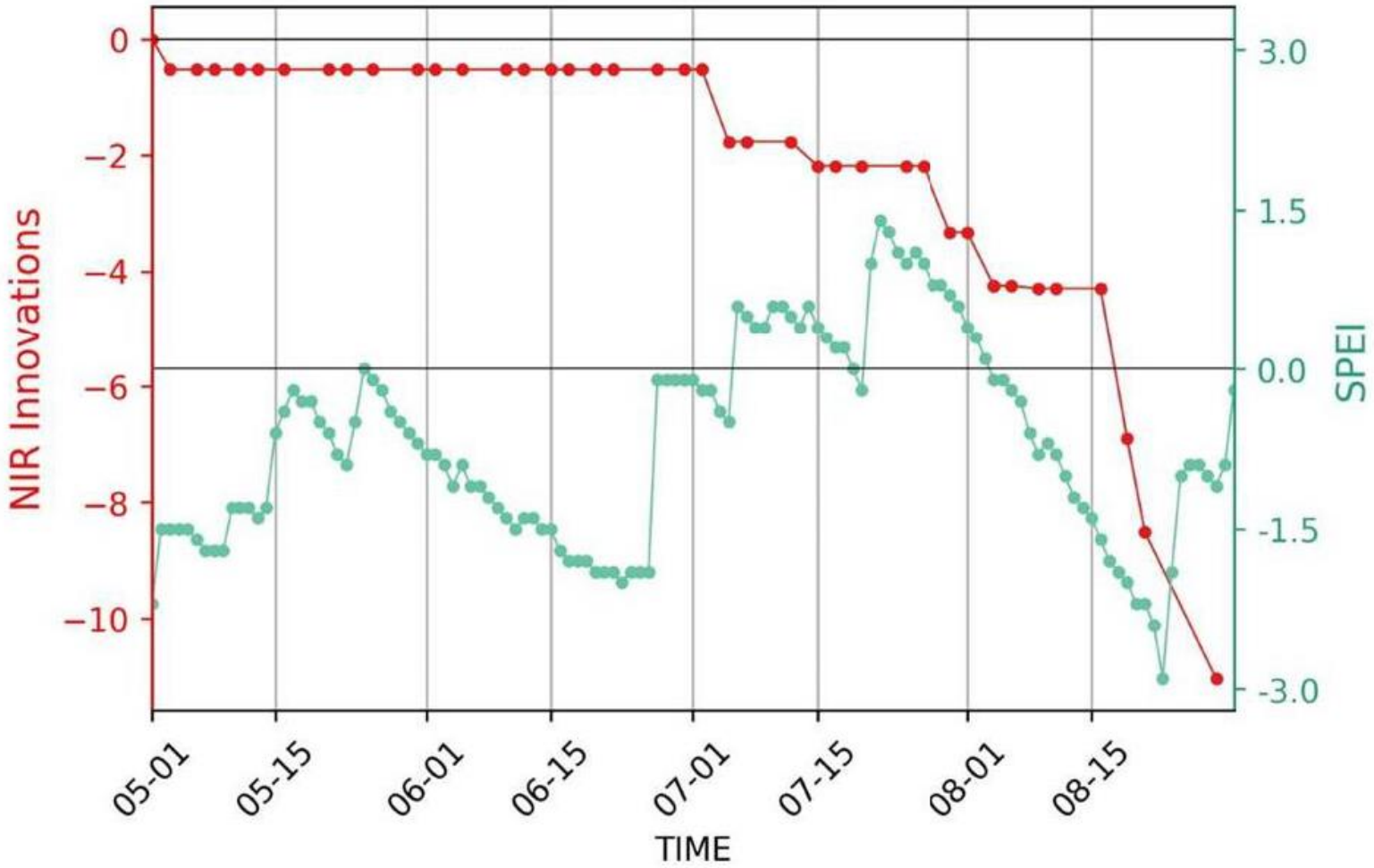
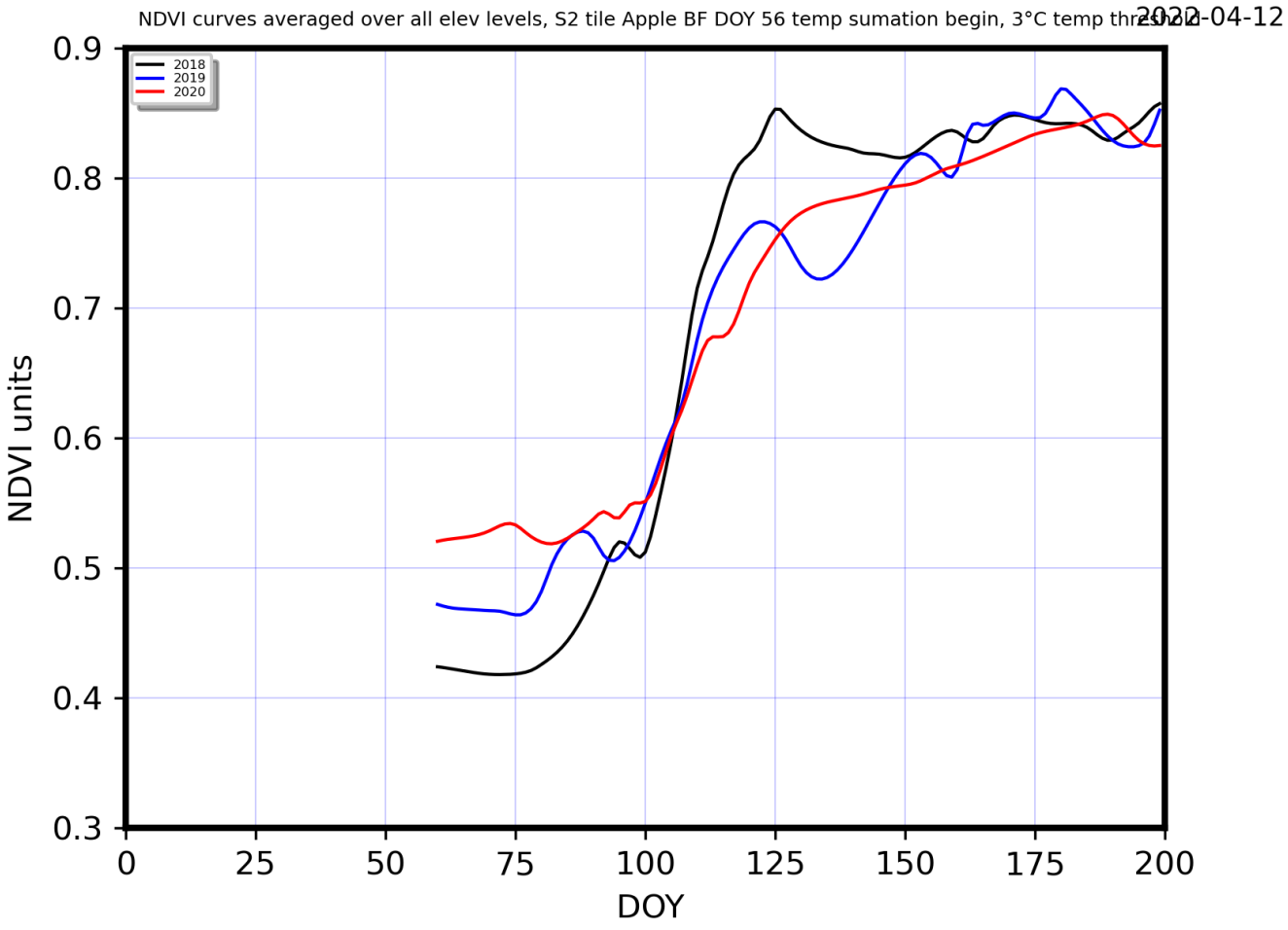
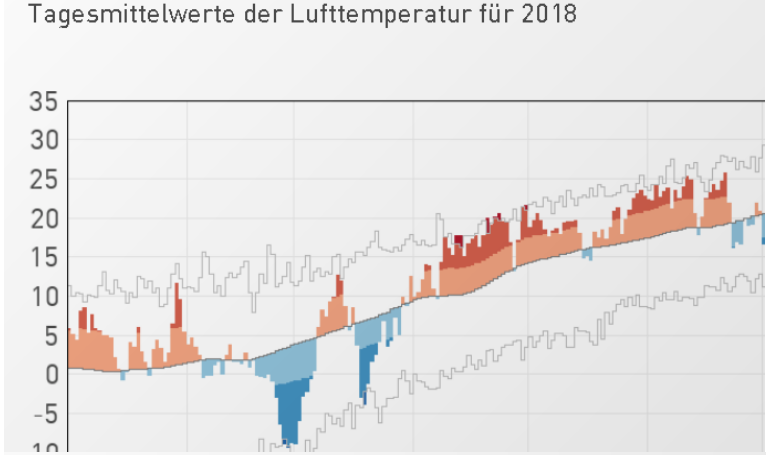
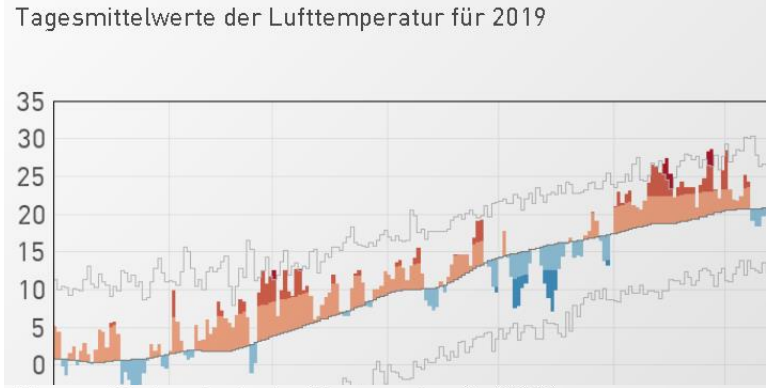


Figure 4: Time series of the sum of negative NIR Kalman innovations (red) and SPEI (green) for the same maize polygon (2018)







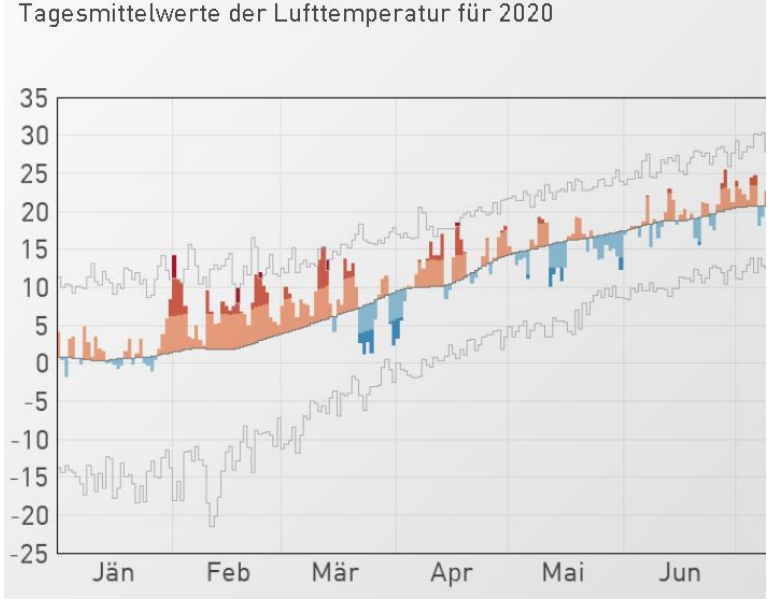
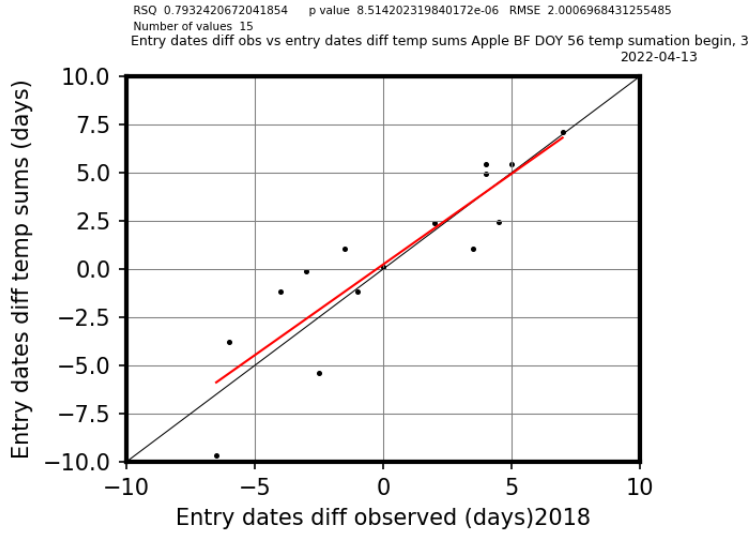
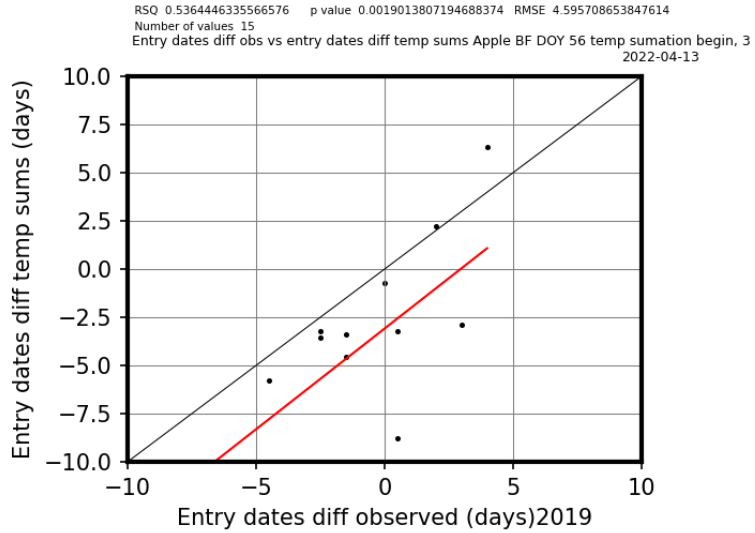


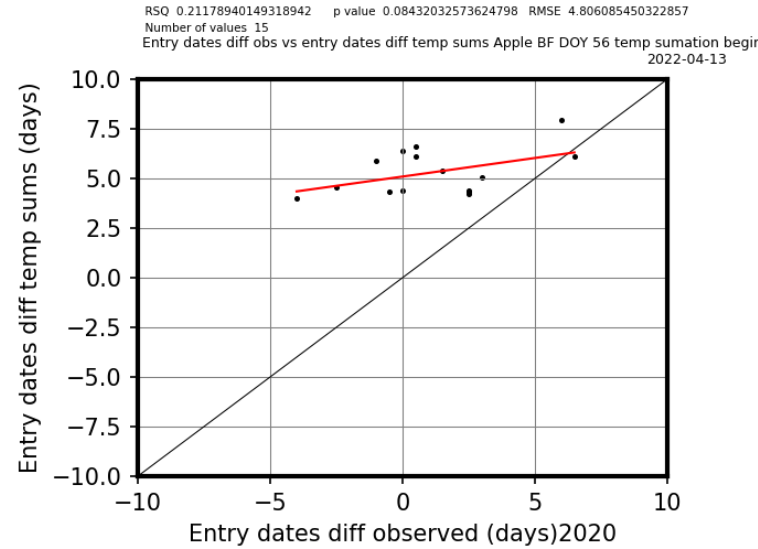
Fig 1160 Plot 8, NDVI averaged over elevations layers 200 – 1000 m per year, temperature absolute plus coloured deviations from long term average (1981 – 2010), Wien Hohe Warte, for the selected three years 2018, 2019, 2020.



2018 RSQ = 0.79 RMSE = 2.0



2019 RSQ = 0.54 RMSE = 4.6

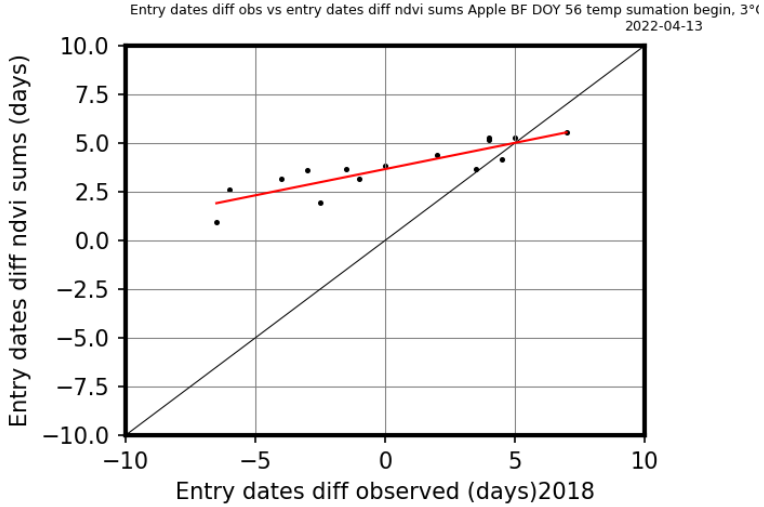


2020 RSQ = 0.21 RMSE = 4.8

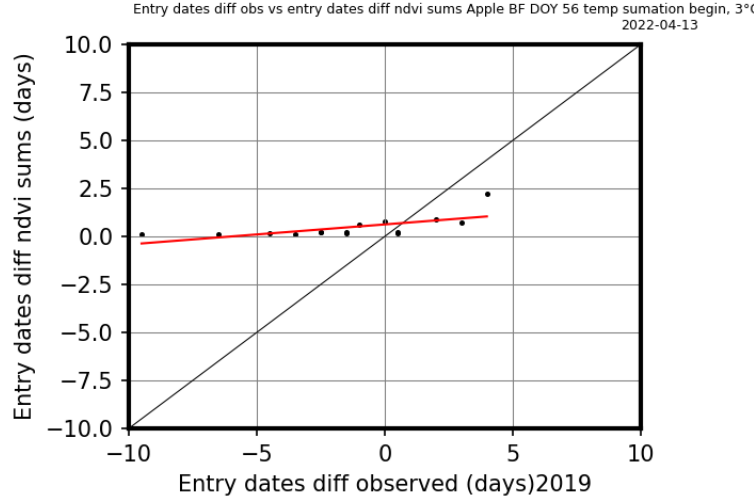
gut

mäßig

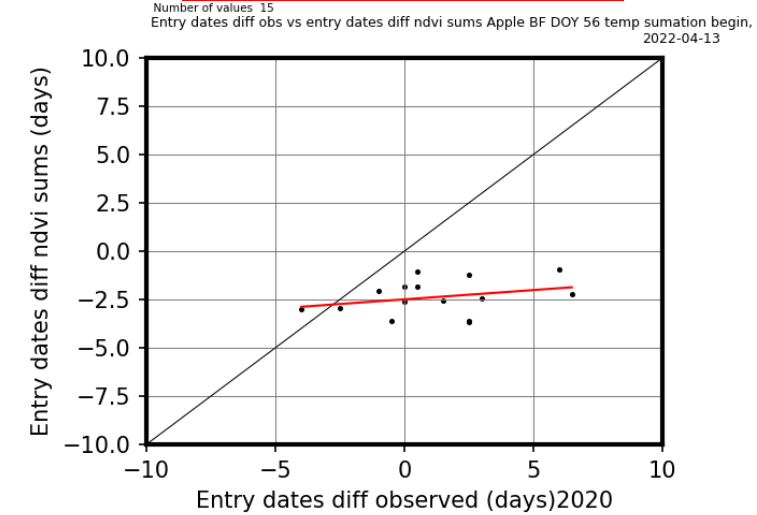
schlecht



2018 RSQ = 0.77 RMSE = 4.5



2019 RSQ = 0.44 RMSE = 3.7



2020 RSQ = 0.09 RMSE = 4.4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