Banksy Crude Oils Modified Oil painting #12

http://virtualforest.io/index.html
Koen Hufkens

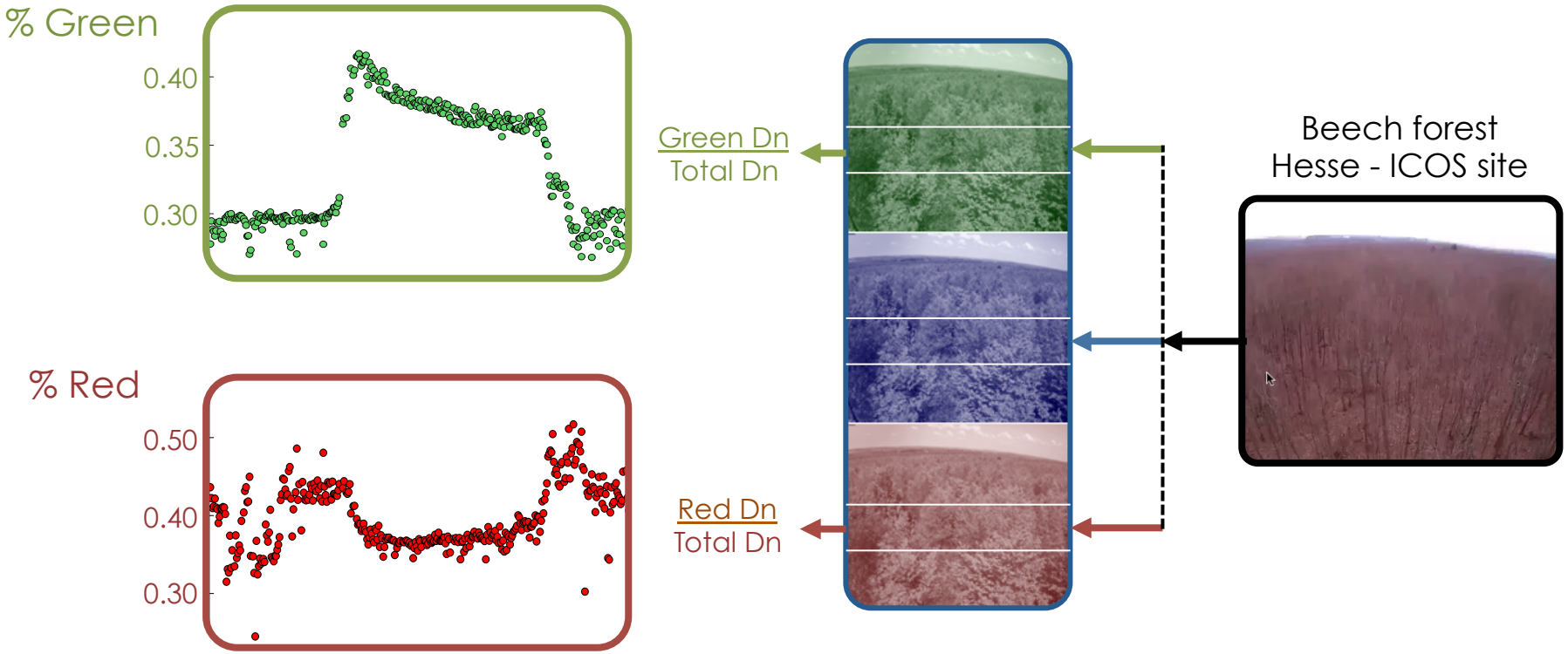
Using DIY technology to monitor forest phenology

Ricoh Theta S	$350
Raspberry pi 2	$36
6-60V - 5V 3A UBEC	$19
24V POE injector	$10
APC surge protector	$18
200ft / 50m Cat5e cable	$13
8" glass globe lamp cover	$35
4" (10cm) PVC pipe	$20
4" (10cm) PVC coupler	$2.5
3.5" Wooden Fence post	$5
36" ground anchor	$30
3mm Plexiglass sheet	$5
1/4" stainless steel rod	$1
1/4" (coupling) nuts	$1
1/4" washers	$1
TOTAL	~$550

http://virtualforest.io/faq.html

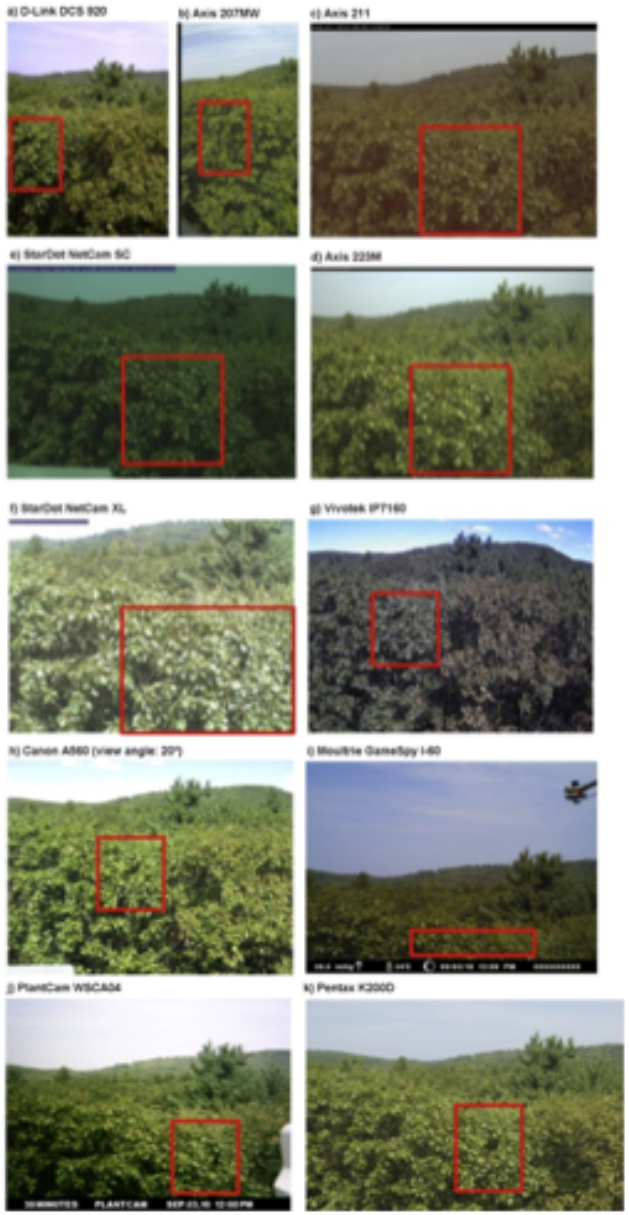
Google Cardboard
+
Open source code
Stored in Github

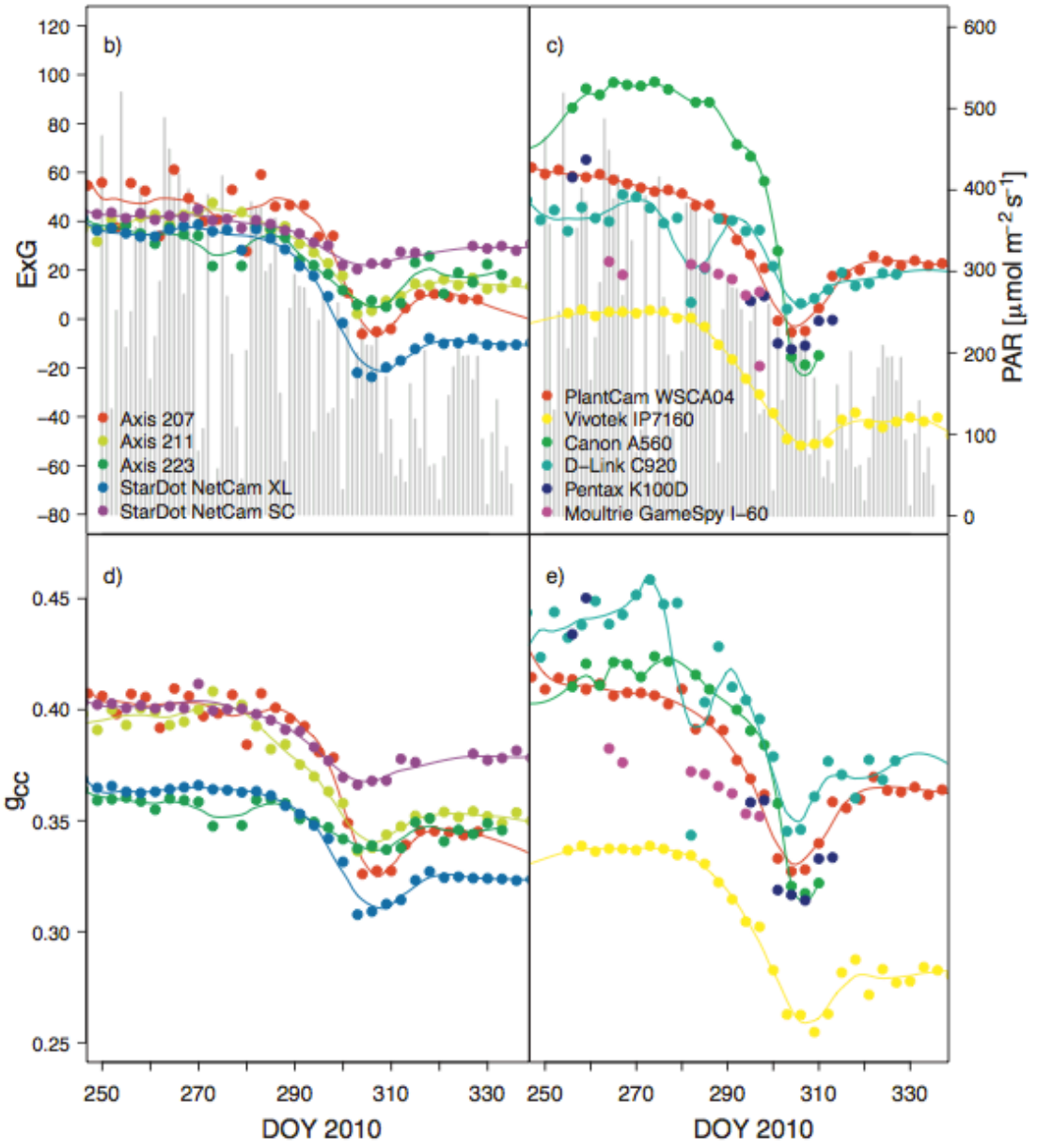
Digital cameras track the phenology of communities



(Richardson et al., Oecologia., 2007)

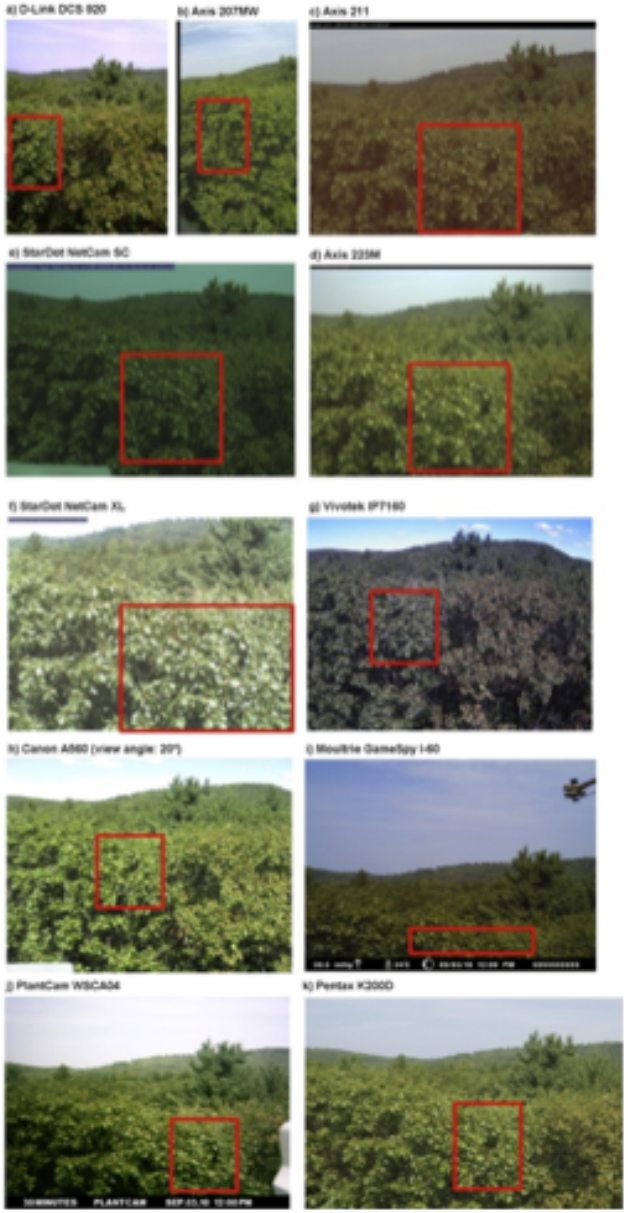
Does it matter what type of camera I use?

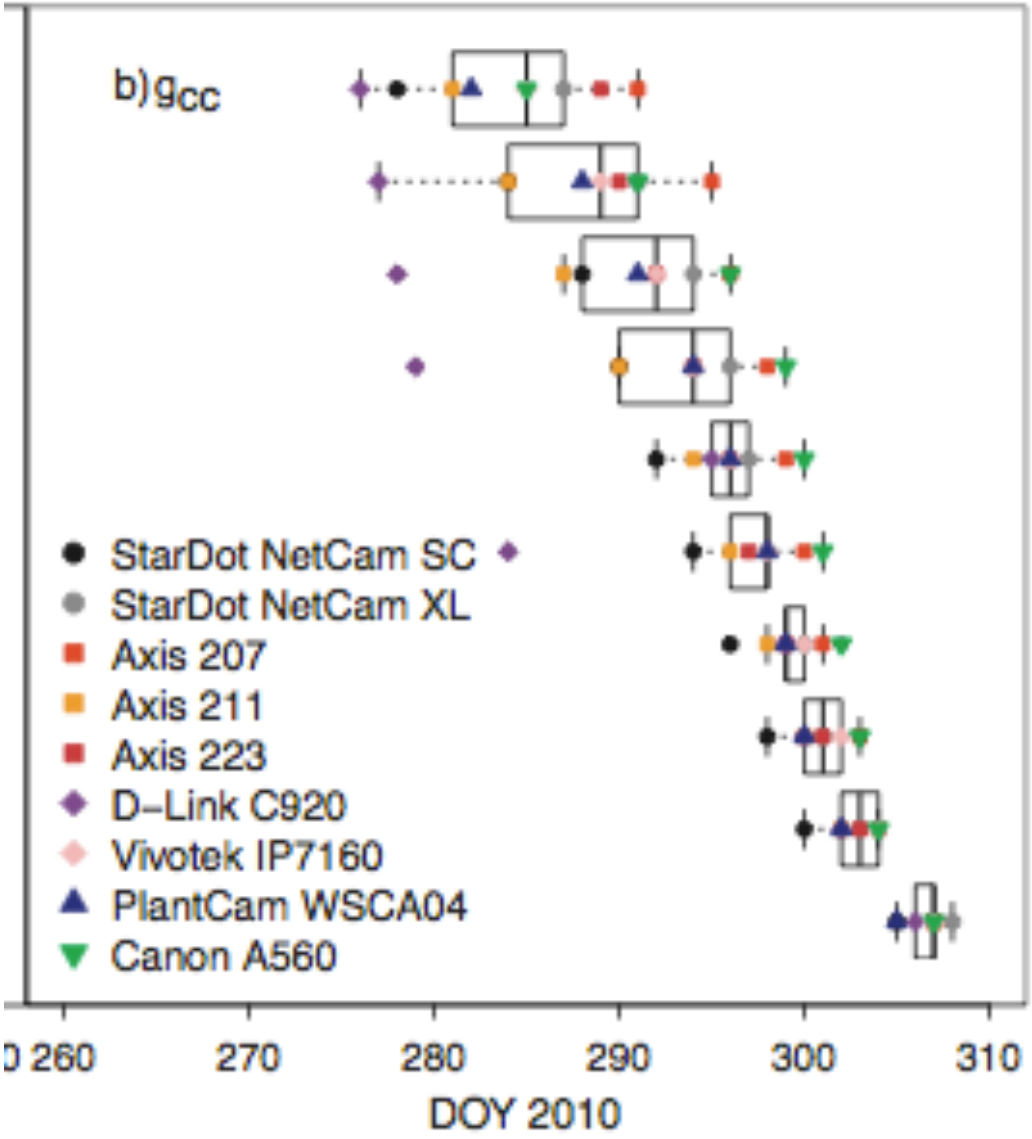




(Sonnentag et al., Agric.For.Met., 201?)

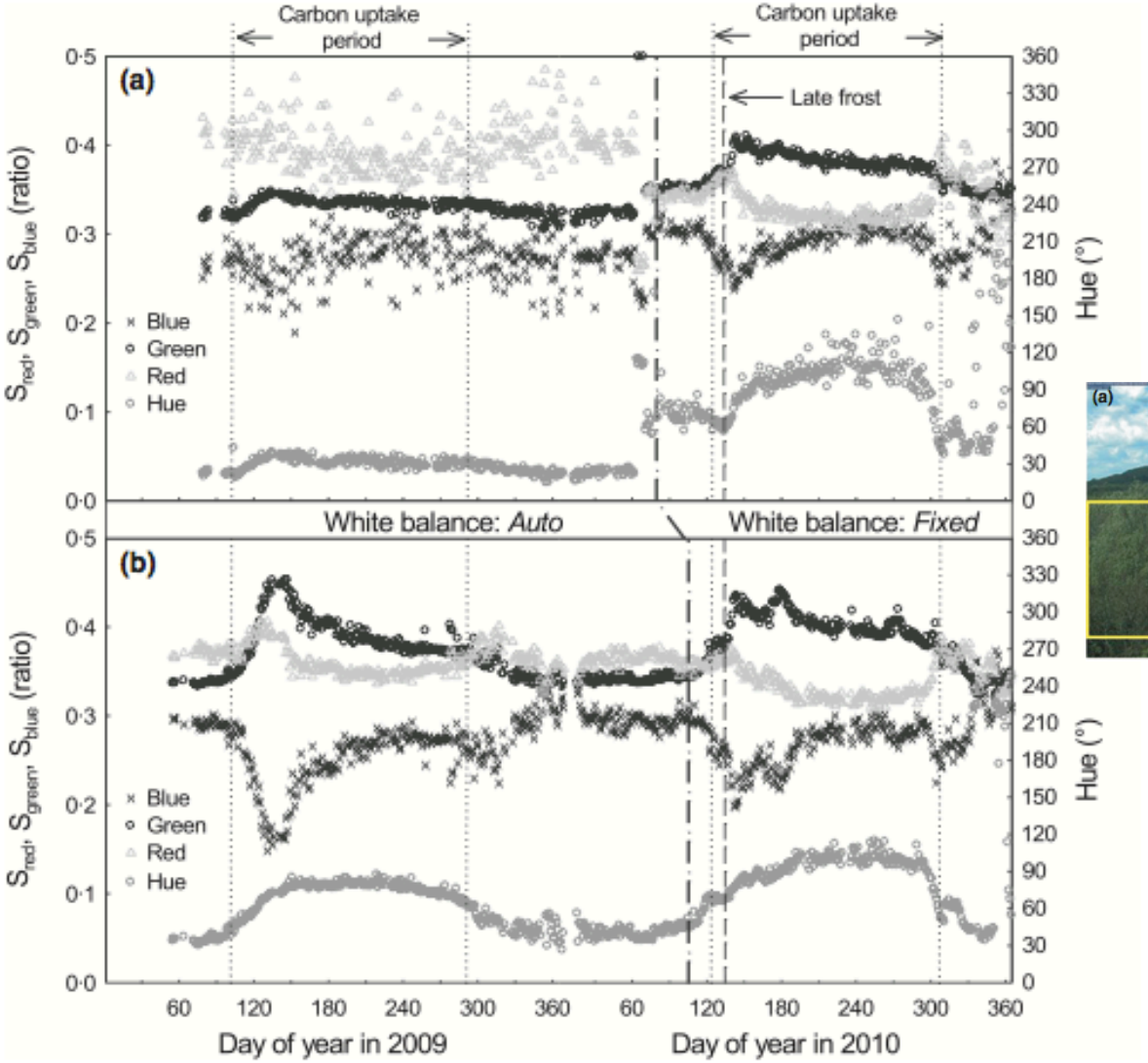
Does it matter what type of camera I use?

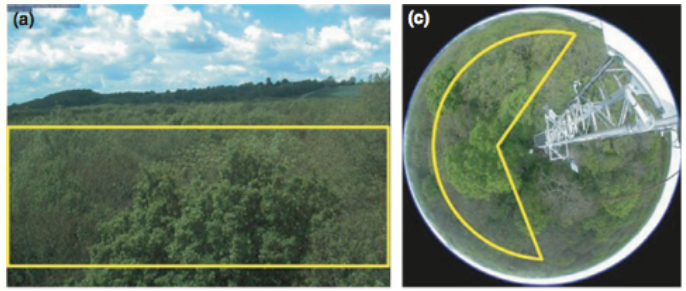




(Sonnentag et al., Agric.For.Met., 201?)

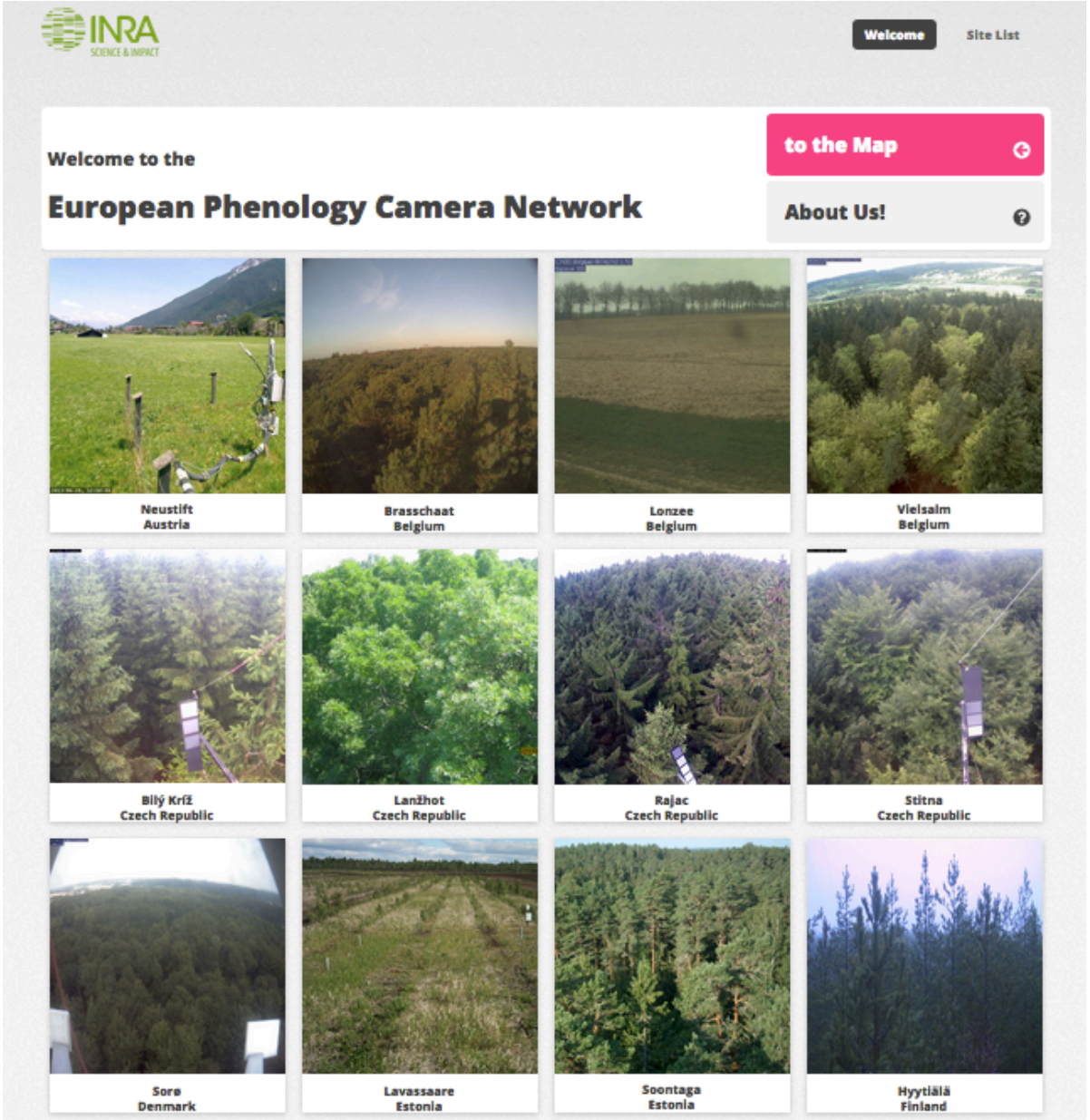
Common problems with colour balance settings





(Mizunuma et al., Functional Ecol, 2013)

Digital cameras networked to study ecosystem function

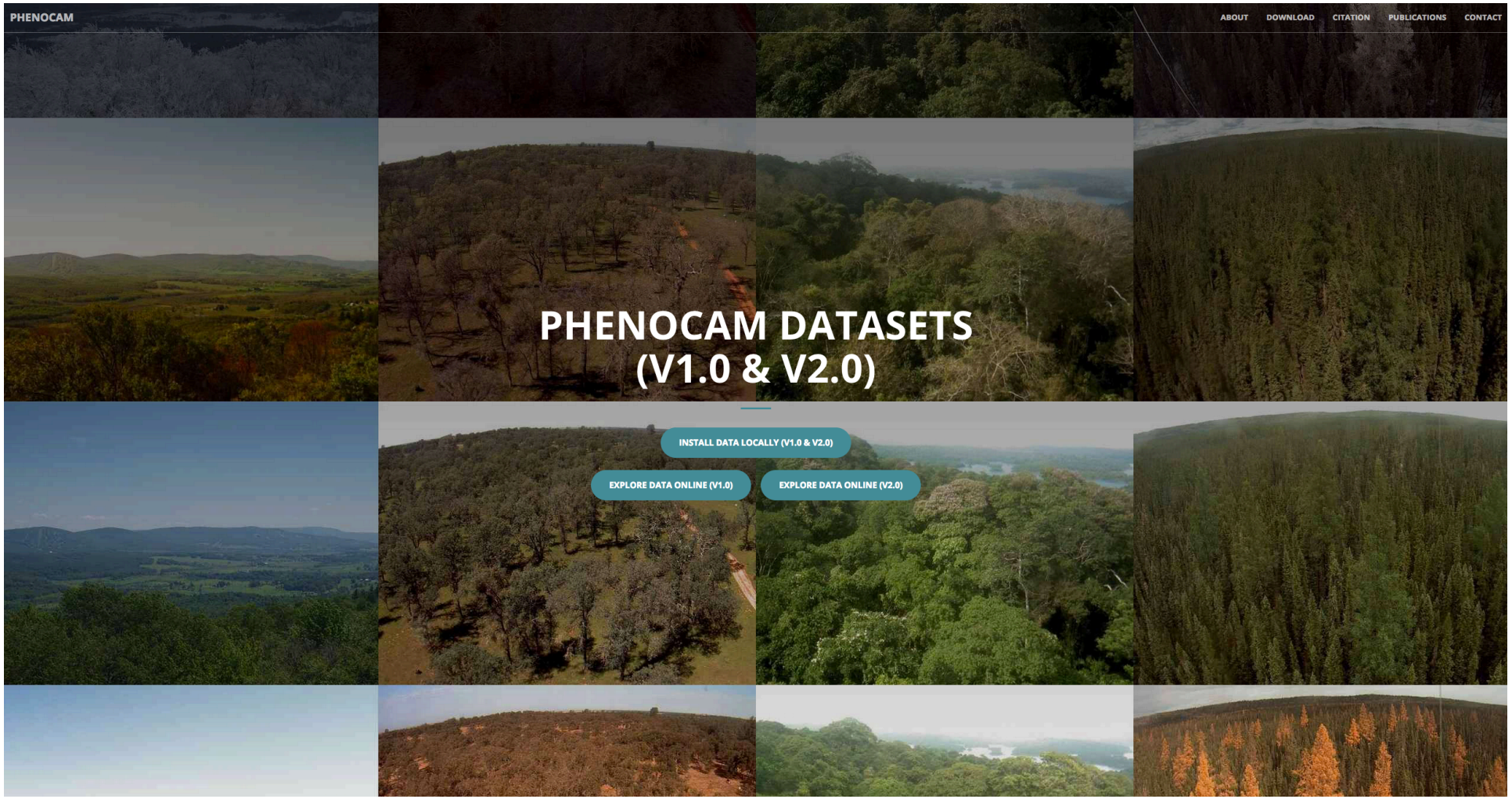


(Wingate et al., Biogeosciences., 2015)

Digital cameras networked to study ecosystem function

http://europhen.org/

Phenocam USA



http://phenocam.us/

PhenoCam Dataset v1.0: Vegetation Phenology from Digital Camera Imagery, 2000-2015

A newer version exists.

Click the DOI link in the following citation for the latest version (as of 2019-09-04):

Seyednasrollah, B., A.M. Young, K. Hufkens, T. Milliman, M.A. Friedl, S. Frolking, A.D. Richardson, M. Abraha, D.W. Allen, M. Apple, M.A. Arain, J. Baker, J.M. Baker, D. Baldocchi, C.J. Bernacchi, J. Bhattacharjee, P. Blanken, D.D. Bosch, R. Boughton, E.H. Boughton, R.F. Brown, D.M. Browning, N. Brunsell, S.P. Burns, M. Cavagna, H. Chu, P.E. Clark, B.J. Conrad, E. Cremonese, D. Debinski, A.R. Desai, R. Diaz-Delgado, L. Duchesne, A.L. Dunn, D.M. Eissenstat, T. El-Madany, D.S.S. Ellum, S.M. Ernest, A. Esposito, L. Fenstermaker, L.B. Flanagan, B. Forsythe, J. Gallagher, D. Gianelle, T. Griffis, P. Groffman, L. Gu, J. Guillemot, M. Halpin, P.J. Hanson, D. Hemming, A.A. Hove, E.R. Humphreys, A. Jaimes-Hernandez, A.A. Jaradat, J. Johnson, E. Keel, V.R. Kelly, J.W. Kirchner, P.B. Kirchner, M. Knapp, M. Krassovski, O. Langvall, G. Lanthier, G.I. Maire, E. Magliulo, T.A. Martin, B. McNeil, G.A. Meyer, M. Migliavacca, B.P. Mohanty, C.E. Moore, R. Mudd, J.W. Munger, Z.E. Murrell, Z. Nesic, H.S. Neufeld, T.L. O'Halloran, W. Oechel, A.C. Oishi, W.W. Oswald, T.D. Perkins, M.L. Reba, B. Rundquist, B.R. Runkle, E.S. Russell, E.J. Sadler, A. Saha, N.Z. Saliendra, L. Schmalbeck, M.D. Schwartz, R.L. Scott, E.M. Smith, O. Sonnentag, P. Stoy, S. Strachan, K. Suvocarev, J.E. Thom, R.Q. Thomas, A.K. Van den berg, R. Vargas, J. Verfaillie, C.S. Vogel, J.J. Walker, N. Webb, P. Wetzel, S. Weyers, A.V. Whipple, T.G. Whitham, G. Wohlfahrt, J.D. Wood, S. Wolf, J. Yang, X. Yang, G. Yenni, Y. Zhang, Q. Zhang, and D. Zona. 2019. PhenoCam Dataset v2.0: Vegetation Phenology from Digital Camera Imagery, 2000-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1674

Overview

DOI	https://doi.org/10.3334/ORNLDAAC/1511
Version	1
Project	Vegetation
Published	2017-12-27
Updated	2017-12-27
Usage	251 downloads
Citations	4 publications cited this dataset

Spatial Coverage

Bounding rectangle

N: 71.28 | S: 9.15 | E: 34.83 | W: -156.61

Temporal Coverage

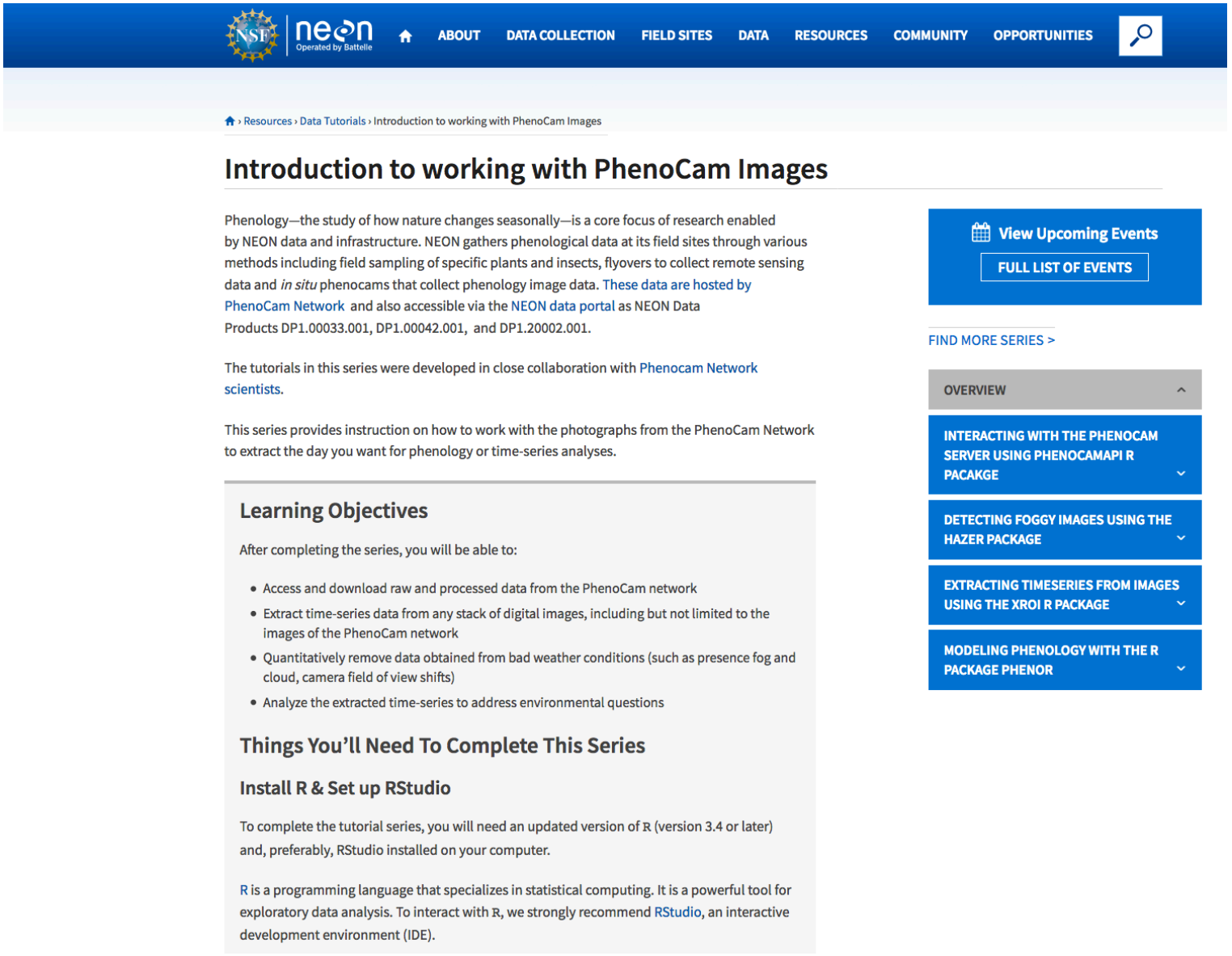
1999-11-16 to 2016-08-08

User Guide

Description

This data set provides a time series of vegetation phenological observations for 133 sites across diverse ecosystems of North America and Europe from 2000-2015. The phenology data were derived from conventional visible-wavelength automated digital camera imagery collected through the PhenoCam Network at each site. From each acquired image, RGB (red, green, blue) color channel information was extracted and means and other statistics calculated for a region-of-interest (ROI) that delineates an area of specific vegetation type. From the high-frequency (typically, 30 minute) imagery collected over several years, time series characterizing vegetation color, including canopy greenness, plus greenness rising and greenness falling transition dates, were summarized over 1- and 3-day intervals.

Other useful resources



https://www.neonscience.org/phenocam-intro-series

Other useful resources

DE GRUYTER OPEN

Int. Agrophys., 2018, 32, 677-687
doi: 10.1515/intag-2017-0050

INTERNATIONAL
Agrophysics
www.international-agrophysics.org

Assimilating phenology datasets automatically across ICOS ecosystem stations

Koen Hufkens[1]*, *Gianluca Filippa*[2], *Edoardo Cremonese*[2], *Mirco Migliavacca*[3], *Petra D'Odorico*[4], *Matthias Peichl*[5], *Bert Gielen*[6], *Lukas Hörtnagl*[7], *Kamel Soudani*[8], *Dario Papale*[9], *Corinna Rebmann*[10], *Tim Brown*[11], *and Lisa Wingate*[1]

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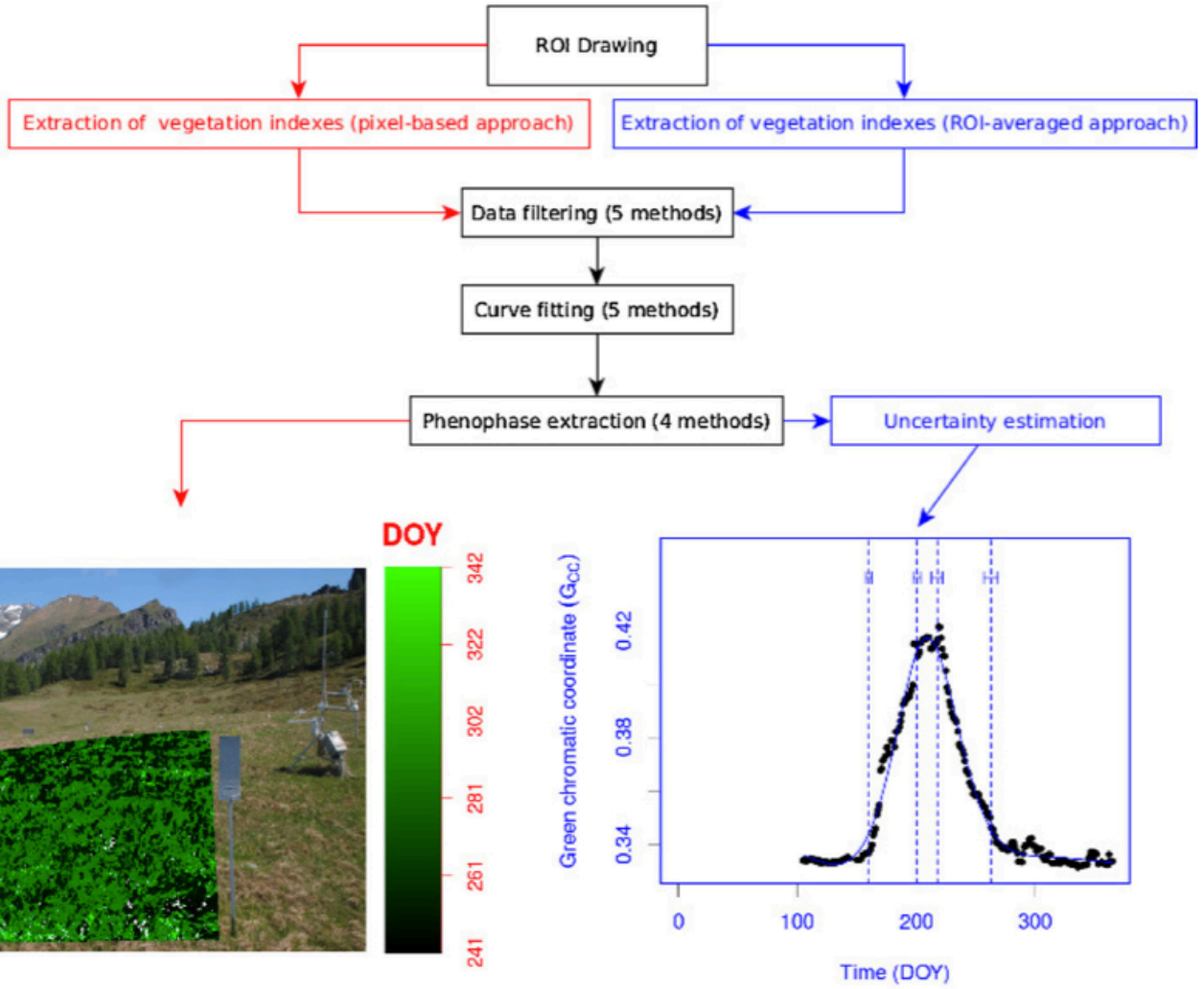
[10]Department of Computational Hydrosystems, Helmholz Centre for Environmental Research, Permoserstraße 15, 04318, Leipzig, Germany
[11]Research School of Biology, Australian National University, ACT 2601, Acton, Australia

Received June 29, 2018; accepted June 29, 2018

ICOS protocol

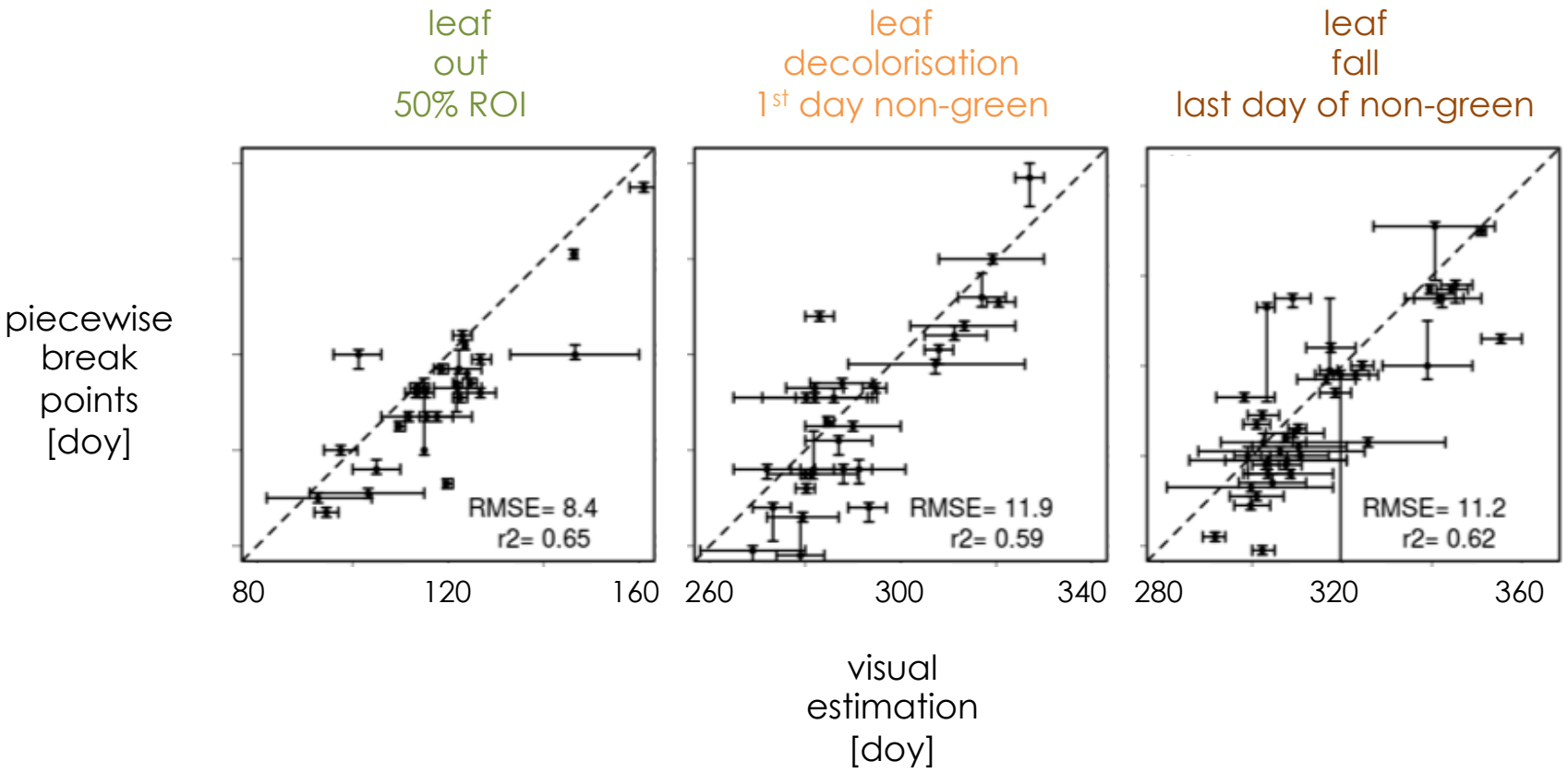
Estimating canopy phenology metrics using open source packages



Phenopix
http://r-forge.r-project.org/projects/phenopix/

Filippa et al., Agric. For. Met. 2016

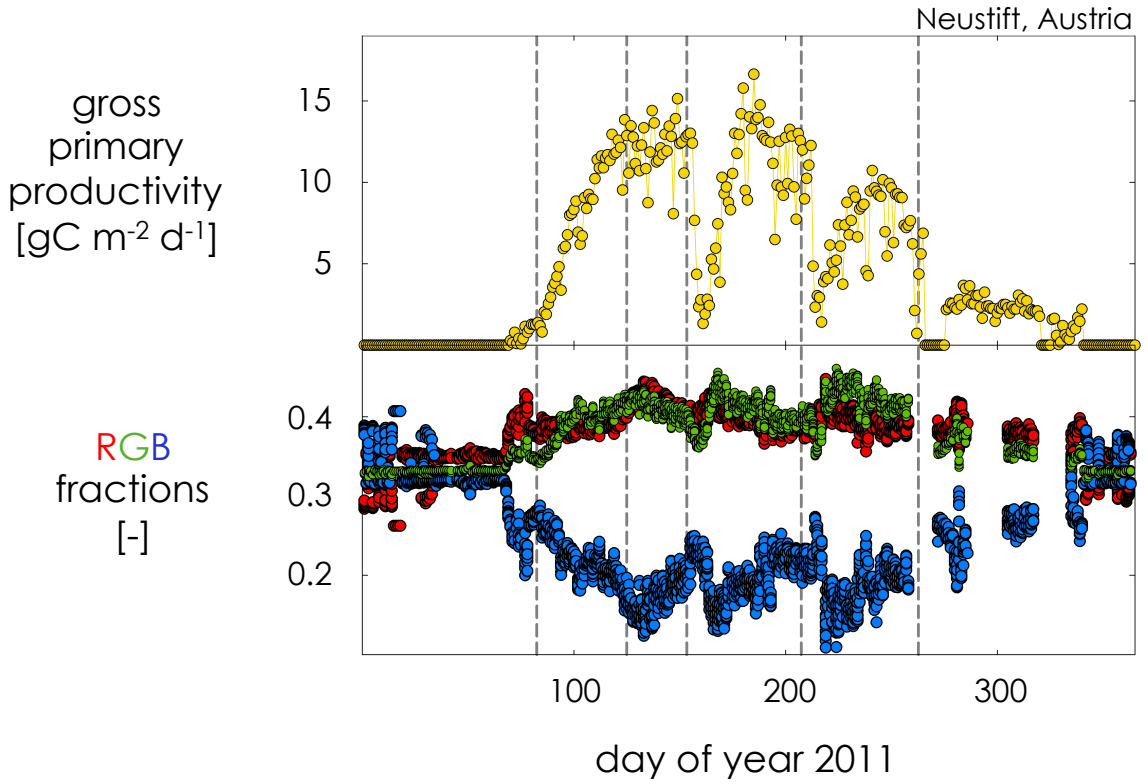
Comparing digital images visually against algorithms



(Wingate et al., Biogeosciences, 2015)

Cameras can track changes in ecology and land use

snow melt | plants flower | grass long | meadow mowed | grass long



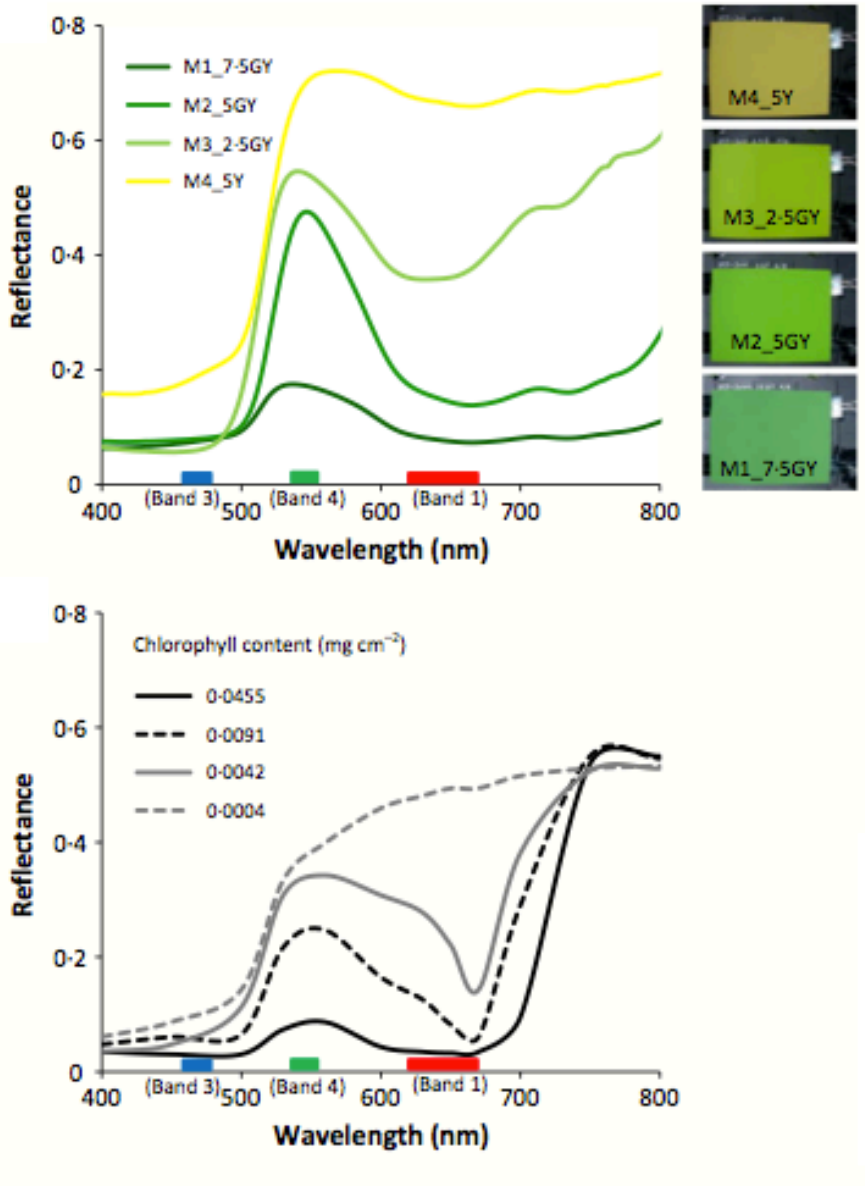
(Wingate et al., Biogeosciences., 2015)

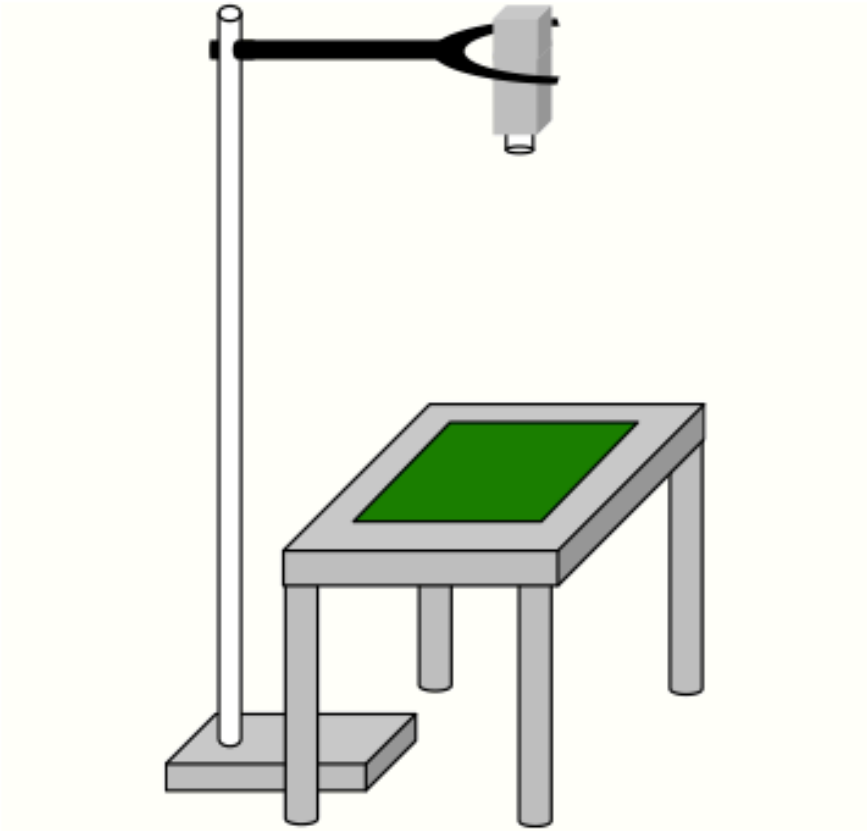
Pete the Maidenhair plant takes a selfie

Microbial Fuel Cells used to power camera

(London Zoo, 2019)

Digital cameras comparison with Munsell spectra





(Mizunuma et al., Method in Ecology and Evolution, 2014)