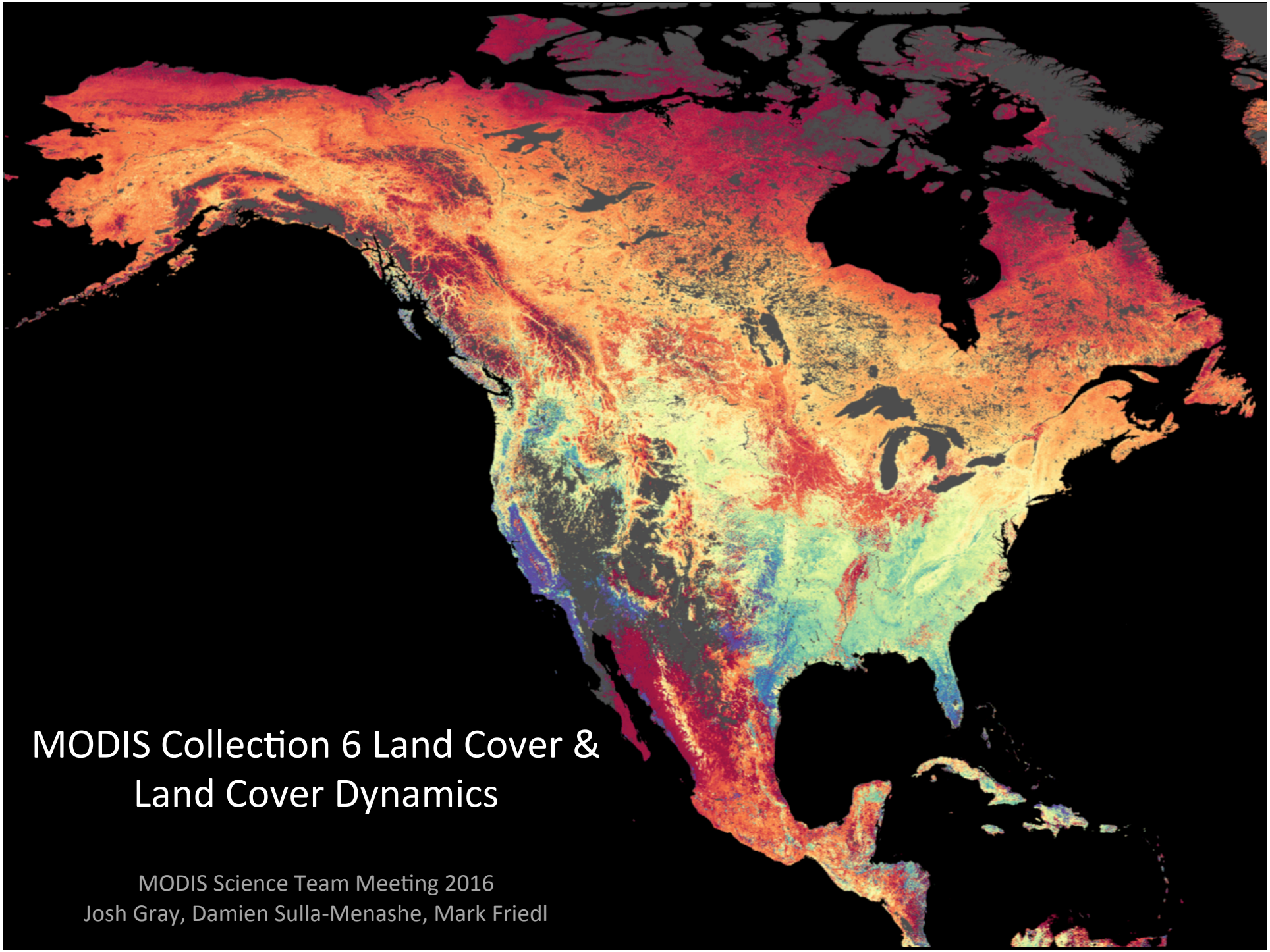
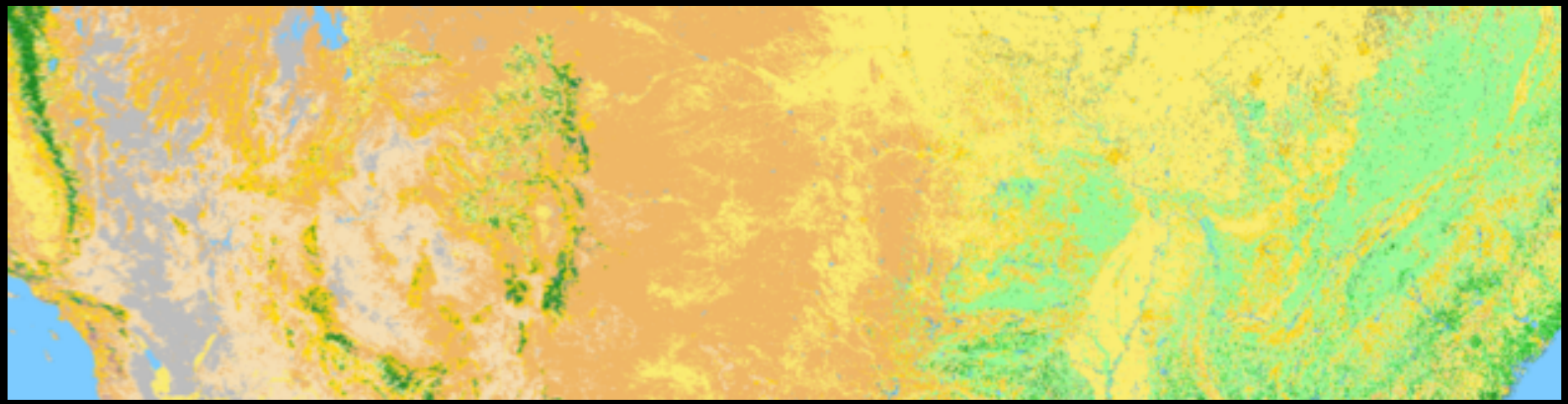


MODIS Collection 6 Land Cover & Land Cover Dynamics

MODIS Science Team Meeting 2016
Josh Gray, Damien Sulla-Menashe, Mark Friedl

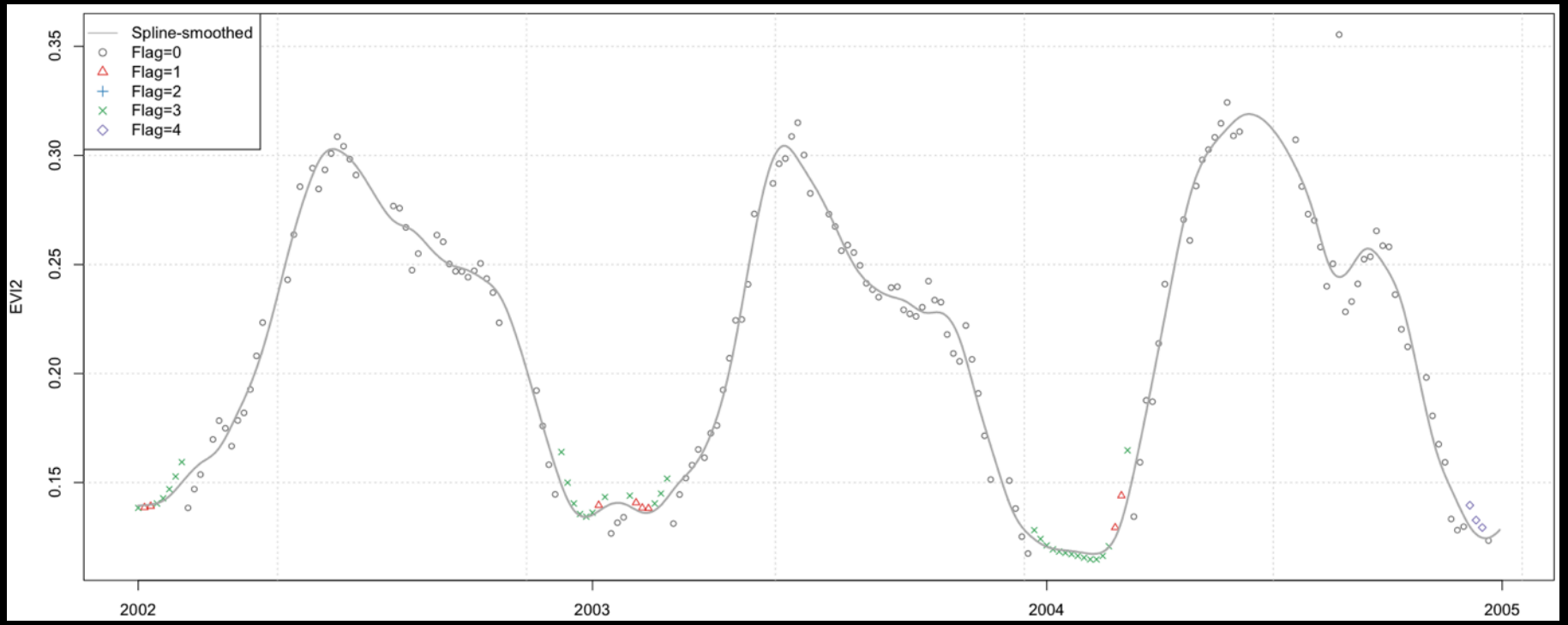
The MCD12 Products

- Primary inputs are MCD43A4/2 products
- MCD12Q1 and MCD12C1
  - Global, annual land cover at 500 m and 0.05°
  - 6 Types: IGBP, UMD, LAI/fPAR, NPP/BGC, PFT, LCCS
- MCD12Q2
  - Global, annual land surface phenology at 500 m
  - Start and end of season, integrated greenness



MCD12 Collection 6

- MCD12Q1/C1 and MCD12Q2 both use:
  - *Daily* Collection 6 NBARs
  - Spline smoothing of band time series
  - Snow screening and filling



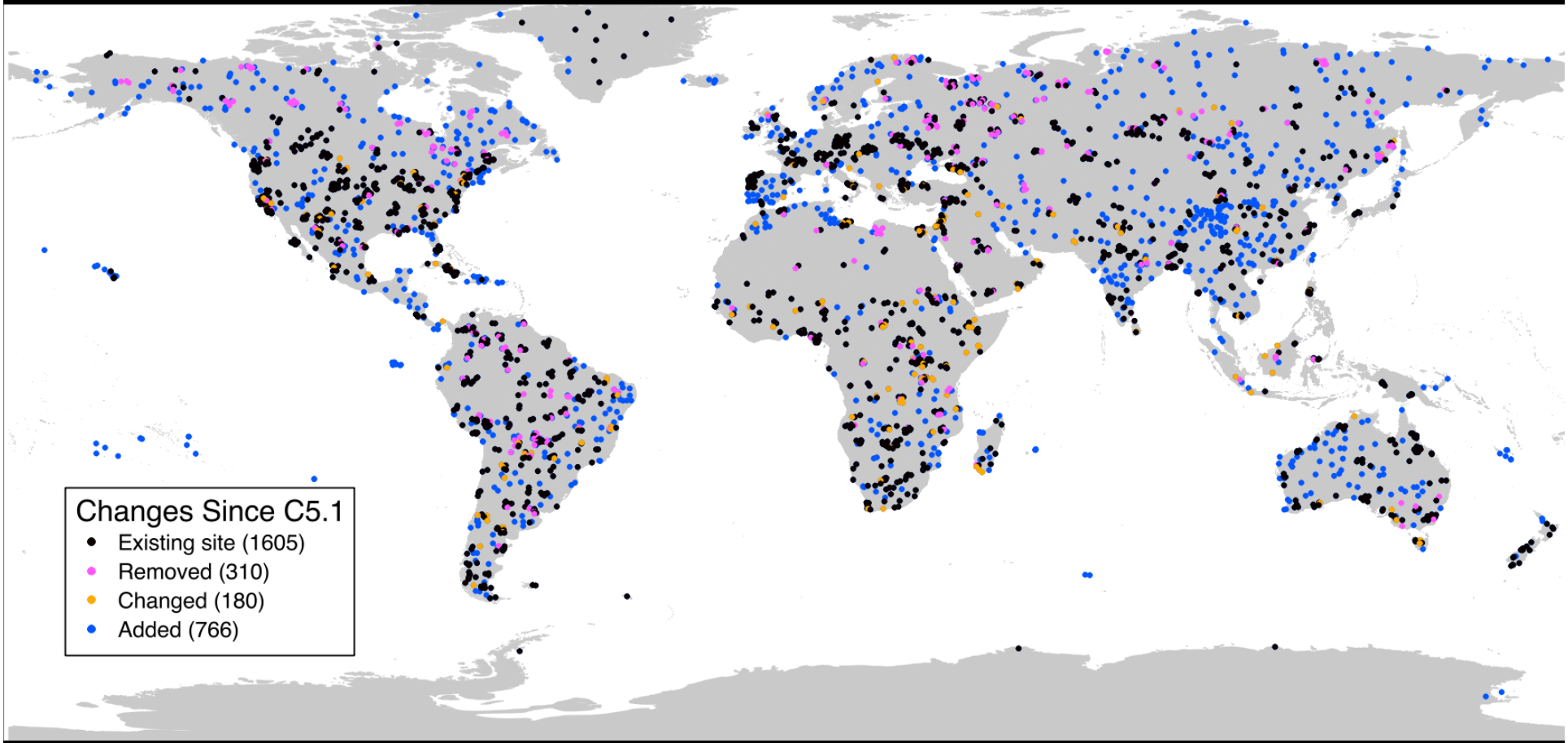
MCD12Q1 Improvements

- Hierarchical classification approach
- RandomForest instead of C4.5
- Improved training data (STEP)
- Improved feature set
- Hidden Markov model (Abercrombie and Friedl, 2016 IEEE TGARS)

STEP Changes

47% more STEP sites

31% of sites modified or removed

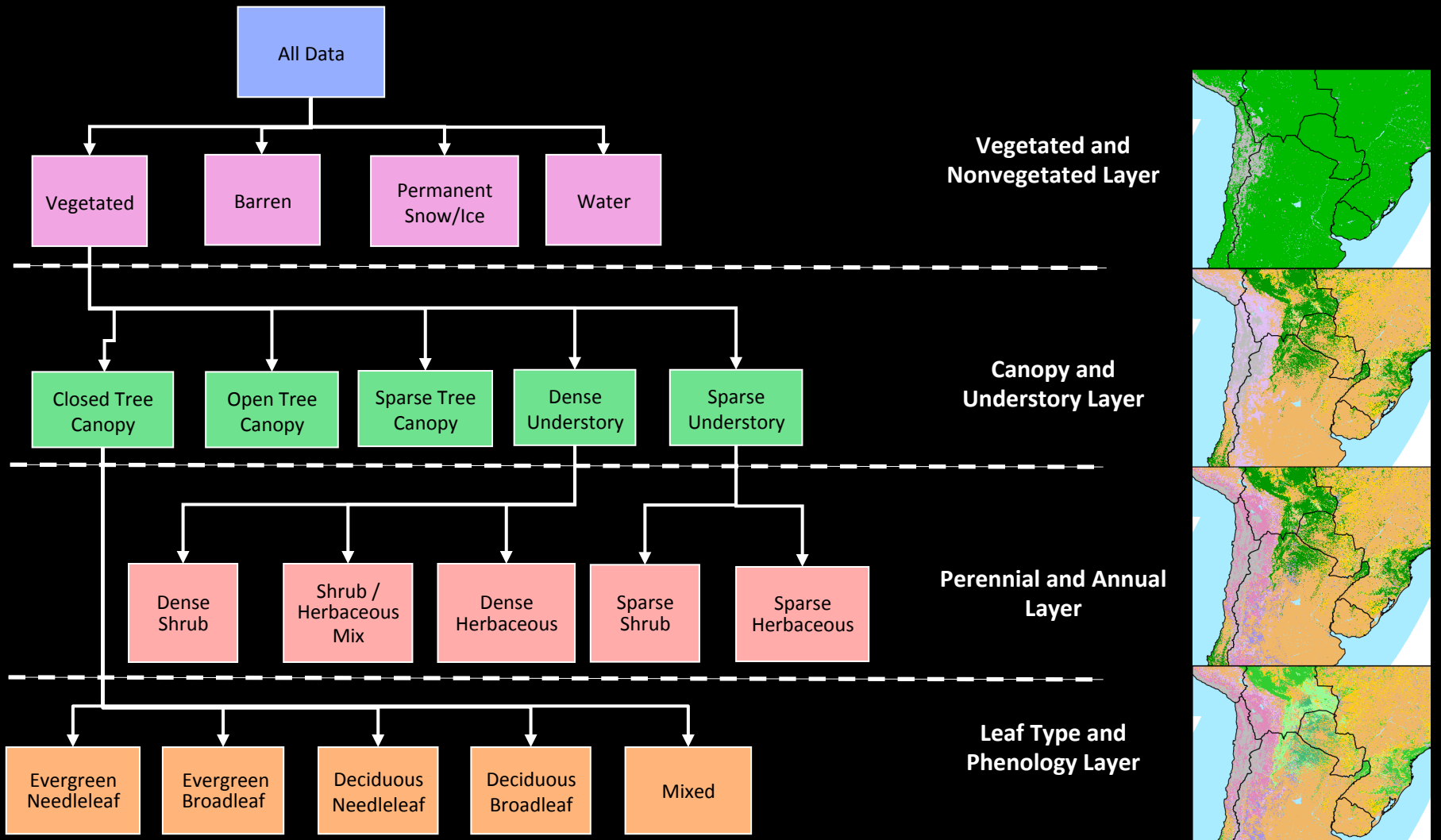


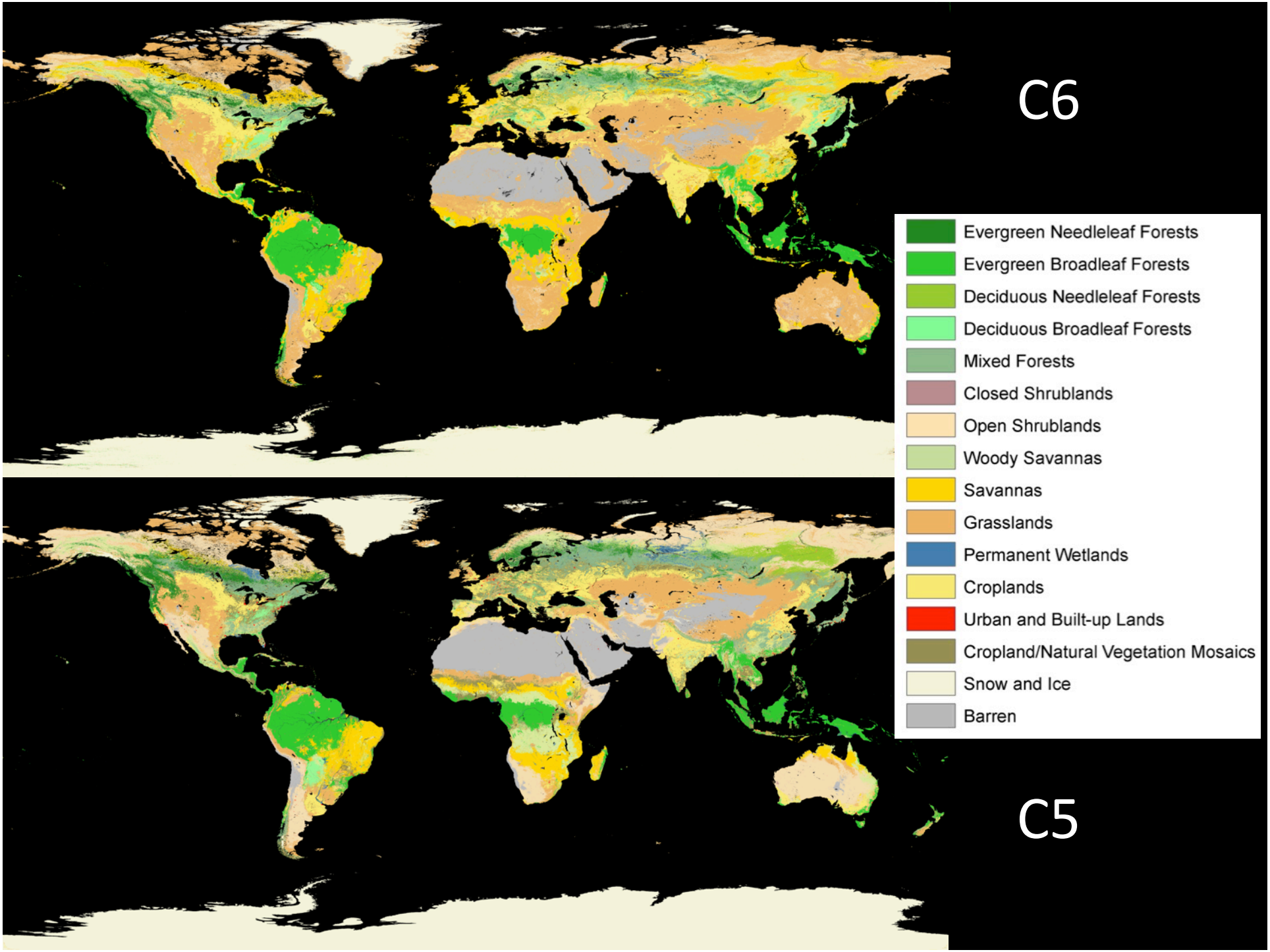
Improved Algorithm and Classification Inputs

	V5	V6
Feature Set	• Monthly NBAR (7 bands), EVI, and LST. • Annual metrics (min, max, mean) for each feature.	• **Annual metrics for growing season:** from NBARs (**7 bands**) and vegetation indices (**EVI2, NDII1, NDII2, NDWI, NDSI)**
Classifier	**C4.5 Decision Tree**	**RandomForest Classifier**

Ancillary Data	• MODIS V5 land-water mask
	• V5 urban layer
	• Prior probability layers based on Collection 4 data with agriculture intensity data
		• MODIS V6 land-water mask at 250-m
		• Updated V6 urban layer
		• Prior probability layers based on:
		  • New agriculture intensity data
		  • Climate-based classifications
		  • MODIS Vegetation Continuous Fields product

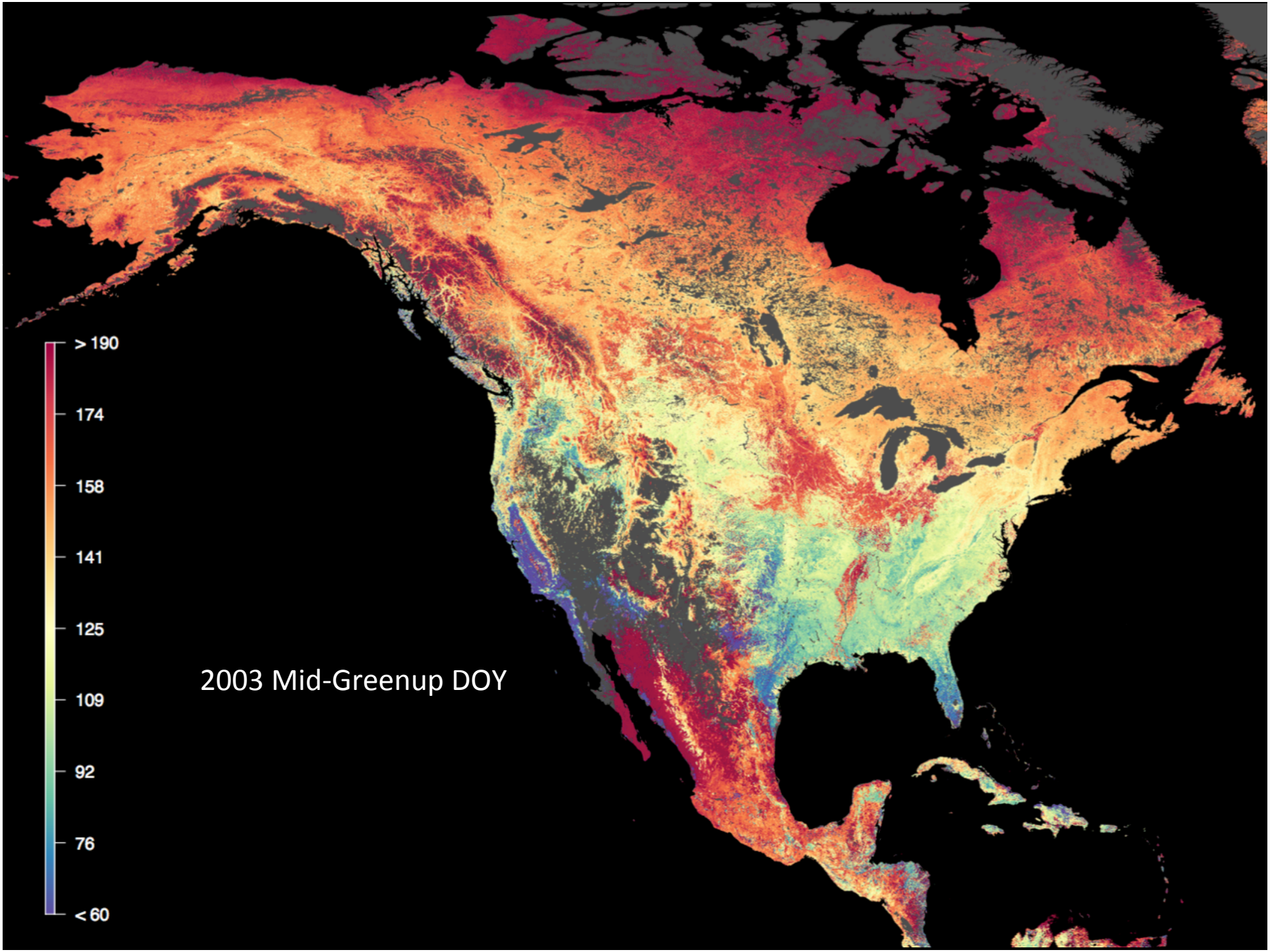
New LCCS Layer

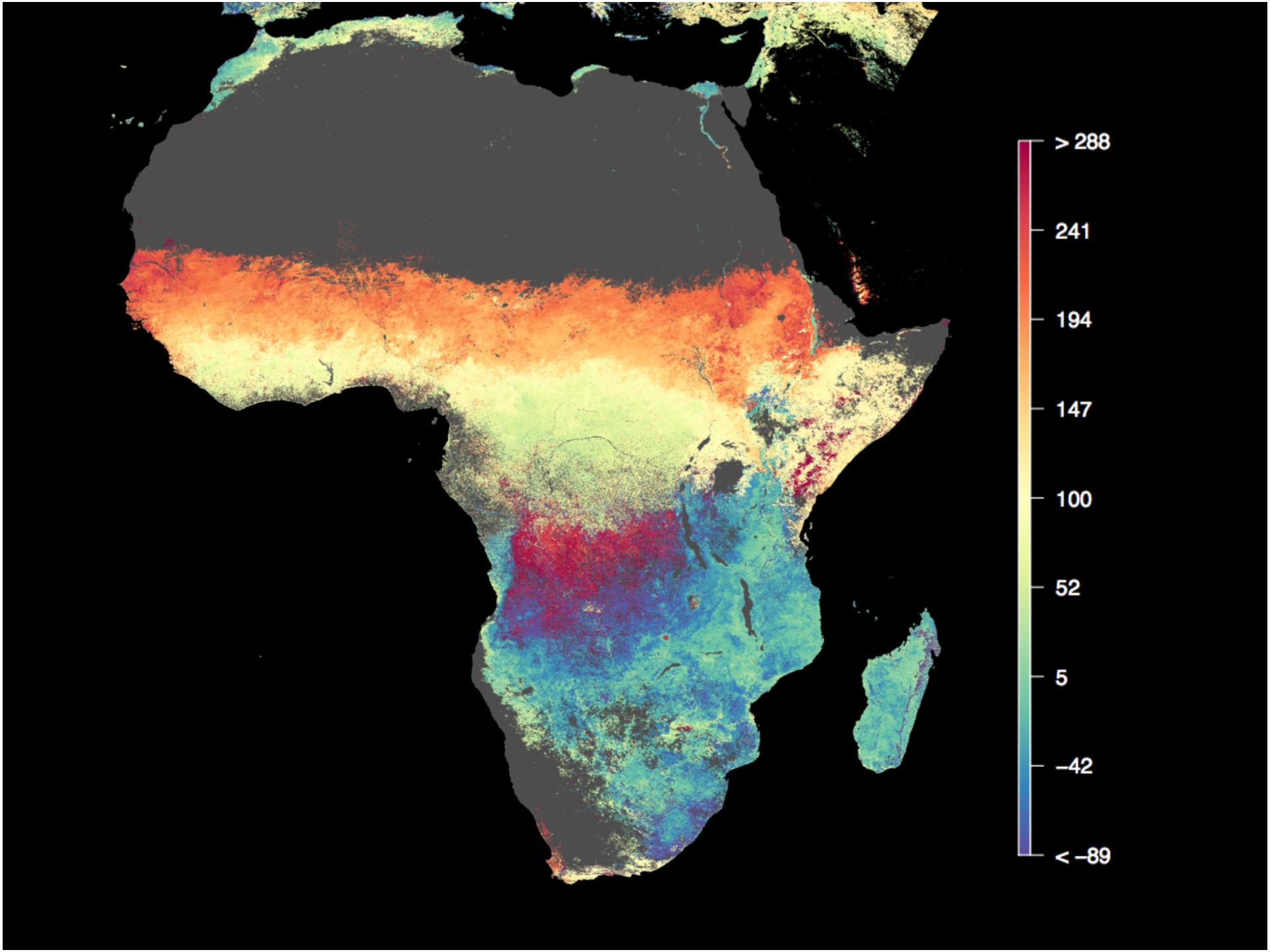


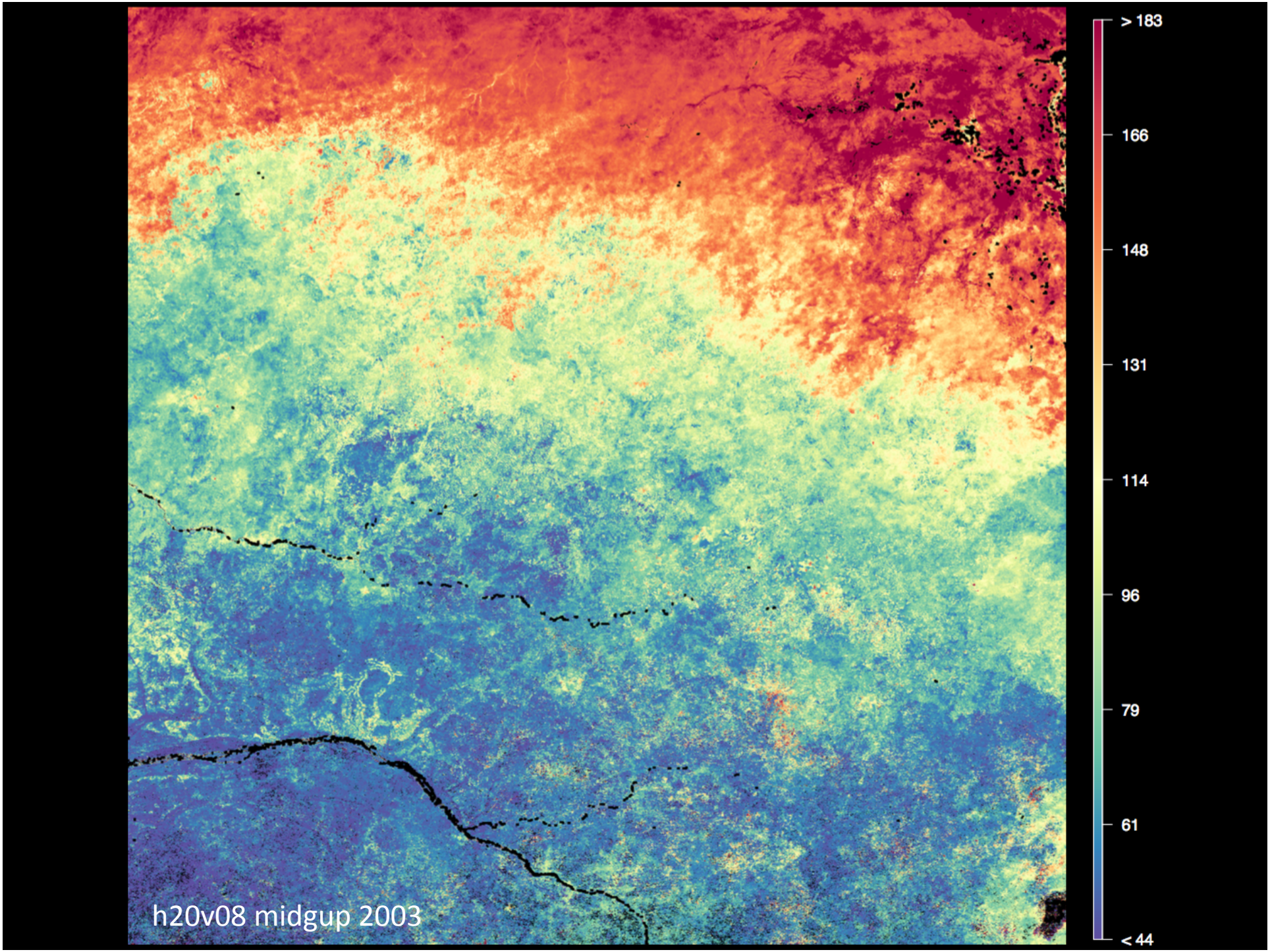

C6
Evergreen Needleleaf Forests
Evergreen Broadleaf Forests
Deciduous Needleleaf Forests
Deciduous Broadleaf Forests
Mixed Forests
Closed Shrublands
Open Shrublands
Woody Savannas
Savannas
Grasslands
Permanent Wetlands
Croplands
Urban and Built-up Lands
Cropland/Natural Vegetation Mosaics
Snow and Ice
Barren
C5

MCD12Q2

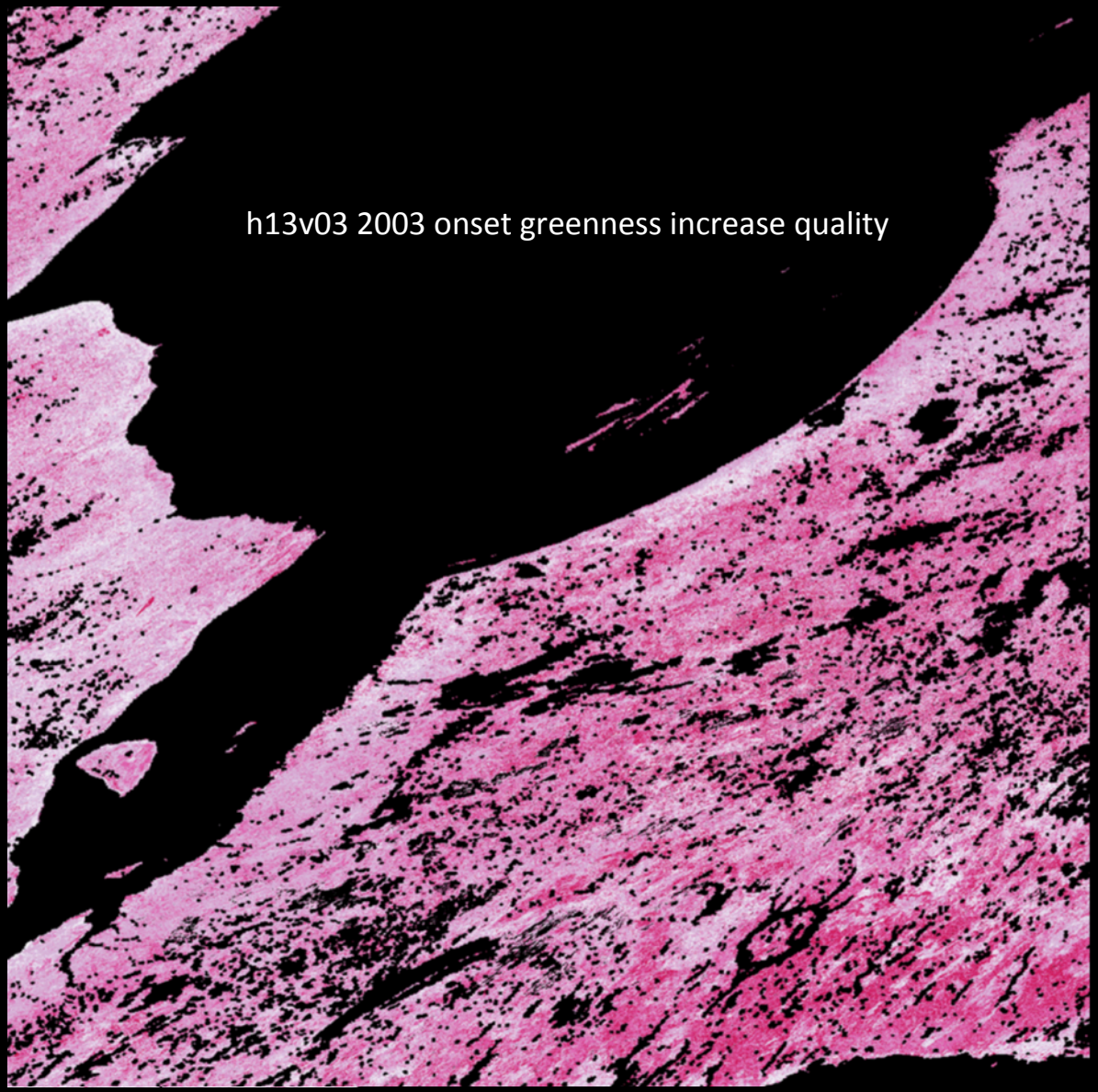
- What's new in C6?
  - Relative thresholds of splined NBAR-EVI2 rather than inversions of piecewise logistic functions
  - New SDS: peak, midpoint of GUP/GDOWN
  - Improved QA: QA value for each phenometric; weighted sum of missing data in vicinity of phenometric and spline goodness of fit


> 190
174
158
141
125
109
92
76
< 60
2003 Mid-Greenup DOY


> 288
241
194
147
100
52
5
–42
< –89


> 183
166
148
131
114
96
79
61
< 44
h20v08 midgup 2003

Phenometric-specific QA



Best

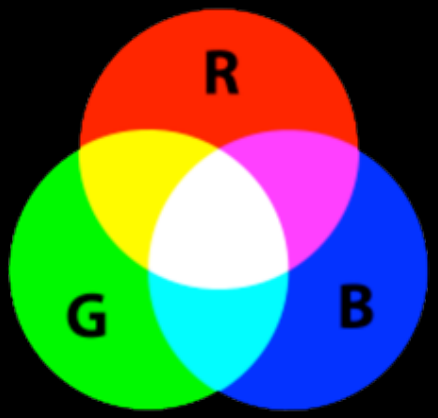
Good

Fair

Marginal

QA score is weighted sum of fraction missing in month centered on phenometric and spline R^2 (80% and 20%, resp.)
Continuous scores collapsed to 1-4 qualitative score

Extracting Phenology Data From Webcam Images



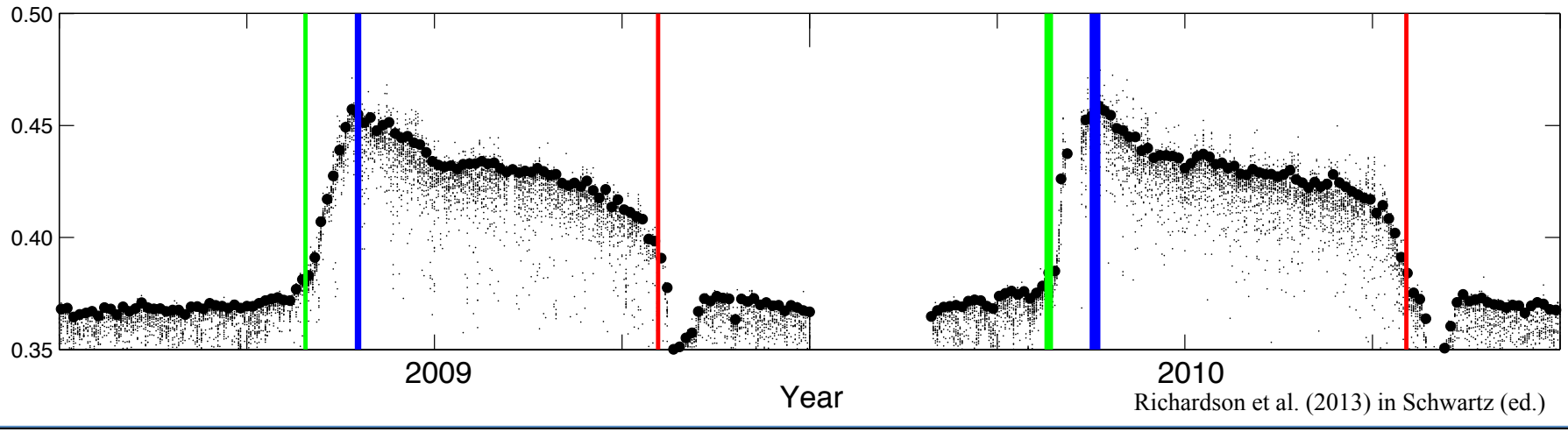
RGB Color Model

RGB Triplet:

$$(R_{DN}, G_{DN}, B_{DN})$$

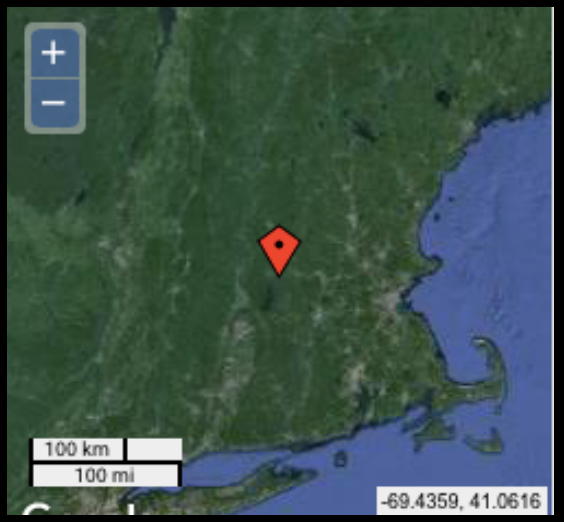
Canopy "Greenness" (GCC)

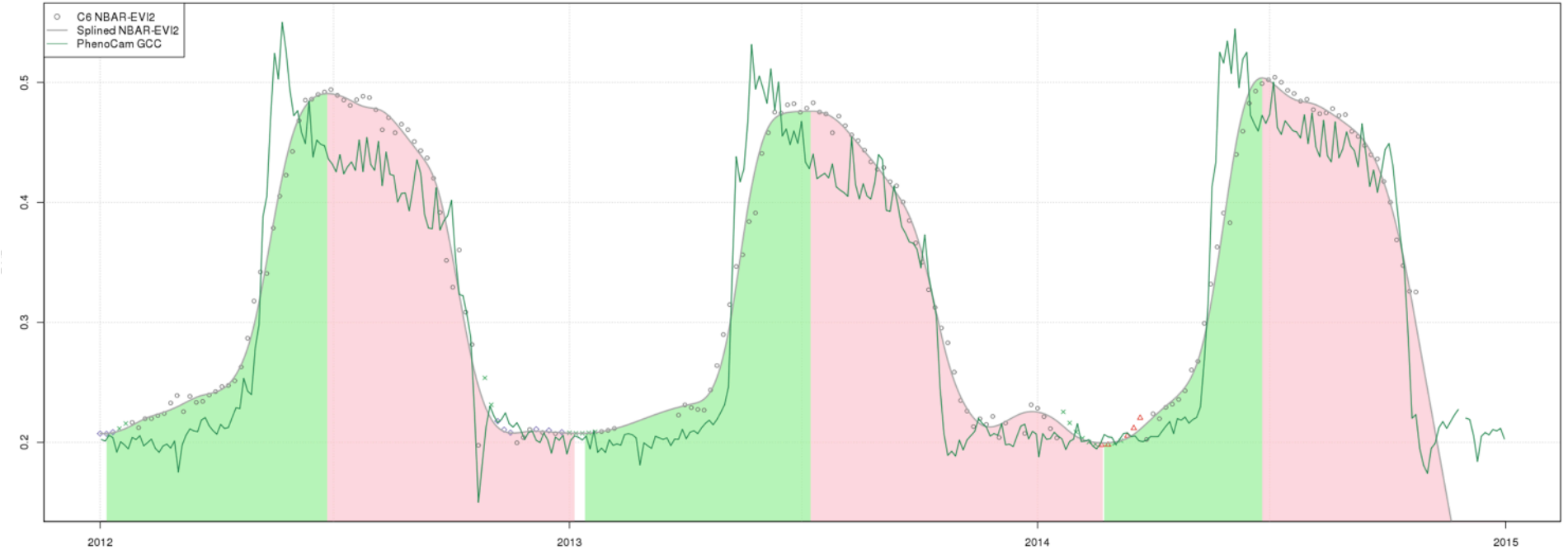
$$= \frac{G_{DN}}{R_{DN} + G_{DN} + B_{DN}}$$

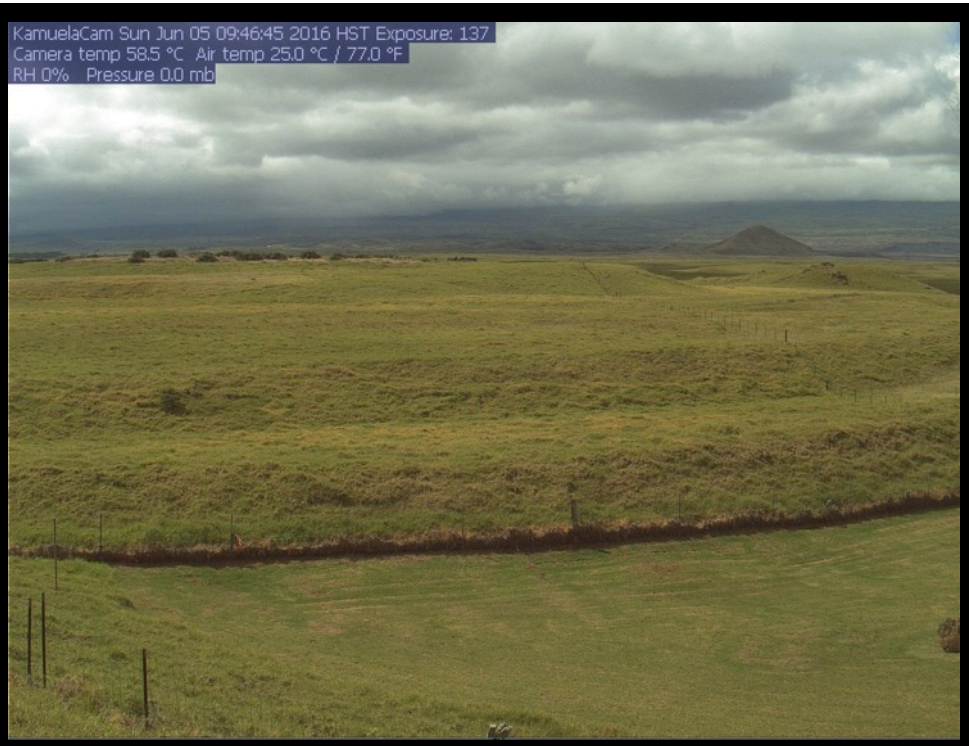


Richardson et al. (2013) in Schwartz (ed.)

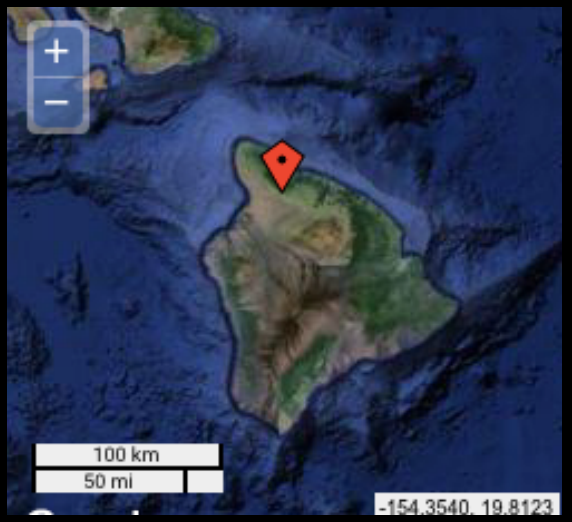
Harvard Forest Phenocam, MA

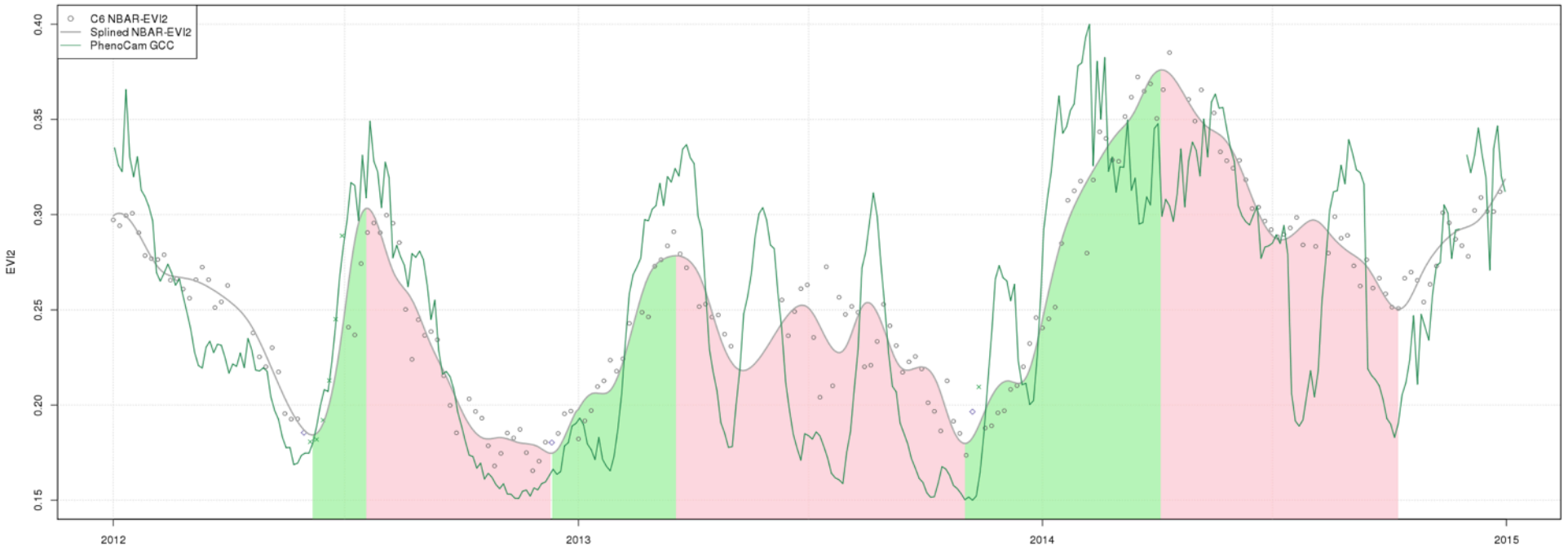




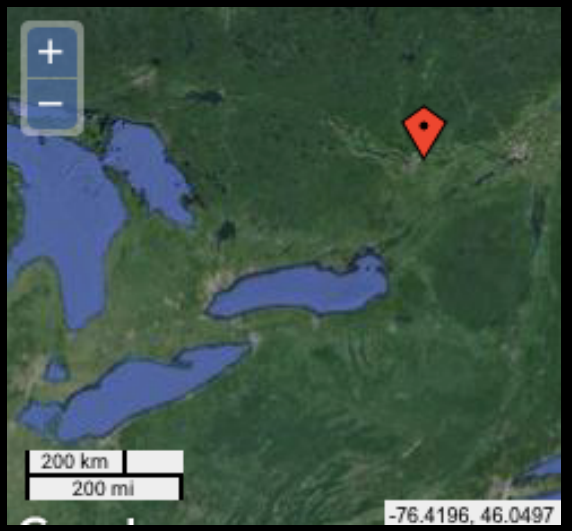


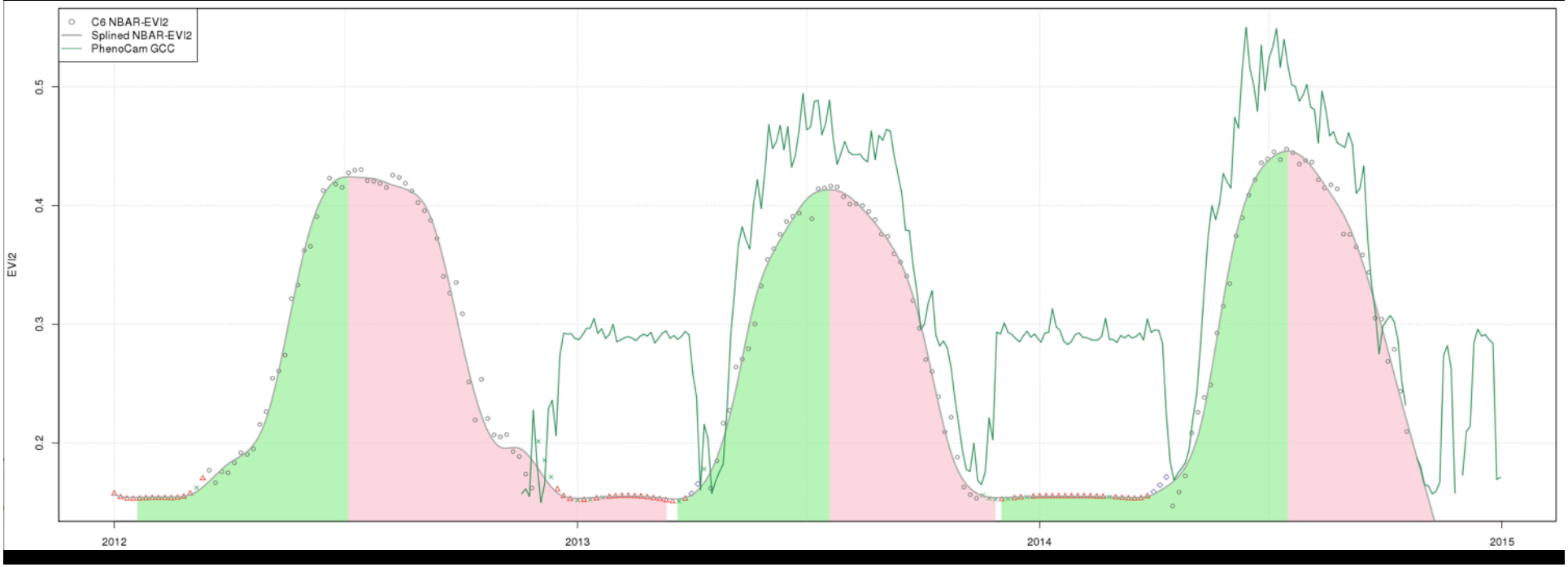
Kamuela Phenocam
Waimea, HI



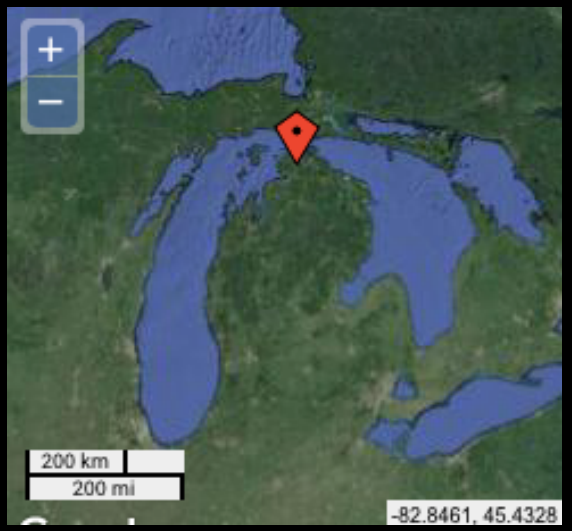


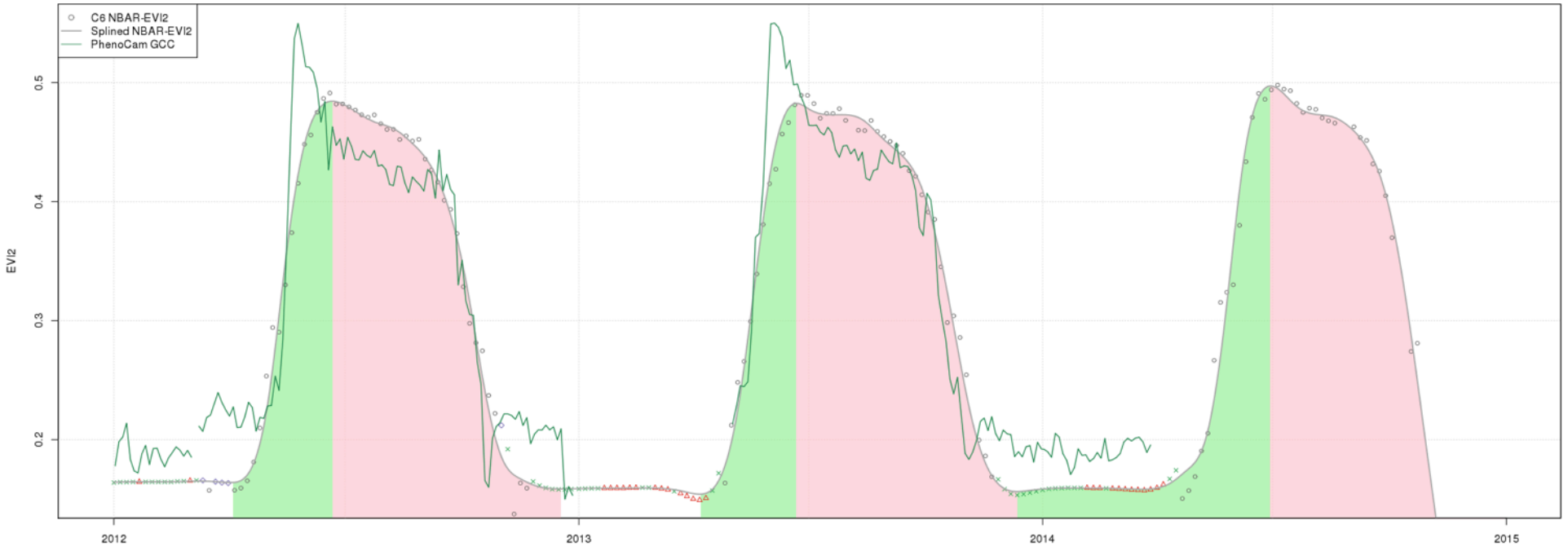
Mer Bleue Phenocam, Ontario

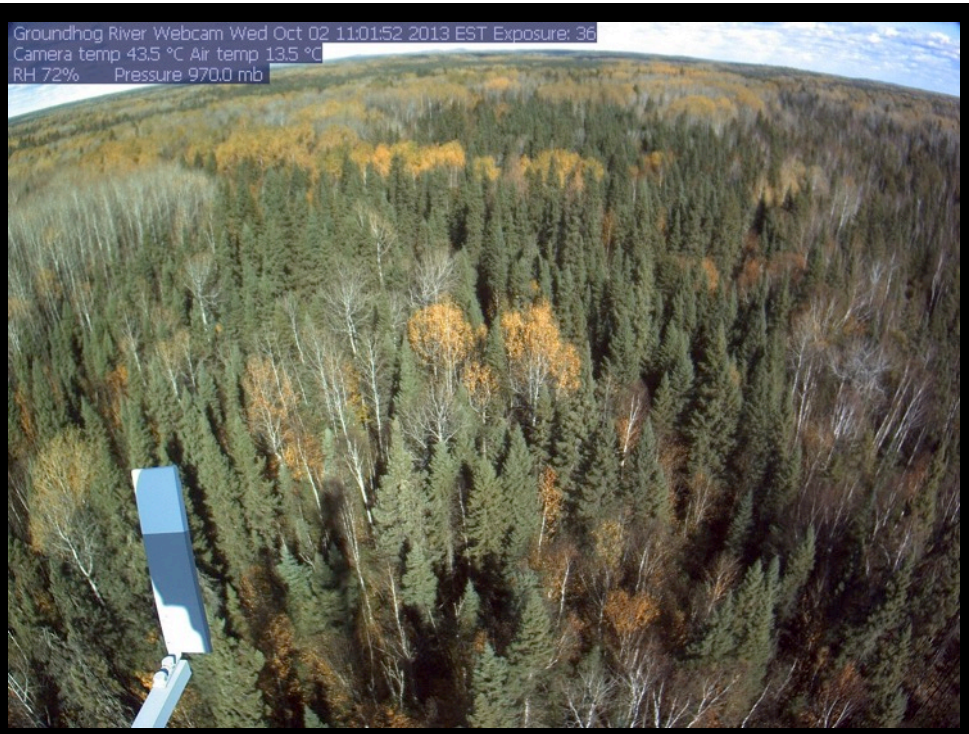




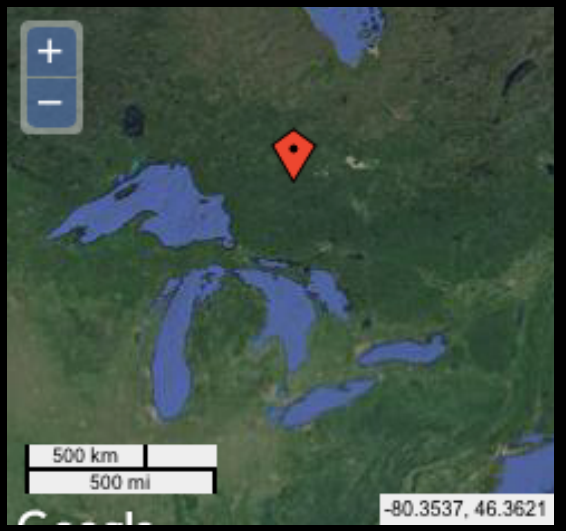
U. Michigan Biological Station

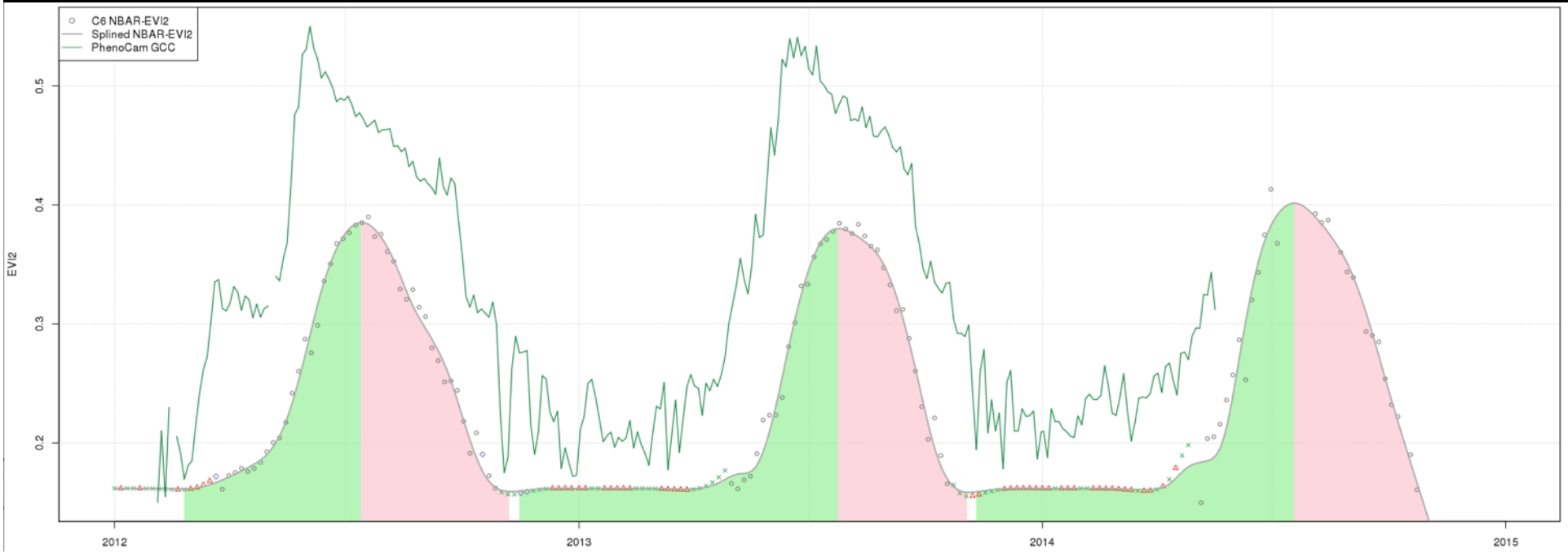


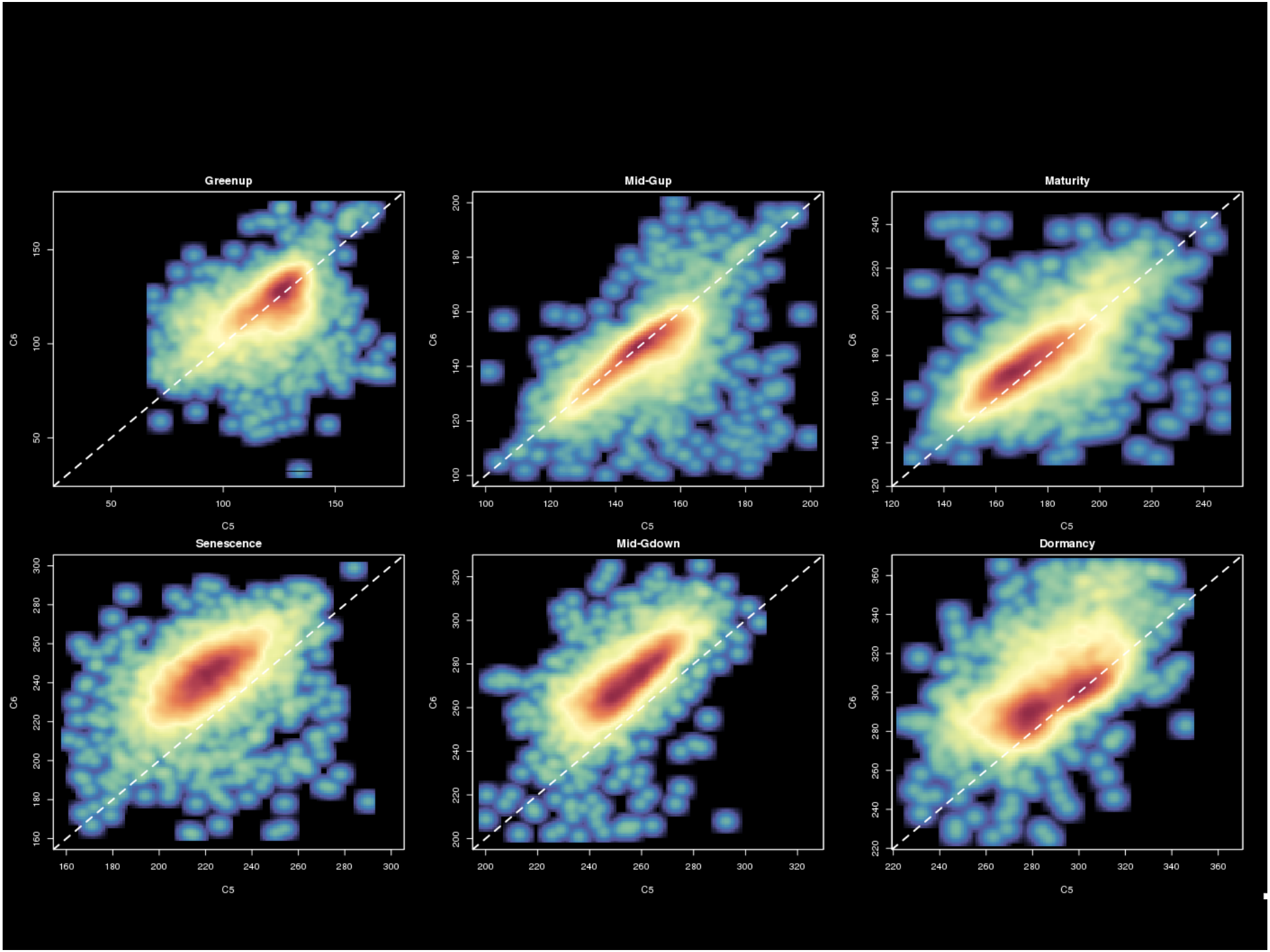


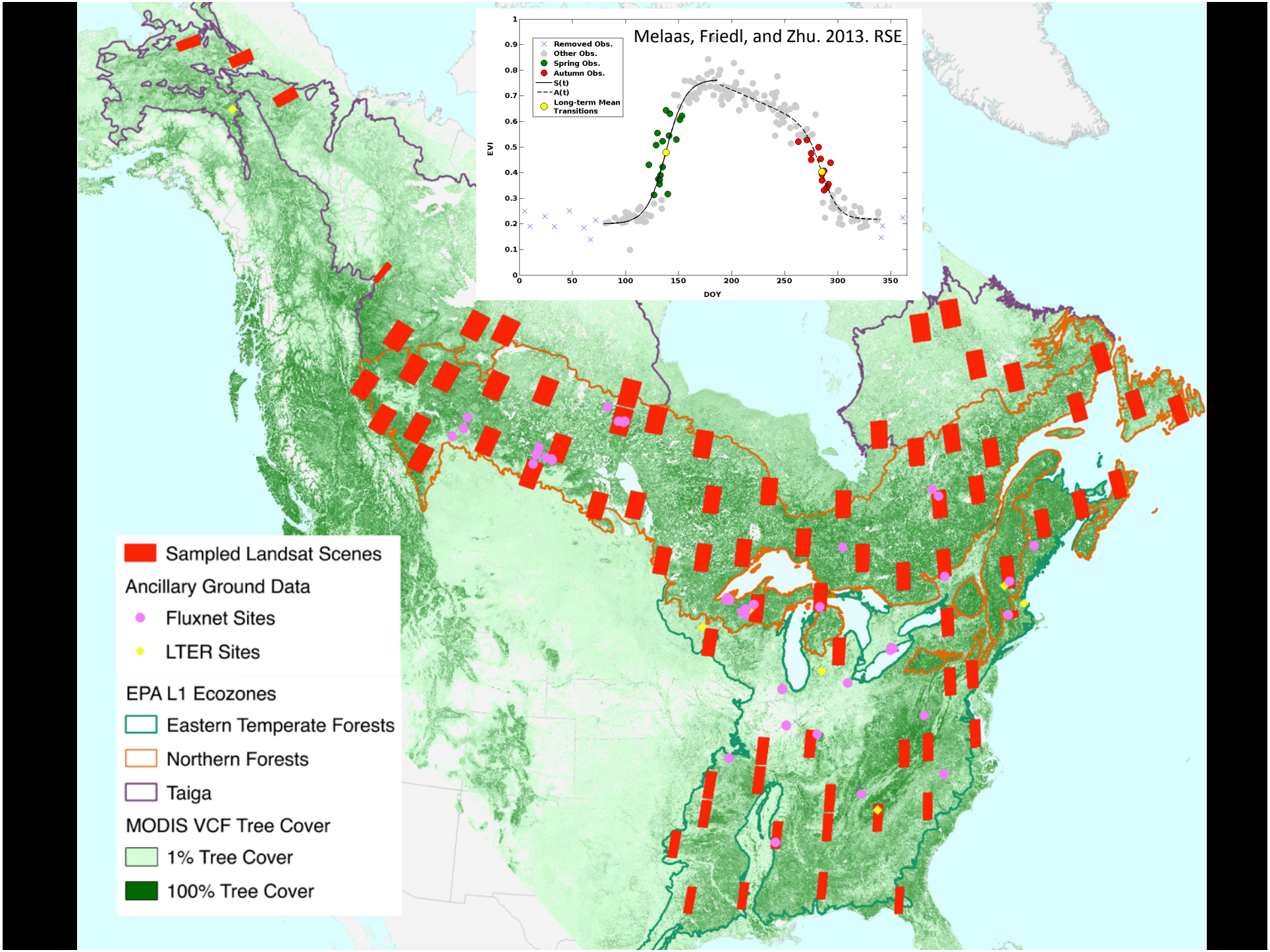


Groundhog River Phenocam, Ontario

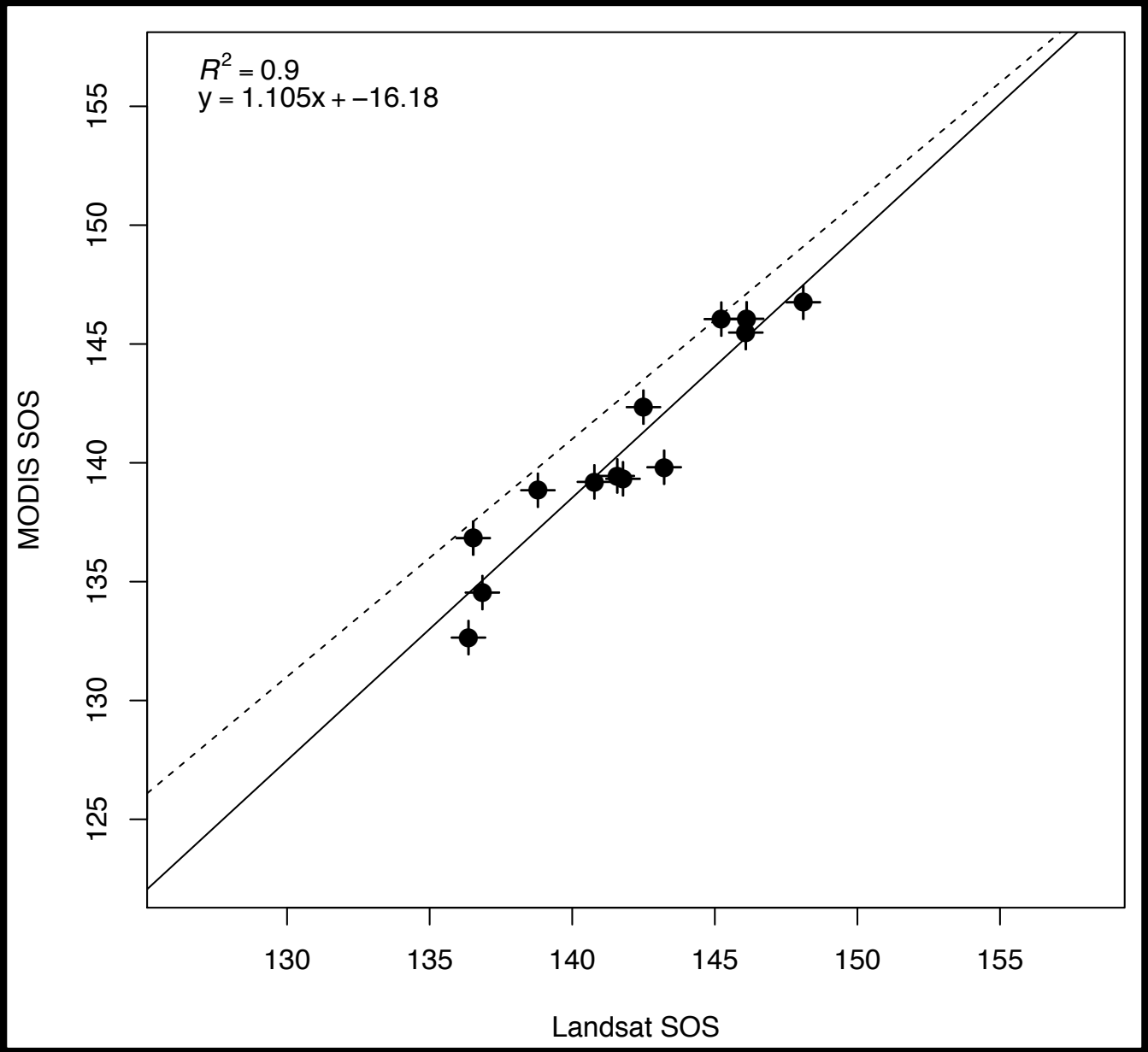





Greenup
Mid-Gup
Maturity
Senescence
Mid-Gdown
Dormancy
C5
C6

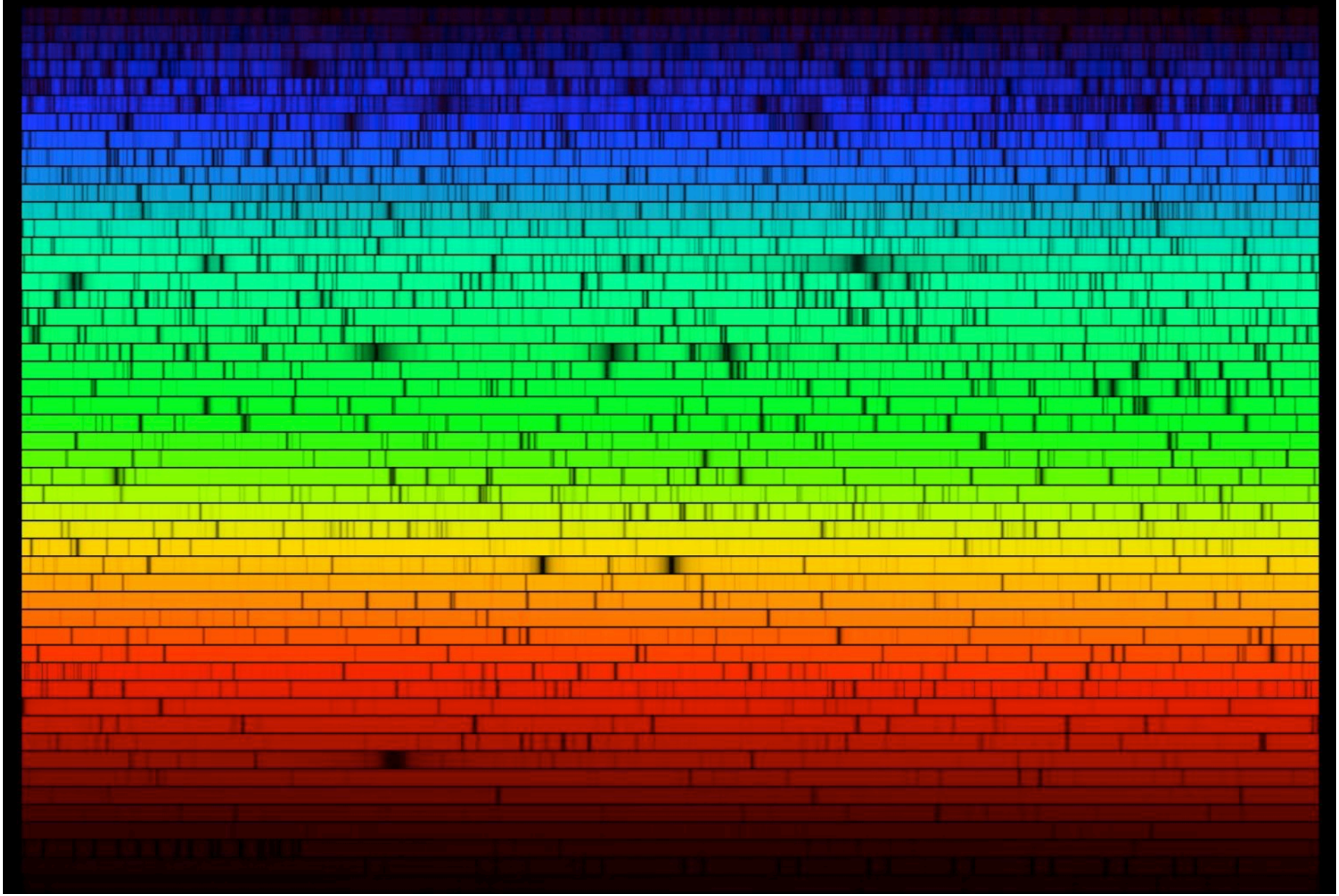

Melaas, Friedl, and Zhu. 2013. RSE
Removed Obs.
Other Obs.
Spring Obs.
Autumn Obs.
S(t)
A(t)
Long-term Mean Transitions
EVI
DOY
0
50
100
150
200
250
300
350
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Sampled Landsat Scenes
Ancillary Ground Data
Fluxnet Sites
LTER Sites
EPA L1 Ecozones
Eastern Temperate Forests
Northern Forests
Taiga
MODIS VCF Tree Cover
1% Tree Cover
100% Tree Cover

50% Greenup Assessment with Melaas et al. Landsat method 2001-2014



Bars are standard errors across pixels within site

Moving Forward

- Code migration to Goddard, will be processed on the PEATE like most other products
- Ongoing assessment and refinement
- Working with XYZ for VIIRS continuity

Questions?