Moving from Prototyping Multisource Imaging of Seasonal Dynamics in Land Surface Phenology to Production

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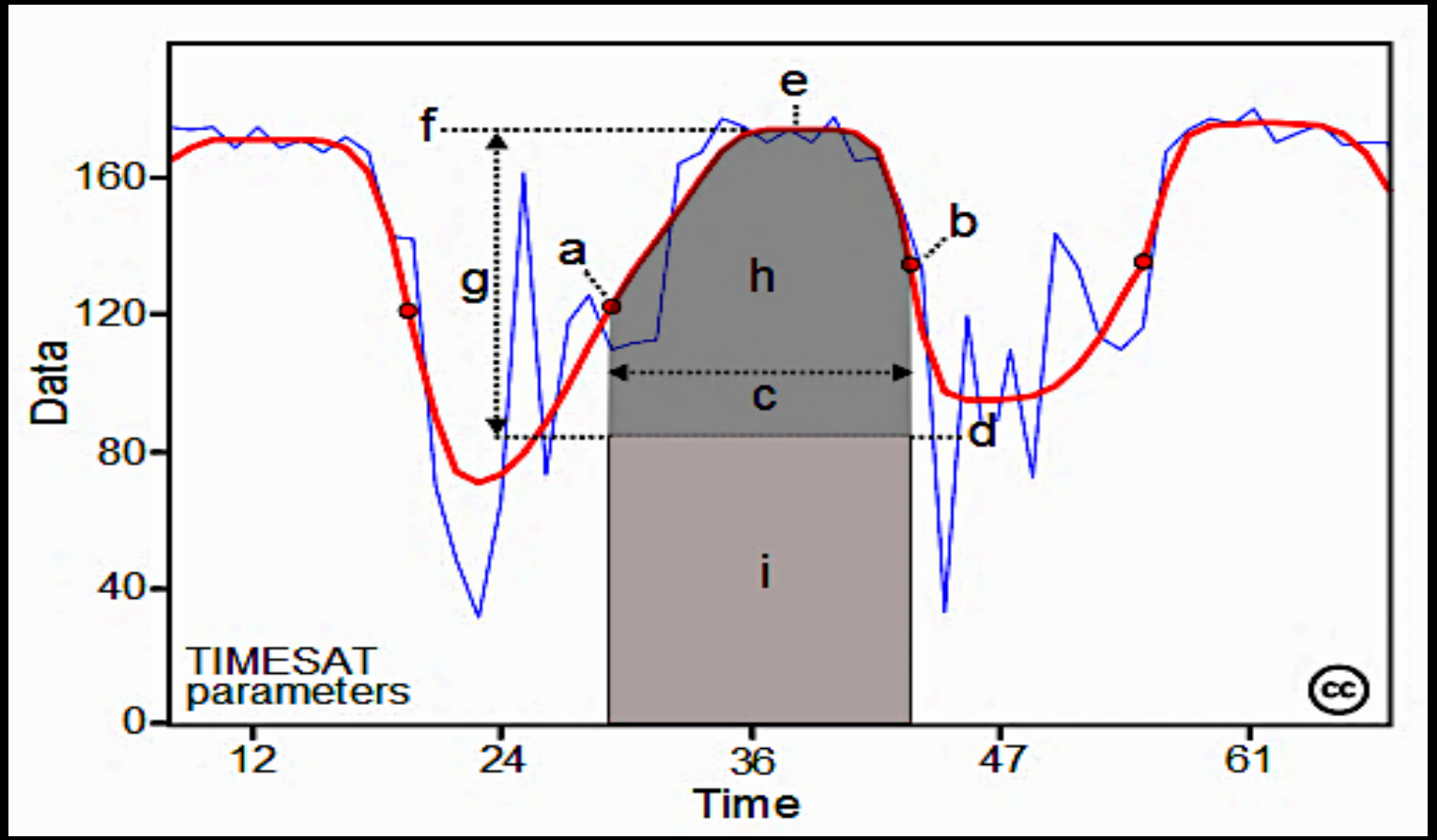
Land Surface Phenology



Project Goals – Phase 1

Exploit temporal density of Landsat + Sentinel 2:

- *To generate gap-filled time series of spectral vegetation indices that characterize the entire seasonal cycle of land surface phenology at fixed time steps.*
- *To quantify the timing and magnitude of land surface phenology events (“phenometrics”) at moderate spatial resolution.*

Heritage: MODIS Land Cover Dynamics (MCD12Q2)

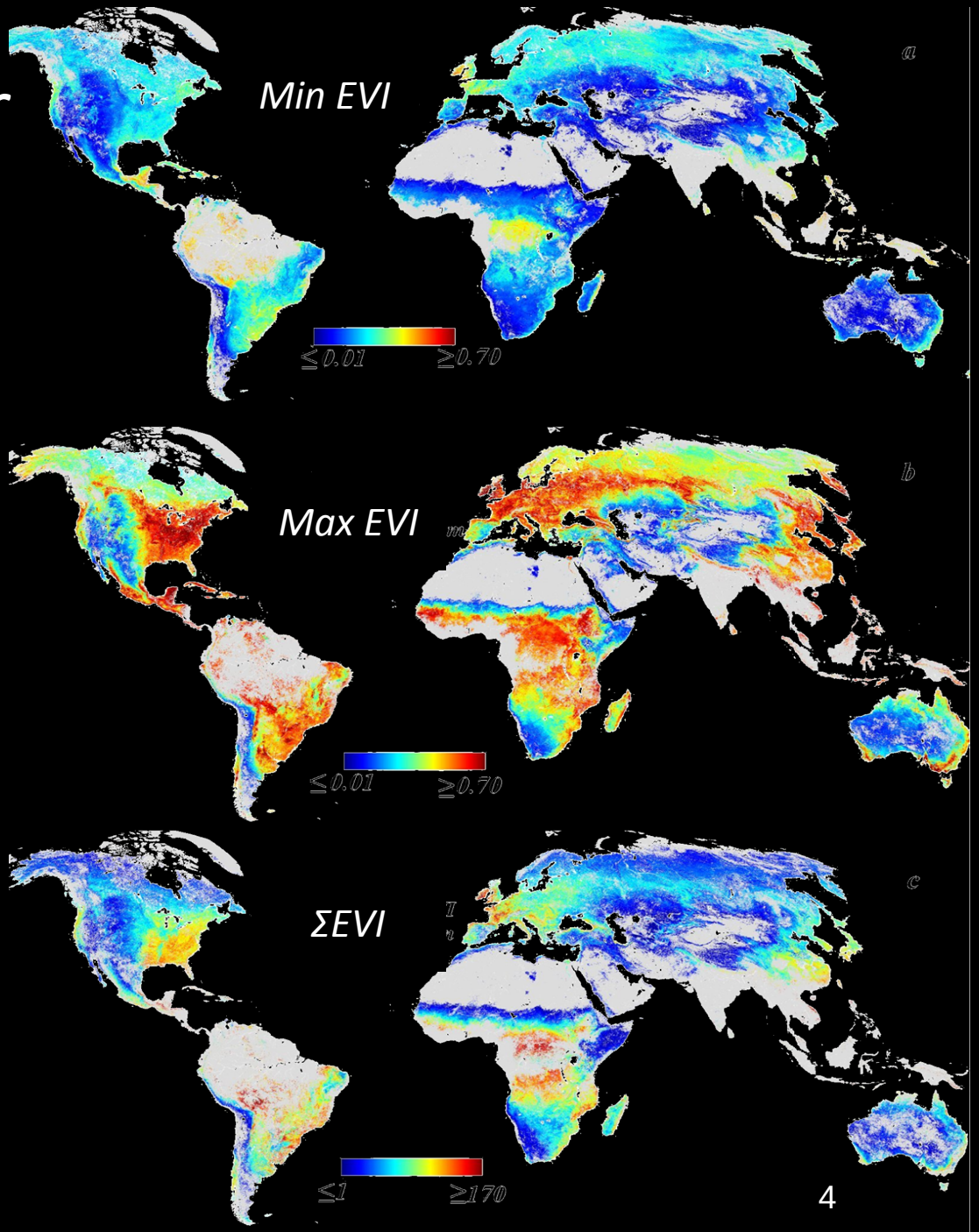
- Includes 7 metrics

Timing

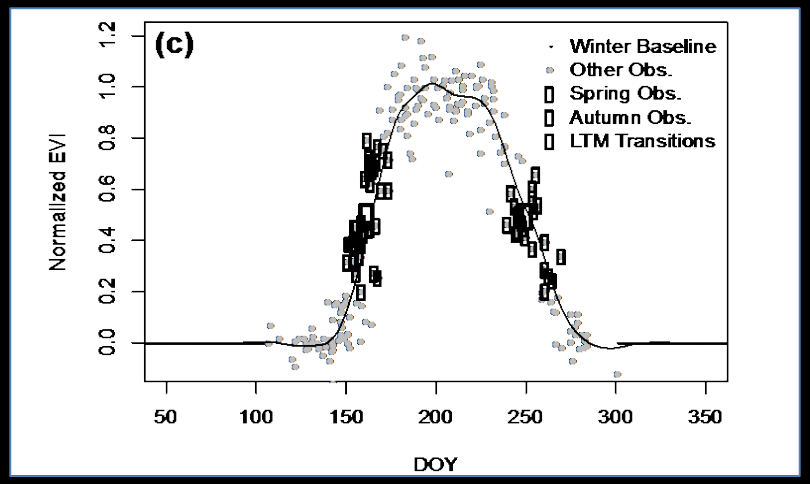
- Onset of EVI increase,
- Onset of EVI maximum,
- Onset of EVI decrease,
- Onset of EVI minimum,

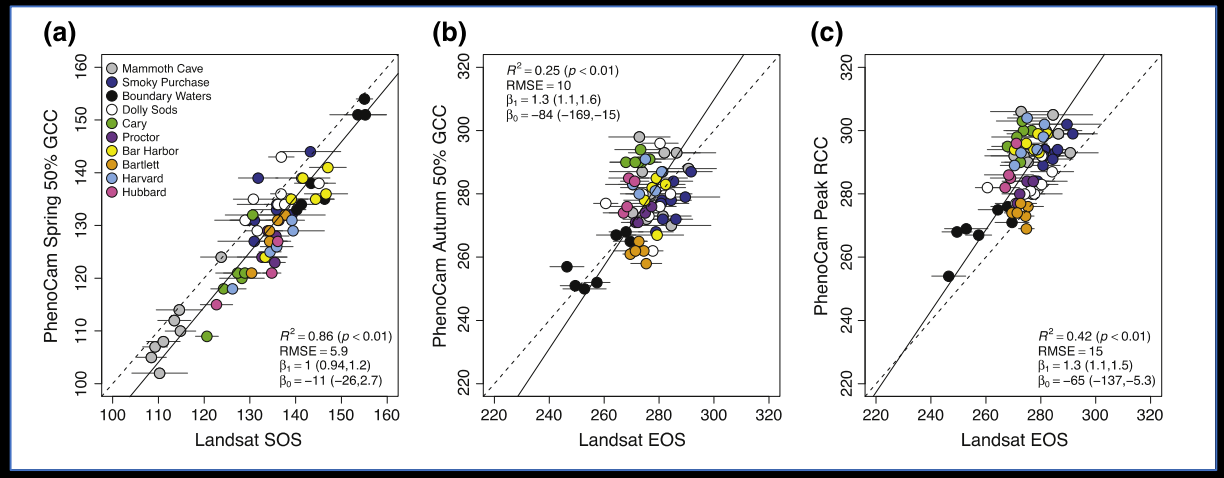
Annual Metrics

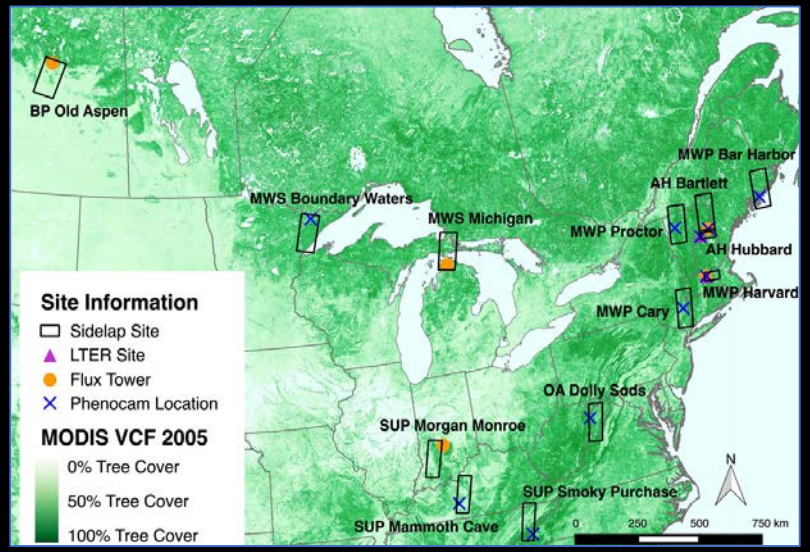
- Min, max, & sum of growing season EVI

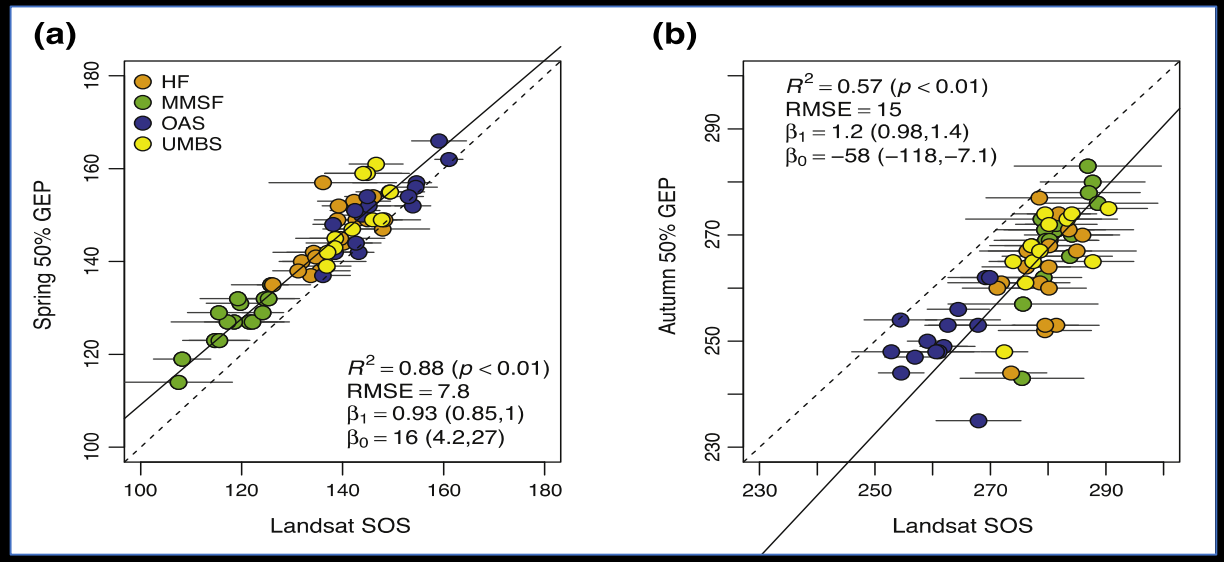


Heritage: Landsat Phenology Algorithm



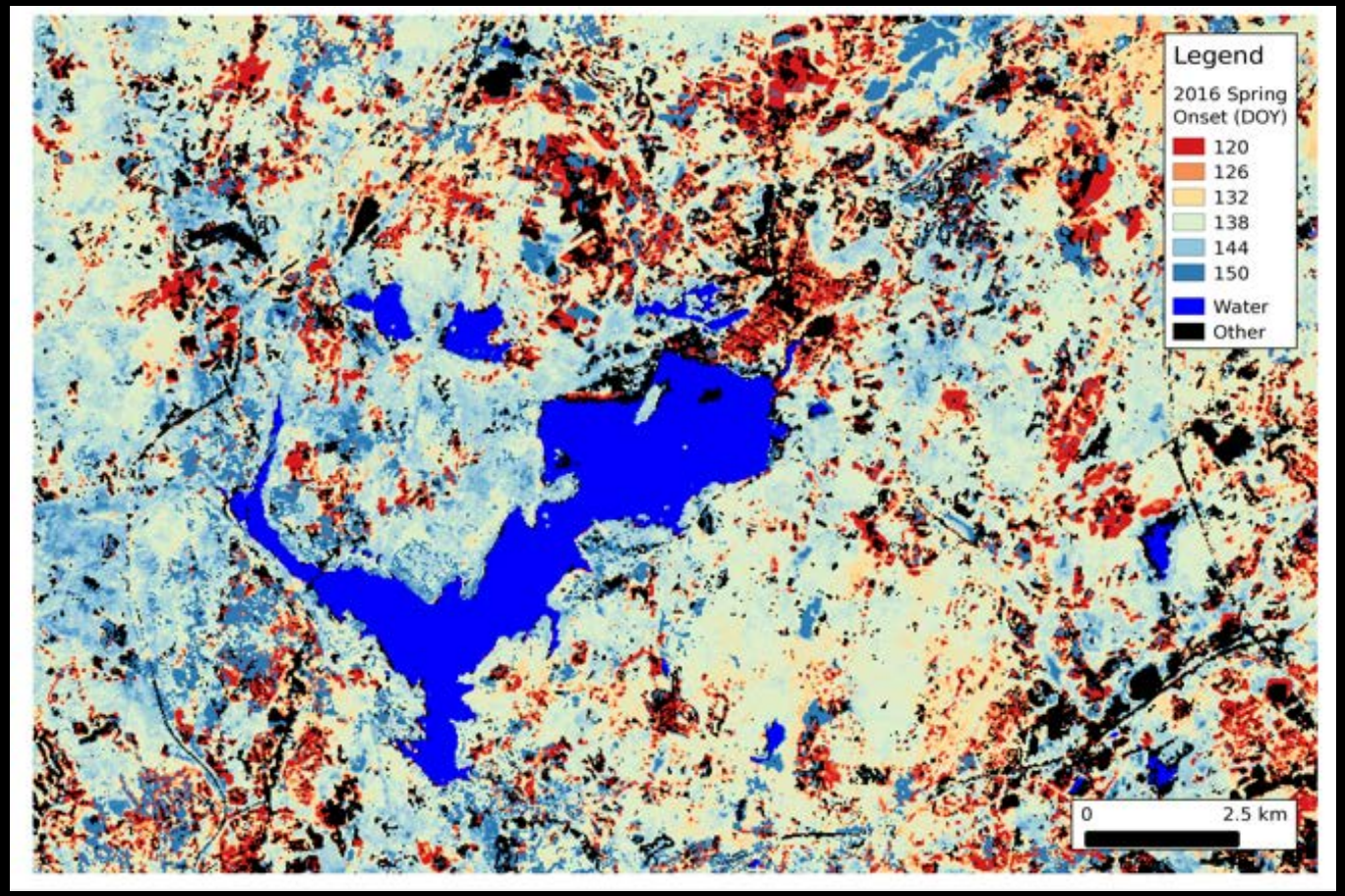






Melaas et al., 2013, 2016

From Coarse to Moderate Spatial Resolution



Project Goals – Phase 2

Operationalize a prototype moderate spatial resolution LSP algorithm at continental scale.

- *To produce moderate spatial resolution land surface phenology data sets at continental scale that provide:* ***(1) the timing of phenological events****, (2) reduced dimension image data sets that maximize multispectral information and minimize temporal correlation in image time series, and (3) identify in-season anomalies in near real-time.*

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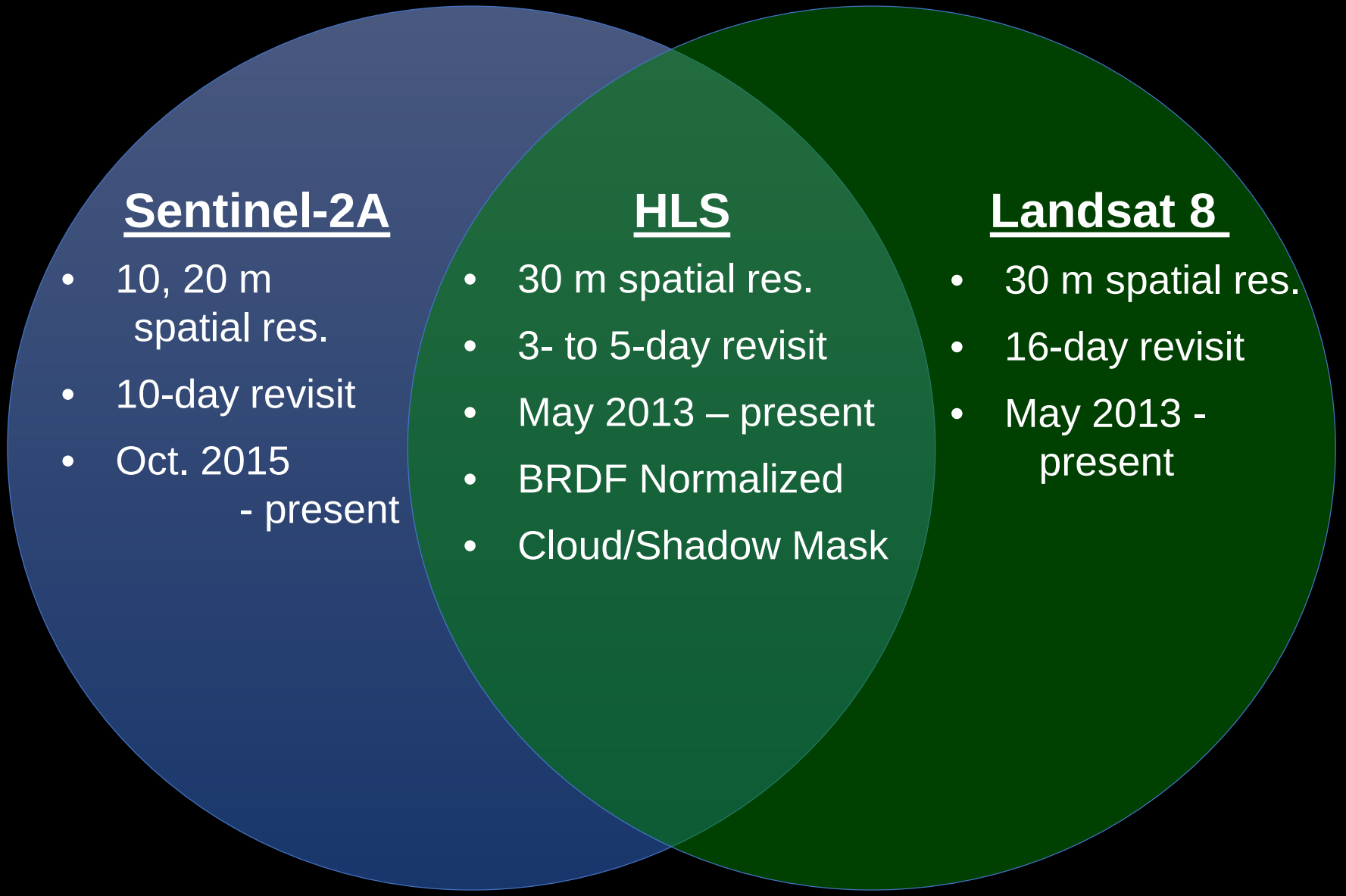
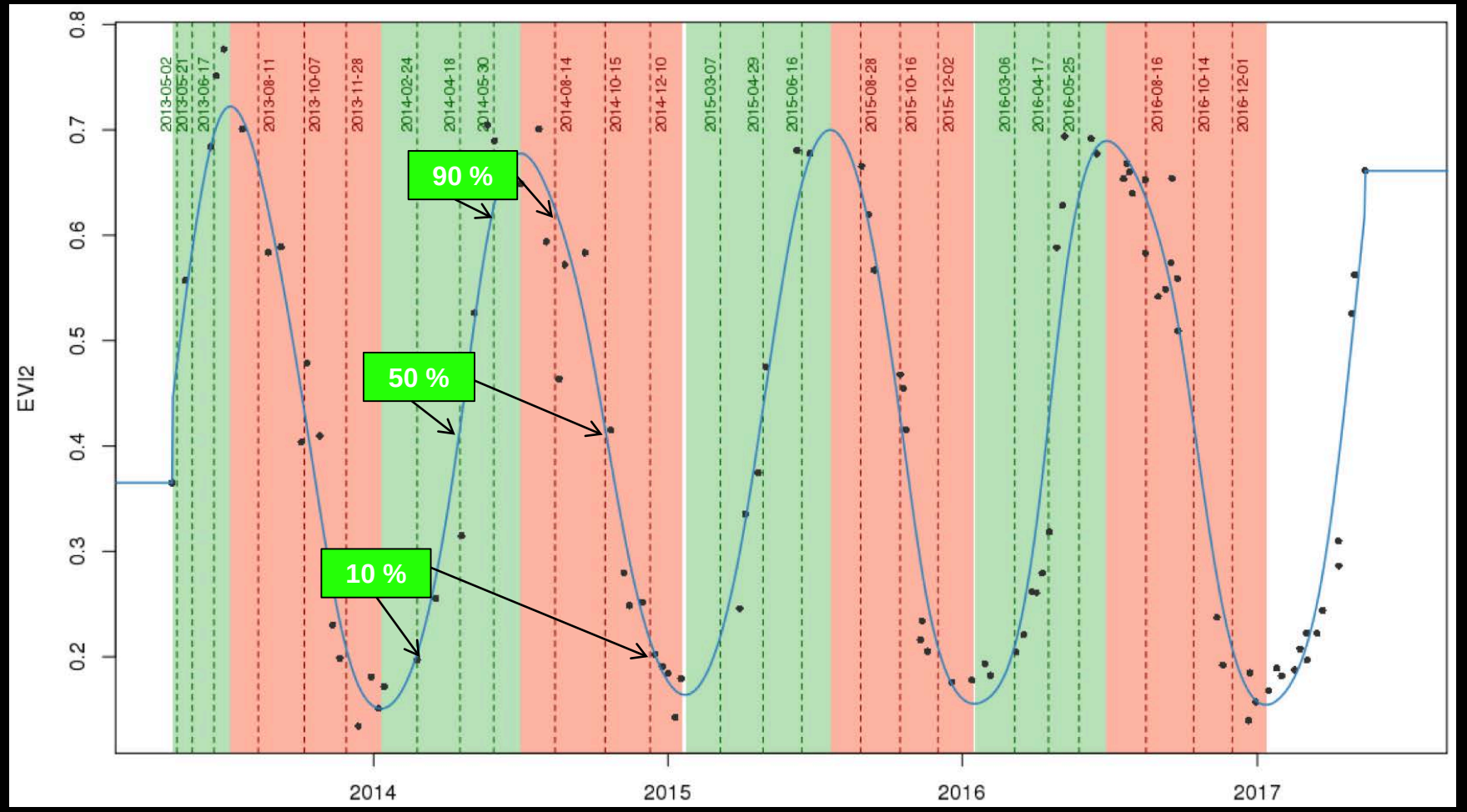
- ***To perform validation and accuracy assessment, provide documentation related to the algorithm and the uncertainty associated with the product, and to work with the Land Processes Distributed Active Archive Center (LP-DAAC) to distribute the product to the user community.***

Harmonized Landsat Sentinel-2 (HLS)



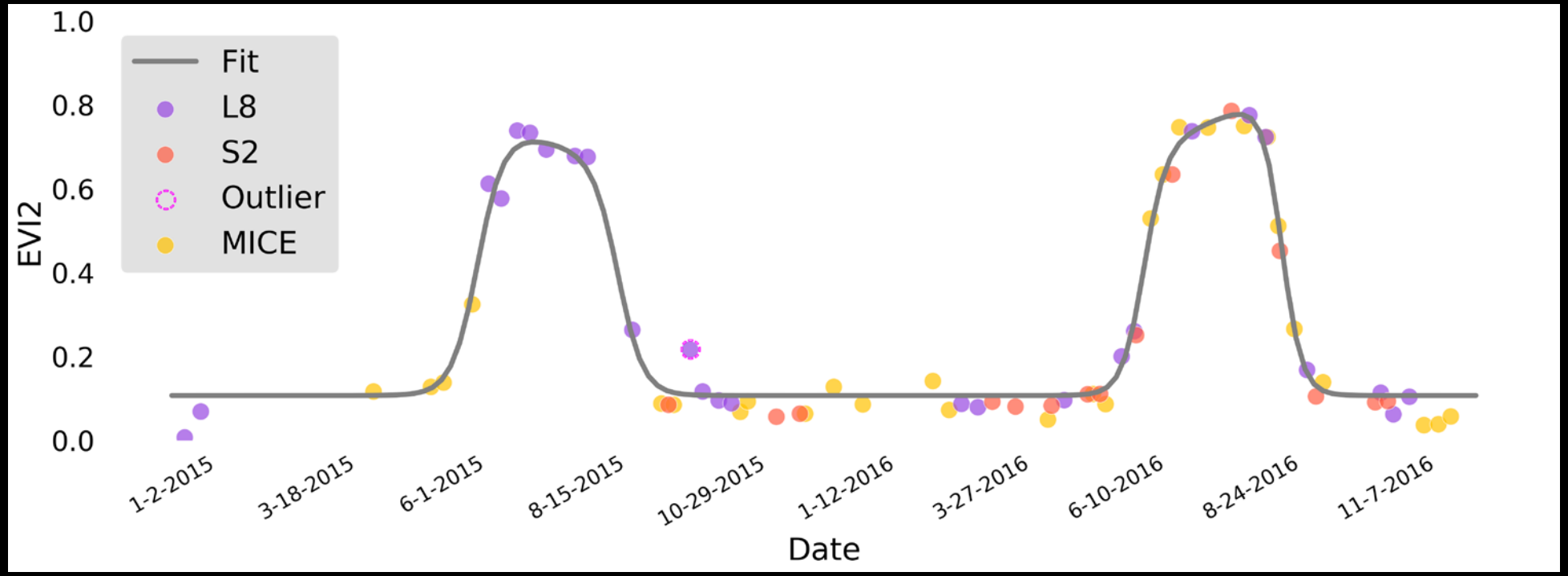
Multisource Land Surface Phenology (MS-LSP)



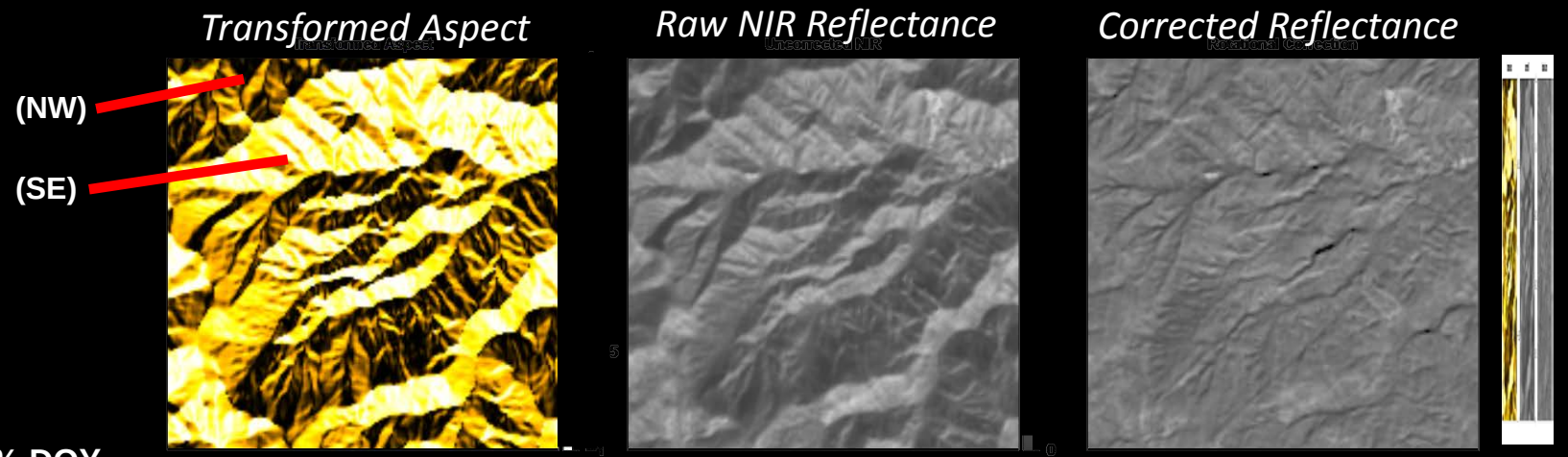
Local vs. Global Fitting Methods: Splines, Double Logistic, Savitzky Golay

Pre-Procesing (1): Gap-Filling/Imputation via MICE

(Multiple Imputation by Chained Equations)

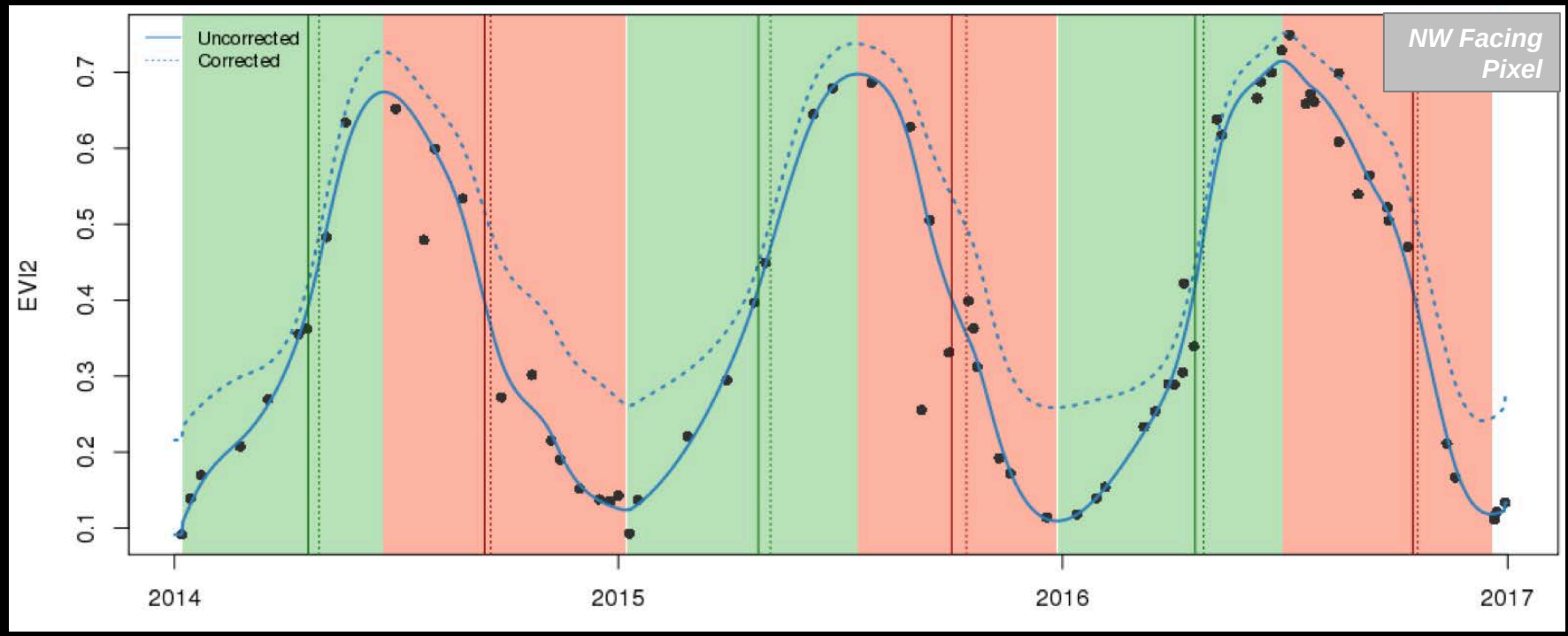


Pre-Procesing(2): Topographic Corrections



Tan et al. 2013

50% DOY difference: 9 d 5 d 10 d 12 d 7 d 4 d

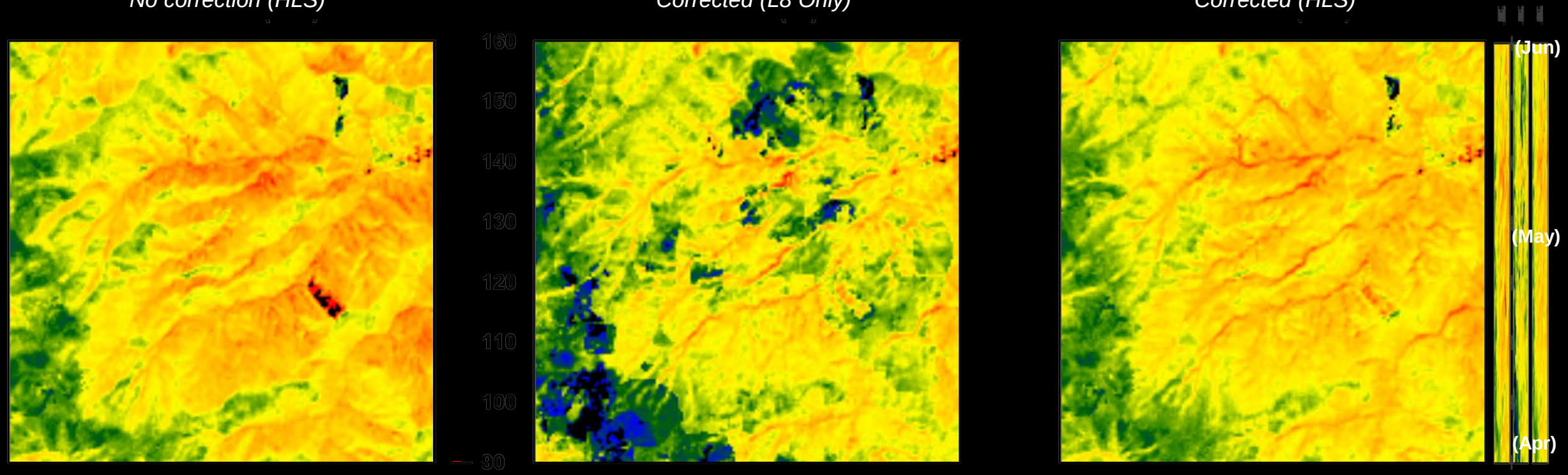


Spring Greenup, Coweeta, 2016

No correction (HLS)

Corrected (L8 Only)

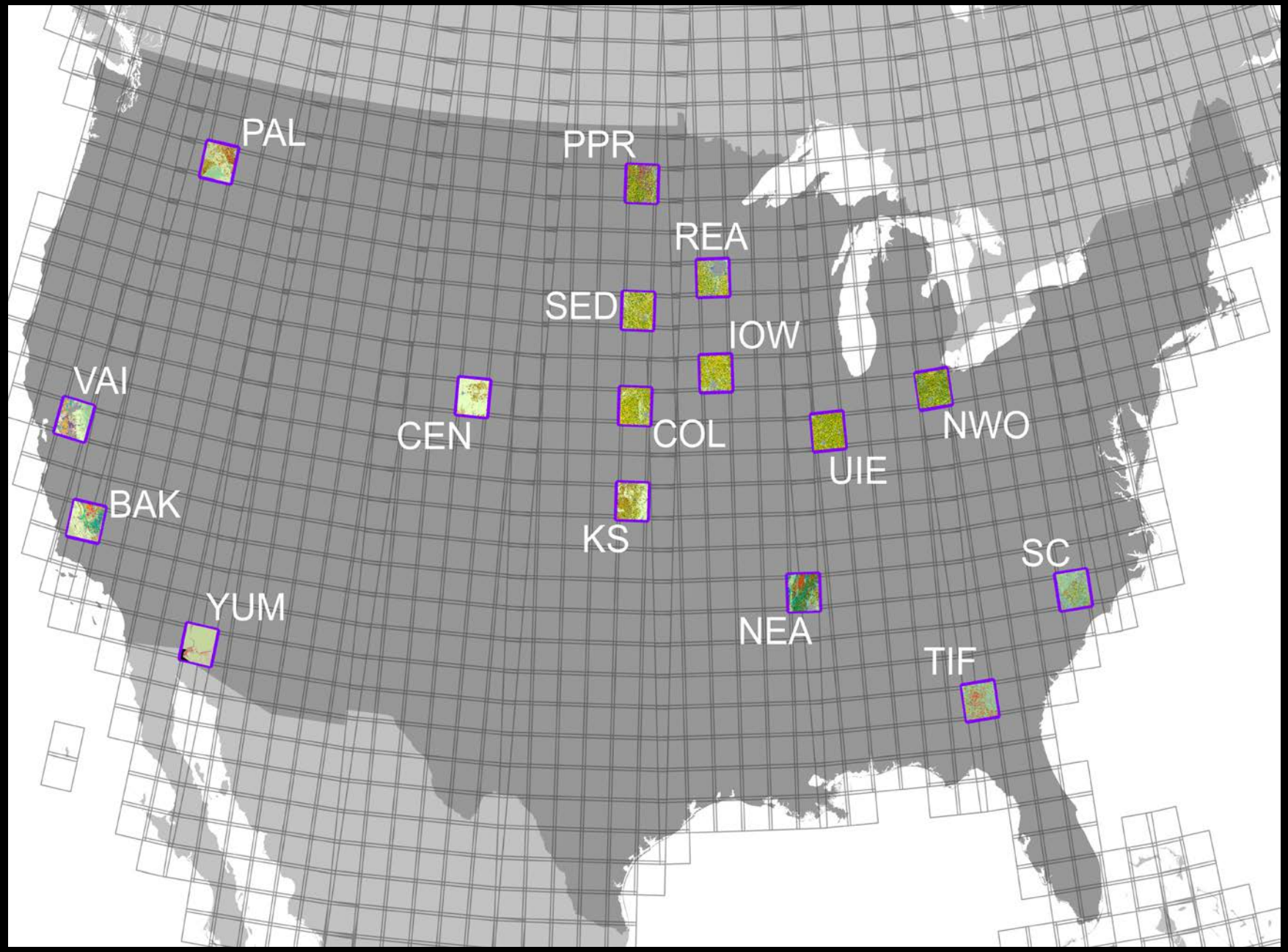
Corrected (HLS)



Sample Results

Cropland Dominated Landscapes

16 HLS Tiles



Sample Results: Eastern Colorado

Blue: DoY 70 — March 10
Green: DoY 170 — June 18
Red: DoY 270 — Sept. 26

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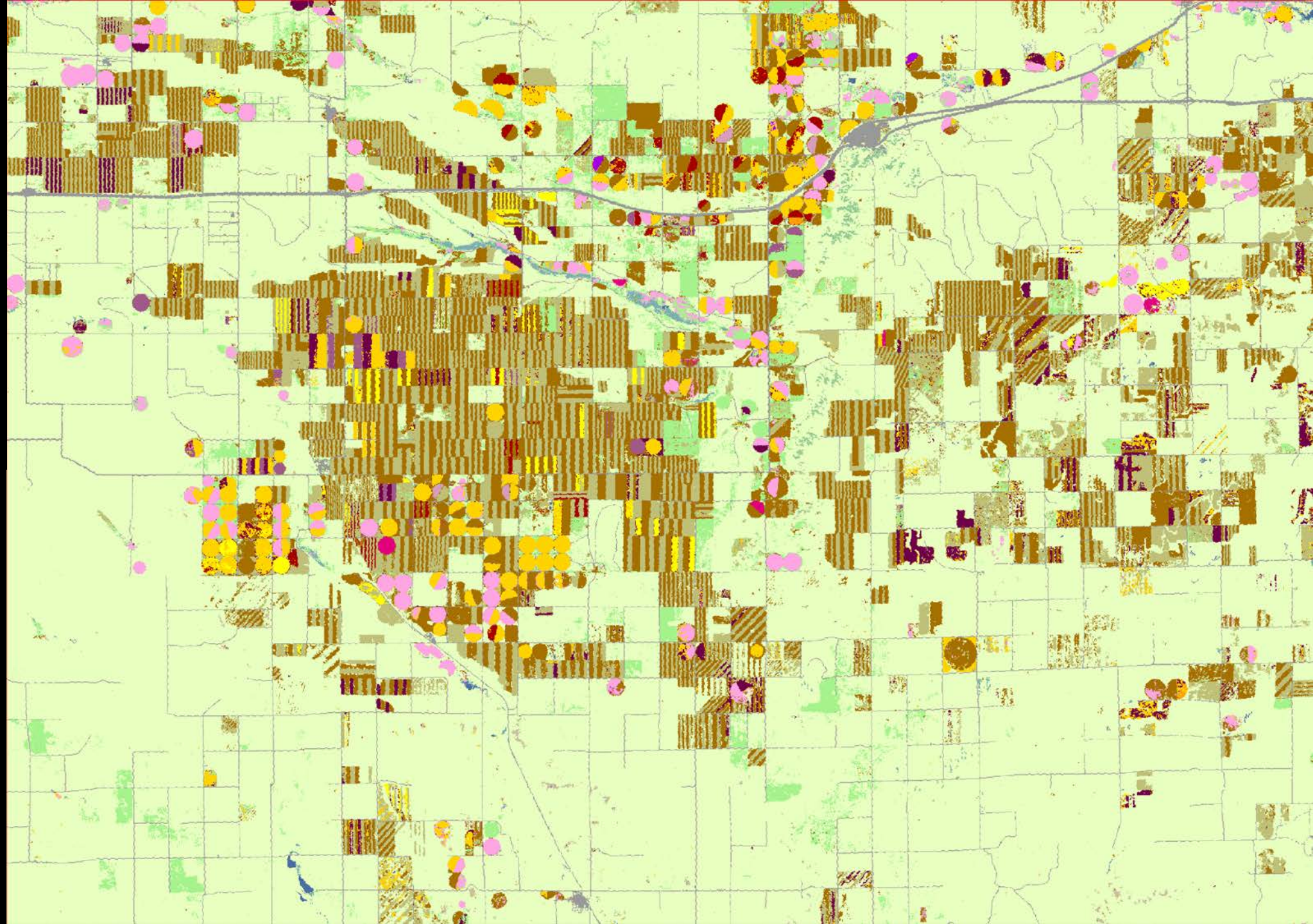

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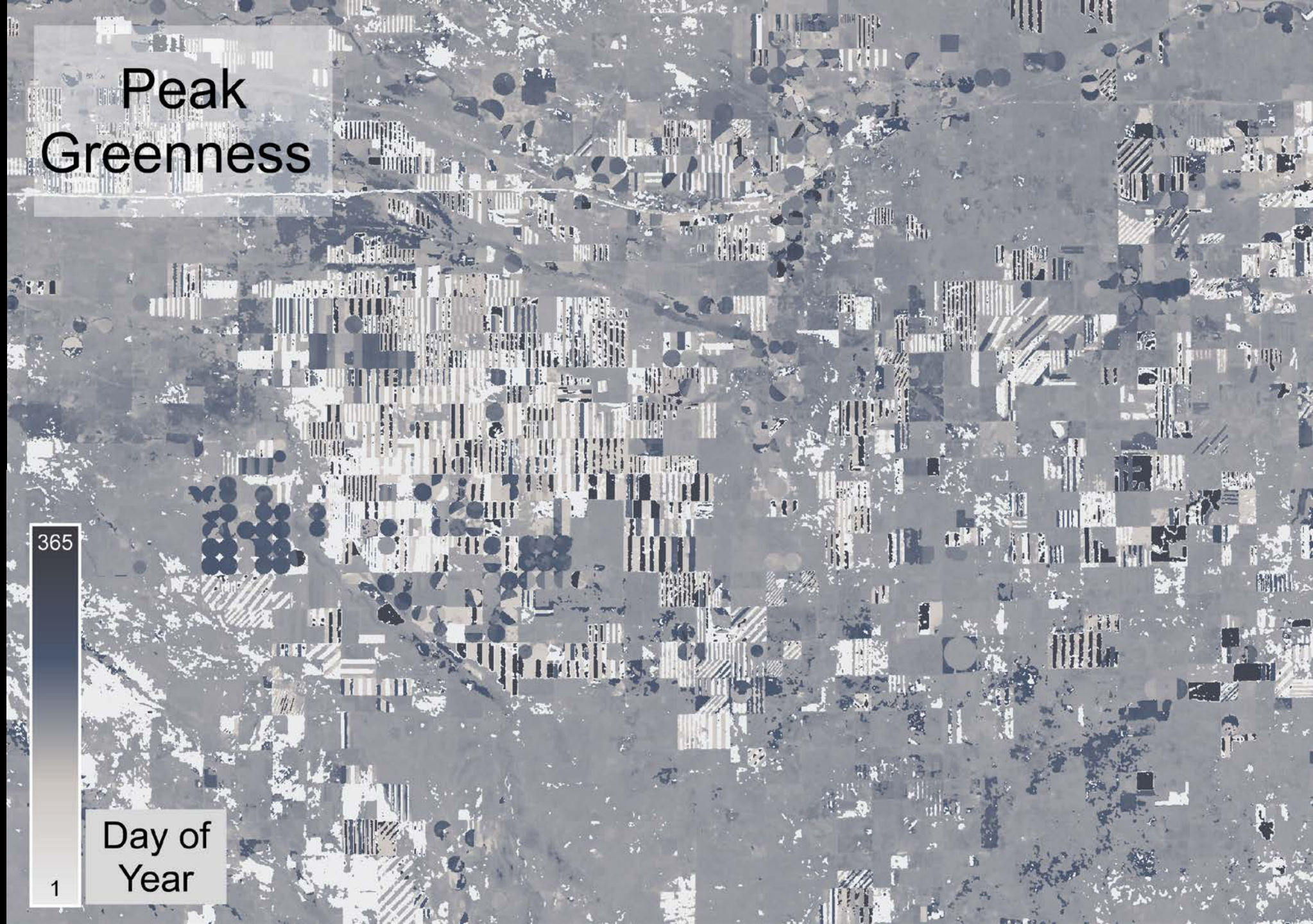
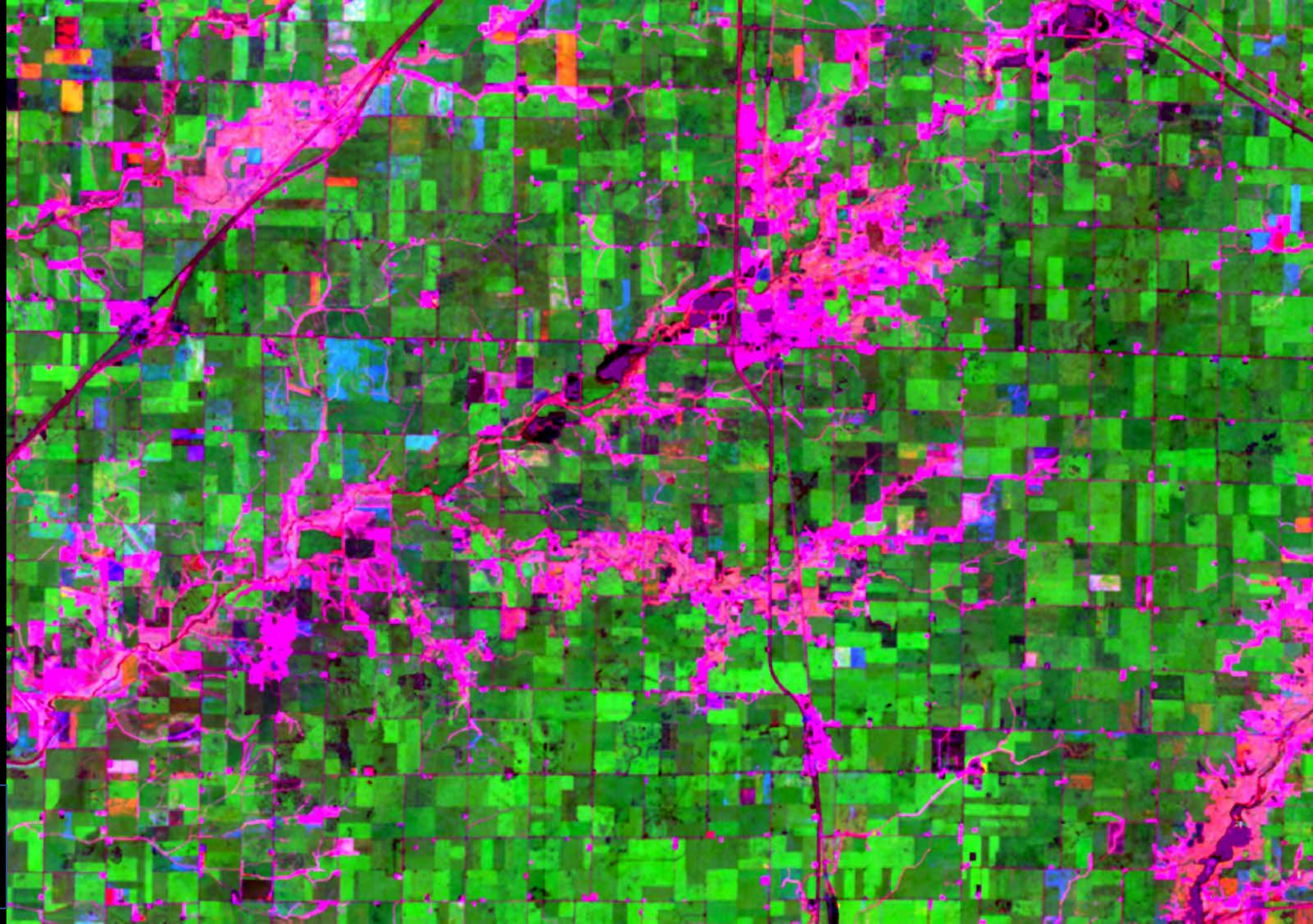


Sample Results: Illinois



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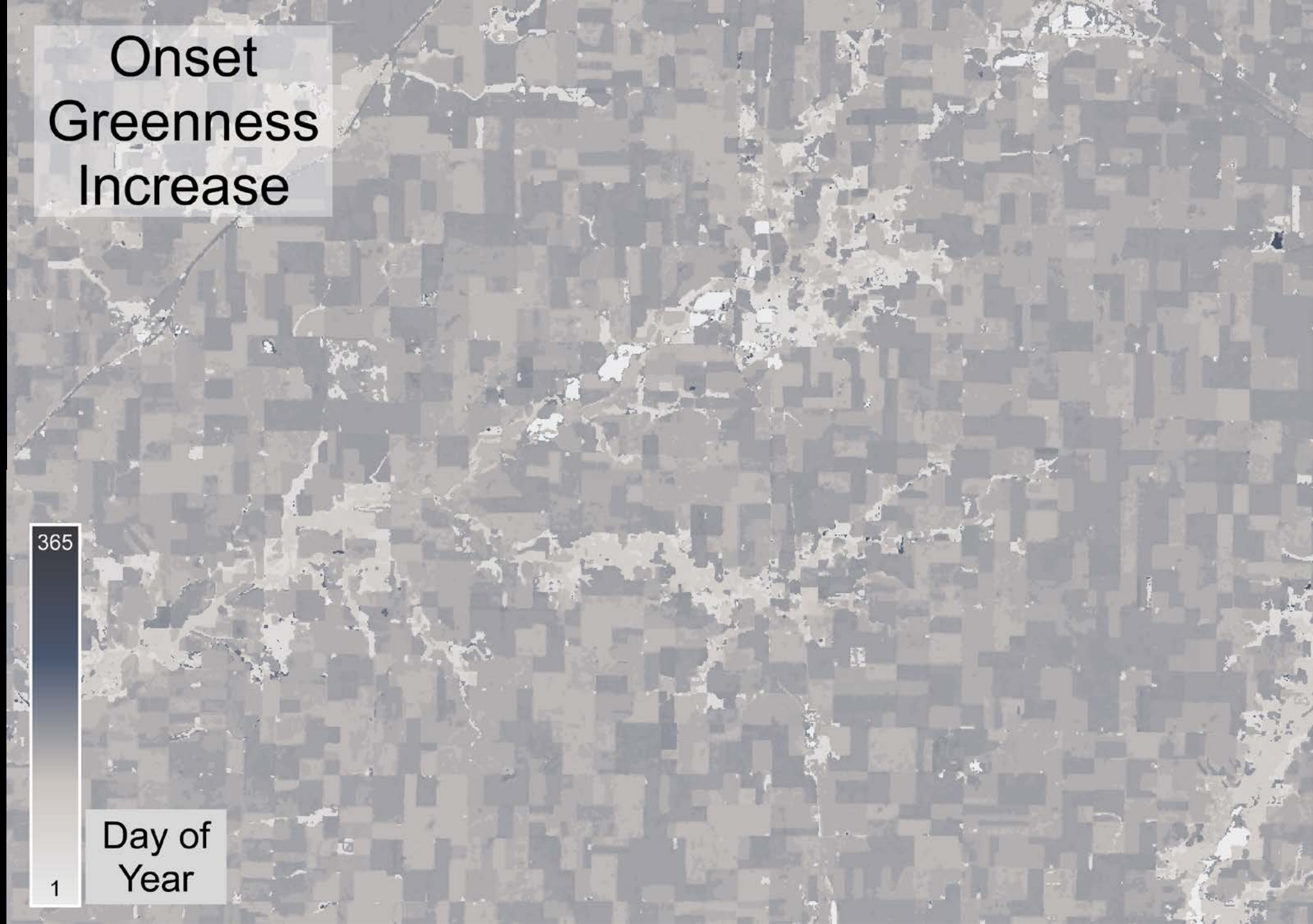

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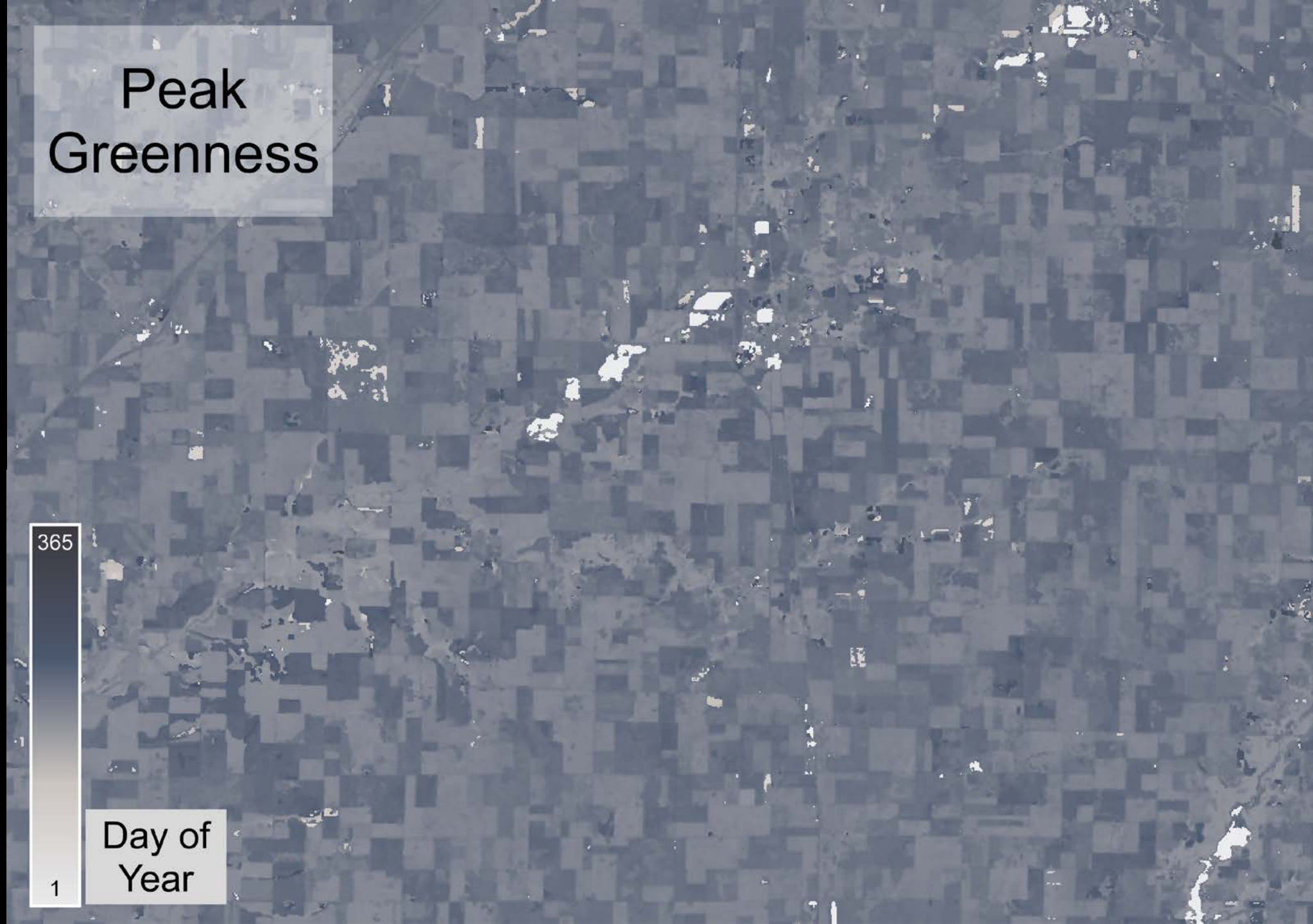
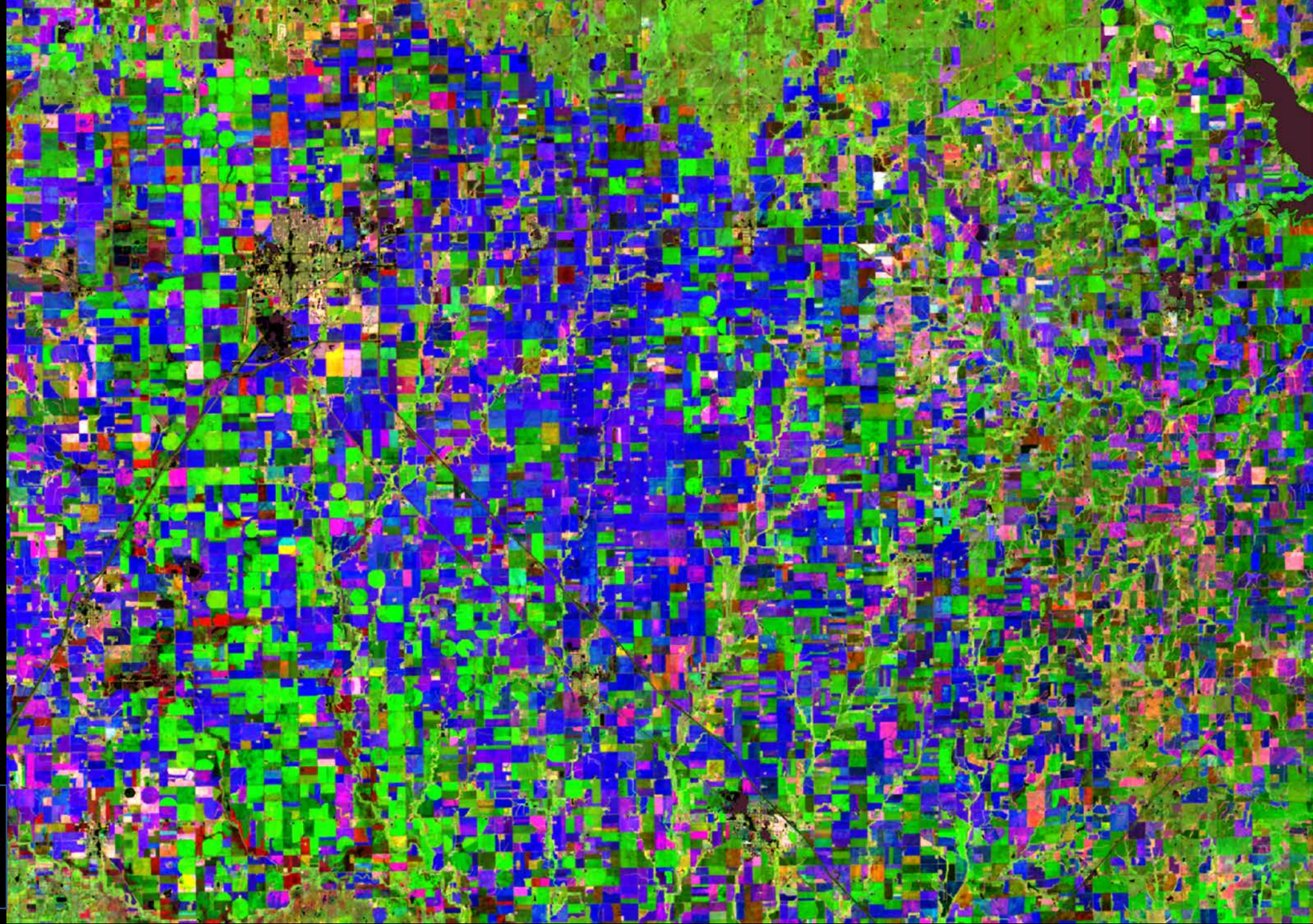


Sample Results: Kansas



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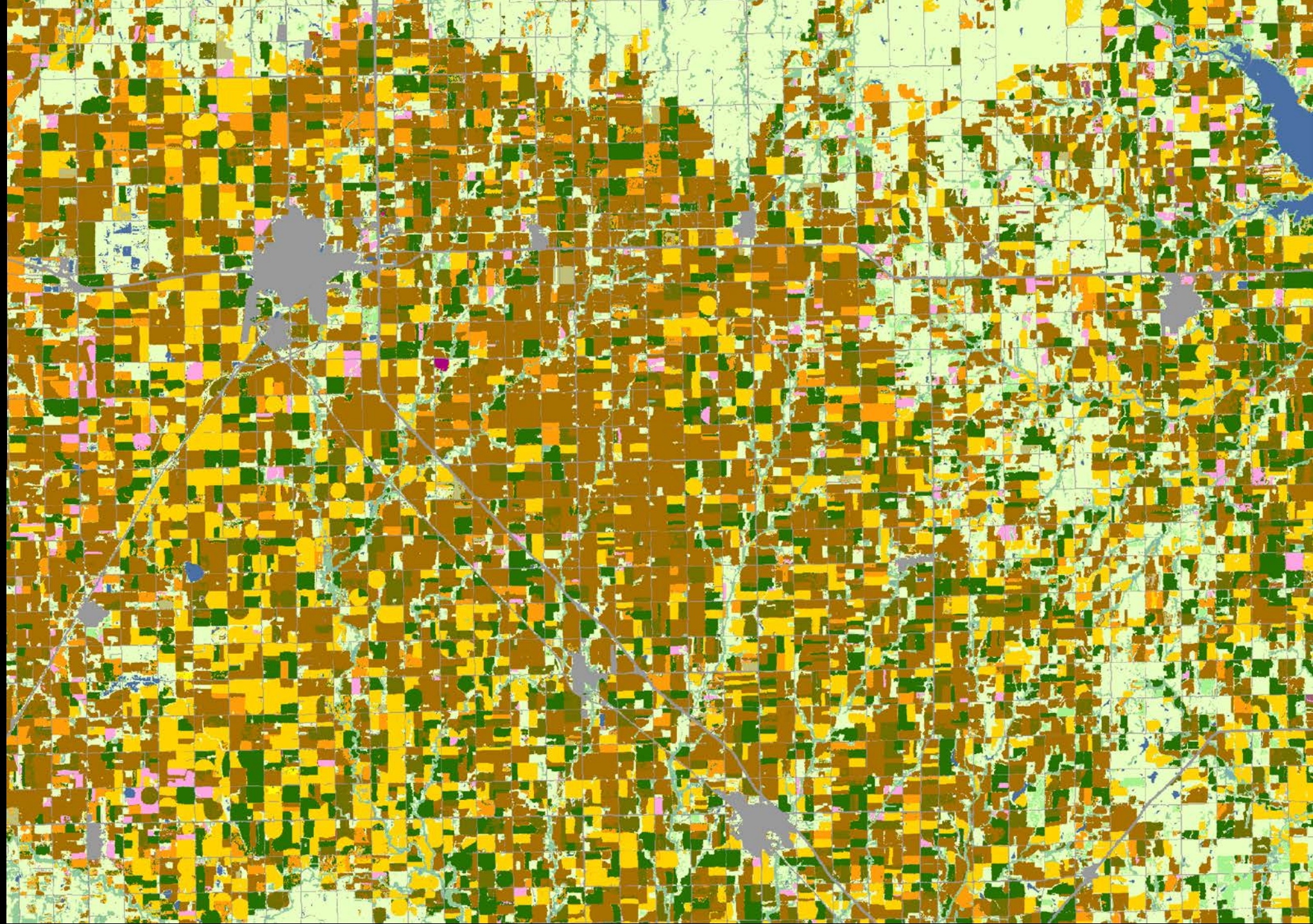
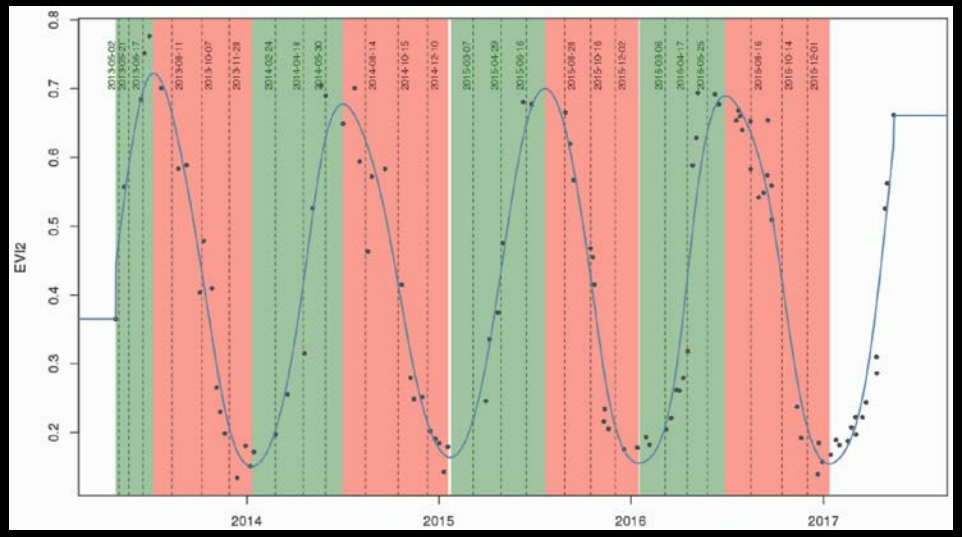


Sample Results: Kansas

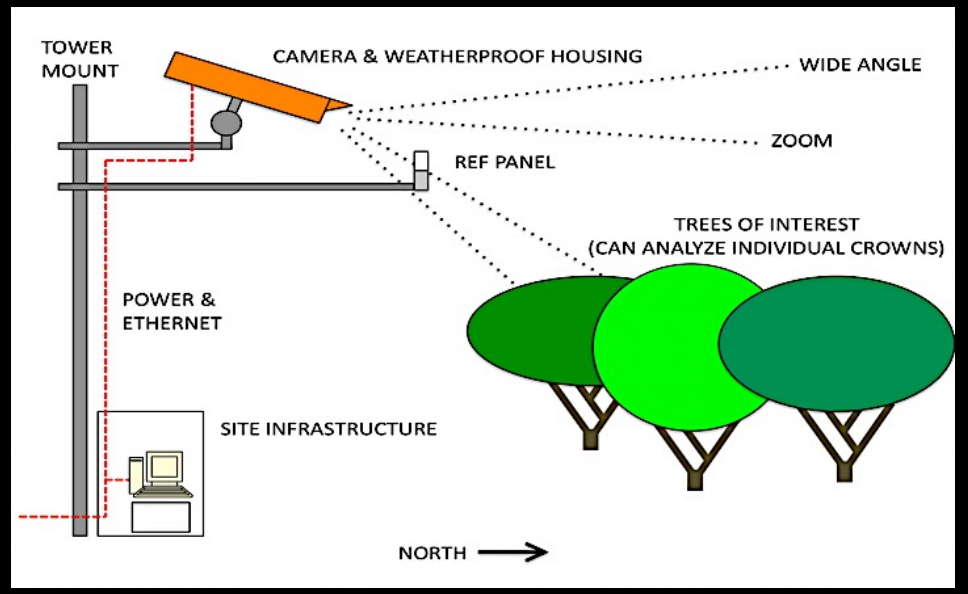
Operational MS-LSP Product

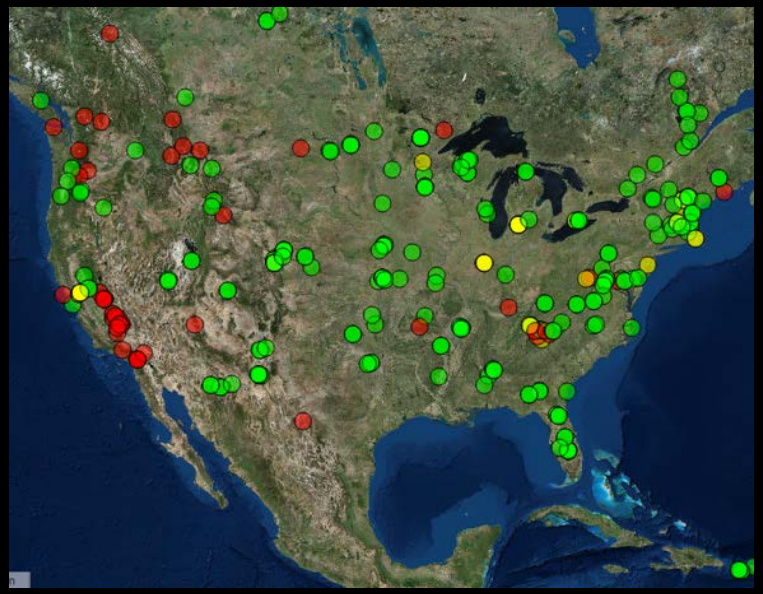
Distributed via LP-DAAC

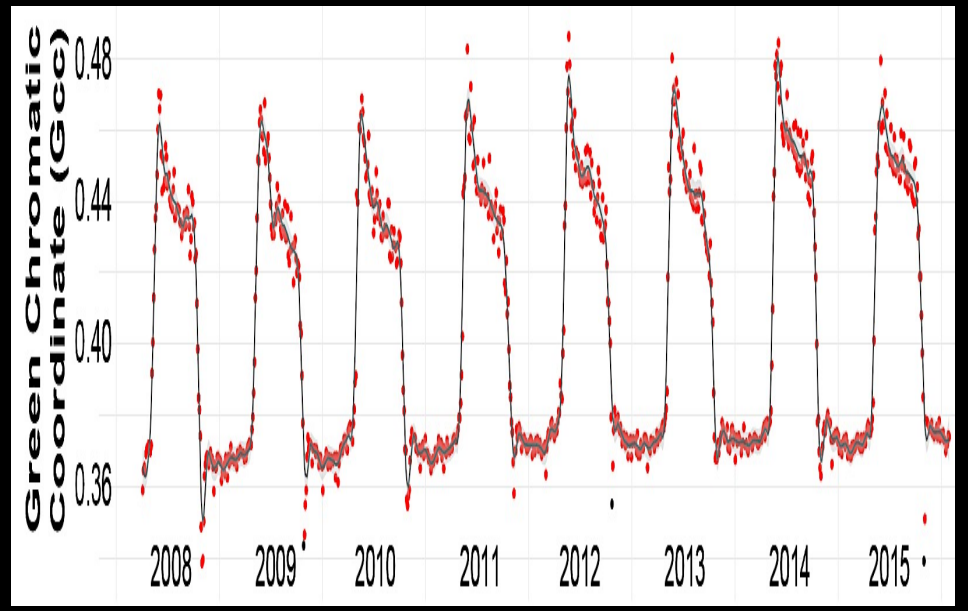


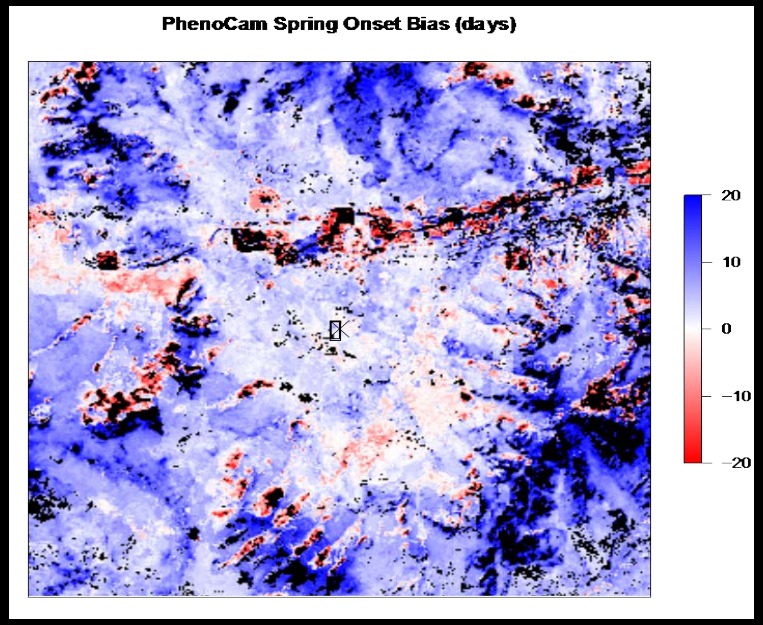
Science Data Set	SDS Description
Reference Date	Accounts for differences in seasonality across hemispheres; Jan 1, 2015 in Northern Hemisphere – see Timing Metrics below
Phenological Timing Metrics	
Onset Greenness Increase (OGI)	Date, number of days from Reference Date
50 Percent Greenness Increase (50PCGI)	Date, number of days from Reference Date
Onset Greenness Maximum (OGMx)	Date, number of days from Reference Date
Onset Greenness Decrease (OGD)	Date, number of days from Reference Date
50 Percent Greenness Decrease (50PCGD)	Date, number of days from Reference Date
Onset Greenness Minimum (OGMn)	Date, number of days from Reference Date
Integrated Greenness	Sum of daily EVI during growing season
HLS Reflectance Metrics	
HLS Reflectance on OGI Date	Bands 1-6 HLS surface reflectance on OGI date
HLS Reflectance on 50PCGI Date	Bands 1-6 HLS surface reflectance on 50PCGI date
HLS Reflectance on OGMx Date	Bands 1-6 HLS surface reflectance on OGMx date
HLS Reflectance on OGD Date	Bands 1-6 HLS surface reflectance on OGD date
HLS Reflectance on 50PCGD Date	Bands 1-6 HLS surface reflectance on 50PCGD date
HLS Reflectance on OGMn Date	Bands 1-6 HLS surface reflectance on OGMn date
LSP Mean and Anomaly Metrics	
Long Term Weekly Mean EVI	Average EVI across available years, at 7-day time steps; Available in 2019.
Weekly EVI Anomaly	In-season anomaly in EVI, relative to long-term mean, at 7-day time steps; Available in 2019.
Cumulative EVI Growing Season Anomaly	Sum of anomalies in daily interpolated EVI versus long-term mean at each pixel; Available in 2019.

Assessment: PhenoCams, NPN









Next Steps

- *HLS 2.0*
- *Addition of Sentinel 2B*
- *Continued prototyping and testing (semi arid, high-latitude systems, etc.)*
- *Deployment in production system*
- *Targeting release of V0 Product in Q2 2019*