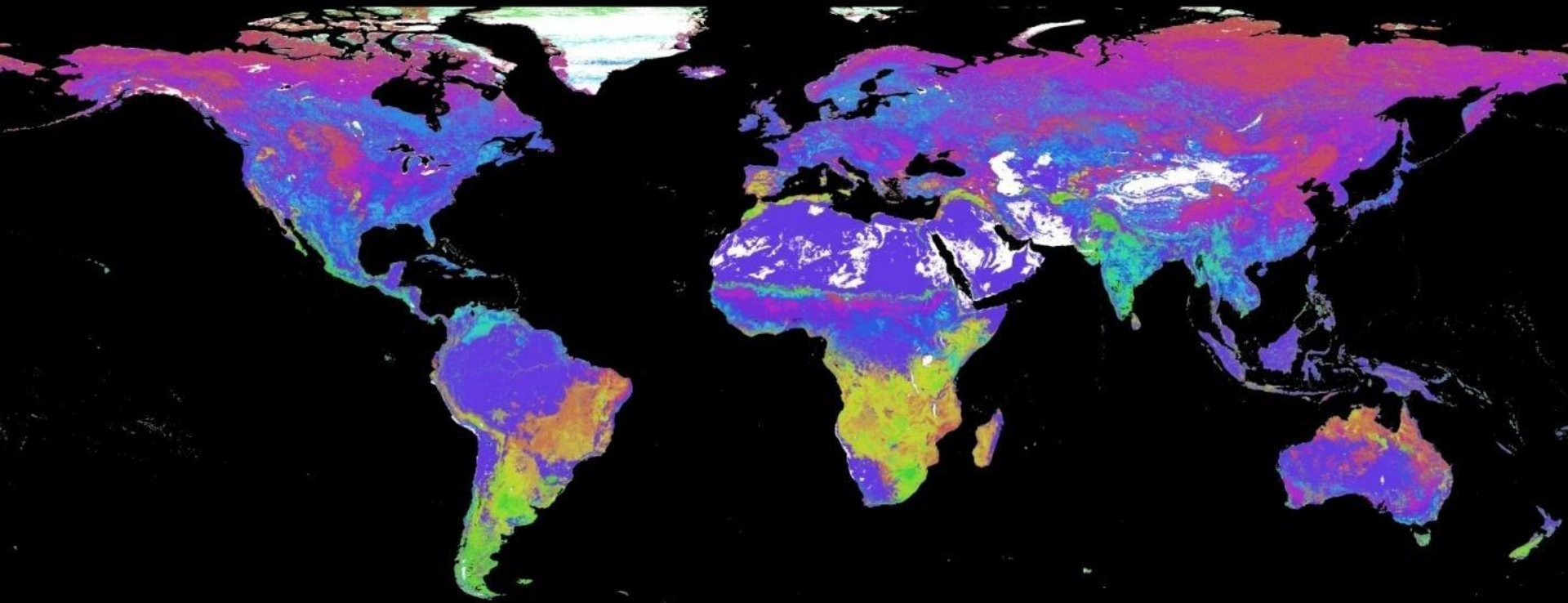


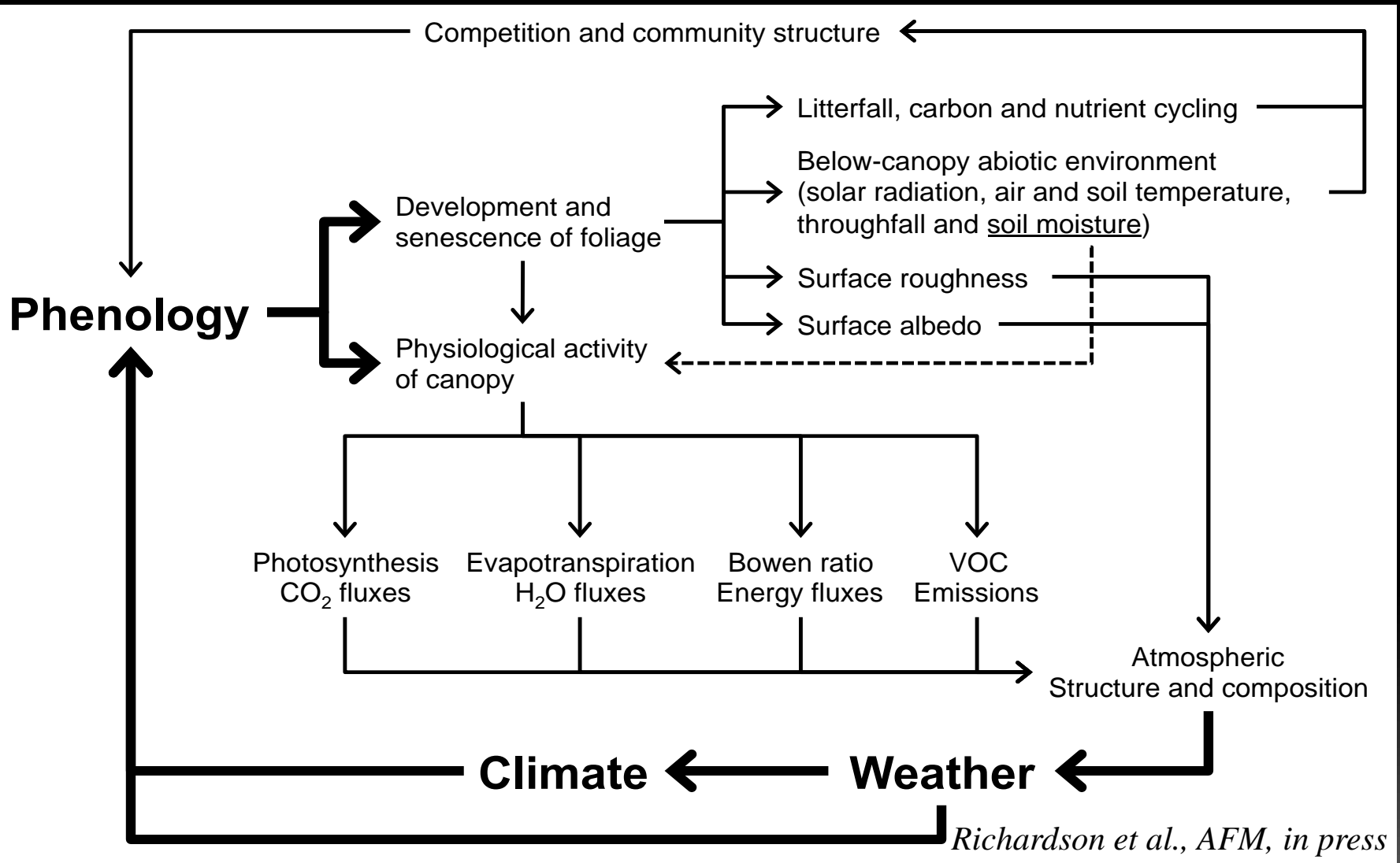
Overview of Progress on the MEaSUREs Phenology Product Assessment

Josh Gray, Mark Friedl, Xiaoyang Zhang, Steve Klosterman



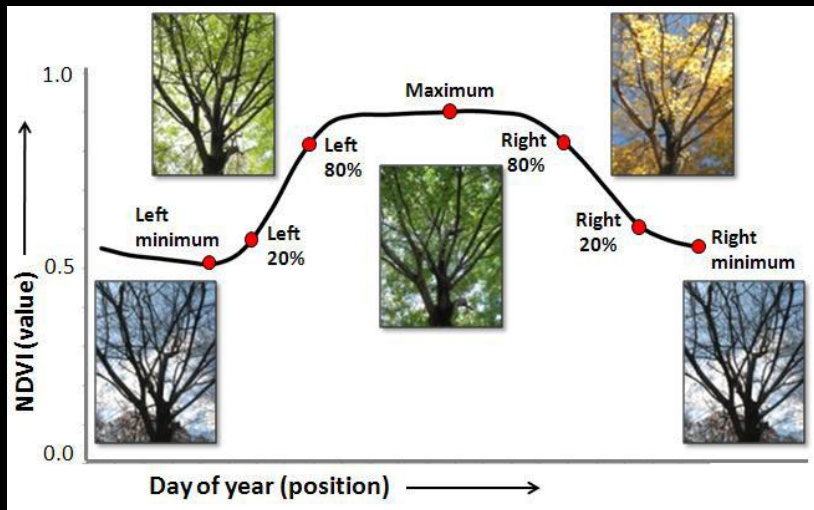
Phenology “is perhaps the simplest process in which to track changes in the ecology of species in response to climate change” (Parry et al., 2007)

Forecasting regional-to-continental scale responses of ecosystem processes, and associated services, to future climate change represents a “grand challenge” for ecology (Clark et al 2001, Moorcroft et al 2006)

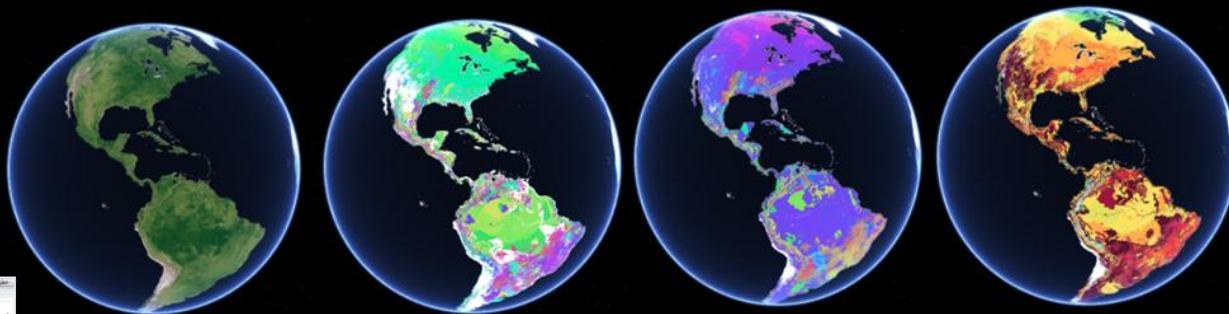
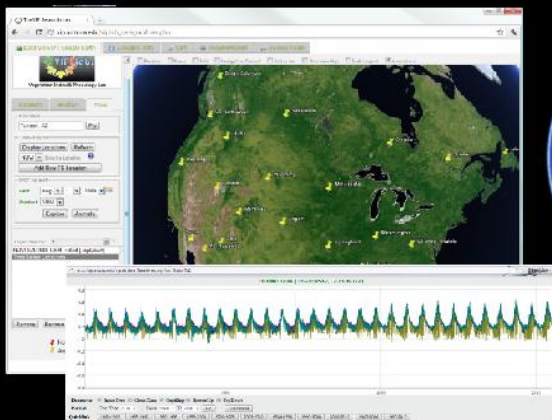
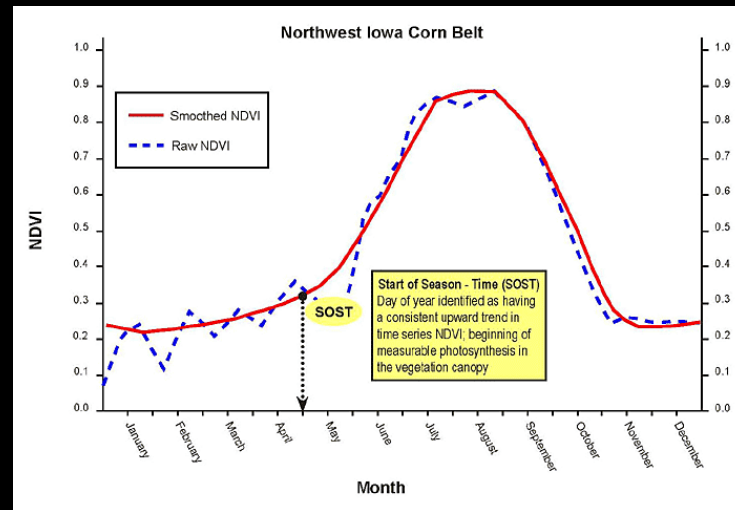




USFS ForWarn Phenology



USGS Phenology



VIP ESDR Data Explorer

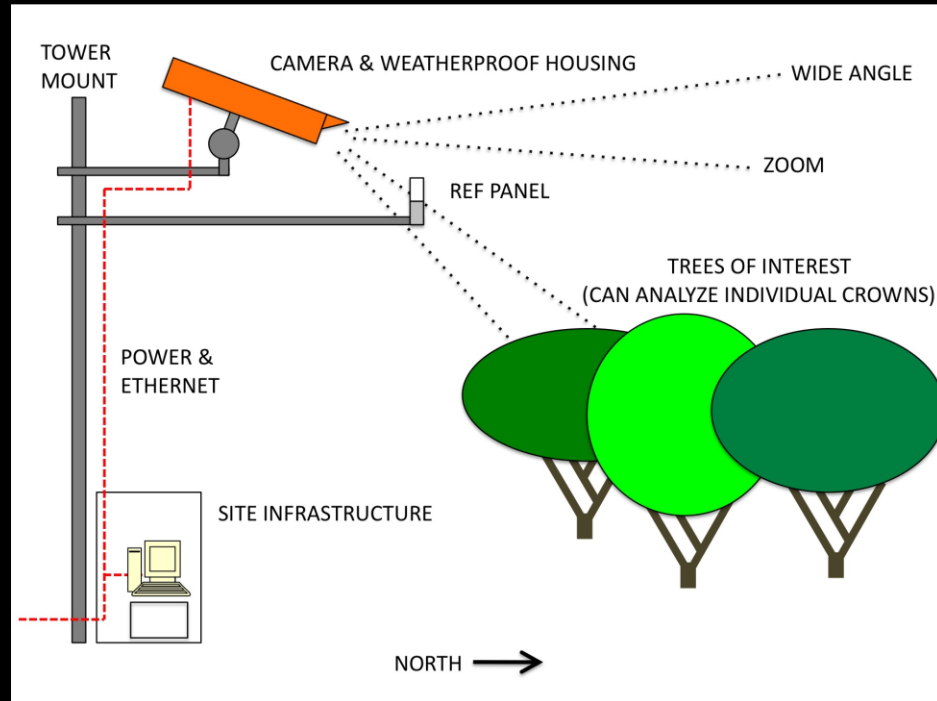
V1 and V2 Datasets are available now

The PhenoCam Network



Bartlett TowerCam

06/06/07 12:50:03



Commercial webcam mounted on tower

- *North Facing, 15° below horiz. (@core sites)*
- *Landscape integration & Individual crowns*
- *Images recorded between 12-2pm daily*
- *Provides a permanent visual record*

Harvard Forest, late April



Harvard Forest, mid-May



Harvard Forest, late June



Harvard Forest, mid-August



Harvard Forest, mid-October



Not Just Seasonal Variation...



Harvard Forest - April 20, 2012



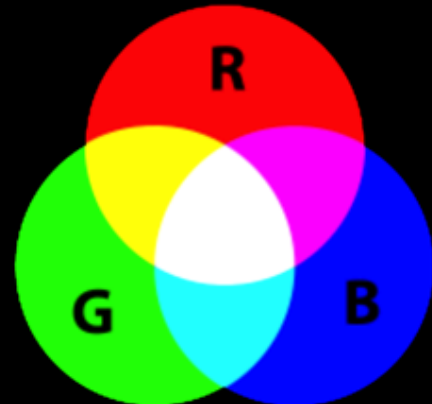
Boston Common - April 20, 2012

60 "core" sites + 75 "affiliate" cameras covering most ecoregions of North America (incl. AK & HI)

Core
Affiliated



Extracting Phenology Data From Webcam Images



RGB Color Model

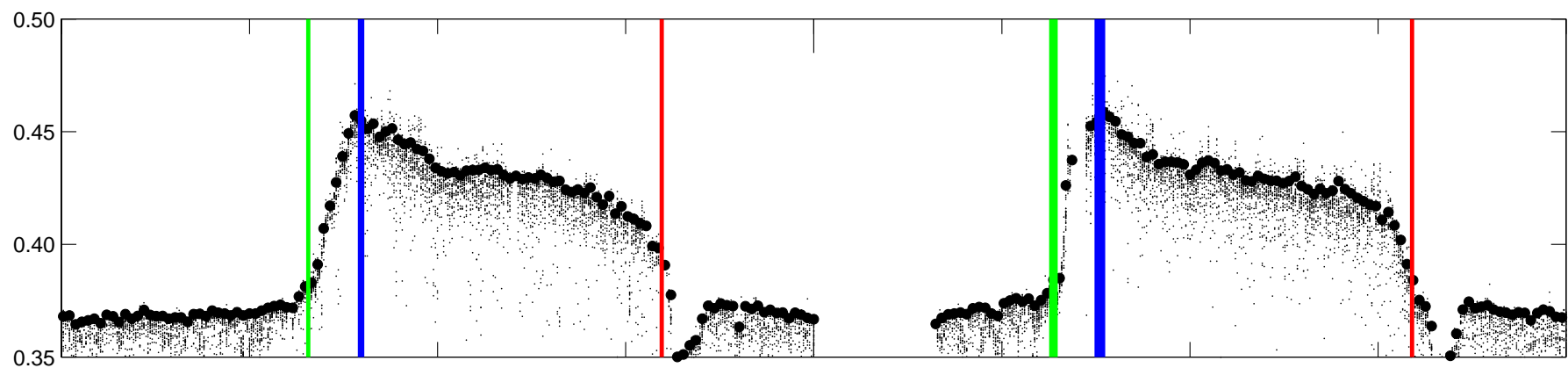
RGB Triplet:

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

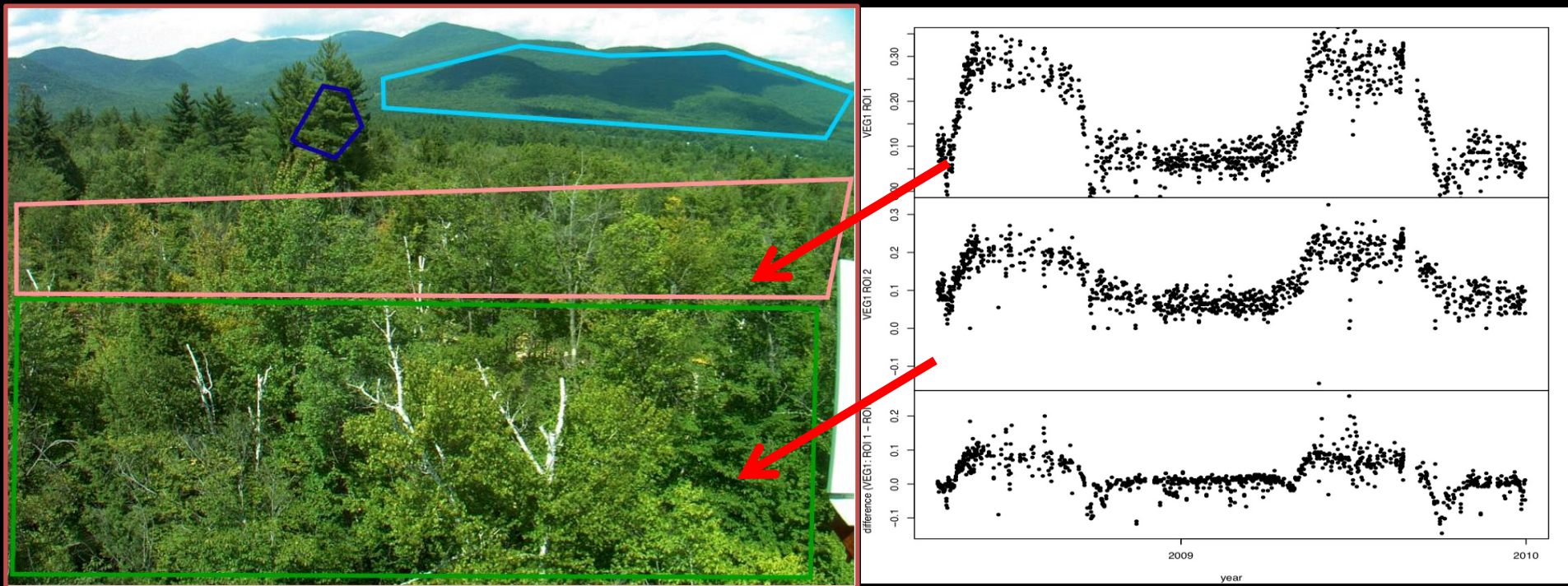


Canopy "Greenness" (GCC)

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



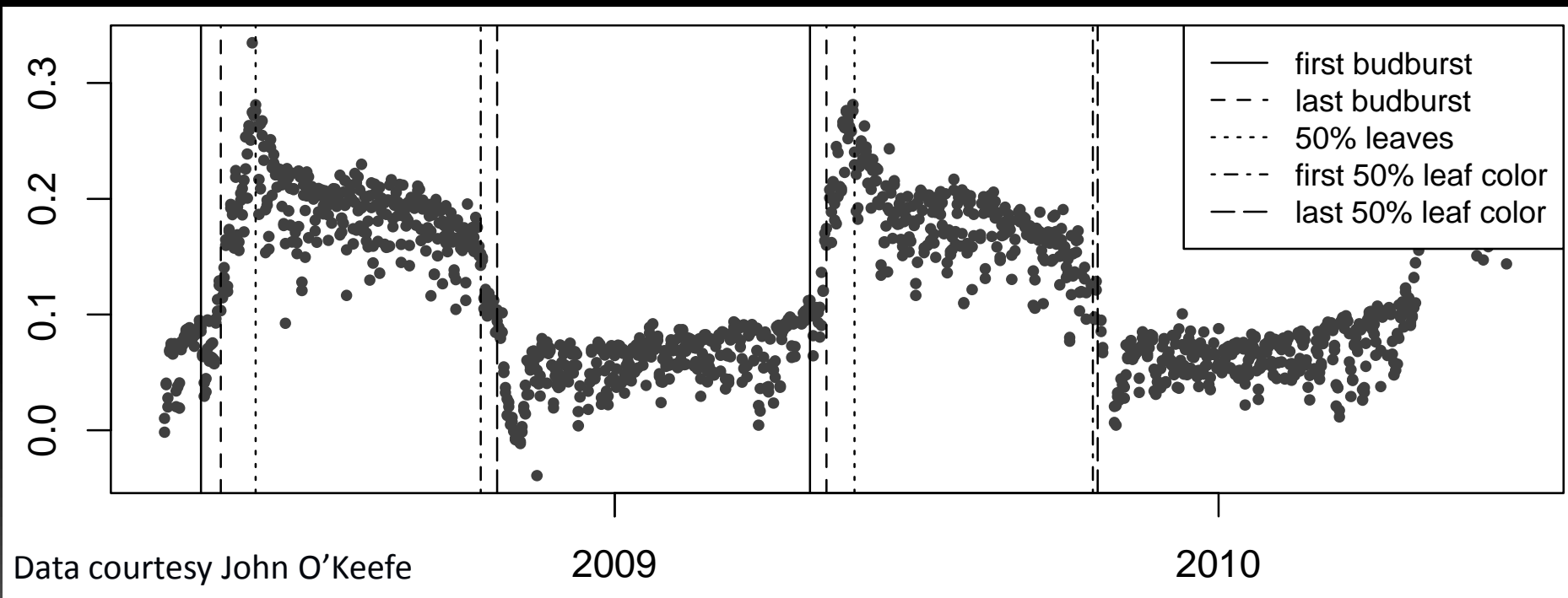
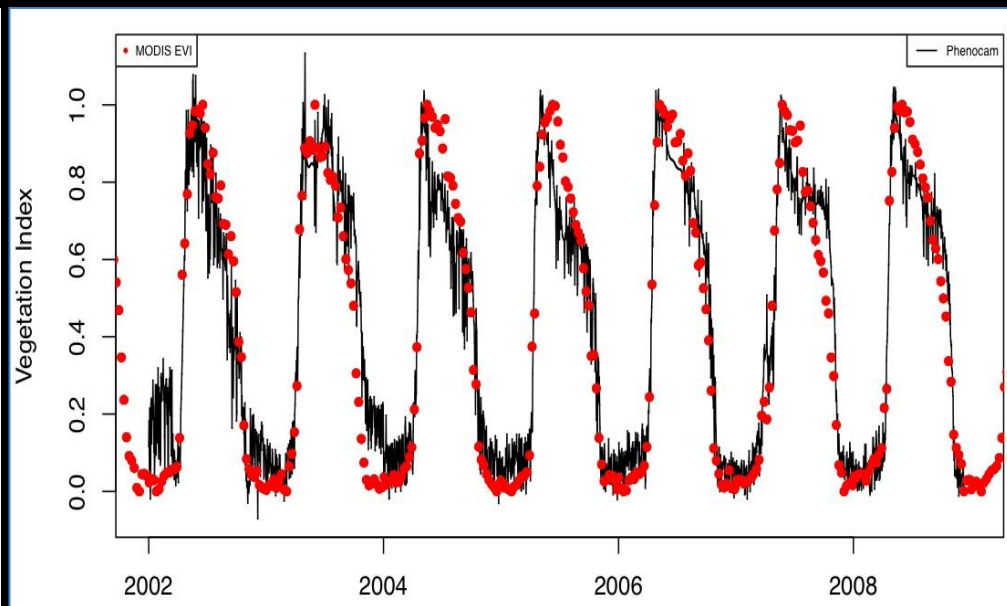
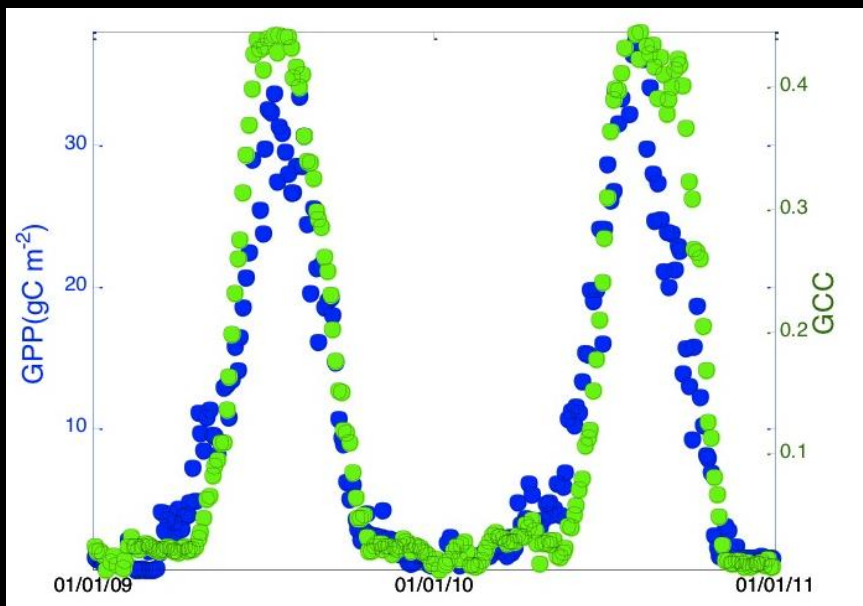
Phenocam Processing: Selecting ROI



Sky, shadow, foreground, background, conifer, broadleaf...

Different ROI's have different VI's values and levels of noise

Selecting representative ROI in foreground improves S/N



Data courtesy John O'Keefe

2009

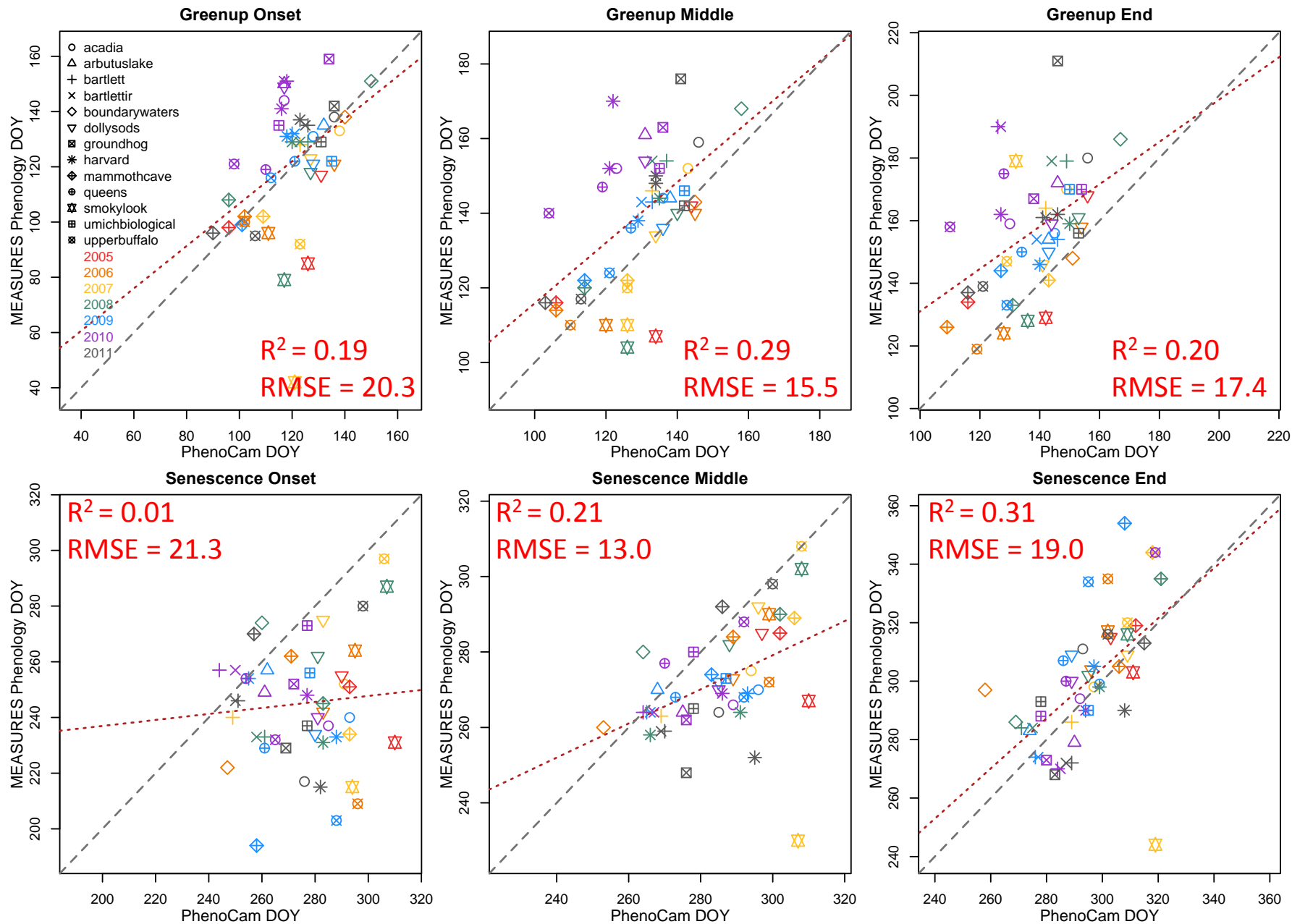
2010



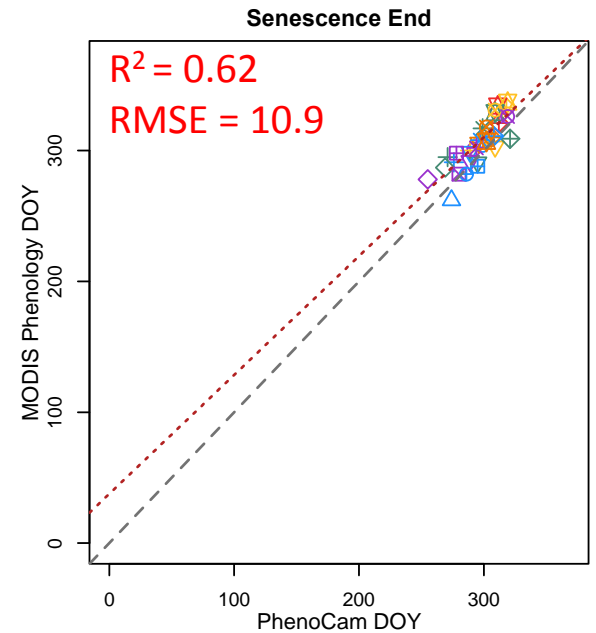
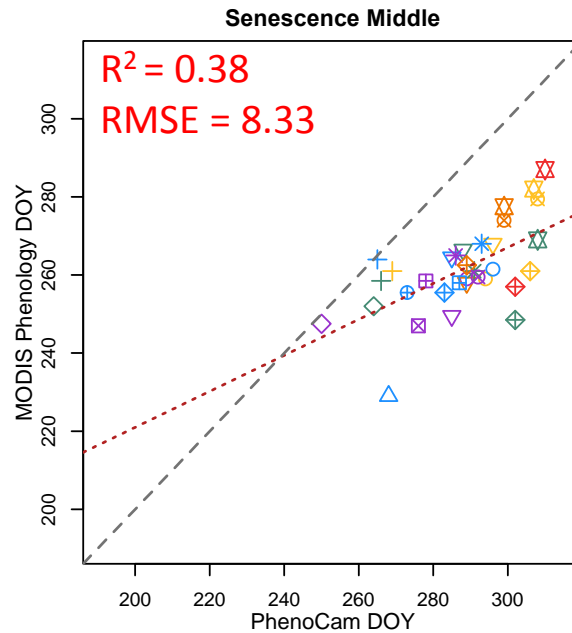
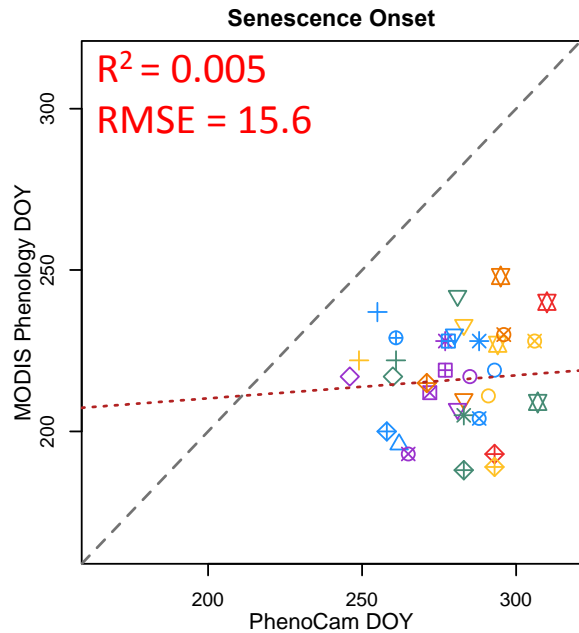
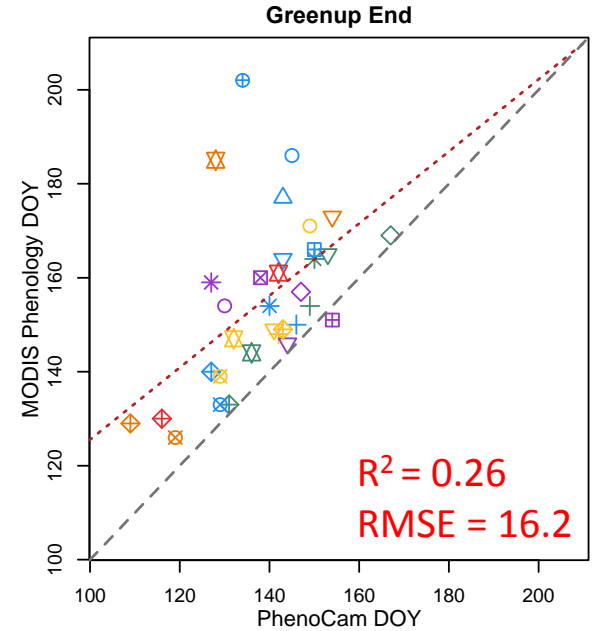
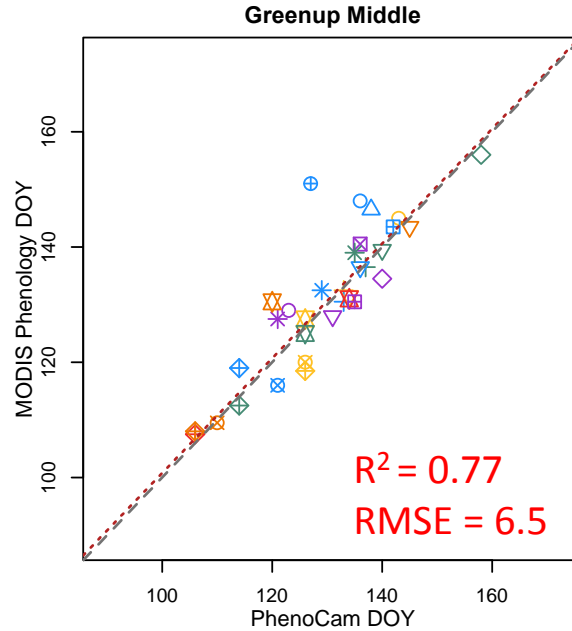
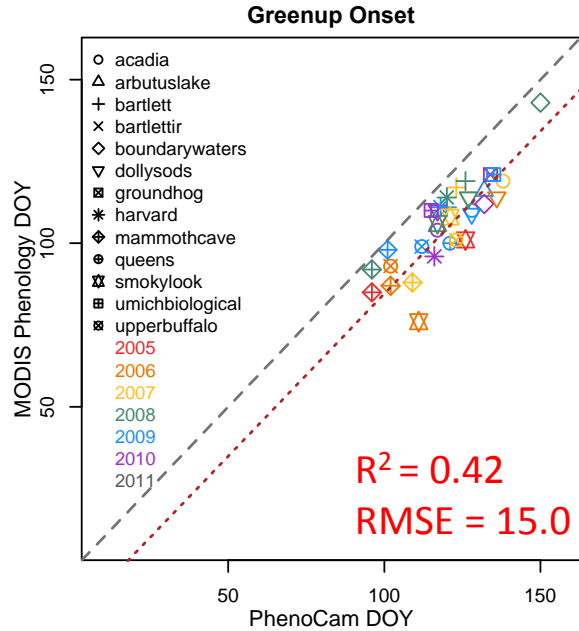
13 PhenoCam sites used for MEaSUREs product assessment



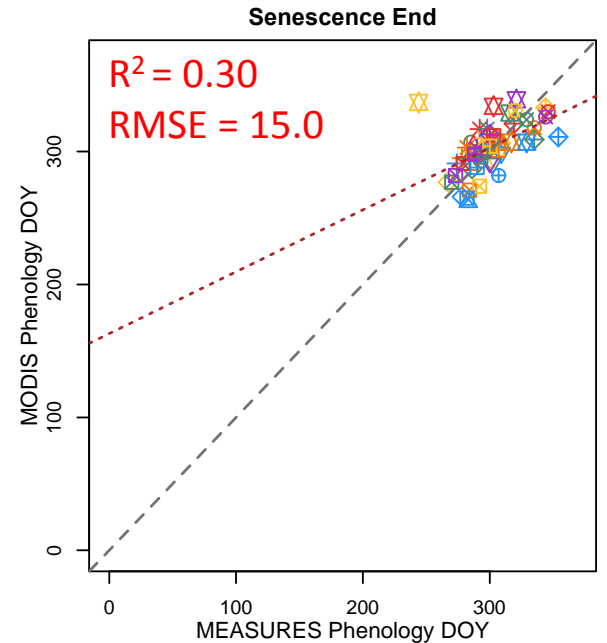
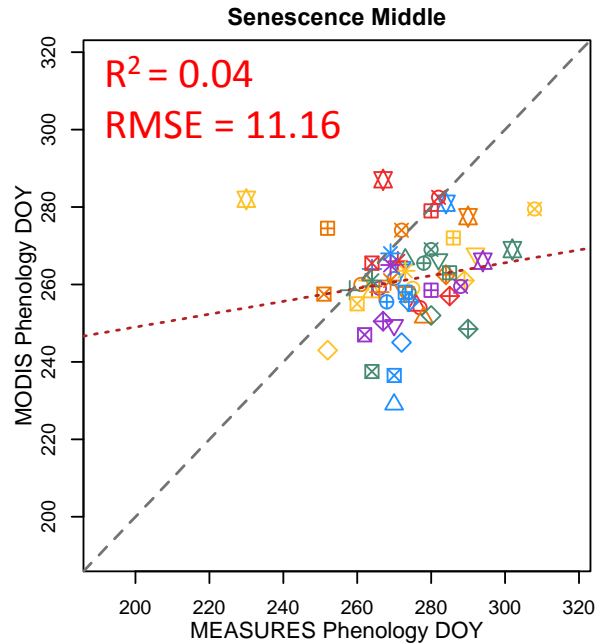
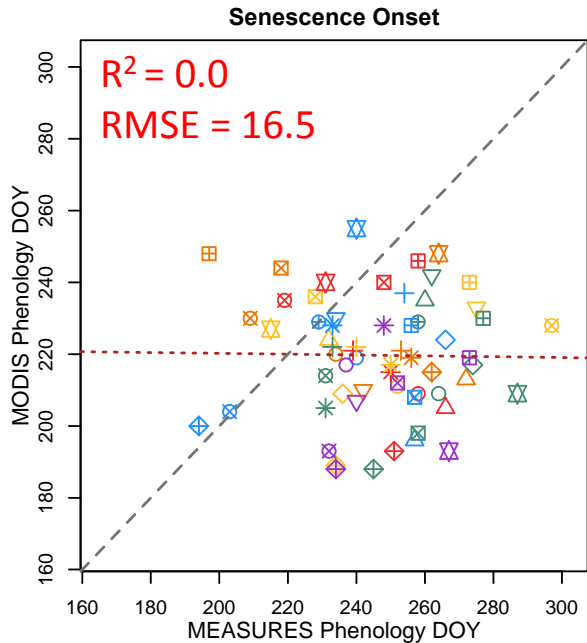
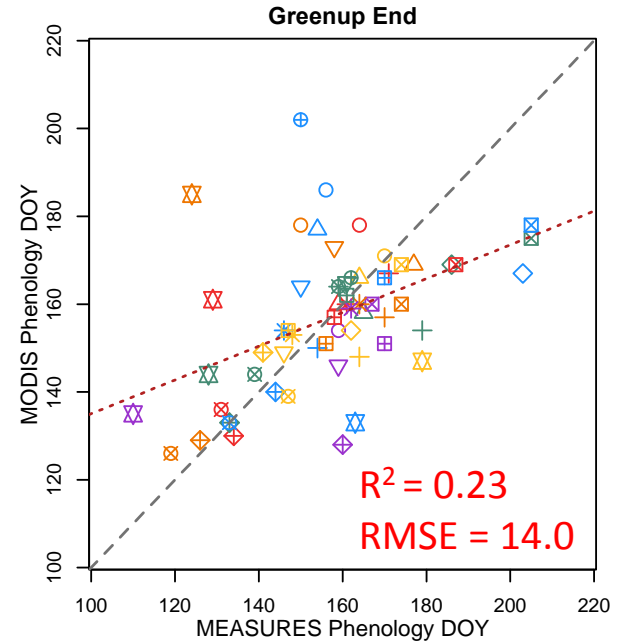
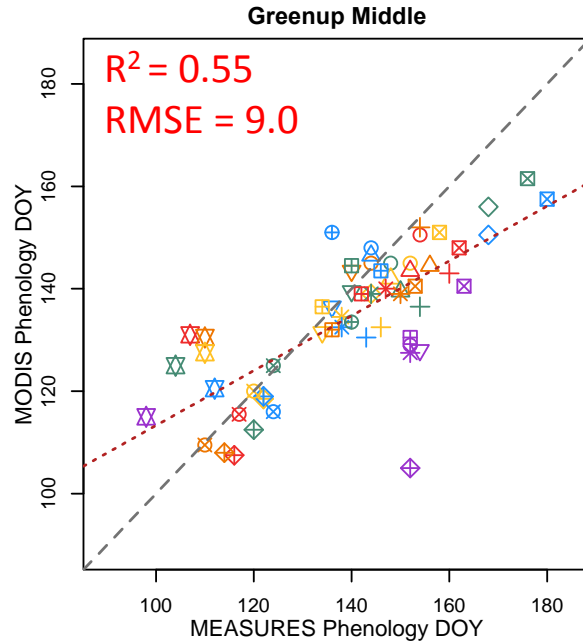
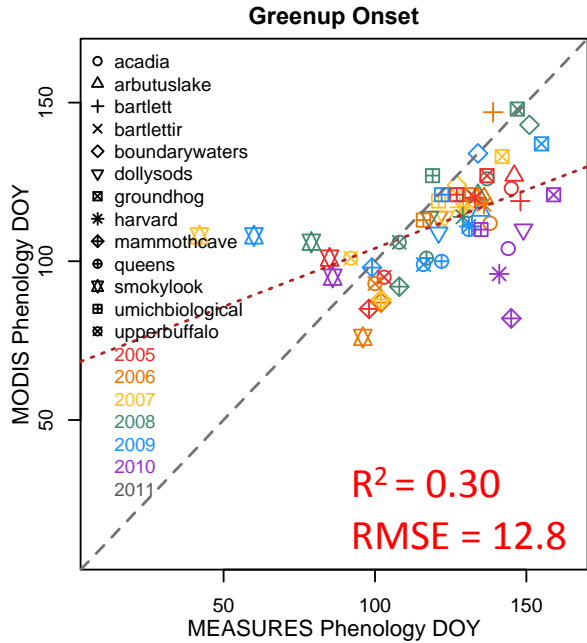
PhenoCam and MEaSUREs



PhenoCam and MODIS



MODIS and MEaSUREs

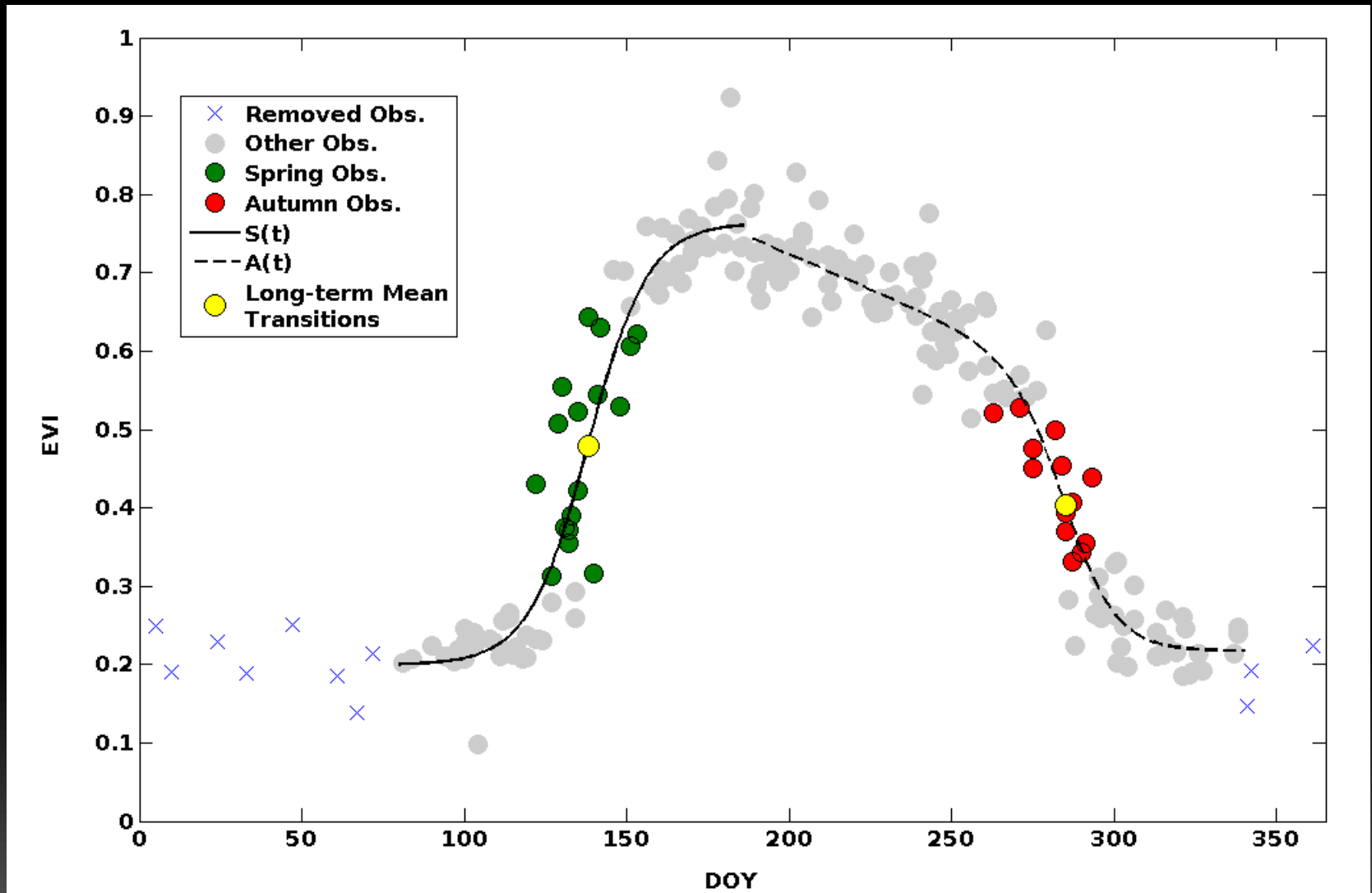


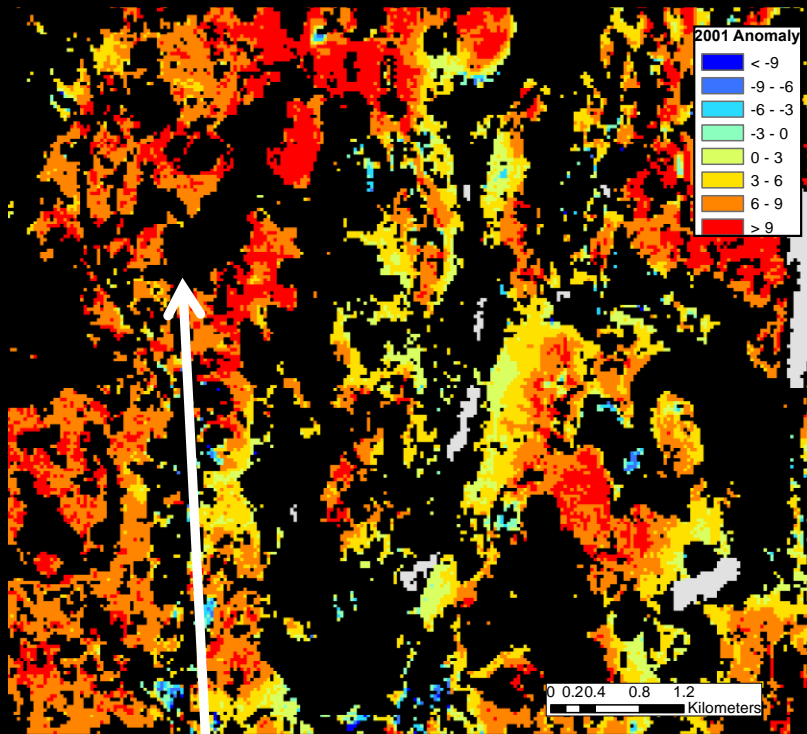
Conclusions

- Good correspondence between PhenoCam and MEaSUREs phenology start of spring metrics
- End of senescence dates also well correlated, but start and middle much poorer
- RMSE around 2 weeks
- *Scale* is the issue

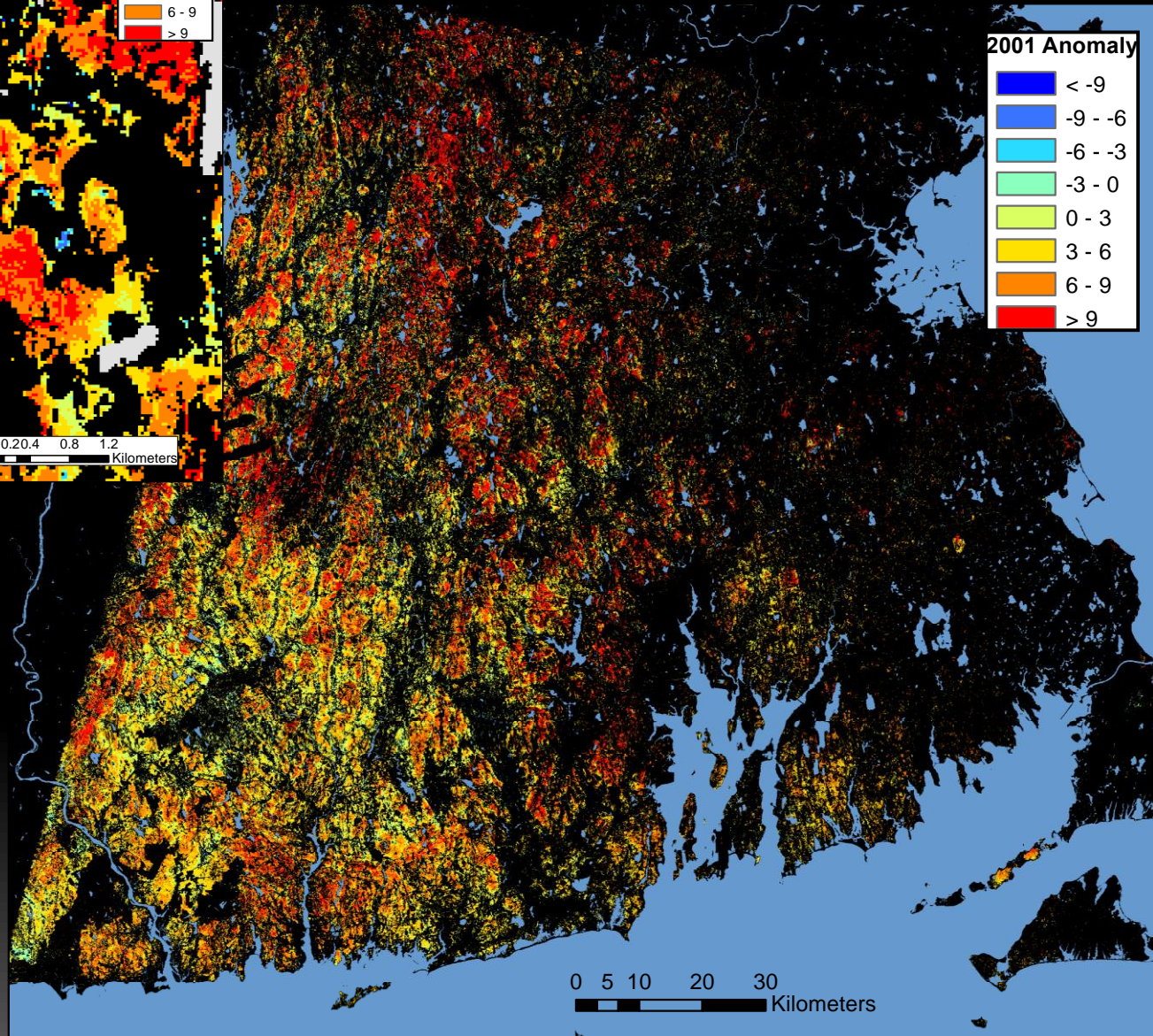


Landsat Phenology: Eli Melaas (BU)



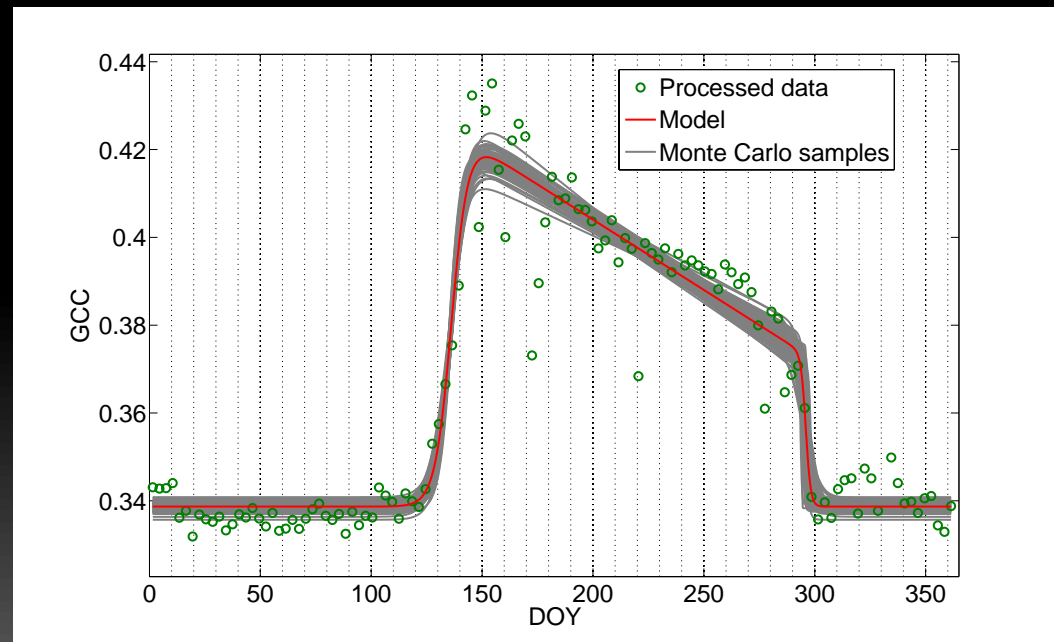
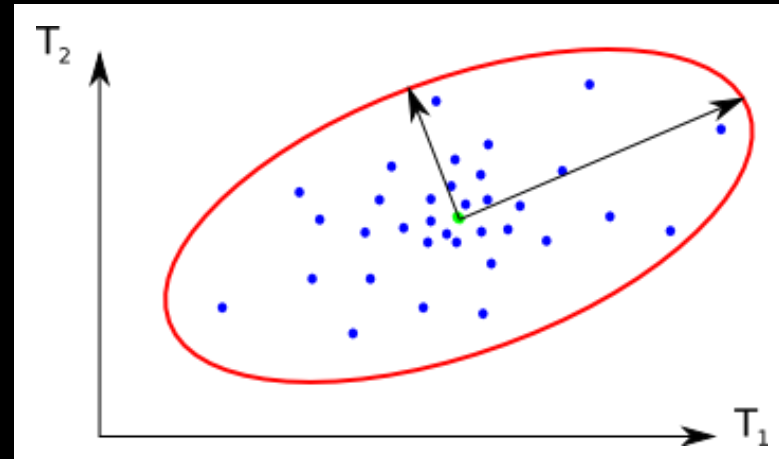


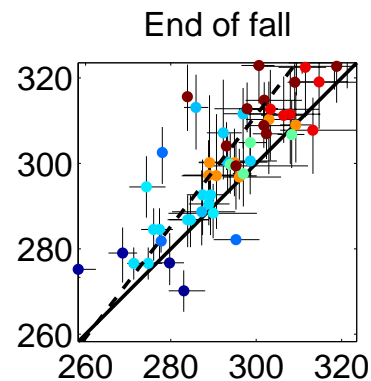
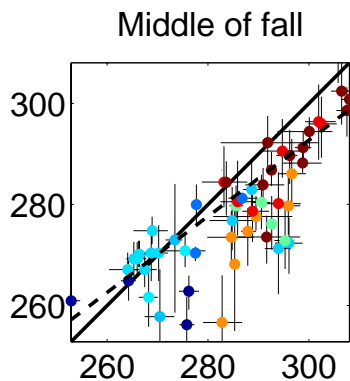
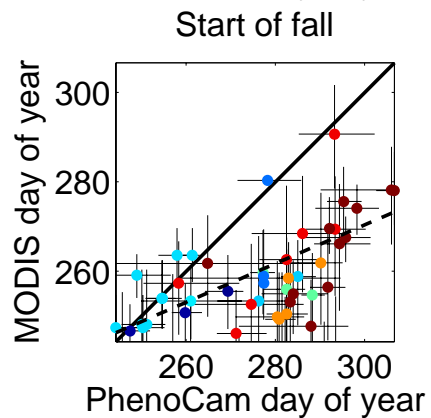
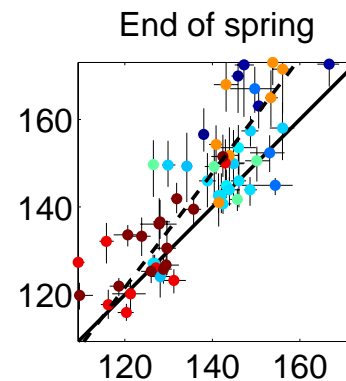
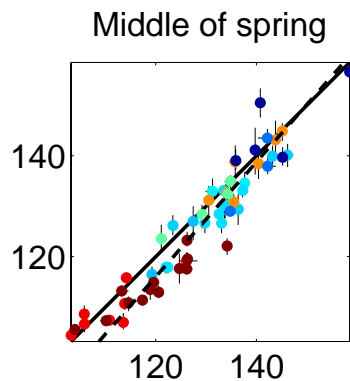
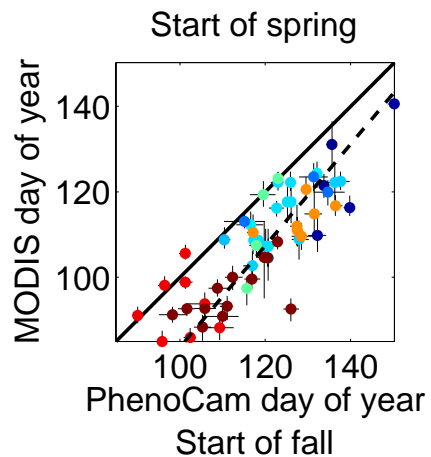
Harvard
Forest



MC uncertainty (Steve Klosterman)

1. Approximate parameter covariance matrix using output from parameter estimation routine
2. Generate random parameter samples using mean and covariance
3. Evaluate phenology dates from each parameter sample





Latitude

