

Land surface Phenology Subgroup- Validation methods

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Validation- Why challenging?

- What LSP metrics mean in regards to biophysical vegetation properties, i.e. Should LSP start of season equate to bud burst, leaf unfolding, or full leaf expansion?
- No comparable direct measurement
- Landscape is heterogeneous , thus *inter* and *intra* species variation in phenology events within a pixel.
- Perhaps most widely available validation data sources are Citizen science data of individual (isolated) trees (issues with scaling and data quality) .

Phenology- validation

Ground based

Citizen science, voluntary based, point-to pixel problem



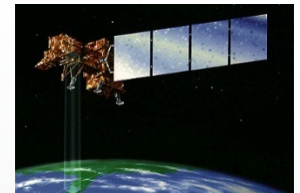
Ground based (intensive monitoring)

Limited coverage, point-to pixel problem



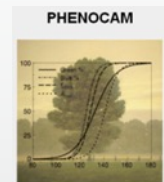
Satellite based (!)

High spatial resolution data, scaling up, Data availability



Camera based

High spatial (mostly horizontal) and hyper temporal resolution, effect of understorey, dominate foreground

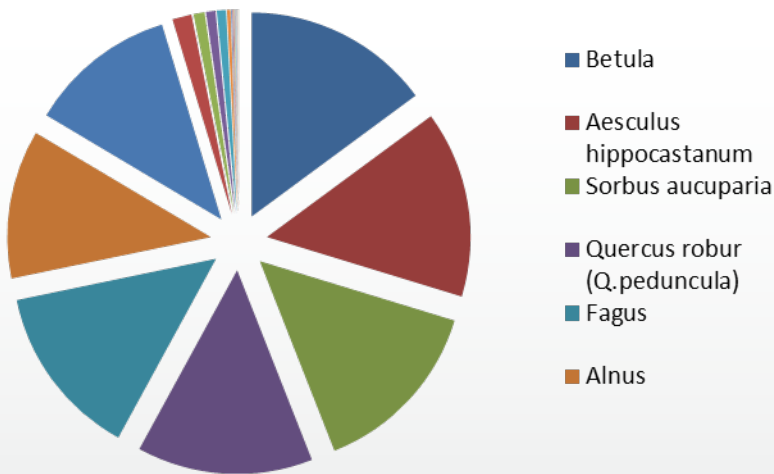


Validation-Ground data

Pep725 database

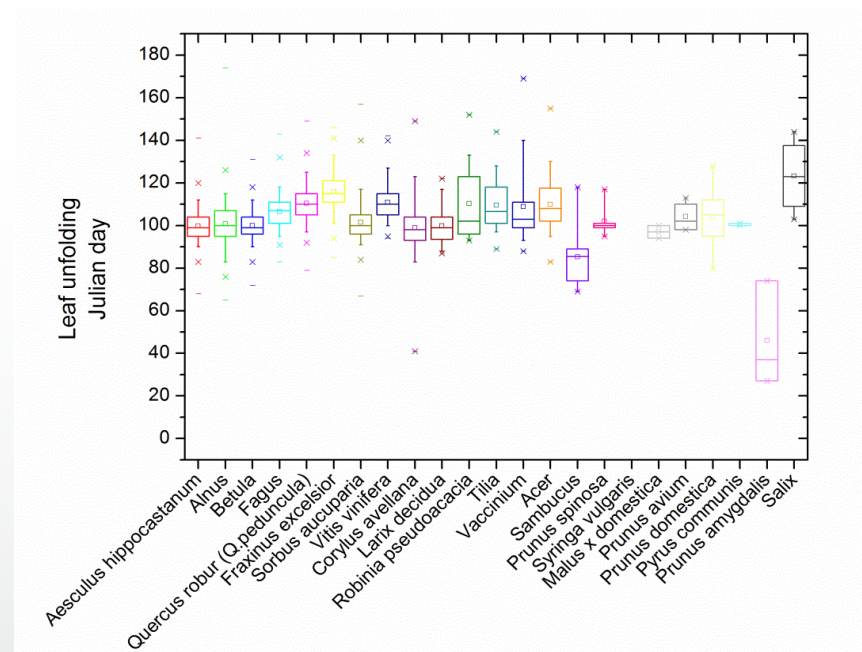
STATION NETWORK: Currently the database implements:

- 9 003 075 observations
- 20 375 locations
- 254 different plants/cultivars
- **38 GROWTH STAGES**



Species composition for 2011.

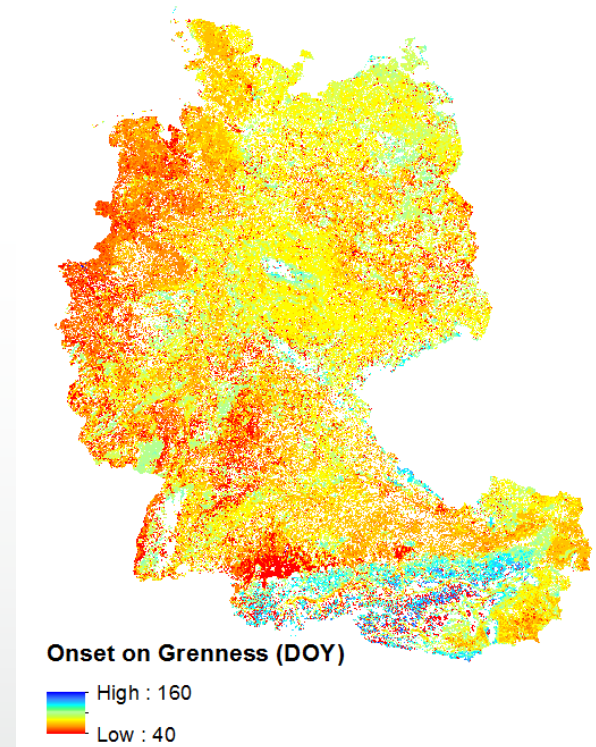
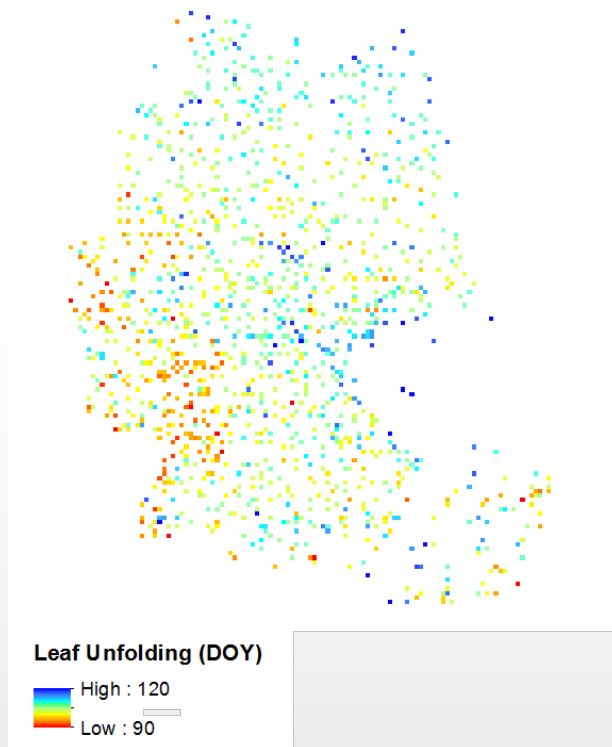
- 8349 phenology observations for the year 2011.
- 1354 different locations
- 8334 observations in Germany (99.8%)



Box plot of leaf unfolding for 2011.

Validation-Ground data

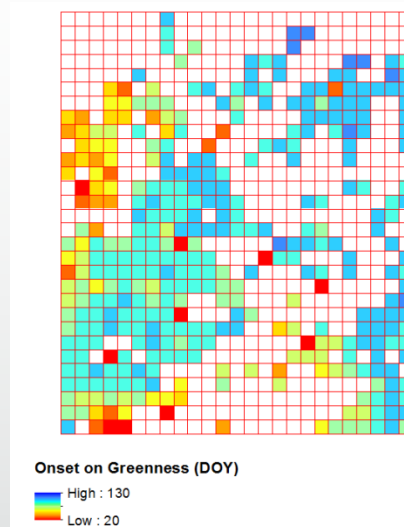
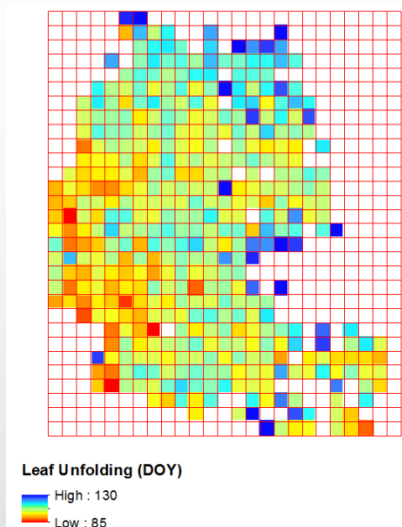
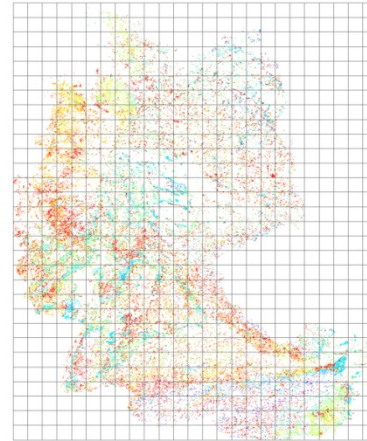
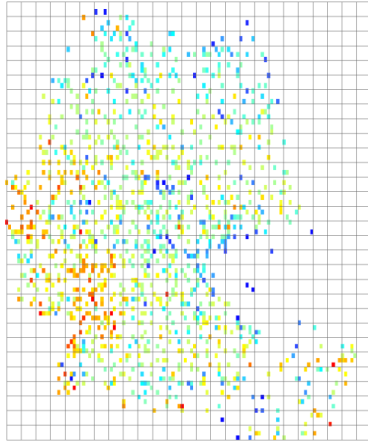
1. Regression between the pep725 leaf unfolding pixels and the onset on greenness extracted at the same locations.



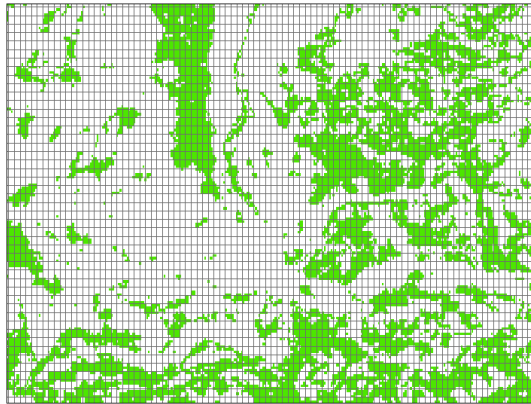
Very Weak correlation

Validation-Ground data

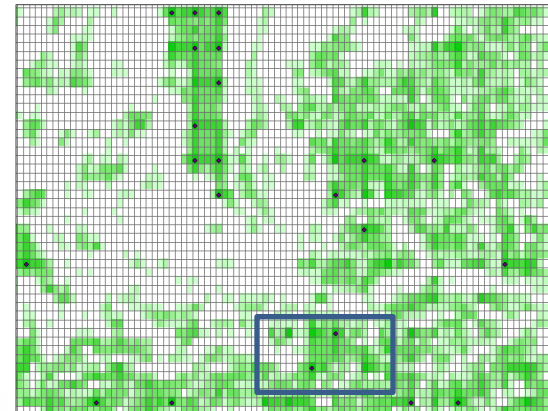
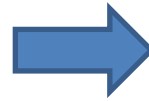
2. Averaging of both, ground and satellite phenology and pep725 data, using different grids (10 and 50 km).



3. A vector grid (fishnet) of 1 square kilometre was created in order to select pixels of 100% deciduous forest.

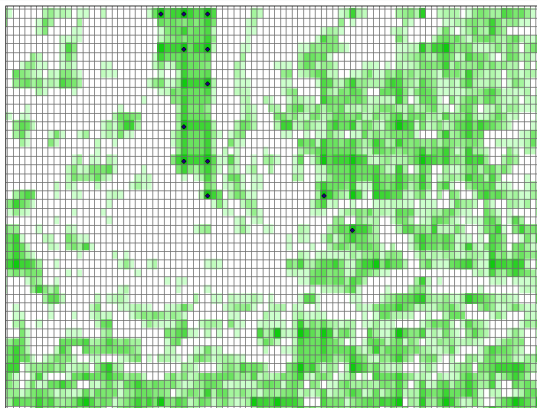


GlobeCover 2009
Deciduous Forest



Percentage of deciduous Forest

- High
- Low
- Pure deciduous points



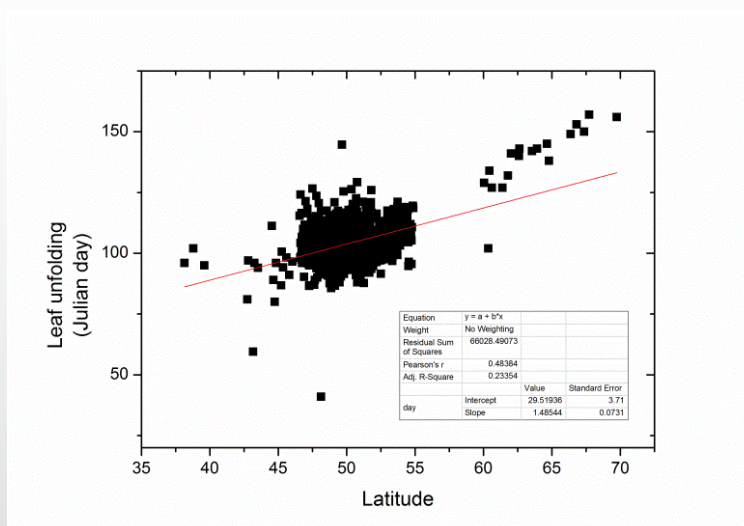
Percentage of deciduous Forest

- High
- Low
- Pure deciduous points (filtered)



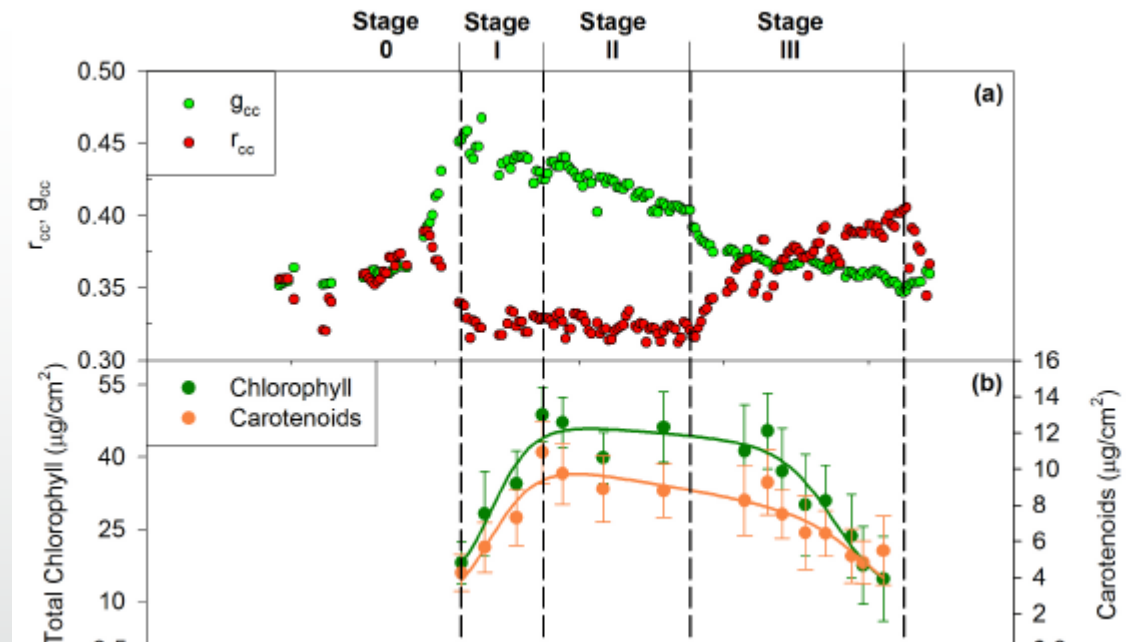
Validation-Ground data

- Most of the methods did not provide any significant correlations
- Spatial resolution of the satellite composite may be one of the reason
- Need to think of another method of inter comparison!
- Issue with ground data?



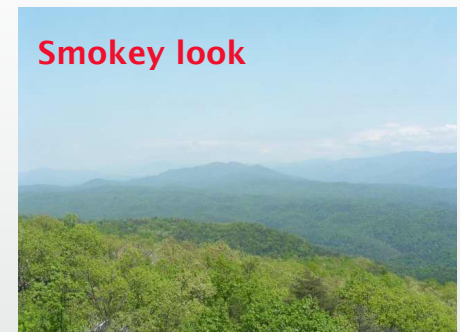
Validation-Phenocam data

- Some studies have related phenocam derived indices to satellite time series
- Although good correlations, question on what we are measuring? (Nadir View vs Oblique view)
- No direct phenological information



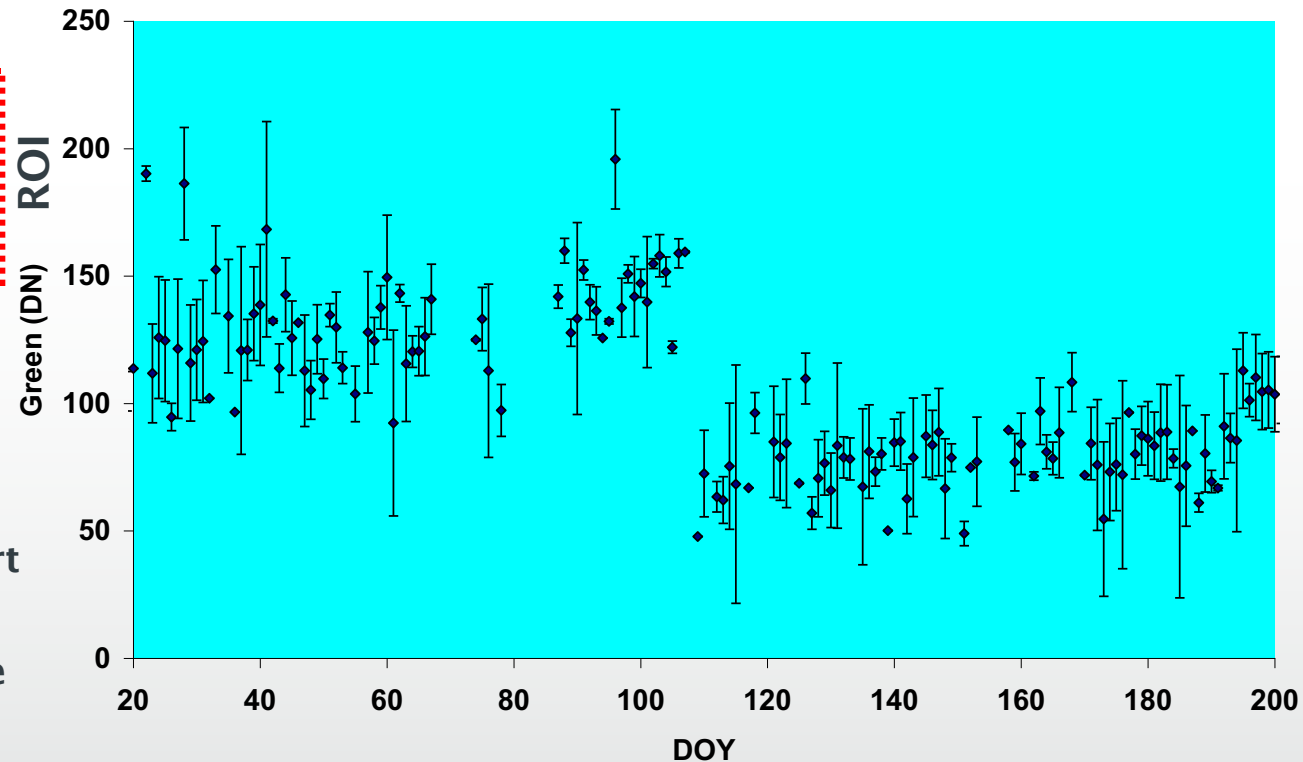
Validation-Phenocam data

- Essentially 3 bands (RGB) image
- sometime issue with data volume
($5 * 365 = 1825$)
- Need to select image area of Interest
- Need to normalise the data (?)
- Extraction of quantitative information
 - Green/Red
 - Difference Index ($2G - (B + R)$)(Richardson et al, 2007)



Validation-Phenocam data

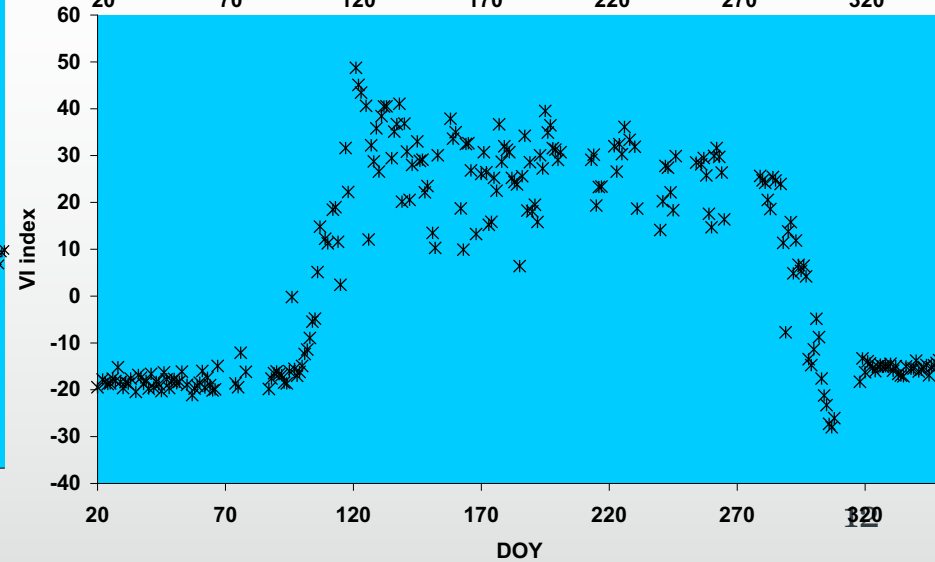
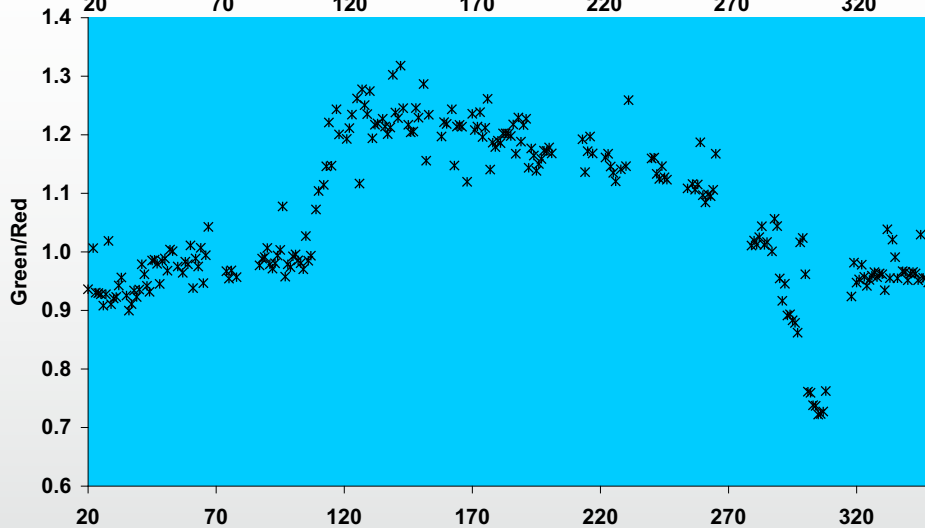
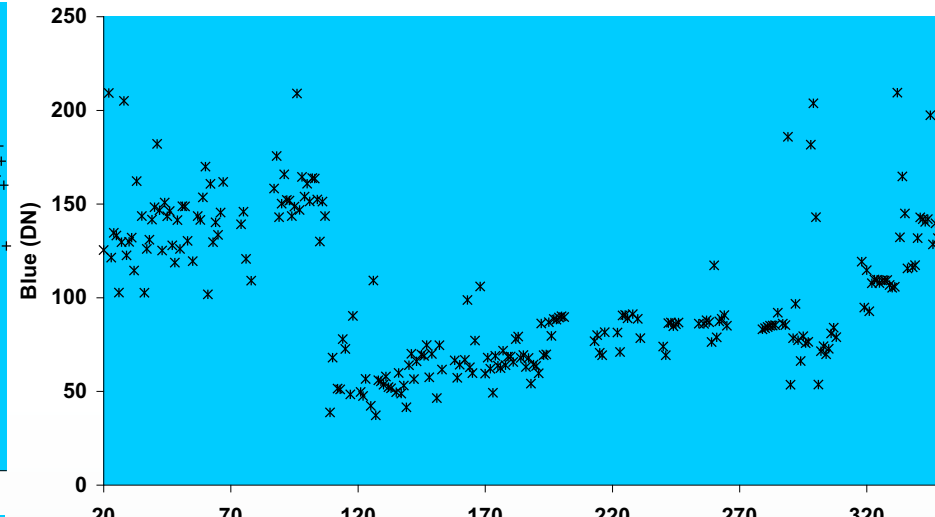
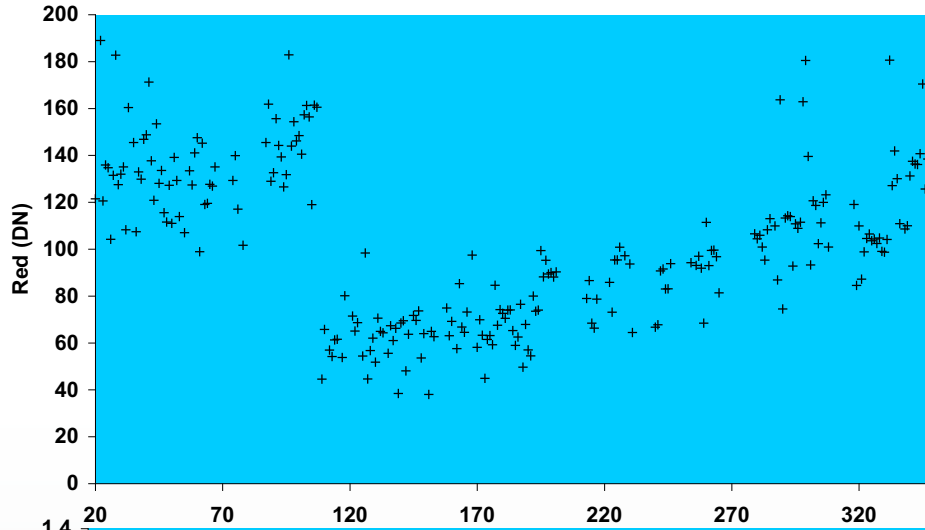
Upper Buffalo (without normalisation)



- Distinct pattern at the start of the growing season,
- No trend in the end of the season
- High intra day variation

Validation-Phenocam data

Upper Buffalo (without normalisation)



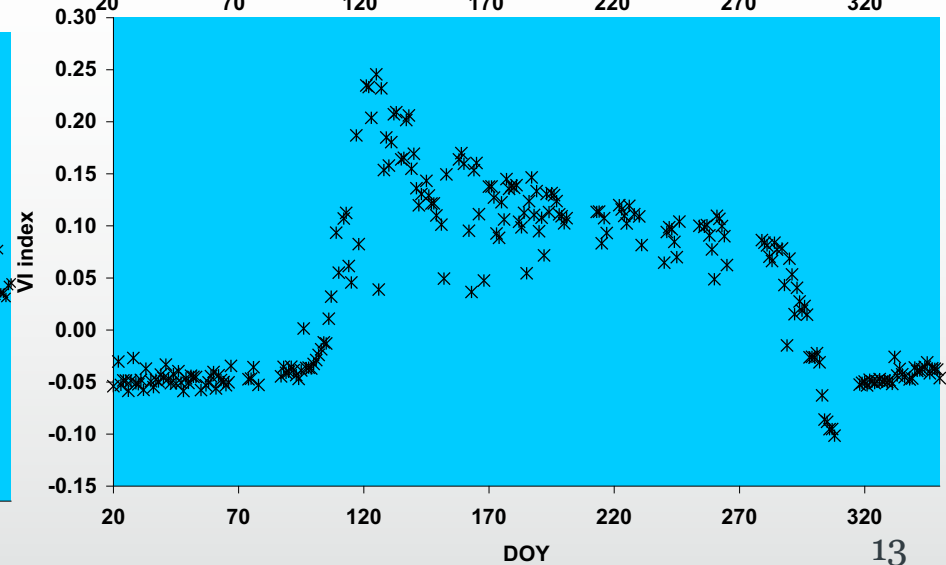
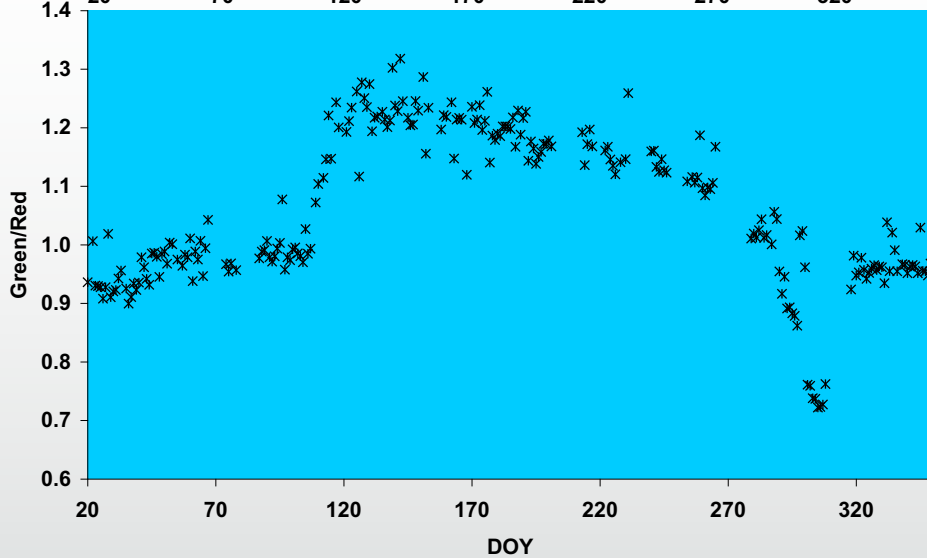
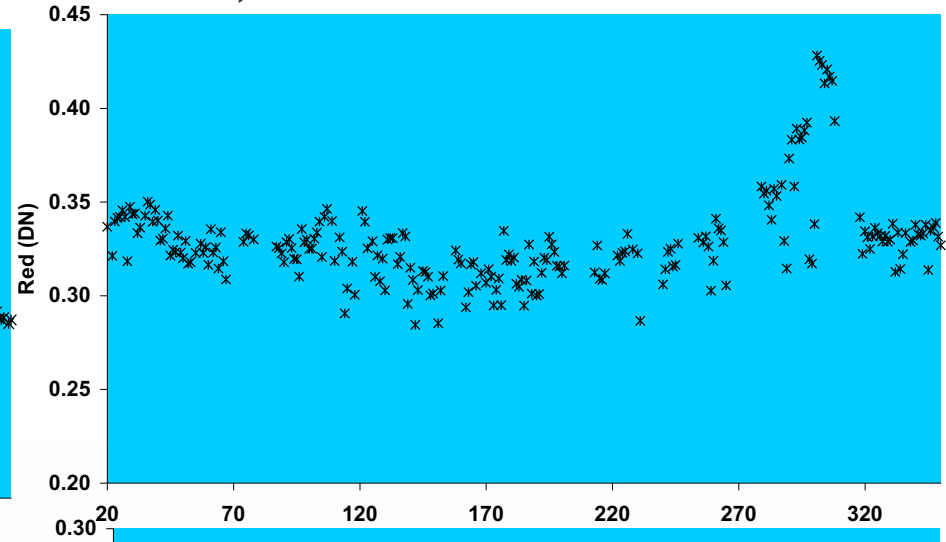
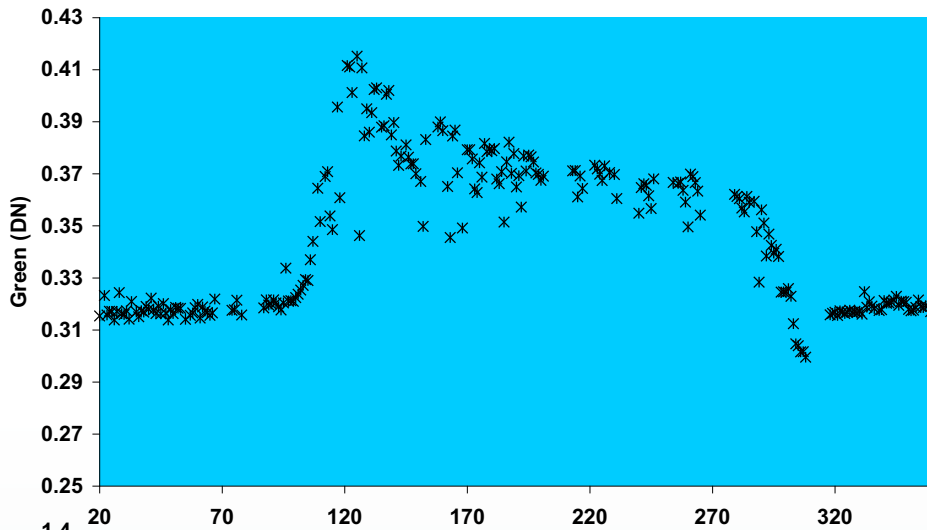
Error bars not shown

DOY

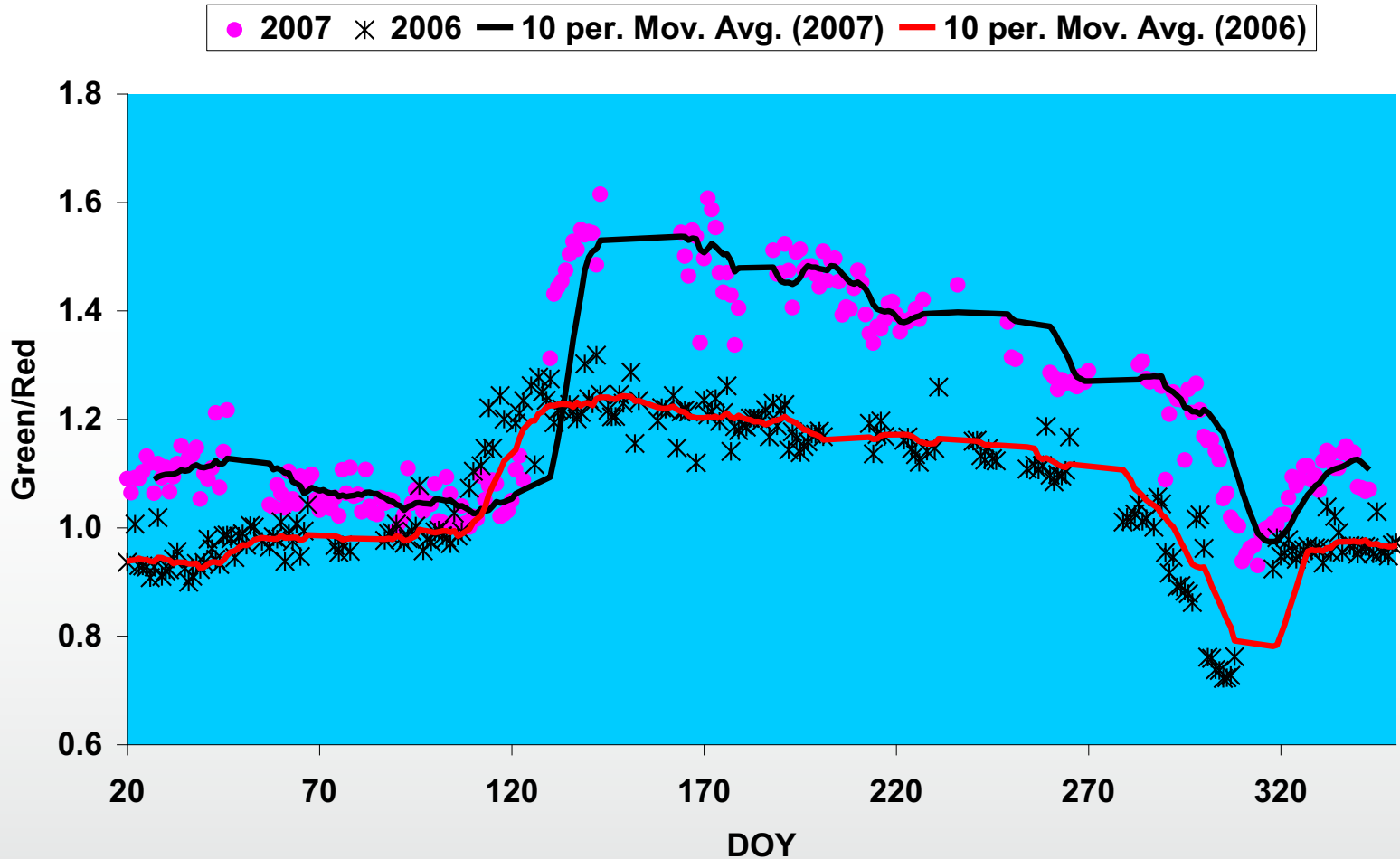
DOY

Validation-Phenocam data

Upper Buffalo (normalisation)



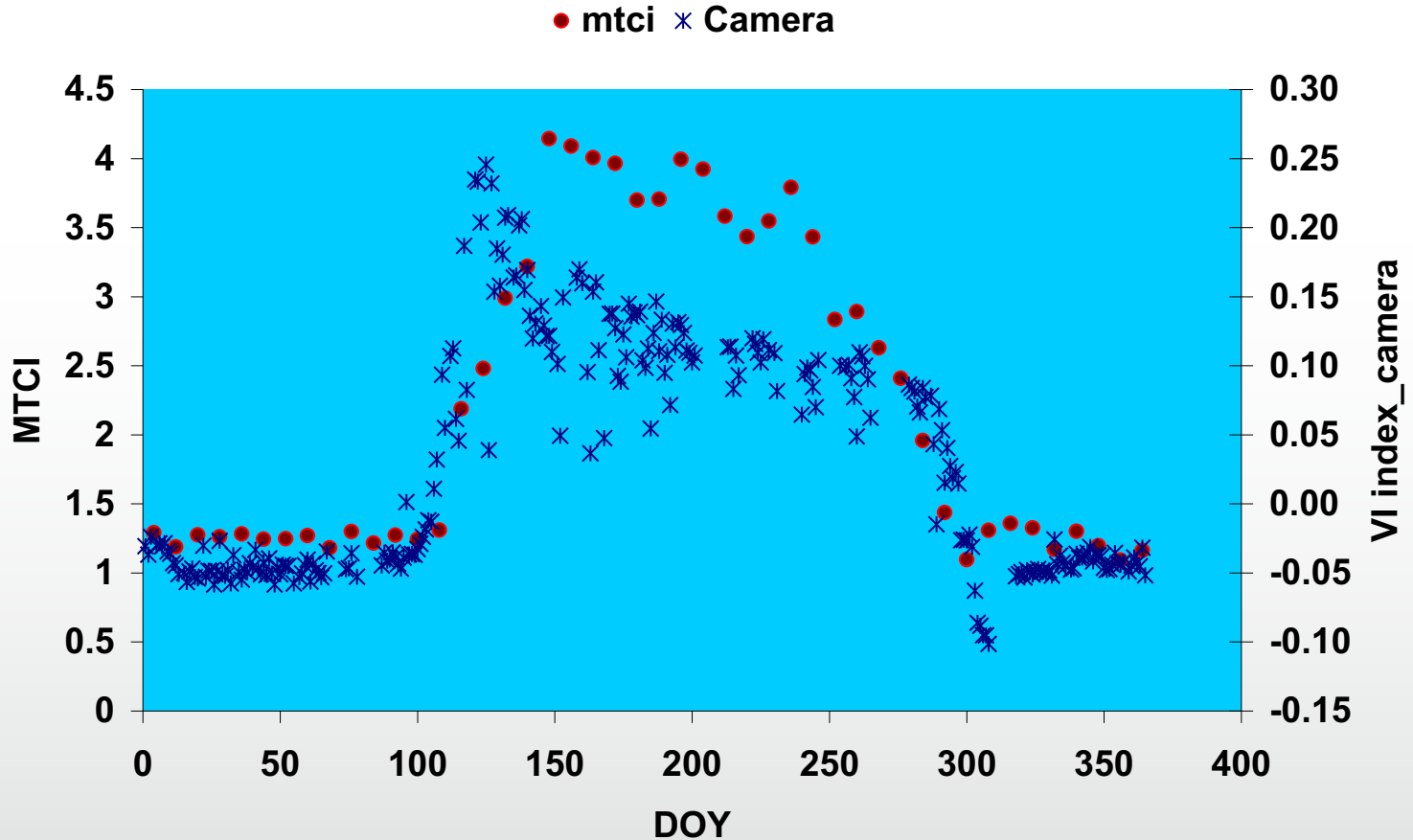
Upper Buffalo (comparison between 2006 and 07)



Validation-Phenocam data

Comparison with satellite time series

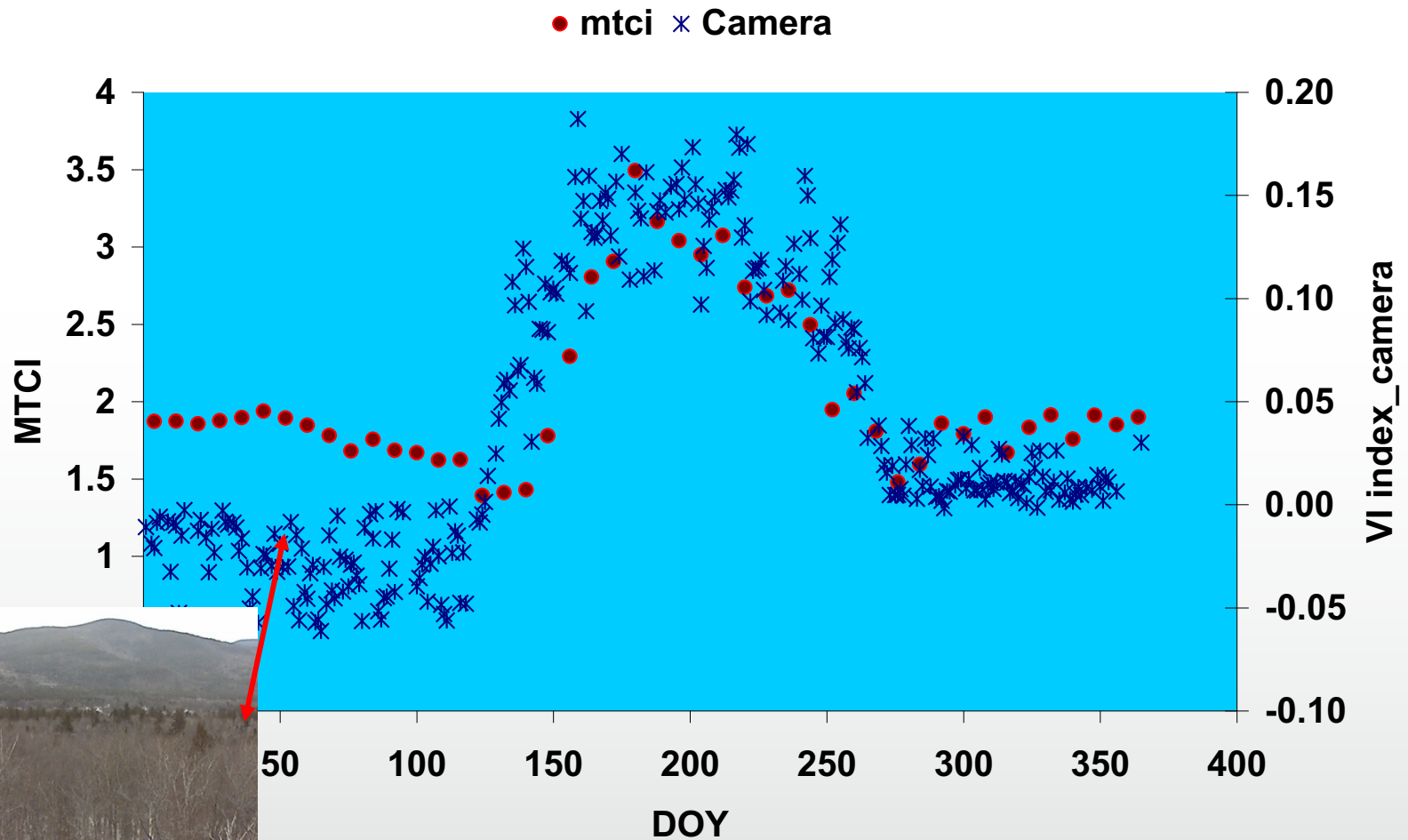
Upper Buffalo (2006)



Validation-Phenocam data

Comparison with satellite time series

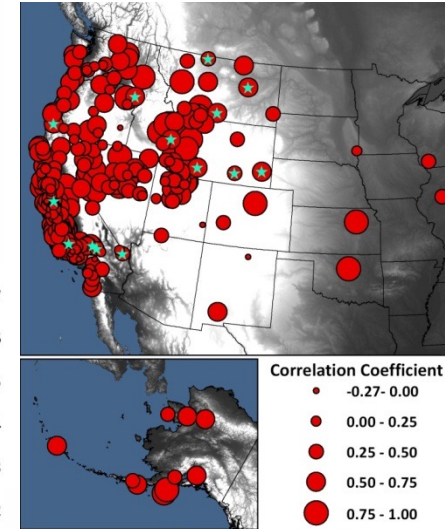
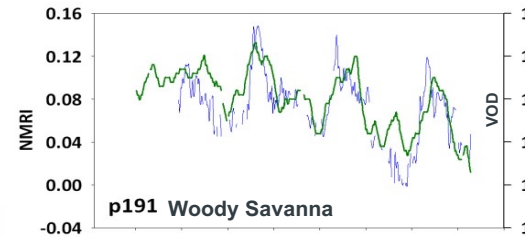
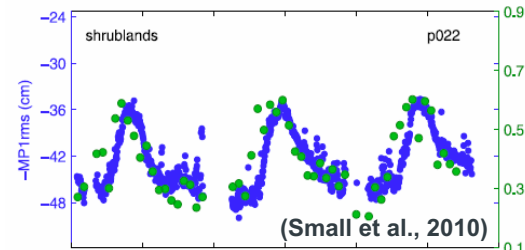
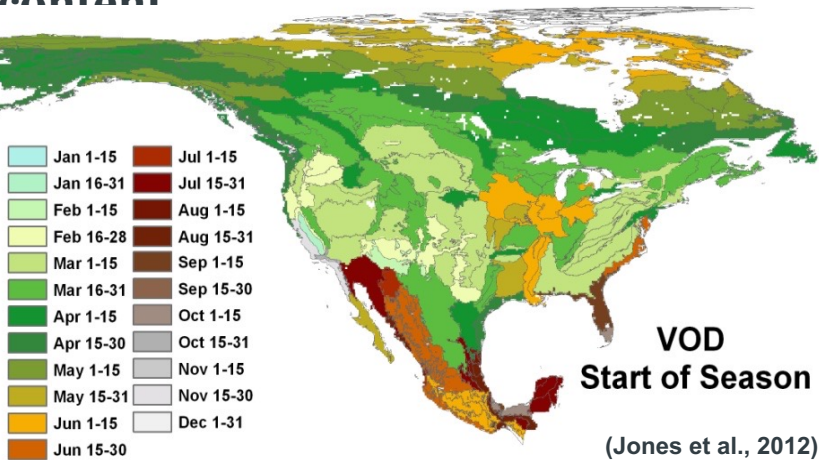
Bartlett (2006)



Beyond optical data

➤ GPS & Microwave signals respond to changes in plant biomass & water

content



➤ The LPV Phenology group is working with core sites to incorporate GPS stations and tower mounted radiometers for validation of microwave vegetation phenology.



Phenology- Conclusion

- Direct comparison with ground data has several issues
- Need to develop a method for upscaling
- Good agreement between phenocam data and satellite measurement of time series, but phenocams don't provide information on phenological stages.
- Perhaps combination of these will provide meaningful information, Hence type -1 sites.