

# MOD43 Validation: UK Activities

## CEOS/WGCV Land Product Validation Workshop on Albedo

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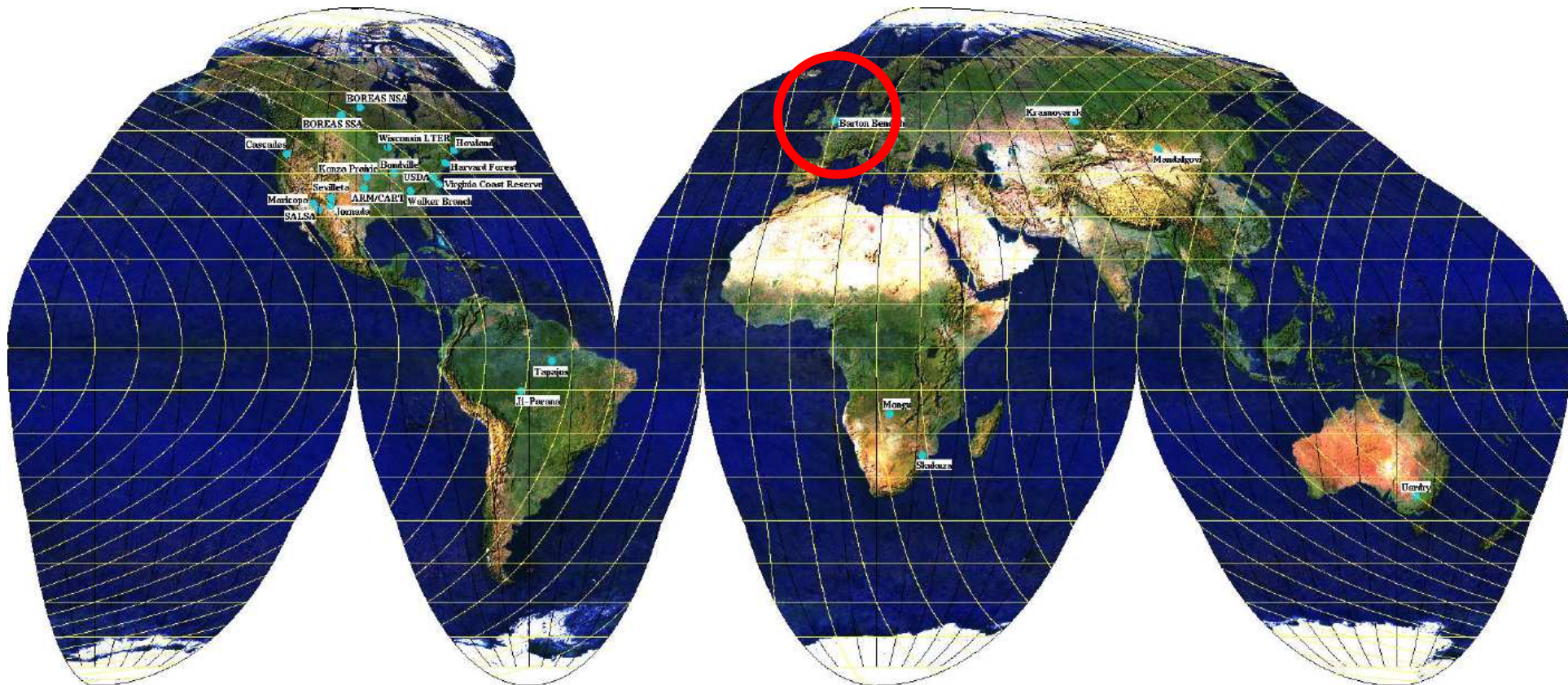
**CLASSIC**  
Climate and Land Surface  
Interactions Centre



# Overview

- Barton Bendish test site, UK
- Evaluation of MOD43 product over Barton Bendish
  - Temporal profiles and consistency: MOD43 (2000-2002)
- Validation of MOD43
  - Narrow-to-broadband conversion and scaling-up
    - Ground measurements→HyMAP→MOD43
  - Land-cover based scaling using canopy growth models
  - Sensitivity to missing samples (cloud cover) and noise

# MODIS Validation: Core Sites



EOS Land validation core sites - Goede hemispheric projection - Black grid: 10 deg. longitude - Yellow grid: MODLAND L3 tiles

Jacques Desloizes (MODLAND/LDOPE) - May 1999

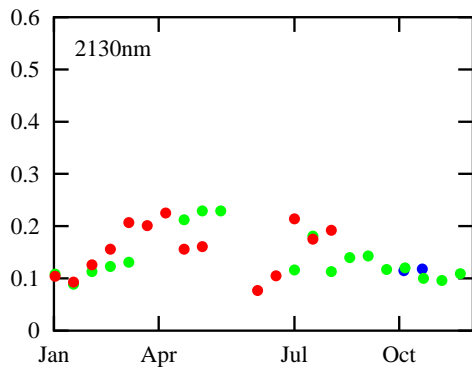
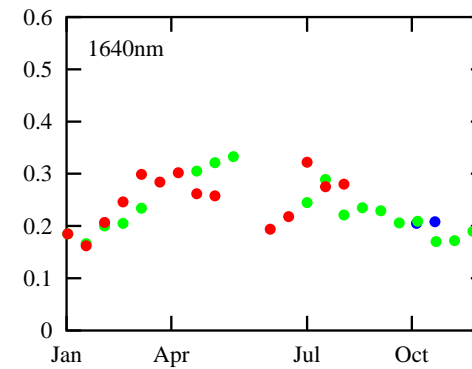
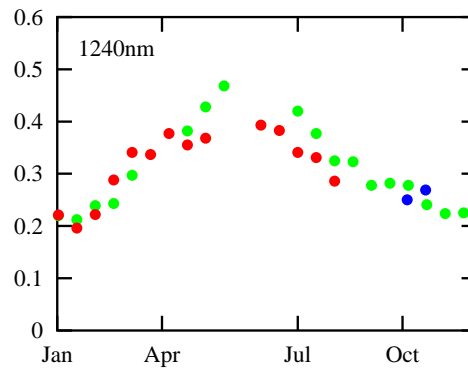
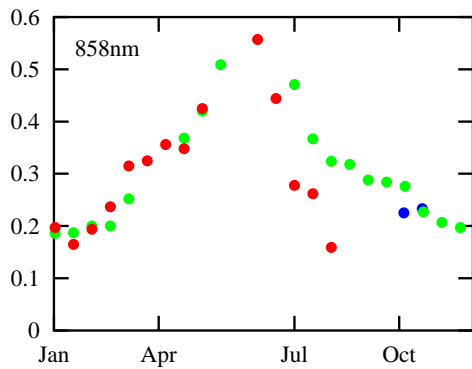
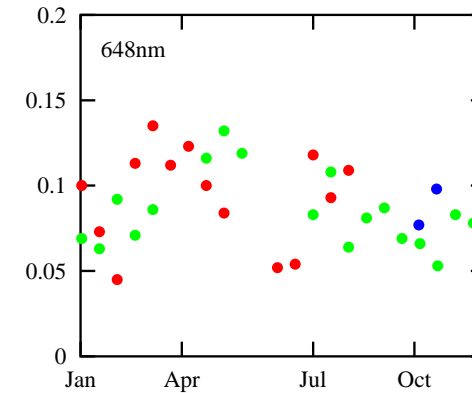
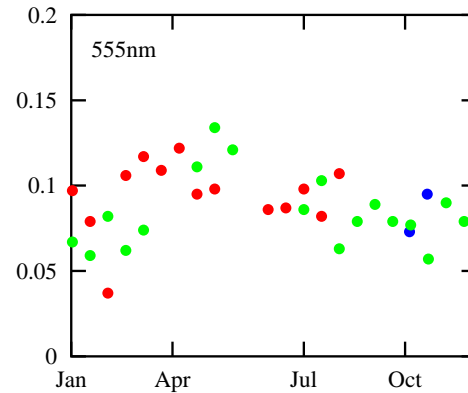
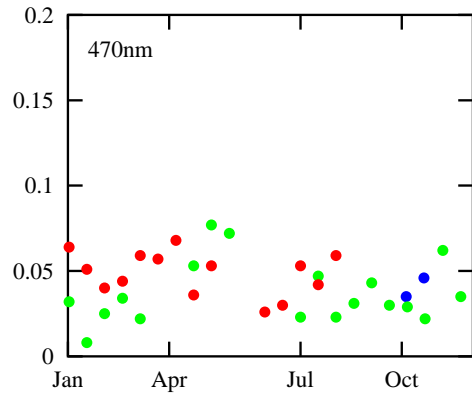
# Barton Bendish, East Anglia, UK



# Evaluating MOD43: Barton Bendish

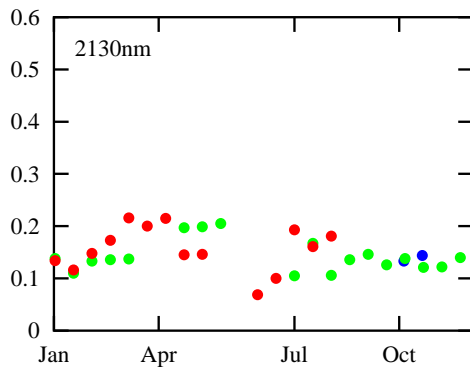
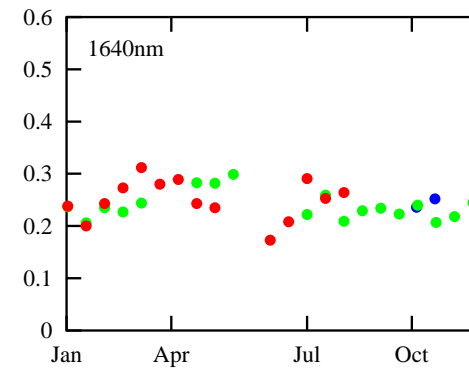
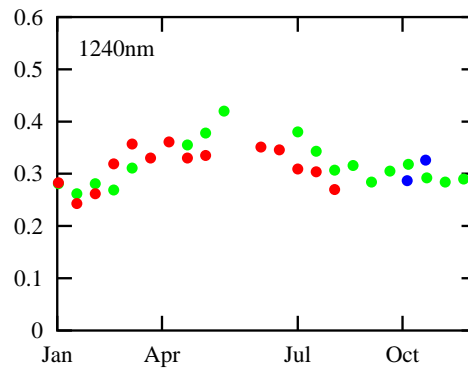
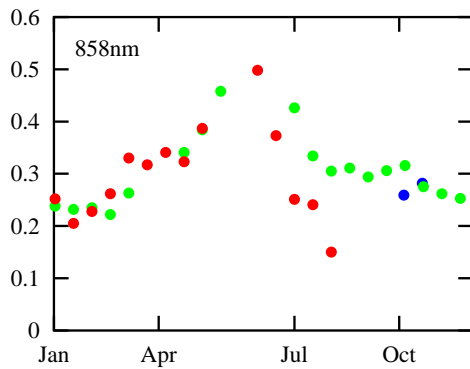
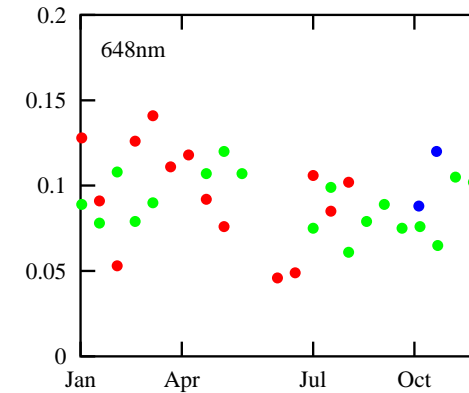
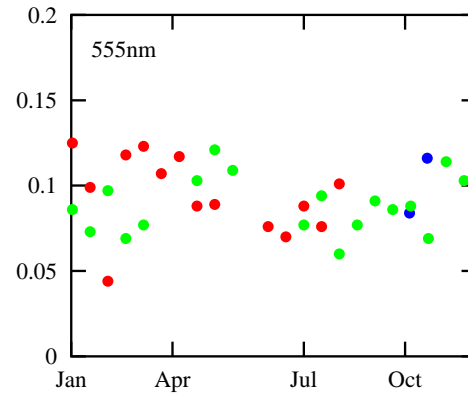
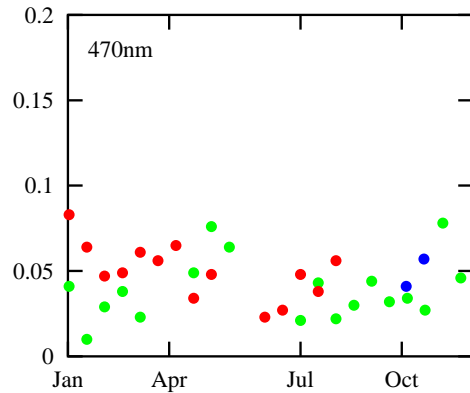
- Interannual consistency of retrievals.
- Test of MOD43 in a cloudy region: loss of angular samples → magnitude inversions.

# MOD43: White-Sky Spectral Albedo



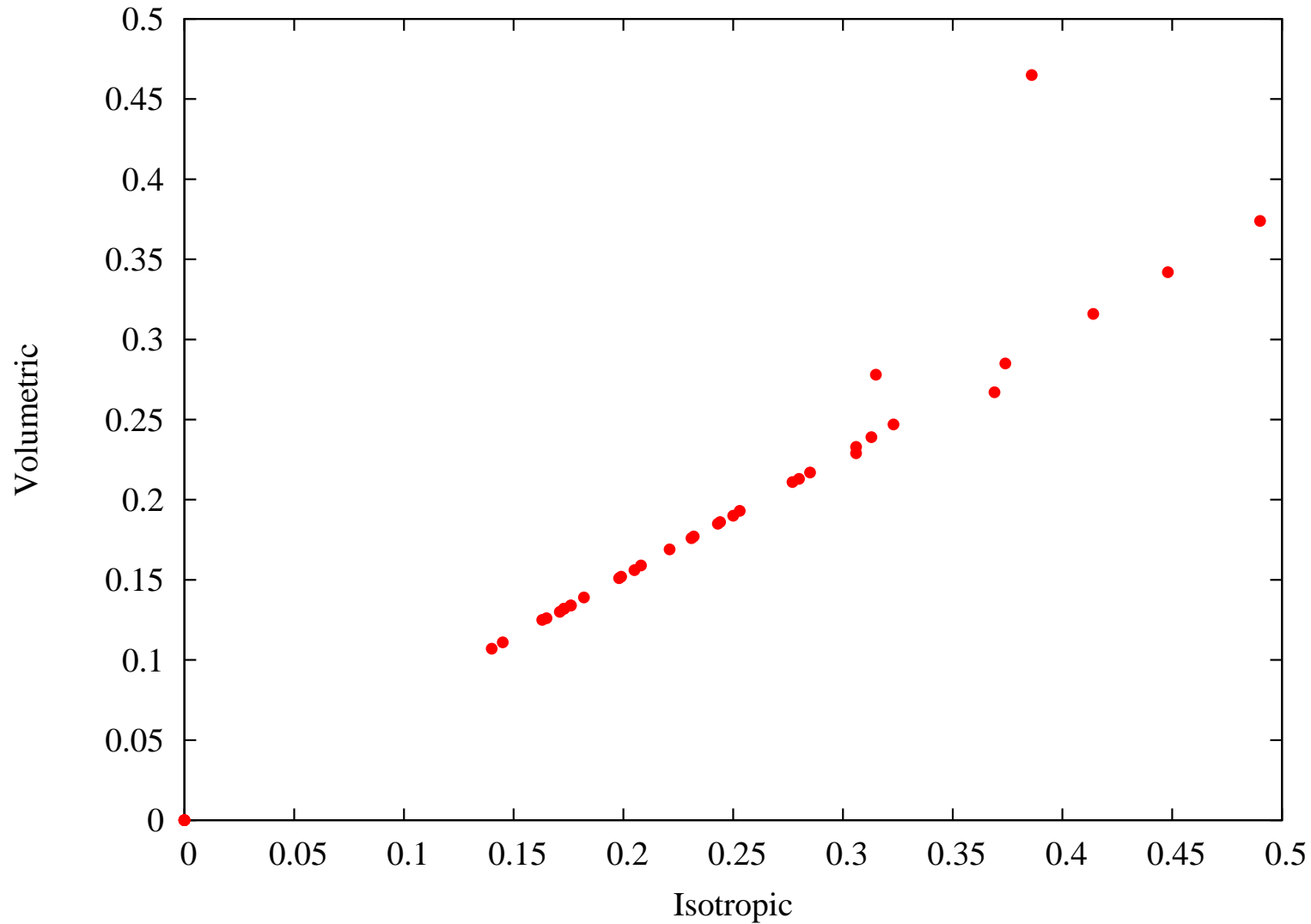
Blue = 2000  
Green = 2001  
Red = 2002

# MOD43: Black-Sky Spectral Albedo

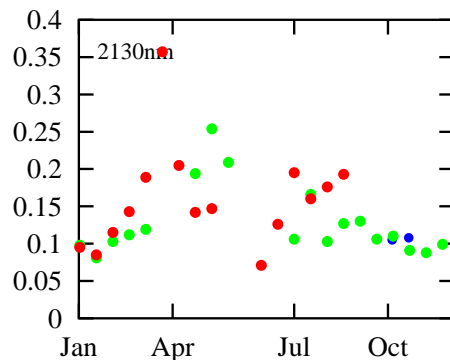
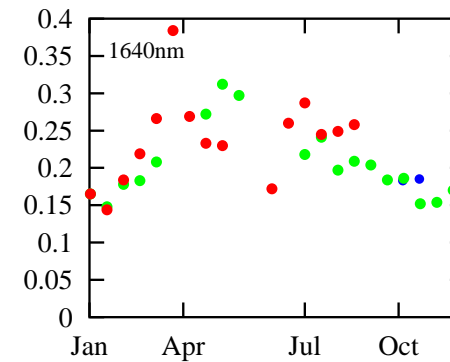
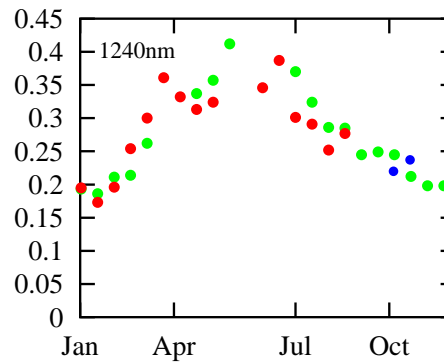
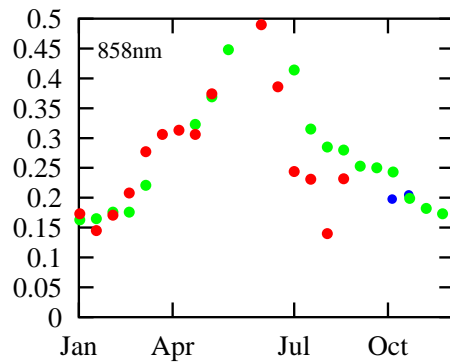
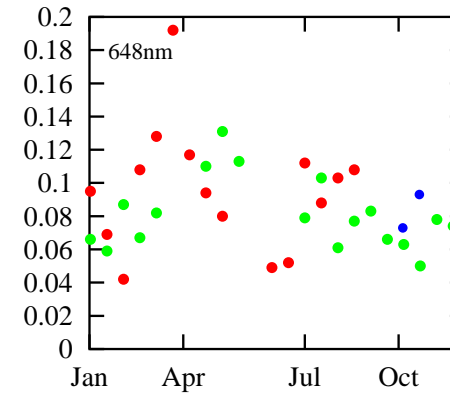
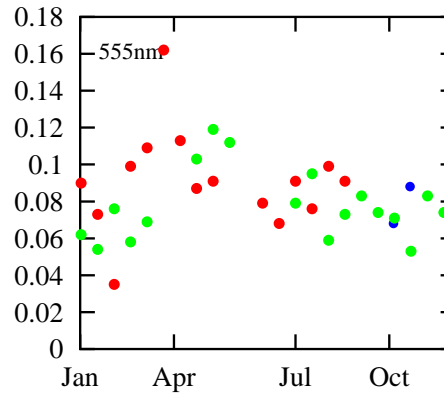
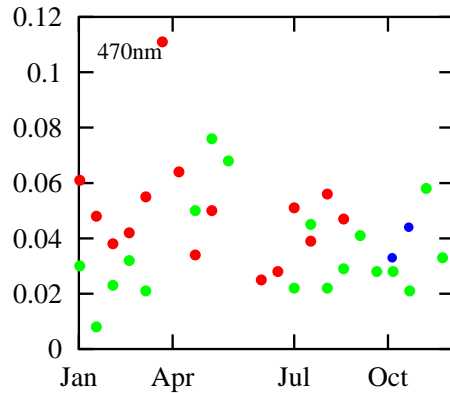


Blue = 2000  
Green = 2001  
Red = 2002

# MOD43: Magnitude Inversions!

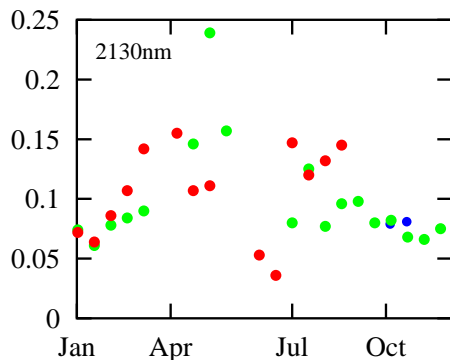
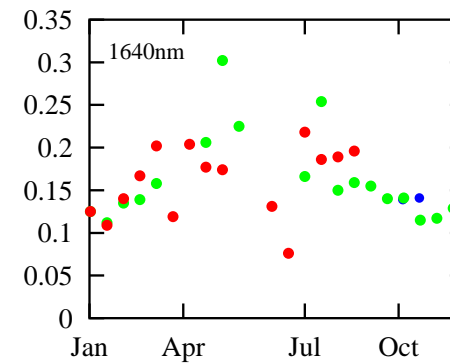
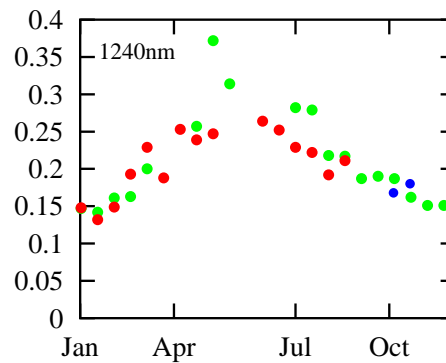
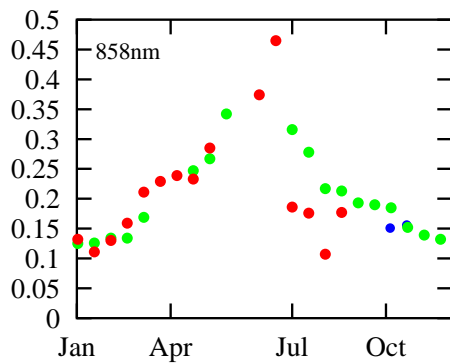
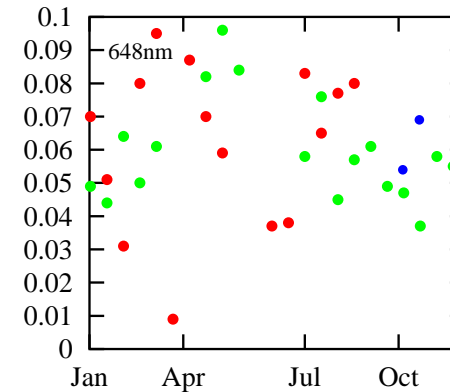
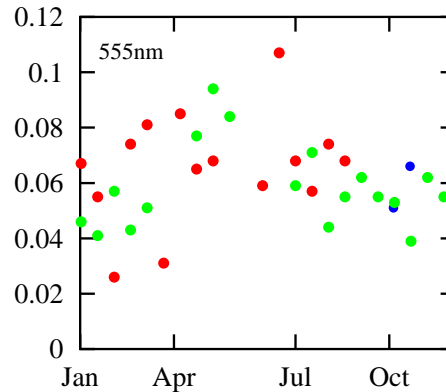
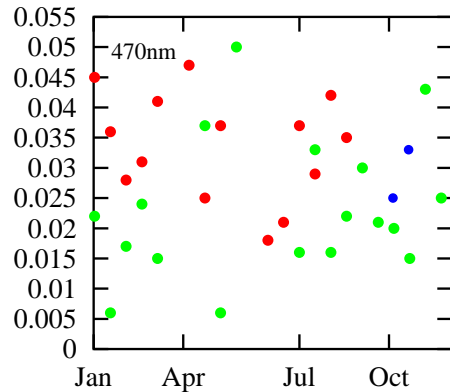


# MOD43: Isotropic Kernel Weights



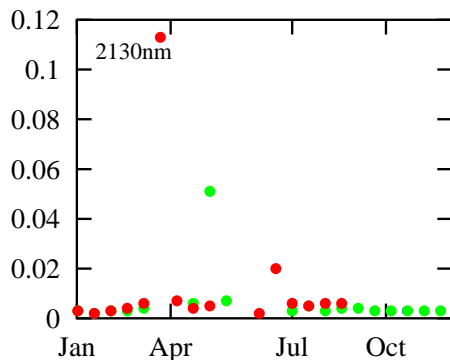
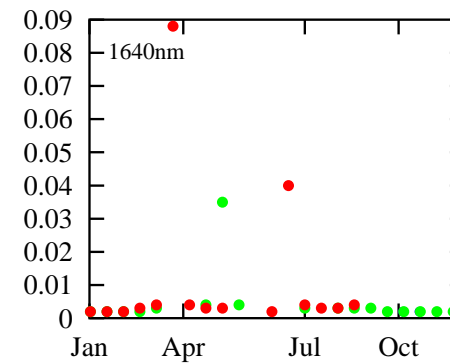
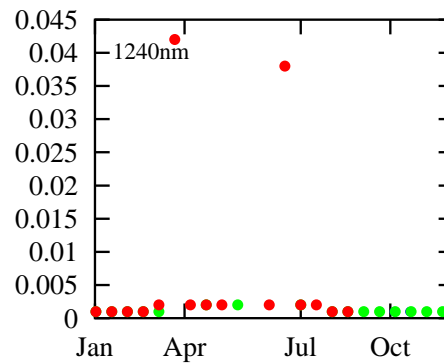
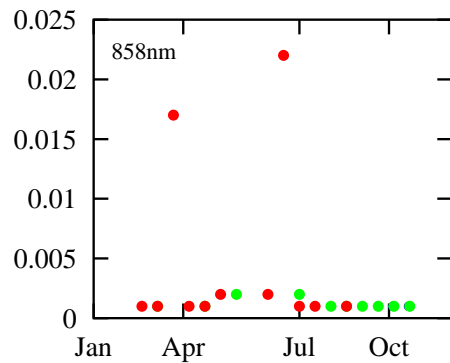
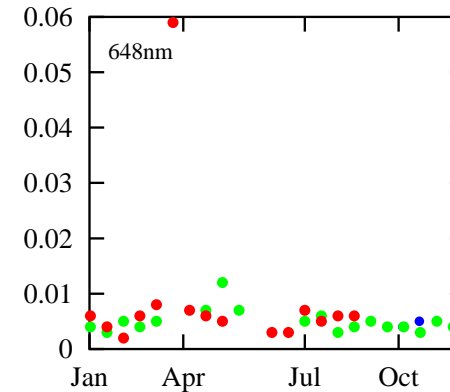
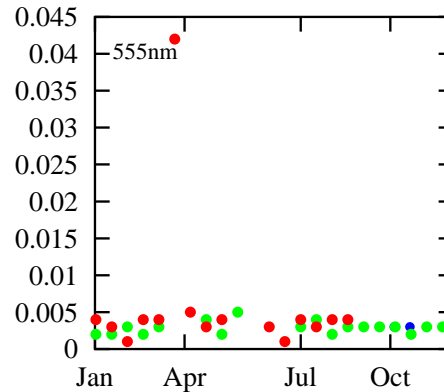
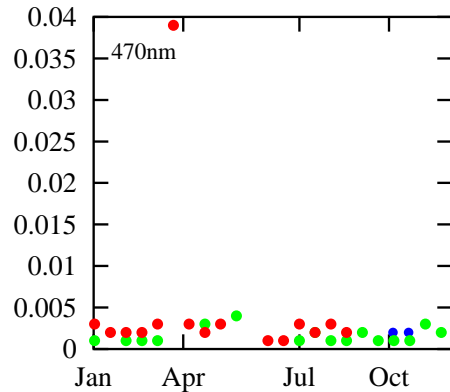
Blue = 2000  
Green = 2001  
Red = 2002

# MOD43: Volumetric Kernel Weights



Blue = 2000  
Green = 2001  
Red = 2002

# MOD43: Geometric Kernel Weights



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Green = 2001  
Red = 2002

# Validation of MOD43

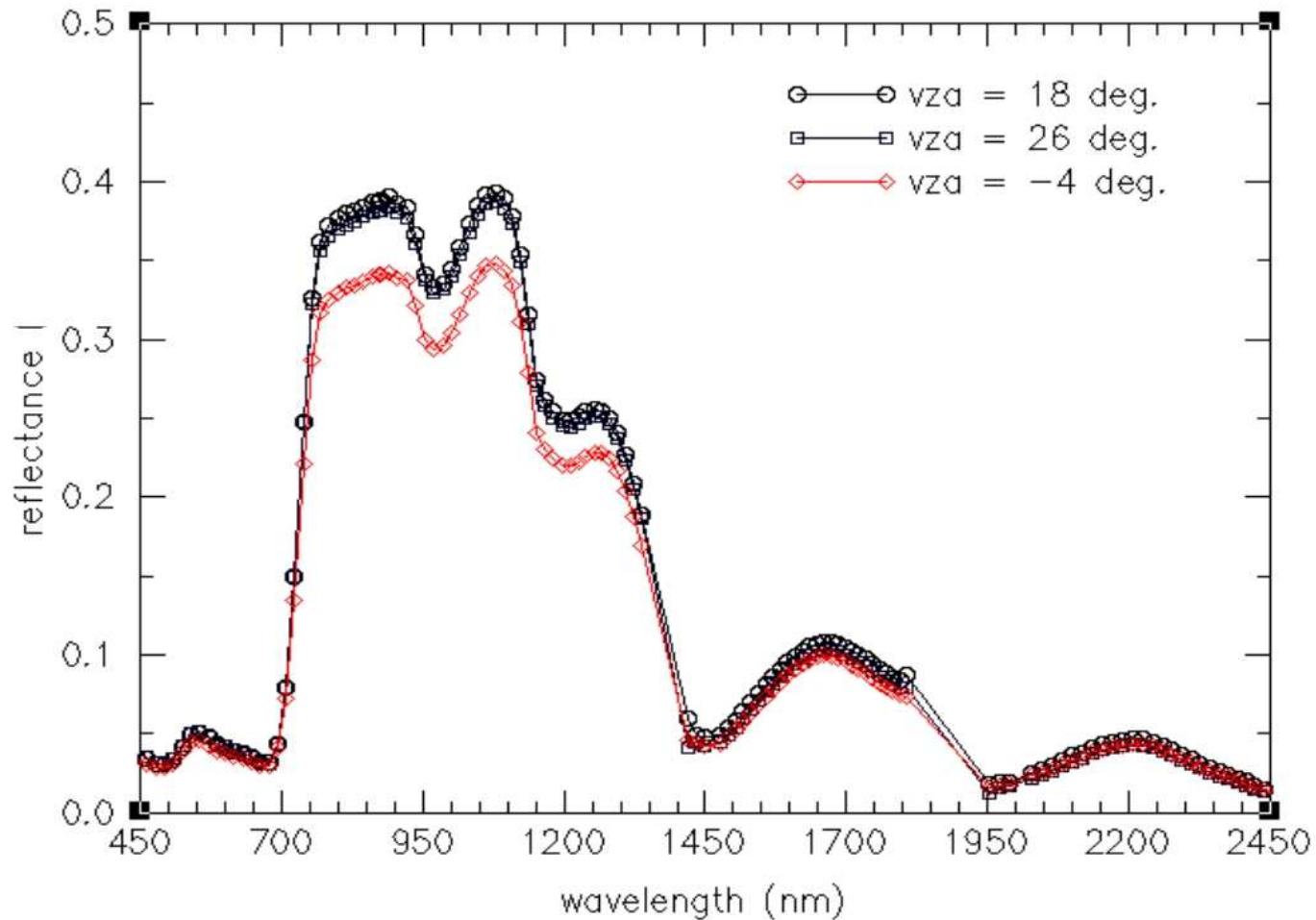
- Narrow-to-broadband conversion and scaling-up
  - Ground measurements (reflectance spectra, albedo, LAI, plant canopy biometric measurements, . . . )
  - Airborne hyperspectral image data (HyMAP)
- Ground→HyMAP→MOD43

# HyMAP: Hyperspectral Image Data



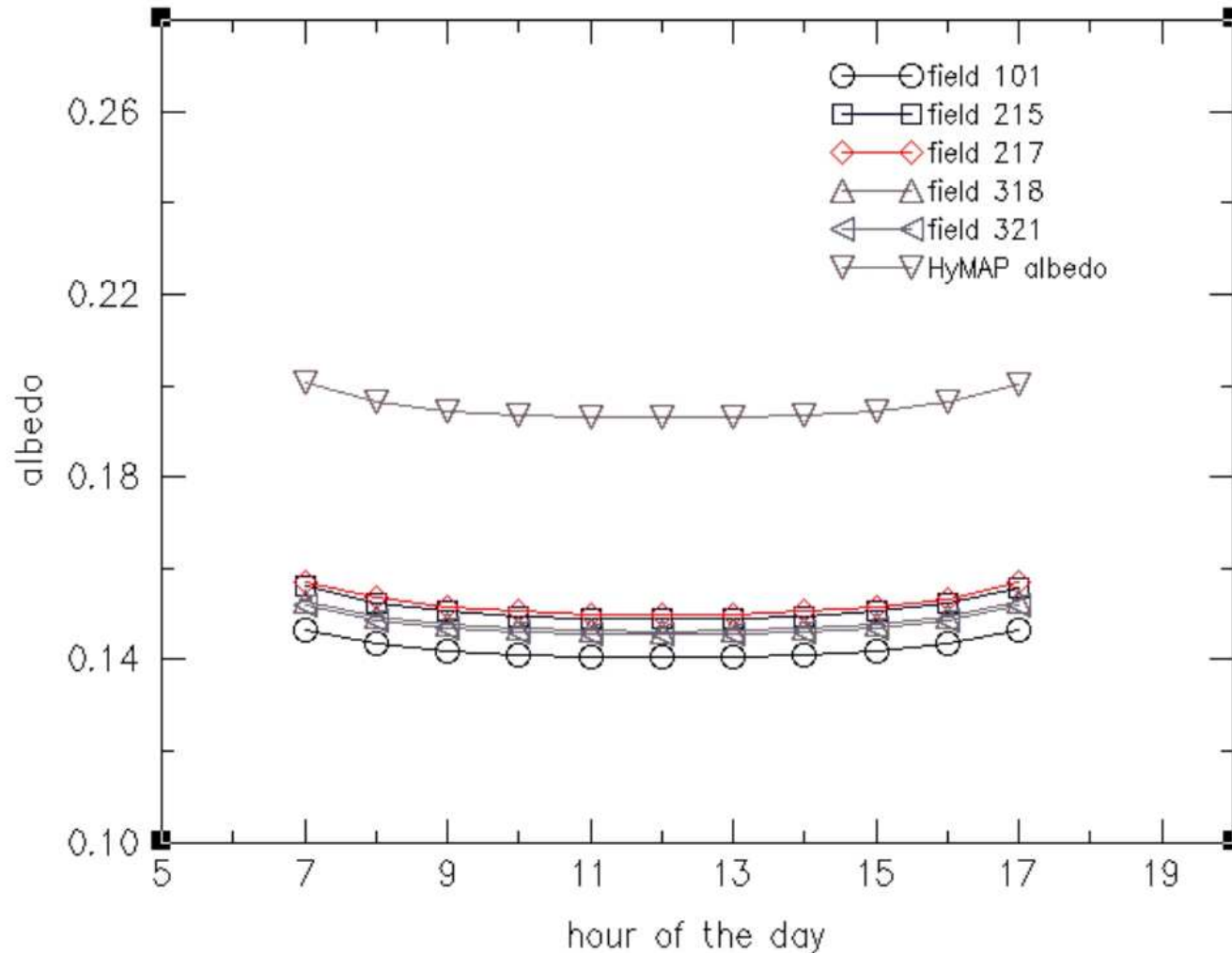
Images acquired on 17 June 2000. HyMAP: 126 bands,  $\pm 30^\circ$  VZA.

# HyMAP Spectra



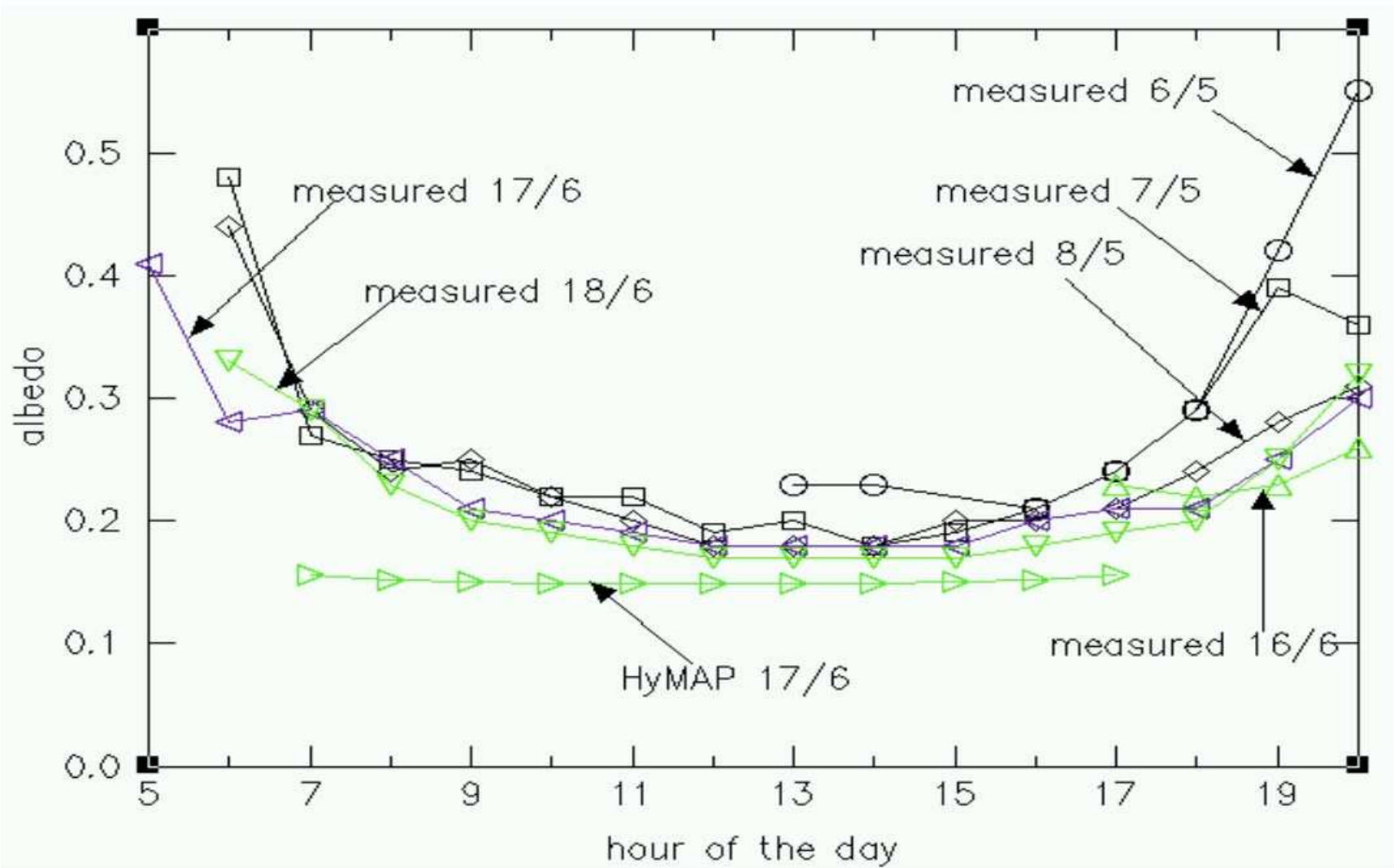
Close match to ground data (ASD FieldSpec Pro) for DOY 168.  
Confirms HyMAP atmospheric correction.

# Diurnal Broadband Albedo

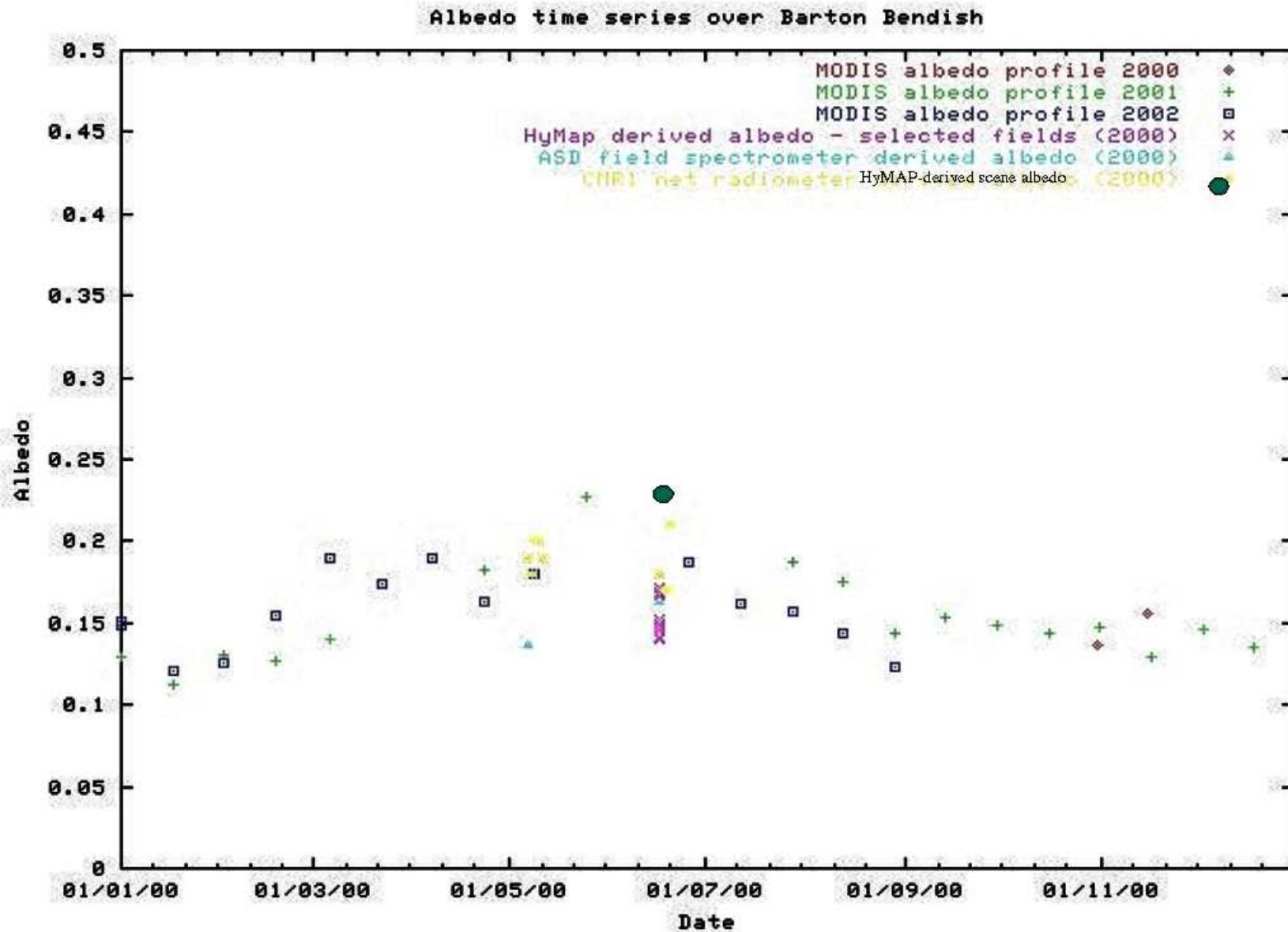


Hourly broadband albedo from HyMAP (overpass around noon).

# Ground & HyMAP Broadband Albedo



# Comparison with MOD43



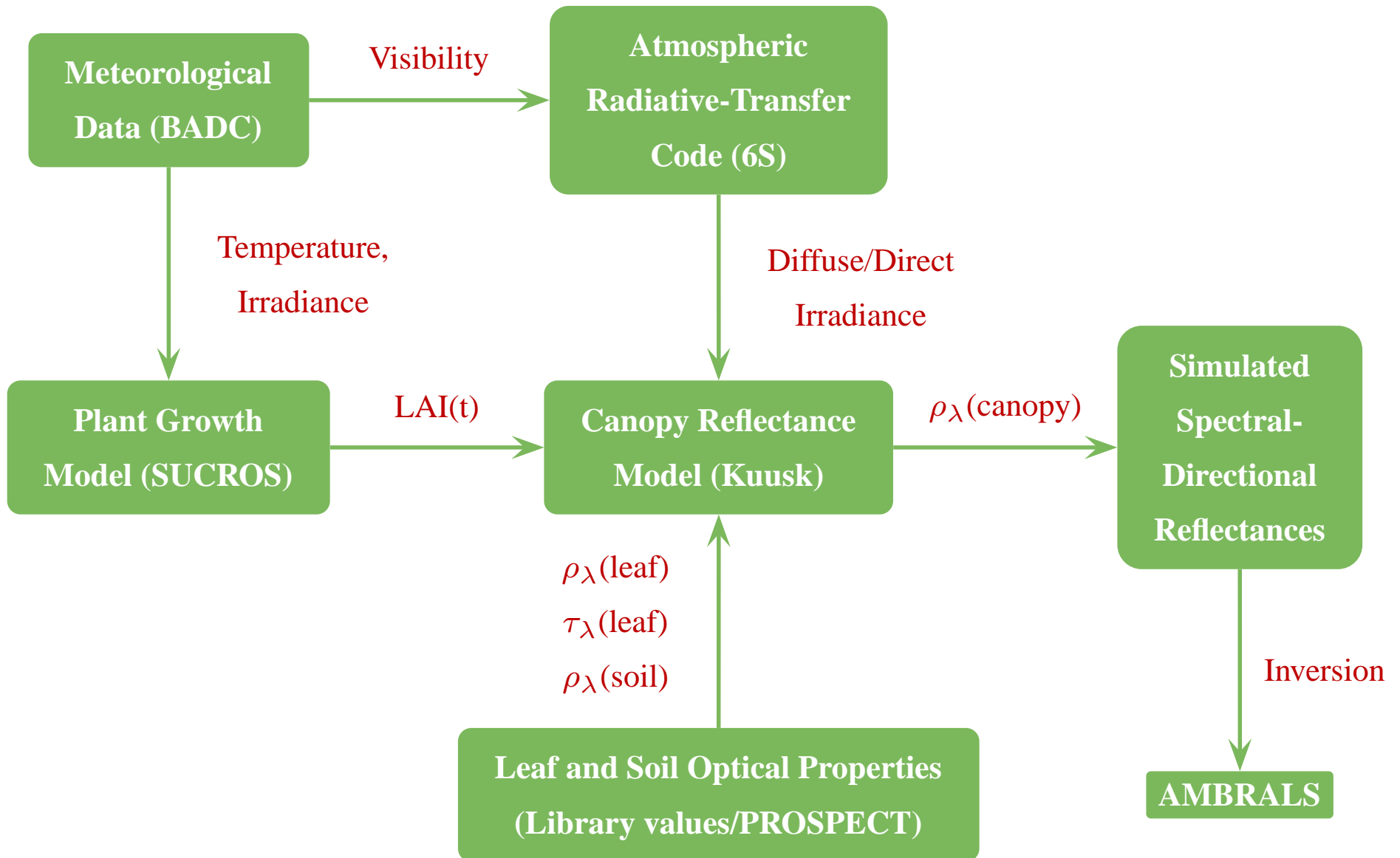
# Evaluation

- Preliminary test of narrow-to-broadband conversion
- HyMAP: wheat field albedo around 0.04 less than whole-scene albedo
  - Close to expected discrepancy because of Lambertian assumption
- HyMAP spectral integral of wheat field albedo around 0.02 below equivalent measured field albedo at solar noon
- HyMAP whole-scene albedo broadly consistent with overall trend in MOD43
  - More quantitative evaluation awaiting MOD43 V004.

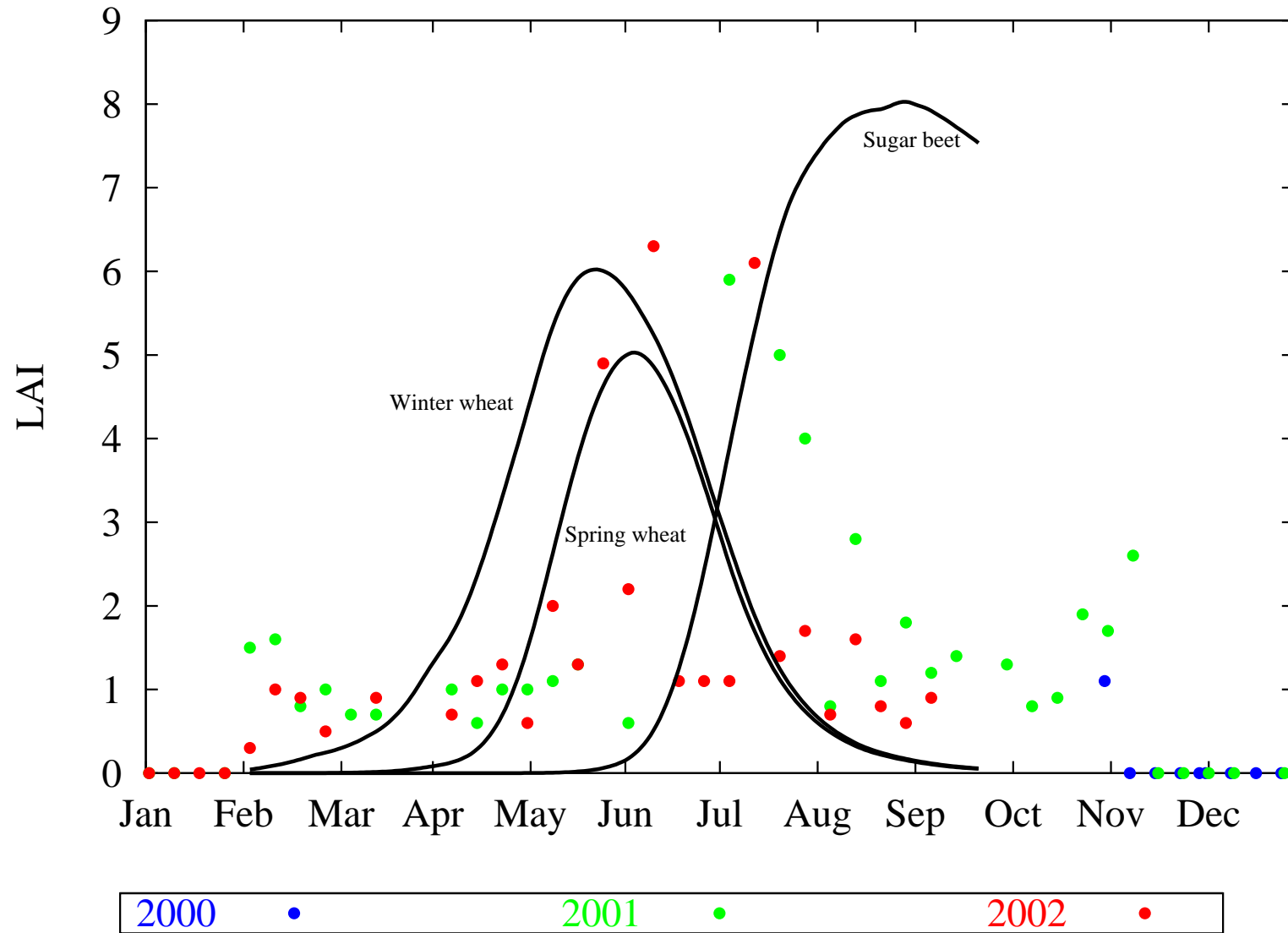
# Validation of MOD43

- How can we validate the performance of MOD43 for many pixels and many points in time?
  - Use plant growth models to simulate temporal profiles in LAI on a per cover-type basis
  - Apply growth model outputs to fine-scale land cover map from TM/ETM+
  - Forward model directional reflectances using canopy reflectance model
  - Invert using AMBRALS
  - Spatial scaling of time-series inversions

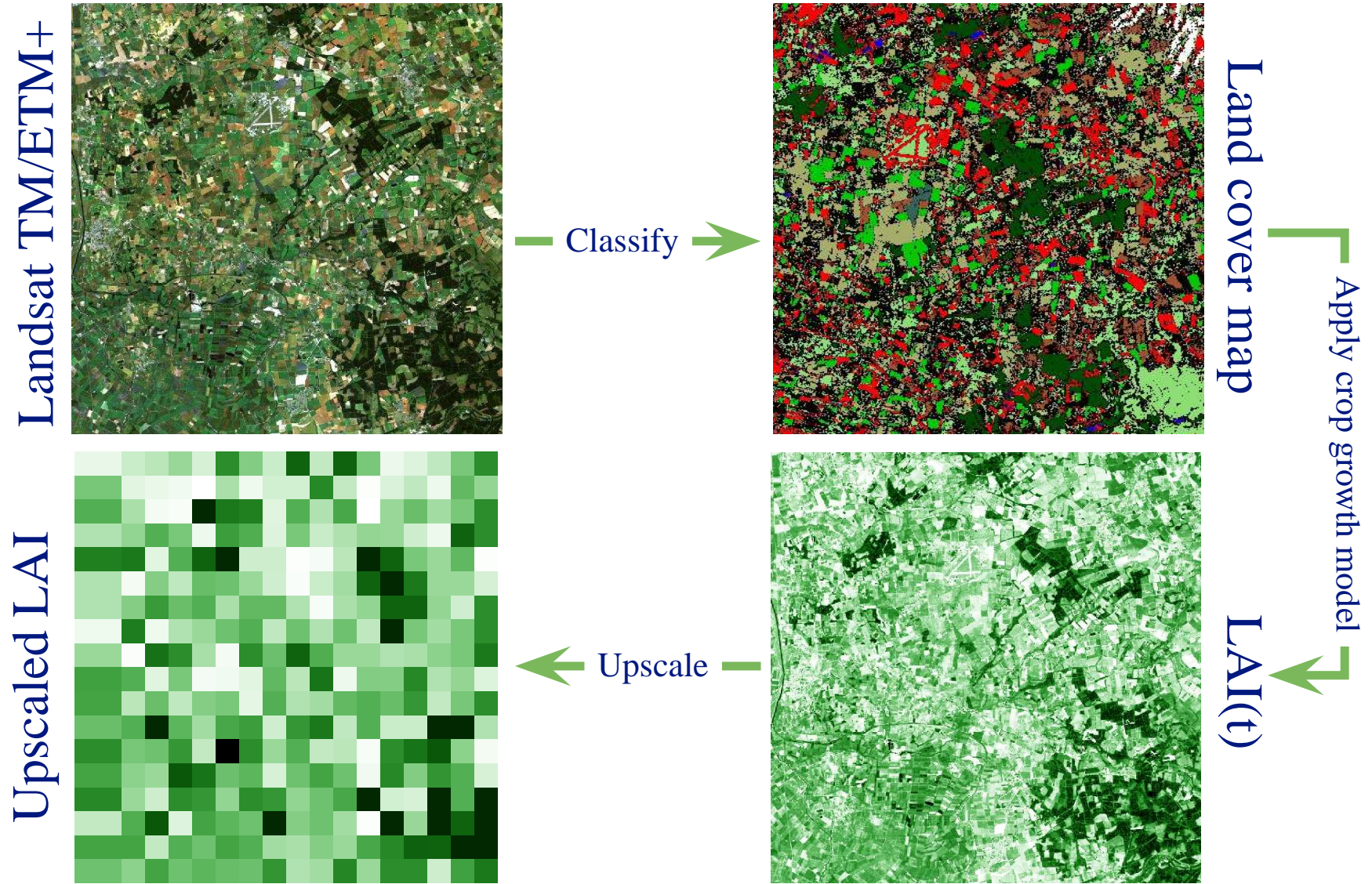
# Temporal Upscaling Method



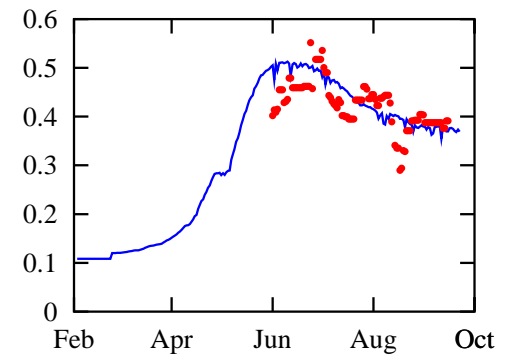
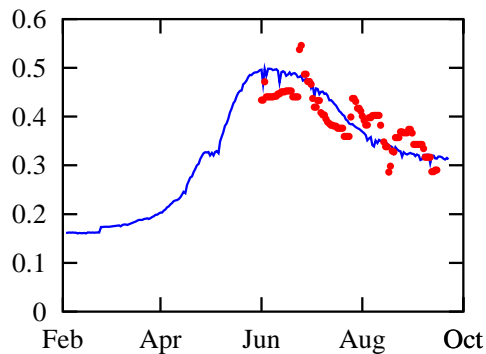
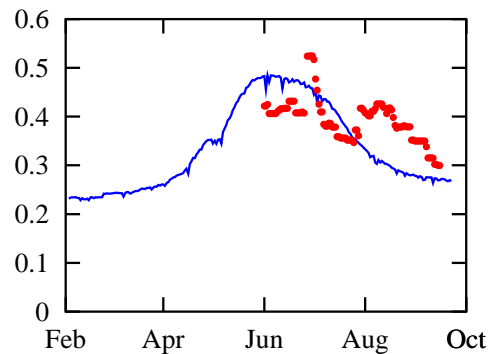
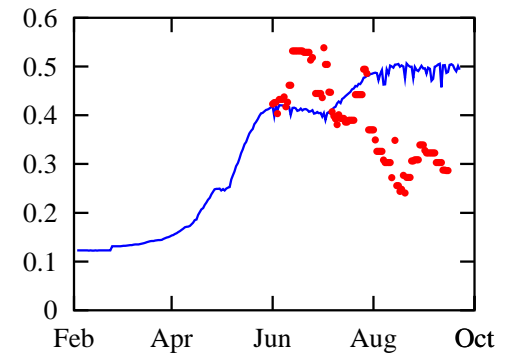
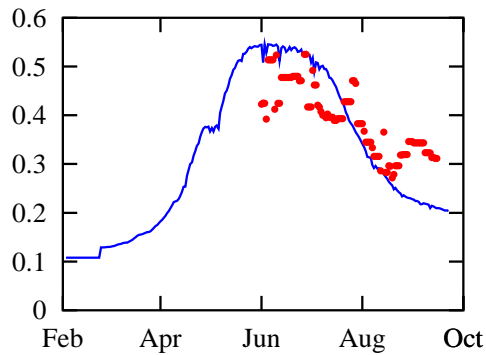
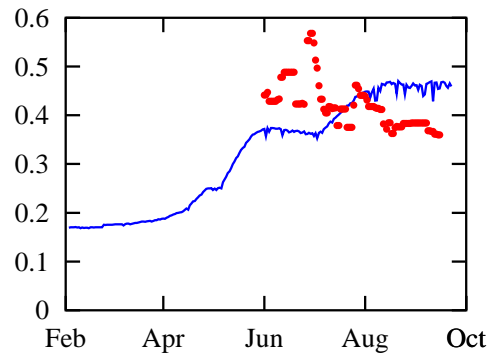
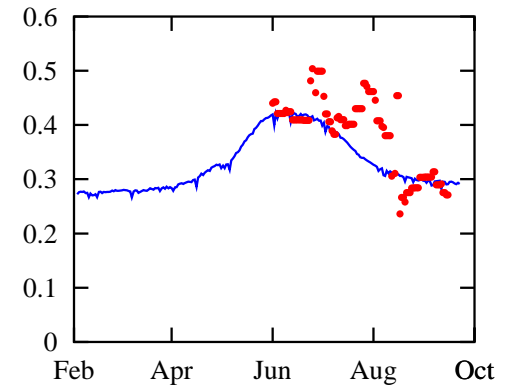
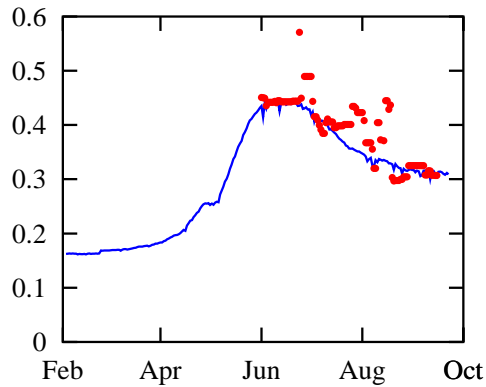
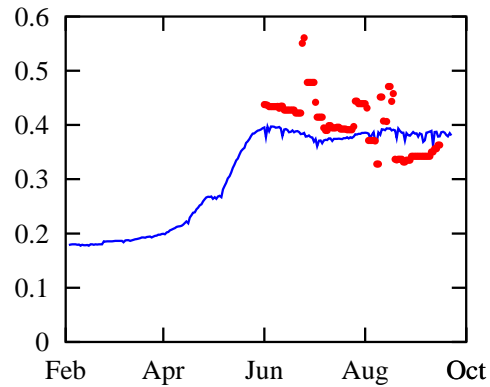
# Temporal trends in LAI



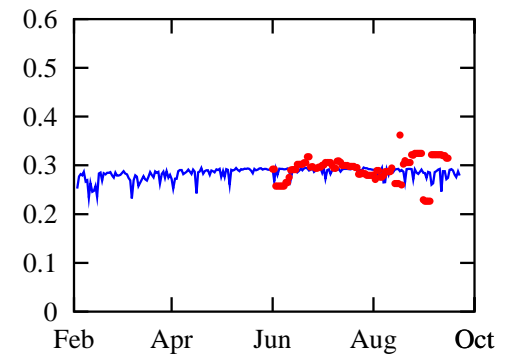
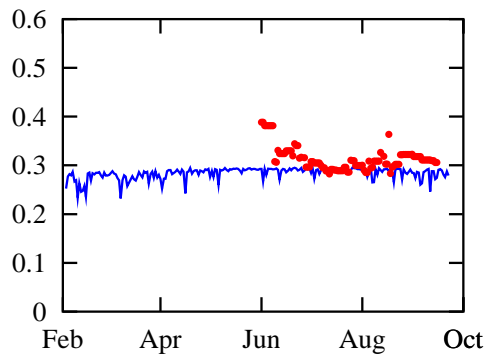
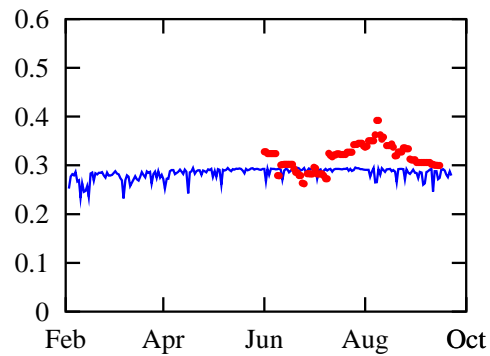
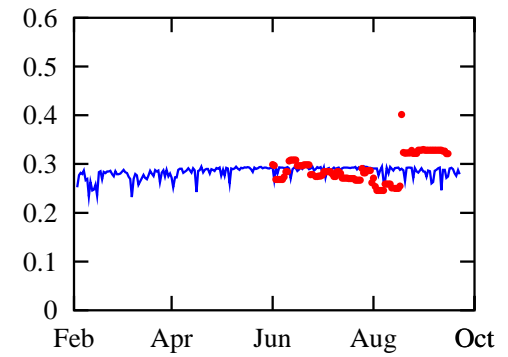
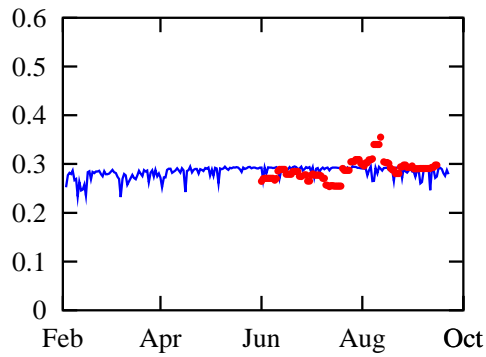
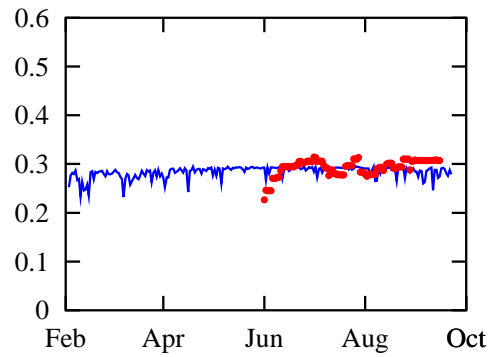
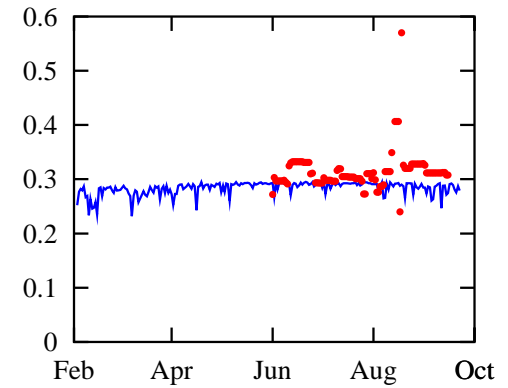
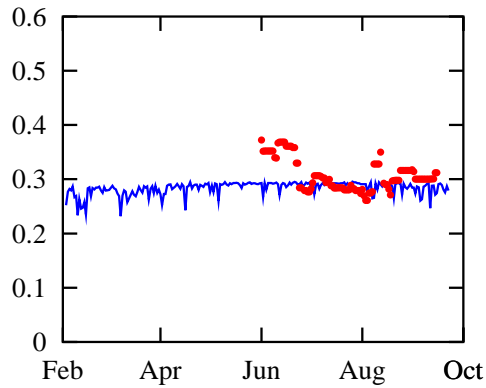
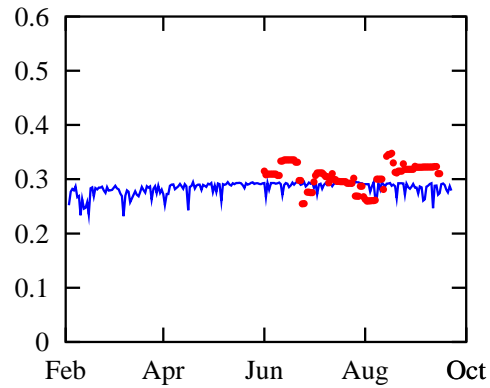
# Spatial Up-Scaling Method



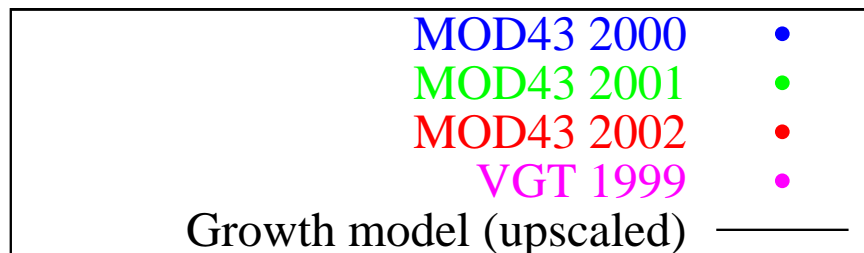
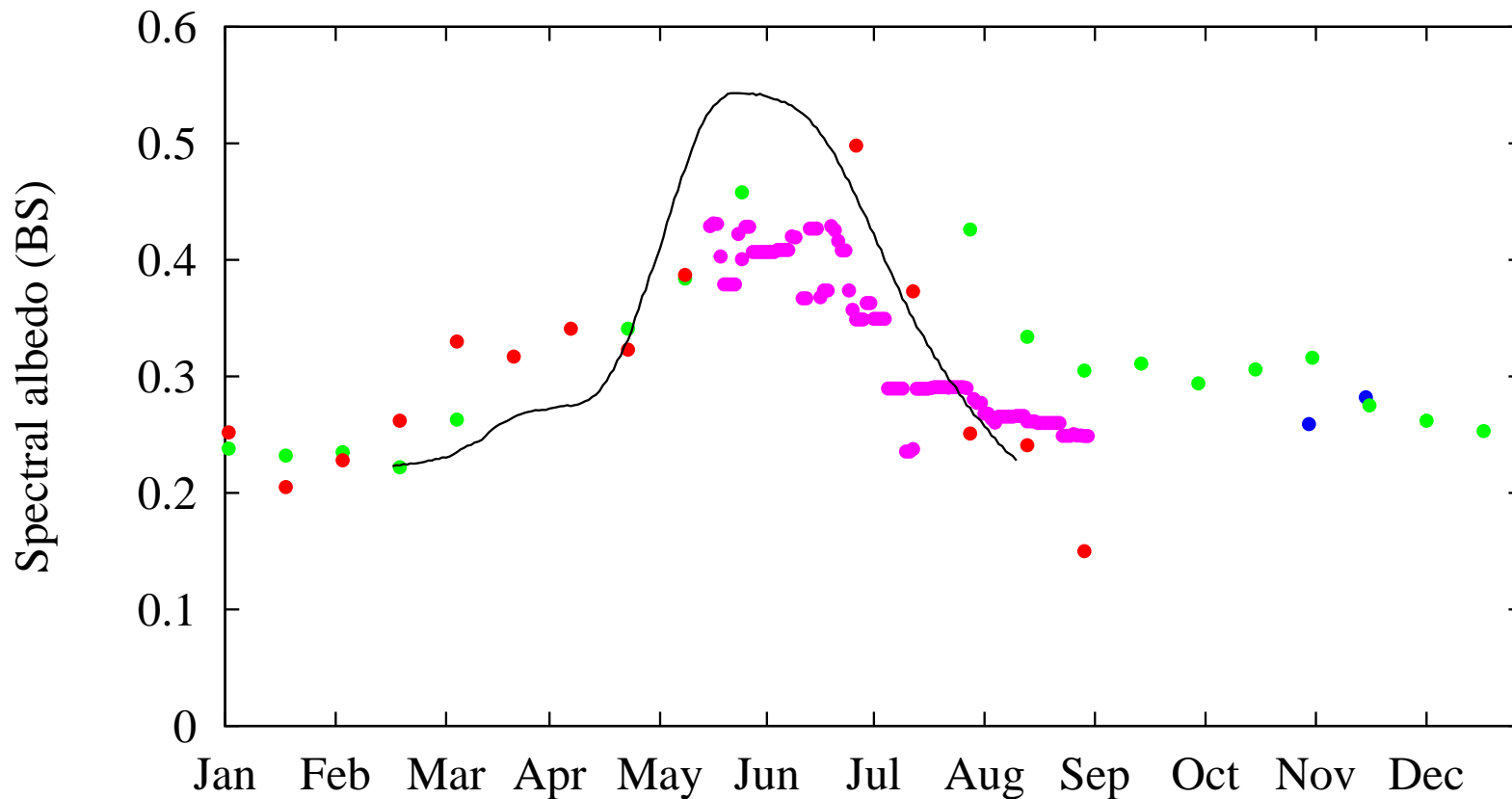
# VGT NBAR: Barton Bendish (NIR)



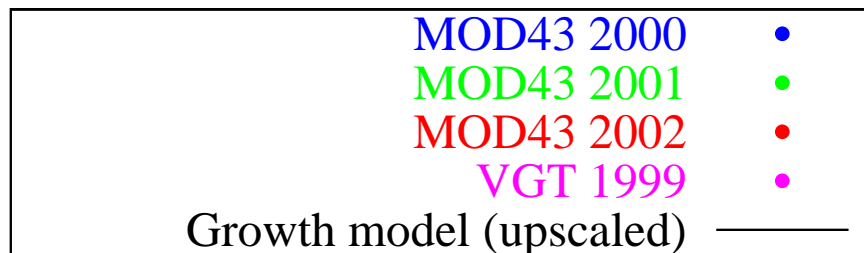
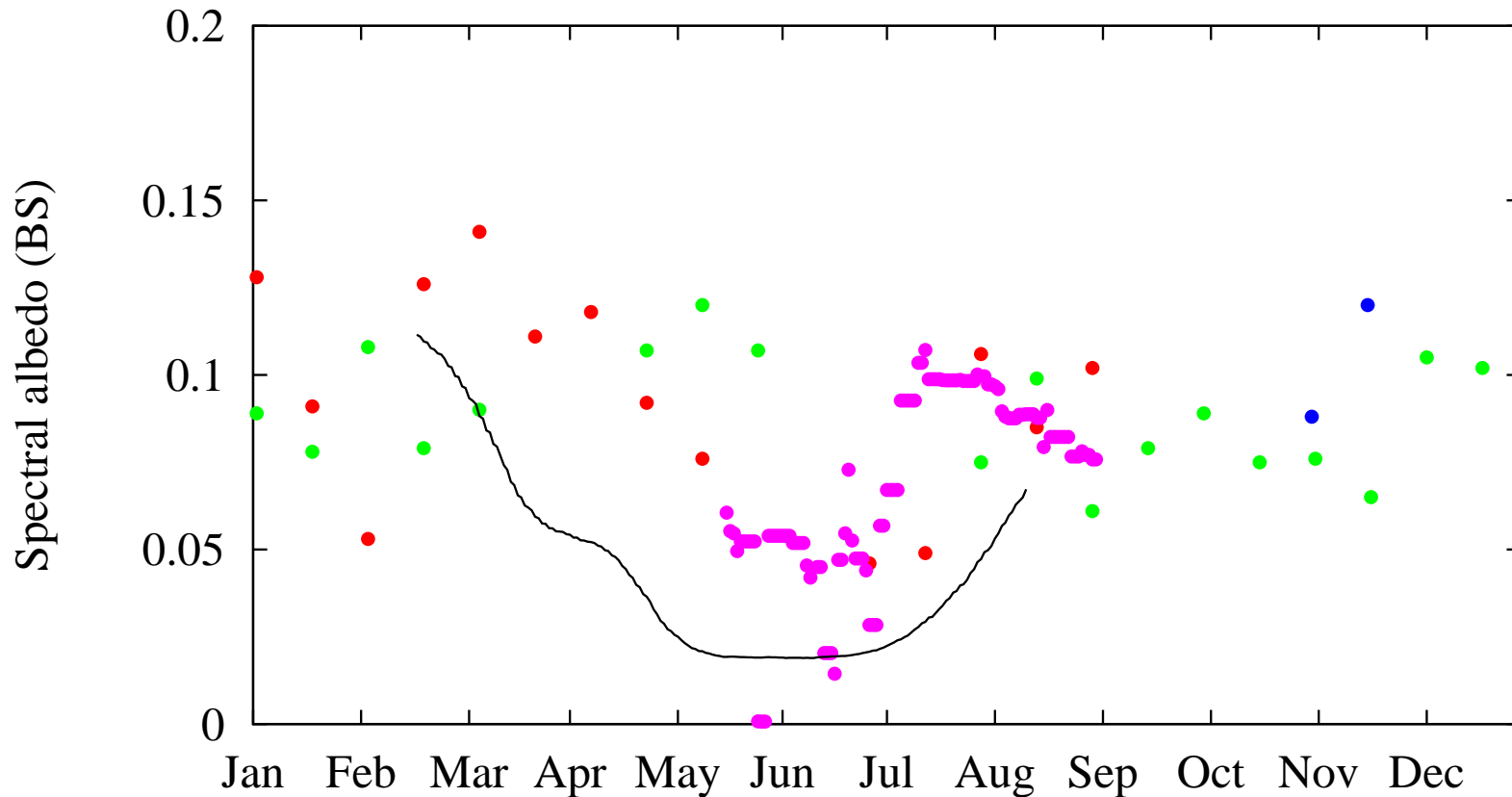
# VGT NBAR: Thetford Forest (NIR)



# MOD43 & VGT BS Albedo (NIR)



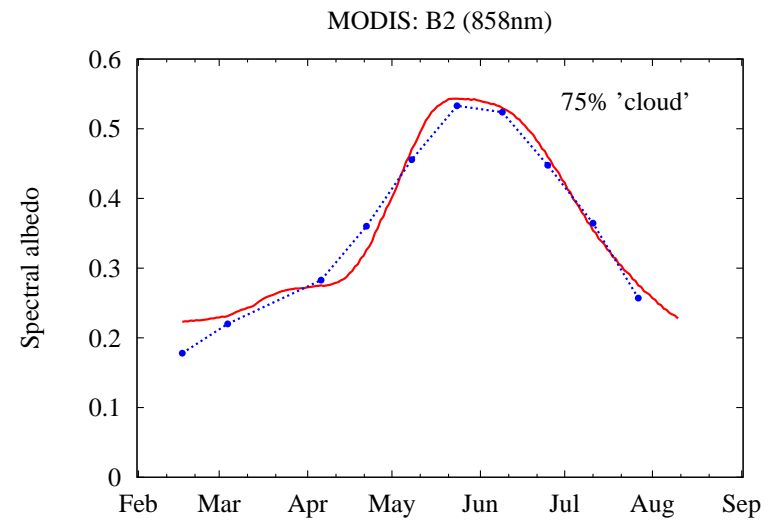
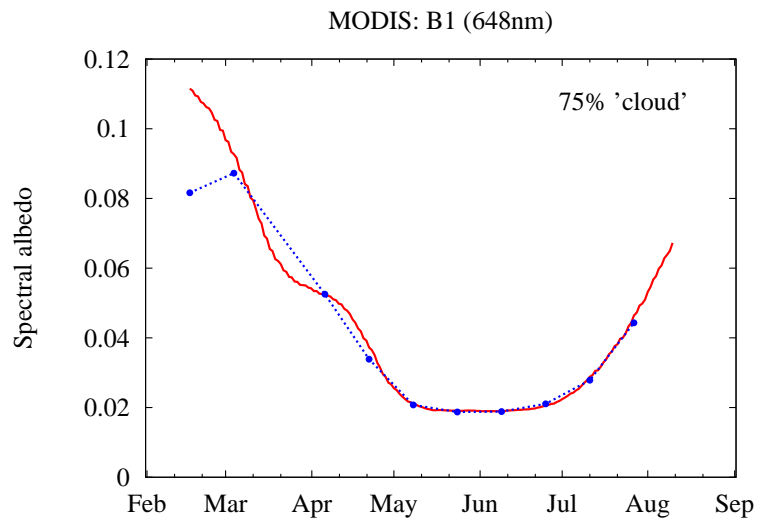
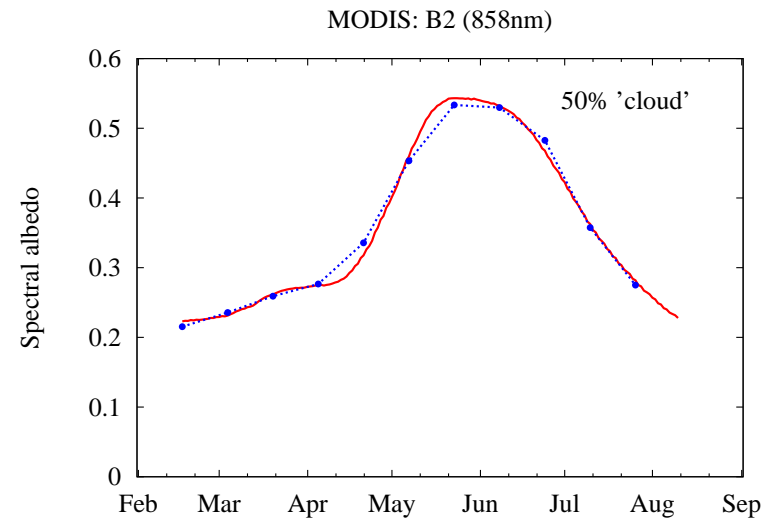
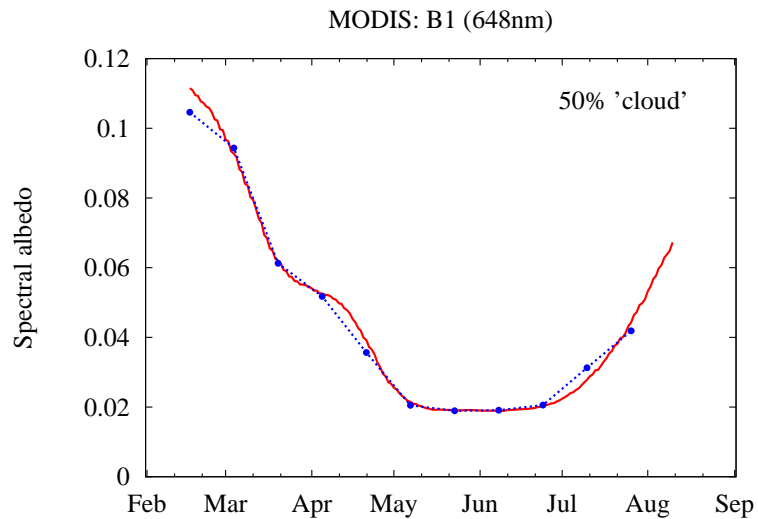
# MOD43 & VGT BS Albedo (Red)



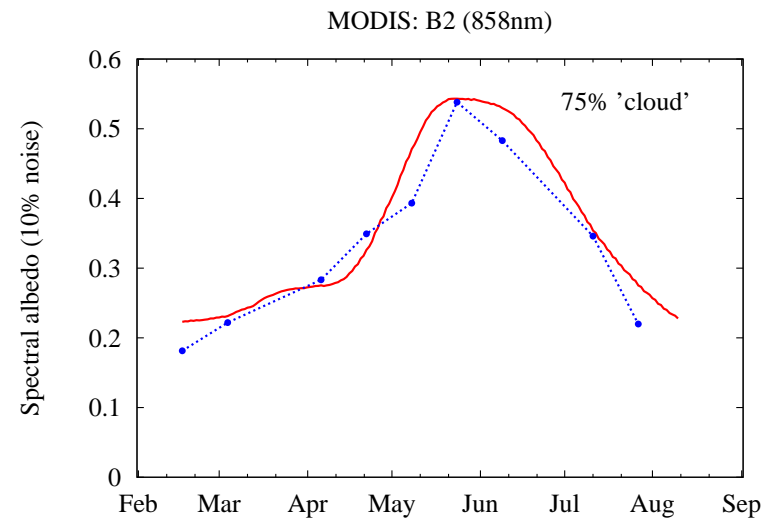
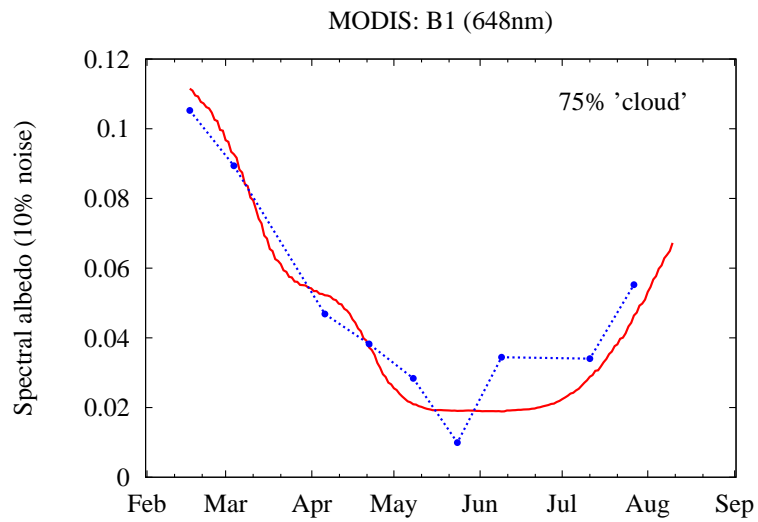
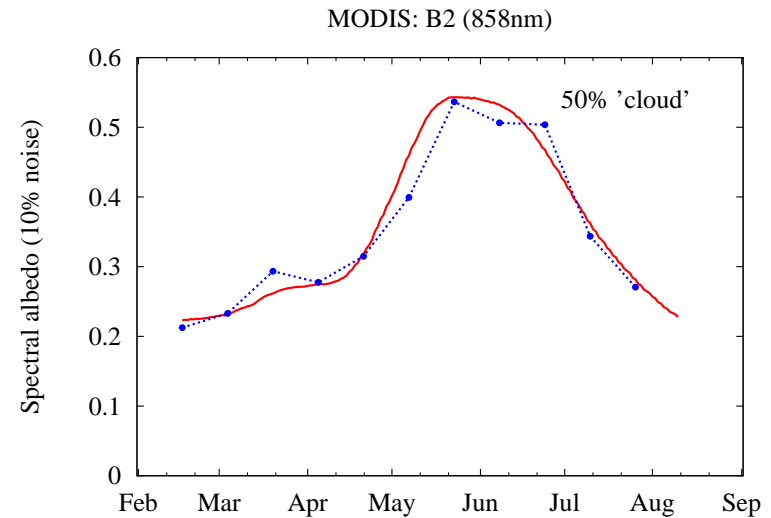
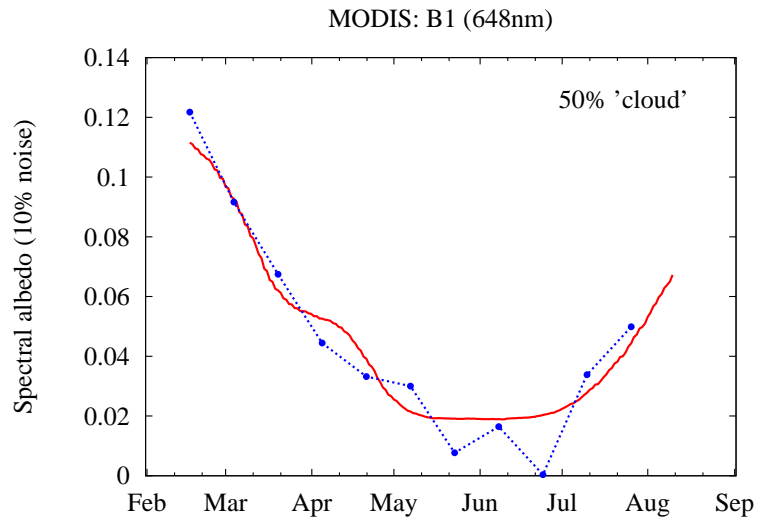
# Understanding Signal Variability

- Simulate temporal profiles of wheat LAI using plant growth model (SUCROS2)
- Predict directional reflectances using canopy reflectance model (Kuusk)
- Invert AMBRALS and produce simulated black-sky albedo
- Investigate effect of missing samples (cloud cover) and additive noise.

# Impact of Missing Samples



# Impact of 10% Noise Variance



# Noise and Missing Samples

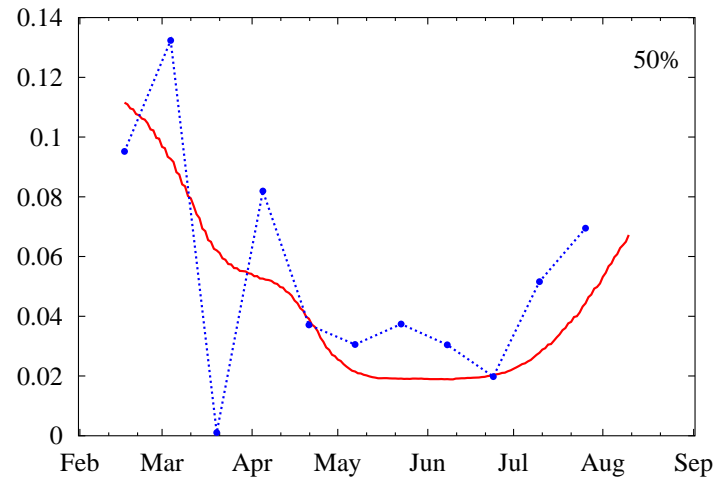
- Models and angular sampling capable of replicating spectral albedo variations
- Sensitivity to 10% noise for 75% cloud cover can lead to up to
  - 0.1 error in black-sky albedo in the NIR, and
  - 0.015 error in black-sky albedo in the red.

# Conclusions

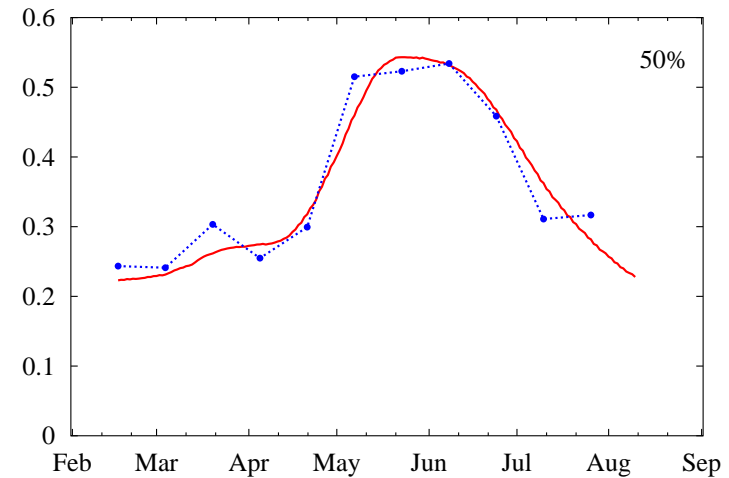
- MOD43 (magnitude inversion) self-consistent year-to-year and broadly consistent with equivalent SPOT-VGT (full inversions, 30-day sliding window)
- Narrow-to-broadband conversion of MOD43 produces similar results to spectral integration of HyMAP data (caveats: different year, no BRDF)
- Method of upscaling via plant growth models to validate MOD43 seems promising
  - Temporal profiles of MOD43/VGT spectral albedo generally consistent with expected trends
- Simulation study suggests AMBRALS reasonably robust to loss of angular samples, but sensitive to additive noise (particularly kernel weights)
- Consider using changing from 'block moving-window' approach in inversion to >16-day 'sliding window' method

# Impact of 20% Noise Variance

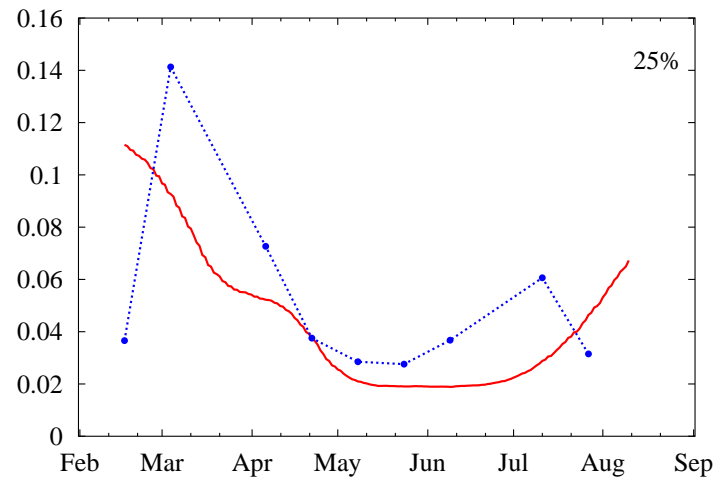
MODIS: B1 (648nm)



MODIS: B2 (858nm)



MODIS: B1 (648nm)



MODIS: B2 (858nm)

