Surface Spectral Albedo VAP

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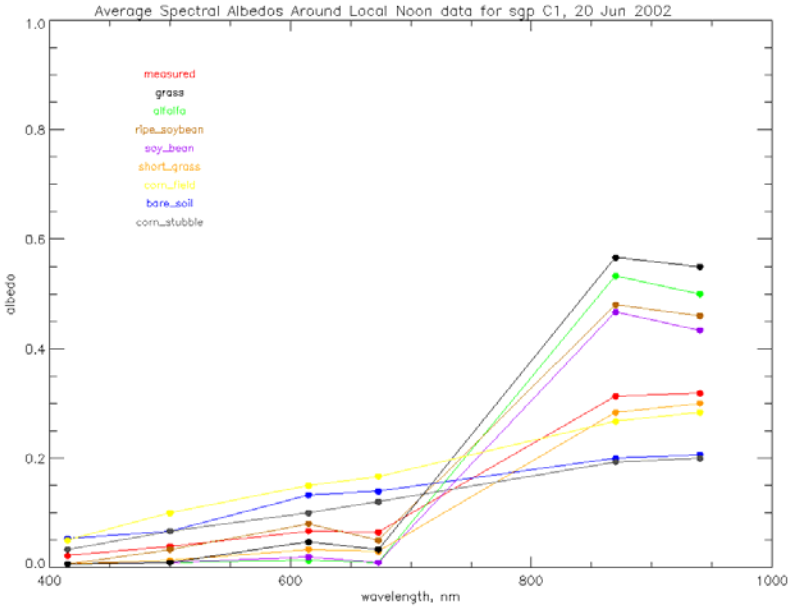
- Objective: produce high-resolution surface spectral albedo for use in radiative transfer calculations
  - Based on methodology developed by Eli Mlawer for BBHRP
- Uses 6-channel upward-looking MFRSRs and downward-looking MFRs on 10m and 25m towers at SGP
  - Quality assess albedos; fill in missing values
  - This ‘Best Estimate MFR tower albedo’ will be released as separate VAP
- Predict surface type
  - snow, brown, vegetated, or partial vegetation
- Estimate high-resolution spectral albedo given MFR values
  - Algorithm developed by Mlawer uses information from spectral albedo libraries to predict behavior in extended spectral range given surface type and albedo at MFR wavelengths
- Caveats:
  - Not currently considering cloud effect on albedos or heterogeneity of surface albedo which are required for BBHRP/SW QME efforts

Identify Surface Type

- Examination of spectral albedo libraries and MFR data indicates we can identify 4 surface types:
  - Snow
  - Green vegetation (veg)
  - Partial vegetation (partial veg)
  - Brown vegetation or soil (non-veg)

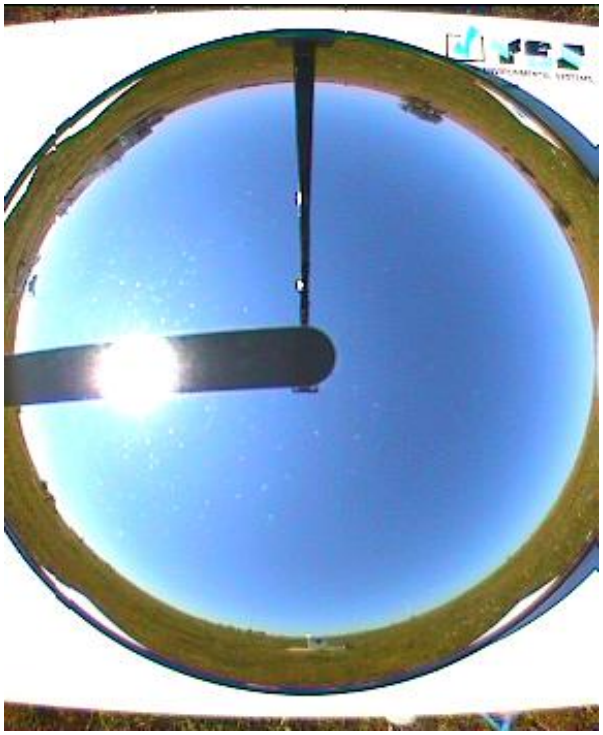


- Use SGP surface log (sgpsurflogC1.c1) and TSI images to identify 100% vegetation and non-vegetation cases
- Note:
  - 10m tower is in un-mown pasture
  - 60m tower is in field: winter wheat before 2005 and corn after

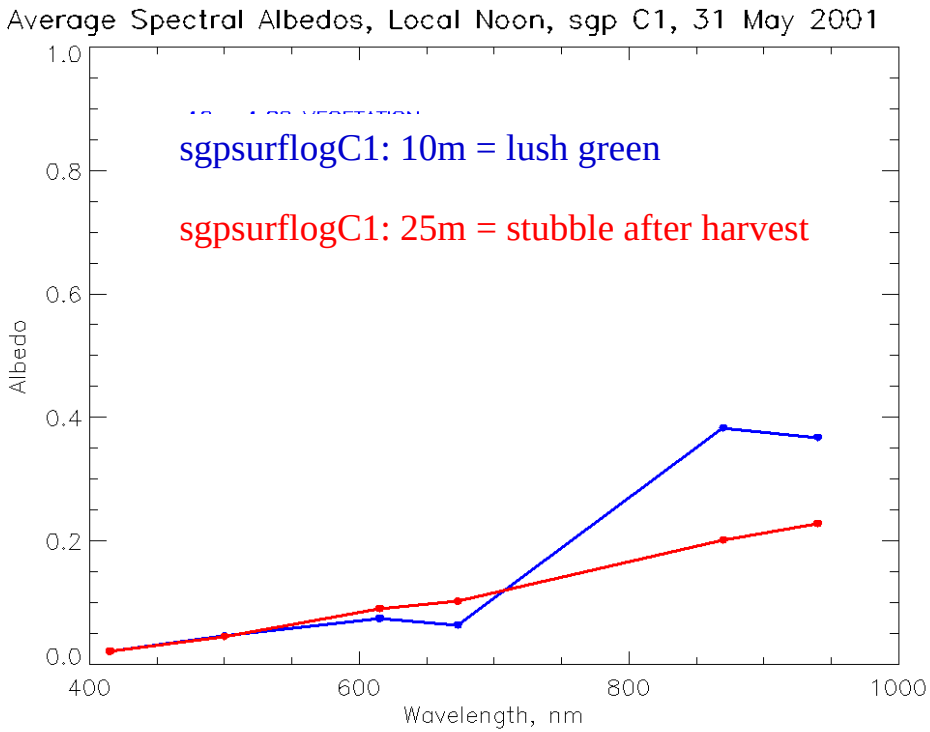
Surface type example: 100% veg

TSI near 10 m tower

Surface type example: 0% veg

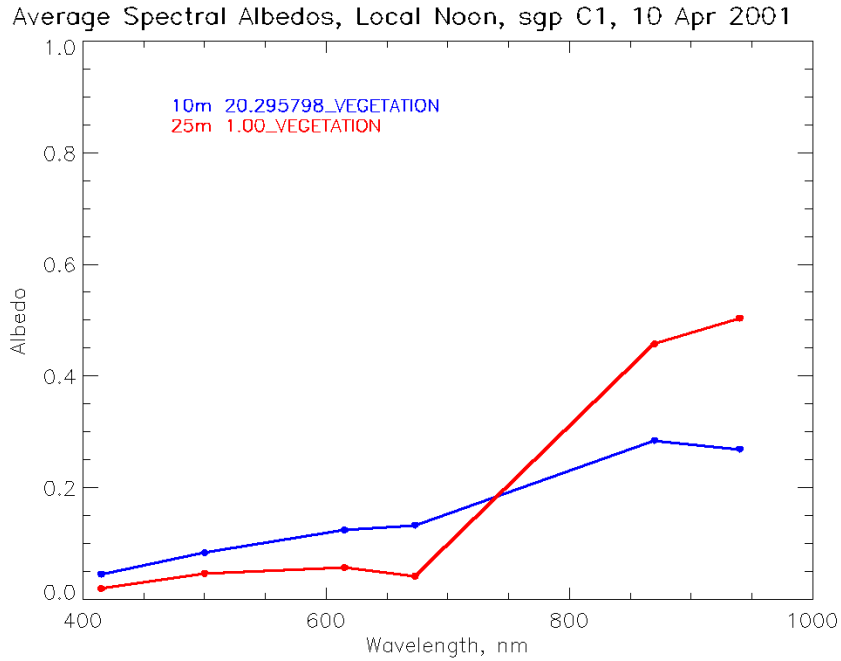


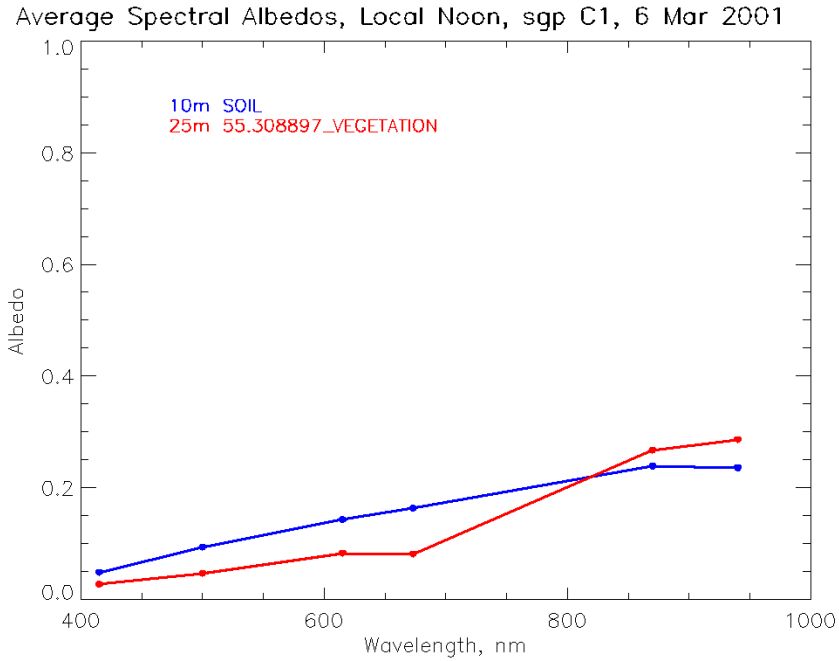
TSI near 10 m tower



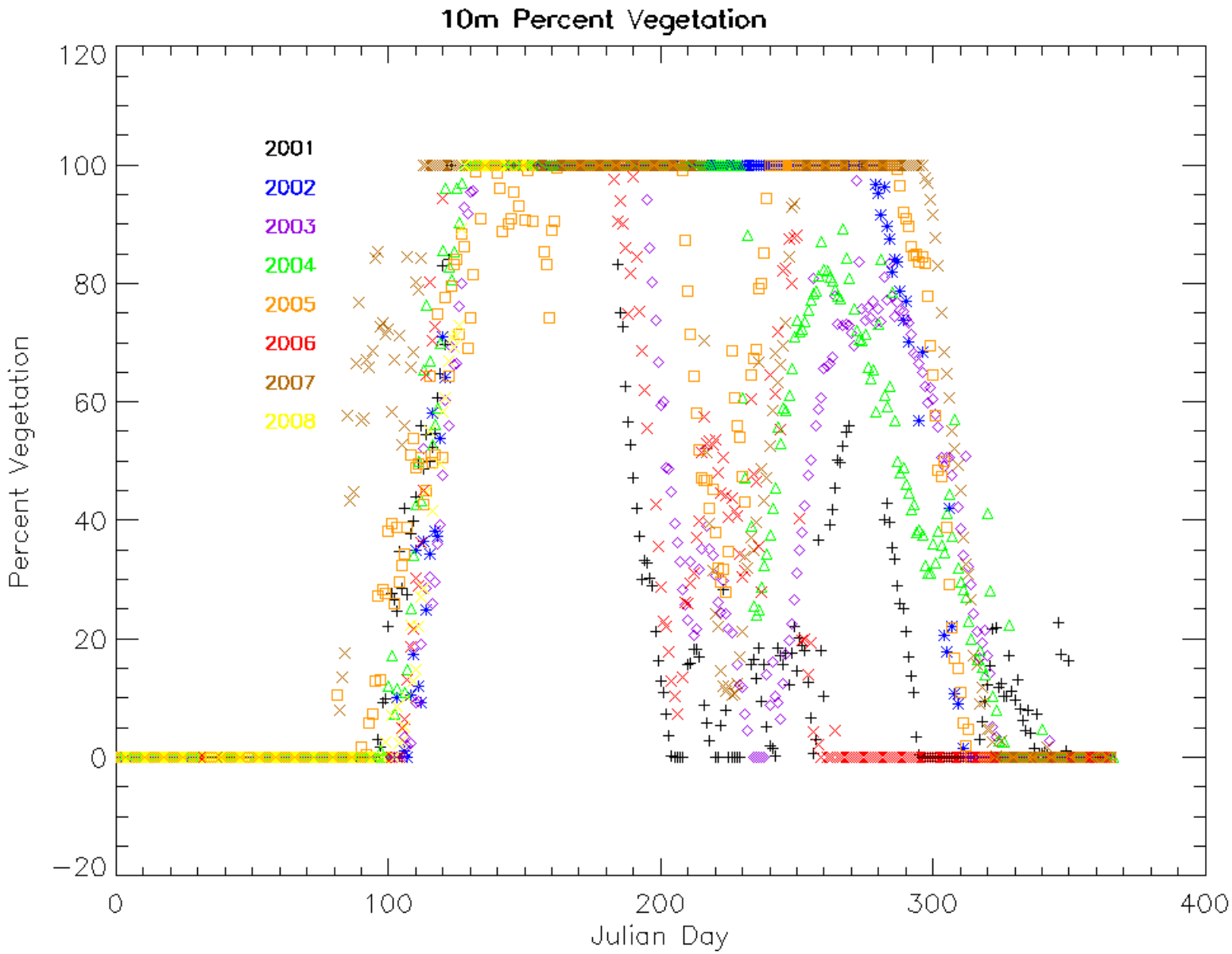
Identify Surface Type

- Use NDVI = (NIR-RED)/(NIR + RED) to distinguish between veg, partial veg, and non-veg
- Set thresholds based on identified 100% and 0% veg cases; estimate percentage vegetated as linear fit between 0 and 100% vegetated

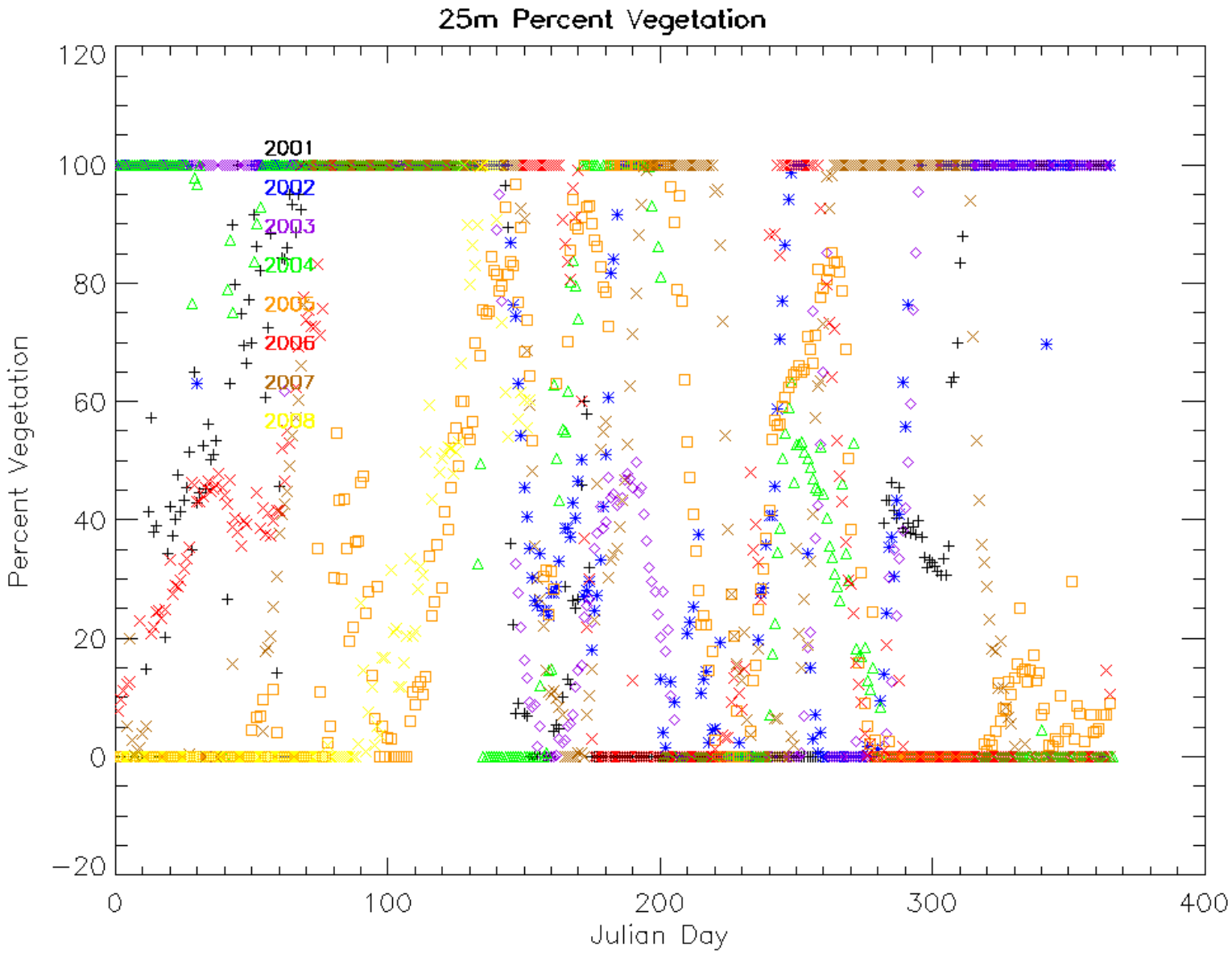


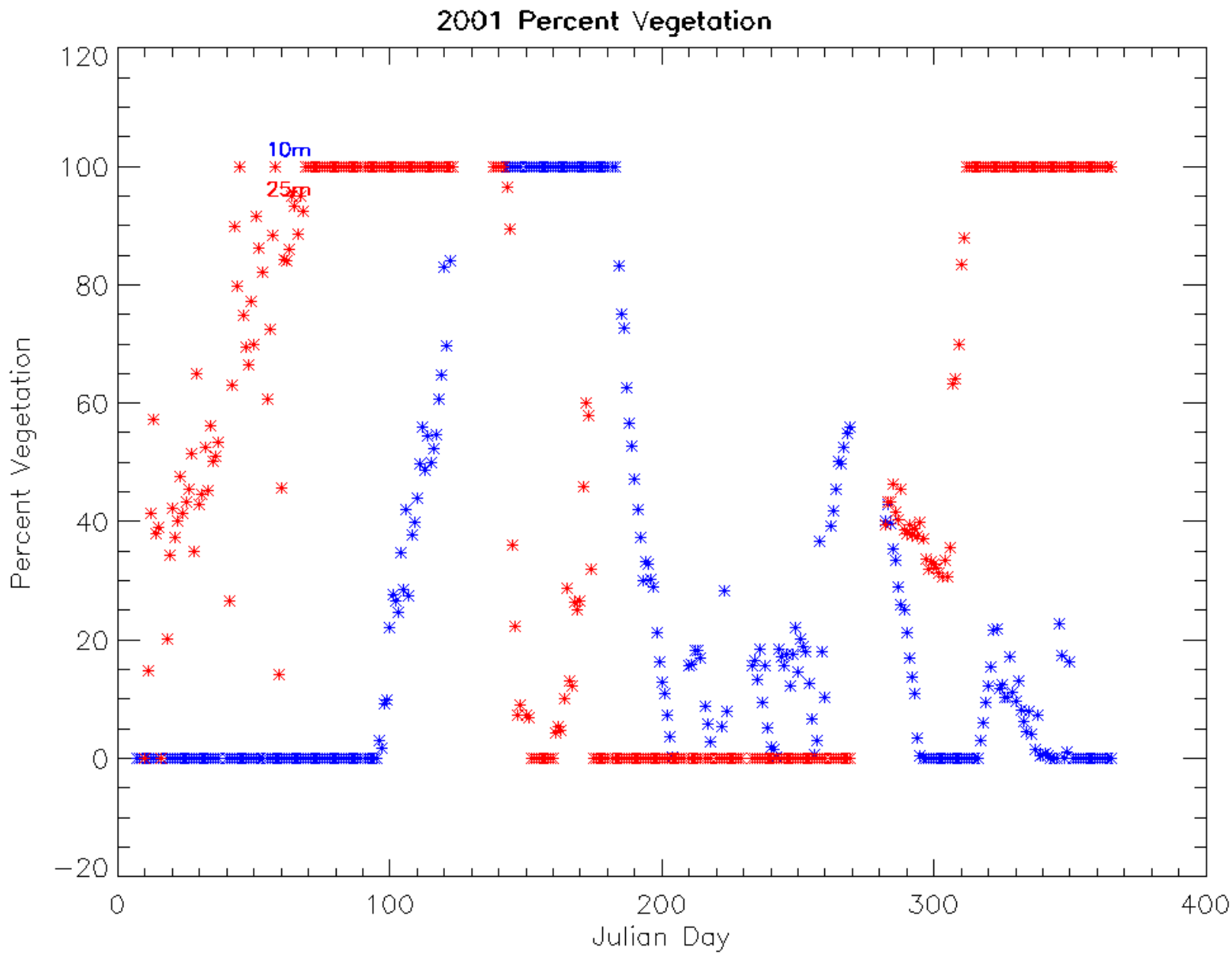


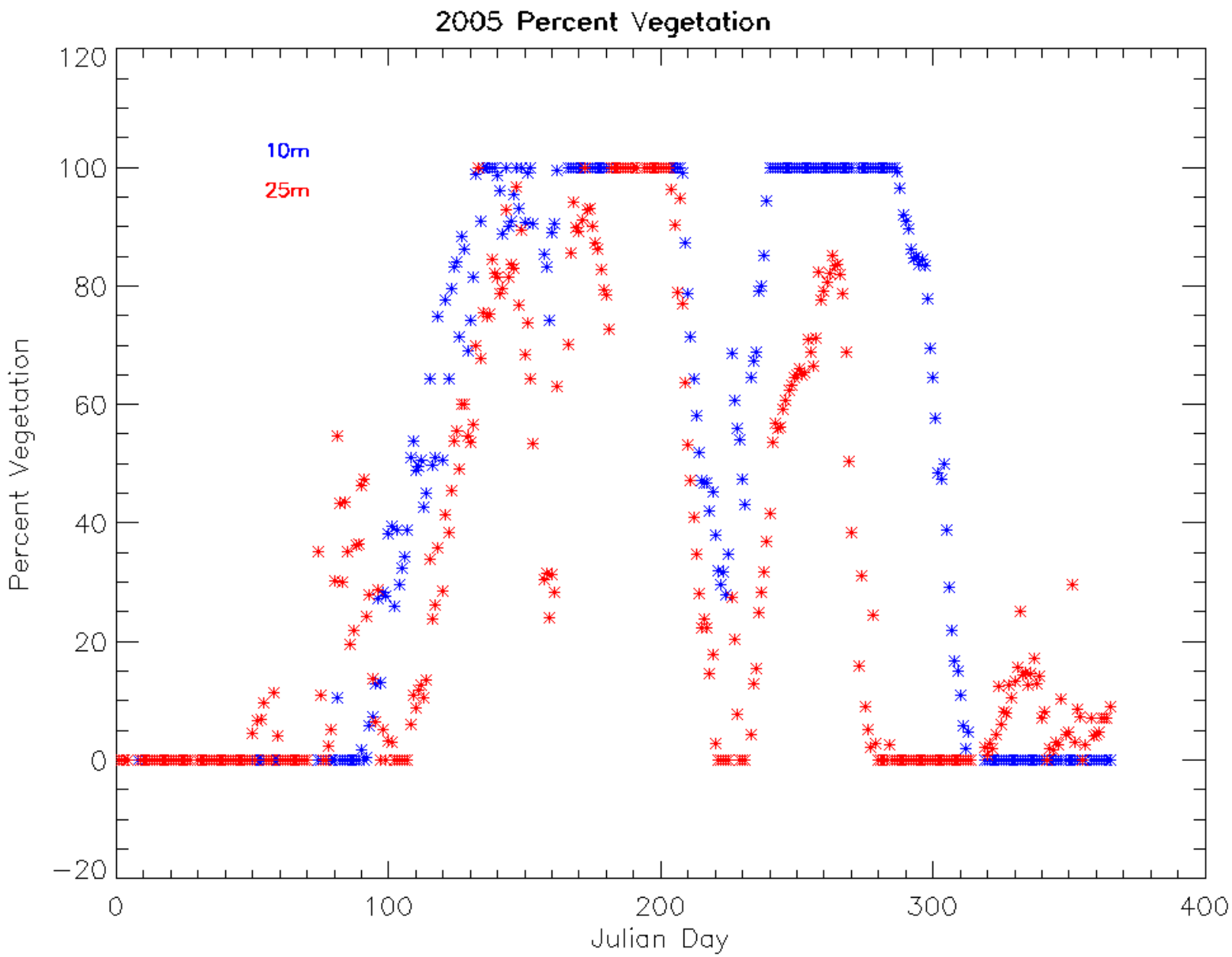
Surface Type from the 10m Tower



Surface Type from the 60m Tower




2001 Percent Vegetation
10m
25m
Percent Vegetation
Julian Day
120
100
80
60
40
20
0
−20
0
100
200
300
400

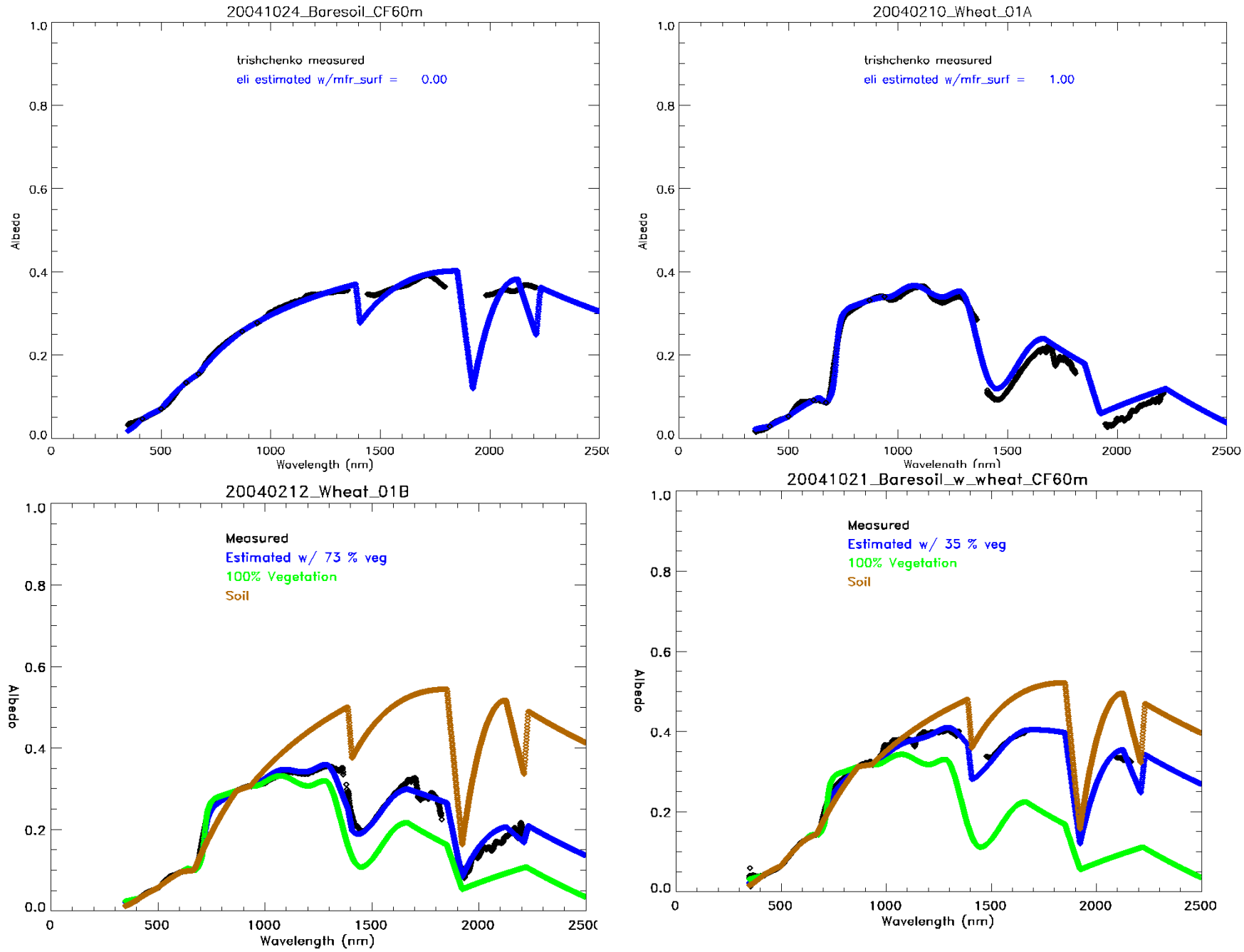

2005 Percent Vegetation
10m
25m
Percent Vegetation
Julian Day
120
100
80
60
40
20
0
−20
0
100
200
300
400

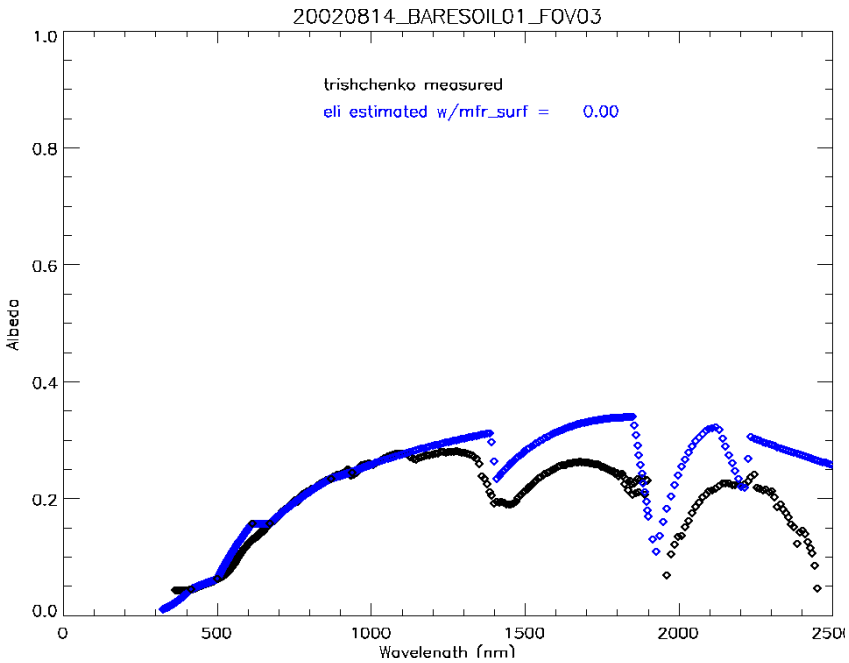
Estimate Spectral Surface Albedo

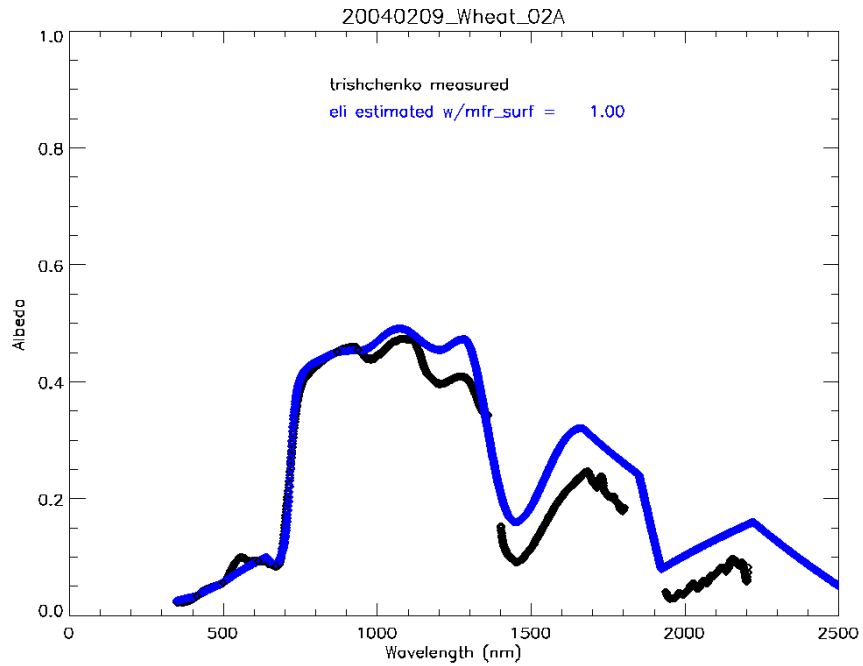
- Given surface type & 6 MFR albedos, estimate high spectral resolution surface albedo
- Algorithm developed by E. Mlawer:
  - Examined spectral libraries of vegetation and soil
  - Identified 23 spectral regions with significant variations in albedo (bin boundaries differ for vegetation and soil)
  - Developed piecewise continuous function to estimate albedo in these regions given MFR values

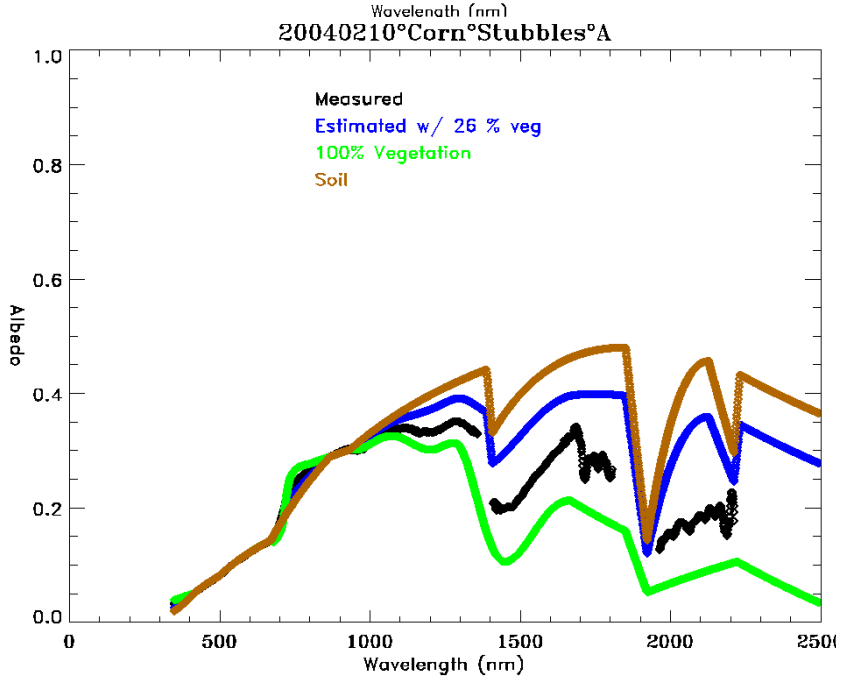
Evaluate Spectral Surface Albedo

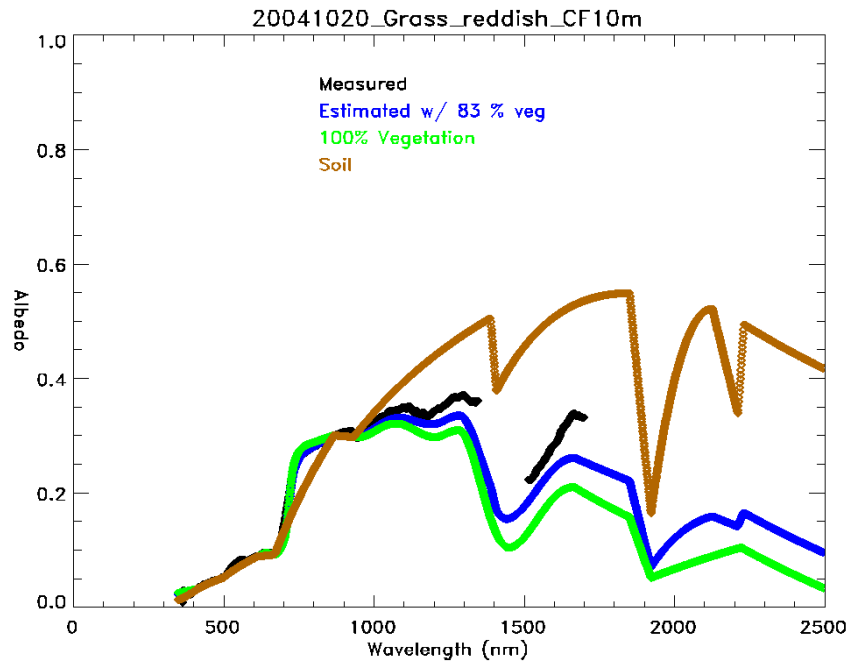
- Evaluate with data from Spectral Albedo IOPs performed at SGP by A. Trishchenko et al.
  - Aug 14 - 19, 2002 – GER3700 Spectroradiometer
  - Feb 8 – 12, 2004 - ASD Spectroradiometer
  - Oct 20 - 26, 2004 – ASD Spectroradiometer
- Given spectral albedo measurements:
  - Extract values at MFR wavelengths
  - Plug into algorithm; estimate spectral albedo
  - Compare estimated and measured albedos


20041024_Baresoil_CF60m
trishchenko measured
eli estimated w/mfr_surf = 0.00
Albedo
Wavelength (nm)
20040210_Wheat_01A
trishchenko measured
eli estimated w/mfr_surf = 1.00
Albedo
Wavelength (nm)
20040212_Wheat_01B
Measured
Estimated w/ 73 % veg
100% Vegetation
Soil
Albedo
Wavelength (nm)
20041021_Baresoil_w_wheat_CF60m
Measured
Estimated w/ 35 % veg
100% Vegetation
Soil
Albedo
Wavelength (nm)

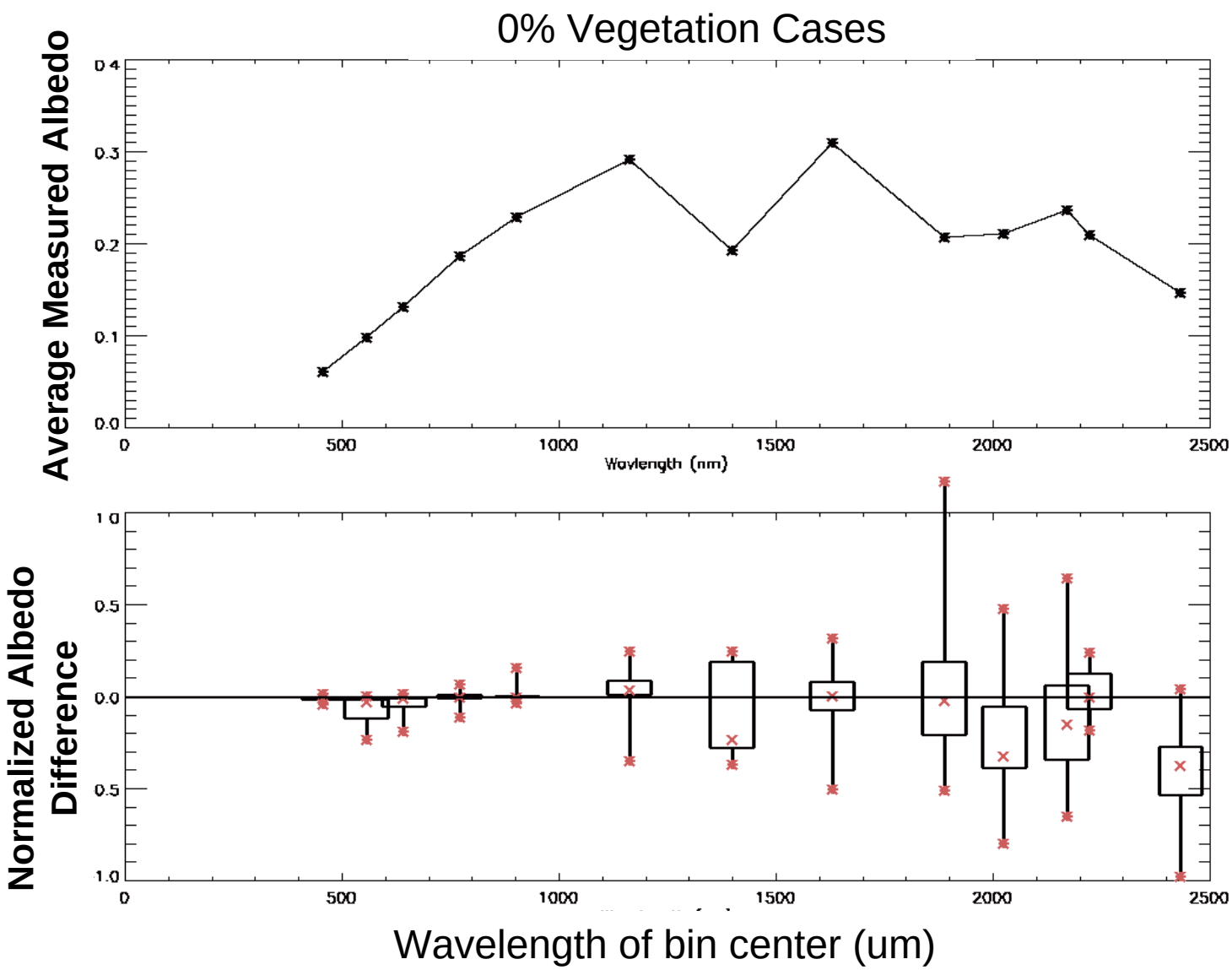

20020814_BARESOIL01_FOV03
trishchenko measured
eli estimated w/mfr_surf = 0.00
Albedo
Wavelength (nm)


20040209_Wheat_02A
trishchenko measured
eli estimated w/mfr_surf = 1.00
Albedo
Wavelength (nm)

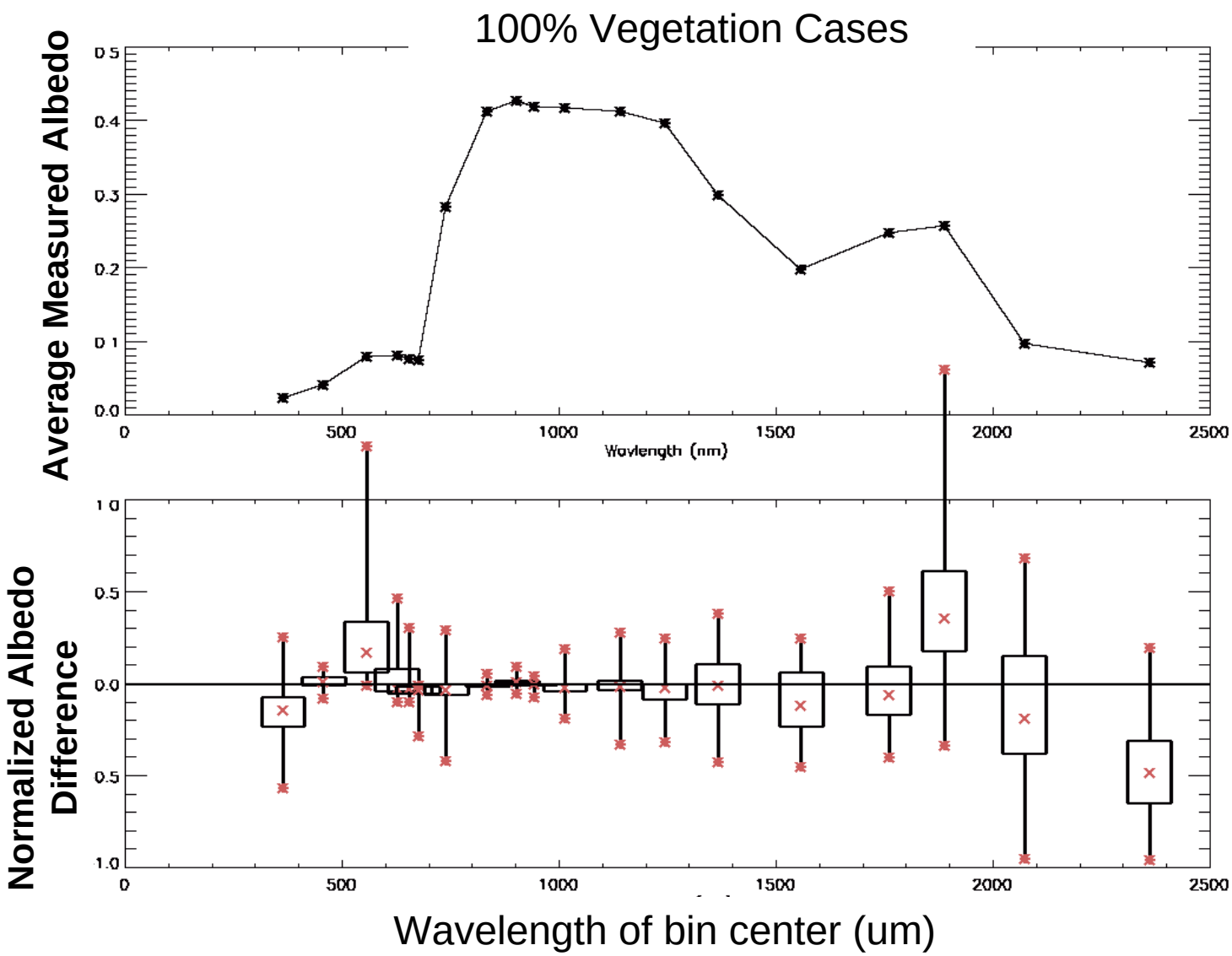

20040210°Corn°Stubbles°A
Measured
Estimated w/ 26 % veg
100% Vegetation
Soil
Albedo
Wavelength (nm)


20041020_Grass_reddish_CF10m
Measured
Estimated w/ 83 % veg
100% Vegetation
Soil
Albedo
Wavelength (nm)

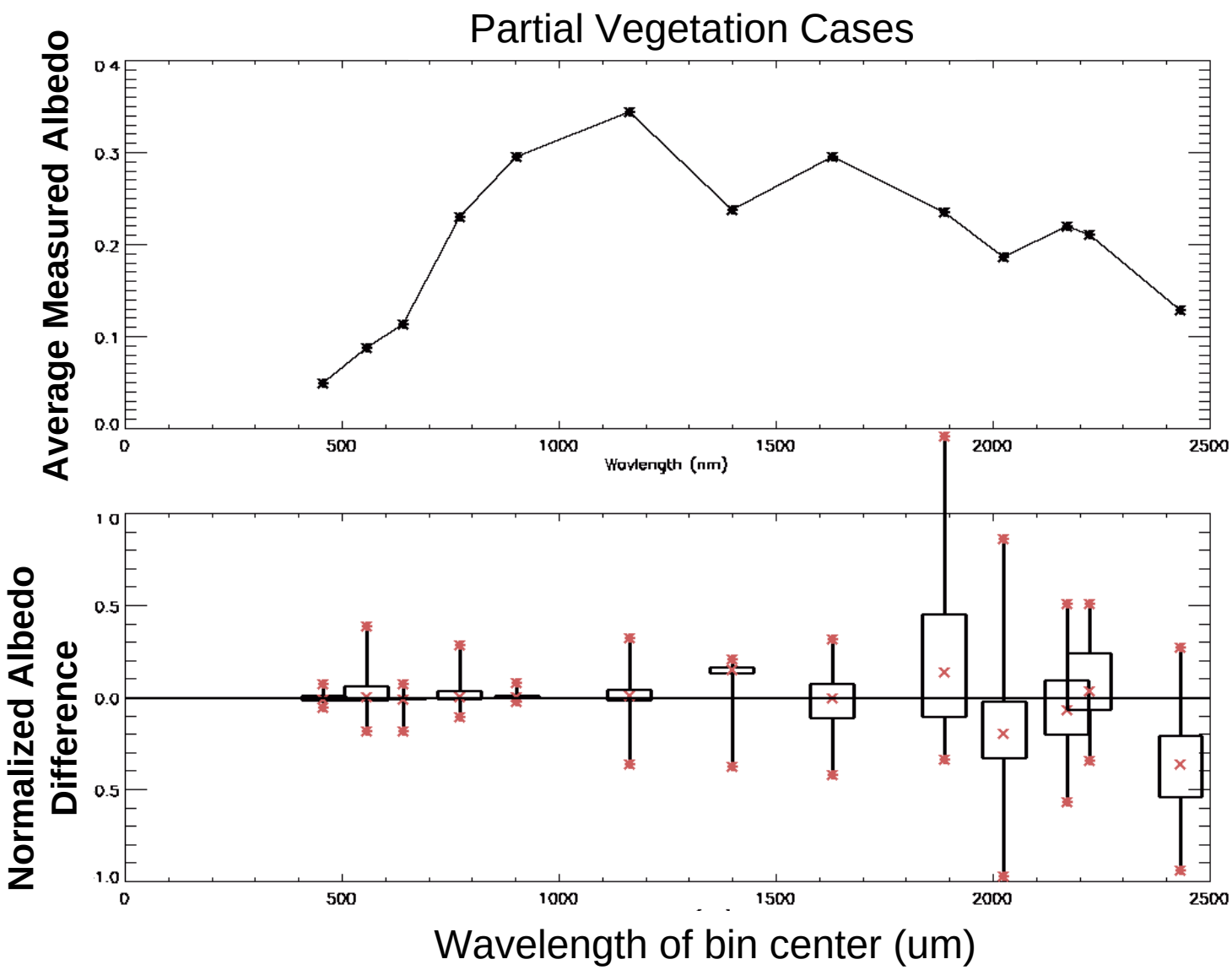
Statistics of spectral albedo evaluation



Statistics of spectral albedo evaluation

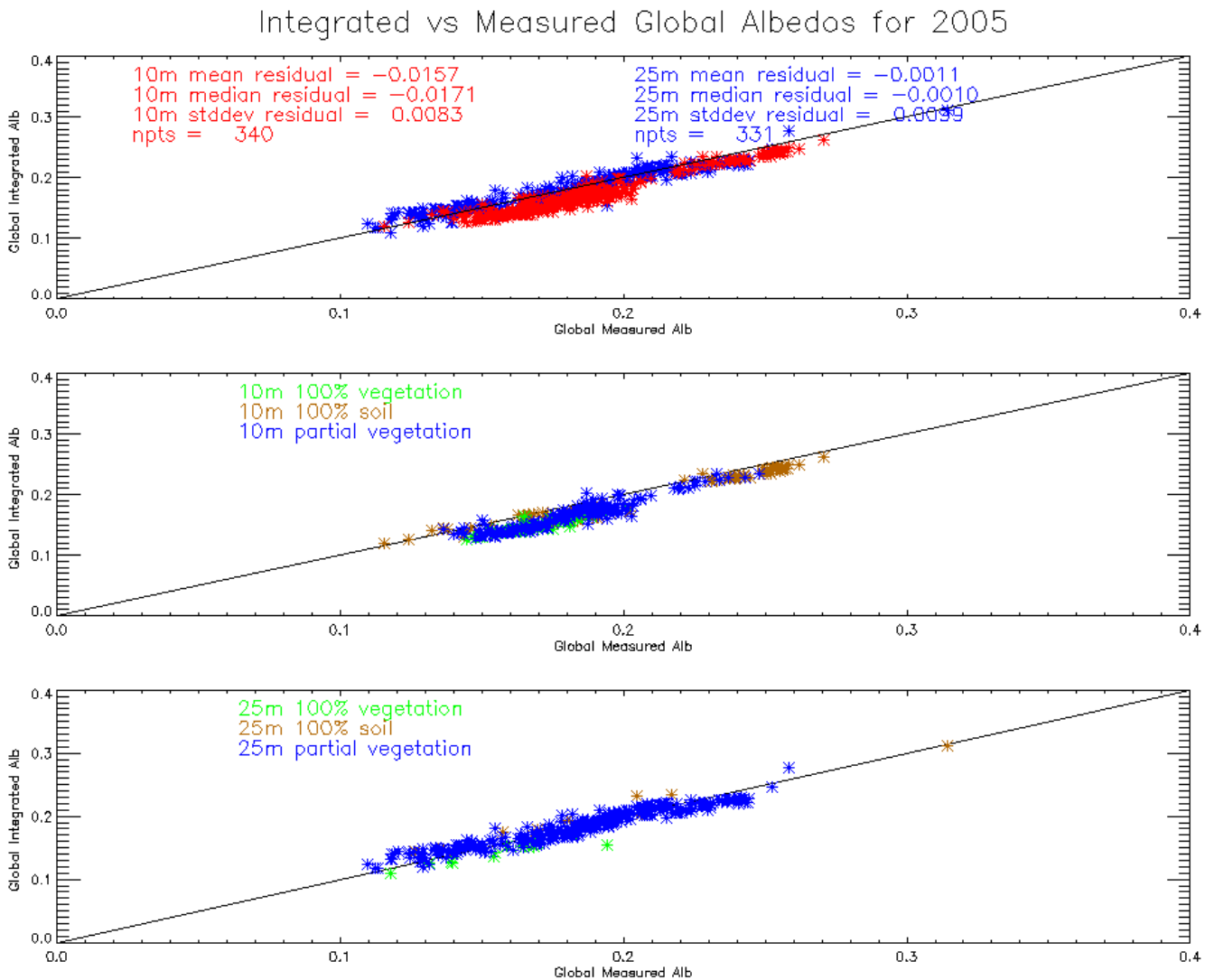


Statistics of spectral albedo evaluation

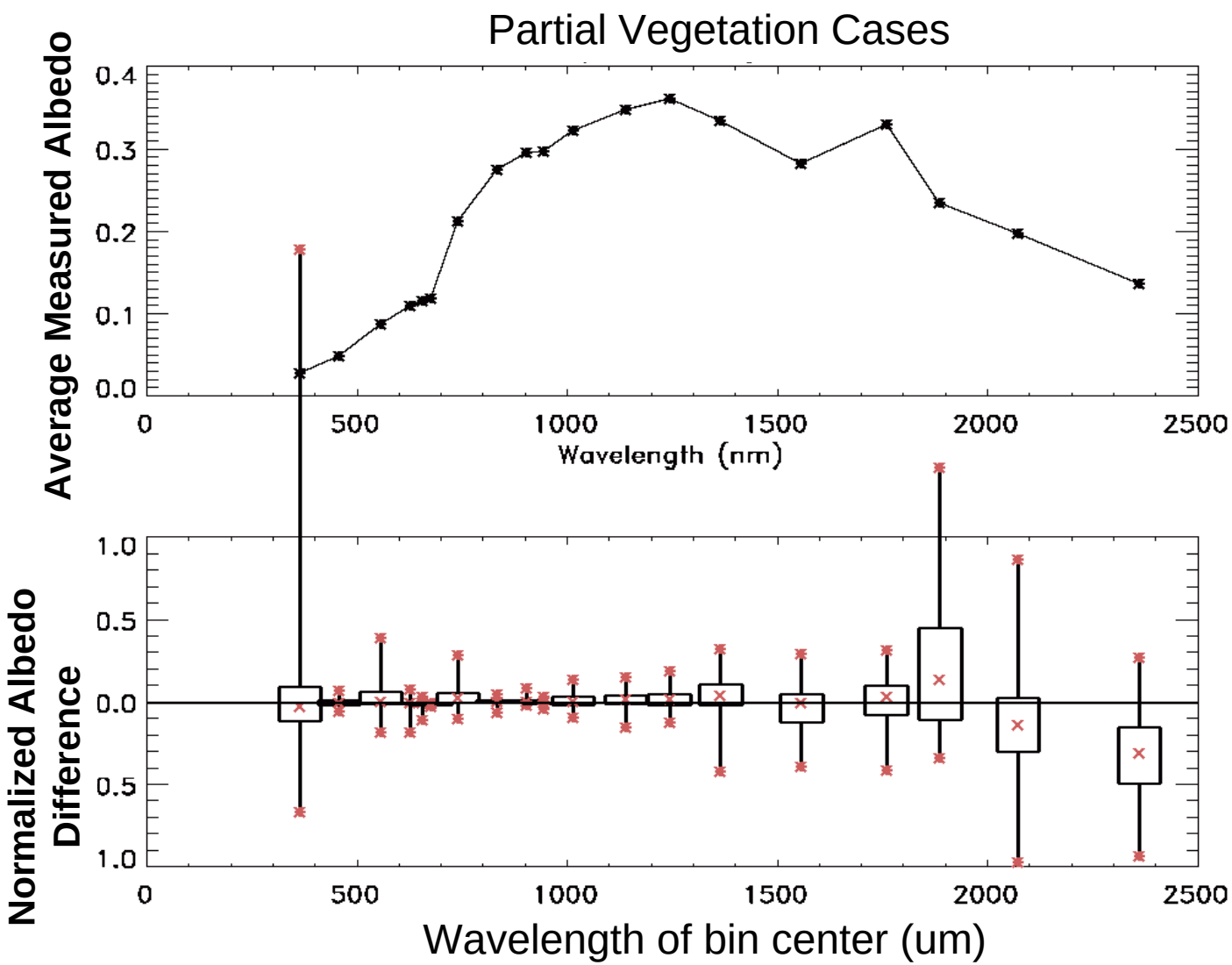


Broadband Albedo Evaluation

- Also evaluate spectral albedo by comparing integrated spectral albedo to measured broadband albedo from PSPs on towers



Next Steps

- Release VAP with Best Estimate MFR albedos
  - Work with Data Quality Office to monitor VAP and MFR performance
- Finish evaluation of spectral albedos
  - Possible issues for lambda > 1000 um identified in comparison to Trischenko data; emphasizes need for 1.6 um MFR channels
  - Small negative bias in 10m broadband albedo
  - Evaluate other methods of determining percent vegetation
- Technical report to document methodology & uncertainties
- Release surface type and spectral albedo as Evaluation Product
- Provide spectral albedos to BBHRP and SW QME efforts
  - Evaluation through these efforts may lead to updates/improvement in methodology
  - Treatment of spatial heterogeneity and cloud effect through these efforts
- Update algorithm when 1.6 um channels available on MFRs

Statistics of spectral albedo evaluation