BRDF Update

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OCO-2 Science Team Meeting
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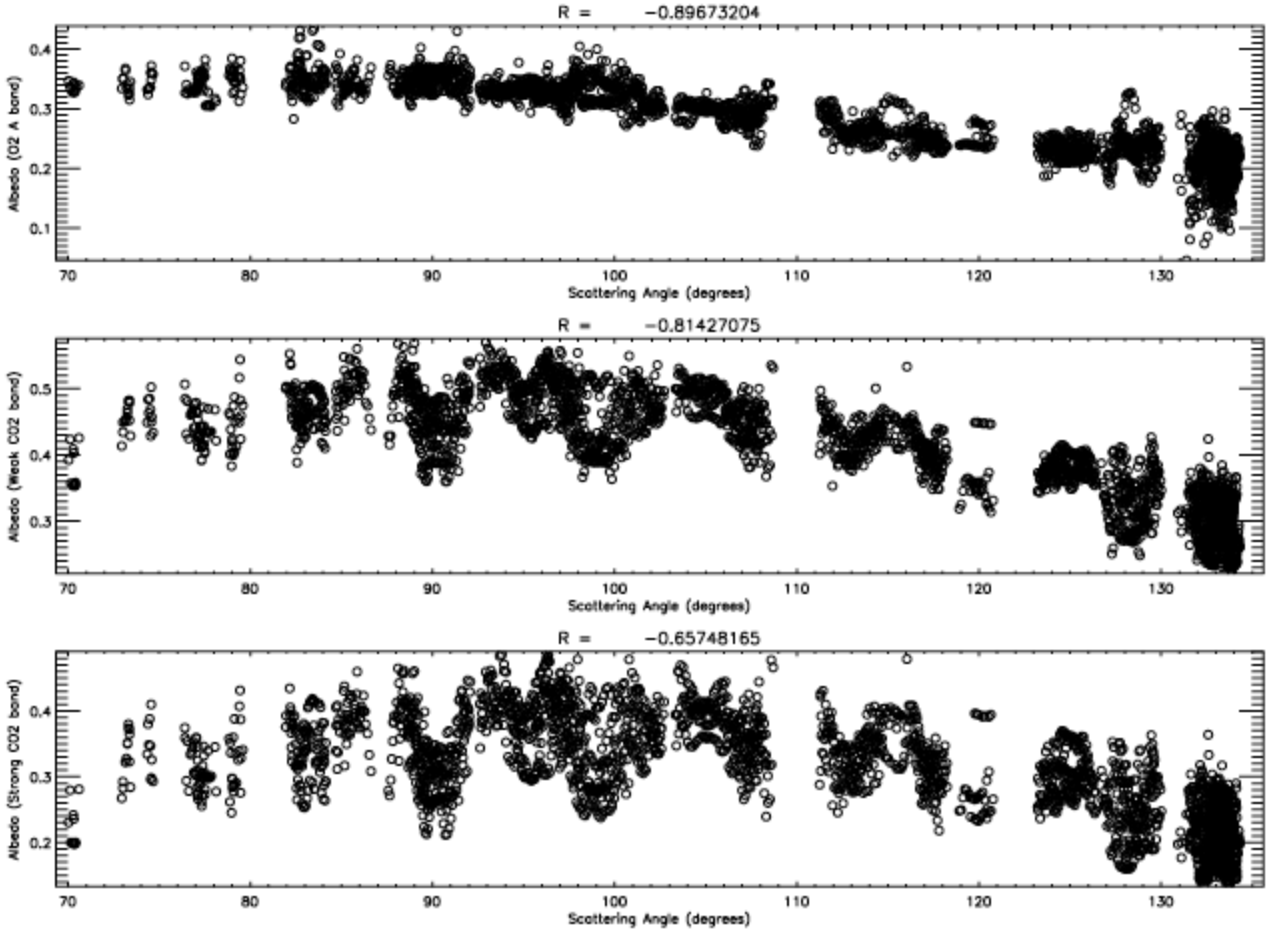
Albedo vs Scattering Angle



Retrieved albedo correlated with scattering angle => BRDF effects?

BRDF Formulation

$$BRDF(\lambda) = \left[w + s(\lambda - \lambda_0)\right] F(p_1, p_2)$$

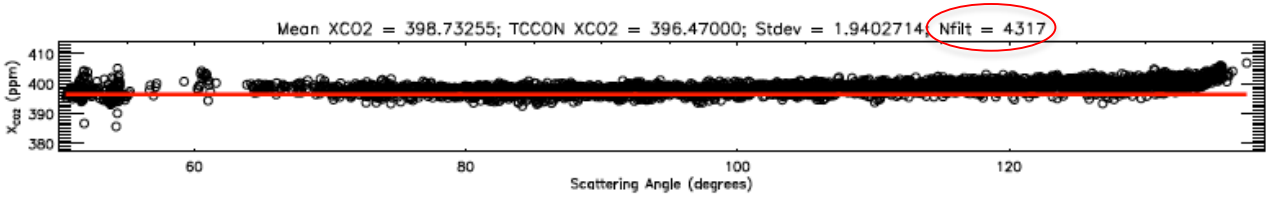
- w: overall BRDF amplitude
- s: slope of BRDF amplitude
- λ: wavelength
- λ_0: central wavelength (where parameters are retrieved)
- F: function describing BRDF shape
- F has slightly different forms for bare soil and vegetated surfaces
- BRDF kernel reduces to Lambertian kernel for certain choice of F
- p_1 and/or p_2 can be retrieved or held fixed

Target Mode Tests

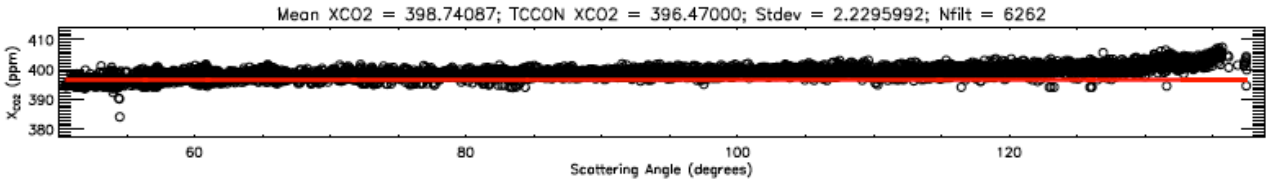
Retrieved XCO2

Number of filtered, converged scenes

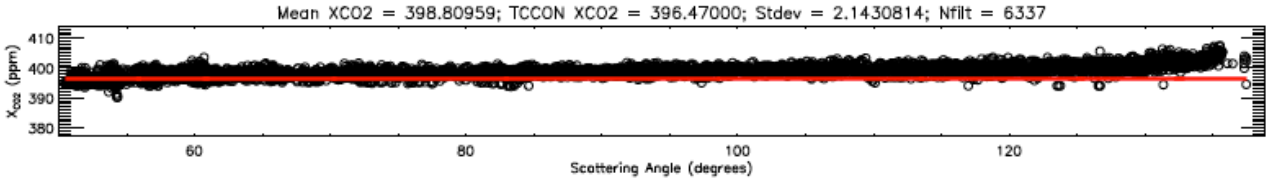
Lambertian



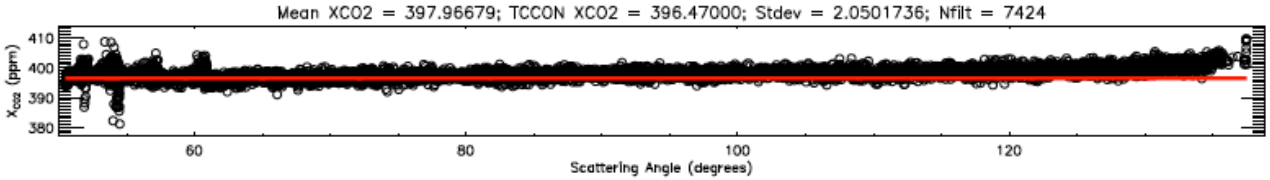
Soil BRDF, p_1, p_2 retrieved



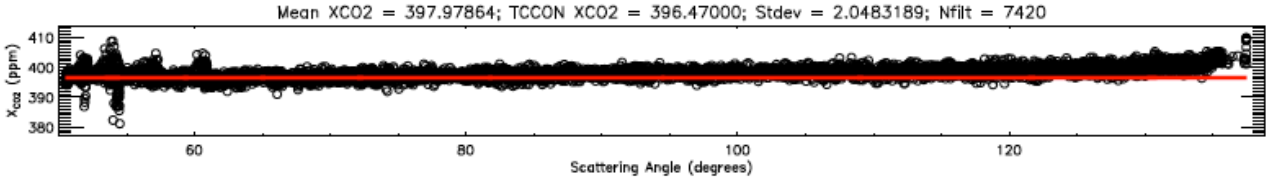
Veg BRDF, p_1, p_2 retrieved



Soil BRDF, p_1, p_2 not retrieved



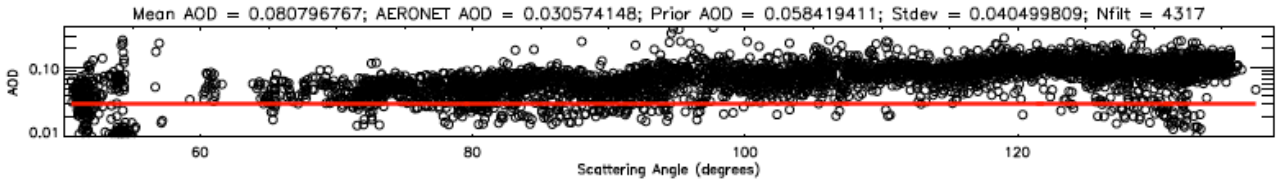
Veg BRDF, p_1, p_2 not retrieved



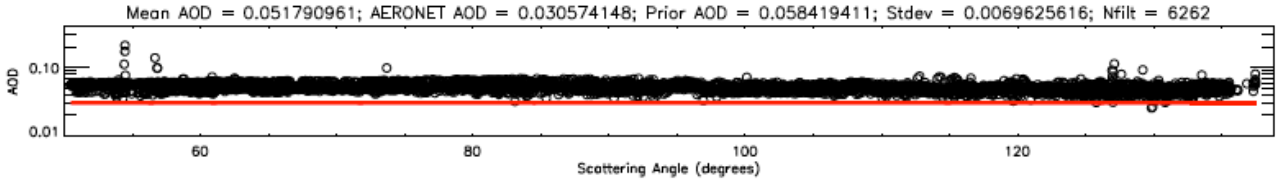
X_{CO2} closer to TCCON value for BRDF models, especially when BRDF shape is fixed

Retrieved AOD

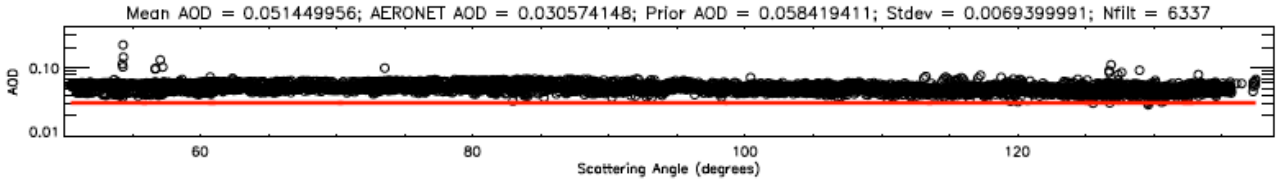
Lambertian



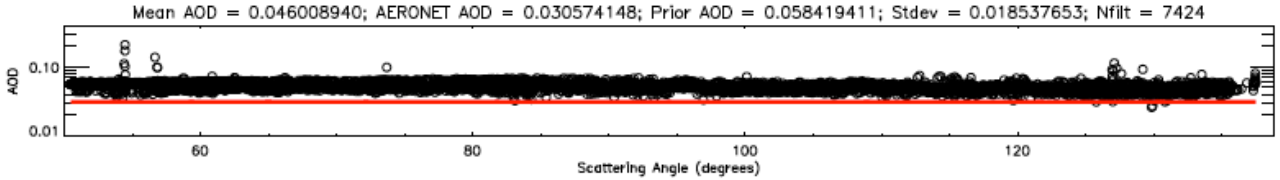
Soil BRDF, p_1, p_2 retrieved



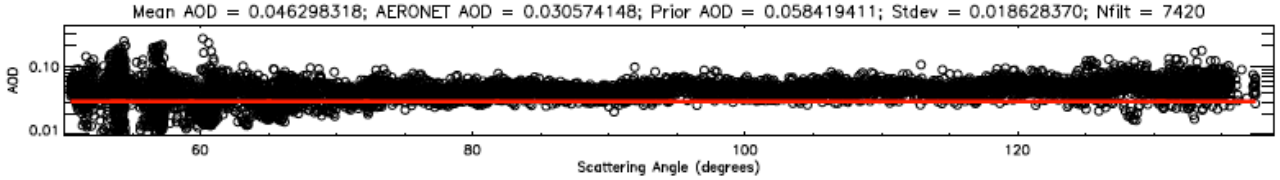
Veg BRDF, p_1, p_2 retrieved



Soil BRDF, p_1, p_2 not retrieved



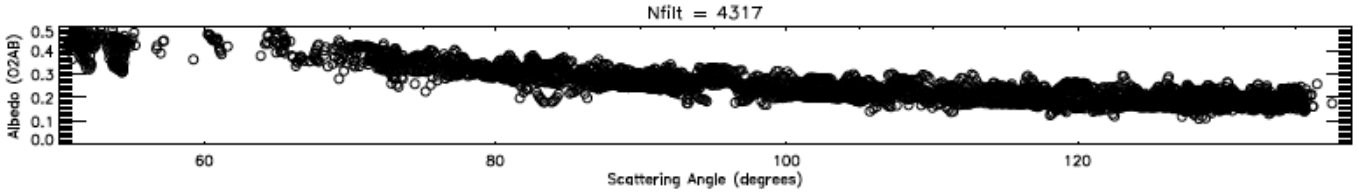
Veg BRDF, p_1, p_2 not retrieved



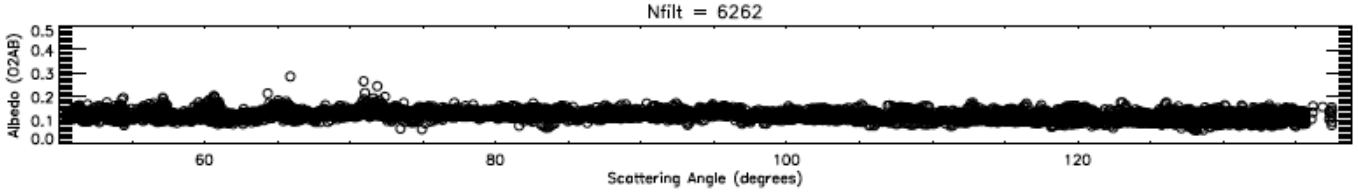
AOD closer to AERONET value, and uncorrelated with scattering angle, for BRDF models

Retrieved Albedo –O_2 A-Band

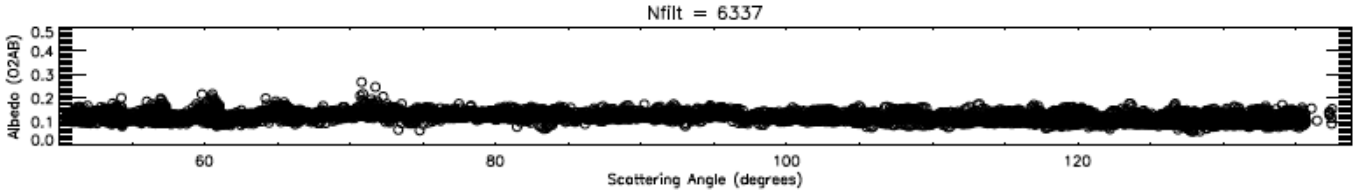
Lambertian



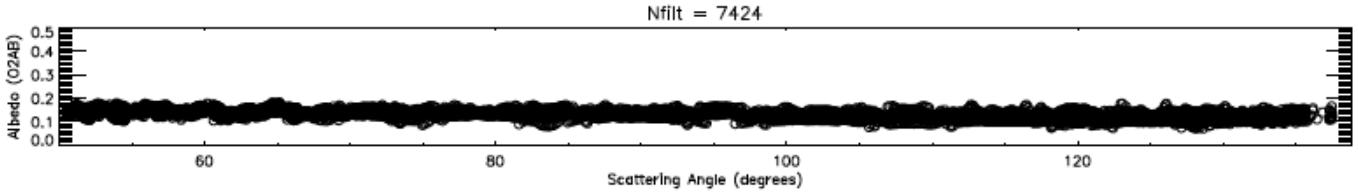
Soil BRDF, p_1, p_2 retrieved



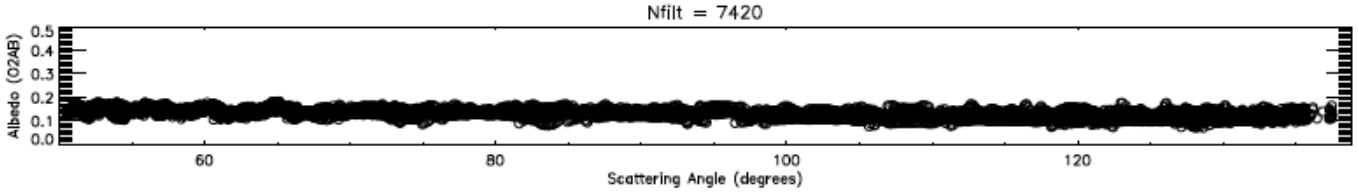
Veg BRDF, p_1, p_2 retrieved



Soil BRDF, p_1, p_2 not retrieved



Veg BRDF, p_1, p_2 not retrieved



Albedo uncorrelated with scattering angle for BRDF models; BRDF models also produce more filtered, converged soundings

Retrieved Albedo – Weak CO_2 Band

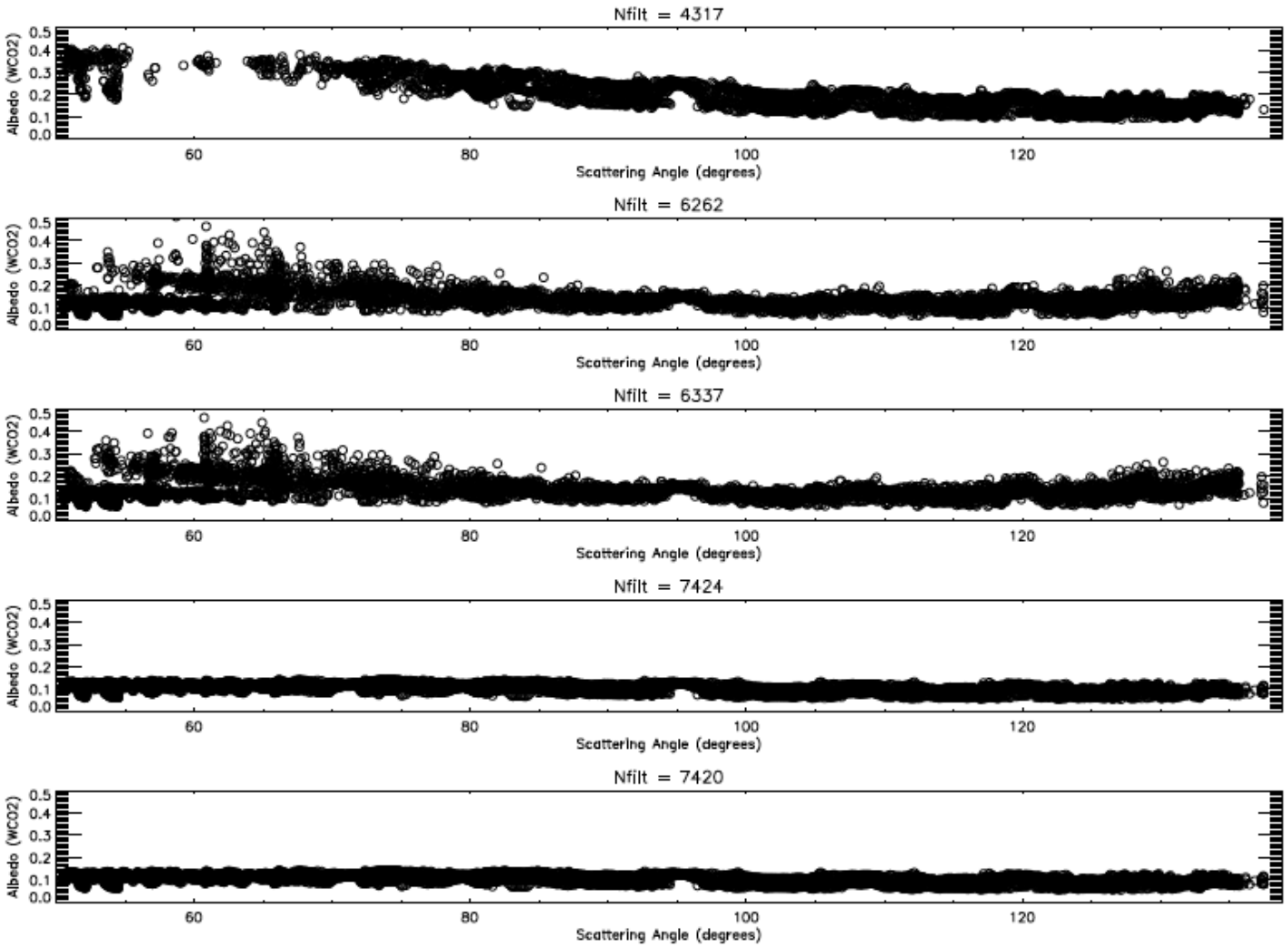
Lambertian

Soil BRDF, p_1, p_2 retrieved

Veg BRDF, p_1, p_2 retrieved

Soil BRDF, p_1, p_2 not retrieved

Veg BRDF, p_1, p_2 not retrieved



Retrieved Albedo – Strong CO_2 Band

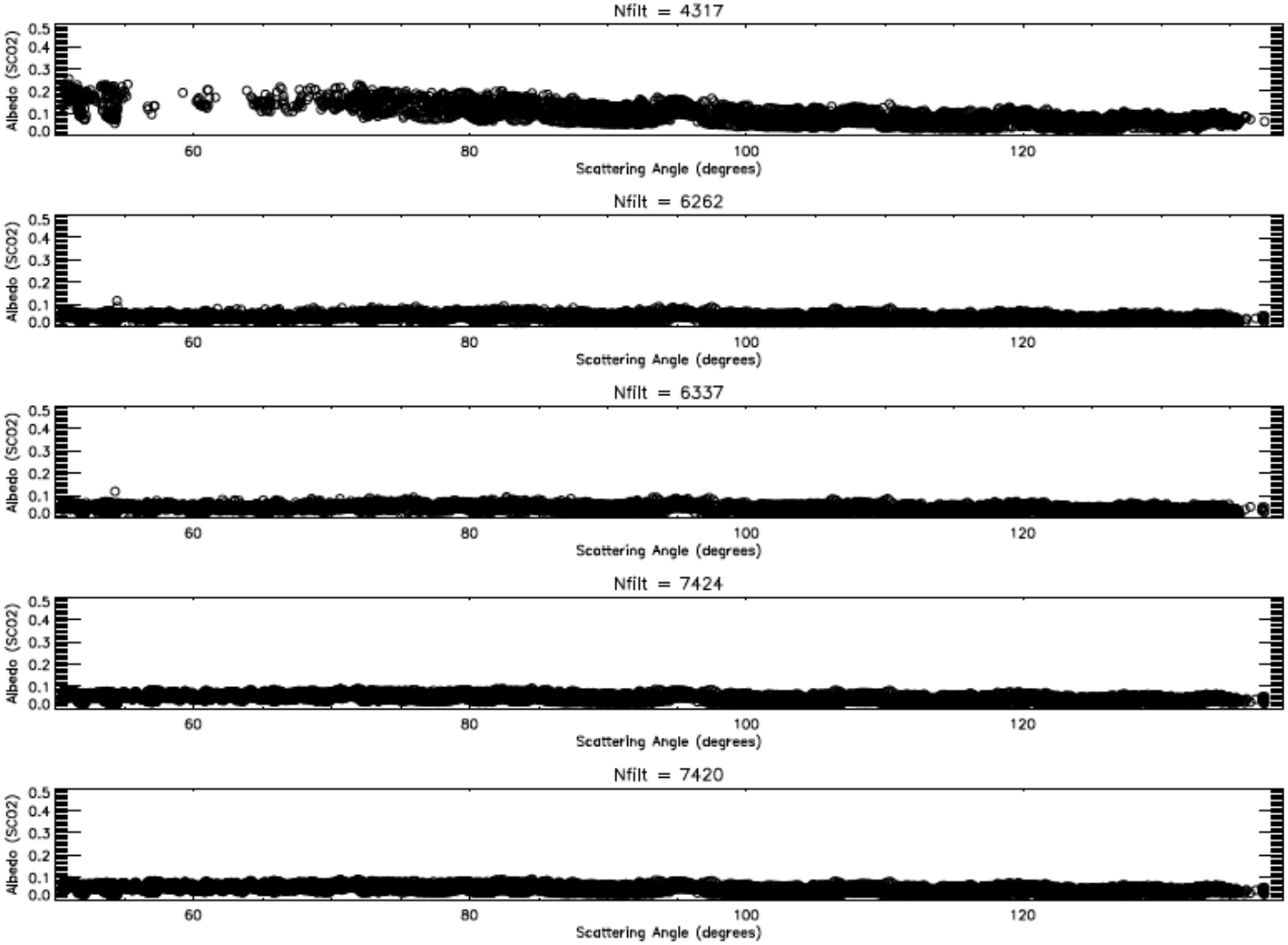
Lambertian

Soil BRDF, p_1, p_2 retrieved

Veg BRDF, p_1, p_2 retrieved

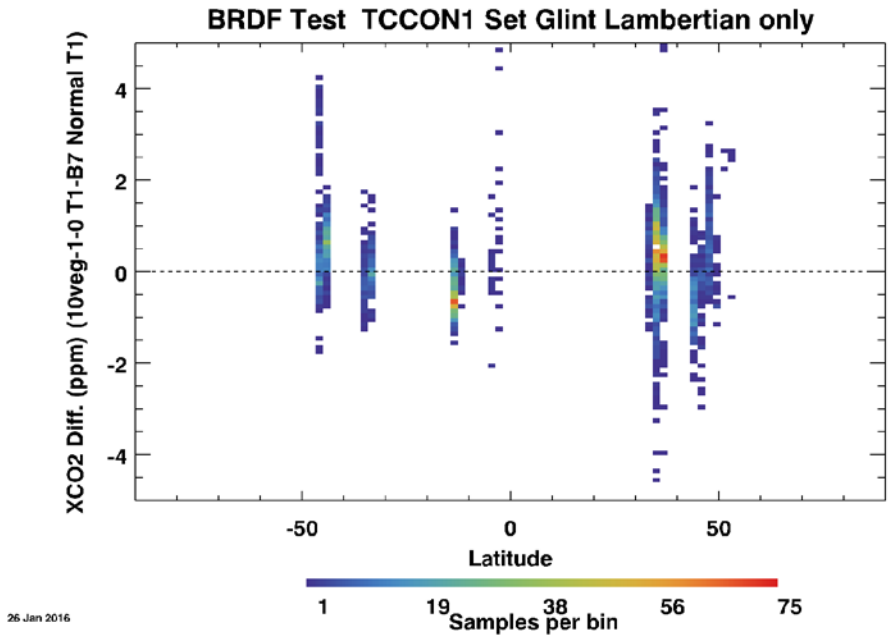
Soil BRDF, p_1, p_2 not retrieved

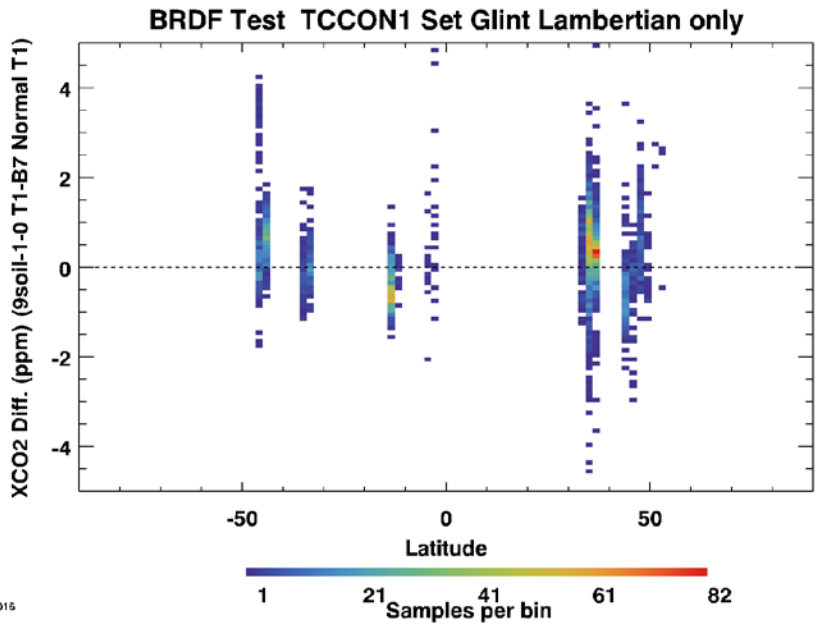
Veg BRDF, p_1, p_2 not retrieved



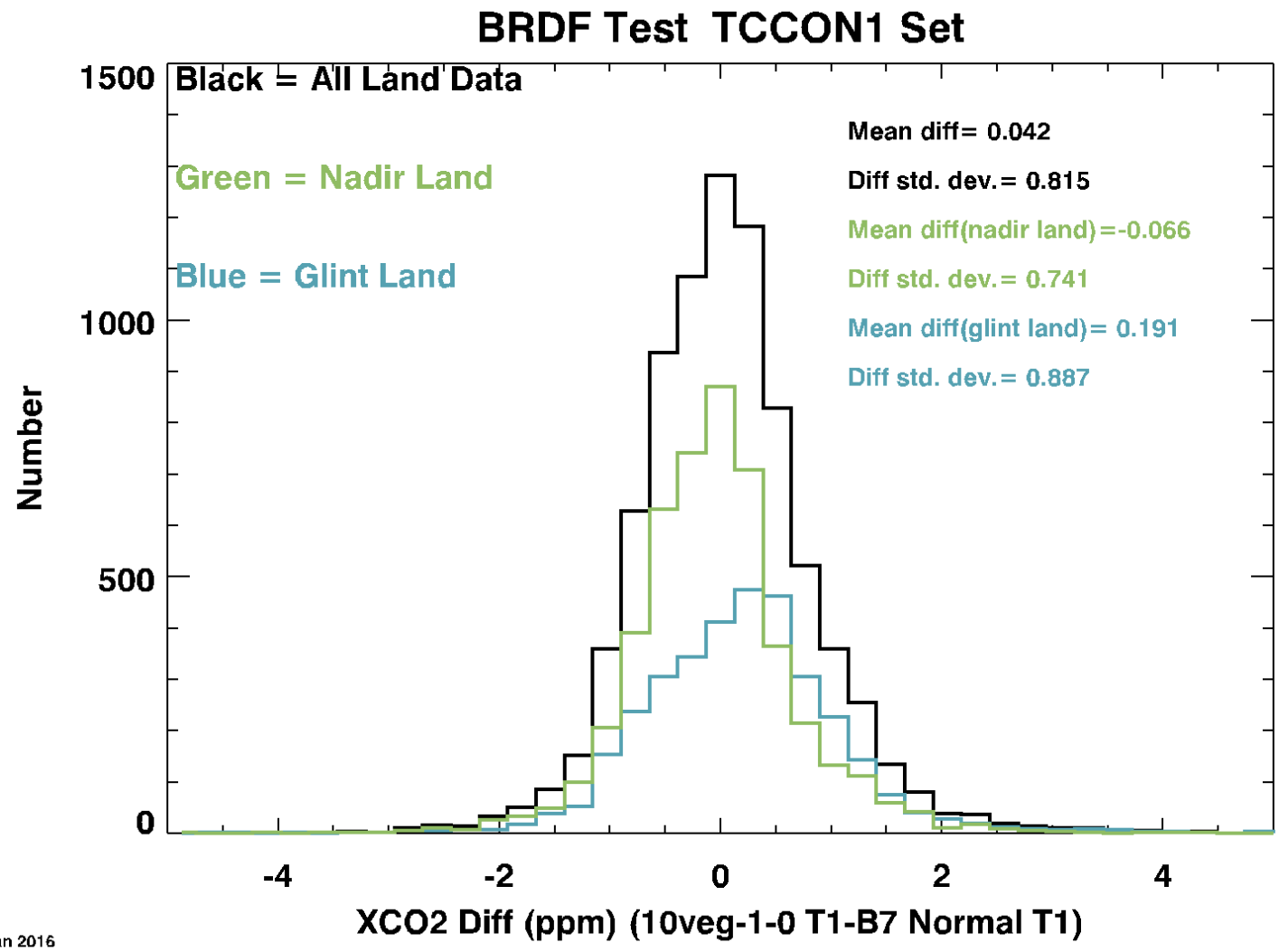
Glint Mode Tests

XCO2 Difference (Land Glint Only)



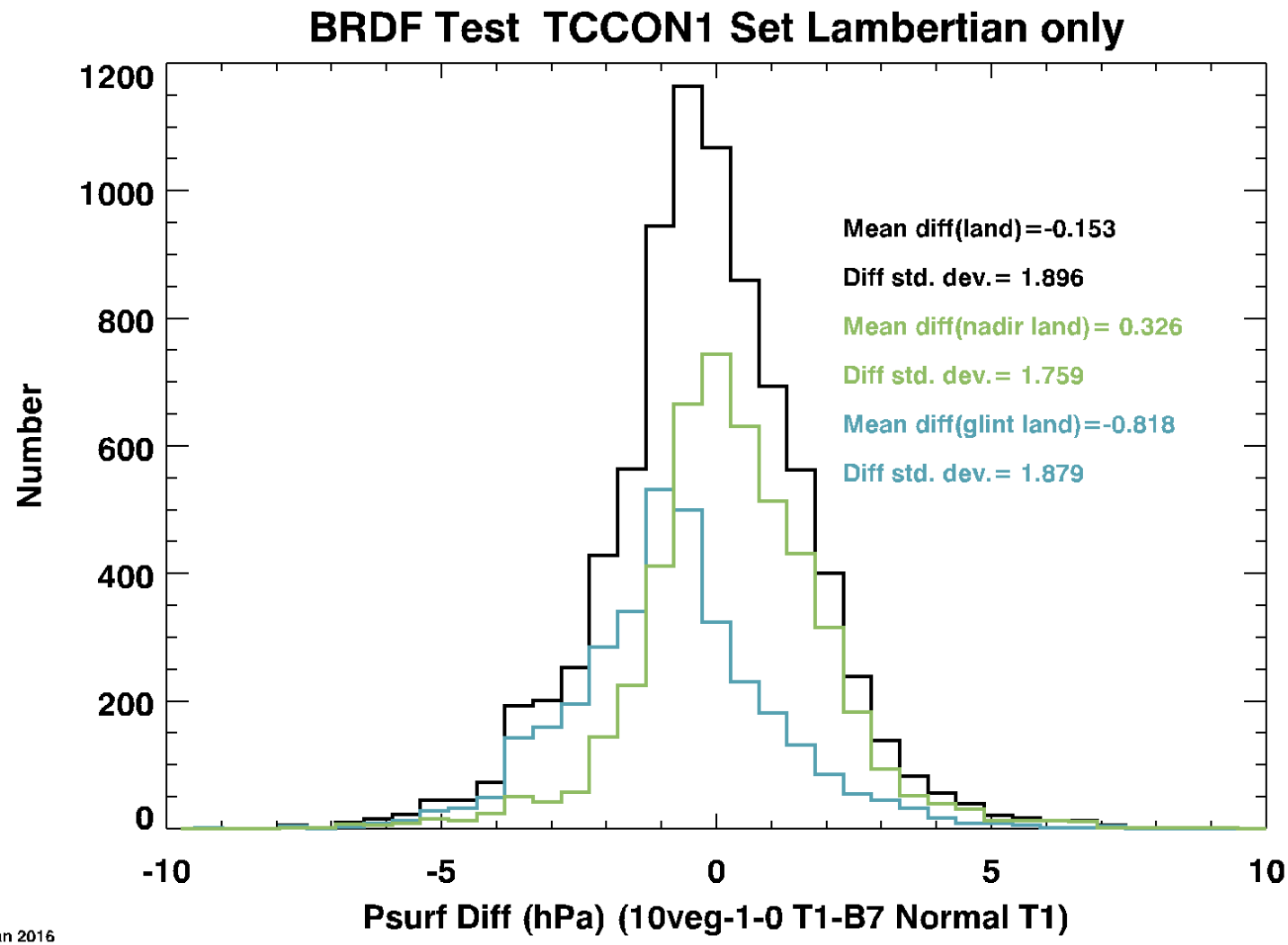


XCO2 Difference Histogram



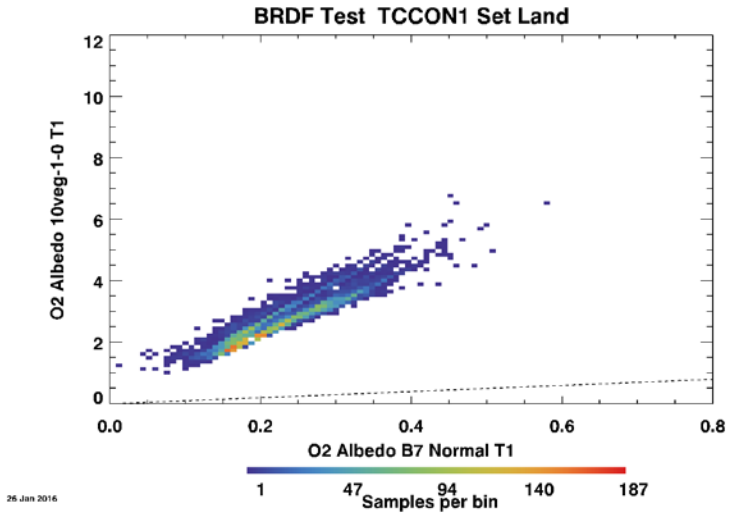
26 Jan 2016

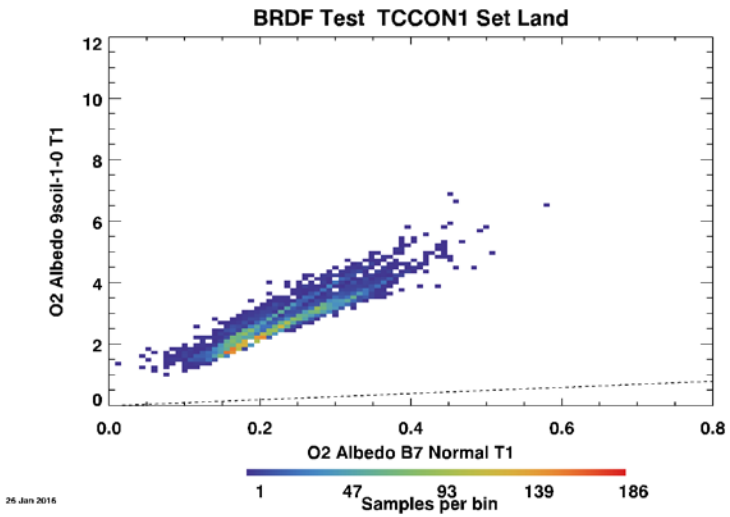
Psurf Difference Histogram



26 Jan 2016

Retrieved Albedo: O_2 A-Band





Unfiltered Small Area Land Tests

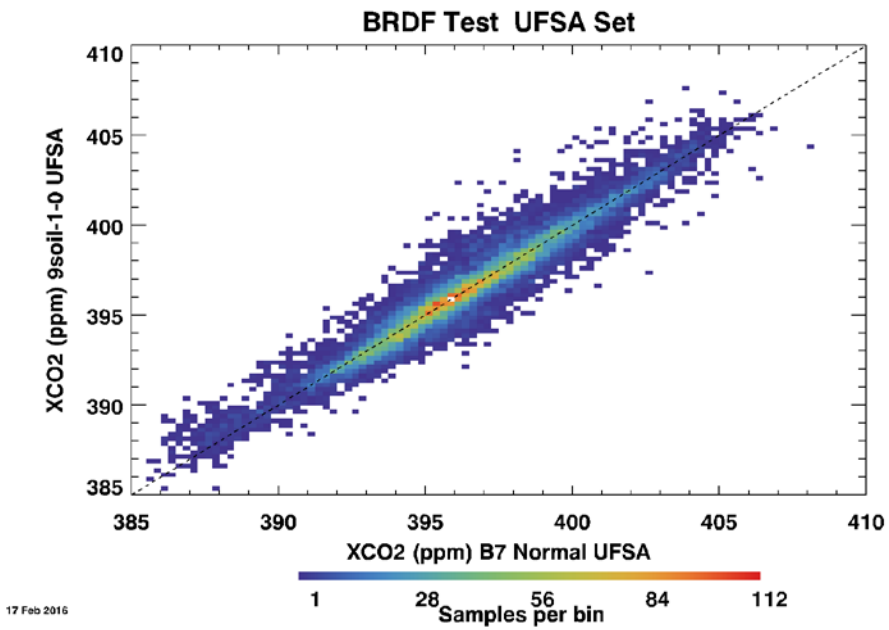
Convergence Statistics

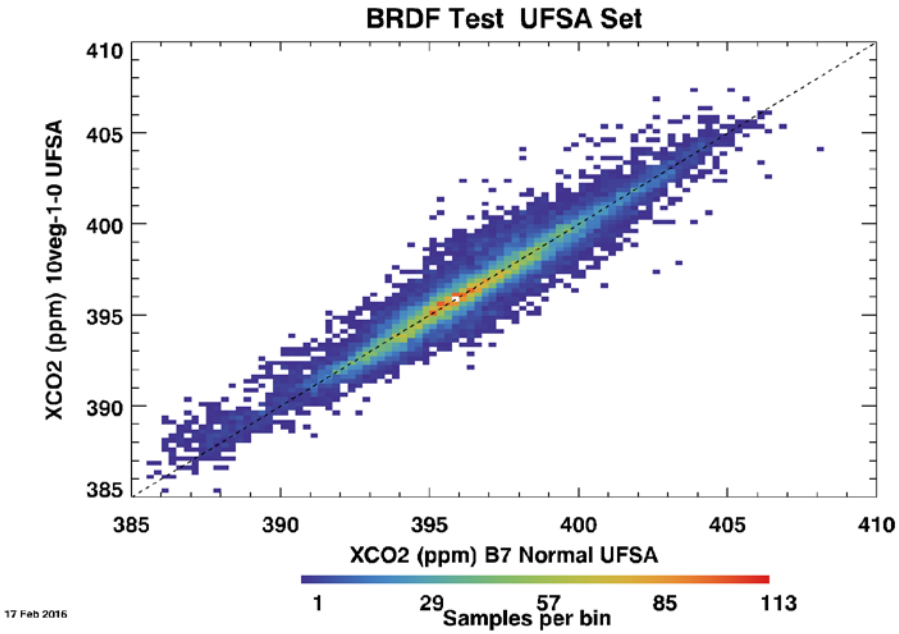
- **Number of soundings**
  - **B7 Baseline: 41873**
  - **Soil: 42551**
  - **Vegetation: 42550**

- **Converged**
  - **B7 Baseline: 36035 (86.06%)**
  - **Soil: 42539 (99.97%)**
  - **Vegetation: 42541 (99.98%)**

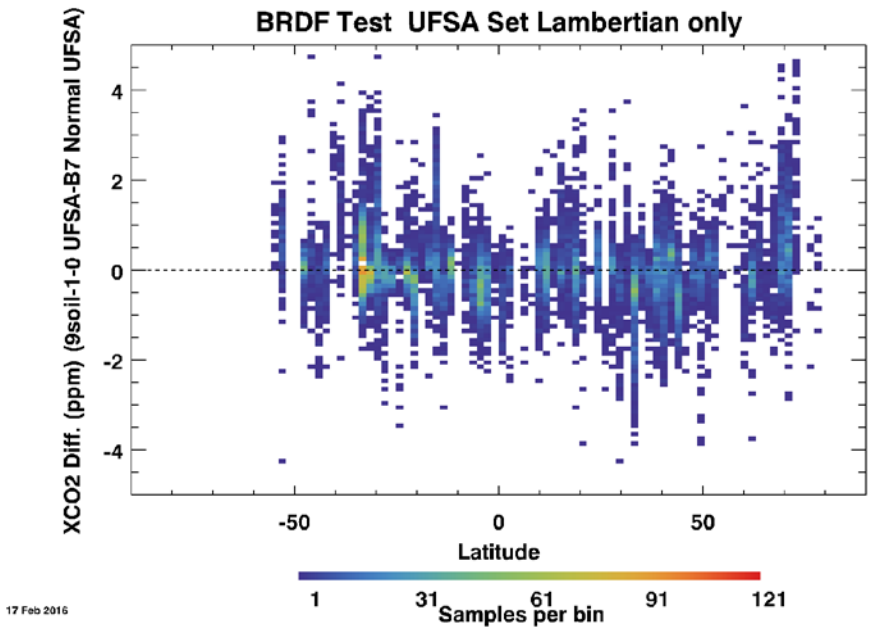
- **Good Quality**
  - **B7 Baseline: 12958 (30.95%)**
  - **Soil: 15239 (35.81%)**
  - **Vegetation: 15210 (35.75%)**

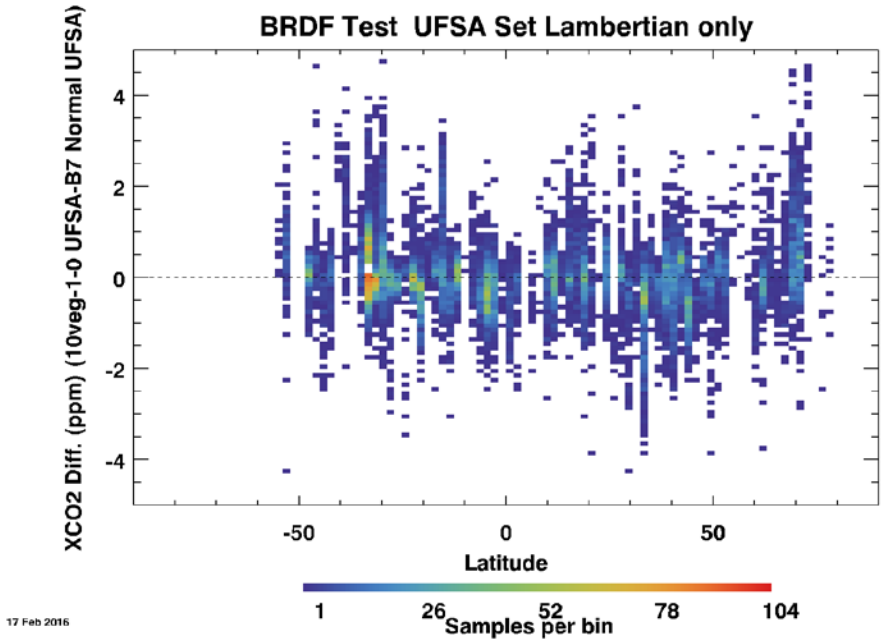
XCO2


BRDF Test UFSA Set
XCO2 (ppm) 9soil-1-0 UFSA
XCO2 (ppm) B7 Normal UFSA
385
390
395
400
405
410
1
28
56
84
112
Samples per bin
17 Feb 2016

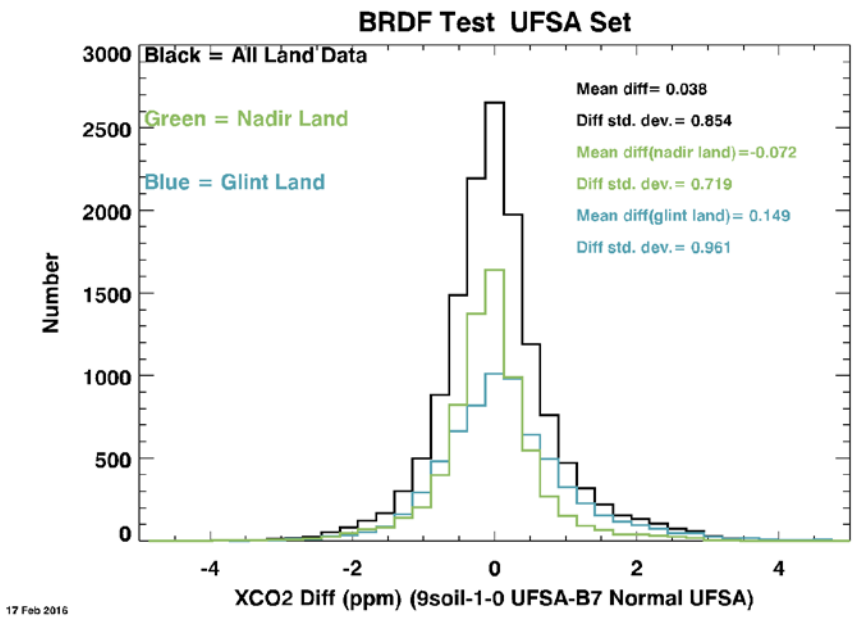

BRDF Test UFSA Set
XCO2 (ppm) 10veg-1-0 UFSA
XCO2 (ppm) B7 Normal UFSA
385
390
395
400
405
410
1
29
57
85
113
Samples per bin
17 Feb 2016

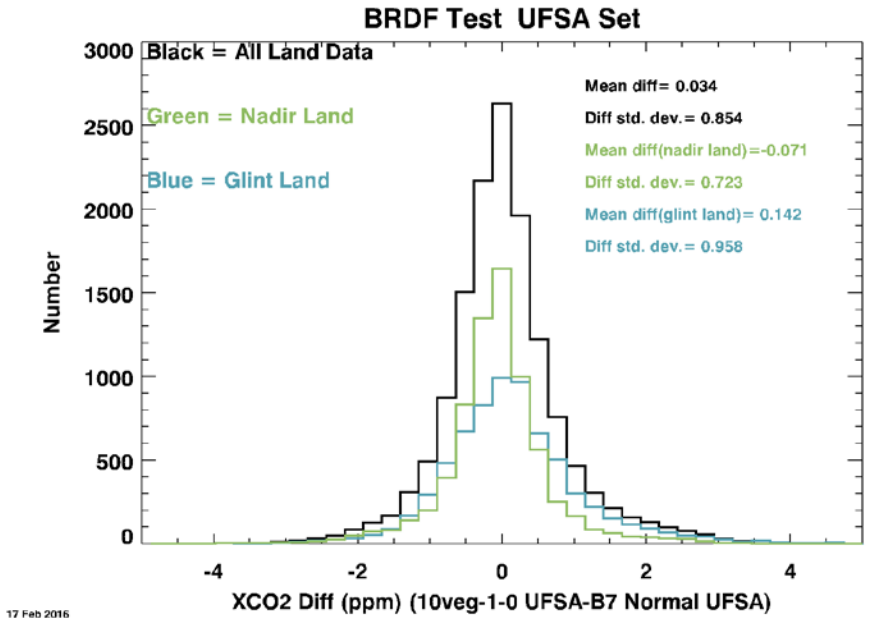
XCO2 Difference





XCO2 Difference Histogram





Next Steps

- **Re-baseline with new ABSCO tables and EOFs**

- **How do we compare Lambertian and BRDF results?**
  - **Use WLs from Lambertian run to start with**
  - **For WL <= 10, compare standard deviation of XCO2 in each small area encompassed in the set. This is a metric we would like to reduce.**
  - **Do above for southern hemisphere**
  - **Do above but comparing each with TCCON (for TCCON 1 and TCCON 2 runs)**
  - **Repeat analysis for 10 <= WL <=15, 15 < WL <=19**

- **Compute new WLs for BRDF models and compare against Lambertian results. Do the BRDF models produce more retrievals with lower WLs?**

- **Implement BRDF model in operational code**