A surface reflectance standard product from LDCM and supporting activities

June 2010 update

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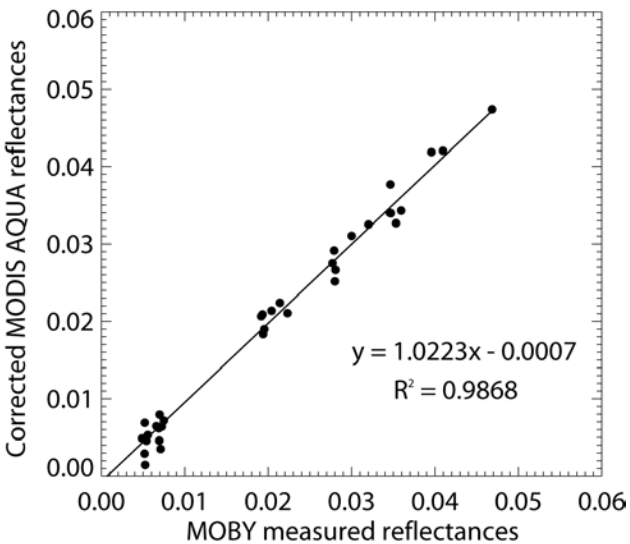
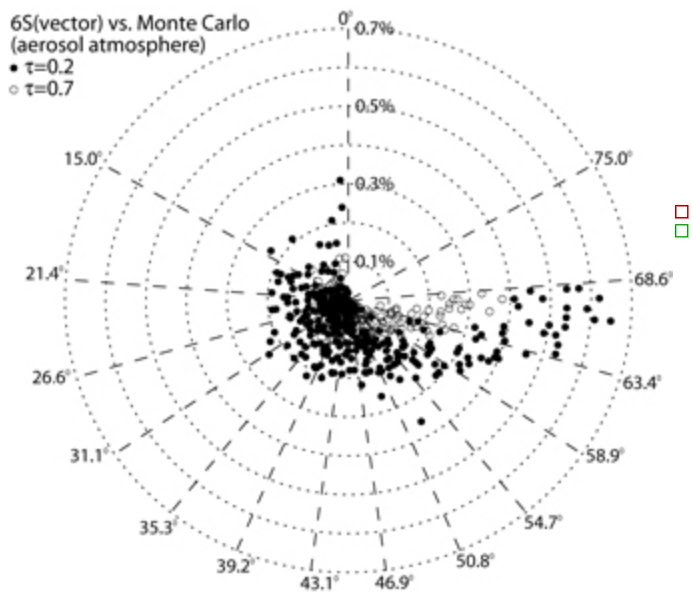
Approach for the surface reflectance product

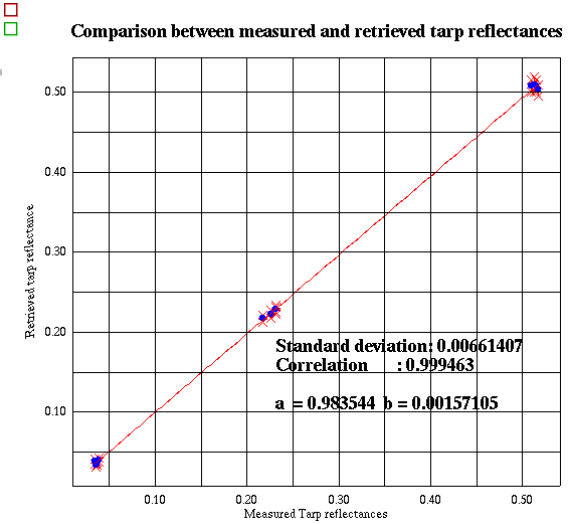
- **Atmospheric correction consistent with the MODIS, AVHRR and NPP-VIIRS approach, ensuring consistent reflectance data across resolutions based on rigorous radiative transfer**

  http://6s.ltdri.org

  http://rtcodes.ltdri.org/



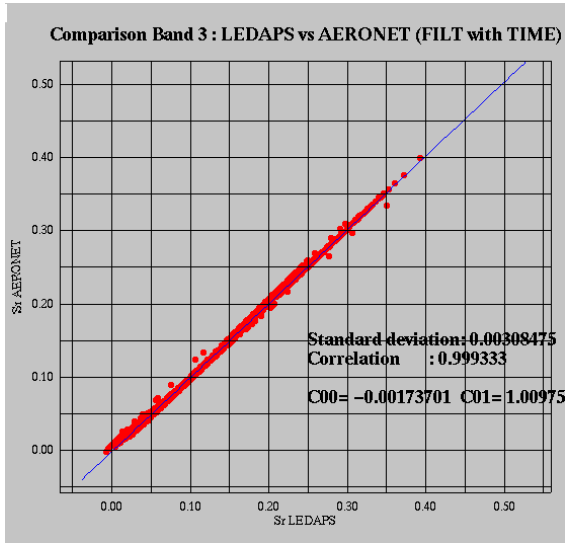


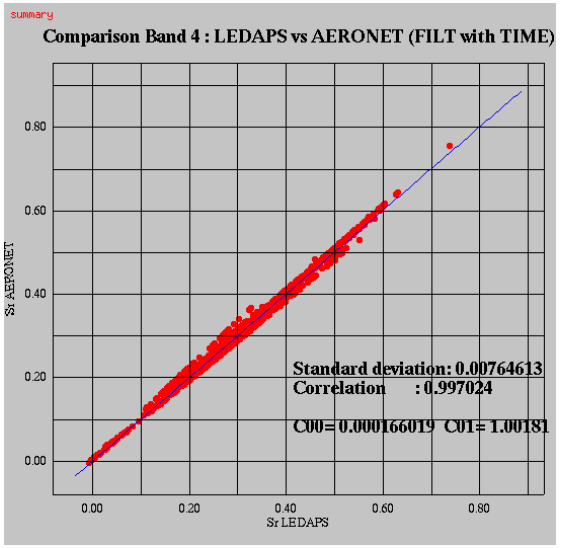


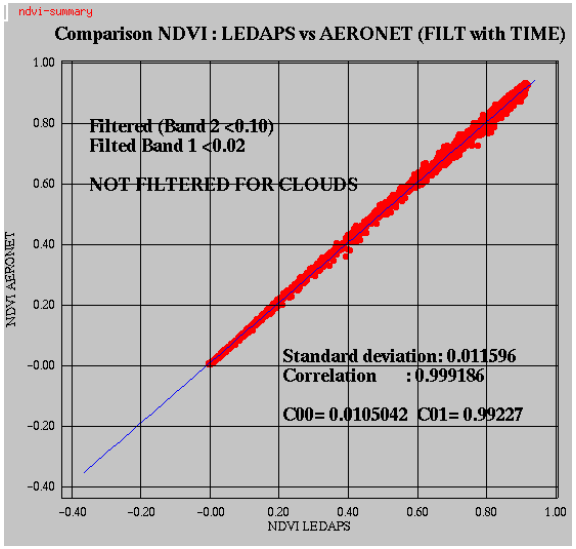
Evaluation/Validation of the Surface reflectance product

- Using AERONET sites
- Comparison to MODIS SR product
- Independent evaluation (vs ground measurements)

AERONET site based evaluation





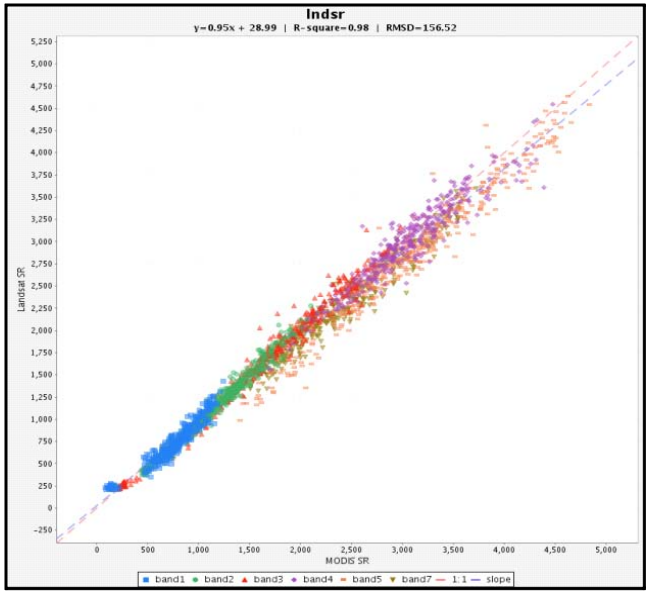


DATE.PATH/ROW	AOT	TIMEDIFF	AERONET SITE
a2000122.w2p041r036	0.0932345	15	Rogers_Dry_Lake
a2000122.w2p041r037	0.162749	15	UCLA
a2000170.w2p009r029	0.0449007	60	Kejimkujik
a2000191.w2p028r035	0.0858729	30	Cart_Site
a2000247.w2p036r038	0.0365191	205	Tucson
a2000261.w2p022r039	0.0722956	14	Stennis
a2000267.w2p048r026	0.0727889	14	Saturn_Island
a2001155.w2p034r036	0.105914	29	Sevilleta
a2001216.w2p029r030	0.133025	14	Sioux_Falls
a2001217.w2p036r025	0.0797376	188	Bratts_Lake
a2001218.w2p043r028	0.0735507	254	Rimrock
a2001267.w2p034r032	0.0717833	14	BSRN_BAO_Boulder
a2001278.w2p015r033	0.147011	15	GSFC

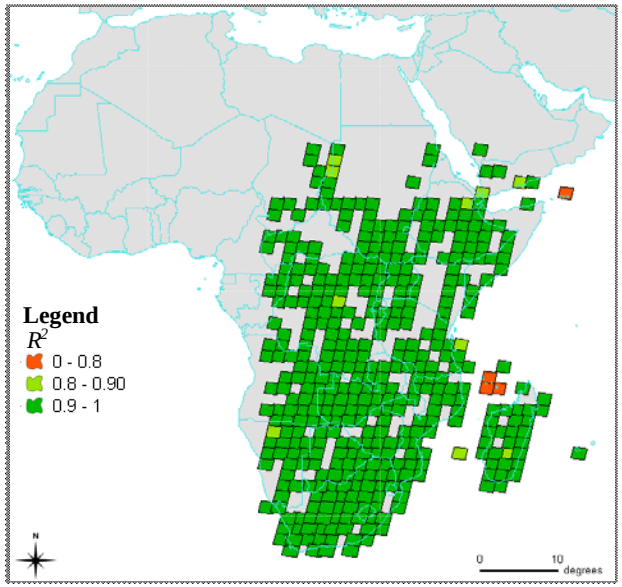
Will be extended to a variety of sites in the framework of the LEDAPS/WELD inter-comparison for 2003

LEDAPS-MODIS SR Comparison
Cheng Huang (GFCC project)

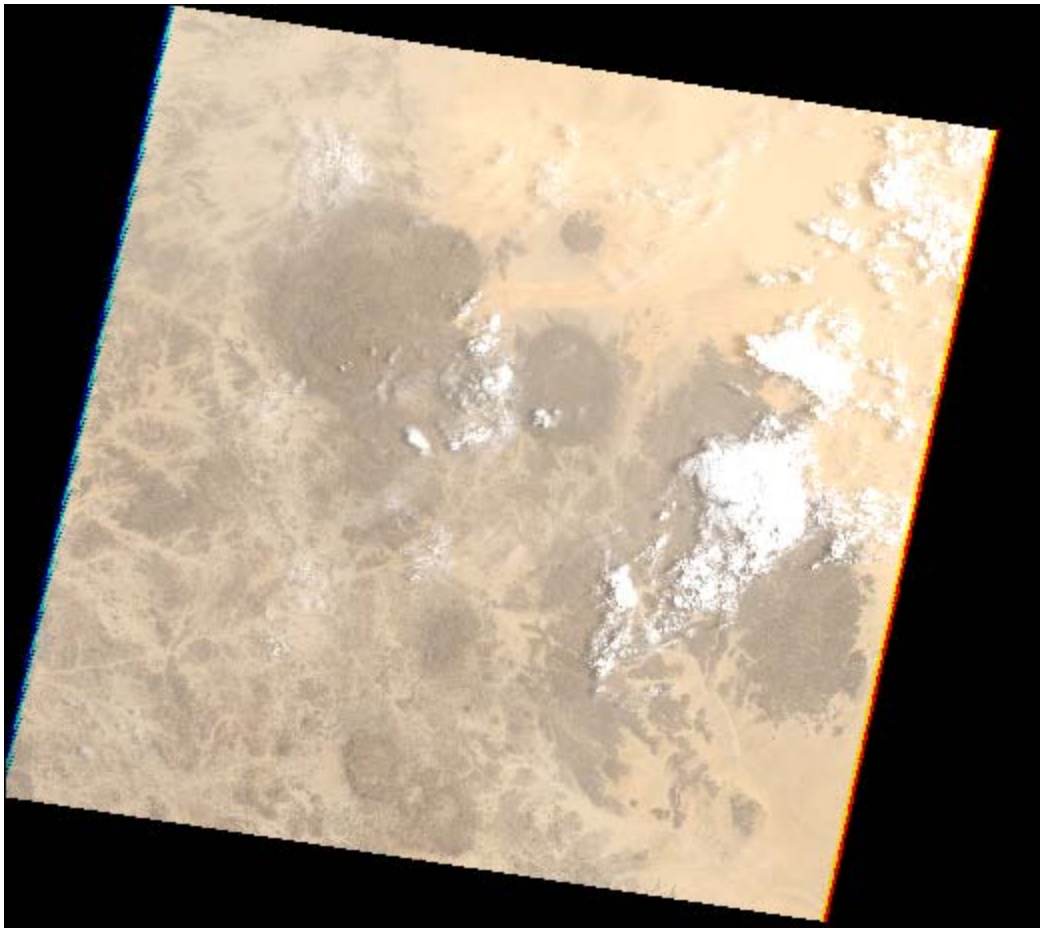
- Landsat 7 SR ≈ MODIS SR (daily)
  - Same acquisition date, ~30 minutes apart (Landsat 7 images)
  - Aggregate Landsat to MODIS resolution
  - Use samples from homogeneous areas
- Fully automated, will be applied to all Landsat 7 images
- Landsat 5 SR ≈ MODIS SR (NBAR)



R square
RMSD

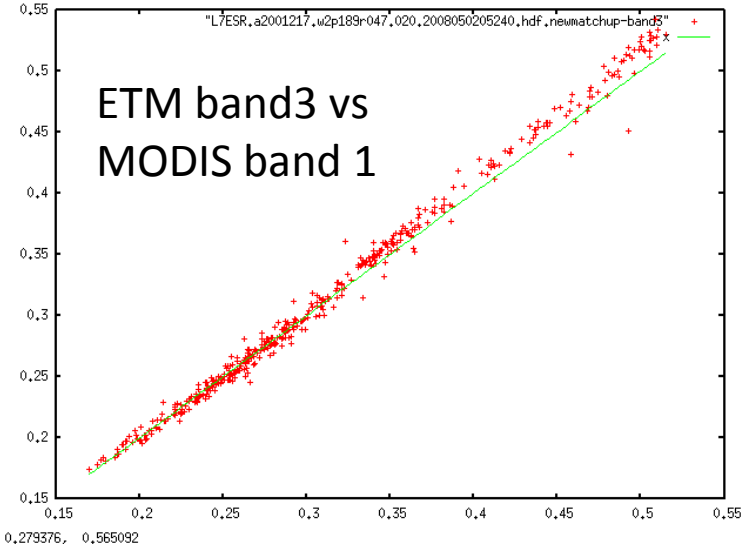


Comparison to MODIS Terra (CMG at 0.05 deg)

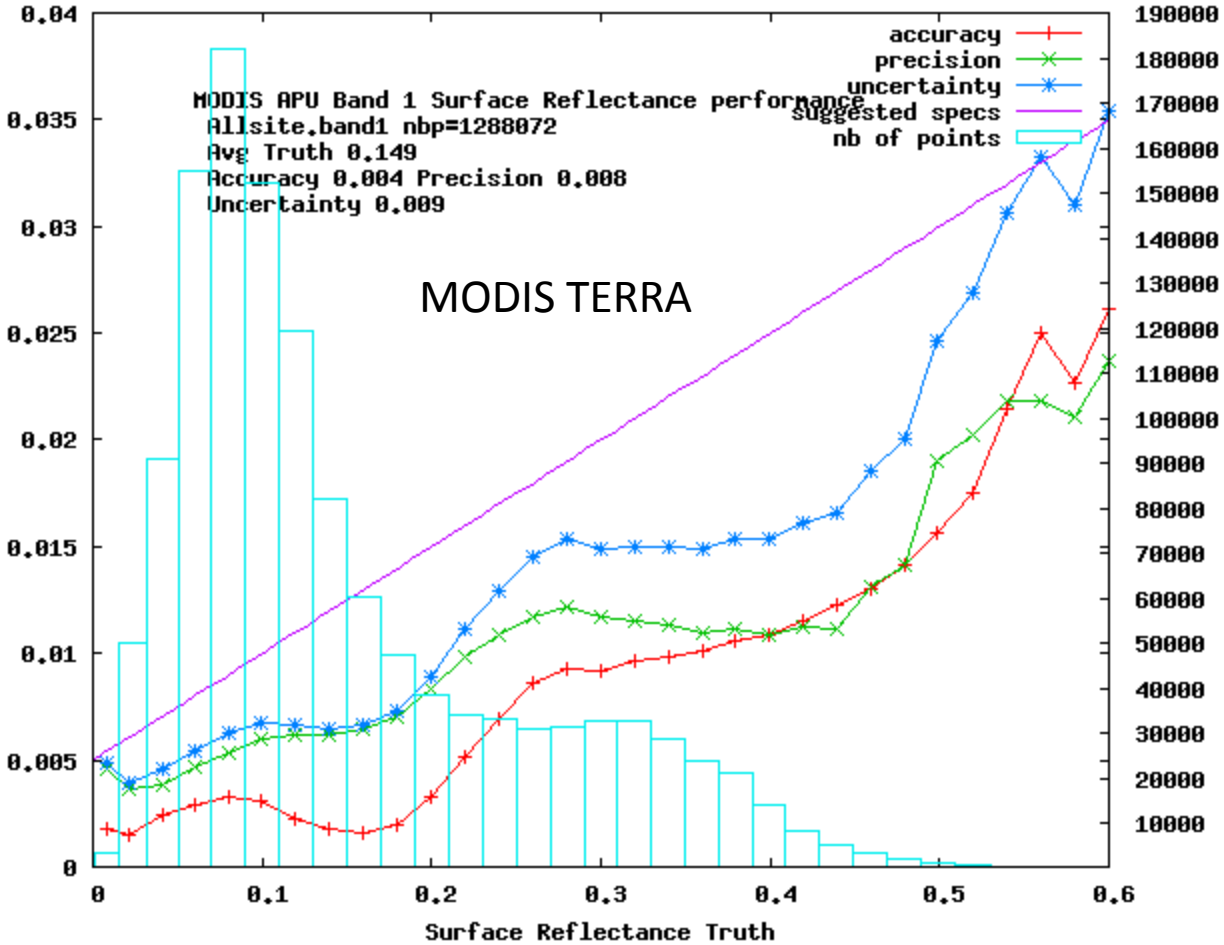


ETM+ Year 2001 Day 217 path 189 row 47

Terra CMG subset



Toward a quantitative assessment of performances (APU) as MODIS/VIIRS

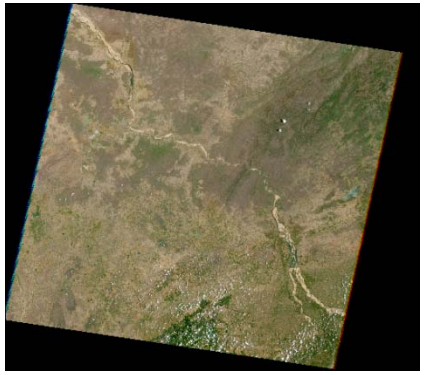
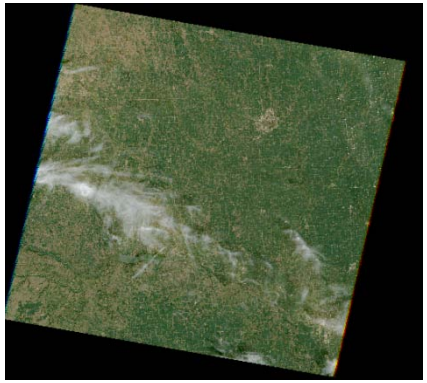
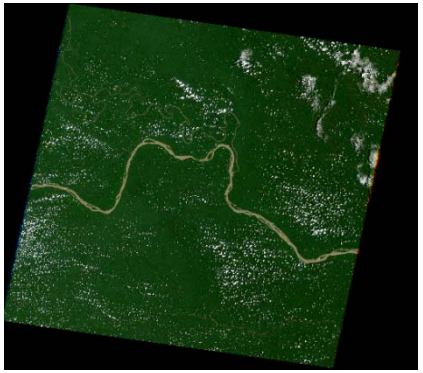
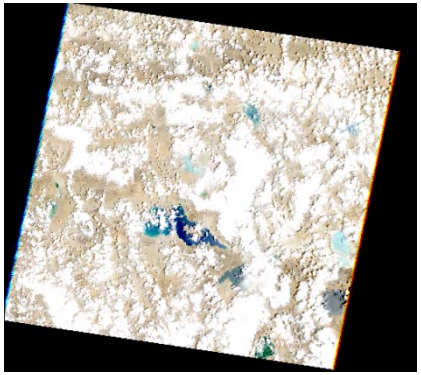
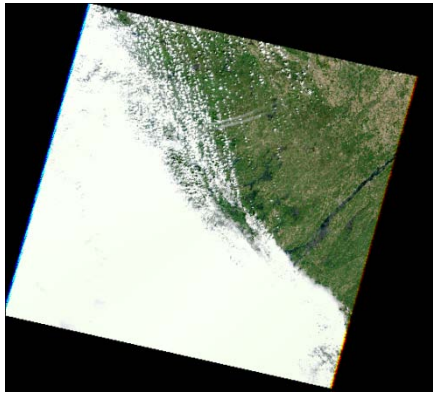
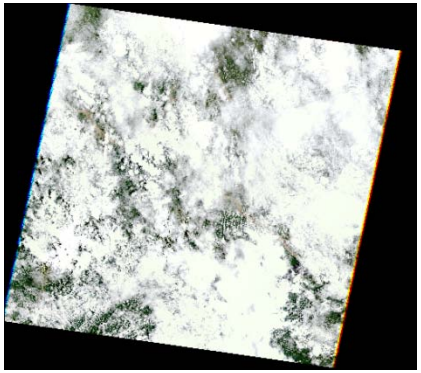
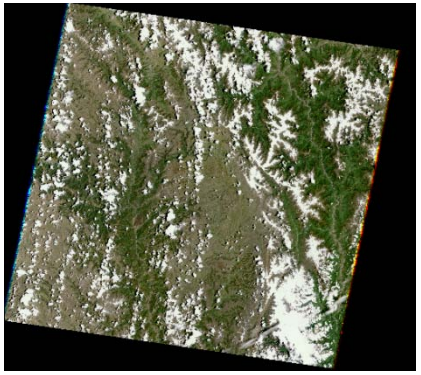
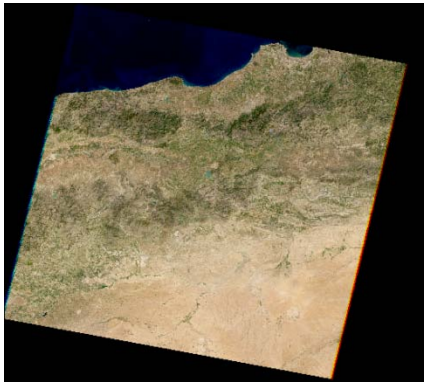
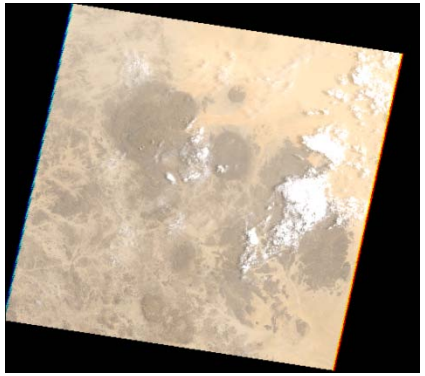
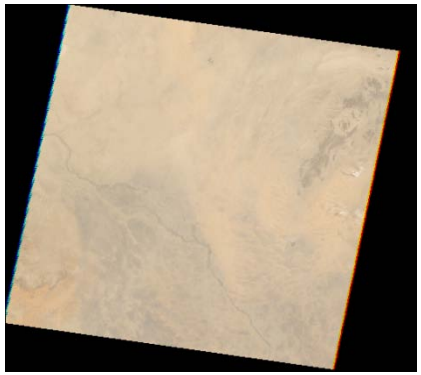


1,3 Millions 1 km pixels were analyzed for each band.

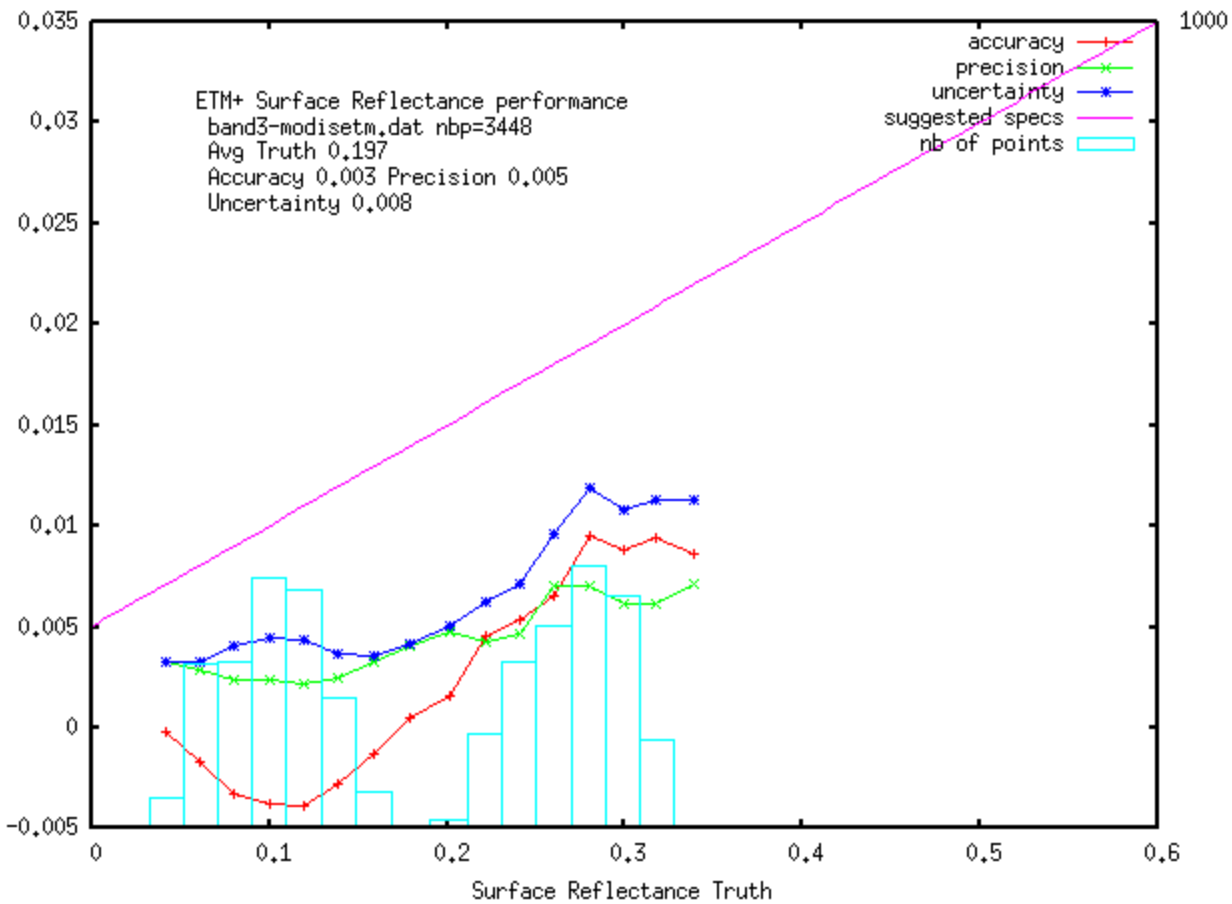
Red = Accuracy (mean bias)
Green = Precision (repeatability)
Blue = Uncertainty (quadatric sum of A and P)

On average well below magenta theoretical error bar

Scenes analyzed for APU

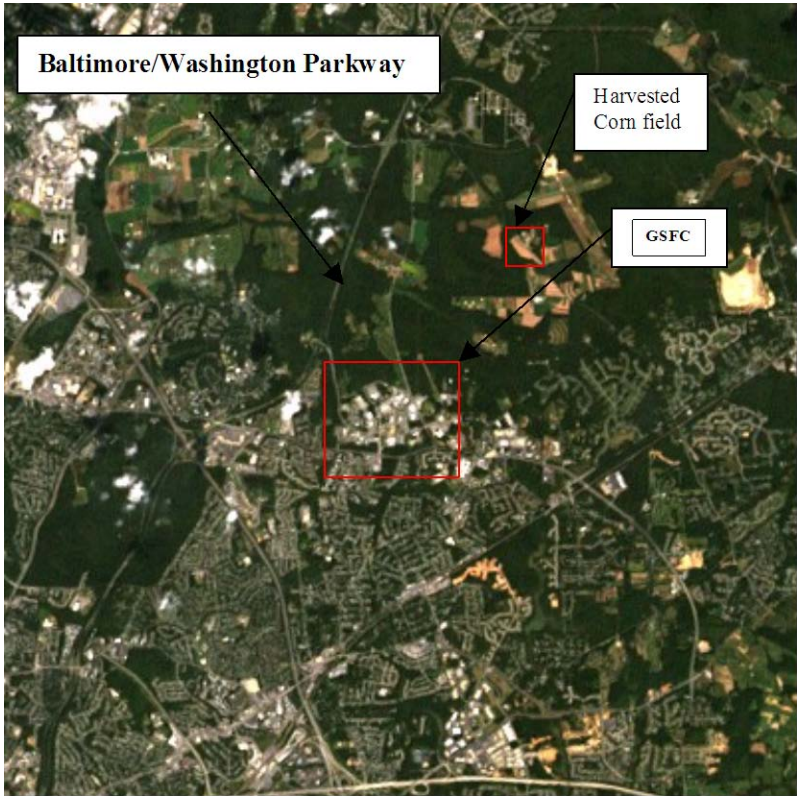











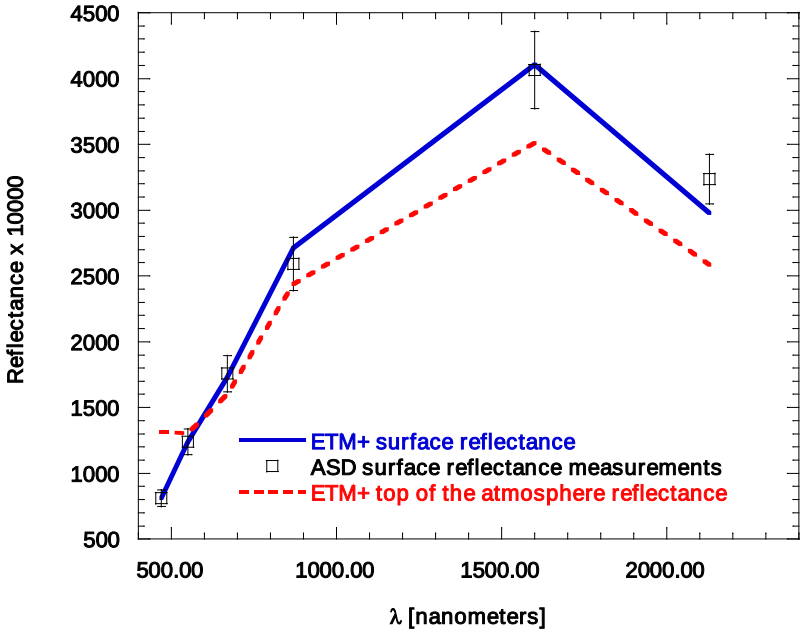
ETM+ APU results: Band 3 (670nm)

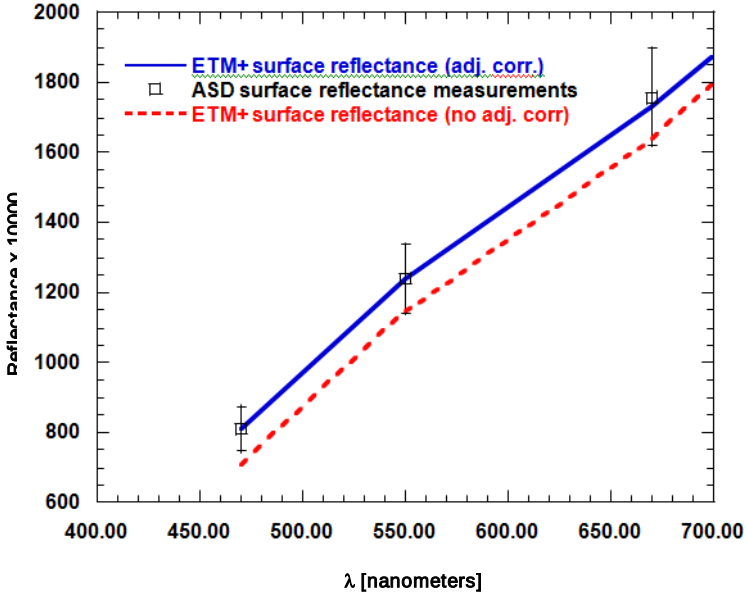


Direct comparison to ground Truth

Vermote E.F., "Adjacency effect on Remotely Sensed Data: Theory and Correction", 2003, contribution to the *Encyclopedia of optical engineering,* Driggers R.G. and E. Lichtenstein (Eds.), publisher Marcel Dekker, Inc.

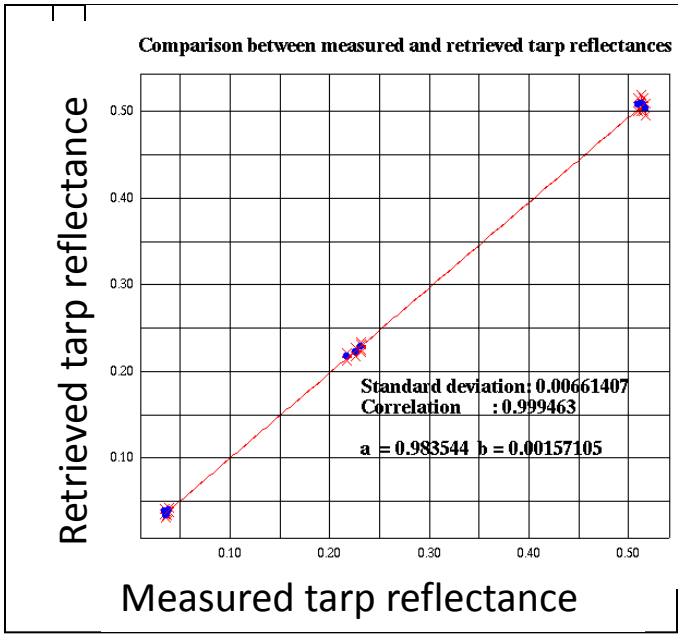




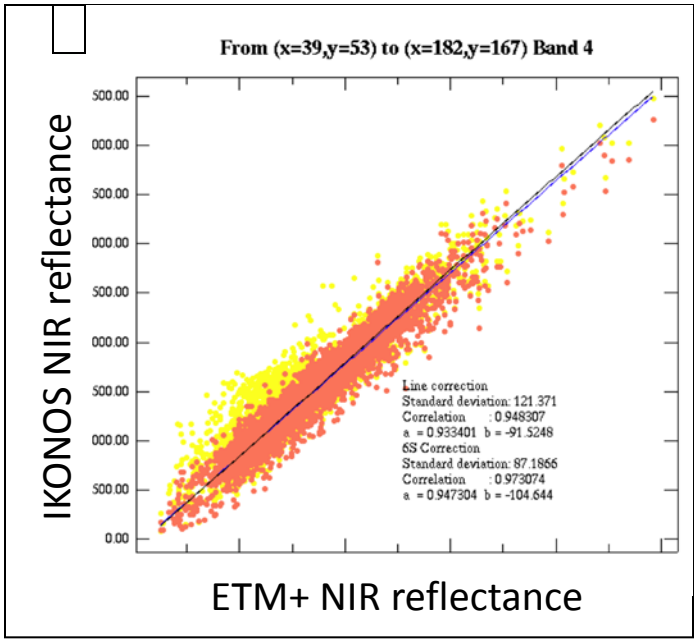


Indirect comparison with ground truth using IKONOS data

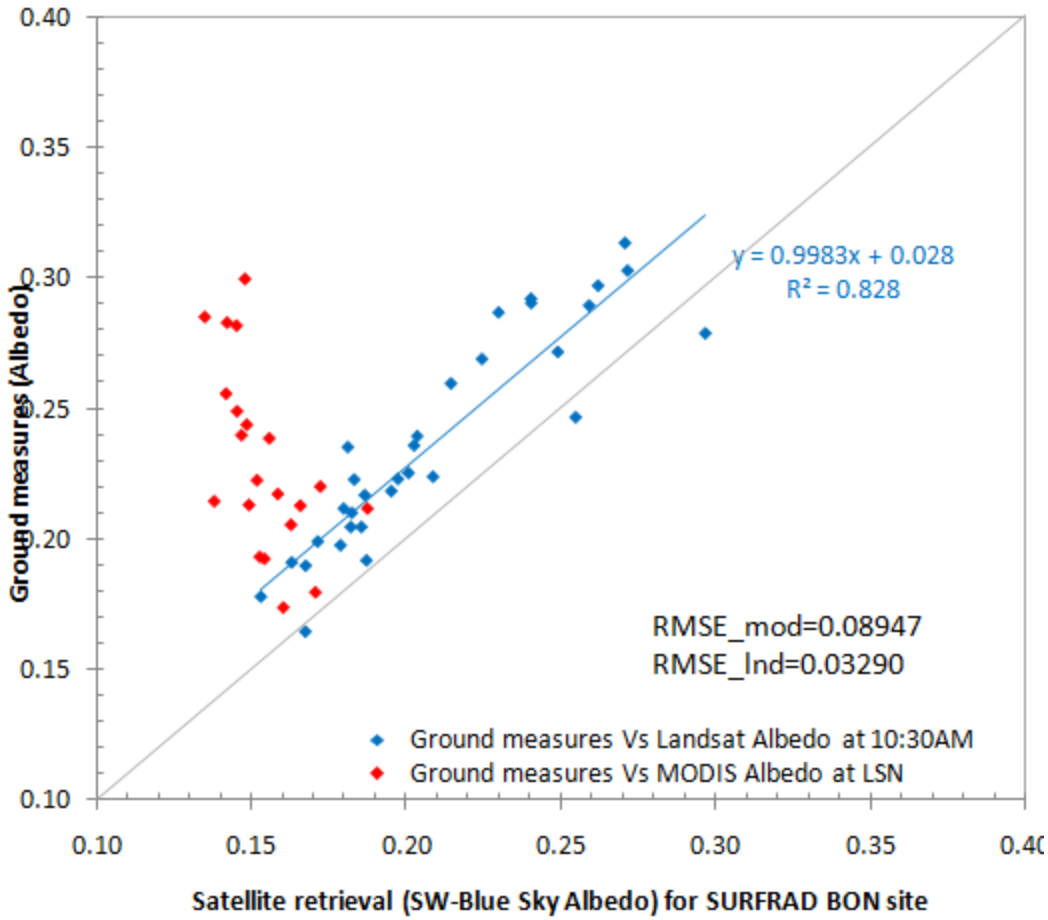
Comparison of 6S-corrected IKONOS vs laboratory-measured tarp reflectances, Stennis Space Center, Feb 15, 2002



Comparison of 6S-corrected Landsat vs IKONOS SR "truth", February 27, 2002



Indirect comparison to ground Truth using MODIS BRDF – Feng Gao



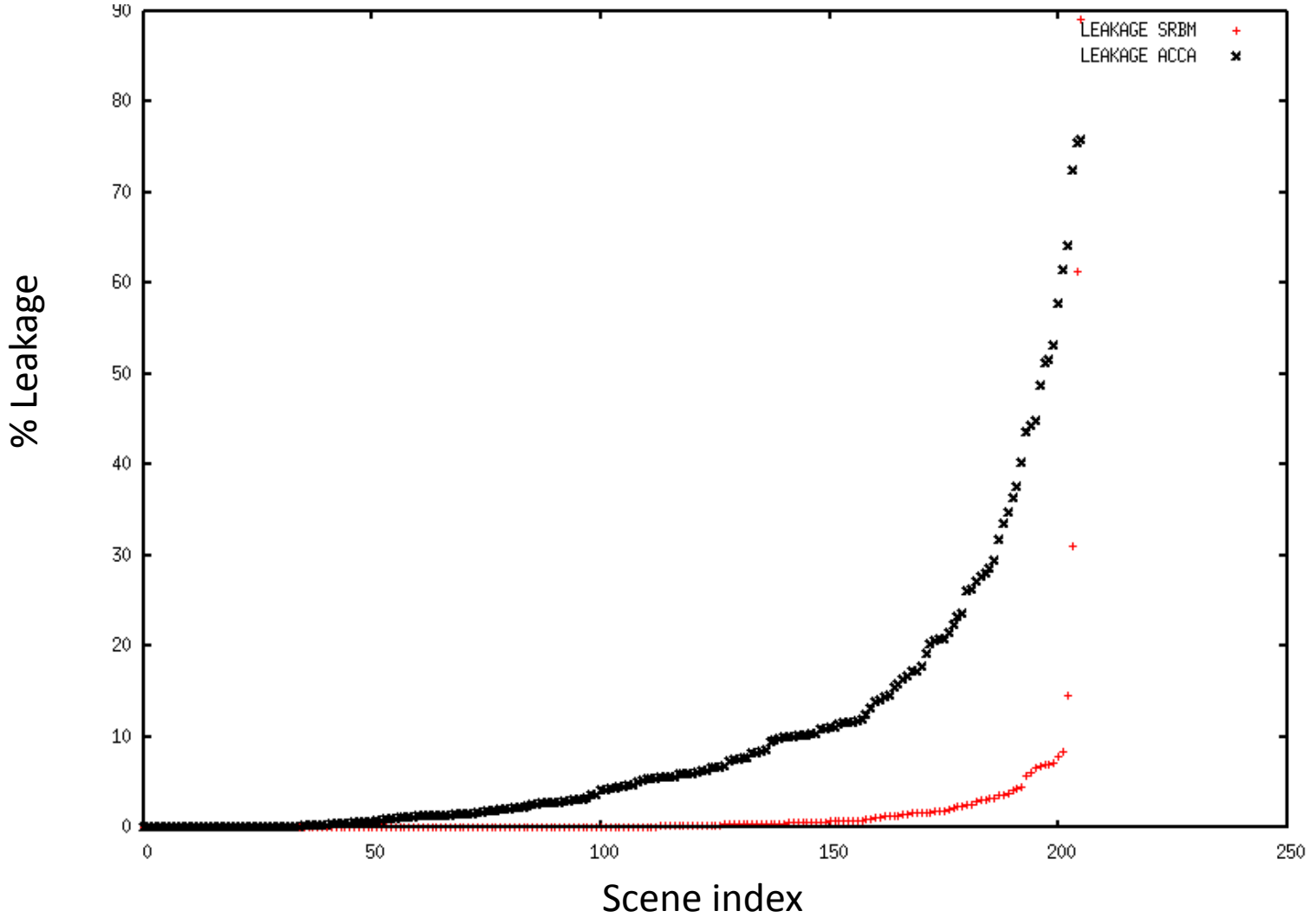
Cloud, Cloud shadow mask is as important as deriving the correct surface reflectance and are probably much more difficult to evaluate and validate

LEDAPS Surface Reflectance Cloud mask evaluation

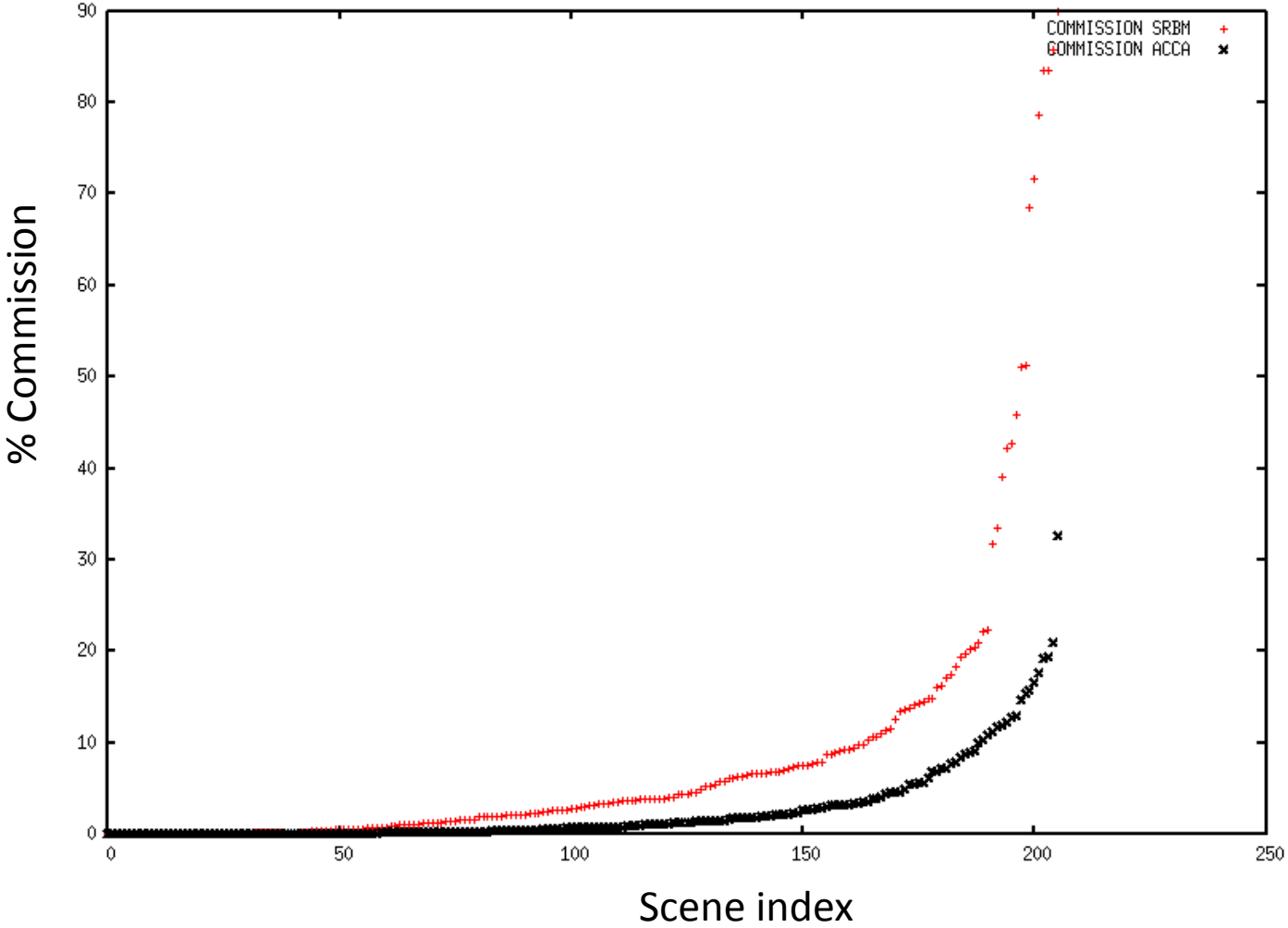
Method

- 206 Landsat scenes covering a variety of conditions
- Cloud mask comparison
  - ACCA cloud mask
  - SRBM (Surface reflectance Based Mask): Internal cloud mask based on SR product
  - VCM :Validation Cloud Mask (operator made)
- Metrics for cloud detection versus VCM
  - Rate of omission of cloud %: Leakage
  - Rate of commission of cloud % : False detection

LEAKAGE RATE comparison



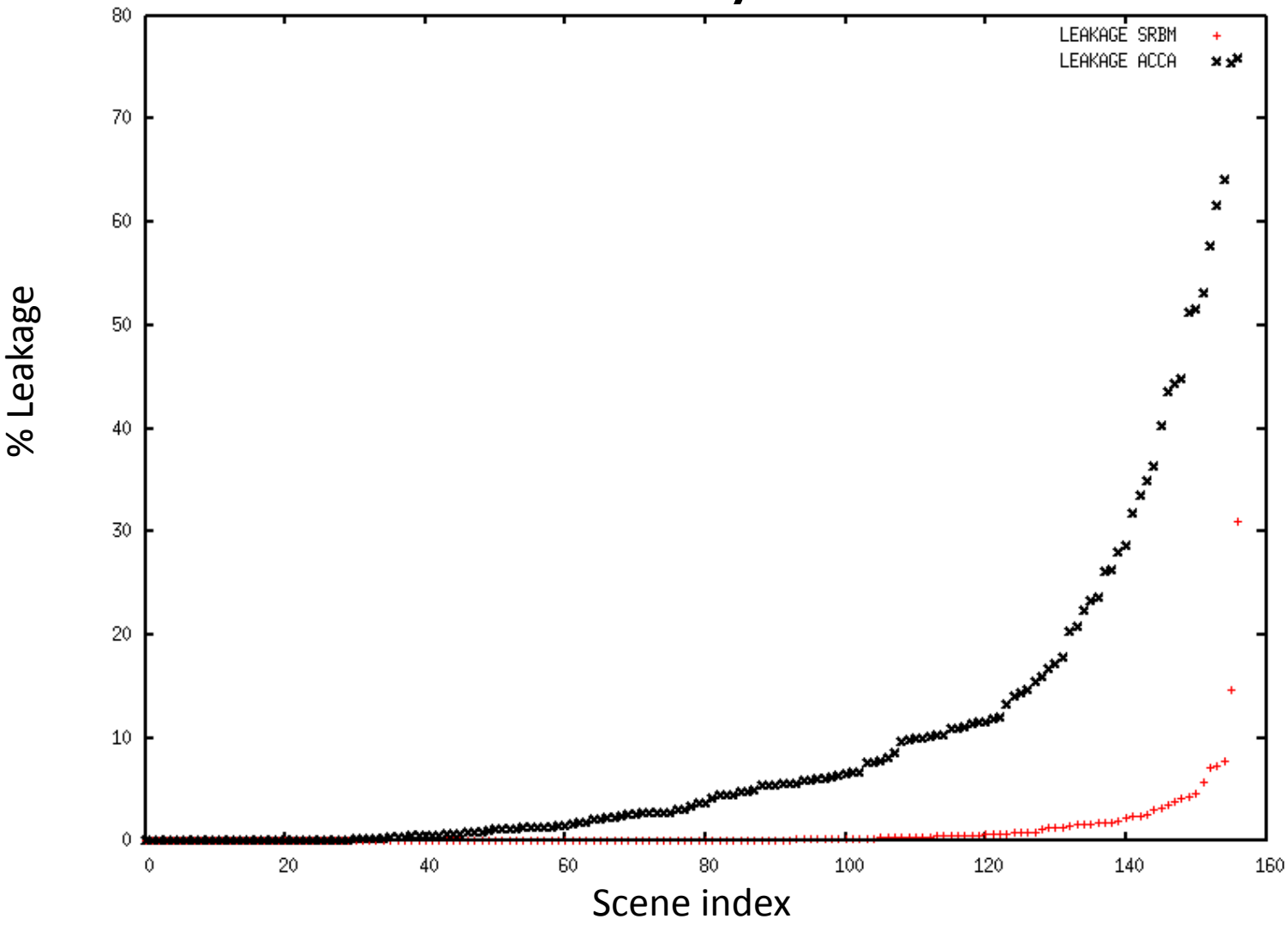
COMMISSION RATE Comparison



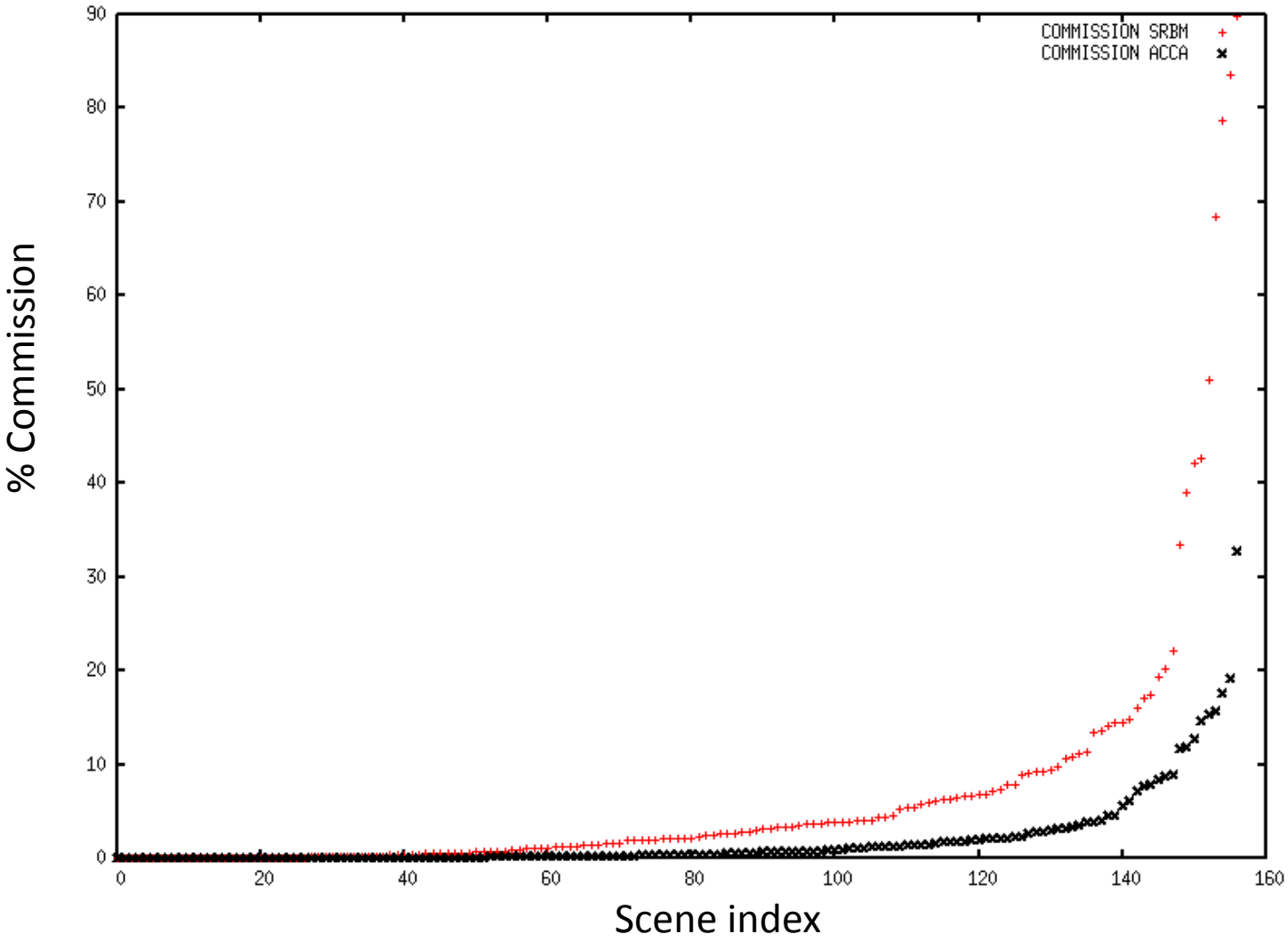
Re-analysis on reduced number of scenes

- Lazaros Oreopoulos selected a subset of 157 scenes where validation mask could be fully trusted.

LEAKAGE RATE comparison (selected scenes)



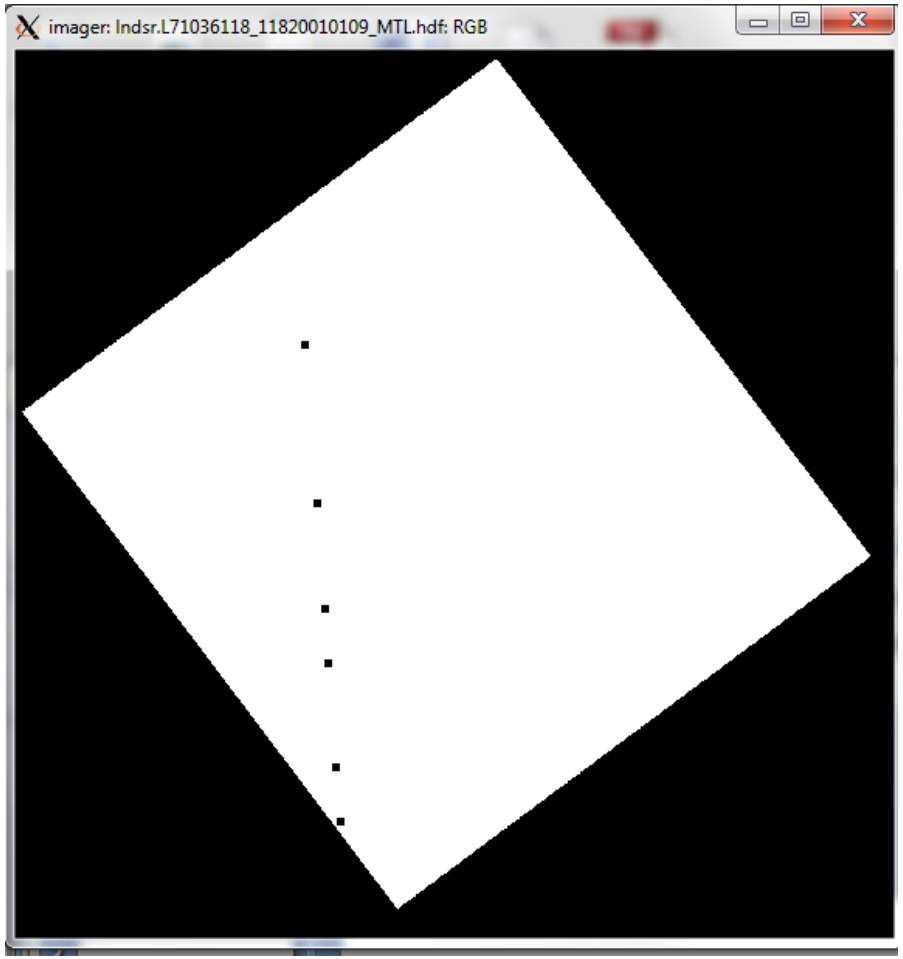
COMMISSION RATE Comparison (selected scenes)



Conclusions

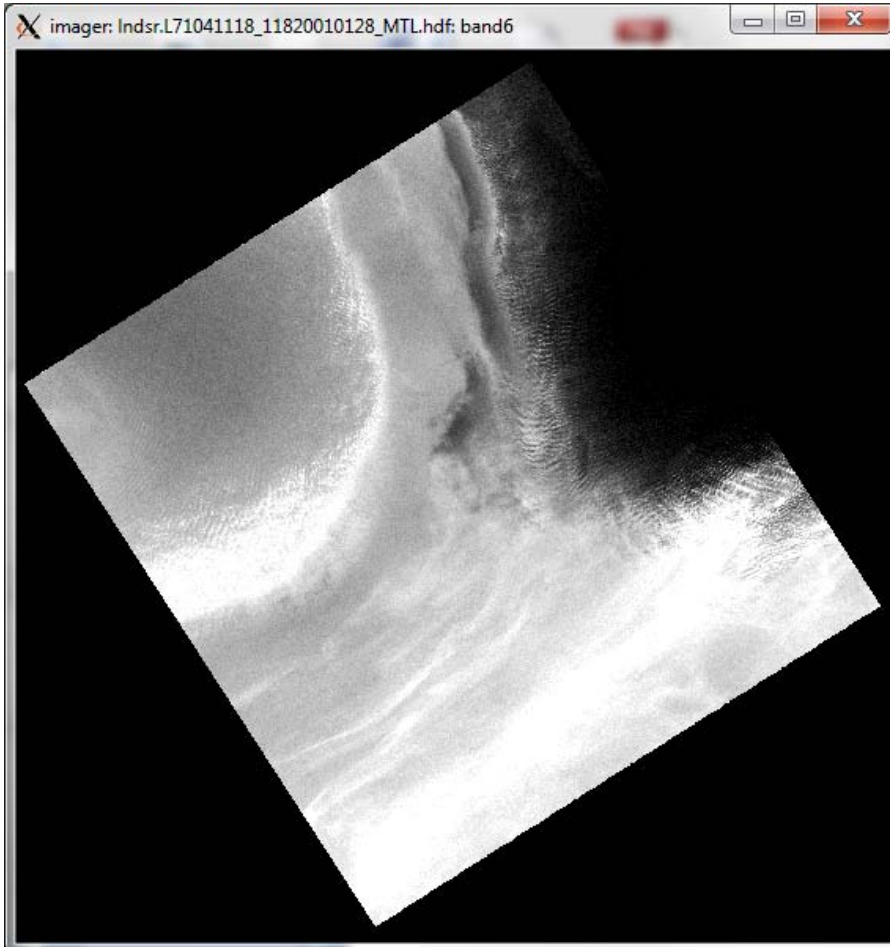
- As far as leakage the internal cloud mask, SRBM, is superior to ACCA.
- In term of commission ACCA has better performance than SRBM

Problem scenes



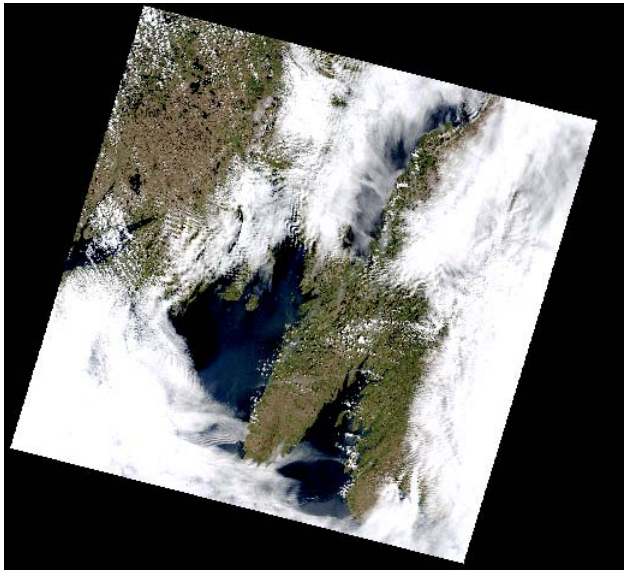
South pole: ~90% leakage

Another south pole scene (no visible data.. All zero 61% leakage)

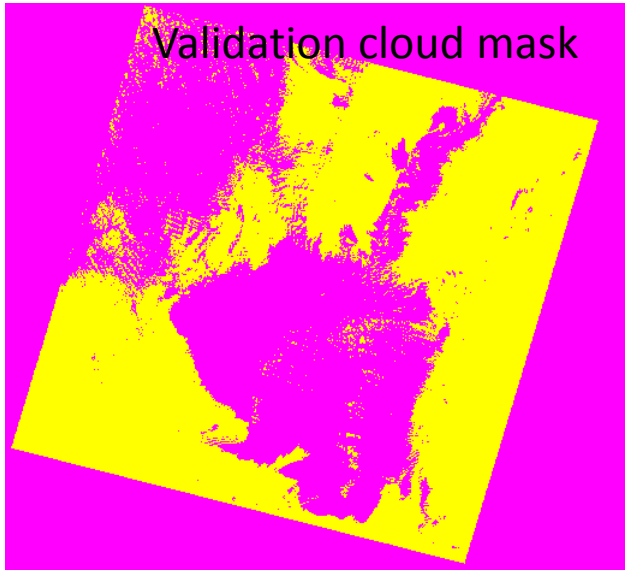


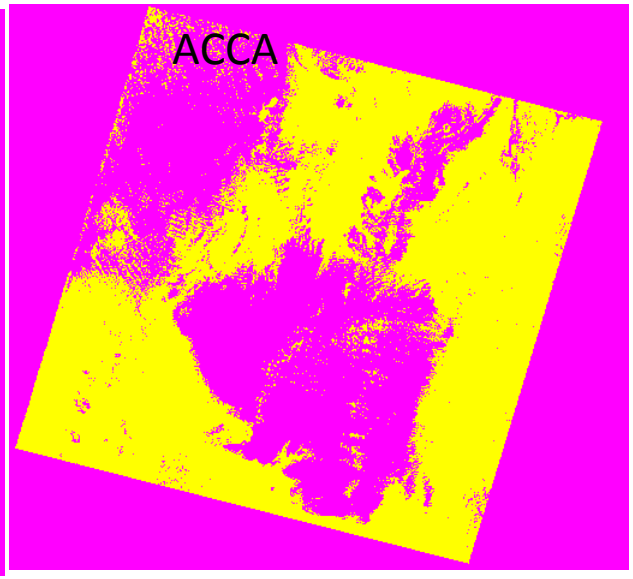
Thermal bands

P002R027



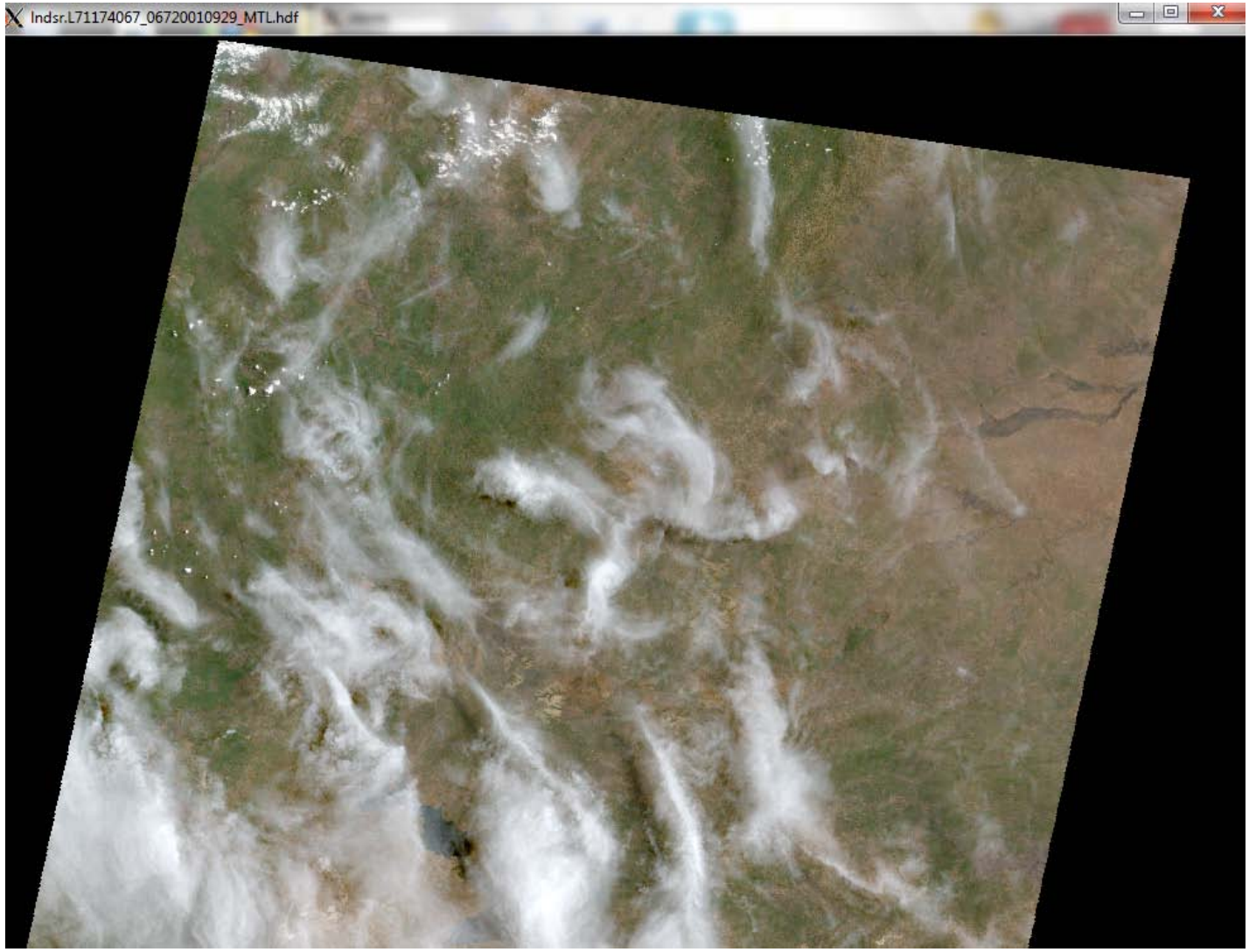
Leakage
30%





This case is still under investigation and is probably related to the use of wrong ancillary data (air temperature)

p174_r67: Leakage ~14%



Conclusions

- Evaluation/Validation of Landsat SR is on-going through several independent efforts.
- Comparison to ground truth still needs development. It is difficult and costly maybe we can leverage on future effort (NEON?)
- SRBM cloud mask has been evaluated in a variety of conditions and performs well in the context of LEDAPS/GFCC objectives.
- Cloud shadow mask is next on the list of the variable to be evaluated (only ~25 manual mask are available)