Evaluation and Inter-comparison of MODIS and VIIRS Measures of Daily Albedo

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And a huge cast of past students, researchers, and colleagues!

*NASA/GSFC

MODIS BRDF, NBAR, Albedo (MCD43)

- Utilizes multi-angle, multi-date, cloud-free, surface reflectances
  - Terra (Dec 1999) and Aqua (May 2002)
- Retrieves of per pixel BRDF model (RTLSR)
  - Seven Land Bands, 3 Broadbands
- Computes Albedos and NBAR
  - Black-sky (directional hemispherical reflectance DHR)
  - White-sky (bihemispherical with isotopic illumination BHR_{iso})
  - Nadir BRDF-Adjusted Reflectance (NBAR)
  - Blue-sky can be computed (actual albedo – BHR)
- Includes Extensive Quality Flags (bit packed)
  - Snow vs non-snow values (majority situation)
  - Input quality, Observation coverage, Outlier, WoD, RMSE
- Climate Modeling Grid (CMG)
  - 30arc second, 0.05degree (global lat/lon)
- Undergoes frequent archive reprocessing
  - Beta-V005 (no V002)
  - V006 underway

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MODIS BRDF, NBAR, Albedo (MCD43)

- Product was original bid as a rolling daily product
  - (Strahler et al., ~1994)
- Due to long term archive space, constrained to retrievals every 16-day (with a 16-day period)
  - Increased to 8-day retrievals in V005 (still 16-day period)
- Initially 1km, increased to 500m gridded retrievals (MCD43A)
  - MCD43B became lower quality average of underlying 500m
  - MCD43B dropped in V006
- Daily in V006 (reprocessing just underway)
  - Multi-date inputs with emphasis on center day of interest
  - Increased Quality Flags (unpacked)
  - Snow vs non-snow based on MODIS snow product
  - CMG retrieved as 30arc second (not just average of 500m)
    - Additional uncertainty information
- Update of Direct Broadcast version also underway

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MODIS BRDF, NBAR, Albedo Evaluation

- Albedo Validation at stage 3

http://landval.gsfc.nasa.gov/ProductStatus.php?ProductID=MOD43

  - Cescatti et al., 2012
  - Wang et al., 2012; 2014
  - Quality degrades at SZNs >70-75º

- Tower Albedometers
  - BSRN (Surfrad)
  - Fluxnet
  - NEON
  - Spatial Representativeness

- Multi-angle aircraft data to evaluation BRDF
  - Cloud Airborne Radiometer (CAR)
  - Román et al., 2009; 2011; 2013
  - NEON/AVIRISng/GLiHT hyperspectral, lidar

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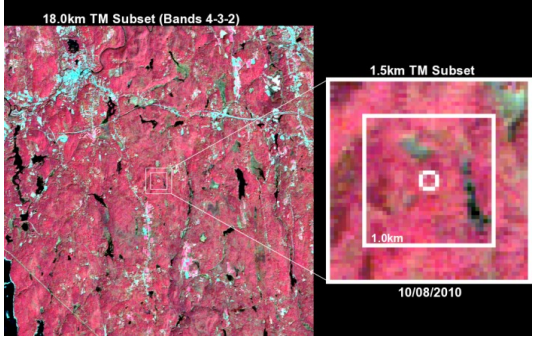
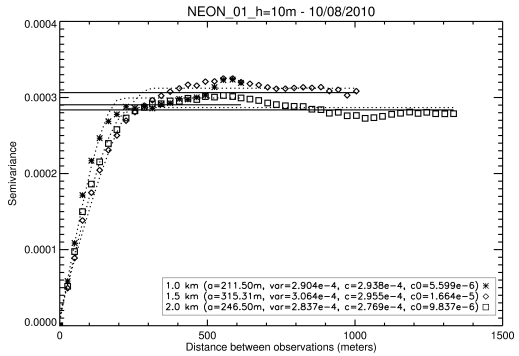
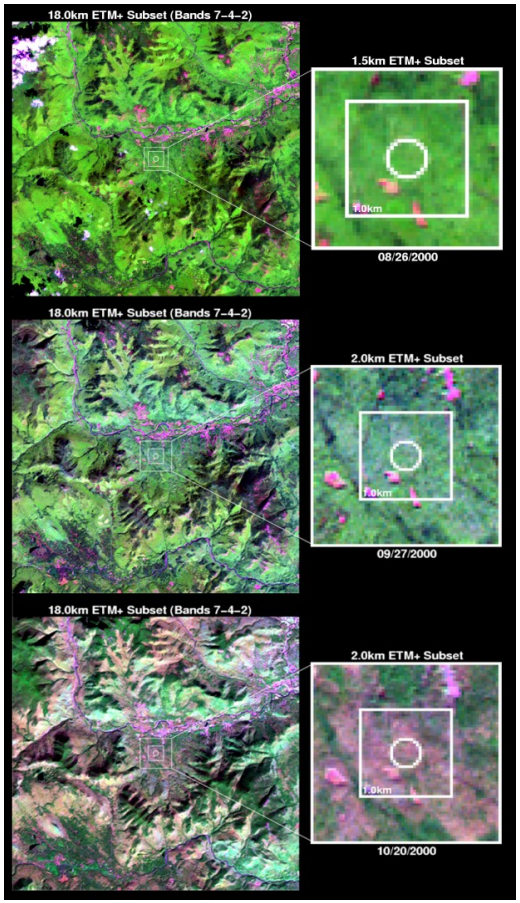
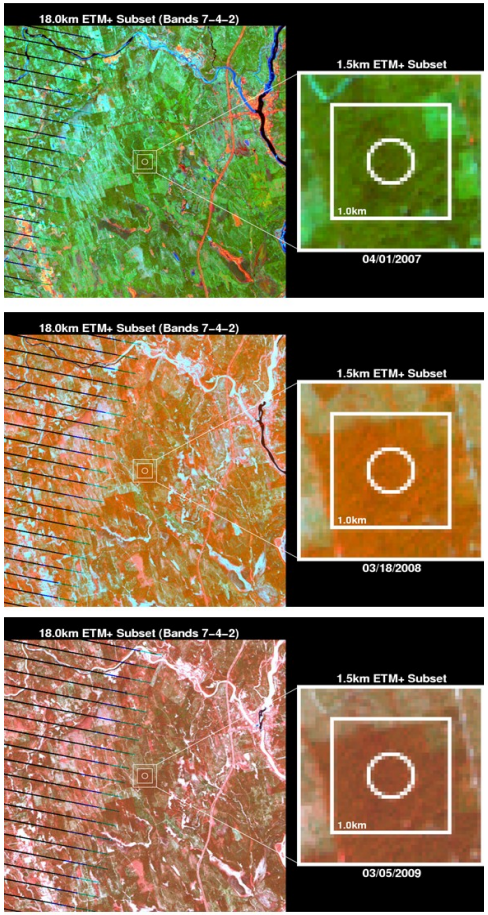
Spatially Representative Sites





Harvard Forest 10/08/2010





Seasonal variation (Aug, Sep, Oct 2000) in Landsat values (Bartlett Experimental Forest tower, Bartlett, NH (mixed forest)

Variation in Landsat values over time (2007, 2008, 2009) due to clearcuts in the areas surrounding Howland Experimental Forest west tower, Howland,

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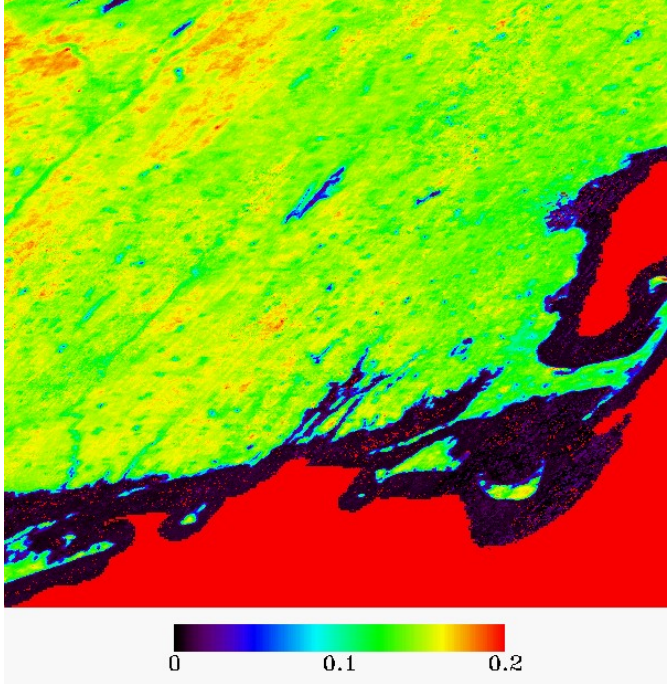
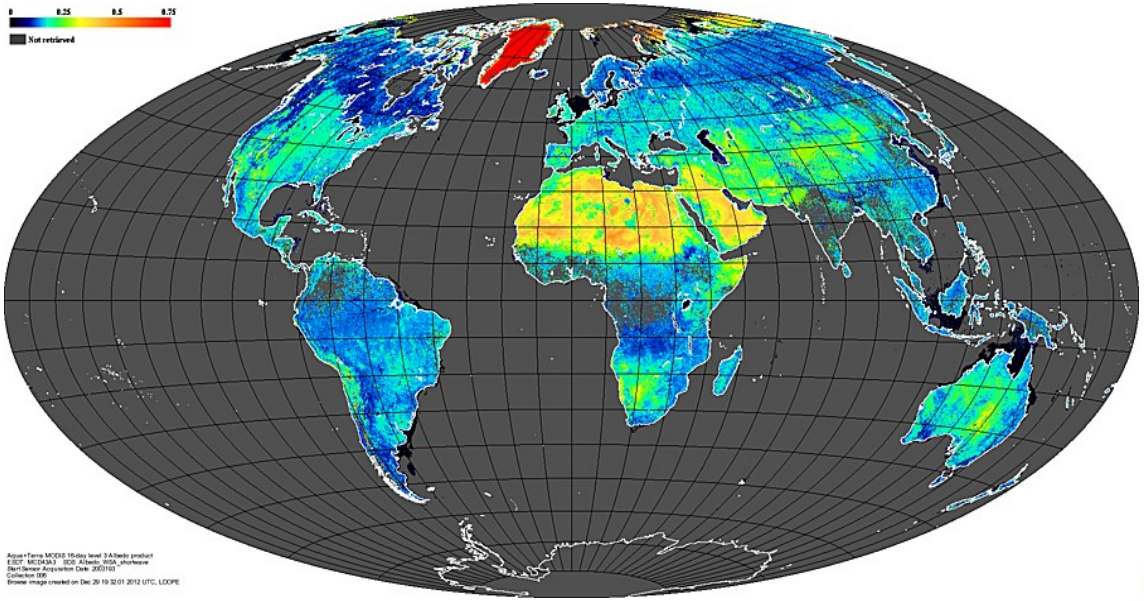
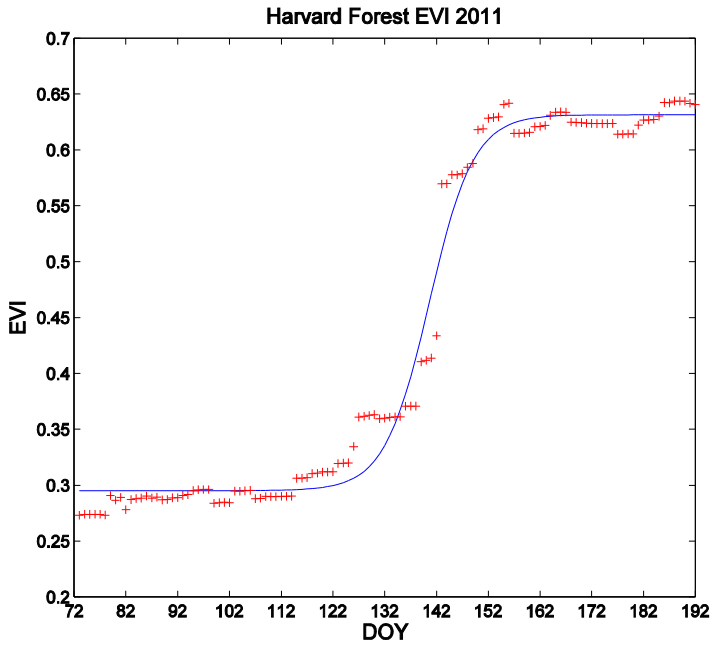


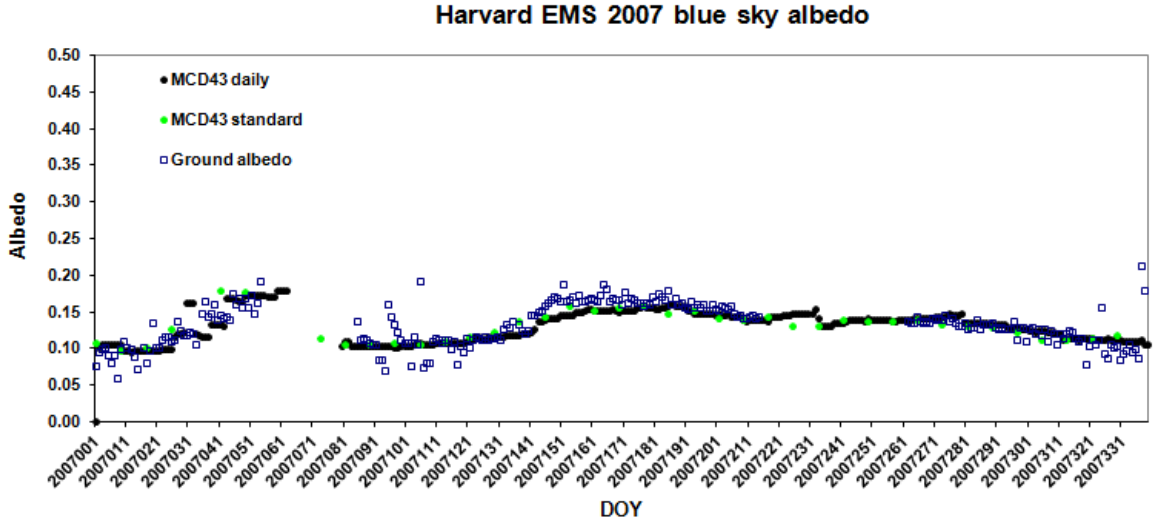
Harvard Forest shortwave white sky albedo on 2011192



Collection 6 shortwave White-Sky Albedo (WSA) 2003193

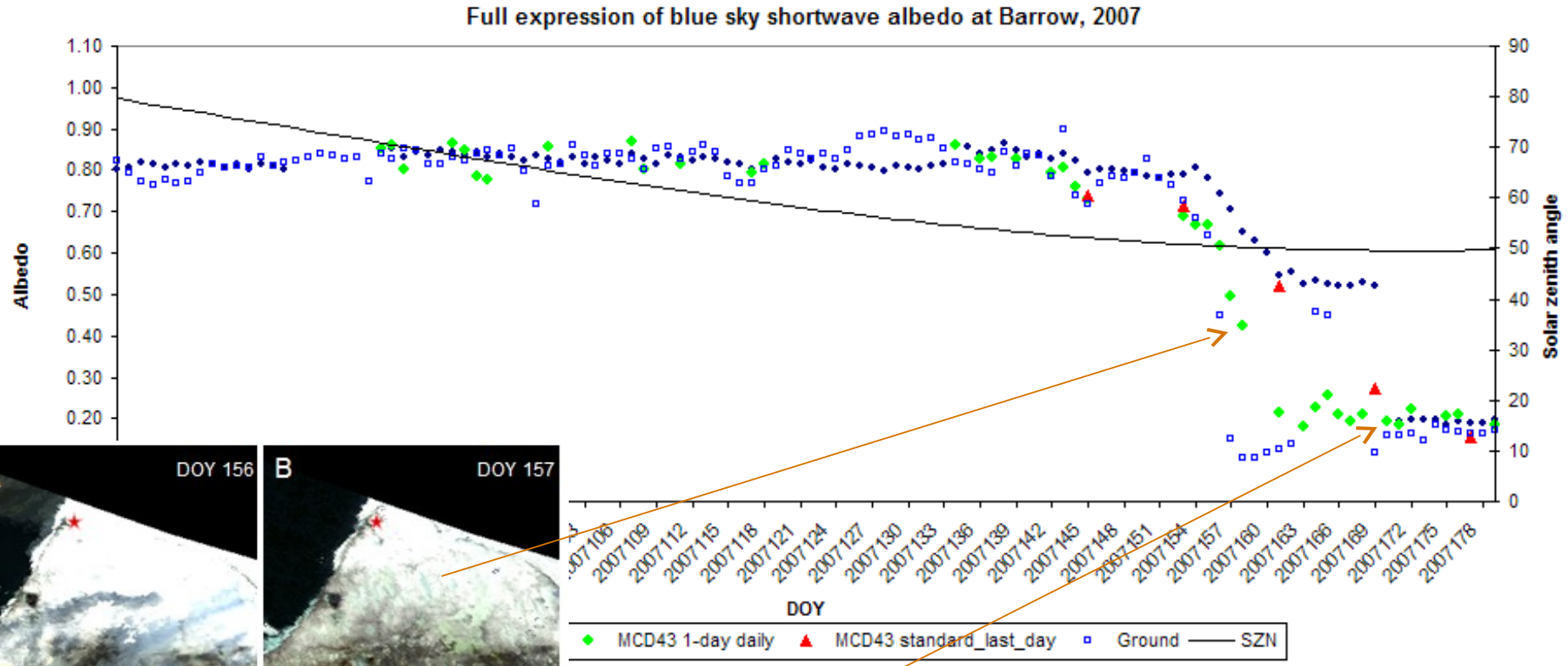
Time series of EVI from MODIS daily NBAR

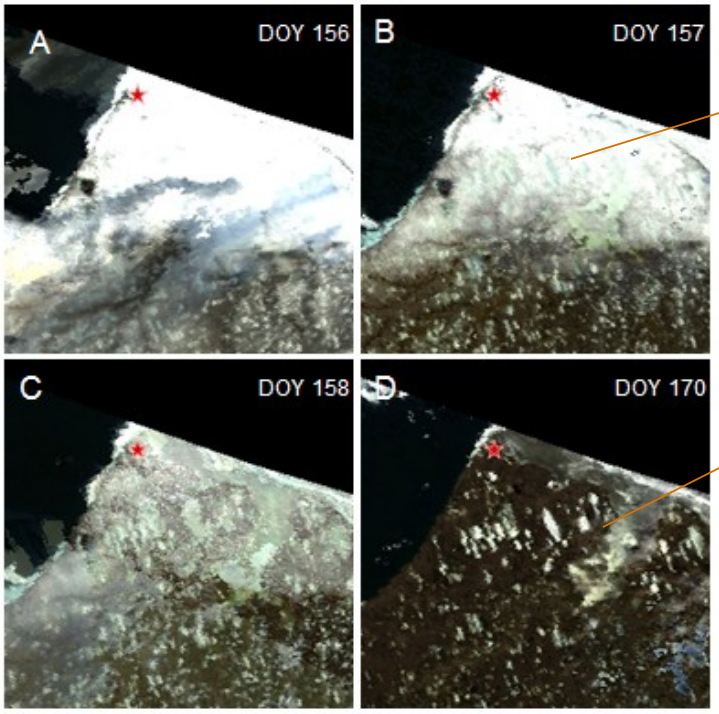




Harvard Forest daily MODIS blue sky albedo in 2007

Albedo at Barrow Alaska





Red: 0-0.5 Green: 0-0.5 Blue: 0-0.5

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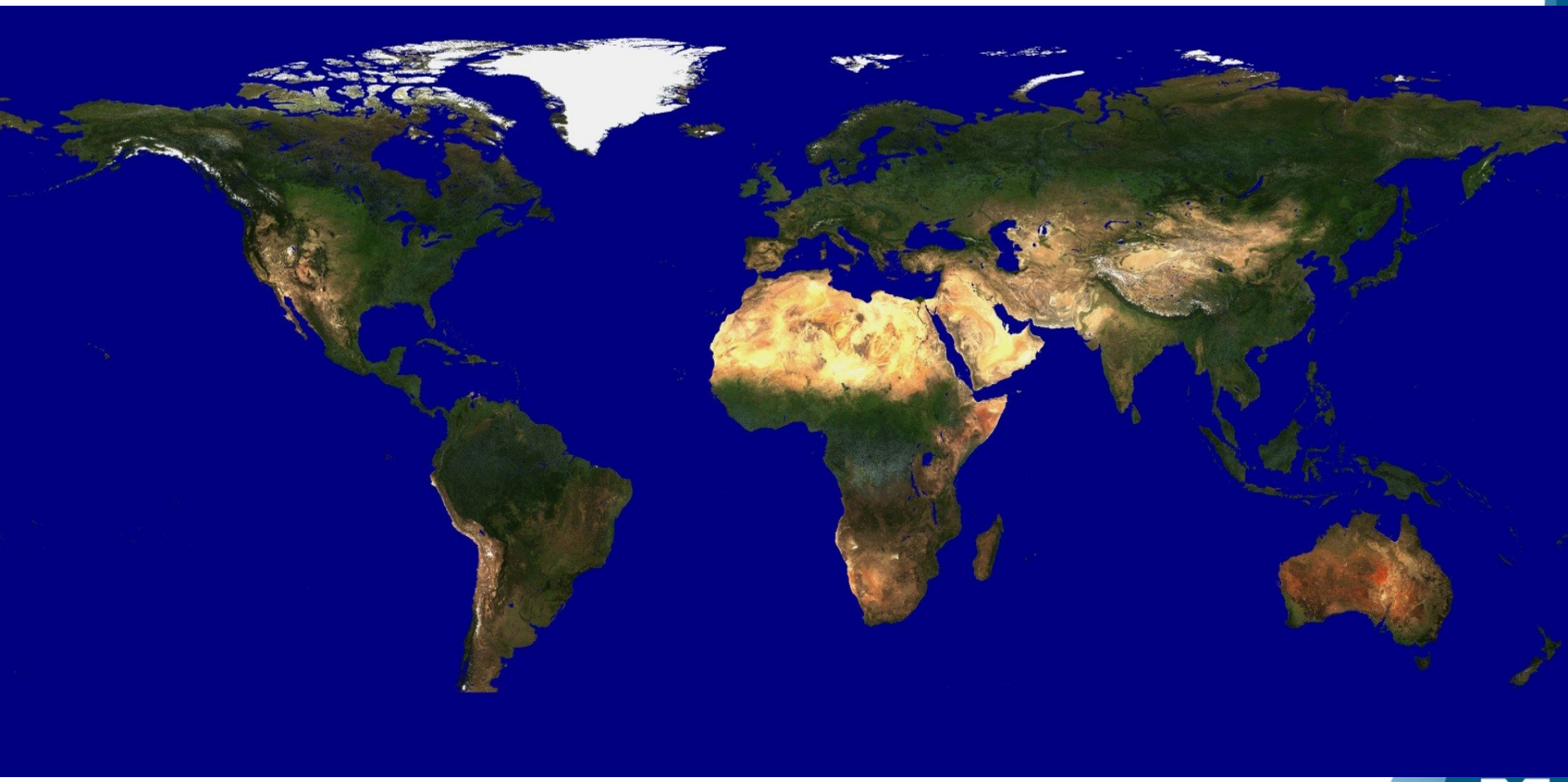
Gap-filled Snow-Free Albedo



WSA 2004-193

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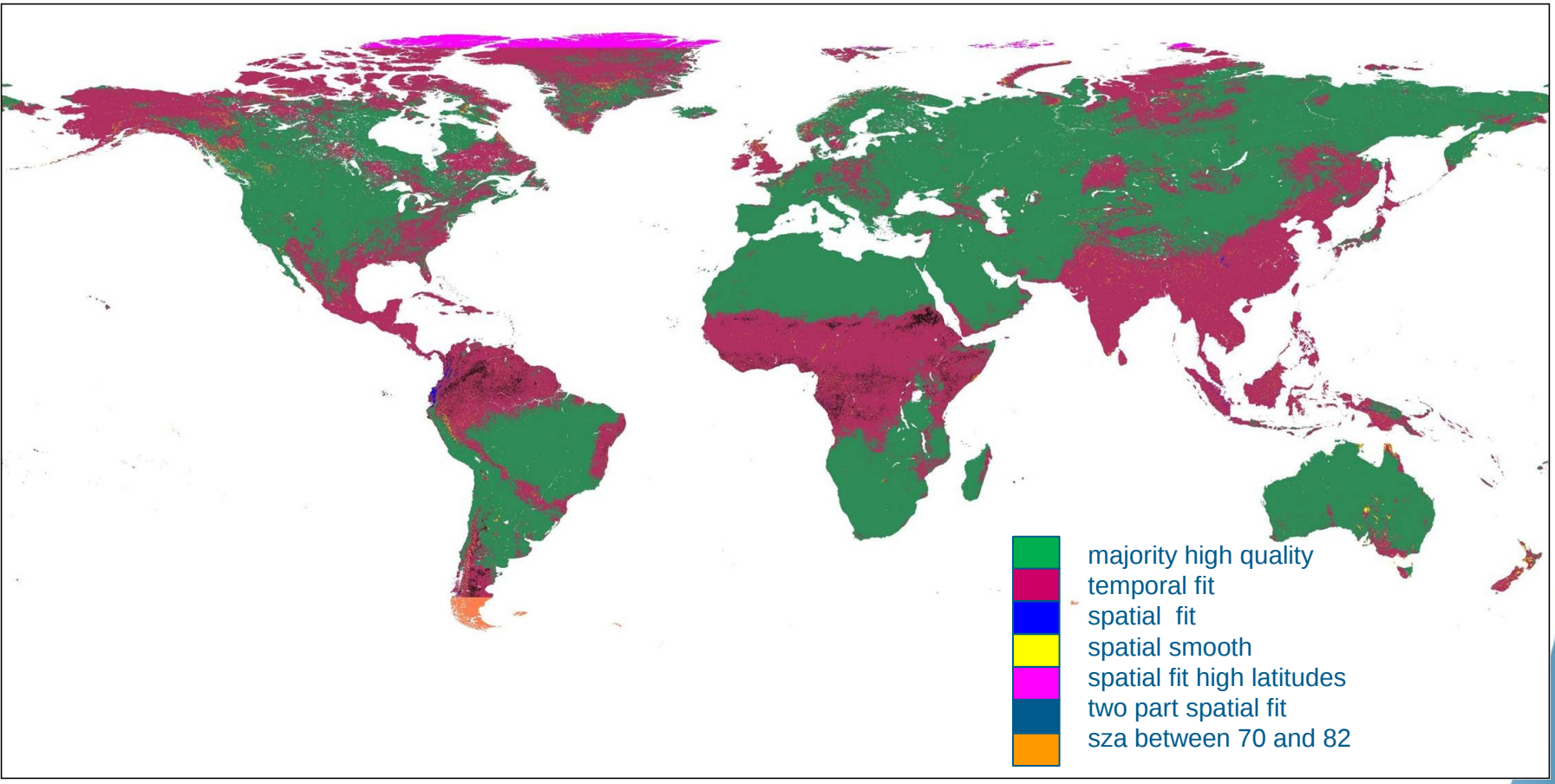
Quality Flags
Gap-filled Snow Free BRDF/albedo



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Suomi-NPP VIIRS Albedo

- National Polar-orbiting Partnership (NPP)
  - Launched Oct 2011
- VIIRS Albedo algorithm produces only a single **Daily Broadband Albedo**
  - **I**n swath at the time of overpass
- **Two** algorithms were originally implemented in code
  - Bright Pixel Surface Albedo (**BPSA**) uses a **TOA LUT** approach
    - Liang, 2003; Liang et al., 2010
    - Designated as primary algorithm
    - **ONLY** rudimentary results currently being output
  - Dark Pixel Surface Albedo (**DPSA**) based on MODIS heritage
    - **Spectral** BRDF models, coarse **NBAR,** were supposed to be produced in **unreleased IP**
    - Retrieval, broadband computation **different** from daily MODIS V006
    - Discovered after launch that DPSA had been turned off
- At present VIIRS **does not** provide MODIS continuity
  - NASA proposal due 10 March 2014

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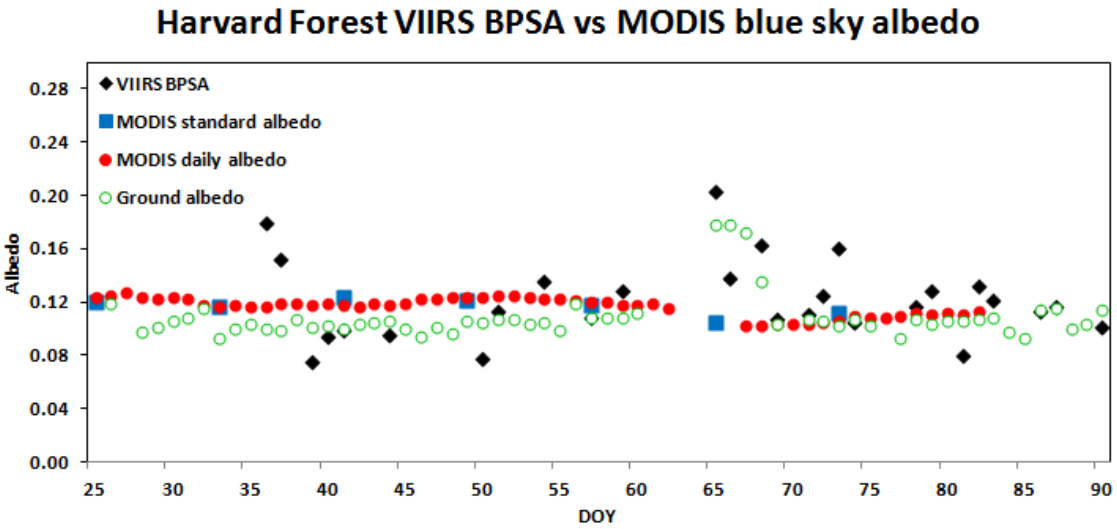
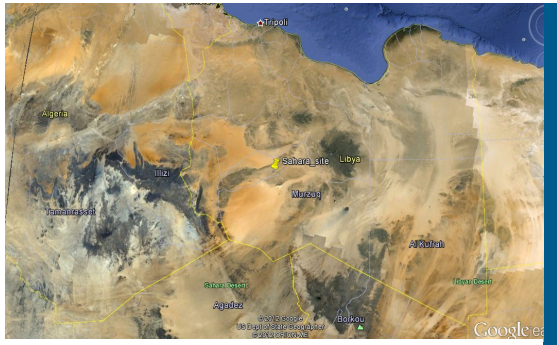
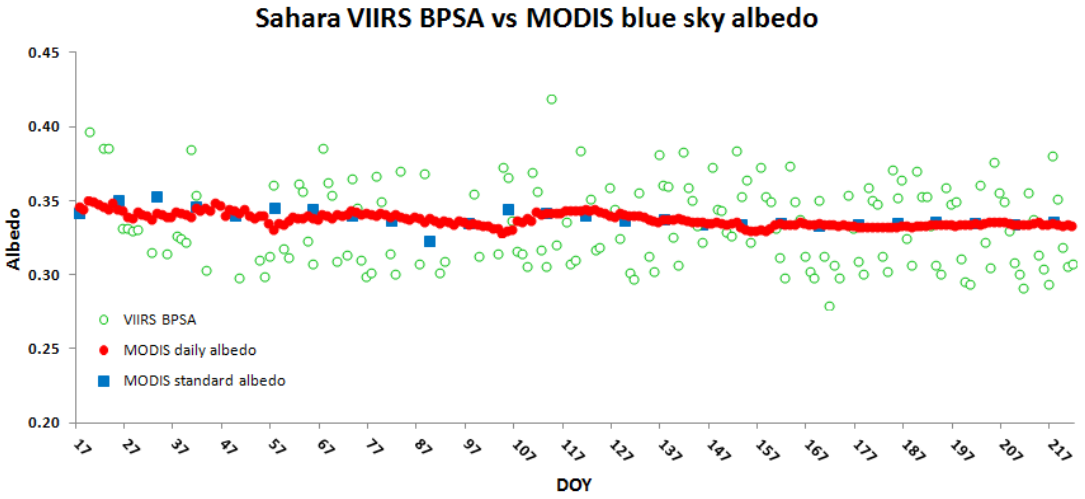
VIIRS Albedo Evaluation

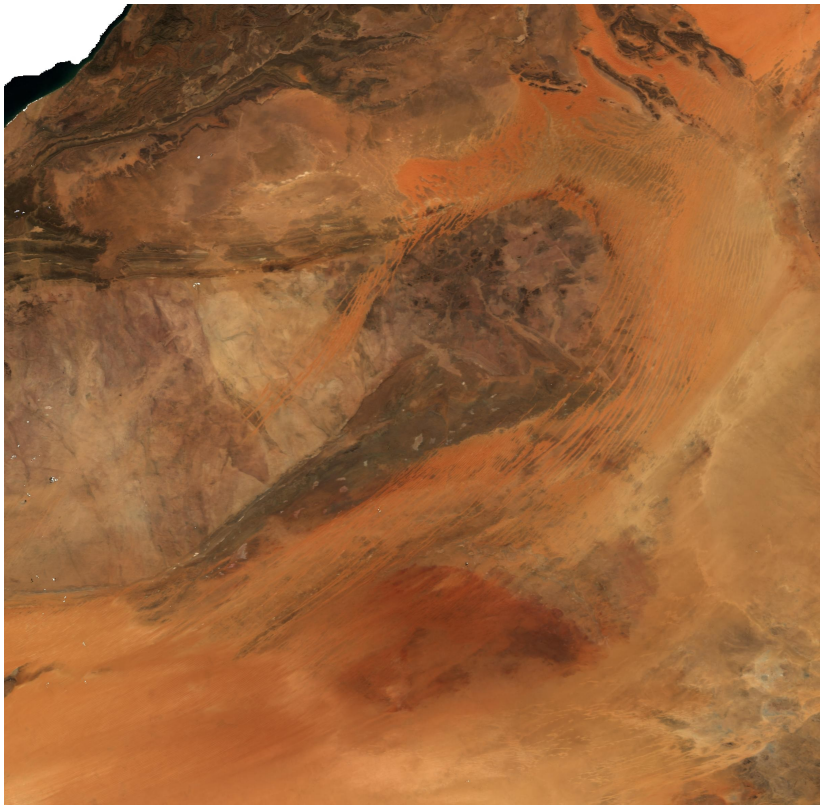
- VIIRS Albedo was extremely unstable in the early days
  - Tungsten Oxide Contamination
  - cloud/snow/SR
- BPSA **only** algorithm being processed
  - prototype gridded DPSA has to be evaluated at LPEATE
- Monitoring VIIRS
  - versus MODIS
  - versus tower albedometers

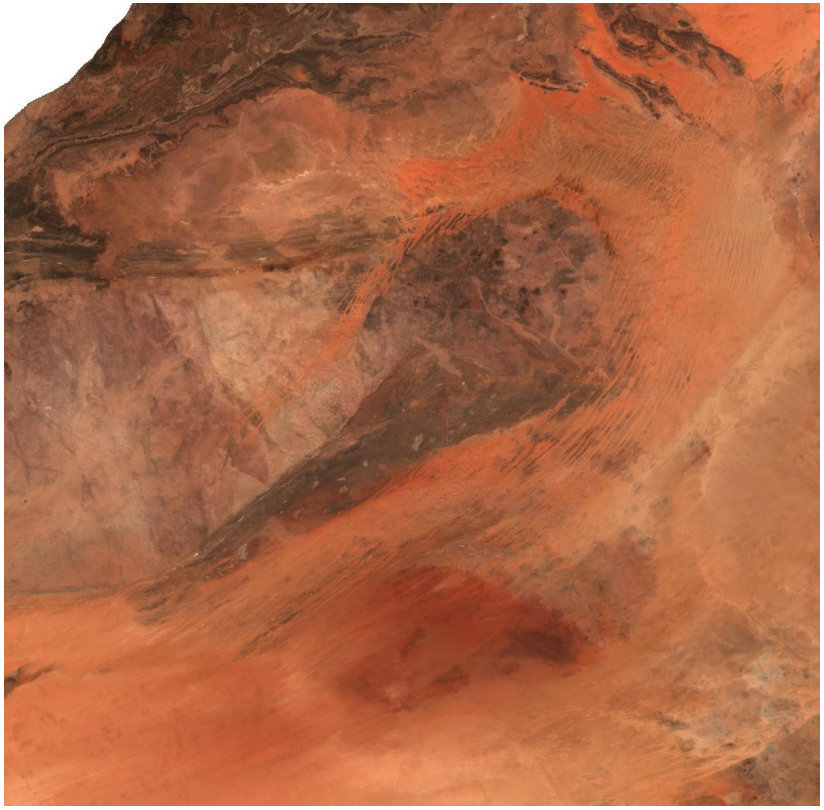




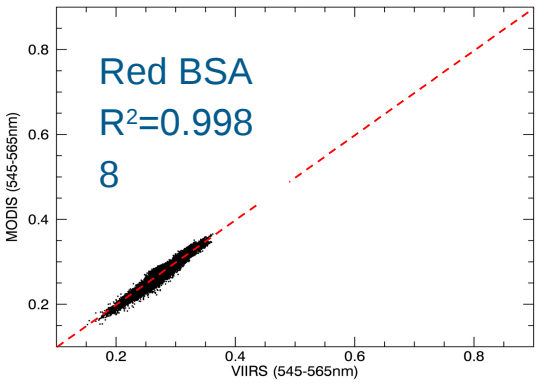


Suomi-NPP VIIRS Sahara 2014 DOY013

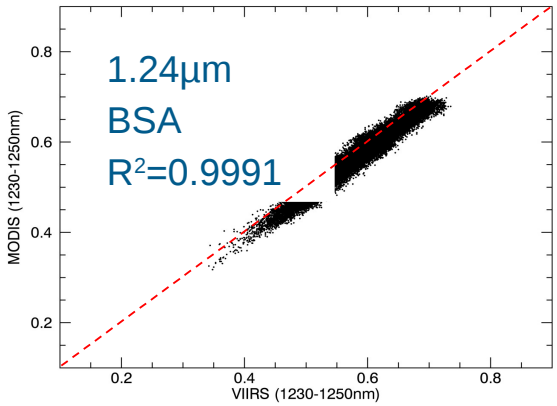




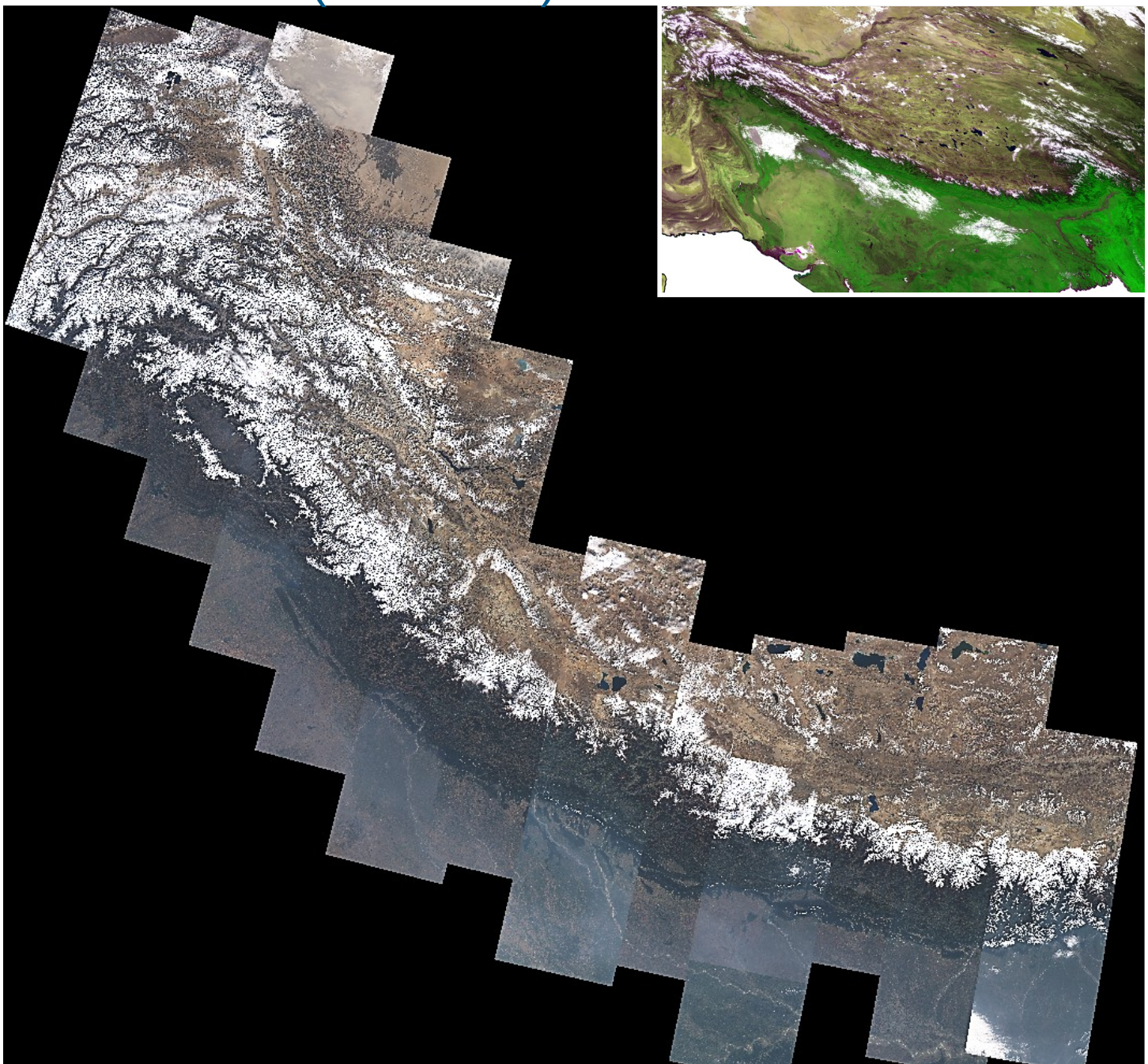
MODIS Version 006 (left) VIIRS (right) BSA (Black-sky albedo) Tile H17V06



	R	G	B
VIIRS	662 - 682 nm	545 -565 nm	478 - 488 nm
MODIS	620 - 670 nm	545 - 565 nm	459 - 479 nm



LANDSAT-8 (Feb 2013)



Landsat-8 mosaic of the Himalaya, Oct 2013 (63 path/rows) with MODIS NBAR Nadir BRDF-Adjusted Reflectance – NBAR (8 MODIS tiles)

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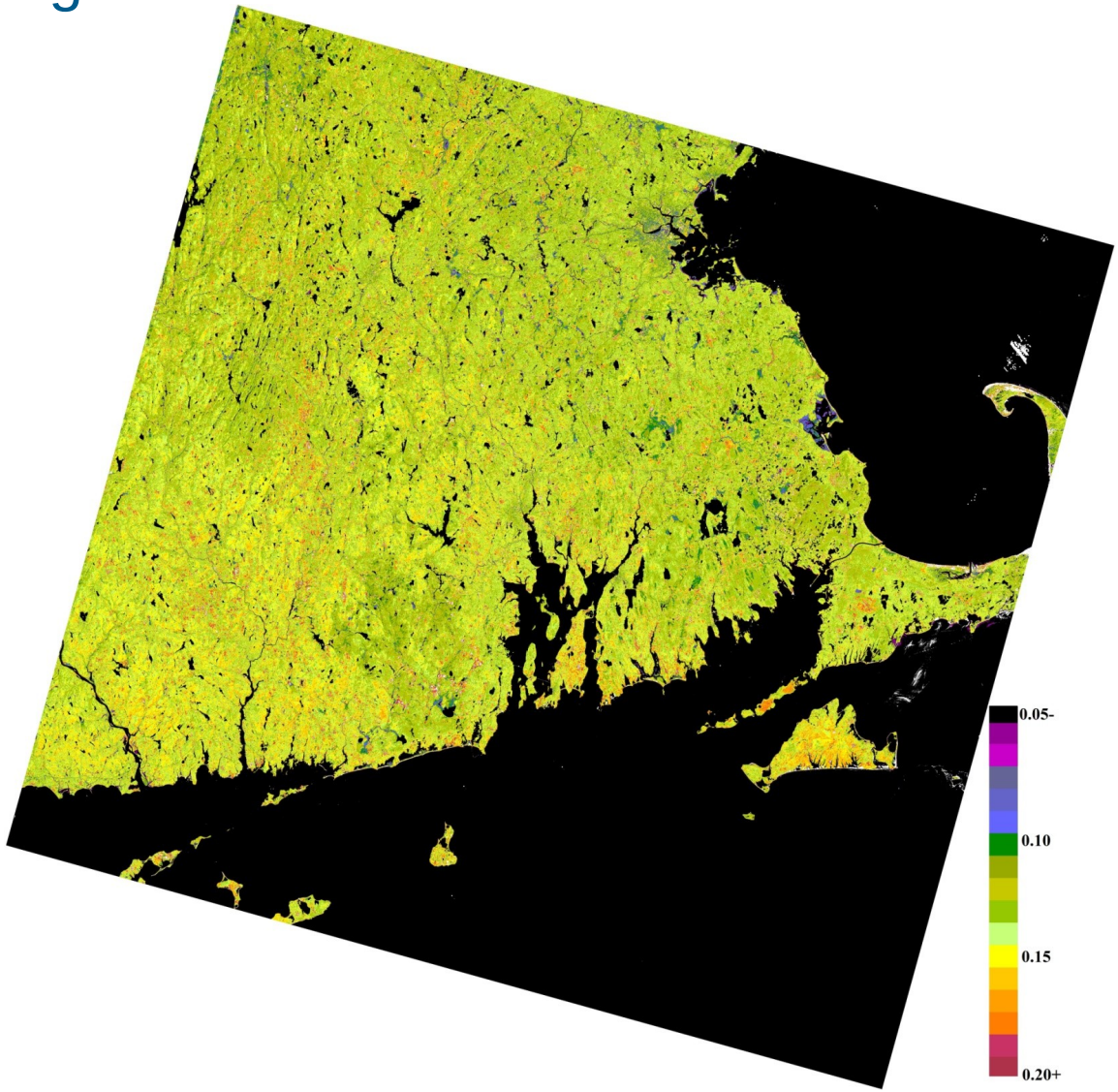
Landsat-8 Albedo (coupled with MODIS) Shuai et al., 2011
And looking forward to Sentinel-2



White Sky Albedo for Landsat8 WSA p12r31 2013-122 (2 May)

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Summary

- MODIS Daily V006 is underway
- Validation at spatially representative tower sites
  - BSRN standards
  - LPV protocols
- Airborne Field campaigns of opportunity
  - e.g. CAR, NEON, AVIRISng, GLiHT
- Global gap-filled 30arc second CMG products
- VIIRS processing through MODIS heritage algorithms
  - Climate quality continuity products
  - New NPP proposals due in March 2014
- Landsat Albedo
  - Landsat-8

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