Current Status of the Terrestrial Environmental Data Products from the Suomi NPP Satellite

Ivan Csiszar *(NOAA/NESDIS/STAR)*

Jeff Privette *(NOAA/National Climatic Data Center)*

Miguel Román, Eric Vermote *(NASA/GSFC)*

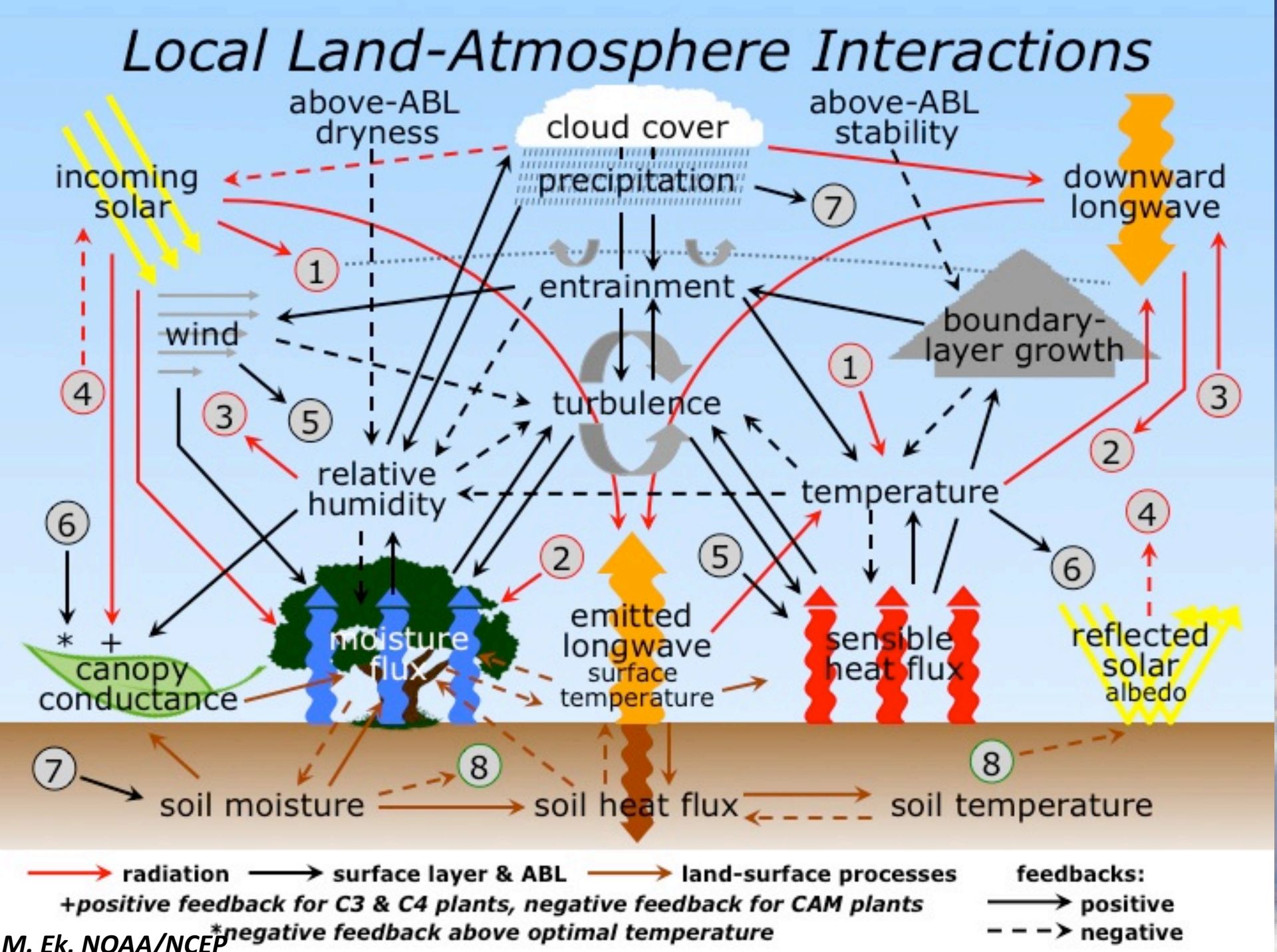
Chris Justice *(University of Maryland)*

NOAA JPSS Land Calibration and Validation Team

NASA SNPP VIIRS Land Discipline Team

NOAA JPSS SNPP VIIRS Land Products and Team Principals

Role or Product Focus	Name (+ et al.)	Affiliation
NOAA Product Team Lead, **Fire**	*Ivan Csiszar* / Wilfrid Schroeder	NOAA / UMD
NASA Coordination, Validation co-lead	Miguel Román, Chris Justice	NASA / UMD
Surface Reflectance, VCM, calibration	*Eric Vermote*	NASA
Surface Reflectance	Alex Lyapustin	NASA
Vegetation Index	*Marco Vargas*	NOAA
Vegetation Index	Tomoaki Miura/ Alfredo Huete	Univ. of Hawaii / Arizona
Albedo	*Yunyue (Bob) Yu* / Shunlin Liang	NOAA / UMD
Albedo	Crystal Schaaf	Univ. Mass.
Land Surface Temperature	*Bob Yu*	NOAA
NOAA CDR coordination, LST	Jeff Privette / Pierre Guillevic	NOAA / NASA JPL
Surface Type	*Jerry Zhan*	NOAA
Surface Type	Mark Friedl	Boston Univ.
STAR AIT Land	Walter Wolf, Youhua Tang	NOAA
NASA LandPEATE, **gridding/granulation**	Robert Wolfe, Sadashiva Devadiga	NASA
Northrop Grumman	Alain Sei, Justin Ip	NGAS
Raytheon	Daniel Cumpton	Raytheon
JPSS Algorithm Manager	Leslie Belsma	Aerospace



M. Ek, NOAA/NCEP

Land Model Requirements

To provide these proper boundary conditions, land model must have:

- **Atmospheric forcing** to drive land model,
- Appropriate **physics** to represent land-surface processes,
- Proper **initial land states**, such as snow & soil moisture (analogous to initial atmospheric conditions, though land states may carry more "memory", especially deep soil moisture, similar to ocean SSTs),
- **Land data sets**, e.g. land use/land cover (vegetation type), soil type, surface albedo, and associated parameters, e.g. surface roughness, soil and vegetation properties.

M. Ek, NOAA/NCEP

VIIRS vs. MODIS for land monitoring

- What can VIIRS do better than MODIS?
  - Better coverage and scanning geometry, including higher resolution of "M" bands
    - Improved fire detections (25% higher VIIRS fire counts than MODIS in the three-pixel VIIRS aggregation zone)
    - No gaps at low latitudes, more consistent data for temporal compositing
- What can VIIRS do that MODIS cannot?
  - VIIRS Day/Night Band: VIIRS can directly assess a variety of phenomenon associated with human settlements (e.g., population, socio-economic activity, the built environment, and urbanization).
- What can MODIS do better than VIIRS?
  - *MODIS can 'see' the Amazon better*: TERRA-MODIS was designed to cross the equator at a time when cloud cover is at its daily minimum (10:30AM, descending).
- What can VIIRS do that is currently missing?
  - VIIRS can/should be used to measure the Earth's Biosphere: (i.e., not just daily VI and Surface Type, but also LAI/FPAR, NPP/GPP, Burned Area, Phenology, etc.)
  - Multiple threads of VIIRS product development and generation: IDPS, NOAA JPSS (NDE), Proving Ground, NASA Science Team and Applied Science etc.

Surface Reflectance

2013-04-15 (GranuleID – NPP000467286982)

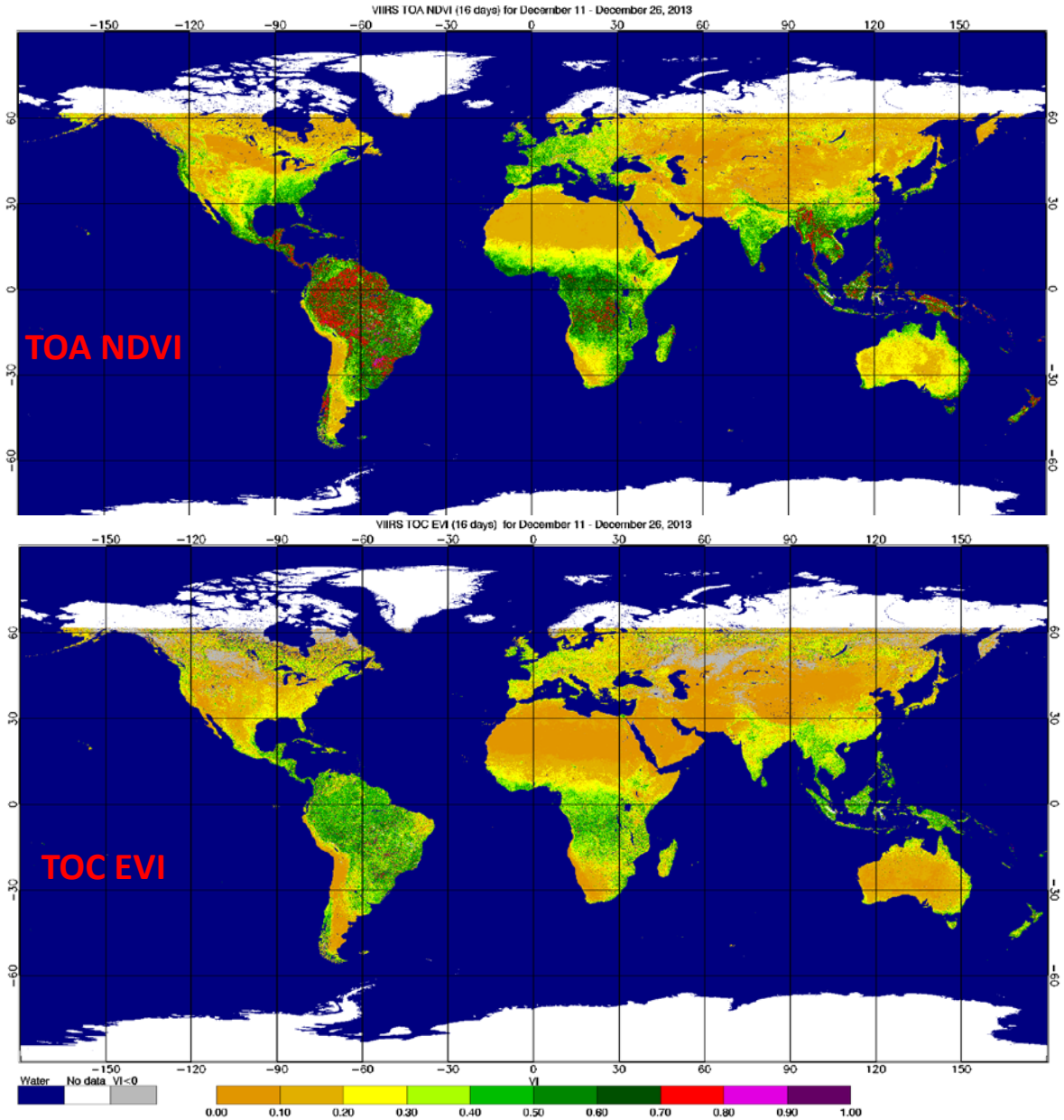
DR4488: ADL test result over one VIIRS granule showing retrieval under all conditions except night and ocean (showing RGB composite of Bands: M5,M4 and M3 respectively)

ADL TEST RESULT

E. Vermote, NASA GSFC

VIIRS Vegetation Index EDR

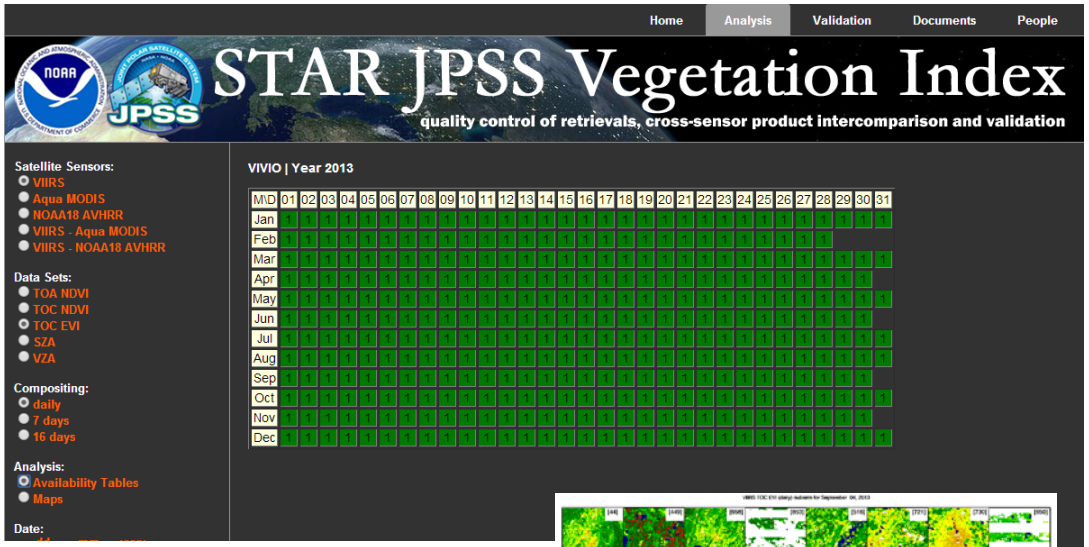
- **VI Product**: TOA-NDVI and TOC- EVI
- **Maturity Status**: Provisional
- **Archive**: CLASS
- **Validation 1 maturity :** scheduled for Summer 2014
- **Product Improvements**: Additional Quality Flags, VIIRS VI EVI Backup Algorithm
- **J1**: Add top-of-canopy NDVI

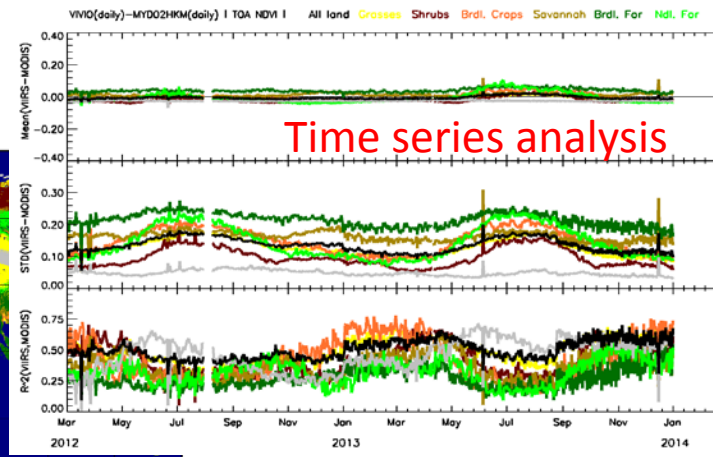


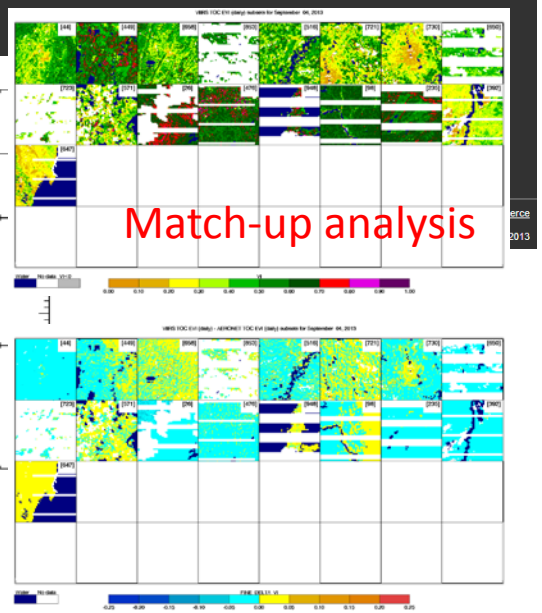
M. Vargas, NOAA/STAR

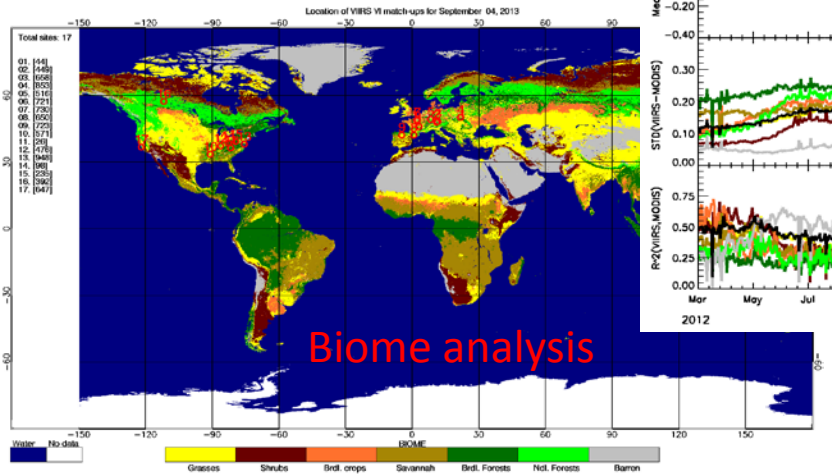
STAR JPSS Vegetation Index Web Tool

- **Validation of the VI product includes comparison with heritage products (MODIS and AVHRR), Aeronet match-up analysis, time series analysis, biome analysis, and validation using in situ tower reflectance data (FLUXNET)**





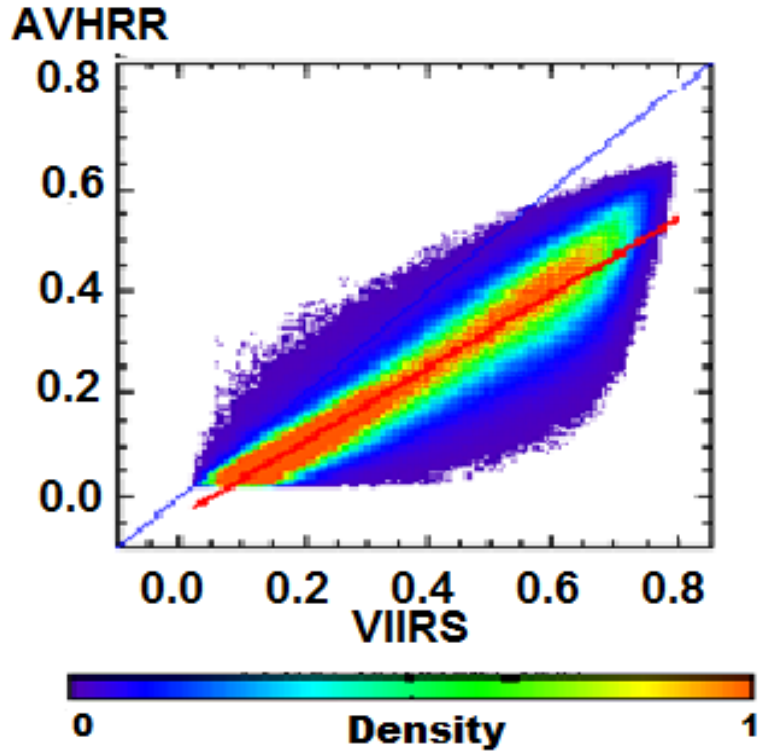




M. Vargas, NOAA/STAR

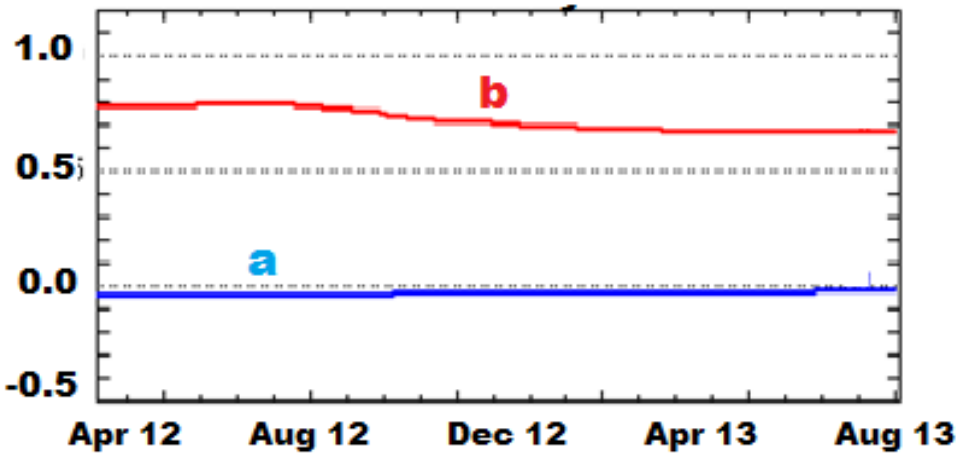
http://www.star.nesdis.noaa.gov/smcd/viirs_vi/Validation.htm

Correlation between VIIRS and AVHRR (TOA)



Correlation of AVHRR & VIIRS NDVI, for the week June 4-12, 2012; CC=0.943
Area 40 S - 60 N & 180 W - 180 E

Coefficients a and b for linear equation of AVHRR and VIIRS weekly NDVI



$NDVI_{avhrr} = a + b^{*}NDVI_{viirs}$

Apr 12-Aug 13:

$a_{mean} = -0.0369$; $b_{mean} = 0.713$

Mean Cor. Coef. (CC) = 0.94

VIIRS NDVI is ~30% higher than AVHRR. In order to apply VIIRS NDVI to continue 34-year AVHRR's NDVI data records & analysis of changes in land cover, drought, climate etc we need to convert NDVI from VIIRS to AVHRR

F. Kogan, NOAA/STAR

Green Vegetation on Our Planet

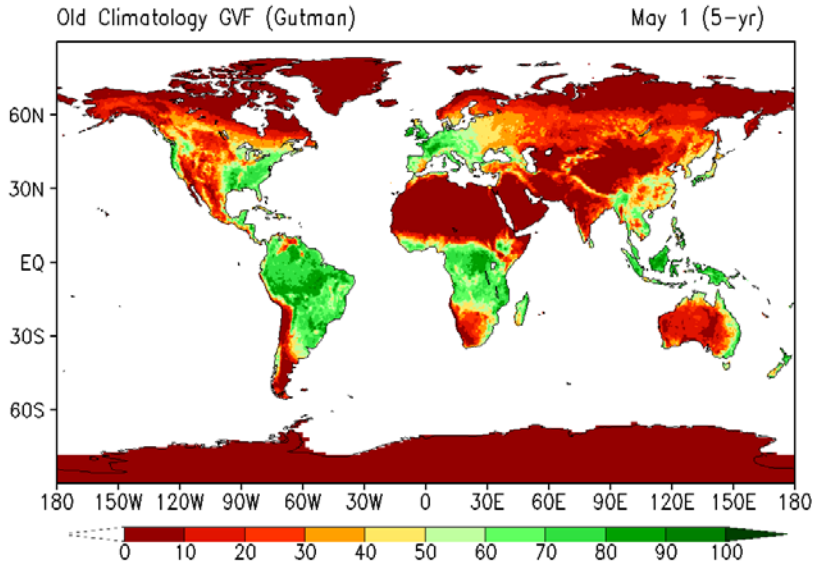
http://www.nnvl.noaa.gov/green.php

April 2012 – April 2013
500 m grid; NDVI weekly composite / gap filled

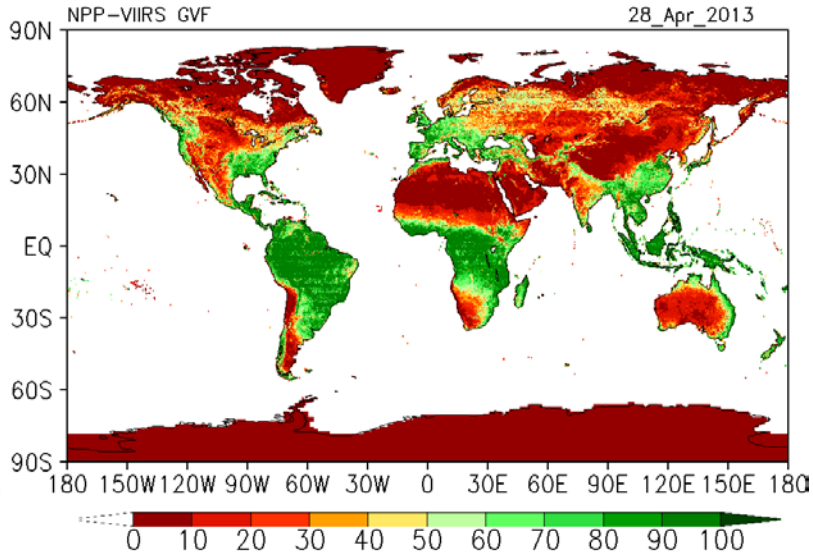
F. Kogan, NOAA/STAR
D. Pisut, NOAA Visualization Laboratory

Green Vegetation Fraction

- **Climatology vs. near real-time GVF**
- **Ingested into NCEP models** where near real-time GVF leads to better partition between surface heating & evaporation --> impacts surface energy budget, PBL evolution, clouds & convection.



AVHRR 5-year Climatology

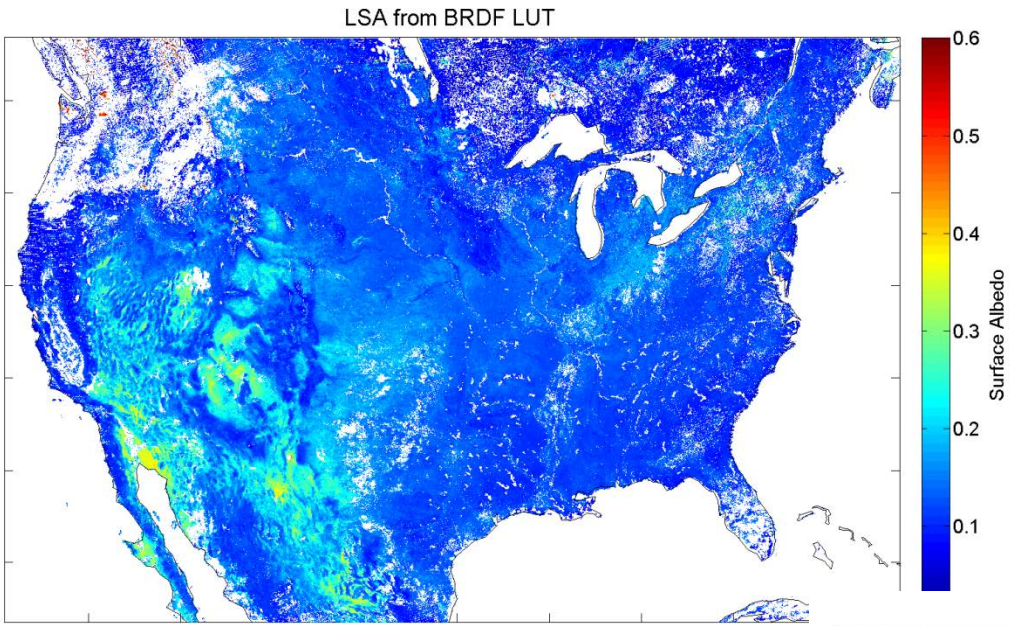


VIIRS

Note: *VIIRS GVF in Midwestern US much lower than AVHRR GVF Climatology.*

M. Vargas, NOAA/STAR

Maps of 16-day mean albedo

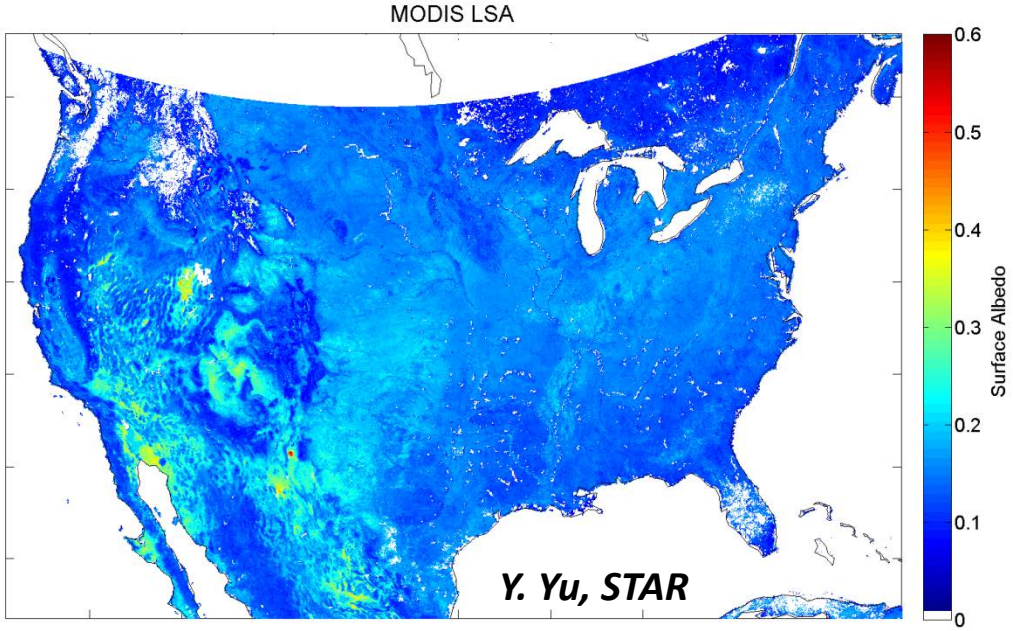


An LUT update for the VIIRS provisional albedo (BPSA – Bright Pixel Surface Albedo) is in testing . . .

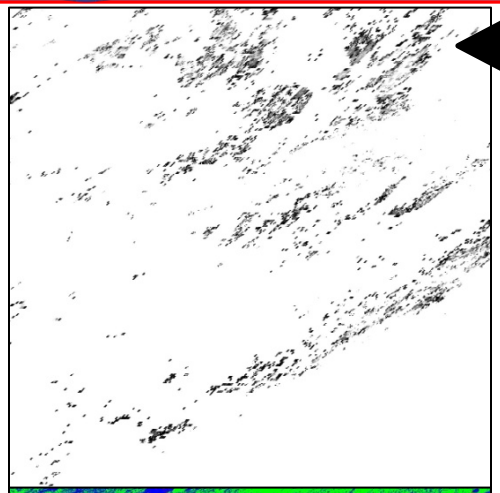
Contiguous US maps of 16-day (DOY 145-160, 2012) mean LSA and MODIS albedo.

Top: the VIIRS BPSA albedo

Bottom: the MODIS albedo

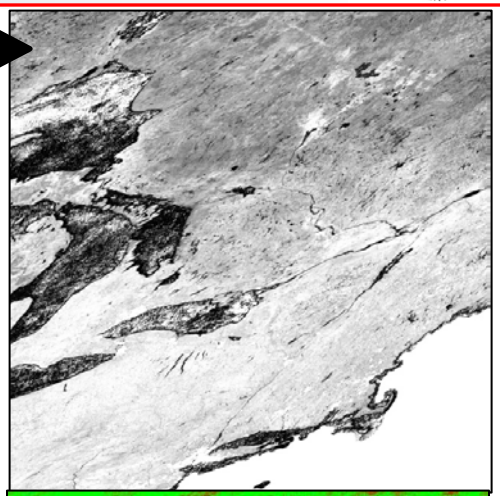


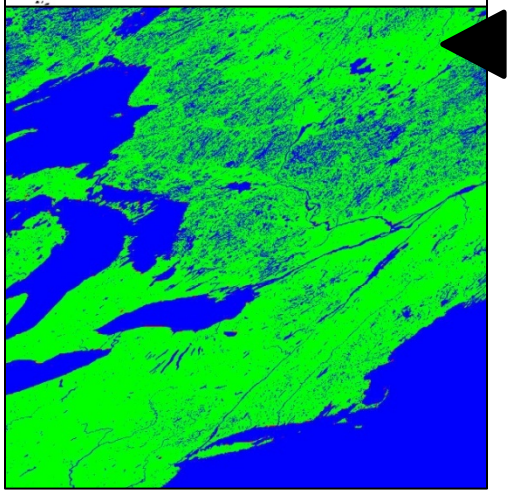
Evaluation of the VIIRS Dark Pixel Surface Albedo EDR (New England 2013183)



VIIRS DPSA White color is fill value. Valid retrievals are nearly all from history, and most of the historical data are fill values.

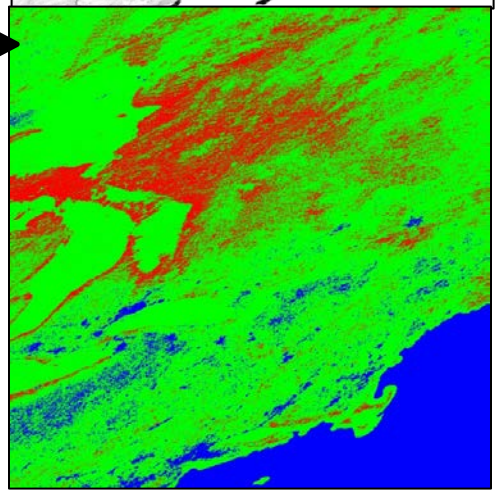
MODIS Aqua-only Black-Sky Albedo.





VIIRS DPSA QA. Red (missing) = full inversion, green = 'historical' data and blue = no-data values.

MODIS Aqua only QA. Red = full inversion, green = magnitude inversion and blue = no-data value.

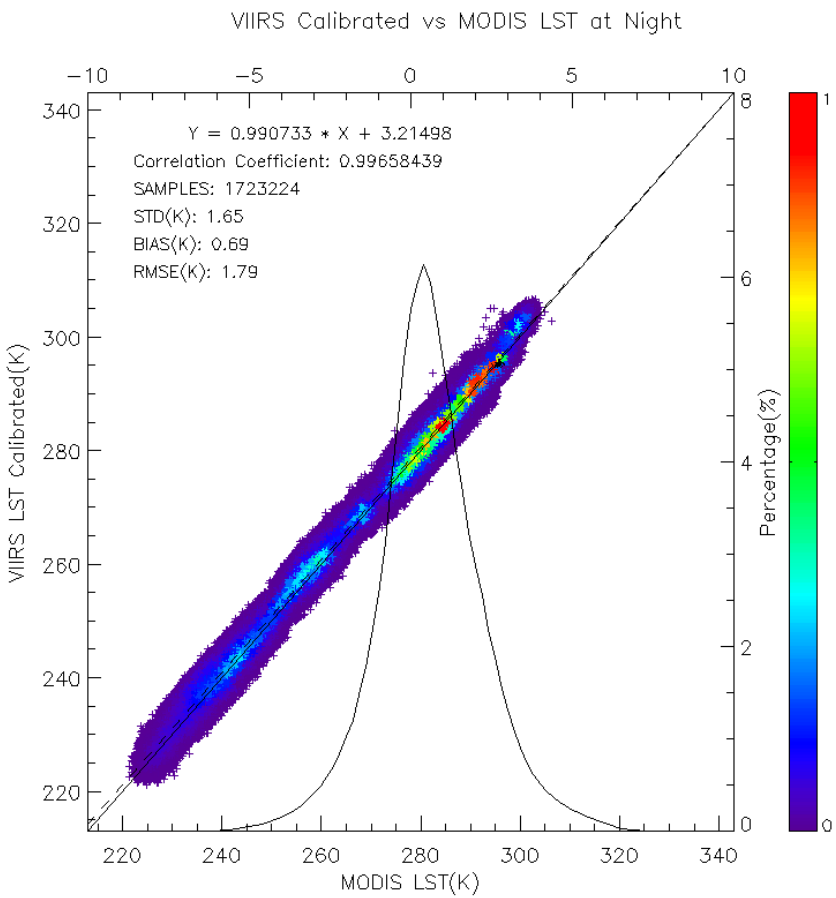


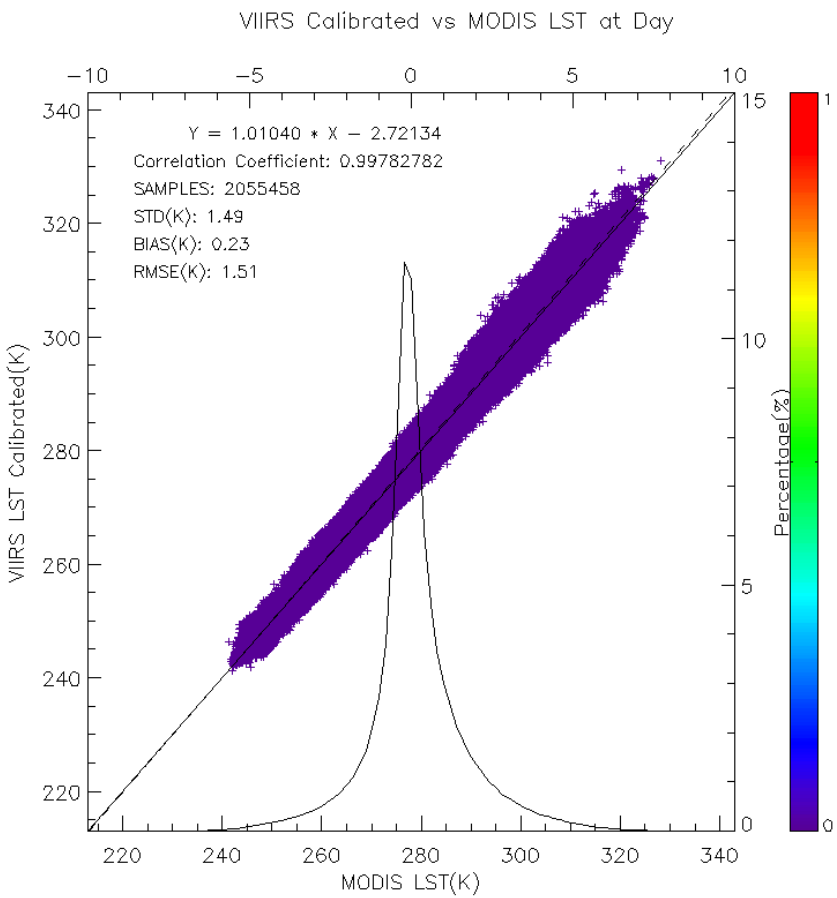
-- VIIRS DPSA albedo is uses the daily gridded surface reflectance IP as input and only few observations meet the reflectance overall quality for albedo retrieval.

-- Current criteria for DPSA full inversion are limited. A crucial parameter, the WODs (weights of determination), which describes the angular sampling status of the input reflectances, are not even considered.

Zhuosen Wang, Yan Liu, and Crystal Schaaf (UMASS Boston)

Land Surface Temperature: VIIRS vs. MODIS





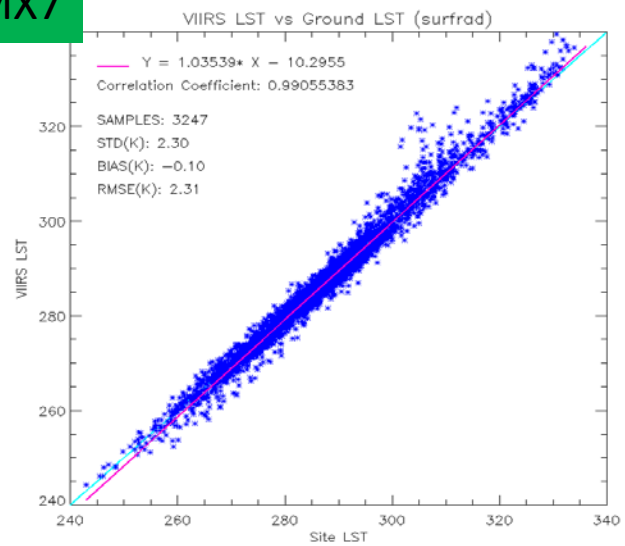
Calibrated Provisional VIIRS LSTs (Mx8.x) compared to MODIS LSTs (C6)

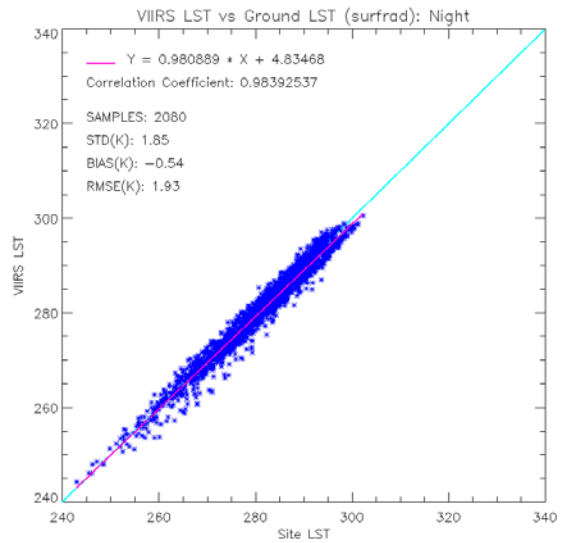
See posters 683 (Yu et al.) and 678 (Biard et al.)

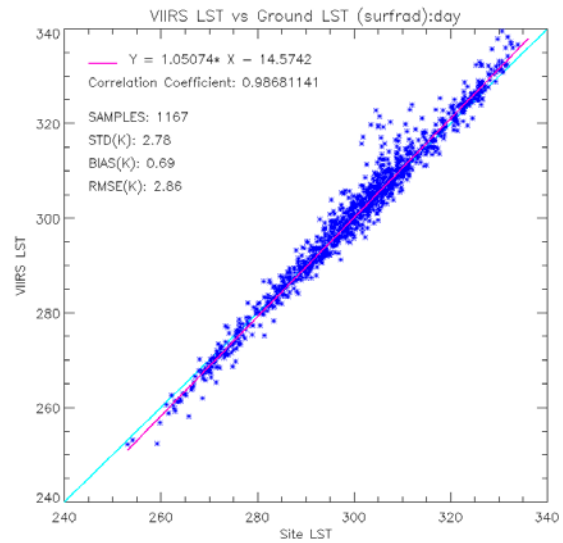
Y. Yu, STAR

LST evaluation using ground data

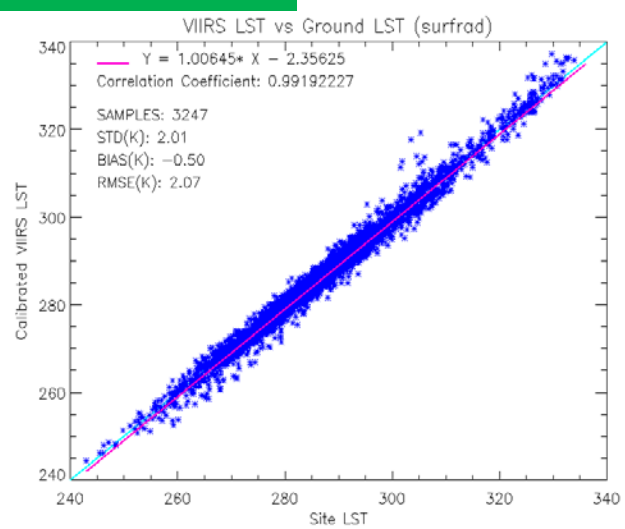
MX7

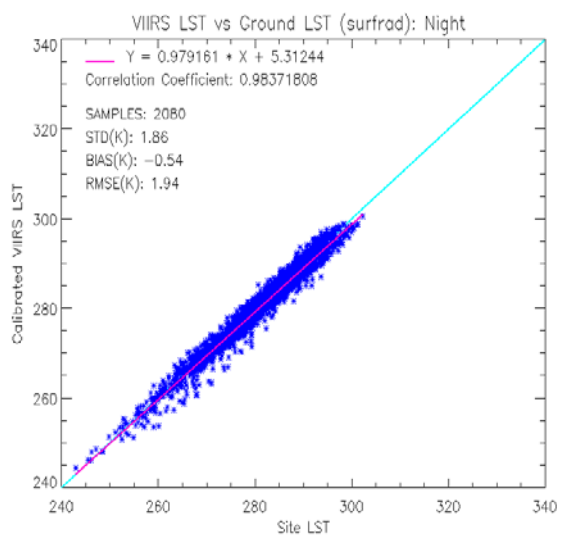


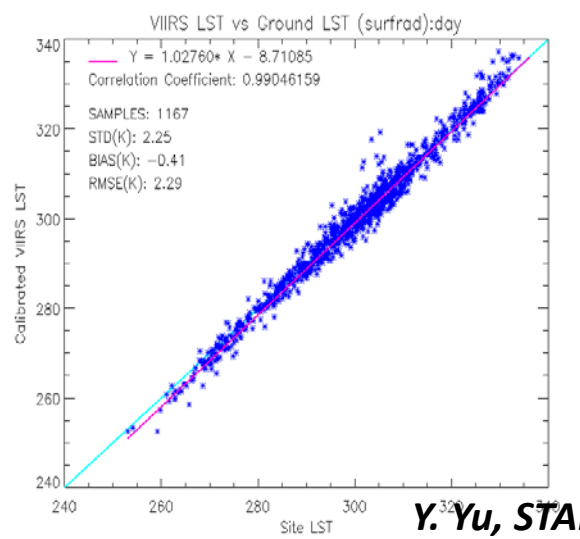




MX8_corrected



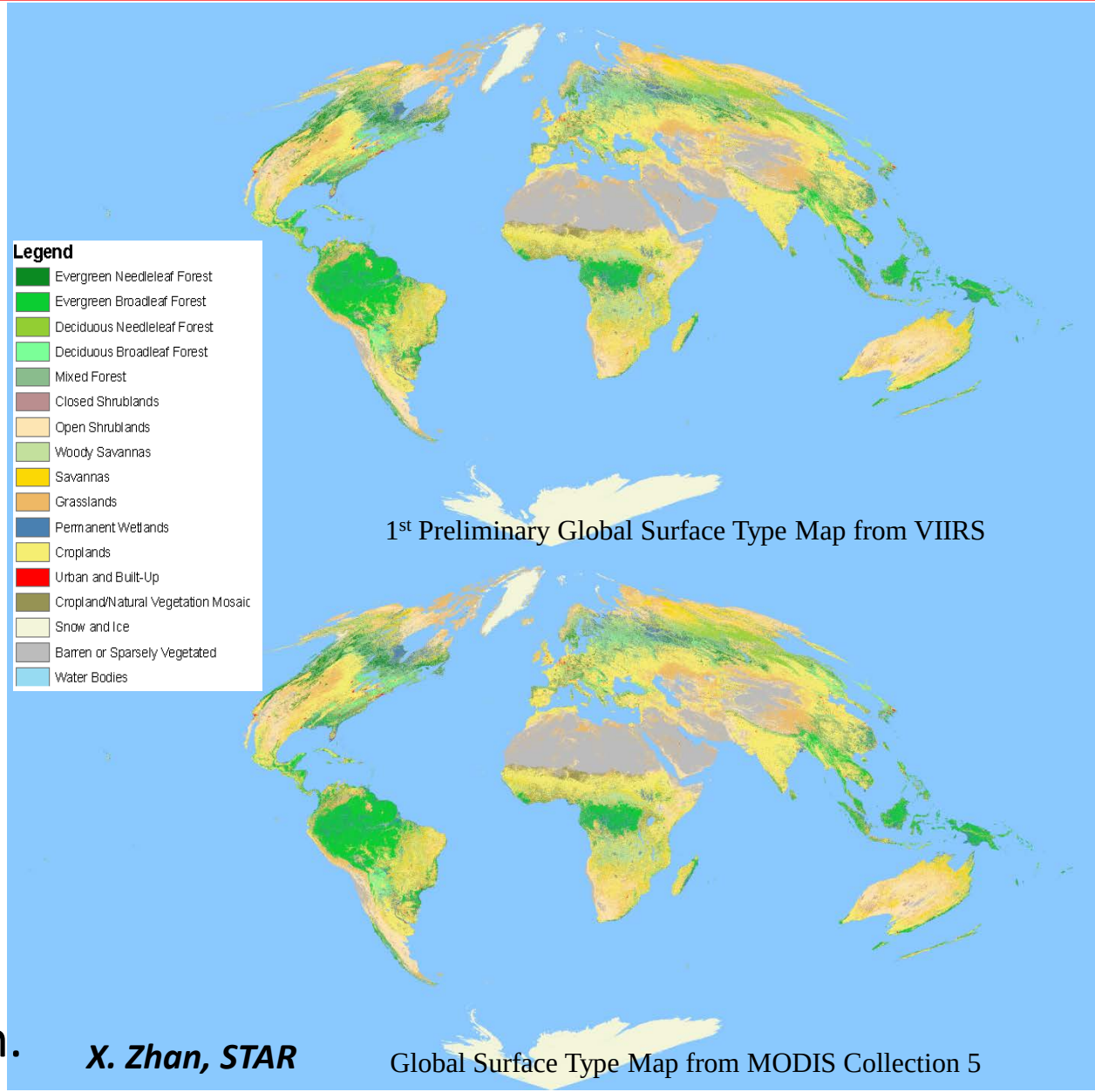




Y. Yu, STAR

S-NPP VIIRS Surface Type EDR

- ST EDR product passed science provisional maturity review in Jan 2014.
- First full year VIIRS data were collected from LPEATE for First VIIRS Quarterly Surface Type Intermediate Product creation by Mar 2013.
- First VIIRS QST IP is produced and will be delivered to IDPS soon.

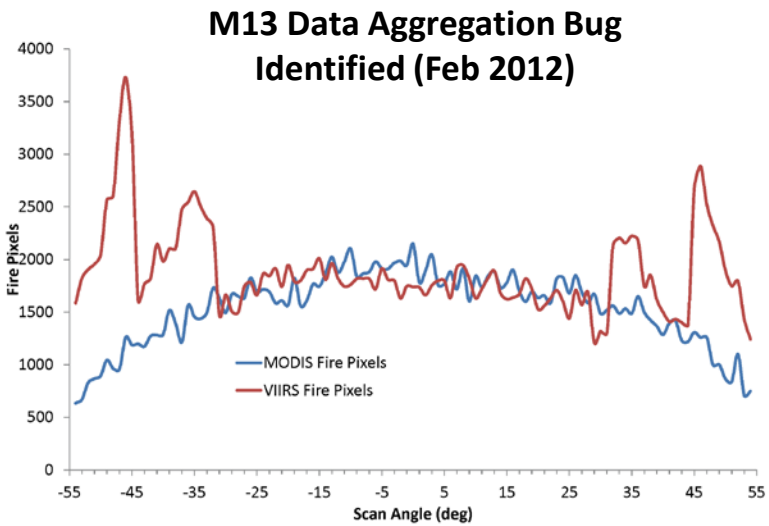


1st Preliminary Global Surface Type Map from VIIRS

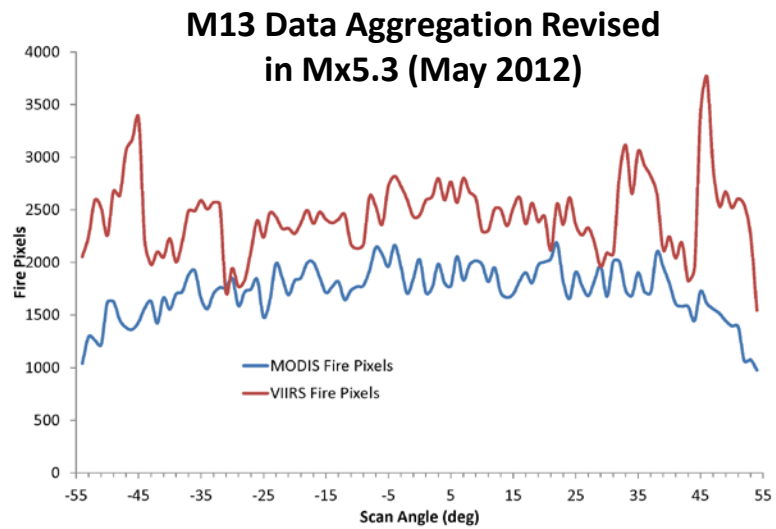
Global Surface Type Map from MODIS Collection 5

X. Zhan, STAR

Active Fires: VIIRS (M-band) vs. MODIS

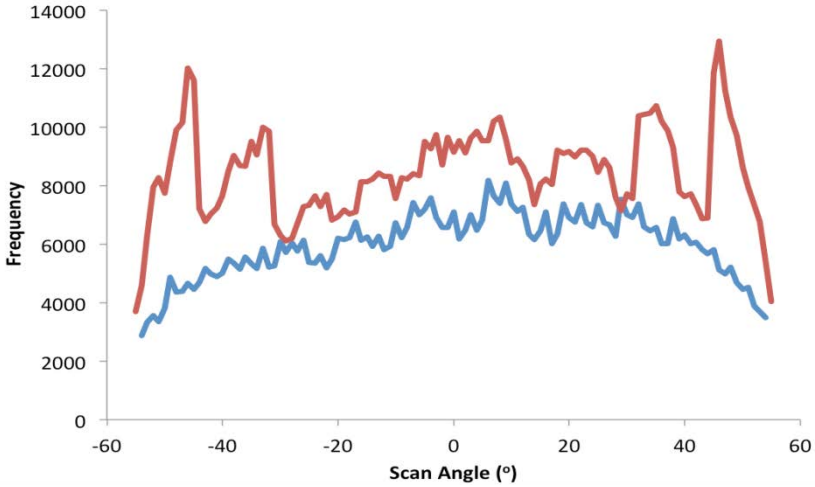


19 Jan - 13 Feb 2012



11 May - 10 Jun 2012

The <u>overall features</u> of the Aqua MODIS and S-NPP functional dependence on scan angle <u>remained the same a year later</u> and over a longer time period



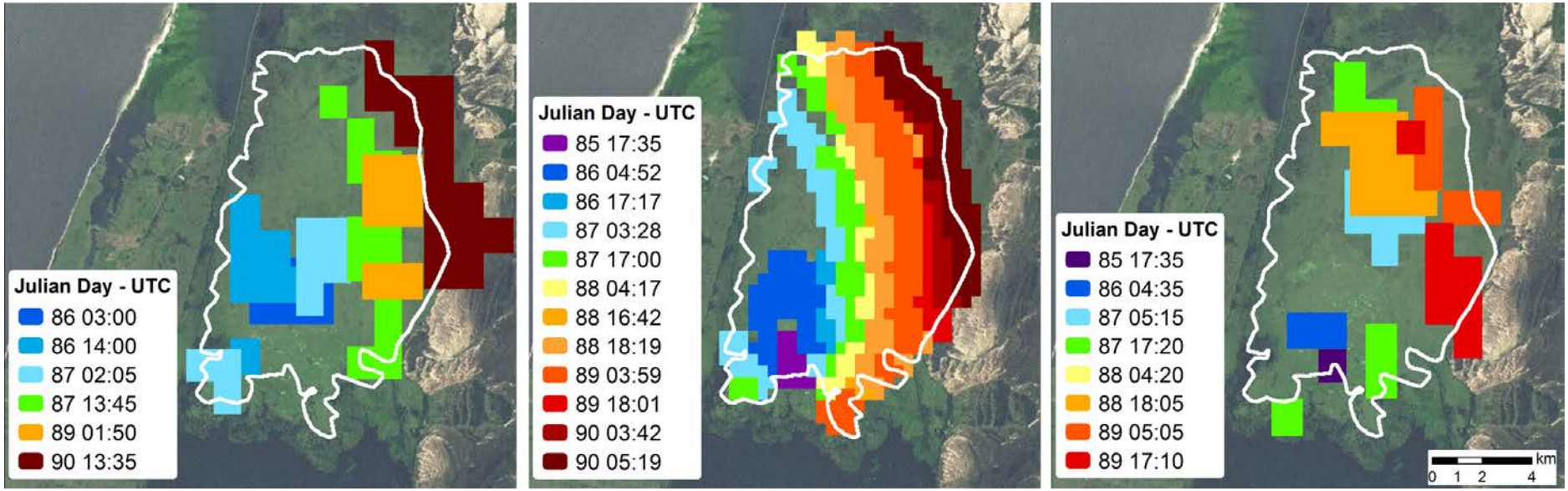
Feb - Jun 2013

See presentations 9.5 (Csiszar et al.) and J6.2 (Ellicott et al.)

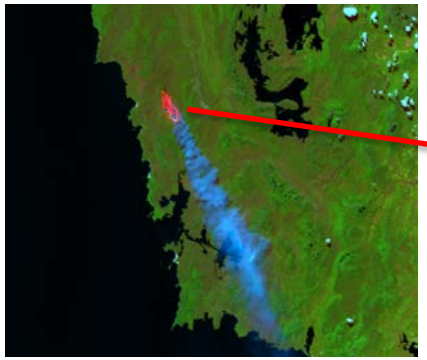
I. Csiszar, STAR

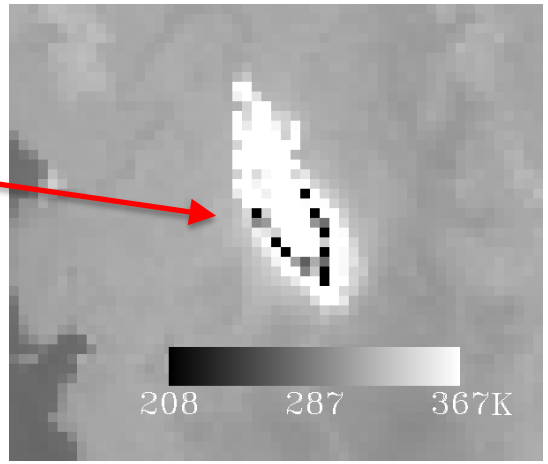
Improved Satellite Mapping of Active Fires Achieved Using VIIRS I-bands

Terra/MODIS 1km | **S-NPP/VIIRS 375m** | **Aqua/MODIS 1km**



Wildfire in southern Brazil, March/2013





<u>Issues of VIIRS fire detection:</u>

- Anomalous behavior at sensor saturation
- Inconsistent quality flags
- Unknown saturation of native resolution pixels prior to aggregation (single-gain bands)
- South Atlantic Magnetic Anomaly

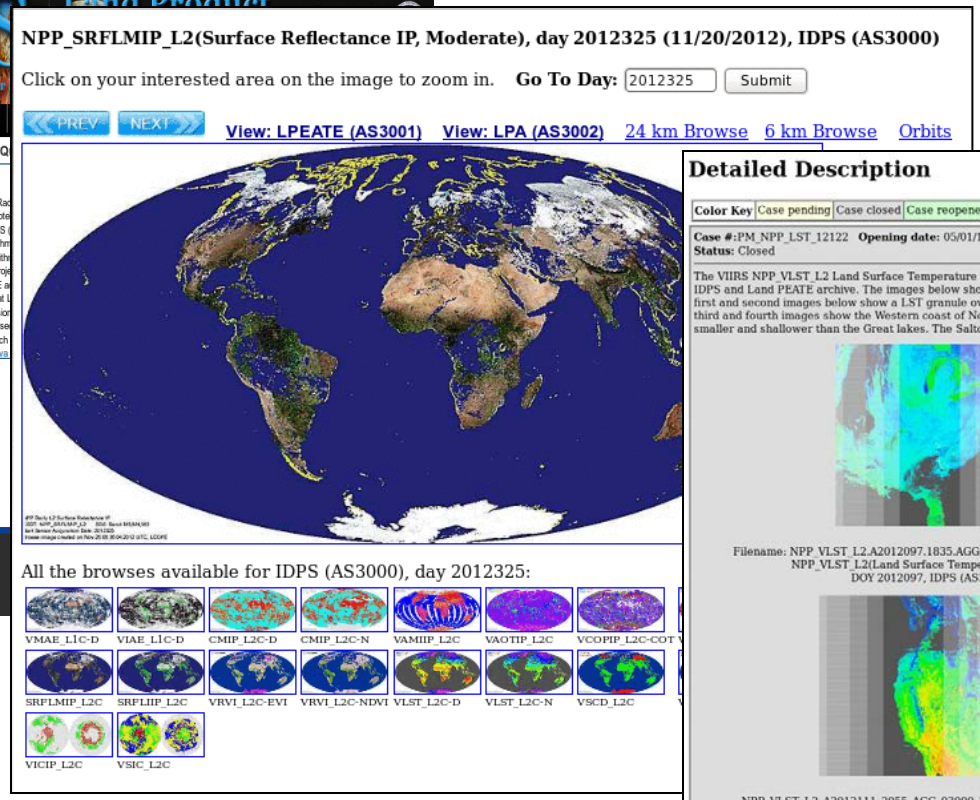
See presentation J6.3 (Coen et al.)

W. Schroeder, UMD

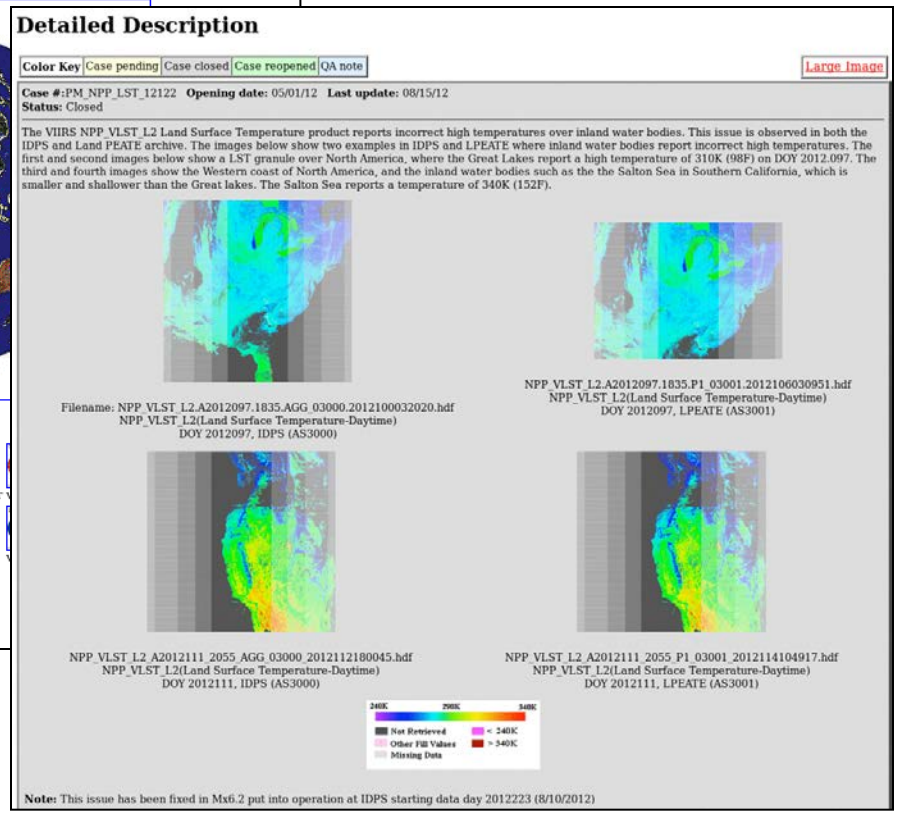
The Land PEATE: meeting the needs of the NASA Science Team and helping the NOAA IDPS

VIIRS LDOPE QA: http://landweb.nascom.nasa.gov/NPP_QA/

VIIRS Global Browse

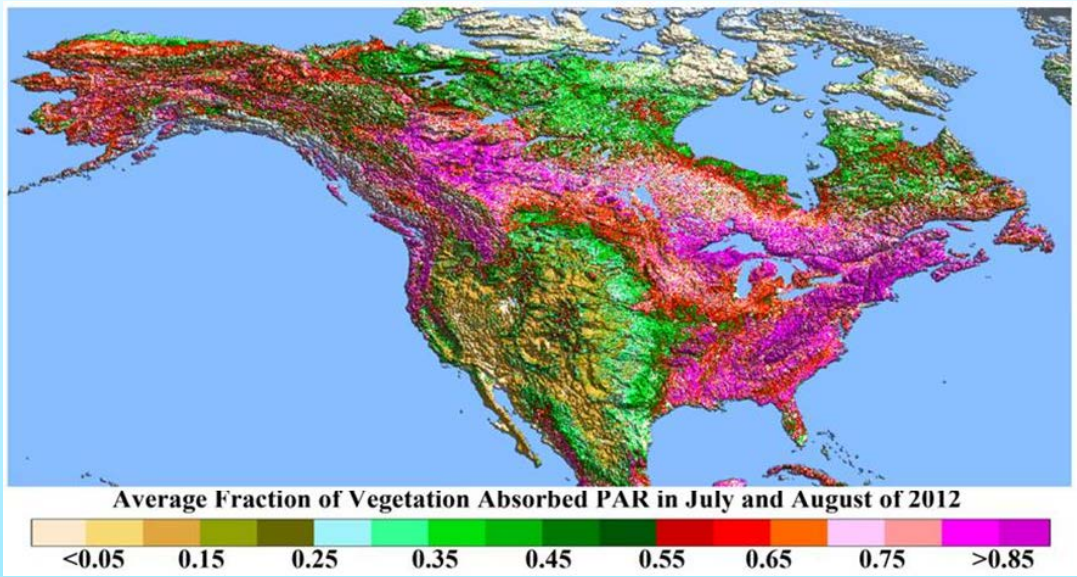


Known Issues Page



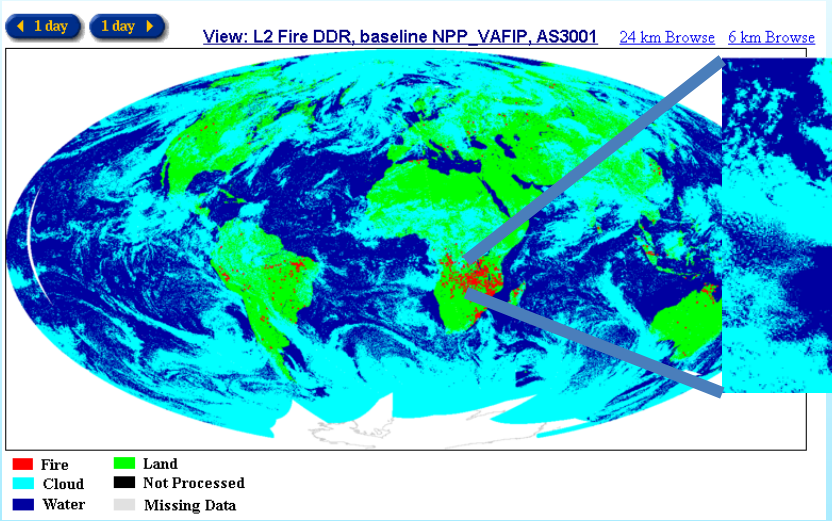
VIIRS Level 3 Products

VIIRS Land Science Team Support Activities



Conversion of MODIS code for Daily LAI/FPAR to VIIRS Land Science DDR is complete.

R. Myneni (BU)

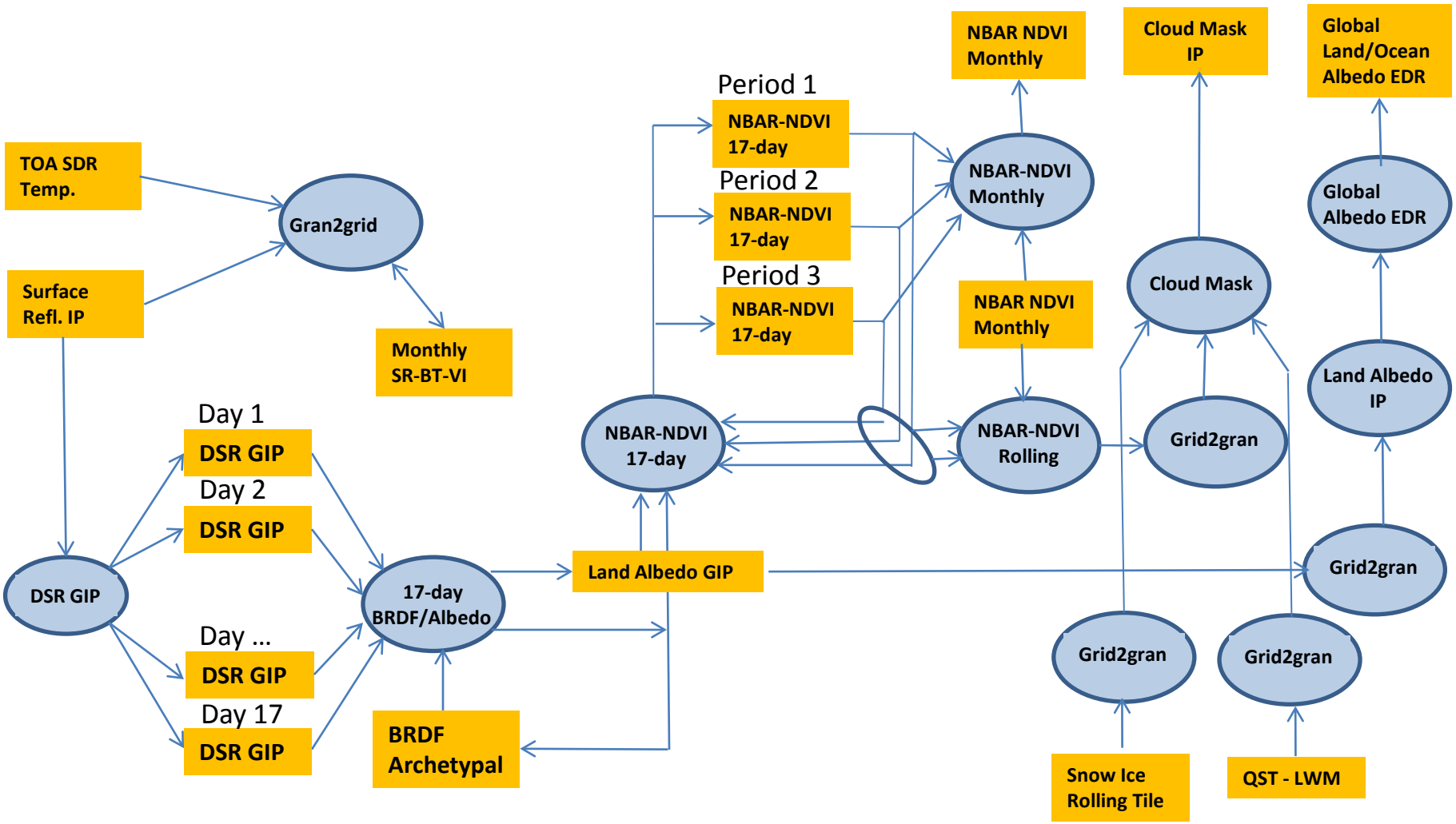


Level 2 Fire DDR, baseline NPP_VAFIP, 8/12/2012

Integration and testing of VIIRS Active Fire DDR. New PGE installed to operations.

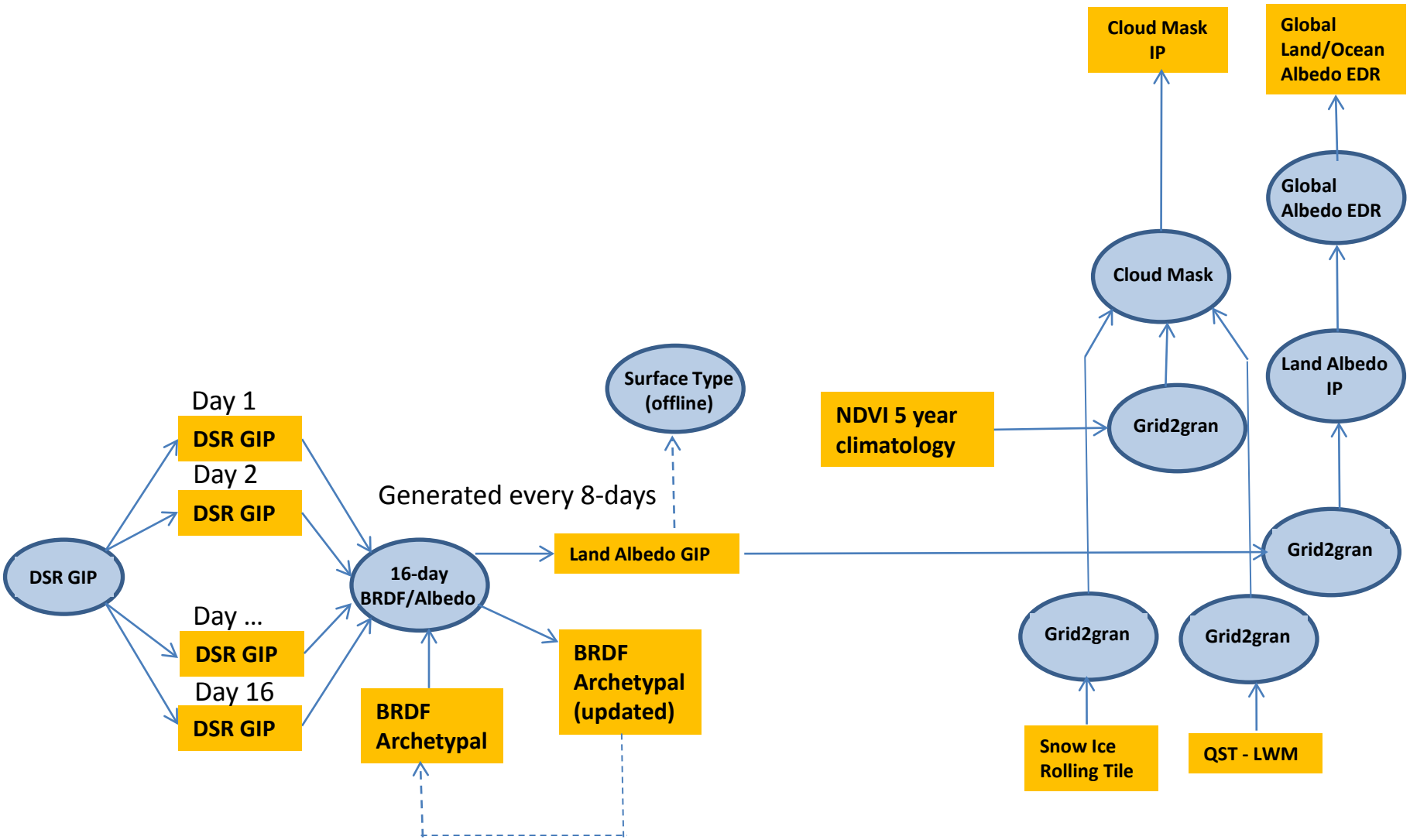
L. Giglio (UMD)

VIIRS Land Gridding/Granulation - Current



S. Devadiga (GSFC/LDOPE)

VIIRS Land Gridding/Granulation - Proposed



S. Devadiga (GSFC/LDOPE)

Summary and Conclusions (1/2)

- S-NPP VIIRS land core IDPS product development and evaluation is progressing well
  - Provisional: Surface Reflectance, LST, Active Fires, Vegetation Index, Surface Type
  - Beta: albedo
- Finish Suomi NPP product evaluation and development
  - Surface albedo to provisional; all products to validated
  - Gridding/granulation
  - Auxiliary data
- Continue interaction with upstream product teams
  - SDR data is good - work is underway to resolve remaining quality flag and sensor performance issues (e.g. Active Fires)
  - VIIRS Cloud Mask – coordination regarding gridding/granulation

Summary and conclusions (2/2)

- Development of data products not in the suite of operational NOAA products (i.e. IDPS or NDE)
  - NOAA JPSS Proving Ground and Risk Reduction
  - NASA SNPP Science Team
- Teams are continuing the development of improved and additional products
  - Green Vegetation Fraction, I-band Active Fires, LAI/FPAR etc.
- Development and operational implementation of products to meet new Level 1 requirements
  - Top-of-canopy vegetation index
  - Full active fire mask and fire radiative power
- Product continuity and reprocessing with latest algorithm
- Publications (JGR SNPP Special Issue and other)