VIIRS for Land EDR(s)
(and IPs, ARP)

Ivan Csiszar

NOAA/NESDIS/STAR

and many members of the

JPSS Land Algorithm Development, Calibration and Validation Team

and

NASA SNPP VIIRS Land Discipline Team

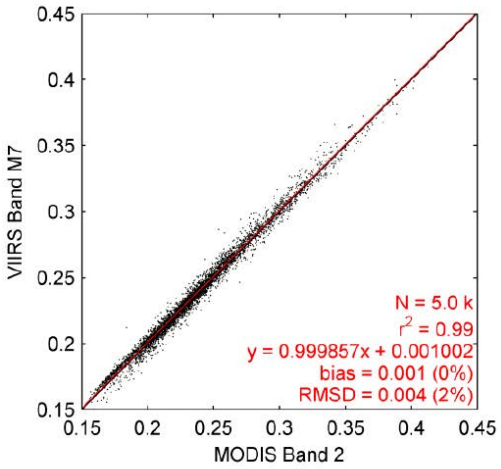
NOAA JPSS SNPP VIIRS Land Products and Team Principals

Role or Product Focus	Name (+ et al.)	Affiliation
Product Lead, **Fire**	*Ivan Csiszar* / Wilfrid Schroeder	NOAA / UMD
Validation Lead, LST	Jeff Privette / Pierre Guillevic	NOAA / NCState
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
Team Coordination, Fire	Chris Justice	UMD
NASA Coordination & Validation	Miguel Román	NASA
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

VIIRS vs. MODIS for land monitoring

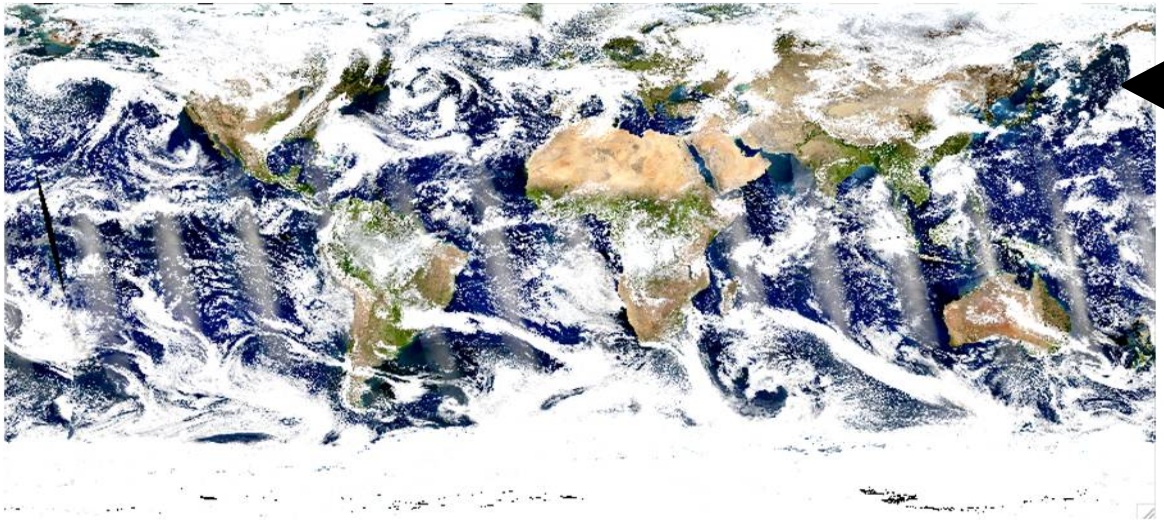
- What can VIIRS do better than MODIS?
  - Better coverage and scanning geometry, including higher resolution of "M" bands
    - Improved fire detections (25% higher VIIRS fire counts than MODIS in the three-pixel VIIRS aggregation zone)
    - No gaps at low latitudes, more consistent data for temporal 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





MODIS/VIIRS cross calibration over a 50km x 50km site in Australia (left),and true color image of the site (right). The agreement between the two reflectance products is excellent. Data were acquired on 3/6/2012 after a calibration update of the VIIRS.

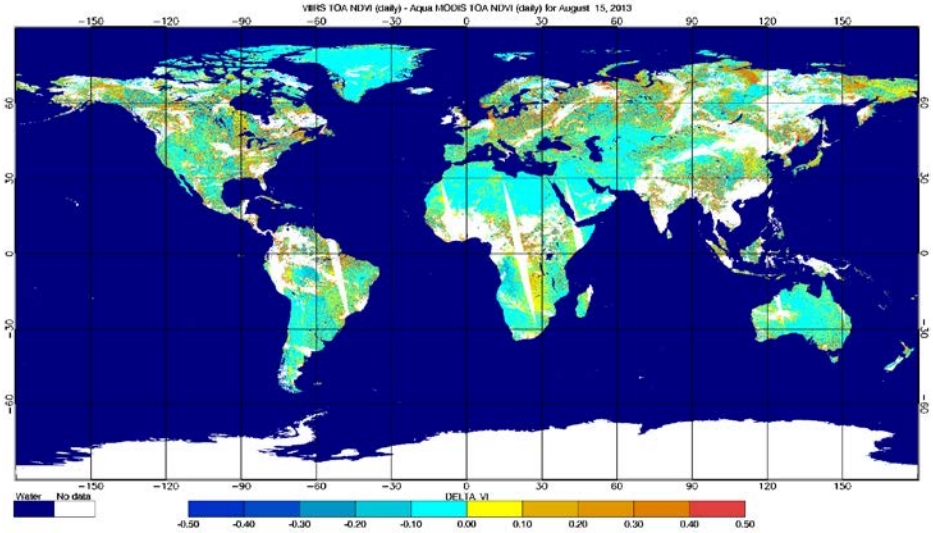


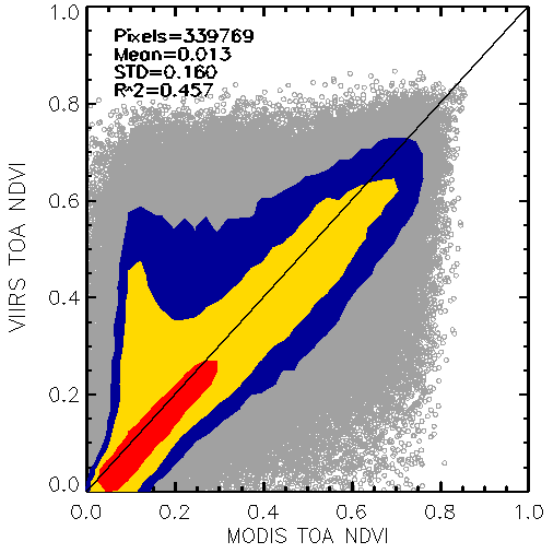
Provision of spatially gridded VIIRS Surface Reflectance at both moderate (0.5 – 1.0 km) and CMG resolutions.

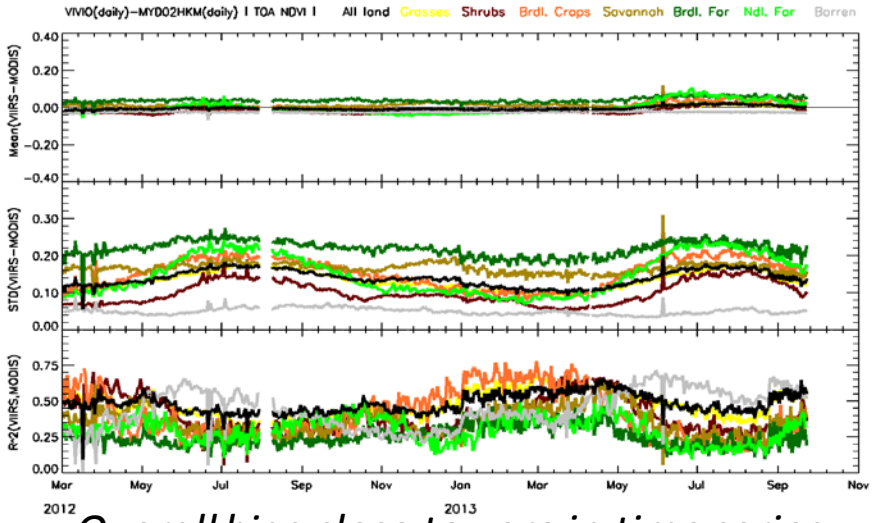
Land PEATE- adjusted version of VIIRS Surface Reflectance IP

E. Vermote, NASA GSFC

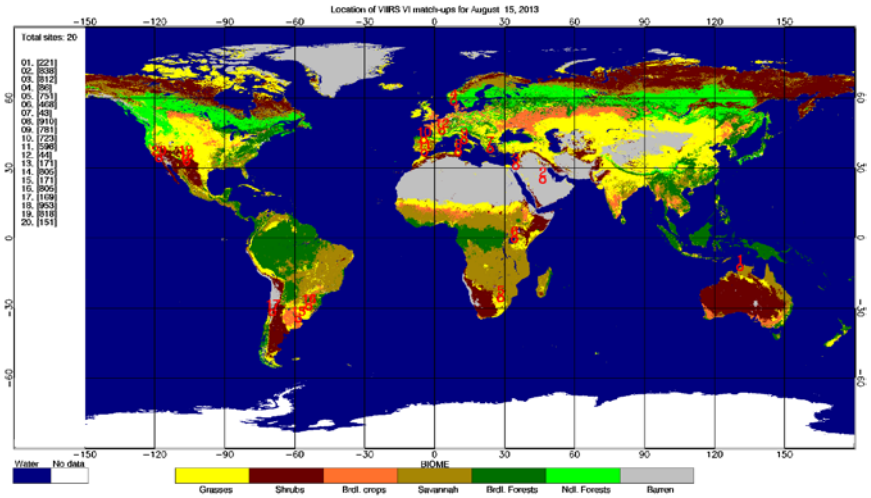
TOA NDVI: VIIRS vs. MODIS







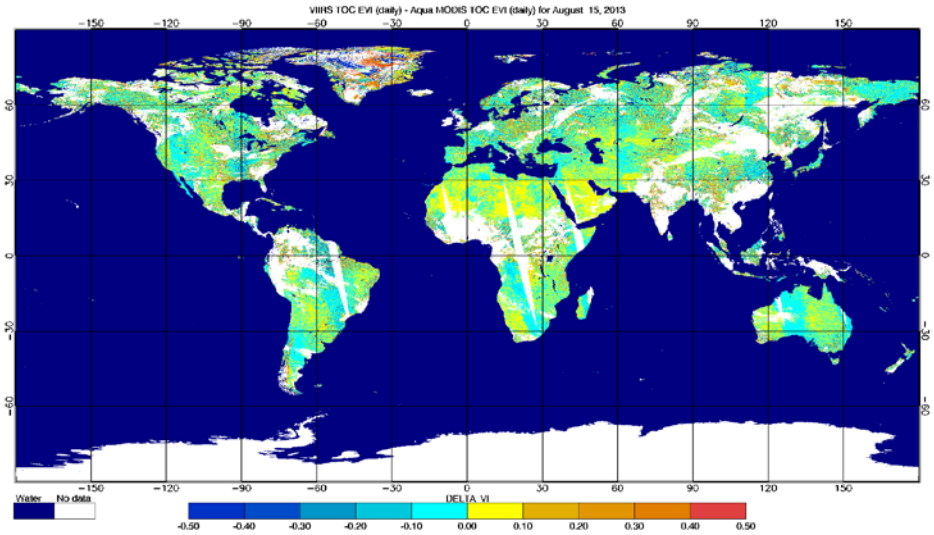
Overall bias close to zero in time series.

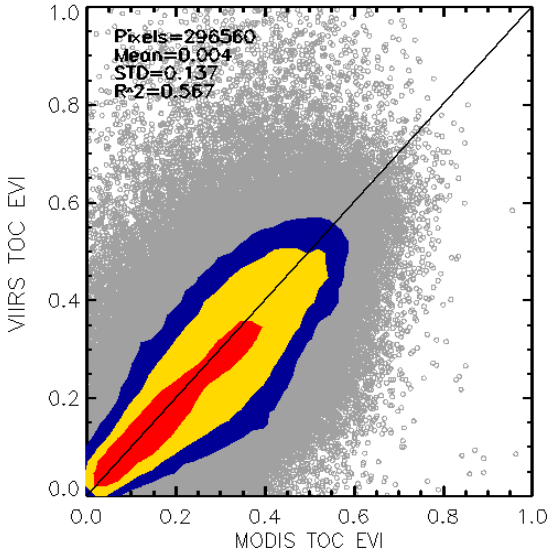


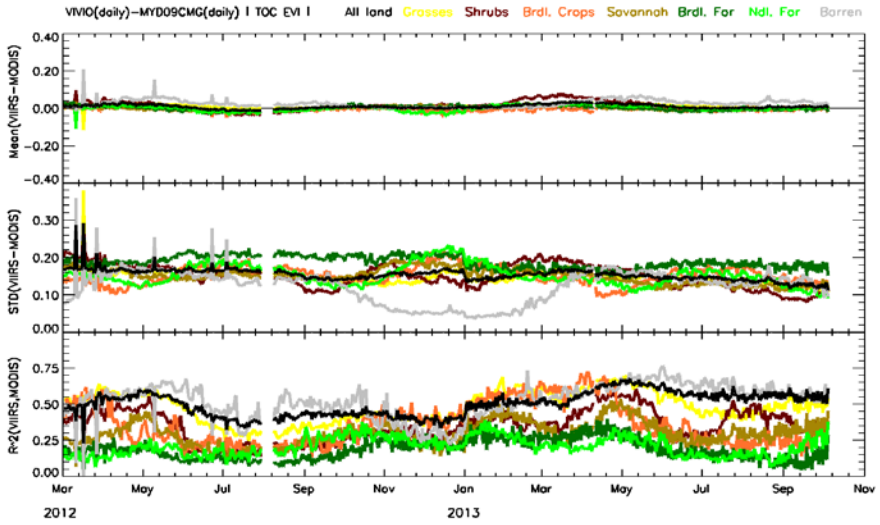
Land cover types and AERONET sites

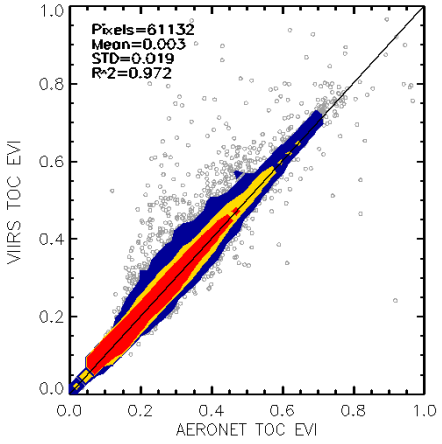
M. Vargas, STAR

TOC EVI: VIIRS vs. MODIS and AERONET





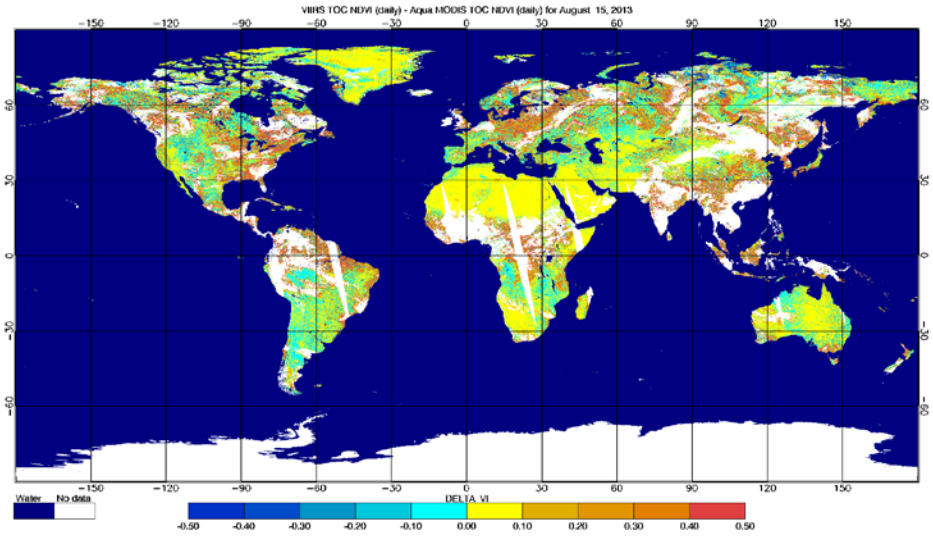


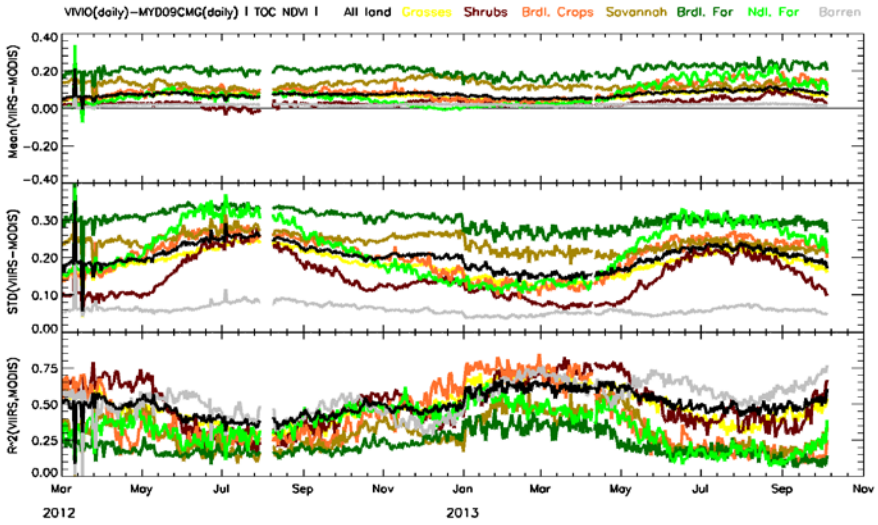


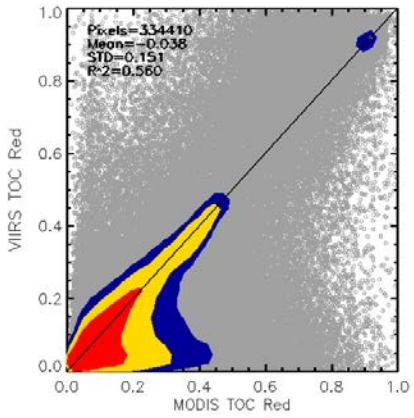
Good agreement between VIIRS and MODIS TOC EVI on global scale.

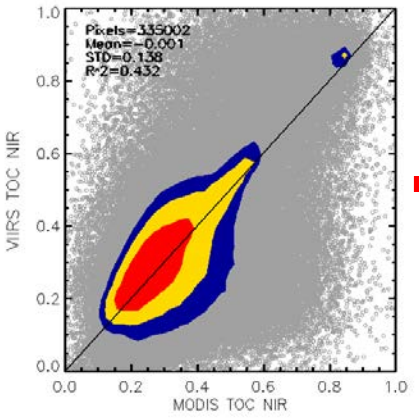
M. Vargas, STAR

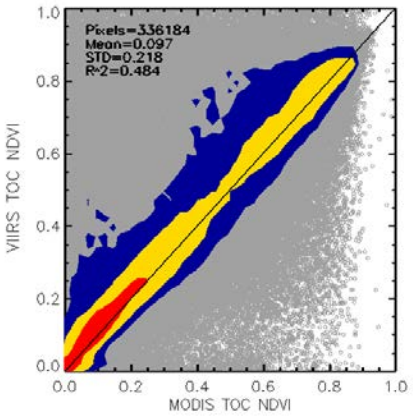
TOC NDVI: VIIRS vs. MODIS and AERONET

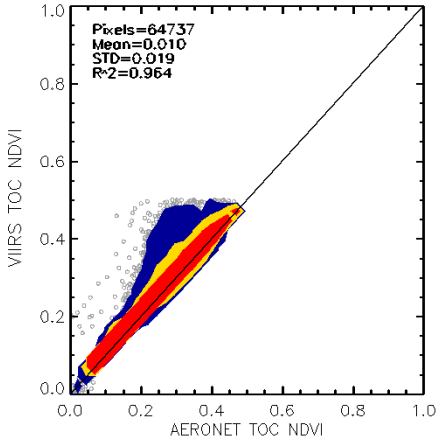








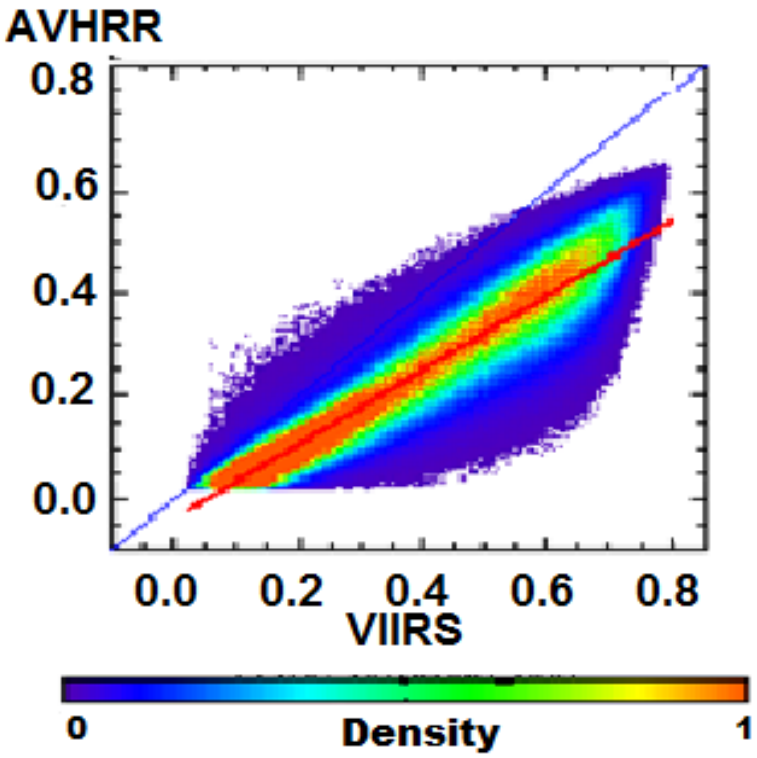




VIIRS tends to overestimate TOC NDVI especially over broadleaf forests (cf. time series and maps). Scatter plots indicate that the VIIRS TOC red band is overcorrected for atmospheric effects; VIIRS NIR is higher than MODIS.

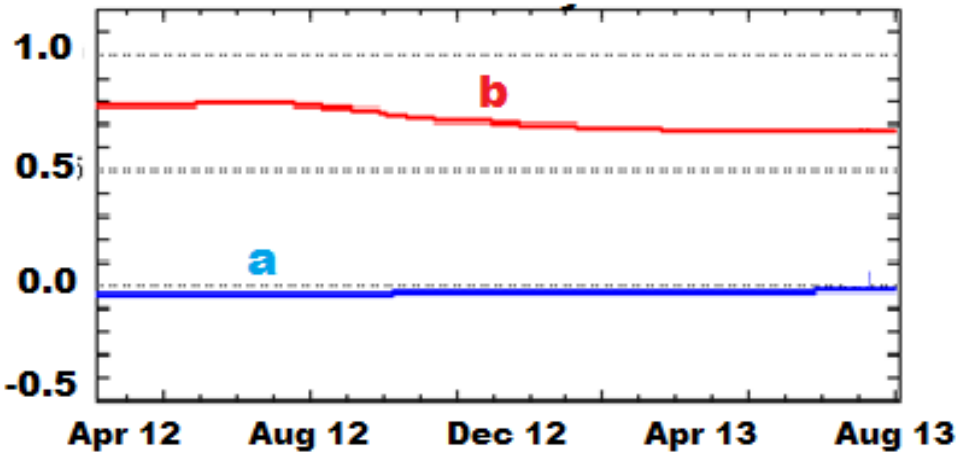
M. Vargas, STAR

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, STAR

Green Vegetation on Our Planet

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

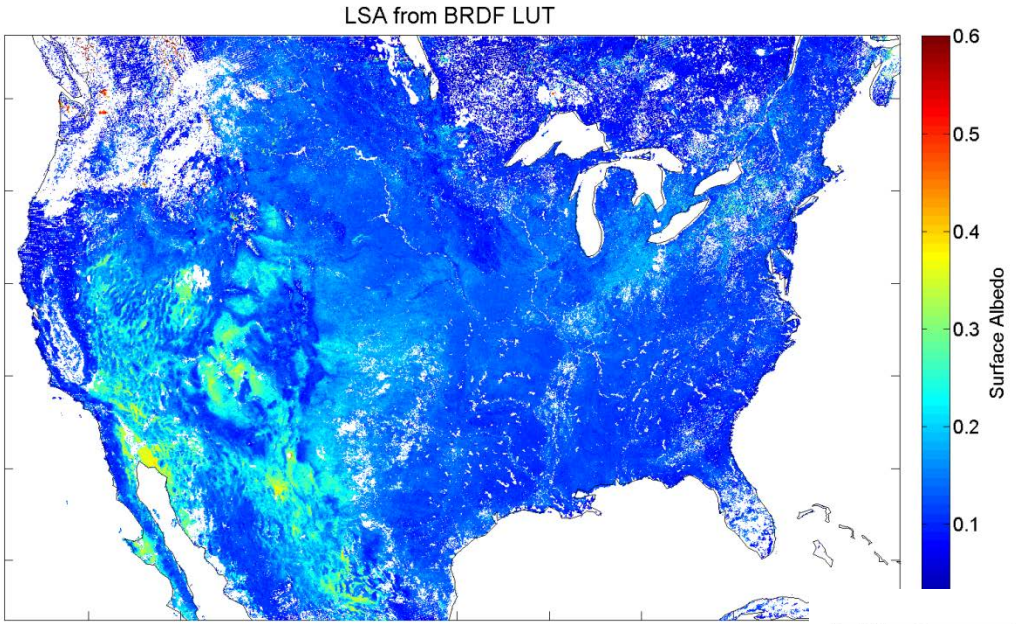




April 2012 – April 2013
500 m grid; NDVI weekly composite / gap filled

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

Maps of 16-day mean albedo

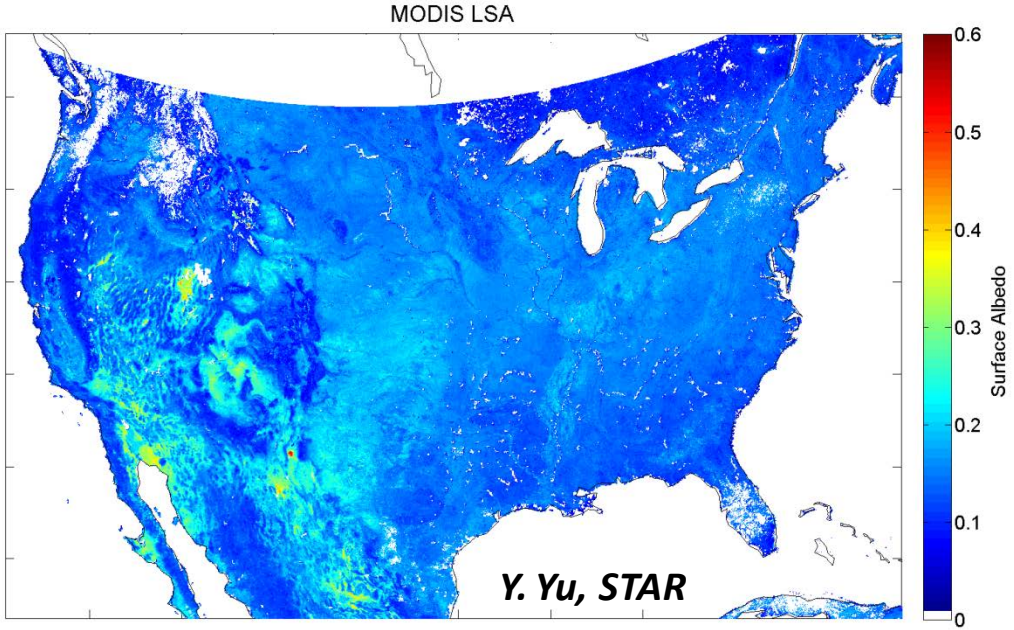


An LUT update for the VIIRS provisional albedo (BPSA – Bright Pixel Surface Albedo) is in testing . . .

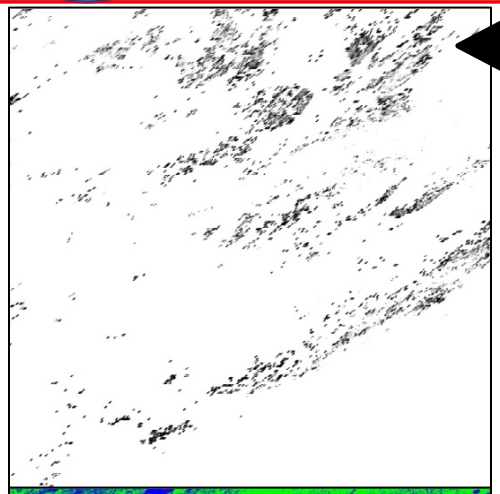
Contiguous US maps of 16-day (DOY 145-160, 2012) mean LSA shows its comparisons to the MODIS albedo.

Top: the VIIRS BPSA albedo

Bottom: the MODIS albedo

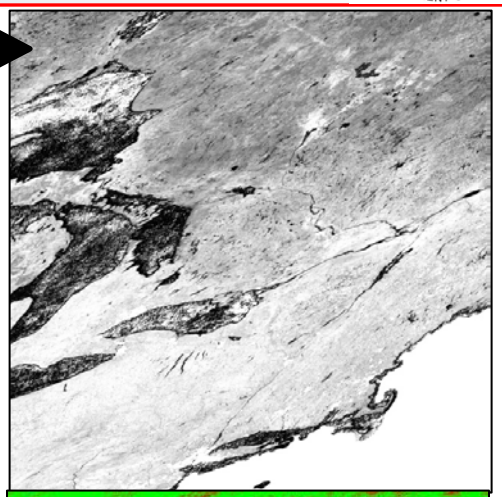


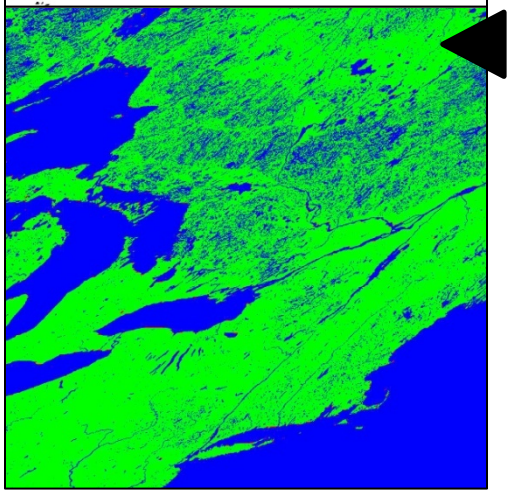
Evaluation of the VIIRS Dark Pixel Surface Albedo EDR (New England 2013183)



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

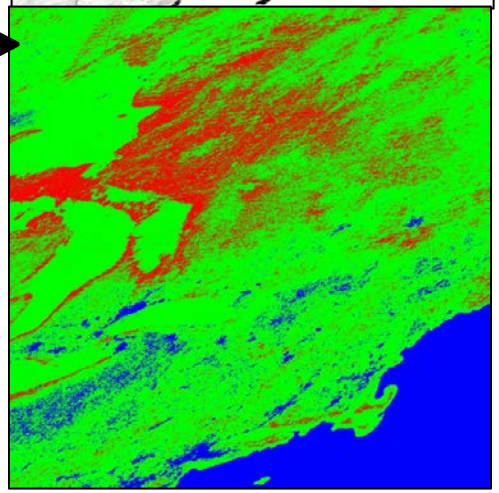
MODIS Aqua-only Black-Sky Albedo.





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.

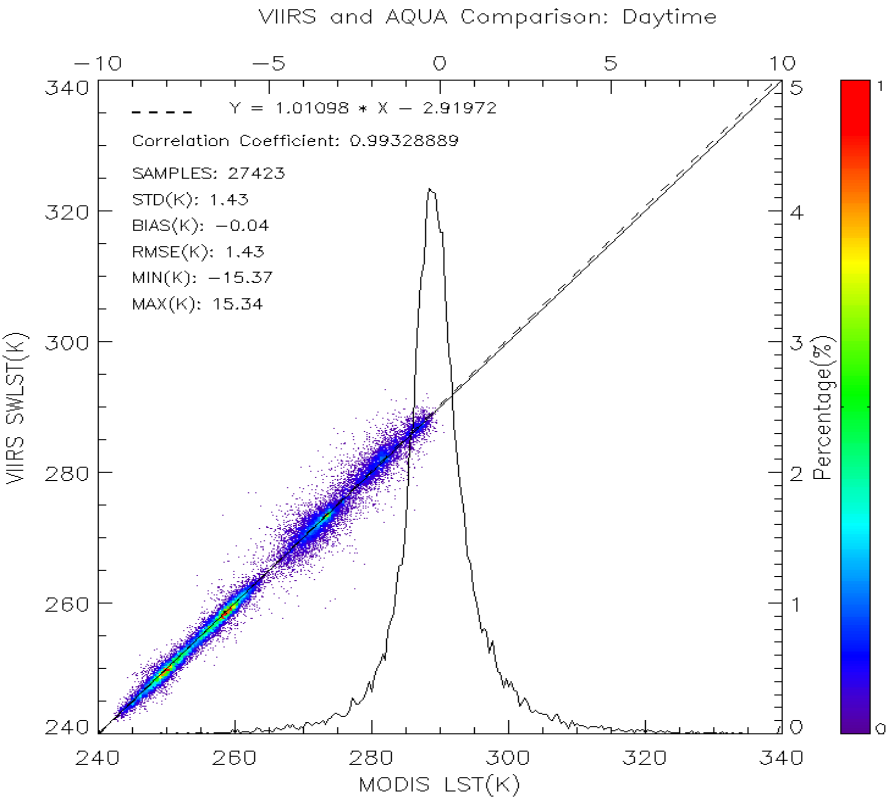


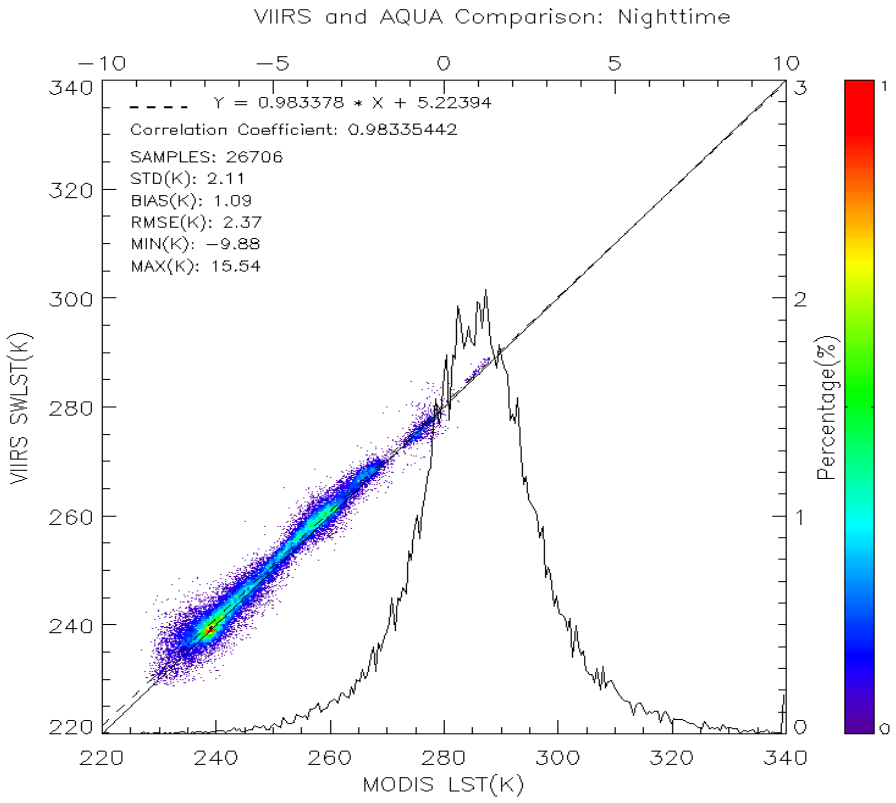
-- VIIRS DPSA albedo is uses the daily gridded surface reflectance IP as input and only few observations meet the reflectance overall quality for albedo retrieval.

-- 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





A satellite–to-satellite LST comparison tool is built up. It is based on the Simultaneous Nadir Observation (SNO) utility, for the match up selection. Here is an example of the comparisons between the VIIRS LSTs and the MODIS LSTs.

Y. Yu, STAR

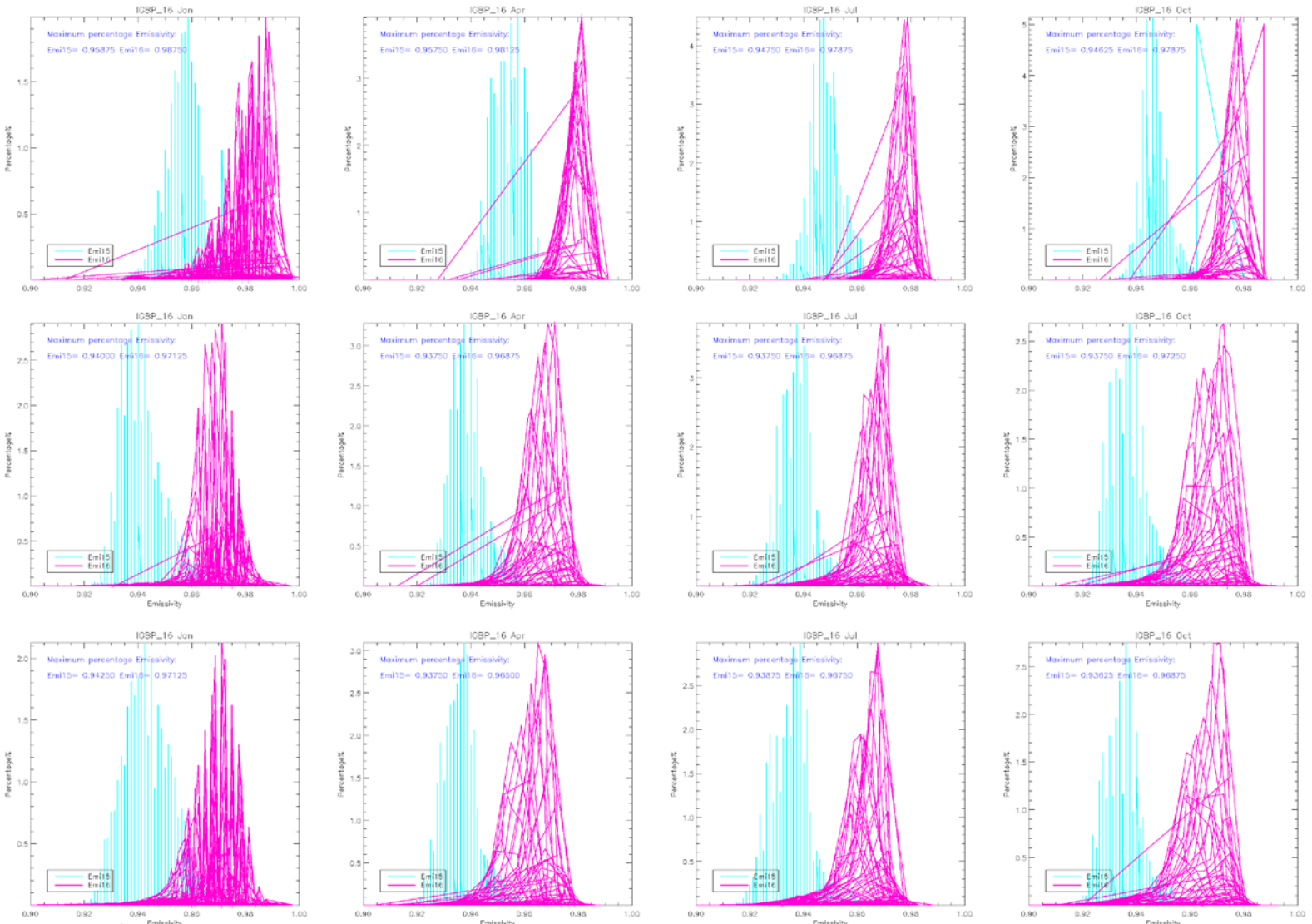
Emissivity over IGBP surface type

Barren Soil Surface

2009

2011

2012

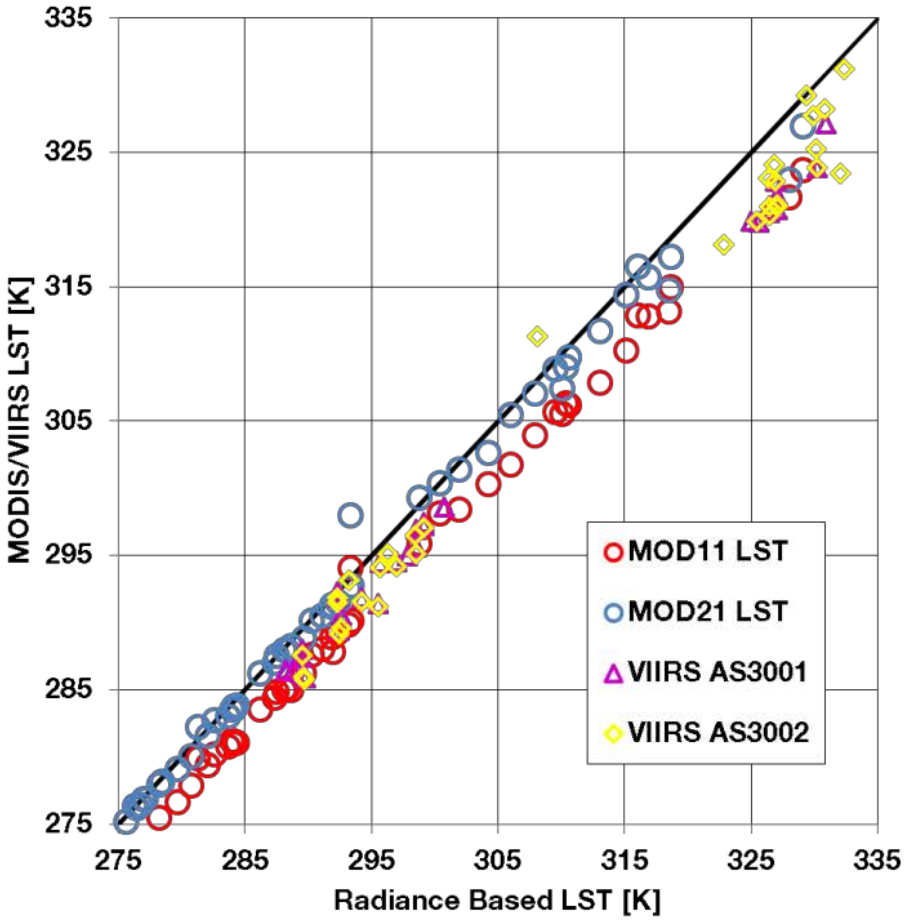


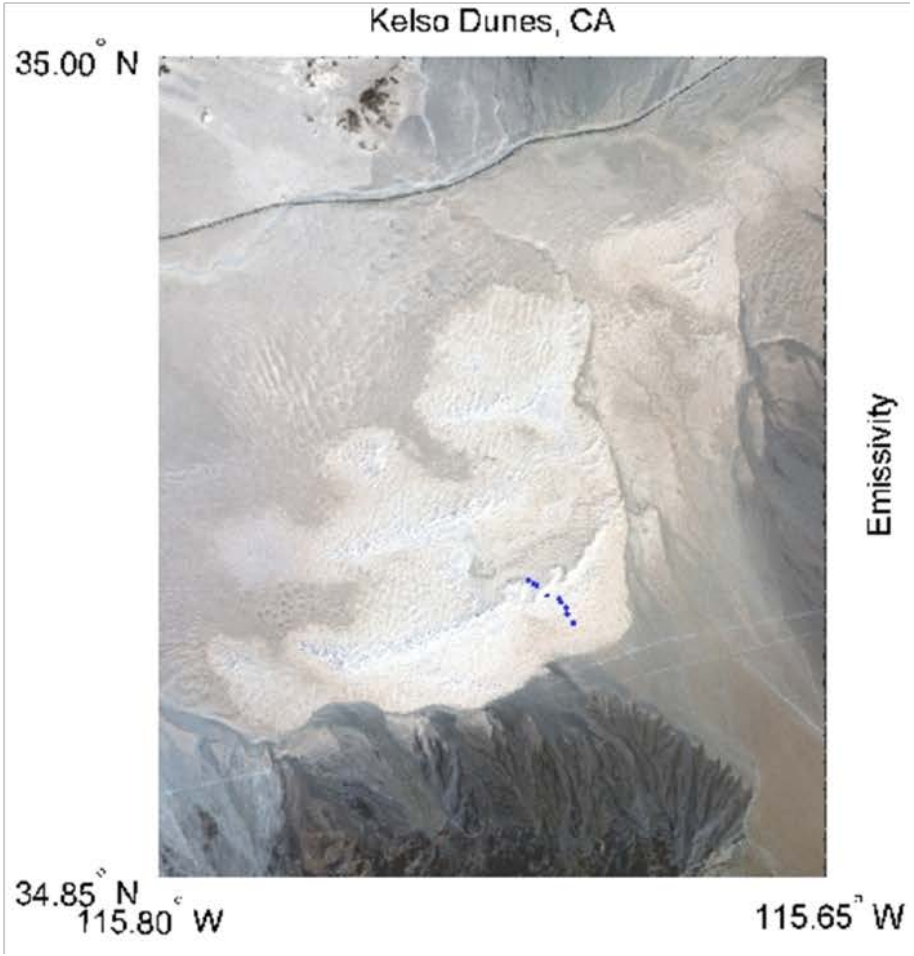
The VIIRS LST algorithm is surface type dependent. Emissivity variation study is conducted to understand its impact. Monthly MODIS emissivity data at VIIRS channel 15 (blue) and 16 (red) is plotted showing its variation in Jan, Apr, Jul, and Oct. Also, it is shown the emissivity value shift in 2009.

Y. Yu, STAR

Evaluation of the VIIRS Land Surface Temperature (LST) EDR

The generation of an VIIRS LST product compatible with MODIS (i.e., a merged product using both split-window and dynamic emissivity retrieval) will result in a much more stable EDR.



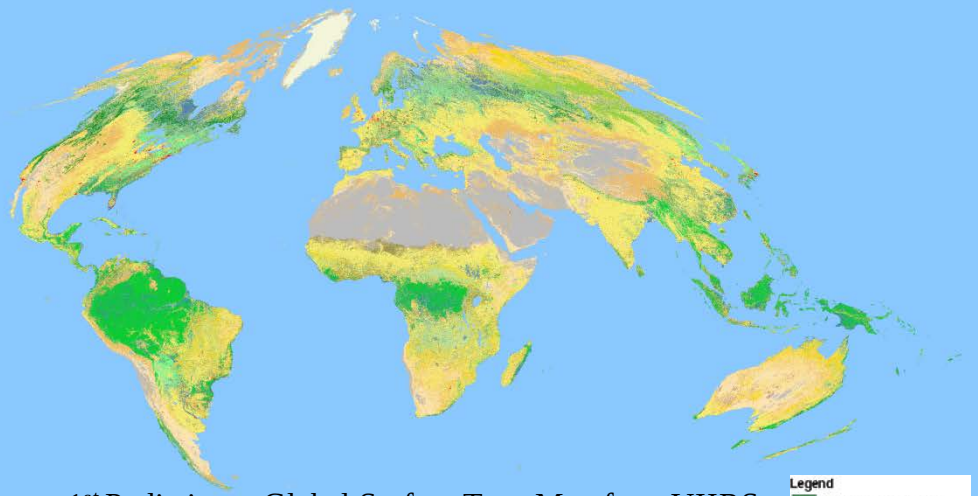


MODIS/VIIRS LST at the Kelso Dunes, California, pseudo-invariant site (right) versus radiance-based LST.

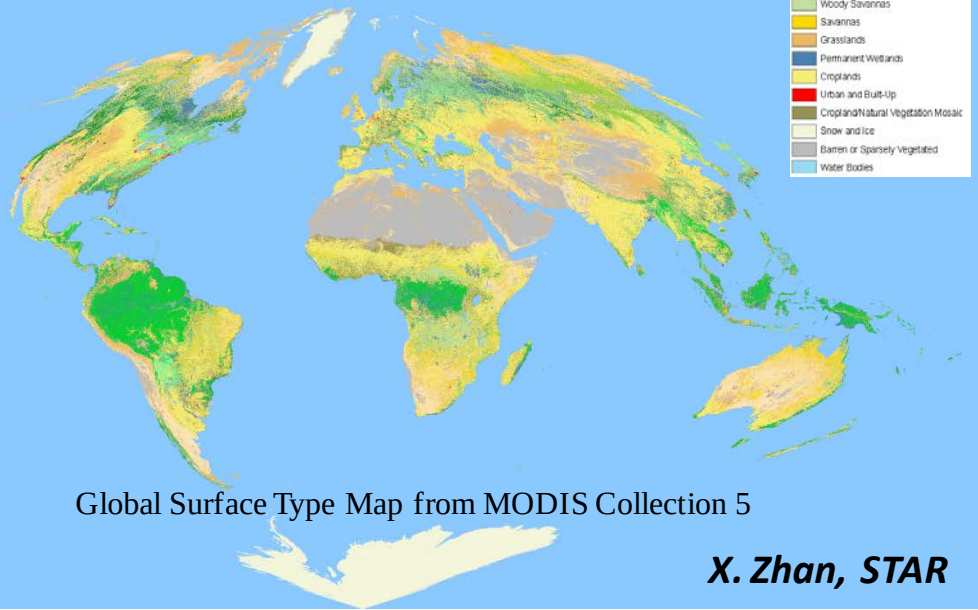
Simon Hook (JPL)

Surface Type EDR

- 1st Quarterly Surface Type IP (QST IP) has been produced with VIIRS data and compares well with the MODIS map (see maps on right side)
- No direct impact noticed on Surface Type EDR production so far. However, any SDR issues that affect the Fire and Snow/Ice products will also affect ST EDR, because those products are copied to ST EDR
- Lack of gridding products from IDPS forces ST EDR team to do offline gridding and compositing of orbital data to monthly gridded data, which is labor intensive, not planned for QST production task, distracts or slows down QST product development and validation efforts



1st Preliminary Global Surface Type Map from VIIRS

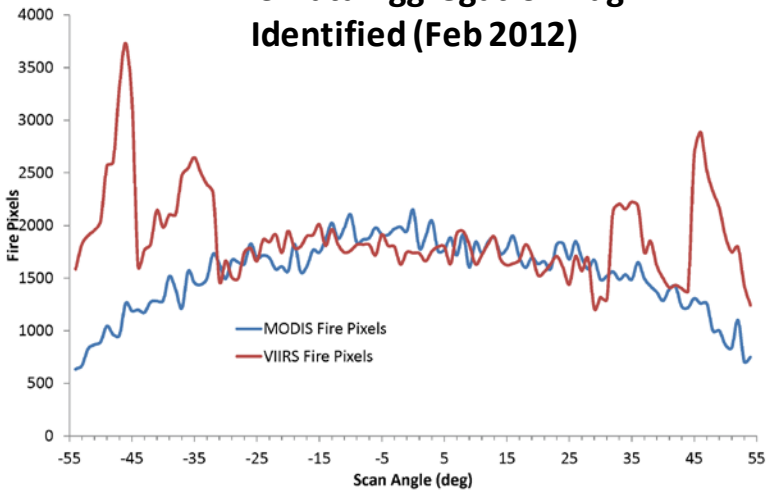


Global Surface Type Map from MODIS Collection 5

X. Zhan, STAR

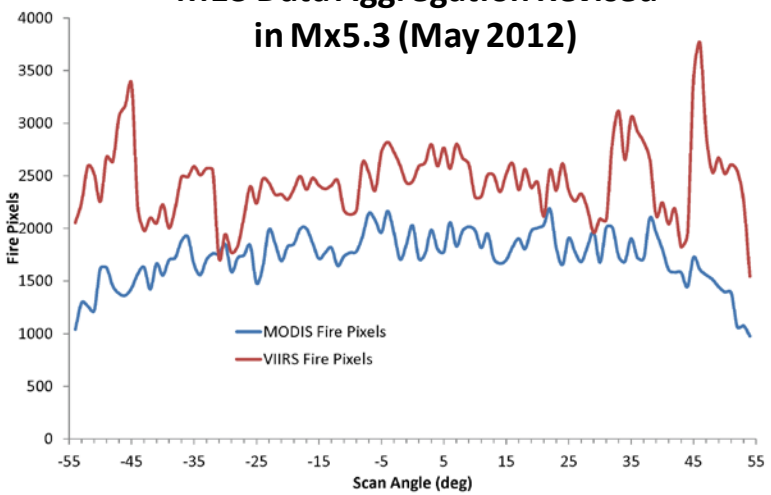
Active Fires: VIIRS (M-band) vs. MODIS

M13 Data Aggregation Bug Identified (Feb 2012)



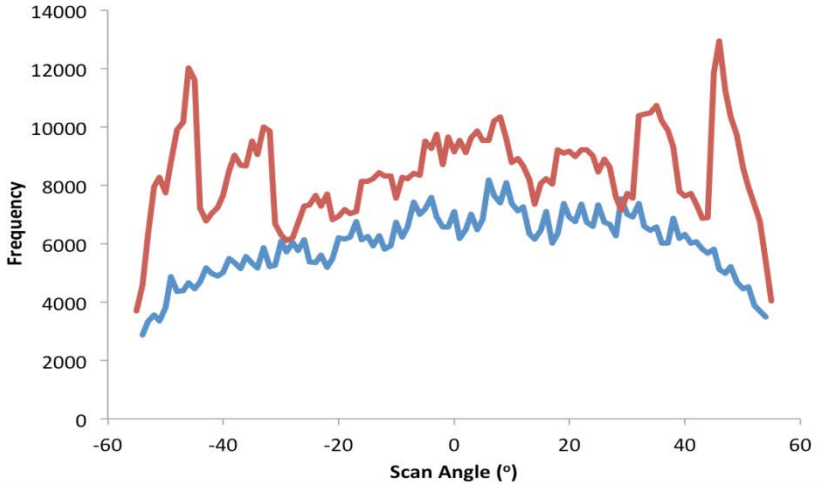
19 Jan - 13 Feb 2012

M13 Data Aggregation Revised in Mx5.3 (May 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

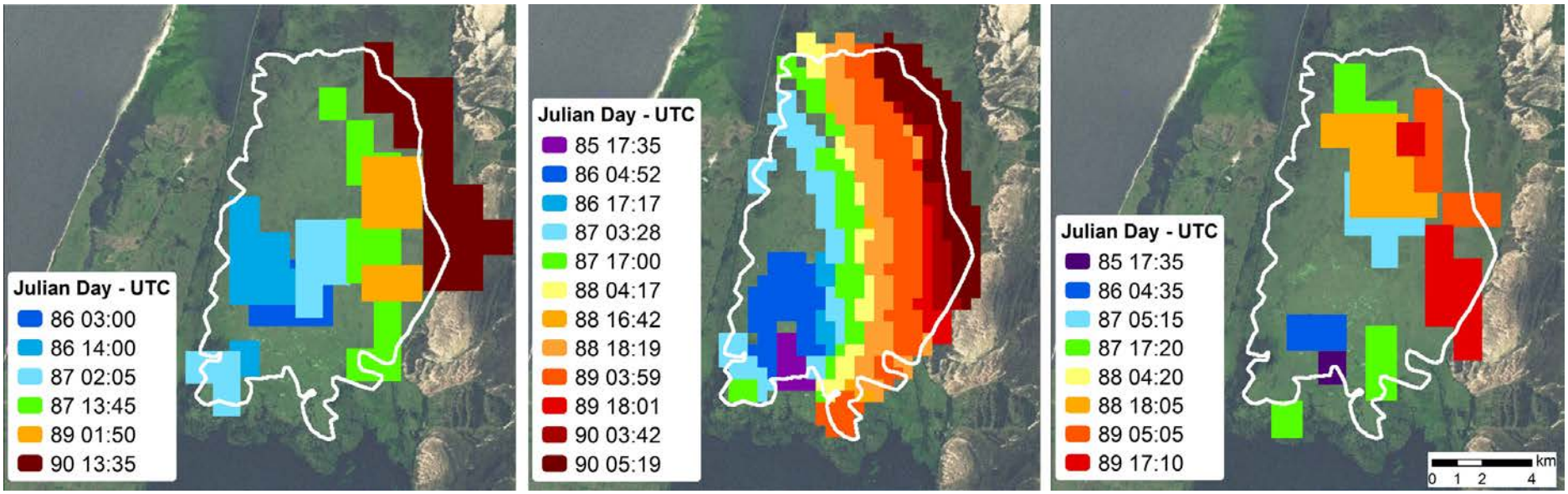


Feb - Jun 2013

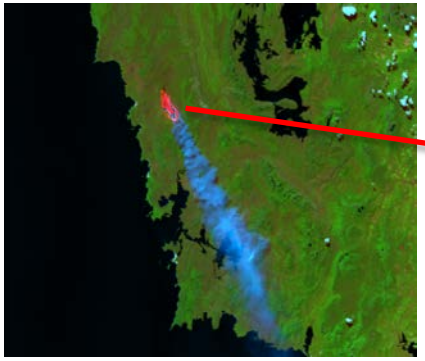
I. Csiszar, STAR

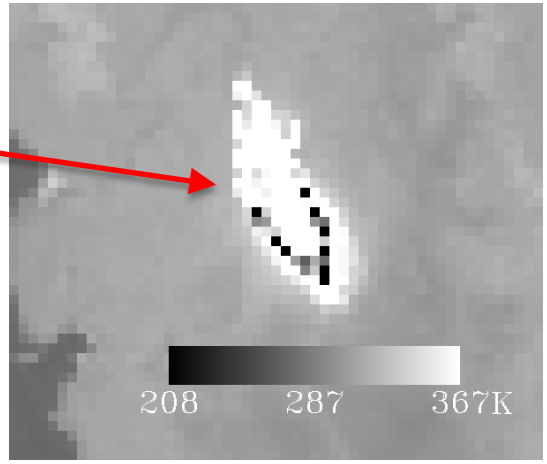
Improved Satellite Mapping of Active Fires Achieved Using VIIRS I-bands

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



Wildfire in southern Brazil, March/2013





Issues of VIIRS fire detection:

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

W. Schroeder, UMD

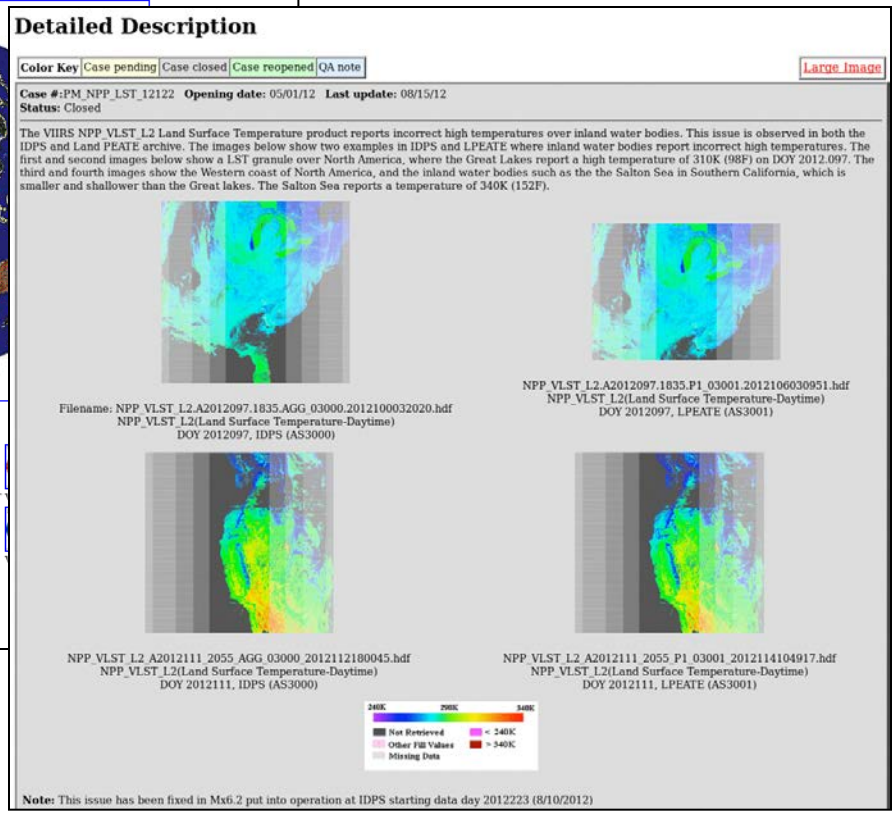
The Land PEATE: meeting the needs of the NASA Science Team and helping the NOAA IDPS

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



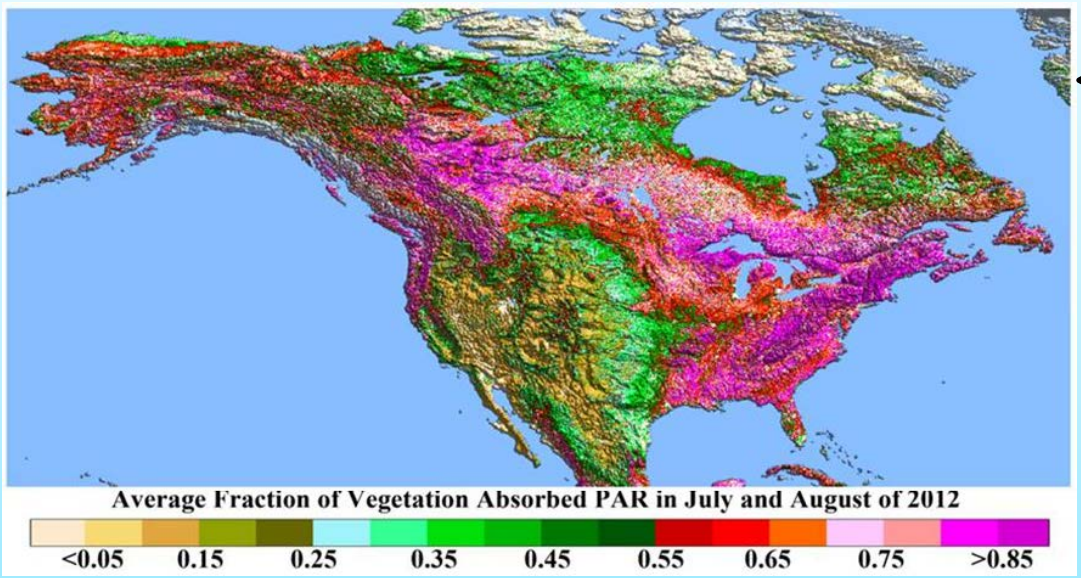
VIIRS Global Browse

Known Issues Page



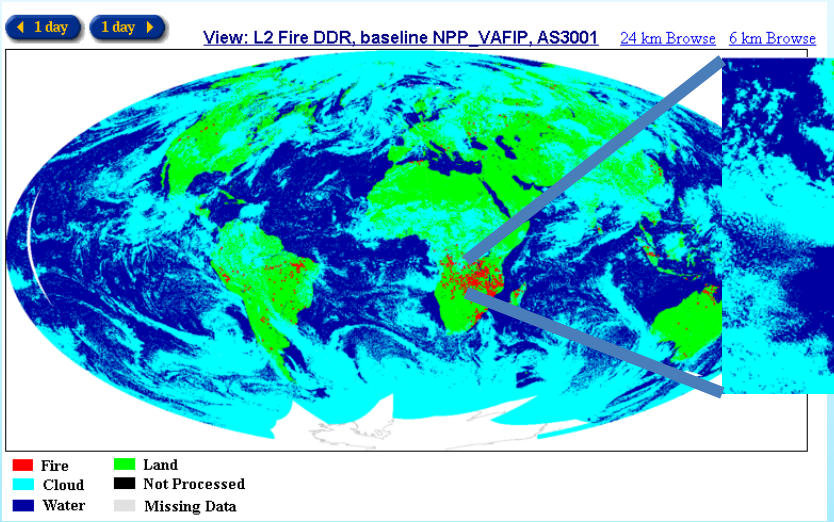
VIIRS Level 3 Products

VIIRS Land Science Team Support Activities



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

R. Myneni (BU)

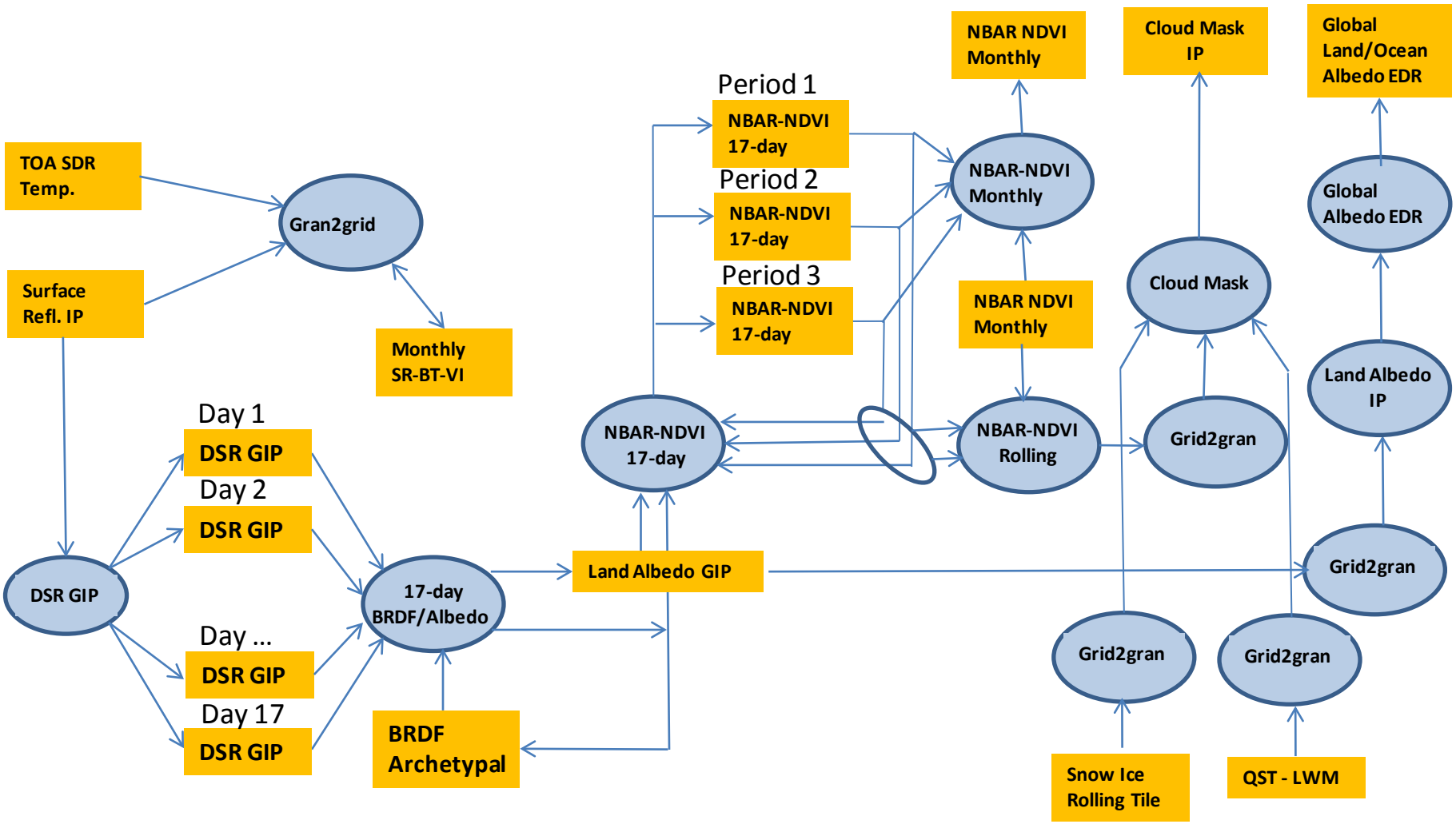


- Integration and testing of VIIRS Active Fire DDR. New PGE installed to operations.

L. Giglio (UMD)

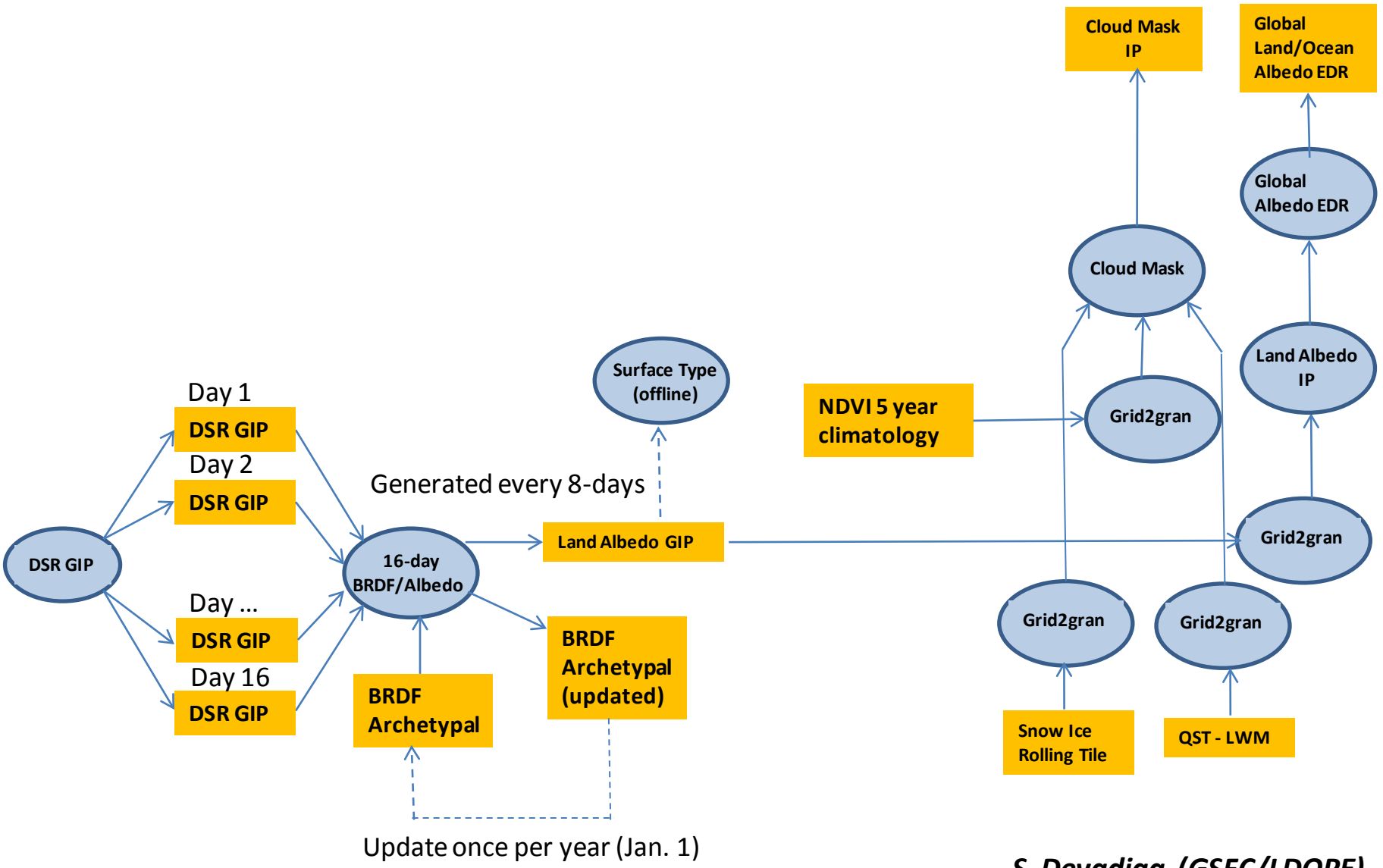
Level 2 Fire DDR, baseline NPP_VAFIP, 8/12/2012

VIIRS Land Gridding/Granulation - Current



S. Devadiga (GSFC/LDOPE)

VIIRS Land Gridding/Granulation - Proposed



S. Devadiga (GSFC/LDOPE)

Summary and Conclusions

- Overall, the quality of input SDR data is good
  - More work needed to resolve quality flag and sensor performance issues (e.g. Active Fires)
- S-NPP VIIRS land core IDPS product development and evaluation is progressing well
  - Provisional: Surface Reflectance, LST, Active Fires (approved); Vegetation Index (in progress) and Surface Type (January 2014)
  - Beta: albedo
- Teams are continuing the development of improved and additional products
  - Green Vegetation Fraction, I-band Active Fires, LAI/FPAR etc.
- Improvements in auxiliary data and processing scheme
- Publications (JGR and other) and presentations