Validated Stage 1 Science Maturity Review
SNPP VIIRS Vegetation Index EDR

Presented by

Marco Vargas (NOAA/STAR)

September 4, 2014

TOA NDVI May 01, 2013

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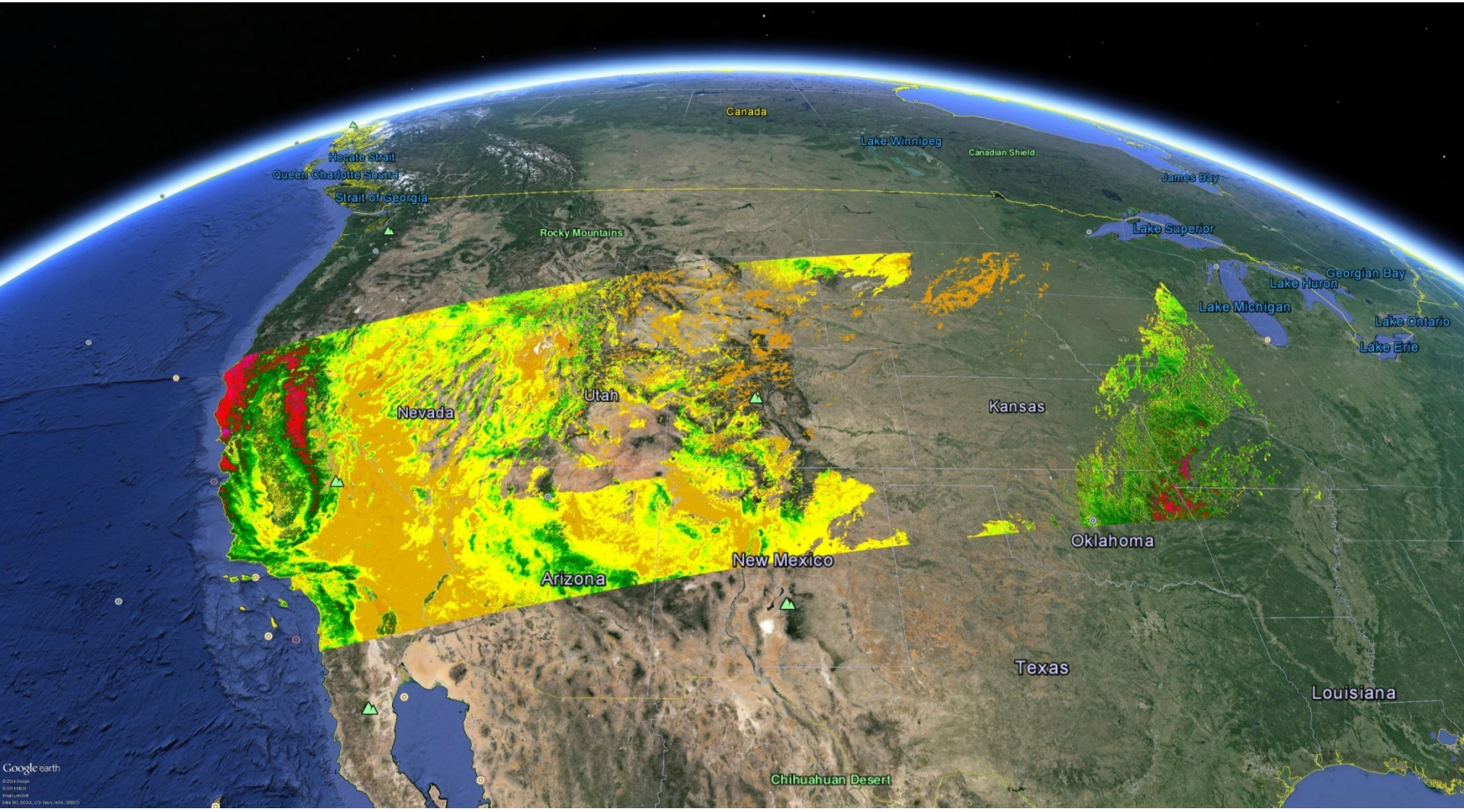

TOA NDVI August 28, 2014 (Mx8.5)

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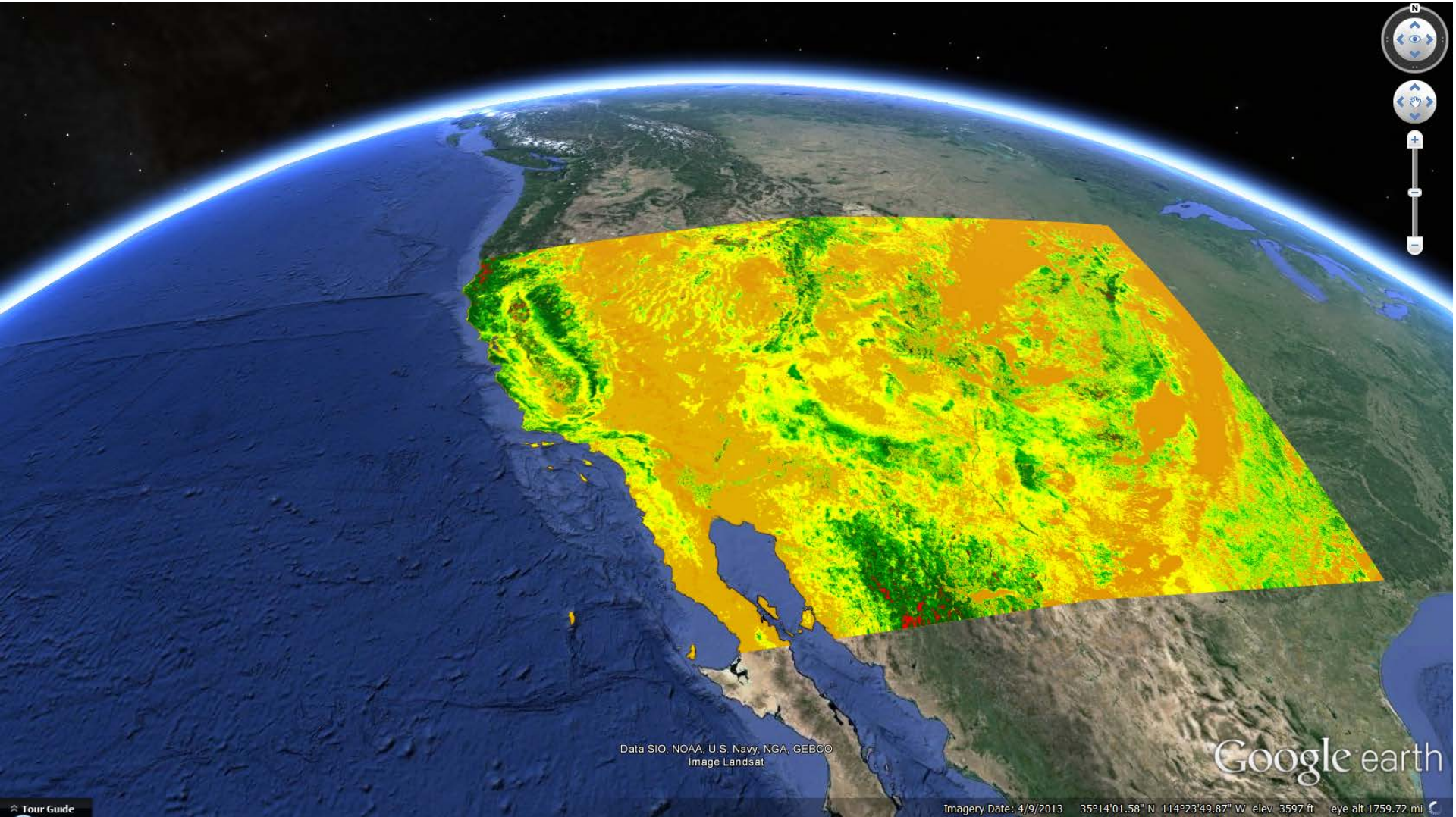
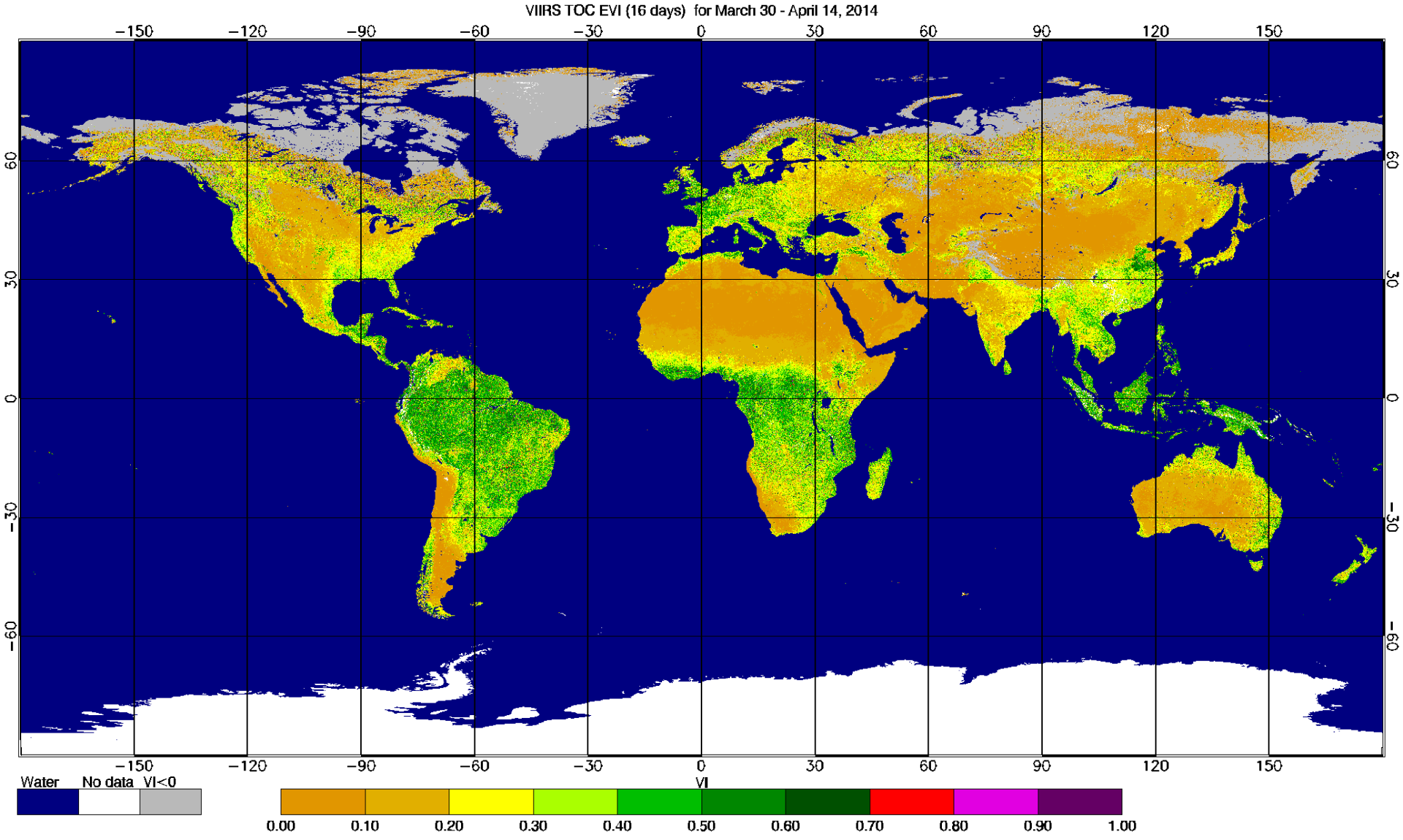


RGB composite August 28, 2014

Surface Reflectance bands bands M5, M4 and M3 (Mx8.5)

TOC EVI 16-day composite



Outline

- Algorithm Cal/Val Team Members
- Product Requirements
- Evaluation of Algorithm Performance to Specification Requirements
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error budget
- Documentation
- Identification of Processing Environment
- Users & User Feedback
- Conclusion
- Path Forward

Vegetation Index EDR Cal/Val Team

Name	Organization	Major Task
Marco Vargas	NOAA/STAR	VI EDR Algorithm Lead
Tomoaki Miura	University of Hawaii	VI EDR Cal/Val Lead
Javzan Azuma	University of Hawaii	Cal/Val Team Member
Jiao Wang	University of Hawaii	Cal/Val Team Member
Anna Kato	University of Hawaii	Cal/Val Team Member
Alfredo Huete	UTS	Cal/Val Team Member
Leslie Belsma	Aerospace	Land JAM
Michael Ek	NOAA/NCEP	User Readiness
Walter Wolf	NOAA/STAR	AI&T Team Lead
Nikolay Shabanov	NOAA/STAR/IMSG	Algorithm Support

Requirements

Table 5.5.9 - Vegetation Indices (VIIRS)		
EDR Attribute	**Threshold**	**Objective**
Vegetation Indices Applicable Conditions		
1. Clear, land (not ocean),day time only		
a. Horizontal Cell Size	0.4 km	0.25 km
b. Mapping Uncertainty, 3 Sigma	4 km	1 km
c. Measurement Range		
1. NDVITOA	-1 to +1	NS
2. EVI (1)	-1 to +1	NS
3. NDVITOC	-1 to +1	NS
d. Measurement Accuracy - $NDVI_{TOA}$ (2)	0.05 NDVI units	0.03 NDVI units
e. Measurement Precision - $NDVI_{TOA}$ (2)	0.04 NDVI units	0.02 NDVI units
f. Measurement Accuracy - EVI (2)	0.05 EVI units	NS
g. Measurement Precision - EVI (2)	0.04 EVI units	NS
h. Measurement Accuracy - $NDVI_{TOC}$ (2)	0.05 NDVI units	NS
i. Measurement Precision - $NDVI_{TOC}$ (2)	0.04 NDVI units	NS
j. Refresh	At least 90% coverage of the globe every 24 hours (monthly average)	24 hrs.

Notes:

1. EVI can produce faulty values over snow, ice, and residual clouds (EVI > 1).
2. Accuracy and precision performance will be verified and validated for an aggregated 4 km horizontal cell to provide for adequate comparability of performance across the scan.

New for JPSS1

$NDVI_{TOC}$ Excluded for SNPP (L1RD-S Appendix D, Table D-1)

Source: Level 1 Requirements Supplement – Final Version:2.9 June 27, 2013

SNPP Validation Stages Maturity Definition

Validated Stage 1:

Using a limited set of samples, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

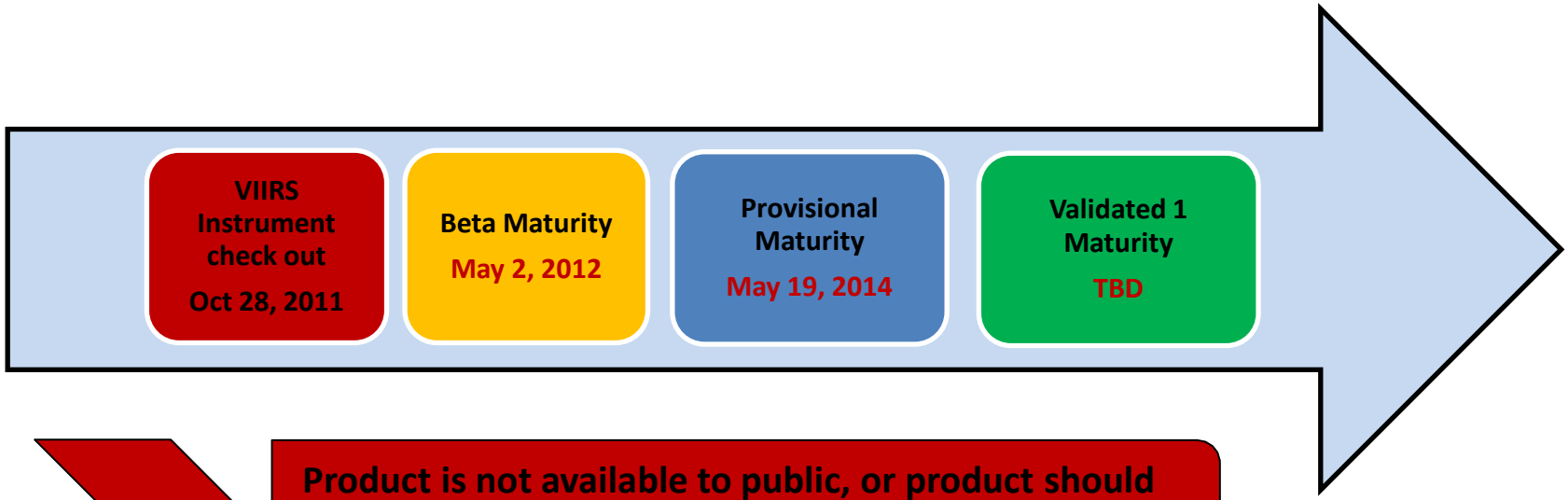
Validated Stage 2:

Using a moderate set of samples, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

Validated Stage 3:

Using a large set of samples representing global conditions over four seasons, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

Vegetation Index EDR Product Timeline



Product is not available to public, or product should not be used

Product is available to public, but it should be used with caution, known problems, frequent changes

Product is available to public; users are encouraged to evaluate

Product performance has been demonstrated using a limited set of samples, and is ready for operational use

SNPP VIIRS VI EDR Algorithm Description

- Suomi NPP VIIRS VI EDR consists of two vegetation indices: the "top-of-the-atmosphere (TOA)" **Normalized Difference Vegetation Index** (TOA-NDVI) and the "top-of-canopy (TOC)" **Enhanced Vegetation Index** (TOC-EVI).
  - **TOA NDVI:** is most directly related to absorption of photosynthetically active radiation, but is often correlated with biomass or primary productivity.
  - **TOC EVI:** was developed to optimize the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a reduction in atmosphere influences.
- VI EDR provides continuity with NOAA POES **AVHRR** and NASA EOS **MODIS**.
- Vegetation Index (VI) is one key parameter to specify the boundary condition in global climate models, weather forecasting models and numerous remote sensing applications for monitoring environmental state and its change.

SNPP VIIRS VI EDR Algorithm Description

- The SNPP VIIRS Vegetation Index EDR consists of two vegetation indices:
  1. Normalized Difference Vegetation Index (NDVI) from top-of-atmosphere (TOA) reflectances
  2. Enhanced Vegetation Index (EVI) from top of canopy (TOC) reflectances.
- These indices are produced at the VIIRS image channel resolution (375 m)

VI EDR Algorithm

$$NDVI = (\rho_{I2}^{TOA} - \rho_{I1}^{TOA}) / (\rho_{I2}^{TOA} + \rho_{I1}^{TOA})$$

$$EVI = (1+L) \cdot \frac{\rho_{I2}^{TOC} - \rho_{I1}^{TOC}}{\rho_{I2}^{TOC} + C_1 \cdot \rho_{I1}^{TOC} - C_2 \cdot \rho_{M3}^{TOC} + L}$$

ρ_{M3}^{TOC} Surface reflectance band M3 (488 nm)

ρ_{I1}^{TOC} Surface reflectance band I1 (640 nm)

ρ_{I2}^{TOC} Surface reflectance band I2 (865 nm)

ρ_{I1}^{TOA} Top of the atmosphere reflectance band I1 (640)

ρ_{I2}^{TOA} Top of the atmosphere reflectance band I2 (865 nm)

C_1, C_2 and L are constants

Vegetation Index EDR Dataflow

- The VIIRS Vegetation Index EDR requires: calibrated TOA reflectances (bands I1, I2), SDR
- Auxiliary data (solar zenith angle)
- Surface Reflectance (bands I1, I2, M3, Land Quality Flags)
- VI coefficients

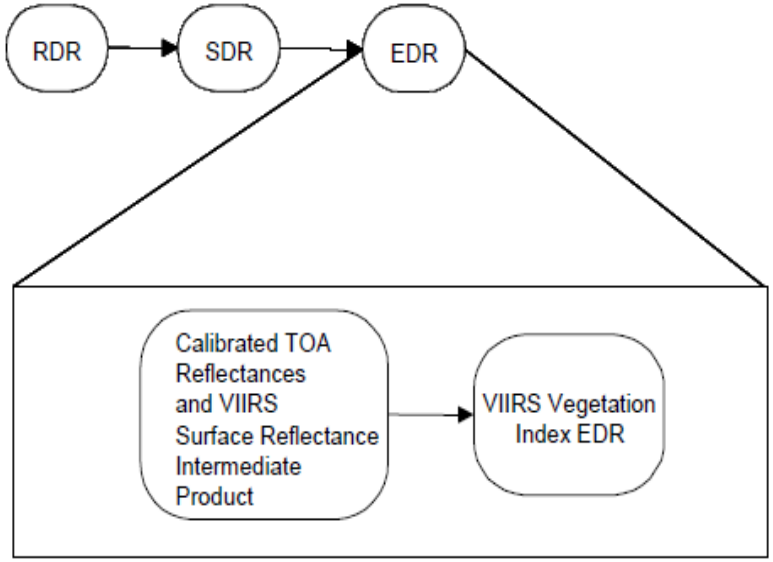


Figure 1 (Processing chain associated with VIIRS Vegetation Index EDR)

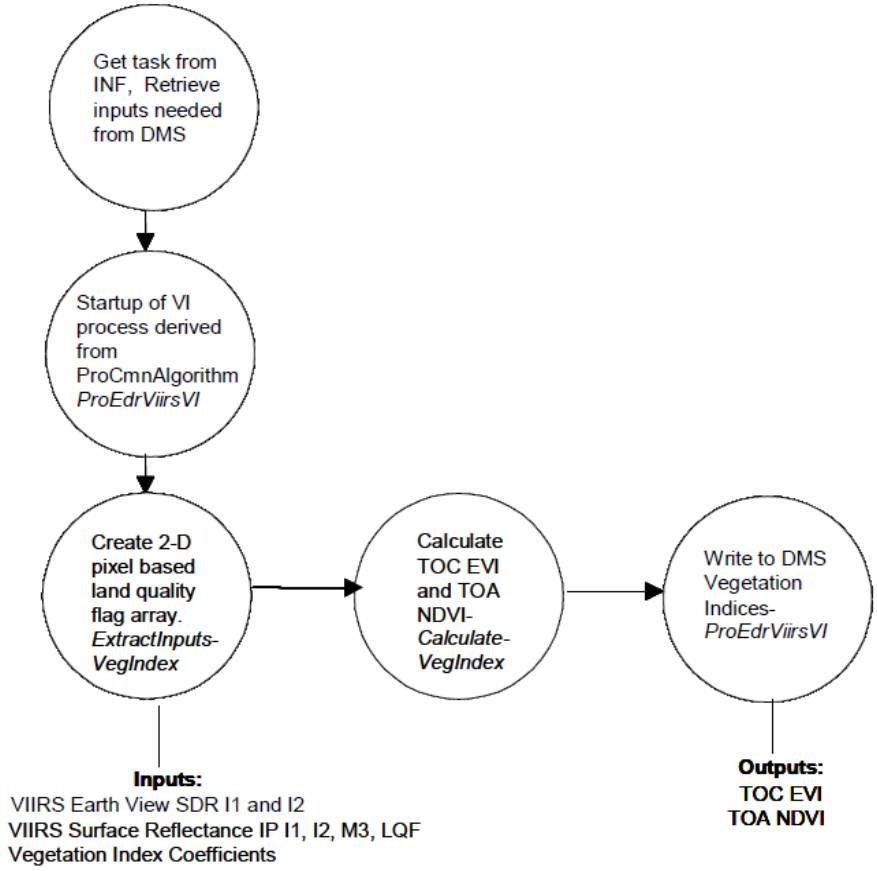


Figure 2 (Data Flow Diagram of Overall VVI EDR Call Sequence from the Main Program)

Evaluation of algorithm performance to specification requirements

- Findings/Issues from Provisional Review
  - Atmospheric correction over bright surface and cloud edges
  - Overestimation of shadow areas and adjacency clouds
  - Suspicious EVI over snow/ice and clouds

- Improvements since Provisional
  - No changes have been made to the Vegetation Index EDR algorithm since Provisional.
    - An EVI backup algorithm has been prototyped (refer to “Pathway Forward”)
  - Gradual quality improvements were observed with improvements in the input data quality:
    - VIIRS Cloud Mask (by the Cloud team)
    - VIIRS SDR (by the SDR team)

Evaluation of algorithm performance to specification requirements (cont.)

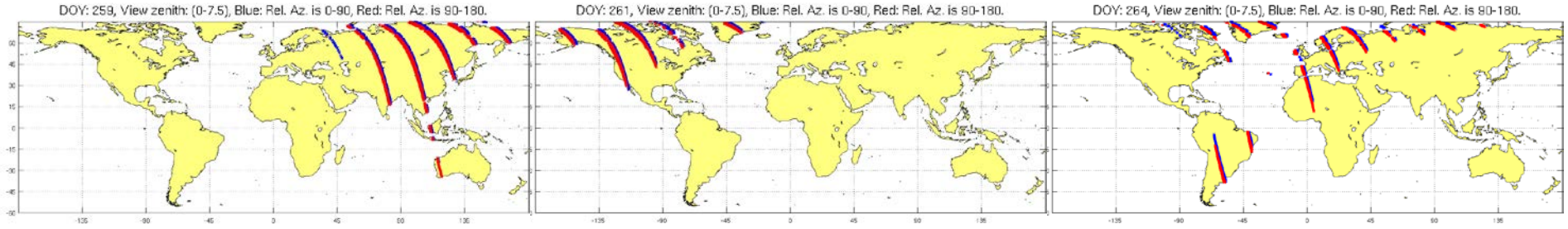
- Calibration/Validation Activities

  The following Cal/Val activities have been conducted to evaluate the VI EDR maturity since the provisional maturity review

  1) Cross-comparison with Aqua MODIS
     a) Global comparison for APU (Accuracy, Precision, Uncertainty) estimation
     b) Subset comparison for evaluation of quality flags
  2) NGAS match-up data analysis for APU estimation (atmospheric correction)
  3) Cross-comparison with *in situ* tower-based VI time series measurements

VIIRS vs. MODIS Global Comparison

- ***Radiometric accuracies*** of VIIRS VI EDR were evaluated and estimated by global cross-comparison with Aqua MODIS
  - Using observation pairs along overlapping orbital tracks
    - Four view zenith (VZ) angle bins:
      $VZ < 7.5^o$, $20^o < VZ < 27.5^o$, $40^o < VZ < 47.5^o$, $55^o < VZ < 62.5^o$
  - Sets of three days of data to obtain global coverage
    - DOY 104, 106, and 109, 2014
    - DOY 120, 122, and 125, 2014
    - DOY 136, 138, and 141, 2014
    - DOY 152, 154, and 157, 2014

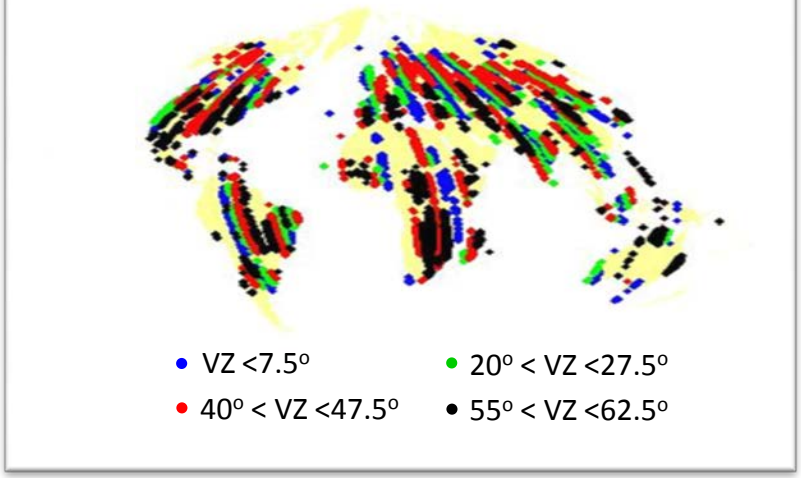


Figures indicating VIIRS-MODIS overlapping orbital tracks ($VZ < 7.5^o$)
(Red = forward scattering geometry; Blue = backward scattering geometry)

VIIRS vs. MODIS Global Comparison (cont.)

- APU metrics computed using MODIS as a reference
  - Granules reprojected to Sinusoidal grid (~463.313 m resolution) and mosaiced
  - Averaged on a 8 pixel-by-8 pixel window basis (4 km-by-4 km) when 80% of pixels (52 pixels) having values
    - Exclusion conditions: confidently cloudy, solar zenith angle > 65°, ocean, AOT > 1.0
    - Additional screening: thin cirrus, inland water, cloud adjacency, high aerosol quantity, snow/ice, shadow

Pixels used for APU computations



VIIRS TOA NDVI (June 6, 2014)

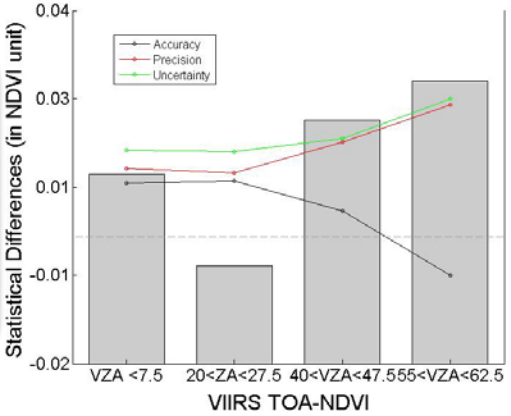
MODIS TOA NDVI (June 6 2014)

VIIRS VI EDR APU Metrics

MODIS Reference; All Data Days

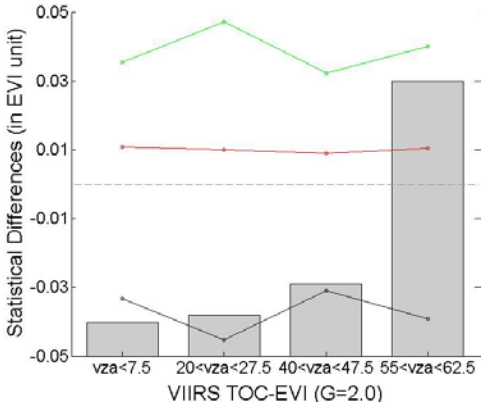
TOA NDVI

	Summary
A	0.005
P	0.017
U	0.020

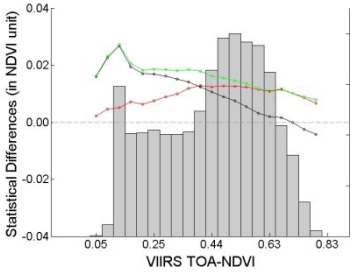


TOC EVI

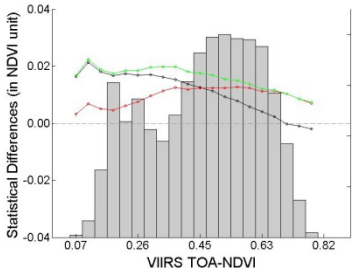
	Summary
A	-0.037
P	0.011
U	0.039



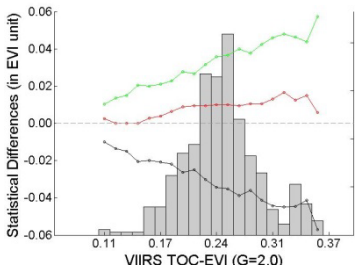
VZ <7.5°



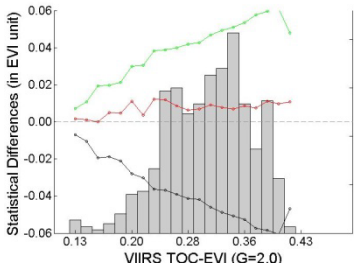
20° < VZ <27.5°



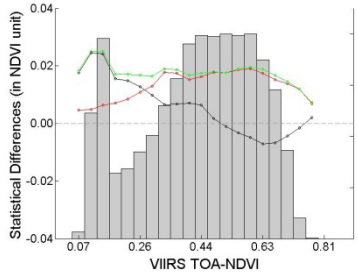
VZ <7.5°



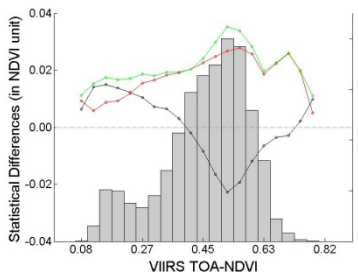
20° < VZ <27.5°



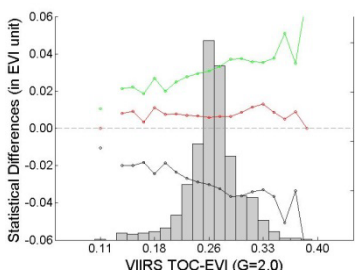
40° < VZ <47.5°



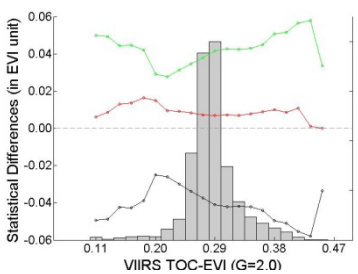
55° < VZ <62.5°



40° < VZ <47.5°



55° < VZ <62.5°



Subset Time Series Analysis: Quality flag analysis/validation

Validation using MODIS VI time-series at 40 Flux Sites

VRVI (375m)
TOA_NDVI, TOC_EVI

Surface Reflectance
I1&I2, M3 bands

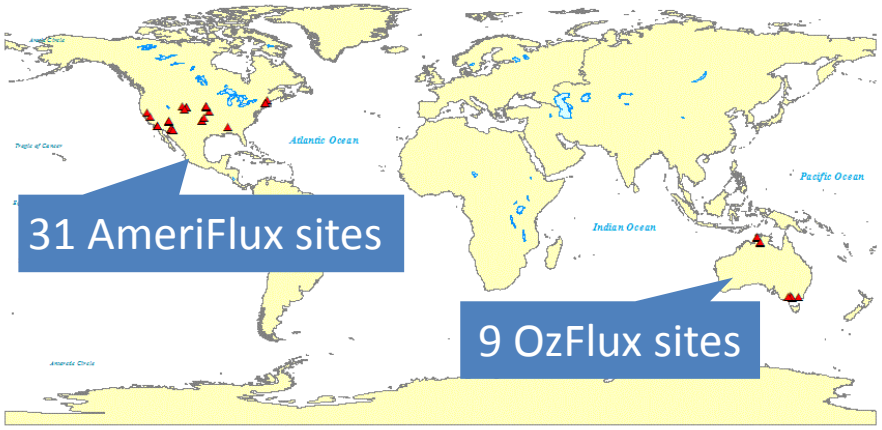
Resample M-band into I-resolution

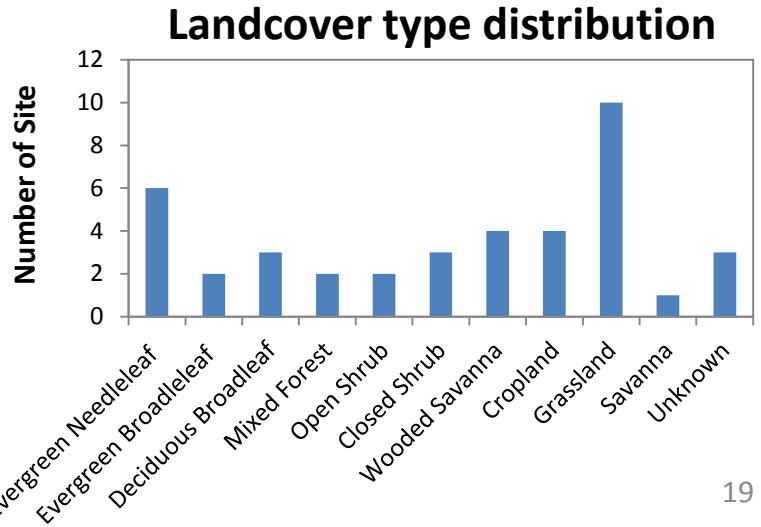
VIIRS Cloud Mask (VCM)
Quality flag (QF) check

TOA_NDVI
TOC_EVI (G=2.0)

TOC_NDVI
TOC_EVI (G=2.5)

MODIS (500m) TOC_NDVI, TOC_EVI (G=2.5)





VI screening test using additional Quality Flag

- Time series comparison of screened VIIRS VIs against screened MODIS VIs (Assuming MODIS VIs having "good quality")

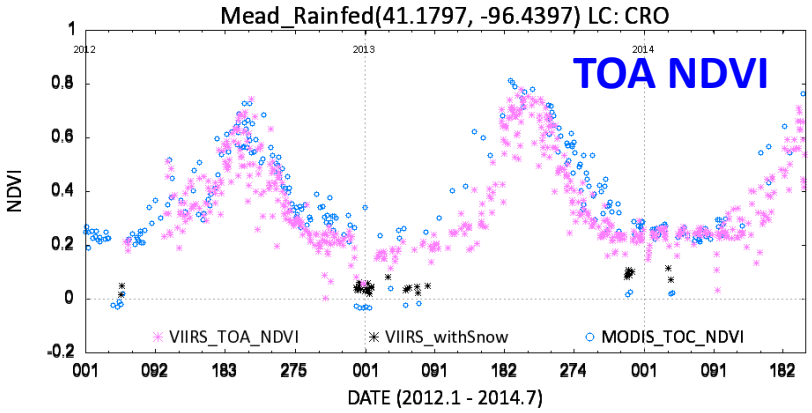
- Flags used

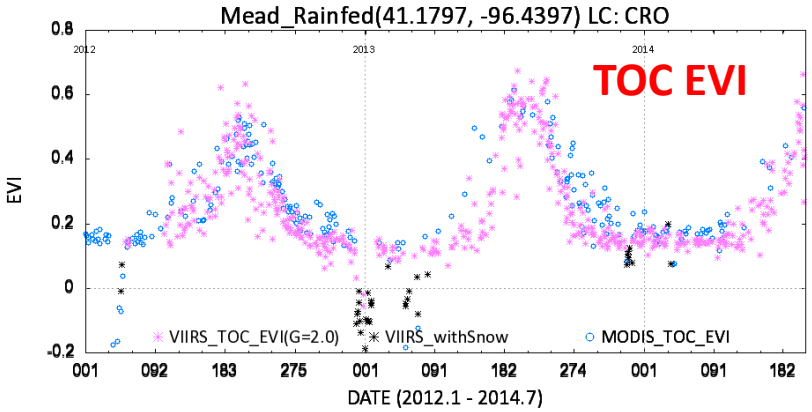
VIIRS (Additional QFs)	MODIS (1km State QA)
- Trial 1: Only Snow - Trial 2: Only Adjacency cloud - Trial 3: Only Shadow - Trial 4: Only Aerosol	- Cloud state (other than 'clear') - Cloud shadow - Aerosol (other than 'low') - Cirrus (other than 'none') - Internal cloud - MOD35 Snow/Ice - Pixel is adjacent to cloud

Subset Time Series Analysis: Quality flag analysis/validation (cont.)

Snow Flag

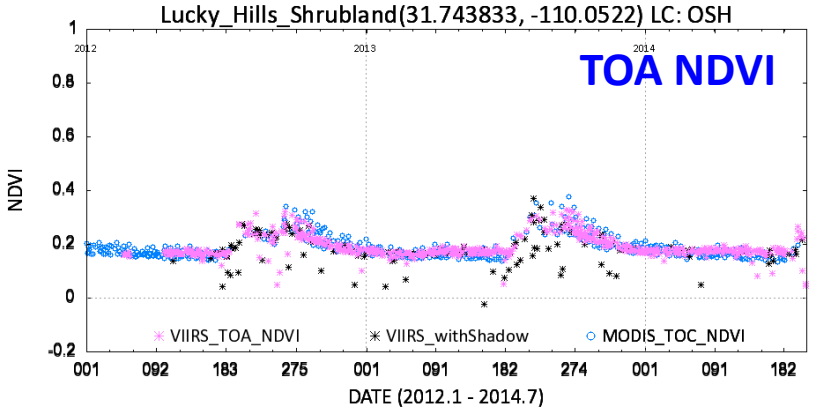
- Snow flag effectively screened low VI values especially for EVI

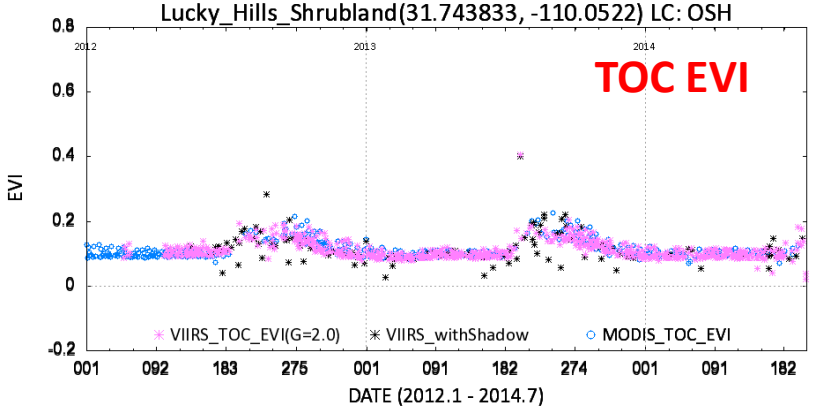




Shadow Flag

- Shadow flag screened low TOA NDVI and extremely high TOC EVI, but tented to over-screen data especially during greening-up season

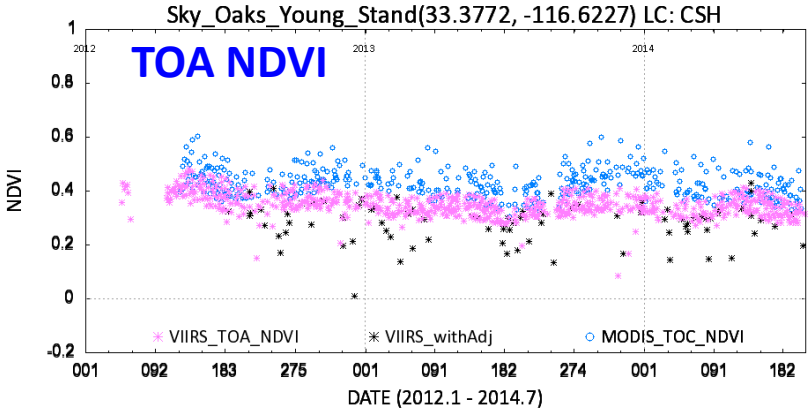


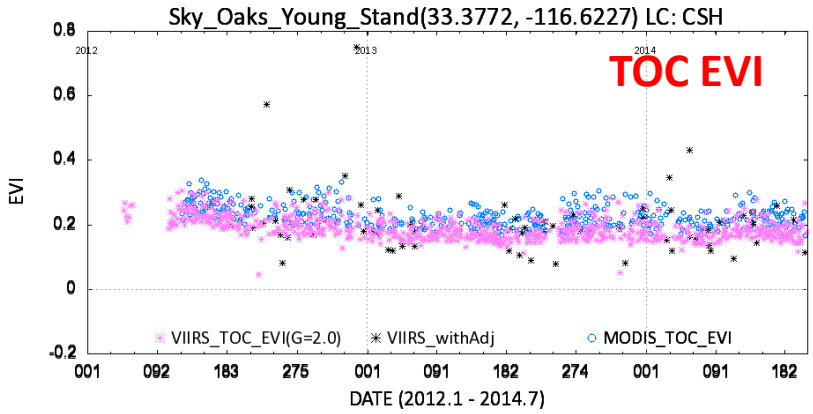


Subset Time Series Analysis: Quality flag analysis/validation (cont.)

Adjacency Cloud Flag

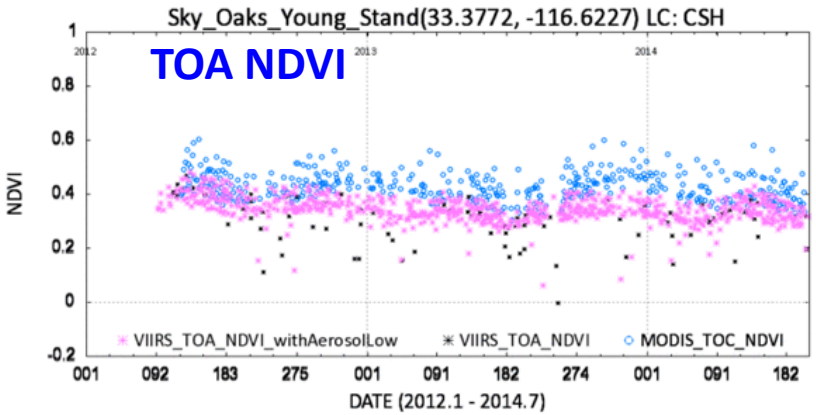
- Adjacency flag screened low TOA NDVI values, and extremely high TOC EVI values
- Adjacency flag screened extremely high and low VIs better since 2013

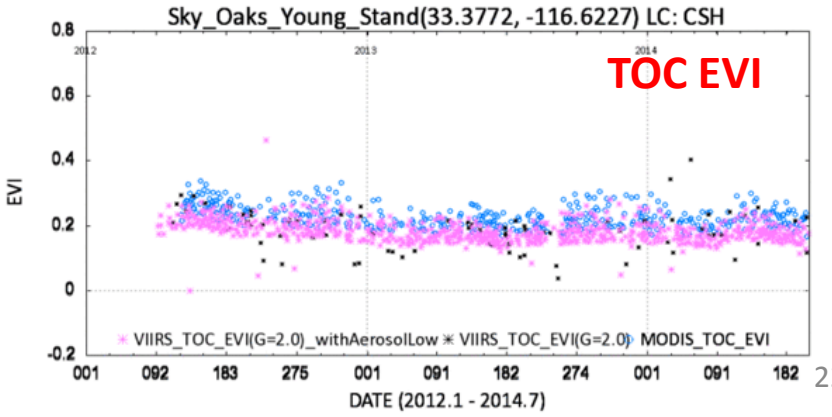




Aerosol Quantity Flag

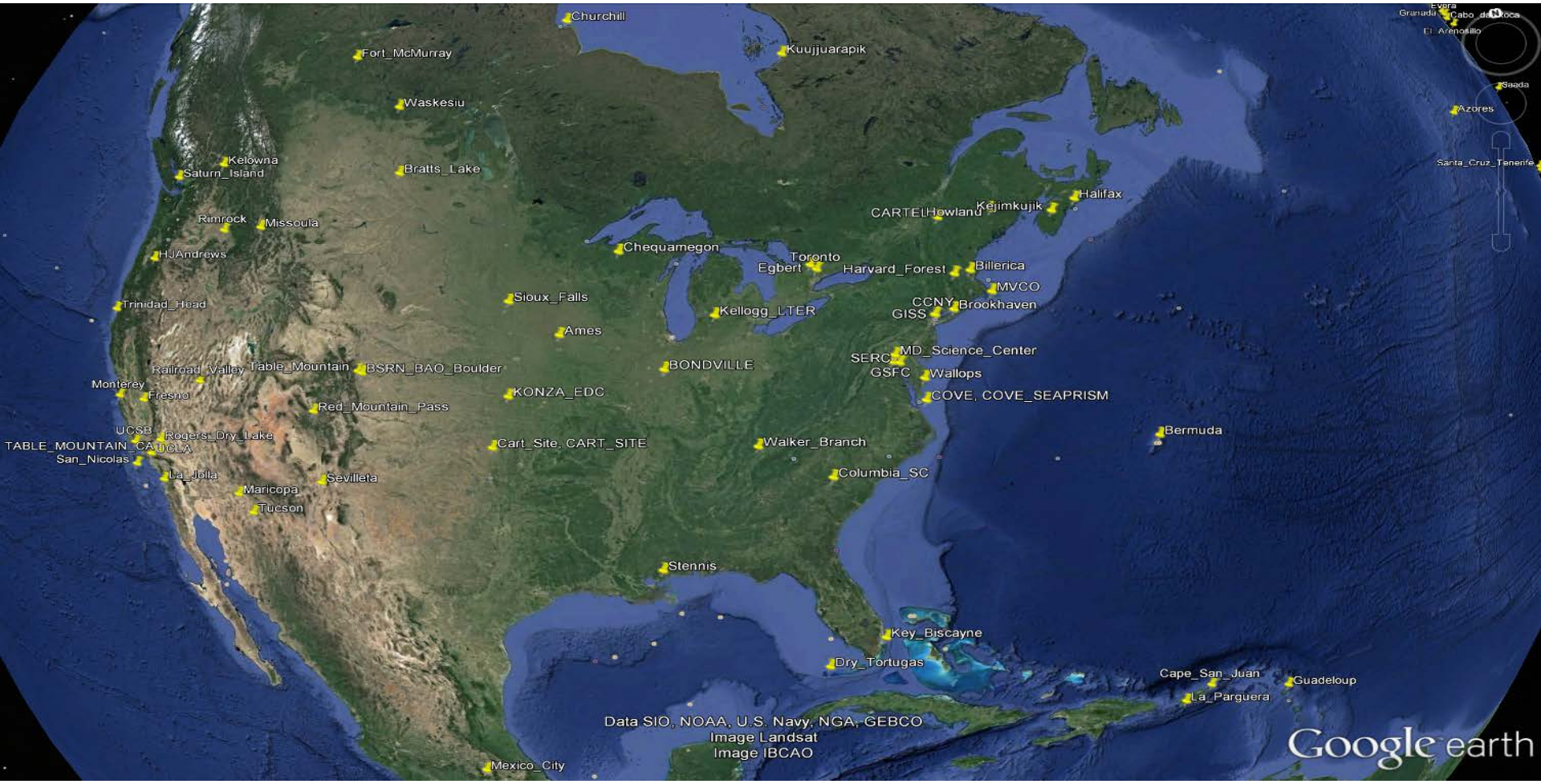
- Aerosol quantity flag (climatology, medium, & high) screened additional outliers.





VI EDR Validation: Matchup Data Analysis

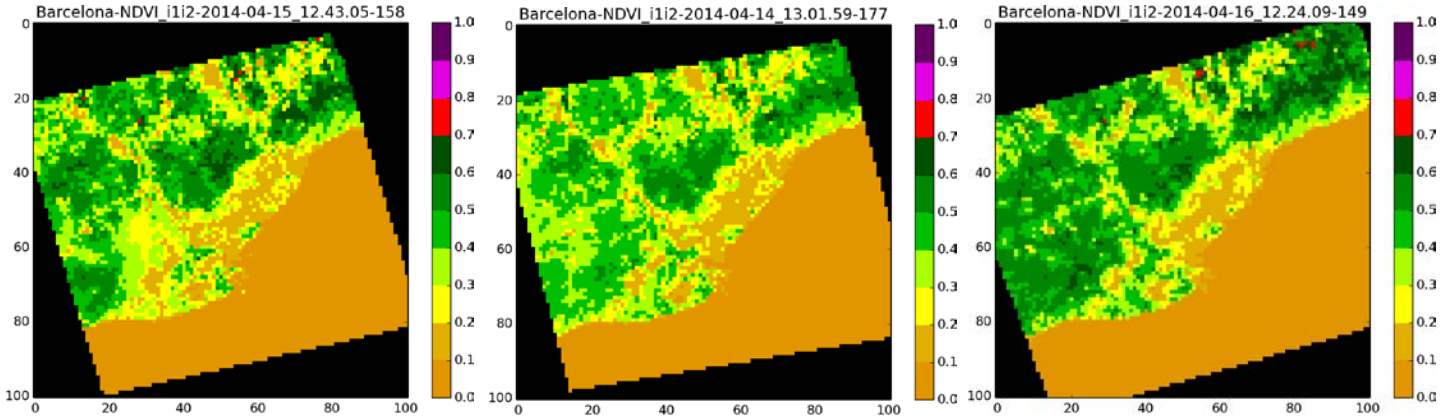
Surface Reflectance and VI cutouts collected daily at 229 Aeronet sites: North America Example



VI EDR Validation: Matchup Data Analysis

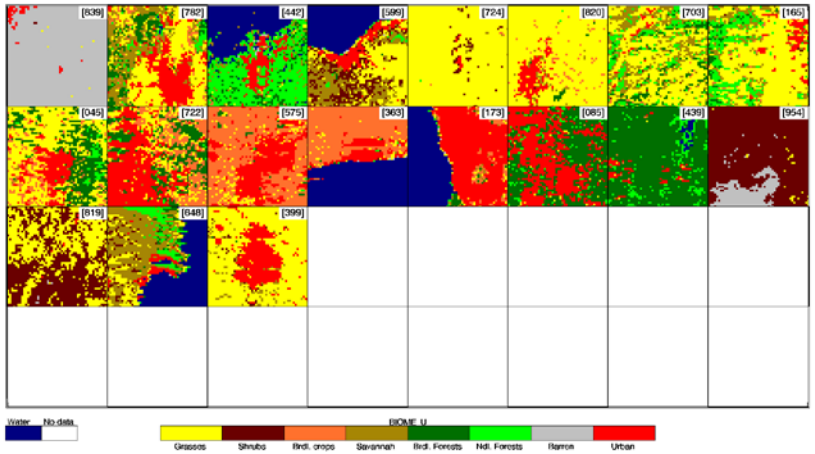
Example of Cutouts of TOA NDVI at Barcelona. First three weeks in April, 2014

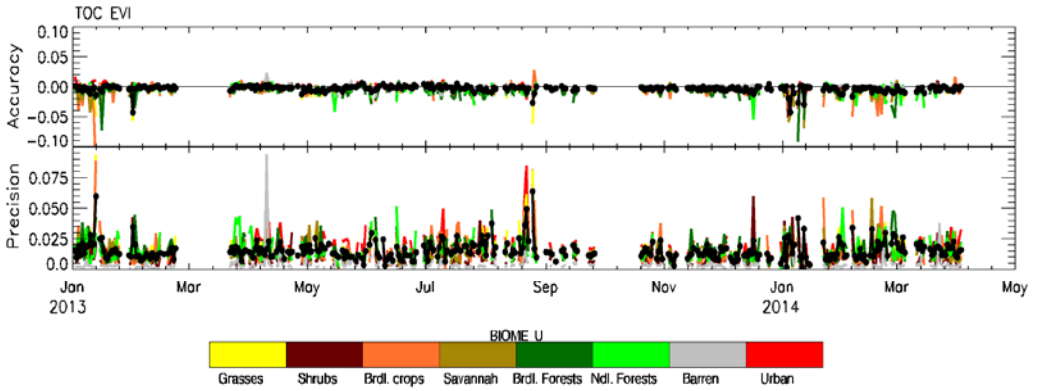
Sinusoidal projection allows co-located 500 m cells to be tracked chronologically

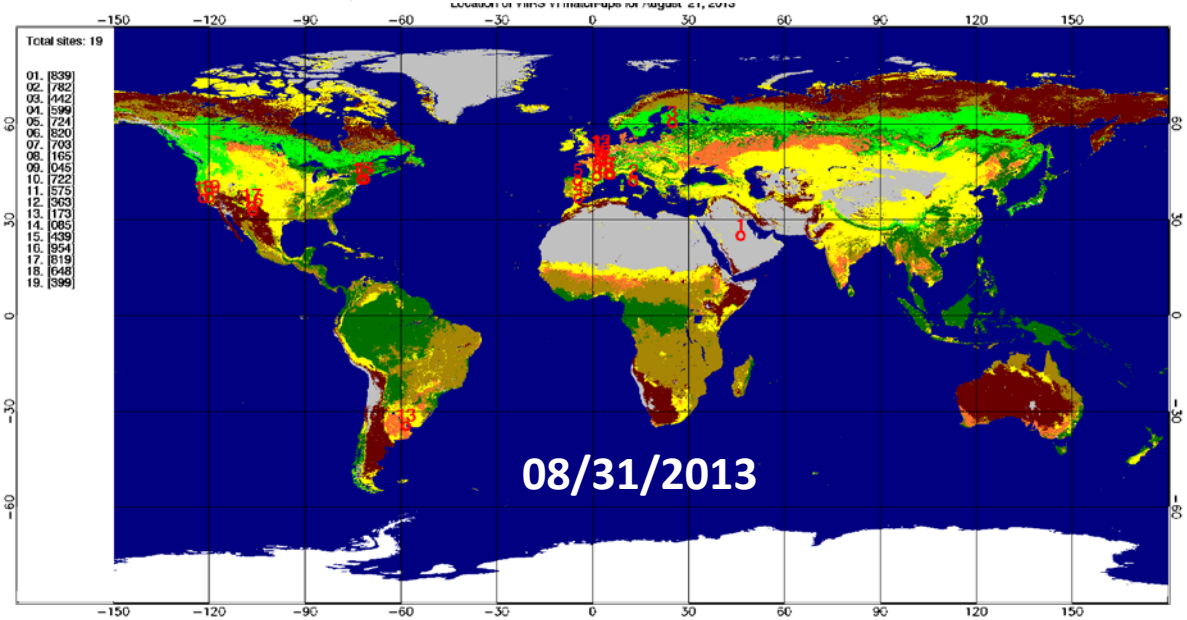


VI EDR Validation
Using AERONET Based SR (Matchup Data)

Sample of global daily distribution of match-up sites (August 21, 2013) covering different surface types and including urban areas. Global Land cover is derived from Combined Terra & Aqua MODIS LAI/FPAR LC product (MCD12C1, ver. 5.1).







Global APUs

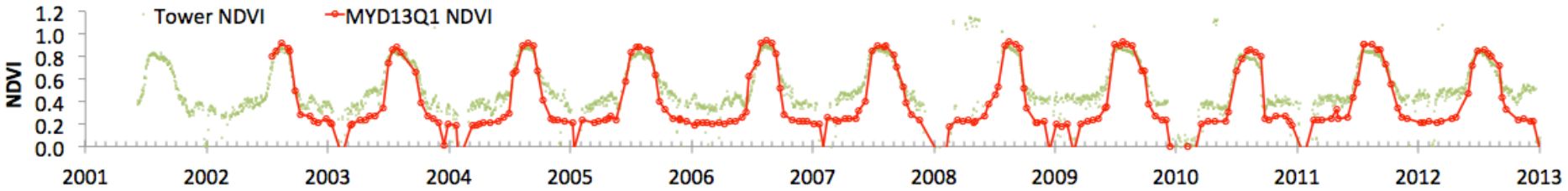
(Jan 1, 2013 – Mar 31, 2014)

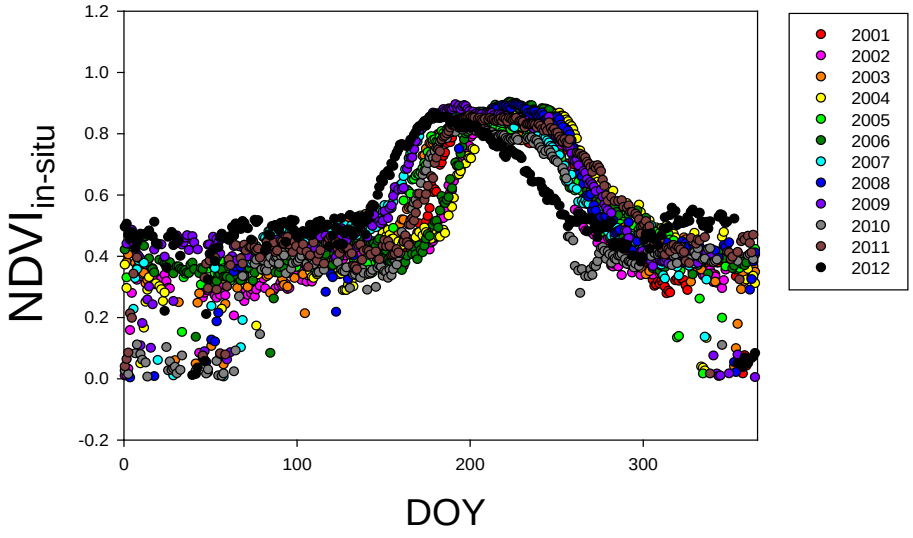
	TOC EVI	TOC NDVI
A	-0.004	0.009
P	0.015	0.035
U	0.016	0.038

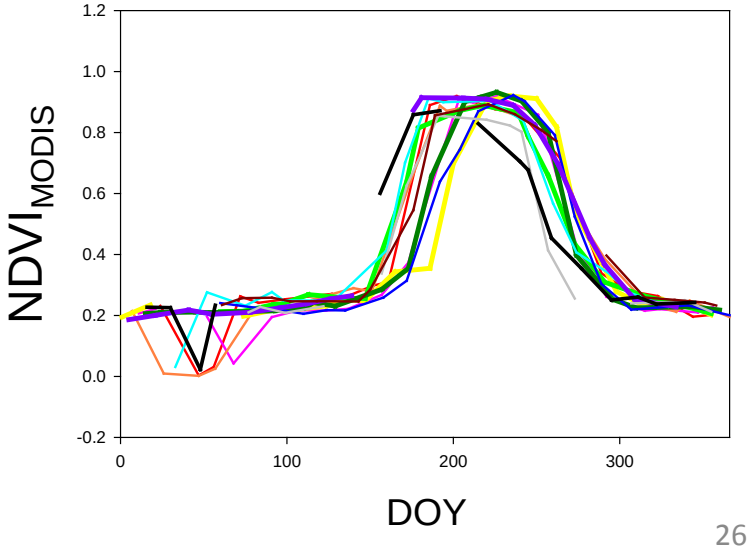
Validation of VI Products:
Use of In Situ (Tower) VI Measurements

- High temporal resolution, *in situ* measurements from flux towers used to validate VIIRS VI time series

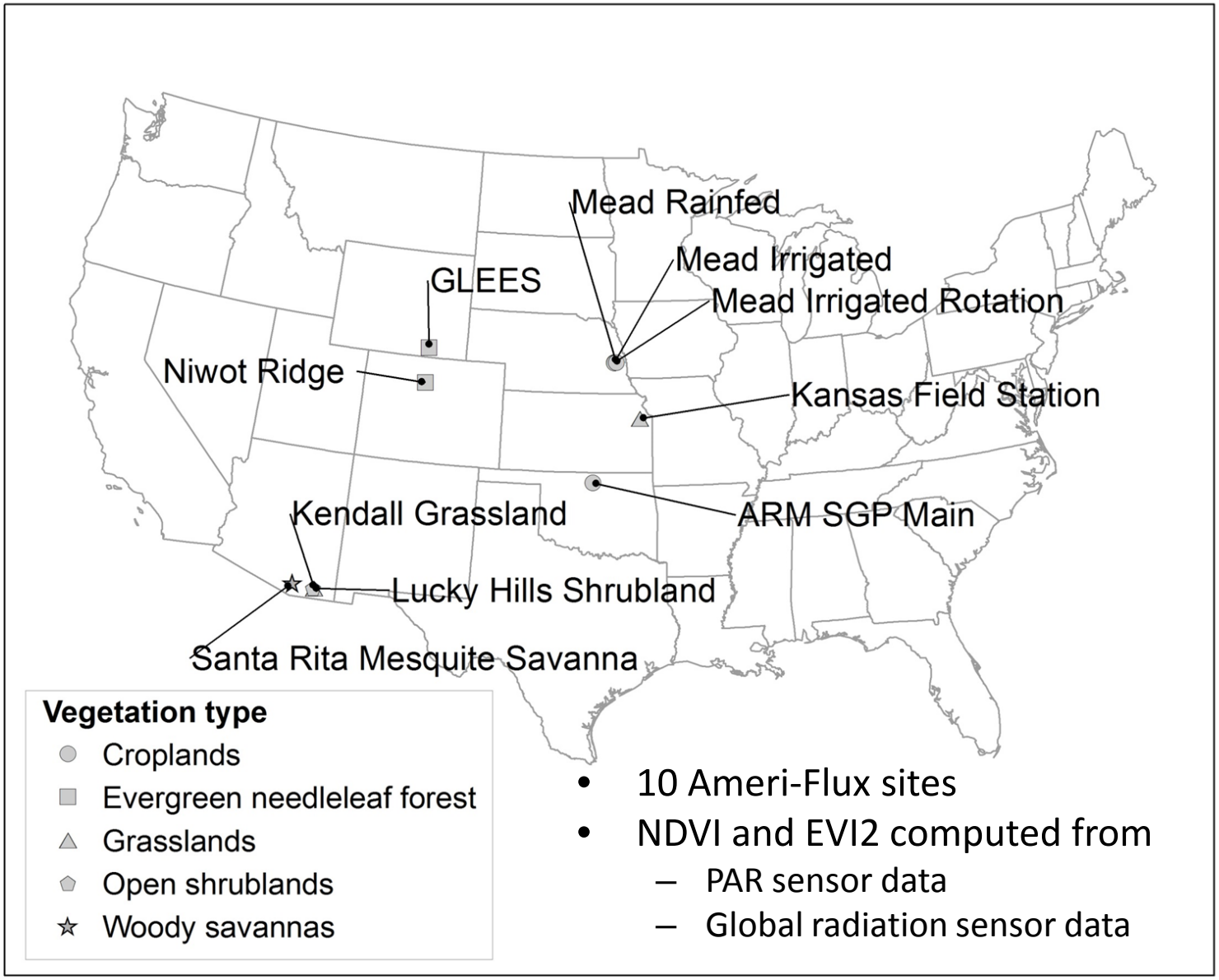
Mead Irrigated Rotation Flux Site, Nebraska, USA (US-Ne2: 41.1649, -96.4701)







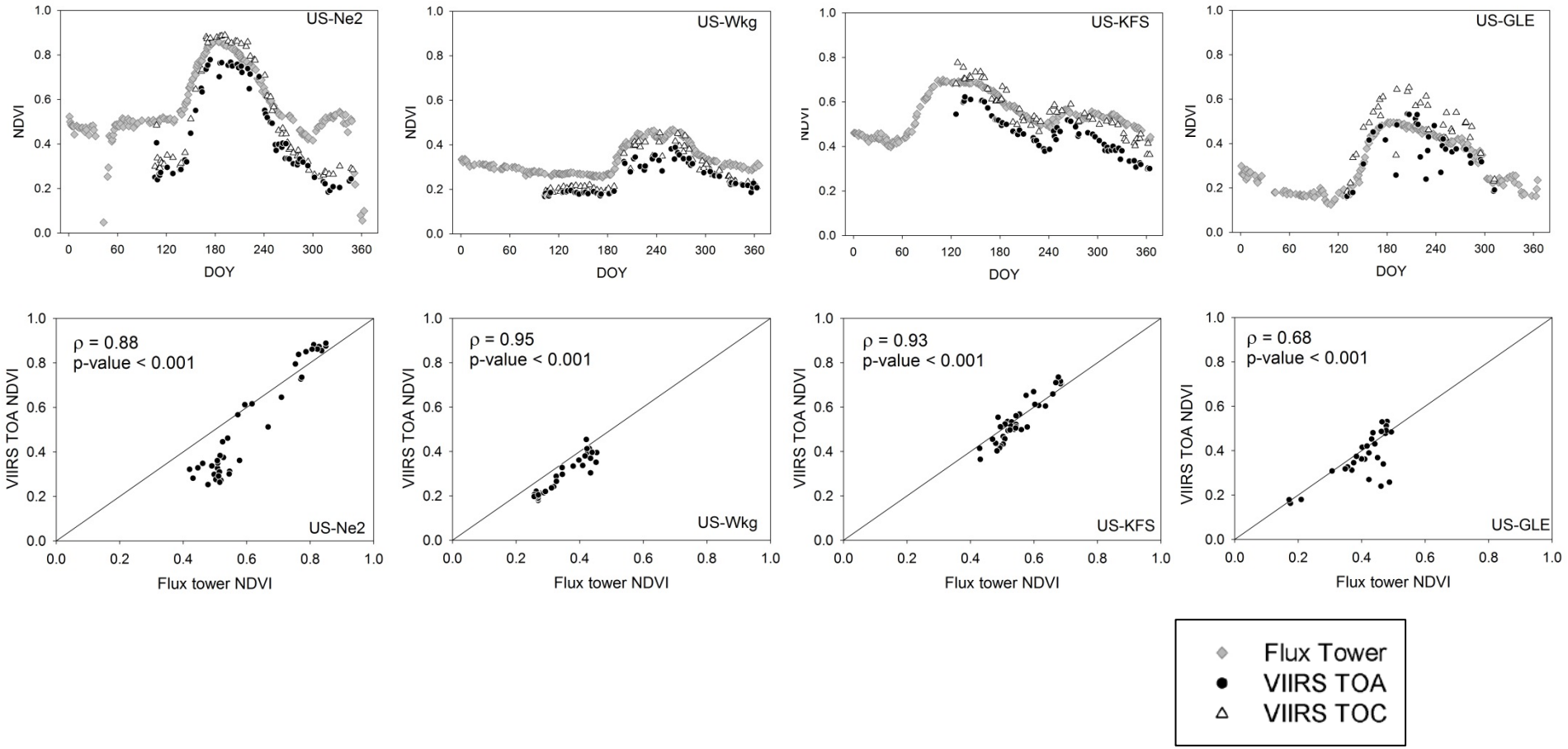
In Situ (Tower) VI Measurement Sites



- 10 Ameri-Flux sites
- NDVI and EVI2 computed from
  - PAR sensor data
  - Global radiation sensor data

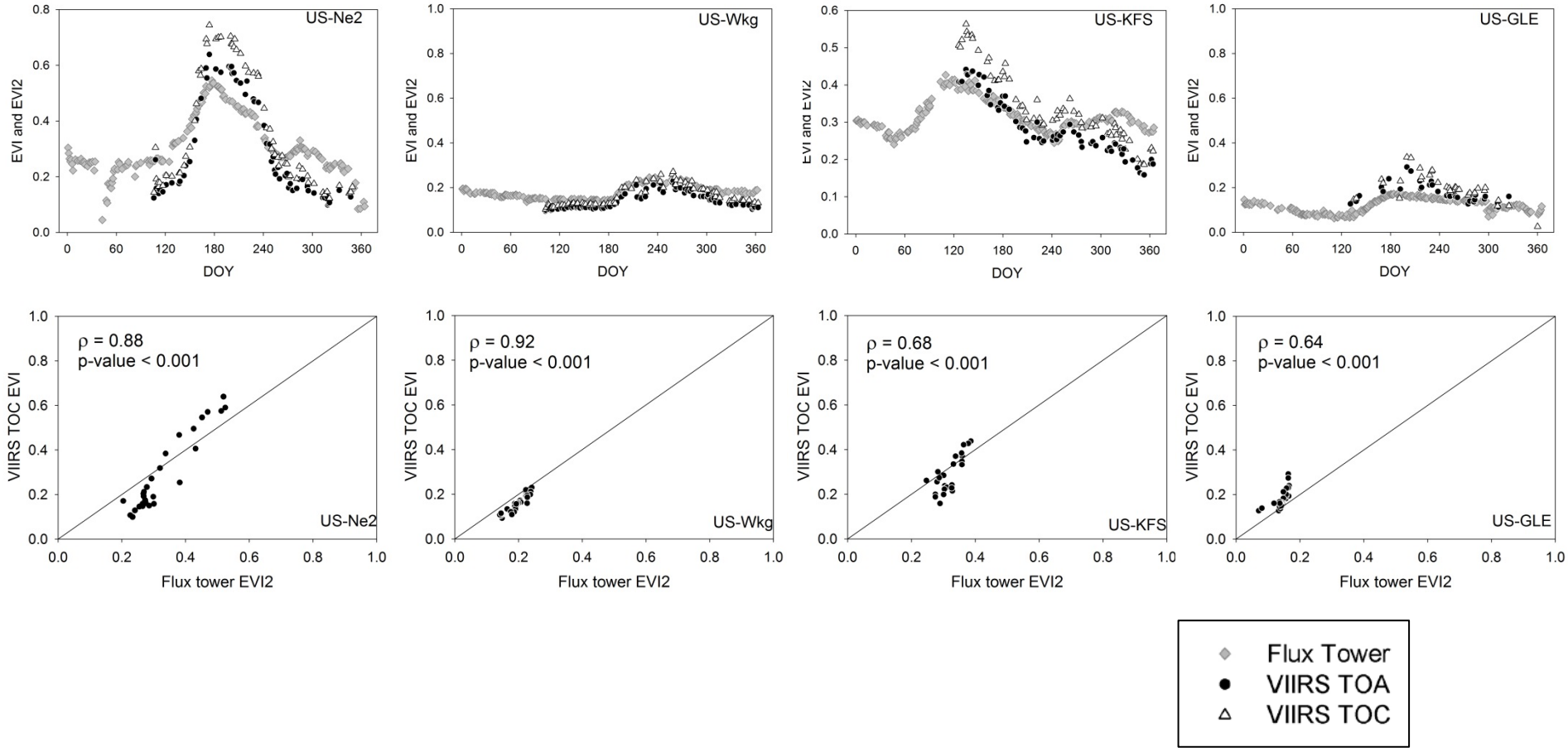
VIIRS vs. Tower NDVI Time Series

- VIIRS TOA NDVI (as well as TOC NDVI) and Tower NDVI show comparable temporal profiles
- VIIRS TOA NDVI and Tower NDVI correlate well



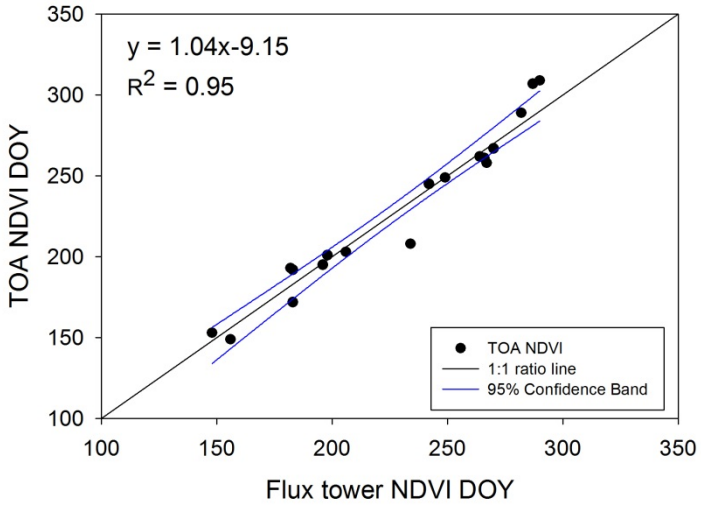
VIIRS vs. Tower EVI Time Series

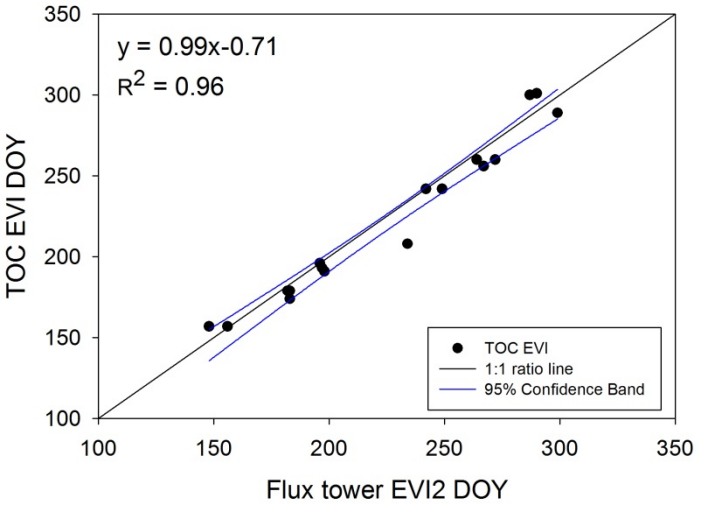
- VIIRS TOC EVI (as well as TOC EVI2) and Tower EVI2 show comparable temporal profiles
- VIIRS TOC EVI and Tower EVI2 correlate well

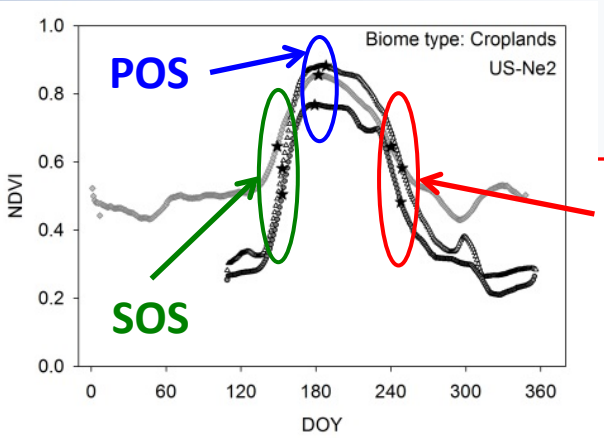


Phenological Metrics Cross-Comparison

*Phenological metrics extracted from VIIRS and tower VI time series matching well







Start of Greening Season (SOS)

SOS	TOA NDVI	TOC EVI	TOC NDVI
Bias (days)	-2	-2	-4
RMSE (days)	5	6	7

End of Greening Season (EOS)

EOS	TOA NDVI	TOC EVI	TOC NDVI
Bias (days)	8	2	4
RMSE (days)	13	10	9

Peak of Greening Season (POS)

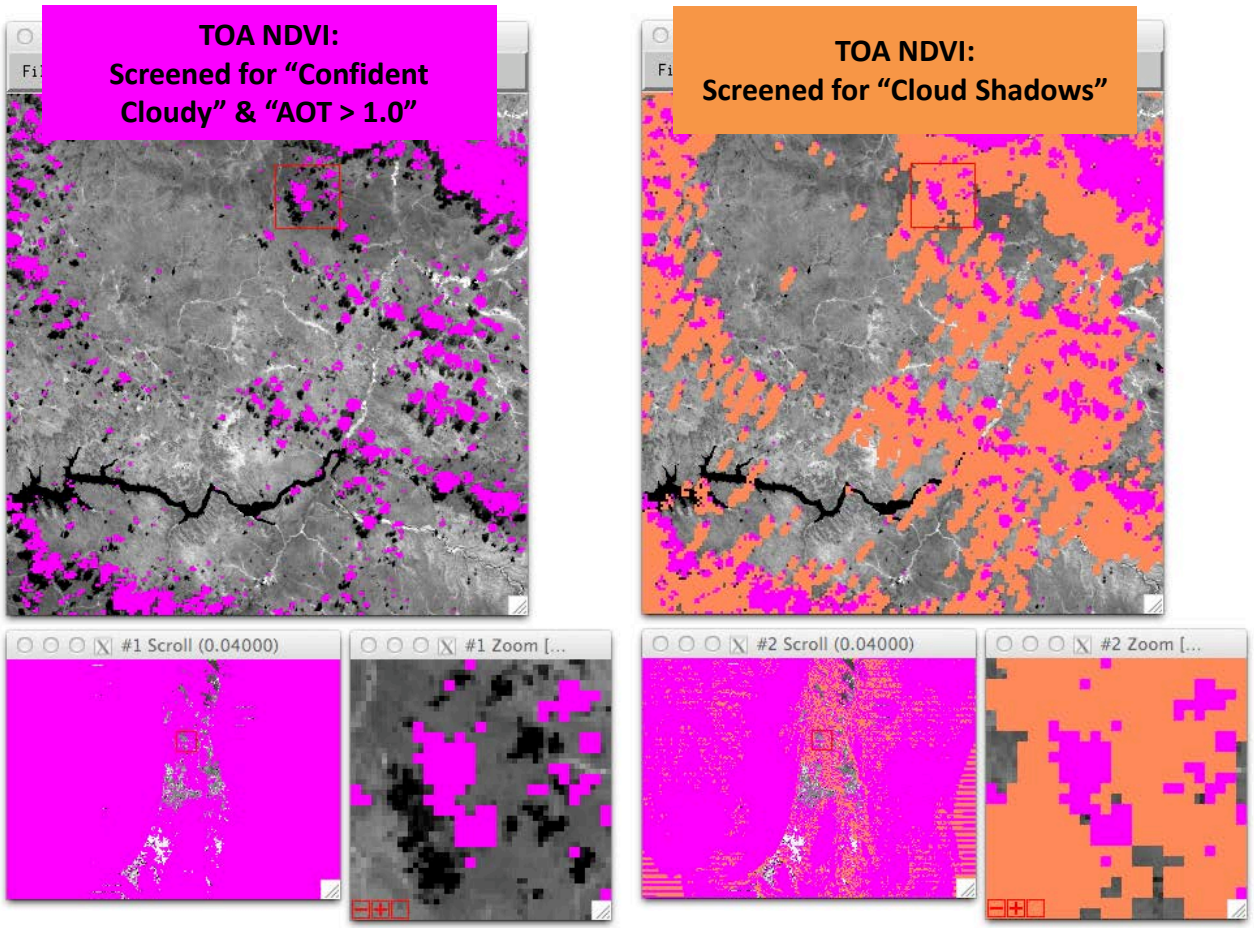
POS	TOA NDVI	TOC EVI	TOC NDVI
Bias (days)	-3	-10	-6
RMSE (days)	12	13	11

VI EDR Required Algorithm Inputs

Input	Description
Reflectance_Img	Calibrated TOA Reflectances for band I1
Reflectance_Img	Calibrated TOA Reflectances for band I2
SolZenAng_Img	Solar zenith angle at each pixel from VIIRS SDR IMG geolocation structure
VIIRS Surface Reflectance IP	Surface Reflectance (TOC) for band I1
VIIRS Surface Reflectance IP	Surface Reflectance (TOC) for band I2
VIIRS Surface Reflectance IP	Surface Reflectance (TOC) for band M3
VIIRS Surface Reflectance IP	Land Quality Flags in moderate resolution 56-bit unsigned integer array
VVI Retrieval Coefficients	Vegetation Index Coefficients for TOC EVI processing, C_1, C_2, and L

Impacts of Required Algorithm Inputs

- Apparent overcorrection of atmospheric effects
  - Missing M3 reflectances; spatial discontinuity/gaps
- Apparent overestimation of cloud shadowed areas



"Cloud shadow" QF can be used to screen shadow-affected pixels which produce faulty low NDVI or EVI values.

VI EDR Quality Flags
QF1 (Byte 0) Quality Flag Structure

Byte	VIIRS VI Flag	Result	Bits
0	Overall NDVI Quality	1 = High 0 = Low NOTE: NDVI quality is set to high (1) if ALL of these conditions are met: 1) I1 TOA reflectance flag = avail 2) I2 TOA reflectance flag = avail 3) Cloud Confidence flag = confidently clear 4) Thin Cirrus flag = no thin cirrus 5) Solar Zenith Angle < 65 deg 6) Sun glint (Geometry based) = none	1
	Overall EVI Quality	1 = High 0 = Low NOTE: EVI quality is set to high (1) if ALL of these conditions are met: 1) I1 Surface reflectance flag = avail 2) I2 Surface reflectance flag = avail 3) M3 Surface reflectance flag = avail 4) Cloud Confidence flag = confidently clear 5) Thin Cirrus flag = no thin cirrus 6) Solar Zenith Angle < 65 deg 7) Sun glint (Geometry based) = none 8) EVI range flag = in range	1
	I1 TOA Reflectance	1 = Not Available 0 = Available	1
	I2 TOA Reflectance	1 = Not Available 0 = Available	1
	I1 Surface Reflectance	1 = Not Available 0 = Available	1
	I2 Surface Reflectance	1 = Not Available 0 = Available	1
	M3 Surface Reflectance	1 = Not Available 0 = Available	1
		1 = Out of Range 0 = In Range	1

VI EDR Quality Flags
QF2 (Byte 1) Quality Flag Structure

Byte	VIIRS VI Flag	Result	Bits
1	Land/Water	101 = Coastal 011 = Sea Water 010 = Inland Water 001 = Land / No Desert 000 = Land & Desert	3
	Cloud Confidence	11 = Confidently Cloudy 10 = Probably Cloudy 01 = Probably Clear 00 = Confidently Clear	2
	Sun Glint	11 = Geometry & Wind 10 = Wind Speed Based 01 = Geometry Based 00 = None	2
	Thin Cirrus (reflective)	1 = Cloud 0 = No Cloud	1

VI EDR Quality Flags
QF3 (Byte 2) Quality Flag Structure

Byte	VIIRS VI Flag	Result	Bits
2	Stratification – Solar Zenith Angle	1 = 65 Degrees <= SZA <= 85 Degrees 0 = SZA < 65 Degrees or SZA > 85 Degrees	1
	Excl – AOT > 1.0	1 = AOT > 1.0 0 = AOT <= 1.0	1
	Excl – Solar Zenith Angle > 85 Deg	1 = SZA > 85 degrees 0 = SZA <= 85 degrees	1
	*Snow/Ice	0 = False (no) 1 = True (yes)	1
	* Adjacent to Clouds	0 = False (no) 1 = True (yes)	1
	*Aerosol Quantity	00 = Climatology 01 = Low 10 = Average 11 = High	2
	*Cloud Shadows	0 = False (no) 1 = True (yes)	1

*Four additional QFs added to the VI EDR official product on Mx8.4 build

Quality flag analysis/validation

- **Mapping of Additional QFs (DR7038)**

  The following four additional QFs were added to QF3 (implemented in Mx8.4)

  1) snow/ice
  2) adjacent clouds
  3) aerosol quantity
  4) cloud shadows

- All quality flags perform as expected with the exception of cloud shadows. See discrepancy reports submitted below:

  – DR 7537 describes cases of discontinuities in the cloud shadow results
  – DR 7538 deals with cloud shadows of excessive length
  – Both DRs were driven by concerns noted by both the Land and Cryosphere Cal/Val teams

Quality flag analysis/validation

In addition to common metadata items, VI also produces the following granule-level metadata values, which are the granule level quality flags for the VIIRS VI

Name	Value	Description
EVI Summary Quality	0 - 100	Percent of cells with high quality
TOA NDVI Summary Quality	0 - 100	Percent of cells with high quality
EVI Exclusion Summary	0 - 100	Percent of pixels with one or more EVI exclusion criteria flags
TOA NDVI Exclusion Summary	0 - 100	Percent of pixels with one or more NDVI exclusion criteria flags
No Land in Granule	0	Land in Granule
	1	No Land in Granule

Vegetation Index EDR Error Budget

Attribute Analyzed	L1RD Threshold (VI units)	Analysis/Validation Results	Error Summary
TOA NDVI Accuracy	0.05	0.005	Global comparison with Aqua MODIS (no spectral correction)
TOA NDVI Precision	0.04	0.017	Global comparison with Aqua MODIS (no spectral correction)
TOA NDVI Uncertainty	0.06	0.020	Global comparison with Aqua MODIS (no spectral correction)
TOC EVI Accuracy	0.05	0.037	Global comparison with Aqua MODIS (no spectral correction)
		0.004	Matchup data analysis (atmospheric correction error)
TOC EVI Precision	0.04	0.011	Global comparison with Aqua MODIS (no spectral correction)
		0.015	Matchup data analysis (atmospheric correction error)
TOC EVI Uncertainty	0.06	0.039	Global comparison with Aqua MODIS (no spectral correction)
		0.016	Matchup data analysis (atmospheric correction error)

Vegetation Index EDR Documentation

- The following Vegetation Index documents will be provided to the EDR Review Board:

Name	Additional information
Algorithm Theoretical Basis Document (ATBD)	The VIIRS Vegetation Index algorithm did not change since the provisional review; hence the ATBD that was valid at that review is still applicable
Operational Algorithm Description (OAD) with algorithm-related redline updates	The VIIRS Vegetation Index Operational Algorithm Description (OAD) did not change since the provisional review
Updated README file for CLASS	Summary statement for users
Product User's Guide (Recommended)	- User's guide not available for this review - Peer-reviewed publications available

Identification of Processing Environment

Item	Brief Summary
Validated 1 - IDPS Build Number and effectivity date:	Contingent on SR Validated 1 maturity (TBD)
LUT used	N/A
Version of PCT(s) used	N/A
Description of environment used to achieve Validated 1 stage	TBD

Users & User Feedback

Key User	Brief Summary
NCEP	NCEP is interested in using the VIIRS Vegetation Index products as part of a new global forecasting capability The S-NPP VI EDR is a critical upstream product for various derived variables needed by NCEP applications (Green Vegetation Fraction, Leaf Area Index). NCEP needs a consistent suite of tailored data products suitable for NCEP applications, i.e., for use in the Noah land model, an important component in the suite of NCEP weather and climate models.
Molinier Matthieu VTT Technical Research Centre of Finland	Using SNPP VIIRS VI data to extract phenology markers over Finland
Felix Kogan NESDIS/STAR	SNPP VIIRS TOA NDVI will be used as input to the SNPP VIIRS Vegetation Health system (under development)
Kevin Gallo USGS – NESDIS/STAR	- Developing a project to use SNPP VIIRS VI EDR for assessment of the areal extent and severity of hail damage - USGS is collaborating with NOAA to develop a Land Product Validation System (LPVS). LPVS is a web-based system designed to use moderate to high-resolution satellite data (including SNPP VIIRS) for validation of GOES-R ABI and JPSS VIIRS products.
CLASS	VIIRS VI EDR product archive and distribution
Doruju Ichikawa Japan Manned Space Systems Corporation	Using SNPP VIIRS VI data to develop a composite time series database for environmental monitoring in South Asia
Jess Brown USGS EROS	Developing weekly VI composites (using SNPP VIIRS) for various applications including drought monitoring

User Precautions

Known issues to date are described below:

- Cloud Shadows QF is currently known to overestimate shadow-affected areas. Use this flag with caution.
- Aerosol Quantity QF. Use this flag to identify the source of aerosol information and the degree of aerosol contamination in individual pixels.
- Cloud Adjacency QF. This flag can overestimate affected areas.
- Snow/Ice QF. Use this flag to screen pixels with suspicious EVI values over snow/ice-covered surface.
- Incremental improvements in the VIIRS VI-EDR operational product are expected as the quality of the upstream products (VCM-IP and SR-IP as well as Aerosol Optical Thickness IP) continues to improve.
- TOC EVI data can contain unrealistically high/low values over snow/ice covered areas at high latitudes, over clouds, and over cloud shadows.
- The quality of the VI-EDR is sensitive to the performance of the VIIRS Cloud Mask (VCM) and Surface Reflectance (SR) Intermediate Products (IPs).

Conclusion

- The VI Team recommends that the VIIRS Vegetation Index (VI) Environmental Data Record (EDR) be released to users and the public with a Validation Stage 1 maturity and with an effective date of TBD
- The VI EDR does meet the threshold attributes for a limited set of samples
- This assessment is based on both qualitative and quantitative limited set of analysis of the VIIRS VI EDR
- The VIIRS VI EDR has been compared with MODIS Vegetation Index products and with AERONET and Flux Tower observations
- The VI Team will continue monitoring the product quality and any anomalies will be investigated and resolved in a timely manner

Path Forward - Planned further improvements

- Implementation of DR7039 - TOC-EVI backup algorithm
- Implementation of DR7697 – Redefine Granule Level Summary QF and pro Pixel Overall QFs
- Implementation of DR 7041, Code change and implementation of a revised EVI equation
- Temporal compositing (weekly, 16-day, monthly), and spatial compositing (global) (DR7488)

TOC EVI Backup Algorithm Prototype

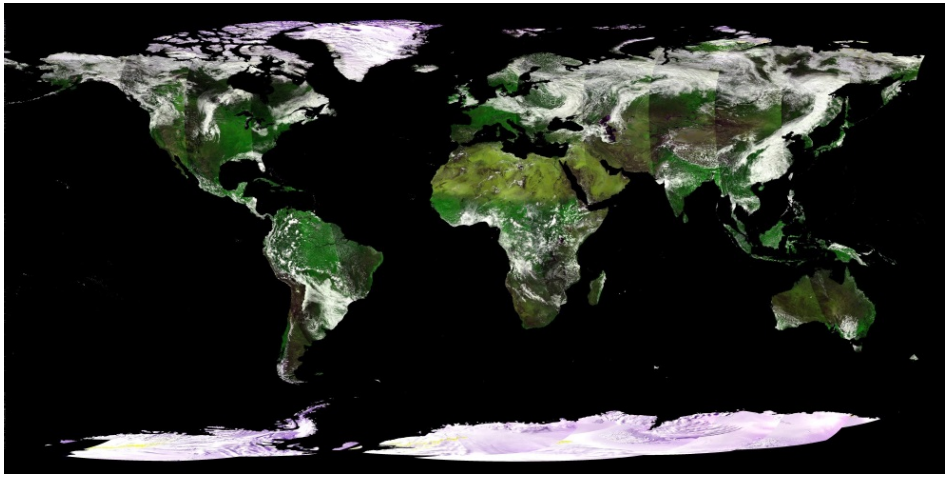
- DR 7039 - A backup algorithm for EVI over snow/ice and clouds
- TOC EVI is unstable over snow/ice and cloud edges
- An EVI backup algorithm is being prototyped based on the MODIS VI algorithm
  - It switches the EVI equation to a two-band EVI equation
- The current set of criteria (prototype) are:
  - If Confident Cloudy or Probably Cloudy or Thin cirrus or Adjacent pixels or snow or snow/ice then switch EVI to EVI2
  - If Inland water or coastal lines then switch EVI to EVI2
  - If M3>0.25 then switch EVI to EVI2
  - If M3<0.25 and M3>0.05 and I1<0.1 7 then switch EVI to EVI2
  - If M3<0.05 and I1<0.0 3 then switch EVI to EVI2

TOC EVI Backup Algorithm Prototype

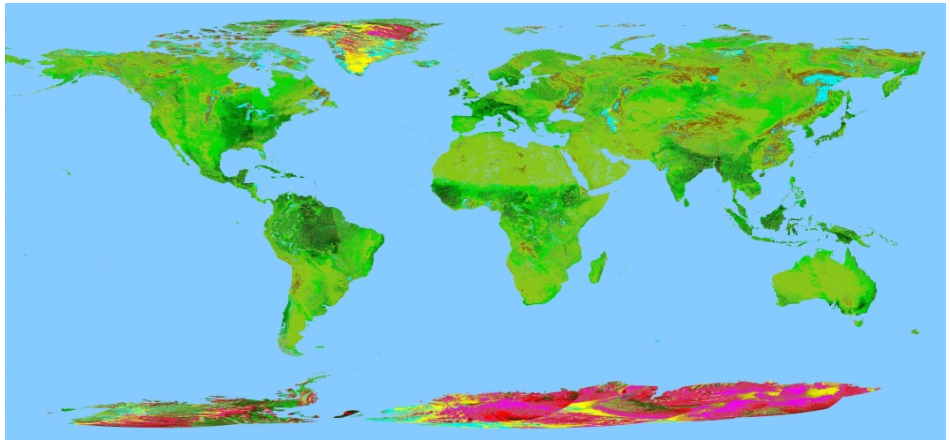
- TOC EVI values are unrealistically high/low over the snow/ice covered areas in the high northern latitude area and most of Antarctica as well as over clouds
- They become around “zero” in the backup algorithm output

VIIRS Data of Sep 23, 2013

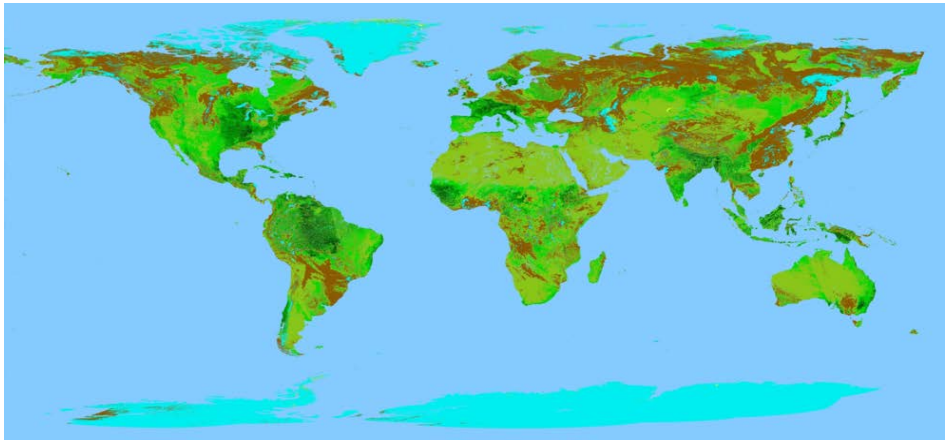
TOC Reflectance (RGB: I1, I2, M3)



TOC EVI Current Algorithm



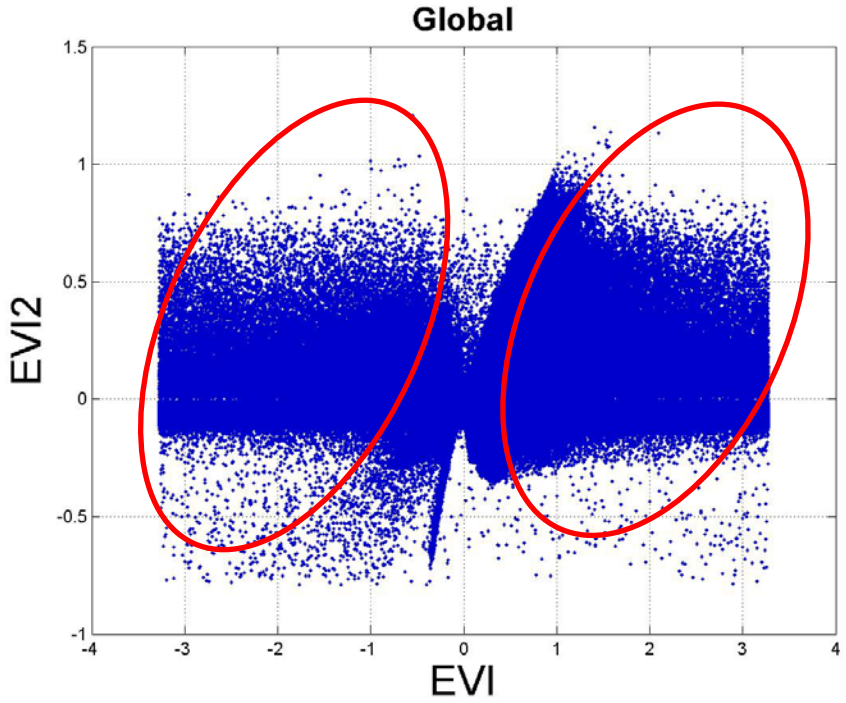
TOC EVI with Backup Algorithm



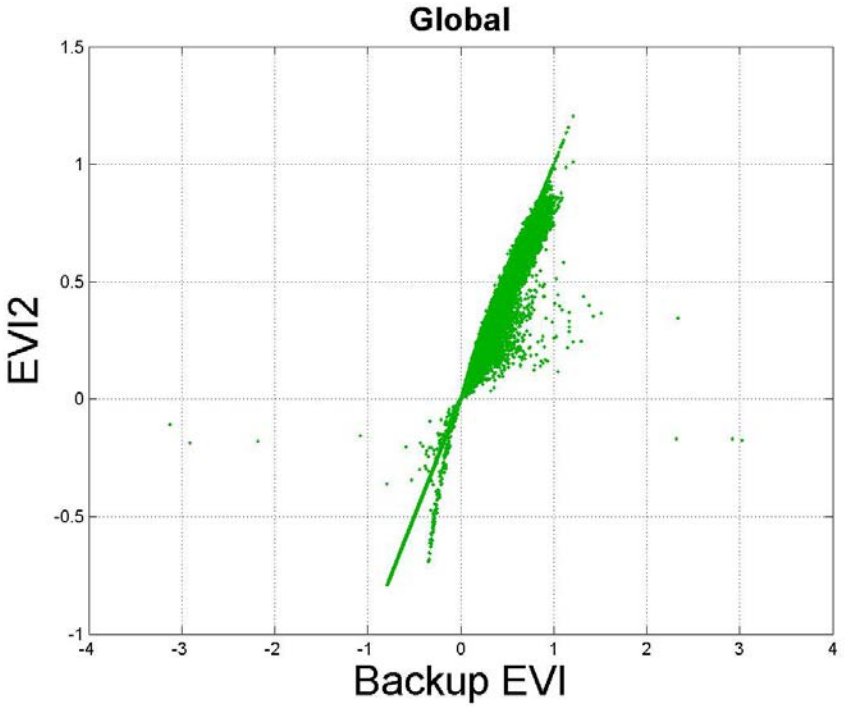
TOC EVI Backup Algorithm Prototype

- Unrealistically high/low EVI values in the current EVI algorithm output (left) are not seen in the output from the EVI backup algorithm (right)

TOC EVI Current Algorithm



TOC EVI with Backup Algorithm



Path Forward – Future Milestones

- SNPP VIIRS VI EDR Validated 2: Expected February 2015 (TBD)
- SNPP VIIRS VI EDR Validated 3: Expected February 2016 (TBD)
- Continue long term monitoring of SNPP VIIRS VI EDR
- JPSS1 TOC NDVI Test Readiness Review (TRR) in September 30, 2014
- JPSS1 TOC NDVI Algorithm Change Package delivered to DPES in January 2015
- JPSS1 TOC NDVI DPES delivers to Raytheon – 02/25/2015
- JPSS1 TOC NDVI Ready for ARC – 3/16/15
- JPSS TOC NDVI Algorithm Readiness Review – 03/2015
- Begin JPSS1 validation planning

Backup Slides

Backup: JPSS-1 Product Maturity Definition

JPSS/GOES-R Data Product Validation Maturity Stages – COMMON DEFINITIONS (Nominal Mission)
1. Beta o Product is minimally validated, and may still contain significant identified and unidentified errors. o Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose. o Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists.
2. Provisional o Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts. o Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose. o Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists. o Product is recommended for operational use (user decision) and in scientific publications.
3. Validated o Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal). o Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level. o Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose. o Product is ready for operational use based on documented validation findings and user feedback. o Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.