Validated Maturity Science Review For VIIRS-VH

Presented by Felix Kogan

Contributed by Wei Guo

Date: 10/18/2016

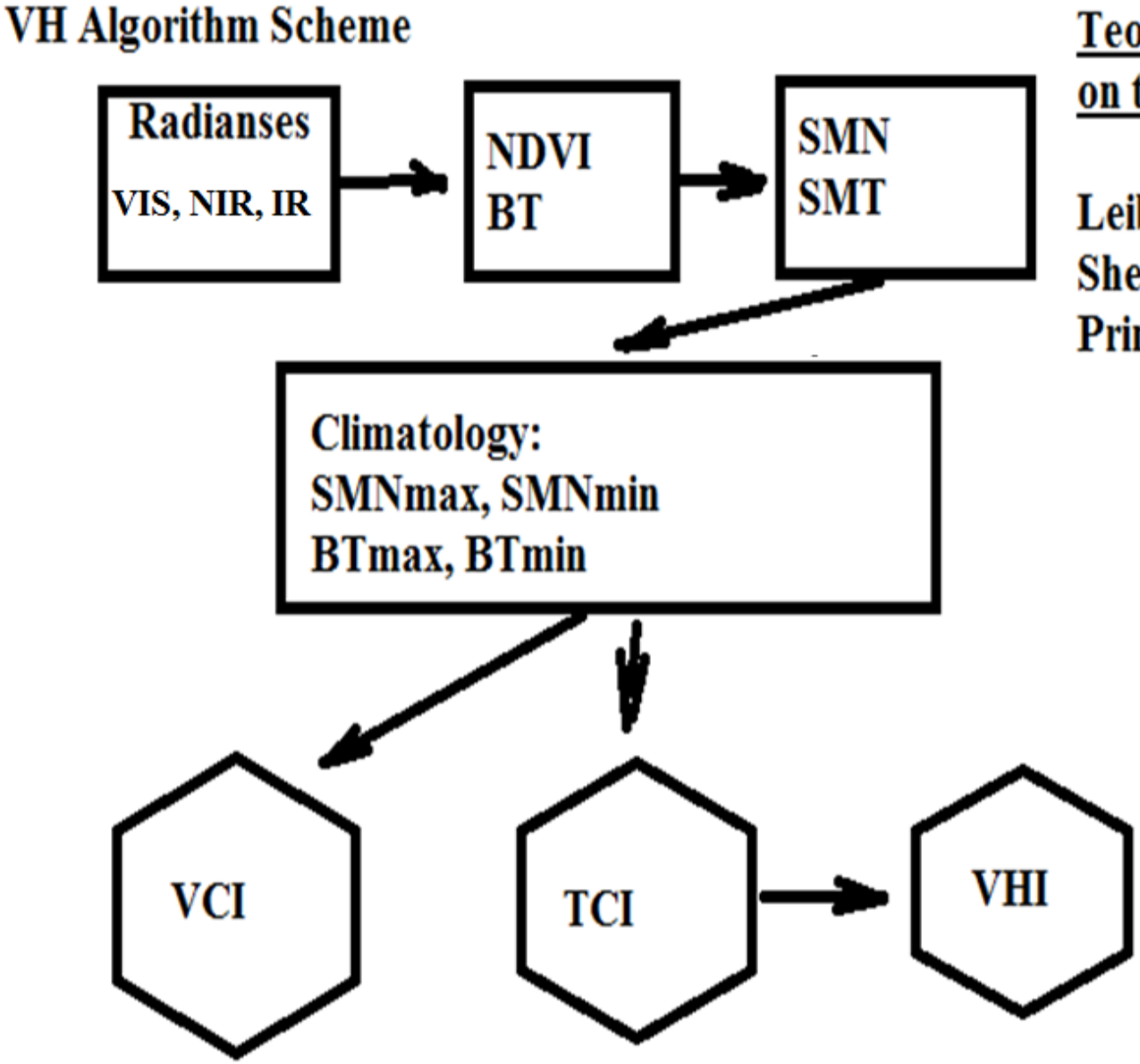
Outline

- 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
- Identification of Processing Environment
- Users & User Feedback
- Documentations (Science Maturity Check List)
- Conclusion
- Path Forward

Algorithm Cal/Val Team Members

Name	Organization	Major Task
Felix Kogan	NESDIS/STAR	Leader; Evaluating the validation result
Wei Guo	IMSG	Data collection, processing and analysis

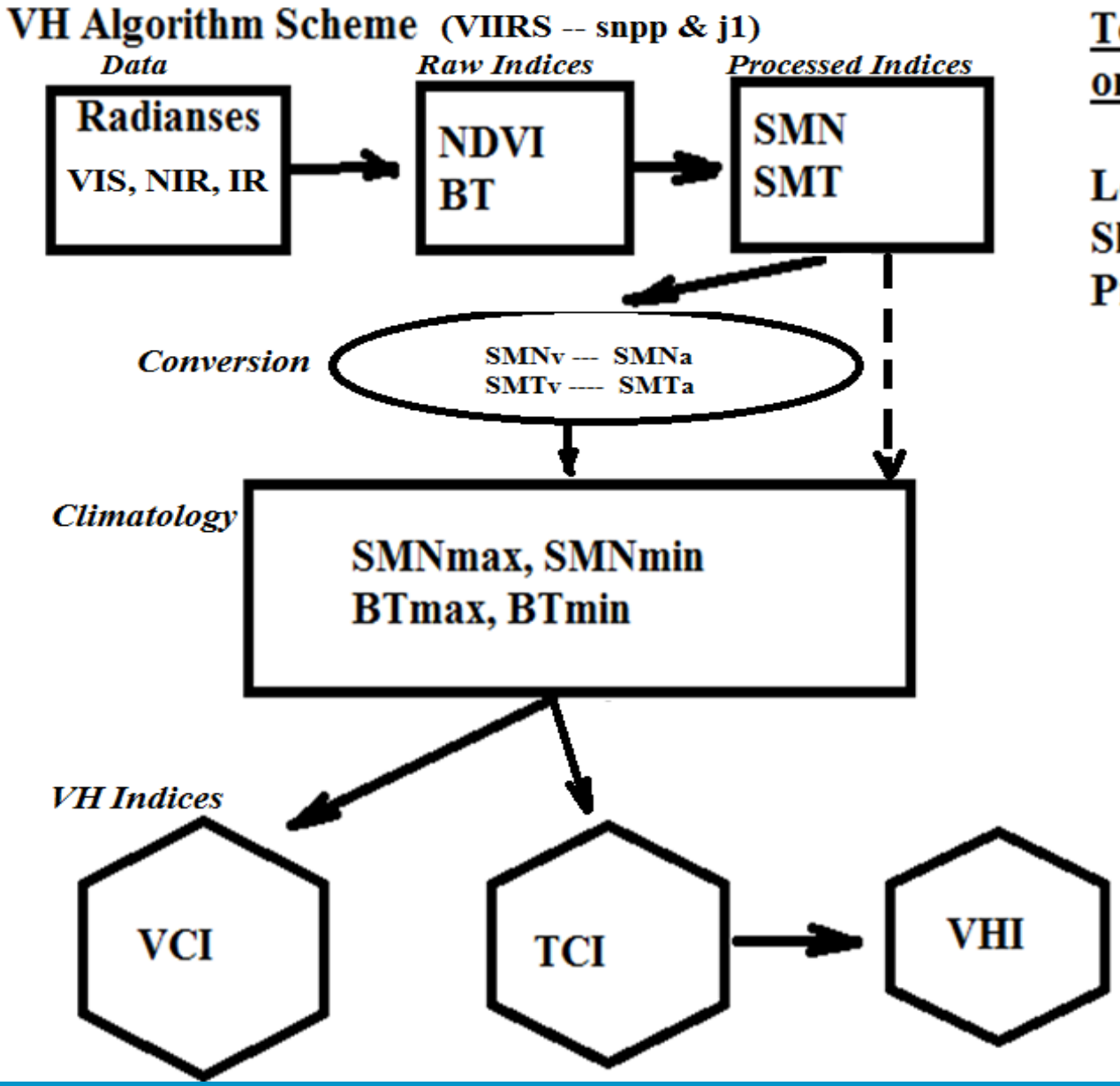
Vegetation Health (VH) Algorithm



Teoretical Basis is founded on three biophysical LAWS

Leibig Law-of-Minimum
Shefield Law-of-Tolerance
Principle of Carrying Capacity

VH Algorithm for SNPP and J1 components



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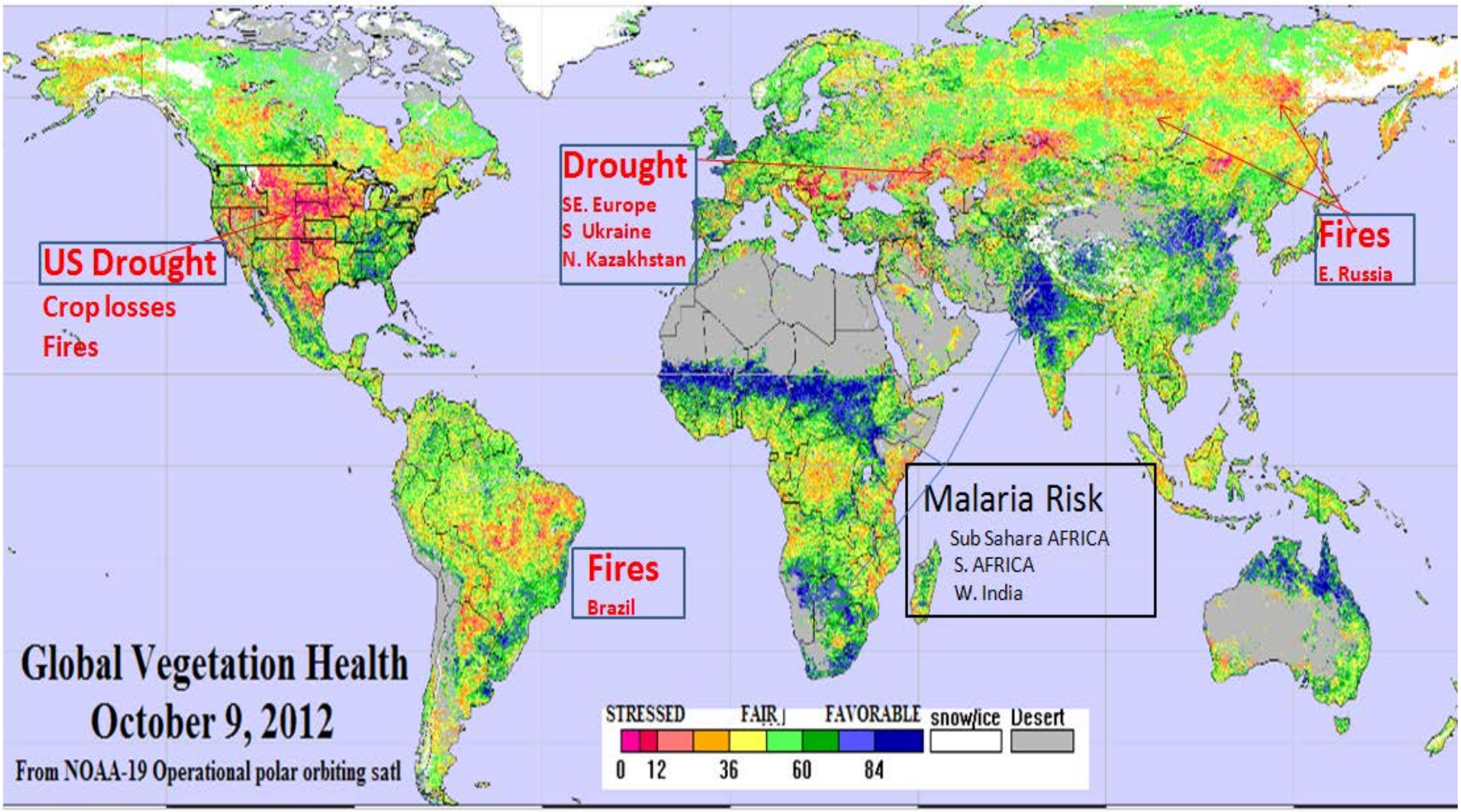
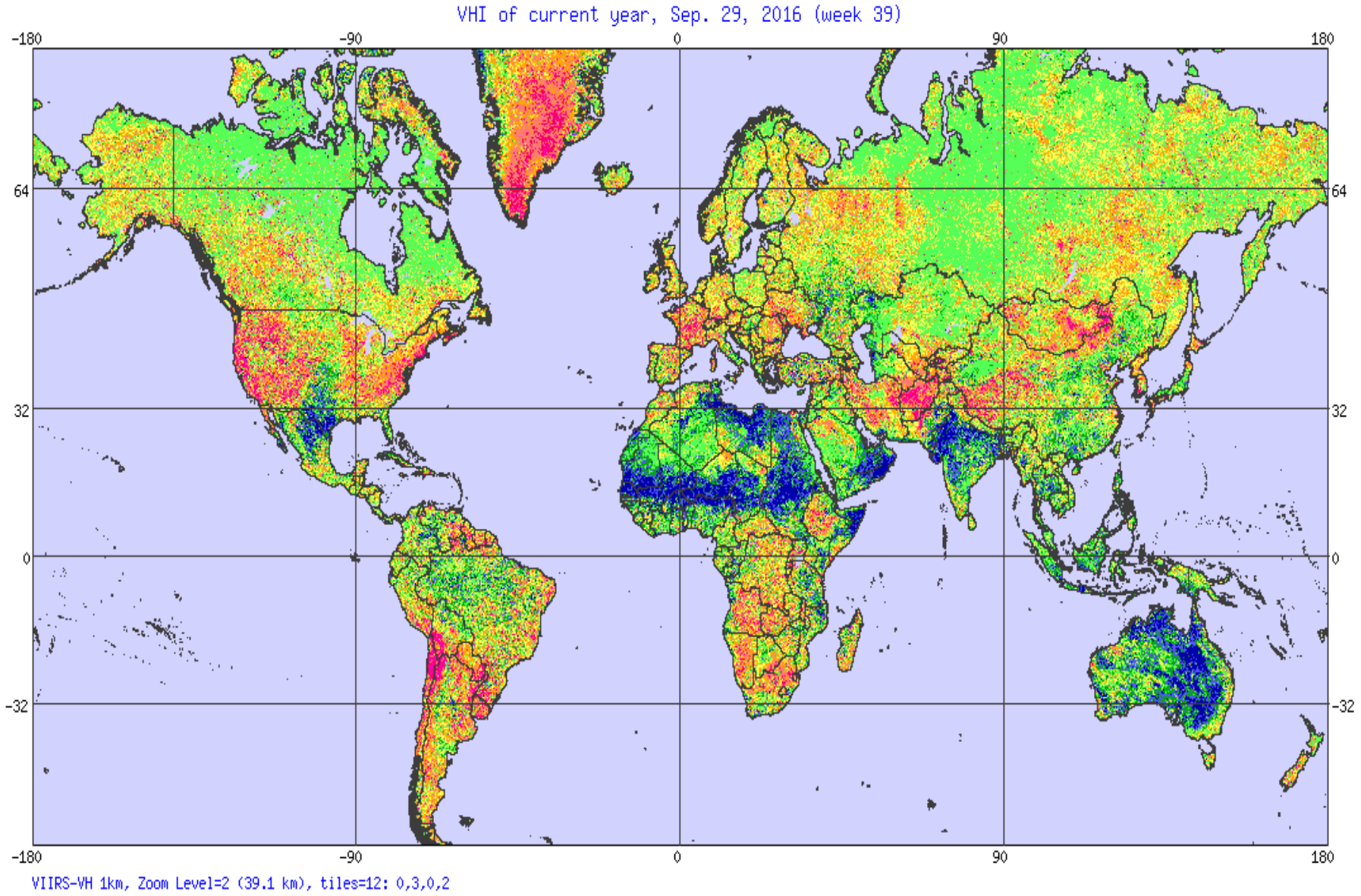
Vegetation Health Index & applications, Oct 9, 2012



http://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php

SNPP-VIIRS Vegetation Health Index, 1 km, Sep29, 2016



Requirements

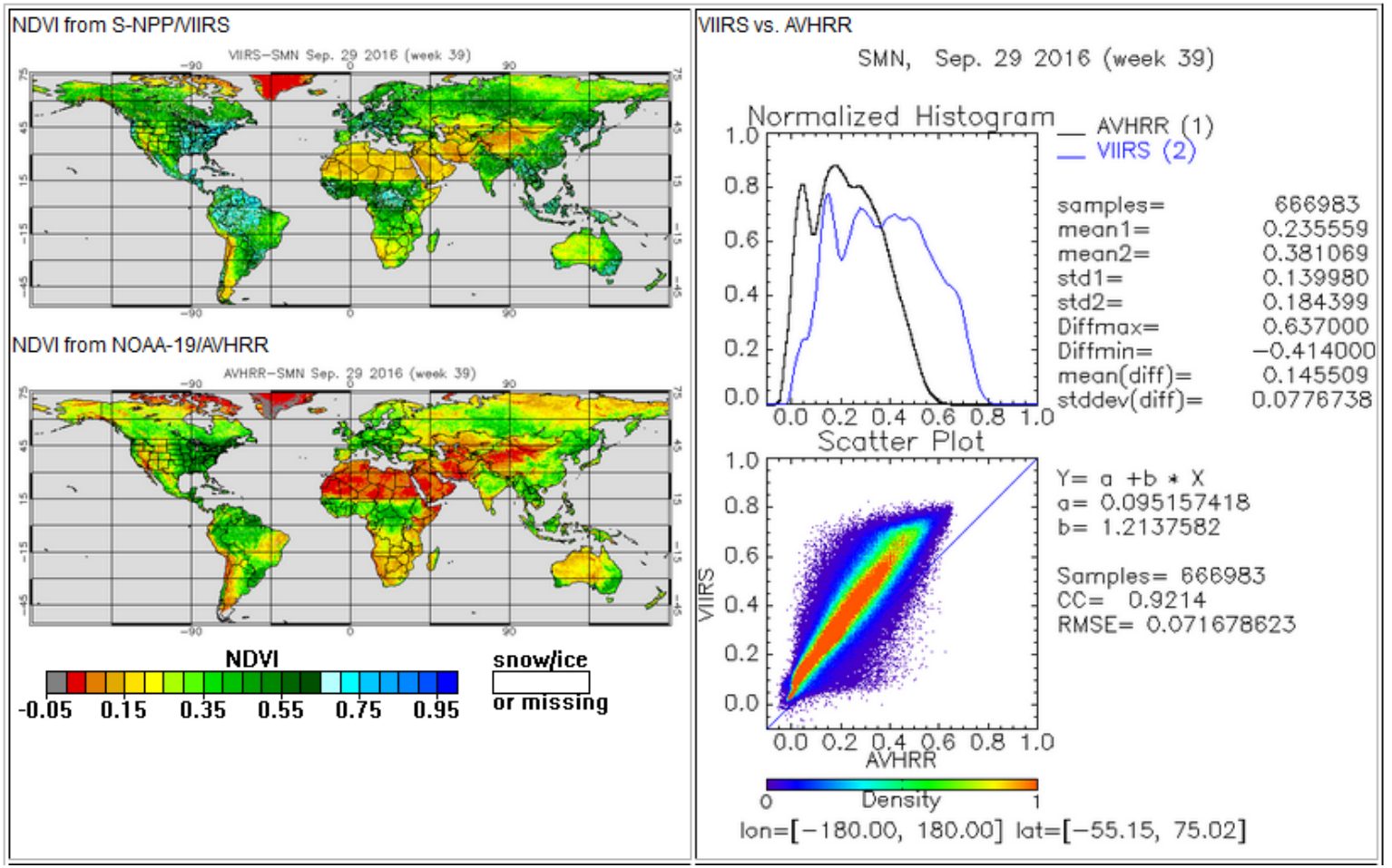
- Product performance requirements from JPSS L1RD supplement (threshold) versus observed/validated

EDR Attributes	JPSS L1RD	Veg. Health Product System
Horizontal Cell Size	Threshold – 0.036º (4km) Objective – 0.018º, 0.009º (2 and 1 km)	Threshold – 0.036º (4km) Objective – 0.018º, 0.009º (2 and 1 km)
Vertical Reporting Interval	NS	NS
Mapping Uncertainty, 3 sigma	Threshold – <0.036º (4km) Objective – <0.018º, <0.009º , <0.0045º	Threshold – <0.036º (4km) Objective – <0.018º, <0.009º , <0.0045º
Measurement Precision	Threshold – 4.0% (For the range 0-100%) Objective – NS	Threshold – 4.0% (For the range 0-100%) Objective – NS
Measurement Accuracy	Threshold – 1.0% Objective – NS	Threshold – 1.0% Objective – NS
Refresh	Threshold – Every 7 day period Objective – Every 5 day period	Threshold – Every 7 day period Objective – Every 5 day period

Evaluation of algorithm performance to specification requirements

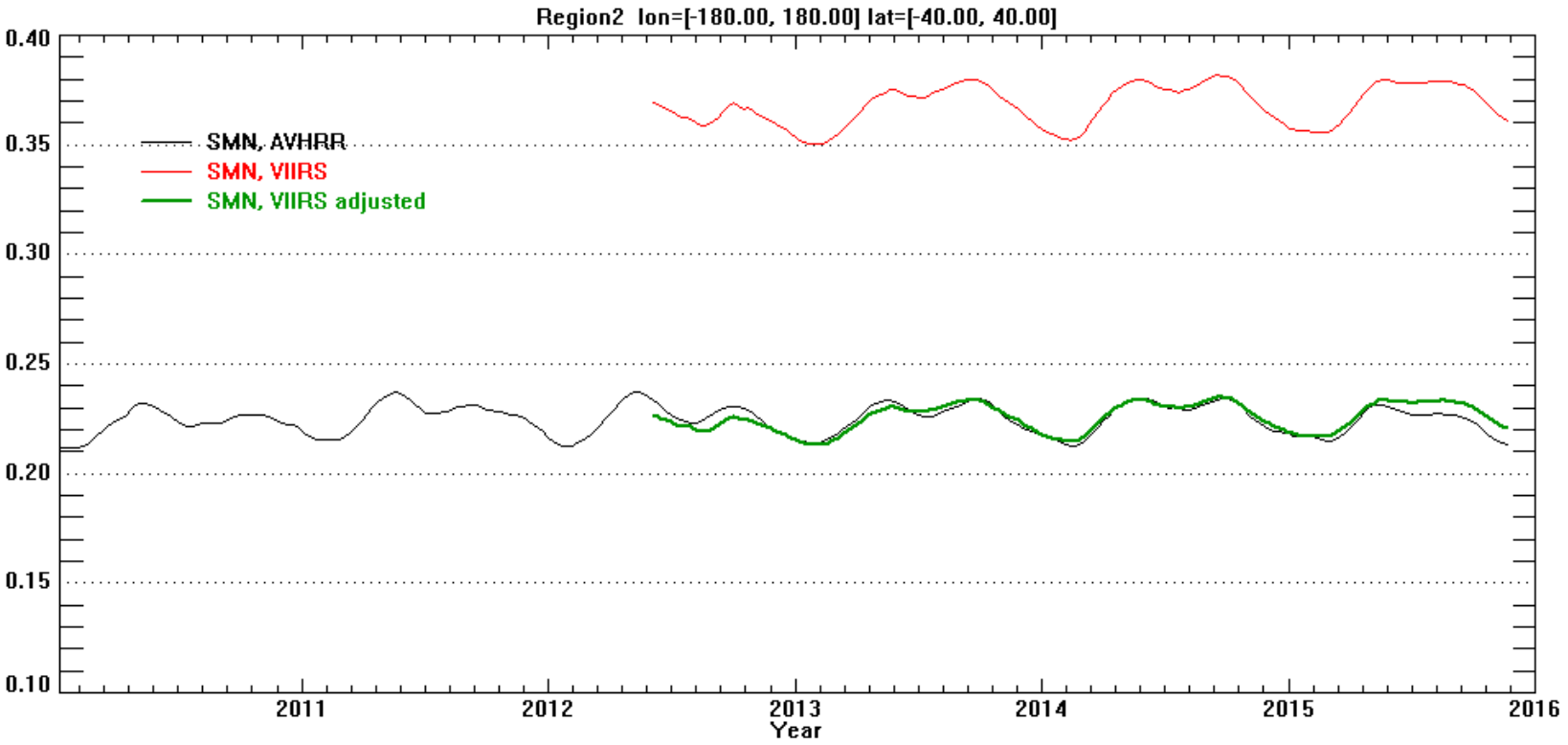
- Improvements since Algorithm Readiness Review (ARR, Provisional)
  - **Algorithm Improvements**
    - **4 and 1 km Climatology from AVHRR (MODIS?)**
  - LUT / PCT updates
    - Regression coefficient 2.0 (using 3 years' data)
- **Cal/Val Activities for evaluating algorithm performance:**
  - **Comparison with other algorithms**
  - **Comparison with *in situ* data**
  - **Validation strategy/method**
    - **Correlation and regression analysis**
    - **Time series analysis**
    - **Comparison of VIIRS VH with other similar products**
    - **Agricultural, health and economic data**
    - **Users response**

ADJUST: Comparison of SMN from VIIRS and AVHRR



The SMN from VIIRS and AVHRR are not on the same level. Adjustment is required to make the long term time series aligned.

ADJUST: Time series of SMN from VIIRS and AVHRR



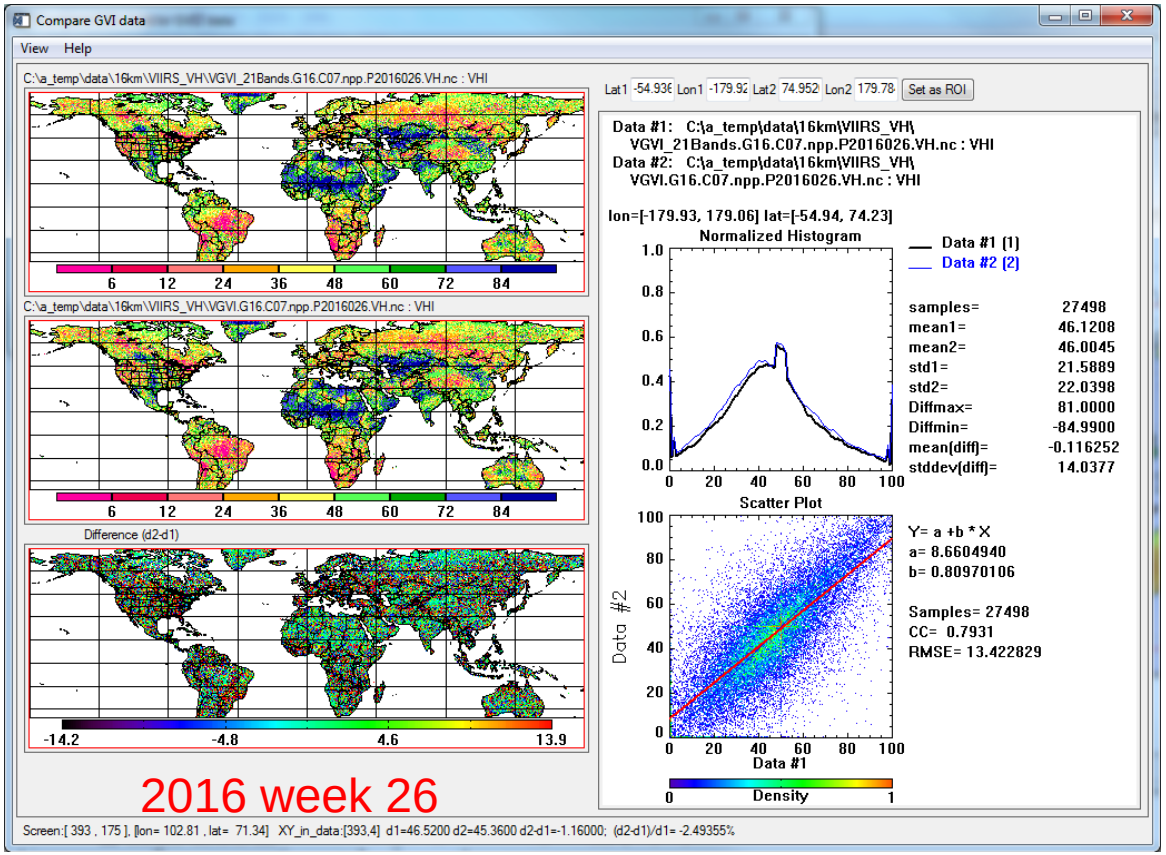
The SMN from VIIRS and AVHRR are not on the same level. Adjustment is required to make the long term time series aligned.

VALID: Comparison on VHI from VIIRS, 4km vs. 500m

VIIRS 4km VH product is an operational product running at OSPO.

VHI from 4km dataset

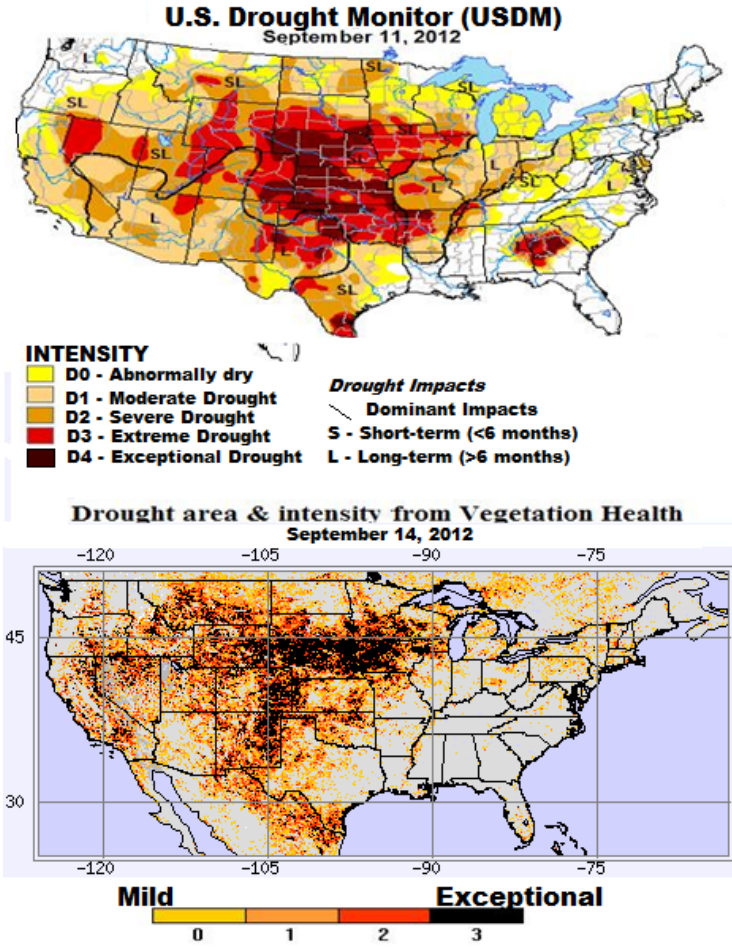
VHI from 500m dataset



Data was extracted from sampled (16km) files which were created from VIIRS 4km and 500m data sets respectively. The major difference of VIIRS 4km and 500m data sets is the high resolution climatology (using MODIS and AVHRR).

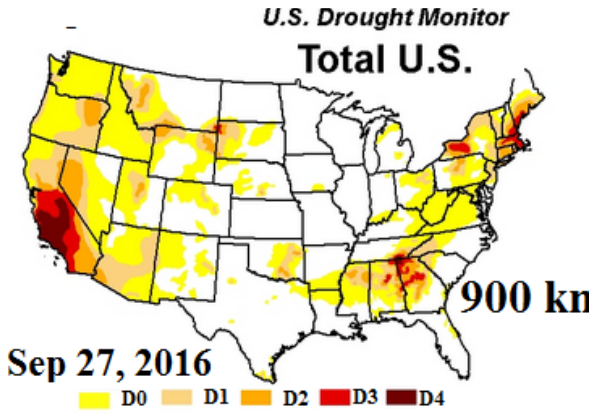
VALID: Drought USDM versus VIIRS/VHI

USDM Sep 11, 2012

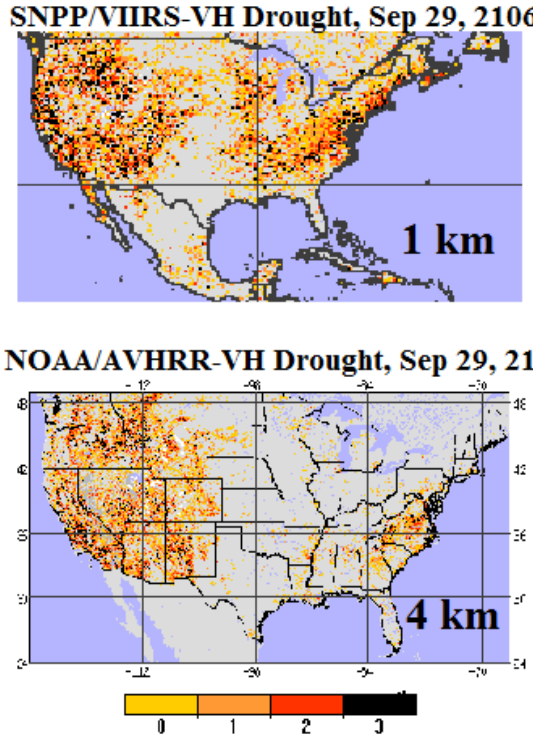


VIIRS/VHI Sep 14, 2012

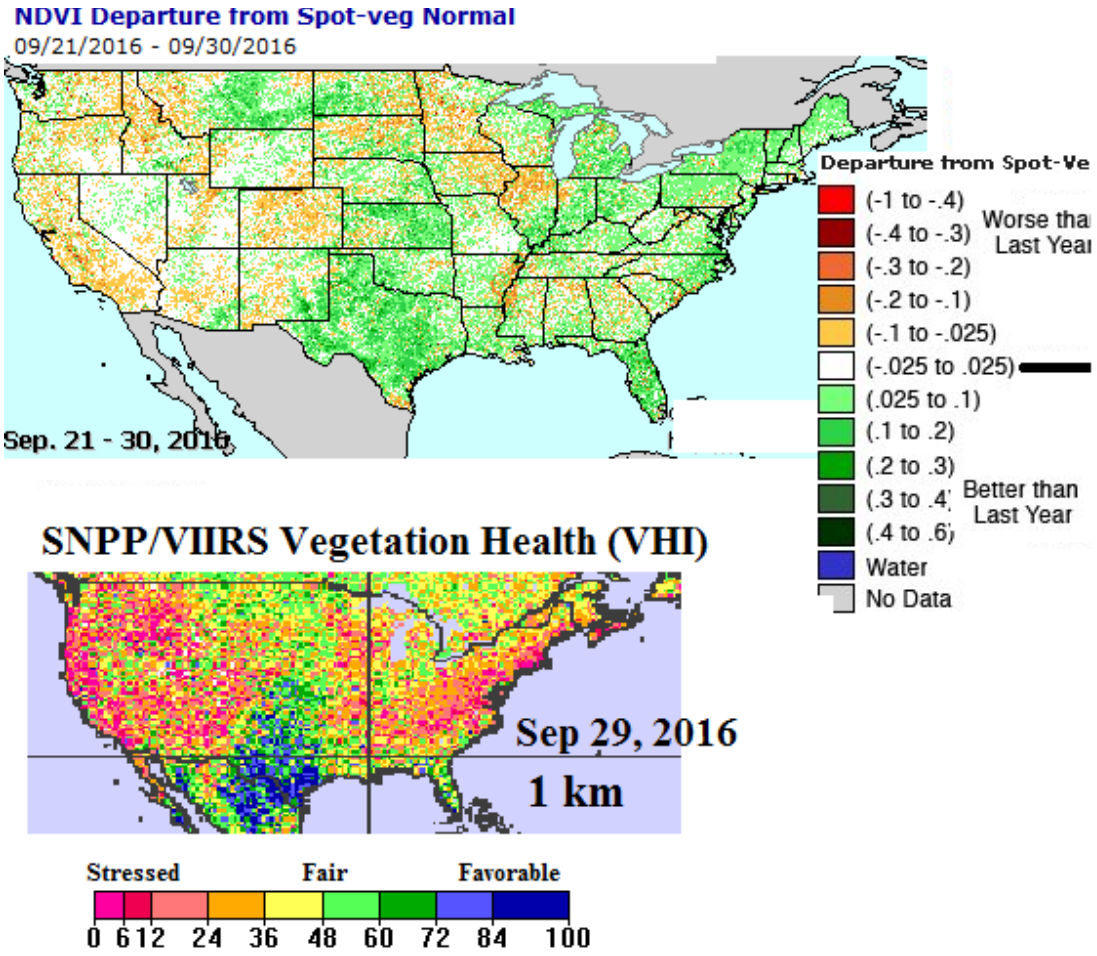
USDM



VIIRS/VHI

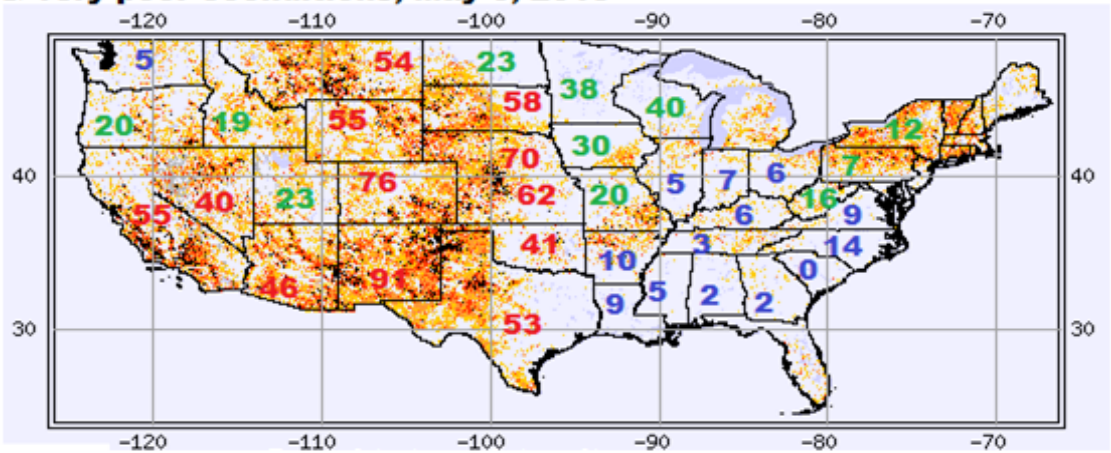


VALID: SPOT dNDVI versus VIIRS/VHI

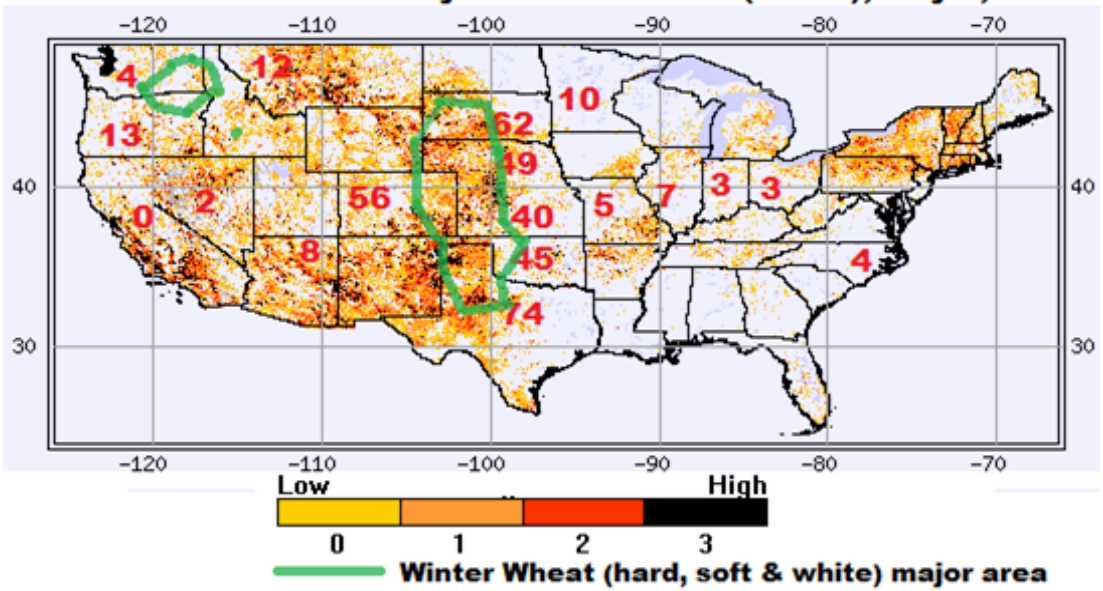


VALID: US Drought versus poor and very poor w. wheat & pasture, May 2013

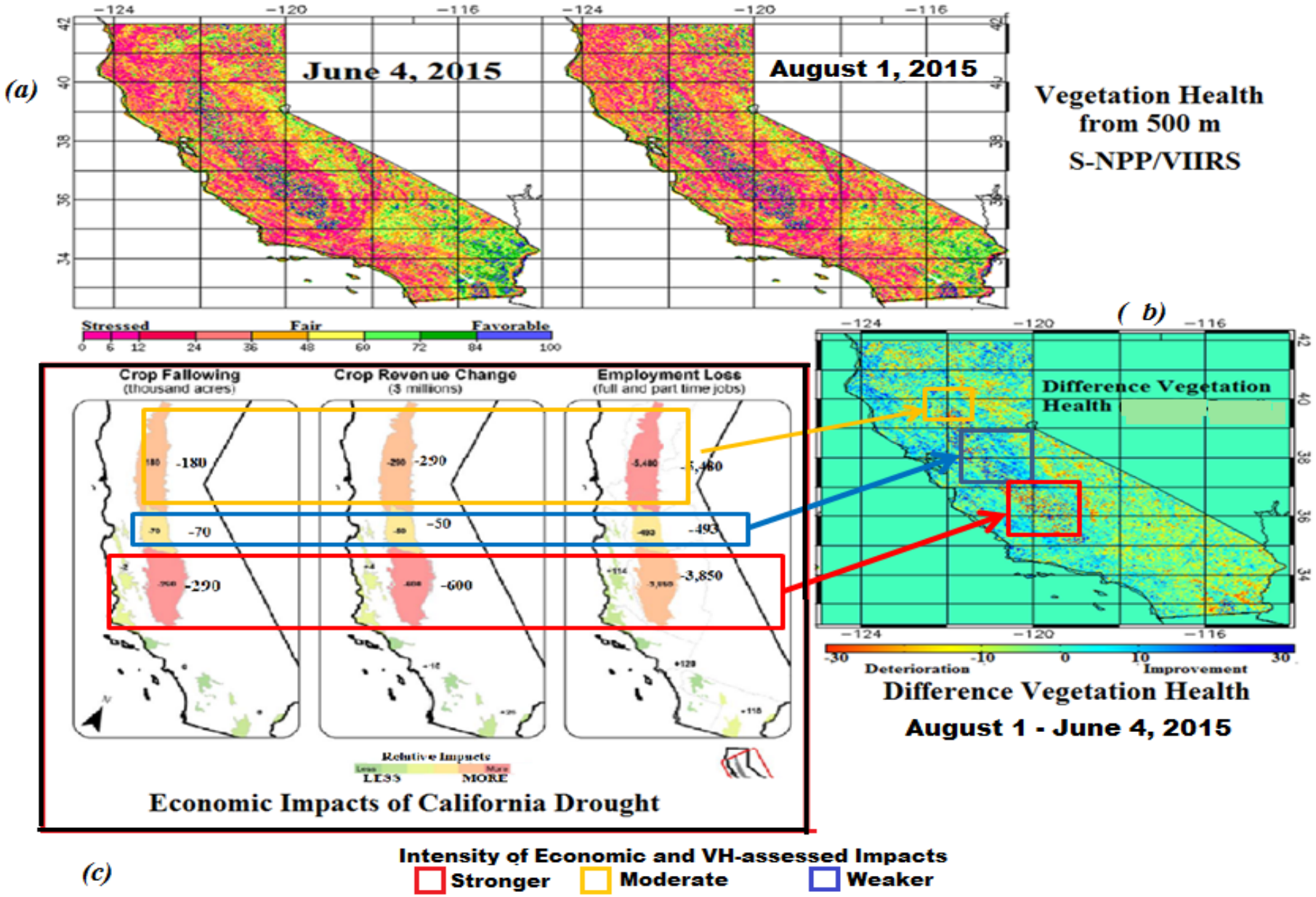
VH-based Drought Stress & % state with pasture & range land in pc & very poor coonditions, May 6, 2013



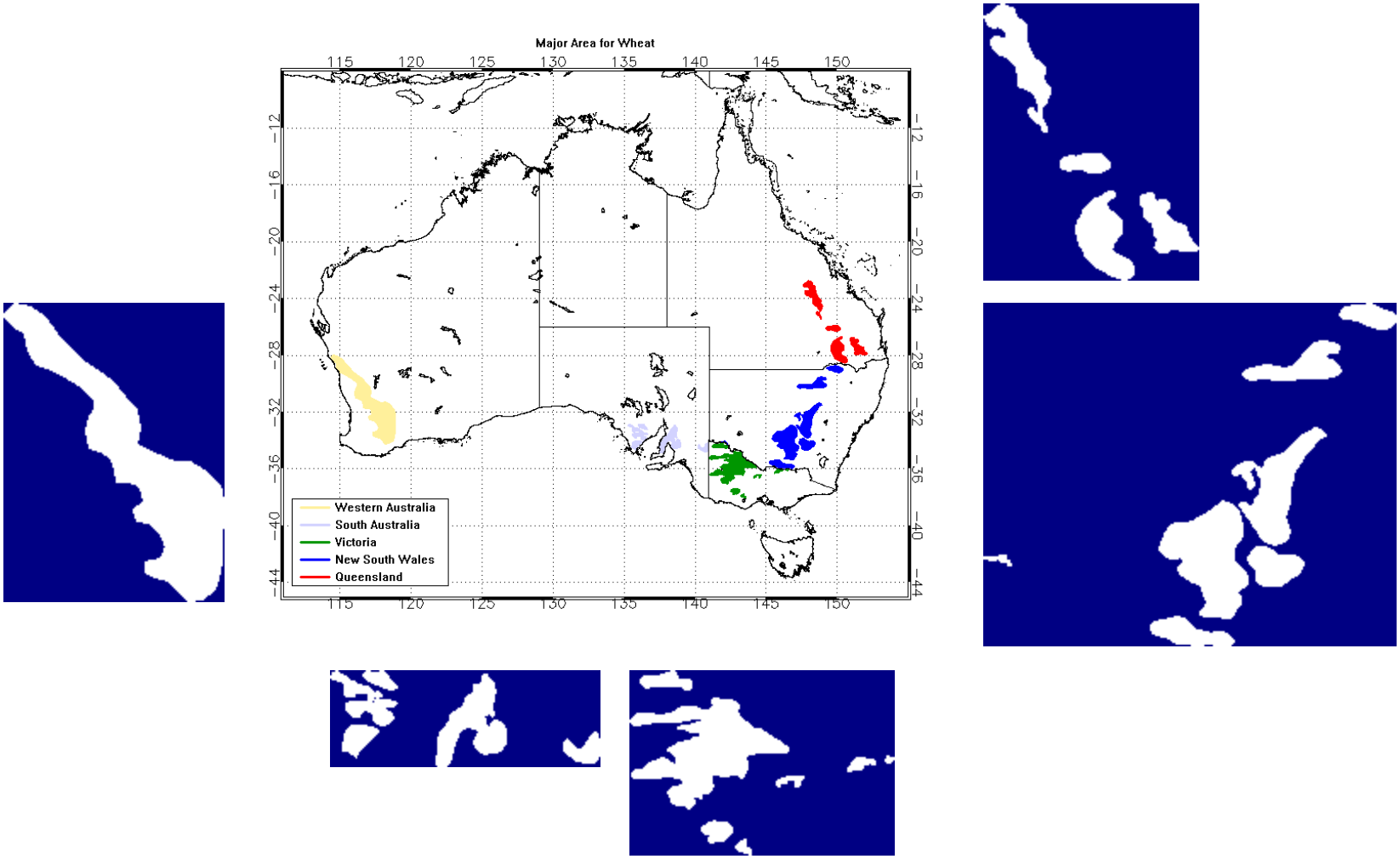
VH-based Drought Stress (NOAA), May 6, 2013 & Percent Whinter Wheat Area in Poor and Very Poor Conditions (USDA), May 5, 2013



VIIRS/VHI versus Economic Indicators, California 2015

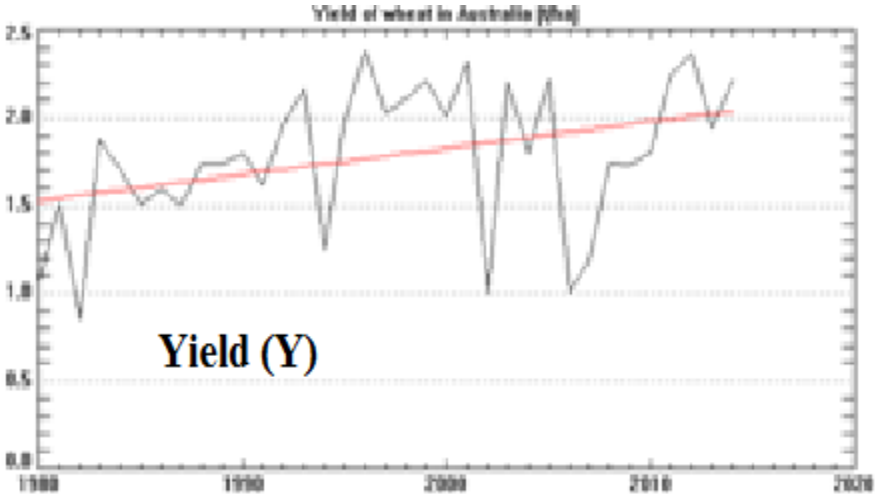


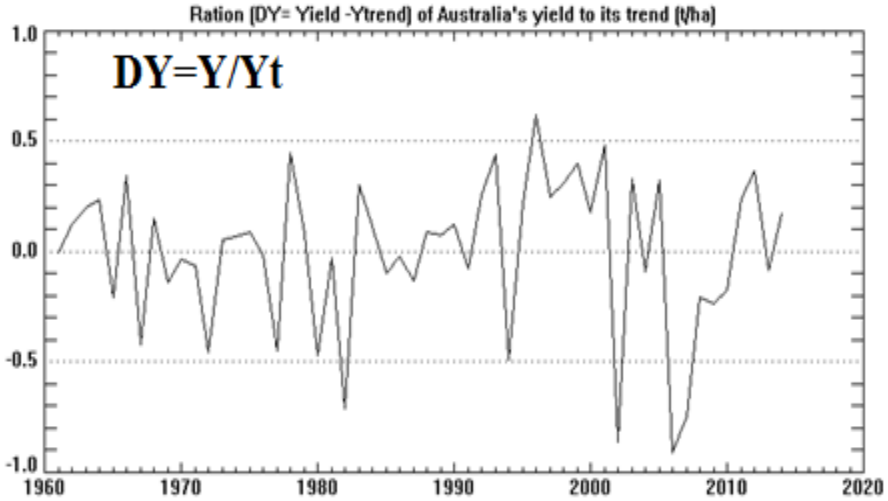
Major Wheat Area of Australia

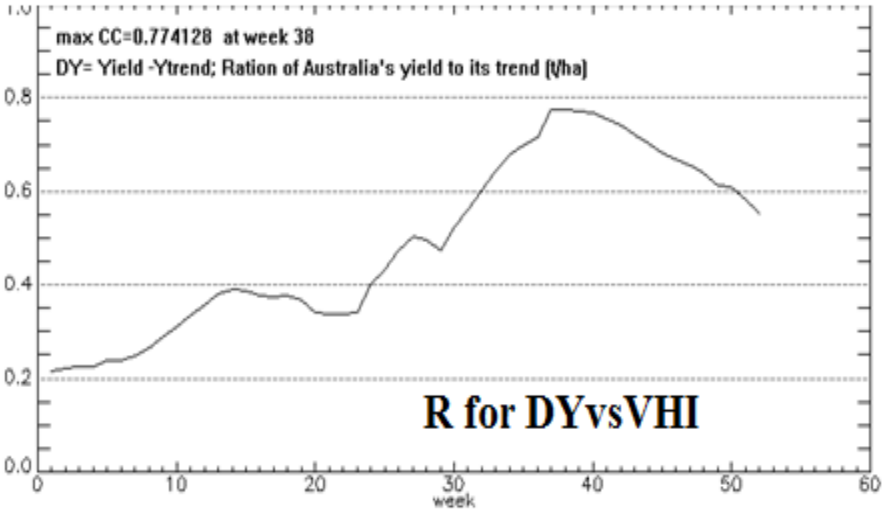


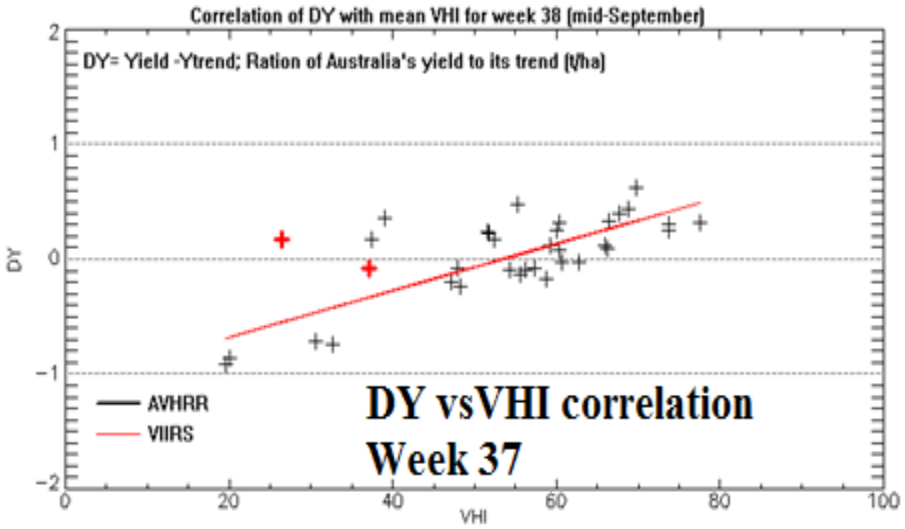
The small images with blue background are mask files generated from the polygons provided by USDA.

Yield versus VHI for Australia major wheat area 1982-2015







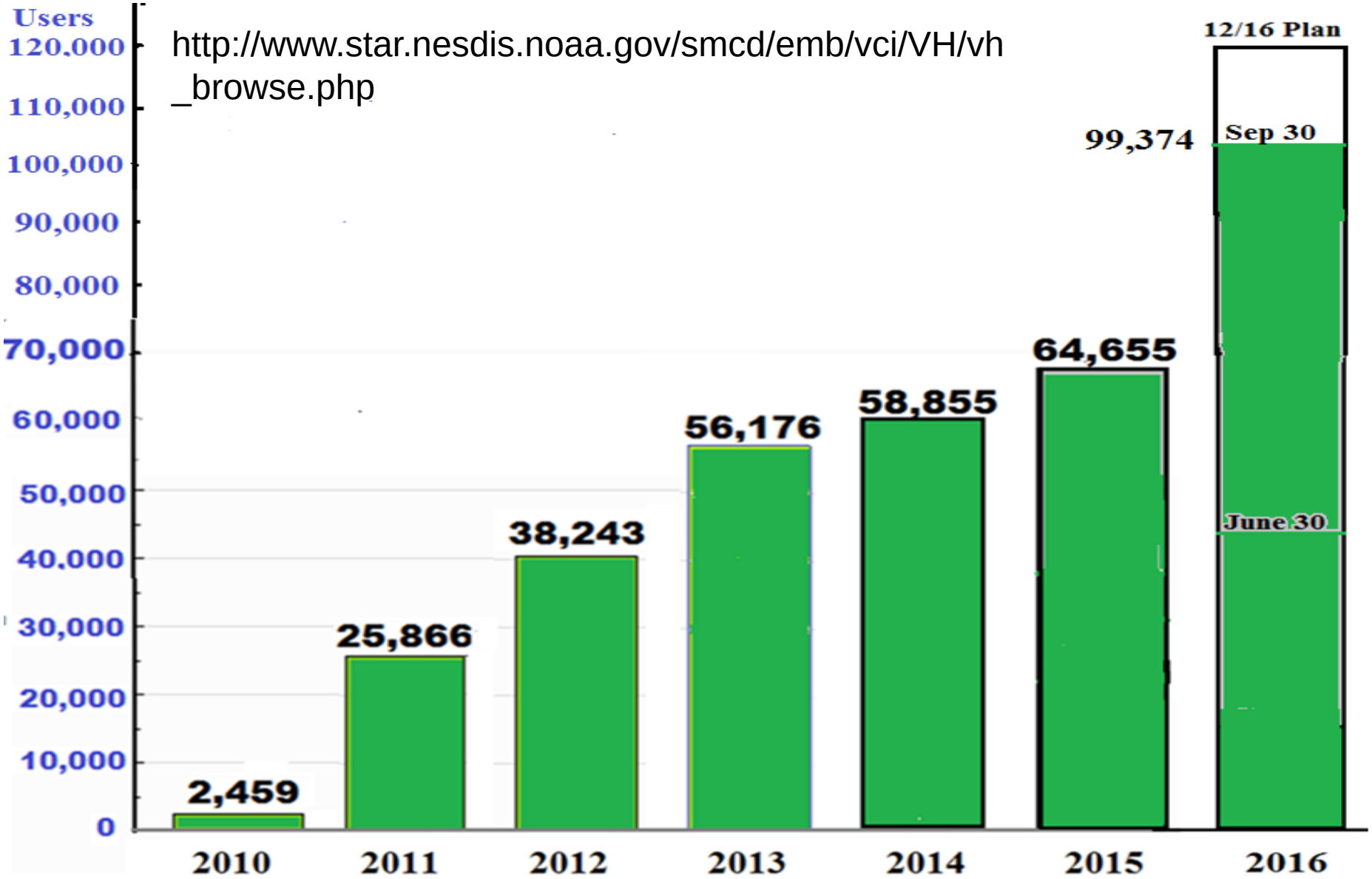


Users & User Feedback

- User list
  - USDA
  - Other users: bank, insurance company, research institute.
- Feedback from users
  - *USDS used STAR VH data in their monthly report*
- Downstream product list
  - Drought,
  - Moisture stress,
  - Thermal stress,
  - Fire risk,
  - Malaria risk
  - Vegetation health
  - Moisture condition
  - Thermal condition
  - Mosquitoes' born diseases
  - Landslides
  - Land cover changes
  - Climate warming
  - Crop/pasture condition
- Reports from downstream product teams on the dependencies and impacts
  - Pending

Number of Users for the VH WEB site

http://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh_browse.php



Evaluation of the effect of required algorithm inputs (2-5 slides)

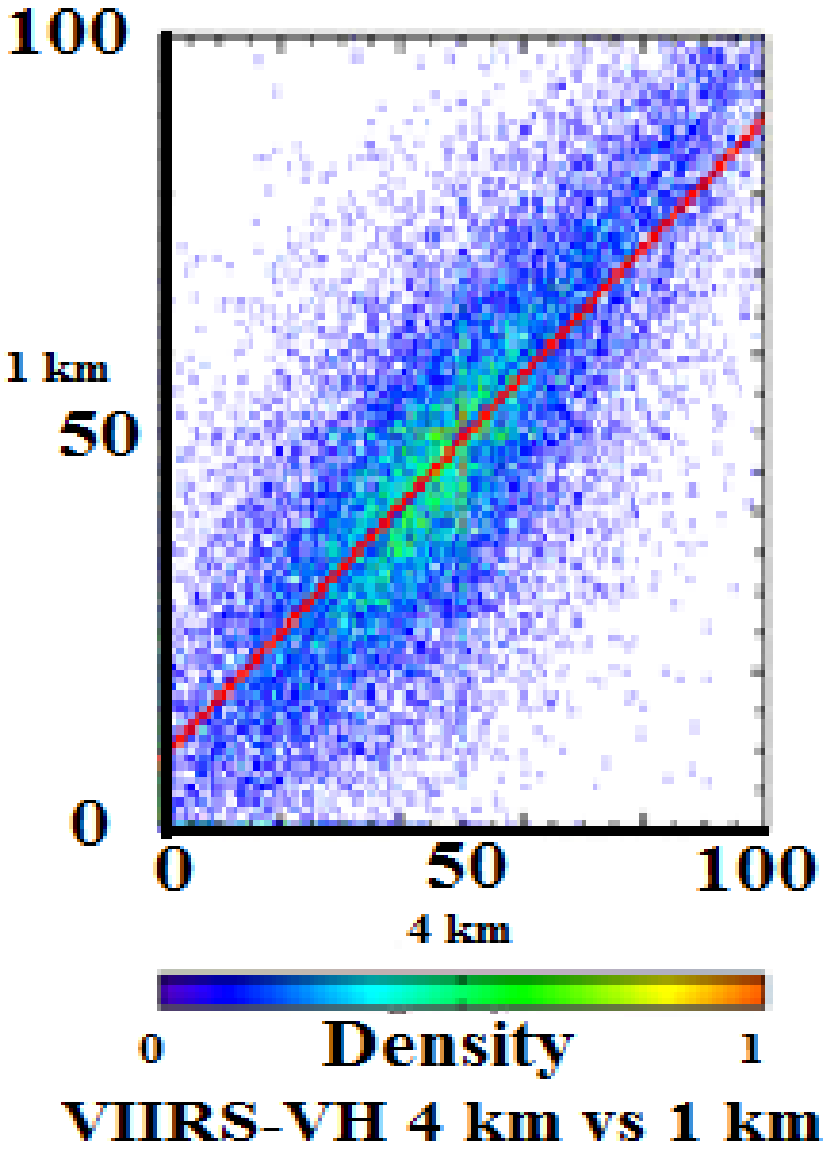
- Required Algorithm Inputs
  - Primary Sensor Data
    - VIIRS SDR I1,I2, I5, M3, cloud mask
  - Ancillary Data
    - Land types, land sea mask, snow
  - Upstream algorithms
    - NA
  - LUTs / PCTs
    - Regression coefficients between VIIRS and AVHRR SMN (SMT)
- Evaluation of the effect of required algorithm inputs
  - Study / test cases
  - Results

-- Quality flag analysis/validation (2-5 slides)

- Defined Quality Flags
  - Variable
  - Description
  - Value
- Quality flag analysis/validation
  - Test / example / ground truth data sets
  - Analysis/validation results
  - Analysis/validation plan

1. VH products will be validated by countries & admin. Regions (not by pixels)
2. Validation data: Official products, Ag. Production, crop conditions, Malaria, Similar products, Economic indicators etc.
3. No quality flags is needed.

VALID: VIIRS-VH 1 vs 4 km, June (26) 2016



Sample	27,438
CC	0.793
a	8.660
b	0.810

-- Error Budget (1 slide)

Compare analysis/validation results against requirements, present as a table. Error budget limitations should be explained. Describe prospects for overcoming error budget limitations with future improvement of the algorithm, test data, and error analysis methodology.

Attribute Analyzed	L1RD Threshold	Analysis/Validation Result	Error Summary	Support Artifacts

NO pixel validation

-- Identification of Processing

- ESPC (e.g., NDE, Okeanos) build (version) number and effective date
  - Version 1.1
  - SPSRB briefing on 7/31/2015
- Algorithm version
  - ATBD 1.0
- Version of LUTs used
  - Regression coefficient 2.0 (using 3 years' data)
- Version of PCTs used
  - Need revise this page
- Description of environment used to achieve validated maturity stage
  - Need revise this page

Documentations (Check List, 1 slide)

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Yes
Algorithm Theoretical Basis Document (ATBD)	Yes
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	Yes
System Maintenance Manual (for ESPC products)	Yes
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes
Regular Validation Reports (at least. annually) (Demonstrates long-term performance of the algorithm)	will do annually report

Path Forward

- Planned further improvements
  - Update Regression Coefficients between VIIRS SMN (SMT) and AVHRR SMN (SMT)
  - Update algorithm for VH climatology
  - Start developing VIIRS-VH climatology
  - Climate warming and VH climatology
- Planned Cal/Val activities / milestones
  - Validate by standard drought products
  - Validate by crop yield data for more locations.
  - Validate by comparing with other events
  - Validate by agricultural condition
  - Validate by users response
  - Validate by standard product
  - Validate by users' responce