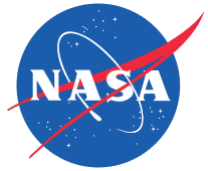


NOAA-20 VIIRS Vegetation Health Beta Maturity

August 22, 2018

VIIRS Vegetation Health Team

Felix Kogan (STAR); Wei Guo, Wenze Yang (IMSG); Hanjun Ding (OSPO)

Outline

- Vegetation Health Product Team Members
- Product Requirements
- Findings/Issues for Beta maturity
- Verification
- Documentation (Science Maturity Check List)
- Conclusions and Path Forward

Vegetation Health Product Team

- Lead: Felix Kogan (STAR)
- Backup Lead: Hanjun Ding (OSPO)
- NESDIS team:
  - STAR: Felix Kogan, Wei Guo (IMSG), Wenze Yang (IMSG)
  - OSGS: Geoffery Goodrum, Brandon Bethune
  - JPSS: Arron Layns
  - OSAAP: Kathryn Shontz
  - OSPO: Hanjun Ding, Yufeng Zhu
  - NCEI: Phil Jones
- User team
  - NWS/NCEP CPC: Contact (Matthew Rosencrans)
  - USDA WAOB: Contact (Eric Luebehusen)
- Product Oversight Panel: Land Surface POP (LSPOP)

GOALS: Follow NOAA/NESDIS Mission

- **VH supports NOAA Mission:**

  (1) Understand climate variability and change;

  (2) Serve society's needs for **weather and water** information;

  (3) **International Cooperation** and Collaboration;

  (4) Environmental Literacy, Outreach, and Education

- **Requirement(s): Develop Unique** NOAA Products
  - **Vegetation Health (VH)**

- **User community: Agriculture**, Forestry, Water, **Climate,** Health (WMO, FAO, UNESCO, USDA, USAID, Commerce), **Drought**, Moisture & Thermal stress, Weather impacts, Land surface change, **Food security**,
- **Current Mission: 1 km** Vegetation Health NOAA-20

Requirements

Veg. Health Index Suit

EDR Attributes	JPSS L1RD	Veg. Health Product System
Horizontal Cell Size	Objective – 0.009º (1 km)	Objective – **0.009º (1 km)**
Vertical Reporting Interval	NA	NA
Mapping Uncertainty, 3 sigma	Objective – <0.009º	Objective – **<0.009º**
Measurement Precision	Threshold – 2.0% (For the range 0-100%) Objective – NS	Threshold – **2.0% (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	Threshold – **Every 7 day period**

Principle

- **Matching Cannels, Indices & Products with Other Satellites (SNPP/VIIRS, NOAA/AVHRR, MODIS)**
- Matching with *in situ* Records (P, T, SST, Soil moisture, Crop/pasture, Forestry
- Preparation for NOAA-21
- Continuity of VH Data Records
- New Development (0.5 km, climatology)
- Advanced Products

Primary VIIRS bands used for blended AVHRR – like vegetation health algorithms

VIIRS			MODIS Equivalent			AVHRR-3 Equivalent			OLS Equivalent		
Band	Range (um)	HSR (m)	Band	Range	HSR	Band	Range	HSR	Band	Range	HSR
DNB	0.500 - 0.900								HRD PMT	0.580 - 0.910 0.510 - 0.860	550 2700
M1	0.402 - 0.422	750	8	0.405 - 0.420	1000						
M2	0.436 - 0.454	750	9	0.438 - 0.448	1000						
M3	0.478 - 0.498	750	3 10	0.459 - 0.479 0.483 - 0.493	500 1000						
M4	0.545 - 0.565	750	4 12	0.545 - 0.565 0.546 - 0.556	500 1000						
I1	0.600 - 0.680	375	1	0.620 - 0.670	250	1	0.572 - 0.703	1100			
M5	0.662 - 0.682	750	13 14	0.662 - 0.672 0.673 - 0.683	1000 1000	1	0.572 - 0.703	1100			
M6	0.739 - 0.754	750	15	0.743 - 0.753	1000						
I2	0.846 - 0.885	375	2	0.841 - 0.876	250	2	0.720 - 1.000	1100			
M7	0.846 - 0.885	750	16	0.862 - 0.877	1000	2	0.720 - 1.000	1100			
M8	1.230 - 1.250	750	5	SAME	500						
M9	1.371 - 1.386	750	26	1.360 - 1.390	1000						
I3	1.580 - 1.640	375	6	1.628 - 1.652	500						
M10	1.580 - 1.640	750	6	1.628 - 1.652	500	3					
M11	2.225 - 2.275	750	7	2.105 - 2.155	500						
I4	3.550 - 3.930	375	20	3.660 - 3.840	1000	3					
M12	3.660 - 3.840	750	20	SAME	1000	3					
M13	3.973 - 4.128	750	21 22 23	3.929 - 3.989 3.929 - 3.989 4.020 - 4.080	1000 1000 1000						
M14	8.400 - 8.700	750	29	SAME	1000						
M15	10.263 - 11.263	750	31	10.780 - 11.280	1000	4	10.300 - 11.300	1100			
I5	10.500 - 12.400	375	31 32	10.780 - 11.280 11.770 - 12.270	1000 1000	4 5	10.300 - 11.300 11.500 - 12.500	1100 1100	HRD	10.300 - 12.900	550
M16	11.538 - 12.488	750	32	11.770 - 12.270	1000	5	11.500 - 12.500	1100			

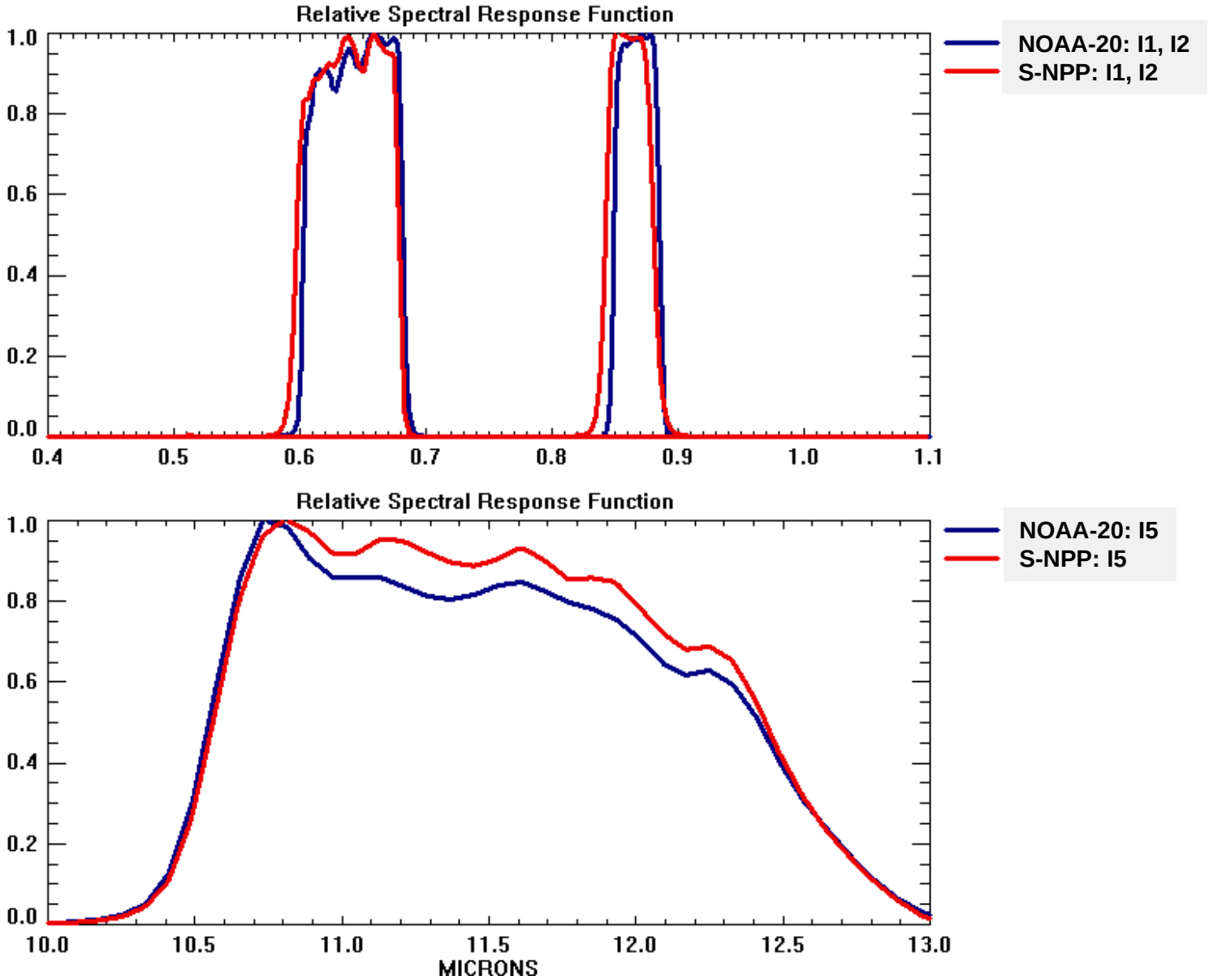
I-band: 375m resolution
low 4 µm (I4) saturation
poor signal for FRP

Evaluation methodology

For Beta evaluation the operational Suomi NPP product is used as reference

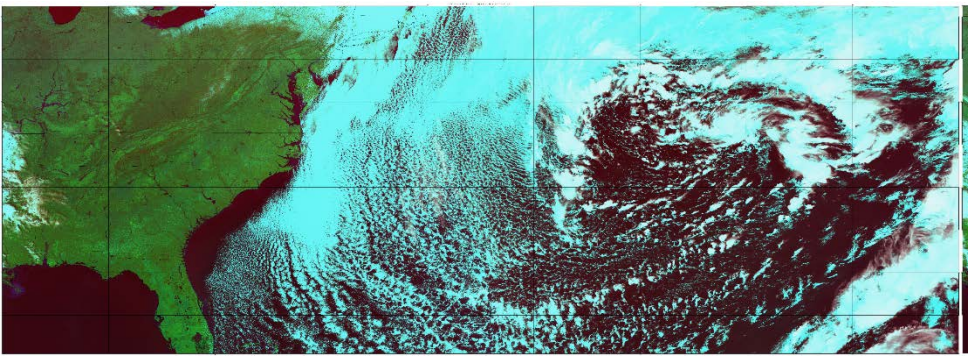
- **Comparison** between Suomi NPP and NOAA-20 vegetation health **original data, products on a tile basis**
  - Daily RGB from I1, I2 and I5
  - Daily NDVI (from I1, I2) and BT (from I5)
- **Comparison** of **global maps of Suomi NPP and NOAA-20** vegetation health products
  - Daily RGB from I1, I2 and I5
  - Daily NDVI and BT
- **Comparison** of global **vegetation health statistics** from Suomi NPP and NOAA-20
  - Weekly **Reflectance, NDVI/BT, processed SMN/SMT, VH indices** VCI/TCI/VHI
- **Time series** comparison at site level

Spectral Response Functions

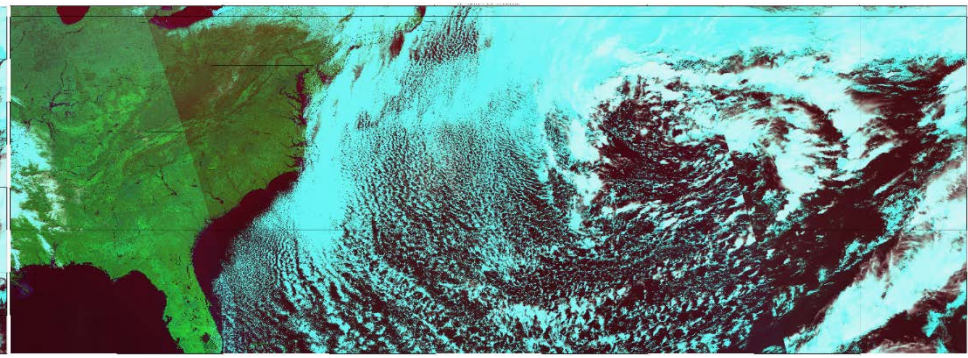


VIIRS Local: Daily Image on March 4, 2018 - Tile

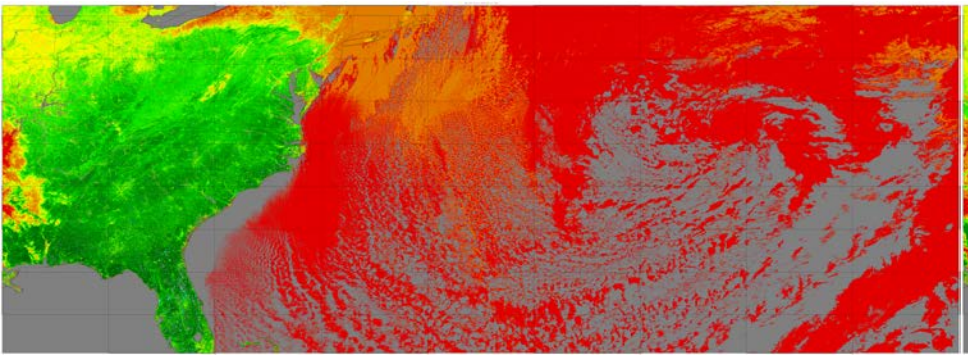
NOAA-20, RGB,
Day 63, 2018



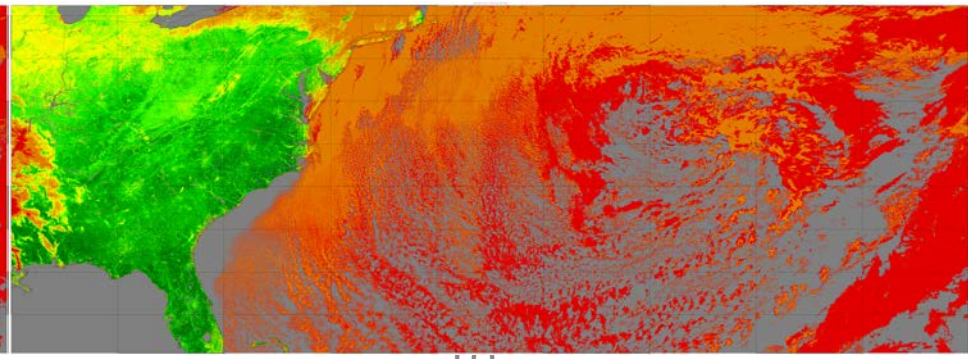
Operational S-NPP,
RGB, Day 63, 2018



NOAA-20, NDVI,
Day 63, 2018

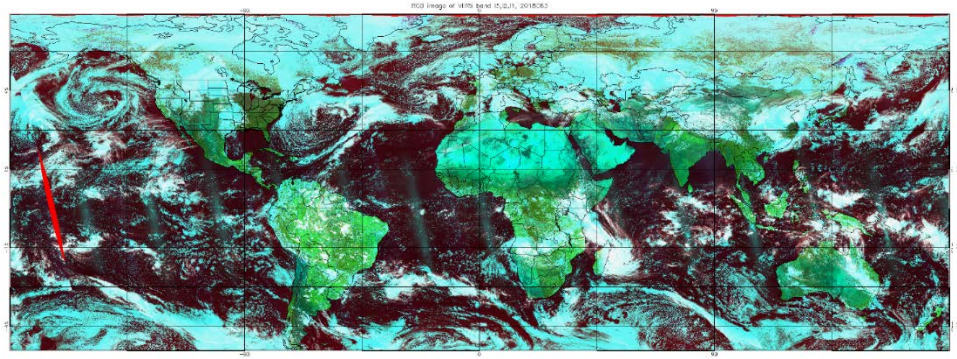


Operational S-NPP,
NDVI, Day 63, 2018

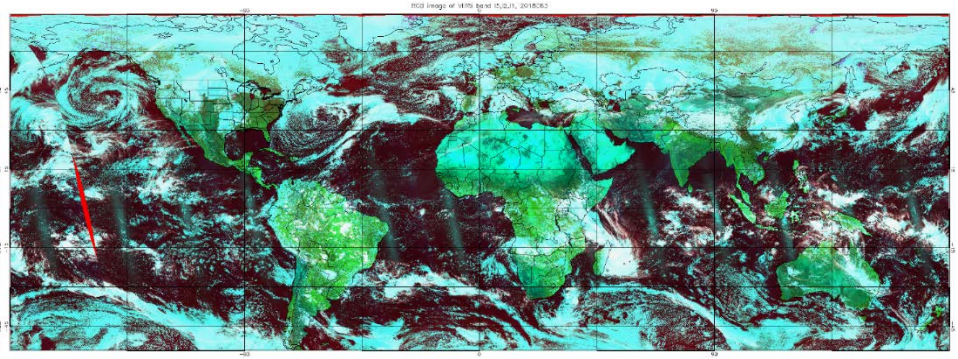


VIIRS Global Daily Image on March 4, 2018 - Global

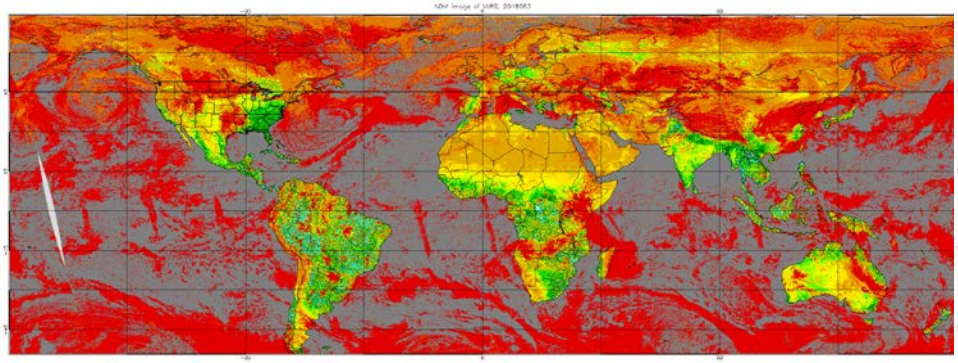
NOAA-20, RGB,
Day 63, 2018



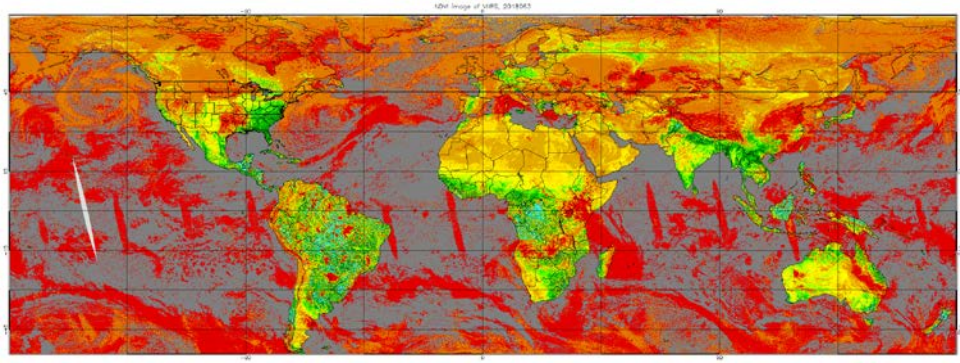
Operational S-NPP,
RGB, Day 63, 2018



NOAA-20, NDVI,
Day 63, 2018

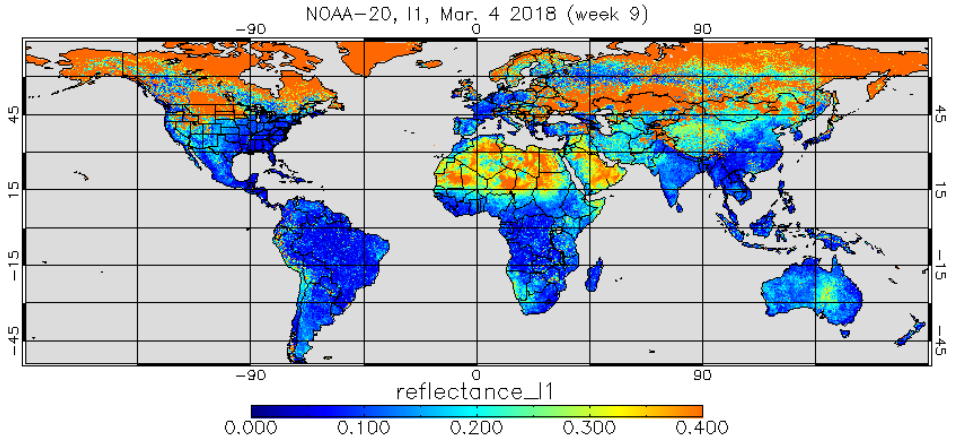


Operational S-NPP,
NDVI, Day 63, 2018

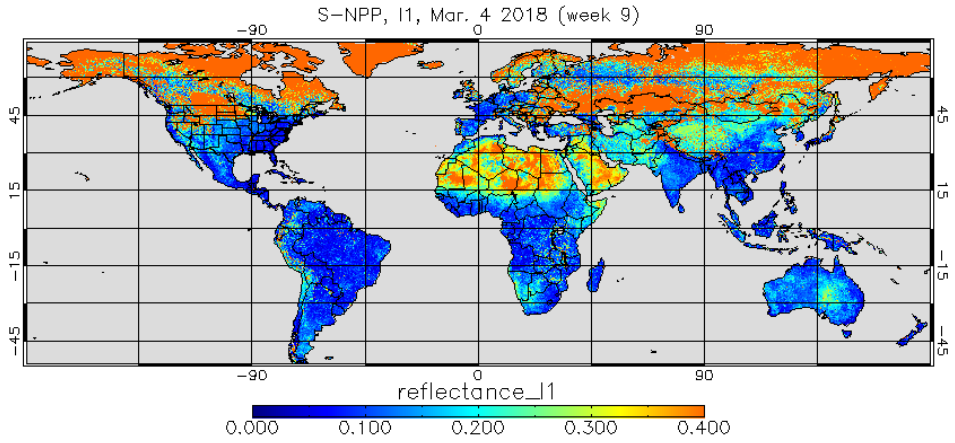


VIIRS Weekly Reflectance I1 (VIS) March 4, 2018

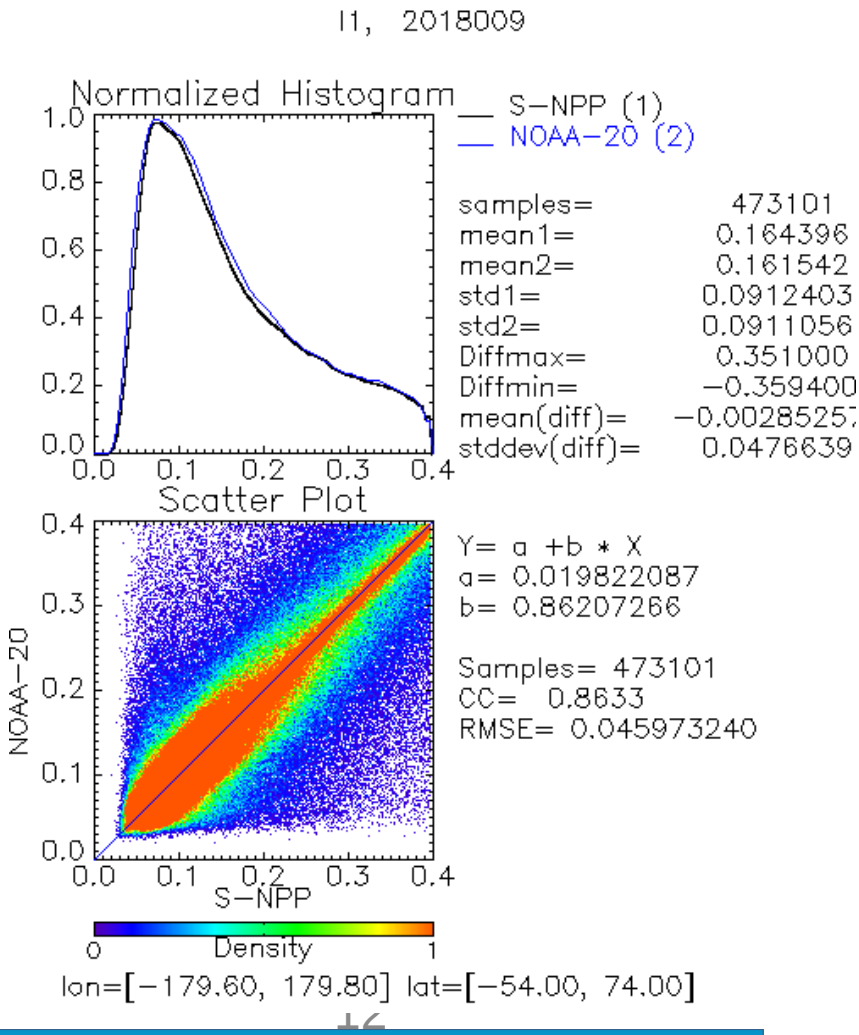
NOAA-20, I1, Week 9, 2018



S-NPP, I1, Week 9, 2018

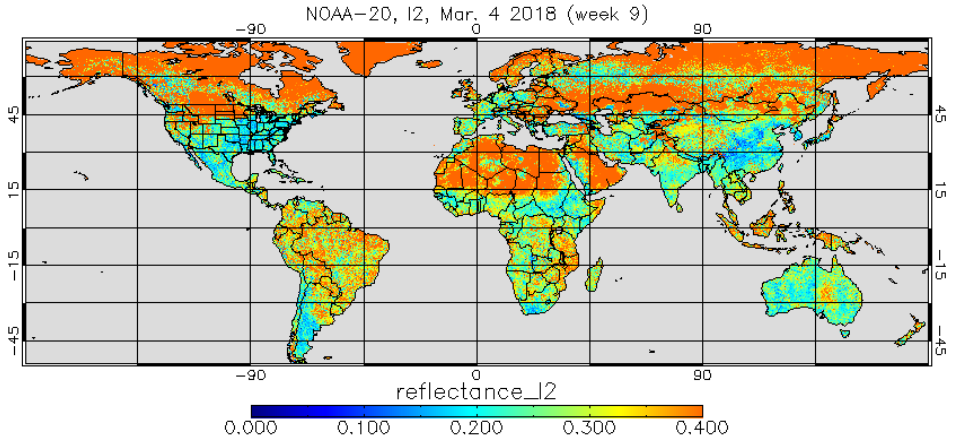


NOAA-20 vs. S-NPP, I1, Week 9, 2018

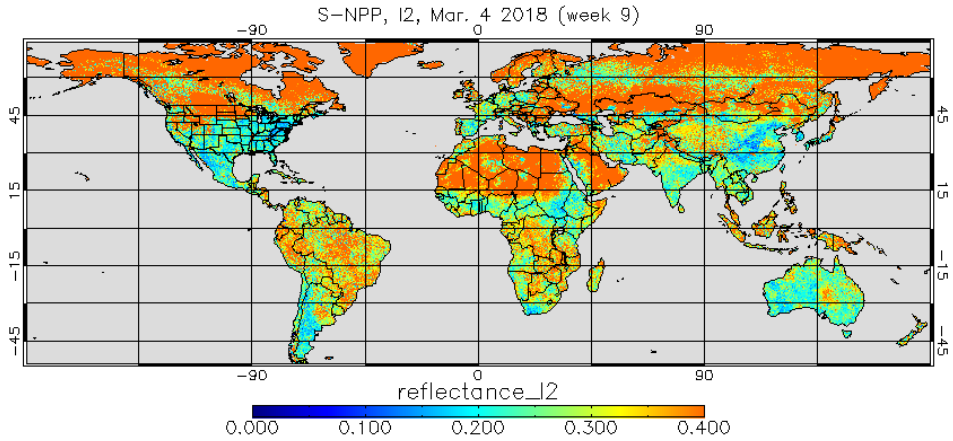


VIIRS Weekly Reflectance I2 (NIR) March 4, 2018

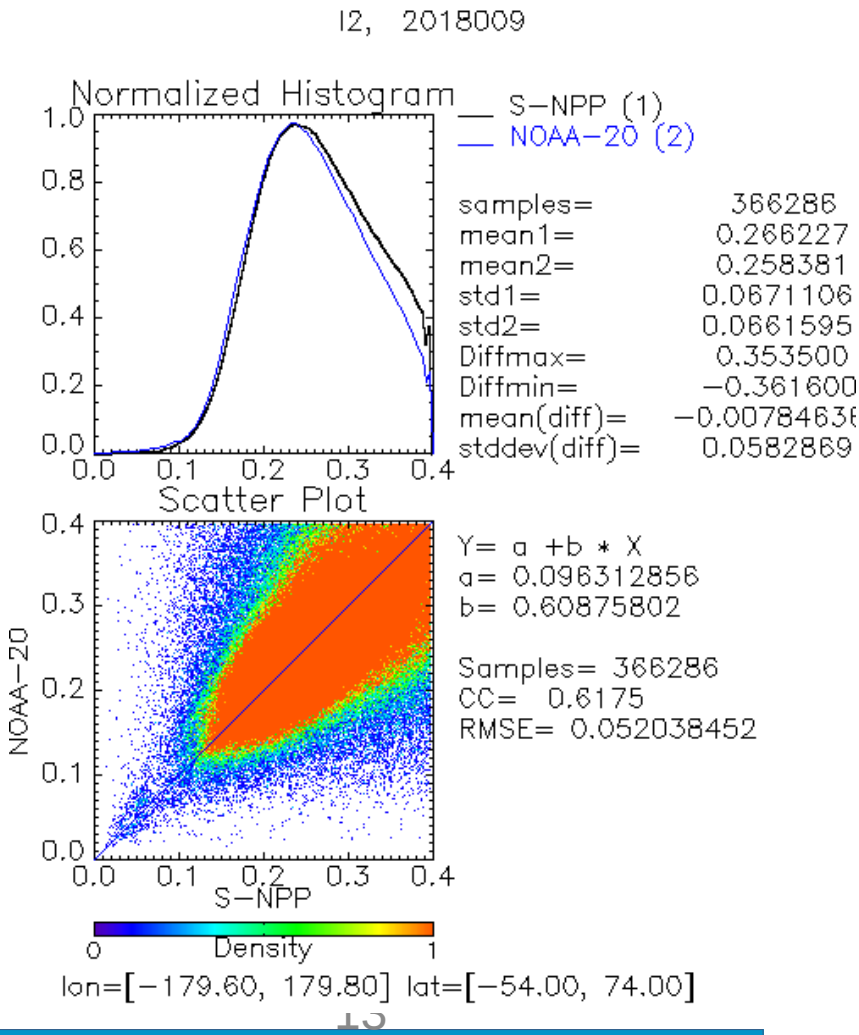
NOAA-20, I2, Week 9, 2018



S-NPP, I2, Week 9, 2018

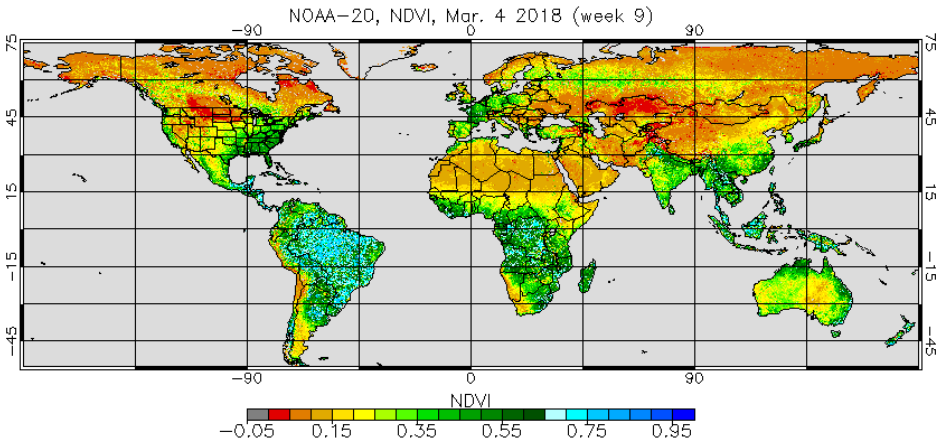


NOAA-20 vs. S-NPP, I2, Week 9, 2018

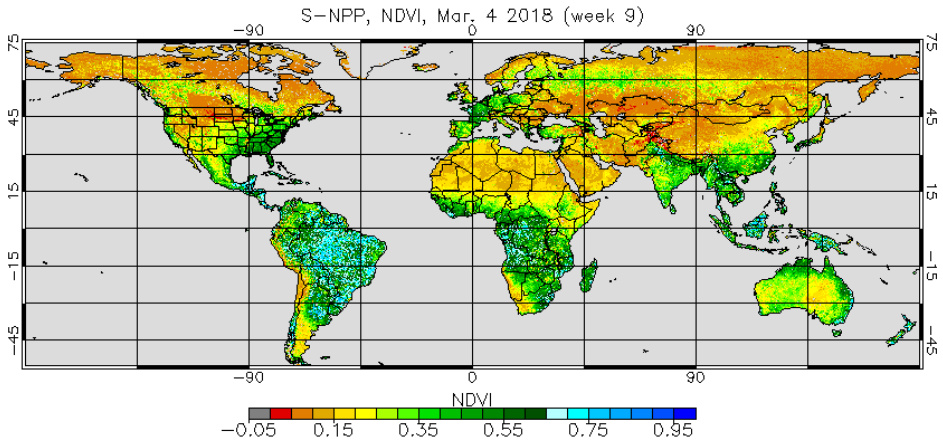


VIIRS Weekly NDVI March 4, 2018

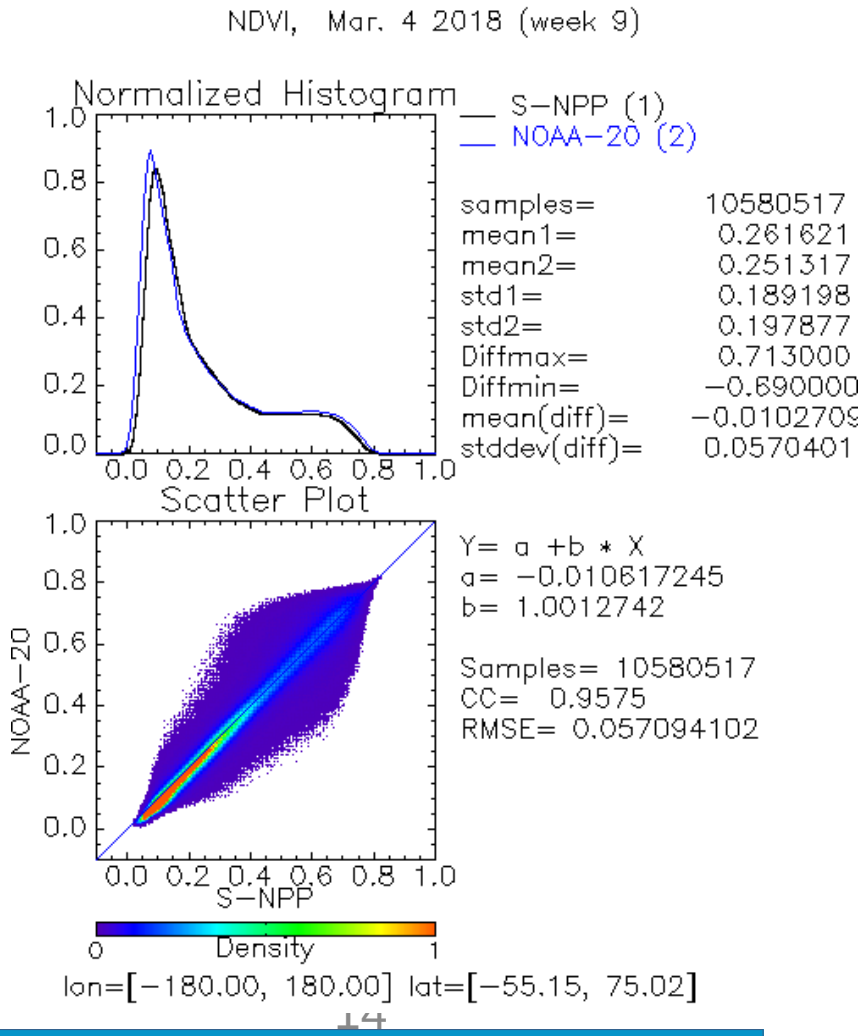
NOAA-20, NDVI, Week 9, 2018



S-NPP, NDVI, Week 9, 2018

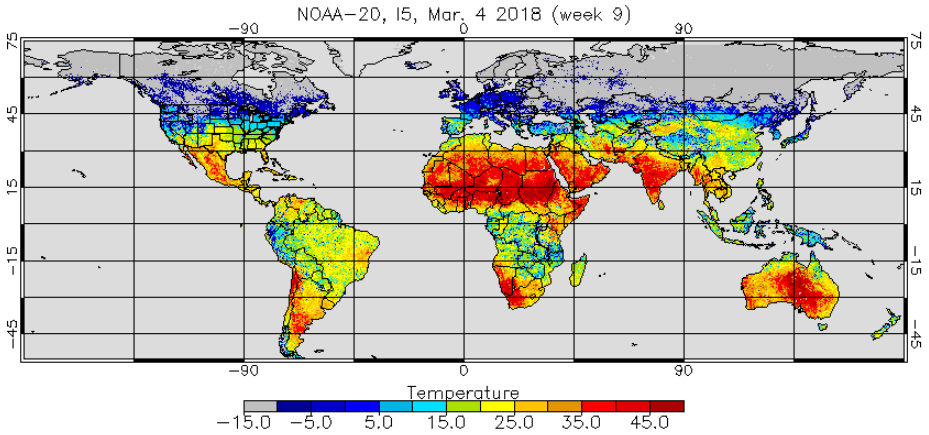


NOAA-20 vs. S-NPP, NDVI, Week 9, 2018

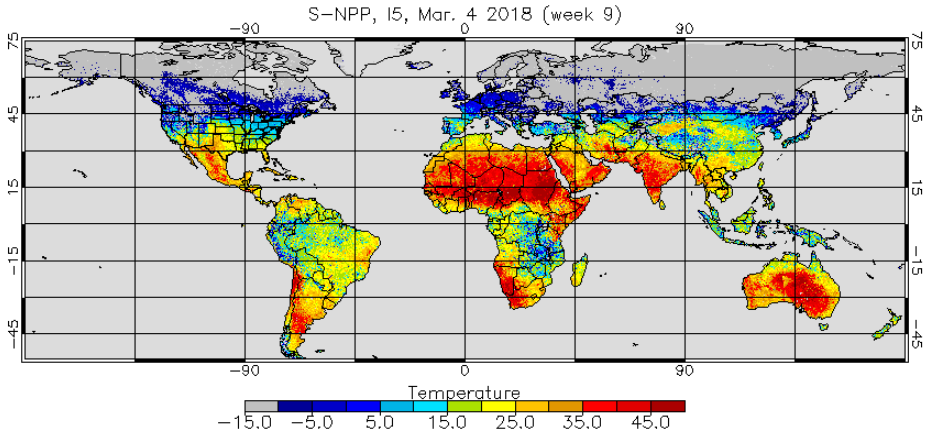


VIIRS Weekly BT March 4, 2018

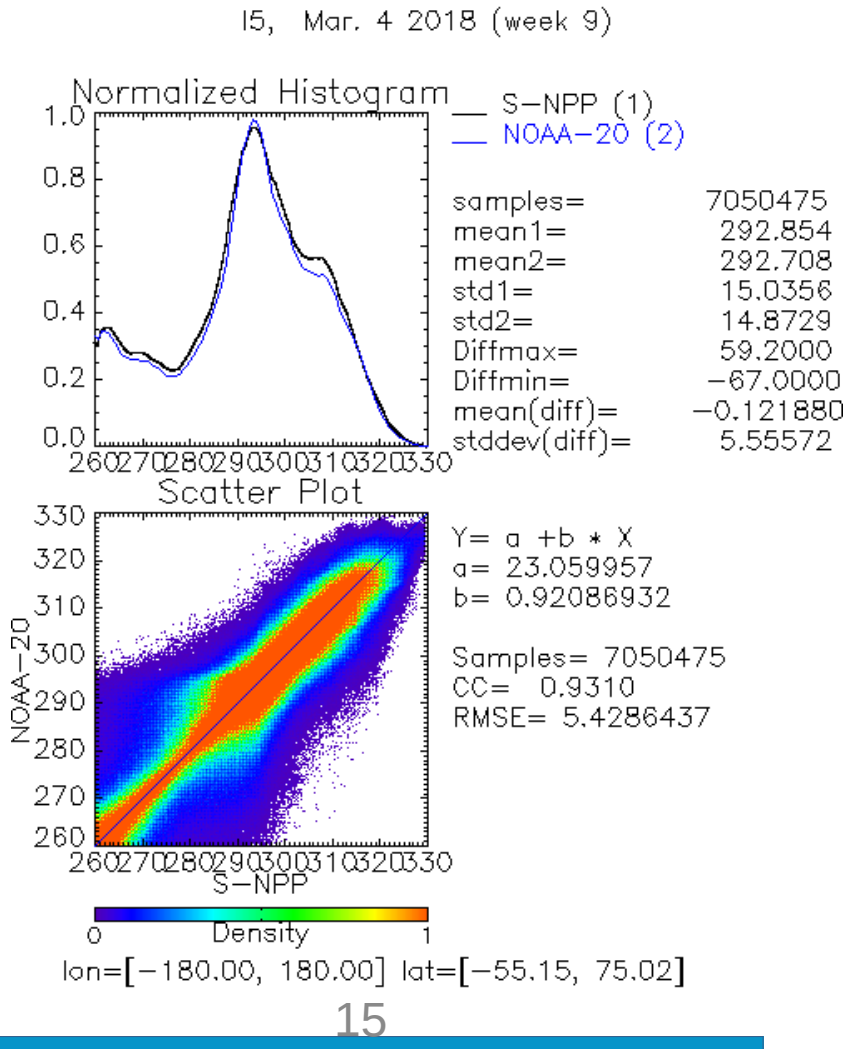
NOAA-20, BT, Week 9, 2018



S-NPP, BT, Week 9, 2018

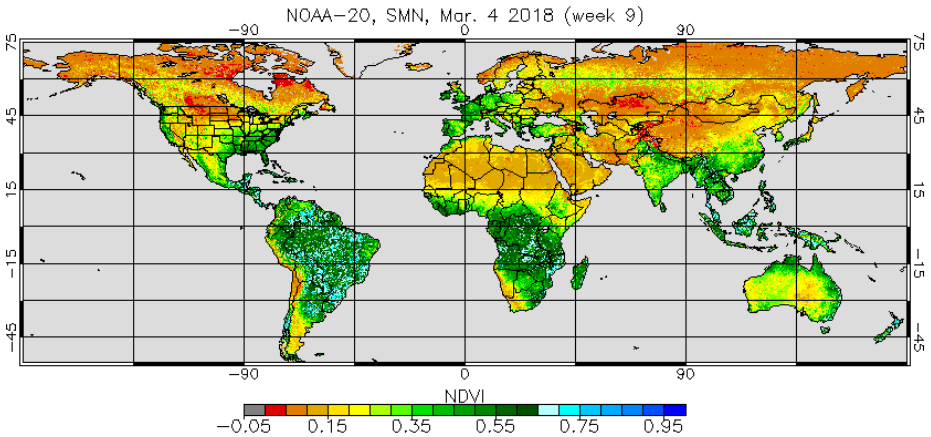


NOAA-20 vs. S-NPP, BT, Week 9, 2018

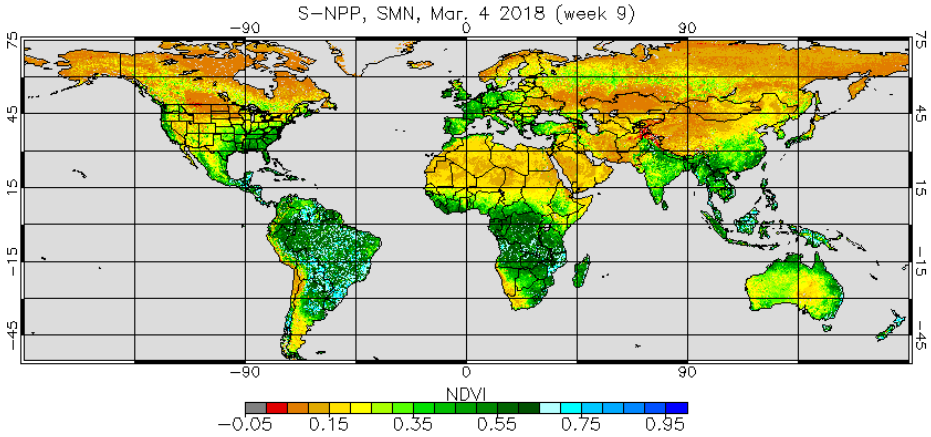


VIIRS Weekly SMN March 4, 2018

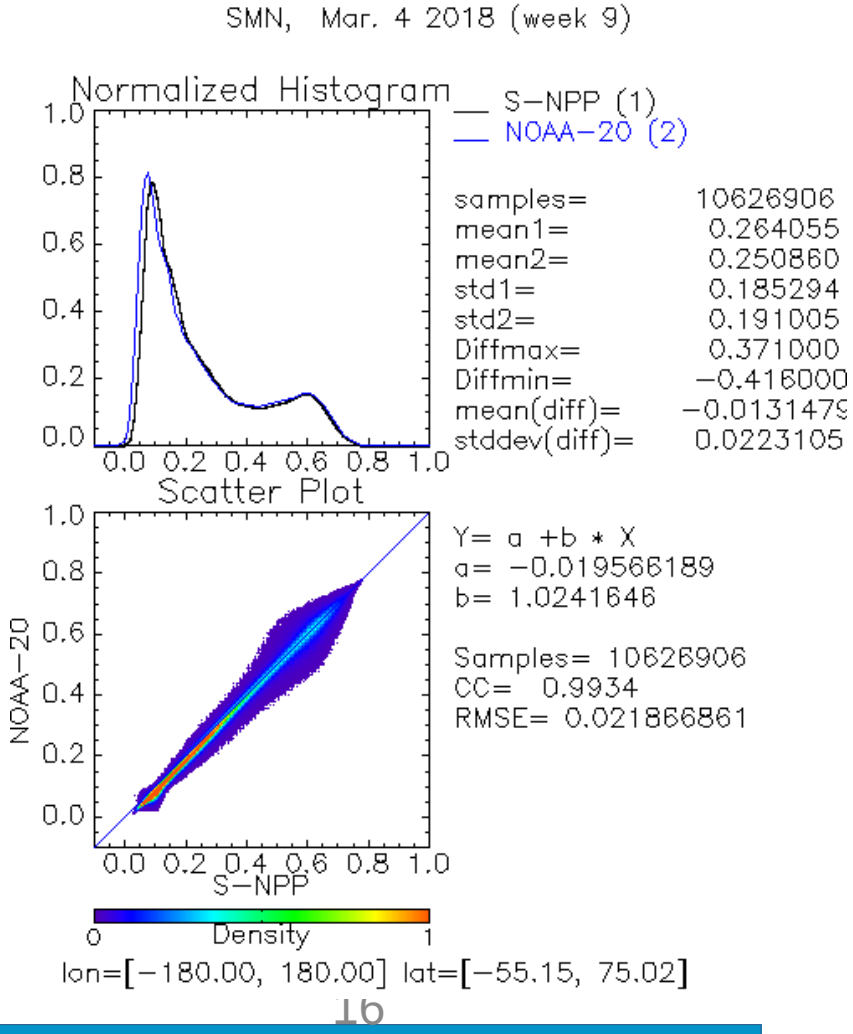
NOAA-20, SMN, Week 9, 2018



S-NPP, SMN, Week 9, 2018

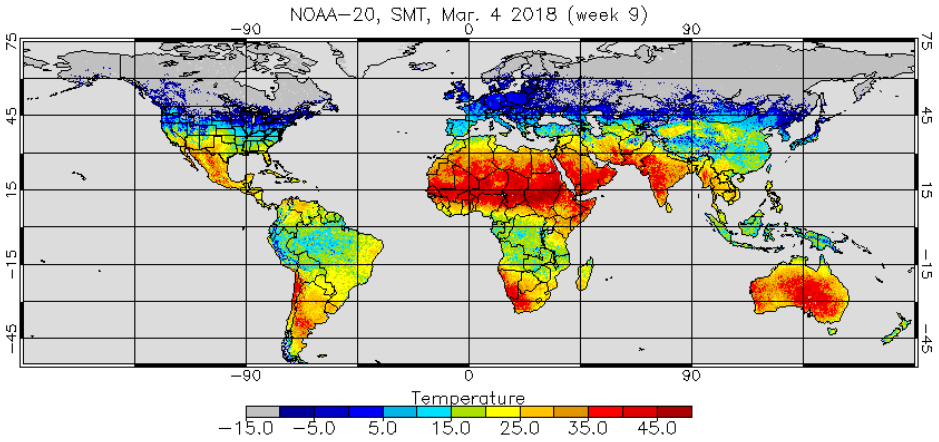


NOAA-20 vs. S-NPP, SMN, Week 9, 2018

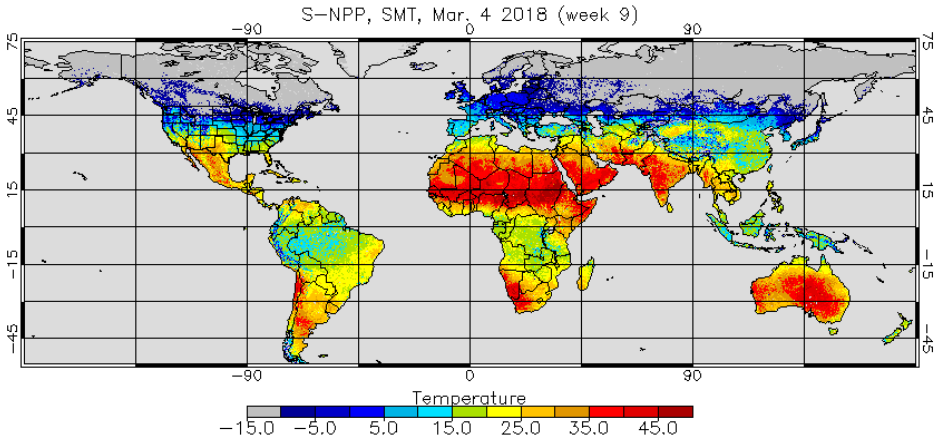


VIIRS Weekly SMT March 4, 2018

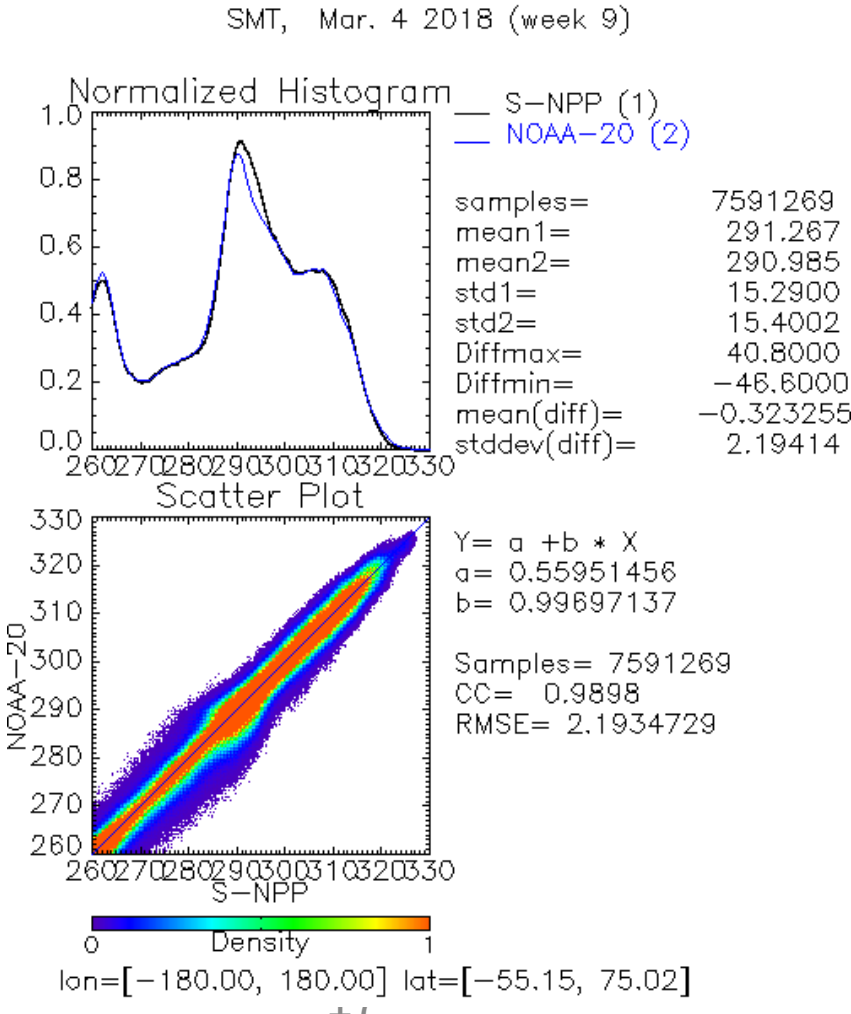
NOAA-20, SMT, Week 9, 2018



S-NPP, SMT, Week 9, 2018

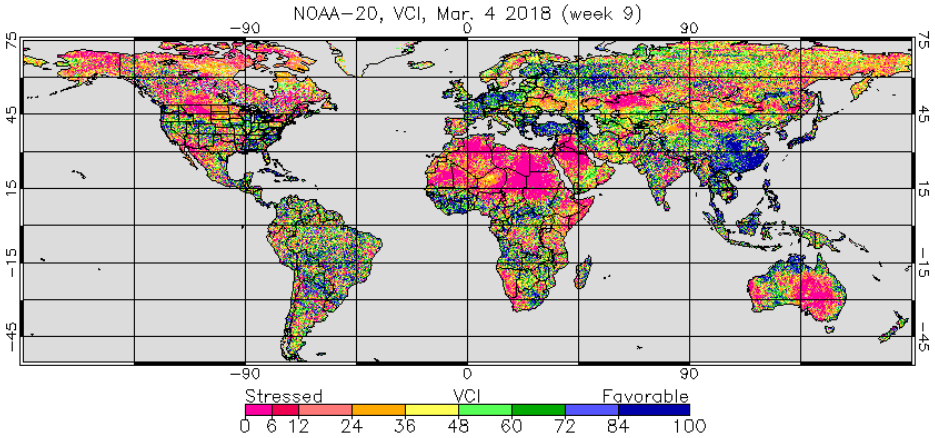


NOAA-20 vs. S-NPP, SMT, Week 9, 2018

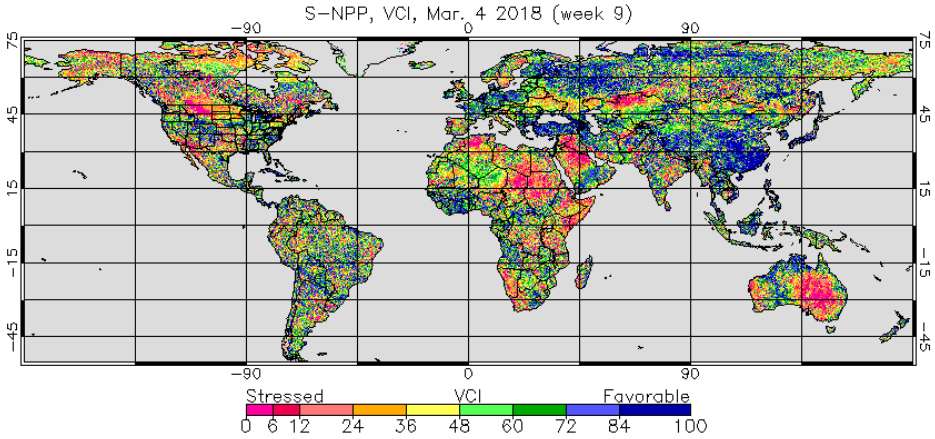


VIIRS Weekly VCI March 4, 2018

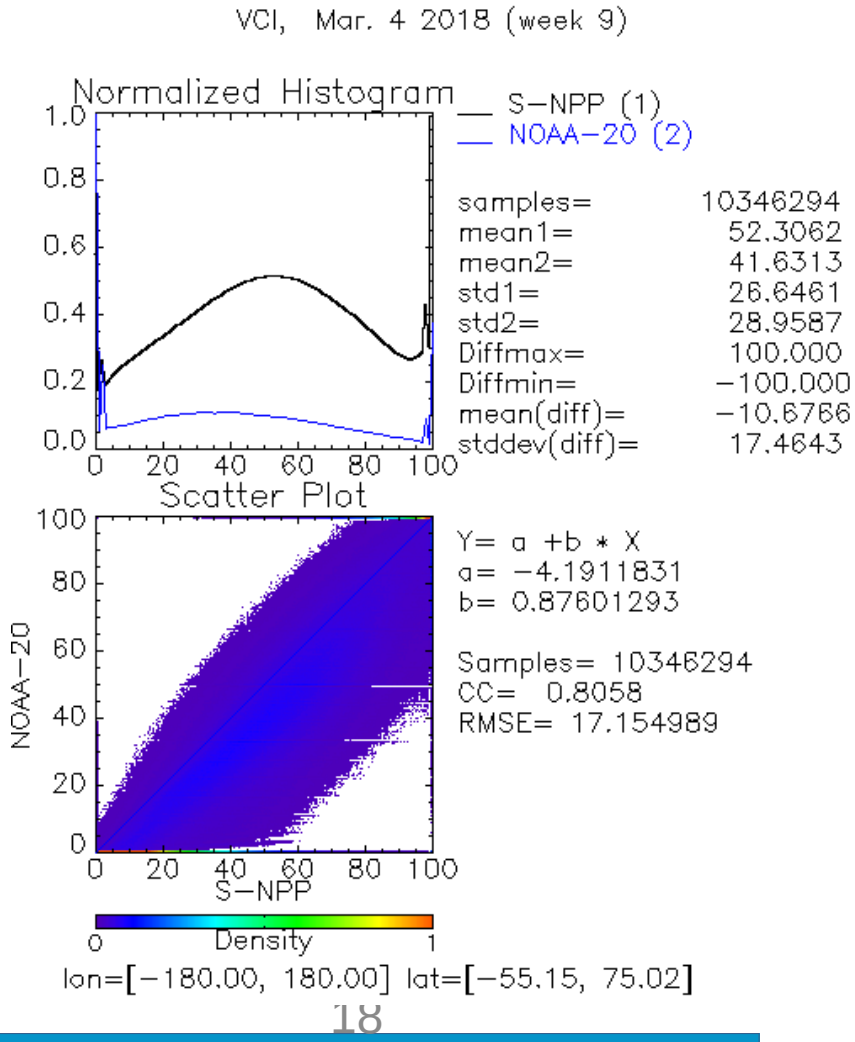
NOAA-20, VCI, Week 9, 2018



S-NPP, VCI, Week 9, 2018

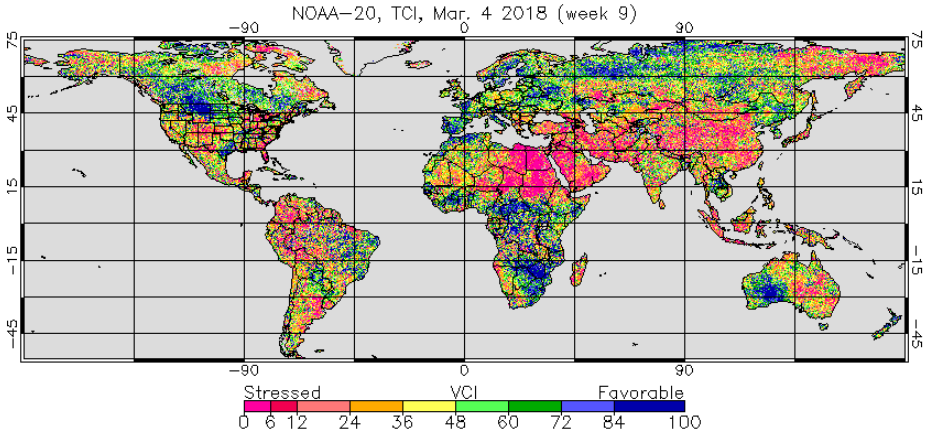


NOAA-20 vs. S-NPP, VCI, Week 9, 2018

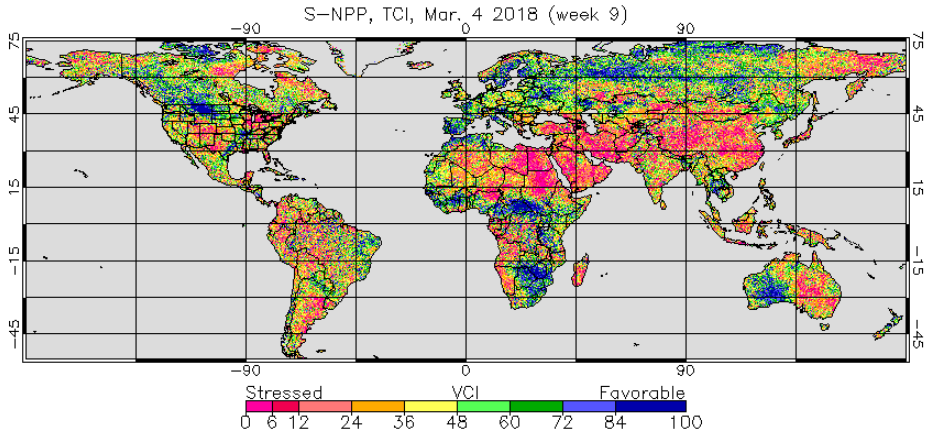


VIIRS Weekly TCI March 4, 2018

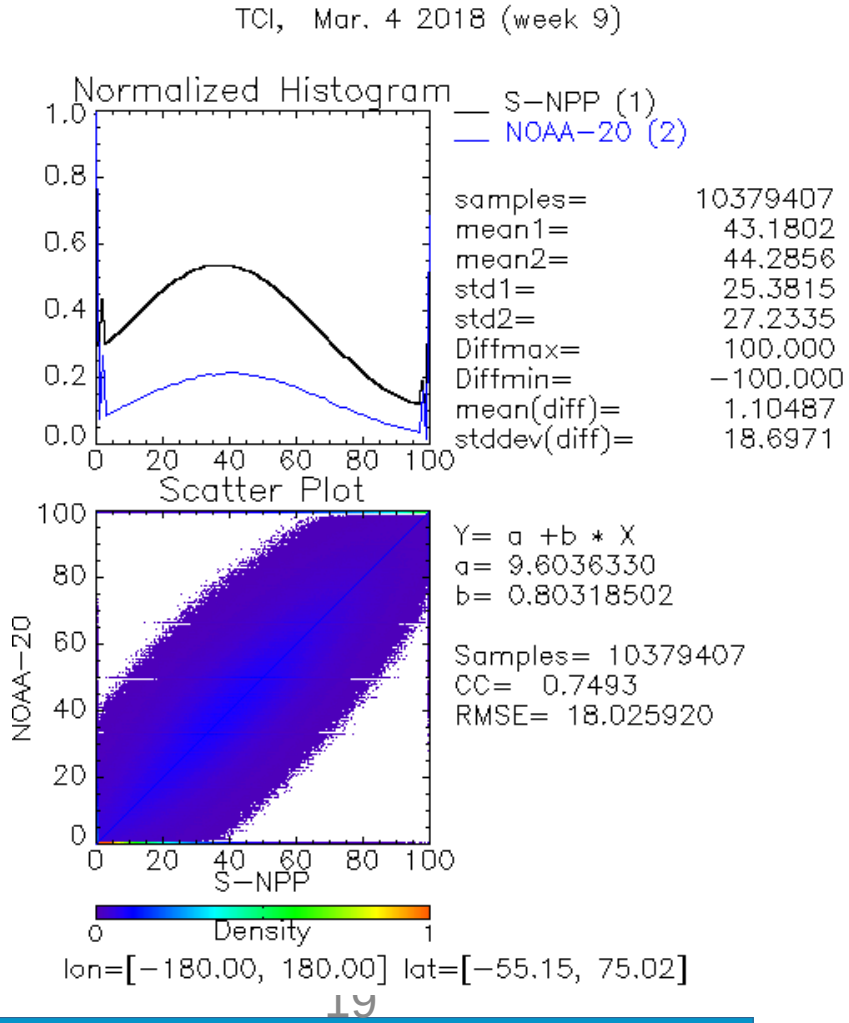
NOAA-20, TCI, Week 9, 2018



S-NPP, TCI, Week 9, 2018

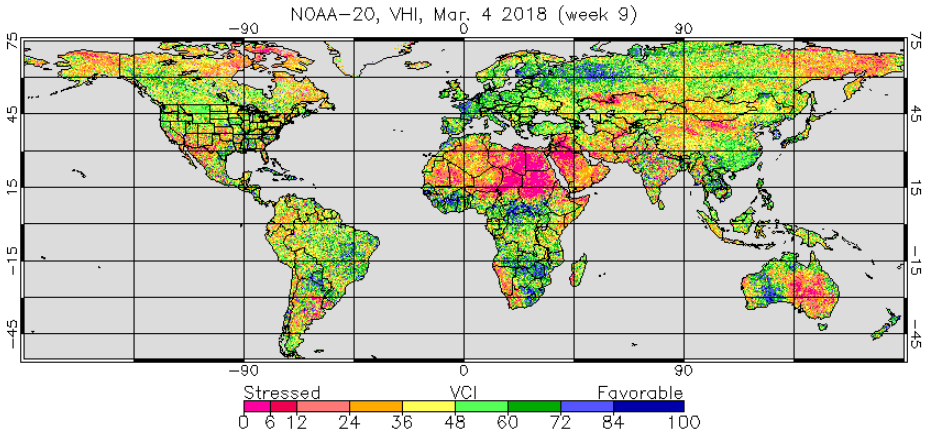


NOAA-20 vs. S-NPP, TCI, Week 9, 2018

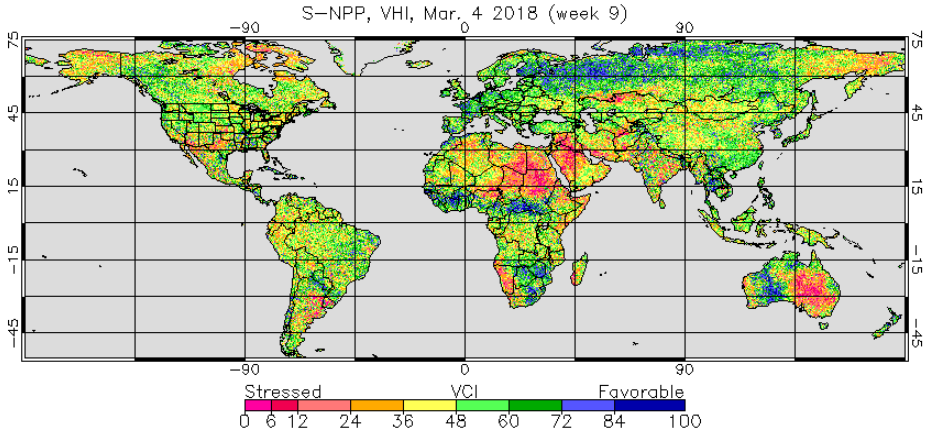


VIIRS Weekly VHI March 4, 2018

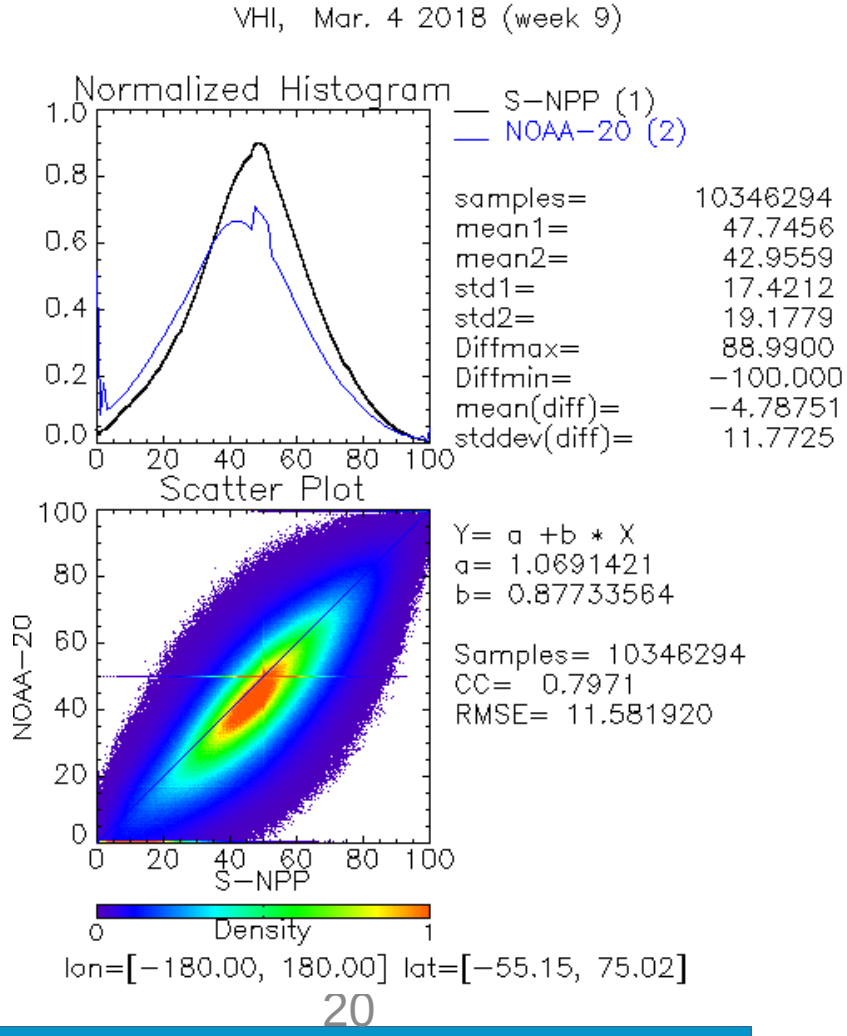
NOAA-20, VHI, Week 9, 2018



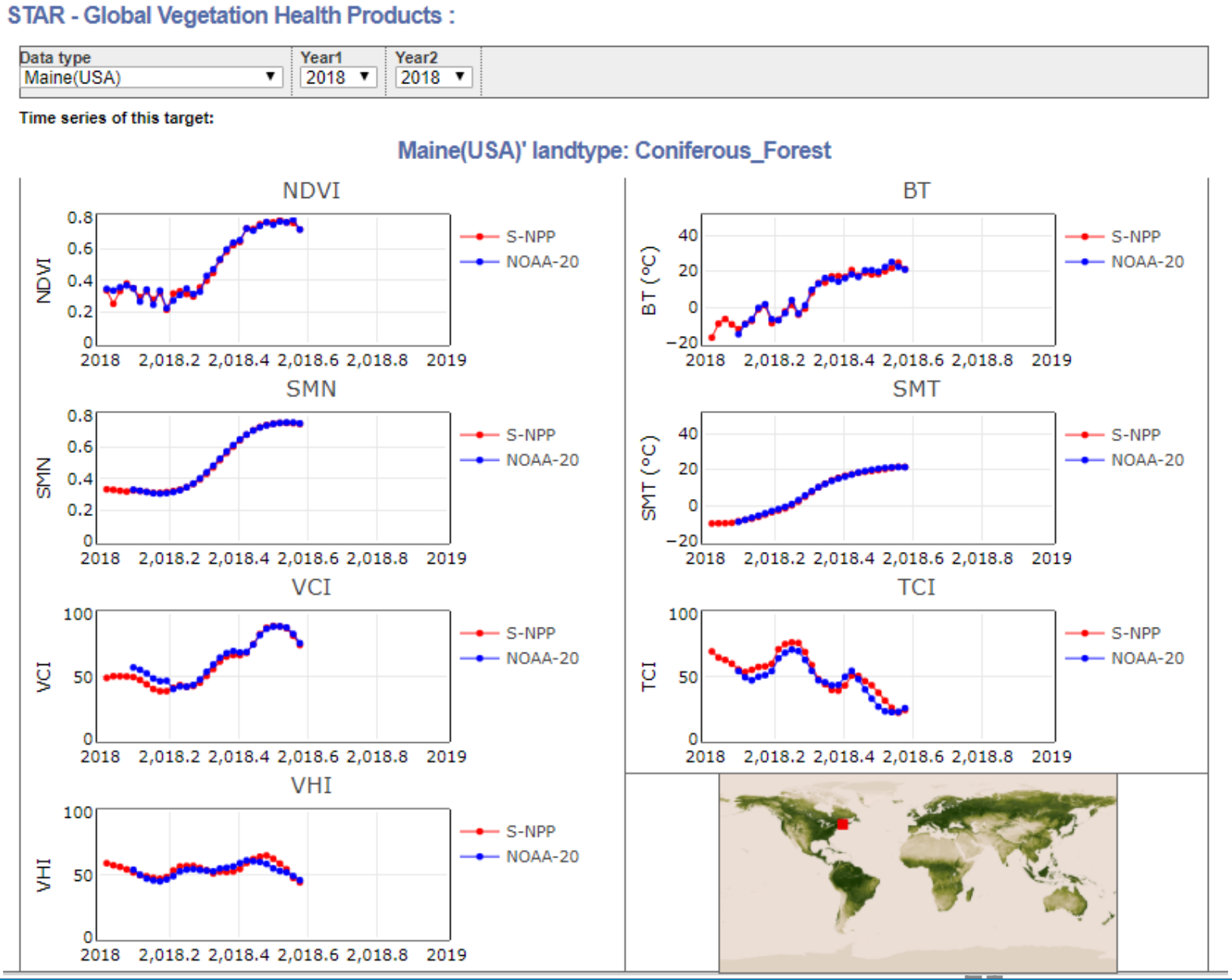
S-NPP, VHI, Week 9, 2018



NOAA-20 vs. S-NPP, VHI, Week 9, 2018



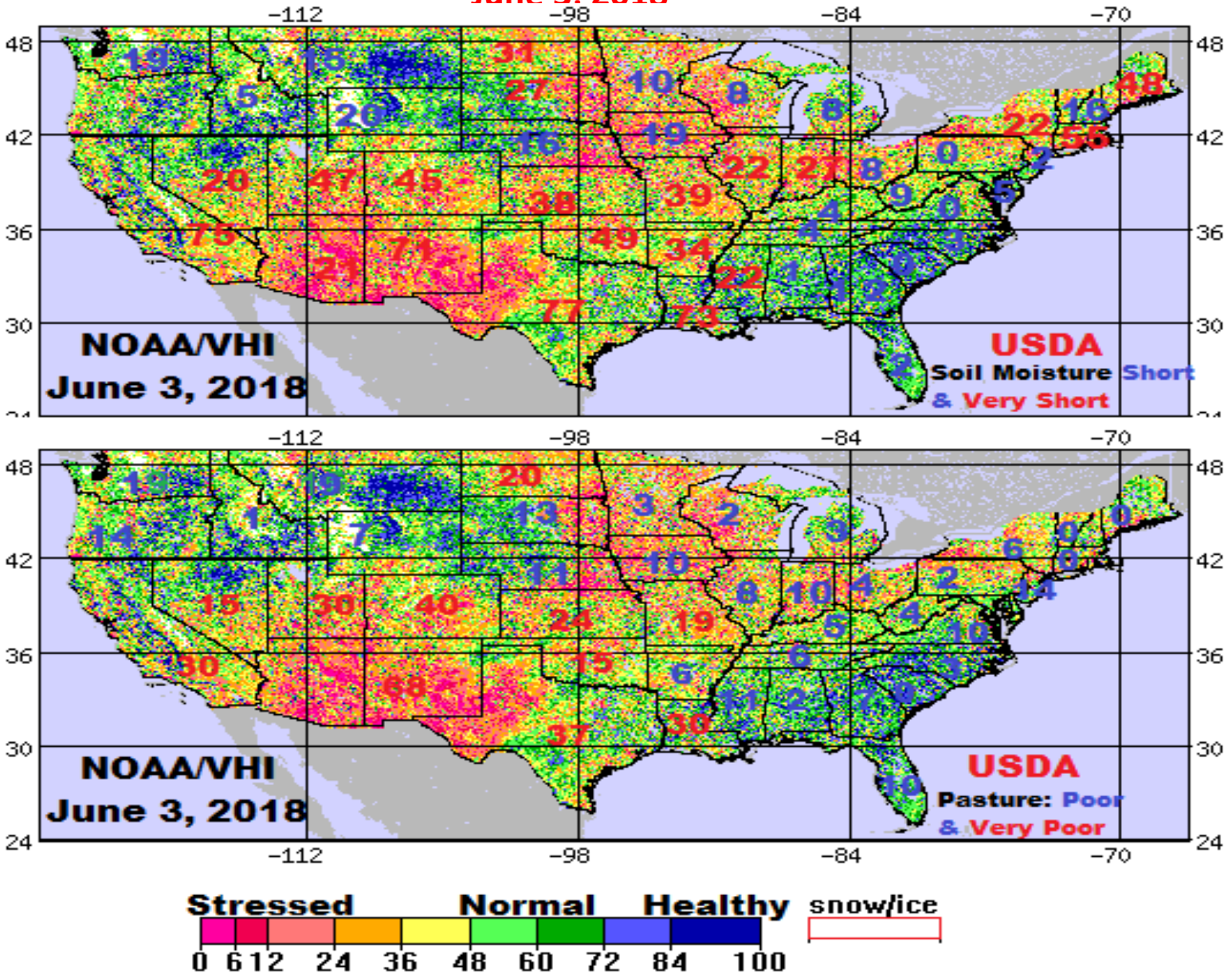
2018 Weekly VH Comparison: NOAA-20/VIIRS & SNPP/VIIRS



VALIDATION

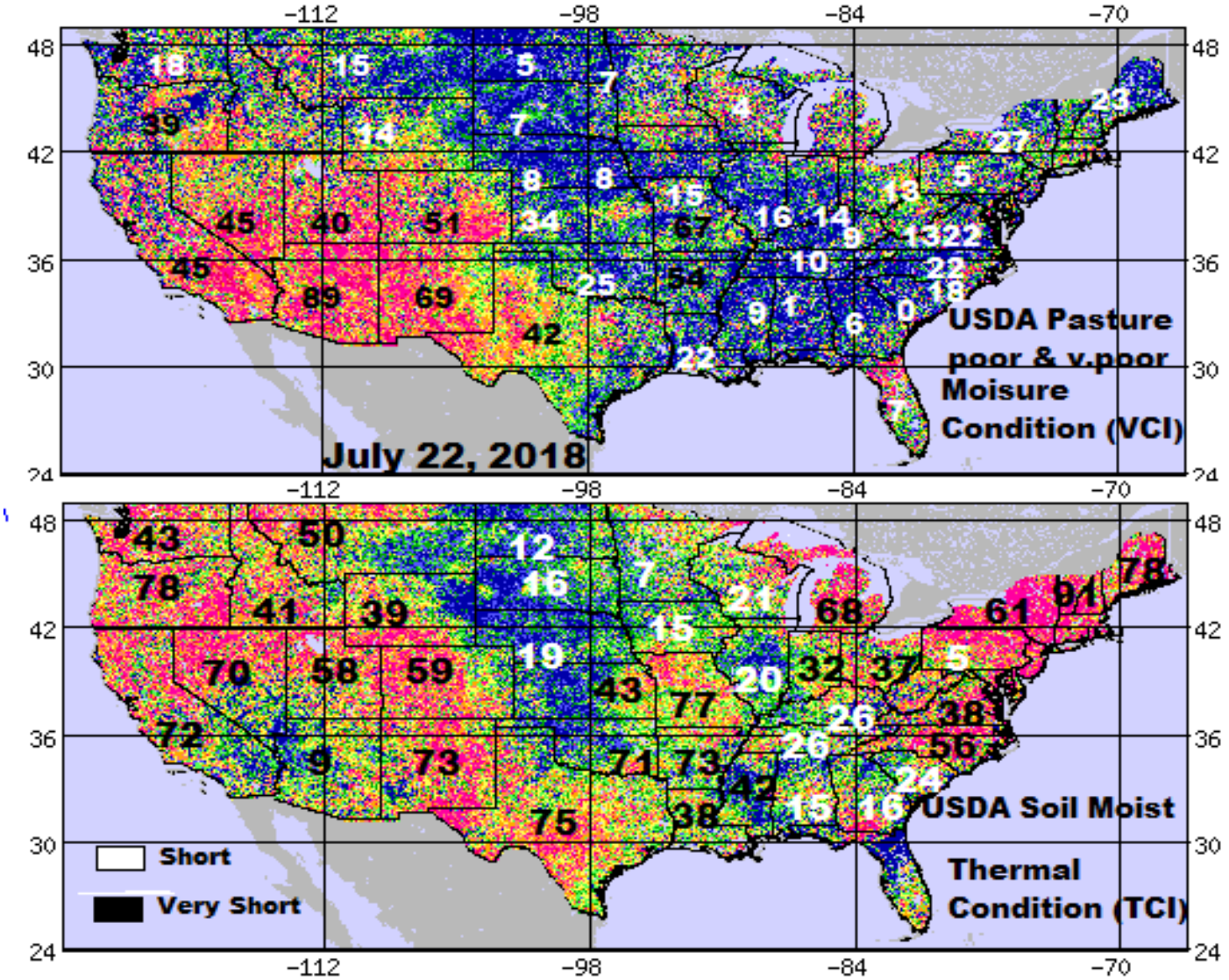
Vegetation Health & USDA Top Soil Short & V. Short, % Pasture in Good & V. Good Condition:

June 3, 2018

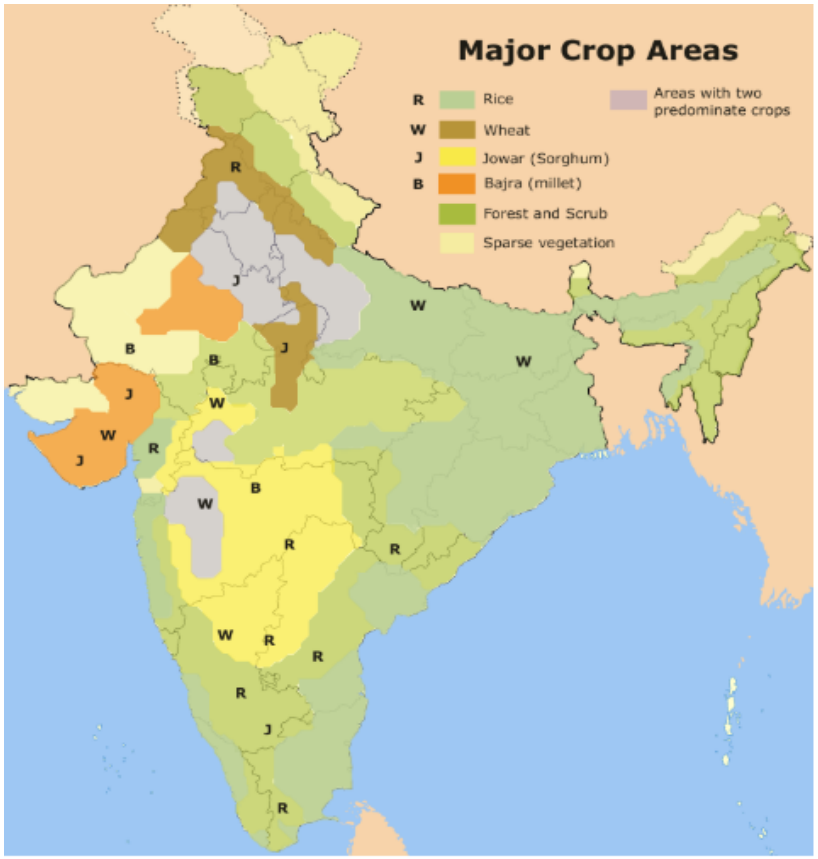


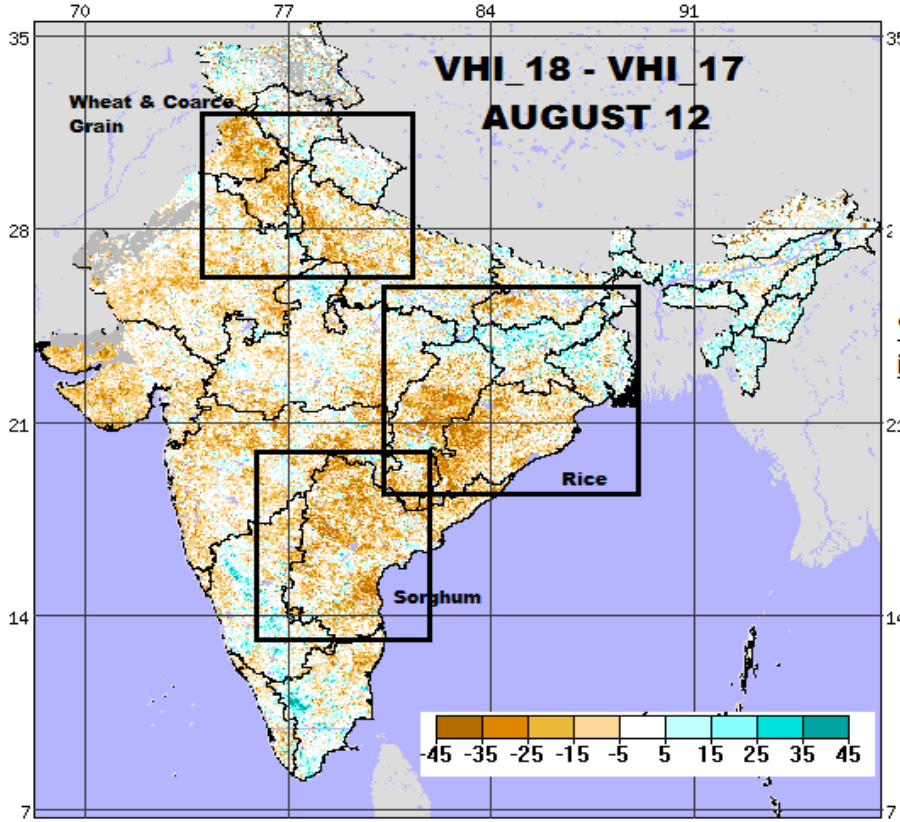
Vegetation Health & USDA Top Soil Short & V. Short, % Pasture i

Good & V. Good Condition: June 3, 2018



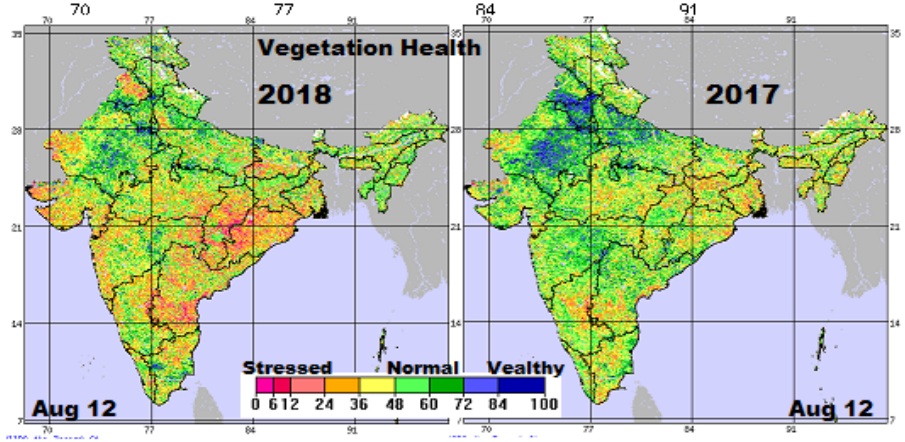
VHI-18 Validation INDIA





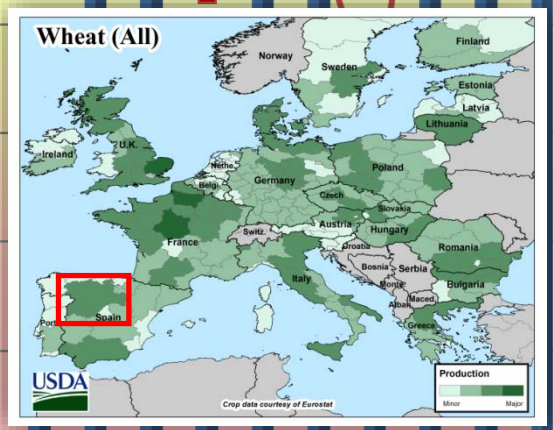
% Crop Pr
in 2018 vs

Wheat
Coarse
Sorghu
Rice
Peanut
Cotton



Your Stress product is telling a MAJOR VEGETATION STRESS which is not correct as we have very good rainfall this year and agriculture growth is great this year.

Spain VHI for Wheat @ Filling



While most winter crop areas of northern Europe bake, **Spain** has been the exception with wet, cool weather; this is reflected in the VHI.

Data Missing

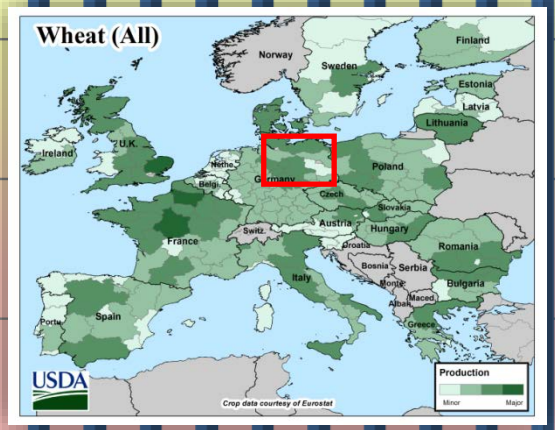
VHI data for Castilla (ESP)

VHI | Yield | 5 per. Mov. Avg. (Yield)

* *Yield data from PSD Online, 2018 yield is from last month*

August 10, 2018

Germany VHI for Wheat @ Flowering



Data Missing

The VHI for flowering *wheat* in **northeastern Germany** was the lowest value since the VHI's inception in 1988.

VHI data for DEU (Nied/Meck/Sach/Meck/Baye)

VHI | Yield | 5 per. Mov. Avg. (Yield)

** Yield data from PSD Online, 2018 yield is from last month*

August 10, 2018

Documents (Check List)

Science Maturity Check List	Yes
ReadMe for Data Product Users	Yes (NOAA-20, S-NPP)
Algorithm Theoretical Basis Document (ATBD)	Yes (Suomi NPP)
Algorithm Calibration/Validation Plan	Yes (NOAA-20)
(External/Internal) Users Manual	Yes (Suomi NPP)
System Maintenance Manual	Yes (Suomi NPP)
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes (Suomi NPP)
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	Webpage presentations

Summary and path forward

- **RESULTS indicate:**

  - **No spurious histogram** for raw data & indices
  - **Strong correlation** between indices
  - NOAA-20/VIIRS VH **has reached Beta maturity**

- **Path forward**
  - **Detailed evaluation** of the SDR and EDR quality flags
  - Comparison VH NOAA-20/VIIRS & SNPP/VIIRS for **32 ecosystems**
  - Validation with ***in situ data***

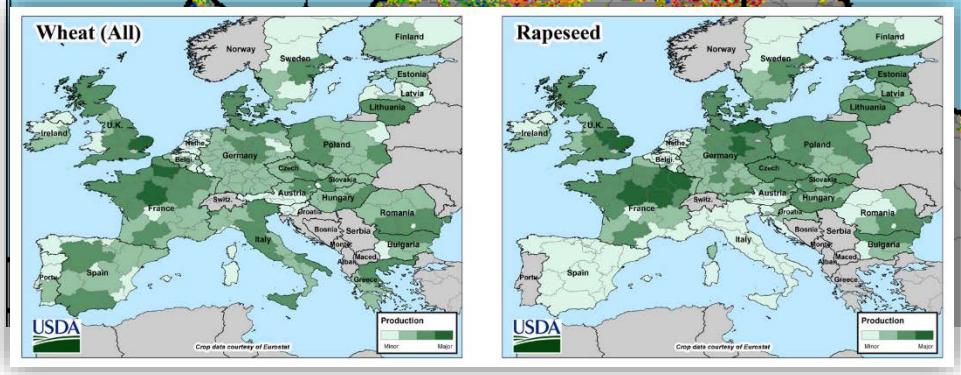
- BACK UP

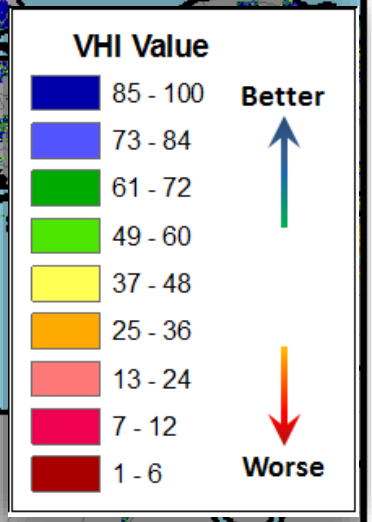
First, an FYI.
The regression I am running for my international areas using the VHI ascii data in conjunction with our in-house WMO weather data continues to expand and draw attention (in a good way!).
In fact, my counterparts in the Foreign Ag Service (FAS) are asking for the results from my yield modeling,
as are the Economist Chairpersons of the World Board. At last count, I I have over 50 different country-crop yield regression pairs up and running operationally, and in large part my success with this endeavor has been greatly assisted by you.
Thank you!

Vegetation Health Index

August 6, 2018

Over the past month, drought has continued to afflict filling to maturing wheat and rapeseed in **northern Europe** outside of **Poland**, where much-needed rain fell.





Products Webpages

- Geophysical Image? Comparison Webpage:
  https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/j01_browseCompareVH.php

- Time Series Comparison Webpage:
  https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh_targetTimeseries.php

- Both Webpages are being updated weekly