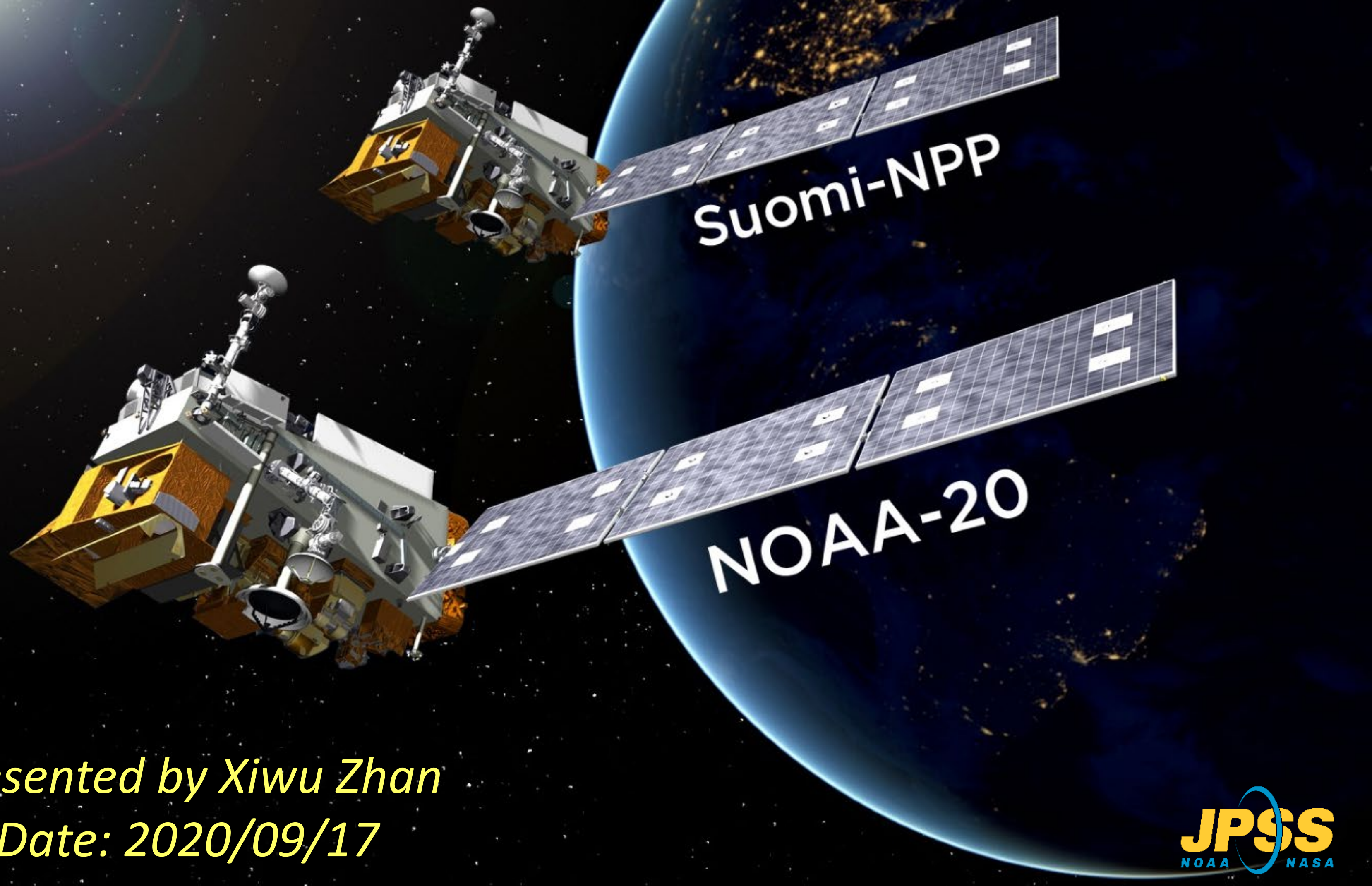
Validated Maturity Science Review
For VIIRS Surface Type



Presented by Xiwu Zhan
Date: 2020/09/17

JPSS
NOAA NASA

JPSS Data Products Maturity Definition

1. Beta

- Product is minimally validated, and may still contain significant identified and unidentified errors.
- Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose.
- Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists.

2. Provisional

- 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.
- Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
- Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.
- Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

3. Validated

- Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
- 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.
- Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
- Product is ready for operational use based on documented validation findings and user feedback.
- Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

Validated Maturity Review - Entry Criteria

- Product Requirements
- Pre-launch Performance Matrix/Waivers
- Validated Maturity Performance Validation
  - On-orbit instrument performance assessment
    - Identify all of the instrument and product characteristics you have verified/validated as individual bullets
    - Identify pre-launch concerns/waivers, mitigation and evaluation attempts with on-orbit data
- Users/EDRs feedback
- Risks, Actions, Mitigations
  - Potential issues, concerns
- Path forward
- Summary

Validated Maturity Review - Exit Criteria

- Validated Maturity Performance is well characterized and meets/exceeds the requirements:
  - On-orbit instrument performance assessment
    - Provide summary for each identified instrument and product characteristic you have validated/verified as part of the entry criteria
    - Provide summary of pre-launch concerns/waivers mitigations/evaluation and address whether any of them are still a concern that raises any risk.
- Updated Validated Maturity Slide Package addressing review committee’s comments for:
  - Cal/Val Plan and Schedules
  - Product Requirements
  - Validated Maturity Performance
  - Risks, Actions, Mitigations
  - Path forward

VALIDATED MATURITY REVIEW MATERIAL

Outline

- Algorithm Cal/Val Team Members
- Product Overview/Requirements
- Evaluation of algorithm performance to specification requirements
  - Algorithm version, processing environment
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error Budget
- User Feedback
- Downstream Product Feedback
- Risks, Actions, and Mitigations
- Documentation (Science Maturity Check List)
- Conclusion
- Path Forward

NOAA-20 Surface Type Cal/Val Team

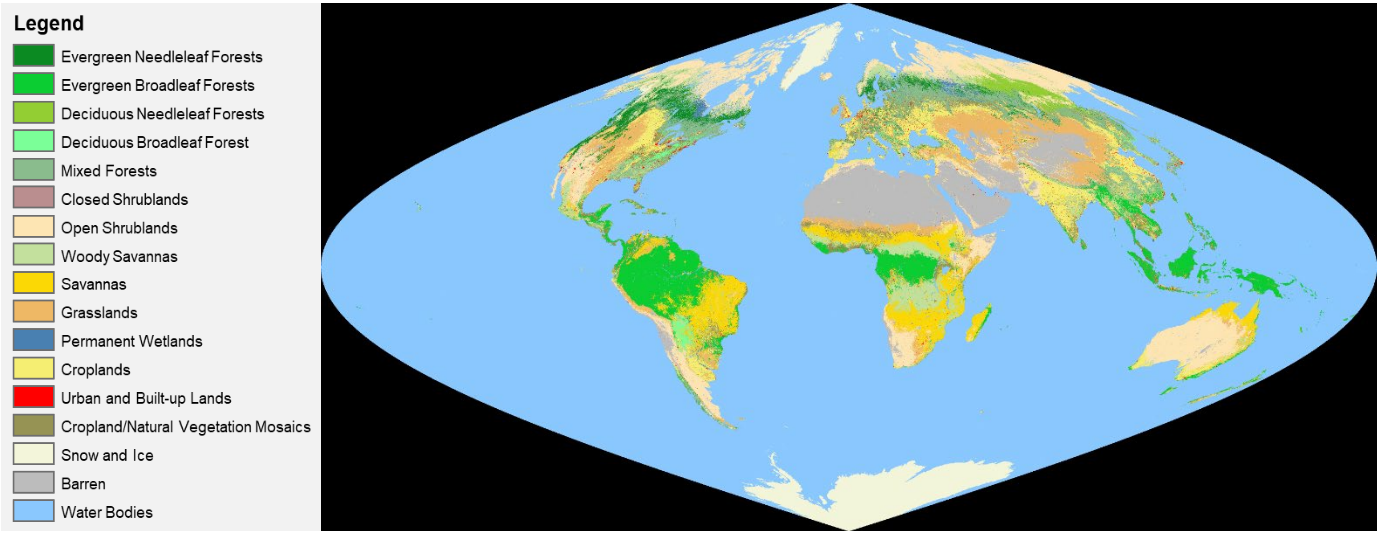
Algorithm Cal/Val Team Members

Name	Organization	Major Task
Xiwu Zhan	NESDIS/STAR	Surface Type lead
Chengquan Huang	UMD	Surface type algorithm/product lead
Khaldoun Rishimawi	UMD	Algorithm development and testing
Zhenhua Zou	UMD	Code refinement and optimization
David Minor	UMD	Data downloading, processing
Jiaming Lu	UMD	Training data collection, validation
Ivan Csiszar	NESDIS-STAR	VIIRS Land Team Lead

Product Overview/Requirements

- Product Overview
  - Global surface type (GST) map is required to support land surface modeling/parameterization in weather/climate models
  - Primary classification system: 17 IGBP types
  - Additional classification systems: 20 types for NCEP, 9 biome types required by LAI/GPP/NPP algorithms
  - Spatial resolution: 1 km
  - Temporal intervals: produced annually using 12 months of VIIRS data

2019 VIIRS Global Surface Type (GST) map



Product Overview/Requirements

- GST product performance requirements from JPSS L1RD:

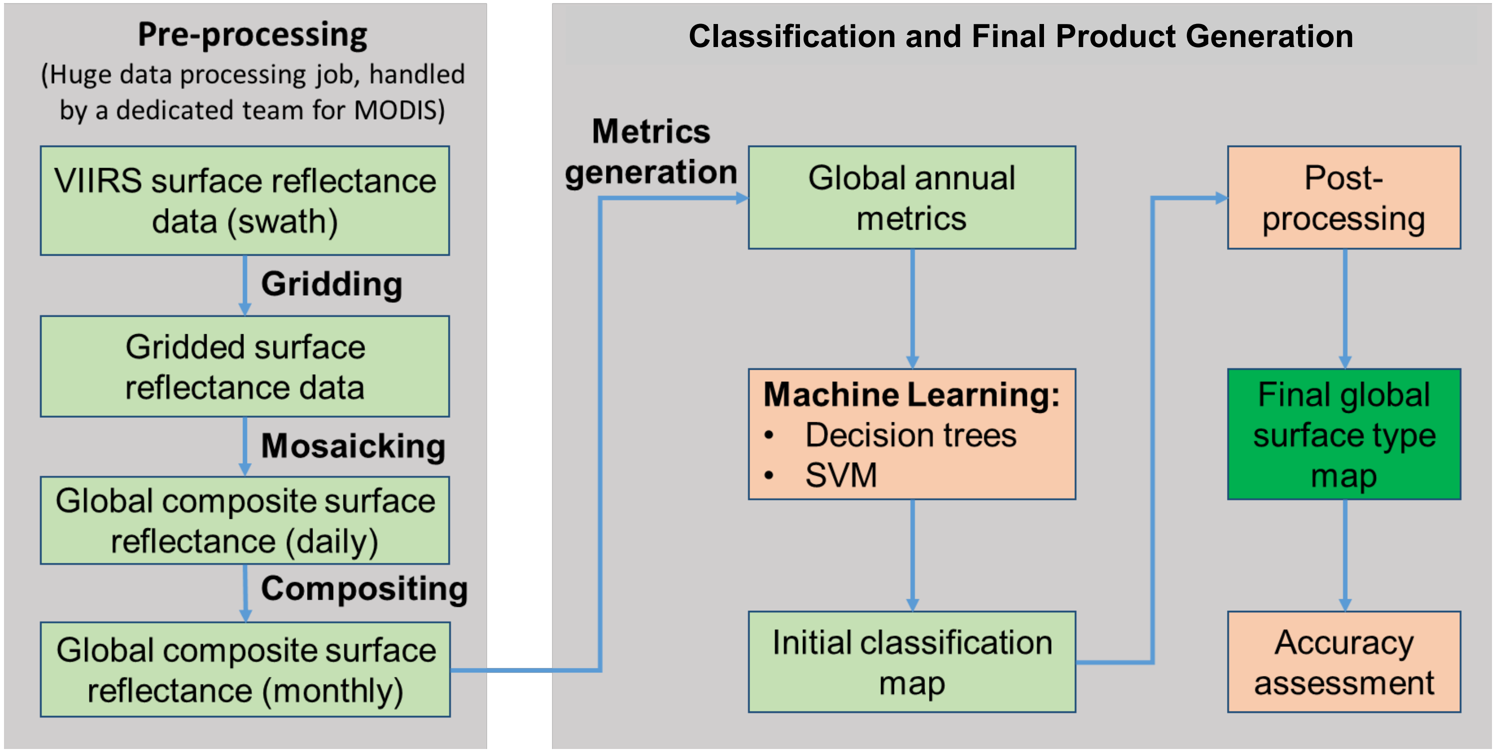
Attribute	Objective
Geographic coverage	Global
Vertical Coverage	
Vertical Cell Size	N/A
Horizontal Cell Size	1 km at nadir
Mapping Uncertainty	1 km
Measurement Range	17 IGBP types
Measurement Accuracy	70% correct for 17 types
Measurement Precision	N/A
Measurement Uncertainty	N/A

Evergreen Needleleaf Forests
Evergreen Broadleaf Forests
Deciduous Needleleaf Forests
Deciduous Broadleaf Forest
Mixed Forests
Closed Shrublands
Open Shrublands
Woody Savannas
Savannas
Grasslands
Permanent Wetlands
Croplands
Urban and Built-up Lands
Cropland/Natural Vegetation Mosaics
Snow and Ice
Barren
Water Bodies

- JPSS Ground Segment Data Product Specification (GSegDPS-2019): DPS-818 (global IGBP), DPS-819 (1km), DPS-820 (70%), DPS-821 (once/year)

Processing Environment and Algorithms

- Processing Environment:
  - UMD/Geography local high performance LINUX clusters
  - Local processing system needed to provide flexibility for:
    - Deriving/improving training/test data
    - Interactive product verification by analyst at each processing stage
    - Rapid reprocessing whenever issues identified



- Findings/Issues from Beta Maturity Review
  - NOAA-20 data available for only 3 months (May – July 2019) by then
    - AST algorithm requires data over 12 months
    - Compared NOAA-20 with S-NPP for those three months
    - Generated a test AST product by replacing S-NPP data with NOAA-20 data for those three months
  - NOAA-20 data were found highly comparable with S-NPP data
- Improvements since Beta Maturity Review
  - More than 12 months of NOAA-20 data required by the AST algorithm have become available
  - Developed methods/code for combining NOAA-20 and S-NPP data for improved surface type monitoring

- Algorithm performance evaluation
  - Validation data sets (type, periods, coverage)
    - STAR VIIRS data from S-NPP and NOAA-20
      - May 2019 – April 2020
    - Daily, monthly, and annual composites
      - M01 – M11 (except M06, M09)
    - GST products
  - Validation strategies / methods
    - Compare NOAA-20 based results with S-NPP based results
    - Examine improvements derived by combining NOAA-20 and S-NPP for surface type monitoring
  - Validation results
  - Long term monitoring readiness

Evaluation of the effect of required algorithm inputs

- Required Algorithm Inputs
  - Primary Sensor Data
    - VIIRS bands M1, M2, M3, M4, M5,M7, M8, M10, M11
  - Upstream algorithms
    - VIIRS surface reflectance EDR
  - LUTs / PCTs
    - N/A
  - Ancillary Data
    - Postprocessing ancillary datasets (e.g. crop probability, urban, water)
    - Surface type training, validation points

Training Data

- Include more than 45 K labeled pixels
- Represent different surface types in different geographical regions
  - Classes 13 and 17 are derived based on ancillary data, and hence no need for training pixels

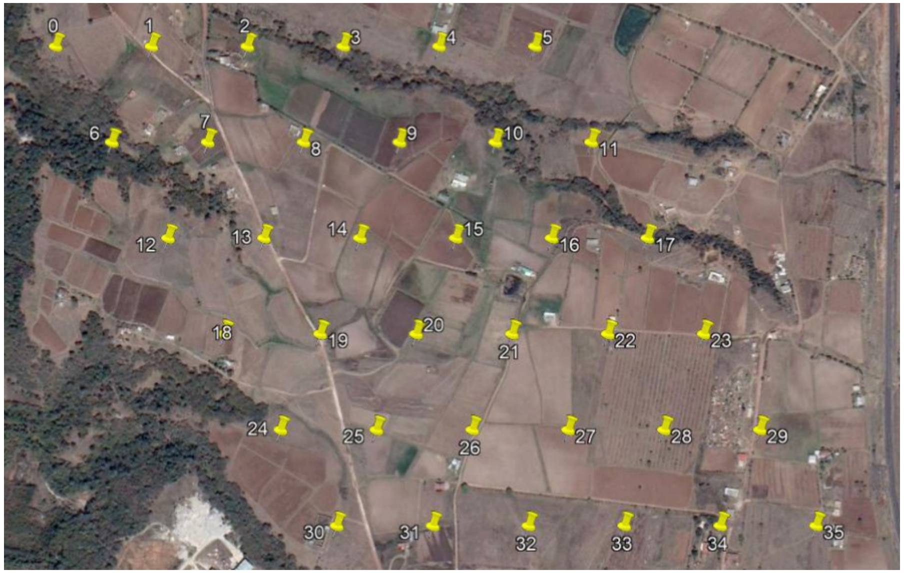
IGBP class number	IGBP class name	Number of pixels in training
1	Evergreen needleleaf forests	1223
2	Evergreen broadleaf forests	5881
3	Deciduous needleleaf forests	558
4	Deciduous broadleaf forest	991
5	Mixed forests	1972
6	Closed shrublands	389
7	Open shrublands	6239
8	Woody savannas	2933
9	Savannas	3330
10	Grasslands	5554
11	Permanent wetlands	1439
12	Croplands	8184
13	Urban and built-up lands	0
14	Cropland/natural vegetation mosaics	1304
15	Snow and ice	859
16	Barren	4233
17	Water bodies	0
Total		45089


Distribution of Surface Type Training Points

Training Data

- Developed by VIIRS Surface Type team
- An in-house tool was developed to facilitate class labeling:
  - Divide each 1-km grid into 36 sub-grids
  - Overlay them on Google Earth (GE) high resolution imagery
  - Image analyst determine surface type based on GE imagery

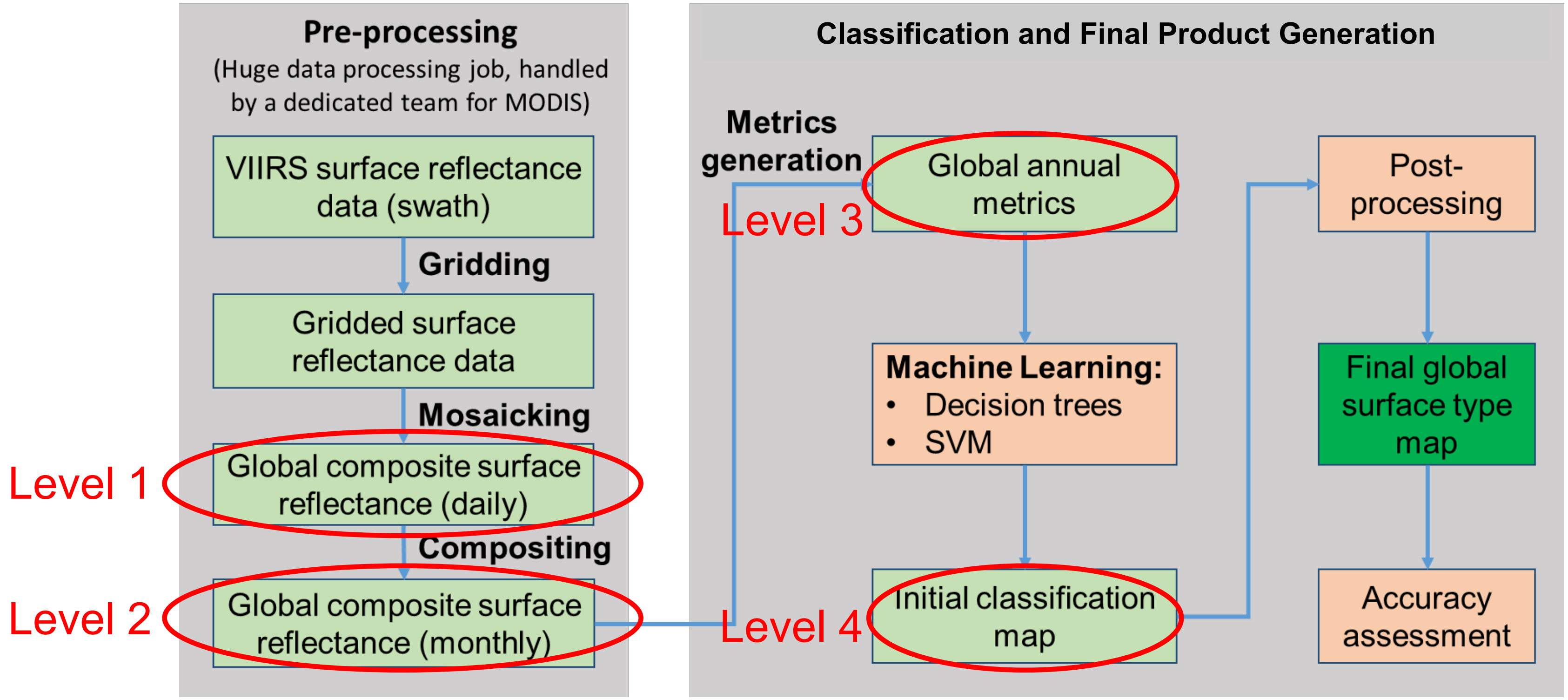
(a) Evergreen broadleaf forest (Central Africa)



(b) Cropland (North America)

Surface Type Maturity Evaluation Methodology

- Use Suomi NPP as reference, compare NOAA-20 data with S-NPP data at each key steps of the AST algorithm
  - Surface reflectance data
    - Gridded daily data (Level 1)
    - Monthly composites (Level 2)
    - Annual metrics (Level 3)
  - Annual surface type classification (Level 4)
- Integration of NOAA-20 with S-NPP for improved surface type monitoring



Accuracy/Performance Measures

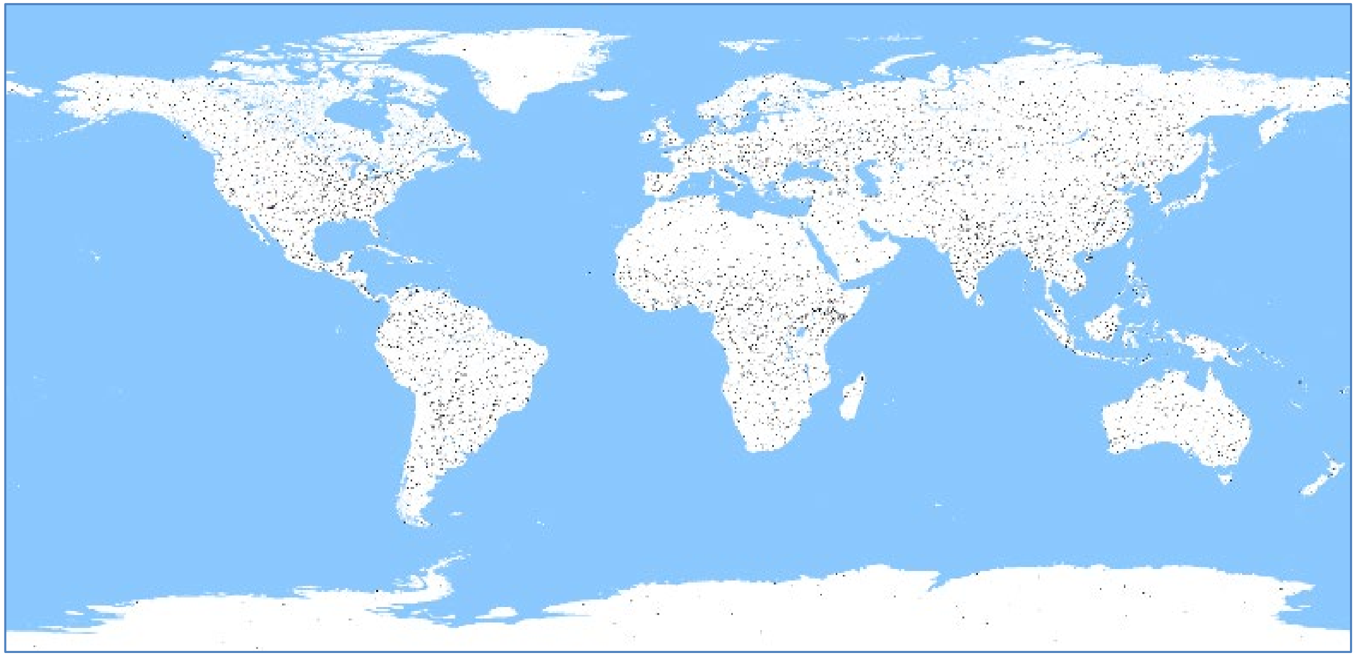
- Surface reflectance data (daily, monthly, annual composites)
  - Visual assessment
  - Scatterplot
- Annual surface type classification
  - Visual assessment
  - Accuracy estimates
    - based on a global validation dataset

Validation Data

- Developed by VIIRS Surface Type team
- Include 6000 labeled pixels
  - Selected following an established method (Olofsson et al. 2014)
  - Labeled according to GE high resolution images using an in-house tool (see slide #15)

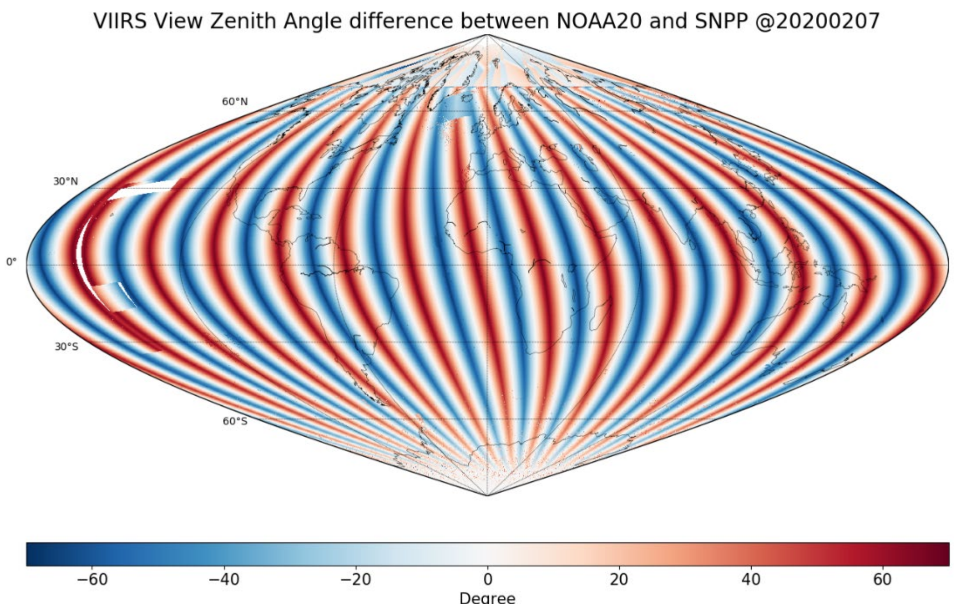
Class number	Class name	Number of validation samples	Percentage in the validation dataset (%)
1	Evergreen needleleaf forests	240	4
2	Evergreen broadleaf forests	600	10
3	Deciduous needleleaf forests	120	2
4	Deciduous broadleaf forest	180	3
5	Mixed forests	360	6
6	Closed shrublands	60	1
7	Open shrublands	660	11
8	Woody savannas	660	11
9	Savannas	300	5
10	Grasslands	720	12
11	Permanent wetlands	60	1
12	Croplands	960	16
13	Urban and built-up lands	120	2
14	Cropland/natural vegetation mosaics	540	9
15	Snow and ice	60	1
16	Barren	300	5
17	Water bodies	60	1
Total		6000	100

Distribution of Surface Type Validation Points

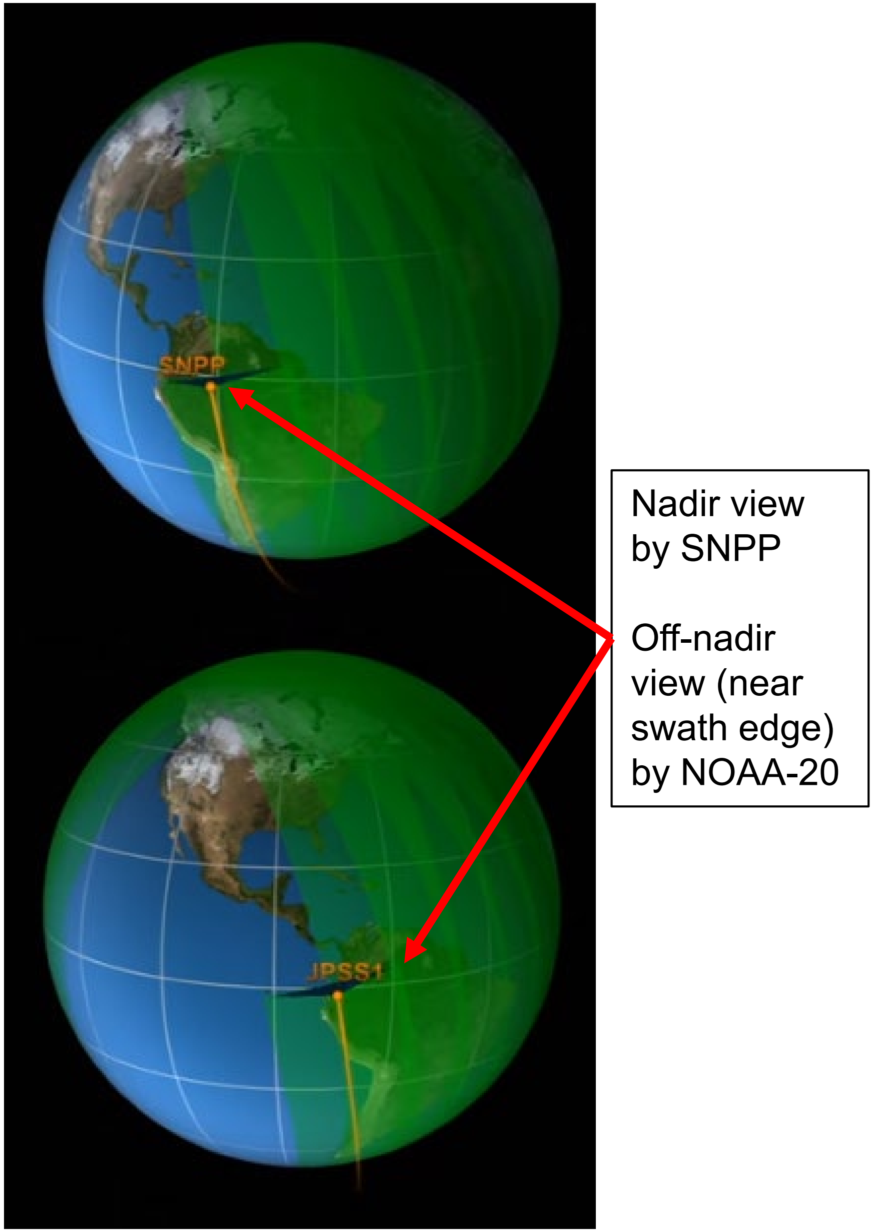


Level 1 Comparison: Daily Surface Reflectance

- VIIRS on NOAA-20 and S-NPP near identical
  - Same spectral bands
  - Same spatial resolutions
  - Follow each other on the same orbit
  - Near identical equator crossing time
- But same day data over same ground targets not identical
  - Different local solar time: ~50 minutes difference (NOAA-20 earlier)
  - Different sensor zenith angles



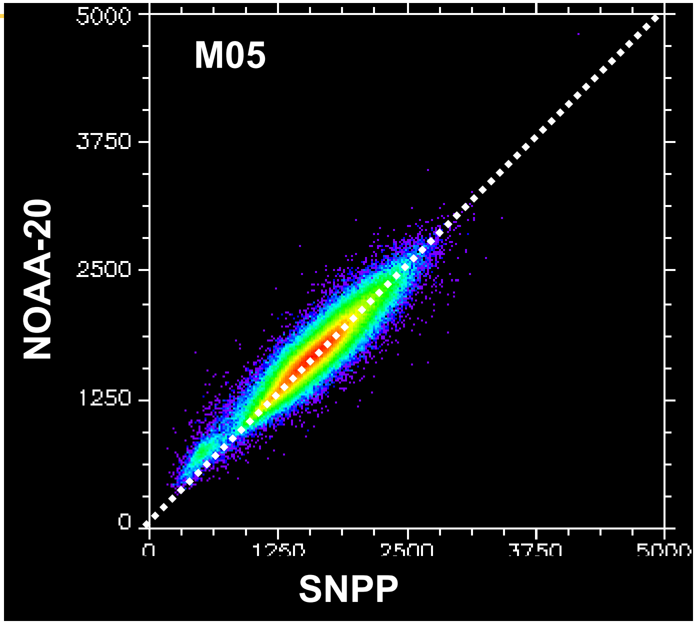
(Courtesy VIIRS SR team)

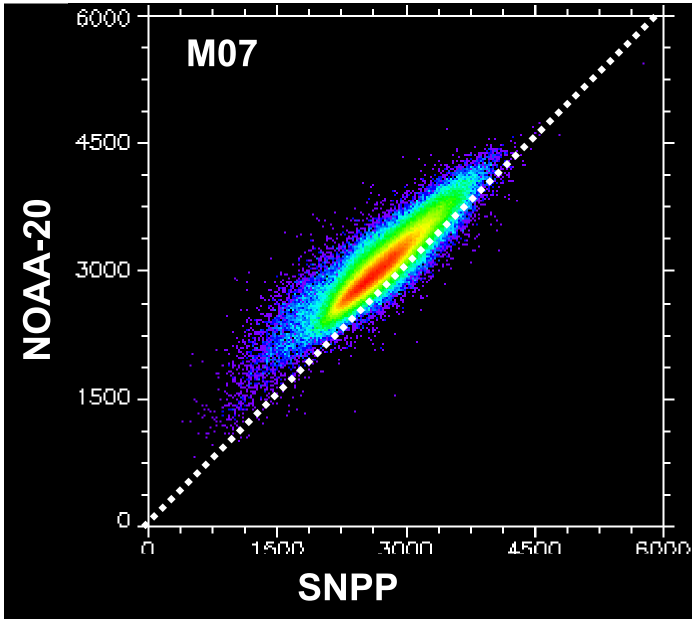


Daily Surface Reflectance Data – Detailed Comparison

- Same Day NOAA-20 and SNPP Data Correlated But Not Identical
  - Sun angle changes substantially in 50 minutes
  - Large differences in view geometry

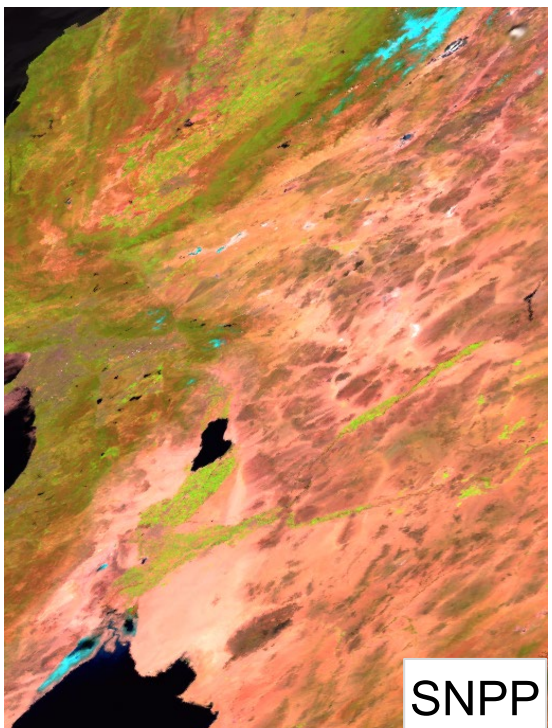
Southwest Africa
June 28, 2019
RGB: M10/7/5

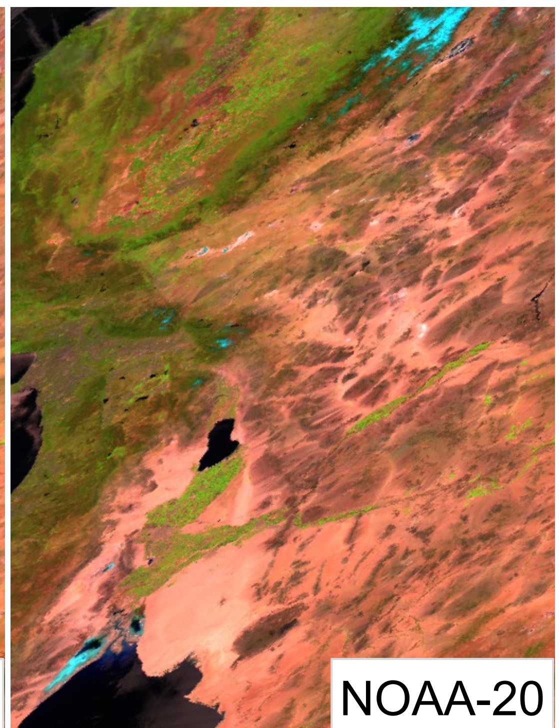


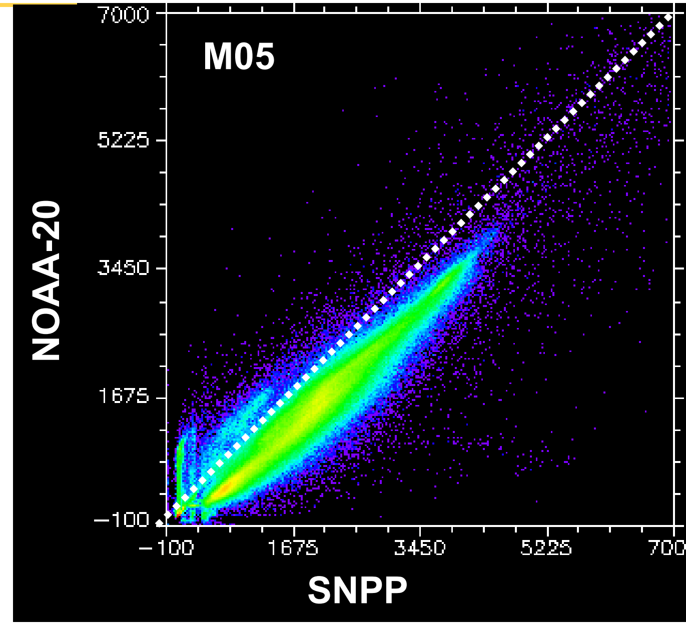


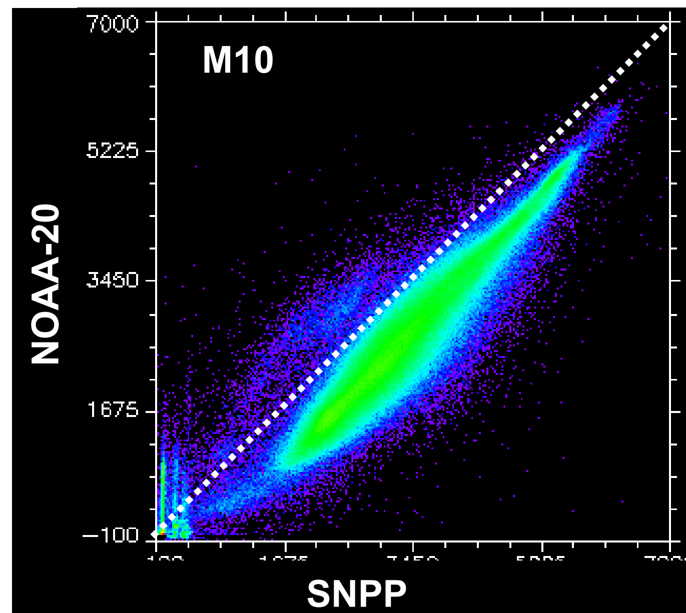
Daily Surface Reflectance Data – Detailed Comparison

Southwest US
April 25, 2020
RGB: M10/7/5



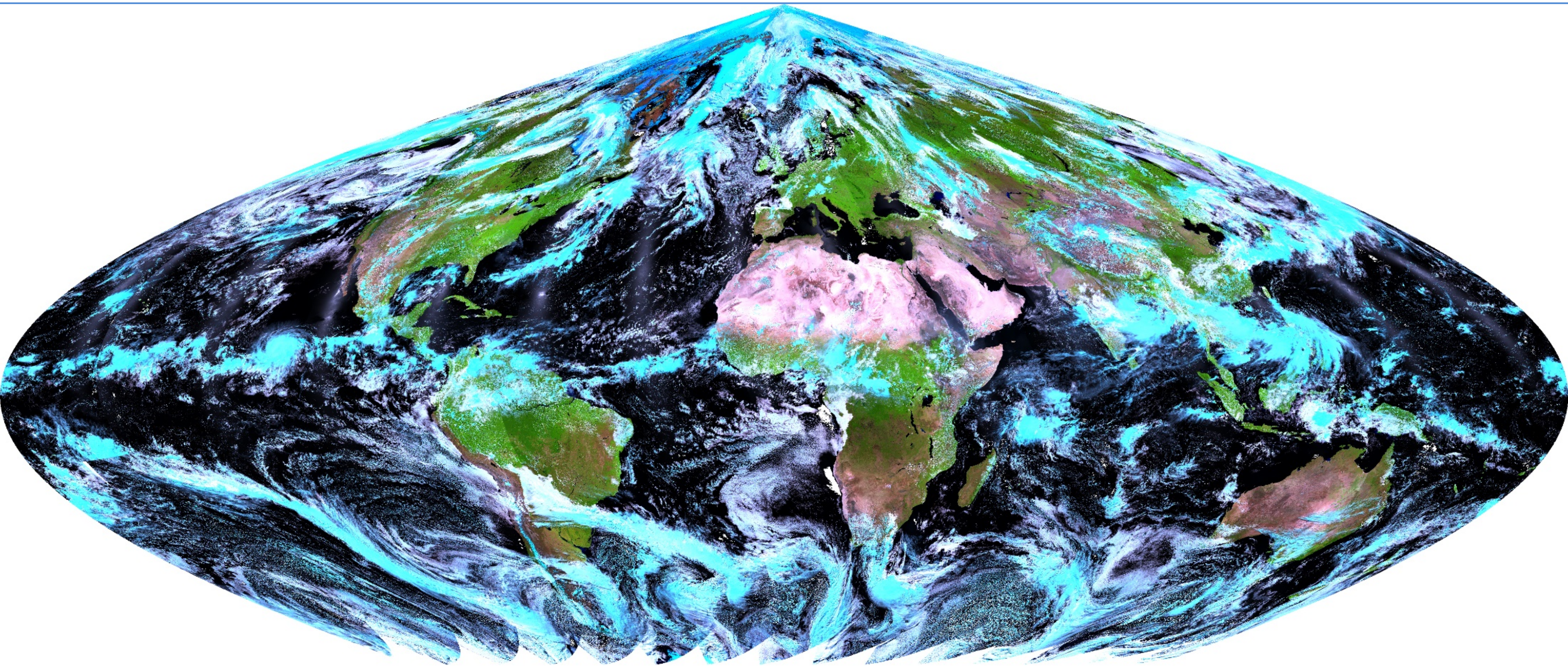






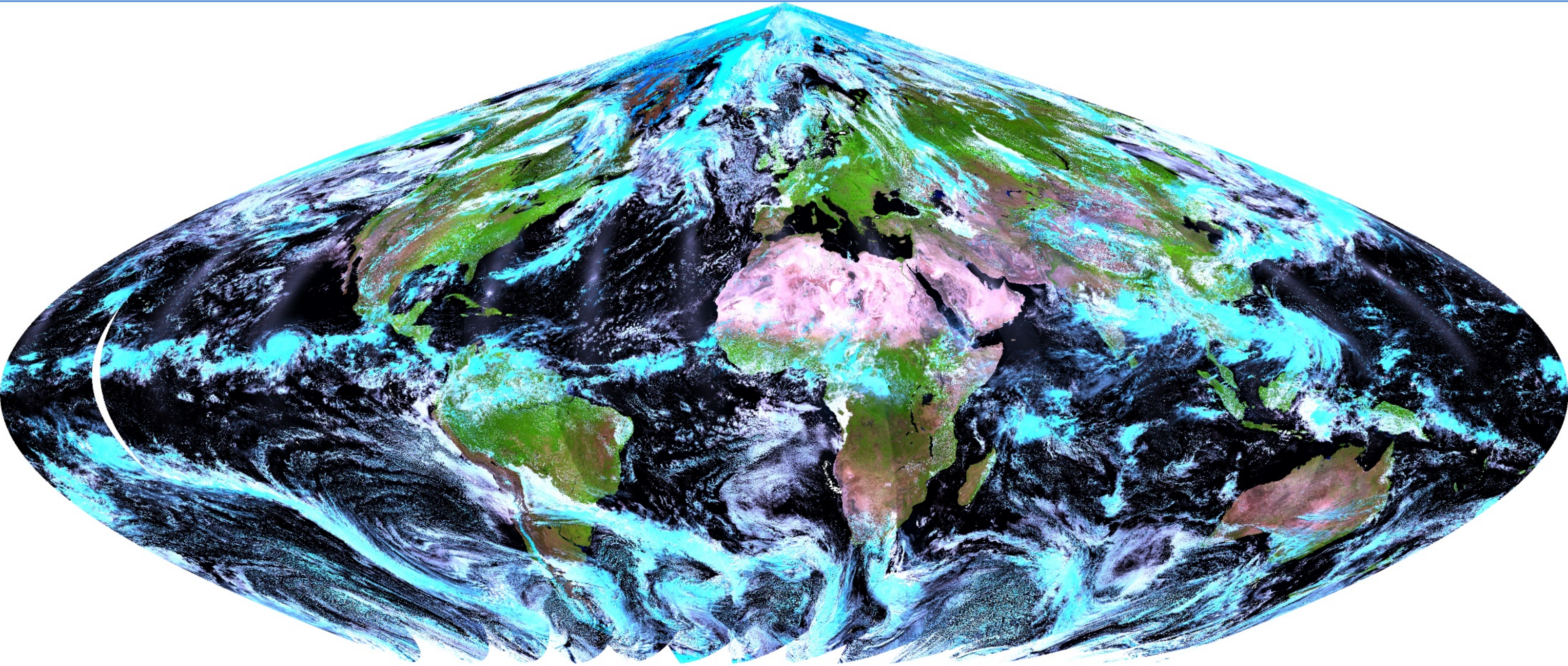
Global Daily Mosaics Are Very Similar

Daily Composite (NOAA-20), July 1, 2019, RGB: M10, M7, M5



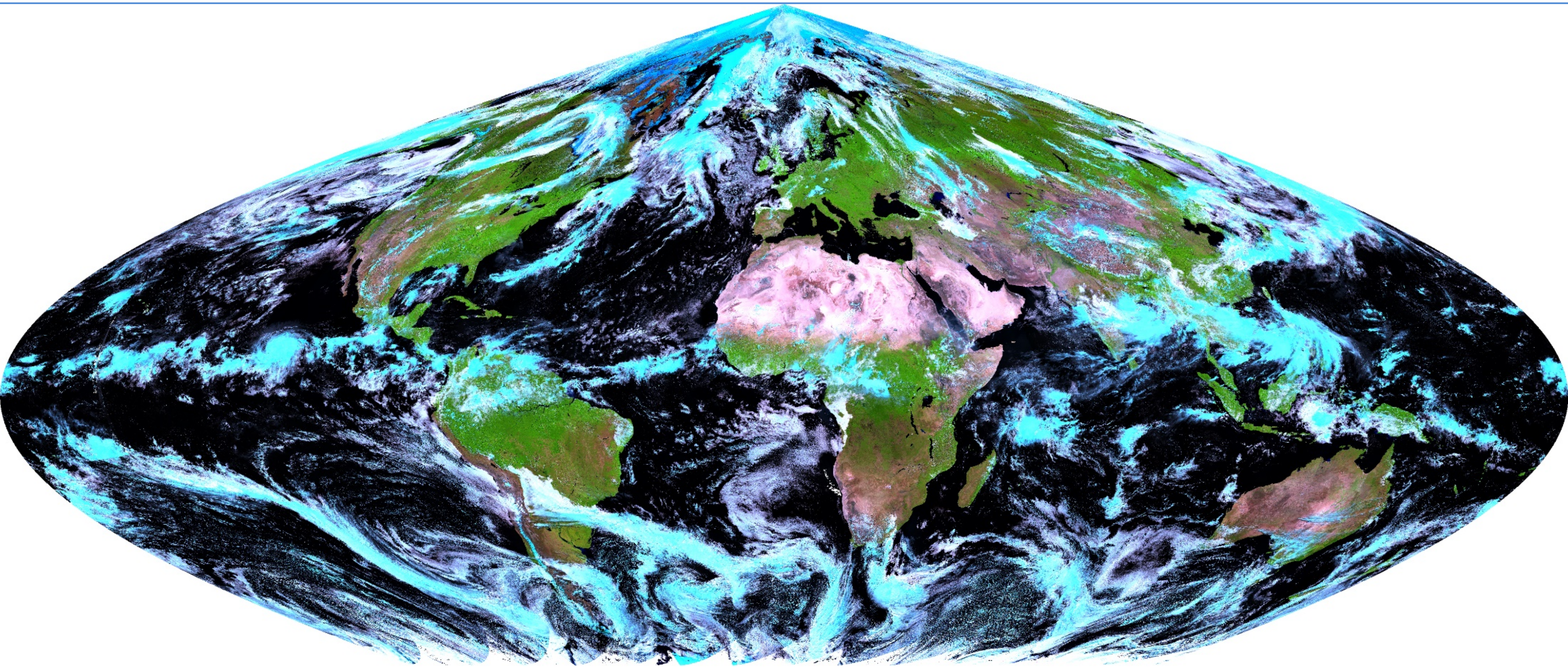
Global Daily Mosaics Are Very Similar

Daily Composite (S-NPP), July 1, 2019, RGB: M10, M7, M5



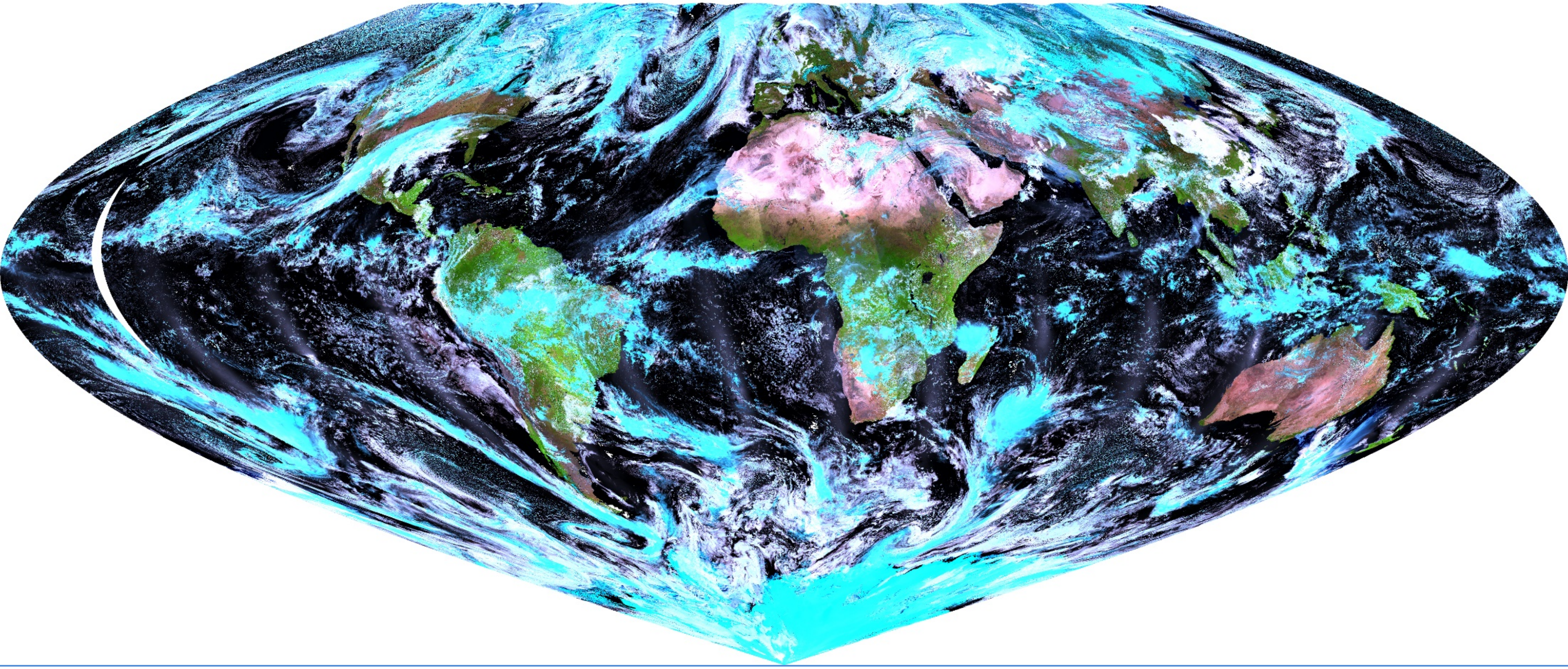
Improved Global Daily Mosaics from Both

Daily Composite (NOAA-20 + S-NPP), July 1, 2019, RGB: M10, M7, M5



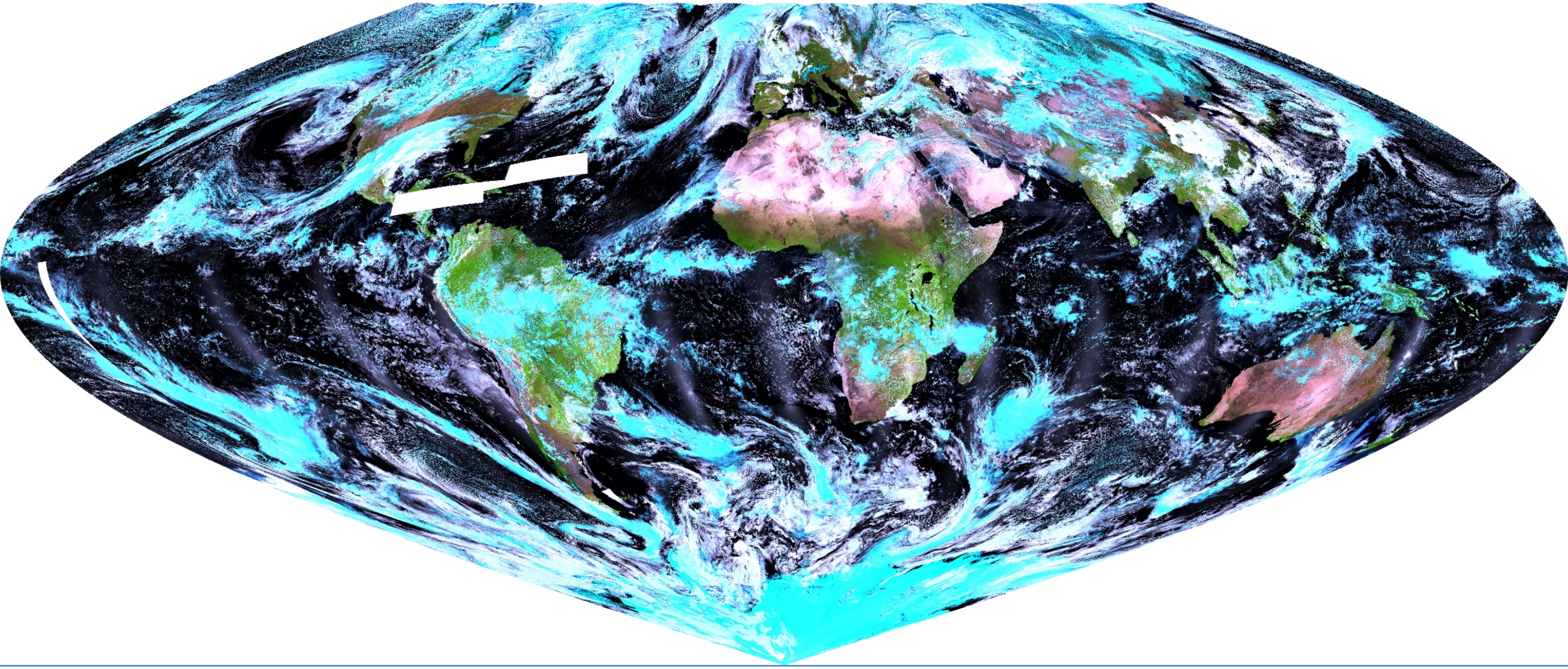
Global Daily Mosaics Are Very Similar

Daily Composite (NOAA-20), January 1, 2020, RGB: M10, M7, M5



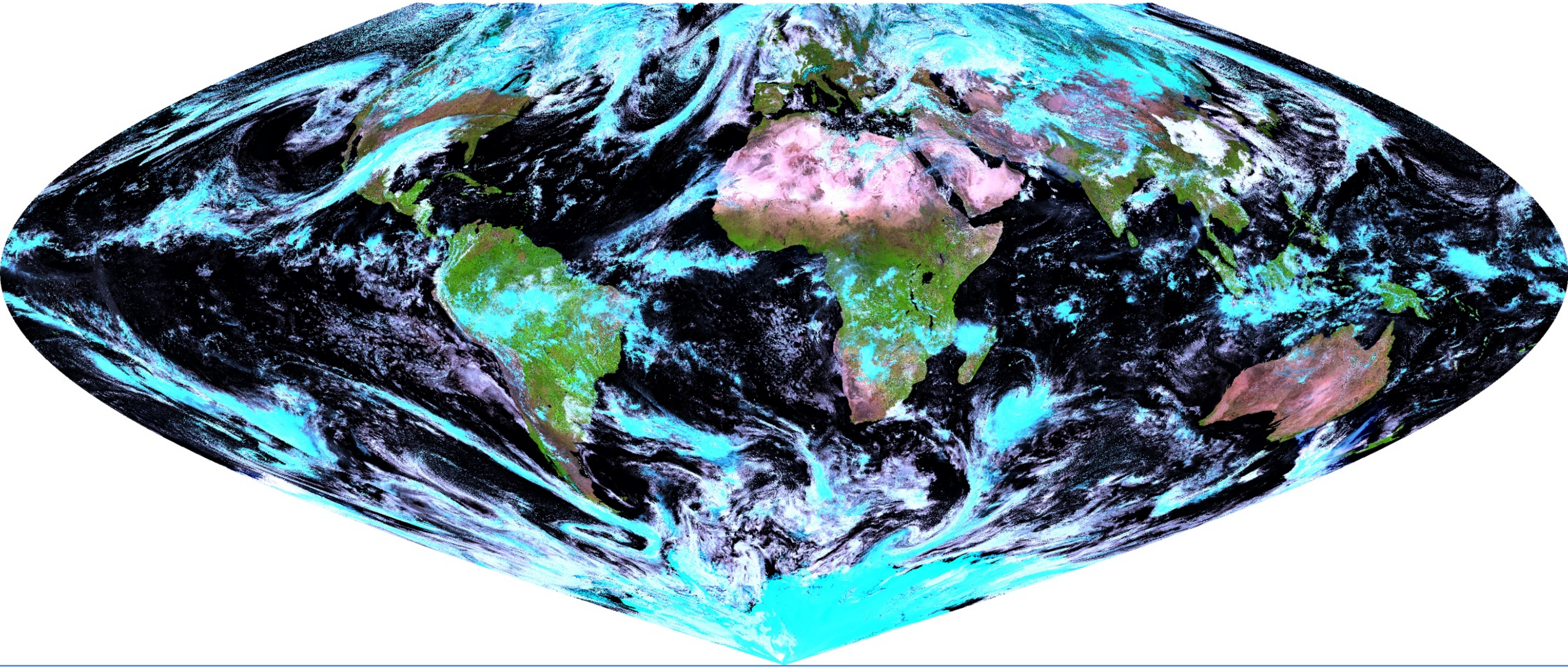
Global Daily Mosaics Are Very Similar

Daily Composite (S-NPP), January 1, 2020, RGB: M10, M7, M5



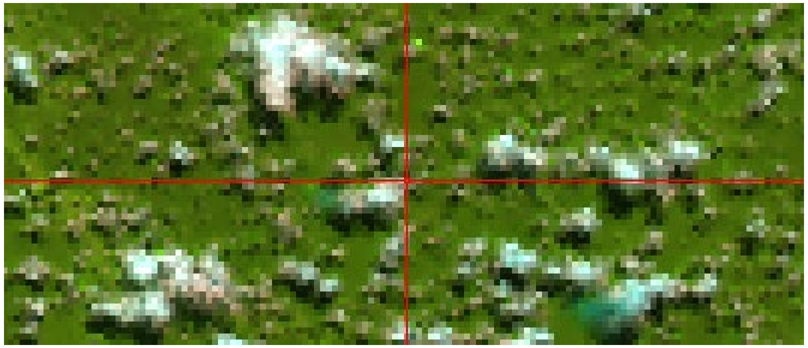
Improved Global Daily Mosaics from Both

Daily Composite (NOAA-20 + S-NPP), January 1, 2020, RGB: M10, M7, M5

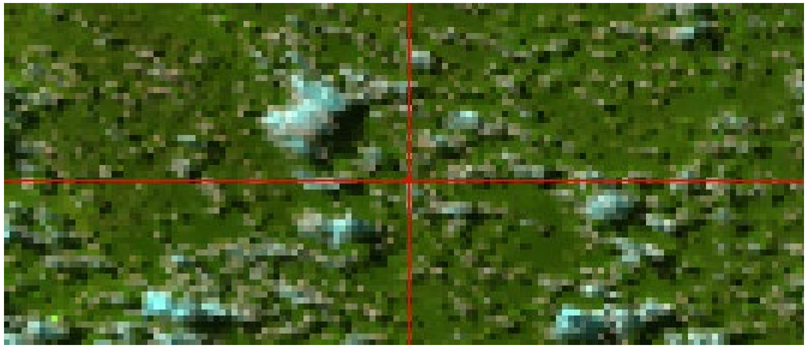


Daily Surface Reflectance Data – Detailed Comparison

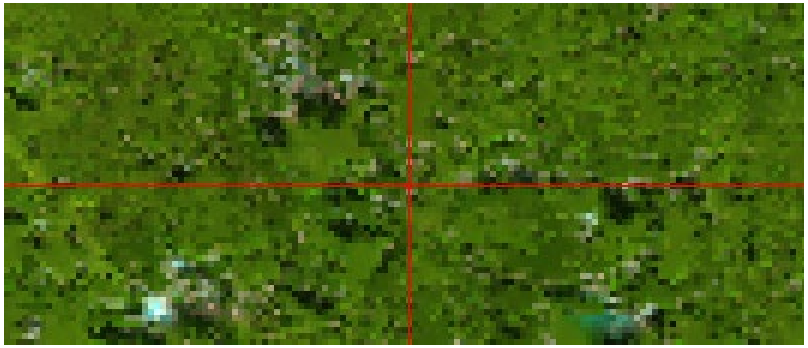
NOAA-20



S-NPP



NOAA-20 + S-NPP



South America (July 1, 2019)

Daily Surface Reflectance Data – Detailed Comparison

NOAA-20

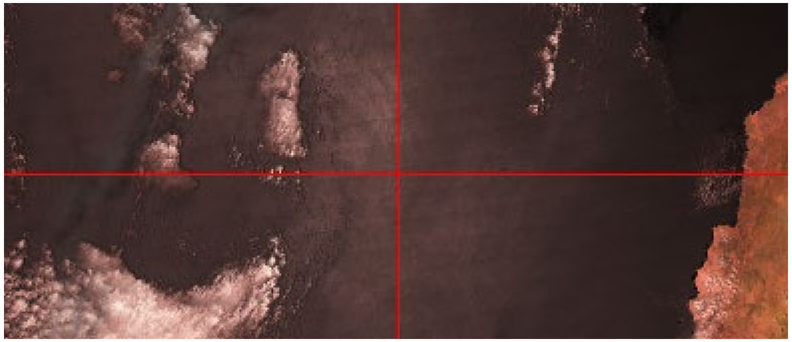
S-NPP

NOAA-20 + S-NPP

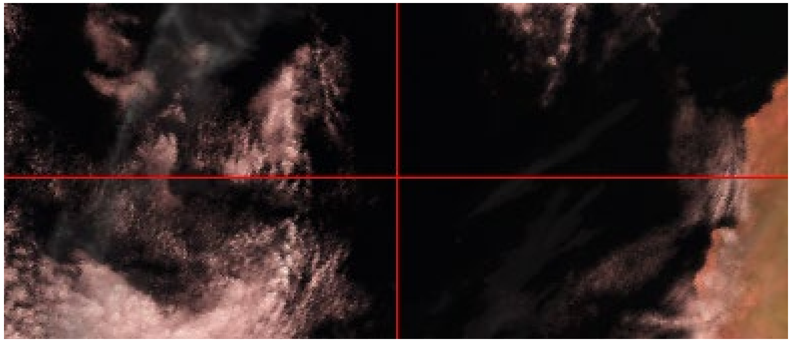
United States (Eastern Coast, July 1, 2019)

Daily Surface Reflectance Data – Detailed Comparison

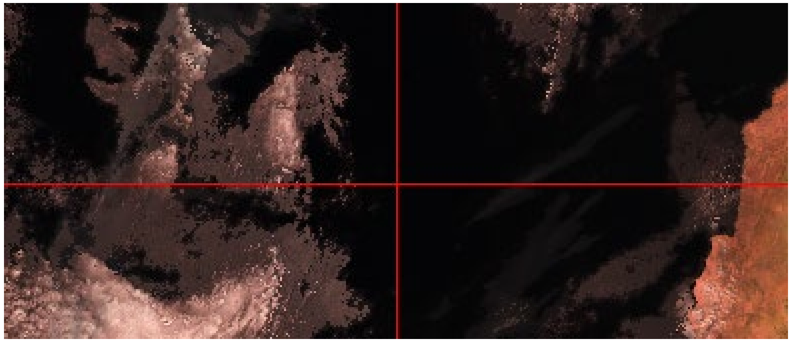
NOAA-20



S-NPP



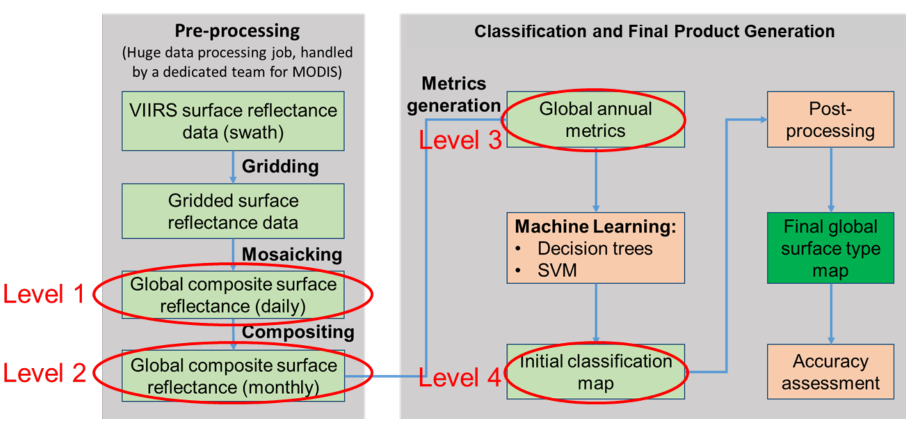
NOAA-20 + S-NPP



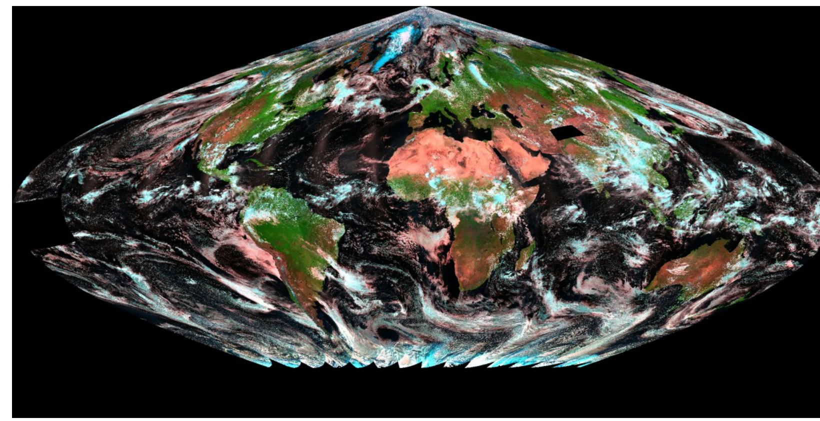
South Africa (western coast, January 1, 2020)

Level 2: Monthly Composites

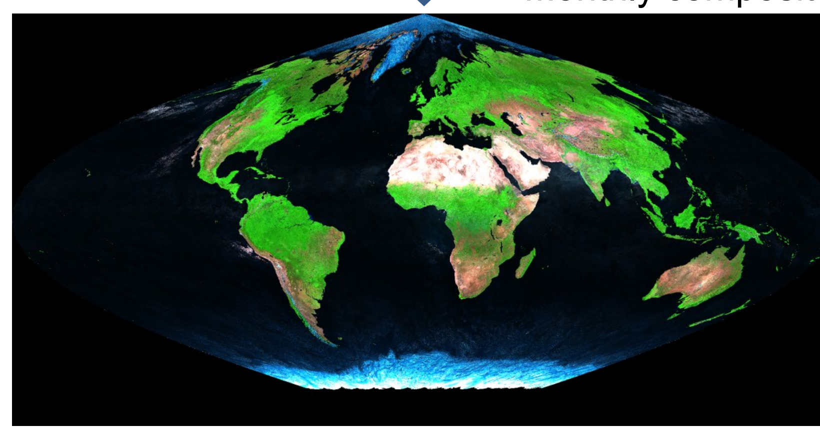
- Purpose: create global data with minimum or no cloud cover
- General idea:
  - Define compositing period: one month
  - At each pixel location, select the best observation within each month as the composited observation for that month
- Input:
  - Gridded daily surface reflectance for all days within a month
- Output
  - One composite per month, near cloud free



Daily surface reflectance



Monthly composite



New Compositing Algorithm Developed for VIIRS

Better Than

MODIS

Heritage

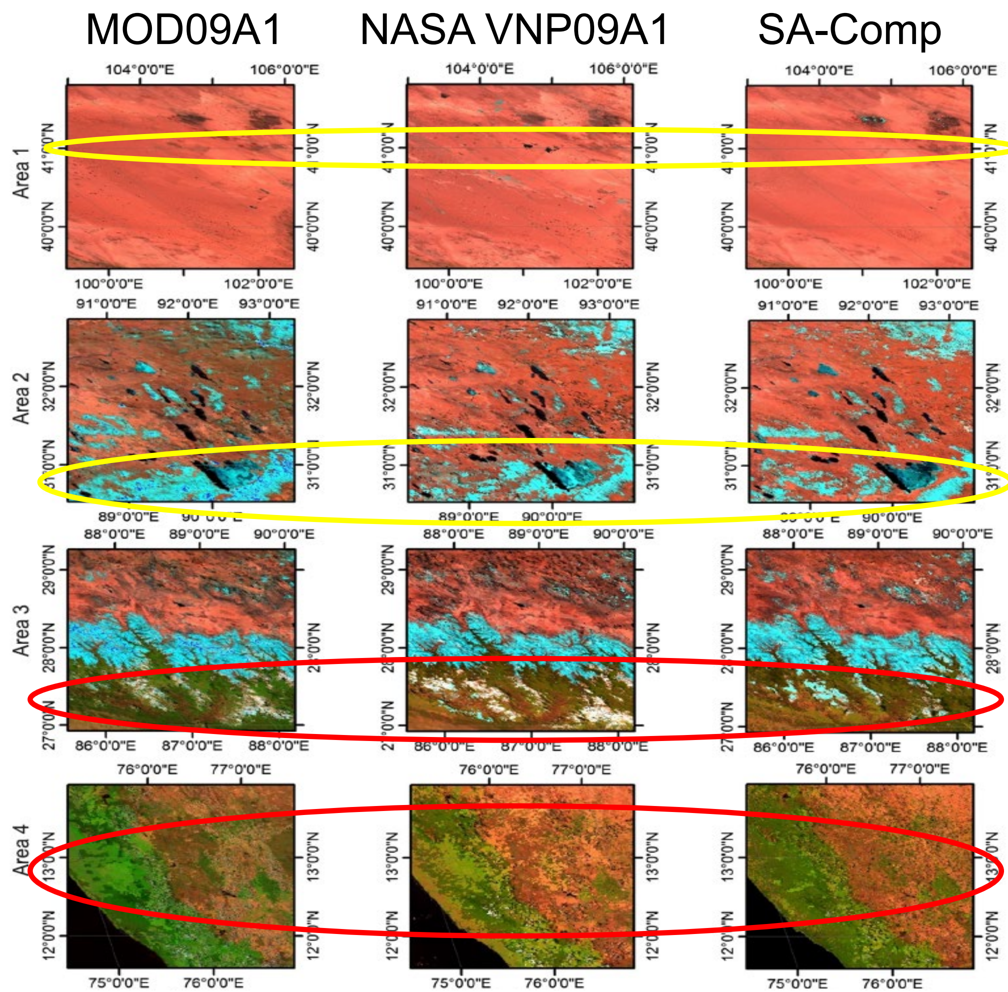
Methods

Less shadow

Non-snow selected when exist

Less cloud

Smoother results over vegetated and non-vegetated areas



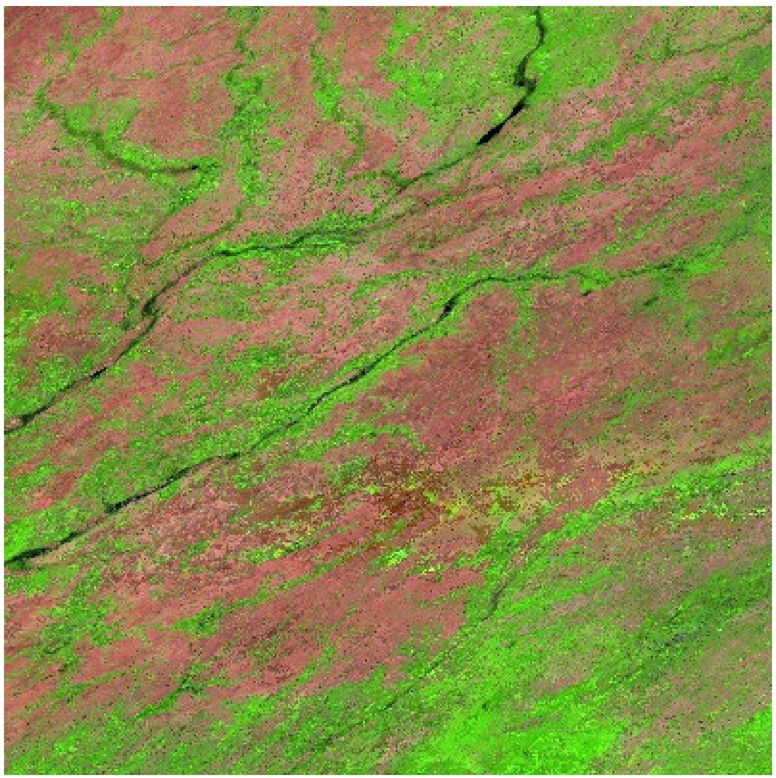
Bian, J., Li, A., Huang, C., Zhang, R., & Zhan, X. (2018). A self-adaptive approach for producing clear-sky composites from VIIRS surface reflectance datasets. *ISPRS Journal of Photogrammetry and Remote Sensing, 144, 189-201.*

Monthly Composites Assessment: Scope and Expectations

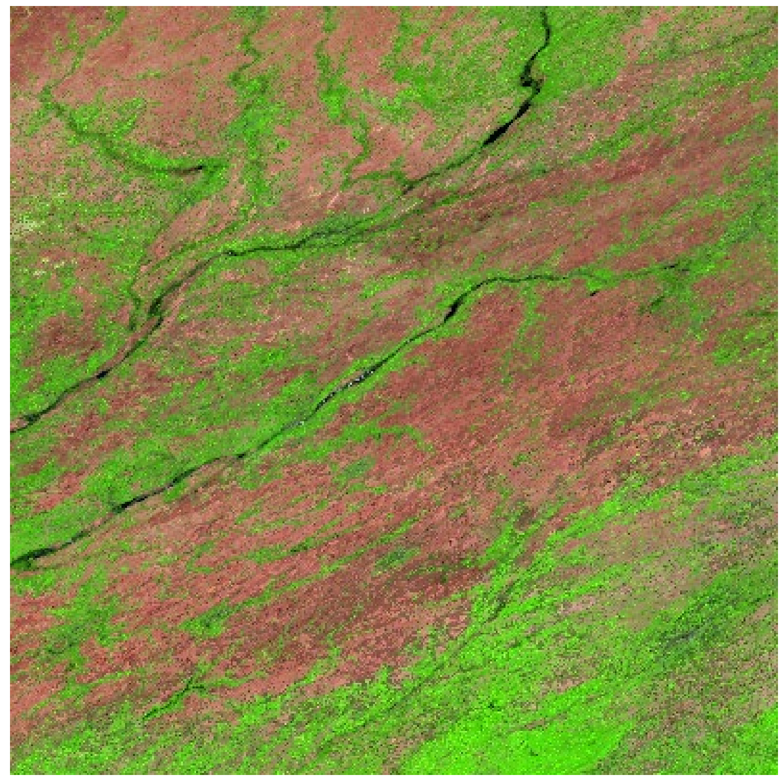
- Monthly composites generated
  - May 2019 – April 2020
    - Full month NOAA-20 not available until May 2019
- Are NOAA-20 and S-NPP monthly composites comparable?
  - Not identical at individual pixel level
    - Not identical in each individual day
    - NOAA-20 and S-NPP composites may be selected from different dates
  - Statistically comparable, visually very similar
- Use data from both satellites to generate monthly composites

Monthly Composites Comparison Examples

May 2019, US Midwest
RGB: M10, M7, M5



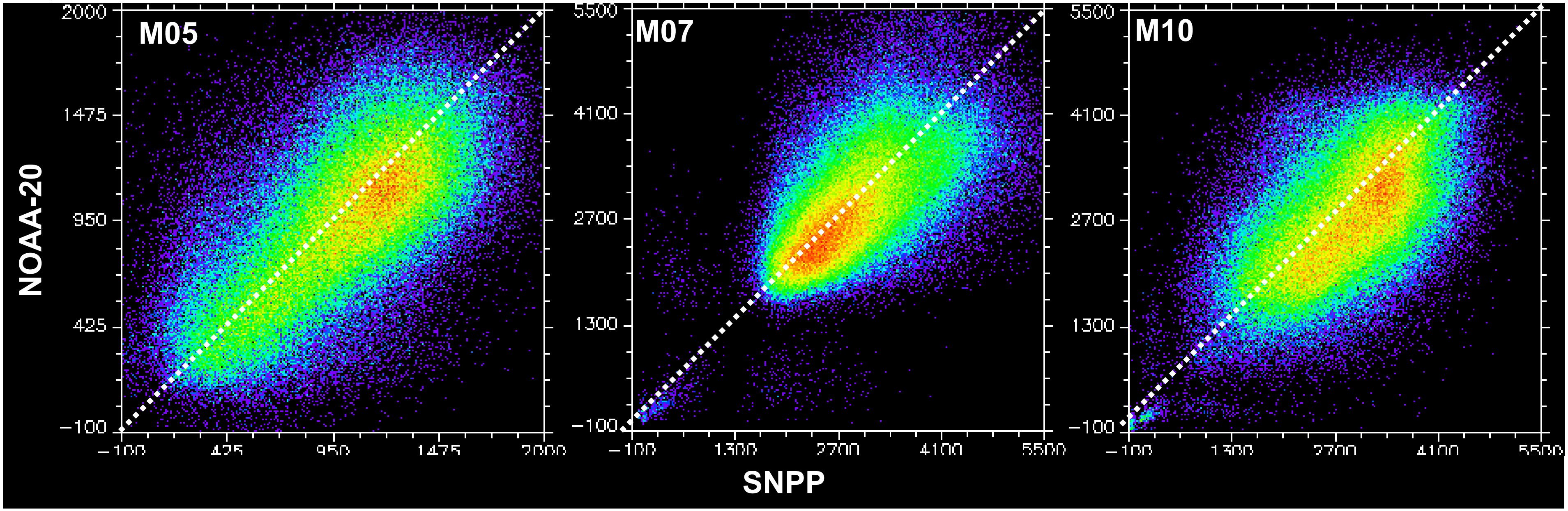
S-NPP



NOAA-20

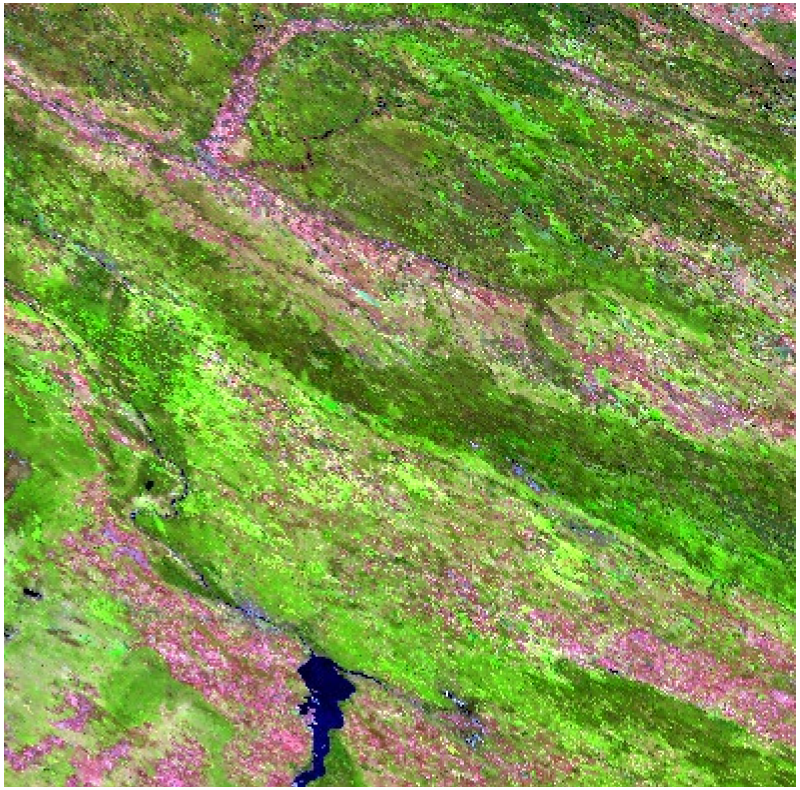
Monthly Composites Comparison Examples

May 2019
US Midwest

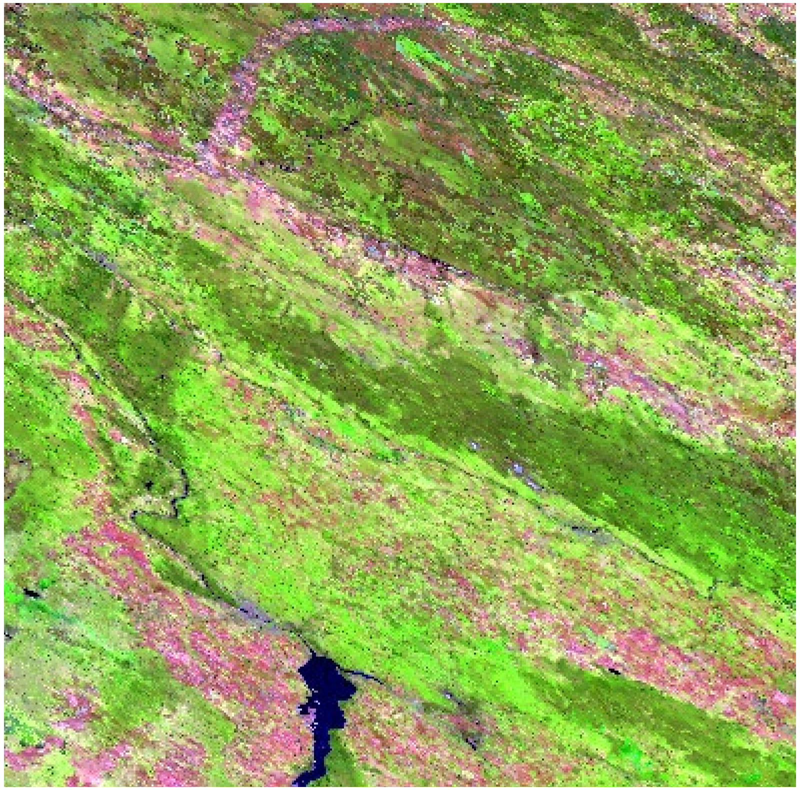


Monthly Composites Comparison Examples

May 2019, Central Asia
RGB: M10, M7, M5



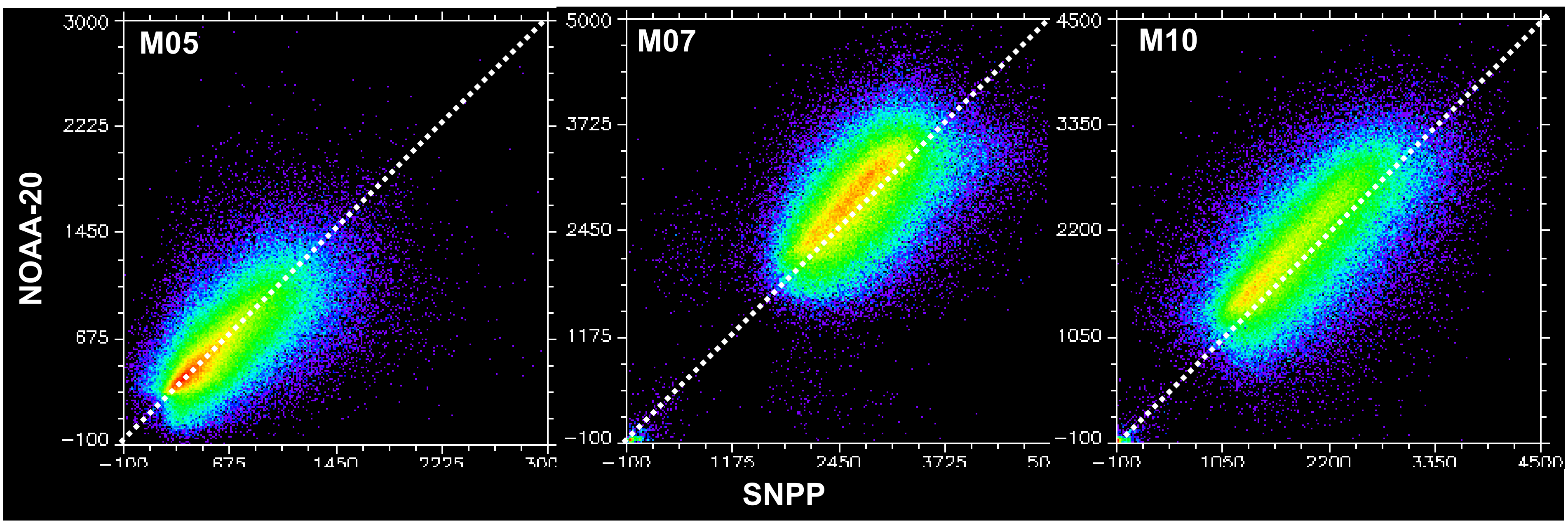
S-NPP



NOAA-20

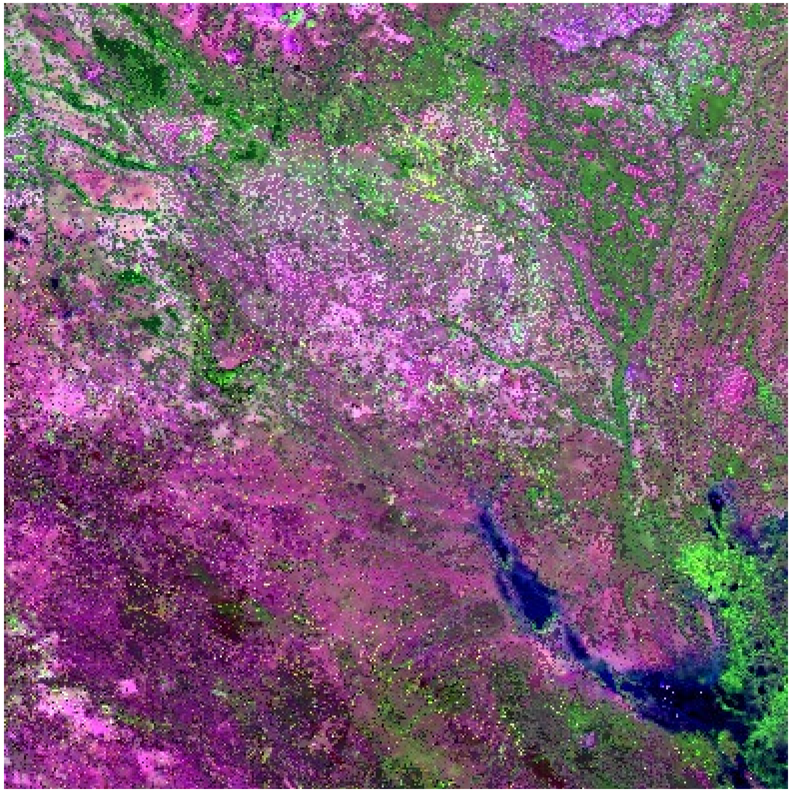
Monthly Composites Comparison Examples

May 2019
Central Asia

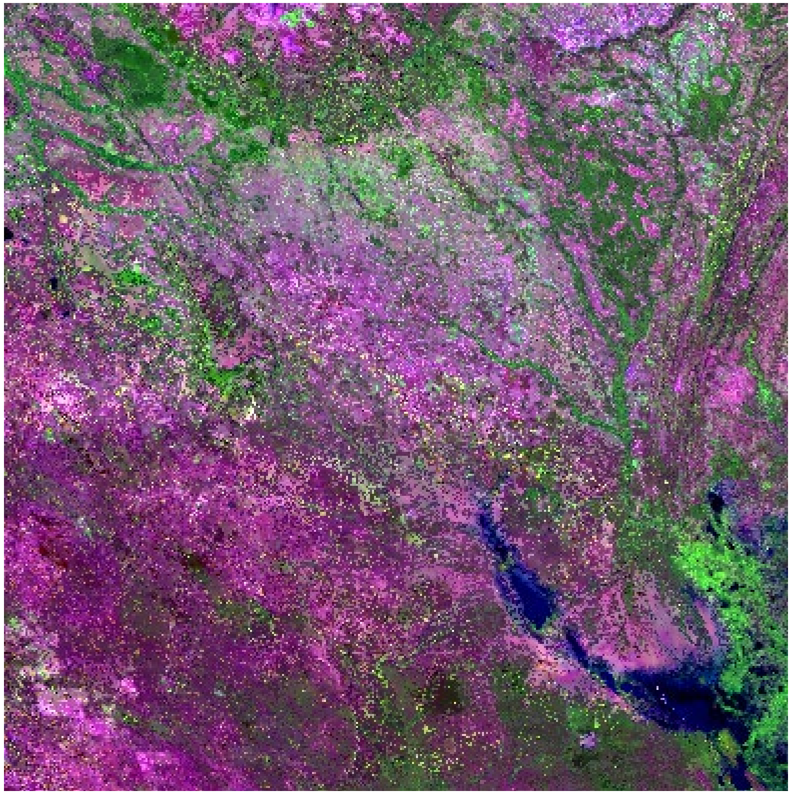


Monthly Composites Comparison Examples

July 2019, Central South America
RGB: M10, M7, M5



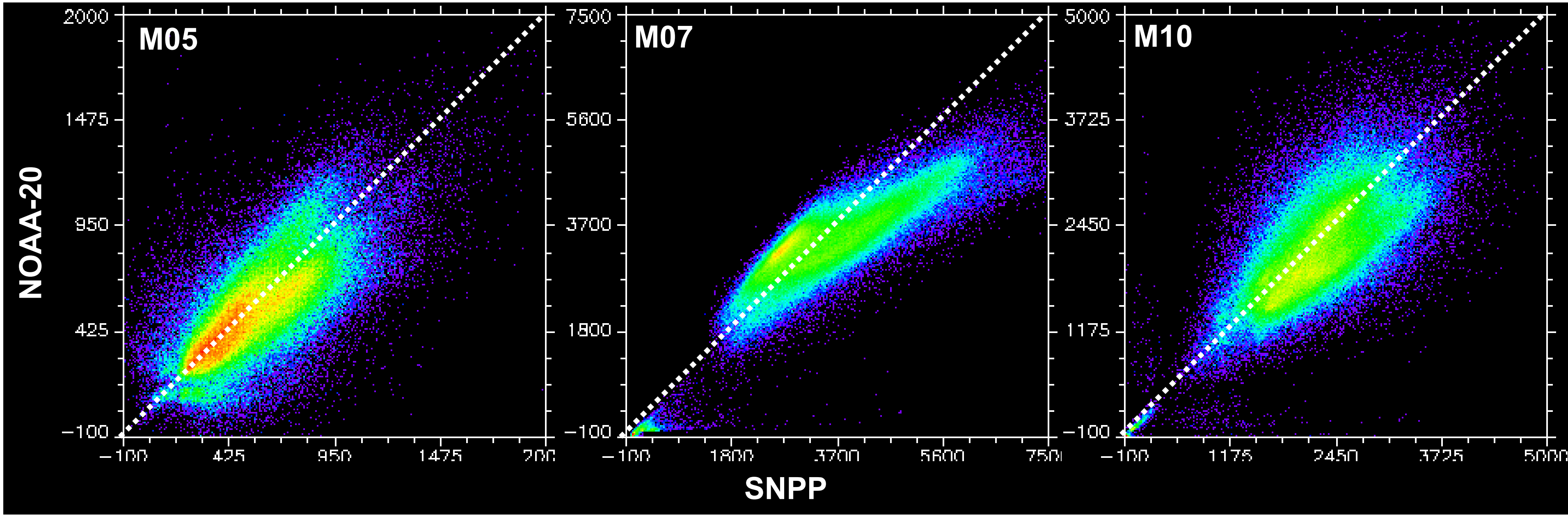
S-NPP



NOAA-20

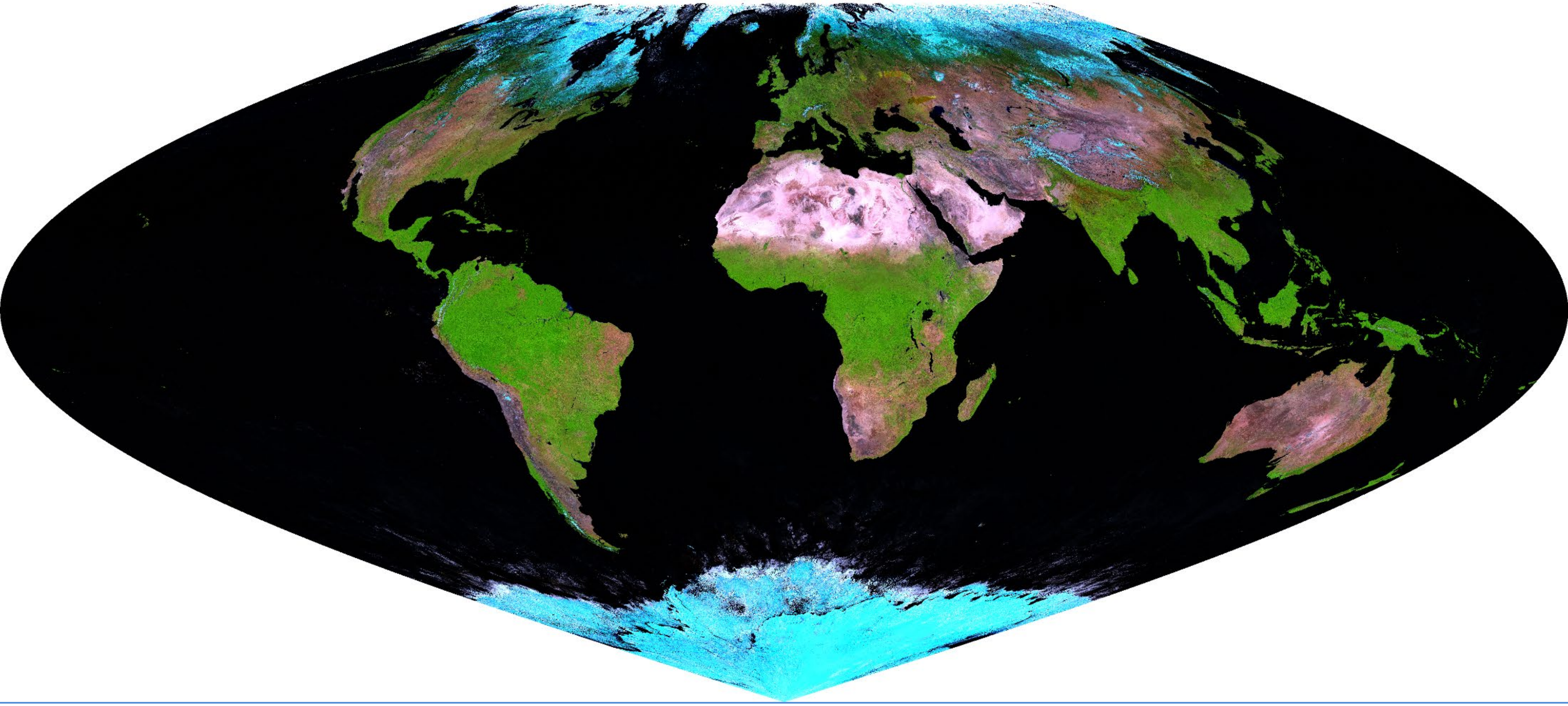
Monthly Composites Comparison Examples

July 2019
South America



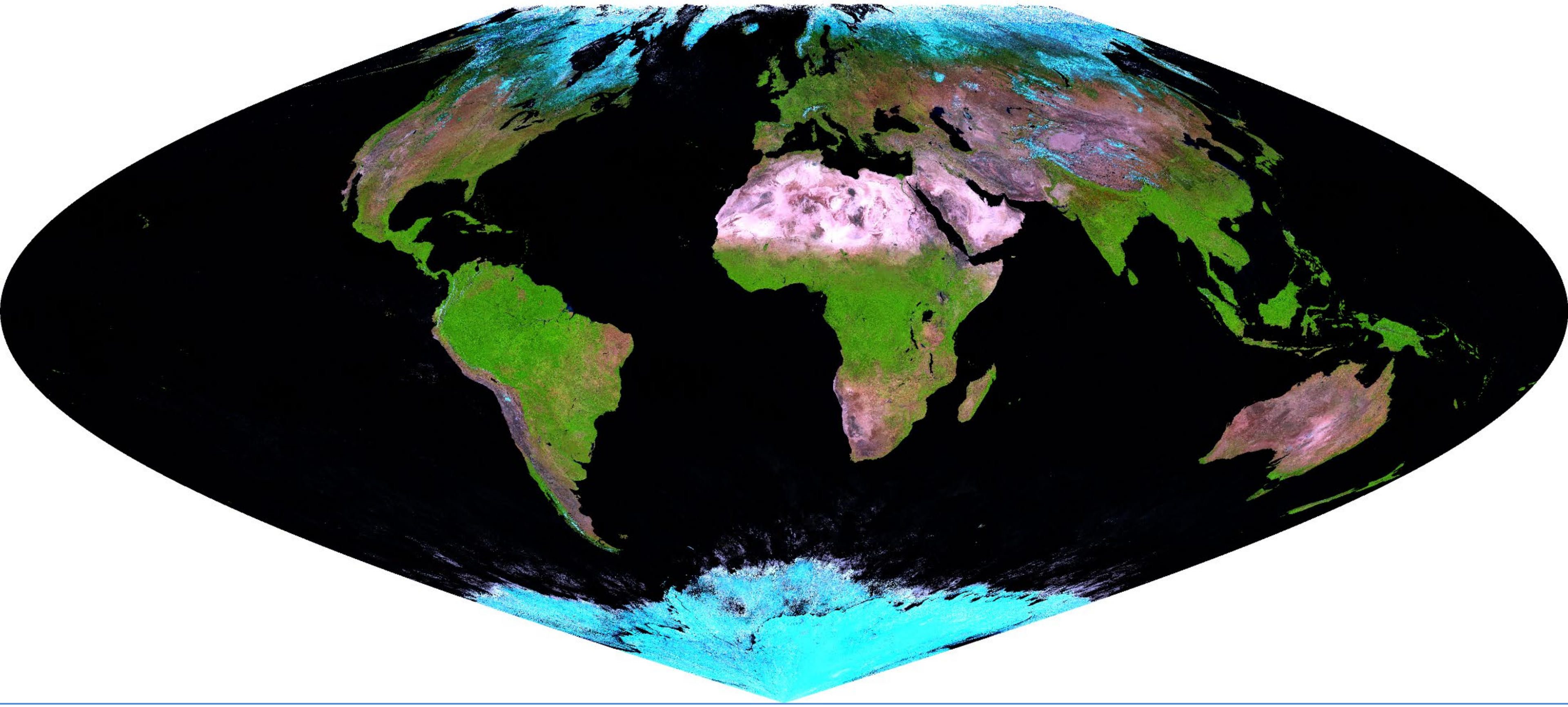
Global Monthly Mosaics Are Very Similar

NOAA-20 Monthly Mosaic, November 2019, RGB: M10, M7, M5



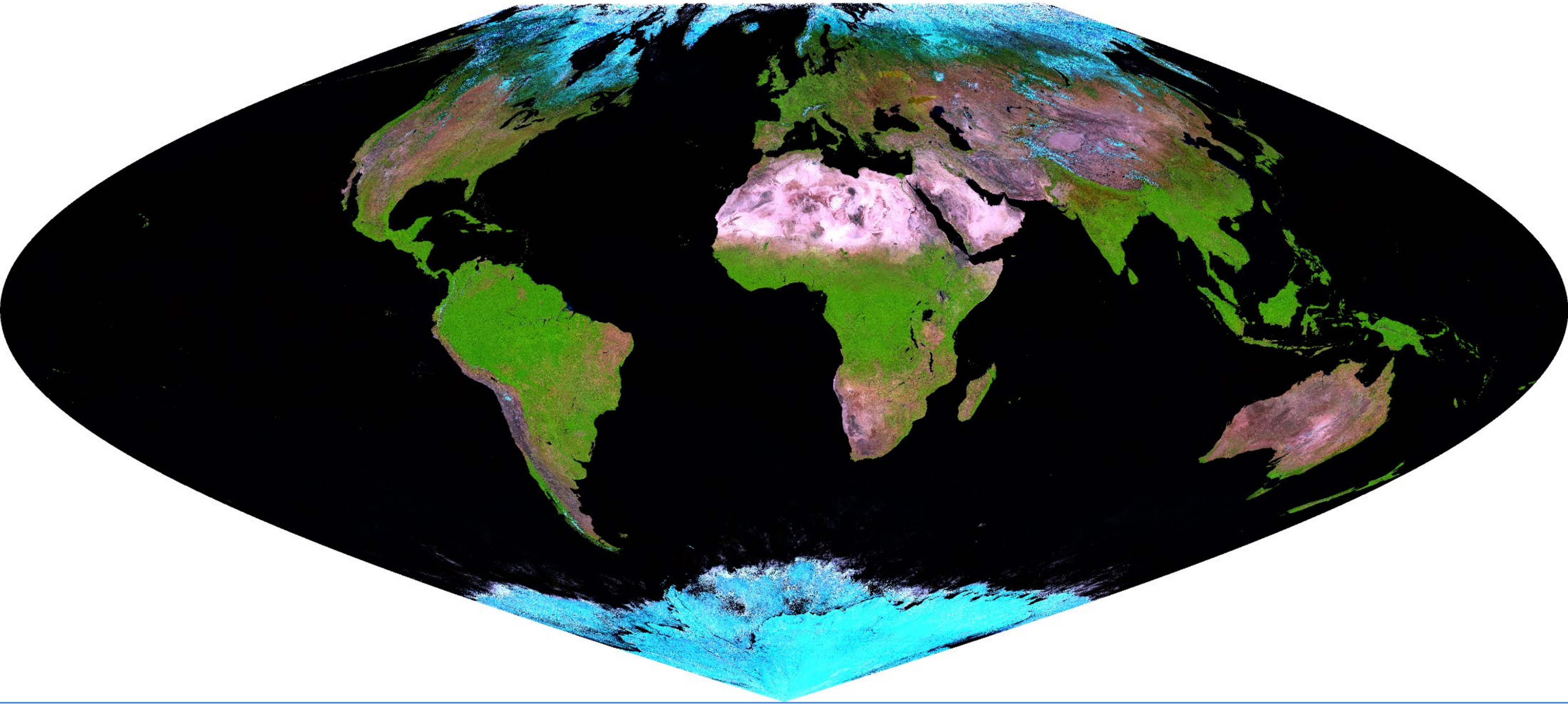
Global Monthly Mosaics Are Very Similar

S-NPP Monthly Mosaic, November 2019, RGB: M10, M7, M5



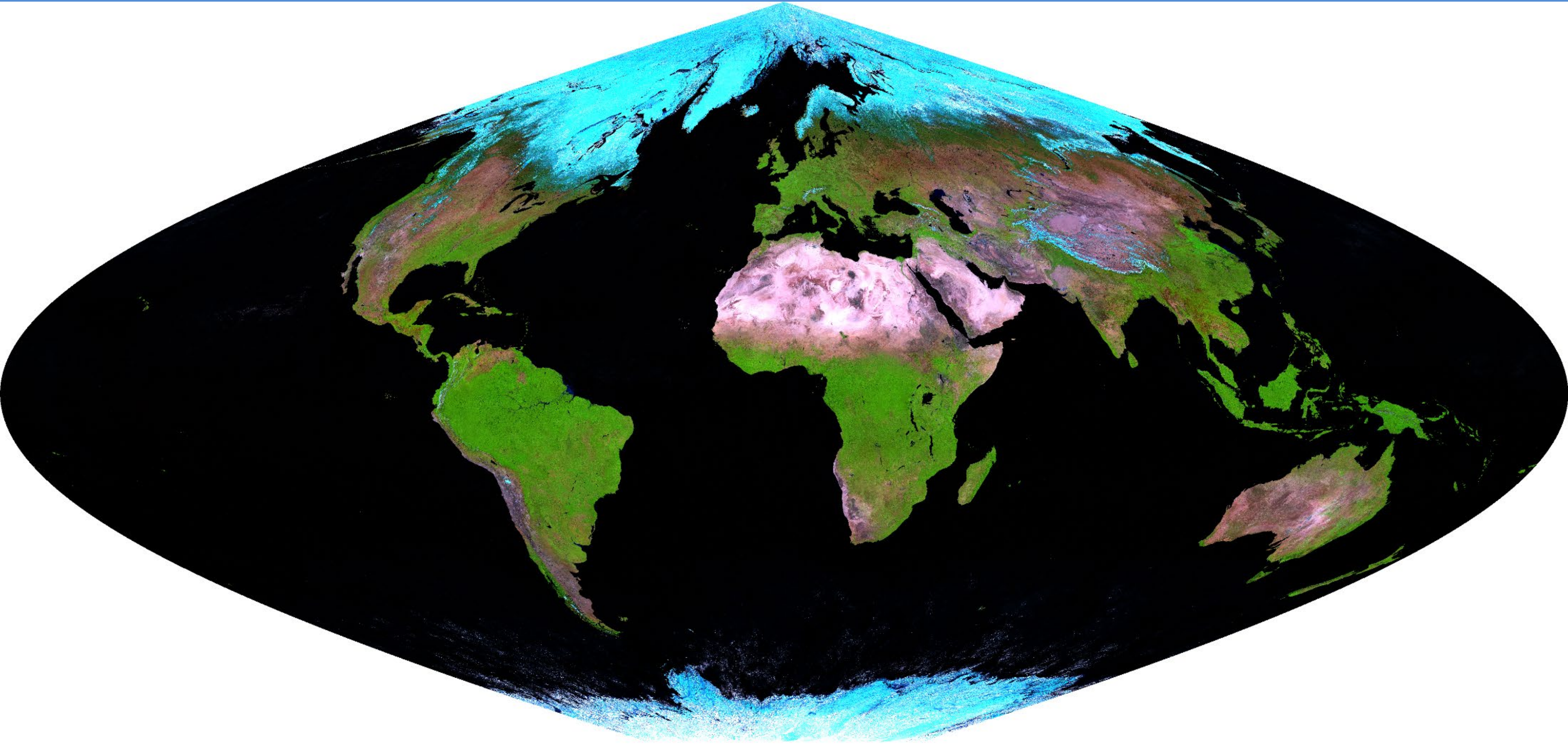
Global Monthly Mosaics Are Very Similar

NOAA-20 + S-NPP Monthly Mosaic, November 2019, RGB: M10, M7, M5



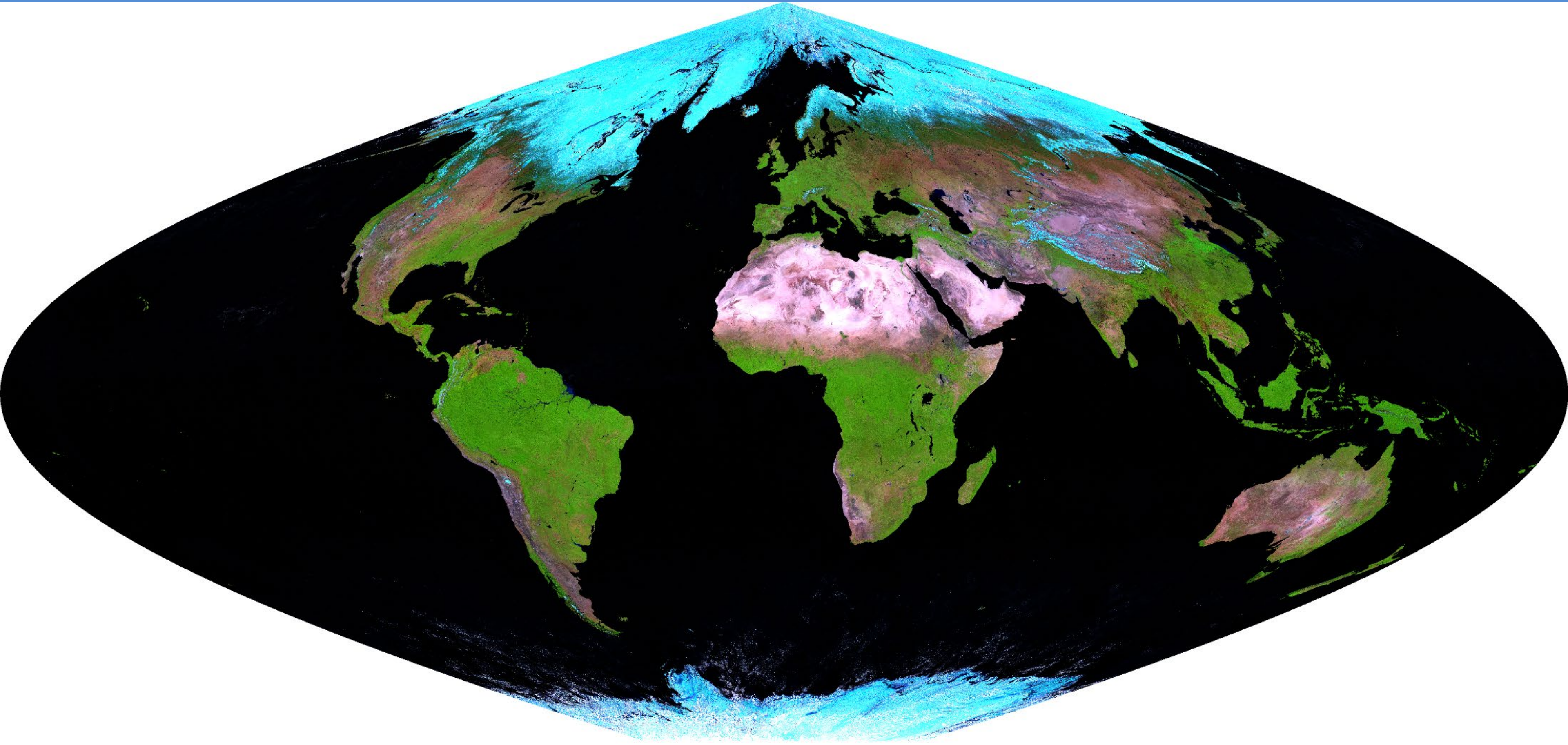
Global Monthly Mosaics Are Very Similar

NOAA-20 Monthly Mosaic, April 2020, RGB: M10, M7, M5



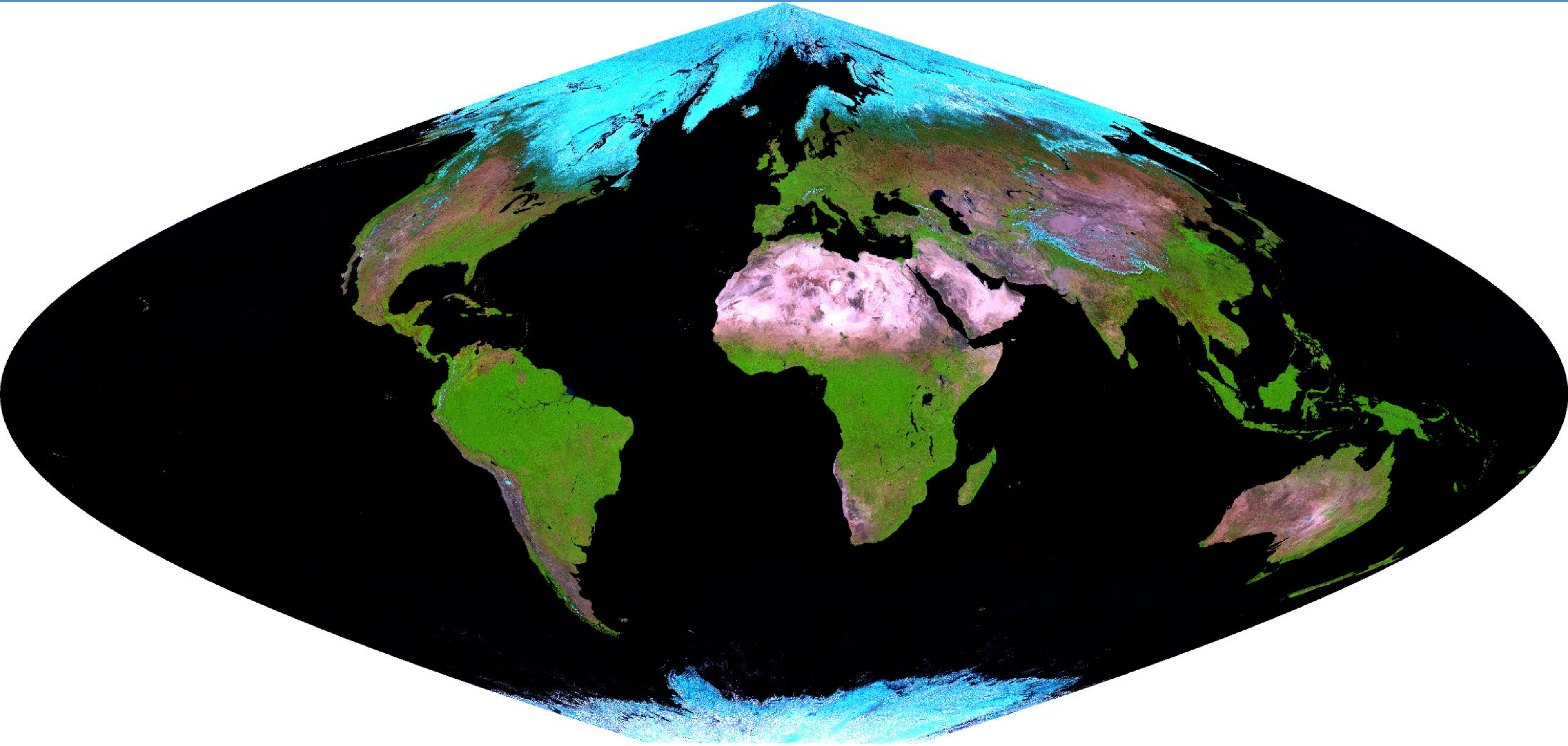
Global Monthly Mosaics Are Very Similar

S-NPP Monthly Mosaic, April 2020, RGB: M10, M7, M5



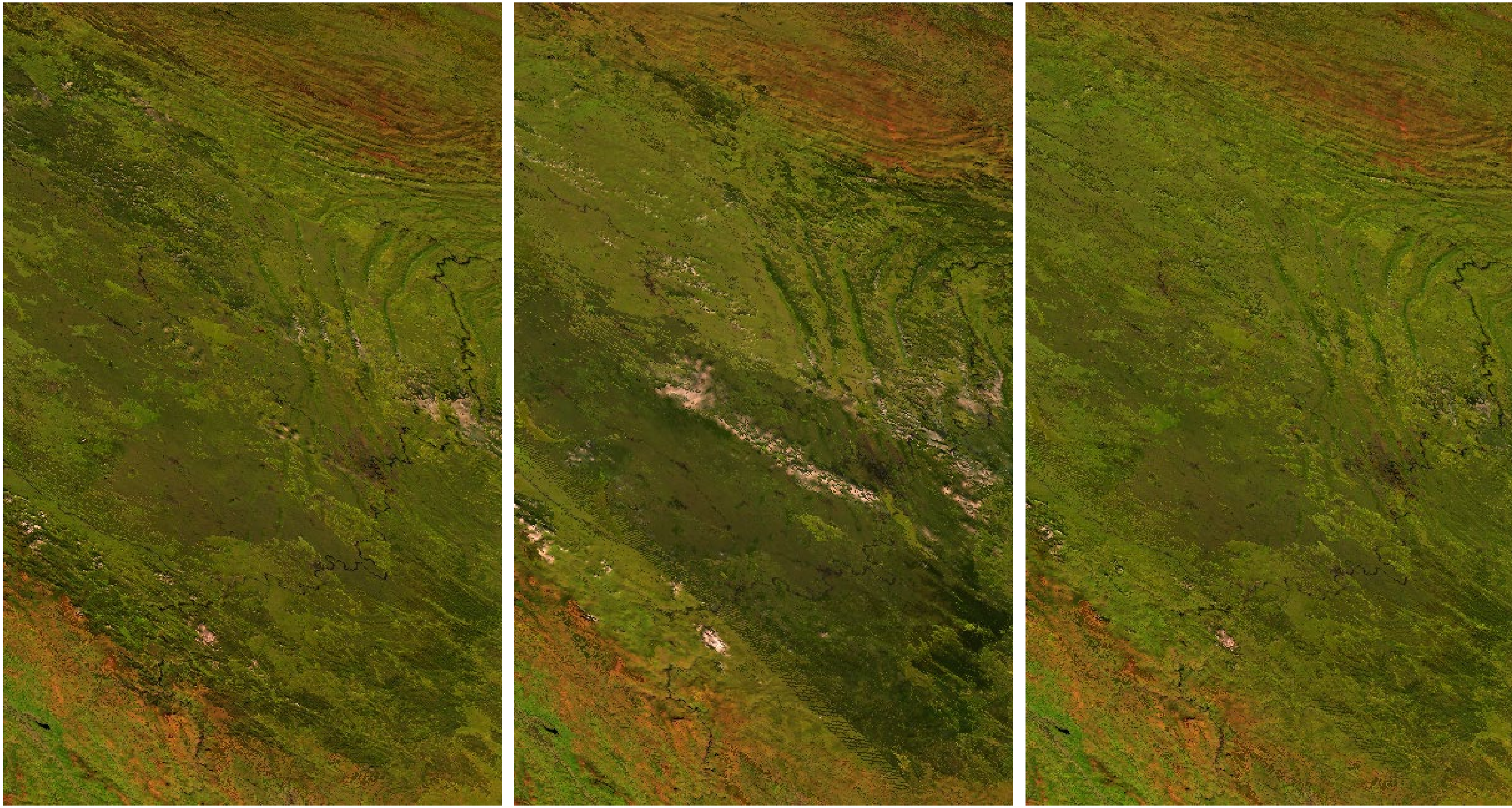
Global Monthly Mosaics Are Very Similar

NOAA-20 + S-NPP Monthly Mosaic, April 2020, RGB: M10, M7, M5



Monthly Composites from Both Satellites Better

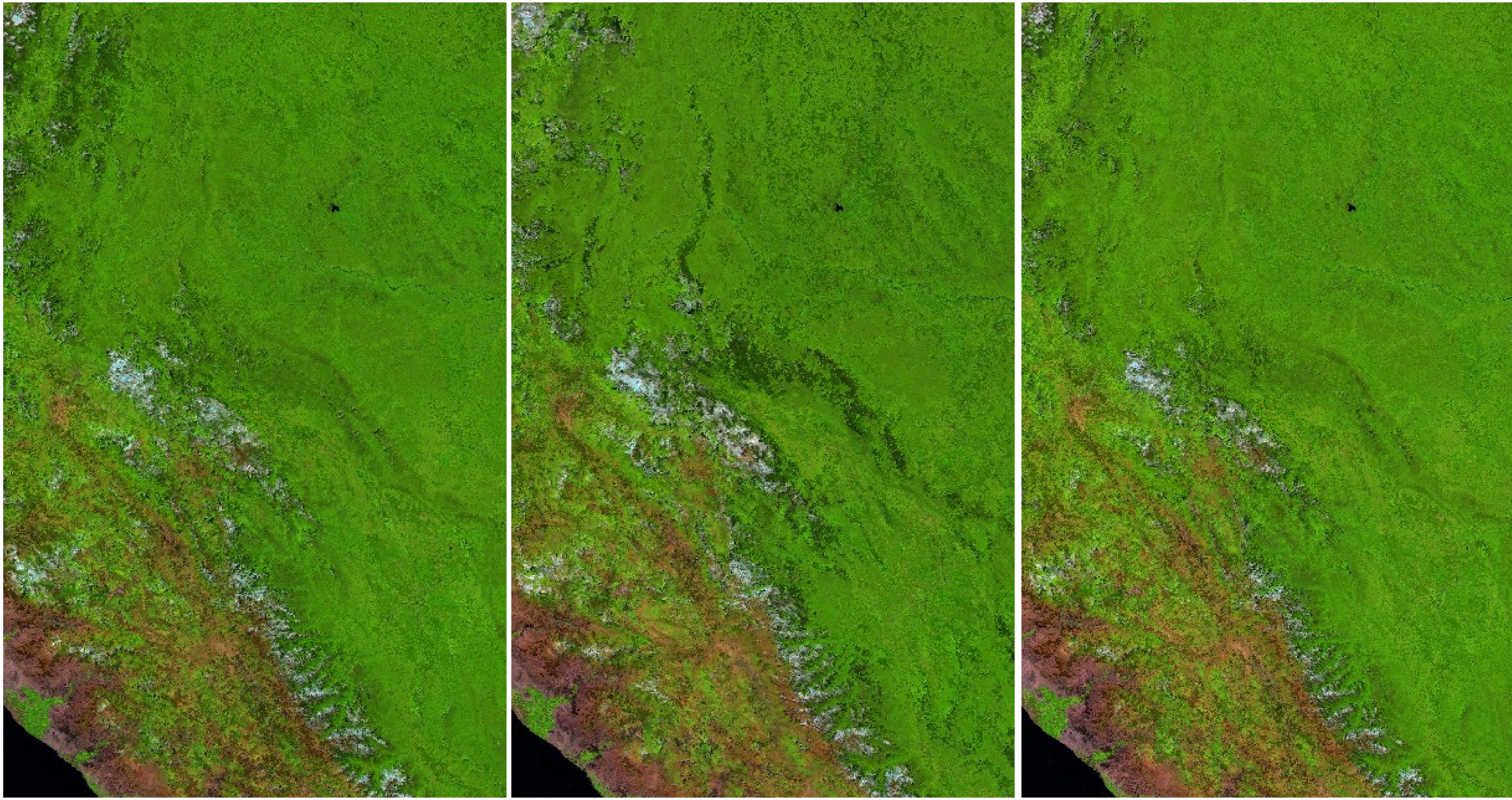
NOAA-20 S-NPP NOAA-20 + S-NPP



Monthly Composite, 2019/11, SE Asia

Monthly Composites from Both Satellites Better

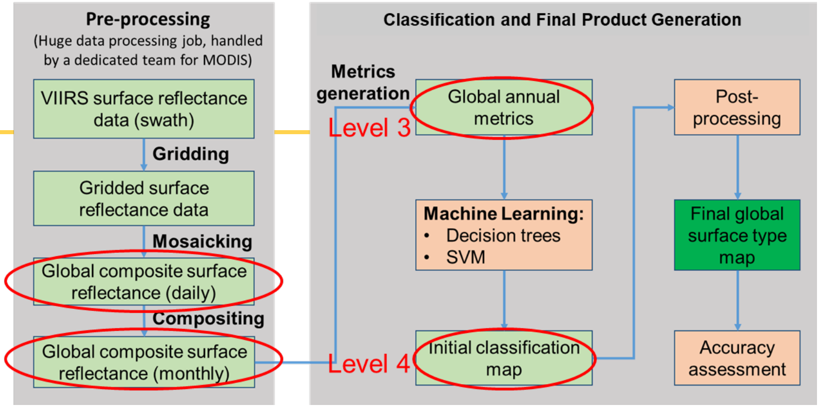
NOAA-20 S-NPP NOAA-20 + S-NPP

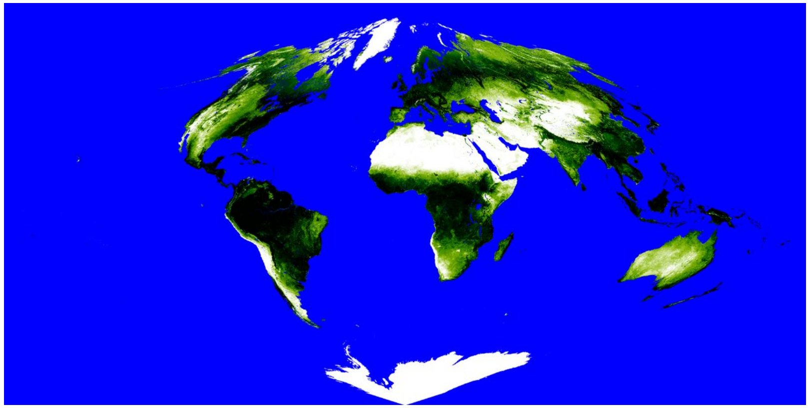


Monthly Composite, 2020/04, Tropical South America

Level 3: Annual Metrics

- Purpose:
  - minimize spectral differences between northern and southern hemispheres and/or along other geographical gradients
- Input: Monthly composites in 12 months: May 2019 – April 2020
- Output: three sets of metrics (Zhang et al. 2016, 2017)
  - NOAA-20 only
  - S-NPP only
  - Both





mean NDVI

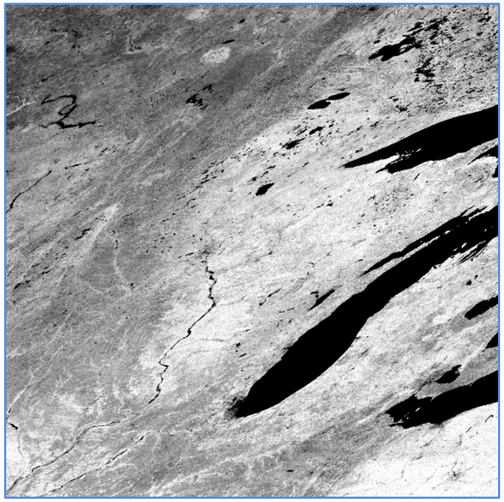
Table 2. Details of annual metrics used in classification.

Metrics number(s)	Description
1	Maximum NDVI value
2	Minimum NDVI value of eight greenest months
3	Mean NDVI value of eight greenest months
4	Amplitude of NDVI over eight greenest months
5	Mean NDVI value of four warmest months
6	NDVI value of warmest month
7,14,21,28,35,42,49,56,63	Maximum band *x* value of eight greenest months
8,15,22,29,36,43,50,57,64	Minimum band *x* value of eight greenest months
9,16,23,30,37,44,51,58,65	Mean band *x* value of eight greenest months
10,17,24,31,38,45,52,59,66	Amplitude of band *x* value over eight greenest months
11,18,25,32,39,46,53,60,67	Band *x* value from month of maximum NDVI
12,19,26,33,40,47,54,61,68	Mean band *x* value of four warmest months
13,20,27,34,41,48,55,62,69	Band *x* value of warmest month

Note: *x* is the band used in annual metrics, which includes M1, M2, M3, M4, M5, M7, M8, M10 and M11.

Annual Metrics Comparison Examples

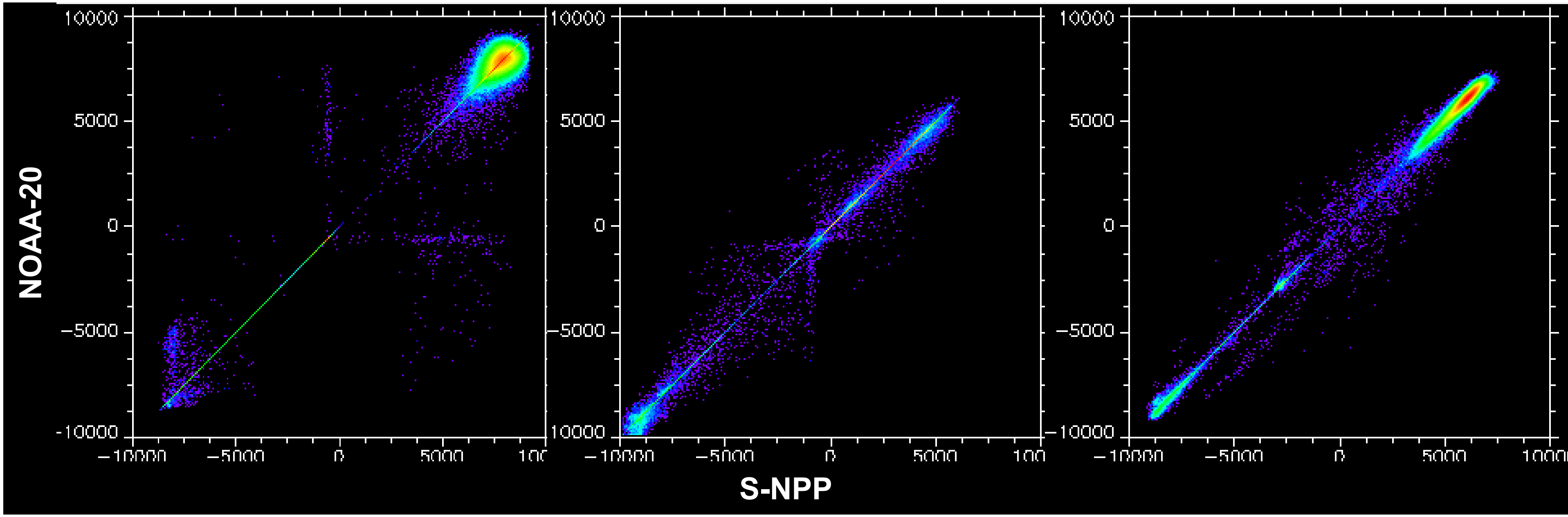
Great Lakes/Midwest



Max NDVI

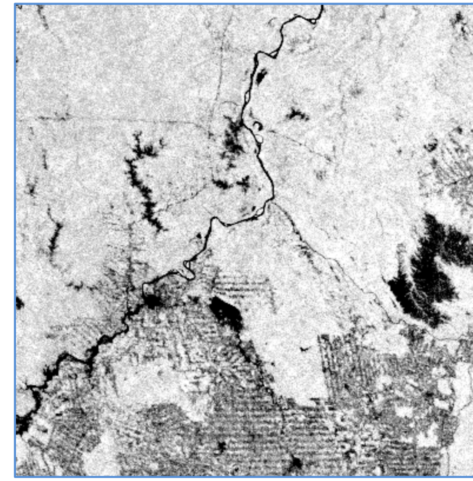
Min NDVI

Mean NDVI

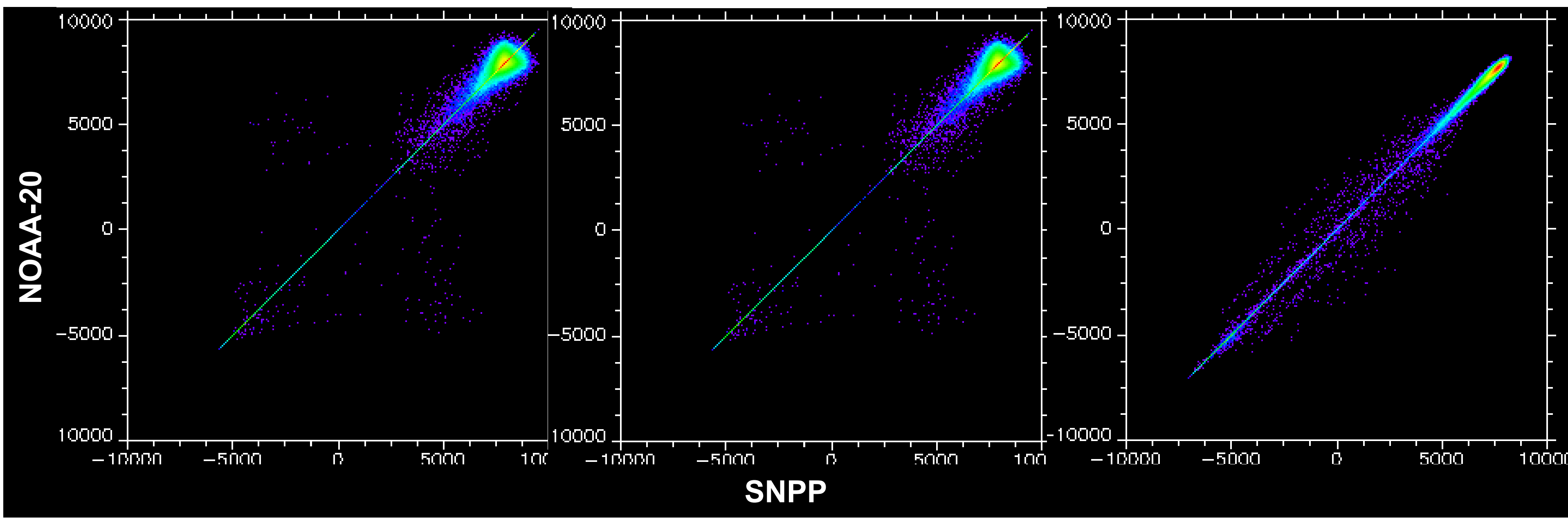


Annual Metrics Comparison Examples

Deforestation in South America

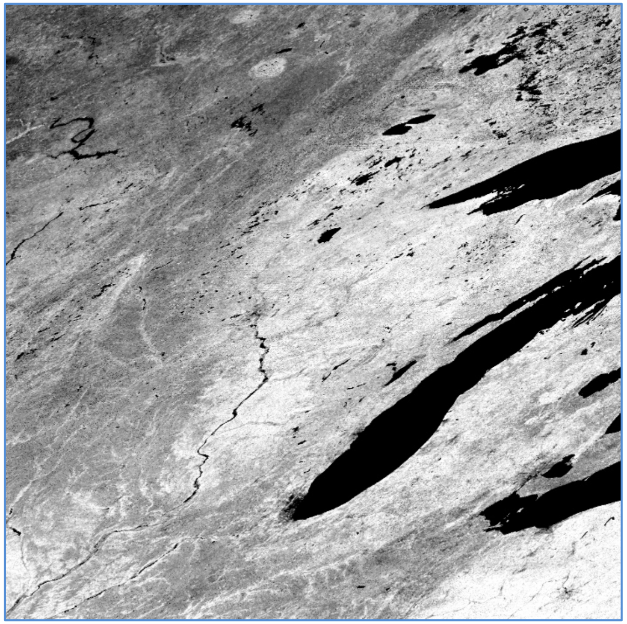


Max NDVI | Min NDVI | Mean NDVI

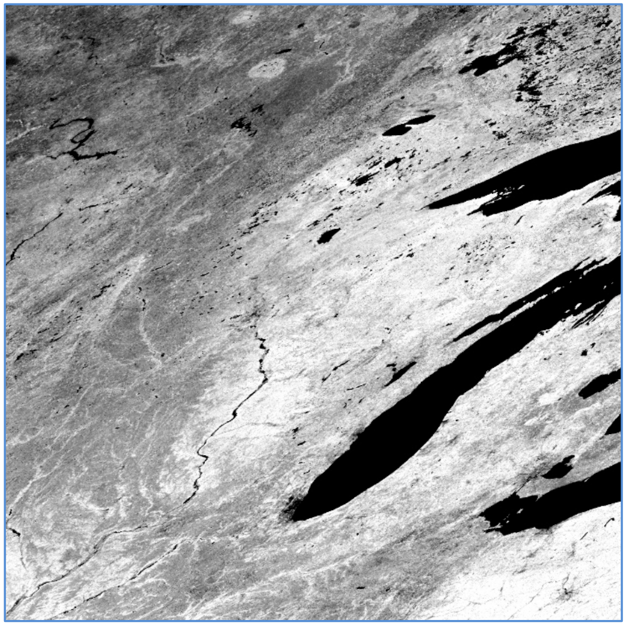


Annual Metrics Comparison Examples

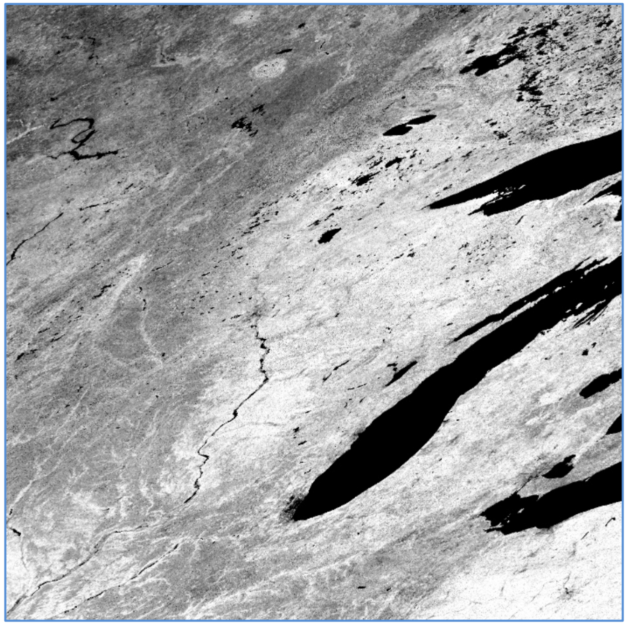
US Midwest, Annual Mean NDVI



NOAA-20



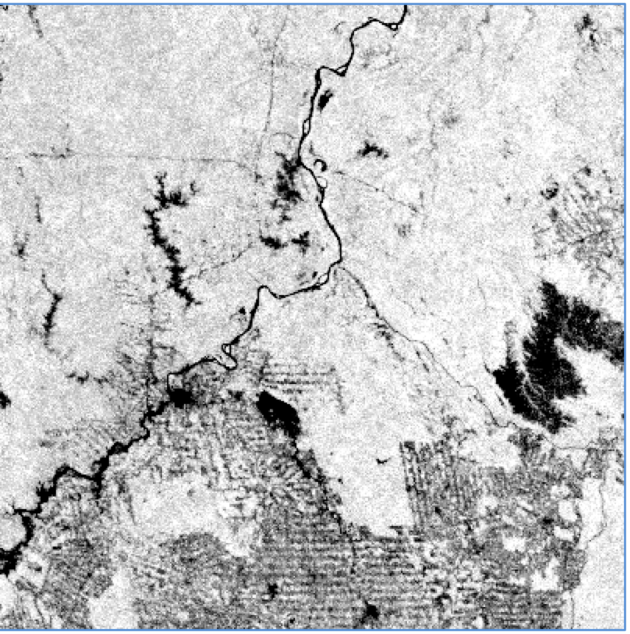
S-NPP



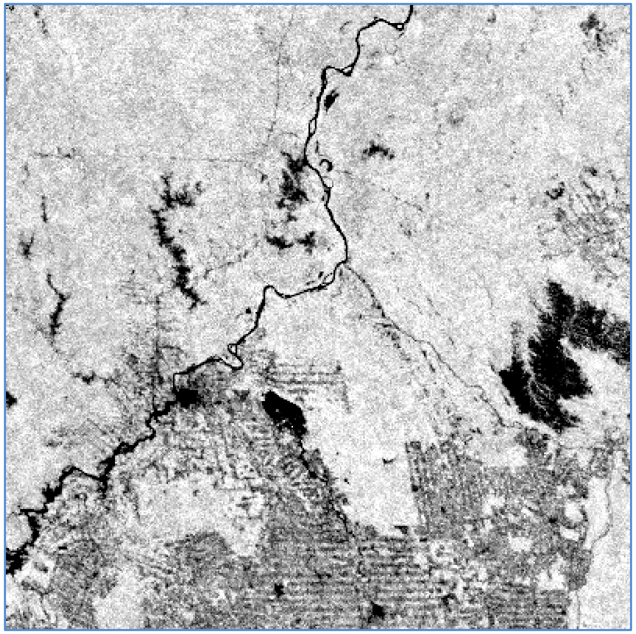
NOAA-20 + S-NPP

Annual Metrics Comparison Examples

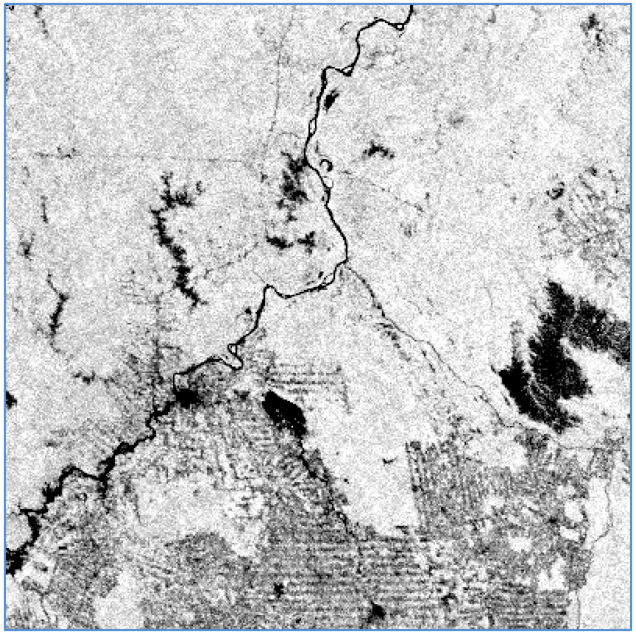
South America, Annual Mean NDVI



NOAA-20



S-NPP



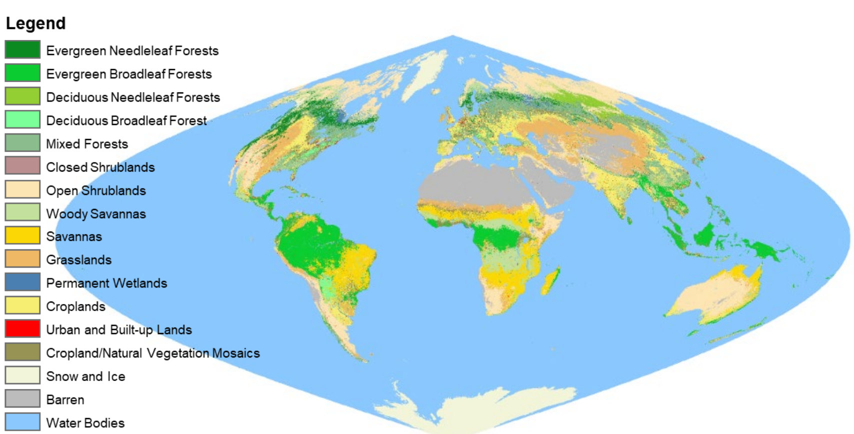
NOAA-20 + S-NPP

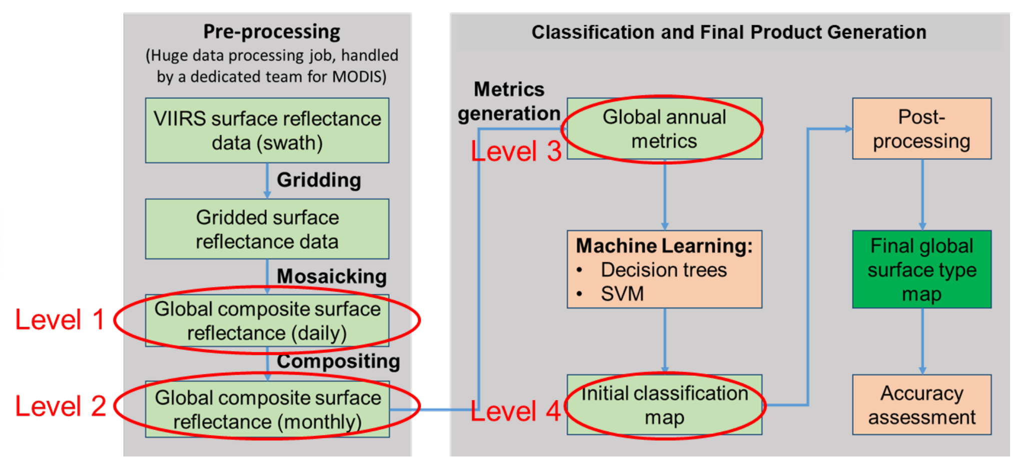
Level 4: Surface Type Classification

GST Mapping Using NOAA-20 and S-NPP

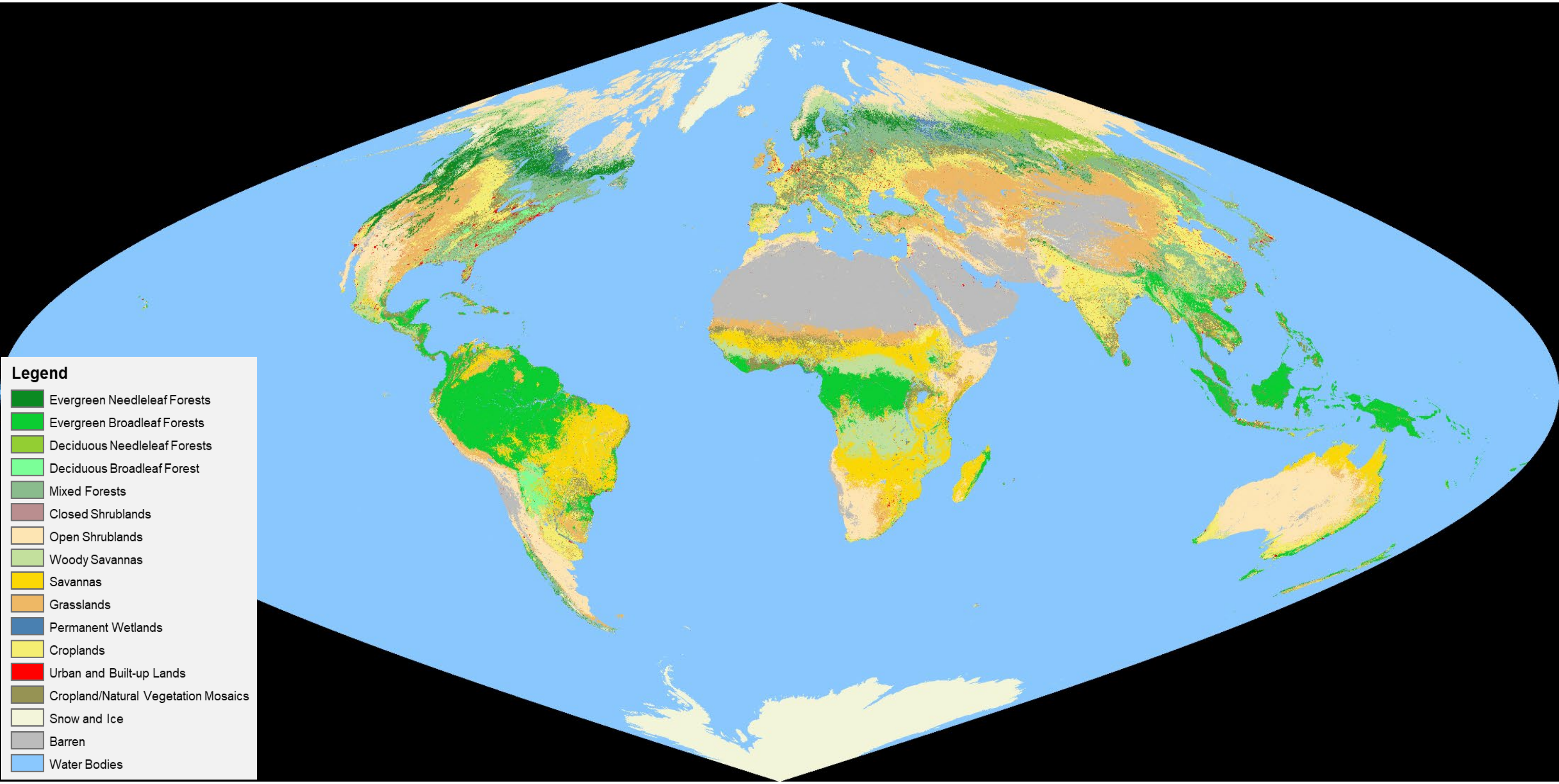
	NOAA-20	S-NPP	NOAA-20 + S-PP
Annual metrics	NOAA-20 based	S-NPP based	Based on both
Training sample	Same set of training pixels		
Classification algorithm	Same: SVM		
Classification model	NOAA-20 based	S-NPP based	Based on both
Classification results	NOAA-20 based	S-NPP based	Based on both

Classifications should be similar but not identical



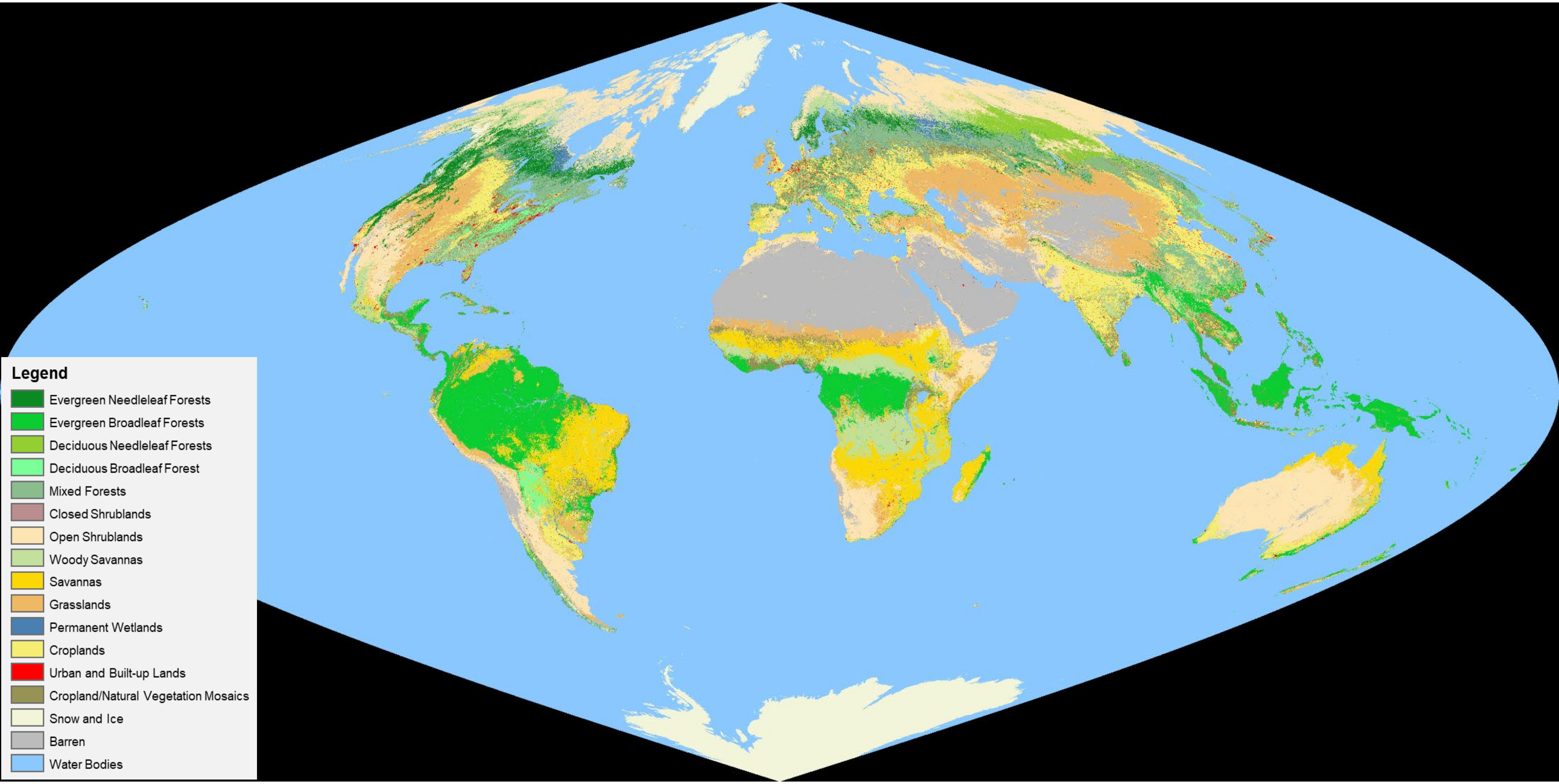


NOAA-20 Based GST (May 2019 – April 2020)



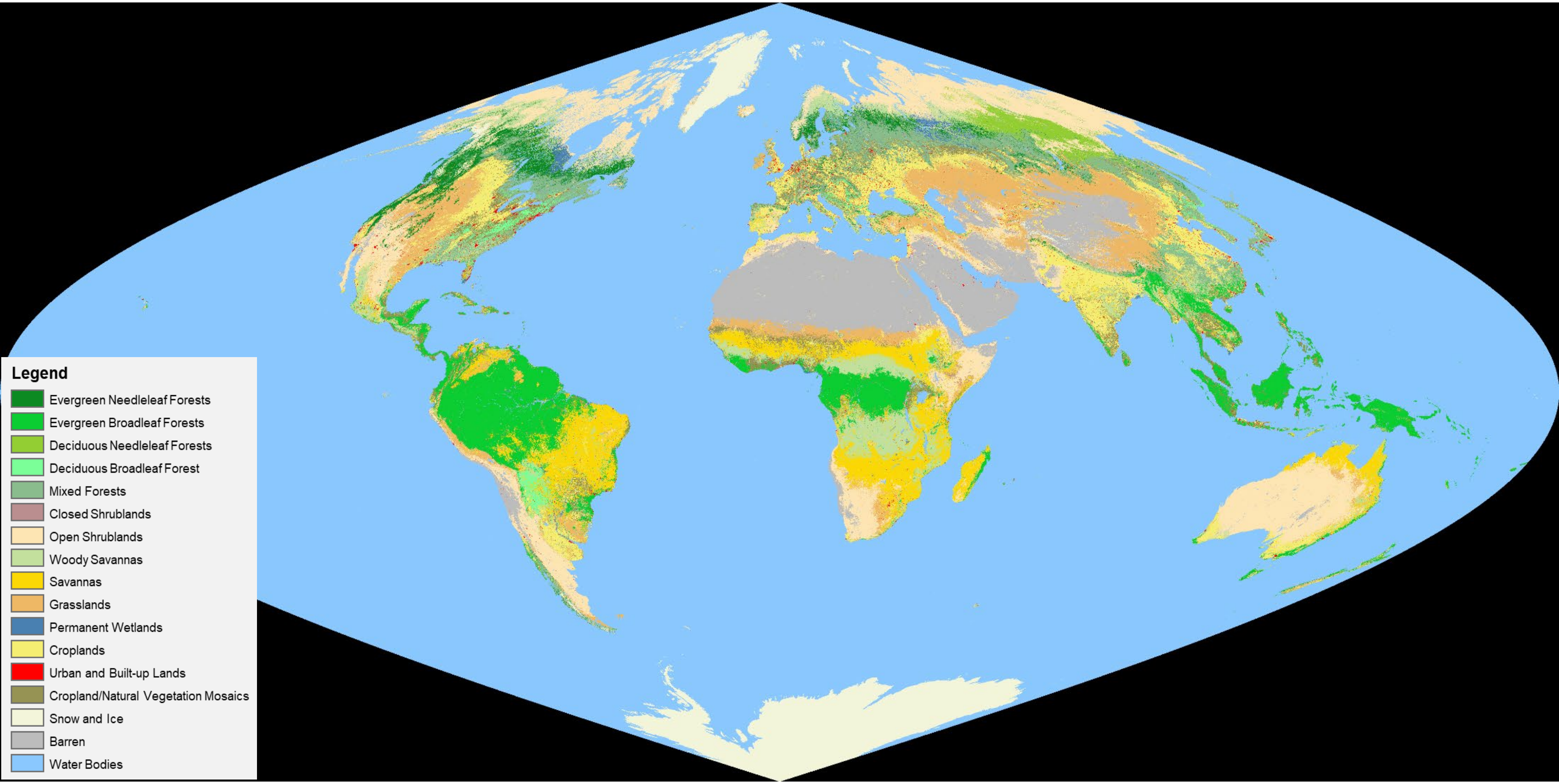
Overall Accuracy: 77.5±0.6%

S-NPP Based GST (May 2019 – April 2020)



Overall Accuracy: 77.7±0.6%

NOAA-20 and S-NPP Based GST (May 2019 – April 2020)



Overall Accuracy: 78.0±0.6%

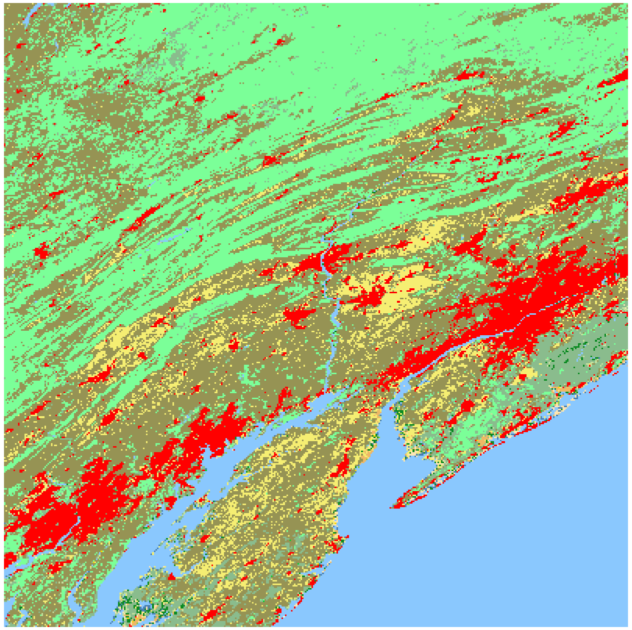
Classification Comparison Examples

Baltimore-Philadelphia

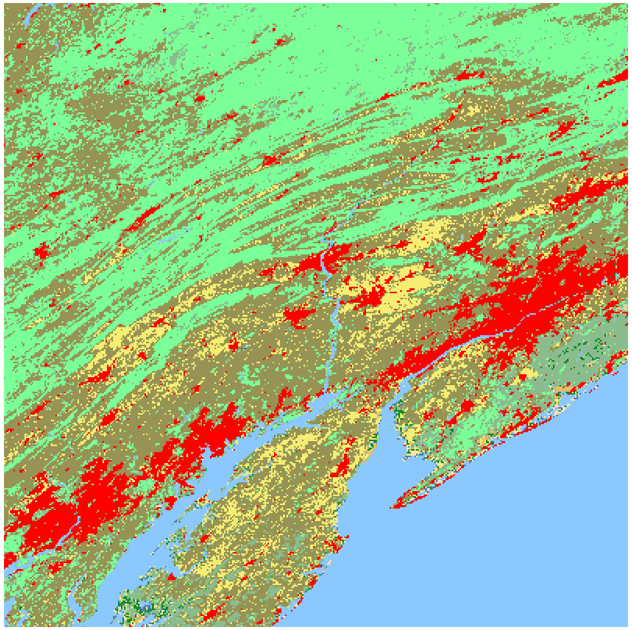
Legend

- Evergreen Needleleaf Forests
- Evergreen Broadleaf Forests
- Deciduous Needleleaf Forests
- Deciduous Broadleaf Forest
- Mixed Forests
- Closed Shrublands
- Open Shrublands
- Woody Savannas
- Savannas
- Grasslands
- Permanent Wetlands
- Croplands
- Urban and Built-up Lands
- Cropland/Natural Vegetation Mosaics
- Snow and Ice
- Barren
- Water Bodies

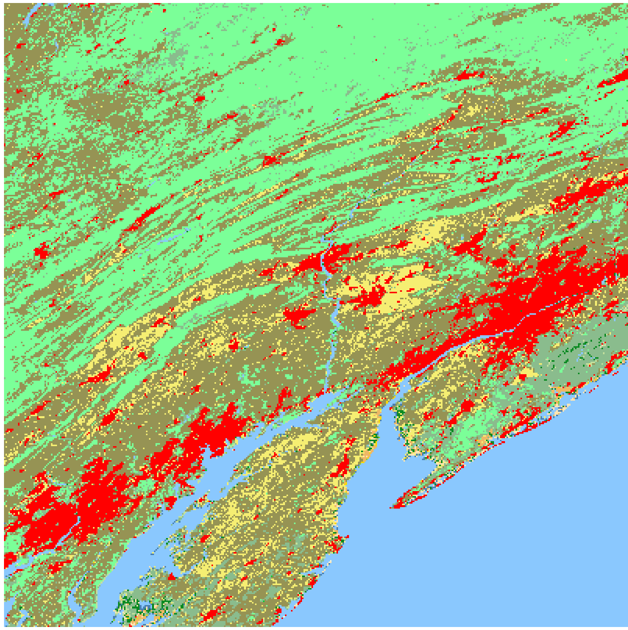
NOAA-20



S-NPP



NOAA-20 + S-NPP



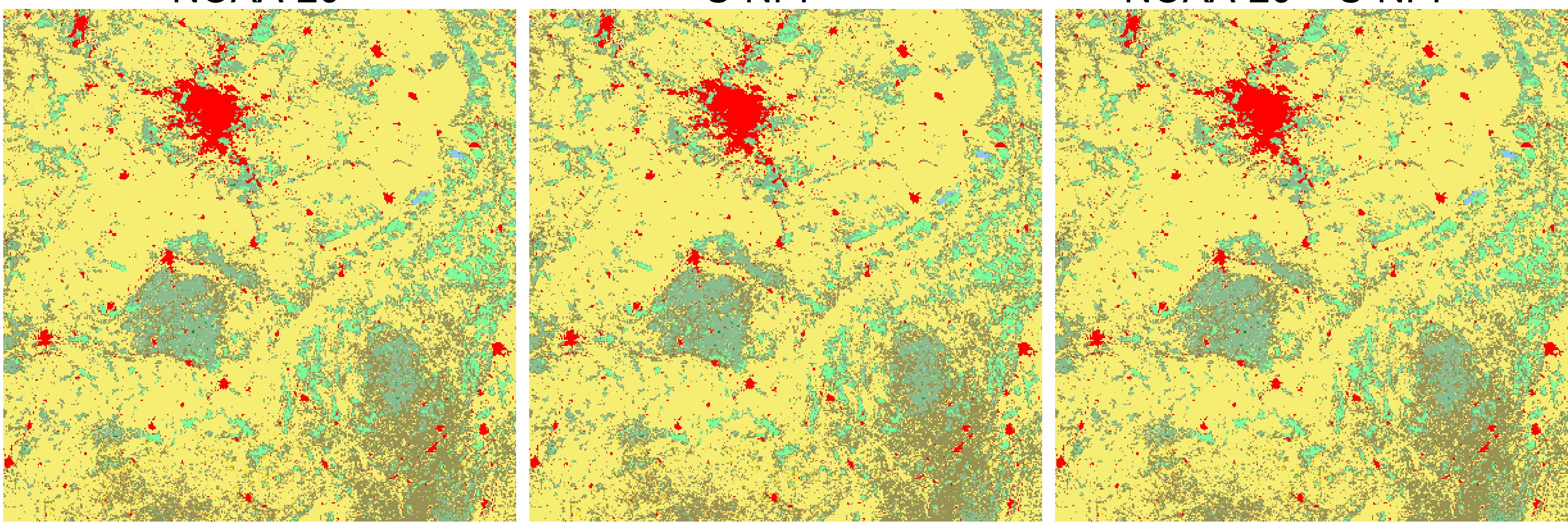
Classification Comparison Examples

Legend

- Evergreen Needleleaf Forests
- Evergreen Broadleaf Forests
- Deciduous Needleleaf Forests
- Deciduous Broadleaf Forest
- Mixed Forests
- Closed Shrublands
- Open Shrublands
- Woody Savannas
- Savannas
- Grasslands
- Permanent Wetlands
- Croplands
- Urban and Built-up Lands
- Cropland/Natural Vegetation Mosaics
- Snow and Ice
- Barren
- Water Bodies

Paris

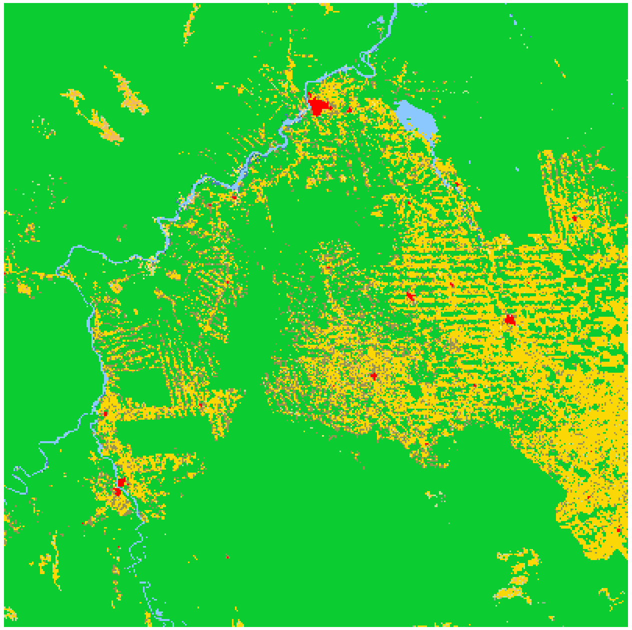
NOAA-20 | S-NPP | NOAA-20 + S-NPP



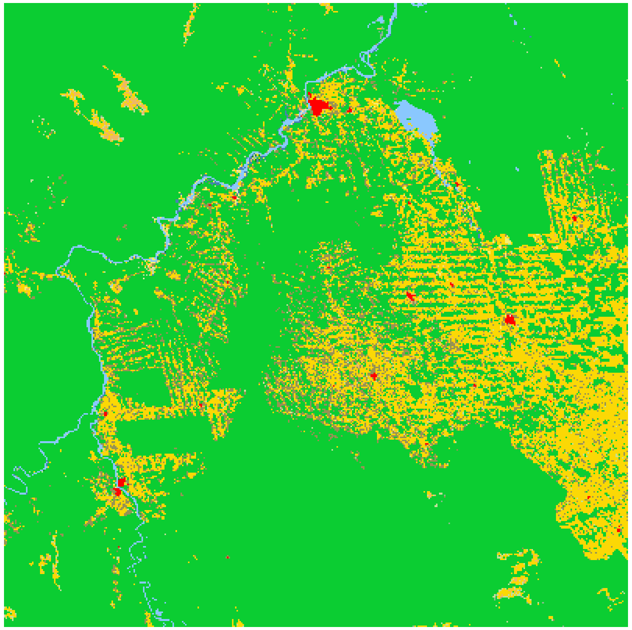
Classification Comparison Examples

South America

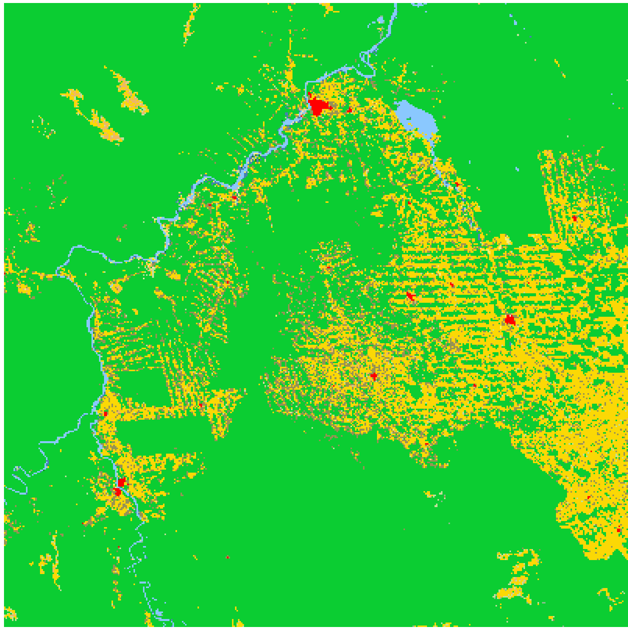
NOAA-20



S-NPP



NOAA-20 + S-NPP



Error Budget

GST Products from either NOAA-20 only or NOAA-20 + S-NPP meet L1RD Requirements (DPS-820: 70% accuracy)

Attribute	Objective
Geographic coverage	Global
Vertical Coverage	
Vertical Cell Size	N/A
Horizontal Cell Size	1 km at nadir
Mapping Uncertainty	1 km
Measurement Range	17 IGBP types
Measurement Accuracy	70% correct for 17 types
Measurement Precision	N/A
Measurement Uncertainty	N/A

Evergreen Needleleaf Forests
Evergreen Broadleaf Forests
Deciduous Needleleaf Forests
Deciduous Broadleaf Forest
Mixed Forests
Closed Shrublands
Open Shrublands
Woody Savannas
Savannas
Grasslands
Permanent Wetlands
Croplands
Urban and Built-up Lands
Cropland/Natural Vegetation Mosaics
Snow and Ice
Barren
Water Bodies

User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Helin Wei	NCEP EMC	Noah LSM input	Currently MODIS, will use VIIRS AST soon
Michael Barlage	NCAR/ NCEP EMC	Noah-MP LSM input	Many sources, generally satellite based, tree cover map/vegetation continuous fields

Downstream Product Feedback

Algorithm	Product	Downstream Product Feedback - Reports from downstream product teams on the dependencies and impacts
LST	LST	Deliver to NDE by ASSISTT
LSA	LSA	Deliver to NDE by ASSISTT

Risks, Actions, and Mitigations

- Provide updates for the status of the risks/actions identified during the previous maturity review(s); add new ones as needed

Identified Risk	Description	Impact	Action/Mitigation and Schedule
Surface type change at Training locations	Current surface type label no longer correct due to surface type change	Less accurate classification model	Identify training sites that had surface type changes and relabel those sites
Surface type change at validation locations	Current surface type label no longer correct due to surface type change	More uncertainties with accuracy estimates	Identify validation sites that had surface type changes and relabel those sites

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)	N/A
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	Yes

Check List - Validated Maturity

Validated Maturity End State	Assessment
Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).	*Global annual product accuracy met requirements*
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.	*ATBD and journal publications for the products*
Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.	*Qualitative and quantitative assessments presented*
Product is ready for operational use based on documented validation findings and user feedback.	*A digital map and associated documents are ready for users*
Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument	*Product validation is done before it's delivered to users every year*

Requirement Check List – Surface Type

DPS	Requirement	Performance
DPS-818	The Global Surface Type product shall provide the IGBP land cover classification, globally	*Satisfied*
DPS-901	The Global Surface Type product shall provide global 8-day and monthly composites of surface reflectance from their daily granule reflectance data	*N/A*
DPS-819	The Global Surface Type product shall provide the IGBP land cover classification with a horizontal cell size of 1 kilometer	*Satisfied*
DPS-820	The Global Surface Type product shall provide the IGBP land cover classification with a probability of correct typing of 70%	*Satisfied*
DPS-821	The Global Surface Type product shall be updated once per year	*Satisfied*

JPSS Conclusion

- Cal/Val results summary:
  - Team recommends algorithm Validated maturity based on analyses of VIIRS observations acquired over one full year (May 2019 – April 2020):
    - Daily, monthly, and annual composites from NOAA-20 data are comparable with those from S-NPP
    - The GST map from NOAA-20 is very similar to that from S-NPP and meets L1RD/GSegDPS Requirements
    - Combined use of NOAA-20 and S-NPP can
      - reduces noise due to cloud/shadow in monthly and sub-monthly composites and hence may improve monitoring of short term surface type dynamics
      - improves GST accuracy
- Caveats
  - Results derived from combined use of NOAA-20 and S-NPP are preliminary
    - Further improvements likely with more effective methods

Path Forward

- Lessons learned for N20 Cal/Val
  - Need to continue to improve code robustness and efficiency to handle greatly increased data volume
- Planned improvements
  - Develop more robust methods to integrate NOAA-20 and S-NPP for monitoring surface type changes
- Future Cal/Val activities / milestones
  - Continue to monitor training/validation sites to identify sites that had surface type changes and relabel those sites
  - Generate new GST products

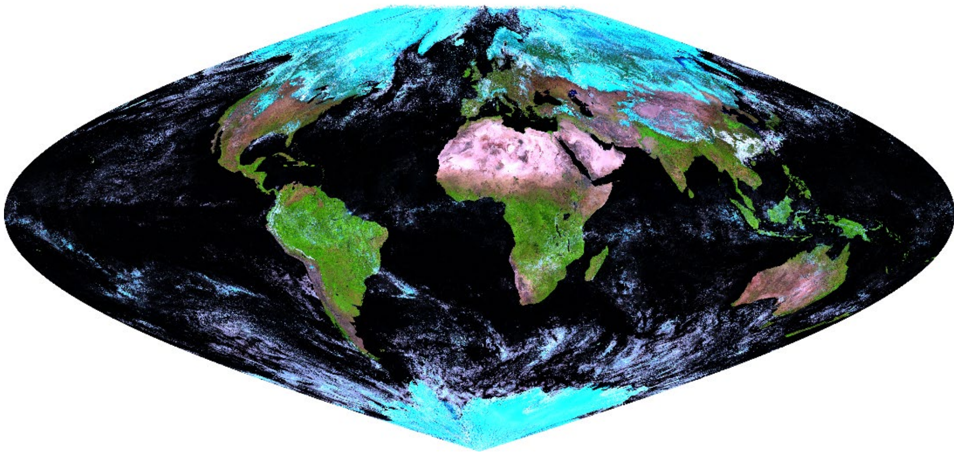
Questions?

Potential Synergy of NOAA-20 and S-NPP

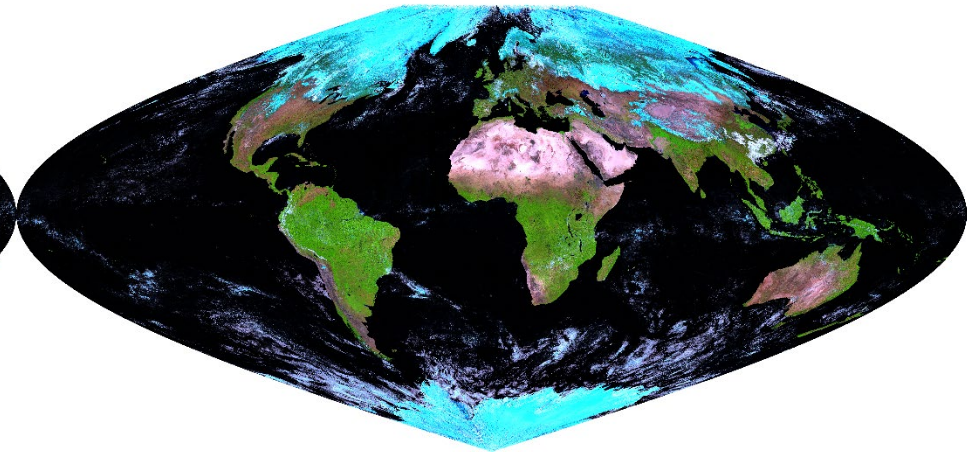
- Complement each other most at very short temporal intervals
  - Daily
  - Weekly
  - Benefits less significant at monthly to annual level
- Best for monitoring short term surface type dynamics
  - Rapid changes in vegetation phenology
  - Large scale seasonal snow cover dynamics
  - Large fire followed by rapid recovery
  - Temporal flooding

Visible Improvements in 5-day Composites

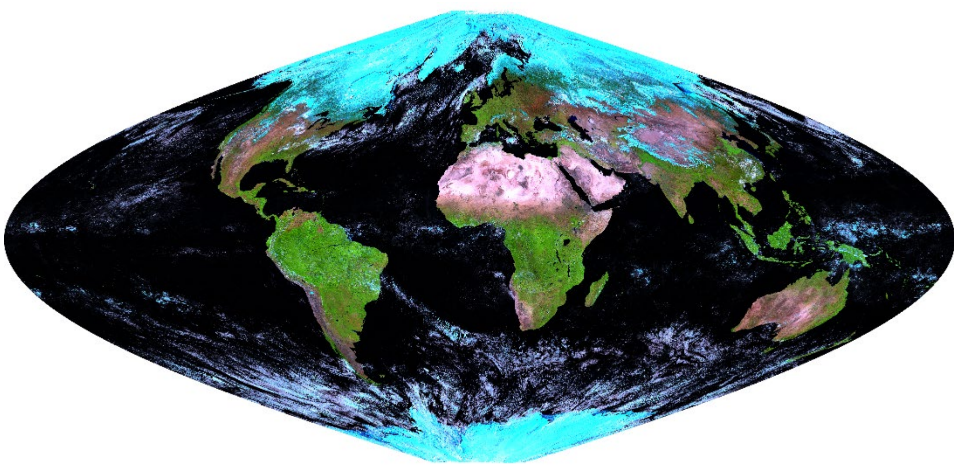
NOAA-20, 3/1/2020-3/5/2020



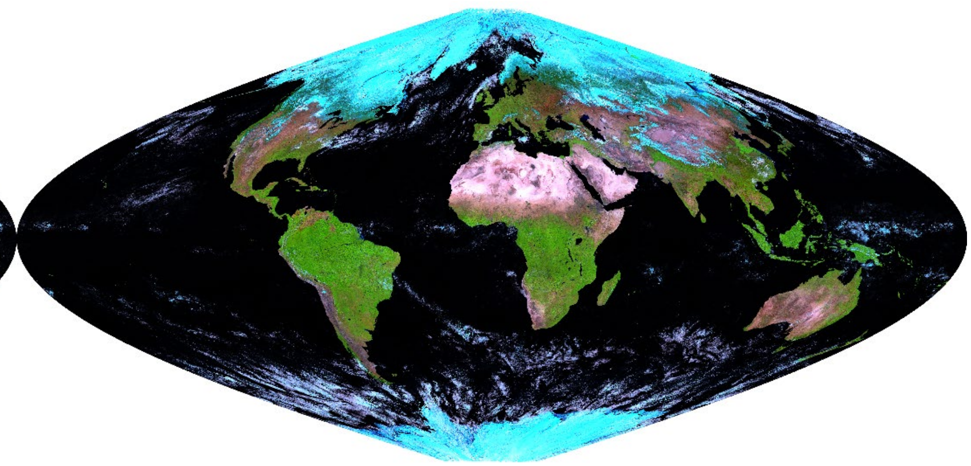
NOAA-20 + S-NPP, 3/1/2020-3/5/2020



NOAA-20, 3/21/2020-3/25/2020

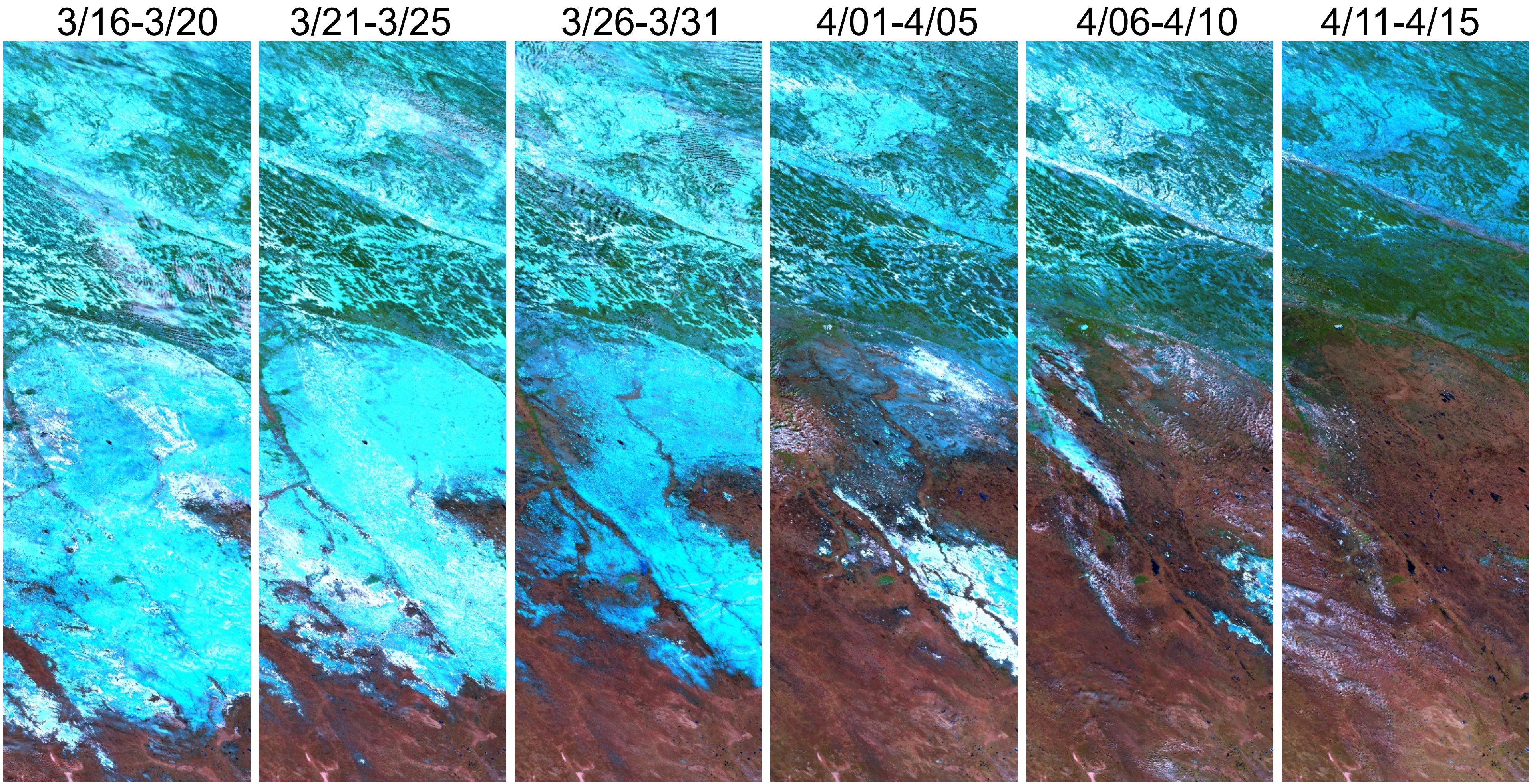


NOAA-20 + S-NPP, 3/21/2020-3/25/2020



Large Scale Snow Retreat (~1000km) Captured by 5-Day Composites

NOAA-20 Only, Central Asia



Large Scale Snow Retreat (~1000km) Captured by 5-Day Composites

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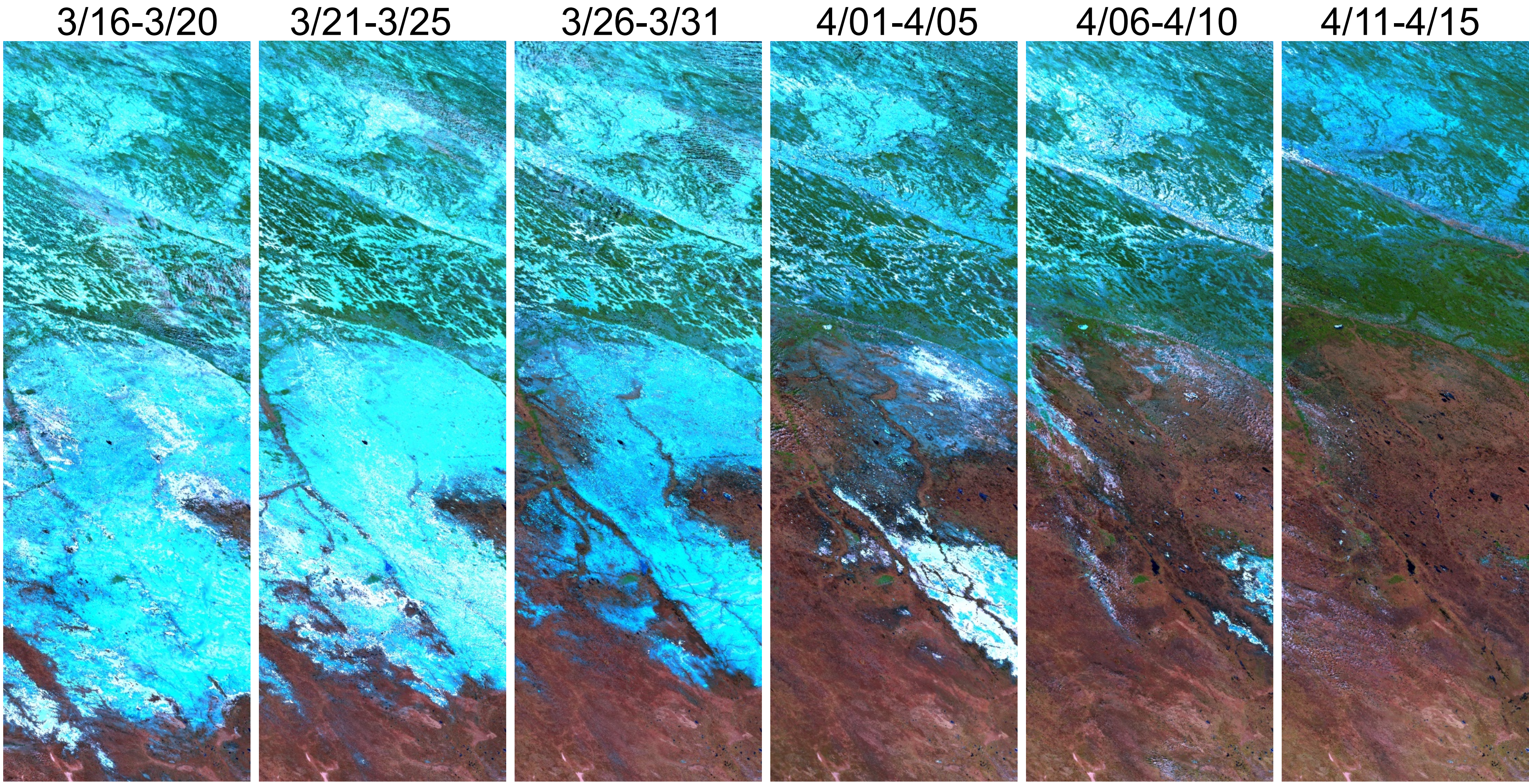
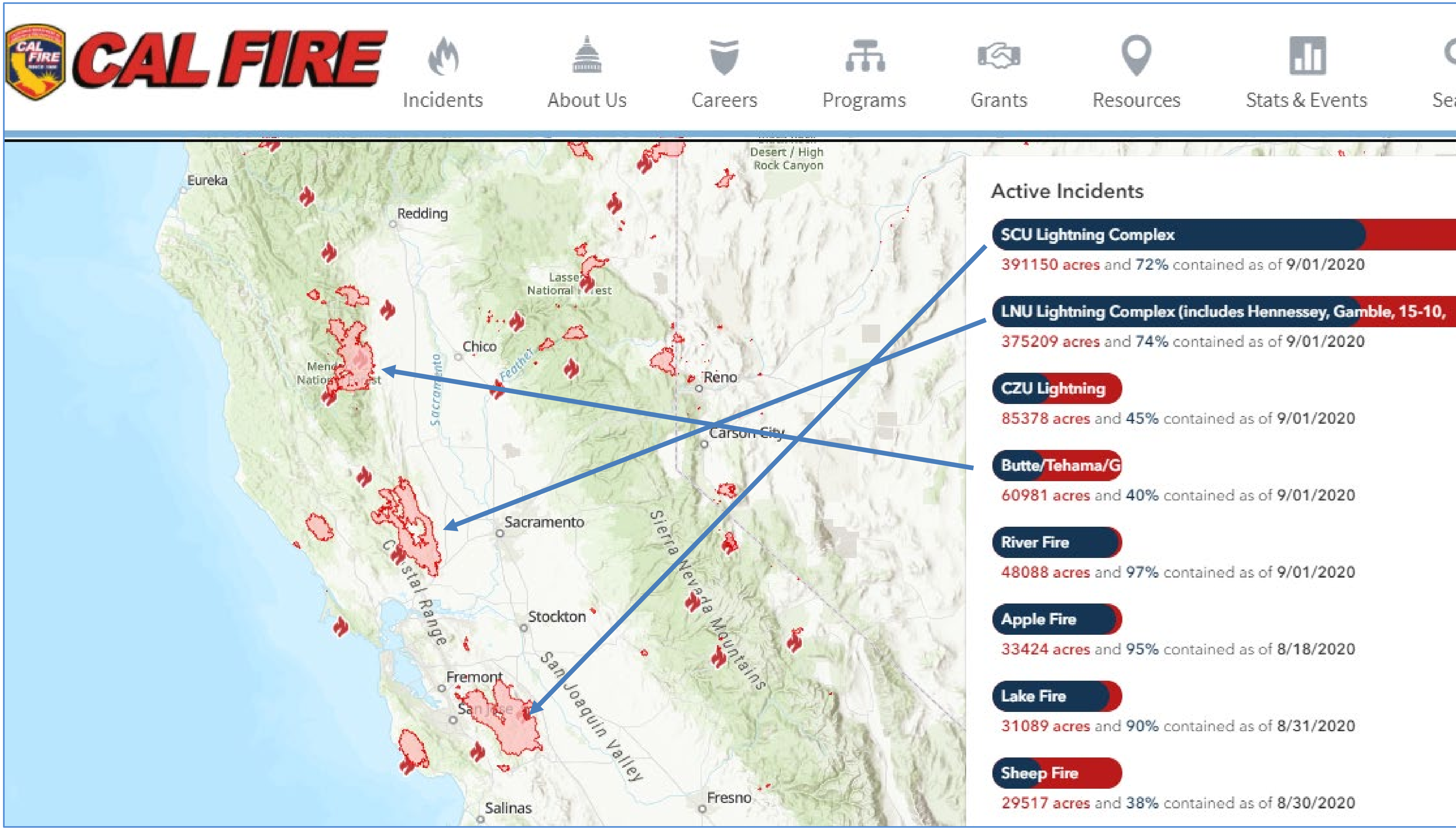
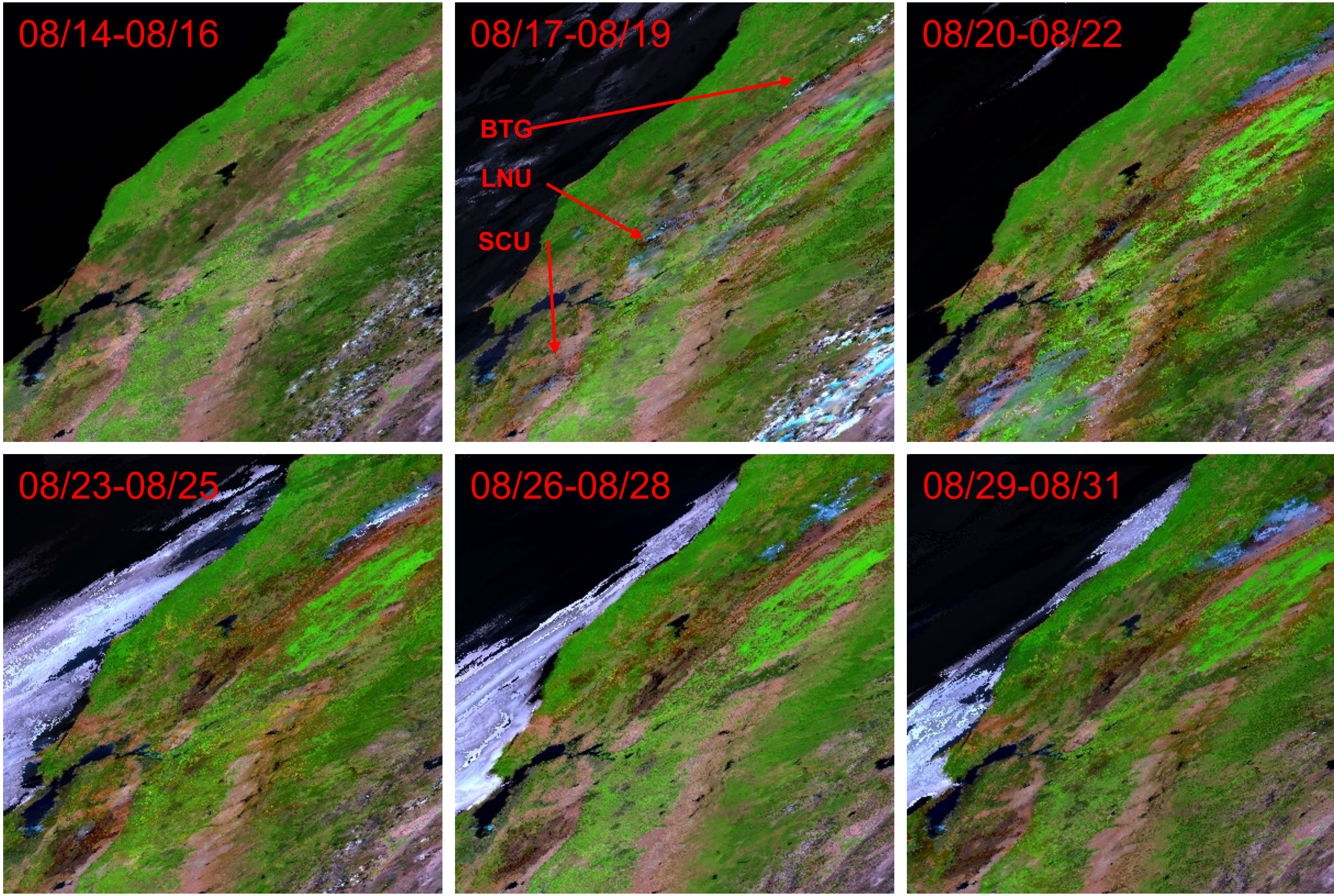


Use 3-Day Composites to Monitor California Fires



3-Day Composites from NOAA-20



3-Day Composites from NOAA-20 + S-NPP