Current Status of Cloud Properties from VIIRS on JPSS-1 for CERES

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Outline

- J1-VIIRS Introduction & Data used for this work
- Reflectance and brightness temperature comparisons between J1-VIIRS & NPP-VIIRS
- Pixel level examples, NPP-VIIRS vs J1-VIIRS
- Global maps and stats, NPP-VIIRS vs J1-VIIRS
- Summary & Future Plans

- J1 was launched on November 18, 2017

- J1 was renamed NOAA-20 after launch

- J1 carries 5 Instruments:
  - **VIIRS**
  - **CERES**
  - ATMS
  - CrIS
  - OMPS

- CERES analyzes VIIRS data to derive cloud properties

NPP-VIIRS	J1-VIIRS
Polar Orbital Satellite	
Altitude: 824 km	
Period: 1.7 hr (101.44 min)	
Inclination: 98.7 degree	← Same
Ground track: 20 km repeat accuracy at equator with 16 days repeat cycle	
Each scan: 3040 km wide x 12 km	
M band: 16 detectors	
I band: 32 detectors	

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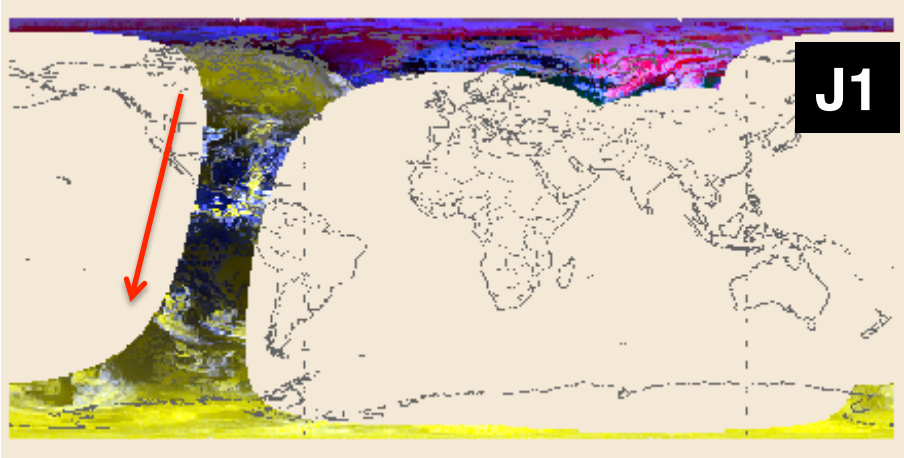
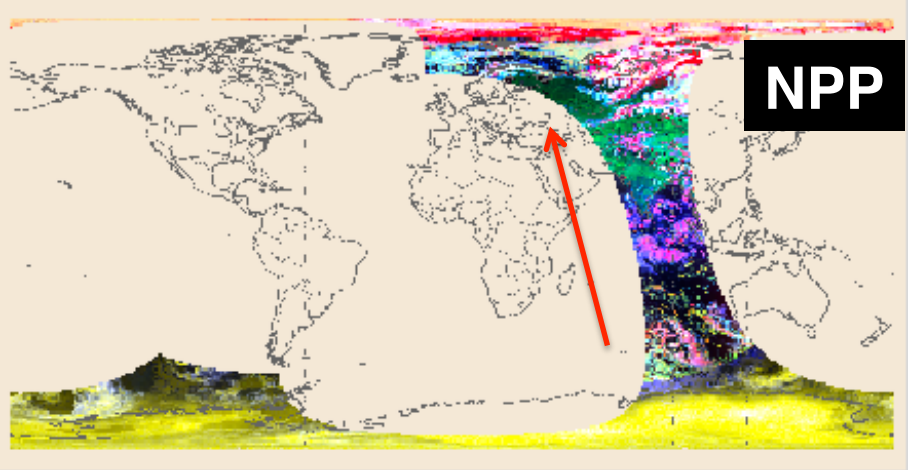
J1 leads NPP by 50.75 min.

Examples of J1 and NPP orbits

May 2018, day 22



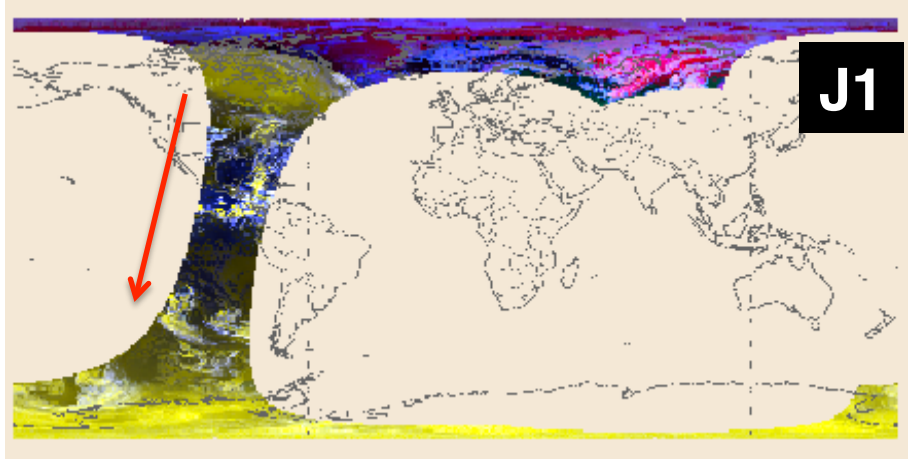
Hour 7



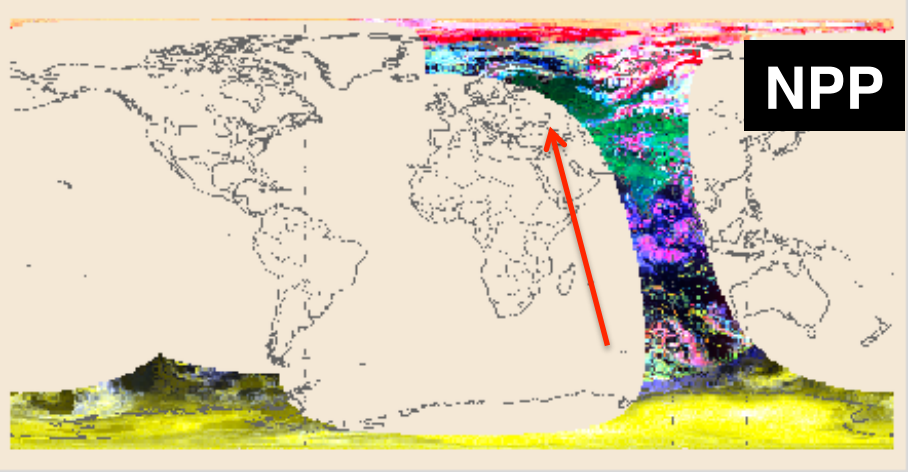
Hour 7, same hour

Examples of J1 and NPP tracks

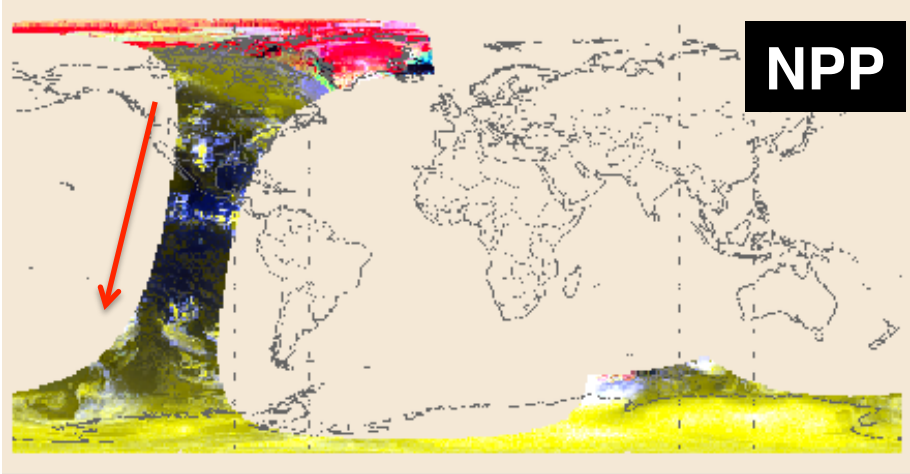
201805 day 22



Hour 7



Hour 7, same hour



Hour 8, an hour later

Data

- J1, the first data date was April 11, 2018
- For this work:
  J1-VIIRS, May 2018
  NPP-VIIRS, May 2018
  Aqua-MODIS, May 2018

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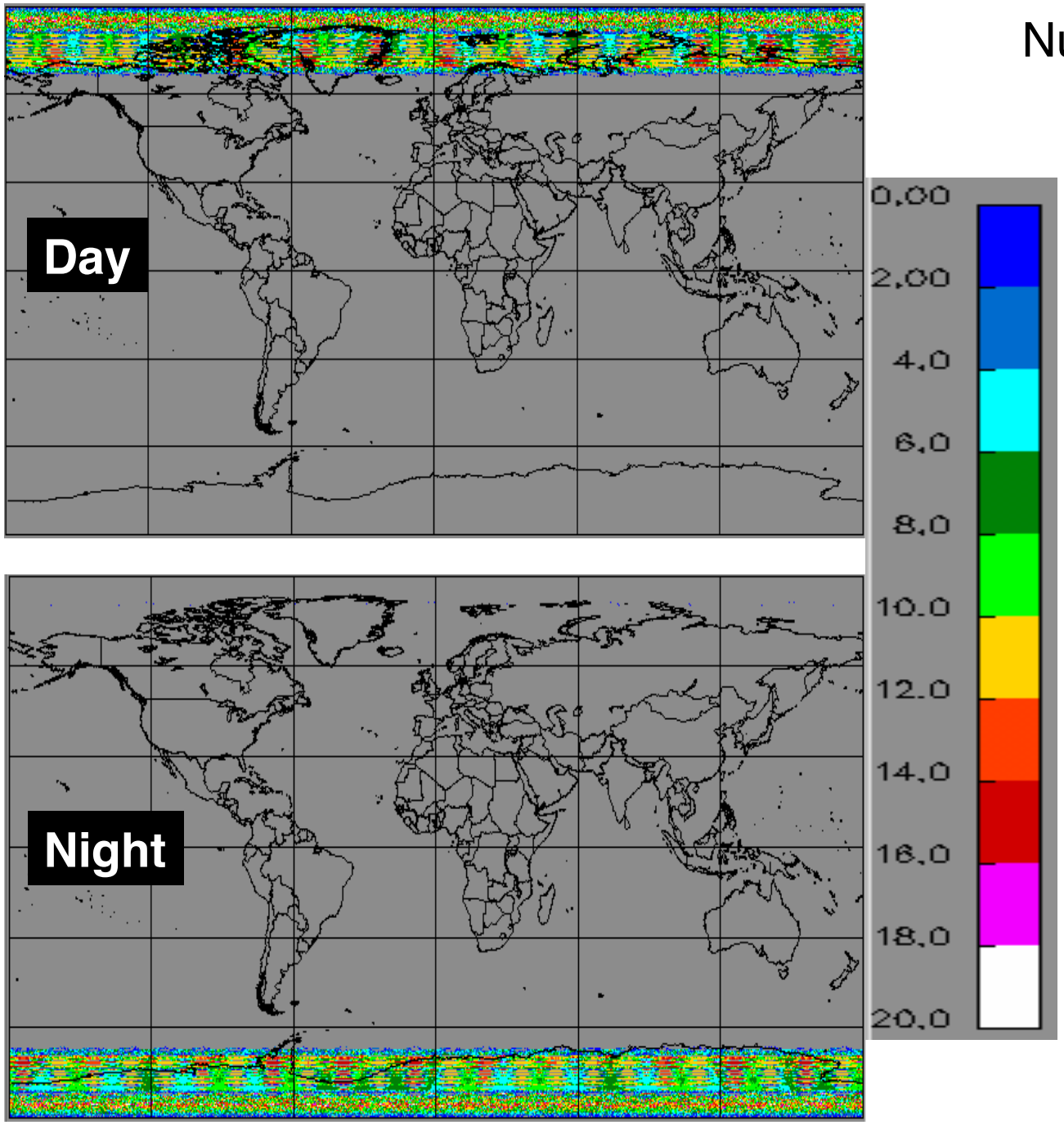
Conditions for matching pixels from J1-VIIRS and NPP-VIIRS

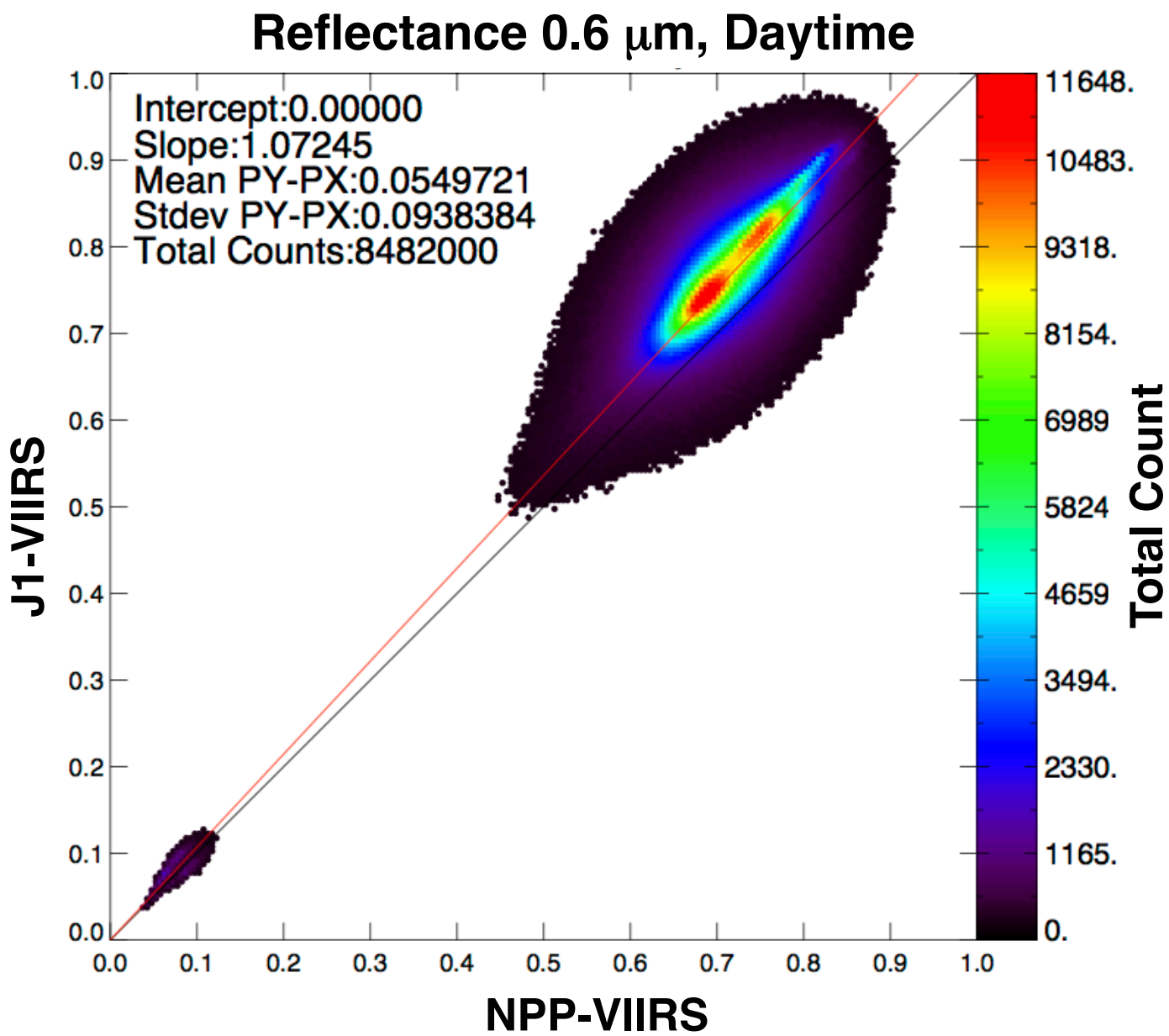
- Time within half hour
- Solar zenith angles within 5°
- View zenith angles within 5°
- Azimuth angles within 7.5^o
- 5 min grid box

Number of matched pixels

May 2018

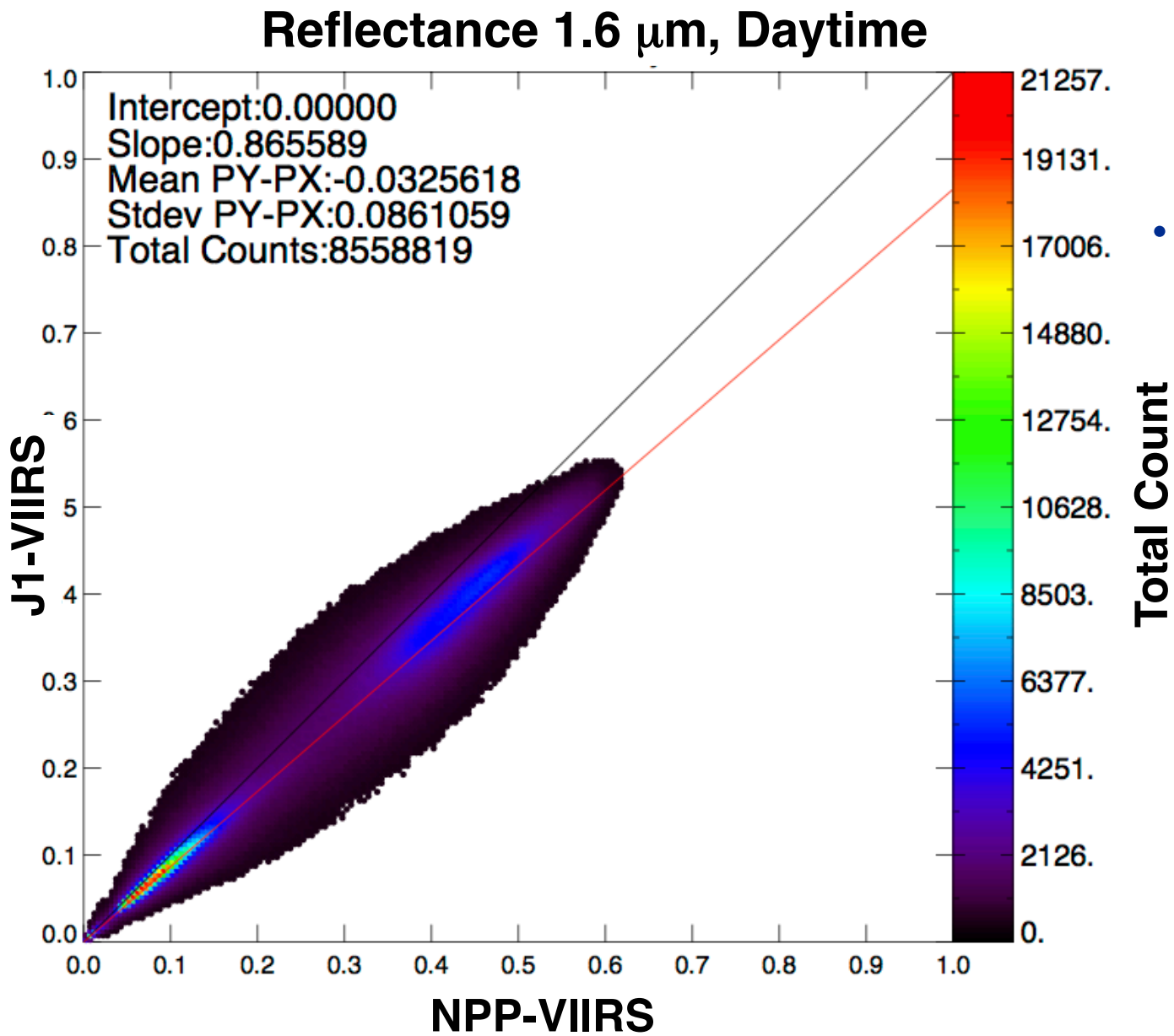


May 2018



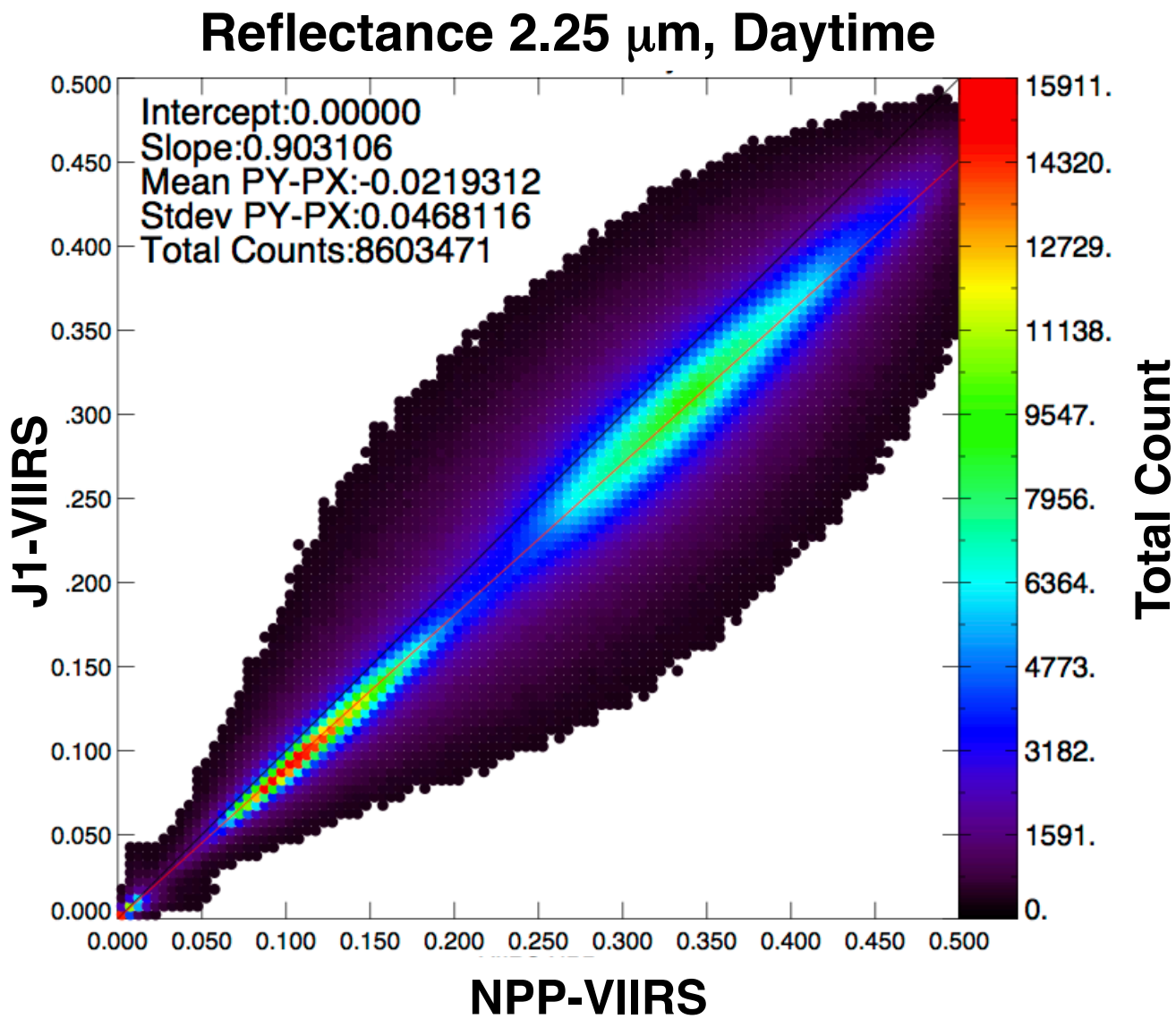
- J1-VIIRS: 7-8% higher than NPP

May 2018



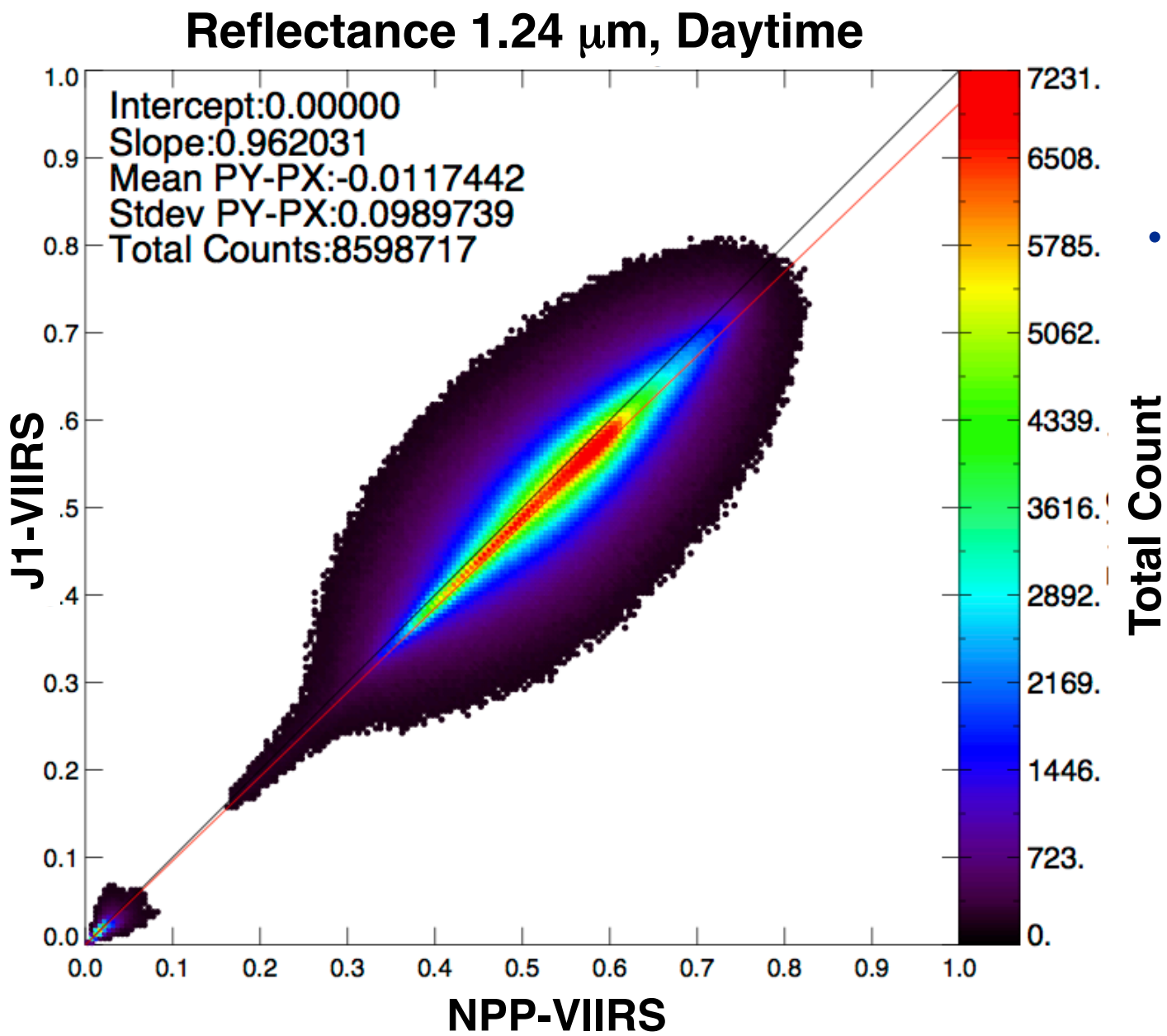
- J1-VIIRS: 13-14% lower than NPP

May 2018



- J1-VIIRS: 10% lower than NPP

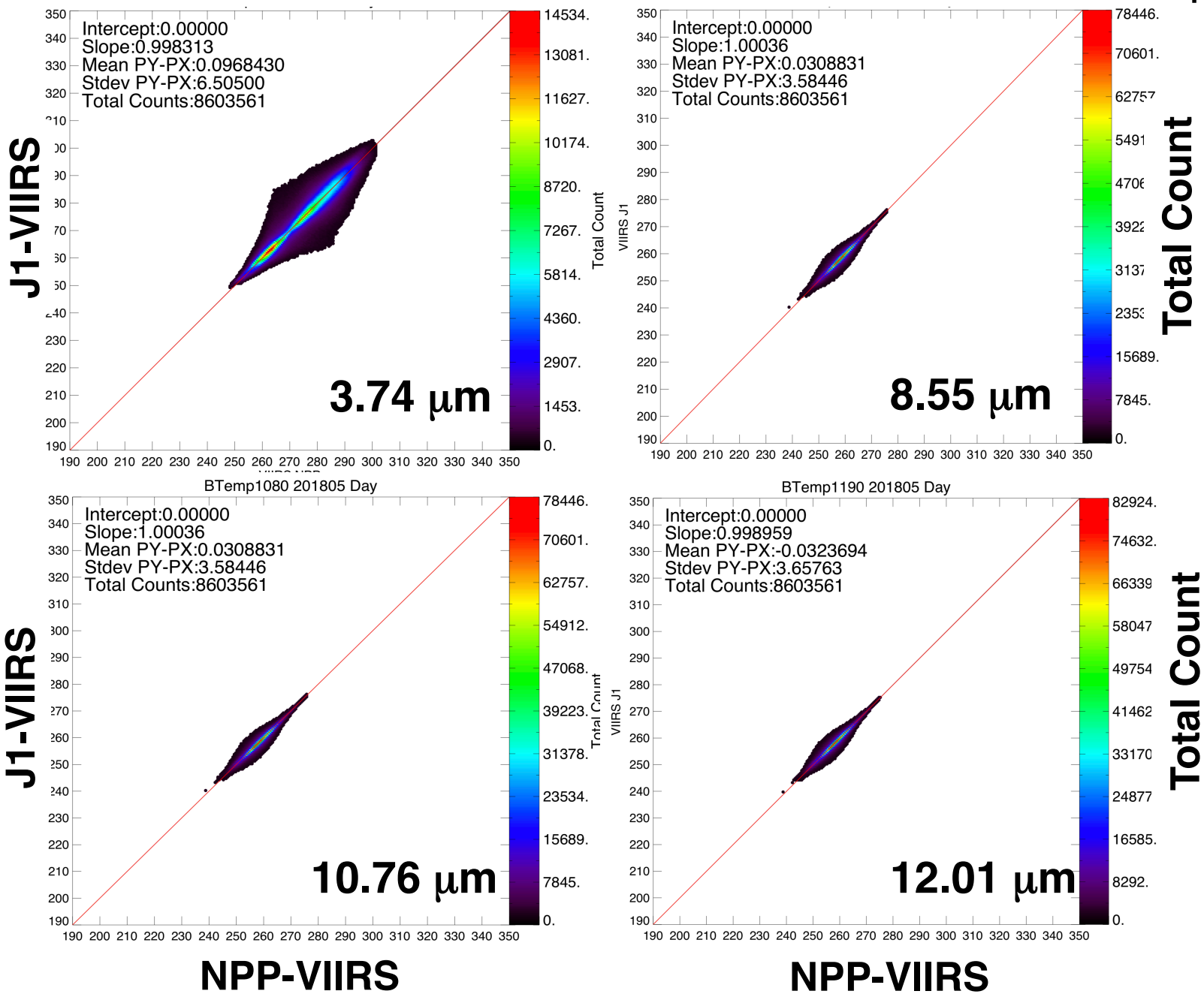
May 2018



- J1-VIIRS: 4% lower than NPP

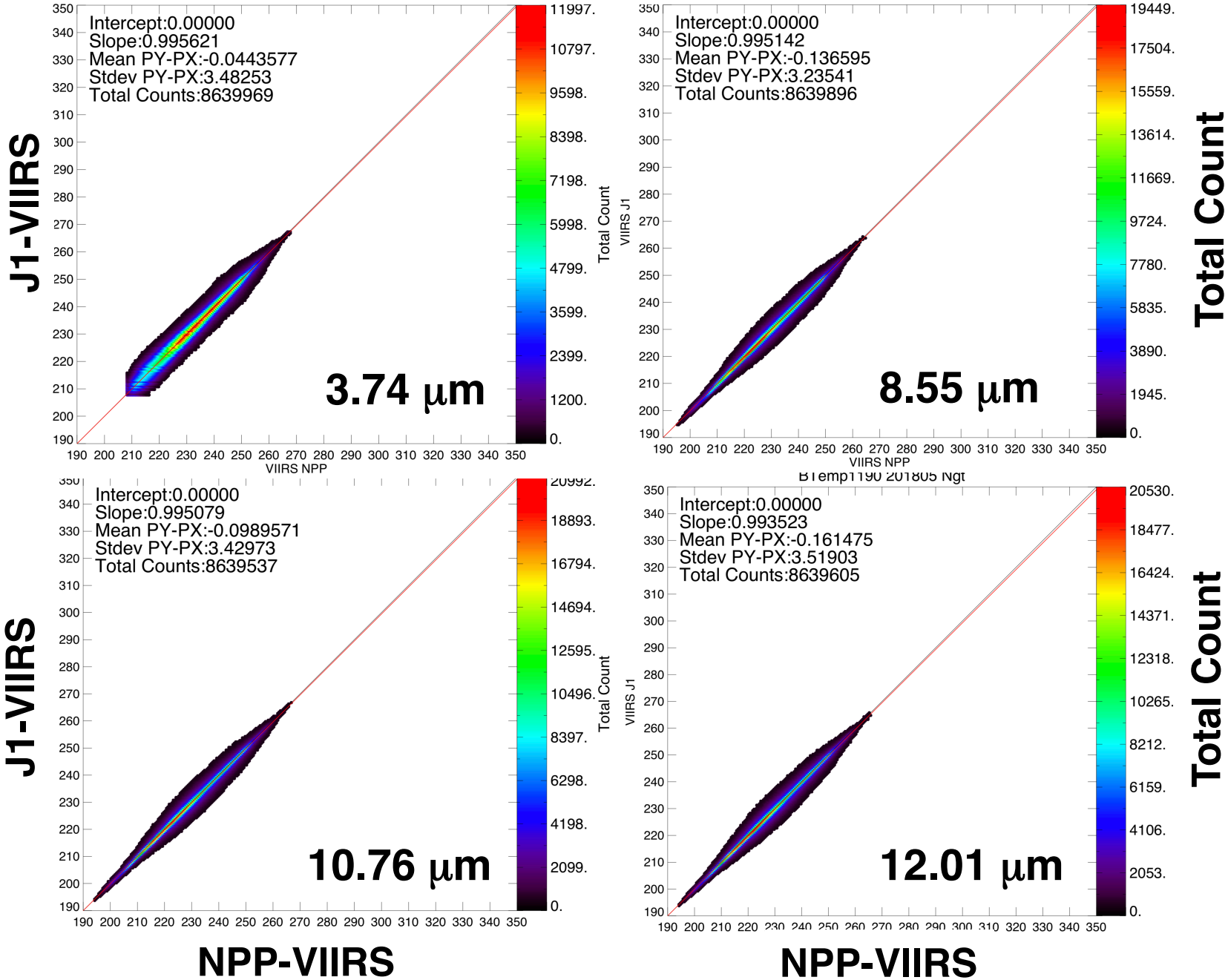
Brightness Temperature, Daytime

May 2018



Brightness Temperature, Nighttime

May 2018

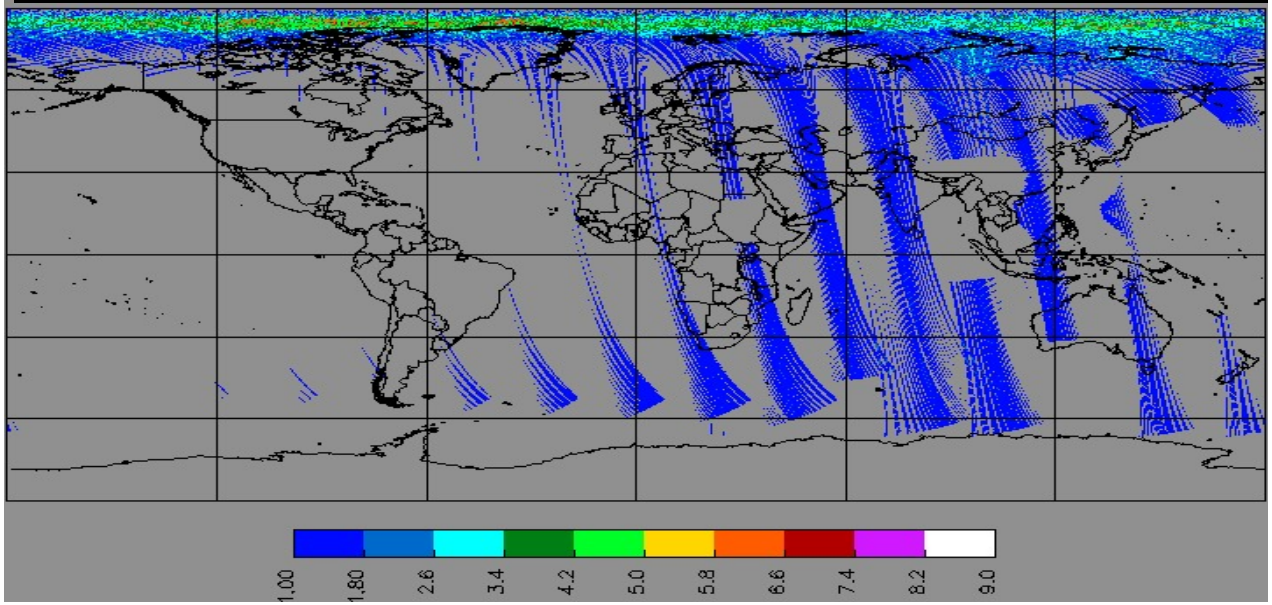


J1 and NPP matching areas are over polar regions

To see comparisons for non-polar regions:

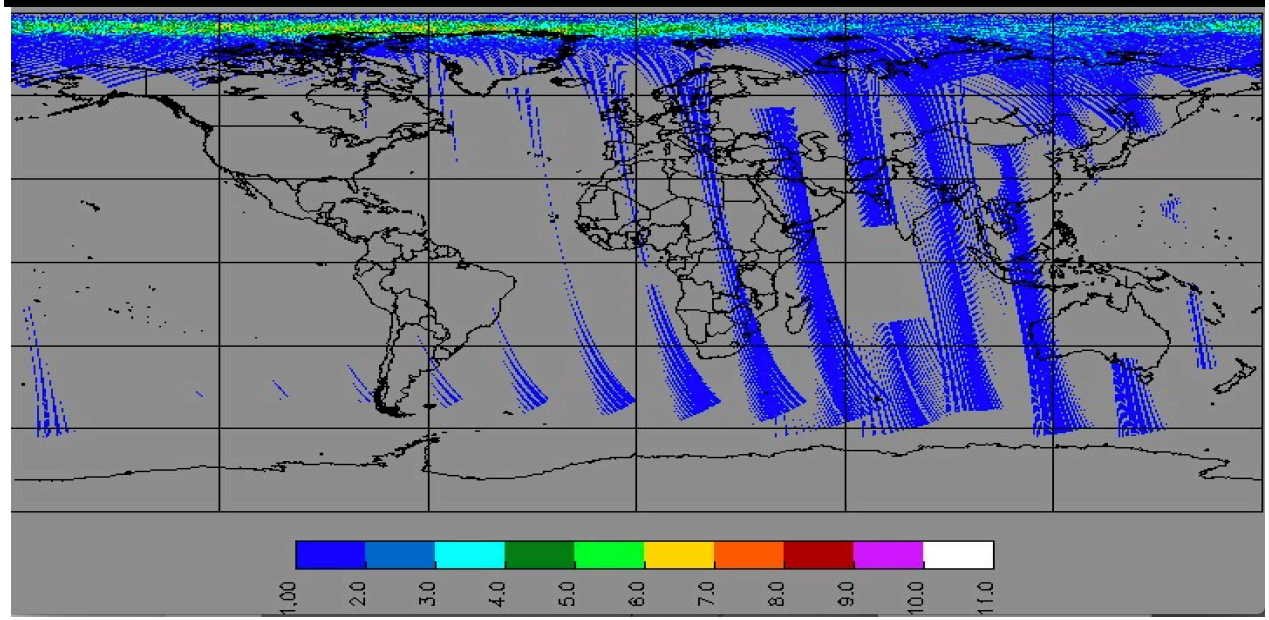
- Match NPP with Aqua to find the relationship between Aqua and NPP
- Match J1 with Aqua, using relationship of Aqua and NPP → J1 vs NPP

Number of matched counts from NPP and Aqua



20180503 day time

Number of matched counts from J1 and Aqua

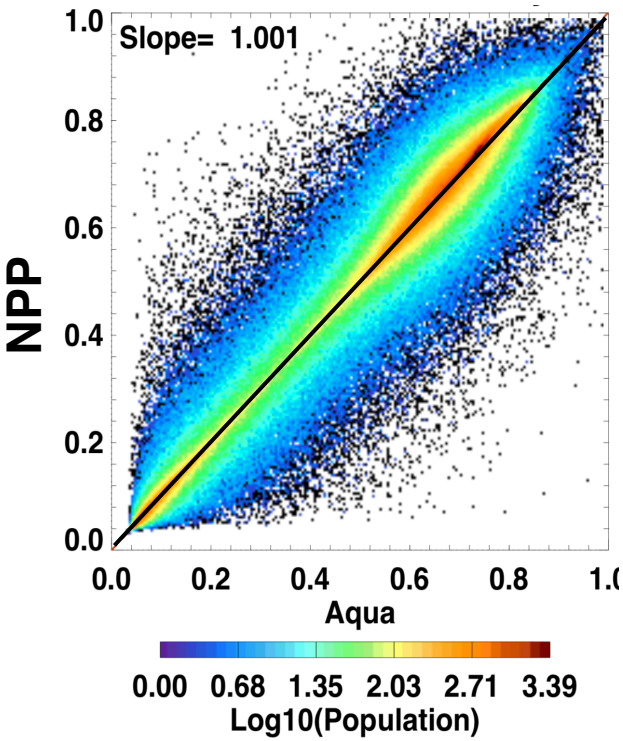


20180515 day time

Reflectance 0.6 μm, Daytime

May 3rd, 2018

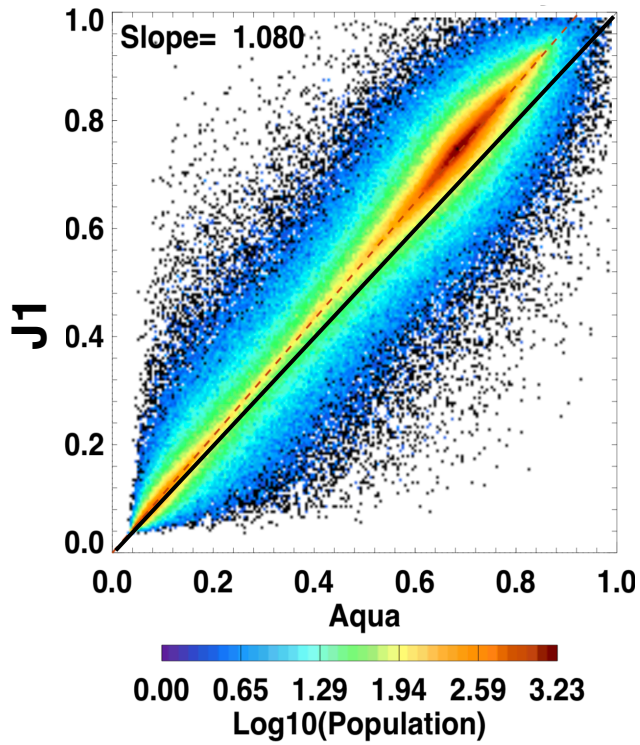
NPP .vs. Aqua



N= 736491.

	Mean	(StdDev
Aqua	0.541(	0.23
VIIRSNPP	0.544(	0.23
Y-X	0.003(	0.05
RMS(	0.058).....	

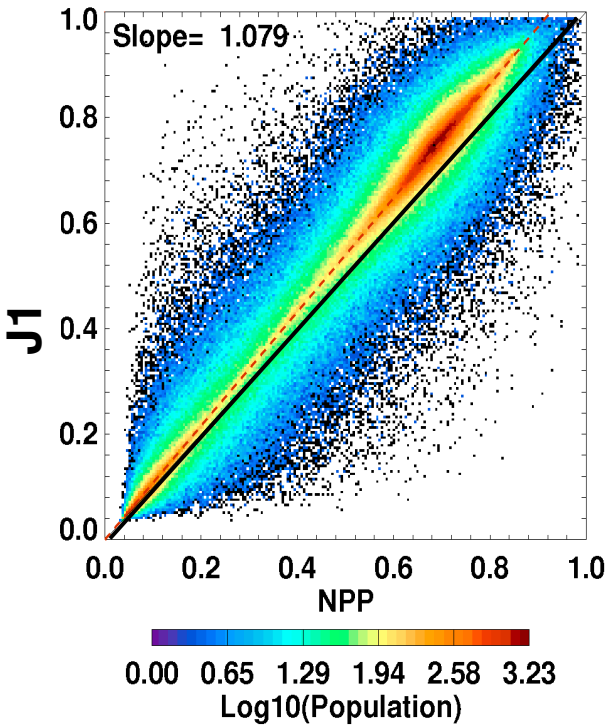
J1 .vs. Aqua



N= 701515.

	Mean	(StdDev
Aqua	0.562(	0.220
VIIRSJ1	0.609(	0.239
Y-X	0.047(	0.061
RMS(	0.077).....	

J1 .vs. NPP



N= 701512.

	Mean	(StdDev)
NPP	0.563(	0.220)
NOAA20	0.609(	0.239)
Y-X	0.047(	0.061)
RMS(	0.077).....	

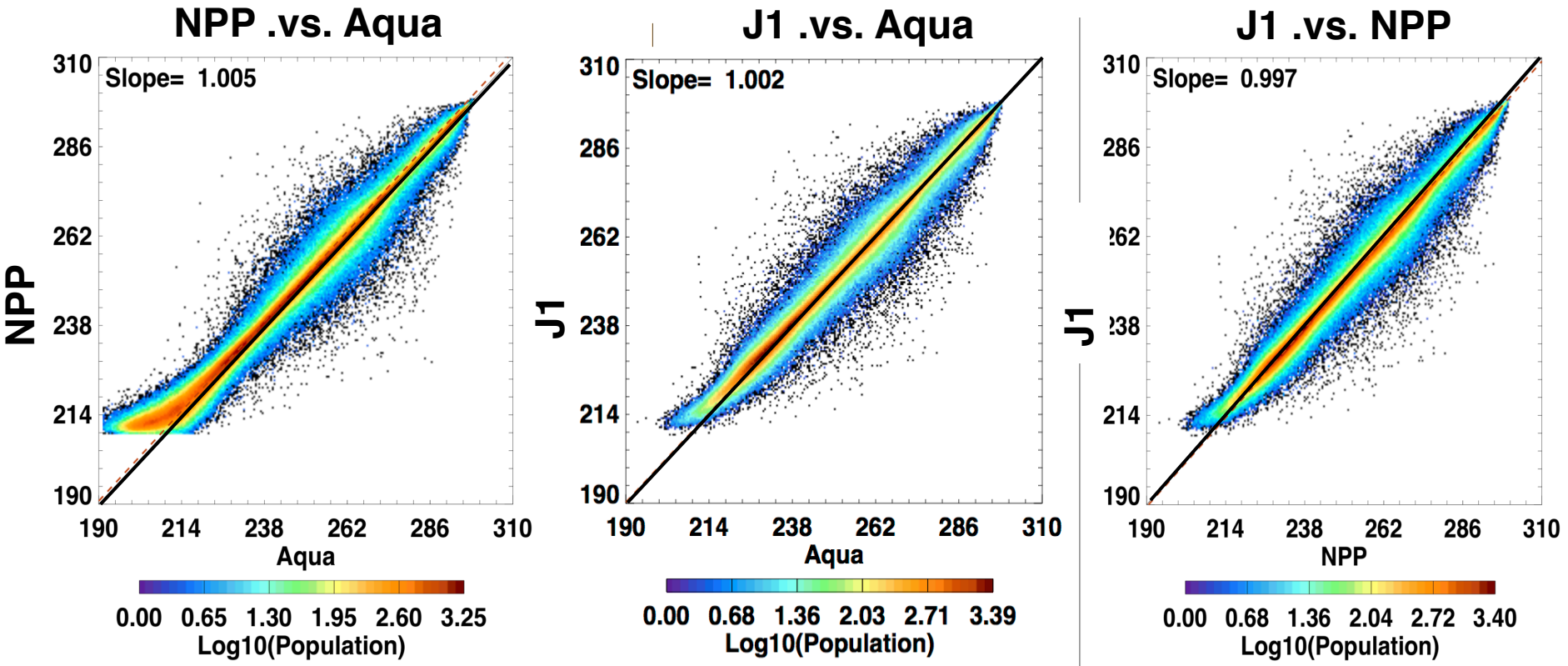
NPP agrees with Aqua well

J1 ~ 8% higher than Aqua

J1 ~ 7-8% higher than NPP

May 3rd, 2018

Brightness Temperature 3.74 μm, Night time



N= 1043165.

	Mean	(StdDev)
Aqua	240.8(	24.27)
VIIRSNPP	242.1(	22.78)
Y-X	1.29(	3.33)
RMS(	3.57).....	

N= 942407.

	Mean	(StdDev)
Aqua	247.6(	19.95)
VIIRSJ1	248.0(	19.56)
Y-X	0.420(	2.31)
RMS(	2.35).....	

N= 942407.

	Mean	(StdDev)
NPP	248.7(	20.04)
NOAA20	248.0(	19.56)
Y-X	-0.721(	2.34)
RMS(	2.44).....	

NPP cutoff ~ 210 K

J1 cutoff ~ 210 K

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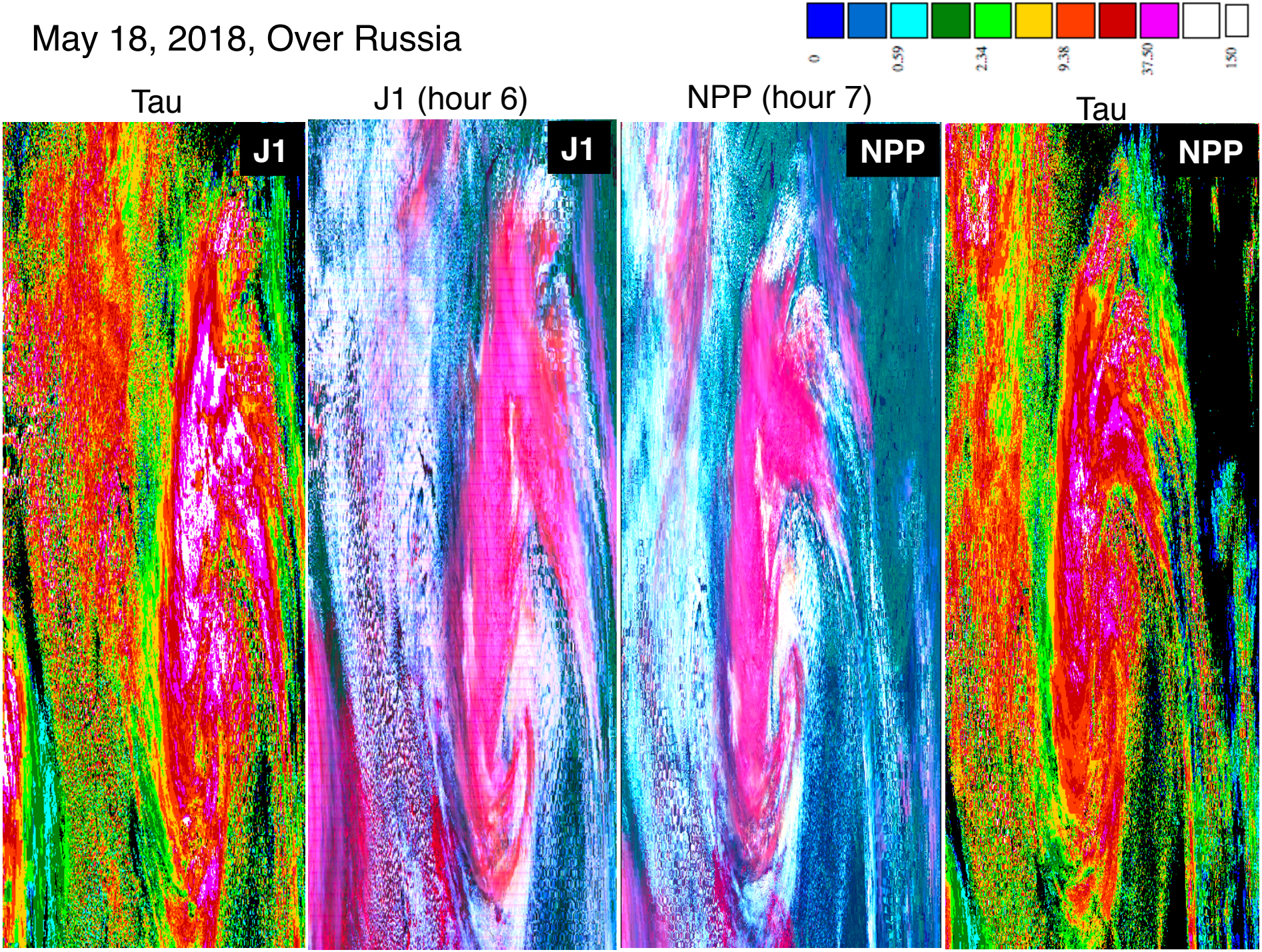
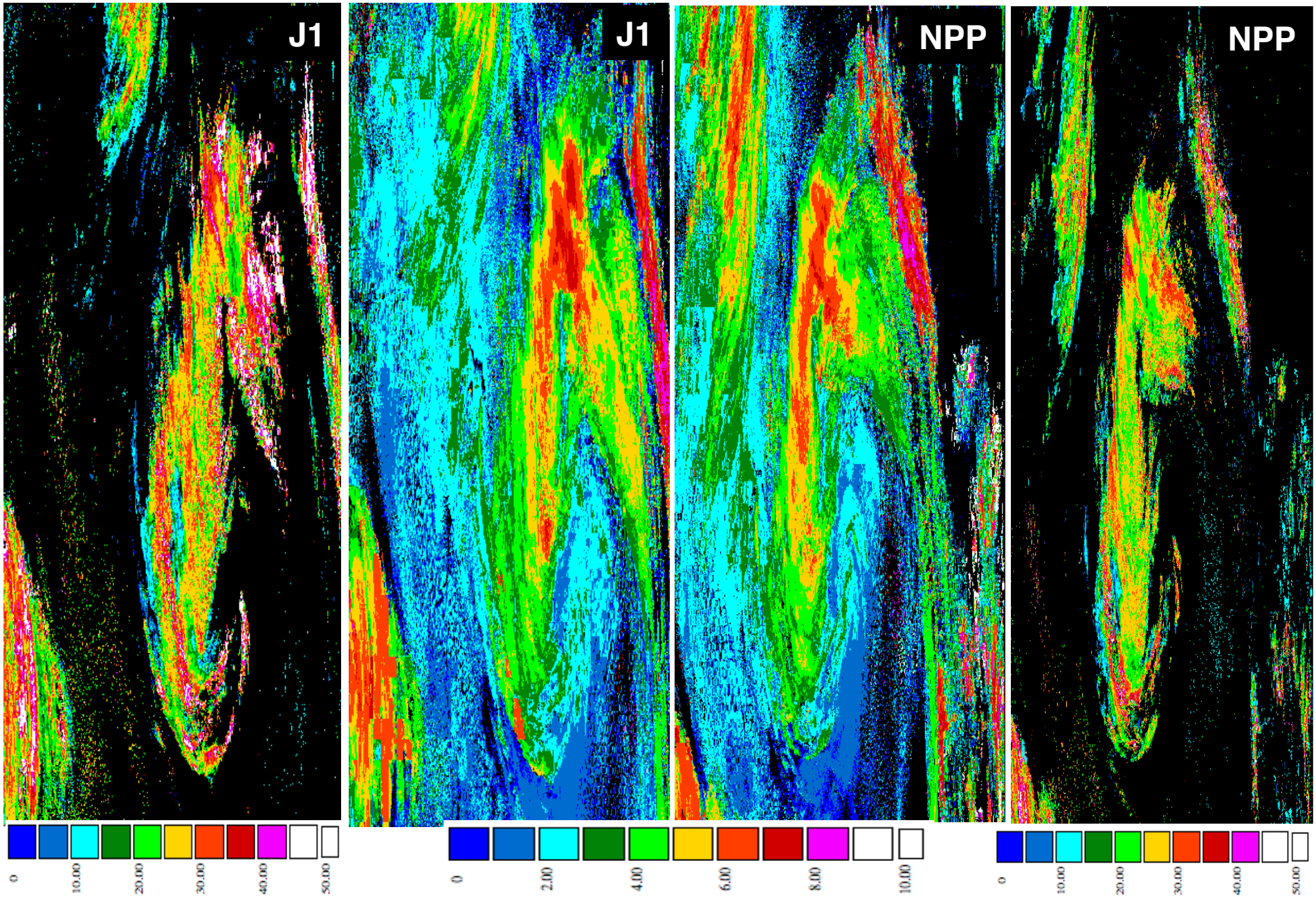
May 18, 2018, Over Russia

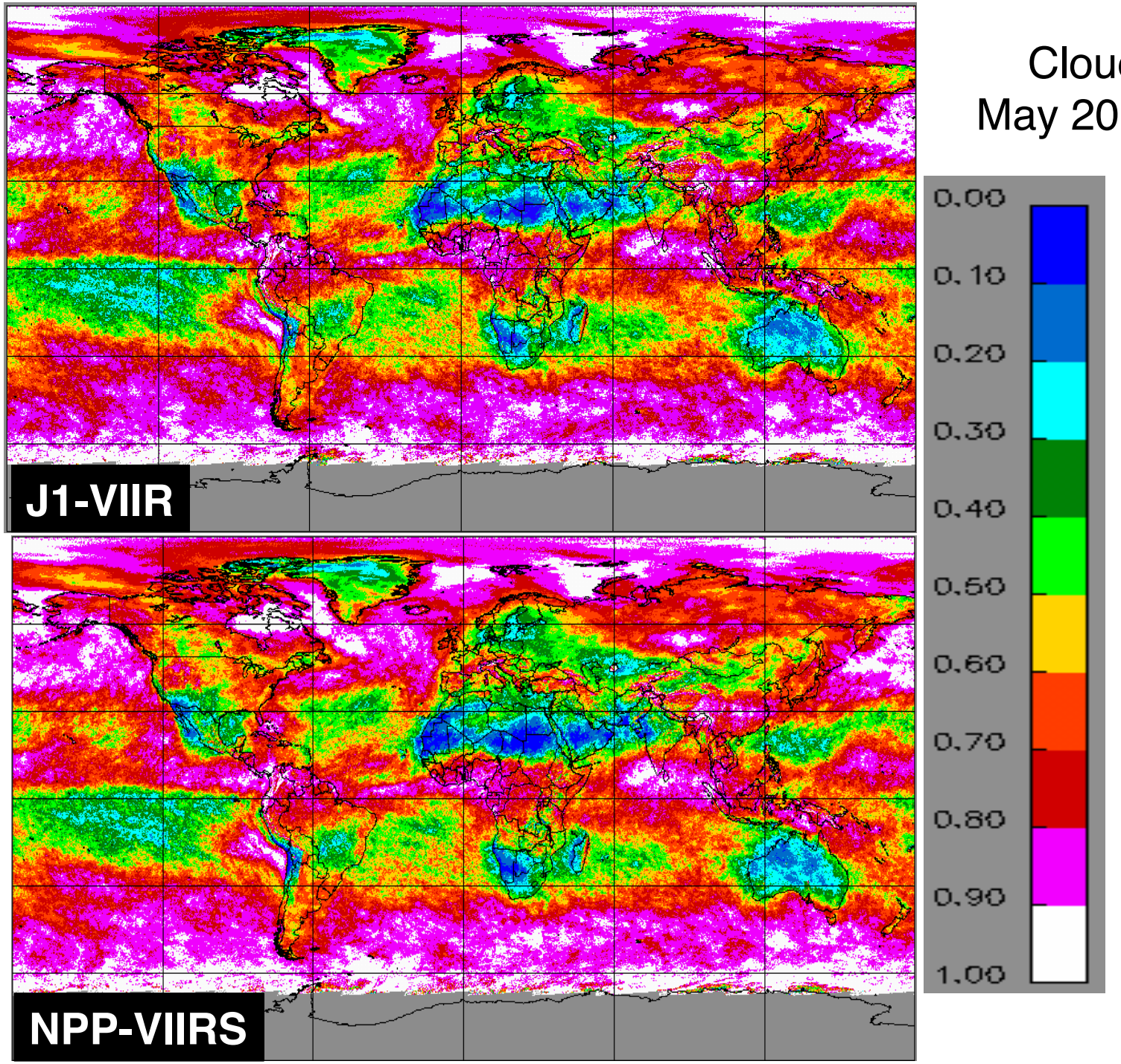


May 18, 2018, Over Russia

Ice Particle Size (μm) | Eff Height (km) | Eff Height (km) | Ice Particle Size (μm)

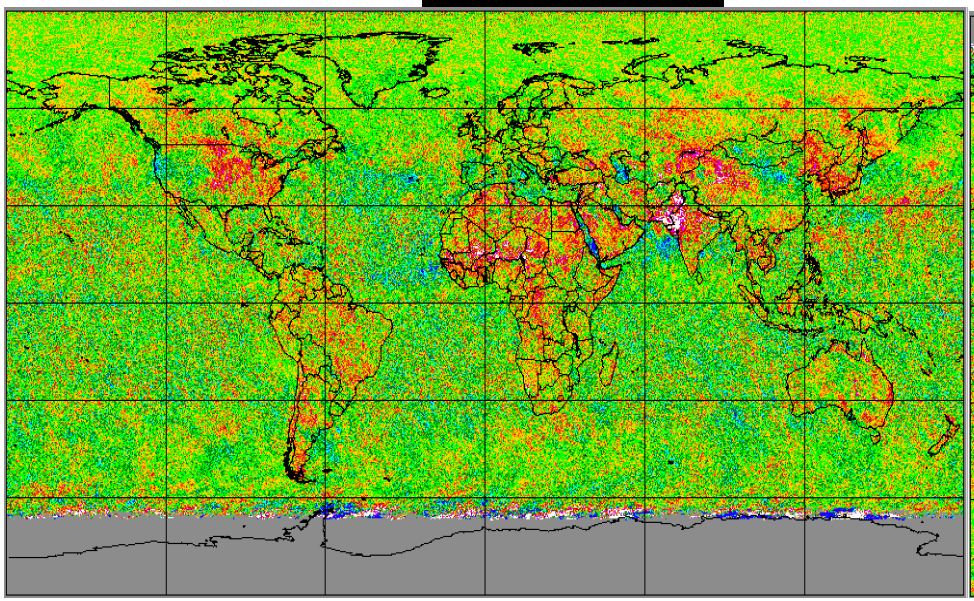


Cloud Fraction
May 2018, Day time

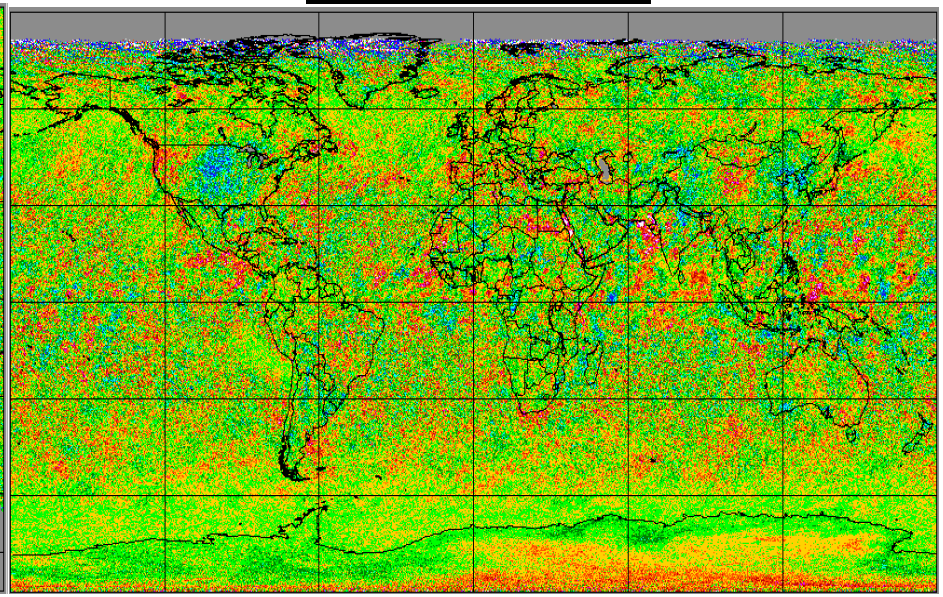


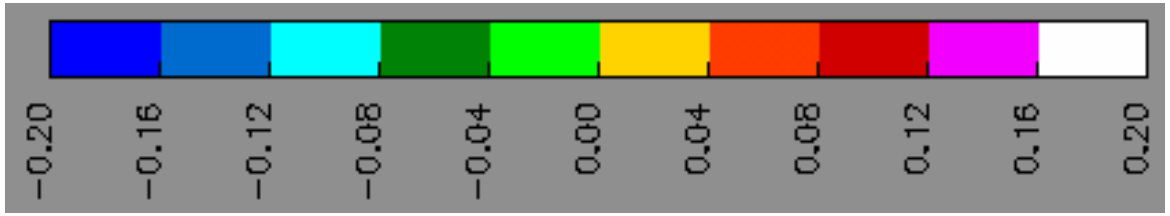
Cloud Fraction Difference (**J1 – NPP),** May 2018

Day Time



Night Time

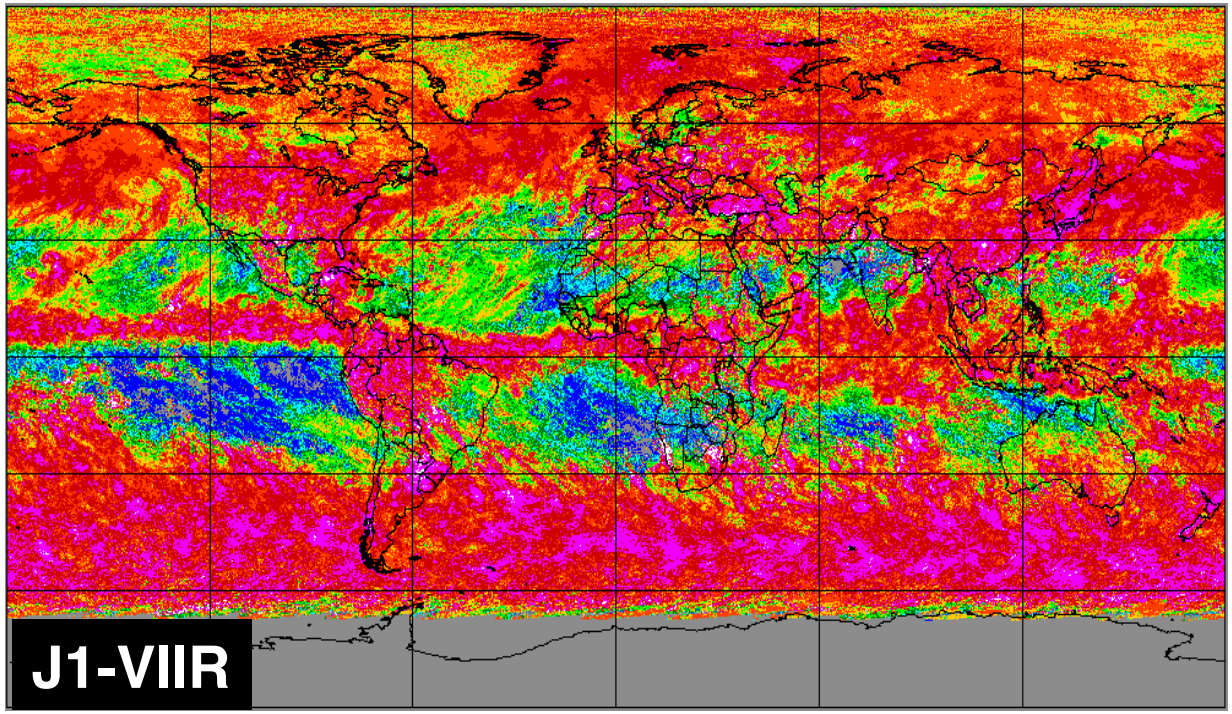


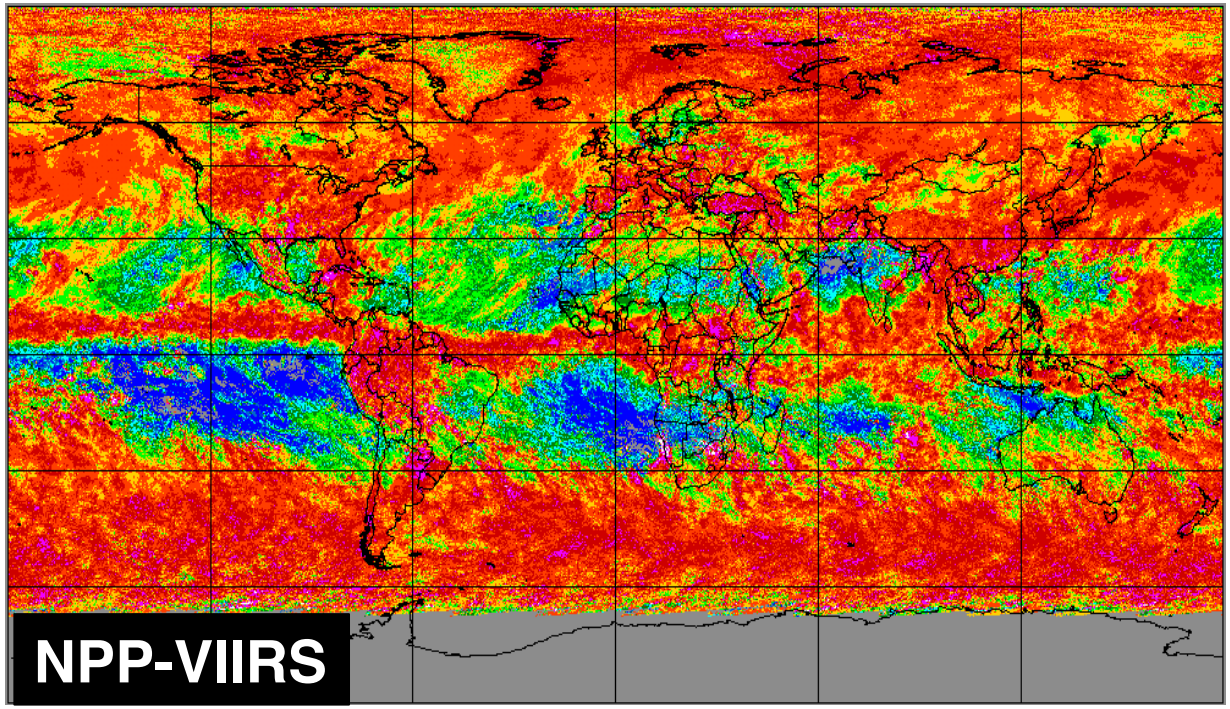


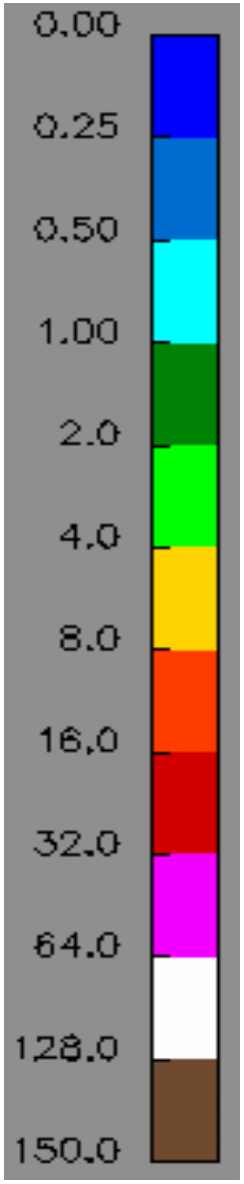
Cloud Fraction (J1 – NPP) (%)

	Ocean	Land
Day	-1.3	1.7
Night	-0.03	-1.0

Ice Cloud Optical Depth
May 2018, Day time

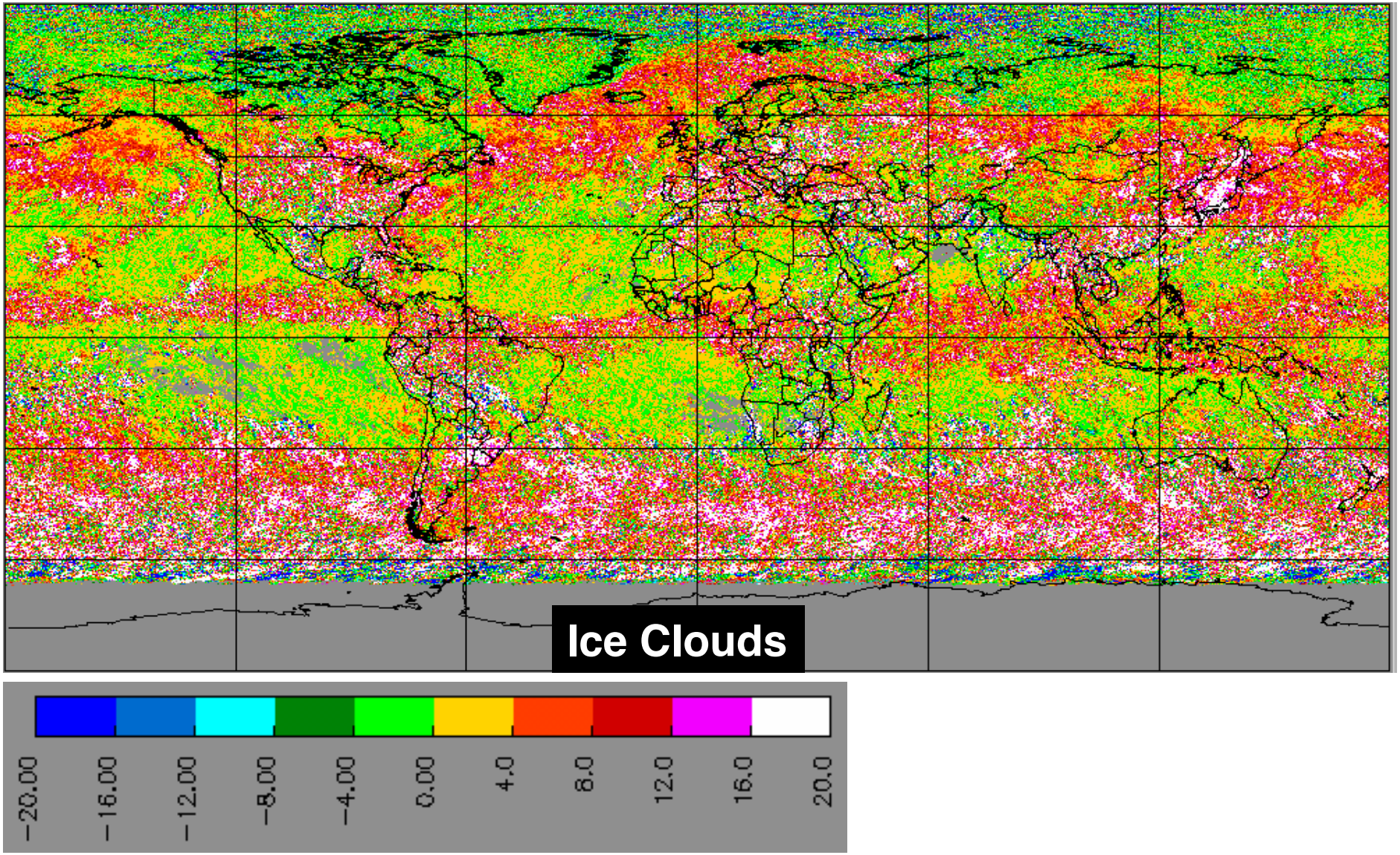






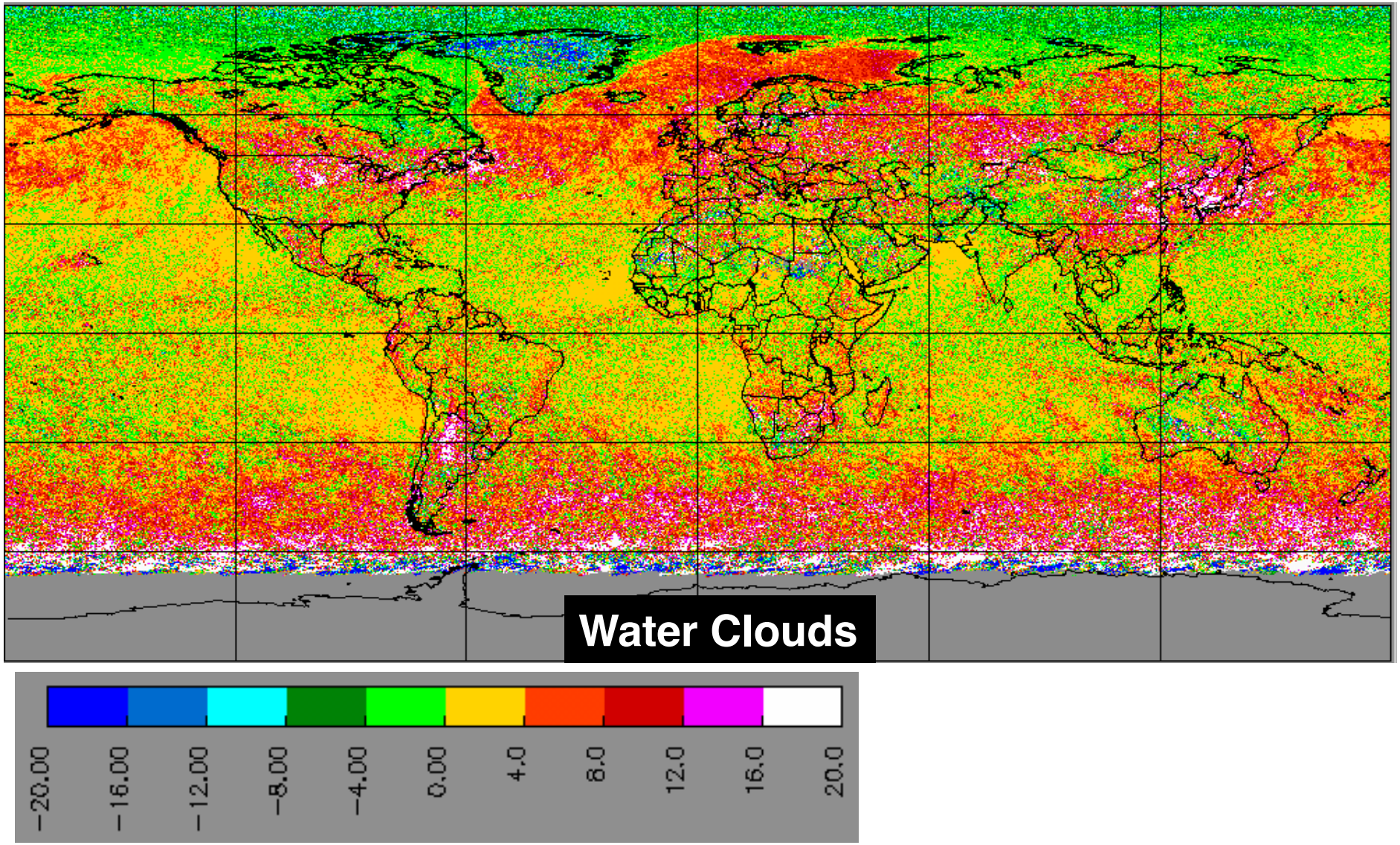
Ice Clouds

Ice Cloud Optical Depth Difference (**J1 – NPP),** May 2018, Day



- J1 ice tau is ~ 5 larger than NPP globally
- Due to J1 0.6 μm ref 7-8% too high

Water Cloud Optical Depth Difference (**J1 – NPP),** May 2018, Day



- J1 water tau is ~ 3 larger than NPP globally
- Due to J1 0.6 μm ref 7-8% too high

Cloud Effective Height Difference (J1 – NPP) (km), May 2018

Day Time

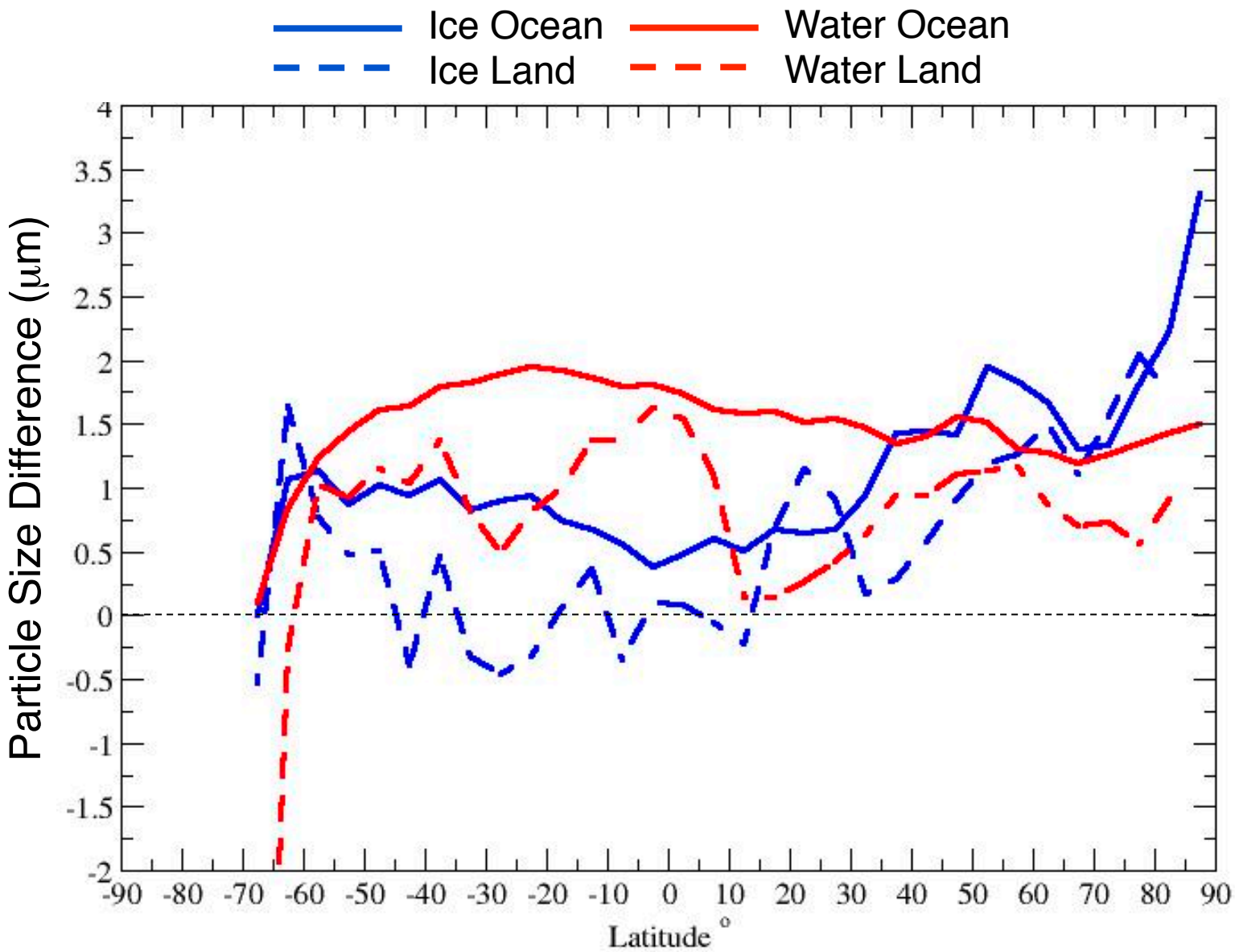
	Ice	Water
Non-polar	-0.39	-0.19
polar	-0.13	-0.07

Night Time

	Ice	Water
Non-polar	-0.04	-0.00
polar	0.04	-0.01

- Regional differences exist
- Essentially no differences globally

Particle Size Difference (**J1 – NPP**) (μm), May 2018, Day



J1 re:
1 – 1.5 μm
larger than
NPP

Summary

- J1 Solar channels:
  - 0.6 μm → 8% higher than NPP
  - 1.6 μm → 13-14% lower than NPP
  - 2.25 μm → 10% lower than NPP
  - 1.24 μm → 4% lower than NPP.

- J1 Thermal channels are quite consistent with NPP

- Calibrate both J1 and NPP with Aqua respectively to have a better coverage.

- With current J1-VIIRS,
  - clouds 1.3% lower than NPP over ocean and 1.7% higher
  - tau is 5-8 higher than NPP
  - clouds height consistent with NPP
  - re ~ 1-1.5 μm larger than NPP

Future Plan

- J1 Solar Channels Calibrations
- After calibration, repeat the same process. Hopefully the inconsistency issues in cloud properties will be resolved
- Deliver one PGE to run both NPP-VIIRS and J1-VIIRS.