NOAA-20 VIIRS Daytime (DCOMP) Provisional Maturity

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VIIRS DCOMP Team

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Executive Summary

- NDE DCOMP Cloud Optical Thickness (COT) and Cloud Particle Size (CPS) products were evaluated both visually and quantitatively with other products.
- Visual inspections reveal issues such as missing granules due to NDE processing.
- The CPS product shows erroneous pattern in strong glint areas.
- Comparison to MODIS-AQUA products demonstrated good product performance. All products meet requirements except COT for ice phase. We discuss the possible reasons (calibration or too loose data filtering)
- A further validation with AMSR2 for Liquid Water Path meet all requirements.
- **The cloud team recommends provisional maturity**

JPSS Data Products Maturity Definition

JPSS/GOES-R Data Product Validation Maturity Stages – COMMON DEFINITIONS (Nominal Mission)

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.

Requirement Check List – Cloud Optical Depth

JERD	Requirement	Meet Requirement (Y/N)?
	Applicable Conditions: 1. Requirements apply whenever detectable clouds are present	
JERD-2430	The algorithm shall produce a cloud optical depth product that has a horizontal cell size of 0.8 km	
JERD-2482	The algorithm shall produce a cloud optical depth product that has a mapping uncertainty (3 sigma) of 4 km	
JERD-2483	The algorithm shall produce a cloud optical depth product that has a measurement range of 0.3 – 64 (Day) and 0.3 – 8 (Night)	
JERD-2484	The algorithm shall produce a cloud optical depth product that has a measurement precision of greater of 30% or 3.0 Tau (Day) and greater of 30% or 0.8 Tau (Night)	
JERD-2485	The algorithm shall produce a cloud optical depth product that has a measurement accuracy of Liquid phase: 20% (Day), 30% (Night); Ice phase: 20% (Day), 30% (Night)	

Requirement Check List – Cloud Particle Size Distribution

JERD	Requirement	Meet Requirement (Y/N)?
	Applicable Conditions: 1. Requirements apply both day and night and whenever detectable clouds are present	
JERD-2431	The algorithm shall produce a cloud particle size distribution product that has a horizontal cell size of 0.8 km	
JERD-2486	The algorithm shall produce a cloud particle size distribution product that has a mapping uncertainty (3 sigma) of 4 km	
JERD-2487	The algorithm shall produce a cloud particle size distribution product that has a measurement range of 2 to 50 µm (day), 2 to 32 µm for water (night), and 2 to 50 µm for ice (night)	
JERD-2488	The algorithm shall produce a cloud particle size distribution product that has a measurement precision of greater of 4 µm or 25% for water and greater of 10 µm or 25% for ice	
JERD-2489	The algorithm shall produce a cloud particle size distribution product that has a measurement accuracy of Greater of 4 µm or 30% for water and 10 µm for ice	

Specs Requirement for Cloud Top Products

- COT = Cloud Optical Thickness
- CPS = Cloud Particle Size
- LWP = Liquid Water Path
- IWP = Ice Water Path

* Not an official NDE product

Product	Validation Source	Range	Accuracy	Precision
COT Water	MODIS	1-50	2 or 20%	2 or 20%
COT Ice	MODIS	1-50	3 or 30%	3 or 30%
CPS Water	MODIS	1-50µm	4µm	4µm
CPS Ice	MODIS	1-50µm	10µm	10µm
*LWP**	*AMSR2*	*1-200*	*50g/m2*	*50g/m2*

Outline

- DCOMP Description
- DCOMP Status in NDE
- Evaluation of the DCOMP
- Provisional Maturity Conclusions
- Path Forward to Validated
- Future Plans

DCOMP Channels

- DCOMP is currently set up to run with the M6 (0.64mm) and M11 (2.2mm)

- DCOMP can be used with the M7 or M12 Band instead of the M11 Band

- It also can use Visible Reflectance from backscattered moonlight (“lunar reflectance”) from DNB, but this is currently not set up within NDE

		Band No.	Driving EDR(s)	Spectral Range (um)	Horiz Sample Interval (km) (track x Scan) Nadir	End of Scan
Reflective Bands	VisNIR	M1	Ocean Color Aerosol	0.402 - 0.422	0.742 x 0.259	1.60 x 1.58
Reflective Bands	VisNIR	M2	Ocean Color Aerosol	0.436 - 0.454	0.742 x 0.259	1.60 x 1.58
Reflective Bands	VisNIR	M3	Ocean Color Aerosol	0.478 - 0.498	0.742 x 0.259	1.60 x 1.58
Reflective Bands	VisNIR	M4	Ocean Color Aerosol	0.545 - 0.565	0.742 x 0.259	1.60 x 1.58
Reflective Bands	VisNIR	I1	Imagery EDR	0.600 - 0.680	0.371 x 0.387	0.80 x 0.789
Reflective Bands	VisNIR	M5	Ocean Color Aerosol	0.662 - 0.682	0.742 x 0.259	1.60 x 1.58
Reflective Bands	VisNIR	M6	Atmosph. Correct.	0.739 - 0.754	0.742 x 0.776	1.60 x 1.58
Reflective Bands	VisNIR	I2	NDVI	0.846 - 0.885	0.371 x 0.387	0.80 x 0.789
Reflective Bands	VisNIR	M7	Ocean Color Aerosol	0.846 - 0.885	0.742 x 0.259	1.60 x 1.58
Reflective Bands	S/MWIR	M8	Cloud Particle Size	1.230 - 1.250	0.742 x 0.776	1.60 x 1.58
Reflective Bands	S/MWIR	M9	Cirrius/Cloud Cover	1.371 - 1.386	0.742 x 0.776	1.60 x 1.58
Reflective Bands	S/MWIR	I3	Binary Snow Map	1.580 - 1.640	0.371 x 0.387	0.80 x 0.789
Reflective Bands	S/MWIR	M10	Snow Fraction	1.580 - 1.640	0.742 x 0.776	1.60 x 1.58
Reflective Bands	S/MWIR	M11	Clouds	2.225 - 2.275	0.742 x 0.776	1.60 x 1.58
Emissive Bands	S/MWIR	I4	Imagery Clouds	3.550 - 3.930	0.371 x 0.387	0.80 x 0.789
Emissive Bands	S/MWIR	M12	SST	3.660 - 3.840	0.742 x 0.776	1.60 x 1.58
Emissive Bands	S/MWIR	M13	SST Fires	3.973 - 4.128	0.742 x 0.259	1.60 x 1.58
Emissive Bands	LWIR	M14	Cloud Top Properties	8.400 - 8.700	0.742 x 0.776	1.60 x 1.58
Emissive Bands	LWIR	M15	SST	10.263 - 11.263	0.742 x 0.776	1.60 x 1.58
Emissive Bands	LWIR	I5	Cloud Imagery	10.500 - 12.400	0.371 x 0.387	0.80 x 0.789
Emissive Bands	LWIR	M16	SST	11.538 - 12.488	0.742 x 0.776	1.60 x 1.58

DCOMP

- DCOMP is the Daytime Cloud Optical and Microphysical Properties algorithm of the NOAA-AWG retrieval scheme PATMOS-x.
- DCOMP was developed for GOES-AWG and works presently on VIIRS-SNPP and VIIRS-NOAA-20, MODIS, GOES, SEVIRI, MSAT, GOES-ABI and others.
- DCOMP is a FORTRAN 90/95 package which works with the identical code for all sensors and software environments (e.g. CLAVR-x, GEOCAT, FRAMEWORK).
- CLAVR-x/DCOMP is the current development code.

- **DCOMP** uses the following **input**: (and has to deal with their uncertainties.)
  - Reflectance in two channels.
  - Cloud mask
  - Cloud phase
  - Cloud top pressure (for atmospheric correction)
  - Surface albedo from MODIS climatology
  - Atmospheric profile of water vapor, Ozone and aerosol path

DCOMP retrieval

- DCOMP is based on **bi-spectral measurements** in a visible non-absorbing channel, and a Near-IR weakly absorbing channel.
- Main information for **COT** lies in **visible** channel.
- The **absorption channel** provides additional information **on particle size** and indirectly helps correcting COT estimates for differences in scattering due to variable particle size.
- **Inversion via 1D-Var.** Optimal estimation enables full uncertainty propagation from input to output.
- Fig.1 visualizes theoretical forward model with the propagation of typical error uncertainties from channel reflectance uncertainty (red), adding atmospheric correction uncertainty (yellow) and surface albedo uncertainty (green).
- **Theoretical product uncertainties** are a function of COD (Fig.2). Thin clouds and thick clouds have the highest theoretical uncertainty. Thick clouds' COT cannot be retrieved quantitatively.

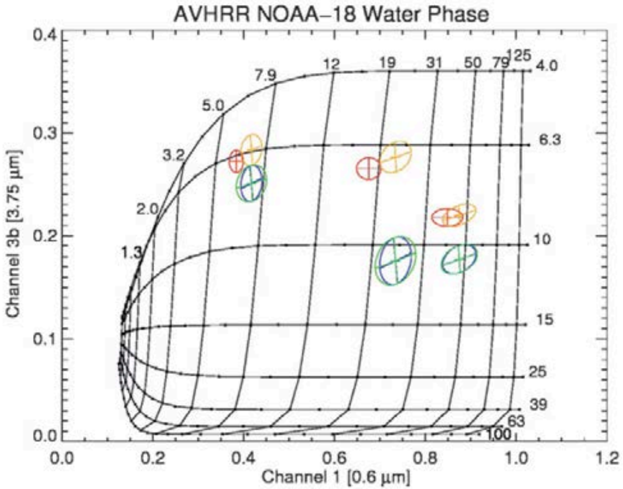


Fig.1. DCOMP Forward Model

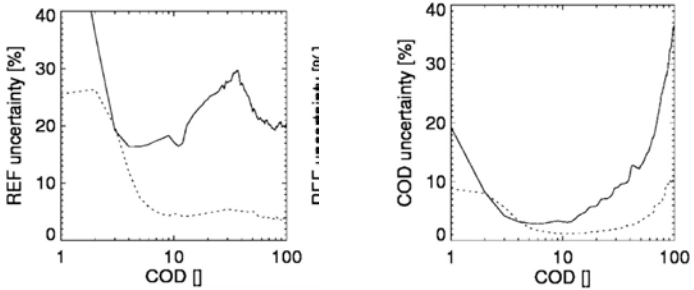


Fig.2. Uncertainty of COT and CPS as a function of COD

Evaluation Methodology

Other than other cloud products (cloud height, cloud fraction, cloud phase) DCOMP products are radiative parameters. Thus, it is not possible to validate optical thickness and effective radius directly from in-situ observations without making assumptions about the scattering properties of cloud particles. Therefore really independent validation sources are not existing.

Our Specific Evaluation Methodology applied here:

- Visual checks of product imagery
- Direct comparison with MODIS products.
- For liquid clouds, the use of passive microwave retrievals to validate cloud water path. Liquid Water Path is a directly computed from COT and CPS. Validation of LWP is therefore an indirect validation of COD and CPS.

Data Used in this Analysis

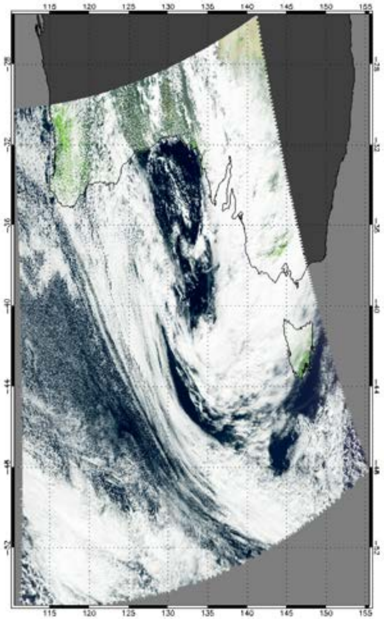
- NOAA-20 NDE v1r2 from 12 days from June to September, 2018 (DOY 167,173,183,186,239,242,244,247,250,252,255,258)
- NOAA-20 CLAVR-x from 12 days from June to September, 2018
- NASA AQUA/MODIS from 12 days from June to September, 2018
- AMSR2/GCOM-W from 12 days from June to September, 2018

Visual checks of product imagery

Visual checks

True Color Mosaic

NDE VIIRS N-20 Granule: 201808300512013



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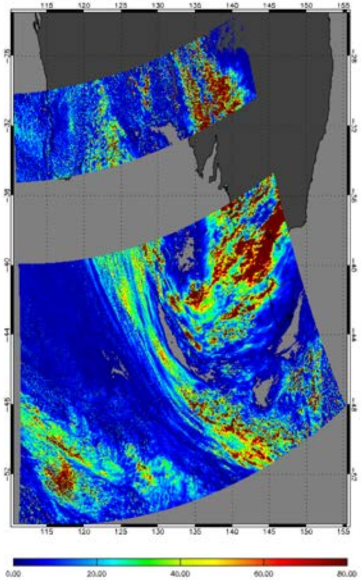
Cloud Optical Thickness NDE

NDE VIIRS N-20 Granule: 201808300512013



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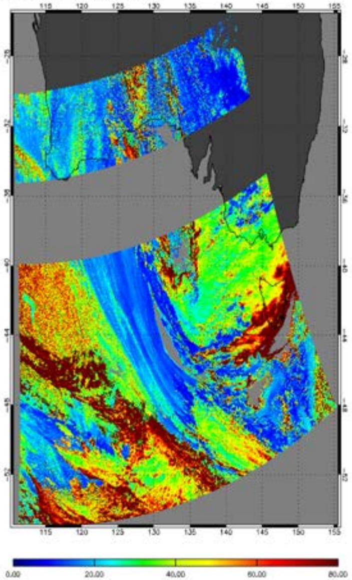
Cloud Effective Radius NDE

NDE VIIRS N-20 Granule: 201808300512013



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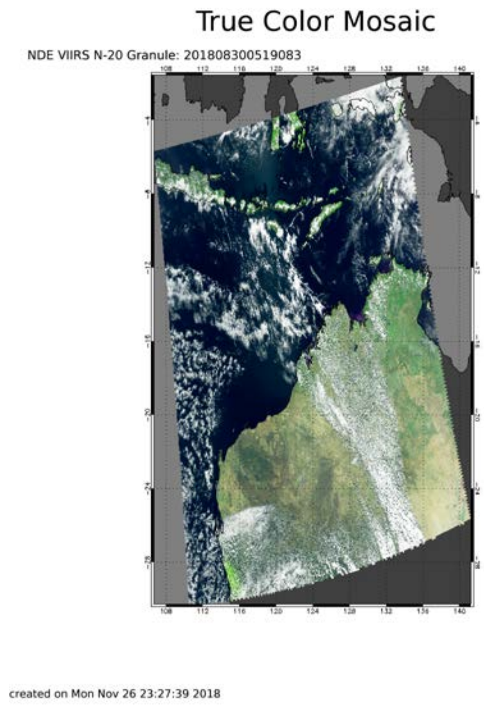
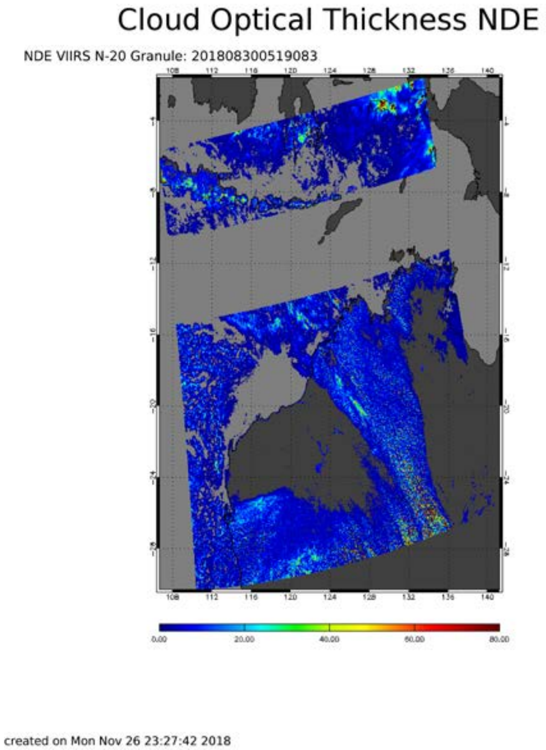
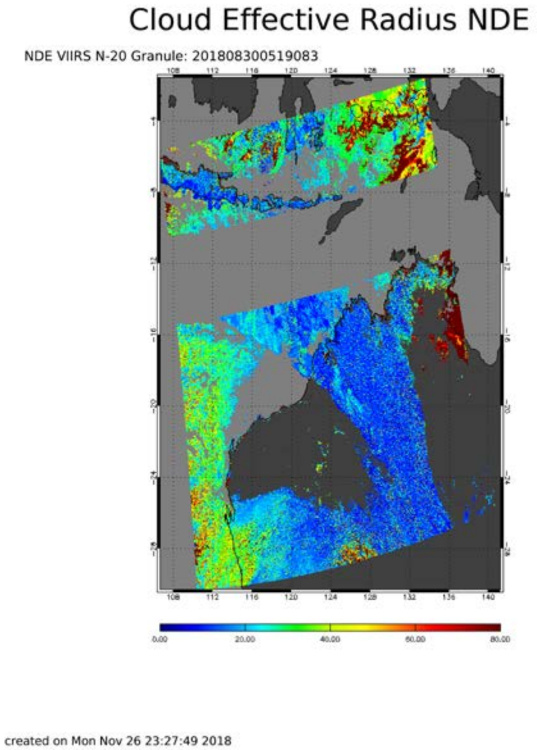
Visual checks



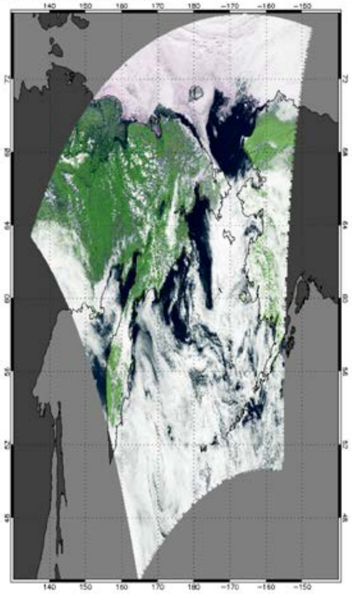




Visual Check- NDE

True Color Mosaic

NDE VIIRS N-20 Granule: 201806220030105



Cloud Optical Thickness NDE

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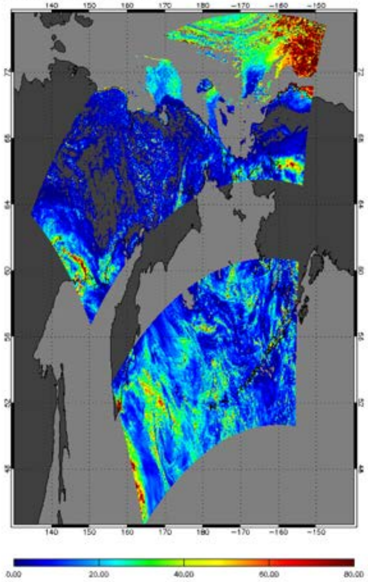
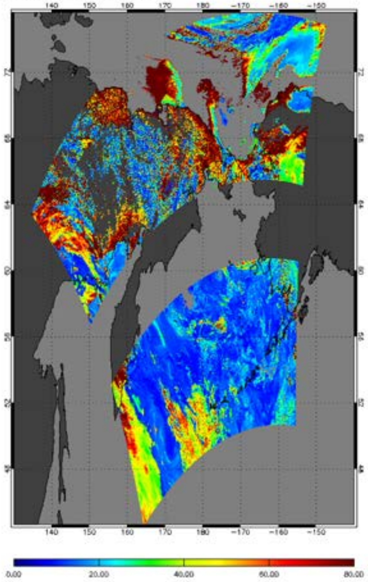


Cloud Effective Radius NDE

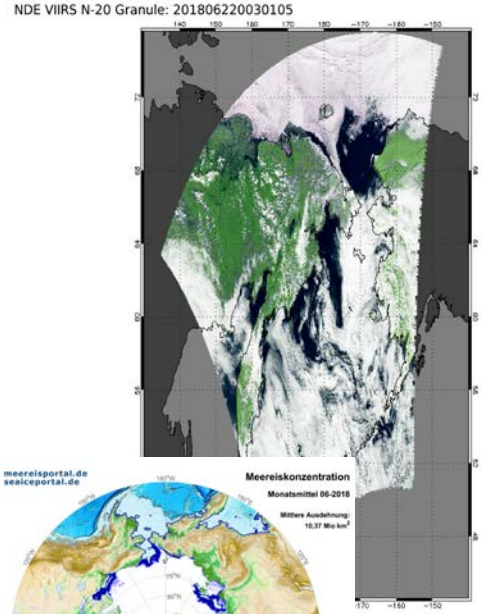
NDE VIIRS N-20 Granule: 201806220030105

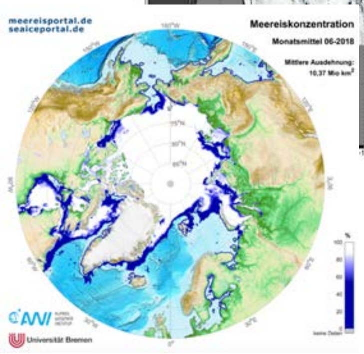


NDE cloud mask recognizes correctly cloud–free sea-ice areas.

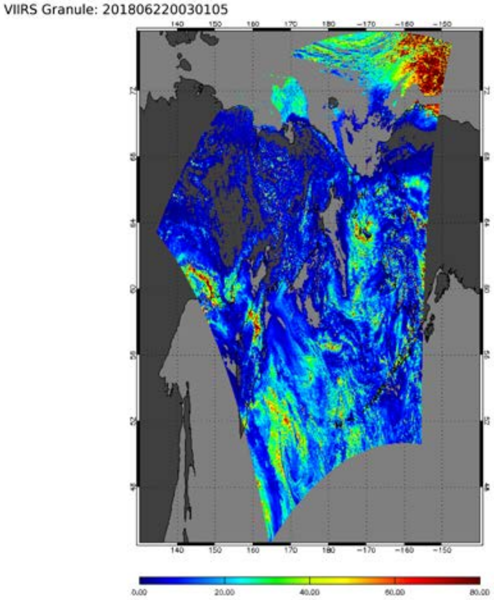
Visual Check-CLAVRx

True Color Mosaic

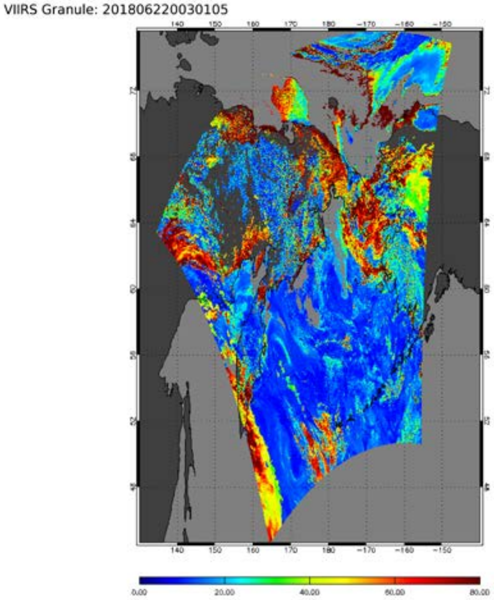




Cloud Optical Thickness CLAVR-x



Cloud Effective Radius CLAVR-x



NDE and CLAVR-x COT agrees well over most of the observation area.


True Color Mosaic
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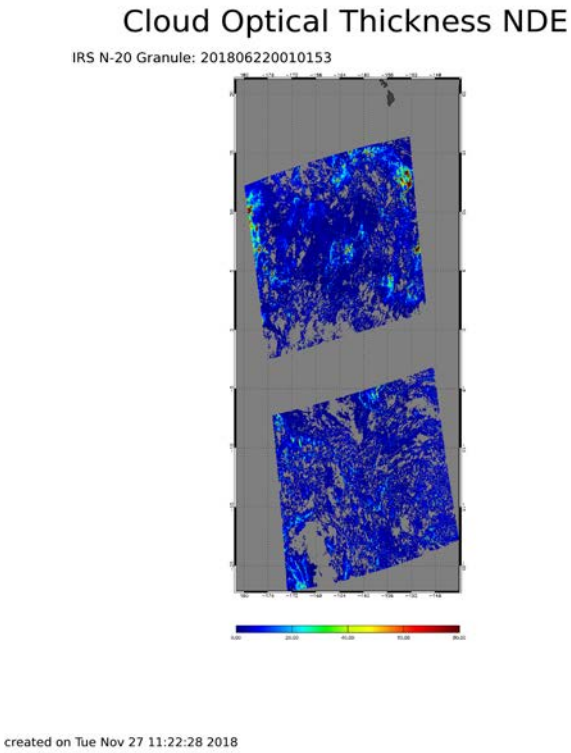
Cloud Optical Thickness NDE
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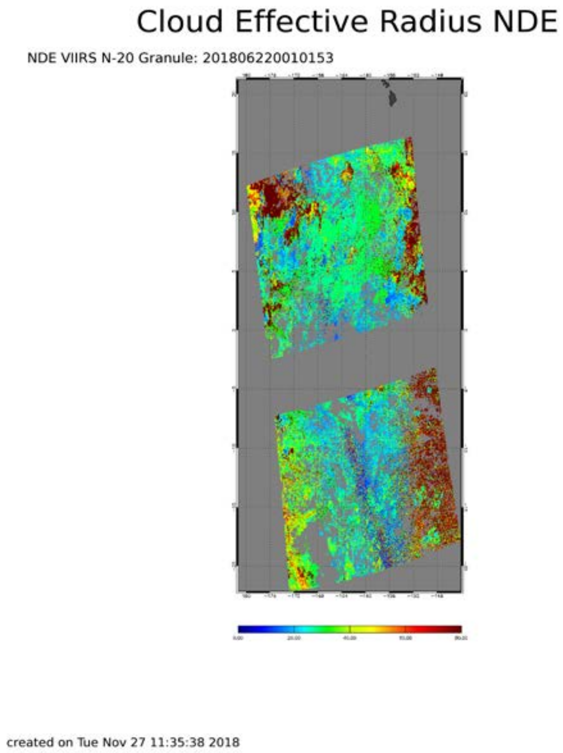
Cloud Effective Radius NDE
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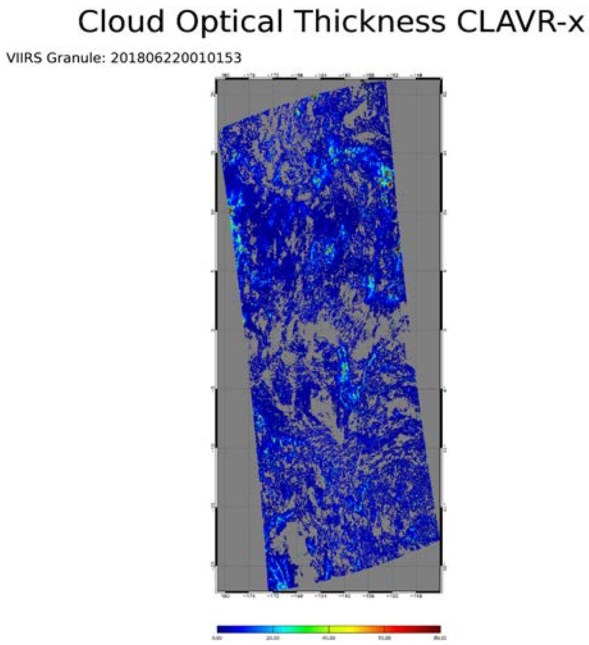
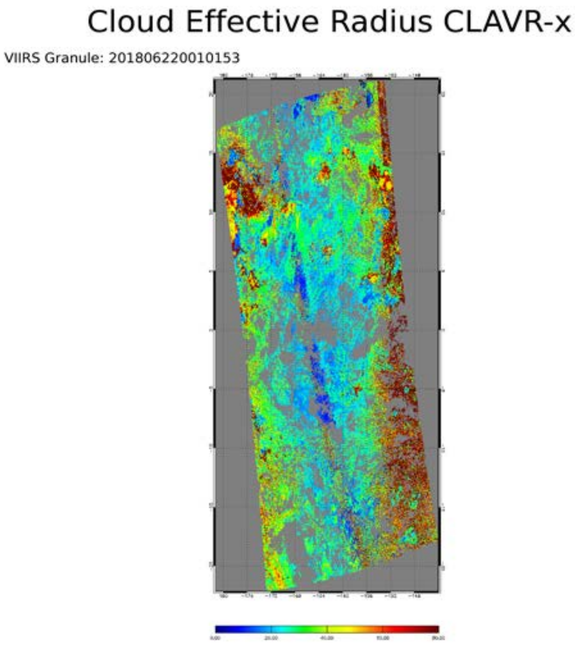
Visual Check-CLAVRx

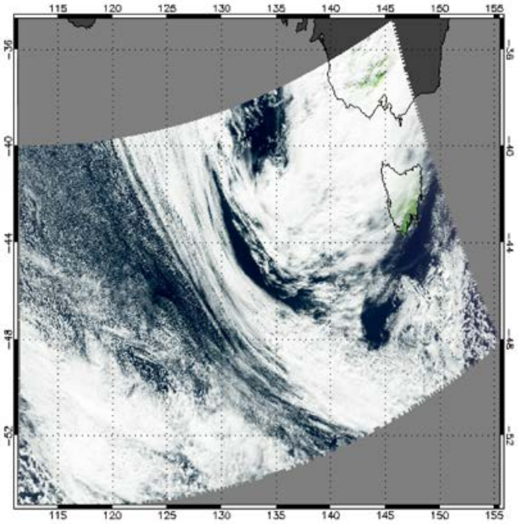




Glint areas show occasionally typical strip-shaped pattern.

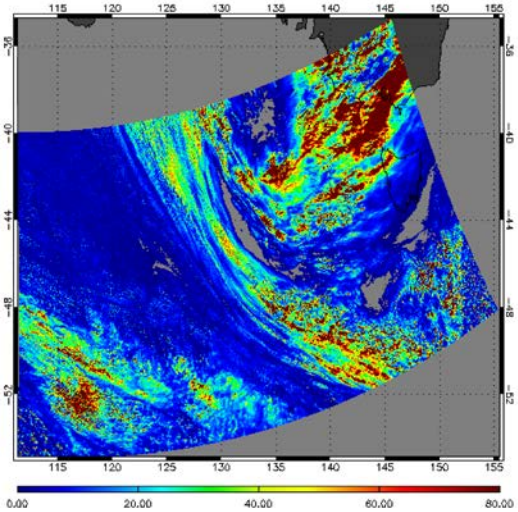
True Color Mosaic

NDE VIIRS N-20 Granule: 201808300512



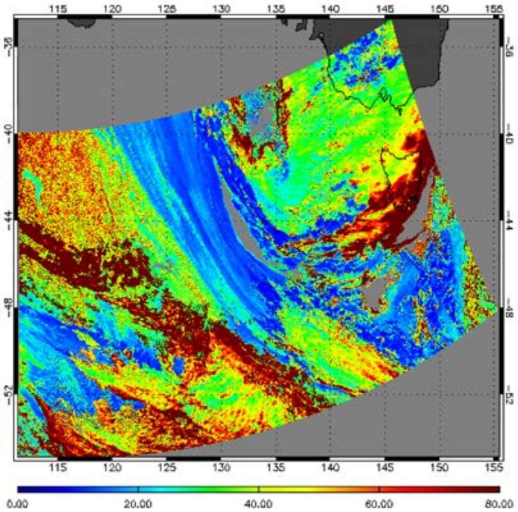
Cloud Optical Thickness NDE

NDE VIIRS N-20 Granule: 201808300512



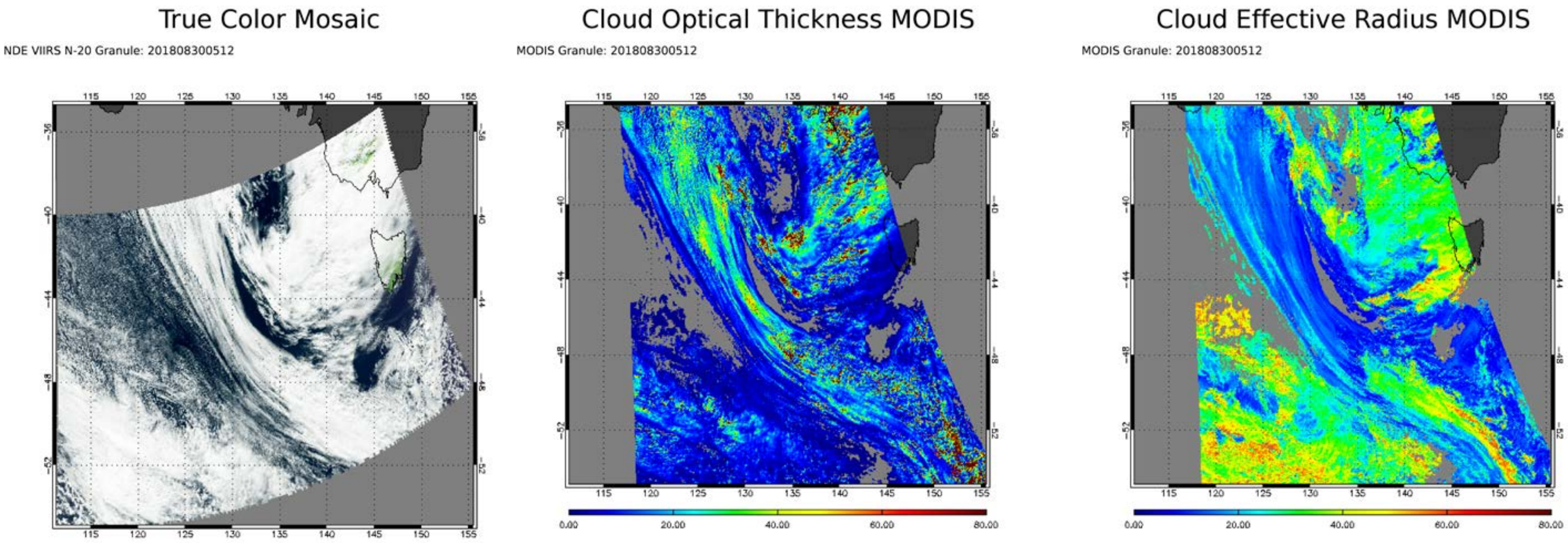
Cloud Effective Radius NDE

NDE VIIRS N-20 Granule: 201808300512



created on Fri Nov 23

Case study - Modis



NDE DCOMP COT agrees well with MODIS.

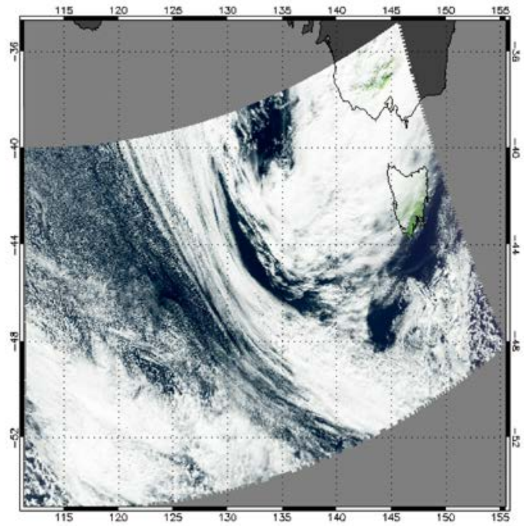
NDE DCOMP CPS

- has higher values in broken clouds and cloud edge areas.
- agrees well in homogenous clouds.

Case study- Water Path

True Color Mosaic

NDE VIIRS N-20 Granule: 201808300512



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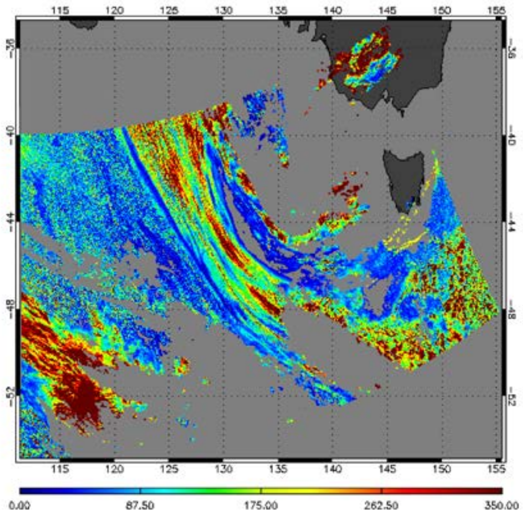
Liquid Water Path NDE

NDE VIIRS N-20 Granule: 201808300512



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Ice Water Path NDE

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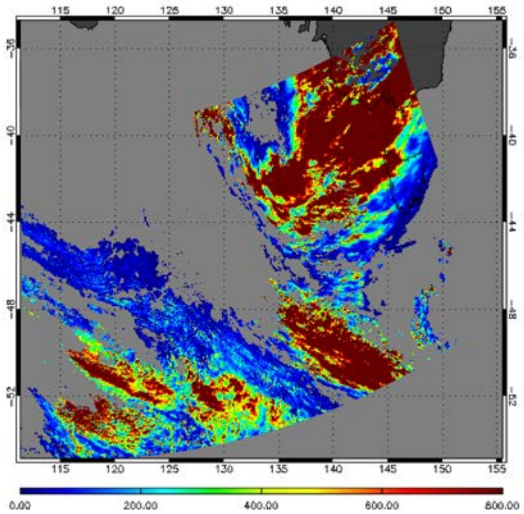

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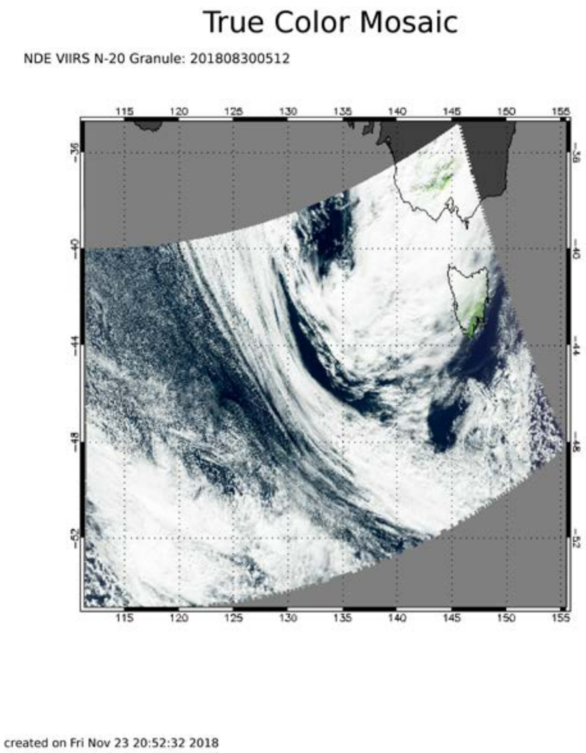
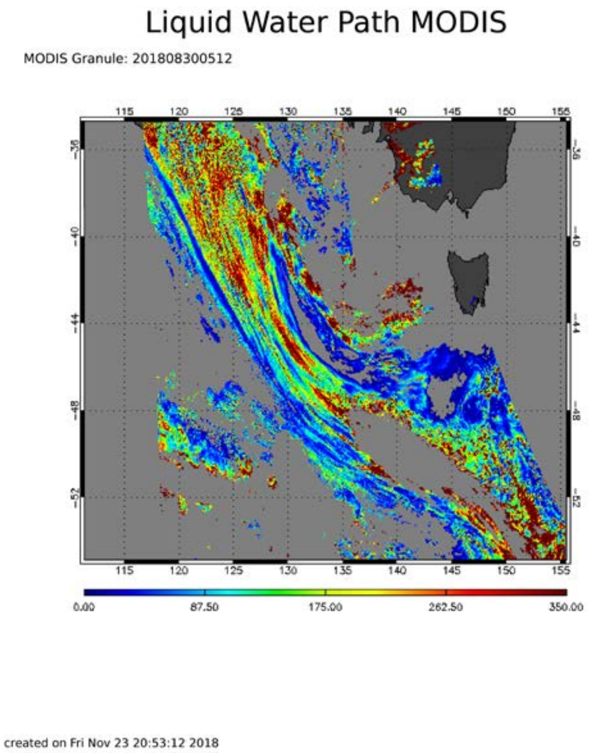
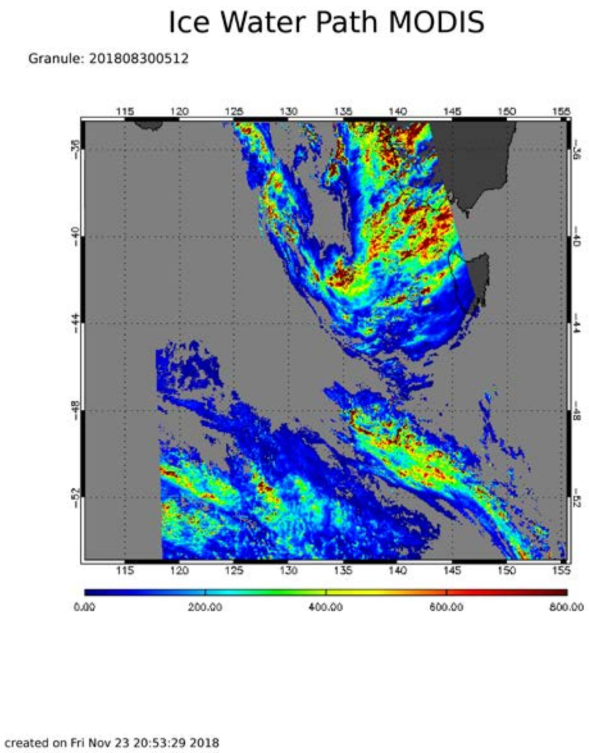
Case study- Water Path Modis







Conclusions from Visual Comparisons

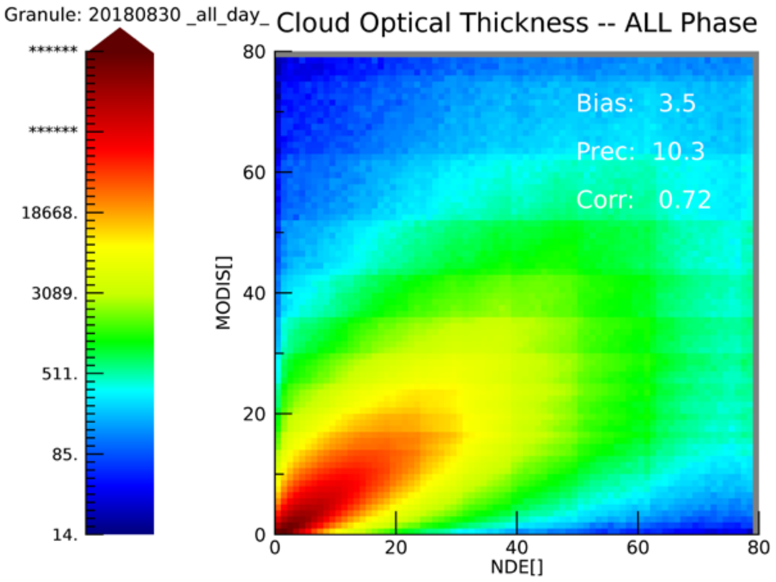
Issue	Comment
Less retrievals in Polar	This was already stated in ACHA review: “This is partially a cloud mask issue”. DCOMP needs Cloud mask and ACHA input.
Missing granules	This is a PDA issue and has been resolved in v2r0 (currently running in I&T)
CPS shows occasionally too high values in glint areas.	Glint is a quality flag in quality file of DCOMP. We will check of this is a cloud mask issue.
CPS shows partly high values in broken cloud areas.	It is initially not clear what the truth is. This need to be investigated.

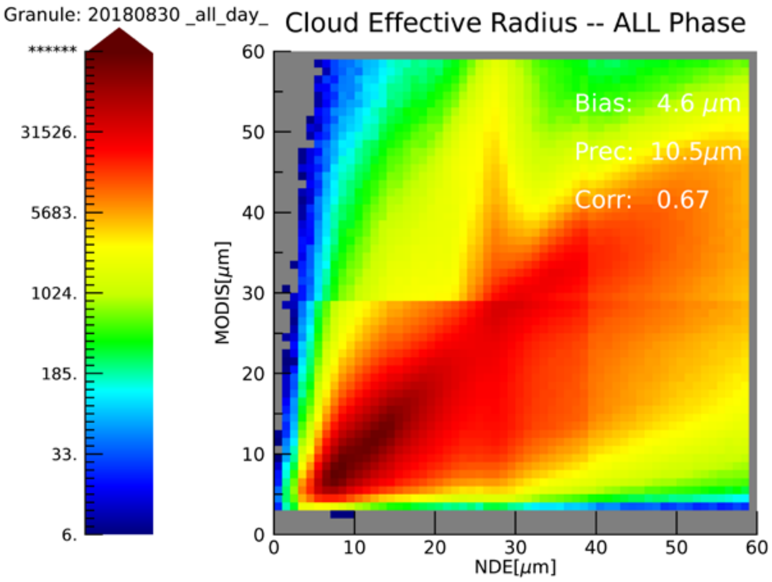
Comparison with MODIS-AQUA

Data and Methods

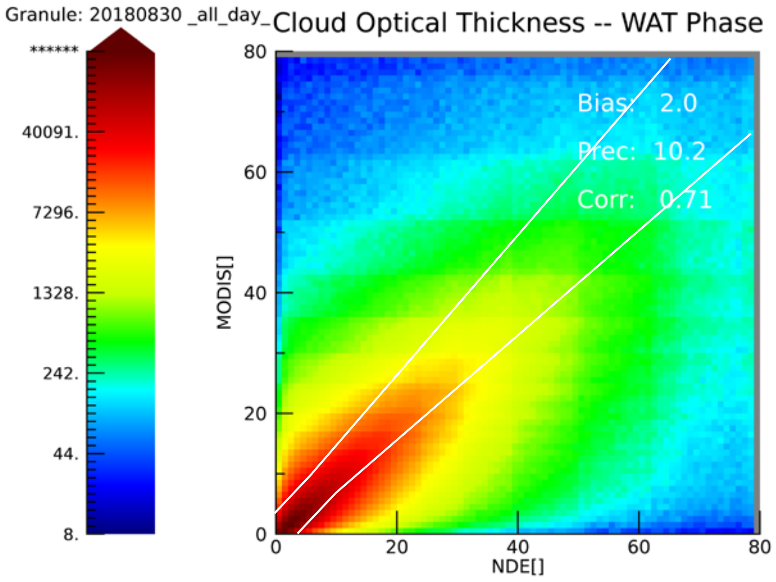
- 12 days of matchup files between NOAA-20 and Aqua MODIS from June to September 2018 were used
- DCOMP NDE NOAA-20 were compared to NASA MODIS cloud products.
- MODIS retrieval uses same retrieval approach as DCOMP. It is therefore not an independent validation source.
- There is a temporal and spatial difference of maximal 6 minutes and 5 km. This has an impact on accuracy and precision in inhomogeneous cloud fields.
- Use of DCOMP nearest neighbor value from a VIIRS footprints to a MODIS footprint. We decided against averaging, because this would lead to unrealistic values in highly inhomogeneous cloud fields due to needed filtering for thin clouds and due to saturation effects for thick clouds.
- We provide joint histograms (COD-CTP, and COD-REF) to prove and visualize the overall consistency between NDE and MODIS.

MODIS Comparison

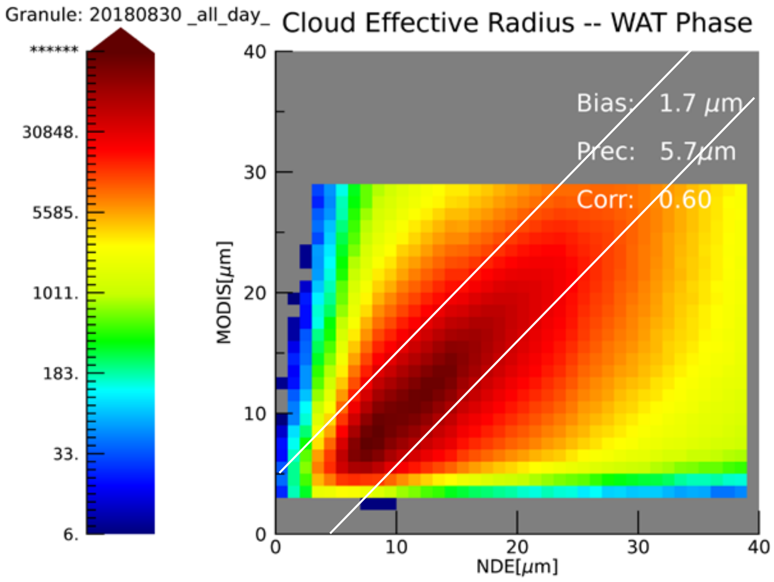




MODIS Comparison

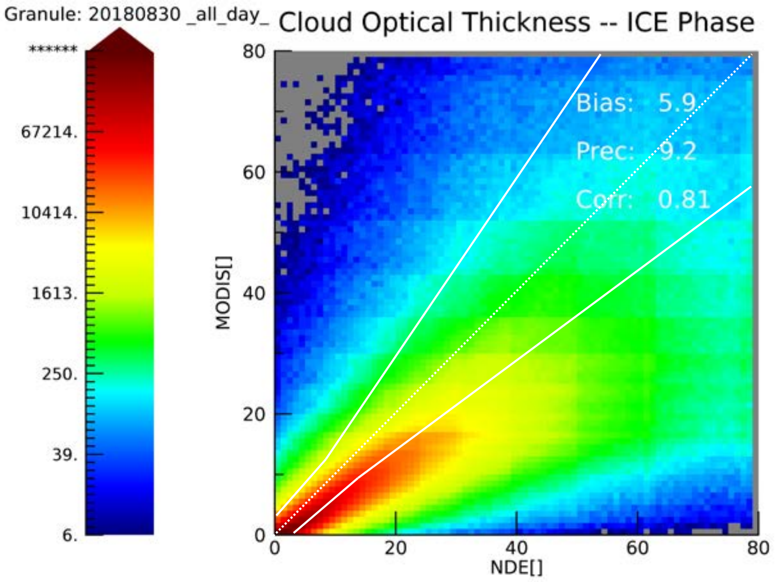


86.5 % of individual pixels are inside Spec range.

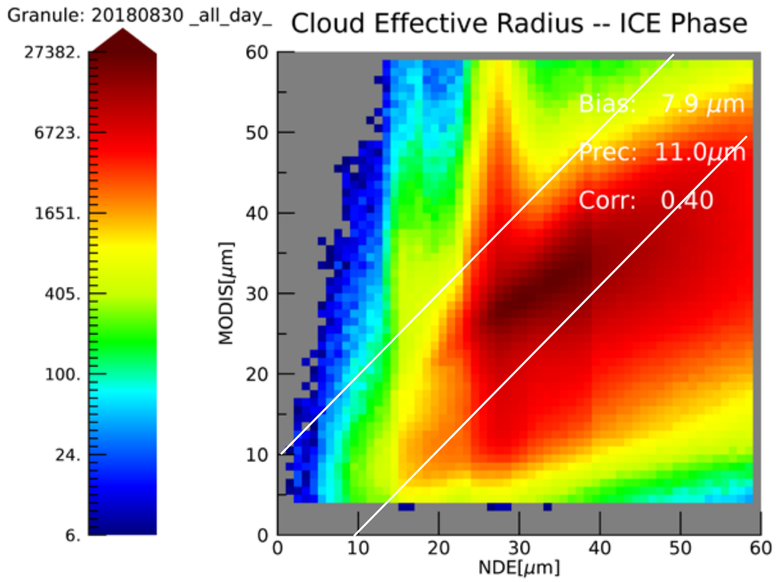


78.5 % of individual pixels are inside Spec range.

MODIS Comparison

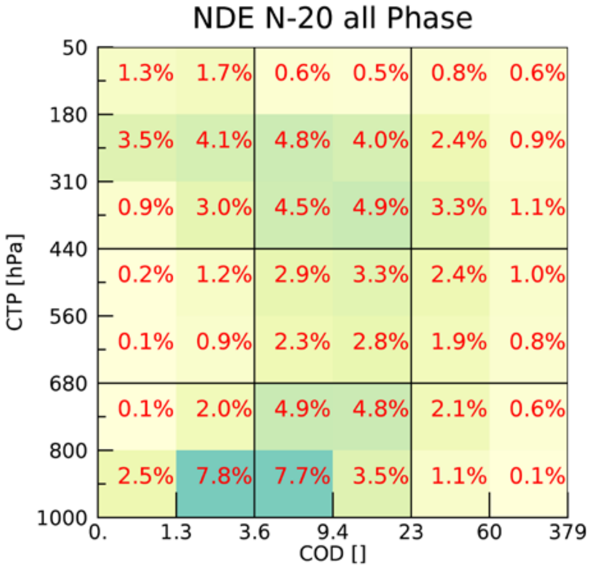


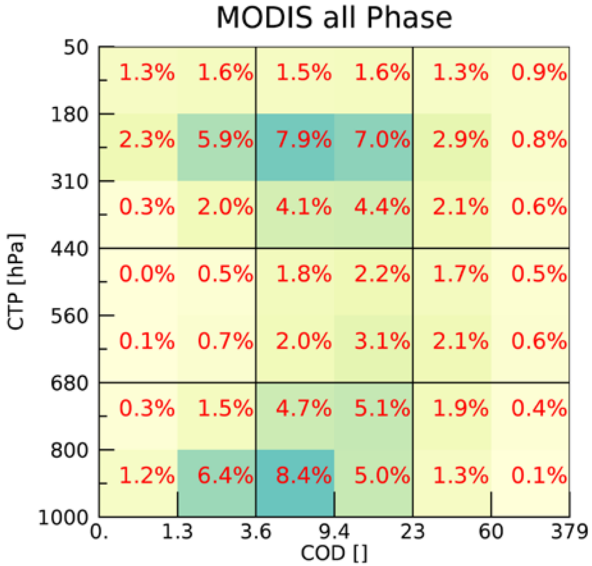
74.3 % of individual pixels are inside Spec range.



70.2 % of individual pixels are inside Spec range.

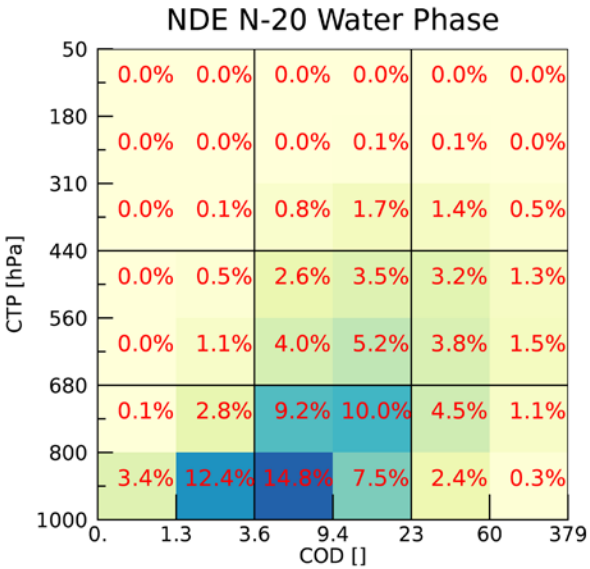
MODIS COD-CTP Joint Histograms

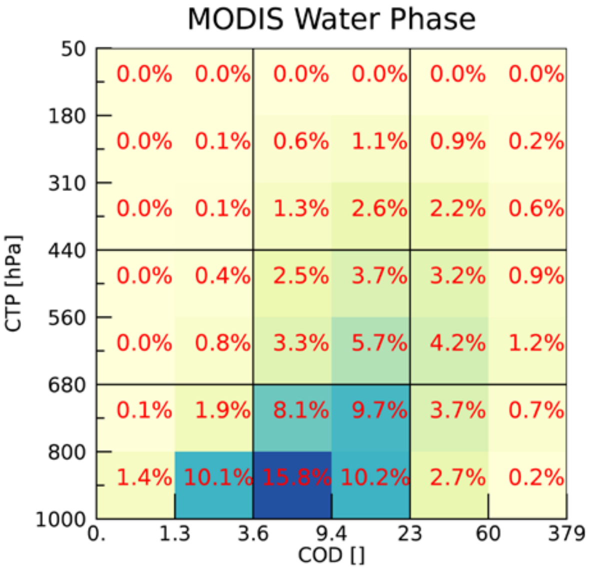




Joint-histograms combines the comparison of multiple cloud retrievals. CTP is a DCOMP input and is crucial for atmospheric correction.

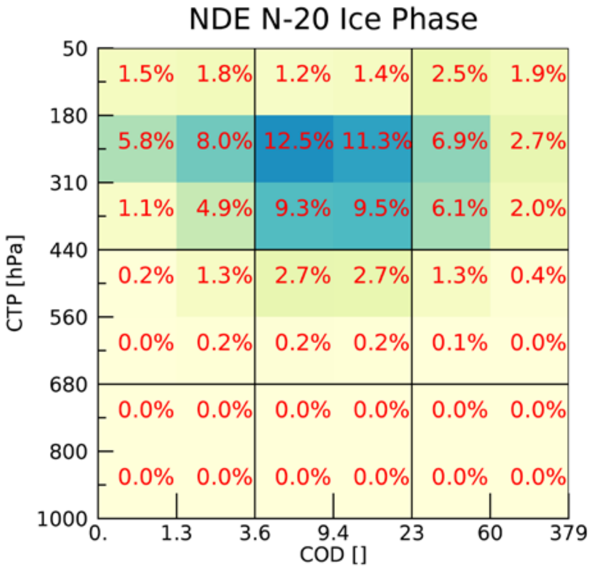
MODIS COD-CTP Joint Histograms

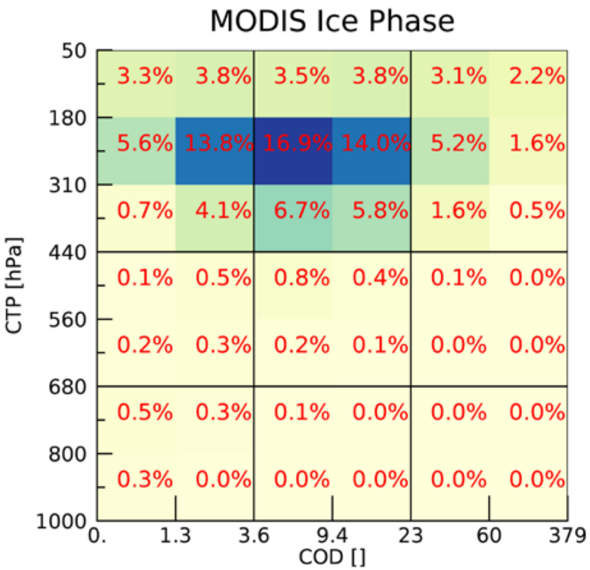




NDE DCOMP and MODIS retrieval show a high agreement in the distribution of cloud thickness and cloud height for water phase.

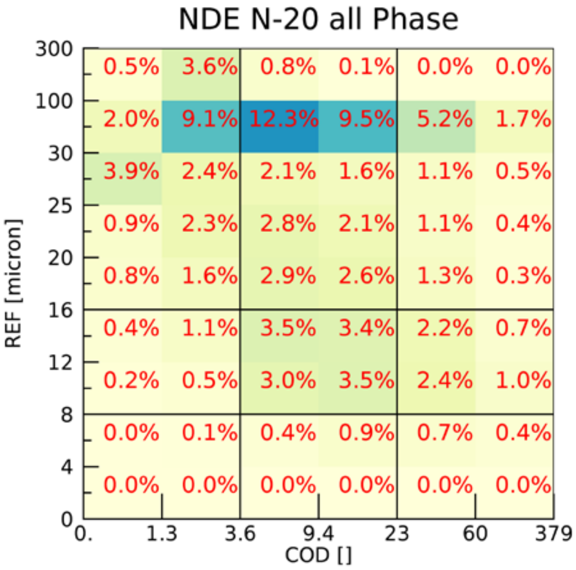
MODIS COD-CTP Joint Histograms

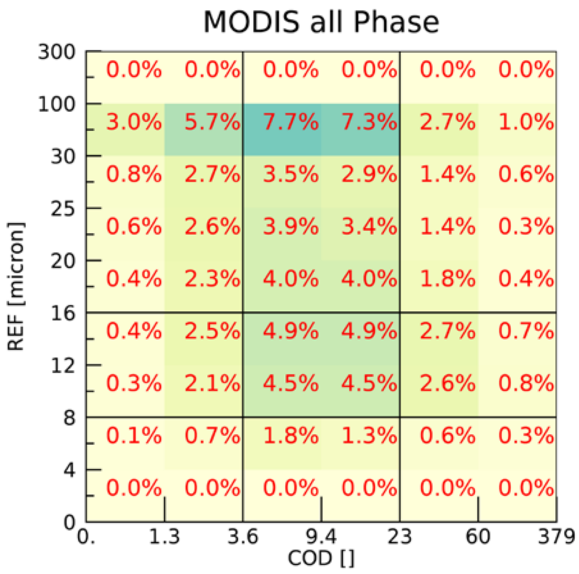




While the overall pattern is in a good agreement, NDE tends to higher cloud thickness for ice clouds. Since this is likely convective clouds, the reason may be in different behavior for clouds with radiance measurements close to saturation.

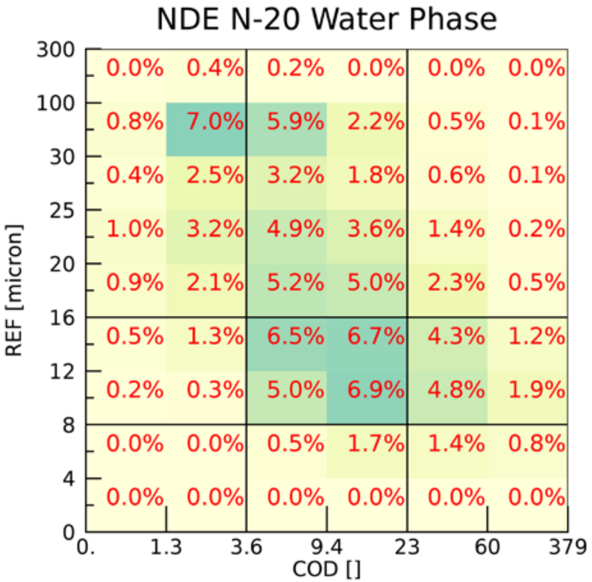
MODIS COD-REF Joint Histograms

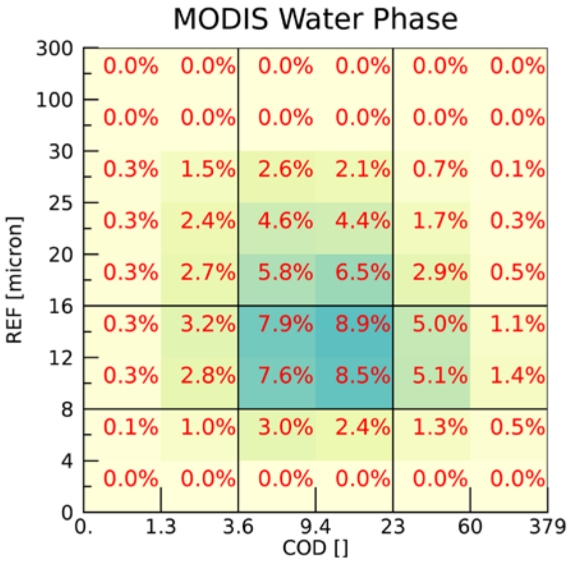




The COT-REF histograms displays the tendency of NDE CPS to higher values in comparison to MODIS.

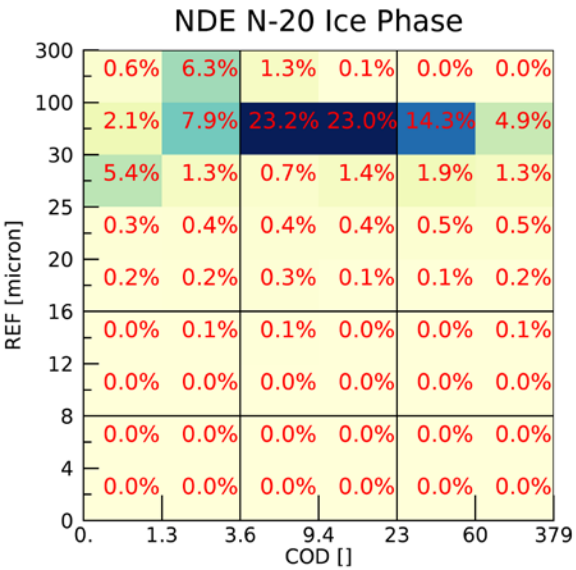
MODIS COD-CTP Joint Histograms

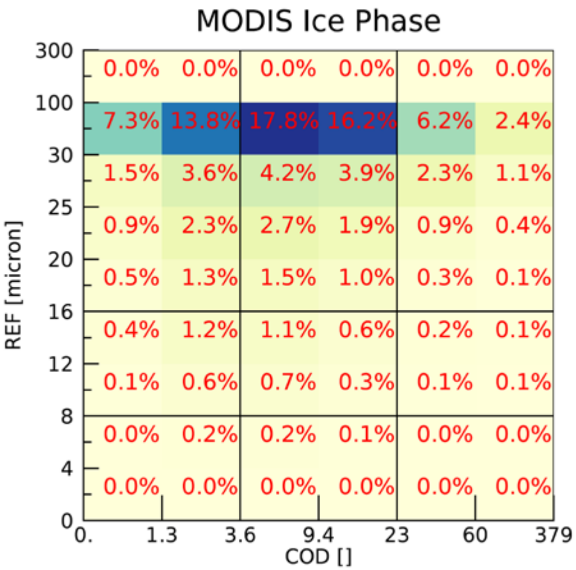




The 17% of NDE water phase CPS have values above 30 micron. MODIS retrieval limits water phase CPS to 30 micron.
Most of the high CPS observations are for thin clouds with low information depth.

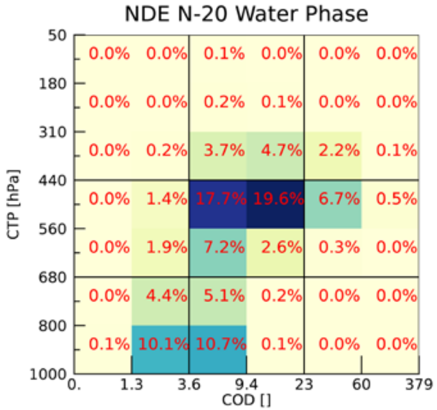
MODIS COD-CTP Joint Histograms

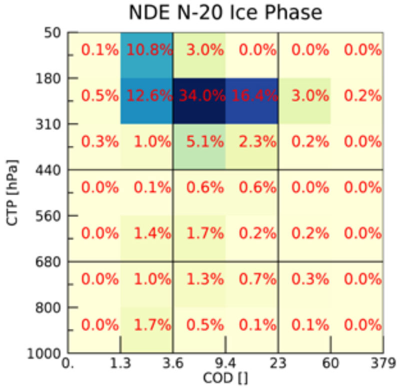




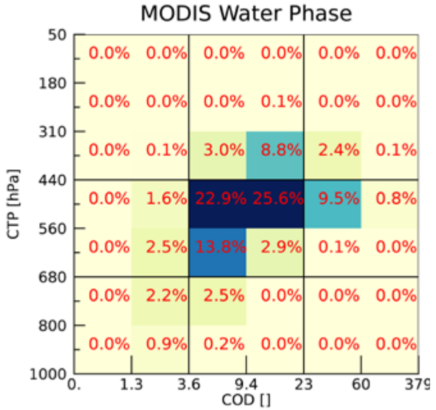
The NDE CPS for ice clouds are in a very good agreement with MODIS except the high amount of thin clouds with CPS over 100 micron. MODIS retrieval has the upper limit of 100 micron.

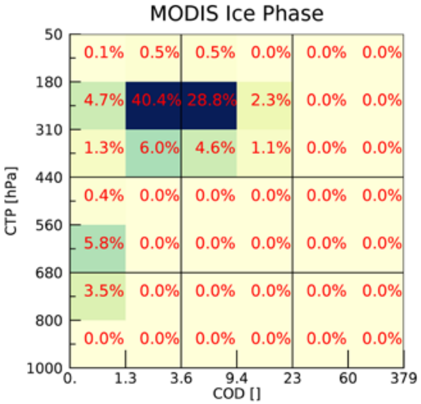
Regional- Atlantic



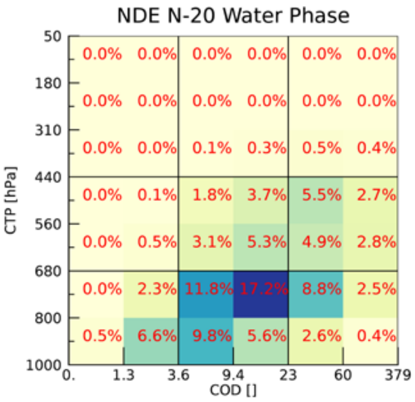


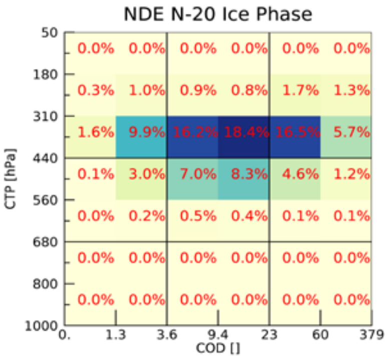
Regional studies show also similar and good agreement between NDE and MODIS.



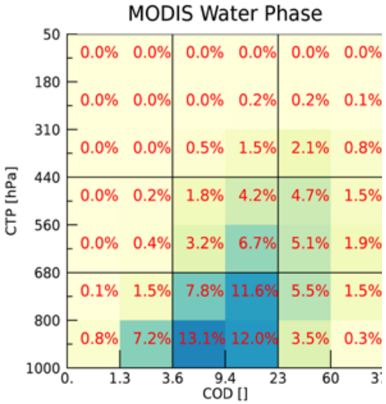


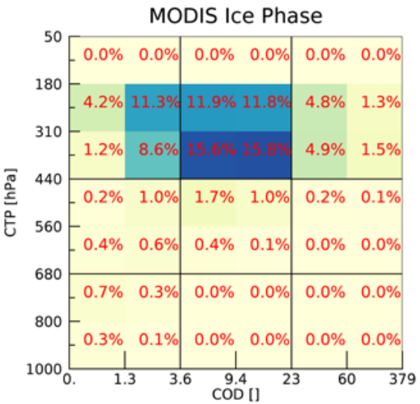
Regional-Arctic





Regional studies show also similar pattern and a good agreement between NDE and MODIS.





Conclusions from MODIS Comparisons

- DCOMP NDE NOAA-20 performs well comparing to MODIS
- Accuracy requirements are reached for all parameters except for COT ice phase where it is close.
- Precision is close to the requirements. We think that the spatial and temporal differences, the different spatial resolution and the different observation geometry is the reason.
- Another likely reason is the currently discussed calibration offset of the M5 (0.6 micron) channel between MODIS and VIIRS.

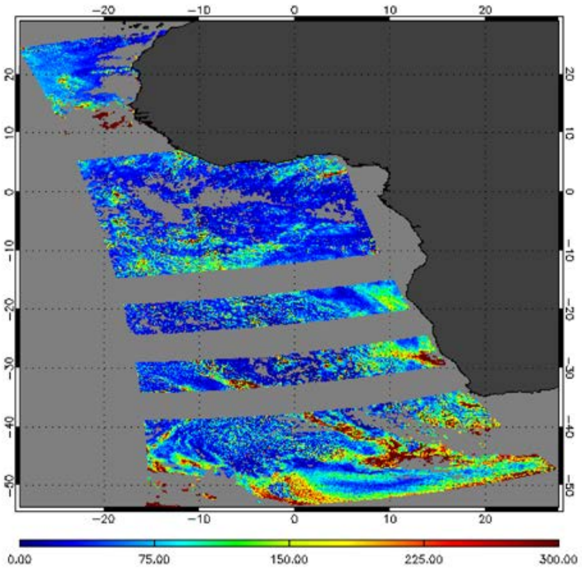
Validation of Liquid Water Path with ASMR2

AMSR2- Data and Methodology

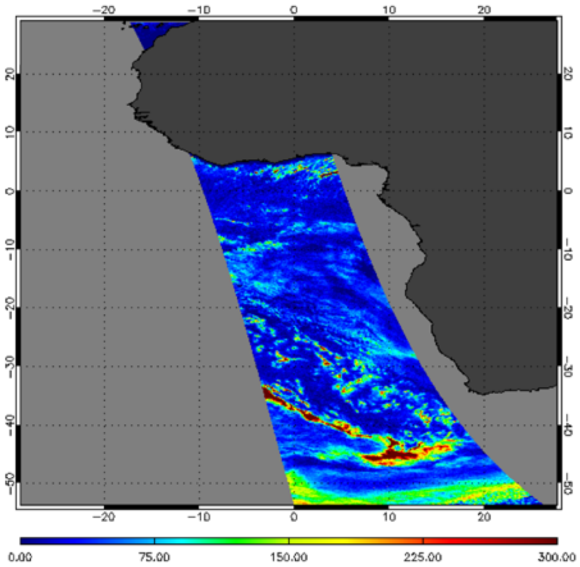
- Microwave satellite based sensors offer the only really independent satellite-based validation source.
- AMSR2 is installed on GCOM-W satellite.
- NDE Liquid Water Path is computed by a simple equation from NDE products CPS and COT, therefore a validation of LWP is also an assessment of both DCOMP products.
- Validation is limited due to coarse spatial resolution and to only liquid phase sensitivity
- We apply several filter criteria:
    - 90% of DCOMP pixels must be covered by liquid clouds
    - MW is insensitive to thin clouds. We exclude clouds thinner than COD = 5.
    - We exclude all MW pixels with rain flag.

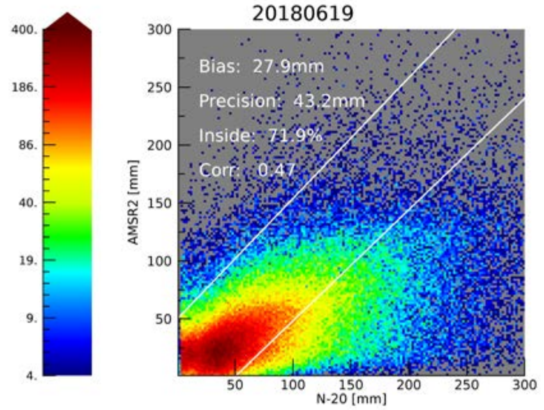
AMSR2- Example

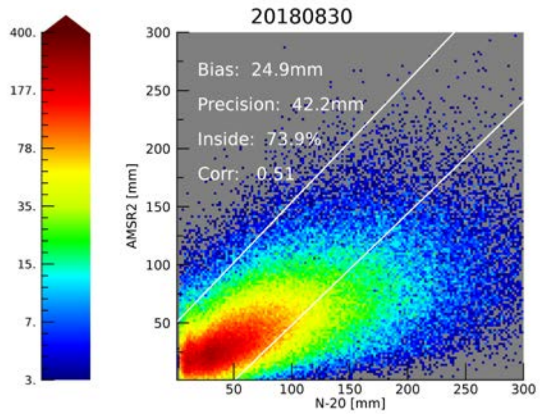
Liquid Water Path NDE

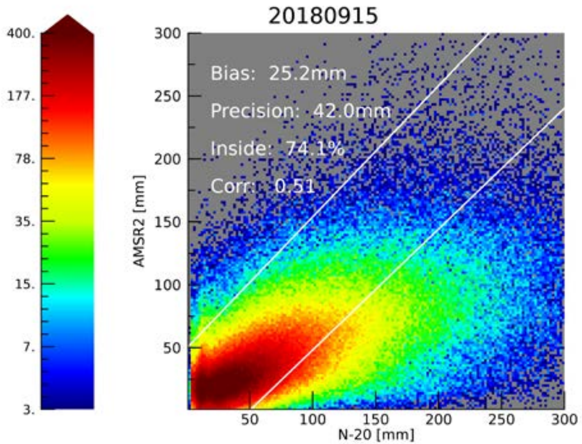


Liquid Water Path AMSR2









All observed days are in the same range of comparison results. The requirements for accuracy and precision are met for all days. PASS

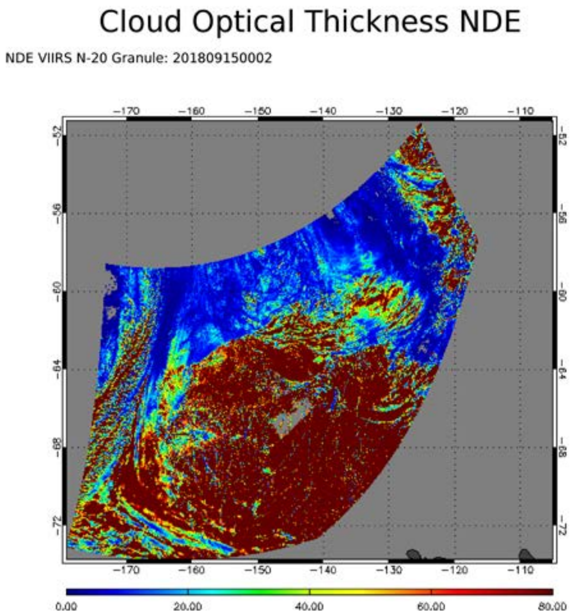
However, the NDE retrieval seems to systematically overestimate high liquid water path values.

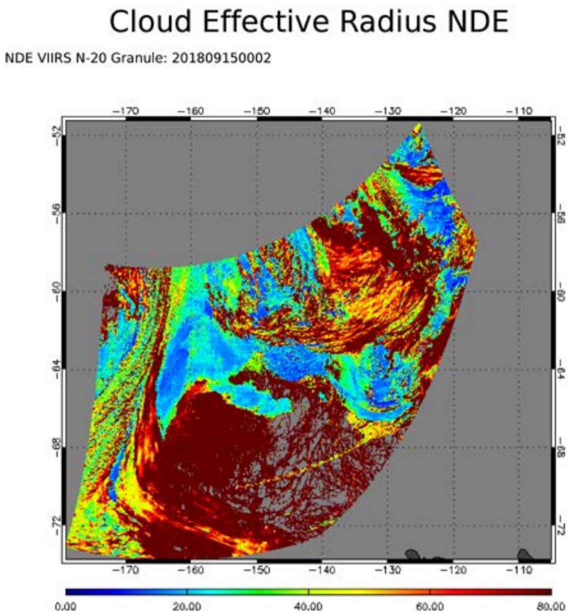
Possible reasons are filtering technique, the too high CPS for water clouds as seen in the MODIS comparisons, and the overestimation of COT for saturated clouds for which DCOMP has no information skill.

Conclusions from AMSR2 Comparisons

- DCOMP NDE NOAA-20 performs well comparing to AMSR-2 observations of liquid water path

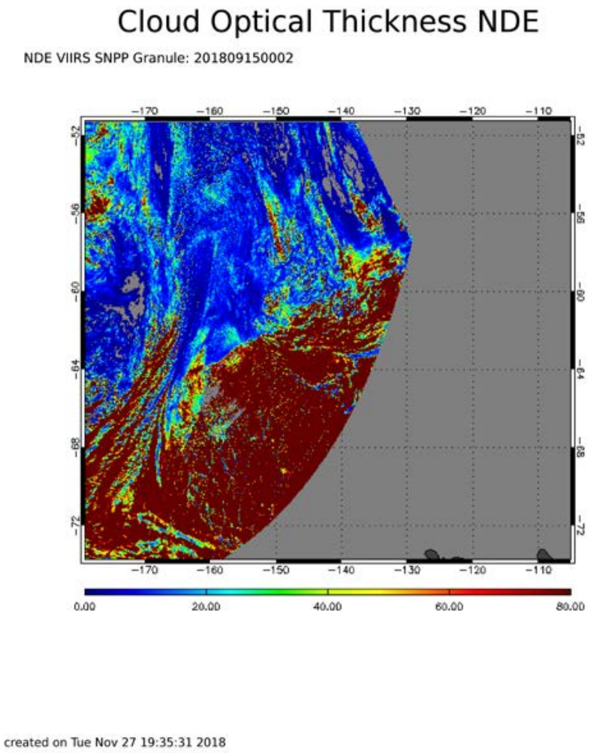
Consistency between SNPP and NOAA-20

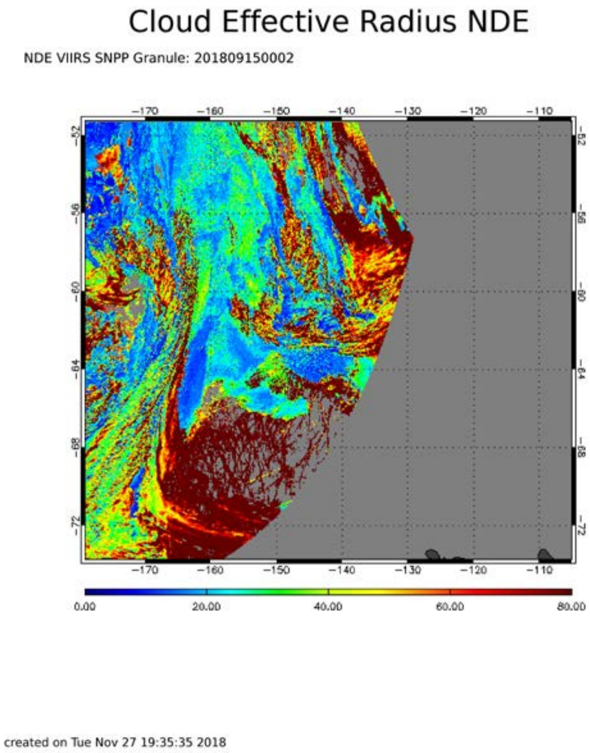




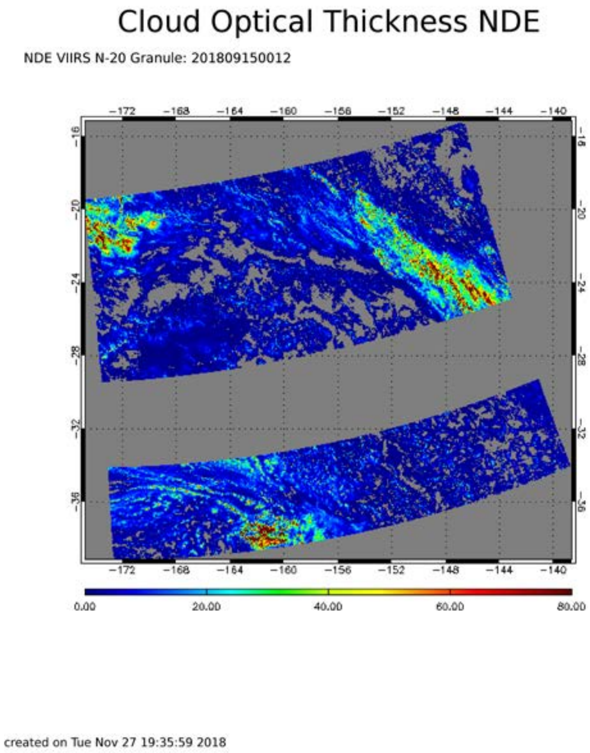
NOAA-20 is 50 minutes ahead of Suomi NPP satellite. Both have VIIRS sensor onboard. We show here a visually the consistency of VIIRS cloud products from both platforms.

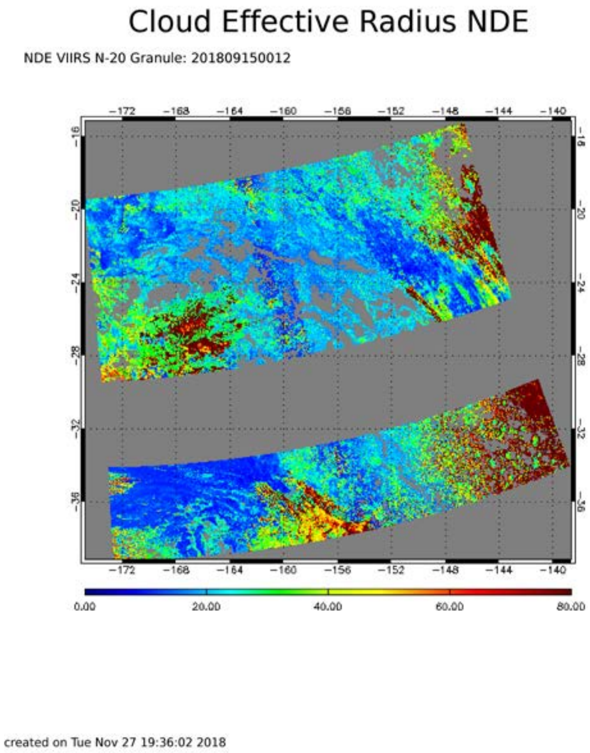
Consistency between SNPP and NOAA-20



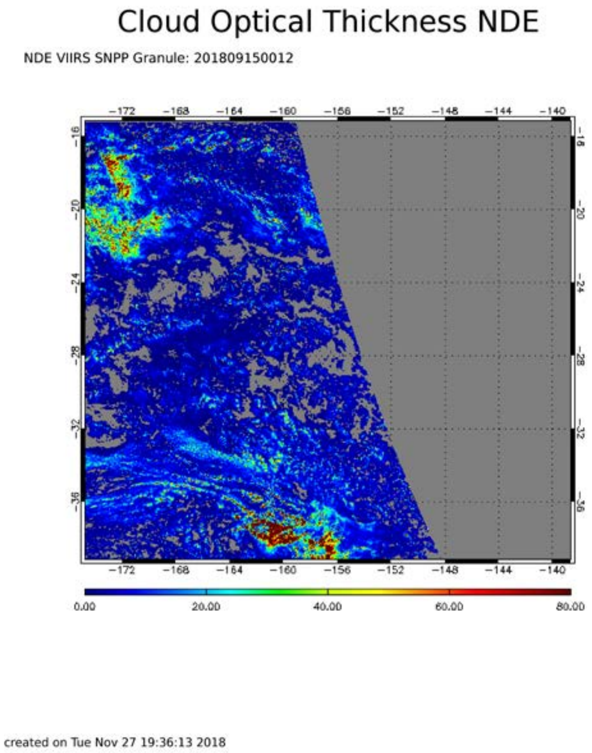


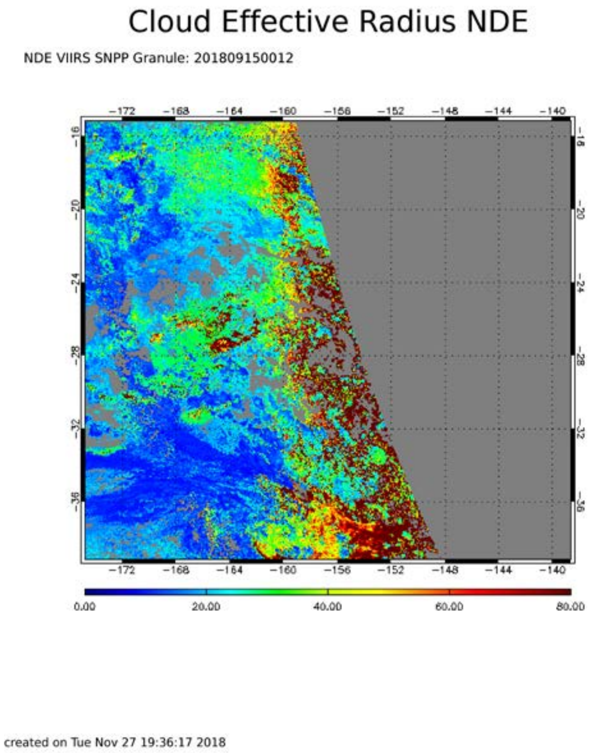
Consistency between SNPP and NOAA-20



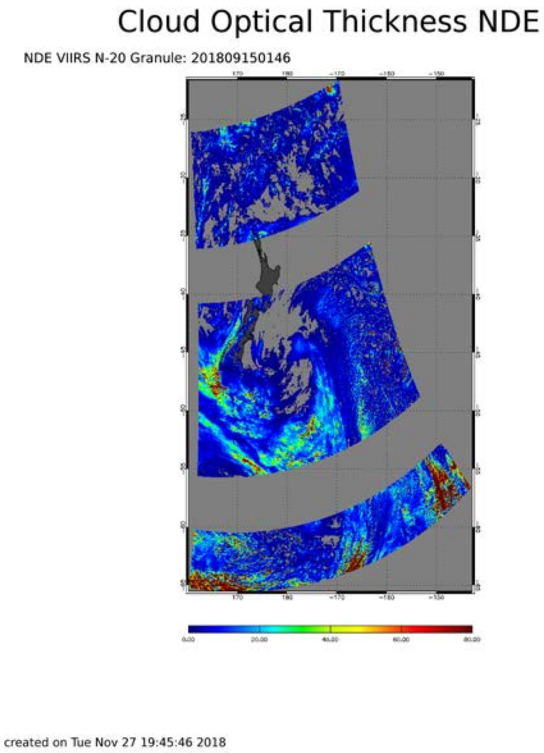


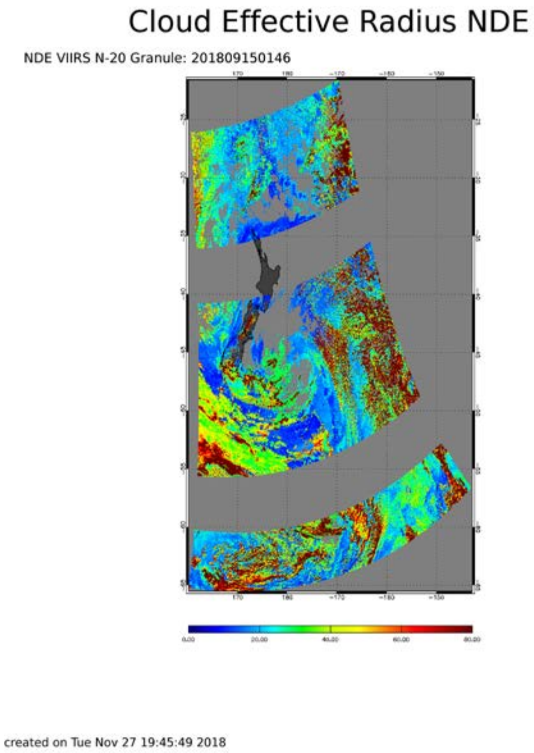
Consistency between SNPP and NOAA-20





Consistency between SNPP and NOAA-20

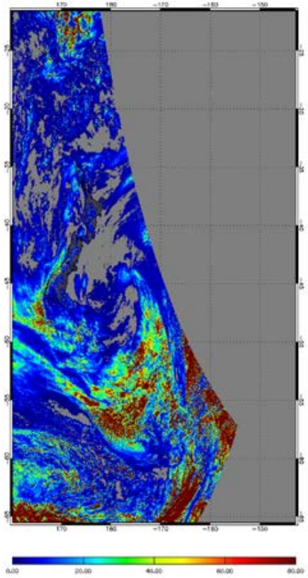




Consistency between SNPP and NOAA-20

Cloud Optical Thickness NDE

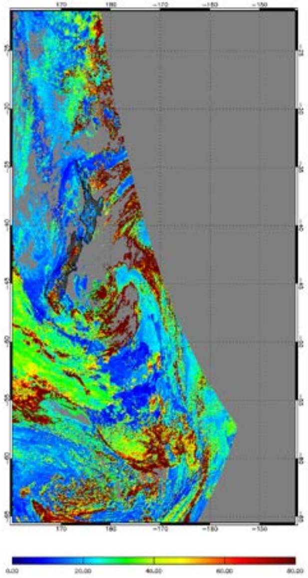
NDE VIIRS SNPP Granule: 201809150146



created on Tue Nov 27 19:46:05 2018

Cloud Effective Radius NDE

NDE VIIRS SNPP Granule: 201809150146



created on Tue Nov 27 19:46:13 2018

Validation- Summary

Product	Validation Source	Accuracy	Specs	Precision	Specs	Inside Specs
COD Water	MODIS	2.	2 or 20%	10.2	2 or 20%	86.5%
COD Ice	MODIS	5.9	3 or 30%	9.7	3 or 30%	74.3%
CPS Water	MODIS	1.7µm	4µm	5.7µm	4µm	78.5%
CPS Ice	MODIS	7.9µm	10µm	11.0µm	10µm	70.2%
LWP	AMSR2	25.4 mm	50mm	41.9mm	50mm	73.9%

SDR calibration issue

- **Recent discussions state that M5 on SNPP is 5% too bright.**
- The observed COT bias between MODIS and NDE may be a consequence of this calibration difference between VIIRS and MODIS.
- This may have also impact on cloud mask, phase and ACHA. The Cloud mask SNPP LUT automatically tuned out this calibration error so we expect NOAA-20 to ‘miss’ cloud due to this issue.
- There are other issues that may be related to the SDR or SDR parameters in the SAPF.

Provisional Maturity Conclusions

- Accuracy spec is always met except for COD ice clouds (there it is close). We expect an improvement once the calibration differences between MODIS and VIIRS are solved.

- The only fully independent validation source of LWP with AMSR2 has met all requirement specifications of similar projects. NDE LWP has a linear correlation to DCOMP products COT and CPS. A successful validation of LWP therefore demonstrates product performance of DCOMP.

- We expect to meet precision specs with a more rigorous filtering on spatial and temporal differences.

- **The Cloud Team recommends Provisional Maturity at this time.**

Requirement Check List – Cloud Optical Depth

JERD	Requirement	Meet Requirement (Y/N)?
	Applicable Conditions: 1. Requirements apply whenever detectable clouds are present	
JERD-2430	The algorithm shall produce a cloud optical depth product that has a horizontal cell size of 0.8 km	Y
JERD-2482	The algorithm shall produce a cloud optical depth product that has a mapping uncertainty (3 sigma) of 4 km	Y
JERD-2483	The algorithm shall produce a cloud optical depth product that has a measurement range of 0.3 – 64 (Day) and 0.3 – 8 (Night)	Y (Day)
JERD-2484	The algorithm shall produce a cloud optical depth product that has a measurement precision of greater of 30% or 3.0 Tau (Day) and greater of 30% or 0.8 Tau (Night)	
JERD-2485	The algorithm shall produce a cloud optical depth product that has a measurement accuracy of Liquid phase: 20% (Day), 30% (Night); Ice phase: 20% (Day), 30% (Night)	Y (Day)

Requirement Check List – Cloud Particle Size Distribution

JERD	Requirement	Meet Requirement (Y/N)?
	Applicable Conditions: 1. Requirements apply both day and night and whenever detectable clouds are present	
JERD-2431	The algorithm shall produce a cloud particle size distribution product that has a horizontal cell size of 0.8 km	Y
JERD-2486	The algorithm shall produce a cloud particle size distribution product that has a mapping uncertainty (3 sigma) of 4 km	Y
JERD-2487	The algorithm shall produce a cloud particle size distribution product that has a measurement range of 2 to 50 µm (day), 2 to 32 µm for water (night), and 2 to 50 µm for ice (night)	Y
JERD-2488	The algorithm shall produce a cloud particle size distribution product that has a measurement precision of greater of 4 µm or 25% for water and greater of 10 µm or 25% for ice	Close (met for LWP)
JERD-2489	The algorithm shall produce a cloud particle size distribution product that has a measurement accuracy of Greater of 4 µm or 30% for water and 10 µm for ice	Y

Pathway to Full Validation

Pathway to Full Maturity

- We expect to apply the same activities to be conducted for Full Maturity:
  - We continue to gather an archive of golden days where we save SDRs and EDRs spread from June 2018. This collection is ongoing.
  - We will apply different levels of data filtering to prove precision specs.
  - We hope to continue to engage the teams and continue application-specific analysis.

Risks for Full Validation

Currently outstanding issues, unless fixed by handover, may prevent declaration of Full Validation Maturity:

- **NDE processing issues (Low)**
  - Missing granules in NDE processing
    - Only existed in v1r2 and previous DAP deliveries. Currently resolved
- **Precision (Low)**
  - Data filter for provisional was very loose to include as many data as possible. We are convinced that strict filtering of data on temporal, spatial and observation geometry differences will improve precision result of the comparison.
- **Performance in glint areas (Low)**
  - CPS show occasionally increased and potential erroneous pattern in glint areas. Glint areas have a flag bit in DQF product.

Next Future Plans of DCOMP

- We will work on improvements for CPS retrieval in **glint** areas.

- The CLAVR-x / DCOMP retrieval also includes a **nighttime** version which is based on **reflected moonlight** measurements in the **DNB**. This retrieval provides COT and CPS at about 70% of the time depending on the moon phase. This retrieval component may be included in NDE framework.

- We plan to investigate the impact of chosen **effective variance** of cloud particle size distribution function for water cloud retrieval in rainbow areas, and if needed for improvement to **adjust the LUTs**.

- DCOMP/CLAVR-x has an improved **over-snow retrieval** which uses 1.6µm/3.7µm (M10/M12) channel combination. This retrieval component may be included in NDE framework.

Far Future Plans of DCOMP

- Use of I-bands for a fine resolution COT
- Near-real time use of higher resolved and dynamic snow maps for regions and periods with highly variable snow extent
- Considering processing all pixels (no consideration of cloud mask)
- Include Two-layer forward model

NOAA-20 VIIRS Daytime (DCOMP) Provisional Maturity

Additional Material:
Consistency between S-NPP and NOAA-20

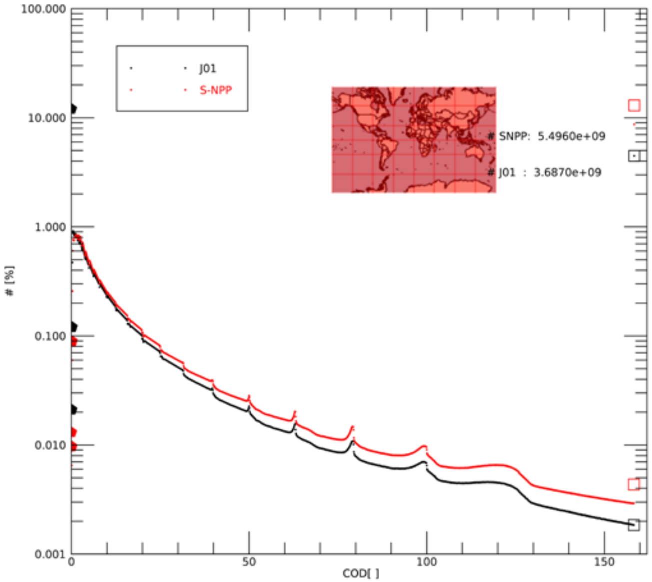
VIIRS DCOMP Team

Andi Walther (CIMSS), William Straka(CIMSS), Andrew Heidinger(NOAA/STAR)

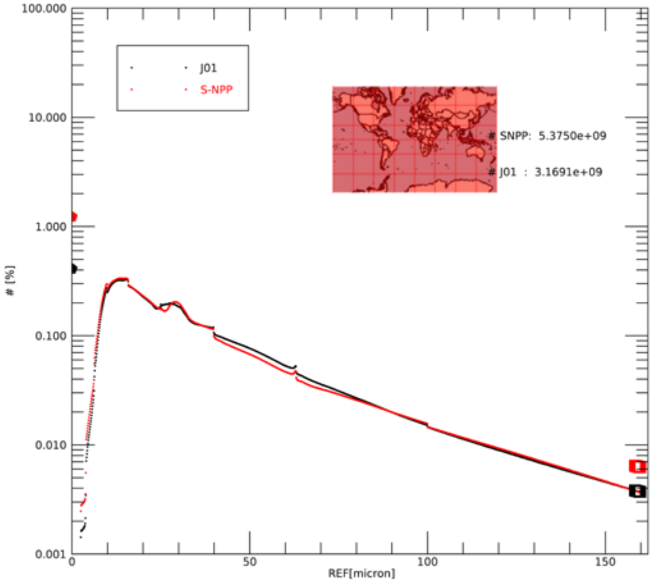
Overview

- **Motivation:** Showing consistency between S-NPP and NOAA-20 for DCOMP products
- **Method:** Histograms with bin fine size of 0.1 for both COD and CPS.
- **Why no averages?** We don't use averages because this would be heavily impacted by the number of saturated clouds (in the following images as rectangles at around 160) and the number of very thin cloud
- **Data:** All days 2018 day of years 239, 242, 247,250,252,255,258, 328,329,330
- We use **every granule** for both sensors regardless if J-01 has gaps. (no collocations)
- We don't expect identical histograms, because DCOMP products may have a diurnal cycle
- NOAA-20 misses many granules → This has an impact on results.

All Days Histograms

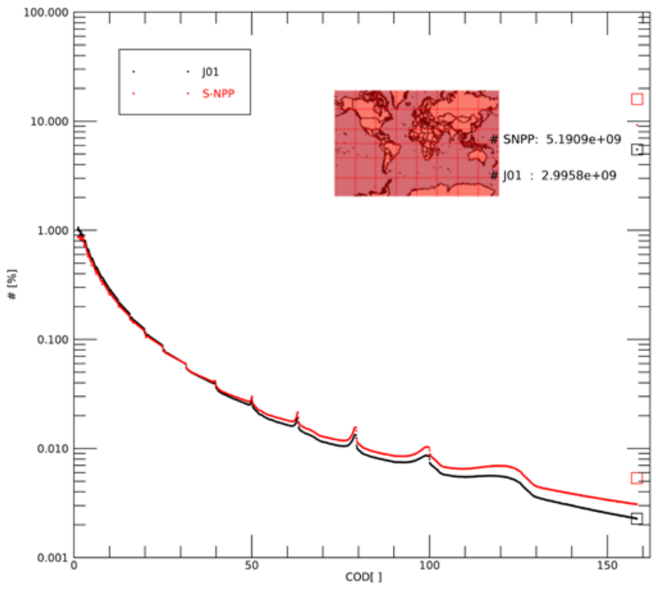


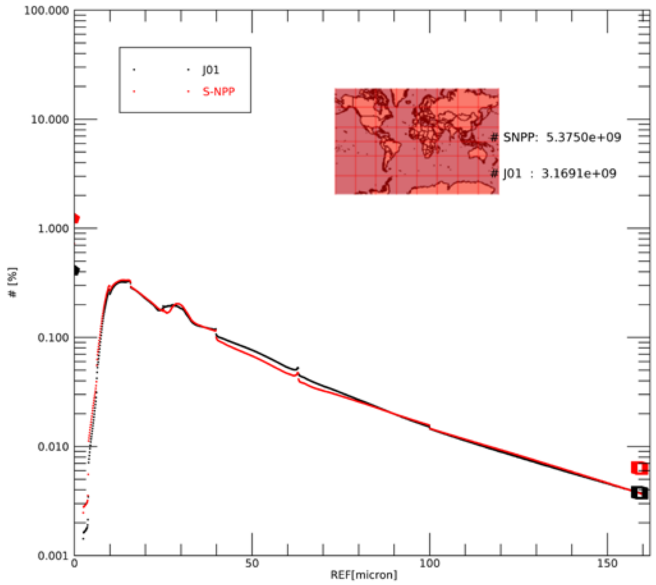
S-NPP has higher percentage value over almost entire range for COT. But: High percentage of very close to 0 pixels for J-01.
J-01 declares cloud-free COT to 0. Peaks in histograms are caused by low-information-skill pixels, which tend to have COD values close to LUT bin boundaries



CPS (Represented by Effective Radius) shows good agreement without a bias.

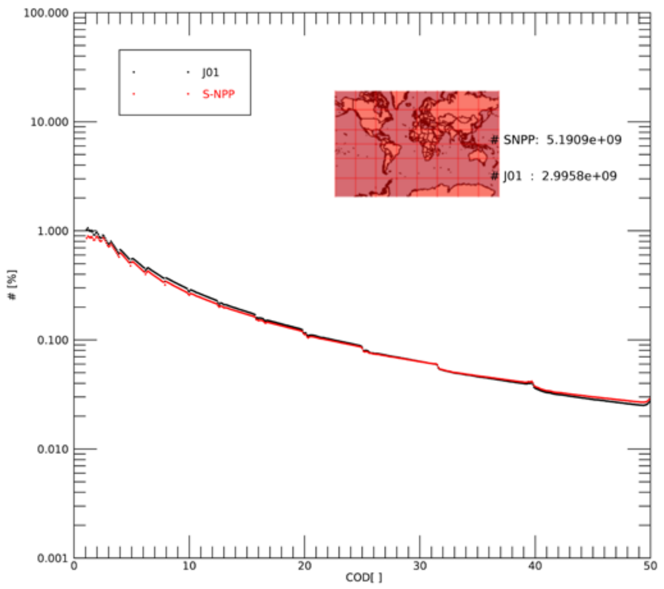
All Days Histograms- Close to 0 removed

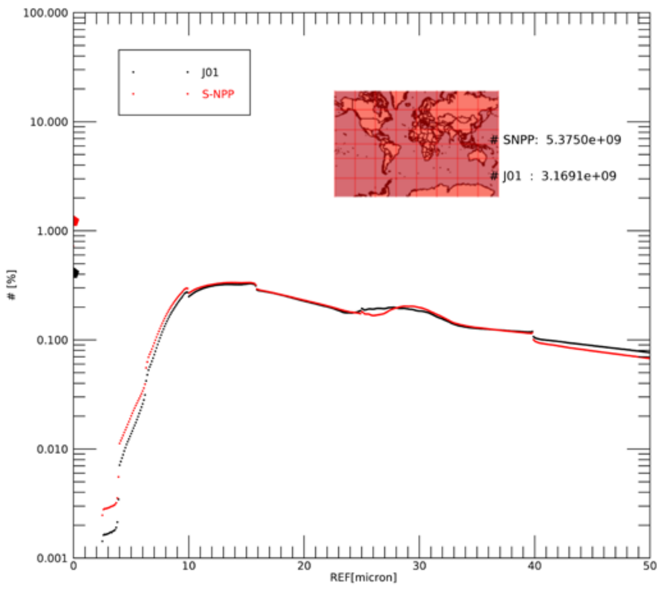




Deleting close-to-0 values shows that S-NPP has slightly more higher COD values (y-axis is logarithmic stretched)

All Days Histograms – Only small values



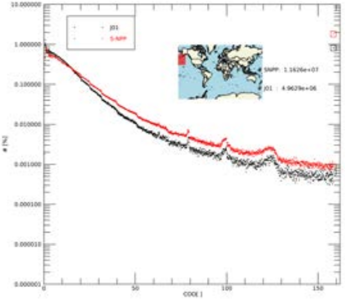


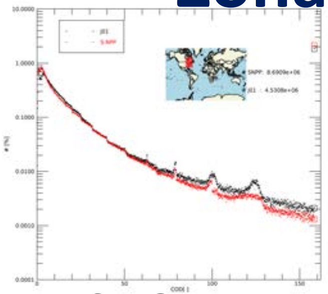
Finned-bin histograms show a high agreement for both DCOMP products between S-NPP and J-01 (NOAA-20)

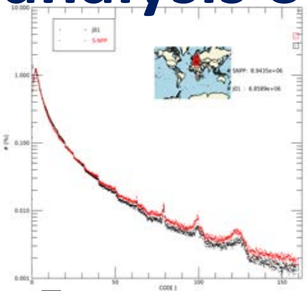
Zonal histograms

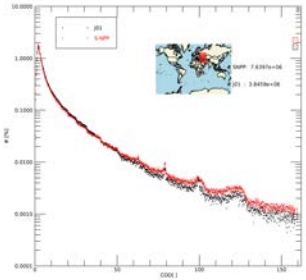
- The following two slides show the zonal histograms from various selected regions around the globe.
- The axes are the same as shown on the previous three slides (COD or CPS on the x-axis, logarithmic # of values on the y-axis
- Slide 7 is a zonal comparison of a 10^{o} x 10^{o} box over various regions of the globe
- Slide 8 is a zonal comparison for all longitudes in a given latitude zone

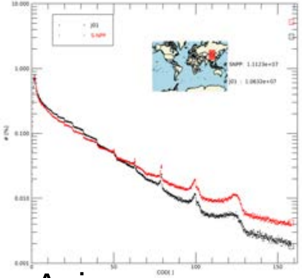
Zonal analysis of COD

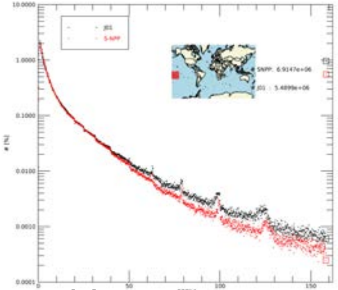

NPac

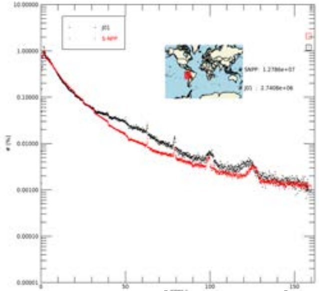

EC US

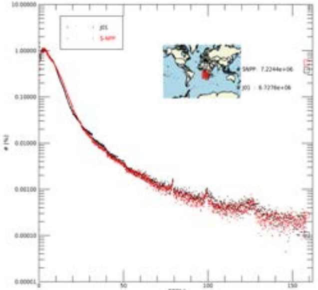

Europe

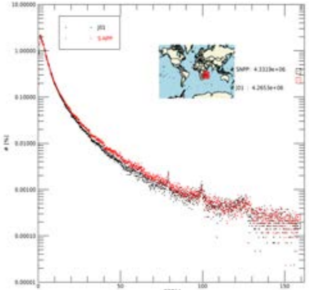

MidEast


Asia


Mid Pac


W South America


SE Africa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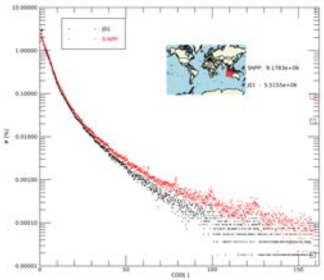
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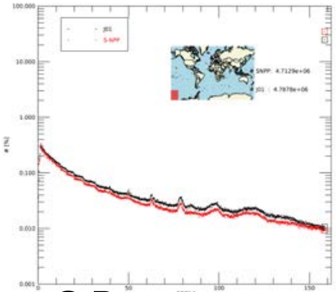
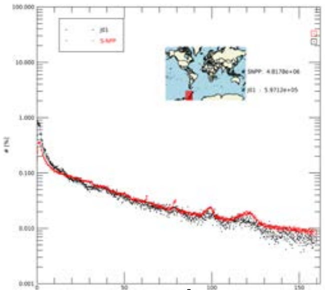
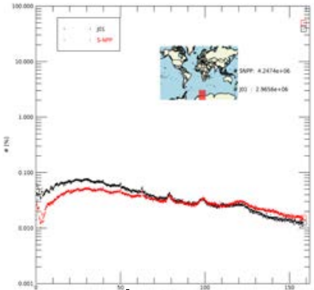
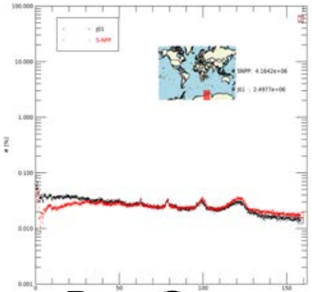
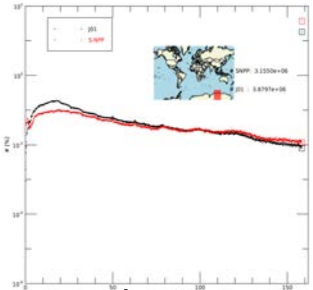

S Pac

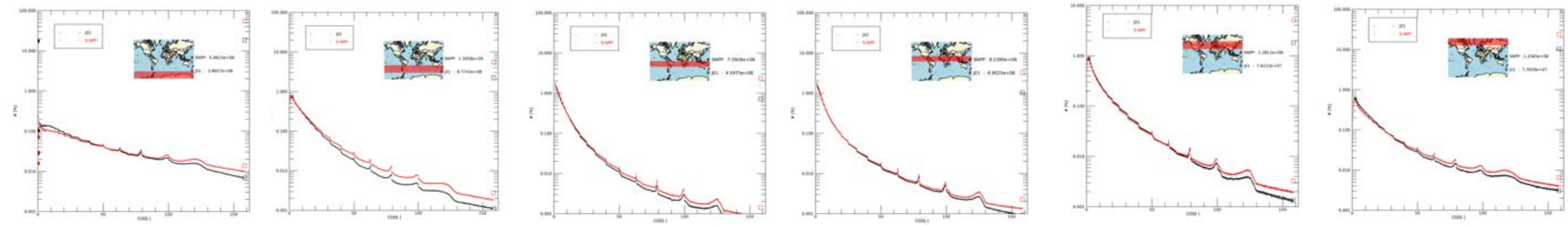

Antarctic Pen


Southern Ocn


Ross Sea

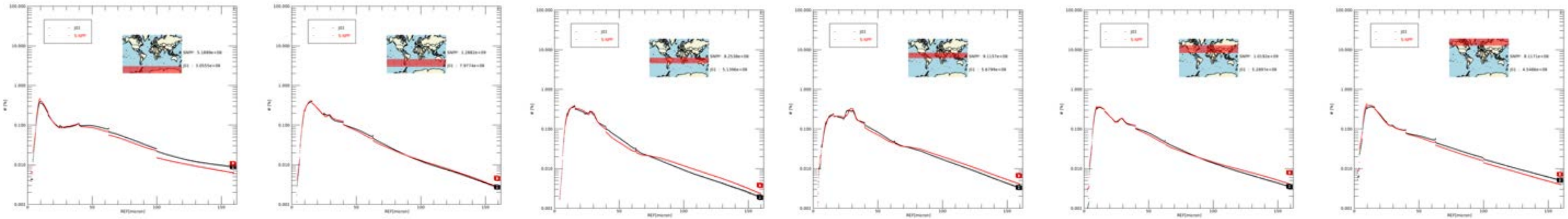

Davis Sea

Zonal Histograms



COD

0ºS - 60ºS | 60ºS - 30ºS | 30ºS - 0ºS | 0ºN - 30ºN | 30ºN - 60ºN | 60ºN - 0ºN



CPS

Conclusions

- Comparison of very fine binned 1d histograms of 10 days shows high agreement between S-NPP and NOAA-20 DCOMP results.
- S-NPP has slightly higher percentage of thicker clouds. Reason can be that likelihood of thick, convective clouds increases over the time of day. (NOAA-20 measures 51 minutes ahead of S-NPP). Other possible reason is currently discussed possible calibration issues of M5 channel for VIIRS sensors.
- CPS histograms show no clear bias.
- Zonal and regional specific results show same or similar results.
- Conclusion: DCOMP products of NOAA-20 (J-01) are in consistency to S-NPP's products.

Backup slides

NDE/STAR VIIRS DCOMP Production Status

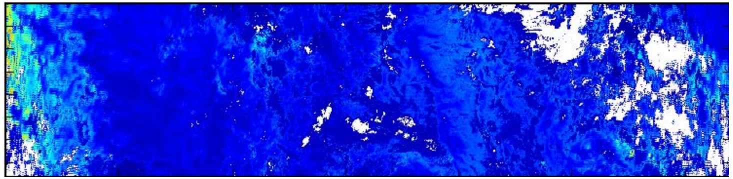
Algorithm	Suomi NPP	NOAA-20
February 2018 DAP **w/o April patch (missing granules)** August 2017 Science Code delivery **(v1r2)**	**NDE** **Currently in Operations since 1200 UTC on 13 August 2018**	**NDE** In I&T since 28 March, 2018 until 28 September
August 2018 DAP February 2018 Science Code delivery (**v2r0**)	**STAR** Systematic production since June, 2018 **NDE** **I&T on as of 28 September, 2018**	**STAR** Systematic production since June, 2018 **NDE** **I&T on as of 28 September, 2018**
Jan/Feb 2019 DAP August 2018 Science Code delivery (**v2r1**)	**Delivery and development in progress** Delivery schedule provided by ASSISTT	**Delivery and development in progress** Delivery schedule provided by ASSISTT

DCOMP integration into NDE

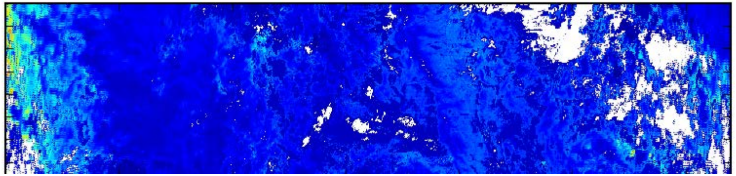
- Analysis was performed using GLANCE (which is used for algorithm integration verification) with an epsilon of 0 (i.e. a perfect match).
  - Small differences are to be expected due to slight run to run rounding differences.

- Data were taken from the v2r0 integration test between ASSISTT and NDE using data from 8 (NOAA-20) and 13 November (SNPP) 2018
  - Only data from 13 Nov, 2018 at 0250Z are shown.

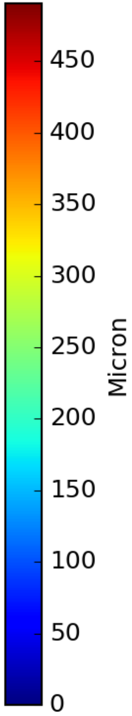
DCOMP CPS v2r0 Integration Results from Nov 13 2018 @ 0251Z



CIMSS SAPF

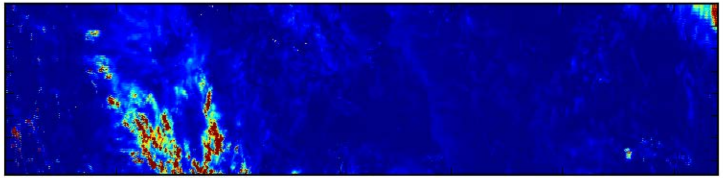


NDE SAPF

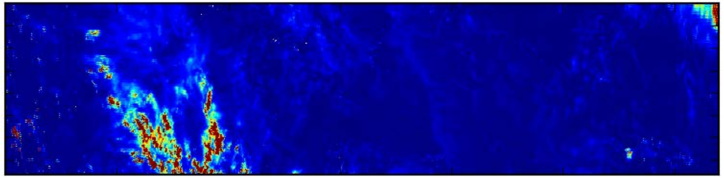


- Correlation between NDE and CIMSS SAPF run : 0.996
- Mean difference : 0.083
- Other scenes show similar results
- As mentioned previously, it is expected that there will be differences due to machine and run to run differences, and minor differences (as seen) are as expected.

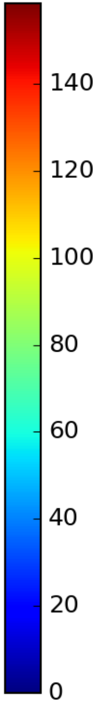
DCOMP COD v2r0 Integration Results from Nov 13 2018 @ 0251Z



CIMSS SAPF



NDE SAPF



- Correlation between NDE and CIMSS SAPF run : 0.99998099
- Mean difference : 0.0047980826
- Other scenes show similar results
- As mentioned previously, it is expected that there will be differences due to machine and run to run differences, and minor differences (as seen) are as expected.