



## *Read-me for Data Users*

**MEMORANDUM FOR:** The JPSS Program Record  
**SUBMITTED BY:** JPSS VIIRS Cloud Height (ACHA) Team:  
Andrew Heidinger (NOAA, Cloud Team Lead),  
Steve Wanzong and Yue Li (CIMSS)  
**CONCURRED BY:** JPSS Algorithm Management Project Lead Arron Layns  
JPSS STAR Program Manager Lihang Zhou  
**APPROVED BY:** JPSS Program Scientist Mitch Goldberg

**SUBJECT:** NOAA-20 VIIRS Cloud Height beta maturity status  
**DATE:** 07/19/2018

### **Beta maturity status declaration for NOAA-20 VIIRS Enterprise Cloud Height**

**Maturity Review Date:** 07/19/2018  
**Effective Date:** xx/xx/2018  
**Operational System:** NDE 2.0

The JPSS Algorithm Maturity Readiness Review Board approved the release of the NOAA Enterprise Cloud Height to the public with a Beta maturity level quality as of xx/xx/2018 (effective date), based on JPSS Validation Maturity Review held on 07/19/2018 (link to review artifacts).

#### **1. Maturity stage definition**

The Definition of Beta maturity stage is available at the JPSS Algorithm Maturity Matrix webpage: <https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

- 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. Algorithm Description:**

The NDE VIIRS Enterprise Cloud Height product contains mainly cloud top temperature, height and pressure. The retrieval uncertainties of these products are also available. Fundamentally the cloud height algorithm (ACHA) uses a 1-D var optimal estimation approach and employs a combination of infrared channels. The algorithm processes all daytime and nighttime VIIRS pixels globally detected as cloudy from the cloud mask algorithm. The direct output is cloud top temperature and the numerical weather prediction (NWP) profiles are used to derive cloud top height and pressure. The ACHA

algorithm uses the radiometric information from three VIIRS bands M14, M15 and M16. Specific details on the output are documented below. An extensive description of ACHA may be found in the ACHA ATBD delivered to NOAA Enterprise.

VIIRS Cloud Top Height product requirements are documented in the Joint Polar Satellite System (JPSS) Level 1 Requirements Supplement (L1RDS). The current version of the L1RDS is available at [http://www.jpss.noaa.gov/technical\\_documents.html](http://www.jpss.noaa.gov/technical_documents.html). The NDE VIIRS Cloud Height product meets the full set of JPSS Level 1 requirements. VIIRS Cloud Height product requirements are also documented in the JPSS ESPC Requirements Document (JERD) Volume 2: Science Requirements Version 2.0.

The key product outputs in the ACHA are:

- Cloud Top Temperature
- Cloud Top Pressure
- Cloud Top Height
- Cloud 11  $\mu$ m emissivity
- Cloud microphysical index ( $\mu$ )
- Cloud optical depth
- Cloud particle size

**Quality flags**

The data quality flags are placed in “CloudHgtQF” and diagnostic flags are in “CldPackedFlag”. The details are illustrated in Tables 1 and 2.

Table 1. Cloud top height retrieval quality flags

Flag Value	Description
0	Fully successful retrieval
1	Marginally successful retrieval
2	Retrieval attempted and failed
3	No retrieval attempted

Table 2. Processing information flags for the ACHA algorithm

Bit	Description
1	Cloud Height Attempted
2	Bias Correction Employed
3	Ice cloud retrieval
4	Local Radiative Center Processing Used
5	Multi-layer Retrieval
6	Lower Cloud Interpolation used
7	Cloud Height estimated using fixed lapse rate
8	Cloud layer found in inversion layer

**Product evaluation/validation**

- Visual comparisons were conducted with the NOAA-20 ACHA generated outside of NDE
- Cloud top temperature/height/pressure were compared to the NASA CALIPSO/CALIOP 1 and 5km Cloud Layer Product
- Cloud top temperature/height/pressure were compared to the NASA AQUA/MODIS MYD06 C6.1 Cloud Product

**Product availability/reliability**

- NOAA-20 Enterprise cloud top height EDR data were produced on the NDE Integration and Testing (I&T) string since 03/26/2018. Data availability was not reliable as the NDE I&T string during the beta test period as a result of scheduled

maintenance throughout. As such, data availability was not reliable from 2 April to 20 April.

- Roughly 25% of the Enterprise cloud height files for NOAA-20 are missing for any given day due to known product distribution at NESDIS Environmental Satellite Processing and Distribution Services (ESPDS) Product Distribution and Access (PDA) system. This issue exists on both the operational and I&T strings of NDE. A resolution has been identified and will be fixed on the I&T string in mid to late 2018 and will be transitioned to the operational string late 2018, early 2019.

### **Algorithm performance dependence**

The performance of the VIIRS cloud height product largely depends on the performance of the VIIRS cloud mask and phase products. The cloud mask product tends to miss low clouds at night and water phased clouds over snow/ice as noted in the Cloud Mask Beta Readme file and this affects the ACHA. This issue was corrected in June 2018 in the NOAA-20 and NPP processing in the I&T string. Additionally, the optimal estimation approach in ACHA employs a phase-dependent first guess for its retrieval. So any misclassification of clouds phase would also negatively affect ACHA retrieval.

### **Known errors/issues/limitations**

- Unrealistic cloud top height and pressure values are occasionally spotted in the products. This is most likely due to bad NWP profiles. A fix to this issue has been implemented in ACHA and will be effective in the next DAP delivery to NDE
- Any issue on NDE (e.g. missing granules) will negatively impact ACHA

### **3. Changes since last maturity stage**

This is the Beta maturity declaration of the NOAA-20 NDE VIIRS Enterprise Cloud Height product.

### **4. Review board recommendations**

N/A

### **5. Path Forward/Future Plan**

- Focus on specific scenarios that the products not performing well
- Attempt to bring in Polar Winds results
- Work with Phase team and explore methods that allow ACHA to try a different phase when ACHA retrievals fail
- Continue to expand the multilayer capability in ACHA

### **6. Additional Items to note**



## *Read-me for Data Users*

The cloud team welcomes any feedback on user issues and suggestions on the evolution of ACHA.

Point of Contact:

Name: Andrew Heidinger

Email: [Andrew.heidinger@noaa.gov](mailto:Andrew.heidinger@noaa.gov)

Phone: 608-263-6757