MEMORANDUM FOR: The JPSS Program Record
SUBMITTED BY: JPSS VIIRS Cloud Base Height (CBH) Team:
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SUBJECT: NOAA-20 VIIRS Cloud Base Height beta maturity status
DATE: 07/19/2018

Beta maturity status declaration for NOAA-20 VIIRS Enterprise Cloud Base 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 Base 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 Base Height product contains mainly cloud base height (CBH), an estimation of the base altitude of the uppermost cloud layer in each column of the atmosphere as viewed from above by VIIRS. The cloud base height algorithm (ACBA) is a semi-empirical approach, based on a statistical analysis of multiple satellite data (CloudSat/CALIPSO and Aqua MODIS). In the algorithm, CGT is derived from statistical relationships between observed CGT and CWP expressed as a

function of CTH and subtracted from CTH to generate CBH. The algorithm includes special accommodations for handling optically thin cirrus (an extinction method) and deep convection (supplementary NWP convective condensation level data). The ACBA algorithm processes all daytime and nighttime VIIRS pixels which are detected as cloudy from the cloud mask algorithm and have valid CTH. The direct output is cloud base height. Specific details on the output are documented below. An extensive description of ACHA may be found in the ACBA ATBD delivered to NOAA Enterprise.

Product requirements for the ACBA are now specified in the JPSS National Environmental Satellite, Data, and Information Service (NESDIS) Environmental Satellite Processing Center (ESPC) Requirements Document (L1RDS) Volume 2: Science Requirements. The current version of the L1RDS is available at http://www.jpss.noaa.gov/technical_documents.html. The NDE VIIRS Cloud Height product meets the full set of JPSS Level 2 requirements.

The key product outputs in the ACHA are:
- Cloud Base Height

Quality flags

The data quality flags are placed in "CldBaseQF". The details are illustrated in Tables 1.

Table 1. Cloud base height retrieval quality flags

Flag Value	Description
0	Valid retrieval
1	Invalid due to the upstream input being invalid or clear
2	Out of range due to CBH lower than Terrain (set to CBH = Terrain)
3	Out of range due to CBH < minCbh (0 km) or CBH > maxCbh (20 km)
4	Invalid due to CBH >= CTH

Product evaluation/validation
- Visual and histogram comparisons were conducted with the NOAA-20 ACBA generated outside of NDE
- Monitoring time series of CBHs between S-NPP and NOAA-20

- CBHs for selected cases were compared to ceilometer measurements from the Atmospheric Radiation Measurement (ARM) Northern Slope of Alaska (NSA) and Southern Great Plains (SGP) sites

Product availability/reliability
- NOAA-20 Enterprise Cloud Base Height EDR data were produced on the NDE Integration and Testing (I&T) string since 03/28/2018. 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 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. The problem also affects the CBH retrieval. 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 base height product largely depends on the performance of the VIIRS cloud top height (from the cloud height algorithm, ACHA) and cloud water path (from the daytime cloud optical property algorithm, DCOMP during daytime and supplementary NWP data at night) products as well as the cloud mask product. The enterprise cloud mask (ECM) 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 and thus ACBA. The issue with the ECM was identified and resolved within the I&T string in June 2018.

Known errors/issues/limitations
- Any issue on NDE (e.g. missing granules) will negatively impact ACBA
- Errors in the upstream CTH (ACHA) and CWP (DCOMP and NWP input) retrievals directly affect the CBH product quality.

3. Changes since last maturity stage
This is the Beta maturity declaration of the NOAA-20 NDE VIIRS Enterprise Cloud Base Height product.

4. Review board recommendations
N/A

5.   Path Forward/Future Plan
- Focus on specific scenarios that the products not performing well
- Continue to validate the product over an extended period
- Space-borne active sensor data will be incorporated upon data availability for further evaluation

6.   Additional Items to note

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

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