



Read-me for Data Users

MEMORANDUM FOR: The JPSS Program Record
SUBMITTED BY: JPSS Enterprise CBH/CCL Team Lead: Mark Kulie (NOAA)
CIRA Enterprise CBH/CCL Team: Yoo-Jeong Noh, John Haynes and
Brandon Daub
CIMSS Enterprise CBH/CCL Team: Yue Li and William Straka

CONCURRED BY: JPSS Algorithm Management Project Lead Lihang Zhou
JPSS STAR Program Manager Ingrid Guch

APPROVED BY: JPSS Program Scientist Satya Kalluri

SUBJECT: NOAA-21 Provisional maturity status

DATE: 10/26/2023

Provisional maturity status declaration for Cloud Base Height (CBH) and Cloud Cover Layers (CCL)

Maturity Review Date: 10/26/2023
Effective Date: 03/30/2023
Operational System: NCCF, Enterprise Cloud Cover Layers Version v2.0.1,
Processing Version Tag v2r0
Cloud Base Height Processing Version Tag v3r2

The JPSS Algorithm Maturity Readiness Review Board approved the release of the JPSS Products Enterprise Cloud Base Height (CBH) and Cloud Cover Layers (CCL) with a Provisional Maturity level quality as of 03/30/2023, based on the JPSS Enterprise [Cloud Base Height/Cloud Cover Layers Beta/Provisional Validation Maturity Review](#) held on 10/26/2023.

1. Provisional Maturity Stage Definition

- 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.

2. Algorithm Description

The Enterprise Cloud Base Height (CBH) provides derived estimates of cloud base height and cloud geometrical thickness, while the Cloud Cover Layers (CCL) algorithm produces a derived cloud fraction at a predefined spatial resolution and between specified cloud layers. The CCL algorithm also retrieves the total cloud fraction from surface to top of the atmosphere at the same resolution. It mainly utilizes cloud mask, cloud top and base products from upstream cloud mask, height and base



Read-me for Data Users

algorithms to derive CCL information. CCL products include 6 cloud fractions: total fraction and 5 cloud layer fractions at predefined flight levels (SFC-FL050, FL050-FL100, FL100-FL180, FL180-FL240, and FL240-TOA). Specific details on the output are documented below. An extensive description of both CBH and CCL may be found in the Algorithm Theoretical Basis Document (ATBD) delivered to NOAA Enterprise (<http://www.star.nesdis.noaa.gov/jpss/Docs.php>).

VIIRS CBH and CCL product requirements are documented in the [JPSS Ground Segment Data Product Specifications \(DPS\)](#) published in December 2019. It is assumed that the DPS requirements supersede the requirements listed in the JPSS Level1 Requirements Supplement (L1RDS).

The CBH Collection Short Name NOAA-21 is:

JRR-

CloudBase_v3r2_n21_sYYYYMMDDSSSSSSSS_eYYYYMMDDSSSSSSSS_cYYYYMMDDSSSSSSSS

The CCL Collection Short Name NOAA-21 is:

JRR-

CloudCoverLayers_v2r0_n21_sYYYYMMDDSSSSSSSS_eYYYYMMDDSSSSSSSS_cYYYYMMDDSSSSSSSSSSSSSS

YYYY is the year in 4 digits, MM the month, DD the day, and SS the seconds down to the sixth or seventh significant digit depending on whether the reference is to the start time of the granule (s), the end time of the granule (e), or the time it was created (c).

Product requirements published in the JPSS Ground Segment DPS (December 2019) are:

Cloud Base Height

Attribute	DPS	Requirement/Threshold
Coverage	DPS-481	The Cloud Height product shall provide geolocated cloud top and base heights per cell, for the highest cloud in the column, globally, day and night, whenever detectable clouds are present, at the refresh rates of the instrument.
Accuracy	DPS-485	The algorithm shall produce a cloud base height product that has a measurement accuracy of 2.0 km for COT >=1 and 3.0 km for COT < 1
Precision	DPS-482	The algorithm shall produce a cloud base height product that has a measurement precision of 2.0 km for COT >=1 and 3.0 km for COT < 1

Uncertainty	DPS	The algorithm shall produce a cloud height product that has a mapping uncertainty, (3 sigma) of 4 km.
-------------	-----	---

Cloud Cover Layers:

DPS	Requirement
DPS-458	The Cloud Cover/Layers product shall provide geolocated fractional cloud cover per cell, for three atmospheric layers and for the total of all layers, globally, day and night, whenever detectable clouds are present, at the refresh rates of the instrument.
DPS-591	The Cloud Cover/Layers product shall provide geolocated fractional cloud cover per cell at the three atmospheric layers of 0 to 350 millibars (mb), 350 to 642 mb, and 642 to 1100 mb.*
DPS-459	The Cloud Cover/Layers product shall provide fractional cloud cover per cell with a measurement uncertainty of 15%.
DPS-461	The Cloud Cover/Layers product shall provide fractional cloud cover with a horizontal cell size of 10 kilometers.
DPS-462	The Cloud Cover/Layers product shall geolocate the center of the fractional cloud cover cell with a 3-sigma mapping uncertainty of 4 kilometers.

The main CBH/CCL product outputs are:

- Cloud base height
- Cloud geometrical thickness
- Total cloud fraction
- Cloud fractions at five designated cloud layers based on flight levels
- Cloud layers (flagged as clear or cloudy for each layer or a combination of layers)

Quality flags

The data quality flags are placed in the “CldBaseQF” and “CCL_DQF” variables and are shown in the table below.

Flag Value	CldBaseQF Description
0	Valid retrieval from the statistical method
1	Invalid due to the upstream input being invalid or clear
2	CBH = Terrain due to CBH lower than Terrain
3	Out of range due to $CBH < minCbh$ (0 km) or $CBH > maxCbh$ (20 km)
4	Invalid due to $CBH \geq CTH$
5	Valid retrieval from the extinction method
6	Valid retrieval from NWP for deep convection

Flag Value	CCL_DQF Description
0	Valid retrieval
1	Degraded (due to upstream errors)
2	Bad (Invalid)

Product evaluation/validation

- Visual inspections
- Visual and quantitative comparisons between NOAA-21, NOAA-20 and SNPP CCL generated within the NCCF.
- Comparisons with CBH and CCL generated from NASA CloudSat and CALIPSO Sensors
- Comparisons with CBH and CCL generated from DOE ARM ground-based sensors.

- Quality flags/variable checks

Product availability/reliability

NOAA-21 Enterprise Cloud Base Height (CBH) v3r2 and Cloud Cover Layers (CCL) v2r0 products have been produced since 03/30/2023.

- Inconsistent dataset production from the NDE Integration and Testing (I&T) string created a somewhat limited dataset for the Provisional Maturity review. A continued lack of a consistently-generated global datastream over a longer period of time may produce an insufficient dataset needed for the Validated Maturity evaluation.

Algorithm performance dependence

The performance of the VIIRS CBH and CCL products largely depend on the performance of the VIIRS cloud mask, height, and microphysical property products. The optimal estimation approach in ACHA employs a phase-dependent first guess for its retrieval, so any misclassification of cloud phase could negatively affect CBH and CCL retrievals. Validation datasets are often phase-matched to mitigate such discrepancies.

Known errors/issues/limitations

- Lower level cloud validation is challenging with limited evaluation data resources, especially with no additional CloudSat/CALIPSO data products available due to end-of-life for those respective missions.
- Quantitative assessments against 4-month ARM ground radar/lidar/ceilometer measurements and global CALIPSO case studies confirm that CBH and CCL products perform normally, best for single layer clouds.
- Upstream cloud product errors directly affect CBH and CCL performance
- “Invalid CBH” pixels when cloud top height is valid primarily due to no valid CWP input.
- Occasional blocky features in nighttime CBH from NWP-CWP input for all three VIIRS instruments. NWP data remapping/smoothing needs to be examined further.
- Any NCCF/NDE issues (e.g. missing SDR granules) will negatively impact CBH/CCL.

3. Changes Since Last Maturity Stage

- This is a combined Beta and Provisional Maturity review, so this is the first formal NOAA-21 CBH/CCL review.
-

4. Review Board Recommendations

- None

5. Path Forward/Future Plan

- Further assessment of using or not using VIIRS day/night band (DNB) information for



Read-me for Data Users

CBH

- Explore potential AI-based CWP input for CBH
- Improve CBH retrievals in multilayer cloud scenarios
- Continue evaluating additional CCL output (e.g., supercooled and convective layers)
- Explore Oxygen-A band impact from EPS-SG METImage

6. Additional Items to Note

- The Cloud Team welcomes any feedback on user issues and suggestions to improve CBH/CCL performance.

Additional information is available in the CBH/CCL algorithm theoretical basis documents (ATBD) and validation maturity review briefing, which can be accessed at:

<http://www.star.nesdis.noaa.gov/jpss/Docs.php>

Point of Contact

Name: Mark Kulie

Email: mark.kulie@noaa.gov

Phone: 608.263.6583