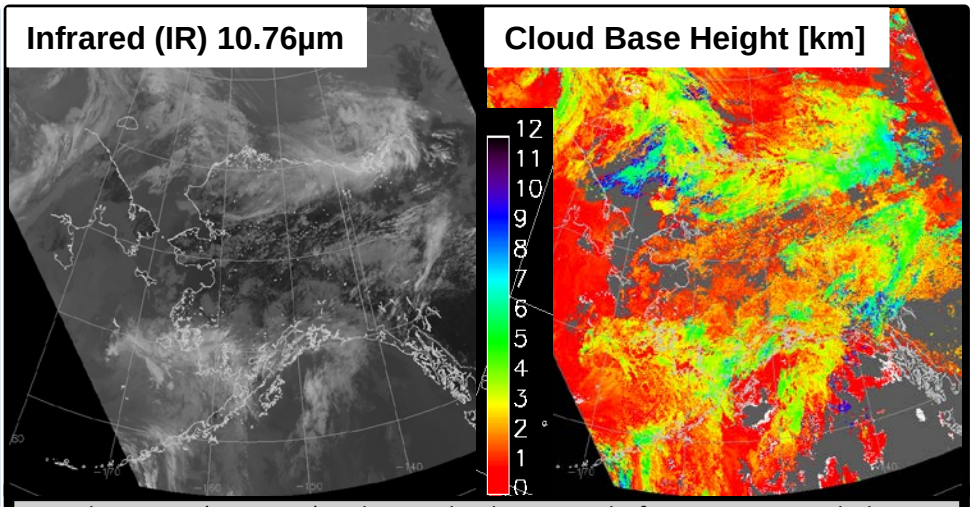
VIIRS Cloud Base Height

Quick Guide

Why is the Cloud Base Height (CBH) Important?

The CBH is an estimation of the base altitude of the uppermost cloud layer in each column of the atmosphere as viewed from above by satellite. Information of 3-D cloud structure is significant to the aviation community. It also bears high relevance to model developers for weather and climate applications. CBH is a key component required to construct a full 3-D cloud field, although assigning cloud base from satellite data is still challenging. The current CBH algorithm is operational as part of the NOAA Enterprise Cloud Algorithms.



Sample VIIRS IR (10.76 μm) and VIIRS Cloud Base Height from S-NPP over Alaska at 2203 UTC, 28 July 2018. Note to aviation users: CBH is also displayed in kilofeet [kft] for aviation purposes. The height in kilometer [km] is converted to pressure and next to kilofeet using a polynomial fit.

How is the VIIRS CBH Created?

The CBH is obtained from a semi-empirical approach, based on a statistical analysis of multiple satellite data (CloudSat/CALIPSO and Aqua MODIS). In the algorithm, Cloud Geometric Thickness (CGT) is derived from statistical relationships between observed CGT, Cloud Water Path (CWP), Cloud Top Height (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 data). The CBH product is provided for any cloudy pixel with valid cloud top height globally, day and night (750 m resolution, ~50 min revisit between S-NPP and NOAA-20).

$$CBH = CTH - CGT \quad and \quad CGT = (a * CWP) + b, \text{ where } a \text{ and } b \text{ are obtained from statistical relationships.}$$

Impact on Operations

Applications:

Cloud product improvement: CBH information can be used to improve the Cloud Cover Layers (CCL) products by introducing additional cloud coverage at lower levels of the profile, typically hidden under cloud top.

Aviation: Vertical cloud structures including CBH provide useful information for aviation weather applications.

NWP models: The CBH algorithm is also applicable to geostationary sensors as well as polar satellite sensors. Global observations of 3-D cloud fields are relevant to model developers for integrating improved cloud radiative feedbacks in numerical models.

Limitations

Nighttime observations: The nighttime CBH retrieval performance would be degraded due to the difficulty of CWP retrievals.

Dependency on cloud optical properties: The performance of the CBH retrieval is highly dependent on the accuracy of CTH and CWP.

Multi-layer clouds: The algorithm is optimal for single layer clouds. Most likely CBH = actual ceiling in cases an optically thin cirrus cloud, a boundary layer cloud, and deep convection but may not be 'ceiling' for multi-layered cloudy scenes. The accuracy of the CBH product for multi-layer clouds may comprise the uncertainties of the upstream retrievals.

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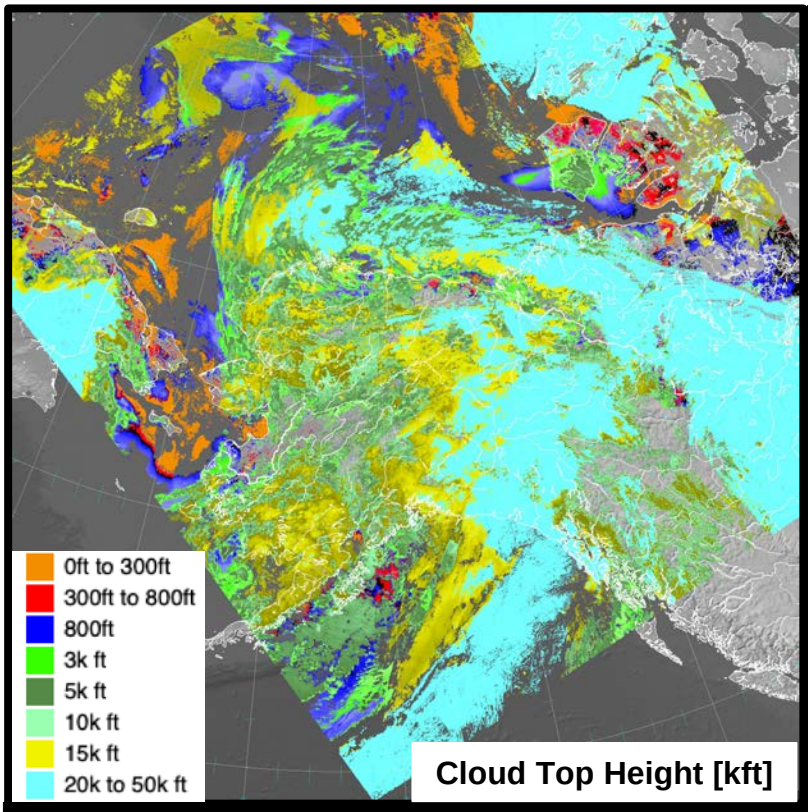
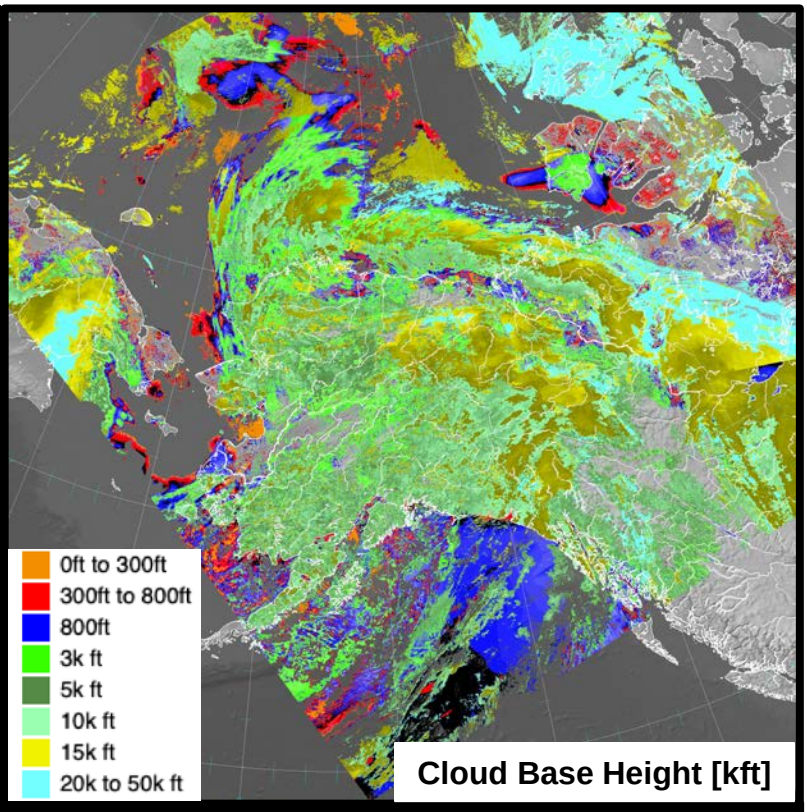
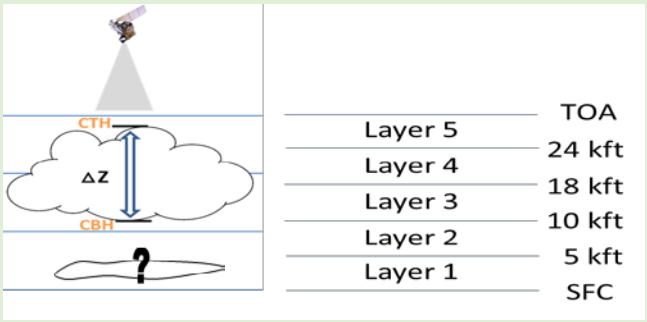


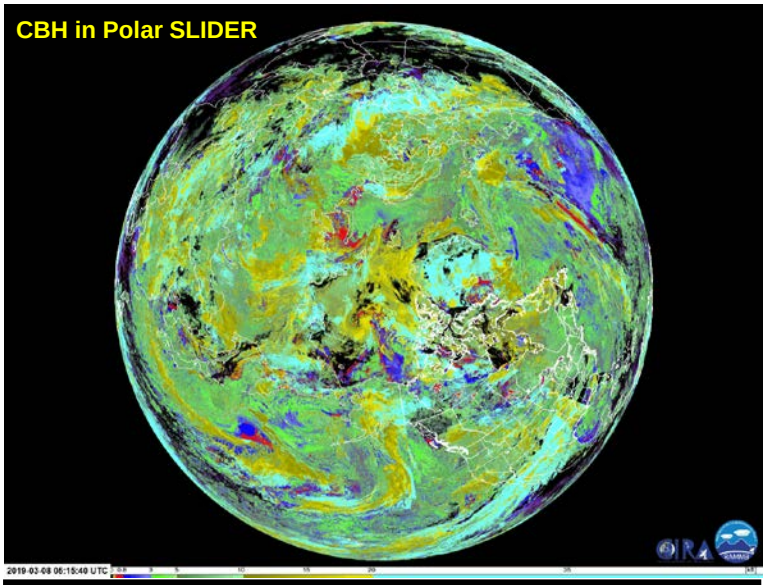


VIIRS IR Cloud Top Height and VIIRS Cloud Base Height displayed in kilofeet [kft] for aviation users (S-NPP VIIRS at 2122 UTC, 18 February 2019). JPSS VIIRS cloud products over Alaska are viewable on the GINA Website (http://hippy.gina.alaska.edu/distro/aviation/).

CBH applied to Cloud Cover Layers (CCL)

- The CBH information is used for improved CCL products, which enhances lower cloud coverage hidden below cloud top.
- Again, it should be noted the algorithm is optimal for single layer clouds. The CBH (and low CCL) may not be the lowest 'ceiling' for multi-layered cloudy scenes when thick top layers are present. The nighttime performance would be degraded.





CIRA's Polar SLIDER for VIIRS imagery & cloud products at http://rammb-slider.cira.colostate.edu (Satellite "***JPSS***")

Resource: Development of a statistical cloud base height retrieval algorithm: Noh et al., 2017, J. Atmos. Ocean. Tech., 34(3), 585-598.

Hyperlinks not available when viewing material in AIR Tool

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