

Cloud Top Height Product: Product Guide

Doc.No. : EUM/TSS/MAN/14/786420
Issue : v1C e-signed
Date : 26 April 2017
WBS :

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Document Change Record

<i>Issue / Revision</i>	<i>Date</i>	<i>DCN. No</i>	<i>Changed Pages / Paragraphs</i>
1	6 October 2010		Initial release of Document
1A	21 August 2015		Review by subject matter expert. Final edits and elimination of Algorithm section. Product output table moved to Section 2.
1B	4 April 2017		Corrections to text in Section 3 and links in Section 4.
1C	25 April 2017		Added definition of CTH bands used to designate cloud top height levels.

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1 PRODUCT DESCRIPTION

The Cloud Top Height (CTH) product is an image-based GRIB (Edition 2)-encoded product which indicates the height of the highest cloud. Using pixel-based cloud analysis retrieval, the CTH product is derived for 3×3 pixel areas in which the highest cloud top is assigned to a 320 m thick cloud height band. If a specified minimum number of cloudy pixels are available within the CTH 3×3 pixel processing area, then the pressure level of the highest cloud is extracted for determining the aforementioned cloud height band. The pressure level is taken from a cloud analysis that uses forecast data for the determination of the cloud height in the geophysical unit of “pressure”. Currently, the product may contain up to 51 bands reaching up to approximately 15 km. For the CTH height band determination, the International Civil Aviation Organization (ICAO) standard atmosphere (pressure and height) is used to derive the heights corresponding to the pressure levels determined in the cloud analysis product.

An important user community for the CTH products is the aviation industry. CTH products are typically used to provide aircraft crew with information on the presence of high-level clouds. The latest change to the product increased the frequency of the product generation and distribution. This greatly improved the service for the aviation user community. With dissemination only on the hour, a single missed product immediately resulted in a gap of two hours between consecutive products deliveries. This is no longer the case.

Settings:

- The minimum number of available cloudy pixels is set to four pixels.
- The maximum percentage allowed for pixels flagged in the intermediate cloud analysis product is set to 33%.

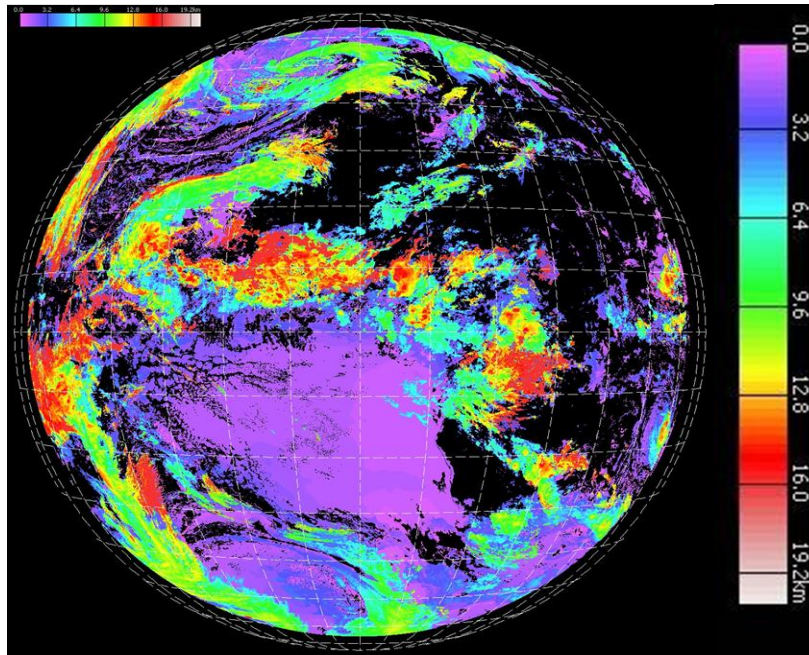


Figure 1: Sample of full-disk CTH product. Colour code at right indicates highest cloud height. See also Section 3 for more product illustrations.

2 PRODUCT SPECIFICATIONS

<i>Category</i>	<i>Specification</i>
Application Users	Aviation meteorology
Product Distribution	<ul style="list-style-type: none"> • EUMETCast • Direct • EUMETSAT Data Centre
Product Area	Full Earth Scanning Area (FES)
Product Resolution	3 × 3 pixel
Product Distribution	<ul style="list-style-type: none"> • EUMETCast: every 15 minutes for the 00:15, 00:30, 00:45, 01:00, ...23:45 UTC products • Direct: every 3 hours for the 02:45, 05:45, 08:45, ...23:45 UTC products • EUMETSAT Data Centre: every 15 minutes for the 00:15, 00:30, 00:45, 01:00, ...23:45 UTC products
Product Names	<ul style="list-style-type: none"> • EUMETCast: L-000-MSG2__-MPEF_____-CTH_____-000001____-200611130545-__ • Direct Dissemination: L-101-MSG2__-MPEF_____-CTH_____-000001____-200611130045-__
Product Format	GRIB format
Product Size	About 0.8 MB (variable)

2.1 Product history and gaps in coverage:

<i>Date</i>	<i>Event</i>
26 November 1996	Baseline established
24 June 1997	Use of quality flag from intermediate CLA rather than final CLA.
25 July 2005	Revised description of fog indicator.
8 June 2010	Increased EUMET Cast dissemination frequency from every 3 hours to hourly.
15 June 2011	Increased CTH product generation and EUMETCast dissemination frequency from hourly to every repeat cycle.

2.2 Product Outputs

The following data are produced for each CTH processing segment in the form of a GRIB (Edition 2) encoded product, which includes a six-bit image plus two bits of quality information.

<i>Parameter</i>	<i>Mnemonic</i>	<i>Units</i>	<i>Min</i>	<i>Max</i>	<i>Prec</i>	<i>Acc</i>	<i>To</i>
Height band of the cloud top height of the highest cloud	cth_height_band	-	0	51	1	1	CTH product
CTH quality flag	CTH_quality_flag	-	0	3	1	1	CTH product

<i>Parameter</i>	<i>Bit</i>	<i>Meaning</i>
CTH_quality_flag	Bit 0:1	Fog in CTH segment
	Bit 1:1	Poor Quality Height estimation

Table 1: Data produced for each CTH Processing Segment

2.3 Operations Limitations

There are no known operational limitations.

3 PRODUCT ILLUSTRATION

An example of a CTH product from 28 April 2011 13:00 UTC is given in Figure 1. Figure 2 shows the same CTH product within a limited area over the South American coast. A frequency histogram for the band occurrences is presented on the right side of both figures.

Currently, the product may contain up to 51 bands up to about 16 km. For the CTH height band determination, the International Civil Aviation Organization (ICAO) standard atmosphere (*pressure* and *height*) is used to derive the heights corresponding to the pressure levels determined in the cloud analysis product. This is done by interpolating the observed cloud top height between the pressure and ICAO height levels with values that are greater and less (respectively (p_n, Z_n) and (p_{n+1}, Z_{n+1})) than the observed cloud top height. The interpolation relationship to convert the cloud top height (in hPa) to the geometrical height is as follows:

$Z_{CTH} = Z_n + ((\ln(\text{cloud_top_height}) - \ln(p_n)) * (Z_{n+1} - Z_n)) / (\ln(p_{n+1}) - \ln(p_n))$	Formula 1
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The encoded CTH product disseminated to the user community supplies the cloud top height in increments of 320 m (cloud tops at 320 m, 640 m, 960 m...up to about 16,000 m). In this scene, band 1 means a cloud top of 320 meters, band 2 indicates a cloud top of 640 meters, etc. At the extremes, band 50 would correspond to 16000 meters, while band 0 would indicate no cloud (no CTH).

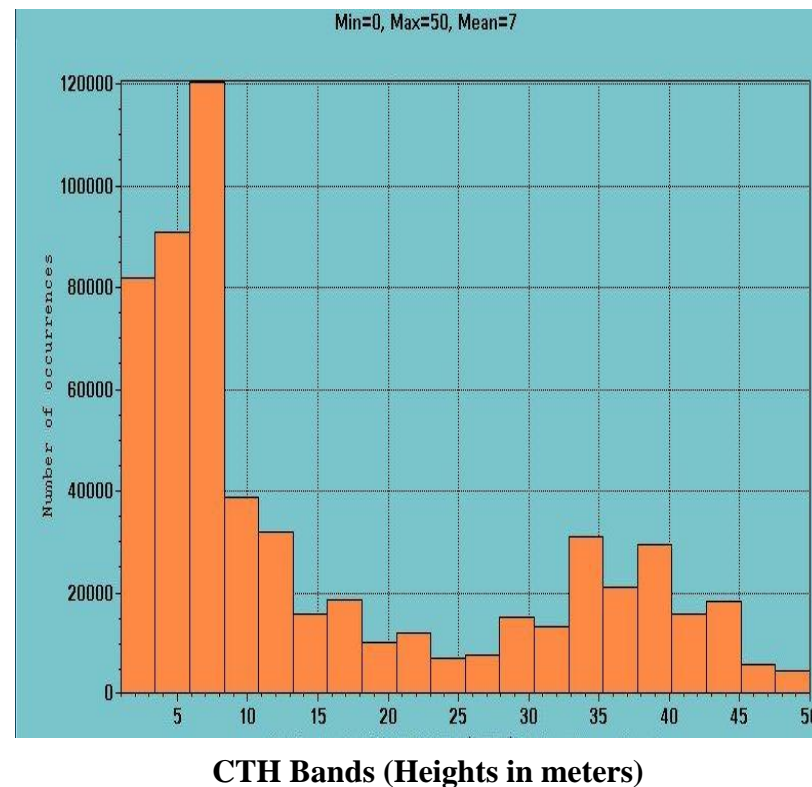
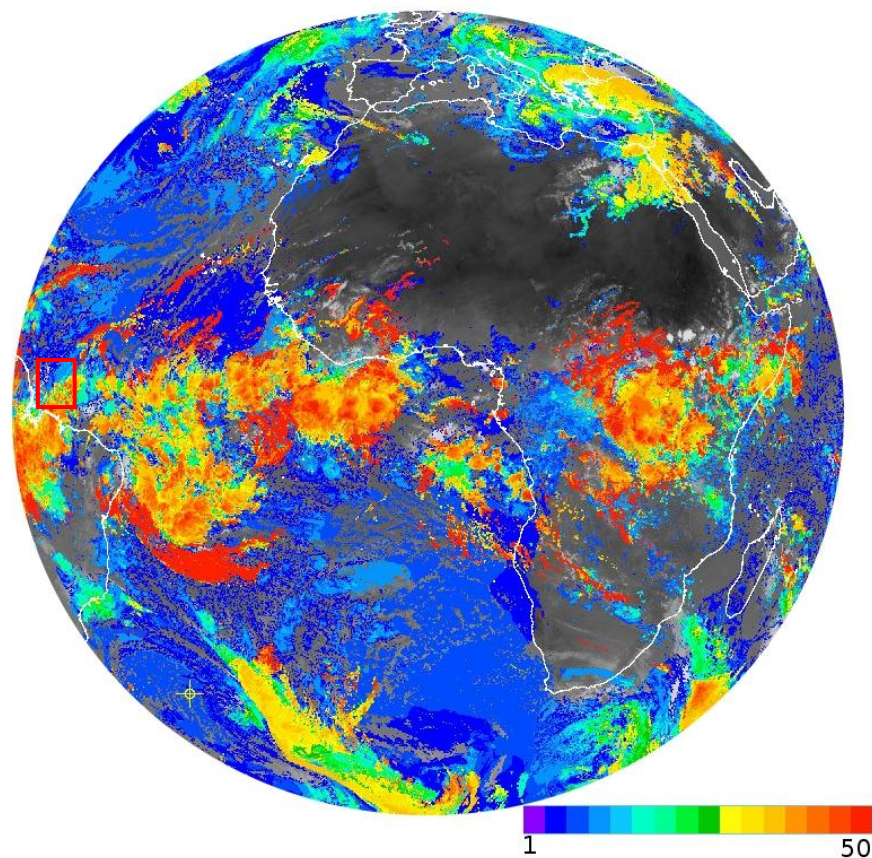


Figure 2: An example of the CTH product (left) from 28 April 2011 13:00 UTC. The colour scale presents only 16 values for 50 bands. A frequency histogram for the band occurrences is presented on the right. The CTH bands shown (orange bars) represent a height (in meters) designation based on Formula 1 above.

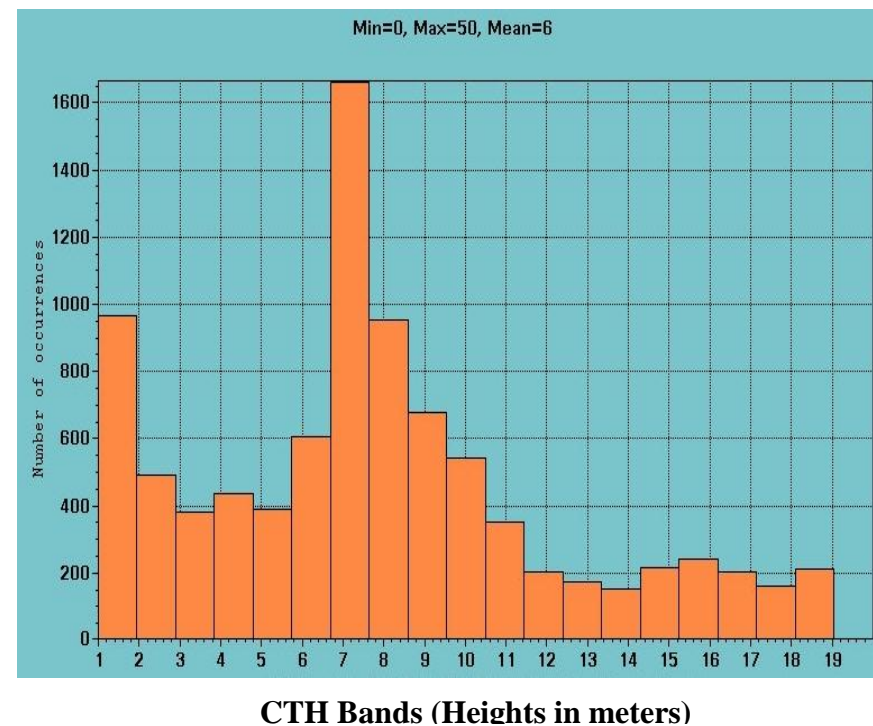
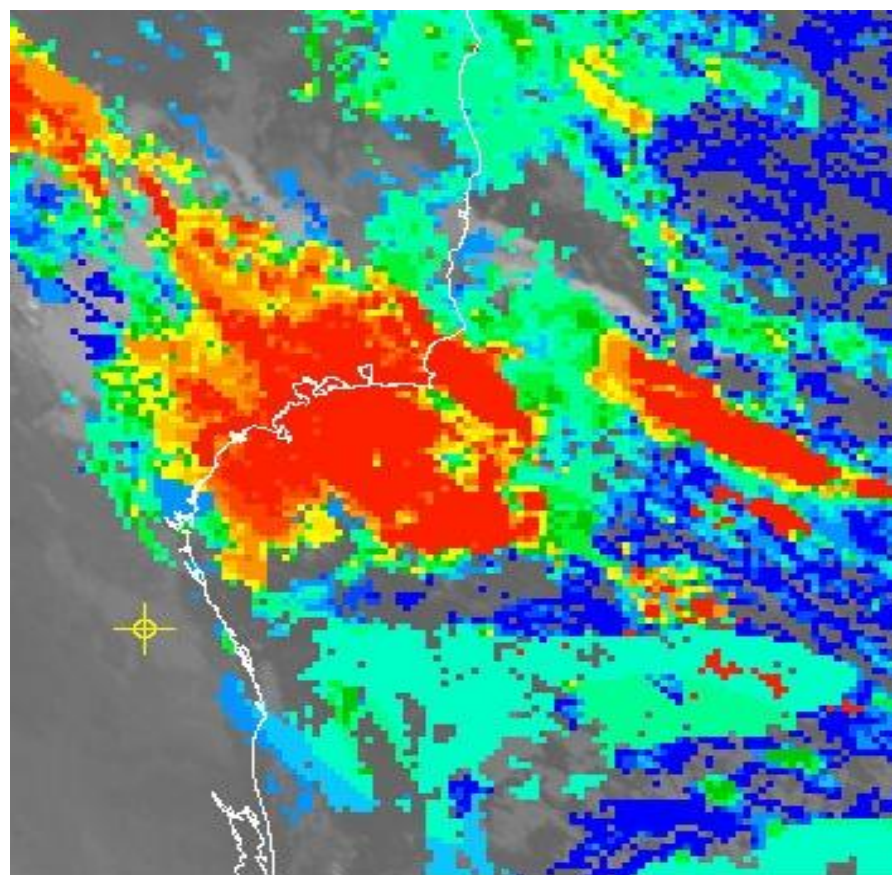


Figure 3: An example of the CTH product (left) from 28 April 2011 13:00 UTC, but for a smaller area over the South American coast. The colour scale now covers 20 bands. The CTH bands shown (orange bars) represent a height (in meters) designation based on Formula 1 above.

4 REFERENCES AND LINKS

4.1 Reference Documents

<i>Type</i>	<i>Document Name</i>	<i>Reference</i>
Algorithm	MSG Meteorological Products Extraction Facility (MPEF) Algorithm Specification Document	EUM/MSG/SPE/022
Detailed Algorithm	Cloud Detection for MSG - Algorithm Theoretical Basis Document	EUM/MET/REP/07/0132

4.2 Online Resources and Assistance

All of the reference documents listed above are in the EUMETSAT Technical Documents page.

www.eumetsat.int > Satellites > Technical Documents
> Meteosat Services
> 0° Meteosat Meteorological Products

To register for data delivery from this product, go to the Data Registration page on the EUMETSAT web page:

www.eumetsat.int > Data > Data Delivery > Data Registration

GRIB (**GR**Idded **B**inary) is the WMO standard binary format for exchanging gridded data. GRIB Edition 2 is an extension of GRIB, with a much higher degree of flexibility and expandability. For complete details on the format, see the WMO web page:

<http://www.wmo.int/pages/prog/www/WMOCodes.html>

Information about the service status of EUMETSAT satellites and the data they deliver is this EUMETSAT web page:

www.eumetsat.int > Data > Service Status

To get answers to questions about data delivery, registration or documentation, contact the EUMETSAT User Service Help Desk:

Telephone: +49 6151 807 3660/3770
e-mail: ops@eumetsat.int