

## NASA Ames Convective Cloud Top Height Product

### Data Description:

The NASA Ames convective height algorithm was developed by L. Pfister and is described in various publications (e.g., Ueyama et al., 2014, 2018; Schoeberl et al., 2019, 2020). The convective cloud height product is available on a  $0.25^\circ$  longitude x  $0.25^\circ$  latitude grid in the  $60^\circ\text{S}$  -  $60^\circ\text{N}$  domain every 3 hours for the years 2006-16.

The approach is based on the assumption that rainfall above a given threshold can define the convective region. Rainfall data, coupled with satellite infrared (IR) information, can then identify both the regions where the mass-transporting convective cores occur and their altitudes. The algorithm uses rainfall data from the Global Precipitation Mission combined radar/microwave/IR 3B42RT dataset available at 3-hour intervals on a quarter degree longitude-latitude grid in the  $60^\circ\text{S}$  -  $60^\circ\text{N}$  domain (Huffman et al, 2007), the same temporal and spatial resolution as the NASA Ames convective cloud height product. In order to relate the rainfall to deep convection, rainfall rate thresholds are calculated separately for oceanic and land regions. The rainfall rate thresholds are derived by matching the incidences of rainfall rate with the incidences of deep convective and nimbus cloud tops  $> 9$  km from CloudSat (2B-CLDCLASS; Sassen and Wang, 2008). After the regions of convective cores are identified, convective altitudes and potential temperatures are calculated by matching the coldest IR brightness temperatures (GPM\_MERGIR: NCEP/CPC L3 dataset from NASA GES DISC) within each quarter degree grid box with temperature profiles from NOAA Global Forecast System analyses. For locations where the brightness temperatures are colder than the level of neutral buoyancy (i.e., near the tropopause) (LNB), the algorithm uses a simple mixing scheme to create a temperature profile above the LNB. This temperature profile is then re-matched with the brightness temperature to calculate the altitude and potential temperature. The estimated cloud top heights are adjusted for known biases in IR cloud top temperature (Minnis et al., 2008; Sherwood et al., 2004) by uniformly adding 1 km to the cloud top altitudes. The derived convective cloud top altitudes are calibrated to match the statistics of the combined CloudSat and CALIOP cloud tops. These cloud tops are determined using the CALIOP Vertical Feature Mask information coupled with the column ice water content (Winker et al., 2006). The ice water content is used to eliminate non-convective thin clouds above convection based on estimates of convective ice water content from Wang and Dessler (2012). The calibration is limited to nighttime data, when the noise levels in the CALIOP measurements are lowest.

### Data format:

The convective cloud product is stored as IDL .sav files, which can be read by IDL and Python.

The file names have the form:

*cloudaltthetkm\_'+date+hr+'\_reanmix\_noice\_ocean\_trmm.15.9\_srch.3\_offs1.00\_tropw0.70.sav*  
where date is a string YYYYMMDD and hr is a string HH (ex. 2007100103 = October 1, 2007 at 03 hours).

Table 1: List of relevant variable names, their dimensions, units, and description

Variable name	dimension	units	Variable description
rainlon	1D	deg E	longitudes
rainlat	1D	deg N	latitudes
rainthet	2D (rainlon,rainlat)	K	potential temperature of the convective cloud top height
rainalt	2D (rainlon,rainlat)	km	pressure altitude of the convective cloud top height
tdiff	2D (rainlon,rainlat)	K	temperature difference between the convective top from the mixing scheme and the environmental temperature
offset	single number	K	offset temperature used in adjusting the convective cloud top height
descript[XXX]			descriptors of the data

## References

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