Summary of the Microwave Temperature Profiler (MTP) data from ACCLIP

File Descriptions

The MTP data set consists of two file types. File names of the form *MPyyyymmdd.NGV* contain vertical temperature profile data. Files named *TCyyyymmdd.PNG* contain quick-look images showing temperature curtain plots for each flight.

The MP files are written in a variation of NASA Ames format. A 64-line header describes the data. The first several lines of the header give variable names and units. Subsequent lines describe the format of the actual temperature profiles that follow the header. There is one profile for each 17-sec scan. Each profile has a single header line followed by temperature and altitude data at each vertical level. Missing scans have a header line without any temperature/altitude data following. Missing scans may occur due aircraft turns and rapid ascents/descents, instrument malfunction, or radio frequency interference.

For the TC plots, the x-axis is the Universal Time (UT) in kilo-seconds (ks), the left y-axis is the pressure altitude in kilometers (km), and the right y-axis is the pressure altitude in thousands of feet (kft). On the right is the color-coded temperature scale, which ranges from 170- 320 K. Also shown on each plot is the GV's altitude (black trace), the tropopause altitude (white trace), and a quality metric (gray trace at the bottom). The quality metric, which is called the MRI, ranges from 0 to 2 on the left pressure altitude scale. If the MRI is <1, the retrieval is considered reliable; if it is >1 the retrieval is less reliable, and users should contact the instrument POC as to whether it can be used or not. The MTP final data have been edited to include retrievals with the MRI<0.8. If this excludes a specific time period that someone is interested in, they should contact us to discuss whether that time period can be salvaged.

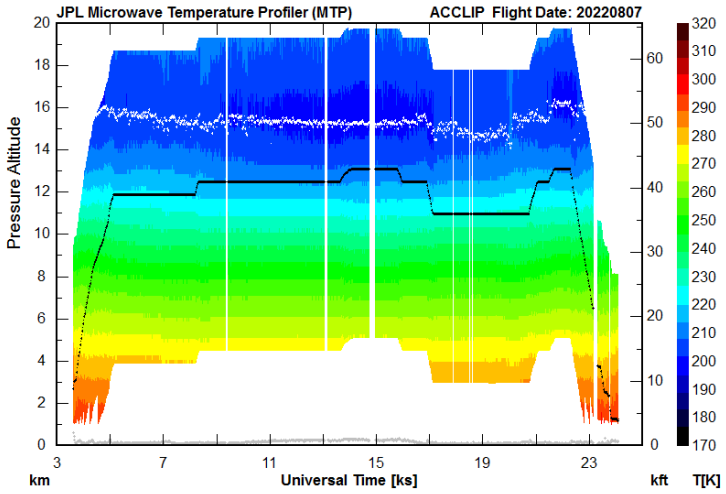
When retrievals are performed, the retrieval coefficients used assume that the pressure altitude is approximately constant. Clearly over an ~17 second MTP scan, this is not the case if the GV is ascending or descending. We have tried to preserve as much of the ascent and descent data as possible by changing the editing threshold when it appears that the retrievals are consistent with adjacent level flight segments. This is done by examining the behavior of the tropopause or the temperature field retrievals during ascent or descent compared to those during the level flight segments.

Data Quality Overview

MTP collected good quality data and successful retrievals were achieved on all ACCLIP research flights except for RF02. During RF02, the real-time transmission of aircraft attitude data via the IWG1 line was disrupted for most of the flight. Hence, variables that control the viewing orientation of the sensor were erroneous, and proper geolocation of measured radiances is not possible.

For flights RF01 and RF03-RF14, raw data are of high quality and retrieval parameters indicate that derived temperature profiles are of generally good quality. Local radiosonde profiles provide

a priori observations which serve as first-guess information in the MTP retrieval scheme. A comprehensive set of radiosonde data during ACCLIP provided good representation of the atmospheric conditions. Success of the retrieval is quantified by a metric known at the MRI; its value is given in the header line of each profile. The temperature curtain plot below shows the MRI as a gray line at the bottom.

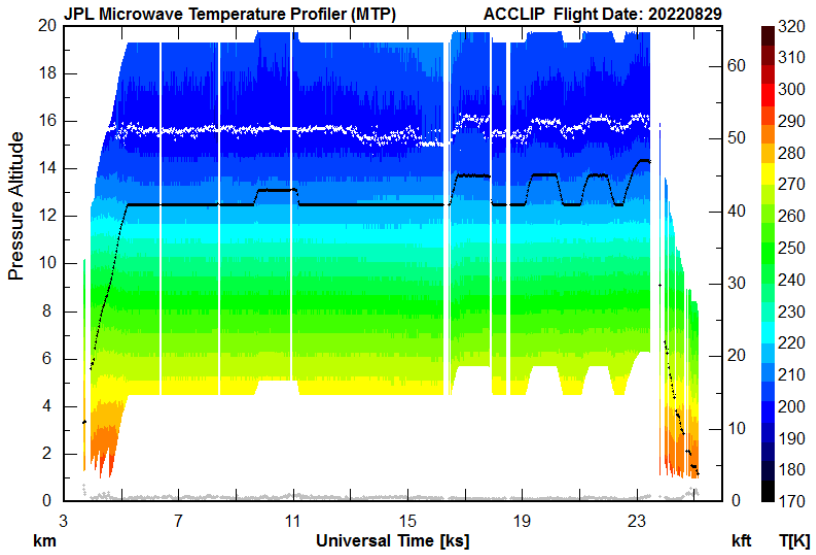


In the temperature curtain plots, the color scale represents retrieved physical temperature. The black line shows flight altitude, and the white dots indicate estimated tropopause height.

For portions of certain ACCLIP flights, users will notice that the tropopause height estimate fluctuates from scan-to-scan in a likely unrealistic way. This tends to happen especially during sawtooth patterns (i.e., short-lived changes in aircraft altitude). We believe this is an artifact of the retrieval process combined with the observed small lapse rates in the tropopause region for these flights.

Tropopause height from MTP is calculated by applying the WMO definition of the tropopause height to the retrieved temperature profile. During some flights, temperature profiles in the UT/LS region exhibited slowly changing lapse rates over a fairly deep vertical layer (in contrast to situations where the tropopause transition is marked by a sharper shift with a more dramatic change in lapse rate). Both the retrieved MTP profiles and radiosondes in the region contain such features. WMO defines the tropopause as the lowest level at which the temperature lapse rate decreases to 2 K/km or less (WMO, 1957). If this definition is applied to a retrieved temperature profile with a lapse rate near the 2 K/km threshold over a significant vertical layer, uncertainty in the MTP measurements and the retrieval process will cause the assigned tropopause height to fluctuate more than it would if the transition occurred over a narrow vertical layer, i.e. the threshold may be met at different altitudes. The variation in estimated tropopause height with changes in aircraft altitude (e.g., sawtooth patterns) on some flights may be a result of the uncertainty in the retrieved profiles combined with the WMO hard threshold applied to a deeper vertical transition region. An example is shown below in the latter part of RF13. Note

variations in the estimated tropopause height on the order of 0.5 km as the aircraft changes altitude.



References

NCAR/EOL, Microwave Temperature Profiler, https://www.eol.ucar.edu/instruments/microwave-temperature-profiler

WMO Bulletin, Vol. VI, No. 4, October 1957. Available at https://library.wmo.int/doc_num.php?explnum_id=6960

Haggerty, J., K. Schick, B. Lim, and M.J. Mahoney, 2014: The NCAR Microwave Temperature Profiler: Data applications from recent deployments. *Proceedings of the IEEE MicroRad14 Conference on Microwave Radiometry*, Pasadena, CA, 24-27 March 2014.