TRMM Common Flight Product Definition Version 4 Document

[January-2002]

This document represents Version 4 of the TRMM Common Flight Product Definition (CFPD). The CFPD ASCII products in a standardized format will be used as input to the TRMM Microphysics Software (TMS) and perhaps to the SPEC CPI processing software. Ultimately, the application of these components with relevant OAP and CPI data files will yield ASCII products that adhere to the TRMM Common Microphysics Product Definition (CMPD).

The CFPD has three primary purposes: 1) to define the 1 km flight segments in terms of UTC time, 2) to compile flight level data that was collected independently of the particle probes and 3) to compile 1D microphysics data (i.e., FSSP, King and Rosemount probe data) that will be accessed but not processed with the TMS.

A coordinator from each field campaign (G. Heymsfield-TEFLUN A and B/CAMEX, W. Petersen- LBA, S. Yuter-KWAJEX) will specify the latitude-longitude coordinates of the start and end points of the microphysical legs to be processed so that the data from each aircraft can be associated in the vertical. Although the stacked aircraft tracks were usually within a few km in the horizontal, they often were not precisely overlaid. The point at which an aircraft passes closest to the defined start point lat-lon is defined as the 0-km coordinate along a flight track. The point closest to the end point lat-lon is defined as within the N km coordinate along the flight track (N is determined as the scalar distance between the start and end points). This method of defining straight and spiral flight tracks will yield integer numbers of kilometers (N_i) for each ith leg.

An example of a proposed flight leg from KWAJEX (Fig. 1) is as follows: This leg is from the 11 Aug 1999 mission at ~2213-2225 UTC. The Citation and Convair are heading SW. The beginning point is 8.81 deg N/168.10 deg E while the end point is 8.23 deg N/167.85 deg E. The flight leg length is ~68 km.

Please note that the defined start and end times may not correspond to the actual start and end times for a specific aircraft, parameters that will be a function of exactly when the aircraft in question passes closest to the defined start and end locations. If an aircraft is executing a turn or another maneuver at the beginning or end of a defined, straight microphysical leg, and the microphysical data collected onboard are not considered to be usable for research purposes, the values of the product variables for the affected km coordinates will be set to missing. Another issue to address is when aircraft are flying in opposite directions along a flight track. In these cases the data file from an aircraft whose track starts with the end point (and ends with the start point) will need to be reversed in time order and then coordinate tagged accordingly. The proposed KWAJEX flight leg from ~2151-2159 UTC during the 19 Aug 1999 mission is an example of this scenario (Fig. 2). In this flight leg, the DC-8 is moving NE to SW whereas the Citation is on a reverse track heading SW to NE. The beginning point (i.e., the NE end of the leg) is at 8.45 deg N / 167.22 deg E while the end point (i.e., the SW end of the leg) is at 8.22 deg N / 166.83 deg E. The length of this flight leg is 50 km.

Data from each flight leg will be in a separate file consisting of header information followed by the actual time series data. The file naming convention is based on CFPD Version # (which is the same as the CMPD Version #), UTC date, experiment name, aircraft name, and total number of 1-km leg segments. Leg start times and segment counts are determined by the field campaign flight leg coordinator and are intended to be accessible from an online web master list:

http://www.atmos.washington.edu/gcg/MG/KWAJ/ops-web/intro_microphys.html

The filename format convention is to be given as:

cfp_vers#_yyyymmddhhmm_expname_acname_totseg#

For example, "cfp_vers4_199908112213_kwajex_cit_68" names a common flight level and 1d microphysics product data file using the Version 4 CFPD (versions are now in whole rather than decimal numbers), for an August 11, 1999 KWAJEX flight leg from the Citation with defined leg start time of 2213 and with 68 1-km segments. Although dates alone would be adequate to differentiate between different field campaigns, the field campaign name is incorporated in the file definition to minimize file recognition mistakes. Note that “defined leg start time” is a label assigned by the field campaign flight leg coordinator and may or may not correspond to the exact start time of the leg for a particular A/C. The totseg# is the actual number of 1 km segments defined for the leg for the particular aircraft. It may or may not exactly correspond to the leg length estimated by the flight leg coordinator.

The common flight level and 1D microphysics product variables will be given in ASCII format, with all lines ending in a carriage return. The format consists of several header lines followed by lines containing data for each 1-km leg segment.

Header

The 1st header line will contain an integer indicating the total number of header lines (which must NOT be less than 7). The 2nd header line will contain the filename described in the section above. The 3rd header line will contain the bin centers in μm for the FSSP spectra (to comply with the CMPD, 7 bins from 5-40 μm with 5 μm widths should be used). Header lines 4 through 7 will contain the file names for CPI, 2DC, 2DP and HVPS data, respectively, to be analyzed for the leg associated with this file (these file names should not contain directory or path information). If data is not available for one of these probes, then NO_DATA should be listed on the relevant header line. Since either 2DP or HVPS data (but not both) will be used on any one leg, the NO_DATA string will be in either header line 6 or 7 (or both lines if there is no data from either of these probes). Additional header comment lines can be defined by a data provider as long as they are accounted for in the 1st header line. The comment lines are a good place to list “user beware” information regarding the uncertainties of various fields.

Time series

The time series data will be presented as columns delimited by a blank space, with a carriage return at the end of each line. A value of -999.99 must be used for missing values. Each 1-km segment along a flight track will be represented by 1 line containing eleven parameter sectors in order, containing 47 fields as follows: time tags (18 fields), position coordinate (4 fields), ambient temperature (1 field), true air speed (1 field), ground speed (1 field) pressure (1 field), dewpoint (1 field), vertical air velocity (1 field), cloud liquid water (3 fields), FSSP total concentrations and counts (2 fields), and FSSP size spectra (14 fields).

1. Time Tag: 18 fields containing UTC time at beginning, end, and center of 1-km flight track segment -- format is 4-digit year, 2-digit month, 2-digit day, hour, minute, seconds to 1-decimal place accuracy (note leading zeros must be present for 2-digit month, day, hour, and min values).

Example: 1999 08 05 22 14 57.4 1999 08 05 22 15 7.2 1999 08 05 22 15 2.3

2. Position Coordinate: 4 fields total, first two fields contain lat-lon coordinates at center of 1-km flight track segment (e.g., first position coordinate indicates position where A/C is 500 m from start point) -- format in decimal degrees to 4-decimal place accuracy with north (south) latitudes given as positive (negative) and east (west) longitudes given as positive (negative). Third field contains best measurement of average altitude in meters MSL at center of 1-km flight track segment to nearest meter. Fourth field is a flag indicating source of lat-lon position data (I for INS, G for GPS).

Example: 8.8555 168.1000 5056 G

3. Ambient Temperature: 1 field containing best measurement of average temperature along 1-km flight track segment -- format in deg C to 1 decimal place accuracy.

Example: -2.1

4. True Air Speed: 1 field containing best measurement of average true air speed along 1-km flight track segment -- format in m/s to 1 decimal place accuracy.

Example: 150.3

5. Ground Speed: 1 field containing best measurement of average ground speed along 1-km flight track segment – format in m/s to 1 decimal place accuracy.

Example: 150.3

6. Pressure: 1 field containing best measurement of average pressure along 1-km flight track segment -- format in mb to nearest mb.

Example: 772

7. Dewpoint: 1 field containing best measurement of average dewpoint along 1-km flight track segment -- format in deg C to 1 decimal place accuracy. If data is considered unreliable set to missing.

Example: 5.3

8. Vertical air velocity: 1 field containing best measurement of average vertical air velocity along 1-km flight track segment -- format in m/s to 1 decimal place accuracy. If data is considered unreliable or is unavailable set to missing.

Example: 2.5

9. Cloud liquid water content: 3 fields containing (a) cloud liquid water existence (yes/no) as observed by either the King hot-wire, Rosemount icing, or FSSP probes, (b) cloud liquid water content (LWC) as observed by either the King hot-wire, Rosemount icing, or FSSP probes, and (c) flag for probe used in determination of cloud LWC: K for King hot-wire, R for Rosemount icing or F for FSSP. These LWC values will be reported in units of gram per cubic meter to 2 decimal place accuracy. If a mass field is unable to be calculated, a value of -999.99 will be set.

Example: Y 0.15 K

10. FSSP Total Counts and Concentrations: 2 fields computed for the FSSP over the size range of 5-40 μm. Counts (non-dimensional) will be displayed in floating point notation with 1 decimal place accuracy. Concentrations (L^{-1}) will be displayed in exponential notation with 3 decimal place accuracy (e.g., 1.234e-56).

11. FSSP Size Spectra: Fourteen fields consisting of 7 fields containing a size spectrum in units of counts followed by 7 fields containing a size spectrum in units of concentration. Each size spectrum will utilize the 7 FSSP size bins (5-10, 10-15, 15-20, 20-25, 25-30, 30-35, and 35-40 μm). Counts per bin (non-dimensional) will be displayed in floating point notation with 1 decimal place accuracy. Concentrations per bin per bin width (L^{-1} μm^{-1}) will be displayed in exponential notation with 3 decimal place accuracy (e.g., 1.234e-56).

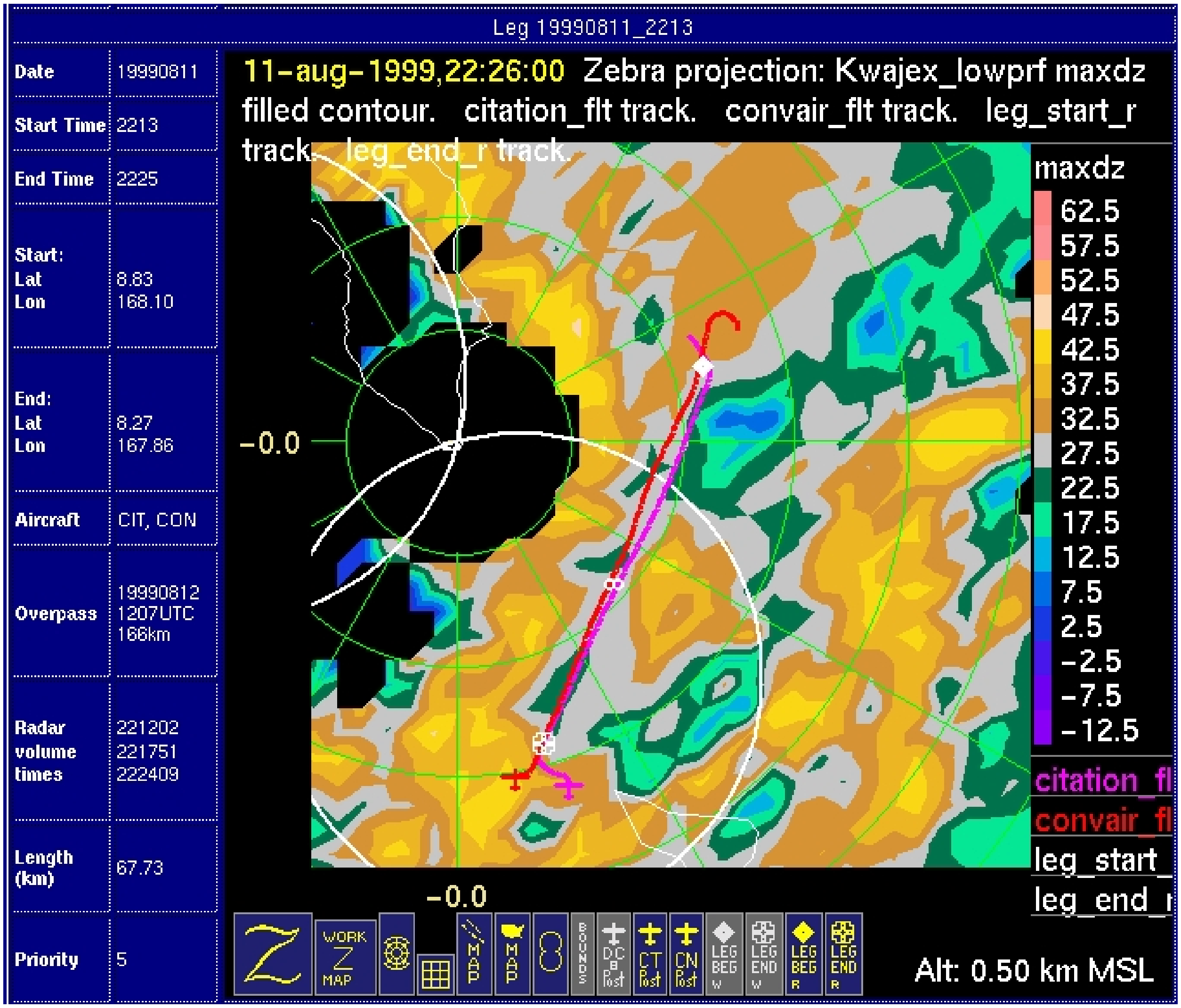

Fig. 1: KWAJEX aircraft flight legs from 11 August 1999 for the period 2213-2225 UTC overlaid on reflectivity from the Kwajalein radar. The Citation (purple) and Convair (red) are heading SW. The beginning point is indicated by the diamond and the end point by the circle enclosing a plus sign. The flight leg length is ~68 km.

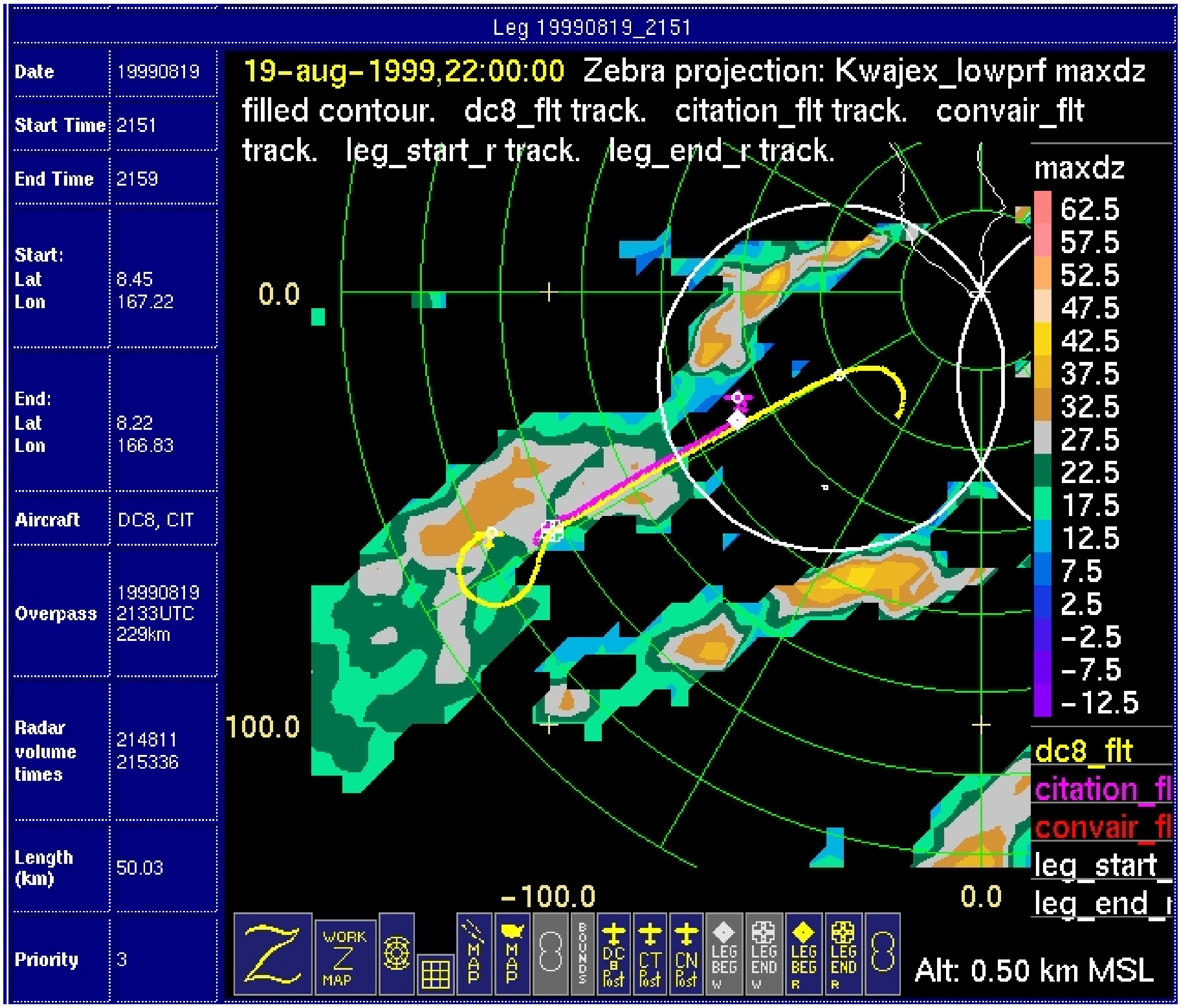

Fig. 2: KWAJEX aircraft flight legs from 19 August 1999 for the period 2251-2259 UTC overlaid on reflectivity from the Kwajalein radar. The DC8 (yellow) is moving NE to SW whereas the Citation (purple) is moving SW to NE. The beginning point (i.e., the NE end of the leg) is indicated by the diamond and the end point (i.e., the SW end of the leg) by the circle enclosing a plus sign. The flight leg length is ~50 km.