CERES Software Bulletin 95-10

Time Stream and Format for the Archival Parameter Time, August 25,1995

1.0 Purpose:
To provide a time stream and format for the CERES Release 1 archival parameter time.

2.0 Originator/DMO Approval:
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Description:
A time stream together with a format comprise the archival parameter time. Listed below are values for the same instant in time (0 hours, 0 minutes, 0 seconds, October 1, 1986) for the four time streams the CERES DMS would be most likely to use, displayed in the Julian date format:

- 2446704.50026620 in International Atomic Time (TAI) = continuous count of seconds at the uniform rate of the atomic clock.
- 2446704.50000000 in Coordinated Universal Time (UTC) = TAI + accumulated leap seconds, in sync with the diurnal cycle.
- 2446704.50063870 in Terrestrial Dynamical Time (TDT) = UTC + 32.184 seconds.
- 2446704.50063868 in Barycentric Dynamical Time (TDB) ~ TDT + 0.001658 * sin(g) + 0.000014 * sin(2g) in seconds where g = 357.53 + 0.9856003 * (JD - 2451545.0) in degrees.

Utilizing the UTC time stream value for the same time instant as above, its representations in the two formats the CERES DMS would be most likely to use are:

CCSDS ASCII Format A	Julian Date
1986-10-01T00:00:00.0Z	2446704.5000000

The combinations of time stream and format yield eight possible choices for the archival parameter time.

Discussion: Time Streams

- UTC, TAI, and TDT all run at the uniform rate of the atomic clock.
- TAI, TDT, and TDB are continuous whereas UTC is discontinuous at leap second boundaries. The leap seconds are applied as needed (about one every 18 months) to maintain UTC synchronization with the diurnal cycle.
- At TRMM launch, the difference between UTC and TDT will be 63.184 seconds.
- Since TDB does not run at a uniform rate, time series analysis may become more complicated. Time series analysis of UTC data must also be performed with caution to avoid spurious results due to time discontinuity at leap second boundaries.

Discussion: Formats

A continuous real variable (e.g. a Julian date) is needed to perform calculations. However, the ASCII format is more convenient for users when browsing or requesting data sets. When the UTC time stream is used with a Julian date format, the last second of the last day of June or December is repeated to perform the leap second adjustment. Unique time tagging of the repeated second is not possible in Julian date format. In the ASCII format, during a leap second adjustment, the seconds field is allowed to run to 60.99999 to provide a unique time tag for the repeated second.

Proposal:

As approved by the 7/12/95 DMT, the CERES DMS will use the UTC time stream. The CCSDS ASCII Format A will be used in record headers and the Julian date format will be used to time tag data.

Discussion:

Use of the UTC time stream seems appropriate for research of the Earth's radiation fields which are influenced by the diurnal cycle. The uniform rate simplifies time series analysis although caution must be used at leap second boundaries. Although the Toolkit provides a method for handling the repeated leap second, it may be easiest to simply throw out the leap second. One second every 18 months = 0.8 milli-percent data loss.

Use of the ASCII format for record headers and the Julian date format for tagging data is a reasonable compromise between the competing needs for user convenience and computational requirements.

If alternate time streams and formats are chosen by producers of required input data products (e.g. MODIS), the Toolkit supplies conversion routines between UTC in ASCII or Julian date format and all the likely alternative choices.

One should note that except for the use of the ASCII format for the record header, this is the same combination of time stream and format used for ERBE processing.