### L1 – TM data products

*Description of the process used to obtain this type of data*

#### PAS 3D distribution

This file contains the PAS 3D distribution data, in raw counts, for both Normal mode, Busrt mode and Snapshots.

The file format is .cdf.

**Filename:**

solo\_L1\_swa-pas\_3D\_yyyymmdd\_V01.cdf

**Time resolution:**

This file contains PAS 3D data for a whole days.

The time resolution is record varying, depending of the type of data (normal, burst or snapshot) and the number of sub-sampling for a same 1s interval.

Each record is time tagged with the Epoch variable, expressed in CDF\_TT2000, giving the center of the interval and another variable, called HALF\_INTERVAL, expressed in seconds.

**Data volume:**

Each record contains a 3D distribution (96 energies, 9 elevations, 11 CEM), counts are expressed in CDF\_INT2 with a given fill value FILLVAL=-1 for empty solid angles.

**Global Attributes**

|  |  |  |
| --- | --- | --- |
| **Name** | **Entry** | **Value** |
| Project | 1 | Solar Orbiter |
| Project | 2 | Cosmic Visions |
| Source Name | 1 | SOLO>Solar Orbiter |
| Discipline | 1 | Space Physics>Interplanetary Studies |
| Data Type | 1 | L1 |
| Descriptor | 1 | SWA-PAS |
| Data Version | 1 | 01 |
| Software Version | 1 | 01.00.00 |
| PI Name | 1 | C. J. Owen |
| PI Affiliation | 1 | MSSL-UCL, University College London |
| Instrument Type | 1 | Space Plasma |
| Mission Group | 1 | Solar Orbiter |
| Logical Source | 1 | SWA\_L0\_EAS1\_data |
| Logical File id | 1 | solo\_L1\_swa-pas\_3D\_0000000000\_V01 |
| Logical Source Description | 1 | SWA-PAS L1 3D distribution |
| Rules of Use | 1 | Consult with MSSL-UCL before using |
| Generated by | 1 | MSSL |
| Generation date | 1 | YYYY-MM-DDTHH:MN:SS |
| Mods | 1 | V01 First Version |
| Level | 1 | L1 |
| Instrument | 1 | SWA-PAS>Solar-Wind-Analyser Proton-Alpha-Sensor |

**Variables (overview)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable\_Name** | **Data\_type** | **Dimensions** | **Variability** |
| Epoch | CDT\_TT2000 | 0:[] | T/ |
| Half\_interval | CDF\_FLOAT | 0:[] | T/ |
| CCSDS\_coarse\_time | CDF\_UINT4 | 0:[] | T/ |
| CCSDS\_file\_time | CDF\_UINT2 | 0:[] | T/ |
| SCET\_coarse\_time | CDF\_UINT4 | 0:[] | T/ |
| SCET\_file\_time | CDF\_UINT2 | 0:[] | T/ |
| INFO | CDF\_INT1 | 0:[] | T/ |
| SCHEME | CDF\_INT1 | 0:[] | T/ |
| FULL\_3D | CDF\_INT1 | 0:[] | T/ |
| SAMPLE | CDF\_INT2 | 0:[] | T/ |
| NB\_SAMPLE | CDF\_INT2 | 0:[] | T/ |
| K | CDF\_INT2 | 0:[] | T/ |
| NB\_K | CDF\_INT2 | 0:[] | T/ |
| FIRST\_ENERGY | CDF\_INT2 | 0:[] | T/ |
| NB\_ENERGY | CDF\_INT2 | 0:[] | T/ |
| FIRST\_ELEVATION | CDF\_INT2 | 0:[] | T/ |
| NB\_ELEVATION | CDF\_INT2 | 0:[] | T/ |
| NB\_CEM | CDF\_INT2 | 0:[] | T/ |
| MAX\_CNT\_ENERGY | CDF\_INT2 | 0:[] | T/ |
| MAX\_CNT\_ELEVATION | CDF\_INT2 | 0:[] | T/ |
| MAX\_CNT\_CEM | CDF\_INT2 | 0:[] | T/ |
| COUNTS | CDF\_INT2 | 3:[11,9,96] | T/TTT |
| CEM\_table | CDF\_FLOAT | 1:[11] | F/T |
| CEM\_half\_bin | CDF\_FLOAT | 0:[] | F/F |
| Elevation\_table | CDF\_FLOAT | 1:[9] | F/T |
| Elevation\_half\_bin | CDF\_FLOAT | 0:[] | F/F |
| Energy\_table | CDF\_FLOAT | 1:[96] | F/T |
| Energy\_delta\_plus | CDF\_FLOAT | 1:[96] | F/T |
| Energy\_delta\_minus | CDF\_FLOAT | 1:[96] | F/T |

**Detailed attributes for each CDF variable**

|  |
| --- |
| **Epoch** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | SCET |
| CATDESC | CDF\_CHAR | Centered acquisition time |
| DISPLAY\_TYPE | CDF\_CHAR | Time Series |
| FILLVAL | CDF\_REAL8 | -1E31 |
| FORMAT | CDF\_CHAR | f14.3 |
| LABLAXIS | CDF\_CHAR | Epoch |
| UNITS | CDF\_CHAR | ns |
| SI\_CONVERSION | CDF\_CHAR | 1.0e-9>s |
| VALIDMIN | CDF\_REAL8 | 0000-01-01T00:00:00.000000000 |
| VALIDMAX | CDF\_REAL8 | TBD |
| SCALETYP | CDF\_CHAR | Linear |
| SCALEMIN | CDF\_REAL8 | TBD |
| SCALEMAX | CDF\_REAL8 | TBD |

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| --- |
| **Half\_interval** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Half interval |
| CATDESC | CDF\_CHAR | Half interval of acquisition period |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| DISPLAY\_TYPE | CDF\_CHAR | Time series |
| FILLVAL | CDF\_REAL8 | -1.0 |
| FORMAT | CDF\_CHAR | F5.3 |
| LABLAXIS | CDF\_CHAR | Half interval |
| UNITS | CDF\_CHAR | S |
| SI\_CONVERSION | CDF\_CHAR | 1.0>s |
| VALIDMIN | CDF\_FLOAT | 0 |
| VALIDMAX | CDF\_FLOAT | 100 |
| SCALETYP | CDF\_CHAR | Linear |
| SCALEMIN | CDF\_REAL8 | TBD |
| SCALEMAX | CDF\_REAL8 | TBD |

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| **CCSDS\_coarse\_time** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | CCSDS Coarse time |
| CATDESC | CDF\_CHAR | CCSDS Coarse time |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I12 |
| UNITS | CDF\_CHAR | s |
| SI\_CONVERSION | CDF\_CHAR | 1.0>s |
| VALIDMIN | CDF\_UINT4 | 0 |
| VALIDMAX | CDF\_UINT4 | 4294967296 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| **CCSDS\_fine\_time** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | CCSDS Fine time |
| CATDESC | CDF\_CHAR | CCSDS Fine time |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I12 |
| UNITS | CDF\_CHAR | 1s/65536 |
| SI\_CONVERSION | CDF\_CHAR | 1.5258789065e-05>s |
| VALIDMIN | CDF\_UINT2 | 0 |
| VALIDMAX | CDF\_UINT2 | 65536 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **SCET\_coarse\_time** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | SCET Coarse time |
| CATDESC | CDF\_CHAR | SCET Coarse time |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | f14.4 |
| UNITS | CDF\_CHAR | s |
| SI\_CONVERSION | CDF\_CHAR | 1.0>s |
| VALIDMIN | CDF\_UINT4 | 0 |
| VALIDMAX | CDF\_UINT4 | 4294967296 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **SCET\_fine\_time** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | SCET Fine time |
| CATDESC | CDF\_CHAR | SCET Fine time |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I12 |
| UNITS | CDF\_CHAR | 1s/65536 |
| SI\_CONVERSION | CDF\_CHAR | 1.5258789065e-05>s |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 65536 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| SAMPLE |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Sample |
| CATDESC | CDF\_CHAR | Sample index |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 300 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| NB\_SAMPLE |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Number of samples |
| CATDESC | CDF\_CHAR | Number of samples |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 300 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| **K** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Sub-sampling # |
| CATDESC | CDF\_CHAR | Sub-sampling index |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 4 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **NB\_K** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Sub-sampling total |
| CATDESC | CDF\_CHAR | Total of sub-sampling |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 4 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **FIRST\_ENERGY** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | First energy |
| CATDESC | CDF\_CHAR | First selected energy |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 96 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **NB\_ENERGY** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Number energies |
| CATDESC | CDF\_CHAR | Number of selected energies |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 96 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **FIRST\_ELEVATION** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | First elevation |
| CATDESC | CDF\_CHAR | First selected elevation |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 9 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **NB\_ELEVATION** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Number elevations |
| CATDESC | CDF\_CHAR | Number of selected elevations |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 9 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **NB\_CEM** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Number CEM |
| CATDESC | CDF\_CHAR | Number of selected CEM  (7 central or all 11) |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT1 | 0 |
| VALIDMAX | CDF\_INT1 | 11 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| **INFO** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Science mode |
| CATDESC | CDF\_CHAR | Scientific mode |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT1 | 0 |
| VALIDMAX | CDF\_INT1 | 11 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| **SCHEME** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Scheme |
| CATDESC | CDF\_CHAR | Scheme (0: static, 1: dynamic) |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT1 | 0 |
| VALIDMAX | CDF\_INT1 | 1 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **FULL\_3D** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Full 3D |
| CATDESC | CDF\_CHAR | Full 3D indicator |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT1 | 0 |
| VALIDMAX | CDF\_INT1 | 1 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| **MAX\_CNT\_ENERGY** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Max count energy |
| CATDESC | CDF\_CHAR | Energy index where max count was found |
| FORMAT | CDF\_CHAR | I3 |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 96 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **MAX\_CNT\_ELEVATION** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Max count elevation |
| CATDESC | CDF\_CHAR | Elevation index where max count was found |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 9 |
| SCALETYP | CDF\_CHAR | LINEAR |

|  |
| --- |
| **MAX\_CNT\_CEM** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Max count CEM |
| CATDESC | CDF\_CHAR | CEM index where max count was found |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| FORMAT | CDF\_CHAR | I3 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 11 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **COUNTS** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Counts |
| CATDESC | CDF\_CHAR | 3D counts |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| DEPEND\_1 | CDF\_CHAR | CEM\_table |
| DEPEND\_2 | CDF\_CHAR | Elevation\_table |
| DEPEND\_3 | CDF\_CHAR | Energy\_table |
| FORMAT | CDF\_CHAR | I5 |
| UNITS | CDF\_CHAR | Unitless |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | 11 |
| SCALETYP | CDF\_CHAR | LINEAR |

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| --- |
| **Energy\_table** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Energy table |
| CATDESC | CDF\_CHAR | Energy table bins (center value) |
| DEPEND\_0 | CDF\_CHAR | Epoch |
| DELTA\_PLUS\_VAR | CDF\_CHAR | Energy\_delta\_plus |
| DELTA\_MINUS\_VAR | CDF\_CHAR | Energy\_delta\_minus |
| FORMAT | CDF\_CHAR | F10.3 |
| UNITS | CDF\_CHAR | eV |
| VALIDMIN | CDF\_INT2 | 0 |
| VALIDMAX | CDF\_INT2 | TBD |
| SCALETYP | CDF\_CHAR | Log |

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| **Energy\_delta\_plus** |
| **Attribute\_name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Energy delta plus |
| CATDESC | CDF\_CHAR | Difference top to center energy bin |
| FORMAT | CDF\_CHAR | F10.3 |
| UNITS | CDF\_CHAR | eV |
| SCALETYP | CDF\_CHAR | Log |

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| --- |
| **Energy\_delta\_minus** |
| **Attribute\_name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Energy delta minus |
| CATDESC | CDF\_CHAR | Difference bottom to center energy bin |
| UNITS | CDF\_CHAR | eV |
| SCALETYP | CDF\_CHAR | Log |

|  |
| --- |
| **CEM\_table** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Azimuth bin |
| CATDESC | CDF\_CHAR | Center of CEM azimuth bins |
| DELTA\_PLUS\_VAR | CDF\_CHAR | CEM\_half\_bin |
| DELTA\_MINUS\_VAR | CDF\_CHAR | CEM\_half\_bin |
| UNITS | CDF\_CHAR | degree |
| SCALETYP | CDF\_CHAR | Linear |

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| --- |
| **CEM\_half\_bin** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | CEM half bin |
| CATDESC | CDF\_CHAR | CEM half azimuth bin |
| UNITS | CDF\_CHAR | degree |
| SCALETYP | CDF\_CHAR | Linear |

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| **Elevation\_table** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Elevation bin |
| CATDESC | CDF\_CHAR | Center of elevation bins |
| DELTA\_PLUS\_VAR | CDF\_CHAR | Elevation\_half\_bin |
| DELTA\_MINUS\_VAR | CDF\_CHAR | Elevation\_half\_bin |
| UNITS | CDF\_CHAR | degree |
| SCALETYP | CDF\_CHAR | Linear |

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| --- |
| **Elevation\_half\_bin** |
| **Attribute Name** | **Data Type** | **Value** |
| FIELDNAM | CDF\_CHAR | Elevation half bin |
| CATDESC | CDF\_CHAR | Elevation half bin |
| UNITS | CDF\_CHAR | degree |
| SCALETYP | CDF\_CHAR | Linear |

**Planned metadata improvements**

**Time variables**

As indicated in [RD7] we have to provide several time-tags variables:

1. Epoch in CDF\_TT2000
2. SCET (CDF\_REAL8) : number of seconds since time base
3. ACQUISITION\_TIME (CDF\_REAL8) : number of seconds (CCSDS time-tag)

The Epoch variable is already included in our datasets, using CDF\_TT2000 data type.

For SCET we have actually two different variables:

* SCET\_coarse\_time : number of seconds from time base
* SCET\_fine\_time : number of ticks (1..65536) per seconds

For ACQUISITION\_TIME, we have CCSDS\_coarse\_time and CCSDS\_fine\_time variables.

If needed, we can replace these 4 variables, with 2 new CDF\_REAL8 variables:

* SCET = SCET\_coarse\_time + SCET\_fine\_time / 65536
* ACQUISITION\_TIME = CCSDS\_coarse\_time + CCSDS\_fine\_time / 65536