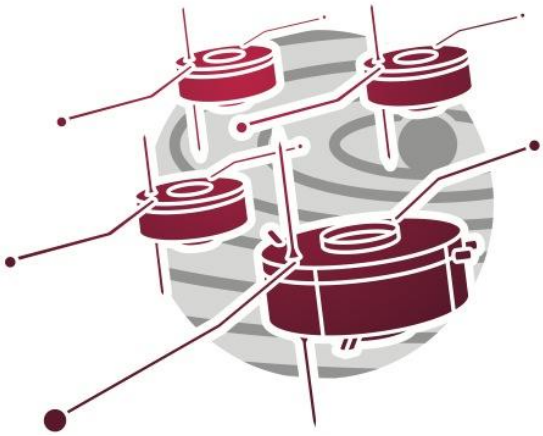

cluster

Cluster Active Archive

ESA Horizons 2000 Programme

SOHO/Cluster First Cornerstone Mission

CAA AUX User Manual

Issue: 1.0

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ACRONYM LIST

Acronym	**Description**
AUX	Auxiliary
BM	Burst Mode
CAA	Cluster Active Archive
CD	Cluster Document
CDF	Common Data Format
CE	Cluster External (format)
CIS	Composition Ion Spectrometer
CL	Cluster (reference spacecraft)
CM	Cluster Multi observatory
CP	Cluster Parameter
CQ	Cluster Caveat
CSA	Cluster Science Archive
CSDS	Cluster Science Data System
CT	Cluster Time List
CTU	Central Telemetry Unit
D1	Double Star 1 (see TC1)
D2	Double Star 2 (see TC2)
DDID	Data Delivery Interface Document
DM	Double Star Multi-Observatory
DSDS	Double Star Science Data System
DSI	De-spub System Inverted
ECLAT	European Cluster Assimilation Technology
EFW	Electric Field and Waves (instrument)
EPD	External Power Dumper
ESA	European Space Agency
ESOC	European Space Operations Centre
FGM	FluxGate Magnetometer
GRMB	Geospace Region And Magnetospheric Boundary identification
GSE	Geocentric Solar Ecliptic
HK	HouseKeeping
ID	Identifier
IDX	Index

IPD	Internal Power Dumper
ISR2	Inverted Spin Reference
JP	JSOC Parameter
JSOC	Joint Science Operations Centre
LTOF	Long Term Orbit File
MAARBLE	Monitoring, Analyzing and Assessing Radiation Belt Loss and Energization
MEP	Main Equipment Platform
MOC	Mission Operations Centre
NM	Normal Mode
PEACE	Plasma Electron And Current Experiment
PMP	Predicted Magnetic Position
PP	Prime Parameter (spin, 4s, resolution)
PSE	Predicted Scientific Events
RDM	Raw Data Media
SP	Summary Parameter (1 minute)
STOF	Short Term Orbit File
TC1	Tan Ce 1 (DS1 Double Star 1) Equatorial
TC2	Tan Ce 2 (DS2 Double Star 2) Polar
UG	User Guide
UTC	Coordinated Universal Time

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References

ID	Reference
CM_CD_AUX_DDID	Cluster Data Disposition System data Delivery Interface Document https://caa.esac.esa.int/documents/CDDID3-0.pdf
CSDS_UG	User Guide to the Cluster Science Data System v3 https://caa.esac.esa.int/documents/publications/csds_guide_3_0.pdf
DM_CD_AUX_DDID	Double Star Data Delivery Interface Document https://caa.esac.esa.int/documents/publications/DS/DSP-IWF-ID-0001.pdf
DSDS_UG	User Guide to the Double Star Data System https://caa.esac.esa.int/documents/publications/DS/DSP-IWF-TN-0002.pdf
GMRB	GMRB paper - https://doi.org/10.1038/s41597-025-04639-z
SPIN_REF	Spin Timing Reference DS-QMW-TN-0007 https://caa.esac.esa.int/documents/DS-QMW-TN-0007.pdf

1 INTRODUCTION

1.1 BACKGROUND

In addition to the core instrument science and ancillary products, the Cluster Active Archive (CAA) provides a range of support, contextual and miscellaneous products. These are needed by the archive users to make the most effective use of the science data.

The products can be categorised into the following groups:-

- Raw Data from the Cluster and Double Star missions.
- Spacecraft orbit, attitude and configuration
- Key timing information (data packet, spin, orbit, telemetry mode)
- Scientific event and region information
- Contextual information from outside the mission (solar cycle trends, solar proton events)
- Mission operations, status and planning information (from the ESOC and JSOC)
- Graphical information (multi-instrument survey plots)
- Data mining (survey datasets)
- Products from related activities (two projects, ECLAT and MAARBLE)
- CAA generated instrument team, data system and miscellaneous products (e.g. coordinate conversion)

Each of these is elaborated in Section 2 providing a brief description of the relevant datasets. Where there is relevant documentation detailing the contents of the datasets, references are given rather than replicating the information here. In some cases examples showing a short extract of data from the datasets is presented, note that these only contain the data records the full, machine readable, CEF metadata header which provides a detailed description of the product has been removed for brevity. This only applies to datasets supplied in the standard format used by the Archive, namely CEF, other products retain their original native format (e.g. GIF, TXT, PDF, binary etc) and cannot be subset except at the file interval level. The archive treats datasets provide in CEF as a single contiguous dataset for the entire period covered by the dataset, independent of the underlying file intervals, with the archive delivery service merging and sub setting records as necessary to meet the user request.

2 AUX DATASET ELABORATION

2.1 RAW DATA

These datasets include the instrument Level-0 data including HK, Normal and Burst mode telemetry together with some ancillary information including reconstructed orbit ephemeris. The datasets cover the entire duration of the missions from commissioning through to end of science operations. Detail descriptions of the instrument HK and science telemetry is included in the instrument team ancillary documentation.

These data are used as the main input to instrument team processing pipelines. Please note that it requires specialised knowledge to correctly use these data, and general users are directed to the high quality calibrated and validated science products provided by each of the instrument and mission operations teams.

2.1.1 CLUSTER RAW DATA

Data set IDs	Title
CM_CE_AUX_ESOC_RDM	Raw Data Medium for the four Cluster spacecraft

This dataset contains the final version of the Raw Data Medium for the four CLUSTER Spacecraft. This is the raw data that volumes generated by the MOC at ESOC and distributed to the instrument teams and data centres.

The data are organised into volumes matching the original content of the raw data made available via the data distribution system (see [CM_CD_AUX_DDID]). The data are stored in a ZIP archive. Each ZIP file will contain one or more top level directories corresponding to the original raw data volumes generated for a given day. The raw data was originally distributed on CD-ROM with a maximum size of each volume being 650MB. Once this limit was reached a new volume was started for the remaining data. The number of volumes per day is usually 2 but may be 1 or 3 depending on operations planning and data coverage. The name of the top-level directories will correspond to the volume ID with lower-level directories ordered by spacecraft. The ".IDX" file in the root directory of the volume lists all volumes, versions and the time intervals covered, up to and including the current volume. Further information on the organisation of the data is provided in the reference document [CM_CD_AUX_DDID].

2.1.2 DOUBLE STAR RAW DATA

Data set IDs	Title
D1_CE_AUX_RDM	Raw Data Medium for Double Star TC1 Spacecraft
D2_CE_AUX_RDM	Raw Data Medium for Double Star TC2 Spacecraft

These datasets contain all versions of the Raw Data Medium for the Double Star TC1 (D1_CE_AUX_RDM) and TC2 (D2_CE_AUX_RDM) Spacecraft. The data are organised into volumes matching the original content of the raw data made available via the data distribution system (see [DM_CD_AUX_DDID]). The data are stored in a ZIP archive. Within the ZIP file there will usually be two top level directories, one corresponding to the release of the raw data during the operational phase, the other (with subscript _G) from post operations phase reconstruction of the raw data. It should be noted that the _G version is not always an improvement on the original. Processed data from the instruments available via the archive has usually been optimised to select the best raw data inputs from either volume. Each of the two volumes will contain the same period of data (usually 3 days) and named according to the first day in the volume. Each day within a volume is contained in a separate sub-directory named according to the convention YYMMDD_X where X is the version letter A-F or G of that day release. The version letter of a given day may not match that of the volume.

2.2 SPACECRAFT POSITION, ATTITUDE AND CONFIGURATION

This class of products provides the location and attitude of the spacecraft as a function of spacecraft and time. Since the spacecraft fly through different space plasma regions as they travel round their orbits it is important to know exactly where the spacecraft are at any point in time. The orbit also evolves over time due to manoeuvres and gravitational perturbations. This evolution has meant that over the course of the mission the spacecraft fly through different regions that were not accessible earlier in the mission or has the possibility for conjunctions with other spacecraft or ground facilities. Another key consideration for Cluster is the separation of the spacecraft which has also been varied over the course of the mission to focus more on different characteristic plasma scales or cross scale coupling. Products are further split into the definitive information based on the final reconstruction of the orbit and the predicted information that was used as part of the mission planning. The final predictions were usually very close to the definitive orbit, but it is still recommended that the definitive orbit is used for any detailed analysis work. In the case of Cluster there is also useful information about the configuration of the four-spacecraft indicating how close and where in the orbit a tetrahedron configuration was achieved (this is particularly important for calculations such as the Curl of the magnetic field).

2.2.1 CLUSTER ORBIT AND ATTITUDE

The standard coordinate system used for Cluster science data is the GSE (Geocentric Solar Ecliptic) system where the X-axis is pointing from the Earth toward the Sun and the Y-axis is chosen to be in the ecliptic plane pointing towards dusk. The GSE Z-axis is parallel to the ecliptic pole.

You may also see products and references to the ISR2(Inverted Spin Reference) system, also sometimes known as the De-spun System Inverted (DSI). This is a spacecraft system where the X-axis is in the spin plane and pointing, as near as possible, towards the Sun, the Y-axis is in the spin plane perpendicular to the X-axis and positive towards dusk. The Z-axis anti aligned with space spin axis, positive towards the north ecliptic pole. For most of the mission ISR2 and GSE are closely aligned with the main difference being a 2-7 degree offset around the Y-axis. So why is ISR2 sometimes used? This is because the instrument observations are relative to the spacecraft and some further calculation is then required to transform to true GSE. This is particularly true for the electric field instrument (EFW) that is based on electric field booms making observations of the 2D electric field in the spin plane.

Please note that during the May 2008 tilt campaign (2008-04-25T09:00Z to 2006-04-25T08:24Z) the spin axis of Cluster-3 was tilted by up to 45 degrees around the X-axis and therefore for this period the GSE and ISR2 on Cluster-3 differ significantly.

The key Cluster orbit and attitude datasets are listed below and elaborated in the following sub-sections:-

Data set IDs	Title
C[1234]_CP_AUX_POSGSE_1M	Cluster [1234] position and velocity in GSE at 1 minute resolution
C[1234]_CP_AUX_POSACCGSE_1M	Cluster [1234] accuracy of position and velocity in GSE at 1 minute resolution
C[1234]_CP_AUX_SPIN_AXIS	Cluster [1234] spin axis orientation in GSE at 1 minute resolution
CL_SP_AUX	Cluster spacecraft position, attitude and configuration
CL_JP_AUX_PGP	Cluster predicted spacecraft position, attitude and configuration used during the operations planning
C[1234]_JP_AUX_PMP	Cluster[1234] predicted magnetic positions
C[1234]_CP_AUX_LSTAR	

2.2.1.1 C[1234]_CP_AUX_POSGSE_1M

The POSGSE_1M is the primary dataset for spacecraft location. It provides spacecraft position and velocity vectors in GSE together with orbit number and phase at 1 minute resolution. A separate dataset is provided for each spacecraft 'n'.

- time_tags__Cn_CP_AUX_POSGSE_1M — Time, UTC
- sc_r_xyz_gse__Cn_CP_AUX_POSGSE_1M — Spacecraft location vector, cartesian GSE, km
- sc_v_xyz_gse__Cn_CP_AUX_POSGSE_1M — Spacecraft velocity vector, cartesian GSE, km/s
- sc_orb_num__Cn_CP_AUX_POSGSE_1M — Spacecraft orbit number including fractional orbit

2.2.1.2 C[1234]_CP_AUX_POSACCGSE_1M

This product should be considered in conjunction with C[1234]_CP_AUX_POSGSE_1M and provides the accuracy of the position and velocity measurements based on analysis of the orbital element's covariance matrix as supplied by the ESA flight dynamics team. The data is provided at 1 minute resolution with a separate dataset per spacecraft.

- time_tags__Cn_CP_AUX_POSACCGSE_1M — Time, UTC
- sc_posacc_xyz_gse__Cn_CP_AUX_POSACCGSE_1M — Spacecraft position uncertainty, km
- sc_velacc_xyz_gse__Cn_CP_AUX_POSACCGSE_1M — Spacecraft velocity uncertainty, km/s

2.2.1.3 C[1234]_CP_AUX_SPIN_AXIS

This dataset contains the orientation of the spacecraft spin axis in GSE. The information has been extracted from the CL_SP_AUX (see below) file which contained the information for all four spacecraft in a single file and was therefore not always easy to locate within all the datasets. The dataset contains the following three parameters at one minute resolution with a separate dataset per spacecraft.

- time_tags__Cn_CP_AUX_SPIN_AXIS — Time, UTC
- sc_lat__Cn_CP_AUX_SPIN_AXIS — GSE Latitude of spin axis, angle from Ecliptic Plane
- sc_long__Cn_CP_AUX_SPIN_AXIS — GSE Longitude of spin axis, angle from Ecliptic Plane

2.2.1.4 CL_SP_AUX

This dataset contains summary parameter (1 minute resolution) measurements of the position, velocity, attitude and configuration of the four Cluster spacecraft in The GSE reference frame. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Summary Parameter files that were made available through the Cluster Science Data System. The original CDF version is also available on the archive.

The dataset contains numerous parameters with some information, such as spacecraft positions being provided as offsets from the reference spacecraft (Cluser-3). Some of the information provided in this file is more readily available through the POSGSE_1M and SPIN-AXIS datasets described previously within this section and also includes information on telemetry mode which has also been extracted into separate datasets as described in later sections. However, this dataset remains a key source of auxiliary information on the shape of the Cluster constellation and has been widely used in supporting many analyses.

- time_tags__CL_SP_AUX — Time, UTC
- status__CL_SP_AUX — Summary (CSDS SP) Cluster, Spacecraft Status see [CSDS_UG] for details

- sc_orbit_num__CL_SP_AUX — Ref S/C orbit number (with phase)
- sc_r_xyz_gse__CL_SP_AUX — Position of Ref S/C, GSE, km
- sc_v_xyz_gse__CL_SP_AUX — Velocity of Ref S/C, GSE, km/s
- sc_dr1_xyz_gse__CL_SP_AUX — Position of C1 from Ref S/C, GSE, km
- sc_dr2_xyz_gse__CL_SP_AUX — Position of C2 from Ref S/C, GSE, km
- sc_dr3_xyz_gse__CL_SP_AUX — Position of C3 from Ref S/C, GSE, km
- sc_dr4_xyz_gse__CL_SP_AUX — Position of C4 from Ref S/C, GSE, km
- sc_at1_lat__CL_SP_AUX — Latitude of C1 spin axis, GSE, degrees
- sc_at1_long__CL_SP_AUX — Longitude of C1 spin axis, GSE, degrees
- sc_at2_lat__CL_SP_AUX — Latitude of C2 spin axis, GSE, degrees
- sc_at2_long__CL_SP_AUX — Longitude of C2 spin axis, GSE, degrees
- sc_at3_lat__CL_SP_AUX — Latitude of C3 spin axis, GSE, degrees
- sc_at3_long__CL_SP_AUX — Longitude of C3 spin axis, GSE, degrees
- sc_at4_lat__CL_SP_AUX — Latitude of C4 spin axis, GSE, degrees
- sc_at4_long__CL_SP_AUX — Longitude of C4 spin axis, GSE, degrees
- sc_config_QG__CL_SP_AUX — Tetrahedron Quality G, unitless (vol/ideal) + (surf/ideal) + 1
- sc_config_QR__CL_SP_AUX — Tetrahedron Quality R, norm*(vol/sphere vol)^1/3
- sc_dr_min__CL_SP_AUX — Min Distance between Spacecraft, km
- sc_dr_max__CL_SP_AUX — Max Distance between Spacecraft, km
- gse_gsm__CL_SP_AUX — Rotation angle GSE to GSM, positive from +z towards +y, degrees
- dipole_tilt__CL_SP_AUX — Dipole Tilt in GSM z-x Plane, positive from +z towards +x, degrees
- sc_geom_size__CL_SP_AUX — Tetrahedron size L, km
- sc_geom_elong__CL_SP_AUX — Tetrahedron Elongation E
- sc_geom_planarity__CL_SP_AUX — Tetrahedron Planarity P
- sc_geom_E_dir_gse__CL_SP_AUX — Direction of Elongation, GSE direction cosines, unitless
- sc_geom_P_nor_gse__CL_SP_AUX — Normal of Planarity, unitless, GSE direction cosines, GSE

2.2.1.5 CL_JP_AUX_PGP

This dataset contains the JSOC Predicted Geometric Positions. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Prime Parameter files that were made available through the Cluster Science Data System. This dataset closely follows the format of the CL_SP_AUX dataset and was provided and updated in the months leading up to the observations in to support the science mission planning activities. Some parameters including spacecraft longitude, latitude and tetrahedral quality parameters were placeholders in the predicted file and were only filled in CL_SP_AUX. The full description of this dataset can be found in [CSDS_UG]. A full description of the parameters is not provided here as we anticipate users will be wanting to use the definitive (CL_SP_AUX) rather than predicted values for these parameters.

2.2.1.6 C[1234]_JP_AUX_PMP

These datasets contain the JSOC Predicted Magnetic Positions for the Cluster spacecraft. Information is provided for the invariant latitude, magnetic local time, L value and predicted magnetic field magnitude.

- time_tags__Cn_JP_AUX_PMP — Time, UTC
- Invar_Lat__Cn_JP_AUX_PMP — Spacecraft Invariant Latitude (Null outside magnetosphere)
- Mag_Local_time__Cn_JP_AUX_PMP — Spacecraft local magnetic time in hours
- L_value__Cn_JP_AUX_PMP — Spacecraft L-value
- Pred_B_mag__Cn_JP_AUX_PMP — Predicted magnetic field magnitude

2.2.2 DOUBLE STAR ORBIT AND ATTITUDE

Unlike the Cluster configuration where the four spacecraft were launched into similar orbits, the two double star spacecraft were launcher into two very different orbits, one equatorial and one polar. The orbital information is therefore considered separately for each spacecraft.

Data set IDs	Title
D[12]_SP_AUX	Double Star TC[12] Position, Velocity and Attitude in GSE frame
D[12]_JP_AUX_PGP	Double Star TC[12] predicted geometric position in GSE frame
D[12]_JP_AUX_PMP	Double Star TC[12] predicted magnetic positions

2.2.2.1 D[12]_SP_AUX

The SP_AUX datasets contain the reconstructed position, velocity, spin axis and status of the Double Star spacecraft and is similar to the CL_SP_AUX for Cluster described in Section 2.2.1.4 but without the tetrahedral configuration and quality parameters (not relevant here) and with separate datasets for each of the two spacecraft. A detailed description of the datasets is given as part of the DSDS user guide [DSDS_UG].

- time_tags__Dn_SP_AUX — Time, UTC
- status__Dn_SP_AUX — TCn, AUX Status
- sc_orbit_num__Dn_SP_AUX — orbit number including phase
- sc_r_xyz_gse__Dn_SP_AUX — Position of Spacecraft, GSE, km
- sc_v_xyz_gse__Dn_SP_AUX — Velocity of Spacecraft, GSE, km/s
- sc_at_lat__Dn_SP_AUX — GSE Latitude of S/C spin axis, Angle from Ecliptic Plane, degrees
- sc_at_long__Dn_SP_AUX — GSE Longitude of S/C spin axis, Angle from x in the x-y plane, degrees
- gse_gsm__Dn_SP_AUX — Rotation angle GSE to GSM, positive from +z towards +y, degrees
- dipole_tilt__Dn_SP_AUX — Dipole Tilt in GSM z-x Plane, positive from +z towards +x, degrees

2.2.2.2 D[12]_JP_AUX_PGP

These datasets contain the EPOS Predicted Geometric Positions. These datasets closely follow the format of the corresponding reconstructed orbit information in the Dn_SP_AUX datasets. Unless the user has a particular interest in the predicted orbital information, they are advised to use the reconstructed product which provides the most accurate orbit and attitude information.

2.2.2.3 D[12]_JP_AUX_PMP

These datasets contain the EPOS Predicted Magnetic Positions for the Double Star spacecraft. Information is provided for the invariant latitude, magnetic local time, L value and predicted magnetic field magnitude.

- time_tags__Dn_JP_AUX_PMP — Time, UTC

- Invar_Lat__Dn_JP_AUX_PMP — Spacecraft Invariant Latitude (Null outside magnetosphere)
- Mag_Local_time__Dn_JP_AUX_PMP — Spacecraft local magnetic time in hours
- L_value__Dn_JP_AUX_PMP — Spacecraft L-value
- Pred_B_mag__Dn_JP_AUX_PMP — Predicted magnetic field magnitude

2.3 KEY TIMING INFORMATION

The AUX timing products provide useful information related to the data acquisitions, this includes information on telemetry mode, the standard reference time of the spin [SPIN_REF] used by all instruments and details of the start and end of the orbit that are useful when considering where the spacecraft are likely to be in their orbit. Specific datasets containing this information are only available for the Cluster spacecraft.

Data set IDs	Title
C[1234]_CT_AUX_TMMODE	Telemetry mode information
C[1234]_CP_AUX_SPIN_TIME	Spin timing
C[1234]_CT_AUX_ORBIT_SPAN	Orbit time span information

2.3.1 C[1234]_CT_AUX_TMMODE

These datasets contain the spacecraft telemetry mode for the Cn Cluster spacecraft. These data have been extracted from the Cluster Science Data System Auxiliary summary parameter data product (CL_SP_AUX) produced by the Hungarian national data centre. The telemetry mode information is given as time intervals (start/end) for which the specific telemetry mode is active. The telemetry modes are designated as NM (Normal Mode) or BM (Burst Mode) plus a 1 digit value in the range 1 to 4 giving the NM or BM telemetry mode table (details of telemetry modes is provided in [CM_CD_AUX_DDID]). The data rate in Burst Mode is enhanced allowing increased sampling or download of additional products. The telemetry table may prioritise data from instruments, and this was particularly used on spacecraft where an instrument had failed so that it's telemetry could be reallocated to other instruments. BM3 is a special case of Burst Mode used to download instrument internal burst memory; these intervals are short lived a may require specialised knowledge to decode. Since this information has been generated from the CSDS AUX dataset the mode change information is only accurate to one minute resolution.

- time_tags__Cn_CT_AUX_TMMODE — Time range, UTC
- event_code__Cn_CT_AUX_TMMODE — Mode identifier (string)

2.3.2 C[1234]_CP_AUX_SPIN_TIME

These datasets provide information on the time of each spin. The spin timing calculation is based on the extraction of sun reference pulse information from the spacecraft HK data and application of the standard spin calculation algorithm described in document [SPIN_REF]. The nominal offset for the start of the spin relative to the sun reference pulse is 26.367 degrees. Since the instruments are located around the circumference of the spacecraft it can be important to understand the timing and direction of sampling over the spin particularly when considering fast changing phenomena that may be varying on timescales of less than a spin.

- time_tags__Cn_CP_AUX_SPIN_TIME — Time, UTC
- spin_interval__Cn_CP_AUX_SPIN_TIME — Spin interval (start/stop), time range
- spin_period__Cn_CP_AUX_SPIN_TIME — Spin period, s

- algorithm__Cn_CP_AUX_SPIN_TIME — Integer value indicating source of the sun reference (observer or interpolated)
- flag__C3_CP_AUX_SPIN_TIME — Status flag

2.3.3 C[1234]_CT_AUX_ORBIT_SPAN

This dataset contains the time span for each orbit (revolution) for the C3 Cluster spacecraft. The information makes use of the SUPER_LTOF provided by JSOC and the standard ephemeris handling routines supplied by ESOC. The resolution of the orbit time spans is 1s from perigee to the next perigee. The product is generated for the whole mission time span for which reconstituted orbit information is available. Due to the slight differences in orbit of the Cluster spacecraft the timings will be slightly different for each spacecraft. Where multi-instrument orbit analysis is undertaken the orbit times of the reference spacecraft (usually Cluster-3) is usually used.

- time_tags__Cn_CT_AUX_ORBIT_SPAN — Orbit timespan (perigee to perigee)
- orbit_num__Cn_CT_AUX_ORBIT_SPAN — Orbit number

2.4 SCIENTIFIC EVENT AND REGION INFORMATION

The Cluster spacecraft travel through different near-Earth plasma regions as they travel round their orbits and as their orbits evolve over time. When analysing the instrument data, it can be important to understand the magnetospheric region at a specific point in time. The Archive includes the predicted list of regions that were determined by JSOC using models to help with the science mission planning. The models only give a rough indication of where the regions and boundaries are expected to occur and therefore analysis of the data has been used [GRMB] to identify the actual location of boundaries and regions passed through by the spacecraft.

Data set IDs	Title
C[1234]_CT_AUX_GRMB	Geospace Region and Magnetospheric Boundary identification (GRMB)
C[1234]_JP_AUX_PSE	Predicted Scientific Events

2.4.1 C[1234]_CT_AUX_GRMB

The Geospace Region and Magnetospheric Boundary identification (GRMB) dataset contains the label of the region in which C1 is travelling. It results from visual selection of the boundary in the pre-generated plots Each record indicates the time interval passed in a GRMB region (the exit time of this region is the next entry time). The label is described as a string and as number (1 to 15). It comes along with quality factors. Meanings of location_code and location_label variables: 1, IN/UKN: Inside the magnetosphere 2, IN/PLS: Plasmasphere 3, IN/PPTR: Plasmapause Transition Region 4, IN/PSH: Plasmasheet 5, IN/PSTR: Plasmasheet Transition Region 6, IN/LOB: Lobe 7, IN/POL: Polar Regions 8, IN/MP: Magnetopause 9, IN/MPTR: Magnetopause Transition Region 10, OUT/MSH: Magnetosheath 11, OUT/BSTR: Bow Shock Transition Region 12, OUT/SWF: Solar Wind and Foreshock 13, OUT/UKN: Outside the magnetosphere 14, UNKNOWN: Available data are not conclusive 15, N/A: No data Since this information has been generated by visual inspection of existing plots (with a pixel resolution down to 7s), the change of a region is not resolved with a constant time resolution. See the caveats and the user guide for more information. inbound_vs_outbound variable has been generated automatically and it is related to the way the region identified by location_label is crossed (inbound or outbound). It is applicable for the following GRMB items: PPTR, POL (distant part only), MP, MPTR, MSH, BSTR 0: Not Applicable for this item 1: This is an inbound crossing 2: This is an outbound crossing 3: Bound cannot be identified crossing_complexity variable has been attributed by the operator at the selection. Default value is one (simple crossing). In a complex crossing, the region properties are not fully matching the typical location_label item

properties. 1: This is simple region/boundary 2: This is a complex region/boundary quality_location_code has been generated automatically and it is related to the number of prime products displayed to the operator at the item start time. Each GRMB item has 3 to 5 prime products. The more these products are available , the more certain is the region identification. See the user guide for detailed prime products. 0 (bad): no prime products were available. 1 (low): a single prime products was available. 2 (fair): more than one prime product was available and more than one was missing. 3 (good): all but one prime products were available. 4 (top): all prime products were available. quality_location_label has been generated automatically and it is related to the available dataset displayed to the operator at the entry start time. It is a 32-chars long string. This combined 16 product codes (each is a 2-char long string) displayed at the selection time. See the user guide for detailed information and the CSA product of each code. This variable is intended to be checked in case of a suspicious label. See the user guide for more informations: Grison, B. et al. Localization of the Cluster satellites in the geospace environment. Sci Data 12, 327 (2025). https://doi.org/10.1038/s41597-025-04639-z The GRMB project is a cooperation between the Institute of Atmospheric Physics of the Czech Academy of Science and the Royal Belgian Institute for Space Aeronomy.

- time_tags__Cn_CT_AUX_GRMB — Time range, UTC
- location_label__Cn_CT_AUX_GRMB — Location label, string
- location_code__Cn_CT_AUX_GRMB — Location code, unitless
- inbound_vs_outbound__Cn_CT_AUX_GRMB — Inbound/outbound flag, unitless
- crossing_complexity__Cn_CT_AUX_GRMB — Simple/Complex, unitless
- quality_location_code__Cn_CT_AUX_GRMB — quality of the displayed dataset
- quality_location_label__Cn_CT_AUX_GRMB — Displayed dataset

```
example: C3_CT_AUX_GRMB 2018-01-02T12:00:00/2018-01-02T14:00:00

DATA_UNTIL = EOF
2018-01-02T05:04:51Z/2018-01-02T12:13:08Z, "OUT/MSH", 10, 2, 0, 3, "41515352577100000403014243440000"
2018-01-02T12:13:08Z/2018-01-02T13:45:42Z, "OUT/BSTR", 11, 2, 1, 3, "41755352577100000403014243440000"
2018-01-02T13:45:42Z/2018-01-02T13:51:11Z, "OUT/SWF", 12, 0, 0, 3, "41755352577600000403014243440000"
2018-01-02T13:51:11Z/2018-01-02T14:17:44Z, "OUT/BSTR", 11, 3, 1, 3, "41755352577600000403014243440000"
!RECORDS= 4
```

2.4.2 C[1234]_JP_AUX_PSE

This dataset contains the JSOC Predicted Scientific Events for the Cn Cluster spacecraft. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format (CDF) Prime Parameter files that were made available through the Cluster Science Data System. The full details of the product are documented in [CSDS_UG].

- time_tags__Cn_JP_AUX_PSE — Time, UTC
- event_code__Cn_JP_AUX_PSE — Code for predicted event, see [CSDS_UG]
- orbit_num__Cn_JP_AUX_PSE — Orbit number
- event_sub_code__Cn_JP_AUX_PSE — Event sub-type, see [CSDS_UG]
- orbit_phase__Cn_JP_AUX_PSE — Orbit phase 0 to 1
- sc_lat__Cn_JP_AUX_PSE — Predicted gse Latitude of sc, degrees
- sc_mag_local_time__Cn_JP_AUX_PSE — Predicted Magnetic Local Time
- sc_r1_xyz_gse__Cn_JP_AUX_PSE — Position of sc at predicted event, km

The following example covers the same period as the identified boundaries regions example for the GRMB dataset above. Note that this dataset indicates the time of a particular boundary whereas the GRMB provides the observed time range over which the boundary is encountered.

```
example: C3_CT_AUX_GRMB 2018-01-02T12:00:00/2018-01-02T14:00:00

DATA_UNTIL = EOF
2018-01-02T12:16:14.168Z , 17136.917 ,"HA" , 2755 ,"1" , 0.463141 , -21.6000 , 16.8000 , 42559.6 , 88750.8 , -31537.4  $
2018-01-02T12:47:04.196Z , 925.01400 ,"HY" , 2755 ,"1" , 0.472618 , -19.6000 , 16.7000 , 43897.6 , 89196.8 , -29116.4  $
!RECORDS= 2
```

2.5 CONTEXTUAL INFORMATION

The contextual information provides data that is not directly linked to the mission but is useful for placing observations in context. This typically consists of predicted or observed space environment conditions. In future it could be extended to include event lists from other relevant missions or data from conjunctions though currently this sort of information has been developed through parallel activities as described in Section 2.9.

The two datasets currently provided are the NOAA Solar Proton Event list and the JSOC predicted solar cycle trends data that was used during science mission planning.

Data set IDs	Title
CC_CT_AUX_SPE	Solar Proton Events
CC_JP_AUX_PCY	Predicted Solar Cycle Trends

2.5.1 CC_CT_AUX_SPE

This dataset contains Solar Proton Events Affecting the Earth Environment and possibly the Cluster payload observations. These data have been extracted from ftp://ftp.swpc.noaa.gov/pub/indices/SPE.txt, and only the data since September 2000 are given. The dataset contains four parameters: time range, Proton Flux, Information about: the associated CME, and information about Flare and Active Region. The proton flux is given in unit PDU that is particle per square cm per second per steradian. Flare information can contain the following data: Flare Max. (Location/Day UT), Importance (X-ray/Optical class), Location, and Region Nr (SWO).

- time_range__CC_CT_AUX_SPE — Time, UTC
- proton_flux__CC_CT_AUX_SPE — Proton Flux, pfu at >10 MeV
- cme__CC_CT_AUX_SPE — Associated CME info, string
- flare__CC_CT_AUX_SPE — Flare and active region data

```
example: CC_CT_AUX_SPE 2024-01-01T00:00:00/2025-01-01T00:00:00

DATA_UNTIL = "END_OF_DATA"
2024-01-03T20:05:00Z/2024-01-04T08:35:00Z,      20,       "NE/31 2200 ",  "Dec 31/2135 X5/3B N04E73 3536" $
2024-01-29T06:15:00Z/2024-01-29T18:05:00Z,     137,       "NW/29 0424 ",  "Jan 29/0438 M6/SF N29W85 3559" $
2024-02-09T15:30:00Z/2024-02-09T23:55:00Z,     187,       "SW/09 1342 ",  "Feb 09/1314 X3.3 S16E14 3575" $
2024-05-10T13:35:00Z/2024-05-10T17:45:00Z,     207,       "SW/10 0700 ",  "May 10/0654 X4/2B S20W26 3664" $
2024-05-13T14:00:00Z/2024-05-14T05:20:00Z,     121,       "SW/13 0921 ",  "May 13/0944 M6/SF S19W87 3664" $
2024-09-09T16:40:00Z/2024-09-09T22:50:00Z,      34,       "SW/09 0048 ",  "Sep 09/0332 M1.0 S11W88 3806" $
2024-09-17T07:35:00Z/2024-09-17T10:50:00Z,      33,       "SE/14 0424 ",  "Sep 14/1529 X4/2B S18E62 3825" $
!RECORDS= 7
END_OF_DATA
```

2.5.2 CC_JP_AUX_PCY

This dataset contains the JSOC Predicted Solar Cycle Trends over the mission at monthly cadence. The dataset includes the 12 month smoothed sunspot number, statistical information on the predicted solar wind ram pressure and on the interplanetary magnetic field variation. They were used as part of the long-term science planning to take account of where in the solar cycle observations were being made. These data have been converted into Cluster Exchange Format from the original Cluster Science Data System Common Data Format

(CDF) Prime Parameter files that were made available through the Cluster Science Data System (see [CSDS_UG] for further information).

- time_tags__CC_JP_AUX_PCY — Time, UTC
- half_interval__CC_JP_AUX_PCY — Half duration of the record (+/- time tag)
- Sunspot_number__CC_JP_AUX_PCY — Sunspot number, 12 month smoothed
- median_P_pred__CC_JP_AUX_PCY — Predicted solar wind median pressure, nPa
- Lower6_P_pred__CC_JP_AUX_PCY — Predicted Solar Wind lower sextile pressure, nPa
- Upper6_P_pred__CC_JP_AUX_PCY — Predicted Solar Wind upper sextile pressure, nPa
- Sigma_Bz_pred__CC_JP_AUX_PCY — Predicted std dev in interplanetary field, nT

```
example: CC_JP_AUX 2002-01-01T00:00:00/2002-06-01T00:00:00

DATA_UNTIL = EOF
2002-01-01T00:00:00.000Z , 1339200.0 , 114.000 , 2.70000 , 1.60000 , 4.60000 , 1.00000  $
2002-02-01T00:00:00.000Z , 1339200.0 , 115.000 , 2.70000 , 1.60000 , 4.70000 , 1.00000  $
2002-03-01T00:00:00.000Z , 1209600.0 , 113.000 , 2.80000 , 1.70000 , 4.70000 , 1.00000  $
2002-04-01T00:00:00.000Z , 1339200.0 , 111.000 , 2.80000 , 1.70000 , 4.70000 , 1.00000  $
2002-05-01T00:00:00.000Z , 1296000.0 , 109.000 , 2.80000 , 1.80000 , 4.70000 , 1.00000  $
2002-06-01T00:00:00.000Z , 1339200.0 , 106.000 , 2.90000 , 1.80000 , 4.70000 , 1.00000  $
!RECORDS= 6
```

2.6 MISSION OPERATIONS, STATUS AND PLANNING INFORMATION

This section describes the mission operation, status and planning information that was generated by the mission. The mission operations, status and spacecraft level planning information were generated by the Mission Operations Centre (MOC) located at ESOC while the science operations planning information has been provided by the Joint Science Operation Centre (JSOC) located at RAL Space. These data are primarily of historical interest providing details of science planning that gave rise to the observations and data that have subsequently been processed into the high-quality datasets available for use within the Archive. The MOC products provide useful information on what was happening to the spacecraft such as manoeuvres, eclipses, on-board and ground segment anomalies that may have affected the observations.

Data set IDs	Title
CM_CT_AUX_JSOC_PP	JSOC Planning Periods
CM_CD_AUX_ESOC_WR	ESOC Weekly report
C3_CP_AUX_ESOC_ORB_ELEMENTS	Spacecraft Orbital Elements
C3_CT_AUX_ESOC_ECLIPSE	Eclipse Intervals
C3_CT_AUX_ESOC_FD_ECLIPSE	Eclipse Intervals
C3_CT_AUX_ESOC_THRUSTER	Thruster Usage Log
C3_CQ_AUX_ESOC_GAP	Data Gaps
C3_CQ_AUX_ESOC_BIT_ERROR	SSR Bit Errors
C3_CQ_AUX_ESOC_SCIENCE_RETURN	Science Return Percentage
C3_CQ_AUX_ESOC_TC_HIST	Telecommand History
C3_CP_AUX_ESOC_SAP	Solar Array Parameters
C3_CQ_AUX_ESOC_EVENT_EXP	Experiment Power Sharing
C3_CQ_AUX_ESOC_EVENT_CTU_RTU	Spacecraft CTU/RTU switch-over
C3_CT_AUX_ESOC_GSU_LOG	Ground Station Utilization Log
C3_CT_AUX_ESOC_BATTERY_COND	Battery Conditioning History
C3_CP_AUX_ESOC_MEP	IPD/EPD Power and MEP Temperature

A detailed elaboration of these products will be provided in the next issue of this document. Further information can be found in the [ESOC_ICD] and [JSOC_ICD] documentation although these are not currently available via the Archive interface.

2.7 GRAPHICAL INFORMATION

The AUX graphical products consist of a set of four (Overview, Fields, Particles1 and Particles2) multi-instrument plots from each spacecraft. The design matches the layout of the CSDSweb plots, which were provided in near-real-time during the mission, but in the case of these plots they are based on the best quality calibrated data. The CSDSweb plots are also available on the archive but since they are based on default calibrations it is strongly recommended that you use the refactored versions of the plots described here. These survey plots can be a very useful tool for identifying features observed across the different instruments. The different time-scales allow the user to "zoom" in on features of interest. Since the plots are already pre-generated they are quick to browse and can be downloaded for off-line viewing.

Data set IDs	Title
C[1234]_CG_AUX_CAA_2HR_FIELDS_GIF	2-hr CAA Summary Plot (Fields) - GIF
C[1234]_CG_AUX_CAA_2HR_OVERVIEW_GIF	2-hr CAA Summary Plot (Overview) - GIF
C[1234]_CG_AUX_CAA_2HR_PARTICLES1_GIF	2-hr CAA Summary Plot (Particles1) - GIF
C[1234]_CG_AUX_CAA_2HR_PARTICLES2_GIF	2-hr CAA Summary Plot (Particles2) - GIF
C[1234]_CG_AUX_CAA_6HR_OVERVIEW_GIF	6-hr CAA Summary Plot (Fields) - GIF
C[1234]_CG_AUX_CAA_6HR_FIELDS_GIF	6-hr CAA Summary Plot (Overview) - GIF
C[1234]_CG_AUX_CAA_6HR_PARTICLES1_GIF	6-hr CAA Summary Plot (Particles1) - GIF
C[1234]_CG_AUX_CAA_6HR_PARTICLES2_GIF	6-hr CAA Summary Plot (Particles2) - GIF
C[1234]_CG_AUX_CAA_ORBIT_OVERVIEW_GIF	Whole orbit CAA Summary Plot (Fields) - GIF
C[1234]_CG_AUX_CAA_ORBIT_FIELDS_GIF	Whole orbit CAA Summary Plot (Overview) - GIF
C[1234]_CG_AUX_CAA_ORBIT_PARTICLES1_GIF	Whole orbit CAA Summary Plot (Particles1) - GIF
C[1234]_CG_AUX_CAA_ORBIT_PARTICLES2_GIF	Whole orbit CAA Summary Plot (Particles2) - GIF
C[1234]_CG_AUX_ESOC_PLOT1_CAA	ESOC spacecraft plot 1
C[1234]_CG_AUX_ESOC_PLOT2_CAA	ESOC spacecraft plot 2

The following sub-sections give a further elaboration of the plot layout and provides some examples.

2.7.1 OVERVIEW_GIF

This plot, available for each spacecraft, is based on the calibrated CAA data and has a similar layout as the corresponding CSDSweb plot (that is based on default calibration values). The panels from top to bottom are: Total magnetic field (FGM) Spacecraft potential (EFW) Total ion velocity (CIS) Ion energy spectra (CIS) Electron energy spectra (PEACE) Magnetic field wave spectra at 10 Hz – 4 kHz (STAFF) Electric field wave spectra at 2-80 kHz (WHISPER). The plots are provided at three resolutions 2hr, 6hr and whole orbit (perigee to perigee). An example of the whole orbit plot is shown below.

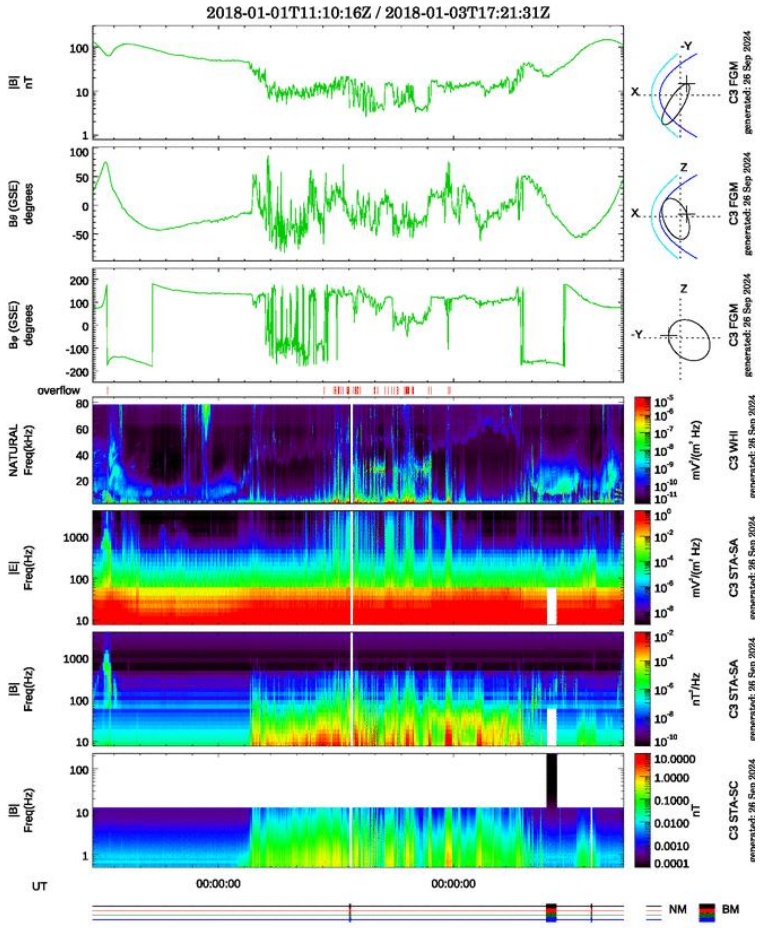


Figure 1: Example of the Overview plot

2.7.2 FIELDS_GIF

This plot, available for each spacecraft, is based on the calibrated CAA data and has a similar layout as the corresponding CSDSweb plot (that is based on default calibration values). The panels from top to bottom are: Total magnetic field (FGM) Magnetic field vector polar angle (FGM) Magnetic field vector azimuthal angle (FGM) Electric field wave spectra at 2-80 kHz (WHISPER) Electric field wave spectra at 10 Hz – 4 kHz (STAFF) Magnetic field wave spectra at 10 Hz – 4 kHz (STAFF) Magnetic field wave spectra at 1- 180 Hz (STAFF). The plots are provided at three resolutions 2hr, 6hr and whole orbit (perigee to perigee). An example of the 2-hour plot is shown below.

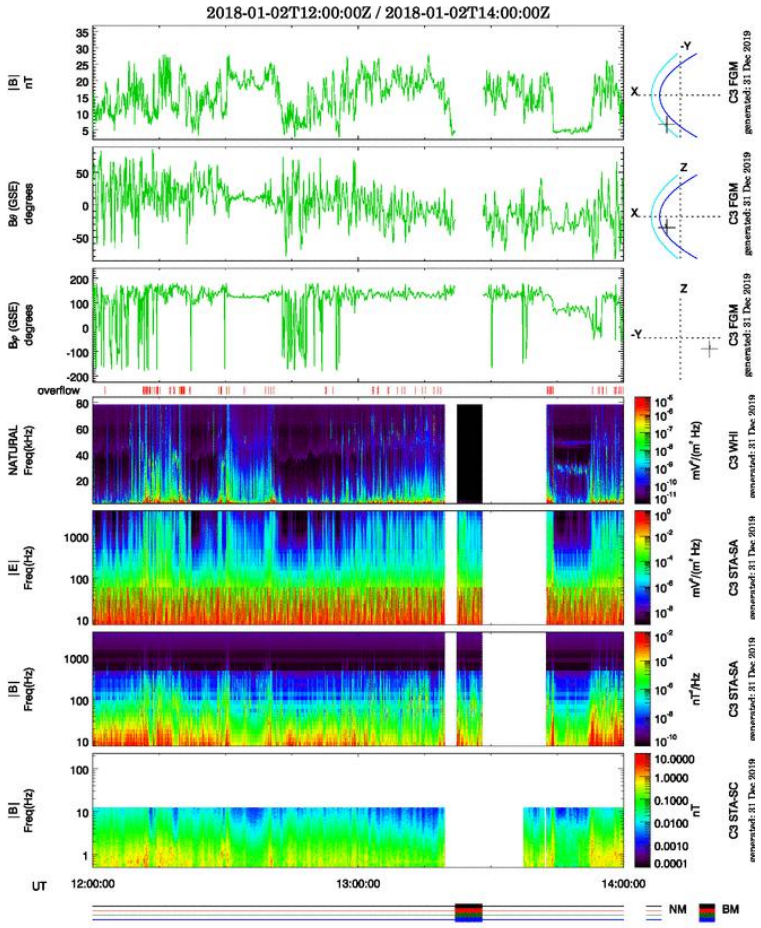


Figure 2: Example of the Fields plot

2.7.3 PARTICLES1_GIF

This plot, available for each spacecraft, is based on the calibrated CAA data and has a similar layout as the corresponding CSDSweb plot (that is based on default calibration values). The panels from top to bottom are: Total magnetic field (FGM) Total ion velocity (CIS-HIA) Polar angle of Ion velocity (CIS-HIA) Azimuthal angle of ion velocity (CIS-HIA) Total ion density (CIS-HIA) Ion energy spectra (CIS) Electron energy spectra (PEACE). The plots are provided at three resolutions 2hr, 6hr and whole orbit (perigee to perigee). An example of the 6-hour plot is shown below.

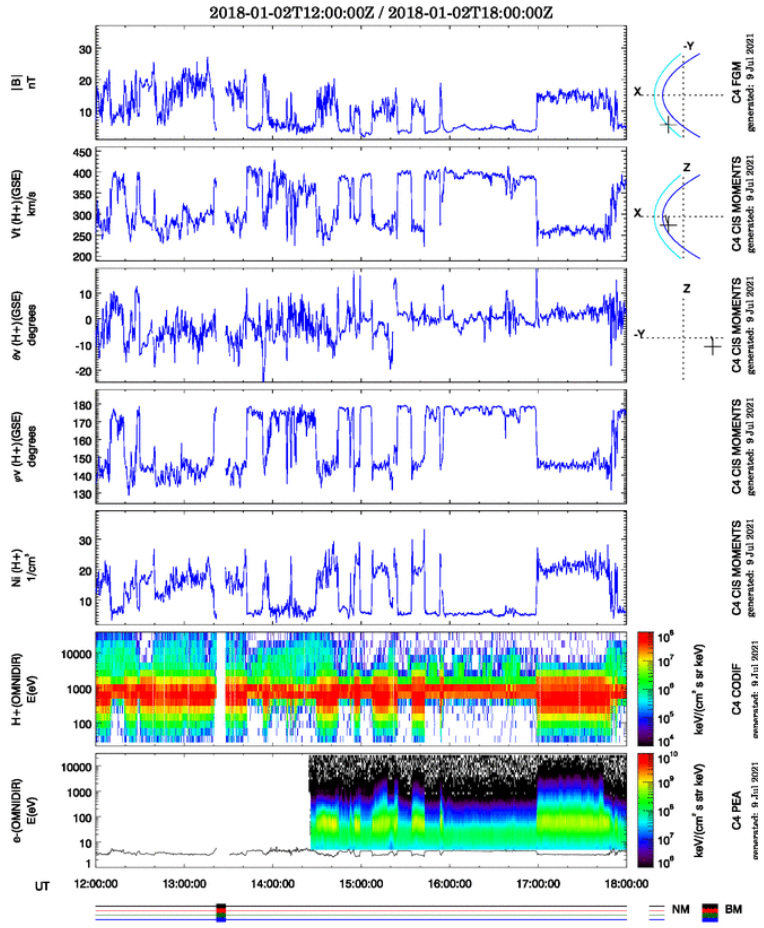


Figure 3: Example of the Particles1 plot

2.7.4 PARTICLES2_GIF

This plot, available for each spacecraft, is based on the calibrated CAA data and has a similar layout as the corresponding CSDSweb plot (that is based on default calibration values). The panels from top to bottom are: Total magnetic field (FGM) Polar angle of magnetic field vector (FGM) Azimuthal angle of magnetic field vector (FGM) Proton energy spectra (RAPID) Ion energy spectra (CIS) Electron energy spectra (RAPID) Electron energy spectra (PEACE). Plots are provided at three resolutions 2hr, 6hr and whole orbit (perigee to perigee). An example of the 6-hour plot is shown below.

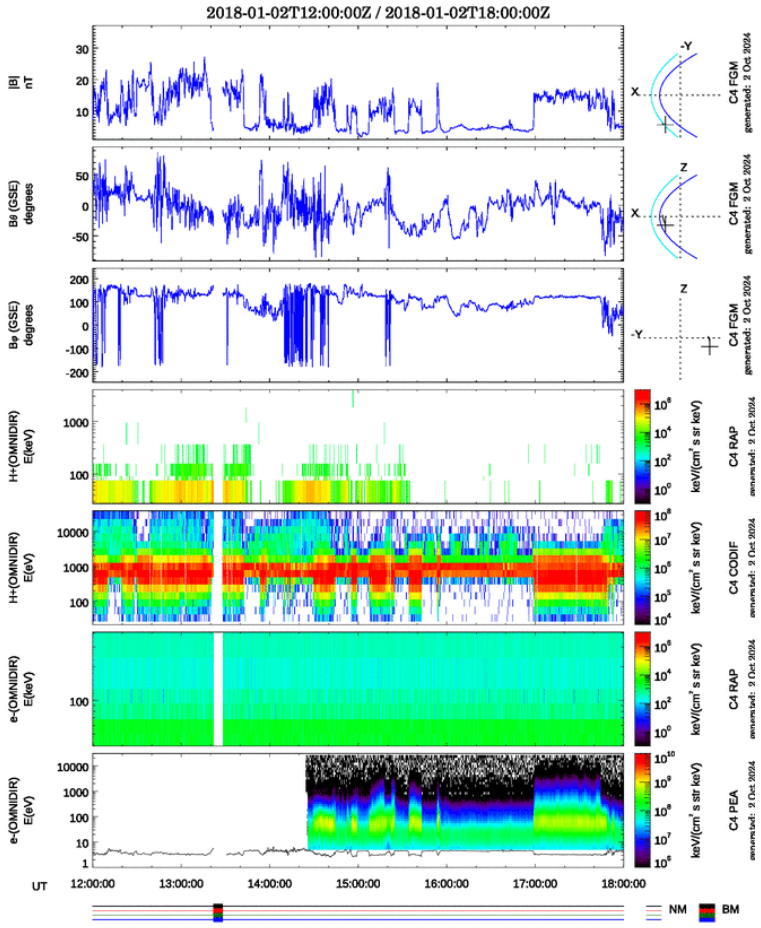


Figure 4: Example of the Partcles2 plot

2.7.5 ESOC SPACECRAFT PLOTS 1 & 2

The EOSC Spacecraft plots provide useful information about the status of the spacecraft. There are two plot styles each covering a duration of 1 month per plot.

In PLOT-1 (left) the Spacecraft platform parameters are displayed. The seven panels from top to bottom include: error rate in unit 1/day; Internal Power Dumper (IPD) power; External Power Dumper (EPD) power; Main Equipment Platform (MEP) temperature; and three Solar Array parameters: main bus voltage; power; and temperature.

In PLOT-2 (right) the Spacecraft status and orbit parameters are displayed. The seven panels from top to bottom include: data gap sources (spacecraft manoeuvre; eclipse; raw data gap); events that can cause data gaps (WEC and EDI power sharing; CTU A/B switch-over); spacecraft solar aspect angle; and four orbit parameters: inclination angle; argument of perigee; perigee altitude; apogee altitude.

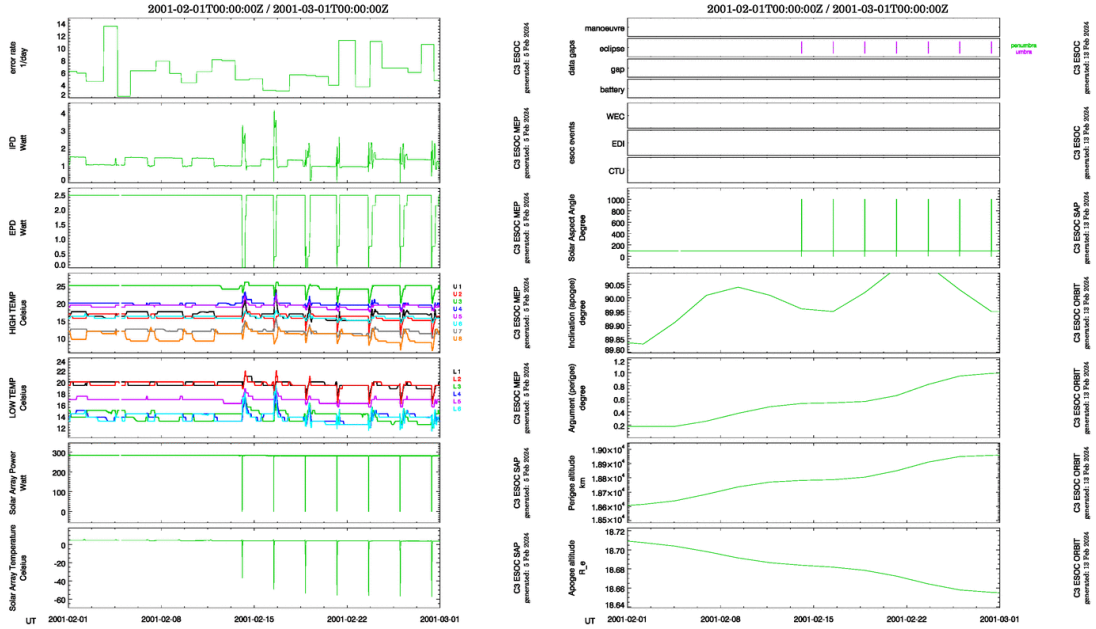


Figure 5: Example of ESOC plot1 (platform parameters) and ESOC plot2 (status)

2.8 DATA MINING

Data set IDs	Title
C[1234]_CP_AUX_DM	Survey 1-minute averaged AUX data

The Data Mining tool consists of a separate database of survey data from each of the Cluster spacecraft. The data used to populate the database used by this tool are also available for download from the archive in CEF for use within users own tools. This dataset contains the auxiliary parameters that are included in the DM system. This dataset contains values of auxiliary parameters. The data have been calculated from the Cluster Science Data System auxiliary parameters CL_SP_AUX and Cn_JP_AUX_PMP and therefore the user is referred to the description of those datasets for further information.

- time_tags__Cn_CP_AUX_DM — Time, UTC
- sc_r_xyz_gse__Cn_CP_AUX_DM — GSE Position of Spacecraft, km
- sc_r_mag__Cn_CP_AUX_DM — Radial distance in Earth, unitless
- Invar_Lat__Cn_CP_AUX_DM — Invariant Latitude
- Mag_Local_time__Cn_CP_AUX_DM — Magnetic local time
- L_value__Cn_CP_AUX_DM — L value, unitless
- sc_geom_size__Cn_CP_AUX_DM — Tetrahedron size L
- sc_geom_elong__Cn_CP_AUX_DM — Tetrahedron Elongation E
- sc_geom_planarity__Cn_CP_AUX_DM — Tetrahedron Planarity P

2.9 PRODUCTS FROM RELATED ACTIVITIES

The archive contains data from two related activities, ECLAT and MAARBLE. Separate documentation is available from those projects describing the delivered products.

A brief overview of these products will be included in this section during the next revision of this document.

2.10 CAA GENERATED INSTRUMENT TEAM, DATA SYSTEM AND MISCELLANEOUS PRODUCTS

In addition to the AUX products described within the earlier sections of this document there are also instrument datasets that the ESA Cluster Archive has produced by post-processing instrument team data to generate higher level products. These include simple functions such as coordinate transformations or converting spin plane data to 3D measurements based on simple assumptions. Where these datasets are not documented within the individual instrument team user guides a brief description is provided here.

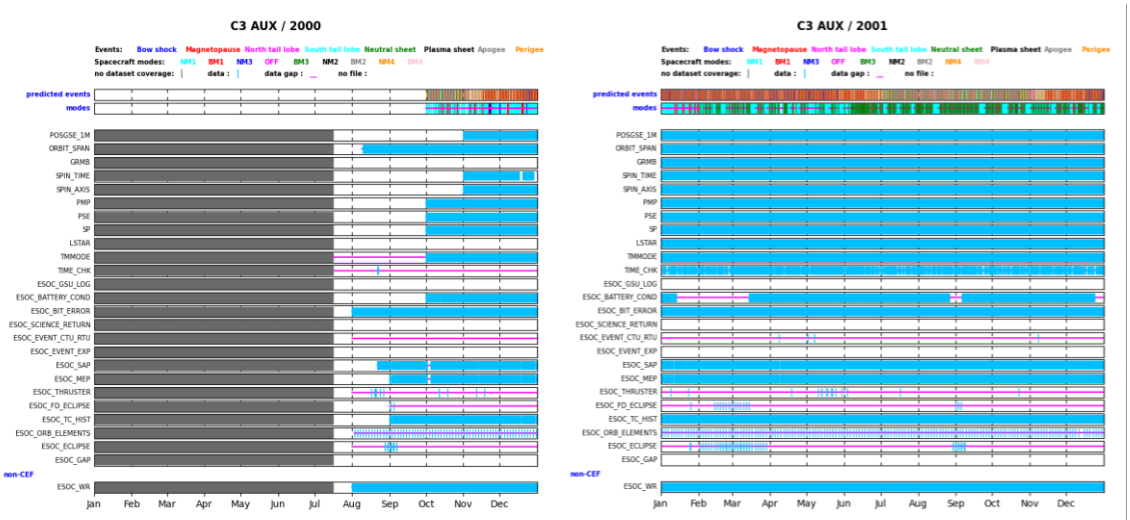
A brief overview of these products will be included in this section during the next revision of this document.

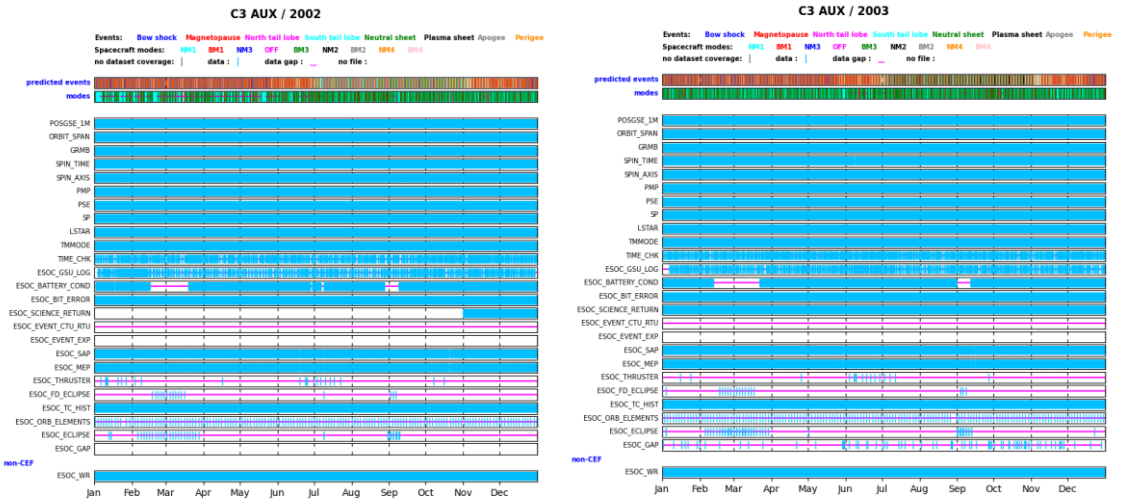
3 ANNEX-1 AUX DATASET MISSION COVERAGE

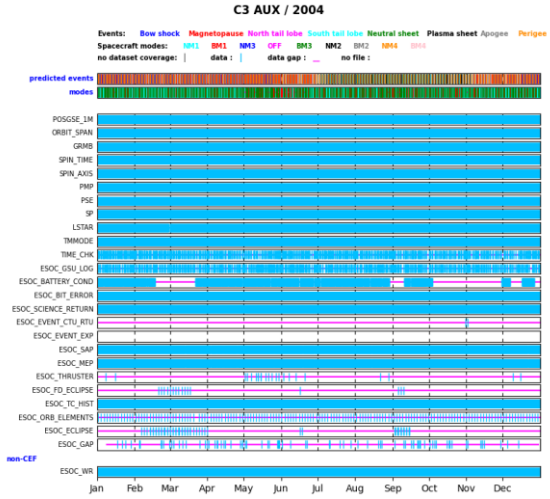
This annex presents the mission coverage of the most useful AUX datasets. More detailed coverage information is available directly via the archive interface.

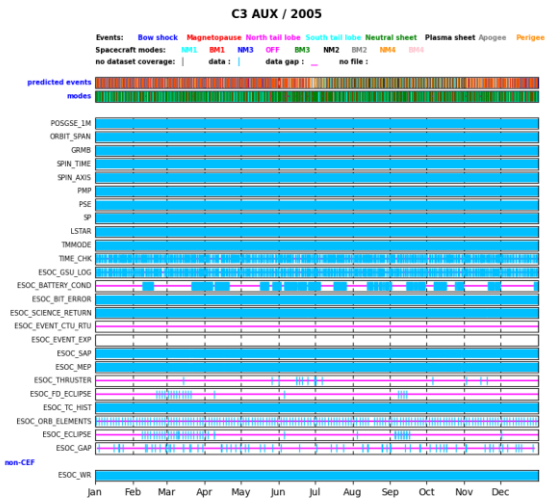
3.1 CLUSTER

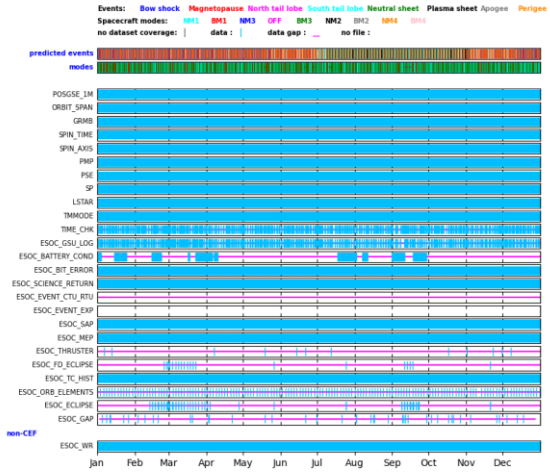
For Cluster the coverage information presented is for the reference spacecraft (Cluster-3) for the entire mission period (Aug 2000 to Sept 2025) it can be assumed that the dataset coverage for the other spacecraft is sufficiently similar that it is not useful to replicate for each individual spacecraft here.

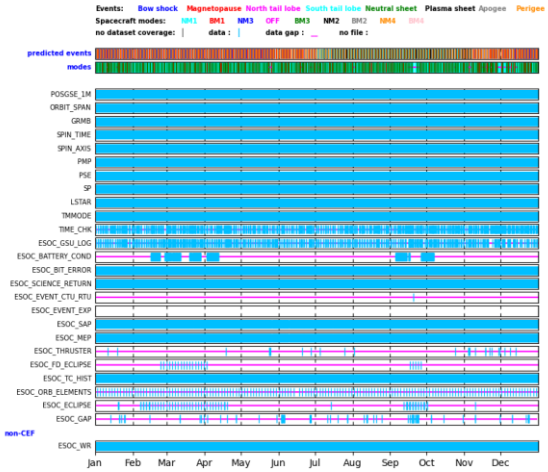


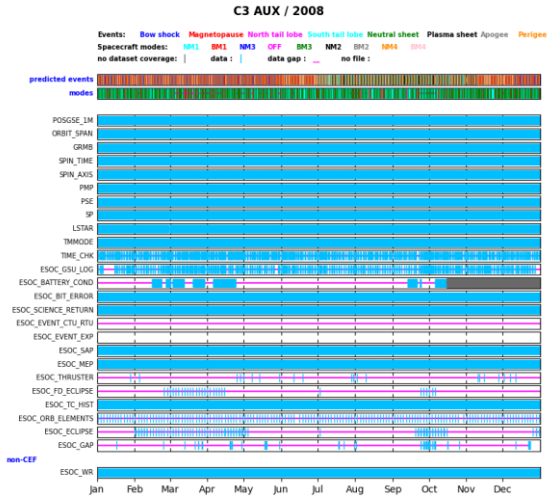


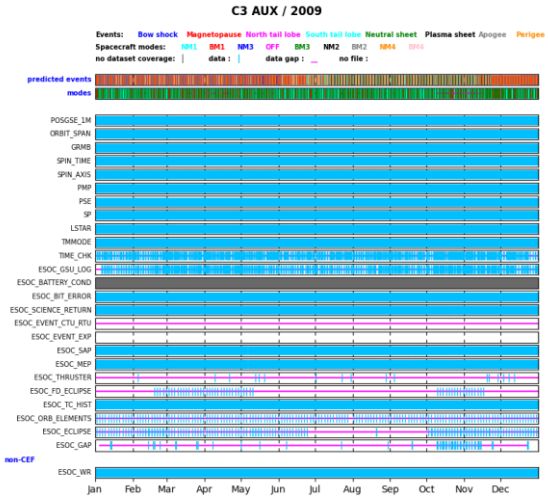

C3 AUX / 2004
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

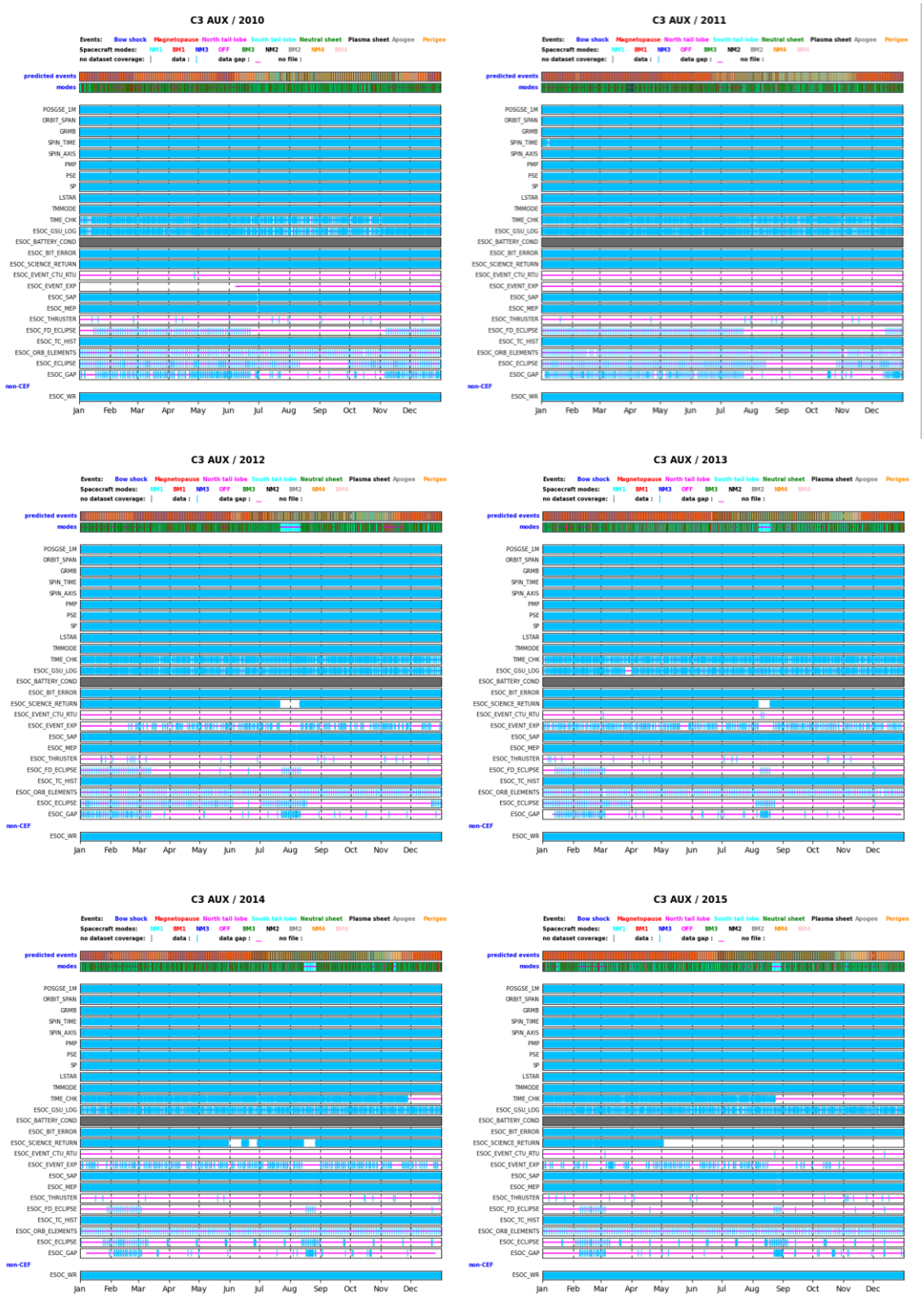

C3 AUX / 2005
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


C3 AUX / 2006
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

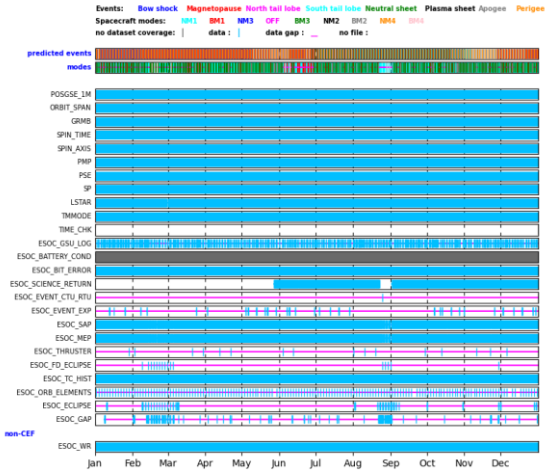

C3 AUX / 2007
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


C3 AUX / 2008
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

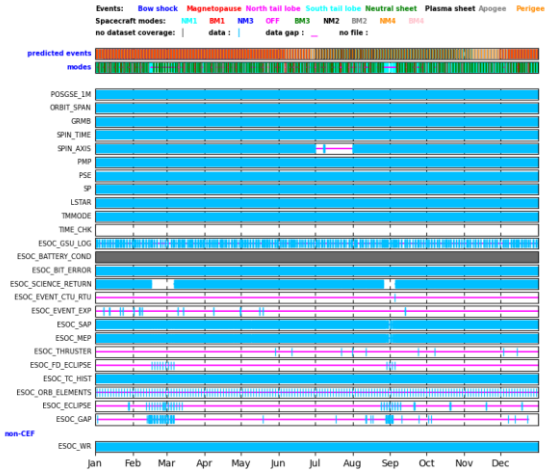

C3 AUX / 2009
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


C3 AUX / 2010
C3 AUX / 2011
C3 AUX / 2012
C3 AUX / 2013
C3 AUX / 2014
C3 AUX / 2015
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

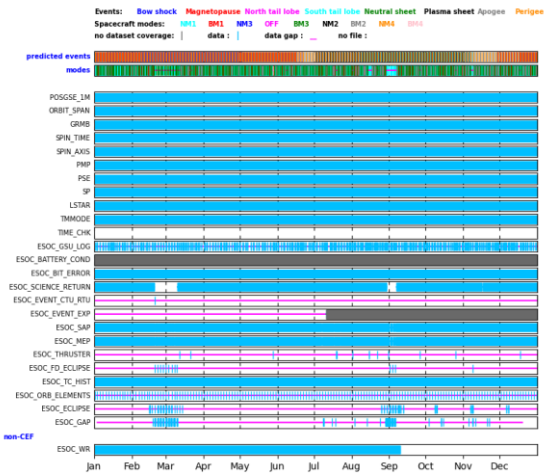
C3 AUX / 2016



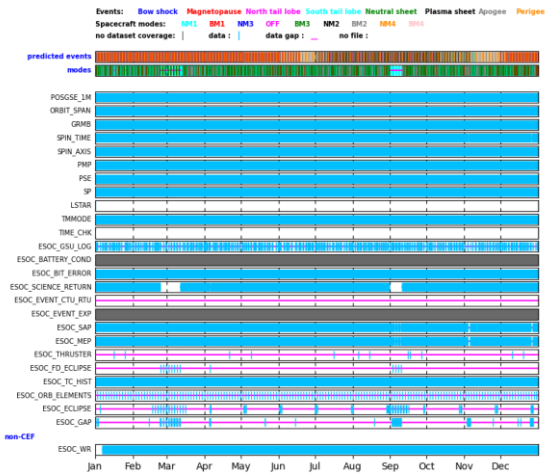
C3 AUX / 2017



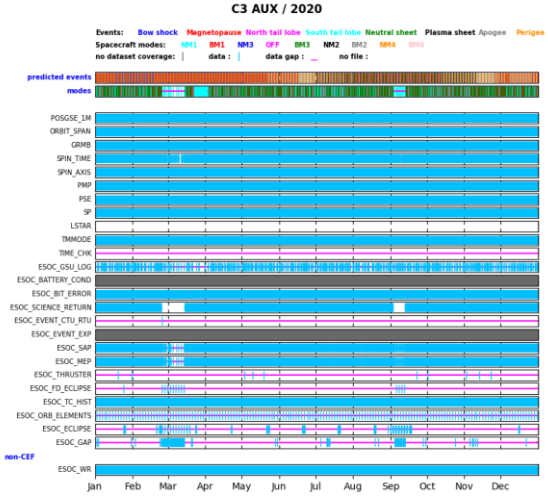
C3 AUX / 2018



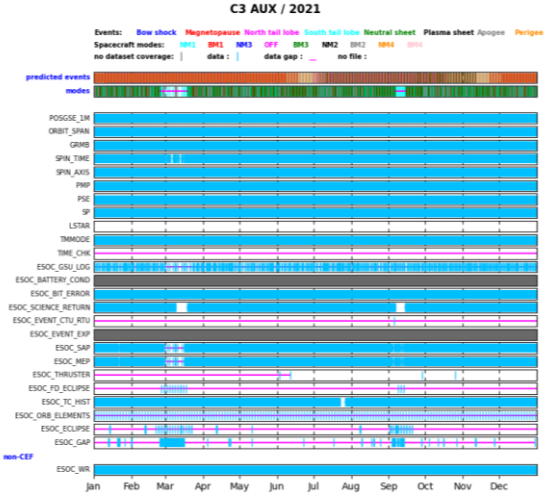
C3 AUX / 2019

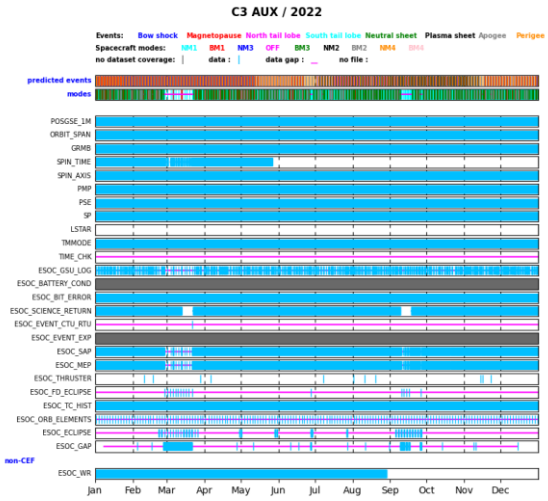


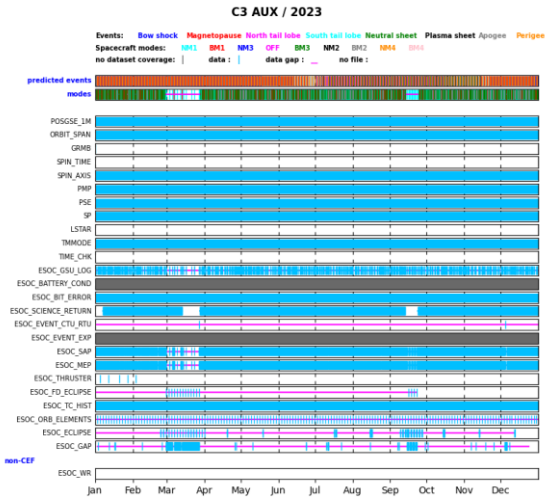
C3 AUX / 2020

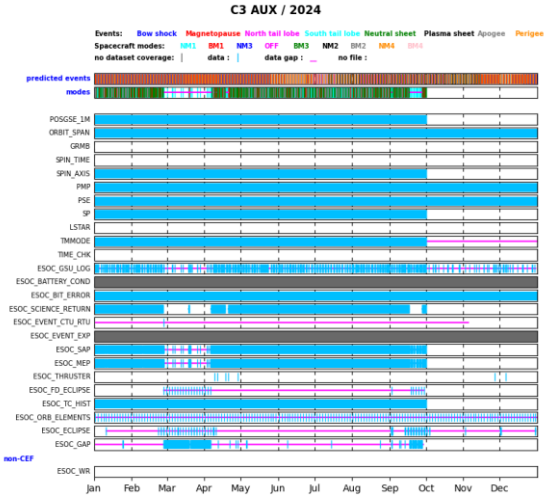


C3 AUX / 2021

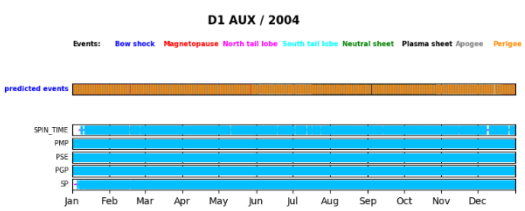


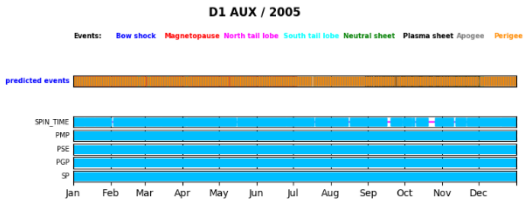

C3 AUX / 2022
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

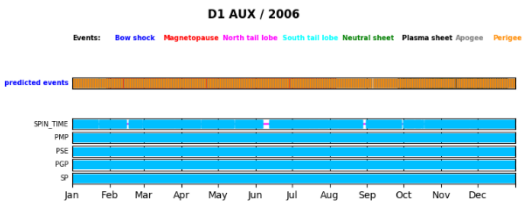

C3 AUX / 2023
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

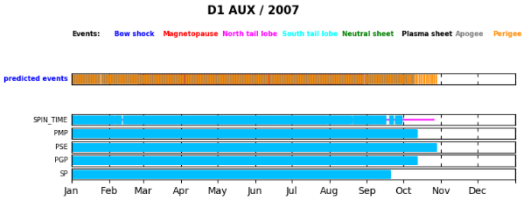

C3 AUX / 2024
Events: Bow shock Magnetopause North tail lobe South tail lobe Neutral sheet Plasma sheet Apogee Perigee
Spacecraft modes: NM1 BM1 NM3 OFF BM3 NM2 BM2 NM4 BM4
no dataset coverage: | data : | data gap : _ no file :
predicted events
modes
POSGSE_1M
ORBIT_SPAN
GRMB
SPIN_TIME
SPIN_AXIS
PMP
PSE
SP
LSTAR
TMMODE
TIME_CHK
ESOC_GSU_LOG
ESOC_BATTERY_COND
ESOC_BIT_ERROR
ESOC_SCIENCE_RETURN
ESOC_EVENT_CTU_RTU
ESOC_EVENT_EXP
ESOC_SAP
ESOC_MEP
ESOC_THRUSTER
ESOC_FD_ECLIPSE
ESOC_TC_HIST
ESOC_ORB_ELEMENTS
ESOC_ECLIPSE
ESOC_GAP
non-CEF
ESOC_WR
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

3.2 DOUBLE STAR 1









3.3 DOUBLE STAR 2