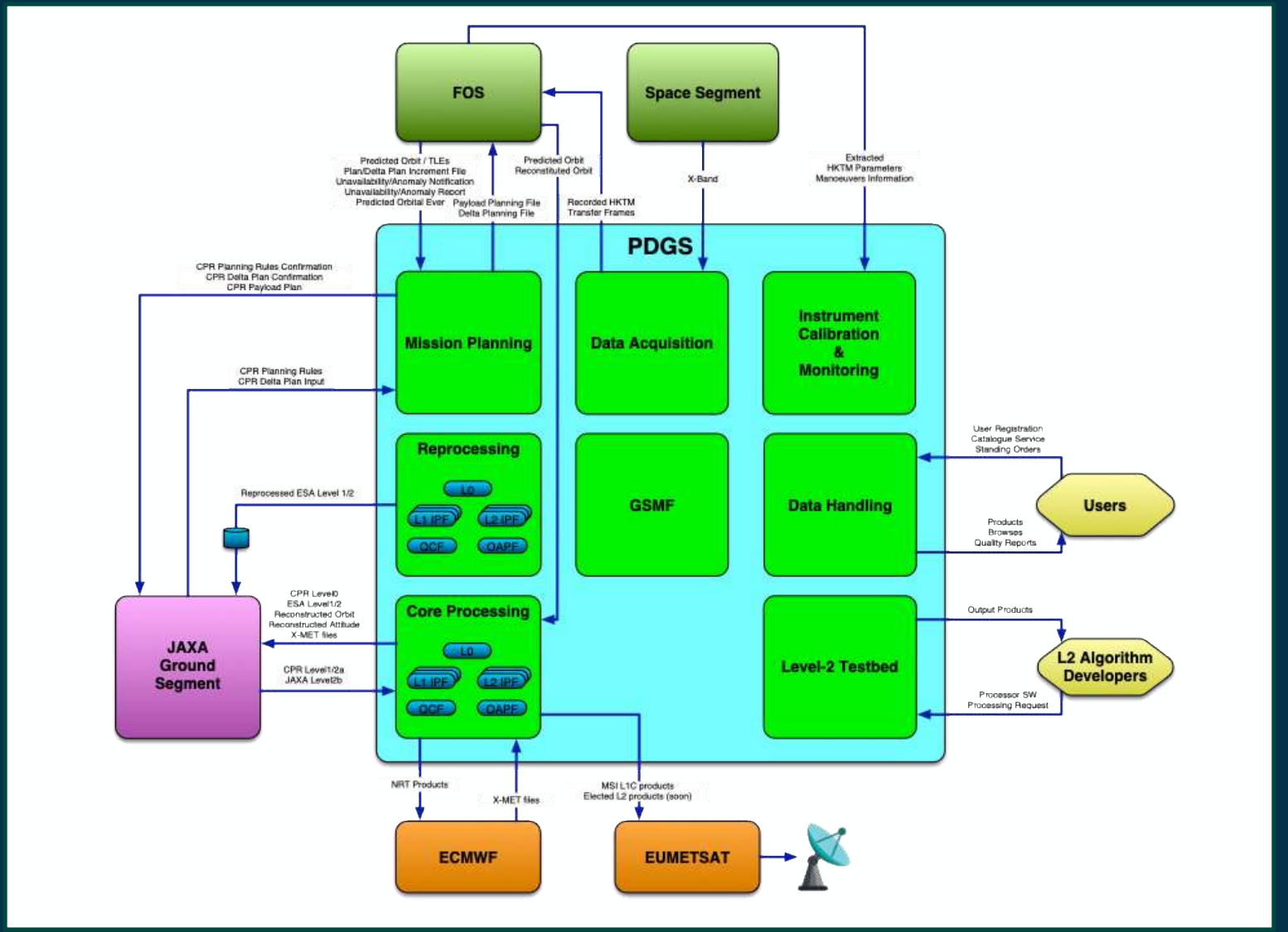
EarthCARE PDGS

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop

17-20 March 2025, ESA-ESRIN

PDGS / ECOPS Teams

PDGS Archicture



Mission Planning Facility (MPF)

Main Functions

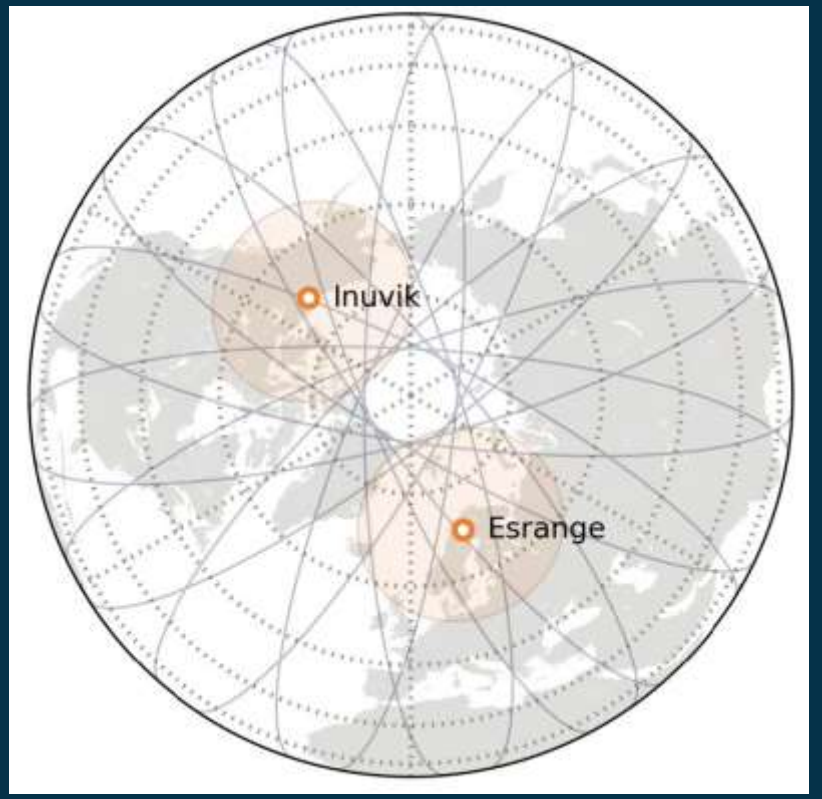
- Routine planning of X-band downlinks distributed between Kiruna and Inuvik
- Routine planning of payload activities (both ESA and JAXA CPR instruments)
- Routine planning of CPF Silent mode over Radio Astronomy Sites
- Delta-planning activities (on-board parameters updates), CPR calibrations
- Allocation of Maneuver Friendly Segments for orbit maintenance

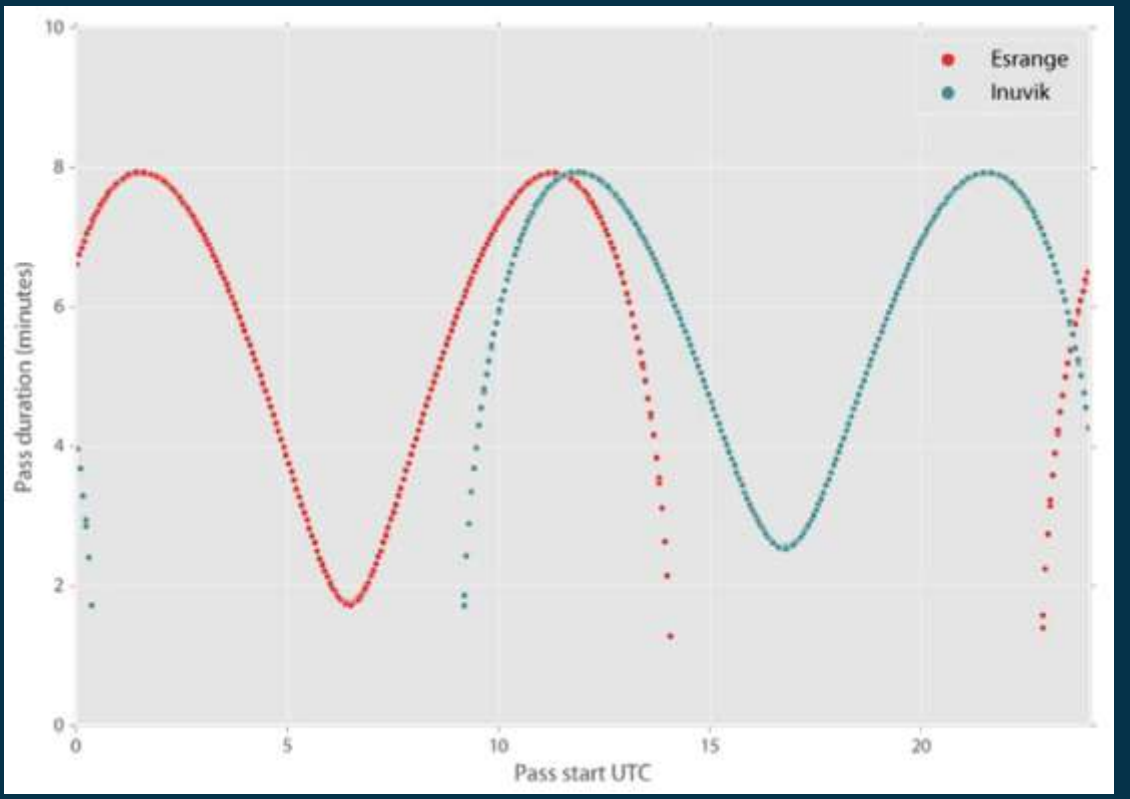
Status

- Plans generated on a weekly basis three weeks ahead
- Minor evolution on-going
  - Extra flags for planning of CPR Internal Calibration 2 (one orbit)
  - Extended CPR Sea Surface Calibration mode to stabilize ATLID alignment loop

Data Acquisition (DAF) – 1/2

- **Service Contract with Swedish Space Corporation**
- Currently 10 downlinks per day distributed between Kiruna (SE) and Inuvik (CA)
- Capacity for one downlink per orbit
- Capacity for re-dump in case of failed acquisition





Data Acquisition (DAF) – 2/2

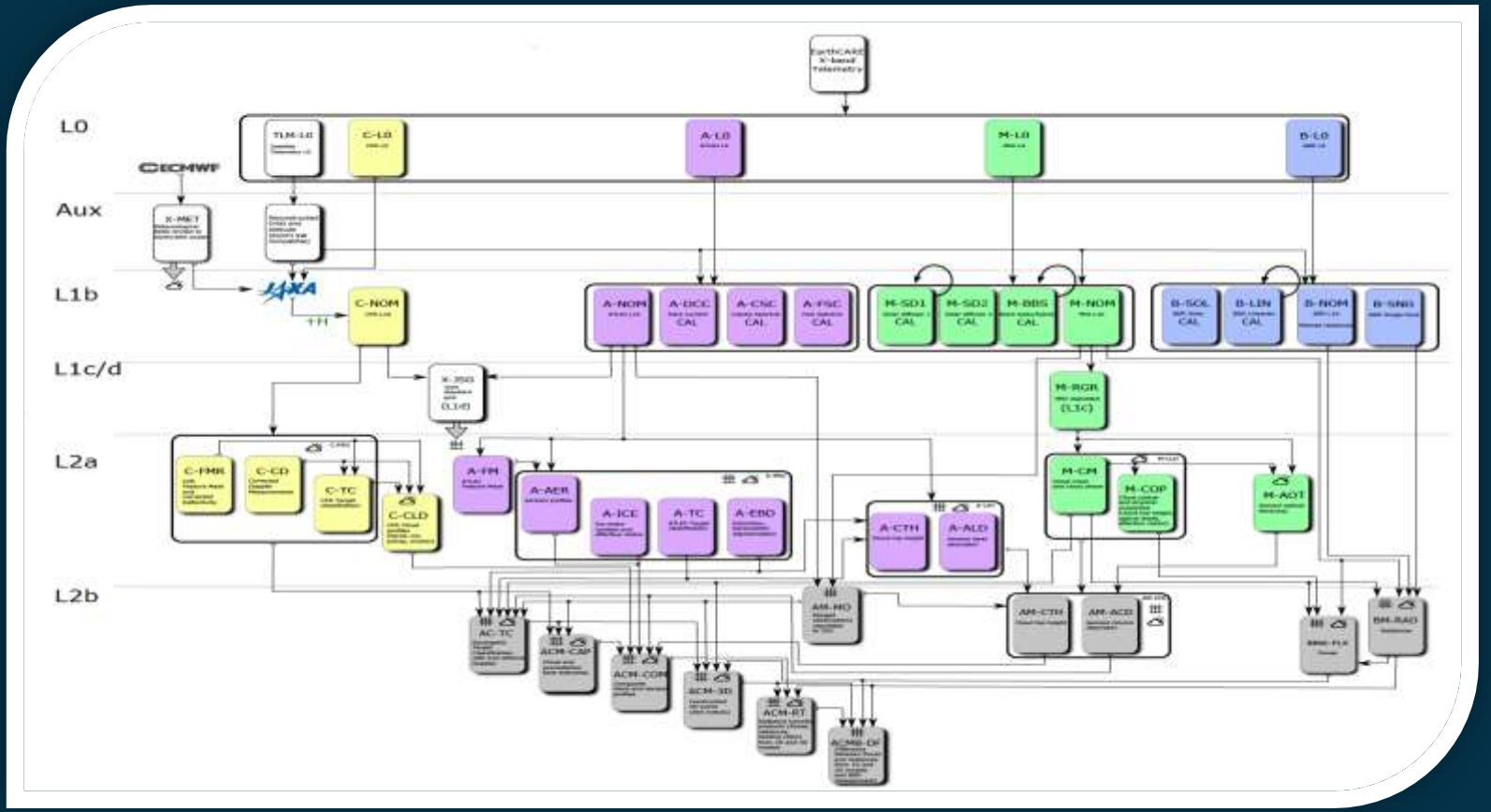
Status

- Initial degradations observed end of August / Early September 2024 solved
- Mainly related to orbital predictions. Timely delivery in place + automatic compensation of possible drift from actual antenna pointing
- Keyhole and Sun Blinding issues removed by additional checks at Mission Planning level.
- Improved monitoring
- Stable service very few anomalies reported ; mainly Radio Frequency Interferences

Core Processing Facility (CPF)

MAIN FUNCTIONS

- Systematic NRT generation of EC products from L0 up to L2B
- Limited re-processing (extensively used during phase E1)



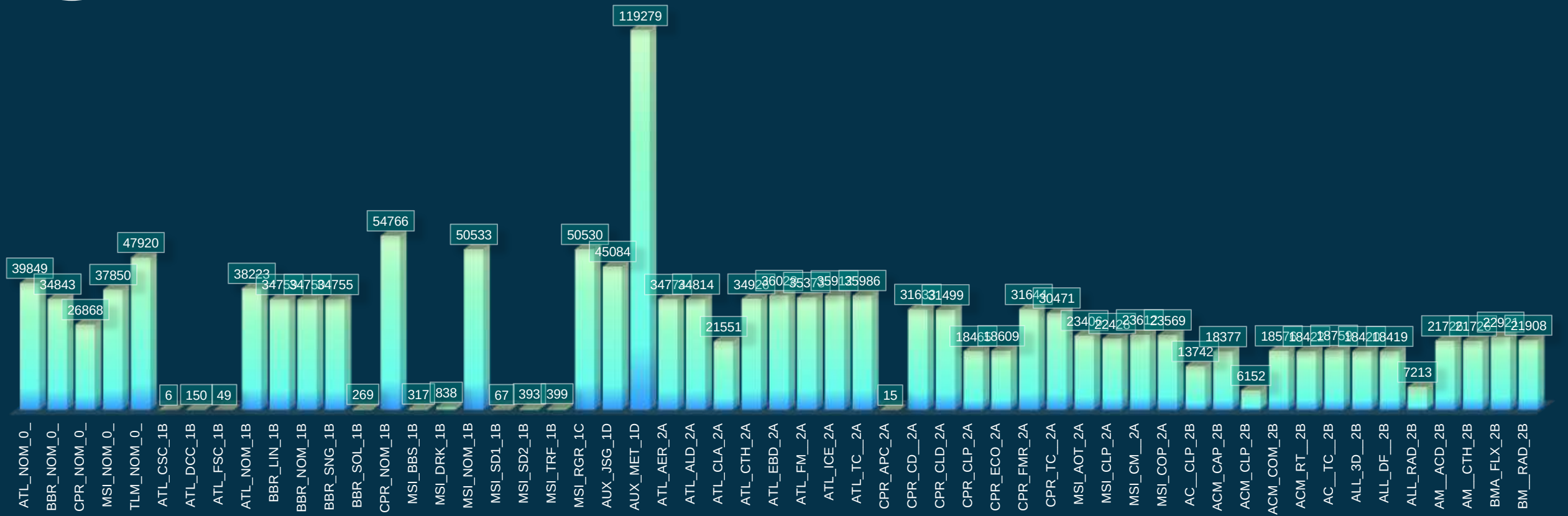
Core Processing Facility (CPF)

STATUS

- No CPF performance issues
- NRT processing can currently run on ~ 64 cores
- Extra 336 cores added to support initially re-processing and then increased resources for ACM-RT processor
- Flexible design to support processor updates with minimum delay including
  - Container technologies
  - Formal machine-readable specification of processors' interface and processing tree
  - Strong baselining concept
  - 20 processors updated since and two new processors integrated since the beginning of 2025

	LEVEL 0						LEVEL 1														LEVEL 2																							JAXA LEVEL 2							
PRODUCT	TLM_NOM_0	GEO_ATTOBS	GEO_ORBOBS	ATL_NOM_0	MSI_NOM_0	BBR_NOM_0	ATL_NOM_1B	ATL_CSC_1B	ATL_FSC_1B	ATL_DCC_1B	MSI_NOM_1B	MSI_RGR_1C	MSI_BBS_1B	MSI_DRK_1B	MSI_SD1_1B	MSI_SD2_1B	MSI_TRF_1B	BBR_NOM_1B	BBR_SNG_1B	BBR_LIN_1B	BBR_SOL_1B	CPR_NOM_1B	AUX_MET_1D	AUX_JSG_1D	ATL_FM__2A	ATL_AER_2A	ATL_EBD_2A	ATL_TC__2A	ATL_ICE_2A	ATL_CTH_2A	ATL_ALD_2A	CPR_FMR_2A	CPR_CD__2A	CPR_TC__2A	CPR_CLD_2A	MSI_CM__2A	MSI_COP_2A	MSI_AOT_2A	AM__CTH_2B	AM__ACD_2B	BM__RAD_2B	BMA_FLX_2B	AC__TC__2B	ACM_CAP_2B	ACM_COM_2B	ALL_3D__2B	ACM_RT__2B	ALL_DF__2B	ATL_CLA_2A	MSI_CLP_2A	AC__CLP_2B	ACM_CLP_2B	ALL_RAD_2B	CPR_ECO_2A	CPR_CLP_2A
BASELINE ACTIVATIONS																																																	
AA																																																	
AB		06/21																				Launch		10/23	11/13							12/19	02/13		12/19		12/18						#####	02/13				12/16			09/10	Launch	12/19
AC		09/20				09/02		10/07				09/20							09/02			08/07		02/13	11/29										03/11	02/13			03/11										07/08	
AD								01/13				10/03							01/13			09/11			03/11	02/13																									
AE								03/11				01/13										09/19				03/11																									
AF												01/27										10/23																													
BA																						11/06																													
BB																						12/05																													
CA																						01/01																													

PDGS: number of products since launch



~ 1.400.00 products (rate: 9800 products/day)

~ 86 TB (rate ~ 600GB/day)

Instrument Calibration and Monitoring Facility (ICMF)

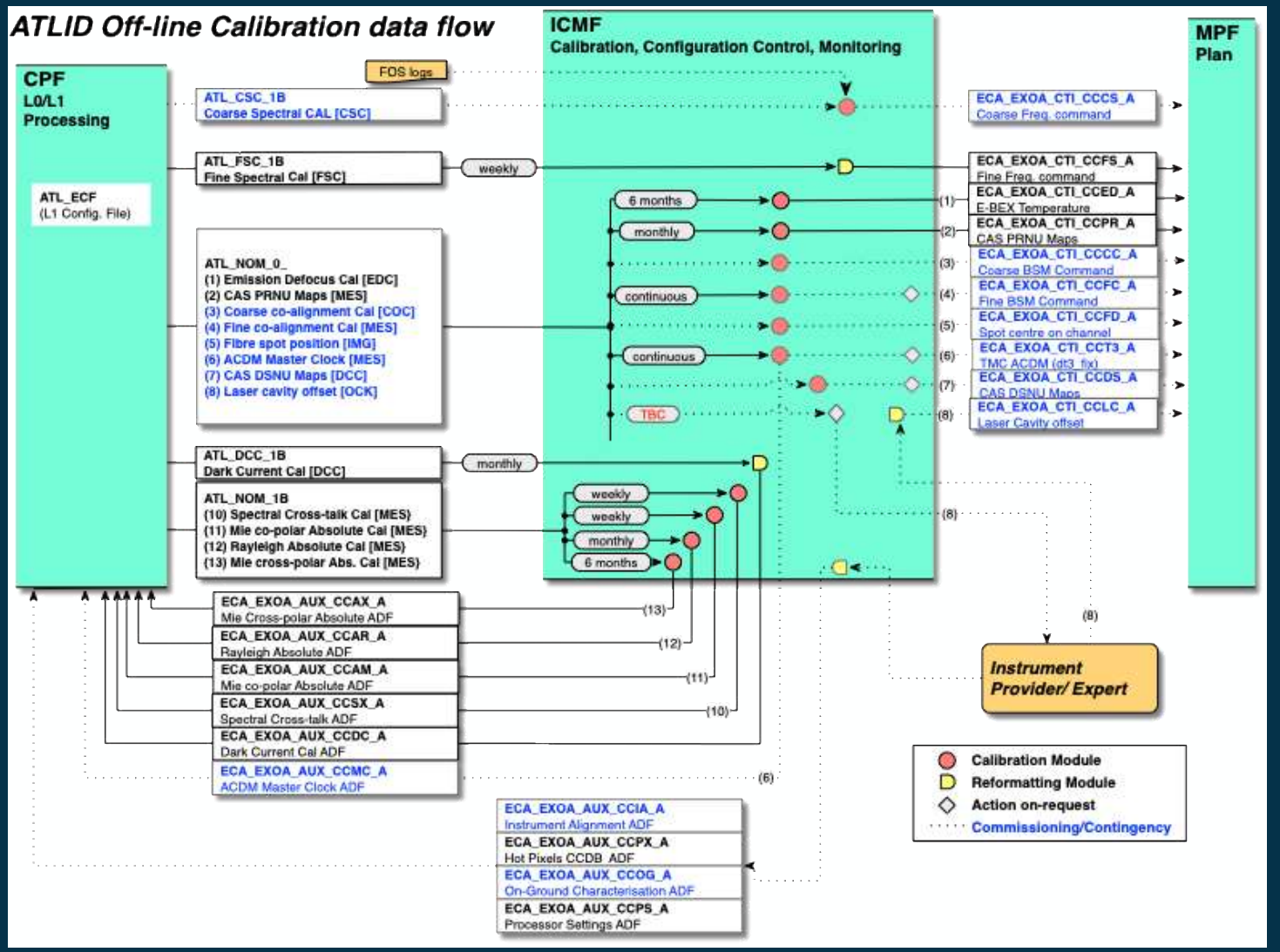
Main Functions

- Systematic processing of in-flight calibration data
- ESA payload monitoring and trend analysis
- Products quality control
- Regular update of:
  - Calibration products for L1 processing at Core Processing Facility
  - Update of on-board settings (e.g. ATLID frequency, BBR black-bodies temperature) as need – NB never used so far.

Status

- ICMF now part of the DISC service contract (Data, Innovation, and Science Cluster)
- Constant improvement of Calibration processors

Instrument Calibration and Monitoring Facility (ICMF)



Data Handling Facility (DHF) 1/2

Main Functions

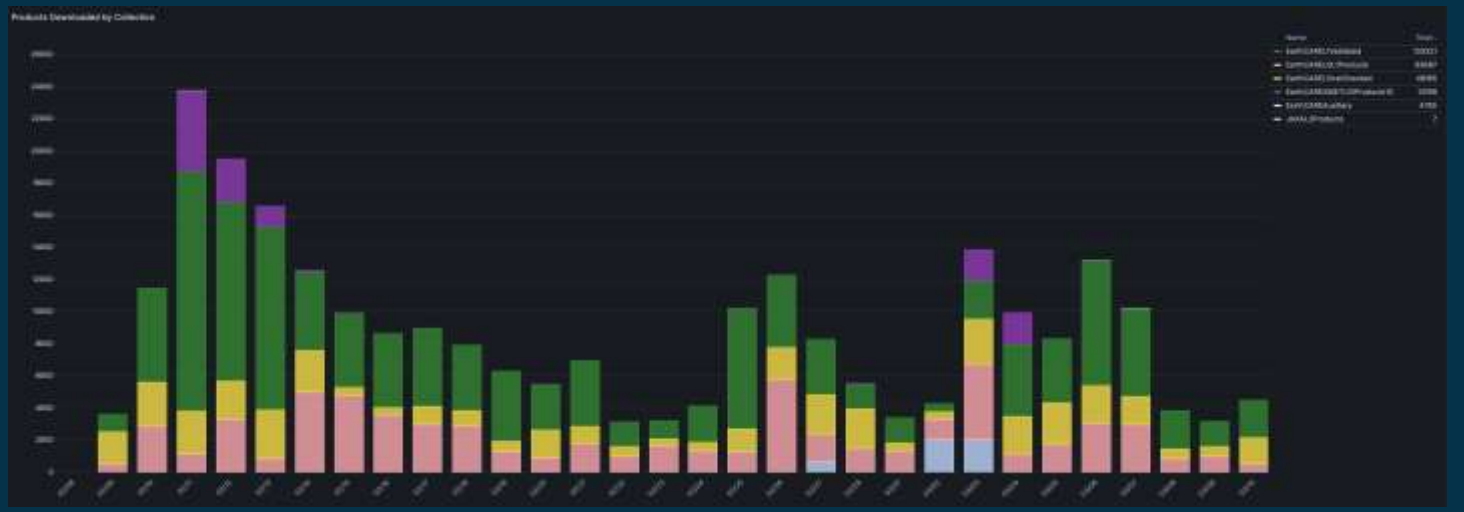
- Ingestion of all EarthCARE products
- Generation of browses and metadata files
- Products on-line dissemination
- Interface with backup and cold backup archive

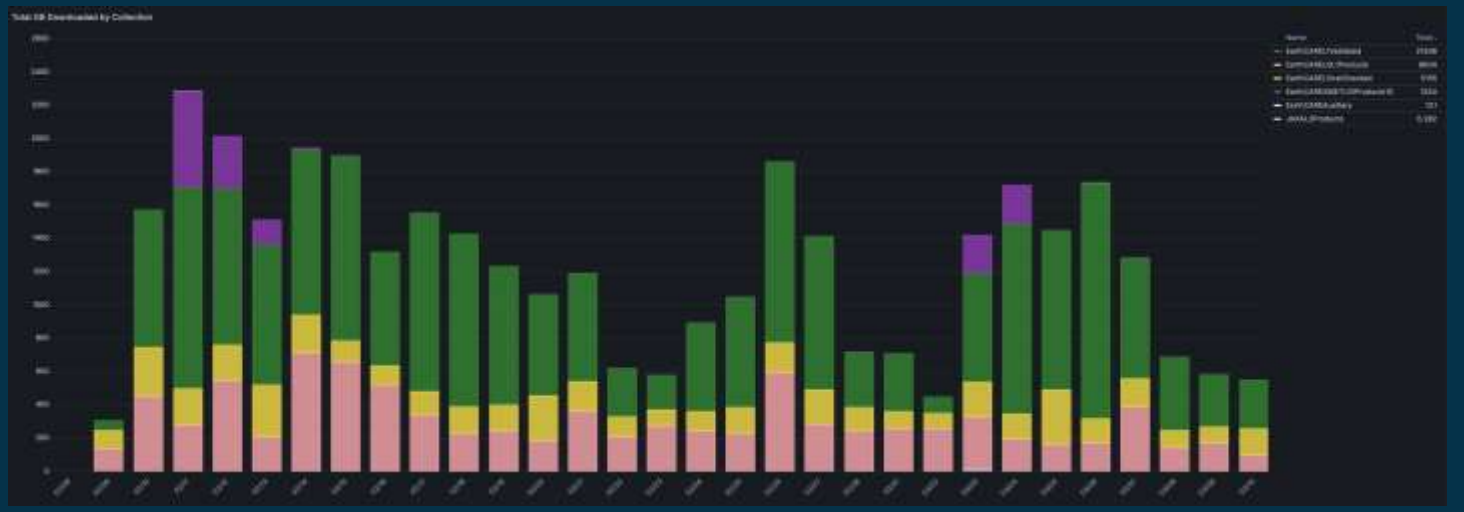
Status

- Two stable servers at the following links:
  - ESA EarthCARE Online Dissemination-1 Service
  - ESA EarthCARE Online Dissemination-2 Service
- 411 total registered users with:
  - 108 Registered Commissioning users
  - 303 Registered CAL&VAL users authorized to access the data
- Growing number of general users following free and open access to:
  - L1 products on 14/01/2025
  - L2A and two sensors L2B product on 17/03/2025 (today)
- Digital Object Identifier (DOI) now assigned to each individual product type/baseline

Data Handling Facility (DHF) 2/2

Data dissemination access L1 products (February 2025)



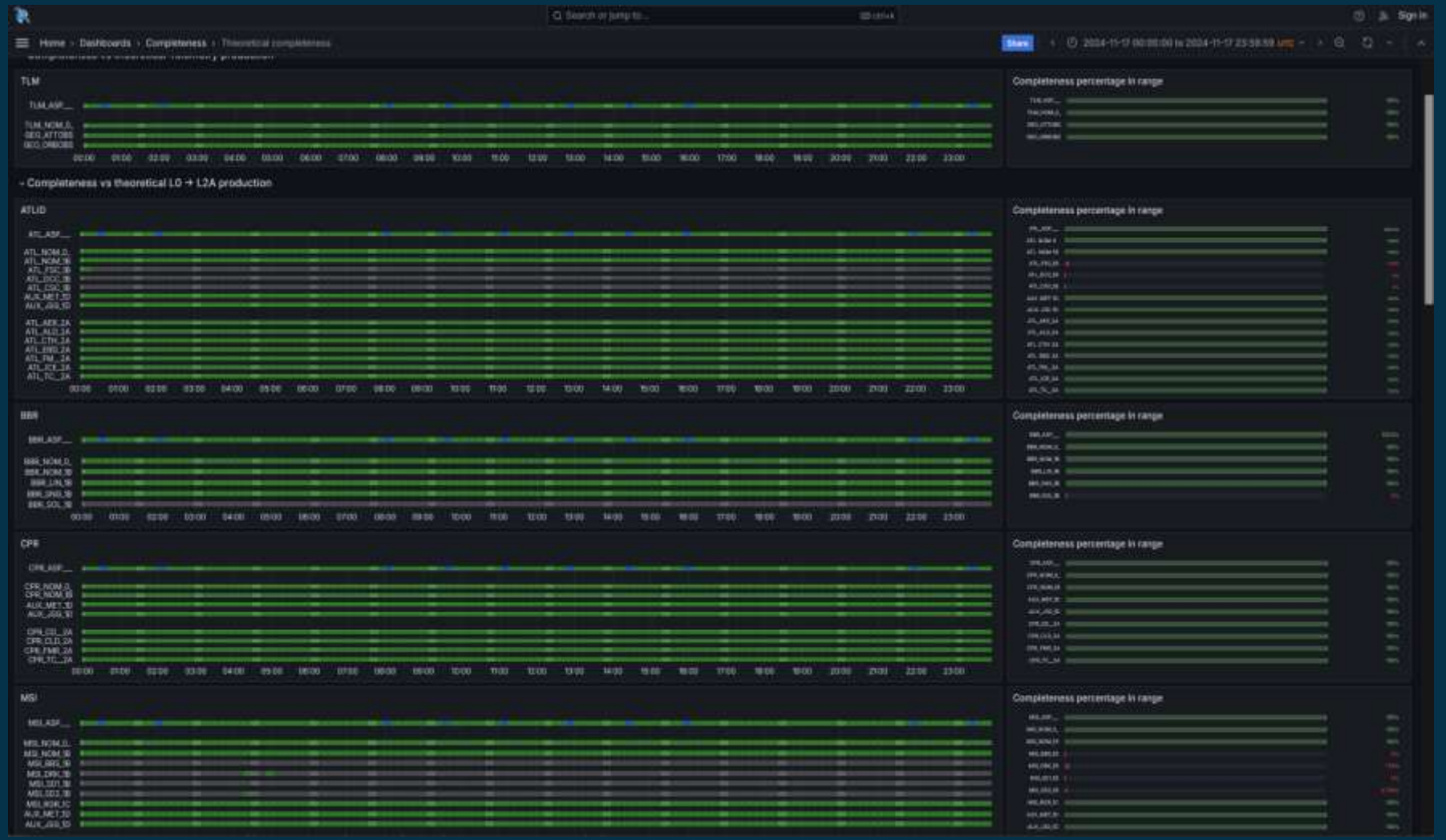


Data Handling Facility (DHF) 2/2

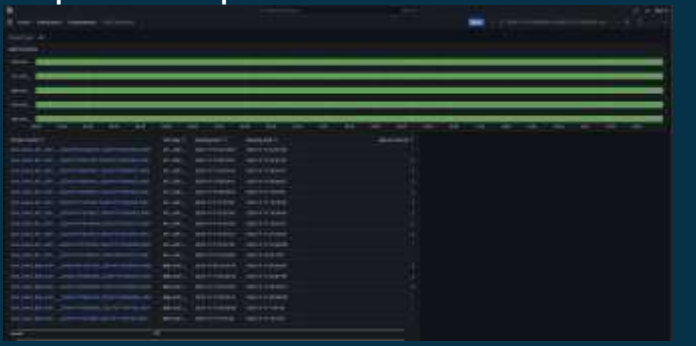
Data dissemination access L2 products (February 2025)

Ground Segment Monitoring Facility - GSMF

Production completeness



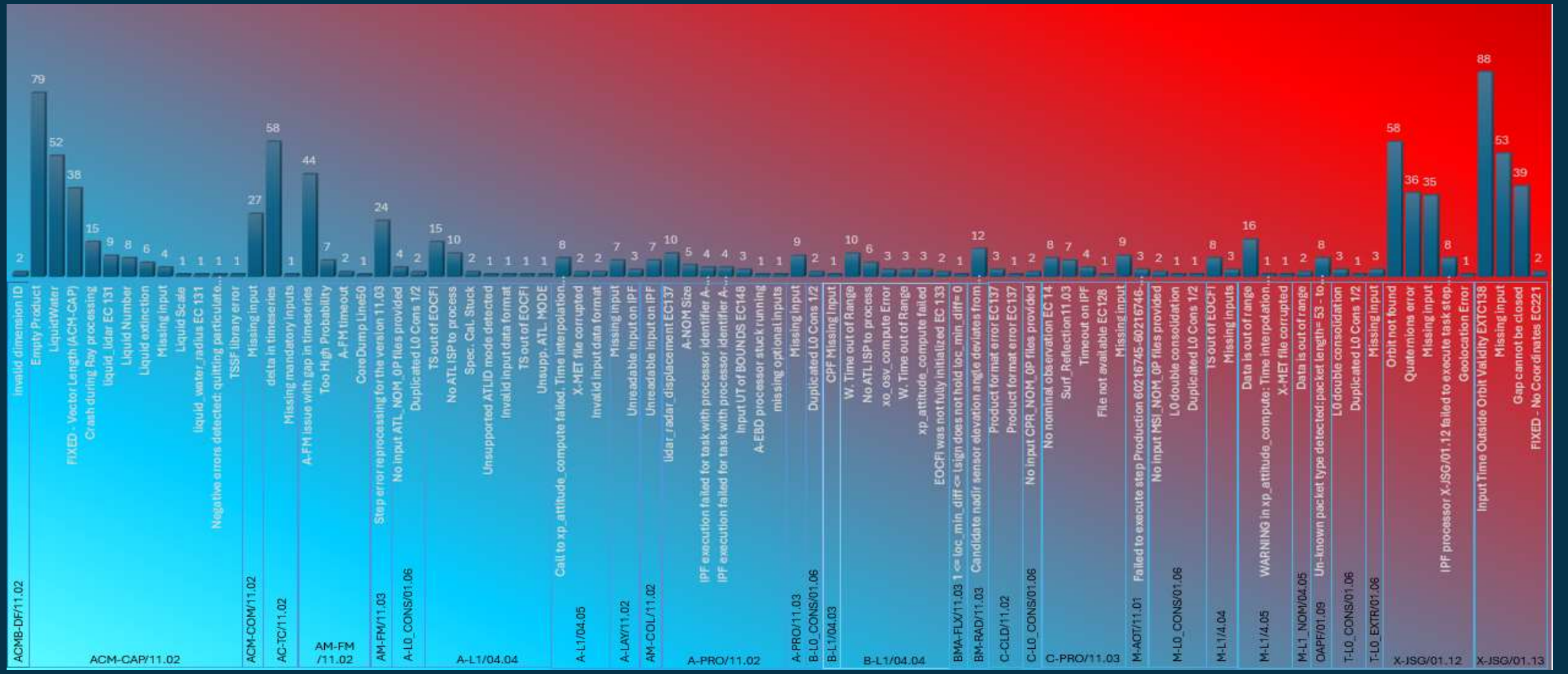
Acquisition completeness



Dissemination completeness

Production performance

Core Processing Facility – Historical Errors by processor < 100 per type



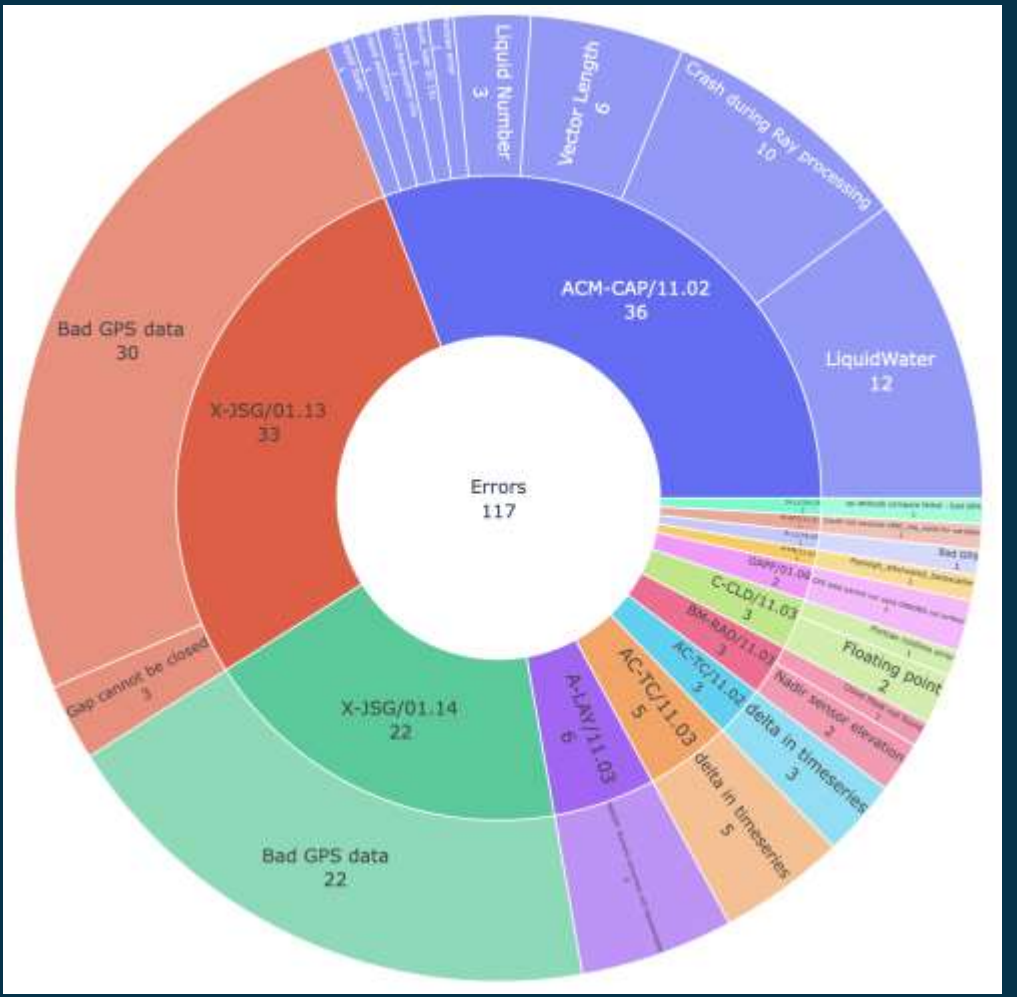
Core Processing Facility – Latest errors

Continuous monitoring of processing errors and

Detection of new error types

All errors tracked by dedicated tickets

#Errors	Error Description	proc	Tracking
18	Numeric conversion: LiquidWater, liquid Scale, Liquid Lidar , Liquid Extintion, Liquid Number	ACM-CAP/11.02	ECL2-1482 RedMine 2162
6	Vector Length	ACM-CAP/11.02	ECL2-1475 RedMine 2165
10	Crash during Ray processing	ACM-CAP/11.02	ECL2-1471 RedMine2012
1	Fortran error	ACM-CAP/11.02	ECL2-1471 RedMine2050
1	Numeric conversion ATLID_backscatter_mie	ACM-CAP/11.02	ECL2-1482 RedMIne2162
8	delta in timeseries	AC-TC	ECL2-1481 RedMine2105 - 1658
1	Infinite values in input: rayleigh_attenuated_backscatter	A-FM/11.03	ECL2-1488 RedMine1571
6	NetCDF: Numeric conversion not representable	A-LAY/11.03	RedMine2154
1	Error while computing sensing time from inputs and configuration	B-L1/04.05	Redmine#1965 bad GPS data
2	Candidate nadir sensor elevation angle deviates	BM-RAD/11.03	ECL2-1499 Redmine2195
1	Variable cloud_mask not found	BM-RAD/11.03	E2ECL2-8 RedMine2200
2	Floating_point_exception_err_arithmetic_operation	C-CLD/11.03	RedMine2048
1	Fortran runtime error	C-CLD/11.03	RedMine#2083
1	Could not execute nf90_inq_varid for variable	M-AOT/11.01	E2ECL2-7 RedMine2202
1	xp_attitude_compute failed -bad GPS	M-L1/04.05	RedMine#1380 Bad GPS data
2	GPS data packet not valid ORBOBS not written	OAPF/01.09	bad GPS data
52	Input Time Outside Orbit Validity - bad GPS	X-JSG/01.13	ECAUX-364 bad GPS data
3	Gap cannot be closed	X-JSG/01.13	ECAUX-371 RedMine1384



Other Facilities

L2TB

- Operational
- Open to Cardinal Users for testing of processor prior to integration at PDGS
- Supports Jupyter Notebooks
- Now part of DISC Contract
- Successfully used to test new processing chain C-APC / C-PRO
- Has become standard tool for testing/delivery of new processors

Reprocessing

- Initial reprocessing done directly at CPF which supports multiple production trees running in parallel
- Activities with “main” re-processing service (DAMPs) initiated

Operational set-up – phase E2

PDGS operated by different service contracts including:

- E-COPS (Core PDGS Operations Service)
  - Core PDGS (CPF, MPF, GSMF and XMET application at ECMWF) operations and maintenance
  - End-to-end system monitoring
- DISC (Data, Innovation, and Science Cluster)
  - ICMF and L2TB operations and maintenance
  - Products quality control
  - Processors Maintenance and Evolution
- Data Acquisition Service
  - X-Band data acquisitions over Kiruna and Inuvik
- Common Services
  - Data dissemination and Users' front-ends (EO-CAT, SX-CAT)
  - Backup and Cold backup
  - User Helpdesk
- HCINSS (Hybrid Cloud Infrastructure Network & Security Services)
  - Network, Infrastructure, Security

All services in place with efficient inter-relations supported by intensive ramp-up during phase E1

Conclusion - next step

All PDGS components and functions stable at the beginning of phase E2

Limited number of incidents solved with minimum delay (barely visible to end-users)

Up-coming activities (short term)

- Orbit and attitude processor update to cope with GPS outages
- Update of 3 and 4 sensors L2B processors (within the coming weeks)
- Complete re-processing campaign (all L1 and L2 from beginning of mission)
- Explore additional product dissemination options for users requiring large amount of data

Useful Links

EarthCARE Mission page:

https://earth.esa.int/eogateway/missions/earthcare

How to access EarthCARE products ?

https://earth.esa.int/eogateway/faq/esa-earthcare-online-dissemination-service-user-s-guidelines

Dissemination servers (EarthCARE specific)

- L1; JAXA L2 products: https://ec-pdgs-dissemination1.eo.esa.int/oads/access/collection
- ESA L2 products: https://ec-pdgs-dissemination2.eo.esa.int/oads/access/collection

EOCAT (Multi-mission):

https://eocat.esa.int/sec/#data-services-area

Thanks for your attention