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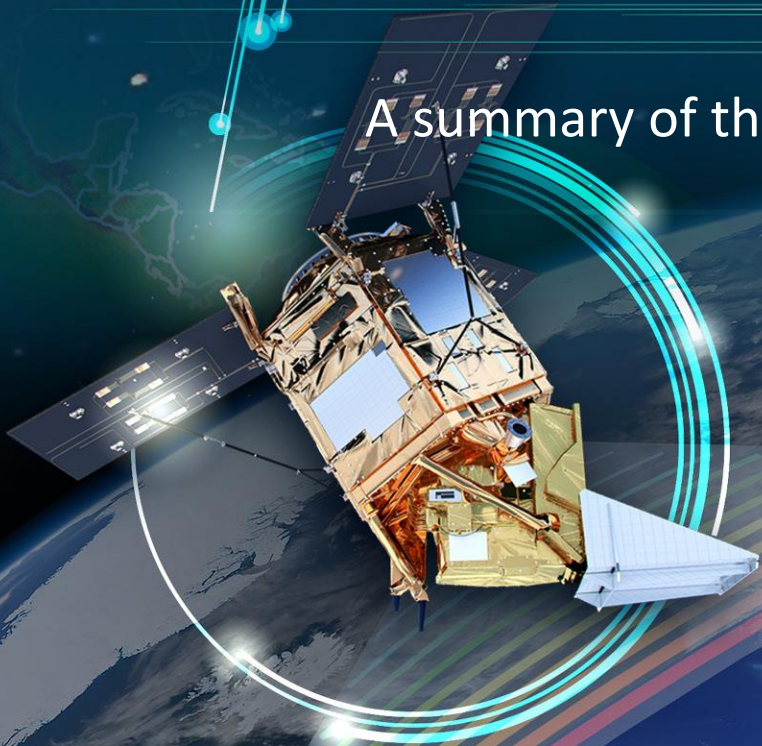


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Sentinel-5p PDGS Operations

A summary of the PDGS Operations, Long Term Archive and Mission Reprocessing



Introduction



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- Summary
- Near Real Time (NRT) and Offline Processing;
- Archive Sizes;
- LTA integrity;
- Mission Reprocessing Status

Summary



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- PDGS Operated by DLR at Oberpfaffenhofen, Germany.
- Responsible for
 - Operations of the PDGS for generating Near Real Time, Offline and Reprocessing;
 - Retrieval and generation of auxiliary data;
 - Archive and maintenance of the Long Term Archive;
 - Configuration of the PDGS and integration and verification of CFIs;
 - New releases of PDGS software (nominally every four months).

Operations 2021-2022



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- Operations have mostly continued nominally
- No interruption to NRT or offline operations during Covid-19 pandemic
- Introduction of O3 PR product generation

PDGS: Performance 2022



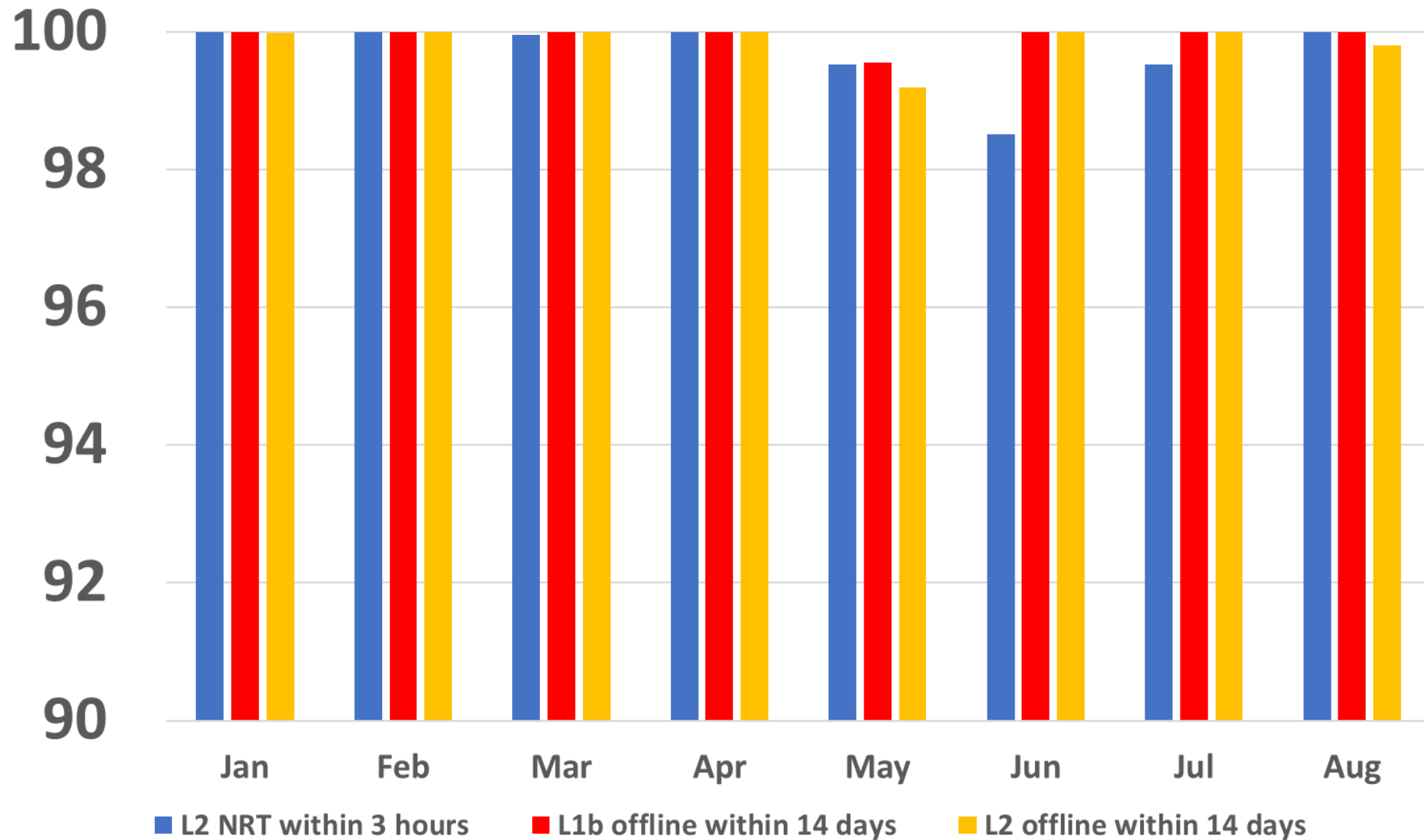
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S5p PDGS Dissemination Performance 2022 (%)



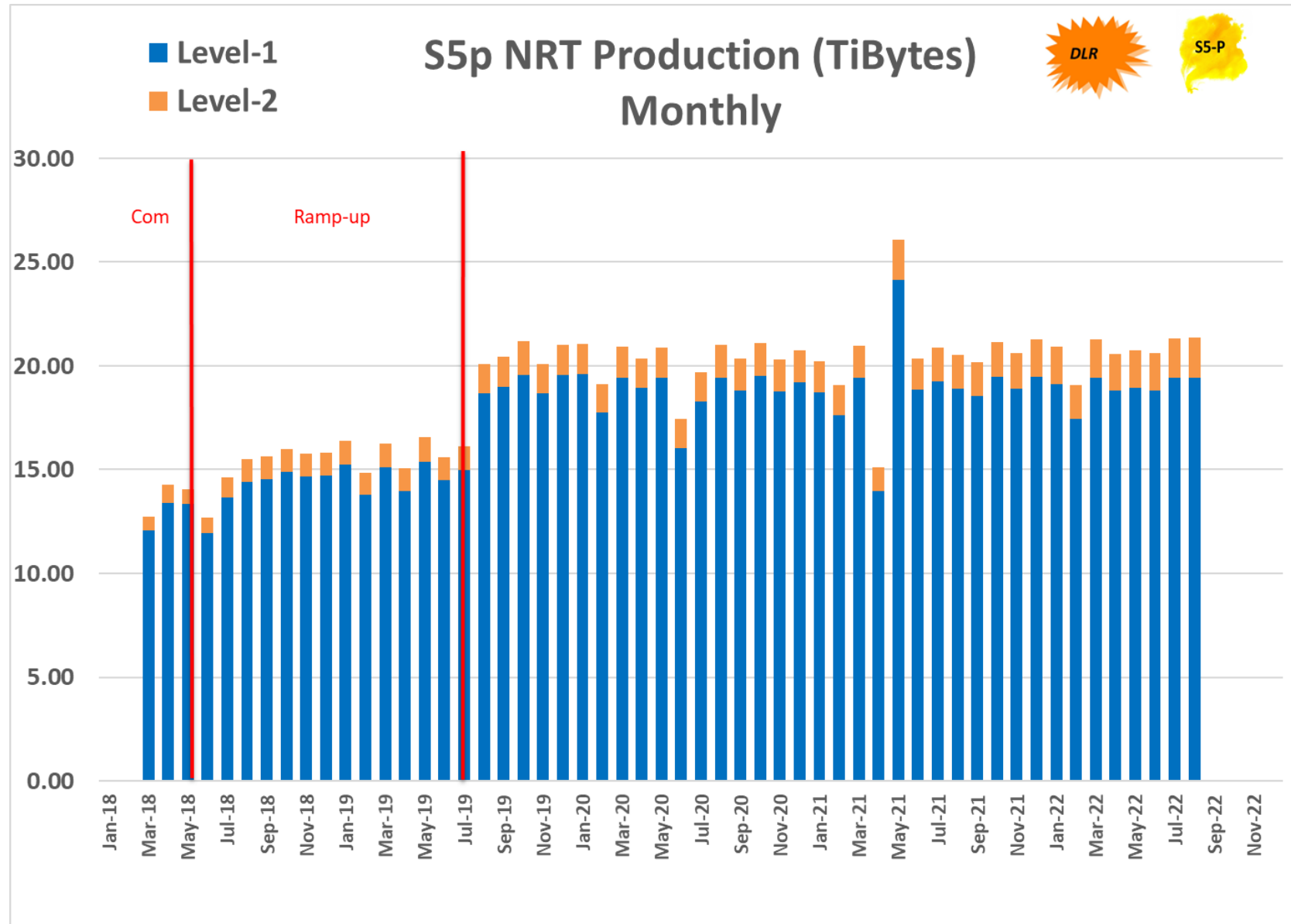
PDGS: NRT Production



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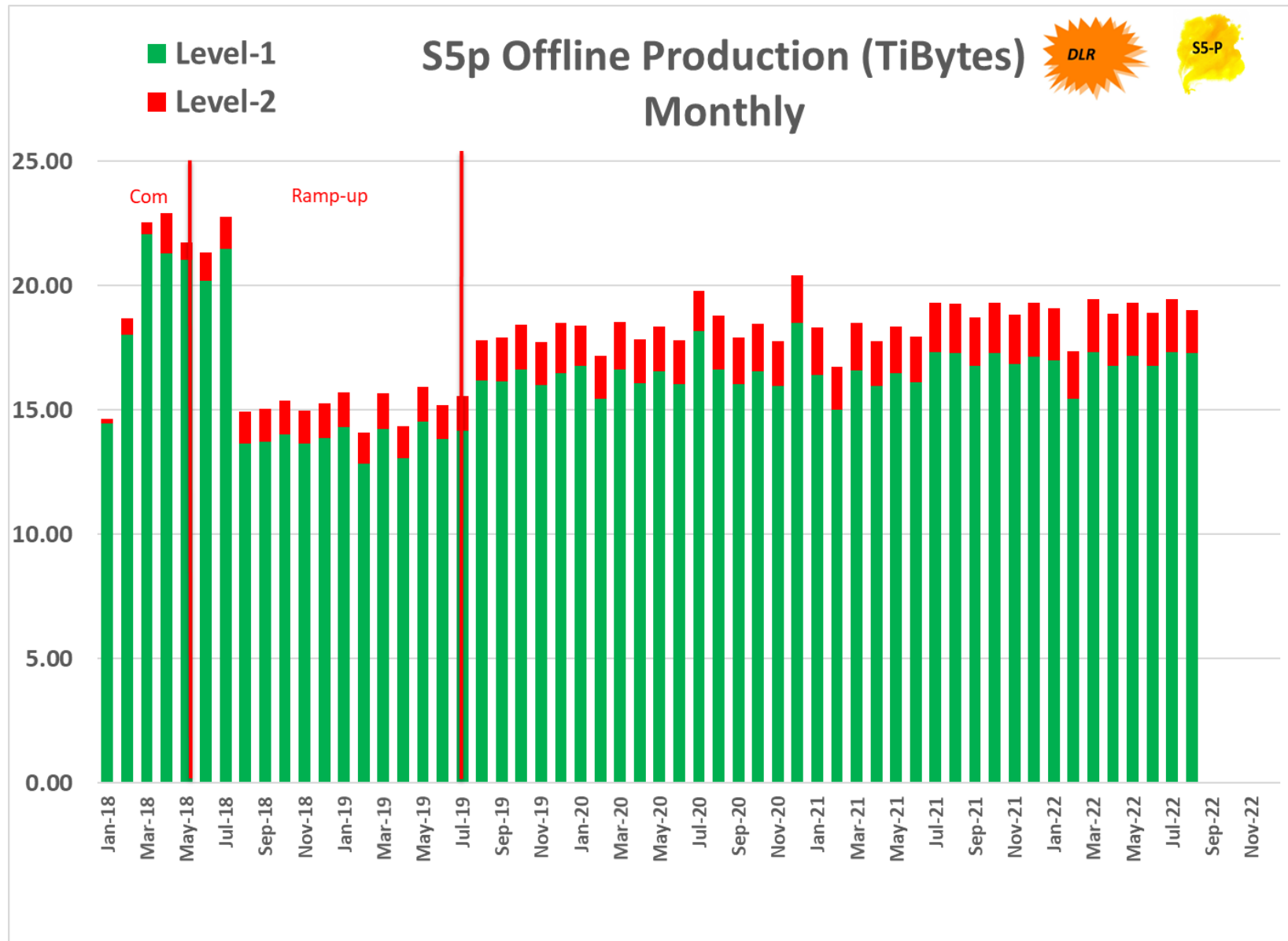
PDGS: Offline Production



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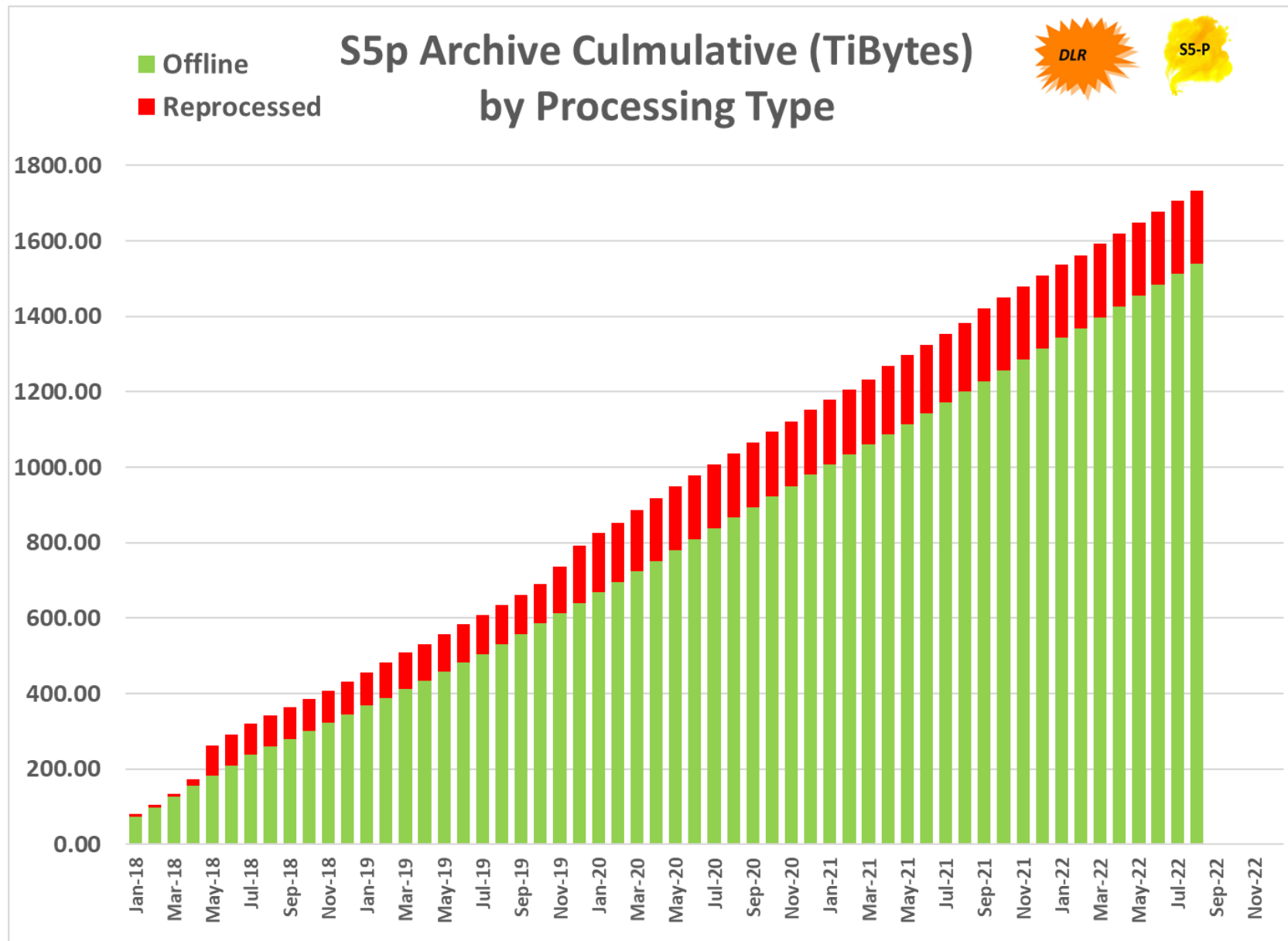
Long Term Archive: Progression



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Long Term Archive: Volume



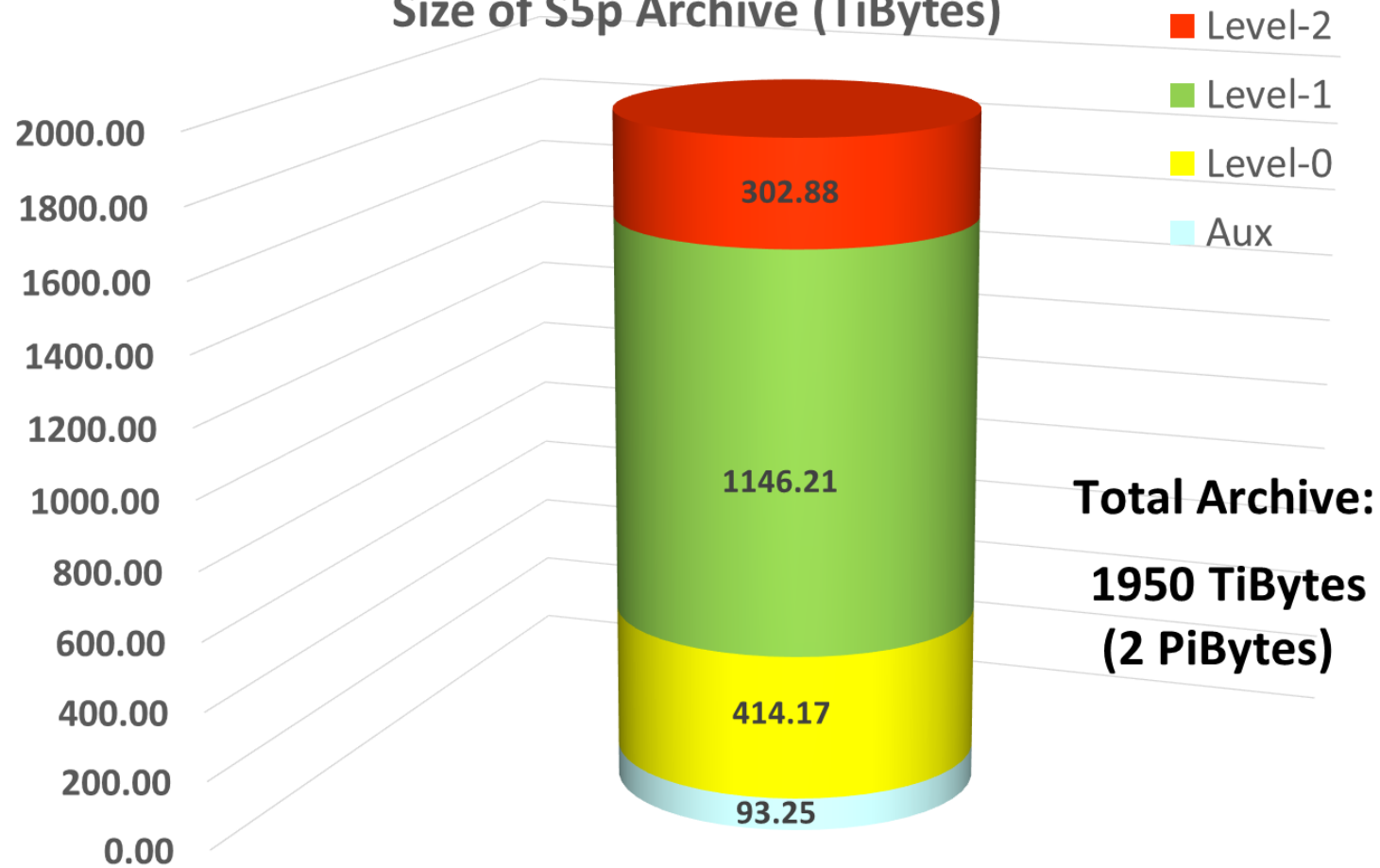
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Size of S5p Archive (TiBytes)



Long Term Archive: Number of products



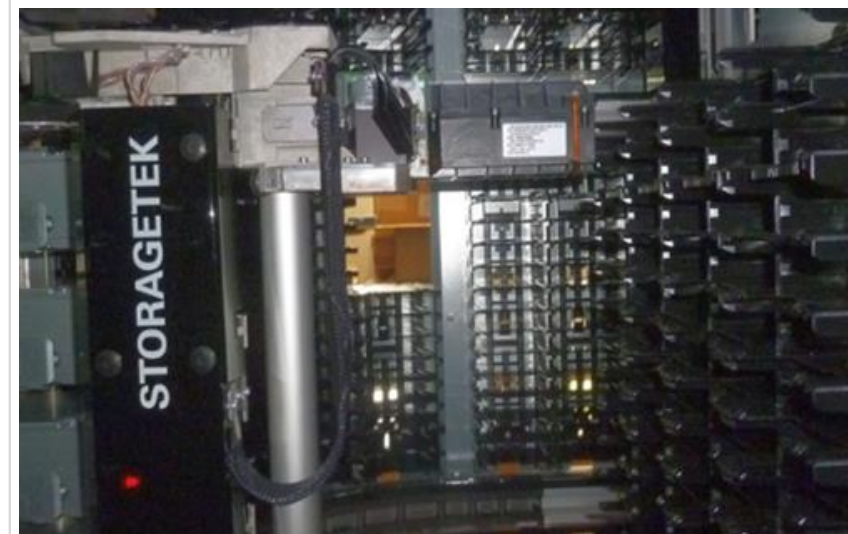
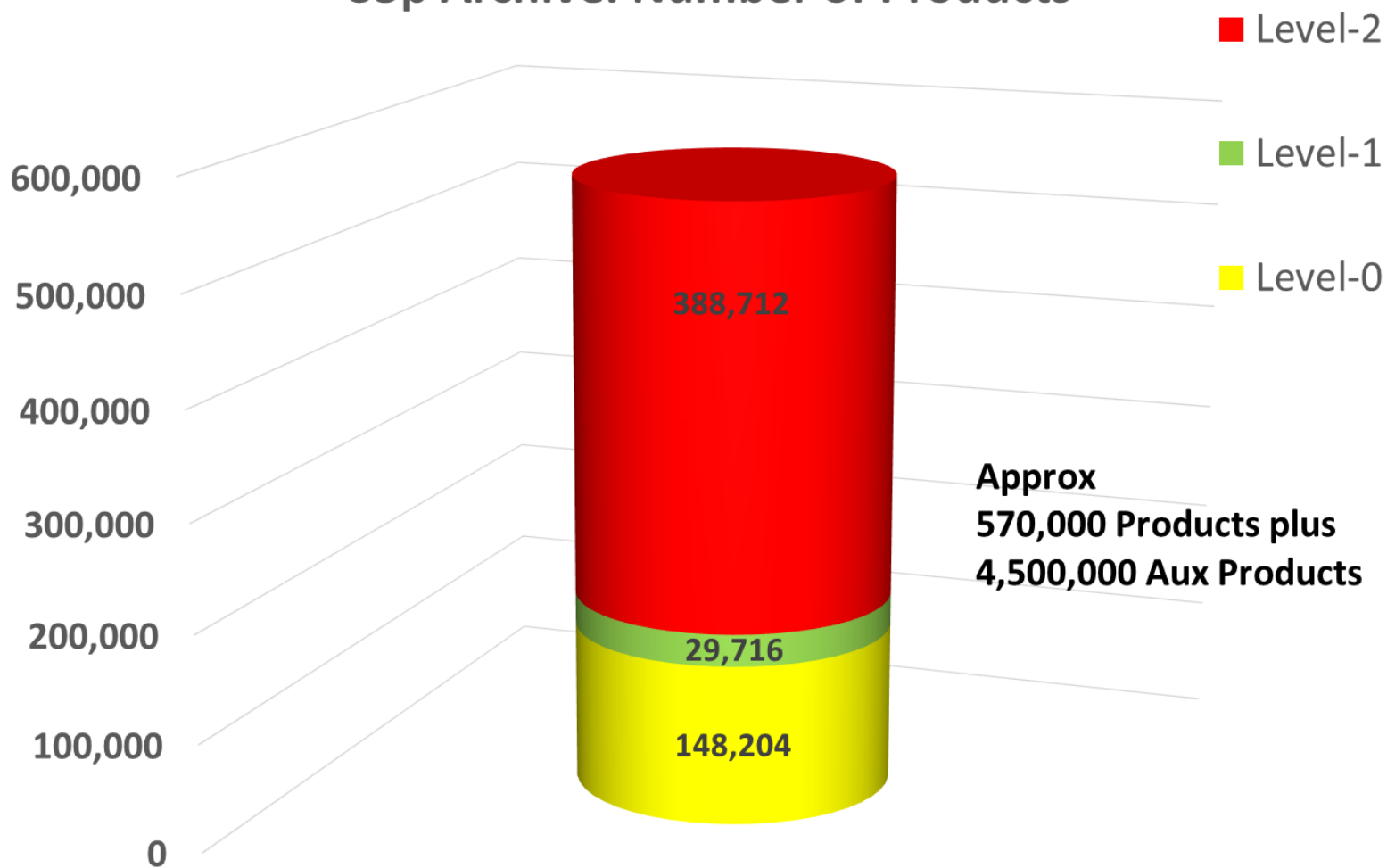
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S5p Archive. Number of Products



LTA Integrity



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- Tape-based libraries designed for minimum loss;
- Two copies of the data physically separated;
- Each copy different technology;
- Regular checks on the integrity of the data (Random read from archive - approximately 1000 media per month – no errors found);
- No data loss events.



Increasing the S5p Archive Resilience



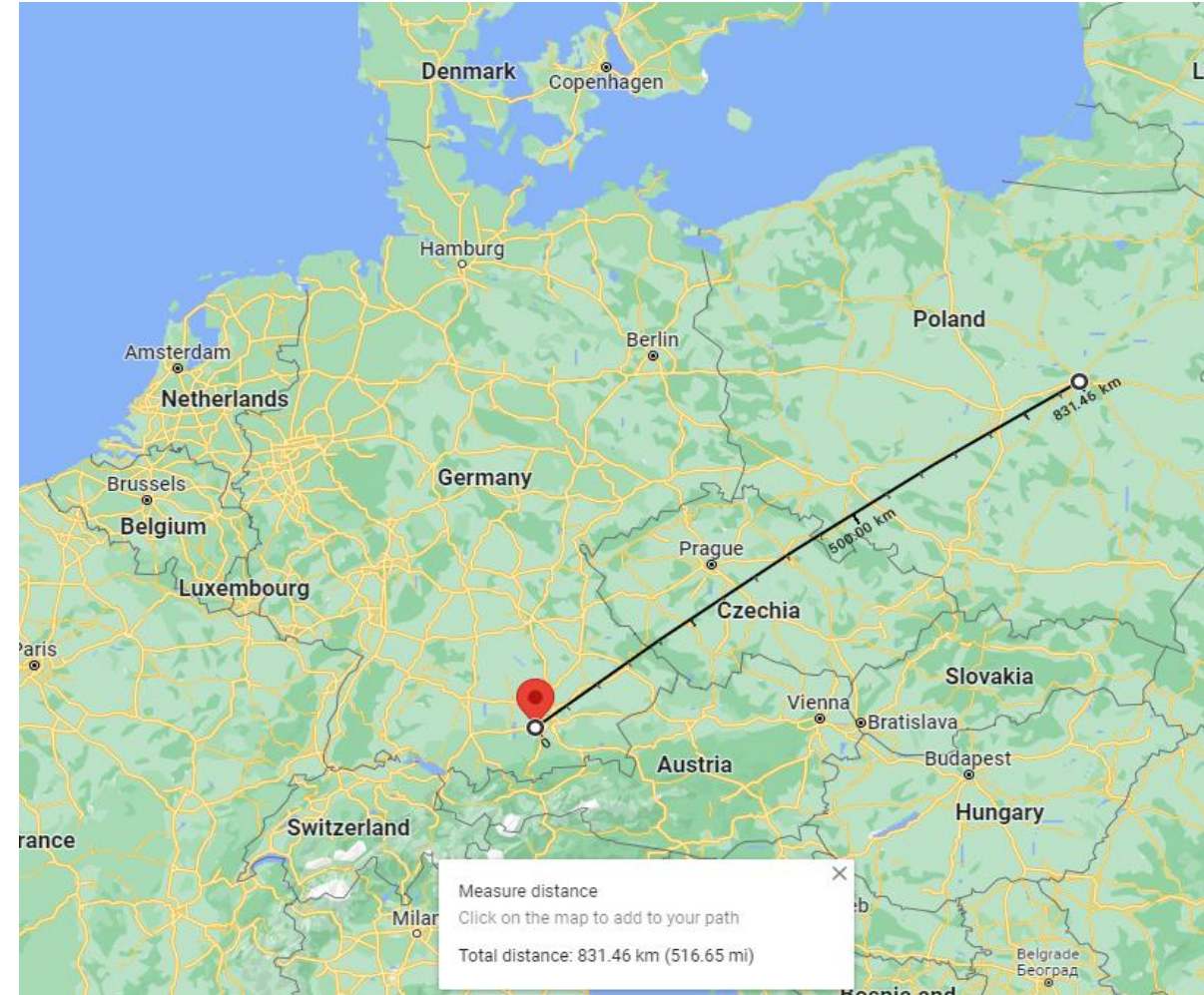
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- Copy of all Sentinel-5p Level-0 products also now archived at CloudFerro for extra security
- DLR and CloudFerro separated by 830km
- Operational since 10th June 2022
- All historical data to be transferred by 2023Q1
- CloudFerro archive is cloud-based.
- New Sentinel-5p archive is alongside existing Sentinel-1, Sentinel-2 and Sentinel-3 Long Term Archives



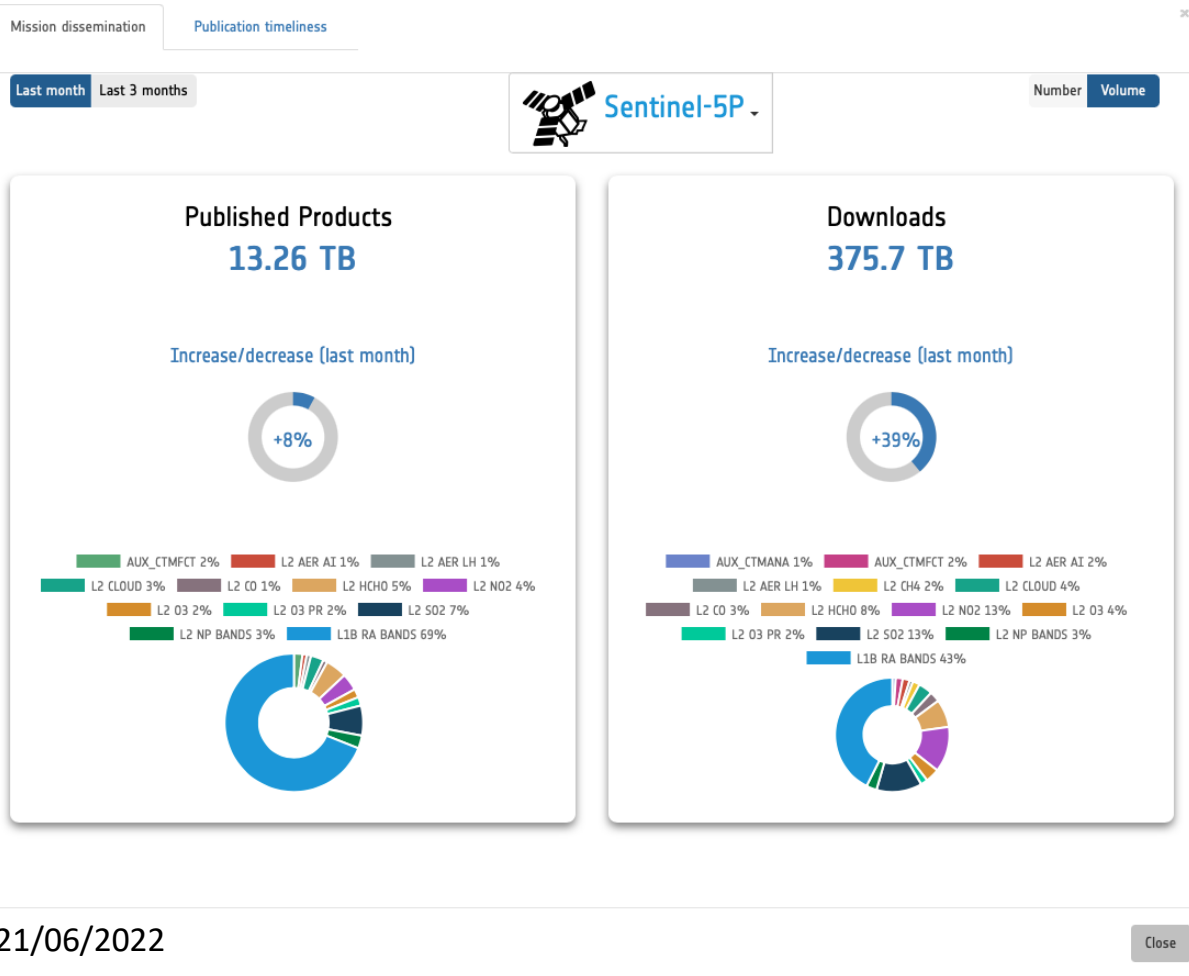
S5P Hub Download Statistics



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• From start of operations to 31/03/2022 S5P data downloaded:

- 63,791,688 products for a total volume of
- 12.5 PiB

User Uptake Demographics



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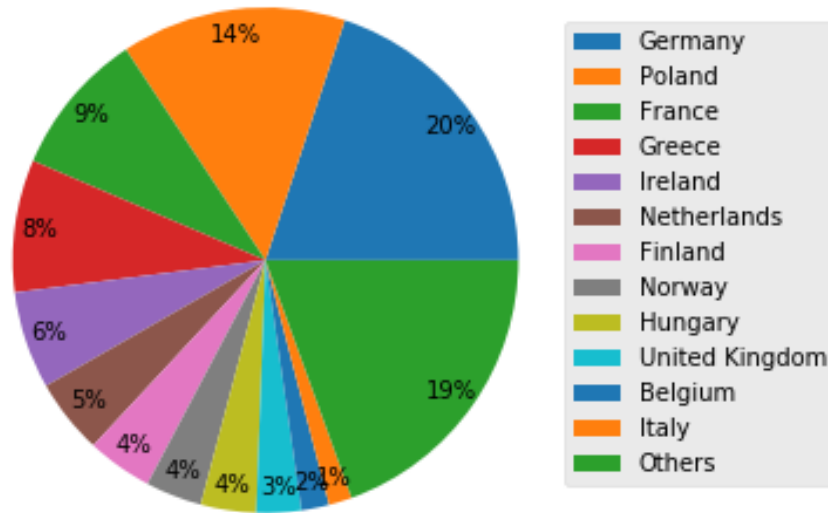


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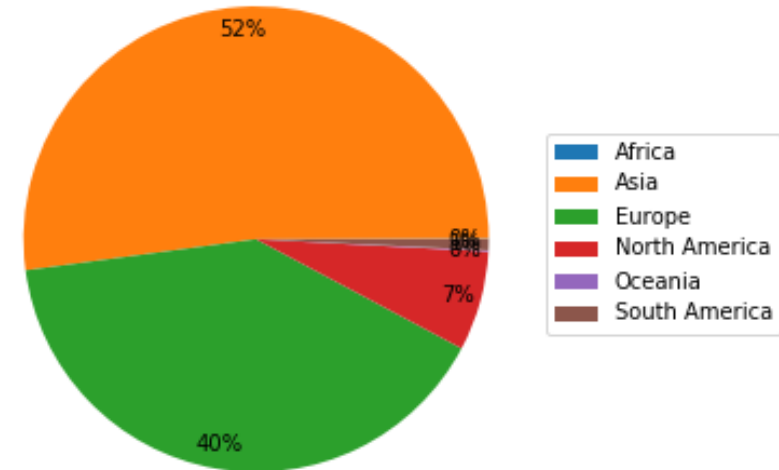


- Analysis based on IP address lookup on last month of downloads
- 141 Countries accessing S5P Hub
- Significant increase in user uptake from Asia (52% from 5% last year)

% S5P Downloads per European Country



% S5P Downloads per Continent



User Interest



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Level	Timeliness	Product Type	Number of Published User-level data since Start of Operations	Number of Downloaded User-level data since Start of Operations	Archive Exploitation Ratio
Level 1B	NTC	[ALL]	151,273	2,583,737	1 : 17.1
		L2__AER_AI	219,372	5,813,807	1 : 26.5
		L2__AER_LH	140,998	1,927,022	1 : 13.7
		L2__CLOUD_	219,245	2,797,326	1 : 12.8
		L2__CO	194,455	7,482,104	1 : 38.5
		L2__HCHO	204,118	4,095,886	1 : 20.1
		L2__NO2	218,869	8,289,284	1 : 37.9
		L2__O3	219,115	5,058,343	1 : 23.1
		L2__O3_PR	1,148	9,979	1 : 8.7
		L2__SO2	204,115	5,030,755	1 : 24.6
Level 2	NRT	[ALL]	1,621,435	40,504,506	1 : 25.0
		L2__AER_AI	17,851	883,528	1 : 49.5
		L2__AER_LH	18,621	583,132	1 : 31.3
		L2__CH4	18,523	2,307,388	1 : 124.6
		L2__CLOUD_	22,855	682,778	1 : 29.9
		L2__CO	19,227	1,740,816	1 : 90.5
		L2__HCHO	19,410	944,419	1 : 48.7
		L2__NO2	20,012	2,644,129	1 : 132.1
		L2__NP_BD3	19,842	442,130	1 : 22.3
		L2__NP_BD6	19,146	376,799	1 : 19.7
	NTC	L2__NP_BD7	19,064	399,704	1 : 21.0
		L2__O3	22,254	1,004,473	1 : 45.1
		L2__O3_PR	180	1,560	1 : 8.7
		L2__O3_TCL	1,331	96,581	1 : 72.6
		L2__SO2	19,717	1,034,192	1 : 52.5
		[ALL]	238,033	13,141,629	1 : 55.2
		[ALL NRT + NTC]	1,859,468	53,646,135	1 : 28.9

- Archive Exploitation Ratio describes the (average) time each product has been downloaded since mission start (grouped by product type)
- L1B 1:17 (compared to 1:14 2021)
- L2NRT 1:25 (same as 2021)
- L2NTC 1:55 (compared to 1:43 2021)
- CH4 and NO2 timeseries have been downloaded over 100 times

Analysis from
31/11/2021

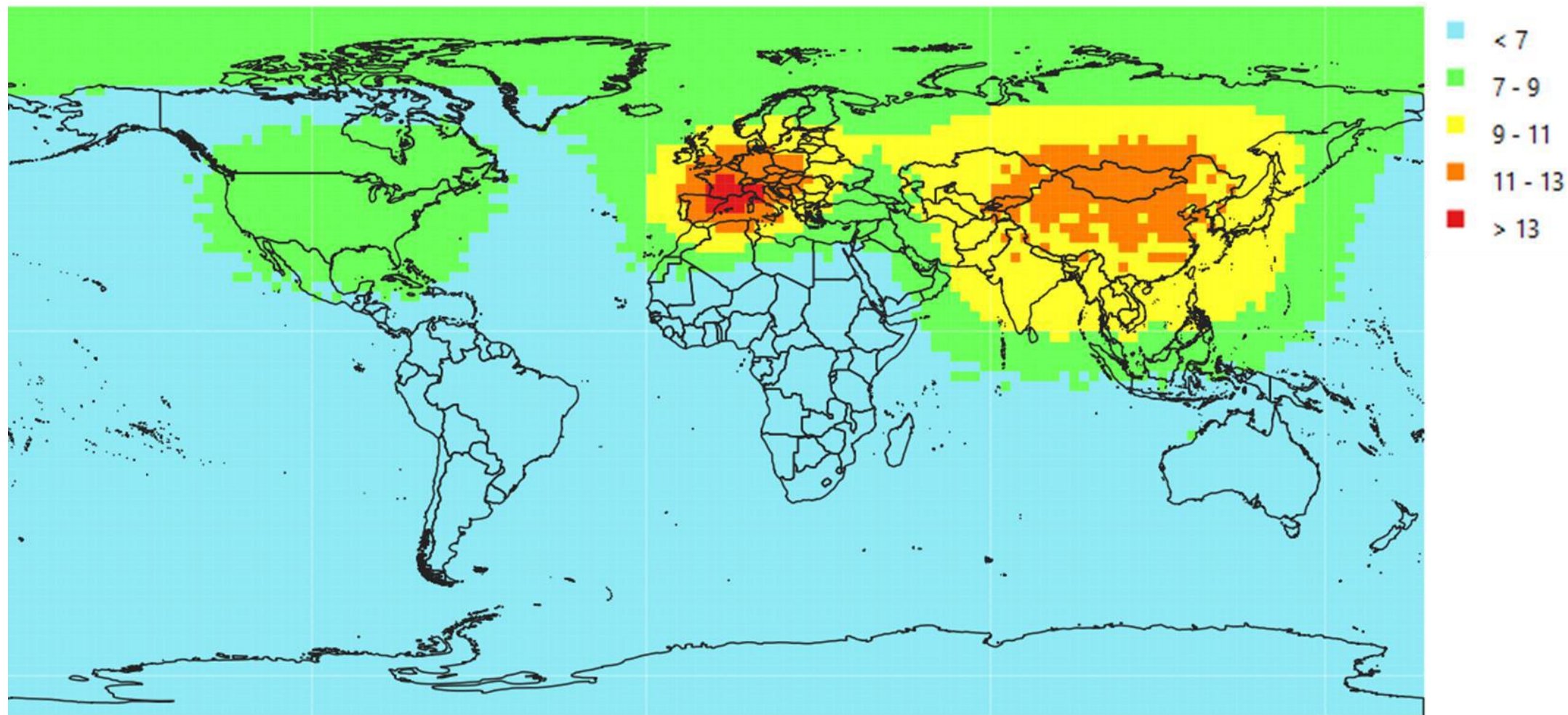
Archive Exploitation Ratio for NRT



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Analysis from
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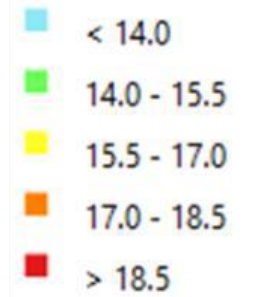
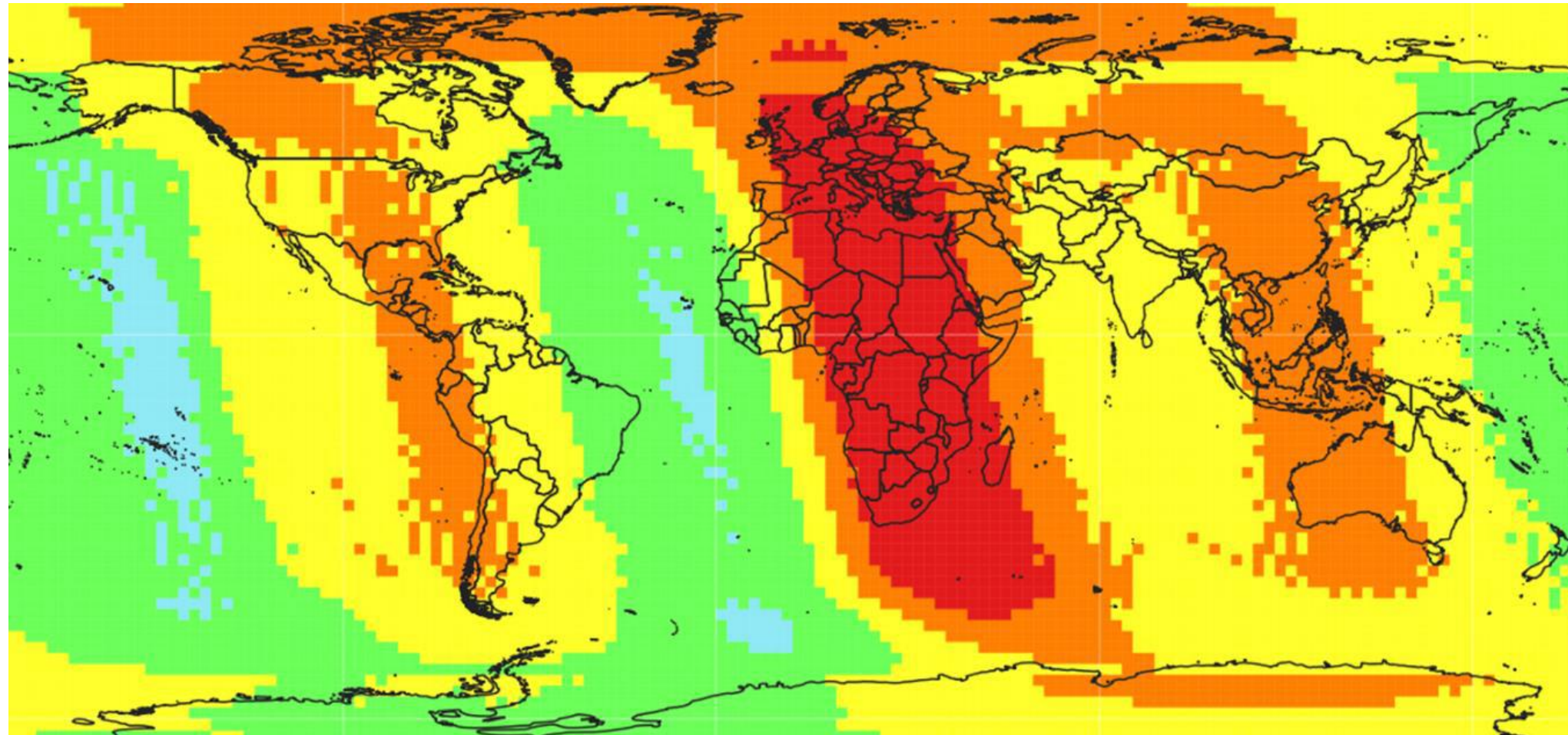
Archive Exploitation Ratio for NTC



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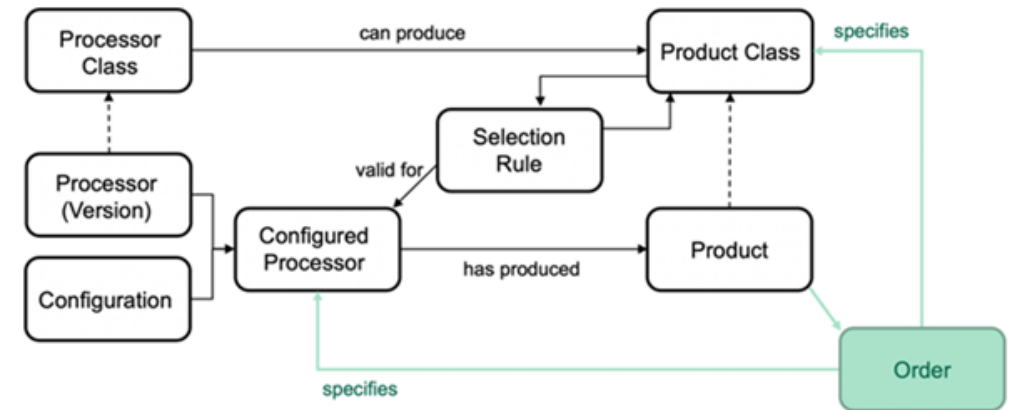
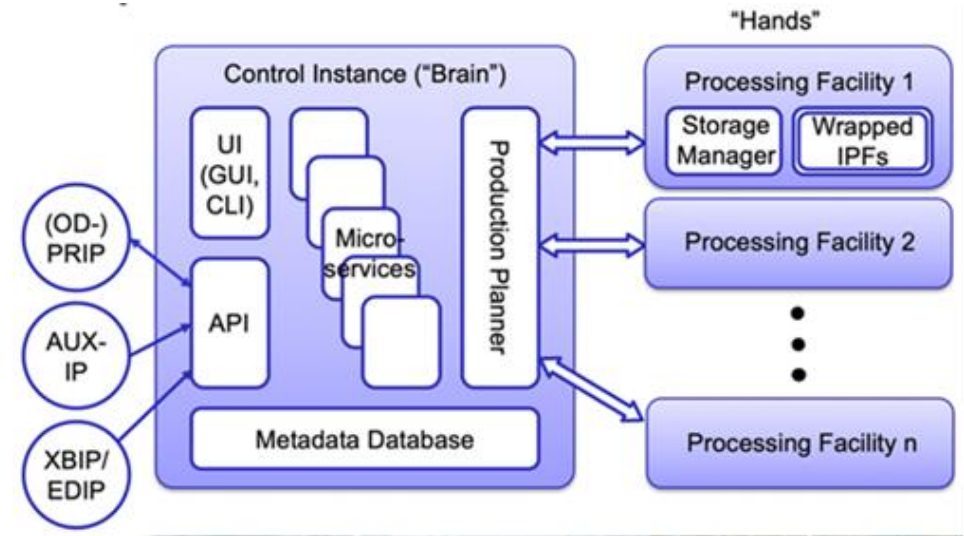


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Analysis from
31/11/2021

- ProsEO: New Processing Environment that enables high speed reprocessing in a Cloud environment developed by DLR;
- ProsEO successfully used for test data generation
- Parallelisation of processing as much as possible.
- Heavy processing load: Up to 50,000 core hours per sensing day (some products very CPU intensive)
- Cloud Environment only possibility to generate mission data sets in a reasonable time period.





- Requirement to process all S5p products to latest version of operational processor;
- From start of mission until switch to newest operational processor in nominal production (August 2022) with overlap;
- All S5-p Products. L1b and L2;
- Reprocessing started June 2022 using ProsEO;
- Whole mission (approximately four years of data) will be processed by the end of 2022;

Reprocessing 2022 – Approach



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- Three stage approach in the following order
 - Part 1: All Level-1B products.
 - Part 2: CLOUD, O3 (& O3 TCL), NO2, & CO products (Priority products for CAMS) reprocessed by end October 2022
 - Part 3: CH4, SO2, HCHO, ALH, AAI and O3PR Products reprocessed by end December 2022.
- Two distinct time periods: April 2018 – March 2022 & April 2022 – August 2022
- Same approach as written above for both time periods.
- Products current available via S5-p Expert Hub (for validators and special users)
- Products released to user community starting from November 2022 in staggered approach after successful QC via S5-p Pre-ops Hub

Reprocessing 2022 – Progress



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Product	Production	Quality Control
Level-1b	Complete	
CO	Complete	Complete
CLOUD	Complete	Started
O3	Started	
NO2		

- **Products April 2018 - March 2022**
- April 2022 – August 2022 not started (but L0 transferred to ProsEO cloud).
- Part-2 expected to be generated by end October 2022.
- **806 TiBytes L1b + 41 TiBytes of L2 produced so far**



- Next priority CH₄
- SO₂, HCHO, ALH, AAI
- O₃PR

Then

- Period April 2022 – August 2022
 - Same approach as first period: L1b, CAMS priority, rest of products
- Completion of processing by end of 2022.
- Up to four weeks required for quality control.

S5p Archive and Processing

- Excellent performances for processing NRT and offline
- Long Term Archive secure with further security added with additional copy geographically separated.

Reprocessing

- Cloud-based approach highly successful for S5-p reprocessing
- 20 days to generate L1b from end of April 2018 (orbit 2818) until end of March 2022.
- Over 70 X real-time.
- Some challenges with certain products (lessons for future reprocessing)