Copernicus Space Component in Operations

State of Play

Collaborative Ground Segment & ESA
Digital Twin Earth Workshop
4-5 March 2025
Lisbon

Copernicus Space Infrastructure status

Copernicus missions managed by ESA:

Excellent missions performances

Satellites in Routine Operations Configuration & nominal status

S1A in quasi nominal operations

S1C in commissioning operations

S2A in transition to extended campaign orbital position.

Sentinel-1 A satellite operations status

Sentinel-1A satellite quasi-nominal operations:

After 10 years in operations, Sentinel-1A spacecraft shows increasing signs of aging with propulsion system degradation:

Since February 2024, out-of-plane orbit control is no more performed.

In June 2024, the thruster used for in-plane orbit control showed a **concerning drop in performance**.

Despite this, **mission operations continue as they are without new event so far**.

No further degradation has been experienced.

- Sentinel-1A operations are planned until the Sentinel-1D IOCR.

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Sentinel missions' operations are commonly managed in the service-based Copernicus Operational Framework, including mission-specific configurations

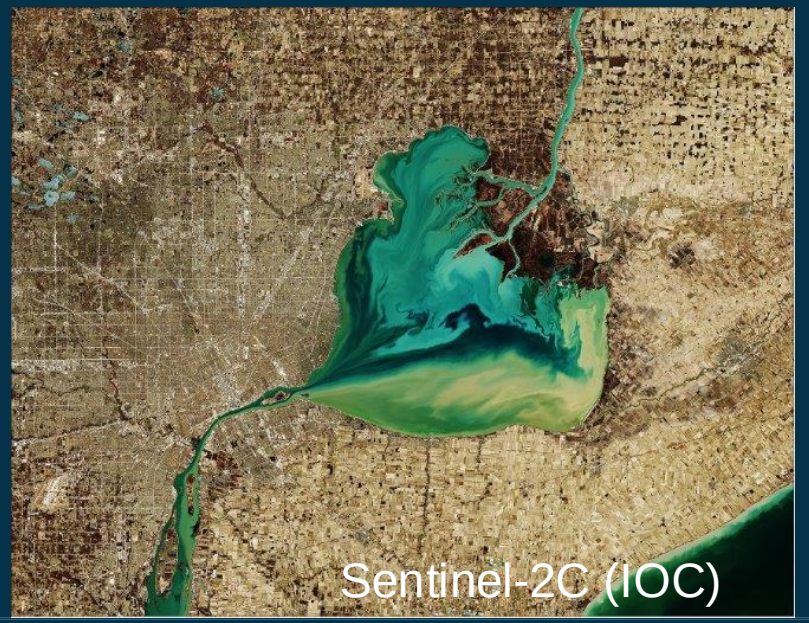
~300,000 Registered Users

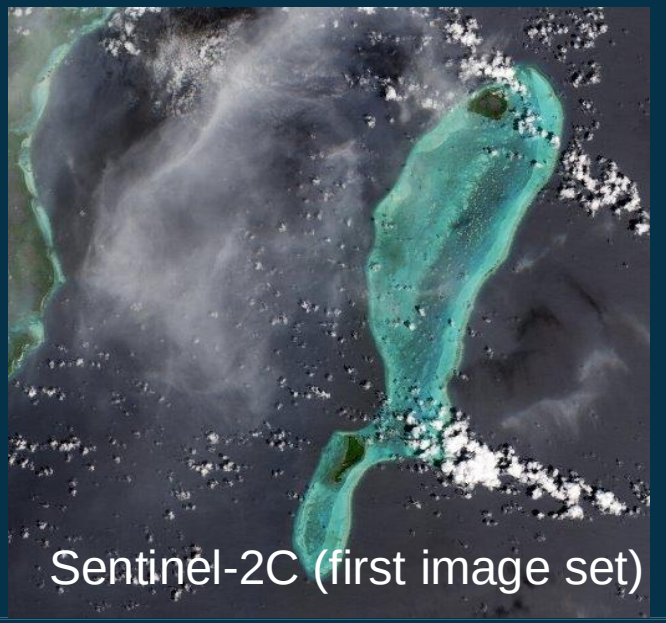
~80 PB of high quality Sentinel data easily accessible

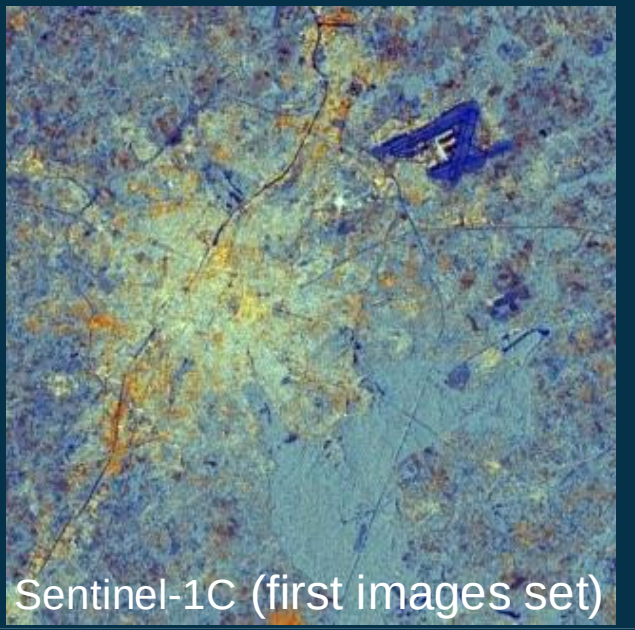
Copernicus missions & data management Framework

Missions configuration highlights

- ✓ S2C launched on 5th September 2024 & successfully commissioned on 19th December 2024
- ✓ S1C launched on 5th December 2024 and satellite commissioning nominally on-going
- ✓ S2C & S1C Smoothly onboarded in the EOF-CSC operational framework : First acquistions and data availability by end of LEOP
- ✓ S2C in Routine Operations since 21 January 2025


Sentinel-2C (IOC)


Sentinel-2C (first image set)


Sentinel-1C (first images set)

Copernicus missions & data management Framework

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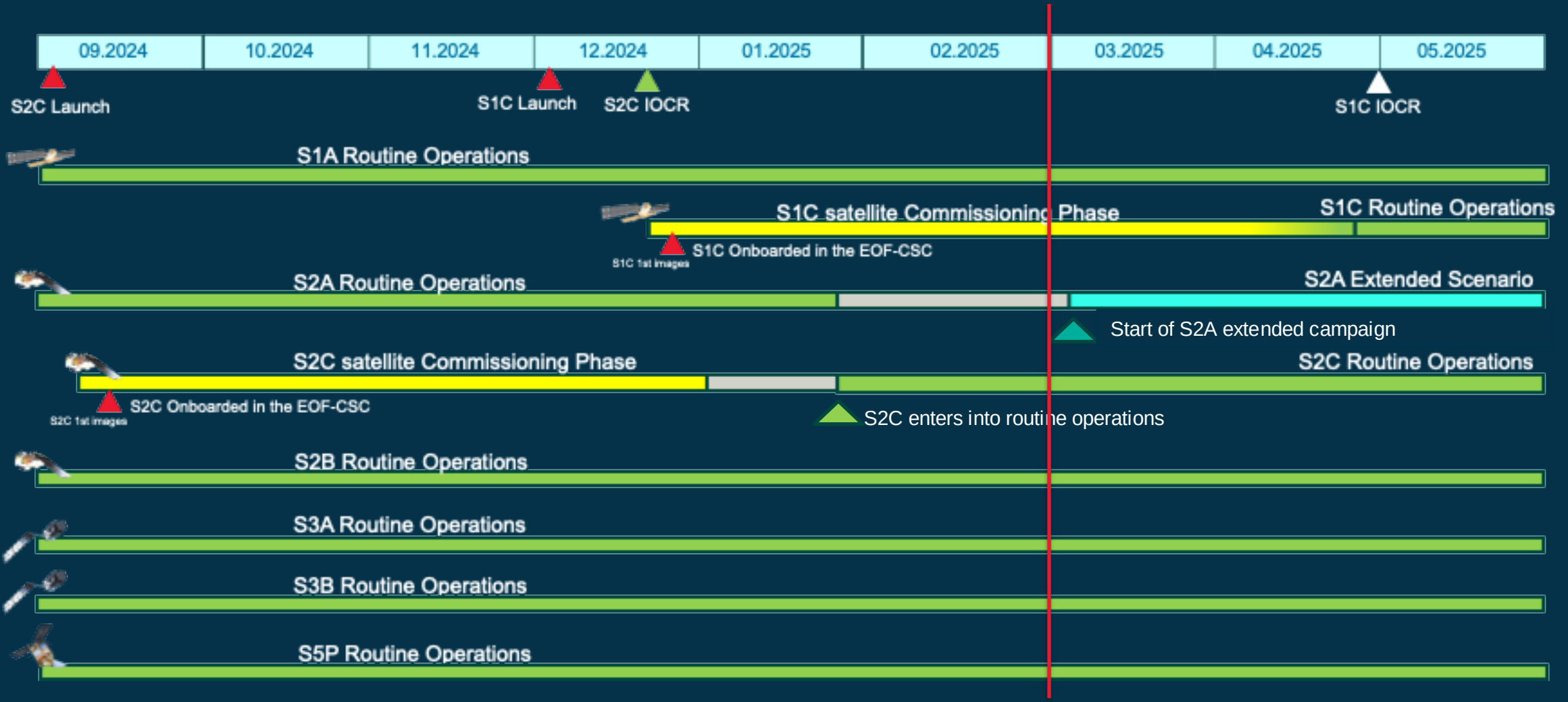
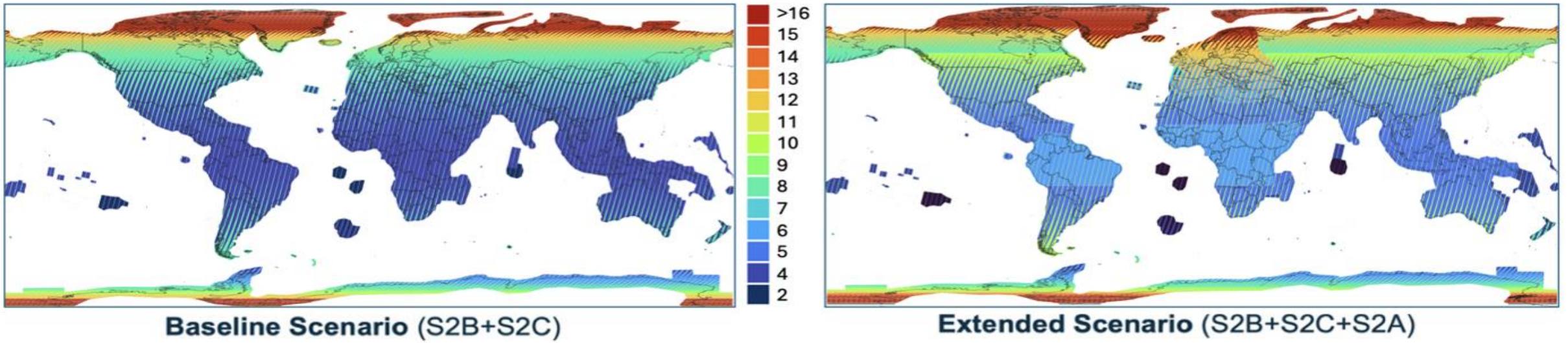
Operational configuration highlights



Sentinel-2A Exceptional Extended Campaign

The **Sentinel-2A** exceptional **extended** campaign will operate for **12 months**, temporarily complementing the nominal constellation with Sentinel-2B and Sentinel-2C. This extension enhances the Sentinel-2 Mission's capabilities, providing greater benefits to both operational and scientific users.

Starting 13th March 2025



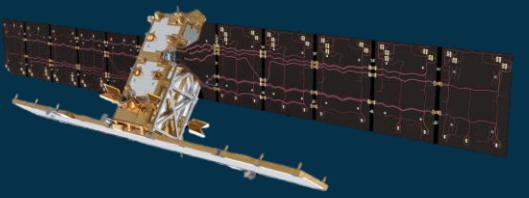
S2A extended campaign observation scenario definition drivers

- Increase **global** revisit frequency
- Maximise revisit frequency over **Europe** and **tropical regions** of Africa and South America (frequently impacted by high cloud cover).
- Optimised use of critical satellite resources.

S1C commissioning & data availability plans

S1C successfully launch on December 5th 2024 lifting off aboard Vega-C

- **December 10th 2025** a few days after launch EOF – CSC generated the first SAR images
- **From mid-January 2025 and until mid-March 2025:**
  - S1C on the same orbital plane as Sentinel-1A (1-day apart w.r.t. S1A)
  - Data acquisitions mainly for satellite calibration and validation activities.
  - January 30, 2025: Release of preliminary Copernicus Sentinel-1C sample dataset.



- **From mid-March to end of April 2025 :**
  - S1C will manoeuvre to be placed in the former Sentinel-1B orbital position (6-days apart w.r.t. S1A), restoring the full constellation capacity for Sentinel-1
  - Foreseen to gradually operate S1C in routine observation scenario with open data access during the month of April (satellite status permitting) to start restoring the mission constellation scenario
- **From May 2025,** following the satellite IOCR, S1C satellite will enter into full routine operations

S1C Automatic Identification System (AIS)

Background

- Sentinel-1C/D embark an AIS payload, enabling simultaneous operations with the Synthetic Aperture Radar (SAR) instrument.
- AIS foreseen to be activated simultaneously with SAR IW/EW observations over ocean and coastal areas and downlinked simultaneously with SAR observations over European waters and the North Sea areas.
- Specific on-ground processing is necessary to retrieve the AIS message encapsulated in the AIS downlinked data.
- AIS data will be processed as part of the Copernicus operations to generate AIS messages in the form of Auxiliary AIS data

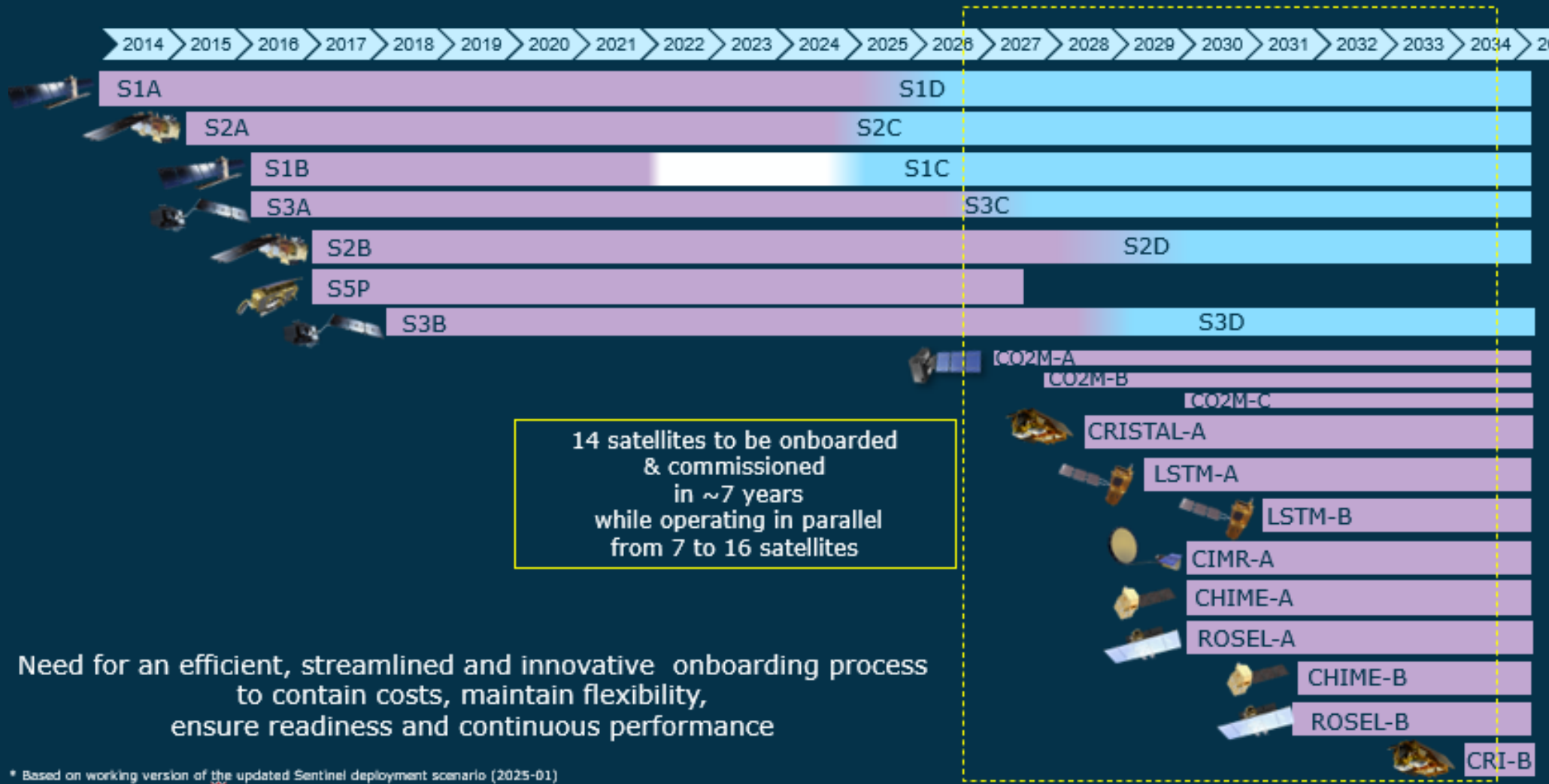
Sentinel-1C AIS data will be available through the CDSE:

Data policy under consolidation by the European Commission.

Collaborative Stations Operations

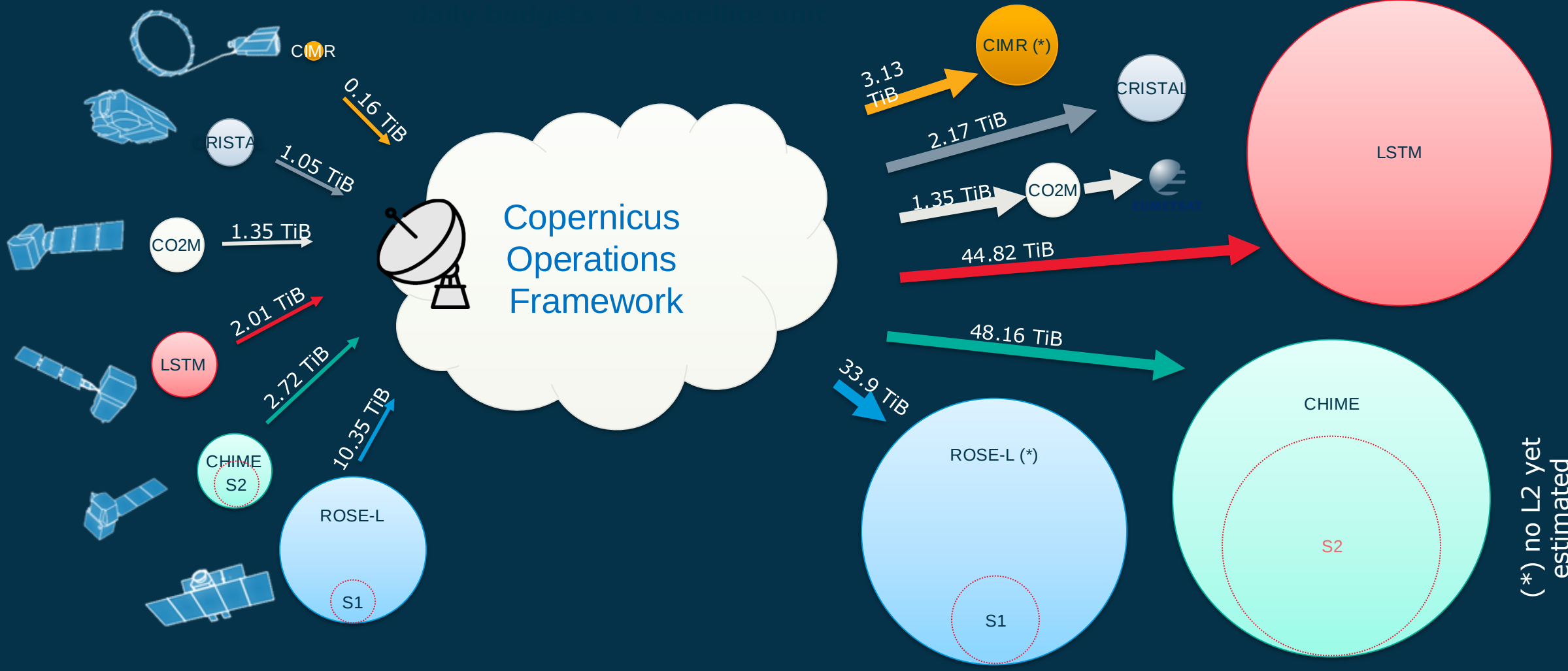
- Collaborative Ground Stations will be authorised to acquire and process AIS data downlinked in pass-through mode as for current S1 listen-in scenario (relevant AIS documentation and software is available to support preparatory activities).
- Potential AIS data usage or distribution restrictions will be indicated by EC as part of the AIS policy clarification.

Evolution of the operations



Update of the deployment scenario will be available with the revised version of the LTS, set to be presented at the May 2025 PB-EO

Data Volumes to a new level…



Preliminary values under consolidation

*Based on decompressed data volumes

The Copernicus Sentinels family grows!

Copernicus Data Access Highlights

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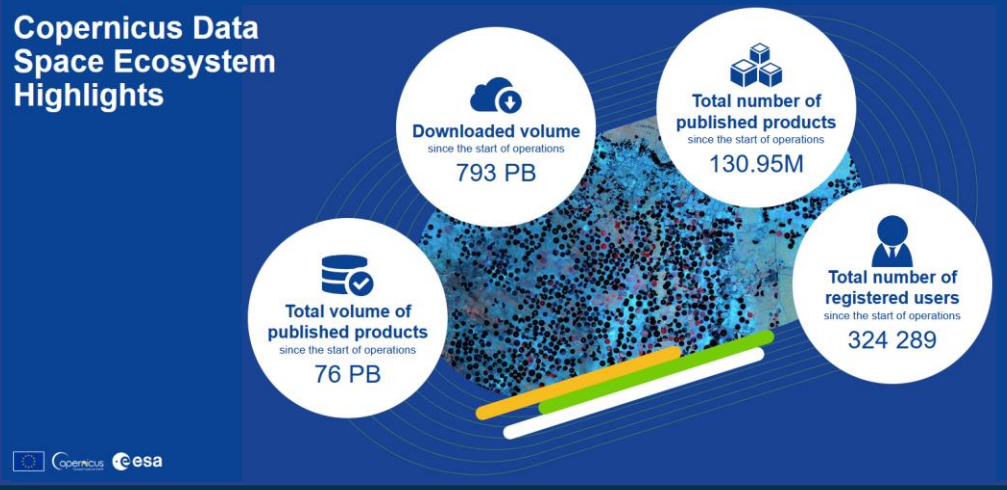
The Copernicus Data Space Ecosystem is the single-entry point for all users

https://dataspace.copernicus.eu



During the last 30 days

Number of Copernicus Browser visitors
370,000

Number of active users
49,000

https://dashboard.dataspace.copernicus.eu

- **Collaborative Partners CDSE 2024 Q4 Statistics (October – December):**
  - Copernicus Collaborative registered users – 19
  - Retrieval from CDSE:
    - 573.5 Million products
    - 5.2 PB
    - ~1/5th of all data retrievals

Copernicus Data Access Annual Reports 2023 issued

Two reports issued for 2023 – transition period between former Data Access Hub and new CDSE

CDSE – Additional Data Offer

- Sentinel-1 and Sentinel-2 Global Mosaics
  - Sentinel-1 GRD Monthly Global Mosaics: 2022-2024
    Continuously generated to 2014.
  - Sentinel-2 Quarterly Global Mosaics: 2020-2024

- Copernicus Contributing Missions
  - All CCM systematic data sets moved from PRISM to CDSE.
    Visualisation gradually deployed.
  - New data set gradually published in 2025: VHR 2024.
  - https://documentation.dataspace.copernicus.eu/Data/Others/CCM.html

CDSE – New Data and Features

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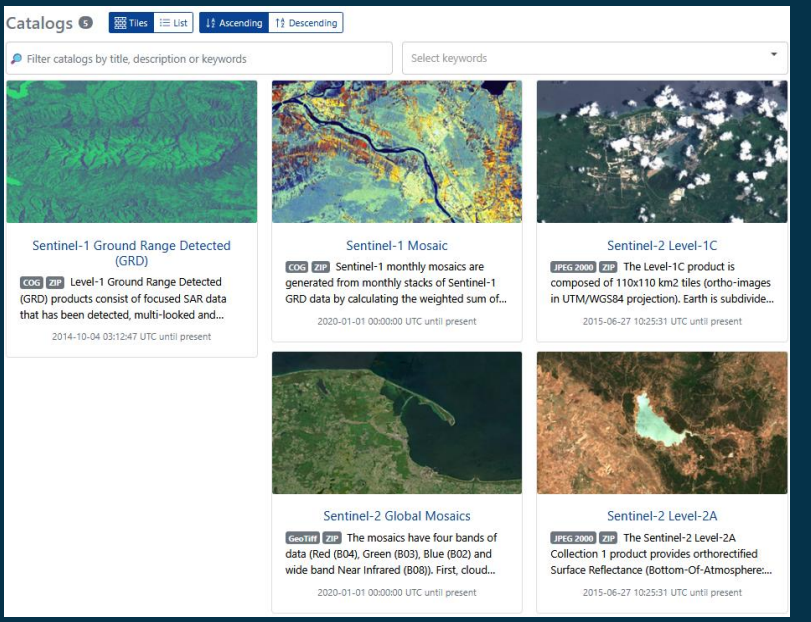
➢ New CDSE Features

- Access to Sentinel-1 SLC Bursts (Nov. 2024): https://documentation.dataspace.copernicus.eu/APIs/Sentinel-1%20SLC%20Burst.html
- Sentinel-1C first data set publication opened to all users (30 Jan. 2025)
- New STAC Product Catalogue & STAC Browser (Feb. 2025)

Roadmap available at: https://documentation.dataspace.copernicus.eu/Roadmap.html



➢ Sentinel-2 Collection 1

- Full Collection 1 available on CDSE by end of Q2-2025. Former baseline being removed.

➢ Additional Data Reprocessing

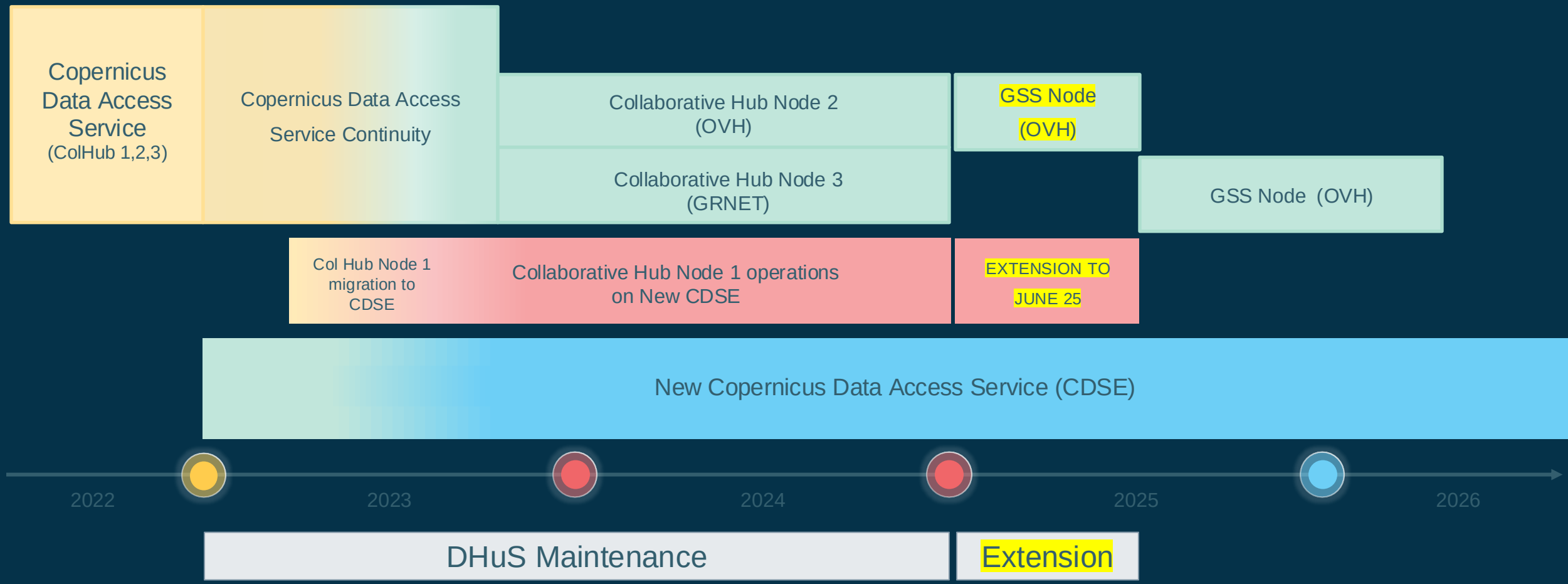
- Sentinel-3 OLCI L2 (March 2025)
- Sentinel-5P SO2

➢ Onboarding of CLMS data portfolio on CDSE

- First phase completed by end 2024
- Initial onboarding of Copernicus Land Monitoring Service Global Component in CDSE in 2025

➢ Onboarding of 9 CCMs Cat-1 on the CDSE under preparation in coordination with COM

Collaborative Data Access – Timeline and Plans



CDSE – Ecosystem Onboarding & Data Access Federation

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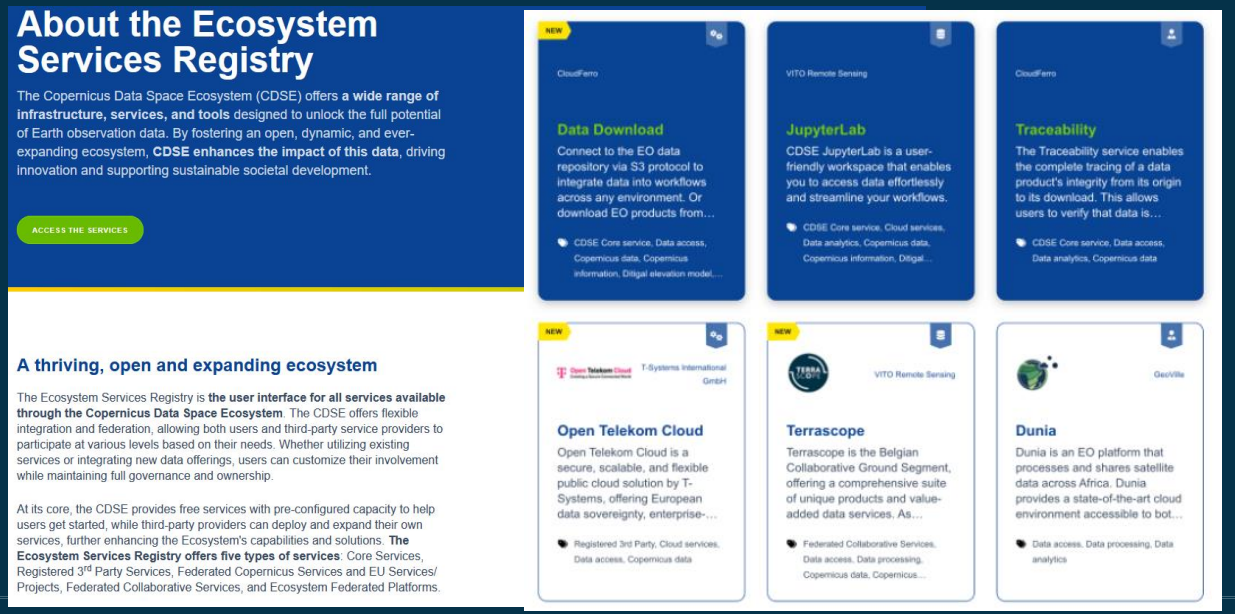
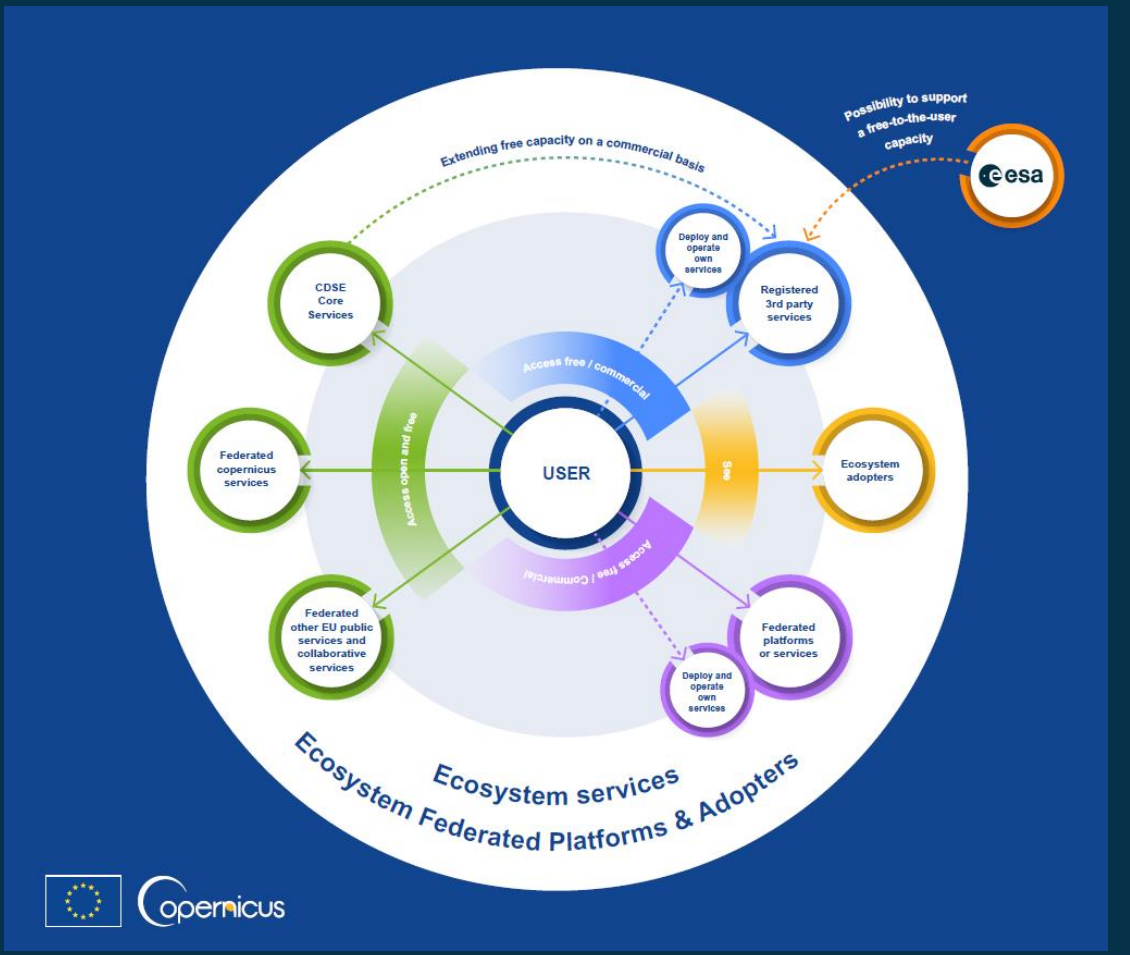
➢ Third Parties Onboarding in the Copernicus Data Space Ecosystem

- Allow 3rd parties to expose their services and/or data to CDSE users
- Third Parties listed in the Ecosystem Services Registry
- Users and services benefit from both the CDSE core and 3rd party data and services
- Enhance the Ecosystem's capabilities and solutions
- Onboarding and Federation with Copernicus Services
- Federation with Collaborative Services





The Destination Earth Initiative & ESA DTE Programme

Collaborative Workshop

4-5 March 2025

DESTINATION EARTH

A DIGITAL REPLICA OF OUR PLANET

Destination Earth (**DestinE**) aims to develop a highly accurate digital model of Earth to monitor the effects of natural and human activity on our planet, anticipate extreme events and adapt policies to climate-related challenges.

- Flagship initiative of the European Commission (DG-CNECT)
- Part of the Digital Strategy[1] and the Green Deal[2]
- Funded under the Digital Europe Programme

European Union ECMWF esa EUMETSAT

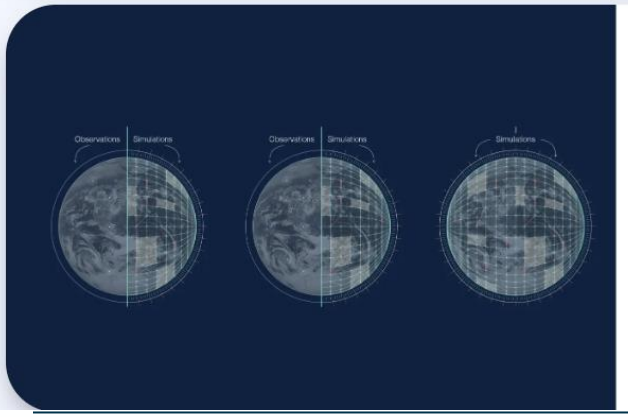
DestinE System

DestinE Platform

The platform will provide evidence-based decision-making tools, applications and services, based on an open, flexible, and secure cloud-based computing infrastructure.

Data Lake

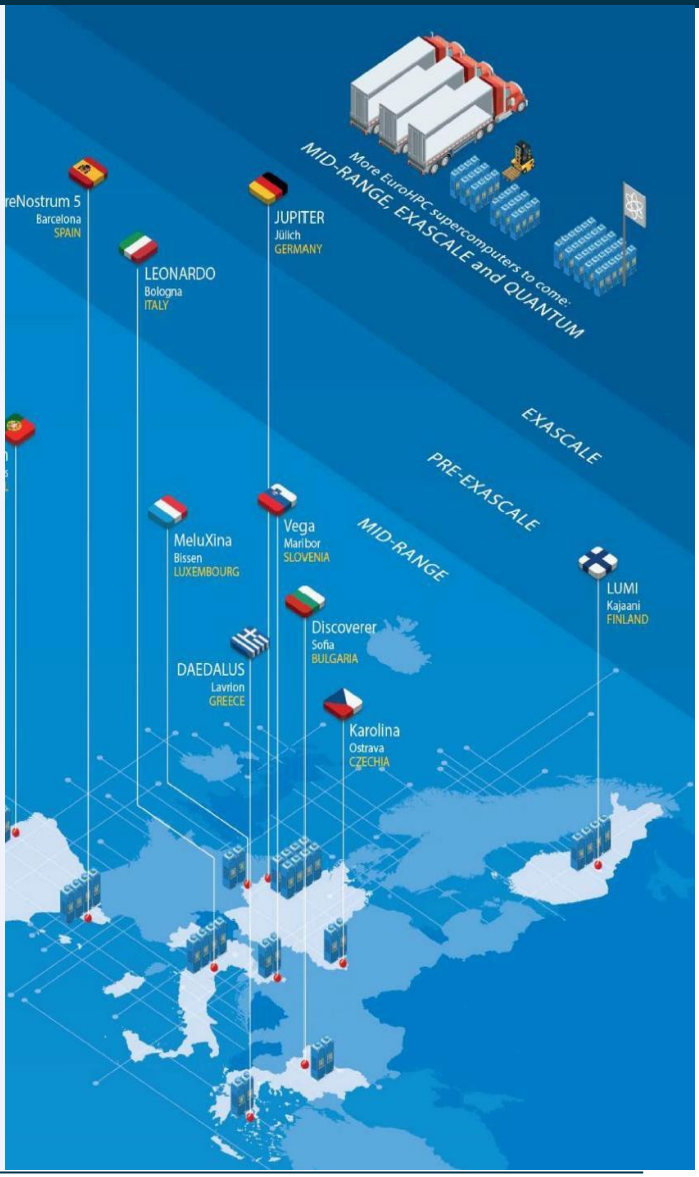
The data lake will bring together data from ESA, EUMETSAT, ECMWF as well as from Copernicus, and many other diverse sources, with new data from the Digital Twins. It will allow discovery and data access as well as big data processing in the cloud.



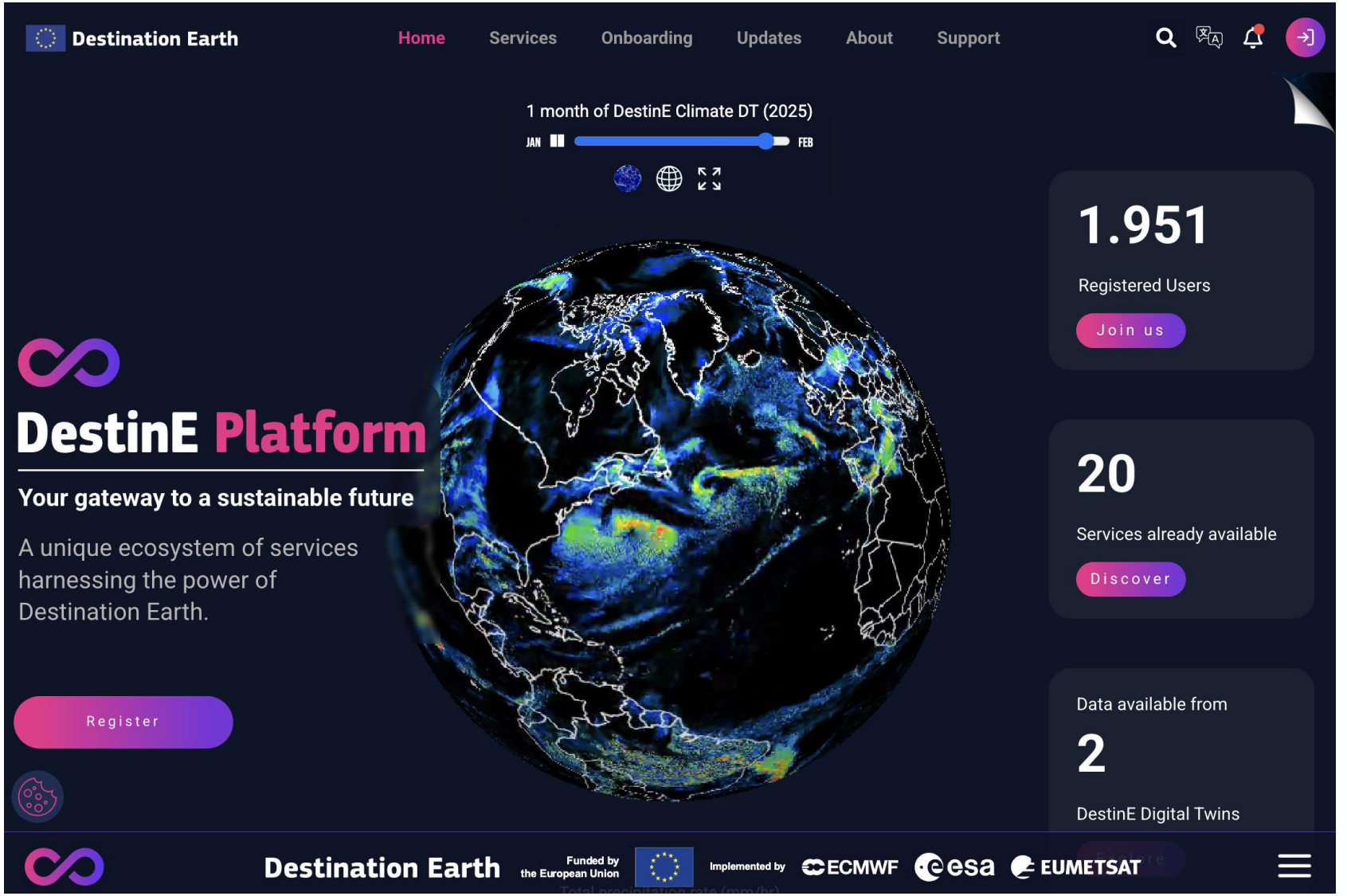
Digital Twins and Digital Twin Engine

DestinE is creating several digital replicas covering different aspects of the Earth system and based on state-of-the-art simulations and observations. ECMWF is implementing the Digital Twin Engine, the complex software and data services needed for Earth System digital replicas, as well as the first two digital twins; Climate Change Adaptation, which will provide multidecadal simulations, and the Weather-induced Extremes twin, with both high-resolution forecasts and on-demand simulations.

Information about DT data available here https://destination-earth.eu/



The DestinE Platform



ESA is responsible for the implementation and operations of the **DestinE Platform** serving as entry point for DestinE users.

https://platform.destine.eu/

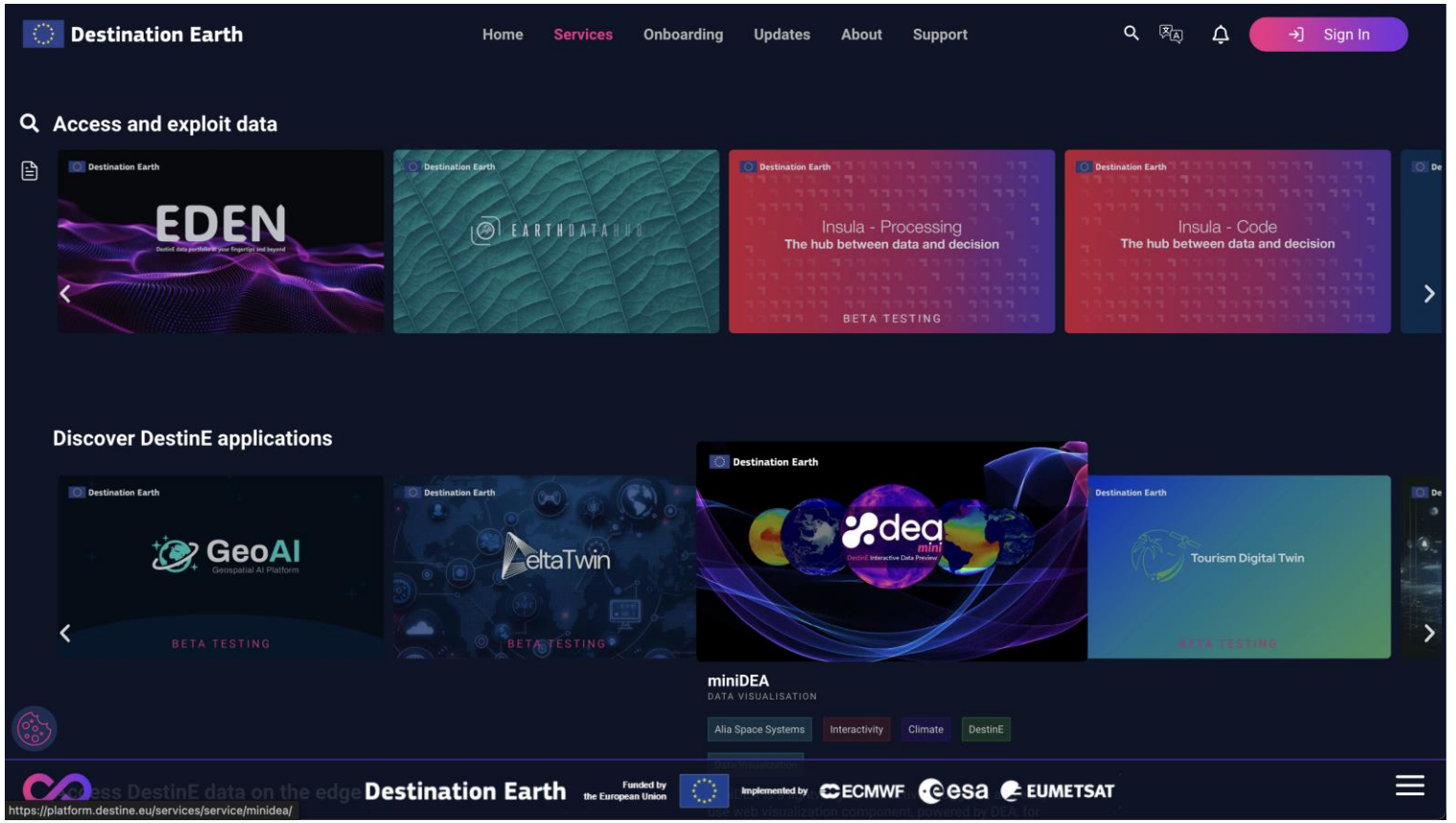
The Destination Earth System was launched on the 10th June 2024 in Kajaani, Finland.
The Platform is in operations since then.

DestinE platform service offer

Currently 20 services are ready to be used in operations.

Three classes of services are available:

- Platform Management Services
- Data Management Services
- Advanced Services



The DestinE Platform allows users to **discover DestinE data and exploit them locally** with:

- Data access services, for DestinE DTs data and more
- Data processing services, for users to exploit and manipulate the data,
- Visualization services based on storytelling approach, for users to communicate the results of their activities.

All services are scalable and designed to adapt resources consumption to demand.

DestinE Timeline

2022 | 2023 | 2024 | 2025 | 2026 | 2027/2028

DestinE Phase 1 — 30 months — DestinE Phase 2 — 24 months — (DestinE Phase 3)

Dec 2021
DestinE signature

Jun 2024
DestinE Launch

Oct 2024
DestinE Opening

Development

Development of the first two Digital Twins
Development of the DestinE Platform
Access to HPC Services
Development of Data Lake

Initial services

Access to DestinE Platform Core Platform Services
Access to Digital Twin Data
Access to Data Lake Services

Enhancement

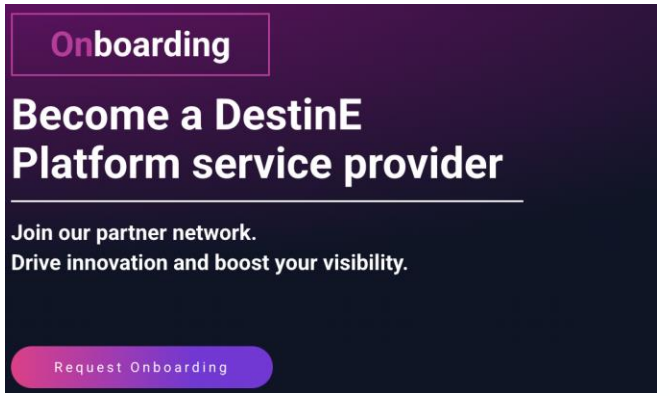
Enhancement of Digital Twins
New Digital Twins
Advances Platform Services
AI Capabilities
Enrichment of the data lake

2030 Digital replica of the Earth

First Successes of the Platform

- **Storytelling** reused in other contexts (e.g. ESA PBEO)

- **Onboarding process** successful with ESA DTE streamer & early development (storytelling, very very fast access to data for large simulations)
- 30 service requests received for onboarding, 16 services being integrated, 2 services published (before advanced applications results…)

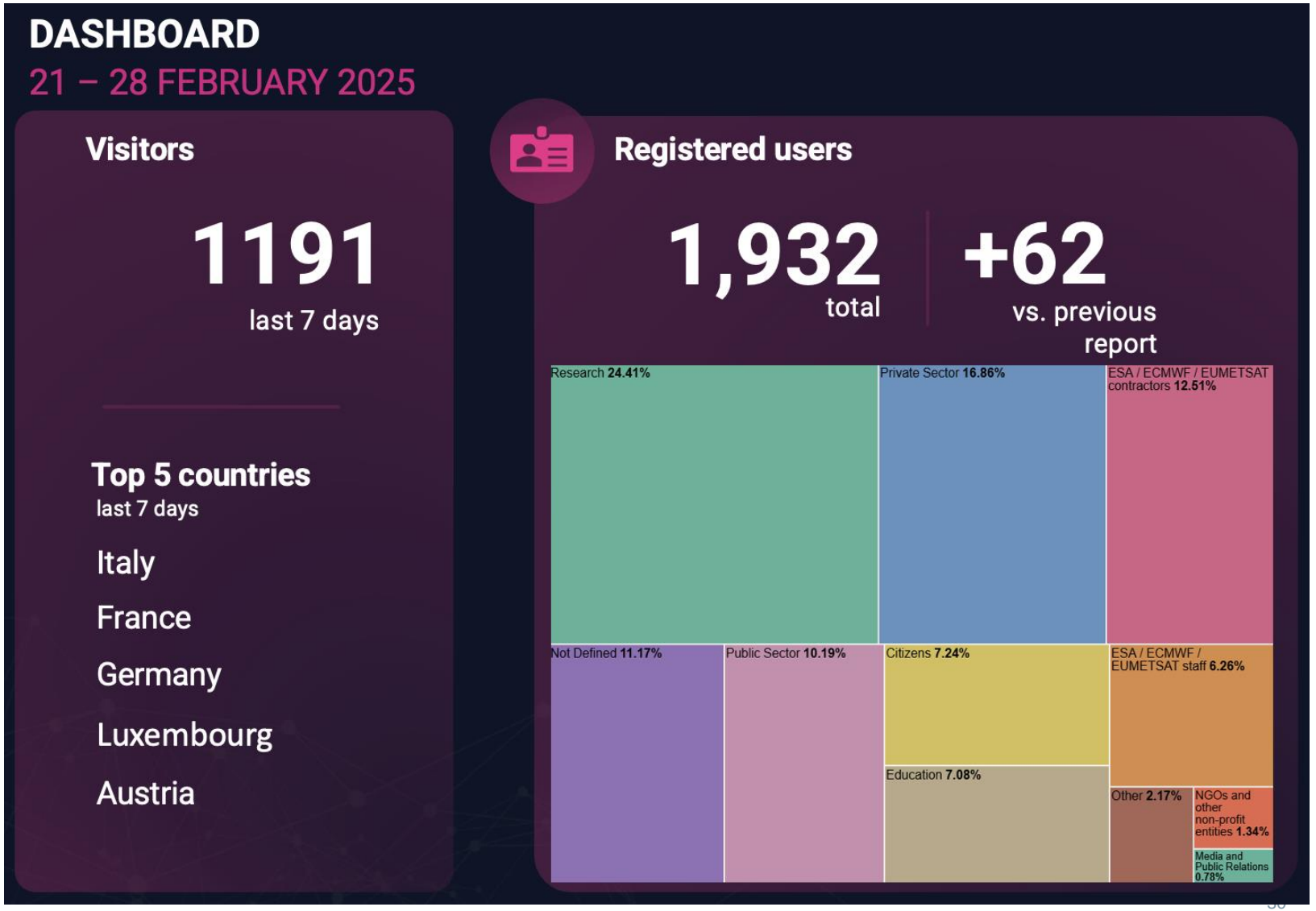


- Giving **access** to ECMWF and EUMETSAT DestinE services
- Giving access to a very large portfolio of diverse data (data lake and direct access)
- DeltaTwin service ready to support local twins and MIMS compliant services (e.g. digital urban twins)

Some DestinE Platform Statistics

Top 5 Countries by percentage of **daily Active Users** during the period **15 October – 21 February**:

- Italy: 40%
- Germany: 14%
- France: 13%
- Spain: 6%
- Greece: 5%



The ESA Digital Twin Earth Programme

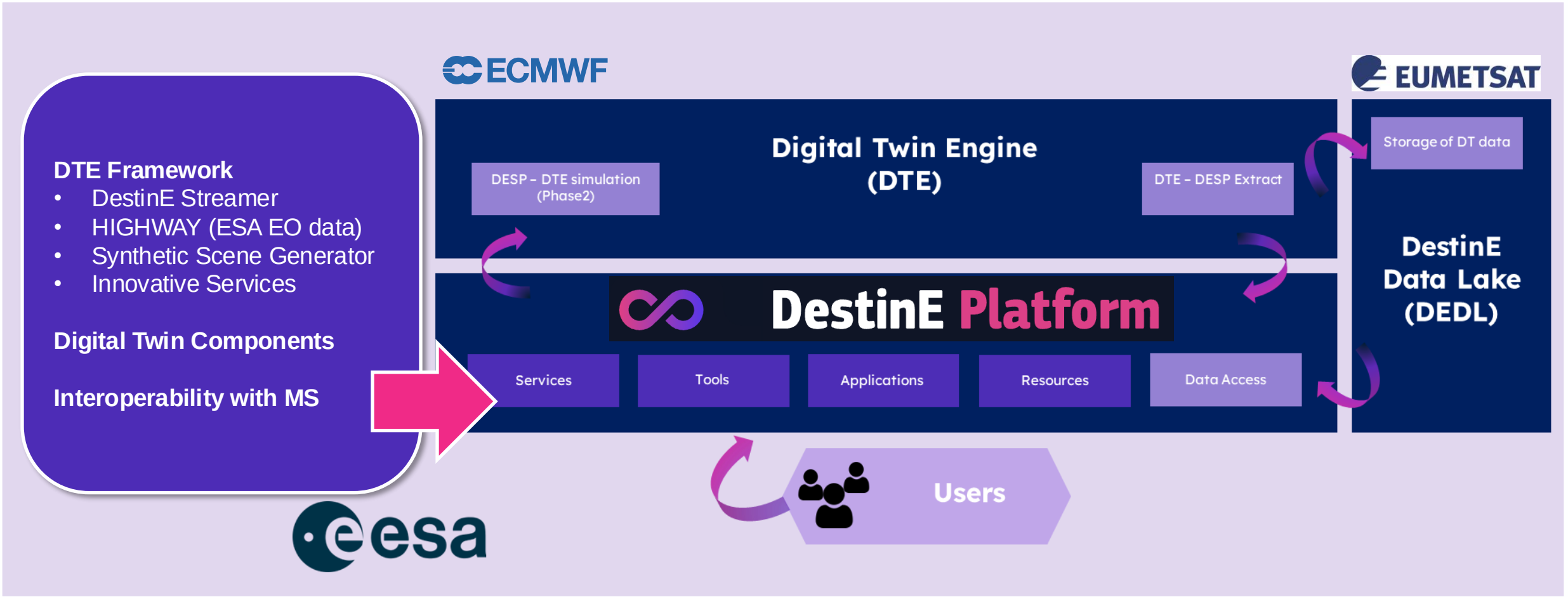
What is the ESA Digital Twin Earth?

- Element of ESA's Earth Watch Programme
- Signed at the ESA Ministerial Conference in 2022 https://www.esa.int/dte

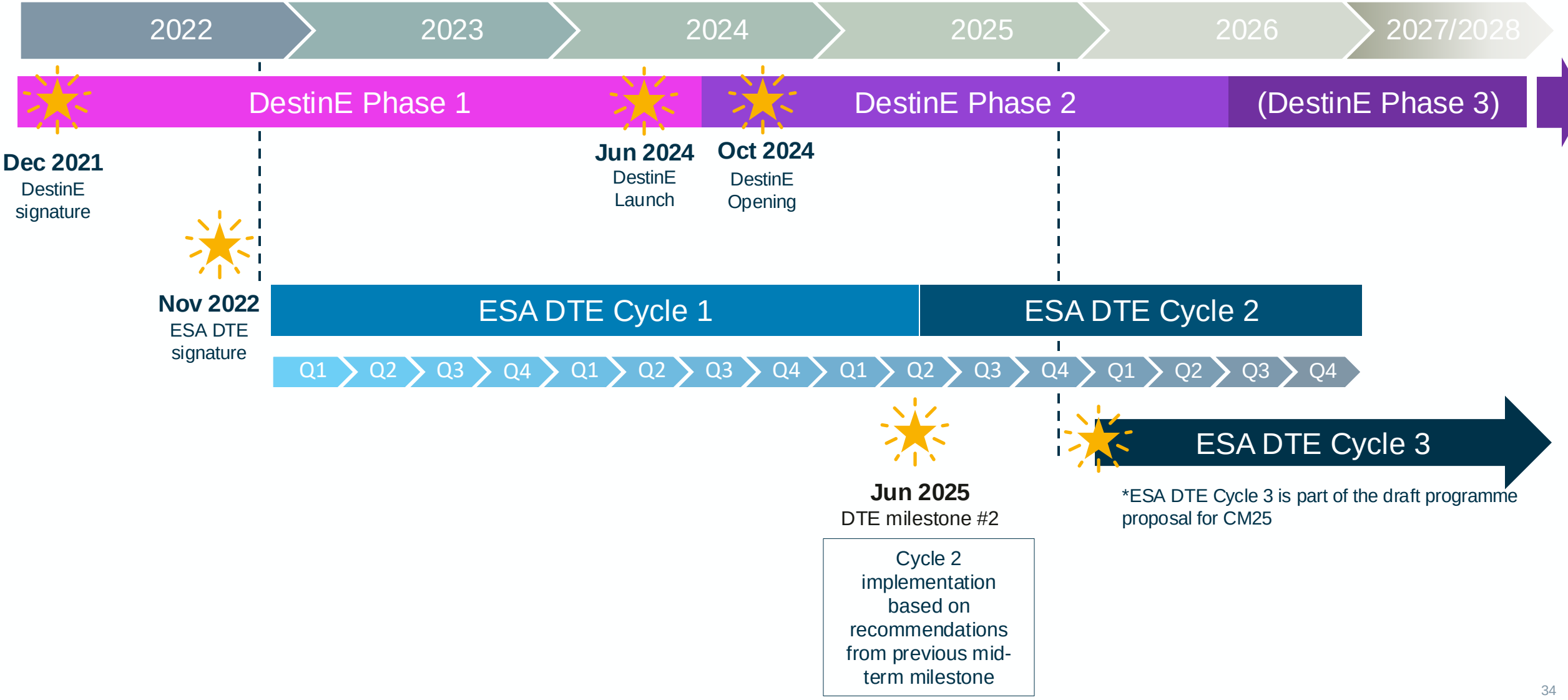
- Development of digital twins using earth observations data and capabilities at a pre-operational level
- Innovative Services
- Support member states in the adoption of Destination Earth

- Close cooperation with Destination Earth
- Use of the free tier of DestinE Platform Services and APIs

ESA DTE Programme in Synergy with DestinE



DestinE & ESA DTE Timeline



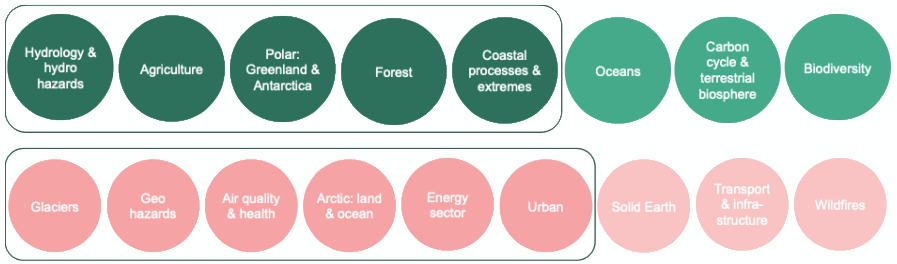
Opportunities via Open Calls

Destination Earth

- Advanced Application and Services (two rounds in 2025; Q2/Q4)
- Best Practises Open Call (opens in March 2025)
- https://destination-earth.eu/procurement/

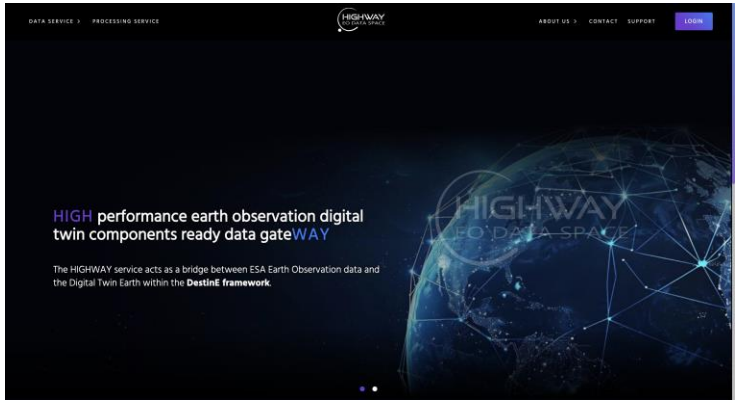
- ESA DTE Digital Components Open Call in Q3/2025
- Interoperability with MS States Initiatives
- https://esastar-publication-ext.sso.esa.int/

First Successes of DTE



- 80 contributions received to define the priority thematic areas
- 31 proposals received to the ITT
- 13 contracts awarded

- DestinE Streamer developed under ESA Digital Twin Earth Programme
- Operational on DestinE as core service



- HIGHWAY providing access to 19 Earth Explorer datasets in COG / ZARR format for all DestinE users for Proba-V, SMOS, Aeolus and Cryosat, more to come soon

Coming soon

ESA DTE Framework being developed at the confluence of **EOF** and **EU Data Space Support Centre** (DSSC) guidelines

V0: end of the year – Supporting ESA EO DTC contracts – providing Digital Twins toolbox (e.g. AI components, AI end points,….)

V1: mid 2026 - fully compatible open-source solution aligned with EOF and DSSC principles, ready for MS reuse (e.g. Copernicus Collaborative, DTE…) and interoperability with European and national initiatives