



ESA DATALABS

ESA Datalabs

Addressing big-data challenges for ESA space science missions

Jos de Bruijne

on behalf of the Science Archives and Data Science Teams
at the European Space Astronomy Centre (ESAC)

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Marcos Lopez-Caniego, Héctor Cánovas, Daniela Coia, Guillaume Belanger

Space astronomy science platform focus week
9 December 2025

ESA UNCLASSIFIED – For ESA Official Use Only

ESDC at ESAC – your gateway to ESA science data

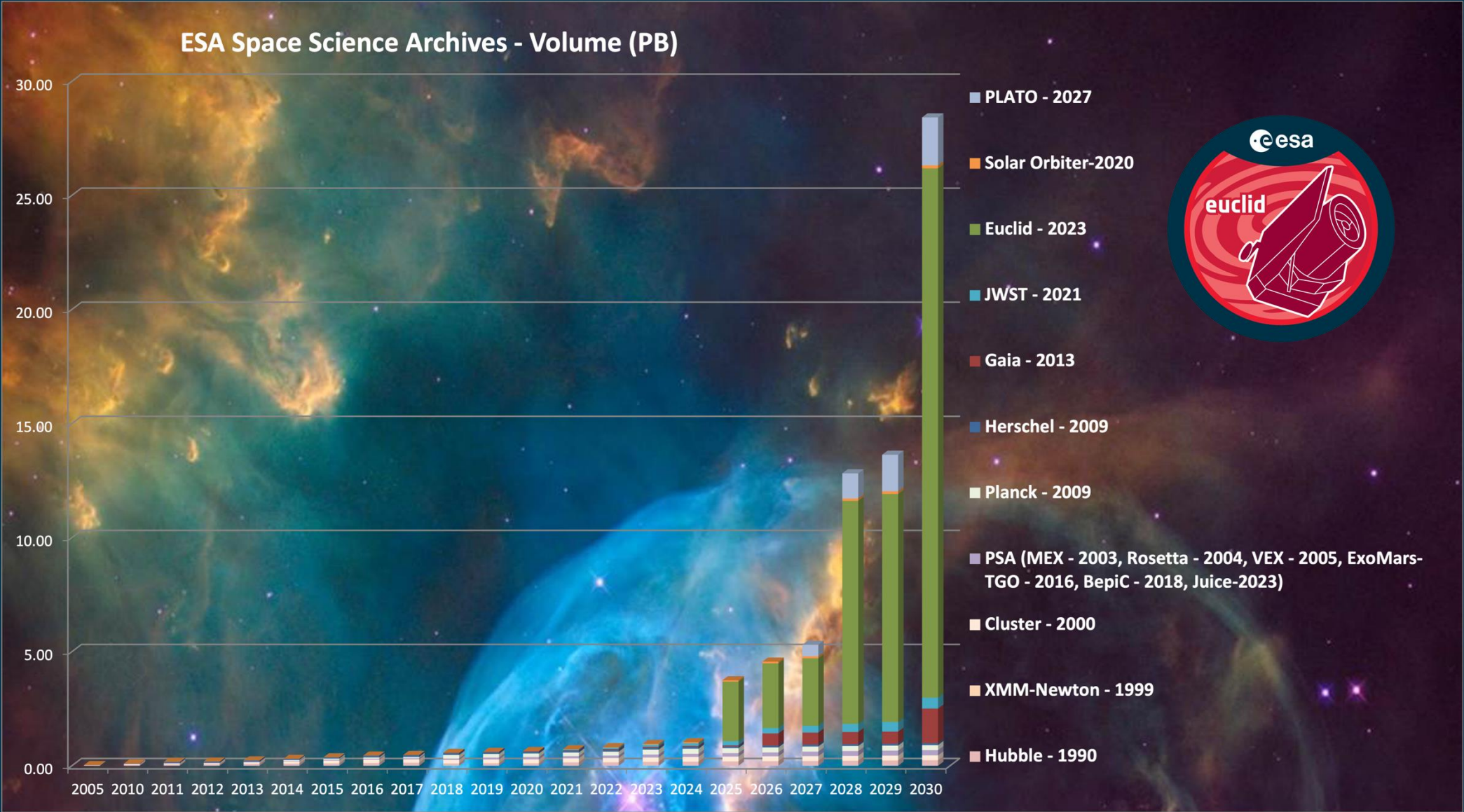


ESAC Science Data Centre, ESDC
European Space Astronomy Centre, ESAC
Villanueva de la Cañada, Madrid, Spain

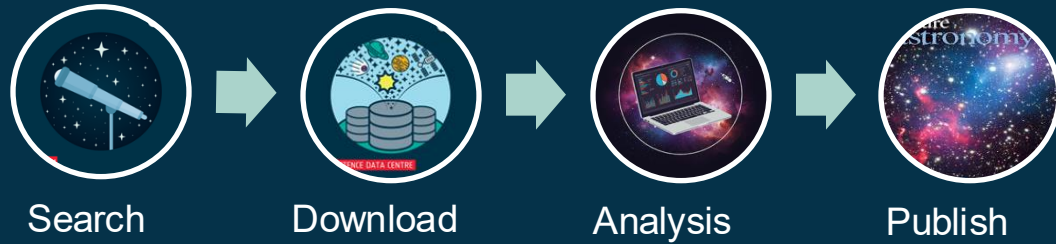
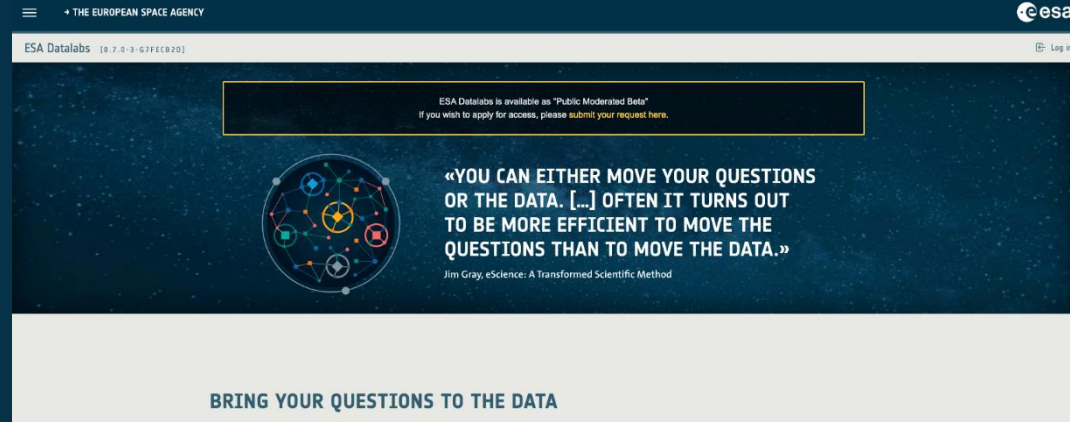


WARNING: ESDC maintenance 5-10 December

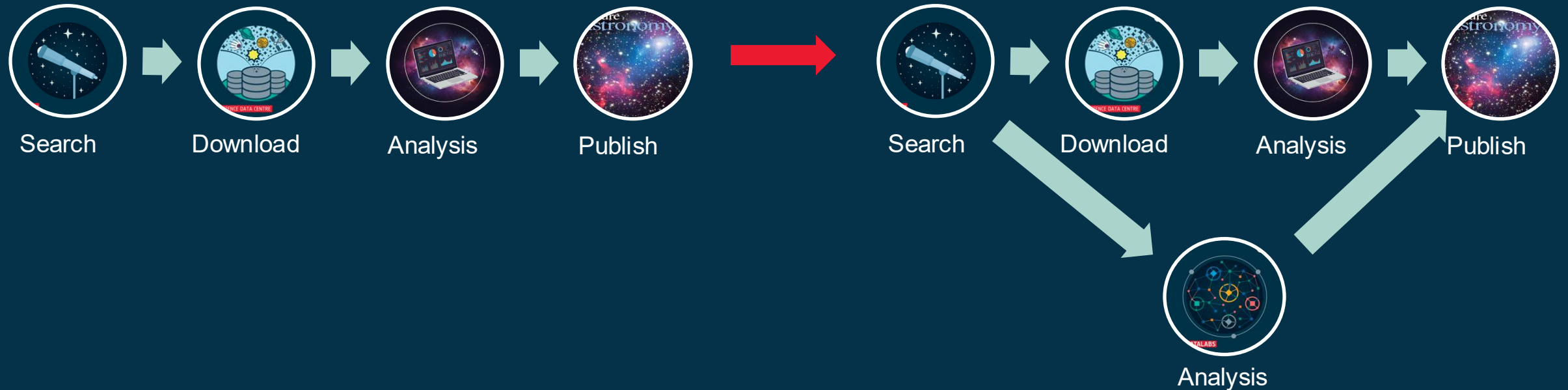
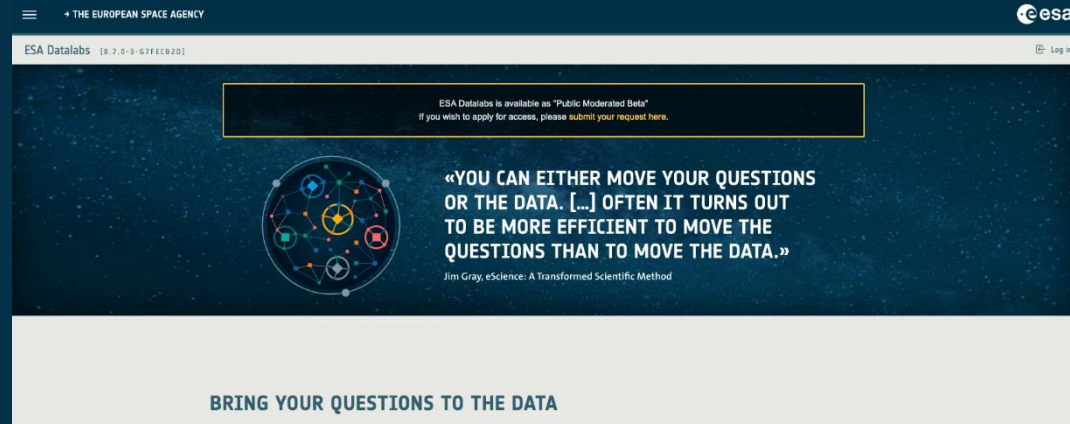
Increasing data volumes in the ESA Science Archives



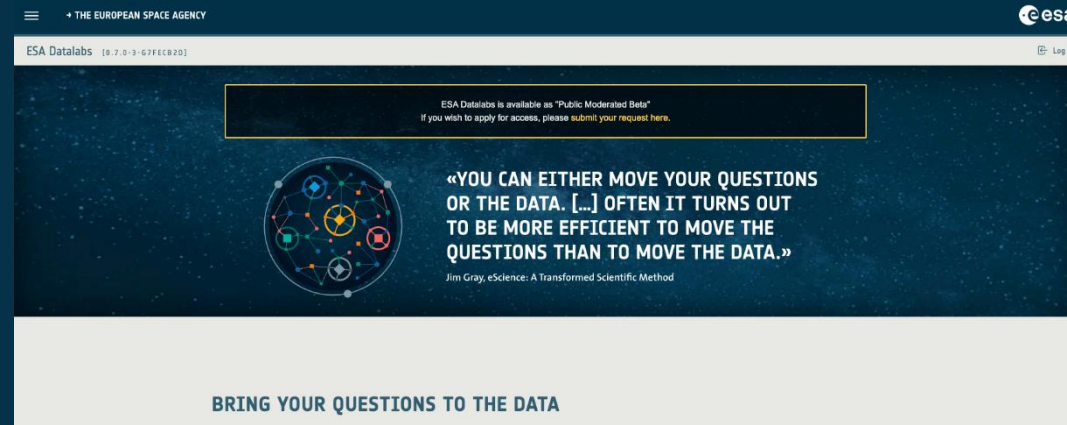
Why a science platform? Change of paradigm



Why a science platform? Change of paradigm



Why a science platform? Change of paradigm





→ THE EUROPEAN SPACE AGENCY



ESA Datalabs [015.1/BETA]

Choose Datalab

Find a datalab in ESA Datalabs catalog



Filter results



EnVisionCoverage

A jupyter lab environment containing the planetary coverage package (vers 1.1.0).



Euclid-Q1

Euclid JupyterLab with access to public Euclid Q1 and ERO data



G-Tomo

The G-Tomo scientific data application (SDA) created by the EXPLORE project allows users to extract 1d profiles and 2d maps from the latest 3d dust extinction maps based on Gaia eDR3 and 2MASS data (Lallement et al. 2022).



GMLD Ephem EDL

GMLD - Ephemeris Parameters Prediction



GMLD Multpth EDL

GMLD - Multipath Prediction



GMLD SBAS EDL

GMLD - Fast and Long Term Corrections (EGNOS SBAS Messages) Prediction

 → THE EUROPEAN SPACE AGENCY 

ESA Datalabs [015.1/BETA]



**XMM-SAS22.1.0**
XMM-Newton SAS v22.1.0

**x-autoplot**
Interactive browser for data. In the same way that you browse content stored in HTML, JPEG, and PNG files on the web, Autoplot allows you to interactively browse data stored in CDF, netCDF, ASCII, and many more data file formats.

**x-ds9**
SAOImageDS9 - An image display and visualization tool for astronomical data

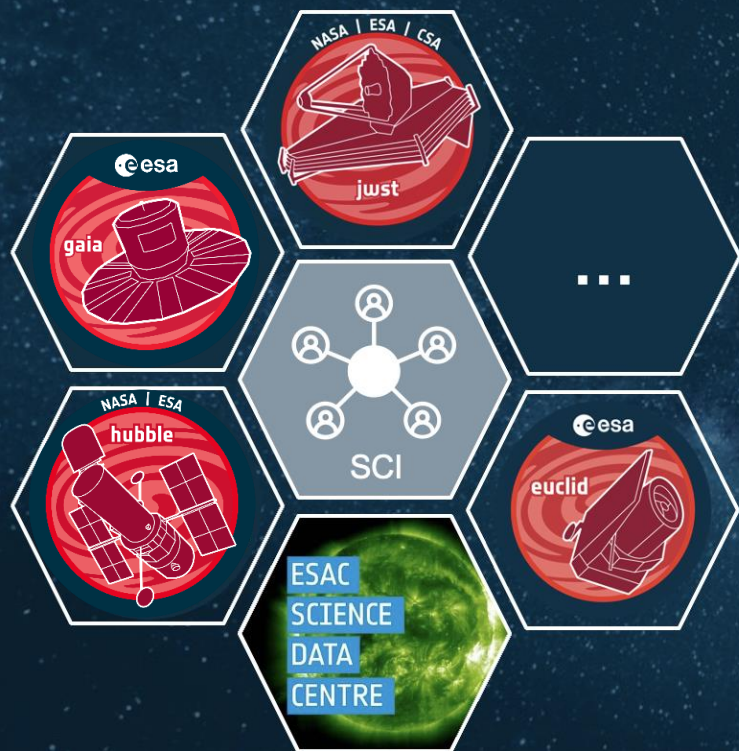
**x-file-manager**
Lightweight file manager from LXDE.

**x-glab**
GNSS-Lab Tool (gLAB)

**x-helio**
Visualization software for solar image data based on the JPEG 2000 compression standard.

**x-octave**
Scientific Programming Language.

**x-topcat**
Tool for OPerations on Catalogues And Tables



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ESA Datasets

Data Volume

Manage your

Domain

☒ Space Science (46)

Mission

Type in your query...

domain:Space Science

HST - NICMOS Data Volume for Hubble Space Telescope Legacy Near Infrared Camera and Multi-Object Spectrometer (NICMOS). Data volume made available by ESDC.	HST - FOC Data Volume for Hubble Space Telescope Legacy Faint Object Camera (FOC). Data volume made available by ESDC.
HST - FOS Data Volume for Hubble Space Telescope Legacy Faint Object Spectrograph (FOS). Data volume made available by ESDC.	HST - HSP Data Volume for Hubble Space Telescope Legacy High Speed Photometer (HSP). Data volume made available by ESDC.
HST - HRS Data Volume for Hubble Space Telescope Legacy Goddard High Resolution Spectrograph (GHRS). Data volume made available by ESDC.	HST - WFPC Data Volume for Hubble Space Telescope Legacy Wide Field / Planetary Camera (WF/PC). Data volume made available by ESDC.
JWST - Ancillary Data Volume for James Webb Space Telescope ancillary files and example notebooks.	XMM-Newton CCFs Data volume for XMM-Newton Calibration CCFs repository. Data volume made available by XMM-Newton mission.
HST - STIS Data Volume for Hubble Space Telescope Imaging Spectrograph (STIS). Data volume made available by ESDC.	PSA Legacy This volume contains data from legacy missions archived in the Planetary Science Archive (PSA). These include Chandrayaan-1, Giotto, Huygens, SMART-1, Venus Express and supporting observations.

The screenshot displays the ESA Data Volume Catalog web application. At the top, the header includes the ESA logo and navigation icons. The main title "Data Volume Catalog" is prominently displayed. Below it, a search bar contains the term "euclid". To the left of the search bar, there's a filter section under the heading "Domain" with a dropdown arrow and a checked checkbox labeled "Space Science (2)". A button below the search bar reads "domain:Space Science". Two result cards are shown side-by-side. The first card, titled "Euclid Q1", describes the release covering 63 square degrees in the Euclid Deep Fields and provides a URL to the datalab. The second card, titled "Euclid ERO", describes the Early Release Observations led by the Euclid Science Team and also provides a URL. Below these cards are two large astronomical images. The left image is captioned "Euclid Deep Field South (Q1 release)" and shows a dense field of distant galaxies against a black background. The right image is captioned "Perseus Cluster (Euclid ERO)" and shows a cluster of galaxies with bright central regions. At the bottom of the page, a credit line states: "Credit: ESA/Euclid/Euclid Consortium/NASA, image processing by J.-C. Guillandre, E. Bertin, G. Anselmi".

Manage the list of teams and their users

☒ Space Science (11)

The FornaX Euclid - XMM-Newton collaboration

- Deep characterisation of Euclid-detected clusters and their selection function

Team workspace for Euclid Pilot Study 5:
Euclid pilot study on spectrum stacking tools

Euclid code that produces the theoretical predictions for Euclid primary observables (power spectra for Weak Lensing and Galaxy Clustering)

Euclid pilot study on Solar System Object detection

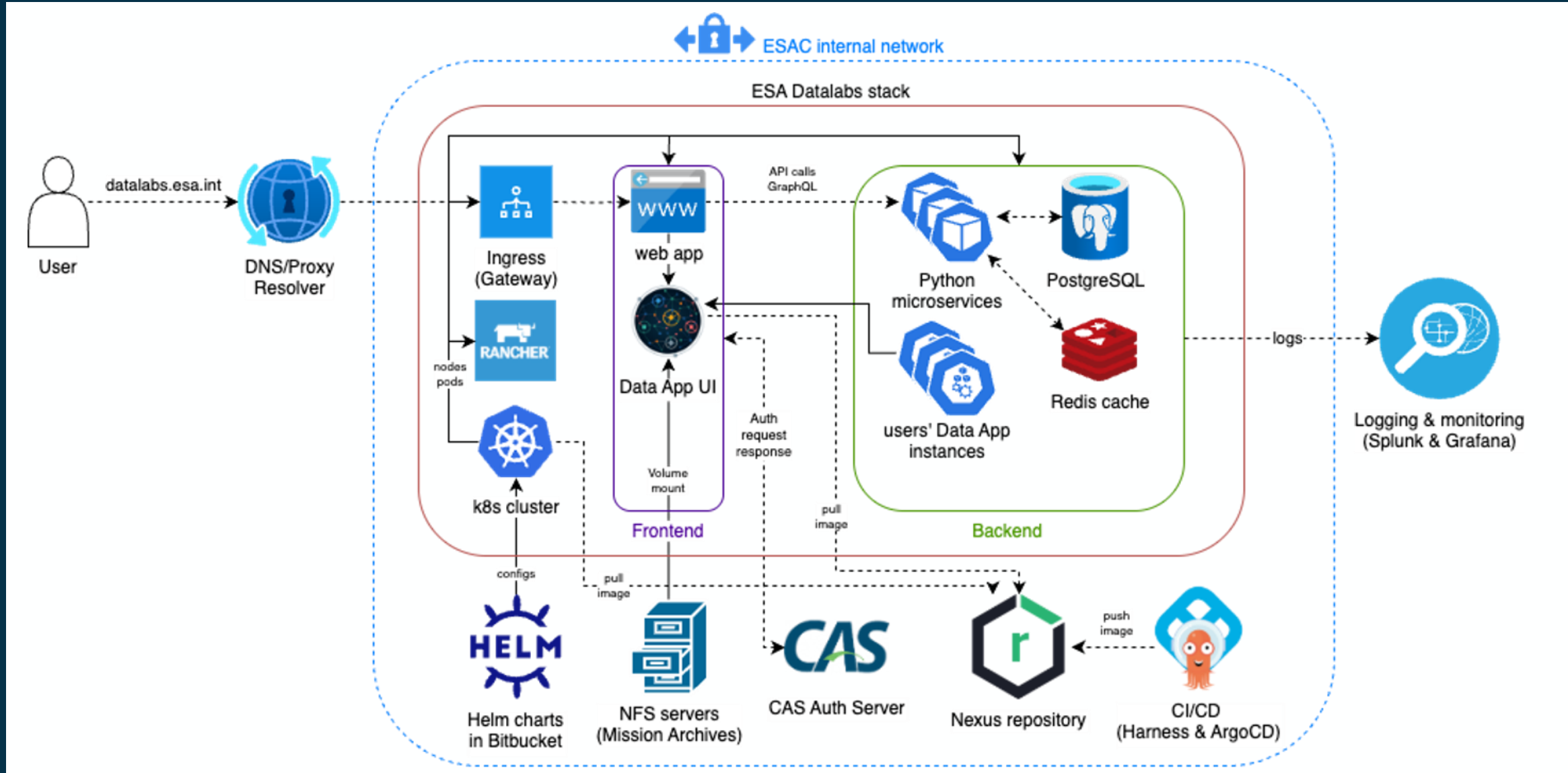
Euclid pilot study on transient object detection pipeline

Euclid pilot study on diffuse emission and LSB pipeline

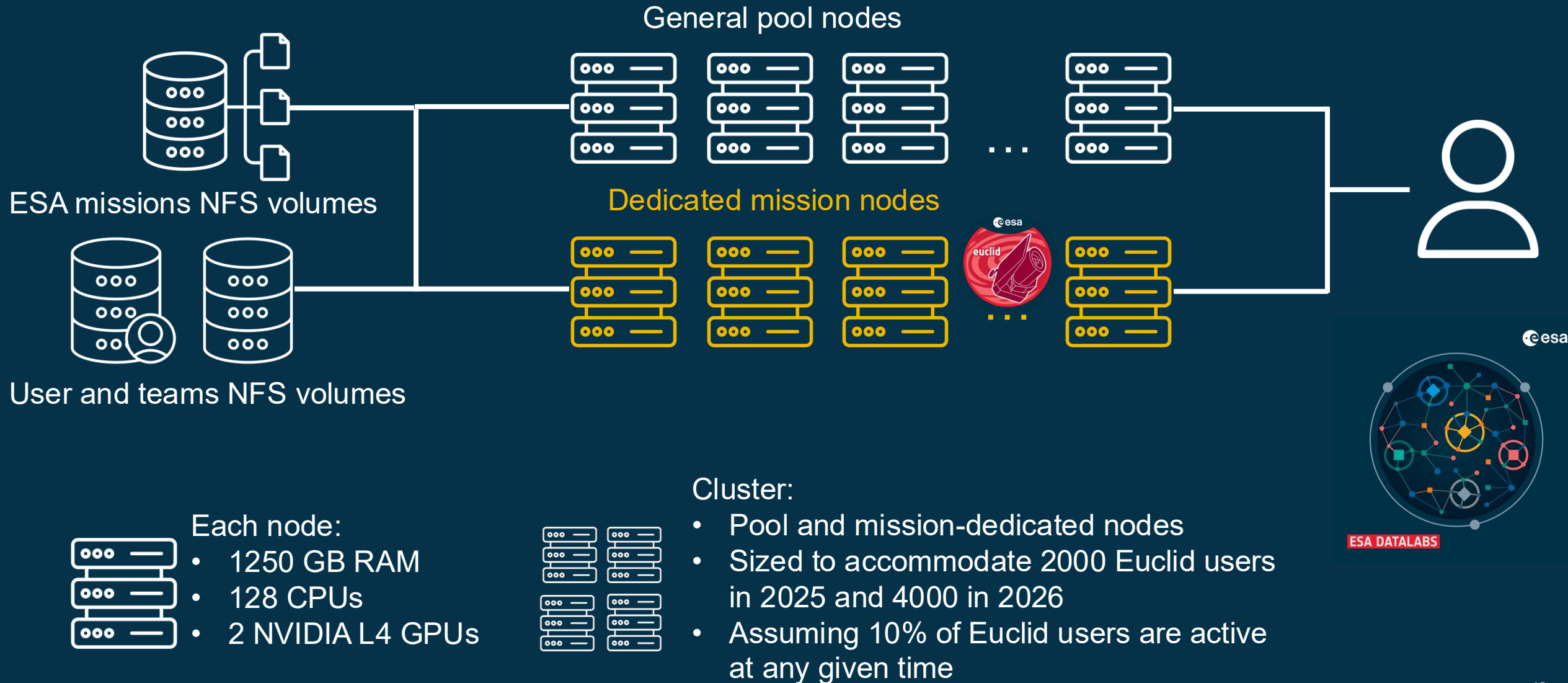
Work area for the members of the Euclid Consortium.

Work area for the Euclid members of the Science Operations Centre at ESAC

ESA Datalabs architectural overview



ESA Datalabs infrastructure overview





Sign in

→ SCIENCE MISSIONS

→ THE EUROPEAN SPACE AGENCY

→ SCIENCE & TECHNOLOGY



esa datalabs

Home

ESA Datalabs > Self-registration

REQUEST AN ESA DATALABS ACCOUNT



Welcome! If you are new to [ESA Datalabs](#), follow the steps below to request an account.

- **At the moment, requests for an ESA Datalabs account are subject to moderation.** Your request will be processed within **1-5 working days**.
- **How to apply:** Follow the steps below to submit your request using your institutional email. If you have an invitation code, make sure to include it in the next step.
- By submitting your information, you agree to our [Terms and Conditions](#).

ESA Datalabs Account Request

ESA Datalabs Community – Today



Euclid Q1 Workshop, ESAC, 1-3 Dec 2025
Euclid Q1 Tutorial, ADASS, Nov 2025
ML in Heliophysics Workshop, ESAC, Sep 2025
ESA Datalabs Hackathon, ESAC, Jan 2025
NLP for Space Science Workshop, ESAC, Sep 2024
.Astronomy 13, ESAC, Apr 2024
Masterclass on JWST, ESAC, Dec 2023
JWST Summer School, Heidelberg, Sep 2023
Euclid Workshop, Copenhagen, Jun 2023
ESA Datalabs Workshop, ESAC, Nov 2022

2800 registered users

100 daily users



The background is a vertical stack of four astronomical images. The top section shows a dense field of stars against a dark sky. The second section from the top shows colorful interstellar clouds in shades of purple, blue, and red. The third section, which contains the text, shows a dense field of stars with a bright, hazy band across the middle. The bottom section shows a large, detailed image of a spiral galaxy with prominent arms and a bright core.

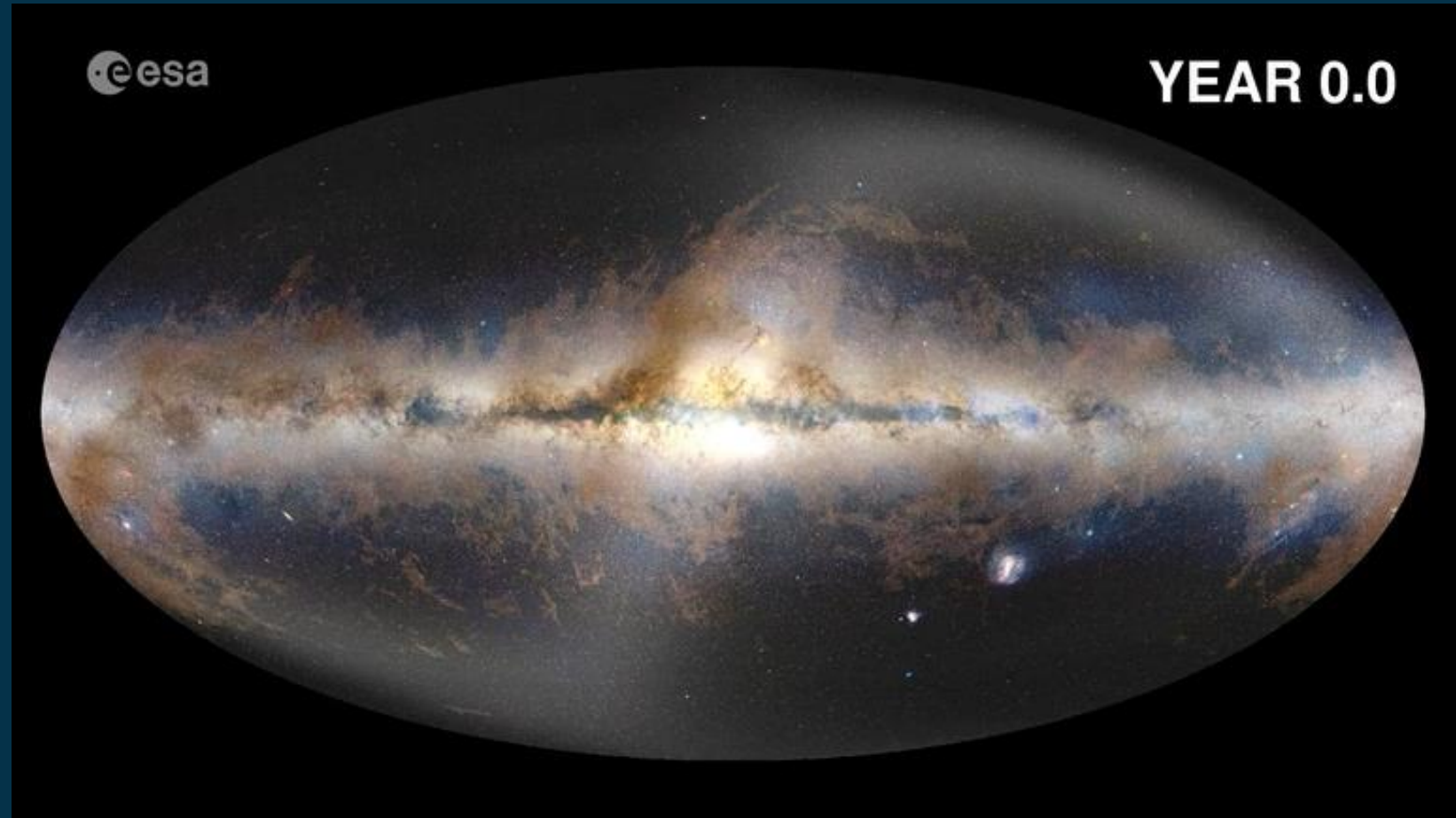
Enabling Euclid data releases

Euclid Q1 (March 2025):

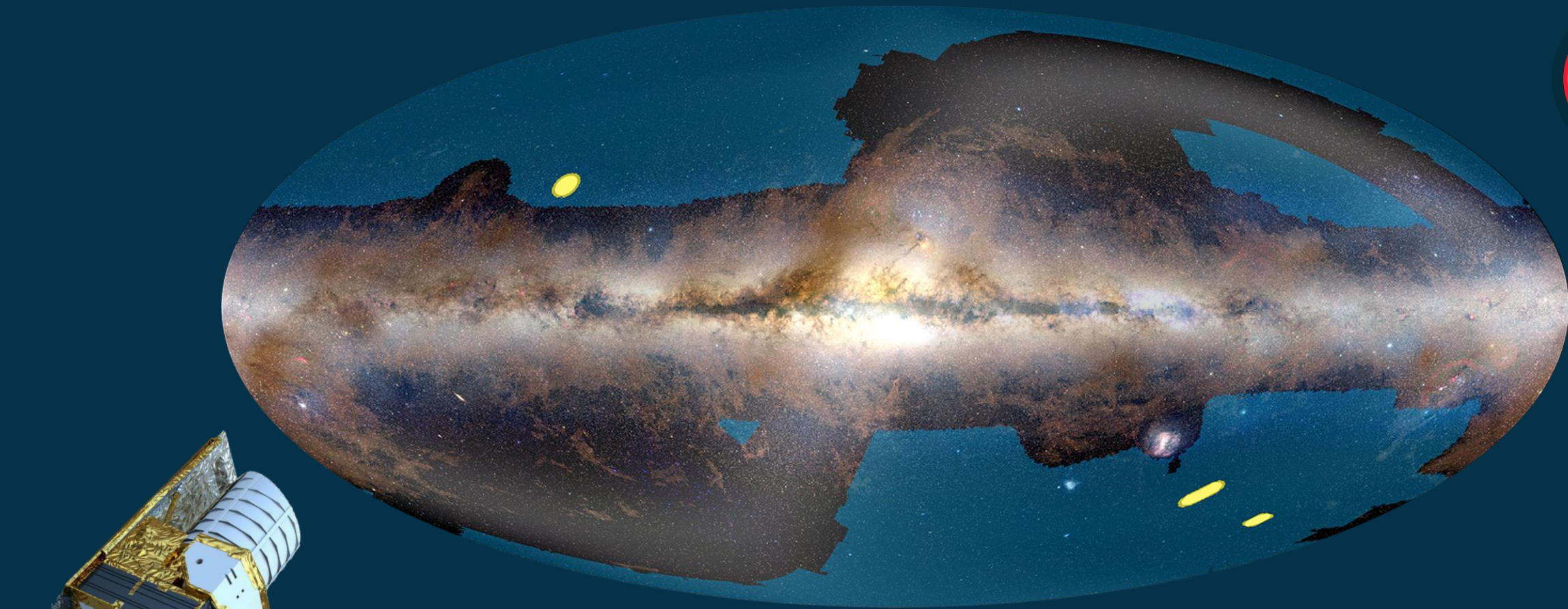
- 63 degrees²
- <1% of the Wide Survey
- 35 TB (still possible to download)

Euclid DR1 (October 2026):

- 1,900 degrees²
- Already released to the Euclid Consortium in October 2025
- 2 PB (hard / impossible to download)



Euclid Quick Data Release (Q1) on 19 March 2025

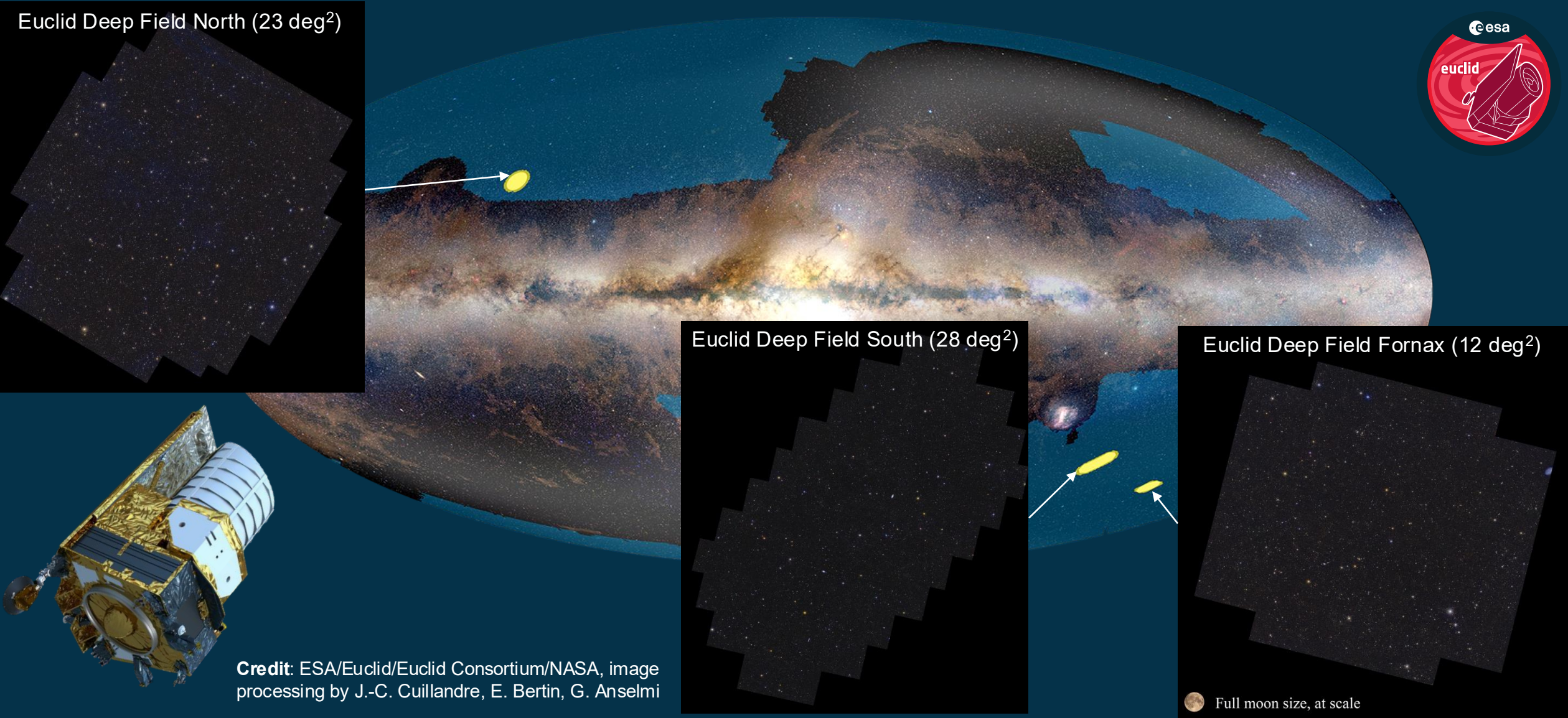


Euclid six-year Surveys: wide (blue) and deep (yellow) surveys

Credit: ESA/Euclid/Euclid Consortium/NASA/Planck Collaboration/A. Mellinger
Acknowledgment: Jean-Charles Cuillandre, João Dinis and Euclid Consortium Survey Group

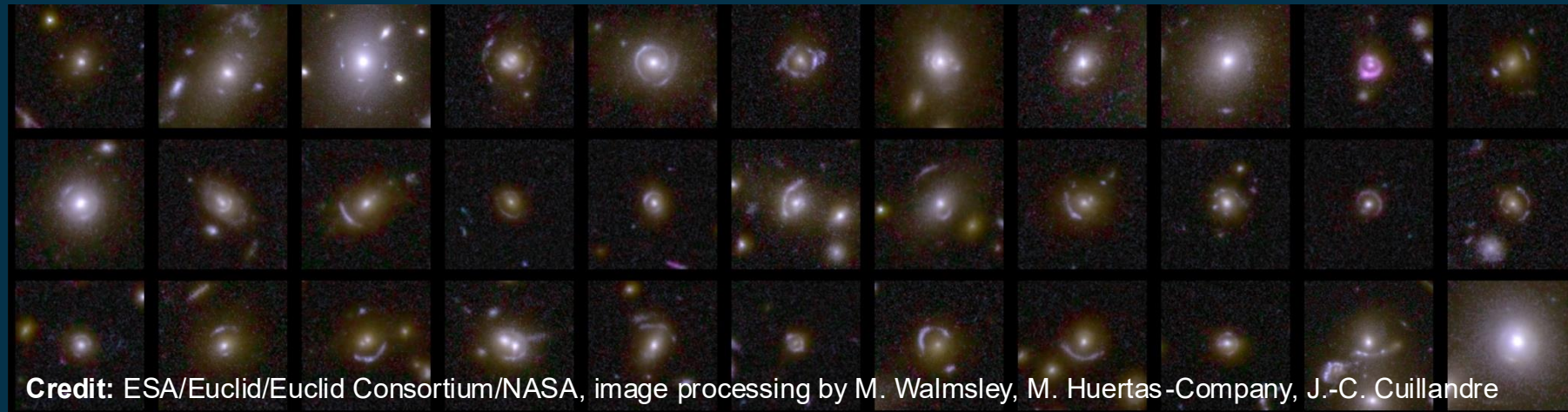


Euclid Quick Data Release (Q1) on 19 March 2025

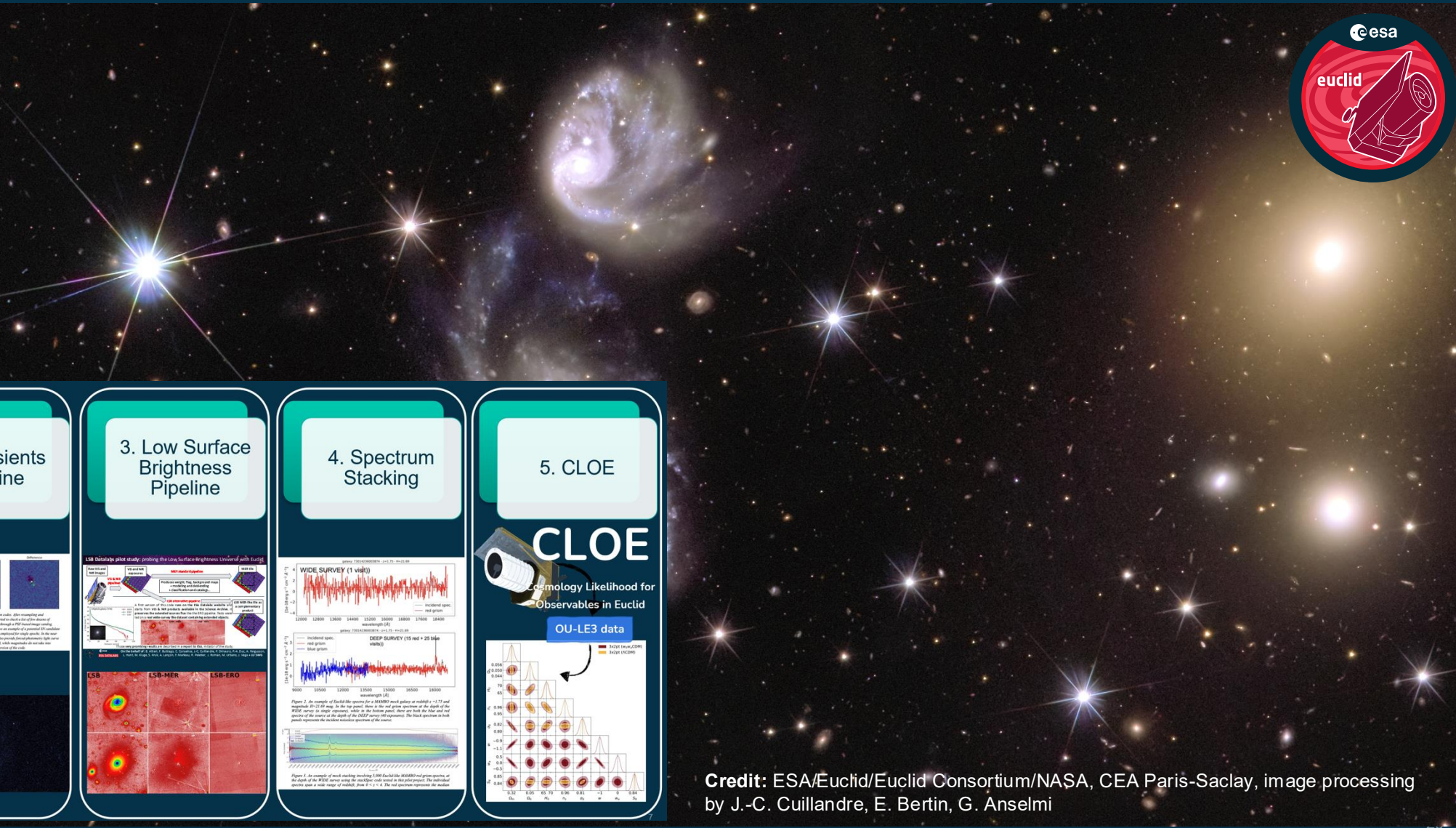


Examples of Euclid use cases in ESA Datalabs

- 11 out of 27 Euclid Q1 science papers mention using ESA Datalabs
- ADQL queries and cross-matches with user catalogues
- Direct access to Euclid Q1 FITS images
- Generating cutouts in-bulk
- Predictions with AI/Zoobot
- Collaborative work
- Galaxy morphology (Walmsley et al. 2025a), Strong lensing (Walmsley et al. 2025b)



Euclid Consortium pilot studies in ESA Datalabs



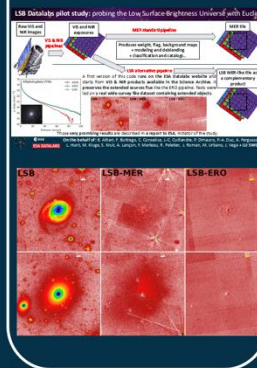
1. Solar System Objects Pipeline



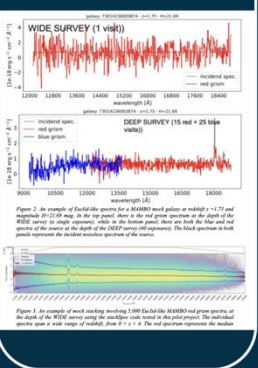
2. Transients Pipeline



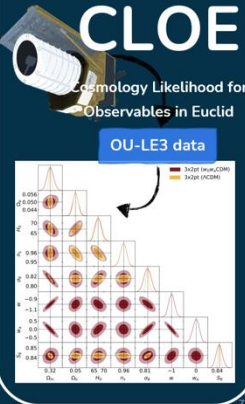
3. Low Surface Brightness Pipeline



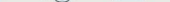
4. Spectrum Stacking



5. CLOE



Credit: ESA/Euclid/Euclid Consortium/NASA, CEA Paris-Saclay, image processing by J.-C. Cuillandre, E. Bertin, G. Anselmi



Find a datalab in ESA Datalabs catalog

Filter results



A jupyter lab environment containing the planetary coverage package (vers 1.1.0).



Euclid Jupyterlab with access to Q1 and ERO data volumes and to the Euclid astroquery module



Euclid JupyterLab with access to public Euclid Q1 and ERO data



The G-Tomo scientific data application (SDA) created by the EXPLORE project allows users to extract 1d profiles and 2d maps from the latest 3d dust extinction maps based on Gaia eDR3 and 2MASS data (Lallement et al. 2022).



GMLD - Ephemeris Parameters Prediction



GMLD - Multipath Prediction



europaesa

europaesa

Getting_started.ipynb | Image_visualisati | Cutouts.ipynb | ADQL_examples.i | Astroquery.ipynb

Getting_started.ipynb

Welcome to the Euclid-Q1 datalab

This file contains some helpful information to get you started on accessing and analysing data from the **ESA Euclid Mission**. For any question related to the use of **ESA Datalabs**, please read the extensive [Datalabs Help Pages](#).

A **datalab** is a purpose-built software application that runs on ESA Datalabs. From the user's perspective, it functions similarly to a virtual machine, allowing users to launch, use, and delete it as needed. For more information on the functionalities of the datalab implementation, please read [here](#). The **Euclid-Q1 datalab** is based on JupyterLab. For basics on JupyterLab, you can access here the [JupyterLab documentation](#).

The goal of the **Euclid-Q1 datalab** is to provide direct access to the Euclid Q1 data and Euclid Early Release Observations (EROs), *without* the need to download the data. The Euclid data is accessible through the **data** folder on the left-hand side. This datalab is built for analysis and we strongly encourage you *not* to download Euclid data via the datalab. User-derived data can be, however, downloaded. For downloading Euclid data, please use the [Euclid Science Archive](#). Information about the Euclid Data is available at:

Dataset	Information
Euclid Q1 data	https://www.cosmos.esa.int/web/euclid/euclid-q1-data-release
Euclid ERO data	https://www.cosmos.esa.int/web/euclid/ero-public-release

Euclid Consortium members can find additional information and guides on accessing data from various Euclid environments in the dedicated **Euclid Consortium team workspace**.

1. Workspaces

EUCLID-TOOLS | Idle Mem: 372.31 / 32000.00 MB Mode: Command Ln 1, Col 1 Getting_started.ipynb

Euclid Astroquery library example notebook

Author(s): Kristin Anett Rimmelgas
Last modified: 14.03.2025

Notebook summary

Euclid Astroquery is a Python library that can be used to access Euclid data through the Euclid Science Archive System. This notebook presents examples of all available astroquery functions with parameter options and usage examples. Note that the Astroquery functions below **access all the data through the SAS archive**. However when working on ESA Datalabs you already have **direct access to the Q1 data volume** so the functions demonstrated below might not be the most optimal way. Instead of using the get_product, get_spectrum and get_cutout methods to download data, on Datalabs you can instead use the path of the data directly. This notebook covers the following topics:

1. Local data
2. Local data
3. Galaxy
4. Cluster
5. M
6. L

ADQL Query examples

Author(s): Héctor Cánovas Cabrera
Last modified: 14.03.2025

Notebook summary

Tutorial: Making image cutouts from Q1 data

Author(s): Kristin Anett Rimmelgas
Last modified: 14.03.2025

Notebook summary

- This example notebook presents an example use case for making cutouts of Euclid images from Q1 data. We will be using the [Euclid Astroquery](#) only for matching the sources with correct file names but accessing those files and making the cutouts is done on ESA Datalabs through the mounted Q1 data volume. Alternatively it is also possible to use the [Euclid Science Archive](#) to download the data directly.
- not covered
- and more

Tutorial: Image visualization

Author(s): Kristin Anett Rimmelgas
Last modified: 14.03.2025

Notebook summary

This notebook demonstrates some methods to visualize Euclid mosaic images. The first part of the notebook focuses on traditional static image visualization using the [Matplotlib](#) package, the second part demonstrates how to visualize images interactively using the [Imviz](#) tool from the [Jdaviz](#) package and the third section shows a small example for using [PyESASky](#). Here is a quick overview of the notebook contents:

1. Traditional image visualization with Matplotlib
 - Exploring the content of the FITS file
 - Loading data from the file
 - Plotting image data with Matplotlib
 - Plotting a cutout of the image
2. Interactive image visualization with Imviz
 - Creating Imviz window
 - Loading image data
 - Basic plot options (changing stretch, zoom, colormap)
 - Plotting a catalogue of sources as markers
 - Working with more images (blinking, side-by-side)
 - Exporting from Imviz



GitHub

Credit:
Kristin Rimmelgas
Héctor Cánovas
Daniela Coia
Marcos López-Caniego
Sandor Kruk

Accessing Q1 data with Euclid astroquery module

ESA Datalabs
(Astroquery + NFS access)



```
Astroquery.ipynb
[22]: #Example cone search for source NGC6505
simbad_out = Simbad.query_object('NGC6505')
ra_gal = simbad_out['ra'][0]
dec_gal = simbad_out['dec'][0]

coord_ngc6505 = SkyCoord(ra_gal, dec_gal, frame='icrs', unit='deg')
radius = u.Quantity(0.5, u.deg)
j = Euclid.cone_search(coordinate=coord_ngc6505, radius=radius, table_name="sedm.mosaic_product", ra_column_name="ra", dec_column

cone_results = j.get_results()
print("Found", len(cone_results), "results")
cone_results['tile_index', 'ra', 'dec', 'datalabs_path', 'file_name', 'filter_name'][:5]

INFO: Query finished. [astroquery.utils.tap.core]
Found 27 results
[22]: Table length=5
```

tile_index	ra	dec	datalabs_path	file_name	filter_name
int64	float64	float64	str43	str88	str11
102158889	267.3807789	65.4983	/data/euclid_q1/Q1_R1/ MER/102158889/ MEGACAM	EUC_MER_BGSUB-MOSAIC-CFIS- R_TILE102158889-4366B7_20241024T203624.450577Z_00.00.fits	MEGACAM_r
102158889	267.3807789	65.4983	/data/euclid_q1/Q1_R1/ MER/102158889/HSC	EUC_MER_BGSUB-MOSAIC-WISHES- G_TILE102158889-3DC3C3_20241024T205647.635112Z_00.00.fits	HSC_g
102158889	267.3807789	65.4983	/data/euclid_q1/Q1_R1/ MER/102158889/NISP	EUC_MER_BGSUB-MOSAIC-NIR-Y_TILE102158889- AC6585_20241024T225321.344048Z_00.00.fits	NIR_Y

Euclid Q1 data app and resources



**Euclid-Q1**
Euclid JupyterLab with access to public Euclid Q1 and ERO data

Resources

User limits

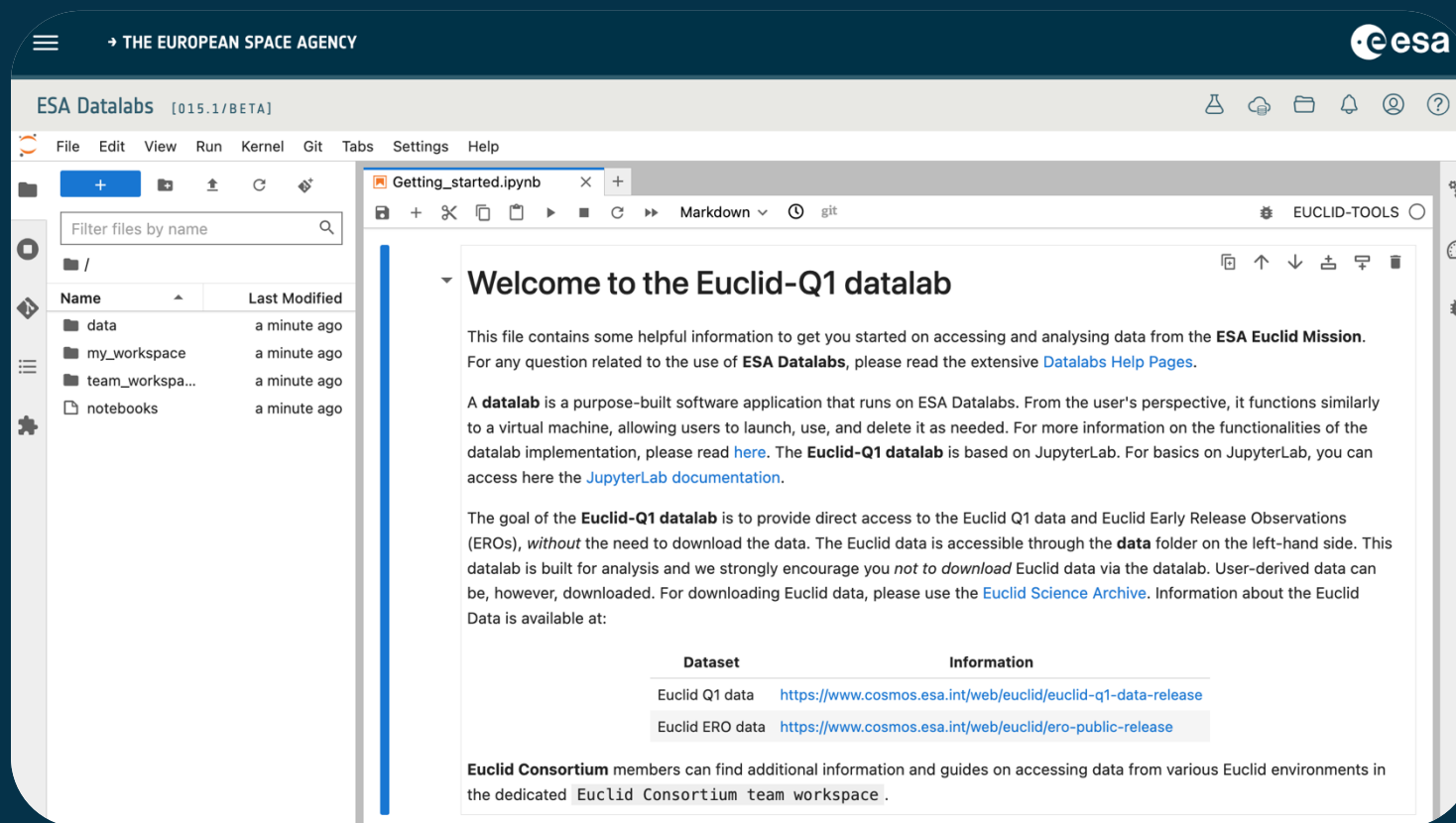
- 2 simultaneous data apps
- 100 GB persistent storage
- 64 GB RAM
- Up to 16 CPUs

Euclid Q1 data app

- 32 GB RAM
- 2 CPUs
- Euclid-Tools kernel

Helpdesk

- For more resources or team workspaces



The screenshot shows the ESA Datalabs interface. The top bar includes the ESA logo and navigation icons. The main content area displays a JupyterLab workspace titled 'Getting_started.ipynb'. The left sidebar shows a file explorer with folders like 'data', 'my_workspace', 'team_workspa...', and 'notebooks'. The central pane shows a 'Welcome to the Euclid-Q1 datalab' message, followed by instructions on how to use the datalab and a table of datasets.

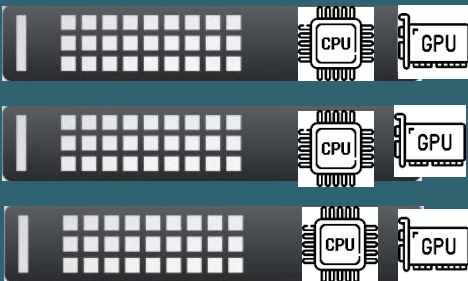
Dataset	Information
Euclid Q1 data	https://www.cosmos.esa.int/web/euclid/euclid-q1-data-release
Euclid ERO data	https://www.cosmos.esa.int/web/euclid/ero-public-release

What is next on ESA Datalabs?

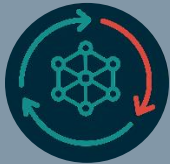
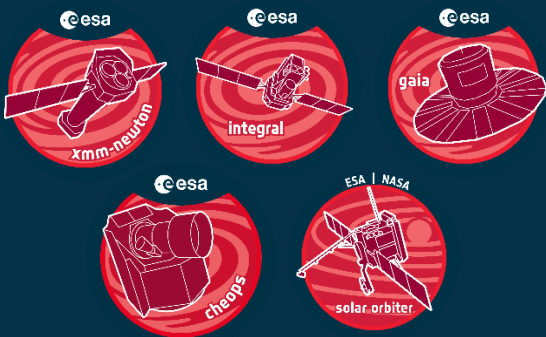


Increasing Capacity

- Increasing capacity for users and teams
- Purchase of additional storage and compute nodes

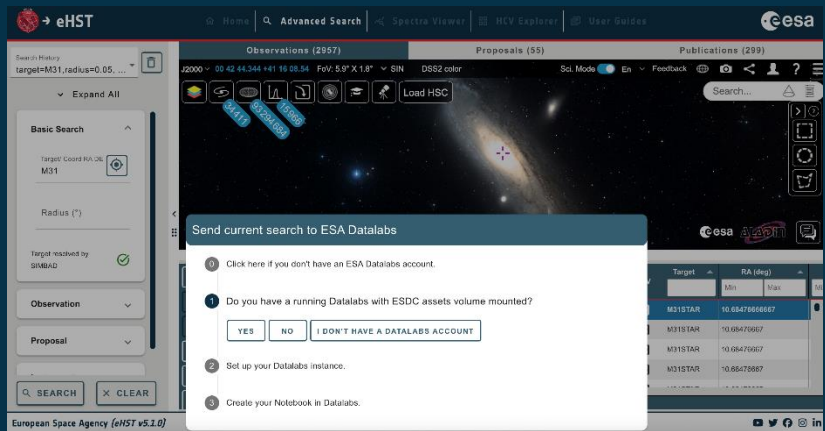


- Increasing content and data from missions



Increasing Functionality

- Interoperability with the mission archives, e.g., launching of apps from archive web interface



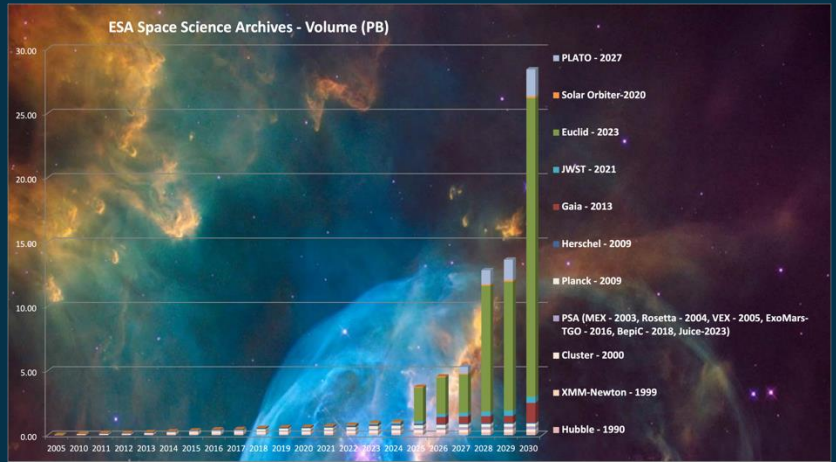
- Programmatically query the archives using, e.g., *astroquery* to identify the path to the data in the volume

datalabs_path	file_name	filter_name
str43	str88	str11
/data/euclid_q1/Q1_R1/MER/102158889/MEGACAM	EUC_MER_BGSUB-MOSAIC-CFIS-R_TILE102158889-4366B7_20241024T203624.450577Z_00.00.fits	MEGACAM_r
/data/euclid_q1/Q1_R1/MER/102158889/HSC	EUC_MER_BGSUB-MOSAIC-WISHES-G_TILE102158889-3DC3C3_20241024T205647.635112Z_00.00.fits	HSC_g
/data/euclid_q1/Q1_R1/MER/102158889/NISP	EUC_MER_BGSUB-MOSAIC-NIR-Y_TILE102158889-AC6585_20241024T225321.344048Z_00.00.fits	NIR_Y

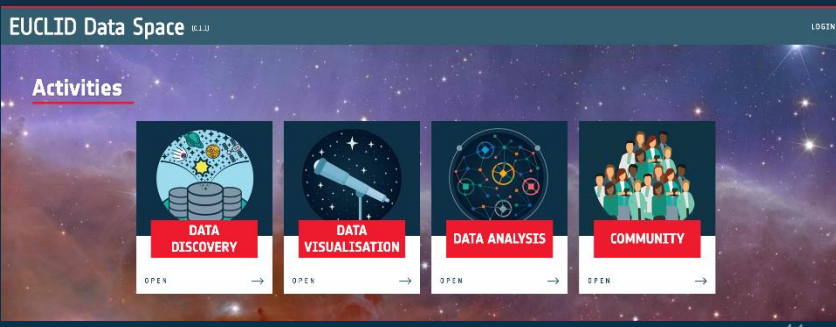


Euclid Data Space

- Solve the Euclid data volume and data access challenge



- Development of Euclid Data Space Portal: Euclid Archives + ESA Datalabs + ESASky



ESA Datalabs: acknowledgements

ESA Datalabs acknowledges the contributions of various multi-disciplinary groups: our industrial partners CGI, ACRI-ST, Edisoft, Uninova, GMV, and Ideorum, the Science and Operations Technical IT Unit (SITU) at ESAC, the ESA Datalabs Users Group, colleagues of ESA space science missions, and the ESAC Science Data Centre (ESDC)



ESA DATALABS