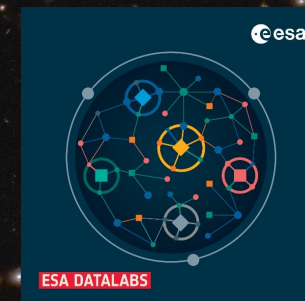


ESA Datalabs

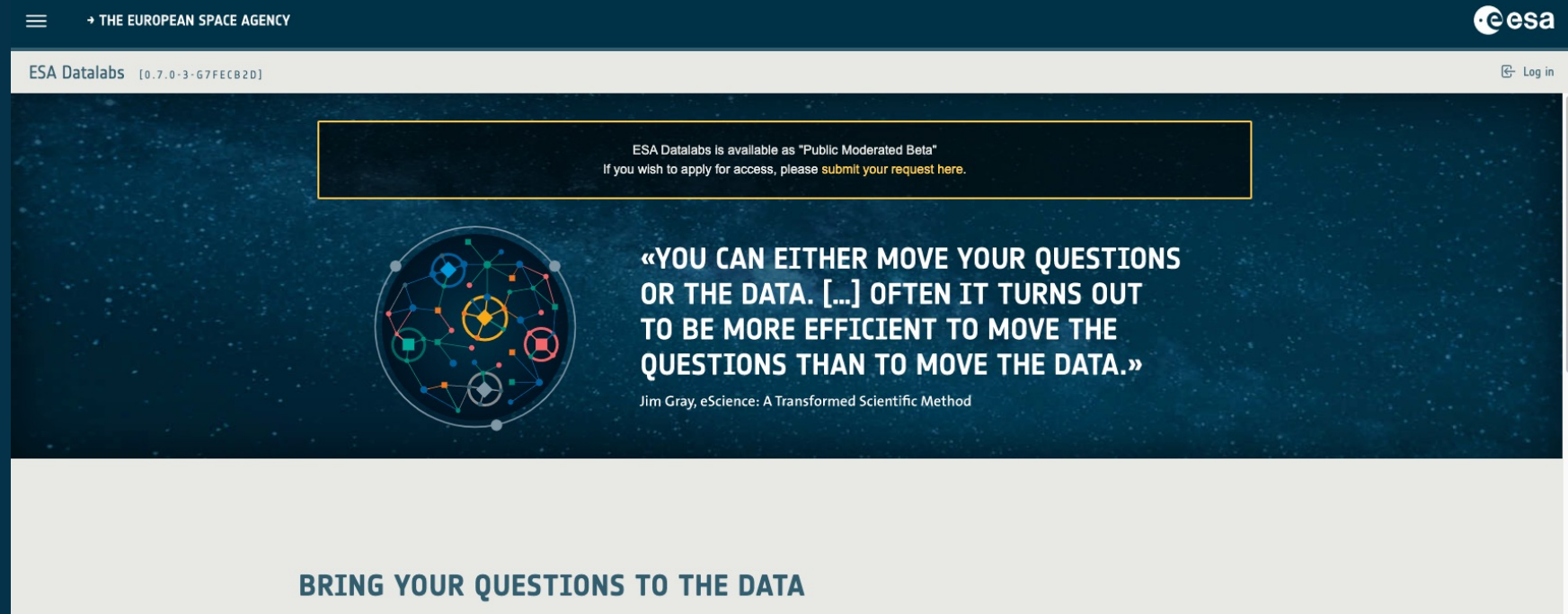
M. López-Caniego, S. Kruk, P. Gómez, V. Navarro, J. Reerink and C. Arviset

on behalf of the Data Science and Archives Team

European Space Astronomy Center (ESAC)



Why science platform?



ESA Datalabs (datalabs.esa.int) is a moderated science platform that complements the ESA science archives by providing computing capability, software and collaborative tools running in the same data center where the archives live at ESAC.

2



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Why science platform? Change of paradigm



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ESA Datalabs [0.7.0-3-G7FECB2D]

Log in

ESA Datalabs is available as "Public Moderated Beta"
If you wish to apply for access, please [submit your request here](#).



«YOU CAN EITHER MOVE YOUR QUESTIONS
OR THE DATA. [...] OFTEN IT TURNS OUT
TO BE MORE EFFICIENT TO MOVE THE
QUESTIONS THAN TO MOVE THE DATA.»

Jim Gray, eScience: A Transformed Scientific Method

BRING YOUR QUESTIONS TO THE DATA



Search



Download



Process



Publish

3



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Why science platform? Change of paradigm



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1

Boost Access to Tools - dedicated software



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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 Multipth EDL

GMLD - Multipath Prediction

GMLD SBAS EDL

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

6



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Boost Access to Tools - dedicated software



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7





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ESA Datalabs [016.0/BETA]



Modification date: n/a
Datalab version:
Author: Marcos Lopez-Caniego
Popularity: ☆0

Basic datalab ☐

Welcome to the datalab creator! To start please select from the pulldown menu below the type of datalab you want to create, select the clusters where the datalab can be launched, and then the files (e.g. Jupyter notebooks) you want to use. You can use files from a git repository (public URL, no login required), your ESA Datalabs workspace or your own computer. To include your favourite python packages upload a requirements.txt file listing all our packages*. Click on next to continue and add metadata for your datalab. If you include a meta-data.yaml file we will prepare your lab based on it.

Select your datalab type

Jupyter Lab

Where are your files?


File upload


Select your source

You can select or drag and drop the files or archive of the exported datalab that you want to use in your next datalab. To upload a complex file structure please use a zip



DRAG & DROP

Cancel next

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ESA Datalabs [016.0/BETA]



Modification date: n/a

Datalab version:

Author: Marcos Lopez-Caniego

Popularity: ☆0

Basic datalab ☐

①

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Select your datalab type

Where are your files?

✓ Jupyter Lab

VNC based X server

File upload

Select your source


①


You can select or drag and drop the files or archive of the exported datalab that you want to use in your next datalab. To upload a complex file structure please use a zip

DRAG & DROP



Cancel

next

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ESA Datalabs [016.0/BETA]



Modification date: n/a
Datalab version:
Author: Marcos Lopez-Caniego
Popularity: ☆0

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Select your datalab type

Where are your files?

Select your source

You can select or drag and drop the files or archive of the exported datalab that you want to use in your next datalab. To upload a complex file structure please use a zip

DRAG & DROP

Git repository

✓ File upload

Cancel

next

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ESA Datalabs [016.0/BETA]

Euclid-Tools

DRAFT

Modification date: 12/01/2024 13:22

Datalab version: 0.0.1

Author: Marcos Lopez-Caniego

Popularity: ☆0

Link: [bf98e588-c2a9-49ab-bb3d-fd6...](#)

Delete

Metadata Testing Visibility

Mandatory information

title Euclid-Tools

alternate Name Euclid astroquery

abstract JupyterLab is a web-based interactive computational environment. This version was customized by the Euclid mission with additional Python libraries + astroquery. It

contact Point email Email of the contact point

creator name Name of the organisation authoring the datalab

version 0.0.1

Recommended information

Optional information

Update

1

Boost Access to Tools - Datalab editor



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ESA Datalabs [016.0/BETA]

Euclid-Tools

DRAFT

Modification date: 12/01/2024 13:22

Datalab version: 0.0.1

Author: Marcos Lopez-Caniego

Popularity: ☆0

Link: [bf98e588-c2a9-49ab-bb3d-fd6...](#)

Delete

Metadata **Testing** Visibility

Tips for internal developers:

- Use the docker ARG REGISTRY to get the registry used to pull base image
- Use the special docker ARG JL_BASE_VERSION (i.e. FROM \$REGISTRY/datalabs/jl_base:\$JL_BASE_VERSION) works with X_BASE_VERSION datalab
- 3 Types of image jl_base, x_base, datalab_base
- Try to combine Install command in a single Docker command to reduce the size of the image
- You can check your dockerfile with Hadolint: `docker run --rm -i hadolint/hadolint < Dockerfile`

Build date: 12/01/2024 12:04 Build version: 0.0.1-0 **SUCCESS**

Rebuild

Upload new sources

Start

Previous build

sciapps-build-datalab-4nw58 [12/01/2024 11:42] ▾

Pipeline Logs

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1

Boost Access to Tools - Datalab editor



ESA Datalabs [016.0/BETA]

Euclid-Tools

DRAFT

Modification date: 12/01/2024 13:22
Datalab version: 0.0.1
Author: Marcos Lopez-Caniego
Popularity: ☆0
Link: [bf98e588-c2a9-49ab-bb3d-fd6...](#)

Delete

Metadata Testing **Visibility**

Use this form to share with some users as a private access, only them will have access to your lab. Or you can share with everyone using the publish flow. Your datalab will be reviewed by a moderator

Build date: 12/01/2024 12:04 Build version: 0.0.1-0 SUCCESS

Sharing audience ☒ Public, everyone can use it ☐ Private, specify a list of users

Publish

License

Submit

Export

History

Please select a license

Popular Licenses

- Apache License 2.0
- BSD 3-Clause No Nuclear Warranty
- Creative Commons Attribution Non Commercial 3.0 Germany
- GNU General Public License v2.0 only
- GNU General Public License v3.0 or later
- GNU Library General Public License v2.1 or later
- MIT License

European Space Agency

- European Space Agency Community License – v2.4 Permissive (Type 3)
- European Space Agency Community License – v2.4 Strong Copyleft (Type 1)
- European Space Agency Community License – v2.4 Weak Copyleft (Type 2)
- European Space Agency Public License (ESA-PL) Commentary – v2.3
- European Space Agency Public License – v2.4 – Permissive (Type 3)
- European Space Agency Public License – v2.4 – Strong Copyleft (Type 1)
- European Space Agency Public License – v2.4 – Weak Copyleft (Type 2)

Others

12/01/2024 11:42: Build started (sciapps-build-
12/01/2024 11:45: Build ended with status BUILD
12/01/2024 11:46: Build started (sciapps-build-
12/01/2024 11:49: Build ended with status BUILD
12/01/2024 12:04: Build started (sciapps-build-
12/01/2024 12:08: Build ended with status BUILD

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Boost Access to Tools – standalone applications



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ESA Datalabs [015.1/BETA]

sensors.

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

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

x-glab
GNSS-Lab Tool (gLAB)

x-octave
Scientific Programming Language.

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-file-manager
Lightweight file manager from LXDE.

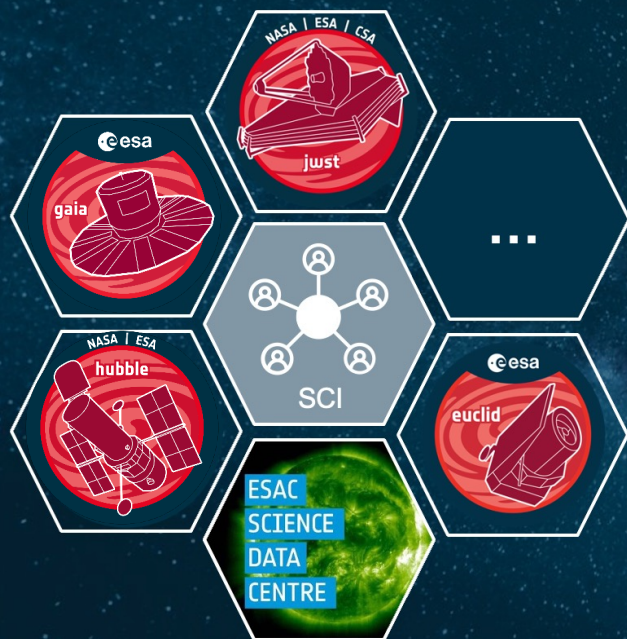
x-helio
Visualization software for solar image data based on the JPEG 2000 compression standard.

x-topcat
Tool for OPerations on Catalogues And Tables

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The screenshot displays the ESA Data Labs interface, specifically the Space Science domain. The interface includes a search bar, a filter for 'Space Science (46)', and a list of datasets:

Domain	Type in your query...
Space Science (46)	domain:Space Science
Mission	
HST - NICMOS	Data Volume for Hubble Space Telescope Legacy Near Infrared Camera and Multi-Object Spectrometer (NICMOS). 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 - HRS	Data Volume for Hubble Space Telescope Legacy Goddard High Resolution Spectrograph (GHRS). Data volume made available by ESDC.
JWST - Ancillary	Data Volume for James Webb Space Telescope ancillary files and example notebooks.
HST - STIS	Data Volume for Hubble Space Telescope Imaging Spectrograph (STIS). 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 - HSP	Data Volume for Hubble Space Telescope Legacy High Speed Photometer (HSP). 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.
XMM-Newton CCFs	Data volume for XMM-Newton Calibration CCFs repository. Data volume made available by XMM-Newton mission.
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.

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ESA Datalabs

Data Volume Catalog

Domain

☒ Space Science (2) domain:Space Science


Euclid Q1

The Euclid Q1 release covers 63 square degrees in the Euclid Deep Fields at the depth of the Euclid Wide survey. Details are available at <https://www.cosmos.esa.int/web/euclid/euclid-q1-data-release> and tutorial notebooks accessible via the Euclid-Q1 datalab.


Euclid ERO

The Euclid Early Release Observations (ERO), led by the Euclid Science Team and ESA, showcase the Euclid mission's capabilities, focusing on legacy science. ERO DR3 includes image stacks and validation catalogues for 16 fields from six selected projects. Detailed dataset information is available <https://www.cosmos.esa.int/web/euclid/ero-data-release>.


Euclid Deep Field South (Q1 release)











Perseus Cluster (Euclid ERO)



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


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ESA Datalabs [015.1/BETA]
 







Teams

Manage the list of teams and their users

Domain
 ☐ Space Science (11)

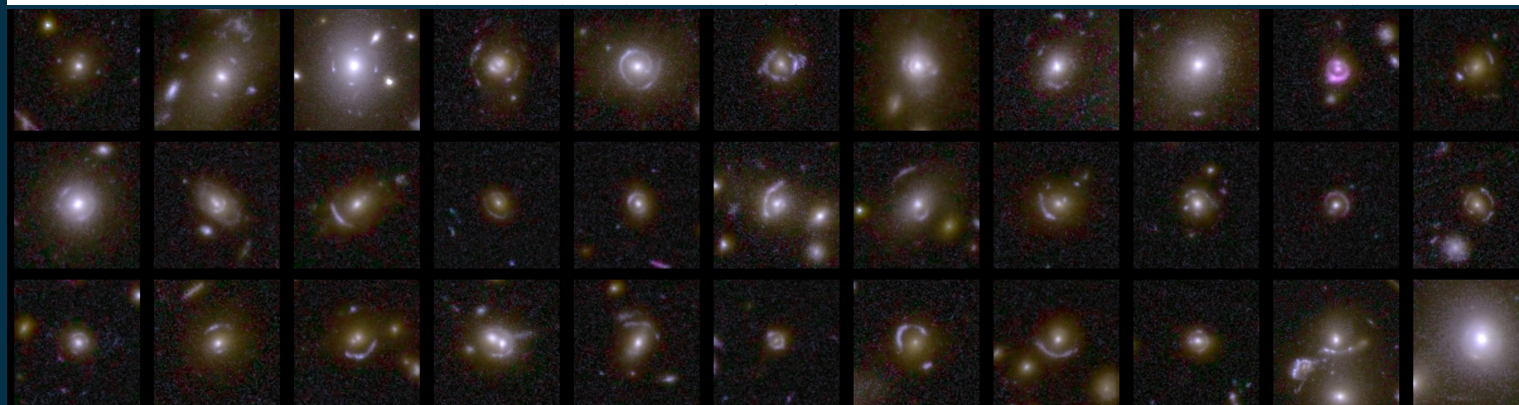
Euclid
 


domain:Space Science

The FornaX Euclid - XMM-Newton collaboration The 10 deg ² Euclid Deep Fornax Field (EDFF) will be the foremost extragalactic medium-area deep field and we aim to enhance its legacy value by providing the X-ray view by mapping the entire EDFF at 40 ks depth. The XMM data will enable major advances in the study of AGN and galaxy clusters, including: <i>*Deep characterisation of Euclid-detected clusters and their selection function</i>	Euclid Spectrum Stacking Team workspace for Euclid Pilot Study 5: Euclid pilot study on spectrum stacking tools
Euclid CLOE Euclid code that produces the theoretical predictions for Euclid primary observables (power spectra for Weak Lensing and Galaxy Clustering)	Euclid SSO pipeline Euclid pilot study on Solar System Object detection
Euclid Transients pipeline Euclid pilot study on transient object detection pipeline	Euclid LSB pipeline Euclid pilot study on diffuse emission and LSB pipeline
Euclid Consortium Work Space Work area for the members of the Euclid Consortium.	Euclid SOC Work Space Work area for the Euclid members of the Science Operations Centre at ESAC



• Euclid Collaboration: Walmsley et al., 2025, "*Euclid Quick Data Release (Q1). First visual morphology catalogue*"



• Euclid Collaboration: Walmsley et al., 2025, "*Euclid Quick Data Release (Q1). The Strong Lensing Discovery Engine A -- System overview and lens catalogue*"

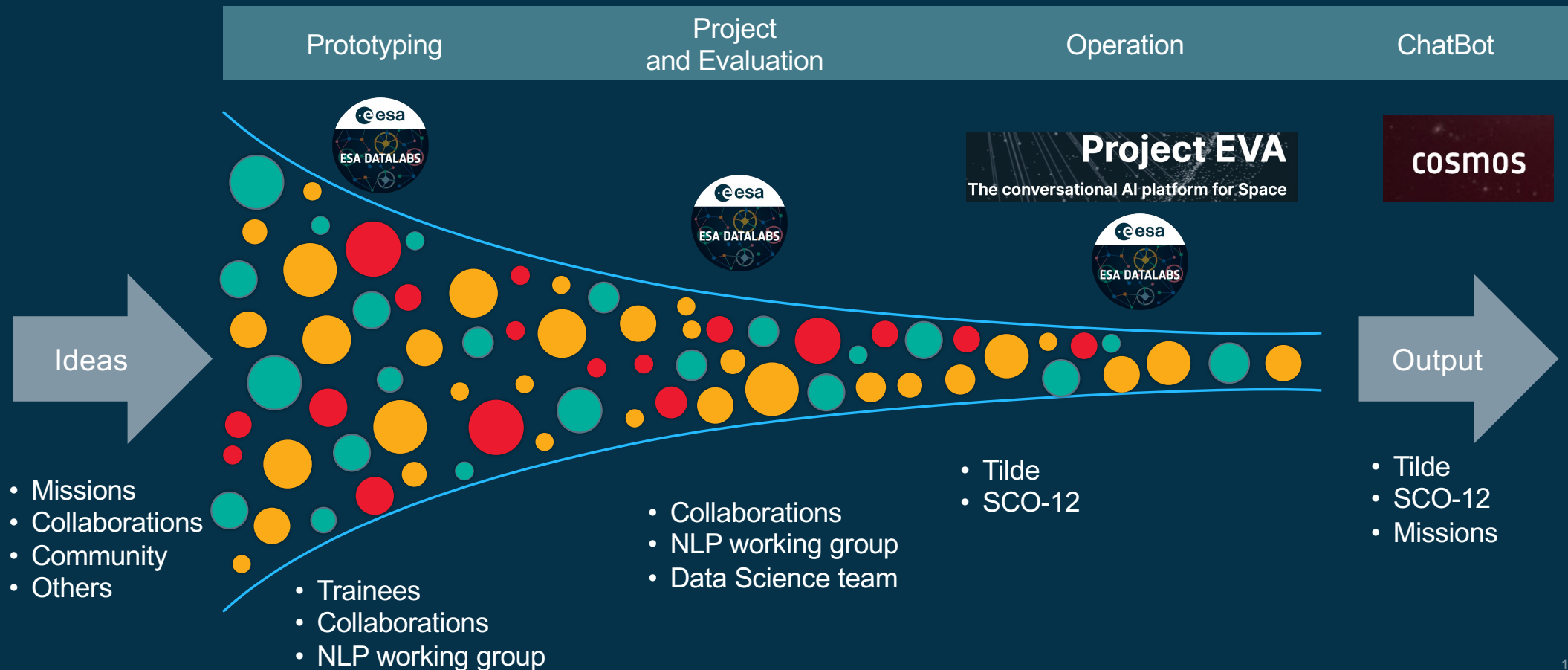


Credit: ESA/Euclid/Euclid Consortium/NASA, image processing by M. Walmsley, M. Huertas-Company, J.-C. Cuillandre

4 Support Data Science activities



LLM+RAG project development plan



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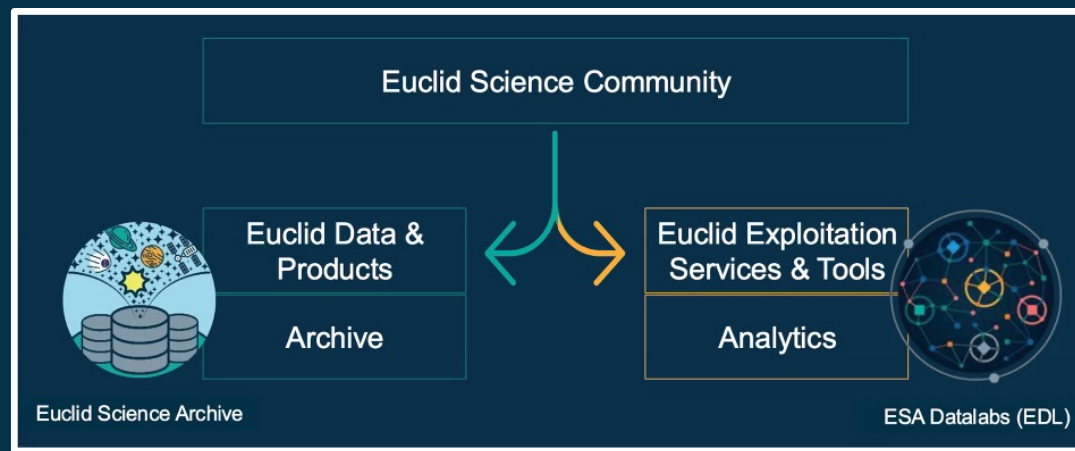
BRING YOUR QUESTIONS TO THE DATA

There is a new paradigm, opening completely new opportunities for discovery – a data-intensive approach to science. In many domains, we have entered what could be called



ESA Datalabs core infrastructure and Euclid Data Space

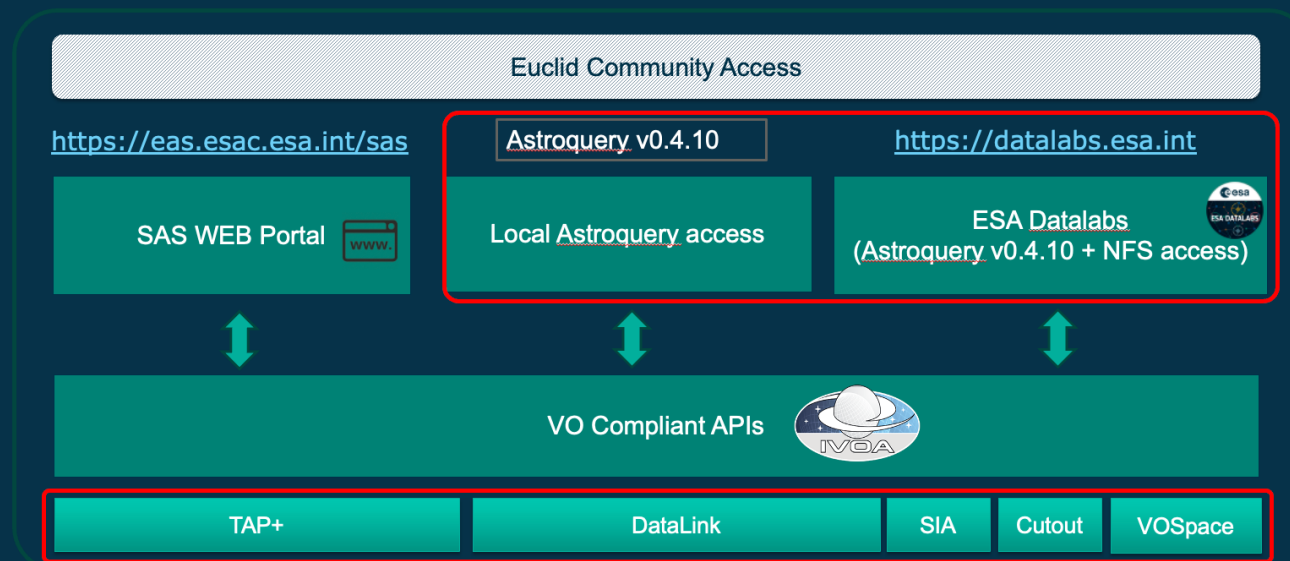
- ESA Datalabs supports tens of ESA missions: astronomy, planetary, helio and navigation.
- Euclid is bringing in new requirements: accessibility of the data, authentication, multi-clustering, computing capabilities, number of concurrent users, object storage, etc.
- These requirements go beyond the current design and ESA has realized that a higher level of integration between the Euclid Science Archive and ESA Datalabs is needed to support the huge community of users willing to access and analyze Euclid data, offering a solution that does not imply downloading data.



- The solution is the new Euclid Data Space platform (see presentation by Euclid Mission Manager P. Ferruit).

ESA Datalabs core infrastructure and Euclid Data Space

- At the core of the Euclid Science Archive, and therefore at the core of Euclid Data Space, we are using several VO protocols (TAP+, DataLink, SIA, etc.).
- Additional new protocols would be needed in the near future (VOParquet and SODA).



- The combination of VO compliant APIs + astroquery to **obtain the path to the products + ESA Datalabs** computing and collaboration infrastructure is a game changer.

ESA Datalabs core infrastructure and Euclid Data Space

- In the era of big data sets from Euclid, Roman, Rubin or SKA, it is becoming more and more important to foster collaboration between data centers to solve new problems and to support scientific use cases that were not even on the table in the recent past.
- ESA Datalabs is mature enough to join the discussion and contribute to IVOA efforts on some very important topics that could be interesting for Euclid Data Space and for other missions using ESA Datalabs:
 - Federation of data centers to facilitate software and data access
 - Common registry of infrastructure agnostic container images for sharing software
 - Seamless integration between science archives and science platforms
 - Solutions to expose users to file repositories that require fine-grained data access layers
 - New approaches for cross-matching catalogues
 - AI related tools and services that could be shared among data centers.
 - ...

Take away messages



ESA Datalabs:

- Provides by default (a good) laptop-level resources for scientists
- Provides ready-to-use scientific environments with pre-installed tools and direct access to ESA mission's science ready data
- Facilitates accessibility, collaboration and open science
- Core component of new projects like Euclid Data Space

ESA Datalabs is not:

- A replacement for archives, but complementary and a must in PB data era

ESA Datalabs is willing to join forces with other players to explore solutions to new problems

Note: ESA Datalabs is still in development

Users may encounter glitches, feedback is much appreciated

