



GALAXY ANNUAL REPORT

2023

This document is a summary of the Galaxy activities and achievements in 2023. More detailed information can always be found at the group homepage, The European Galaxy Project <https://galaxyproject.eu>.

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WHO WE ARE

Galaxy is a very mature, successful software infrastructure project, with a large and diverse global audience. For more than 18 years

(<https://galaxyproject.org/news/2023-09-28-galaxy-birthday-18>), the Galaxy Project (<https://galaxyproject.org>) has worked to solve key issues challenging modern data intensive research: the ability of researchers to access cutting-edge analysis methods, to share analysis results transparently, and to precisely reproduce complex computational analyses. Galaxy has become one of the largest and most widely used open source platforms for the analysis of scientific data used by over 500,000 users worldwide.



The Galaxy framework is an open-source platform for FAIR (findable, accessible, interoperable, reusable) data analysis that enables users to:

- Use tools from various domains that can be plugged into workflows through its graphical web interface. No programming skills are required!
- Run code in interactive environments (RStudio, Jupyter...) along with other tools or workflows.
- Manage your data by sharing and publishing results, workflows, and visualizations.
- Ensure reproducibility by capturing the provenance of the information to repeat and understand data analyses.

The Galaxy project is a worldwide project with the biggest public Galaxy servers located in the US (<https://usegalaxy.org>), Europe (<https://usegalaxy.eu>) and Australia (<https://usegalaxy.au>) (Fig.1).



Fig.1: The three main Galaxy servers in the US, Europe and Australia

GALAXY MISSION & VISION

The Galaxy project is a global open science collaboration, providing free access to shareable, reproducible, transparent, and best practice data intensive analysis for all researchers.

In support of this mission, project activities include maintaining source code, documentation, data analysis tools, training resources, analysis services, technical support and an inclusive, self-governing community.

MEET THE GALAXY TEAM

The Galaxy Team Freiburg at the Chair for Bioinformatics is led by Björn Grüning and consists of Data Analysts, Tool Developers, Administrators, Teaching experts, Training Coordinators, Project Managers, students and student helpers. In 2023, 19 people belonged to the Galaxy Team Freiburg. The international team comes from 8 different countries and has a multidisciplinary background which displays various competencies and allows them to be involved in different projects within Galaxy, expand their professional horizons and diversify their career paths (<https://galaxyproject.eu/freiburg/people>).

On social media, the Galaxy Team Freiburg is present on LinkedIn (#usegalaxy, #eurosciencegateway) and Mastodon (<https://bawü.social/@galaxyfreiburg>).

MEET THE GALAXY PARTNERS, COLLABORATORS AND FUNDERS

The Galaxy Team Freiburg is involved in 15 national, international, and European projects as partner or lead to support these projects with the provision of the Galaxy infrastructure, specific tools and workflows, and training (Fig.2).

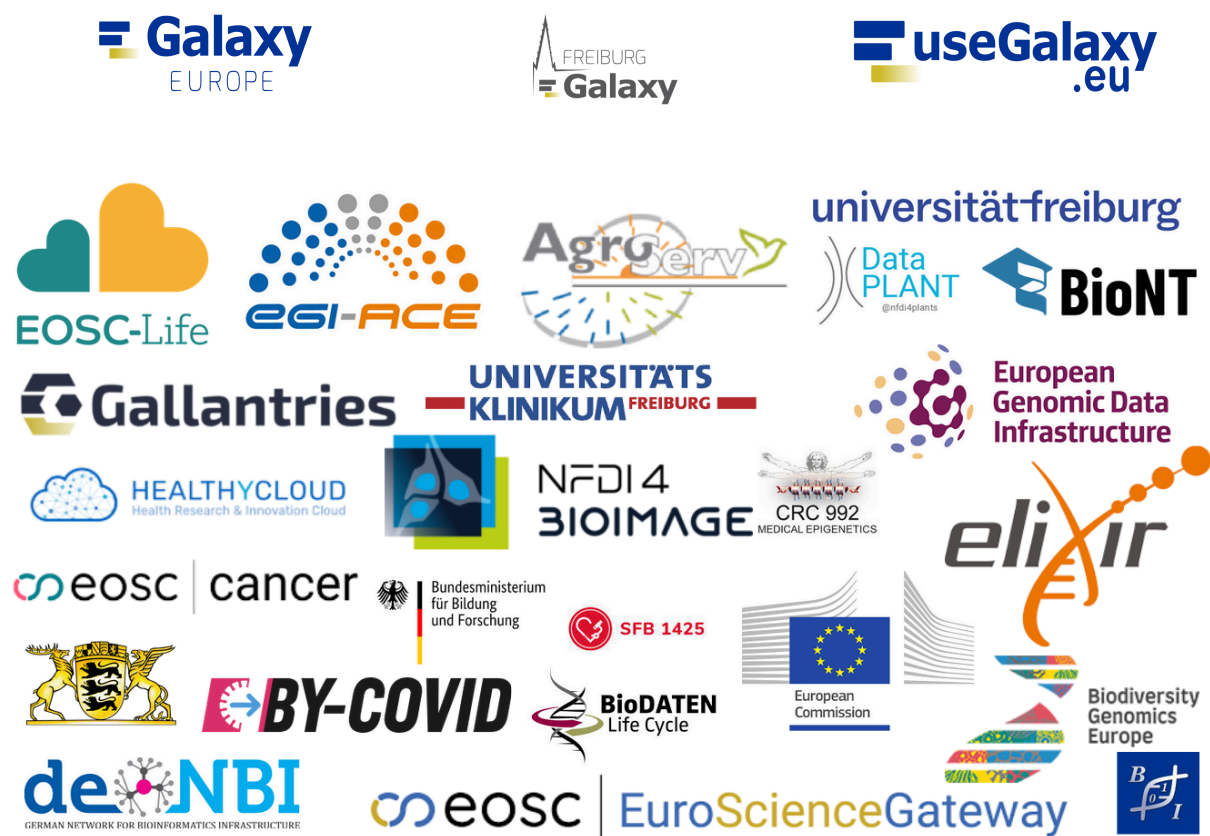


Fig. 2: Partners, collaborators, and funders of the Galaxy Team Freiburg

Besides our partners and collaborators, we know many more projects which are using Galaxy as core infrastructure for their data analysis (Table 1).

Table 1: List of Partners, Collaborators and Funders of the Galaxy Team Freiburg, and projects which are using the Galaxy infrastructure (Dec 2023)

Project	Webpage
EU Project EOSC-Life	https://www.eosc-life.eu
EU Project EGI-ACE	https://www.egi.eu/project/egi-ace
Erasmus Gallantries	https://gallantries.github.io
ELIXIR	https://elixir-europe.org
EU Project EOSC4Cancer	https://eosc4cancer.eu
EU Project EuroScienceGateway	https://eurosciencegateway.eu
EU Project ELIXIR Converge	https://elixir-europe.org/about-us/how-funded/eu-projects/converge
EU Project BYCOVID	https://by-covid.org

EU Project GDI	https://gdi.onemilliongenomes.eu
EU Project AgroServ	https://agroserv.eu
EU Project BGE	https://biodiversitygenomics.eu
EU Project BioNT	https://biont-training.eu
EU Healthy Cloud	https://healthycloud.eu
DFG NFDI4BioImage	https://nfdi4bioimage.de
DFG NFDI Dataplant	https://www.nfdi4plants.de
OpenAire	https://www.openaire.eu
BMBF German Network of Bioinformatics Infrastructure (de.NBI)	https://www.denbi.de
de.NBI Cloud	https://www.denbi.de/cloud
de.KCD	tba
Ministry of Science, Research and the Arts Baden-Württemberg (MWK)	https://mwk.baden-wuerttemberg.de
BioDaten	https://portal.biodaten.info
University of Freiburg	https://uni-freiburg.de
Uniklinikum Freiburg	https://www.uniklinik-freiburg.de
CRC992	https://www.sfb992.uni-freiburg.de
CRC1425	https://www.sfb1425.uni-freiburg.de
European Commission	https://commission.europa.eu

THE EUROPEAN GALAXY SERVER 2023

With currently more than 85,000 users (Dec 2023), the biggest European Galaxy instance is the European Galaxy Server (<https://usegalaxy.eu>). Being hosted at the compute center of the University of Freiburg, the European Galaxy Server is developed and maintained by the Galaxy Team Freiburg (<https://galaxyproject.eu/freiburg/people>), headed by Dr. Björn Grüning (Bioinformatics, Prof. Rolf Backofen) since 2015. By free registration, users get 250GB storage and access to a huge computational infrastructure with more than 3,200 tools and workflows. Since 2023, Galaxy is an ELIXIR-recommended infrastructure (RIR) (<https://galaxyproject.org/news/2023-12-14-elixir-rir-for-galaxy-europe>) with strong emphasis on interoperability and FAIR data analysis.

Galaxy provides researchers a powerful analysis platform populated with the latest tools, reference data, and databases. Scientists from many diverse scientific disciplines run their data analysis on Galaxy, such as life science, climate science, astrophysics, material sciences, and many more. For tool developers, it provides a community-supported mechanism for deploying tools to a wide audience of users. For system administrators and engineers, Galaxy provides a flexible framework they feel comfortable deploying on any infrastructure.

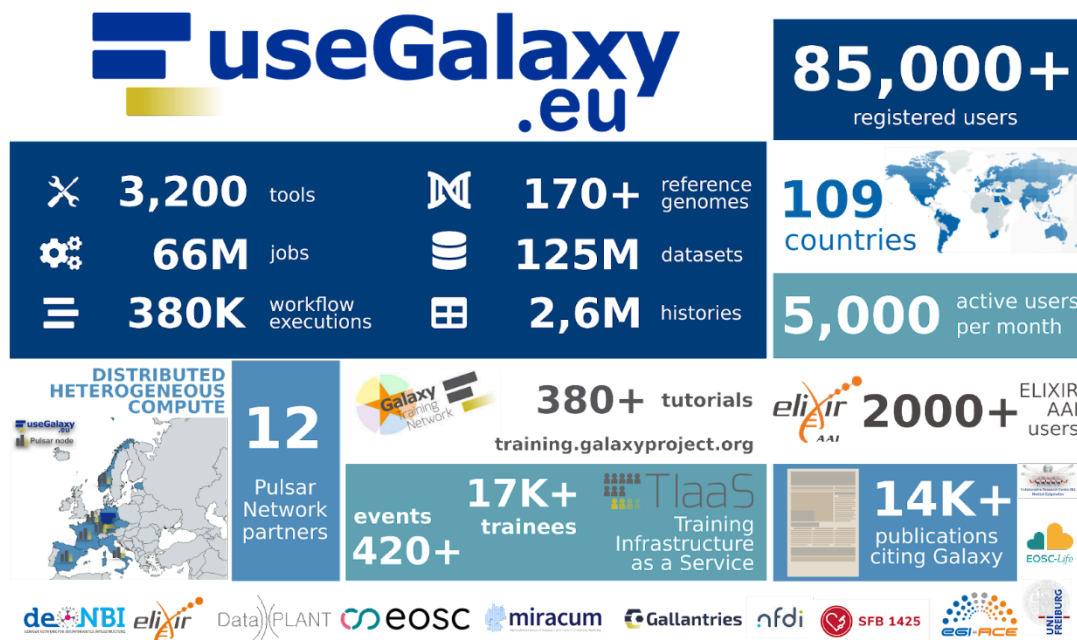


Fig.3: Fact sheet of the European Galaxy Server (Dec. 2023)

GALAXY NEWS & UPDATES 2023

Galaxy release - In 2023, there were two new Galaxy releases, overall 2,182 tool updates and installations with many new features and implementations (latest one 23.1 <https://galaxyproject.org/news/2023-10-05-galaxy23-1-release>).

Some major news and updates from 2023 are wrapped up here.

History Update - Data search ability in the Galaxy history panel has been taken to new levels with the advanced search options that allow users to not only find items with more ease, but also find relations within items in their history (<https://galaxyproject.org/news/2023-03-15-new-history-search>).

GPU Infrastructure - Scientists find now democratizing GPU infrastructures by providing accelerated JupyterLab instances via Galaxy and can combine them with HPC workflows (<https://galaxyproject.org/news/2023-01-24-gpu-jupyterlab-galaxy>).

Interactive Tools - Galaxy offers a big collection of 46 different interactive tools which can be accessed only via a web browser (<https://live.usegalaxy.eu>). These interactive tools have been executed already over 20,000 times (<https://galaxyproject.org/news/2023-09-15-interactive-tools>).

Geographic Information System QGIS - [QGIS](#) is a professional Geographic Information System (GIS) application that is built on top of and proud to be itself Free and Open Source Software (FOSS). QGIS provides a continuously growing number of capabilities provided by core functions and plugins. It can be used to visualize, manage, edit, analyze spatial files, and compose printable maps (<https://galaxyproject.org/news/2023-10-06-qgis>).

Chat-GPT - Many generative AI models by [OpenAI](#) are now accessible via a [UI plugin](#) in the GPU-enabled JupyterLab interactive tool on Galaxy Europe (<https://galaxyproject.org/news/2023-08-14-chat-gpt>).

New Client Routing - Following up on our modernization efforts, we now introduce a single top-router written in Vue, which brings all our Vue components together in a seamless user experience, dramatically reducing the number of required page reloads when navigating the Galaxy user interface (<https://galaxyproject.org/news/2023-03-14-new-client-routing>).

Beacon Integration - Science is most efficient when researchers share their data and results, so others can re-use them. Some datasets, however, cannot easily be shared because they contain sensitive information about, for example, a patient. For human genome variation data, the [Beacon network](#) (<https://beacon-project.io>) enables querying genomic variant catalogs without the risk of exposing sensitive data. Galaxy has gained a Beacon integration

that enables users to publish genetic variance data conveniently via Beacon project (<https://galaxyproject.org/news/2023-01-beacon-integration>).

VirHunter - A Deep Learning-Based Method for the detection of novel RNA Viruses in Plant Sequencing Data is available now in Galaxy (<https://galaxyproject.org/news/2023-02-05-virhunter>).

“Run on Galaxy” Button in WorkflowHub - The WorkflowHub (<https://workflowhub.eu>) platform aims to support researchers in discovering and re-using workflows from various platforms. Following the FAIR principles, the registry lists workflows and their metadata in an accessible and interoperable way, agnostic to particular workflow management systems. Find solutions and templates in WorkflowHub and immediately import it to Galaxy with one click (<https://galaxyproject.org/news/2023-11-13-run-in-galaxy-button-workflowhub>).

AI Model in Galaxy - Inference using a publicly available pre-trained AI model (BioModels) in Galaxy for to predict efficacy of immune checkpoint blockade across multiple cancer patient cohorts on test data (<https://galaxyproject.org/news/2023-11-29-bio-m-ltool>).

Accessibility in Galaxy - Improvements on Galaxy have been made in the 23.0 release. The highlights are summarized in the accessibility report which shows the benefits for everyone's user experience (<https://galaxyproject.org/news/2023-01-20-accessibility-report>).

Science Communication - As drivers of the Galaxy project, we have responsibility for good scientific communication. This includes not supporting hostile environments. As such we have decided to leave Twitter/X, effective March 31st, 2024 (<https://galaxyproject.org/news/2024-01-26-galaxy-leaves-twitter>). You can find Galaxy on [BlueSky](https://bsky.app/profile/galaxyproject.bsky.social) (<https://bsky.app/profile/galaxyproject.bsky.social>), [Mastodon](https://mstdn.science/@gtn)

(<https://bawü.social/@galaxyfreiburg>), and LinkedIn (<https://www.linkedin.com/groups/4907635>), and of course, you can stay up to date by visiting the [Galaxy Hub](https://galaxyproject.org/eu) (<https://galaxyproject.org/eu>). Additionally, we encourage you to stay connected with the [Galaxy Training Network](https://training.galaxyproject.org) (<https://training.galaxyproject.org>), who are active on [BlueSky](https://bsky.app/profile/galaxytraining.bsky.social) (<https://bsky.app/profile/galaxytraining.bsky.social>) and [Mastodon](https://mstdn.science/@gtn) (<https://mstdn.science/@gtn>).

GALAXY EVENTS 2023

The Galaxy Team Freiburg presents Galaxy and the Galaxy Training Network at different conferences and meetings (see “News” and “Events” sections on <https://galaxyproject.org>). The most important ones from 2023 are listed in this section.

ELIXIR All Hands Meeting, June 2023, Dublin, Ireland - Galaxy had a broad presence across the different workshops, symposia, plenary sessions, and posters. As use cases pathogen analysis was presented, single cell data analysis, the ELIXIR Microbiome community, and the Galaxy Training Network (<https://galaxyproject.org/news/2023-06-26-elixir-ahm>).

German Conference on Bioinformatics (GCB), September 2023, Hamburg, Germany - Presentation of the foodborne and microbiome analysis projects “Accessible and scalable Galaxy pipelines for fast and easy (foodborne) Pathogen detection and tracking” and “Microbiome data analysis using the Galaxy platform” (<https://galaxyproject.org/news/2023-09-18-gcb-2023>).

Galaxy Community Conference (GCC), July 2023, Brisbane, Queensland, Australia - The 2023 Galaxy Community Conference (GCC2023) was held at the Queensland University of Technology in Brisbane, Queensland, Australia, from July 10th–16th. The GCC is an annual meeting of the Galaxy community, providing an opportunity to discover the incredible new work done on Galaxy in the past year scientifically and technically, create new collaborations and strengthen existing connections, and forge paths in new directions as a result of meeting together in person. Hosted by Galaxy Australia and Australian BioCommons, GCC2023 consisted of four days of talks, workshops and trainings, posters, and demos; three keynote speakers; and three days of Collaboration Fest (CoFest) (<https://galaxyproject.org/news/2023-08-15-gc-c2023-meeting-report>). The European Galaxy Team joined with a few people there who afterwards spent some time in Australia to work with the Australian Galaxy community.

European Galaxy Days, October 2023, Freiburg, Germany - The co-location of three main events, the European Galaxy Days, ELIXIR Galaxy Community meeting, and the annual EuroScienceGateway meeting, brought together 80 people from various disciplines working with Galaxy (Fig.4). Use cases and technical updates were presented in talks, demos and trainings (<https://galaxyproject.org/news/2023-10-13-egd-2023-the-wrapup>).



Fig.4: Group picture of participants of the European Galaxy Days meeting in Freiburg

BioHackathon Europe, October 2023, Barcelona, Spain - ELIXIR organized the annual event that brings together life scientists from around the world and offers an intense week of hacking, with over 160 participants working on diverse and exciting projects. The goal is to create code that addresses challenges in bioinformatics research. The Galaxy team took part in different projects (<https://galaxyproject.org/news/2023-11-06-biohackathon>).

Conference on Research Data Infrastructure CORDI, September 2023, Karlsruhe, Germany - The Galaxy Team is member of two NFDI projects, NFDI4Bioimage and NFDI DataPlant and presented on the NFDI conference Galaxy as Research Data Management (RDM) platform (<https://galaxyproject.org/news/2023-09-12-cordi>) with two posters and two talks. The posters presented were about "[Conda, Container and Bots - Managing Tool Dependencies in Workflows and Training Materials](#)" and "[Interactive Tools in Galaxy: Combining Synchronous and Asynchronous Workflows](#)", generating high interest and discussions on architecture and applications. Both talks "[FAIR and Scalable Education - Galaxy Training Network \(GTN\) and Training Infrastructure as a Service \(TlaaS\)](#)" and "[Galaxy and RDM](#)" emphasizing the GTN and TlaaS and Galaxy's coverage of the entire data life cycle and improved interoperability with resources like WorkflowHub and Zenodo, highlighting the adoption of standards like RO-Crate for data and metadata exchange.

EURO SCIENCE GATEWAY

The EuroScienceGateway (ESG) project, funded by the European Union's HORIZON-INFRA-2021- EOSC-01 under Grant Agreement number 101057388, builds heavily on the Galaxy infrastructure and is the first Horizon Europe EOSC project which is coordinated by the Galaxy Team Freiburg as ALU FR partner. EuroScienceGateway will leverage a distributed computing network across 13 European countries, accessible via 6 national Galaxy servers, facilitating access to compute and storage infrastructures across Europe as well as to data, tools, workflows and services that can be customized to suit researchers' needs. Communities across disciplines -- Life Sciences, Climate and Biodiversity, Astrophysics, Materials science - will demonstrate the bridge from EOSC's technical services to scientific analysis.

EuroScienceGateway will deliver a robust, scalable, seamlessly integrated open infrastructure for data-driven research, contributing an innovative and customizable service for EOSC that enables operational open and FAIR data and data processing, empowering European researchers to embrace the new digital age of science (Fig. 5).

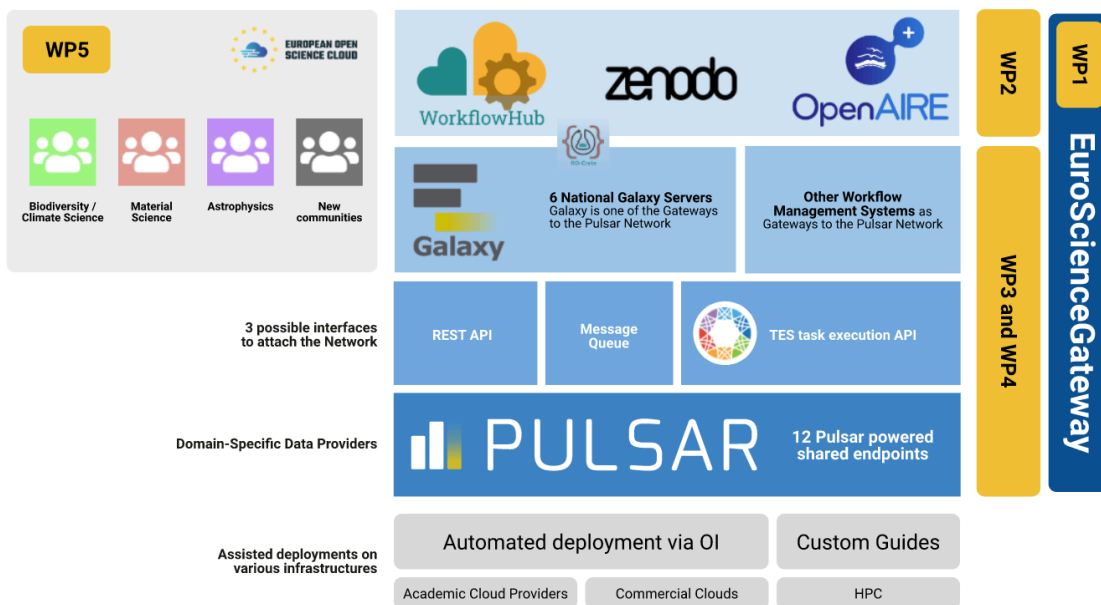


Fig.5: The EuroScienceGateway project infrastructure with its work packages (WPs)

As this project reflects an important core pillar of our work, we want to present the progress of the project-specific objectives in this section.

eOSC | EuroScienceGateway

Project link: <https://eurosciencegateway.eu>

Pulsar Network

The goal is to implement a mature and tested (TRL-9) distributed compute network with demonstrated usage across at least 12 European partners.

The EuroScienceGateway Pulsar Network aims to deploy an European wide network of Pulsar endpoints, enabling end-users to easily access and exploit remote compute resources, and resource providers to offer compute resources for scientific purposes through a web-based interface (<https://galaxyproject.org/news/2023-01-19-eurosciencegateway-wp3>).

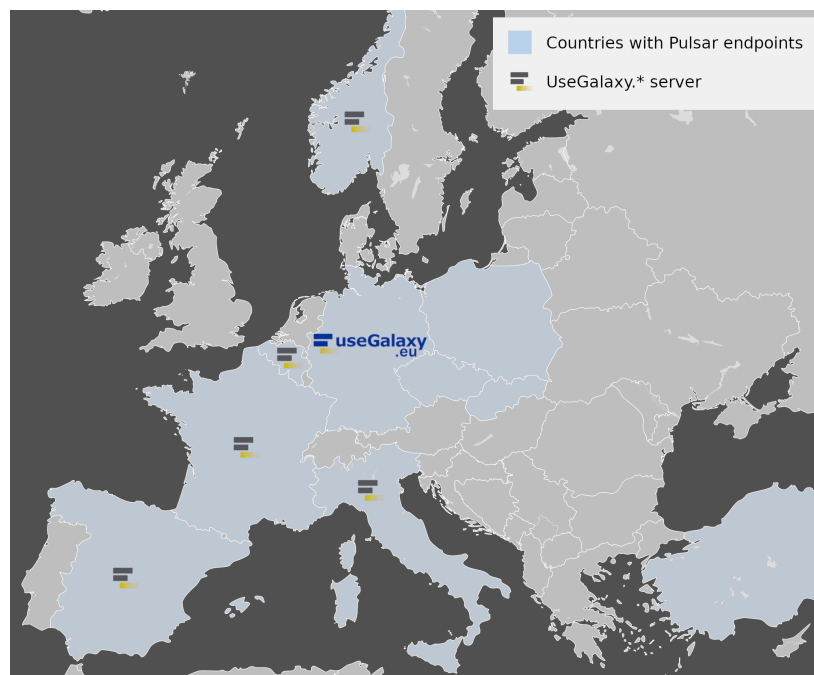


Fig.6: The Pulsar Network is built within the EuroScienceGateway project with its endpoints and national Galaxy servers

Two new concepts are being developed within this task: Bring Your Own Compute (BYOC) and Bring Your Own Storage (BYOS). These features will allow users to add new, external compute endpoints to Galaxy to be able to run jobs on them. Currently, a new form has been added to Galaxy under the user preferences menu that allows users to connect external computing resources with Galaxy via a Pulsar endpoint. This form gathers details such as the credentials for the Message Queue (RabbitMQ, used to communicate Pulsar with

Galaxy), plus the specifics of their available compute resources such as RAM, CPU cores and GPUs (<https://galaxyproject.org/news/2023-10-31-esg-byoc-im>).

Enabling users to bring their own storage to publicly hosted Galaxy instances has now been implemented. The main features of this work include: a graphical way for users to select an object store they define for their analysis (tools, histories, workflows, etc.); a visual

framework for describing aspects of object stores such as the quota applied, speed, location, accessibility of the object store; a way for secrets of the object stores to be stored securely; an object store templating system for admins to allow their users to configure their object stores (from a set of given providers, e.g. S3, Azure, disk) with a set of required variables. Given the PRs are merged in time for the next Galaxy release (24.0), we are planning to deploy this feature in the first quarter of 2024.

Science Gateways

The goal of the objective is to have 6 national Galaxy instances operational and proven by the scientific community with more than 100,000 users. Currently, the European Galaxy Server has 85,000 users. By onboarding more communities to Galaxy with their tools, workflows and applications, the Galaxy framework will be extended to new target users.

Communities

The European Galaxy Server already has now 40 subdomains (<https://usegalaxy-eu.github.io/posts/2020/12/28/subdomains>) and more communities will be onboarded during the ESG project run time. Specifically, the EuroScienceGateway project will build sub domains with a custom set of tools and workflows for the Biodiversity/Climate (<https://galaxyproject.org/news/2023-01-12-esg-wp5>, Fig.7), Materials Science (<https://galaxyproject.org/news/2023-01-09-esg-wp5>) and Astrophysics (<https://galaxyproject.org/news/2023-09-07-esg-wp5-astronomy-archives>) community.

Welcome to **Galaxy for Ecology** – a web platform to get, process, analyze and visualize ecological data



1. [Getting started](#)
2. [Tools](#)
 1. [Tutorials](#)
3. [Workflows](#)
 1. [References](#)

Getting started

Are you new to Galaxy, or returning after a long time, and looking for help to get started? Take [a guided tour](#) through Galaxy's user interface.

Want to learn about ecology analyses? Check our [tutorials](#) or take one of our guided tour:

- Introduction to species phenology study and abundance index as trends computation.

Fig.7: The sub domain web page of the biodiversity community on <https://ecology.usegalaxy.eu>

Galaxy is open for all communities and is not restricted to life sciences. Onboarding new communities to Galaxy need some guidelines and experiences which are collected in the Community Cookbook (<https://galaxyproject.org/get-started/new-leads>).

FAIR DATA

The EuroScienceGateway project will establish FAIR practices in computational research by adding Galaxy workflow integration with FAIR Digital Objects (FDOs) as well as capturing workflow run provenance, and making EuroScienceGateway workflow definitions available as FAIR Computational Workflows through WorkflowHub. It will build and mature existing implementations with RO-Crate and FAIR Signposting combined with flexible use of existing data and compute infrastructure, and validate consumption of FAIR workflow metadata to support use cases. EOSC-cataloged FAIR data and workflows that can be found, consumed, created and published by users of the EuroScienceGateway, demonstrated for each of the 3 domain-specific use-cases (<https://galaxyproject.org/news/2023-01-12-eurosciencegateway-wp2>).

GALAXY AS A RESEARCH DATA MANAGEMENT PLATFORM

The Galaxy project places a strong emphasis on research data management (RDM). The platform includes tools for data import, organization, sharing, annotation, and export. Data can be stored and accessed through a variety of providers, including cloud storages like NextCloud (Fig.8). This allows researchers to work with large datasets without the need for local storage infrastructure. The project encourages researchers to share their data and analysis workflows with the wider scientific community with the aim of accelerating scientific discovery and innovation. An overview about our latest achievements can be found at the RDMkit (https://rdmkit.elixir-europe.org/galaxy_assembly).

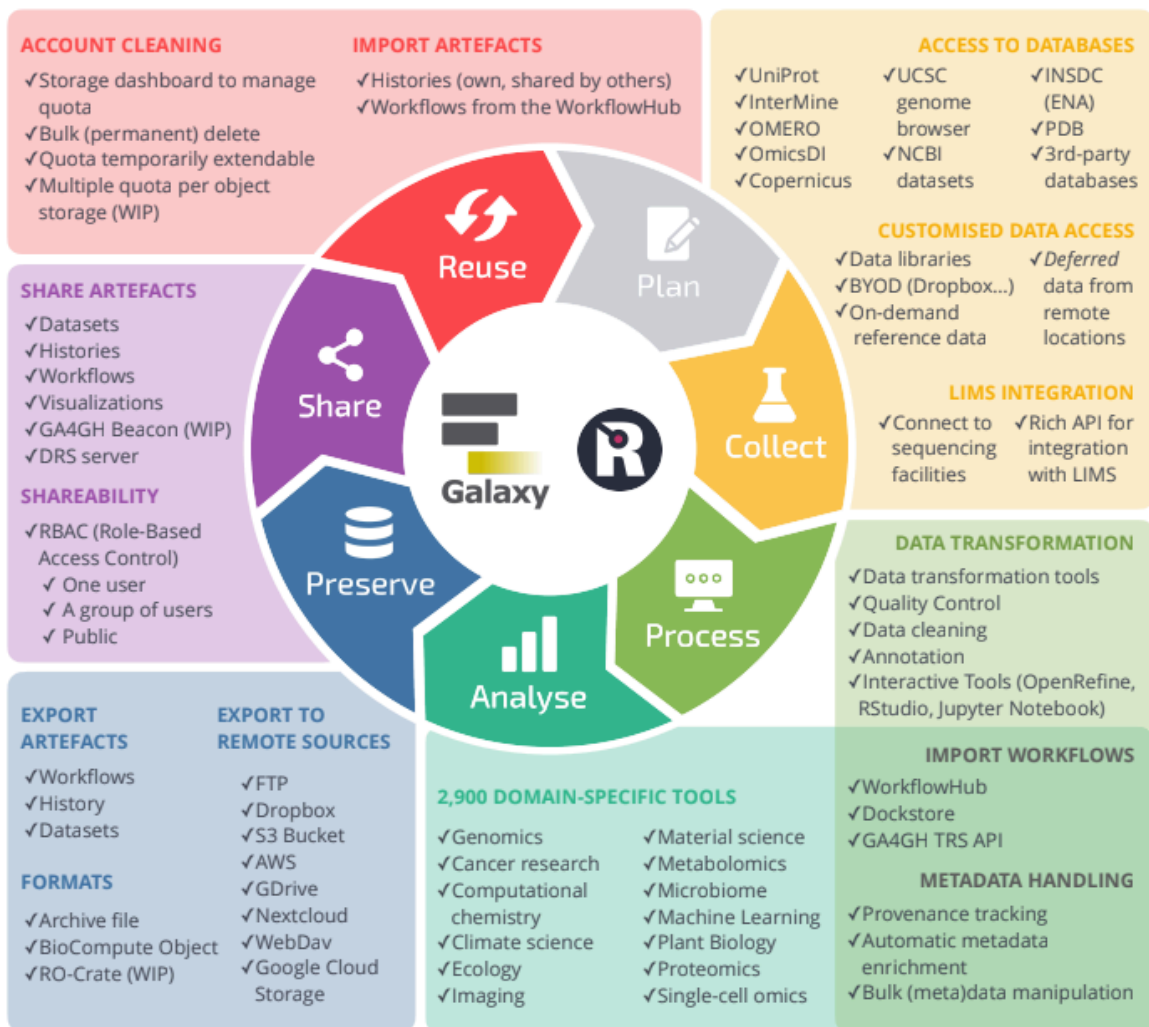


Fig. 8. Galaxy as FAIR Research Data Management platform (Image made by Beatriz Serrano-Solano).

GALAXY TRAINING NETWORK

Together with the Galaxy infrastructure, the Galaxy Training Network (GTN) (<https://training.galaxyproject.org>) provides more than 380 free tutorials from over 30 scientific topics for researchers, Galaxy administrators and developers for data analysis, tool development and workflow creation. Each e-learning tutorial comes with introductory slides, a detailed step-by-step-instruction, videos and recordings, and sample data. It is easy to learn about e.g. RNA-Seq data analysis, climate data analyses, metagenomics, R, and python programming. For educators, Galaxy provides a training infrastructure for delivering interactive, hands-on training workshops (<https://galaxyproject.eu/tiaas>) for audiences of different sizes. Using Tlaas, we have already educated more than 17,000 trainees (<https://usegalaxy.eu/tiaas/stats>).

The European Open Science cloud has featured TlaaS on the EOSC-life webpage (<https://www.eosc-life.eu/news/success-story-tlaas-training-infrastructure-as-a-service>).

“Learning pathways” (Fig.9) are sets of tutorials curated for our users by community experts to form a coherent set of lessons around a topic, building up knowledge step-by-step (<https://training.galaxyproject.org/training-material/learning-pathways>). Thanks to the over 300 contributors for updating and adding new trainings.

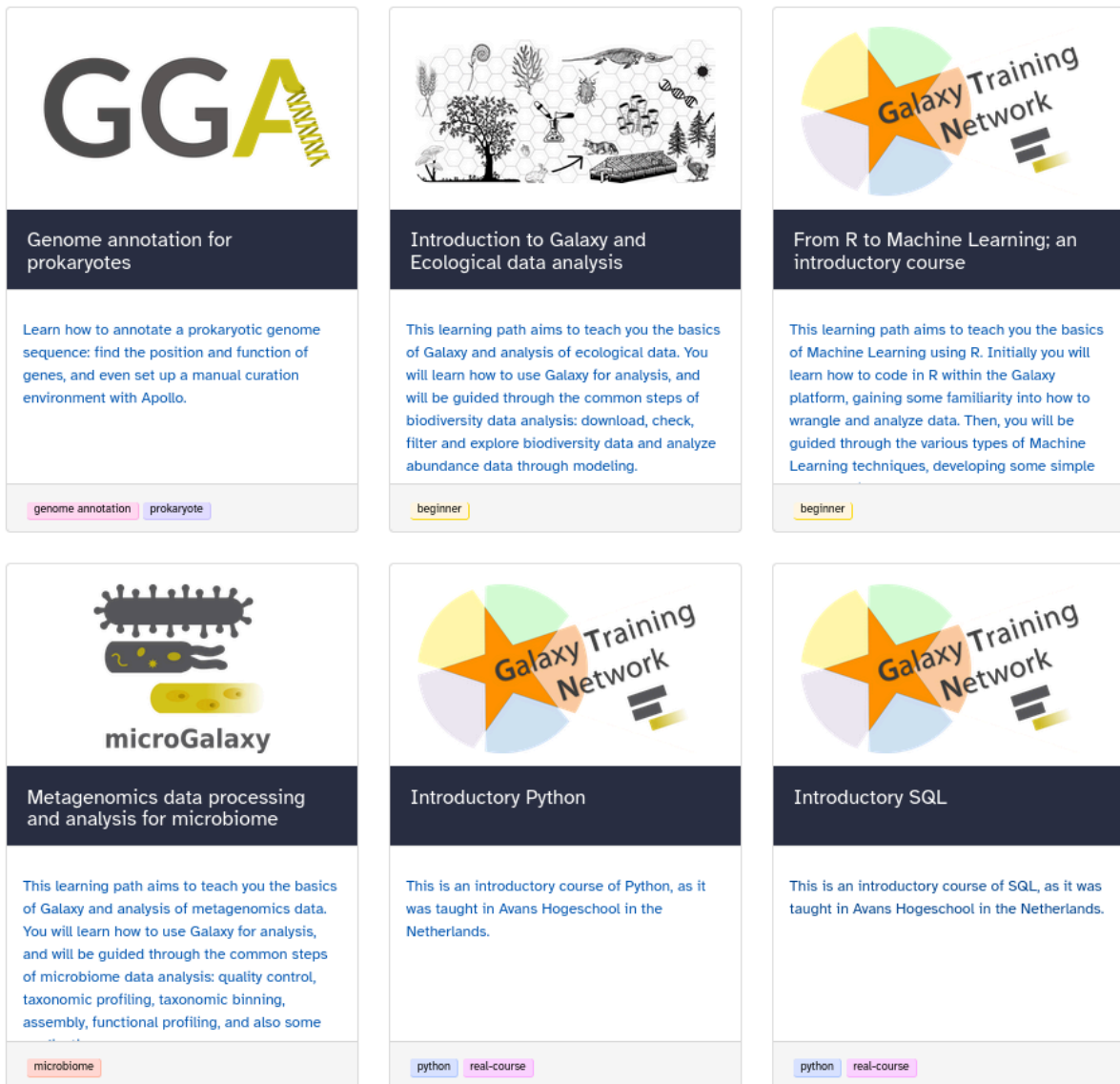


Fig.9: Learning pathways from the Galaxy Training Network

GALAXY COMMUNITIES AND NEW GOVERNANCE

Active Galaxy communities are encouraged to form and govern their own Special Interest Group (SIG), with a focus on specific shared interests.

Each SIG may elect one member to represent their interests on the Galaxy Community Board (<https://galaxyproject.org/community/governance/gcb>). This is analogous to the Galaxy Technical Board (<https://galaxyproject.org/community/governance/gtb>), consisting of representatives of the Working Groups (WG, <https://galaxyproject.org/community/wg>).

In Galaxy, there are communities of practice, creating groups with a shared interest on a scientific research field, e.g. metabolomics, ecology, machine learning, and regional

communities from different countries or continents, e.g. the Arabic and African communities (<https://galaxyproject.org/community/sig>).

All these communities are sharing their news and outcomes with all Galaxy users. In 2023, the earth system community for example published earth system models (ESM) which seek to simulate all relevant aspects of the Earth system. ESMs are composed by a set of equations describing atmospheric and oceanic circulation and thermodynamics, but also the biological and chemical processes that feedback on to the physics of climate, all solved for a number of locations in space that form a three-dimensional grid over the surface of the Earth and underneath the surface of the oceans. The five domains creating a model of an earth system in Galaxy are Coastal Water Dynamics, Earth Critical Zone, Volcano Space Observatory, Ocean Bio-Geochemical Observations, and Marine Omics (<https://galaxyproject.org/news/2023-10-17-earth-system>, <https://galaxyproject.org/news/2023-10-18-odv>). The Galaxy Single-cell Community provided a 2023 review on their updates (<https://galaxyproject.org/news/2023-12-23-galaxy-sc-2023-in-review>).

TEAM PUBLICATIONS 2023

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Kumar,A. et al. (2023) Transformer-based tool recommendation system in Galaxy. BMC Bioinformatics, 24. DOI: [10.1186/s12859-023-05573-w](https://doi.org/10.1186/s12859-023-05573-w)

David,R. et al. (2023) “Be sustainable”: EOSC-Life recommendations for implementation of FAIR principles in life science data handling. The EMBO Journal. DOI: [/10.15252/embj.2023115008](https://doi.org/10.15252/embj.2023115008)

Williams,J.J. et al. (2023) An international consensus on effective, inclusive, and career-spanning short-format training in the life sciences and beyond. PLOS ONE, 18, 1–19. DOI: [10.1371/journal.pone.0293879](https://doi.org/10.1371/journal.pone.0293879)

Weil,H.L. et al. (2023) PLANTdataHUB: a collaborative platform for continuous FAIR data sharing in plant research. The Plant Journal. DOI: [10.1111/tpj.16474](https://doi.org/10.1111/tpj.16474)

Mehta,S. et al. (2023) A Galaxy of informatics resources for MS-based proteomics. Expert Review of Proteomics, 1–16. DOI: [10.1080/14789450.2023.2265062](https://doi.org/10.1080/14789450.2023.2265062)

The European Reference Genome Atlas: piloting a decentralised approach to equitable biodiversity genomics (2023) bioRxiv. DOI:[10.1101/2023.09.25.559365](https://doi.org/10.1101/2023.09.25.559365)

Härdtner,C. et al. (2023) A comparative gene expression matrix in Apoe-deficient mice identifies unique and atherosclerotic disease stage-specific gene regulation patterns in monocytes and macrophages. *Atherosclerosis*, 371, 1–13. DOI:[10.1101/2023.09.25.559365](https://doi.org/10.1101/2023.09.25.559365)

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Guerler,A. et al. (2023) Fast and accurate genome-wide predictions and structural modeling of protein–protein interactions using Galaxy. *BMC Bioinformatics*, 24. DOI: [10.1186/s12859-023-05389-8](https://doi.org/10.1186/s12859-023-05389-8)

Riesle,A.J. et al. (2023) Activator-blocker model of transcriptional regulation by pioneer-like factors. *Nature Communications*, 14. DOI: [10.1038/s41467-023-41507-z](https://doi.org/10.1038/s41467-023-41507-z)

Schimi,V.C. et al. (2023) Integrative meta-omics in Galaxy and beyond. *Environmental Microbiome*, 18. DOI: [10.1186/s40793-023-00514-9](https://doi.org/10.1186/s40793-023-00514-9)

Hiltemann,S. et al. (2023) Galaxy Training: A powerful framework for teaching! *PLOS Computational Biology*, 19, e1010752. DOI: [10.1371/journal.pcbi.1010752](https://doi.org/10.1371/journal.pcbi.1010752)

Bray,S. et al. (2023) The Planemo toolkit for developing, deploying, and executing scientific data analyses in Galaxy and beyond. *Genome Research*. DOI: [10.1101/gr.276963.122](https://doi.org/10.1101/gr.276963.122)

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