COMUNIDAD

D3.2
Materials and documentations for components

Connecting Europe and Latin America
Transforming Today's Data into
Tomorrow's Solutions

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0.1	1.10.2024	SINNO, BOSC	Template and first content
0.2	30.11.2024	BOSC	Components of the Infrastructure described.
0.3	20.12.2024	SINNO	Described open-source components.
0.4	30.1.2025	BOSC, SINNO	Components of the Platform described.
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Table of content

1. Project Summary

The COMUNIDAD project, led by Lesprojekt, utilises Copernicus satellite data and the European Global Navigation Satellite System (EGNSS), along with Artificial Intelligence

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(AI), Big Data technologies and numerical modelling to transfer technologies and know-how to Latin America. The COMUNIDAD project focuses on improving agricultural and forestry management in Chile and Colombia through infrastructure development and a basic platform for creating applications that enhance precision, efficiency, and sustainability. The South American region benefits from this initiative by contributing to its socio-economic growth. Technological advancements are expected to lead significantly to practical applications due to the open-source approach in development.

Lesprojekt, the project coordinator, draws on its expertise in technology applications in agriculture and forestry to guide the consortium. The project provides actionable insights by employing advanced techniques to incorporate Copernicus services, EGNSS and other spatial datasets. These insights help stakeholders, including farmers, advisors, policymakers, and land managers, make informed decisions that support sustainable practices. Essential data on crop health, land use, and forestry conservation are provided, enhancing land management practices and boosting agricultural productivity.

In the COMUNIDAD project, experiences and knowledge are transferred through developing and using technological components, infrastructure, and training materials.

The COMUNIDAD project aims to transform agricultural and forestry management in South America through technological innovation and international collaboration based on experiences and know-how from European partners and international cooperation with partners from Latin America. The integration of cutting-edge technologies with strategic data analysis is set to improve different domains and promote environmental sustainability in the region.

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2. Acknowledgement

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101136910.

3. Copyright Statement

4. Executive Summary

The Deliverable “D3.2 – Materials and Documentations for Components” overviews the software tools and components integrated into the COMUNIDAD project infrastructure and platform.

This document briefly describes various software components used within the COMUNIDAD infrastructure and platform, outlining their functionalities, documentation, and other online resources. The deliverable helps end-users and developers find more information about each tool, facilitating the creation of training materials and supporting the effective use of COMUNIDAD technical solutions. The document references external sources, including video presentations from various events, project websites, repositories, and technical documentation, allowing users to access comprehensive guidelines and additional learning materials.

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5. Introduction

Meeting the ambitious objectives of the COMUNIDAD project requires integrating and extending the functionality of various software tools, leading to the creation and deployment of the COMUNIDAD infrastructure and platform. The COMUNIDAD platform will serve as a publication and presentation component of datasets and functions deployed on the Infrastructure.

The first version of the requirements for infrastructure was defined in "D2.1 - Requirements for infrastructure" and further elaborated based on the detailed needs of pilots in Chile and Colombia described in the deliverables "D4.1 - Colombian application requirements" and "D4.2 - Advanced algorithm for snow coverage." The result of the elaboration of requirements, either coming directly from the pilots or general requirements taking into account the future extensibility and scalability of the COMUNIDAD infrastructure and platform beyond the pilots, are described in deliverables “D2.2 - Infrastructure design document” and “D5.1 - Definition of architecture for COMUNIDAD platform."

As the COMUNIDAD platform will serve not only end-users but also other developers who will create applications running on top of the COMUNIDAD platform, it is essential to develop a set of training materials that will help different categories of end-users to use the COMUNIDAD platform and developers to create applications that will be able to use the full potential of the COMUNIDAD platform.

The scope of this deliverable, "D3.2 - Materials and documentations for components", is to provide a brief overview of the tools that will be integrated within the COMUNIDAD infrastructure and platform, to refer the reader to the websites, documentation and other relevant materials for these software tools and thereby facilitate the creation of COMUNIDAD project training materials, or to help users and developers to find appropriate information directly.

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1 Documentation and user manuals for components

1.1 Open-Source Powerhouse (OpenStack)

Cloud solution powering COMUNIDAD Infrastructure leverages the power of OpenStack, a leading open-source cloud software platform. OpenStack is a cloud operating system that controls large pools of computing, storage, and networking resources throughout a data centre. All nodes are managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface.

Main website: https://www.openstack.org/

Project documentation: https://docs.openstack.org/

1.2 PostgreSQL database

PostgreSQL, a widely adopted open-source relational database management system (RDBMS), is a robust foundation for managing various data types. PostgreSQL transforms into a comprehensive Geographic Information System (GIS) database with the PostGIS extension. PostgreSQL transforms into a comprehensive Geographic Information System (GIS) database with the PostGIS extension. PostGIS unlocks a suite of functionalities specifically designed for storing, manipulating, and analysing geospatial data. PostgreSQL's robust data management capabilities and PostGIS's specialised functionalities create a powerful duo for handling geospatial data. This integrated solution streamlines data management, facilitates efficient retrieval, and empowers in-depth spatial analysis, paving the way for informed decision-making across various disciplines.

PostgreSQL will be the primary database system on the infrastructure to store different kinds of data. It will be extended by the PostGIS spatial extension to store spatial data.

PostgreSQL is a very popular open-source database management system developed by the community. A comprehensive set of tutorials and supporting materials is

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available on project or community pages.

PostGIS is a spatial extension of the PostgreSQL database system, an open-source project developed by the community. The community created a lot of supporting materials that can be utilised for the project training materials.

PostgreSQL Main website https://www.postgresql.org/

PostgreSQL documentation: https://www.postgresql.org/about/

PostGIS project website: https://postgis.net/

PostGIS documentation: https://postgis.net/docs/index.html

1.3 Metadata Catalogue (MICKA)

MICKA is a comprehensive system for managing and publishing spatial data metadata. It is built on the ISO 191xx and INSPIRE standards and supports the OGC CSW 2.0.2 ISO AP-1.0 catalogue service. MICKA offers various advanced features and supports multiple other standards, ensuring interoperability with other applications.

Micka will be used as the main metadata catalogue of the whole architecture; it will integrate and publish metadata of datasets on the infrastructure and metadata harvested from public data providers.

Micka was initially developed by the Czech company Help Service - Remote Sensing and later developed by the community as an open-source project.

Several presentations and tutorials were already prepared in English and Czech.

Main website (in Czech only): https://www.bnhelp.cz/produkty/metadata/

GitHub repository of Open Micka: https://github.com/hsrs-cz/Micka

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1.4 Layman

Layman facilitates the online publication of geospatial data through a REST API. It offers two publication paradigms: layers and maps. Layman exhibits broad data format support, accepting vector layer data in GeoJSON, Shapefile, or PostGIS tables referenced by PostgreSQL connection URIs. Layman offers a comprehensive suite of services through URL endpoints, including a REST API, Web Map Service (WMS), Web Feature Service (WFS), and Catalogue Service (CSW). Layman is developed as an open-source project under the GPL-3.0 licence. Layman will serve as a publication tool for spatial data on the infrastructure.

Several presentations and tutorials were already prepared in English and Czech.

GitHub repository of the Layman project: https://github.com/LayerManager/layman

A video tutorial: https://youtu.be/8Z1Gube6nuc?feature=shared

1.5 Remote Sensing Data Processing System (RSDPS)

The Remote Sensing Data Processing System (RSDPS) is a robust pipeline designed to efficiently handle satellite imagery, from initial download to final product dissemination. The system automates the intricate process of acquiring, processing, storing, and publishing satellite data, primarily focusing on Sentinel-1 and Sentinel-2 imagery sourced from the Copernicus Data Spaces Environment. RSDPS will process raw satellite data to a defined set of indices and products. It will be the main component for integrating and processing satellite images. Different components will then publish data and products. RSDPS will provide API to get original data or products through a standardised interface using the OGC SpatioTemporal Asset Catalog (STAC).

The RSDSP was designed and developed by the Lesprojekt company, and a tutorial will be created for the COMUNIDAD project. A set of documentation and a tutorial is under development.

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1.6 Climatic Data Processing System (CDPS)

The Climatic Data Processing System is an application designed to use the ERA5-Land dataset from the Copernicus Climate Change Service (C3S). The system automates the intricate process of acquiring, processing, storing, and publishing climatic data. The CDPS uses Python and Jupyter Notebooks tools as its main components. It obtains NetCDF files from the C3S for a defined period and area. It stores original data in the database and processes different algorithms to calculate agro-climatic factors.

The CDPS will provide the set of raw climatic data and calculate climatic factors for localities in the project.

The description of agroclimatic factors calculations is part of the GitHub repository: https://github.com/JiriVales/agroclimatic-factors

The description of algorithms of factors: https://github.com/JiriVales/agroclimatic-factors/wiki/Description-of-algorithms

Webinar presentation: https://youtu.be/4rymQZqAwtM?feature=shared

1.7 SensLog

SensLog is an open sensor data management solution for receiving, storing, managing, analysing, and publishing sensor data. This solution is suitable for static in-situ sensors, sensors on mobile carriers, and Volunteered Geographic Information (VGI) gathered by smart devices. SensLog is a backend solution that runs on a web server and stores data in an RDBMS. SensLog is a modular solution where every module is designed as a separate component. Thus, the scalability of the solution is ensured. The solution is developed as an open-source project by a consortium of different companies under the BSD-3 Licence.

SensLog will integrate sensor data from local meteorological stations (if farmers will provide them or local providers) and climatic and weather data from different data

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providers (GFS, CDS).

Several presentations and tutorials were prepared in English, Czech, and Spanish and can be used to create the training materials.

Main website: https://www.senslog.org/

An overview article on the software was published by Kepka, M. et al. (2017). The SensLog Platform – A Solution for Sensors and Citizen Observatories. In: Hřebíček, J., Denzer, R., Schimak, G., Pitner, T. (eds) Environmental Software Systems. Computer Science for Environmental Protection. ISESS 2017. IFIP Advances in Information and Communication Technology, vol 507. Springer, Cham. https://doi.org/10.1007/978-3-319-89935-0_31

An overview webinar of the SensLog solution was presented during the OpenSpring 2021 event and is available in Czech at: https://youtu.be/g7V-ADDK6vY?feature=shared

1.8 GDAL/OGR

GDAL and OGR are important libraries for data processing. Geospatial Data Abstraction Library (GDAL) is a translator library for raster and vector geospatial data formats. The related OGR library (OGR Simple Features Library), part of the GDAL source tree, provides a similar ability for simple features vector graphics data. The library supports more than 150 formats for raster and 90 vector formats. The GDAL library will process spatial data at the infrastructure level.

GDAL is an open-source project developed by the community under the Open Source Geospatial Foundation. The community provides a set of tutorials and workshops.

Main website: https://gdal.org/en/stable/

1.9 DRUtES

DRUtES is a finite element method solver that addresses the Richards equation problem.

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In the COMUNIDAD project, DRUtES will integrate ERA5 data series, soil hydraulic properties, and the root water demand of specific crops to assess soil moisture comfort for these crops.

The team of CZU developed the DRUtES library, and there are presentations in English and Czech.

Main website: https://drutes.org/

GitHub repository of the project: https://github.com/michalkuraz/drutes-dev

1.10 Hub4Everybody

Hub4Everybody is a comprehensive solution for publishing, sharing, and collaborative management of geospatial data. It encompasses many data types, including professional data, measurements, research project outputs, student work results, teaching materials, sensory maps, field survey visualisations, and other maps, tables, or databases.

Hub4Everybody will be the main component of the COMUNIDAD platform, which will contain applications utilising services and datasets from the Infrastructure. The platform will host different pilot applications.

The Hub4Everybody is developed by a developers group led by the Lesprojekt company. Several presentations and tutorials were already prepared in English, Czech and Spanish.

Main website: https://hub4everybody.com/

Blog of the project: https://hub4everybody.com/blog/

Several **tutorials** have already been presented on YouTube.

- Hub4Everybody - tutorial 1st part: https://youtu.be/NZAv58phAI0?feature=shared

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- Hub4Everybody - tutorial 2nd part: https://youtu.be/h0F_CDSY97c?feature=shared
- Hub4Everybody: https://youtu.be/AdMoQnYQ2C8?feature=shared

An **overview article** about the solution was published by CHARVÁT, Karel, et al. Hub4Everybody-New Collaborative Environment for Sharing. *Agris on-line Papers in Economics and Informatics*, 4. December: 39-52. DOI: 10.7160/aol.2022.140404

1.11 Wagtail CMS

Wagtail is a leading open-source Content Management System (CMS). Built upon the Django framework with Python as its primary development language, Wagtail offers exceptional extensibility. Functionality can be readily expanded through custom widgets, page templates, permission configurations, and other system parameters.

Main website: https://wagtail.org/

User guide: https://guide.wagtail.org/en-latest/

1.12 HS Layers NG

HS Layers-NG framework is the open-source web mapping component. Lesprojekt and BOSC have actively participated in developing this tool for more than 10 years, and it can be significantly customised or functionally extended depending on the system's specific requirements. There is already a functional integration with the Wagtail CMS in the form of a map widget. This widget enables straightforward map creation within all HTML pages of the content management system, including detailed configuration of map layers and tools, if required.

The HSLayersNG library has been developed by an international team for over 10 years. A lot of presentations and tutorials were already prepared in English and Czech. These tutorials will be used to develop training materials for the COMUNIDAD project.

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Main website: https://ng.hslayers.org/

Project GitHub: https://github.com/hslayers/hslayers-ng

1.13 SensClient

The SensClient application visualises sensor data through charts and a map-based view of the sensors' location. The main overview is a dashboard placing all units onto a map. Graphical data visualisation is convenient for users due to easy and quick data correctness checking. For the convenience of administering sensor networks, the SensClient allows managing new and current sensors and units.

The SensClient will be used to visualise sensor data of different kinds.

The software has a tutorial in English and Czech, which will be necessary to modify for the COMUNIDAD project and translate into Spanish.

1.14 FIE20

The FIE20 is an expert system that supports farmers in decision-making and planning processes for field interventions. The FIE20 solution integrates different types of data, such as local sensor data and online analysis based on this data, Earth Observation and remote sensing data, farm and regional thematic spatial data, and weather model data - to be visualised in the web application and used in implemented analytical functions. The FIE20 solution is designed as a modular solution where the main components are mainly built based on open-source software and services. Additional functionality of the solution can be extended by using charged services and datasets of external data providers.

The software has a tutorial in English, Latvian, and Czech, which will be necessary to modify for the COMUNIDAD project and translate into Spanish. Several presentations were prepared in English and Czech, and one in Spanish.

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The **video tutorial** is available on YouTube.

- Part 1 - https://youtu.be/kzZGuXi-Q94?feature=shared
- Part 2 - https://youtu.be/j8OpAdxwnT0?feature=shared
- Part 3 - https://youtu.be/MM_Cv7YT6Xo?feature=shared

1.15 QGIS Desktop

QGIS is a powerful, free, open-source Geographic Information System (GIS) application enabling users to create, edit, visualise, analyse, and share geospatial data. As a cross-platform software, it runs on Windows, macOS, Linux, and Android, offering accessibility to a wide range of users, including researchers, planners, engineers, and educators. QGIS software will be used as a central component for processing spatial data by different users of the Platform.

QGIS is an open-source project developed by a large international community that provides a lot of tutorials and training materials to support users on different levels.

Main website: https://qgis.org/

Documentation: https://qgis.org/resources/hub/

1.15.1 Layman QGIS plugin

The Layman QGIS plugin is a client application that prepares data in the freeware QGIS environment. The application can upload/download map layers and compose groups of layers into map compositions to a Layman server. Layman publishes the QGIS project layers as a WMS or WFS service under the user workspace. Layman will be a plugin for QGIS software to publish spatial data from the desktop to the Web.

The primary purpose of this plug-in in the COMUNIDAD project is to bring advanced QGIS capabilities, particularly advanced geospatial data analysis and styling of map layers, to the COMUNIDAD platform.

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Several presentations and tutorials were prepared in English and Czech, and some in Spanish.

Main website: https://www.agrihub.cz/nastroje/layman-qgis-plugin/

GitHub repository: https://github.com/LESPROJEKT/qgis-layman-plugin

1.16 Computer Vision Service

The Coffee Plantation Monitoring System is a complex computer vision-driven tool for detecting, monitoring, and predicting coffee plantation dynamics running a neural network based on the TensorFlow software library. Built on Sentinel-2 satellite imagery, the neural network identifies active, abandoned, and potential coffee fields and allows the users to see the detected locations as a part of the interactive map within the platform environment.

The service has several documents and English presentations, which must be improved and published online.

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6. Conclusion

This deliverable provides an overview of the software tools part of COMUNIDAD technology solutions, either as infrastructure components or platforms. In addition to a brief description of each tool, the subsection includes links to websites, documentation and, in some cases, other relevant resources, including video presentations.

The integration of components into the COMUNIDAD Infrastructure and Platform is the scope of deliverables D2.2, D2.3 and D5.1.

For some of the tools, it is noted that the available descriptions, documentation, and other materials are not sufficient at this point, and some improvements will be necessary.

This deliverable aims to guide primarily the creators of the training materials but also users and developers to resources where they can find relevant information on the individual tools and get to know them in detail.

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