FIREURISK - DEVELOPING A HOLISTIC, RISK-WISE STRATEGY FOR EUROPEAN WILDFIRE MANAGEMENT

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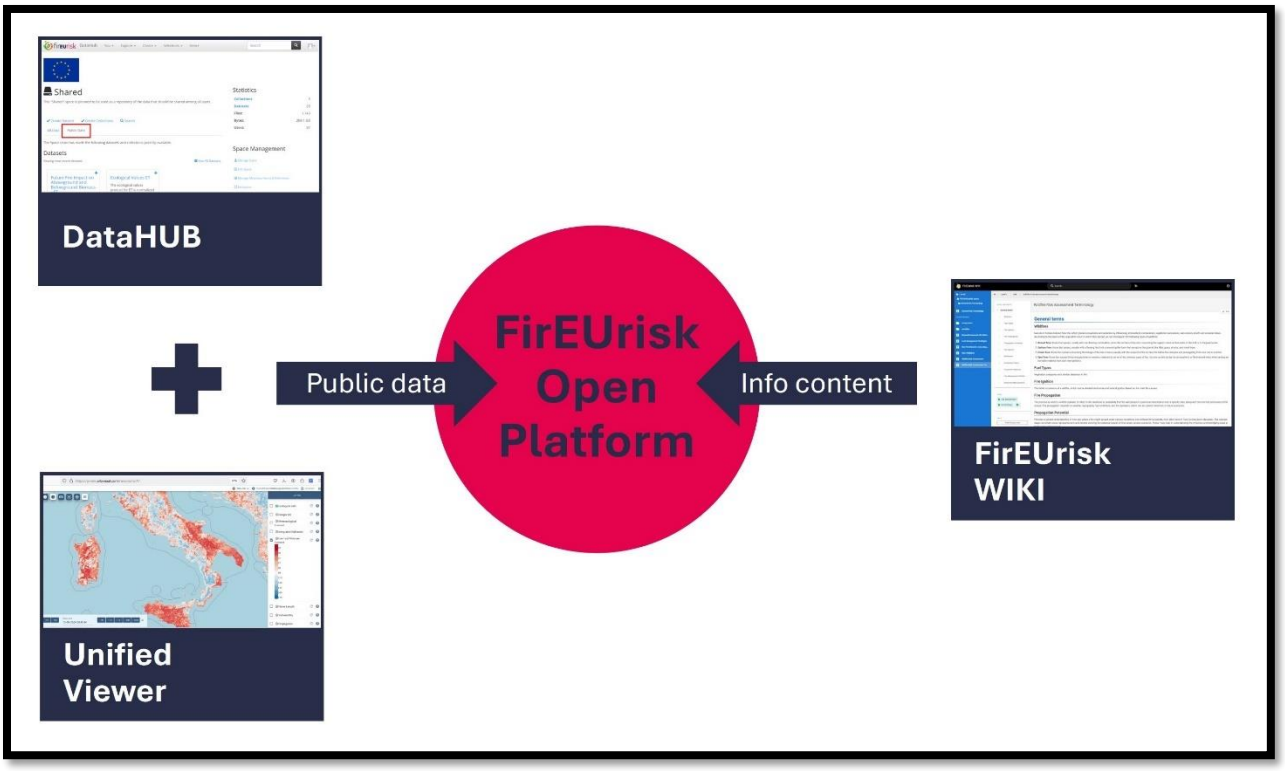
Executive Summary

*The **FirEURisk Open platform** serves as a critical resource for wildfire risk management in Europe, offering robust data integration, advanced visualization capabilities, and a collaborative knowledge-sharing environment. Its ongoing development will continue to enhance stakeholders' ability to understand, anticipate, and mitigate the impacts of wildfires, ultimately contributing to a more resilient and safer Europe.*

The efficient integration and distribution of the information on wildfire risk in Europe, not only among the involved partners (internally) but also with external end-users / stakeholders and the general audience, constitutes a high priority for the success of the FirEURisk project. In this direction, the specific document presents the **FirEURisk Open platform** which allows sharing such information and data defined and produced within the project, from a public, stakeholder-oriented perspective. The Open platform follows the Consortium's decision on publicly distributed data, as has been specified in the FirEURisk deliverable D4.2 of Data Management Plan (DMP) [1]. Additionally, it has been built on the deliverables D4.3 [2] and D4.7 [3], in which the internal cooperative platform for "within Consortium" data storage and management, and a unified user interface for displaying outputs from this platform and from existing external systems are presented, respectively, as FirEURisk's developed online services. These two already available services (after reconfiguration) in combination with a new information/knowledge exchange (wiki) service constituted the basis for the Open platform (see graphic below) documented in this deliverable (D4.8). Therefore, to some degree, the specific document can be also considered a supportive user handbook that accompanies the three integrated services: DataHUB (https://fireurisk.satways.net), *Section 3*; Unified Viewer (https://proms.arbonaut.com/newproms), *Section 4*; and FirEURisk WIKI (https://fireurisk.wiki.satways.cloud/en/public), *Section 6*.

Key take away messages:

- COMPREHENSIVE DATA INTEGRATION: The platform integrates diverse (time-sensitive) datasets, allowing for a multifaceted analysis of wildfire risk.
- MODULAR AND SCALABLE ARCHITECTURE: Its architecture makes the platform flexible and adaptable to evolving broader wildfire risk scenarios and technological advancements.
- ENHANCED DATA ACCESSIBILITY AND VISUALIZATION: The platform facilitates easy access to data and provides powerful visualization tools.
- SUPPORT FOR A HOLISTIC RISK MANAGAMENT APPROACH: The platform is designed to support the full cycle of wildfire risk management, from assessment and mitigation to adaptation planning.
- PROMOTION OF KNOWLEDGE SHARING AND STAKEHOLDER ENGAGEMENT: The platform has fostered an environment of collaborative knowledge sharing among stakeholders.



Graphical summary

Disclaimer

Copyright message

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Table 1: List of Acronyms

List of Acronyms	
API	Application Programming Interface
COG	Cloud Optimized GeoTIFF
DMP	Data Management Plan
DMB	Data Management Board
DTM	Digital Terrain Model
EFFIS	European Forest Fire Information System
EO	Earth Observation
ET	European Territory
EU	European Union
GeoTIFF	Geographic Tagged Image File Format
GIS	Geographic Information System
HTML	HyperText Markup Language
IRI	Integrated Risk Index
REST	Representational State Transfer
URL	Uniform Resource Locator
WMS	Web Map Service
WFS	Web Feature Service
VIIRS	Visible Infrared Imaging Radiometer Suite

1 Introduction

The FirEURisk project is planned to take advantage of several models, tools, and data produced by its WPs (1-3), in order to propose solutions, recommendations, and an overall science-based strategy for wildfire risk management in Europe. Following the Data Management Plan (DMP) that has been defined in deliverable D4.2 [1], the management and sharing of this information internally in the project have been supported by the respective cooperative platform **Erro! A origem da referência não foi encontrada.**[2]. The same is planned to be supported externally by an open platform. Through this platform, scientific experts, end-users, stakeholders, and the general audience will be able to have access to (publicly distributed) information related to wildfire risk assessment, adaptation, and mitigation approaches in Europe.

Under an integrated structure, the open platform consists of a data repository service, a Geographic Information System (GIS)-based service for the display of georeferenced data, and a wiki for information and knowledge exchange. Additionally, it is compatible with products from other European Union (EU) projects and with existing systems being used in the various countries, aiming to be adopted for training and operational use in Europe.

The current deliverable and the open platform documented here resulted from the activities of Task 4.3 (“Integration with external platforms and legacy systems”), particularly activity A4.3.2 (“Open platform of models, data and knowledge”). All these are part of the WP4, which is related to the integration of the different phases and scales of wildfire risk management (“Multi-level integration”).

Relevant updates may be implemented in the future, taking into consideration potential updates of the DMP as well as the data integration requirements that may be identified within the upcoming period until the end of the project.

1.1 Purpose of the document

The technical core components of the open platform have been designed and deployed on a cloud infrastructure. They are ready for use. This document’s purpose is to accompany the deployment, presenting the platform’s high-level integrated structure and its components’ capabilities. Moreover, this document can be used as training material, which the readers and users can exploit to be informed about the platform and its components’ provided functionalities and guided in executing these functionalities.

1.2 Structure of the document

The document’s structure has been designed to address the dual objectives of this deliverable. The content is organized into two main groups: Section 2 that provides a description of the open platform’s integrated structure, and the subsequent sections that provide details on the capabilities and functionalities of its components, along with instructions for their use. Specifically, Section 3 covers the configuration of the internal cooperative platform’s data repository to support the open platform’s requirements. Section 4 presents an overview of the GIS-based service for visualizing geospatial data. Section 5 details the publicly accessible data available through the open platform, and Section 6 provides a high-level presentation of the wiki for sharing wildfire risk-related information and knowledge.

2 Open platform

The FirEUrisk Open platform is conceptualized as an “one-stop-shop” for accessing publicly available data, models and knowledge related to wildfire risk in Europe. The platform facilitates communication, interaction, and linkage among various online services developed within the project framework. This integration aims to maximize the dissemination of content and recommendations associated with the project’s integrated risk-based fire management strategy. By freely providing datasets, tools, and training materials developed, tested and refined during the project, the platform serves a wide range of stakeholders and end-users, including fire services, forest services, civil protection agencies, planners, and policymakers.

2.1 Integrated structure

The Open platform is designed to consist of three distinct online services developed in the context of FirEUrisk, as illustrated in the following figure (Figure 2). These services include:

- **DataHUB**: The internal data repository service, which enables the storage and management of scientific information and datasets [2].
- **FirEUrisk Viewer**: A GIS-based service that facilitates the visualization of the geospatial data sourced from DataHUB and other existing external platforms across Europe [3].
- **FirEUrisk WIKI**: A collaborative wiki service for the exchange of information and knowledge.

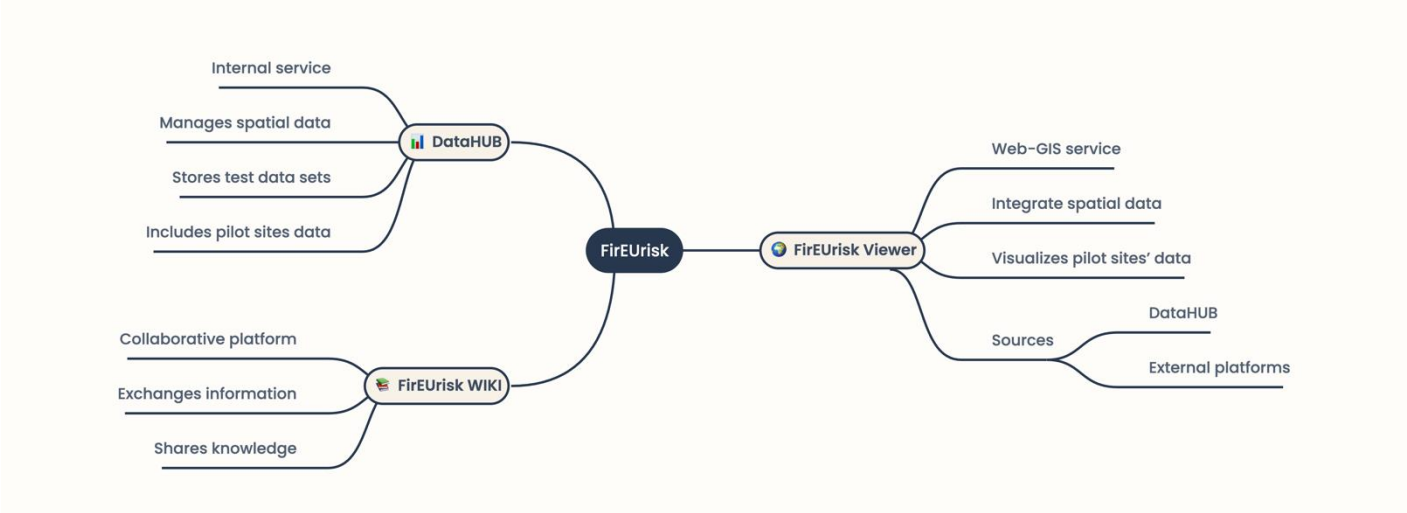


Figure 1: Overview of the Open platform concept

Together, these services form the platform’s structural components, enabling seamless integration and functionality, as shown in the integrated structure diagram (Figure 2). DataHUB currently hosts a substantial collection of data and corresponding metadata essential for validating the findings of WP1-3 and supporting the results published in FirEUrisk’s scientific outputs. Initially configured as a project-internal/private resource (detailed in Section 3), DataHUB

was adapted to provide open access to external users as well. Following this reconfiguration, the Consortium can make some datasets publicly available in accordance with the project's DMP. DataHUB also includes a robust mapping feature utilizing GeoServer [4] to create visual displays of geospatial data on a base map. The Unified Viewer (covered in Section 4) utilizes these Web Map Service (WMS) outputs to showcase and handle both static and dynamic geospatial data that is publicly available via DataHUB, along with data from specific external sources (covered in Section 5).

Additionally, as part of the Open platform, the FirEUrisk WIKI (introduced in Section 6) serves as a comprehensive knowledge base for wildfire risk assessment, adaptation, and mitigation strategies. This interactive wiki service allows users to engage with and expand upon its content by adding their own contributions.

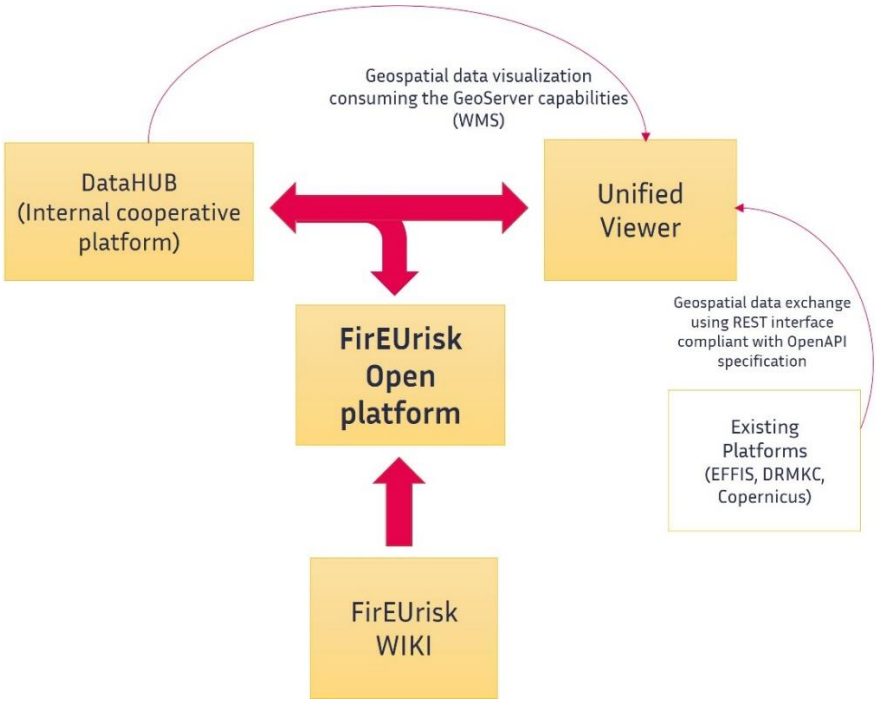


Figure 2: Open platform's integrated structure

3 Configuration of Internal platform

The Internal cooperative platform, developed during previous WP4 activities (specifically T4.1 and A4.1.3), served as the foundation for the development of the Open platform. Among the various subcomponents of this platform named DataHUB – detailed in D4.3 [2] – the data repository plays a pivotal role. Created by SATWAYS as a cloud-based service (accessible at https://fireurisk.satways.net) using open-source framework, DataHUB was initially designed to manage the storage and sharing of data and information within the FirEUrisk project. Its access was restricted to authorized Consortium members through a controlled sign-up/log-in concept, and its user interface only supported private data sharing.

DataHUB organizes uploaded information using a hierarchical structure consisting of three levels:

- **Space**: The primary grouping entity for information and data.
- **Collection**: An organizational unit within a Space.
- **Dataset**: The level at which files are directly hosted.

The hierarchical structure not only makes the data easier to navigate but also supports programmatic access through web-based Application Programming Interfaces (APIs) that adhere to OpenAPI specifications. This enables seamless integration of FirEUrisk data into external applications, ensuring broad usability.

To accommodate the requirements of the Open platform, DataHUB has been reconfigured to offer an additional open access option for these items. The open access configuration aligns with the DMP, ensuring compliance with open science principles. This included enabling public sharing, accessible through specific interface widgets. For example, when creating a new Space, Collection, or Dataset (via the “Create” menu), an authorized user is now required to specify the access level for the content, in addition to providing the necessary descriptions and metadata. By selecting the “Public” option in the “Access” widget (as shown in Figure 4 and Figure 4), the item becomes accessible to the general public, allowing visibility and access without the need for user sign-up or log-in. Additionally, by exploring an existing Dataset and selecting the “Public” option in the “Access” widget (as shown in Figure 5), the authorized user can make this Dataset and, by extension, all its included files/folders publicly available.

Apart from the above public sharing options for authorized users, it worth noting that any, non-authorized user (without sign-up/log-in) can explore and display all the public Spaces, Collections, or Datasets of DataHUB via the “Explore” menu. After that, at a Space level, the user is able to display the public Datasets contained in a specific Space, by entering it and clicking on the “Public Data” tab (as shown in Figure 6). Publicly accessible Datasets can be downloaded directly or accessed via the service’s API.

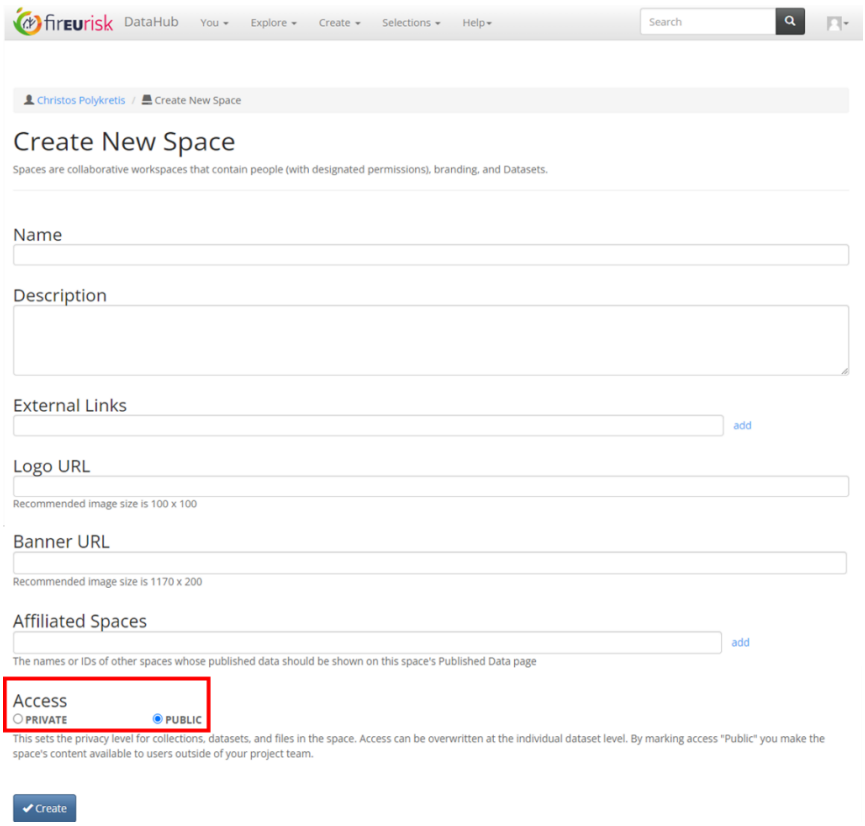


Figure 3: Creating a new Space in DataHUB, with public access

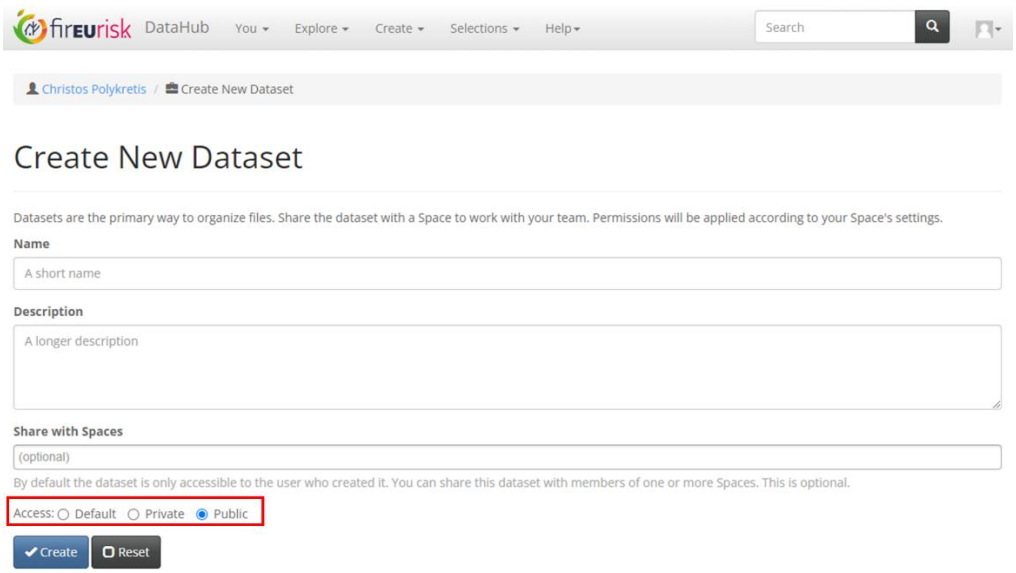


Figure 4: Creating a new Dataset in DataHUB, with public access

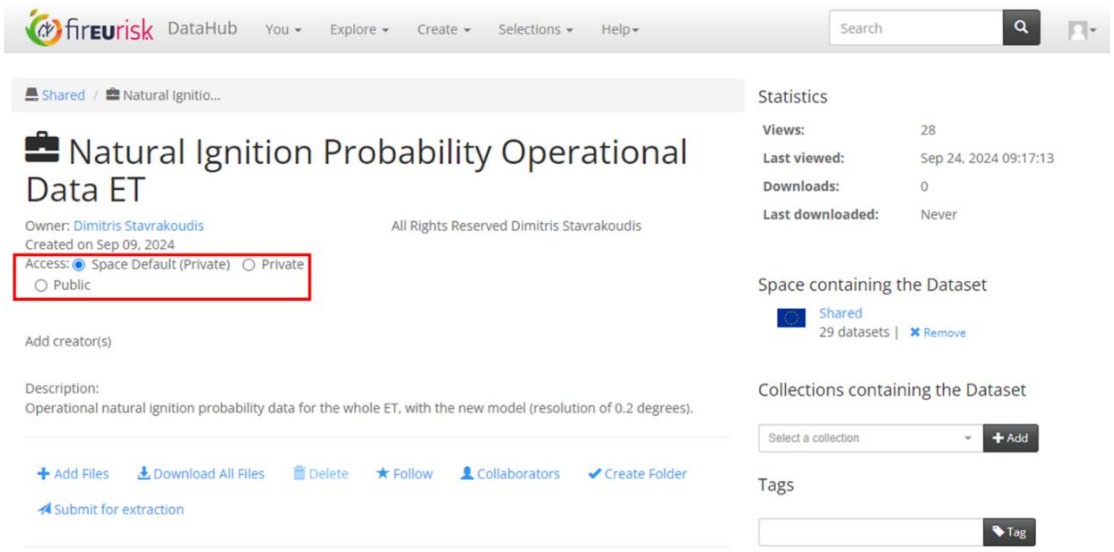


Figure 5: Making public an existing Dataset in DataHUB

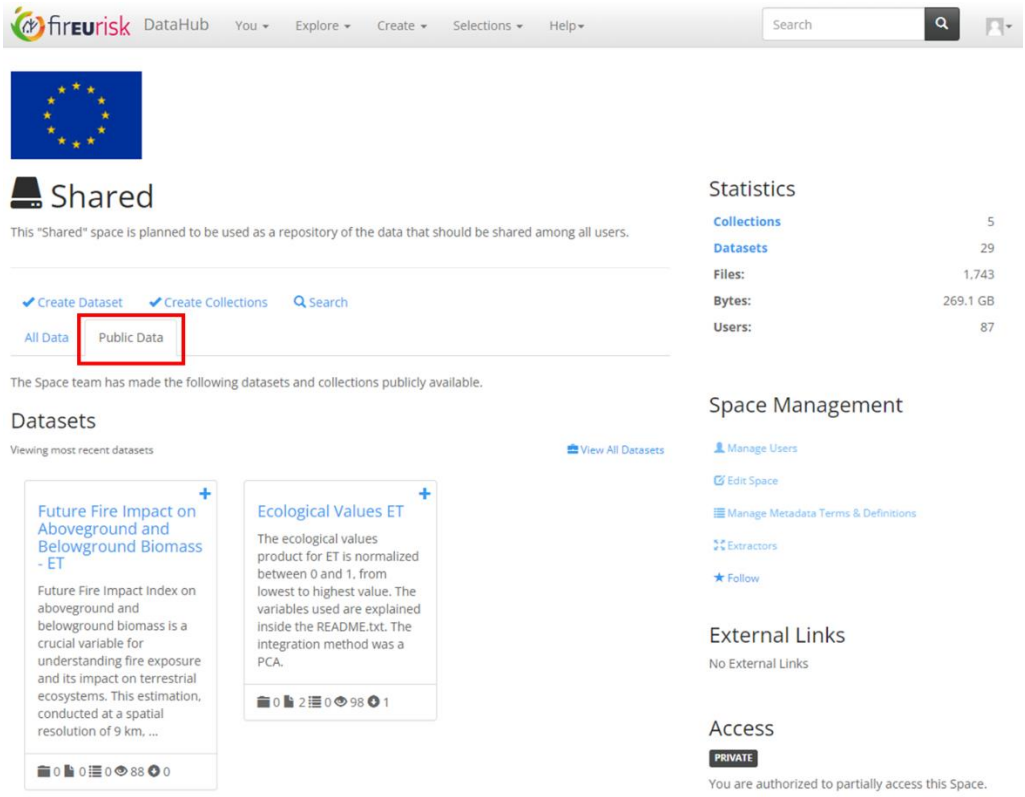


Figure 6: Displaying the public Datasets contained in a Space of DataHUB

4 Unified Viewer

During the project, the Unified Viewer was developed by ARBONAUT as per project specifications (accessible at https://proms.arbonaut.com/newproms – the temporary credentials of *"FirEUrisk"* as username, and *"FirEUrisk_demo_2023"* as password can be used for entry). The Viewer was designed to display and process static and dynamic information related to fire risk assessment, adaptation, and mitigation strategies. The previous version of the Viewer [3] has been upgraded to a more modern design and layout. All existing functionalities have been integrated and improved under this new design, thus enhancing the user experience and building a stable base for future use. Among them, the main functionalities are:

- **Layer Management**: Users can select and overlay multiple layers (e.g., vegetation types, fire risk zones, real-time weather conditions); each layer is represented with distinct styles and legends for clarity.
- **Time-Series Visualization**: Dynamic data can be visualized across different time periods, allowing users to analyse changes in risk-related variables, such as fuel moisture content or meteorological conditions.
- **Data from External Sources**: The Unified Viewer can also display map layers of data produced from other EU projects (e.g., EFFIS, Copernicus) or existing systems being used in the various countries, as far as the technical requirements are met.

The Viewer has potential to be adopted for training and operational use in the EU for different fire related use cases.

4.1 Technical architecture aspects

The Viewer is composed of a GIS web interface and supporting backend services. The web application is compatible with the most widely used browsers across Windows, Linux, and iOS operating systems. Additionally, a separate Android mobile version is available. However, for FirEUrisk user accounts, a mobile application has not been released, as no clear use cases have been identified to justify its development and deployment.

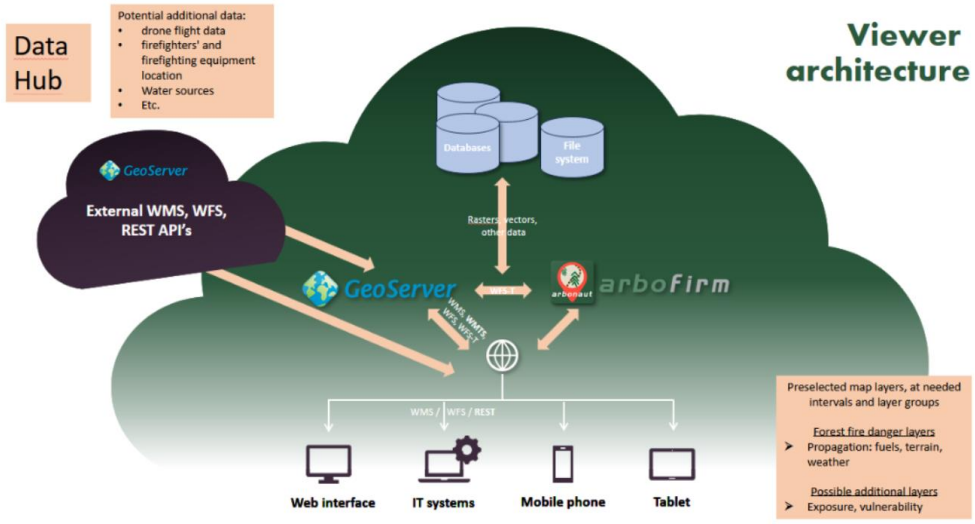


Figure 7: Overview of Viewer's architecture

The PostGIS database has been enhanced with additional GIS data, organized into separate tables within the central database, hosted by ARBONAUT (Figure 7). The data are displayed as distinct map layers within the application.

4.2 User Interface (UI)

The Viewer's UI mainly consists of a map layer view equipped with various menu, widgets, and others that are presented in this section.

As the tool is designed to serve different spatial scales, it provides different map layers for European Territory (ET) and each pilot area, thus supporting the fire risk management for each scale/area. The map layers that are currently configured on the Viewer include base maps (e.g., OpenStreetMap) and ET or pilot area-specific lists of geospatial data layers. Each pilot area leader is responsible for deciding the layers to be presented, as the focus and interests differ between pilot areas. For every pilot area, there is already a list of layers presented in the Viewer, but it is quite likely that the layers will need some updates and additions to meet the pilot area requirements. After that update, the final version of the layers as published in the DataHUB could be visualized in the Viewer, on a short notice (even layers outside of DataHUB, if provided as WMS, WFS, or REST APIs can be included in the Viewer).
Some of the layers that are already included in the Viewer are:

- **Terrain related**: Hillshade, Digital Terrain Model (DTM), Aspect, Slope
- **Tree Cover related**: Canopy height model, Canopy bulk density, Crown base height, Canopy coverage, Stands
- **Fire Ignition, Propagation and Suppression related**: Fuel model, Ecoservice losses, Human ignition probability, Suppression difficulty, Crown of fire activity, Crown of fire burned, Rate of spread, Heat released, Fireline intensity, Fuel map, Human settlements, Likelihood of human ignitions, Ecological vulnerability, Socio-economic value, Ecosystem services, WUI interface
- **External Sources**: European Forest Fire Information System (EFFIS) fuel map, METEO DTM, Visible Infrared Imaging Radiometer Suite (VIIRS) fire season, VIIRS burned areas, etc.

A variety of ET layers recently produced/updated within the FirEUrisk project have been also added in the Viewer. These include:

- Fuel types
- Human ignitions
- Ecological vulnerability
- Danger (time layer)
- Meteorological forecast (time layer)
- Integrated risk index (time layer)
- Fuel moisture content (time layer)
- Flame length (time layer)

- Vulnerability (time layer)
- Propagation (time layer)

During the project, it has become evident that the decisions and work needed for correct and informative map layers is quite high and should be resourced accordingly to serve different needs of fire management. In short, it needs time and effort to prepare the map layers for the DataHUB and get it accessible for the Viewer. When this is achieved, then getting the layers visible in the Viewer has proved to be quite fast (within a timeline of 2 weeks or less after the layers being available at the DataHUB).

The Viewer's UI provides tools for selecting the area of interest, implementing measurements, displaying legends, printing, exploring time layers, and other tools to get a good picture of the fire danger and risk related data (Figure 8).

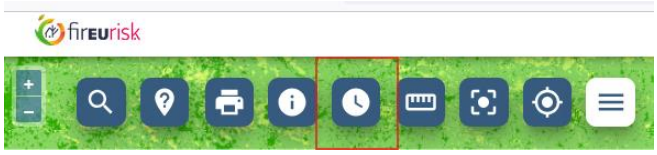
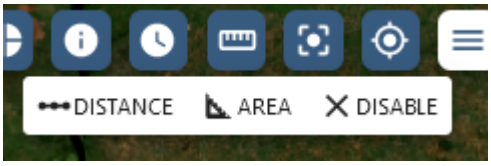


Figure 8: Tools on Viewer's UI (the "Time control" tool is marked with a red square)

The tools are associated with respective icons, as presented in the following Table.

Table 2: Description of the tool icons

Tool icon	Tool name	Short description
	Search location	Type the location (e.g., city) you want to find.
	Show / Hide coordinates	When drawing new features on the map, coordinates are shown/hidden based on this setting.
	Print map	After a printing background process is implemented, a new tab is opened on your web browser. It shows a map area clip from the view that was active, legend, scale, and north arrow. You can download and save the file as needed.
	Show raster maps background info	Click on the tool icon to activate it (icon turns white). Switch on the map layer(s) for which you want to see map values. Click on the map at a location for which you want to view the values. Map values of the activated layers are then shown in the information panel on the right side.
	Time control	This tool allows you to select the period you want to view changes on the layer data. When time is set, the layer from that period is shown. By selecting different times, you can identify when the change has happened.

	Measure distance and area	When pressed, this tool opens a submenu as below.  "Distance": Click the points from start to end. You can show the distance from the previous point at each point you clicked and also the total distance from start to end, after you double click or right click to end the measurement. "Area": After selecting it, you can start clicking the area. You can see the point distance from a previous point, and the area in hectares and square kilometres. "Disable": When you want to quit the measurement tool. Otherwise, the tool stays active.
	Centre map	Centres the map view to a predefined scale, in the middle of the screen.
	Show / hide GPS	If GPS is available on your device, you can put GPS on / off. When turned on, you can see your location on the map.
	Show / hide sidebar	Controls the right panel (showing layers, etc.) visibility.

If the dataset is presented as a time layer (indicated as in the layer list), then the selection of the time of interest is done in a separate bar, as shown below (Figure 9). The bar appears by pressing the time control icon (red rectangle in Figure 8). Using this bar, users can analyse changes by time for any time layer. Below is an example showing the fuel moisture content layer; the first map displays the situation of 14/06/2024 (left side in Figure 9), and the other 2 months later, 14/08/2024 (right side in Figure 9).

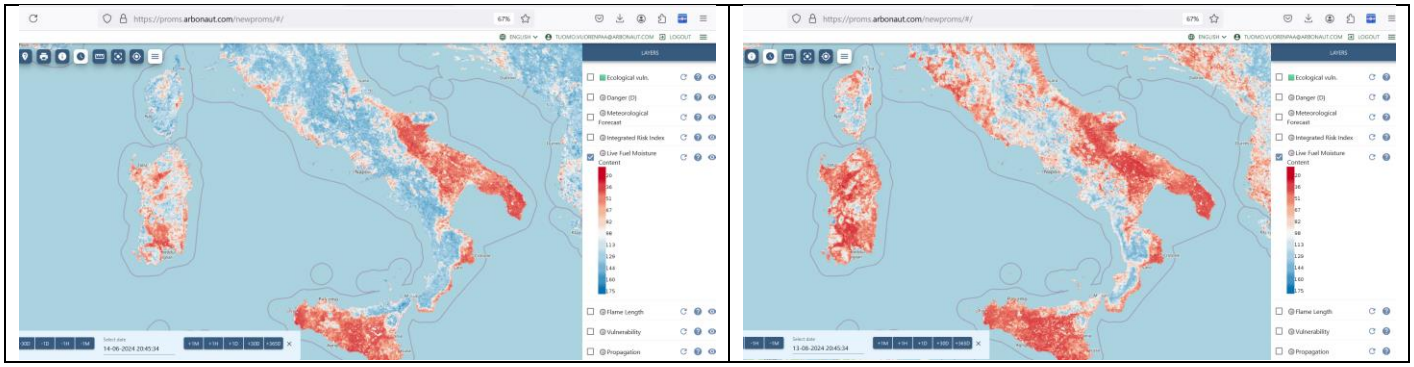


Figure 9: Screenshot of the Viewer, with time layer and its selection activated

5 Publicly distributed data

The FirEURisk Open platform is central in making data and information on wildfire risk in Europe accessible to a wide range of stakeholders. It aims to support risk assessment, mitigation planning and adaptation strategies by providing high-quality data. The hosted datasets are derived from multiple sources, processed according to rigorous methodologies, and categorized into static and dynamic datasets. This comprehensive data ecosystem supports scientific research, operational decision-making and policy development.

5.1 Types of data available

The data available through the Open platform encompasses a broad spectrum of wildfire-related information. Since most FirEURisk products are based on Earth Observation (EO) data, most (although, not all) of the products on the platform are raster datasets, categorized into two broad categories:

- **Static Datasets**: These datasets contain geospatial layers with information such as topography, land cover, fuel types and fuel models. These layers are essential for understanding the environmental factors that influence fire behaviour, such as terrain and vegetation characteristics. Static datasets may also include maps of historical fire events, enabling the identification of areas with recurring fire patterns. Additionally, static data supports modelling fire risk across different temporal and spatial scales, which is crucial for long-term planning and risk mitigation.
- **Dynamic Datasets**: The platform also provides access to time-sensitive data that is updated regularly to reflect the current conditions. Dynamic datasets include live fuel moisture content, daily meteorological forecasts (e.g., temperature, wind speed, relative humidity) and ignition probabilities derived from weather and lightning data. These datasets are processed using advanced algorithms that downscale meteorological data to resolutions as fine as 1 km. In addition, several variables (intermediate and final ones) of FirEURisk's Integrated Risk Index are also calculated daily and exposed via the platform. The availability of dynamic datasets enables near-real-time risk assessment and supports adaptive fire management strategies, making it possible to respond to evolving wildfire conditions.

5.2 Data generation by Integrated Risk Index (IRI) calculation

A significant portion of both static and dynamic data, currently stored on the DataHUB and displayed in the Unified Viewer, are the inputs and outputs of FirEURisk's IRI calculated over the whole ET. IRI calculation follows a standardized processing workflow that ensures data consistency, accuracy, and scientific validity, as shown in the high-level diagram below (Figure 10). Its overall design supports modular updates and interoperability with other European services (web-based APIs), in order to facilitate a collaborative and extensible data ecosystem where datasets are not only stored and visualized but can also be dynamically linked to modelling tools and decision support systems.

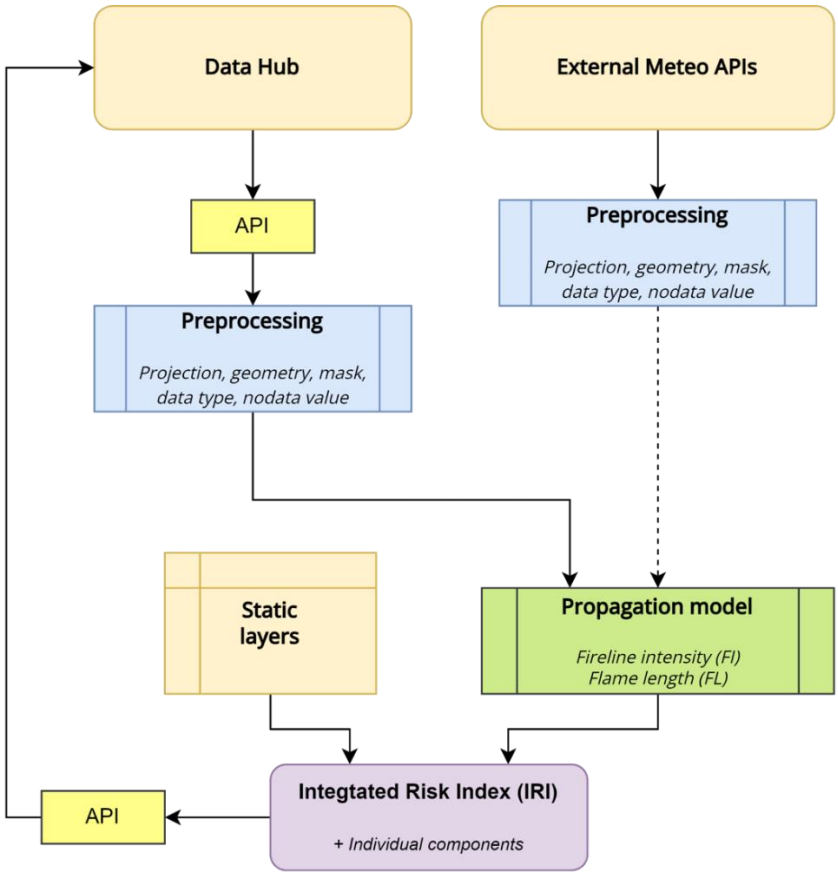


Figure 10: Workflow of FirEURisk's Integrated Risk Index (IRI) calculation and interfacing with the Open platform

Taking the ET-wide IRI implementation as an example, key aspects of the workflow include:

- **Meteorological Data Processing**: multiple sources of meteorological data are integrated, including downscaled forecasts from ICON-EU (provided by Meteogrid), ERA5-Land, as well as the original ICON-EU forecasts. The forecasts undergo a series of preprocessing steps to ensure uniform spatial resolution and data format, using the ETRS LAEA (EPSG:3035) projection. These steps include cubic resampling to a 1 km grid, and data quality checks to identify and address gaps in the datasets. Fallback mechanisms, such as switching to alternative data sources (e.g., ICON-DEU when the downscaled forecasts are not available when needed for whatever reason), are implemented to maintain data availability during periods of missing or incomplete data.
- **Fire Risk Modelling**: Risk modelling integrates static and dynamic data to calculate key variables used in wildfire risk assessment, such as the fireline intensity and flame length, or the calculated IRI itself. These variables are generated using models that combine multiple inputs, including weather data, vegetation characteristics, and ignition probability factors (both natural and human-induced). The integration of these data allows for comprehensive assessments that can inform management actions and policy decisions.

- **Data Quality and Standardization**: The data are stored in standardized formats (e.g., Cloud Optimized GeoTIFF – COG) with metadata that describes their origin, processing steps, and quality indicators. This ensures that the data are not only accessible but also understandable and reusable by other researchers and practitioners. The standardization process is supported by naming conventions, file formats, and geospatial attributes, ensuring interoperability with other data systems.

The IRI-related data are systematically organized in the DataHUB to ensure efficient management and accessibility. Specifically, a single ET Space has been created for each purpose (i.e., the open ET Space is different than the internal one, to avoid mistakes). Each variable then defines its unique Dataset, inside the Space, where the actual data files are stored. Static Datasets (e.g., fuel type map) will generally be composed of a single COG file, but time-series Datasets (e.g., the daily forecasts of cumulative precipitation) comprise multiple files, one for each day (or whatever temporal granularity is needed). Collections serve as tags or organization mechanisms (e.g., Risk Assessment, Risk Adaptation, Danger IRI Components, Vulnerability IRI Components, etc.), enabling easy search and a hierarchical view of all data based on thematic categories, such as meteorological inputs or fire risk indicators.

The management of Datasets is streamlined through an Excel-based system that tracks Dataset IDs and controls the upload and download processes. This approach ensures that even non-essential datasets, which may serve primarily for visualization purposes, are maintained in an orderly and accessible manner, supporting both internal project needs and external stakeholder use. The table in the following figure (Figure 11) provides a snapshot of the list of Datasets available in the DataHUB that are related with the ET IRI implementation, including metadata such as Variable Symbols, Dataset Titles, and Collection information. It highlights whether the datasets are time-series or static and categorizes them as inputs or outputs based on their role in the platform's data ecosystem.

VariableSymbol	DatasetID	FolderID	DatasetTitle	SpaceID	SpaceTitle	CollectionID	CollectionName	IsTimeseries	VariableType	VariableName	PilotSite	HasRATag	UpdatedByPartner	Filenam
FuelTypes	66966f1fe4b02cc2805206ea		FirEUrisk Fuel Types Map [ET	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			FALSE	Input	FuelTypes	ET	FALSE	FALSE	FirEUris
FuelModels	66966fd3e4b02cc280520733		Fuel Models (FBFM40) [ET] [V	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			FALSE	Input	FuelModels-FBFM40	ET	FALSE	FALSE	FirEUris
WindSpeed	66913890e4b02cc28050d3f5		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-WindSpeed-T1200	ET	TRUE	FALSE	
WindDirection	6691349ae4b02cc280506ea9		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-WindDirAzim-T120(	ET	TRUE	FALSE	
FL	6690e5f1e4b02cc2804e47e2		IRI-Propagation: Flame Leng	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Propagation-FL	ET	TRUE	FALSE	
FI	668ff76ee4b02cc2804e3ef8		IRI-Propagation: Fireline Int	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Propagation-FI	ET	TRUE	FALSE	FirEUris
DailyPrecipitation	66913481e4b02cc280506d8c		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-Prec-24h	ET	TRUE	FALSE	
CloudCover	6691346ce4b02cc280506cb3		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-CC-T1200	ET	TRUE	FALSE	
RelativeHumidity	6691345ee4b02cc280506c21		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-RH-T1200	ET	TRUE	FALSE	
Temperature	6691344de4b02cc280506b86		IRI-Input: Meteorological Foi	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Meteo-T2m-T1200	ET	TRUE	FALSE	
DFMC1h	66913137e4b02cc280501a29		IRI-Input: Dry Fuel Moisture (	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	DFMC-1h-T1200	ET	TRUE	FALSE	
DFMC10h	66913129e4b02cc2805019e6		IRI-Input: Dry Fuel Moisture (	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	DFMC-10h-T1200	ET	TRUE	FALSE	
DFMC100h	6691311ce4b02cc2805019af		IRI-Input: Dry Fuel Moisture (	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	DFMC-100h-T1200	ET	TRUE	FALSE	
LFMC	66913104e4b02cc280501940		IRI-Input: Live Fuel Moisture	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	LFMC-S3-1km	ET	TRUE	TRUE	FirEUris
PHI	66912bf2e4b02cc2804fa388		IRI-Danger: Probability of Hu	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			FALSE	Input	Ignition-Human	ET	TRUE	FALSE	
PNI	66912babe4b02cc2804f99dd		IRI-Danger: Probability of Na	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Input	Ignition-Natural	ET	TRUE	TRUE	
E	66912752e4b02cc2804f8a65		IRI-Exposure: Exposure (E) [E	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			FALSE	Input	Exposure	ET	TRUE	FALSE	
V	66911cbce4b02cc2804eee31		IRI-Vulnerability: Vulnerabili	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-V	ET	TRUE	FALSE	FirEUris
RSEV	66911c90e4b02cc2804eee23		IRI-Vulnerability: Reduction	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-RSEV	ET	TRUE	FALSE	
REV	66911c61e4b02cc2804eee15		IRI-Vulnerability: Reduction	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-REV	ET	TRUE	FALSE	
RESV	66911c43e4b02cc2804eee07		IRI-Vulnerability: Reduction	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-RESV	ET	TRUE	FALSE	FirEUris
HV	66911c09e4b02cc2804eedf9		IRI-Vulnerability: Human Vul	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-Human	ET	TRUE	FALSE	
FFI	66911bb6e4b02cc2804eedd9		IRI-Vulnerability: Foreseen F	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-FFI	ET	TRUE	FALSE	
EV	66911b76e4b02cc2804eedca		IRI-Vulnerability: Ecological	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Vulnerability-Ecological	ET	TRUE	FALSE	
PP	6690fd66e4b02cc2804e8199		IRI-Danger: Probability of Pr	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Danger-PP	ET	TRUE	FALSE	
PI	6690fd4ae4b02cc2804e818e		IRI-Danger: Probability of Ign	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Danger-PI	ET	TRUE	FALSE	
D	6690fd26e4b02cc2804e8185		IRI-Danger: Danger (D) [ET] ['	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	Danger-D	ET	TRUE	FALSE	FirEUris
IRI	668f92a8e4b02cc2804e3592		Integrated Risk Index (IRI) [E	66755be2e4b0c	European Territory [ET] Demonstration Data Spac			TRUE	Output	IRI	ET	TRUE	FALSE	FirEUris

Figure 11: Example of the variables involved with the ET-wide IRI calculation, as organized in the DataHUB

5.3 Compliance with the Data Management Plan (DMP)

All data provided through the FirEUrisk Open Platform complies with the DMP [1], establishing protocols for data governance, accessibility, and ethical considerations. The DMP ensures:

- **Adherence to FAIR Principles**: The data are Findable, Accessible, Interoperable, and Reusable (FAIR). Metadata standards are applied to each dataset, making it easier for users to search for and understand the data.
- **Transparent Data Sharing Policies**: Publicly available data are accompanied by documentation that outlines their origin, intended use, and any applicable limitations.
- **Ethical Considerations**: The DMP addresses ethical aspects related to data sharing, such as privacy concerns for datasets that may include sensitive environmental or socioeconomic information.

In addition to the above, the DMP is periodically updated to accommodate new data types, methods of data integration, and feedback from users, ensuring that the platform remains responsive to evolving needs. For all Datasets involved in the ET IRI implementation, the DMB has defined the naming scheme of the files, Datasets, etc., and has solely regulated the data upload process (since AUTH members both implemented the software implementation of IRI and constitute the DMB at the same time). In general, though, the DMB only monitors the adherence to the DMP guidelines, intervenes providing suggestions where needed, and offers assistance if requested.

6 FirEURisk WIKI

To enhance knowledge sharing and foster collaboration, a WIKI was deployed by SATWAYS as part of the open platform for the FirEURisk project (accessible at https://fireurisk.wiki.satways.cloud/en/public). This WIKI serves as a centralized repository for information and documentation on data, models and services produced during the project, making it easily accessible to potential end-users. By leveraging an open-source framework, the WIKI ensures transparency, encourages community engagement, and provides a dynamic space for contributors to share insights, updates, and resources. This approach aligns with the FirEURisk's commitment to openness and knowledge dissemination, supporting the wider community in understanding and contributing to the goals of project.

6.1 Open-source framework

Several open-source wiki frameworks are currently available, with each one presenting its own strengths and capabilities, tailored to different use cases and requirements. In terms of selecting such a framework for FirEURisk WIKI, some popular open-source options were evaluated. This evaluation was based on the features, ease of use, performance, scalability, and community support of each solution. After that, the **"Wiki.js"** was eventually selected to be used for FirEURisk project.

"Wiki.js" distinguishes itself with a comprehensive set of features designed to accommodate both technical and non-technical users. For example, it allows users to contribute effectively to the wiki by choosing the editing mode that best suits their needs and varying levels of technical expertise (see below, Section 6.3.2). Real-time collaboration also is a powerful editing aspect, enabling multiple users to edit the same page simultaneously; changes are synchronized instantly, allowing users to see who is editing in real time and ensuring everyone is working with the latest information.

Additionally, "Wiki.js" is equipped with features that enhance search engine optimization and accessibility, including customizable URLs, meta tags, and compliance with various accessibility standards. These capabilities ensure that the platform's content is not only easily discoverable but also usable by all users, regardless of their abilities or the devices they use. Moreover, the platform's modular architecture further enhances its appeal by supporting extensive customization through plugins and themes; this allows the users to tailor the wiki to their specific requirements, whether by adding custom functionality or altering the platform's appearance (with SATWAYS's system administrator being in charge of revising and/or approving all these).

As an open-source platform, "Wiki.js" can be used without extra costs. This open-source nature also allows the users to review the source code, contribute to its development, and ensure that the platform aligns with their security and privacy standards. The platform is optimized for performance, utilizing server-side rendering and caching to ensure fast page loads and efficient data handling. Furthermore, "Wiki.js" supports multiple storage backends, such as PostgreSQL, SQLite, and MySQL, enabling it to scale effectively with the growth of our content and user base.

In a nutshell, by selecting "Wiki.js", a modern, versatile, and scalable platform was chosen that meets FirEURisk's current needs and provides the flexibility to adapt to its future requirements. The combination of its rich feature set, ease of use, strong community support, and cost-effectiveness makes "Wiki.js" the ideal choice for FirEURisk WIKI solution.

6.2 Open access and authentication mechanism

The FirEURisk WIKI has been designed to be an integral part of an open platform, where the primary goal is to share knowledge and make information easily accessible to a wide audience. In this context, any user can browse and access the WIKI's content freely without the need to log-in. This open-access approach ensures that the content served by the WIKI is readily available to anyone who needs it, promoting transparency, ease of use, and a broad reach.

Simultaneously, "Wiki.js" offers a wide range of user authentication options to provide flexibility and security for managing the content creation and editing. These available options cater to different needs, from individual setups to large organizations. Given the FirEURisk project's needs, Local Authentication was selected to be used. This approach offers simplicity and ease of management, as it allows users to create accounts directly on the "Wiki.js" platform using a username and password. It's also straightforward and ideal for smaller teams or projects that do not require integration with external authentication services.

6.3 User Interface

The UI of "Wiki.js" stands out for its seamless and intuitive experience, catering to users of all technical backgrounds. The clean, modern design strikes a balance between functionality and aesthetics, enhancing the user experience by making navigation straightforward and content easily accessible. Moreover, its responsive design ensures that the wiki remains functional and visually appealing across a variety of devices, from desktops to smartphones.

The interface includes a main menu that provides quick access to key sections like the dashboards, pages, assets, users, and settings. A collapsable sidebar further aids navigation, displaying the site structure in a clear, hierarchical format. This format helps users quickly understand the organization of content and access various sections with ease. Moreover, the prominent search bar at the top of the interface makes it easy to find pages, assets, and other content, with options to customize the search engine in order to include or exclude specific types of content.

The platform is designed to be multilingual, supporting multiple languages directly from the interface. Administrators can manage language packs and translations, making "Wiki.js" ideal for global teams and organizations operating in various languages. Furthermore, accessibility is a core consideration in the UI design of "Wiki.js", with features like keyboard navigation, screen reader compatibility, and high-contrast themes to ensure the platform is usable for all individuals, including those with disabilities.

6.3.1 UI elements

In this section, the main UI elements of FirEURisk WIKI (Figure 12) are laid out, focusing on those that support the users in interacting with it, and the editors provided to create and edit pages. By analysing these, users will gain a comprehensive understanding of how the WIKI is structured and how to effectively interact with its various features.

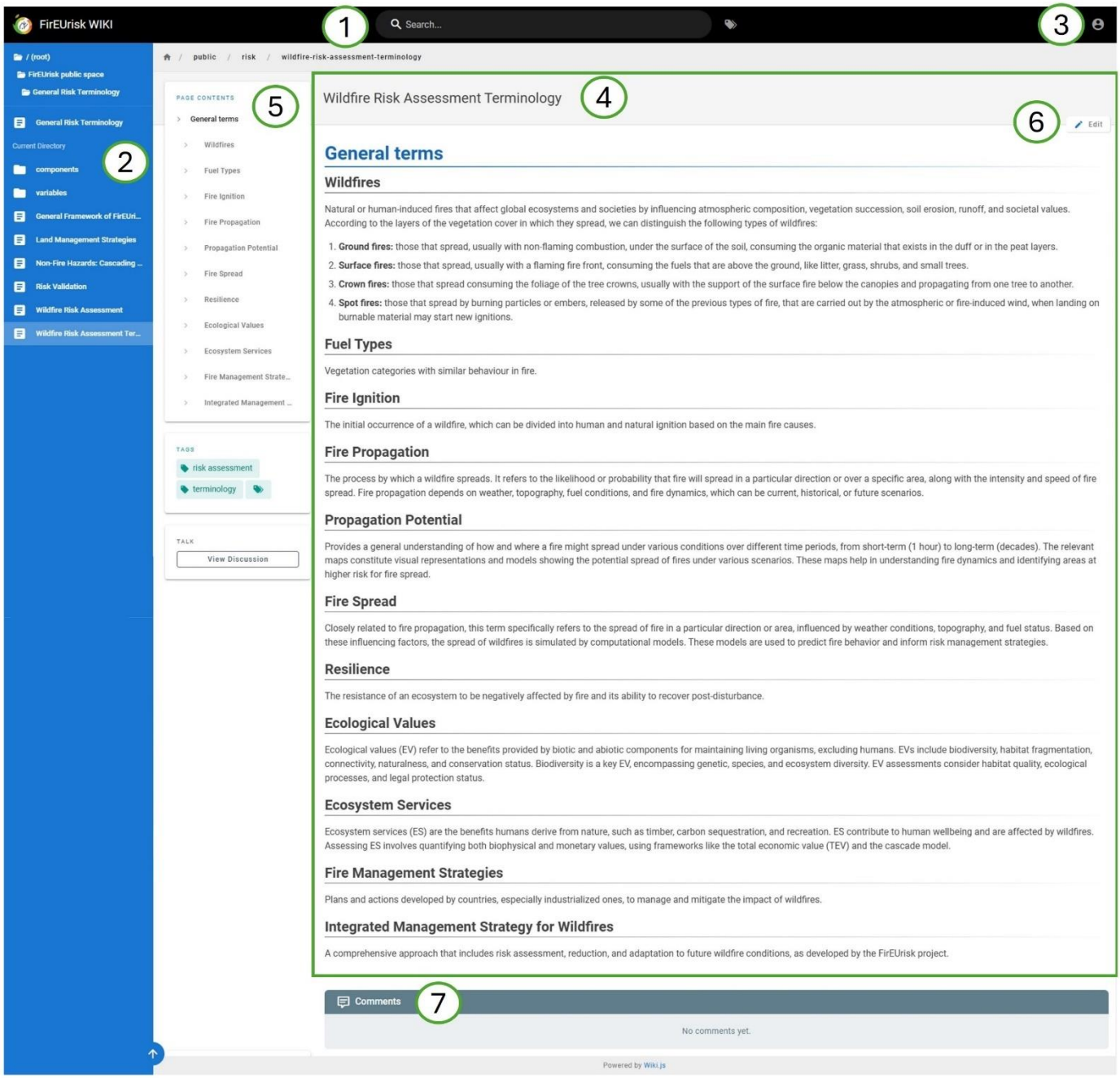


Figure 12: Overview of main UI elements of FirEUrisk WIKI

6.3.1.1 Global UI elements

The section of global UI elements provides an overview of the interface components that are consistent across the entire WIKI platform. This includes navigation menus, search functionality, and other elements that offer unified user

experience and facilitate easy access to various parts of the WIKI. In the figure above (**Erro! A origem da referência não foi encontrada.**), the main global UI elements are presented as follows:

1. Global Search bar, which is the widget used for searching the information that is uploaded on the WIKI.
2. Global Navigation, which provides links to the pages that the user can access.
3. "Login" button, which enables an authorized user to log-in or an unauthorized user to create an account (sign-up); after user log-in, it provides access to a menu regarding the logged user profile and logout option. Additionally, after log-in, the "New Page" button  is visible to the user, which triggers the new page creation dialog.

6.3.1.2 Page-specific UI elements

The section of page-specific UI elements delves into the components used for presenting or performing actions on individual pages within the WIKI. This includes features such as content formatting tools, page navigation links, and interactive elements tailored to the context of each specific page. In the figure above (Figure 12), the main page-specific UI elements are presented as follows:

4. The actual page, presented in the largest part of the screen.
5. "Page contents" box, which presents as a list the different sections of the page, based on direct links to level-2 headers in the document.
6. "Edit" button, which enables an (authorized) user to edit the current page.
7. "Comments" box, which can be used by the (authorized) users to exchange messages regarding the page content.

It is worth noting that after user log-in, two more page-specific elements become available:

- "Page Actions" button  , which presents a menu with feasible actions that the user may perform to interact with the current page.
- Quick menu button  , which provides feasible page actions on the bottom of the page through a quick menu.

6.3.2 Editors

"Wiki.js" offers robust support for multiple editors, allowing users to choose from various content editing tools based on their needs and preferences. This flexibility is designed to accommodate different styles of content creation and editing, ensuring that users can work in an environment that best suits their workflow.

The editors are available to the authorized users (with a user account), and are the following:

- **Markdown editor**: It provides a straightforward way to format text using Markdown syntax (Figure 13). This editor is ideal for users who prefer a lightweight and more hands-on approach to create content, particularly for those comfortable with the specific syntax. The live preview pane shows directly the content editing result, enabling the users to see changes in real time.

- **Visual editor**: For those who prefer a more graphical interface, this editor offers a “What You See Is What You Get” experience. Based on a rich set of tools for text styling, media embedding, and layout adjustments, this editor allows users to create and edit content visually, without needing to understand or write code.
- **Raw HTML editor**: For users who need fine-grained control over content formatting, “Wiki.js” includes a HyperText Markup Language (HTML) editor. This editor allows for direct manipulation of HTML code, offering advanced users the ability to create and edit content with precise control over the structure and presentation. The HTML editor is particularly useful for integrating complex elements and custom designs that go beyond standard Markdown or Visual editing capabilities.

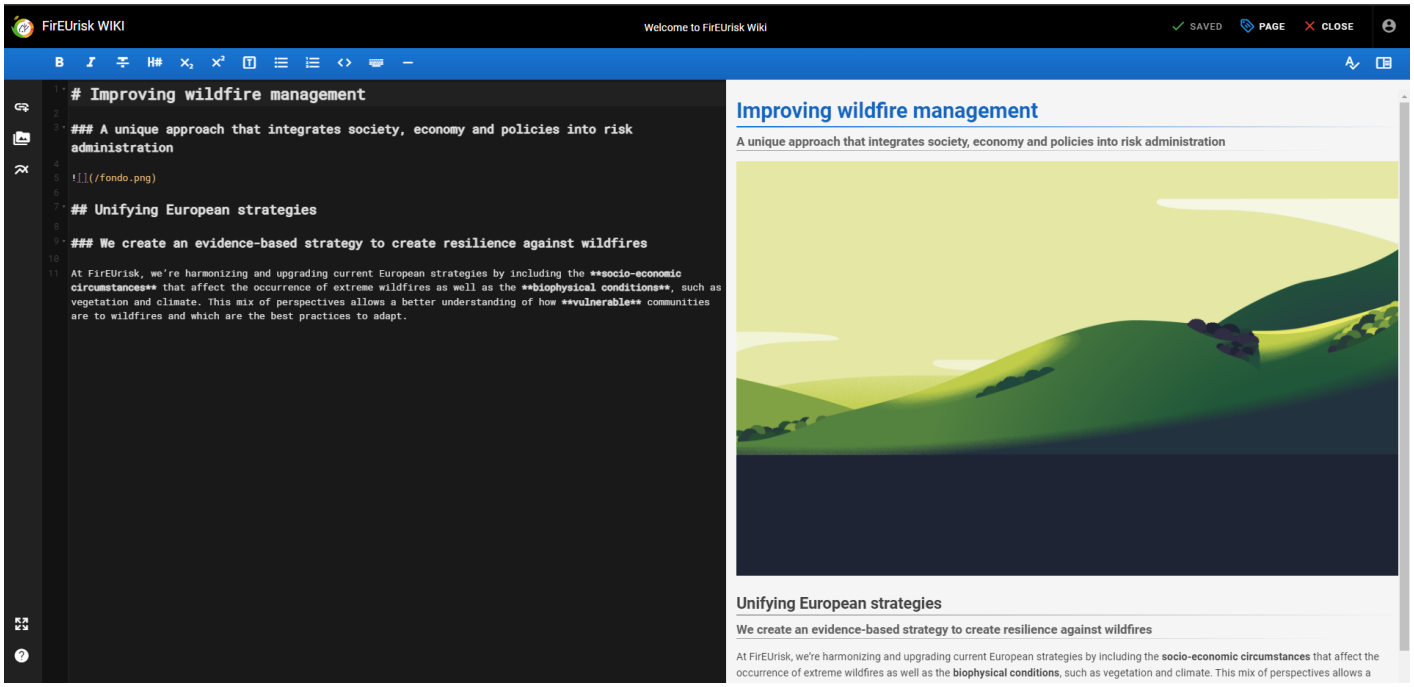


Figure 13: Overview of Markdown page editor

For each page, the (authorized) user can choose to convert it into any of the provided editors. This operation can be performed through the “Page Actions” or quick menu button (see above, Section 6.3.1.2), by selecting the “Convert” option; when pressed, a dialog appears letting the user select the editor to be used.

6.3.3 Media assets

All editors have a button to open the “Insert Assets” dialog (Figure 14). The assets can be of any file type, such as images, documents, compressed files (.zip), etc. Images will automatically be displayed as images, while other file types will simply display a standard link.

In order to upload new assets, the “Upload Assets” box (located on the upper right part, as shown in Figure 14) is used. In this box, the user can either press the “Browse...” button (or click on the grey area just below) or drag-n-drop files onto the grey area directly. Once ready, the “Upload” button should be pressed to initiate the upload for all files.

Using an asset that is already uploaded is straightforward. The user has just to select the asset he/she wants to insert, and then press the “Insert” button. When inserting an image, the user can also set a specific alignment using the “Image Alignment” dropdown menu (located on the bottom right part, as shown in Figure 14). Depending on the editor used, there is a set of actions that the user may perform to configure how an asset is presented in the page.

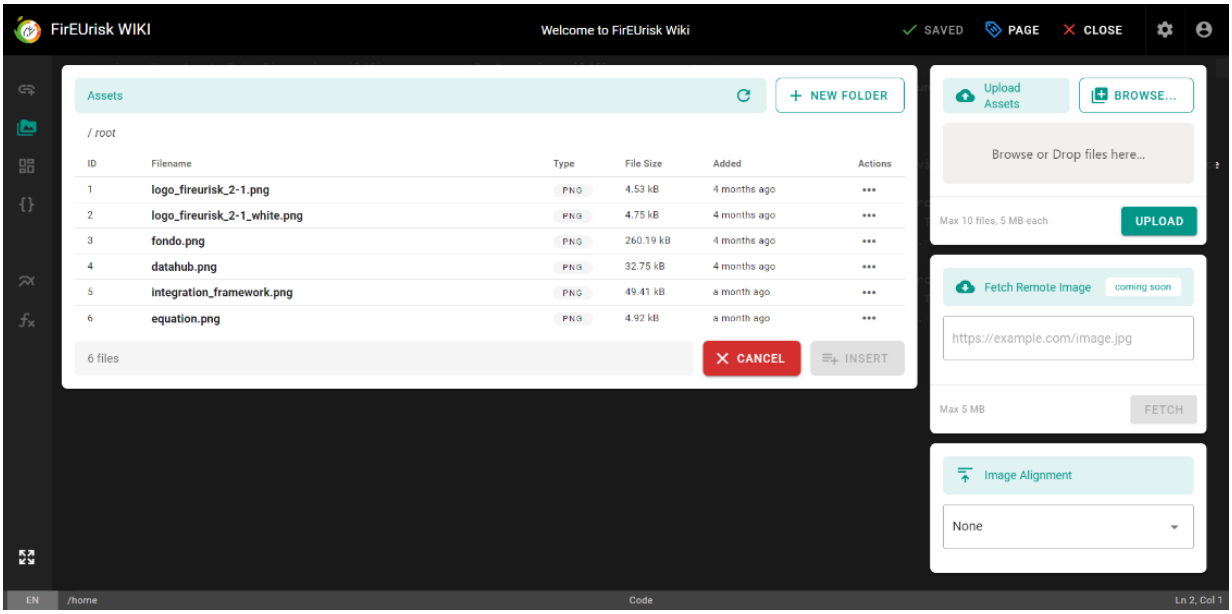


Figure 14: Overview of “Insert Assets” dialog

6.3.4 Folder structure

“Wiki.js” does not follow a traditional folder structure. There is no need to create folders for adding new pages within them; instead, pages are created at the desired path. For example, to create a page at the path “/fire/fuels/vegetation”, there is no need to manually create the “fire” and “fuels” folders, as they are automatically inferred. This method provides more flexibility and reduces dependencies between pages. However, a traditional folder system can still be used when creating or moving pages. The main difference is that folders do not need to be managed manually, as they are automatically generated based on the page paths.

When setting up multi-level pages, it is helpful to create a landing page for each virtual folder. For instance, if there is a page at the path “/fire/wildfire-behaviour”, it is beneficial to also create a page at “/fire”. This ensures that when someone clicks the “fire” breadcrumb link on the “/fire/wildfire-behaviour” page, they are directed to the “/fire” page.

If the site tree navigation mode (or custom navigation) is used, the title for each level in the navigation is derived from the title of its corresponding page; for example, creating the following pages:

- A page at the path “/fire” with the title “Fire Types”.
- A page at the path “/fire/fuels” with the title “Wildfire Fuels”.
- A page at the path “/fire/fuels/vegetation” with the title “Vegetation”.

In this case, the user would create a site tree with the entries shown in the figure below (Figure 15).

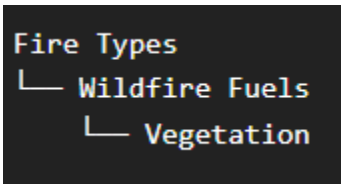


Figure 15: Site tree folder and page structure

7 Conclusions

The FirEURisk Open platform represents a significant outcome of the FirEURisk project. Throughout the development of the platform, several key achievements have been realized, each contributing to the project's overarching goal of improving wildfire risk assessment, mitigation, and adaptation strategies. These key achievements can be pointed out as follows:

Comprehensive Data Integration

The Open platform successfully integrates diverse datasets, including static and dynamic, time-sensitive geospatial data layers, allowing for a multifaceted analysis of wildfire risks. By systematically organizing data in the DataHUB with a hierarchical structure and standardized formats, the platform ensures that users can access high-quality, consistent information. The inclusion of both static and dynamic datasets supports long-term planning and near-real-time decision-making, addressing the needs of various stakeholders, such as policymakers, emergency services and researchers.

Modular and Scalable Architecture

The platform’s architecture is built on a modular framework that enables seamless data ingestion, processing, and visualization. This flexibility supports the integration of new datasets, models, and tools, making the system adaptable to evolving wildfire risk scenarios and technological advancements. The platform's interoperability with external systems, such as other European data repositories, further extends its capabilities and ensures its utility in broader risk management efforts across Europe.

Enhanced Data Accessibility and Visualization

Through the combination of the DataHUB repository and the Unified Viewer, the platform facilitates easy access to data and provides powerful visualization tools. The Viewer allows users to interactively explore geospatial data, overlay various thematic layers, and visualize time-series data, enhancing the understanding of complex wildfire risk factors. The platform’s compliance with the DMP ensures that data are shared openly and transparently, adhering to FAIR (Findable, Accessible, Interoperable, Reusable) principles.

Support for a Holistic Risk Management Approach

The platform is designed to support the full cycle of wildfire risk management, from risk assessment and mitigation to adaptation planning. By integrating data from WP1-3, the platform provides a comprehensive framework that aligns with the project's holistic strategy for addressing wildfire risks. The platform’s ability to incorporate various risk modelling outputs, such as the integrated risk index, fireline intensity, and ignition probabilities, empowers stakeholders to make informed decisions based on scientifically validated data.

Promotion of Knowledge Sharing and Stakeholder Engagement

The deployment of the FirEURisk WIKI as part of the platform has fostered an environment of collaborative knowledge sharing, where stakeholders can access, contribute to, and expand on information related to wildfire risk management. The selected open-source framework, which the design of WIKI was based on, ensures accessibility and encourages continuous community engagement, which is essential for improving wildfire management practices and policies.

While the platform has achieved significant milestones, certain **challenges remain for future development**. These include addressing data quality variations across different scales/regions, ensuring the continuous updating of dynamic datasets, and further refining the integration of diverse data sources to enhance the accuracy of risk assessments. Future development efforts should focus on expanding the platform's capabilities, including the incorporation of additional datasets and advanced modelling techniques, as well as improving user experience based on stakeholder feedback.

8 References

[1] D4.2: Data Management Plan. FirEURisk project – 101003890

[2] D4.3: Internal cooperative platform of models, data and knowledge. FirEURisk project – 101003890

[3] D4.7: Implementation of prototype datasets and services with existing and future systems. FirEURisk project – 101003890

[4] GeoServer. https://geoserver.org/ (accessed 18/09/2024)