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Transboundary Storm Risk and Impact Assessment in Alpine Regions

DELIVERABLE D5.1
OPEN WEB-GIS MAPPING PLATFORM

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Main changes compared to previous version	Page(s)
First official version (11/05/2021)	

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1 INTRODUCTION

In order to visualise, explore and share the geospatial information and documents collected and developed within the framework of the project, it has been decided to exploit a combination of an SDI (Spatial Data Infrastructure) and a standard website. The purpose of the SDI is to store the underlying data and the accompanying metadata in accordance with the F.A.I.R. principles outlined in the Data Management Plan (see also deliverable D4.1), and to allow for synchronised ingestion, processing and sharing of geoinformation throughout the project duration. In order to accomplish these tasks, we exploited an already existing EURAC SDI platform (https://maps.eurac.edu), which has been specifically tailored to the TRANS-ALP Project.
An external website has been also developed, based on a standard and lightweight CMS (Content Management System) platform, and associated to the domain name *https://project-TRANS-ALP.eu*.
Both the SDI platform and the website can be accessed separately and independently, however the website is designed to use the interactive Web-GIS features of the SDI platform in order to provide a more user-friendly access and interaction to selected, public geospatial content (in forms of raster and vector data webmaps). This also allows to shape some of the content of the planned deliverables to be presented also in a story-telling (story maps), narrative context.
In the next sections the architecture of the TRANS-ALP-specific SDI platform and its capabilities will be outlined, and the data-access and data-publication processes will be described. Finally, an example of linking between the TRANS-ALP website and the SDI platform will be provided.

2 SYSTEM ARCHITECTURE

The whole infrastructure is layered into separate tiers and components, allowing access to the data to multiple types of clients: from the simple visualisation and embedding of maps in a browser, to connectors for actual data access and processing on a client remote application (see Figure 1).
On the backend side, a database server hosts a geo-enabled DBMS (Database Management System) where all spatial datasets of both vectorial and raster nature, are stored. This system relies on the *PostgreSQL* system, extended with geospatial support through the *PostGIS* extension. The spatial database is embedded as a data store in a separate application server where a *GeoServer* instance is installed: all datasets are here published as spatial layers that can be publicly accessed and viewed through the usual OGC (Open Geospatial Consortium) standards. Data caching, image mosaicing and time composition are among the high-level features that are also offered by this server.
The ultimate front-end of this infrastructure is deployed through a public website[1] based on the *Geonode* framework and CMS, which wraps the underlying *GeoServer* installation and lets users easily browse the catalogue of spatial data, view them on a map, and even create own customised maps with arbitrary styles and widgets that can be embedded in any web page.
A final and fundamental component is represented by a separate application server which harvests the data and metadata of the *Geonode* catalogue — and other catalogues within the EURAC network —, and makes them available to other federated external catalogues, most

[1] https://maps.eurac.edu/

notably the GEOSS Portal[2]. This way the *Geonode* portal turns from a data silo to an interconnected and interoperable source of spatial data.
The *GeoNetwork* web application is deployed for this, and in addition to the underlying catalogue functionality based on well-known Web Standards (the OGC CSW Standard above all), it can be publicly consulted through a public web site[3].

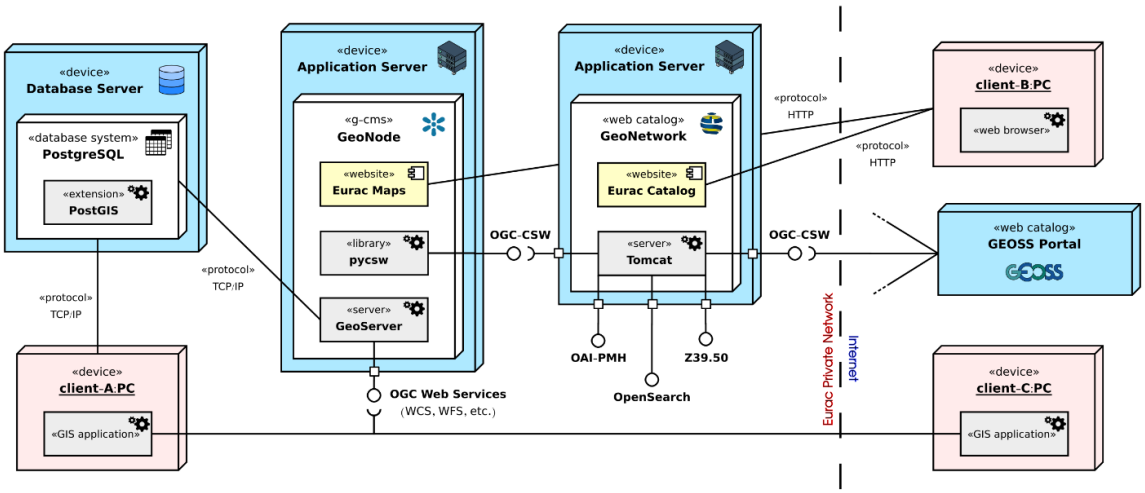

Figure 1 Schema of Spatial Data Infrastructure Deployment (source: EURAC Research)

The proposed architecture is open and standard by design: FOSS (free and open-source software) is used throughout the system, and adherence to well-known Web Standards is ensured throughout and in particular following the OGC standards.

2.1 Data Access

Users from Eurac's private network can be granted access to the PostGIS tables on the database server, hence granting data access and the manipulation capability offered by the spatial DBMS. In *Figure* 2 an exemplification of the process is provided. A user within the EURAC VPN network can add the TRANSALP DB as a data source in its own standalone GIS platform (in this case the free, open source QGIS application) and retrieve one or more geospatial layers for visualization and subsequent processing. Any modification to the layers is made directly in the database, if the user chooses not to make a local copy of the datasets.

[2] https://www.geoportal.org/
[3] http://sdi.eurac.edu/

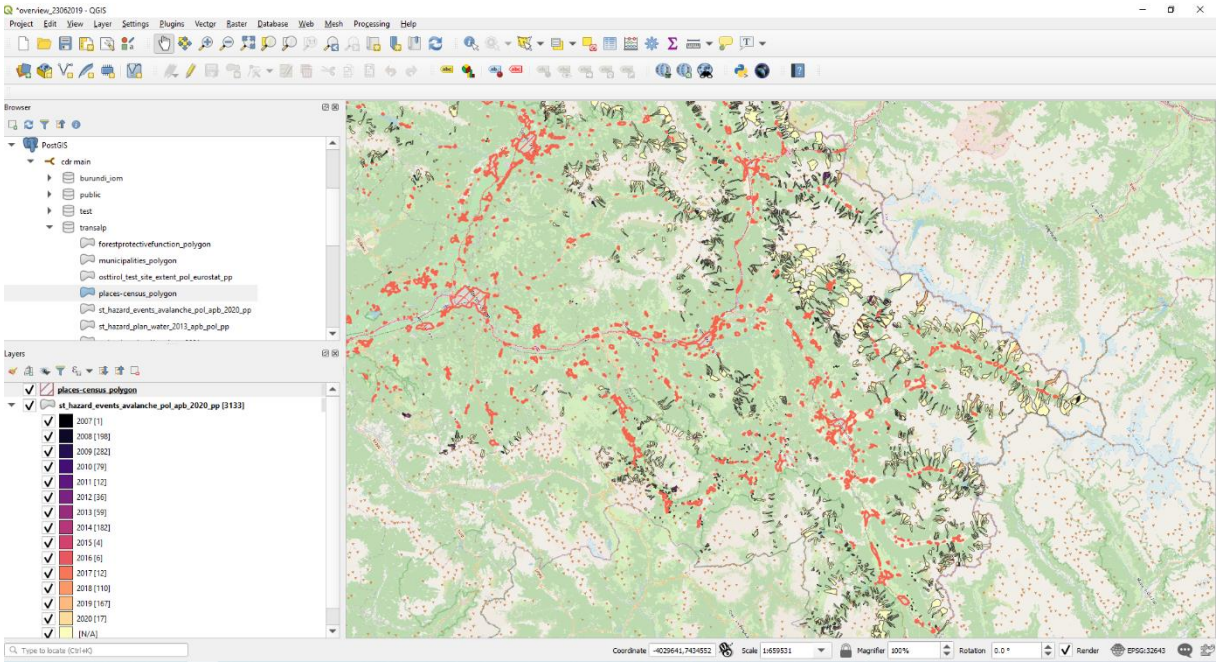

Figure 2 Direct access from QGIS (Quantum GIS) to the TRANSALP PostgreSQL/PostGIS database. Two layers are shown with customized visualization styles (source: EURAC Research).

All datasets can also always be queried and downloaded through the OGC Web Services (WCS, WFS, etc.) offered by the *GeoServer* service endpoint. This way clients — both inside and outside the Eurac network — can write portable and store-independent scripts, relying on internal caching through the *GeoWebCache* component, while also able to reach DBMS-level optimised data pre-processing via *GeoServer* SQL views.
Finally, the SDI offers a very easy-to-use and flexible public web platform for styled visualisation of the data on webmaps through the *Geonode* website: authenticated (and authorised) users can preview the data through a browser, and create visual webmaps with customised styles, background tiles and widget overlays that can be directly referenced and seamlessly embedded from an external web page.

2.2 Data Publication

The publication of a spatial dataset starts with the ingestion of the original data source (usually a shapefile, a geo-referenced raster file, or other common formats) into the spatial database.
The new database table is then published as a new layer in the *GeoServer* instance by means of the REST API offered by the server. The spatial database is already registered as a data source in the *GeoServer* application, but a metadata XML file is required for successful publication with relevant mandatory fields like the layer's title, abstract or geographic boundaries.
The application server hosting the *Geonode* framework periodically executes a synchronisation script between the *Geonode* and the underlying *GeoServer*'s catalogues. Each layer's default and available pool of styles can be configured both through the *GeoServer* REST API, or via the *Geonode* Web Interface.
The dataset is now also automatically available to external federated CSW-compliant catalogues via the *GeoNetwork* server.

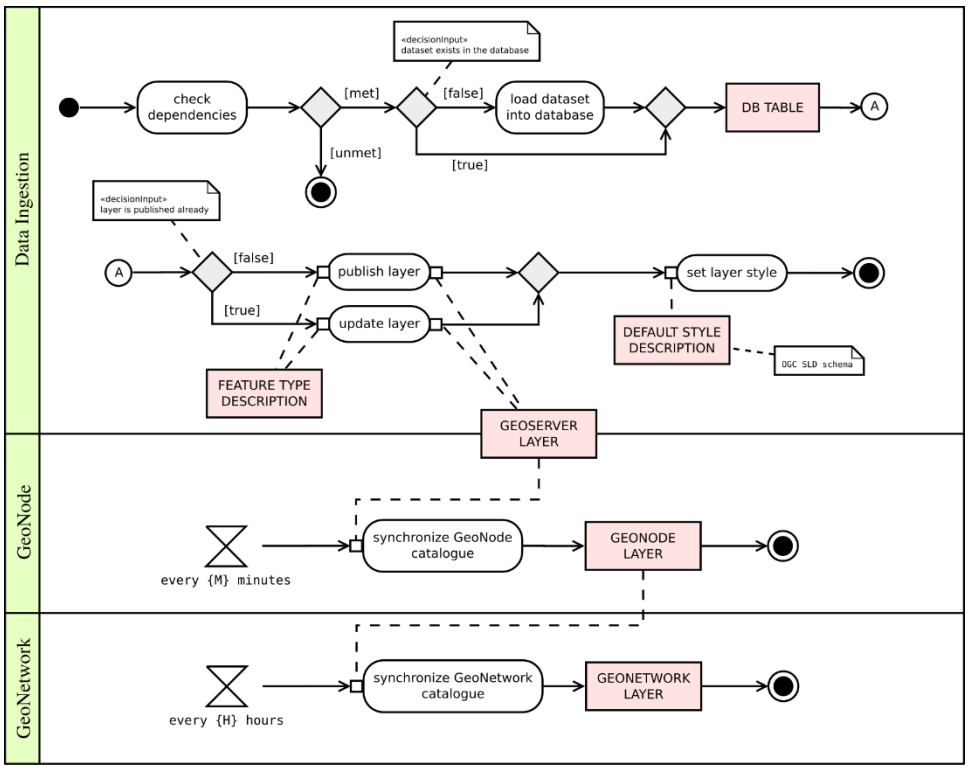

Figure 3 Schema of main data publication process flow (Source: Eurac Research).

3 EXAMPLES

In this section several examples of the interaction and use of the sharing platform are provided. The platform can be accessed either from the public, hence as a not-registered user, or by logging in as a registered user. Although everybody can register, the membership of a particular group (e.g. the TRANS-ALP public and restricted repositories) has to be manually granted by the related administrators.

3.1 TRANS-ALP GROUP

In Figure 4 the TRANS-ALP Public group description is shown. The members of the group and their role in the platform are reported, along with a description of the most recent group activities (useful, e.g., to check which new data and documents have been added to the repository). Different persons from the partners of the TRANS-ALP consortium have been granted administrator privileges in order to share the administration of the group.

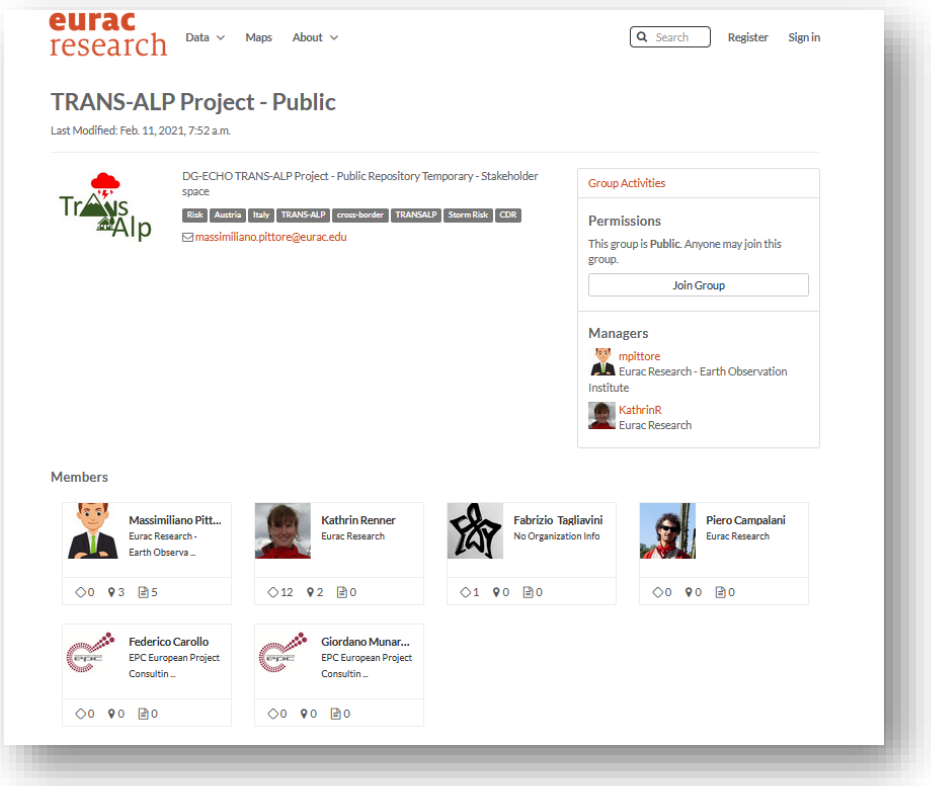

Figure 4: Public TRANS-ALP repository within the Geonode / SDI platform (Source: https://maps.eurac.edu/groups/group/trans-alp-project-public/?limit=20&offset=0, EURAC Research)

Any user that is granted the related permissions can upload, edit, modify and in case delete datasets and documents from the platform (see also the section DATA PUBLICATION). All operations are logged to keep track of the activities.

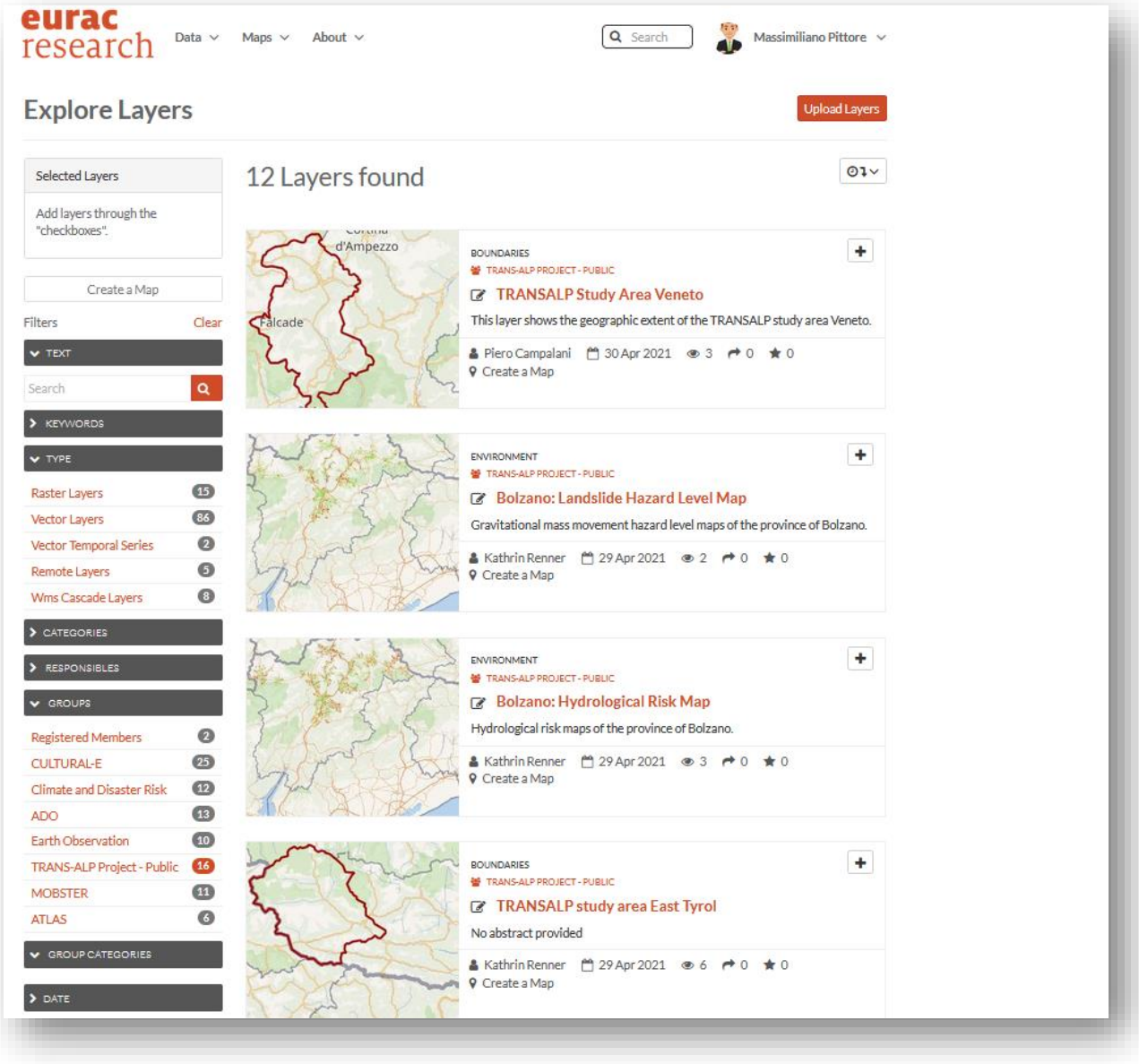

Figure 5: List of vector layers in the TRANS-ALP public repository (Source: https://maps.eurac.edu/layers/?limit=20&offset=0&group__group_profile__slug__in=trans-alp-project-public&type__in=vector, EURAC Research)

3.2 LAYERS

Users can also upload virtual layers referring to resources hosted in an external SDI and available through standard web-services (e.g. using the WFS / WMS protocols). This is useful to cluster and make available for visualisation and processing structured datasets and information already collected by local, national or European stakeholders, avoiding unnecessary duplication of the related data. All layers (vector, raster and external services) are listed[4] and can also be searched using tags or other information included in the metadata (see Figure 5).
Once the layers are uploaded onto the platform, users can enter, modify and visualise all related information, as well as explore the specific features and modify the specific visualisation style (see Figure 6). The web-based GIS interface provides also basic measuring tools.

[4] See here for an updated list of available layers.

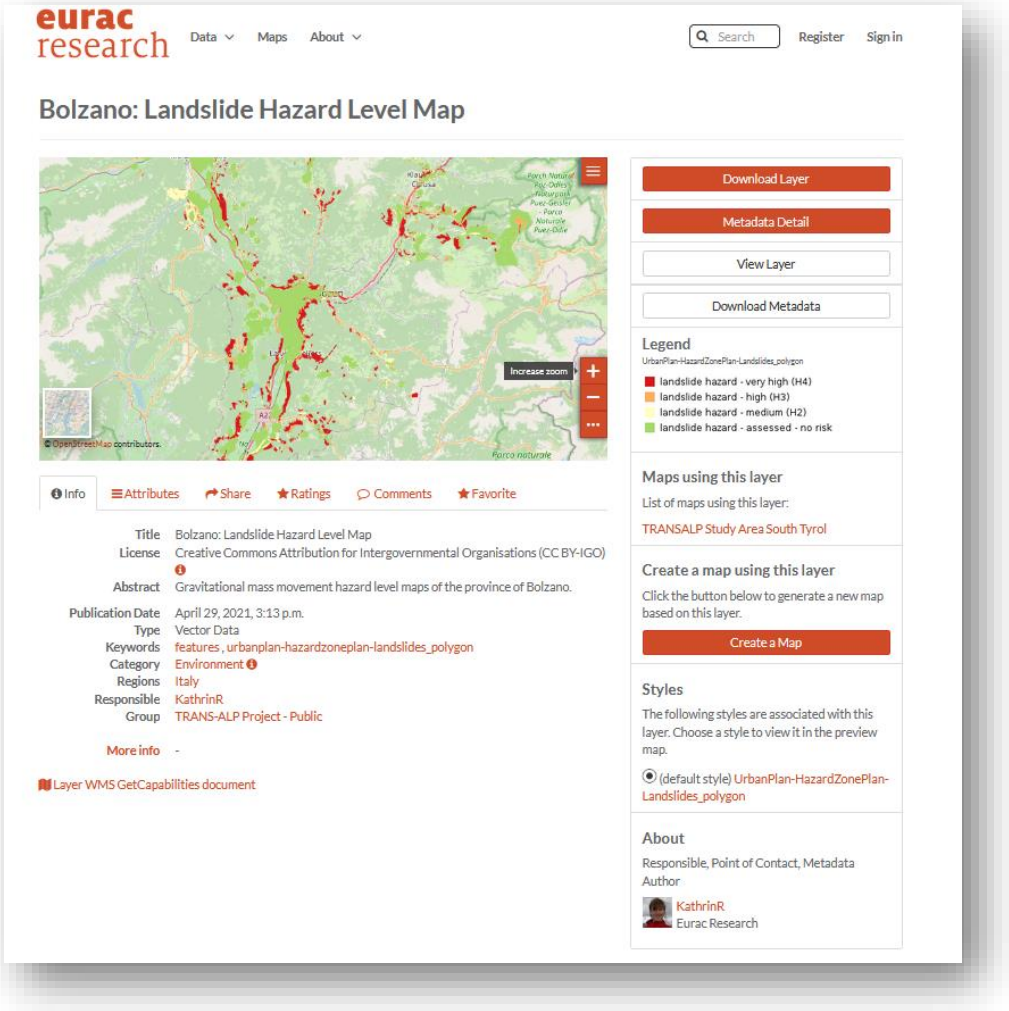

Figure 6 Example of a specific vector layer. The main metadata are shown below the map window. On the right hand side other related information are provided, including the name and contact information of the responsible data manager (Source: https://maps.eurac.edu/layers/eo_cdr_transalp:EO_CDR:urbanplan-hazardzoneplan-landslides_polygon, EURAC Research).

3.3 METADATA ASSIGNMENT

Once a layer has been uploaded and the privileges to edit, visualise, delete, etc. set, the user can start populating the related metadata. This procedure can be carried out using a user-friendly procedure (wizard, see Figure 7) which guides the user through four consecutive steps, each dedicated to one of the following areas:

1. Basic metadata,
2. Location and licenses,
3. Optional,
4. Dataset attributes

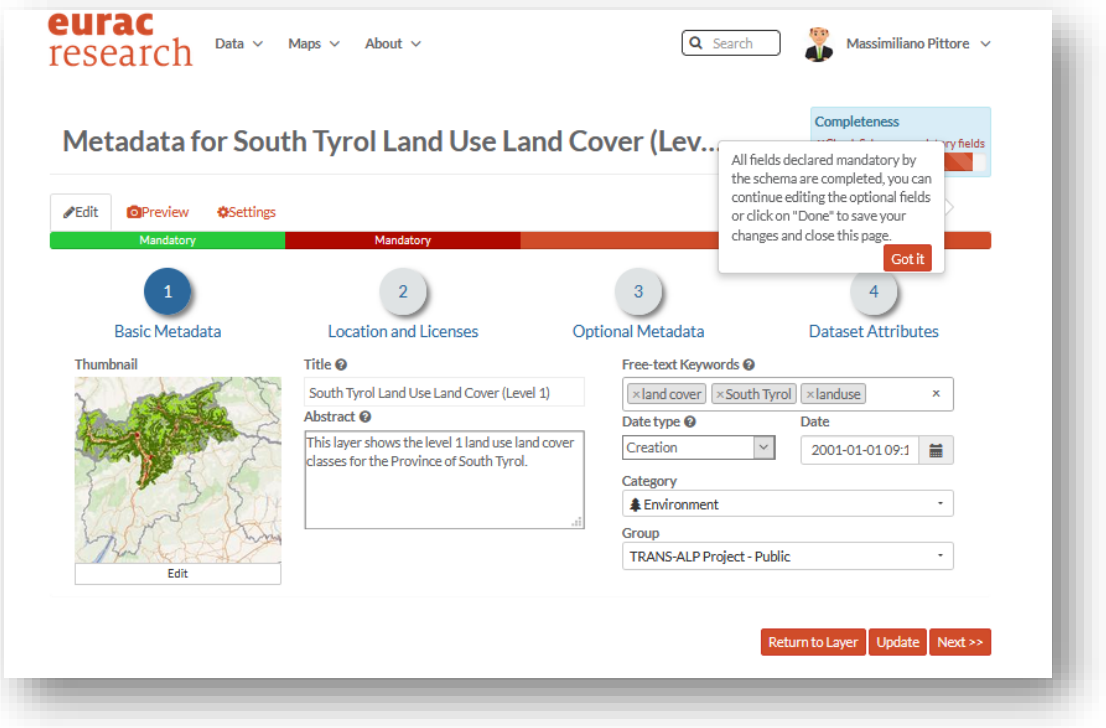

Figure 7: Wizard-based metadata entry section. A four-tier metadata entry is followed. For expert users an advanced metadata editing mode is also available. Metadata for each layer can be exported according to different standard formats (Source: https://maps.eurac.edu/layers/EO_CDR:st_landuse_level1_pol_pp_2001/metadata, EURAC Research).

The procedure is designed to ease up the compilation of metadata, and to spare as much as possible the technical details related to, e.g., the specific employed formats. As an alternative for expert users, a more complete (advanced) interface is available to edit specific metadata features or to follow a different order in the compilation, or to provide further details on the underlying dataset.

3.4 DOCUMENTS

On the same platform, along with the geodata also documents can be uploaded, stored and managed. The documents are managed like the other data items managed by the platform (see, e.g., Figure 8). As such, each document can be assigned a set of metadata, which is useful for instance to track information provided by third parties. Each document (as well as any other data item and compatibly with the permissions set) can be downloaded.

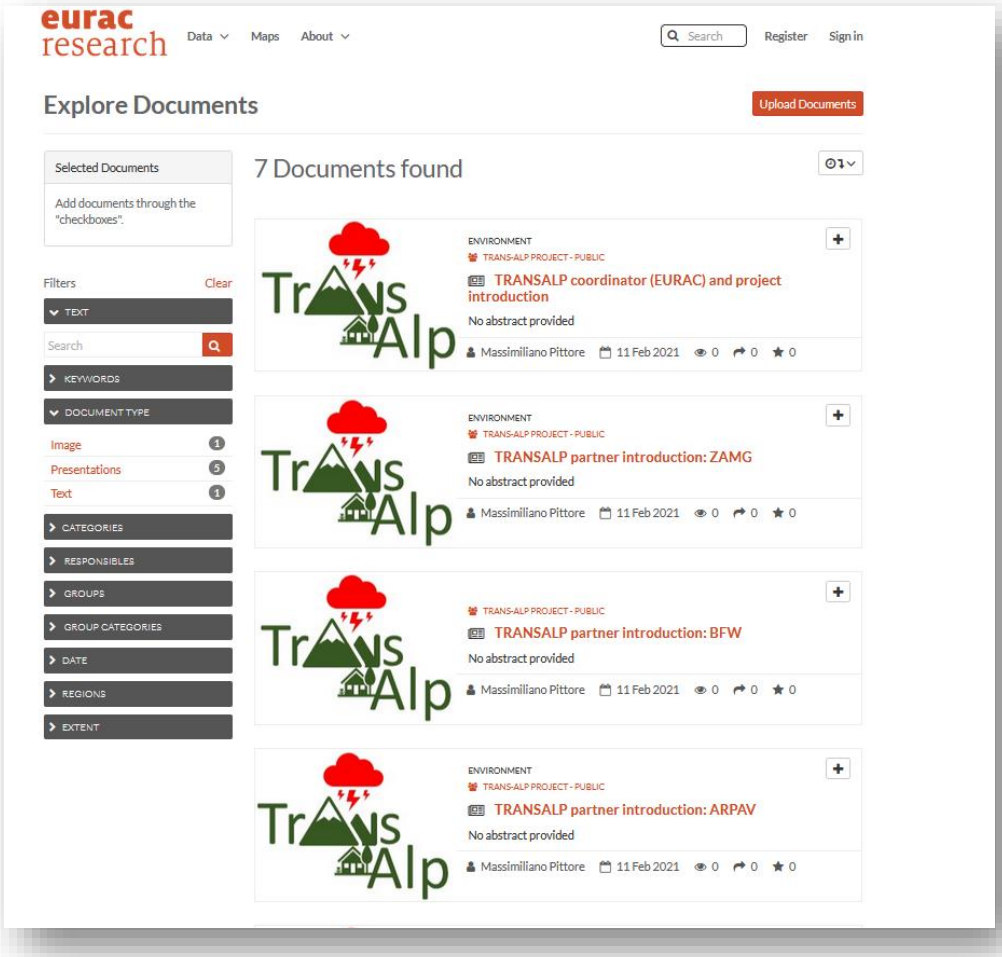

Figure 8: List of documents stored on the platform. Different formats can be managed, including for instance .DOC, .PDF, .PPT, etc. Each document can be assigned a related set of metadata (Source: https://maps.eurac.edu/documents/?limit=20&offset=0&group__group_profile__slug__in=trans-alp-project-public, EURAC Research).

3.5 MAPS

Maps can defined as a collection of geospatial layers which are superimposed with different level of opacity and a given hierarchy. Each layer has its own visualisation style, and collectively the set of layers of such a webmap provide a user-tailord perspective on a given issue. In the TRANS-ALP Geonode platform registered users can generate new webmaps or modify existing ones (according to the permissions granted by the administrators), each webmap therefore providing a specific context view of the information described by the individual layers (see, e.g., Figure 9).
Each map can be assigned a specific set of metadata, independent on the metadata of the underlying layers, hence qualifiying potentially as a new piece of information (see Figure 10).
Each webmap can be recalled and explored interactively using the controls provided by the web platform, in a similar fashion as with a usual GIS system.
Figure 11 provides an overview of the features of the map visualisation in the TRANS-ALP Geonode platform. On the left hand side of the map a layer setting panel allows for the toggling and opacity control of the individual layers, as well as for the visualisation of the feature legend, if present.

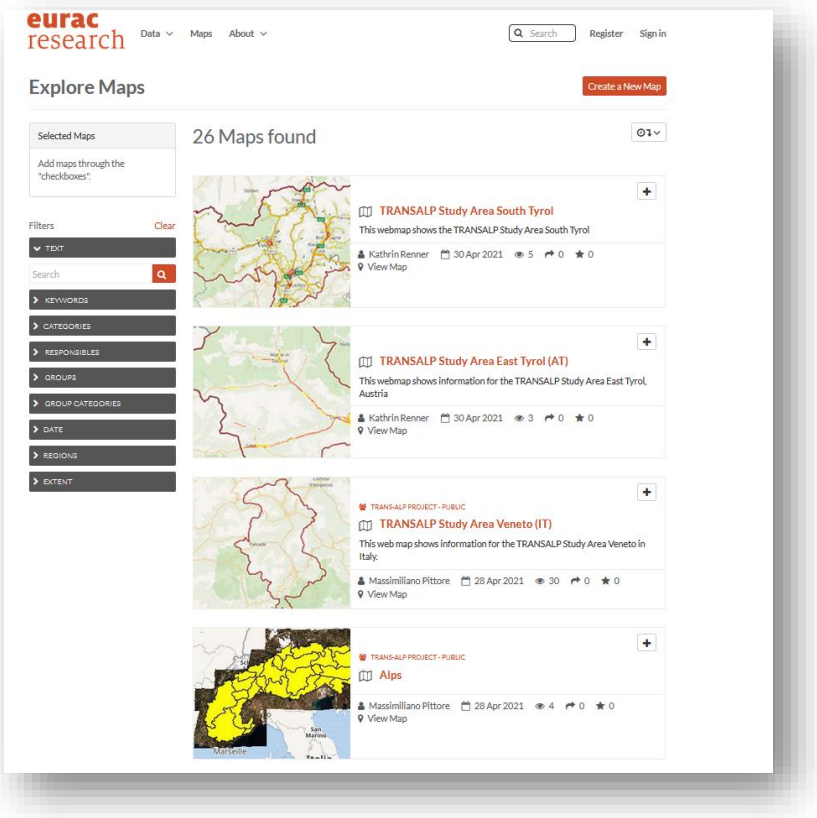

Figure 9: List of webmaps available within the TRANS-ALP repository. Each map includes one or more layers (vector and raster) and can also include layers from external services (Source: https://maps.eurac.edu/maps/?limit=20&offset=0&group__group_profile__slug__in=trans-alp-project-public, EURAC Research).

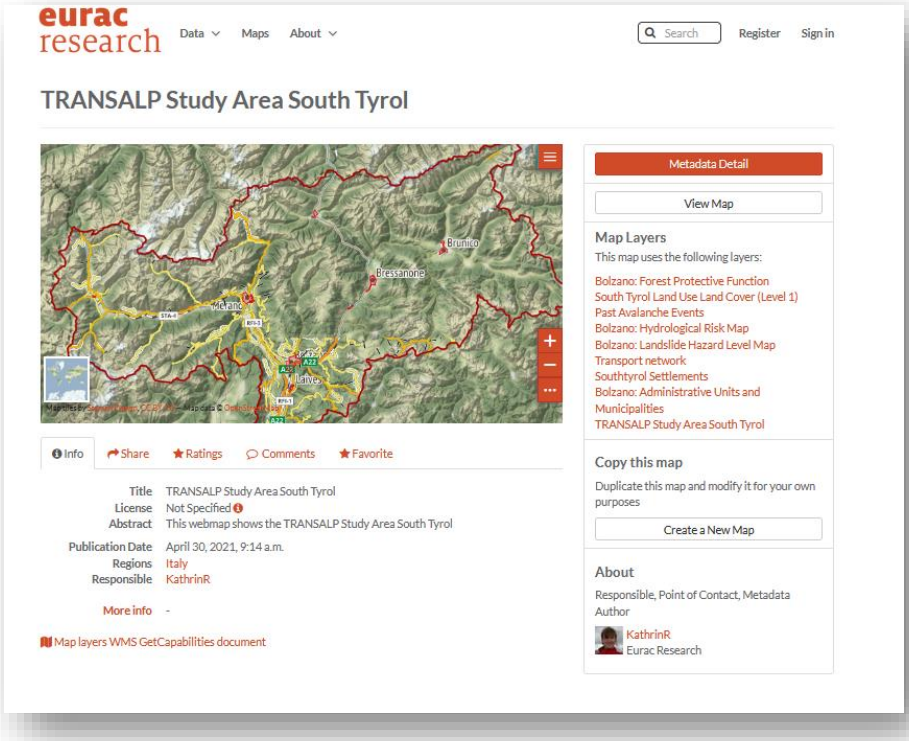

Figure 10: Information about a specific map. On the right hand side, the list of the employed layers is provided (Source: https://maps.eurac.edu/maps/486, EURAC Research).

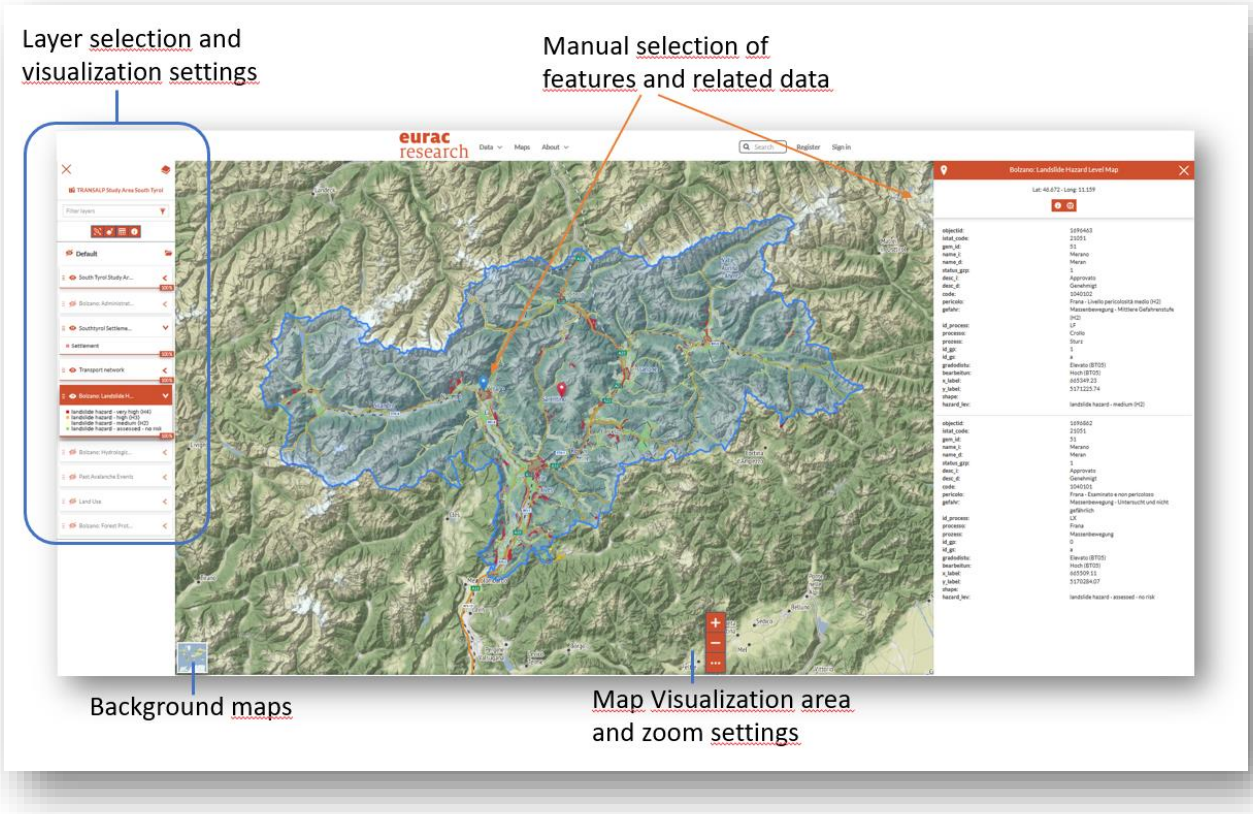

Figure 11: Visualisation and editing of a map. On the left hand side, the controls of the individual layers. If the user selects a layer and clicks on a point in the map, a pop-up window (on the right hand side) shows the information associated with the selected feature (Source: https://maps.eurac.edu/maps/486/edit, EURAC Research).

By clicking on the central active map area, the user can select a specific geospatial feature of the layer currently highlighted, automatically prompting a panel on the right hand side showing the attributes of the selected feature. In case the highlighted layer is of raster type, the value of the raster in correspondance of the selected position in the map will be shown. The right side feature visualisation panel is automatically retrieving and visualising all attributes present in the vector layer in a standard, textual arrangement. Advanced visualisation can be optionally used to generate custom-tailored views based on embedded html code.

4 INTEGRATION IN THE TRANS-ALP WEBSITE

The TRANS-ALP SDI and Geonode platform can be efficiently employed as a collaborative data and information sharing tool, as described in the preceding sections. The platform is flexible and has several desirable features to foster sustainable and consistent data management practices.

Alongside with the use of the platform as a stand-alone tool, the webmap components can also be accessed independently from an external platform or embedded into a web-page.

This provides a viable solution to develop user-tailored narratives around geospatial data, for instance by interleaving text, static images, tables and interactive webmaps on a single page.

An example is shown in Figure 12.

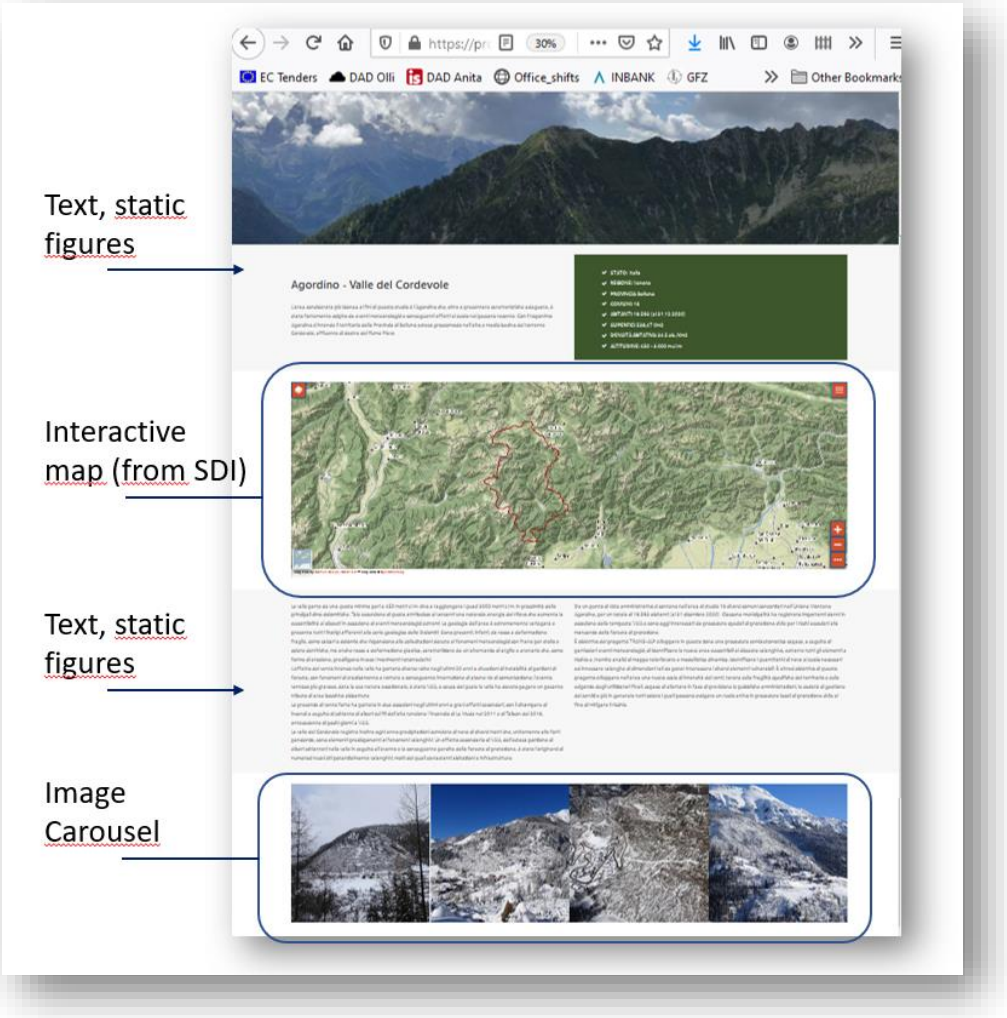

Figure 12: Example of integrating TRANS-ALP webmaps as interactive components into the TRANS-ALP website (Source: https://project-transalp.eu/sitipilota/agordino-valle-del-cordevole/, EURAC Research, EPC Srl).

On this web page of the TRANS-ALP web site several elements are integrated, allowing the external user (for instance the general public) to be exposed in a selective way to different type of multimedia content.

5 OUTLOOK AND NEXT STEPS

The current system´s architecture allows for a simple and flexible and consistent management and sharing of geospatial data and documents. The integration of web-GIS capability within different communication and dissemination framework is key to leverage the already existing data items, often fragmented and dispersed across different partners and the local stakeholders.

Such technological platform will further evolve within the TRANS-ALP project, and the envisaged next steps include:

- The seamless integration of static and dynamic datasets, therefore including the explicit consideration of time and the capability of visualize time-dependent information, possibly for both vector and raster data;
- The integration of *descriptive (and prescriptive) data analytics*[5] components in the platform, in order to enrich the interactive visualization and understanding of the collected datasets. This can be obtained through, e.g., tailored dashboards;
- The integration of automated processing components implementing specific risk assessment and impact forecasting tasks to exemplify the conceptual framework for storm risk assessment to be developed within the project;

[5] See, e.g., this page