

Tutorial Smart Altitude WebGIS

What is the Smart Altitude WebGIS and how can it be used?

Practical overview of the Smart Altitude WebGIS possibilities on the basis of examples

Version 1.0

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1 INTRODUCTION

This tutorial gives you a detailed overview of how to use the Smart Altitude WebGIS and presents all the functions through various examples.

1.1 Purpose of this tutorial

In this tutorial you will learn and find answers on the following questions:

- How do I use the Smart Altitude WebGIS and its data sets?
- Where do I find metadata information of all integrated data?
- How do I use and interpret the project-specific datasets on Renewable Energy Potential and the Key Performance Indicators (KPIs)?
- How can the Smart Altitude WebGIS help me with spatial planning?
- How do I create online maps?
- How do I download project specific data as csv?

1.2 What is a WebGIS?

A WebGIS is a web-based Geographic Information System. It has selected GIS functionalities and can be easily accessed through the internet (Bartoschek, 2009). Painho et al (2001) define a WebGIS as “A complex system with access to the Internet, for capturing, storing, integrating, manipulating, analyzing and displaying data related to locations without the need of having proprietary GIS software.” In every WebGIS you can visualize the individual integrated spatial data; that is any kind of attribute data that is referenced by geographic coordinates or location (Curran, 1984). The aim of the providers of a WebGIS is to disseminate specific, often thematic information, about selected areas of the earth (Dueker & Kjerne 1989) in order to make the analysis of spatio-temporal phenomena/geodata and their relations possible (Goodchild, 2009). Advantages of a WebGIS are that a large number of people can use a specific WebGIS at the same time and that there is no need for proprietary GIS software (Painho et al., 2001), local storage capacity, and professional knowledge. It only requires a web browser. The best known example of a WebGIS is probably Google Maps.

1.3 The objectives of the Smart Altitude WebGIS

The Smart Altitude WebGIS is an interactive and easy-to-use tool, which is developed by the Institute of Interdisciplinary Mountain Research (Austrian Academy of Sciences) within the Smart Altitude project (see <https://www.alpine-space.eu/projects/smart-altitude/en/home>). **The Smart Altitude project aims to enable and accelerate the implementation of low-carbon policies in winter tourism regions in the Alpine Space.** The focus of the Smart Altitude WebGIS is to present/visualize the four Living Labs as tests regions and their Key Performance Indicators (KPI), which are derived by energy, environmental and management datasets and processed using the Smart Altitude Wi-EMT audit tool (see <https://smartaltitude.eu/tools/audit/>). Furthermore, spatial data on renewable energy potential (wind, solar, etc.) and ski resorts specific data (types and length of pistes, etc.) are presented. The

spatial extent of the WebGIS is the Alpine Space (see the green line/frame on the start page of the Smart Altitude WebGIS on <http://webgis.smartaltitude.eu/>). **The purpose of the Smart Altitude project is to develop a web-based GIS application to visualize territorial assets, untapped renewable energy potential and Key Performance Indicators for the living labs and potential replication sites.** The Smart Altitude WebGIS makes the spatial project data results available to the stakeholders and the public, which can be further processed (see also <https://www.alpine-space.eu/projects/smart-altitude/en/project-results/measuring-visualizing-performance/webgis>). In addition, the WebGIS architecture allows users to access the spatial data directly through the desktop GIS applications like QGIS or ESRI ArcPro utilising OGC's WMS/WFS/WMTS standards.

Why does the Smart Altitude project use a WebGIS?

Because it is the easiest and cheapest way to publish spatial data results to a broad audience. It can be used as planning tool concerning renewable energy potential in the context of ski resorts. Users can display these datasets online, create maps, and print them. They can inform themselves about individual renewable energy potential in a specific municipality or region within the Alpine Space. Users can also compare the different Key Performance Indicators (KPI) of the four test regions, which are called Living Labs. This can be useful in contacting the best Living Lab on a particular topic of interest and discussing how to implement improvements. Spatial data of ski resorts are also available. The Smart Altitude WebGIS is available in the five project languages (EN, DE, FR, IT and SL). This guarantees that the application is understandable to the majority of people in the Alpine Space.

The Smart Altitude WebGIS is linked to the Alpine knowledge platform WIKIAlps (www.wikialps.eu), where you can find important information about the project itself. It serves as a look-up tool for questions that might arise when working with the Smart Altitude WebGIS. Especially relevant are the detailed information about the metadata of all datasets and for the interpretation of the KPIs. (See http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:geodata_sources_of_smart_altitude_webgis.pdf)

The Smart Altitude WebGIS is part of the online toolkit of the Smart Altitude project. Stakeholders can find in the **Smart Altitude Toolkit** a set of tools for planning, optimizing and implementing low-carbon measures in Alpine ski areas. The focus of the toolkit is on energy efficiency, renewable energy, sustainable mobility, energy management, smart grid and climate adaptation. (See <https://smartaltitude.eu/>). Additionally, five **Smart Altitude Webinars** are offered which share best practices and tools for implementing low-carbon measures in Alpine ski areas (See <https://smartaltitude.eu/tools/plan/>).

1.4 Smart Altitude WebGIS – Facts and functions

The Smart Altitude WebGIS...

- presents Renewable Energy Potential datasets and ski resorts related datasets for the whole Alpine Space
- makes Key Performance Indicators (KPI) for four Living Labs visible

- is a useful spatial planning tool
- is one tool within the Smart Altitude project (also Toolkit and Webinars)
- has pre-generated styled project results and background data
- offers the possibility to perform your own calculations and generate maps based on the provided datasets
- is interactive and user-friendly
- has a responsive and up-to-date web design
- is multilingual (DE, EN, FR, IT, SL)
- is linked to WIKIAlps – useful for looking up metadata information
- only requires internet connection and a web browser
- is based on open-source WebGIS architecture
- uses open web standards (OGC WMS, WMTS, WFS)
- is provided by IGF/ÖAW

General idea behind Smart Altitude WebGIS - Users can...

- analyse their region of interest regarding renewable energy Potential
- create their own renewable energy and ski resorts related maps online
- use the tools from the Smart Altitude project for planning strategies
- save and print the results as individual generated maps (pdf)
- find metadata information for the correct interpretation of the offered datasets and especially for the Key Performance Indicators

Detailed functions of the Smart Altitude WebGIS - Users can...

- choose their language
- select and activate layers of interest
- zoom in and out
- shift to an area of interest
- search and zoom to a specific municipality or ski resort for the whole Alpine Space through a search window
- access layer legend and metadata information
- query feature information of specific selected areas
- get coordinates from a specific location
- calculate and create own layers based on the offered datasets

- change background map
- change layer's transparency
- change layer's order
- create and print maps (as pdf)
- possibility for download of some datasets
- save the results through personalised view in the web browser
- display spatial layers in their desktop GIS packages (QGIS, ESRI ArcPro, ..)

1.5 Which datasets are available

Following datasets are available in the Smart Altitude WebGIS. Here a short description is given. More detailed explanations can be found on WIKIAlps (see http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:geodata_sources_of_smart_altitude_webgis.pdf)

Content Tree	Dataset	Short description	Format/ Type/ Date
Ski Resorts -> Key Performance Indicators (KPI)	Ski resorts KPIs are measurable values that demonstrates how effectively the ski resort is achieving key business objectives. Unit: 1-5 as weighted average of scores regarding following parameters: For more information see http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:smart-altitude_wi-emt_evaluation-report_final_xxx.pdf .		Polygons, only for four Living Labs in the Alpine Space
	Overall Ski-Resort KPI (OV)	This value is designed as average of scores from the 8 following KPIs.	
	Energy Efficiency (E_EF)		
	Energy Economy (E_EC)		
	Sustainability (S)		
	Energy Management (EM)		
	Smart Grid (SG)		
	Adaptation to Climate Change (ACC)		
	Self Evaluation (SE)		
	Future Outlook (FO)		
Ski Resorts -> Open Ski Map	Through the Open Ski Map ski related datasets can be found, which are implemented in the Smart Altitude WebGIS.		Downloaded 09.08.2019
	Pistes		Line Vectors
	Aerialways		Line Vectors
	Ski Resorts		Polygons
	Pistes length per LAU		Polygons

Content Tree	Dataset	Short description	Format/ Type/ Date
	Pistes length per resort		Polygons
Ski Resorts -> Smart Altitude Study Sites	The WebGIS offers different border layers concerning the Alpine Space.		Polygons
	Alpine Space Area		
	Alpine Convention Area		
	Smart Altitude – Case Study Areas (Ski Resort LAU Communities)		
Renewable Energy Potential -> Solar -> Global Solar Atlas (GSA Version 2.0)	The Global Solar Atlas offers long-term yearly/monthly averaged daily totals of several datasets for solar resources and the photovoltaic power potential. The data presented here is only suitable for preliminary analysis.		Raster, 1x1km
	Photovoltaic Electricity Output (PVOU)	Amount of energy, converted by a PV system into electricity that is expected to be generated according to the geographical conditions of a site and the configuration of a PV system.	[kWh/kWp]
	Global Horizontal Irradiation (GHI)	Sum of direct and diffuse components of solar radiation.	[kWh/m ²]
	Diffuse Horizontal Irradiation (DIF)	Solar radiation component that is scattered by the atmosphere.	[kWh/m ²]
	Global Irradiation for Optimally Tilted Surface (GTI)	Sum of direct and diffuse solar radiation falling on a tilted surface of fixed-mounted PV modules. Compared to the horizontal surface, the tilted surface also receives a small amount of ground-reflected solar radiation.	[kWh/m ²]
	Optimum Tilt to Maximize Yearly Yield (OPTA)	Optimum inclination of an inclined and fixed PV module for a specific azimuth (orientation), for which the PV modules receive the highest amount of solar radiation per year.	[°]
	Direct Normal Irradiation (DNI)	Solar radiation component that directly reaches the surface.	[kWh/m ²]
	Air Temperature at 2m AGL (TEMP)	Air temperature determines the temperature of PV cells and modules. It has a direct impact on PV energy conversion efficiency and resulting energy losses.	[°C]
	Terrain Elevation ASL (ELE)	Represents terrain elevation (altitude) relative to the sea level. Only data for the land area is shown.	[m]; Raster, 90x90m

Content Tree	Dataset	Short description	Format/ Type/ Date
Renewable Energy Potential -> Solar -> Global Solar Atlas (GSA Version 2.0) -> Median per LAU	Median per LAU: see above		Polygon
	LAU median: Photovoltaic Electricity Output (PVOOUT)	see above	[kWh/kWp]
	LAU median: Global Horizontal Irradiation (GHI)	see above	[kWh/m ²]
	LAU median: Diffuse Horizontal Irradiation (DIF)	see above	[kWh/m ²]
	LAU median: Global Irradiation for Optimally Tilted Surface (GTI)	see above	[kWh/m ²]
	LAU median: Optimum Tilt to Maximize Yearly Yield (OPTA)	see above	[°]
	LAU median: Direct Normal Irradiation (DNI)	see above	[kWh/m ²]
	LAU median: Air Temperature at 2m AGL (TEMP)	see above	[°C]
Renewable Energy Potential -> Solar -> Hotmaps Project	The EU project Hotmaps collected data on energy potential of renewable sources and re-elaborated them on national level, in order to build datasets for all EU28 countries at NUTS3 level. Several renewable sources have been considered. All Hotmaps data must be interpreted as indicators.		Raster, 100x100m
	Solar Energy Potential	Data on annual global radiation on globally inclined surfaces were retrieved from the PVGIS as a 1km x 1km raster layer and clipped by considering the building footprint with a resolution of 100m x 100m from Copernicus Services.	[kWh/m ²], Downloaded 10.08.2019;
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Wind Energy Layers	The Global Wind Atlas is a free, web-based application developed to help policymakers, planners, and investors to identify high-wind areas for wind power generation, and then perform preliminary calculations. A high value indicates a high potential for renewable energy from wind.		Simulation period 2008-2017; Raster, 1x1km
	Capacity Factor IEC Class 1	High wind	

Content Tree	Dataset	Short description	Format/ Type/ Date
	Capacity Factor IEC Class 2	Medium wind	
	Capacity Factor IEC Class 3	Low wind	
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Wind Energy Layers -> Median per LAU	Median per LAU: see above		Simulation period 2008-2017; Polygon
	LAU median: Capacity Factor IEC Class 1	High wind	
	LAU median: Capacity Factor IEC Class 2	Medium wind	
	LAU median: Capacity Factor IEC Class 3	Low wind	
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Wind-Speed at a height of	Mean wind speed at a specific height is a measure of the wind resource. Higher values normally indicate better wind resources, but mean wind power density gives a more accurate indication of the available wind resource.		Simulation period 2008-2017; Raster, 1x1km
	10m		[m/s]
	50m		[m/s]
	100m		[m/s]
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Wind-Speed at a height of -> Median per LAU	Median per LAU: see above		Simulation period 2008-2017;
	LAU median: 10m		[m/s]
	LAU median: 50m		[m/s]
	LAU median: 100m		[m/s]

Content Tree	Dataset	Short description	Format/ Type/ Date
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Power-Density at a height of	Mean wind power density at a specific height is a measure of the wind resource. Higher values indicate better wind resources.		Simulation period 2008-2017; Raster, 1x1km
	10m		[W/m ²]
	50m		[W/m ²]
	100m		[W/m ²]
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Power-Density at a height of -> Median per LAU	Median per LAU: see above		Simulation period 2008-2017;
	LAU median: 10m		[W/m ²]
	LAU median: 50m		[W/m ²]
	LAU median: 100m		[W/m ²]
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Air-Density at a height of	Mean air density at a specific height is a measure of the wind resource.		Simulation period 2008-2017; Raster, 1x1km
	10m		[kg/m ³]
	50m		[kg/m ³]
	100m		[kg/m ³]
Renewable Energy Potential -> Wind -> Global Wind Atlas (GWA Version 3.0) -> Air-Density at a height of -> Median per LAU	Median per LAU: see above		Simulation period 2008-2017;
	LAU median: 10m		[kg/m ³]
	LAU median: 50m		[kg/m ³]
	LAU median: 100m		[kg/m ³]

Content Tree	Dataset	Short description	Format/ Type/ Date
Renewable Energy Potential -> Wind -> Hotmaps Project		This data shows the total energy potential of wind in the EU28 at NUTS3 level. The original dataset is the Wind Global Atlas, which was aggregated at NUTS3 level, through the CORINE Land Cover and by excluding urban areas, bird connectivity corridors, mountain peaks over 2500m and protected areas from the Natura 2000 framework.	Raster, 300x300m
	Power Density Potential at 50m height		[W/m ²]; Downloaded 10.08.2019
Renewable Energy Potential -> Geothermal -> Thermomap Project / Hotmaps Project		Data on very shallow geothermal energy potential (up to 10 metres) were retrieved from the project Thermomap as a vector layer and presented in the Hotmaps project without further elaboration.	Polygon, downloaded 10.08.2019
	Thermomap (Geothermal Energy Potential)		[W/m K]
Renewable Energy Potential -> Biomass -> Hotmaps Project		Data concerning biomass developed within the EU project Hotmaps.	Polygon (NUTS 3);
	Energy Potential from Agricultural Residues	Considered agricultural residues are crop, cereals, maize, oilseed rape and sunflower, sugar beet, rice, olives, citrus and grape.	[PJ]
	Energy Potential from Forest Residues	Energy potential have been spatialized by using the CORINE Land Cover. Forest biomass includes two categories of residues: Fuelwood and roundwood.	[PJ]
	Energy Potential from Livestock Effluents	Considered livestock effluents for the energy generation are solid and liquid manure from breeding of cattle, pigs and poultry.	[PJ]
Renewable Energy Potential -> Biomass -> Global Forest Watch Project		Presents data concerning biomass potential from the open data portal Global Forest.	[Mg ha-1];
	Aboveground Biomass		Raster, 30x30m
	Aboveground Biomass per LAU		Polygon (LAU)
Renewable Energy Potential -> Biomass -> AlpES Project		The calculated indicator represents the mapping of biomass production supply and was created within the AlpES project. http://www.wikialps.eu/doku.php?id=wiki:grassland_biomass	Polygon (LAU)
	Grassland Biomass Ecosystem Service		[t DM ha-1 y-1]

Content Tree	Dataset	Short description	Format/ Type/ Date
Renewable Energy Potential -> Hydro	The dataset contains all potential hydropower plant locations for micro to large hydropower plants based on the GMTED2010 breakline dataset (elevation) and runoff data from the Global Runoff Data Centre.		Coverage time 2010
	Hydropower Potential Locations		Point Feature
Energy Infrastructure -> Power Plants – Global Power Plant Database	Database covers approximately 30000 power plants around the world. Beside thermal plants also renewable plants are included.		
	Power Plants, incl. Renewables		Point Feature
Energy Infrastructure			
	Charging Points	Open Charge Map is a non-commercial, non-profit, electric vehicle data service hosted and supported by a community of businesses, charities, developers and interested parties around the world. The aim is to work with the community to develop and provide a high quality, public, free, open database of charging equipment locations globally.	Point Feature
Land Use and Land Cover	Land use and land cover mapping for all EEA39 countries (2018). 25 ha minimum mapping unit, 100m minimum mapping width, 100m positional accuracy, >85% thematic accuracy.		Raster, 100x100m;
	CORINE Land Cover (CLC)	CORINE Land Cover (CLC) was specified to standardize data collection on land cover in Europe to support environmental policy development.	downloaded 08.08.2019
	European Forest Areas	This dataset shows the European forest area for 2012 and 2015 covering EEA39 countries.	downloaded 11.08.2019; 1 (forest), 0 (non-forest)
Political-Geographical Boundaries -> Administrative Units	Euro Boundary Map provides a European geographic database for administrative and statistical regions. EBM offers the combination of detailed European administrative units and linkages to the corresponding LAU and NUTS codes.		Polygons; Data delivery: Mai 2019
	Admin Unit/Boundary Level 1	National borders/ states	
	Admin Unit/Boundary Level 2	Federal states	
	Admin Unit/Boundary Level 3		
	Admin Unit/Boundary Level 4		

Content Tree	Dataset	Short description	Format/ Type/ Date
	LAU – Local Administrative Units	Municipality level	
Political-Geographical Boundaries -> Statistical Units	The database includes relations between the European-wide unique identifiers of administrative units and their corresponding statistical codes and units (NUTS) maintained and published by Eurostat.		Polygons
	NUTS 1 – Major socio-economic regions		
	NUTS 2 – Basic regions for the application of regional policies		
	NUTS 3 – Small regions for specific diagnoses		
Political-Geographical Boundaries	The WebGIS offers different border layers concerning the Alpine Space.		Polygon
	Alpine Space Area		
	Alpine Convention Area		
Political-Geographical Boundaries -> Protected Areas -> World Database on Protected Areas (WDPA)	Protected Planet is a source of information on protected areas, updated monthly with submissions from governments, non-governmental organizations, landowners and communities.		Downloaded 12.08.2019
	WDPA Areas		Polygon
	WDPA Points (Addition only for Slovenia)		Point Feature
Political-Geographical Boundaries -> Protected Areas			
	Natura 2000	Natura 2000 is the key instrument to protect biodiversity. It is an ecological network of protected areas, set up to ensure the survival of Europe's most valuable species and habitats.	Polygon; downloaded 08.08.2019
	Nationally Designated Areas (CDDA)	The dataset contains data on nationally designated areas and corresponding protected site for spatial features in EEA member and collaborating countries.	Polygon; Downloaded 08.08.2019

Content Tree	Dataset	Short description	Format/ Type/ Date
Political-Geographical Boundaries - > Protected Areas - > Protected Areas – IGF curated			Polygon
	Biosphere Reserves		
	National Parks		
	Natural Parks		
	World Heritage Sites		
Digital Elevation Model & Hillshade	DEM and Hillshade are resampled (250m, 1000m) from EU-DEM, which is a 1:100 000 scale digital elevation model providing height data for 40 European countries and territories. It describes the distribution of terrain, not including vegetation and man-made structures.		
	Digital Elevation Model (DEM)		[m]
	Hillshade		[°]
	Combined DEM & Hillshade		

1.6 Which political and geographical units are offered

Different political and statistical units can be displayed ranging from the cooperation area of the Alpine Space programme, the NUTS regions 1 to 3, to the LAU units. The format of specific datasets, such as on renewable energy, can be polygons addressing different political units or can be in raster format with different spatial pixel resolution. Depending on the single raster datasets, the spatial resolution ranges from 30 m to 1000 m for each pixel. Ski resorts and ski pistes are represented by vector formats.

What are LAU units?

LAU stands for Local Administrative Units (LAU). Those units, maintained by Eurostat, comprise municipalities and communes (or equivalent units) of European Union (see <http://ec.europa.eu/eurostat/web/nuts/local-administrative-units>). Because there are frequent changes to the LAU unit boundaries, Eurostat offers yearly updated lists and datasets. The LAU units that are used in the Smart Altitude project are taken from the EuroBoundaryMap v11, a DVD database offered by EuroGeographics, current in 2019. EuroGeographics offers exact LAU boundaries with a highest accuracy and resolution; even on country borders there are no overlaps or missing parts. Those harmonised and consistent boundaries, available for the total European territory, are furthermore synchronized with the additional datasets of NUTS 1-3 and the AdminUnits 1-4.

1.7 Short introduction of the Living Labs

The Smart Altitude project focuses on four test regions, which are called Living Labs.

1.7.1. Les Orres (France)

Les Orres is the French Living Lab of the Smart Altitude project. They are building a model with their project partner EDF to evolve the existing energy management system to a smart grid model. Furthermore, some other major points of energy consumption and local renewable energy production are integrated. It is performed at the territory level (municipality + resort), implying both the private power grid operated by SEMLORE and the public power grid to which the commerce, tourism housing and municipality is connected. For more information see <https://www.alpine-space.eu/projects/smart-altitude/en/project-results/smart-altitude-living-labs/les-orres>.

1.7.2. Pinzolo/ Madonna di Campiglio (Italy)

Madonna di Campiglio is the Italian Living Lab of the Smart Altitude project. They are testing an Integrated Energy Management System to improve energy efficiency, optimize the use of water, integrate renewable energy sources and reduce CO2 emissions in the ski area. Their mission is to achieve zero CO2 emissions by 2026, the year of the XXV Winter Olympic Games hosted in Italy. For more information see <https://www.alpine-space.eu/projects/smart-altitude/en/project-results/smart-altitude-living-labs/madonna-di-campiglio>.

1.7.3. Cerklje na Gorenjskem (Slovenia)

Kravec is the Slovenian Living Lab of the Smart Altitude project. They are implementing a multi-energy consumption reduction approach on snow-making processes, ski lifts and heating. Solutions will be based on expected and unexpected impacts (e.g. rebound effects), potential for new activity and further local innovations. Data on GHG emissions reduction, equipment performance and investment efficiency will be provided. RTC Kravec is responsible for pilot implementation and BSC Kranj for Lab animation. For more information see <https://www.alpine-space.eu/projects/smart-altitude/en/project-results/smart-altitude-living-labs/kravec>.

1.7.4. Bagnes/ Verbier (Switzerland)

Verbier is the Swiss Living Lab of the Smart Altitude project and developed as a winter tourism centre in the early 20th century. The ski resort is operated by Téléréverbier. Verbier is part of the largest ski area in Switzerland – “Les 4 Vallées”. In the last few years Téléréverbier has already taken important steps towards a low-carbon economy. They build upon existing systems and expertise to increase energy efficiency and renewable energy use within the Smart Altitude project. KPIs are now going to be set. At the end of the Smart Altitude project, energy saving policies and actions will be harmonized across the territory in order to reach the “Energy city” gold label. For more information see <https://www.alpine-space.eu/projects/smart-altitude/en/project-results/smart-altitude-living-labs/verbier>.

1.8 Tutorial Case Study

Imagine a regional council of winter tourism stakeholders, including ski resorts manager and municipal planners. The main topic for their next council meeting is Renewable Energy Potential for ski resorts in the challenging situation of climate change. More precise, **the council wants to discuss different offered possibilities and tools, how ski resorts can inform and prepare themselves for using renewable energy, especially focussing on their spatial extent.** The task of the council is to motivate the members for evaluating their current emission situation and think about more sustainable strategies for the future. Projects, tools and partners should be presented.

In preparation for the next council meeting, council member Ms. Curious has the task to look for spatial information on renewable energy potential for the Alpine Space. Ms. Curious remembers that in a former meeting her colleague Mr. Curious used a WebGIS for the analysis of “Protection Forest” in Innsbruck as an indicator for ecosystem services. Ms. Curious remembers the informative maps and possibilities, which have been presented by her colleague using the AlpES WebGIS (Have a look at the WebGIS concerning Ecosystem Services <http://www.alpes-webgis.eu/>).

Now Ms. Curious is looking for a tool, which can support her purpose and therefore she finds the Smart Altitude WebGIS (see webgis.smartaltitude.eu). Here she can see ski resorts, pistes, aerialways and various datasets on renewable energy potential for the whole Alpine Space and by zooming in detail information on every region of interest can be found. She detects that some ski resorts already cooperated with the Smart Altitude project and Key Performance Indicators of these test regions are visible.

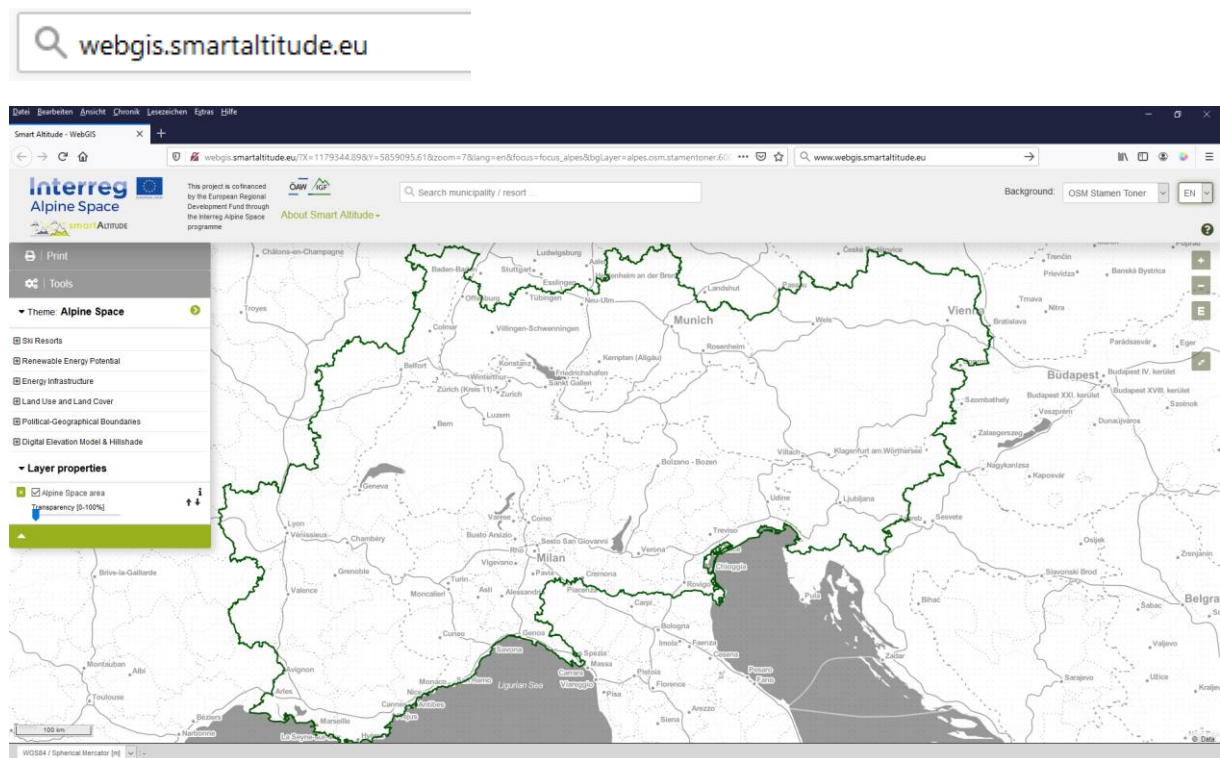
In the next council meeting Ms. Curious wants to present the WebGIS, the datasets, the possibilities and she wants to motivate here colleagues to have a look themselves. Therefore, she works through the WebGIS and documents her tasks.

2 GETTING STARTED

This chapter starts with a first overview of the structure and the possible information offered by the Smart Altitude WebGIS.

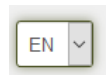
2.1 Access the Smart Altitude WebGIS

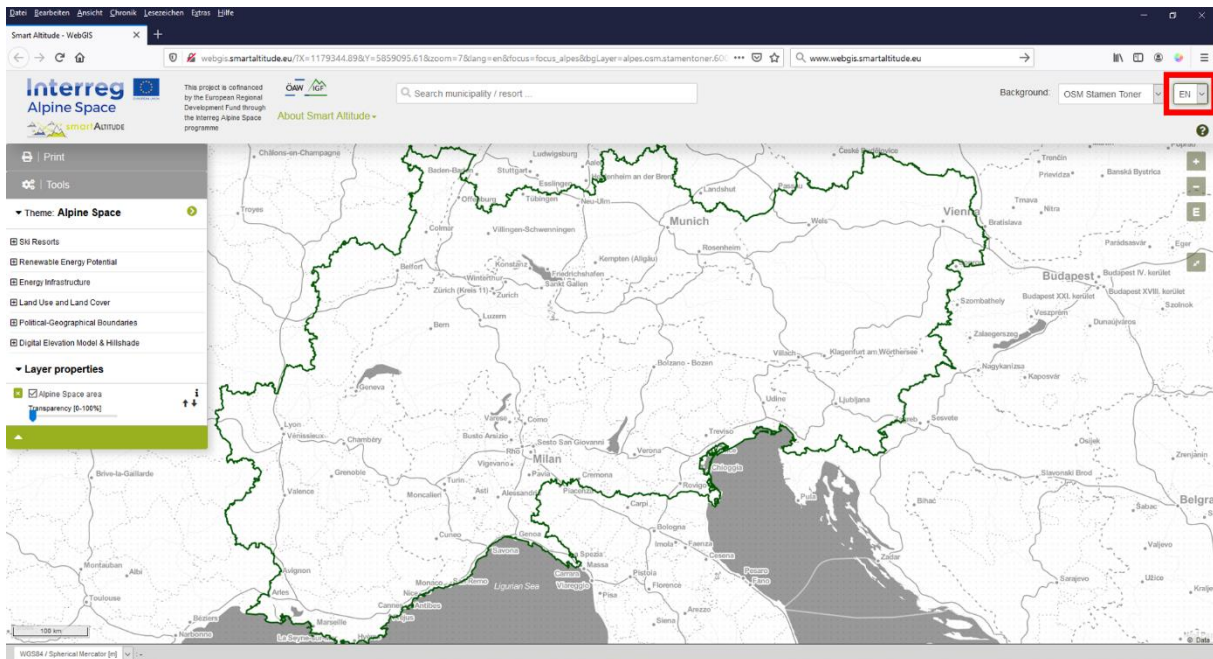
Council member Ms. Curious just heard about the Smart Altitude project and its WebGIS. This tool sounds quite useful for achieving her purpose. **She enters “Smart Altitude WebGIS” into the search engine of her web browser** and the returned search result leads her to the Smart Altitude WebGIS. She saves the URL <http://webgis.smartaltitude.eu/> for future usage.



2.2 Choose your language

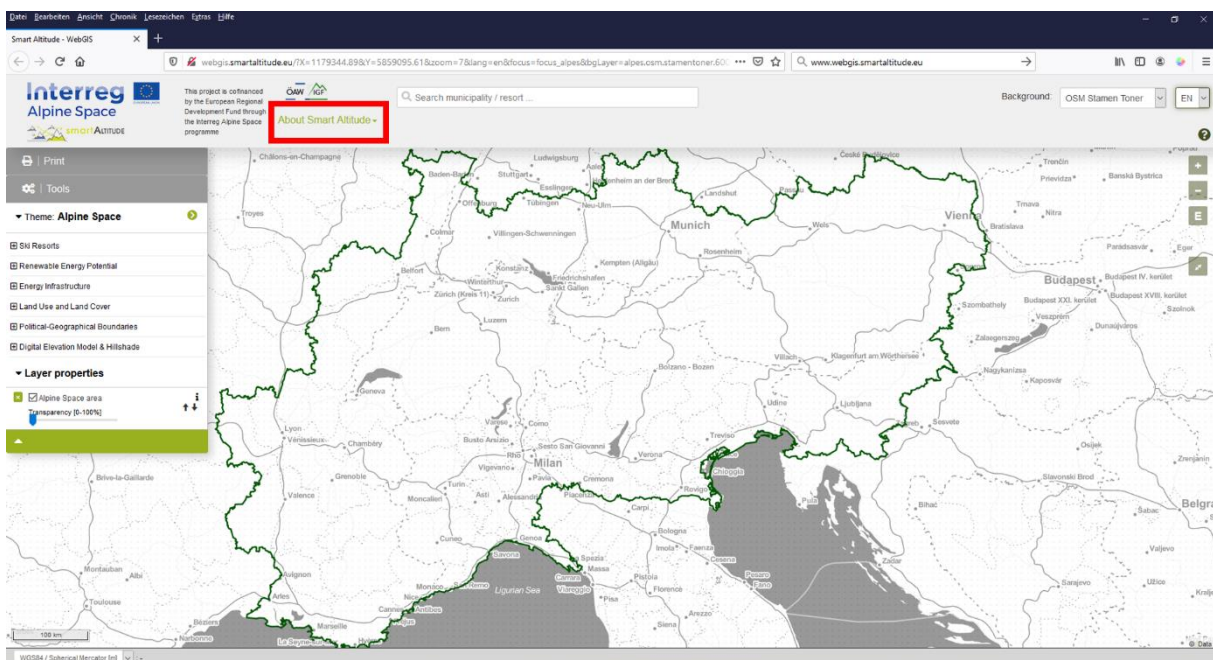
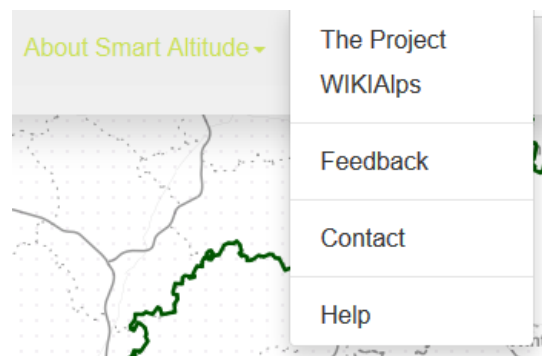
First Ms. Curious chooses her preferred language in the upper right corner of her screen. It is possible to choose between English, German, French, Italian and Slovenian. Please note that layer attributes (characteristics) are only available in English.





2.3 About Smart Altitude

In the middle of the grey bar on the top of the website, she finds the **“About Smart Altitude”** button. Because she is not that familiar with the Smart Altitude project yet, she uses these links to inform herself on the Smart Altitude project homepage (<https://www.alpine-space.eu/projects/smart-altitude/en/home>). Here she can find important information about the project and also other offered tools, like the Smart Altitude Toolkit (<https://smartaltitude.eu/>) including the Smart Altitude Webinar Series (<https://smartaltitude.eu/tools/plan/>).



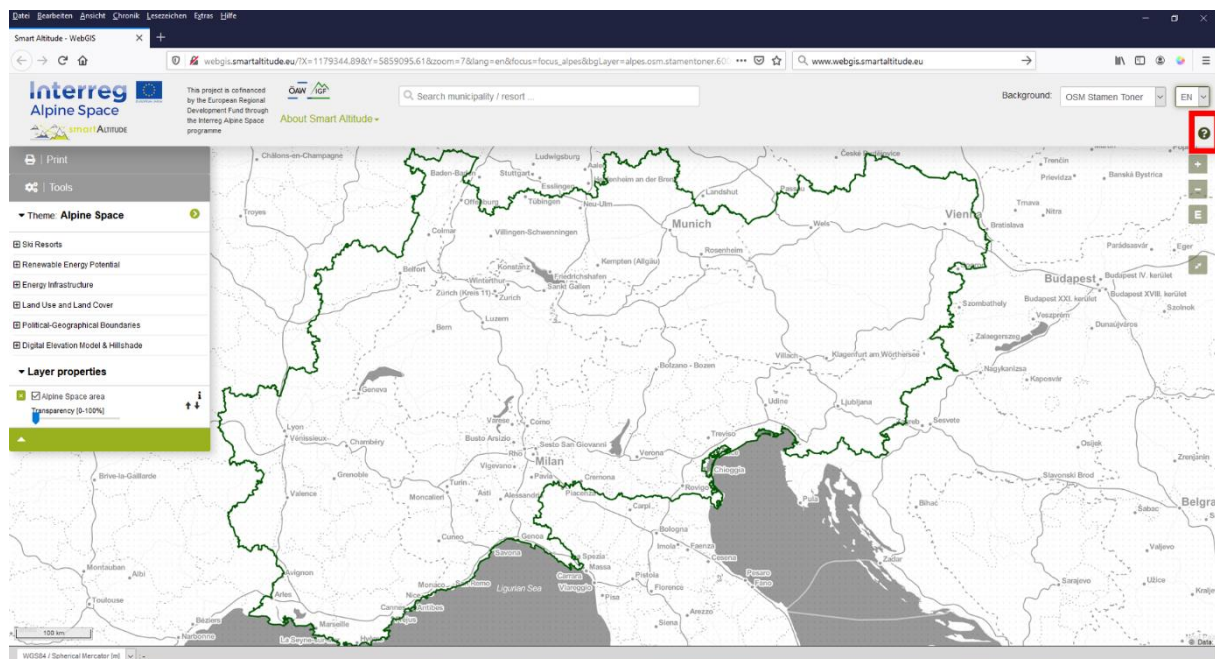
She also clicks on the link to **WIKIAlps**, where further information about the WebGIS including the different functions and operations of the WebGIS are presented (see http://www.wikialps.eu/doku.php?id=wiki:smart_altitude_webgis). There is also a table showing all available datasets within the Smart altitude WebGIS with their main characteristics (see http://www.wikialps.eu/doku.php?id=wiki:smartaltitude_webgis_layers). On the WIKIAlps homepage she finds an article about the Key Performance Indicators (KPIs), which are visible for three of the four Living Labs on the WebGIS (see http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:smart-altitude_wi-emt_evaluation-report_final_xxx.pdf). On page four there are some explanations, helping her to understand the KPIs.

In addition, she finds detailed descriptions of all offered datasets and their metadata on WIKIAlps. This information is highly important for a correct usage and interpretation of the data. Have a look at http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:geodata_sources_of_smart_altitude_webgis.pdf.

Mr. Curious finds out that she can also contact the developing and project team of the Smart Altitude WebGIS through the **Feedback** and **Contact** buttons. Feedback is highly appreciated, so please send an email with suggestions on how to improve the WebGIS.

2.4 Basic introduction

Now Ms. Curious is ready to start working with the Smart Altitude WebGIS. Since she has no idea what to do, **she starts with the basic introduction**. This is found on the right hand side in the grey bar on the top, shown as a **little green question icon**. This introduction automatically starts when first visiting this homepage. She is guided through the main parts and possibilities of the WebGIS platform. After this short introduction she feels confident enough to try and play around with the Smart Altitude WebGIS by herself.

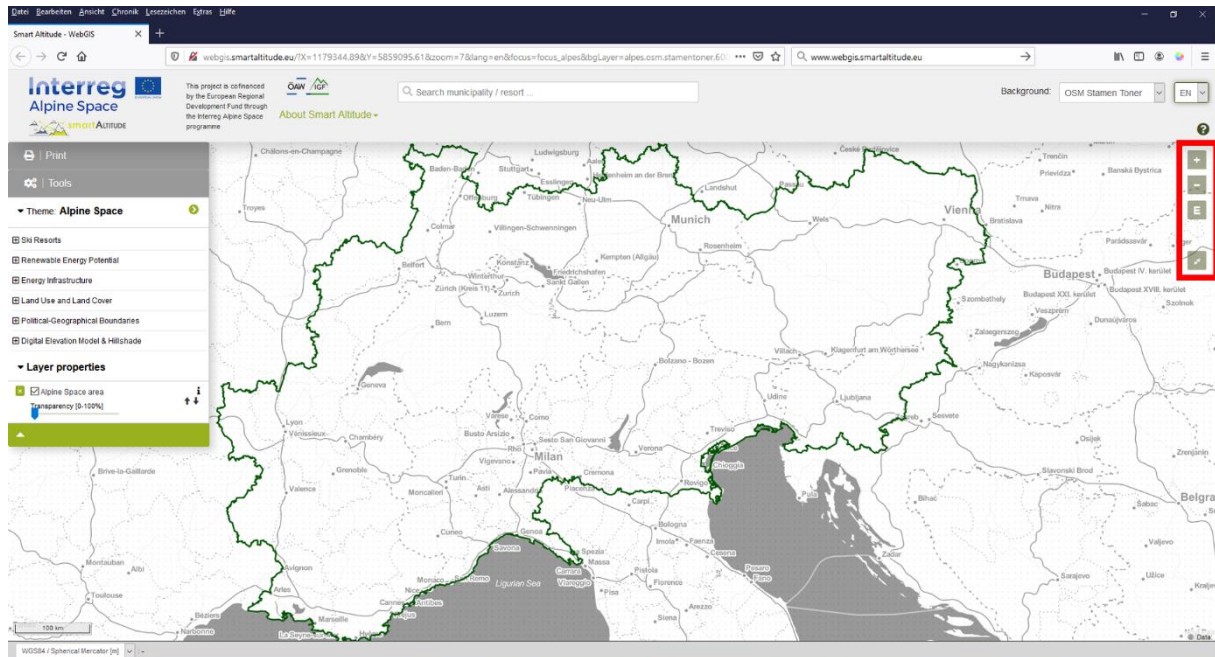


3 BASIC FUNCTIONS

This chapter presents the main basic functions for orientation purposes of the Smart Altitude WebGIS.

3.1 Change view extent

As she cannot wait to see some results, the first thing she does is to zoom to an area of interest, for example Innsbruck. This can be done in multiple ways.



3.1.1. Zoom manually

Either just zoom in or out using the + and – icons on the right hand side of the mapping window or use your mouse scroll wheel doing the same job. Note, that there are altogether 19 zoom steps possible and no steps in between. This might be important if you try to get the best resolution to see your region of interest in the mapping area of the Smart Altitude WebGIS. Clicking on the “E” symbol leads you directly to the largest extent of the selected theme.



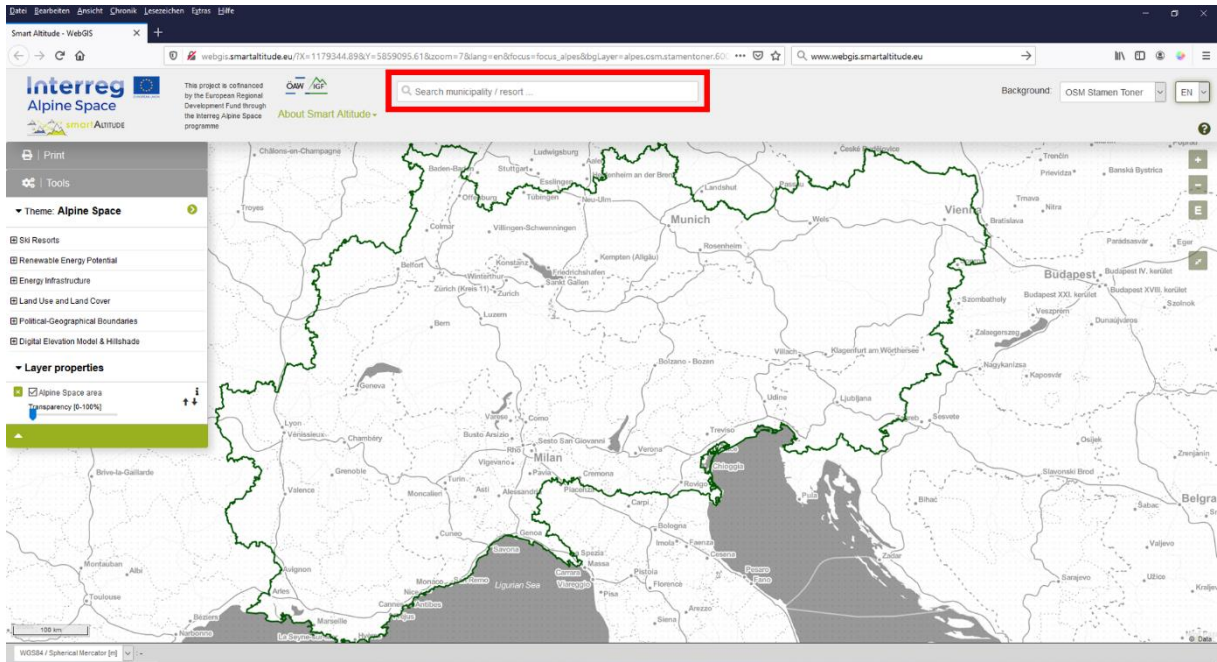
3.1.2. Full screen

To use the Smart Altitude WebGIS in full screen modus Ms. Curious clicks on the “full screen” icon below the zooming tools.

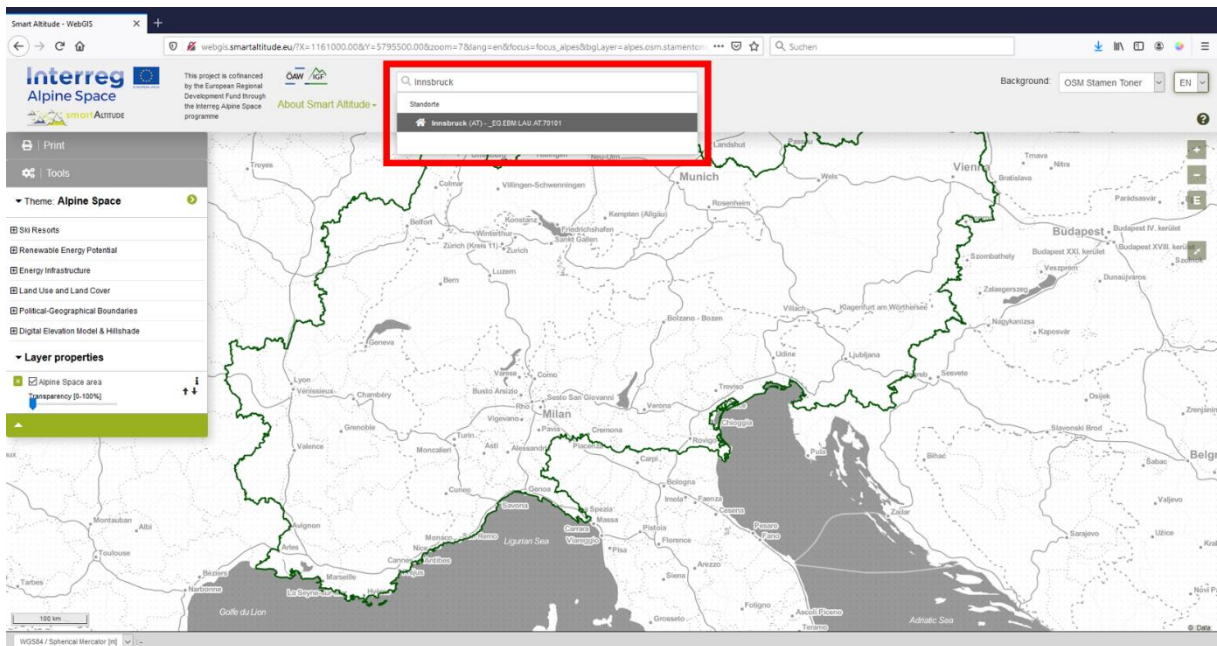


3.1.3. Zoom to a specific municipality or ski resort

Ms. Curious also uses the search function within the grey bar as another way to zoom to her area of interest. To zoom to a specific municipality or ski resort, type its name into the search field and select one of the proposed names, which appear below. Then hit <Enter>. The extent will be immediately zoomed to the selected municipality.

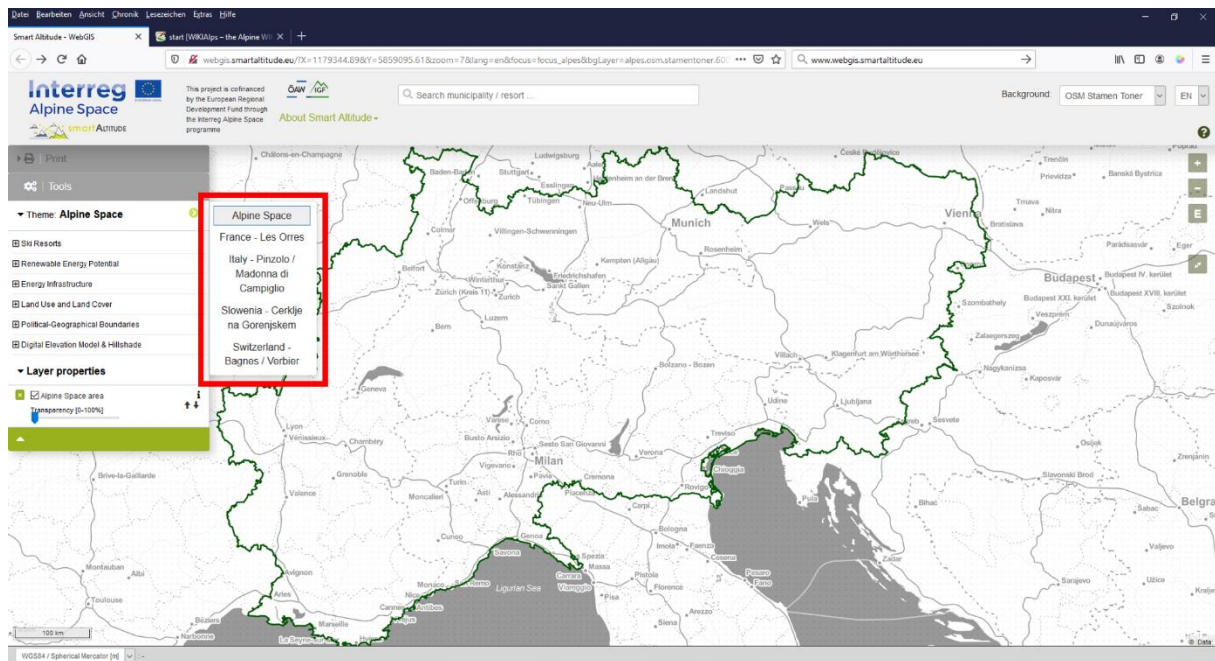


Ms. Curious types “Innsbruck” into this field and then uses the “–” button to zoom out a bit to see the full region of interest.

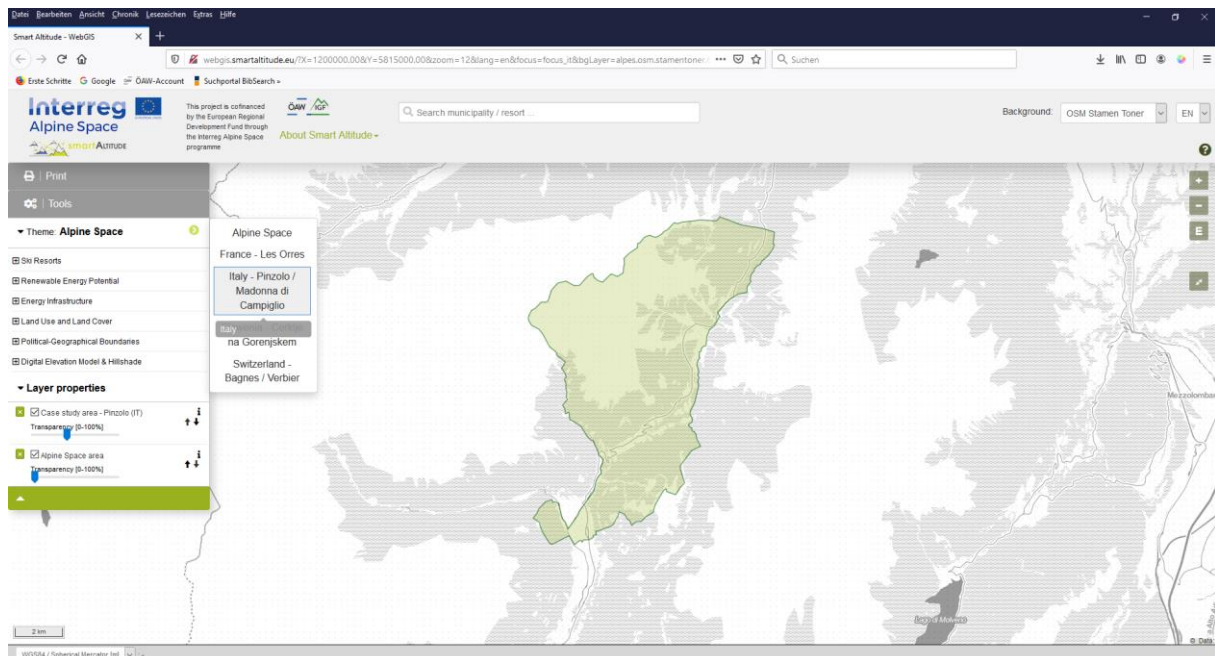


3.1.4. Zoom to a Living Lab

To look at the Smart Altitude test regions, just click on the arrow on the right side of the “Theme” bar and then choose one. The default extent of the WebGIS is the whole Alpine Space.



Ms. Curious selects the Italian Living Lab of Madonna di Campiglio and the WebGIS directs her automatically to the extent of her chosen Living Lab.

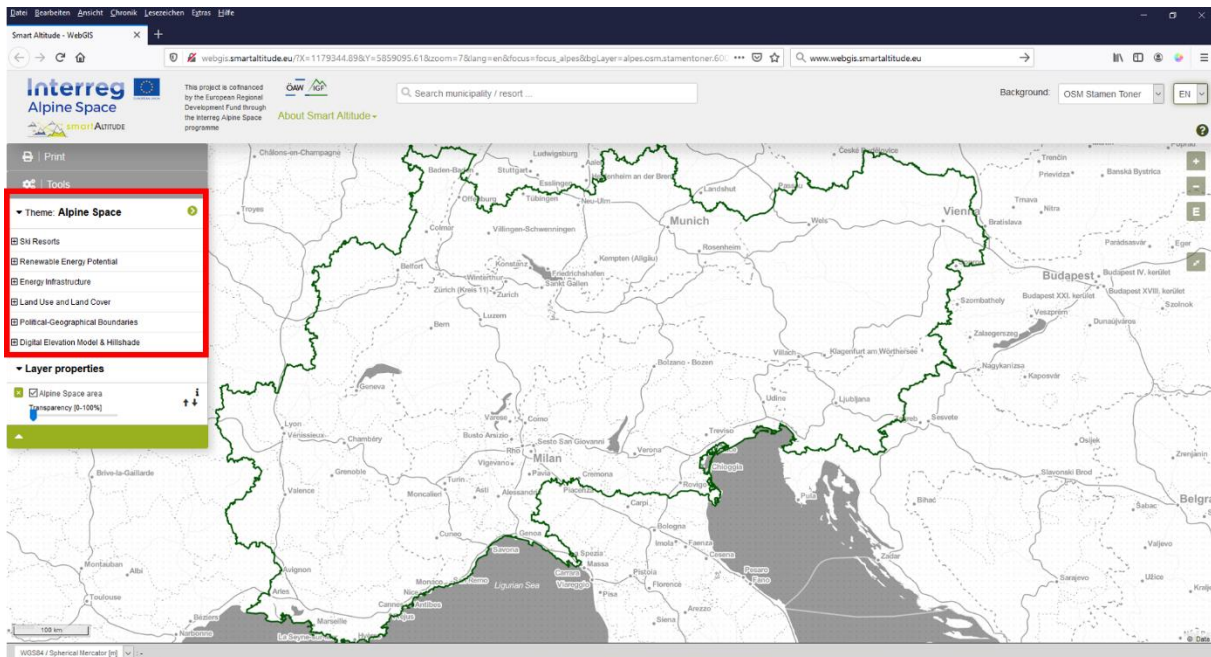


3.2 Chose and learn about single datasets

To see which layers are integrated in the Smart Altitude WebGIS, Ms. Curious clicks on “Theme: Alpine Space” to pop up the layer tree. **In the menu tree, she finds all datasets that are available in the WebGIS organized by content.**

3.2.1. Choose layers

You can fold up the menu by clicking on the field “Theme” again.

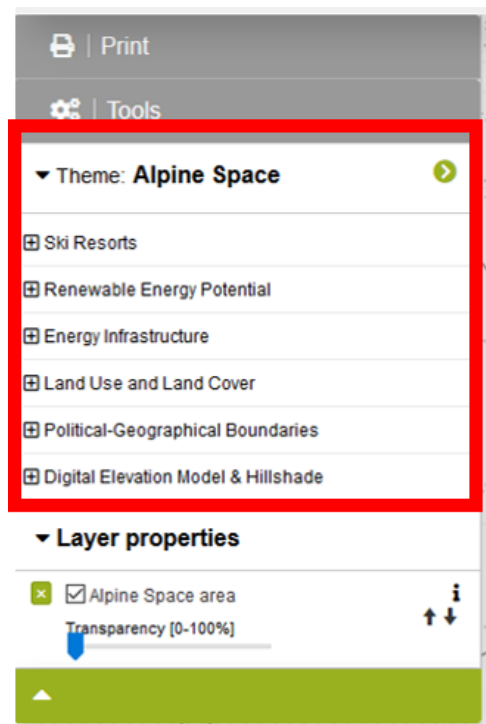


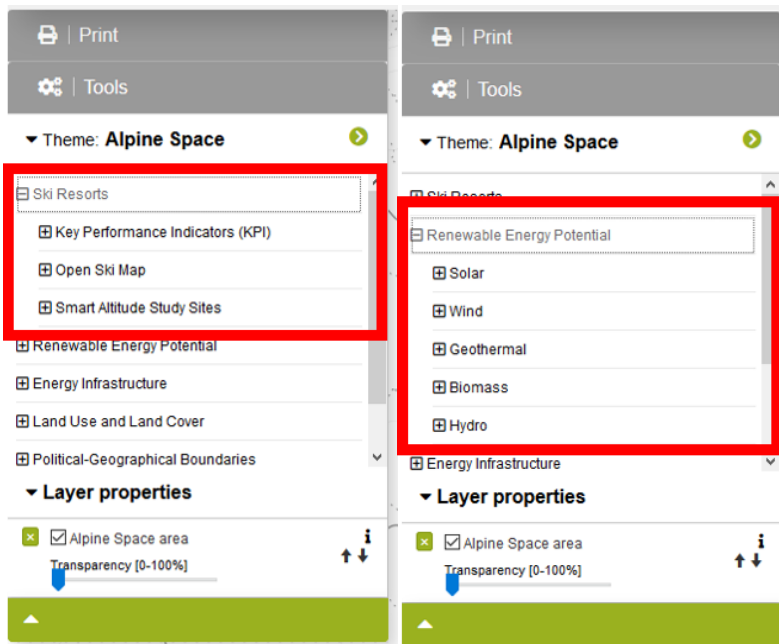
In the first menu category, Ms. Curious finds layers concerning ski resorts (pistes types, aerialways, etc.) from the Open Ski Map and the Key Performance Indicators (KPI) for each Living Lab – one of the Smart Altitude project data results-, which are accessible to the public through the Smart Altitude WebGIS tool.

In the second menu category, Ms. Curious finds different layers concerning renewable energy potential (wind, solar, biomass, etc.), which are available for the whole Alpine Space and can be important for planning and interpretation purposes for stakeholders.

All other datasets listed below can be used as additional information, for analysing, interpreting and styling purposes.

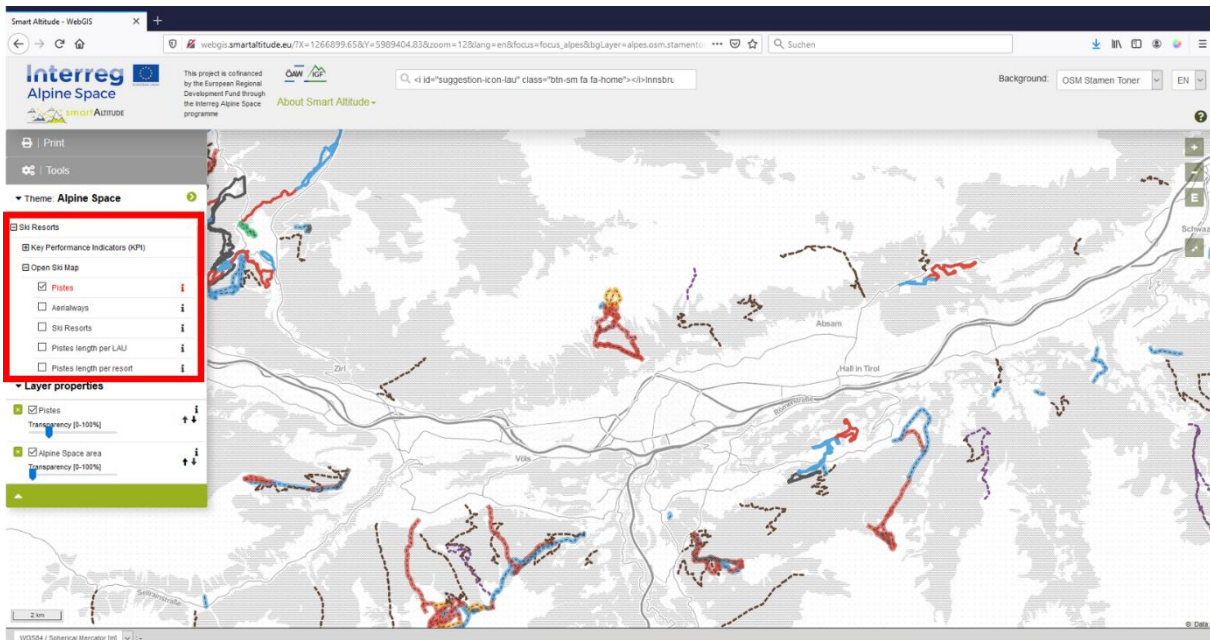
There are also thematic background datasets available including land use, land cover, protected areas, administrative units, the Alpine Space boundary, and other base layers like the digital elevation model combined with a hillshade.





3.2.2. Activate layers

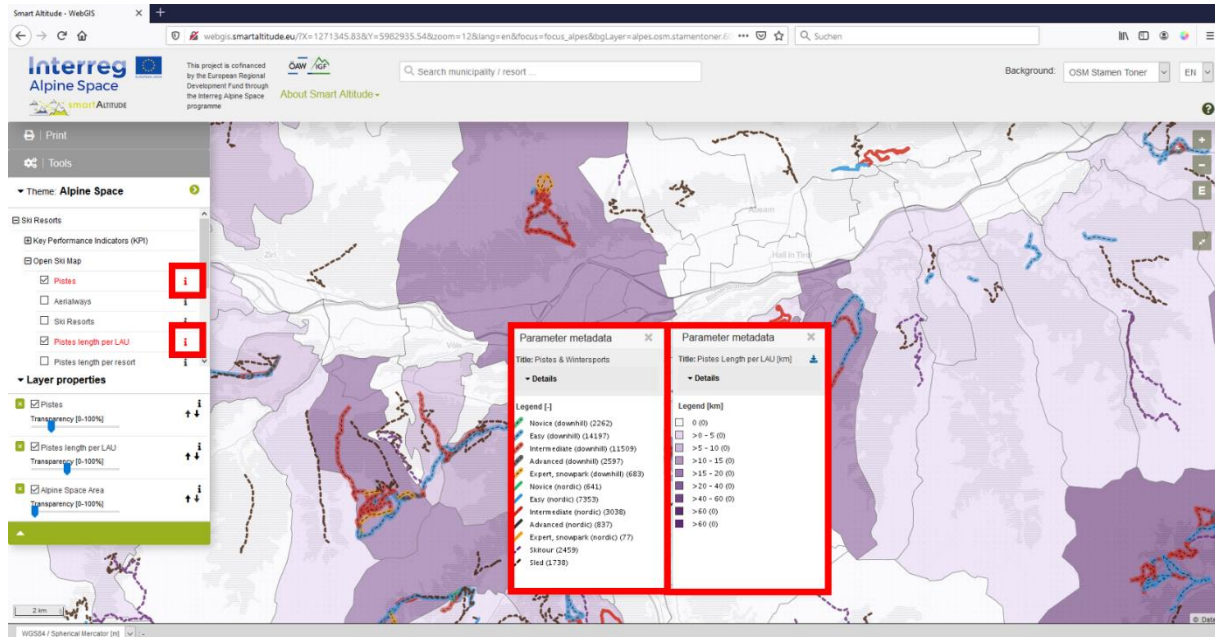
As Ms. Curious is interested in ski resorts, pistes and aerialways, she opens the content tree as follows: Ski Resorts -> Open Ski Map. **She decides on one of the given themes and activates the layer through clicking the checkbox on the left hand side of the layer name.** A pre-styled visualization of the selected layer appears on the map.



After playing around a bit, she finds out that there is a convention of showing pistes and aerialways in different types and colours.

3.2.3. Get legend and further information

Ms. Curious is looking for the legend, in order to understand what the different types and colours of the line signs mean. She also wants to find out the represented units, especially for the layer “Pistes length per LAU”. **She finds the legend as well as further information** (unit, data source, metadata, etc.) **by clicking on the little “i”-icon on the right hand side of each layer.** The “Parameter metadata box” will then appear.

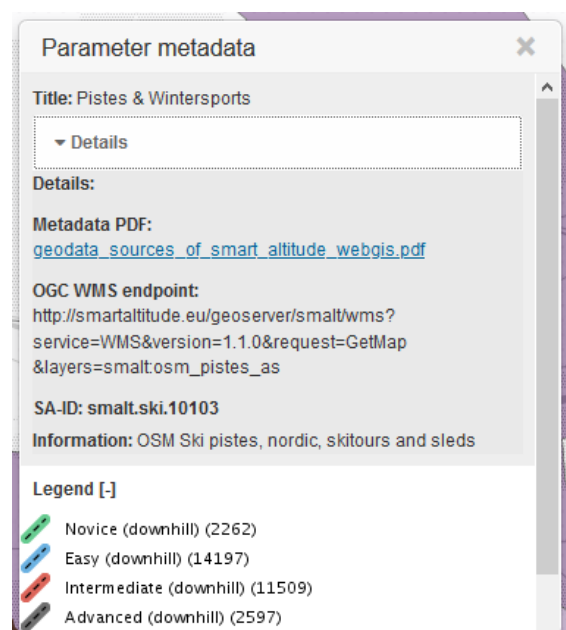


In the upper part of the “Parameter metadata box”, as “**Metadata PDF**”, she finds some information about the dataset and a link to an informative article on the project-specific datasets on WIKIALps. **This article is highly relevant for understanding and interpretation purposes of the datasets.** Have a look http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:geodata_sources_of_smart_altitude_webgis.pdf. **A more general overview of the available datasets** is given here http://www.wikialps.eu/doku.php?id=wiki:smartaltitude_webgis_layers.

Ms. Curious, for example, finds out that the Key Performance Indicators (KPIs) are “indices” meaning values without units and in this case reaching from 1 to 5.

In the lower part, she finds the legend that tells her which value is associated with a particular sign type and colour. The units are shown in the square brackets. Now she has almost all information she needs to interpret the map, i.e. she has the information to ‘read’ the colours in her area of interest.

Ms. Curious ends up with the following basic knowledge: Within the layer “Pistes” different types



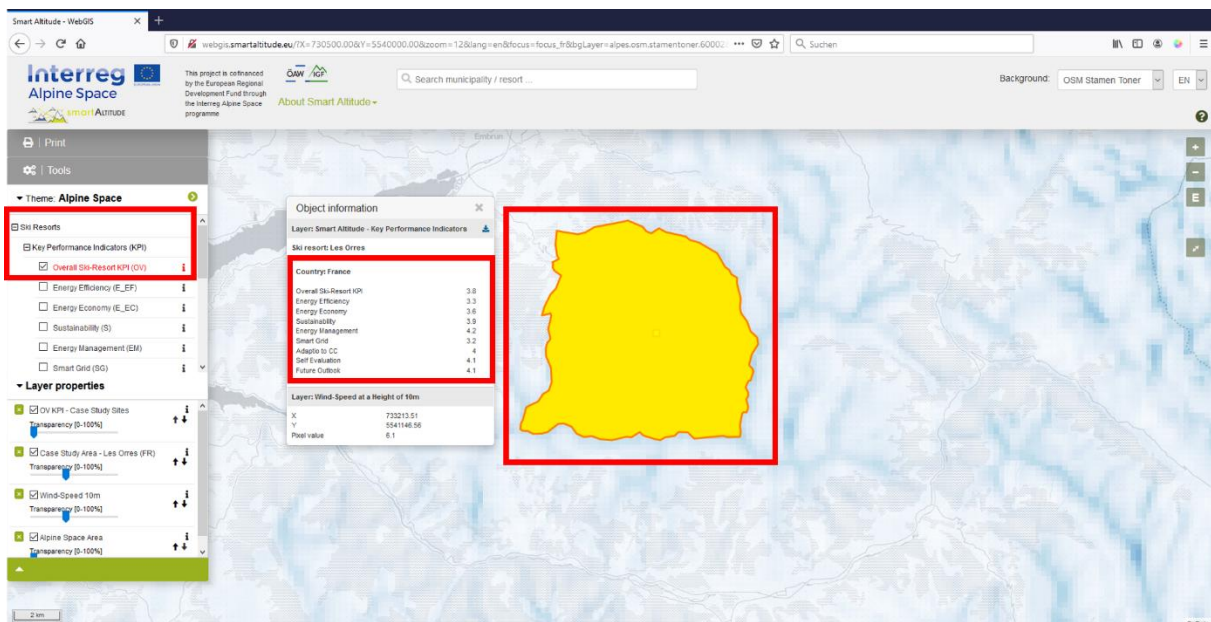
of pistes referring to downhill, nordic, skitour and sleds can be distinguished. All downhill pistes are indicated by a dashed line and in addition also a coloured background is given. The colours represent the difficulties of the individual slopes, which are used in the same way for downhill and nordic pistes. Skitours and sled pistes are shown in dashed coloured lines referring violet for skitour and black for sled pistes. The layer “Pistes length per LAU” shows the pistes length for each municipality (LAU) and the units are kilometres [km]. Pistes and aerialways are taken from the OpenSnowMap, which are extracts of the openstreetmap database.

3.2.4. Get single area’s attributes

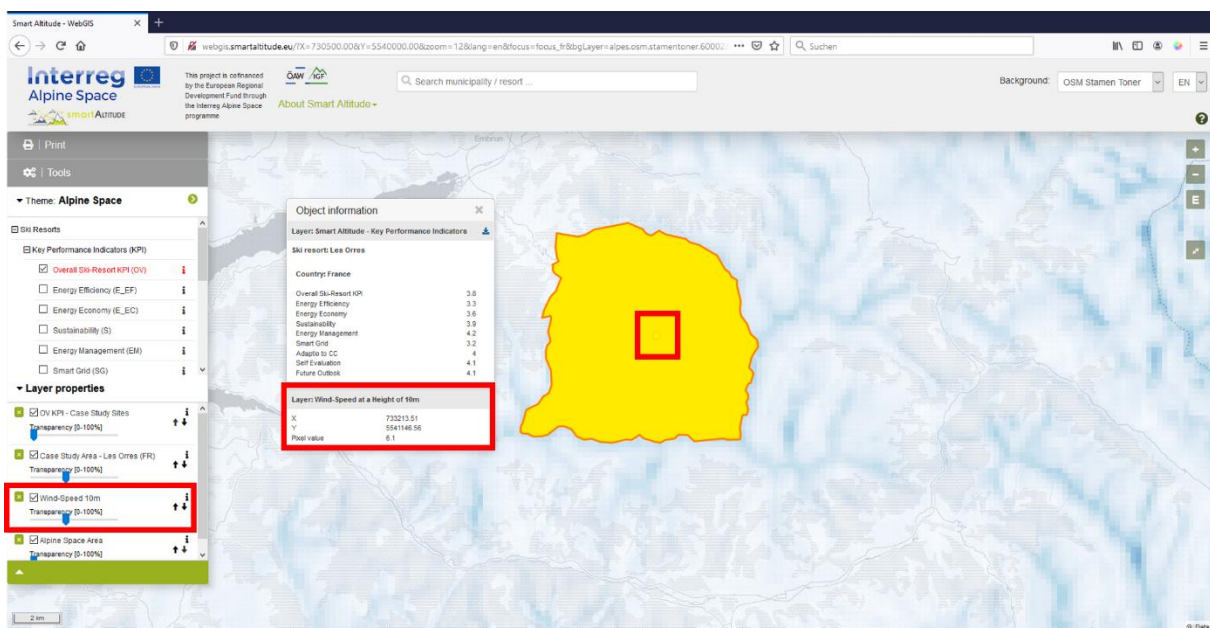
By visually comparing the Key Performance Indicators (KPIs) of the Living Labs, Ms. Curious detects that the same type of KPI can be represented in the same or in different colours shade. Ms. Curious wonders what the difference is between them. Therefore, **she wants to know the exact values for several municipalities or spots, so she can compare them directly** – value by value.

It is quite easy to get the information of a single area’s attribute. The Smart Altitude WebGIS has according to the format of the datasets two different spatial units: (1) polygons and (2) raster datasets with individual pixels. You only have to click on a municipality or a pixel to get information of this specific polygon or pixel.

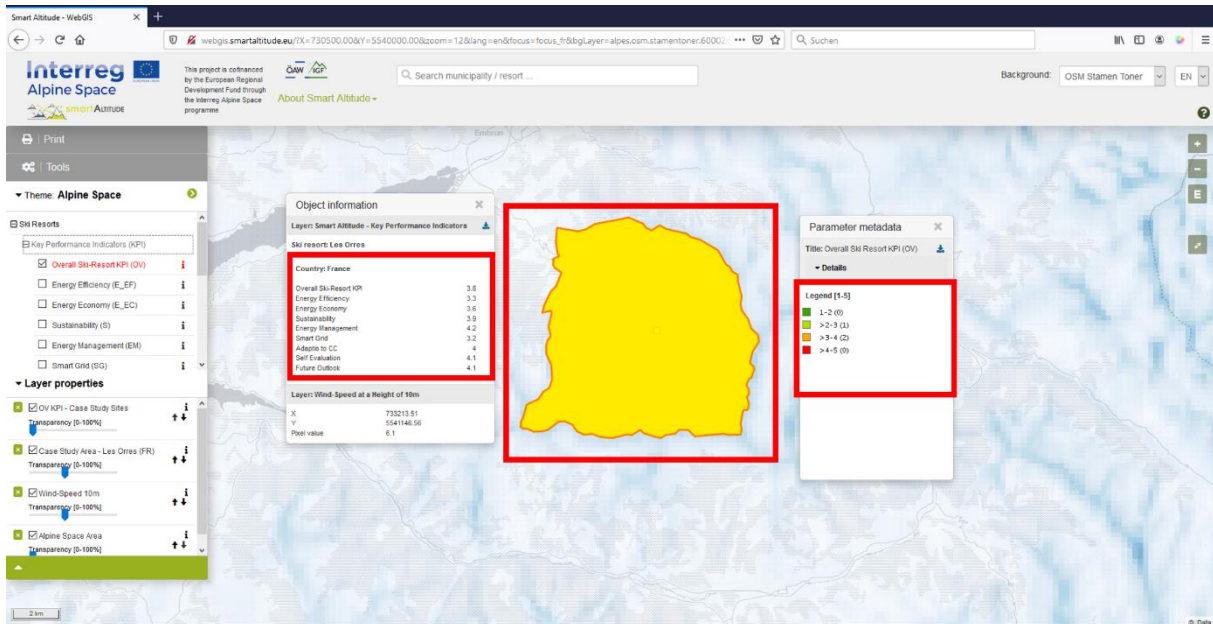
1. **Polygon:** You can get information on a single municipality, a Living Lab or another polygon. Ms. Curious zooms to the Living Lab of Les Orres (France) and activates the layer “Overall Ski-Resort KPI (OV)”, which she finds in the content tree -> Ski Resorts -> Key Performance Indicators (KPI). She selects the Living Lab by clicking once on the green area. The selected object turns into yellow and the relating “Object information box” appears immediately. In this case values for all Key Performance Indicators are listed for the selected Living Lab (here Les Orres in France) in the “Object information box”.



2. **Pixel for raster datasets:** At the end of the “Object information box” also the coordinates and a pixel value can be found. This information is requested for every pixel and belongs to the exact clicking point position (red frame of the pixel). For example, most layers relating to Renewable Energy Potential are normally raster datasets, built by individual pixels. The information/ values can be queried for each pixel. For example, the wind speed at a height of 50 m can be requested for each pixel. By clicking on several pixels Ms. Curious finds out that every pixel has a different value. According to the legend, categories are designed to gather several values into different classes with particular ranges represented by the same colour shade. Only those pixel values are presented in the “Object information box” which layers are activated. These layers are listed in the same order like in the “Layer properties” at the bottom left.

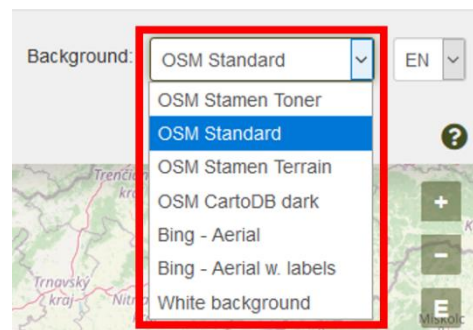


Ms. Curious finds out from the “Object information box”, that the Overall Ski-Resort KPI is 3.8 for Les Orres. Ms. Curious needs further information for interpreting these values. She opens the “Parameter metadata box” through the “i” icon. All KPIs are indices, which are ranging from 1 to 5, ranging from the worst to the best performance according to their specific topics. The Overall Ski-Resort KPI represents the mean of all other 8 indicators. For the Living Lab of Les Orres Ms. Curious can conclude that the Energy Management (4.2) reaches rather high values. But the Energy Efficiency (3.3) is lower. The Overall Ski-Resort KPI (3.8) is rather good, but there is still potential for future improvements. **For more information regarding the KPIs see http://www.wikialps.eu/lib/exe/fetch.php?media=wiki:smart-altitude_wi-emt_evaluation-report_final_xxx.pdf.**

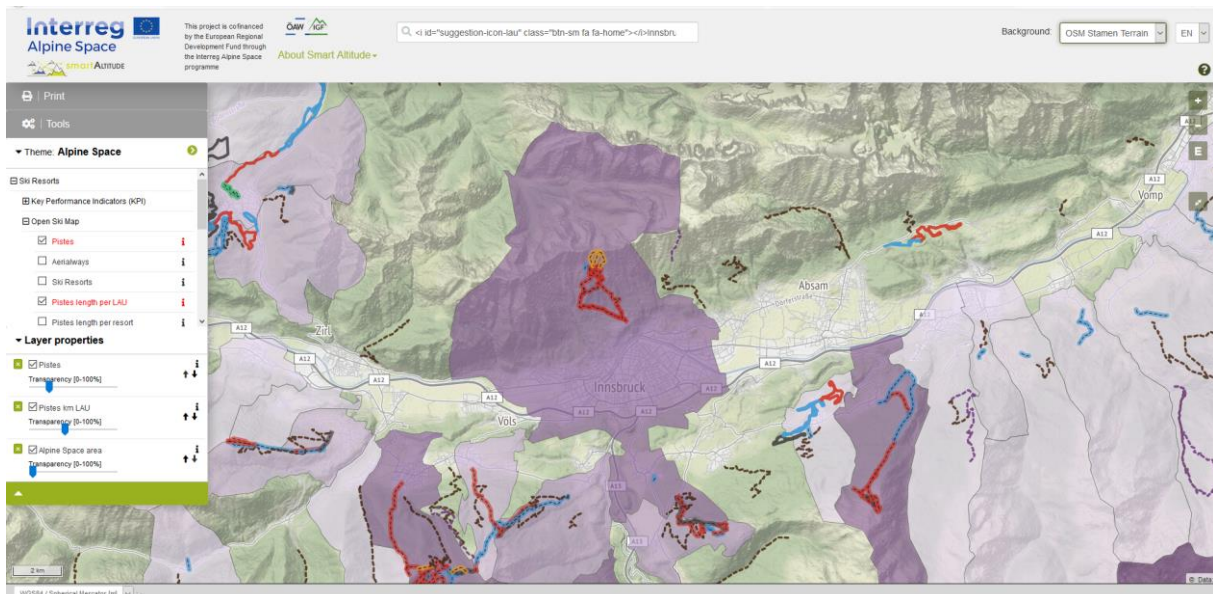


3.3 Change background map

Ms. Curious is not really satisfied with the background map. She wants to try some alternatives. **She can change the background map by clicking on the “Background” drop down menu located in the upper right corner of the website.** She can pick a background that best supports her layers and facilitates easy orientation.



From the menu, she chooses her preferred background map: OSM Stamen Terrain



4 OFFERED TOPICS AND TOOLS

This chapter presents the project-specific topics and tools, which are offered exclusively by the Smart Altitude WebGIS.

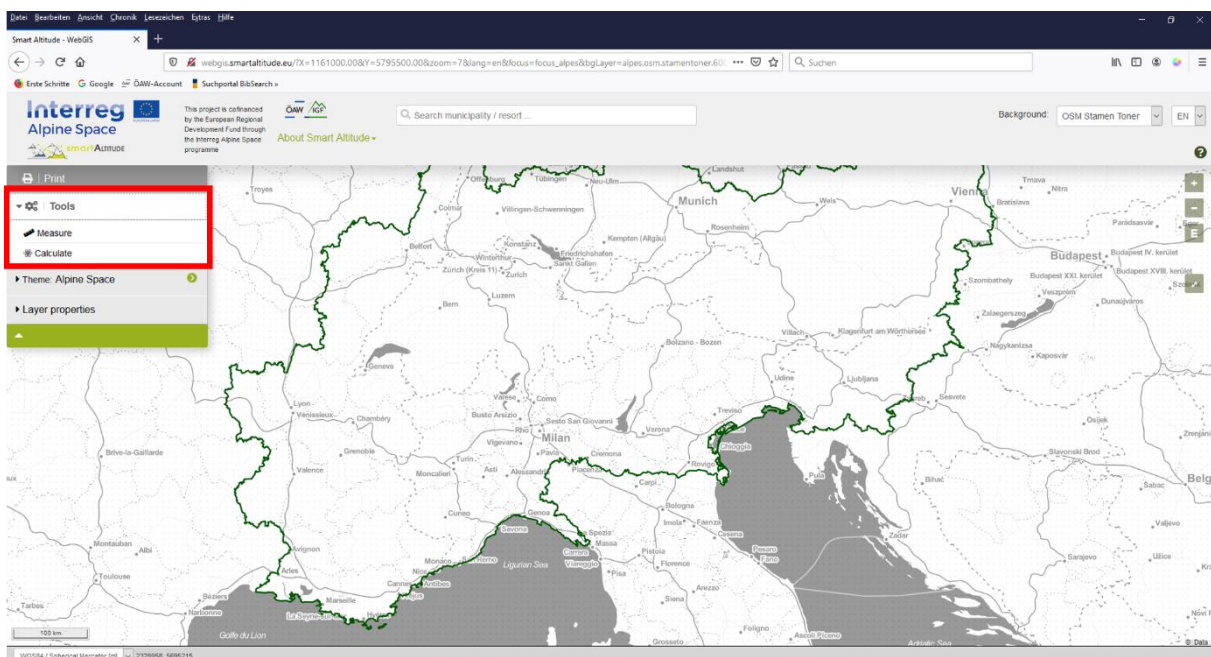
4.1 Smart Altitude specific themes

As the Smart Altitude project focuses on enabling and accelerating the implementation of low-carbon policies, project specific themes are implemented, which should help stakeholders with their planning and inform interested people about specific topics. The Key Performance Indicators (KPIs) are visualized by the Living Labs and can only be found for them. The total list is given in chapter 1.5 and at WIKIALps http://www.wikialps.eu/doku.php?id=wiki:smartaltitude_webgis_layers.

Ms. Curious clicks through some datasets. The legend and the “Parameter metadata box” support her with screening the data. She gets a better idea of what she could use for her council meeting.

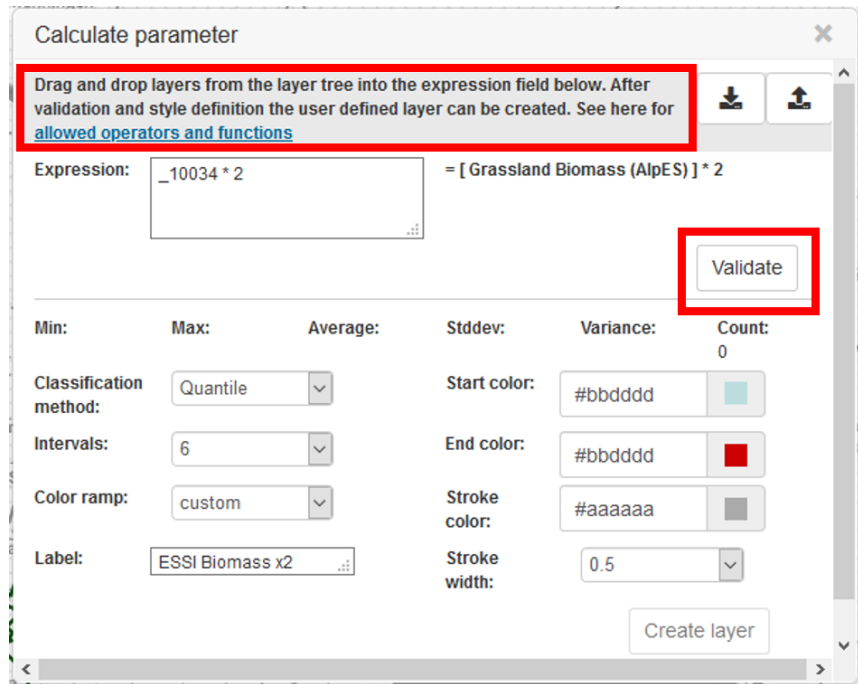
4.2 Calculate new parameters

Ms. Curious wants to find out more about the offered tools. **She clicks on “Tools”** on the left hand side above “Theme”, where the **“Measure”** and **“Calculate”** tool are provided.

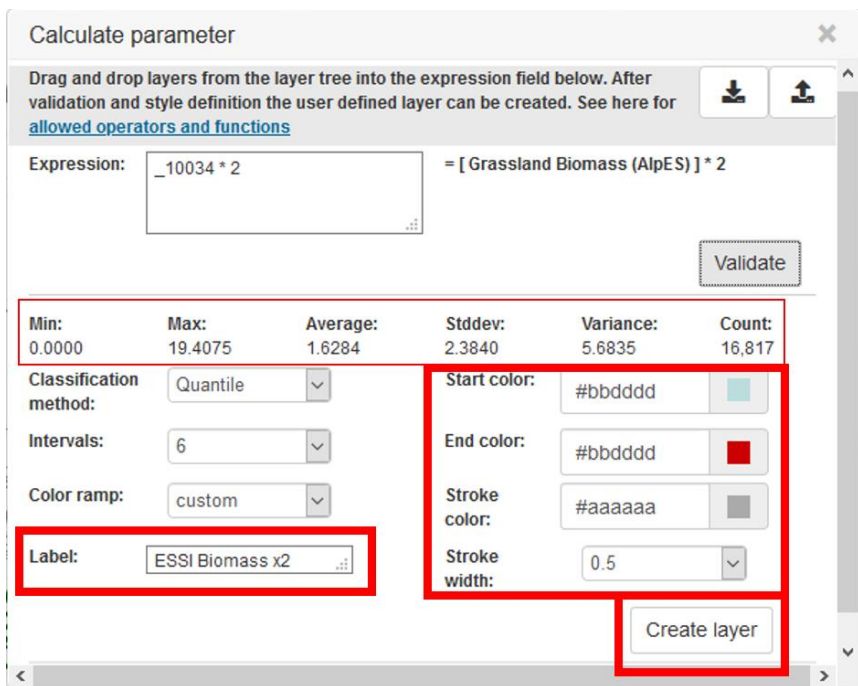


Ms. Curious clicks on “Calculate” and the “Calculate parameter” window pops up. At the top there is a short explanation. Through drag and drop of layers into the expression field below, different layers can be used for calculations. In the “Expression field” an example is given. The first digits represent a specific layer and the operation of multiplying by two can be done by the user through typing the wanted operation. **Following operators and functions are possible**, see http://www.wikialps.eu/doku.php?id=wiki:smartaltitude_webgis_calc_operators_functions. By clicking on the “Validate” bottom, the expression is controlled for a correct syntax operation.

It is important to understand that the operation is done for every pixel in a raster format or for every polygon in a layer. For example, every value of a pixel is multiplied by two. The best way to understand how spatial calculations work is to play around and test some operations. For example, compare the values of several calculation results with the same pixels of your input data. You will find out what happened through the calculation.



Statistical parameters are calculated automatically and are shown in the “Calculate parameter box”. Ms. Curious can choose the fill colours, the outline width and outline colours (right). Also a new label can be formulated (bottom left). After a successful validation and the style settings have been finalized, the new layer is created through clicking on “Create layer”. Ms. Curious

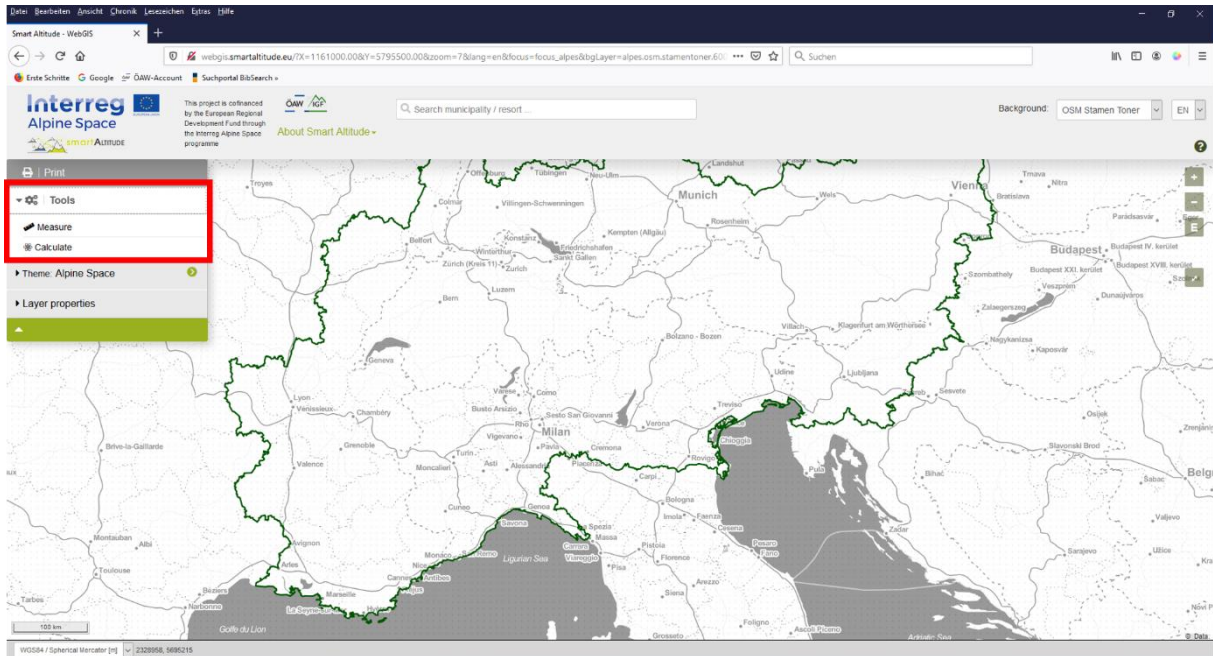


finds her new layer in the layer list, where she can edit the appearance of her own layer in the same way as for all other layers (see chapter 5.2).

Ms. Curious is excited about this tool and wants to create her own layer, see chapter 5.1. But first she explores the other tools.

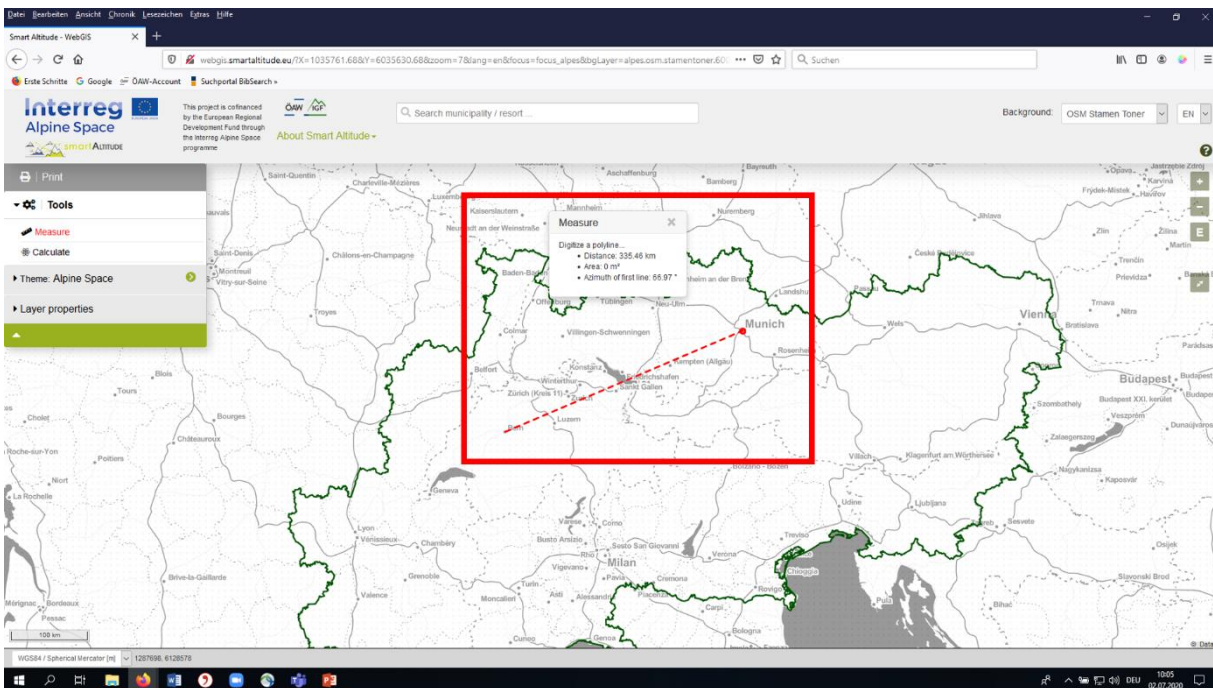
4.3 Measure distances and areas

In a next step Ms. Curious finds out that she can measure within the map of the WebGIS. Spontaneously she wants to know the distance between Bern and Munich. The “Measure” tool is located in the category “Tools” above the “Calculate” tool.



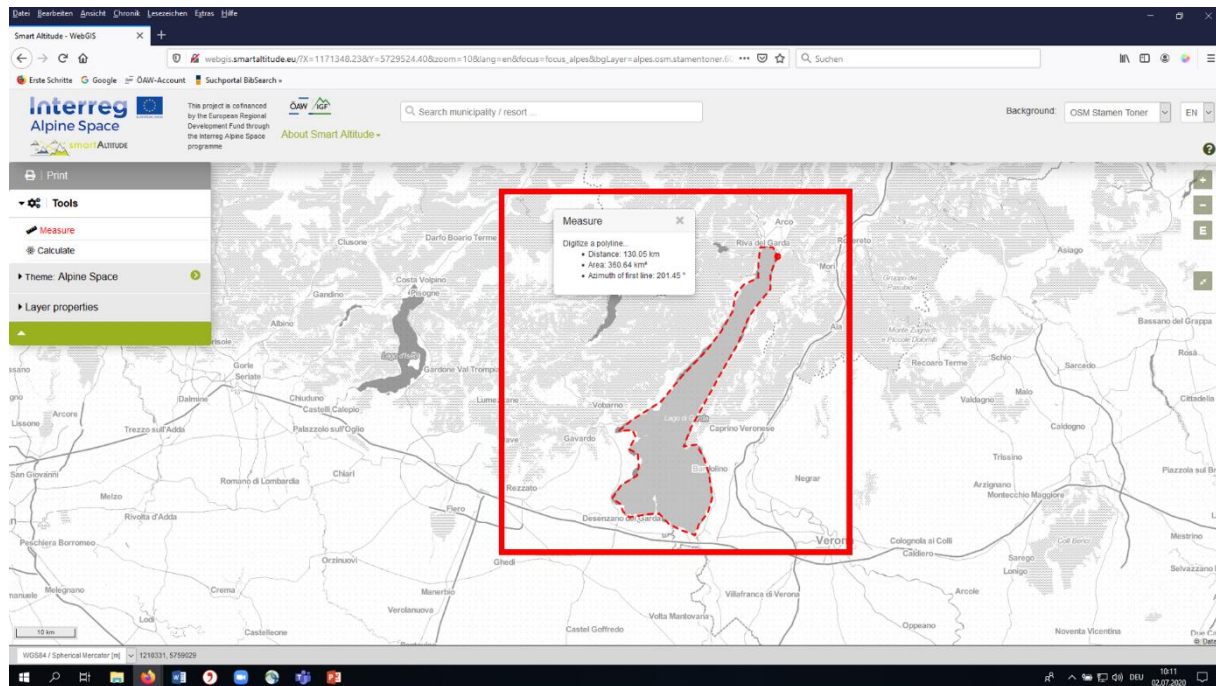
By clicking on it a red spot appears under the mouse pointer. She clicks on the start point at Bern and on the end point of her interested distance in Munich.

A box appears and gives the value for the distance in kilometres.



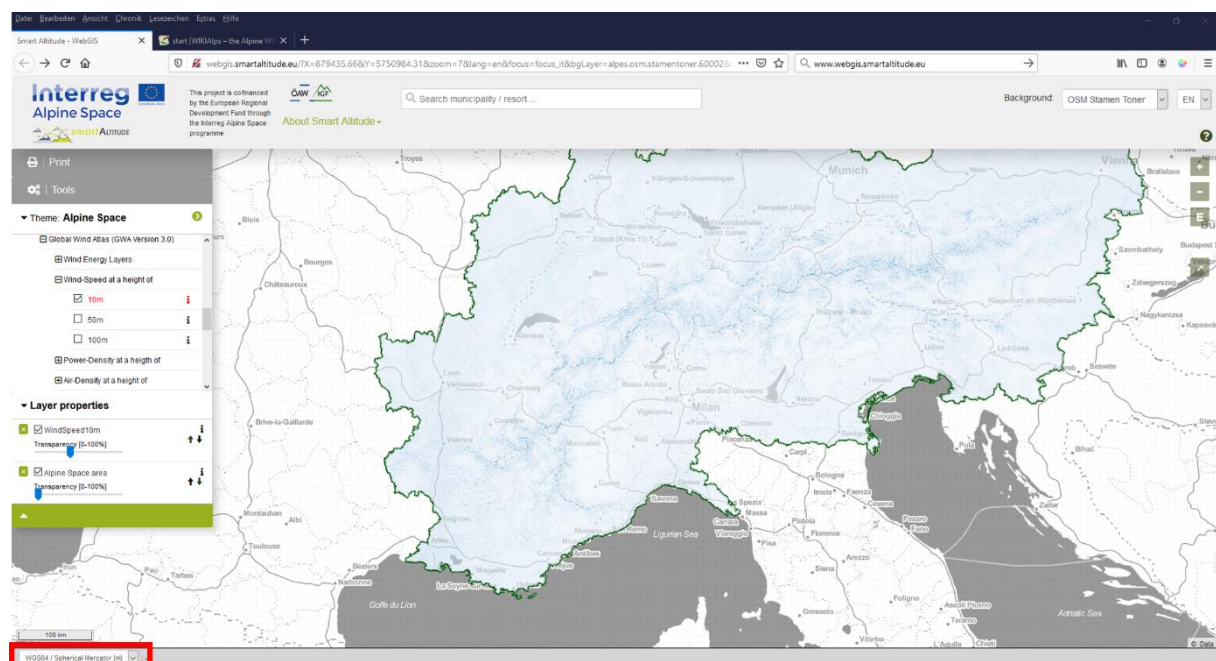
Ms. Curious detects that she can also measure the area and the azimuth of the first line. The area can be calculated when clicking around the area of interest. The polygon should be closed for achieving

an exact result. Ms. Curious digitises roughly the borders of the Lake Garda (Italy) and finds out that the area is about 361 km².

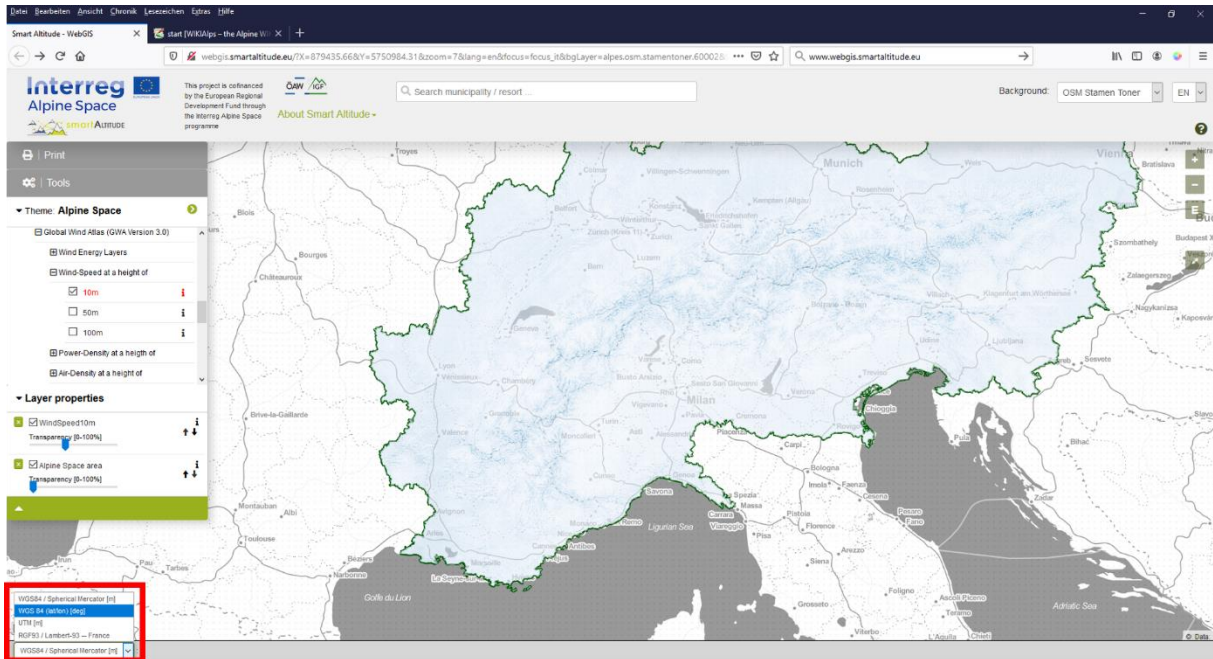


4.4 Get coordinates of a specific location

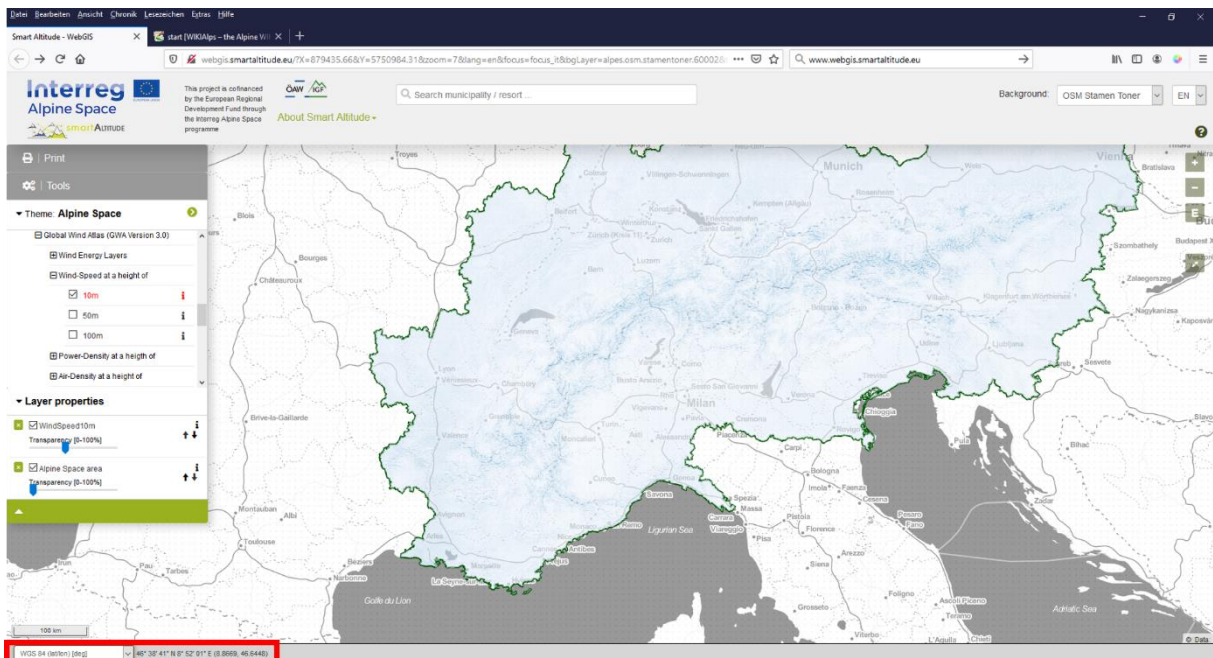
A friend of Ms. Curious, who heard about her project and ambitions, wonders if Ms. Curious could look up the concrete value for wind speed at a height of 10 m (in the content tree: Renewable Energy Potential -> Wind -> Global Wind Atlas -> Wind-Speed at a height of -> 10m) for a specific location, namely the location of a ski resort. She has the coordinates of the spot in the coordinate system WGS 84 from his GPS. **Ms. Curious soon discovers the word “Coordinate” at the bottom of the Smart Altitude WebGIS interface.**



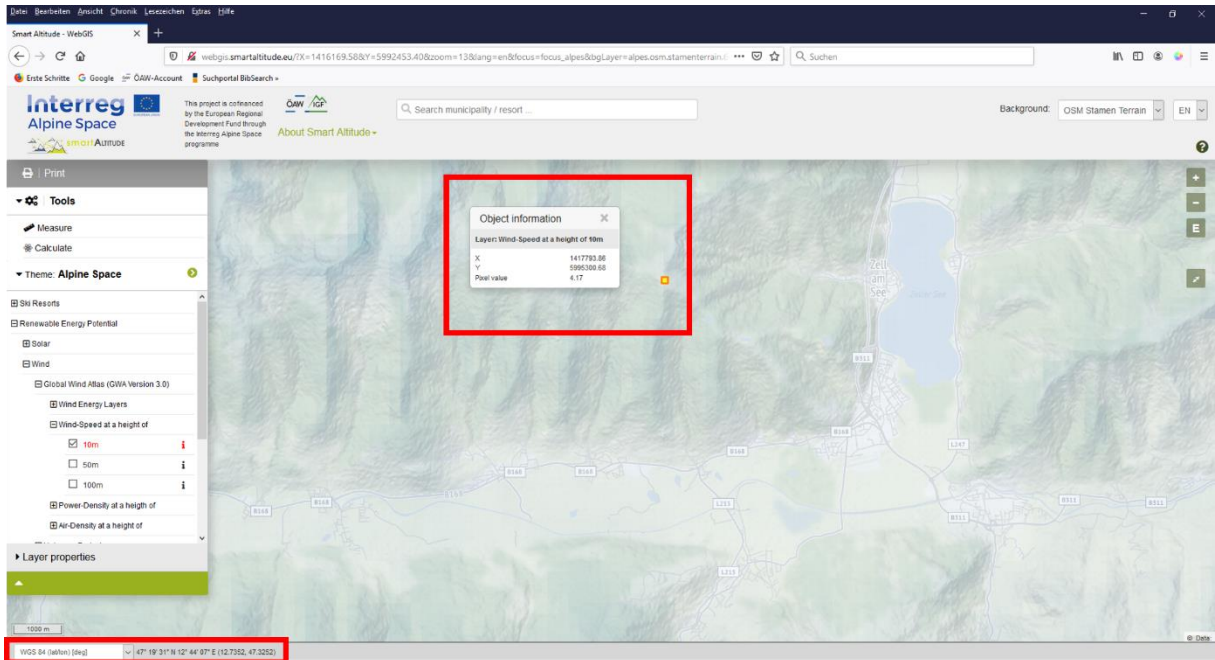
First she switches the Coordinate System to WGS 84 using the drop down menu.



The coordinates on the right hand side directly beside the drop down menu show the coordinates of the current mouse position in the chosen coordinates system. Thus, **if Ms. Curious moves her cursor across the screen, the coordinates change accordingly.** If the mouse cursor position is located outside of the mapping area, no coordinates are shown.

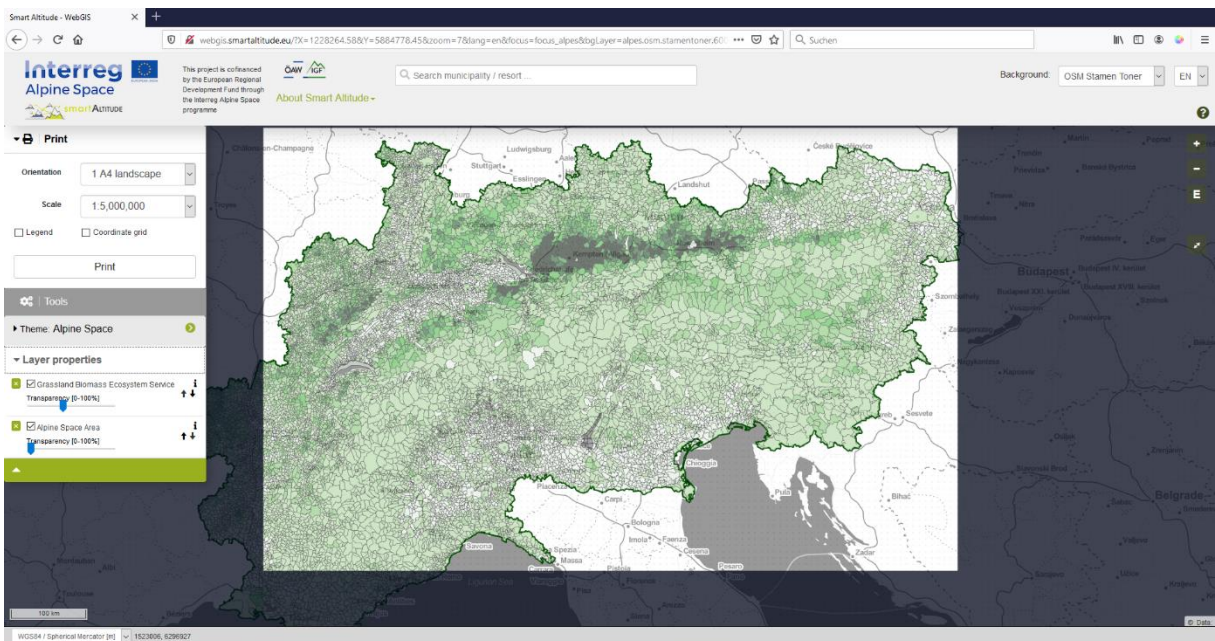


When Ms. Curious moves her mouse cursor to the municipality where the requested spot is located, she soon locates the given smart coordinates. Ms. Curious finds the renewable parameter of wind speed in 10 m height in the content tree. Because all the renewable datasets are shown in raster format the information can be queried for each pixel. Selecting the needed pixel, she can quickly write down the precise value given in the "Object information box", where also the coordinates (WGS84 Spherical Mercator [m]) are given.

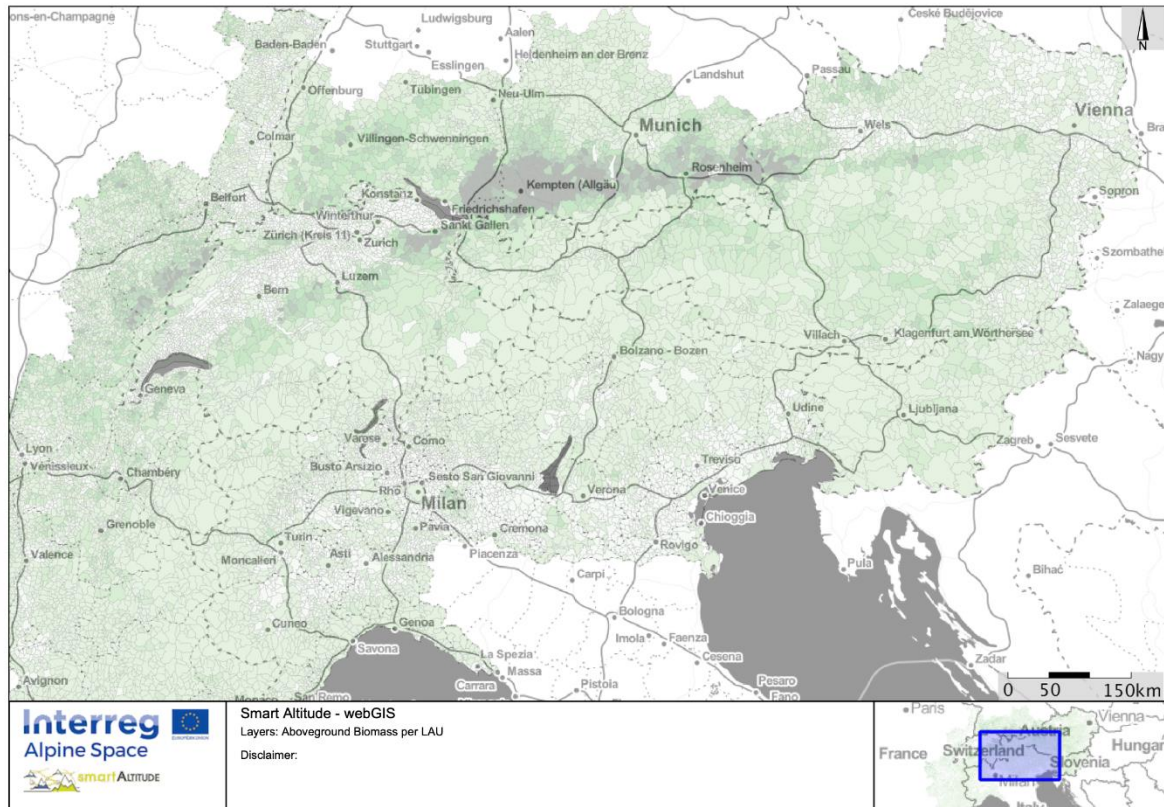


4.5 Print and create PDF files as maps

The Smart Altitude WebGIS offers the possibility of printing and saving your own generated maps. The **“Print”** button is located above the menu tree and guides through the work steps of printing.



The extent of interest has to be shifted into the middle of the printing view. The orientation and the scale can be adapted. Check **“Legend”** and **“Coordinate grid”**, if you want to implement those features in your final map. The print function then converts the current map view to a pdf file, which can be saved as separate PDF file.



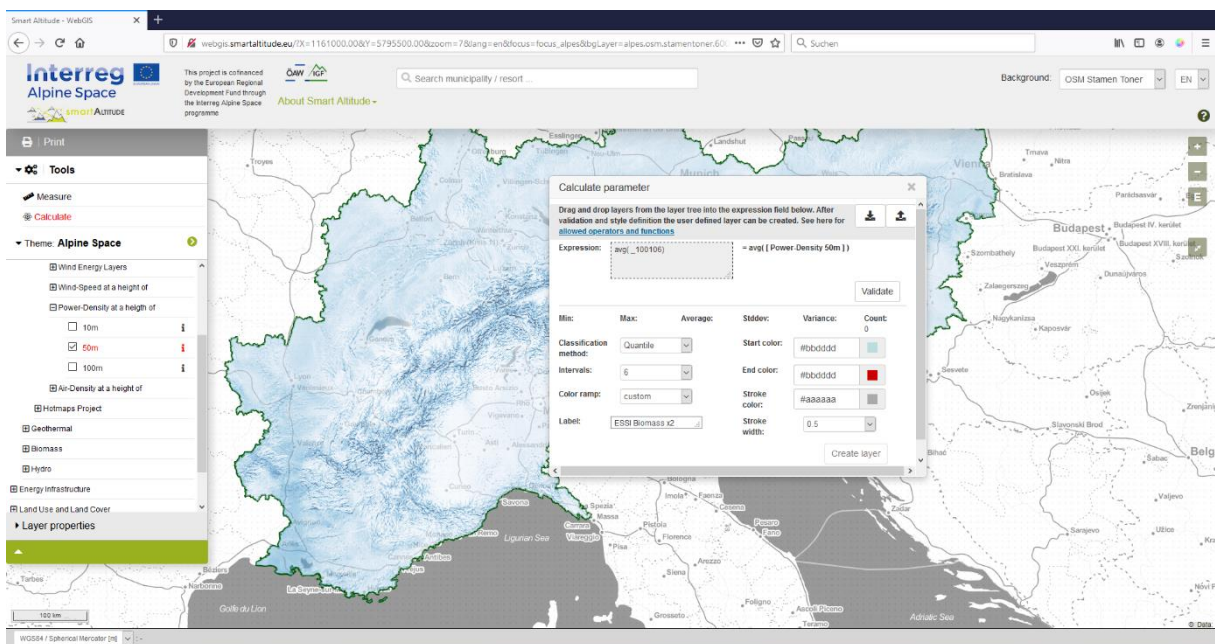
Ms. Curious is excited of how easy it is, to work with the tools and how much information she can gather by using the WebGIS. Now she wants to create her own maps of her region of interest with the data she needs for the council meeting.

5 CREATE YOUR OWN MAP

This chapter presents how a new layer can be calculated and how a proper map can be generated.

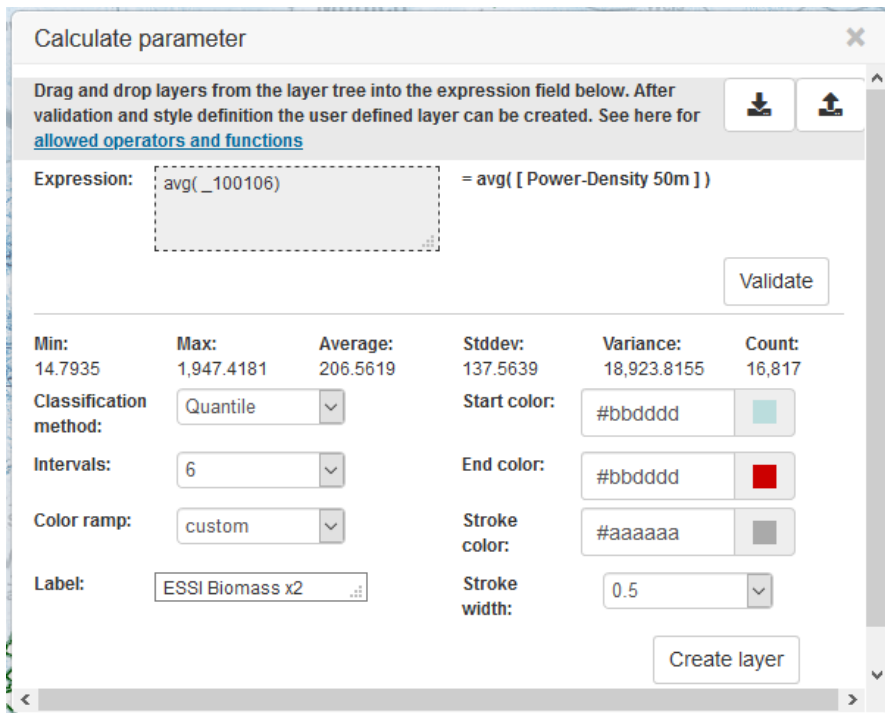
5.1 Calculate a new layer

Now Ms. Curious wants to create her own new layer. Chapter 4.2 already gives an overview of the “Calculate” tool. The basic data she needs is offered within the WebGIS, but **she would like to compare and calculate the average of wind power density for two different municipalities: Brunico/Bruneck and Cortina d’Ampezzo**. Therefore Ms. Curious activates the layer “Power-Density at a height of 50 m” in the content tree. She also has to start the “Calculate” tool.

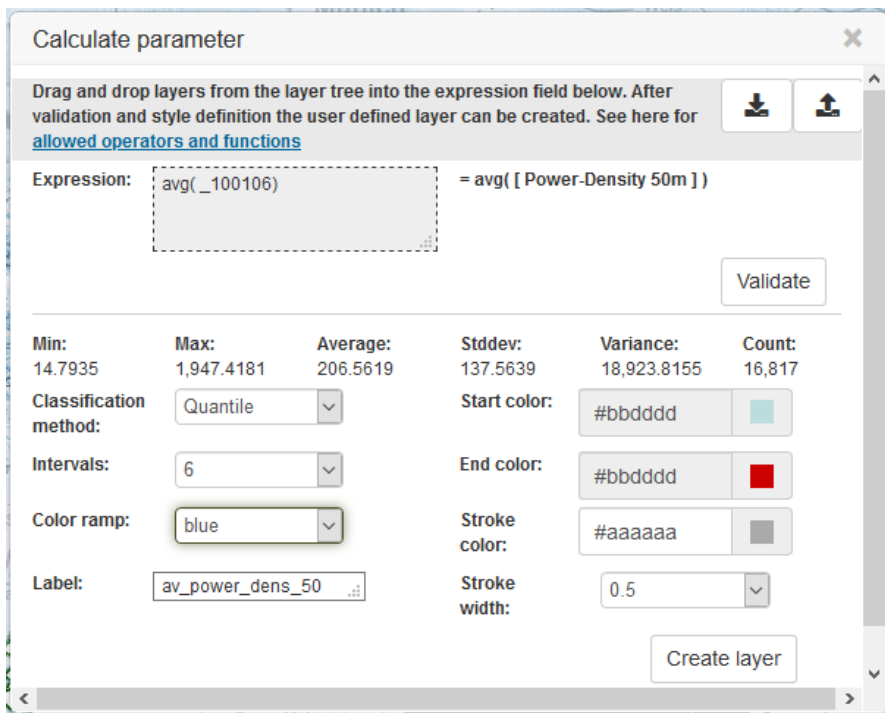


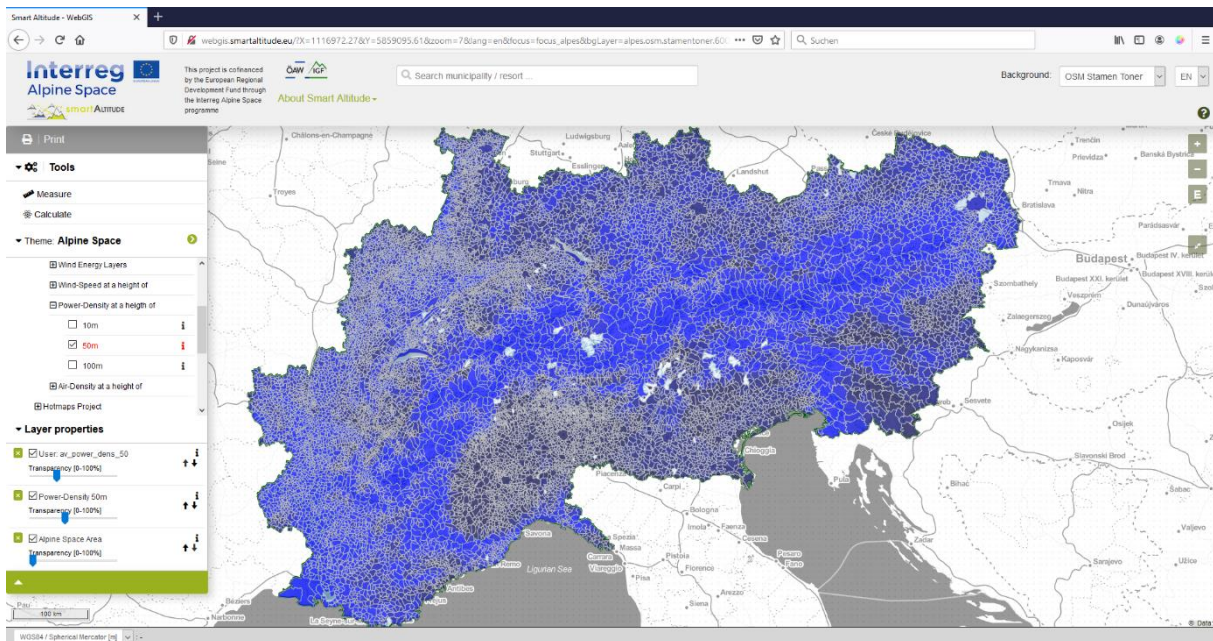
Ms. Curious deletes the example expression. She drags and drops the layer into the calculation field. Then she sets the required operation “av()” - average for pixel values per LAU unit and clicks “Validate” to proof a successful syntax. All possible mathematical operations and their explanations are listed in http://www.wikialps.eu/doku.php?id=wiki:smartaltitude_webgis_calc_operators_functions.

Statistical parameter arises when a correct validation is proven.

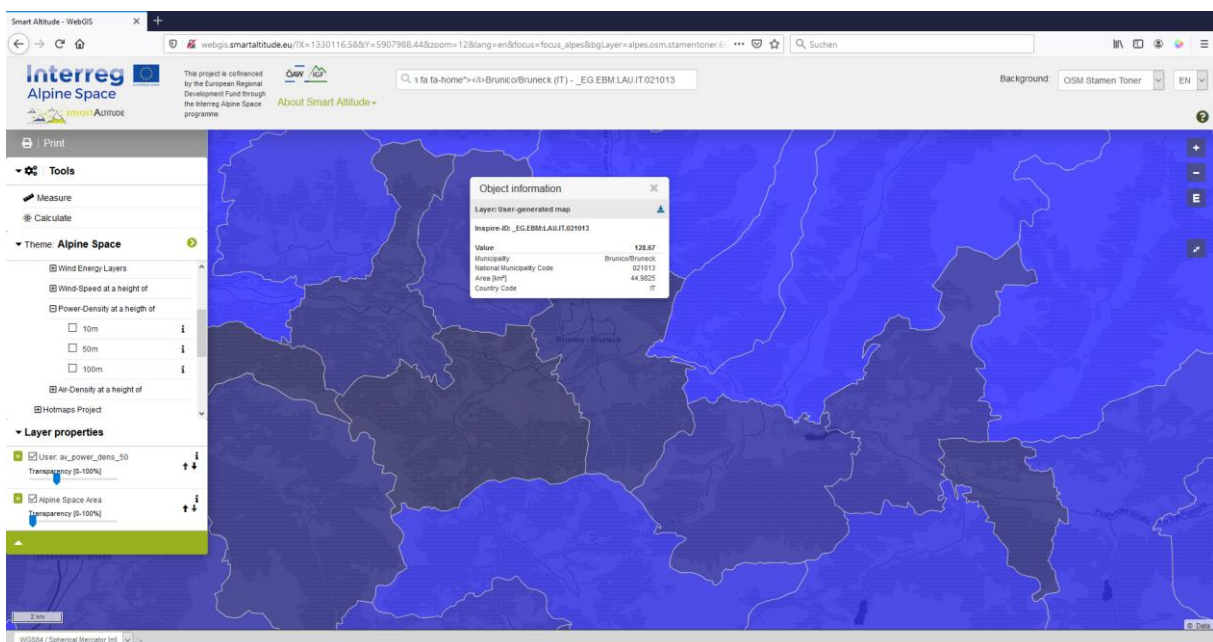


Ms. Curious decides on a blue colour ramp, the outline width and outline colour. Also a new label is typed into the corresponding field. By clicking on “Create layer”, the new layer appears and is listed in the layer list. Now she can continue with further styling of the map.

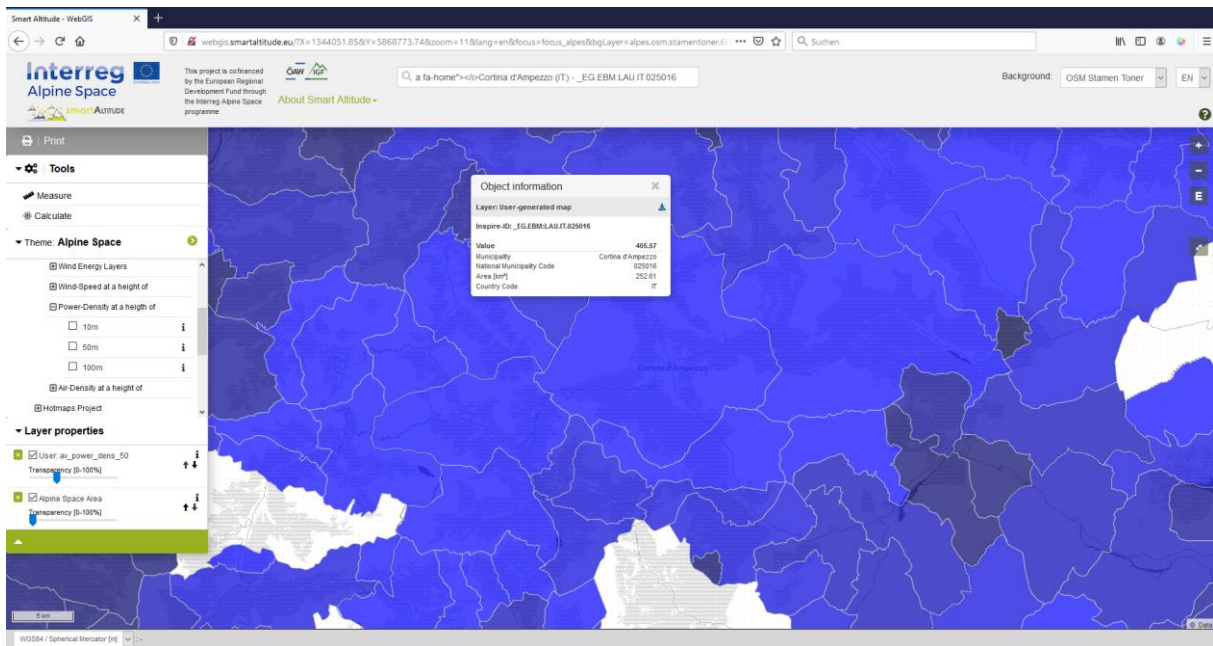




Ms. Curious uses the municipality search window and searches for “Bruneck”. By clicking on the polygon of this municipality she finds out that the average power density at a height of 50 m is 128,67 W/m² for the whole municipality.



To compare, she searches for the municipality of Cortina d’Ampezzo, where the average power density at a height of 50 m is 405,57 W/m² for the whole municipality.



Ms. Curious found out that the average power density is higher at Cortina d’Ampezzo than for Bruneck. She gets the idea that this wind power could be used for energy supply. This information can be used to contact other stakeholders and companies, for a concrete evaluation and planning of a potential wind park in this municipality.

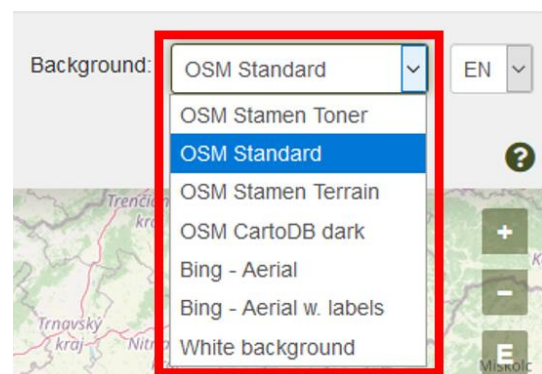
5.2 Style your new map

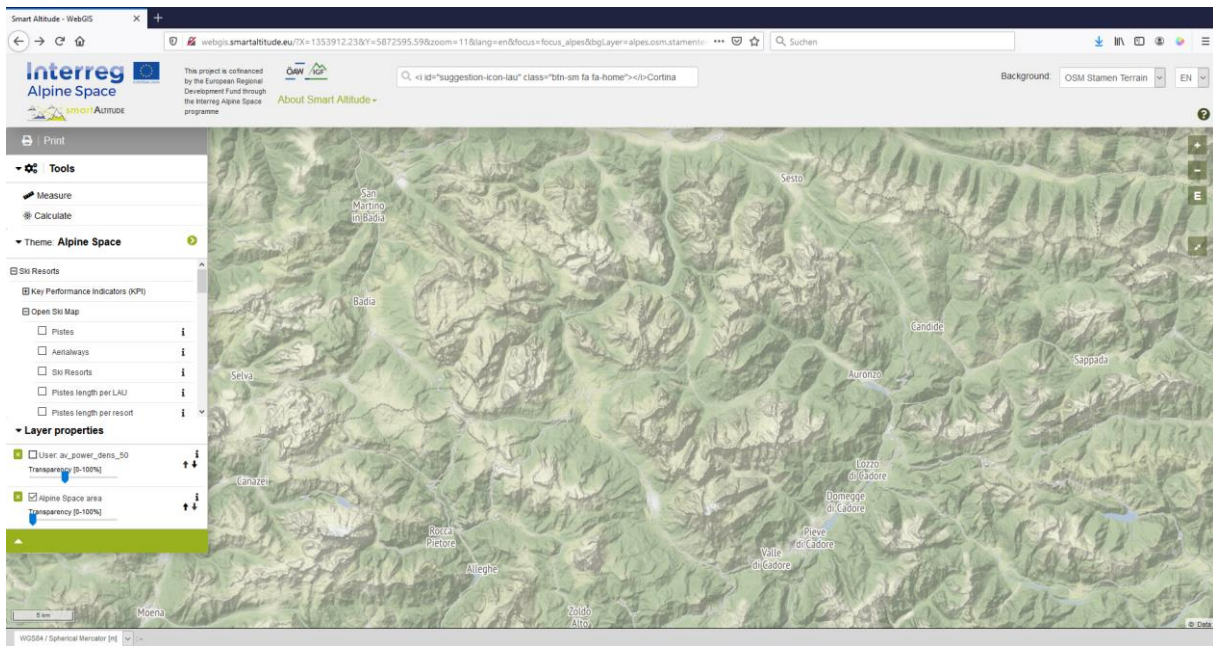
The listed layers, which are required for Ms. Curious map, can be further edited to create a corresponding map.

5.2.1. Change background map

Ms. Curious is not really satisfied with the background map. She wants to try some alternatives. **She can change the background map by clicking on the “Background” drop down menu located in the upper right corner of the website.** She has to decide which of these options best supports her layers and which of these help her with the orientation.

Afterwards she zooms to the extent of her interest: Cortina d’Ampezzo.

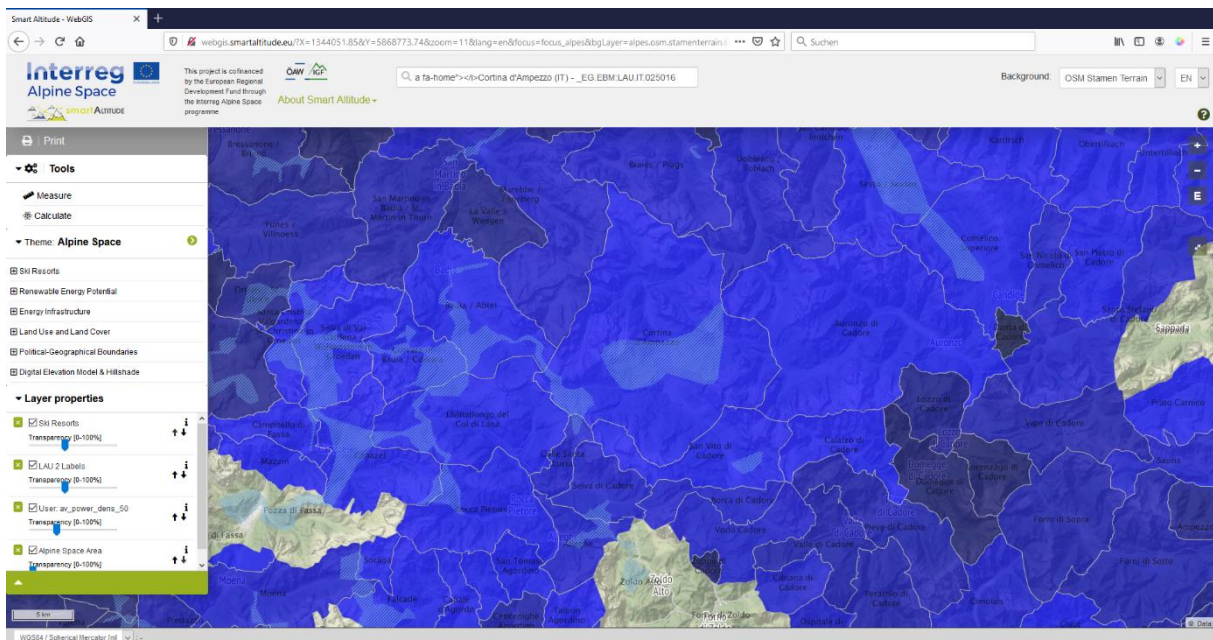




5.2.2. Change transparency of the layer

Ms. Curious wants to see her generated layer, the background map, the labels for the municipalities for her region of interest and the ski resorts in one single map.

She activates the following layers: Av_power_dens_50, LAU – Labels (Political-Geographical Boundaries -> Administrative Units) and Ski Resorts (Ski Resorts -> Open Ski Map) –by clicking on the layer name.



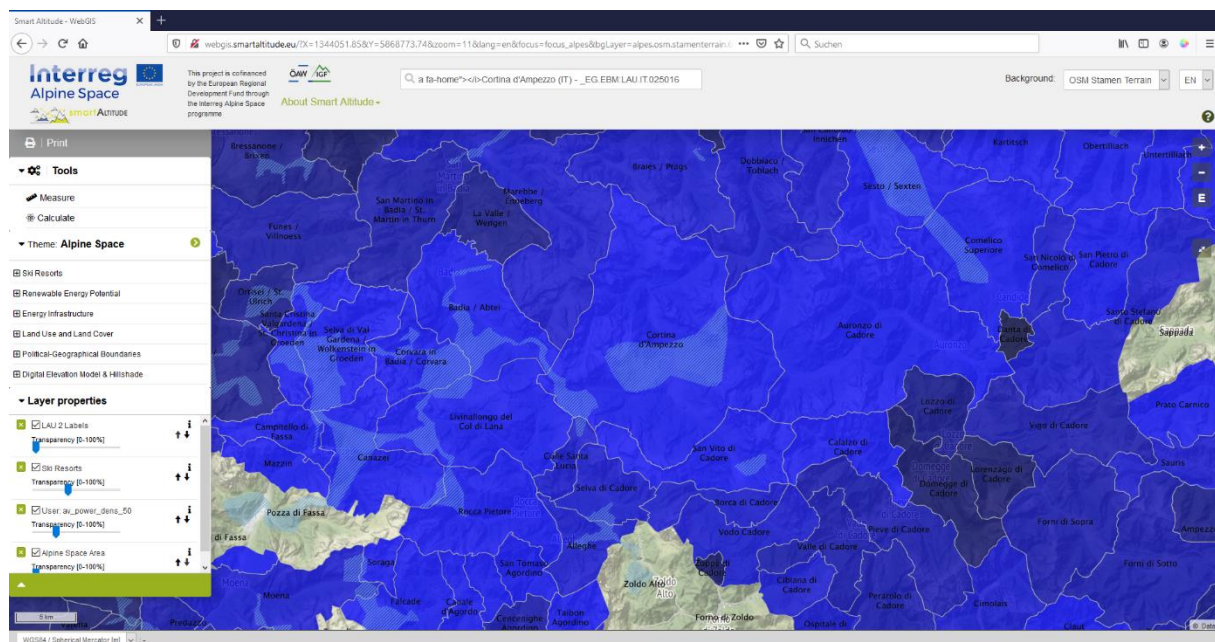
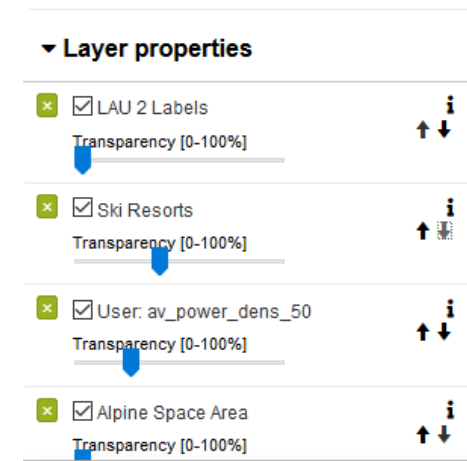
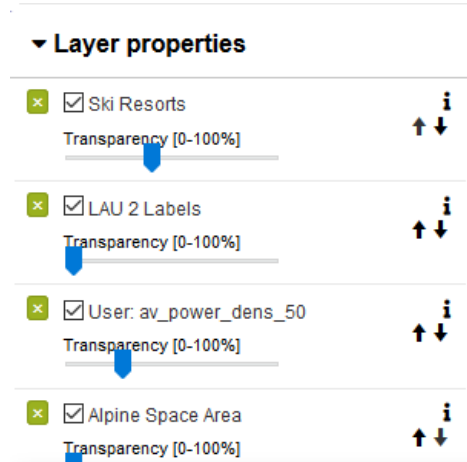
For visibility purposes, Ms. Curious wants to see the background map through the resulting datasets. Therefore, she needs to change the transparency of the layer “av_power_dens_50”. She changes the transparency by moving the slider between 0 % and 100 % invisibility in the layer properties below the menu tree.

Ms. Curious prefers to see the LAU labels in solid colours in the front of all other layers. This can be done by setting the transparency of the main presented layer to 0 %. Next she wants to see the ski resorts with about 50 % transparency, her own calculated layer with about 30 % transparency and in the background the OSM Stamen Terrain.

The way the selected layers appear in the map and in the layer properties, depends on the order in which Ms. Curious activated the single layers in the Smart Altitude WebGIS. The last selected layer is located at the top of the layer properties list.

5.2.3. Change order of the layer

Ms. Curious wants to have the LAU labels at the top of her layers. Then she wants to see the ski resorts. To do so, **she changes the order using the arrows on the right hand side of the layers in the layer properties.** Clicking on an upward arrow brings the layer one level higher. Clicking the downward arrow brings a layer one level lower. Ms. Curious changes the order until she has her desired sequence. Additionally, she sets the wanted transparencies by moving the slider.



Ms. Curious now has a first impression of the average power density of Cortina d'Ampezzo and the surrounding municipalities. She can open the "Parameter metadata" through the "i" icon to see the legend and the unit of the new layer. The unit is "W/m²" and the map shows that this municipality has a quite high potential of power density at a height of 50 m.

6 SAVE YOUR WORK

This chapter presents how the created layer can be printed and saved as a proper map with all its important mapping components.

6.1 Print and save your own map

Ms. Curious wants to present the created map as a coloured printout to the council, so she can easily show how maps can be created within the Smart Altitude WebGIS.

She uses the “Print” button, located above the menu tree. First, she has to move her extent of interest into



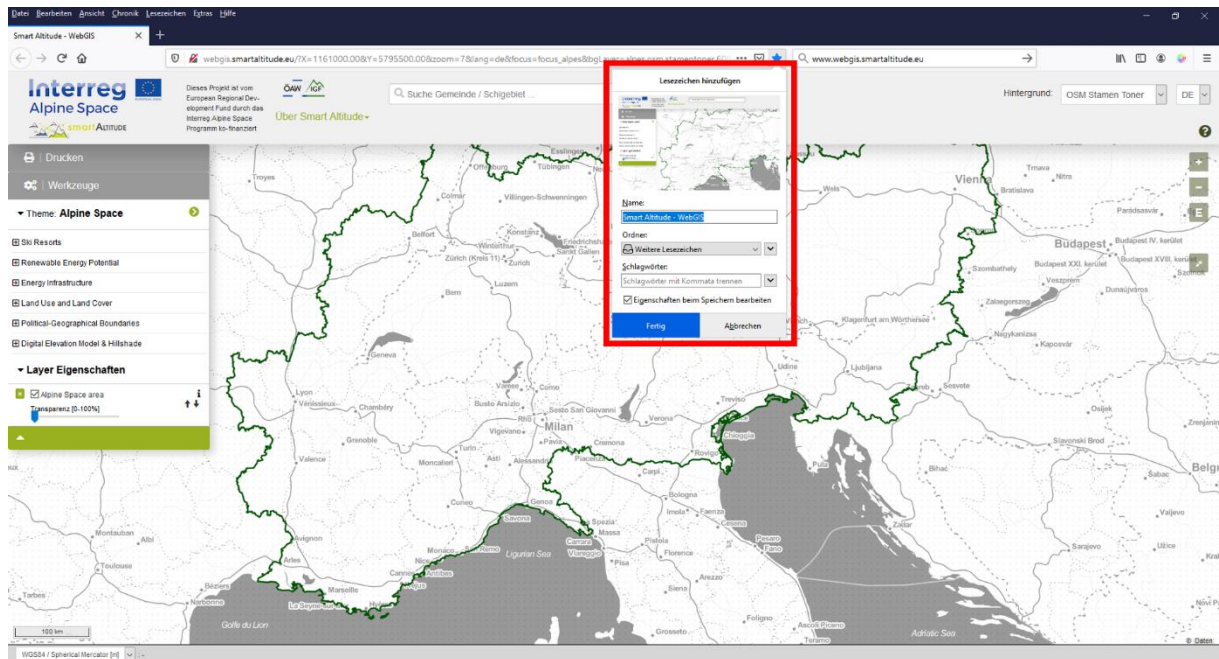
the middle of the print view. **The orientation and the scale can be adapted.** Check “Legend” and “Coordinate grid”, if you want to implement those features in your final map. The print function then converts her current map view to a pdf file. She saves the pdf and prints out the map with her printer. For further information see 4.5.

Ms. Curious is proud of her first map that she created with the Smart Altitude WebGIS. It is colourful and includes a scale and a legend, so that people can easily understand it. With this map, she can explain to the council that the municipality of Cortina d’Ampezzo has a higher average power density than Bruneck. Ms. Curious also wants to print the map for Bruneck, therefore she only has to repeat the printing task by moving the extent of Bruneck into the print view. Bright blue colours mean high power density and dark blue colours show low values.

Ms. Curious is looking forward to discuss her ideas with experts on renewable energy, ski resorts managers and other stakeholders. Maybe her first attempts with the WebGIS can lead to a more sustainable renewable energy solution.

6.2 Return to your own project

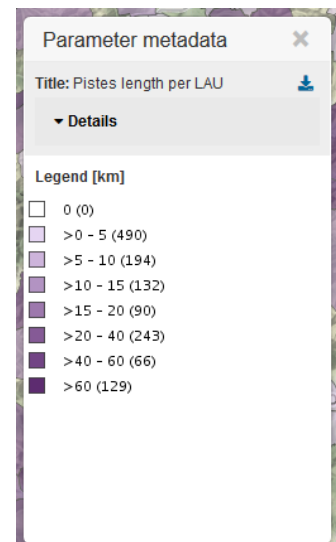
As the working day comes to an end, Ms. Curious makes sure to save her own Smart Altitude WebGIS map, so she can easily return to the same map, by saving the web address (URL) as favourite or bookmark (depending on the used browser).



6.3 Download your own project results

In general, it is possible to download some project results out of the Smart Altitude project as csv file. Also self calculated layers can be downloaded. **For the following layers a download symbol is visible next to the title in the “Parameter metadata” box:**

- All KPIs together in one csv file
- Pistes length per LAU
- Pistes length per ski resort
- Biosphere Reserves (Protected Areas - IGF curated)
- National Parks (Protected Areas - IGF curated)
- Natural Parks (Protected Areas - IGF curated)
- World Heritage Sites (Protected Areas - IGF curated)
- Grassland Biomass Ecosystem Service (Biomass ->AlpES Project)



Ms. Curious now feels confident enough to explain and present the WebGIS at the council meeting. She wants to underline that there are many datasets covering a wide range of themes, which are highly relevant for adaptation and mitigation strategies for ski resorts.

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Have fun generating your own Renewable Energy Potential and specific ski resorts related maps in the Alpine Space!

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Questions and Comments?

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