



TUTORIAL

1. GETTING STARTED

- 1.1 Uses and purposes
- 1.2 User's account

2. PROJECT EDITOR

- 2.1 "Projects" section
 - 2.1.1 Add a new project
 - 2.1.2 Settings
 - 2.1.3 People
 - 2.1.4 Components
 - 2.1.5 Tables
 - 2.1.5.1 Add private table
 - 2.1.5.2 Forbidden characters
 - 2.1.5.3 Forbidden words
 - 2.1.5.4 Type of data
 - 2.1.5.5 Configure a table
 - 2.1.5.6 Appearance setting
 - 2.1.5.7 Filter setting
 - 2.1.5.8 Weighting setting
- 2.2 "Curves" section
- 2.3 "Map Styles" section
- 2.4 "Color Sets" section
- 2.5 "Log" section

3. DATA EXPLORER

- 3.1 Data Filtering
- 3.2 Map Weighting
- 3.3 Data Visualization
 - 3.3.1 Colour and size
 - 3.3.2 Inverse selection
 - 3.3.3 Map styles
 - 3.3.4 Tables
 - 3.3.5 Graphs
- 3.4 Description of the project
- 3.5 Export data
- 3.6 Comments and feedbacks

4. REFERENCES

1. Getting started

The Interactive Visualisation Tool (**InViTo**) is an instrument conceived as a toolbox for visually supporting the analysis, the exploration, the visualisation and communication of both spatial and non-spatial data in order to facilitate policy and decision making. InViTo focuses on data sharing and visualisation of information as a vehicle for the social inclusion in the planning processes. InViTo produces maps, where the correlation between information and their localisation generates an essential instrument for the knowledge of urban dynamics and resilience in answering to specific policies. A higher knowledge enhances the decision-making process, providing opportunities for better choices. For this reason, it can be classified within the category of spatial Decision Support System (sDSS) as a Web-GIS tool.

In particular, InViTo does not provide spatial solutions, but it aims at facilitating the analysis, exploration, visualisation and communication of data in order to improve the communication between actors coming from various backgrounds and with different interests. Projects can be managed and set in an easy and accessible way by people also with a low expertise in GIS technologies. Meanwhile, users have a high level of possibilities for customising their project and relative visualisations. In addition, InViTo can be part of instrumental equipment for collaborative working sessions, such as meeting or workshops, thanks to its interactive and dynamic usability. Its quick responses and visual interface can improve the discussion among people, offering a shared basis for enhancing the debate.

As a toolbox, InViTo was developed as a set of instruments for dealing with different spatial issues, disciplines and case studies. InViTo allows the **weighting** of different maps, as in a simplified multi-criteria analysis, and the **exporting** of maps with filters and weights to different formats (*.csv; *.pdf; *.jpg), so that the outcomes can be re-used for many other purposes.

InViTo can be accessed on the base of individual involvement in projects. In particular, there are **three different kind of users**: the project contributors, who have a personal account for full access to the creation and editing of a project; the project advisors, who have a personal account for accessing to non-public project, download maps and leave comments; and, finally, the public users, who do not need an account but can only view and explore the data within public projects.

The structure of InViTo

This configuration implies that the structure of InViTo is based on two main sections: the **project editor**, and **data explorer**.

The **project editor** is designed for GIS technicians, planners and administrators of projects. Here the logged-in users can create new projects and manage existing ones deciding the information that need to be seen by exploring users. Moreover, in the back-end interface, the logged-in users can decide the filter modality choosing among checkbox, dropdown menu, range sliders or single choice range sliders. Finally, specific buttons provide possibilities for customising the visualisation or for enabling particular elements such as tables, analysis grids or background maps.

The **data explorer** is designed for final users. In fact it can be public and allows people visualizing, filtering and exploring data related to specific projects.

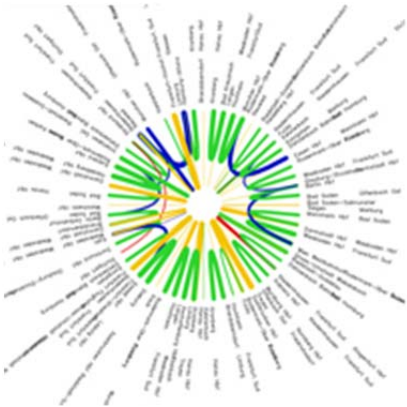
The structure of data explorer can be in turn divided into three subsections:

- the **data filtering** section;
- the **map weighting** section;
- the **data visualization** section.

The distinctive features of InViTo are therefore dynamicity and interactivity, which make it open to variously skilled users and suitable to be part of instrumental equipment for meetings and workshops. It can be used by a single person or collectively during discussion sessions. In this case, the displayed map can become the interface for sharing opinions and reasoning. Its quick responses and visual interface offers possibilities for improving the discussion among people, providing a shared basis for enhancing the debate.

1.1 Uses and purposes

The main task of InViTo is to create opportunities for reasoning on data.



InViTo can be used to:

- detect critical areas and areas with more opportunities;
- design alternative options;
- evaluate "what if" scenarios;
- investigate data spatial distribution;
- data mining;
- customise data visualisation;
- stimulate discussions;
- elaborate shared solutions.

1.2 User's account

According to the individual involvement in projects, InViTo has three different kinds of user's access.

In order to create, edit or delete projects:



users need to login with a "*project contributor*" account. In order to have a personal account, please, request it to stefano.pensa@polito.it.

In order to explore an existing project, there are two possible cases:



If it is a **non-public project**, users need to login with a "*project advisors*" account. Such kind of users can also download maps and leave comments to the project. In this case of private project, the log-in permission is provided directly by the project administrator.



If it is a **public project**, log-in is not needed and you have open access to its visualisation. Public users can not download data, nor leave comments.

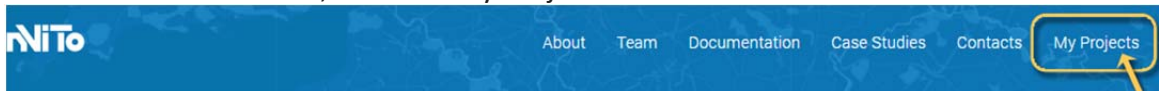
2. PROJECT EDITOR

WARNING! This section is only for logged-in users. Depending on user's profile, InViTo allows different options on the visibility and editing of projects.

See paragraph 1.2 to know the possible options. If you are a Project Advisor or a Project Contributor (logged-in user) continue reading Section 2 to discover the possibilities for editing and customising projects. Otherwise, skip to Section 3 and discover how explore data.

If you are a logged-in user, you can access to your project list and back-end interface in two ways:

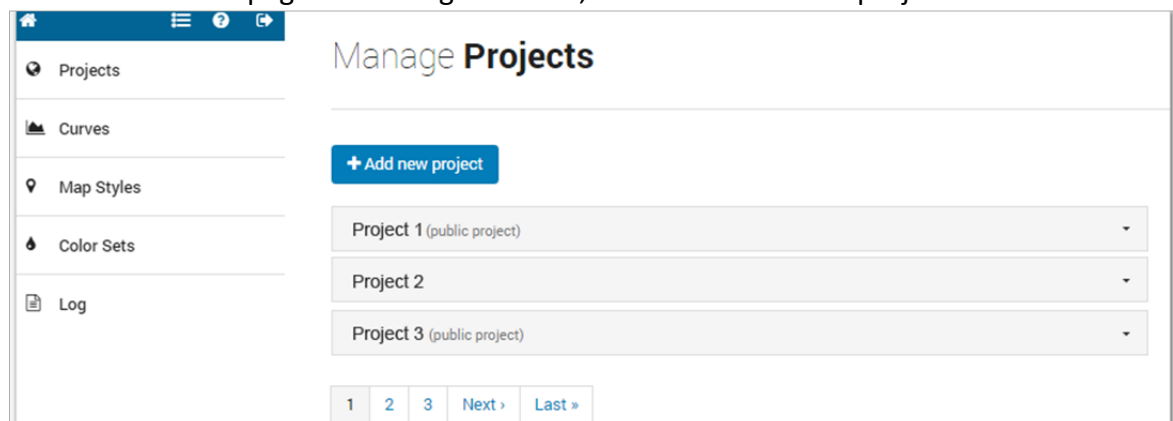
- from the InViTo website, click on “My Projects” menu.



- from the data explorer window, clicking on the project list icon.



Then, you will access to a page containing a toolbar, a menu and a list of projects:



The toolbar, on the upper left side, allows the access to the following activities:

- *Home icon*: link to the home page of Urban Toolbox;
- *List icon*: link to the list of projects accessible by each single user;
- *Question point*: access to the documentantion useful for the use of InViTo;
- *Arrow icon*: link to the home page of Urban Toolbox.

The menu on the left allows the access to the different sections for setting the visualization and interaction of each project. The sections are:

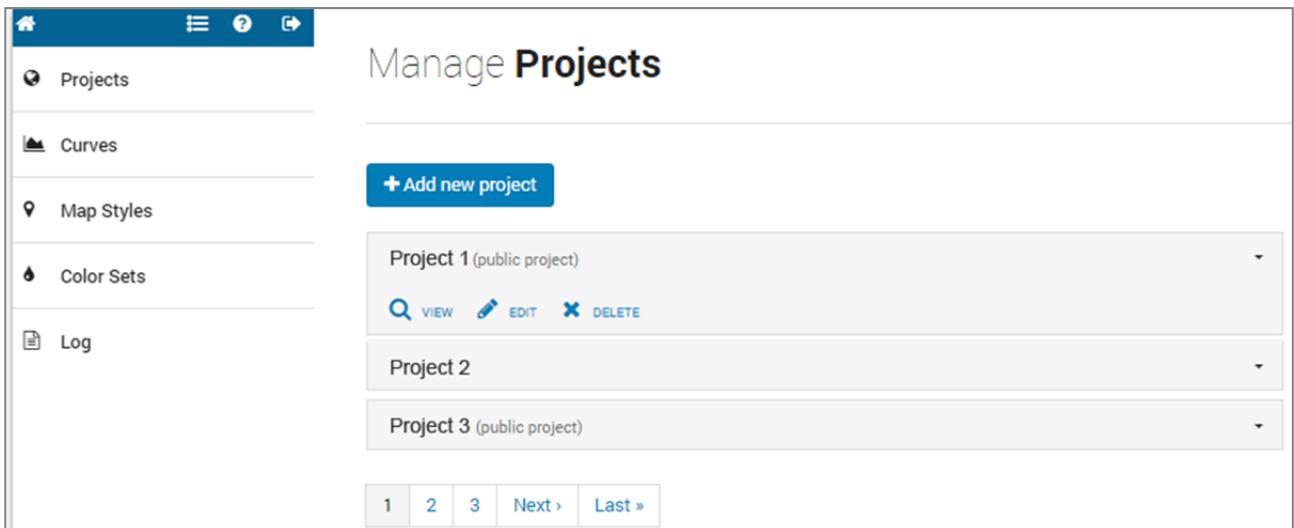
- *Projects section*: it allows to configure a project;
- *Curves section*: it allows to decide the mathematical curves necessary to build the relationships between data;
- *Map Styles section*: it allows to configure the style of background map;
- *Color Sets section*: it is necessary for defininf the colours used in the visualization of data;
- *Log section*: here you can see the last days of InViTo logs.

2.1 “Projects” section

WARNING! This section is only for logged-in users.

If you have a project advisors account, you can view the list of projects you are involved in.

If you have a project contributor account, clicking on the arrow on the right of project’s name, you can View, Edit or Delete your projects.



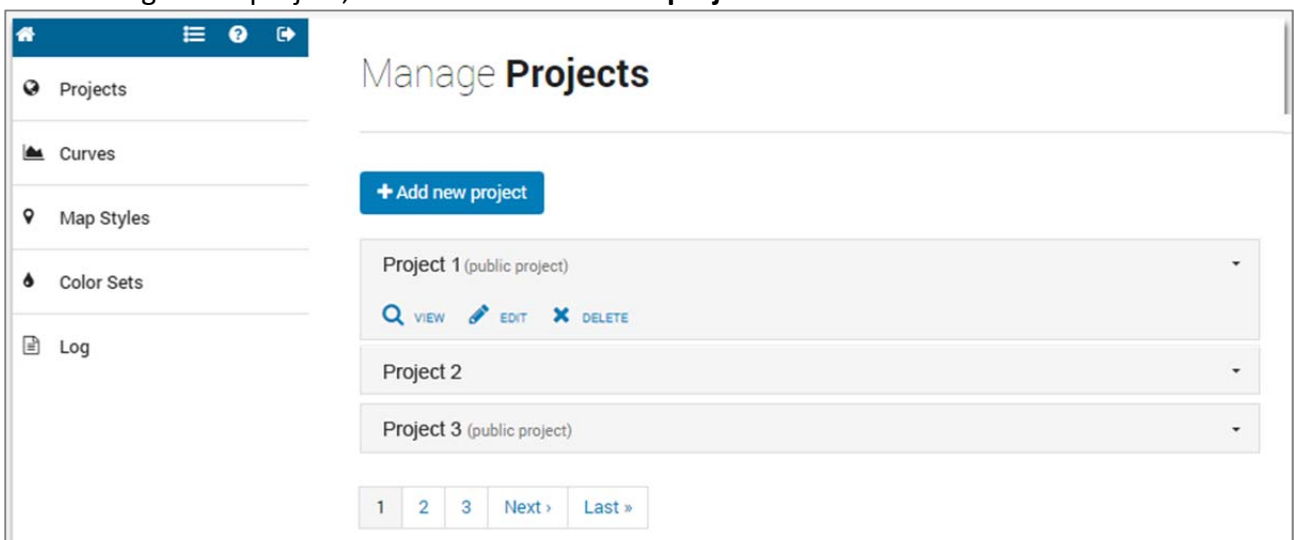
Through this section, you can configure/edit or delete a project in InViTo.

In order to start your project, go the Project Manager page (**section 2.1.1**).

2.1.1 Add new project

- If you have a project advisors account, clicking on the arrow on the right of project’s name, you can click on “View” button to display the project.
- If you have a project contributor account, clicking on the arrow on the right of project’s name, you can View, Edit or Delete the project.

For building a new project, click on the “+Add new project” blue button.



The “**+Add new project**” button opens a setting page where providing a title and a description of the project.



The screenshot shows a web form titled "Create new project". At the top left, there is a tab labeled "SETTINGS". Below this, there are two input fields. The first is labeled "Title" and contains the text "Tutorial". The second is labeled "Description" and contains the text "Description of the project". Below the description field, there is a small text label "Project description". At the bottom right of the form, there is a blue button labeled "Register new project".

After that, click on “**Register new project**” button and you will be redirected to the Edit project page.



The screenshot shows a web page titled "Edit Tutorial Demo Project". Below the title, there is a line of text "Schema user: user_160" and another line "Schema password: %yQ2qL&^JvcM". At the bottom, there is a navigation bar with five buttons: "SETTINGS", "PEOPLE", "COMPONENTS", "TABLES", and "Q VIEW". The "Q VIEW" button is highlighted in blue.

Here *Project Contributor* users have to compile 4 sections and view the model as it appears in the **data explorer view**:

- **Settings** (section 2.1.2)
- **People** (section 2.1.3)
- **Components** (section 2.1.4)
- **Tables** (section 2.1.5)

2.1.2 Settings

When you create a New Project or click on the edit button near to the project list, you access to the settings project page.

Edit Tutorial Demo Project

Schema user: user_160
Schema password: %yQ2qL&^JvcM

SETTINGS PEOPLE COMPONENTS TABLES **VIEW**

Title Tutorial Demo Project

Subtitle

Short sentence after the title

Description

Project description

Public project ☒ Yes

check yes if you want to use this project as Public

Project Logo Add Logo

Add jpg or png file (max 300x150px)

Project Logo Link

The link that will appear by clicking on the logo.

Project Color Select Color

Background GoogleMaps

Flat Background Color Select Color

Default Map Style -- Select One --

Save Changes

Compile the form considering suggestions as follow:

- “*Project contributors*” users can assign a title, a sub-title and a description related to each single project. They can also upload the project logo picture and link it to project website. Among the front interface appearance settings, also the main colour can be chosen, so that each project visualised in InViTo can maintain the same graphic line of its parent project.
- *Title*: title of the project visible on the front-end interface
- *Subtitle*: short sentence after the title.
- *Description*: description visible in the front-end interface (par. 3.4).

- *Public project*: check yes if you want to use this project as Public. You can keep this button unchecked while you need to work on the project. In this case, the project will be accessible only by the users included in the “people” list.
- *Public export*: check yes if you want data included in the project can publicly exported.
- *Project Logo* :add jpg or png file (maximum size: 300px x 150px).
- *Project Logo Link*: web address that will appear by clicking on the logo.
- *Project Color*: define the main colour theme for the front-end interface.
- Background:
 - **Google Maps**. You can choose among different Maps styles or customize it.
 - **Open Street Maps (OSM)**,
 - or a **flat colour** map within the RGB palette colours. In addition, you can customise the and use it for your project. Flat colour maps (non-geographical maps) are very useful to visualise non-spatial data which should be represented through an abstract mode, such as charts, diagrams or info-graphics. In that case, a geometry can be upload to be used as background for the exploration of non-spatial data.
- *Flat Background Color*: choose which colour should be visualised in the case the user will select a flat colour map style.
- *Default Map Style*: choose which map style do you want when accessing to the project.

Then, save the setting.

2.1.3 People

In the “People” section, “Project Contributors” users can include people in the project:

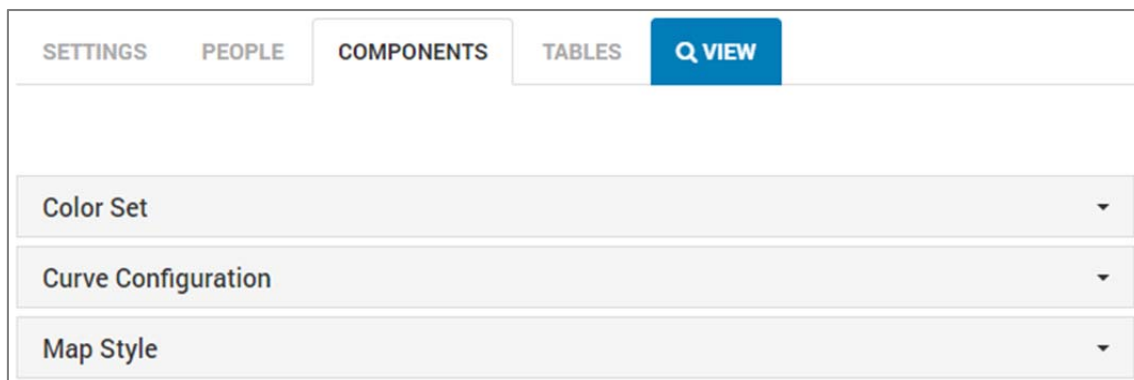
- people in the “Project contributors” are enabled to edit/delete the project;
- if the project is **public**, this field can be left empty; if the project is not public, people in the “Project advisors” are allowed to assess to the project.

The screenshot shows a web interface with a top navigation bar containing five tabs: 'SETTINGS', 'PEOPLE', 'COMPONENTS', 'TABLES', and 'VIEW'. The 'PEOPLE' tab is currently selected. Below the tabs, there are two input fields. The first is labeled 'Project Contributors' and has a text input box with a cursor. Below this input box is a smaller, faint label 'Project Contributors'. The second is labeled 'Project advisors' and also has a text input box. Below this input box is a smaller, faint label 'Project advisors'. In the bottom right corner of the form area, there is a blue button labeled 'Save Changes'.

2.1.4 Components

In the components section are listed external configuration of the project.

- **Color Set:** a list of color sets through which users can set the color of geometry in the data explorer view.
- **Curve Configuration:** a list of pre-defined curves which describes how an element generates attraction or repulsion on the basis of the distance. The application of curves is at the basis of the weighted sum of maps in the **Weighting section** (3.2).
- **Map Style:** a list of pre-defined map styles through which users can set the background map in the data explorer view.



2.1.5 Tables

The Tables menu is the data core. Here you have to upload your tables in **.Json** or **GeoJSON** file format. The tables show the attributes of data to be filtered, providing pre-set additional information field by field.

The setting of table visualization allows a high level of customization on **colours, dimensions, styles, map styles** and on a series of utilities by means of which the tool is expected to offer a wide range of possibilities for users to improve their analytical skills and enhancing the discussion.

To add a private table, click on the blue button “**+Add private table**”



WARNING! for a correct use of InViTo, Json files have to be projected as follows:

- Projected Coordinate System: WGS_1984_Web_Mercator_Auxiliary_Sphere
- Projection: Mercator_Auxiliary_Sphere

2.1.5.1 Add private table

TIP #1! Pay attention to the editing of the table. Each table you add, will be displayed in the filtering section of the data explorer as last layer. Thus, if you want to maintain a specific order of layers when you access to the viewer, keep in mind the order of uploading. However, this order can be modified just clicking on the layer's name and moving it up and down the other layers.

TIP #2! The name of table's columns (field name) will determine the order of filtering data. The way data are displayed respect the alphabetical order.

2.1.5.2 TIP #3! Check Forbidden characters (see section 2.1.5.2)

TIP #4! Check Forbidden words (see section 2.1.5.3).

After clicking on the blue button "+Add private table", a form will be displayed. First of all, click on "Scegli file" button and browse your folder to choose the .json or .geojson file.

Add new **Table**

Table associated to **Tutorial** project

Name

Description

File to upload Nessun file selezionato

Name	PRIMARY KEY	Type	MaxLength
------	-------------	------	-----------

As the file is uploaded on InViTo's server, a green text will confirm the file is "Uploaded with success".

Then, provide a name and a description to the table.

WARNING! Before save changes

- check the Primary Key relative to the FID field;
- check the type for each field corresponds to your setting.

Add new Table

Table associated to **Tutorial** project

Name

Description

File to upload TWX_BCN_2015Ottobre03.json

Upload with success.

Name	PRIMARY KEY	Type	MaxLength
FID	<input checked="" type="checkbox"/>	<input type="text" value="SERIAL"/>	<input type="text"/>
USER_ID	<input type="checkbox"/>	<input type="text" value="DOUBLE PRECISION"/>	<input type="text"/>

[Save table](#)

When it is all ok, click on **save changes and wait** until green banner on the top confirms the table has been created. Then, click on the name of the project (in blue).

Add new Table

Table table-1 created.

Table associated to **Tutorial** project

Name

Description

File to upload Nessun file selezionato

Name	PRIMARY KEY	Type	MaxLength
------	-------------	------	-----------

[Save table](#)

2.1.5.3 Forbidden characters

When editing a table, please consider that a number of characters can generate some errors due to the incompatibility between some platforms.

In order to avoid errors, some letters are automatically substituted or, in case a proper substitution is not found, trimmed from strings during upload a table in InViTo.

The following list shows the substitutions:

from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
α	a	/	-	À	A	ç	c	đ	d	Ē	E	Ĥ	H	Î	I
-	--	/	-	Á	A	Ć	C	ē	e	ē	E	ĥ	h	î	i
-	-	v	V	Ā	a	Ĉ	C	é	E	ĕ	e	Ħ	H	!	!
-	-	ç	C	ā	a	Ċ	c	è	E	ě	e	Ħ	h	!	!
—	-	\$	\$	ą	a	Č	C	ě	E	Ě	E	Ħ	h	!	!
¿		£	£	Ā	A	č	c	ē	e	Ě	E	Ħ	h	!	!
ı	i	€	€	ā	a	Č	C	ē	e	Ě	E	Ħ	h	!	!
...	...	A	A	Ā	A	č	c	ē	e	Ě	E	Ħ	h	!	!
·	·	a	a	ǎ	a	Ç	C	ê	E	Ě	E	Ħ	h	!	!
,	"	ä	a	Ǟ	A	ç	c	ë	E	Ě	E	Ħ	h	!	!
,	"	Á	A	ǻ	a	Č	C	ē	E	Ě	E	Ħ	h	!	!
,	"	á	a	Ǽ	A	ć	c	ē	E	Ě	E	Ħ	h	!	!
<	<	À	A	Ǿ	a	%	%	ē	E	Ě	E	Ħ	h	!	!
>	>	à	a	Ǻ	A	Ɔ	C	ē	E	Ě	E	Ħ	h	!	!
"	"	Ǻ	A	ǻ	a	Ɔ	c	ē	E	Ě	E	Ħ	h	!	!
"	"	ǻ	a	Ǽ	A	Ɔ	c	ē	E	Ě	E	Ħ	h	!	!
"	"	Ǽ	A	Ǿ	a	D	D	ē	E	Ě	E	Ħ	h	!	!
"	"	Ǿ	a	Ǻ	A	d	d	ē	E	Ě	E	Ħ	h	!	!
«	<	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
»	>	ǻ	a	Ǽ	A	ď	d	ē	E	Ě	E	Ħ	h	!	!
(	(	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
)	)	Ǿ	a	Ǻ	A	đ	d	ē	E	Ě	E	Ħ	h	!	!
[	[	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
]	]	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
{	{	Ǽ	A	Ǿ	a	đ	d	ē	E	Ě	E	Ħ	h	!	!
}	}	Ǿ	a	Ǻ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
@	@	Ǻ	A	ǻ	a	đ	d	ē	E	Ě	E	Ħ	h	!	!
*	*	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
&	&	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
%	%	Ǿ	a	Ǻ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
%	%	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
=	=	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
=	=	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
°	°	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
©	C	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
®	R	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
®	P	Ǿ	a	Ǻ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
€	e	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
+	+	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
±	±	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
÷	:	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
×	x	ǻ	a	Ǽ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
<	<	Ǽ	A	Ǿ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!
=	=	Ǿ	a	Ǻ	A	Đ	D	ē	E	Ě	E	Ħ	h	!	!
>	>	Ǻ	A	ǻ	a	Đ	D	ē	E	Ě	E	Ħ	h	!	!

13

2.1.5.4 Forbidden words for table name or column name

When editing a table, please consider that the following words cannot be used for table name or for column name.

Most of those words are commands and are misinterpreted in the database.

More info in [official Postgresql documentation](#).

a	bernoulli	cs	constraint	estamp	dense_rank	equals
abort	between	characters	constraint_c	current_tra	depth	escape
abs	bigint	check	atalog	nsform_gro	deref	escaped
absolute	binary	checked	constraint_	up_for_type	derived	every
access	bit	checkpoint	name	current_use	desc	except
accessible	bit_length	class	constraint_s	r	describe	exception
action	bitvar	class_origin	chema	cursor	descriptor	exclude
ada	blob	clob	constraints	cursor_nam	destroy	excluding
add	boolean	close	constructor	e	destructor	exclusive
admin	both	cluster	contains	cycle	deterministi	exec
after,aggreg	breadth	coalesce	continue	data	c	execute
ate	by	cobol	conversion	database	diagnostics	existing
alias	c	collate	convert	databases	dictionary	exists
all	cache	collation	copy	date	disable	exit
allocate	call	collation_ca	corr	datetime_in	disconnect	exp
also	called	talog	correspondi	terval_code	dispatch	explain
alter	cardinality	collation_na	ng	datetime_in	distinct	external
always	cascade	me	count	terval_preci	distinctrow	extract
analyse	cascaded	collation_sc	covar_pop	sion	div	false
analyze	case	hema	covar_samp	day	do	fetch
and	cast	collect	create	day_hour	domain	filter
any	catalog	column	createdb	day_micros	double	final
are	catalog_na	column_na	creatorole	econd	drop	first
array	me	me	createuser	day_minute	dual	float
as	ceil	command_f	cross	day_second	dynamic	float4
asc	ceiling	unction	csv	deallocate	dynamic_fu	float8
asensitive	chain	command_f	cube	dec	nction	floor
assertion	change	unction_cod	cume_dist	decimal	dynamic_fu	following
assignment	char	e	current	declare	nction_code	for
asymmetric	char_length	comment	current_dat	default	each	force
at	character	commit	e	defaults	element	foreign
atomic	character_le	committed	current_def	deferrable	else	fortran
attribute	ngth	completion	ault_transfo	deferred	elseif	forward
attributes	character_s	condition	rm_group	defined	enable	found
authorization	et_catalog	condition_n	current_pat	definer	enclosed	free
n	character_s	umber	h	degree	encoding	freeze
avg	et_name	connect	current_role	delayed	encrypted	from
backward	character_s	connection	current_tim	delete	end	full
before	et_schema	connection_	e	delimiter	end-exec	fulltext
begin	characteristi	name	current_tim	delimiters	enum	function

fusion	inner	left	middleint	nullif	alog	ref
g	inout	length	min	nulls	parameter_	references
general	input	less	minute	number	specific_na	referencing
generated	insensitive	level	minute_mic	numeric	me	regex
get	insert	like	rosecond	object	parameter_	regr_avgx
global	instance	limit	minute_sec	octet_lengt	specific_sch	regr_avgy
go	instantiable	linear	ond	h	ema	regr_count
goto	instead	listen	minvalue	octets	parameters	regr_interce
grant	int	ln	mod	of	partial	pt
granted	int1	load	mode	off	partition	regr_r2
greatest	int2	local	modifies	offset	pascal	regr_slope
group	int3	localtime	modify	oids	password	regr_sxx
grouping	int4	localtimesta	module	old	path	regr_sxy
handler	int8	mp	month	on	percent_ran	regr_syy
having	integer	location	more	one_shot	k	reindex
header	intersect	locator	move	only	percentile_c	relative
hierarchy	intersection	lock	multiset	open	ont	release
high_priorit	interval	login	mumps	operation	percentile_	rename
y	into	long	name	operator	disc	repeat
hold	invoker	longblob	names	optimize	placing	repeatable
host	io_after_gti	longtext	national	option	pli	replace
hour	ds	loop	natural	optionally	position	require
hour_micro	io_after_gti	low_priority	nchar	options	postfix	reset
second	ds	lower	nclob	or	power	resignal
hour_minut	io_before_g	m	nesting	order	preceding	restart
e	tids	map	new	ordering	precision	restrict
hour_secon	io_before_g	master_bin	next	ordinality	prefix	result
d	tids	d	no	others	preorder	return
identity	is	master_ssl_	no_write_to	out	prepare	returned_ca
if	isnull	verify_serve	_binlog	outer	prepared	rdinality
ignore	isolation	r_cert	nocreatedb	outfile	preserve	returned_le
ilike	iterate	match	nocreaterol	output	primary	ngth
immediate	join	matched	e	over	prior	returned_oc
immutable	k	max	nocreateuse	overlaps	privileges	tet_length
implementa	key	maxvalue	r	overlay	procedural	returned_sq
tion	key_membe	mediumblo	noinherit	overriding	procedure	lstate
implicit	r	b	nologin	owner	public	returns
in	key_type	mediumint	none	pad	purge	revoke
including	keys	mediumtext	normalize	parameter	quote	right
increment	kill	member	normalized	parameter_	range	rlike
index	lancompiler	merge	nosuperuser	mode	rank	role
indicator	language	message_le	not	parameter_	read	rollback
infile	large	ngth	nothing	name	read_write	rollup
infix	last	message_oc	notify	parameter_	reads	routine
inherit	lateral	tet_length	notnull	ordinal_posi	real	routine_cat
inherits	leading	message_te	nowait	tion	real	alog
initialize	least	xt	null	parameter_	recheck	routine_na
initially	leave	method	nullable	specific_cat	recursive	me

routine_sch	smallint	sublist	treat	utc_date
ema	some	submultiset	trigger	utc_time
row	source	substring	trigger_cata	utc_timesta
row_count	space	sum	log	mp
row_numbe	spatial	superuser	trigger_nam	vacuum
r	specific	symmetric	e	valid
rows	specific_na	sysid	trigger_sche	validator
rule	me	system	ma	value
savepoint	specifictype	system_user	trim	values
scale	sql	table	true	var_pop
schema	sql_after_gt	table_name	truncate	var_samp
schema_na	ids	tablesampl	trusted	varbinary
me	sql_before_	tablespace	type	varchar
schemas	gtids	temp	uescape	varcharacte
scope	sql_big_res	template	unbounded	r
scope_catal	ult	temporary	uncommitte	variable
og	sql_calc_fou	terminate	d	varying
scope_nam	nd_rows	terminated	under	verbose
e	sql_small_re	text	undo	view
scope_sche	sult	than	unencrypte	volatile
ma	sqlcode	then	d	when
scroll	sqlerror	ties	union	whenever
search	sqlexceptio	time	unique	where
second	n	timestamp	unknown	while
second_mic	sqlstate	timezone_h	unlisten	width_buck
rosecond	sqlwarning	our	unlock	et
section	sqrt	timezone_m	unnamed	window
security	ssl	inute	unnest	with
select	stable	tinyblob	unsigned	within
self	start	tinyint	until	without
sensitive	starting	tinytext	update	work
separator	state	to	upper	write
sequence	statement	toast	usage	xor
serializable	static	top_level_c	use	year
server_nam	statistics	ount	user	year_month
e	stddev_pop	trailing	user_define	zerofill
session	stddev_sam	transaction	d_type_cata	zone
session_use	p	transaction_	log	
r	stdin	active	user_define	
set	stdout	transactions	d_type_cod	
setof	storage	_committed	e	
sets	straight_joi	transactions	user_define	
share	n	_rolled_bac	d_type_na	
show	strict	k	me	
signal	structure	transform	user_define	
similar	style	transforms	d_type_sch	
simple	subclass_ori	translate	ema	
size	gin	translation	using	

2.1.5.5 Type of data

List of available data type in InViTo tables. This is a small subset of the available data in PostgreSQL.

For more information have a look to the official documentation on the specific types:

<http://www.postgresql.org/docs/9.3/static/datatype.html>

SMALLSERIAL
SERIAL
BIGSERIAL
SMALLINT
INTEGER
BIGINT
BOOLEAN
TEXT
CHARACTER
CHARACTER VARYING
REAL
DOUBLE PRECISION
INTERVAL
NUMERIC
JSON

2.1.5.6 Configure a table

In order to configure the visualisation of a table, in the table section click on the arrow near the table name and click in the “**+Add Config**” button.

The screenshot shows the 'Edit Tutorial' interface. At the top, there's a header with 'Edit Tutorial' and schema information: 'Schema user: user_783' and 'Schema password: OT1YvQ4yeRS5'. Below this is a navigation bar with 'SETTINGS', 'PEOPLE', 'COMPONENTS', 'TABLES', and a 'Q VIEW' button. The 'TABLES' tab is active. Underneath, there's a '+ Add private table' button. A table entry 'table-1' with '0 rows' is shown. Below the table name, the source is listed: 'Source: TWX_BCN_2015Ottobre03_from_esri.geojson. Date: 15 September 2017, 12:27. tweets in Barcelona - Oct.2015'. At the bottom of the table entry, there are three buttons: 'VIEW' (with a magnifying glass icon), '+ ADD CONFIG' (with a plus icon), and 'DELETE' (with an 'X' icon). A red arrow points to the '+ ADD CONFIG' button.

You will access to the Configuration Setting page

Add new Table configuration

New configuration for **Tutorial** project, **table-1** table

Name *

Description
Insert a short description

Configuration
All the configuration for this table in json format.

Active in project ☒

Filter hierarchy
Is this configuration loaded in this project
Json defining filter visual hierarchy: {"filterName": "active", "when": "filterParent", "values": [{"onValue4": "onValue5"}]}

APPEARANCE **FILTERS** **WEIGHTING**

Default visibility: ☒

Background only: ☐

Fill style 80%

Line style 80%

Point style 80%

Info box content

weight 3px 5px

Create configuration

Here you have to compile the form as follows:

- **Name:** provide a name to the table configuration which could be easily understood by final users. This name will be the title of layers in the visualisation.
- **Description:** this field can be used to add a description to the layer.
- **Configuration:** for advanced users, this field can be used to copy and paste the same configuration from other projects.
- **Active in Project:** if not enabled, the table will not be visible in the project visualisation
- **Filter Hierarchy:** for advanced users, this field allows to create a hierarchy between filters.

Then, further 3 sections have to be compiled:

- Appearance (see section 2.1.5.6)
- Filters (see section 2.1.5.7)
- Weighting (see section 2.1.5.8)

2.1.5.7 Appearance setting

The appearance setting of geometries has to be done layer by layer, field by field. In the appearance menu, "project contributors" users can choose the basic aspect of all geometries when no map style is enabled.

APPEARANCE FILTERS WEIGHTING

Default visibility: ☒

Background only: ☐

Fill style opacity 80%

Line style opacity 80% weight 3px

Point style opacity 80% weight 5px

Info box content

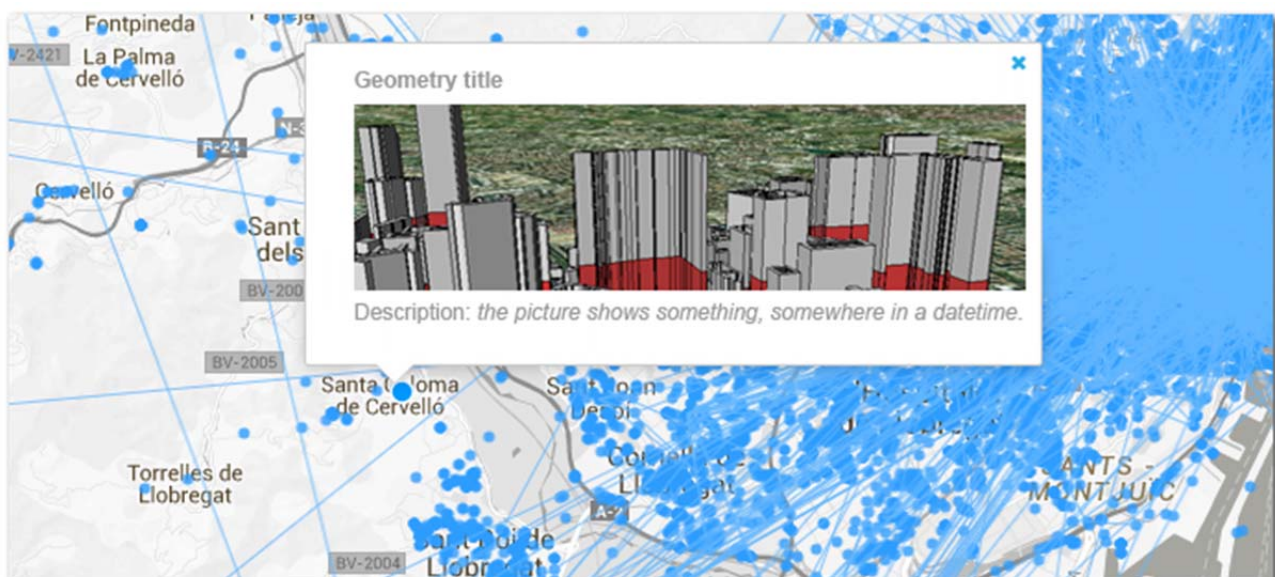
```
<b>{{title_}}</b><br/><br/>
<br/><br/>
Description: <i>{{descr_}}</i>
```

Edit configuration

A difference is considered among points, lines and areal geometries as well as in GIS data. For all of these elements, a colour, a dimension and a level of opacity have to be assigned.

A checkbox allows users to decide if the layer should be visible when opening the project, and if the layer can be filtered by the final user or it should be used only as a background image.

An info box content window can be compiled in order to have a **pop-up window** for each geometry when double-clicking on it in the front interface.



The pop-up window containing the info box. It appears when double-clicking on a geometry in the map window.

The info box window should be compiled in html. Here below an example shows the content of an info-box window where:

- the title of the image, included in the database field named "title_", is in bold.
- a picture of the geometry is loaded from an url contained in the database field named "image_".
- a description (in italic style) of the feature is loaded from the database field named "descr_".

```
<b>{{title_}}</b><br/>
```

```
<br/>
```

```
Description: <i>{{descr_}}</i>
```

2.1.5.8 Filters setting

Through the filtering section, *project contributor* users are guided to design the visualisation of data, which will be displayed in the front-end interface. Project contributors can decide which layers and sub-layers of data can be visualised in the front interface, and how data should be displayed. Therefore, they can decide the degree of freedom of final users in knowing the information included within data.

When opening the filtering section, you will find the list of fields included in the table.

The screenshot shows a web application interface for configuring filters. On the left, there is a sidebar with navigation options: Projects, Curves, Map Styles, and Color Sets. The main area is titled 'Filter hierarchy' and contains a large text area for JSON configuration. Below this, there are three tabs: APPEARANCE, FILTERS (which is active), and WEIGHTING. Under the FILTERS tab, there is a list of fields with checkboxes and dropdown menus. The fields are: diff_time (text), dist_metri (bigint), fid (integer), id (double precision), id1 (double precision), id_arcmap (bigint), month_day (double precision), month_day_ (double precision), and twz (text). The 'twz' field is selected, and its alias is 'Tweets location' and its description is 'Location of sent tweets'.

For each field, click on the arrow, then open and compile the form.

- *Alias*: is the name visible in the filtering section of data explorer.
- *Description*: is the name visible when passing with the mouse over the field's name in the filtering section of data explorer.
- *Appears in table*: checking it enables the field to be visible in the table in data explorer.
- *Draw graph*: checking it enables the field to be visible in the graph in data explorer.

FILTERING

- Filtering: checking it enables the field to be visible in the filtering section of data explorer.
- Each kind of data can be visualised through different types of filters:

- *checkbox*: for text fields.
- *dropdown menu*: for text fields.
- *range sliders*: for numeric fields.
- single choice range slider: numeric fields.
- *tag*: text fields in ["txt1","t2",".."] format.

- *Filtering panel*: writing a name, you automatically create a panel containing the field. You can use the same panel's name for different field in order to create sub-folders for visualization.

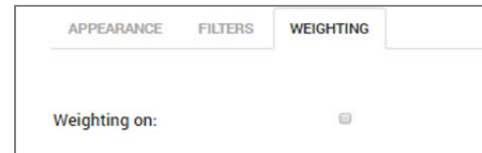
APPEARANCE (how to visualise data)

- *Filtered opacity*: set the geometry opacity;
- *Fill Style*: choose the set of colours for filling the geometry in relation to the values included in the table field.
- *Line Style*: choose the set of colours and width for lines and polygons' perimeters in relation to the values included in the table field.
- *Point Style*: choose the set of colours and radius (n. of pixels) of point geometries in relation to the values included in the table field.

The screenshot shows the QGIS Data Explorer interface with three tabs: APPEARANCE, FILTERS, and WEIGHTING. The 'FILTERS' tab is active, showing the configuration for the 'user_id' field (double precision). The 'Alias' is set to 'user_id'. The 'Description' field is empty. The 'Appears in table' checkbox is checked. The 'Draw graph' checkbox is checked. The 'Filtering' section shows the 'Filtering' checkbox checked and the 'Filtering panel' name set to 'user_id'. The 'Appearance' section shows the 'Filtered opacity' slider at 100%. The 'Fill style', 'Line style', and 'Point style' are all set to 'Traffic light'. The 'Weight' slider is set to 3px.

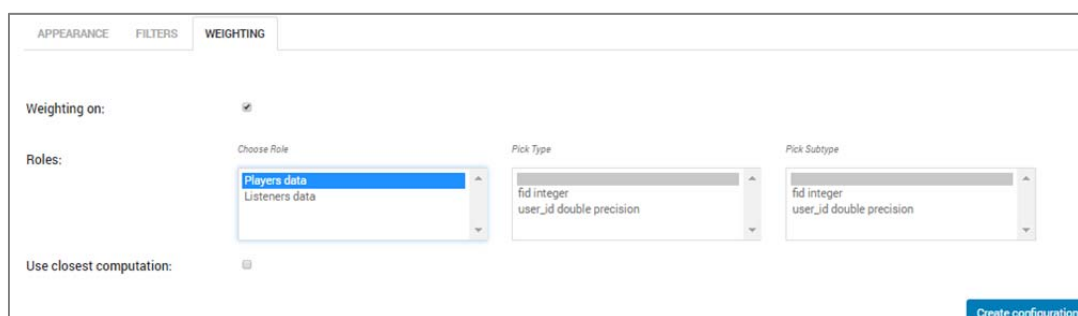
2.1.5.9 Weighting setting

The weighting section allows data to have an influence on other data on the basis of mathematical curves.

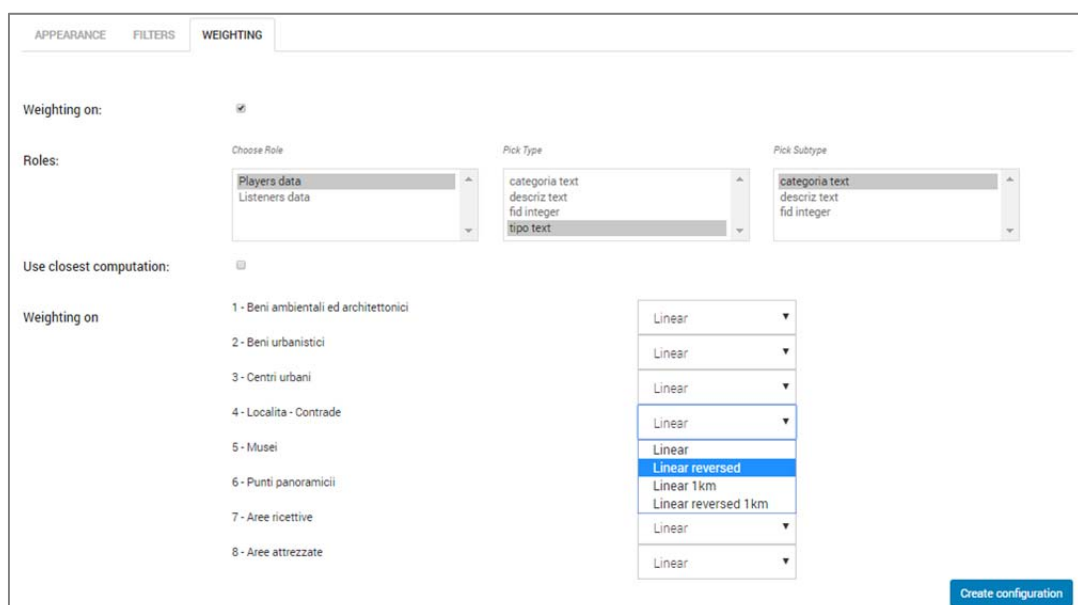


Through this section, users can assign a curve to each value included in a specific field of the table. In order to weight maps, firstly check the “Weighting on” box. Then, Roles should be assigned to the layer:

- **“Listeners data”** : this role can be assigned to one map for each project. This map has the function of defining the land subdivision. For this purposes, it can be used a grid, a census map, a zoning map or whatever land classification map.
- **“Players data”**: all the other layer can be weighted assigning them a “players data” role. Then, two fields of the table must be chosen for defining the role:
 - *Type field* is the field of the table which contains the family name of the values to be weighted (i.e. Transport network).
 - *Sub-Type* field is the field which contains the sub-type of the values to be weighted. To each subtype, users can assign a different curve (i.e. Public Transport, Bykelanes, Highways,..).



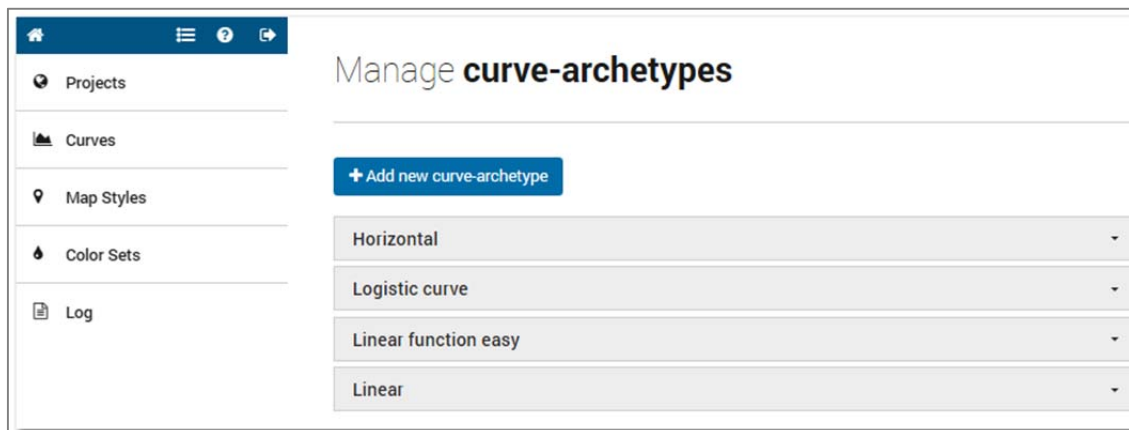
By default, mathematical curves have been previously set to linear functions. Clicking on the dropdown menu, users can choose between the curve types associated to the project.



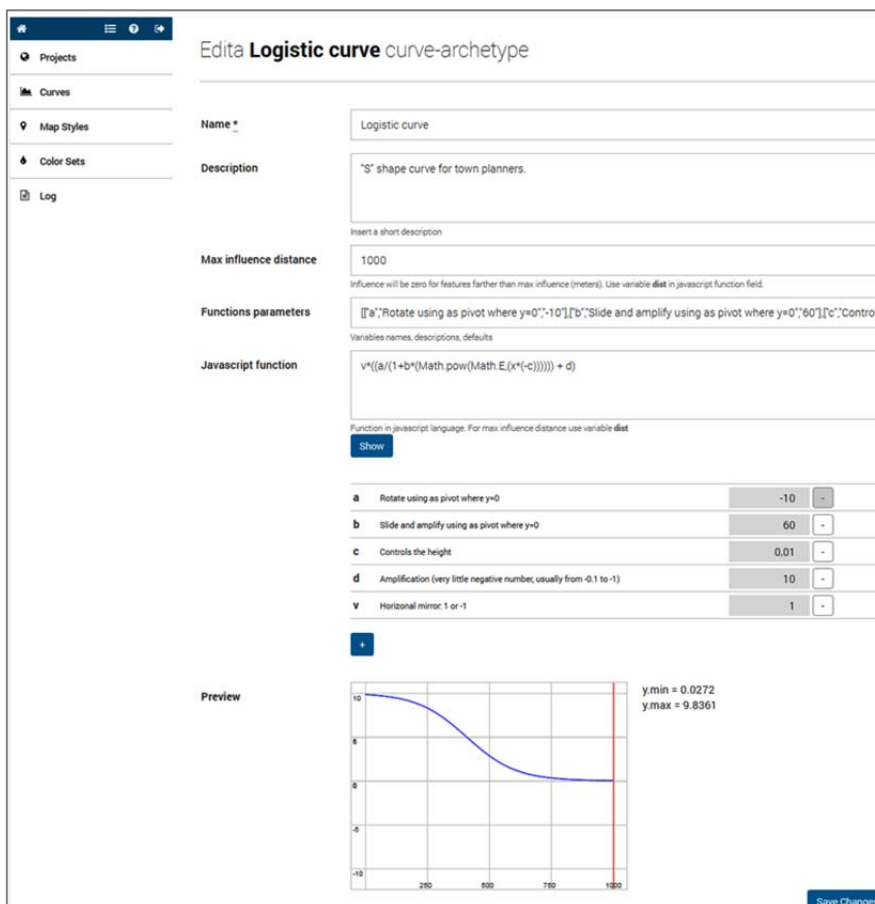
2.2 “Curves” section: configuration

In order to calculate the influence of each layer on the other layers, InViTo makes use of mathematical curves which describe the behaviour.

The curve configuration sub-menu allows administrator users to create or edit one of the already available curve. For each curve archetype, users can set the radius of action, the intensity, and all the parameters that define the behaviour of the curve. Once curves are edited, users assign them to the relative layer. Their working is then visible in the front interface.



In the curves setting page, administrator users can set the typology and the parameters of each curve to be used to weight maps in the front interface.



The weights are calculated on the data filtered in the previous section of data filtering. Therefore, both administrator and public users have the opportunity to evaluate the response of different scenarios through an interactive and dynamic visualisation, which immediately provides the response of land to specific planning choices or policies.

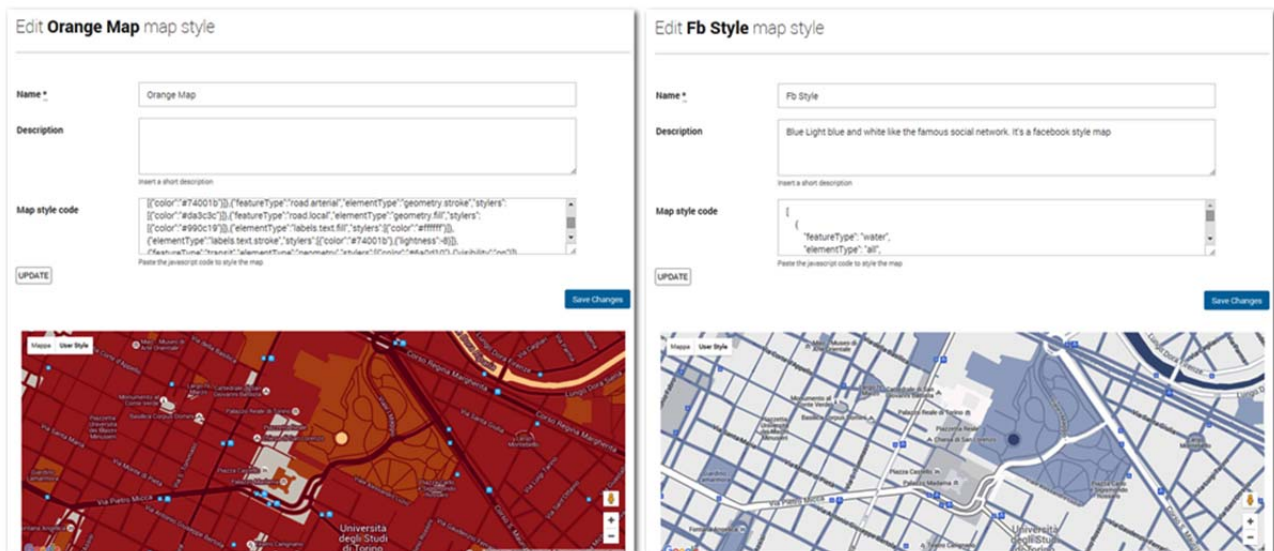
Curves assign a behaviour on the basis of a distance:

$$f(x)=d$$

2.3 “Map Styles” section: configuration

Here, "Project contributors" users can choose or customise the map style(s), through assigning different setting to a **Google Maps style**.

For example, map styles can be customised by the use of html script provided by specific open source data repository, where communities share their own map styles and allow users to create their own. One of this portal is for example Snazzy Maps (<https://snazzymaps.com/>), which allows highly detailed generation of map styles under the Creative Commons licence.



Back interface of InViTo: definition of map styles. Here, "Project contributors" users can set the Map styles parameters, to be visualised in the front interface.

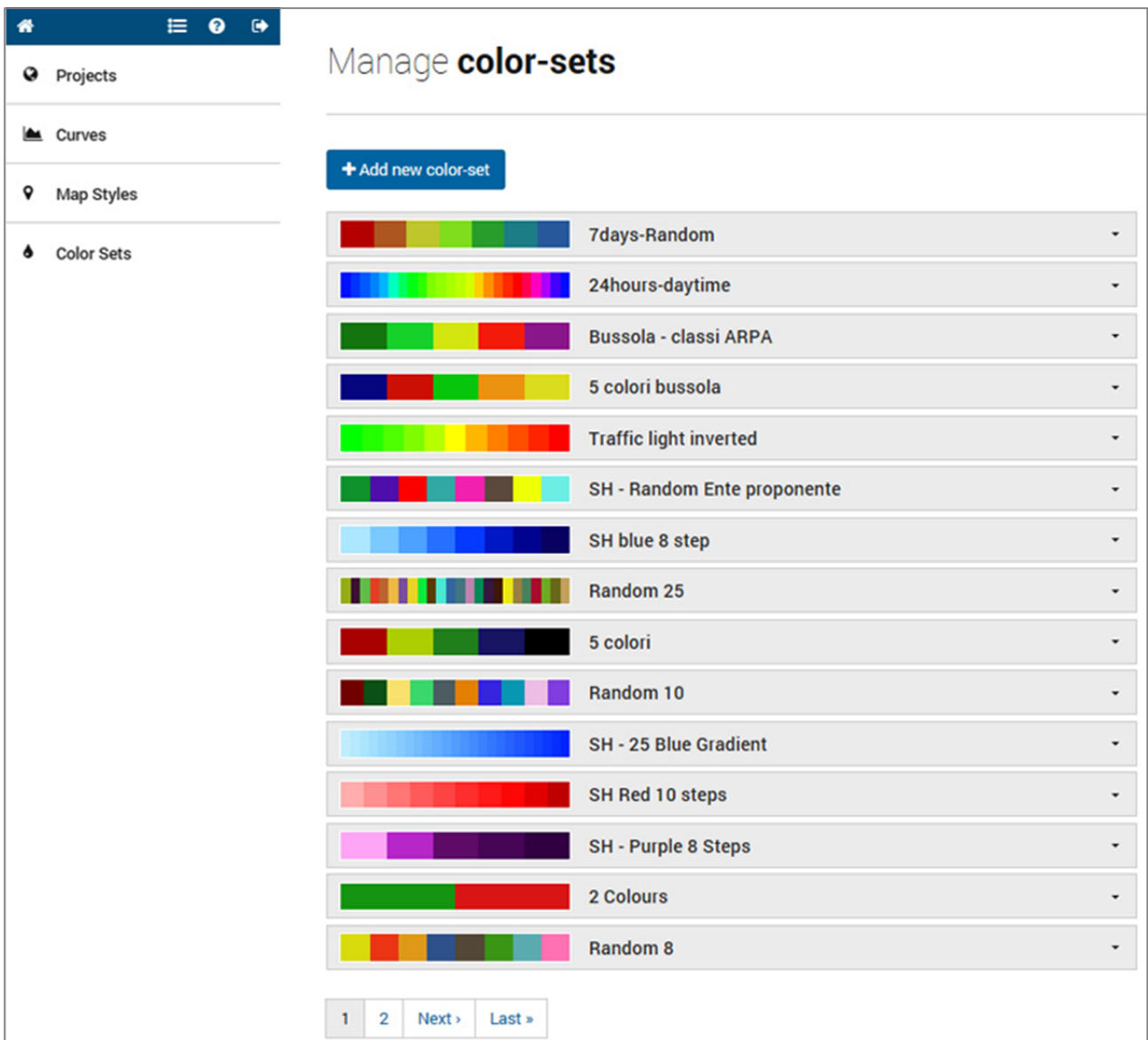
2.4 “Color Sets” section: configuration

A specific menu for colour-set management is available in order to choose the map style to be assigned to each layer when selected. Here, *project contributors* users can choose, edit or create a specific set of colour to be assigned to a specific field of data. This set of colours will be visible when the final user will click on the **fill** icon (section 3.3.1) near each layer name on the front-end interface.

For creating a new color set, click on the blue button on the top. Provide it with a name and a related project. If you want that your color set could be used in other projects, enable the Public check box. Then choose the Color set nature between:

- *Blending*: choose the number of colours (Color steps) and the key colours to be used for creating a graduated scale.
- *Random*: choose the number of random colours you need and click to update the view. Clicking on the colour you can change it.
- *Code*: write your code as this example: [FFFFFF, 000000]

If you need to change an existing color set, click on the arrow near the color set name and click on the edit icon.



The menu for the color-sets management.

WARNING! In changing a color set, verify that the color set is not used by other projects. If so, please, build a NEW color set in order to not damage other project.

2.5 “Log” section

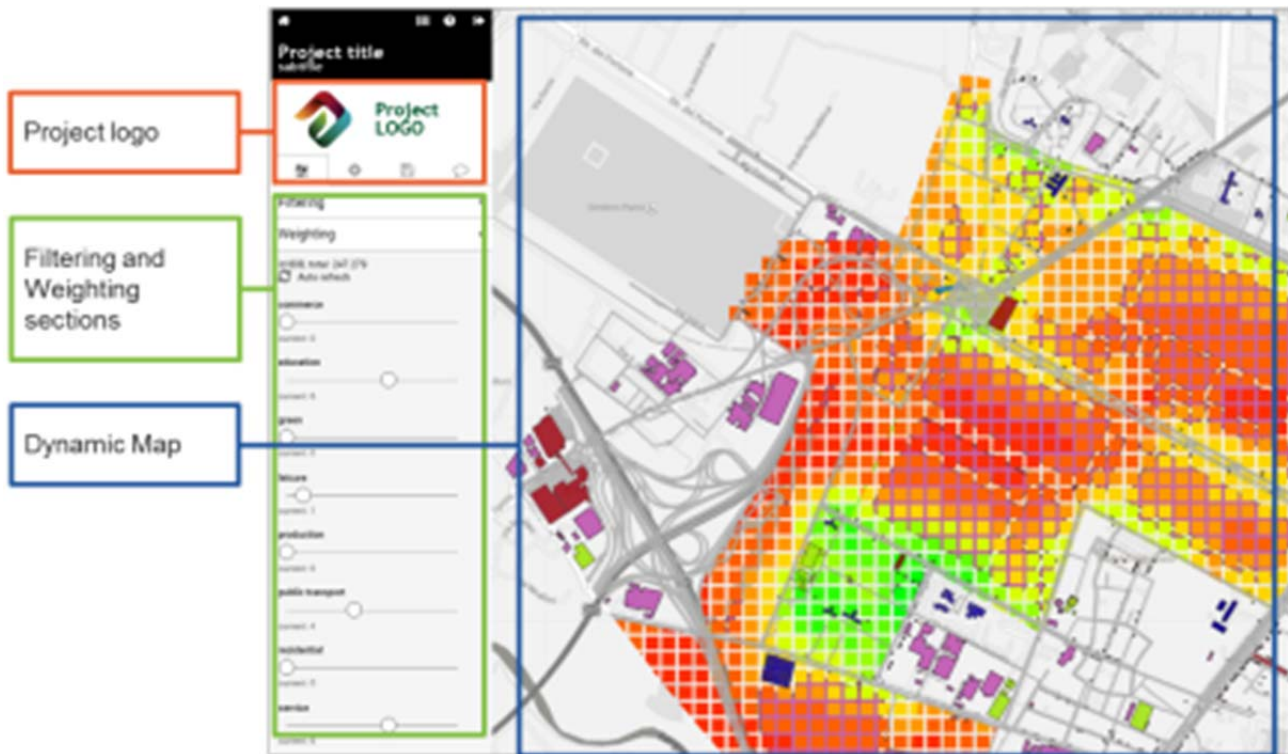
In this page you can see the last days of InViTo logs.

Timestamp with with time zone, host, application, [pid]: [client ip], user(wodpress user id if wpUser:id else postgresql user), message.

3. DATA EXPLORER

The data explorer interface is graphically structured by two main elements:

- a viewer window containing an interactive map;
- a vertical menu on the left side containing all the parameters setting.



The interactive map can be both geographical or not, so that also non spatial-data can be visualised and explored. This means that the geographical maps can be replaced by info-graphics, according to the choice of the project project contributor.

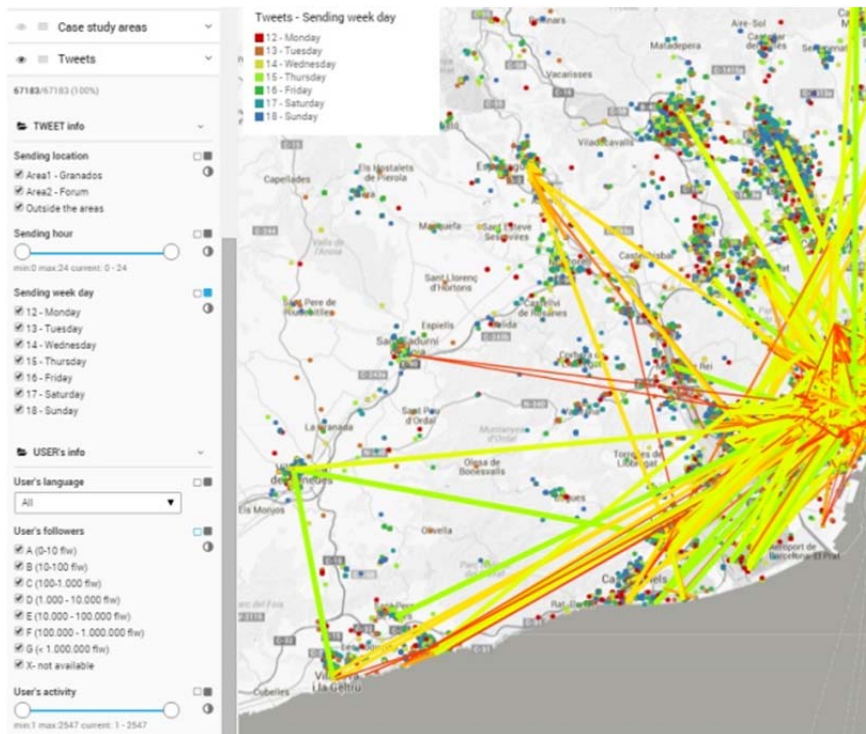


The menu on the left side contains all the elements for exploring data and interact with the information.

The map scale and the zoom commands are on the upper right side of the dynamic map frame.

3.1 Data Filtering

InViTo proposes a web interface where people can easily decide the information to see. The data filtering section allows data to be interactively selected and filtered by the end users in order to customise the visualisation.



Despite basically InViTo works as other GIS viewers, it does not visualise only the different layers of a set of data, but it allows users to explore the single records of a dataset by the use of different kind of filters.

All data can be selected and filtered through checkbox windows, dropdown menu or sliding cursors.

Filters can be grouped in specific panels, so that the visualisation of data is supported by specific steps to follow.

Specific buttons provide possibilities for enabling particular elements such as tables, analysis grids or background maps.

InViTo allows data to be investigated at different levels with also intersection of attributes, in order to analyse data clusters in relation to specific parameters.

In order to filter data, explore the content of each layer clicking on the arrow on the right of the layer's name. A number of sub-layers appear. Data in sub-layers can be filtered in five ways:

- moving the sliders and selecting the range of interest;
- (un)checking the checkbox;
- selecting the tag you want to include in your visualisation;
- selecting the sub-menu from a list of possibilities;
- clicking on the Invert icon, so that you can invert the selection of data.

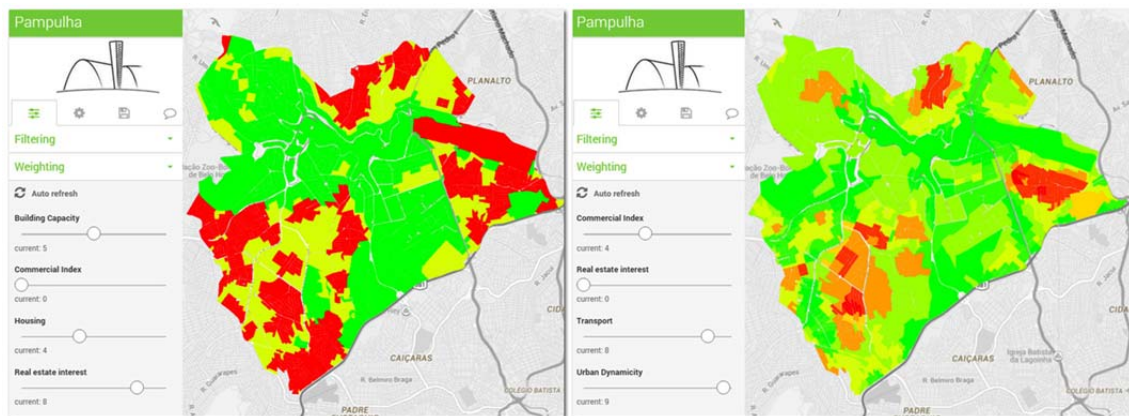
Last but not least, during the visualisation on the front-end interface, some changes in the order of layers can be necessary. Therefore, users can change this order simply dragging up and down the layer name in menu on the left side of the front interface.

3.2 Map Weighting

The map weighting section allows the filtered maps to be overlapped and weighted on the basis of their priority.

The aim of the map weighting section is to provide users with a tool for analysing the localisation of expected effects of specific elements and evaluating the sum of effects on the basis of a specific mathematical curve associated to the layers.

On the basis of a green-yellow-red gradient colour scale, InViTo shows where specific requested aspects are present (green colour) or absent (red colour).



The maps show the spatial effect of selected criteria depending on assigned weights.

The variation of weights on the left side menu makes the map changing in colours through a traffic-light colour gradient scale.

The weighting section can be used to determine the presence of specific elements in an area and to understand the influence of these elements on their surroundings. Combining the effects of each aspect, InViTo generates one single map which highlights the suitability of the area to respond to a specific question according to the chosen parameters. Through the resulting maps, actors could understand which areas already had the requirements to fit their preferences. InViTo can be useful in suggesting new planning decisions, providing responses in real time to “what if” questions and displaying the effects of planning choices.

This section is an on-going part of the research. In fact, the map weighting is currently based on the sum of maps as in the basic methodology of Multicriteria Decision Analysis (MCDA) [1]. Further developments of InViTo will improve this section in order to integrate the opportunity to develop MCDA directly in the tool as the spatial Multicriteria Analyses combining GIS and MCDA [2, 3].

The weighting section is set as follows:

- It is composed by a set of slider cursors, which allow users to set the importance of each element on a scale from -10 to 10.
- The computing can be performed not only on regular grids but in any kind of irregular grid.
- The calculation of values can be given not only by a function of distance as in the previous version of the tool, but also by considering a proper value of each single cell.
- The mathematical curves, that calculate the effect of an element on land, can be easily set up by users through a specific submenu of InViTo named “curve configuration”.

The weighting section includes a further range filter, which allows weighted maps to be filtered on the basis of their resulting values. By this filter, users can select the areas which respond to a specific range of selected criteria and visualise which areas are over or under a specific threshold or comprised between a defined range.

3.3 Data Visualization

The setting of data visualization allows a high level of customization on:

- **Colours** (section 3.3.1)
- **Dimensions** (section 2.1.5.7)
- **Styles** (section 2.1.5.8)
- **Map styles** (section 2.3)

and on a series of utilities by means of which the tool is expected to offer a wide range of possibilities for users to improve their analytical skills and enhancing the discussion.

Furthermore, users can visualize:



- **Tables** (section 3.3.5)
- **Graphs** (section 3.3.6)

showing data according to the filters activated in the filtering section. The tables show the attributes related to the filtered data, providing pre settled additional information field by field. The charts show the values of the filtered data in relation to the whole set of data, highlighting the selected geometries.

Colours and thickness of lines change according to the setting made by the users, providing further information on the selected elements.

3.3.1 Colour and size

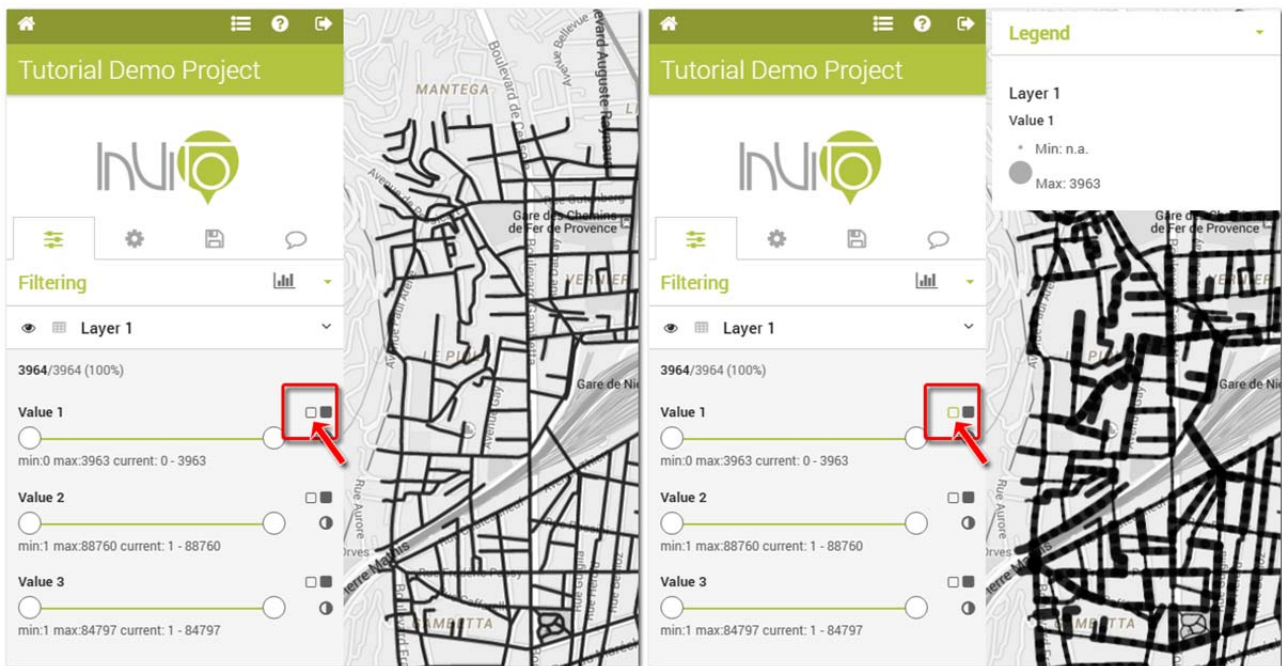
Data visualisation can be customised by the user clicking on the following icons:

-  Weight feature's stroke with thickness dependent on this property. Clicking on this button you can modify the thickness of lines or the radius of points.
-  Fill feature's area with color dependent on this property. Clicking on this button you can enable and disable the colour map style associated to each layer.

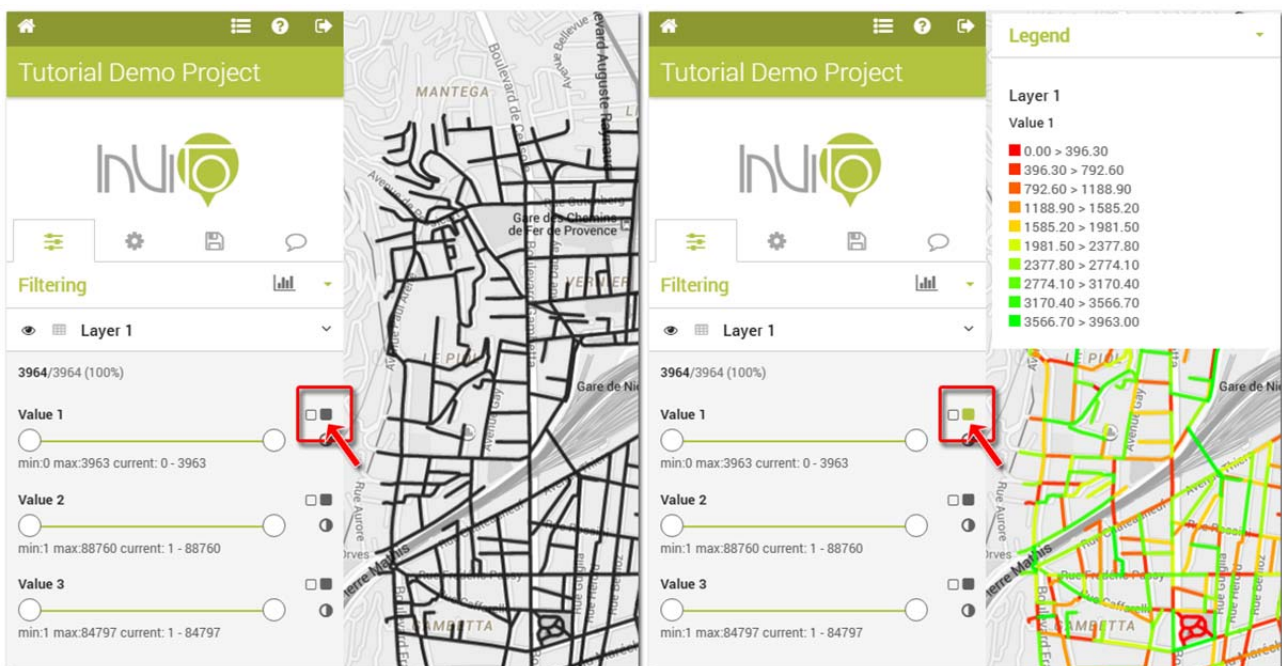
[1] Figueira, J., Greco, S., & Ehrgott, M. (Eds). (2005). *Multiple Criteria Decision Analysis: State of the Art Surveys*. New York, NY, USA: Springer.

[2] Malczewski, J. (1999). *Gis and Multicriteria Decision Analysis*. New York, NY, USA: Wiley.

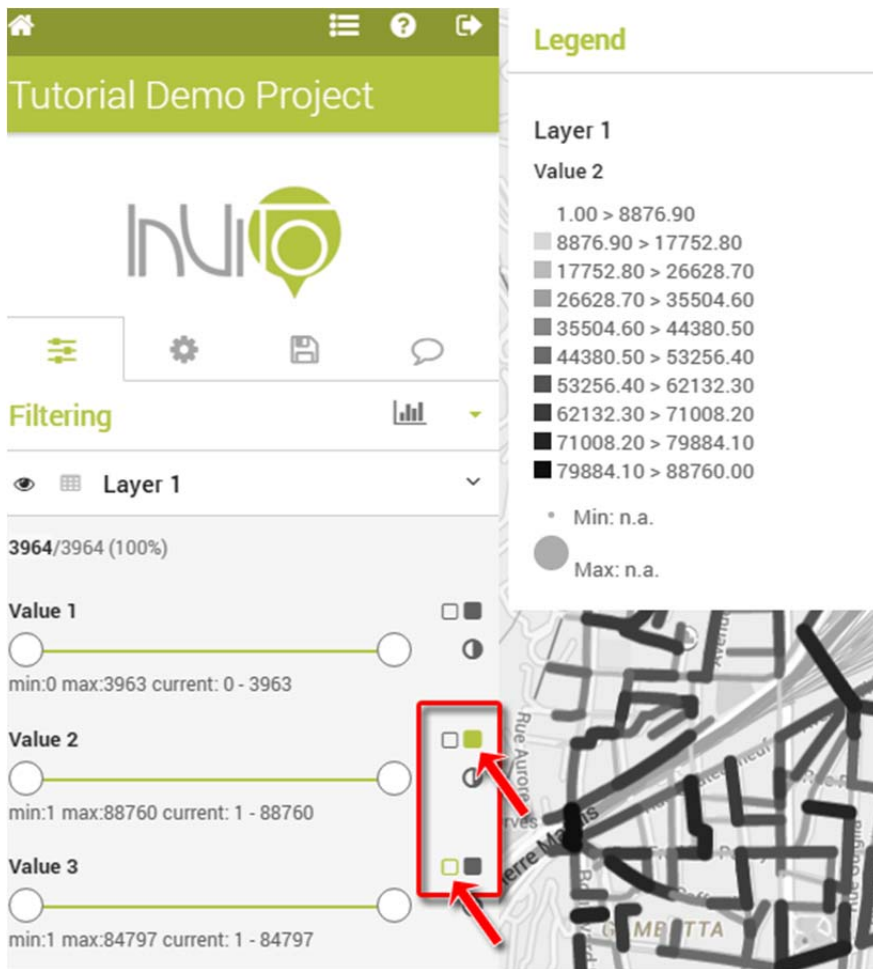
[3] Ferretti V. (2013). *Le Analisi Multicriteri spaziali a supporto delle procedure di pianificazione e valutazione: analisi e classificazione della letteratura scientifica, Geoingegneria Ambientale e Mineraria*, (2), 53-66.



Clicking on the thickness button, lines assume different thickness according to their value, as shown in the legend window. The selected button has a different colour dependent on the colour configuration of the project interface.



Clicking on the fill button, lines assume different colours according to their value, as shown in the legend window. The selected button has a different colour dependent on the colour configuration of the project interface.

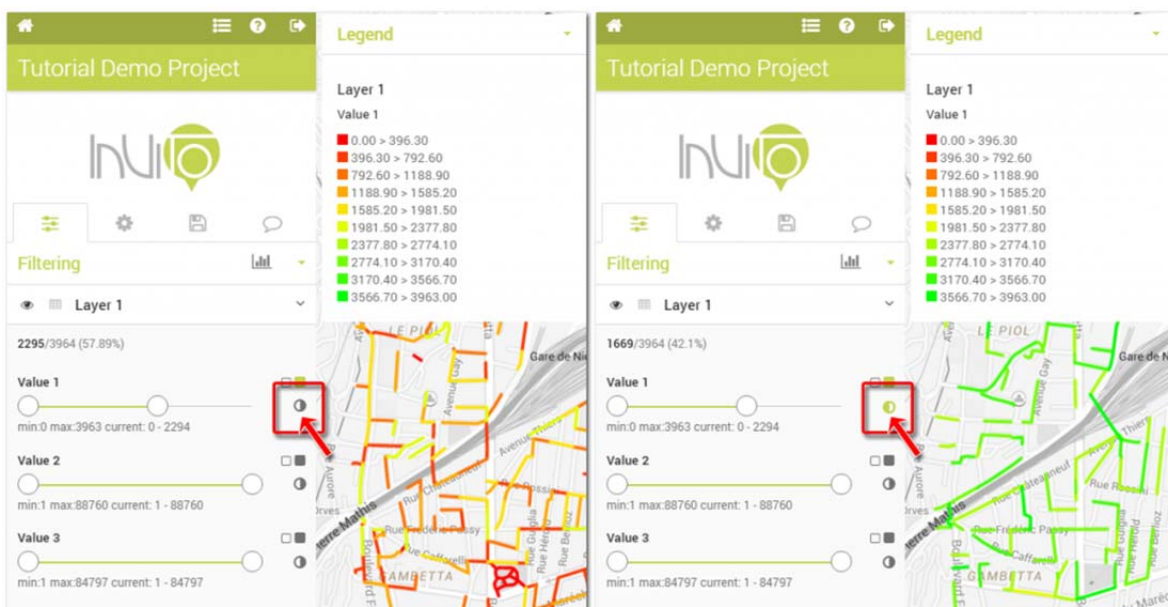


The intersection of the colour style from one layer with the thickness relative to another layer, provide interesting opportunities for reading maps and increasing the knowledge which can be achieved from data visualisation. In this case, you can visualise the colour scale according to a field (value 2) and the size according to another field (value 3). Such a visualisation can provide a number of outcomes. For example black and thicker lines correspond to the maximum values of two fields (value 2 and 3), while thinner white lines refer to minimum values.

3.3.2 Inverse selection



Clicking on this icon, you can invert the data selection of each single field.



3.3.3 Map styles

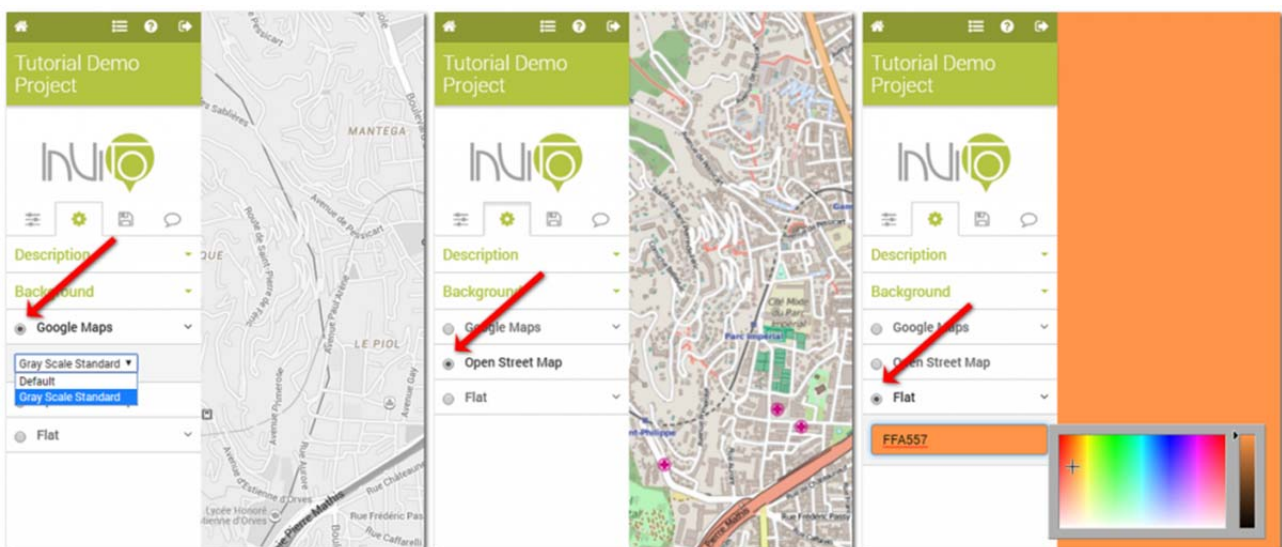
Users can customise the visualisation of the background map.



In the options menu, select "background".

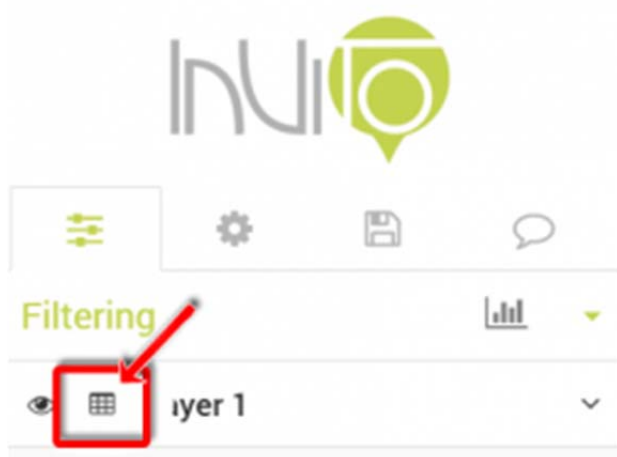
Here you can choose between different [map styles](#), as set by the "Project contributors" user. Generally, map styles can vary on a number of:

- **Google Maps styles** (with pre-set colours listed in a menu);
- **Open Street Map** (OSM);
- and **flat colours** (well indicated for non-geographical representations such as info-graphics or interactive diagrams).



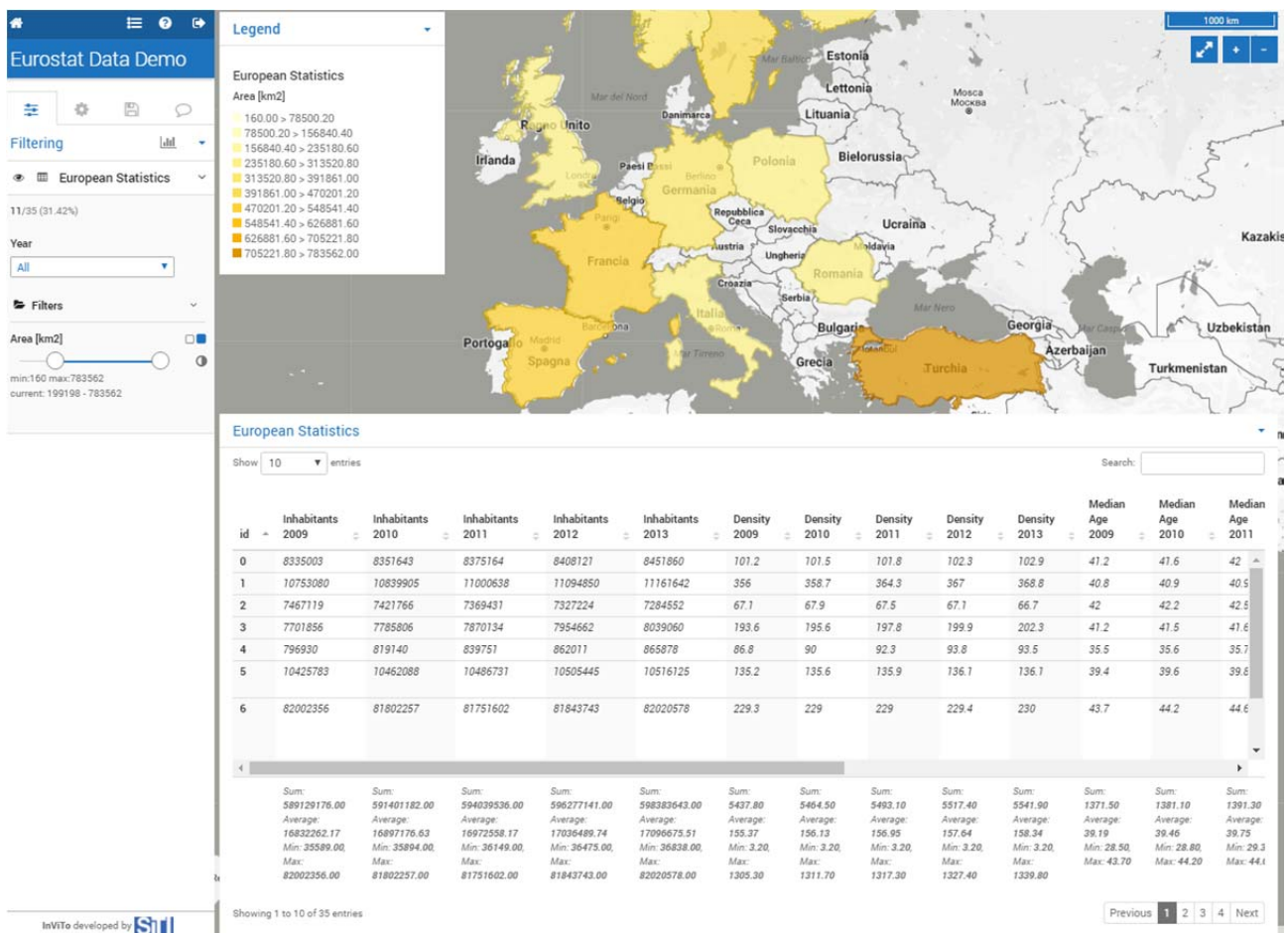
Example of background map: a gray scaled Google Maps style (left), an Open Street Map (center) and a flat colour (right).

3.3.4 Tables



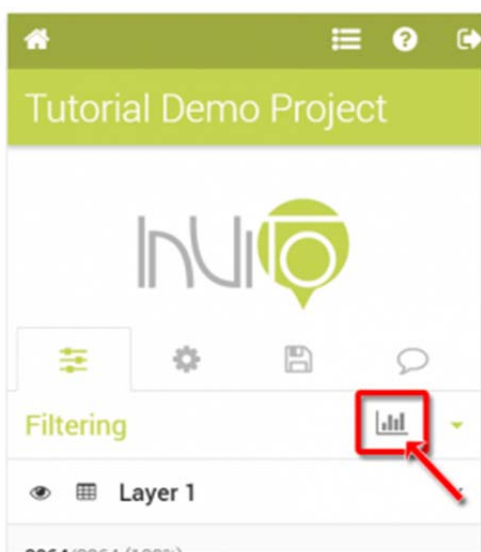
Filtered data can be displayed also within a table, providing pre-settled additional information field by field.

On the front interface, clicking on the table icon near the layer name, a table appears on the bottom side of the screen. It contains the attributes relative to the filtered data, providing some more information on the sum, average, minimum and maximum values, field by field. In order to determine which attributes should be visible to the final users, administrators have to choose the setting of the table.

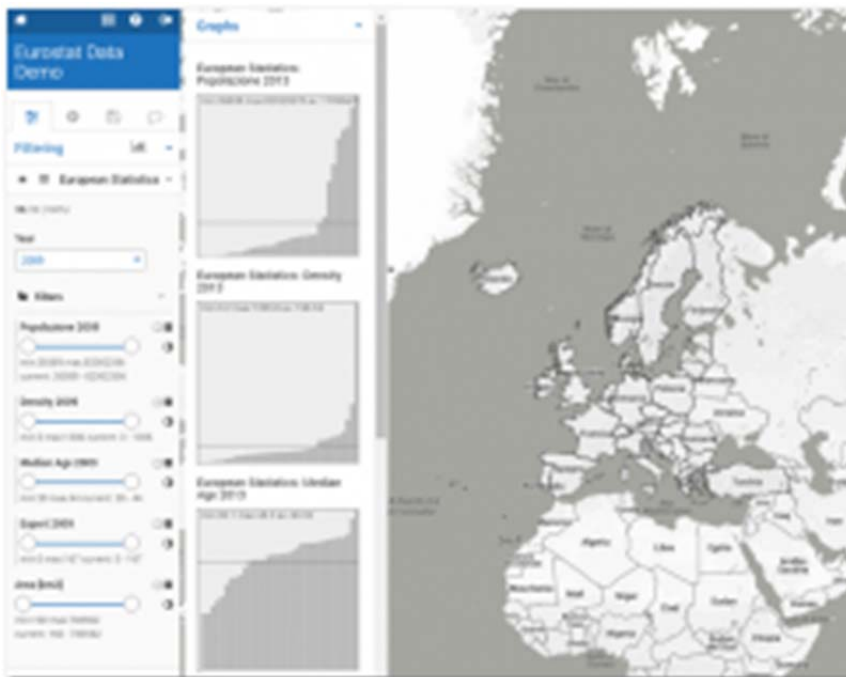


Example of table relative to the data displayed in the map.

3.3.5 Graphs



Clicking on the graphs icon (as shown in the image on the left), you can open the graphs relative to the project database.

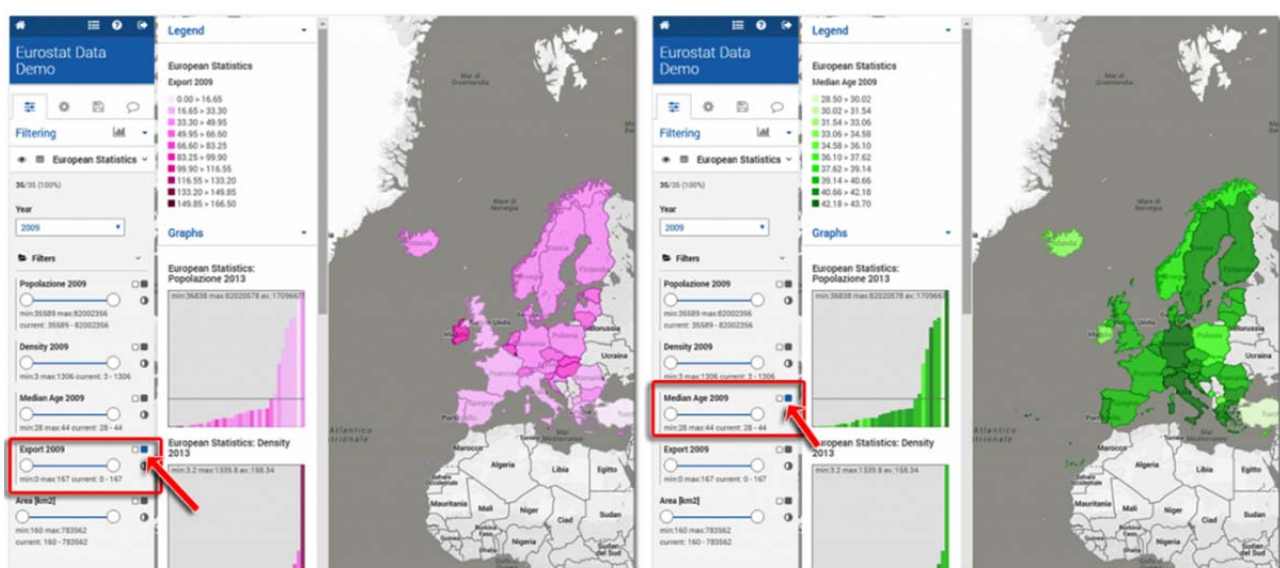


If you do not have selected any colour styles, the graphs appear gray. In this case, the graphs show only the trend of data and they average value (the horizontal line within the graph).

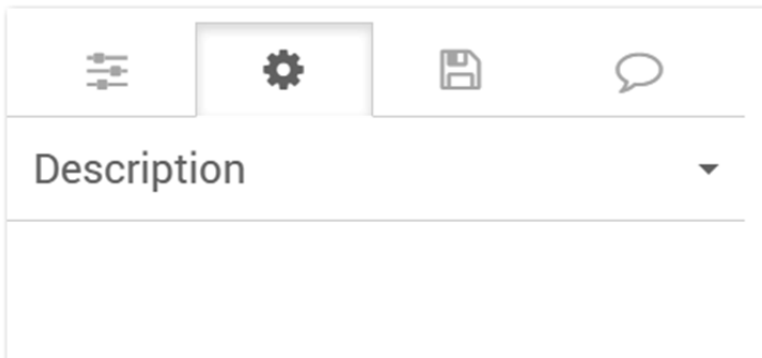
If you click on a colour style, the bar of the charts will assume the same colours of the geometries within the map, showing data according to the filters activated in the filtering section.

The tables show the attributes related to the filtered data, providing pre settled additional information field by field.

The graphs show the values of the filtered data in relation to the whole set of data, highlighting the selected geometries.

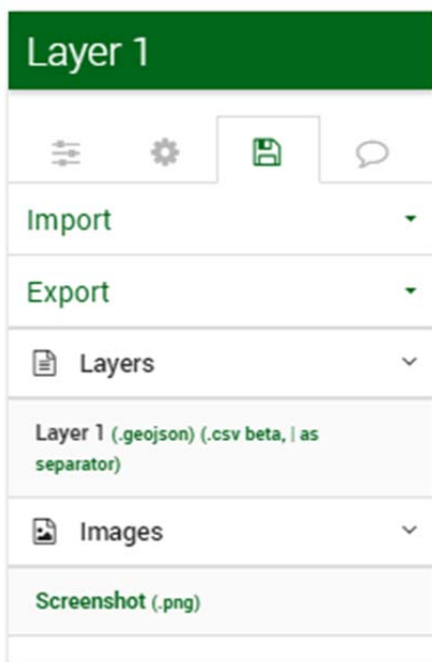


3.4 Description of the project



In this section you will find a brief description of the project.

3.5 Export data



Maps created through InViTo can be exported and used to produce further elaborations such as analysis or visualisations. This function is available only for authorised projects.

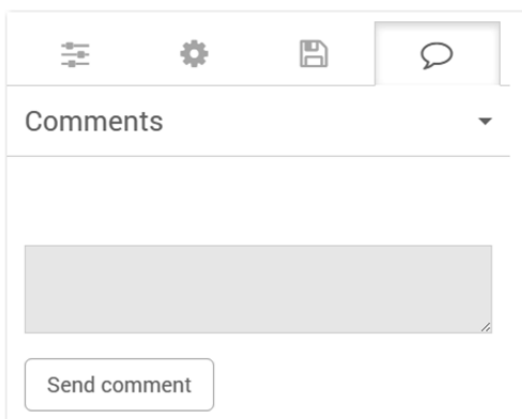
Currently, only the export function is activate, while the import one is under construction.

You can export data in three different formats:

- .GeoJSON
- .csv, | as separator
- .png

To export data, click on the Floppy icon and select the file format you prefer.

3.6 Comments and feedbacks



Here, users can leave their own comments to the use of InViTo or on the project usability. Any feedback is always welcome!

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