

LUMAT TOOL MANUAL - INVITO

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MESTNA OBČINA KRANJ



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A. 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:

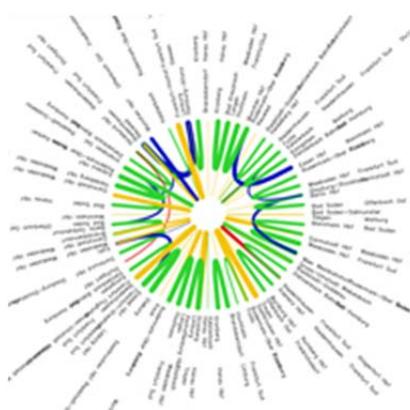
- the data filtering section;
- the map weighting section;
- the data visualization section.

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.

A.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.

A.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.

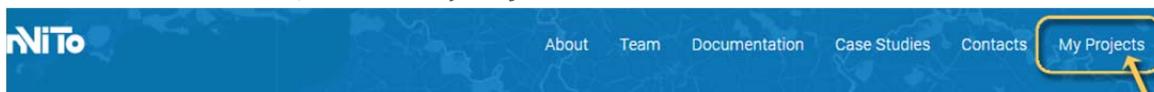
B. PROJECT EDITOR

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:

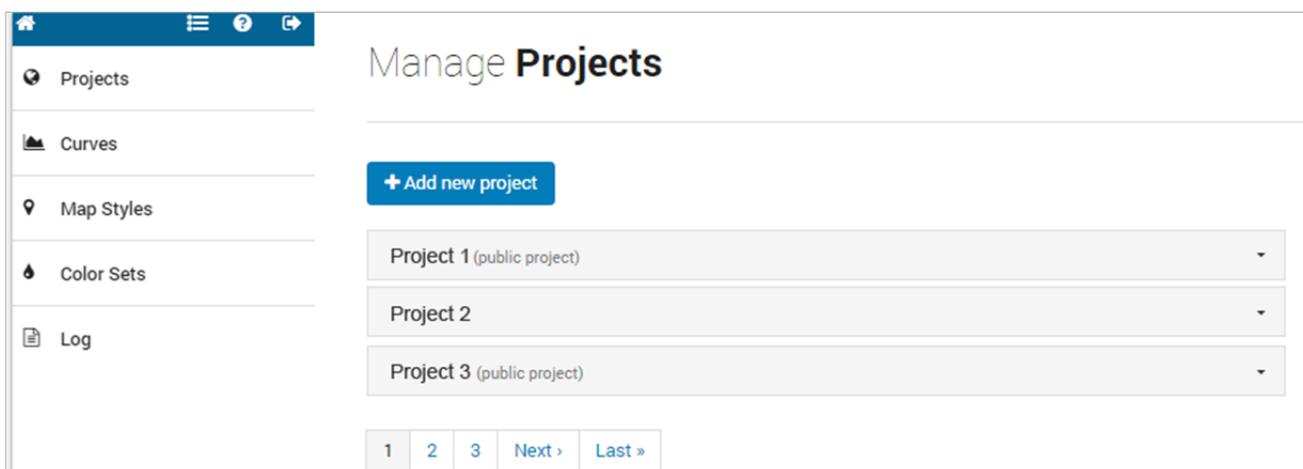
- from the InViTo website, click on “My Projects” menu.



- 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 documentation 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 defining the colours used in the visualization of data;
- *Log section*: here you can see the last days of InViTo logs.

B.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.

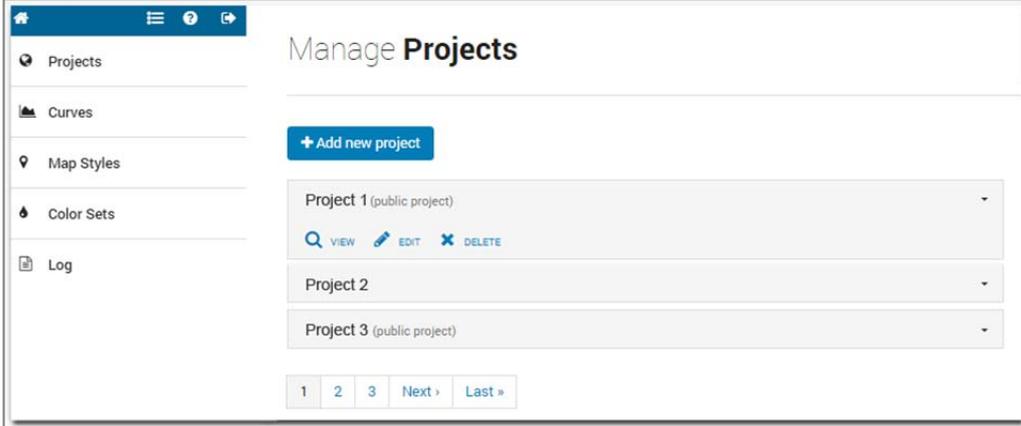
Through this section, you can configure/edit or delete a project in InViTo.

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

B.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.



<p>For building a new project, click on the “+Add new project” blue button.</p>	
<p>The “+Add new project” button opens a setting page where providing a title and a description of the project.</p>	
<p>After that, click on “Register new project” button and you will be redirected to the Edit project page.</p>	

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)



B.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.

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.

B.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.
-

SETTINGS PEOPLE COMPONENTS TABLES VIEW

Project Contributors

Project advisors

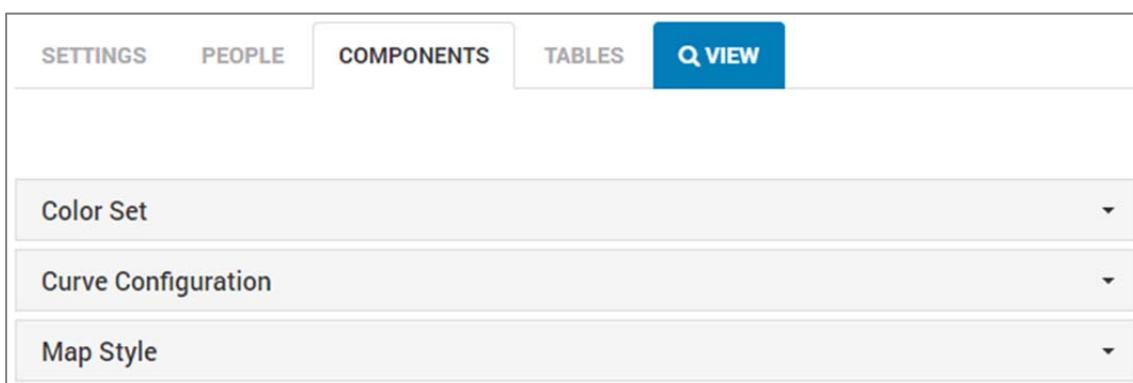
Save Changes



B.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.



B.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



B.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.

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 uploades 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"/>

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
------	-------------	------	-----------



B.1.5.3 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	bitvar	collation_schema	current_path	destroy
abort	blob	collect	current_role	destructor
abs	boolean	column	current_time	deterministic
absolute	both	column_name	current_timestamp	diagnostics
access	breadth	command_function	current_transform_group_for_type	dictionary
accessible	by	command_function_code	current_user	disable
action	c	e	cursor	disconnect
ada	cache	comment	cursor_name	dispatch
add	call	commit	cycle	distinct
admin	called	committed	data	distinctrow
after,aggregate	cardinality	completion	database	div
alias	cascade	condition	databases	do
all	cascaded	condition_number	date	domain
allocate	case	connect	datetime_interval_code	double
also	cast	connection	datetime_interval_precision	drop
alter	catalog	connection_name	day	dual
always	catalog_name	constraint	day_hour	dynamic
analyse	ceil	constraint_catalog	day_microsecond	dynamic_function
analyze	ceiling	constraint_name	day_minute	dynamic_function_code
and	chain	constraint_schema	day_second	each
any	change	constraints	deallocate	element
are	char	constructor	dec	else
array	char_length	contains	decimal	elseif
as	character	continue	declare	enable
asc	character_length	conversion	defaults	enclosed
asensitive	character_set_catalog	convert	deferrable	encoding
assertion	character_set_name	copy	deferred	encrypted
assignment	character_set_schema	corr	defined	end
asymmetric	characteristics	corresponding	definer	end-exec
at	characters	count	degree	enum
atomic	check	covar_pop	delayed	equals
attribute	checked	covar_samp	delete	escape
attributes	checkpoint	create	delimiter	escaped
authorization	class	createdb	delimiters	every
avg	class_origin	createuser	dense_rank	except
backward	clob	cross	depth	exception
before	close	csv	deref	exclude
begin	cluster	cube	derived	excluding
bernoulli	coalesce	cume_dist	desc	exclusive
between	cobol	current	describe	exec
bigint	collate	current_date	descriptor	execute
binary	collation	current_default_transform_group_for_type		existing
bit	collation_catalog	rm_group		exists
bit_length	collation_name			exit



exp	immutable	least	more	ordering
explain	implementation	leave	move	ordinality
external	implicit	left	multiset	others
extract	in	length	mumps	out
false	including	less	name	outer
fetch	increment	level	names	outfile
filter	index	like	national	output
final	indicator	limit	natural	over
first	infile	linear	nchar	overlaps
float	infix	listen	nclob	overlay
float4	inherit	ln	nesting	overriding
float8	inherits	load	new	owner
floor	initialize	local	next	pad
following	initially	localtime	no	parameter
for	inner	localtimestamp	no_write_to_binlog	parameter_mode
force	inout	location	nocreatedb	parameter_name
foreign	input	locator	nocreaterole	parameter_ordinal_posi
fortran	insensitive	lock	nocreateuser	tion
forward	insert	login	noinherit	parameter_specific_cat
found	instance	long	nologin	alog
free	instantiable	longblob	none	parameter_specific_na
freeze	instead	longtext	normalize	me
from	int	loop	normalized	parameter_specific_sch
full	int1	low_priority	nosuperuser	ema
fulltext	int2	lower	not	parameters
function	int3	m	nothing	partial
fusion	int4	map	notify	partition
g	int8	master_bind	notnull	pascal
general	integer	master_ssl_verify_serve	nowait	password
generated	intersect	r_cert	null	path
get	intersection	match	nullable	percent_rank
global	interval	matched	nullif	percentile_cont
go	into	max	nulls	percentile_disc
goto	invoker	maxvalue	number	placing
grant	io_after_gtids	mediumblob	numeric	pli
granted	io_after_gtids	mediumint	object	position
greatest	io_before_gtids	mediumtext	octet_length	postfix
group	io_before_gtids	member	octets	power
grouping	is	merge	of	preceding
handler	isnull	message_length	off	precision
having	isolation	message_octet_length	offset	prefix
header	iterate	message_text	oids	preorder
hierarchy	join	method	old	prepare
high_priority	k	middleint	on	prepared
hold	key	min	one_shot	preserve
host	key_member	minute	only	primary
hour	key_type	minute_microsecond	open	prior
hour_microsecond	keys	minute_second	operation	privileges
hour_minute	kill	minvalue	operator	procedural
hour_second	lancompiler	mod	optimize	procedure
identity	language	mode	option	public
if	large	modifies	optionally	purge
ignore	last	modify	options	quote
ilike	lateral	module	or	range
immediate	leading	month	order	rank



read	routine_schema	sql_after_gtids	than	update
read_write	row	sql_before_gtids	then	upper
reads	row_count	sql_big_result	ties	usage
real	row_number	sql_calc_found_rows	time	use
real	rows	sql_small_result	timestamp	user
recheck	rule	sqlcode	timezone_hour	user_defined_type_cata
recursive	savepoint	sqlerror	timezone_minute	log
ref	scale	sqlexception	tinyblob	user_defined_type_cod
references	schema	sqlstate	tinyint	e
referencing	schema_name	sqlwarning	tinytext	user_defined_type_nam
regexp	schemas	sqrt	to	e
regr_avgx	scope	ssl	toast	user_defined_type_sche
regr_avgy	scope_catalog	stable	top_level_count	ma
regr_count	scope_name	start	trailing	using
regr_intercept	scope_schema	starting	transaction	utc_date
regr_r2	scroll	state	transaction_active	utc_time
regr_slope	search	statement	transactions_committed	utc_timestamp
regr_sxx	second	static	transactions_rolled_bac	vacuum
regr_sxy	second_microsecond	statistics	k	valid
regr_syy	section	stddev_pop	transform	validator
reindex	security	stddev_samp	transforms	value
relative	select	stdin	translate	values
release	self	stdout	translation	var_pop
rename	sensitive	storage	treat	var_samp
repeat	separator	straight_join	trigger	varbinary
repeatable	sequence	strict	trigger_catalog	varchar
replace	serializable	structure	trigger_name	varcharacter
require	server_name	style	trigger_schema	variable
reset	session	subclass_origin	trim	varying
resignal	session_user	sublist	true	verbose
restart	set	submultiset	truncate	view
restrict	setof	substring	trusted	volatile
result	sets	sum	type	when
return	share	superuser	uescape	whenever
returned_cardinality	show	symmetric	unbounded	where
returned_length	signal	sysid	uncommitted	while
returned_octet_length	similar	system	under	width_bucket
returned_sqlstate	simple	system_user	undo	window
returns	size	table	unencrypted	with
revoke	smallint	table_name	union	within
right	some	tablesample	unique	without
rlike	source	tablespace	unknown	work
role	space	temp	unlisten	write
rollback	spatial	template	unlock	xor
rollup	specific	temporary	unnamed	year
routine	specific_name	terminate	unnest	year_month
routine_catalog	specificity	terminated	unsigned	zerofill
routine_name	sql	text	until	zone



B.1.5.4 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

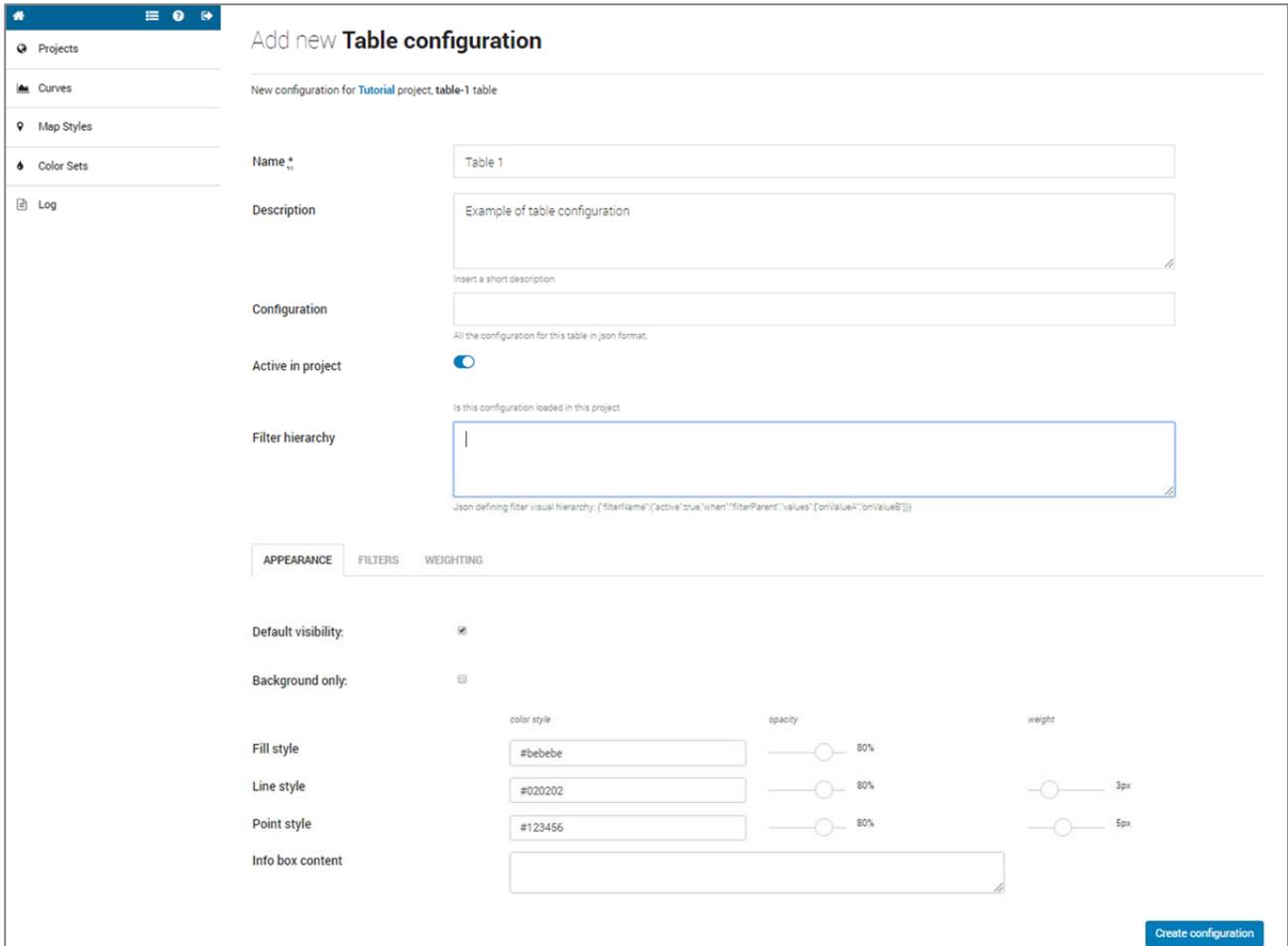
B.1.5.5 Configure a table

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 a web interface titled "Edit Tutorial". At the top, it displays "Schema user: user_783" and "Schema password: OT1YvQ4yeRS5". Below this are navigation tabs: "SETTINGS", "PEOPLE", "COMPONENTS", "TABLES", and "Q VIEW". The "TABLES" tab is active. A blue button labeled "+ Add private table" is visible. Below it, a table entry for "table-1" is shown with "0 rows". The source information is "Source: TWX_BCN_20150ttobre03_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

Is this configuration loaded in this project

Filter hierarchy
Json defining filter visual hierarchy: {"filterName":{"active":true,"when":{"filterParent":{"values":{"onValueA":{"onValueB}}}}

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

[Create configuration](#)

Here you have to compile the form as follows:

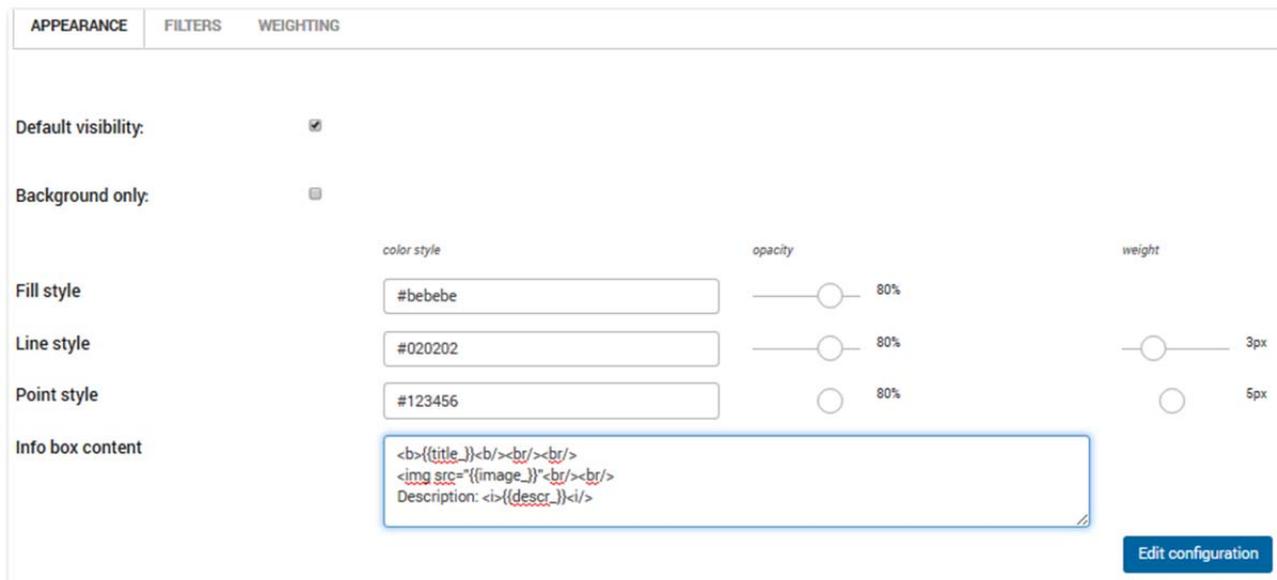
- **Name:** provide a name to the table configuration which could be easily understood by final users. This name will be the title of layers in the visualisation.
- **Description:** this field can be used to add a description to the layer.
- **Configuration:** for advanced users, this field can be used 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 B.1.5.6)
- Filters (see section B.1.5.7)
- Weighting (see section B.1.5.8)

B.1.5.6 Appearance setting

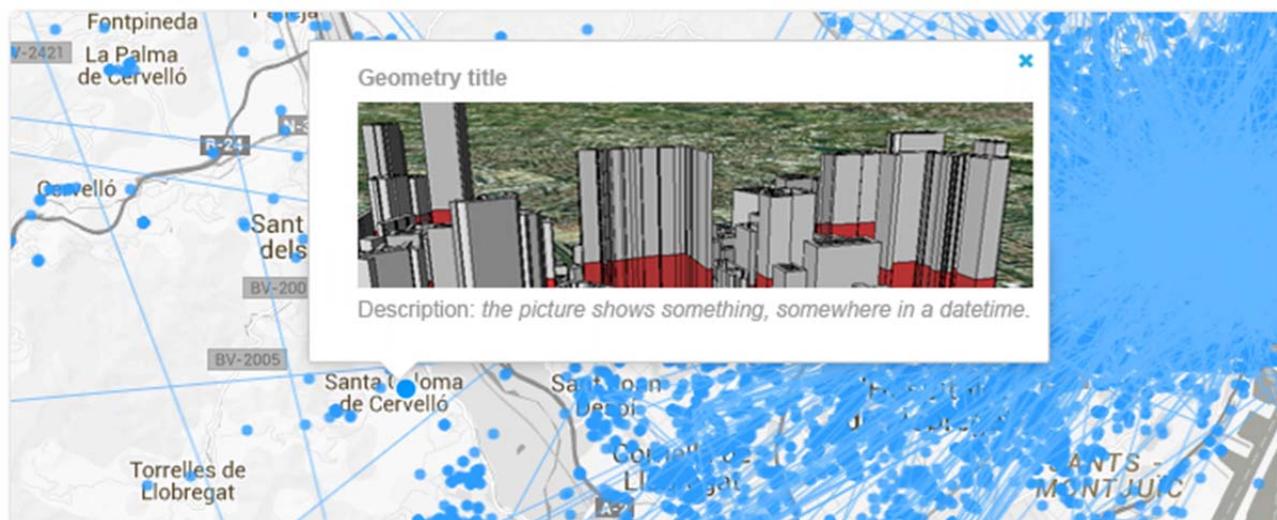
The appearance setting of geometries has to be done layer by layer, field by field. In the appearance menu, "project contributors" users can choose the basic aspect of all geometries when no map style is enabled.



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_"

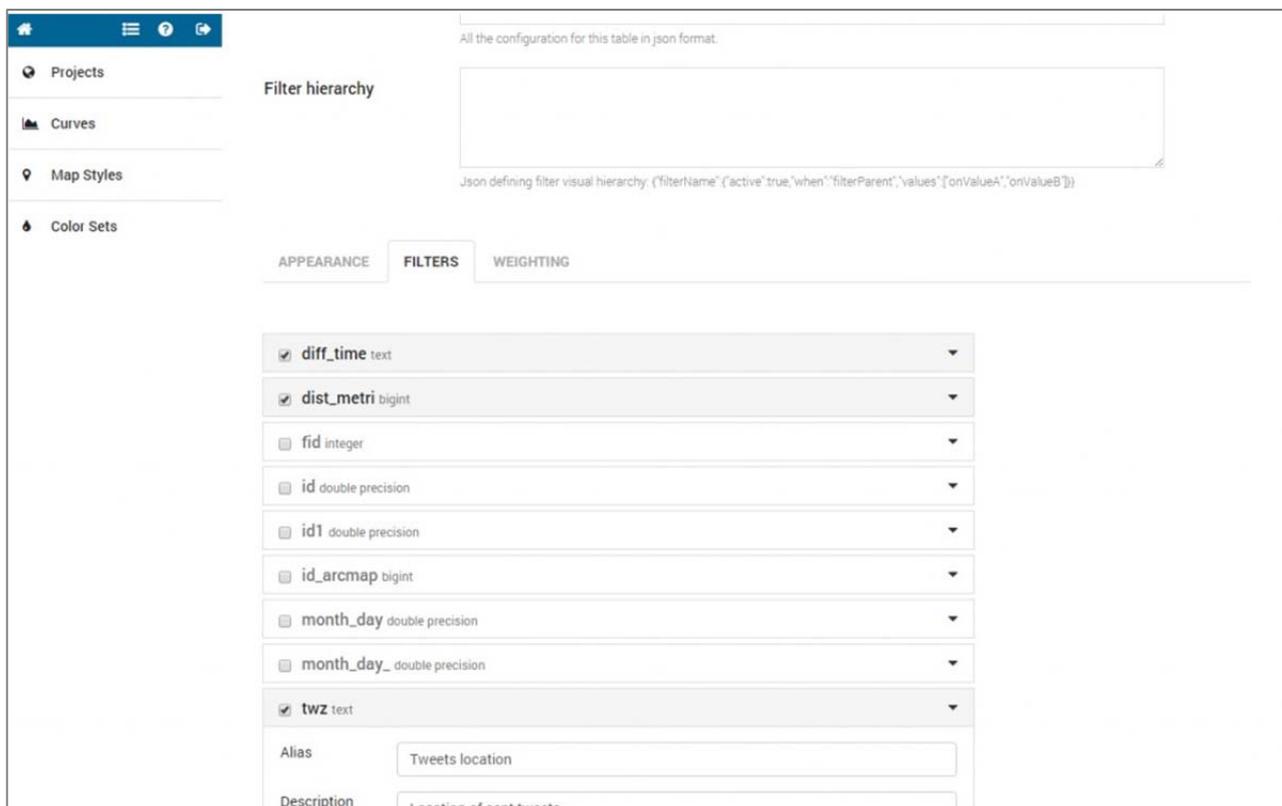
```

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

B.1.5.7 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.





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.

The screenshot shows a configuration panel for a field named 'user_id' (double precision). The panel is divided into three tabs: APPEARANCE, FILTERS, and WEIGHTING. The FILTERS tab is active. It contains the following sections:

- Field Information**: 'fid integer' and 'user_id double precision' are listed with dropdown arrows.
- Alias**: A text input field containing 'user_id'.
- Description**: An empty text area.
- Appearance**:
 - Appears in table**:
 - Draw graph**:
- Filtering**:
 - Filtering**:
 - Filtering panel**: An empty text input field.
- Appearance**:
 - Filtered opacity**: A slider set to 100%.
 - Fill style**: A dropdown menu set to 'Traffic light'.
 - Line style**: A dropdown menu set to 'Traffic light'.
 - Point style**: A dropdown menu set to 'Traffic light'.
 - Weight**: A slider set to 3px.
 - Point weight**: A slider set to 5px.

APPEARANCE (how to visualise data)

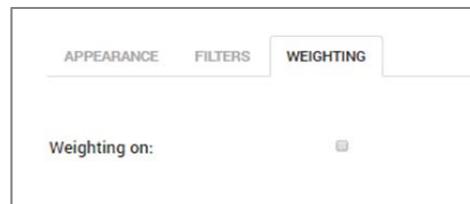
- *Filtered opacity*: set the geometry opacity;
- *Fill Style*: choose the set of colours for filling the geometry in relation to the values included in the table field.
- *Line Style*: choose the set of colours and width for lines and polygons' perimeters in relation to the values included in the table 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.



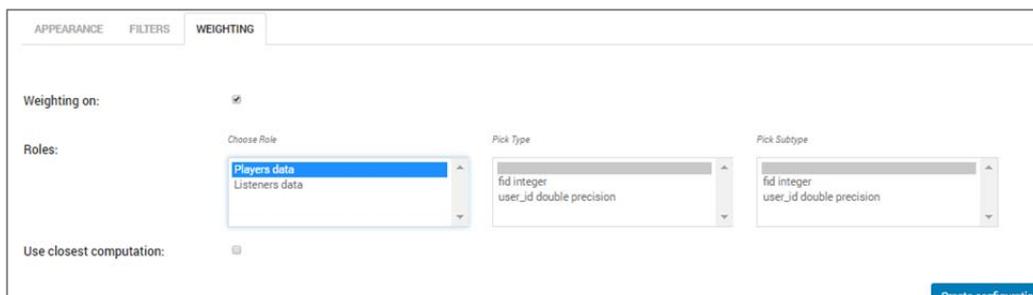
B.1.6 Weighting setting

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

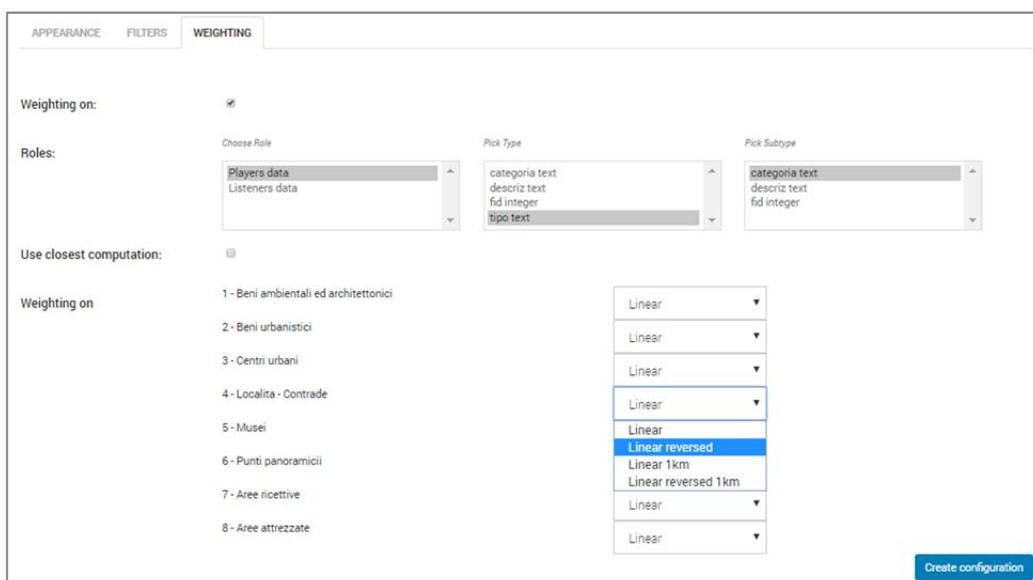
Through this section, users can assign a curve to each value included in a specific field of the table. In order to weight maps, firstly check the “Weighting on” box. Then, Roles should be assigned to the layer:



- **“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 weightd 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.

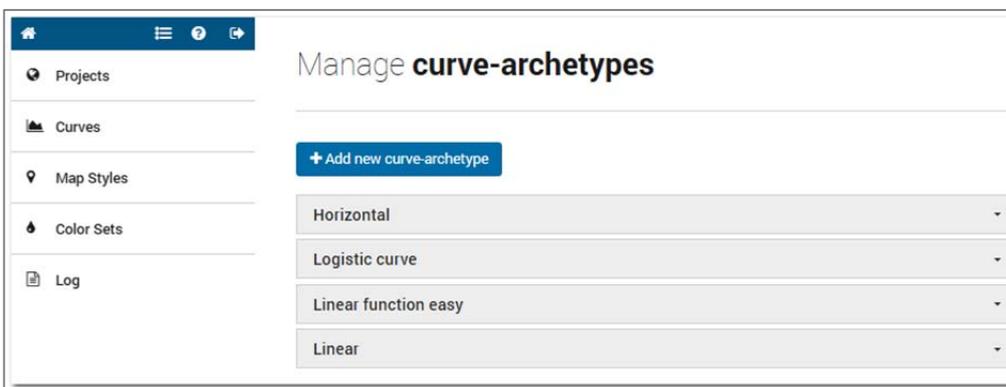




B.2 “Curves” section: configuration

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.

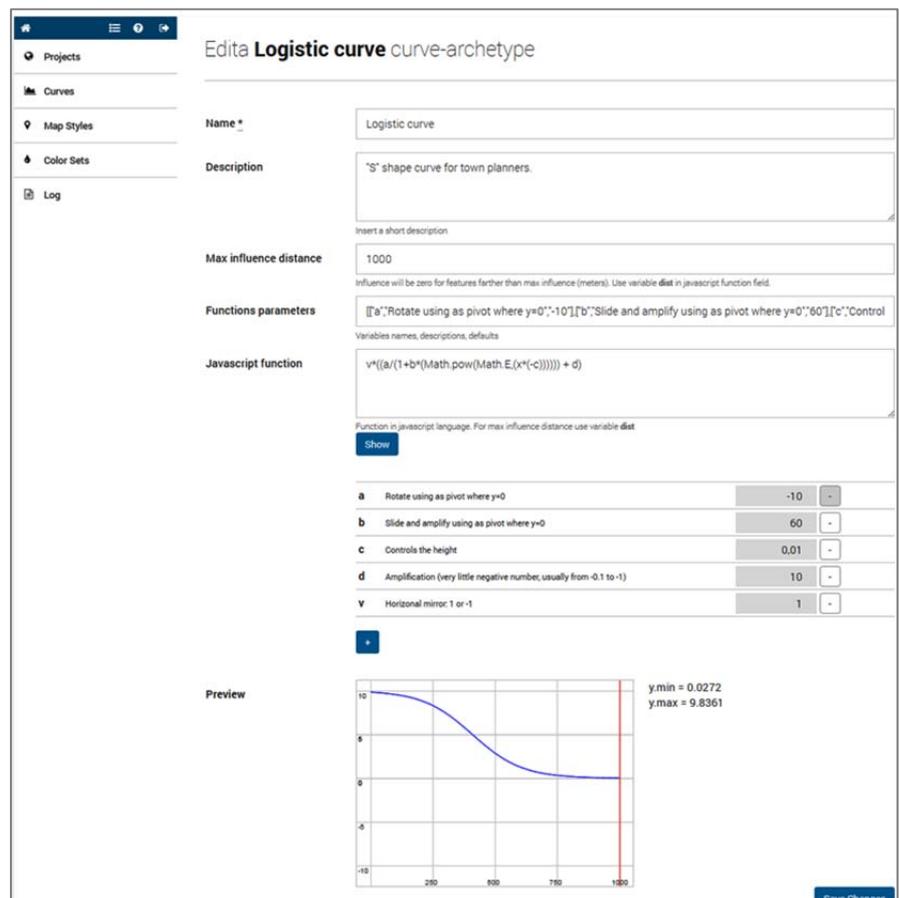


In the curves setting page, administrator users can set the typology and the parameters of each curve to be used to weight maps in the front interface.

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:

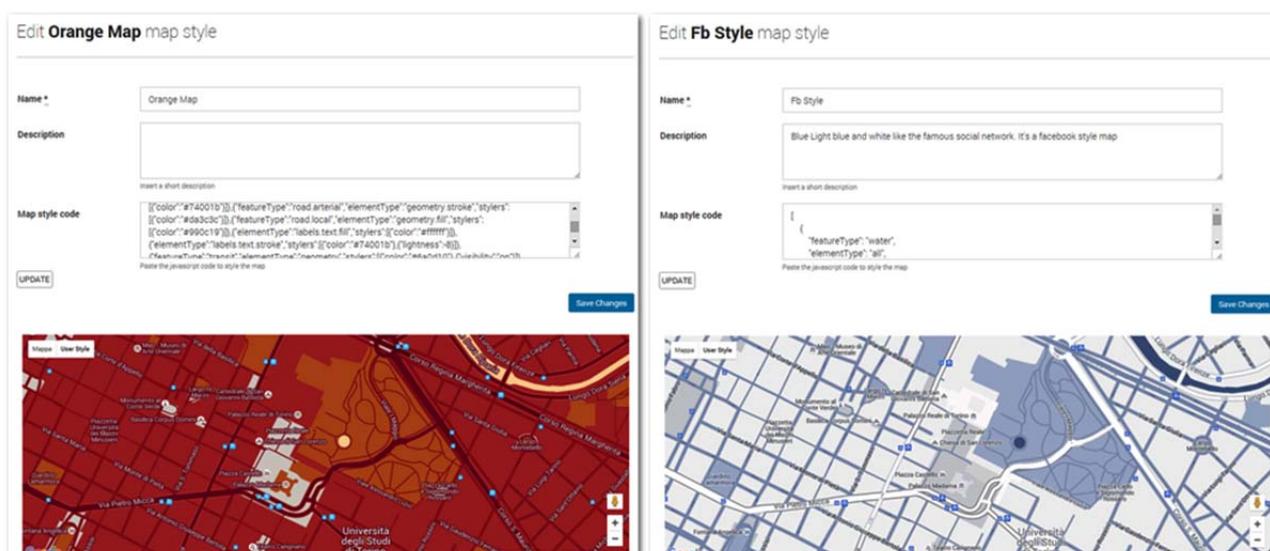
$$f(x)=d$$



B.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.

B.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.

B.5 “Log” section

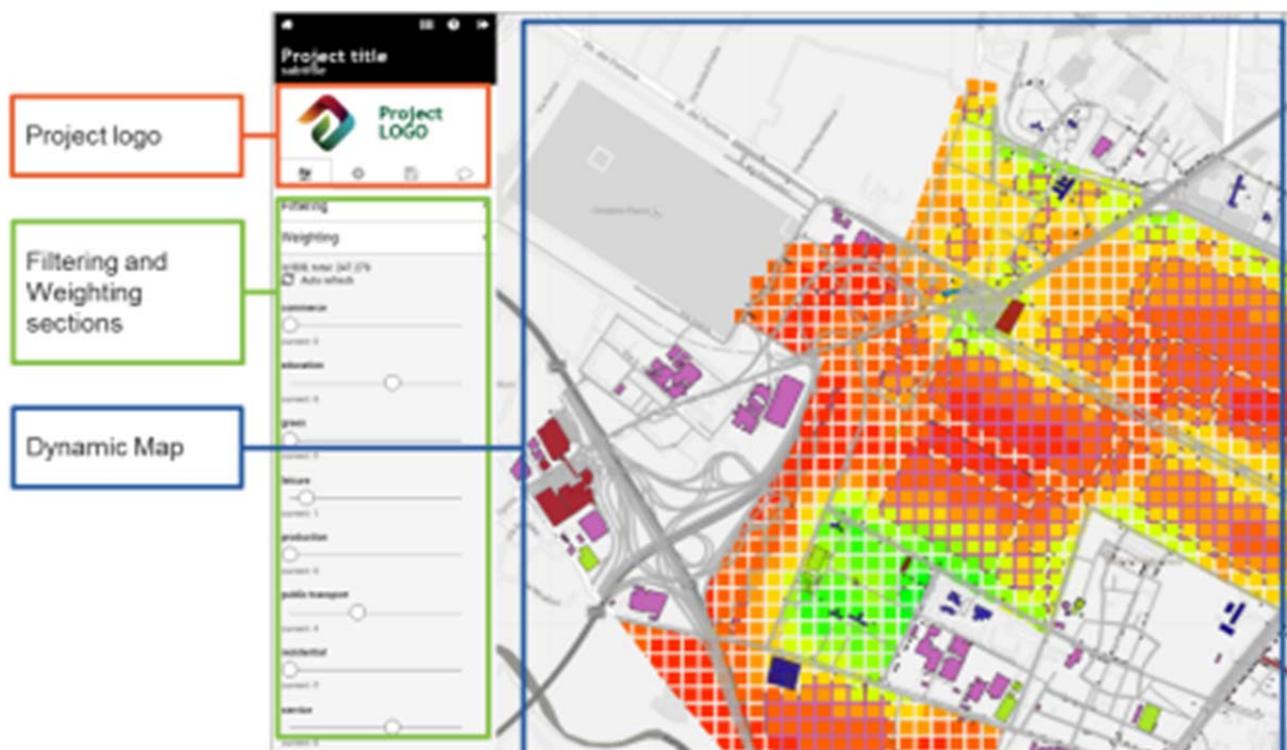
In this page you can see the last days of InViTo logs.

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

C. 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.

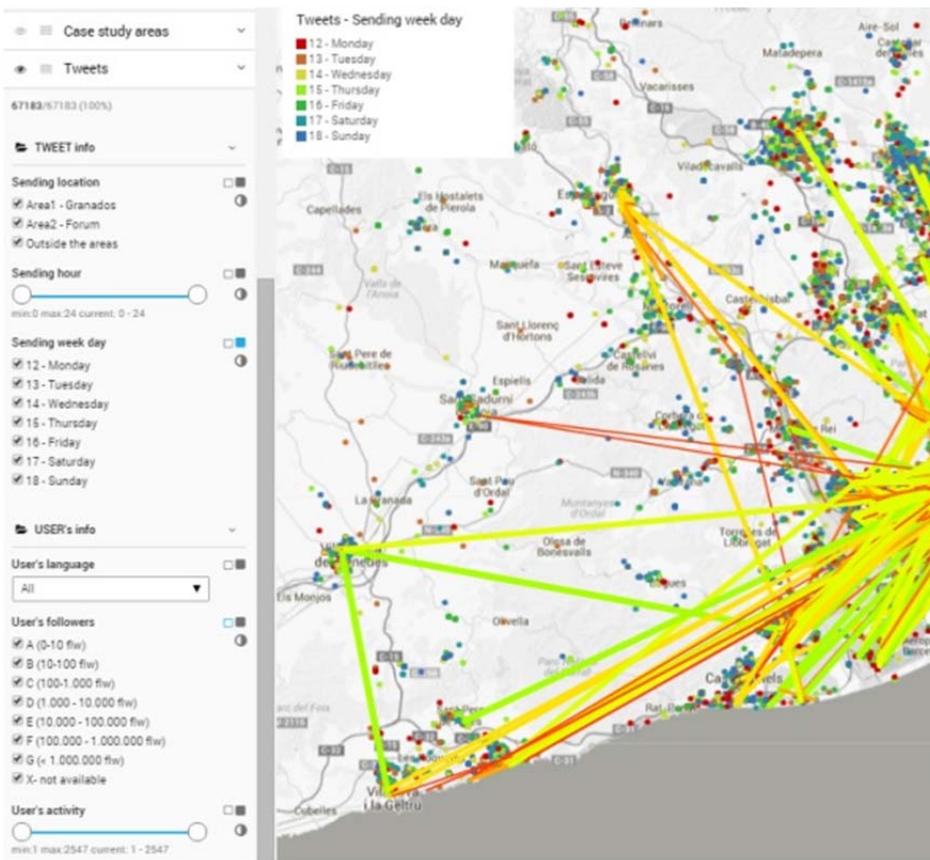


The menu on the left side contains all the elements for exploring data and interact with the information.

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

C.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:

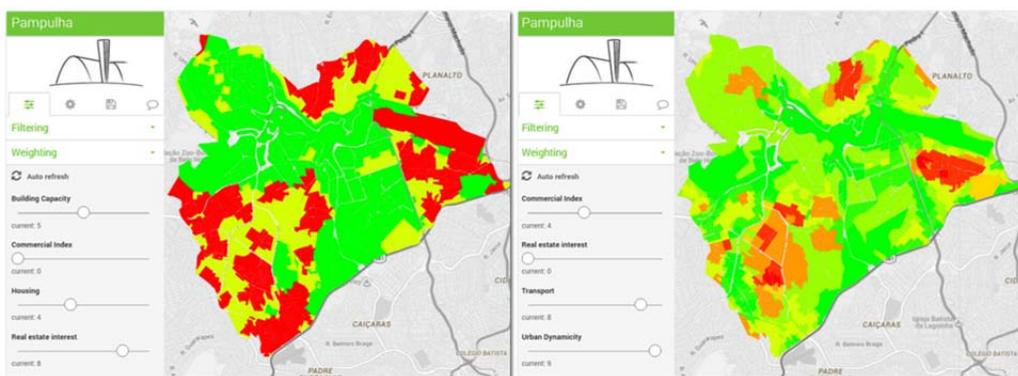
- moving the sliders and selecting the range of interest;
- (un)checking the checkbox;
- selecting the tag you want to include in your visualisation;
- selecting the sub-menu from a list of possibilities;
- clicking on the Invert icon, so that you can invert the selection of data.

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.

C.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.

C.3 Data Visualization

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

- Colours (section C.3.1)
- Dimensions (section B.1.5.7)
- Styles (section B.1.5.8)
- Map styles (section B.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 C.3.5)
- Graphs (section C.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.

C.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.

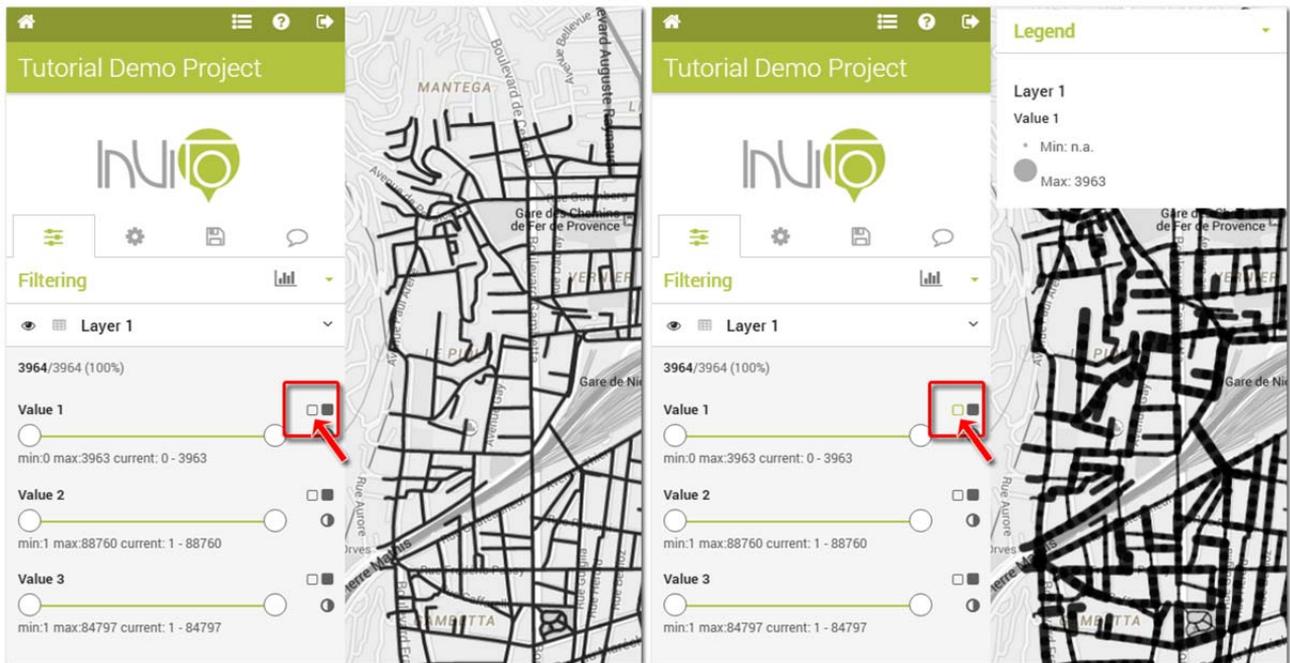


Fill feature's area with color dependent on this property. Clicking on this button you can enable and disable the colour map style associated to each layer.

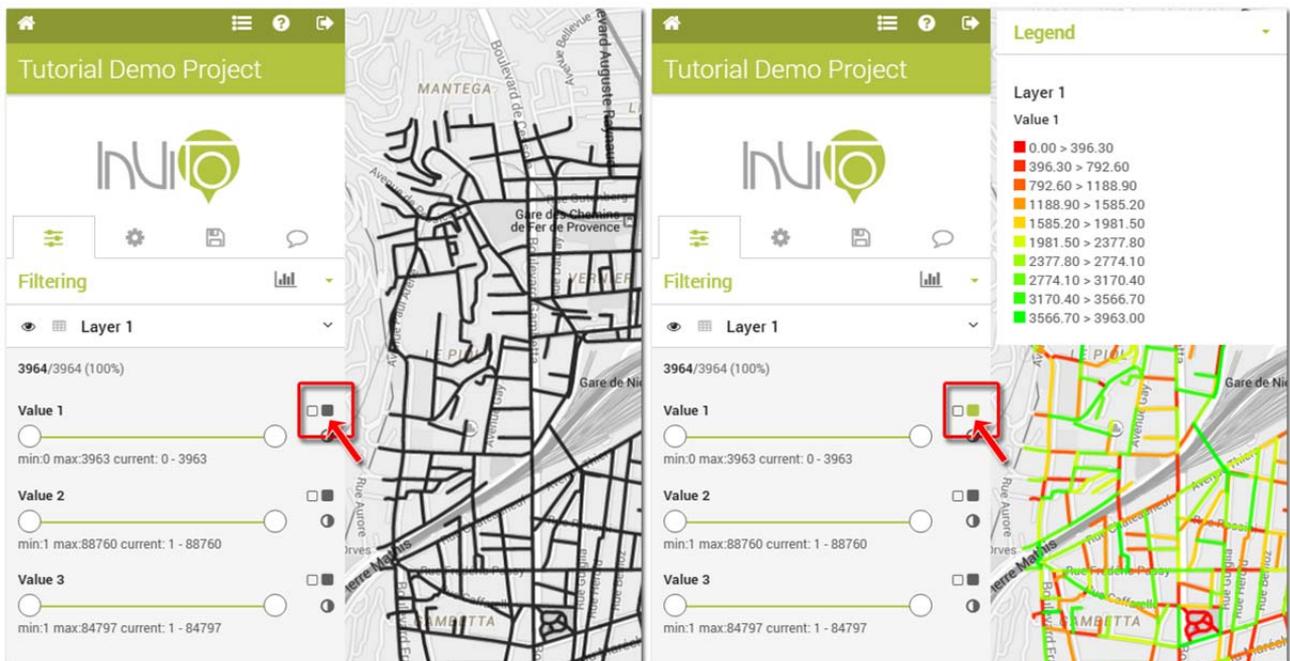
[1] Figueira, J., Greco, S., & Ehrgott, M. (Eds). (2005). Multiple Criteria Decision Analysis: State of the Art Surveys. New York, NY, USA: Springer.

[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.



Tutorial Demo Project

Legend

Layer 1

Value 2

1.00 > 8876.90
8876.90 > 17752.80
17752.80 > 26628.70
26628.70 > 35504.60
35504.60 > 44380.50
44380.50 > 53256.40
53256.40 > 62132.30
62132.30 > 71008.20
71008.20 > 79884.10
79884.10 > 88760.00

• Min: n.a.
• Max: n.a.

Filtering

Layer 1

3964/3964 (100%)

Value 1

min:0 max:3963 current: 0 - 3963

Value 2

min:1 max:88760 current: 1 - 88760

Value 3

min:1 max:84797 current: 1 - 84797

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.

C.3.2 Inverse selection



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

Tutorial Demo Project

Legend

Layer 1

Value 1

0.00 > 396.30
396.30 > 792.60
792.60 > 1188.90
1188.90 > 1585.20
1585.20 > 1981.50
1981.50 > 2377.80
2377.80 > 2774.10
2774.10 > 3170.40
3170.40 > 3566.70
3566.70 > 3963.00

Filtering

Layer 1

2295/3964 (57.89%)

Value 1

min:0 max:3963 current: 0 - 2294

Value 2

min:1 max:88760 current: 1 - 88760

Value 3

min:1 max:84797 current: 1 - 84797

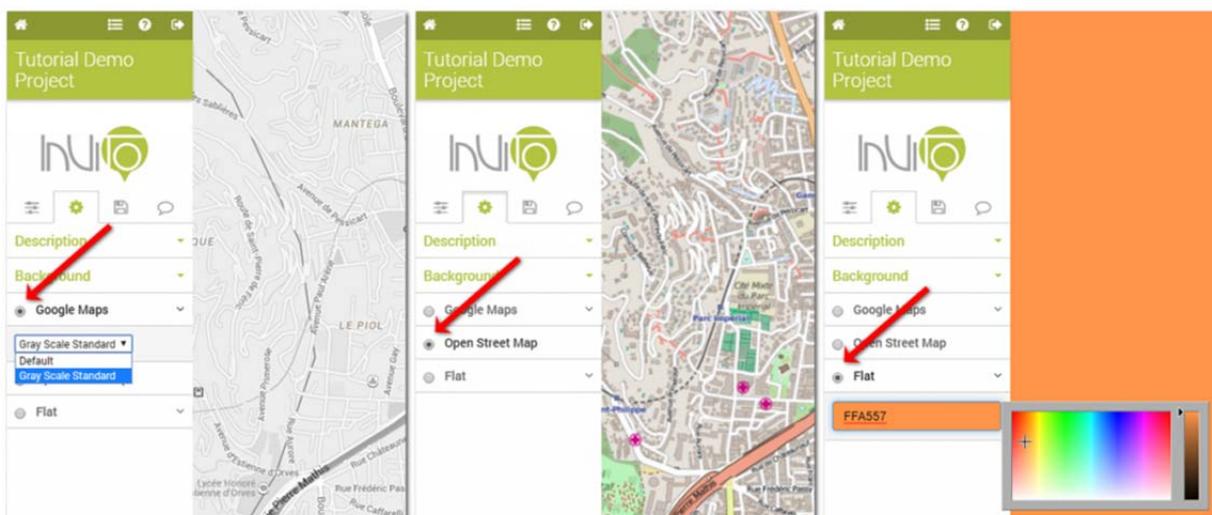
C.3.3 Map styles

Users can customise the visualisation of the background map.

 In the options menu, select "background".

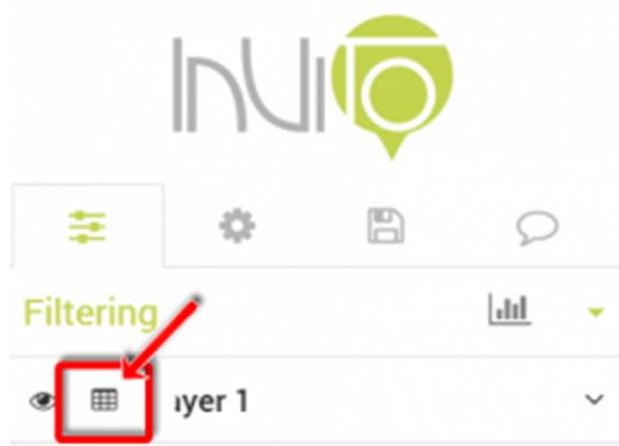
Here you can choose between different [map styles](#), as set by the "Project contributors" user. Generally, map styles can vary on a number of:

- 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).



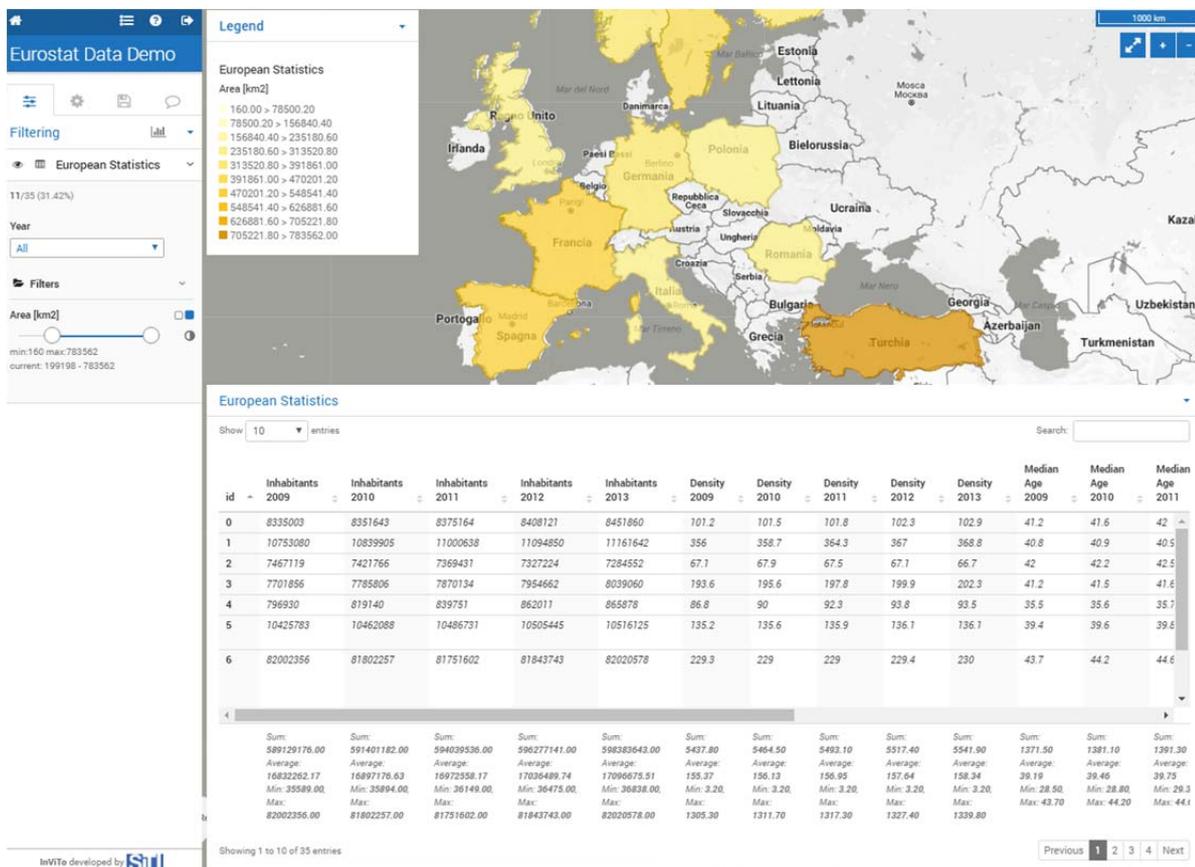
Example of background map: a gray scaled Google Maps style (left), an Open Street Map (center) and a flat colour (right).

C.3.4 Tables



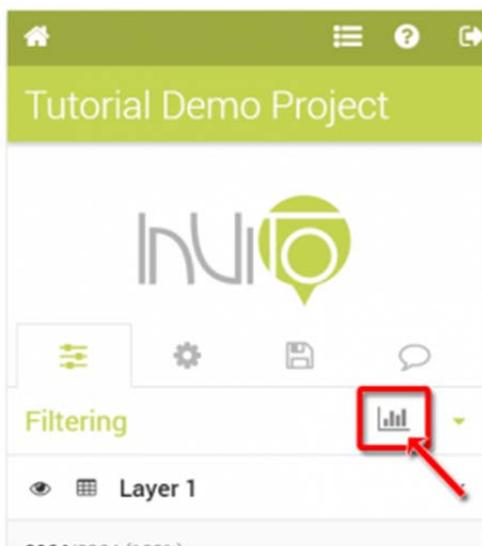
Filtered data can be displayed also within a table, providing pre-settled additional information field by field.

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.

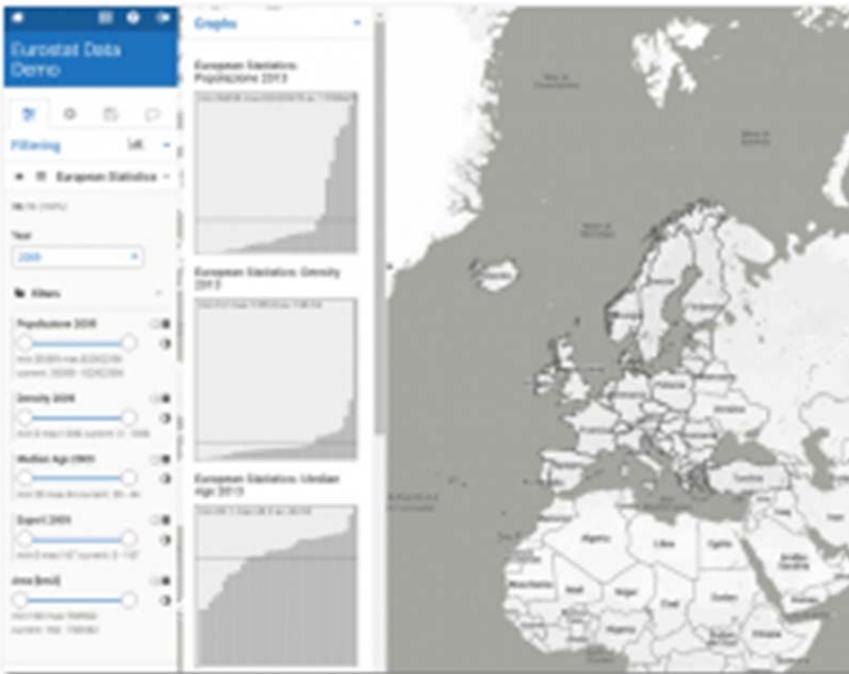


Example of table relative to the data displayed in the map.

C.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.

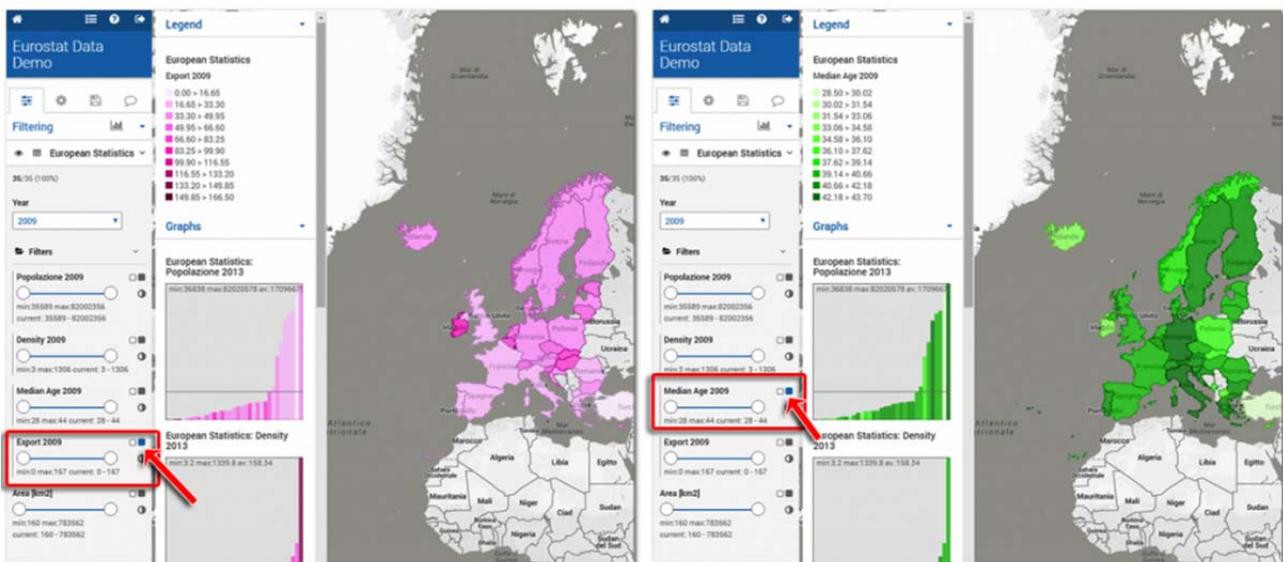


If you do not have selected any colour styles, the graphs appear gray. In this case, the graphs show only the trend of data and they average value (the horizontal line within the graph).

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.

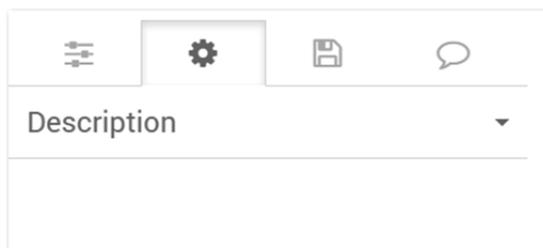
The tables show the attributes related to the filtered data, providing pre settled additional information field by field.

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



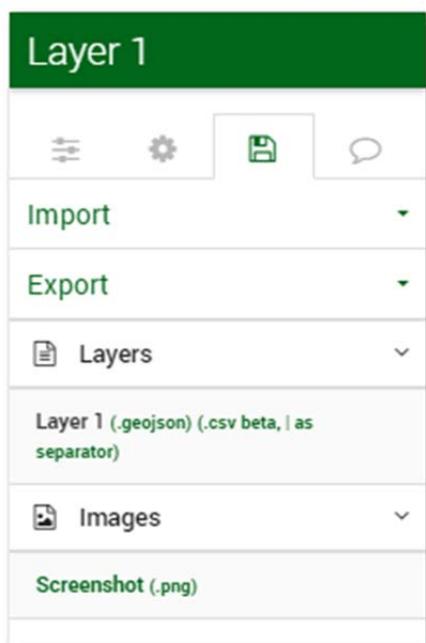


C.4 Description of the project



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

C.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.

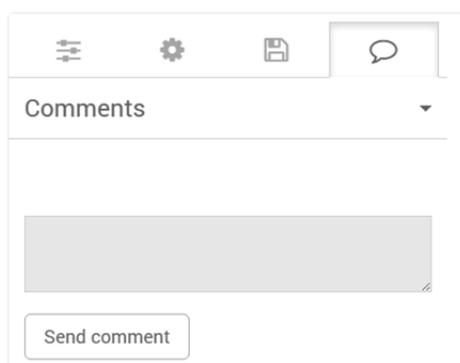
Currently, only the export function is activate, while the import one is under construction.

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.

C.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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