POLITECNICO DI MILANO
GEO Laboratory





Citizen Generated Content and FOS Participative Platforms: VGI

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Topics of this lesson

- Citizen science and VGI
- Quality Assesment of OpenStreetMap Data
- Our systems and platforms

Citizen science

Citizen science: scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions.

Oxford Dictionary of English

June 2014

It is a fairly new name but an old practice

Citizen science

- Set of practices in which citizens participate in data collection, analysis and dissemination of a scientific project (Cohn 2008)

- Classification (Haklay 2013)

  - 'classic' citizen science: amateurs engaged in traditional scientific activities
  - community science: measurements and analysis carried out by amateurs in order to set action plans to deal with environmental problems
  - citizen cyberscience: use of computers, GPS receivers and mobile phones

    - volunteered computing: citizens download data, run analyses on their own computers and send back data to the server
    - volunteered thinking: citizens perform classification works
    - participatory sensing: applications centered on mobile phones capabilities

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Citizen Science and Europe

- JRC Summit Technical Report “Citizen Science and Smart Cities” - February 2014
  (Max Craglia and Carlos Granell)

https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/

Citizen- Generated Geographic Information

Typology of Citizen-Generated Geographic Information

	Explicitly Geographic	Implicitly Geographic
Explicit or Active Volunteering	This is "True" Volunteered Geographic Information in the strictest sense. Examples include Open Street Map.	Volunteered (geo)spatial information (VSI). Examples would include Wikipedia articles about non-geographic topics, which contain place names
Implicit or Passive Volunteering	Citizen-generated geographic content (CGGC). Examples would include any public Tweet referring to the properties of an Identifiable place.	Citizen-generated (geo)spatial content (CGSC) such as a Tweet simply mentioning a place in the context of another (non-geographic) topic.

Citizen Observatories Projects

GEOSS Citizen Observatories
https://www.youtube.com/watch?v=05aWijbfxq4

European Commission

Citizens' Observatories Projects

5 projects have been funded and started in Autumn 2012:

1. **CITI-SENSE** "Development of Sensor-based Citizens' Observatory Community for Improving Quality of Life in Cities", http://citi-sense.nilu.no/ (4 years, from Oct 2012)
2. **WeSenseIt**: Citizen Observatory of Water http://www.wesenseit.eu/ (4 years, from Oct 2012)
3. **COBWEB**: Citizen (Biosphere) Observatory Web http://cobwebproject.eu/ (4 years, from Nov 2012)
4. **Citclops**: Citizens' Observatory for Coast and Ocean Optical Monitoring, http://www.citclops.eu/ (3 years from Oct 2012)
5. **OMNISCIENTIS**: Odour Monitoring and Information System based on Citizen and Technology Innovative Sensors, http://www.omniscientis.eu/ (2 years from Oct 2012)

CITI-SENSE
WESENSEIT
COBWEB
Citclops
omniscientis

5

Research and Innovation

COST Netwoks

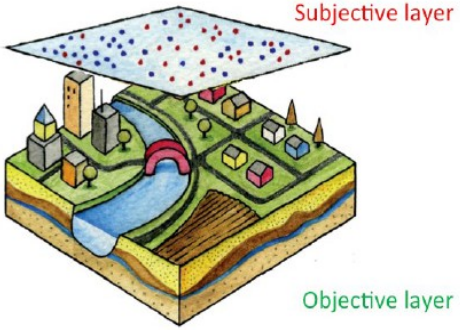
http://vgibox.eu/

http://www.citizensensor-cost.eu/

Other Projects (just a selection...)

The EmoMap project

- To create a "subjective" layer aggregating people's subjective experiences in space, and overlay this layer on top of existing "objective" geospatial data
  - Crowdsourcing approaches, social media data analysis
  - Geography (GIScience), Environmental Psychology, Urban Planning, Architecture, Policy Making, Computer Science, ...
  - An important source for Smart City: as humans are recipients of smart services



EMOMAP

TU- Wien

http://cartography.tuwien.ac.at/emomap/

Open Air Lab

OPAL Surveys

- Community Scientists – staff who work directly with communities and schools to carry out:
  - Survey activities
  - Training events
  - Talks, workshops, conferences
- Surveys can also be carried out independently
- Survey results are entered on the OPAL website
- So far, over 50,000 submissions
- Over 10% survey return rate

http://www.opalexplorenature.org/

www.everyaware.eu/

Air quality

Sound pollution

Volunteered Geographic Information

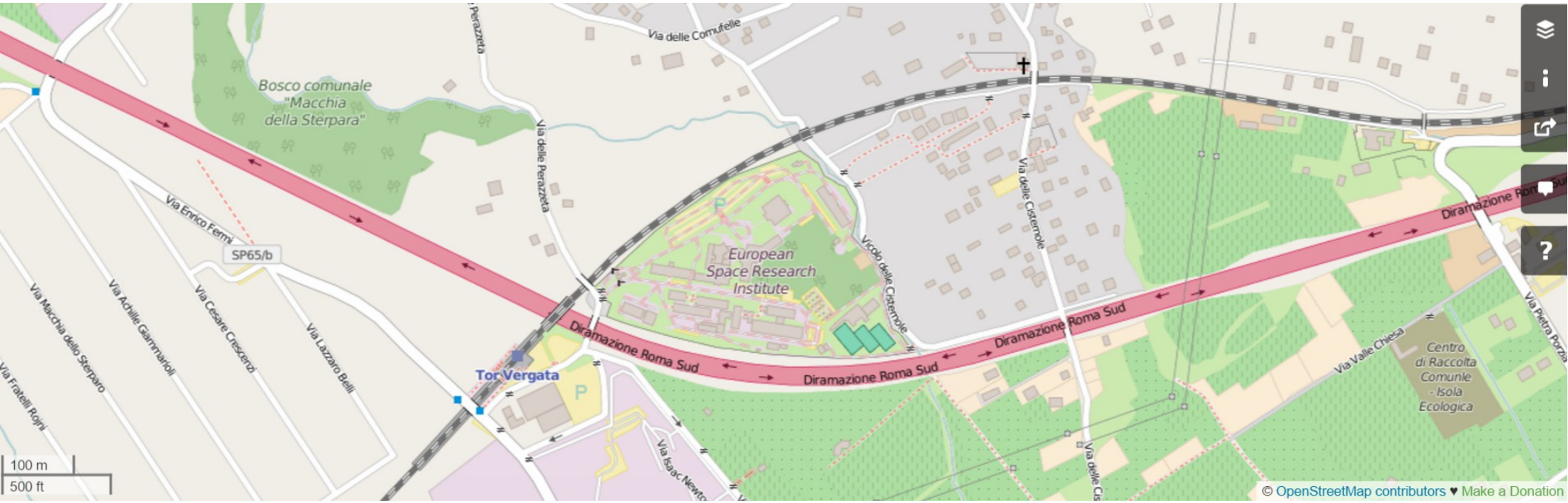
The name was coined in 2007 (Goodchild), but it was already a real practice.

Field papers

Geopaparazzi. Because not all paparazzis are evil!

Volunteered Geographic Information: OSM

- The most popular project of Volunteered Geographic Information (VGI):
  - born in 2004 for streets, then evolved into the largest, most diverse, most complete & most up-to-date geospatial database of the world
  - increasing number of contributors (currently about 2.5M)
  - database available under an open license (ODbL)
  - increasing interest from the academic community



Quality assesment of OpenStreetMap Data

- Earliest researches on OSM quality assessment were all focused on streets, that were the initial mapping target of the OSM project.

- Recently, researches on other OSM elements have begun to appear:
  - completeness and accuracy of OSM point features related to schools in Denver (Jackson et al. 2013)
  - accuracy of OSM land use features in Portugal and Germany (Estima and Painho, 2013; Jokar Arsanjani et al. 2015)
  - completeness and accuracy of the public properties mapped in OSM for Victoria (Kalantari and La, 2015)
  - completeness and accuracy of building footprints in OSM

Assessing street quality

- ✔ Novel methodology to compare OSM and authoritative road datasets:
  - → fully automated
  - → focused on spatial accuracy and completeness
  - → flexible, i.e. not developed for a specific dataset
    - ✗ made of required and optional operations
    - ✗ users can define the value of the parameters involved to adapt the procedure to their specific authoritative datasets
    - ✗ users are supposed to be familiar with the authoritative dataset used as reference
  - → built with FOSS4G (Free and Open Source Software for Geospatial)
    - ✗ reusable and extensible in case of need
- ✔ Currently developed as 3 GRASS GIS modules:
  - → written in Python
  - → available with a Graphical User Interface (GUI)

Steps of the assesment

Step 1

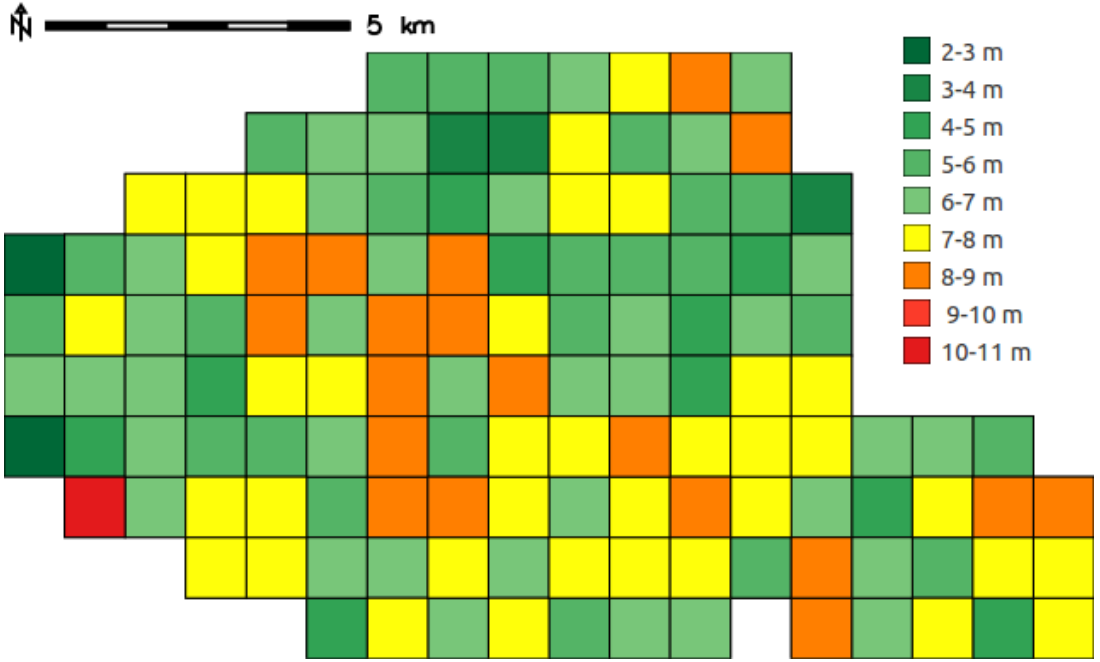
- sensitivity analysis on the buffer width

Step 2

- cleaning of OSM dataset to make it comparable with the authoritative dataset

Step 3

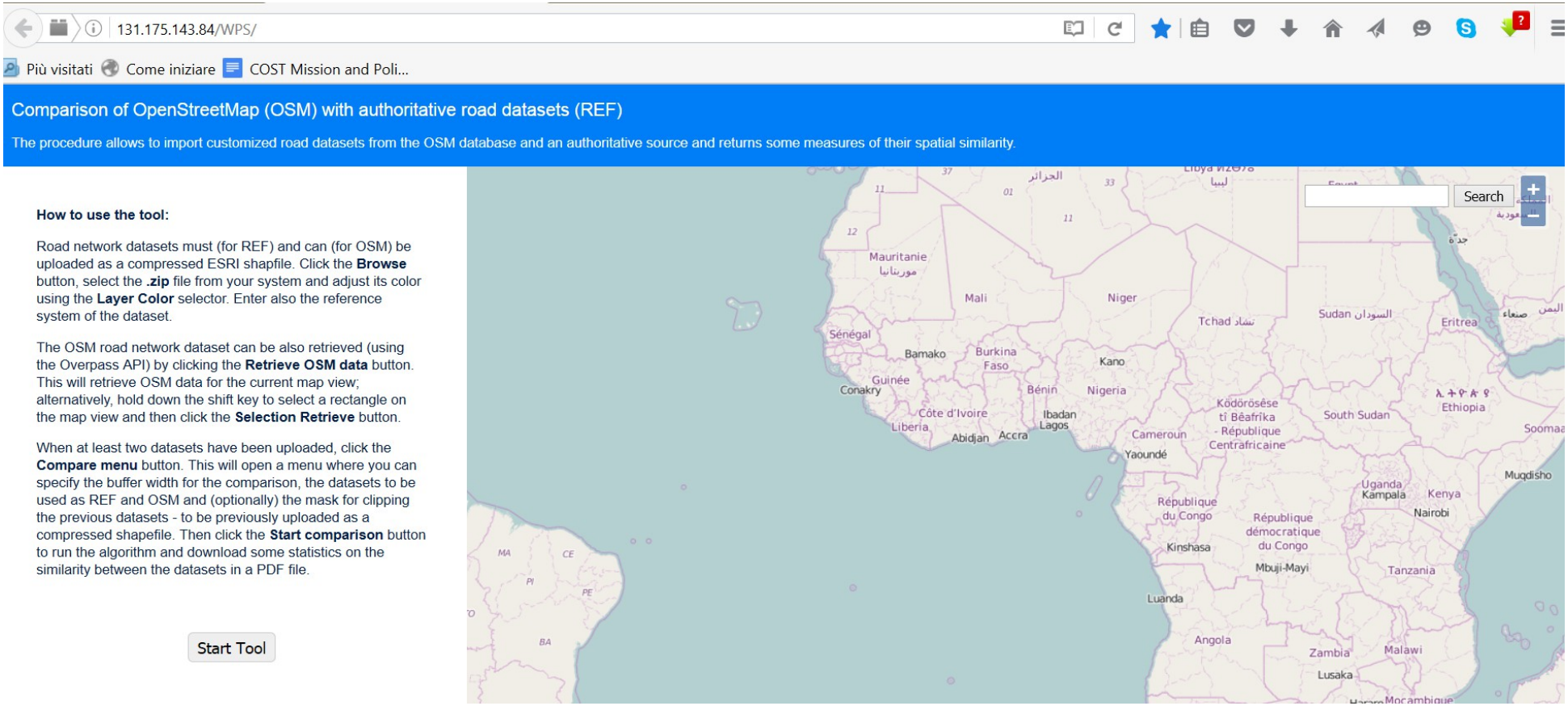
- grid-based evaluation of OSM accuracy



Example max deviation of OSM from IGN : case study Paris

Steps of the assesment

- ✔ Step 1 → WPS client http://131.175.143.84/WPS
- ✔ Steps 2/3 → code available in github
  https://github.com/MoniaMolinari/OSM-roads-comparison



OSM buildings accuracy: related work

AUTHORS	AREA	PURPOSE	RESULTS
Goetz and Zipf (2012)	Germany	Investigate the suitability of OSM data for 3D building model generation	Low completeness (30%); only the 0.5% of buildings with info about the number of levels
Hecht et al. (2013)	North Rhine Westphalia and Saxony (Germany)	Evaluate the OSM building completeness by means of a comparison against an official dataset.	Low degree of completeness; higher in urban areas
Fan et al. (2014)	Munich City (Germany)	Comparison between OSM and ATKIS (Authority Topographic-Cartographic Information System) buildings	High completeness; deficiencies in attributes; high similariry in shape;offset of 4 m
Tornros et al. (2015)	Ludwigshafen Municipality (Germany)	Assessment of OSM building completeness by means of a comparison with the official cadastre data	Analysis of the different assessment methods and their effects on the completeness results
Fram et al. (2015)	Sheffield, Leeds and london (UK)	Investigate the potential of OSM data in Risk Management Solutions. Comparison with Ordnance Survey dataset.	Completeness very variable both within and among UK cities
Klonner et al. (2015)	Bregenz (Austria)	Combine up-to-date OSM building data with the rarely up-to-date LiDAR information	Satisfactory level of upgrade of OSM dataset; suitability for the proposed application

Building quality assesment

- The quality assessment has been performed by comparing the OSM data (downloaded in January 2016) against the building layer of the official vector cartography of Milan Municipality (produced in 2012).

- Two different quality parameters were evaluated:
  - completeness evaluation based on methods suggested by literature
  - positional accuracy evaluation based on a novel, quasi-automated matching algorithm developed at GEOlab – PoliMI
- The completeness analysis was performed through the area ratio unit-based method proposed by Hecht et al. (2013)

$$C = A_{OSM} / A_{REF}$$

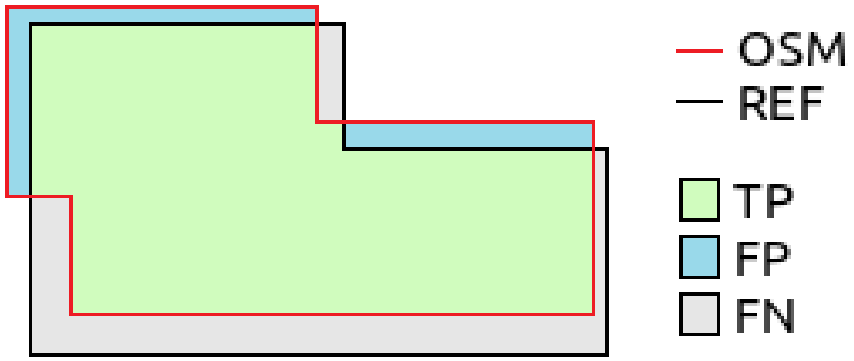
C = completeness

A_{REF} = total area of reference buildings

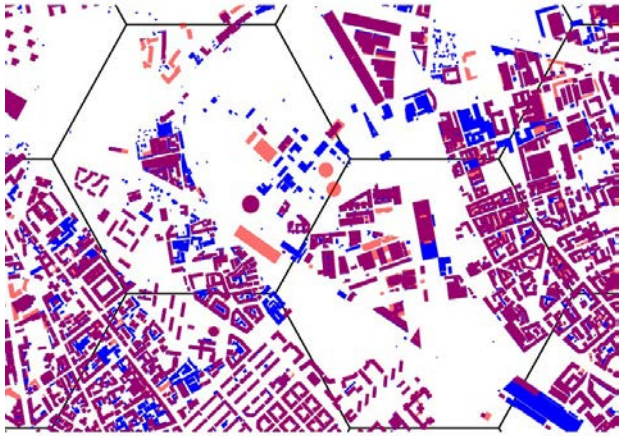
A_{OSM} = total area of OSM buildings

Completeness assessment

- The area ratio method can introduce an overestimation of C due to exceeding data available in OSM. For this reason the computation of three additional rates is recommended:
  - True Positive (TP): the areas of agreement between the datasets
  - False Positive (FP): the OSM building areas which do not exist in the REF dataset
  - False Negative (FN): the REF building areas which do not exist in the OSM dataset.



Technicalities



DATASETS

- **REF**: buildings of Milan (Lombardy Region)
- **OSM**: building of Milan (OpenStreetMap)
- **GRID**: hexagonal grid

For each cell *k* of the grid:

- Extract the CELL

v.extract input=GRID output=CELL cats=k

- Extract OSM buildings

v.overlay ainput=OSM atype="area" binput=CELL btype="area" operator="and" output=OSM_CELL

- Extract REF buildings

v.overlay ainput=REF atype="area" binput=CELL btype="area" operator="and" output=REF_CELL

- Calculate the area of OSM_CELL and REF_CELL

v.to.db map=OSM_CELL (or REF_CELL) option= "area" -p + Python code

Technicalities

For each cell *k* of the grid:

- Calculate the completeness index as $(Area_{OSM}/Area_{REF})*100$

  Python code

- Extract the overlapped area between OSM_CELL and REF_CELL

v.overlay *ainput=OSM _CELL atype="area" binput=REF_CELL btype="area" operator="and" output=TP*

- Calculate area of TP

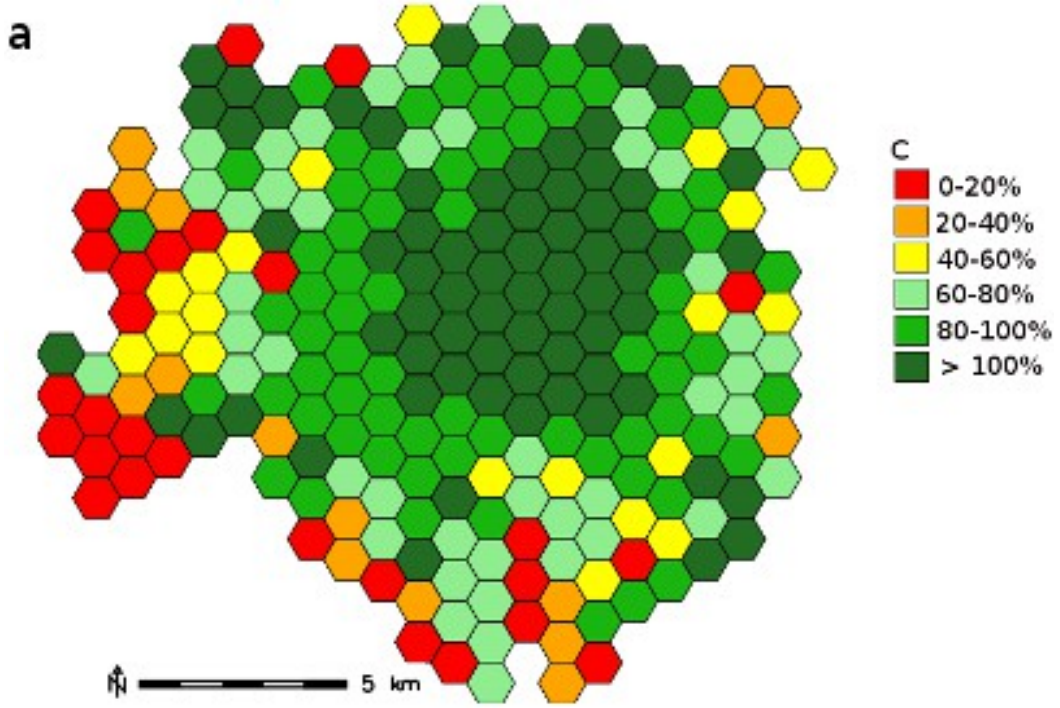
v.to.db *map=TP option= "area" -p* ***+ Python code***

- Calculate TP rate as $(Area_{TP}/Area_{REF})*100$

Python code

Completeness analysis results

- Spatial distribution of completeness rate in Milan area:

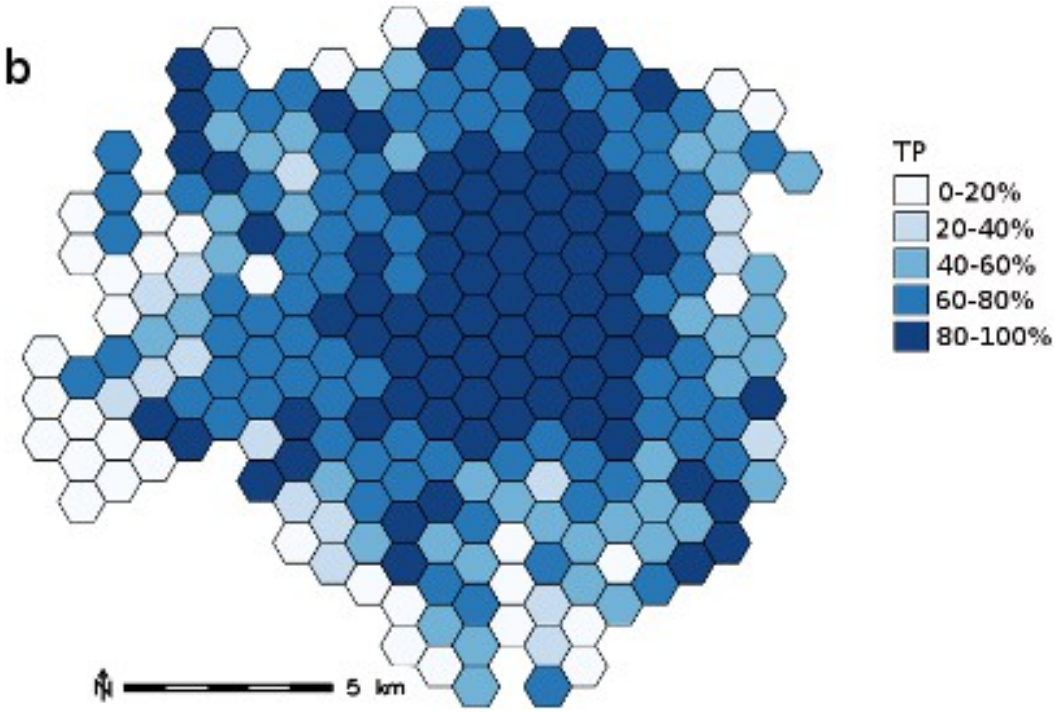


C VALUES	%
> 100%	28.9%
80% < C < 100%	27.7%
60% < C < 80%	18.5%
40% < C < 60%	8%
C < 40%	16.9%

- The completeness of the OSM dataset is very high in the city center and gradually decreases when moving towards the periphery.

TP analysis results

- Spatial distribution of TP rate in Milan area:



TP VALUES	%
100% > C > 60%	63.9%
60% < C < 40%	16.0%
C < 40%	20.1%

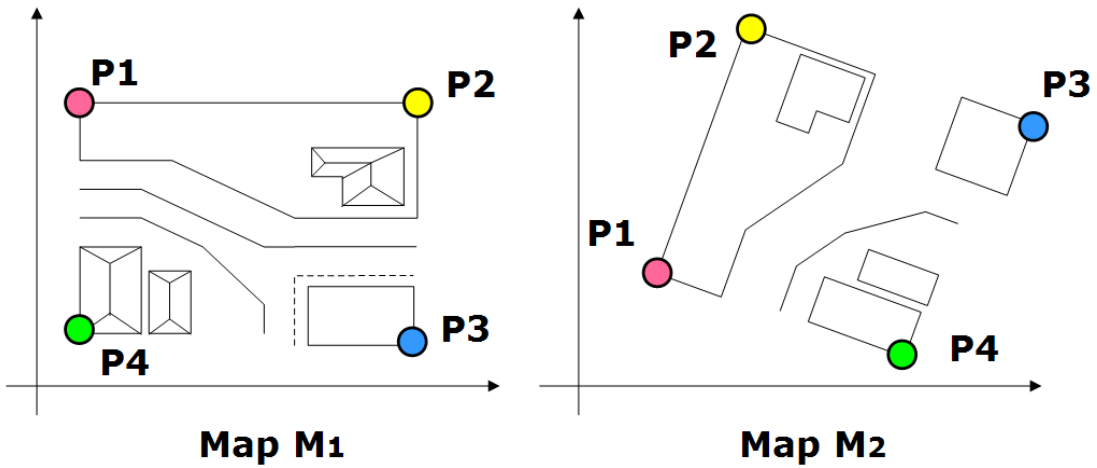
- Results largely confirm the trend observed for C: OSM completeness is higher in the city center and gradually lower in the peripheral areas.

Positional accuracy assessment

- Algorithms allowing to:
  - the quasi-automated detection of homologous pairs between REF and OSM by means of geometric, topological and semantic analyses;
  - the application of a set of warping transformations to the OSM dataset in order to optimize its match with the REF dataset

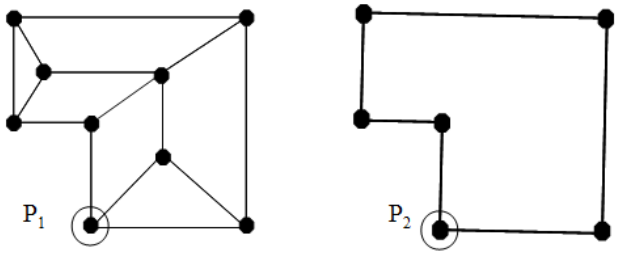
Homologous pairs:

A point P_A on map M_1 is homologous of a point P_B on map M_2 if the geographic feature related to the two points "corresponds".

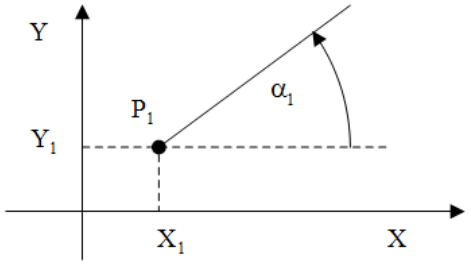


Positional accuracy assessment: analysis

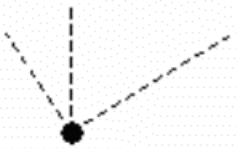
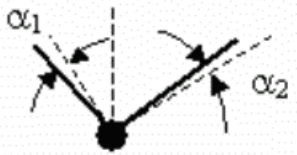
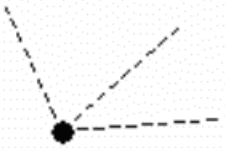
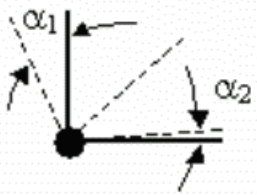
Different representation of the same feature:



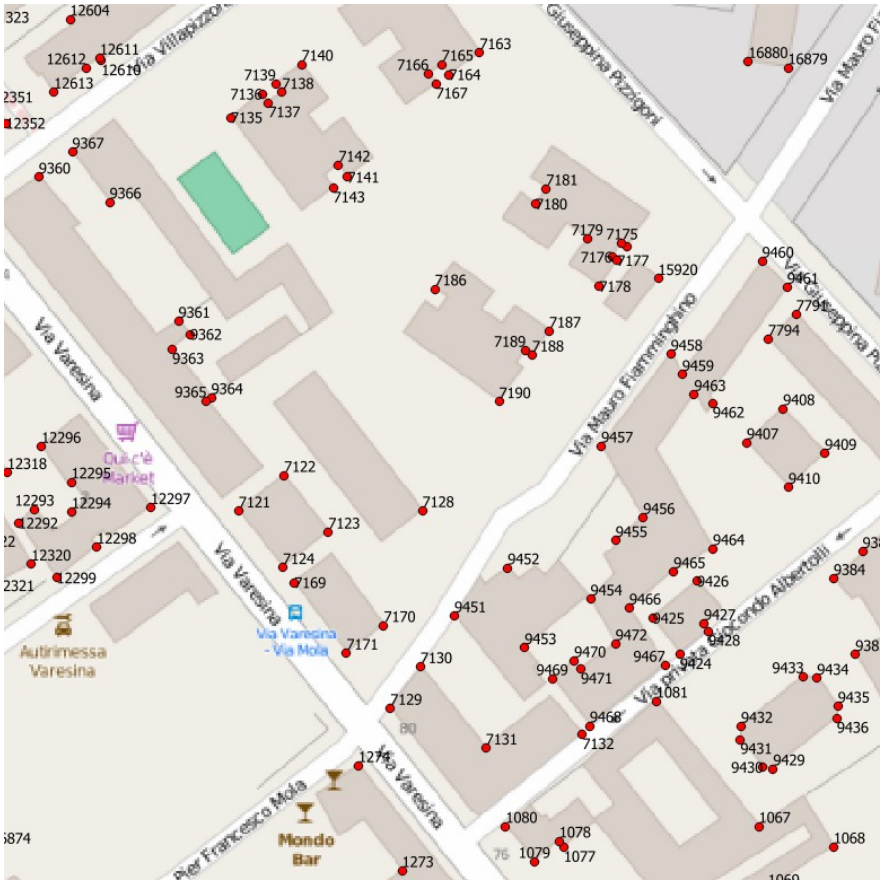
Angle (direction) of a segment:



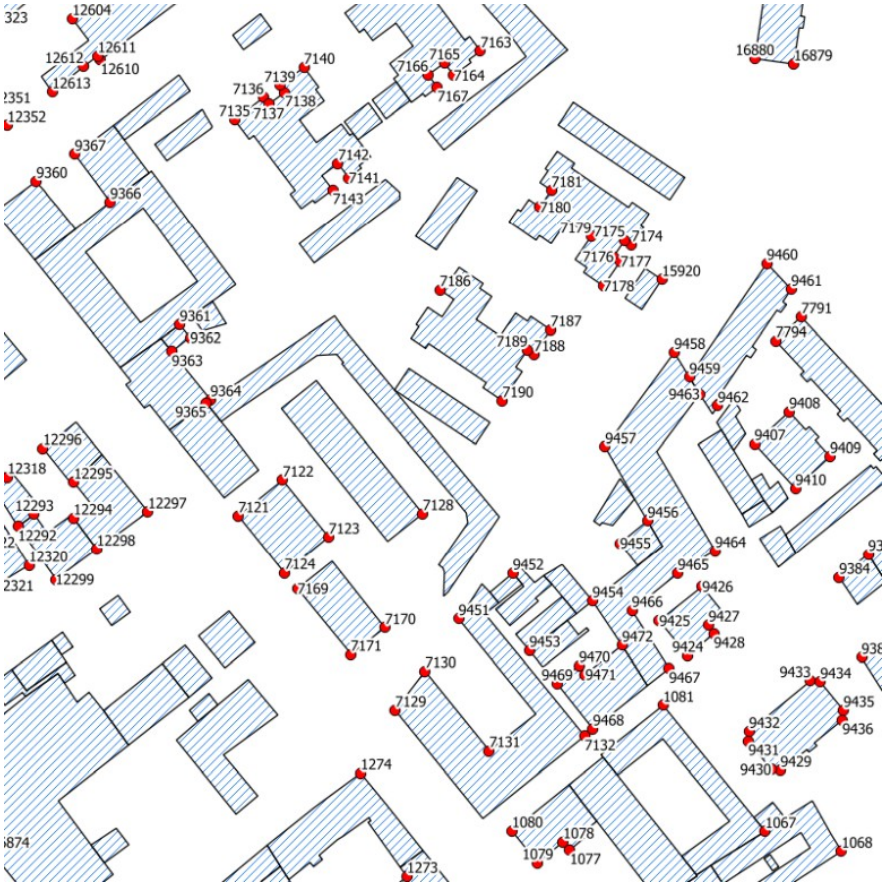
Examples of compatible – incompatible points:

Point P_1 on c_1	Point P_2 on c_2	Geometrical check	Angle relations	Result
			$\alpha_1 < \alpha_{TOL}$ $\alpha_2 < \alpha_{TOL}$	Compatible points
			$\alpha_1 > \alpha_{TOL}$ $\alpha_2 < \alpha_{TOL}$	Incompatible points

Positional accuracy assessment: results



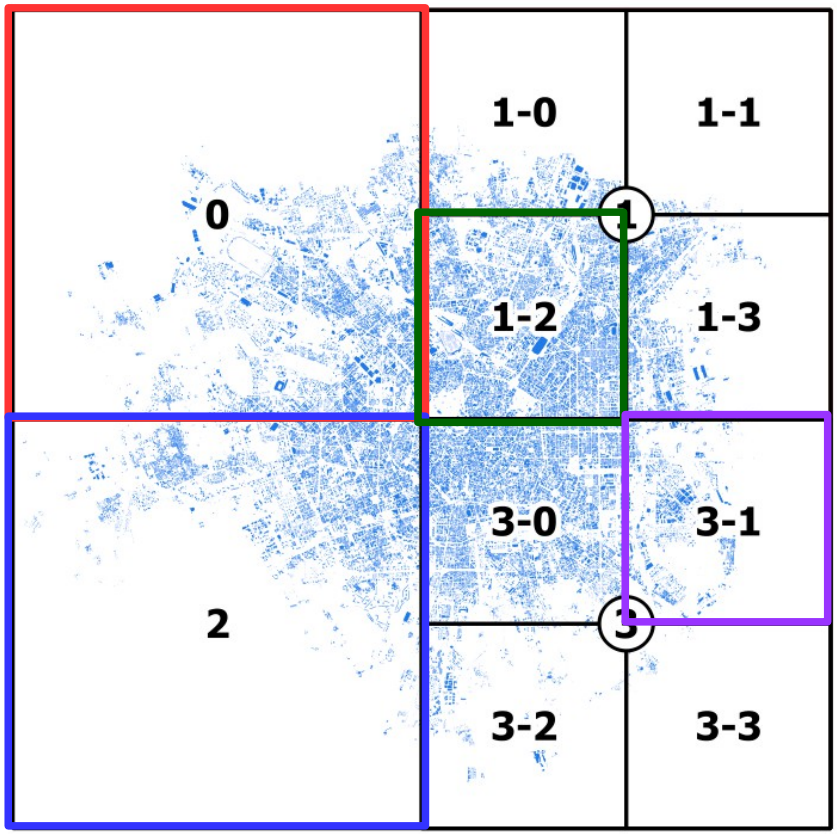
Homologous points
OSM buildings



Homologous points
REF buildings

Positional accuracy analysis results

- ✔ The number of homologous pairs detected is approximately 100 000



Cell	Points	Trasf.	ΔY μ [m]	ΔX μ [m]	d μ [m]
0	19135	None	0.45	0.46	0.81
1-2	16480	None	0.35	0.46	0.77
2	18732	None	0.44	0.43	0.79
3-1	4318	None	0.28	0.41	0.71

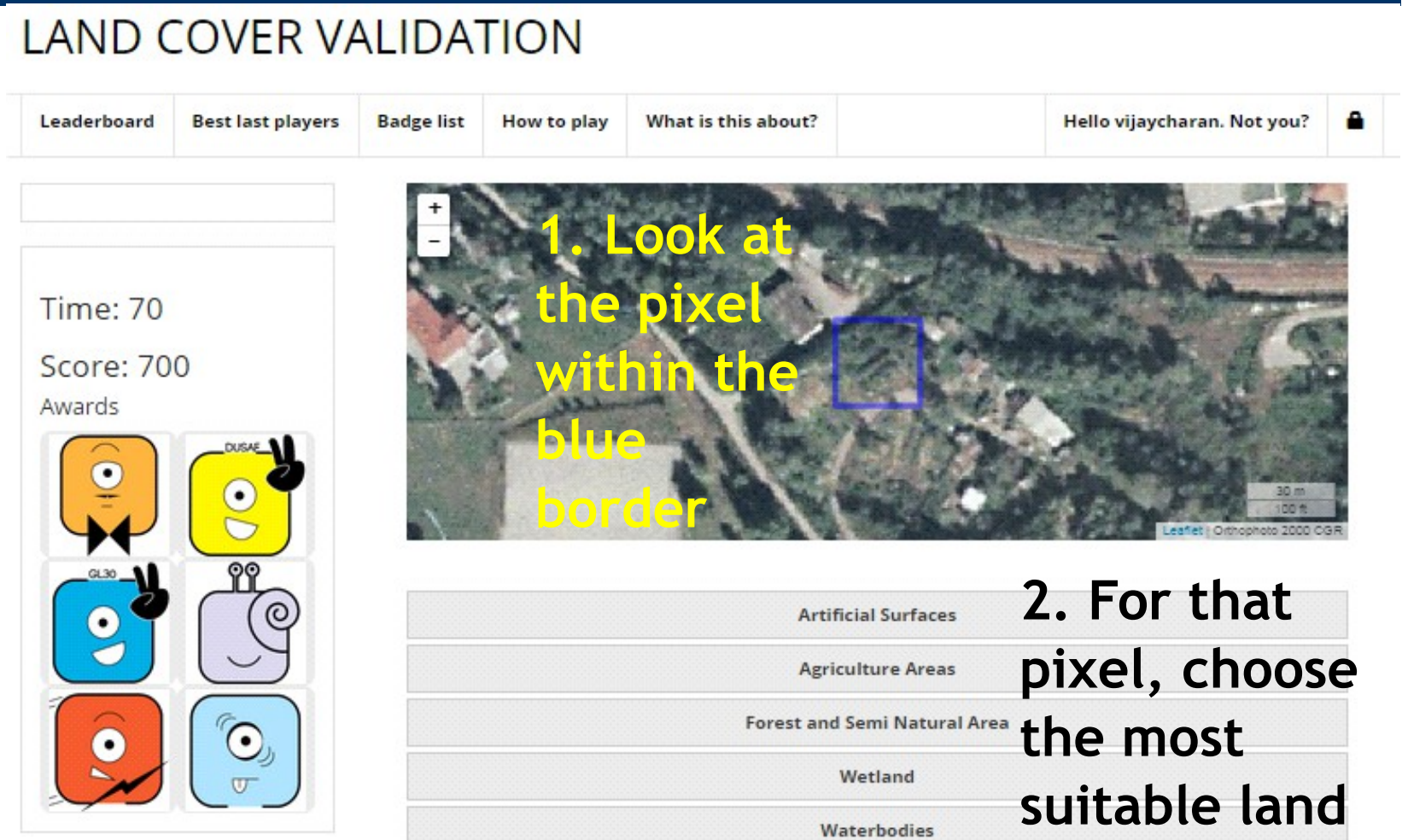
The positional accuracy is the same in both Milan center and periphery.

Positional accuracy analysis results

- Using the homologous points detected, it is possible to estimate the parameters of an affine or MR spline transformation to remove the systematic translation and reduce the mean distance: this warped layer may become the new version in the OSM database

Cell	Points	Trasf.	d μ [m]
0	19135	None	0.81
		Affine	0.56
		Spline MR	0.50
1-2	16480	None	0.77
		Affine	0.57
		Spline MR	0.50
2	18732	None	0.79
		Affine	0.55
		Spline MR	0.49
3-1	4318	None	0.71
		Affine	0.55
		Spline MR	0.48

Volunteered thinking



3. Watch the time!

2. For that pixel, choose the most suitable land cover category

4. Win scores and badges and beat your friends!

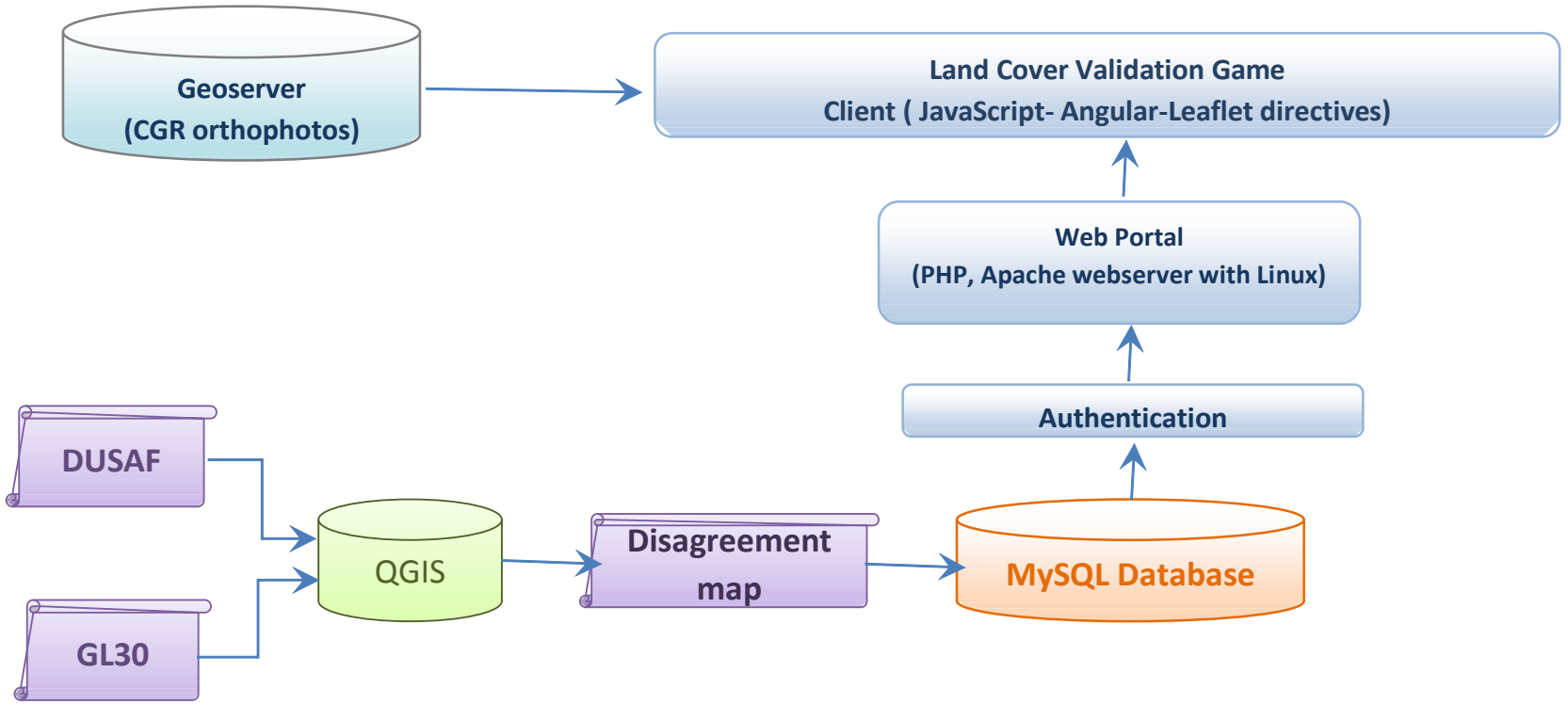
http://bit.ly/foss4game

GLOBELAND30

DUSAF (Lombardy)

CGR SPA YOUR WORLD, OUR EYES.

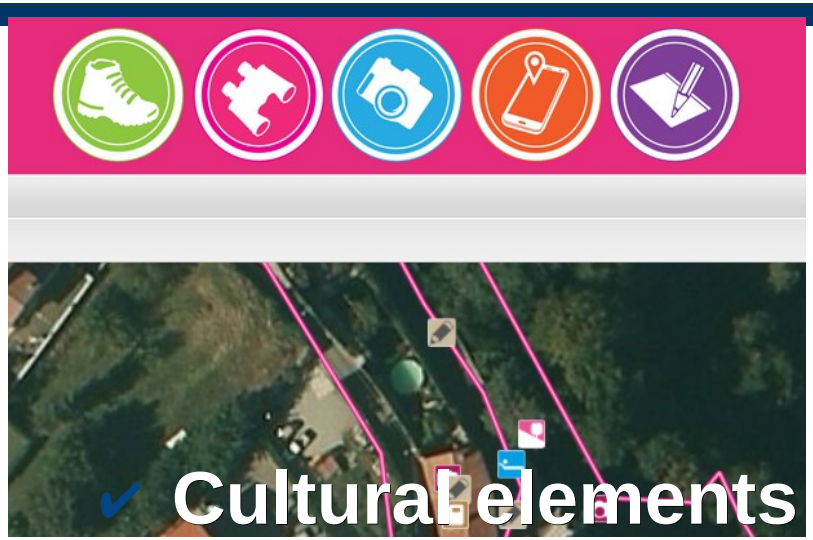
Land cover validation game architecture



DUSAF Agreements	87 %
GLOBELAND30 Agreements	11 %
Disagreements	1 %

Participatory sensing applications

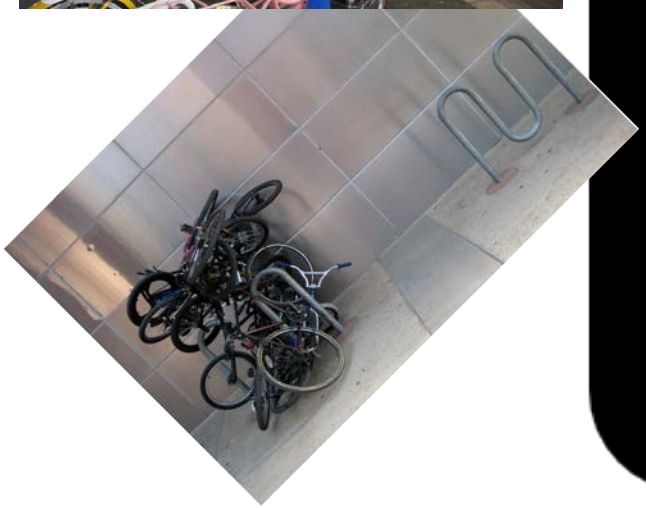
✔ Architectural barriers



✔ Cultural elements

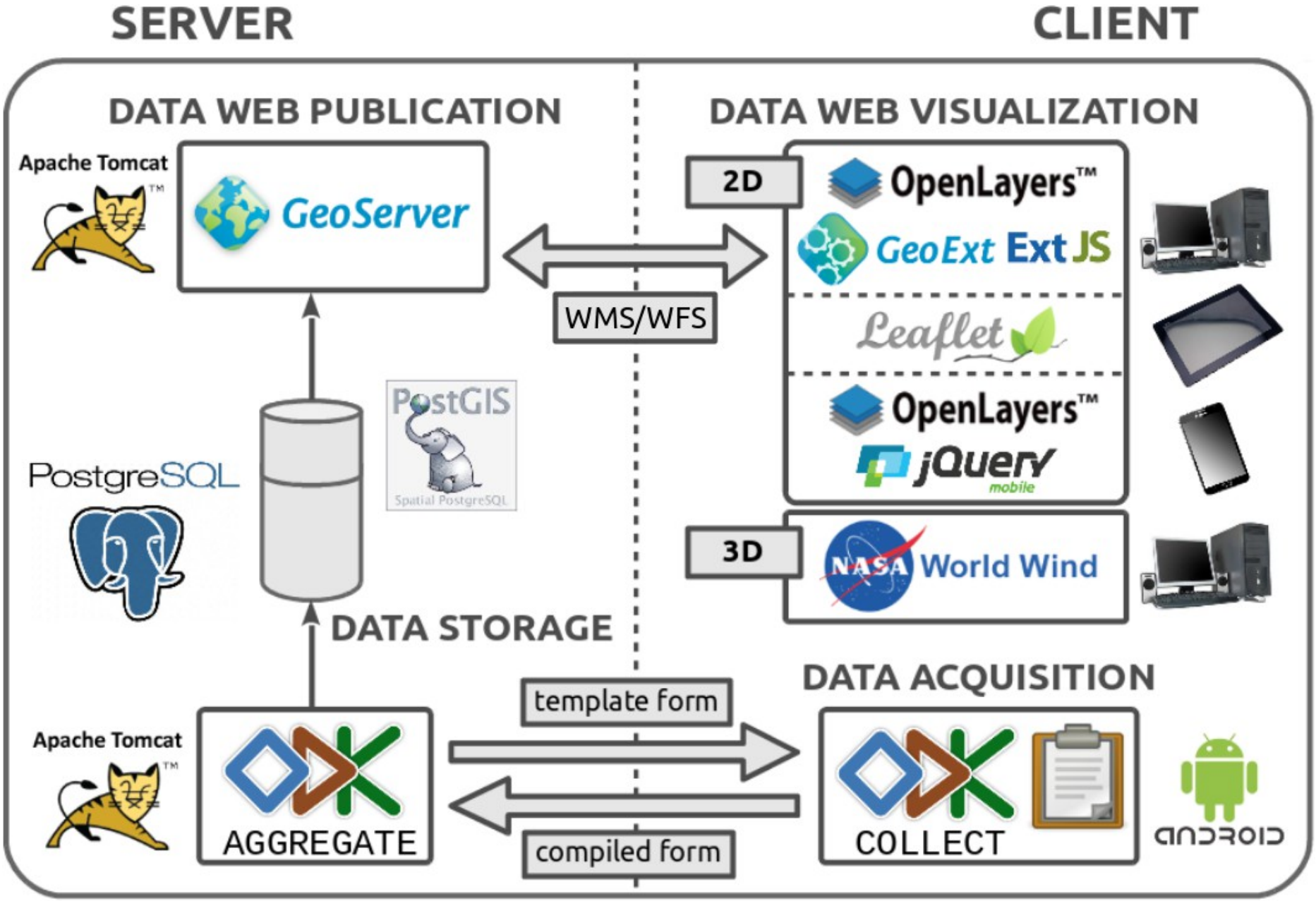
✔ Street furniture

✔ Biodiversity

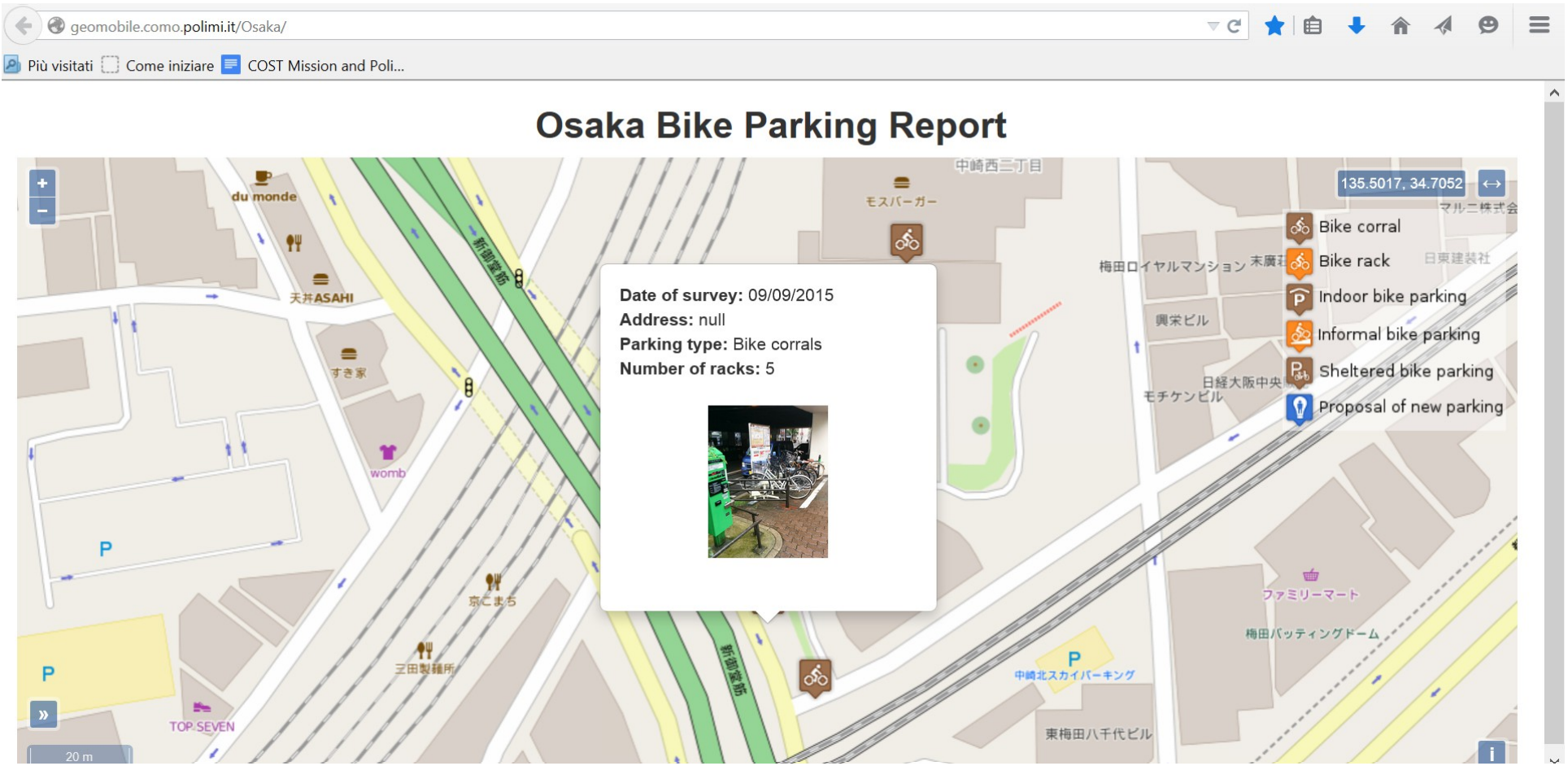



21:32
ODK Collect > Osaka...
OSAKA
bike parking
REPORT
OSAKA CITY UNIVERSITY
POLITECNICO DI MILANO
You are at the start of Osaka Bike Parking Report. Swipe the screen as shown below to go backward and forward.
backward to previous
forward to next
OPEN DATA KIT

Participatory sensing FOSS architecture



2D viewer



OpenLayers http://geomobile.como.polimi.it/Osaka/

Policrowd2.0 Osaka

INSTRUCTIONS		
STEP	**WINDOWS**	**LINUX**
1) Install the Java Virtual Machine (JVM)	- Download and install from here	
2) Install the multimedia viewer	- Download and install from here	
3) Launch the Java Control Panel:	- Launch the Windows Start menu - Click on Programs - Find the Java program listing - Click on Configure Java	- Open the Terminal Window - Type: ControlPanel
4) Set the JVM security exception:	- Click on the Security tab - Click on the Edit Site List button - Click Add in the Exception Site List window - Add the IP: 131.175.143.48	
5) Start the application	- Click here or on the banner below	
6) Configure the multimedia viewer	- Select Preferences in the Options menu of the 3D Viewer - Check the VLC radiobutton, click the Browse button and select the following vlc executable file:	
	for 64bit version: C:\Program Files\VideoLAN\VLC\vlc.exe for 32bit version: C:\Program Files x86\VideoLAN\VLC\vlc.exe	/usr/bin/vlc

http://geomobile.como.polimi.it/policrowd2.0/

http://viaregina2.como.polimi.it/Osaka/

Mapping elements along cultural paths

Via Regina Cross-platform App

The application relies on Apache Cordova mobile application development framework.

The map is built using mobile-friendly Leaflet library.

The data is stored in JSON format in a document-oriented NoSQL PouchDB/CouchDB database.

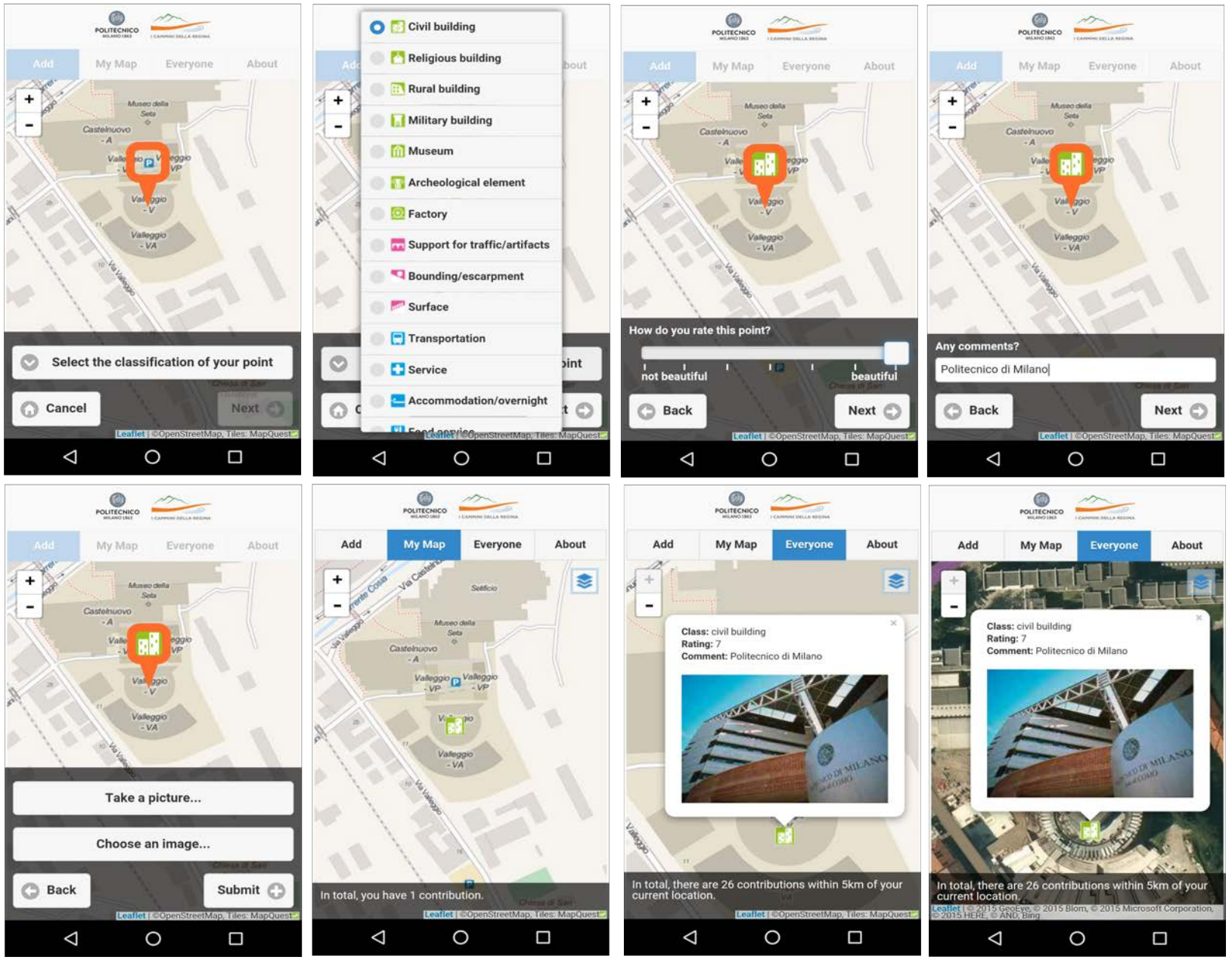
Moreover the data stored in the ODK Aggregate server is displayed.

The App is available as Web App

http://viaregina3.como.polimi.it/app/

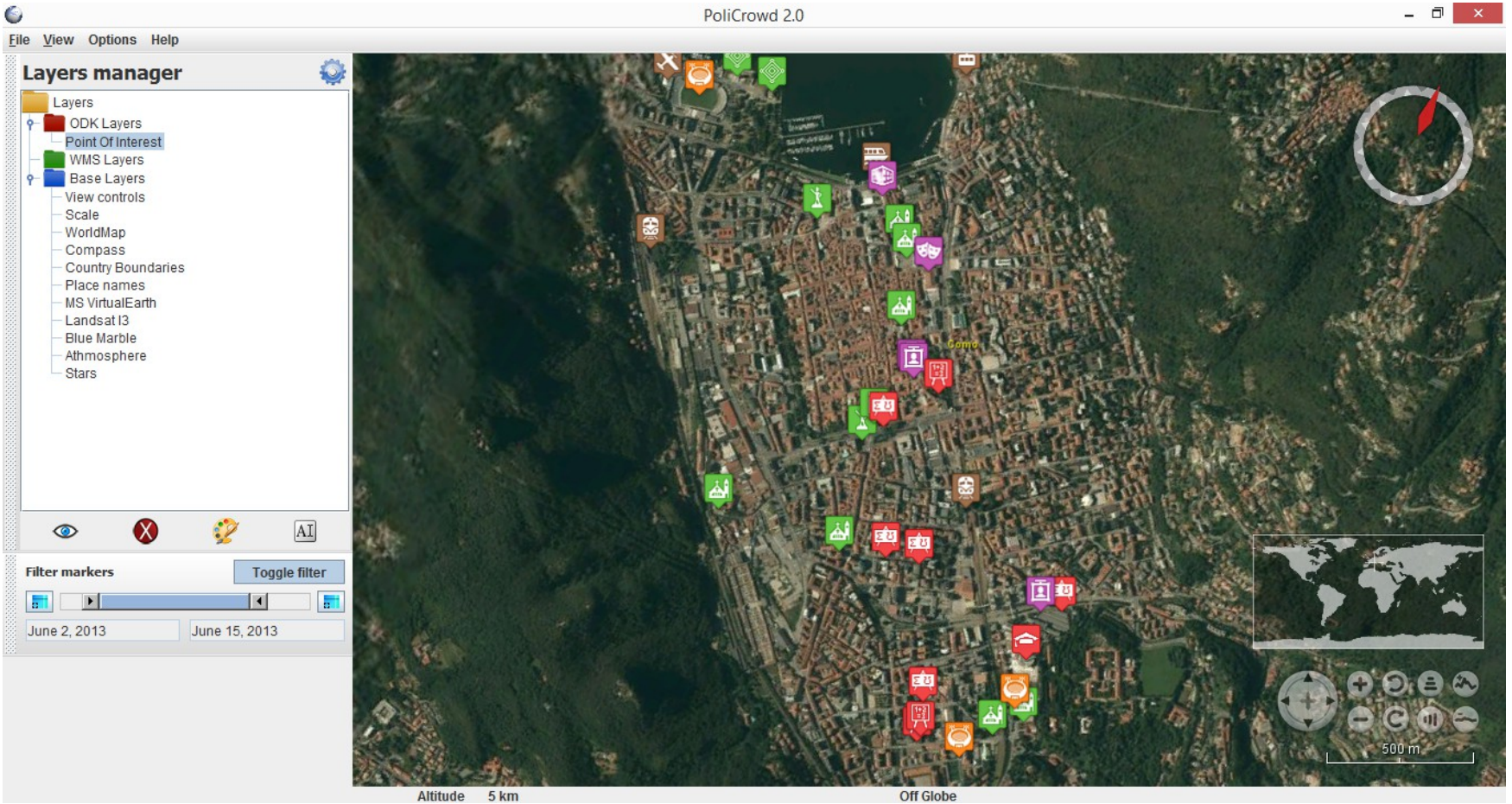
or in Play and Apple Stores (Via Regina)

Via Regina Cross-platform App



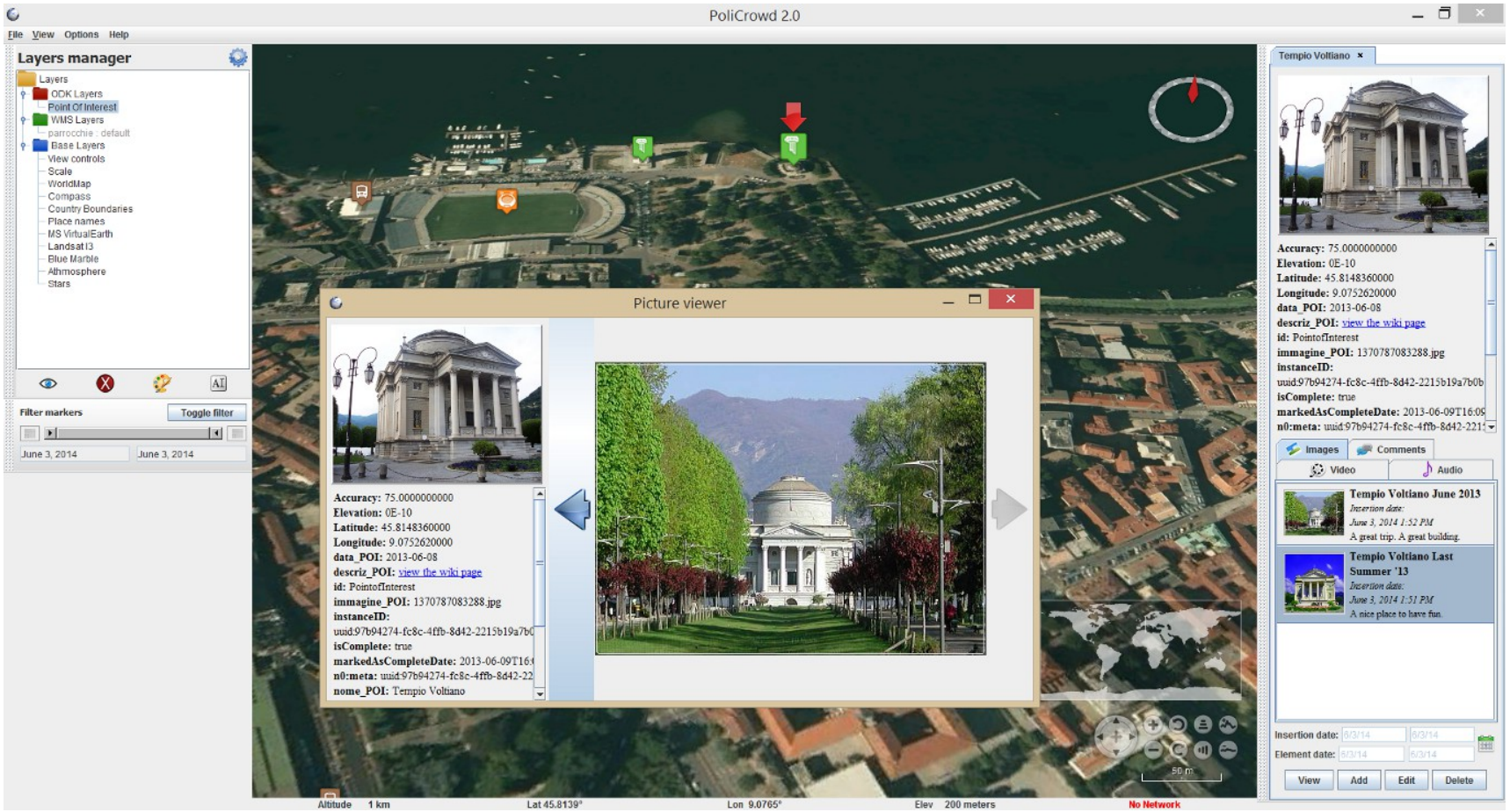
PoliCrowd – A social World Wind platform

- Web-based 3D participatory platform, ongoing (Brovelli et al. 2013)
  - Born for tourism, culture, sports & transportation Points Of Interest (POIs)
  - POIs 3D visualization on NASA World Wind virtual globe
  - participative functionalities: POIs collaborative enrichment & project creation



PoliCrowd2.0 – A social World Wind platform

- Web-based 3D participatory platform
  - non mono-thematic application – connection to any WMS and ODK server
  - customizable data styling & multimedia support
  - support for time dimension (4D visualization)



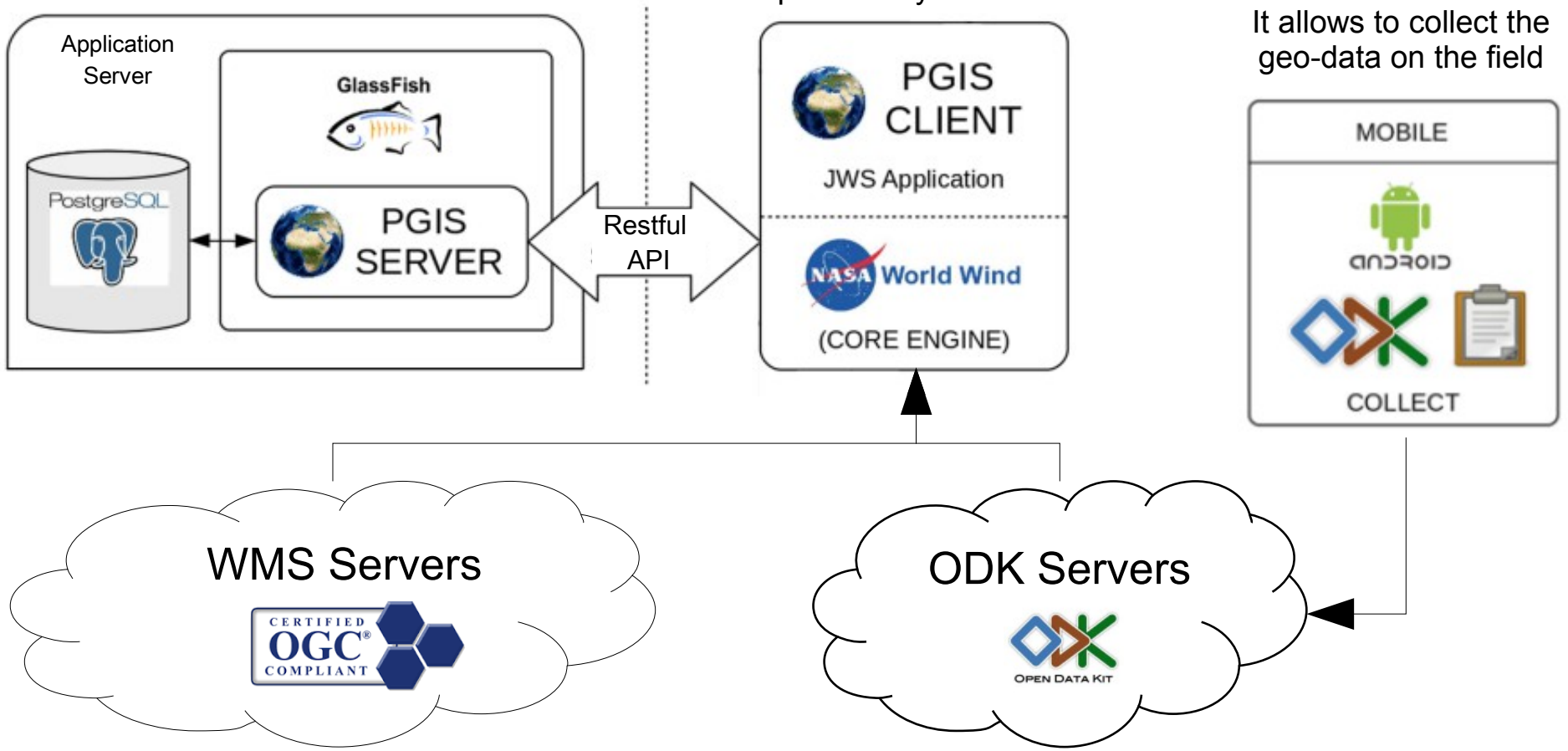
PoliCrowd 2.0 architecture

In addition to the WMS servers, PoliCrowd 2.0 has also an innovative capability to directly connect with any Open Data Kit (ODK) server available on the network and publish the related data collected by the community

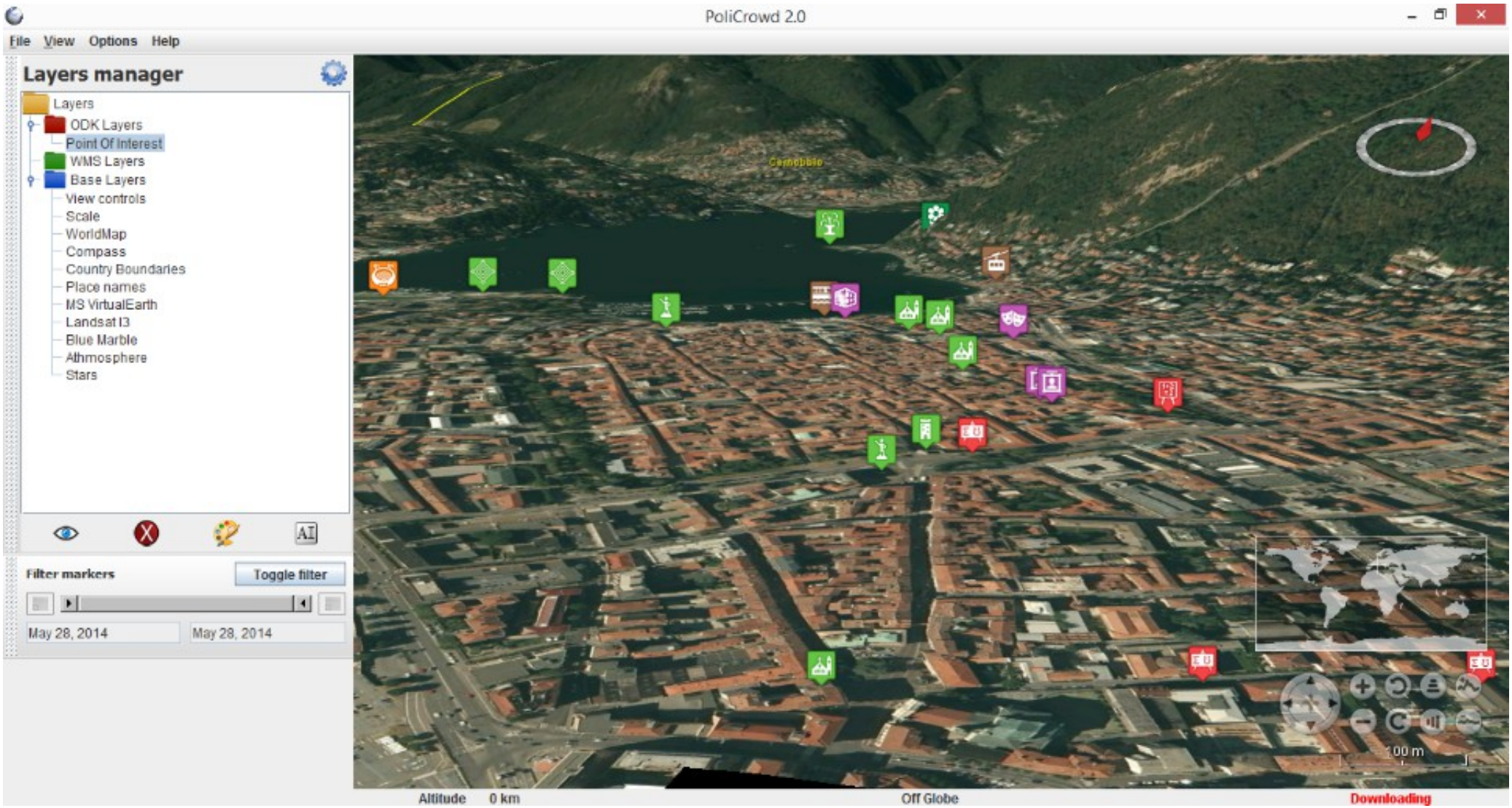
POLICROWD 2.0 SERVER
Management of: accounts (authentications, authorizations), projects, mutimedia contents

POLICROWD 2.0 CLIENT
It allows to interact with the data uploaded by the users

MOBILE CLIENT
It allows to collect the geo-data on the field



3D data visualization



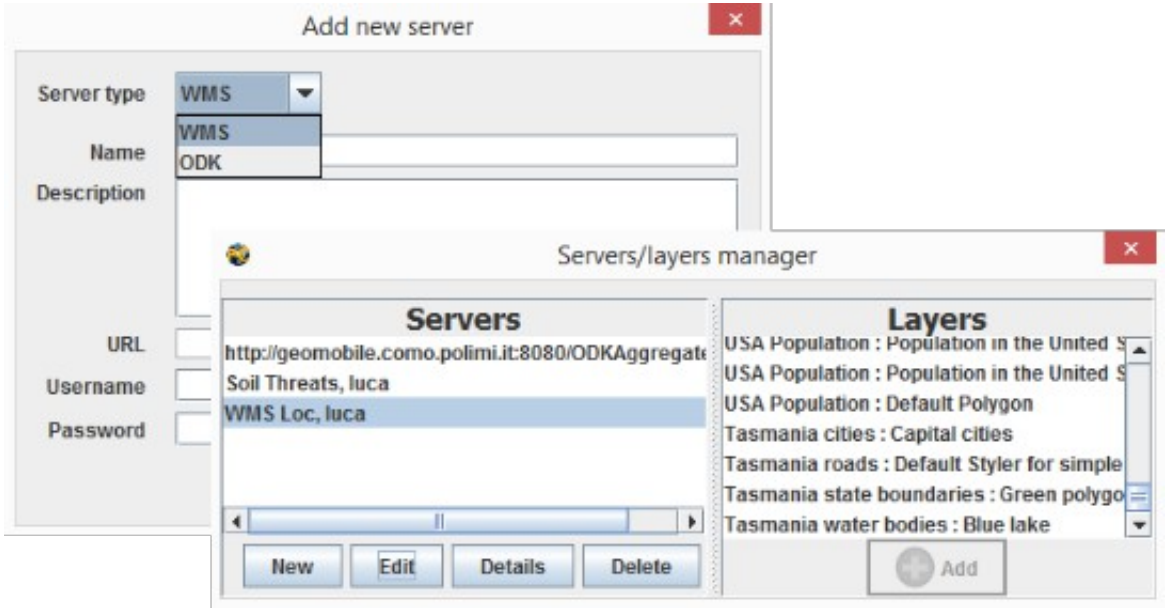
Policrowd 2.0: Projects

Every user can:

- create, save and share their own projects
- populate them with both WMS and ODK layers

WMS and ODK layers can be added:

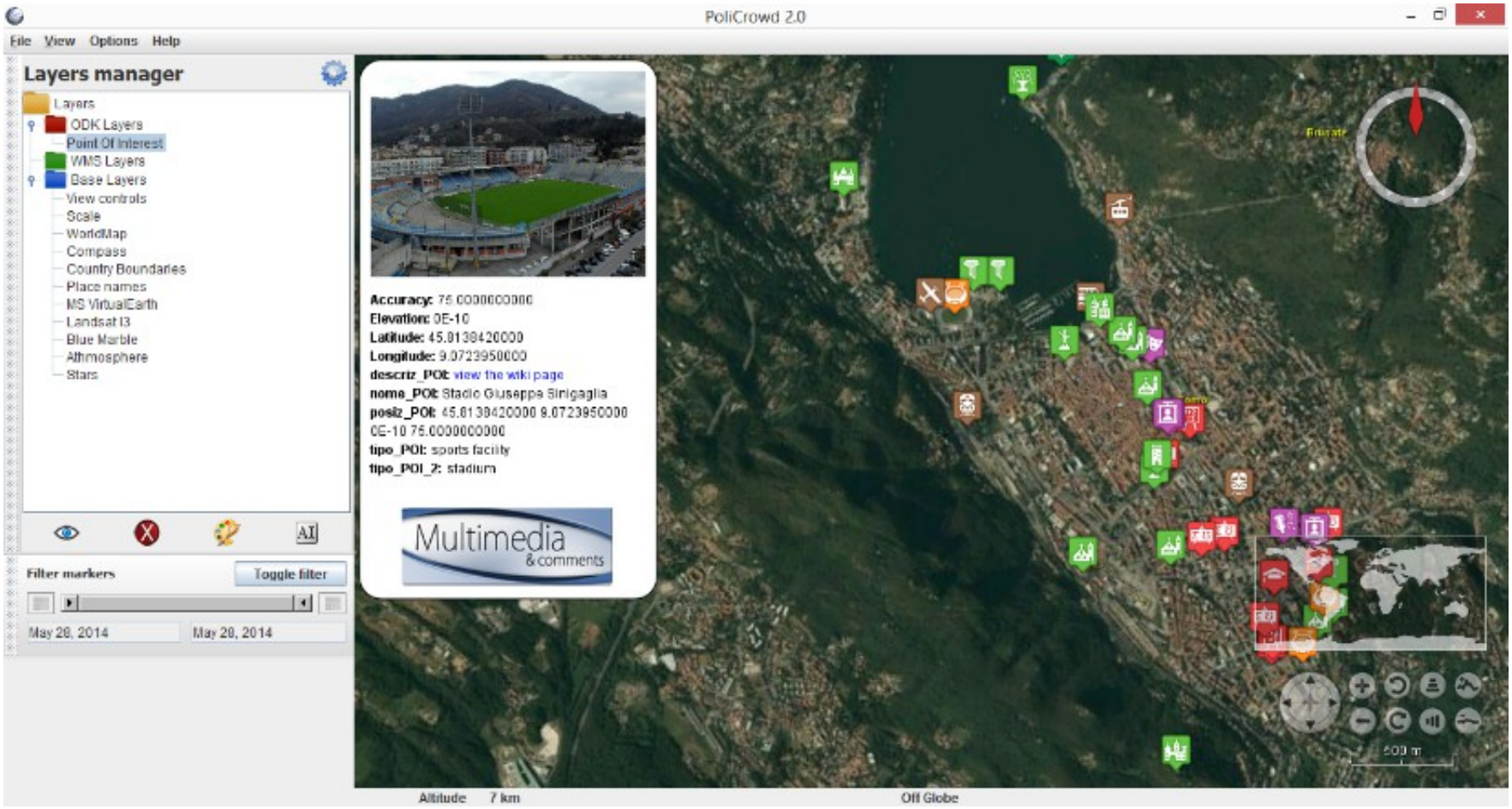
- by entering the specific URL of the server
- by selecting from a default list, constantly updated by aggregating all the servers time to time inserted by the community



All the projects are publicly accessible by design, in order to promote the community participation.

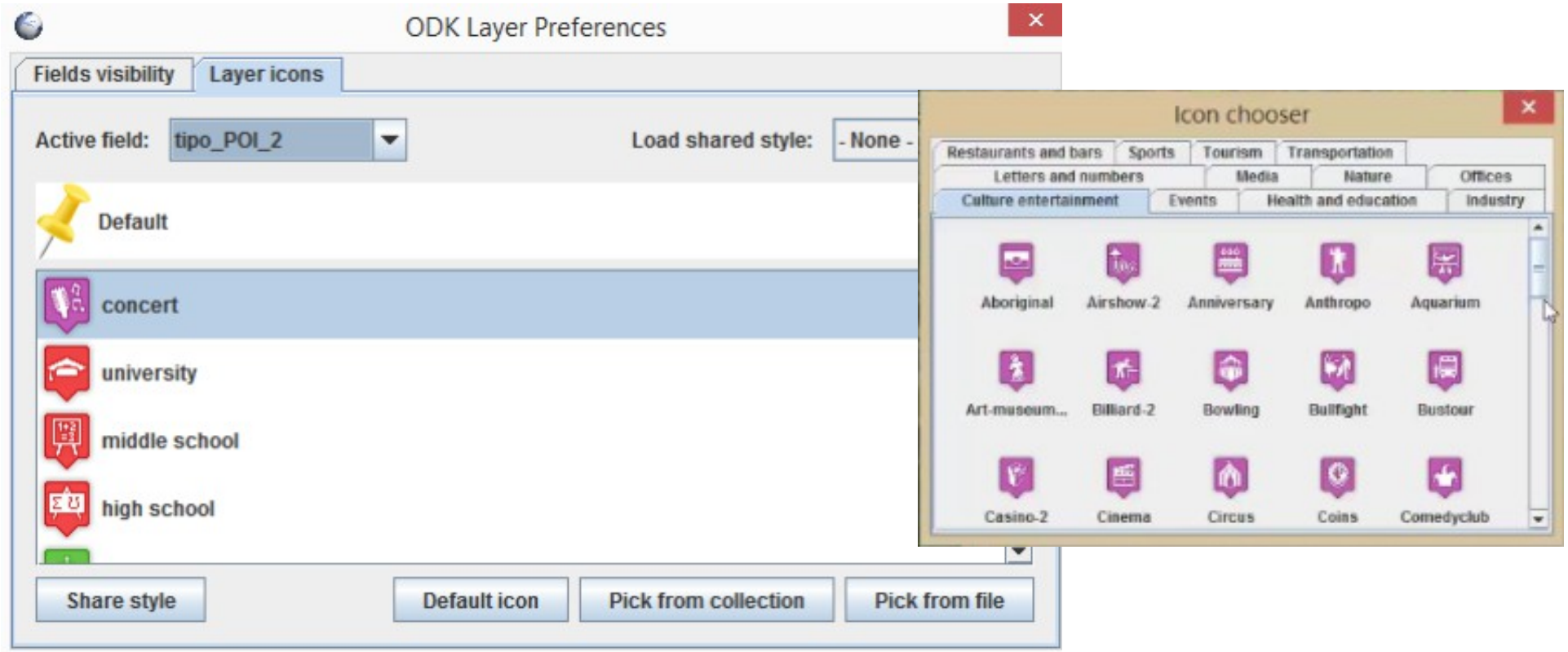
Policrowd 2.0: POIs information

- Clickable POIs placemarks
- Visualization of the ODK Collect-reported information (including picture)



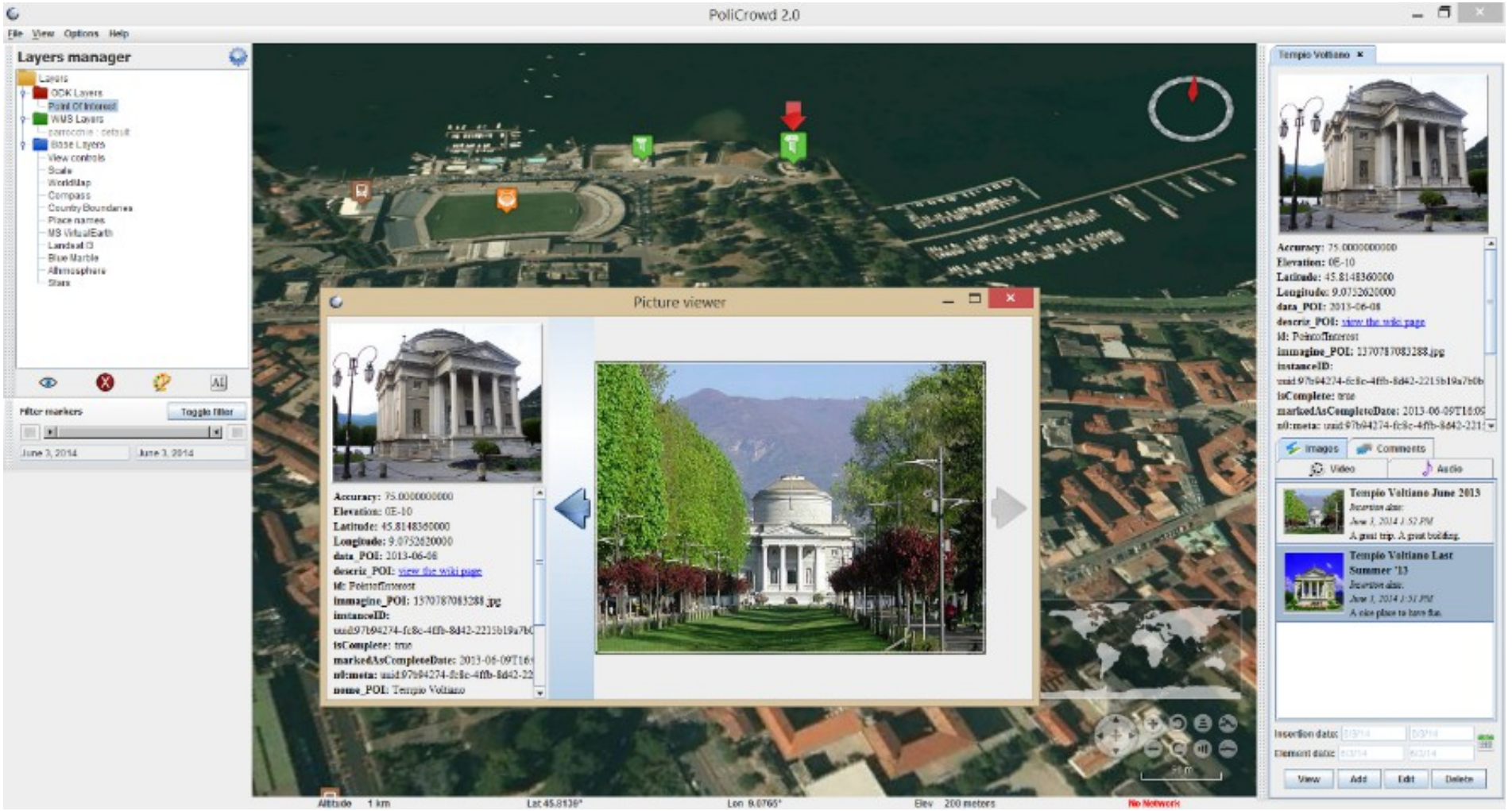
Policrowd 2.0: ODK Layer customization

- ODK layers are fully customizable, thanks to a suitable layer management interface
- Users select the fields they want to display for each layer of a given project, and personalize marker icons by picking them from a default collection or providing them manually
- Styles are also shareable, so that users can take advantage of the already available icons provided by other users in their own projects



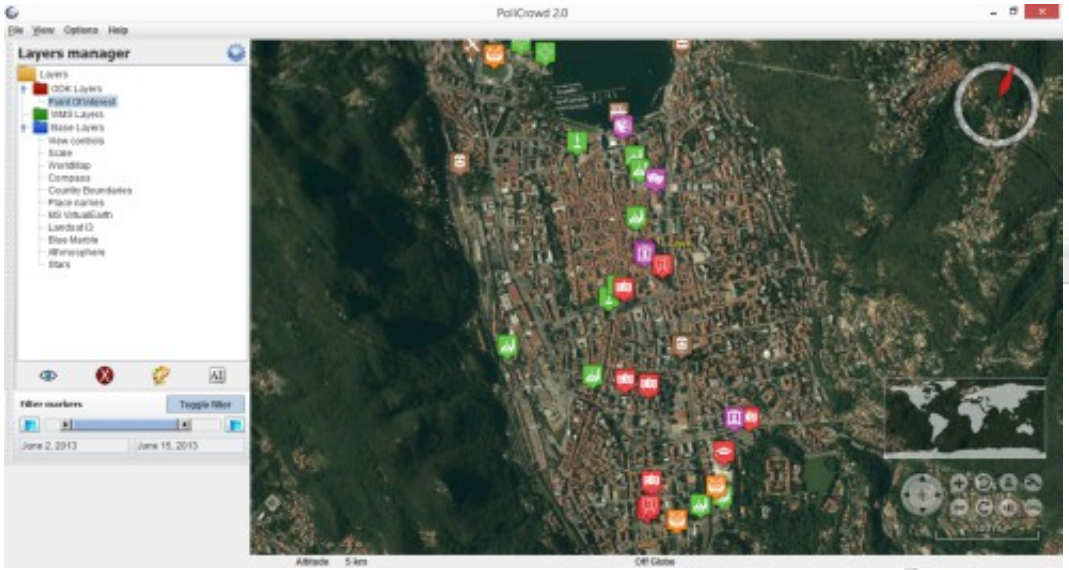
Policrowd 2.0: Collaborative POIs characterization

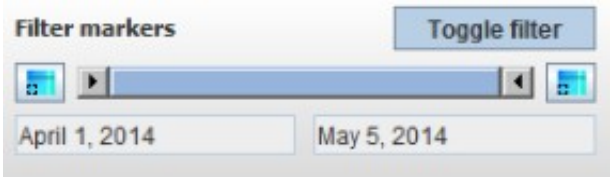
Every marker is open to collaborative contribution: everyone can add their POI-related textual (comments) and multimedia contents (images, audios and videos)

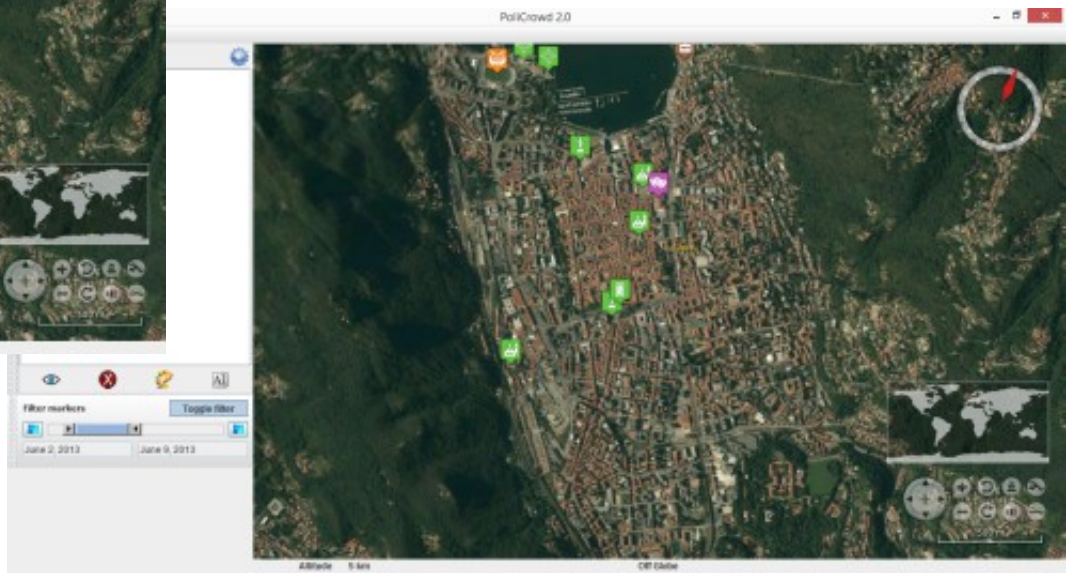


Policrowd 2.0: the 4th dimension (time)

- The time bar enables temporal filtering of all the POIs on the globe, just by picking a given date or setting a range
- More in-depth navigation through the content



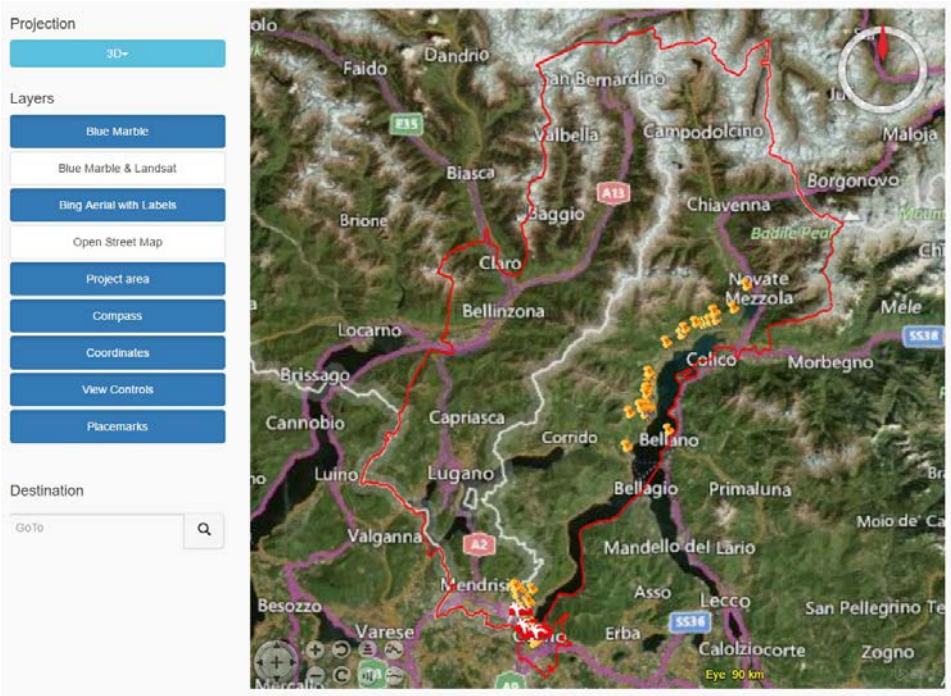




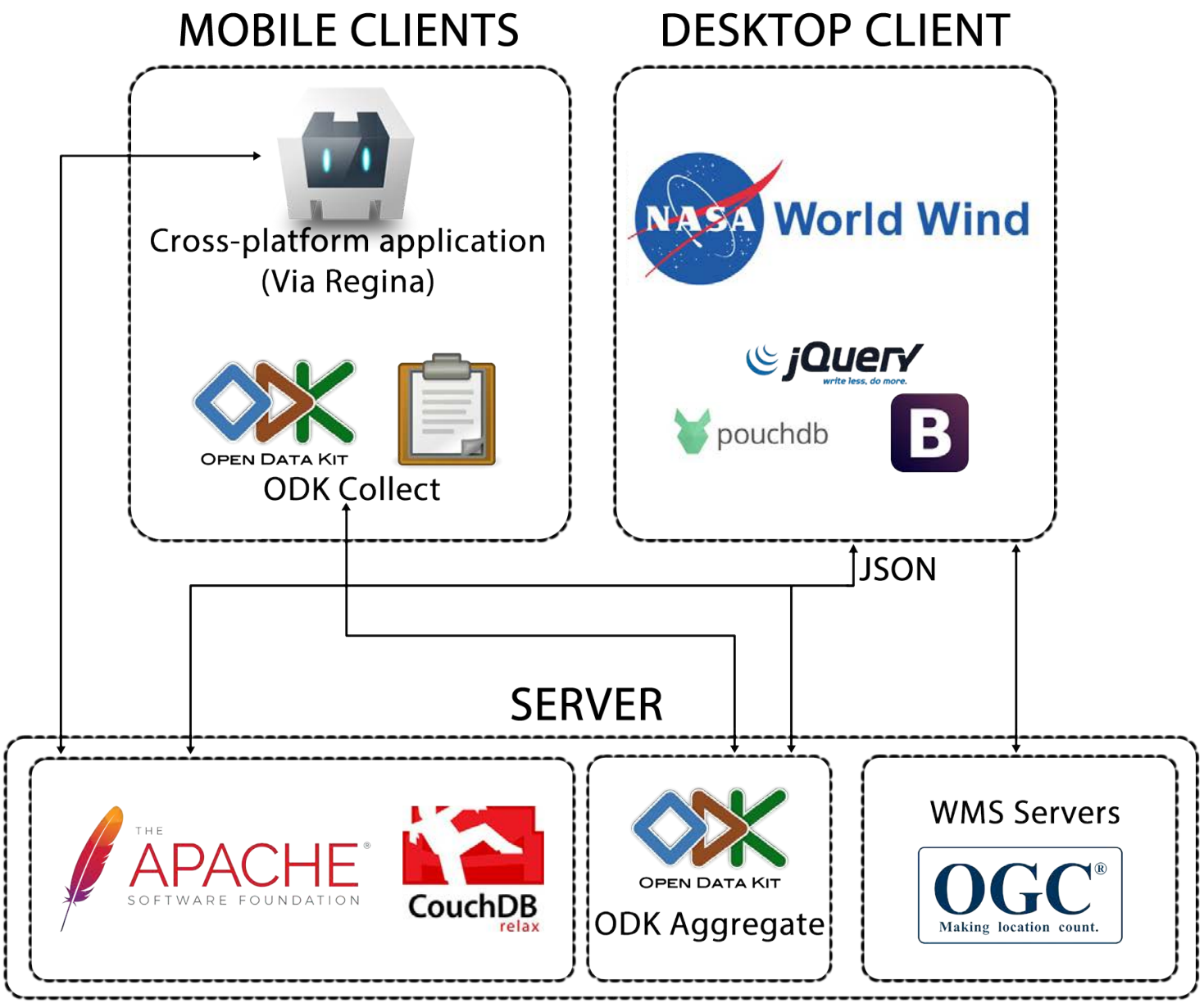
- The same capabilities are also made available for multimedia data, which can be independently filtered according to the date of the content upload or (if provided) to the actual date of the element, e.g. useful to filter historical data

WWW Policrowd

- The virtual globe, developed using NASA Web World Wind API is able to display data stored in the ODK Aggregate server of Via Regina project and in CouchDB database of aforementioned cross-platform application, both on desktop and on mobile devices through WebGL supported browsers.
- http://viaregina3.como.polimi.it/WorldWind/



WWW Policrowd Architecture



Thanks for your attention!

Thanks to all people contributing on these topics: Carolina Arias, Irene Celino, Eylul Kilsedar, Marco Minghini, Monia Molinari, Daniele Oxoli, Marco Pelucchi, Gabriele Prestifilippo, Vijay Venkatachalam, Giorgio Zamboni, Mayra Nucci Zurbaran

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