The power of virtual globes for valorising cultural heritage and enabling sustainable tourism: NASA World Wind applications

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Introduction

- Use of the Web for disseminating geospatial data
  - watershed in the history of cartography
  - new opportunities vs new challenges
  - from static to dynamic maps
  - from 2D to 3D viewers
- Virtual globes
  - software allowing to explore the Earth in three dimensions while streaming satellite imagery, elevation and other data from the Internet
  - crucial for achieving the Digital Earth vision (Gore, 1998) as a multi-resolution, three dimensional representation of the planet allowing to find, visualize and make sense of vast amounts of georeferenced information, navigating through both space and time

Virtual globes

- Main features:
  - user freedom to move around the globe and interact with it
  - multi-disciplinary, multi-resolution and multi-dimensional (even 4D)
  - context capability, ease of use, realistic user experience
  - growing popularity due to increased Internet availability of accurate geospatial data (e.g. aerial and satellite imagery, topographic maps and DTMs)

Virtual globes

- Many of them are available

Google earth
WebGL Earth
erdas
OSSIM Planet
NASA World Wind
gvSIG
osgEarth Terrain on demand.
bing maps
CESIUM
Skyline
esri ArcGlobe
Norkart
OpenWebGlobe
Citysurf
TerraExplorer
MARBLE
EARTH3D

Virtual globes

- Many of them are available
- They can be classified according to different properties

Virtual globes

- Many of them are available
- They can be classified according to different properties
  - license type:
    - ✗ Free and Open Source Software (FOSS)

    - ✗ proprietary (closed source) software
      - ✔ purchase license

      - ✔ freeware/paid license

Virtual globes

- Many of them are available
- They can be classified according to different properties
  - supported platform(s):
    - ✗ one specific OS required

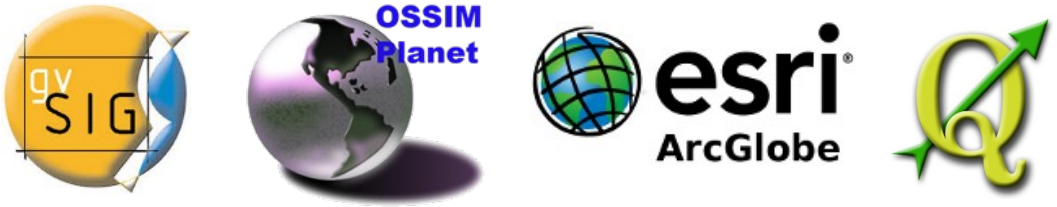
      esri ArcGlobe erdas
    - ✗ available for multiple OS

      Google earth MARBLE
    - ✗ platform-independent

      NASA World Wind WebGL Earth

Virtual globes

- Many of them are available
- They can be classified according to different properties
  - type of application:
    - desktop application



    - Web application

    - both desktop and Web application

Virtual globes

- Many of them are available
- They can be classified according to different properties
  - default available layers:
    - satellite/aerial imagery, DEMs (e.g. SRTM and ASTER), thematic maps
  - external loadable data
    - layers from proprietary data servers

erdas

    - layers available in standard formats (e.g. OGC KML/KMZ and WMS)

NASA World Wind Google earth Skyline®

Virtual globes

- Many of them are available
- They can be classified according to different properties
  - available functionalities:
    - navigation, geometric measurement, route computation, geocoding, etc.
  - customization
    - use of external APIs

Google earth bing maps TerraExplorer

    - modification/enrichment of source code

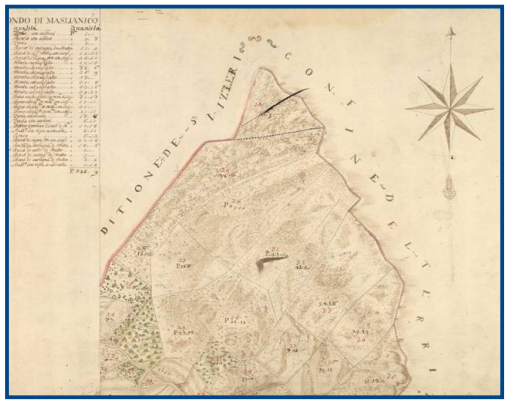
NASA World Wind

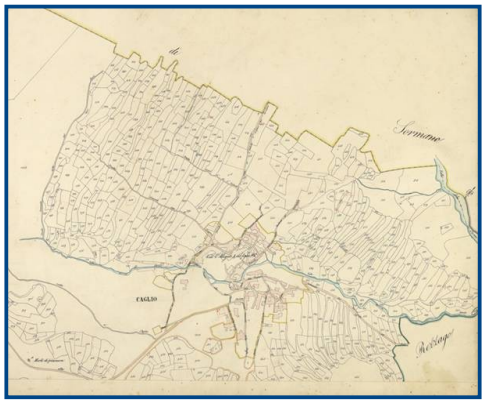
NASA World Wind

- NASA's virtual globe
  - http://goworldwind.org
  - free and open source under the NASA Open Source Agreement (NOSA) license
  - Java Software Development Kit (SDK)
  - multi-platform (Java: “Write once, run anywhere”)
  - JOGL (Java OpenGL 3D – Engine)
  - 3D Web visualization as Java Application, Java Applet or Java Web Start Application
  - based on open standards, accommodates any desired data format
- Main features
  - quality/accuracy control of horizontal (texture) and vertical (DTM) components
  - upload layers from OGC-compliant WMS servers
  - default WMS layers (i.e. satellite imagery and DTMs) from NASA and USGS
  - 2D objects (e.g. lines, polygons, markers) and 3D objects (e.g. parallelepipeds, spheres, extruded polygons) can be placed on the globe or in its surroundings

Web C.A.R.T.E.

- In the State Archive of Como (Northern Italy) about 15000 historical maps (scale 1:2000) are preserved, belonging to four cadastral series:
  - Theresian Cadastre (1718-1722)
  - Lombardo-Veneto Cadastre (1854-1858) with Updates (1898)
  - New Lands Cadastre (1905)
- The Web C.A.R.T.E. project (Web Catalog and Archive of the Territory and its Evolutions Representations) was born to enhance this cultural and historical heritage using GIS FOSS for processing and Web publishing.

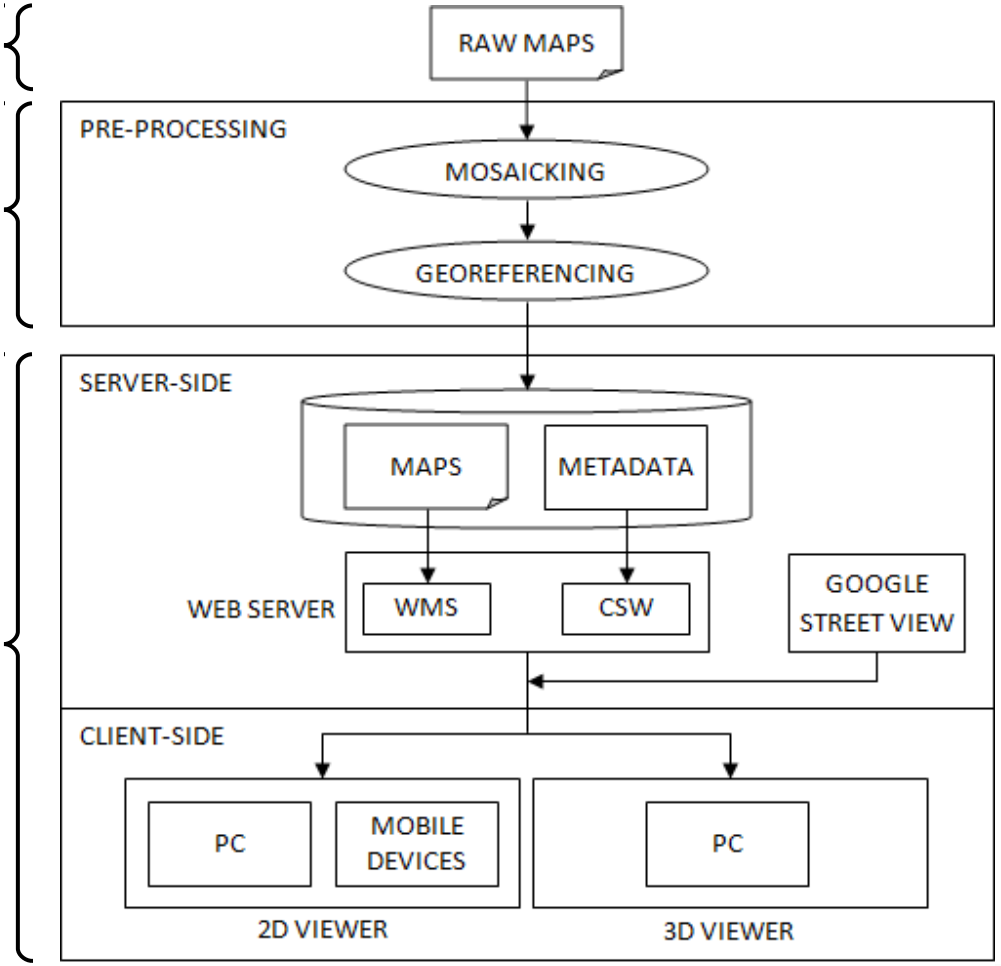




http://webcarte.como.polimi.it

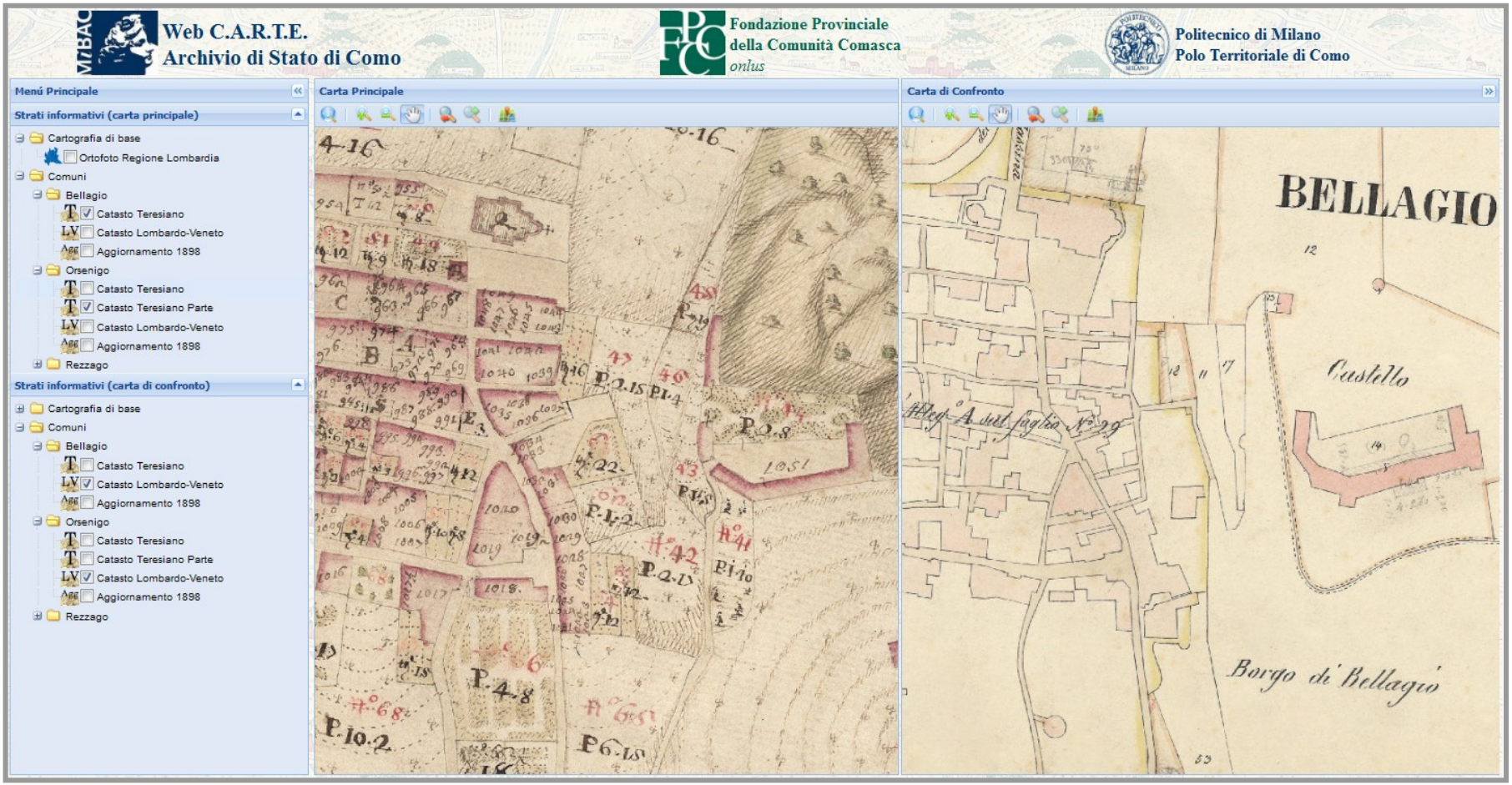
Web C.A.R.T.E.

- Maps undergo a set of well-defined procedures for:
  - digitization
  - pre-processing
    (mosaicking + georeferencing)
  - creation of a metadata
    Web geocatolog
  - Web publication
    (2D and 3D, PC and mobile devices)



Web C.A.R.T.E.

- 2D visualization



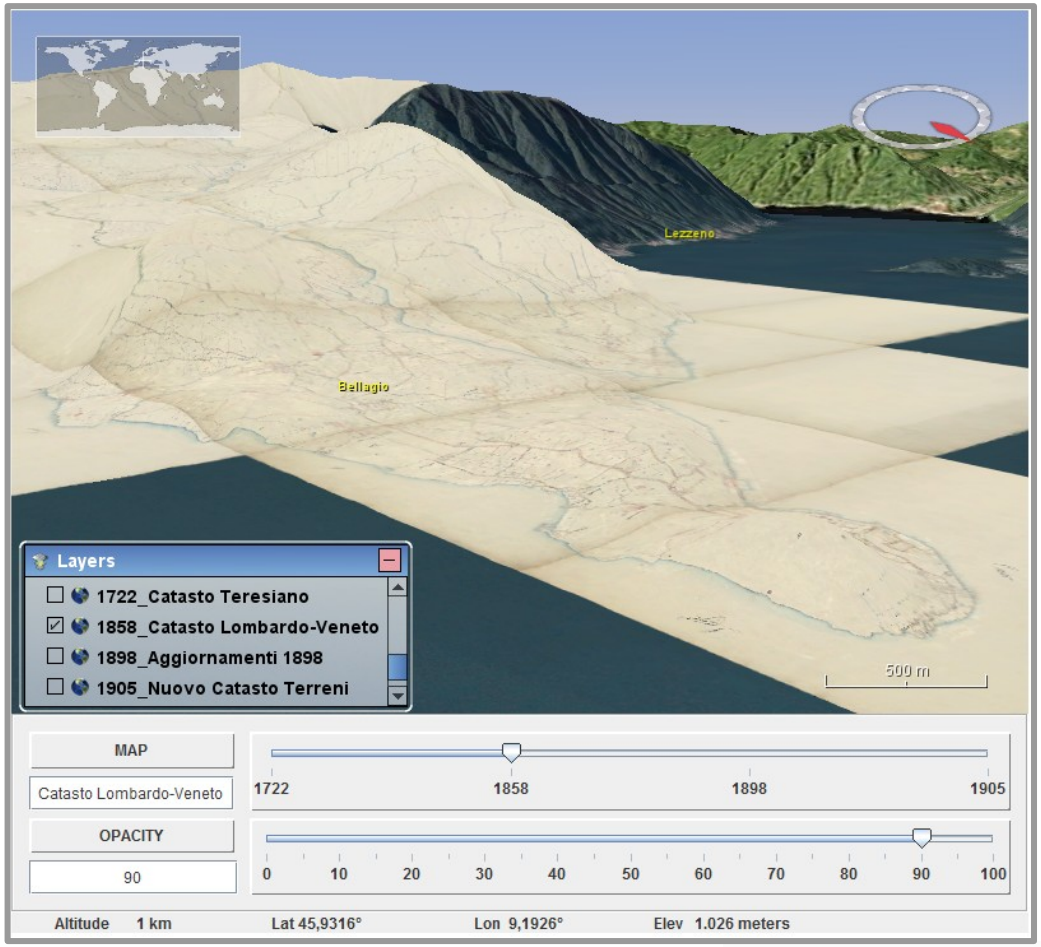
Web C.A.R.T.E.

- 3D visualization

MapServer open source web mapping

NASA World Wind

  - use of specific layers (local orthophoto and DTM)
  - creation of a temporal slidebar to provide 4D navigation
  - creation of an opacity slidebar to favor map comparison



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Historical maps

- Multi-frame and multi-dimensional Web visualization of historical maps
  - buildings time-varying features visualized on synchronized 2D and 3D viewers

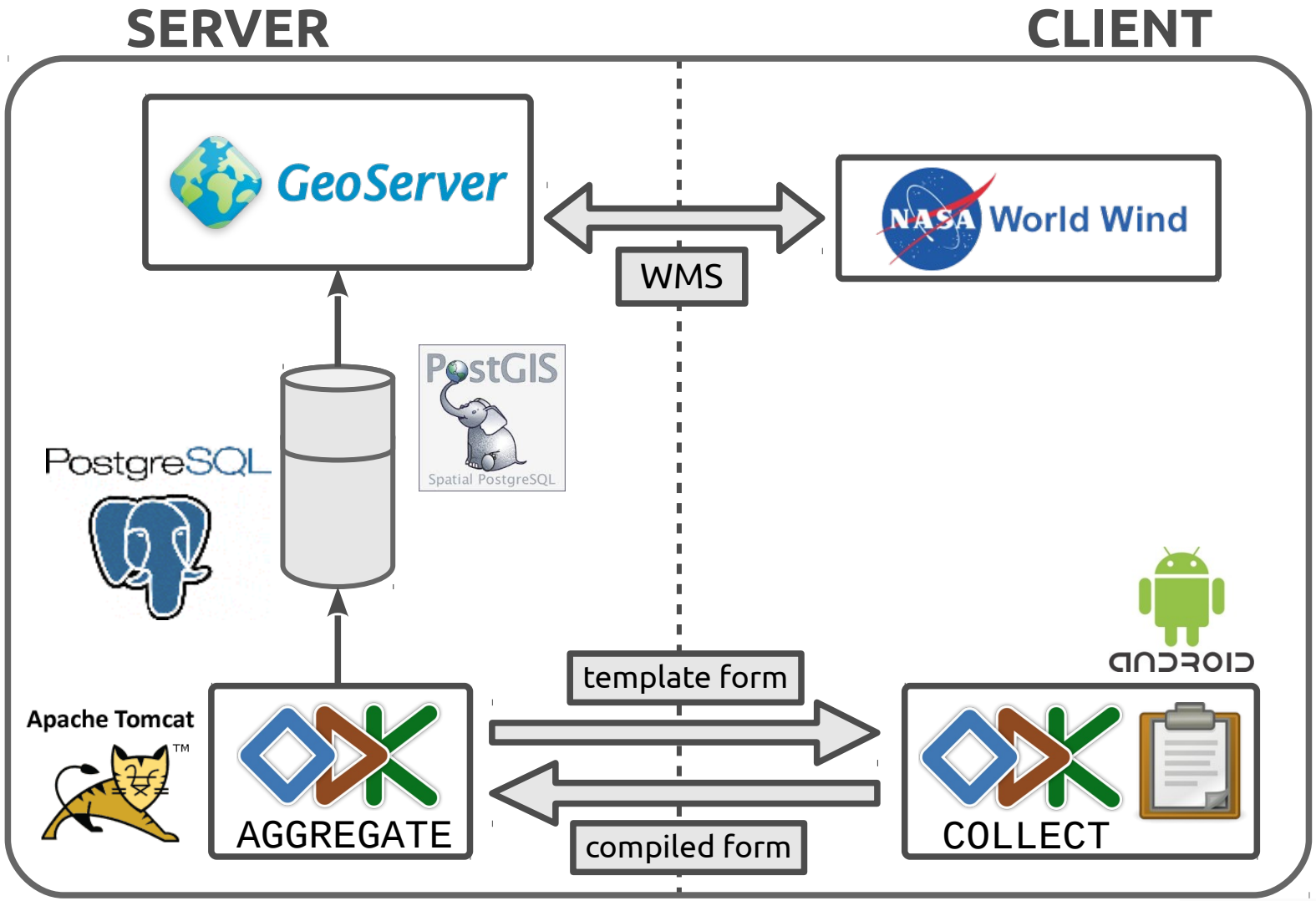
http://historicalmaps.como.polimi.it

PoliCrowd

- PoliCrowd is a Web-based 3D Participatory GIS platform
  - born to promote tourism and cultural heritage
  - interaction with user mobile devices for uploading Points Of interest (POIs)
  - POIs three-dimensional visualization on World Wind virtual globe
  - user collaborative contribution in POIs characterization
  - creating, saving and sharing customized maps with the community

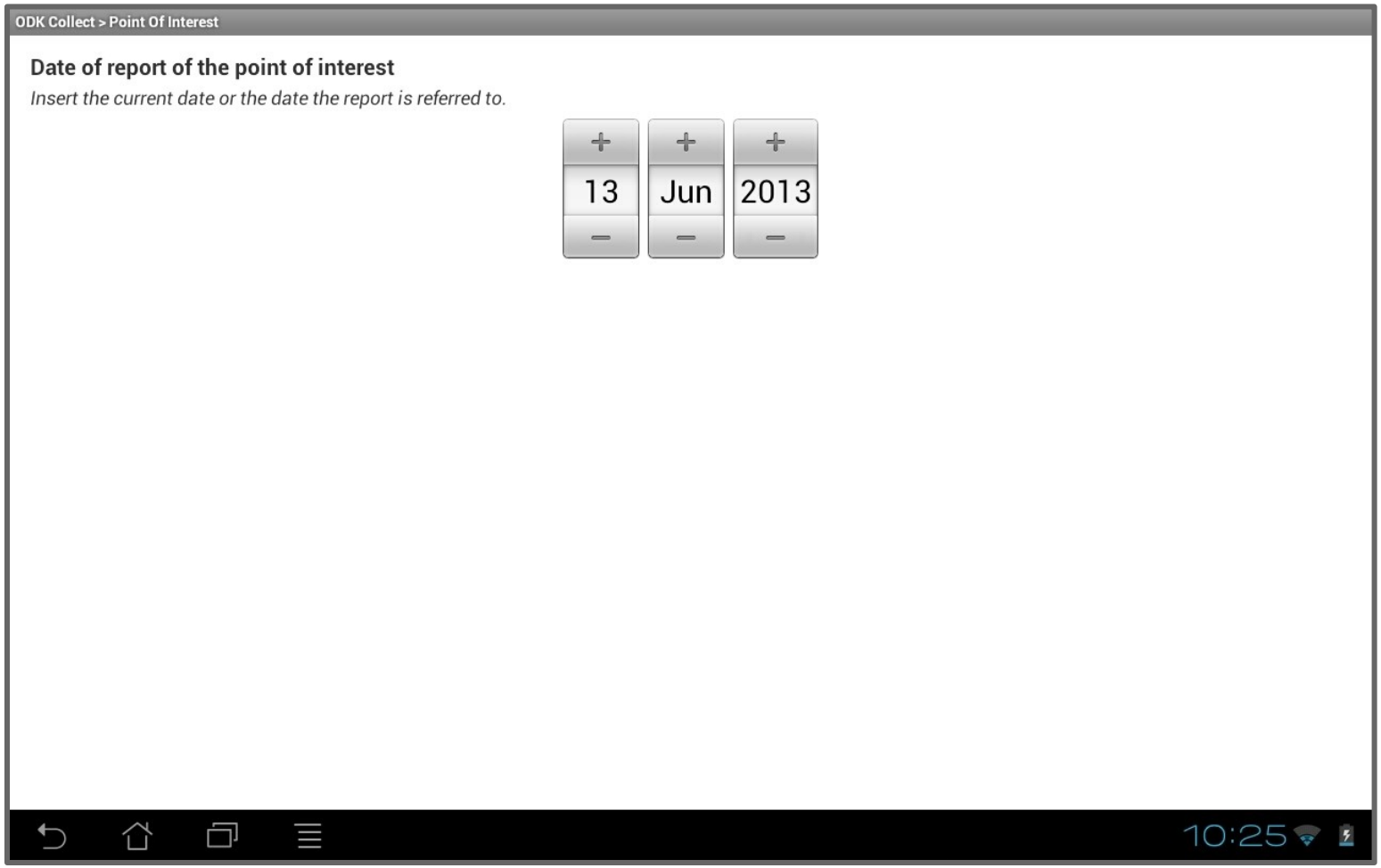
http://geomobile.como.polimi.it/policrowd

PoliCrowd



PoliCrowd

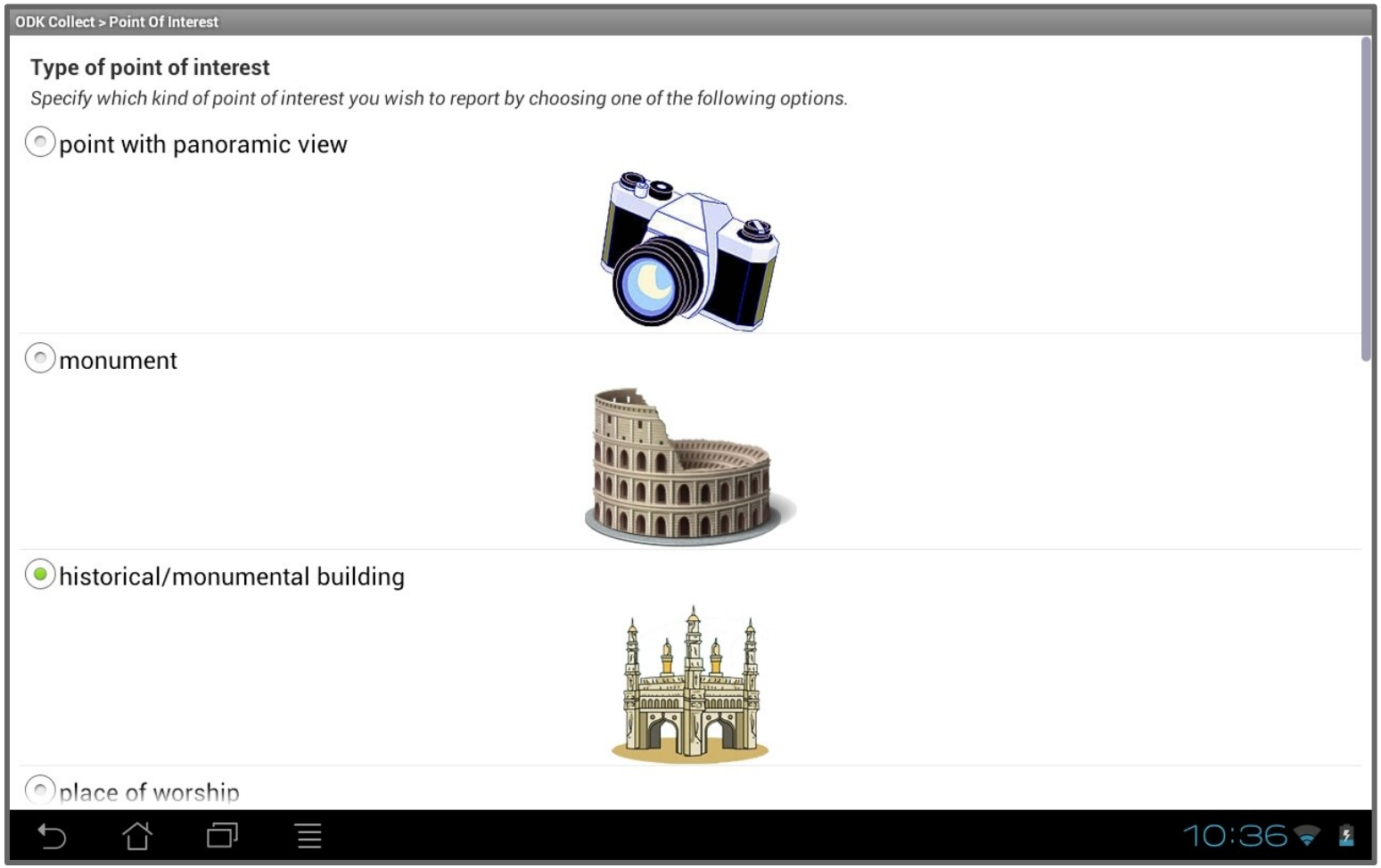
- Data collection



PoliCrowd

- Data collection

ODK COLLECT



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PoliCrowd

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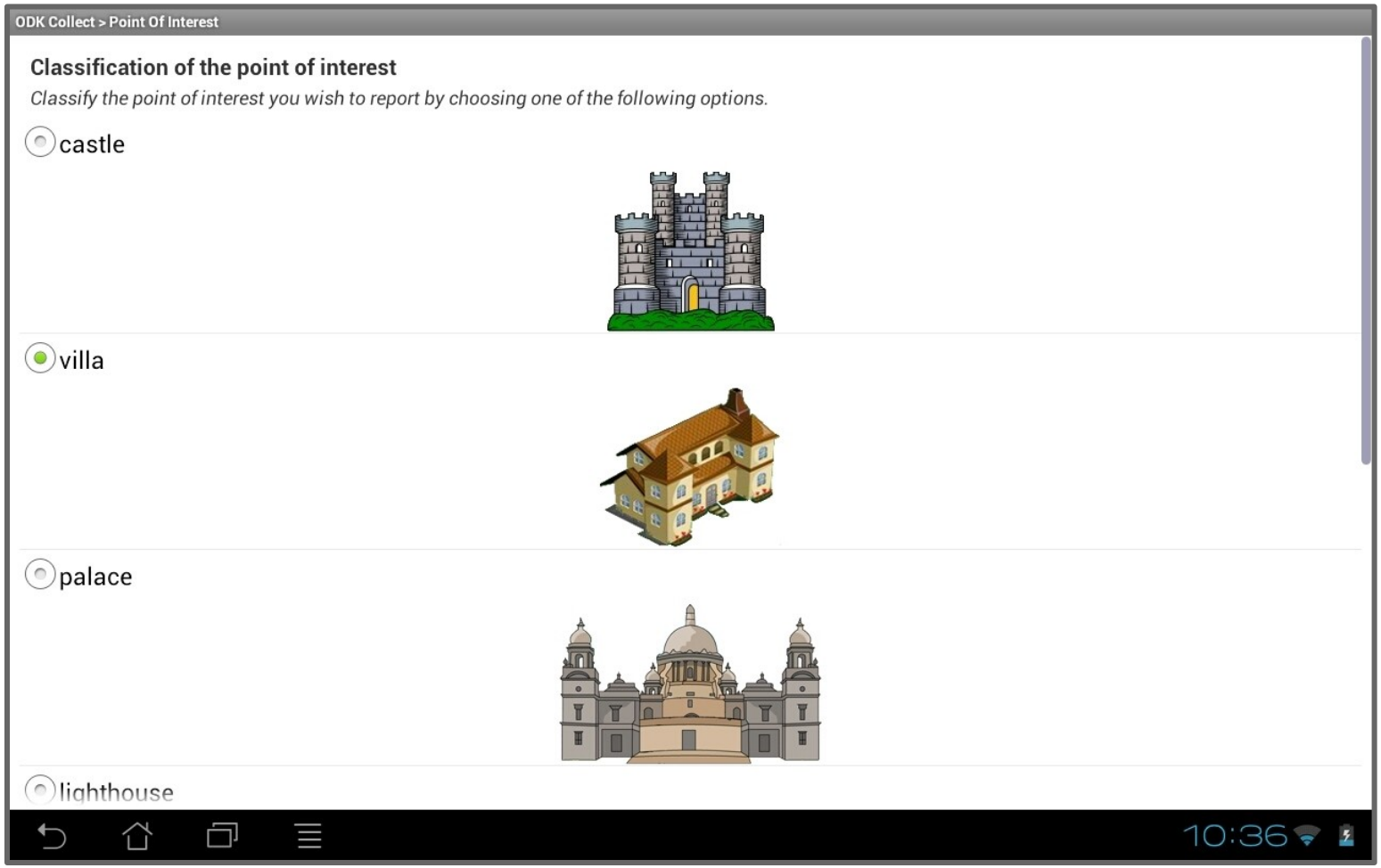
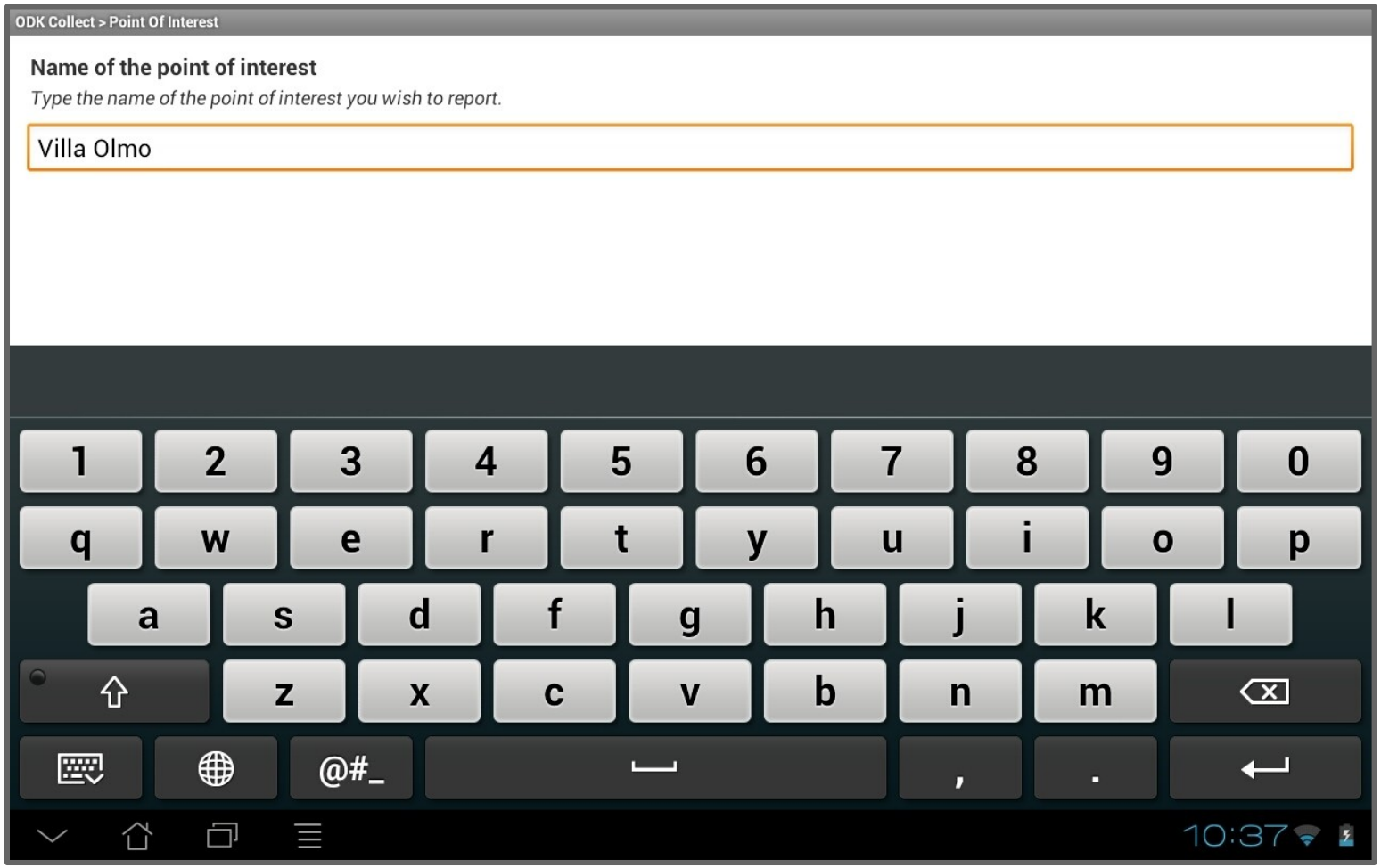


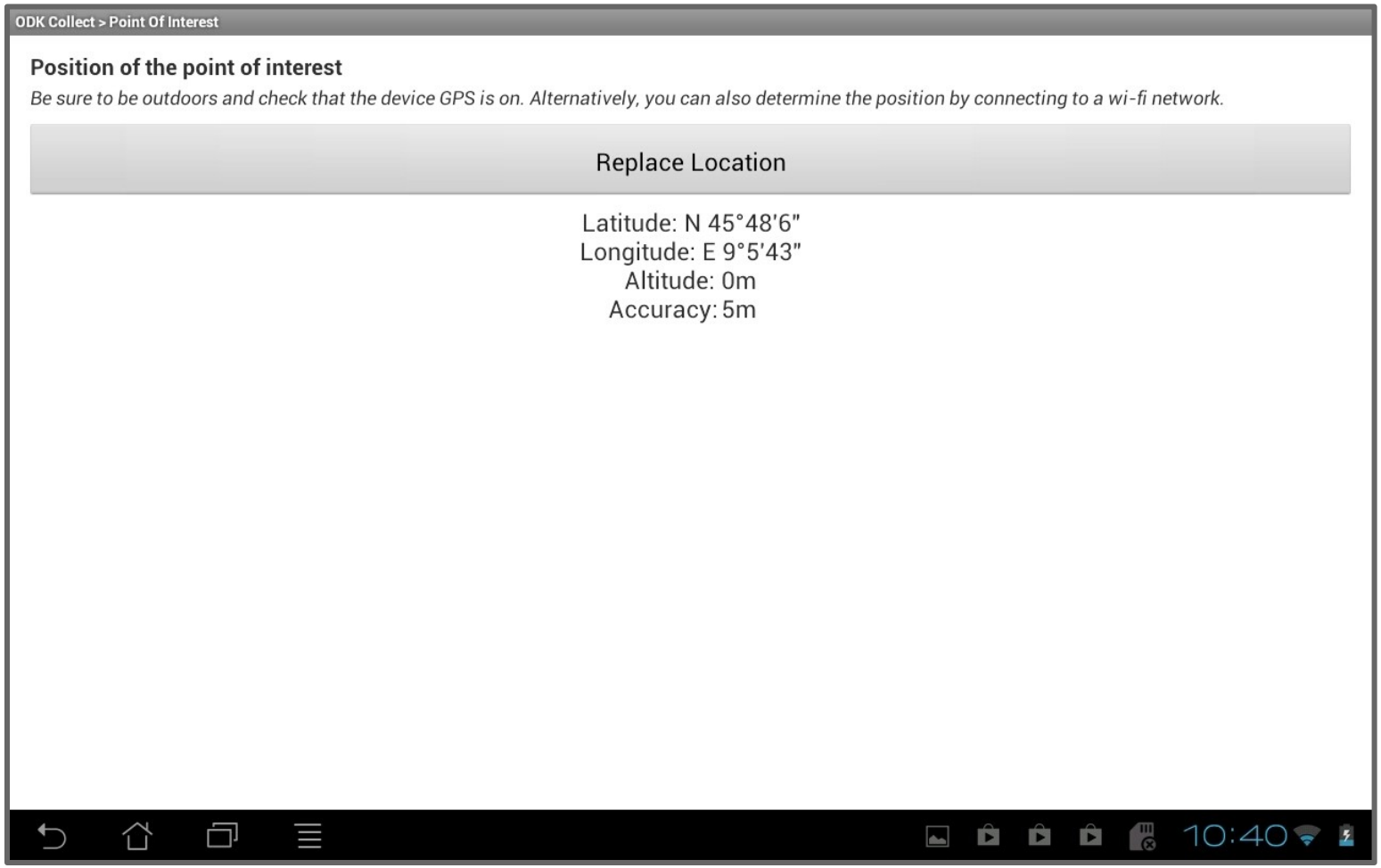
PoliCrowd

- Data collection



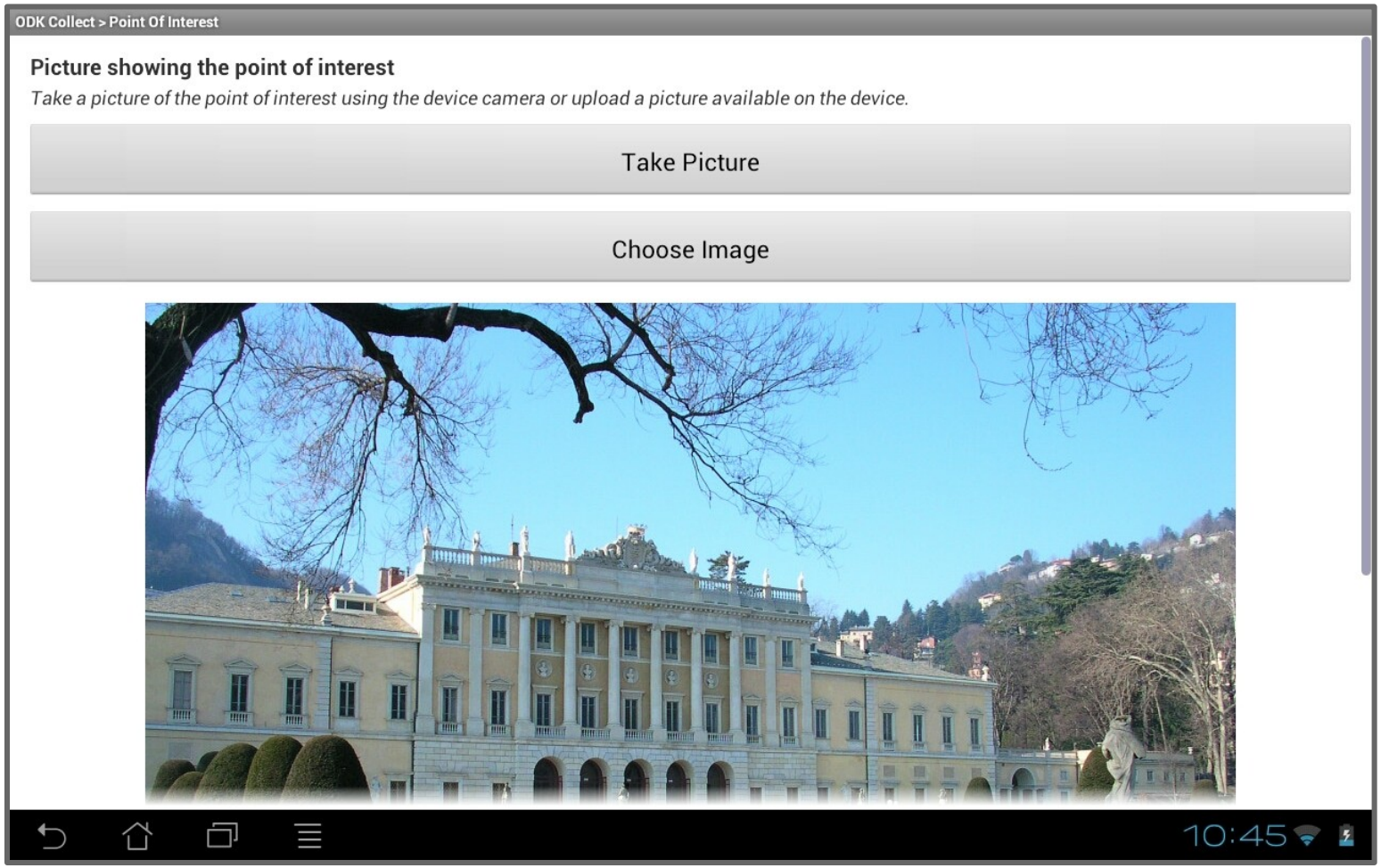
PoliCrowd

- Data collection



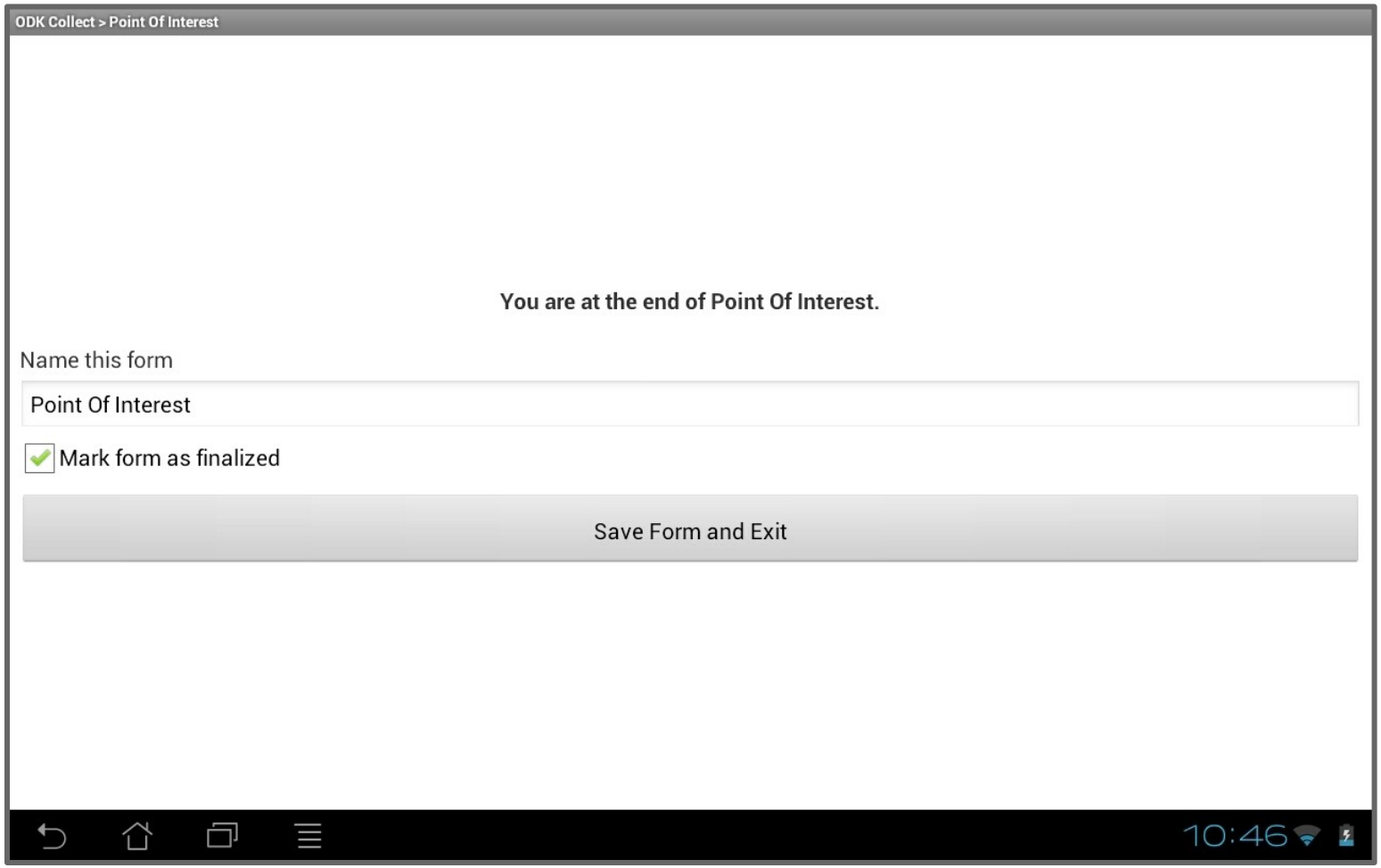
PoliCrowd

- Data collection



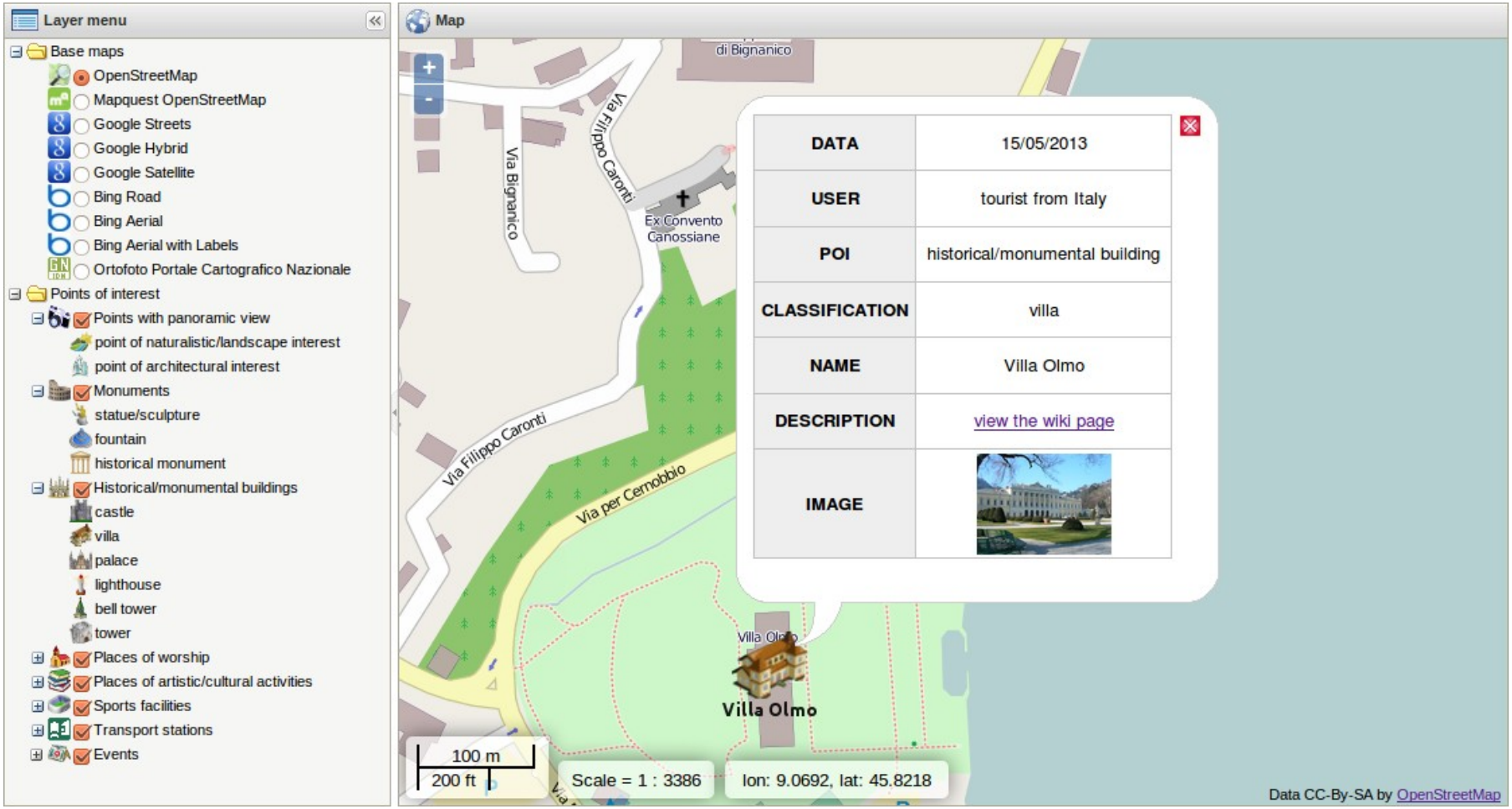
PoliCrowd

- Data collection



PoliCrowd

- 2D visualization - computers OpenLayers™ GeoExt Ext JS



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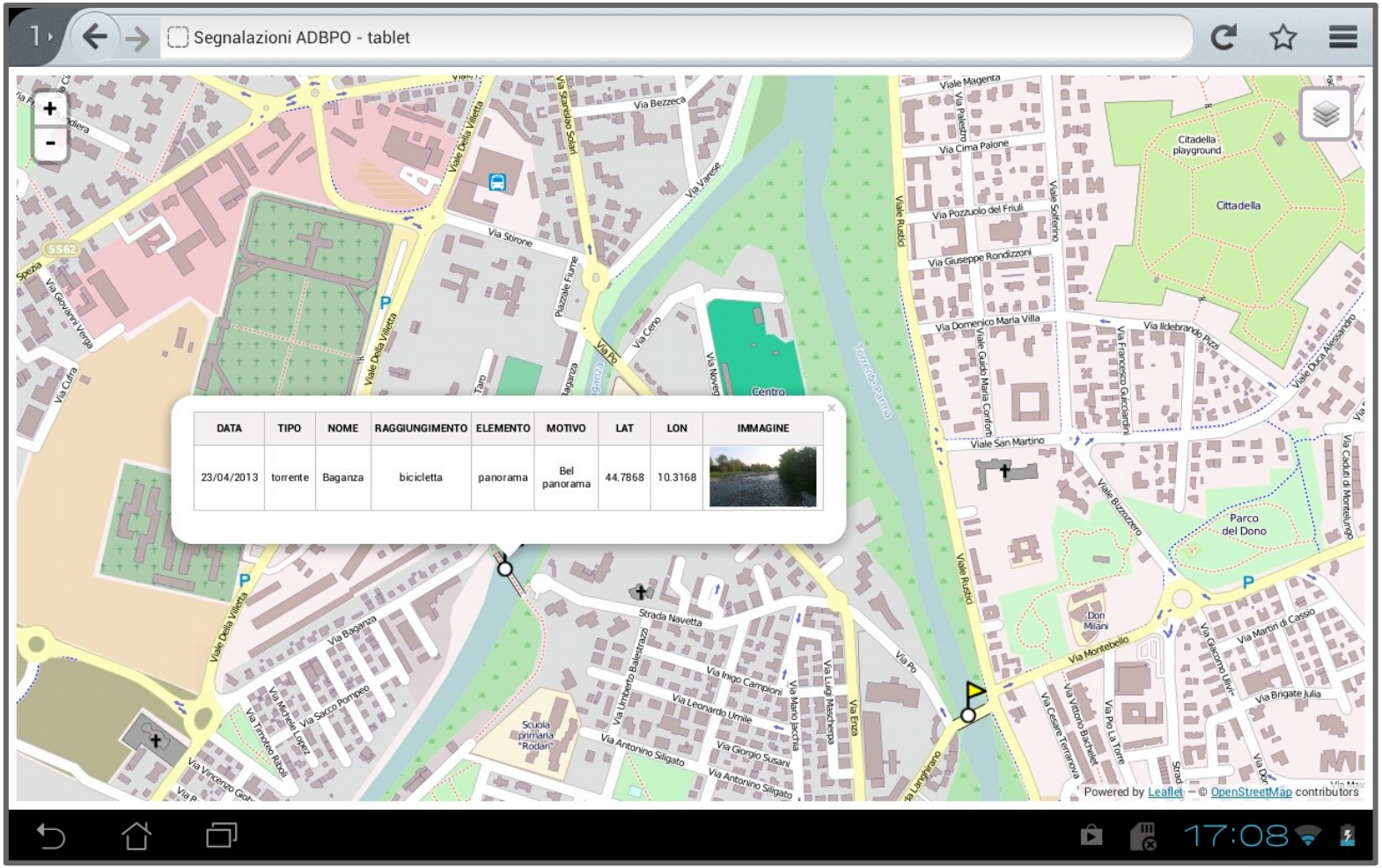
- 2D visualization - tablets Leaflet



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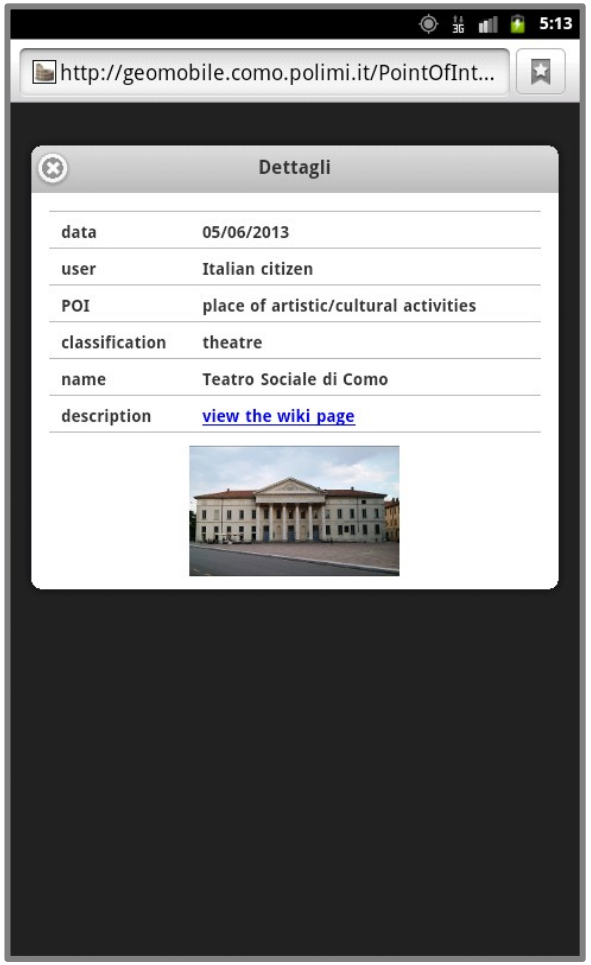
- 2D visualization - smartphone



PoliCrowd

- Points Of Interest (POIs) 3D visualization on top of World Wind
  - 3 Levels Of Detail according to the altitude of the point of view over the globe
    - first LOD: representation of all the POIs with a common icon (i.e. a pin)

PoliCrowd

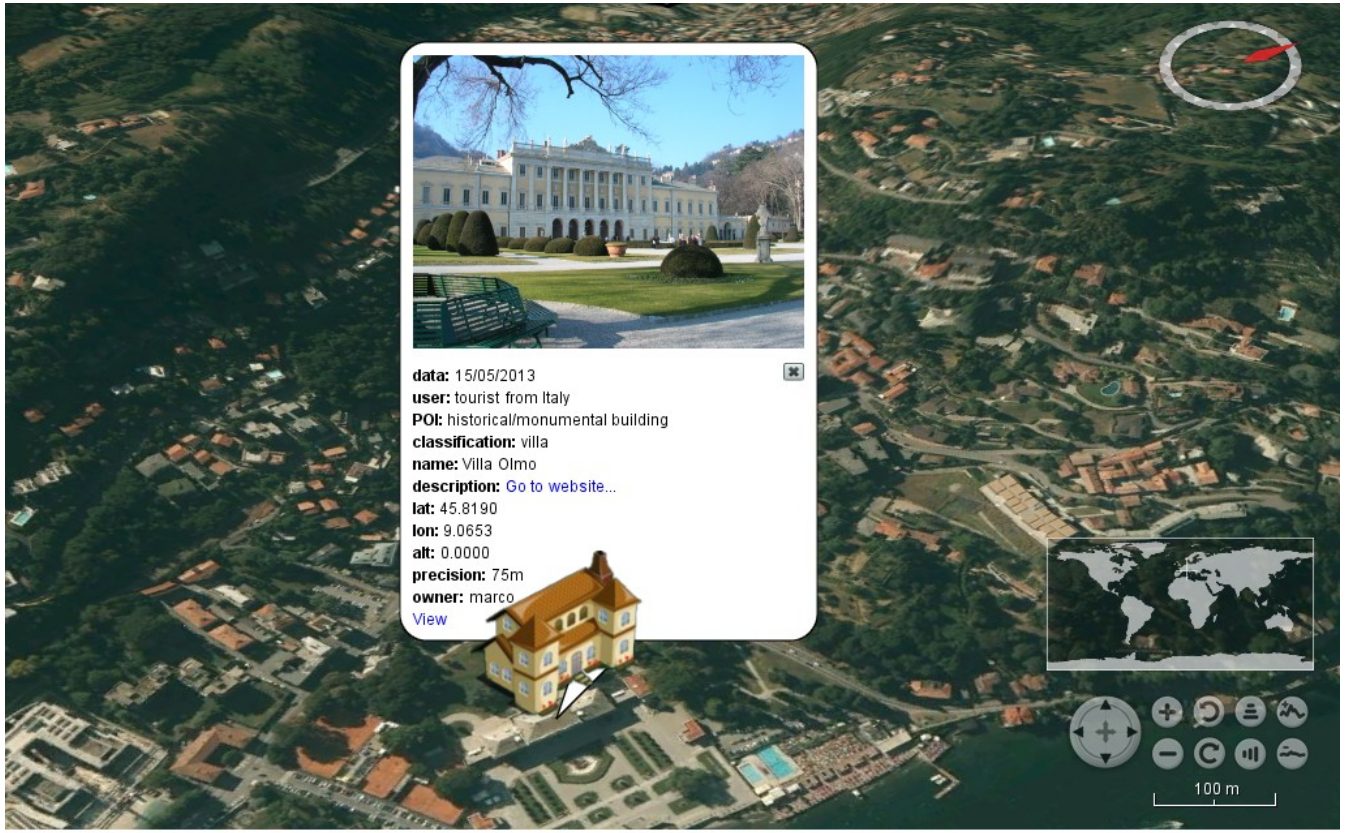
- Points Of Interest (POIs) 3D visualization on top of World Wind
  - 3 Levels Of Detail according to the altitude of the point of view over the globe
    - second LOD: representation of POIs with icons showing their category

PoliCrowd

- Points Of Interest (POIs) 3D visualization on top of World Wind
  - 3 Levels Of Detail according to the altitude of the point of view over the globe
    - third LOD: representation of POIs with icons showing their classification

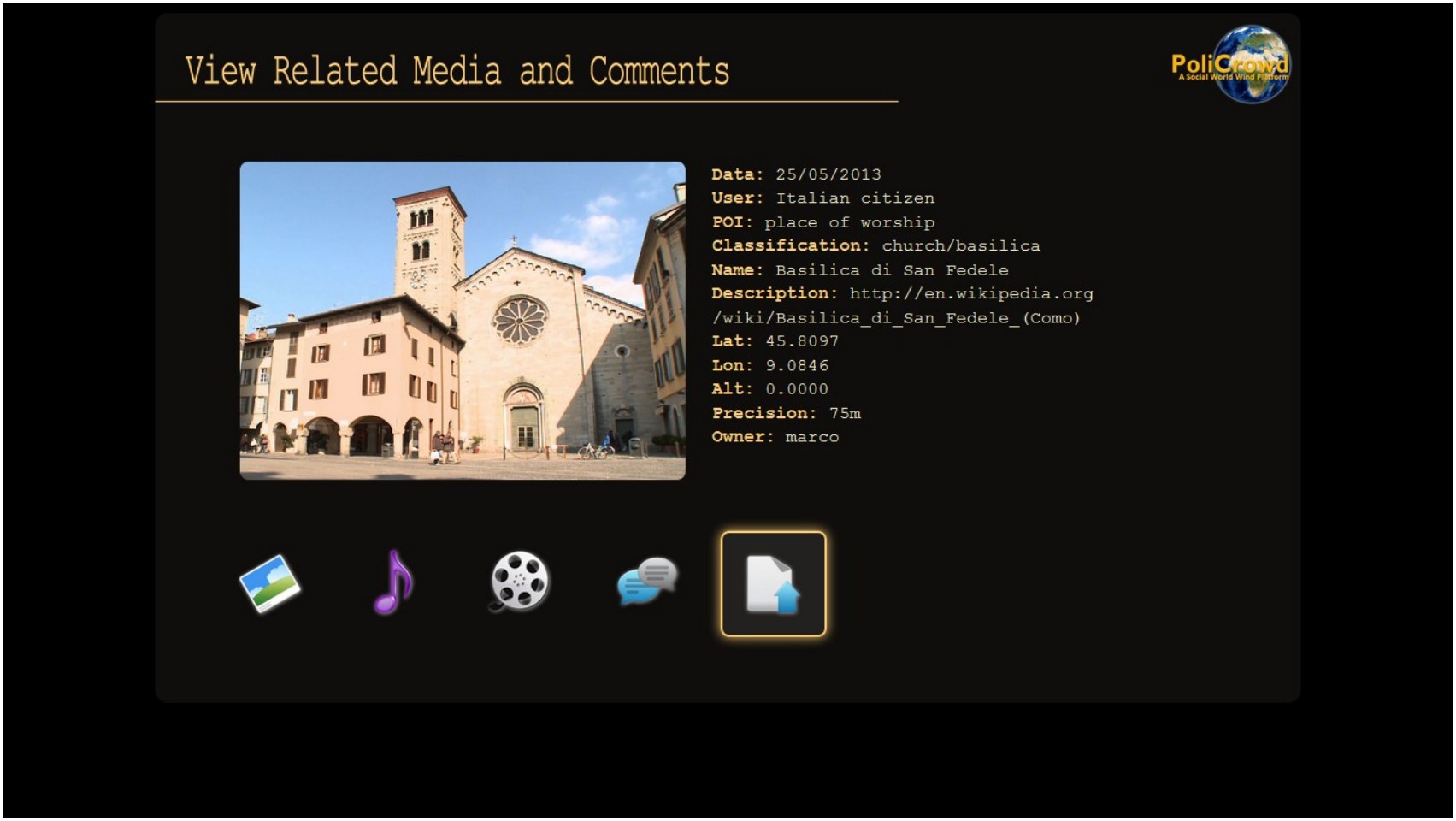
PoliCrowd

- Querying Points Of Interest
  - clickable POIs placemarks
  - visualization of Android ODK Collect-reported information in a balloon



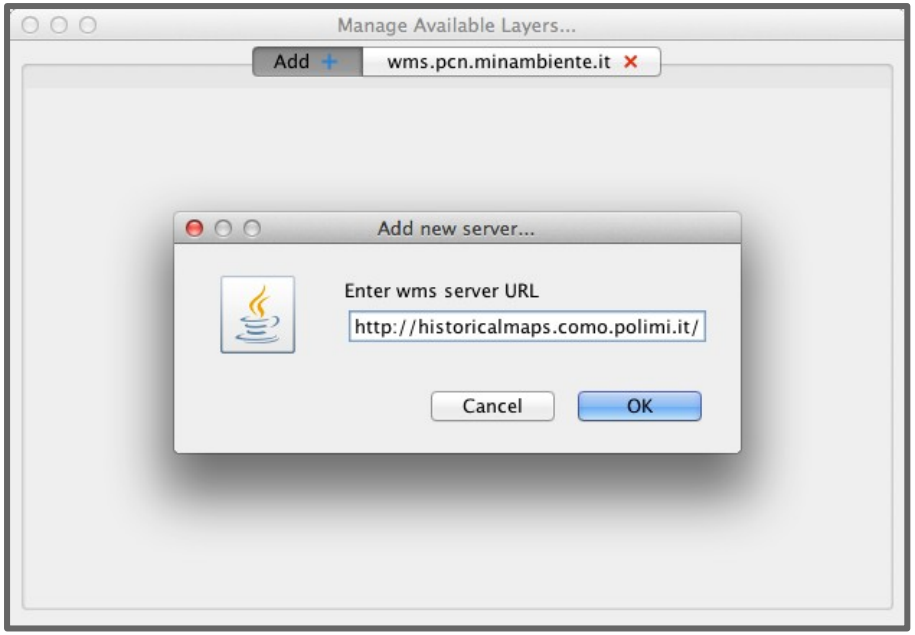
PoliCrowd

- View/upload additional contents about POIs



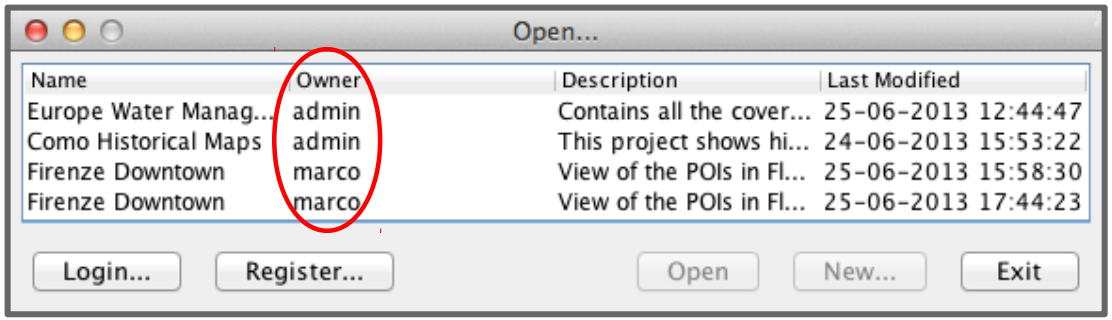
PoliCrowd

- Adding layers from available WMS servers
  - users have to enter a valid WMS server URL and then select from the list the desired layer(s)
  - all the WMS layers added to a PoliCrowd projec feed a catalogue available for the whole community



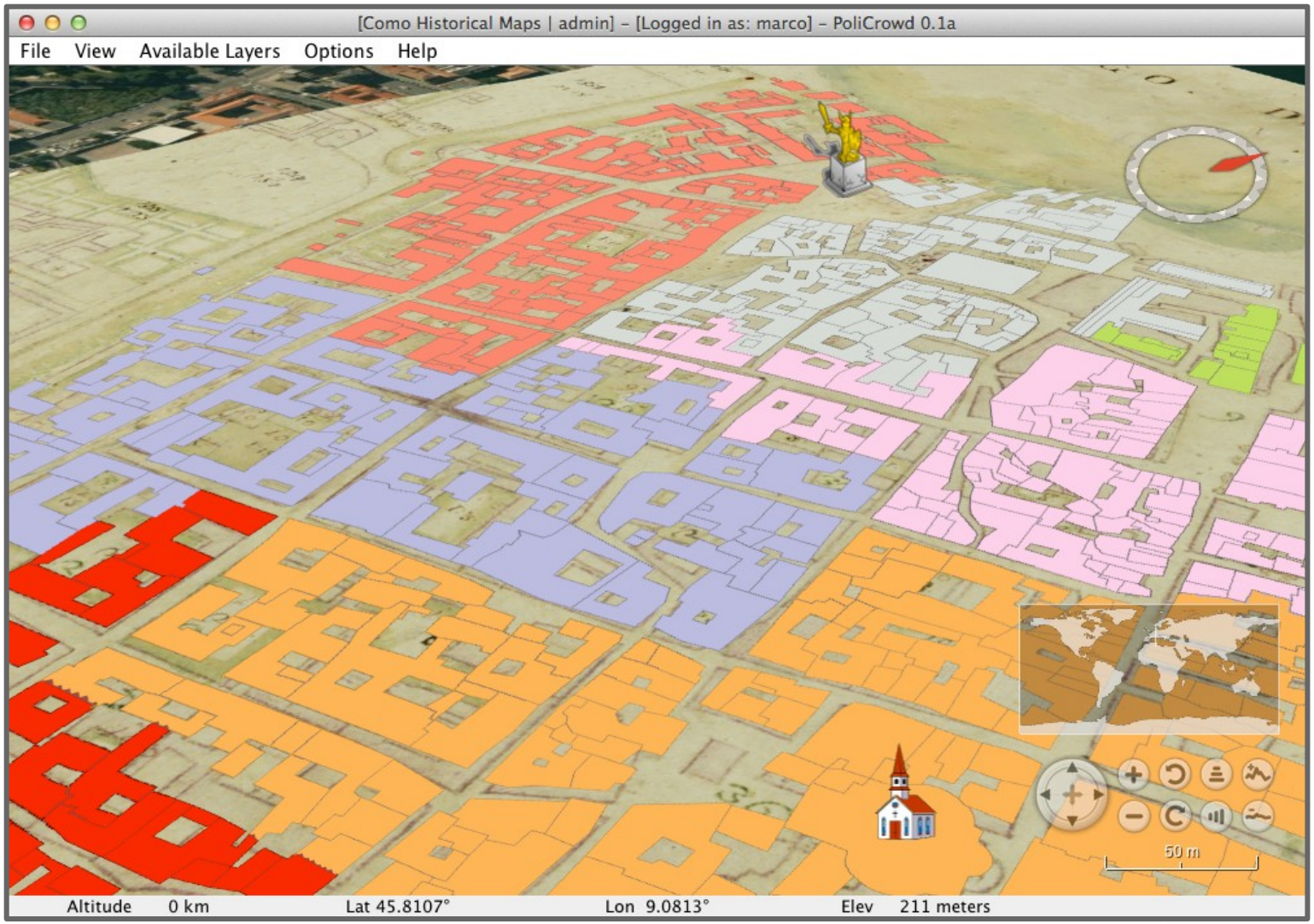
PoliCrowd

- Creation of a new PoliCrowd project
  - authenticated users can create a new project, entering a name and a description
- Saving a PoliCrowd project
  - storage of the current layers, the position (i.e. latitude, longitude and altitude) and the camera orientation of the point of view over the globe
- Visualization of user-created projects
  - all the created project feed a catalogue available for the whole community
  - the catalogue keeps trace of the project owner



  - all users can visualize PoliCrowd projects
  - project owners have also editing options available

PoliCrowd



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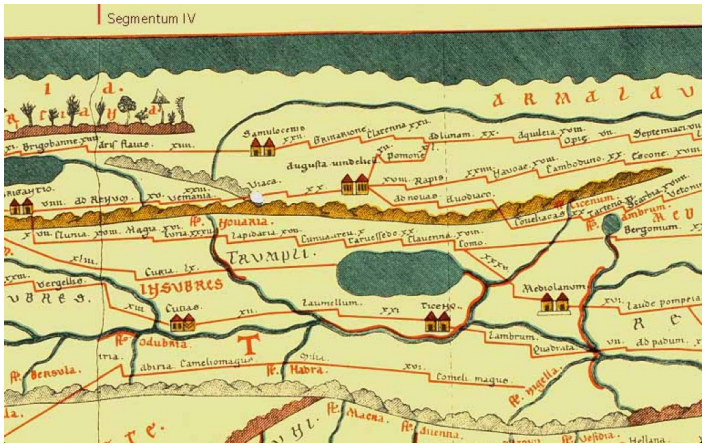
The Paths of Via Regina

- Via Regina defines a cross-border area between Italy and Switzerland
  - trade, pilgrim and cultural route since Roman times
  - transalpine system of soft mobility links



- "The Paths of Via Regina" INTERREG project
  - purpose: to valorise the cultural heritage of the area and foster tourism
  - beneficiaries: local communities, administrations, pilgrims, tourists
  - expertise involved: cultural heritage, land planning and management, geomatics

http://www.viaregina.eu

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The Paths of Via Regina

- Exploitation of the available Web Mapping technologies
  - crowdsourcing: upload of field-collected data (e.g. photos, notes, travel routes)
  - augmented reality: real-time access to local cultural and historical information
  - 3D visualization: realistic user experience
- NASA World Wind is a suitable tool for 3D visualization
  - available functions: upload and use of custom base layers (e.g. the LiDAR DTM) and overlay layers (e.g. historical/thematic maps, tourism info, GPS tracks)
  - functions to be customized: default WMS layer connection to the institutional geoportals of interest (i.e. INSPIRE, Italian Environmental Ministry, Lombardy Region and Ticino)
  - functions to be added: computation of terrain profile and statistics about paths (e.g. length, slope, level of difficulty), creation of virtual tours

Conclusions

- Virtual globes have been changing the way we experience the world
  - powerful, intuitive, easy to use
  - used in many disciplines and for many purposes
  - many virtual globes available → choose the best one according to your needs!
- NASA World Wind virtual globe
  - free and open source, allows rich customization
  - multi-platform
  - based on open standards, ensures interoperability
- NASA World Wind projects supporting tourism and cultural heritage
  - 3D visualization & interaction
  - synchronization with 2D viewers
  - 4D extension
  - management of crowdsourced data
  - complex GIS computation

Acknowledgments

- This research has been funded by the INTERREG “I cammini della Regina - Percorsi transfrontalieri legati alla Via Regina (The paths of Via Regina - Crossborder paths departing from Via Regina)” 2007-2013 project.

Thanks for your attention!

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NASA WW Challenge

- Second NASA World Wind Europa Challenge in 2014 (first edition in 2013, (http://eurochallenge.como.polimi.it)

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