URBAN-GEO BIG DATA

POLITECNICO MILANO 1863

istituto per il rilevamento elettromagnetico dell'ambiente

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

23 July 2019, Naples

PoliMi
Progress Report

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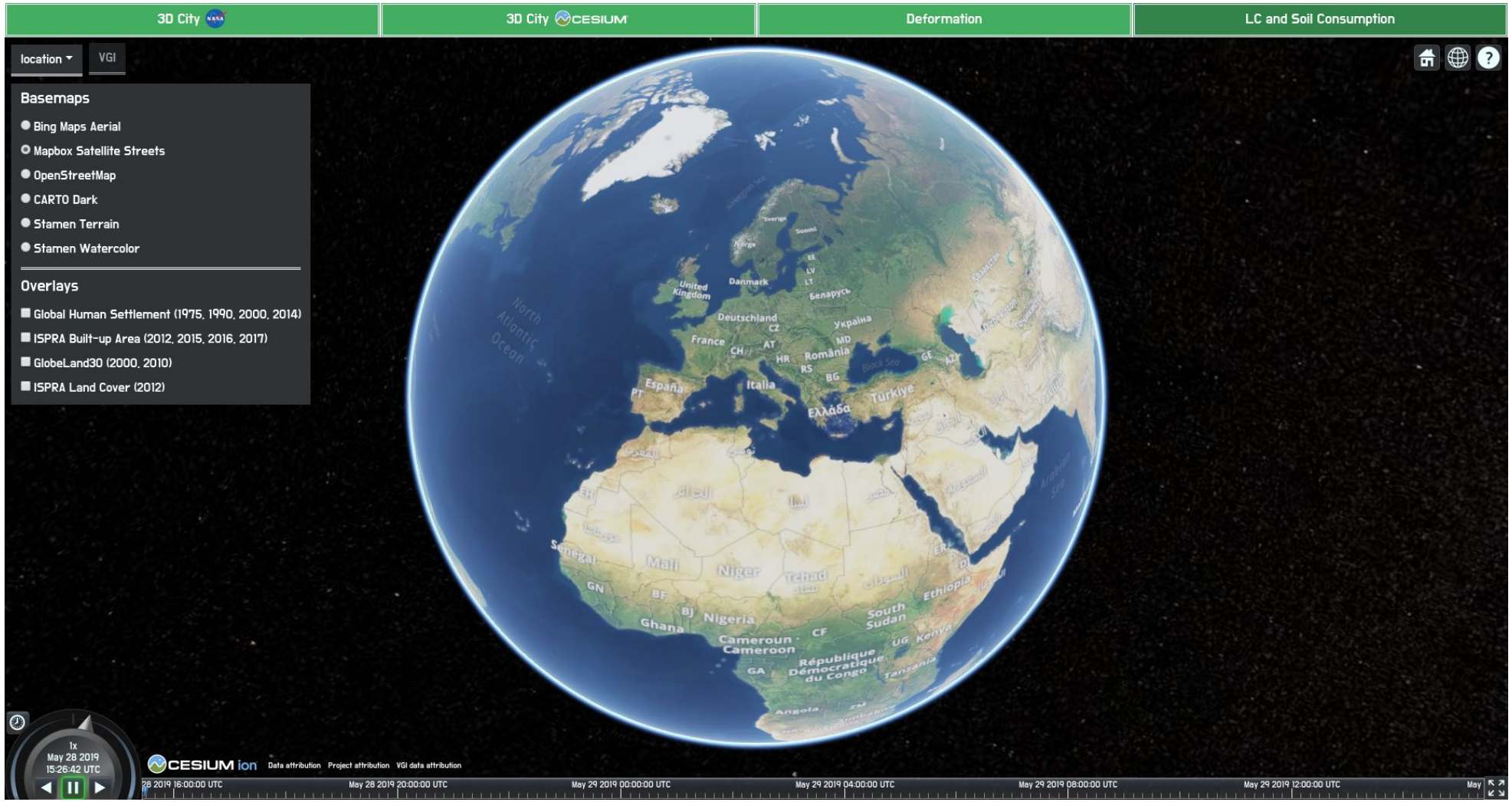
MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITA' E DELLA RICERCA

Web GIS Interface



https://github.com/kilsedar/urban-geo-big-data-3d

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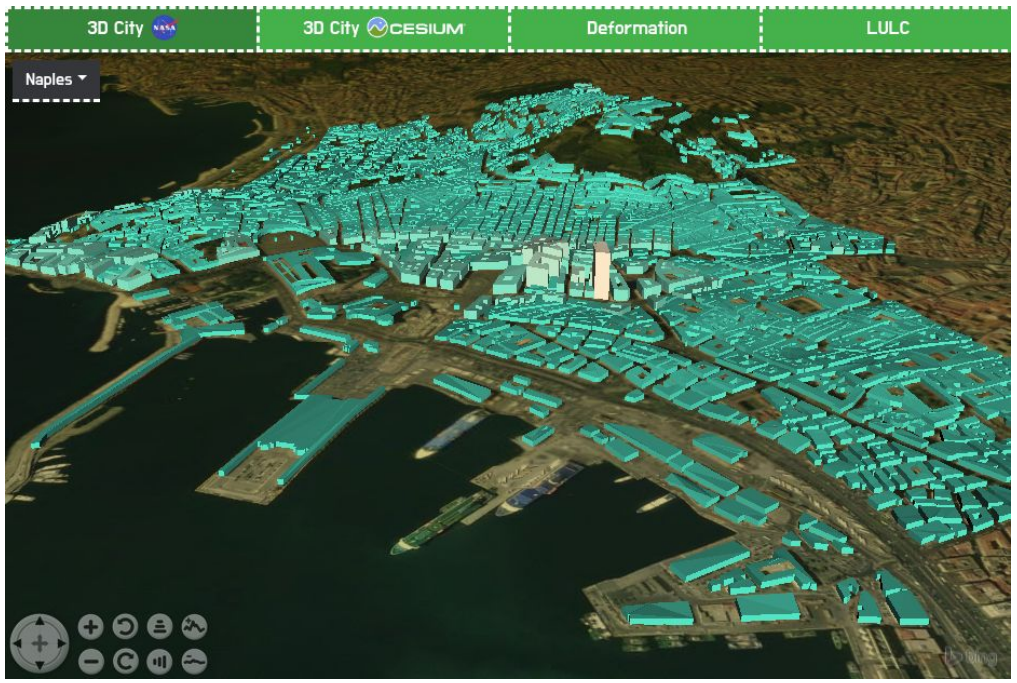
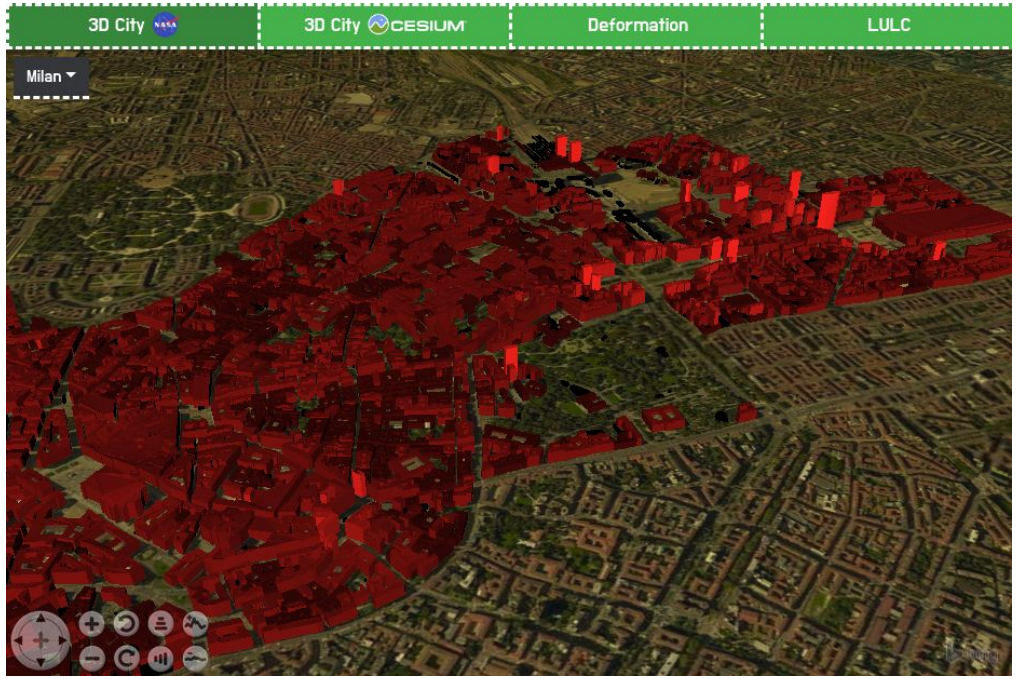
3D City Visualization

- 3D OSM buildings visualization is performed using NASA Web WorldWind API and my 2017 GSoC project 3D OSM Plugin API. Its source code is available at https://github.com/kilsedar/3dosm.
- LiDAR and OSM GeoJSON are used in GRASS GIS to set **Milan** buildings' height.
- Urban Atlas Building Height 2012 data of the Copernicus programme and OSM GeoJSON are used in GRASS GIS to set **Rome** buildings' height.
- OSM attributes are used to set the buildings' height in **Naples, Padua,** and **Turin**.





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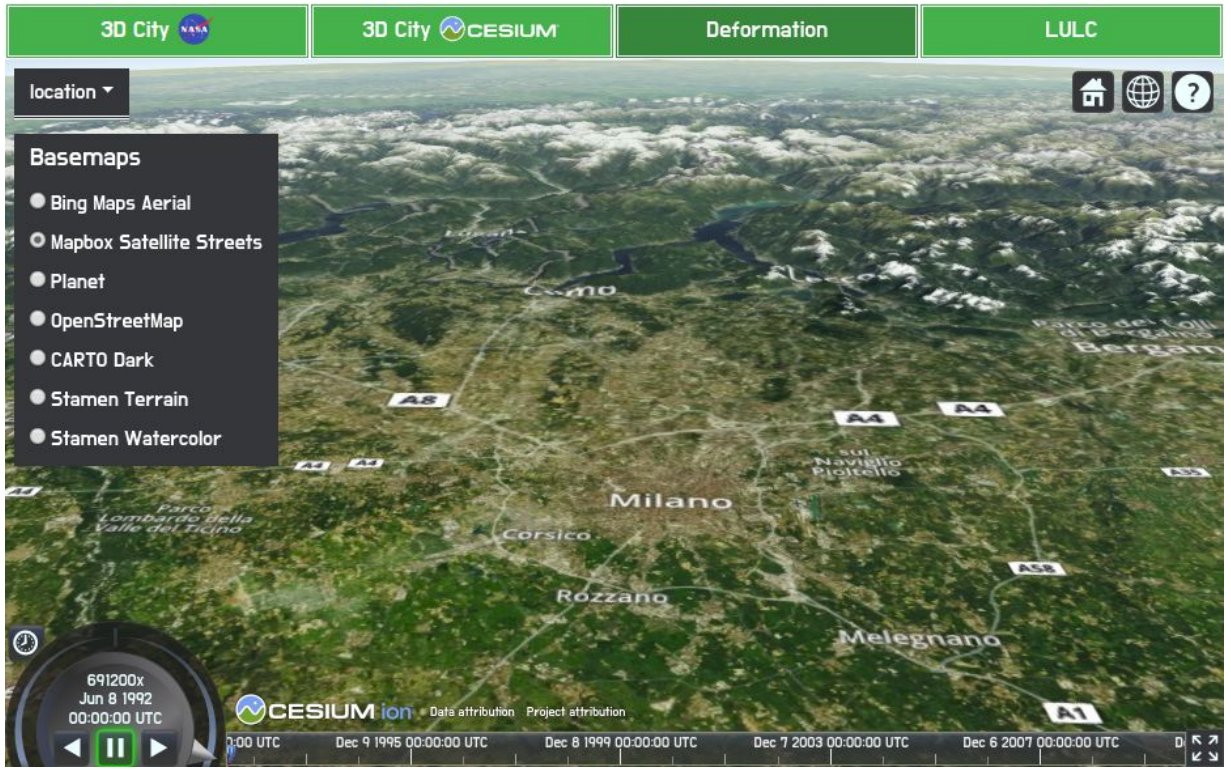
CesiumJS Basemaps and Terrain

- Added 6 basemaps to the CesiumJS-based virtual globe:
  - Bing Maps Aerial
  - Mapbox Satellite Streets
  - OpenStreetMap
  - CARTO Dark
  - Stamen Terrain
  - Stamen Watercolor

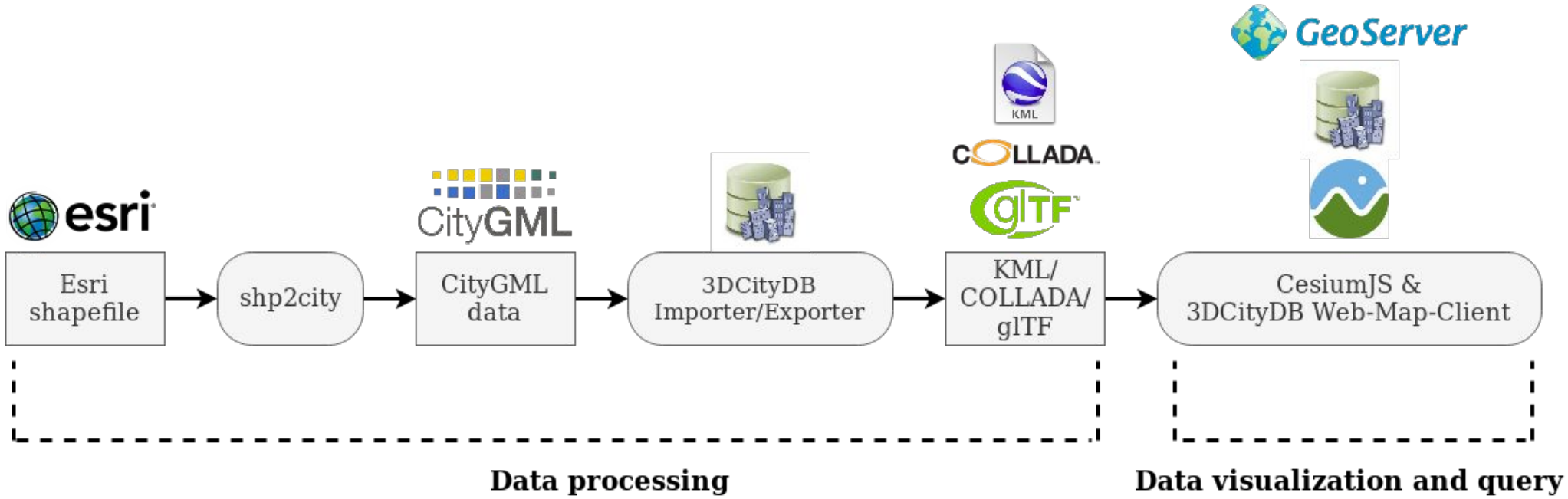


- VR-TheWorld Server is used to construct terrain. It provides global elevation data with 90-meter resolution (DTED level 1) for the entire globe, including bathymetry.

3D City Visualization

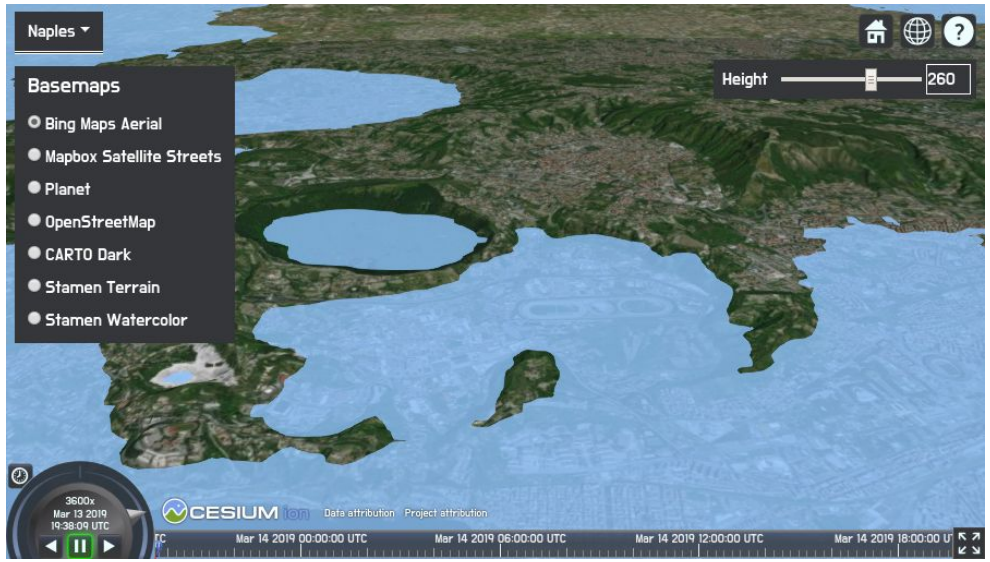
- CityGML data is used for 3D city visualization. Conversion from shapefile to CityGML is developed by the University of Padua (Francesca Fissore and Francesco Pirotti).
- CityGML dataset is converted to KML/gltF using 3DCityDB and 3DCityDB Importer/Exporter. Data is visualized and queried using CesiumJS and 3DCityDB-Web-Map-Client.
- On the Web GIS, it is also possible to simulate the sun, which enables to visualize the shadows of terrain and buildings at different times of the day and year.

3D City Visualization

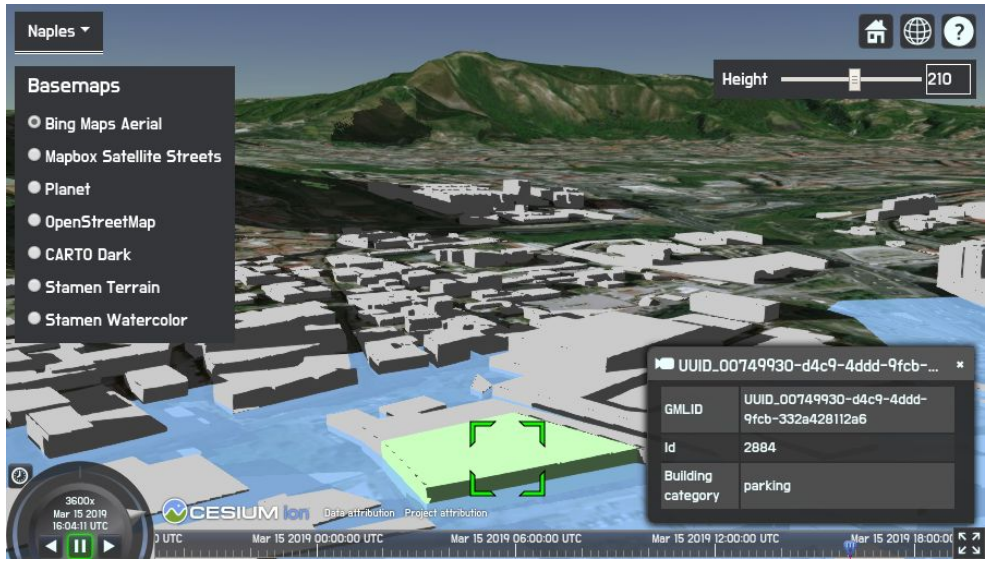


3D City Visualization

- We placed a semi-transparent polygon on the ellipsoid surface of the virtual globe and let the users change the height of the polygon in meters.
- Since the buildings in CityGML data also have the altitude values, we could place the buildings on the terrain, but the elevations don't match perfectly.



Flood simulation in Naples



Flood simulation in Naples with 3D buildings visualization and query

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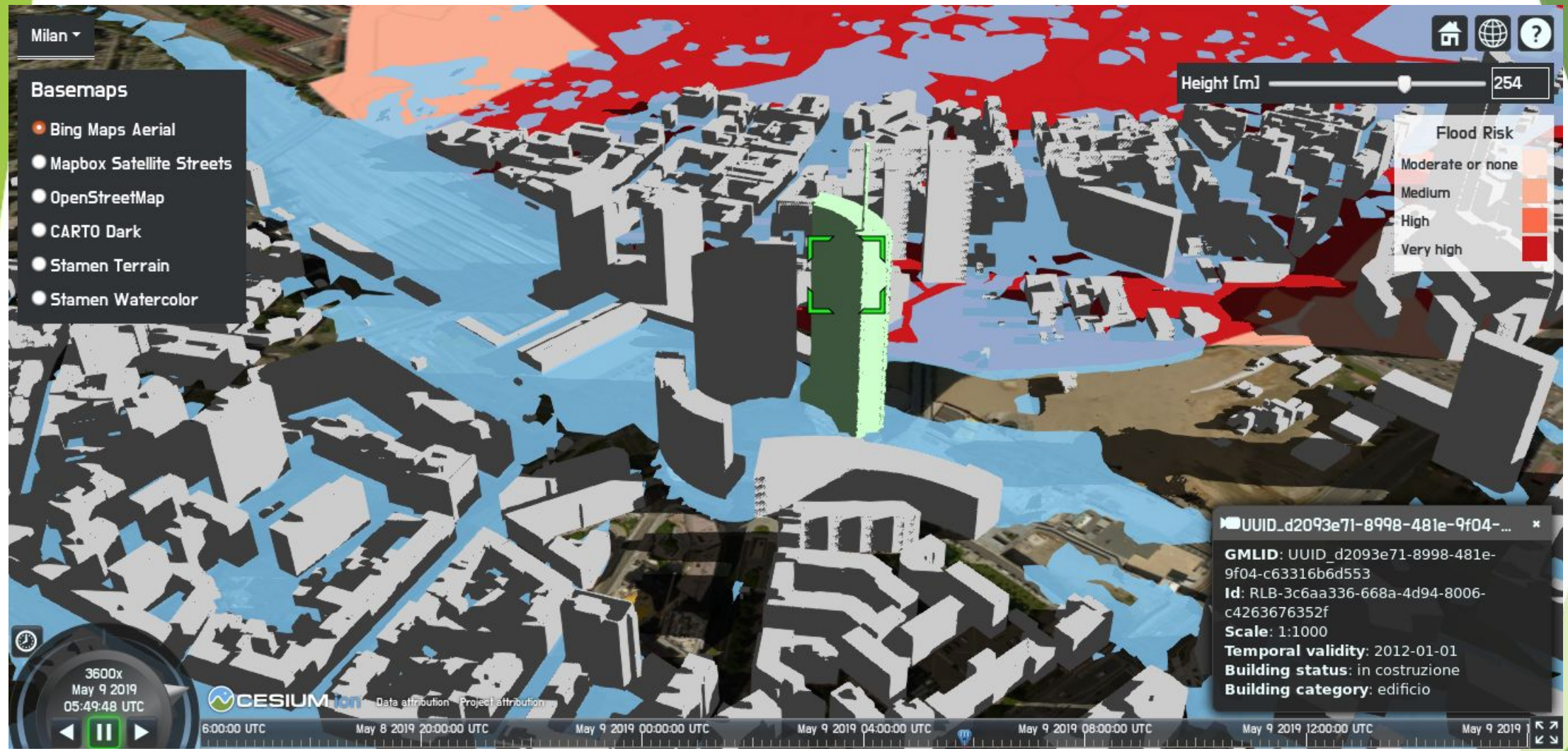
3D City Visualization

- The flood risk map of Milan published by Lombardy region as open data (http://www.geoportale.regione.lombardia.it/en/home) is integrated into the Web GIS using Web Map Tile Service (WMTS) in GeoServer.
- We used a 5-meter digital terrain model (DTM) of Milan instead of a 90-meter DEM to increase the accuracy of the flood simulation. This dataset too is published by the Lombardy region as open data.
- Integration of the DTM to the virtual globe requires:
  - creating terrain tiles in quantized-mesh-1.0 format,

    (https://github.com/tum-gis/cesium-terrain-builder-docker, https://github.com/AnalyticalGraphicsInc/quantized-mesh)
  - using a server to host the tiles.

    (https://github.com/geo-data/cesium-terrain-server)

3D City Visualization



Flood simulation in Milan with flood risk map and 3D buildings visualization and query

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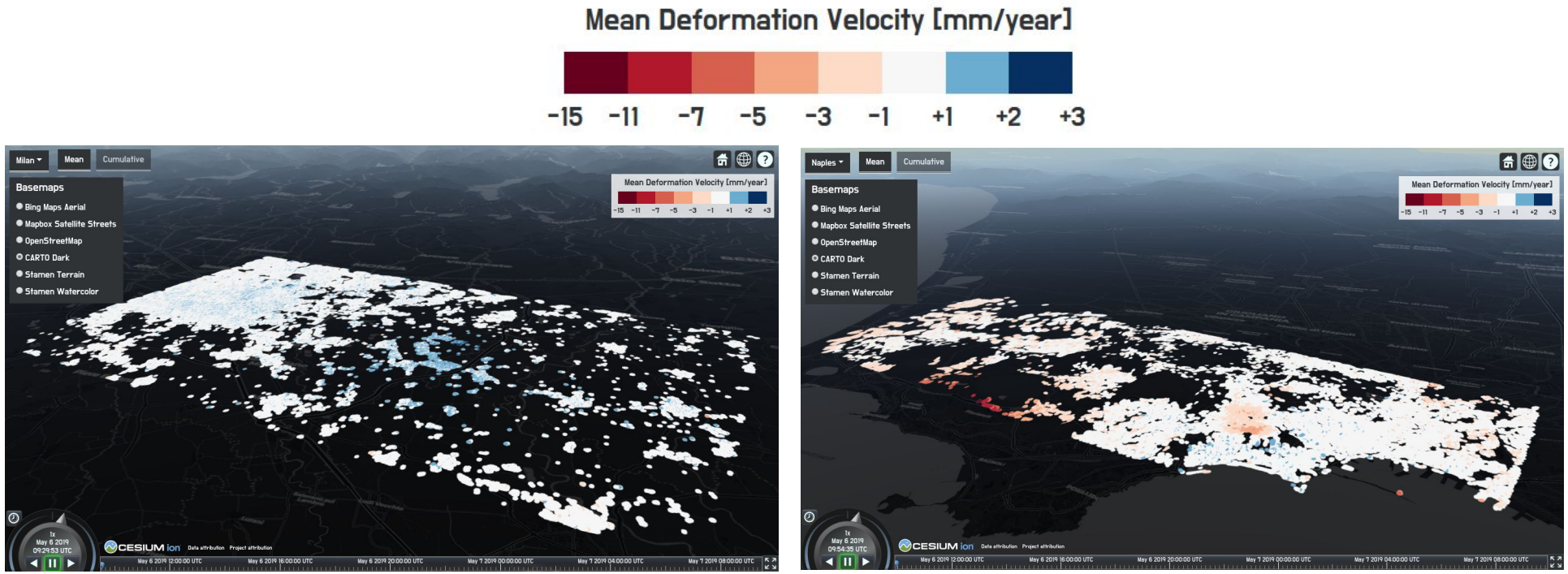
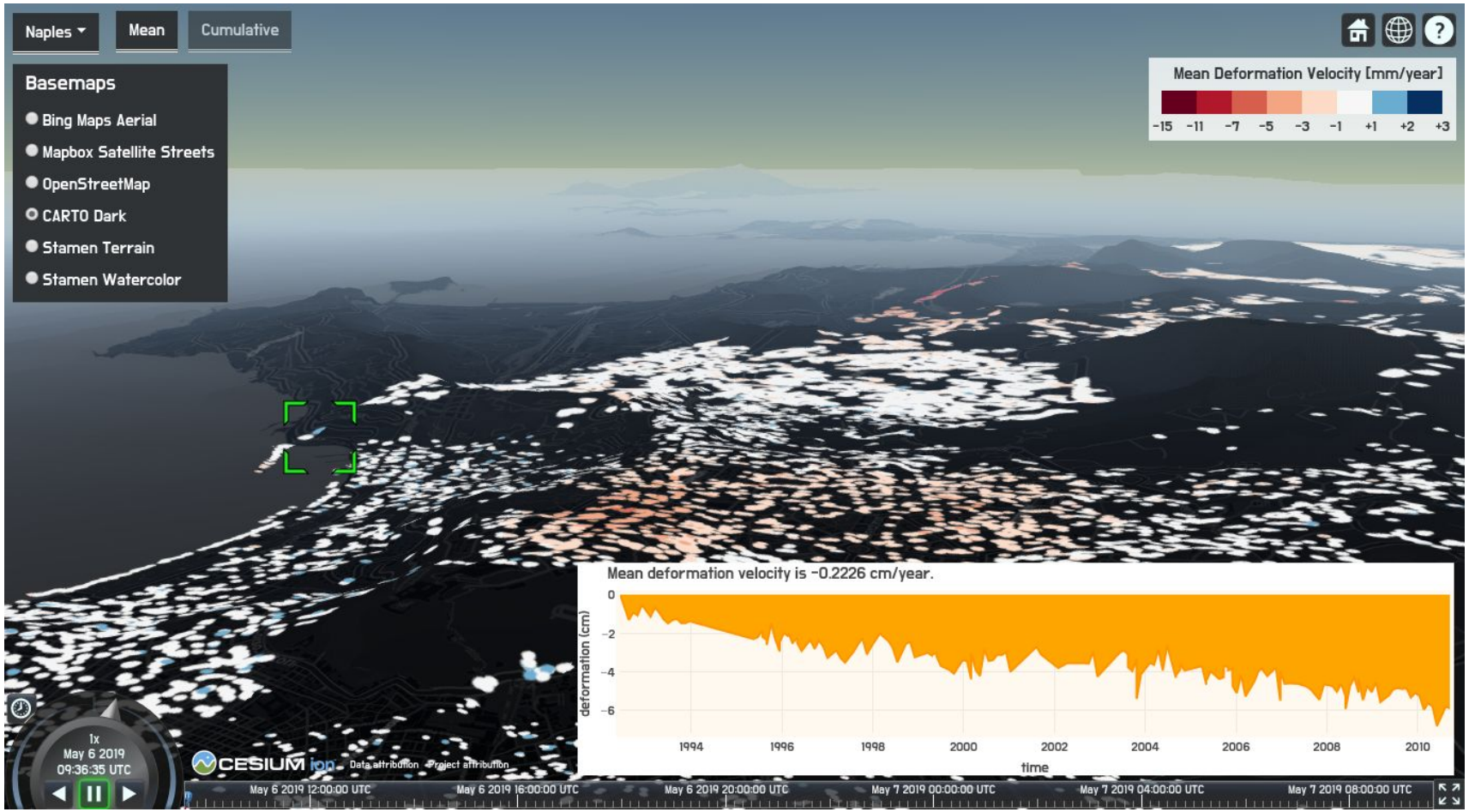
Deformation Visualization and Query

- Data is stored on GeoServer and used through Web Map Service (WMS) on a virtual globe created with CesiumJS. Data is currently available for Milan, Naples, Rome, and Turin.
- The intervals for colors do not exceed the standard deviation of about 1 mm/year. We chose the color scheme for diverging data with eleven classes using ColorBrewer 2.0 (http://colorbrewer2.org/#type=diverging&scheme=RdBu&n=11).



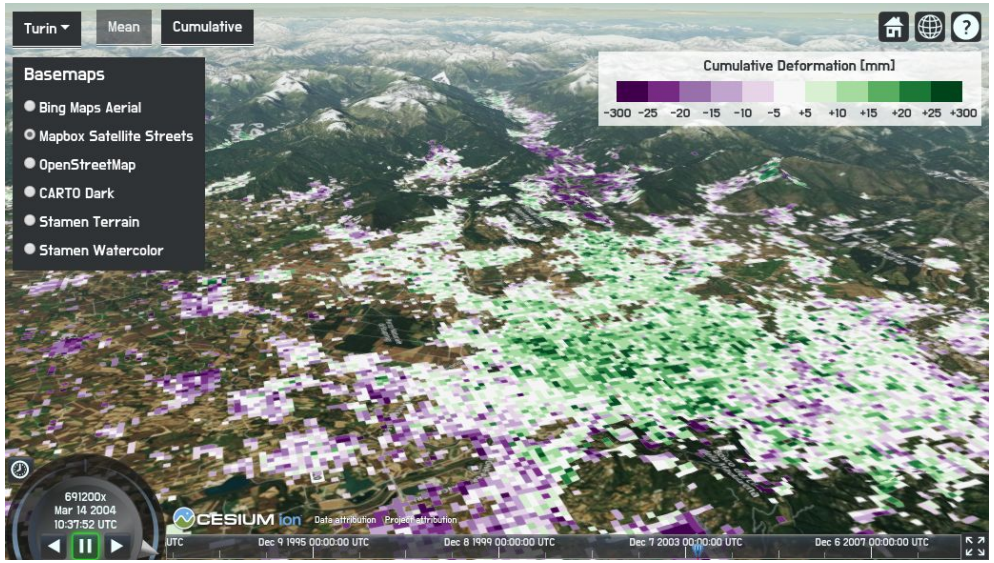
Deformation Visualization and Query

- Each point on the map can be queried to display the deformation time series plot. Plotted the time series using Plotly.



Deformation Animation

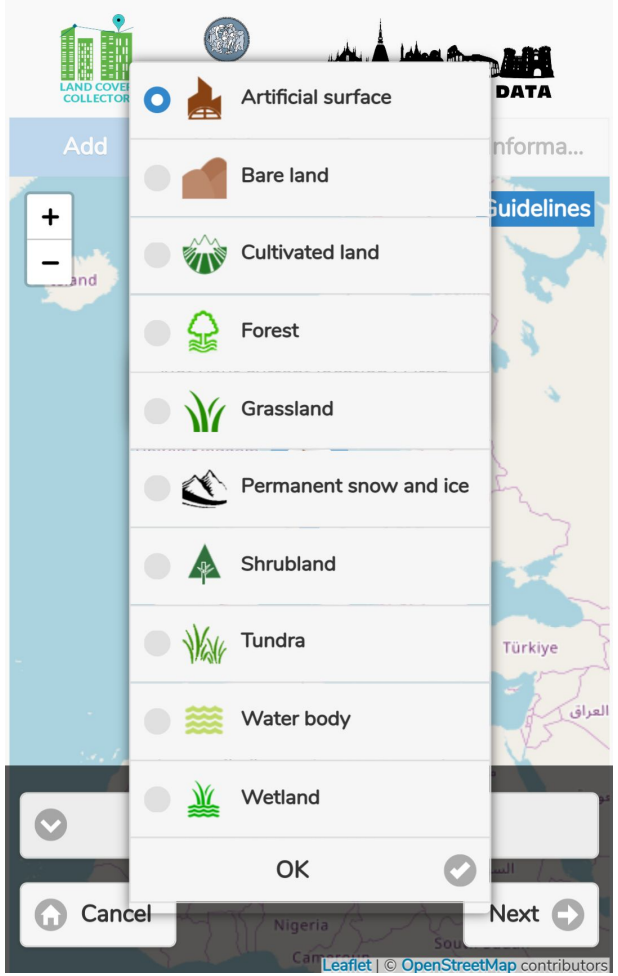
- Deformation is also visualized for 18 years as animation using Web Map Tile Service (WMTS) and ImageMosaic through GeoServer and timeline and animation widgets of CesiumJS. It is currently available for Naples, Milan, Rome, and Turin.
- The intervals for colors do not exceed the standard deviation of about 5 mm.
- We chose the color scheme for diverging data with eleven classes using ColorBrewer 2.0 (http://colorbrewer2.org/#type=diverging&scheme=PRGn&n=11).
- Both for mean deformation velocity maps and cumulative deformation animation the same style (color scheme) is used for all the cities to enable comparison among them.



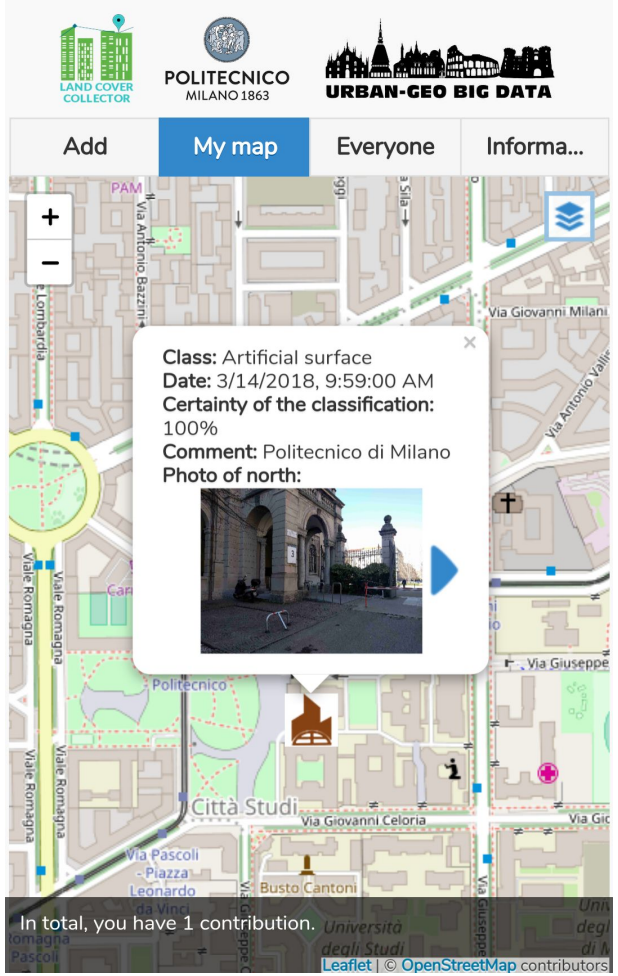
Land Cover Collector

- Land Cover Collector application aims to enable data collection on land cover classification using the nomenclature of GlobeLand30 (GL30).
- When collecting a land cover observation, in addition to enabling their GPS, users are required to indicate the land cover class, the degree of certainty; to take four photos in the north, east, south and west directions; and optionally to add a comment.
- It is possible to collect data online and offline.
- It is cross-platform and available as Android and iOS applications and on Web.
- Collected data are released under the Open Database License (Odbl) v1.0 and can be downloaded in JavaScript Object Notation (JSON) format.
- Guidelines are provided.
- It is available in eight languages: English, Italian, Arabic, Chinese, Spanish, Russian, Portuguese and French.
- It is an open source project, available on GitHub at https://github.com/kilsedar/land-cover-collector. The project is protected under the GNU GPLv3 license. The application is partially based on and extends the project EmoMap.

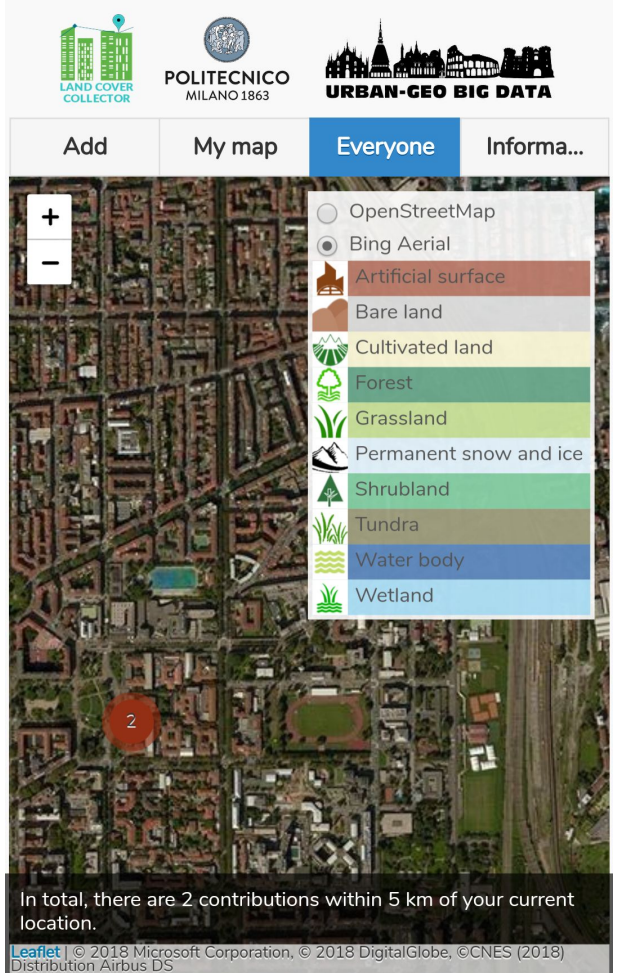
Land Cover Collector



While submitting a land cover point, its class according to GL30 classification is set.



The details of each point can be queried by clicking on its marker on the map.



The collected land cover data can be visualized as clusters, aggregated based on the declared land cover class.

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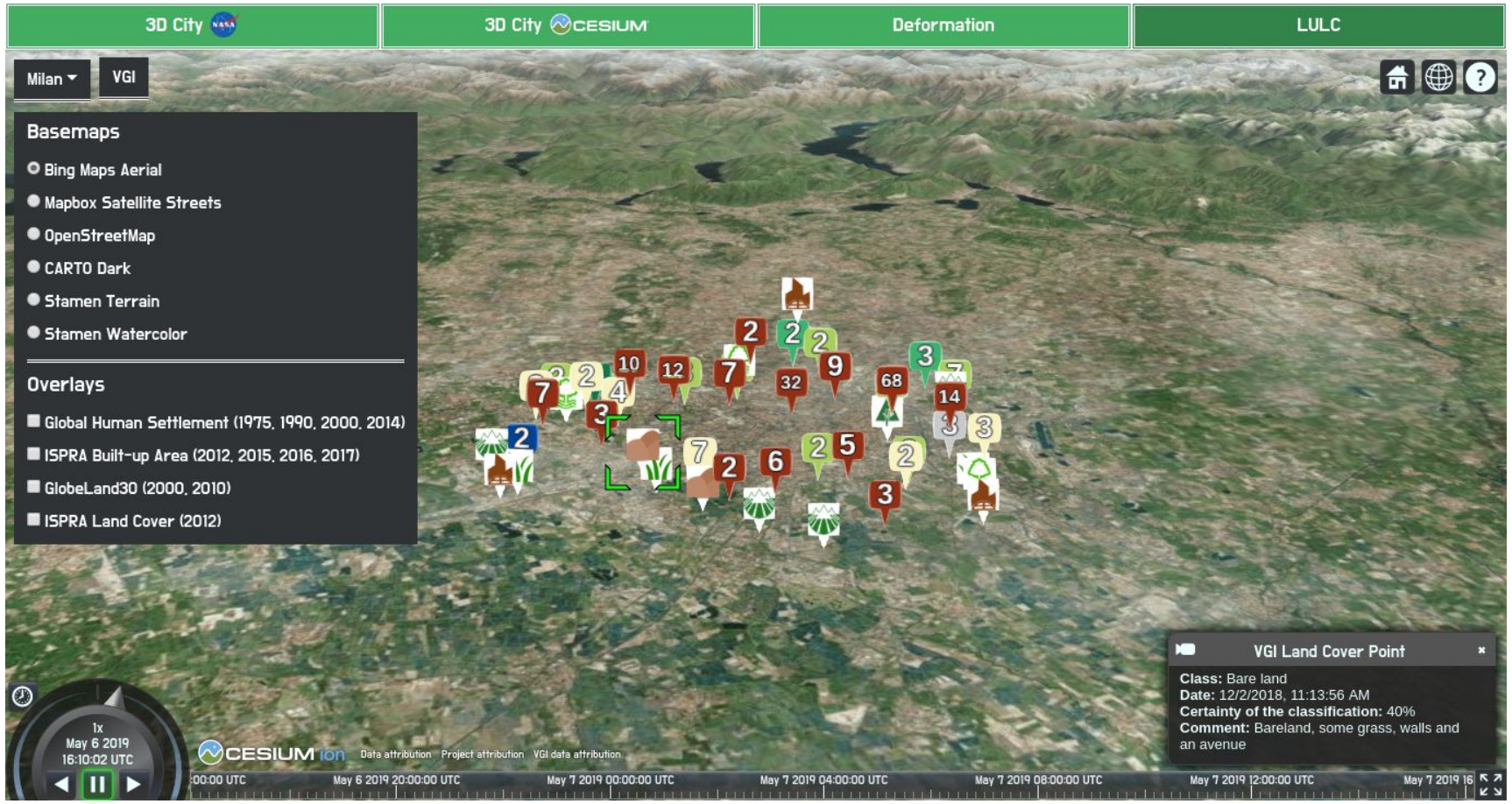
Land Cover VGI Visualization



- Data collected using Land Cover Collector application can be visualized as “billboard” clusters on CesiumJS-based virtual globe. Icons and cluster colors are adopted from GL30. Each billboard can be queried. (Photos of north, east, south, and west are to be added.)

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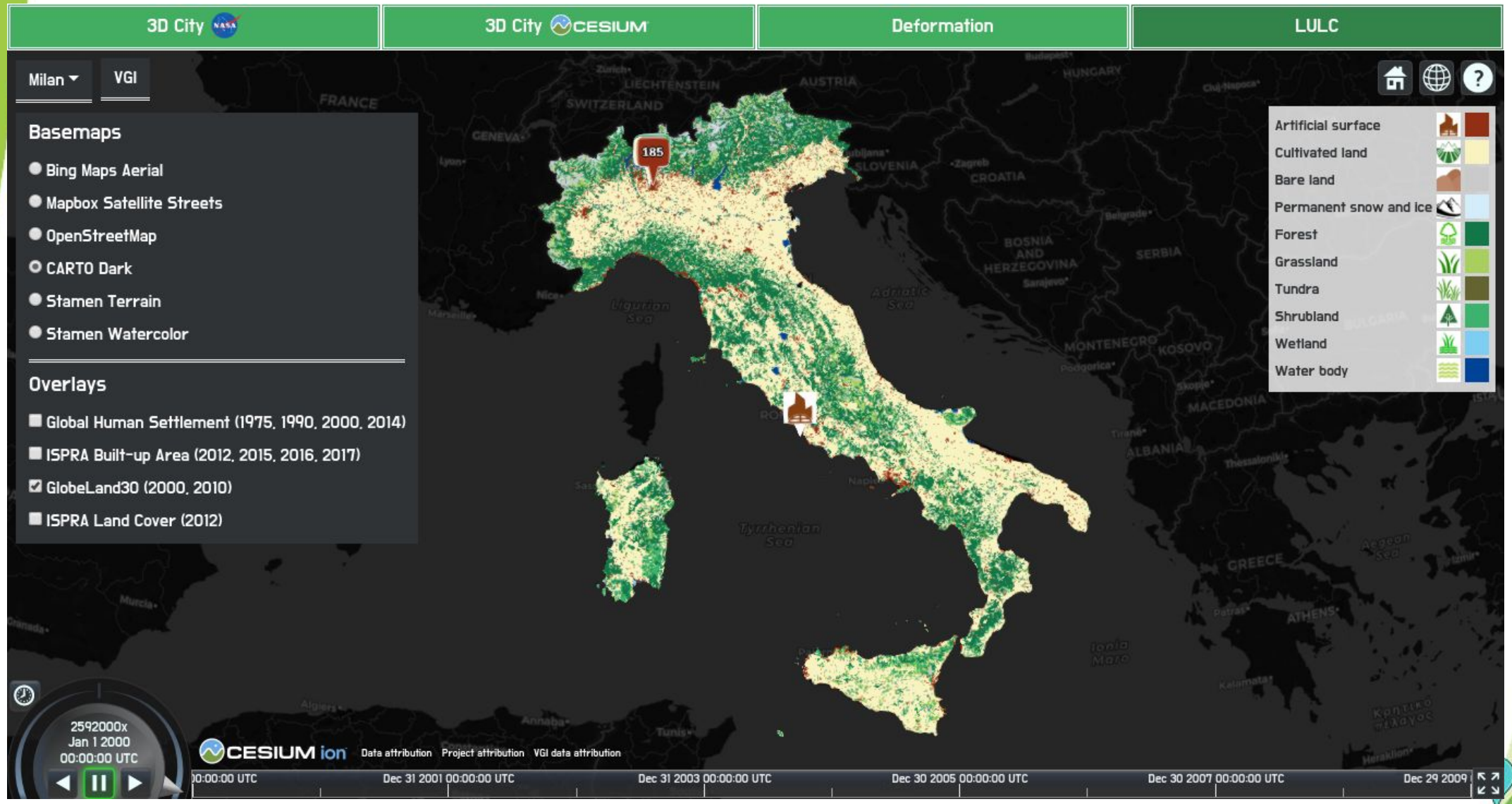
GL30 and Land Cover VGI



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GL30 and Land Cover VGI

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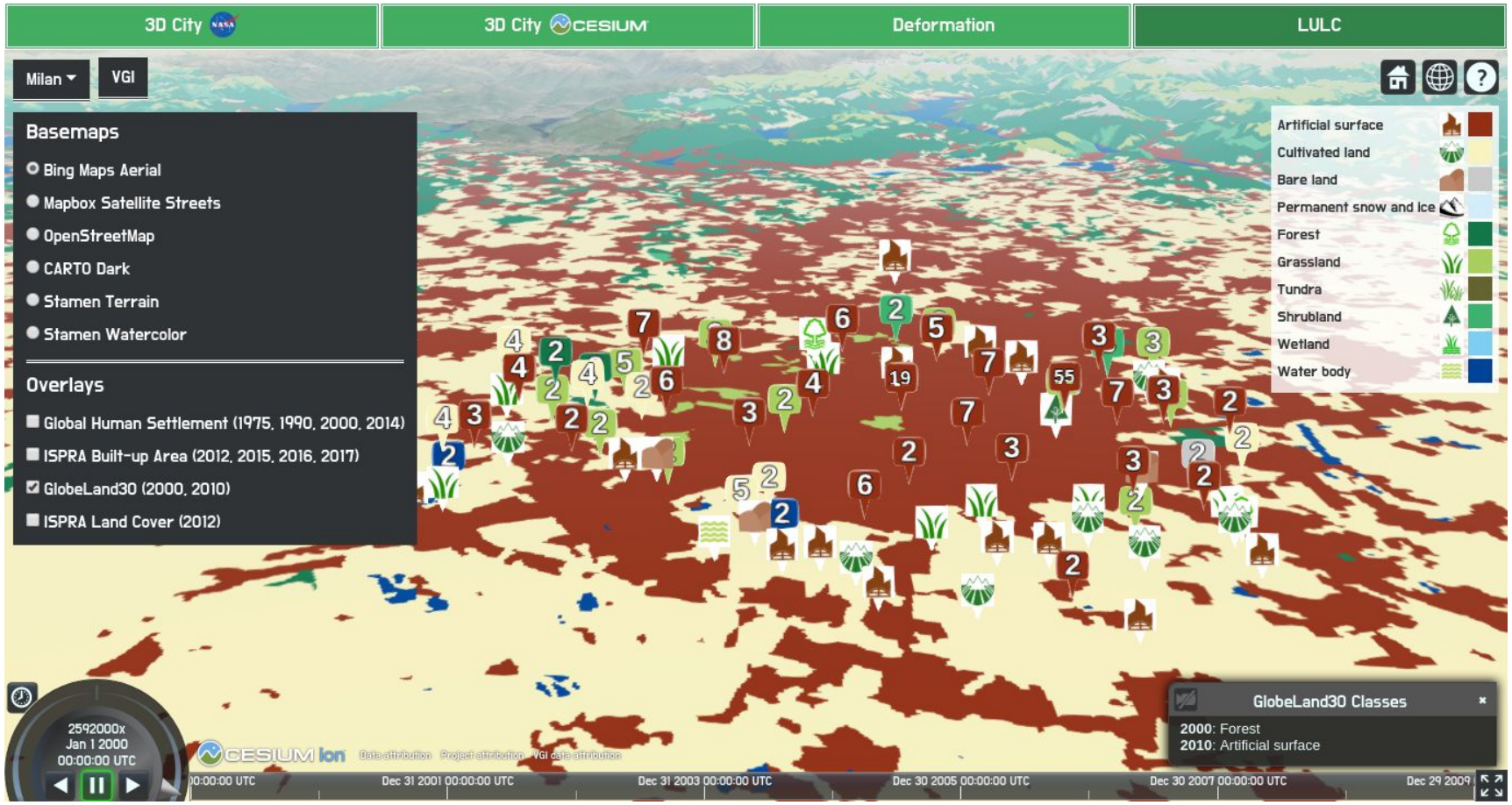
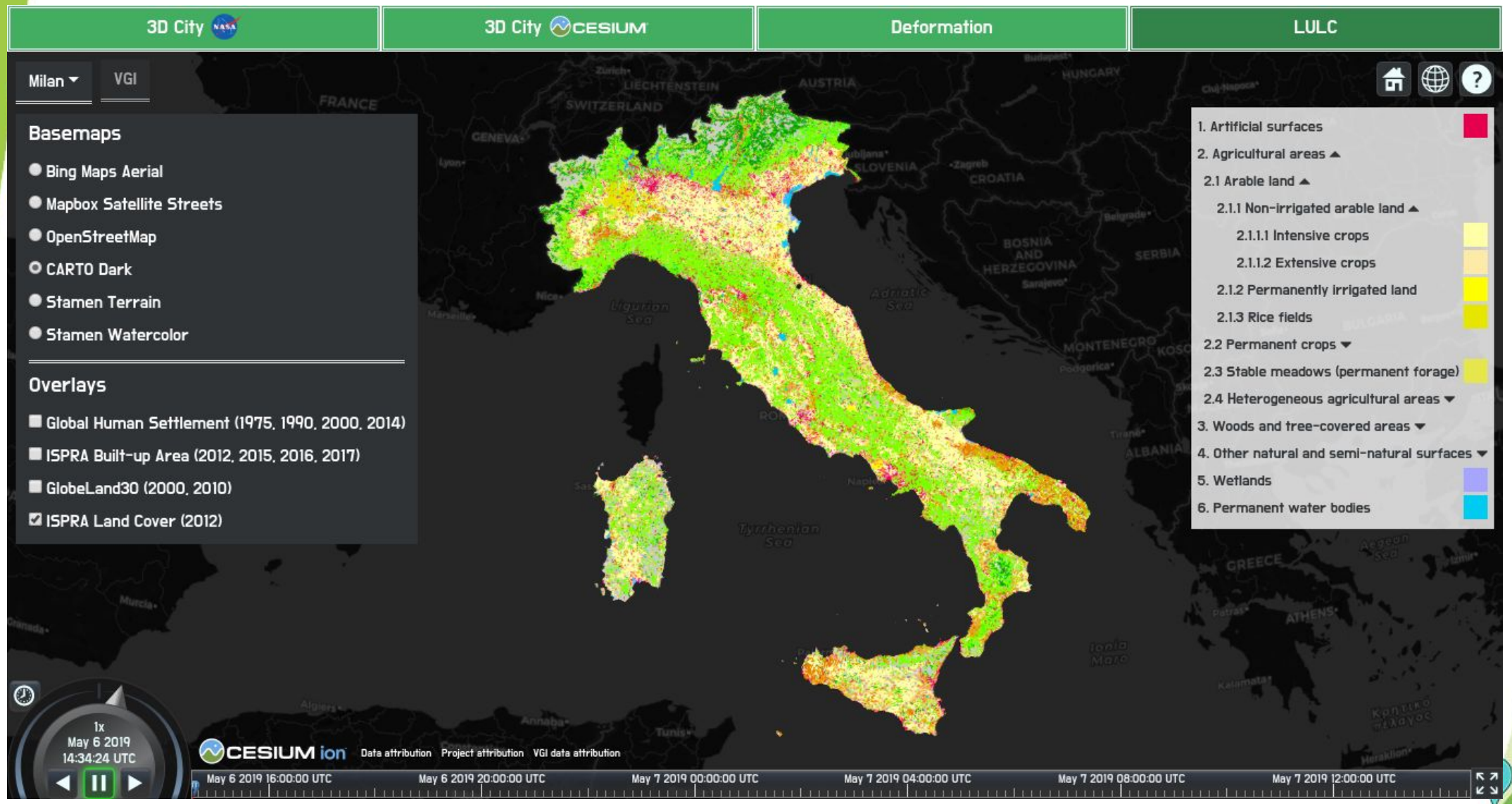
Query Multidimensional GLC30



- Big multidimensional raster data (x/y/t) can be queried within the 3D Web GIS using rasdaman (raster data manager) clicking on the map.

ISPRA Land Cover



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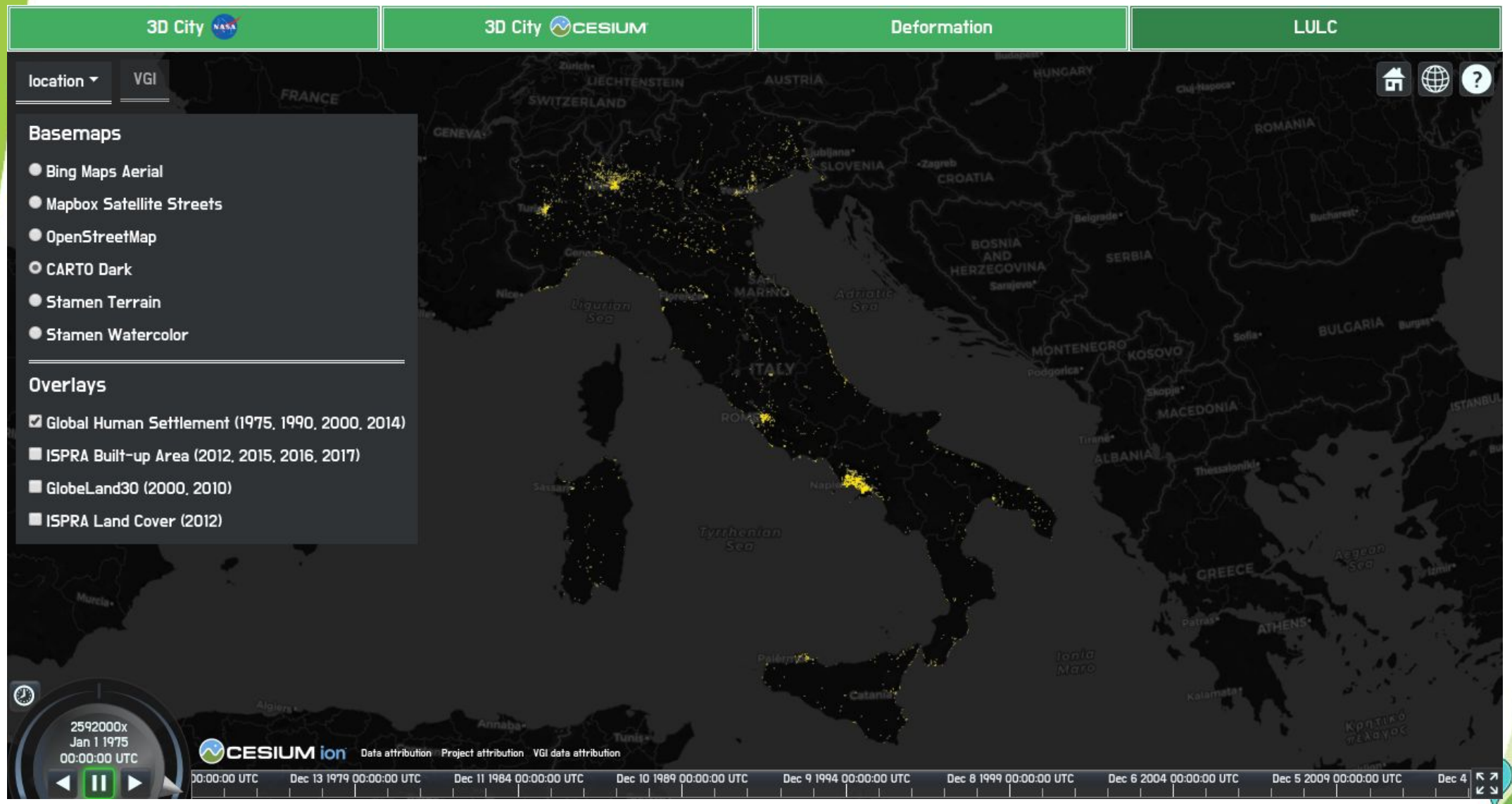
Query ISPRA Land Cover

- Big raster data can be queried within the 3D Web GIS using rasdaman (raster data manager) clicking on the map.

Global Human Settlement Layer



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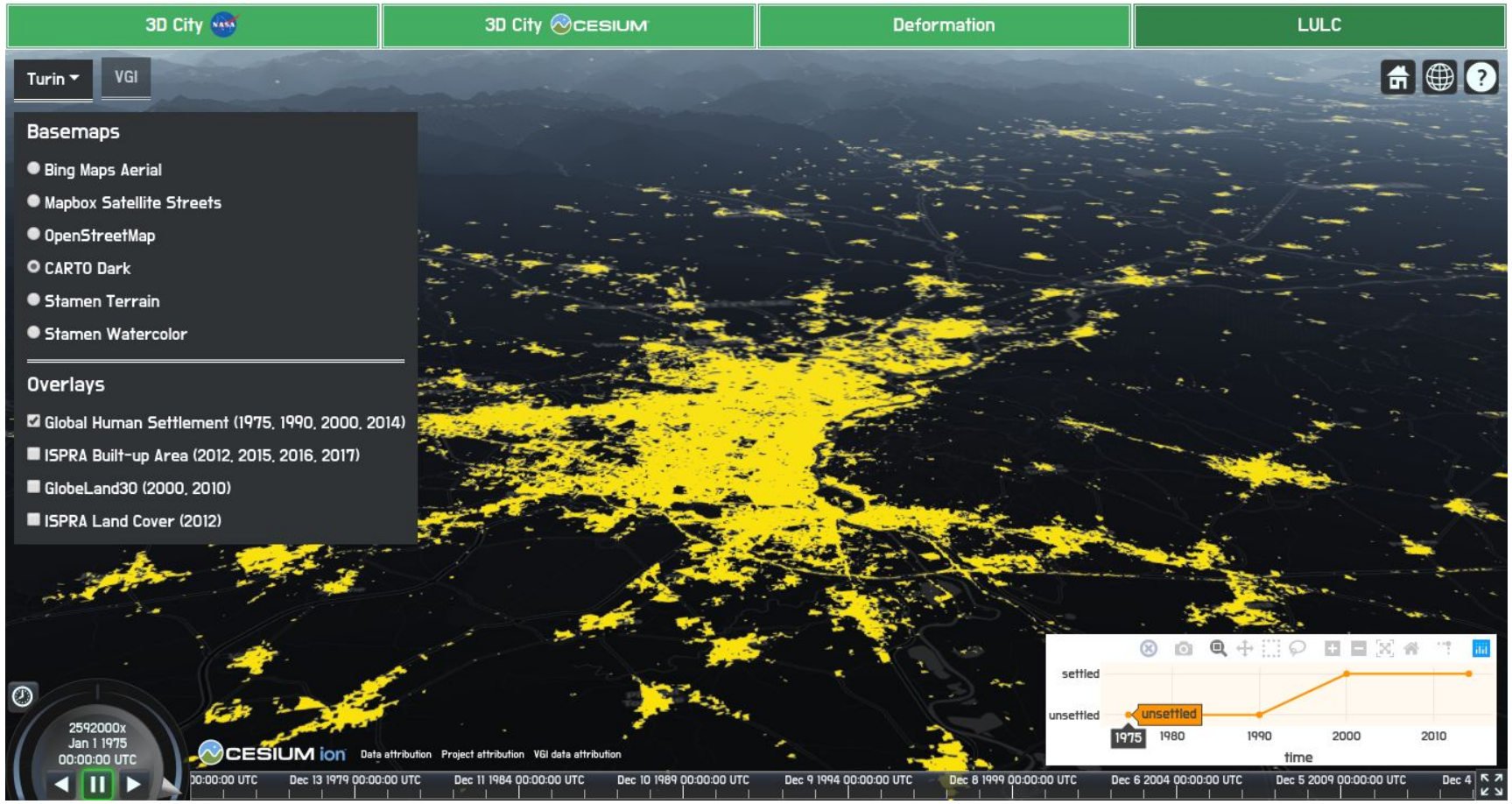
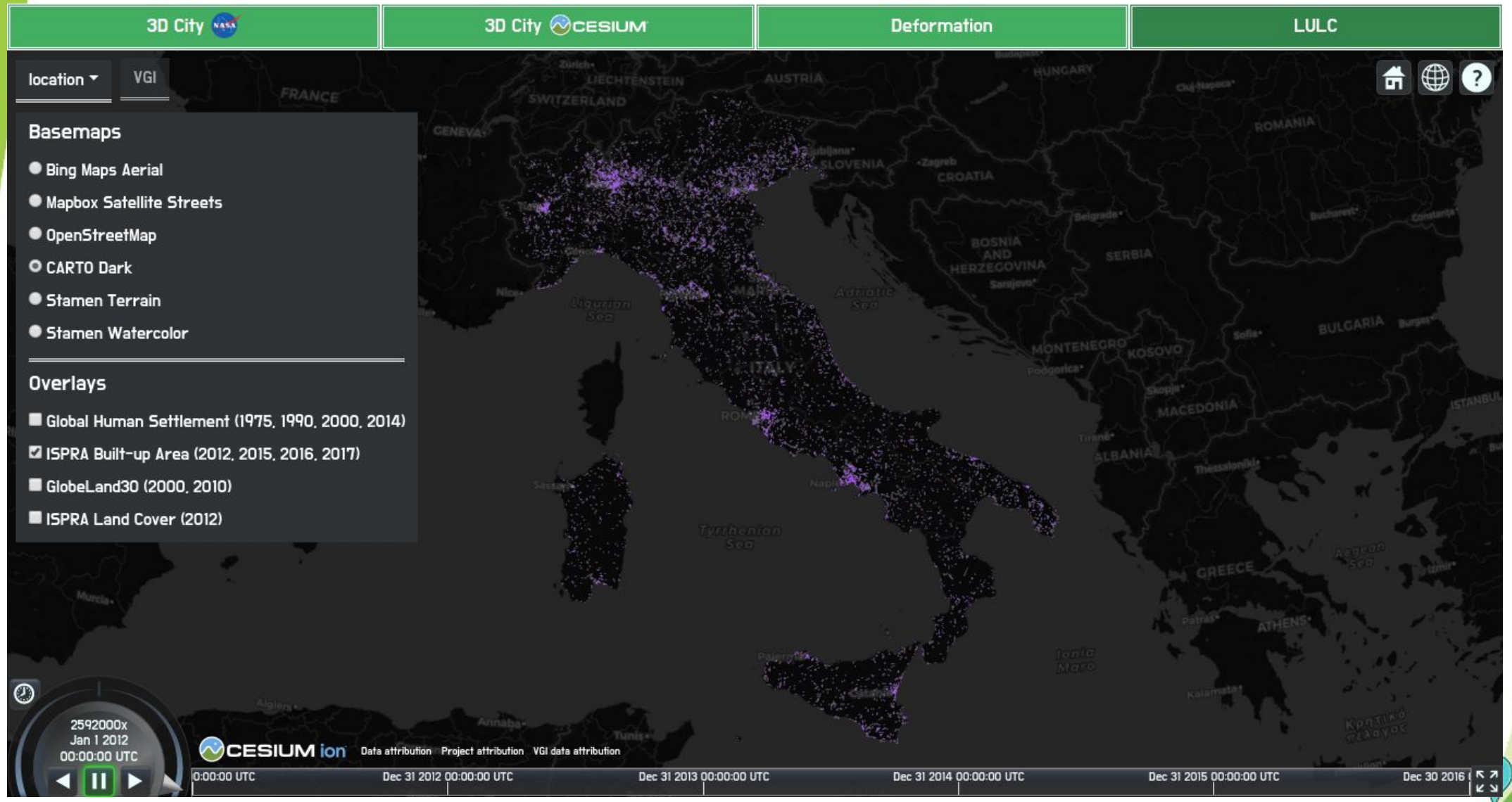
Query Multidimensional Global Human Settlement Layer



- Big multidimensional raster data (x/y/t) can be queried within the 3D Web GIS using rasdaman (raster data manager) clicking on the map.

ISPRA Built-up Area Map



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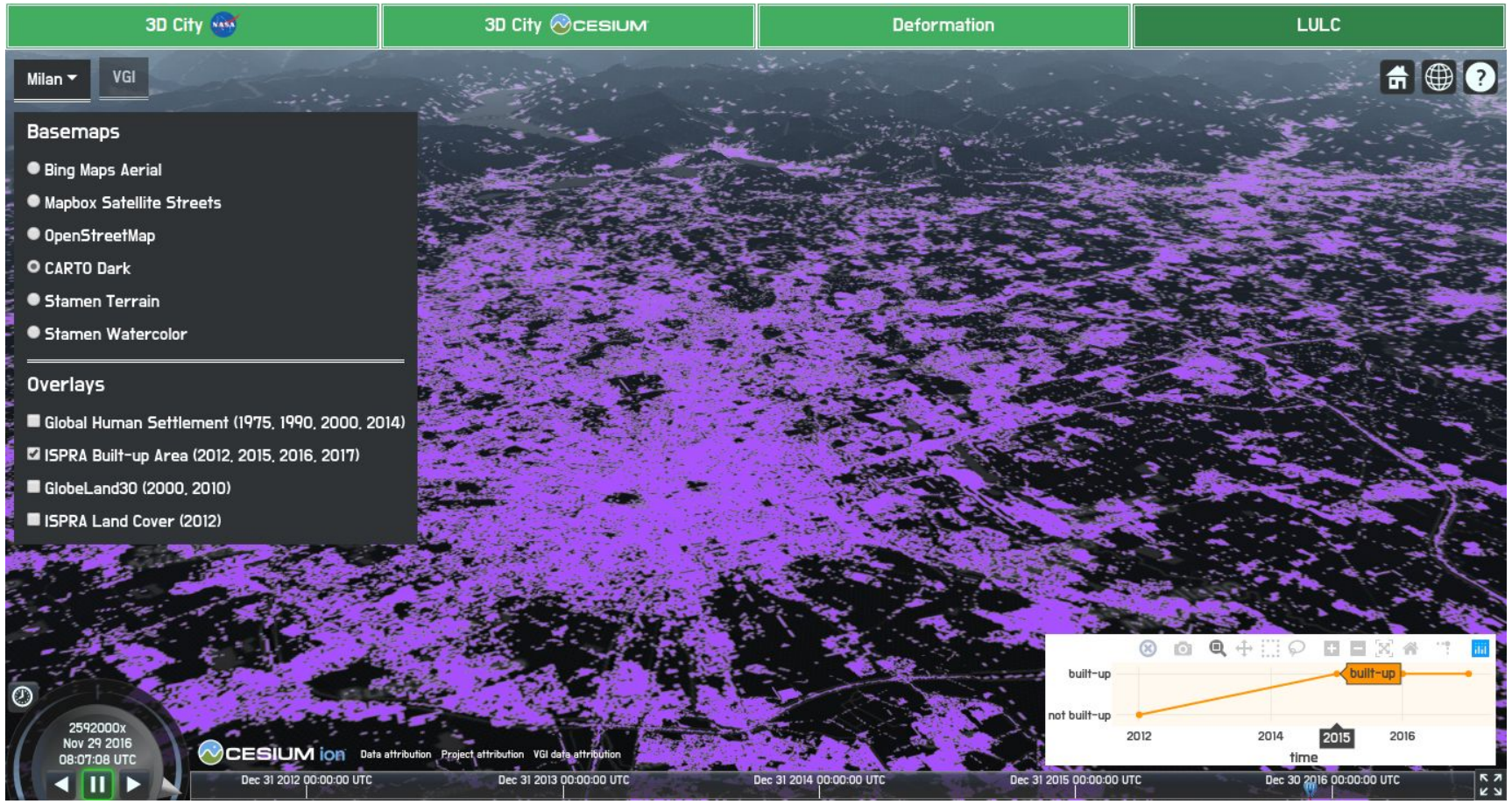
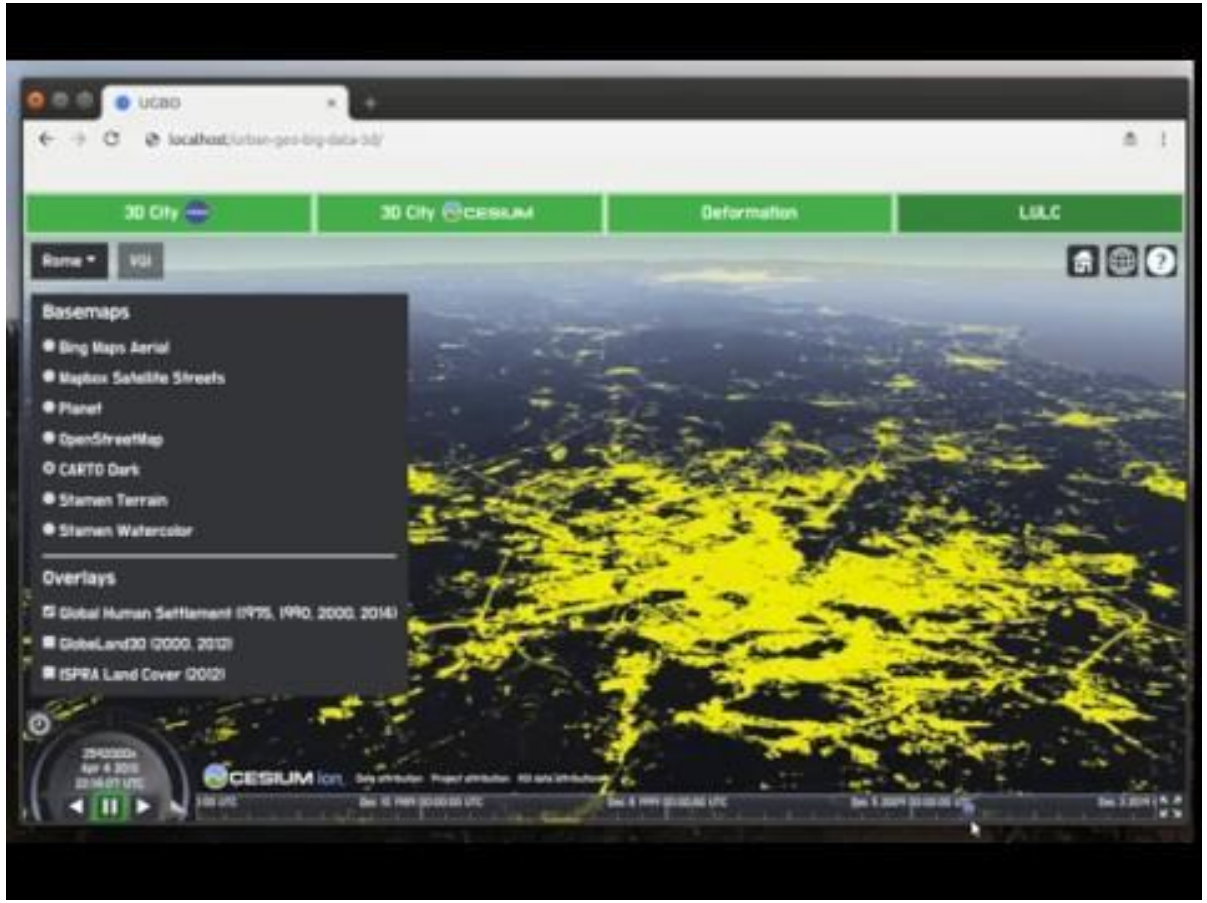
Query Multidimensional ISPRA Built-up Area Map



- Big multidimensional raster data (x/y/t) can be queried within the 3D Web GIS using rasdaman (raster data manager) clicking on the map.

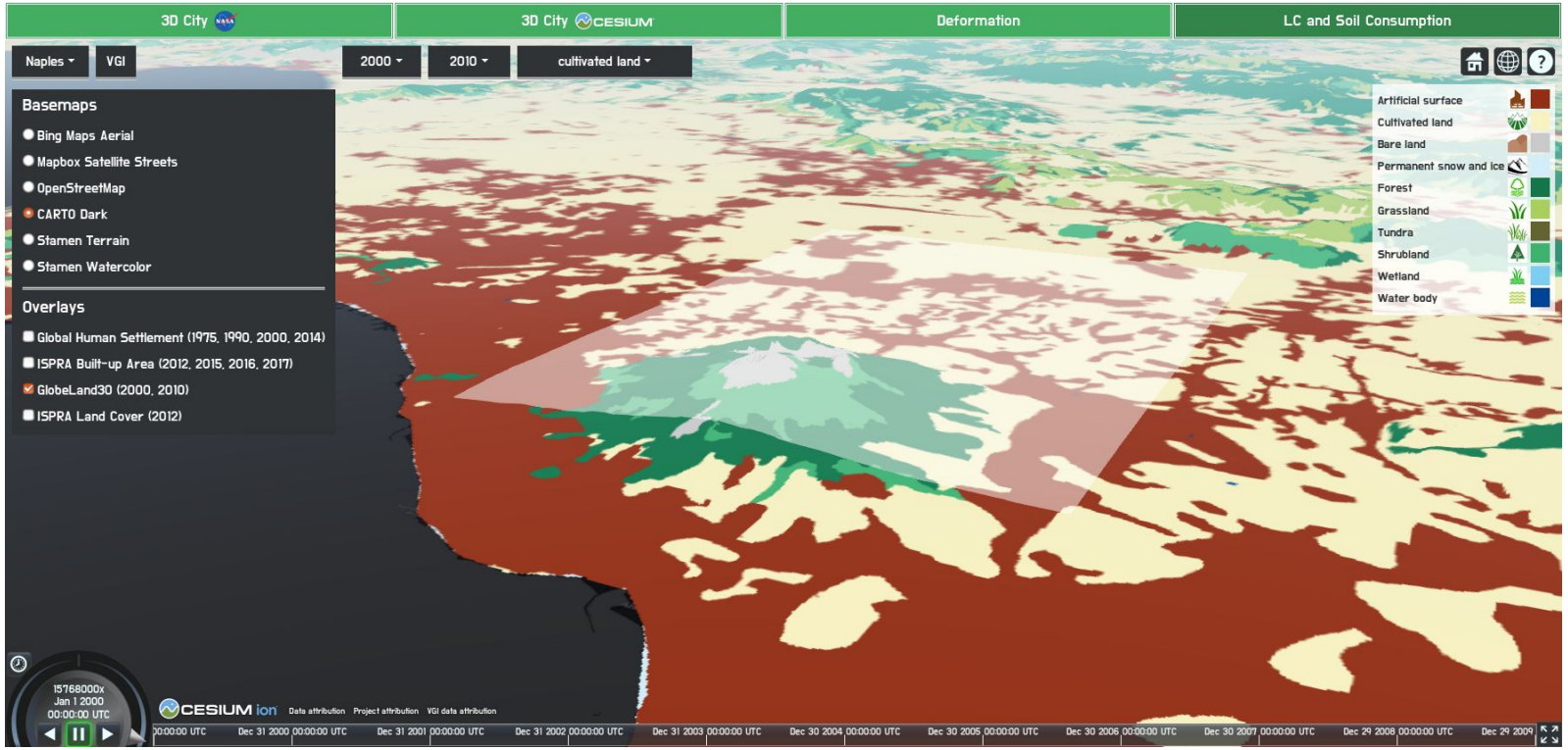
LULC and Soil Consumption Animation



- Data is visualized using WMTS and ImageMosaic through GeoServer and timeline and animation widgets of CesiumJS to detect LULC and soil consumption change in time visually. Implemented for all three datasets.

Processing Big Multidimensional Raster Data

- Rasdaman is used for processing big multidimensional raster data.
- The amount of change of a land cover class or soil consumption for an area drawn by the user for two selected years will be returned.



- In the future, it is possible to return also the difference image between two selected years for the drawn area.

Traffic Visualization

- The 5th use case related to mobility will be added to the Web GIS.
- Traffic for 5 cities and 24 hours will be animated using the same tools.

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Thank You!

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