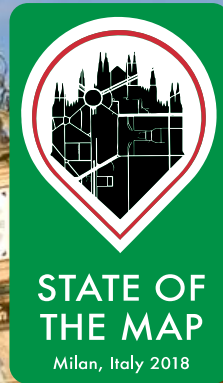




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# 2D and 3D visualization of OpenStreetMap Data

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# OpenStreetMap (OSM) visualization

- ✓ OSM data have **big data** characteristics, such as velocity, veracity and volume.
- ✓ **Visualizing** big data is one of the challenges regarding the big data phenomenon (Li et al., 2016).
- ✓ A plugin Application Programming Interface (API) has been developed for NASA Web WorldWind during **Google Summer of Code (GSoC)** in 2017 for OSM visualization.
- ✓ **NASA Web WorldWind** is a free and open source API for building virtual globes and maps, built using JavaScript and WebGL. It is developed in partnership with **European Space Agency (ESA)**.



# An open source plugin API

- ✓ OSM may hold for each building its height or number of levels, which can be used for **3D** visualization. The rest of the OSM data are overlaid on the virtual globe in **2D**.
- ✓ The source code of the plugin API is available at <https://github.com/kilsedar/3dosm>.
- ✓ <http://osm.eoapps.eu> & <http://osm.eoapps.eu/application/> can be used to visualize the data, which reached the finals at **NASA Europa Challenge** in 2017.



Google  
Summer of Code



# Existing platforms that displays OSM data in 3D on Web

- ✓ **MapBox** has good performance thanks to vector tiling, paid after 50000 map views per month.
- ✓ **OSMBuildings** data is paid after 50000 requests per month.
- ✓ **F4 Map** is not open source.
- ✓ **OpenScienceMap** is not an API.
- ✓ **OSM go** currently is not an API nor on GitHub.
- ✓ **Mapzen** has shut down in January 2018.
- ✓ **OSM-3D** is now offline.
- ✓ More info on how to map OSM buildings in 3D how is available at [https://wiki.openstreetmap.org/wiki/Simple\\_3D\\_buildings](https://wiki.openstreetmap.org/wiki/Simple_3D_buildings).



# An open source plugin API

- ✓ *The plugin API developed is **free and open source**, and supports visualization of **both 2D and 3D OSM** data.*
- ✓ The API fetches the OSM data in real time based on a **bounding box**, or uses a **local file** or the **data itself in GeoJSON format**.
- ✓ Height to the buildings can be assigned using the **OSM database**, a **property in a GeoJSON file** or an **arbitrary value**.
- ✓ In case the OSM database is used the “**height**” tag is used if available, if not “**building:levels**” tag is used to approximate the height, if neither are available a 5 level building is assumed.
- ✓ The API can create a **heatmap** based on the heights of the buildings.
- ✓ The API also offers **caching and sectorizing (tiling)** to improve the performance.
- ✓ **Downside**: it doesn't perform vector tiling entirely, so for large datasets, especially in 3D may cause performance problems.



# 2D and 3D visualization of OSM data

## 3D OpenStreetMap (OSM)

Fetch and display any OSM data.



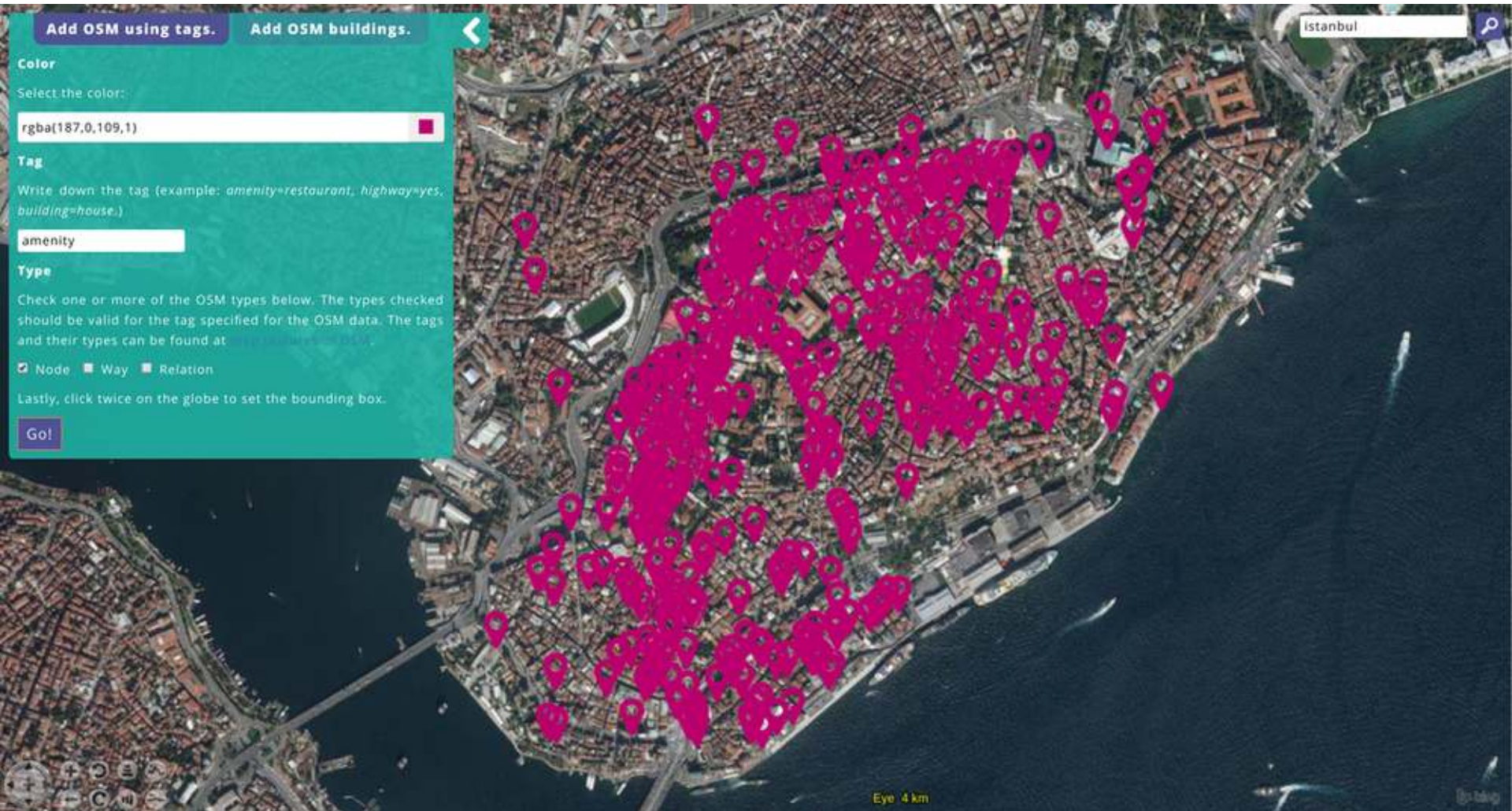
# Visualizing OSM buildings in 3D

- ✓ Buildings in New York.



# Visualizing the OSM data in 2D

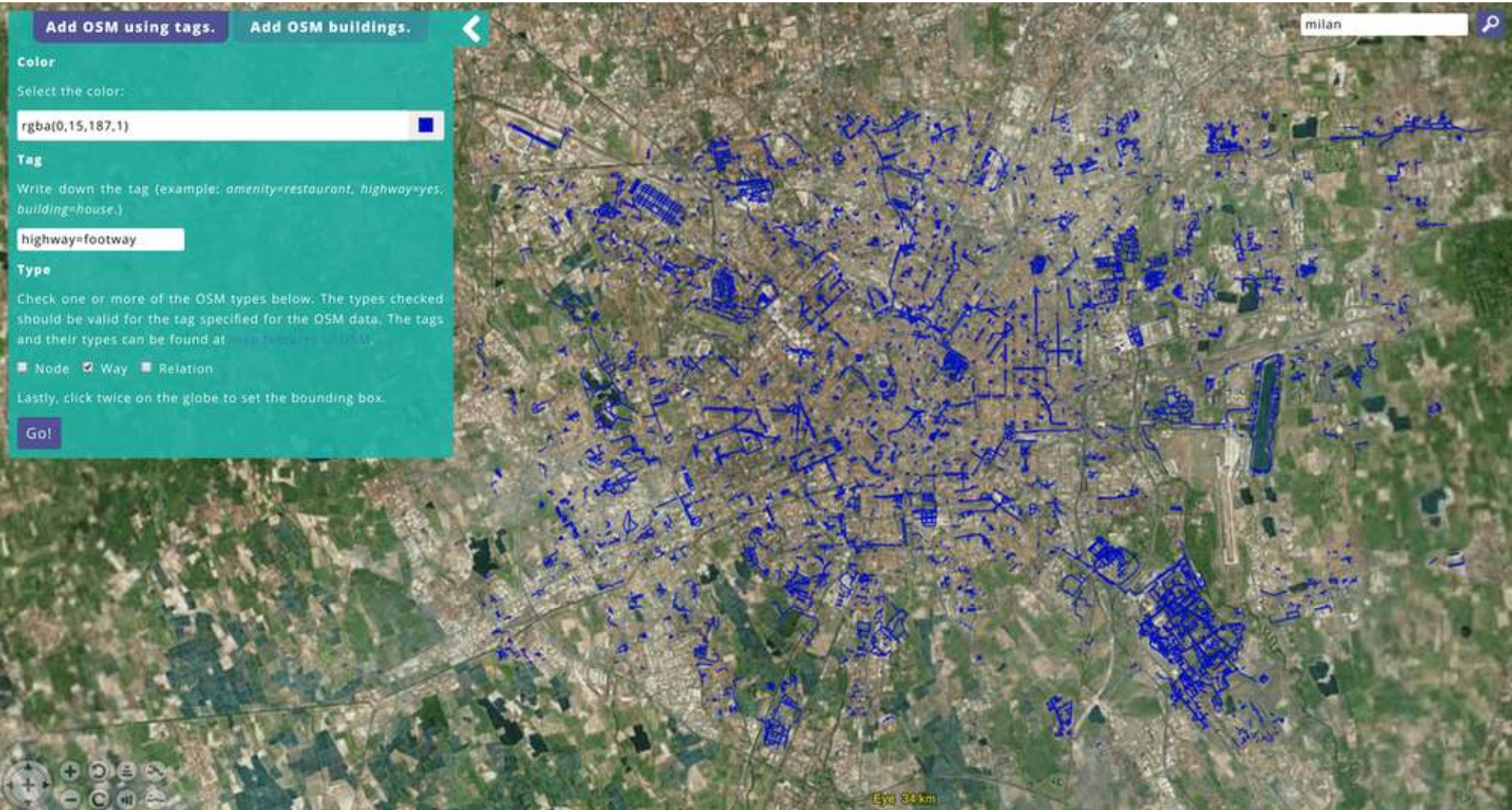
- ✓ Points can be added on the globe (amenities in Istanbul).





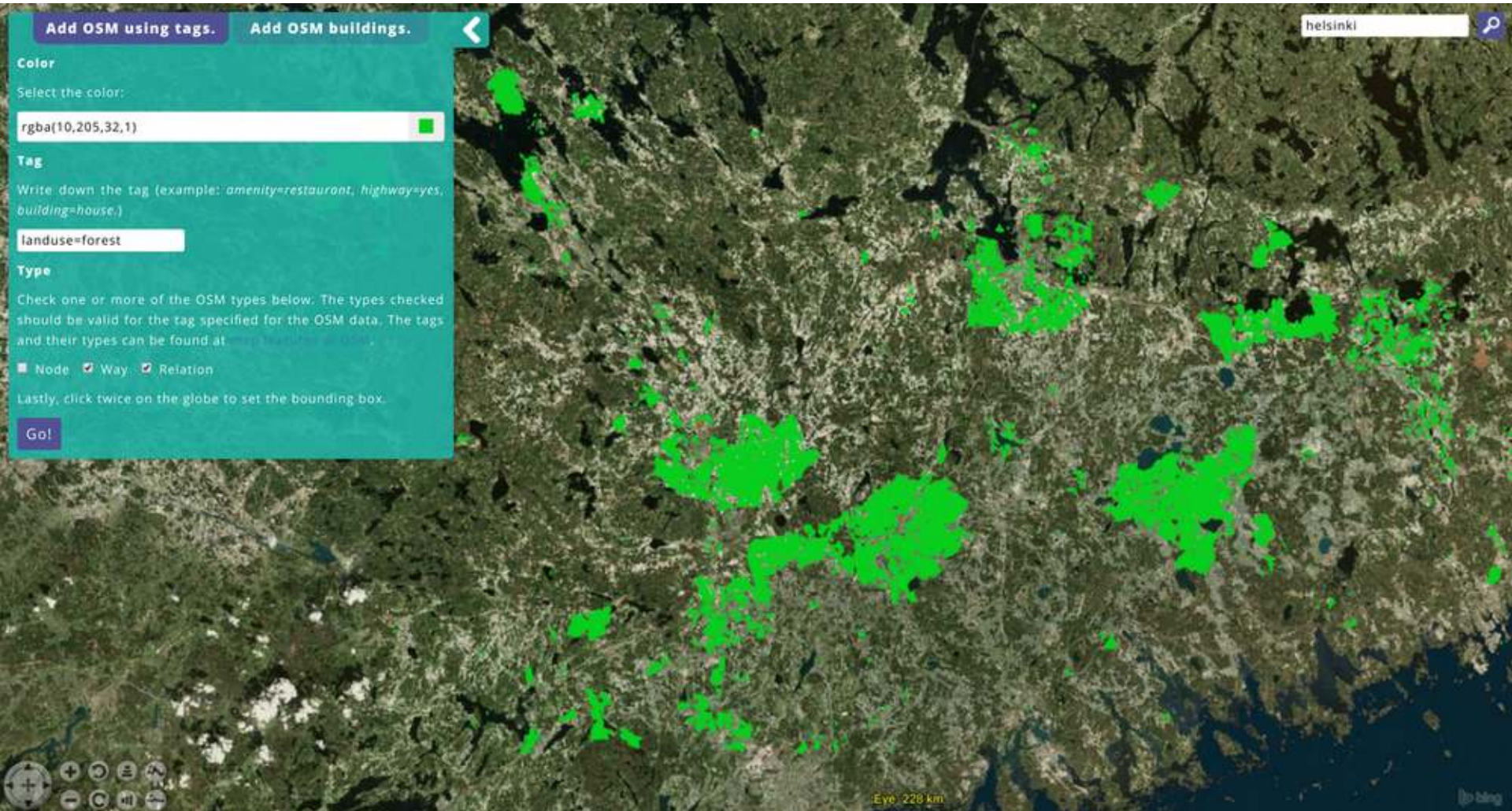
# Visualizing the OSM data in 2D

- ✓ Lines can be added on the globe (footways in Milan).



# Visualizing the OSM data in 2D

- ✓ Polygons can be added on the globe (forests in Helsinki).



# Research aspects

- ✓ The project also improves the painting and rendering **performance** of 3D buildings in the browser, in total by 15%. To achieve the improved performance, using the footprint and height of the buildings and the **earcut** algorithm (<https://github.com/mapbox/earcut>) triangle meshes are created, instead of extruding the footprints.
- ✓ **Lidar** data for Milan and **GRASS GIS** were used to extract the building heights, store the results in GeoJSON, and visualize this data.



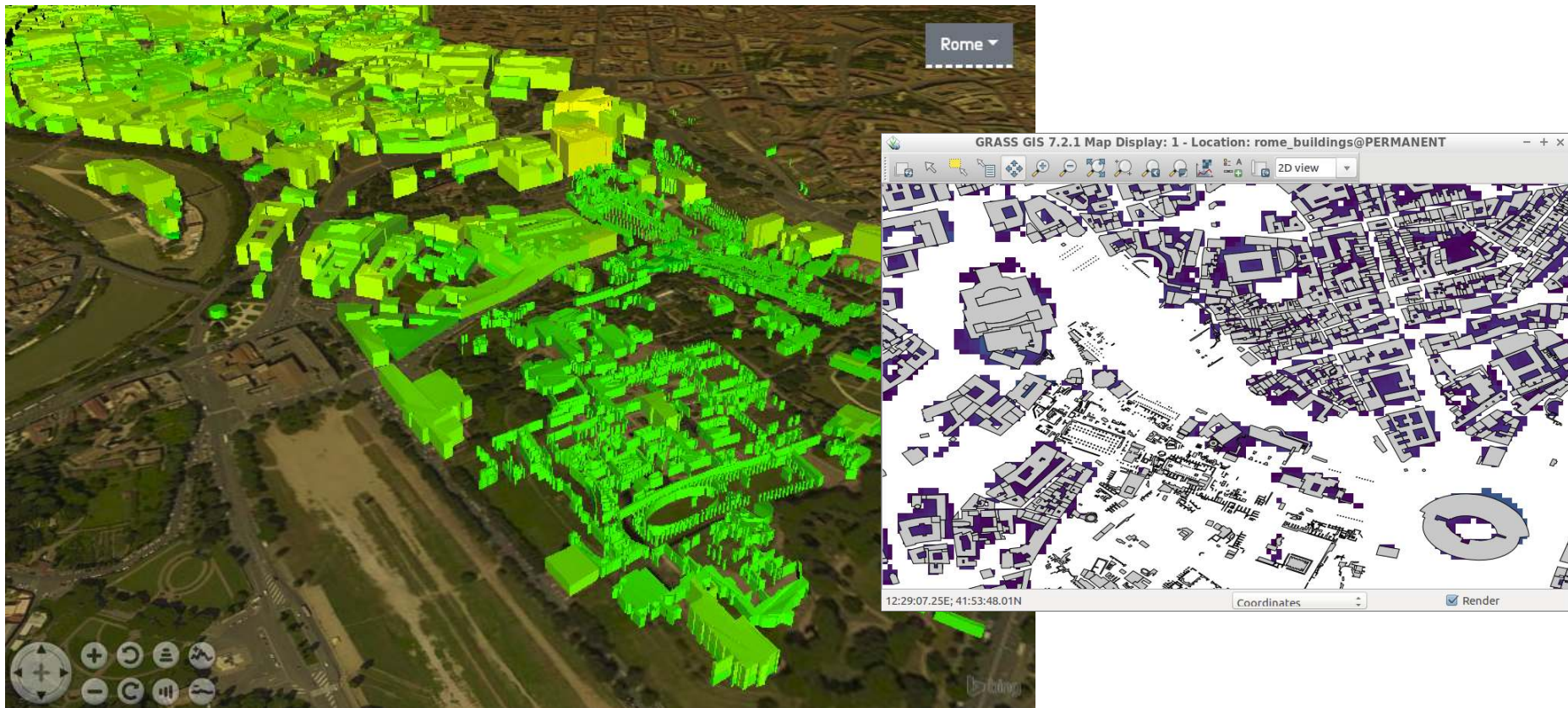
# Extracting OpenStreetMap (OSM) building heights using GRASS GIS and Lidar

- ✓ Create a Vector Virtual Format (VRT) of the first (DSM) and last (DTM) returns of the lidar data using GDAL (Geospatial Data Abstraction Library). (**gdalbuildvrt**)
- ✓ Subtract DTM from DSM. (**r.mapcalc**)
- ✓ Generate a new layer in GeoJSON format with an additional attribute to the GeoJSON layer of the OSM data for the region of interest, denoting the median of the points inside the polygon of each building (**v.rast.stats**: calculates statistics from a raster map based on a vector map and uploads statistics to new attribute columns).



# Research aspects

- ✓ A similar procedure has been followed for Rome. Rome building heights are obtained using the [Urban Atlas - Building Height 2012](#) data of the Copernicus programme and OSM GeoJSON in GRASS GIS.



# So?

- ✓ Fetches a subset of the data for a specific region and visualizes it instantly, which enables:
  - ✓ overlay of different data in OSM with preferred colors,
  - ✓ comparing OSM data visually with satellite imagery detecting where OSM data is missing (applies to entities visible in satellite imagery).
- ✓ Heatmaps enable visual analysis.

## Future directions

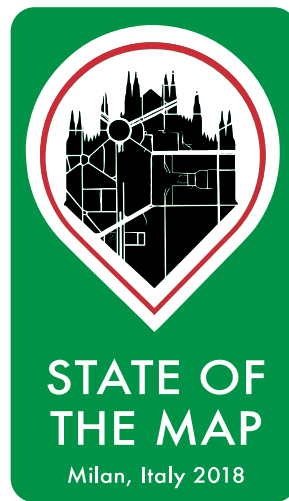
- ✓ Use the “min\_height” and “building:min\_level” tags, roof tags, surface color and material tags to improve visualization (move forward from LoD1).
- ✓ Develop vector tiling fully.
- ✓ Fetch and display data based on visible area (frustum culling).



# References

- ✓ Li, S., Dragicevic, S., Castro, F.A., Sester, M., Winter, S., Çöltekin, A., Pettit, C., Jiang, B., Haworth, J., Stein, A., Cheng T., 2016. Geospatial big data handling theory and methods: A review and research challenges. ISPRS Journal of Photogrammetry and Remote Sensing, 115, pp. 119-133. <https://doi.org/10.1016/j.isprsjprs.2015.10.012>





# Thank you!

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