



# GEO-XIII Plenary

7-10 November 2016, St. Petersburg  
Russian Federation

Side Event: Citizen GEOSS



**A web-based interactive 2D and 3D GIS application to find the best place to live in a city, using open data and open source software**

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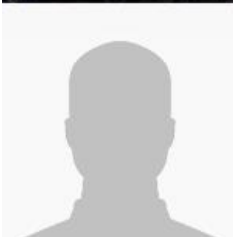
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PhD student in Environmental and Infrastructure Engineering



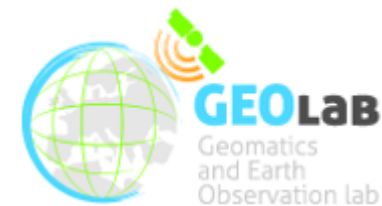
**Eng. Gabriele Prestifilippo**

MSc degree in Computer Science and Engineering



**Simone Corti**

Computer technician, linux system administrator and web developer



**WebGIS,  
Volunteered Geographic  
Information (VGI)  
and Geo Big Data.**

## What is City Focus?

- Is a **web-based interactive 2D and 3D GIS application** to find the best place in a city to live, or to pass shorter staying
- The user can select among different criteria and **decide their importance by assigning weights** to each of them
- The application provides thematic maps on the **places which better fit the user's preferences**

## How is City Focus different from other apps?

- Most of the existing apps:

<http://teleport.org>   <http://www.findyourspot.com>   <http://where2roost.com>

focus on finding a **city to live** and not on identifying a suitable place within a city.

- The existing apps also allow searching for places to live by specifying few parameters such as apartment or house prices.
- City focus help to perform this task in an automatic as well as user-friendly way avoiding long and hand-made search on the Web.
- City Focus takes into account environmental conditions, that existing apps do not consider.
- The app **exploits exclusively open data as well as Free and Open Source Software (FOSS)** for its implementation by enabling continuous improvements while minimizing development costs.

## MYGEOSS: Innovative Apps in the environmental and social domains

- City Focus is a Winner of the **MYGEOSS third call for innovative Apps**, launched by the European Commission
- The aim: **Development of innovative applications** (mobile or web-based) using **openly available** or crowd-generated data in different domains **addressing citizens' needs**
- MYGEOSS is a two-year project (2014-16) by the European Commission to develop Global Earth Observation System of Systems **based smart Internet applications**



<http://digitalearthlab.jrc.ec.europa.eu/mygeoss/results3.cfm>

# City Focus Data

## Case Study: Milan, Italy

Repository	License	Link
Open Data Lombardia	Italian Open Data License v.2.0 (IODL 2.0) ( <a href="http://www.dati.gov.it/iodl/2.0">http://www.dati.gov.it/iodl/2.0</a> )	<a href="https://www.dati.lombardia.it">https://www.dati.lombardia.it</a>
Dati Comune Milano	Italian Open Data License v.2.0 (IODL 2.0) ( <a href="http://www.dati.gov.it/iodl/2.0">http://www.dati.gov.it/iodl/2.0</a> )	<a href="http://dati.comune.milano.it">http://dati.comune.milano.it</a>
OpenStreetMap	Open Data Commons Open Database License (ODbL) ( <a href="http://opendatacommons.org/licenses/odbl">http://opendatacommons.org/licenses/odbl</a> )	<a href="https://www.openstreetmap.org">https://www.openstreetmap.org</a>
ISTAT	CC-BY 3.0 ( <a href="https://creativecommons.org/licenses/by/3.0/it">https://creativecommons.org/licenses/by/3.0/it</a> )	<a href="http://www.istat.it">http://www.istat.it</a>
GEOSS data core	/	<a href="https://www.earthobservations.org/geoss_dsp.shtml">https://www.earthobservations.org/geoss_dsp.shtml</a>





## City Focus Data

### Environmental conditions

- 📌 Air Quality
- 📌 Low Temperature
- 📌 Medium Temperature
- 📌 High Temperature

### Near to Transportation

- 📌 Train and Metro Stations
- 📌 Bus Stops

### Population Density

- 📌 Low Population Density
- 📌 Medium Population Density
- 📌 High Population Density

## City Focus Data

### Near to Services

- 📍 ATMs
- 📍 Banks
- 📍 Coffee Shops
- 📍 Hospitals
- 📍 Pharmacies
- 📍 Police Stations
- 📍 Post Offices
- 📍 Supermarkets
- 📍 Veterinary Clinics

### Near to Nature

- 📍 Parks
- 📍 Dog Parks
- 📍 Green Areas
- 📍 Natural Water

### Landuse Type

- 📍 Industrial or commercial units
- 📍 Continuous urban fabric
- 📍 Discontinuous urban fabric

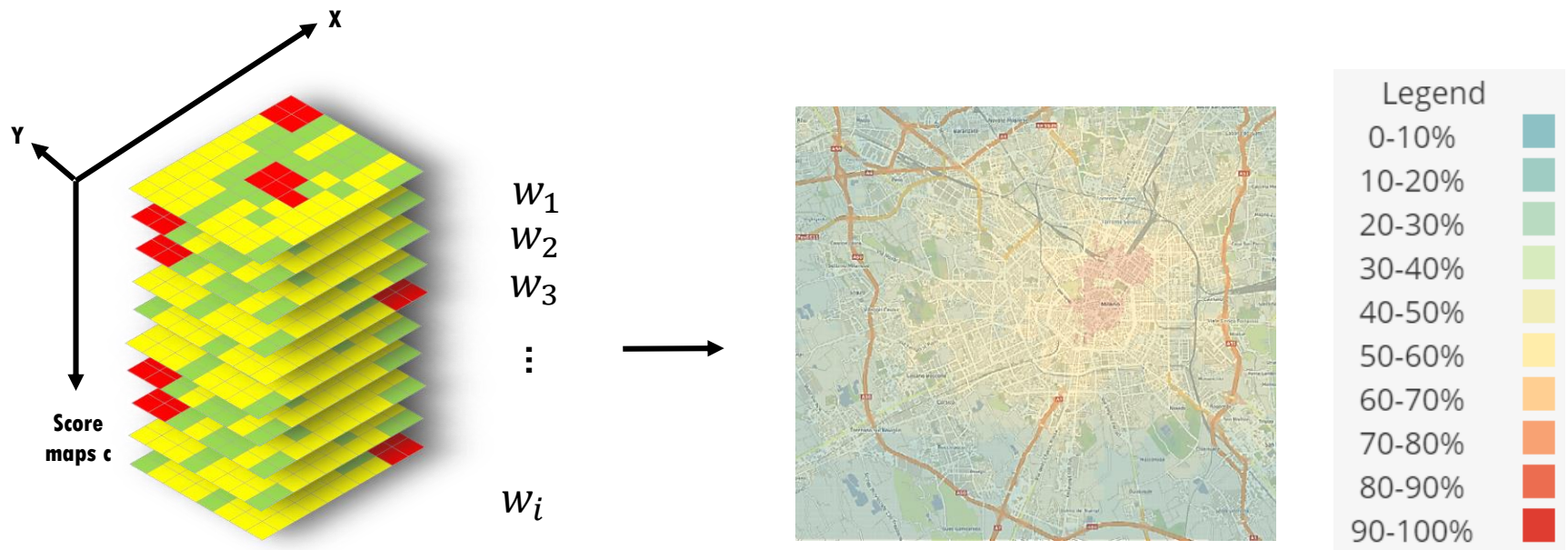
### Near to Education

- 📍 Universities
- 📍 High Schools
- 📍 Primary Schools
- 📍 Secondary Schools
- 📍 Kindergartens



## Application principle

The output consists of a **raster computed as a weighted average** of the score maps representing the user's selected criteria. The final map is then displayed with an intuitive color gradient, enabling the user to identify the best places within the city which better fits his/her preferences.



\*200 m resolution

Final Map

$$r = \frac{\sum_{i=1}^n w_i c_i}{\sum_{i=1}^n w_i} \quad \{r \in \mathbb{R} \mid 0 \leq r \leq 1\}$$

# Data Processing



**GRASS GIS**  
The world's leading Free GIS software.

## A. Data cleaning



# Data Processing

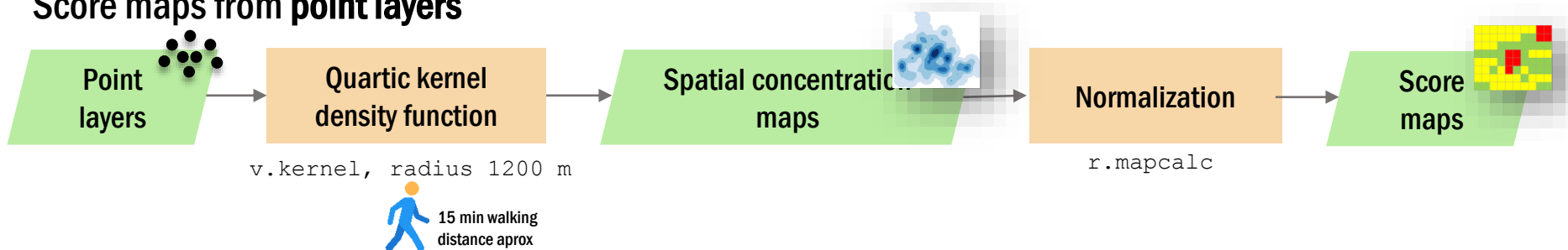


GRASS GIS  
The world's leading Free GIS software



## B. Score maps creation

### Score maps from point layers



Services (hospitals, banks, post offices, etc.)

Education (universities, kindergartens, primary schools, etc.)

Transportation (train and metro stations, bus stops) information.

# Data Processing



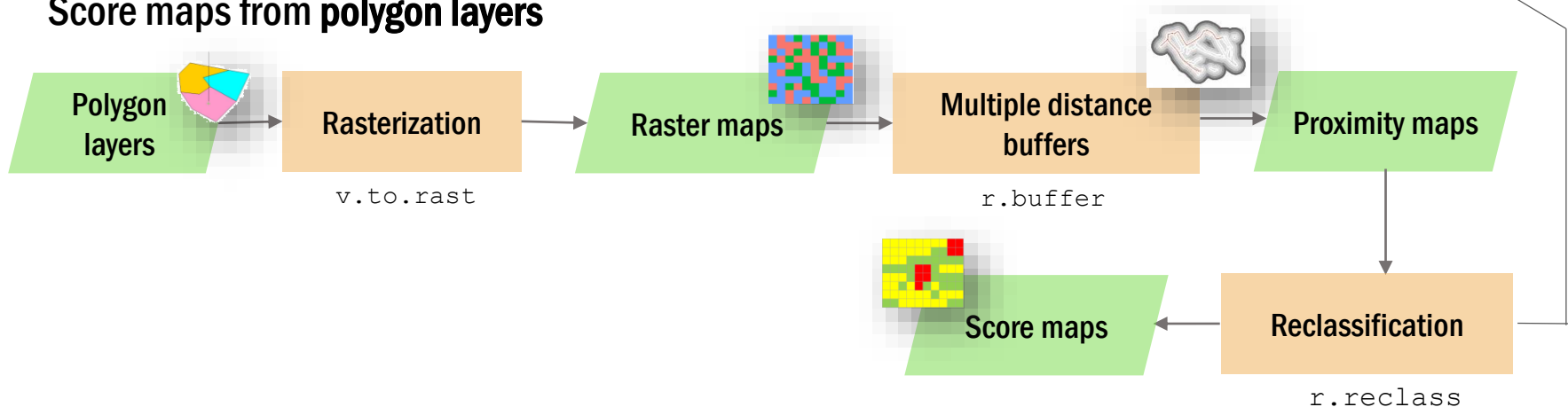
GRASS GIS  
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Natural data such as parks, green areas, natural waters, etc.

Distance d [m] classes	Score
d = 0	1
$0 < d \leq 400$	0.75
$400 < d \leq 800$	0.50
$800 < d \leq 1200$	0.25
d > 1200	0

## Score maps from polygon layers



# Data Processing

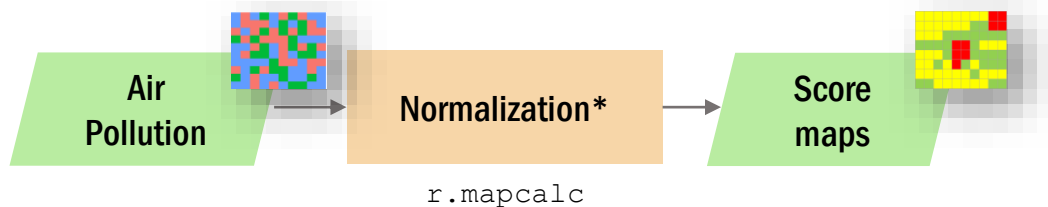


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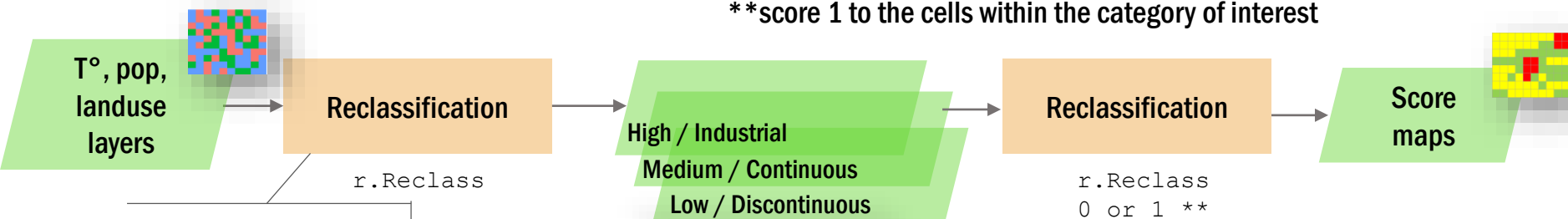


## Score maps from raster layers

\* High scores on less polluted areas



\*\* score 1 to the cells within the category of interest



Classes	Category
$\text{MIN} \leq x < \frac{1}{3} * \text{MAX}$	low
$\frac{1}{3} * \text{MAX} \leq x < \frac{2}{3} * \text{MAX}$	medium
$\frac{2}{3} * \text{MAX} \leq x \leq \text{MAX}$	high

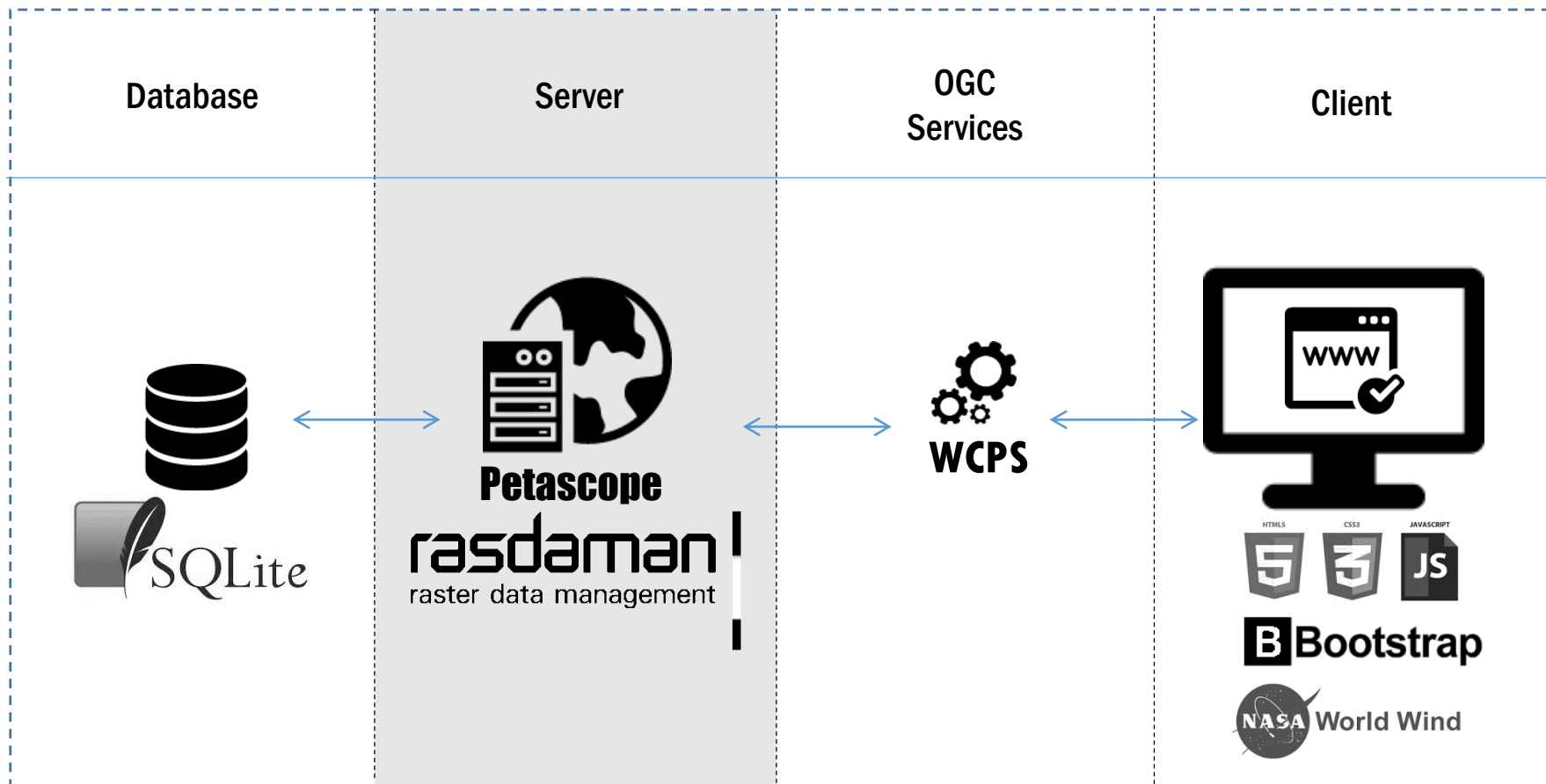
Temperature (high, medium, low)

Population density (high, medium, low)

Land use (Industrial or commercial units, Continuous urban fabric, Discontinuous urban fabric)

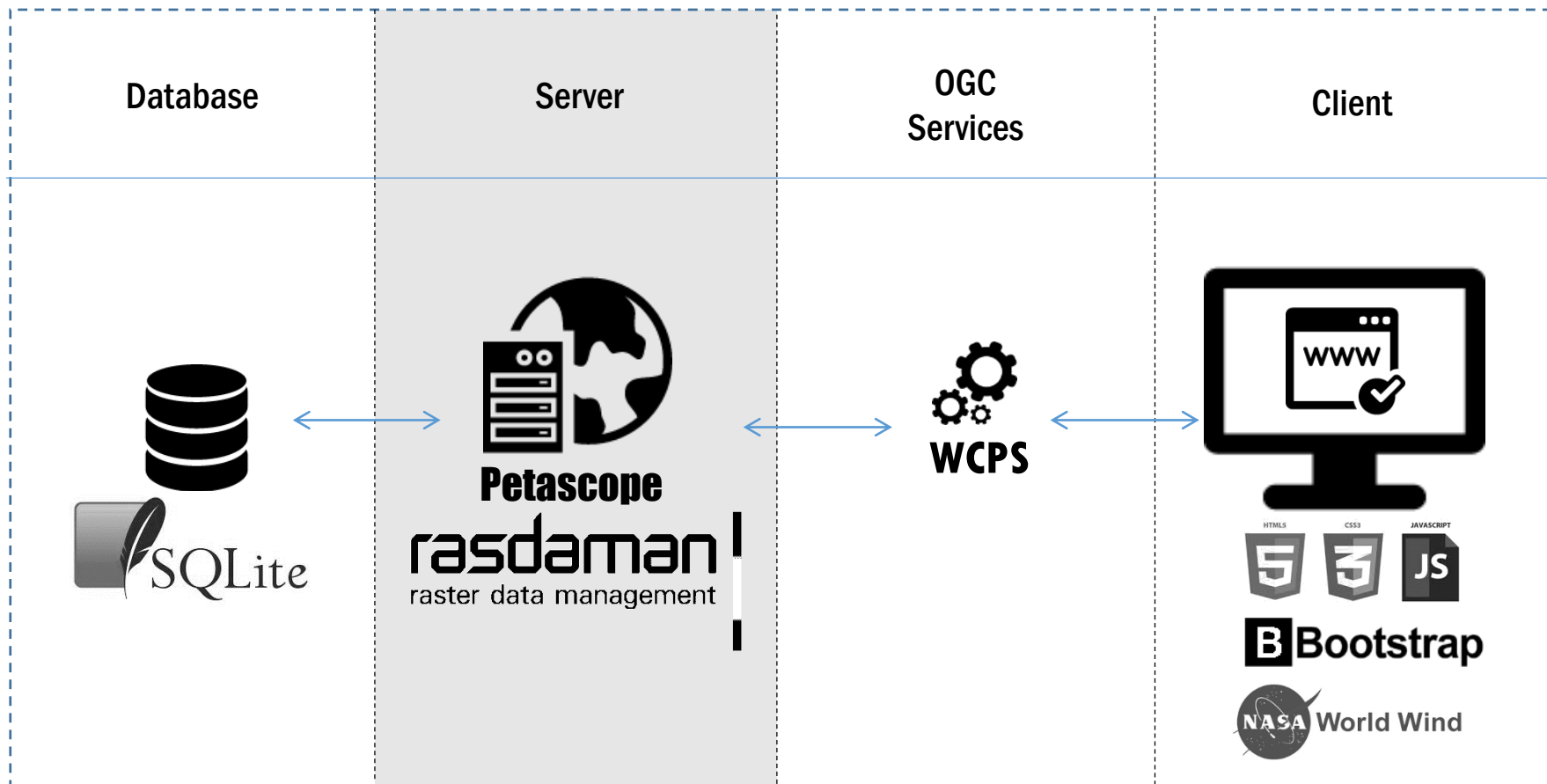
Air pollution (PM2,5)

## Application architecture



City Focus relies on a standard installation of **RASDAMAN** with a SQLite database backend

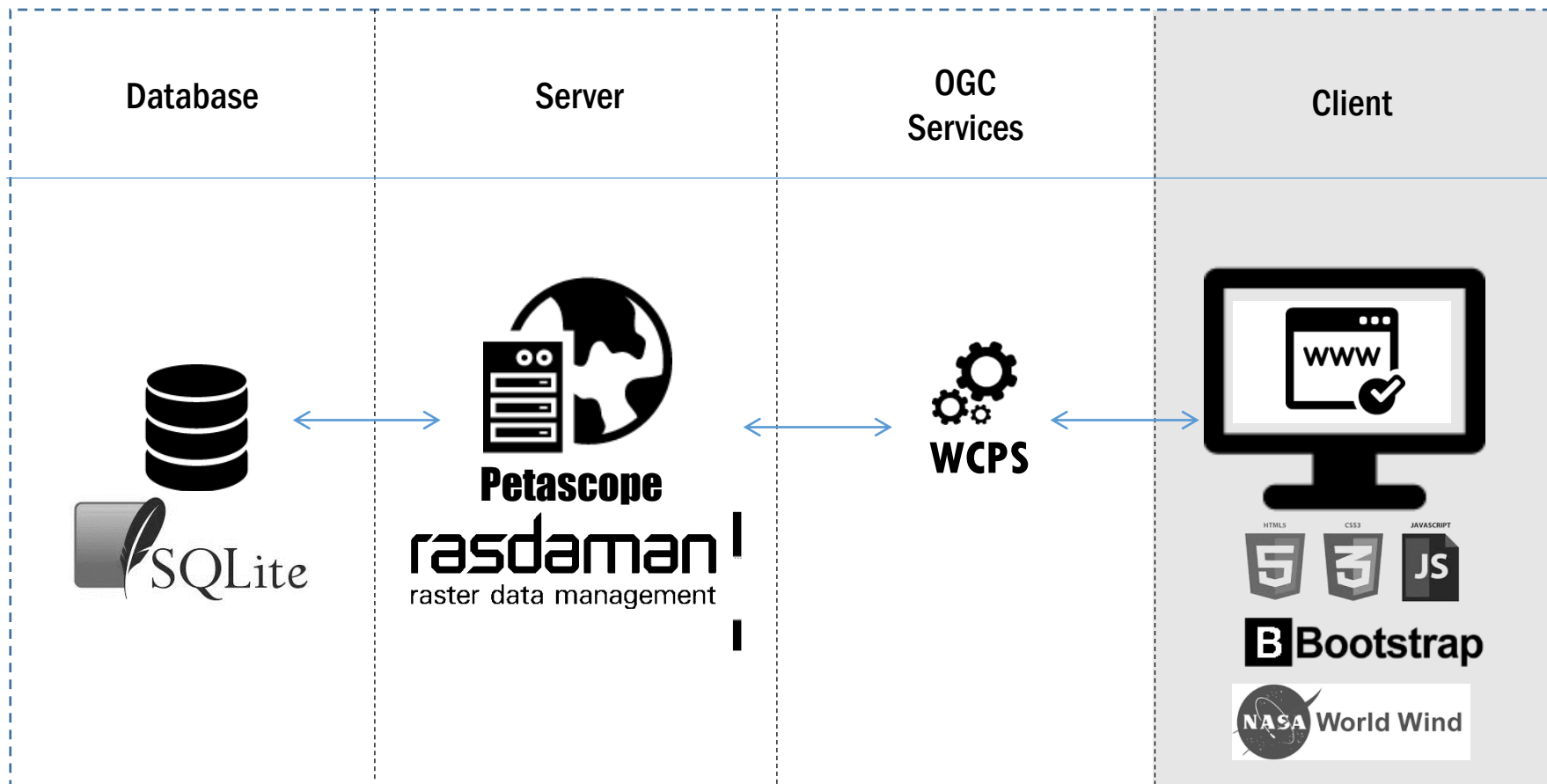
## Application architecture



Data are accessed over the web by the **Petascope** component of RASDAMAN, translating the incoming **WCPS** request into RASDAMAN rasql language queries and generating the output map



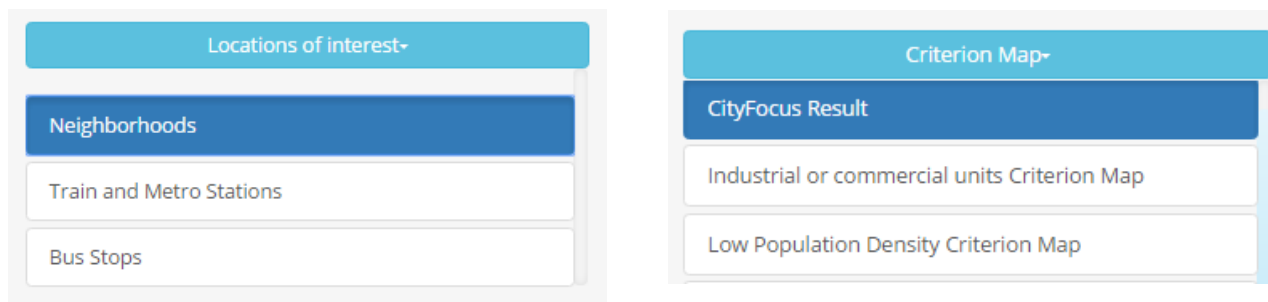
## Application architecture



Combining **jQuery** and **Web WorldWind**, it is possible to retrieve maps from RASDAMAN through the WPCS and show them to the end-user.

## Application architecture

- Criteria vector layers “locations of interest” are added into the application as geojson



- The **final map**, as well as the **criteria raster layers** “criterion map” are «painted» by coloring a **grid** (vector version of the score maps) using the values of the retrieved **csv files** from the WCPS requests
- The POST WCPS request is of the form:

```
for a in (atms), b in (banks), c in (cafe), d in (hospitals) ... z in (discontinuous)
    return encode ( ( (a*50 + b*50 + c*80 + d*70 ... z*80)/180.4), "csv" )
```

Hi there!

Rate the topic below between 0 to 100 points, to find the best place for you to live in!

Criteria for the city of Milan, Italy:

[Near to Services](#)
[Near to Nature](#)
[Near to Education](#)
[Near to Transportation](#)
[Environmental conditions](#)
[Landuse Type](#)
[Population Density](#)
[Find Your Place!](#)
[Locations of interest](#)


Legend

- 0-10%
- 10-20%
- 20-30%
- 30-40%
- 40-50%
- 50-60%
- 60-70%
- 70-80%
- 80-90%
- 90-100%

## Conclusions

### ♫ Possible improvements:

- ♫ Possibility for users to get a **glimpse of the changing environment** within a city through trend maps or graphs (e.g. temperature changes in the last five years, etc.)
- ♫ Add the **name of best scored city blocks** from the final map (i.e. the cells with the highest scores) by means of geocoding.
- ♫ Take more advantage of the **3D functionalities** (e.g. elevate cells according to cells values)
- ♫ Add **user-administration functionalities** to gather information about user preferences: useful for urban management and marketing analytics purposes
- ♫ Add information about house sale/rent prices as well as **customize criteria for different potential customers** (e.g. accommodation booking website, etc.)
- ♫ As a first case study, we considered the city of Milan. In the future, other Italian as well as European cities are planned to be included.

**Check the application on:**

<http://muvias.eoapps.eu/cityfocus/application.html>

**And the documentation /source code:**



**GitHub**

<https://github.com/GabrielePrestifilippo/CityFocus>

**Thank you for your attention!**

*This application has been developed within the MYGEOSS project, which has received funding from the European Union's Horizon 2020 research and innovation programme. The JRC, or as the case may be the European Commission, shall not be held liable for any direct or indirect, incidental, consequential or other damages, including but not limited to the loss of data, loss of profits, or any other financial loss arising from the use of this application, or inability to use it, even if the JRC is notified of the possibility of such damages.*