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Introducing GreenEx_Py

A python package for modelling multidimensional greenspace exposure

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Background & Aim

Studies suggest that **exposure to greenspace** provides a range of social benefits as it **improves physical health and mental well-being** by reducing health risk factors and alleviating anxiety, stress and depression [1-4]. To assess greenspace exposure, researchers use three perspectives; **availability, accessibility and visibility** [4,5]. However, current methods present challenges related to the **transparency, reproducibility and replicability** of research due to the usage of **diverse software tools** [4,6,7]. Consequently, the aim of this study was to introduce an **open-source python tool** for analysing multidimensional greenspace exposure while adhering to **FAIR4RS principles**, emphasizing the need for Findable, Accessible, Interoperable and Reusable software [8].

Software architecture

The 'GreenEx_Py' package architecture comprises five general workflow components shown in Fig. 1.

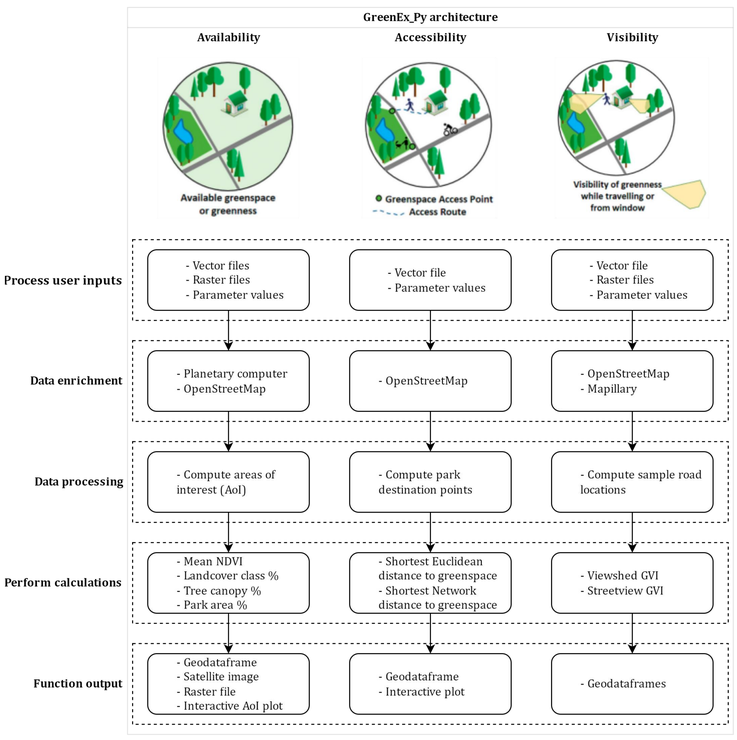

Fig. 1. GreenEx_Py package architecture

Software functionalities

The package comprises functions to retrieve the;

- **average** Normalised Vegetation Difference Index (**NDVI**) within an area of interest (Fig. 2a)
- **proportions of landcover classes** within an area of interest (Fig. 2b)
- **percentage** of **greenspace coverage** within an area of interest (Fig. 2c)
- **percentage** of **tree canopy coverage** within an area of interest (Fig. 2d)
- **presence** of **greenspace** within **threshold distance** (Fig. 3)
- **average Greenness Visibility Index (GVI)** based on **streetview images** (Fig. 4a)
- **average GVI** based on a **viewshed analysis** (Fig. 4b)

Availability

Fig. 2a. Average NDVI for locations in Amsterdam

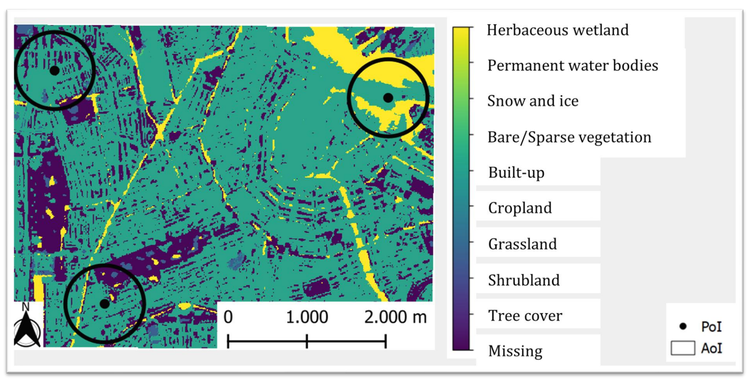

Fig. 2b. Landcover classes for locations in Amsterdam

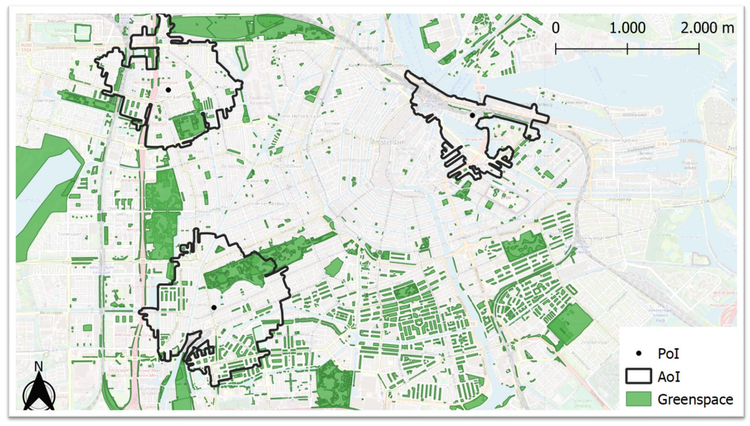

Fig. 2c. Greenspace coverage for locations in Amsterdam

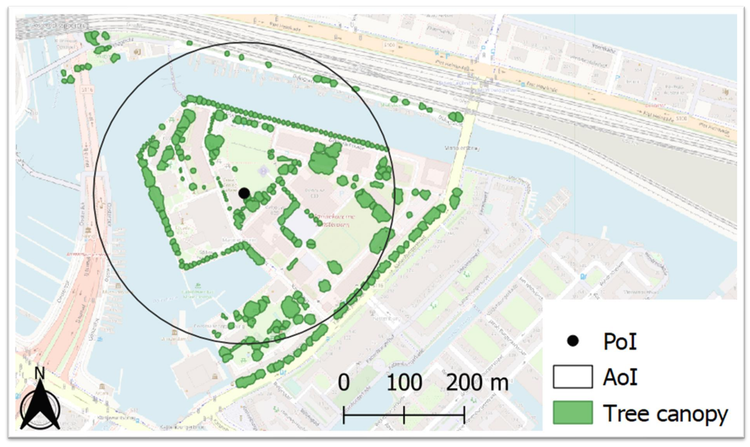

Fig. 2d. Tree canopy coverage for location in Amsterdam

Accessibility

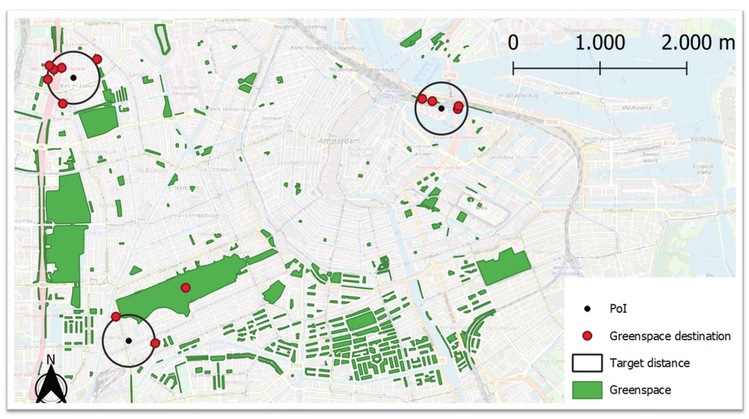

Fig. 3a. Assessing greenspaces within threshold distance

Fig. 3b. Euclidean vs. network distance

Visibility

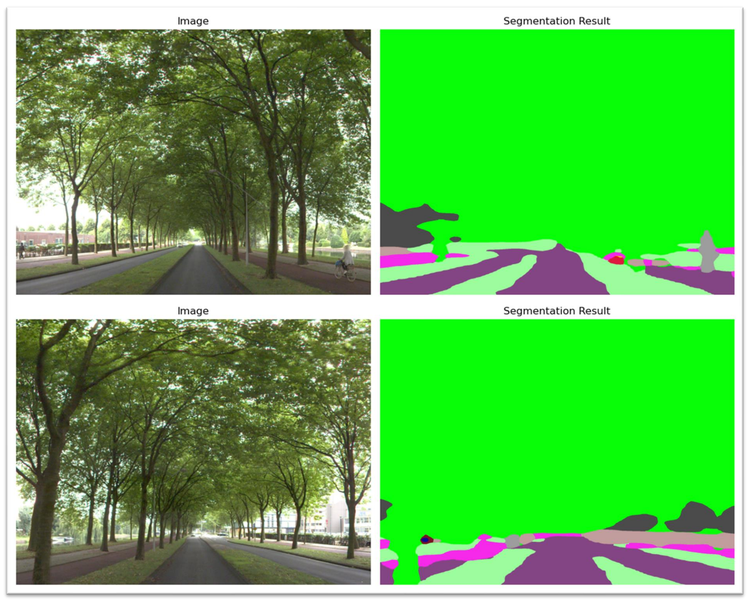

Fig. 4a. Segmentation of panoramic streetview image

Fig. 4b. Viewshed GVI for locations in Amsterdam

Conclusion

GreenEx_Py is an **open-source python package** that allows researchers to model greenspace from three perspectives; availability, accessibility and visibility. The package **aligns with FAIR4RS principles** by effectively addressing barriers related to transparent, reproducible and replicable research. It specifically shows **strengths** in its usage of **open-access data** and ability to model **eye-level greenness visibility**. We strongly believe that this package establishes a robust foundation for advancing research in geospatial analysis and presents opportunities for further development.

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