Analyzing social media photo posts distribution as a potential indicator for UGBI user preferences: the case of Coimbra, Portugal

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1. Introduction

Indicators regarding the relevance and efficiency of UGBI are abundant, but they have been mainly focused on environmental related aspects, while the socio-cultural aspects of UGBI are still under represented. A major and growing portion of recreation is indeed "nature-based", involving interactions with the natural environment.

For these types of activities, different characteristics of the environment influence people's decisions about where, when, and how to recreate. But fine-scale data collection regarding these aspects are usually site specific, and time and labour intensive. Wood et al. (2013) showed that the number of users who visit a location annually is related to the number of photographs taken in the same area and uploaded to the flickr database.

Using the InVEST recreation model, this work aims to (1) test social media photo posts on Flickr as an indicator for the use of UGBI, and to (2) analyse its potential correlation with a set of cultural and recreational equipment in and around UGBI units.

Two different periods are analysed, with the intention to identify and evaluate the differences introduced with the implementation of a major city park near the river Mondego.

2. Location

Coimbra is a medium size city, hosting one of the oldest universities in the world. It is located in the central region of Portugal, on the eastern limits of the Mondego river flood plains. The river is a fundamental landmark of the city, and several of the city's most relevant UGS are located next to it.

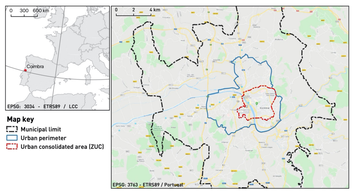


Figure 1 - Coimbra municipality with city and historical area limits

3. Methodology

Step1
The InVEST model was used to perform a correlation analysis with a set of 'predictors' for the Coimbra municipality (figure 1 and table 1), for the years 2007 and 2017. We used the city limit as the area of interest (AOI), which roughly covers 50 sq.km (the municipal area covers 320 sq.km). As we intended to analyse the effect of the green urban areas, we needed some level of detail, so the cell size was defined at 25 m.

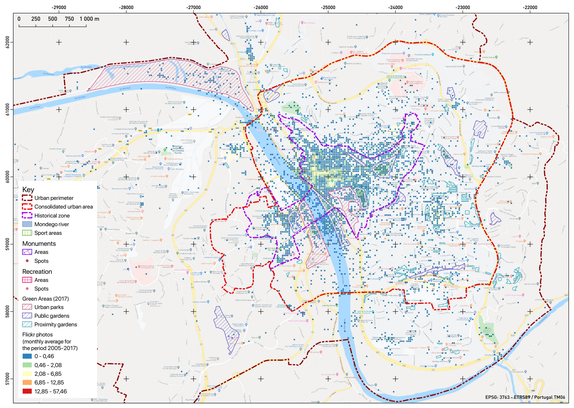
Predictor	Type
Gardens (2007 / 2017)	Polygon percentage coverage
300 m. buffer to gardens	Polygon percentage coverage
600 m. buffer to gardens	Polygon percentage coverage
900 m. buffer to gardens	Polygon percentage coverage
Mondego river	Polygon percentage coverage
300 m. buffer to the Mondego river	Polygon percentage coverage
Bridges	Polygon percentage coverage
Monuments (points)	Point distance
Monuments (polygons)	Polygon percentage coverage
Recreation (points)	Polygon percentage coverage
Recreation (polygons)	Polygon percentage coverage
Urban perimeter	Polygon percentage coverage

Step 2
Based on this visual analysis, a second analysis was done, using the InVEST PUD grid for the period 2005-2017 as the basis, and crossing it with the areas of the different types of green spaces. As we were interested in trying to understand if there are any differences between different green urban areas, we used the classification shown in table 3, adapted from Pereira (2017). For the analysis we focused on the first 3 classes, also including the urban perimeter and the historical area in the analysis (table 4). A Kendall correlation analysis was performed.

Name	Dimension
Urban Park	> 10 ha.
Public Garden	Between 1 and 10 ha.
Proximity Gardens	under 1 ha, with minimum infrastructures / equipment for the use of the inner area (walking paths AND benches).
Framing spaces / leftovers	spaces under 1000m2 OR with higher areas, but fulfilling at least one of the following criteria: linear spaces along roads or streets; with no infrastructures / equipment for the use of the inner area, such as formal paths, stairs or benches; can include short 'go-through' paths only.
Roundabouts	Green / grassy roundabouts, independent of size.

Step 3
The analysis included a study of the relations between the PUD values per class and class area.

Factor
Year average photos
Urban parks
Urban gardens
Proximity gardens
Consolidated urban area
Historical center
Stadium

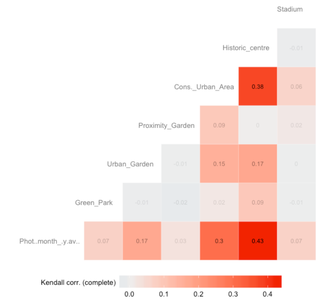


4. Data analysis

The results from step 1 (table 2) show no significant correlation with any of the predictors. This can in part be due to the fact that the analysis is based on the area covered with positive PUD values for each class. As can be seen in figure 2, the share of cells showing PUD values above 0 is relatively small, comparing to the AOI, which severely decreases the efficiency of the analysis.

	2007			2017		
	estimate	stderr	t value	estimate	stderr	t value
(Intercept)	0,002738	0,000823	3,327000	**0,001142**	0,000837	1,365000
Green areas (GA)	0,000163	0,000020	**8,239000**	-0,000024	0,000018	-1,319000
GA buffer (300m)	0,000094	0,000009	**10,090000**	0,000030	0,000009	3,405000
GA buffer (600m)	0,000019	0,000009	2,071000	0,000004	0,000009	0,427200
GA buffer (900m)	-0,000019	0,000009	-2,077000	-0,000066	0,000009	**-7,312000**
Mondego river	0,000091	0,000018	**5,049000**	0,000063	0,000018	3,579000
River buffer (300m)	-0,000002	0,000009	-0,256800	0,000082	0,000009	**9,138000**
Bridges	**0,003623**	0,000183	**19,760000**	**0,002688**	0,000179	**14,990000**
Monuments (spots)	-0,000003	0,000001	-5,171000	-0,000003	0,000001	-5,328000
Monuments (areas)	0,000245	0,000018	**13,300000**	0,000491	0,000018	**27,190000**
Recreation (spots)	0,000001	0,000000	1,235000	0,000001	0,000000	2,120000
Recreation (areas)	0,000725	0,000048	**14,980000**	0,000618	0,000047	**13,040000**
Urban perimeter	0,000900	0,000017	**53,620000**	**0,001229**	0,000016	**75,210000**

The results from step 2 (figure 2) The results do show some (week) correlation between the number of PUD visitors and the green areas, especially at the level of the urban gardens. The correlation with the historical centre is quite clear in the results.



5. Conclusions

Further work should be devoted to the analysis of the InVEST model results. Although the regression analysis didn't show relevant results, the outputted PUD matrix can be used to support the analysis of potential visitation uses of green urban spaces, on a relatively detailed level.

Possible factors influencing the non-relevance of the InVEST Visitation model results include the level of detail of analysis, with a grid size of 25 meters, the focus on small areas, and the focus on a small to medium city.

The results of the final analysis for Coimbra show that Flickr users can effectively be linked to historical areas, as well as urban green areas, especially at the level of the urban gardens.

As for the results from step 3, considering the daily average number of Flickr users (figure 5), which took at least one picture, geotagged it, and uploaded it to the Flickr service, overall, the city registers an average of 96 PUD – or photo visitors - per day. From these, around 92 PUD are registered inside the consolidated urban area, including 58 PUD daily registered in the historical area. Concerning the urban green spaces, these have, on average, around 28 PUD, with more than 50% of them focused on urban gardens.

Now, focusing on geographical distribution inside the different classes (figures 6 and 7), the share of class area which has been 'covered' by Flickr users (figure 6), we can see that, while the share for the city of Coimbra reaches just over 5%, all the other classes show significant higher values. The historical areas show a coverage of more than 46% of its area. When considering the urban green areas, the average amount of area covered by users is just over 20%, although significant differences show up when analysing sub-class values, with urban gardens reaching near 35% of coverage.

As for the daily average of the number of Flickr users per ha (figure 7), we see a similar pattern, with all classes showing a higher value that the city average. The historical area keeps the lead, but urban green spaces show a higher value that the consolidated urban area, due to the share of urban garden users.

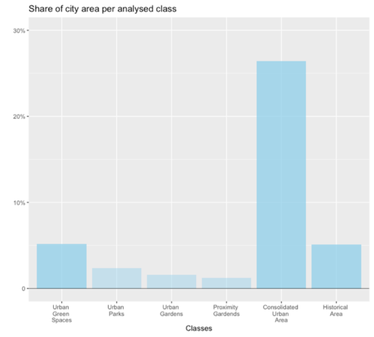


Figure 1 - Share of city area per analysed class

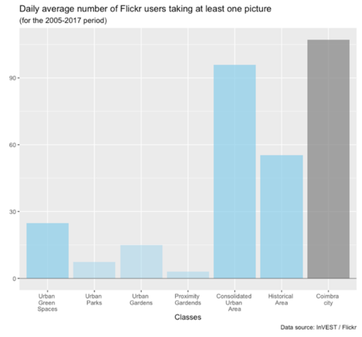


Figure 2 - Daily average number of Flickr users taking at least one picture, per class, for the 2005-2017 period

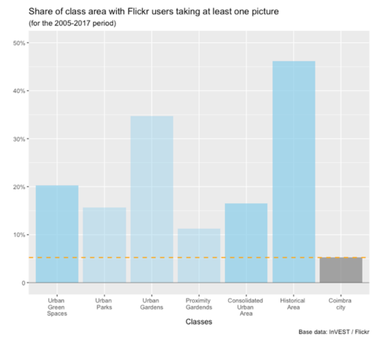


Figure 3 - Share of class area with Flickr users taking at least one picture

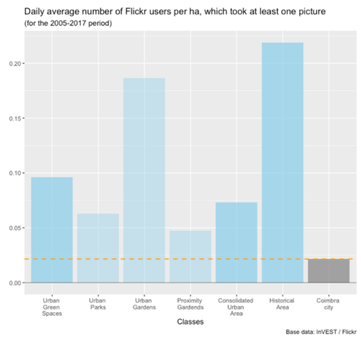


Figure 4 - Daily average number of Flickr users per ha. which took at least one geotagged picture

6. Acknowledgements

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