The spatial distribution of photo locations
of locals and tourists in Lund

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1. Description of the dataset

The study examined the spatial distribution of photo locations of locals and tourists in Lund using Flickr data.

Locals are users who have their origin inside the large bounding box
Tourists are users who have their origin outside the large bounding box

Large bounding box coordinates:
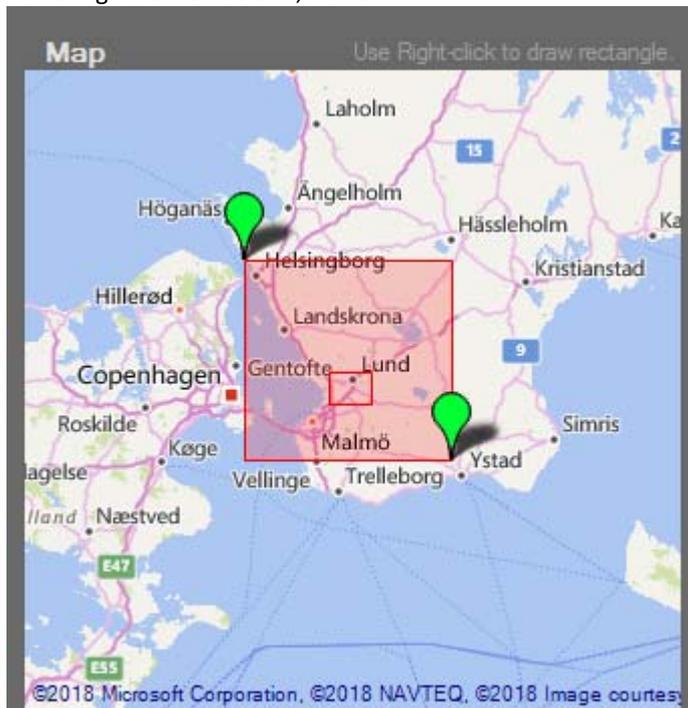Upper left corner: 56.1°N, 12.65°E
Lower right corner: 55.5°N, 13.75°E

Figure 1: Large bounding box to separate locals and tourists, small bounding box to extract photo locations for Lund.

The photo locations of the area of Lund were extracted using a bounding box with the following coordinates:

Upper left corner: 55.752°N, 13.090°E
Lower right corner: 55.660°N, 13.310°E

The dataset has been cleaned afterwards by merging multiple user's photo locations with the same coordinate into one location.

	Original Dataset:	Cleaned Dataset
Locals:		
Number of different users	151	151
Number of different photo locations	3168	3168
Number of different photos	7728	3261
Tourists:		
Number of different users	339	339
Number of different photo locations	2098	2098
Number of different photos	7184	2144

2. Method to calculate the density of photo locations

To estimate the number of photo occurrences per unit area, we performed a kernel density analysis using the photo locations. Kernel density is a way of estimating the intensity of points by creating a smooth surface using a bivariate probability density function.

Kernel density estimation:
Kernel bandwidth   300 m
Cell size   10 m

The following figures show the density of the photo locations for locals and tourists. As shown in the Figures 2 and 3, both locals and tourist tend to cluster in the city center. But there are also some places that are mainly photographed by locals such as Western parts of the city or that are mainly photographed by tourists, e.g. the Southeastern part of the city.
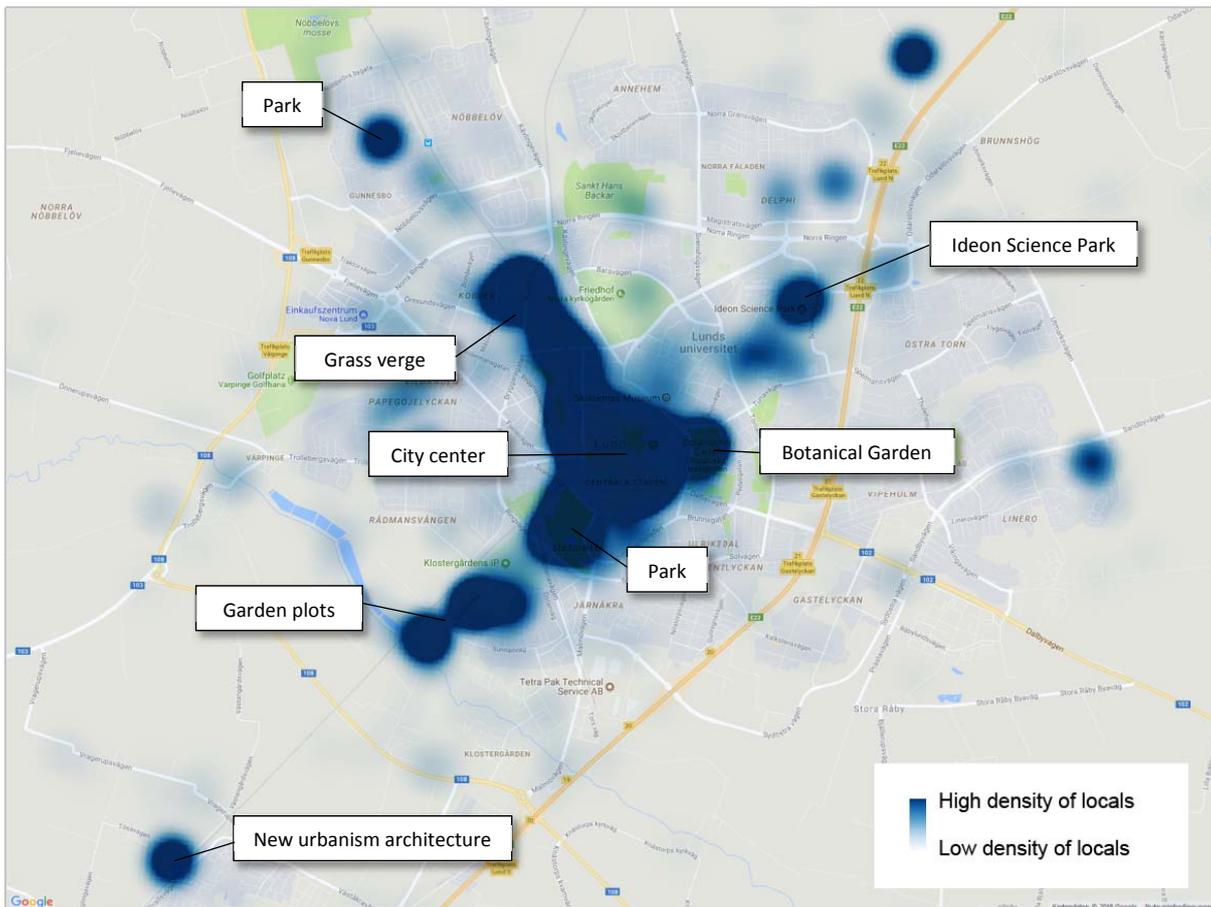

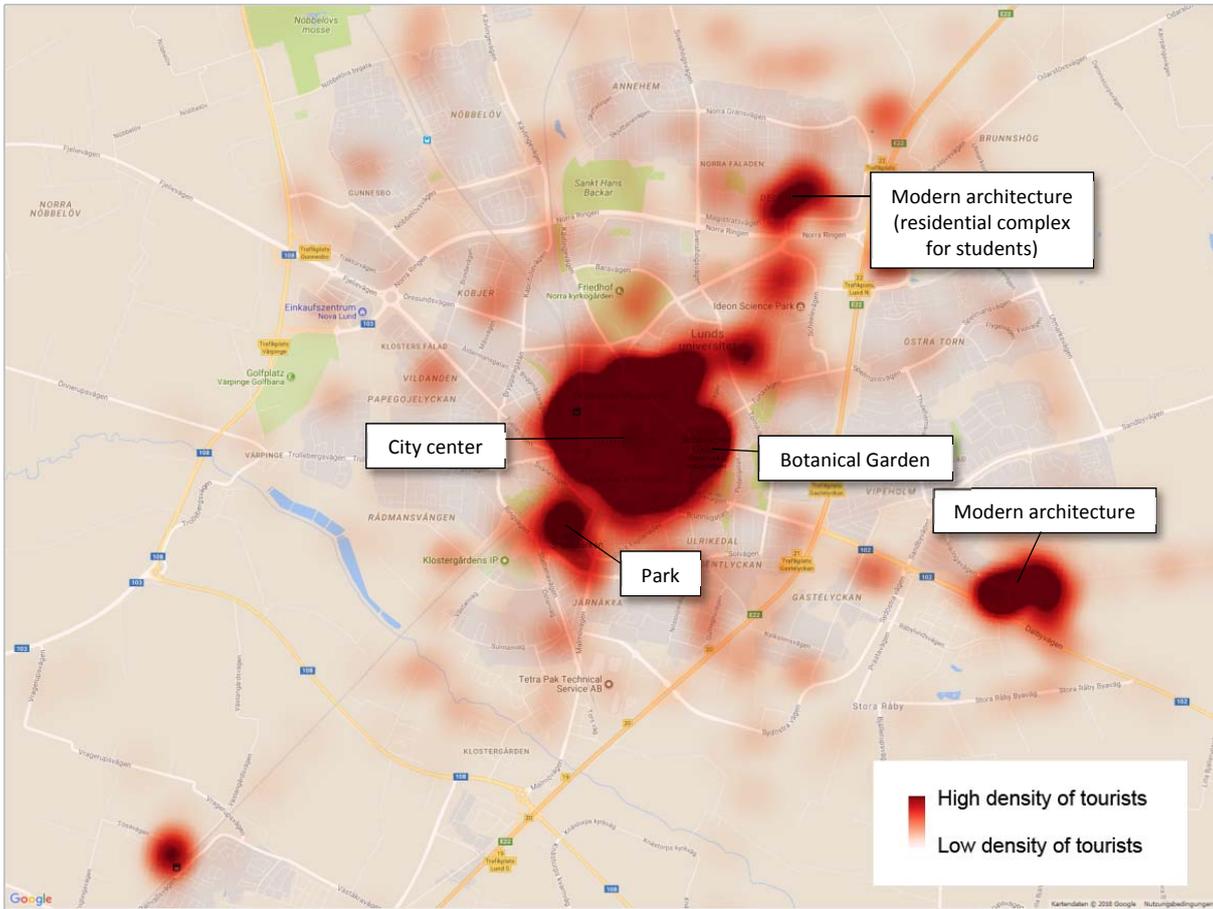**Figure 2:** Density of photo locations of locals.

Figure 3: Density of photo locations of tourists.

3. Method to calculate the relative difference between photo density of locals and tourists

Next, we calculated the normalized density difference as follows:

$$D_d = D_L / \max(D_L) \ - \ D_T / \max(D_T)$$

where D_d measures the relative difference between photo density of locals and tourists, D_L and D_T are photo density of locals and tourists at a location, respectively, and $\max(D_L)$ and $\max(D_T)$ are the maximum photo density of locals and tourists within the study area. To account for the total amount of difference between the two user types, we normalized the density value by the maximum density for each user type, so the range of density for both sources is between 0 and 1. This allows us to compare density at each location as opposed to other locations. As shown in Figure 4, some locations stand out in the map of density difference as places with high photo density of locals, such the Southern and Western part of the city center. On the other hand, the Northern part of the city center have significantly higher normalized photo density of tourists.
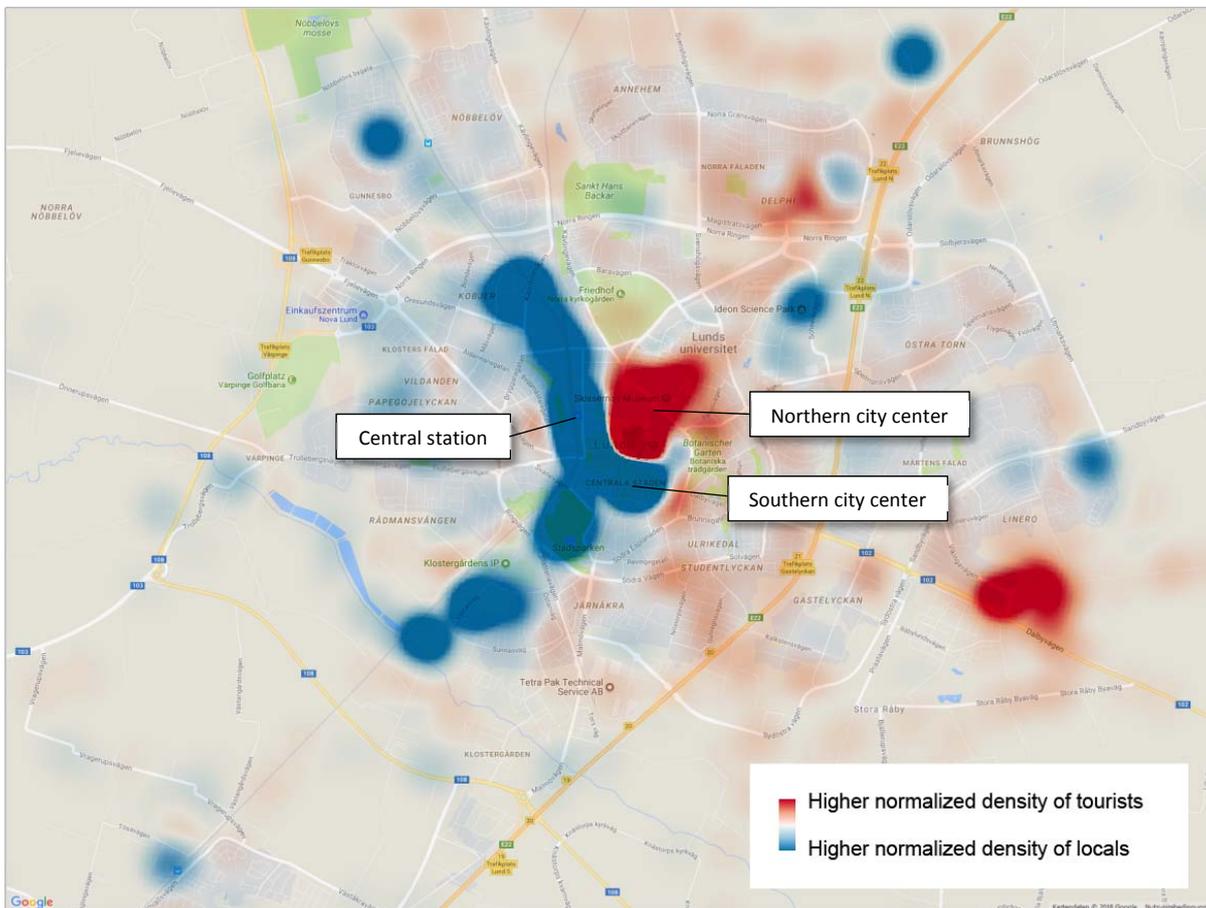
Figure 4: Normalized density difference between photo locations of locals and tourists.

4. References

[1] G. Chareyron, J. Da-Rugna and B. Branchet. Mining tourist routes using flickr traces. In *Proceedings of the 2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining*, pages 1488 – 1489, IEEE, 2013.

[2] D. Crandall, L. Backstrom, D. Huttenlocher and J. Kleinberg. Mapping the World's Photos. In *Proceedings of the 18th international conference on World Wide Web*, pages 761-770, ACM, New York, 2009.

[3] J.C. García-Palomares, J. Gutiérrez and C. Mínguez. Identification of tourist hot spots based on social networks: A comparative analysis of European metropolises using photo-sharing services and GIS. In *Applied Geography*, 63: 408-417, 2015.

[4] F. Girardin, F.D. Fiore, J. Blat and C. Ratti. Understanding of tourist dynamics from explicitly disclosed location information. In *International Symposium on LBS & TeleCartography*, 2007.

[5] E. Hauthal, E., D. Burghardt. Using VGI for analyzing activities and emotions of locals and tourists. *Paper presented at the Link-VGI workshop in connection with the AGILE 2016, Helsinki*, 2016

[6] B.J. Hecht and D. Gergle. On the "localness" of user-generated content. In *Proceedings of CSCW '10 Proceedings of the 2010 ACM conference on Computer supported cooperative work*, pages 229-232, ACM, New York, 2010.

[7] S. Kisilevich, M. Krstajic, D. Keim, N. Andrienko and G. Andrienko. Event-based analysis of people's activities and behavior using Flickr and Panoramio geotagged photo collections. In *Proceedings of the 14th International Conference Information Visualisation*, pages 289-296, IEEE, 2010.

[8] Y. Pang, Q. Hao, Y. Yuan, T. Hu, R. Cai and L. Zhang. Summarizing tourist destinations by mining user-generated travelogues and photos. In *Computer Vision and Image Understanding*, 3 (115): 352-363, 2011.

[9] A. Popescu, G. Grefenstette and P.-A. Moëllic. Mining tourist information from user-supplied collections. In *Proceedings of the 18th ACM conference on Information and knowledge management*, 2009.

[10] Y. Sun, H. Fan, M. Helbich and A. Zipf. Analyzing Human Activities Through Volunteered Geographic Information: Using Flickr to Analyze Spatial and Temporal Pattern of Tourist Accommodation. In J.M. Krisp, editor, *Progress in Location-Based Services, Lecture Notes in Geoinformation and Cartography*, pages 57-69 Springer, Heidelberg, 2013.

[11] H.Q. Vu, G. Li, R. Law and B.H. Ye. Exploring the travel behaviors of inbound tourists to Hong Kong using geotagged photos. In *Tourism Management*, 46: 222-232, 2015.