Automatic production of environmental indicators from freely available remote sensing data: from a global to a local scale

Lys Thay

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Motivations

- Demographic studies need to take into account environmental data.
- Need for matching and harmonized **demographic** and **environmental** data.
- Satelitte imagery is an opportunity for the production of standardized indicators at the global scale.

Objectives

- Automatically predict LCZ from Sentinel-2 imagery
- Explore potential links between predicted LCZ and demographic data

Dataset Description

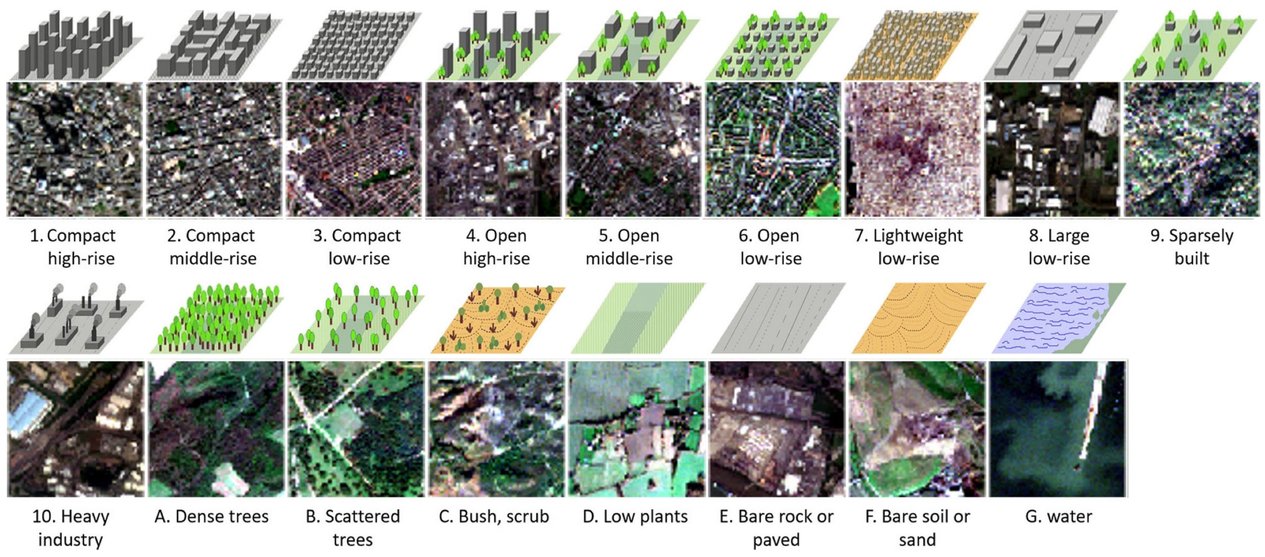
So2Sat dataset:

- 400’673 pairs of Sentinel-2 (multispectral imagery) and Sentinel-1 (Synthetic Aperture Radar) labeled with corresponding LCZ
- In 42 agglomerations and 10 smaller areas.

Census-based gridded population estimates for Burkina Faso (2019)

Local Climate Zones

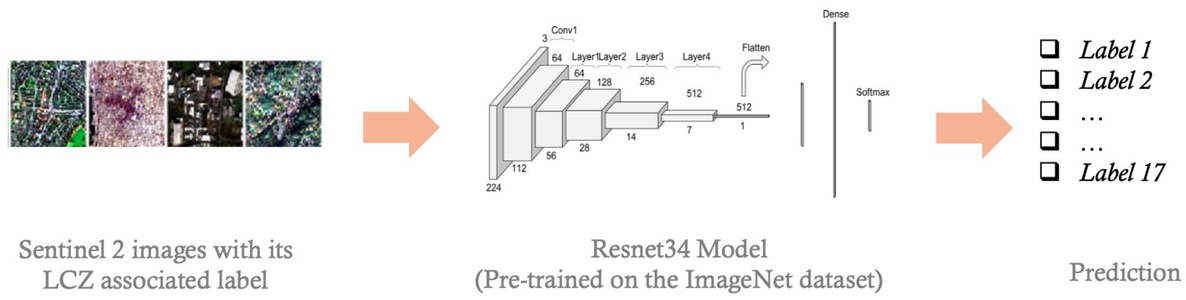
- Local climate zones (LCZ) have been proposed by WUDAPT (World Urban Database and Access Portal Tools) to systematically label urban areas [1]



LCZ classes and corresponding Sentinel-2 imagery [2]

Model

Convolutional Neural Network (CNN)-based model [3]



Sentinel 2 images with its LCZ associated label

Resnet34 Model (Pre-trained on the ImageNet dataset)

Prediction

Results

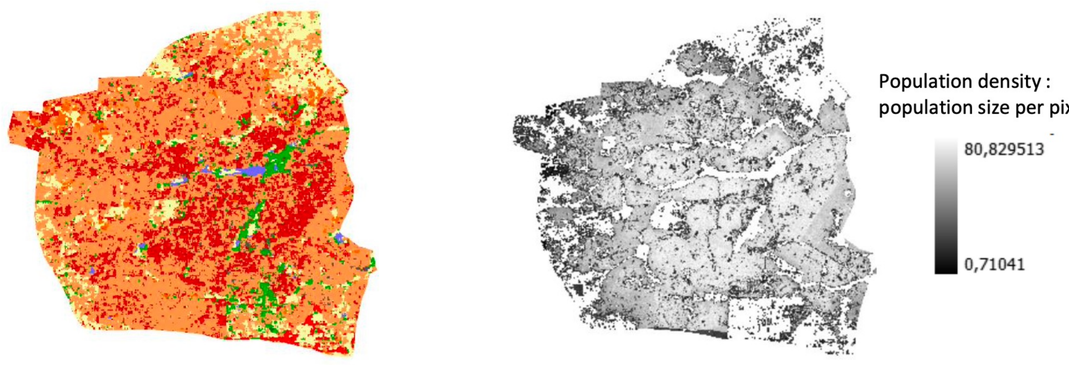
Label 1 Compact high-rise	Label 2 Compact midrise	Label 3 Compact low-rise	Label 4 Open high-rise	Label 5 Open midrise	Label 6 Open low-rise	Label 7 Lightweight low-rise	Label 8 Large low-rise	Label 9 Sparsely built
(230/231) **95 %**	(1447/1546) **93 %**	(1215/1343) **90 %**	(292/306) **95 %**	(366/386) **94 %**	(1217/1456) **83 %**	(522/535) **97 %**	(1889/2009) **94 %**	(1047/1065) **98 %**

Label 10 Heavy industry	Label 11 Dense trees	Label 12 Scattered trees	Label 13 Bush, scrub	Label 14 Low plants	Label 15 Bare rock or paved	Label 16 Bare soil or sand	Label 17 Water
(315/338) **93 %**	(1244/1268) **98 %**	(318/337) **94 %**	(589/618) **95 %**	(895/935) **95 %**	(44/50) **88 %**	(1385/1418) **97 %**	(1342/1349) **99 %**

Overall : *(14357/15200)* **94 %**

Min : 83%
Max : 99%

LCZ prediction performances



Ouagadougou's LCZ classification (left) and map of its population density (right). Lighter grey pixels represent higher density, white is no data.

References

[1] Benjamin Bechtel et. al. Mapping local climate zones for a worldwide database of the form and function of cities. ISPRS International Journal of Geo-Information, 4(1):199–219, 2015.

[2] Zhu, Xiao Xiang, et al. "So2Sat LCZ42: A benchmark dataset for global local climate zones classification." arXiv preprint arXiv:1912.12171 (2019).

[3] He, Kaiming, et al. "Deep residual learning for image recognition." *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2016.

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