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## Using the LCZ framework for change detection and urban growth monitoring

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The world's population reached 7.3 billion in 2015 and it is projected to increase further to 9.7 billion by 2050. Population growth is strongly linked to city expansion, as many people are moving from rural to urban areas. In order to enhance inclusive and sustainable urbanization, we need an efficient workflow for assessing the corresponding SDG (Sustainable Development Goal) targets.

In this study we investigate how the Local Climate Zone (LCZ) classification framework can be used for monitoring sustainable urbanization and assess the availability of adequate and safe housing. The original LCZ classification system consists of 10 urban classes, which can be characterized by urban structure, the type of roads and buildings, the density of the built-up area, etc. The other seven classes in the classification scheme include natural land cover classes that do not contain any buildings (e.g., forest, low vegetation, bare land, water, etc).

As a case study area we have chosen the cities of Johannesburg and Pretoria in South Africa. According to the 2011 Census, the population of Gauteng province (which includes both Johannesburg and Pretoria) increased by 32.55% compared to 2001 Census and reached 12 million in 2011. A large number of people live in slums and informal housing, which makes this area relevant for such an analysis.

Using available satellite images for different years, we classified the case-study areas into the main LCZ classes, including the lightweight lowrise building zone, which corresponds to informal housing. We estimated the land use efficiency as the ratio of the land consumption rate to the population growth rate to illustrate how the LCZ framework can be applied to the assessment of urban growth and to help understand the trajectories of the changes in the urban environment. We show that a low value of this ratio does not necessarily indicate sustainable city expansion, but may instead signal a growing population density in the slum areas.