Mapping the rural-urban transition zone: Peri-urban development in Accra, Ghana

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This classification is based purely on texture-measures computed from co-occurrence matrices. Basis for computations is the second principal component of the image bands (10m resolution) with a kernel size of 8x8 pixels for texture. A maximum likelihood classification has been performed with training areas for 4 classes: Urban, Urbanizing, Non-urban and Water. Urban and Urbanizing have subsequently been combined.

Visual comparison with high resolution images (Google Earth) in fig. 4 indicates that GUF is ‘conservative’ in terms of when to assign a pixel as urban. The sentinel-based classification is more ‘liberal’ and includes substantially more areas that, by visual comparison with the image is from 2017. Comparison was made with high-resolution Google images from 2015.

Fig. 3 shows the GUF classification for Accra superimposed on an earlier texture-based classification of urban growth from 1985-2002 (Møller-Jensen, 2005) with 1944 and 1966 extent added (AUE, 2016). Fig. 5 indicates the total extent of areas designated as urban within the western parts of the city for both GUF, sentinel classification and 1985-2002 classification (same area as fig. 3).

It can be seen that the urban class of the GUF data is comparable to Accra is expanding in a largely uncontrolled manner. Individual builders typically erect houses gradually over several years when funds are available, as mortgage schemes are often not available. Individual housing development urban fringe (or ilo, ilo) area typically takes place before infrastructure and service provision is implemented. Due to the slow building process, many fringes areas constitute rural-urban transition zones with houses in various stages of completion.

The visual landscape of these new urban areas is often dominated for several years by a high percentage of plots with natural vegetation or exposed surfaces between half-finished brick walls. Most of the recent development in peri-urban Accra is characterized by this appearance: wide areas of land dotted with large vikas at various stages of completion (see fig. 1a and 1b).

**Characteristics of the spatial development**

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**Definition of “urban”**

Information about the magnitude and rate of urban growth is clearly important, but even though many countries have strict spatial-statistical methods to identify urban areas, there is no globally agreed definition.

According to the UN, because of national differences in the characteristics that distinguish urban from rural areas, the distinction between the urban and the rural population is not yet amenable to a single definition that would be applicable to all countries. (UN, 2018).

UN further states that where there are no regional recommendations on the matter, countries must establish their own definitions in accordance with their own needs.

Satellite-based methods are seen by UN mainly as an additional tool to assist census-based statistics on population numbers. Images obtained by remote sensing may be of use in the demarcation or boundaries of urban areas when density of habitation is a criterion. For assembling information from more than one source, the importance of a well-developed system of geocoding should not be overlooked.

It is hard to see how density of habitation could not be a criterion for defining urban locations. Moreover, the provision of fully geo-located census data is only in its infancy in many African cities including Accra. Satellite data and air photos will, therefore, be a vital source for delineating urban areas and monitoring urban growth.

**Classification methodology**

Remote sensing-based attempts to delineate urban areas are plentiful and applied on many scales and types of imagery. Recently, the appearance of global datasets on urban areas and locations has put increased focus on how results from different studies may be compared to better understand the ongoing spatial development processes.

Differences in the underlying definition of urban may, however, hamper a direct comparison. A common, formal definition is not in sight for reasons discussed above and also because such a definition would most likely have to rely on information that is difficult to extract from a satellite image, at least on a large scale, such as the precise location of individual completed buildings.

Examples

To illustrate the fact that care should be taken when comparing different remote sensing derived maps of urban expansion, fig. 2 shows the global data set Global Urban Footprint (DLR, 2016) together with a new classification based on a Sentinel-2 10m image covering the western parts of Accra.

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