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

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Introduction

Comparing satellite derived maps of urban growth in Africa can be difficult for reasons related to characteristcs of the spatial development process, the applied definition of urban", and the classification methodology. Peri-urban areas are especially challenging, since there are often no crisp boundaries, but rather a rural-urban continuum with areas characterized by different "degrees of urbanization".

Different classification methods may easily come to different results concerning the categorization and boundary delineation of peri-urban areas, and direct comparison may, therefore, be misleading. This is discussed below with specific reference to the city of Accra, Ghana.

Characteristics of the spatial development

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 sprawl, but a specific typology 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 vixias at various stages of completion (see fig. 1a and 1b).

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.

In the definition of urban, or meaning 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.

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 87x87 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 where to assign a pixel as urban. The sentinel-based classification is more liberal and includes substantially more areas that, by visual comparison with the high-resolution images, seems to be urbanizing. It should be noted that the GUF map is based on images from 2011-12 while the Sentinel 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 the conclusion that the spatial expansion has slowed down, while comparison with the more inclusive sentinel-based classification indicates that Accra is still expanding fast.