Identifying Urban Corridors.

Unified concept and global analysis.

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Introduction

Fast-growing spatial expansion and merging of urban areas on a global scale generate new forms such as *megacities, mega-regions* or *urban corridors* [e.g. UN-Habitat 2009; Florida et al., 2007]. With populations exceeding tens of millions, extents of hundreds of kilometres and the crossing of water bodies as well as international boundaries, these areas pose new challenges to authorities including planning and administration. One of these challenges is the lack of dependable information on their characteristics and development, especially concerning spatial and temporal resolution. Over the last years, remote sensing has provided a significant contribution to data availability. This includes both medium and high resolution imagery such as NOAA's Defense Meteorological Satellite Program's Operational Linescan System (DMSP-OLS) or the German Aerospace Center's Global Urban Footprint (GUF) data which are used in this study.

While megacity research is a well-established field in urban geography, sociology and policy, urban corridors have not received much attention in scientific literature. The concept of these corridors is not new but dates back to the 1960s when Whebell [1969] described the urban development in Southern Ontario, Canada. The term is used in scientific papers around the world and the corridors identified range from local (e.g., Cairns CBD to the suburb of Edmonton [Bohnet & Pert, 2010]) to transnational (such as the BESETO corridor from Beijing to Tokyo via Pyongyang and Seoul [Choe, 1998; see Figure 1], a 2500 km stretch of land with about 100 million people). The general understanding of an urban corridor is that of a number of cities connected by linear (surface) transportation routes [e.g., Priemus & Zonneveld, 2003]. Nevertheless, a widely accepted definition of the term is still missing; thus, urban corridors can still be regarded as a "fuzzy concept". Our study addresses this gap by investigating large urban corridors with extents which often exceed mega-regions, describing them from a spatial point of view.

Figure 1: The BESETO urban corridor

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Data and method

This research aims at providing information on urban corridors on a global scale. Part of this process is the investigation of urban corridors in a literature review and their perception in a survey. In order to map these properly, we use remotely sensed imagery from NOAA's Defense Meteorological Satellite Program's Operational Linescan System (DMSP-OLS) which acquires night-time images in a 30 arc second grid (around 1 km^2 at the equator). Night-time lights have been used for global mapping of human settlements, energy use and economic output [e.g., Imhoff et al, 1997; Doll et al., 2000; Welch, 1980]. Additional street data, drawn from the OpenStreetMap-based *project-osrm.org* route planner, is used to assist in the identification of these urban corridors. This takes into account the importance of transportation links between the main centres of a corridor.

Another data set which will be used in our analysis is the GUF model, derived from TerraSAR-X radar imagery (see Figure 2). The GUF has been developed using the standard acquisition mode on TerraSAR-X (Stripmap mode with a 3m resolution). Using a texture filter and the original intensity information, the final product is a binary mask with a 12m resolution showing vertical man-made structures (such as buildings or traffic signs, but not streets or runways) [Esch et al., 2012]. As an example for applications regarding the spatial process of urbanization, Taubenböck et al. [2012] use the GUF model in combination with Landsat data to monitor 27 megacities in a time-series analysis. In another study, Taubenböck et al. [2014] use these multitemporal classifications to delineate megaregions from the surrounding rural hinterlands. However, the *urban corridor* addressed in our study shows a larger dimension than megaregions – for example, the Boswash area extends around 1000 kilometres. This type of new dimension of contiguous urban landscape has not yet been analysed spatially in this resolution on a global scale.

Figure 2: Global urban corridor example: the Boswash area. DMSP-OLS, left (http://ngdc.noaa.gov/), and GUF, right (e.g. Esch et al., 2015)

While we are aware that interrelations between cities and the urban spaces in between exist on many levels, our focus is on physically measurable parameters only. For other criteria (such as population, economic performance, infrastructure, or commuting patterns), a globally consistent dataset does not exist.

Results

In our systematic literature review, we identified 66 areas which the respective authors referred to as "urban corridor". Their extents and shapes vary greatly – from just over 100 to 4200 km long, and ranging from very compact and round to very elongated. Some even have their own acronym. Examples include

- Boston to Washington ("Boswash"), USA (around 1000 km in length);
- Beijing via Pyongyang and Seoul to Tokyo ("BESETO"), China–Korea–Japan (more than 2500 km); but also the sub-corridor Tokyo to Kobe, Japan (750 km);
- the Venezuela Coastal Corridor (around 1300 km);
- Greater Ibadan–Lagos–Accra ("GILA"), Nigeria–Benin–Togo–Ghana (600 km).

The largest number of corridors identified is in Asia, Europe, and North America, while South America and Africa only contribute three corridors each.

Conclusions and Outlook

Our analysis showed that the term "urban corridors" is widely used in scientific literature. However, hardly any of them are described properly: some may not withstand a proper delineation based on a universal definition.

We seriously question whether shorter and more compact (i.e., less lengthy) areas identified in the review would still fall under the "urban corridor" category if a proper definition of the term existed. The RhineRuhr area in Germany or the Texas Triangle in the USA would most likely have to be omitted in a global inventory of urban corridors due to their compactness. We aim to test this assumption in our further analysis.

Our overall aim is to develop a map of global urban corridors. We expect that remote sensing imagery will contribute to the understanding of urban corridors on a global scale. The DMSP-OLS are proving useful for a first delimitation of those urban corridors identified in our literature review, while the GUF model will be used in a detailed analysis of a case study (the Boswash area; see Figure 2).

The information obtained in the study will provide valuable information for urban management and planning institutions. This includes the prediction of growth directions of cities, hot-spots of urban growth, or inter-urban relationships.

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