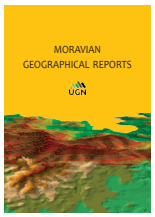

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Mobile phone data in studying urban rhythms: Towards an analytical framework

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Abstract

Mobile phone data are considered one of the most promising information sources for monitoring and measuring the spatio-temporal activities of the population. Today, large-volume mobile phone datasets are widely applied to monitor the daily life of the urban population and to examine the structuring of the urban environment. In this paper, we discuss and develop a methodological procedure that uses such data to observe temporal differences of human presence in Bratislava, Slovakia. The study is based on a large-scale dataset of hourly records of signalling exchanges (VLR data) from all major mobile network operators in Slovakia. The records of the mobile network infrastructure are used as a suitable proxy variable for complex human activity at the city level, in the sense that they capture various kinds of spatial practices, and not only some specific activities (work cycle of a given locale, shopping, and similar events). Such an approach allows the classification of urban space using diurnal logs activity curves of mobile network cells. Six temporality types in Bratislava were identified, which may be designated as examples of an urban chronopolis. The results show the potential of the proposed method for measuring place temporality in cities and monitoring the urban environment with geo-referenced mobile phone data.

Keywords: *mobile phone data, diurnal rhythms, urban timespace, chronopolis, Bratislava, Slovakia*

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1. Introduction

The availability of spatial and temporal data through various location-aware technologies has led to increasing interest in time geography in the past decade (Sui, 2012). Mobile phone data are one of the most promising data sources to monitor daily life and short-term processes because of their ability to capture population movement patterns and trajectories (Deville et al., 2014; Kang et al., 2012).

These large volume datasets are considered a valuable indicator of human presence and provide us with the opportunity to track spatial mobility patterns at an individual level (Ahas et al., 2010; González et al., 2008; Novák and Temelová, 2012; Song et al., 2010), as well as to map the movement and activity of the population by using aggregated data (Ma et al., 2019; Ratti et al., 2006; Reades et al., 2009; Yuan and Raubal, 2016). The mobile positioning has found considerable use in mobility and traffic studies (Järv et al., 2012; Calabrese et al., 2011), but also in areas such as crisis management (Bengtsson et al., 2011), the monitoring of foreign tourist visits (Ahas et al., 2008; Šveda et al., 2019), or the spread of epidemics (Weselowski et al., 2012). Urban space and dynamic processes in cities are particularly of central interest, where the usefulness of mobile phone-based data has been demonstrated (Calabrese et al., 2011; Csáji et al., 2013; Nemeškal et al., 2020; Ratti et al., 2006; Sagl et al., 2014; Slim and Ahas, 2014).

Calls to study the diurnal variations of the population in urban localities from the viewpoint of the time geography paradigm were made decades ago (Bromley et al., 2003; Goodchild and Janelle, 1984; Muller, 1982; Taylor and Parks, 1975), but technological advances in mobile communications have brought new challenges in revealing time-space changes in population distribution. The ability to monitor daily movements for any time-period has opened new horizons in studying everyday urbanism and urban rhythmicity. Several attempts to include temporal aspects

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