# Sensing Urban Patterns with Antenna Mappings: The Case of Santiago, Chile

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**SENSORS**

Vol.16, n° 7, Article Number: 1098

**DOI:** 10.3390/s16071098

**Published:** JUL 2016

## Abstract

Mobile data has allowed us to sense urban dynamics at scales and granularities not known before, helping urban planners to cope with urban growth. A frequently used kind of dataset are Call Detail Records (CDR), used by telecommunication operators for billing purposes. Being an already extracted and processed dataset, it is inexpensive and reliable. A common assumption with respect to geography when working with CDR data is that the position of a device is the same as the Base Transceiver Station (BTS) it is connected to. Because the city is divided into a square grid, or by coverage zones approximated by Voronoi tessellations, CDR network events are assigned to corresponding areas according to BTS position. This geolocation may suffer from non negligible error in almost all cases. In this paper we propose "Antenna Virtual Placement" (AVP), a method to geolocate mobile devices according to their connections to BTS, based on decoupling antennas from its corresponding BTS according to its physical configuration (height, downtilt, and azimuth). We use AVP applied to CDR data as input for two different tasks: first, from an individual perspective, what places are meaningful for them? And second, from a global perspective, how to cluster city areas to understand land use using floating population flows? For both tasks we propose methods that complement or improve prior work in the literature. Our proposed methods are simple, yet not trivial, and work with daily CDR data from the biggest telecommunication operator in Chile. We evaluate them in Santiago, the capital of Chile, with data from working days from June 2015. We find that: (1) AVP improves city coverage of CDR data by geolocating devices to more city areas than using standard methods; (2) we find important places (home and work) for a 10% of the sample using just daily information, and recreate the population distribution as well as commuting trips; (3) the daily rhythms of floating population allow to cluster areas of the city, and explain them from a land use perspective by finding signature points of interest from crowdsourced geographical information. These results have implications for the design of applications based on CDR data like recommendation of places and routes, retail store placement, and estimation of transport effects from pollution alerts.

## Keywords

**Author Keywords:** Call Detail Records; Urban dynamics; Human mobility; Origin-destiny matrix; Land use clustering; Crowdsourced data; OpenStreetMap

**KeyWords Plus:** ORIGIN-DESTINATION MATRICES; HUMAN MOBILITY; OPENSTREETMAP; INFORMATION; NETWORK; PHONES; PLACES