STUDY OF MAPPING AND TECHNOLOGY IN THE CONTEXT OF DISPLACEMENT

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by

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OUTLINE

1. Introduction

The world is facing an unprecedented crisis of displacement. An estimated 60 million people have been internally displaced due to conflict, natural disasters and climate change, and a colossal 1.6 billion more face inadequate housing. Despite the high incidence of displacement, particularly resulting from development and market led processes, robust data on the numbers of people displaced, where they end up, conditions they face post-displacement, and how displacement affects the physical, social and economic structures of cities is lacking. To address this, scholars, practitioners and activists across the globe are increasingly applying new digital tools and technologies to produce exploratory analysis, visualization and mapping of displacement cases. Such data-driven tools provide powerful visual analysis to assist organizations in their advocacy work to resist or minimize displacement.

This report aims to unfold two main questions:

a) What are the tools and methodologies for tracking demographic, physical, and economic transformation due to displacement and relocation?

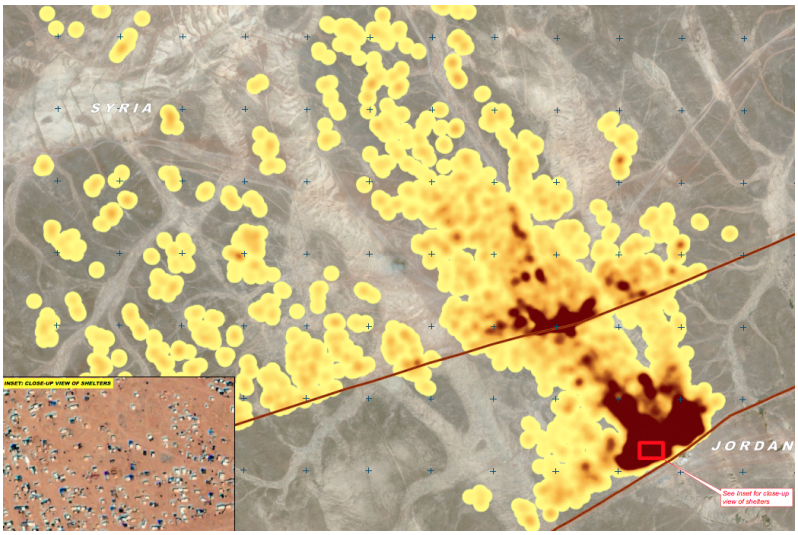
b) How can methodologies focused on data visualization and mapping assist IDP research and advocacy work of respective organization?

To answer these questions, the report presents an overview of displacement data collecting tools and methods, and displacement data analysis and visualization methods together with a comparative matrix of various mapping cases.

2. Review of Displacement Data Collecting Tools and Methods

In this section, three main data collecting tools are introduced; satellite imagery, field-based data and existing databases, and crowdsourcing and self-reporting.

a. Satellite Imagery



Shelter density map by UNITAR

Satellite monitoring and assessment technologies are increasingly used for documentation, monitoring and advocacy efforts in human rights and humanitarian issues. In protracted displacement situations, satellite tools can be used to monitor the events, study the health and security features, and respond to emergencies. Satellite technology is a powerful and useful complement to the information collected on the ground[1]. A report by UNOSAT – the UN Institute for Training and Research's Operational Satellite Applications Programme demonstrated the dramatic change in Syria's urban structure due to the ongoing conflict. The UN organization documented the impacts on local economies through shutdown of markets, damage level of schools, hospitals and residential settlements, and displacement of populations through the use of

[1] Bjorgo, Einar. Space aid. [electronic resource] : current and potential uses of satellite imagery in UN humanitarian organizations. n.p.: Washington, DC : U.S. Institute of Peace, 2002.
Bjorgo, Einar, et al. "Satellite imagery in use." *Forced Migration Review* no. 31 (October 2008): 72-73.

remote sensing technology[2]. Such visual and analytical documentation enable to track the movement of displaced people and its impacts on physical, economic, social and environmental structures of cities.

Displacement mapping can benefit from the satellite technologies in two ways: First, integrating remote sensing imagery systems with field-based survey data provides opportunity to monitor the movement of displaced populations. High-level details in the imagery allow tracking the flow patterns of people and collecting the movement data in a GIS database. Second, analytical analysis of high-resolution ground imagery enables to study the physical changes in the eviction and resettlement areas. Comparison of aerial photos from different periods of time demonstrates the transformation of urban fabric due to the displacement.

b. Field-based Survey Data and Existing Databases

In humanitarian technology, field surveys and existing databases – such as census databases or other databases created by local community groups – have been used for two main purposes. First, survey method can be primary tool to collect displacement data. Depending on the scale of displacement and amount of data that needs to be gathered, surveys are employed either as structured set of questions or as open ended interviews. Istanbul 2009 Eviction Mapping[3] is one of the rare examples that successfully combine existing databases and surveys. In 2009, a group of students and Yasar Adanali, A community organizer and team leader, created the evictions maps that shows multiple layers of information including designated renewal project areas, ongoing demolitions, completed demolitions, areas where planning processes underway and 2nd wave of evictions. The mapping team undertook a comprehensive research scanning

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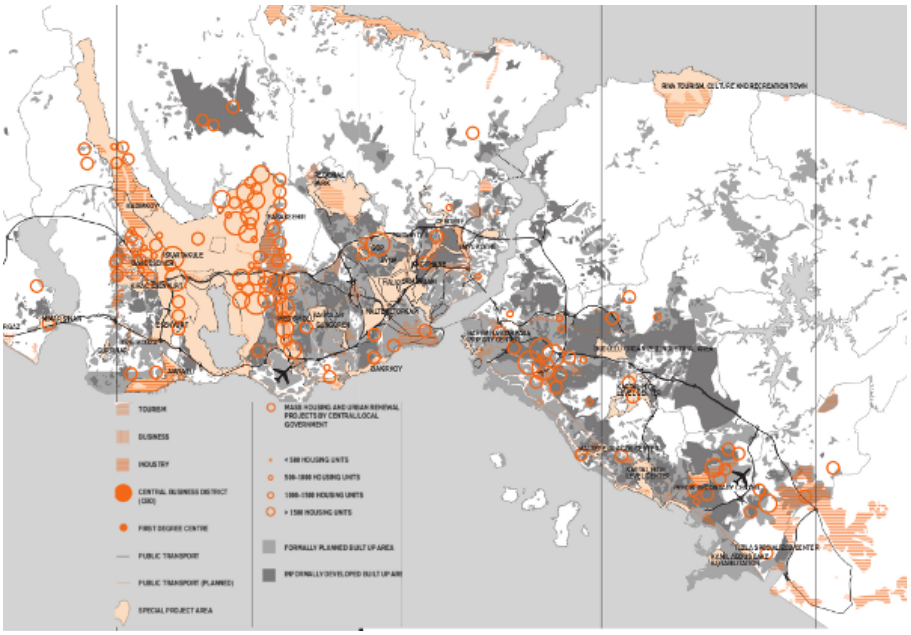
[2] UNOSAT. Four Years of Human Suffering – the Syria Conflict as Observed through Satellite Imagery. (2015)

[3] Adanali, Y., Morali, Z., et al. (2010) Istanbul: Living in Voluntary and Involuntary Exclusion, Istanbul Research Newsletter

municipality reports, newspaper archives, neighborhood master plans, and previous field surveys by local NGOs. Additionally, they have done multiple interviews with city officials, displaced people, community leaders and journalists.

The main challenge on using survey data and existing databases is the lack of standardized data structures. Because local community organizations usually collect modest size of data depending on their temporal needs, it is often a labor heavy task to integrate all small-scale databases into a meaningful data system. As an example, one of the challenge that Istanbul Eviction mapping group faced was the way how location information were collected by various organizations. While some groups have collected only neighborhood names, other groups have collected street and apartment names. The team had to work to convert all eviction address into the same format.



Istanbul Eviction Map, 2009

Second, surveys and existing databases can be instrumental in verifying already collected displacement data. Data verification is a process in which different types of data are checked for

accuracy and inconsistencies. In this case, a small-scale data from survey can be crosschecked with the new data to detect any possible conflicts.

c. Crowdsourcing and Self-reporting

In humanitarian technology, the concept of crowdsourcing emerged as a data collection strategy during crises, where active contribution of people is essential. This idea is pioneered by Ushahidi, which was initially a web-based platform to map reports of violence in Kenya after the post-election fallout and now is a global non-profit technology firm with a mission to change the way information flows[4]. On the other hand, crowd-seeding approach[5], as defined by Van der Wind and Humphreys, uses information from selected people who report on events in real time and combines the crowdsourcing technology with the traditional approaches that rely on known sources and representative samples. Besides the conflict and disaster situations, crowdsourcing methods have also been employed to document the eviction and displacement. For example, *The Anti-Eviction Mapping Project*[6] uses crowd-sourced information to map dispossession of San Francisco residents to facilitate collective resistance. The sample questions of the Mapping Project crowd-sourcing tool includes: location data where they are being forced out of and current relocation, reasons of eviction, total number of people and their demographics, approximate dates and legal processes of eviction and displacement.

Citizen-generated information is a substantial component of displacement data collection strategy. In crowdsourcing methods, users usually provided with an online form accessible through a phone or a web-based system, which integrates data from voluntary citizens (crowdsourcing) and pre-identified informants (crowd-seeding). All the data are processed and stored in the spatial database for further mapping and visualization.

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[4] http://www.ushahidi.com

[5] Van der Wind, P., & Humphreys, M. *Crowdseeding conflict data: An application of an SMS-based data system to estimate the conflict effects of development aid*. New York: Columbia University. (2012)

[6] http://www.antievictionmap.com/

3. REVIEW OF DISPLACEMENT DATA VISUALIZATION TOOLS AND METHODS

In this section, three main visualizing methods are introduced and analyzed; flow maps, computer vision and pattern recognition, and spatial data mining and superimposing multiple layers of data.

a. Flow Maps

(a) Minard's 1864 flow map of wine exports from France (b) Tobler's computer generated flow map of migration from California from 1995 - 2000. (c) A flow map produced by our system that shows the same migration data.

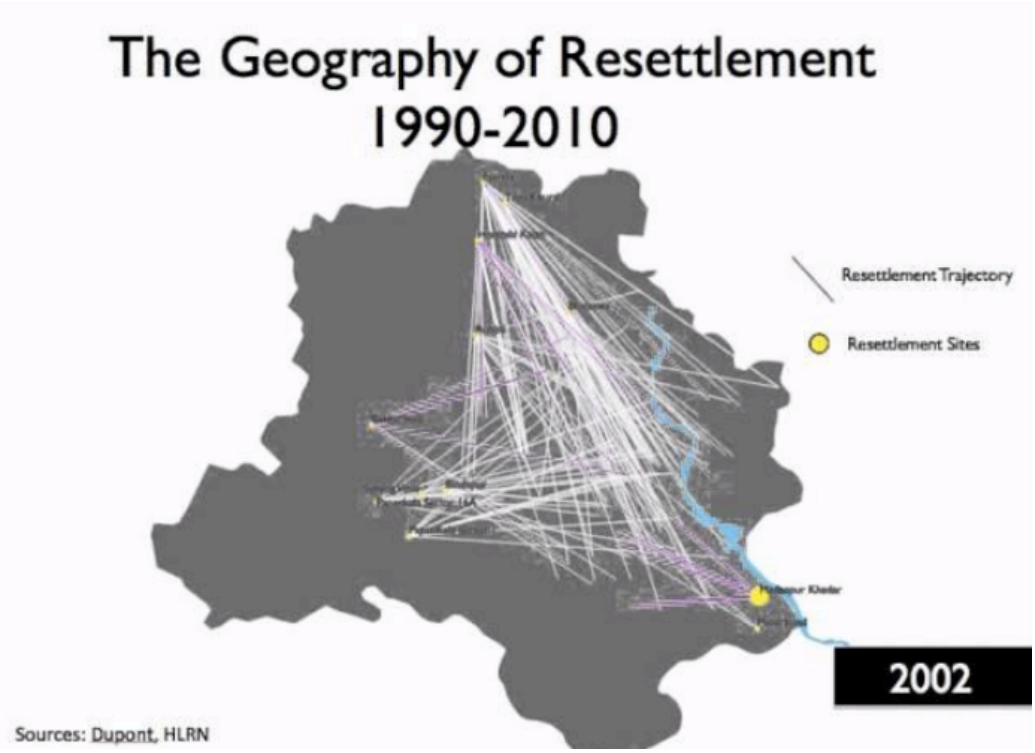
Geographical flow maps are effective tools to depict and analyze the spatial mobility of populations, commodities and disease spread. Flow maps in cartography are a mix of maps and flow charts, which "show the movement of objects from one location to another, such as the number of people in a migration, the amount of goods being traded, or the number of packets in a network[7].

Use of flow maps to visualize human migration was first introduced by Tobler[8] in 1987. Since then, a large body of research has focused on computerized mapping methods to process large

[7] Borden D. Dent (1999). *Cartography: Thematic map design*. McGraw-Hill. New York. 1999.

[8] Tobler W R 1987 Experiments in migration mapping by computer. American Cartographer 14: 155–63

spatial flow datasets[9,10,11]. Rendering geographical movement of internally displaced people as flow maps is crucial to demonstrate the patterns of eviction and resettlement sites.
Because multiple parameters are associated with each flow such as number of people for different age groups, gender and displacement types, displacement documentation should employ hierarchical clustering methods to process datasets of displaced people. Processed data can be visualized as animated interactive maps as a web-mapping and publish online for further communication and research.



Displacement Research Action Network India Practicum Flow Map, 2014

b. Computer Vision and Pattern Recognition

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[9] Buchin, K., B. Speckmann, and K. Verbeek. "Flow map layout via spiral trees." IEEE Transactions On Visualization And Computer Graphics 17, no. 12 (December 1, 2011): 2536-2544.

[10] Diansheng, Guo. "Flow mapping and multivariate visualization of large spatial interaction data." IEEE Transactions On Visualization And Computer Graphics 15, no. 6 (November 1, 2009): 1041-1048

[11] Zhu, Xi, and Diansheng Guo. "Mapping Large Spatial Flow Data with Hierarchical Clustering." Transactions In GIS 18, no. 3 (June 2014): 421-435.

In recent years, due to the increasing availability of high-resolution commercial satellite imagery, many researchers have focused on variety of new remote-sensing applications. Remote sensing[12] is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. Different methodologies have been developed for accurate and efficient extraction of semantic information from remote-sensing data[13]. Because there is a significant need for data acquisition to update GIS databases, a large body of research particularly studies methods and tools to extract urban elements such as buildings, road networks and open spaces from high-resolution aerial images. Remote-sensing data processing built on automated object recognition algorithms is essential to combine with GIS to analyze the morphological changes on satellite and aerial imagery.

c. Spatial Data Mining and Superimposing Multiple Layers of Data

Spatial data mining is the process of discovering potentially useful patterns from large spatial datasets. Extracting useful patterns from spatial datasets is more difficult than extracting the corresponding patterns from traditional numeric and categorical data due to the complexity of spatial data types, spatial relationships, and spatial autocorrelation. In term of displacement mapping, such approach can be achieved by superimposing layers such as movement of displaced people, patterns of eviction and resettlement sites together with their demographics and socioeconomic statistics, and series of geo-tagged satellite imagery showing the change of urban fabric for the given period.

This multi-layered mapping technique can also integrate master plans, land use data, census data, socio-economic and housing characteristics, transportation networks, water and sanitation

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[12] noaa.gov/facts/remotesensing.html

[13] Hamid, Raffay, Stephen O'Hara, and Mark Tabb. "Global-Scale Object Detection Using Satellite Imagery." International Archives Of The Photogrammetry, Remote Sensing & Spatial Information Sciences 40-3, (August 2014): 109.

sources, land ownership data, and qualitative data about socio-economic conditions. Organizing all layers of visual documentation in the GIS can lead to comprehensive citywide analysis on displacement and eviction.

4. Comparative Matrix of Displacement Mapping Practices

Important Note: The case studies only focus on IDP situations. Refugee related projects are excluded from the matrix system.

Criteria for Case Study Selection

- Clear description of data collecting methods, producer of the maps and accessible visual materials.
- Case selections include different organizations including IDMC, UNOSAT, community-based organizations and researchers; and various methods including crowd-sourced data collecting, governmental documents and satellite imageries.

Case Study Matrix

Id | Years	Maps	Data Collecting Methods	Data Visualization Methods	Source
1 | 2009	Istanbul Eviction Maps	Municipal documents and field-based survey	Static map showing eviction sites, resettlement sites and potential eviction sites	A research group involved a political scientist and design students

2 | 2005	Katrina Diaspora	Census-based data	Static map showing spatial distribution of IDPs in the USA	The New York Times
3 | 2005	Sulukule Displacement Map	Crowd-sourced data collected by a collective	Static map showing spatial distribution of IDPs in Istanbul	A research group involved a political scientist and design students
5 | 2015	Ukraine Internal Displacement Map	Data received by Ministry of Social Policy	Static map with area-based data clustering	UNHCR – Kyiv
6 | 2015	Ellis Act Eviction	Crowd-sourced data by the activist groups	Interactive map with a timeline	Anti- Eviction Mapping Project
7 | 2009-2016	IDMC Multiple Maps	Mix methods (differ based on the country) CIS-Timor, UN Habitat, IDMC interviews	Static maps with area-based data clustering	IDMC
8 | 201x	Somalia IDP Camp Map	Vectorization of satellite imageries	Static maps with vector-based data	UNOSAT

5. CONCLUSION

This report summarized most common methods and practices of displacement data collecting and processing. The primary intention of such data collecting and processing is to provide a

powerful visual tool to assist organizations in their advocacy work to minimize eviction and displacement. Moreover, through better analysis of the consequences and causes of displacement, the goal is to improve the capacity for realizing housing rights for all.

Although, today's technology allows us to produce communicative maps of displacement and to bolster displacement resistance, there are still many questions that need to be discussed in order to create a powerful discourse for displacement data analysis. What are the ethics and politics of mapping is the outstanding question among many. In order to ensure the full protection of vulnerable communities, current practices and techniques of displacement data analysis should be regulated by a global guideline.