Advancing Data for Street-Level Flood Vulnerability: Extraction of Variables from Google Street View in Quito, Ecuador to Enhance Earth Observation Driven Flash Flood Risk Assessment

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Introduction

Novel geospatial and crowdsourcing technology provide ways to collect vulnerability data. We develop a framework to collect data with a human-machine interface technique using satellite imagery and Google Street View (GSV). Outputs of our method are coupled with EO-driven flash flood modelling to develop an anticipatory action program for flash floods. We focus on Quito, Ecuador, an urban area in a valley surrounded by mountainous terrain with high flood exposure. The study advances data for the development of regional training datasets that will aid in automating the mapping of flood vulnerability in urban areas for flood risk assessment and early warning.

Flowchart of Methods

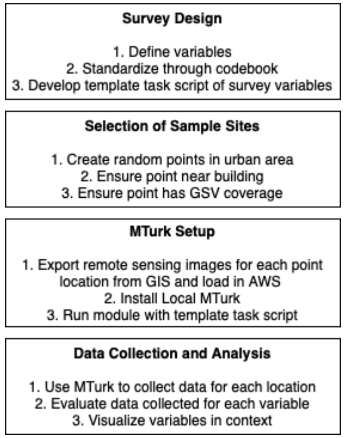

Figure 1: Description of each step from survey design to sampling, setup, and data.

Data and Methods

We use a crowdsourcing method to build a database of flood vulnerability variables (e.g., drains, sill height) collected from GSV. Turking is a form of crowdsourcing which breaks down tasks into simpler components with easier decision processes then distributes these focused tasks to many individuals. Our variables were selected as critical factors in flood risk assessment, particularly for floods occurring in urban settings. We developed an interface using the local Mechanical Turk (MTurk) environment that required two primary inputs: (1) geographic coordinates associated with remote sensing imagery and GSV, and (2) a survey document that includes our variables of interest for collection. A basemap layer to better assess co-location with building location. Points not coinciding with a building location were assigned to the closest building. We note our approach requires a standardization matrix (table) to document variable categories to ensure consistency in data entry for all participants. Once standardized, variables were classified using image examples from GSV and general descriptors such as the sill height, the roof type, and the visible condition of a building. Finally, we use GIS to check consistency and describe spatial patterns of flood vulnerability data.

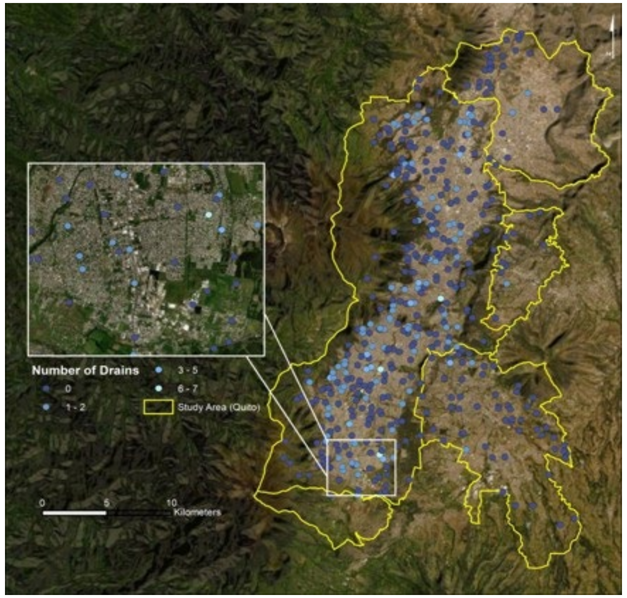

Figure 2: Map of variable collected on number of drains visible at specific point locations.

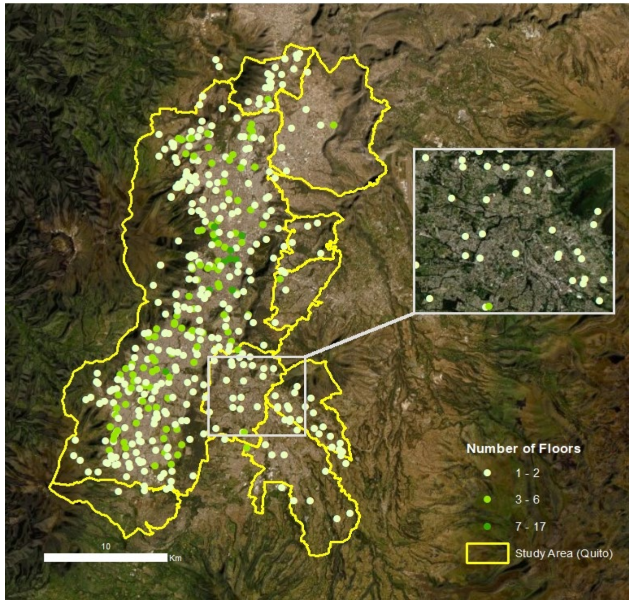

Figure 3: Map of observations collected on the number of floors at point locations.

Results

Mechanical turking is presented as an alternative to field surveys. Data about variables were collected at sample points in Quito, Ecuador. Google Street View (GSV) within the MTurk interface is used to virtually navigate the study area in a short period of time. We collected data for 458 points in Quito. For 42 points, we were unable to collect data, either as the points were too close together or GSV coverage was not available. The mean duration for the processing of a point using turking was 3-5 minutes, with each location having 12 variables to collect. Figures 2 and 3 illustrate the ability to capture characteristics relevant to flooding where GSV is available. Building and street-level data are useful for flood risk assessment as contributors of additional standpoints for detecting vulnerability to flood risk in urban areas.

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