Understanding the Mapping Sequence of Online Volunteers in Disaster Response

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Introduction

• The role of online volunteers in disaster response
“When a major disaster strikes anywhere in the world, HOT rallies a huge network of online volunteers to create the maps that enable responders to reach those in need.”
Coordination by grid-based tessellation
Understanding the mapping sequence of online volunteers

- Online volunteers can help generate up-to-date geographic information

- The time that a grid cell was mapped can be as different as 3 to 4 days from another

- Emergency responders who need information within one cell may have to wait for a long time
Dataset

• Online mapping projects in three different cities

<table>
<thead>
<tr>
<th>Information about the three studied projects.</th>
<th>Kathmandu, Nepal</th>
<th>Pedernales, Ecuador</th>
<th>Kumamoto, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cells</td>
<td>208</td>
<td>186</td>
<td>340</td>
</tr>
<tr>
<td>Varied Cell Sizes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Number of Volunteers</td>
<td>321</td>
<td>85</td>
<td>52</td>
</tr>
</tbody>
</table>

(a) Kathmandu, Nepal (b) Pedernales, Ecuador (c) Kumamoto, Japan
Method

- Real mapping case
- Reproduced grid
- Volunteer mapping
- Road network
- Population

Possible Solution

Conclusions
Method

\[ \rho = 1 - \frac{6 \sum_i d_i^2}{n(n^2 - 1)} \]

**Population-based Ranking**

**Mapping-time-based Ranking**

**Road-network-based Ranking**
Result

- (a) Ranking based on mapping time
- (b) Ranking based on population
- (c) Ranking based on roads
Result

Result of the correlation analysis.

<table>
<thead>
<tr>
<th></th>
<th>Kathmandu, Nepal</th>
<th>Pedernales, Ecuador</th>
<th>Kumamoto, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation with Population</td>
<td>0.45 (p &lt; 0.001)</td>
<td>-0.05 (p = 0.521)</td>
<td>0.48 (p &lt; 0.001)</td>
</tr>
<tr>
<td>Correlation with roads</td>
<td>0.46 (p &lt; 0.001)</td>
<td>0.07 (p = 0.369)</td>
<td>0.26 (p &lt; 0.001)</td>
</tr>
</tbody>
</table>
Discussion

• It’s possible that the mapping sequence of volunteers may correlate well with other datasets

• 3 mapping projects are examined, and more projects can also be studied

• It’s also likely that online volunteers have been mapping cells in a more or less random order
A possible solution

• Maybe we can guide the online volunteers by highlighting the priorities of these grid cells

• Prioritizing the grid cells by population, by road network, by …

• Prioritizing the grid cells by the value of information within each grid
A possible solution

- Prioritizing by the **value of information** within each grid
A possible solution

- Identifying the **possible routes** to disaster-affected areas
A possible solution

- Integrating population and disaster severity
A possible solution

- $d = \{t_1, t_2, \ldots, t_{|V_a|}\}$
- $U(d) = \sum U(t_h)$
- $U(t_h) = Pop_h \cdot s_k$
- $EU(t_h) = p_h \cdot U(t_h)$
- $p_h = \prod p_{hk}$
- $EU(d) = \sum EU(t_h)$
Application to a mapping case in 2015 Nepal earthquake

(a) Real mapping case

(b) Reproduced grid tessellation
Application to a mapping case in 2015 Nepal earthquake

(a) Road network and the earthquake intensities
(b) Voronoi polygons and LandScan data
Application to a mapping case in 2015 Nepal earthquake

1) Spearman’s rho: 0.333; (p < 0.001)  
2) Moran’s I: (a) = 0.445, (b) = 0.358
Conclusions

- Examined the mapping sequence performed by online volunteers

- 3 mapping projects, 3 different cities and countries, 458 online volunteers, 734 mapping cells

- Guiding online volunteers on the priorities of the grid cells can be beneficial

- One possible approach on measuring the value of information within each grid cell
Questions and comments?

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