Understanding the Mapping Sequence of Online Volunteers in Disaster Response

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Introduction

- The role of online volunteers in disaster response

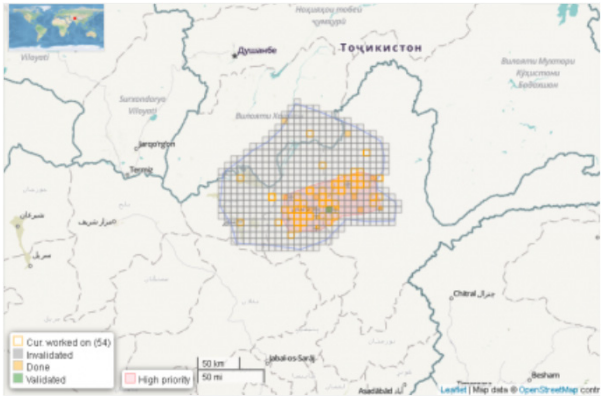
CRiS!S mappers

HOT

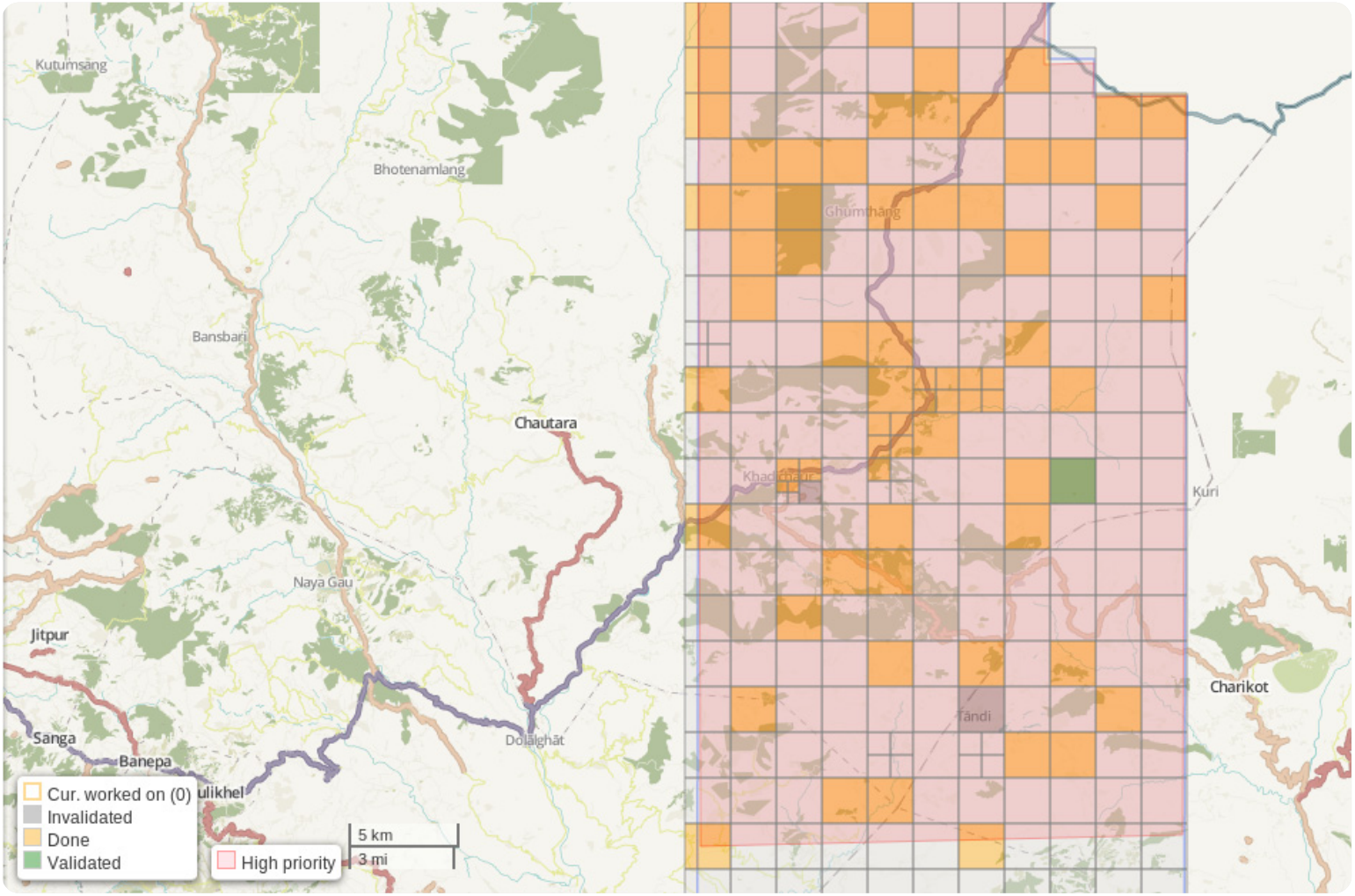
Introduction

"*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.*"

Humanitarian OpenStreetMap Team

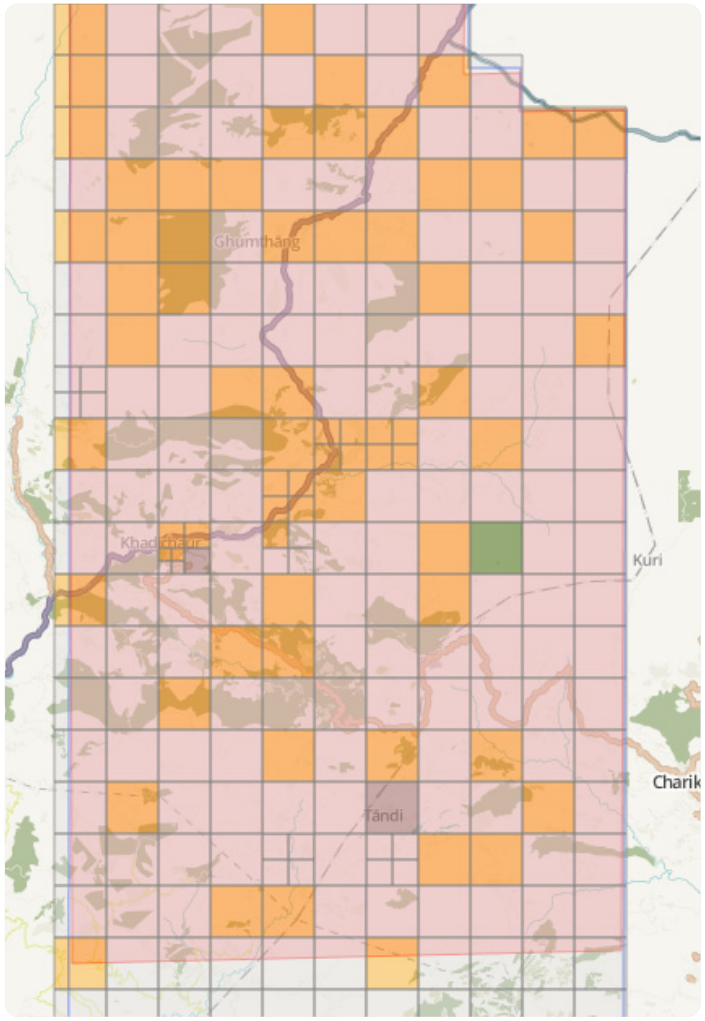


Coordination by grid-based tessellation



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

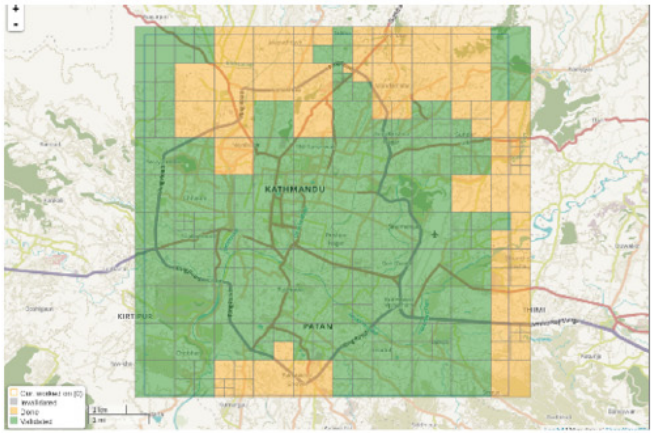


Dataset

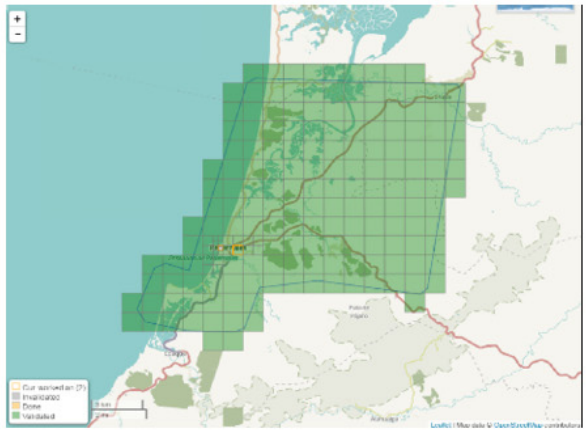
- Online mapping projects in three different cities

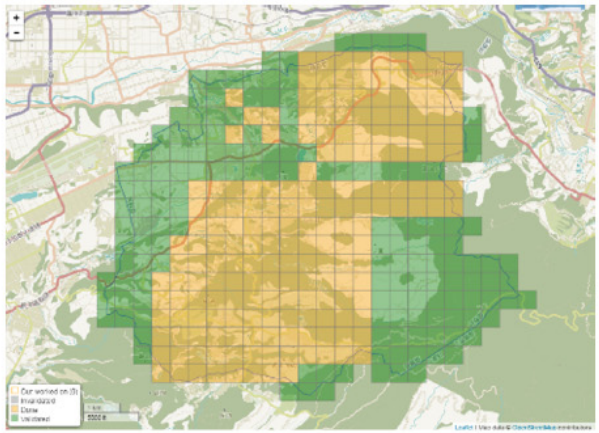
Information about the three studied projects.

	Kathmandu, Nepal	Pedernales, Ecuador	Kumamoto, Japan
Number of Cells	208	186	340
Varied Cell Sizes	Yes	Yes	No
Number of Volunteers	321	85	52
Earliest Finish Time	2015-04-27 15:20:43	2016-04-23 13:40:13	2016-04-16 21:41:46
Latest Finish Time	2015-04-30 10:57:21	2016-04-25 21:29:25	2016-04-20 01:54:14

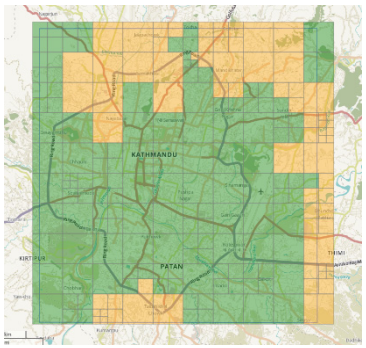


(a) Kathmandu, Nepal

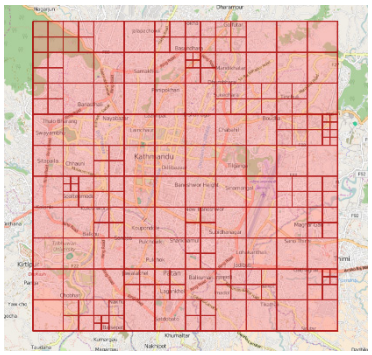

(b) Pedernales, Ecuador


(c) Kumamoto, Japan

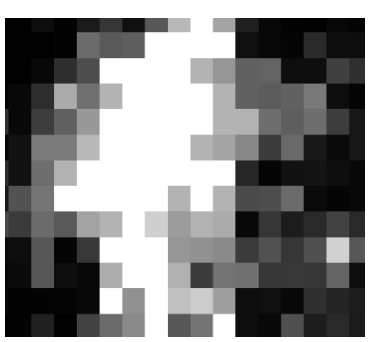
Method



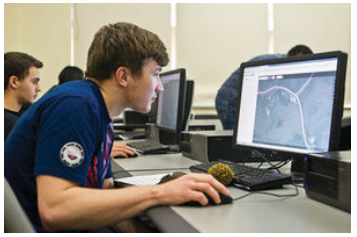
Real mapping case



Reproduced grid

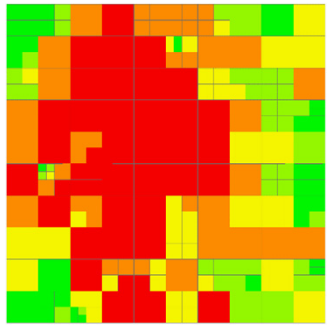


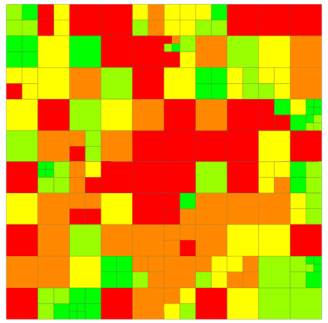
Population

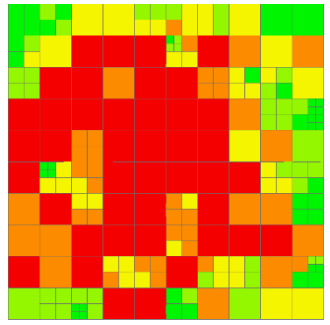


Volunteer mapping

Road network

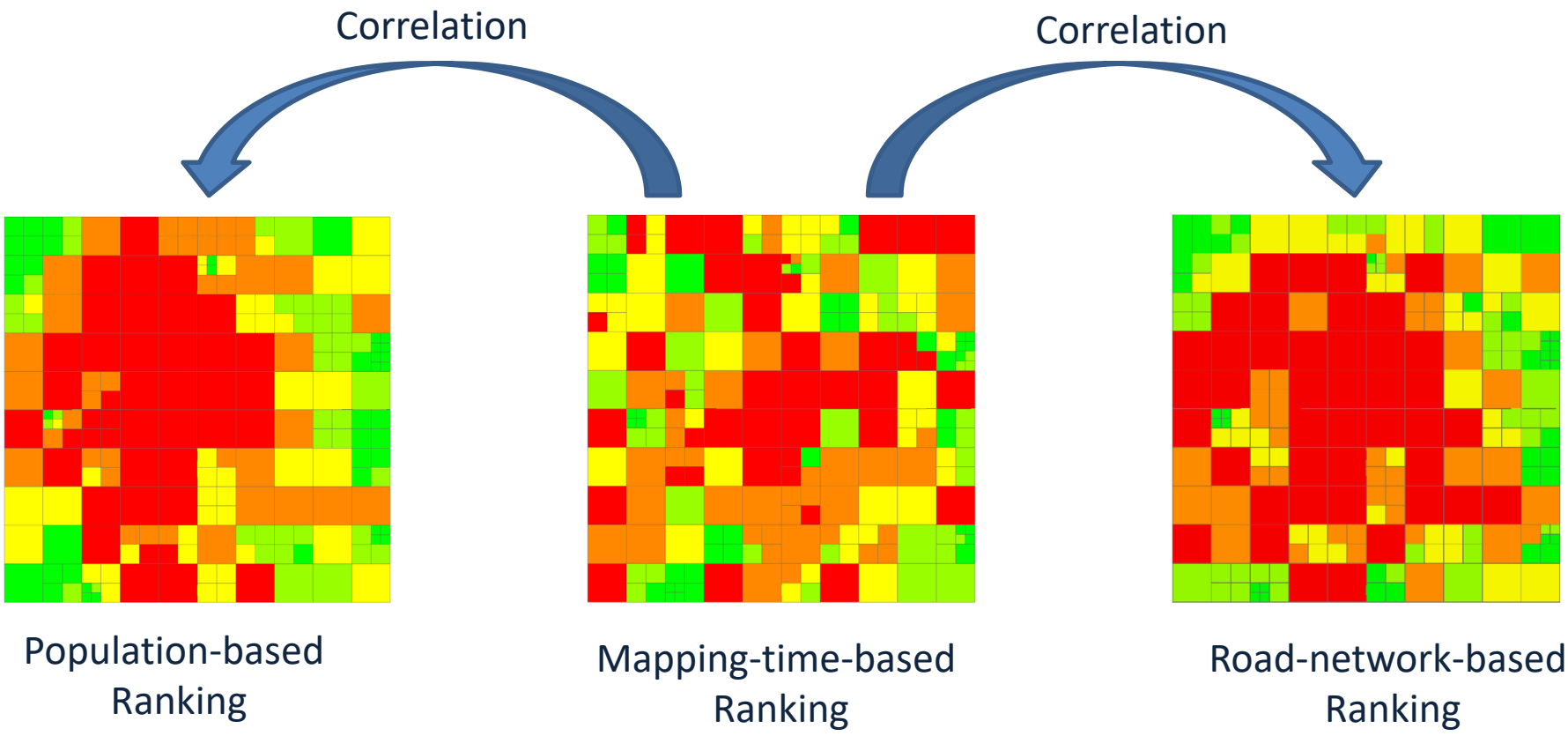




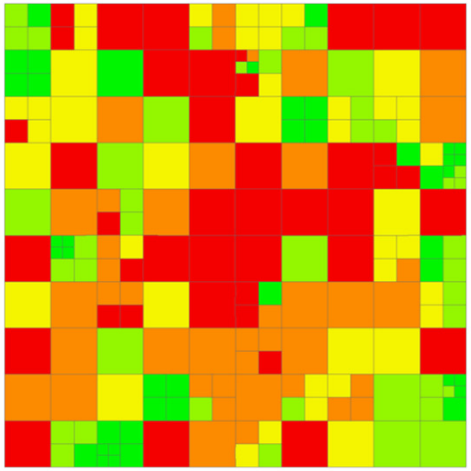


Method

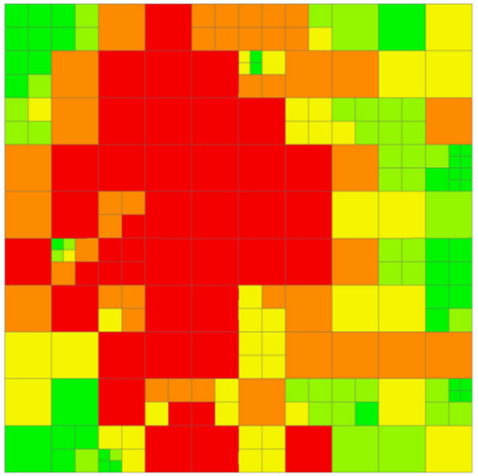
$$\rho = 1 - \frac{6 \sum_i d_i^2}{n(n^2 - 1)}$$



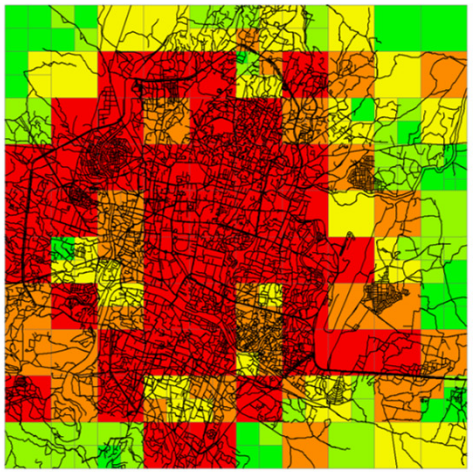
Result



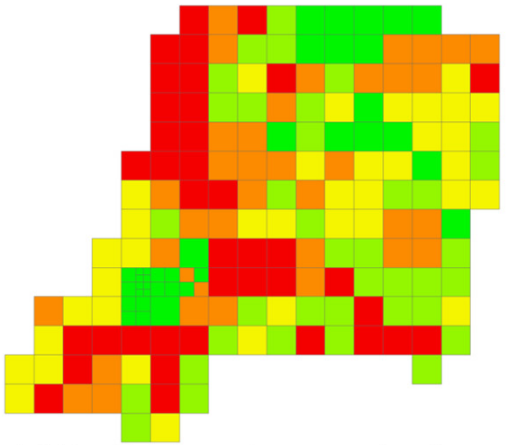
(a) Ranking based on mapping time



(b) Ranking based on population



(c) Ranking based on roads



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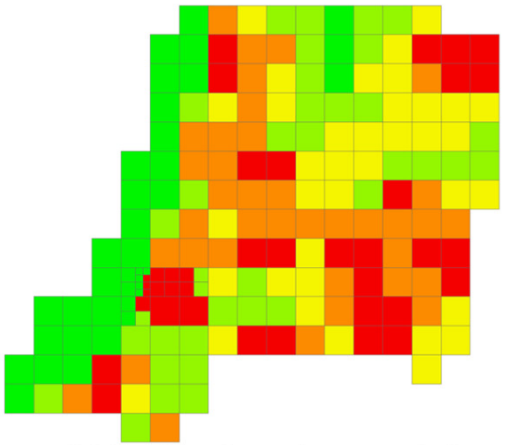
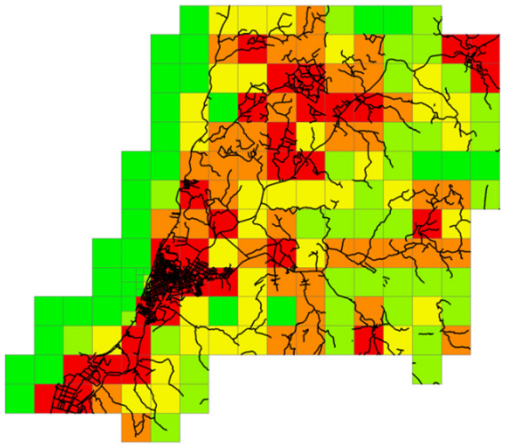
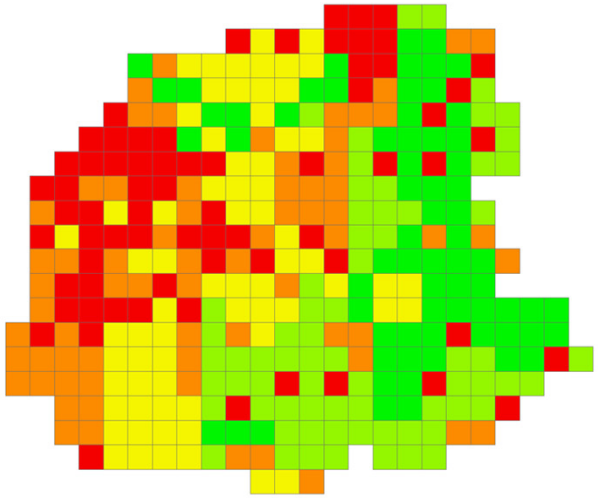


(b) Ranking based on population

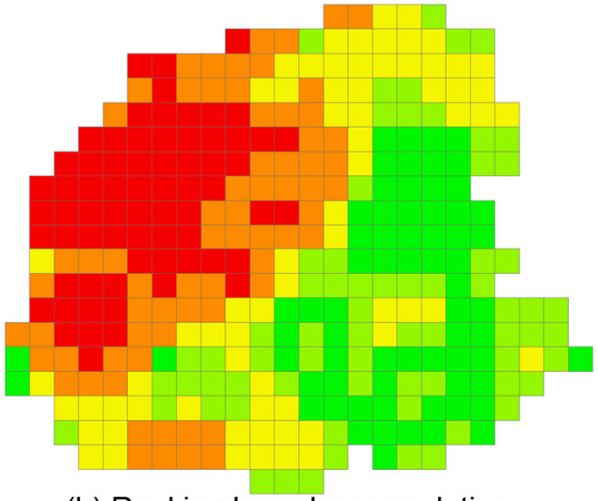


(c) Ranking based on roads

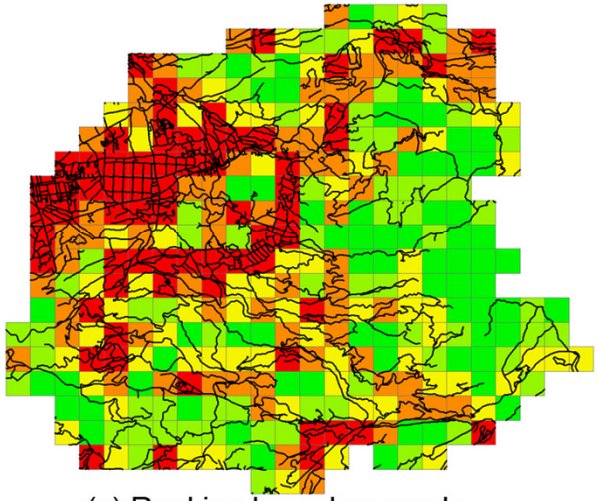
Result



(a) Ranking based on mapping time



(b) Ranking based on population



(c) Ranking based on roads

Result of the correlation analysis.

	Kathmandu, Nepal	Pedernales, Ecuador	Kumamoto, Japan
Correlation with Population	0.45 ($p < 0.001$)	-0.05 ($p = 0.521$)	0.48 ($p < 0.001$)
Correlation with roads	0.46 ($p < 0.001$)	0.07 ($p = 0.369$)	0.26 ($p < 0.001$)

Discussion

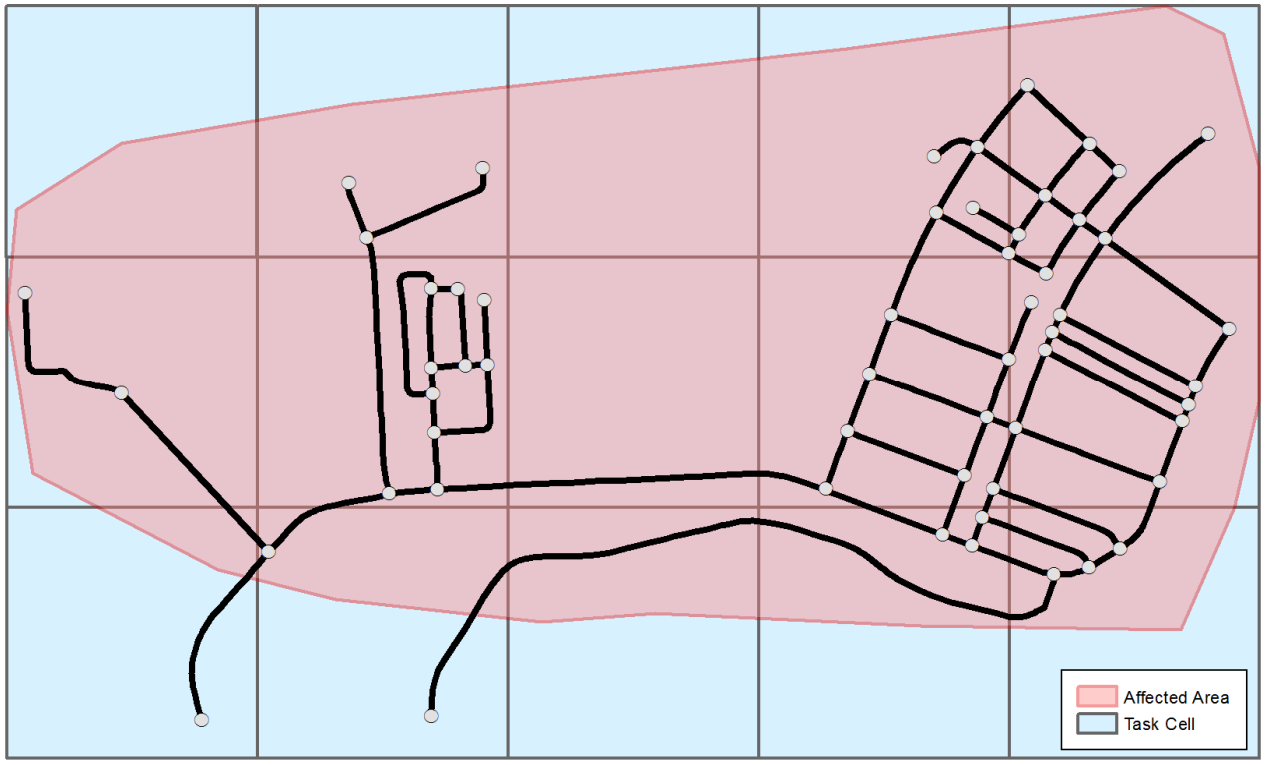
- It's possible that the mapping sequence of volunteers may correlate well with other datasets
- 3 mapping projects are examined, and more projects can also be studied
- It's also likely that online volunteers have been mapping cells in a more or less random order

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

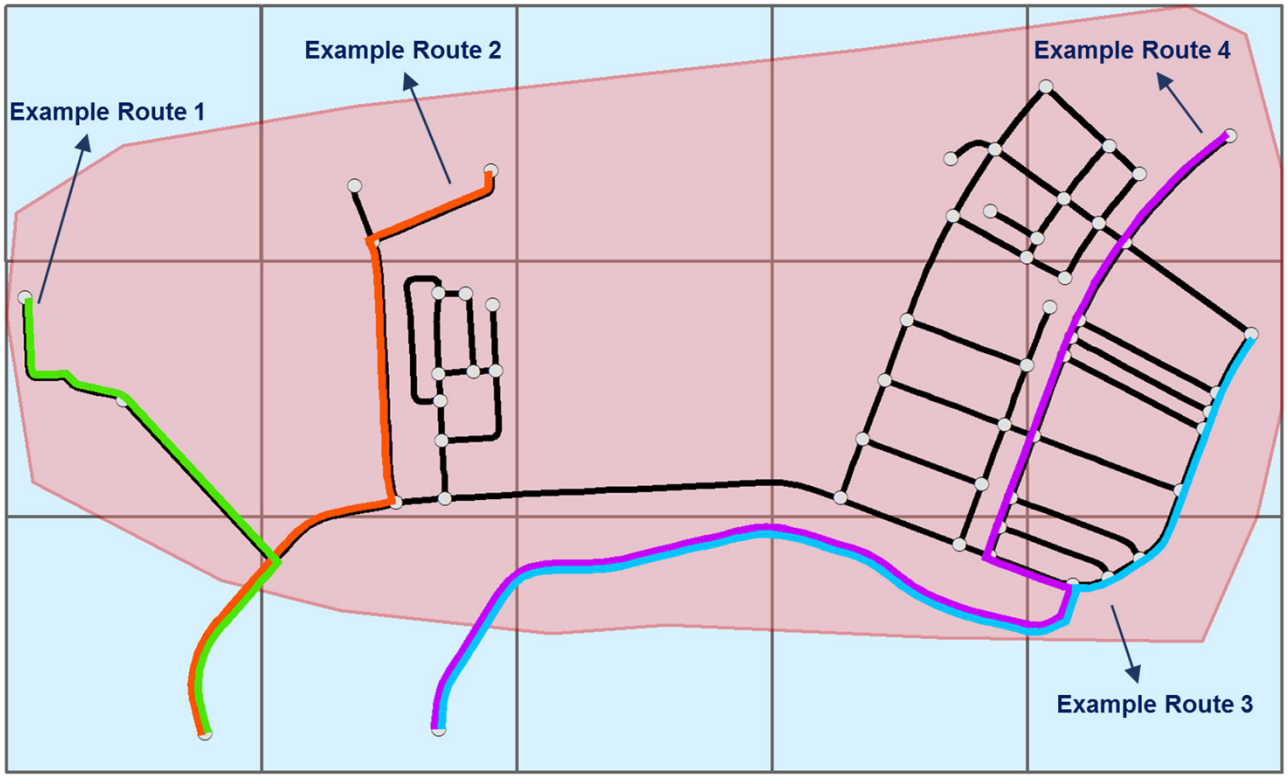
A possible solution

- Prioritizing by the value of information within each grid



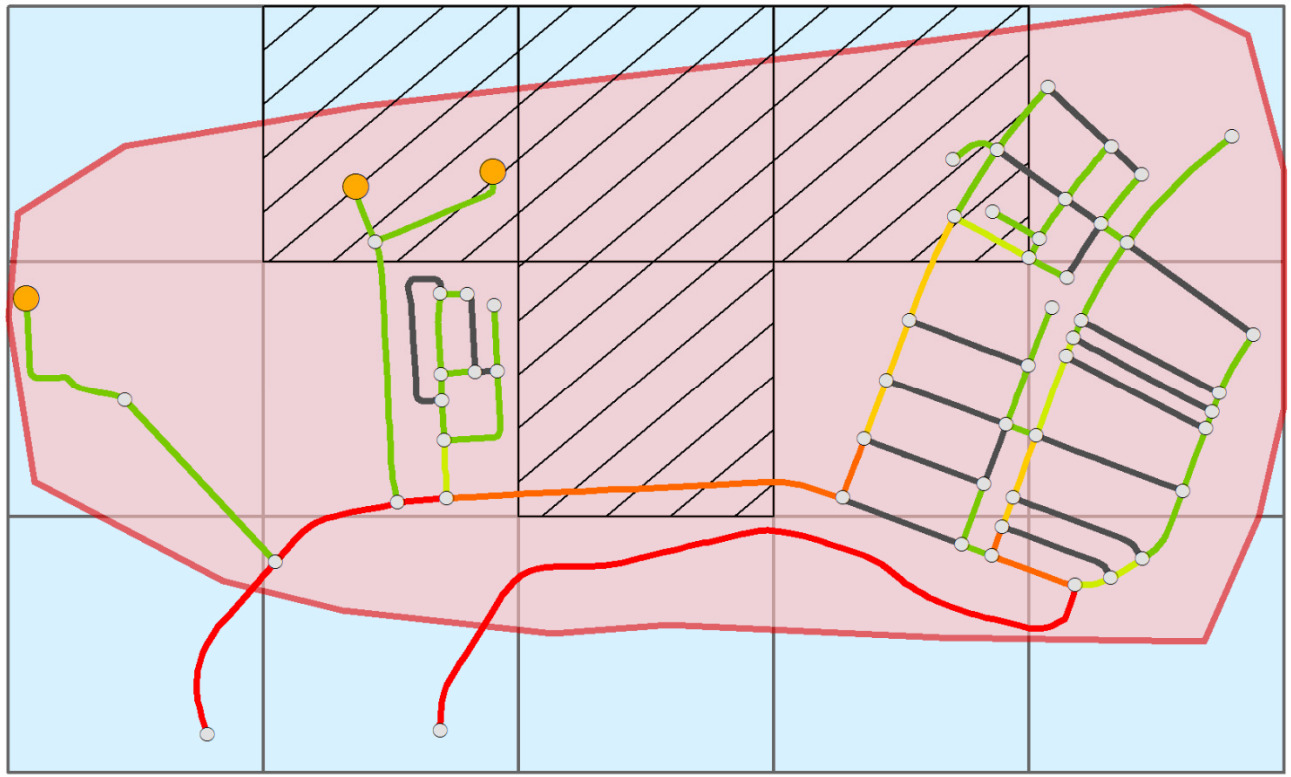
A possible solution

- Identifying the possible routes to disaster-affected areas



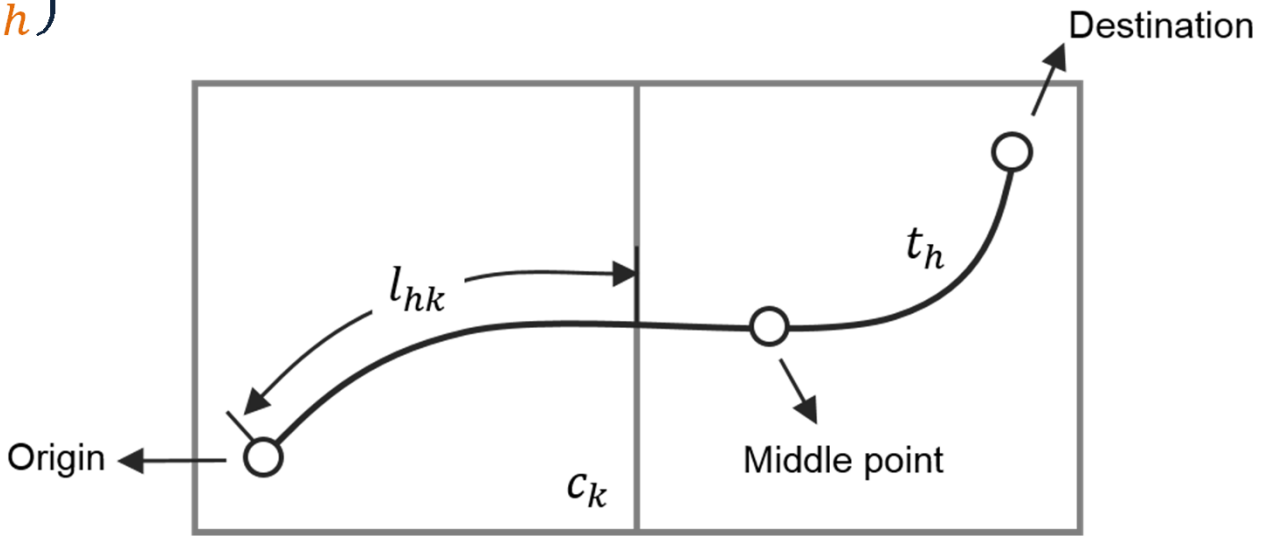
A possible solution

- Integrating population and disaster severity

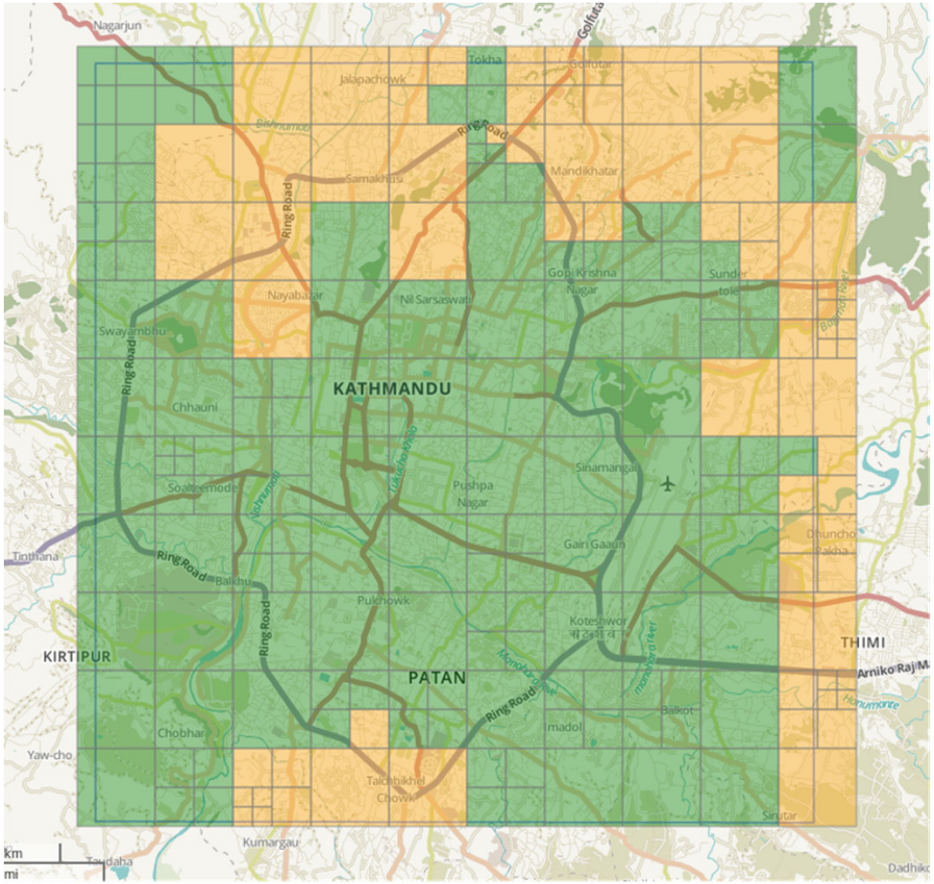


A possible solution

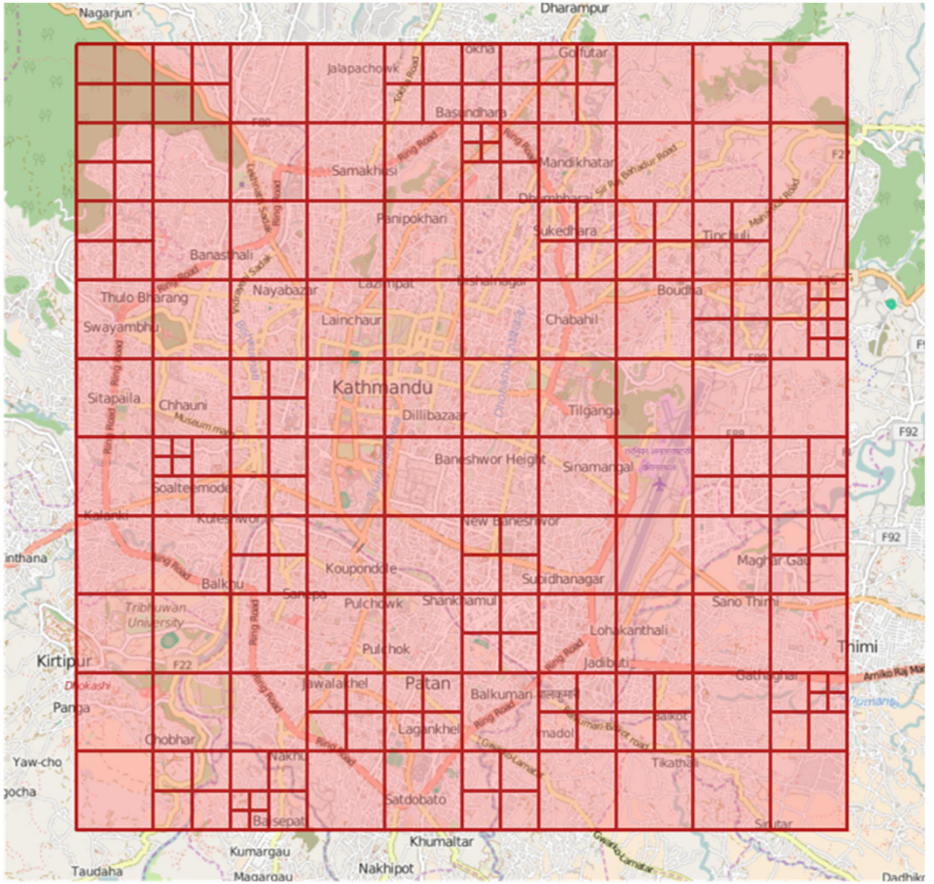
- $d = \{t_1, t_2, \ \ldots, t_{|V_a|}\}$
- $U(d) = \sum U(t_h)$
- $U(t_h) = Pop_h \ . \ s_k$
- $EU(t_h) = p_h \ . U(t_h)$
- $p_h = \prod p_{hk}$
- $EU(d) = \sum EU(t_h)$



Application to a mapping case in 2015 Nepal earthquake

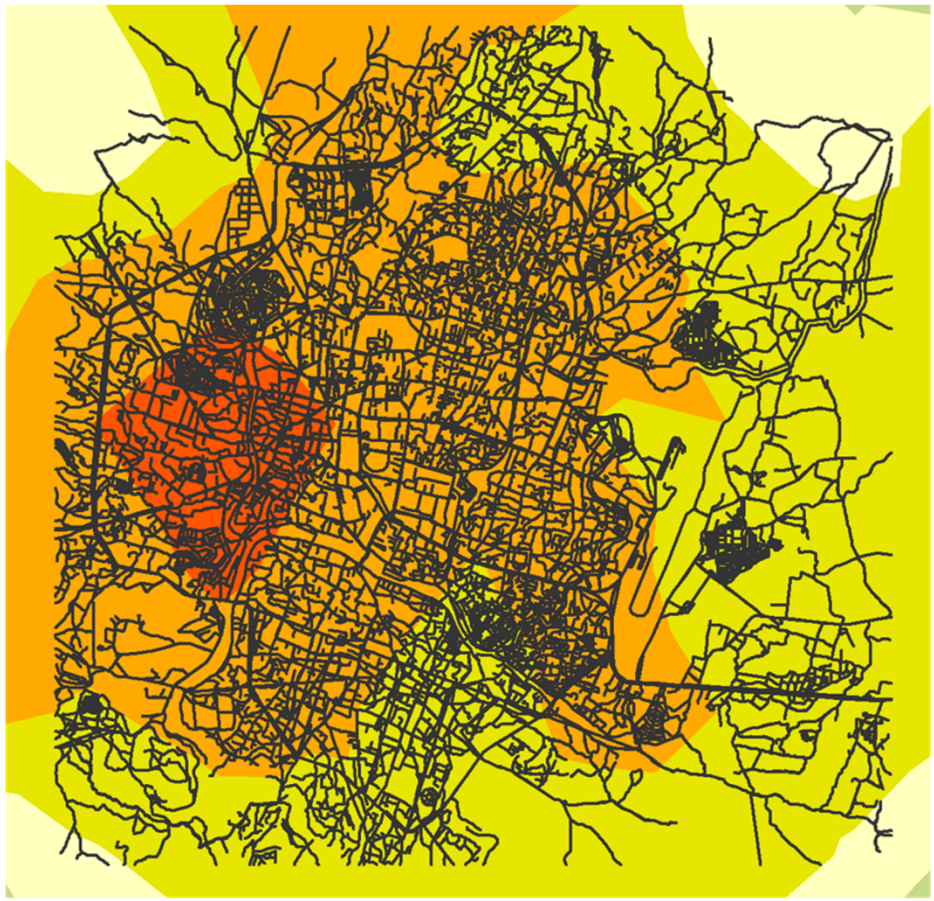


(a) Real mapping case

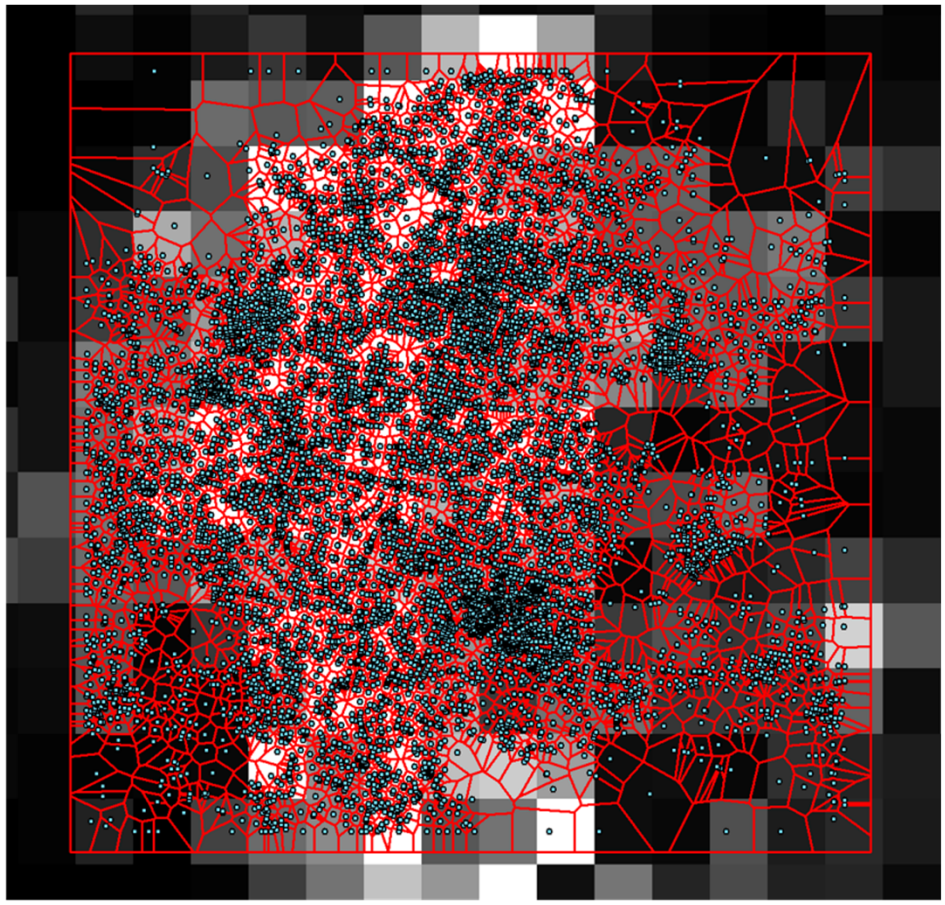


(b) Reproduced grid tessellation

Application to a mapping case in 2015 Nepal earthquake

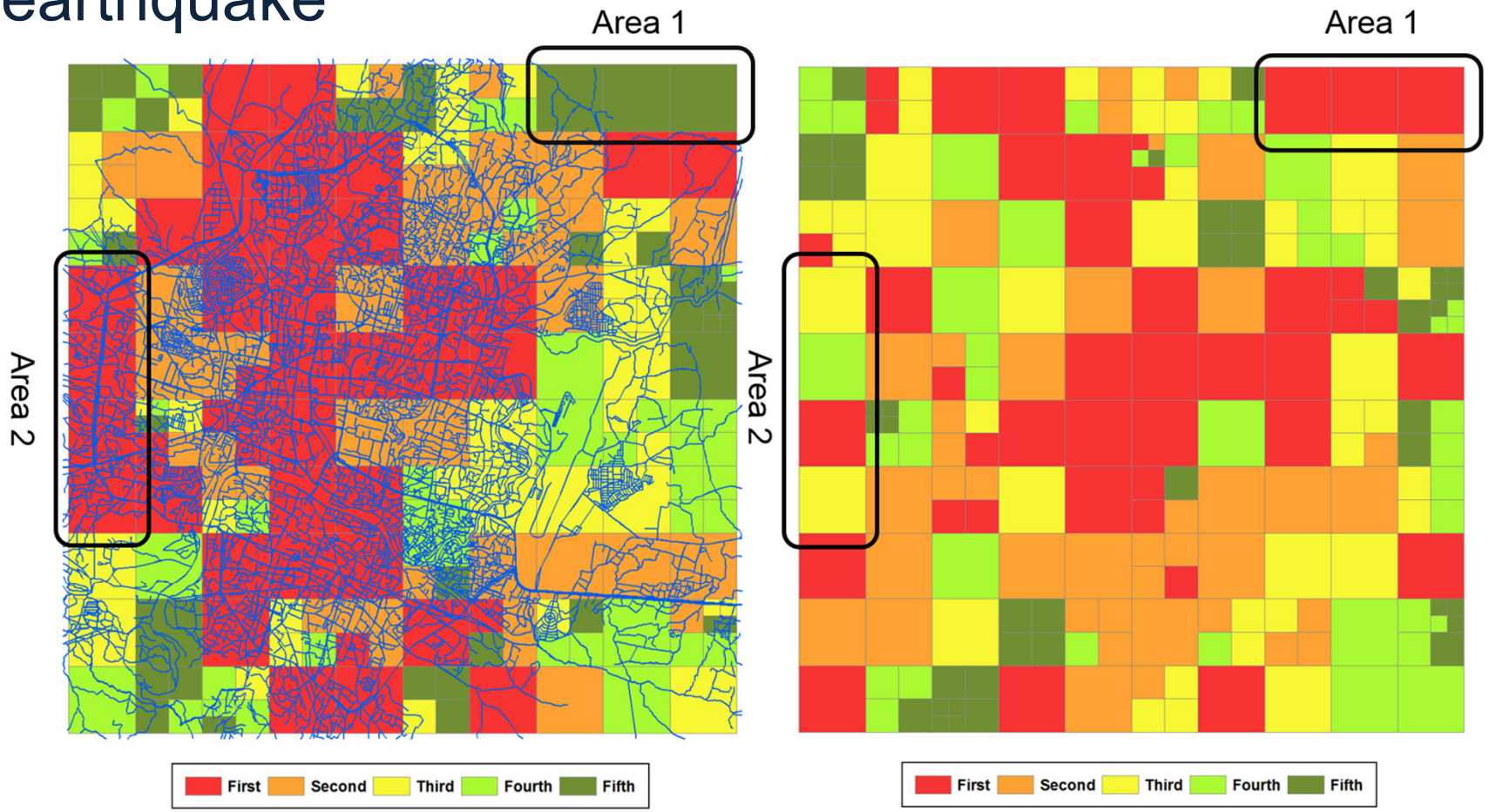


(a) Road network and the earthquake intensities



(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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