Ethical Use of Space-Based Technologies for Disaster Management

Talbot Brooks, Director

Center for Interdisciplinary Geospatial Information Technologies
Delta State University

UN-SPIDER Regional Support Office, North America

Just because we can does not mean we should.

Purpose: To Promote Dialogue

- The basic problem set
  - A COVID-19-based example
- Challenges
  - Temporal and spatial resolutions appropriate to the problem set
  - Protecting at-risk populations
  - Intellectual property – data and copyright issues
  - Qualifications for producers and users
- Ethics and UN-SPIDER
- Summary

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Monitoring Disease Trends using Hospital Traffic Data from High Resolution Satellite Imagery: A Feasibility Study

Elaine O. Nsoesie,[a,1,2] Patrick Butler,[4] Naren Ramakrishnan,[4] Sumiko R. Mekaru,[1] and John S. Brownstein[1,2,3]

▸ Author information ▸ Article notes ▸ Copyright and License information Disclaimer

Associated Data

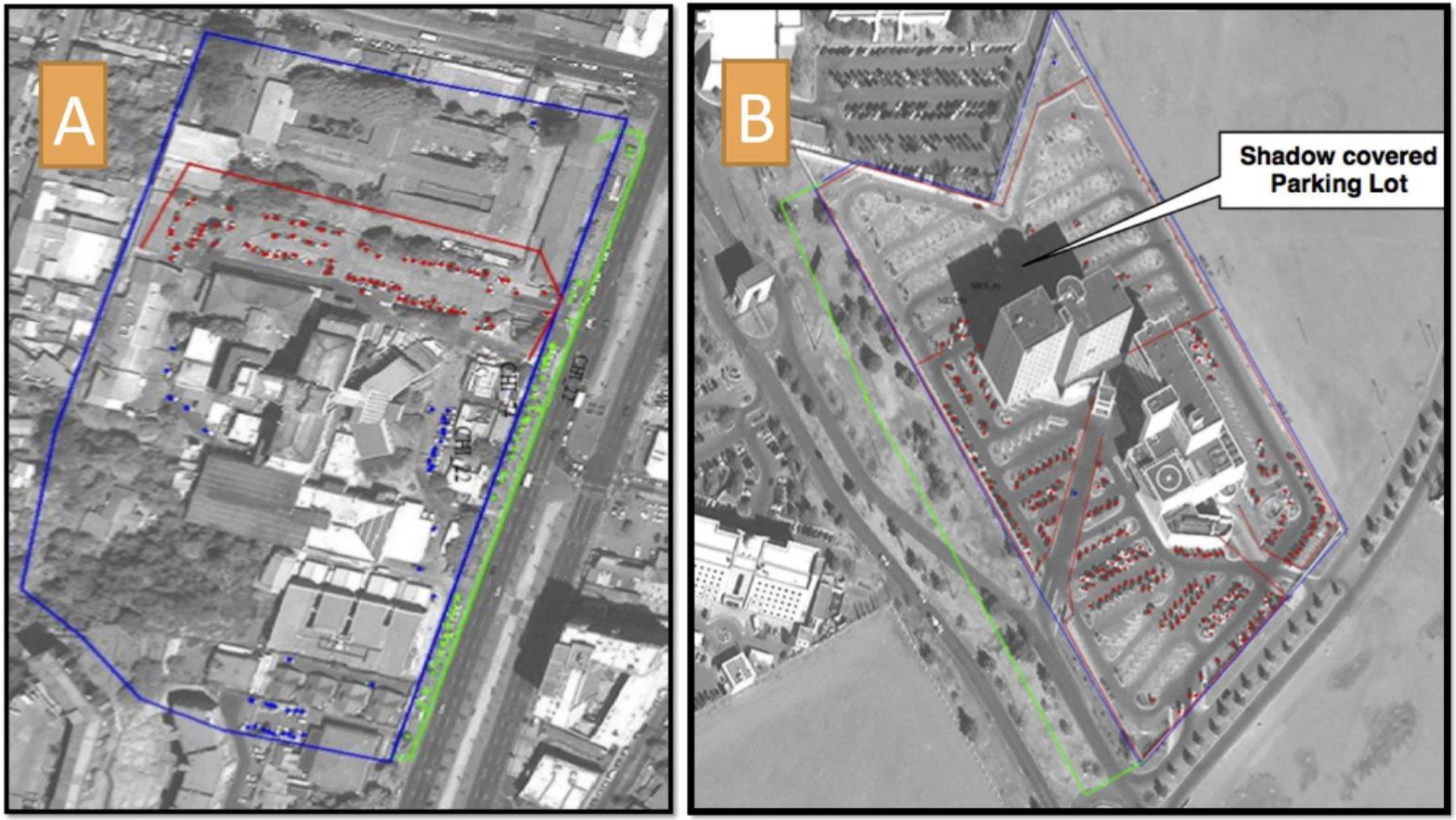
▸ Supplementary Materials

Abstract

Go to:

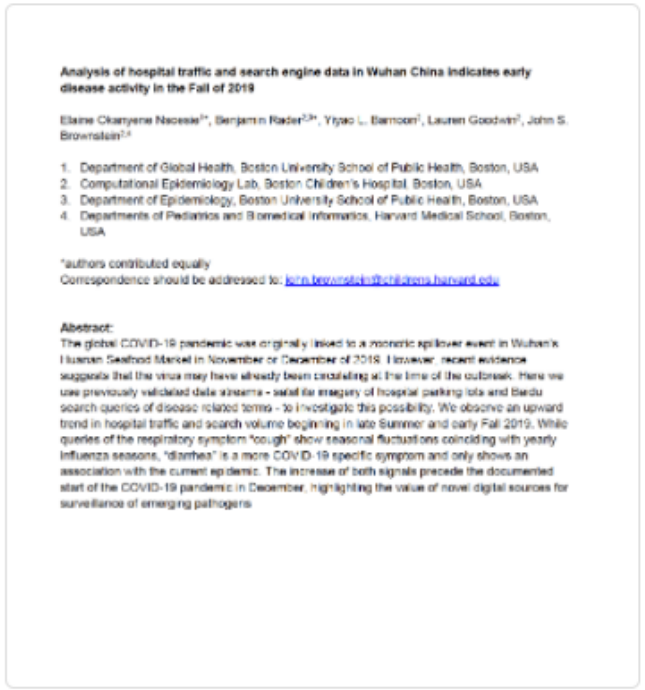
Challenges with alternative data sources for disease surveillance include differentiating the signal from the noise, and obtaining information from data constrained settings. For the latter, events such as increases in hospital traffic could serve as early indicators of social disruption resulting from disease. In this study, we evaluate the feasibility of using hospital parking lot traffic data extracted from high-resolution satellite imagery to augment public health disease surveillance in Chile, Argentina and Mexico. We used archived satellite imagery collected from January 2010 to May 2013 and data on the incidence of respiratory virus illnesses from the Pan American Health Organization as a reference. We developed dynamical Elastic Net multivariable linear regression models to estimate the incidence of respiratory virus illnesses using hospital traffic and assessed how to minimize the effects of noise on the models. We noted that predictions based on models fitted using a sample of observations were better. The results were consistent across countries with selected models having reasonably low normalized root-mean-squared errors and high correlations for both the fits and predictions. The observations from this study suggest that if properly procured and combined with other information, this data source could be useful for monitoring disease trends.

From: Monitoring Disease Trends using Hospital Traffic Data from High Resolution Satellite Imagery: A Feasibility Study



(A) Stencils in different colors were used to delineate hospital premises, parking lot borders and street parking. (B) Example of hospital that was excluded from analysis due to shadow in the parking lot. Remote Sensing Metrics Analysis; Imagery (c) 2014 DigitalGlobe.

Analysis of hospital traffic and search engine data in Wuhan China indicates early disease activity in the Fall of 2019



Analysis of hospital traffic and search engine data in Wuhan China indicates early disease activity in the Fall of 2019

Elaine Okanyene Nsoesie[1*], Benjamin Rader[2,3*], Yiyao L. Barnoon[3], Lauren Goodwin[3], John S. Brownstein[2,4]

1. Department of Global Health, Boston University School of Public Health, Boston, USA
2. Computational Epidemiology Lab, Boston Children's Hospital, Boston, USA
3. Department of Epidemiology, Boston University School of Public Health, Boston, USA
4. Departments of Pediatrics and Biomedical Informatics, Harvard Medical School, Boston, USA

*authors contributed equally
Correspondence should be addressed to: [illegible]

Abstract:
The global COVID-19 pandemic was originally linked to a zoonotic spillover event in Wuhan's Huanan Seafood Market in November or December of 2019. However, recent evidence suggests that the virus may have already been circulating at the time of the outbreak. Here we use previously validated data streams - satellite imagery of hospital parking lots and Baidu search queries of disease related terms - to investigate this possibility. We observe an upward trend in hospital traffic and search volume beginning in late Summer and early Fall 2019. While queries of the respiratory symptom "cough" show seasonal fluctuations coinciding with yearly influenza seasons, "diarrhea" is a more COVID-19 specific symptom and only shows an association with the current epidemic. The increase of both signals precede the documented start of the COVID-19 pandemic in December, highlighting the value of novel digital sources for surveillance of emerging pathogens

View/Open

Satellite_Images_Baidu_COVID19_manuscript_DASH.pdf (1.805Mb)

Author

Nsoesie, Elaine Okanyene

Rader, Benjamin

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Abstract

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Potential for Equity or Abuse?

- A map of neighborhood demographics, hospital/clinic location, and frequent high-resolution imagery has as much potential for harm as it does for good
  - Identify and remedy under-served areas
  - Identify and starve under-served areas

CASES, DATA & SURVEILLANCE

COVID-19 Hospitalization and Death by Race/Ethnicity

Updated Aug. 18, 2020 Print

Race and ethnicity are risk markers for other underlying conditions that impact health — including socioeconomic status, access to health care, and increased exposure to the virus due to occupation (e.g., frontline, essential, and critical infrastructure workers).

Rate ratios compared to White, Non-Hispanic Persons	American Indian or Alaska Native, Non-Hispanic persons	Asian, Non-Hispanic persons	Black or African American, Non-Hispanic persons	Hispanic or Latino persons
Cases[1]	2.8x higher	1.1x higher	2.6x higher	2.8x higher
Hospitalization[2]	5.3x higher	1.3x higher	4.7x higher	4.6x higher
Death[3]	1.4x higher	No Increase	2.1x higher	1.1x higher

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html

Temporal and Spatial Resolution

- Space-based imaging systems are capable of obtaining high resolution images which exceed fundamental problem set requirements
  - The potential for information overload/saturation is a massive risk
  - Temptation to let technology do the work for us – platform and sensor capabilities do not substitute for expertise
  - In a world where everyone with Google is an expert, the need for true expertise (and those who will listen to it) is often overlooked
  - The temptation to forget our own limits for the purpose of helping other or solving “the problem” is all too easy

Vulnerable and At-Risk Populations

- The use of space-based imagery as part of a disaster response has the potential to hurt one population group while helping another
- Areas effected by regional conflict and disaster are ripe for the abuse of space-based imagery
  - What are the possibilities for abusing COVID-19 and drought monitoring imagery in Ethiopia at present day?
  - How were recent elections in the US effected by imagery used for COVID-19 surveillance?
- Do commercial- and government-based imagery providers have an equitable stake in the ethical distribution of products and services?

Data Fusion – Endless Possibilities

- The recombination or fusion of space-based data with other sources opens unlimited potential applications
- Are there certain use cases for which space-based data serve as the critical key to unlocking abuse?
  - What space-based data sets serve a pivotal role in creating greater threat than solution and under what circumstances?
  - How is “more harm than good” weighed and measured?

Screenshot from a DVD copy of *Austin Powers: International Man of Mystery' created and uploaded by Blackwatch21 to Wikipedia. Image copyright for the film is owned by the New Line Cinema and presented here as fair use under US copyright law.*

Licensing and Intellectual Property

- UN-SPIDER and its immediate collaborators do are sensitive about licensing and intellectual property, BUT
  - How are down-stream users educated?
  - Is competition inadvertently created among imagery providers?
- How long is intellectual property maintained?
- Are there standards within UN-SPIDER for source referencing?

Qualifications and Equity

- An obligation to ensure end-to-end quality assurance
  - What qualifications are required to create maps, distribute space-based data, or otherwise engage in geospatial activities in support of crisis or disaster?
  - How are uncertainties about the maps and data shared relayed to end users?
- The humanitarian geospatial support community relies heavily on volunteers
  - What steps are taken to ensure that volunteered efforts are not unfairly re-purposed to create derivative for-profit products?
  - **Hypothetical example** – huge swaths of previously blank space on the map in developing countries were filled in using volunteer crowd source efforts responding to calls for help. Numerous geospatial service providers raced to provide platforms and systems to facilitate the response, but were there ulterior motives which may have ultimately cost the nation/region suffering disaster more in the longer term???

Thoughts for Discussion

- Is there a need to formulate a clear statement on ethics and include it in work agreements/processes, training, and outreach?
- Is there a need to introduce neutral expertise in regional cultural geography to ensure products do not compromise populations at risk due to local/regional conflict (or the potential thereof)?
- What mechanisms may be created to help improve ethical conduct within our community and those communities whom we serve?
- What training can UN-SPIDER facilitate in this arena?
- Are there other ethical considerations in need of attention?

Closing Thoughts

- COVID-19 is another milestone for the application of geospatial to disaster response
  - Hurricane Katrina was a watershed moment in the US because it created massive awareness about the BASIC usefulness of geospatial technologies within the disaster response community
  - Coronavirus is the second pivotal moment in disaster geospatial because it has raised awareness about the power of integrating/fusing geospatial from infinitely diverse sources for infinitely diverse purposes
- Use of space-based and geospatial technologies to combat this plague provide an ideal opportunity to explore ethical issues in this arena and the international nature of UN-SPIDER provides an ideal forum