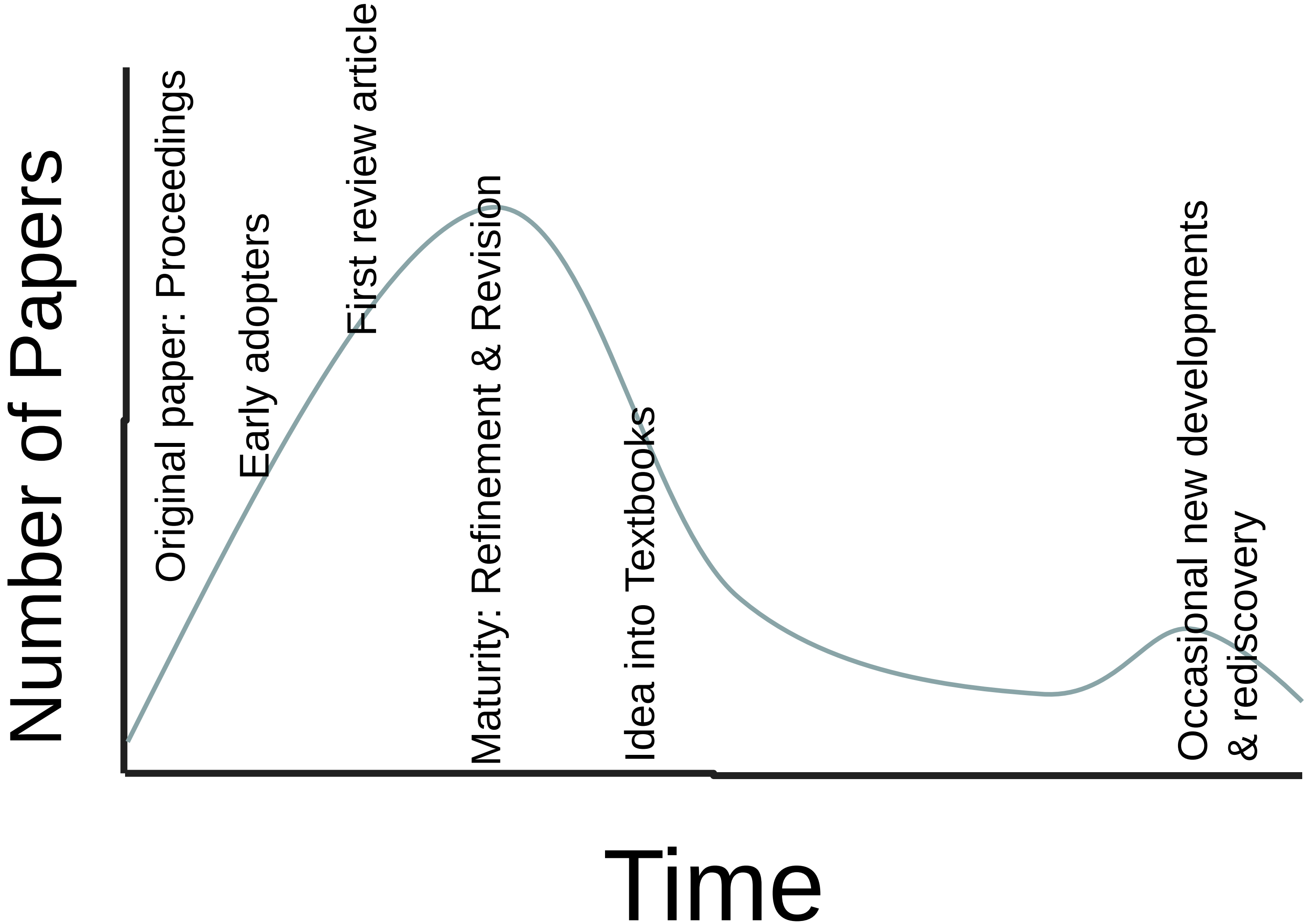
Analytical and Computer Cartography Winter Quarter 2017

Lecture 17:
Current Research in Analytical and Computer Cartography

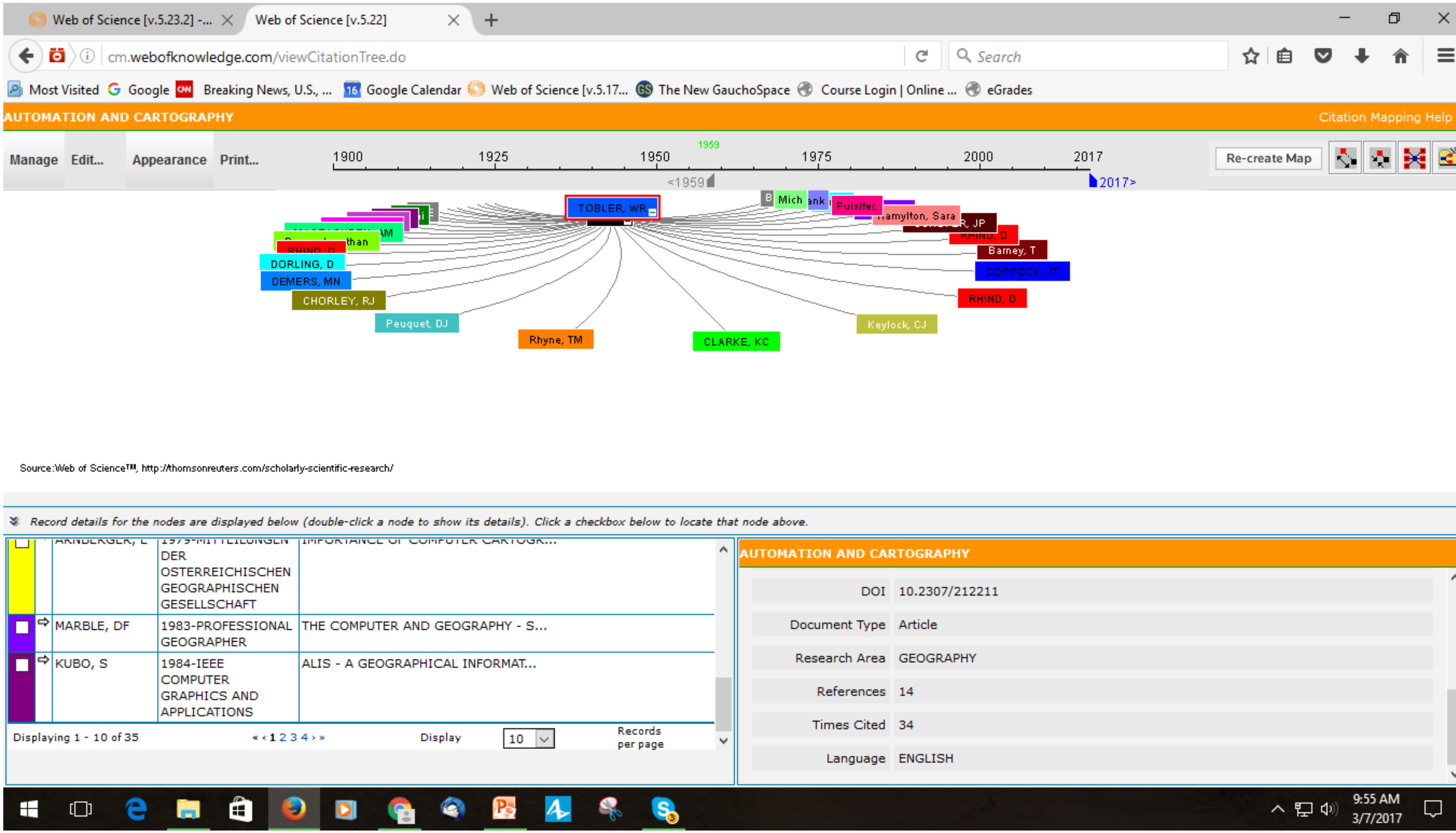
Current Research

- Already looked at major cartographic journals
- Will cover a sample of recent papers doing new research using analytical and computer cartography
- Note the methods, universities and value of the findings
- No attempt to be comprehensive, a moving target

The Nature of New Ideas



Citation maps



Metaanalysis

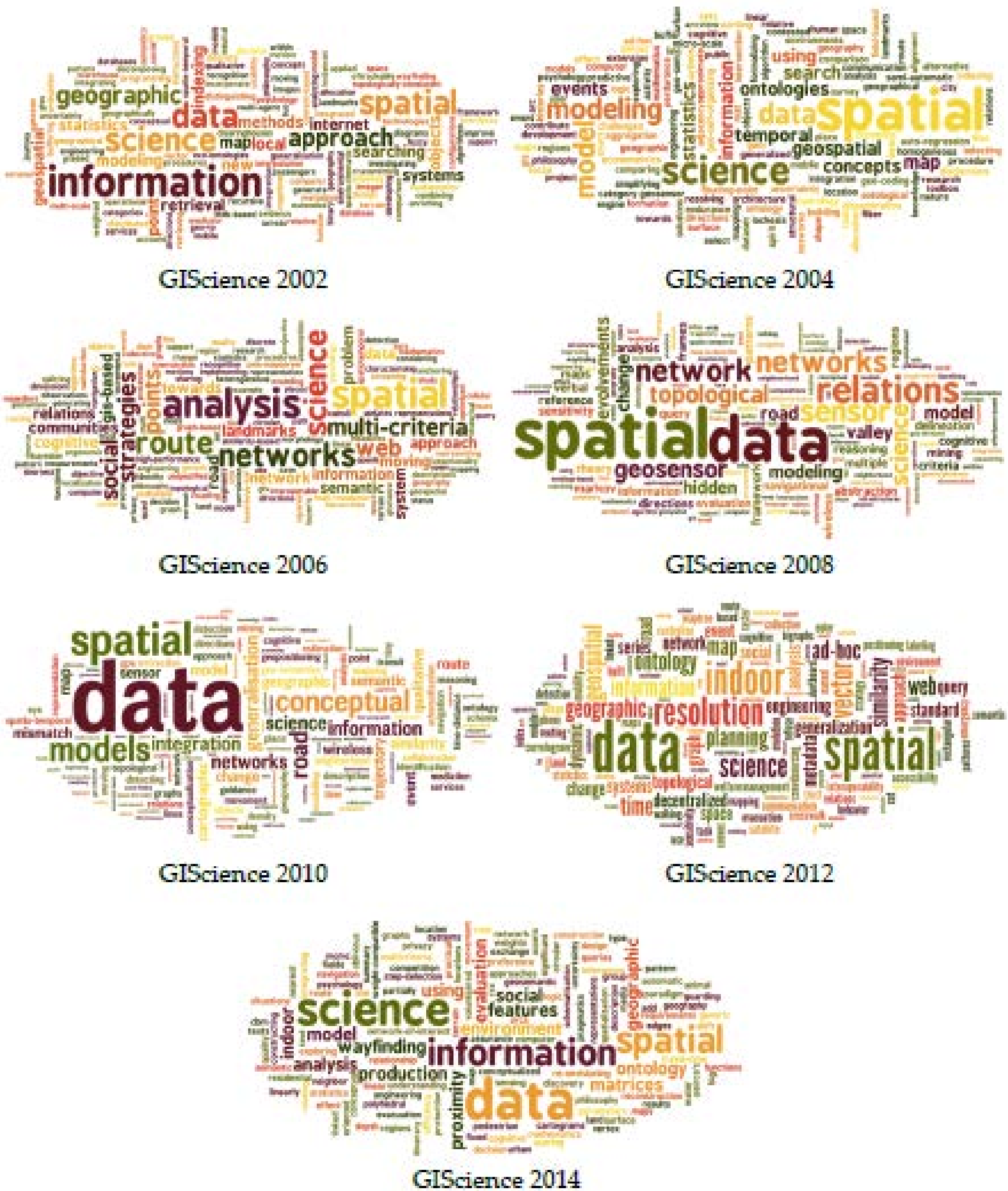
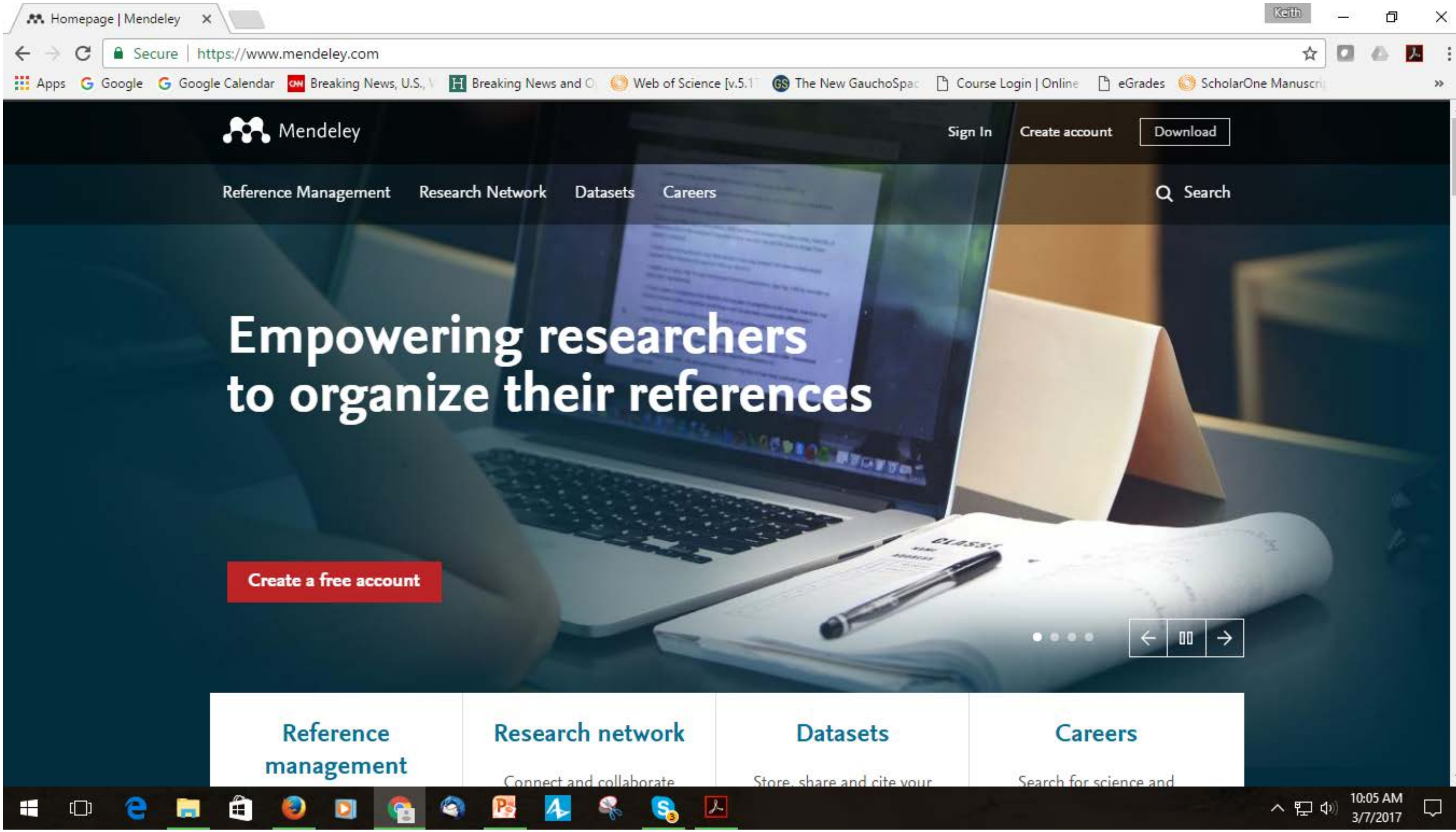


Figure 2: Word clouds of full papers of the GIScience conference 2002–2014.

Some research tools

- DOI: papers and data
- Supplemental material, citations to SourceForge, etc
- Interactive PDFs: Links etc
- Online support for submittal, review and publication
- Online only, eTexts, eBooks, eJournals
- Endnote, Zotero, Mendeley
- Google Scholar, Web of Science
- Researchgate, LinkedIn, etc

Mendeley


Homepage | Mendeley
Secure
https://www.mendeley.com
Apps
Google
Google Calendar
eGrades
Mendeley
Sign In
Create account
Download
Reference Management
Research Network
Datasets
Careers
Search
Empowering researchers to organize their references
Create a free account
Reference management
Research network
Datasets
Careers
10:05 AM
3/7/2017

The four papers

- Zhenlong Li, Cuizhen Wang, Christopher T. Emrich & Diansheng Guo (2017): A novel approach to leveraging social media for rapid flood mapping: a case study of the 2015 South Carolina floods *Cartography and Geographic Information Science*, DOI: 10.1080/15230406.2016.1271356
- Ian J. Irmischer & Keith C. Clarke (2017): Measuring and modeling the speed of human navigation, *Cartography and Geographic Information Science*. DOI: 10.1080/15230406.2017.1292150
- Eric Nost, Heather Rosenfeld, Kristen Vincent, Sarah A. Moore & Robert E. Roth (2017) HazMatMapper: an online and interactive geographic visualization tool for exploring transnational flows of hazardous waste and environmental justice, *Journal of Maps*, 13:1, 14-23, DOI: 10.1080/17445647.2017.1282384
- Michael J. Campbell, Philip E. Dennison & Bret W. Butler (2016): Safe separation distance score: a new metric for evaluating wildland firefighter safety zones using lidar, *International Journal of Geographical Information Science,* DOI: 10.1080/13658816.2016.1270453

Zhenlong Li et al. (2017)

CARTOGRAPHY AND GEOGRAPHIC INFORMATION SCIENCE, 2017
http://dx.doi.org/10.1080/15230406.2016.1271356

Taylor & Francis
Taylor & Francis Group

A novel approach to leveraging social media for rapid flood mapping: a case study of the 2015 South Carolina floods

Zhenlong Li [a], Cuizhen Wang [a], Christopher T. Emrich [b] and Diansheng Guo [a]

[a]Department of Geography, University of South Carolina, Columbia, USA; [b]School of Public Administration & Sustainable Coastal Systems Cluster, University of Central Florida, Orlando, USA

Study

- Twitter as a new data source for disaster management and flood mapping
- “Using the 2015 South Carolina floods as the study case, this paper introduces a novel approach to mapping the flood in near real time by leveraging Twitter data in geospatial processes”
- Analyzed the spatiotemporal patterns of flood-related tweets using quantitative methods to better understand how Twitter activity is related to flood phenomena
- Kernel-based flood mapping model was developed to map the flooding possibility for the study area based on the water height points derived from tweets and stream gauges
- Patterns of Tweets used to assign the weights of flood model parameters.
- Feasibility and accuracy of the model evaluated

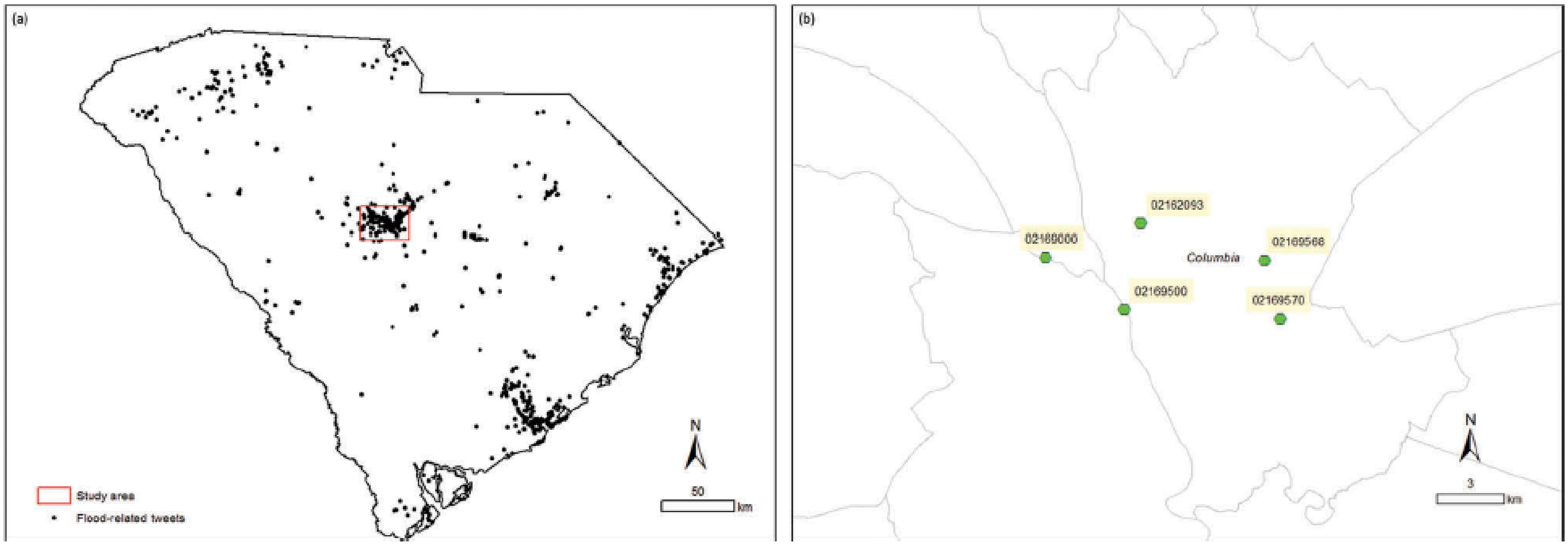


Figure 1. (a) Flood-related georeferenced tweets in South Carolina. The red rectangle indicates the study area (Columbia area). (b) Location of the five selected USGS Stream gauges within the study area.

Workflow

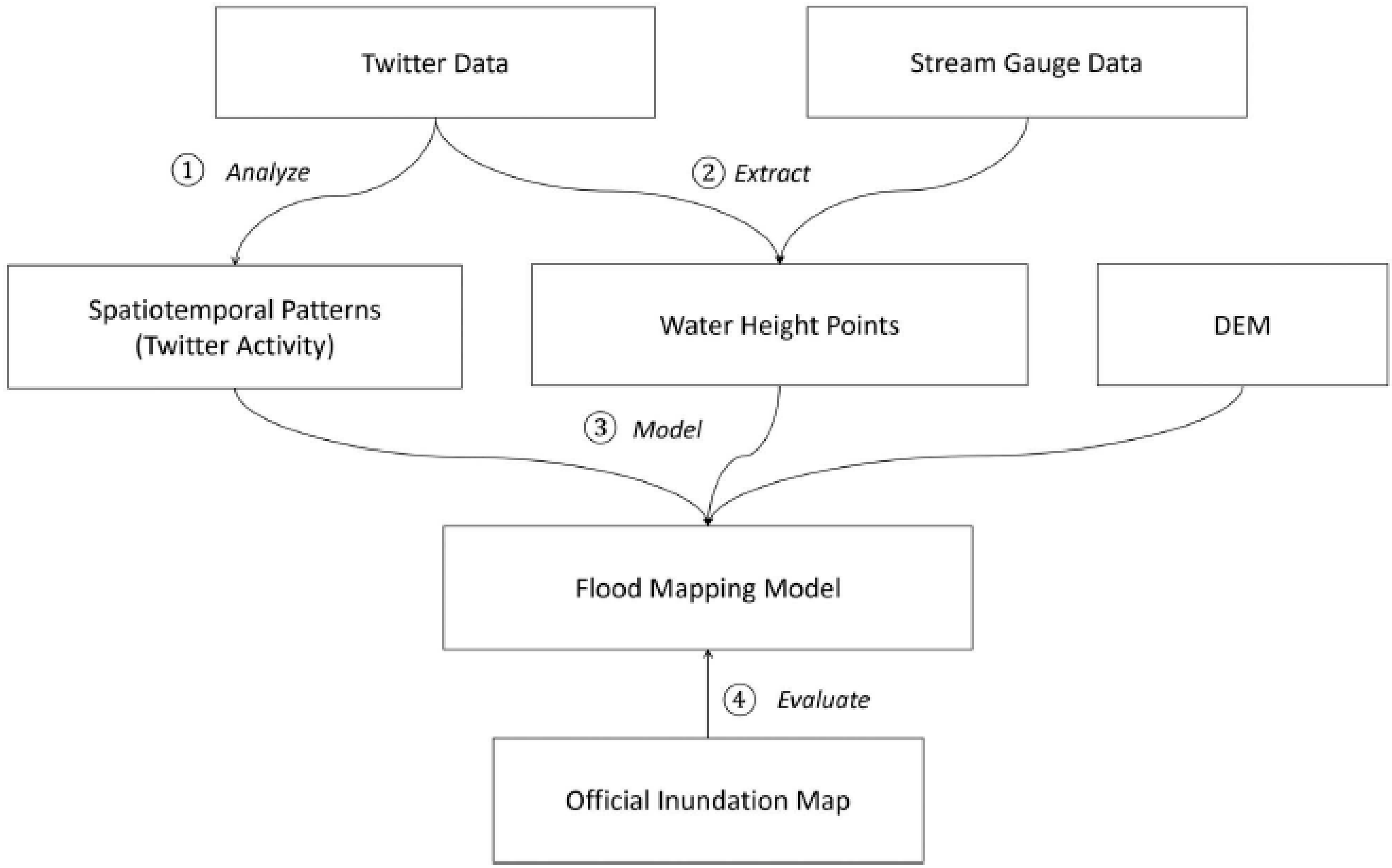


Figure 2. Overview of our research approach.

Modeled flooding

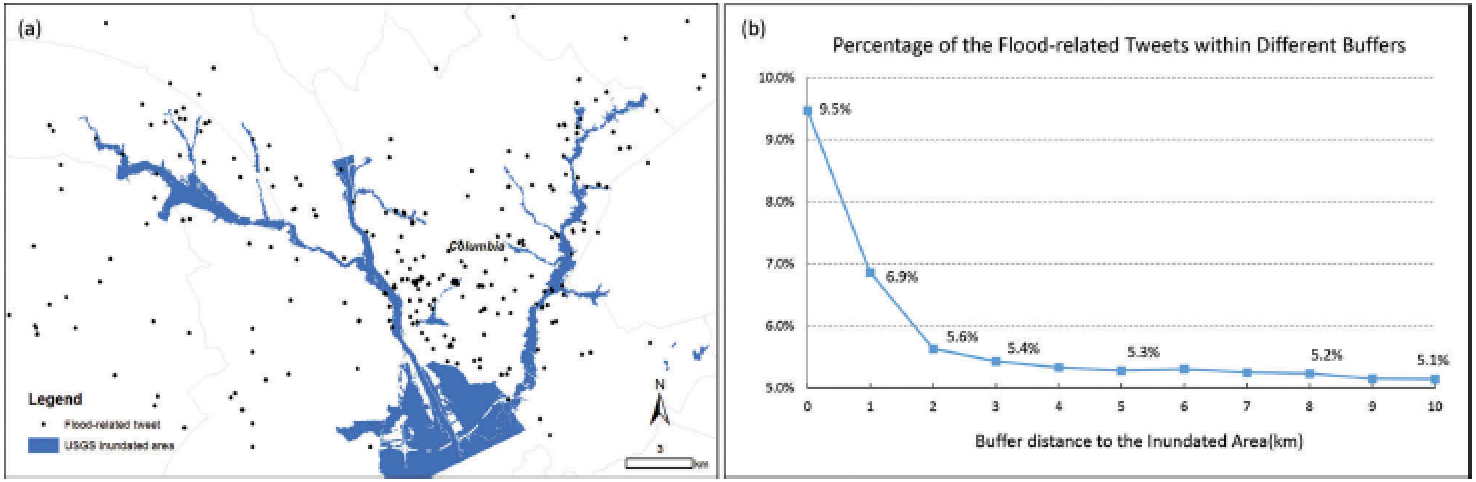


Fig
dif

ith

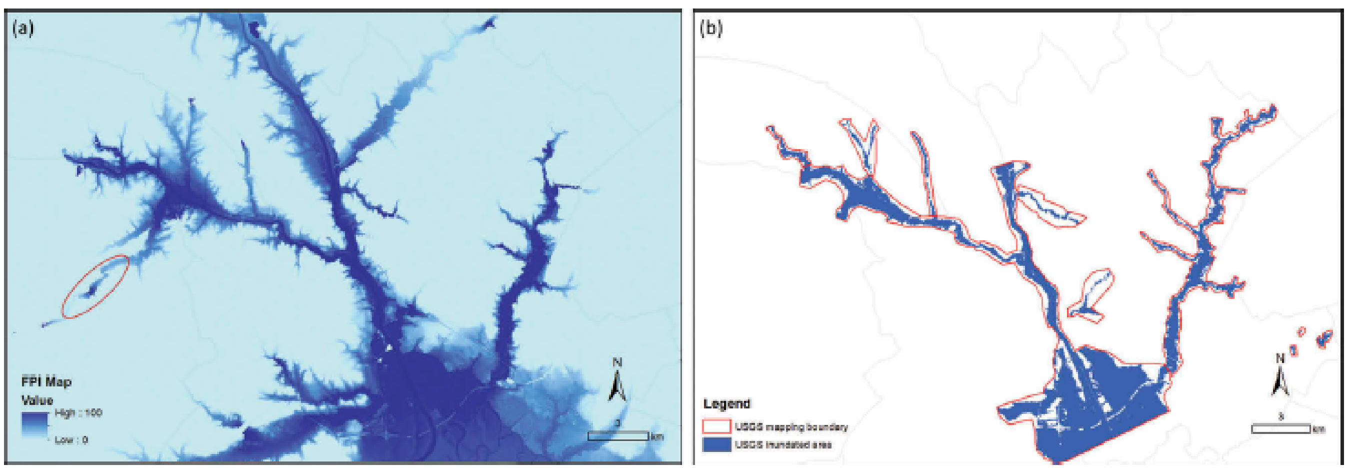


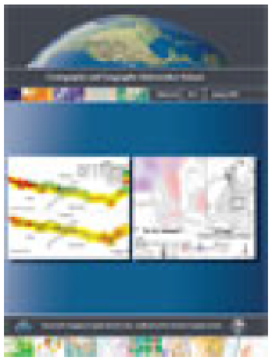
Figure 9. (a) Final FPI map based on 25 FPI surfaces. Larger value (darker blue area) indicates a higher possibility of being flooded. (b) USGS inundation maps (red polygon shows the mapping boundary used by USGS).

Social Media Data as Map Information

“Using the 2015 South Carolina floods in October as the study case, this paper proposed a novel approach to extracting potentially useful information from social media data (tweets) to assist rapid flood mapping, thus represents an improvement in situational awareness during a flooding event.”

“The preliminary results showed that the model output provided a consistent and comparable estimation of the flood situation across the whole study area. Such a map, which can be generated in near real time, is useful for improving situational awareness during or right after the flooding event. This is of particular importance when social media (and/or stream gauges) is the only data available during the floods.”

Irmischer & Clarke (2017)



Taylor & Francis
Taylor & Francis Group

Cartography and Geographic Information Science

ISSN: 1523-0406 (Print) 1545-0465 (Online) Journal homepage: http://www.tandfonline.com/loi/tcag20

Measuring and modeling the speed of human navigation

Ian J. Irmischer & Keith C. Clarke

To cite this article: Ian J. Irmischer & Keith C. Clarke (2017): Measuring and modeling the speed of human navigation, Cartography and Geographic Information Science

To link to this article: http://dx.doi.org/10.1080/15230406.2017.1292150

Irmischer & Clarke (2017)

- Navigation, the goal-related movement through space and time
- Modeled the speed of movement of humans engaged in navigation in wooded environments with varied terrain
- Movement models were developed using spatiotemporal analysis of multiple subjects' trajectories with GPS
- Trajectory data were merged with land-cover data to analyze human navigation over varying slopes and terrain.
- Tested Tobler's hiking function and Naismith's rule
- The model created from this study was shown to outperform those classic human movement speed estimators by predicting route completion time within 10% accuracy (M = 11.1min, 95% CI [9.8, 12.4] min).

The test area

Figure 2. USMA navigation training area.

Tobler’s Hiking Function

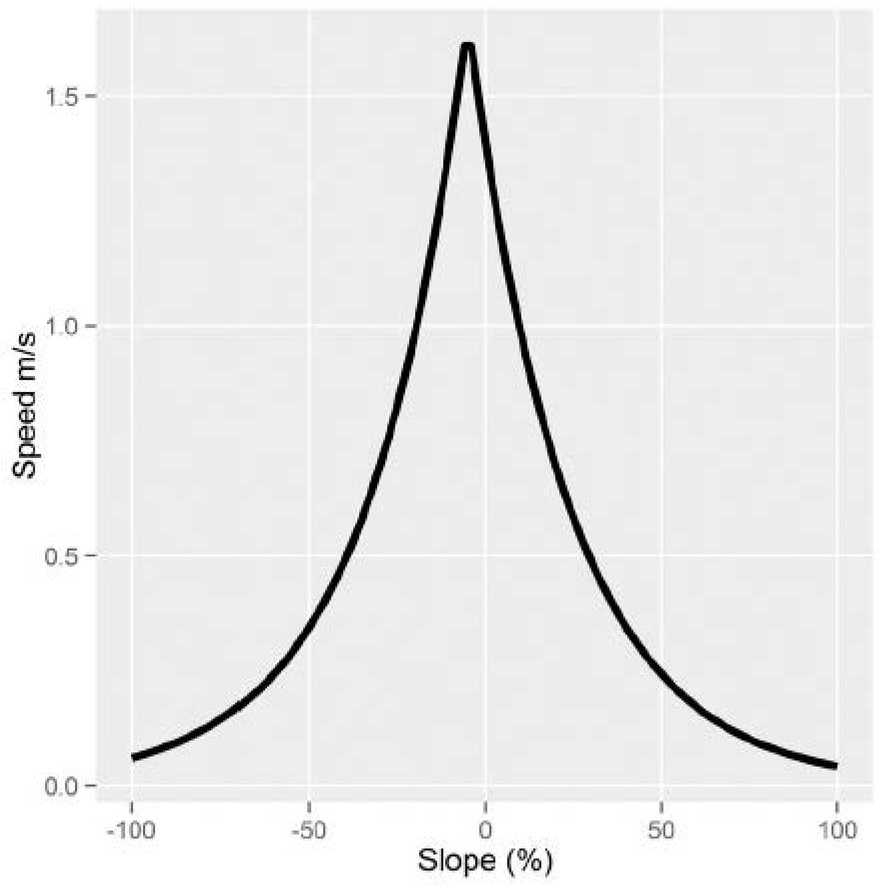


Figure 1. Tobler’s hiking function.

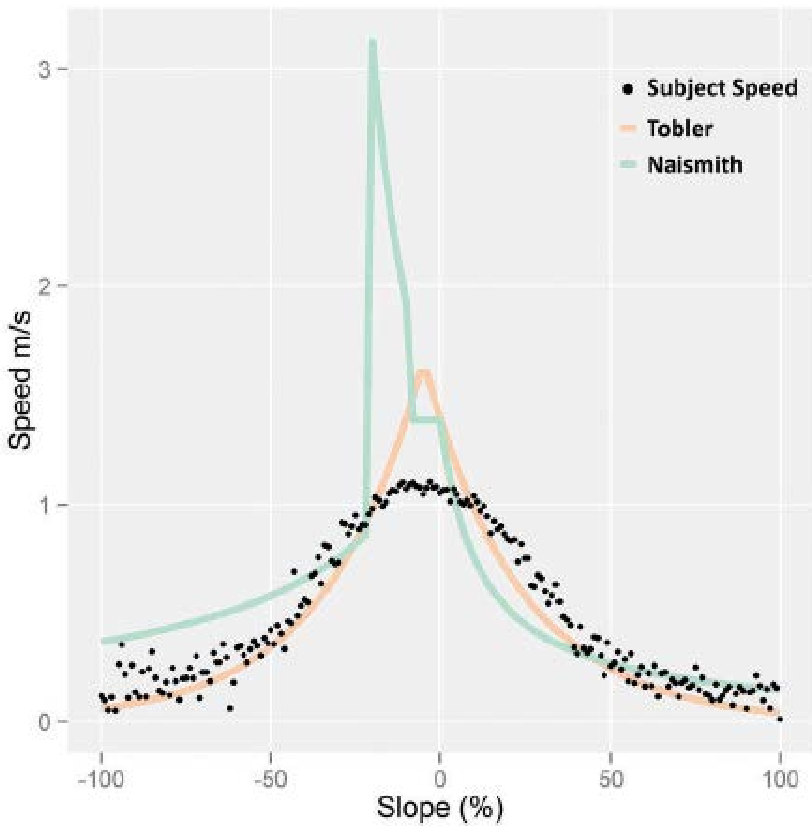


Figure 4. On-road speed of navigation – males.

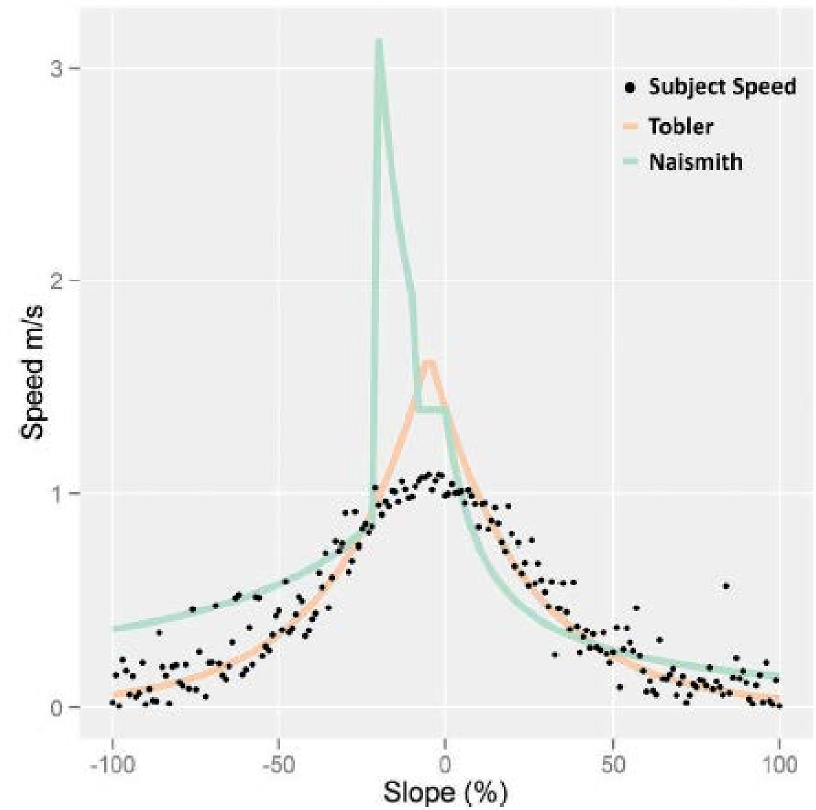


Figure 5. On-road speed of navigation – females.

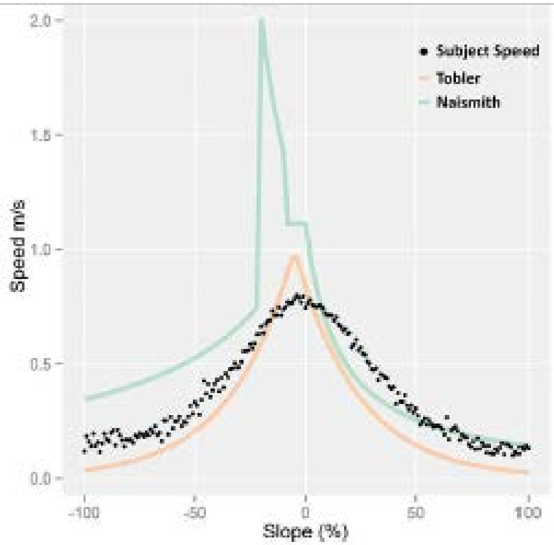


Figure 6. Off-road speed of navigation – males.

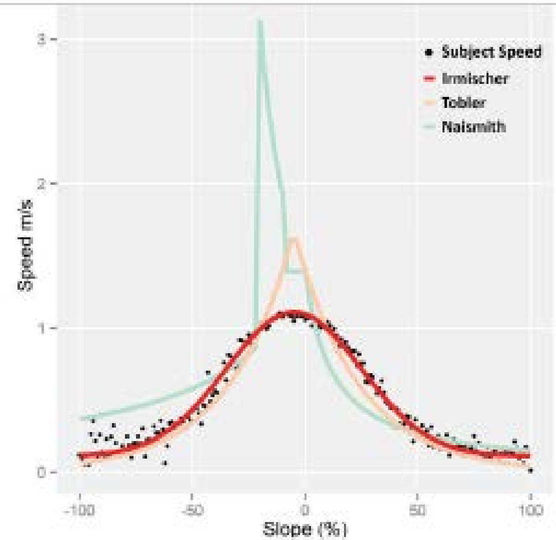


Figure 8. Irmischer model of on-road navigation speed – males.

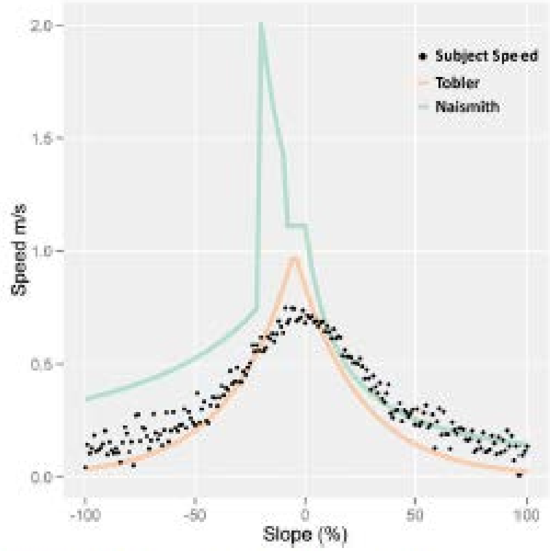


Figure 7. Off-road speed of navigation – females.

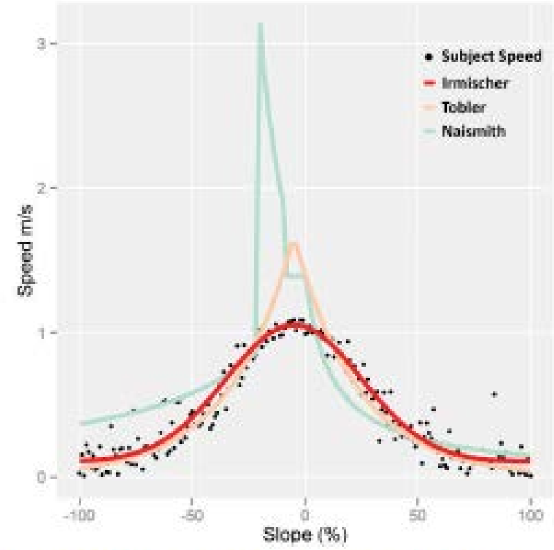


Figure 9. Irmischer model of on-road navigation speed – females.

Conclusion

- Developed and tested a model of navigation speed.
- Exploration of navigation, locomotion, and wayfinding has developed a methodology and framework to define the cognitive cost of navigation, which amounted to 34% of the task time in the West Point data.
- The ability to predict and model the speed of navigation has widespread use:
  - Models of navigation speeds can be used to help wilderness recreation aficionados plan how far they can travel in a day along specified routes.
  - Archaeologists can use these models to predict time-space computations of ancient travel.
  - Back-country search and rescue teams can use the equations to estimate ranges of lost persons.
  - The military will undoubtedly benefit by using these models to plan missions that require overland navigation.
- Research has developed a model for human navigation that includes both wayfinding and locomotion.

Nost et al. (2017)

Taylor & Francis
Taylor & Francis Group

Journal of Maps

ISSN: (Print) 1744-5647 (Online) Journal homepage: http://www.tandfonline.com/loi/tjom20

HazMatMapper: an online and interactive geographic visualization tool for exploring transnational flows of hazardous waste and environmental justice

Eric Nost, Heather Rosenfeld, Kristen Vincent, Sarah A. Moore & Robert E. Roth

HazMatMapper

- Online and interactive geographic visualization tool designed to facilitate exploration of transnational flows of hazardous waste in North America (http://geography.wisc.edu/hazardouswaste/map/).
- Build using Java and D3
- Little is known about how waste trading may affect specific sites within USA/Mexico/Canada.
- Assembled a novel geographic dataset describing transnational hazardous waste shipments from 2007 to 2012 through two FOIA requests for documents held by the US EPA
- HazMatMapper supports multiscale and site-specific visual exploration of US imports of hazardous waste from Canada and Mexico
- Discuss the dataset and design process behind HazMatMapper and demonstrate its utility for understanding the transnational hazardous waste trade.

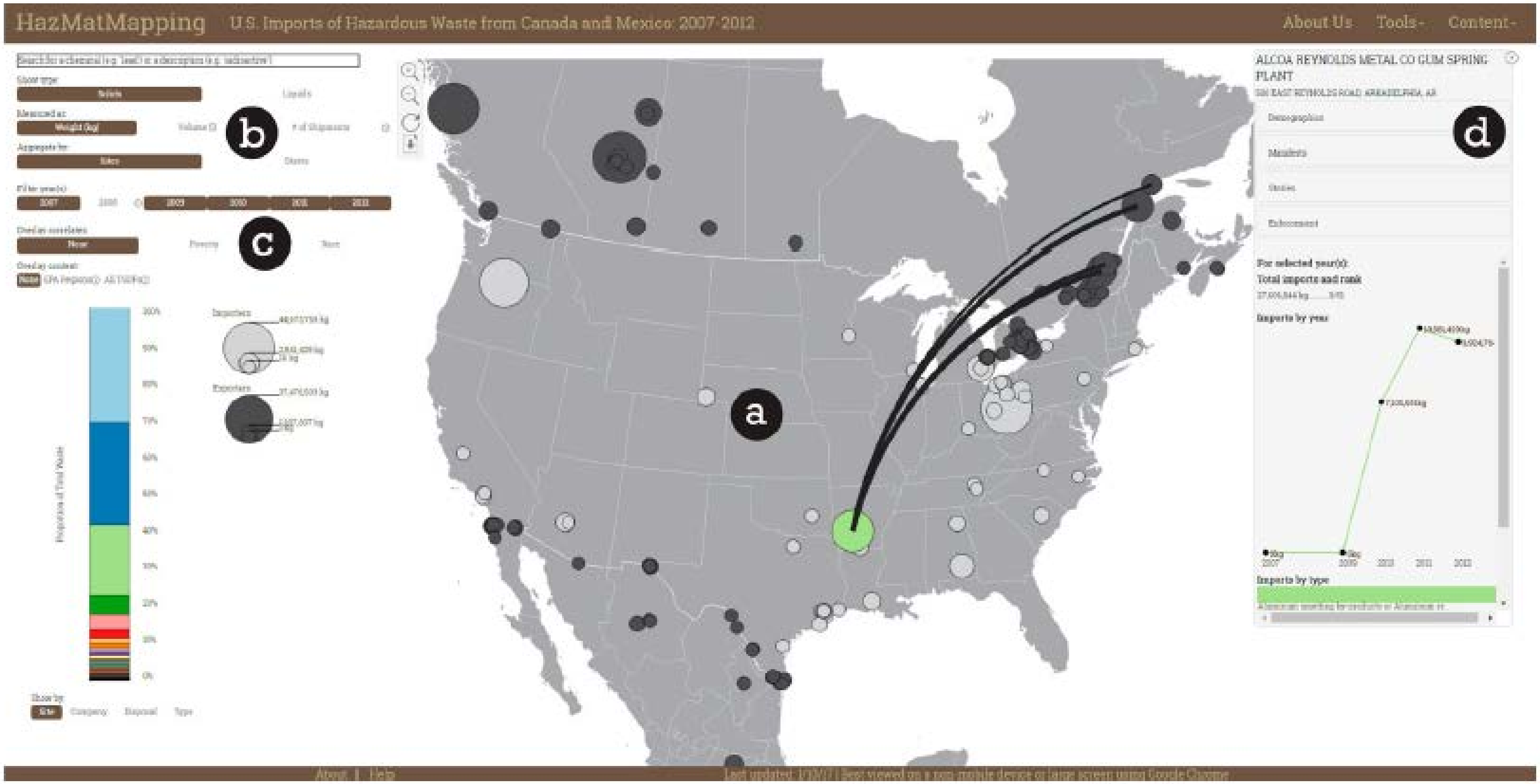


Figure 1. HazMatMapper in action: (a) central map; (b) configuration controls; (c) advanced context controls; and (d) information panel.

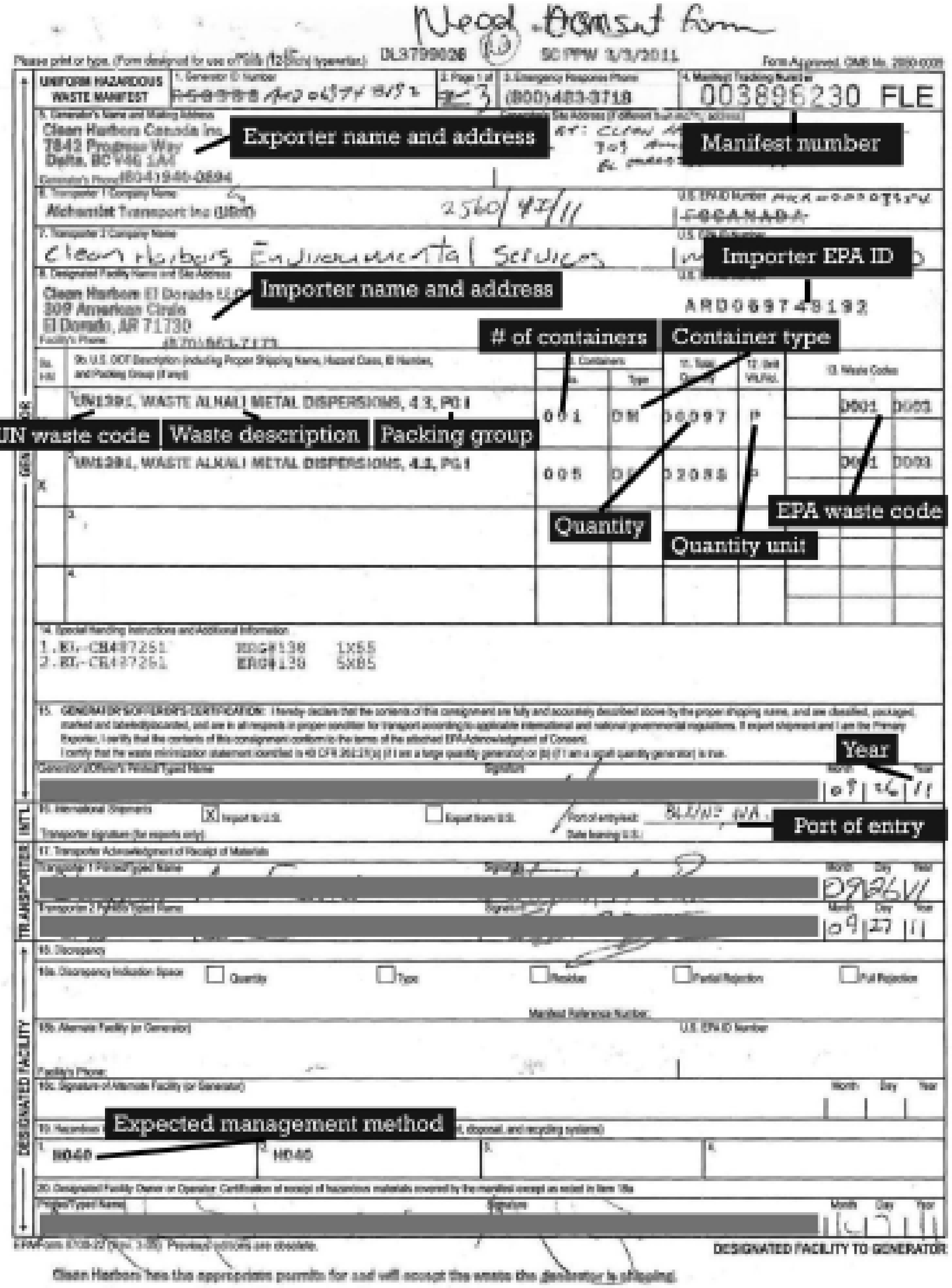


Figure 2. Sample RCRA manifest. Information coded into the spatial database is highlighted. Personal information is screened.

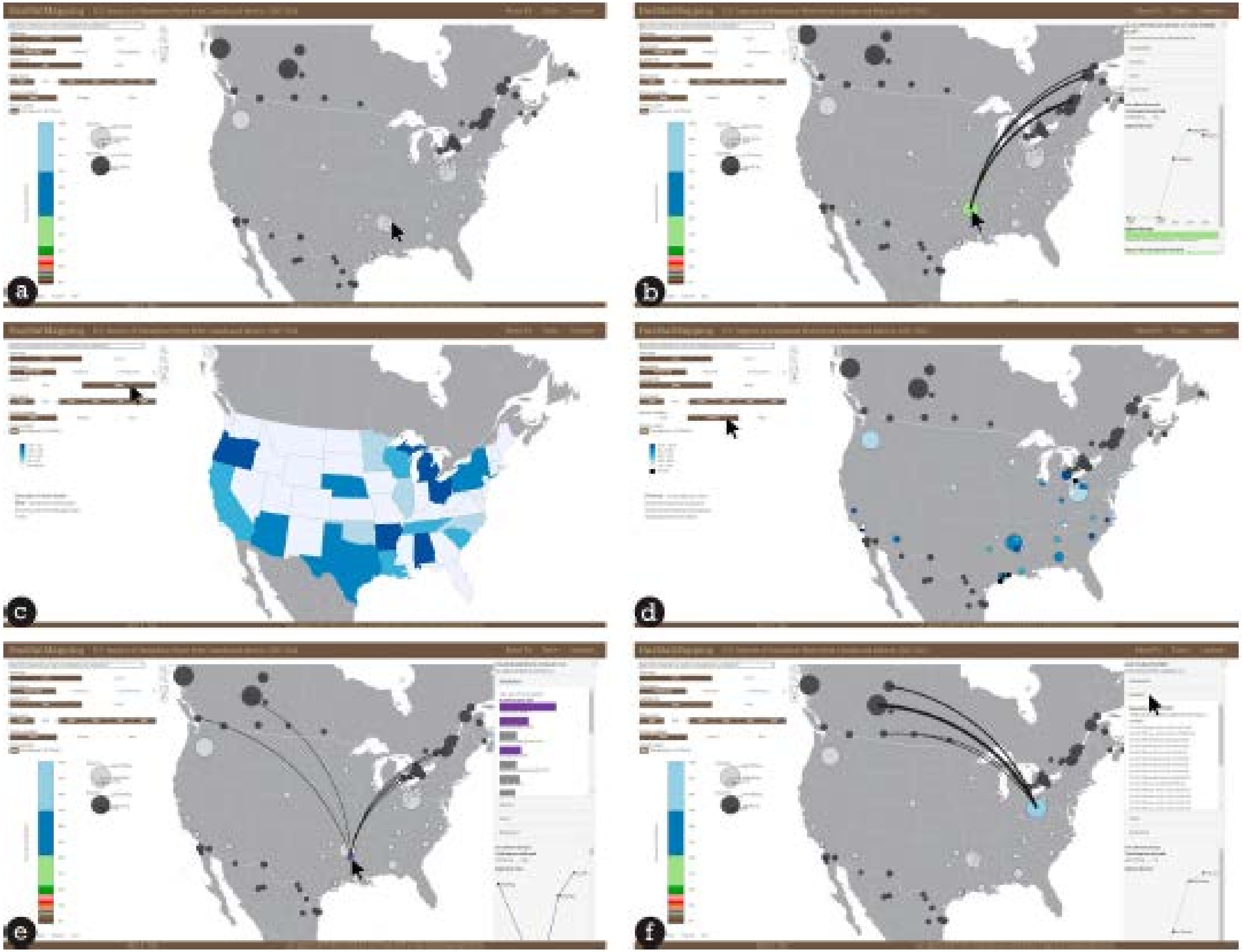
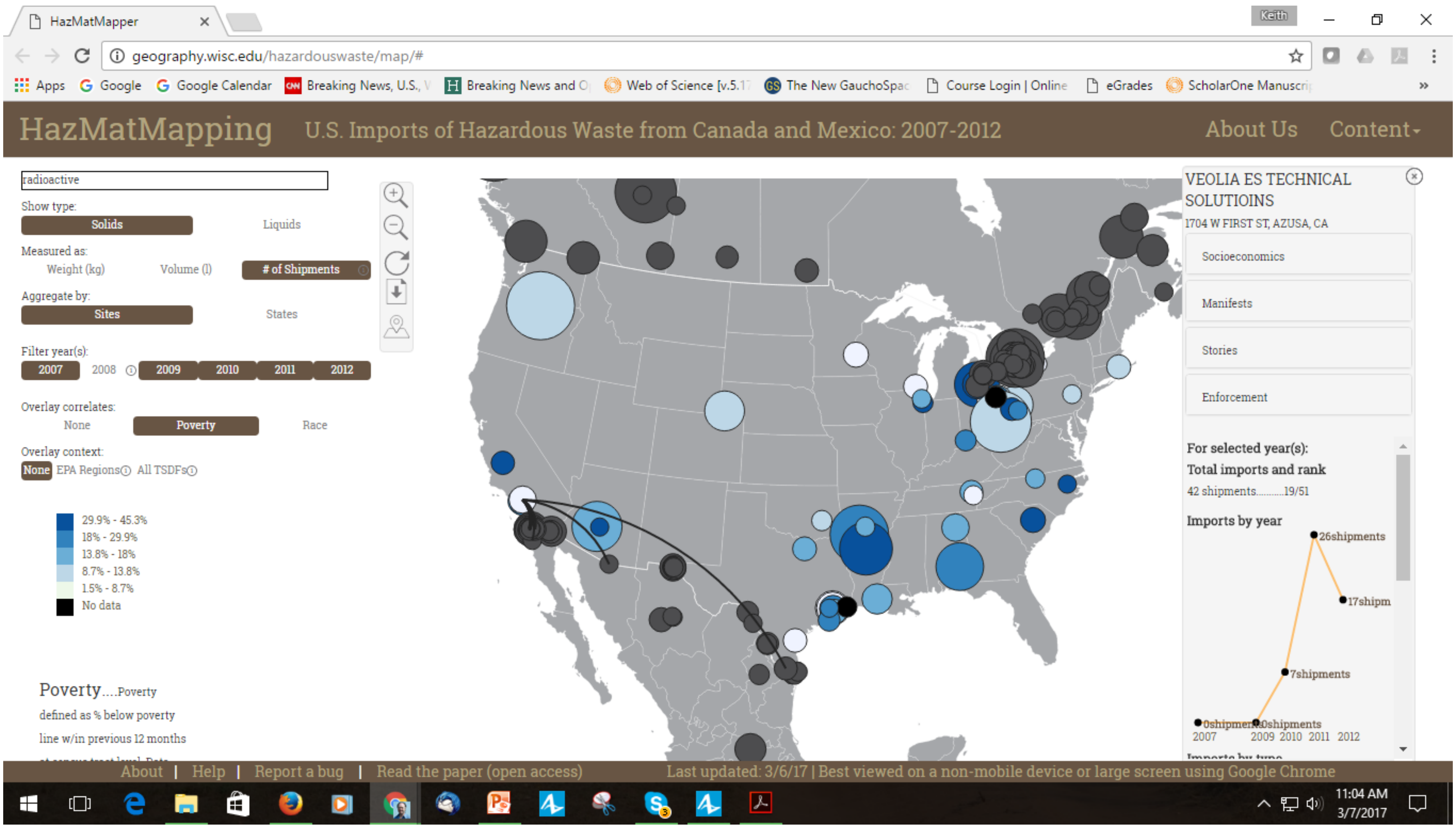


Figure 4. Using HazMatMapper through the four different interface controls: (a) proportional symbols of waste sites are the default view on the central map; (b) clicking on a site draws flow lines between exporters and importers; (c) accessing the configuration controls allows users to draw choropleths of waste imports binned by state; (d) users overlay poverty statistics through the advanced context controls; (e) clicking on a site retrieves further EJ-relevant site data in an information panel; (f) selecting 'manifests' in the informational panel lets the user download copies of the site's waste trade forms.

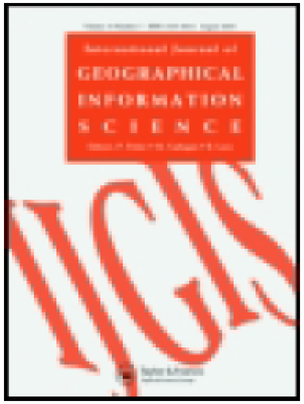
Radioactive Solid Waste to Azusa, CA



Conclusion

- Geographic visualization provides a number of opportunities for understanding the dataset on hazardous waste imports that we have assembled
- HazMatMapper interactive map enables map users to switch between context and detail, in the vein of Shneiderman’s design mantra and in line with our attempt to overcome methodological nationalism

Campbell et al. (2016)



Taylor & Francis
Taylor & Francis Group

International Journal of Geographical Information Science

ISSN: 1365-8816 (Print) 1362-3087 (Online) Journal homepage: http://www.tandfonline.com/loi/tgis20

Safe separation distance score: a new metric for evaluating wildland firefighter safety zones using lidar

Michael J. Campbell, Philip E. Dennison & Bret W. Butler

Campbell et al. (2016)

- Safety zones: areas where firefighters can retreat to in order to avoid entrapment from wildland fire. Currently, individual firefighter's or crew boss interprets vegetation conditions, topography, and spatial characteristics of potential safety zones
- Introduces a new metric for safety zone evaluation: the Safe Separation Distance Score (SSDS) and describes an algorithm for calculating pixel-based and polygon-based SSDS from lidar data.
- SSDS is calculated for every potential safety zone within a lidar dataset covering Tahoe National Forest, California, USA.
- Potential safety zones were clustered in space
- SSDS can be calculated for potential safety zones in advance of firefighting

Safety Zone

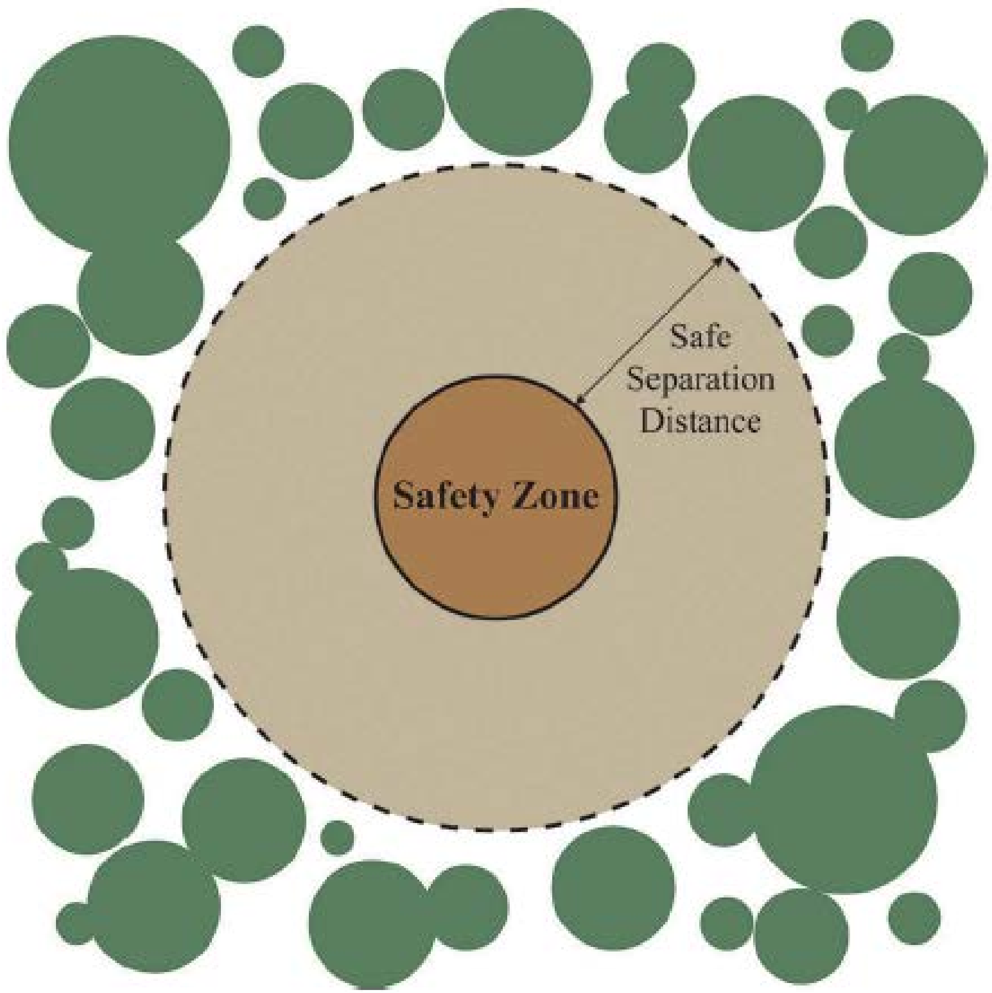


Figure 2. Basic safety zone example diagram (after Dennison *et al*. 2014).

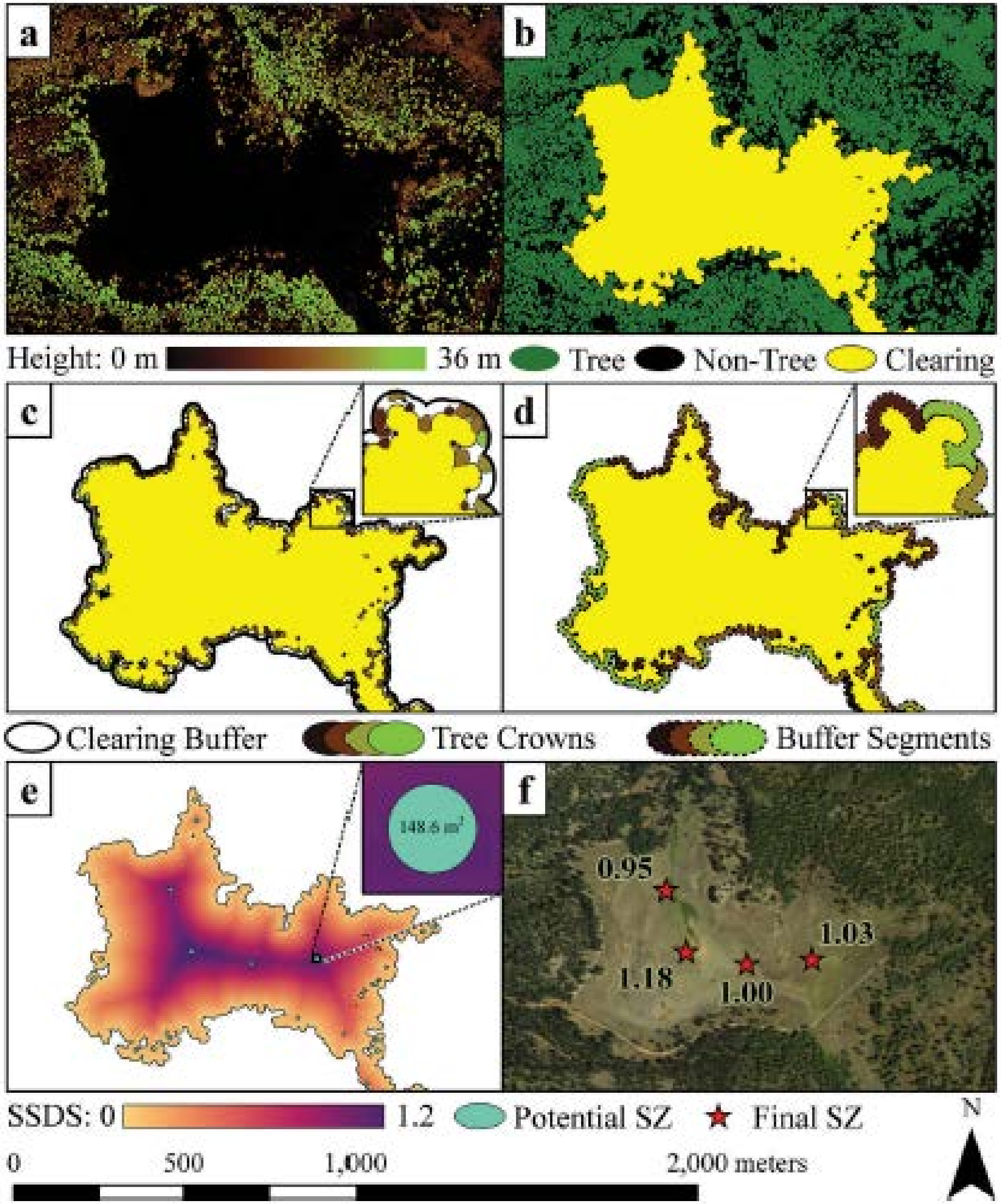


Figure 4. Model workflow from canopy height model (a) to clearing classification (b), surrounding tree crown delineation and height calculation (c), segment-based mean surrounding vegetation height calculation (d), pixel-based SSDS calculation and safety zone placement (e), and safety zone SSDS result (f).

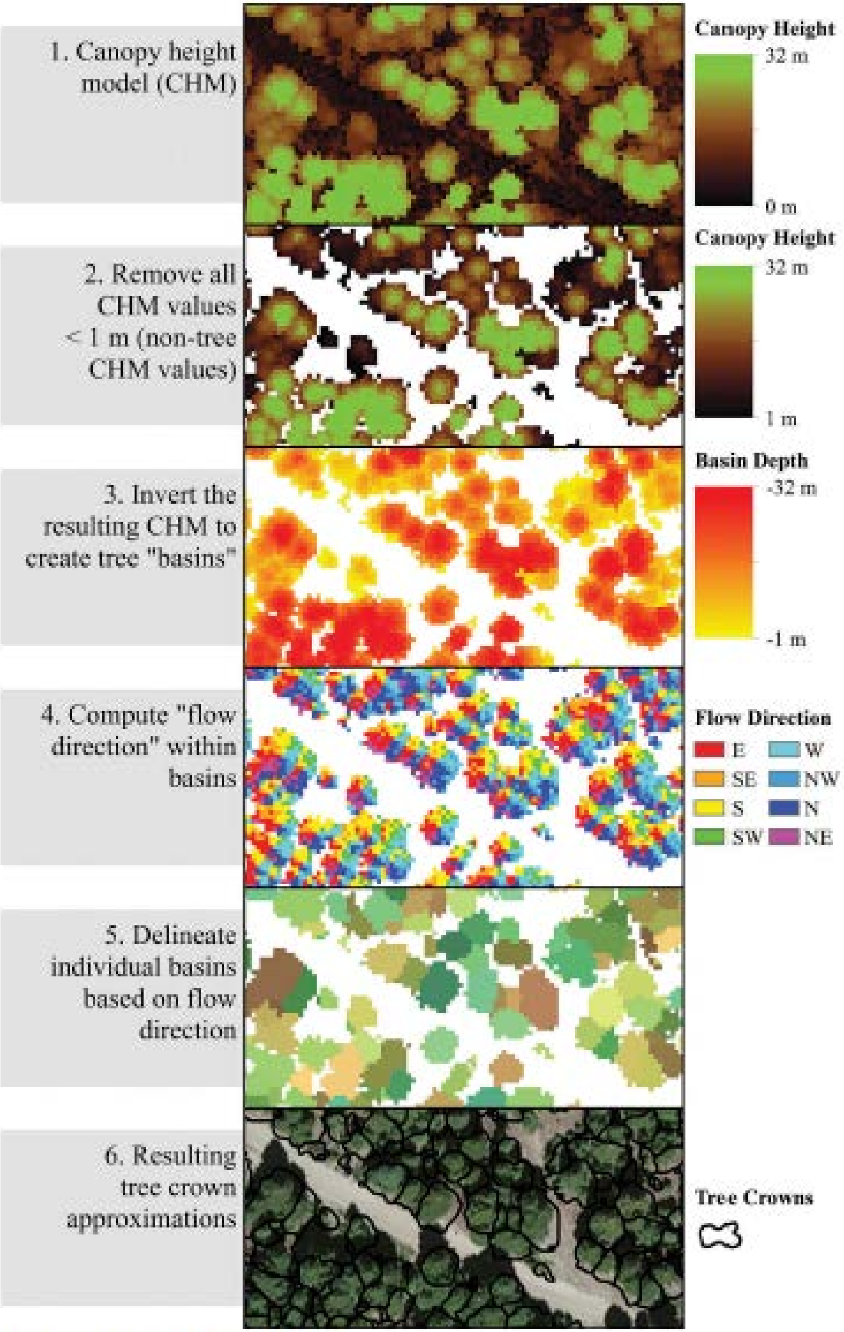


Figure 5. Tree crown delineation method.

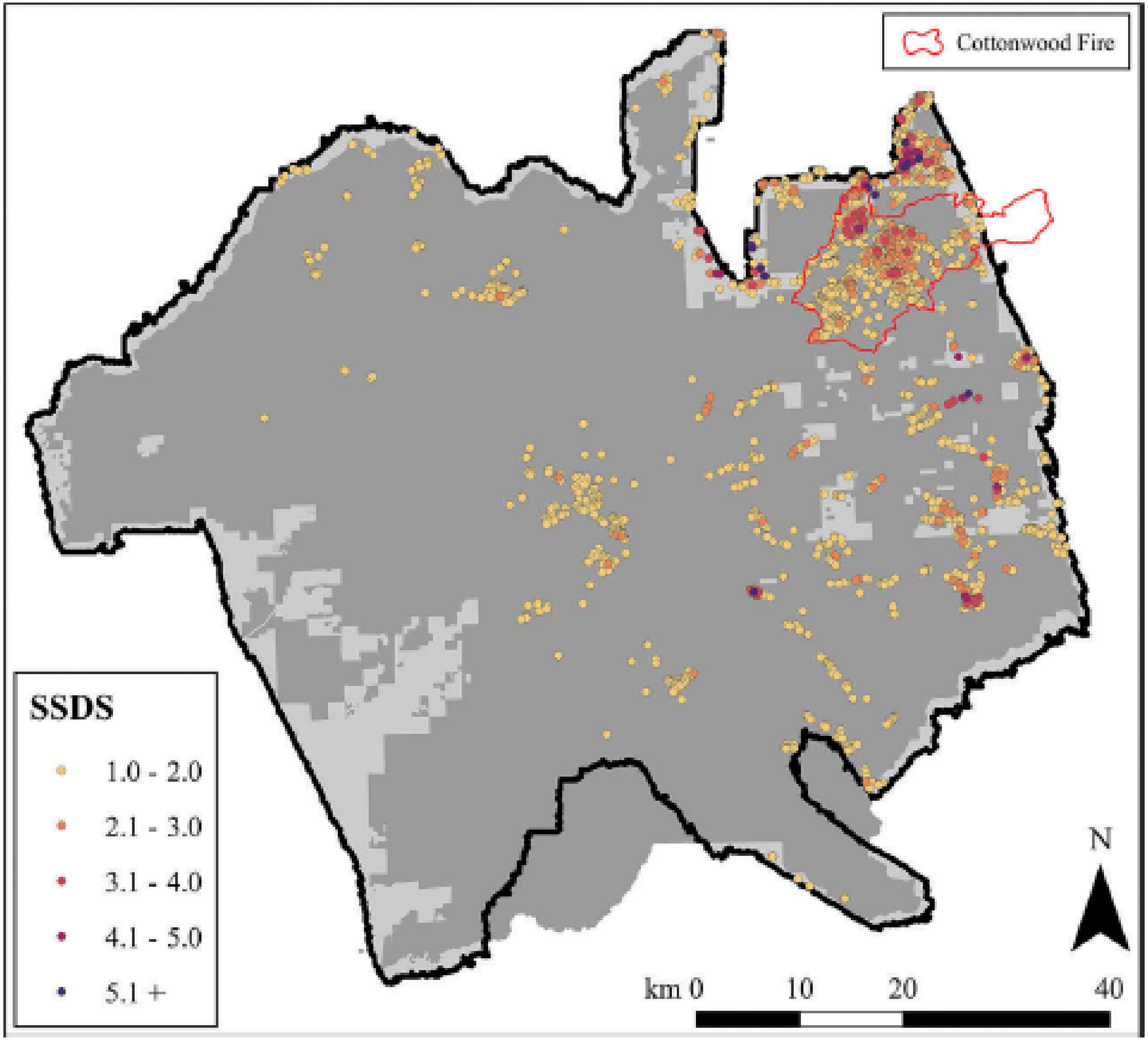


Figure 6. Potential safety zones with associated safe separation distance score values throughout the study area. The area burned by the 1994 Cottonwood fire is outlined in red.

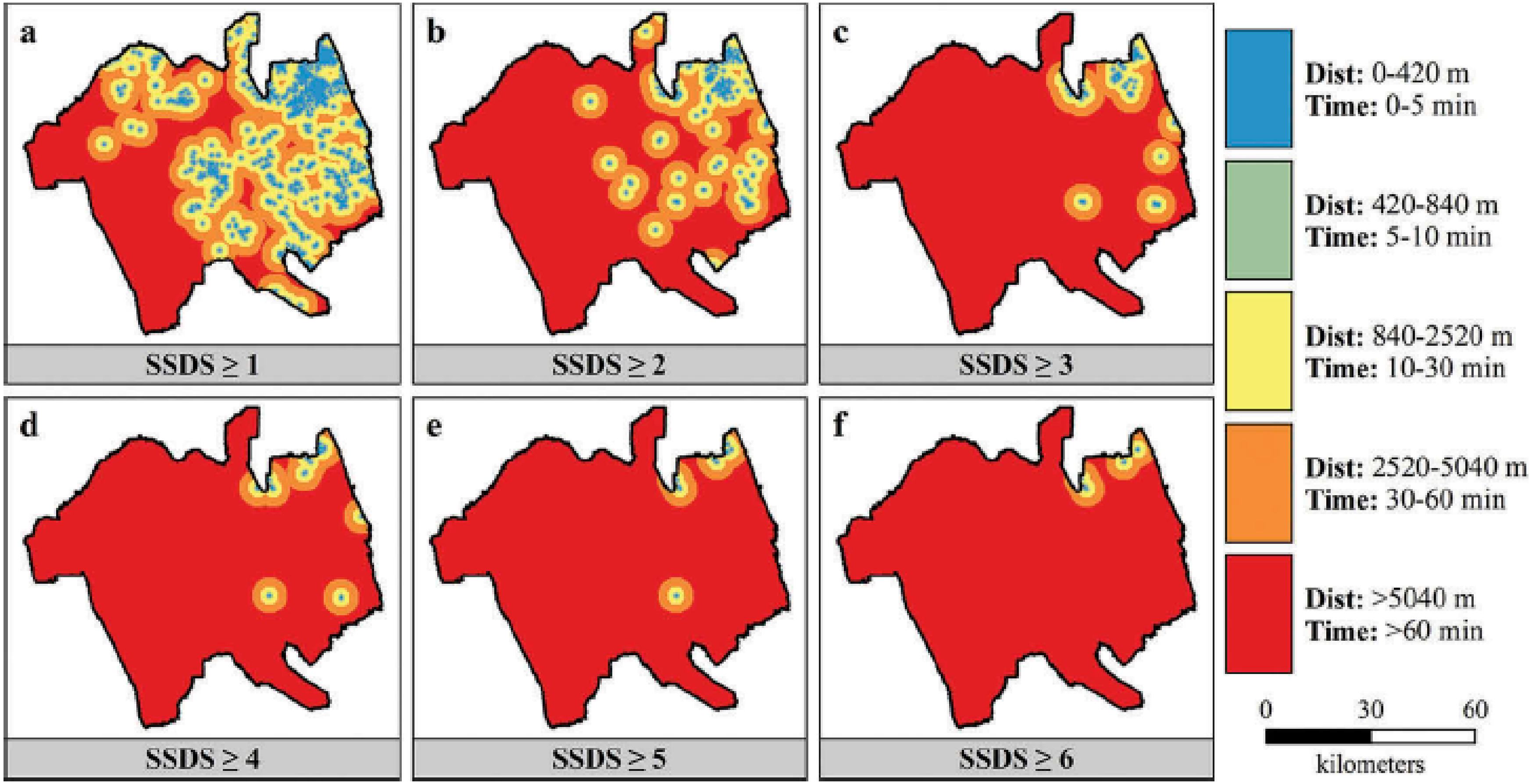


Figure 8. Euclidean distance and estimated travel time to nearest potential safety zone at a range of SSDS thresholds throughout the study area.

Findings

- Able to process LiDAR to extract clearings
- Adjust suitability for slope and wind
- Identify areas meeting a minimum standard
- Computed distance to safety
- Should make maps available for firefighters
- Can replicate elsewhere

Summary

- Li et al (2017) looked at using social media data for flood mapping
- Irmischer (2017) looked at human navigation and movement speed vs slope
- Nost et al. (2017) created an interactive map and infographic viewer for hazardous waste shipments in North America
- Campbell et al. (2016) used LiDAR and GIS to find safety zones in the Tahoe National Forest to protect firefighters

Conclusion

- New academic research adds to the scientific knowledge base behind analytical and computer cartography
- Improvement is usually incremental sometimes transformational
- Research and publishing has a set of tools and methods that can be learned (grad school)
- Whatever idea you have, someone has thought of it before!
- Can learn from both successes and mistakes