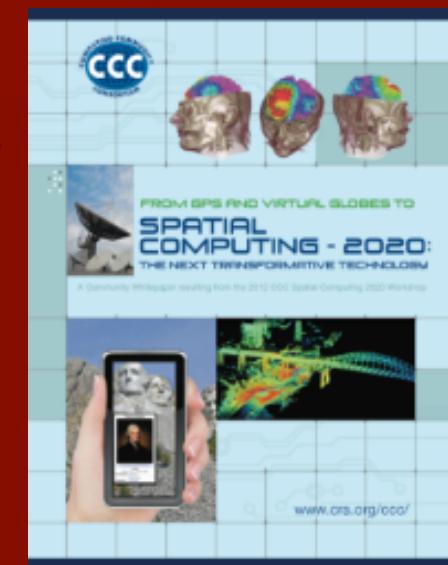


Spatial Computing

Spatial Computing
Research Group

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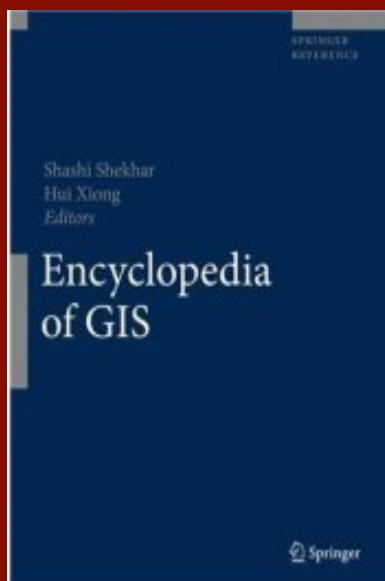
*Spatial Databases
A TOUR*



Shashi Shekhar
Hui Xiong
Editors

Encyclopedia
of GIS

Shashi Shekhar · Sanjay Chawla



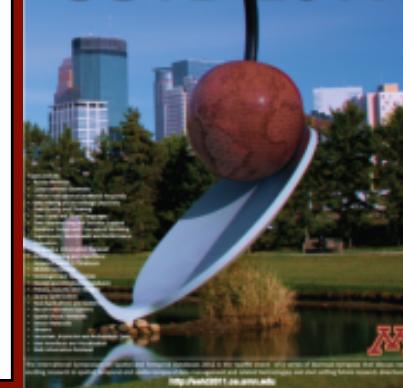
Springer



Springer

12th International Symposium on
Spatial and Temporal Databases
Minneapolis, MN, USA August 24th – 26th, 2011
The Digital Technology Center at the University of Minnesota

SSTD 2011



LNCS 7478

Geographic
Information Science

7th International Conference, GIScience 2012
Columbus, OH, USA, September 2012
Proceedings

Springer

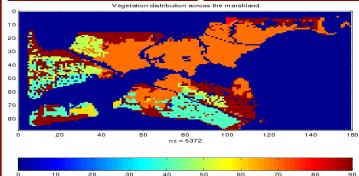
Spatial/Spatio-temporal Data Mining: Representative Projects

Location prediction: nesting sites

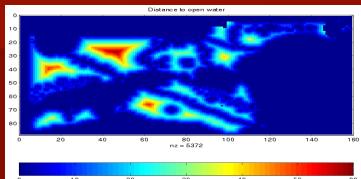
Nest locations



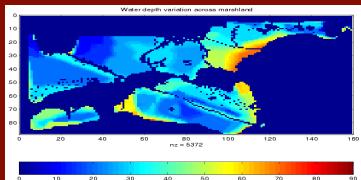
Vegetation durability



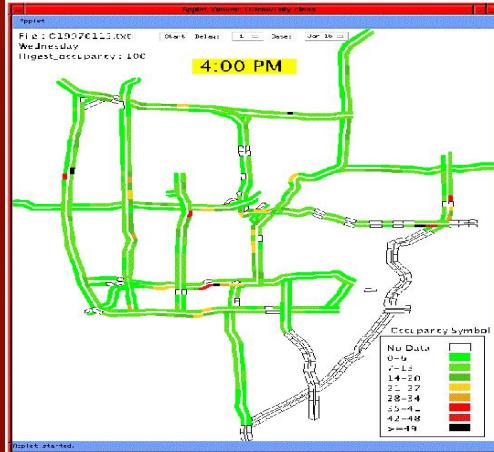
Distance to open water



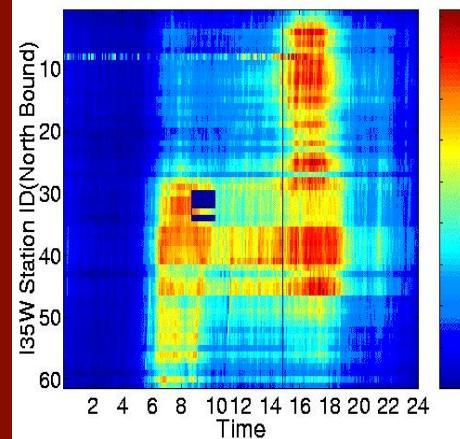
Water depth



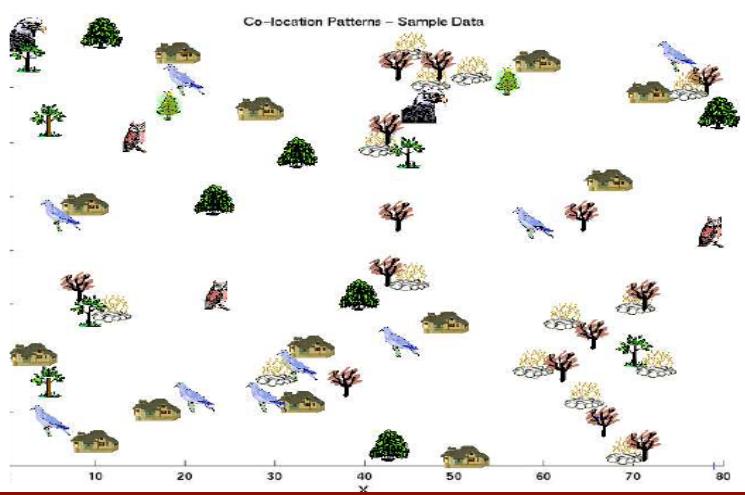
Spatial outliers: sensor (#9) on I-35



Average Traffic Volume(Time v.s. Station)



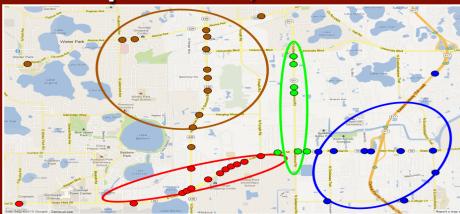
Co-location Patterns



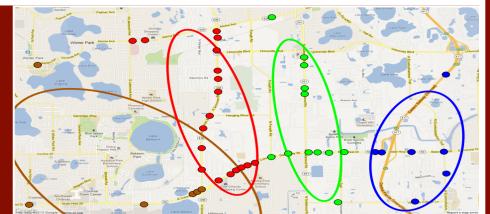
Spatial Network Activity Summarization



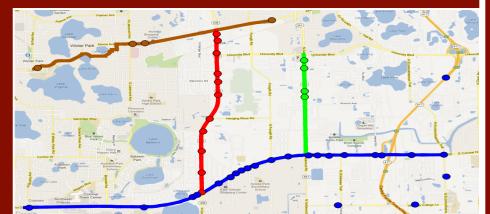
Input: k = 4, 43 fatalities



Network Distance

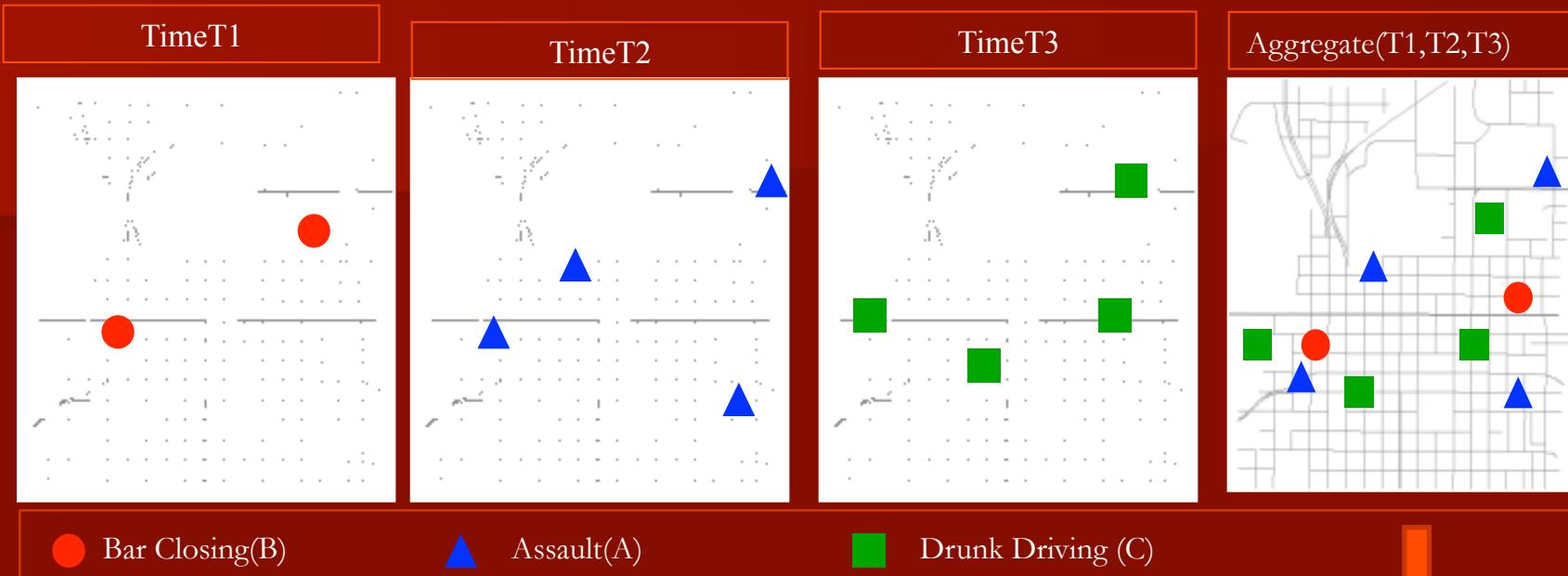


Euclidean Distance



KMR

Cascading spatio-temporal pattern (CSTP)

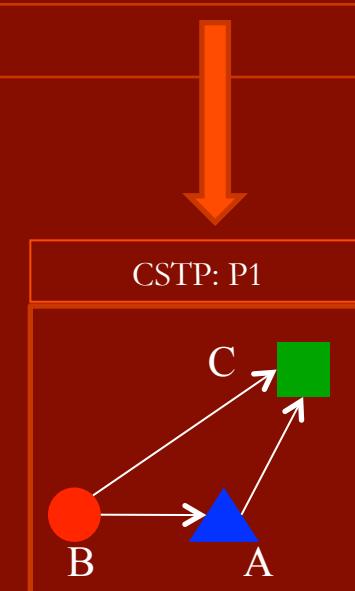


❑ *Input:* Urban Activity Reports

❑ *Output:* *CSTP*

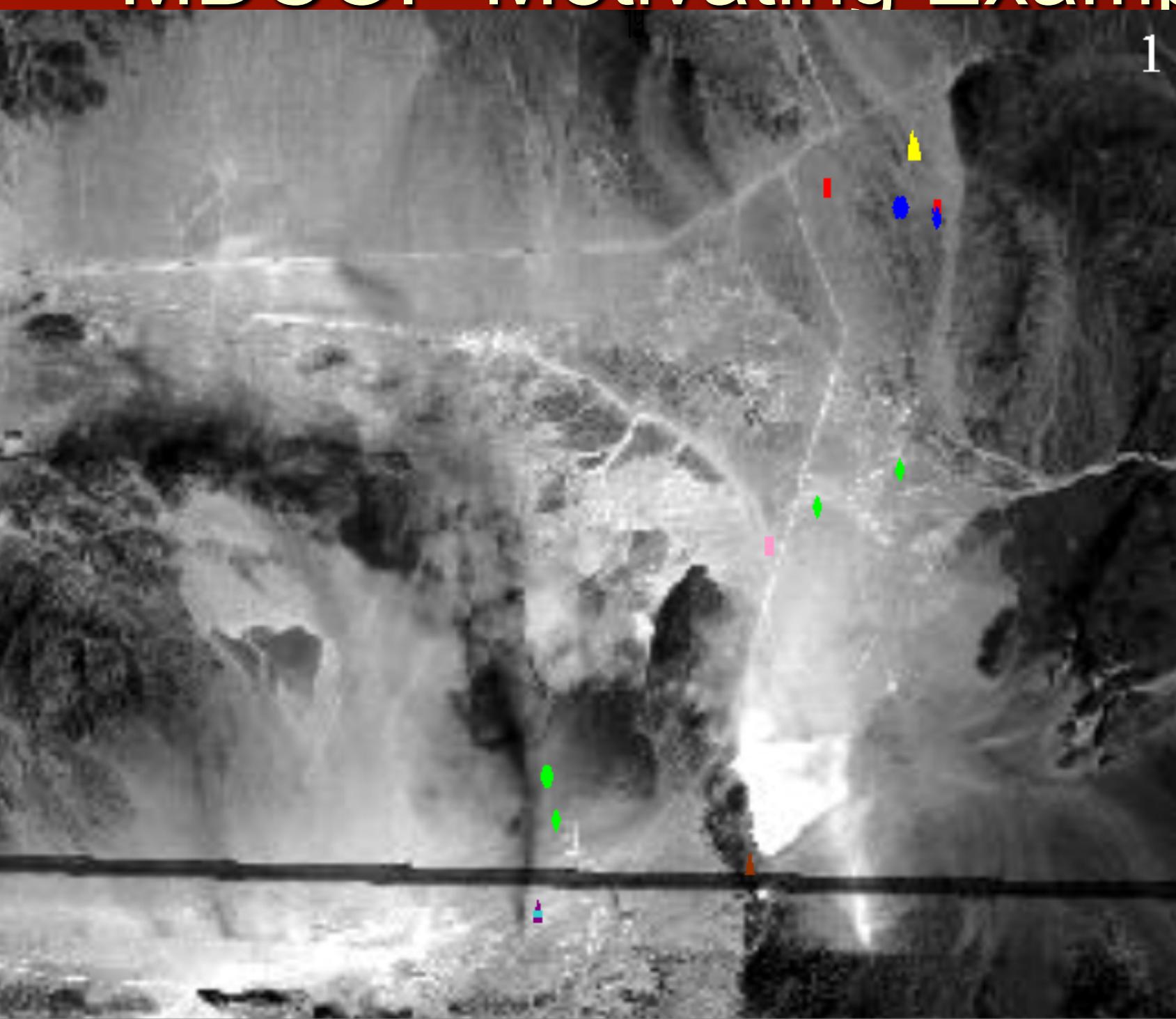
- ❑ *Partially ordered* subsets of ST event types.
- ❑ Located together in space.
- ❑ Occur in *stages* over time.

❑ *Applications:* Public Health, Public Safety, ...



Details: Cascading Spatio-Temporal Pattern Discovery,
IEEE Transactions on Knowledge and Data Engineering, 24(11), Nov. 2012.

MDCOP Motivating Example :



1

- Manpack stinger
(2 Objects)



- M1A1_tank
(3 Objects)



- M2_IFV
(3 Objects)



- Field_Marker
(6 Objects)



- T80_tank
(2 Objects)



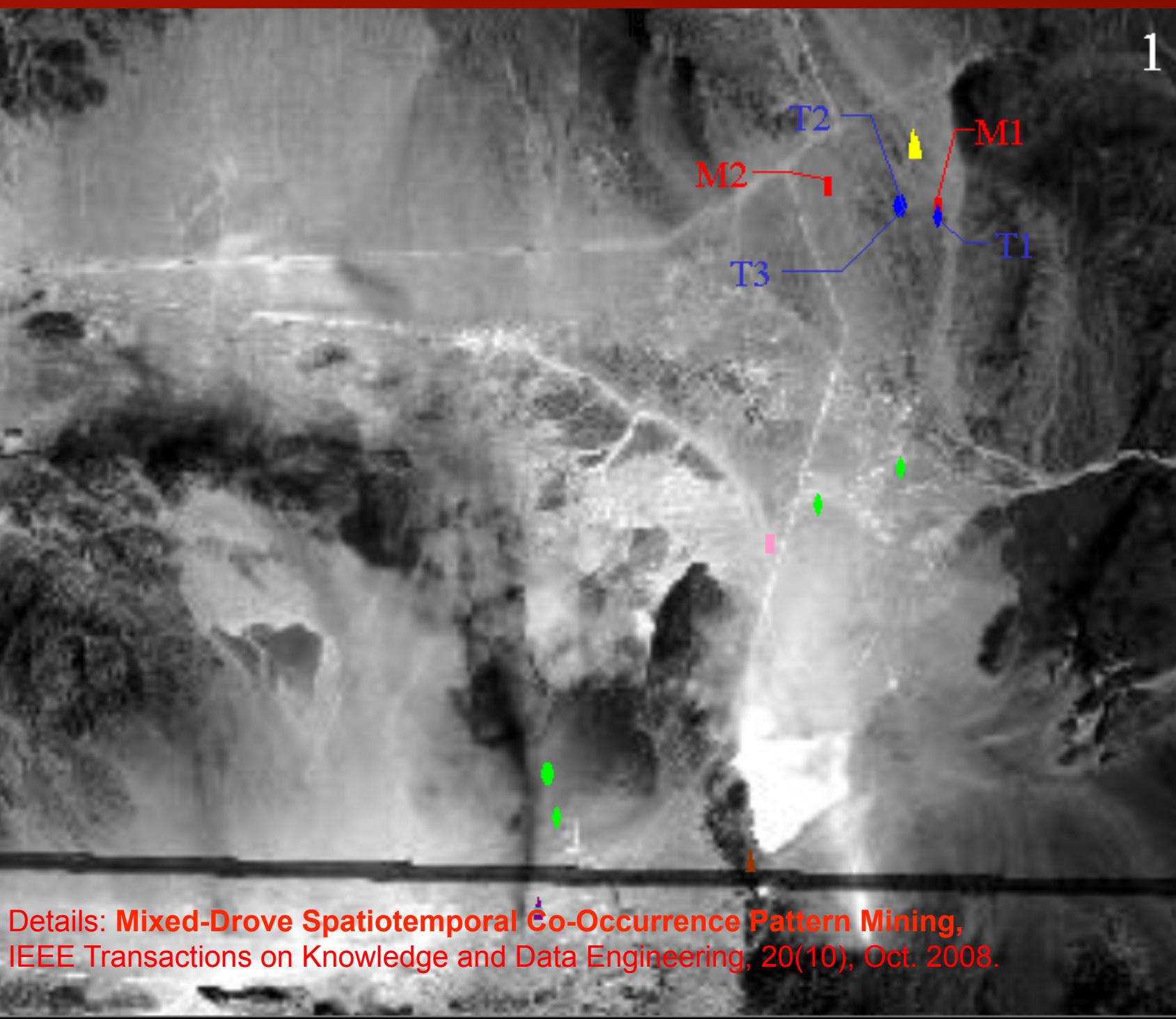
- BRJ
(enemy) (1 Object)



- (1)



MDCOP Motivating Example : Output



- Manpack stinger
(2 Objects)



- M1AT_tank
(3 Objects)



- M2_IFV
(3 Objects)



- Field_Marker
(6 Objects)



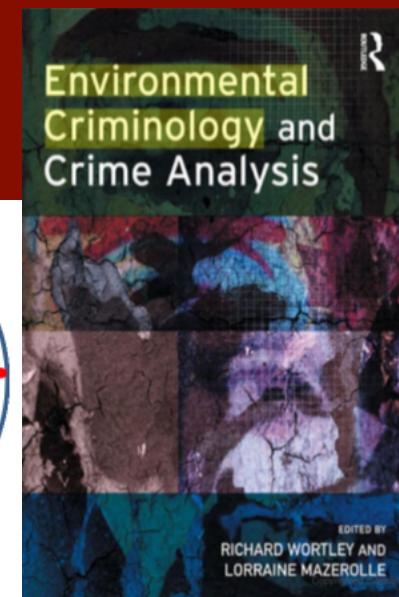
- T80_tank
(2 Objects)

- BRJ
(enemy) (1 Object)



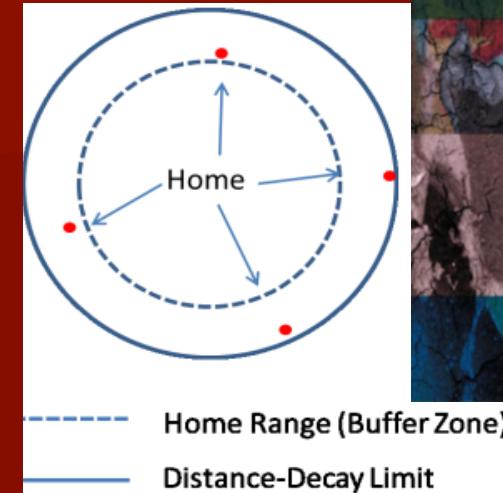
Details: Mixed-Drove Spatiotemporal Co-Occurrence Pattern Mining,
IEEE Transactions on Knowledge and Data Engineering, 20(10), Oct. 2008.

Identifying and Analyzing Patterns of Evasion



Motivation: Public safety: Serial Criminal, Meth. labs

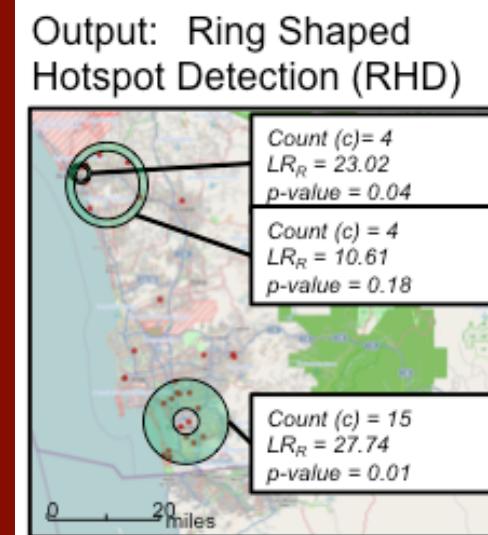
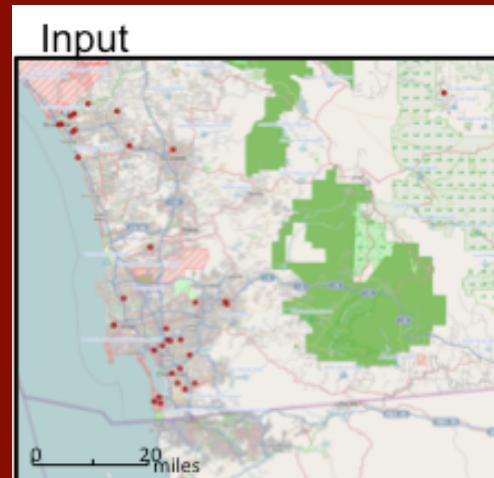
- Evasion: No crimes near home
- Transportation cost: do not go too far from home
- Leads to doughnut footprint
- Environmental Criminology, Geographic Profiling



Ring Shaped Hotspots: Concentric rings, where inside concentration of activities is much higher than outside one

Problem Definition

- Inputs: A set of activities,
 - Likelihood Ratio Threshold,
 - Statistical Significance Level (p -value)
- Output: Ring Shaped Hotspots
- Objective: Computational Efficiency
- Constraints: Statistical Significance



Acknowledgements

National Science Foundation (Current Grants)

- 1320580 : III:Investigating Spatial Big Data for Next Generation Routing Services
- 1029711 : Expedition: Understanding Climate Change: A Data Driven Approach
- IIS-1218168 : III:Towards Spatial Database Management Systems for Flash Memory Storage
- 0940818 : Datanet: Terra Populus: A Global Population / Environment Data Network

USDOD (Current Grants)

- • HM0210-13-1-0005: Identifying and Analyzing Patterns of Evasion
• SBIR Phase II: Spatio-Temporal Analysis in GIS Environments (STAGE) (with Architecture Technology Corporation)

University of Minnesota (Current Grants)

- Infrastructure Initiative: U-Spatial - Support for Spatial Research
- MOOC Initiative: From GPS and Google Earth to Spatial Computing
- Past Sponsors, e.g., NASA, ARL, AGC/TEC, Mn/DOT, ...

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- A join-less approach for mining spatial colocation patterns, *IEEE Transactions on Knowledge and Data Engineering*, 18 (10), 2006. (with J. Yoo).

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- A unified approach to detecting spatial outliers, *Springer GeoInformatica*, 7 (2), 2003. (w/ C. T. Lu, et al.)

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- Discovering personally meaningful places: An interactive clustering approach, *ACM Transactions on Information Systems (TOIS)* 25 (3), 2007. (with C. Zhou et al.)
- A K-Main Routes Approach to Spatial Network Activity Summarization, *IEEE Transactions on Knowledge & Data Engineering*, 26(6), 2014. (with D. Oliver et al.)

Location Prediction

- Spatial contextual classification and prediction models for mining geospatial data, *IEEE Transactions on Multimedia*, 4 (2), 2002. (with P. Schrater et al.)
- Focal-Test-Based Spatial Decision Tree Learning, to appear in *IEEE Transactions on Knowledge and Data Eng.* (a summary in Proc. IEEE Intl. Conference on Data Mining, 2013).

Change Detection

- Spatiotemporal change footprint pattern discovery: an inter-disciplinary survey. Wiley Interdisc. Rev.: Data Mining and Knowledge Discovery 4(1), 2014. (with X. Zhou et al.)