

PROJECT GEOINFORMATIC SURVEILLANCE DECISION SUPPORT SYSTEM
Geographic and Network Surveillance for Arbitrarily Shaped Hotspots
-Next Generation of Geographic Hotspot Detection, Prioritization, and Early Warning System-

G. P. Patil, W. L. Myers, C. Taillie, and D. Wardrop
Pennsylvania State University, University Park, PA 16802
Email: gpp@stat.psu.edu
Webpage: <http://www.stat.psu.edu/~gpp>

We present a version of the spatial scan statistic system that is intended to address the following shortcomings of circle-based scans:

- Circles are able to capture only compactly shaped clusters. In many applications, clusters can have a very irregular shape, for example, in a disease outbreak along a winding river valley or other natural landscape feature. Similarly, cylindrical zones can yield poor hotspot delineation in a space-time scan.
- The circle-based zonation relies on Euclidean distance and is inappropriate for data defined along a network, such as a stream or subway system.

Our version of the scan statistic employs the notion of an upper level set and is accordingly called the upper level set scan statistic, leading to a sophisticated analytical and computational system, effective for the purpose.

Attractive features of the upper level set scan statistic system include:

- Identifies arbitrarily shaped clusters
- Data-adaptive zonation of candidate hotspots
- Applicable to data on a network
- Provides both a point estimate as well as a confidence set for the hotspot
- Uses hotspot-membership rating to map hotspot boundary uncertainty
- Computationally efficient
- Applicable to both discrete and continuous syndromic responses
- Identifies arbitrarily shaped clusters in the spatial-temporal domain
- Provides a typology of space-time hotspots with discriminatory surveillance potential


We also present a prioritization innovation. It lies in the ability for prioritization and ranking of hotspots based on multiple indicator and stakeholder criteria without having to integrate indicators into an index, using Hasse diagrams and partial order sets. This leads us to early warning systems, and also to the selection of investigational areas.

You are invited to participate in this promising cross-disciplinary cross-fertilization project for geoinformatic surveillance decision support system to accomplish next generation of geographic hotspot detection and prioritization system needed for synoptic and network surveillance to accomplish early warning systems and also to the selection of investigational areas.

POTENTIAL AREAS FOR NASA REASON SOLICITATION PROJECT COLLABORATION
Carbon Management, Coastal Management, Early Warning for Homeland Security, Invasive Species Management, Public Health, Water Management

Website Links


1. Prospectus 8: Synoptic Surveillance
<http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-8.pdf>
2. Prospectus 11: Network-Based Surveillance
<http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-11.pdf>
3. Prospectus 10: Classification and Prioritization
<http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-10.pdf>
4. Prospectus 9: Crop Surveillance
<http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-9.pdf>
5. Prospectus Abstract Syndromic Surveillance
<http://www.stat.psu.edu/~gpp/PDFfiles/prospectus-12.pdf>
6. Poster for Geographic and Network Surveillance for Hotspots
<http://www.stat.psu.edu/~gpp/PDFfiles/Poster%201.pdf>
7. Proof-of-Concept Paper-1
<http://www.stat.psu.edu/~gpp/PDFfiles/TR2002-0501.pdf>
8. Proof-of-Concept Paper-2
<http://www.stat.psu.edu/~gpp/PDFfiles/TR2002-0801.pdf>
9. Proof-of-Concept Paper-3
<http://www.stat.psu.edu/~gpp/PDFfiles/TR2001-1204.pdf>
10. Background Biographics 1
<http://www.stat.psu.edu/~gpp/PDFfiles/Patil-3-page%20bio.pdf>
11. Background Biographics 2
<http://www.stat.psu.edu/~gpp/PDFfiles/GP%20NSF%20Bio.pdf>

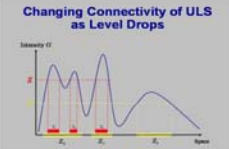
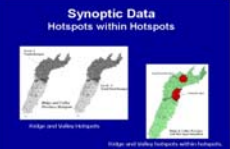


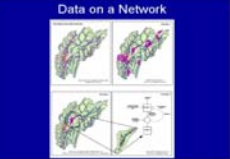
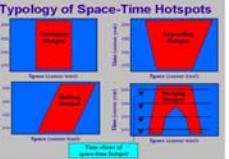

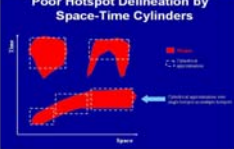

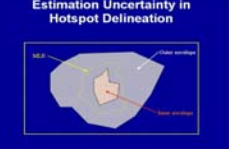
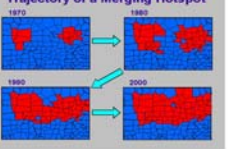
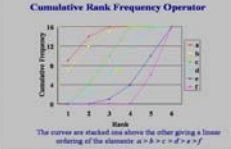


PENN STATE

Geographic and Network Surveillance for Arbitrarily Shaped Hotspots

Next Generation of Potential Outbreak Detection and Prioritization System



Issue	Method	Geospatial Surveillance	Spatial-Temporal Surveillance	Hotspot Prioritization																																																																																
<p>Limitations of Circle-Based SaTScan</p> <p>Proof of Concept Paper #1</p>	<p>Upper Level Set (ULS) Scan Statistic for Arbitrarily Shaped Clusters</p> <p>Concept Paper #1</p>	<p>Hotspot Identification and Uncertainty Assessment</p> <p>Penn State EPA/Atlantic Slope Consortium</p>	<p>Typology of Space-Time Hotspots</p> <p>Penn State Ford Foundation Poverty Research</p>	<p>Ranking Without Having to Integrate the Multiple Indicators</p> <p>Penn State EPA/Watersheds Research</p>																																																																																
<p>Limitations and Needs</p> <ul style="list-style-type: none"> Circle-based only complex-shaped clusters Want to identify clusters of arbitrary shape Circle-based only synoptic, cross-sectional data Want to also handle data on a network Circle-based point estimates of hotspot Want to assess estimation uncertainty (hotspot confidence set) 	<p>Changing Connectivity of ULS as Level Drops</p> 	<p>Synoptic Data Hotspots within Hotspots</p> 		<p>Prioritization of Disease Clusters with Multiple Indicators</p> <table border="1" style="width: 100%; font-size: small;"> <thead> <tr> <th>cluster</th> <th>ESR</th> <th>UL</th> <th>Young</th> <th>Median</th> <th>Alcohol</th> <th>Latin</th> <th>Black</th> </tr> </thead> <tbody> <tr> <td>LFD</td> <td>2.88</td> <td>10.36</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>2</td> </tr> <tr> <td>LMH</td> <td>1.5</td> <td>36</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>LMH</td> <td>2.68</td> <td>18.21</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>LFF</td> <td>1.91</td> <td>16.43</td> <td>3</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>BS</td> <td>1.51</td> <td>15.23</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>BS</td> <td>1.53</td> <td>28.4</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>LMP</td> <td>2.33</td> <td>21.91</td> <td>3</td> <td>1</td> <td>0</td> <td>0</td> <td>2</td> </tr> <tr> <td>LMP</td> <td>2.12</td> <td>21.96</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>LMP</td> <td>2.12</td> <td>13.32</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>2</td> </tr> </tbody> </table> <p>* LF = Lung, Female; LM = Lung, male; B = breast</p>	cluster	ESR	UL	Young	Median	Alcohol	Latin	Black	LFD	2.88	10.36	2	0	1	0	2	LMH	1.5	36	2	0	0	0	2	LMH	2.68	18.21	2	0	0	0	2	LFF	1.91	16.43	3	1	0	0	1	BS	1.51	15.23	2	0	0	0	2	BS	1.53	28.4	1	0	0	0	2	LMP	2.33	21.91	3	1	0	0	2	LMP	2.12	21.96	1	0	0	0	1	LMP	2.12	13.32	1	0	0	0	2
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<p>Poor Hotspot Delineation by Space-Time Cylinders</p> 	<p>Confidence Region on ULS Tree</p> 	<p>Estimation Uncertainty in Hotspot Delineation</p> 	<p>Trajectory of a Merging Hotspot</p> 	<p>Cumulative Rank Frequency Operator</p> 																																																																																

Webpage: <http://www.stat.psu.edu/~gpp/PDFfiles/Poster%201.pdf>

Welcome to the

Center for Statistical Ecology and Environmental Statistics

G. P. Patil, Director

The Pennsylvania State University, Department of Statistics, 421 Thomas Building, University Park,
PA 16802

Tel.: 814/865-9442 Fax: 814/865-1278 Email: gpp@stat.psu.edu

MARMAP System Partnership

A primary purpose of MARMAP System Partnership is to develop sound methodology and appropriate software for the quantitative analysis and interpretation of multi-categorical raster maps and cellular surfaces (inferential geospatial informatics) involving landscape pattern analysis, multiscale landcover landuse change detection, accuracy assessment, critical area detection and delineation, disease mapping and geographic surveillance, prioritization and ranking without having to integrate multiple indicators, and a few more. It will be nice to see you participate in one capacity or the other. The following websites may be of particular interest at this time, giving recent publications together with current exciting events. Please feel free also to share this material with your potentially interested friends and colleagues.

1. [MARMAP and MARMAP Prospectus 1, 2, 3, 4, 5, 6, 7.](#)
2. [Multiscale Advanced Raster Map Analysis System](#): Definition, Design, and Development. Invited Paper for Joint Statistical Meetings (New York City), Portuguese Statistical Congress, International Environmetrics Society, Brazilian Ecological Congress, and Italian Ecological Society.
3. Project MARMAP System Partnership Collaboration with EPA STAR Grant Atlantic Slope Consortium for Development, Testing, and Application of Ecological and Socioeconomic Indicators for Integrated Assessment of Atlantic Slope in the mid-Atlantic states.
Website: http://es.epa.gov/ncer_abstracts/grants/00/envind/brooks.html
4. [Project MARMAP System Partnership Collaboration with UNEP](#) Division of Early Warning and Assessment on Human Environment Index based on Countrywide Land, Air, and Water Indicators.
5. Project MARMAP Show and Tell Seminar series: EPA ORD NCEA, EPA ORD NERL, EPA OEI, NASA HQ, NASA GSFC, NCHS, NYSDEH; UMD, GWU, UCB, MSU, UM, SUNY SPH.
[Powerpoint Presentations](#)
6. Ecosystem Health and Its Measurement at Landscape Scale: Towards the Next Generation of Quantitative Assessments. [Invited Paper for Ecosystem Health](#), International Society for Ecosystem Health.

7. Multiscale Advanced Raster Map Analysis System for Measurement of Ecosystem Health at Landscape Scale: A Novel Synergistic Consortium Initiative. [Invited Paper for Managing for Healthy Ecosystems](#), International Society for Ecosystem Health.
8. Washington DC Conference on Linkages Between Biodiversity, Ecosystem Health, and Human Health, June 6-11, 2002. [A Special Session on Ecosystem Health](#) and Its Measurement at Landscape Scale. June 10, 10:00AM - 12:00Noon.
9. Joint Statistical Meetings on Statistics in Era of Technological Change, August 11-15, 2002, New York City. [A Special Session on Multiscale Advanced Raster Map Analysis System for Digital Government in the 21st Century](#). August 13, 2:00PM - 3:45 PM.
10. [Short Course and Research Workshop](#) on Multiscale Advanced Raster Map Analysis System for the Map of Italian Nature, University of Parma, Parma, Italy, June 21-22, 2002.
11. [MARMAP System Partnership](#). Biometric Bulletin, 2002 (to appear).

Consider a 21st Century digital government scenario of the following nature: What message does a remote sensing-derived land cover land use map have about the large landscape it represents? And at what scale and at what level of detail?...Does the spatial pattern of the map reveal any societal, ecological, environmental condition of the landscape? And therefore can it be an indicator of change?...How do you automate the assessment of the spatial structure and behavior of change to discover critical areas, hot spots, and their corridors?...Is the map accurate? How accurate is it? How do you assess the accuracy of the map? Of the change map over time for change detection? What are the implications of the kind and amount of change and accuracy on what matters, whether climate change, carbon emission, water resources, urban sprawl, biodiversity, indicator species, or early warning? And with what confidence, even with a single map/change-map? ...The needed research is expected to find answers to these questions and a few more that involve multicategorical raster maps based on remote sensing and other geospatial data. It is also expected to design a prototype advanced raster map analysis system for digital governance.

Initial 45 publications and prospectus initiatives are available on the link:

<http://www.stat.psu.edu/~gpp/newpage11.htm>