



Issue

Limitations of Circle-Based SaTScan

Proof of Concept Paper #1

Method

Upper Level Set (ULS) Scan Statistic for Arbitrarily Shaped Clusters

Concept Paper #1

Geospatial Surveillance

Hotspot Identification and Uncertainty Assessment

Penn State/EPA/Atlantic Slope Consortium

Spatial-Temporal Surveillance

Typology of Space-Time Hotspots

Penn State/Ford Foundation/Poverty Research

Hotspot Prioritization

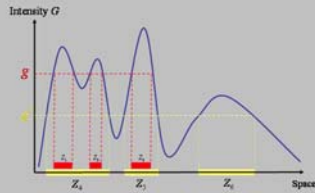
Ranking Without Having to Integrate the Multiple Indicators

Penn State/EPA/Watersheds Research

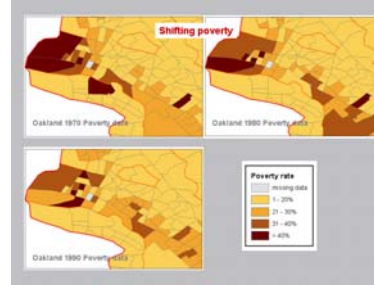
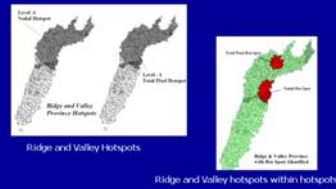
Limitations and Needs

- Circles capture only compactly shaped clusters
- Want to identify clusters of arbitrary shape
- Circles handle only synoptic (teaselated) data
- Want to also handle data on a network
- Circles provide point estimate of hotspot
- Want to assess estimation uncertainty (hotspot confidence set)

Changing Connectivity of ULS as Level Drops



Synoptic Data Hotspots within Hotspots



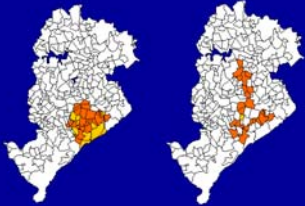
Prioritization of Disease Clusters with Multiple Indicators

Data Matrix

cluster*	BR	LL	Young Cases	Multiple Cancers	Atypical Demographics	Late Stage of Diagnosis
LF2	2.09	10.38	2	1	1	2
LM14	1.5	36	2	0	0	2
LM8	2.04	19.21	2	0	0	2
LF7	1.51	15.43	1	1	1	1
B2	1.21	31.3	2	1	0	2
B4	1.25	28.4	1	0	0	0
LM1	2.32	21.91	0	1	0	2
LM2	2.13	21.26	1	1	0	1
LM7	2.12	13.33	1	0	0	2

* LF = lung, female; LM = lung, male; B = breast

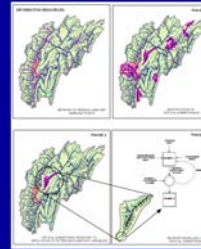
Poor Hotspot Delineation by Circular Zones



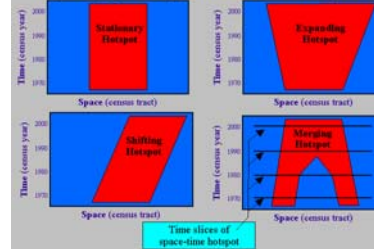
Features of ULS Scan Statistic

- Identifies arbitrary shaped clusters
- Applicable to data on a network
- Confidence set, hotspot rating
- Computationally efficient
- Applicable to continuous response
- Generalizes to space-time scan

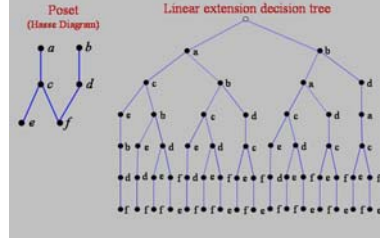
Data on a Network



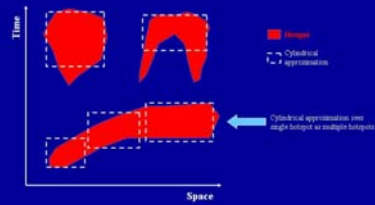
Typology of Space-Time Hotspots



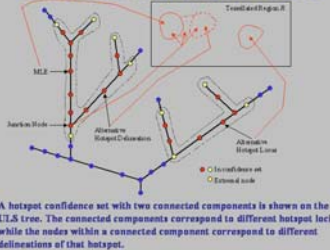
Ranking Partially Ordered Sets



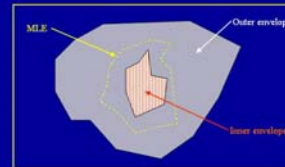
Poor Hotspot Delineation by Space-Time Cylinders



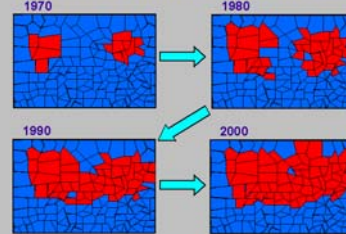
Confidence Region on ULS Tree



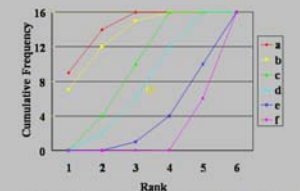
Estimation Uncertainty in Hotspot Delineation



Trajectory of a Merging Hotspot



Cumulative Rank Frequency Operator



The curves are stacked one above the other giving a linear ordering of the elements: $a > b > c > d > e > f$