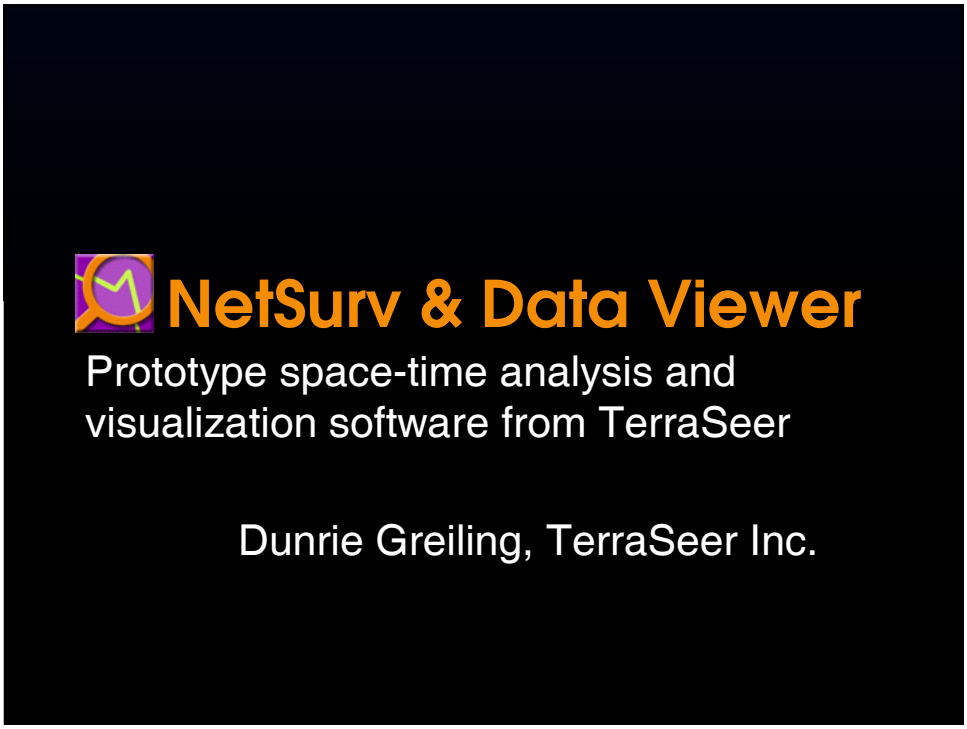
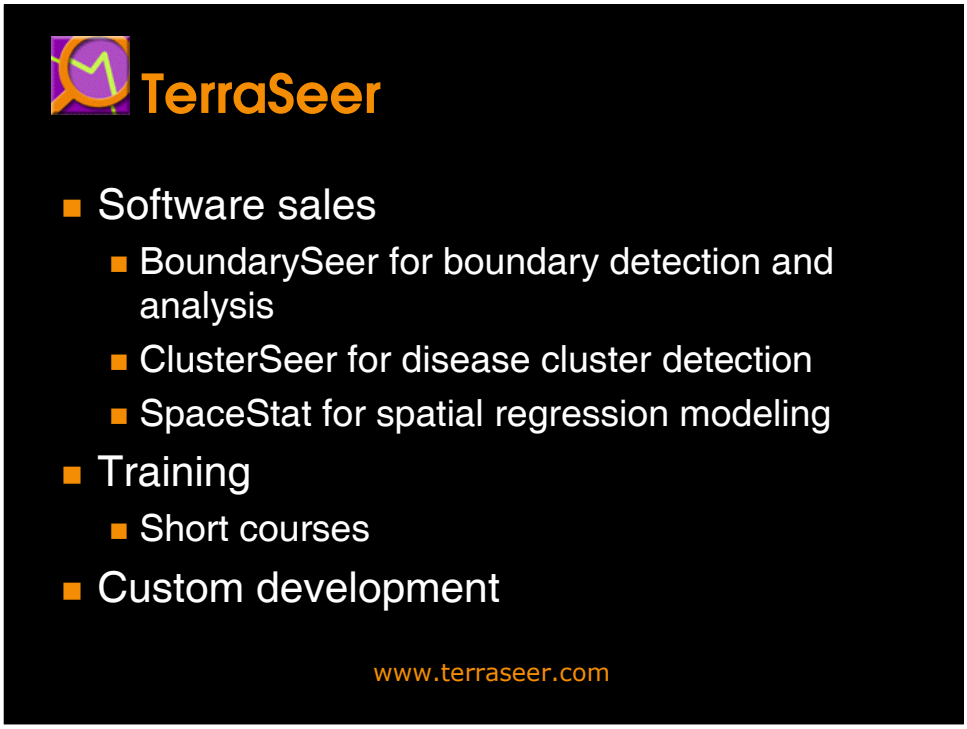
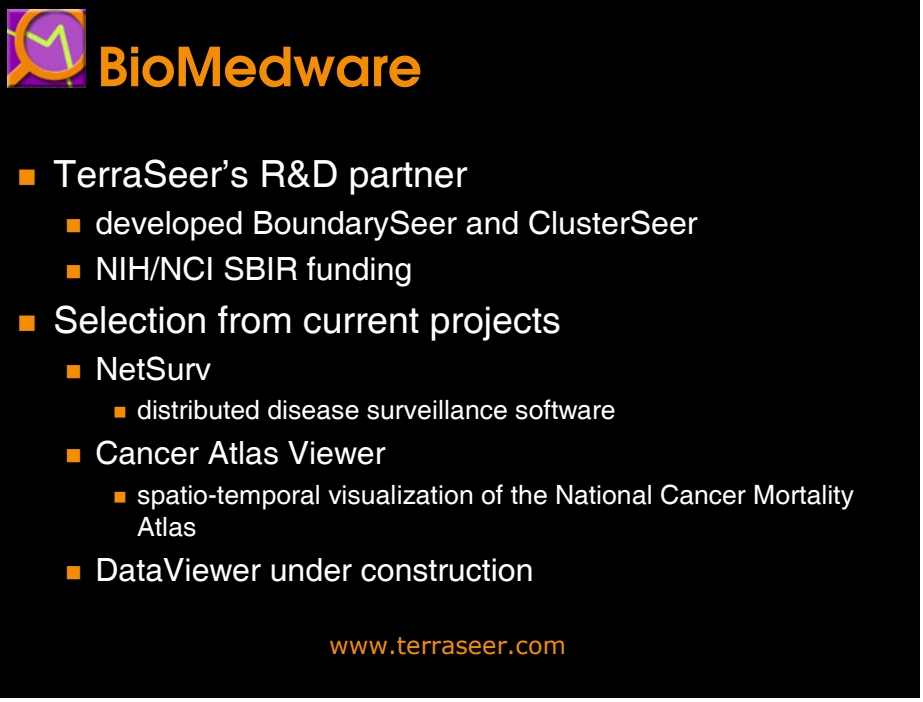
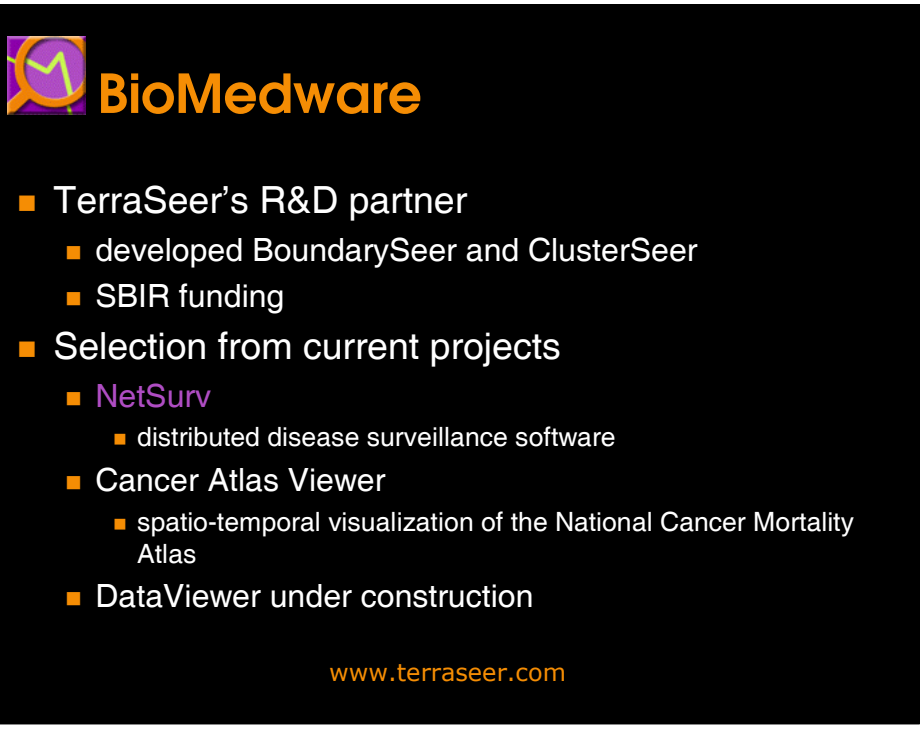

NetSurv & Data Viewer
Prototype space-time analysis and visualization software from TerraSeer
Dunrie Greiling, TerraSeer Inc.


TerraSeer
Software sales
BoundarySeer for boundary detection and analysis
ClusterSeer for disease cluster detection
SpaceStat for spatial regression modeling
Training
Short courses
Custom development
www.terraseer.com


BioMedware
TerraSeer's R&D partner
developed BoundarySeer and ClusterSeer
NIH/NCI SBIR funding
Selection from current projects
NetSurv
distributed disease surveillance software
Cancer Atlas Viewer
spatio-temporal visualization of the National Cancer Mortality Atlas
DataViewer under construction
www.terraseer.com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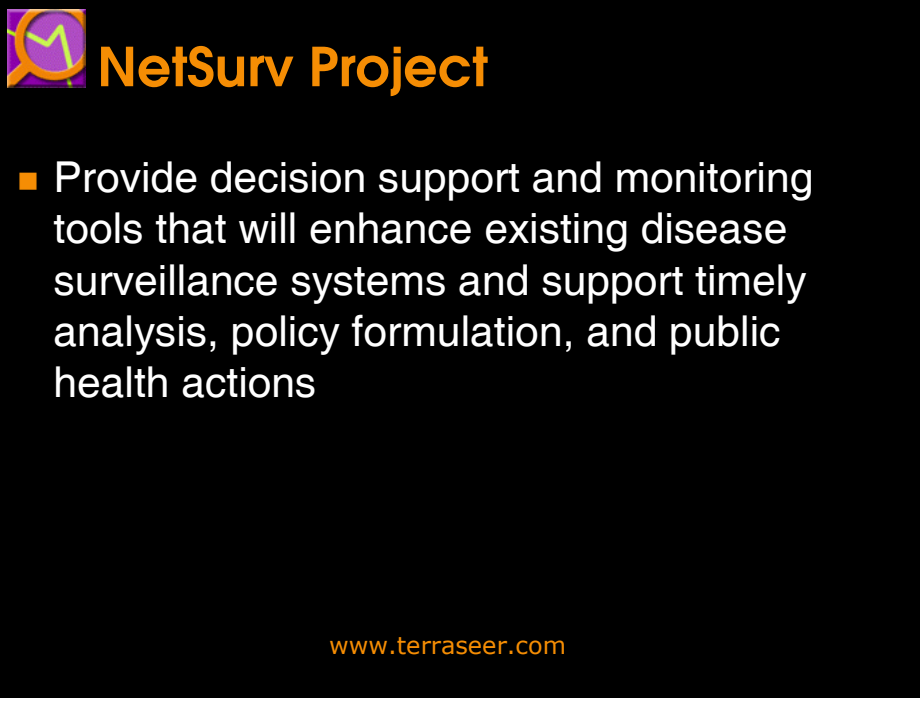
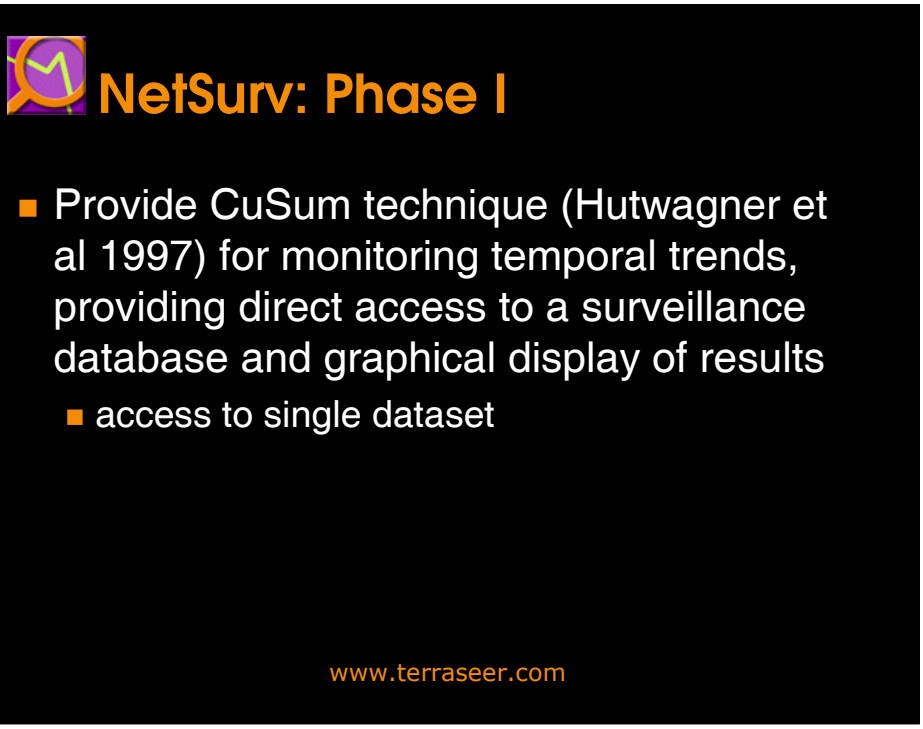
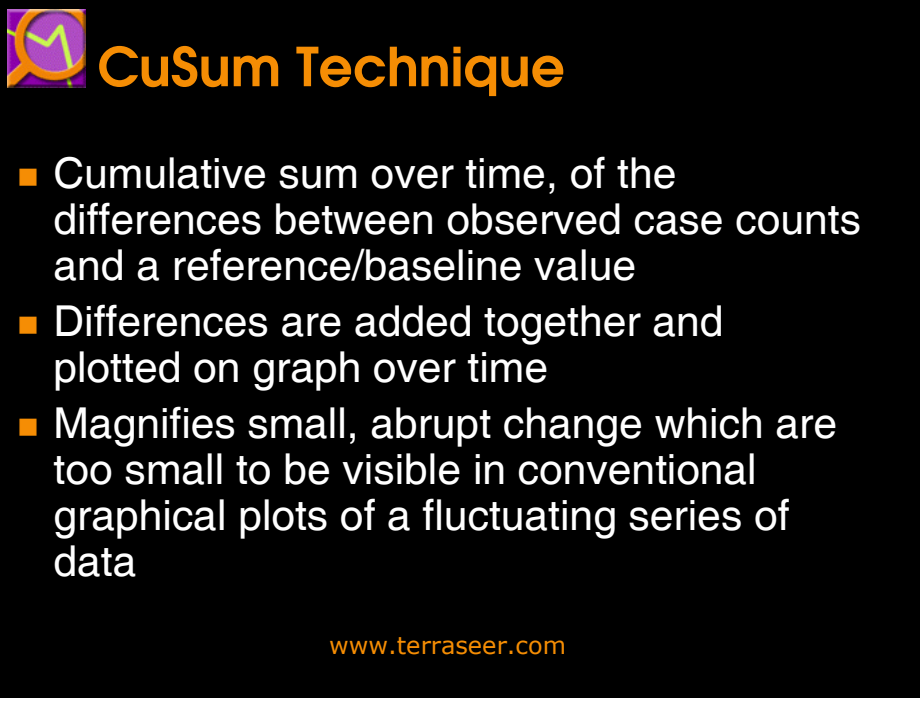
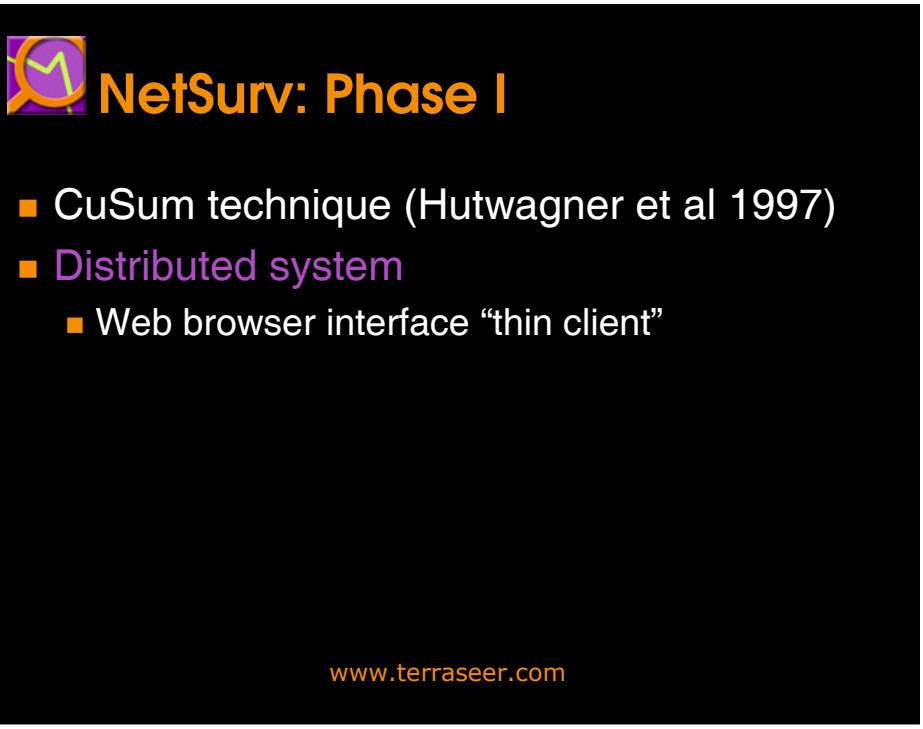

NetSurv Project
Provide decision support and monitoring tools that will enhance existing disease surveillance systems and support timely analysis, policy formulation, and public health actions
www.terraseer.com

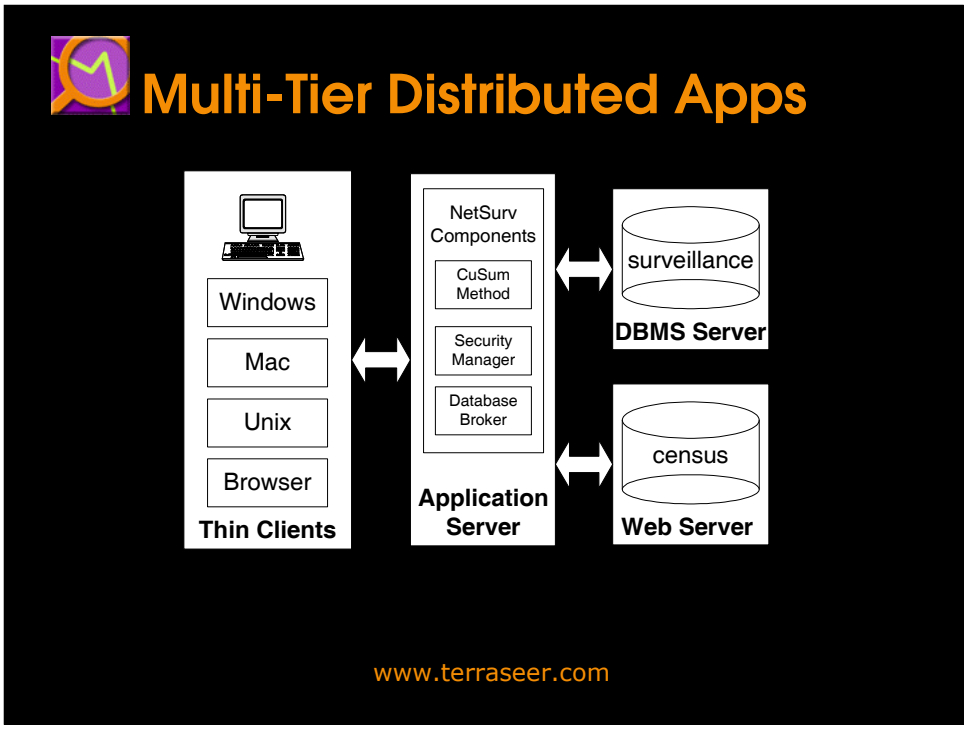

Surveillance
Continuous and systematic process of collection, *analysis*, and *interpretation* of information for monitoring health problems
Ongoing monitoring of temporal and spatial disease trends
www.terraseer.com

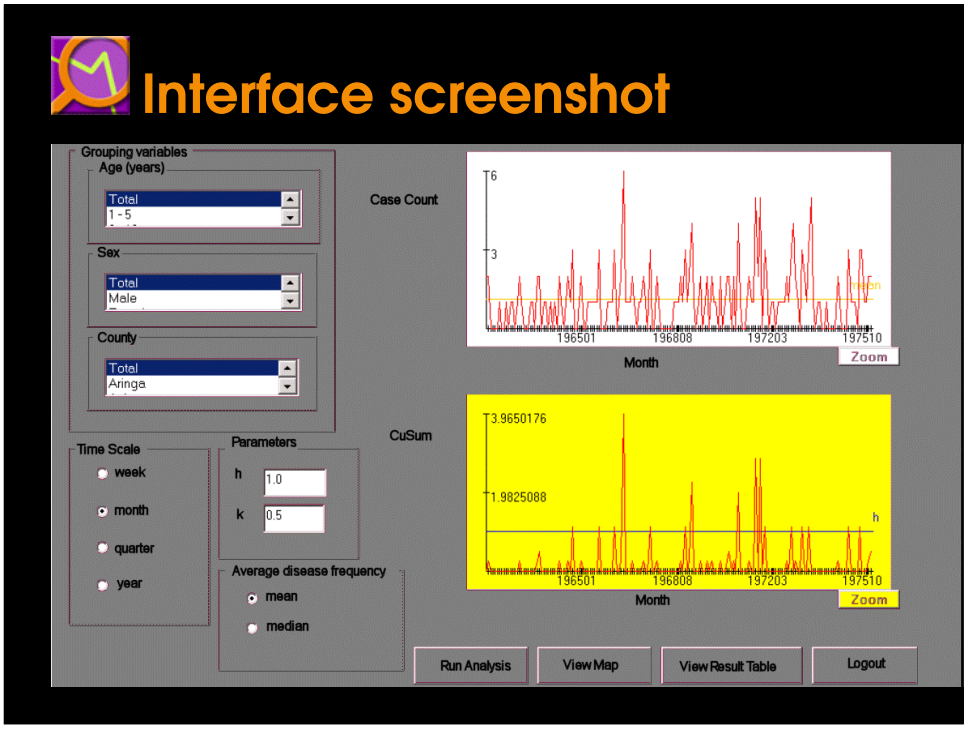

NIH SBIR grants
Small Business Innovation Research
Phase I
Evaluate scientific and technical merit and feasibility of an idea (6 months)
Phase II
Expand on the results and further pursue the development of Phase 1 (2 years)
www.terraseer.com

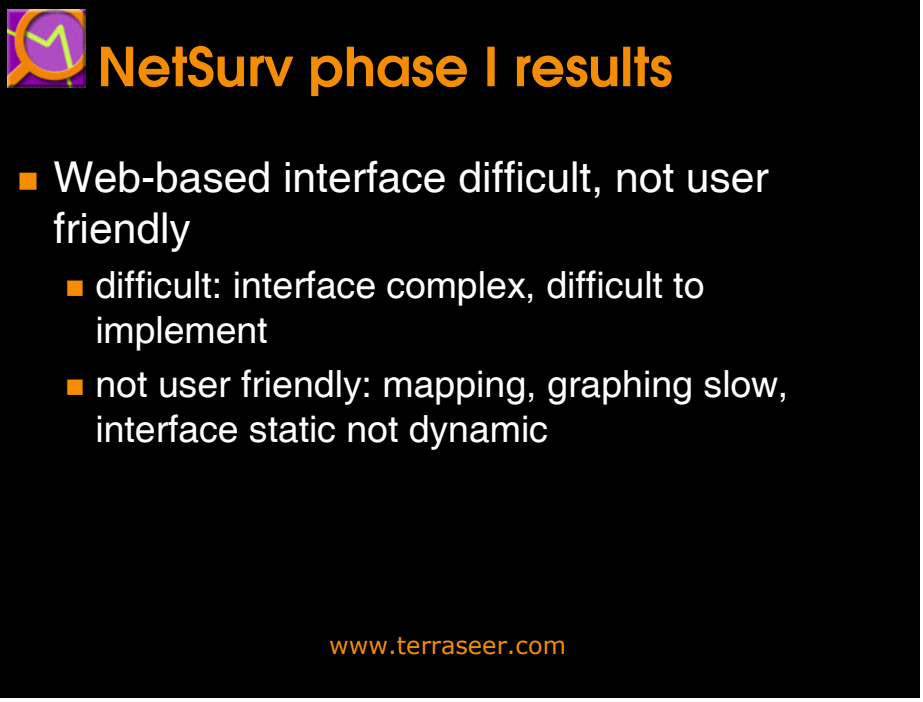

NetSurv: Phase I
Provide CuSum technique (Hutwagner et al 1997) for monitoring temporal trends, providing direct access to a surveillance database and graphical display of results
access to single dataset
www.terraseer.com

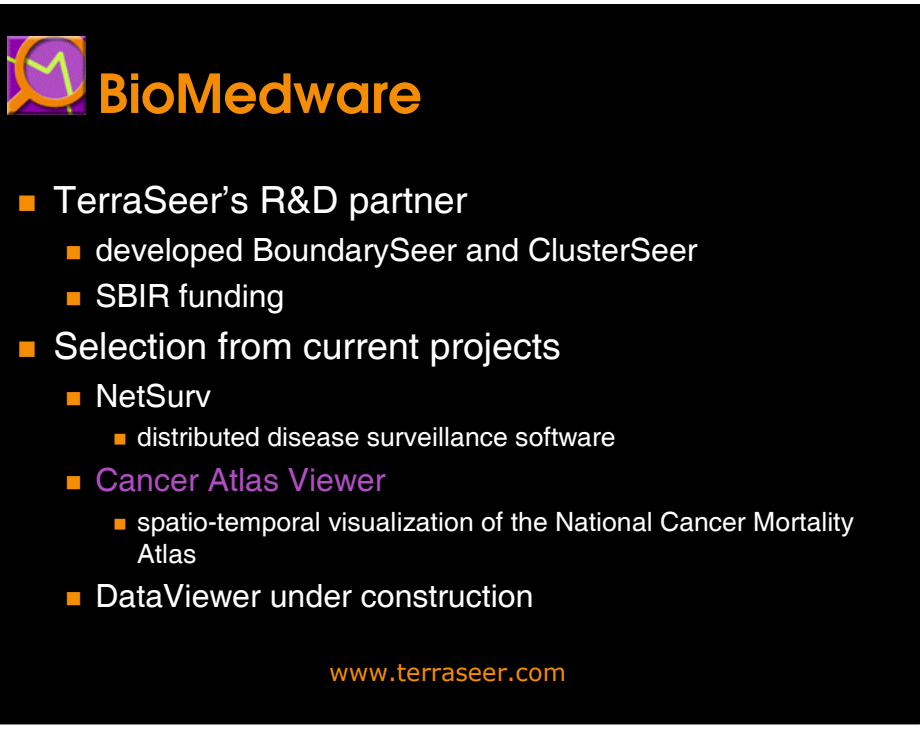

CuSum Technique
Cumulative sum over time, of the differences between observed case counts and a reference/baseline value
Differences are added together and plotted on graph over time
Magnifies small, abrupt change which are too small to be visible in conventional graphical plots of a fluctuating series of data
www.terraseer.com


NetSurv: Phase I
CuSum technique (Hutwagner et al 1997)
Distributed system
Web browser interface “thin client”
www.terraseer.com


Multi-Tier Distributed Apps
Windows
Mac
Unix
Browser
Thin Clients
NetSurv Components
CuSum Method
Security Manager
Database Broker
Application Server
surveillance
DBMS Server
census
Web Server
www.terraseer.com


Interface screenshot
Grouping variables
Age (years)
Total
1 - 5
Sex
Total
Male
County
Total
Aringa
Time Scale
week
month
quarter
year
Parameters
h
1.0
k
0.5
Average disease frequency
mean
median
Case Count
CuSum
Month
Zoom
Run Analysis
View Map
View Result Table
Logout


NetSurv phase I results
Web-based interface difficult, not user friendly
difficult: interface complex, difficult to implement
not user friendly: mapping, graphing slow, interface static not dynamic
www.terraseer.com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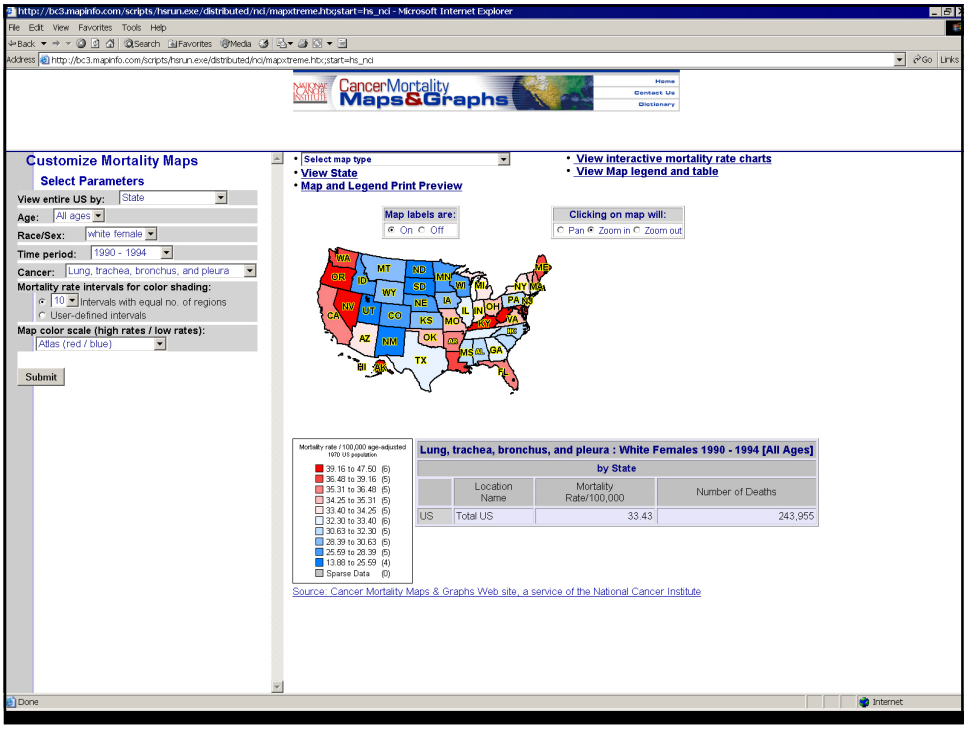
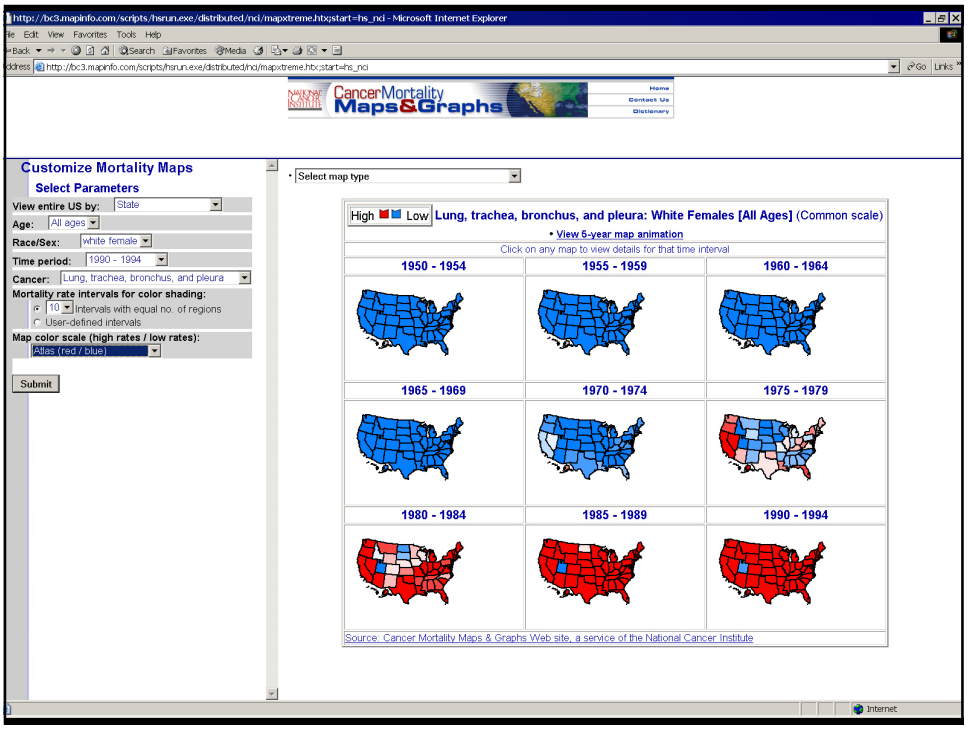
Motivation for Cancer Atlas Viewer

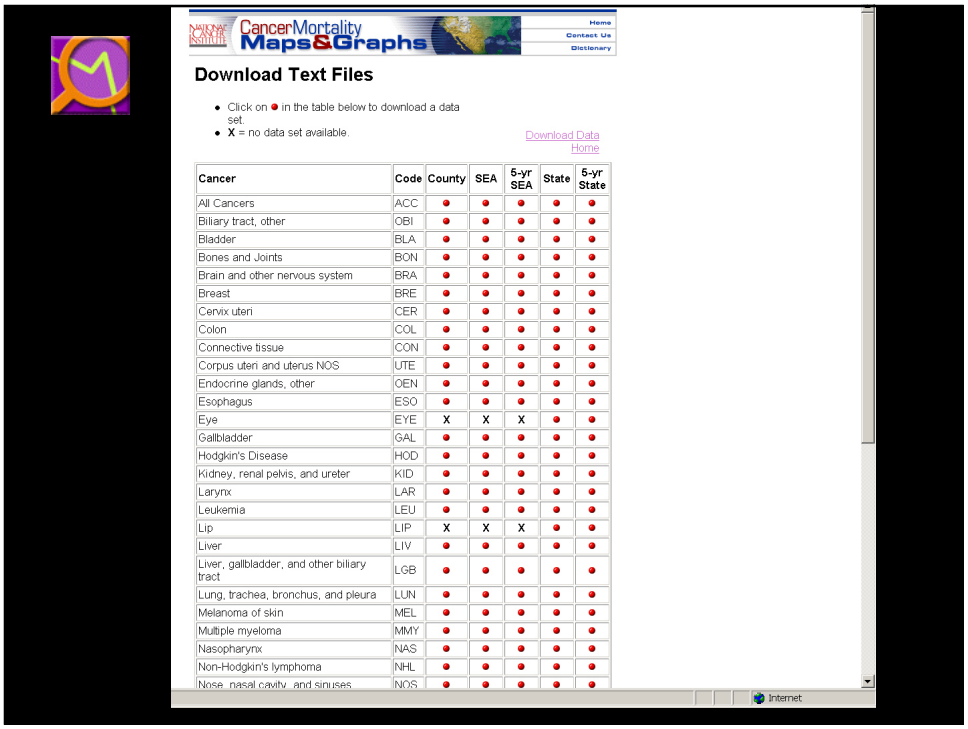
- Provide real-time visualization of the National Cancer Mortality Atlas Data
- Provide statistics for spatial, temporal, and space-time evaluation of Atlas data
- Explore general STIS specifications with a specific example

www.terraseer.com




CancerMortality Maps&Graphs
Customize Mortality Maps
Select Parameters
View entire US by: State
Age: All ages
Race/Sex: white female
Time period: 1990 - 1994
Cancer: Lung, trachea, bronchus, and pleura
Mortality rate intervals for color shading:
10 intervals with equal no. of regions
User-defined intervals
Map color scale (high rates / low rates):
Atlas (red / blue)
Submit
Select map type
High Low Lung, trachea, bronchus, and pleura: White Females [All Ages] (Common scale)
View 5-year map animation
Click on any map to view details for that time interval
1950 - 1954
1955 - 1959
1960 - 1964
1965 - 1969
1970 - 1974
1975 - 1979
1980 - 1984
1985 - 1989
1990 - 1994
Source: Cancer Mortality Maps & Graphs Web site, a service of the National Cancer Institute


Real Time Interaction
Avoid the “world wide wait”
CancerMortality Maps&Graphs
Customize Mortality Maps
Select Parameters
View entire US by: State
Age: All ages
Race/Sex: white female
Time period: 1990 - 1994
Cancer: All cancers
Mortality rate intervals for color shading:
10 intervals with equal no. of regions
User-defined intervals
Map color scale (high rates / low rates):
Atlas (red / blue)
Submit
Map being produced....
Please wait for map creation.
Map creation may take up to a minute, depending upon your connection speed



Real Time Interaction

- Provide more flexible access to the data.
- Concurrency issues

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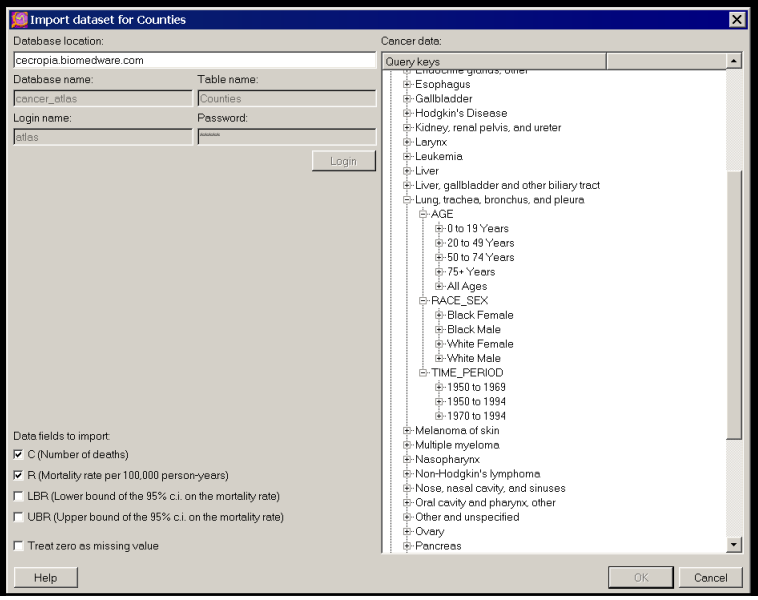
Downloading Data



Real Time Interaction

- Provide linked views that you can brush for interactive data exploration
  - Map
  - Scatterplot
  - Box plot
  - Histogram
  - Table

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Space-Time Viz
Slideshow
Group of maps with a common legend
www.terraseer.com


Provide Statistics
Standardization
Z-score
LISA
Univariate
spatial contagion
Bivariate
space-time contagion
Cluster persistence
www.terraseer.com

Moran's I

- Global statistic – 1 value for entire dataset
- Spatially weighted correlation coefficient
- Range ~ (-1, 1)
- Moran, P.A.P. 1950. Notes on continuous stochastic phenomena. Biometrika 37: 17-23.

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Calculation of LISA's

1. Standardize data as z-score

$$z_i = (x_i - \mu_x)/ \text{var}(x)^{½}$$

2. Calculate LISA statistics (Anselin, 1995)
   - local statistic, 1 value for every location

$$I_i = z_i \Sigma w_{ij} z_j$$

3. Evaluate significance of LISA statistics via Monte Carlo randomization

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The Moran Scatter Plot

- Graphs the values (z_i) of each area versus the average of its neighbors
  - $\Sigma\ w_{ij}\ z_j$
- Has four quadrants that display high-high and low-low clusters, and high-low and low-high outliers

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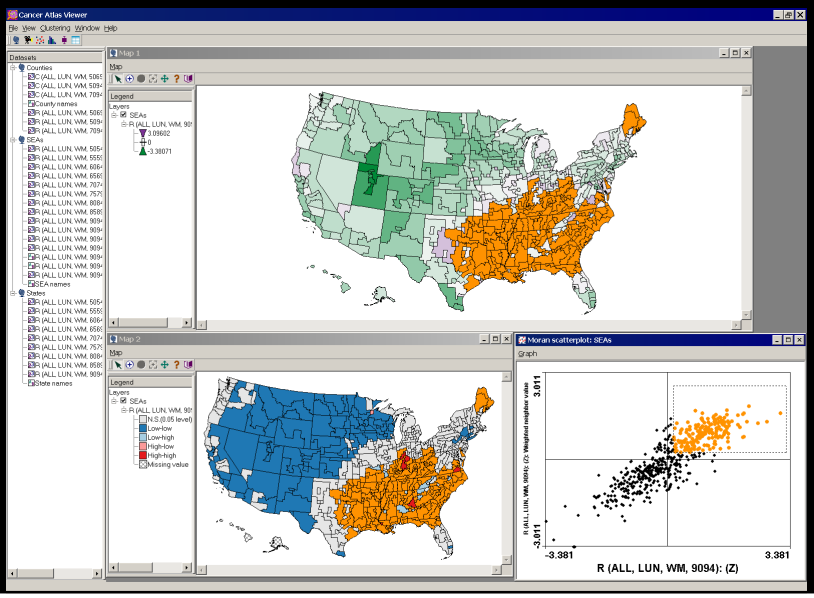
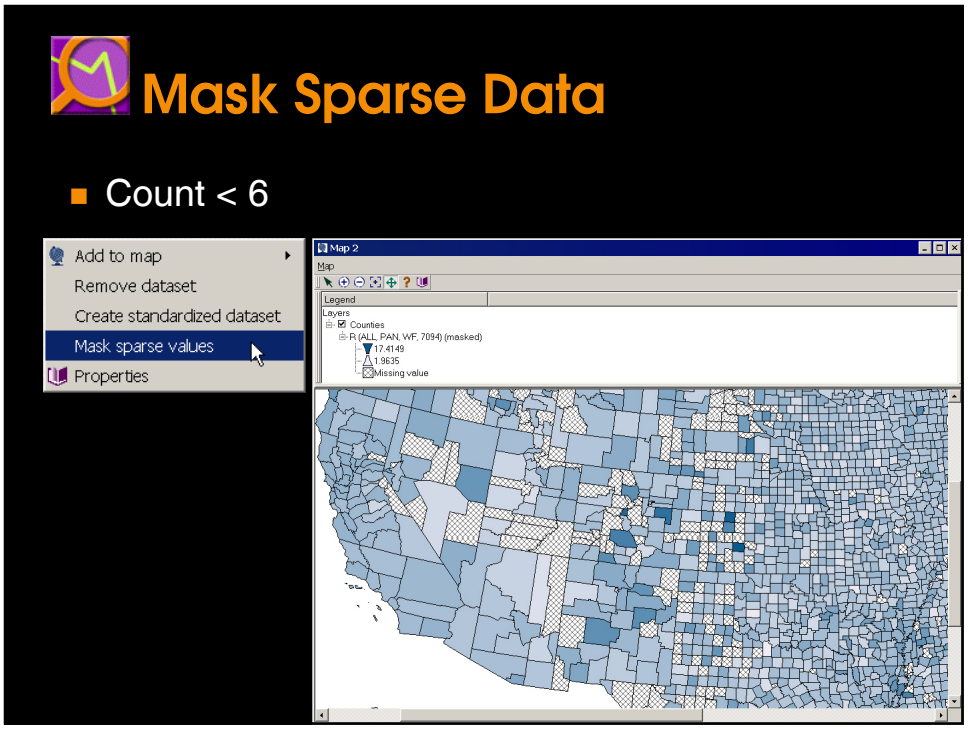
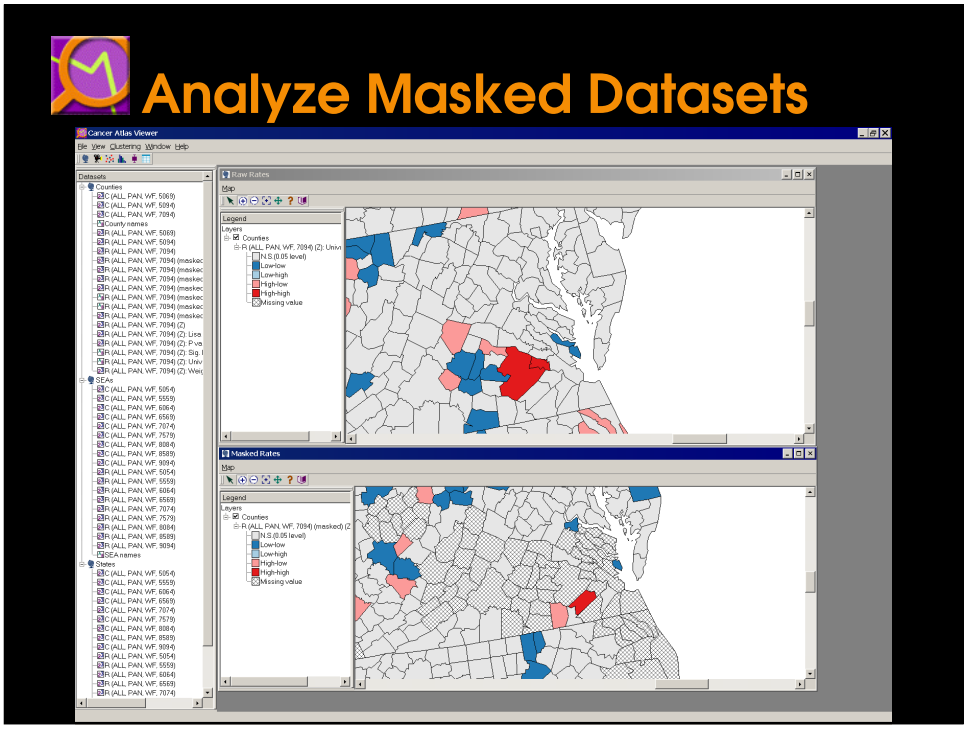
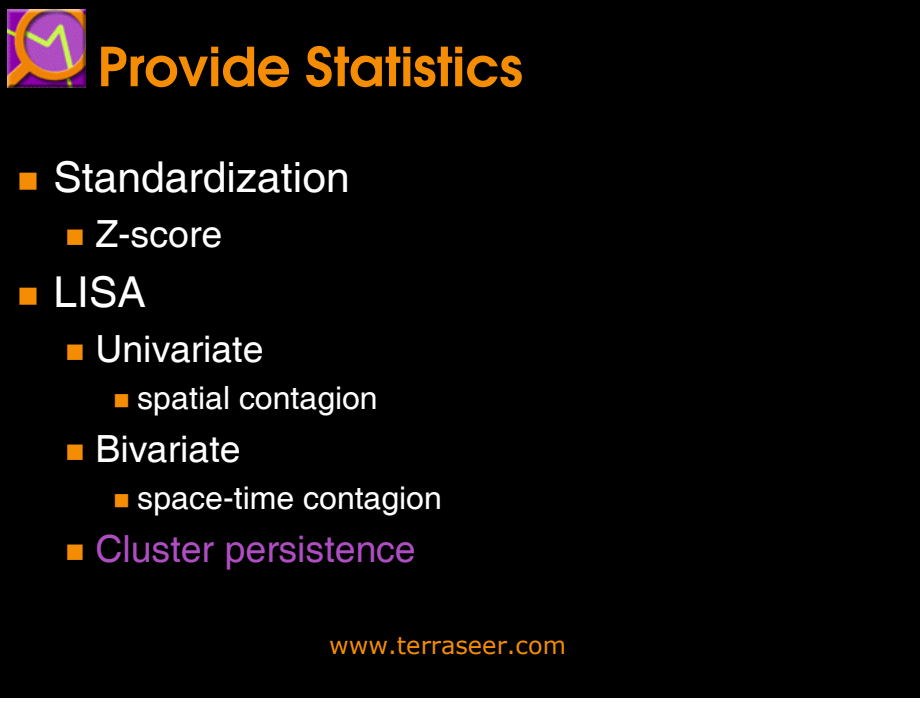
Local Clustering (LISA)




Mask Sparse Data
Count < 6
Add to map
Remove dataset
Create standardized dataset
Mask sparse values
Properties
Map 2
Map
Legend
Layers
Counties
R (ALL, PAN, WF, 7094) (masked)
17.4149
1.9635
Missing value


Analyze Masked Datasets
Cancer Atlas Viewer
Raw Rates
Masked Rates
Legend
Layers
Counties
Low-low
Low-high
High-low
High-high
Missing value


Provide Statistics
Standardization
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LISA
Univariate
spatial contagion
Bivariate
space-time contagion
Cluster persistence
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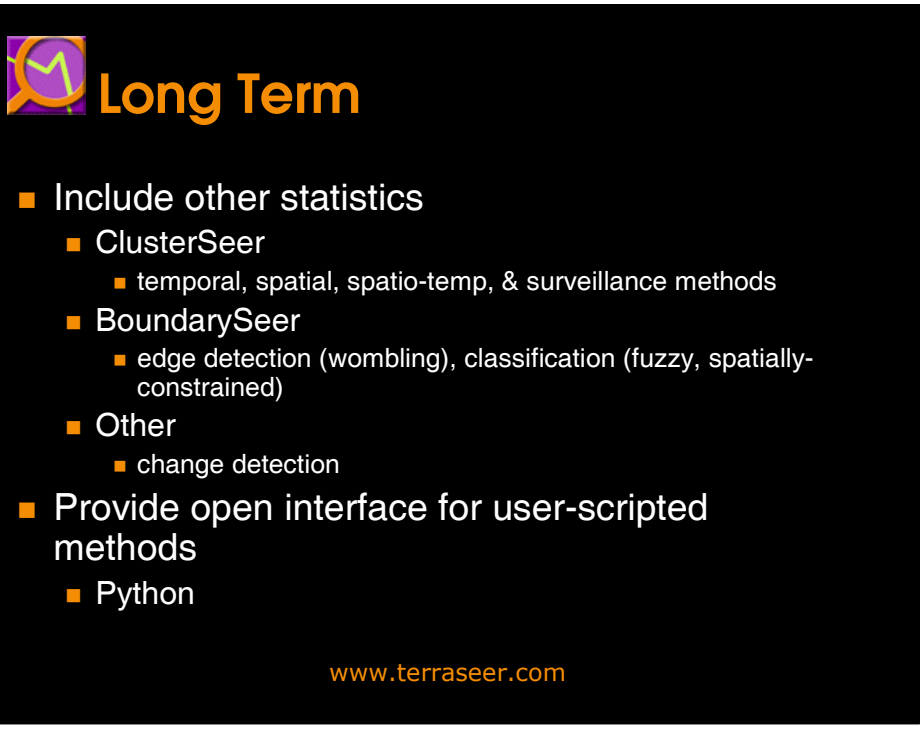
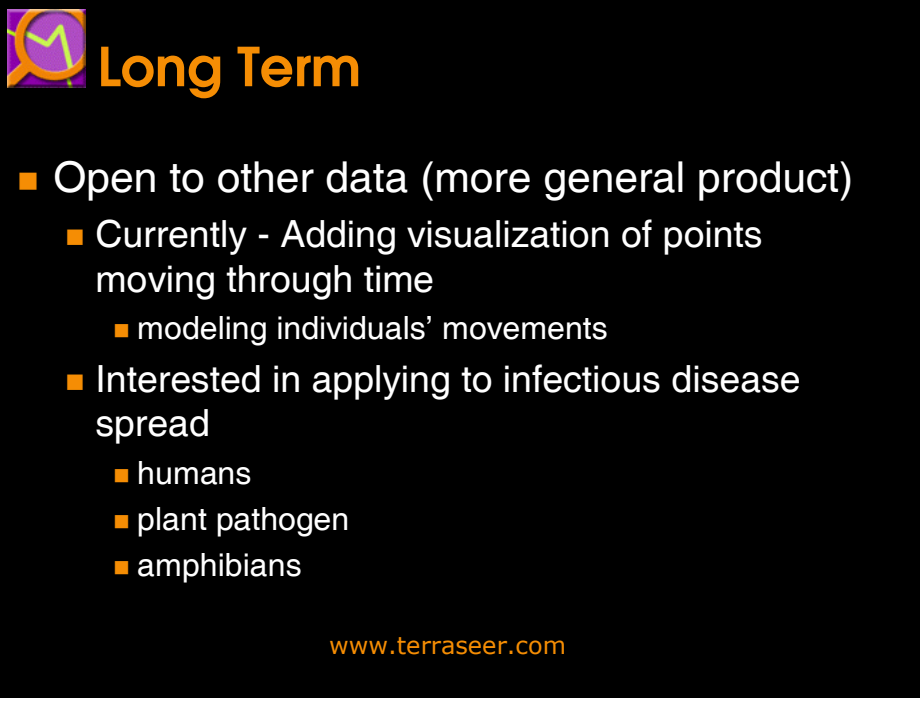
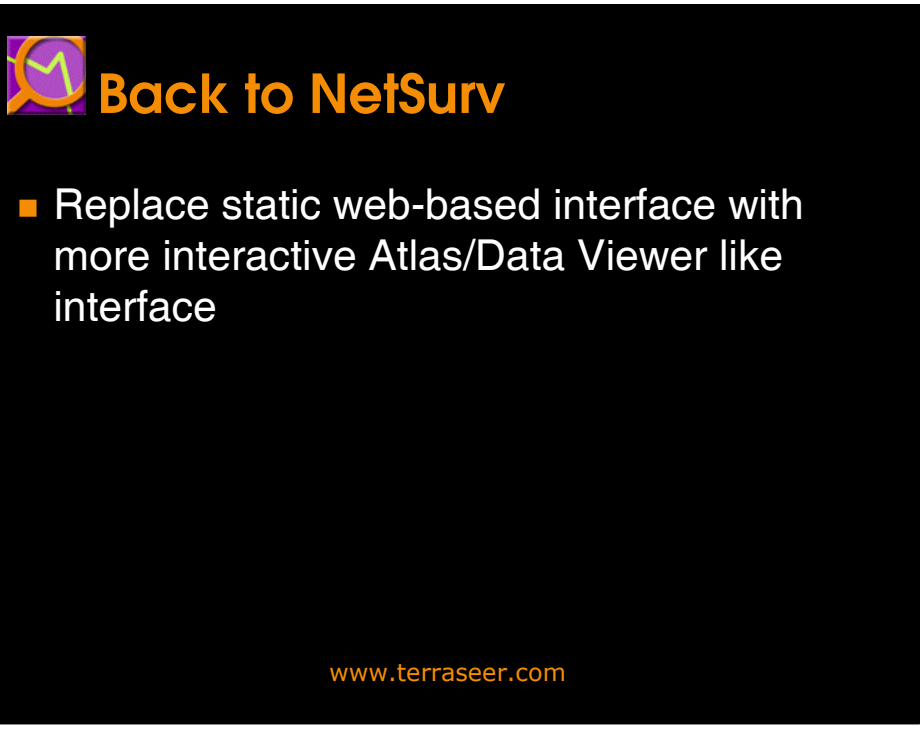
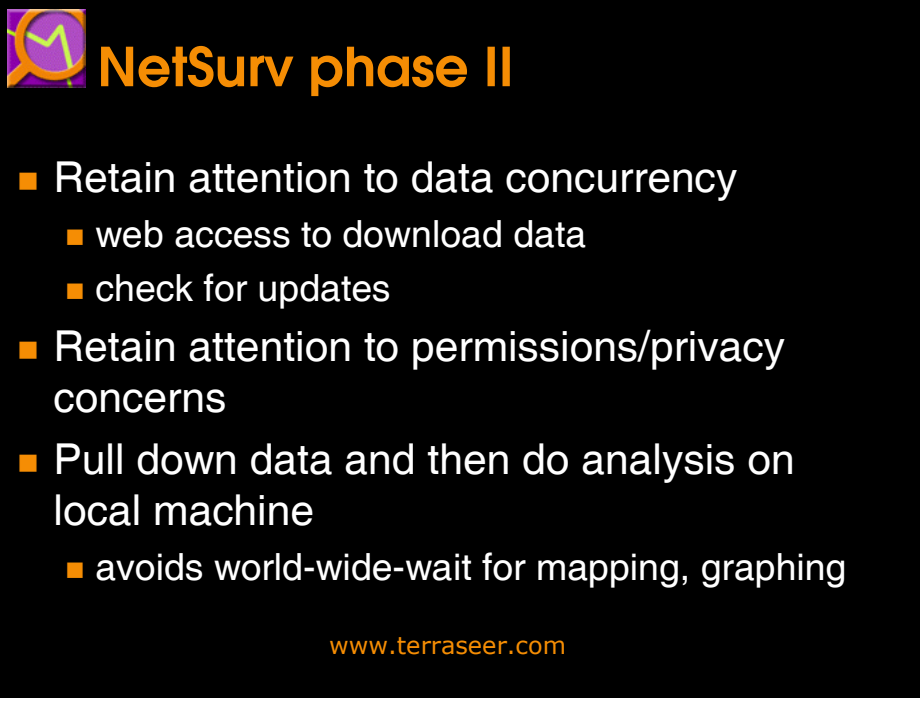
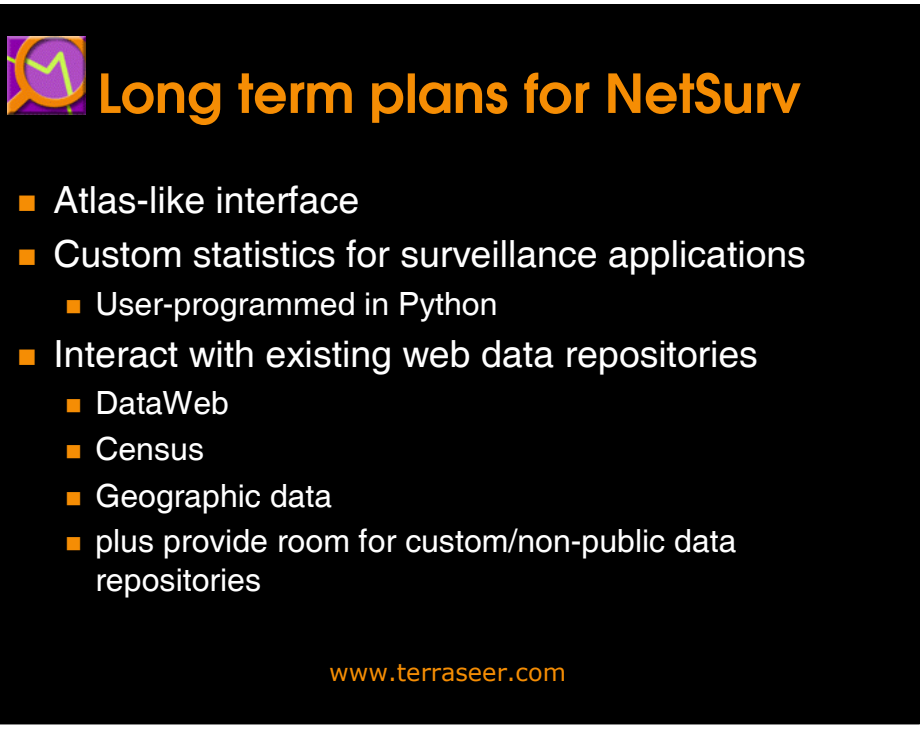
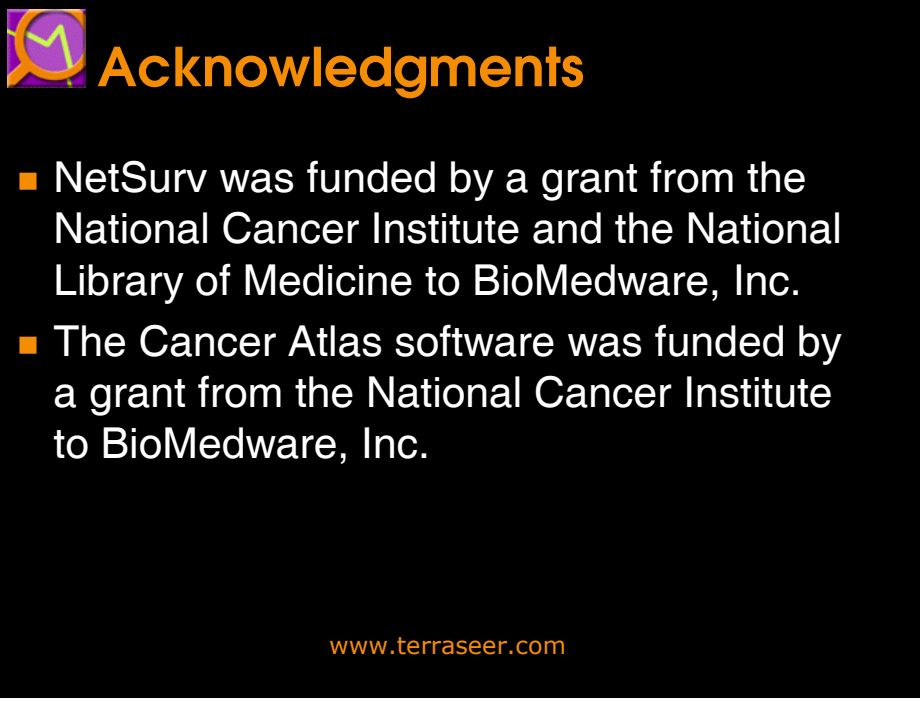

Long Term
Include other statistics
ClusterSeer
temporal, spatial, spatio-temp, & surveillance methods
BoundarySeer
edge detection (wombling), classification (fuzzy, spatially-constrained)
Other
change detection
Provide open interface for user-scripted methods
Python
www.terraseer.com


Long Term
Open to other data (more general product)
Currently - Adding visualization of points moving through time
modeling individuals' movements
Interested in applying to infectious disease spread
humans
plant pathogen
amphibians
www.terraseer.com


Back to NetSurv
Replace static web-based interface with more interactive Atlas/Data Viewer like interface
www.terraseer.com


NetSurv phase II
Retain attention to data concurrency
web access to download data
check for updates
Retain attention to permissions/privacy concerns
Pull down data and then do analysis on local machine
avoids world-wide-wait for mapping, graphing
www.terraseer.com


Long term plans for NetSurv
Atlas-like interface
Custom statistics for surveillance applications
User-programmed in Python
Interact with existing web data repositories
DataWeb
Census
Geographic data
plus provide room for custom/non-public data repositories
www.terraseer.com


Acknowledgments
NetSurv was funded by a grant from the National Cancer Institute and the National Library of Medicine to BioMedware, Inc.
The Cancer Atlas software was funded by a grant from the National Cancer Institute to BioMedware, Inc.
www.terraseer.com