Spatial(-temporal) Interpolation with R

International Summer Academy on Spatial Ecotoxicology and Ecotoxicological Risk Assessment
Using an Open Commmunity Approach

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What is GIS?

GIS

GIS
? Information ?

GIS
? Information ?

- **Geographic**
  Parent and Church, 1987. Conf. GIS
- **Spatial (Geospatial)**
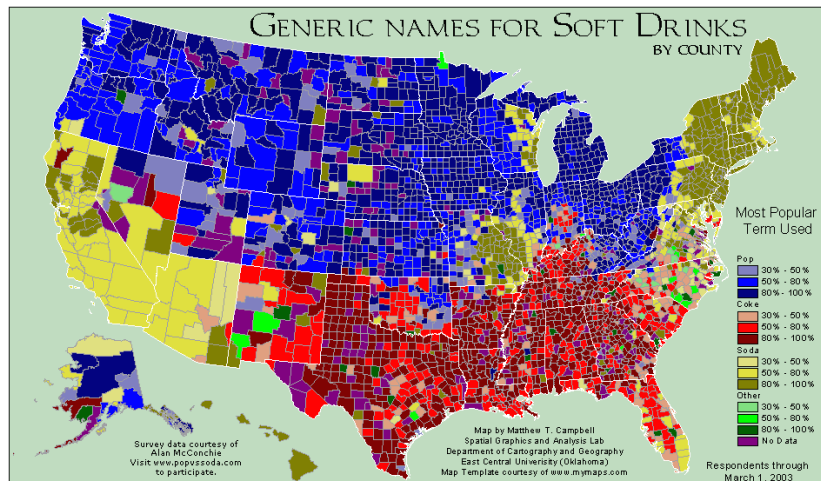 Anselin, 1989. What is special about spatial data?
- **Spatiotemporal**
  Burrough and Frank, 1995. Int J GIS

GIS
? Information ?
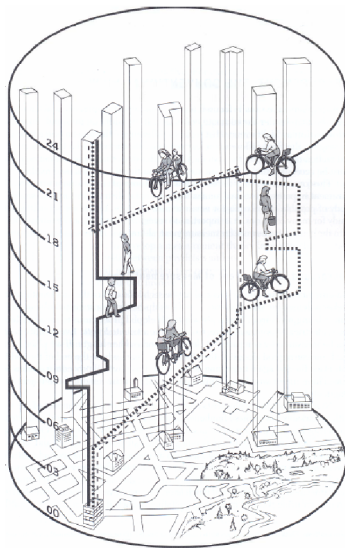
- **Geographic**
  Parent and Church, 1987. Conf. GIS

- **Spatial (Geospatial)**
  Anselin, 1989. What is special about spatial data?

- **Spatiotemporal**
  Burrough and Frank, 1995. Int J GIS

- **System**
- **Science**
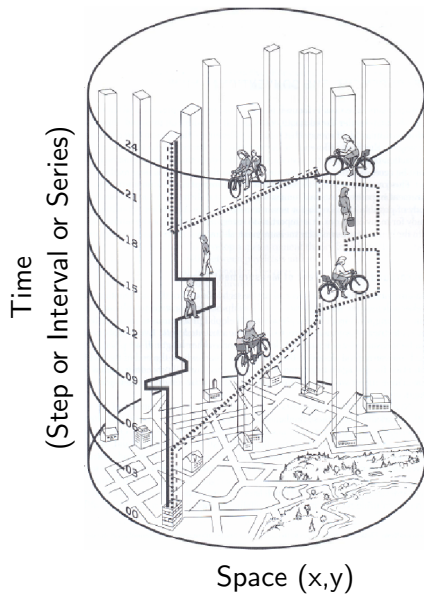 Goodchild, 1992. Int J GIS

80% of data are Spatiotemporal

Bossler, 2002. Manual of Geospatial Science and Technology
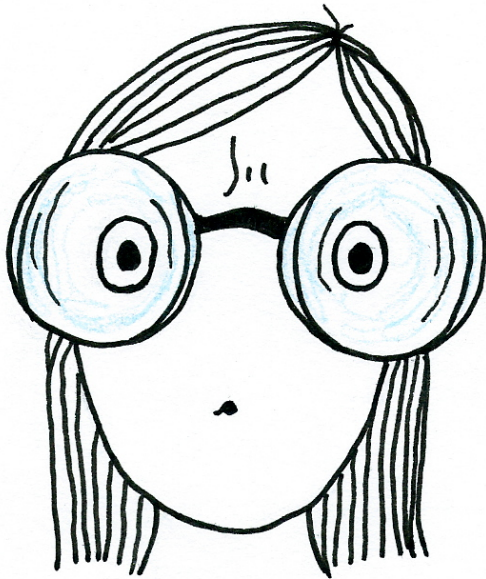
Representation of Spatiotemporal Data

Chrisman,1997.Exploring GIS

Representation of Spatiotemporal Data

Chrisman,1997.Exploring GIS

Wear the GI Glasses

What is Spatial Statistics?

Spatial(-temporal) Statistics

Experts' Thoughts

- Spatial statistics offers a way of describing the spatial continuity that is an essential feature of many natural phenomena and provides adaptations of classical regression techniques to take the advantage of this continuity
  Isaaks and Srivastava, 1989. An Introduction to Applied Geostatistics

- Spatial statistics provides a set of statistical tools for incorporating the spatial coordinates of observations in data processing
  Goovaerts, 2007. Geostatistics for Natural Resources Evaluation

Spatial(-temporal) Interpolation
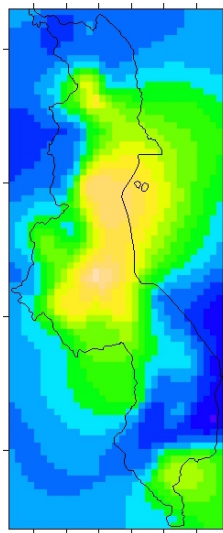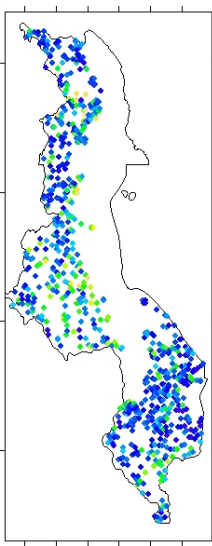
Spatial(-temporal) Interpolation
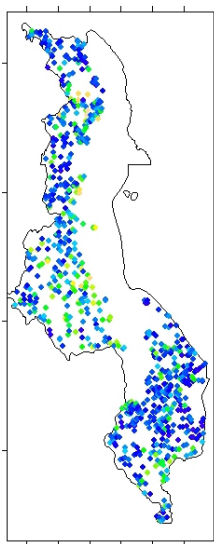
Z
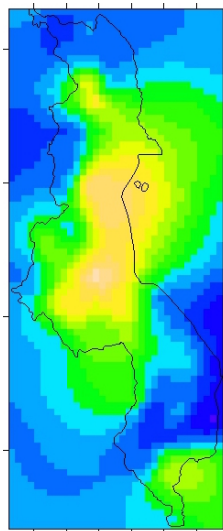
z is a random process with unique mean and variance
z(sampled locations) ≈ z(unsampled location)

Spatial(-temporal) Interpolation

Input

- Set of Points sampled, sparsely distributed in space and time
- Each point represents a measurement of a variable (spatiotemporal attribute) that occurs in that space and time location
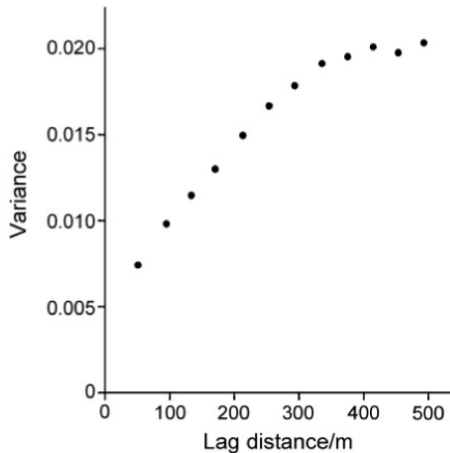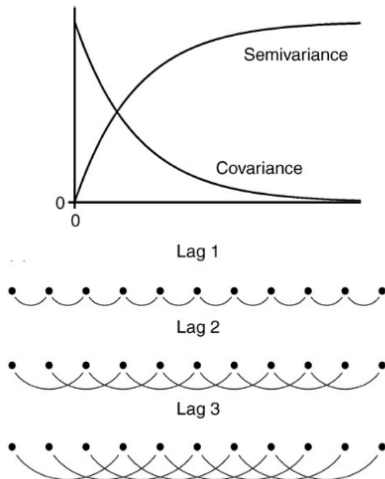
Spatial(-temporal) Interpolation

Input

- Set of Points sampled, sparsely distributed in space and time
- Each point represents a measurement of a variable (spatiotemporal attribute) that occurs in that space and time location

Output

- Spatial Data Model
- Computer/mathematical representation that allows one to perform estimations and/or simulations for attribute values at spatial/temporal locations not sampled

Spatial(-temporal) Variability
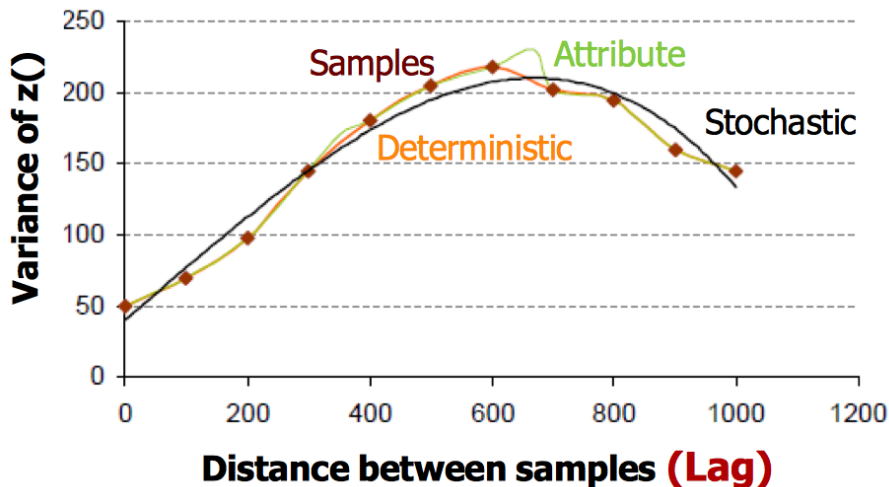
Spatial(-temporal) Variability

Spatial(-temporal) Variogram
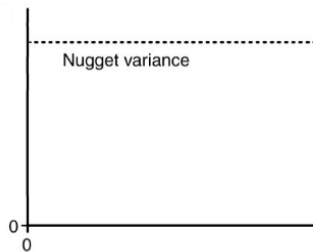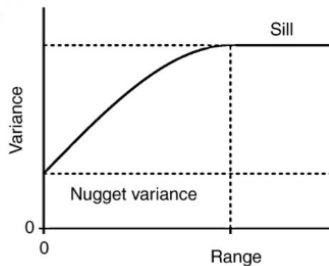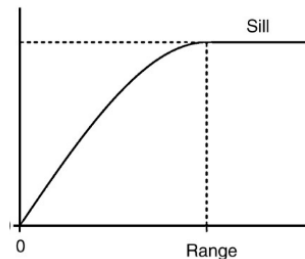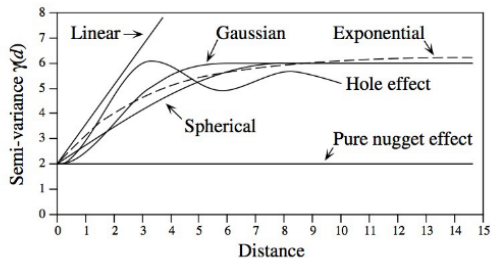
Stochastic or Geostatistical Interpolation

- A probability distribution function is associated to its probable values
- Uncertainties can be associated to its estimation
- e.g. Kriging
- Minimization of estimation variance (error)

Normal Distribution
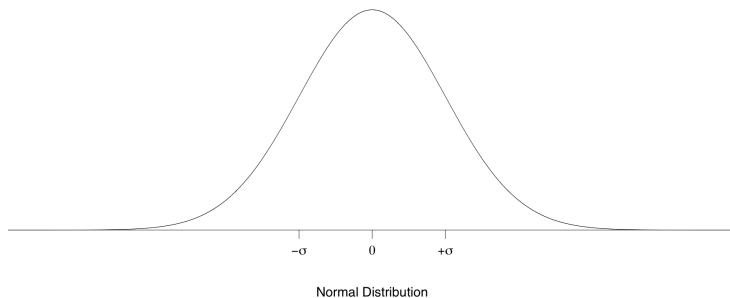
Deterministic Interpolation

- An unique value is associated to its spatial location
- No uncertainty is associated to its estimation
- e.g. Inverse Distance Weighting (IDW)

$$Z^*(x_0) = \frac{\sum\limits_{i=1}^{n} \frac{1}{d_i^2} z(x_i)}{\sum\limits_{i=1}^{n} \frac{1}{d_i^2}}$$

Learn more about Spatial(-temporal) Statistics

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The slides, scripts, materials and data are available from:
https://github.com/AvitBhowmik/SA16

Learning by doing!

Thank You!