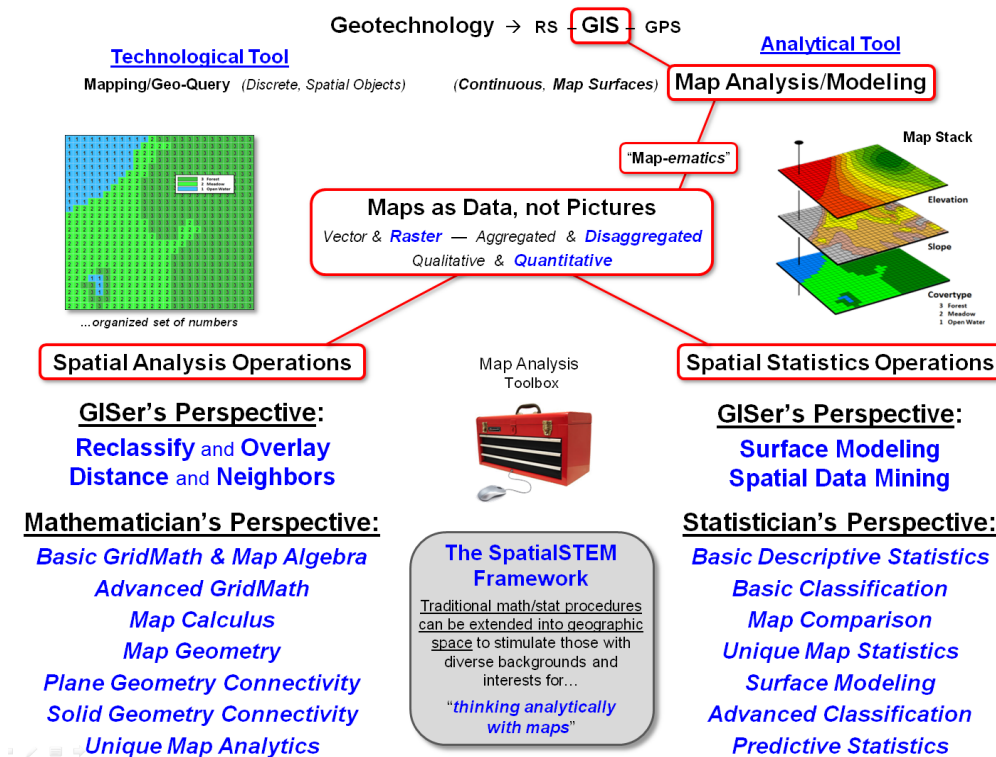


# SpatialSTEM:

## A Mathematical/Statistical Framework for Understanding and Communicating Grid-based Map Analysis and Modeling

Presentation by Joseph K. Berry



This paper describes the idea of **SpatialSTEM** for understanding and communicating spatial reasoning, map analysis and modeling fundamentals within a mathematical/statistical framework that resonates with science, technology, engineering and math/stat communities. The premise is that "modern maps are numbers first, pictures later" and we do mathematical things to mapped data for insight and better understanding of spatial patterns and relationships within decision-making contexts— from *Where is What* graphical inventories to a *Why, So What* and *What If* problem-solving environment.

The map-ematical approach focuses on analytical tools used in spatial reasoning by non-GIS communities instead of traditional "GIS mechanics" of data acquisition,

storage, retrieval, query and display of map features directed toward GIS specialists. The goal is to get the STEM communities to "think with maps" and infuse direct consideration of spatial patterns and relationships into their endeavors, as an alternative to spatially-aggregated math/stat procedures that assume uniform or random distribution of map variables in geographic space.

### Topics:

- Quantitative Nature of Modern Maps** – conceptual approach, mathematical framework and data structure supporting a mathematical treatment of mapped data; grid-based data format uses Lat/Lon to form a Universal dB Key for joining data tables based on location
- Spatial Analysis Operations** – extensions of traditional mathematics that focus on "contextual" geographic relationships (e.g., map math, algebra, calculus, plane and solid geometry, and unique map analytics)
- Spatial Statistics Operations** – extensions of traditional statistics that focus on "numerical" relationships of map values (e.g., map descriptive statistics, normalization, comparison, classification, surface modeling, and predictive statistics)



**About the Presenter:** Dr. Berry is a leading consultant and educator in the application of GIS technology. He is the principal of Berry and Associates // Spatial Information Systems (**BASIS**), consultants and software developers in geotechnology and the author of the "Beyond Mapping" column for GeoWorld magazine since 1989, several books and over 200 papers on GIS theory and applications. He conducted basic research and taught courses in GIS for twelve years at Yale University's Graduate School of Forestry and Environmental Studies, and is currently an adjunct faculty member in Geosciences at the University of Denver and in Natural Resources at Colorado State University.  
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### Additional Information:

- [Making a Case for SpatialSTEM](http://www.innovativegis.com/basis/Papers/Other/SpatialSTEM/SpatialSTEM_case.pdf) — white paper describing a framework for grid-based map analysis and modeling concepts and procedures as direct spatial extensions of traditional mathematics and statistics.
- [SpatialSTEM: A Mathematical Structure for Teaching Fundamental Concepts in Spatial Reasoning, Map Analysis and Modeling](http://www.innovativegis.com/basis/Papers/Other/SpatialSTEM/) — references and teaching materials supporting a 50 minute seminar and a 6 contact hour workshop.
- [Beyond Mapping III](http://www.innovativegis.com/basis/MapAnalysis/) — an online book containing Introduction, 28 Chapters and Epilog as a compilation of the popular Beyond Mapping columns published in GeoWorld magazine from 1996 through present, BASIS, Fort Collins, Colorado, 2012. J.K. Berry.

# Online Book Chapter on the SpatialSTEM Approach

**Spatial STEM: A Framework for Understanding and Communicating Geospatial Data Analysis and Modeling**

**Abstract:** There is a "gap" between the traditional, individual concepts and procedures for the quantitative analysis of the variables (spatial data) and the visualization of the results. This gap is the focus of the SpatialSTEM approach. The approach is based on the integration of the concepts of the SpatialSTEM approach. The approach is based on the integration of the concepts of the SpatialSTEM approach.

**Keywords:** SpatialSTEM, Geospatial Data, Analysis, Modeling, Visualization, Communication.

**URL:** [www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm](http://www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm)

**Geospatial Information Systems (GIS)**

**Geospatial Information Systems (GIS)** are systems that capture, store, manipulate, analyze, and display spatial data. They are used in a wide range of applications, including urban planning, environmental management, and transportation.

**Key Concepts:** Spatial Data, Geospatial Data, GIS, GIS Applications, GIS Software, GIS Hardware, GIS Data Sources, GIS Data Management, GIS Data Analysis, GIS Data Visualization, GIS Data Communication.

**URL:** [www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm](http://www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm)

**A Mathematical Structure for Map Analysis/Modeling**

**Mathematical Structure for Map Analysis/Modeling** is a framework for understanding and communicating geospatial data analysis and modeling. It is based on the integration of the concepts of the SpatialSTEM approach.

**Key Concepts:** Mathematical Structure, Map Analysis, Modeling, Geospatial Data, GIS, GIS Applications, GIS Software, GIS Hardware, GIS Data Sources, GIS Data Management, GIS Data Analysis, GIS Data Visualization, GIS Data Communication.

**URL:** [www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm](http://www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm)

**Spatial Analysis Operations (SpatialSTEM)**

**Spatial Analysis Operations (SpatialSTEM)** is a framework for understanding and communicating geospatial data analysis and modeling. It is based on the integration of the concepts of the SpatialSTEM approach.

**Key Concepts:** Spatial Analysis, Operations, Geospatial Data, GIS, GIS Applications, GIS Software, GIS Hardware, GIS Data Sources, GIS Data Management, GIS Data Analysis, GIS Data Visualization, GIS Data Communication.

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**So What's the Point? (Key Point)**

**So What's the Point? (Key Point)** is a framework for understanding and communicating geospatial data analysis and modeling. It is based on the integration of the concepts of the SpatialSTEM approach.

**Key Concepts:** So What's the Point, Key Point, Geospatial Data, GIS, GIS Applications, GIS Software, GIS Hardware, GIS Data Sources, GIS Data Management, GIS Data Analysis, GIS Data Visualization, GIS Data Communication.

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A ten-part series of Beyond Mapping columns in GeoWorld is compiled into Topic 30, "SpatialSTEM: A Math/Stat Framework for Grid-based Map Analysis and Modeling" in the online book Beyond Mapping III posted at... [www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm](http://www.innovativegis.com/basis/MapAnalysis/Topic30/Topic30.htm)