UC Santa Barbara

Center Reports

Title

spatial@ucsb
—perspectives for teaching and research

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what spatial means:

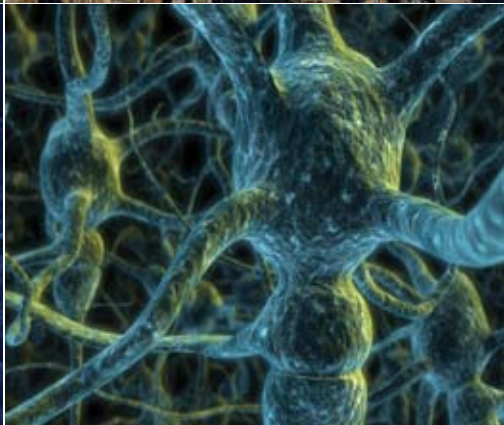from the mind . . .

. . . to society

from local . . .

. . . to global

from the micro . . .

. . . to the cosmos

spatial@ucsb believes that spatial literacy is crucial to America's scientific leadership, competitiveness, and prosperity

about **spatial@ucsb**:

The University of California, Santa Barbara, is engaged in a world-class initiative dedicated to one of the most powerful yet under-utilized abilities of the human mind—spatial thinking.

spatial@ucsb, led by renowned geographer Michael F. Goodchild, was established to increase our understanding of spatial thinking, explore its uses, and promote spatial literacy.
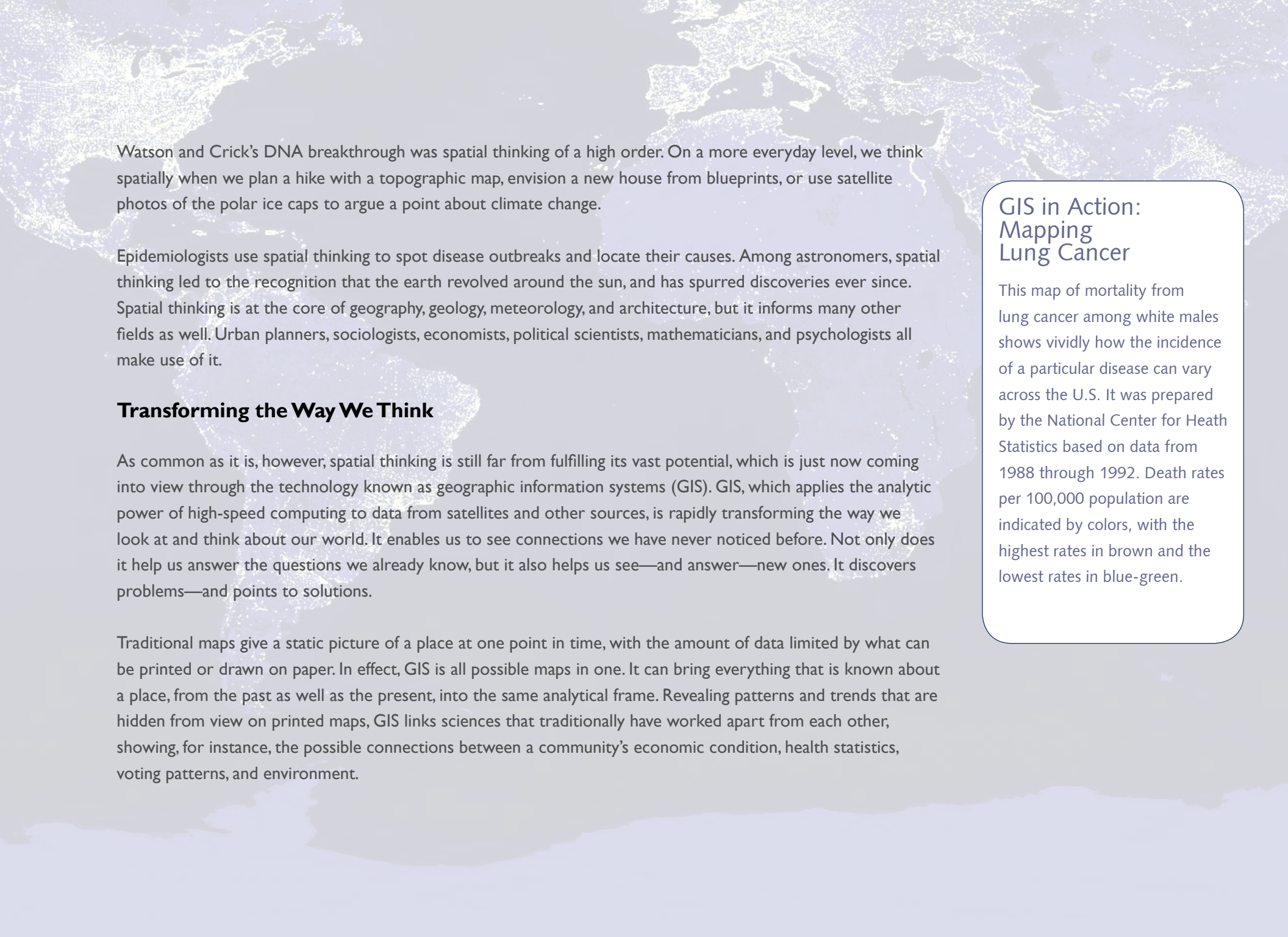
Toward a Spatially Literate Nation

What does it mean to be "spatially literate"? Simply put, spatial literacy is the ability to use the concepts that define space—such as height, depth, nearness, and distance—to understand and describe the natural and social universe. The National Research Council says the spatially literate:
• Have the habit of thinking spatially.
• Are informed in their spatial thinking; well-versed in spatial reasoning, spatial concepts, and spatial representations; and adept at the spatial use of tools and technologies.
• Can judge the accuracy and reliability of spatial data, can use spatial data to illustrate and argue a point of view, and can assess the validity of arguments based on spatial information.

Central to the mission of **spatial@ucsb** is the belief that spatial literacy is crucial to America's scientific leadership, competitiveness, and prosperity. **spatial@ucsb** is working to make this a spatially literate nation.

Spatial Thinking and Science

Spatial thinking is a powerful tool of discovery. James Watson and Francis Crick thought spatially when they unlocked the structure of DNA in 1953. Lacking microscopes powerful enough to reveal the molecule's secrets to the human eye, Watson and Crick relied on their spatial intuition to develop a complex and elegant model, the famous "double helix" of complementary phosphate-sugar chains that fit the experimental data on DNA and obeyed the laws of chemistry.

Watson and Crick's DNA breakthrough was spatial thinking of a high order. On a more everyday level, we think spatially when we plan a hike with a topographic map, envision a new house from blueprints, or use satellite photos of the polar ice caps to argue a point about climate change.

Epidemiologists use spatial thinking to spot disease outbreaks and locate their causes. Among astronomers, spatial thinking led to the recognition that the earth revolved around the sun, and has spurred discoveries ever since. Spatial thinking is at the core of geography, geology, meteorology, and architecture, but it informs many other fields as well. Urban planners, sociologists, economists, political scientists, mathematicians, and psychologists all make use of it.

Transforming the Way We Think

As common as it is, however, spatial thinking is still far from fulfilling its vast potential, which is just now coming into view through the technology known as geographic information systems (GIS). GIS, which applies the analytic power of high-speed computing to data from satellites and other sources, is rapidly transforming the way we look at and think about our world. It enables us to see connections we have never noticed before. Not only does it help us answer the questions we already know, but it also helps us see—and answer—new ones. It discovers problems—and points to solutions.

Traditional maps give a static picture of a place at one point in time, with the amount of data limited by what can be printed or drawn on paper. In effect, GIS is all possible maps in one. It can bring everything that is known about a place, from the past as well as the present, into the same analytical frame. Revealing patterns and trends that are hidden from view on printed maps, GIS links sciences that traditionally have worked apart from each other, showing, for instance, the possible connections between a community's economic condition, health statistics, voting patterns, and environment.

GIS in Action:
Mapping
Lung Cancer

This map of mortality from lung cancer among white males shows vividly how the incidence of a particular disease can vary across the U.S. It was prepared by the National Center for Heath Statistics based on data from 1988 through 1992. Death rates per 100,000 population are indicated by colors, with the highest rates in brown and the lowest rates in blue-green.

Rates of Lung Cancer, 1988–1992
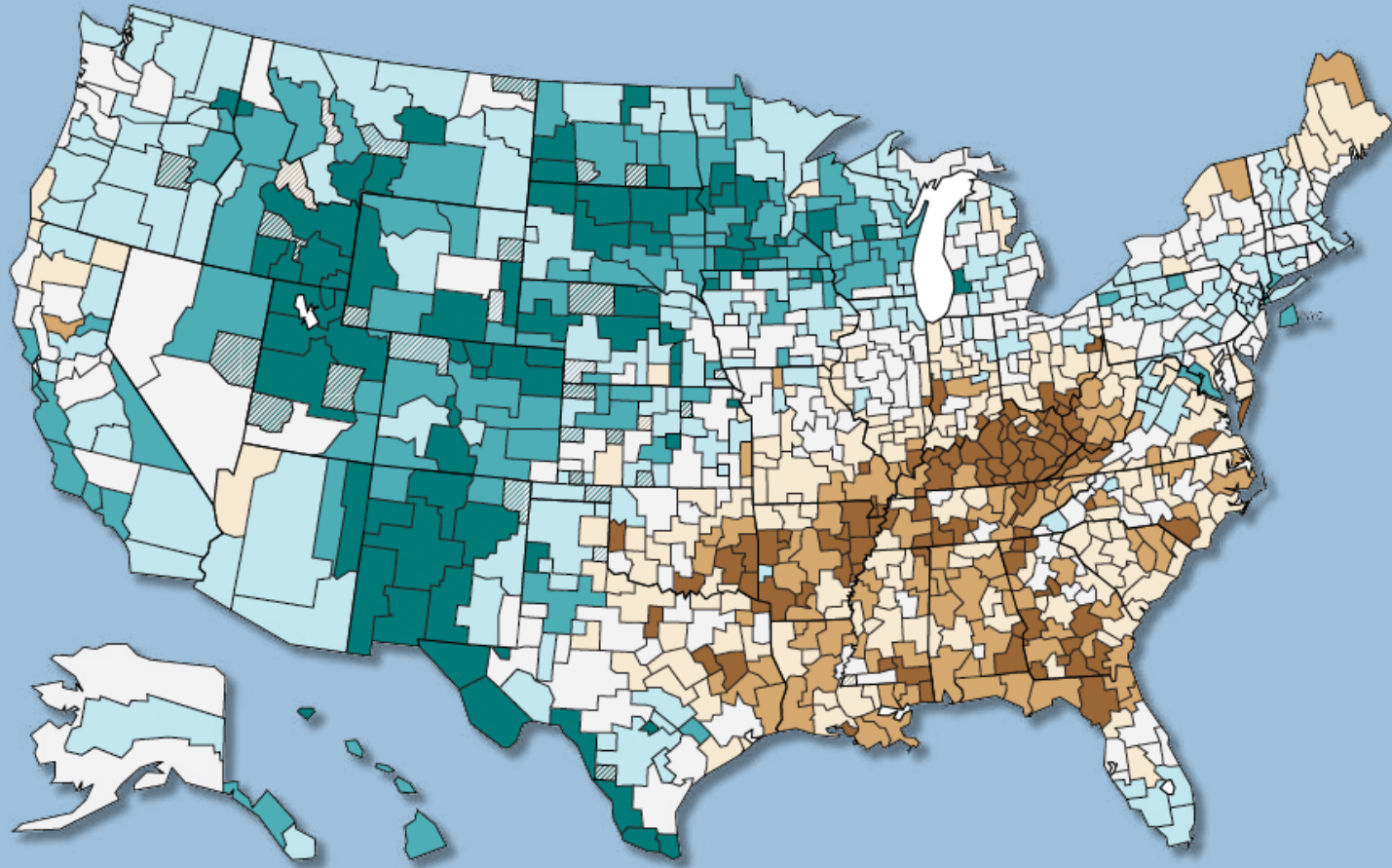
UCSB at the Forefront

UC Santa Barbara has played a key role in developing GIS and applying spatial thinking across the disciplines. It teaches and uses spatial thinking in many venues, including virtual immersive environments, brain imaging studies, information visualization, quantitative methods and spatial statistics, simulation of space-time interactions, satellite imagery and remote sensing, and spatial relationships in the creative arts. Spatial thinking is a central theme for centers, projects, and faculty interests such as these:

- **The Alexandria Digital Library**, developed with National Science Foundation (NSF) funding, provides remote access to the university's outstanding map and imagery collection.

- **The National Center for Ecological Analysis and Synthesis** uses and promotes spatial methods in ecology.

- **The Allosphere**, a spherical, completely immersive environment for research and visualization in science, engineering, and art.

- **The Sage Center for the Study of the Mind** uses functional magnetic resonance imaging to map cognitive processes in the brain.

- **The Center for Spatially Integrated Social Science,** developed with NSF funding, provides research tools in support of spatial methods across the social sciences.

- The lead site of the **National Center for Geographic Information and Analysis**.

- **The Center for Nanotechnology in Society**, in which spatial visualization plays a key role in tracking the globalization of nanotechnology research, development, and commercialization.

- The national center for academic distribution of imagery from the **French SPOT satellite**.

- **Extensive use of GIS software** in projects that range from archaeology and religious studies to environmental restoration and the evolution of mountain belts.

- **Strong links to ESRI**, the world's leading vendor of GIS software.

- A focus on spatial cognition that links researchers in the departments of **Psychology, Geography, Anthropology,** and the **Gevirtz Graduate School of Education.**

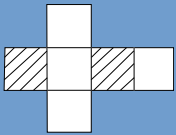- One of the **nation's top departments** of **Geography**.

Test your Spatial Literacy

Here are some questions to measure your spatial thinking skill and spatial knowledge:
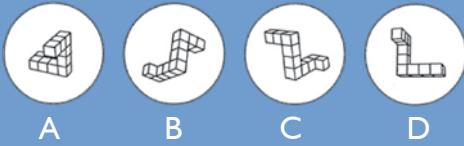
1. Which is further west, San Diego or Reno?

2. When leaving a building, do you always know which way to turn?

3. Name the two pairs of states that are adjacent on a map and also on an alphabetical list?

4. Will make ?

5. Which two drawings below show the same shape as this drawing ?

A   B   C   D

5. A and C
4. No
3. Florida and Georgia; Illinois and Indiana
2. If you never turn the wrong way when leaving a building, your spatial sense is strong
1. Reno

why spatial@ucsb?

Until recently, the university had no place where all this knowledge, infrastructure, and effort could come together to focus on the spatial-thinking theme. With **spatial@ucsb**, the campus now hosts one of the world's leading centers devoted to the possibilities of analyzing, understanding, and describing the world in multiple dimensions. **spatial@ucsb** offers new capacity for growth through its strong existing programs and facilities. It expands their scope and effectiveness by creating new opportunities for collaboration. In addition to building on the strengths of the present, it looks to the future by growing the young science of spatial thinking into a major field of research and teaching. Its goals are to:

• Integrate spatial thinking into the corpus of reasoning across the domains of knowledge for research and teaching.
• Frame curricula to equip UCSB graduates with the concepts, methods, and applications of spatial thinking.
• Provide a Web portal to curriculum and learning resources and a Web forum for exchange of ideas and training opportunities for faculty, researchers, and students.
• Promote research on new tools and applications of spatial thinking.
• Sponsor advanced research seminars, specialist meetings, workshops, and other events that serve the UCSB academic community and its leadership role nationally and internationally.

What is spatial@ucsb doing to further spatial thinking?

Here are some of its current activities:

Academic Presentations: Through series such as the "ThinkSpatial" public lectures and "brownbag" events for UCSB faculty and students, **spatial@ucsb** gives distinguished scholars a forum for sharing their expertise on spatial thinking and its application to subjects of broad interest. Recent "ThinkSpatial" presentations have covered spatial thinking in the contexts of computer science, college curricula, mathematics, geography, and media.

Graduate Student Forum: spatial@ucsb holds regular informal gatherings of students from different disciplines to share research interests involving spatial perspectives.

Specialist Meetings: Groups of researchers come to Santa Barbara under the auspices of **spatial@ucsb** to discuss the state of knowledge in cutting-edge topics, formulate a research agenda, and build a research community.

Drop-in Consultation: spatial@ucsb offers assistance with designing applications of geographic information systems (GIS) and spatial statistics.

Short Courses: These half-day or multi-day workshops explain the applications of spatial tools and concepts in research and teaching.

GIS for Graduate Students: This new course teaches GIS with a multi-disciplinary focus on the uses of this technology.

Proposal Development: spatial@ucsb helps strengthen proposals, either by partnering in projects or by advising on spatial aspects.

GIS Support for the Santa Barbara Region: spatial@ucsb is the gateway for GIS applications on the physical and human environment and on planning for the local area and for the UCSB campus.

UCSB Spatial Review: Research and teaching programs at UCSB reflect both discipline-specific and interdisciplinary innovations that draw on the power of spatial thinking. **spatial@ucsb** operates *UCSB Spatial Review* as a portal to examples of spatial perspectives from across the university. It offers colleges, divisions, departments, centers, labs, service units, and individual scholars an opportunity to share their contributions to, and their uses of, spatial thinking.

Sign up for updates and news from **spatial@ucsb** at www.spatial.ucsb.edu

"Spatial thinking applies across a continuum, from the workings of the human brain to the far reaches of the cosmos."

Michael Goodchild, Professor of Geography and Director of **spatial@ucsb**

About Michael Goodchild

Michael Goodchild, Founder and Director of **spatial@ucsb**, is a professor of geography at UCSB. Known internationally as a leader in spatial thinking and a pioneer in the theory and development of geographic information systems (GIS), Goodchild has been awarded the Prix Vautrin Lud, regarded by many as Geography's equivalent of the Nobel Prize. He earned his B.A. from Cambridge University in Physics in 1965 and his Ph.D. in Geography from McMaster University in 1969. After 19 years at the University of Western Ontario, he moved to Santa Barbara in 1988.

Goodchild is Chair of the Executive Committee of the National Center for Geographic Information and Analysis (NCGIA), associate director of the Alexandria Digital Library Project, and director of NCGIA's Center for Spatially Integrated Social Science. He is a member of the National Academy of Sciences, a Foreign Fellow of the Royal Society of Canada, and a member of the American Academy of Arts and Sciences. He has written nearly 400 scholarly papers. His research focuses on geographic information science, spatial analysis, and accuracy in geographic data.