

March 2013–March 2016
Report on the
Center for Spatial Studies



<http://spatial.ucsb.edu/>

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Executive Summary

The vision inspiring the Center for Spatial Studies (spatial@ucsb) is that spatial thinking and computing can serve all disciplines and promote interdisciplinary problem solving. The Center mission, thus, is to engage in interdisciplinary research and education on how people and technology solve spatial problems in the natural and social sciences, as well as in engineering, the humanities, and the arts. The University of California has been known as a world leader in the arena of spatial studies, with a strong reputation worldwide.

This report provides an overview of the Center's personnel, resources, and activities in research and education, and describes the Center's evolving initiatives from March 2013 (the date of the previous report to then Executive Vice Chancellor Gene Lucas) to March 2016, highlighting its role as a catalyst for interdisciplinary communication, learning, and research. In addition, this report proposes new initiatives for sustaining and expanding the Center's mission both on and off campus.

The Center was founded in July 2007 through an initiative by Michael Goodchild (Director and Prof. Emeritus of Geography), who directed the Center until his retirement in July 2012. Mary Hegarty (Dept. of Psychological & Brain Sciences) served as interim director from 2012 to 2013, until Werner Kuhn was appointed Chair of the Jack and Laura Dangermond Endowment, director of the Center, and professor in the Dept. of Geography. Hegarty will continue her Center leadership as Associate Director until June 2016. Briefly, the Center provides a number of innovative educational resources and services to the academic community at UCSB and beyond. These include a consulting service (the GIS Help Desk) and two seminar series (ThinkSpatial and Spatial Technology Lunches); community outreach (most notably an annual poster and plenary session, spatial@ucsb.local); office space for students and visitors; student internships; a Specialist Meeting series; a new series of Spatial Un-conferences (participant-driven meetings); a Minor in Spatial Studies; and a Freshman Seminar in Thinking Spatially in the Arts and Sciences. These offerings have all helped to enrich the resources at UCSB for spatially-enabled research and have contributed to the development of a strong interdisciplinary thread of spatial studies, as well as to broadening undergraduate and graduate educational opportunities.

In the period covered in this report (2013–2016) Center personnel have received \$1,831,451 in external funding and gifts, and have welcomed 16 international scholars for extended visits and collaboration. Important new initiatives during this period have included the Center's pivotal role in conceiving and implementing the Interdisciplinary Research Collaboratory in collaboration with the Library, the development of a spatial archive through the California Digital Library's e-Scholarship initiative, student internships, a new "SPATIAL un-conference series," and research coffee hours with different disciplinary groups on campus aimed at defining promising research areas for joint grant proposals.

In addition to continuing all of these programs, the Center goals for the next three years include the development of a new Master's Degree in Spatial Studies, the deployment of a spatially-indexed knowledge infrastructure at the Library, and the expansion of campus services to include workshops on spatial technologies. Through these continued and new initiatives, the Center aspires to maintain its position as a role model for spatially-enabled interdisciplinary science on campus, nationally, and internationally.

Personnel

The academic team that has led the Center's activities includes **Werner Kuhn** (current director), **Mary Hegarty** (associate director, 2012–2016), **Donald Janelle** (former program director; 2007–January 2014), **Andrea Ballatore** (former research coordinator; February 2014–December 2015), and **Antonio Medrano** (former postdoctoral researcher; April 2015–January 2016). The Center routinely consults with a 2-year rotating cross-campus **Executive Committee**, consisting of prominent UCSB faculty engaged in spatial research, to ensure that interdisciplinary perspectives are well represented in the design of the Center's programs.

A number of research associates have contributed to the Center's activities and intellectual growth, including graduate students (**Kitty Currier**, **Song Gao**, **Sara Lafia**, **Thomas Hervey**, **Behzad Vahedi**, **Heather Burte**, and **Crystal Bae**), postdoctoral fellows (SAGE fellow **Margaret R. Tarampi** and Fulbright scholar **Selena Daly**), and research scientists (**Jordan Hastings** and **Andrew Stull**). Academic visitors at all levels are also an important part of the Center's activities (see p. 16, Appendix V, p. 55), while a new internship program also attracts undergraduate students from several disciplines, providing opportunities for career development and interdisciplinary learning (see p. 9).

The administrative personnel consists of a full-time administrative coordinator (**Karen Doehner**), a part-time graduate student to run the Center's Help Desk (**Song Gao**), a part-time graduate student to organize the Spatial Technology Lunches (**Kitty Currier**, 2013–September 2015; **Crystal Bae**, November 2015–), and two part-time IT staff members (**Alex Feldwinn** for hardware issues and **Guylene Gadai** for web management). A complete list of faculty, staff, Executive Committee members, research associates, and interns is available at <http://spatial.ucsb.edu/people>.

Research Activities and Funding

The Center's research is driven by the interests and expertise of the director and associate director, enriched and complemented by the interests of postdoctoral fellows, associate researchers, and visiting scholars. For the current reporting cycle the Center has contributed to research by attracting competitive funding for a total of \$1,831,451 (Table 1), providing a hub for interdisciplinary collaborations, and producing substantial, high-quality research that has resulted in peer-reviewed publications. Below we present an overview of our research activities, including a summary of the core research contributors and a breakdown of the research funding obtained by each person. A complete list of publications by our contributors can be seen in Appendix I (p. 24).

Werner Kuhn (Director) is an information scientist conducting research in geographic information science, aimed at improving the usability of spatial data and information systems. He has collaborated with university libraries in Germany and at UCSB to bring spatial and temporal search capacities to regular library users and to extend library access mechanisms to research data. His main research contribution during this reporting cycle has been a refinement and implementation of Core Concepts of Spatial Information. These concepts form a high-level language for users of Geographic Information Systems (GIS) and other spatial information technologies. Currently, project funding is primarily secured from private industry donors, while an NSF grant proposal (in cooperation with colleagues from the Dept. of Computer Science) is under review.

Kuhn Research Funding:

Jack and Laura Dangermond Endowment

Recipient: Werner Kuhn

Funding: Jack and Laura Dangermond Endowed Chair: \$70,095

The Center has worked closely with the UCSB Office of Development staff since its inception. Esri Inc., the leading developer of GIS software, has had a close relationship with UCSB for the past 30 years and has provided substantial funding for research, conferences and workshops, and student support. In 2010 Esri owners, Jack and Laura Dangermond, funded an endowed chair with a donation of \$500,000. Michael Goodchild was the first holder of the chair; upon Goodchild's retirement in 2012, the Dangermond Chair was awarded to Werner Kuhn.

Jack and Laura Dangermond Lecture Series

Recipient: Werner Kuhn

Funding: Jack and Laura Dangermond: \$100,000

This is one of three areas of support provided by Jack and Laura Dangermond. This funding supports travel and campus visits and lectures by prominent and distinguished researchers.

Dangermond Graduate Student Fund

Recipient: Werner Kuhn

Funding: Jack and Laura Dangermond Graduate Student Support Fund: \$24,500

These funds enable graduate and undergraduate student travel and participation in conferences to present their research in GIS. Recipients are listed in Appendix II (p. 33).

Specialist Meetings

Recipient: Werner Kuhn

Funding: Esri, specialist meeting support. **2013** \$10,000; **2014** \$5,000

Funding: Google: **2013** \$3,000

Supplemental funds are requested and obtained as needed to cover the expenses of hosting the Center's annual specialist meetings.

Spatial Discovery

Recipient: Denise Stephens and Werner Kuhn

Funding: Jack and Laura Dangermond: \$250,000

After a concerted effort by Dean Wiltzius, the Office of Development, Werner Kuhn, and the Library, a private donation from Jack and Laura Dangermond enabled the Center for Spatial Studies and the UCSB Library to investigate data-seeking behavior and requirements to fully exploit the spatial dimension of research data and publications. In anticipation of the establishment of the Interdisciplinary Research Collaboratory, an expert meeting was hosted in collaboration with the Library, convening information scientists, librarians, geographers, and software developers to identify and discuss the challenges, practices, and potential strategies associated with the cross-platform discovery of spatial data in the context of a modern research library. Among other services the Collaboratory will provide a single point of access to spatial data, enabling discovery across distributed repositories, search catalogs, and databases.

Orfalea Center for Global and International Studies Research Cluster Award

Funding: \$1,500

PI: Javiera Barandiaran (Global & International Studies)

Co-PIs: Werner Kuhn (Center for Spatial Studies), Lisa Parks (Film & Media Studies), Paul Amar (Global & International Studies), Stephan Miescher (History), Corey Byrnes (East Asian Languages & Cultural Studies).

1/1/2014 to 6/30/2014

Funding Agency: Orfalea Center for Global and International Studies

What are developing countries doing to switch to cleaner energies and with what effects? How are they participating in the rise of new energy challenges? Can they benefit from new energy sources, such as lithium used in electric cars? Or are fossil fuels still black gold, as Brazil's recent oil discoveries suggest? The Orfalea Research Cluster created a cluster around humanities approaches to energy issues, focused on the intersecting challenges of development and climate change. The project was carried out at a series of cluster meetings in various educational and research settings, culminating in a conference showcasing a leading researcher in this field (Gabrielle Hecht) and attracting students and faculty from across campus.

Mary Hegarty (Associate Director) is a cognitive psychologist whose research focuses on spatial cognition, including individual differences in spatial abilities and comprehension of spatial representations such as diagrams, maps, and graphs. Her current research focuses on the nature of individual differences in navigation tasks, how to best develop spatial thinking skills in the context of STEM domains, and how people understand visualizations of uncertainty in data. During this reporting cycle, Hegarty has published more than 20 journal articles and her research has been supported by two grants from the National Science Foundation and a grant from the Army Research Institute (via the UCSB Institute for Creative Biotechnologies).

Hegarty Research Funding:

Representation Translation with Concrete and Virtual Models in Chemistry

PI: Mary Hegarty

8/15/2010 to 7/31/2014

Funding Agency: National Science Foundation: \$667,559

This project examined how students use concrete and virtual molecular models to understand the spatial structure of molecules, reason about spatial transformations in the domain of organic chemistry, and to develop competence in using various spatial representations, including models and diagrams. The approach combines laboratory studies of student learning and classroom interventions. This project was collaborative with the University of Illinois, Chicago and the University of Maryland. At UCSB it was led by Hegarty and provided funding for two postdoctoral scholars, Andrew Stull and Shamin Padalkar, and two graduate students, Trevor Barrett and Heather Burte (Dept. of Psychological & Brain Sciences).

Investigating the Neural Basis of Individual Differences in Navigational Abilities

PI: Mary Hegarty

12/1/2012 to 11/30/2013

Funding Agency: UCSB Center for Collaborative Biotechnologies, Army Research Institute: \$100,000

The goal of this project was to study the neural basis of individual differences in navigational abilities. Specifically, it studied both structural and functional differences in the brains of people with good and poor sense of direction using functional magnetic resonance imaging (fMRI). This project was directed by Hegarty and provided funding for graduate student Heather Burte, who received her Ph.D. in the Dept. of Psychological & Brain Sciences in December 2014.

Modeling, Display, and Understanding Uncertainty in simulations for Policy Decision Making

PIs: Mary Hegarty and Michael Goodchild

10/1/2012 to 9/30/2016

Funding Agency: National Science Foundation: \$599,797

This is a large-scale effort to consider the visualization of uncertainty in a systematic end-to-end manner, with the goal of developing a generalizable set of techniques and procedures for accurately and effectively conveying the appropriate level of uncertainties in a wide range of decision-making processes of national importance. The approach combines a principled mathematical treatment of uncertainty in simulations, a comprehensive analysis of how this information can be transformed into a visual representation, and a careful study and evaluation of human perception and cognition of spatial and multidimensional uncertainty, all informed by the needs of real-world applications. This project is collaborative with the University of Utah and Clemson University. It is led at UCSB by Hegarty and Goodchild, and has provided funding for three graduate students: Grant McKenzie (Dept. of Geography) and Trevor Barrett and Alexander Boone (Dept. of Psychological & Brain Sciences).

Andrea Ballatore (Research Coordinator and Postdoctoral Fellow, 2014–2015), a geographer, conducted research for parallelism in geographic information science and, in particular, on digital cartography, geo-semantics, crowdsourcing, information retrieval, and media studies. In his period at the Center, Ballatore published 20 peer-reviewed articles, conference proceedings, and book chapters. His research has appeared in journals such as the *International Journal of Geographical Information Science*, *Communications of the ACM*, and *Knowledge and Information Systems*. In June 2015 he earned the Best Full Paper Award at the AGILE International Conference on Geographic Information Science for a paper co-authored with Werner Kuhn. In December 2015 his work was covered in a video produced by the ACM, featuring UCSB and the Center.

Antonio Medrano (Postdoctoral Fellow, 2015–2016), a geographer, led the research related to the Spatial Discovery project in cooperation with the UCSB Library. His work included organizing an Expert Meeting on Spatial Discovery, publishing a meeting report, and submitting a peer-reviewed publication based on the initial research results. He also conducted additional GIS research on the effects of data parameters on analysis results, presenting his work at two invited conferences, with a

journal article currently in development. In September and October 2015 he took a sabbatical to serve as a visiting professor at Universitat Jaume I in Castellón, Spain, where he taught a GIS course for their Erasmus Mundus Geospatial Technologies Master's program. He was on the organizing committee for SPATIAL 2015, Un-conference on Spatial Information for Human Health.

Donald Janelle (Program Director 2007–2015, currently Emeritus researcher) is a geographer with research specializations in space-time patterns of human spatial behavior, focusing on the history of human settlement patterns and the implications of transportation-communication innovations on urban social patterns and processes. As program director, Janelle contributed to an understanding of spatial concepts in a transdisciplinary context. He served as NSF principal investigator for the development of <http://teachspatial.org> and as UCSB PI for the NIH-supported training program in Advanced Spatial Analysis (<http://gispopsci.org>). Further, he masterminded and developed UCSB's interdisciplinary undergraduate Minor in Spatial Studies and the Freshman Seminar on Spatial Thinking in the Arts and Sciences. More recently, he was responsible for the e-Scholarship initiative to preserve publications of the National Center for Geographic Information and Analysis (NCGIA), the Center for Spatially Integrated Social Science (CSISS), and the Center for Spatial Studies in perpetuity.

Jordan Hastings (Assistant Project Scientist) is a computational geographer who was employed as the chief cartographer and GIS manager for the Nevada Bureau of Mines and Geology in Reno, Nevada. Prior to joining the Center, he was appointed assistant professor of the Practice of Spatial Sciences at the University of Southern California in Los Angeles. Hastings' academic work at the Center focuses on gazetteers, geological maps, hydrogeology, and management of data in the geosciences. He is currently pursuing research in collaboration with the Eye on Earth (EoE) Alliance regarding the availability and sustainability of the Earth's freshwater. In October 2015 he was an invited speaker at the second EoE Summit in Abu Dhabi (<http://www.eoesummit.org>), where he also demonstrated a large touch-screen "Water Table," superimposing surface hydrology on map of ecological land units for Africa.

Margaret R. Tarampi (Postdoctoral Fellow) is a cognitive psychologist and former SAGE Junior Research Fellow in the SAGE Center for the Study of the Mind (2013–2015) at UCSB. She trained as an architect and practicing artist whose work is influenced by her psychology research. Her research investigates the cognitive and neural mechanisms that underlie space perception and spatial cognition in select populations, including individuals with visual impairments and spatial experts such as dancers and architects. Her other research interests include spatial thinking, perception and action, perspective taking, and kinesthetic imagery. Since joining the Center in January 2016 her work has focused on education in spatial thinking and in characterizing the nature of spatial expertise. Tarampi leads the research related to updating the resources on the TeachSpatial website. Her work includes developing a comprehensive literature database on spatial thinking in psychology, educational psychology and urban design, and a published conference paper co-authored with Hegarty titled, "Teaching Spatial Thinking: Perspectives from Cognitive Psychology." Through the backing of the Center and the SAGE Center, Tarampi wrote a grant to the National Endowment of the Arts to study the efficacy of training in the visual arts on spatial thinking.

Table 1. Summary of Research Funding 2013–2016

Funding Agency	Recipient	Title	Award
Jack and Laura Dangermond Endowment	Werner Kuhn	Jack and Laura Dangermond Endowed Chair; Endowment is \$500,000; payout is listed as award during this project period	\$100,000
Jack and Laura Dangermond Fund	Werner Kuhn	Jack and Laura Dangermond Lecture Series and GIS related travel/ presentations	\$70,095
Jack and Laura Dangermond Graduate Student Fund	Werner Kuhn	Jack and Laura Dangermond Graduate Student Support Fund	\$24,500
Esri	Werner Kuhn	Specialist Meeting Support (2013, 2014)	\$15,000
Google	Werner Kuhn	Specialist Meeting Support	\$3,000
Jack and Laura Dangermond	Werner Kuhn with Denise Stephens	Spatial Discovery	\$250,000
Orphalea Center for Global and International Studies	Werner Kuhn with Javiera Barandiaran	Orphalea Center for Global and International Studies Research Cluster Award	\$1,500
National Science Foundation	Mary Hegarty	Representation Translation with Concrete and Virtual Models in Chemistry	\$667,559
UCSB Center for Collaborative Biotechnologies, Army Research Institute	Mary Hegarty	Investigating the Neural Basis of Individual Differences in Navigational Abilities	\$100,000
National Science Foundation	Mary Hegarty with Michael Goodchild	Modeling, Display, and Understanding Uncertainty in Simulations for Policy Decision Making	\$599,797
Total			\$1,831,451

Education in Spatial Thinking and Computing

One of the Center’s goals is to increase student access to courses and instructional materials that build spatial intelligence enhancing the impact of spatial thinking on campus and beyond. Efforts in this direction include the undergraduate Minor in Spatial Studies; the Freshman Seminar in Thinking Spatially in the Arts and Sciences; summer internships for undergraduate students; postgraduate student involvement and support; curation and maintenance of extensive online resources; as well as a proposed Master’s Degree in Spatial Studies (see p. 20).

Academic Minor in Spatial Studies

In consultation with an advisory board, after two years of course design by Don Janelle, the Minor in Spatial Studies was inaugurated in 2011. It has been administered through the Dept. of Geography, with Karen Doehner serving as student advisor and Hegarty and Kuhn serving as academic advisors.

This interdisciplinary minor is designed to be customized to complement a student’s academic major with concepts and tools for spatial thinking, spatial analysis, and spatial representation. For the minor, students select one of three foci that allies most clearly with their areas of disciplinary and/or career interest: (a) **Spatial Thinking**, emphasizing spatial cognition and behavioral sciences; (b) **Space and Place**, focused on the arts and humanities; and (c) **Spatial Science**, oriented toward the natural sciences and engineering.

The curricula for these areas of study include a breadth of courses that reflect the pervasive nature of spatial reasoning across diverse fields of knowledge. Geography 12 (Maps and Spatial Reasoning) is the required core course, providing foundations in geographic information science and technologies.

To date, 90 students have completed the minor, of which 42 graduated between 2011–2013 (previous report period) and 47 (thus far) between 2013–2016. As is generally the case, many more students are expected to present their documentation at the end of each academic year, significantly increasing the number of graduates for 2015–2016. Although no prior “declaration” of the minor is required, currently 40 students have expressed their interest in obtaining the minor in the coming years (2016–2018).

Table 2. Minors in Spatial Studies for each focus per academic year

	Spatial Thinking	Space and Place	Spatial Science	Total
2011–2012	1	1	16	18
2012–2013	2	8	14	24
2013–2014	4	3	13	20
2014–2015	1	3	9	13
2015–2016*		3	12	15
Total	8	18	64	90

* Graduates thus far; total will significantly increase at the end of the academic year

The relevance and popularity of this academic minor is reflected in the broad range of disciplines in which the students major, although the majority of students seem to come from the sciences. With continuous promotion and outreach, we anticipate that interest in the minor will continue to grow and more students from the arts and humanities and the social sciences will pursue the minor. Student survey results show an overall high level of satisfaction with the program. More information about the minor can be seen at <http://spatial.ucsb.edu/academic-minor>.

Freshman Seminar: Thinking Spatially in the Arts and Sciences

Since 2012, through the initiatives of Mary Hegarty, Dan Montello, and Don Janelle, the Center has been offering a Freshman Seminar in the fall quarter, entitled *Thinking Spatially in the Arts and Sciences* (INT 94PN) (<http://spatial.ucsb.edu/freshman-seminar>). Each week, an instructor from a different department showcases applications of spatial thinking and computing in his/her discipline. The complete list of instructors and the titles of their presentations is presented in Appendix III (p. 44). For this reporting cycle 56 students have taken the seminar.

Students learn how statistics, graphs, maps, and virtual reality aid learning, analysis, data visualization, discovery of solutions to socio-environmental problems, and space/place interpretations in the arts and humanities. This course is intended to promote an early interest in spatial thinking, which in turn, may lead to the student's pursuit of the Minor in Spatial Studies. Kuhn and Hegarty jointly serve as instructors on record for each edition.

Graduate Student Involvement and Support

In its educational efforts, the Center involves and supports graduate students in a variety of ways that are advantageous to their professional development. Initiatives such as the GIS Help Desk (p. 16; staffed by Song Gao); the annual Lightning Talks and monthly Spatial Technology Lunches (p. 11; formerly organized by Kitty Currier and currently run by Crystal Bae); and the discovery project (involving Sara Lafia). Currier also contributed substantially to the e-Scholarship Spatial Archives (p. 19) and ran the 4-H GIS Project Days, teaching elementary school children mapping skills and data collection. Heather Burte and Margaret Tarampi have worked on developing resources for faculty who are interested in teaching interdisciplinary courses on spatial thinking.

Informally, Kuhn and Hegarty encourage graduate students from multiple disciplines to enroll in their graduate-level courses on spatial cognition and geographic information science. Students from computer science, the Bren School, environmental science, the social sciences, education, and engineering have taken advantage of these courses. Financial support for student travel to conferences and workshops is offered, to provide them with opportunities for presenting their work in a professional venue, learning, and networking.

Student Internships

(New Initiative)

Beginning in 2014, under the new directorship, the Center has created opportunities for undergraduate and graduate students to participate in ongoing research projects. Paid summer internships, typically of 12 weeks, have been offered to students during each summer quarter on projects supervised by Werner Kuhn, Mary Hegarty, Andrea Ballatore, and Antonio Medrano. To

date, 12 students have taken part in this initiative, gaining valuable work experience that has enriched their education and their professional profiles.

Student interns 2015–2016:

- **Yelizaveta Aleksyuk** (undergraduate student, UCSB, Geography) assisted with the revision of 176A lab materials, including ICM data as WFS.
- **Chris Chien** (undergraduate student, UCSB, Geography) is developing new ways to teach GIS and its spatial core concepts for transdisciplinary studies.
- **Savannah Cooley** (undergraduate student, Clark University, Economics and GIS) worked in the Spatial Discovery project with Medrano, exploring spatial information archiving and search.
- **Xarene Eskandar** (graduate student, UCSB, MAT) working with Kuhn on illustrating core concepts of spatial information.
- **Noah Gluschankoff** (undergraduate student, UCSB, Geography) worked on the Seasketch project with Will McClintock.
- **David Gordon** (graduate student, UCSB, MAT) worked with Hegarty on developing virtual environments for research on spatial cognition and education.
- **Sara Lafia** (graduate student, UCSB, Geography) also worked with Medrano on the Spatial Discovery project.
- **Ben Lei** and **Nick Eidler** (undergraduate students, UCSB, Computer Science and Engineering) are currently working with Kuhn to develop the upcoming version of the Interactive Campus Map (ICM), which will better support mobile use.
- **Jessica Marter-Kenyon** (graduate student, UCSB, Geography) worked with Janelle on e-Scholarship metadata.
- **Bryce Newman** (undergraduate student, UCSB, Geography) assisted with the revision of 176A lab materials, including ICM data as WFS.
- **Bo Yan** (graduate student, UCSB, Geography) worked on a project with Ballatore on a place search engine.

Academic Events

The most visible of the Center's efforts focus on the organization and promotion of a variety of academic events, ranging from seminar series to international conferences. These events play a key role in promoting spatial thinking and computing, fostering a broad interdisciplinary dialogue that involves natural and social scientists, and scholars in the humanities and the arts, as well as the local community. The Center sponsors these events either as the sole funder, or in collaboration with other organizations on campus. On a regular basis, the Center assists in publicizing other spatially relevant events on campus, including programs sponsored by the Interdisciplinary Humanities Center (IHC), the Center for Information Technology & Society, the Cognitive Science program, and talks at the departments of Computer Science and Media Arts & Technology (MAT). As detailed below, the Center's personnel contributes to the organization of several international conferences and workshops. The complete record of events can be seen at <http://spatial.ucsb.edu/events>.

Year-round Lecture and Discussion Series

The Center has made special efforts to bring together faculty and student researchers from across campus to exchange ideas and methodologies about spatial thinking and spatial analysis. Appendix IV (Academic Events, p. 47) lists all the events hosted in the past three years.

ThinkSpatial (<http://spatial.ucsb.edu/thinkspatial>). This is the Center's flagship event series at UCSB, and consists of brown-bag lunch presentations on a broad range of perspectives about interdisciplinary spatial thinking, from the natural and the social sciences to the humanities. In academic year of 2013–2014, Don Janelle organized 11 presentations in this series. A total of 20 presentations were organized by Andrea Ballatore in 2014–2015, and 14 presentations have been made and/or scheduled in 2015–2016, organized by Ballatore and Antonio Medrano. This series is well attended by academics campus-wide, and involves speakers and attendees from both on and off campus. Sessions average 20+ attendees, with some speakers and topics attracting as many as 40. A complete list of speakers for this reporting cycle can be seen in Appendix IVa (p.47).

Technology Lunches. This series originated as an occasional, small student forum to discuss technological developments and, over the years, it has grown in popularity and demand to become a more regular event that draws attendance from students and faculty/researchers alike. Organized by graduate students Kitty Currier (2013–2015) and Crystal Bae (2015–2016) these sessions include lunch discussions of spatial technology. Currier organized four presentations in 2013–2014 and six talks in 2014–2015; Bae's organization of this event for the 2015–2016 academic year have thus far included three talks. Appendix IVb (p. 51) lists the speakers and topics in this series.

Spatial Lightning Talks. An annual outreach event, the Lightning Talks feature a full slate of 3-minute talks on spatial topics during a lunch period. In 2013–2014, Currier secured presentations by 12 people; in 2014–2015, 14 presentations were delivered, from multiple departments as well as from the local community. The 2016 talks organized by Bae featured 16 talks. All sessions have been filled to capacity, drawing participants from many walks of life. Examples of the topics covered include *Experimental Game Spaces: Virtual Visions, Architectures, and Dimensions* (Jeremy Douglass, Dept. of English); *Why isn't the United States Metric?* (Keith C. Clarke, Dept. of Geography), *More than Four Colors* (Skona Britain, Santa Barbara Family School); *Image, Interaction, and Representation: Some Artistic Projects that Address Space* (George Legrady, MAT); *Airport Terminal Designs* (William F. Yim, Aviation Consultant, Santa Barbara County Association of Governments, Ret.). The full archive of videos is available on YouTube (<https://www.youtube.com/user/spatialUCSB>) and the titles and presenters are detailed in Appendix IVc (p. 53).

Spatial Coffee Hour. After having provided the venue for the March 2014 Coffee Hour under the impulse of the Brain initiative and the Kavli Institute, the Center has begun to develop its own Spatial Coffee Hour. This new event series consists of interdisciplinary, PowerPoint-free discussions of interdisciplinary spatial topics, aimed at defining promising research areas for joint grant proposals. A Spatial Coffee Hour on Ecology was held in January 2015 (with 19 attendees from across campus), and one on Spatial and the Arts was held in May 2015 (with 12 attendees), fostering scientific networking and cooperation.

Specialist Meetings

Another longstanding spatial tradition at UCSB has been the Specialist Meeting. Each meeting convenes 30–40 researchers from around the world to discuss a single cutting-edge topic, and to formulate a community research agenda. Fifty such meetings have been held since 1988, with support from a variety of funding sources, including NSF, NIH, Google, and Esri. Final reports on meetings are available at <http://spatial.ucsb.edu/specialist-meetings>. Summaries of the Specialist Meetings convened during this reporting cycle follow:

Advancing the Spatially Enabled Smart Campus (December 2013)

Funding: Center for Spatial Studies (\$20,000), Esri (\$10,000)

This specialist meeting outlined new frontiers for smart campus research and deployment. It formulated scenarios of future campuses, defined a prioritized list of services, and identified research needs to realize them. Experiences with smart cities and scenarios from that arena served as inspiration and reality check. Some unique challenges for academic environments were identified in relation to the radical transformation in how universities digitally enable learning, discovery, and invention. A particular focus combined state-of-the-art smart campuses with spatially enabled knowledge infrastructures and sensor networks (<http://spatial.ucsb.edu/events/specialist-meetings/asesc-home>).

Spatial Search (December 2014)

Funding: Center for Spatial Studies (\$23,000), Google (\$2,000), and Esri (\$5,000)

The premise of this specialist meeting was that information search has become an enabler across the spectrum of human activity. Operating at two levels, there is a spatial component at the core of search. At the first level, search technologies rely on a spatial metaphor: We browse our favorite websites to help search for fragments in an overwhelmingly large space of documents, images, and videos. At a second level, geographic space helps index information and refine search strategies, relying on the geo-location of entities to assess their relevance. Intense and focused discussion among 36 participants helped illuminate these matters and contributed toward the development of an interdisciplinary research agenda to advance spatial search from scientific as well as engineering viewpoints (<http://spatial.ucsb.edu/2014/spatial-search>).

Spatial Discovery (June 2015)

Funding: Esri (\$25,000)

An expert meeting was held in conjunction with the Spatial Discovery grant to convene a diverse range of experts to ensure that the direction of research on spatial discovery would appropriately consider the needs of researchers across all disciplines. Keynote speakers included Alan Liu (Dept. of English, UCSB), Anabel Ford (Mesoamerican Research Center, UCSB), James Boxall (GISciences Centre Libraries, Dalhousie University), and Christopher Gist (GIS Specialist, Library at Scholars' Lab, University of Virginia). Marcel Fortin (Map & Data Library, University of Toronto) was invited as a world expert in the digital humanities (<http://spatial.ucsb.edu/2015/spatial-discovery>).

Visualization of Uncertainty (January 2016)

Funding: National Science Foundation (\$15,000)

The Center hosted the annual project meeting for PIs, postdocs, and graduate students collaborating on an NSF-sponsored project on visualization of uncertainty, including PIs from UCSB (Mary Hegarty and Michael Goodchild), the University of Utah (Ross Whitaker, Michael Kirby, William Thompson, Sarah Creem Regehr, and Miriah Meyer), Clemson University (Donald House) and the University of Washington (Michael Lindell). The goal of this collaborative project is to establish the foundations for capturing and conveying the uncertainty associated with predictive simulations, so that future tools for visualizing these predictions will accurately and effectively present information about their uncertainty to a wide range of users. The project is making scientific contributions in the areas of simulation and uncertainty quantification, scientific visualization, perception and cognition, and decision making in the presence of uncertainty.

Spatio-temporal Modeling and Reasoning in the Humanities (planned for December 2016).

Discussions with Anne Knowles (University of Maine, Author of *Geographies of the Holocaust*) are underway to address computational and infrastructural needs in accessing, visualizing, and analyzing historic data, including oral history resources.

Special Events and Co-sponsored Lectures

The Center collaborates in organizing and hosting the annual Dept. of Geography Golledge and Dangermond Distinguished Lecture series, which bring prominent researchers to campus to discuss their spatially focused research. **Golledge Lectures** in this period included talks by Patrick Suppes (Professor of Philosophy Emeritus at Stanford University) and Stephen Hirtle (Information Science, University of Pittsburgh). Stephen Levinson (Max Planck Institute for Psycholinguistics) has been invited to be the speaker in 2016. **Dangermond Lecturers** included Yvan Bedard (Geomatics, Sciences, University of Laval), Jacqueline McGlade (UNEP Chief Scientist) and Dirk Brockmann (Theoretical Biology, Humboldt University of Berlin).

The Center also co-sponsors occasional lectures with other organizations on campus. In February 2015 we collaborated with several departments in the Humanities division and the IHC to bring Anne K. Knowles (Middlebury College) and Alberto Giordano (Texas State University) for an event entitled, *Geographies of the Holocaust*. A collaboration with the MAT program organized a talk by Jon Hagstrum (U.S. Geological Survey) on Avian Navigation. This year we are collaborating with the IHC to bring Philosopher Alva Noë (UC Berkeley) to campus for a talk entitled, *Can Neuroscience Help us Understand Art*. However, the date for this has not yet been set. A complete list of speakers and topics is listed in Appendix IVd (p. 54).

International Workshops and Institutes

Center faculty, graduate students, and postdocs have contributed to the organization and planning of several international scientific events, including conferences and workshops.

International Spatial Cognition Summer Institute (Summer 2013)

The Center hosted the International Spatial Cognition Summer Institute (ICSCI), with Mary Hegarty and Daniel Montello as the lead UCSB organizers. ICSCI 2013 consisted of two consecutive week-

long events, with intensive lectures, tutorials, and student presentations on spatial cognition and perception, thinking, reasoning, and communication by humans, nonhuman animals, and computational entities such as robots. Like its predecessor, held in Germany in 2003, the 2013 Institute was primarily aimed at graduate students, postdoctoral students, and early-career researchers and academics with a strong interdisciplinary interest in spatial cognition research. Nineteen instructors and approximately 50 students from the disciplines of psychology, geography, computer and information science, architecture, and education participated.

International Conference on Spatial Cognition (September 2014 and August 2016)

Spatial Cognition is a biennial conference concerned with the acquisition, organization, and utilization of knowledge about spatial objects and environments, be they real, virtual, or abstract, human or machine. Spatial Cognition comprises research in different scientific fields insofar as they are concerned with cognitive agents and space, such as cognitive psychology, linguistics, computer science, geography, cartography, philosophy, neuroscience, and education.

Mary Hegarty [with Christian Freksa and Thomas Barkowsky (University of Bremen); and Bernhard Nebel (University of Freiburg)] was program co-chair of Spatial Cognition 2014, an international conference held in Bremen Germany in September 2014. Hegarty is also program co-chair of the 2016 Spatial Cognition Conference [with Nora Newcombe (Temple University); Daniel Montello (UCSB); and Christoph Hoelscher (ETH, Zürich)], to be held in Philadelphia, PA on August 2–5, 2016.

Vespucci Initiative

The Center actively supports the Vespucci Initiative for the Advancement of Geographic Information in Science, with Kuhn being one of its key leaders. The Center's existing alliances with NCEAS, NCGIA, and UCGIS, and its presence within the UC system, position it as a central contributor to the Vespucci Initiative. This interdisciplinary effort has organized a range of research and teaching activities, bringing together senior scientists and promising young researchers from various fields and from around the world. All participants share a special interest in the locational aspects of societal challenges that are being studied in the emerging field of GIS and are exploited by location-based systems, applied geography, and related industries (<http://www.vespucci.org>). A particularly successful recent Vespucci Institute was one on *Brain and Space*, held at the Champalimaud Foundation in Lisbon, Portugal, in September 2014.

A week on global population data (exact topic TBD) is planned for late 2016 or early 2017. Vespucci Institutes are cost neutral for the Center, but provide excellent international outreach opportunities.

International Workshop on Semantic and Conceptual Issues in GIS (SeCoGIS 2014)

In collaboration with other scientists, Andrea Ballatore organized this international workshop at the 33rd International Conference on Conceptual Modeling (ER 2014), which was held in Atlanta, GA October 27–29, 2015. The workshop provided a forum for original research contributions and practical experiences of conceptual modeling and semantic web technologies for GIS, fostering interdisciplinary discussions of all aspects of these two fields, and highlighting future trends in this area. A total of six papers were presented and discussed (<http://cs.ulb.ac.be/conferences/secogis2014>).

Workshop on Teaching Spatial Thinking from Interdisciplinary Perspectives (TSTIP) at COSIT, October 2015

This workshop, organized by Heather Burte (former graduate student at the center), Tomi Kauppinen (Alto University, Finland), and Hegarty, was held at the Conference on Spatial Information Theory (COSIT) 2015 in Santa Fe, NM. Its objective was to bring together researchers from a diverse set of fields to address the issue of how to best promote teaching spatial thinking topics from interdisciplinary perspectives. The workshop included participants from the fields of geography, psychology, computer science, cognitive neuroscience, and architecture. The proceedings are published online at <http://ceur-ws.org/Vol-1557/>.

Architecture & Mind Research Focus Group (2015–2016)

This initiative, promoted by the Center in collaboration with the IHC and organized and facilitated by Hegarty, Montello (Dept. of Geography), and Volker Welter (Dept. of History of Art & Architecture), has offered a forum for UCSB faculty, postdocs, and graduate students to explore and discuss issues around the design and experience of architecture and the scientific study of human spatial perception, cognition, and behavior. Among other issues considered were the contrasting nature of arts and science; the psychology of aesthetics; and the relationship of architectural design to spatial orientation, perceived privacy, social interaction, and other aspects of human behavior and experience. These issues were addressed through an interdisciplinary program of readings, discussions, and field trips; the proceedings are available at (<http://www.ihc.ucsb.edu/architecture-and-mind-rfg>).

New Academic Initiatives

SPATIAL Un-conferences

An “un-conference” is a relatively new type of meeting emphasizing the informal exchange of information and ideas between participants, rather than a conventionally structured program of academic presentations. Differing from traditional conferences where the bulk of time is spent listening to paper presentations, in the un-conference format attendees debate new ideas, address challenges, discuss how to improve solutions, and begin implementing solutions based on these interactions. In 2015 the Center launched a new series of SPATIAL un-conferences to be hosted every other year, with the objective to reach out to domain specialists to inspire and guide research on spatial information. Each un-conference will focus on key domain applications of spatial information as a primary force to push the frontiers of GIS, spatial cognition, and related fields.

SPATIAL 2015: Spatial Information for Human Health (December 2015)

Funding: Center for Spatial Studies (\$7,000)

This inaugural event was dedicated to applying spatial information to human health. It challenged the state-of-the-art in research on spatial information by discussing spatial approaches to problems and opportunities around human health. Thirty-three attendees shared and developed bold visions, new insights, and best practices in applications of spatial information to the study of epidemics, nutrition, aging, health psychology, and other aspects of human health (<http://spatial.ucsb.edu/spatial2015>). As a departure from the traditional specialist meeting model, participants self-funded travel and lodging expenses as an effective cost-saving measure.

Interdisciplinary Research Collaboratory

The Center has played a pivotal role in conceiving and implementing the Interdisciplinary Research Collaboratory, a campus-wide initiative in collaboration with the UCSB Library. Championed by Kuhn and Denise Stephens (university librarian, UCSB Library) the Collaboratory provides a physical environment for researchers to collaborate, explore, and resolve disparate questions using digital tools and focusing on qualitative and quantitative research across the physical and social sciences, as well as the humanities. The Collaboratory and its facilities support data creation, curation, and analysis—particularly spatial analysis—locally and globally, raising the visibility and impact of research.

To support the development of the Collaboratory, the Center co-organized the Expert Meeting on Spatial Discovery in June 2015, gathering 25 world experts to discuss the role of the spatial dimension in information management and retrieval (p. 12), with a sequel meeting targeted for summer 2017. Subsequently, a task force was assembled to collect feedback from key stakeholders on campus, to identify and recommend services, technologies, and human resources to promote interdisciplinary work and collaboration between researchers from the faculty, the student body, and the greater research community. The preeminent needs that were identified include how to find and share data and tools, how to interlink data, map data, meet researchers with similar problems, and match problems to solvers. The Collaboratory opened with a full workstation capacity launch in January 2016, with planned implementation of new services and collaborations throughout the 2016 calendar year.

Visitors and International Collaboration

To facilitate international scientific networking and collaborative research, the Center hosted productive visits by 16 scholars and scientists over the past three years. Visitors have given presentations in the ThinkSpatial Brown-bag series, interacted and collaborated with UCSB faculty and students in research and educational activities, and have participated in Center-sponsored workshops and specialist meetings. The complete list of visitors is presented in Appendix V (p. 55), demonstrating the range of scholars who request to conduct their research at the Center.

The Center was instrumental in developing a Memorandum of Understanding (MOU) between UCSB and the University of Bremen, the University of Giessen, ETH Zurich, and the University of Muenster. These universities all include prominent researchers pursuing far-reaching goals regarding the understanding and utilization of spatial thinking in cognitive agents, including humans and machines, for the benefit of science and society. The MOU allows for the exchange of faculty and students, sharing software and data, joint research projects, conferences and telepresence colloquia, joint teaching projects, and cultural programs. To date this MOU has led to visits from Christian Freksa (faculty, University of Bremen); Christoph Hoelscher and Martin Raubal (faculty, ETH Zurich); and Markus Knauff (faculty, University of Giessen).

Also as part of this MOU, the Center has partnered with the University of Bremen to encourage student exchange to enhance their education. In 2014 and 2015 four students (two graduate and two undergraduate students) came to UCSB to audit classes during two academic quarters and collaborated on projects with Kuhn.

Service and Outreach

GIS Help Desk

The Center has offered a consulting service since its inception. The GIS Help Desk provides advice to the campus community on the uses of spatial data and tools (<http://spatial.ucsb.edu/helpdesk>). This free service has been continuously staffed by graduate research assistants (currently by Song Gao, Dept. of Geography). The service is hosted at the Map & Imagery Laboratory at Davidson Library on Fridays from 9:00 a.m.–1:00 p.m. The GIS Help Desk serves as a starting point to connect with spatial resources available around campus, such as expert personnel, instructional materials, and software. Support requests range from simple cartographic design to complex, multistep spatial information modeling, and come from several UCSB departments and research groups. A sample of queries from UCSB departments that have benefitted from technical support from the GIS Help Desk include:

- Spatial analysis on the locations of weather stations (Bren School of Environmental Science & Management)
- Web mapping of global biodiversity (Ecology, Evolution, and Marine Biology)
- Analysis and mapping scholar movements and co-authorship networks (Center for Nanotechnology in Society)
- Volume calculation under sea surface (Marine Science)

In addition, the GIS Help Desk has begun teaching public workshops on topics related to GIS. Each workshop is a hands-on tutorial that guides attendees through a specific GIS topic. The first two workshops, held earlier this spring, were on “Installation of ArcGIS,” and “Introduction to ArcGIS Pro.” These were open to the public, and were held in the UCSB Library Collaboratory. Based on the attendance, we plan to expand this service to the community.

spatial@ucsb.local

While the primary orientation of the Center is toward the campus, an annual outreach event strives to foster relations with the non-academic local community. The **spatial@ucsb.local** event is publicized widely to the campus and county-wide community, and includes plenary speakers and poster displays. Posters feature the work of UCSB students and faculty, as well as community projects. Typically, 30 to 40 participants display their research in a poster format or as computer-based demonstrations, and have an opportunity to explain their work to attendees and visitors. Submissions have come from multiple UCSB departments (Computer Science, Physics, Psychological & Brain Sciences, Communication, Chicano Studies, NCEAS, the Gevirtz School of Education, the Map and Imagery Laboratory, the Four Eyes Lab, and the Sage Center), and many other public agencies and private companies throughout Santa Barbara County. Students from the Geography 115C and 176C courses are often required to participate in this event as part of their final evaluation for the course.

The **Channel Islands Regional GIS (CIRGIS)** has used this event as an opportunity to convene its quarterly meeting of the Ventura/Santa Barbara Esri ArcGIS Users Group and then attend the plenary and poster sessions. CIRGIS is a support group of GIS and planning professionals that meet regularly to share insights on geospatial solutions to local problems. This provides excellent

opportunities for the university to showcase the relevance of its programs to the region, for students to interact with potential employers, and for the community to review interdisciplinary themes in research and education.

The sessions attract between 150 and 200 participants and we often provide attendees with the opportunity to tour campus facilities (e.g., the AlloSphere, the Marine Science Institute, the Map & Imagery Laboratory, the campus sustainability infrastructure, and the Center for Spatial Studies), showcasing the university's diverse resources to the visiting community. Thematic topics and speakers for these events are listed below:

spatial@ucsb.local2014—*Spatially Enabled Smart Places* (June 3, 2014)

- Alexander Stepanov (Campus Planning, University of Massachusetts, Amherst) *Spatially Enabled Smart Campus: Coupling GIS and Operations Research*
- Jon Jablonski (Director, Map and Imagery Library, UCSB) *Sound Map: A Library Engagement with Research and Educational Spatial Science*

spatial@ucsb.local2015—*Spatial Search* (June 2, 2015)

- Peter Pirolli (Research Fellow, Interactive Intelligence Area, Palo Alto Research Center) *Seeking Answers, Making Sense, Changing Lifestyles: Scientific and Engineering Models for Human-Information Interaction*
- Krzysztof Janowicz (Assoc. Professor, Dept. of Geography, UCSB) *Vague Cognitive Regions: Data-Synthesis-Driven Perspective*

spatial@ucsb.local2016—*Spatial Information for Human Health* (upcoming, June 2, 2016)

- David Kerr (Director of Research and Innovation, William Sansum Diabetes Center)
- Aaron D. Blackwell (Department of Anthropology, UCSB)
- Susan Cassels (Department of Geography, UCSB)

Speakers' slide presentations and student poster displays are available at <http://spatial.ucsb.edu/local>.

Interactive Campus Map

The Center has taken on responsibility for the existing Interactive Campus Map (<http://map.geog.ucsb.edu>), expanding its interactive capabilities and creating a **mobile** version. With undergraduate interns from Computer Science, a first prototype of a new mobile map has been developed and will be tested during Spring Insight 2016.

The **expansion** will turn this map—which grew out of geography courses and student internship work—into the backbone for a campus spatial information infrastructure. Rather than duplicating data from various providers (e.g., facilities, registrar, parking, safety, etc.), these data would be kept and maintained where they are produced and used, with the map serving as a live window, answering questions about where things are on campus and how to get there. The Center is engaged in a dialogue with Public Affairs & Communications as well as other campus administrators (Registrar, Facilities, Housing) to make the expanded services of this map useful to the broad community of students, staff, academics, and visitors as well.

Resources

Facilities

Phelps 3510/12, redeveloped in 2007 to serve as the administrative hub for the Center, provides space for a full-time office administrative coordinator (Karen Doehner), a program director (TBA), postdoctoral researchers (beginning April 15th: George Technitis), and workstations for graduate students, interns, and visitors. With the success of the Center's programs and increased attendance to events, the conference area of 3512 was modified in 2013 to increase its seating capacity (formerly for 10 and currently for 24+ people). This space is now more amenable to hosting our events and meetings, including the *Freshman Seminar in Spatial Thinking*, the ThinkSpatial brown-bags, and the Student Forums.

In addition to serving the needs of the Center, the facility is also made available for hosting events organized by the Dept. of Geography and other campus departments. Events that have made use of the Center include:

GIS Day. Beginning in 2014 the Center has hosted a new event series as part of the Geography Awareness Week, a global initiative to promote geography. The series provides a venue to encourage the adoption of spatial technologies in academia, government, and industry. Graduate student Yingjie Hu (Dept. of Geography) organized a smaller version of the Lightning Talks in November 2014. A second edition of the event was hosted in November 2015, featuring presentations by Song Gao (Dept. of Geography) and Todd Mitchell (director, Pacific Southwest Chapter of ASPRS).

Occasional Meetings

- **Coffee Hour** organized by the Brain initiative and the Kavli Institute (mentioned above).
- **Advisory Board meetings** for NSF funded project Representation Translation with Concrete and Virtual Models in Chemistry (PIs Andrew T. Stull and Mary Hegarty) in 2014 and 2015.
- **Dept. of Geography Open House for Prospective Graduate Students.** We provide the venue for the lunch.

Media Presence

One of the Center's significant contributions is the development of extensive online resources. The **new Center website** was designed by Ballatore and launched in April 2014 (<http://spatial.ucsb.edu>). This website provides a wealth of information about the Center and its programs, draws attention to events, provides access to Center reports, presentations, and videos, and includes extensive educational resources. The Center also increased its social media presence in 2014, synchronizing its initiatives with other platforms such as LinkedIn, Facebook, and Twitter. This increase in public engagement has resulted in a sharp increase in visits to the Center's website and activities.

The Center's activities are also disseminated by the **Vertices newsletter**, produced and distributed campus-wide and to hundreds of researchers worldwide by Doehner (<http://spatial.ucsb.edu/vertices-newsletter>).

Further, the Center actively maintains a number of educational resources that were developed in the past and are well used by teachers and researchers worldwide. These resources include the NSF-funded **teachspatial.org**, which offers a substantial collection of materials relating to fundamental

spatial concepts in different disciplines, included in the National Science Digital Library. This collection of concepts and related teaching materials allows users to approach the resource from a range of perspectives. The website gispopsci.org, launched for public access in May 2013, provides advanced teaching materials on spatial analysis for population science and demography. The new **Spatial Archives** (e-Scholarship) initiative, detailed below, provides long-term access to core informational assets, streamlining the content formats and reducing maintenance costs.

Spatial Archives—e-Scholarship (new resource)

In 2015 the Center assembled a permanent digital archive through the California Digital Library's e-Scholarship initiative, to preserve in perpetuity and enhance access to the accomplishments and publications of three generations of geospatial enterprises at UCSB: the National Center for Geographic Information and Analysis (NCGIA), the Center for Spatially Integrated Social Science (CSISS), and the Center for Spatial Studies (<http://spatial.ucsb.edu/spatial-archives>). The initiative was led by Don Janelle and Werner Kuhn. Hosted on the UC e-Scholarship platform, the archive features hundreds of technical, program and meeting reports (including more than 1,600 position papers by meeting participants over a span of 27 years), special publications, and curricula and other educational resources. These are freely available on the web to researchers, teachers, and the general public. All materials are also deposited in the California Digital Library's Merritt Preservation Repository, thus ensuring their long-term security and accessibility. The intent of this year-long effort has been to (1) provide the community with reliable access to a primary collection of geographic information science, and (2) position these resources for integration within the broader literature to help document the initial development of GIS.

Extended Center Vision for 2020

The Center has made very significant campus contributions over the past nine years, building awareness of the role of spatial perspectives in research, initiating new educational and research programs, and nurturing cross-disciplinary collaboration. As detailed in this report, directors Kuhn and Hegarty have carefully examined the program and recalibrated the Center's mission over the past three years, recasting the initial spirit of the Center to a rapidly changing research, educational, and service context. Looking forward toward 2020, the Center seeks to further broaden its impact in these contexts by launching new initiatives and by maintaining and strengthening its existing successful programs.

A Hub for Spatially Enabled Interdisciplinary Scholarship

Kuhn presented the Center's new vision to then-Executive Vice Chancellor Gene Lucas in 2013, proposing that the Center act as a hub for spatially enabled interdisciplinary science, drawing on the concepts of linked science and smart campus. Since then, the Center has made significant strides in this direction, particularly by **exploring spatial library search** and by supporting the **Interdisciplinary Research Collaboratory** as one of the core spatial services for the University.

The idea of "linked science" is to combine **open access to research results** (data, models, publications) with **semantic and spatio-temporal links** and discovery across disciplinary silos. The

realization that location is a basis for (a) linking data resources, (b) enabling spatio-temporal search and discovery of research materials, and (c) visualizing and analyzing processes offers researchers, educators, and students a near seamless approach to knowledge development and transfer.

The ideas outlined in 2013 are now growing from their exploratory stage (see, for example, <http://discovery.ucsb.opendata.arcgis.com/>) into software tools and human services deployed at the Collaboratory. Our implementation of the 2013 vision also responds to the pressing need for campus- and system-wide **cyber-infrastructures for sharing and accessing research data**. Discussions with the new campus CIO on this topic, which clearly requires substantial IT support, are already underway.

In close cooperation with the Library, the Center will make the Collaboratory a hub for data sharing and interdisciplinary activities, advancing UCSB as a world-recognized spatially-integrated smart campus. The Center will continue to help implement the expanded technical and human services that such an initiative entails.

Development of a Master's Degree in Spatial Studies

Building on the success of the Minor in Spatial Studies and the Freshman Seminar, the Center is in the process of developing a proposal for a **Master's in Spatial Studies** to provide a new and unique interdisciplinary program at the graduate level. The academic coordinator position that the budget requests is intended to be focused on the development and deployment of this new Master's program, while providing a more coordinated educational strategy across Freshman Seminars, the Minor, the Master's, and the Center's other educational activities.

This Master's program will focus on spatial thinking and computing as an enabler in multiple areas, providing students with highly transferable skills in information technology, geodesign, and critical thinking. There is demand for this new type of Master's degree from a number of industries and government agencies involved in urban planning, (e.g., traffic and transportation systems), and health (e.g., agencies concerned with demography, epidemiology, and education). In addition, many disciplines in both the physical and social sciences, as well as increasingly in the humanities, benefit from spatial analysis, such that students from a variety of disciplines at UCSB would be able to increase their career choices, within and outside the academy, by enrolling in this program.

The curriculum for this Master's will be structured similarly to the Minor in Spatial Studies. It will include core coursework in GIS (currently offered in the Dept. of Geography), together with graduate electives in a range of departments (e.g., Bren School; the Departments of Ecology, Evolution, & Marine Biology; Earth Science; Geography; History of Art & Architecture; Psychological & Brain Sciences), depending upon the student's particular career interests and needs. Students will be required to attend lectures by visiting speakers on a range of topics related to spatial studies (routinely organized by the Center), and they also will have the opportunity to participate in an internship, conducting research in collaboration with a faculty member in any department at UCSB or with a professional working in a local company or government. The program will include significant professional development activities, including a requirement to present a talk in the ThinkSpatial or Technology Lunch series and receive feedback from faculty and peers, a professional training course on preparing resumes/curriculum vitae for different employers (in business, government agencies, and academia), and workshops with employers from the private and public sectors. The planning of the Master's program evolves in close collaboration with that of a

complementary Environmental Informatics (professional) Master's program envisioned by colleagues at the Bren School.

While Mary Hegarty is stepping down as associate director due to her obligations in the Graduate Division, she will provide a liaison with the Center in this initiative in her new position as associate dean of the Graduate Division.

New and Extended Research Initiatives

The Center's research agenda will continue its cutting-edge research on spatial thinking and computing. To maximize impact, these research efforts reflect Kuhn's and Hegarty's primary interests and expertise, but they will be guided as well by the interests of other Center research affiliates, particularly those of its post-doctoral scholars.

Kuhn's **Core Concepts of Spatial Information**, a research and educational project aimed at reducing the conceptual confusion and complexity of GIS, will be a common thread in future research as well as in the Discovery project at the library. The Core Concepts have the potential to lower the entry barriers to GIS, making spatial computing and data more accessible to scholars and scientists from fields as diverse as history, economics, sociology, and the geo-sciences. Pilot projects with campus researchers in archaeology and marine ecology are under way.

Improved usability of **data visualization** technologies is a second theme that cuts across the academy, and has long been central to the research that has been established by Kuhn, Hegarty, and their students. Results are already being applied to map-based library search capacities, for example, and to the re-launching of the Interactive Campus Map. Closely related to visualization, empirical methods in human-computer interaction will be applied to evaluate the usability of portals to linked data and to the campus map. The Discovery project with the UCSB Library makes research data discoverable spatially and semantically by encoding them (or data about them) as Linked Data. This project combines cognitive and computational methods for the engineering and evaluation of new library search interfaces, involving dynamic map views with spatial as well as topical querying techniques. The combination of Kuhn's usability and Linked Data expertise with campus expertise on cognitive psychology of space and experimental evaluation creates a unique setting to design and deploy library functionality that is unique worldwide.

Hegarty's interest in collaborating with disciplinary specialists to document **spatial cognition** within specific disciplines (such as medical surgery, chemistry, and mechanics), emerges as a platform for refining the understanding of spatial thinking in different disciplines, and informs questions of education in spatial thinking and how spatial technologies can augment human spatial reasoning and enhance spatial methodologies across disciplines. The Center expects the new appointment of Elizabeth Chrastil to the Dept. of Geography to provide excellent reinforcement for this domain area, broadening its spatial cognition emphasis.

To carry out work along these and emerging new research lines, we will launch new initiatives and continue to submit grant proposals to NSF and other funding agencies. All our research efforts are characterized by a level of interdisciplinarity that would be extremely difficult to achieve without the presence of a research hub at the Center that is neutral regarding disciplinary perspectives.

The envisioned research is clearly fundable, as inter- and trans-disciplinary research remains high on the agenda of funding agencies and "spatial" keeps demonstrating its value by connecting disciplines and worldviews in a data-driven way. Kuhn and Hegarty already have grants under review

at NSF and NIH that address some of these questions. The private donation to the Library obtained through the past three years of Center efforts strengthens the basis to seek research funding.

Expansion of Technical and Human Services to the Campus

Given the campus geospatial needs detected by the Center's Help Desk, the Center is currently organizing a series of **training workshops** to enhance basic and advanced training in spatial thinking and computing. Faculty, graduate students, and researchers from different departments have consistently expressed interest in hands-on training in spatial computing, and have taken advantage of recent, usable spatial technologies and tools. To fill this gap, the Center is developing **peer-to-peer graduate workshops**, where graduate students specialized in spatial technologies will provide practical, hands-on training, under the coordination of the Center's faculty and postdocs. This initiative will promote spatial technological know-how at UCSB among students and faculty, and will also increase interaction between UCSB researchers who are working on related topics. Further, we propose to **expand the help desk services beyond GIS** help to include assistance to researchers in research design and data analysis relevant to the evaluation of human interaction with new geospatial technologies, including navigation devices and data portals.

In pursuing these new challenges, the Center will continue to provide stimulating research and learning opportunities for students and faculty—opportunities that are not necessarily available in their home departments—by maintaining and further evolving its current initiatives, including:

- ThinkSpatial Brown-bag Lectures
- Spatial Technology Lunches
- Minor in Spatial Studies
- Freshman Seminars
- GIS Help Desk and hands-on workshops
- Specialist and expert meetings, un-conferences
- Annual outreach events (e.g., spatial@ucsb.local)
- Year-long and summer internships for local, national, and international students
- Accumulation of contents and organizing events for the Collaboratory
- Co-hosting and inviting prominent speakers to campus (with IHC, Geography, SAGE, and other partners)
- Rebuilding the Interactive Campus Map.

National and International Networking

As the letters of support from renowned researchers underline (see Appendix VII, p. 58), the success of the Center for Spatial Studies continues to inspire similar efforts at other universities in the United States and internationally. We believe the time has come to turn the many informal links between "spatial centers" into a global network. The primary goal of such a network will be **to share experiences, strategies, program elements, and tools more effectively**. Discussions with partners at several universities in the U.S., Canada, Australia, New Zealand, and Europe are under way to launch such a network. These discussions confirm the strong and growing interest in bridging geographical distance and collaborating in the creation of spatially empowered universities. UCSB is an acknowledged world leader in this effort. It can cement that leadership through continued support and commitment to the Center for Spatial Studies.

Appendix I: Publications and Presentations 2013–2016

Appendix Ia. Publications

Publications by Werner Kuhn

- Onsrud, H. and **W. Kuhn** (2016). *Advancing Geographic Information Science: The Past and Next Twenty Years*. GSDI Association Press.
- Allen, C., T. Hervey, **W. Kuhn**, S. Lafia, D.W. Phillips, and B. Vahedi (2016). Exploring the Notion of Spatial Data Lenses (full paper, submitted to GIScience 2016).
- Kuhn, W.** (2016). Spatial Computation as an Extension of Spatial Cognition (extended abstract, submitted to *Spatial Cognition*).
- Kuhn, W.** (2016). Toward an Outward-Looking GIScience. In *AAG Annual Meeting* (abstract, accepted).
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- Kuhn, W.**, W. McClintock, G. Goldberg (in press). Spatial Thinking and Computing as a General STEM Skill. *STEM and GIS in Higher Education*. Cowen, D., (Ed.), Esri Press.
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- Schöning, J., B. Hecht, **W. Kuhn** (2014). Informing online and mobile map design with the collective wisdom of cartographers. ACM Conference on Designing Interactive Systems (DIS'14): pp. 765–774.
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Publications by Mary Hegarty

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- Stull, A.T. and **M. Hegarty** (in press). Model Manipulation and Learning: Fostering Representational Competence with Virtual and Concrete Models. *Journal of Educational Psychology*.
- Xiao, C., Y. Lian, and **M. Hegarty** (2015). Spatial updating of map-acquired representations. *Memory and Cognition* 43: 1032–1042 .
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- Davies, C., S. Fabrikant, and **M. Hegarty** (2015). Towards empirically verified cartographic displays. In R. R., Hoffman et al (Eds.) *Handbook of Applied Perception Research*. Cambridge, MA: Cambridge University Press.
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- Hegarty, M.** (2014). Spatial thinking in undergraduate science education. *Spatial Cognition and Computation* 14: 142–167.
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- Zwick, R., D. Zapata, and **M. Hegarty** (2014). Comparing graphical and verbal representations of measurement error in test scores. *Educational Assessment* 19: 116–138.
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Publications by Andrea Ballatore (February 2014–December 2015)

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- Ballatore, A.** and P. Mooney (2015). Conceptualising the geographic world: The dimensions of negotiation in crowdsourced cartography. *International Journal of Geographical Information Science* 29(12): 2310–2327.
- W. Kuhn** and **A. Ballatore** (2015). Designing a Language for Spatial Computing. AGILE 2015, Lecture Notes in Geoinformation and Cartography, Lisbon, June 2015, pp. 309–326.
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- Ballatore, A.** and S. Natale (2015). E-Readers and the Death of the Book: or, New Media and the Myth of the Disappearing Medium. *New Media and Society*. pp. 1–16.
- Ballatore, A.** and A. Zipf (2015). A Conceptual Quality Framework for Volunteered Geographic Information. *Spatial Information Theory (COSIT)*, Santa Fe, NM, pp. 89–107.
- Ballatore, A.** and **W. Kuhn** (2015). Thinking about Spatial Computing. *COSIT Workshop on Teaching Spatial Thinking*, pp. 1–4.
- Ballatore, A.**, T. Pham, J. Yin, L. Truong-Hong, and J.D. Carswell (2015). Design and Development of Personal GeoServices for Universities. In *Information Fusion and Geographic Information Systems (IF&GIS 2015)*, V. Popovich et al. (Eds.), *Lecture Notes in Geoinformation and Cartography 2015*. Berlin: Springer, pp. 3–26.
- Yan, B., Y. Hu, B. Kuczynski, K. Janowicz, **A. Ballatore**, et al. (2015). An Ontology for Specifying Spatiotemporal Scopes in Life Cycle Assessment. *Diversity++ Workshop, 14th International Semantic Web Conference, ISWC 2015*. pp. 1–6.
- Janowicz, K., T. Kauppinen, S. Schade, **A. Ballatore**, and G. McKenzie (2015). Contextual Information: Lenses for Observing the Data Universe. *Workshop on Geographic Information Observatories 2014, COSIT 2015*. pp. 1–3.
- Ballatore, A.** and B. Adams (2015). Extracting Place Emotions from Travel Blogs. AGILE 2015, Lecture Notes in Geoinformation and Cartography, Lisbon, June 2015, pp. 1–5.
- Malherbe, E., M. Cataldi, and **A. Ballatore** (2015). Bringing Order to the Job Market: Efficient Job Offer Categorization in E-Recruitment, *Symposium on IR in Practice (SIRIP 2015)*. ACM SIGIR Conference, industry track, pp. 1–4.
- Ballatore, A.** (2014). Defacing the Map: Cartographic Vandalism in the Digital Commons. *The Cartographic Journal* 51(3): 214–224.

- Ballatore, A.** (2014). The myth of the Digital Earth between fragmentation and wholeness. Wi: *Journal of Mobile Culture* 8(2): 1–20.
- Ballatore, A., M. Bertolotto, and D.C. Wilson** (2014). Linking geographic vocabularies through WordNet. *Annals of GIS* 20(2): 73–84.
- Ballatore, A., M. Bertolotto, M., and D.C. Wilson** (2014). An evaluative baseline for geo-semantic relatedness and similarity. *GeoInformatica* 18(4): 747–767.
- Natale, S. and **A. Ballatore** (2014). The web will kill them all: New media, digital utopia, and political struggle in the Italian 5-Star Movement, Media. *Culture and Society* 36(1): 105–121.
- Ballatore, A., M. Bertolotto, and D.C. Wilson** (2014). The semantic similarity ensemble. *Journal of Spatial Information Science (JOSIS)* 7: 27–44.
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Publications by Antonio Medrano (April 2015–January 2016)

- Lafia, S., F.A. Medrano, J. Jablonski, W. Kuhn, and S. Cooley** (*submitted, under review*) Spatial Discovery and the Research Library.
- Medrano, F.A.** and R.L. Church (2015). A Parallel Computing Framework for Finding the Supported Solutions to a Biobjective Network Optimization Problem. *Journal of Multi-Criteria Decision Analysis* 22: 244–259.

Publications by Donald Janelle

- Janelle, D.G.** (2016 in press). Time, Space, and the Human Geographies of Opportunity. In S. Iyengar and G. Ghirardi (Eds.) *Space, Time, and Limits of Human Understanding*, Springer Publications.
- Janelle, D.G.** (2016 in press). Time-space Convergence. In D. Richardson (Ed.) *The International Encyclopedia of Geography*. John Wiley and the Association of American Geographers.
- Janelle, D.G.** (2016 in press). Time-space, in Geography. In J. Wright (Ed.) *International Encyclopedia of the Social and Behavioral Sciences, 2nd Edition*. Kidlington, Oxford, UK: Elsevier, Ltd.
- Grossner, K. and **D.G. Janelle** (2014). Concepts and Principles for Spatial Literacy. In D.R. Montello, Grossner, K., and **Janelle, D.G.** (Eds.) *Space in Mind: Concepts for Spatial Learning and Education*, Cambridge, MA: MIT Press, pp. 239–261.
- Montello, D.R., K. Grossner, K., and **D.G. Janelle** (Eds.) (2014). *Space in Mind: Concepts for Spatial Learning and Education*. Cambridge, MA: MIT Press, 336 pages.
- Montello, D.R., K. Grossner, and **D.G. Janelle** (2014). Concepts for Spatial Learning and Education: An Introduction. In D.R. Montello, Grossner, K., and **Janelle, D.G.** (Eds.) *Space in Mind: Concepts for Spatial Learning and Education*. Cambridge, MA: MIT Press, pp. 3–29.
- Janelle, D.G., M. Hegarty, and N.S. Newcombe** (2014). Spatial Thinking across the College Curriculum: A Report on a Specialist Meeting. *Spatial Cognition and Computation, An Interdisciplinary Journal* 14(2): 124–141. DOI: 10.1080/13875868.2014.888558
- Janelle, D.G.** (2014). Time-space Convergence. In R.J. Stimson (Ed.) *Handbook of Research Methods and Applications in Spatially Integrated Social Science*. Cheltenham, UK: Edward Elgar Publishing, pp. 43–60.

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Appendix Ib. Center Reports

Cooley, S., S. Lafia, F.A. Medrano, D. Stephens, and **W. Kuhn** (2015). Spatial Discovery Expert Meeting: Final Report. <http://escholarship.org/uc/item/64p820kg>

A. Ballatore, W. Kuhn, M. Hegarty, and E. Parsons (2014). Spatial Search: Final Report on Specialist Meeting. Center for Spatial Studies, University of California, Santa Barbara. <http://escholarship.org/uc/item/33t8h2nw>

Janelle, D.G., W. Kuhn, M. Gould, and M. Lovegreen (2014). *Advancing the Spatially Enabled Smart Campus; Final Report*. 45 Pages. Meeting sponsored by the UCSB Center for Spatial Studies, with support from Esri. December 11–12, 2013. Santa Barbara, CA. <http://escholarship.org/uc/item/8tg6x4j9>

Hegarty, M., N. Newcombe, **M.F. Goodchild, D.G. Janelle,** T. Shipley, and D. Sinton (2013). *Spatial Thinking Across the College Curriculum Specialist Meeting—Final Report*. 42 pages. Meeting sponsored by the UCSB Center for Spatial Studies and the Spatial Intelligence and Learning Center (Temple University). December 10–11, 2012, Santa Barbara, CA. <http://escholarship.org/uc/item/4f6768h4>

Appendix Ic. Presentations

The following presentations have described the work of the Center to audiences worldwide.

Presentations by Werner Kuhn

September 2013

Computing with Core Concepts of Spatial Information; with Mohamed Bishr. COSIT 2013, Scarborough, North Yorkshire, UK.

September 2013

A Geo-Ontology Design Pattern for Semantic Trajectories; with Y. Hu, K. Janowicz, D. Carral, S. Scheider, G. Berg-Cross, P. Hitzler, M. Dean. COSIT 2013, Scarborough, North Yorkshire, UK.

September 2013

Linked Data and Time—Modeling Researcher Life Lines by Events; with J. Trame and C. Keßler. COSIT 2013, Scarborough, North Yorkshire, UK.

January 2014

Spatializing Research Hypotheses—A Long-term Vision for spatial@ucsb. ThinkSpatial presentation, UCSB.

April 2014

Geospatial Ontology, Semantics, and Metadata III: GeoVocamp—A bottom-up and participatory method for developing lightweight geospatial vocabularies and ontologies. Panelist; AAG, Tampa, FL.

April 2014

Visioning GIScience Education. Panelist; AAG, Tampa, FL.

October 2015

Computing with Core Concepts of Spatial Information. COSIT, Santa Fe, NM.

February 2016

Core Concepts of Spatial Information—An Update. Talk presented at San Diego State University, Dept. of Geography colloquium.

April 2016

Toward an Outward-Looking Geographic Information Science. AAG, San Francisco, CA.

Presentations by Mary Hegarty

July 2013

Cognition and metacognition in learning and reasoning with diagrams. Talk presented in the Workshop on Diagrammatic Cognition: Discovery and Design. Cognitive Science Conference, Berlin.

November 2013

Individual differences and strategies in the allocentric-heading recall task. Talk presented at the Annual Meeting of the Psychonomic Society, Boston, MA.

May 2014

Developing representational competence with drawings and models. Presented at the SILC workshop on sketching and spatial cognition, Chicago, IL.

August 2014

Designing Media for Learning: The Case of Understanding Physical Systems, Keynote Lecture, EARLI SIG 2 Comprehension of Text and Graphics Conference, Rotterdam, The Netherlands.

April 2015

Individual differences in spatial thinking: Implications for education. Invited lecture, Temple Institute for Learning and Education Sciences, Temple University, Philadelphia, PA.

April 2015

The power of diagrams in science and challenges of diagrams in science education. Keynote Lecture, Diagrams as Vehicles of Scientific Reasoning, Center for Philosophy of Science, University of Pittsburgh, Pittsburgh, PA.

September 2015

Individual Differences in Spatial Abilities across Different Scales of Space. Presented at the 6th International Conference on Spatial Cognition, Rome, Italy.

Presentations by Andrea Ballatore

Sept. 24, 2014

Workshop at GIScience, Vienna: Exploring the geographic information universe: The role of search technologies.

April 20, 2015

Workshop on *Managing Coastal Environments: Organizational Responses to Uncertainty*, UCSB: Mapping Spatial Uncertainty in Sight and Sound.

June 10, 2015

AGILE International Conference on Geographic Information Science, Lisbon, Portugal: Designing a Language for Spatial Computing.

July 1, 2015

Vespucci Institutes, Bar Harbor, ME: Prolegomena for an Ontology of Place.

Oct. 13, 2015

COSIT, Santa Fe, NM: A Conceptual Quality Framework for Volunteered Geographic Information.

Presentations by Antonio Medrano

Nov. 3, 2015

Spatial Data for Multiobjective Shortest Path Analyses: Small Decisions with Large Consequences. Institute for Operations Research and the Management Sciences (INFORMS) Annual Meeting, Philadelphia, PA.

Nov. 14, 2015

GIS Raster Data for Multi-Objective Shortest Path Analysis: The Elephant in the Room. 62nd Annual North American Meetings of the Regional Science Association International (RSAI), Portland, OR.

Jan. 26, 2016

Attribute Scale on GIS Raster Data: What to Avoid at All Costs! ThinkSpatial Brown-bags, Center for Spatial Studies, UCSB.

Presentations by Donald Janelle

April 30, 2013

Rivers, Bridges, Stagecoaches, and the Early Nineteenth-Century Space-time Structure of Maine's Settlement System. ThinkSpatial Brown-bag Forum, UCSB.

March 11, 2015

Convergent Places—Warped Spaces: Implications for Spatial Analysis. MSGIS Colloquium, University of Redlands, Redlands, CA.

April 23, 2015, with Karl Grossner,

A Transdisciplinary Undergraduate Course in Spatial Literacy. Association of American Geographers Annual Meeting, Chicago, IL.

May 1, 2015

Spatial Thinking and the Unpublished Works of William Warntz. Harvard University Center for Geographic Analysis Spring Conference. The Computer Graphics and Spatial Analysis Lab and Its Legacy, Cambridge, MA.

Appendix II: Recipients of Dangermond Graduate Student Support

Dangermond Awards for GIS Related Presentations:

Spring 2016

(Partial list; application window still open)

Name	Conference Dates	Purpose/Destination	Presentation
Tuholske, Cascade	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>The Effects of Tourism on Land Cover and Land Use Change in Roatán, Honduras</i>
Ervin, Daniel	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>International Migration, Economic, Environmental, and Sociodemographic Factors Correspond with Forest Cover Change in Mexico from 2000–2010</i>
Ramos, Rafael	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Exploring the Spatial-temporal Relations between Burglary and Socioeconomic Factors using GIS</i>
Salap-Ayca, Seda	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Investigating the Effects of Neighborhood Schemes on Local Multi-Criteria Evaluation</i>
Lafia, Sara	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>People and Places: Resource Discovery in a Library Context</i>
Hu, Yingjie	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Task-oriented Information Value Measurement based on Space-time Prisms</i>
Zhu, Rui	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Gazetteer Place Matching using Spatial Analysis</i>
Gao, Song	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Employing Spatial Analysis in Indoor Positioning and Tracking Using Wi-Fi Access Points</i>
Regalia, Blake	5/29–6/2/2016	ESWC 2016 Extended Semantic Web Conference, Anissaras, Crete, Greece	<i>VOLT: A Provenance-Producing, Transparent SPARQL Proxy for the On-Demand Computation of Linked Data and its Application to Spatiotemporally Dependent Data</i>
Mai, Gengchen	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Tea Plantation Expansion in Hangzhou, China: Process, Related Factors and Ecological Effect</i>
Ju, Yiting	3/29–4/2/2016	AAG Annual Meeting, San Francisco, CA	<i>Ontology Design Pattern of Spatiotemporal Scope: From an Application to Life Cycle Assessment</i>
Crook, Stephen	7/5–8/2016	GI Forum, Salzburg, Austria	<i>An Agent Based Model for Exploring Wolf Recolonization in Austria</i>

Fall 2015

Name	Conference Dates	Purpose/Destination	Presentation
Yan, Bo	10/12–16/2015	Conference on Spatial Information Theory (COSIT), Santa Fe, NM	<i>Geo-ontology Quality Evaluation and Difference Measurement</i>
Tuholske, Cascade	12/ 9–11/2015	SPATIAL 2015, Spatial Information on Human Health, UCSB	Lightning talk: <i>Reconciling Space and Place to Reveal the Determinate of Health: Integrated Research in Roatán, Honduras</i>
Voss, Katalyn	12/ 14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>But What do the Data Say? Lessons in Integrating Science and Policy to Inform International and Domestic Water Management Decisions</i>
Lafia, Sara	10/12–16/2015	Conference on Spatial Information Theory (COSIT), Santa Fe, NM	<i>Computing with Core Concepts of Spatial Information</i>
Ervin, Daniel	10/21–24/2015	2015 Association of Pacific Coast Geographers Annual Meeting, Palm Springs, CA	<i>Predicting Land Use and Land Cover Change using Demographic and Economic Variables</i>
Shivers, Sarah	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Using Imaging Spectrometry to Identify Crops in California's Central Valley</i>
Irmischer, Ian	11/9–13/2015	Geoinformatics and Spatial Cognition in Humans' Movement and Navigation, Copenhagen, Denmark	<i>Space, Time, and Energy in Dismounted Navigation</i>
Niblett, Tim	11/11–14/2015	North American Meetings of the Regional Science Association International, Portland, OR	<i>TRANSMAX II: An Alternative Formulation for Solving Maximal Covering Shortest Path Problems</i>
Bingham, Nina	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Strontium Isotopes Provide Clues for a Process Shift in Base cation Dynamics in Young Volcanic Soils</i>
Chen, Helen	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Water, Energy, and Society in Urban Systems</i>
Zilli, Marcia	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Observed Decadal Variability in Precipitation and Circulation over South America during Austral Summer</i>
Cannon, Forest	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>The Influence of Tropical Forcing on Westerly Disturbances: Implications for Extreme Precipitation in High Asia</i>

Meerdink, Susan	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Discriminating Plant Species across California's Diverse Ecosystems using Airborne VSWIR and TIR Images</i>
Wetherley, Erin	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Using HypsIRI Campaign Data for Sub-pixel Classification of the Urban Land Surface</i>
Heidinger, Haline	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>The influence of the Madden-Julian Oscillation (MJO) on Extreme Rainfall over the Central and Southern Peruvian Andes</i>
Mwenda, Kevin	12/ 9– 11/2015	SPATIAL 2015, Spatial Information on Human Health, UCSB	<i>A Spatiotemporal Approach to Modeling Populations at Risk of Vector-borne Diseases</i>
Harris, Sarah	12/14–18/2015	2015 American Geophysical Meeting, Fall Meeting, San Francisco, CA	<i>Identifying and Characterizing Atmospheric Rivers Impacting Southern California</i>

Spring–Summer 2015

Name	Conference Dates	Purpose/Destination	Presentation
McKenzie, Grant	3/12–13/2015	International Conference on Location-Based Social Media Data, Athens, GA	(1) <i>The Pretense of Residential Privacy in Geosocial Networking Data</i> (2) <i>POI Type Matching Based on Culturally Different Datasets</i>
HU, Yingjie	4/21–25/2015	AAG 2015, Chicago, IL	<i>Emerging Topics in Data-driven Geography</i>
Irmischer, Ian	4/21–25/2015	AAG 2015, Chicago, IL	<i>Individual Differences that Affect Navigational Performance</i>
Lundberg, Ansel	4/21–25/2015	AAG 2015, Chicago, IL	Poster: <i>Not so Golden: Which Counties in California are Most Accommodating for Low-income Residents?</i>
Alonzo, Mike	4/21–25/2015	AAG 2015, Chicago, IL	<i>Trees in the City 2: Mapping and Measurement</i>
Alonzo, Mike	July 20–24/2015	9 th International Conference on Urban Climate, Toulouse, France.	<i>Spatially Explicit Urban Ecosystem Analysis for Improved Urban Climate Modeling</i>
Gao, Song	4/21–25/2015	AAG 2015, Chicago, IL	<i>Place-Based GIS: The Next Frontier of GIScience Research</i>
Gao, Song	5/20–23/2015	The 13 th International Conference of GeoComputation (GeoComputation 2015), Dallas, TX	<i>Using Mobile Phone Data</i>
Voss, Katalyn	4/26–5/1/2015	CUASHI 2015 Watershed Science Master Class; Biosphere 2, The University of Arizona, Oracle, AZ	<i>Harnessing Water: Is Irrigation a Panacea for Food Security? A Case Study in High Mountain Nepal</i>
Menzer, Olaf	July 20–24, 2015	9 th International Conference on Urban Climate, Toulouse, France	<i>Statistical Partitioning of Net Carbon Dioxide Fluxes over a Heterogeneous Urban Landscape</i>

Winter 2015

Name	Conference Dates	Purpose/Destination	Presentation
Antunes, Gabriel	12/14–18/2015	2015 AGU Fall Meeting, San Francisco, CA	<i>Mapping the Cerrado Vegetation Classes using RapidEye Imagery</i>
Ribeiro, Fernanda	12/14–18/2015	2015 AGU Fall Meeting, San Francisco, CA	<i>Mapping the Cerrado Vegetation Classes using RapidEye Imagery</i>
Tuholske, Cascade	12/14–18/2015	2015 AGU Fall Meeting, San Francisco, CA	<i>Bridging Epidemiology and Remote Sensing: A Case Study of Dengue Fever and Land Use and Land Cover Change in Roatán, Honduras</i>
Baez, Carlos	11/ 11–23/2015	Disrupt Mobility, Cambridge, MA at MIT	<i>Disrupting the Economics of Private-hire Vehicle and Rideshare Markets</i>
Baez, Carlos	10/12–16/2015	Conference on Spatial Information Theory, Santa Fe, NM	<i>Closing the “Data-Gap” with Theoretical Geography and Synthetic Geographic Information</i>
Harris, Sarah	1/10–14/2016	American Meteorology Society Annual Meeting, New Orleans, LA	<i>Investigating Atmospheric Rivers Affecting Southern California</i>
Lee, Jae Hyun	1/10–14/2016	The 95 th Annual Meeting of the Transportation Research Board, Washington, DC	(1) <i>Activity Space Estimation with Longitudinal Observations of Social Media Data</i> (2) <i>Comparing the Origin-Destination Matrices from Travel Demand Model and Social Media Data</i> (3) <i>Taking Place Attitudes into Travel Behavior Research</i> (4) <i>Behavioral Micro-dynamics of Car Ownership and Travel in the Seattle Metropolitan Region from 1989 to 2002</i>
Mwenda, Kevin	4/29–2/2016	AAG 2016, San Francisco, CA	<i>Modeling Woody Vegetation Cover Change in Boyaca, Colombia, using OLS, GWR and Random Forests</i>
Davis, Adam	1/10–14/2016	The 95 th Annual Meeting of the Transportation Research Board, Washington, DC	<i>Taking Place Attitudes into Travel Behavior Research</i>
Meerdink, Susan	3/29–4/2/2016	AAG 2016, San Francisco, CA	<i>Differentiating California Plant Species Across Seasons using Airborne VSWIR and TIR imagery</i>
Niblett, Tim	2/14–17/2016	Western Regional Science Association, Waikoloa Village, HI	<i>TRANSMax II: An Extended Model for Transit Route Optimization</i>
McBride, Elizabeth	1/10–14/2016	The 95 th Annual Meeting of the Transportation Research Board, Washington, DC	<i>Behavioral Microdynamics of Car Ownership and Travel in the Seattle Metropolitan Region from 1989 to 2002</i>

Fall 2014

Name	Conference Dates	Purpose/Destination	Presentation
Hu, Yingjie	11/4–7/2014	International Conference on Advances in Geographic Information Systems (ACM SIGSPATIAL) 2014, Dallas, TX	<i>Improving Wikipedia-based Place Name Disambiguation in Short Texts Using Structured Data from DBpedia</i>
McKenzie, Grant	11/4–7/2014	International Conference on Advances in Geographic Information Systems (ACM SIGSPATIAL) 2014, Dallas, TX	Chair: <i>The First Workshop on Privacy in Geographic Information Collection and Analysis</i> Present a paper on behalf of his advisor and another lab member
Lee, Jaehyun	1/11–15/2015	The 94 th Annual Meeting of the Transportation Research Board, Washington, DC	<i>Examining Differences and Commonalities of Life Cycle Stages in Daily Contacts and Activity-Travel Time Allocation</i>
Thorpe, Andrew	12/15–19/2014	American Geophysical Union Fall Meeting, San Francisco, CA	<i>Mapping Methane Concentrations from a Controlled Release Experiment using the Next Generation Airborne Visible/Infrared Imaging Spectrometer (AVIRISng)</i>
Romero, Bo	4/21–25/2015	Association of American Geographers 2015 Annual Meeting, Chicago, IL	<i>An Evaluation of Sampling Methods for Spatial Outlier Detection and On the Topology of Topography</i> (with Keith Clarke)
Elwell, Tammy	3/23–25/2015	2015 Natural Capital Symposium, Stanford University, Palo Alto, CA	<i>From Science to Policy Outcomes: How an Ecosystem Service Approach Informed Planning Decisions in Chile</i>
Davis, Adam	1/11–15/2015	The 94 th Annual Meeting of the Transportation Research Board, Washington, DC	<i>Analyzing Bay Area Bike-share Usage in Space and Time</i>
K. Majid Sadeghi	5/17/21/2015	1015 Environmental and Water Resources Institute, Austin, TX	<i>Storm-water Management: Application to the City of Los Angeles</i>

Late Summer–Fall 2014

Name	Conference Dates	Purpose/Destination	Presentation
Voss, Katalyn	12/15–19/2014	American Geophysical Union, Fall Meeting, San Francisco, CA	<p>(1) Session convener: <i>GC080: Water Resources in Glacierized Mountain Watersheds: Hydrological Transitions and Vulnerability in a Changing Climate</i></p> <p>(2) Awarded Editor's Choice Award: <i>Groundwater depletion in the Middle East from GRACE with Implications for Transboundary Water Management in the Tigris-Euphrates-Western Iran Region</i></p> <p>(3) Poster: <i>Evaluating Coupled Human-Hydrologic Systems in High Altitude Regions: A Case Study of the Arun Watershed, Eastern Nepal</i></p>
Menzer, Olaf	12/15–19/2014	American Geophysical Union, Fall Meeting, San Francisco, CA	<p>(1) Mapping AmeriFlux Footprints: Toward Knowing the Flux Source Area across a Network of Towers</p> <p>(2) Evaluation of Growing Season Milestones, Using Eddy Covariance Time-Series of Net Ecosystem Exchange</p>
Cannon, Forest	12/15–19/2014	American Geophysical Union, Fall Meeting, San Francisco, CA	<i>Winter Westerly Disturbance Activity in High Mountain Asia: A Wave Tracking Approach</i>
Niblett, Timothy	11/11–15, 2014	Meetings of the North American Regional Science Association, Washington, DC	<i>Will the Real Optimal Solution Stand Up: Solving the Maximal Covering Shortest Path Problem</i>
Chen, Jorge	10/5–7/2014	AutoCarto 2014, Pittsburgh, PA	<i>Analysis of Webcam Photogrammetry for Indoor Mapping Applications</i>
Zilli, Marcia	12/15–19/2014	American Geophysical Union, Fall Meeting, San Francisco, CA	<i>Decadal Variability in the South Atlantic Convergence Zone and Changes in Precipitation over Southeastern Brazil</i>
Neely, Al	12/15–19/2014	American Geophysical Union, Fall Meeting, San Francisco, CA	<i>An Automated System of Knickpoint Definition and Extraction from a Digital Elevation Model (DEM): Implications for More Efficient Large-Scale Mapping and Statistical Analyses of Knickpoint Distributions in Fluvial Systems</i>
Medrano, Antonio	11/9–12/2014	INFORMS Annual Meeting, San Francisco, CA	<i>Ticket To Ride: A Maximum Covering Communication Design Problem</i>
Medrano, Antonio	11/12–15/2014	61st Annual Meeting of the Regional Science Association, Bethesda, MD	<i>A Simple Framework for Parallel Multi-Objective Optimization using Java</i>
Yang, Jiue-An	9/23–26/2014	The 8 th International Conference on Geographic Information Science, Vienna, Austria	<i>TrajAnalyst: Matching Data to Trajectory Analysis Modules via a Conceptual Framework and Detecting Origin-Destination Mobility Flows from Geotagged Tweets in Greater LA Area</i>

Spring/Summer 2014

Name	Conference Dates	Purpose/Destination	Presentation
Hu, Yingjie	3/24–28/2014	4 th International Conference on Learning Analytics and Knowledge, Indianapolis, Indiana	<i>A Linked-Data-Driven Web Portal for Learning Analytics: Data Enrichment, Interactive Visualization, and Knowledge Discovery</i>
Alonzo, Mike	4/8–12/2014	AAG in Tampa, Florida	<i>Mapping Urban Tree Leaf Area Index (LAI) Using High Point Density Lidar</i>
Thorpe, Andrew	4/8–12/2014	AAG in Tampa, Florida	<i>Mapping and Quantifying Methane Emissions using Airborne Imaging Spectroscopy</i>
Medrano, Antonio	7/13–18/2014	Conf. of the International Federation of Operational Research Societies (IFORS), Barcelona, Spain	<i>A Simple Framework for Parallel Multi-Objective Optimization using JAVA</i>
Romero, Bo	7/7–11/2014	Spatial Accuracy 2014, East Lansing, MI	<i>Spatial Outlier Detection of Gaussian Shapes</i>
McKenzie, Grant	9/23–26/2014	8 th International Conference on Geographic Information Science (GIScience), Vienna, Austria	<i>Coerced Geographic Information: The Not-so-voluntary Side of User-generated Geo-content</i>
Gao, Song	9/23–26/2014	8 th International Conference on Geographic Information Science (GIScience), Vienna, Austria	(1) <i>TrajAnalyst: Matching Data to Trajectory Analysis Modules via a Conceptual Framework</i> (2) <i>Detecting Origin-Destination Mobility Flows from Geo-tagged Tweets in Greater Los Angeles Area</i> (extended abstract)

Fall 2013

Name	Conference Dates	Purpose/Destination	Presentation
Cannon, Forest	12/9–13/2013	AGU in San Francisco, CA	<i>Multi-Annual Variations in Winter Westerly Disturbance Activity Affecting the Himalaya</i>
Currier, Kitty	9/ 19–20/2013	Geodesign Summit Europe, Herwijnen, Netherlands	<i>Geodesigning "From the Inside Out"</i>
Gao, Song	7/22–24/2013	The 4 th International Conference on Computing for Geospatial Research and Application, San Jose, CA	<i>Asking Spatial Questions to Identify GIS Functionality</i>
Gao, Song	11/5–8/2013	ACM SIGSPATIAL GIS 2013, Orlando, FL	(1) <i>Place-Based GIS Theory and Operations: The Start from Platial Join and Buffer</i> (2) <i>A Geospatial Scientometrics Framework for Measuring the Citation Impact of Publications and Scientists</i>
Garcia, Elizabeth	12/9–13/2013	AGU in San Francisco, CA	<i>Comparison of Interannual Climate Variability and Soil Moisture Capacity as Controls of Evapotranspiration in Western U.S. Mountain Forests</i>
Grigsby, Shane	12/9–13/2013	AGU in San Francisco, CA	<i>Determining the Structure of Vegetation Canopies—An Object-based Approach</i>
Hartman, Brett	10/ 6–11/2013	Society for Ecological Restoration, 5 th World Conference on Ecological Restoration, University of Wisconsin- Madison	(1) <i>The Influence of Social Factors on Land Restoration in Developing Countries: Watershed Rehabilitation</i> (2) <i>Wet Meadow (bofedal) Restoration in the Bolivian Andes</i>
Hu, Yingjie	11/5–8/2013	ACM SIGSPATIAL GIS 2013, Orlando, FL	<i>A Spatiotemporal Scientometrics Framework for Exploring the Citation Impact of Publications and Scientists</i>
McKenzie, Grant	9/2–5/2013	Conference on Spatial Information theory (COSIT) and Visual Uncertainty workshop, Scarborough, England	<i>Assessing the Effectiveness of Visualizations for Accurate Judgements of Geospatial Uncertainty</i>
McKenzie, Grant	10/21–25/2013	International Semantic Web Conference, Sydney, Australia	(1) <i>Linked Scientometrics: Designing Interactive Scientometrics with Linked Data and Semantic Web Reasoning</i> (2) <i>A Linked-Data-driven and Semantically-enabled Journal Portal for Scientometrics</i>
Medrano, Antonio	11/6–9/2013	INFORMS Annual Meeting, Minneapolis, MN	<i>Between Terrain and a NP-hard Place: Challenges of Solving Multiobjective Shortest Paths on GIS Networks</i>
Medrano, Antonio	11/12–16/2013	60 th Annual North American Meetings of the Rsai (NARSC), Atlanta, GA	<i>Fast Generation of Spatially Diverse One-to-one Shortest Path Options</i>

Menzer, Olaf	12/9–13/2013	AGU in San Francisco, CA	<i>Post Processing of CO2 Flux Measurements from an Urban Landscape</i>
Niblett, Matt	10/6–9/2013	INFORMS 2013 Annual Conference, Minneapolis, MN	<i>A GIS Scheduling System for Fuels Treatment Optimization in National Forests: A Look Under the Hood</i>
Niblett, Matt	11/12–16/2013	North American Meetings of the Regional Science Association International, Atlanta, GA	<i>Choosing Adjacency Constraints for Anti-Cover: A New Perspective</i>
Niblett, Tim	11/12–16/2013	North American Meetings of the Regional Science Association International, Atlanta, GA	<i>The Shortest Covering Path Problem: A New Perspective</i>
Prentice, Samuel	10/21–24/2013	AGU Chapman Conference on Soil-mediated Drivers of Coupled Biogeochemical and Hydrological Processes Across Scales, Tucson, AZ	<i>Quantifying Hillslope Soil Thickness Using Fine-scale Terrain Modeling</i>
Prentice, Samuel	11/3–6/2013	Soil Science Society of America Annual Conference, Tampa, FL	<i>Predictive Soil Mapping in a Rolling Hillslope Terrain</i>
Prentice, Samuel	12/9–13/2013	AGU in San Francisco, CA	<i>Modelling Soil-Landscapes in Coastal California Hills Using Fine Scale Terrestrial Lidar</i>
Tan, Ann	10/21–24/2013	AGU Chapman Conference on Soil-mediated Drivers of Coupled Biogeochemical and Hydrological Processes Across Scales, Tucson, AZ	<i>Soil Resource as a Primary Driver of Ecosystem Services II</i>
Voss, Kate	12/9–13/2013	AGU in San Francisco, CA	<i>Water Resources in Glacierized Mountain Watersheds: Monitoring Hydrological Transitions and Assessing Vulnerability in a Changing Climate</i>
Zilli, Marcia	12/9–13/2013	AGU in San Francisco, CA	<i>Frequency Analysis of Extreme Events Based on Precipitation Station Data over Southeastern Brazil</i>

In addition to the lecture and GIS presentations funded by the Dangermonds, they also provide funds that allow us to select one top graduate student, and one top undergraduate student working in GIS each year. Below is a list of awardees:

The Jack and Laura Dangermond Graduate Fellowship Award Winners:

2013 Yingjie Hu

2014 Song Gao

2015 Bo Romero

The Jack and Laura Dangermond Undergraduate Scholarship Winners:

2013 Terrell Beesley and Qingyun Zhang shared the award

2014 McGrath, Collin

2015 Sophia Macarewich

Appendix III: Instructors and Topics, Thinking Spatially in the Arts and Sciences



FALL 2013

**FRESHMAN SEMINAR
(INT 94PN)**

***Thinking Spatially
in the Arts and Sciences***

**Wednesdays, 2 Oct.–4 Dec., 2013
4:00–4:50 p.m.
HSSB 2201
Enrollment Code 26542**

- **Explore** spatial reasoning for problem solving (sciences), creative expression (arts), and interpretation (humanities)
- **Learn** how statistics, graphs, maps, and virtual reality aid learning, analysis, data visualization, discovery/solutions to socio-environmental problems, and space/place interpretation
- **Arts, humanities, social and natural sciences, and engineering faculty illustrate** spatial tools to integrate knowledge across disciplines

2 Oct. **Mary Hegarty**, Professor, Psychological and Brain Sciences;
Donald Janelle, Researcher, Center for Spatial Studies; and
Daniel Montello, Professor, Geography
Why Think Spatially? Spatial Studies at UCSB

9 Oct. **Mary Hegarty** and **Daniel Montello**
Sense-of-Direction: Are You a Space Wizard or Just Lost in Space?

16 Oct. **Richard Church**, Professor, Geography
The Art Gallery Problem: A Spatial Perspective

23 Oct. **Wendy Meiring**, Associate Professor, Statistics and Applied Probability
Spatial Association and Spatial Prediction

30 Oct. **Volker Welter**, Professor, History of Art & Architecture
Architecture: Learning to Dwell in Space

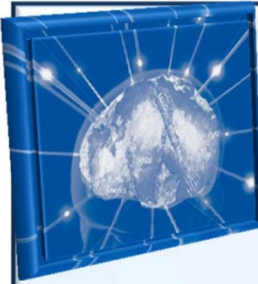
6 Nov. **Kim Yasuda**, Professor, Art Studio
Proximity Art Research

13 Nov. **Jon Jablonski**, Librarian, Map & Imagery Laboratory, Davidson Library
A History of Maps in 45 Minutes

20 Nov. **Donald Janelle**
Convergent Places, Warped Spaces

4 Dec. **Michael Goodchild**, Professor Emeritus, Geography
How I Think Spatially

*Note: Professor Hegarty is the professor of record and
Dr. Janelle is the course coordinator for INT 94PN*



FALL 2014

**FRESHMAN SEMINAR
(INT 94PN)**

***Thinking Spatially
in the Arts and Sciences***

Wednesdays, 8 Oct.–10 Dec., 2014

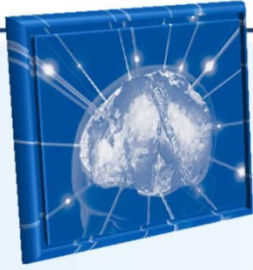
3:00–3:50 p.m.

3512 Phelps Hall

Enrollment Code 27417

- **Explore** spatial reasoning for problem solving (sciences), creative expression (arts), and interpretation (humanities)
 - **Learn** how statistics, graphs, maps, and virtual reality aid learning, analysis, data visualization, discovery/solutions to socio-environmental problems, and space/place interpretation
 - **Arts, humanities, social and natural sciences, and engineering faculty illustrate** spatial tools to integrate knowledge across disciplines
- 8 Oct. **Werner Kuhn**, Professor, Geography and Director, Center for Spatial Studies
Mary Hegarty, Professor, Psychological & Brain Sciences
Andrea Ballatore, Research Coordinator, Center for Spatial Studies
Why Think Spatially? Spatial Studies at UCSB
- 15 Oct. **Jon Jablonski**, Librarian, Map & Imagery Laboratory, Davidson Library
Spatial Information Management
- 22 Oct. **Volker Welter**, Professor, History of Art & Architecture
Architecture: Learning to Dwell in Space
- 29 Oct. **Mary Hegarty** and **Daniel Montello**
Sense-of-Direction: Are You a Space Wizard or Just Lost in Space?
- 5 Nov. **Wendy Meiring**, Associate Professor, Statistics and Applied Probability
Spatial Association and Spatial Prediction
- 12 Nov. **Kim Yasuda**, Professor, Art Studio
Proximity Art Research
- 19 Nov. **Richard Church**, Professor, Geography
The Art Gallery Problem: A Spatial Perspective
- 26 Nov. No class, Thanksgiving
- 3 Dec. **Will McClintock**, Project Scientist, Marine Science Institute
Collaborative Geodesign and Marine Spatial Planning with Seasketch
- 10 Dec. **Werner Kuhn**, **Mary Hegarty**, & **Andrea Ballatore**
Review and Discussion of Opportunities for Spatial Studies at UCSB

*Note: Professor Kuhn is the professor of record and
Dr. Hegarty is the course coordinator for INT 94PN*



FALL 2015

**FRESHMAN SEMINAR
(INT 94PN)**

***Thinking Spatially
in the Arts and Sciences***

Wednesdays

30 September–2 December, 2015

3:00–3:50 p.m.

3512 Phelps Hall

Enrollment Code 27110

- **Explore** spatial reasoning for problem solving (sciences), creative expression (arts), and interpretation (humanities)
- **Learn** how statistics, graphs, maps, and virtual reality aid learning, analysis, data visualization, discovery/solutions to socio-environmental problems, and space/place interpretation
- **Arts, humanities, social and natural sciences, and engineering faculty** illustrate spatial tools to integrate knowledge across disciplines

- 30 Sept. **Werner Kuhn**, Professor, Department of Geography and Director, Center for Spatial Studies
Mary Hegarty, Professor, Department of Psychological & Brain Sciences
Andrea Ballatore, Research Coordinator, Center for Spatial Studies
Why Think Spatially? Spatial Studies at UCSB
- 7 Oct. **Jon Jablonski**, Librarian, Map & Imagery Laboratory, Davidson Library
Spatial Information Management
- 14 Oct. **Volker Welter**, Professor, History of Art & Architecture
Architecture: Learning to Dwell in Space
- 21 Oct. **Mary Hegarty** and **Daniel Montello**, Depts. of Psychological & Brain Sciences and Geography
Sense-of-Direction: Are You a Space Wizard or Just Lost in Space?
- 28 Oct. **Will McClintock**, Project Scientist, Marine Science Institute
Valuing Ocean Space through Participatory Mapping
- 4 Nov. **Susan Cassels**, Professor, Department of Geography
Migration and the Transmission of Infectious Diseases
- 18 Nov. **Richard Church**, Professor, Department of Geography
The Art Gallery Problem: A Spatial Perspective
- 25 Nov. **Kim Yasuda**, Professor, Department of Art Studio
The Price of a Good Time
- 2 Dec. **Krzysztof Janowicz**, Professor, Department of Geography
Places and Signatures

Note: Professor Kuhn is the professor of record for INT 94PN

Appendix IV: Academic Events 2013–2016

IVa. ThinkSpatial Brown-bag Forum

ThinkSpatial 2013–2014 (organized by Donald Janelle)

- Aug. 22, 2013 **Tao Cheng**
Civil, Environmental and Geomatics Engineering, University College London
Spatio-temporal Analytics and Applications
- Oct. 8, 2013 **M. A. Greenstein**
The George Greenstein Institute, Pasadena
Why Growing Spatial Intelligence Matters
- Oct. 15, 2013 **Anabel Ford**
Mesoamerican Research Center, UCSB
Using Cutting-edge LiDAR Technology at El Pilar Belize-Guatemala in Discovering Ancient Maya Sites—There is Still a Need for Archaeologists!
- Oct. 22, 2013 **Federica Burini**
Languages, Foreign Literatures, and Communication, University of Bergamo, Italy
Collaborative Mapping for Environmental and Cultural Planning: MULTIMAP and Bergamo Open Mapping
- Nov. 5, 2013 **William F. Yim**
Santa Barbara County Association of Governments (ret.)
Spatial Considerations in the Design of Beijing's Daxing International Airport
- Dec. 3, 2013 **Sara Fabrikant**
Geography, University of Zürich
Mapping Emotions to Reason with Visual Displays
- Jan. 7, 2014 **Werner Kuhn**
Geography, UCSB
Spatializing Research Hypotheses—A Long-term Vision for spatial@ucsb
- Jan. 21, 2014 **Mary Hegarty**
Psychological & Brain Sciences, UCSB
Broadening the Study of Spatial Intelligence
- Feb. 11, 2014 **Ambuj Singh**
Computer Science, UCSB
Modeling the Dynamics of Social (and other) Networks
- April 8, 2014 **Margaret Tarampi**
Sage Center for the Study of the Mind, UCSB
The Interdisciplinarity of Spatial Thinking in Psychology and the Arts
- April 22, 2014 **Paul Wilson**
General Electric Digital Energy (retired)
Keeping the Lights On: Geospatial Technology and the Electric Grid

ThinkSpatial 2014–2015 (organized by Andrea Ballatore)

- July 15, 2014 **David Lanter**
CDM Smith Inc.
A Social Vulnerability Analysis Framework for Flood Prevention Civil Works Projects
- Oct. 7, 2014 **Linda Hill**
Dept. of Geography, UCSB (retired) et al.
Gazetteers: Tools for Spatial Search, Identification, and Reasoning

- Oct. 21, 2014 **Eric Prieto**
Dept. of French & Italian, UCSB
Place, Poststructuralism, and Informal Urbanism
- Oct. 28, 2014 **Thomas Stahovich**
University of California, Riverside
Does neatness count? Inferring Student Competence from the Temporal and Spatial Organization of Handwritten Solutions to Engineering Problems
- Nov. 4, 2014 **Lisa Parks**
Dept. of Film & Media Studies, UCSB
Drones, Media, and Mobility in the Horn of Africa
- Nov. 25, 2014 **Steve Franconeri**
Dept. of Psychology, Northwestern University
Visual Attention Creates Structure over Space and Time
- Dec. 2, 2014 **Debra Lieberman and Erica Biely**
Center for Digital Games Research, UCSB
Using Spatial Experience in Digital Games to Support Learning and Health Behavior Change
- Jan. 13, 2015 **Andrea Ballatore**
Center for Spatial Studies, UCSB
Defacing the Map: Cartographic Vandalism in Volunteered Geographic Information
- Jan. 27, 2015 **Christopher Pilafian**
Dept. of Theater & Dance, UCSB
Between/Around/Within: How a Choreographer Thinks about, Explores and Experiences Space
- Feb. 3, 2015 **Anne K. Knowles**
Dept. of Geography, Middlebury College
Alberto Giordano
Dept. of Geography, Texas State University
From Space to Place: Exploring Geographies of the Holocaust
- Feb. 17, 2015 **Javiera Barandiaran**
Global & International Studies, UCSB
Scientists, Maps, and Environmental Conflict in the Chilean Patagonia
- March 3, 2015 **Marije van Amelsvoort and Lisanne van Weelden**
Tilburg University, Netherlands
Spatial Visualization
- March 10, 2015 **Stephanie Malia Hom**
Modern Languages, University of Oklahoma
The Drowned and the Defeated: On the Limits of the Camp in Italian Colonial Libya
- April 7, 2015 **Peter S. Alagona**
Dept. of History, UCSB
Species Complex: Classification and Conservation in American Environmental History
- April 21, 2015 **Elisabeth Skou Pedersen**
Dept. of Aesthetics and Communication, Aarhus University, Denmark
The Unanimist Geographies of Jules Romains and Virginia Woolf
- April 28, 2015 **Roland Geyer**
Bren, UCSB
Spatially-explicit Environmental Assessment of Renewable Transportation

- May 19, 2015 **Amr El Abbadi**
Dept. of Computer Science, UCSB
Big Data and the Cloud: The Challenges of Spatial Co-location, Global Fault-tolerance and Geographically Correlated Trends
- May 26, 2015 **David Kerr**
Sansum Clinic
Environmental Diabetes Care
- July 15, 2015 **Miguel Camacho Collados**
Univ. of Granada/Spanish National Police; Corps/UCLA
Federico Liberatore
Rey Juan Carlos University/UCLA
Spatial Partitioning of Police Districts: A Multi-Criteria Model
- July 28, 2015 **Christoph Hölscher**
Cognitive Science, ETH, Zürich
Wayfinding—Where Cognition meets Architectural Design
- ThinkSpatial 2015–2016 (organized by Andrea Ballatore and Antonio Medrano)*
- Oct. 9, 2015 **Andrew Frank**
Professor for Geoinformation, TU Wien, Austria
Differences in Ontologies
- Oct. 20, 2015 **Mark Buntaine**
Bren School of Environmental Science, UCSB
Geospatial Impact Evaluation: Using Land Cover to Measure the Impacts of Development Programs
- Nov. 10, 2015 **W Randolph Franklin**
Rensselaer Polytechnic Institute, NY
Global Properties from Local Topology
- Nov. 17, 2015 **John O'Donovan and Byungkyu (Jay) Kang**
Computer Science, UCSB
Interactive Spatial Representations for Search and Recommendation Algorithms
- Nov. 24, 2015 **Martin Raubal**
Institute of Cartography and Geoinformation, ETH Zürich
Investigating Human Behavior in Urban Environments
- Dec. 1, 2015 **Lucia Jacobs**
Dept. of Psychology, UC Berkeley
The Evolution and Ecology of Olfactory Navigation: Using Odors to Navigate across Space and Time
- Jan. 26, 2016 **Antonio Medrano**
Center for Spatial Studies, UCSB
Attribute Scale on GIS Raster Data: What to Avoid at All Costs!
- Feb. 9, 2016 **Stephanie Tulley**
Interdisciplinary Research Collaboratory, UCSB Library
Expanding Data Services of the UCSB Library
- Feb. 16, 2016 **Normand Bergeron**
Center for Water Earth and Environment Université d'avante-garde
Riverscape Scale Analysis of Fish/Habitat Relationships
- March 1, 2016 **Arthur Getis**
Dept. of Geography (Emeritus), UC San Diego
Spatial Modeling, Regional Science, and UCSB

- April 5, 2016 **Dan Montello**
Dept. of Geography, UCSB
Social Wayfinding
- April 19, 2016 **Ninotchka Bennahum**
Dept. of Theater & Dance, UCSB
Space and Place in Contemporary Performance Art
- May 3, 2016 **Alan Murray**
Dept. of Geography, UCSB
TBA
- May 31, 2016 **Katja Seltmann**
CCBER, UCSB
TBA

IVb. Spatial Technology Lunches

2013–2014 (*Organized by Kitty Currier*)

Open Source Tools and Web Applications

October 29, 2013

Ph.D. Candidate **Grant McKenzie** described an ecology of open-source geospatial tools and demonstrated a range of web applications that use them. As a founding member of the Seattle based start-up Spatial Development International, McKenzie's expertise comes from his work as a geospatial technology consultant as well as his research as part of the Space and Time for Knowledge Organization (STKO) lab.

Marine Geospatial Data Tools

November 13, 2013

Ben Best, Senior Analyst for the Ocean Health Index Project, presented a smorgasbord of tools for discovering, analyzing, and communicating marine geospatial data. Featured tools included OBIS-SEAMAP, the Marine Geospatial Ecology Tools, the SERDP marine animal mapper, and the Ocean Health Index Tools.

Virtual and Physical Models in STEM

January 28, 2014

Graduate student **Trevor Barrett** and project scientist **Andrew Stull** of the Hegarty Spatial Thinking Lab discussed their research on learning with virtual and physical models in the STEM disciplines. Barrett shared examples from his work that investigate the role of computer interface design and individual spatial ability on learning with models in organic chemistry. Stull introduced a basic framework for the taxonomy of models that considered how visual, haptic, and proprioceptive cues interact in the design of effective models for chemistry education.

Decision Support for Environmental Planning

May 1, 2014

Stanford Ph.D. candidate **Amanda Cravens** of the Emmett Interdisciplinary Program in Environment and Resources presented findings from her research on environmental decision making with geospatial decision support tools (DSTs).

2014–2015 (*Organized by Kitty Currier*)

SoundMap

August 18, 2014

Jon Jablonski, Head of the University Library's [Map and Imagery Lab \(MIL\)](#), related his experiences with the SoundMap, a joint project between spatial@ucsb and the MIL during the summer of 2014.

Removing Terrorist Group Leaders

October 23, 2014

Yasutaka "Tomi" Tominaga, a visiting scholar from Osaka University, Japan, presented results from his research on the strategy of targeted killing and capturing of group leaders on terrorist activities.

Google's Geo-Tools for Research and the Classroom

November 13, 2014

Geography Ph.D. student **Ian Irmischer** gave an overview of practical online tools to collect, host, analyze, visualize, and publish map data using the power of the cloud, focusing on Google Earth Engine and Open Data Kit (ODK) Collect.

Integrating Esri's ArcGIS Pro and ArcGIS Online

January 29, 2015

Geography alumni and current Esri Support Analysts **Scott Prindle** and **Thomas Jensen** presented *Storytelling with Maps: A Demonstration of ArcGIS Pro and ArcGIS Online Integration*.

Geotagged Photos and Urban Areas of Interest

April 27, 2015

Geography Ph.D. candidate **Yingjie Hu** presented *Extracting and Understanding Urban Areas of Interest Using Geotagged Photos*, a talk and web demonstration. Hu is a member of the STKO Lab and has held internships at Esri's Applications Prototype Lab. His research focuses on the semantics of geographic information.

Semi-automated Detection and Counting of Gray Whales

May 14, 2015

UCSB alumnus **Kevin Sullivan** (Toyon Research Corporation) presented a talk on processing infrared video streams to automatically detect gray whale blows. Sullivan described some of the techniques and software they developed for this project, which was conducted in partnership with NOAA.

2015–2016 (*Organized by Crystal Bae*)

LiDAR Mapping

February 15, 2016

Paul Alessio, from the Department of Earth Science, discussed how by analyzing terrestrial LiDAR scans, the ongoing 2015–2016 El Niño year was used as a surrogate for future sea-level rise by determining the impact of a 20–30 cm sea-level rise on open beach and coastal cliff ecosystems.

Navigation in Virtual Environments: Measuring Strategy and Efficiency

March 29, 2016

Ph.D. student **Alex Boone** (Dept. of Psychological & Brain Sciences) explored the connection between measures of navigation strategy and navigation efficiency in virtual environments.

TBA

May 2016

Beth Anderson

Appendix IVc. Spatial Lightning Talks

2014 (Organized by Kitty Currier)

Andrea Ballatore: *Computing the Spirit of Place*

Crystal Bae: *Lessons from the Road: Cross-Country by Bicycle*

Heather Burte: *Individual Differences and the Neural Bases of Allocentric-Headings*

Keith C. Clarke: *The Four Washington Meridians*

Kitty Currier: *Shipshaping and Fiafia (or How I Became a Geographer)*

Tommy Dickey: *Teddy, and Linkin, Brave Arctic Gold Rush Dogs*

Jeremy Douglass: *Navigating Narratives as Networks*

Song Gao: *Spatial Questions Collected from GIS HelpDesk*

George Legrady: *Image, Interaction, and Representation: Some Artistic Projects that Address Space*

Margaret R. Tarampi: *A Little Pictorial Space can Change your Perception of Art*

Paul Wilson: *Whale Traffic Control*

William Yim: *Airport Terminal Designs*

2015 (Organized by Kitty Currier)

Skona Brittain: *More than Four Colors*

Todd Bryan: *Wedding Cake Geoprocessing for Web GIS*

Keith C. Clarke: *Why isn't the United States Metric?*

Bernard Comrie: *Go West, Young Man: Consistency and Inconsistency in Cognitive Representations of Cardinal Directions*

Selena Daly: *Mapping the Italian Avant-Garde: Futurism in Space and Time (1909–1944)*

Tommy Dickey and Hot Rod Linkin: *Polar Bears and Great Pyrenees Dogs: A Matter of Scale!*

Jeremy Douglass: *Experimental Game Spaces: Virtual Visions, Architectures, and Dimensions*

David Gordon: *Linking Sound, Image and Place*

David A. Hallowell: *First-Grade Students and Geometric Diagrams: What do they Notice?*

Yingjie Hu: *Metadata Harmonization in Spatial Data Infrastructures*

Steve Miley: *Beyond the Locked Gate*

Amy Shadkamyant-Talamantes: *UCSB Business Continuity*

Kim Yasuda: *Light Works: Isla Vista*

William F. Yim: *Chinese Calligraphy*

2016 (Organized by Crystal Bae)

Alexander Boone: *Navigation and the Human Stress Response*

Susan Cassels: *Syphilis, Circuit Parties, and Circular Migration*

James Caesar: *Emergency Management and the Use of Information and Maps*

Keith Clarke: *How to Prove the Earth is Round*

Tommie Dickie: *The Iditarod: 1000 Mile Alaskan Test of Courageous Dogs and Musher*

Jeremy Douglass: *Page Spaces, Remixed: 500+ Excursions through House of Leaves Pages*

Song Gao: *Earth's Biggest Seasonal Human Migration on a Map*

Adam Grosshans: *Navigating a Volume: The Seattle Public Library*

Jordan Hastings: *What's in a Gazetteer?*

Donald Janelle: *UCSB Spatial Archives @ eScholarship*

Sara Lafia: *Degrees of Separation: Measuring Musicians and Places*

Sijie Loo: *Space Traveling in Paintings*

Kevin Mwenda: *How High can Mosquitoes Get?*

Celeste Pilegard: *Training Spatial Skills with Video Games*

Paul Wilson: *The Geography in Cancer*

William F. Yim: *Coast Redwoods in California*

Appendix IVd. Co-sponsored Lectures

Golledge Distinguished Lecture Series

Patrick Suppes (The Lucie Stern Professor of Philosophy Emeritus, Stanford University)

May 15, 2014

Mental Resurrection and How to Live Forever: Speculations on Future Interactions between Technology and Our Minds

<http://spatial.ucsb.edu/2014-reginald-golledge-distinguished-lecture/>

Stephen C. Hirtle (School of Information Sciences, University of Pittsburgh)

May 7, 2015

The Cognition of Space

<http://spatial.ucsb.edu/2015/hirtle-cognition-of-space>

Stephen C. Levinson (Max Planck Institute for Psycholinguistics)

TBA 2016

Dangermond Distinguished Lecture Series

Yvan Bédard (Professor, Geomatics Sciences Dept., University of Laval)

Feb. 6, 2014

Beyond GIS: Spatial Online Analytical Processing and Big Data

Jacqueline McGlade (UNEP Chief Scientist, Director of the Division of Early Warning and Assessment)

April 9, 2015

Healthy Planet, Healthy People—The Future We Can Have

<http://spatial.ucsb.edu/2015/dangermond-lecture-mcglade>

Dirk Brockmann, Institute for Theoretical Biology, Humboldt University of Berlin

May 26, 2016

TBA

In collaboration with the Departments of French & Italian, History, Religion (Jewish Studies), Germanic & Slavic Studies, and the Interdisciplinary Humanities Center (IHC):

Anne K. Knowles (Middlebury College)

Alberto Giordano, Texas State University

Geographies of the Holocaust

February 2015

<http://spatial.ucsb.edu/2015/geographies-of-the-holocaust>

In collaboration with the Media Arts & Technology Program:

Jon Hagstrum (U.S. Geological Survey)

Unraveling the Mystery of Avian Navigation Using Propagation Modeling of Atmospheric Infrasound

May 2015

<http://spatial.ucsb.edu/2015/hagstrum-bird-navigation>

In collaboration with the IHC:

Alva Noë (Dept. of Philosophy, University of California, Berkeley)

Can Neuroscience Help Us Understand Art?

May 5, 2016

Appendix V: Visitors (2013–2016)

The Center for Spatial Studies provides work space for visiting scholars and collaborators, offering opportunities for them to take part in the Center's activities and engage in joint research efforts.

Visitors in 2013–2014:

Alinda Friedman

University of Alberta, Edmonton, Canada
Feb. 2013

Cecilia Xia

Curtin University, Australia
Feb.–June 2013

Jeff Howarth

Middlebury College, Vermont
April–June 2013

Visitors in 2014–2015:

Markus Knauff

Justus-Liebig-Universität Giessen, Germany
Aug.–Sept. 2013

Federica Burini

University of Bergamo, Italy
Oct. 2013

Sara Irina Fabrikant

University of Zurich, Switzerland
Nov. 2013–Feb. 2014

Yasutaka Tominaga

Osaka University, Japan
May–Nov. 2014

Marc Tim Thiemann

University of Bremen, Germany
Sept. 2014–March 2015

Michel Zimmer

University of Bremen, Germany
Sept. 2014–March 2015

Alexander Zipf

Dept. of Geography, Heidelberg University,
Germany
Sept. 2014–Feb. 2015

Julia Metelka

Wilfrid Laurier University in Waterloo, Ontario
Oct.–Dec. 2014

Christian Freksa

University of Bremen, Germany
Dec. 2014

Alex Borgida

Rutgers University, New Brunswick, NJ
Feb. 2015

Marije van Amelsvoort

Tilburg University, Netherlands
March 2015

Lisanne van Weelden

Tilburg University, Netherlands
March 2015

Christian Czotscher

University of Bremen
April–Aug. 2015

Thorben Schiller

University of Bremen
April–Aug. 2015

Visitors in 2015–2016:

Christoph Hölscher

ETH Zürich
July–Sept. 2015

W. Randolph Franklin

Rensselaer Polytechnic Institute

Nov. 8–21, 2015

Martin Raubal

ETH Zürich
Nov. 14–Dec. 5, 2015