

Spatial Perspectives on Analysis for Curriculum Enhancement (*SPACE*)

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Project Summary

SPACE is a proposed three-year program to achieve systemic change within undergraduate education in the social sciences, with extension to the environmental sciences. Our approach is based on the value of spatial thinking, and associated technologies (geographic information systems, tools for spatial analysis), as the basis for greater integration among the social science disciplines, greater motivation for students, greater relevance to societal problems, greater integration of technology into undergraduate instruction, and greater employment prospects for graduates.

The program will be centered on a series of professional development workshops, with extensive follow-on activities; and will feature additional programs designed to leverage these workshops, to achieve high rates of participation among traditionally under-represented groups, and to bridge the gap between research and teaching in the social sciences. It will be organized by a consortium led by the University of California, Santa Barbara, and will include The Ohio State University (PI, Mei-Po Kwan), and the University Consortium for Geographic Information Science (PI, Arthur Getis), a consortium of over 60 institutions with strong commitments to the principles on which *SPACE* is based.

The program will build on the successful experience of the Center for Spatially Integrated Social Science (CSISS), a project funded by NSF since 1999 under its program of support for research infrastructure in the social sciences. CSISS organizes workshops for graduate students and young faculty, to introduce them to GIS and spatial analysis as research tools. We believe the time is ripe for a major new initiative that will teach the teachers, and move the focus from research to undergraduate learning.

The proposed Spatial Perspectives on Analysis for Curriculum Enhancement (*SPACE*) will focus primarily on National Education Workshops to provide undergraduate instructors with basic skills in GIS and spatial analysis, and introduce them to the latest techniques, software, and learning resources. *SPACE* will also organize sessions at major conferences to provide instructors with basic introductions to using spatial technologies in the classroom, to maintain engagement with participants in the national workshops, and to reach wider audiences than the workshops. A program of dissemination will ensure that learning materials and innovative approaches to undergraduate learning become widely available. Finally, the project will develop an extensive set of Web resources to facilitate the sharing of materials and assessment instruments among undergraduate instructors.

PROGRAM SCOPE

SPACE will advance the use of powerful new tools for spatial thinking within undergraduate education for the social sciences. The primary goal of *SPACE* is to strengthen academic programs and student capabilities to integrate information scientifically and spatially across a broad range of disciplinary and policy domains, including extensions to the environmental sciences. The tools for building a strong emphasis on spatial thinking in social science curricula include geographic information systems (GIS), spatial pattern recognition, spatially sensitive statistical analysis, cartographic visualization, and place-based search methodologies. These tools have documented relevance for programs of research and teaching at the disciplinary level in Anthropology, Economics, Geography, Political Science, Social Science History, Sociology, Statistics, and at the interdisciplinary level in such areas as urban studies, demography, criminology, public health, environmental assessment, and public policy analysis. It is argued that undergraduate courses and programs at all levels will benefit from increased systematic exposure to spatial thinking and analysis, enhancing student scientific capabilities for entering exciting graduate programs and expanding job markets.

The proposed program includes national level workshops taught by outstanding instructors and scholars from leading universities and the establishment of substantial web-based teaching and learning resources. The program elements of *SPACE* will be designed to prepare teachers for the integration of spatial technologies into the curricula, to achieve faculty development objectives that focus on constructive instructional relationships that bring intellectual challenges to students and that prepare them for rewarding careers and constructive contributions to society. These objectives will be enhanced by encouraging diversity among instructors and participants, and by making significant effort for representation across gender, ethnicity, race, and nationality.

THE *SPACE* CONSORTIUM

The *SPACE* program will be managed through a consortium consisting of the University of California, Santa Barbara; The Ohio State University; and the University Consortium for Geographic Information Science.

Over the past 15 years the **University of California, Santa Barbara** has emerged as a leader in the subject area of the project, receiving a series of major awards from the National Science Foundation (NSF): the National Center for Geographic Information and Analysis (1988-), an early force in GIS research and education efforts; the Alexandria Digital Library (1994-), a major online archive of digital maps and images in support of learning; and the Center for Spatially Integrated Social Science (1999-), a project aimed at fostering the spatial perspective as an integrating research mechanism across the social sciences. Mounting a program for the national dissemination of undergraduate instructor development is a natural extension of CSISS's successful efforts at national outreach and service to the social science research community, providing a base of infrastructure and experience that will benefit the *SPACE* program. UCSB, the lead institution of the consortium, will provide administrative support from the Institute for Social, Behavioral, and Economic Research (ISBER), facilities from the NCGIA and Geography

Department, and experience in national outreach to enhance spatial social science through CSISS.

The Ohio State University (OSU) has a very strong program in spatial analysis and GIS, centered in its Department of Geography and its Center for Mapping. OSU brings a strong commitment to the principles of *SPACE*, and experience in organizing successful workshops in collaboration with CSISS. Under the leadership of Professor Mei-Po Kwan, and with participation of other outstanding spatial scientists, OSU has organized a very popular workshop on Accessibility in Space and Time. In the past three years, this one-week workshop has attracted participants from across the nation and internationally, and from more than a dozen different disciplines – mostly PhD candidates, post-doctoral scholars, and untenured professors. The workshop features applications of GIS, exposure to concepts of space-time mapping and visualization, and applications of spatial optimization and spatial interaction modeling, all suitable candidates for building academically challenging undergraduate courses and programs of value for the broader social sciences.

The University Consortium for Geographic Information Science (UCGIS) was founded in 1996 as a consortium of institutions heavily engaged in research and education in spatial analysis and GIS. It currently includes over 60 academic institutions. Each institution must demonstrate that campus interest spans a number of disciplines, instructional programs, and faculty. It has member academic institutions (large and small) throughout the United States that offer graduate and undergraduate programs in geographic information science and related disciplines. UCGIS provides the *SPACE* consortium with access to a large number of competent instructors and training facilities; and with a basis for publicizing the workshops and other programs. Its extensive links to professional associations and to corporate and government affiliates is another attribute that facilitates the design of workshops to attract participants from a broad range of disciplines. Professor Arthur Getis, the current President of UCGIS, and coordinator of a very successful one-week workshop on “Spatial Pattern Analysis” in the CSISS program, will be the primary liaison between *SPACE* and UCGIS. The incumbent President of UCGIS (changes annually) will assume the role of Project Director for UCGIS.

SPATIAL THINKING

The *SPACE* consortium’s proposed emphasis on space stems from several basic principles (see Goodchild *et al.*, 2000):

- ***Integration.*** Location can provide an essential linkage between disparate forms of information, and between the distinct processes studied by different disciplines. For example, maps of environmental quality and human health can be overlaid to examine correlations.
- ***Context.*** Information about the areas surrounding observations can be of great value in understanding the processes that occur on the Earth's surface. For example, instances of crime may be better understood when mapped and examined in relation to the surrounding neighborhoods in which they occur.

- ***Spatially explicit modeling.*** Many areas of theory in the social sciences explicitly recognize the importance of space. For example, physical distance is an important factor in determining human interaction.
- ***Science and policy.*** Scientific knowledge is most usefully applied when it is combined with specific knowledge of local conditions. GIS combines local knowledge, in the form of the digital maps stored in its database, with general principles in the form of algorithms, models, and methods of analysis, and as such has found abundant application in local planning, where the principles of social science can be applied to the resolution of local issues. GIS has become a major source of employment for graduates, and a major tool in improving the engagement of citizens with local community issues.
- ***Place-based organization of information.*** Location has proven to be a valuable basis for organizing information, and particularly as a basis for searching the vast but disorganized information resources of the WWW. A range of new and powerful technologies has emerged in the past few years to facilitate search for spatial data, using location as the primary key.

The principles noted above are increasingly apparent in graduate-level education in a number of disciplines, but they have not yet been incorporated widely within undergraduate programs -- aside from their traditional home in geography and in selected interdisciplinary programs (e.g., urban planning/studies, environmental science/studies). The possibility to broaden the range of disciplines that feature undergraduate courses in spatial analysis is promising. This is evident from the expanded use of GIS, spatial statistics, and cartographic visualization by leading researchers in a number of fields.

Anthropology features pioneering uses of GIS and remote sensing to study household behavior in relationship to land cover changes in the Amazon rainforest (see Moran, Brondizio, and McCracken 2002). In archaeology, there is a rapidly growing research literature that makes use of analytic mapping and GIS (e.g., Aldenderfer and Maschner, 1996; Lock, 2000). Demography, while drawing significantly on geographically referenced data, has only recently moved towards a spatial analytic framework in studies of fertility, urbanization, density analysis, mortality, migration, family planning, and related topics (see Entwisle, et al. 1997; Weeks, et al., 2000). In economics, the rediscovery of space has added a robust theoretical context to the 'new' economic geography (Fujita, Krugman, and Venables, 1999). Environmental economics, land market studies, and other research areas have benefited significantly from developments in spatial econometrics, with many examples documented in a forthcoming edited book on *Advances in Spatial Econometric Modeling: Methodology, Tools, and Applications* (Anselin, Florax, and Rey, 2002).

Spatial methods and place-based thinking have also invigorated work in political science, as seen in the research of Huckfeldt and Sprague (1995) on the role of communication in election processes, or in the research that underlines *Place Matters*, by Dreier, Mollenkopf, and Swanstrom, (2001). In history, GIS technologies are enabling new interpretations on such past events as the American Dust Bowl, the Salem witch trials, and Civil War battles, as evidenced in a recent edited book by Anne Knowles (2002) --

Past Time, Past Place: GIS for History. In sociology there is a long history of spatial thinking and analysis, but the urban social ecology of Park and Burgess has been replaced with more critical and analytically sophisticated approaches, such as those featured in work on the political economy of place (Logan and Molotch, 1997) and in the rigorous analyses of neighborhood effects on social processes in Chicago (Sampson, Morenoff, and Earls, 1997).

In criminology, there is a rapid infusion of spatial technologies based around concepts of pattern detection. Cohen and Tita (1999) illustrate the integration of spatial theory (diffusion modeling applied to homicide patterns in Pittsburgh) with local measures of spatial association. Research in public health shows similar infusion of spatial theory and methods, drawing support from statisticians Besag and Newell (1991) and geographer Openshaw (1990) in the detection of disease clusters, supplemented more recently with a growing role for GIS technologies, as illustrated in *GIS and Health*, edited by Gatrell and Löytönen (1998).

The above examples scratch the surface to the broadening base of applications of spatial analysis in social science disciplines over the past decade. Spatial analysis is an ideal candidate for wide inclusion in undergraduate programs. Spatial thinking offers logic for interpreting the world, a well established set of models, and a rich set of tools for visualizing, analyzing, and integrating diverse sources of information. The increasing availability of geo-referenced data, advances in theory, and the expanded availability of specialized software have established a momentum of change in research at the graduate and post-doctorate levels that can be extended beneficially to undergraduate education in many of the disciplines and problem areas cited in the previous paragraphs.

It is now time to extend spatial methodologies broadly as one of the underpinnings of information analysis for undergraduate programs and courses in the social, behavioral, and environmental sciences. We propose to do this by providing opportunities and resources for undergraduate instructors through the following three interrelated programs:

- **National Education Workshops**
- **Academic Conference Courses to Enhance Spatial Science (ACCESS)**
- **On-Line Clearing House for Lab Exercises, Data Sets, Test Items, and Assessment Instruments**

Workshops will equip existing undergraduate instructors with the skills and understanding to introduce new spatial approaches to programs and courses, thereby exposing students to new academic challenges and to exciting opportunities for further studies and for employment in a significant number of fields. *SPACE*-sponsored conference presentations and short workshops will broaden further the dissemination of these approaches, illustrating the potential value added to existing instructional offerings, and giving insight on their relationships to prevailing theory and analytic frameworks. Finally, the on-line clearinghouse will enhance accessibility to quality teaching and learning resources – both those produced by *SPACE* and those identified from other sources – and ease the process of program and course implementation for instructors. The *SPACE* programs to achieve these ends are described in detail.

PROGRAM DESCRIPTIONS

I. NATIONAL EDUCATION WORKSHOPS

Three two-week workshops and five one-week workshops will be offered over a three-year period, serving an estimated 195 instructors. These will be supplemented with six short (2-3 day) workshops offered through UCGIS, serving an additional 90 to 150 participants. They will feature the range of specialized training associated with the spatial analytic themes and will offer professional development support for instructors in developing curricular and course modules. In addition, *SPACE* will organize five conference sessions or short workshops at the academic meetings of different disciplines and in different locations each year. It is estimated that these events (half-day didactic and full-day hands-on workshops) should reach an additional 75 to 150 instructors in year 2 and 50 to 100 instructors in year 3. In total, we expect to touch bases with 400 to 600 instructors over the three-year *SPACE* program.

The UCSB-hosted workshops will be two weeks in duration; however we prefer some flexibility to consider both longer and shorter periods of instruction. Workshops at OSU will follow a one-week format, while UCGIS-hosted workshops will include both week-long university hosted workshops and offerings of shorter duration held in conjunction with its annual Summer Assemblies that meet at a different university each year. These shorter workshops are expected to yield synergistic benefits to participants, who will be able to take part in the wider conference venue. The variation in format is seen as a positive attribute of the program, allowing accommodation to the variable work schedules, obligations, and learning styles of participants. The *SPACE* Executive Committee will review the results of the different formats following year one in order to make informed adjustments to offerings in subsequent years.

The longer workshops will be limited to between 20 and 30 participants, drawn from a range of disciplines and from colleges and universities across the United States. The limitation on workshop size is constrained by the desire for significant personal attention to the needs of participants and is subject to the principle of having a fully equipped computer for each person.

To help attract a large number of workshop applicants, the budget model includes a modest subsistence allowance. This may be of special significance for those attending two-week long workshops.

Each workshop will feature some combination of the listed themes, subject to a basic commonality in the principles taught across the different workshops, but allowing some flexibility for instructional teams to vary the emphasis to match the interests of participants. The different approaches will be evaluated and ideas shared among the workshop leaders in different locations, allowing annual adjustments through the progression of annual offerings.

Themes for *SPACE* National Workshops

- Geographic Information Systems (GIS)
- Spatial Pattern Analysis
- Spatial Econometrics
- Map Making and Cartographic Visualization
- Spatial Interaction
- Agent-Based Modeling
- Place-Based Search
- Applications

Each of the themes reflects significant areas of research and use that add value to non-spatial perspectives on understanding scientific and societal problems. The methodologies that they embrace will enrich undergraduate courses and programs in a broad range of disciplines. Brief examples of their use and value are suggested in the following section.

WORKSHOP THEMES

GIS: Geographic information systems are powerful tools for the analysis of geographic data, that is, data referenced to locations on the surface of the Earth. They are widely applied in the management of land and natural resources, in local community planning and government, emergency response and criminal investigation, and scientific research. Virtually all disciplines that address the surface of the Earth now make extensive use of GIS.

Spatial Pattern Analysis: Many of the problems faced by society and in scientific study require consideration of complex patterns of interrelated social, behavioral, economic, and environmental phenomena. The ability to decipher the significance of variable relationships in geo-referenced data is important to resolving societal issues of, for example, crime incidence in urban environments or the diffusion of fertility decline in third world settings. Spatial statistical methods and measures for resolving questions of significance have relevance in many fields.

Spatial Econometrics: Statistics on unemployment, wealth, housing quality, etc., provide a rich source of data for several of the social sciences. But explanations are often hard to unravel because of the complex patterns of interaction that occur in space, and the

somewhat arbitrary nature of the reporting zones used by agencies such as the Census. Spatial econometrics provides a collection of tools, models, and theories that explicitly incorporate space, and thus attempt to deal with these issues.

Map Making and Cartographic Visualization: Maps and the application of cartographic visualization principles (Tufte, 2001) constitute important means of exploratory analysis and communication. Principles of scientific visualization, graphic design and cartographic symbolization, thematic mapping of statistical data over space and time, as well as geographic visualization for spatial data exploration and knowledge construction are of potential value to all of the social sciences. In an era when maps and spatial data are more readily available than ever before, knowledge in representing information spatially offers significant value to an undergraduate education.

Spatial Interaction: Accessibility is a fundamental concept that underlies pivotal social concerns over employment and healthcare opportunities and equitable provision of public services. The range of spatial approaches to analyzing and resolving issues in these areas includes network analysis, time-geographic modeling and visualization, spatial optimization techniques, and spatial interaction modeling. These have applicability across many disciplines and offer scope for introduction into undergraduate programs and courses that have not traditionally dealt spatially with the concepts of accessibility and interaction.

Agent-Based Modeling: In recent years there has been much interest in studying complex social and environmental systems through the use of a new class of models that attempt to replicate the behavior of individuals and groups. These models are grounded in scientific understanding of behavior, and are often explicitly spatial. For example, models have been constructed of processes of land use change, particularly on the urban fringe, and the consequent fragmentation of natural habitat.

Place-Based Search: Reference was made earlier to new technologies that support searches based on geographic location. A geolibrary is defined as a digital library, or WWW site, that is capable of being searched for information based on geographic location. Such tools are of increasing importance as mechanisms for providing the data used in spatial analysis and GIS. Standards for metadata, or the digital catalog information that provides the basis for search, have been developed in the GIS community (the Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata), and in the social science data community (the Data Documentation Initiative).

Applications of GIS and Spatial Analysis: As noted earlier, GIS and the various approaches to spatial analysis now play important roles in demography and population studies, criminology, urban and regional land use investigations, studies of political processes, epidemiology and public health research, and in attempts to draw process associations between human and physical environments. While these domains of scientific study may apply common methodologies for analysis, their historical roots and theoretical foundations differ, as do sources of information and scales of analysis. Their

practitioners and scholars will also differ in the traditions of undergraduate training, drawing students from different academic pools, emphasizing different core requirements for program degrees, and having varied expectations on the likely employment futures for program graduates. For these reasons, a few of the *SPACE* workshops may focus on specific domains of application.

THE *SPACE* WORKSHOP VISION

SPACE workshops will impart technical understanding of analytic approaches to scientific spatial thinking in areas of significant interest to society and of value for undergraduate curricula. Opportunity for dialog between workshop instructors and participants will be provided – both informally through social events and formally through scheduled one-on-one discussions. These discussions will explore whatever issues interest participants, but we hope they yield explicit ideas on how the workshop experience can be translated to serve their teaching and course-development plans. The translation of the workshop experience into new opportunities for student learning at the home institutions of participants is the primary basis upon which the *SPACE* program should be judged.

Our goal is to encourage a sense of excitement that workshop participants will share with their undergraduate students. Applications of spatial analysis will form a basis for motivating student interest in scientific and in societal concerns, and for enhancing student skills in spatial thinking. We will encourage applications of spatial information technologies into undergraduate courses as an important means of sharpening spatial insight into intellectual developments at the core of traditional disciplines and interdisciplinary programs. We will provide resources for workshop participants to engage their students in exploratory research, beginning with principles of scientific problem formulation, data acquisition and measurement, analysis and interpretation, and implementation. We will challenge participants to expose their students to the ways in which spatial methodologies can be used for solving problems of relevance to science, business, and responsible citizenship.

WORKSHOPS AND COURSE CURRICULA ENHANCEMENT

Consistent with the concept of in-service professional development, workshop participants will have opportunities for follow-up initiatives after participating in a workshop. These opportunities will take the form of

- incentives for the integration of **student research** within their courses;
- incentives for **sharing course materials** and exercises with other instructors taking part in the workshops and with other undergraduate teachers across the country;
- access to substantial **on-line resources for teaching and learning** through the CSISS *SPACE* website (see www.csiss.org); and
- participation in a **virtual community** for continuing long-term dialogue on matters of importance to teaching spatial analysis at the undergraduate level.

Incentive Awards for Course Syllabus, Exercises, and Undergraduate Student Papers will provide yet more encouragement for workshop participants to use and adapt what they have learned in their own courses and programs. Awardees (up to four per year) will be invited to post their exercise and syllabi creations to the website, and to recognize their students' research on the *SPACE* web site. These individuals will be offered opportunities to participate in academic or applied conference on the development and uses of spatial technologies. Consistent with standards of good science, the adjudication panel will seek a balanced distribution of awards across disciplines and across topical research domains. The adjudication panel of three individuals will be appointed from the project's PI, Co-PIs, Executive Committee members, and workshop instructors.

OUTREACH TO MINORITY POPULATIONS

SPACE will encourage participation by women and by minority populations. It will identify institutions that are prominent in their service to minority populations – especially Native Americans, African Americans, and Hispanics, and it will attempt to disseminate information about *SPACE* programs to instructors that belong to these populations. To help make the workshops especially attractive to these groups, the budget model includes participant stipends intended solely for instructors from designated minority institutions and for minority individuals from other institutions that qualify as resource poor.

SPACE will seek to identify key contacts and conference venues for spreading the word about *SPACE* programs; to help target themes that will be of special significance to minority communities; and to alert workshop instructors of cultural factors that must be understood for effective communication. One of the first considerations will be the development of an outreach strategy, for application in year one of the workshop program. An evaluation of the results for the first year and for successive years of workshops will permit refinement in the strategies for progressively greater success from year one to year three.

CONSORTIUM WORKSHOP EXPERIENCE

All three institutions, UCSB, OSU, and UCGIS, have experience with organizing and hosting instructional workshops in GIS and spatial analysis.

In the past four years (ending with the upcoming summer 2003 program), 365 young researchers will have benefited from the research-oriented CSISS workshop program, organized through UCSB. These workshops are weeklong events with a combined lecture and laboratory format. The participants have been mostly PhD candidates, post-doctoral scholars, and untenured assistant professors; they have come from more than two-dozen disciplines or interdisciplinary programs, they have represented nearly 200 institutions of higher learning, and about 45 percent of the participants have been women.

Interest in CSISS workshops has been far beyond resources to handle the demand. In workshops for the current year (summer 2003), 329 applications were received to fill 93 positions. The workshops have been hosted locally at UCSB and contracted out to other

institutions -- UCLA and the University of Washington in 2000, and OSU in 2001-2003, and to Pennsylvania State University in 2003. Attempts to augment support for such training have included short one- and two-day workshops at selected institutions and conferences, and through web resources. Over the past three years offerings and instructional approaches have been refined based on analyses of workshop entry and exit surveys and by follow-up surveys several months following the workshops. While the assessments have been overwhelmingly positive, the workshops have benefited significantly from these assessments. Similar practices will be tailored to the new *SPACE* workshop program with a special emphasis on criteria for exemplary professional development.

As noted earlier, OSU's Geography department mounted a very successful workshop on *Accessibility in Space and Time: A GIS Approach* in the summers of 2001 and 2002, and will be repeating this in July 2003. Participants (60 for first the two years) reflect the full diversity of social science disciplines and interdisciplinary interests. Exit survey results from 2001 and 2002 were unanimously positive in the assessment of the learning experience. OSU has a long history of involvement with NSF institutes (from the 1970s) on quantitative approaches in the discipline of geography. The Geography department is also host to the Ohio Geographic Alliance, serving needs of the K-12 instructors in the state, providing likely synergies for work with undergraduate instructors in the *SPACE* workshops.

UCGIS has a strong dedication to integrating new technologies into GIScience education and to diffusing these technologies broadly in different areas of application and academia. It is committed to developing and disseminating a model curriculum in GIScience. UCGIS has organized and hosted a number of successful workshops, some in conjunction with its annual Summer Assemblies. Its membership features universities that are recognized for leadership in spatial analytic technologies, and collectively they host a range of outstanding instructors and facilities for workshop organization and implementation. The concept of UCGIS involvement in the *SPACE* Consortium is that it enhances opportunities to involve a number of universities and organizations from different parts of the country in the development of workshops.

II. ACADEMIC CONFERENCE COURSES TO ENHANCE SPATIAL SCIENCE (ACCESS)

SPACE will sponsor special sessions, short courses, and workshops on curricula development at annual conferences of academic associations – three conferences in year 2 and two conferences in year 3, spread out across disciplines. In addition, UCGIS will sponsor special short workshops (2 to 3 days long), one in year 1, two in year 2, and three in year 3. When appropriate, these sessions and short workshops will feature instructors and participants from prior *SPACE* workshop and symposia programs, and involve educators from the host disciplines of the conference. Some of these will feature demonstrations of how spatial analysis brings added value to instructional programs; others (especially those offered through UCGIS) will feature hands-on instruction in specific spatial methodologies (e.g., spatial visualization of geo-referenced data), or will

address issues regarding student needs, expectations, and assessment of learning. These conference-related events will permit broad exposure to the availability of *SPACE* programs – an opportunity to advertise workshops, and to alert instructors to hardcopy and online resources that might assist their classroom offerings and professional development. In addition, the conference setting exposes *SPACE* personnel to the interests, culture, and needs of scholars from diverse disciplinary backgrounds, enabling more informed and responsive programs for the annual workshop program.

CSISS uses conference programs to help advance its objectives of spatially integrated social science research. Some organizations have specifically requested to host conference workshops and special sessions – examples from 2000-2002 include the American Society of Criminology and the American Sociological Association; others have responded very favorably to our sponsorship of events at their meetings -- the Social Science History Association, American Anthropological Association, Association of American Geographers. Some, such as the American Sociological Association and the Social Science History Association, have followed these events with derived programs of special workshops and sessions in subsequent years. In addition, CSISS has sponsored or participated in special programs involving communication scientists, demographers, economists, urban planners, political scientists, and spatial analytic software developers. *SPACE* can draw on these experiences to make very effective use of conference programs to advance the national dissemination of undergraduate instruction in spatial analysis across disciplines.

III. ON-LINE CLEARING HOUSE FOR INSTRUCTORS IN SPATIAL SOCIAL SCIENCE

Course resources in spatial analysis abound among instructors across the country, but for a narrow range of disciplines, and very little effort has been made to convert such resources for broader distribution. There is need for an organizational framework for cataloging and accessing the piecemeal efforts of instructors across the country. This would involve assembling collections of data, exercises, and test items that can benefit new instructors and students. *SPACE* will seek to meet this need in the following ways:

First, each of the partner organizations involved in this proposal (UCSB, OSU, and UCGIS) will assemble existing instructional resources for use in the workshops that it hosts, modifying them if needed to meet the needs of professional development for social science instructors. These resources will feature relevance to a broad base of disciplines. In addition to making these resources available to all workshop participants, they will be available (as appropriate) on CD-Rom and, on-line, through the program's website.

Second, *SPACE* will solicit resources directly from accomplished instructors and host these on its website – e.g., a special collection of course syllabi in spatial analysis taught in different disciplines and at different levels. These will be posted with agreement from their authors and organized by discipline.

The third approach will be to the implementation of a 'smart' web search engine to locate and organize resources of value for undergraduate instruction. The Center for Spatially

Integrated Social Science has developed exceptional experience in customizing web search engines. These feature automated web searches for research applications of spatial analysis in the social sciences (about 37,000 pages), for geo-referenced data from on-line archives (now at the prototype stage), and for spatial analytic tools software. These are consistent with resources that would be helpful to undergraduate instructors and students; however, the *SPACE* initiative will make searches for teaching resources (e.g., lab exercises, test data sets, examination questions) a priority. An automated search engine would update the databases weekly, provide an interface for users to enter text search strings and create customized directories suited for different disciplines and teaching areas. This work will be based on the Webinator platform and the Taxis scripting language.

PROGRAM MANAGEMENT

The **Executive Committee** for the project will include the Program Director and Co-PIs (Richard Appelbaum and Michael Goodchild), Workshop Coordinators from UCSB (to be appointed), program PIs for Ohio State University (Mei-Po Kwan), and UCGIS (Arthur Getis from San Diego State University), the incumbent president of UCGIS, and Fiona Goodchild. They will meet monthly via telephone conference calls to review program implementation plans and policies. At least once per year, this group will meet face-to-face for a period of two days to review and formulate general planning for the workshop programs. Consultants will be invited (as needed) to advise and assist with such issues as outreach to different disciplines and academic communities (e.g., the needs of small colleges, designated minority colleges, community colleges, etc.). These meetings will be hosted at UCSB.

PRINCIPAL INVESTIGATORS

The *SPACE* consortium brings together academic leaders in spatial analysis and social science with experience in managing large-scale projects, dedication to the importance of teaching, and established research careers.

Donald Janelle (Principal Investigator) is a Research Professor at the University of California Santa Barbara, and is Program Director of the Center for Spatially Integrated Social Science (www.csiss.org). CSISS is funded by the National Science Foundation to develop research infrastructure, with a primary focus to assist in the dissemination of spatial thinking and spatial technologies for research across the social sciences. He served previously as Chair of the Department of Geography and as Assistant Vice Provost at the University of Western Ontario. He is a former editor of *The Canadian Geographer*. His research focuses on temporal patterns of spatial behavior in cities, the social implications of transportation, telecommunication and information technologies, and the development of urban-regional spatial systems. He co-edited with David Hodge *Information, Place, and Cyberspace. Issues in Accessibility* (Springer-Verlag, 2000) and is a recipient of the Edward L. Ullman Award for Career Contributions to Transportation Geography from the Association of American Geographers.

Richard Appelbaum (Co-PI) is the director of the Institute for Social, Behavioral, and Economic Research (ISBER). ISBER is UCSB's second-largest Organized Research Unit; it serves primarily the social sciences, although slightly more than a third of its approximately one hundred researchers come from the humanities and other divisions of the university (including the sciences, engineering, education, and environmental management). Dr. Appelbaum's research examines global commodity chains, focusing in particular on the locational determinants of labor-intensive low-wage production, and its impacts on industrial upgrading as well as economic inequality. One key aspect of this work is the spatial distribution of production sites, the formation of industrial districts. He is especially concerned with the global regulation and enforcement of labor standards, particularly with regard to apparel production. His co-authored book *Behind the Label: Inequality in the Los Angeles Apparel Industry* (with Edna Bonacich, University of California Press, 2000), selected by the *Los Angeles Times* as one of the best non-fiction books of 2000, examines the structural sources of inequality in garment production; spatial configurations play a prominent role in this analysis. The spatial contiguity of numerous actors in the fashion industry acquires special symbolic significance in Los Angeles, where image is all-important; nonetheless, the industry is beginning to move to Mexico and China, driven by stricter enforcement standards in Los Angeles and the ease of movement under NAFTA. Understanding such re-patialization of production represents a significant challenge.

Michael F. Goodchild (Co-PI) is Professor and past Chair of Geography at the University of California, Santa Barbara, and Chair of the Executive Committee of the National Center for Geographic Information and Analysis. He serves as Associate Director of the Alexandria Digital Library Project, and Director of the Center for Spatially Integrated Social Science. He is former Chair of the Department of Geography at the University of Western Ontario, former Editor of *Geographical Analysis*, Editor for Methods, Models, and Geographical Information Sciences for the *Annals of the Association of American Geographers*. His research addresses the accuracy of spatial databases, modeling within GIS, the development and application of location-allocation models, and the theory and methodology of spatial analysis. Under the auspices of NCGIA, he oversaw efforts to improve education in the general area of GIS, beginning with the NCGIA Core Curriculum project in 1989, and continuing with the NSF-funded Core Curriculum for Technical Programs and a recent NCGIA project to develop a core curriculum in geographic information science (see www.ncgia.org). The integration and transfer of knowledge have been strong themes in his work with NCGIA, the Varenus project, and now the Center for Spatially Integrated Social Science (see www.csiss.org). Through the Alexandria Digital Library project, Dr. Goodchild has assisted in making the services of a map and imagery library available to users of all kinds via the WWW. ADL is now embarked on the Alexandria Digital Earth Prototype, which will bring these services into the classroom. Dr. Goodchild is a past member and chair of the NRC's Mapping Science Committee, and currently a member of its Committee on Geography. He was elected to membership of the National Academy of Sciences in 2002.

Arthur Getis is Professor and Birch Foundation Endowed Chair of Geographical Studies at San Diego State University. His Ph.D. is from the University of Washington. He served previously as Head of the Department of Geography and Director of the School of Social Sciences at the University of Illinois. He is Co-editor of the *Journal of Geographical Systems* and has published extensively on spatial statistical modeling, urban growth and change, and general geography. His interests are in GIS, spatial statistics, urban transportation modeling, disease transmission modeling, and geographic education. He is well known for his research in spatial statistics, especially in the area of point pattern analysis. Perhaps his best-known work is the collaborative effort in which he has been engaged with Professor J. Keith Ord (Georgetown University) on the development of a series of mainly locally based spatial association statistics. In 2002 Dr. Getis is recipient of the 1997 North American Regional Science Association International's Walter Isard Award for Distinguished Scholarship. In 2002 he received the Award for Distinguished Scholarship from the Association of American Geographers for contributions to the theoretical understanding of spatial processes and for leadership in promoting understanding of these processes to national and international audiences. He serves currently as Past President of the University Consortium for Geographic Information Science.

Mei-Po Kwan is Associate Professor of Geography at the Ohio State University, and an Ameritech Fellow during year 2000-2001. She is a consulting editor of *Geographical Analysis*. Her research focuses on GIS for transportation, in particular, space-time patterns of human spatial behavior, gender and ethnic dimensions of transportation, telecommunications and information technologies, and Intelligent Transportation Systems. Her recent research on the analysis of activity-travel diary data uses geocomputation and geovisualization methods. Research on information technologies and women's everyday lives is supported by a grant from the Information Technology Research Program of the National Science Foundation.

Fiona Goodchild has been the Education Director for the NSF Materials Research Laboratory (MRL) at UCSB since 1993, a position that she will retire from in May 2003, allowing time for her to participate as Professional Development Coordinator for *SPACE*. She has experience as a Lecturer in the UCSB Graduate School of Education, as Learning Skills Counselor/Coordinator at the University of Western Ontario (1976-1988), and as a High School Teacher (Ancastor, Ontario (1967-1969). She has published papers on mentoring teachers, integrating research and education, changing culture in science, and learning skills for students. Her outstanding work was recognized recently with a 2002 *Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring*.

PROGRAM EVALUATION

A number of evaluative tools will be used to assess the success of the *SPACE* program. These will include **entry and exit surveys** for workshop participants and **follow-up surveys** one year later. We will seek advice from the UCSB Instructional Development unit on survey designs and interpretation; the general intent of developing these instruments will be to assemble documentation to monitor and assess workshops and web resources. We would seek information on the extent to which participants have introduced new content to their courses and the extent to which spatial thinking is

disseminated across disciplinary lines. Quantitative indicators on the number of students instructed by participants in new spatial approaches to analysis and interpretation, the number of hits on the *SPACE* website, and the extent to which *SPACE* teaching and learning resources are used will be analyzed.

The following table summarizes the general goals for *SPACE* as a national dissemination initiative, matches them with the proposal's three programs, and specifies the anticipated outcomes and the bases for evaluation and accountability.

Goals for <i>SPACE</i>	Programs/steps for Achieving Goals	Outcomes Expected for Evaluation and Accountability	
		Year(s)	
Undergraduate Faculty Development in Spatial Social Science	-Workshop (WS) -Conf WS	1 1 2 2 2 3 3 3	3 WS (1-2 weeks) 60 participants 1 UCGIS short WS (15 to 30 part) 3 WS (1-2 w) 80 part 2 UCGIS short WS (30 to 60 part) 3 Conference WS (75 to 150 part) 2 WS (1-2w) 55 part 3 UCGIS short WS (45 to 90) 2 Conf WS / different disciplines / different locations (50 to 100 part)
Curricula Resources in Spatial Social Science	-Clearinghouse (CH) of data exercises, exams and assessment instruments on WWW	1 1-3	-Establish WWW interface for access to resources Assemble and organize CH resources -20% increase per year in web access
Technology Integration	-WS -Website focus	1-3	-Increase the number of <i>SPACE</i> themes in WS (see Program Scope) in successive years -Increase technology integration on website
Discipline Integration	-WS Participant Selection -Conf WS -UCGIS short WS -CH	1-3	-Seek 20% increase in number of applications per year -Seek increasing number of institutions represented in applicant pool each year -Seek increasing mix of WS part from different social science /environment disciplines -CH examples from across disciplines
Diversity	-Targeted advertising -Stipend support for minorities -Participant Selection Criteria -Instruction team mix	1-3	-Seek 5% increase per year in designated minority participants -Increase level of targeted advertising in successive years -Seek gender and minority faculty for WS, Conf WS

Follow-through Professional Development	<ul style="list-style-type: none"> -Conf. travel awards for new course syllabi and student research -Follow-up surveys -Target web resources to WS participants and their students 	1-3	<ul style="list-style-type: none"> -Assess follow-up surveys (1 yr after WS) for evidence of use in courses & teaching programs -Assess participation in <i>SPACE</i>-hosted events at conferences by former WS participants -Assess trends in use of web CH
Support Networks	<ul style="list-style-type: none"> -WS encourage collaboration -WS Social setting -Website on-line forums and CH -Conf WS -FAQ on website 	1-3	<ul style="list-style-type: none"> -Assess evidence of continuing collaboration among teachers -WS participants' forum to share questions, ideas, resources -Web archives and custom search engine for undergraduate teaching
National Dissemination	<ul style="list-style-type: none"> -Encouragement for course and exercise development -Clearinghouse of resources on Web 	1-3	<p>Monitor Evidence of Dissemination and document in Annual Reports:</p> <ul style="list-style-type: none"> -Expectation of <ul style="list-style-type: none"> -Increasing use of CH resources on website -Greater discipline diversity in use of spatial analysis in undergraduate teaching -Increasing use of website forum
Evaluation Standards and Procedures	<ul style="list-style-type: none"> -Entry – Exit surveys for WS participants -Follow-up surveys on WS impact -Build Index measures database -Annual Reports -Final Report 	1-3	<ul style="list-style-type: none"> -100% participation in survey desired / 65% acceptable -Improve participation rate in surveys each year -Seek high (90%+ WS completion) -Assess annual changes in Indices: <ul style="list-style-type: none"> -Number of new courses -Increasing use in established courses of WS and other <i>SPACE</i> resources -Changes by discipline -Website access and use trends