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Editorial

GIScience Research at the Twenty-eighth ESRI International User Conference

Environmental Systems Research Institute, Inc. (ESRI) based in Redlands, California has played a pivotal role in the development and adoption of geographic information technologies throughout the public and private sectors of nations worldwide. From its beginnings nearly 30 years ago, it has grown steadily with the help of a charismatic and visionary leader (Jack Dangermond), a dedicated staff, and an enthusiastic user community that meets every year for a week-long international user conference. This event is a key part of the business strategy in that it offers ESRI a chance to showcase their latest software (ArcGIS, ArcIMS, ArcSDE, etc.) and it provides the user community an opportunity to seek expert guidance and to tell the software developers and support teams what they want in the next release of the software. The user community is large and diverse, spanning most levels and branches of government, the private sector, the non-profit sector, and higher education.

The latter makes up the bulk of the readership for an international, peer-reviewed academic journal like *Transactions in GIS* and has played at least three special roles in the geographic information science enterprise.

First and foremost, academicians have played leading roles in the development of new concepts and methodologies – this is perhaps best represented by the groundbreaking work of David Mark (e.g. O'Callaghan and Mark 1984, Smith and Mark 2001), Michael Hutchinson (e.g. Hutchinson 1989), Max Egenhofer (e.g. Egenhofer and Franzosa 1991), Ian Moore (e.g. Wilson and Gallant 2000), May Yuan (e.g. Yuan 1999), Michael Worboys (e.g. Worboys and Duckham 2004), Luc Anselin (e.g. Anselin et al. 2006), Sergio Rey (e.g. Rey and Janikas 2006), Jonathan Raper (e.g. Raper 2008) and others. Many of these contributions can be traced back to Michael Goodchild and the National Center for Geographic Information and Analysis (NCGIA), and the pivotal roles they played in the 1990s in identifying and connecting scholars interested in geographic information science from previously disparate fields (see Goodchild et al. (1993, 1995) and NCGIA (1996) for a sample of the their contributions).

Second, the academy has in many instances taken the lead in demonstrating the use of existing tools for addressing a series of longstanding and important questions across a steadily expanding range of specific domains – here we might highlight the work of Peter Fisher (viewshed analysis; Fisher 1995, 1996a, b), A-Xing Zhu (automated soil mapping; Zhu et al. 1997, 2001), David Maidment (water resources; Maidment 2002), Helena Mitasova (climate modeling; Hofierka et al. 2002), Paul Longley (geodemographics; Longley 2005) and Mike Batty (cities; Batty 2005) among others.

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And last, but by no means least, the higher education community has a special role in educating and training the next generation of scientists, engineers, and policy analysts who will lead the continued evolution and application of the software tools as we know them today. Their work and its future potential is captured spectacularly in the Geographic Information Science and Technology (GIST) Body of Knowledge that was prepared by the University Consortium of Geographic Information Science and published in conjunction with the Association of American Geographers (see DiBiase et al. 2006 and DiBiase 2007 for additional details). There are two handbooks that have been published in the past couple of years which document various facets of the aforementioned contributions in considerably more detail as well (Wilson and Fotheringham 2007, Kemp 2008).

ESRI, of course, has played a key support role in higher education through its provision of software, training, and data. There is currently over 600 institutions worldwide which are covered by campus site licenses (see http://www.esri.com/sitelicenses for a listing by state or country) and all institutions around the world with at least 10,000 students have some form of access to one or more of their software products. In the United States, all 50 states have multiple campus, system, or statewide licenses. Their reach is extending to younger and younger audiences as well – 38 (soon to be 40) of the 111 California Community Colleges, for example, are part of a statewide license and most of the others have at least some limited lab kits. As we sit today, ESRI software reaches more than 2,000 institutions (with China, India, the United Kingdom (where 125 universities access their software through a single site license arrangement) and the United States leading the way) and there are literally hundreds of thousands of students who are exposed to GIS at some level each year.

The eight papers included in this issue of *Transactions in GIS* nevertheless mark a new beginning for both ESRI and Wiley-Blackwell (the journal publisher). The collaboration evolved from the desire on the part of ESRI to attract academicians to their User Conference so they can learn from them and keep up to date with the state of the art and the position of the research frontier, and for Wiley-Blackwell a desire to identify and publish innovative work on geographic information science and technologies in *Transactions in GIS*. That said, the immediate goal was relatively straightforward: to present at a special research symposium scheduled on the second day of the User Conference and publish in a special issue of *Transactions in GIS* the best GIScience research contributions gathered from a special call for abstracts. A total of 35 abstracts were submitted and eight selected by the journal editors for the preparation of full journal articles. Each of the manuscripts has been through the usual journal peer review process and the final versions included in this issue have been revised in light of both the reviewer's and editor's suggestions. They cover a wide variety of topics and attack some of the key concepts and applications of geographic information science from a variety of perspectives. Some address questions about fundamental principles, some offer new approaches to longstanding challenges and still others offer unique and innovative applications of well tested techniques and tools as described in more detail below.

The first article by Jochen Albrecht, Brandon Derman, and Laxmi Ramasubramanian offers a comparative study of ontology building tools described in some twenty peer-reviewed GIScience journal articles from the perspectives of the crime analysis and transportation/land use application domains. They show in both cases that the currently available sets of tools cannot replace manual coding of ontologies for use with ESRI-based application software and relying on those experiences, they outline an R&D agenda for this important aspect of GIScience.

The second article by Shih-Lung Shaw, Hongbo Yu, and Leonard Bombom presents a generalized space-time path approach to facilitate the visualization and exploration of spatio-temporal changes among individuals in large datasets. The authors derive a small number of representative space-time paths by identifying spatial cluster centers of observations at different times and then linking these centers together in temporal sequences. This article demonstrates an operational space-time prototype in ESRI's ArcScene and ArcMap with a large migration dataset as a proof-of-concept for their new approach.

The third article by Robert Weih, Jr. and Aaron Dick used indicator kriging and Government Land Office notes to interpolate the probable occurrence of tree species in Pre-Euroamerican landscapes spanning 62 Arkansas townships. The continuous probability models developed using this approach provided the base information necessary to quantify vegetation change and the spatial extent and likely causes of that change. The results revealed landscapes with less and different tree cover due to agricultural encroachment and changes in fire regimes over the past two hundred years.

The fourth article by Yu-Feng Lin, Jihua Wang, and Albert Valocchi proposes a new GIS-based approach for estimating shallow groundwater recharge and discharge. The new approach uses a mass balance approach for steady state two-dimensional unconfined aquifers and readily available data for water table and bedrock elevations, and hydraulic conductivities. Several image processing algorithms are then used to estimate and visualize shallow recharge and discharge patterns and rates. These outputs might serve as the initial guidelines for conventional field study planning and decision making or as the initial conditions for numerical simulations.

The fifth article by Jeremy Jackson, Benjamin Forest, and Raja Sengupta uses an agent-based modeling (ABM) approach to simulate residential dynamics in an area of Boston that has experienced increasing gentrification in the past few decades. The model uses basic empirical data and simple decision-making rules to simulate the process of residential dynamics, and the results show how such a model could serve as a valuable explanatory tool for understanding and learning about some of the processes promoting gentrification.

The sixth article by Wen Lin examines the role of GIS in China's urban governance against the backdrop of rapid urbanization and industrial transformation. The author draws on the critical GIS research and GIS implementation literature, and develops a synthesized theoretical framework to interrogate the nature and evolutionary process of Shenzhen's government GIS practices. The three major transformations of GIS development in Shenzhen's planning agency are documented and the results used to illustrate how GIS development in Chinese urban governance has been influenced not only by the instrumental functions of GIS, but also by the interactions and relationships among different actors and institutions with various vested interests in the process of structuring and governing urban spaces.

The seventh article by Benjamin Jacob, Daniel Griffith, James Gunter, Ephantus Muturi, Erick Caamano, Josephat Shililu, John Githure, James Regens, and Robert J. Novak presents a new approach for estimating spatial autocorrelation by including latent map pattern components as predictor variables in a malaria mosquito aquatic habitat model specification. Numerous data sources and software tools are combined and used to construct a geographic weights matrix for evaluation of field and remote sampled covariates of *An. arabiensis* aquatic habitats, a major vector of malaria in East Africa. The authors show how the synthetic map pattern variables, which are eigenvectors computed for a geographic weights matrix, furnish an alternative way of capturing spatial dependency effects in the mean response term of a Poisson regression model.

Such a model can be used to assess the precision of malaria mosquito aquatic habitat maps and the significance of individual factors associated with larval abundance and distribution in rice agroecosystems.

The eighth and final article by Piotr Jankowski, Arika-Ligmann Zielinska, and Martin Swobodzinski presents a Web-based spatial multiple criteria evaluation tool for individual and group use called Choice Modeler (CM). The authors describe the design of CM and discuss its advantages and limitations. The decision support functions provided by CM assist in reducing the cognitive complexity of the decision space characterized by multiple decision options, evaluation criteria, and criterion weights. CM utilizes a Web-service architecture and can be implemented as a part of a larger information system such as PGIST (Participatory Geographic Information System for Transportation project) or a standalone tool for the evaluation of decision variants.

These eight articles, taken as a whole, illustrate the kinds of advances in geographic information science that have occurred in university settings in the U.S. and Canada during the past couple of years. Special thanks are owed to the authors and especially those who provided the peer reviews for helping to move these articles from concept to reality in just a few short months. I trust you will see how your contributions bore fruit when you read the articles included in what I hope will be the first of many special issues organized around a research symposium that is hosted by ESRI and given a prominent place in its International User Conference program.

John P. Wilson
Editor

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