Introduction

Professor Lin Liu

Biographical note: Lin Liu is an Associate Professor of geography at the University of Cincinnati. He received a PhD in geography from The Ohio State University, and an MS in remote sensing and a BS in geography from Peking University. Dr Liu's research focuses on the GIS and its applications to environmental, urban and economic problems. He has 20 years' experience with GIS.

The recent tsunami disaster in South Asia underscores the need for better tools in risk assessment and management. GIS is a particularly powerful tool for modelling such risks and evaluating various responses. Numerous articles addressing the utility of GIS in risk assessment and management have been published in scholarly journals, trade magazines, popular media and on the world wide web. A recent search on Google, for example, using the key words of 'GIS' along with 'risk assessment' and 'risk management' returned over one million hits. The GIS and risk assessment/management literature examines a wide range of hazards, including such man-made hazards as the management of radioactive materials and toxic chemicals, air pollution, water pollution, and crime and terrorism, and a variety of natural hazards including earthquakes, hurricanes, tsunamis, floods, landslides, wildfires, and volcanic eruptions, just to name a few.

This special issue of the *International Journal of Risk Assessment and Management* (IJRAM) focuses on various applications of the latest GIS technologies to risk assessment and management. Twelve peer-reviewed articles are presented in this special issue. These articles tackle various types of risks and modelling techniques. The risks of vector-borne diseases, crime, radioactive materials, arsenic contamination of rice, land use, heritage resources, ground water, flood and natural hazards in general are examined in this issue. These studies take advantage of a number of GIS techniques, including mapping, proximity analysis, spatial interpolation, three-dimensional visualisation, interactive visualisation and web GIS. Most of the models are loosely coupled with GIS, while a few are directly integrated with GIS.

The articles are loosely organised into two parts, each containing six articles. Part one explores specific types of risks. Part two primarily focuses on tool development for risk assessment and management.

The lead article of Part one examines vector-borne diseases as a continuing health risk. In 'Exploring GIS, spatial statistics, and remote sensing for risk assessment of vector-borne diseases: a West Nile virus example', Allen and Wong demonstrate how GIS, remote sensing, and spatial statistics can be used for both surveillance and control of disease vectors. The techniques of spatial interpolation and mapping are used in their study. In 'Estimating the spatial-temporal distribution of radon releases from the K-65 silos', Hasan and Liu investigate the spatial and temporal distribution of Radon at a radioactive waste site. They couple spatial interpolation with a dispersion model, which enables integrated Radon monitoring and assessment in a GIS environment. This coupled model estimates Radon concentrations for the area surrounding the waste site, thus facilitating spatial assessment of Radon exposure and compliance with environmental standards.

In 'Potential for arsenic contamination of rice in Bangladesh: spatial analysis and mapping of high risk areas', Ross, Duxbury, Paul, and DeGloria investigate the location and severity of arsenic contamination of rice and water supplies in Bangladesh. They employ spatial interpolation and spatial statistics to create contamination data in GIS. In 'Identifying regional groundwater risk areas using a www GIS model system', Lim, Engel, and Tang evaluate the National Agricultural Pesticide Risk Analysis (NAPRA) www system, a world wide web GIS for ground water risk analysis. The study confirms that results predicted by the system match observed concentrations reasonably well, and suggests that NAPRA www can be used to facilitate the assessment of the effects of more refined agricultural management on ground water quality.

The final two articles of Part one examine the impact of human activities on heritage resources and climate change. In 'Identifying at-risk heritage resources with GIS: modelling the impact of recreational activities on the archaeological record', Uphus, Sullivan, and Mink use GIS to identify at-risk heritage resources. Proximity analysis is used to determine the extent to which off-highway access points affect the likelihood of heritage resources being impacted by camping, hunting or woodcutting. In 'Modelling the hydrologic effects of land-use and climate changes', Tong and Liu assess the hydrologic effects of different land-use and climatic regimes in the Lower Great Miami River Basin. BASINS, a hydrological model implemented in GIS, is the software used in their study.

Leading off discussions on tool development for risk assessment and management in Part two with 'The influence of hazard models on GIS-based regional risk assessments and mitigation policies', Bernknopf, Rabinovici, Wood and Dinitz present a GIS-based decision support system (DSS) for assessing community vulnerability to natural hazards and evaluating potential mitigation policy outcomes. The system, implemented as an extension of the ArcView and ArcGIS GIS platforms, integrates earth science information with a mean-variance utility model to predict the economic impacts of loss-reduction strategies. In 'Human-GIS interaction issues in crisis response', Cai, Sharma, MacEachren, and Brewer take a human-GIS interaction perspective to develop effective GIS interfaces for supporting crisis management. Their prototype system, DAVE_G, uses a large screen display to create a shared workspace among team members and allows risk managers to interact with a GIS through natural multimodal (speech/gesture) dialogues.

In 'Risk assessment and GIS in natural hazards: issues in the application of HAZUS', Beckmann and Simpson examine issues and limitations of HAZUS, a system implemented on the ArcGIS platform for sophisticated planning and risk assessment. Their study shows that HAZUS can severely over-estimate or under-estimate hazard damage and should therefore be used with caution. In 'Successful application of GIS technology for post-9/11 disaster management: overcoming challenges, capitalising on advantages', Farris, Laska, Wesley, and Sternhell evaluate new disaster management requirements for emergency incident decision making after 9/11. They present an increasing need for quick access to an array of geocoded information about community critical infrastructure, populations at risk, and risk response resources. The article reports on the creation of a GIS-based software application, E3R, for supporting rapid emergency response. In 'A GIS-supported 3D approach for flood risk assessment of the Qu'Appelle River, Southern Saskatchewan', Abdalla, Wu, Maqsood, and Tao introduce a hybrid approach that integrates hydrologic simulation and 3D visualisation for flood risk assessment in GIS. In 'Development of robbery risk analysis tools: using the Australian and New Zealand standard', Draper and Cadzow present a risk assessment tool that facilitates analysis of a range of variables, and delivers a qualitative description of the risk of harm to staff arising from robbery at any given cash handling point. They illustrate the tool with a case study in Australia.

The diversity of the articles in this special issue of IJRAM on GIS and risk assessment/management illustrates the breadth and depth of the contributions that GIS can make to the field of risk assessment and management. The wide range of types of risks and modelling techniques presented here should serve the interests of a broad audience.