KAS Special Symposium

Geospatial Analysis in the Great Plains

A special symposium was held at the Annual Meeting of the Kansas Academy of Science in 1996 on geospatial analysis in natural and cultural sciences of the Great Plains region. Potential applications span the spectrum of biological, cultural and physical conditions that exist in the region. Invited speakers came from academic, governmental, and commercial settings. They described geographic information systems (GIS) and related technologies applied to various research and development projects. The following individuals made presentations. Articles based on these presentations were published in the *Transactions of the Kansas Academy of Science,* volume 100 (1997) in paper and Web formats.

- James S. Aber, Emporia State University
- Ed Crane, M.J. Harden, Kansas City, Missouri
- John A. Harrington, Jr., Kansas State University
- Thomas D. Mettille, DASC, Kansas Geological Survey
- Dr. M. Duane Nellis, Kansas State University
- Dr. Kevin Price, University of Kansas
- Donna Riech, Kansas State University
- Jorgina A. Ross, Kansas Geological Survey
- David J. Sauchyn, University of Regina, Canada

Oral Presentation Abstracts

APPLICATIONS OF LANDSAT IMAGERY IN THE GREAT PLAINS. **James S. ABER**, Laura L. RAND, Michael P. WEBSTER, Earth Science, Emporia State University, Emporia KS 66801; and Everett E. SPELLMAN, Kansas Dept. Health and Environment, Forbes Field, Topeka, KS 66620.

Archive Landsat multispectral scanner (MSS) digital data cover more than 20 years of continuous satellite observations of the Earth. The Great Plains are especially well represented in this database. Landsat data, powerful desktop computers and sophisticated GIS software make remote-sensing research feasible at moderate cost for all manner of colleges, governmental agencies, and commercial users. Many kinds of resource assessment or environmental change applications may benefit from combining Landsat imagery with other kinds of ground-based information and GIS databases.

We have utilized Landsat MSS data for various geologic and hydrologic studies in the Great Plains. Devils Lake is a complex lake system within an enclosed drainage basin in eastern North

Dakota. The lake fluctuates in area, elevation, salinity and biomass because of climatic changes and human impacts. During the period 1973-88, Devils Lake rose 3 m in elevation and increased its surface area by &gt50%. Further increases in 1993-95 have threatened nearby human settlements. In eastern Kansas, many river valleys follow distinct lineaments oriented NW-SE (Fall/Neosho), NNE-SSW (Walnut), and NE-SW (Little Walnut). These patterns correspond to major crustal fractures (joints and buried faults). Based on Landsat imagery, we have identified another significant lineament trend at about 350 degrees. It is best depicted in headwaters of the Verdigris, Fall, and South Fork Cottonwood drainage basins in the Flint Hills. We propose to name this trend the Verdigris lineament.

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DATA MINING IN THE GREAT PLAINS. **Ed CRANE**, M.J. Harden Associates, 1019 Admiral Blvd., Kansas City, MO 64106.

GIS databases in the Great Plains are being constructed for an increasingly wide variety of applications by local governments and utilities. Efforts to standardize data are gaining ground to the extent that eventually, many themes of large scale data will be available across the entire region. Dissemination of process and content guidelines for data and encouraging use of common interchange formats will yield an enormous wealth of raw data about the region. The presentation will focus on a typical range of databases and features that are being automated by local governments, utilities and private enterprise. Road/street centerlines and addresses, property parcels and land monuments, electric/gas/water/telephone utilities, and digital photography databases are all being constructed for communities to operate effectively in the information age. Monitoring the current status of automation of these large-scale features and their availability for use in GIS projects also raise complex institutional issues that will be introduced. The technology of GIS is seductive and continuously improving, however, a comprehensive understanding of the data “fuel” behind GIS analysis is the most essential component of success. Typical guidelines for developing such an understanding of locally produced databases will be presented.

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GEOSPATIAL ANALYSIS OF WATER QUALITY IN GREAT PLAINS RESERVOIRS. **John HARRINGTON, Jr.**, Douglas GOODIN, and Duane NELLIS, Department of Geography, Kansas State University, Manhattan, KS 66506 and Frank SCHIEBE, Site-Specific Technology Development Group, Inc., Stillwater, OK 74074.

Data obtained from broad-band sensors on the Landsat and SPOT satellite systems are useful for assessment of water quality in Great Plains reservoirs. Use of a physically based model, that uses at-satellite measures of surface reflectance, allows estimation of temporal and spatial variations in turbidity, suspended sediment concentration, and Secchi disk depth. Examples from studies in Oklahoma and Kansas, using Landsat MSS, Landsat TM, and SPOT HRV data, document an ability to assess inorganic water quality variations. However, estimates of common measures of organic water quality (*e.g.* chlorophyll a) are problematic in lakes dominated by suspended sediments using the broad-band sensors. Data obtained from both a hand-held spectroradiometer

and narrow-band video remote sensing indicate that estimation of chlorophyll a concentration may be possible with future narrow-band, satellite-based sensor systems.

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DIGITAL ORTHOPHOTOGRAPHY QUARTER QUADRANGLE (DOQQ) DATA AND PRODUCTS. **Thomas D. METTILLE**, Kenneth A. NELSON, David F. HOGBEN, and Erik PATTON. Kansas Geological Survey--DASC, 1930 Constant Ave., Lawrence, Kansas 66047

The State of Kansas Geographic Information Systems (GIS) Policy Board conducted a digital orthophotography pilot project to test the utility of differing Digital Orthophotography Quarter Quadrangle (DOQQ) products and bring to light problems associated with implementing DOQQs in a statewide GIS system. DOQQs are highly accurate rectified scanned aerial photographs that are tied to a real-world coordinate system and can be used in conjunction with other geospatial datasets. Pilot applications were tested by the state's GIS Data Access and Support Center (DASC) and summarized in a report drafted by DASC staff. The oral presentation will address properties of a USGS standard DOQQ product, results of pilot applications, and user considerations for implementing DOQQs in their GIS system. The presentation will detail some of the issues associated with using DOQQs, such as: image formats and compression, spatial resolution, tiling schemes, and coordinate systems. Finally the presentation will outline the benefits of using DOQQs as a common base for heads-up digitizing and conflating existing data sources.

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MODELING SPATIAL DIMENSIONS OF BISON IMPACT ON THE KONZA PRAIRIE LANDSCAPE ECOLOGY. **Duane NELLIS**, Office of the Dean and John M. BRIGGS, Division of Biology; Kansas State University, Manhattan, KS 66506.

Within the Konza Prairie, Kansas (a Nature Conservancy Preserve), grazing, primarily by bison, directly affects primary production, nutrients, organic matter, species composition, and to a degree, drainage and depositional networks. Geographic information systems (GIS) and remote sensing have been used in an attempt to characterize bison grazing as a landscape-level disturbance. Since 1991, bison have been observed twice per week from March through October. Within a superimposed 30 meter cell, bison, as the dependent variable, occupying each cell are recorded and entered into a GIS. Independent variables include burn treatment, soil type, distance to water, vegetation condition, percent slope, and slope aspect. Through GIS modeling approaches, we determined bison preference for burned watersheds in April through June, with soil (which influenced vegetation productivity) a more significant parameter in bison grazing pattern from July through fall. Extrapolating the results to areas outside Konza offers interesting possibilities for more fully understanding the role of bison in the Flint Hills tallgrass prairie ecosystem. This research is ongoing as part of the K.S.U. Division of Biology's Long Term Ecological Research program funded by the National Science Foundation.

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DEVLOPING A LAND COVER MODELING PROCEDURE FOR THE HIGH PLAINS USING MULTI-DATE THEMATIC MAPPER IMAGERY. **Kevin P. PRICE**, Stephen L. EGBERT, Geography & Kansas Applied Remote Sensing, University of Kansas, Lawrence, KS 66045; Duane NELLIS, Department of Geography, Kansas State University, Manhattan, KS 66506; and Re-Yang LEE, Kansas Applied Remote Sensing, University of Kansas, Lawrence, KS 66045.

The objective of this study was to develop a repeatable procedure for modeling land use and land cover within one of the most agro-economically significant and environmentally sensitive areas of the High Plains region--Finney County in southwestern Kansas. The method we developed involves the use of multi-seasonal Landsat Thematic Mapper satellite remotely sensed images collected in spring, mid-summer, and late summer for 1987, 1989, 1992. TM bands [3 (red), 4 (NIR), and 5 and 7 (MIR)] were used to produce a 12-band dataset for each year.

The results of the computer classification of these three datasets showed greater than 95% accuracy in separating cropland from grasslands. By comparison, conventional single image classification approaches yielded less than 60% accuracy. We also developed a method for classifying: winter wheat, grain sorghum (milo), corn, alfalfa, and fallowed lands, and achieved an overall accuracy of greater than 90%. Our total acreage estimates by crop type agreed strongly with government reported acreage for Finney County ($r^2 = 0.93$). The ability to accurately classify land cover at the resolution of Landsat (about 5th acre resolution) is of considerable importance to hydrologic, agricultural, and environmental models that require accurate maps of land cover as an input variable. These land cover maps also provide invaluable information to natural and agricultural resource managers.

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USE OF REMOTELY SENSED DATA ON PHENOLOGICAL ACTIVITY AND HETEROGENEITY TO DETECT CHANGES IN GRASSLAND SPECIES COMPOSITION IN RESPONSE TO STRESS. John M. BRIGGS, **Donna RIECH**, Clarence L. TURNER and Geoffrey M. HENEBRY, Division of Biology Ackert Hall; Douglas G. GOODIN and M. Duane NELLIS, Department of Geography, Dickens Hall, Kansas State University Manhattan, KS 66506.

Prairie dominated by C3 vegetation exhibits two temporally distinct pulses of activity (spring and fall); whereas, C4 vegetation has a single pulse of activity and maximum greenness at midseason. This temporal segregation in C3 and C4 spectral signatures has the potential to indicate the relative contribution of these lifeforms to the regional flora in tallgrass prairie. We are in the process of using this information to develop an ecological indicator for the Flint Hills in KS and OK. This ecological indicator is based on remote sensing data (at present AVHRR) and detects both natural (*e.g.* interannual variation in precipitation and temperature) and anthropogenic (*e.g.* climate change, over-grazing, land-use practices) stresses on grassland ecosystems. We hope that the index will be applicable across larger geographic regions, such as the Central Great Plains of North America. We are correlating shifts in the timing of green-up and/or senescence with meteorological data (from 117 weather stations) and land-use practices to identify key variables that determine vegetation response. The ability to detect vegetation shift

using remote sensing techniques can provide important information within an environmental monitoring program.

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BUTLER COUNTY GEOLOGIC MAP: Case Study of Map Production at the Kansas Geological Survey (KGS). **Jorgina A. ROSS**, Kansas Geological Survey, University of Kansas, Lawrence, KS 66047

Many steps are used in creating a county geologic map at the KGS. The geologist begins data collection on a 7.5' USGS topographic map, at 1:24,000 scale. The geologic data are obtained through field observation, aerial photography, and other sources. Using digital data from the Kansas Cartographic Database (KCD), a mylar base map is produced with the same scale and projection as the USGS topographic map. The base map displays the Public Land Survey (PLS), hydrography, and principal geographic features shown on the USGS map. The geology is transferred to the mylar base map. The mylar base is then used as input to digitize the geology, creating a binary database for the quadrangle. These steps are followed for each of the quadrangles that cover the county. All databases are edge-matched, topology is built and polygons attributed for each quadrangle. After checks for accuracy, individual quad databases are combined to form a digital county geologic database. A digital layout base is created with titles and legends. Overlays of features from KCD, such as hydrography, county lines, PLS, roads and cities, are color coded and labeled. The geology, combined with all other features, is then merged into a plot file for plotting. The Geologic Map of Butler County was produced using the GIMMAP (Geodata Interactive Management Map Analysis and Production) system developed at the Kansas Geological Survey. Export routines permit use of data in ArcView and other GIS software.

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Abstracts for Dr. Sauchyn's Presentations

Public Presentation

LANDSCAPE AND CLIMATE VARIABILITY AND CHANGE ON THE SOUTHERN CANADIAN INTERIOR PLAINS. David J. SAUCHYN, Department of Geography, University of Regina, Regina, Saskatchewan, Canada S4S 0A2

The northern Great Plains extend well into Canada to a latitude of about 52°N. Contrary to the perception of the plains as monotonous, this region has a varied topography and earth history. Bedrock uplands stood in the path of Pleistocene ice sheets. These unglaciated bedrock plateaus rise to the highest elevations in the Canadian interior. The glacial landscapes include large ice-thrust moraines, the limits of the last glaciation, extensive outwash and lake deposits, and meltwater channels up to 3 km wide and more than 100 m deep.

Postglacial landforms include active sand dunes, and a valley network featuring badlands and landslides. The most distinctive characteristic, however, is the dry climate and extreme variations

in weather. Resistance of the landscape to climatic events and change is lacking where vegetation is sparse and substrata are poorly consolidated. The postglacial response of surface processes to climatic variability and change has varied significantly among the landscapes that comprise the southern Canadian Interior Plains. Thus future impacts of climatic change may be largely confined to sensitive landscapes among vast areas that are largely geomorphically inert.

KAS Plenary Session

MODELING AND MAPPING OF LANDSCAPE SENSITIVITY IN THE SOUTHERN CANADIAN INTERIOR PLAINS. David J. Sauchyn, Department of Geography, University of Regina, Regina, Saskatchewan, Canada S4S 0A2

The Canadian Climate Centre's general circulation model predicts that, with increased CO_2 concentrations, the largest rise in mean surface temperature in southern Canada will occur in the Interior Plains. Furthermore, southwestern Saskatchewan and southeastern Alberta--the Palliser Triangle--is the only major subhumid region of Canada. Therefore the Geological Survey of Canada initiated the Palliser Triangle Global Change Project to examine the response of earth surface processes to climatic change and variability.

The modeling and mapping of potential changes in surface process, or landscape sensitivity, require a large digital geographic database, as the degree of sensitivity will vary across this large diverse region. The basic spatial units are derived from digital maps of soil, climate, topography, surficial geology, land cover and hydrography, according to salient landscape parameters (*e.g.* soil and topographic variables) that control geomorphic response to climate. The GIS then is used to couple models of the surface processes with the geographic database. Most models, like the processes themselves, operate at local scales. Therefore a theoretical framework is required to the link the properties of slopes and streams to regional landscape parameter. Only then can sensitivity be expressed in terms and units that are valid at a regional scale.