Spatial methods for solution of

environmental and hydrologic problems

science, policy, and standardization

Editors:
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Foreword

The Symposium on Spatial Methods for the Solution of Environmental and Hydrologic Problems: Science, Policy, and Standardization—Implications for Environmental Decisions was held on 25 January 2001 in Reno, Nevada. ASTM International Committee D-18 on Soil and Rock, in cooperation with ASTM committees D-34 on Waste Management, E-47 on Biological Effects and Environmental Fate, and E-50 on Environmental Assessment served as its sponsors. The symposium chairmen of this publication were Vern Singhroy, David T. Hansen, Robert R. Pierce, and A. Ivan Johnson.

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SESSION V: DEVELOPMENT OF STANDARD DATA SETS

SESSION VI: NATIONAL DATA

Overview

The Symposium on Spatial Methods for the Solution of Environmental and Hydrologic Problems; Science, Policy, and Standardization was held in Reno Nevada on January 25 and 26, 2001 as part of the D-18 scheduled meetings. The symposium was sponsored by ASTM Committee D-18 on Soil and Rock in cooperation with ASTM Committee D-34 on Waste Management, E-47 on Biological Effects and Environmental Fate, and E-50 on Environmental Assessment. Cooperating organizations in this symposium are the International Commission on Remote Sensing of the International Association of Hydrologic Sciences, the Canada Centre for Remote Sensing, the U.S. Geological Survey, and the U.S. Bureau of Reclamation. Over the past two decades, the simple graphic display of environmental data with hydrologic or cultural features of interest has progressed rapidly to modeling and analysis of environmental data with other spatially represented data. New tools such as global positioning systems (GPS) have developed to rapidly and accurately collect the position of data locations. Computer system component architecture has progressed to where data from one application can be incorporated with other applications. This includes the linkage and integration of surface water and groundwater modeling programs with geographic information systems (GIS). Geostatistical and statistical software packages have been developed and integrated with GIS and other spatial modeling software. Standards in computer systems and in the definition of spatial data have progressed to the point where geospatial data in a variety of formats and from different sources can be displayed and manipulated on common computing platforms and across the Internet.

Considering these developments, this symposium focused on issues related to spatial analysis of environmental or hydrologic problems. These issues include methods of spatial analysis, accuracy in the location and spatial representation of data and real world features, and emerging standards for digital spatial methods. Major session topics for the symposium included:

- Modeling and Spatial Analysis of Environmental and Hydrologic Systems
- Accuracy and Uncertainty in Spatial Data and Analysis
- Standardization and Standard Digital Data

This overview covers papers presented at the symposium and additional papers contained in this volume related to these topics.

Accuracy and Uncertainty in Spatial Data and Analysis

Underlying all spatial data is the coordinate control for features represented which are carried into some common coordinate system for manipulation and analysis. This may be standard survey control with measured bearings and distances from marked points or it may be established geodetic control with measured latitude and longitude values of established points. These established points, which in the United States are maintained and reported by the National Geodetic Survey, serve as the underlying control for the national map series and for other data that is compiled or registered to these base maps. GPS has rapidly developed as a tool to accurately capture coordinate values for both standard survey control and for geodetic coordinates. GPS is also commonly used for identifying sample locations and mapping features on the ground. This session discussed issues in the use and application

of GPS. This includes the characteristics of GPS and the various modes of operation and factors affecting the accuracy of values collected and reported by GPS receivers. This discussion included techniques for improving the values reported by post processing and the use of differential GPS. Ikehara discusses the application of GPS for developing highly accurate network for elevation control survey and factors affecting the reported values.

The national map series developed and maintained by mapping organizations in various countries form the underlying accuracy level for much environmental and hydrologic data. In this session, a variety of data products were presented by mapping organizations in Canada and the United States. Singhroy discusses the development of a standard merged product of satellite imagery and elevation data for resource mapping in Canada. In this session, the development and management of high-resolution elevation data and the stream network data for the United States was discussed.

Statistics and geostatistics applied to data represented in GIS or captured via remote sensing are important tools for environmental and hydrologic analysis. This session discussed the application of krieging and other geostatistical techniques. It included a session on fractal analysis for spatial applications. Other topics discussed in this session included the difficulty in defining the level of accuracy for environmental and hydrologic data used in spatial analysis including the variability in spatial accuracy of multiple data sets. Often, it is easier to discuss the uncertainty associated with the data or within the analysis. Knowlton, Peterson, and Zhang model uncertainty in spatial variability for risk assessment in a decision support system. Hansen discusses the uncertainty associated with habitat labels assigned to spectrally defined polygons. Knowlton and others describe spatial variability, uncertainty, and risk for use in decision support systems.

Modeling and Spatial Analysis of Environmental and Hydrologic Systems in Spatial Data Environments

This topic covered the use of spatial techniques to model environmental systems and the development of object models for hydrologic systems. This discussion included the linkage between detailed digital elevation models at a scale of 1:24,000 or better with object models of the hydrologic or stream network. García describes the development of a flood warning system for watersheds in Spain using spatiotemporal techniques to model flood events. Starks, Heathman, and Ross discuss modeling the distribution of soil moisture with remote sensing and GIS. Rich discusses data integration with GIS as a management tool for decision support. Paillet describes the integration of surface and borehole geophysical measurements to model subsurface geology and ground-water systems. Owe and De Jeu describe efforts to model surface soil moisture from satellite microwave observations. Flügel reports on the use of response units to assess erosion processes in semiarid areas in southern Africa.

Standardization and Standard Digital Data Sets

Interspersed throughout the symposium were discussions and presentations on standardization at national and international levels. This includes standards on methods, descriptions, and digital data products such as the watershed boundary standards for the United States. Hansen reviews the status of standards in use by the U.S. government related to GIS data and the role of other organizations in the development of standards for GIS. Recently, active development of standard data sets has been taking place. Singhroy reports on the development of standard merged products of satellite imagery and elevation data for natural resource mapping in Canada. In the United States, the U.S. Geological Survey has been particularly active in the development of a series of standard digital databases.

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