The Neuse prototyping effort will result in an implementation plan for a hydrologic observatory that will include • Design concepts to address both CUAHSI science drivers as well as local-interest hypotheses • The resulting data collection network, including an strategy for integration with existing activities within the basin • A coordination plan with local universities, various government agencies, and stakeholder groups (such as watershed associations to enable collection of data on private lands) • Detailed budget, including build-out strategies, capital, operating and staffing costs. • Plans to disseminate information to the community coordinated with the Hydrologic Information Science (HIS) committee, including contributions to the HIS concept of "Digital Watersheds" • Design of infrastructure to facilitate use of the observatories by individuals or groups of scientists by competitive proposal Two of the three data pools described by Reckhow et al. (this session) will be designed by this effort: the core data and the design data. Core data will be made public as soon as possible and will be subject to oversight by CUAHSI to achieve comparability of data among all observatories. The design data will be proprietary to the principal investigators for a reasonable period of time (e.g., 2 years) to permit interpretation and publication of results. The third data pool, the "network" pool, is data collected specifically to enable intersite comparisons to be made. The intersite studies will be awarded on a competitive basis once multiple observatories have been established. In the long run, we envision resources to be divided evenly among these three activities, although the proportions may shift in favor of the first two pools as observatories are being established. Once the Neuse plan has been reviewed by the community and comments have been received, CUAHSI will hold a competition to select approximately 10 additional groups to develop implementation plans at sites around the Nation. (The Neuse basin is not eligible for such an award.) Information gathered as part of these implementation plans will be used to develop additional "Digital Watersheds" in conjunction with the HIS group. This will extend and make further available detailed information on a set of regional watersheds to the hydrologic community. With the set of "Digital Watersheds" and implementation plans in hand, we envision a subsequent refinement of network objectives to enable a detailed description of how hydrologic observatories will advance hydrologic science. The entire network plan will be submitted to NSF for evaluation for possible funding in 2005.

H12J MCC: 3024 Monday 1600h

Geohydrological Modeling in Support of Litigation *(joint with PA)*

Presiding: **G F Pinder,** University of Vermont**; J F Sykes,** University of Waterloo

H12J-01 1605h INVITED

The Future of the Utility of Groundwater Models for Water Resources Management

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Groundwater models have become indispensable tools for water resources planning and management. After more than 30 years of study, however, the model calibration problem still is not resolved completely. Hydrogeologists may not have sufficient confidence in using their calibrated models for prediction and decision-making purposes. There are two major difficulties in groundwater modeling: (1) the geological structure of a real aquifer usually is very complex and unknown, and (2) the data that can be used for model calibration usually are very limited, in both quantity and quality. These two difficulties are closely interconnected during the model calibration process. A simple model structure may not be able to both fit the observed data and produce reliable predictions. On the other hand, a complex model structure may cause over-parameterization when data are limited. If a model is over-parameterized, the reliability of model prediction will decrease rather than increase. It is well understood that a model that can fit the existing data well may not necessarily be a good model for prediction when it contains significant model error. This paper proposes methods that can be used to calculate the model structure error when a simplified model structure is used to replace a more complex model structure. We consider both the fitting residual as well as the model structure error for model calibration. We propose a generalized parameterization scheme for the distributed hydraulic conductivity field that can vary from a pure zone to a continuous distribution. We also suggest a method which can be used to identify a least complex model that is useful for prediction and decision-making.

H12J-02 1635h INVITED

Modeling in Support of Groundwater-Remediation Cost Allocation

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The allocation of costs for remediation among multiple potentially responsible parties (PRPs) can be addressed using a 'stand alone' method developed and applied initially to water supply problems. The variant of the stand alone approach used in an allocation case in the San Fernando Valley of California involves 1) the development of groundwater flow and transport models that reflect 1) the contributions of each of the PRPs individually and , 2) the combined effect of all parties. The allocation is then based upon the proportional impact of each PRP. The proportional cost is therefore established by taking the ratio of the plume size of each PRP divided by the overall plume size multiplied by the overall remediation costs.

H12J-03 1650h

The Toms River Childhood Cancer Cluster: Coupled Groundwater and Water Distribution System Modeling

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Toms River, New Jersey is the location of a statistically significant childhood cancer cluster. A 1995 cancer investigation indicated that relative to the state, the Toms River section of Dover Township had excess childhood cancer incidence for all malignant cancers combined, brain and central nervous system (CNS) cancers, and leukemia. Children under the age of five were found to have a seven-fold increase in brain and CNS cancer. The community's concern focused on the possibility that exposure to environmental contaminants may be related to the incidence of these childhood cancers. Two Superfund sites in Dover Township were implicated as having a possible impact on the local water supply. One of these, the Reich Farm site, is a source of contaminants to the aquifer that serves a major well field for Toms River. Contaminants in the aquifer include TCE, PCE and styrene-acrylonitrile (SAN) trimer. In 1997, the New Jersey Department of Health and Senior Services and the Agency for Toxic Substances and Disease Registry began an epidemiology study to evaluate the relationship between the environmental exposure pathways and the elevated childhood cancer incidence. Toxicity studies for the SAN trimer were also initiated. Groundwater modeling was undertaken to establish the historical relationship between the Reich Farm site and the municipal well field and to aid in the management and protection of the aquifer and well field to ensure both water quality and quantity. The modeling of the water distribution system for Toms River was also part of the study. Groundwater flow from the Reich Farm Superfund site to the municipal well field for Toms River was modeled for a thirty-year time period using MODFLOW. To account for the growth and development of the well field within the modeling domain, a transient model was constructed. The use of Geographic Information Systems (GIS) and databases to manage, maintain, and compile field observations for model input and calibration was an important part of the work. GIS and databases were important tools in assessing the quality of the data, discovering and correcting errors in the field data (including surveying inconsistencies), as well as providing an efficient and automated means to visualize the data. Model calibration exercises indicated that a more physically based spatial and temporally variable recharge was necessary to account for dramatic fluctuations in water levels due to seasonal variations. The accurate simulation of the transient groundwater flow system was essential for the subsequent prediction of contaminant migration from the superfund site to the municipal wells and then subsequently into the modeled water distribution system. The independent estimation of the adsorption parameters of the SAN trimer on the porous media of the aquifer was an important aspect of the determination of both the average travel time and the breakthrough of the chemical at the municipal well field. The modeling methodology included an uncertainty analysis of the estimated exposure concentration in the water distribution system given uncertain groundwater parameters. Distributed computing with a Monte Carlo analysis was used for this work. The results of the modeling study were used to assist in the definition of the temporal integration periods in the epidemiology study. The predicted historical breakthrough curve of the SAN trimer in the municipal wells correlates with the period with the excess childhood cancer incidence.

H12J-04 1705h

Groundwater Flow Model for Taos, New Mexico

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The New Mexico Office of the State Engineer - Hydrology Bureau (OSE) has developed a regional groundwater flow model for Taos, New Mexico. The MODFLOW 2000 model will serve as a tool to evaluate alternatives in settlement negotiations in an on-going water rights adjudication. If current settlement negotiations fail, it is conceivable that the model might be used in support of litigation. OSE produced the model in cooperation with technical representatives of the various parties to the adjudication. Regional hydrogeologic data including well records, aquifer test results, stream flow measurements and seepage studies have been shared relatively freely among the parties. A recent deep drilling program conducted in conjunction with the negotiation effort has added substantially to the hydrogeologic data set. Among the hydrologic processes simulated by the model are mountain front recharge; areal recharge from precipitation; evapotranspiration; discharge from springs; river and stream flow; accretions to groundwater from irrigation return flow, seepage from acequias, canals, and ditches, and deep percolation; and pumping by municipal entities and mutual domestic water users associations. The resulting model files are available for all parties to review and evaluate. Comments are assessed and many have resulted in significant improvements to the model. At this stage, however, it is unclear whether adopting this cooperative approach will increase the likelihood of model acceptance by the parties.

H12K MCC: 3020 Monday 1600h

Hydrogeophysics: Characterization and Monitoring of Soil Properties and Processes in the Laboratory II *(joint with NG, MR)*

Presiding: **M Prasad,** Stanford University**; X Comas,** Rutgers University

H12K-01 1600h

Intrinsic Anisotropy In Sediments And Its Sesimic Potential

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In this paper we present a study of intrinsic anisotropy focusing on stratification of poured sediments using Vp. We describe the experimental procedure to detect the intrinsic anisotropy with Vp in sand and glass bead samples. We then offer a method to determine textural anisotropy with the spatial autocorrelation function. In this method we use the spatial autocorrelation function and its variation with direction to characterize the stratification texture from images of the samples. To determine if there is a relation between Vp and the textural anisotropy, we compare velocity anisotropy and the spatial autocorrelation function. We find that velocity anisotropy reveals internal packing.

H12K-02 1615h

Near-Seafloor Overpressure in the Deepwater Gulf of Mexico Interpreted from Laboratory Experiments

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