selected GCPs in both cases. The rectified mosaics serve as base maps in our Amazon basin GIS database, and work great with other layers in the database.

H22D-0965 1330h POSTER

Thermal infrared remote sensing and its usefulness in determining regional stream temperatures

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Stream temperatures are an important water quality variable in the Pacific Northwest, especially due their impact on health of regional salmon and steelhead runs. With several of these runs classified as threatened or endangered by the National Marine Fisheries Service in the last decade, monitoring of regional stream temperatures has never been more important. Networks of in-situ temperature observation sites tend to be costly to install and maintain, limiting their ability to monitor large regions in detail. Thermal infrared (TIR) remote sensing from aircraft and satellite based platforms have the potential to provide high resolution regional information about stream temperatures at a specific time. We present results from a three-year study, conducted to investigate the usefulness of TIR images in monitoring and observing regional stream temperatures. This project compared satellite-, aircraft- and ground-based TIR sensors with a network of in-stream temperature loggers and volunteer observations to assess the accuracy and uncertainty of TIR derived stream temperatures. Accuracy and uncertainty of temperatures extracted from the TIR images are strongly related to our ability to correct imagery for the effects of surface emissivity, atmospheric conditions and thermal scattering from the near-bank environment. Limited observations of atmospheric water vapor are of particular concern, however, total column water predictions from a meso-scale atmospheric model can be a useful substitute. The biggest limiting factor in using remote sensing for the evaluation of regional stream temperatures is the resolution of the sensor. Satellite-based sensors are unable to fully resolve all but the largest regional rivers. Higher-resolution aircraft-based images can resolve most regional rivers and stream, but may be unable to yield accurate temperatures in the presence of dense riparian zone vegetation. Very high-resolution images from the ground-based TIR sensors can resolve detailed temperature patterns within the stream, but image noise and the look-angle relative to the stream's surface become significant in analysis.

H22D-0966 1330h POSTER

The GLOBE Soil Moisture Campaign's Light Bulb Oven

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The GLOBE Soil Moisture Campaign (SMC) (www.hwr.arizona.edu/globe/sci/SM/SMC) has developed a light bulb oven to provide a low budget, low-technology method for drying soil samples. Three different soils were used to compare the ability of the light bulb oven to dry soils against a standard laboratory convection oven. The soils were: 1) a very fine sandy loam (the "Gila" soil); 2) a silty clay (the "Pima" soil); and 3) a sandy soil (the "Sonoran" soil). A large batch of each soil was wetted uniformly in the laboratory. Twelve samples of each soil were placed in the light bulb oven and twelve samples were placed in the standard oven. The average gravimetric soil moisture of the Gila soil was 0.214 g/cm3 for both ovens; the average Pima soil moisture was 0.332 g/cm3 and 0.331 g/cm3 for the traditional and light bulb ovens, respectively; and the Sonoran soil moisture was 0.077 g/cm3 for both ovens. These results demonstrate that the low technology light-bulb oven was able to dry the soil samples as well as a standard laboratory oven, offering the ability to make gravimetric water content measurements when a relatively expensive drying oven is not available.

H22D-0967 1330h POSTER

Ground and Space-based Sensor Web System: Streamlining Spacecraft Observation Response to Flood Detection.

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Some of the most important hydrologic phenomena occur in transient fashion and at arbitrary times over regions of varying scales. Major flooding events, such as those that have devastated parts of the world (e.g., major flooding from tropical storms and monsoon-induced activity), often result in tremendous loss of life, major structural damage, and notable modification of the landscape. Such flood-related phenomena can be readily sensed from orbital radar platforms to improve the scientific understanding necessary to mitigate their disastrous consequences. For example, satellite-based flood detection provides important information for governmental agencies monitoring disasters and supplies data to scientists seeking to understand the responses of surface processes to storm events at synoptic scales (e.g., see Dartmouth Flood Observatory, http://www.dartmouth.edu/artsci/geog/floods/). Efforts are underway to streamline the process by which data are obtained and processed in order to effectively monitor transient catastrophic flooding, perform timely hazard assessment, and appraise governmental agencies of pending disasters. The flood sensor web is an application of networked sensor technology that is being applied to flood monitoring. The flood sensor web system utilizes NASA QuikSCAT radar scatterometer data providing global coverage every 2.5 days. Vv/Hh polarity ratios from the radar return are computed and geolocated at JPL, this information is transmitted to Dartmouth, and anomalous results occurring within Dartmouth's global array of river measurement reaches are flagged for the next possible EO-1 acquisition. In addition, JPL automatically generates a spacecraft command sequence that is then transmitted to Goddard Space Flight Center for uplink to the Earth Observing 1 (EO-1) spacecraft. This enables rapid-response, high-resolution multispectral (ALI) and hyperspectral (Hyperion) observations to be obtained of the flood target as quickly as possible. Autonomous Sciencecraft Experiment [1] software onboard EO-1 can then process the data and report the change detection results (e.g., number and location of active pixels). [1] Chien et al. (2003) LPSC34 abstract #1458.

URL: http://ASE.jpl.nasa.gov

H22D-0968 1330h POSTER

Statistical Relationship Between Drought Indices and NDVI Departure at Regional Scale

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In recent years, satellite data have become widely available at global scales and resolutions that are adequate for monitoring drought conditions. Therefore the development of drought monitoring tools that can benefit from such data holds the potential for improving the timeliness and access to drought information without the cost of extensive ground monitoring stations especially in developing countries where meteorological networks are sparse at best, if at all available. This work is motivated by the need to develop a satellite-based drought monitoring tools. The objective is to contribute to the development of such tools through detailed analysis of existing widely used drought indices and information that can be generated from widely used satellite vegetation data. To accomplish these objectives, time-series of several widely used drought indices such as the Palmer Drought Severity Index (PDSI), derived from meteorological data, are analyzed in conjunction with concurrent time series of a coarse resolution Normalized Difference Vegetation Index (NDVI), derived from the Advanced Very High Resolution Radiometer (AVHRR) imagery. In this study, the relationships between several "palmer-based" drought indices and the departure of NDVI from its long-term mean were investigated over semi-arid climate regions in the state of Arizona. The crosscorrelation analysis shows an agreement between the NDVI data and three out of the four Palmer drought indices as far as the spatial distribution is concerned for all climate regions. The subscaling of NDVI data from climate division to vegetation cover type has improved the crosscorrelation between NDVI and drought indices. This test showed positive and stronger correlation for particular vegetation covers such as open shrublands and needleleaf forest.

H22E MCC: 3024 Tuesday 1340h

Early Results From NASA's EOS Aqua Spacecraft Mission I *(joint with A, OS)*

Presiding: **C L Parkinson,** NASA Goddard Space Flight Center**; S Platnick,** NASA Goddard Space Flight Center

H22E-01 1340h INVITED

Potential for Observing the Global Water Cycle from Space

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The fundamental challenge in observing the global water cycle is to understand where the water is, and where it is moving. Of course, the answer to the "where is it?" question is "mostly in the oceans and ice sheets", but when one considers relative mobility, the focus becomes somewhat different. From the standpoint of the land surface, moisture stored in the atmosphere, and especially that released from the atmosphere as precipitation and returned to it as evapotranspiration, are the largest fluxes over most of the globe. Runoff and streamflow, although usually a somewhat smaller fraction of precipitation than ET, are critically important, as they are the source of or contribute directly to much of the water available for human use. Water stored in the subsurface, especially as soil moisture, controls vegetation moisture stress, and hence ET under many conditions. Soil moisture "antecedent conditions" are well known to affect storm runoff production as well. Furthermore, groundwater and variations therein are important both for human use, and through interactions with soil moisture and streamflow, depending on the particular conditions. Current estimates of the terms in the global water cycle are based primarily on in situ observations. For instance, over land, most estimates of precipitation are primarily gage-based. The same is true of streamflow. ET is measured directly only at a relatively small number of sites; large area estimates are primarily based either on the difference between precipitation and runoff (ignoring storage change in the long-term mean) or atmospheric budget analyses. Soil moisture, groundwater, and snow storage (except glaciers) are generally not well enough measured to provide quantitative estimates, except through use of models. Of the major terms on the land surface branch of the global water cycle, most terms (precipitation, streamflow, soil moisture, and snow water storage) are more or less directly

observable from space, albeit at different (and sometimes incompatible) time and space scales. ET is observable only somewhat indirectly, as is groundwater storage. Space-based observation of many, if not most, terms in the global water cycle has considerable advantages, and poses a number of challenges as well. A major advantage of space-based observation is the potential for a truly global observing strategy, free from logistical complications of in situ observations. On the other hand, some terms are not easily observable, if at all. The potential and challenges of a true space-based global water cycle observing system are discussed, with particular focus on the land surface, but considering other aspects of global moisture storage and flux as well.

H22E-02 1410h INVITED

Global Water Cycle Measurements From the Advanced Microwave Scanning Radiometer for EOS (AMSR-E)

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The Advanced Microwave Scanning Radiometer for EOS (AMSR-E) was provided by the National Space Development Agency of Japan (NASDA) to fly on NASA's Aqua satellite. AMSR-E has a wide variety of hydrologic science applications. Retrievals currently being made from the data include: all-weather sea surface temperatures; precipitation; oceanic surface wind speed, integrated cloud water, and water vapor; soil moisture; sea ice parameters; and, snow cover parameters. The AMSR-E performance has been, on the whole, excellent. AMSR-E carries 20 channels, with the highest spatial resolution yet achieved from space, at dual polarized frequencies ranging from 6.9 GHz to 89 GHz. A variety of field experiments supporting validation of most of the geophysical retrieval algorithms have now been completed.

URL: http://wwwghcc.msfc.nasa.gov/AMSR

H22E-03 1425h

On-Orbit Calibration of AMSR-E

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AMSR-E has an on-board 2-point calibration system that continuously compensates for variations in the radiometers gain and noise temperature. The two vital components of this calibration system are the cold mirror and the hot reference load. The cold mirror provides a clear view of deep space, which is at a known temperature of 2.7 K. The hot reference load acts as a black-body emitter and its temperature is measured by precision thermistors. Unfortunately, the design of the AMSR-E hot load is flawed. During the course of an orbit, large thermal gradients develop within the hot load due to solar heating making it difficult to determine the average effective temperature from the thermistor readings. A solution to the hot load problem has been found. Using the existing network of satellite radiometers, we developed a technique for estimating the effective temperature of the AMSR-E hot load. Remote Sensing Systems maintains a real-time database containing daily observations from U.S. operational satellites. These satellite observations are collocated in time and space with the AMSR-E observations. The collocated observations are then processed by a radiative transfer model that computes the intensity of radiation entering the AMSR-E feedhorns. In essence, this process provides an earth-target calibration point. A 2-point linear extrapolation based on the cold mirror and earth-target calibration points yields the desired quantity: the effective temperature for the hot load. The effective temperature is then correlated with variations in the hot load thermistors, and an expression is found that gives the effective temperature as a function of the thermistor array.

URL: http://www.remss.com

H22E-04 1440h

Validation of Snow Cover Information Derived From AMSR-E Data Over Canadian Regions

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CRYSYS (Cryospheric System in Canada) has been an Interdisciplinary Science Investigation (IDS) in NASA's Earth Observing System Program since 1990, hosted and funded by Canadian agencies and universities, with the lead being the Meteorological Service of Canada (MSC). One of the main objectives of CRYSYS is to develop capabilities for improved satellite-based measurement, monitoring and understanding of cryospheric variables over a range of spatial and temporal scales over Canada (for further information see www.crysys.ca). As an EOS IDS team, CRYSYS has a particular interest in cryospheric information derived from EOS sensors. The development, application and validation of methods to extract snow cover information from passive microwave sensors has been a major research thrust within CRYSYS. Algorithms that derive snow water equivalent (SWE) have been developed by the Climate Research Branch (CRB) of MSC and CRYSYS university collaborators and validated for a number of landscape regions including prairie, boreal forest and taiga. The CRB SWE algorithms are used with SSM/I data to generate regional snow cover products that are being used to support a number of research and operational applications. With the launch of the Advanced Microwave Scanning Radiometer (AMSR-E) on the EOS Aqua satellite in May 2002, a new source of passive microwave derived snow cover information became available. AMSR-E offers the potential for retrieval of enhanced SWE information over Canadian regions, particularly with its higher spatial resolution (10 km) than previous satellite microwave radiometers such as SSM/I (25 km). Validation of snow cover information from AMSR-E data is a priority research activity within CRYSYS, and is a contribution to the EOS AMSR-E Science Team validation program. During the winter of 2003, two CRYSYS field campaigns were conducted with a specific focus to acquire data sets in support of AMSR-E snow cover validation over Canadian regions. The first campaign was conducted February 2003 in the prairie and boreal forest regions of Saskatchewan in western Canada and involved the acquisition of airborne microwave radiometer data and ground-based measurements of snow cover properties. The second campaign occurred March 2003 in the James Bay region of Quebec in eastern Canada, involving ground-based measurements of snow cover properties along a 600 km transect transitioning from boreal forest to taiga landscapes. This paper will present initial results of the evaluation of AMSR-E derived snow cover information using data acquired during these CRYSYS validation campaigns. An overview of CRYSYS snow cover validation campaigns planned for the upcoming winter 2004 and beyond will also be presented. Validation data sets from the 2003 field campaigns and future ones will be available to the scientific community via the Canadian Cryospheric Information Network (www.ccin.ca).

URL: http://www.crysys.ca

H22E-05 1455h

AMSR-E Soil Moisture Validation Efforts in the Australian Arid Zone

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Soil moisture content, a vital land surface parameter throughout a wide range of applications, is one of two land surface products to be produced from the AMSR-E (Advanced Microwave Scanning Radiometer for the Earth observing system) instrument on board NASA's Aqua satellite. Using the brightness temperature data at 6.6GHz, average soil moisture content for the surface 1cm layer will be produced on a 25km x 25km grid. In order for this information to be useful, it must first be "validated". In Australia, validation efforts are underway in the temperate and arid zones. This talk will concentrate on results from the arid zone, which comprises 70% of Australia. Four sub-areas were chosen for this exercise (Sturt Stony Desert, Simpson Desert, Western Lake Eyre Basin and Stuart's Shelf), rather than a single large area, so that a wider range of arid zone land cover and climatic conditions could be covered. Each site was approximately 60km x 60km, so that measurements were made across almost an entire sensor footprint (45km x 70km). Monitoring of each site was undertaken on two different occasions; June and September 2003. Measurements of soil moisture content (1cm thermogravimetric and 6cm Theta probes) and supporting data (fraction of bare soil, rock, grass, shrub and trees, vegetation water content and soil temperature) were made along station tracks and access roads with a spacing of approximately 5km. A base station continuously monitored air and soil temperature throughout the day. As many as 100 GPS located measurements were made across any one site. On several occasions rain fell overnight and a repeat sampling was undertaken on the following day. Validation of the AMSR-E soil moisture product includes direct comparison with the average ground-measured near-surface soil moisture content at each of the four sites on each of the field measurement days throughout the year. AMSR-E and ground measured near-surface soil moisture estimates are also compared with those from other passive microwave remote sensing soil moisture algorithms. Moreover, current algorithms do not make any explicit account for the presence of surface rock, a significant attribute in much of the arid zone landscape. This data set allows the effects of rock cover to be assessed.

URL: http://www.civenv.unimelb.edu.au/~jwalker

H22E-06 1510h

A Budget of Equatorial Kelvin Waves as Observed in AIRS Data

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AIRS is the first satellite instrument to offer coverage sufficient to map and characterize Kelvin waves in the stratosphere and troposphere. It generates temperature profiles with 1-K accuracy at 1-km vertical resolution in the troposphere above cloud tops and humidity profiles with 10% accuracy at 2-km vertical resolution below 300 hPa. Profiles at an individual site are obtained twice daily, at 1:30 am and pm, with a horizontal resolution of 50 km. The swath width is 1500 km. We will present an analysis of temperature and humidity fluctuations associated with tropical Kelvin waves by two different analyses. In the first, we bin temperature and humidity fields from the AIRS level 2 retrieved product into 15° longitude bins and 2 days in time, Fourier transform in longitude and time, and, with information on phasing in the vertical dimension, identify modes according to the gravity wave dispersion relation. The large horizontal and temporal bins are necessary to overcome the sounding gaps at low latitude which result from AIRS being a nadir sounder. In the second, we fit temperature and humidity fluctuations to a wave model using Bayesian interpolation, thus overcoming the necessity of binning. With Bayesian interpolation it is possible to fit an atmospheric timeseries to a desired physical model—horizontally propagating waves in this case—while simultaneously distinguishing the waves from the noise of other atmospheric fluctuations. Our final results will be a characterization of the sources and sinks of Kelvin wave activity in the troposphere—to be accomplished by examining momentum flux—and a map of phasing between temperature and humidity fluctuations associated with Kelvin waves which should reveal something about the nature of wave-convection interactions. If AIRS satisfies its design requirements of 1-K temperature accuracy with 1-km vertical resolution, it should easily be able to resolve the temperature fluctuations associated with Kelvin waves.

H22E-07 1525h

Case Studies and Analyses of AIRS Retrievals over Ocean

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The Atmospheric Infrared Sounder (AIRS) instrument on the Aqua spacecraft observes nearly 3 million high-resolution infrared spectra daily. These observations, along with those from companion instruments Advanced Microwave Sounding Unit and Humidity Sounder for Brazil, are inverted via a retrieval algorithm to obtain geophysical quantities at about 300,000 50-km wide fields of view daily. Retrieved quantities include cloud cleared radiances, sea surface temperatures, cloud fraction, cloud top pressures and temperatures, and profiles of temperature and water vapor. We describe here case studies of retrieved quantities for several atmospheric regimes observed by the AIRS instrument suite over ocean during the month of January 2003 in the latitude band 40 S to 40 N. These regimes include shallow and deep tropical convection, regions of temperature inversions with associated low-level clouds, and conditions near the midlatitude storm tracks. These studies are intended to establish the foundation for more detailed examinations of atmospheric phenomena observed by AIRS. We also present initial results of a multiparameter analysis of AIRS retrieved products using a statistical clustering method.

H22F MCC: 3020 Tuesday 1340h

Recent Advances in GIS and Data Visualization in Regional-Scale Groundwater Modeling II

Presiding: **C Zheng,** University of Alabama**; P Hsieh,** U.S. Geological Survey

H22F-01 1340h INVITED

Arc Hydro Groundwater Data Model - A GIS Framework for Groundwater Information

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A progress report on the development of the groundwater section of the Arc Hydro data model is presented. The Arc Hydro surface water data model is a synthesis of geospatial and temporal information that characterize a “hydrologic information system” which supports hydrologic analysis and modeling in the ArcGIS environment. In order to better describe the full hydrologic cycle a groundwater section is developed to be incorporated into Arc Hydro. The integration of the groundwater data model will enable the characterization of surface water and groundwater simultaneously within ArcGIS. Representing the 3-dimensional nature of the subsurface and describing the hydrogeologic architecture of groundwater systems in a GIS framework is an important aspect of this study. The data model is designed to be scalable and will support the management of regional scale data as well as site scale information. The model will also describe surface water - groundwater connectivity by connecting the existing surface water data model with the groundwater section developed. The representation of groundwater systems will be utilized to develop interfaces between the ArcGIS environment and groundwater models such as MODFLOW.

H22F-02 1355h INVITED

Visualizing and Analyzing Geologic and Hydrologic Models of the Death Valley Regional Ground-water Flow System, Nevada and California

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Numerical modeling of the Death Valley regional ground-water flow system, Nevada and California, involves the conceptualization and simulation of a complex and heterogeneous geologic and hydrologic system. The hydrogeologic characteristics of the region result from an arid climate and complex geology. Interbasin regional ground-water flow occurs through a thick Paleozoic carbonate-rock sequence, a locally thick Tertiary volcanic-rock sequence, and basin-fill alluvium. Throughout the system, deep and shallow ground-water flow may be controlled by extensive and pervasive faults and fractures. Understanding ground-water flow requires the formulation of conceptual and digital models that characterize the three-dimensional (3D) hydrogeologic framework within which the water moves. Part of this study includes the construction of a digital 3D geologic model that provides a description of the geometry and composition of the hydrogeologic units and structures that control ground-water flow. These hydrogeologic units and structures are then simulated in the hydrologic model using the Hydrogeologic Unit Flow (HUF) Package and the Horizontal-Flow Barrier (HFB) Package of the ground-water modeling code MODFLOW-2000. The HUF Package allows the geometry of the hydrogeologic units to be defined explicitly using hydrogeologic units that can be different from the defined flow-model layers. The HFB Package allows the simulation of features that retard flow. Likewise, zone and multiplication arrays can be utilized to incorporate hydraulic property detail, such as facies changes within a particular unit. Utilizing these capabilities significantly contributes to the ability of the modeler to better simulate the hydrogeologic conceptual model of the flow system. As geologic and hydrologic modeling software increase in complexity, modelers have the ability to better visualize and interact with the simulated hydrogeologic system and flow-model results. Post-processing utilities such as MODPATH and ZONEBUDGET allow the calculation of information helpful for analyzing the vast quantities of data. New and existing geographic information system (GIS) techniques can be used to visualize these results, such as flow paths and water-budget data, as well as water-level altitudes, hydrogeologic units, zone arrays, and flow-model layers. For example, three-dimensional views of particle paths along with the geometry of hydrogeologic units and structures provide insight into which features may be controlling ground-water flow paths. Employing GIS to develop maps of flux in and out of particular parts of the system aids in the visualization of the water budget. In addition, with the advent of the newer techniques and modeling tools the scientist can better explore the links between the hydrogeologic framework and the flow system. For instance, the scientist may conduct hypothesis testing regarding the hydraulic parameters associated with specific units or features based on visualizations analyses performed with the aid of GIS. Thus, the power of combining the GIS techniques and modeling packages is that, in addition to helping the scientist calibrate the ground-water model, it allows the scientist to test the degree to which the flow-model results match the conceptual model.

H22F-03 1410h

Ground Water Data Management Using the ArcObjects Library

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The principal advantage of utilizing GIS technology for regional ground water modeling is that it allows the model development to occur on the conceptual model level. The principal model features can be defined using points, arcs, and polygons. For example, production and observation wells can be input as points. Rivers, drains, and head-dependent boundary conditions can be defined using arcs. Lakes, recharge zones, seepage faces, and hydraulic conductivity zones can be represented using polygons. Once the conceptual model has been defined, the model can be discretized to the model grid. The feature objects are intersected with the model grid to determine which cells coincide with each model feature. The cell-by-cell model input can then be automatically extracted from the feature object data. This conceptual model approach has numerous advantages: 1. Model development much is more efficient since the tedious discretization process can be automated. 2. Since the conceptual model is defined independent of the model grid, the modeler can quickly test various grid resolutions. 3. Existing GIS data can be integrated into a modeling project with minimal effort. When building a GIS-based ground water modeling tool, one of two approaches is typically used: 1) the tools be built entirely within an existing GIS such as ArcGIS, or 2) the tools can be built in a stand-alone program that imports data provided by a GIS. There are several advantages/disadvantages to each of these methods. We have chosen to build our system in a stand-alone program called the Groundwater Modeling System (GMS). The Map Module in GMS provides an interface for building conceptual models and converting conceptual models to a variety of models including MODFLOW & MT3DMS. One important component of a GIS-based modeling system is the capability to import GIS data. Traditionally, we have used the “shapefile” format for importing and exporting GIS data. The shapefile format is a fairly simple file format designed for exchanging GIS data. The main drawback of the shapefile approach is that not all GIS data are available in shapefile format. Recently, we have developed an entirely new method for importing GIS data for ground water modeling. This method is based on the new ArcObjects software library provided with the ArcGIS software. With ArcObjects, it is possible to embed a large portion of the ArcGIS functionality directly within your own application, provided that ArcGIS has been installed on the computer running the software. In GMS, we have developed a new “GIS Module” that incorporates the ArcObjects technology. With the ArcObjects tools, we can use the native ArcGIS “Add Data” dialog box to open virtually any GIS database supported by ArcGIS. We can then plot the imported database using the ArcObjects code, resulting in high quality map displays. In many cases, a GIS database contains substantially more information than is required by a modeling study. Using the ArcObjects code, we can select a subset of the database either by a graphical selection or by an SQL query. The selected data are then transformed to the format used by GMS for defining the conceptual models. When GIS data are initially developed, the format and naming conventions used are often non-standard. During this transformation process, the user is allowed to identify a filter for the attribute table that controls how the feature object attributes are to be mapped to the corresponding conceptual model attributes.

H22F-04 1425h

Role of the Analytic Element Method in regional-scale GIS-based modeling of groundwater flow and transport

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The basic principle of the Analytic Element Method (AEM) is the superposition: complex regional-scale flows are simulated by adding the influences of individual analytic elements. Each analytic element contains geographic information and mathematical functions that describe its influence on regional groundwater flow. The main AEM advantage, relevant to GIS-based modeling, is a direct correspondence of analytic elements and hydrologic aquifer features (such as lakes, rivers, water-supply wells). The flow solution (water table elevation and fluxes) is created without discretization by including all relevant elements (or features). Several regional-scale groundwater models have been developed using the AEM include NAGROM (the National Groundwater Model of The Netherlands) and the Twin Cities Metropolitan Area Groundwater Model (Metro Model). The one-to-one correspondence of elements to hydrologic features allows for elegant integration of groundwater modeling and GIS software. This simplifies both model development and management. In contrast to finite-difference and finite-element based methods, the AEM does not require any grid-based data; all input data are vector-based. This representational style coincides well with the strengths of Geographic Information Systems. This presentation will focus on both the practical aspects of the AEM relevant to GIS-based modeling and the development of a new GIS-based user interface for AEM modeling. Recent computational advances related to regional-scale modeling using AEM will be discussed and demonstrated. These advances include (1) development of solution algorithms designed for massively parallel supercomputers where the same advantage (one-to-one correspondence of analytic elements and hydrologic features) is responsible for efficient implementation in parallel environments, and (2) algorithm enhancements designed for single-processor machines. Groundwater models with thousands of elements can hence be solved. A public domain GIS graphical user interface has been developed to aid in model construction and output visualization within the ArcGIS® software program ArcMap. The ArcGIS platform can handle multiple formats of geographically referenced field data in conjunction with input and output of the numerical model itself. The user interface, using many extensions available in ArcGIS, provides advanced functionality for analysis of model output and simplification of user input. The application is currently being used to develop a regional scale model of the Trout Lake area in northeastern Wisconsin.

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H22F-05 1440h

An Innovative Real-time Environment for Unified Deterministic and Stochastic Groundwater Modeling

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Despite an exponential growth of computational capability over the last two decadesone that has allowed computational science and engineering to become a