John Criscione
Abstract for Presentation
Dr. Yu, GEY 715

Publication: Jones, Norman L., Davis, R. Jeffrey, and Sabbah Walid, 2003, A Comparison of three-dimensional interpolation techniques for plume characterization: Ground Water, vol. 41, no. 4, p.411-419.

Abstract

When addressing a contaminated site, the development of a remediation strategy and performing an accurate site characterization is paramount to the ultimate cost and success of the clean-up operations. During the site characterization phase, wells are constructed and chemically sampled at different screened intervals. From the chemical analysis from individual determinations the typical approach is to interpolate the concentration values to the nodes of a grid, which is then used to generate a concentration contour map. This approach leads to the development of a three-dimensional grid that surrounds the sampling locations. Once this interpolation is completed, the plume can be visualized by selecting threshold concentration values and generating iso-surface plots using interpolated value at the grid nodes.

With this in mind, Jones et al. (2003), researched commonly used interpolation schemes such as: kriging; natural neighbor, and inverse distance weighted, to characterize three-dimensional plumes from four actual data sets. They tested the accuracy of each scheme by using a cross-validation approach, by comparing each scheme results to the other, and by studying the effects of various interpolation parameters. A summary of their findings is that: the kriging method resulted in the lowest error at three of the four sites; the inverse distance weighted method resulted in lower interpolation error at one site and performed well overall; and the natural neighbors' method resulted in the highest average error at all four sites, but performed well with clustered data. Additionally, they recommended that along with the interpolation method, it is important that the data be cross-checked with information such as: if there is a good knowledge of the stratigraphy, if the plume is floating on the water table and if there is a good cross-validation between interpolation parameters and methods used.

A 1-Dimensional Hydrologic Model of Pesticides in the Scheldt Estuary, The Netherlands

by Peggy Elliott

Pesticides are widely used around the world. Many studies have shown that pesticides are present in lakes, rivers and groundwater, but not much work has been done on the analysis of pesticides in the marine environment. Therefore, a one-dimensional hydrologic model was developed to analyze the relationship between dissolved concentrations of four pesticides (dichlorvos, simazine, atrazine, and metolachlor) and salinity in the Scheldt Estuary, The Netherlands. The model consisted of a method to calculate the net flux of pesticides through the Scheldt Estuary and into the North Sea. The model was developed based on the following information. The estuary was divided into 21 segments to form the model grid. Dispersion

coefficients were calculated using salinity gradients. The flushing time of the estuary was the sum of the flushing time of each segment in the grid. An estuary loss constant was determined first by simulating the model with no loss constant, then the model was simulated until a loss constant was found that best fit plots of experimental data for each pesticide. The loss constant and flushing time were used to calculate effective concentration of the pesticides. The net fluxes of pesticides, which were calculated from the effective concentration and the mean annual flow in the estuary, were compared to gross flux concentrations in the Scheldt River. The gross flux values were corrected with the estuary loss constants simulated in the model. The results of this study show that dispersion coefficients varied from 150-300m^2 s^{-1}, and the flushing time of the estuary ranged from 25-95 days. A comparison of the net fluxes and corrected gross flux values indicate the amount of dichlorvos and simazine that reach the North Sea were reduced by 96 and 64%, respectively. Atrazine and metolachlor had no losses within the estuary. However, metolachlor had an increase in concentration indicating an additional source of this pesticide in the estuary.

Horrison Steed

Abstract

Selroos Et al. "Comparison of Alternative Modelling Approaches for Groundwater Flow in Fractured Rock" Journal of Hydrology Vol 257, 2002 p174-188

This article compares the effectiveness of different conceptual models using the Alternative Flow Models (AFM) Project for groundwater flow in fractured rock. It compares three different model types, Stochastic Continuum, Discrete Fracture Network, and Channel Network. These approaches use the Monte Carlo method to address spatial variability. The values compared use three parameters, travel time, transport resistance, and canister flux. Overall the different methods use the same boundary conditions and hydrogeology and thus the only difference between them is the variability of the methodology.

Class Presentation: GEY-715 Advanced Hydrology
Instructor: Zhong Yu
Prepared by: Tesfaye Zewdu
Title:

The validity of using a simplified distributed hydrological model for estimation of landslide probability under a climate change scenario

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Abstract

This paper describes a simple GIS-based slope-hydrology model, and examines its potential for use in estimation of future landslide activity with respect to climate change. The model was calibrated for humid-temperate (U.K.), and sub-humid (SE Spain) environments, and was found to simulate current water table fluctuation to a reasonable standard using just rainfall and temperature data. The implications of predictions produced using longer term downscaled GCM data are more debatable. If the sensitivity of the model to the natural variability of the input data is high for example, the model may not be able to distinguish more subtle longer-term changes in landslide activity. By comparison of model prediction for past climate data with that predicted for the future, an insight into how landslides might respond to climate change can be obtained. It is concluded that more useful prediction might be obtained by determining landslide sensitivity to the changing variability of the climate. Identifying the threshold conditions needed to cause instability might do this.

Feng Pan

Assessing the response of subgrid hydrologic processes to atmospheric forcing with a hydrologic model system

Z. Yu

Abstract:

An integrated hydrologic model system (HMS) was developed and used to study hydrologic processes and systems responding to various climatic forcings. The modeling system operates with a time step of minutes to days to facilitate coupling with a mesoscale meteorological model (MM). The major emphasis with HMS is on the interaction among climate, land surface, surface water, and ground water. HMS utilizes spatially detailed information on climate, soil type, land use, digital elevation, and hydrologic parameters. The focus of this study was to improve the presentation of rainfall-runoff partitioning by implementing subgrid-scale spatial variability in precipitation and hydraulic conductivity. The practical application of HMS is demonstrated in the hydrologic simulation of a major sub-basin of the Susquehanna River Basin in Pennsylvania. Questions concerning data preparation, model calibration, and subgrid-scale spatial variability are addressed in the hydrologic simulation. The simulation without considering subgrid-scale spatial variability using both observed and MM5-simulated precipitations significantly underestimates the streamflow. The simulated and observed streamflows compare well in the simulation with consideration of the subgrid-scale spatial variability in precipitation and hydraulic conductivity, the simulated results using MM5-simulated precipitation were improved in terms of fit between the simulated and observed streamflows.

Aron Habte
Course: Advanced Hydrogeology (GEY 715)

Publication: Modelling submarine groundwater discharge: an example from the western Baltic Sea
V. Kaleris, G. Lagas, S. Marczinek and J. A. Piotrowski

Abstract
The investigation concerns the Eckernförde Bay in the western Baltic Sea, where the interrelationship between the groundwater and saltwater intrusion is the case for the deterioration of water quality. The investigation accesses the submarine groundwater discharge (SGWD) defined as the net groundwater discharge to the sea and the typical characteristics of the spatial distribution of the groundwater outflow at the sea bottom. A large-scale groundwater model was established in order to model groundwater flow toward the sea. Due to insufficient field data, different scenarios were simulated in order to approximate the value of SGWD. It is found that the probable range of SGWD in the study area per kilometer of the land–sea interface is from 0.05 to 0.07 m3/s. The distribution of the groundwater outflow rates at two sea bottom sites (pockmarks) was investigated using two approaches. First approach, where density effects were neglected, the distribution of the outflow rates at the two pockets differ considerably; that is, due to the difference in the hydraulic conductivity distribution, the distribution of the outflow rates in one pockmark is approximately uniform whereas in the other pocket it is concentrated in the edges. Second approach is when a density-driven flow is taken in to account where the distribution is non-uniform. In this case, for both hydraulic conductivity distributions, the groundwater outflow is displaced toward the edges of the pockmark. The approximately uniform distribution estimated by neglecting the density effects does not reflect the conditions at the sea bottom whereas the strongly non-uniform distribution does. The strongly non-uniform distribution of the outflow rates at local level cannot be used as mean values in order to estimate the total outflow over larger parts of the sea bottom.

Eric Dano
Regional groundwater modeling of teh Yucca Mountain site using analytic elements

M. Baker, E.I. Anderson, T.N. Olsthoorm, O.D.L. Strack

Journal of Hydrology 226 (1999) p. 167-178

Modeling regional groundwater flow in the area of Yucca Mountain presents two main problems. The first is the thickness of the aquifer and the second is the great distance to the boundary conditions. The regional flow system in southwest Nevada consists of fractured carbonate rock up to 5000 m thick, with boundary conditions on the order of 500 km from the Yucca Mountain site. Previous attempts to model the region utilizing multi layer models will be demonstrated to be unnecessary. Regional flow can be reliably modeled in a single layer three dimensional construct. Hydraulic conductivity in fractured limestone governed by open fractures and solution spaces, the amount of open space decreases with depth with a three order of magnitude difference thereby allowing for an average conductivity to be utilized in

a single layer. The single layer approach yields a match between measured and simulated heads consistent with more traditional methods previously conducted on a smaller scale.

Liqiong Zhang
Abstract for Presentation
Dr. Yu, GEY 715

Publication: Scott Painter, James Winterle, and Amit Armstrong, 2003, Using temperature to test models of flow near Yucca Mountain, Nevada: Ground Water, vol. 41, no. 5, p.657-666.

Abstract

A rough correlation exists between elevated groundwater temperatures in the fractured volcanic aquifer and the near vertical north-south trending faults of the Yucca Mountain. Because of this correlation, sometimes the analysis solutions are used in combination with observed temperature profiles to estimate vertical flow in one-dimensional systems.

As for the abnormal temperature distribution in Paintbrush fault zone near Yucca Mountain, Nevada, there are mainly two conflicting research results both in the study of geology and geochemistry. Some of researches suggested that the enhanced thermal in this region is caused evidently by the vertical flow, such as the results of the above one-dimensional models. The others demonstrated no significant vertical flow, such as Bredehoeft (1997)'s finding that no obvious phase shift between the M2 earth-tide signal and the pressure response is observed.

Here, new simulations based upon three-dimensional coupled flow and heat-transport model--METRA show that the increased temperatures can occur without obvious upwelling from the lower Paleozoic carbonate aquifer. And it maybe explained by the thickness and thermal insulation effects of unsaturated zones. But if the recharge is more than $400m^3/s$ along the 10km long fault from the blow aquifer, the calculated temperatures of the three-dimensional model are significantly higher than the observed ones. So results illustrate that both of the thickness and vertical flow may play roles in the temperature abnormality of the fault.

Summarily, the current study demonstrated that one-dimensional models have the potential limitations to interpret the ground water temperature and fully coupled three-dimensional models should be underscored.