Abstracts of Papers in the Journals of KAHS (March 1990 ~ December 1990)

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Development of Generalized Regression Model for Regionalization of River Floods

Cho, Kuk Kwang, Suwon Univ./Kwon, Soon Kuk, Seoul National Univ.

In this study, a regression model, which relates annual flood peak flows collected at streamflow gaging stations in the Han river and Nakdong river basin to both basin characteristics and precipitation data, is developed by using the generalized least squares method which can provide reasonable and unbiased estimator of error variance by separating error variance of the regression model into that due to model error and due to sampling error. This model may be used as a mechanism for transferring hydrologic information from the gaged sites to ungaged sites.

The Analysis of Geomorphologic Instantaneous Unit Hydrograph by the Channel Network

Cho, Hong Je, Assoc. Prof., Ulsan Univ./Lee, Sang Bae, Graduate Student, Ulsan Univ.

This study is developed the runoff analysis method that is used the geomorphologic instantaneous unit hydrograph to the relative role of network geometry in a basin.

The quantitative expressions for the geomorphologic characteristics of a basin are used Shreve's link sepration and width function method.

The network geometry are used Weibull's distribution as probability model of the width function, the structural characteristics of channel networks and the other geomorphologic parameters for the gaged basin.

A Comparison of Univariate and Multivariate AR Models for Monthly River Flow Series

Lee, Weon Hwan, Prof., Yonsei Univ./Shim, Jae Hyun, Graduate Student, Yonsei Univ.

The statistical analysis based on the past hydrologic data is required to set up the water resources development plan and design the hydraulic structures rationally. Because hydrologic

events have random factors implied, the sotchastic analysis is necessary.

In this paper, same order of stochastic models of monthly runoff data (multivariate AR(1) and AR(2) models, univariate AR(1) and AR(2) models) are applied to compare the statistical characteristics. The other purpose of this paper is to compare the monthly series, which is generated by univariate and multivariate models. By comparing and estimating of each simulated series, it is known that the multivariate models, imcluding the time and spatial colinearity, are better in prediction than univariate models in the analysis of monthly flow at south Han river basin.

Palnning of Streamflow Data Collection Network by Regionalized Regression Model

Cho, Kuk Kwang, Suwon Univ./Kwon, Soon Kuk, Seoul National Univ.

In this study, the effectiveness of existing streamflow data collection networks in the Han and the Nakdong River Basin is evaluated for various gaging plans of 5; 10; 15 and 20 years planning horizons by the nonlinear integer programming method, and also a technique for adjustment and planning of the existing network is provided for the purpose of increasing the efficiency of the network in terms of economy. The objective function is minimization of the average sampling mean square error of regional regression model with regression parameters estimated by generalized least squares method.

A Numerical Model for Cohesive Suspended Load Movement

Ahn, Soo Hahn, Prof., Seoul National Univ./Lee, Sang Hwa, Assist. Prof., Dong A Univ.

The concentration of cohesive suspended sediment is determined vy the circulation of water and the material dispersion. The equations of the two-dimensional, depth-integrated dispersive transport are the Reynolds equation, continuity equation, and advection-dispersion equation based on the Fick's law.

A finite defference method has been applied to two models of circulation and dispersion transport. The circulation model is solved by the explicit scheme and the dispersion transport model is solved by multi-operational scheme.

It is investigated whether advective terms are included when the equation of circulation is applied to the model.

For advection-dispersion equation, it Was also investigated about variations of suspended sediment concentration with respect to the critical shear stresses.

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Transverse Dispersion of Pollutant Solute in the Nonuniform Natural Channel - By Using the Cumulative Discharge Model -

Kang, Ju Bok, Prof./Park, Sang Gil, Assist. Prof./Kim, Won Gyu, Graduate

Student./Kim, Jong Hwa, Graduate Student, Pusan Univ.

A mathematical model is presented for predicting the steady state two-demensional distribution of solute concentration in the meandering nonuniform natural chnnel. The dispersion equation derived herein employs the transverse cumulative discharge as an independent variable replacing the transverse distance and that it is developed in an orthogonal curvilinear coordinnate system which follows the flow direction of natural channel. The prediction from the results of numerical model are compared with laboratory experiment data. It is found that results from simulation and experiments are in good agreement.

Evaluation of the Groundwater Flow in Fractured Rock Masses

Kim, Gye Nam, Researcher, KIAER./Kim, Jae Han, Prof., Chungnam Univ./Ahn, Jong Sung, Director, KIAER.

For a detailed understanding of groundwater flow in rock mass, the effect of major fractures, topography and coefficent of permeability has been evaluated. The numerical model of GFFP-WT was used for the purpose. The results indicate that in the granite porphyry layer with a small permeability, the direction of flow path changes due to convergence of equipotential lines, while the tralvel time changes due to the presence of fractures in rock masses.

Artificial Groundwater Recharge by Underground Piping Method

Ahn, Sang Jin, prof., Chungbuk Univ./Lee, Jong Hyoung, Instructor, Chungbuk Univ.

The method for artificial groundwater recharge can be categorized into two groups, ons is well method and the other one is scattering method. Underground piping method belongs to the latter group and it is to infiltrate water from porous pipes buried underground.

This paper shows the result of indoor experiment and numerical analysis concerning this method. The purpose of the study is to make the infiltration aspects and groundwater recharge in underground piping method. We have found that the recharge height is effect by the difference of water level and a distance of pipe laying.

Runoff and Unsteady Pipe Flow Computation

Jun, Byong Ho, Assoc. Prof., Korea Military Academy./Lee, Jae Chul, Graduate Student, Seoul City Univ./Kwon, Young Ha, Graduate Student, Dongkuk Univ.

For surcharge flow in a sewer, the slot technique simulates surcharge flow as open-channel flow using a hypothetical narrow open piezometric slot at the sewer crown. The flow in a sewer is described mathematically using the unsteady open-channel Saint-Venant equations.

In this study, the copmputer simulation medel (USS-slot) using slot techniques is developed to simulate the inlet hydrographs to manholes and the flow under pressure as well s free-surface flow in tree-type sewer networks of circular conduits. The inlet hydrographs are simulated by

using the rational method or the ILSD program. The Saint-Venant equations for unsteady open-channel flow in sewers are solved by using a four-point implicit difference scheme. The flow equations of the sewers and the junction flow equations are solved simultaneously using a sparse matrix solution technique.

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The Parameter Identification of Tidal Model on the Boundary-Fitted Coordinates

Kim, Gyung Soo, Graduate Student, Jeonbuk Univ./Lee, Jae Hyung, Assoc. Prof., Jeonbuk Univ./Lee, Dong Joo, Assoc. Prof., Kunsan Fisheries College/Park, Young Ki, Instructor, Jeonbuk Univ.

The Parameter Identification of 2-demensional estuarine model was carried out using new output ADI-FDM numerical semi-implicit scheme transformed in boundary fitted (BF) -coordinate. The hydrodynamic equations which is coupled with the transport equations were used as basic equations in the model. Thompsons's equations were used to transform governing equations into rectangular plane equations and his elliptic grid generation scheme was used to generate curvilinear grid system in BF-coordinates. The parameters to be identified are friction coefficient and disperse coefficient embedded in the governing equations. The numerical output scheme is tidally averaged salinity model in BF-coordinates. The algorithm to optimize norm of error between observations and calculations is the influence coefficient algorithm associated with least square criterion. The lumped model is considered in identification. This paper was concentrated on checking whether the new output scheme might be useful to identify parameters in estuarine salinity model or not. The proposed method was tested through experimental application With hypothetical simple model. The result of the test shows that the proposed method can be used for parameter identification in estuarine model.

Development and Applications of Hydrologic Model of Storm Sewer Runoff at Small Urban Area

Lee, Young Dai, Assist. Prof., Pusan Industry College/Park, Seung Woo, Assoc. Prof., Seoul National Univ.

The paper presents the development and applications of physically-based urban runoff analysis model, URAM, which is capable of simulating sewer runoff hydrographs and inundation conditions within a small urban catchment. The model coniders three typical flow conditions of urban drainage networks, which are over-land flow, gutter flow, and conduit flow during a storm. imfiltration, retention storage and flow routing procedures are physically depicted in model.

It was tested satisfactorily with the field data from a tested catchment having drainage area of 0. 049㎢. It was also applied to other urban areas and found to adequately simulate inundation areas and duration as observed during storms. The test results as well as model components

are described in the paper.

Hyetograph Model for Reservoir Operation during Flash Flood

Lee, Jae Hyoung, Assoc. Prof., Jeonbuk Univ./Sonu, Jung Ho, Prof., Seoul National Univ./Chung, Dong Kug, Full-time Lecturer, Hannam Univ.

Precise run-off forecasting depends on the ability to predict quantitative rainfall intensity. This study suggests a stochastic model for 1 hour order rainfall prediction. The model simultaneously predicts rainfall intensity at all telemetered rain-gauge locations. All model parameters, velocity and direction of storm movement, radial spectrum, dimensionless time distribution of rainfall, are estimated from telemetered and historical data for the basin being predicted. Also the estimated parameters are based on the previous study. The results are the influence of dimensionless time distributions on the prediction and the model on run-off.

Rainfall Excess Model for Forest Waterheds

Nahm, Sun Woo,Prof.,/Dongkuk Univ./Choi, Eun Ho, Graduate Student, Dongkuk Univ.

Considering the hydrological loss components such as evapotranspiration, interception, surface storage and infiltration, a rainfall excess model for forest watersheds is derived. The Morton model is adopted to estimate the evapotranspiration under the wetted environmental conditions. Canopy effects and ground cover interception storage rates are used to determine the net rainfall rates arrived on the surface soil. The infiltration capacity on the permeable surface is estimated from the revised Green-Ampt model derived for the natural unsteady rainfall events.

The rainfall excess model derived is applied with the data from Jangpyung watershed, one of the representative watersheds of IHP. Parameters which are calibrated with the data from ten storms, the hydrometeorological, land use and soil informations, and other researchers' papers are presented.

Redox Control in Break-point Chlorination of Ammonia

Ha, Sung Ryong, Researcher, New Japan Tech., Consulting Co./Saito, Shigea Kira, Water Quality Research Institute, Japan.

Foundational experiments are conducted to examine the applicability of redox control in break-point chlorination of ammonia on drinking water purification.

Through the research, the behauial affects by ph and temperature to a chloromine forming reactions are evaluated.

The possibility of redox control in breakpoint chlorination is recognized by drawing up the titration curve in terms of redox potential and $C\ell_2$ /N ratios.

A Model for Real-time Reservoir Operations during Flood Period I:Theory and Modeling

Shim, Myung Pill, Assoc. Prof., Inha Univ./Sonu, Jung Ho, Prof., Seoul National Univ./Park, In Bo, Prof., Kukmin Univ./Lee, Jae Hyong, Assoc. Prof., Jeonbuk Univ./Chung, Dong Guk, Assist. Prof., Hannam Univ.

The purposes of the reservoir operation during flood period are the reduction of the flood damage in the downstream reaches and the conservation of flood control for the later use. This paper presents a model of simulation technique to determine the real-time operating rules on an hourly basis. The objective of strategy is to minimize the maximum release through the spillway gates with cosideration of the uncertainties associated with the forecasted inflows. In this paper, a general procedure for solving this problem is described for a single and parallel reservoirs.

A Channel Flood Routing by Muskingum Method Incorporating Lateral Inflows

Kang, Inn Ju, Agricultural Development Corporation/Yoon, Yong Nam, Prof., Korea Univ.

Three-parameter Muskingum flood routing model which incorporates the inflows along side the river channel is applied for the Waegwan-Jeukpogyo reach of the Nakdong River using the flood data of 12 selected flood events experienced in this reach.

The flood routing equations for three-parameter model were expressed as a system of finite difference equations and the routing constants were directly computed by matrix inversion method. Then, the three parameters, which consist of the storage constants(K), weighting factor(x), and lateral inflow parameter(α), were determined from the computed routing constants.

The results of the present study showed that the model can predict with a fair accuracy the flood discharges at the downsteam end of the reach. The parameters K and x were seen as channel parameters which have close relations with the flood magnitude, whereas the lateral inflow parameter was shown to be strongly governed by the rainfall characteristics of the tributary watersheds contributing to the lateral inflows.

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A Study on the Analysis of Hydrologic Similarity of the Catchment Response(I)

Cho, Hong Je, Assoc. Prof., Ulsan Univ./Lee, Sang Bae, Graduate Student, Ulsan Univ.

The problems of hydrologic similarity among river basins was analyzed by a geomorphologic response model using Horton's ordering scheme. The Nash model was used for deriving the

geomorphologic response function, and for the optimization of the response function, incomplete gamma function and Rosso's regression equation were used.

The application of this method was tested on some observed flood data of Pyungchang river basin and Wi stream basin and Bocheong stream, and predictions of hydrologic response were compared with that of the Moment method.

The results show that the proposed model and dimensionless instantaneous unit hydrograph can be used for the runoff analysis of an ungauged basin and the analysis of hydrologic similarity.

Flow Characteristics for the Variation of Radius of Curvature in Open Channel Bends.

Yoon, Sei Eui, Assoc. Prof., Kyongki Univ./Lee, Jong Tae, Assoc. Prof., Kyongki Univ.

The flow characteristics varying with the rate of the radius of curvature to width (Rc/B) in open channel bends are investigated with a simplified numerical model, briefly. Secondary flow velocity and transverse bed slope are formulated from the equations of moment of momentum and force balance analysis, respectively.

The conservation equations of mass and streamwise momentum are simplified by depth integration and its solution could be obtained form explicit finite difference method. Three sets of computer simulation are executed. The rates of Rc/B adopted in simulations are 2. 7, 5. 4 and 8. 1 respectively.

The terms analyzed in this paper are secondary flow velocity, streamwise velocity, the path of maximum streamwise velocity, deviation angle, and mass-shift velocity.

Turbulence Models for the Surface Discharge of Heated Water

Choi, Hung Sik, Researcher, Agricultural Development Corporation/Lee, Kil Seong, Assoc. Prof., Seoul National Univ.

In order to predict the dispersion of a thermal discharge with strong turbulent and buoyant effects, the development of a numerical model using turbulence model and its application are significantly increased.

In this study, a 3-dimensional steady-state model for the surface discharge of heated water into quiescent water body is developed. For the model closure of turbulent terms the 4-equation turbulence model is used. For economic numerical simulation, the elliptic governing equations are transformed to the partially parabolic equations.

In general, the simulated results by the present model, agree well to the experimental results by Pande and Rajaratnam. The model charcteristics are presented in comparison with the predicted results of the 2-equation turbulence model by McGuirk and Rodi. Applying the 4-equation turbulence model to the Korea nuclear unit 1 at Kori site, feasibility and efficiency of the present model are validated.

Hydrological Study of the Freezing in Summer at the Ice Valley, Korea

Bae, Sang Keun, Assist. Prof., Keimyung Univ.

In the Ice Balley, it freezes in summer season. However there is no ice during winter. In order to clarify the phenomenon of unusual temperature numerical experiments were conducted using the coupled equations of fluid flow and heat transfer. The results demonstrated that temperature inversion in the Ice Valley is primarily due to delay of the groundwater temperature. Also, the results of the simulation suggest that major factors affecting the delay are the topographical configuration, geological factors and groundwater flow system, combined with groundwater recharge and discharge systems.

Numerical Simulation of the Floodwave Analysis Resulting from Dam Failure - Floods on Dry Bed from Instantaneous Dam-Break -

Han, Kun Yeun, Assist. Prof., Kyongbuk Univ.

Numerical model for the floodwave propagation on dry bed which is resulting from the instantaneous failure of a dam has been developed by moving Hartree scheme. The numerical simulation result of the model has good agreements with the observed data by WES in terms of stage hydrograph and characteristics profiles. The model would contribute effectively to forecast the flood on dry bed resulting from instantaneous dam-break.

A Design of an Expert System for the Treatment and the Routing of Contaminated Groundwater

Sung, Kee Won, Graduate Student/Sonu, Jung Ho, Prof., Seoul National Univ.

The domain of contaminated groundwater flow is a broad and multidisciplinary field requiring expertise in engineering geology, chemistry and toxicology and is a ideal area for the application of Expert System. The Expert System which is developed in this research can assist user to find possible remedial actions in case that the groundwater was contaminated with toxic pollutants. Documentation including the degree of toxicity, the possibility of chemical reaction and concentration of pollutant can be supported also. Prolog an artificial intelegence programming language is used to implement the prototype expert system. This expert system can explicitly advise users about contaminants toxicity, possibility reaction with other chemicals and their concentrations.

Numerical Models for the Surface Discharge of Heated Water:Comparative Evaluation of Jet Integral Models

Choi, Hung Sik, Researcher, Agricultural Development Corporation/Lee, Kil Seong, Assoc. Prof., Seoul National Univ.

The qualitative and quantitative prediction for the dispersion of thermal discharge from

nuclear/fossil power plant steel works etc. has significant roles for the cooling system design and environmental management.

In this study, the several important physical properties for the behavior of a thermal discharge with strong turbulent and buoyant effects are described. The comparative evaluation between MIT and PDS models is carried out which have the different model structures.

In general, MIT and PDS models are commonly used to calculate the thermal discharge behavior with considering the ambient current and the angle of jet in an unstratified water body. The simulated results by these models have great discrepancies due to the different assumptions in modeling.

A Model for Real-time Reservoir Operations during Flood Period :Single Reservoir Operating Rules at Daecheong Dam

Shim, Myung Pill, Assoc. Prof., Inha Univ./Park, In Bo, Prof., Kukmin Univ./Sonu, Jung Ho, Prof., Seoul National Univ./Hwang, Man Ha, Instructor, Jeonbukl Univ.

Real-time reservoir operation models during flood period require optimization of hourly releases from the input data through on-line system and predicted values. An algorithm of the simulation model to resolve the problem has already been reported with formulation of objectives to minimize the flood damage in downstream reaches and to conserve water at the end of operation for the later use. This paper presents an application of the model to a single reservoir system at the Daechong Dam during flood and the results are reviewed. This paper also reviews measured inflows and releases in the past. The model is applied to the flood hydrographs of several return periods assuming different reservoir levels at the beginning of the operation. Also it demonstrates the simulation of test run with inflow forecasts obtained by rainfall-runoff model and compare the results. As a result, the model can use efficiently the flood control capacity with consideration of risk factor for the uncertainties associated with inflow forecasts.