A Conceptual Model of Drought Characterization Across the Climatic Spectrum
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A conceptual model of drought characterization across the climatic spectrum is developed. Drought duration, intensity, and recurrence interval are expressed in terms of the ratio of mean annual precipitation to annual global terrestrial precipitation. The model is useful as a framework for the systematic analysis of droughts and the assessment of changes in drought characteristics due to climatic changes.

Application of ANN for Reservoir Inflow Prediction and Operation
Jain,S.K., A. Das and D.K. Srivastava,

Journal of Water Resources Planning and Management, ASCE, 125(5), 263-271, 1999.

Artificial Neural Networks (ANNs) are new computing architectures in the area of artificial intelligence. The present study aims at application of ANNs for reservoir inflow prediction and operation. The Upper Indravati multipurpose project, in the state of Orissa, India, has been selected as the focus area. The project has primarily two objectives: to provide irrigation to 0.128 million ha. of agricultural land and to generate 600 MW of electric power.

An ARIMA time-series model and an ANN based model were fitted to the monthly inflow data series and their performances were compared. The ANN was found to model the high flows better while low flows were better predicted through ARIMA model. Reservoir operation policies were formulated through the dynamic programming. The optimal release was related with storage, inflow and demand through linear and non-linear regression and ANN. The results of inter-comparison indicate that the ANN is a powerful tool for input-output mapping and can be effectively used for reservoir inflow forecasting and operation.

Two-Dimensional Analysis of Dam-Break Flow in Vertical Plane
Mohapatra P K, V Eswaran and S M Bhallamudi

ASCE, Jour. of Hydraulic Engineering, Vol.125, No.2, pp.183-192, 1999

This work presents numerical computations for the analysis of Dam-Break Flow using two-dimensional flow equations in a vertical plane. The numerical model uses the general approach

of the simplified marker and cell method combined with the volume of fluid approach for the surface tracking. The time evolution of the flow depth at the dam site and the evolution of the present distribution are investigated for both wet and dry bed conditions. The effect of the initially nonhydrostatic state on the long-term surface profile and wave velocity are studied. These long-term effects are found to be marginal in the case of wet-bed conditions, but are significant on the dry-bed conditions. The dry-bed tip velocity immediately after the dam break, computed numerically, compares well with analytical results published previously. The time taken to obtain a constant flow depth at the dam site increases with decreasing initial depth ratio. The numerical results for this time elapse for dry-bed conditions is close to the experimentally obtained values.

Global Climate Change, Sustainable Development and Environmental Ethics
V M Ponce and Sudhir Kumar

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A systemic analysis leads to the conclusion that the current global climate change is caused by two types of anthropogenic combustion: (1) fossil-fuel combustion, and (2) permanent indirect artificial combustion. These combustions are returning carbon dioxide to the atmosphere at rates far exceeding natural rates of geological and biological carbon sequestering. Human societies cannot continue their over-reliance on fossil-fuel combustion to support their economic development. For development to be sustainable, it must be redefined in such a way that it minimizes permanent indirect artificial combustion.

Groundwater Recharge By Channel Infiltration In El Barbon Basin, Baja California, Mexico
Ponce, V. M., Pandey, R. P. and Kumar, S.

Journal of Hydrology, 214, 1999, 1-7

The amount of groundwater recharge by channel infiltration is estimated for El Barbonbasin, in Baja California, Mexico. The basin's lower portion includes the valleys of Ojos Negros and Real del Castillo Viejo, which are crossed by several ephemeral washes, including the mainstem El Barbon Wash. A distributed catchment model with the capability for nonlinear channel routing and channel abstraction is used to calculate groundwater recharge by channel infiltration for storm events of 2-, 5-, 10-, 25-, 50-, and 100-yr return period. The results confirm that event channel infiltration can be a substantial component of the vertical recharge.

Passive Microwave Data for Snow Depth and Snow Extent Estimations in the Himalayan Mountains

Saraf A K, J L Foster, Pratap Singh and Soukin Tarafdar,

Intl. Jour. of Remote Sensing, Vol.20, pp.83-95, 1999.

In high mountainous areas, such as the Himalayan ranges where snow melt run-off contributes substantially to streamflow, information on snow depth and snow areal extent is vital for the estimation of streamflow and for water resources management. Microwave radiation penetrates through clouds and snowpacks and thus considered an important tool for providing water equivalent information on snow fields. The scanning multichannel microwave radiometer (SMMR) on board the NIMBUS-7 satellite acquired passive microwave data for 9 years (1978-1987). These SMMR data are used to test a snow algorithm that is applicable to high elevation area (>3500 m) in the Himalyan Range. The study demonstrates promising results, suggesting the application of SMMR data to derive snow-depth and snow-extent information for the Himalayan region. The generated snow maps can be used for various hydrological applications. The limited availability of field data and its comparison with the SMMR data which are areal in nature), are major limitations in achieving close correlation between two observations. This is the first application of SMMR data for the determination of snow parameters in the Indian Himalayas. Thus, such an application sets a pace for further research and application of passive microwave data in the most rugged terrains of the world.

On The Sensitivity of Craig and Gordon Model for the Estimation of the Isotopic Composition of Lake Evaporates

Bhishm Kumar and R.P. Nachiappan

Water Resources Research, Vol. 35, No.5, Pages 1689-1691, May 1999

The effect of errors in the estimated isotopic composition of atmospheric moisture by d a-d p equilibrium assumption method on the isotopic composition of lake evaporate (d E) estimated using the Craig and Gordon linear resistance model has been studied. It has been found that the propagated error in estimated d E increases with normalized relative humidity (h) but is less significant for h up to 0.5. The propagated error becomes unrealistic for h above 0.8. Since h is the major factor influencing the propagaged error, an error in h would result in large uncertainty in the estimated d E. Simple analytical expressions for determining the propagated errors have been presented. The study also reveals that for the isotopic enrichment of a water

body to continue, the difference between its isotopic composition and that of atmospheric air (D /a) should be greater than the equilibrium enrichment factor (e *). Using the relationship between D /a and e *, the maximum isotopic enrichment that a water body can achieve at different temperatures can be deduced.

Improved Prediction of Life Expectancy for a Himalayan Lake: Nainital, U.P., India
Bhishm Kumar, Rm.P. Nachiappan, S.P. Rai, U Saravanakumar and S V Navada,

Mountain Research and Development, Vol.19, No.2, 1999, pp. 113-121.

An attempt has been made to predict the life of Lake Nainital, a natural lake located in the Kumaun Himalaya with a fairly large human settlement around it. Sediment accumulation rates estimated by dating the lake sediment cores employing 210Pb and 137Cs dating techniques have been used for the purpose. The sediment accumulation rates estimated by radioisotope techniques are comparable to the rates obtained by the sediment balance method using suspended sediment data. The estimated useful life of the lake is about 2,200 years, which is much higher than the results obtained by earlier investigators who used short-term bathymetric data. In the present study, long-term (46 years) annual lake sounding data have also been analysed. Large bi-directional variations in the annual bathymetry imply that major errors are associated with the lake sounding data that led to the under-estimation of the life span of Lake Nainital by earlier investigators.

Regional Flood Formulae for Seven Subzones of Zone 3 of India
Kumar R, R D Singh and S M Seth,

Jour. of Hydrol. Engg., ASCE, Vol. 4, No. 3, pp 240-244, 1999

Regional Flood frequency curves are developed by fitting the L-moment based generalised extreme value distribution to annual maximum peak flood data of small-to-medium size catchments of seven hydrometeorological subzones of Zone 3 and combined Zone 3 of India. These seven subzones cover an area of about 1,041,661 sq. km.. Relationships developed between mean annual peak flood and catchment area are coupled with the respective regional flood frequency curves for derivation of the regional flood formulas. The regional flood frequency curves developed for each subzone together with at-site mean annual peak floods may be used for gauged catchments, whereas for ungauged catchments, regional flood

formulas developed for the respective subzone may be adopted for obtaining rational flood frequency estimates.

Determination of Recent Sedimentation Rates and Pattern in Lake Naini, India by 210Pb and 137Cs Dating Techniques
U.Sarvana Kumar, S.V. Navada, S.M. Rao, Rm.P. Nachiappan, Bhishm Kumar, et.al.

Jour. of Applied Radiation and Isotopes, UK, pp.97-105, Vol.51, May 1999.

Environmental 210Pb (natural) and 137Cs (anthropogenic) dating techniques were applied to determine recent sedimentation rates and pattern in Lake Naini, Uttar Pradesh, India. Core samples from different locations in the lake were collected and analysed for 210Pb and 137Cs. From the analysis it appears that the lake is not reducing in depth at a rate reported by earlier investigations. Recent sedimentation rate, estimated by the 210Pb dating technique, has been found to be fairly constant at one location (the mean dry mass sedimentation rate being 0.112 ± 0.010 g cm-2 a-1) but varying at other locations in the lake (the dry mass sedimentation rates ranging from 0.026 ± 0.010 to 0.421 ± 0.010 g cm-2 a-1) At all locations the short-term rates (for the last three decades) derived from 137Cs, a fall-out nuclide, have been observed to be marginally higher compared to long-term (last 120-150 yr) rates deduced from 210Pb. The spatial and depthwise distribution of 137Cs and 210Pb and spatial variation of surface 210Pb and 137Cs in the obtained sediment cores of the lake, along with their textural properties (like porosity and water content), provide preliminary information on the existence of different depositional zones throughout the lake and on the physico-chemical nature of the sedimentation process in the lake (i.e., bioturbation, slumping, sediment focusing, land erosion/land slide etc.).

Sensitivity of Runoff, Soil Moisture and Reservoir Design to Climate Change in Central Indian River Basins
R. Mehrotra

Climatic Change, Vol 42, pp:725-757, 1999

Climate change due to doubling of carbon dioxide in the atmosphere and its possible impacts on the hydrological cycle are a matter of growing concern. Hydrologists are specifically interested in an assessment of impacts on occurrence and magnitude of runoff, evapotranspiration and soil moisture; and their temporal and spatial redistribution. Such

impacts become all the more important as these may also affect the water availability in the storage reservoirs.

This paper examines the regional effects of climate change on various components of the hydrologic cycle viz., surface runoff, soil moisture and evapotranspiration for three drainage basins of central India. Plausible hypothetical scenarios of precipitation and temperature changes are used as input to a conceptual rainfall-runoff model. The influences of climate change on flood, drought and agriculture have been highlighted. The response of hypothetical reservoirs in these drainage basins to climate variations has also been studied. Results indicate that the basin located in comparatively drier region is more sensitive to climatic changes. The high probability of significant effect of climate change on reservoir storage, especially for drier scenarios, necessitates the need of further, more critical analysis of these effects.

Estimation of Hydraulic Diffusivity in a Stream-Aquifer System
Mishra,G.C., and S.K. Jain

Journal of Irrigation and Drainage, ASCE, 125(2), 74-81, 1999.

The Laplace transform of convolution equation, which relates aquifer response to boundary perturbation, expresses explicitly the hydraulic diffusivity in terms of the Laplace transform parameter, changes in stream stage, and fluctuations of piezometric level at a point near the stream. Hydraulic diffusivity is predicted using the Laplace transform approach. The diffusivity has also been determined from observed response of an aquifer and the boundary perturbation using a least squares optimization technique. If the observed data are free from random error, the diffusivity can be estimated accurately using the Laplace transform approach. The Marquardt method can be used to determine diffusivity from data containing random error.

Another look at the SCS-CN method
Mishra, S.K., and Vijay P. Singh

J. Hydrologic. Engrg., ASCE, Vol. 4, No. 3, pp. 257-264. 1999

The Soil Conservation Service-Curve Number (SCS-CN) method is analytically derived and its basis in the Mockus method analyzed. A modification and a general form of the SCS-CN method are proposed. Using data from four watersheds, the existing SCS-CN method, the proposed modification, and the Mockus method are compared. For these data the modified version is found to be more accurate than the current version.

Hysteresis-Based Flood Wave Analysis

Mishra, S.K., and Vijay P. Singh

J. Hydrologic Engrg., ASCE, Vol. 4, No. 4, pp. 358-365, 1999

By employing looped or hysteretic rating curves, flood wave propagation in natural and artificial channels is analytically described. The analytical relation between a quantitative descriptor of hysteresis (h ) and phase difference (f ) is verified using numerical and observed data, and a unique relationship among h , f , and logarithmic decrement d is presented for kinematic waves. Finally, the effect of channel and input flood wave characteristics as well as downstream boundary conditions on flood wave propagation is evaluated.

Calibration of a General Infiltration Model

Mishra, S.K., S.R. Kumar and Vijay P. Singh

J. Hydrological Processes, Vol. 13, pp. 1691-1718, 1999

A general infiltration model proposed by Singh and Yu(1990) was calibrated and validated using split sampling approach for 191 sets of infiltration data observed in the states of Minnesota and Georgia in the USA. Of the five model parameter, fc (the final infiltration rate), So (the available storage space), and an exponent 'n' were found to be more predictable than the other two parameters: m (exponent) and a (proportionality factor). A critical examination of the general model revealed that it is related to the Soil Conservation Service (1956) Curve Number (SCS-CN) method and its parameter So is equivalent to the potential maximum retention of the SCS-CN method and is, in turn, found to be a function of soil sorptivity and hydraulic conductivity. The general model was found to describe infiltration rate with the varying curve number.

Time of Opening of Irrigation Canal Gates

Ponce V M, Y R Satyaji Rao and Z M Manusry

Jour. Hydraulic Engg., pp. 979-980, Vol. 125, No. 9, 1999.

Irrigation canal gates should be opened or closed at sufficiently slow speeds: otherwise, surface transients may develop that could negatively impair the operation of the canal. We use an analytical model of unsteady open-channel flow to develop a criterion for the time of opening of an irrigation canal gate. The criterion is based on the fact that in typical canal situation, the longer the wavelength of the disturbance, the faster its attenuation is and also on hydrodynamic principles. An analytical model of unsteady open-channel flow is used to

calculate the attenuation of small amplitude surface transits. Wave attenuation is expressed in terms of a dimensionless parameter containing both steady and unsteady components. The developed criterion is shown to be in agreement with actual field practice in the Imperial Valley, Calif.

Importance of Ice Layers on Liquid Water Storage within a Snowpack
Singh,Pratap, Spitzbart Gerhard, Huebl H. and Weinmeister H.W. Hydrological Processes 13, 1799-1805(1999).

Knowledge of the effect of the physical characteristics of the snowpack on the onset of snowmelt runoff is needed for the modelling of snowmelt runoff. In the present study, the importance of ice layers in the snowpack to the release of meltwater has been investigated. Artificial rain was simulated over a snow plot of known dimensions prepared in the Glatzbach Basin in the Austrian Alps. The experiment was performed at an altitude of 2640 m just before the onset of snowmelt runoff from the snowpack at that altitude. Stratigraphic studies were made before and after the experiment. The snowpack contained five ice layers and the thickness of these layers varied from about 2 to 8 mm. The average liquid water content of the snowpack was about 4% by volume before the rain simulation. The results indicate a substantial increase in the storage capacity of the snowpack due to the presence of ice layers in the snowpack when it met saturated conditions because of rain water input. An amount equivalent to 100 mm, which is about 9.25% by volume, was absorbed by the snow block before the appearance of runoff from the snowplot.