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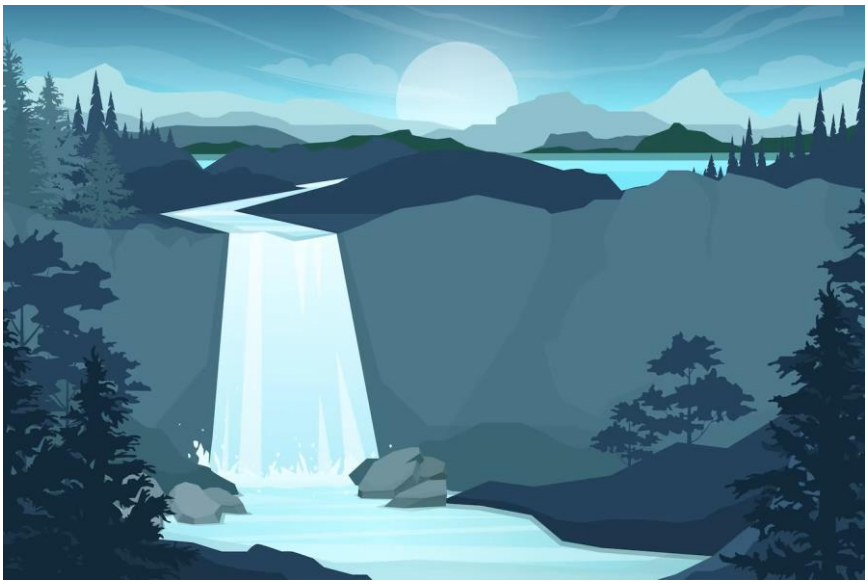
Annotated bibliography on

Flood Routing and Management



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Introduction:

"Flood routing is a science-based specialty that evaluates flood data from rivers and reservoirs. The method uses hydrograph modeling to forecast floodwater effects at every point along a waterway's route. Flood routing is a method of analyzing flood flow data from one or more upstream sections."[1]

The annotated bibliography aims to assist the Water Research Center, and especially the Water Resources Development and Management (WRDM) program by providing a list of most recent articles that cover the topic: Flood Routing and Management.

This annotated bibliography contains articles' abstracts from 2021-2023.

E-resources used: Scopus

Contact NSTIC to request full-text articles.

[1] https://unacademy.com/content/gate/study-material/civil-engineering/flood-routing/

Articles' Abstracts:

1. Chen, C., Wang, Y., Zhang, J., Zhang, H., Li, H., & Chen, Q. (2023). A preliminary study of landslide dam failures induced by the combined influence of piping and overtopping. Journal of Hydrology.

Abstract: Recently, landslides occurred more frequently worldwide due to extreme climatic and geological disasters, many of which blocked the river in mountainous areas, posing a great threat to residents by inundation and outburst flood. The top two failure modes of landslide dams are overtopping and piping. Most of the current studies only investigated landslide dam failures caused purely by overtopping. However, landslide dams are normally composed of poorly graded and unconsolidated sediments, which are highly susceptible to piping. It is recorded that some landslide dams have experienced local piping before it overtopped. Under such circumstance, the dam erodibility and internal structure change accordingly, which further affect the subsequent overtopping and flood routing process. Therefore, the role of piping in landslide dam failures is crucial, which should be seriously considered and needed to be urgently studied. In this study, a preliminary investigation of landslide dam failures induced by the combined influence of piping and overtopping is carried out by laboratory experiments and numerical simulations. Results show that with increasing particle loss by piping, the soil void ratio increases while the friction angle decreases, leading to a more porous dam structure and a dramatically increased dam erodibility. The more particles have lost before overtopping, the larger the peak discharge is, and the thinner the hydrograph becomes, implying that the piping amplifies the outburst flood. It is also found that when the landslide dam has suffered a more serious piping before it overtopped, the peak flood discharge becomes larger and the peak arrival time advanced obviously, nevertheless, the flood attenuates more sharply along the river reach. The outcome of this research will enrich our understanding of landslide dam failures under the combined influence of piping and overtopping, which can provide scientific evidences for risk management and disaster mitigation of landslide dams. © 2023 Elsevier B.V.

2. Baudhanwala, D., Kantharia, V., Patel, D., Mehta, D., & Waikhom, S. (2023). APPLICABILITY OF SWMM FOR URBAN FLOOD FORECASTING A CASE STUDY OF THE WESTERN ZONE OF SURAT CITY. Larhyss Journal, 2023(54), 71-83.

Abstract: Urban flooding is the submergence of an area by a large amount of water that comes from sudden excessive rainfall. As a result, it overwhelms the capability of the drainage system,

such as storm sewers. Surat city is located on India's west coast at the mouth of the Tapi River. Surat city has faced many floods for a long time. The main aim of the study is to simulate the existing stormwater drainage system and to identify any overflowing manholes in Surat City (West Zone) by employing the Storm Water Management Model (SWMM). SWMM is an effective tool for simulating urban floods. In the present study, rainfall data for 2018, 2019 and 2020 and stormwater network data were used to evaluate the present stormwater drainage network. The above data are then imported into SWMM to display the inversion level and drainage network details. The flow direction has been assessed from these inverted-level drain network characteristics to produce a descriptive view of the study area. From the above analysis, it is found that some parts of the western zone are mostly affected by flooding. These flooding conditions can be improved by increasing the dimensions of the conduit pipes of the respective drainage system. Recommendations and suggestive measures are provided to improve the resilience of Surat city against floods.

3. Chen, X., Ma, J., Yu, H., Yu, W., & Liu, C. (2023). Application of multiple methods for reverse flow routing: A case study of Luxi river basin, China. Frontiers in Earth Science.

Abstract: Because of the lack of hydrological monitoring facilities and methods in many areas, basic hydrological elements cannot be obtained directly. In that case, the reverse flow routing method is frequently used, which allows for the simulation of hydraulic elements upstream using downstream data, and is of great significance for river and reservoir joint regulation, flood disaster management, flood control evaluation, and flood forecasting. The hydrological and hydrodynamic methods are the two main approaches to reverse flow routing. The hydrological method is mainly realized by constructing a distributed or lumped hydrological model based on rainfall, soil type, terrain slope, and other data. A distributed hydrological model focuses on the physical mechanism of runoff yield and flow concentration, the spatial variability of model input, and the hydraulic connection between different units. The solution of the hydrological method is relatively simple, but it requires a large amount of measured data, which limits the applicability of this method. The other method builds a hydrodynamic model by solving shallow water equations for reverse flow routing. This method has definite physical significance, higher accuracy, and obvious advantages of simple and fast calculations. It can not only simulate one-dimensional but also two-dimensional flood routing processes. In addition, the slope-area method is frequently used for flood reverse routing in many areas in

China without relevant hydrological data, and can calculate the peak discharge, maximum water level, flood recurrence interval, and other information by the hydrodynamic formula, along with the cross-section and the measured flood mark water level. Due to the influence of extreme weather, a heavy rainstorm and flood occurred in the Luxi river basin in China on 16 August 2020, resulting in severe flood disasters in this area and causing significant economic losses. Moreover, due to the lack and damage of hydrological monitoring equipment, hydrological information such as flood hydrographs and peak discharges of this flood could not be recorded. To reduce the uncertainty of a single method for reverse flow routing, we integrated and applied the hydrodynamic, hydrological, and slope-area methods to reverse flow routing in the Luxi river basin on 16 August 2020. The simulation accuracy of the three methods was verified in terms of the measured flood mark water level, and the simulation results of the three methods were analyzed and compared. The results are as follows: 1) The hydrological method can better simulate flood hydrographs and durations, especially for flood hydrographs with multiple peaks, and is more applicable than the other two methods. However, the hydrodynamic and slope-area methods have better accuracy in the reverse simulation of flood peaks. Therefore, through the comprehensive comparative analysis of these three methods, flood elements such as flood hydrographs, peak discharges, and durations can be simulated more accurately, and the problem of large errors caused by a single method can be avoided; 2) The simulation results of the hydrodynamic and slope-area methods are similar, and the maximum error of the peak discharge calculated using the two methods is within 10%. According to the simulation results, the peak discharge reached 2,920 m3/s downstream of Luxi river basin, which is a flood having more than 100-year recurrence interval; 3) The simulation results of the hydrological method show that the flow hydrograph is a double-peak, and the two peaks occurred at 17:00 on August 16 and 6:00 on 17 August 2020, respectively.

4. Ahmad, F., Shah, Z., & Al-Fagih, L. (2023). Applications of evolutionary game theory in urban road transport network: A state of the art review. Sustainable Cities and Society.

Abstract: A sustainable transport infrastructure is one of the pillars of a sustainable city. However, the literature indicates that urbanization, population growth, changes in population density, and motorization make it difficult for the current road transport system to meet mobility needs for a sustainable city. Traffic crashes and congestion on roads are common as

a result of increasing travel times, fuel consumption, and carbon emissions, thereby reducing efficiency and sustainability of mobility systems. Managing these issues involves the interaction of multiple decision-makers, such as vehicles, pedestrians, traffic system operators, and authorities. Accordingly, these are well-suited to being analyzed under the guise of game theory. While classical game theory possesses multiple limitations, it can be argued that evolutionary game theory (EGT) models are more effective for real-world scenarios. This manuscript presents a state-of-the-art review on EGT applied to the road transportation network. The manuscript has divided the application of EGT in advancing the transportation network into multiple categories, i.e., choice-based analysis, traffic management, behavioral interactions, routing operation, and transport safety. This manuscript provides an in-depth analysis and a comparative criticism of the various proposed evolutionary game models. Finally, the manuscript discusses the challenges and provides recommendations for future research on evolutionary game models in transportation networks. These insights aim to facilitate targeted activities based on current research needs.

5. Katipoğlu, O. M., & Sarıgöl, M. (2023a). Coupling machine learning with signal process techniques and particle swarm optimization for forecasting flood routing calculations in the Eastern Black Sea Basin, Türkiye. Environmental Science and Pollution Research.

Abstract: With the effect of global warming, the frequency of floods, one of the most important natural disasters, increases, and this increases the damage it causes to people and the environment. Flood routing models play an important role in predicting floods so that all necessary precautions are taken before floods reach the region, loss of life and property in the region is prevented, and agricultural lands are protected. This research aims to compare the performance of hybrid machine learning models such as least-squares support vector machine technique hybridized with particle swarm optimization, empirical mode decomposition, variational mode decomposition, and discrete wavelet transform processes for flood routing estimation models in Ordu, Eastern Black Sea Basin, Türkiye. In addition, it is aimed to examine the effect of data division in flood forecasting. Accordingly, 70%, 80%, and 90% of the data were used for training, respectively. For this purpose, the flood data of 2009 and 2013 in Ordu were used. The performance of the established models was evaluated with the help of statistical indicators such as mean bias error, mean absolute percentage error, determination coefficient, Nash–Sutcliffe efficiency, Taylor Diagrams, and boxplot. As a result of the study, the particle swarm optimization least-squares support vector machine technique was chosen as

the most successful model in predicting flood routing results. In addition, the optimum data partition ratio was found to be Train:70:Test:30 in the flood routing calculation. The findings are essential regarding flood management and taking necessary precautions before the flood occurs.

6. Jiang, S. -., Zhi, H. -., Wang, Z. Z., & Zhang, S. (2023). Enhancing Flood Risk Assessment and Mitigation through Numerical Modeling: A Case Study. Natural Hazards Review, 24(1).

Abstract: Evaluation of dike-break-induced flood risk has been a worldwide concern due to its enormous economic, environmental, and societal importance. The mitigation of flood risk in detention basins is a complex decision making process that could span multiple engineering and scientific disciplines. In this paper, an integrated dike-break-induced flood modeling, analysis, and management framework is proposed. The MIKE21-based numerical approach is first adopted to model the flood routing process in detention basins. With the physical behavior of the flood well understood, physics-informed approaches are proposed to better quantify the dike-break-induced flood risks, e.g., human life, economic and environmental losses, offering valuable information for engineers and policymakers to formulate targeted contingency plans. The Zhuhu detention basin in the Poyang Lake district in China is investigated using the proposed framework. The flood movement in the detention basin is first numerically simulated using the MIKE21-based model. Based on the results, i.e., inundation area, water depth, flow velocity, and arrival time of flood peak, the detention basin is divided into several flood disaster zones. The induced flood risks are then estimated for the different zones. Customized emergency evacuation plans are also formulated for the different flood disaster zones. The study of the Zhuhu detention basin confirms that the proposed framework effectively fuses numerical modeling, physics-informed analysis, and management of flood events, providing an integrated and enhanced decision making process for flood warning and risk mitigation in flood detention basins or at other places. © 2022 American Society of Civil Engineers.

7. Gold, T., Reiterer, K., Hauer, C., Habersack, H., & Sindelar, C. (2023). Flushing Efficiency of Run-of-River Hydropower Plants: Novel Approaches Based on Physical Laboratory Experiments. Water (Switzerland), 15(14).

Abstract: Periodic flushing operations during moderate flood events (≤annual flood flow HQ (Formula presented.)) are an approach to counteract problems caused by disturbed sediment continuity in rivers, which is possibly an effect of run-of-river hydropower plants (RoR-HPPs). Considering ecology, flood risk, technical, and economical reasons, discharge values of 0.7 × HQ (Formula presented.) are a good reference point for the initiation of gate operations. This work aimed to investigate the role of different gate opening actions on the effectiveness of such flushing measures. Physical model tests were performed, to capture bed load rates, together with 2D velocity measurements in the vicinity of two movable radial gates above a fixed weir. The length scale of the idealized model arrangement was 1:20, and a conveyor-belt sediment feeder was used to supply a heterogeneous sediment mixture. Velocities were acquired using 2D laser doppler velocimetry (LDV). Based on the LDV measurements, mean velocity profiles and Reynolds stresses were derived. The full opening of both radial gates led to the highest bed load mobility. While the flushing efficiency drastically decreased, even for slightly submerged gates, an asymmetrical gate opening initially led to the formation of a flushing cone in the vicinity of the weir, accompanied by temporarily high flushing efficiency. In conclusion, our results stress the importance of full drawdowns in successfully routing incoming bed load downstream of the HPP. However, the combination of an asymmetric gate opening followed by a full drawdown could be a promising approach to further improve the flushing efficiency of RoR-HPPs.

8. Cobbinah, P. B., Amoako, C., & Yeboah, A. S. (2023). Informality and the politics of urban flood management. Environment and Planning C: Politics and Space, 41(4), 826-843.

Abstract: This paper explores reasons for unproductive urban flood management agendas in informal settlements. Does geography of informal settlements inform city-led flood management agendas? And in what ways have residents of informal settlements responded to city-led flood management approaches? The paper argues that the supposed city managers – both state institutions and professional bodies – have consistently acted in their own interest while successfully using ‘blame game’ to alienate their responsibility of successfully implementing flood management agendas in informal settlements. Using Accra (Ghana) as a case study, the study used multiple qualitative methods such as interviews, focus group discussion and secondary data analysis. Findings indicate that, overall, residents of informal settlements are gradually embracing the reality that city managers do not promote their interests

in addressing perennial flood events. In turn, the flood management outcomes that policies and plans ostensibly seek to achieve have only been modestly realised. Instead, flood management agendas have had perverse implications for residents of informal settlements. Recommendations to improve the situation are proffered. © The Author(s) 2023.

9. Bain, R. L., Shaw, M. J., Geheran, M. P., Tavakoly, A. A., Wahl, M. D., & Zsoter, E. (2023). Intercomparison of global ERA reanalysis products for streamflow simulations at the high-resolution continental scale. Journal of Hydrology.

Abstract: Watershed-scale streamflow routing models play a key role in real-time flood forecasting, flood risk evaluation, and water resource management, but the accuracy of modeled streamflow depends on both the spatial resolution and the accuracy of the runoff data used as the model forcing. The production of new, higher-resolution runoff datasets therefore motivates an evaluation of the relative improvement in streamflow model performance. This study evaluates streamflow routing output for the Mississippi River Basin, with the simulations driven by three different runoff products from the European Centre for Medium-Range Weather Forecasts. The first runoff product is the ERA-Interim surface and subsurface runoff dataset (ERAI), which was projected to a grid with a resolution of ∼39 km at the equator. Second, this study considers the ERA5 reanalysis dataset (ERA5-25km) placed on a quarter degree grid (∼25 km resolution at the equator). The simulations which generated ERA5-25km included land–atmosphere coupling and land data assimilation. The third runoff product is the ERA5-Land dataset (ERA5L-9km), which was produced in an offline simulation at 9-km resolution without land–atmosphere coupling or land data assimilation, forced by the coarser ERA5 meteorological input. For each runoff input, streamflow was simulated by applying the Routing Application for Parallel computation of Discharge (RAPID) model to the vectorized NHDPlus stream network, which comprised 1.2 million reaches within the study area. Comparison of modeled and measured daily and monthly mean discharge from 60 USGS gages reveals several broad trends. Streamflow simulated using the ERAI runoff tends to generate an earlier peak monthly discharge, while peak discharge from the ERA5L-9km runoff systematically exceeds peak discharge from the ERA5-25km runoff. Basin-aggregated model performance varies by metric, with discharge simulated using the ERA5-25km runoff having the smallest median root-mean-square error even as the discharge modeled using ERA5L-9km runoff has the smallest median Kling-Gupta efficiency. Model performance also varies spatially, with all three simulations exhibiting the least accurate results in the western region

of the Mississippi River Basin, and by drainage area, with more accurate results generally obtained for larger drainages. These results suggest that streamflow model accuracy will benefit from the use of either ERA5-25km or ERA5L-9km runoff in place of ERAI. However, the selection of ERA5-25km versus ERA5L-9km depends on regional considerationsas well as which components of model performance are most critical to the user. © 2022

10. Katipoğlu, O. M., & Sarıgöl, M. (2023b). Prediction of flood routing results in the Central Anatolian region of Türkiye with various machine learning models. Stochastic Environmental Research and Risk Assessment, 37(6), 2205-2224.

Abstract: Flood routing models are vital in predicting floods and taking all necessary precautions in the region where floods occur, preventing loss of life and property in the region and protecting agricultural areas. This study aims to compare the performance of various machine learning models such as Bagged Tree, Gradient-Boosted Machine, Random Forest, K-Nearest Neighbor, Support Vector Machine and Extreme Gradient Boosting for flood routing prediction models in Ankara, Eskişehir and Sivas. In addition, the predictive success of tree-based algorithms established according to the optimized and default parameters was compared. For this purpose, the flood data of 2013, 2014 and 2015 discharge observation stations located in Ankara D12A242-D12A126, D12A170-D12A172 in Eskişehir and D15A290-E15A035 in Sivas were used. While establishing the machine learning (ML) models, the data was selected as 80% training and 20% testing. Model performances were tested according to various statistical indicators such as root mean square error, mean absolute error and determination coefficient. As a result of the study, the Gradient-Boosted Machine was chosen as the most successful model in estimating flood routing. In addition, the K-nearest neighbor model with 3-nearest neighbor achieved high-level prediction success with the lowest error rates in Ankara. The findings are important in terms of flood management and taking necessary precautions before the flood occurs. © 2023, The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature.

11. Mo, C., Shen, Y., Lei, X., Ban, H., Ruan, Y., Lai, S., Cen, W., & Xing, Z. (2023). Simulation of one-dimensional dam-break flood routing based on HEC-RAS. Frontiers in Earth Science.

Abstract: Dam-break is a serious disaster resulting in severe damage to downstream communities. Therefore, analyzing the affected range and the evolution process of dam-break

floods in advance is valuable. However, the difficulties and challenges lie in the complexity of the breaking process of earth-rock dams, the uncertainty in the evolution of dam-break floods, and the geographical variability. Given this, the objective of this study is to analyze the characteristics of the dam-break flood evolution. The study chooses Chengbi River Reservoir as the research object, HEC-RAS as the simulation software, unsteady flow differential equations and one-dimensional Saint-Venant equations as the control equations, and it uses four-point implicit finite difference method for discrete solution. In this paper, the dam-break flood evolution is simulated under three boundary conditions (full breach, 1/2 breach, 1/3 breach), and the main results are as follows. From the dam site section to the Tianzhou hydrological station section, the peak discharge decay rates of the three schemes are 78%, 77%, and 67%, respectively. The water level decay rates of the three schemes are 47%, 36%, and 30%, respectively. A 1 m increase in the bursting water level elevation increases the peak flow by ap-proximately 7%, and the highest water level in front of the dam by 1 m, and delays the peak time by 1.5 h on average. In addition, the preliminary inundation extent for the Baise City is obtained. The analysis results can provide a fundamental basis for flood control as well as a reference for flood disaster management.

12. Aureli, F., Prost, F., Mignosa, P., & Tomirotti, M. (2023). Validation of Synthetic Design Hydrographs through 2D hydrodynamic modelling. Journal of Hydrology.

Abstract: The procedure for the determination of Synthetic Design Hydrographs (SDHs), proposed in previous works, is validated by comparing the peak discharges obtained by routing a long series of historical floods and the synthetic floods at different stations along a complex river system. At this aim, the 60 km long terminal stretch of the Dora Baltea river (Northern Italy) has been modelled according to fully 2D high resolution hydrodynamic approach. The fluvial branch is of considerable complexity due to a strong contraction induced by the presence of a narrow Roman bridge, which, during the most important flood events, causes the reactivation of a paleochannel and the flooding of a part of the city of Ivrea. The hydraulic model has been calibrated on the basis of the main historical floods. Then, all the historical floods over a period of more than 80 years (1939–2020) and the SDHs derived by the same series have been routed. Historical and synthetic peak discharges at two downstream stations have been then compared in probability plots. The results show that the peak discharge distributions derived by routing the historical floods and the SDHs compare well. This suggests

that SDHs construction procedure is reliable and has statistical significance. © 2023 Elsevier B.V.

13. Chen, W., Wu, H., Kimball, J. S., Alfieri, L., Nanding, N., Li, X., Jiang, L., Wu, W., Tao, Y., Zhao, S., & Zhong, W. (2022). A Coupled River Basin-Urban Hydrological Model (DRIVE-Urban) for Real-Time Urban Flood Modeling. Water Resources Research, 58(11).

Abstract: Reliable urban flood modeling is highly demanded in emergency response, risk management, and urban planning related to urban flooding. In this paper, the Storm Water Management Model (SWMM) is adapted to simulate urban rainfall-runoff and pipe drainage processes within the Dominant river tracing-Routing Integrated with VIC Environment (DRIVE) model which accounts for natural river basin runoff generation and routing processes. The integrated DRIVE-SWMM model (referred to as DRIVE-Urban) allows to explicitly delineate the mass-energy interactions between urban drainage system (e.g., pipes and dikes) and river networks. This presents a further step model development for accurate urban flooding prediction which is lacking in existing urban flood models and traditional hydrological models. The validity of the DRIVE-Urban model is evaluated for three case studies in Haikou City, China, with camera observations of street inundation during typhoon landfalls and heavy rainfall events. The results show that the DRIVE-Urban model successfully captures 62%, 69%, and 77% of the total observed inundated road-sections for the three cases respectively. The third case study with severe flooding situation shows that the DRIVE-Urban performance is further improved when given reliable river and tidal level information, indicating the importance of integrating river-basin with urban hydrological and hydraulic modeling. © 2022. The Authors.

14. Norouzi, H., & Bazargan, J. (2022). Calculation of Water Depth during Flood in Rivers using Linear Muskingum Method and Particle Swarm Optimization (PSO) Algorithm. Water Resources Management, 36(11), 4343-4361.

Abstract: To estimate the damage caused by flooding rivers, it is critical to analyze unsteady flow and determine downstream water depth. Hydraulic methods for examining unsteady river flow require cross-sectional specifications of the river at a close distance with optimal accuracy. Obtaining these specifications is often time-consuming and expensive. In contrast, hydrologic routing methods, such as the linear Muskingum method, are more beneficial for the

analysis of unsteady flow. In flood routing, the linear Muskingum method has only been utilized to calculate the outflow hydrograph (downstream). However, in practical problems regarding flood analysis, such as economic analysis, damage assessment, and flood management and engineering, downstream water depth is needed. By employing kinematic wave relations, the linear Muskingum method, and the Particle Swarm Optimization (PSO) algorithm, the present study estimates water depth, with respect to time, of a downstream section of the Karun River, between the Mollasani (upstream) and Ahwaz (downstream) hydrometric stations. The proposed approach is simpler and less expensive and more accurate than hydraulic methods. The current work estimated the values of the Mean Relative Error (MRE) to the total flood and the Mean Relative Error (MRE) to the peak section of input depth along with the absolute value of the peak deviations of the observed and routed depth (DPO) as 1.29, 0.24, and 1.16 percent, respectively.

15. Pérez-Morales, A., Gil-Guirado, S., & Martínez-García, V. (2022). Dasymetry Dash Flood (DDF). A method for population mapping and flood exposure assessment in touristic cities. Applied Geography.

Abstract: Population disaggregation methods are a land management tool that is necessary to robustly assess the exposure of populations to natural hazards. The aim of these methods is to translate population values from large spatial units to smaller spatial units. Due to their improvement, the accuracy in quantifying the population exposed to natural hazards has increased significantly in recent years. However, in the case of floods, where the actual exposure to the hazard depends on the height of the buildings, there is a methodological deficiency with regard to reaching the necessary level of detail. This is a methodological challenge that is exacerbated in urban areas specialising in tourism, where there are a large number of dwellings dedicated to the housing of tourists. In this paper we propose a 3D cartographic dasymetry (DDF) method that, based on cadastral information and the population and housing census, manages to solve these problems of flood hazard exposure assessment reasonably well. For validation, the results are compared with three widely used 2D methods. Our work shows that the proposed method offers better outputs for use in high-precision work; but also, when such detail is not necessary, more basic methods achieve results with only marginal differences. © 2022 The Authors

16. Ge, W., Jiao, Y., Wu, M., Li, Z., Wang, T., Li, W., Zhang, Y., Gao, W., & van Gelder, P. (2022). Estimating loss of life caused by dam breaches based on the simulation of floods routing and evacuation potential of population at risk. Journal of Hydrology.

Abstract: Dam breaches often have catastrophic consequences in downstream areas. Hydrodynamic factors and the evacuation potential of the population at risk (PAR) have significant impacts on the loss of life (LOL) caused by dam breaches. However, the existing comprehensive evaluation models have not conducted in-depth research on the evacuation potential of populations. Thus, limited guidance is available for relevant departments to formulate emergency plans to reduce the potential LOL. Therefore, a new comprehensive evaluation model was proposed in this study. According to the relevant references and disaster theory, the main influencing factors and the process through which the LOL is caused by dam breaches were determined. The specific occurrence process was divided into six stages: a dam breach causes flood, the flood puts the PAR, the PAR complete the preparation work, the PAR evacuate, the un-evacuated population shelter themselves inside buildings, and flood causes the death of the exposed population. To calculate the LOL, the parameters relevant at each stage were defined. Furthermore, the Hydrologic Engineering Center's River Analysis System, Geographic Information System, and related materials were used to simulate the flood routing and evacuation potential of the PAR, quantifying the parameters in the model. The model was applied to 14 towns in the downstream areas of the Luhun Reservoir in Henan Province, China, and its accuracy was verified by comparing the results obtained from the two existing models. In addition, the specific suggestions for reducing the potential LOL were proposed based on the results of the simulation. © 2022 Elsevier B.V.

17. Chen, Y., & Alexander, D. (2022). Integrated flood risk assessment of river basins: Application in the Dadu river basin, China. Journal of Hydrology.

Abstract: Flood is the most common worldwide natural disaster with enormous impacts on human society and the ecosystem. Consequently, the research of flood risk assessment and zonation is critical. Its research scope is changeable, wherein the basin-scale research has become more and more important due to the increasing boom of cascade hydropower development in the river basin. The study proposed a basin-wide integrated flood risk assessment method combining index-based evaluation, Analytical Hierarchy Process (AHP) and Geographic Information System (GIS) technologies, which was implemented in the Dadu River basin, southwestern China to assess and zoning the basin flood risk. In the constructed

risk assessment index system, we use extreme rainfall and dam breach to jointly describe the basin flood disaster-inducing factors and select flood control standard and flood routing coefficient as the sub-indicators of basic and specific coping capacity to characterize the flood intervention capacity of hydropower engineering. The results showed that, for the hazard, vulnerability and risk zonation maps with five classified levels, the southern of midstream and downstream of the basin are prone to frequent floods, while higher vulnerability levels mainly concentrate in the downstream but some parts scatter in the medium vulnerability zone. The high and very high risk zones account for 3% of the basin area and mainly concentrate in the southern basin, while 86% of the basin area is assigned as low and very low risk zones. The results of this work quantitatively express the spatial distribution characteristics of basin-wide flood hazard, vulnerability and risk, and provide a reference for practicing an integrated and efficient flood risk management, and disaster prevention and alleviation strategies. © 2022 Elsevier B.V.

18. Bharali, B., & Misra, U. K. (2022). Numerical Approach for Channel Flood Routing in an Ungauged Basin: a Case Study in Kulsi River Basin, India. Water Conservation Science and Engineering, 7(4), 389-404.

Abstract: Flood is the most devastating and frequent disaster in North-East India, resulting in loss of human life and damage of properties. Its deleterious effects can be minimized by appropriate modeling, analysis, and management methods. Such modeling and analyzing techniques are hindered in flood prediction in an ungauged basin due to the lack of hydro-meteorological data. The main objective of this work is to develop a numerical approach for flood routing in an ungauged basin using the rainfall-runoff model and the flood routing models (Muskingum approach, Cunge-Muskingum model, KWM, VPKWM, DWFRM, and MDWMP). The Geographic Information System software has been used to extract the geographical information of the study area. The SCS-CN rainfall-runoff model is employed to obtain the inflow, and lateral inflow hydrographs of the ungauged sub-basins and the routing models are employed to anticipate the flood hydrograph at the outlet of the ungauged basin. The modeling approach is employed to the Kulsi River Basin, India, hypothetically considered an ungauged basin, and the results obtained from the various routing models are compared with the observed data at the outlet of the basin. The performance of the flood routing models is validated by considering nine statical parameters, i.e., RMSE, E-peak, peak flow time error, E-volume, MAE, R-squared, RE, NSE, and KGE. The results reveal that out of all the above

mentioned models, MDWMP shows better performance as far as the predictions in ungauged basin is concerned. The Muskingum approach (MA) and DWFRM routing models can also suitably be used in prediction of flood hydrograph at the downstream of an ungauged basin in less gauged river basin reaches.

19. Wang, J., Zhao, J., Zhao, T., & Wang, H. (2022). Partition of one-dimensional river flood routing uncertainty due to boundary conditions and riverbed roughness. Journal of Hydrology.

Abstract: The partition of flood routing uncertainties from multiple sources provides a foundation for managing flood risks. This paper develops a partition approach for the one-dimensional river flood routing uncertainty due to boundary conditions (upstream inflow hydrograph and downstream stage hydrograph) and riverbed roughness. A theoretical derivation based on the Monte Carlo method is presented using a one-dimensional hydrodynamic model. The developed approach is successfully applied to a real-world case of the Xunjiang River in China. The results indicate the following: (1) each uncertainty source leads to unique effects on flood routing, and the uncertainty contribution ratio varies significantly with both time and space, providing evidences for identifying the dominant uncertainty sources; (2) the uncertainty of the simulated discharge is most influenced by the boundary conditions whereas the simulated water stage is most influenced by the riverbed roughness; and (3) the highly coupled uncertainty propagation is hardly affected by the flood pattern, as well as the probability distribution of uncertainty source, but it is significantly affected by the river morphology. The developed approach can effectively partition the uncertainty effects of the boundary conditions and riverbed roughness without explicating their interactions. And the uncertainty partition of flood routing is useful for risky decision making in flood management.

20. Mahmoud, M. R., Fahmy, H., & Garcia, L. A. (2022). Potential impacts of failure of the Grand Ethiopian Renaissance Dam on downstream countries. Journal of Flood Risk Management, 15(2).

Abstract: This study assesses the potential downstream impacts in the event of a flood due to failure, either structural or operational, of the Grand Ethiopian renaissance dam (GERD). The following two failure scenarios were modeled as part of this study: Dam Break (DB) and

MisGuided Dam Operation (MGDO) as a result of a false flood signature. The DB scenario shows that 40% of the intensively cultivated Gezira Plain would be inundated with average water depths of more than 10 m, resulting in catastrophic loss of highly productive farmlands, livestock, inhabitants, and infrastructure. This scenario did not model damage further downstream since for this magnitude flood it will require another flood routing model given the more complex geometry downstream of the Gezira Plain. In the MGDO scenario flood flows are lower and would have no impact on the Gezira Plain but would reach the High Aswan Dam (HAD) and fill it to its maximum allowable capacity for two and a half months and it would require emergency releases for more than 5 months. The required emergency releases from the HAD are expected to create significant flooding downstream. To accommodate the potential of extra releases from the GERD during flood events the operational rules for the HAD should be modified. However, providing more flood buffer at the HAD will limit the live capacity that is currently used for securing downstream flow requirements during drought periods. One of the expected impacts of increasing the flood buffer would be a reduction of the HAD's contribution to Egypt's GDP. Based on the results of this study the operational rules for the GERD and the HAD should be evaluated and possibly modified.

21. Ji, Y., Chen, A., Li, Z., Li, B., & Ge, W. (2021). A comprehensive evaluation of the consequences of dam failure using improved matter element analysis. Environmental Earth Sciences, 80(20).

Abstract: Although an accidental dam failure has a low probability of occurring, the damage such an event can cause is almost incalculable. It is therefore particularly important to accurately predict losses caused by dam failure. Simulation of flood routing is one approach to analysis of the consequences of dam failure but its usefulness is limited by lack of comprehensive data. Creating a single mathematical model is another approach, but such a model cannot take account of the various uncertainties inherent in a dam failure. Matter element analysis is effective in dealing with factors that are incommensurable, but it does not consider the combined effects of factors that are subject to uncertainty and so produces results that may be inadequate. To address this problem, this paper introduced the eigenvalues of a cloud model (expectation Ex, entropy En and hyperentropy He) and combined the cloud model with matter

element analysis in an improved model. The improved matter element analysis model produced a comprehensive evaluation of the consequences of dam failure by creating a set of evaluation indexes in which life loss, economic loss, and the environmental impact of dam failure were treated as direct losses and societal impact were treated as an indirect loss. Changlong Reservoir provided an illustrative case study to show that the proposed model was able to reliably predict the consequences of dam failure. This model provides a promising solution to risk management of dams.

22. Papaioannou, G., Vasiliades, L., Loukas, A., Alamanos, A., Efstratiadis, A., Koukouvinos, A., Tsoukalas, I., & Kossieris, P. (2021). A flood inundation modeling approach for urban and rural areas in lake and large-scale river basins. Water (Switzerland), 13(9).

Abstract: Fluvial floods are one of the primary natural hazards to our society, and the associated flood risk should always be evaluated for present and future conditions. The European Union's (EU) Floods Directive highlights the importance of flood mapping as a key stage for detecting vulnerable areas, assessing floods' impacts, and identifying damages and compensation plans. The implementation of the EU Flood Directive in Greece is challenging because of its geophysical and climatic variability and diverse hydrologic and hydraulic conditions. This study addressed this challenge by modeling of design rainfall at the sub-watershed level and subsequent estimation of flood design hydrographs using the Natural Resources Conservation Service (NRCS) Unit Hydrograph Procedure. The HEC-RAS 2D model was used for flood routing, estimation of flood attributes (i.e., water depths and flow velocities), and mapping of inundated areas. The modeling approach was applied at two complex and ungauged representative basins: The Lake Pamvotida basin located in the Epirus Region of the wet Western Greece, and the Pinios River basin located in the Thessaly Region of the drier Central Greece, a basin with a complex dendritic hydrographic system, expanding to more than 1188 river-km. The proposed modeling approach aimed at better estimation and mapping of flood inundation areas including relative uncertainties and providing guidance to professionals and academics.

23. Hou, J., Ma, Y., Wang, T., Li, B., Li, X., Wang, F., Jin, S., & Ma, H. (2021). A river channel terrain reconstruction method for flood simulations based on coarse DEMs. Environmental Modelling and Software.

Abstract: To mitigate the unavailability of accurate river channel terrain data for flood modeling, this work develops a new approach to construct channel terrain based on available global coarse digital elevation models (DEMs). Compared to other established methods, the approach constructs the river surface using the sparse cross-section data from available coarse DEMs and not measurements. For a 134 km river reach of the Yangtze River, the absolute percentage error of simulated peak discharge with the coarse DEMs is 76.77%, and the delay time of peak discharge is 13 h; however, with the reconstructed terrain data are 12.13% and 0 h. They are 9.70% and −1 h on a 382 km river reach. The simulation results show that the approach can be used to reliably predict the flood propagation process without fine terrain data. The proposed approach can be used to improve flood management in areas without fine river terrain data. © 2021 Elsevier Ltd

24. Lu, C., Ji, K., Wang, W., Zhang, Y., Ealotswe, T. K., Qin, W., Lu, J., Liu, B., & Shu, L. (2021). Estimation of the Interaction Between Groundwater and Surface Water Based on Flow Routing Using an Improved Nonlinear Muskingum-Cunge Method. Water Resources Management, 35(8), 2649-2666.

Abstract: The interaction between groundwater (GW) and surface water (SW) not only sustains runoff in dry seasons but also plays an important role in river floods. Lateral inflow is the recharge of groundwater to surface water during a river flood; this recharge is part of the GW-SW exchange. Hydrological engineers proposed the idea of modelling flood routing using the Muskingum-Cunge method, in which the GW-SW exchange is not fully considered. This study proposes an improved nonlinear Muskingum-Cunge flood routing model that considers lateral inflow; the new method is denoted as NMCL1 and NMCL2 and can simulate flood routing and calculate the GW-SW exchange. In addition, both the linear and nonlinear lateral inflows (with the channel inflows) are discussed, and the stable lateral inflows that occur due to the GW-SW exchange are considered for the first time. A sensitivity analysis shows that different parameters have different effects on the simulation results. Three different flood cases documented in the literature are selected to compare the four classical and two updated Muskingum-Cunge methods. Two different floods of the River Wye are selected to verify the accuracy of the calibrated model. The simulation results of the improved Muskingum-Cunge

method are compared with the temperature inversion results measured from the Zhongtian River, China, to indicate the feasibility and reliability of the improved method. A comparison shows that, for several cases, the proposed method is capable of obtaining optimal simulation results. The proposed method inherits the ability of the Maskingum-Cunge method to simulate flood routing. Moreover, it can quantify the GW-SW exchange, and the reliability of the estimations is owed to the nonlinearity and sign flexibility of the calculated exchange process.

25. Tahroudi, M. N., Ramezani, Y., de Michele, C., & Mirabbasi, R. (2021). Flood routing via a copula-based approach. Hydrology Research, 52(6), 1294-1308.

Abstract: Floods are among the most common natural disasters that if not controlled may cause severe damage and high costs. Flood control and management can be done using structural measures that should be designed based on the flood design studies. The simulation of outflow hydrograph using inflow hydrograph can provide useful information. In this study, a copula-based approach was applied to simulate the outflow hydrograph of various floods, including the Wilson River flood, the River Wye flood and the Karun River flood. In this regard, two-dimensional copula functions and their conditional density were used. The results of evaluating the dependence structure of the studied variables (inflow and outflow hydrographs) using Kendall's tau confirmed the applicability of copula functions for bivariate modeling of inflow and outflow hydrographs. The simulation results were evaluated using the root-mean-square error, the sum of squared errors and the Nash-Sutcliffe efficiency coefficient (NSE). The results showed that the copula-based approach has high performance. In general, the copula-based approach has been able to simulate the peak flow and the rising and falling limbs of the outflow hydrographs well. Also, all simulated data are at the 95% confidence interval. The NSE values for the copula-based approach are 0.99 for all three case studies. According to NSE values and violin plots, it can be seen that the performance of the copula-based approach in simulating the outflow hydrograph in all three case studies is acceptable and shows a good performance. © 2021 The Authors

26. Kadim, M. A. A., Omran, I. I., & Al-Taai, A. (2021). Optimization of the Nonlinear Muskingum Model Parameters for the River Routing, Tigris River a Case Study. International Journal of Design and Nature and Ecodynamics, 16(6), 649-656.

Abstract: Flood forecasting and management are one of the most important strategies necessary for water resource and decision planners in combating flood problems. The Muskingum model is one of the most popular and widely used applications for the purpose of predicting flood routing. The particle swarm optimization (PSO) methodology was used to estimate the coefficients of the nonlinear Muskingum model in this study, comparing the results with the methods of genetic algorithm (GA), harmony search (HS), least-squares method (LSM), and Hook-Jeeves (HJ). The average monthly inflow for the Tigris River upstream at the Al-Mosul dam was selected as a case study for estimating the Muskingum model's parameters. The analytical and statistical results showed that the PSO method is the best application and corresponds to the results of the Muskingum model, followed by the genetic algorithm method, according to the following general descending sequence: PSO, GA, LSM, HJ, HS. The PSO method is characterized by its accurate results and does not require many assumptions and conditions for its application, which facilitates its use a lot in the subject of hydrology. Therefore, it is better to recommend further research in the use of this method in the implementation of future studies and applications.

27. Wang, K., Wang, Z., Liu, K., Cheng, L., Bai, Y., & Jin, G. (2021). Optimizing flood diversion siting and its control strategy of detention basins: A case study of the Yangtze River, China. Journal of Hydrology.

Abstract: Utilizing detention basin to store flood water and reduce the risk of levee failure, as well as guarantee the security of important regions downstream, is an important flood control measure in some large river catchments. However, the populated and economic detention basins in China are facing the dual challenges of protecting the safety of lives and property and alleviating the pressure of flood control downstream. Maximizing the total benefits of a flood control system by balancing the flooding losses in the detention basin and the flood control benefit of the flood protected regions downstream has been the key factor in river basin flood management. In this paper, a framework is developed to optimize the flood diversion siting and operating policy of a detention basin, which consists of three modules: (1) the flood simulation module, which simulates the flood routing and flood diversion process via a one-dimensional and two-dimensional coupled hydrodynamic model; (2) the cost and benefit

calculation module, which estimates the flood damage in the detention basin and the flood control benefit in flood protected regions based on the results of the flood simulation model, with the diversion structure cost considered; and (3) the optimization module, which optimizes the diversion siting and control strategy with the objective of the maximum system benefit by balancing the flood loss in the detention basin and flood control benefit of the protected area. The framework is applied to the Huayanghe detention basin, the most downstream detention basin along the Yangtze River basin, China. The results state that gate control upstream is the optimal strategy to decrease the flood losses in the detention basin, but the potential flood losses of the protected region increase significantly under this policy. Moreover, an operating policy that balances moderately the flooding losses in the detention basin and the flood control benefit of flood protected regions downstream is provided though the framework. Overall, this study highlights flood simulations and optimization approaches represent a promising solution for filling the gap of densely populated detention basin modeling and real-world management decision-making.

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