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Journal of Water Science

DIRECTIVE PUBLICATIONS

Editorial

Methods And Uses In Water Engineering And Science.

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Abstract

A selection of excellent research articles from the First International Symposium on Water Modelling (iSymWater2019) are published in this Special Issue of Water on "Techniques and Applications in Water Science and Engineering." Beijing Normal University and Manchester Metropolitan University hosted the symposium, which was held in Beijing, China, from July 8–10, 2019. Numerous study areas were taken into consideration, such as software, physical experiments, water management simulation, hydraulic modeling, hydro-environment modeling, and hydro-ecology modeling. Eight papers from researchers from various institutions worldwide are featured in the issue, which focuses on using theoretical and physical modeling techniques to address sustainable water concerns.

Keywords : *hydraulic engineering; environmental hydraulics; physical modelling; numerical modelling.*

INTRODUCTION

Scientific Questions

Future development and well-being are largely dependent on water. Water resources engineers and scientists, however, confront significant challenges as a result of the world's severe water-related issues.

Transient flow frequently happens in pipelines and may interact with pipe structures in hydraulic systems [1,2]; aquatic vegetation is common in surface water and affects the flow field [3], further disrupting the aquatic environment and aquatic biodiversity; and extreme floods are becoming more frequent and intense due to climate change and rapid urbanization, endangering human life and causing significant property damage [4]. River, lake, and ocean cleanup requires an awareness of the waterborne movement of new contaminants, including plastic waste and antibiotics [5,6]. Hydrological change is having a significant impact on hydro-ecology due to both natural and man-made stressors. It is influencing the structural evolution of deltas [7] and reducing the amount of ecological lake water available in arid regions [8]. To address the aforementioned water-related issues, technological tools that describe hydrological and hydraulic conditions as well as possible future changes are necessary.

Technical Problems

Water resources engineers must use sophisticated modeling approaches to guarantee water security and quality in accordance with the Sustainable Development Goals of the UN, especially Goal 6 on clean water and sanitation. Open channels and pipes are frequently used to transfer water. Rapid variations in flow rate that pressurize pipes can cause hydraulic transients, which are defined by high positive and negative pressures. These transients could be significant enough to result in system fatigue, device failure, etc. Regarding open channels, the critical depth is important for the design, analysis, maintenance, and operation of these conduits; nevertheless, the mathematical formulas that determine the critical depth for any given flow section are complicated, implicit, and transcendental, and so have to be solved numerically. Vegetation is found in almost all natural channels, which aids in energy dissipation and can be highly beneficial for flood protection and river restoration projects. It goes without saying that research on flow-vegetation interactions can advance our knowledge of fluvial processes and highlight the advantages of vegetated surface water for the ecosystem. Massive releases of new and developing contaminants, such plastic waste and antibiotics, have caused major harm to aquatic biota and habitats on a global scale, which is linked to socioeconomic growth. Therefore, to simulate the movement and destiny of newly discovered

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Received: 05-Jan-2025, **; Editor Assigned:** 06-Jan-2025 **; Reviewed:** 21-Jan-2025, **; Published:** 27-Jan-2025,
Citation: Zhou Jian Guo. Methods And Uses In Water Engineering And Science. Journal of Water Science. 2025 January; 1(1).

pollutants in natural waterbodies, high performance modeling tools are needed. Another significant worldwide technical issue is hydro-ecology, which is sensitive to human activities that disrupt the aquatic environment and is strongly tied to hydraulic and environmental circumstances , such as dam construction, river dredging, and lake restoration. This Special Issue examines how advanced modeling approaches and their integrated application are necessary for a thorough examination of the hydro-ecological effects of human and climate change on the water environment.

Papers' Categorization

The articles in this Special Issue report on hydraulic mechanisms [1–3], modeling methodologies [4–6], and natural effects [7,8] address various water resources issues using hydraulic modeling [1–4], hydroenvironmental modeling [5,6], and hydro-ecological modeling [7,8].Future ecological modeling performance [7,8] and simulation calibration and validation [1–6] are enhanced by the application of analytical and numerical techniques.

Paper Synopsis (Updated Based On The Papers' Abstract)

Tang Et Al.'S Cfd Studies Of Transient Cavitation Flows In Pipelines Using A Weakly Compressible Model (2020)

This study examined cavitation flow in a pipeline using a computational fluid dynamics (CFD) approach based on Fluent software. A weakly compressible fluid Reynolds Averaged Navier-Stokes (RANS) scheme served as the foundation for the software, and experimental data was used to verify the results. The continuity equation's variable wave speed of the transient cavitation flow was accurately replicated by adding a user-defined density–pressure model. The resulting model demonstrated the vapor cavity's unequal distribution and slow travel in the pipe, as well as its genesis, growth, and collapse. It was discovered that several kinds of cavitation flow can result from the propagation of a rarefaction wave into areas where the pressure rises or falls.

Shang Et Al.'S (2019) Explicit Solution For Critical Depth In Closed Conduits Flowing Partially Full

Water resources engineers involved in conduit construction, operation, and maintenance must assess critical depth, a crucial characteristic. In hydraulic and civil engineering, non-pressure conduits for irrigation and sewerage projects frequently have circular, arched, and egg-shaped cross sections. The formulas controlling the critical depth in different cross sections, however, are intricate, implicit, and transcendental. This study used the mathematical transform approach to create a function model for the geometric aspects of several sections while taking non-dimensional parameters into account. Then, using MATLAB's enhanced PSO algorithm, the right answer for the critical depth was found. Analysis of errors revealed that the strategy has broad applicability.

Zhao Et Al. (2019) Examined How The Density Of Submerged Vegetation Affected The Characteristics Of Turbulent Flow In An Open Channel.

In rivers with submerged vegetation, turbulent flow is influenced by vegetation density λ. This paper describes a laboratory investigation that examined several vegetated turbulent flow types for a wide range of vegetation densities. For various λ circumstances, vertical distributions of the turbulence statistics, turbulence kinetic generation rate, and turbulence spectra were displayed. Spectra of low-frequency eddies above the submerged vegetation showed peak values substantially bigger than those corresponding to eddies passing through the vegetation, and it was discovered that the spectral curves varied intensely within the low-frequency range. By boosting the maximum value of the turbulence kinetic generation rate (GS) and the point at which the GS profile has a vertical maximum towards the top of the submerged vegetation, increased plant density changed the type of turbulent flow.

Cui Et Al.'S (2019) Simulation Of Hydraulic Structures In 2d High-Resolution Urban Flood Modeling

Urban floods brought on by a lack of flood barriers, insufficient drainage capacity, etc., typically shows hydrodynamics that are quite transient. It is still very difficult to anticipate and forecast urban flash floods in a reliable and effective manner. This study outlines a reliable numerical method.

It uses a finite volume Godunov-type shock-capturing shallow water approach to create a 2D high-resolution urban flood model that accurately replicates the impacts of hydraulic gate structures. The urban flood model was improved by using a flux term coupling approach, which was successfully validated by duplicating the hydraulic laboratory's flood routing tests in a flume with partially open sluice gates at Zhejiang Institute of Hydraulics and Estuary, China. The study shows that the suggested model had improved predictive power for urban flood modeling and could faithfully replicate the flow via hydraulic infrastructure.

Ding Et Al. (2019) Predict The Short-Term Path Of Microplastic Particles In Laizhou Bay Numerically

Ecological health is seriously threatened by microplastic particles, which are readily ingested by microbes and make their way into the food chain. Due to local coastal hydrodynamics and garbage flows, these particles have proliferated in coastal locations. Despite a great deal of research on microplastics, it is still difficult to forecast how the particles will move across coastal areas. The paths of microplastic particles emitted from four river mouths surrounding Laizhou Bay are numerically

predicted in this work. The Lagrangian particle-tracking approach, which incorporates particle-wall and inter-particle collisions, is combined with the Lattice Boltzmann method to create the computational model. Results showing the paths taken by the particles discharged from four river mouths, for a total duration of 30 days.

Xing Et Al.'S Numerical Investigation Of Sulfonamide Occurrence And Transport In The Near-Shore Region Of Laizhou Bay (2019)

Throughout aquaculture, antibiotics are widely used to treat microbial illnesses and boost output. In order to address antibiotic pollution of water ecosystems, it is essential to comprehend the destiny of sulphonamides (SA) in the aquatic environment. The transit and incidence of SA in Laizhou Bay, a thriving aquaculture region in China, are examined in this work using a two-dimensional lattice Boltzmann model. The model was successfully validated against experimental data using the Bhatnagaar–Gross–Krook technique to solve the shallow-water and advection–diffusion equations. The model offers a potentially universal technique for simulating antibiotic fate in aquatic environments.

Amenuvor Et Al. (2020) Examine How Dam Regulation Affects The Volta River Delta's Morphological Evolution And Hydrological Alteration.

Being one of the world's most dam-regulated rivers, the Volta River in West Africa has had a significant impact on the morphological evolution and hydrological change of its delta. This study details the application of cutting-edge hydrological techniques to examine intra- and interannual fluctuations in sediment load and river flow during the years 1936–2018 before and after the Akosombo Dam. It was discovered that the pre-dam era had far greater intra- and inter-annual variability, indicating the Akosombo Dam's significant regulatory influence on the Volta River. Morphological studies revealed that the Volta River's erosion and degradation After the 1970s, delta continuously varied within a rather narrow range. Given the current sediment load, a quasi-equilibrium condition may have been formed at the Volta River Delta, according to the relationship between changes in the delta area and sediment load. The Volta River Delta's future control and restoration should benefit from the information in this report.

Liu Et Al. (2019) Used A Landscape Connectivity Approach To Determine The Minimum Ecological Lake Level, With Implications For Lake Restoration.

This study suggests a novel method for figuring out the minimal ecological lake level utilizing ArcGIS and MIKE 21's landscape connectivity. The water landscape and associated connectivity of Baiyangdian Lake on the North China Plain are simulated, and the connection between the landscape connectivity and lake level is examined. The breakpoint of the lake level–connectivity curve was identified as the minimal ecological lake level. According to the findings, Baiyangdian Lake's ecological lake level is 7.8 to 8.0 m, below which the ecosystem of the lake becomes fractured and maybe vulnerable. It has been proposed that engineering changes to landscape patterns could improve connectivity at lower lake levels. These methods can reduce the water and financial waste that results from an over-reliance on high water levels to satisfy minimal connectivity requirements. The study offers a helpful viewpoint on lake ecosystem restoration in relation to landscape and water resource management.

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