The Fourth International Symposium on Flash Floods in Wadi Systems

4th ISFF

Urban Flood Risk Management: Mitigation and Adaptation Measures in the MENA Region

December 4th – 6th , 2018
Palace d'Anfa Hotel, Casablanca, Morocco
www.isff2018.com

Preface

Despite their arid to semi-arid climate and scarcity of water resources, many cities in the Middle East and North Africa (MENA) region have faced flash floods in the past two decades. Such cities are Riyadh (November, 2016 and 2017), Casablanca (March, 2016), Doha (Novembre, 2015) and more recently the touristic city of Petra in Jordan (November 10, 2018). These events caused significant losses of lives and damages, highlighting urban vulnerability to flood risk in the MENA region.

Such disasters are usually due to the combination of many factors such as extreme rainfall, lack or insufficiency of drainage and stormwater infrastructure, urban river reaches flooding, uncontrolled rising groundwater levels or tides generating backwater effects on stormwater system outlets for coastal cities.

Morocco, a country that has accumulated a great knowledge on integrated water management since its independence thanks to its dam policy, deploys a variety of resources in terms of adaptation to climate change, including extreme rainfall leading to the phenomenon of floods. These measures are taken at strategic, legislative and technical levels. However, the development of resilience to flood risk at regional and local levels is still evolving and requires technical knowledge, but also good governance to prevent the risk, mitigate the socio-economic damages it may generate and ensure the safety of citizens.

The 4th edition of the International Symposium on Flash Floods in Wadi Systems (ISFF), organized in Morocco by Hassan II University of Casablanca and Kyoto University in Japan, focuses on the specific problem of floods in urban areas and measures likely to mitigate this risk and adapt to its consequences. The resilience of cities in the MENA

region will be addressed in its hydro-meteorological, urban planning and management aspects at the national, regional and local levels. The sessions focus on technological advances in hydrologic and hydraulic modeling as tools for flood risk analysis and forecasting, sediment and groundwater management, socio-economic vulnerability assessment techniques, and mitigation and adaptation measurement for flood risk control.

Morocco welcome guests from around the world looking for solutions and scientific knowledge exchange on flood risk management. ISFF2018 aims to create a forum for exchange of experiences, best – practices and technology transfer between scientists, practitioners and water management stakeholders at local, regional, national and international levels, be they public or private.

In fact, ISFF 2018 held in Morocco makes this exchange closer to MENA countries and African countries to enhance their capacities and build their cities resilience to flash floods. The international scientific cooperation in this field is more than ever needed, at this time of mankind, where natural and manmade conditions have impacts beyond countries and territories borders.

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Chair of 4th ISFF2018
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Acknowledgments

The organizing instiutions Hassan II University of Casablanca-Faculty of Sciences and Technics at Mohammedia (UH2C-FSTM) are gratefully acknowledged for their administrative and logistical support. We thank Water Resources Research Center (WRRC) and Global Alliance of Disaster Research Institutes (GADRI) of the Disaster Prevention Research Institute (DPRI), Kyoto University, for co-sponsoring the event. We are grateful to the Ministry of Equipment, Transport, Logistics and Water, the Ministry of Land Use, Urban Planning, Housing and City Policy, Hassan II Academy of Sciences and Technics, Casablanca-Settat county council and R&D Maroc (NGO) for their support and involvement. The financial support of LYDEC (Suez-Casablanca) as well as their logistic support are gratefully acknowledged and highly appreciated. We are also thankful to the Central Reinsurance Company for their financial support. Finally, we thank the University of Technology in Oman (GUtech) and the International Association for Hydro-Environment Engineering and Research (IAHR) for advertising and publishing assistance.

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Program of the 4th International Symposium on Flash Floods in Wadi Systems (4th ISFF2018)

Ice Breaker Party: Monday December 3rd, 2018	
19:00-21:00	Hotel Palace d'Anfa, Casablanca

All sessions will be held in the Hotel conference hall

1st Symposium Day: Tuesday December 4th, 2018		
08:00- 09:00	Registration: Conference Hall	
09:00-10:00	Opening session Under the auspices of the Ministry of Land use, Urban Planning, Housing and City Policy Under the auspices of the Ministry of Equipment, Transport, Logistics and Water	
Chair: **Prof. Dalila Loudyi**, *Hassan II University of Casablanca, Morocco*		
09:10-09:15	Message from the representative of the Ministry	Ministry of Equipment, Transport, Logistics and Water, Morocco
09:15-09:20	Message from the representative of the Ministry	Ministry of Land use, Urban Planning, Housing and City Policy, Morocco
09:20-09:25	Message from the President of the County council	*Casablanca-Settat County council, Morocco*
09:25-09:30	Message of the General Director of LYDEC (Suez-Casablanca)	*LYDEC (Suez-Casablanca) Morocco*
09:30-09:40	Welcome message and opening remarks	*Hassan II University of Casablanca Morocco*
09:40-09:50	ISFF background, objectives and perspectives	*Kyoto University, Japan*

10:00-11:20	Session 1-1 Climate change and hydrometeorological data analysis	
Chair: **Prof. Sameh Kantoush**, *Kyoto University, Japan*		
10:00-10:20	***Keynote:*** **On the change, variability and predictability of hydrological extremes in a desert environment**	**Prof. Taha Ouarda** Chaire de recherche du Canada en hydro-climatologie statistique, Institut National de la Recherche Scientifique, Québec, Canada
10:20-10:35	Changement climatique observé et projeté au Maroc Observed and future climate change in Morocco	Khalid El Rhaz, S. Moutia and R. Sebbari Direction de la Météorologie Nationale, Casablanca, Morocco
10:35 –10:50	Rainfall-runoff analysis of the Wadi Bili catchment in the Red Sea Governorate of Egypt	Franziska Tügel, A. Abdelrahman, A. Hadidi and R. Hinkelmann Technical University, TU Berlin, Germany
10:50-11:05	Rainfall and Wadi Flow Data Monitoring and Analysis in Oman	Ayisha Al Khatri Ministry of Regional Municipalities and Water Resources, Muscat, Oman
11:05-11:20	Climate change and water resources management in the coastal El Jadida-Safi subasin, Morocco	Mounia El Azhari and D. Loudyi Faculty of Sciences and Technics, Mohammedia, Morocco
11:20-11:35	Coffee break	

11:35-13:15	Session 1-2 Flood vulnerability and risk assessment	
Chair: **Dr. Kamal El Kadi**, *EDF, France*		
11:35-11:55	**Keynote** **Flood Prediction in Low-Gradient Urbanized Coastal Watersheds: Sharing Lessons-Learned and Challenges from South Louisiana, USA**	**Prof. Emad Habib** University of Louisiana at Lafayette, Louisiana, USA
11:55-12:10	Reinsurance company tools for assessing flood economic losses in Morocco	Dr. Issam Mouyan Société Centrale de Réassurance, Centre Africain des Risques Catastrophiques Casablanca, Morocco
12:10-12:25	Impacts of Floods on the Sultanate of Oman	Omaima Al Manji Ministry of Regional Municipalities and Water Resources, Muscat, Oman
12:25-12:40	Flash flood hazard assessment and mitigation strategies in the arid wadi systems of Egypt	Mohammed Abdel-Fattah, S. Kantoush, M. Saber and T. Sumi Disaster Prevention Research Institute (DPRI), Kyoto University, Japan
12:40-12:55	Database model structured by Merise conception for processing flood hazard in Morocco	Meriam Lahsaini and H. Tabyaoui Faculty of Sciences and Technics, Fez, Morocco
12:55-13:15	**Plenary discussion - Discussion**	

13:15-14:30	Lunch and Poster session 1

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Chair: Dr. Mohammed Amin Hafnaoui, *CRSTRA-Algeria* **and Dr. Ahmed Hadidi,** *Gutech-Oman*	

4:30-16:05	Session 1-3 Hydrologic and hydraulic modelling of flood	
Chair: **Prof. Taha Ouarda**, *Institut National de la Recherche Scientifique, Canada*		
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15:05-15:20	Hydraulic modelling of Octobre 2011 floods in El Bayad city, Algeria	Mohammed Amin Hafnaoui, A. Hachemi, M. Madi and Y. Farhi Centre de Recherche Scientifique et Technique sur les Régions Arides - CRSTRA , Algeria
15:20-15:35	Delineation of catchment boundary in wadis' downstream in south Batina, Oman	Ahmed Hadidi and E. Holzbecher German University of Technology in Oman GUtech, Oman
15:35-15:50	Hydrological modeling of stormwater: Possibilities and applications - case of STORM software	Nour el Houda EL HAMOUMI Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Morocco
15:50-16:05	Composite modelling approach to study compound flooding in coastal areas	Dorina Dragancheva, J. Pan, V. Penchev, J. Zhang, S. Shukrieva, M. Xiong, D. Ting Wang, P. Penchev and J. Wang Bulgarian Ship Hydrodynamics Centre, Bulgaria Nanjing Hydraulic Research Institute, China

16:05-16:20	Coffee break

16:20-18:00	Session 1-4 Hydrologic and hydraulic modelling of flood	
Chair: **Prof. Ekkehard Holzbeche**, *Gutech, Oman.*		
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16:35-16:50	Floodplain modelling for 1D steady -unsteady flow: case study of Sidi Ifni Wadi, Morocco	Saad Aicha, A. Milewski and L. Benaabidate Polydisciplinary Faculty Taroudant, Morocco
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17:05-17:20	Event modelling and simulation of the extreme hydrological contributions of the Zat watershed , High Atlas, Morocco	Myriam Benkirane, M. Saidi, N. Laftouhi, B. El Mansouri and I. Salik Faculty of Sciences, Marrakech, Morocco
17:20-17:35	Application of modeling tools for assessment of flood risk and establishment non structural mitigation: Case study of Malleh dam failure located upstream of Mohammedia city	Ali El Bilali and A. Taleb Hydraulic Basin Agency of Bouregreg and Chaouia & Faculty of Sciences and Technics of Mohammedia, Morocco
17:35-18:00	**Plenary discussion - Discussion**	

2nd Day of Symposium : Wednesday December 5th, 2018		
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Chair: **Prof. Tetsuya Sumi**, *Kyoto University, Japan*		
09:00-09:20	***Keynote:*** **Science-community interface: capacity building for managing natural disasters of flash floods in Egypt, Jordan, Sudan and Yemen**	**Dr. Abdelaziz Zaki** Science National Professional Officer, UNESCO, Cairo, Egypt
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09:35-09:50	Flash floods mitigation and adaptation in Oman	Ahmed Al Barawani Ministry of Regional Municipalities and Water Resources, Muscat, Oman
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Chair: **Dr. Riadh Ata**, *EDF, France*		
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11:40-11:55	Interdisciplinary and interlocked spatial-temporal studies to enhance efficiency and sustainability of environmental management of streams impacted by urbanization (Yzeron catchment, city of Lyon, France)	Laurent Schmitt, P. Namour, P. Breil, M. Lafont, L. Grospretre, N. Jacob-Rousseau, O. Navratil, H. Delile, D. Eschbach and B. Cournoyer University of Strasbourg, France
11:55-12:10	Urban planning documents in the test of flood risk management: Case of the city of Kenitra, Morocco	Khadija Karibi and O. Messous National School of Architecture, Rabat, Morocco
12:10-12:25	Evaluation of Shoreline Change: A Case Study from the Wadi Al Maawil Watershed	Amna Al Ruheili College of Agricultural and Marine Sciences, Sultan Qaboos University, Oman
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12:40-13:00	**Plenary discussion -Discussion**	

13:00-14:15	Lunch and Poster session 2

13:45-14:15	2nd Posters session
Chair: Dr. Mohammed Amin Hafnaoui, *CRSTRA-Algeria* **and Dr. Ahmed Hadidi,** *Gutech-Oman*	

14:15-16:20	Session 2-3 Sediment management and flood control structures	
Chair: **Prof.Mohamed El Manadely**, *King Abdulaziz University,Saudi Arabia*		
14:15-14:35	**Keynote** **Integrated reservoir sedimentation management in arid and semi-arid countries under climate change**	**Prof. Tetsuya Sumi** Disaster Prevention Research Institute (DPRI), Kyoto University, Japan
14:35-14:50	Optimization bias in dam sedimentation management	Tobias Landwehr, M. Irie and C. Pahl-Wostl Osnabrück University, Germany
14:50-15:05	Integrated management of flash floods in Wadi basins considering sedimentation and climate change	Mohamed Saber, T. Al Harrasi, S. Kantoush, M. Abdel-Fattah and T. Sumi Disaster Prevention Research Institute (DPRI), Kyoto University
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15:20-15:35	Mechanical behavior of concretes based of sediment of dam reservoirs in Morocco case study: Dam Mohamed Ben Abdelkrim El Khattabi	Ali Kerdad, L. Mouhir, A. Zakaria and K. Zahidi Faculty of Sciences and Technics, Mohammedia, Morocco
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16:20-16:35	Coffee Break

16:35-17:50	Session 2-4 Groundwater management	
Chair: **Prof. Emad Habib**, *University of Louisiana at Lafayette, USA*		
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16:55-17:10	Floods control dams surface water recovery for groundwater artificial recharge : Case of Settat plain dams and Berrechid aquifer, Morocco	Mohamed Sinan, M. Dchieche and N. Naser Hassania School of Public Works (EHTP) & Hydraulic Bassin Agency of Bouregreg and Chaouia, Morocco
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17:25-17:50	**Plenary discussion - Discussion**	

17:50-18:10	Closing Session Closing Remarks and Announcement of 5th ISFF2019	
Chair: **Prof. Tetsuya Sumi,** *WRRC, DPRI, Kyoto University*, Japan		
17:50-18:00	Closing Statement and Concluding Remarks on the 3rd ISFF	**Prof. Dalila Loudyi** *FSTM, Hassan II University of Casablanca* Morocco
18:00-18:10	The Fifth International Symposium on Flash Floods in Wadi Systems	**Prof. Sameh Kantoush** *WRRC, DPRI, Kyoto University*, Japan

Symposium Banquet Wednesday December 5th , 2018	
19:15-23:00	Headquarters of Casablanca-Settat county council at Habous

3rd Day of Symposium: Thursday December 6th, 2018 Field trip Visit to Wadi el Malleh dam and Mediouna storm water basin for flood control	
8:00-13:30	Field trip program Casablanca – Mohammedia - Mediouna
8:00	Departure from the hotel
9:30	Arrival to Wadi El Malleh Dam for flood control Guided visit by engineers of the River Basin Agency of Bouregreg and Chaouia
10:30	Departure from the dam site towards the storm water basin of Mediouna
12:00	Arrival to Mediouna storm water basin Presentation of the infrastructure by engineers of LYDEC (Suez-Great Casablanca storm water and wastewater utility)
13:30	Return to hotel

ON THE CHANGE, VARIABILITY AND PREDICTABILITY OF HYDROLOGICAL EXTREMES IN A DESERT ENVIRONMENT

Taha Ouarda

Canada Research Chair in Statistical Hydro-Climatology, Canada

Abstract

Wadi systems are characterized by a strong variability, a fast response, and often a lack of knowledge about the processes involved. There is also a lack of availability of long series of flow data in wadi systems, and precipitation series can be used as a proxy to study flash floods in these regions. Precipitation extremes are studied at several stations in the United Arab Emirates (UAE) for assessment of the long-term trends, study of seasonality and variance changes, and analysis of the capacity to include long term low frequency climate oscillations to predict extreme events' magnitudes and frequencies. Results indicate that extreme care needs to be taken to avoid mixing variability and trend signals. Results indicate also that a number of climate oscillation indices have a strong impact on precipitation variability in the whole Arabian Peninsula. The El Niño-Southern Oscillation (ENSO Index and the Southern Oscillation Index (SOI) are shown to especially impact extreme hydro-climatic variables in the region. The impact of the inclusion of the information above on the modeling of the frequency of extreme flash events is also studied. It is possible to develop a long-term prediction model of extreme events in Wadi systems based on teleconnection information. These types of models can be extremely helpful in increasing the preparedness to the occurrence of these events and in attenuating their impacts.

Keywords

Flood, Climate change, Climate variability, Arid region, Frequency analysis, Risk management, Adaptation

OBSERVED AND FUTURE CLIMATE CHANGE IN MOROCCO

Khalid El Rhaz, Sara Moutia and Rachid Sebbari

National Meteorology Direction (DMN), Morocco

Abstract

Climate change is one of the major challenges of the 21st century at both global, regional and local scales. The evolution of the climate system shows that the last three decades have been successively warmer on the Earth's surface than all the previous decades since 1850. In addition to warming, there are also changes in extreme events in terms of intensification, persistence, frequency or spatial distribution; all with significant impacts on humans and ecosystems.

As to its meteorological and geographical position, Morocco is located a climate change vulnerable region in temperature and rainfall terms. Observed evolutions show an intensification of rainfall in few Moroccan regions such as Essaouira and Al Hoceima along with an upward trend of the maximum monthly cumulative rainfall of 5 consecutive days. Unlike rainfall, the upward trend in temperatures is widespread throughout the kingdom.

Future projections, estimated from the outputs of a set of climate models such as Cordex Africa Experience and Aladin-operational climate model at the DMN, provide information on variation rainfall regime combined with additional warming. For 2050 horizon, according to the two scenarios of Representative Concentrations Pathways (RCP) 4.5 and 8.5, the center and north of Morocco will probably experience a reduction in the number and amplitude of heavy rainfall events. On the other hand, for the same horizon and according to the same scenarios, the warming will affect the whole territory.

Keywords

Observed climate, Heavy rainfall, Warming, Climate models, Morocco

RAINFALL-RUNOFF ANALYSIS OF THE WADI BILI CATCHMENT IN THE RED SEA GOVERNORATE OF EGYPT

Franziska Tügel[1],Abdelrahman Abdelrahman[2], Ahmed Hadidi[3], Reinhard Hinkelmann[1]

[1]Technische Universität Berlin, Germany
[2] Technische Universität Berlin Campus El Gouna, Egypt
[3]German University of Technology in Oman, Oman

Abstract
Hydrological models can be used to analyze different processes leading to flash floods in a catchment and to investigate possible mitigation measures. Especially in arid regions, not only the mitigation of damages due to flash floods, but also the effective usage of the valuable fresh water supplied from flash floodsshould be taken into account to find optimum solutions. Among others, the hydrological modeling software STORM is suitable to simulate event-based rainfall-runoff scenarios on the catchment scale considering data about topography, flow stream characteristics, land use, soil and climate. Furthermore, protection measures such as retention basins can be implemented. The aim of this study is to investigate the rainfall-runoff behavior of the Wadi Bili catchment in the Red Sea Governorate of Egypt by using STORM and GIS applications. The runoff measurements, which were conducted by Hadidi (2016) during the flash flood event on 9 March 2014, should be used to calibrate the catchment model. Afterwards, the model is used to simulate stronger rainfall events as well as to investigate mitigation measures. Furthermore, the model will be coupled with the two-dimensional shallow water model of the region of El Gouna. Therefore, hydrographs which were calculated with STORM for different rainfall scenarios are used as boundary conditions for the 2D shallow water model to simulate water depths, flooding areas and flow velocities on the plain part of the catchment, where the flow crosses infrastructure and parts of the city before draining into the Red Sea.

Keywords
Hydrological modeling, Model coupling, Flash flood modeling, STORM

RAINFALL AND WADI FLOW DATA MONITORING AND ANALYSIS IN OMAN

Ayisha Al Khatri

Ministry of Regional Municipalities and Water Resources, Oman

Abstract

The wadi valleys in Oman are usually dry, however when it rains it results in flash floods which could be devastating. This creates a challenge for measuring equipment and hydrologists alike. Since early 70's the government of Oman has recognised the importance of having an extensive hydrometric network for the country. Therefore, rainfall gauging station and wadi flow stations were installed to record rainfall amounts and depth of flows and peak flows since 1974. The Water Resources Monitoring Department, in the Ministry of Regional Municipalities and Water Resources (MRMWR) supervises on the establishment, development, upgrading and maintenance of the national hydrometric network. It also collects, analyzes and processes the field measuring data, as well as introduces their final result which could be used later. The network proved to be a very important tool of monitoring the flash floods and store a huge database. The data and information collected through the network have supported many water related projects. In this regard, the Monitoring network department is performing periodical studies which are related to the revision of the existing network aiming to update operation and maintenance tasks. This is done under the consideration of the WMO guidelines. For the purpose of the forth International Symposium on Flash Floods in Wadi Systems we will introduce the procedures followed by the MRMWR in establishing, collecting, analyzing and compiling of rainfall and wadi flow data and also highlights the publication and reporting procedures. We will also give an overview of the recent network expansion (2016).

Keywords

Hydrometric Network, Rainfall gauging, Wadi flow, Oman

CLIMATE CHANGE AND WATER RESOURCES MANAGEMENT IN THE COASTAL SUB-BASIN OF EL JADIDA SAFI - MOROCCO

Mounia El Azhari, Dalila Loudyi

Faculty of Sciences and Technics –Mohammedia, Hassan II University of Casablanca, Morocco

Abstract

According to the 5th assessment report of the Intergovernmental Panel on Climate Change (IPCC), temperature is projected to rise over the 21st century under all assessed emissions scenarios while precipitation will likely decrease, thus reducing renewable surface water an groundwater resources in most dry subtropical regions such as Morocco. Moreover, most projections of global circulation models predict a dryer future for North African countries.

The objective of this work is to assess the impact of climate variability on water resources in the coastal sub-basin of El Jadida Safi (Oum Er Rbia basin). To determine future climate projections in the sub-basin by 2099, we are using statistical downscaling method which is based on both observed data and anthropogenic emission scenario data for the RCP 8.5 (pessimistic) and RCP 4.5 (optimistic) scenarios. Results will help decision makers and stakeholders to better manage their water resources, to prepare for extreme hydrological hazards and to enhance development planning in the river basin.

Keywords

Climate variability, El Jadida-Safi sub-basin, Downscaling, Climate projection

FLOOD PREDICTION IN LOW-GRADIENT URBANIZED COASTAL WATERSHEDS: SHARING LESSONS-LEARNED AND CHALLENGES FROM SOUTH LOUISIANA, USA

Emad Habib

University of Louisiana at Lafayette, USA

Abstract

In August 2016, the city of Lafayette and many other urban centers in Louisiana, USA, have experienced catastrophic flooding resulting from what was classified as >1000-year rainfall event. Statewide, this historic storm displaced more than 30,000 people, resulted in damages up to $8.7 billion, and resulted in the loss of life of at least 13 Louisiana residents. With the increasing frequency of major floods, local communities need improved capabilities for forecasting flood events to enhance community resiliency and economic development. The current study presents the application of a coupled hydrologic and hydrodynamic modeling approach to predict flooding in urban basins at small temporal and spatial scales. The study site is the 25-mile2 Coulee mine catchment in Lafayette, south Louisiana, which is part of the Vermilion River that drains into the Gulf of Mexico. The hydrogeomorphic setting, growing urbanization, low-gradient topography, and interdependent infrastructure, present challenges for modeling extreme floods events in these environments. We developed a nested multi-scale model where distributed runoff estimates from a national-scale community modeling system (WRF-Hydro) are used to drive a hydrodynamic model and generate detailed flood inundation maps. We also constructed an operational flood forecasting system that automatically generates inundation maps in real-time using the atmospheric forcings and rainfall forecasts from the High Resolution Rapid Refresh (HRRR) as an input to WRF-Hydro system. This framework will enable local communities to take advantage of the emerging forecasting resources and data technologies and enhance their resiliency in face of increasing threats from extreme flood events.

Keywords

Flood forecasting, WRF-Hydro, Floodplain, Rainfall forecasts

REINSURANCE COMPANY TOOLS FOR ASSESSING FLOOD ECONOMIC LOSSES IN MOROCCO

Issam Mouayn

African Centre for Catastrophe Risks (ACCR) - Société Centrale de Réassurance (SCR), Morocco

Abstract

In recent decades, Morocco has become increasingly vulnerable to natural disasters, including frequent floods, causing considerable loss of life and major economic impacts.
While disaster response has improved through national efforts, risk management is, according to the Moroccan government, less satisfactory. Indeed, much of the data on natural hazards and vulnerability is not well documented. Therefore, the Moroccan government has recently decided to develop a national strategy for prevention and management of natural disasters risks, which implementation requires a good knowledge of the country's exposure to various natural hazards.Today, the SCR-CARC consortium has invested in the improvement and customization of the Morocco Natural Hazard Probabilistic Risk Analysis (Mnhpra) tool. This tool initial version was developed within a World Bank project for probabilistic risk assessment of natural disasters and planning of mitigation measures to reduce these risks in Morocco.
This work will primarily address the different aspects offered by this tool in for assessing the flood impacts, from economic exposure, through probabilistic and deterministic analyzes to assessment of overall economic losses, probable annual and maximum averages. This tool provides the insurance and reinsurance industry with successful models for setting up insurance covers adapted to this type of natural hazard.

Keywords
Flood insurance, Probabilistic and determistic tools, Mnhpra, Risk analysis

IMPACTS OF FLOODS ON THE SULTANATE OF OMAN

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Abstract

In the last ten years many gulf countries such as the sultanate of Oman, Saudi Arabia, United Arab Emirates and Yemen have experienced tropical cyclones. Most of these cyclones have been generated in the Arabian Sea, part of the Indian Ocean. These cyclones have caused flash flooding that has impacted on human's lives, resources and the environment. This paper is going to discuss the history of cyclones specifically in the Sultanate of Oman. It will specifically compare between three types of cyclones that struck Oman in the last ten years in Gonu, Phet and Mekuno. These cyclones have resulted in many positive and negative economic and environmental impacts on the Omani society. These impacts will be presented in this paper using GIS photos and charts. Additionally, this paper is going to discuss the comparison between cyclones and the following factors: reached time, wind speed, rainfall amount and flood warning system. The findings of this paper will show that the numbers of human's lives lost has decreased since the last cyclone. Moreover, the benefits of the alarm flood systems in decreasing damages will be discussed. Besides, the economic loss varies according to the power of the cyclone and the images mapped for the three cyclones display the flooding and damage to roads and infrastructure. In brief, this paper discusses the impact of three types of cyclones which struck the Sultanate of Oman in the last years in order to reduce the impacts of natural disasters in the future.

Keywords

Gonu, Phet, Mekuno cyclones, Omani society, Flood damages, Environment

FLASH FLOOD HAZARD ASSESSMENT AND MITIGATION STRATEGIES IN THE ARID WADI SYSTEMS OF EGYPT

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Abstract

In this study, we developed an integrated approach based on geomorphometric analysis, hydrological modeling, flood hazard assessment and mitigation. The Wadis of Qena, Valley of Kings (KV), Abadi (at the Eastern and Western Deserts of Egypt), were selected to apply and validate the developed approaches and methods. To investigate the relationship between variations in geomorphometric and rainfall characteristics and the responses of wadi flash floods, Wadi Qena was employed. The distributed hydrological model, Hydro-BEAM, used to obtain a good representation of the spatial variability of the rainfall and geomorphology in the basin. The results exhibit strong correlations between scale and topographic parameters and the hydrological indices of the wadi flash floods, while the shape and drainage network metrics have smaller impacts. In the second case study, which is KV the important UNESCO World Heritage site, a 2D hydrodynamic model, TELEMAC-2D, utilized to assess flood hazard with and without the current flood mitigation measures for the 1994 flood which damaged and inundated most tombs in KV. Finally, flood mitigation scenarios of using a single concentrated dam or group of distributed dams have been assessed in Wadi Abadi, where a high-resolution DEM data and additional satellite imagery were utilized to propose the locations and design characteristics of flood management dams based. The results revealed that the distributed dams scenario outperform the concentrated dam in the flood mitigation and water resources management aspects, whereas the concentrated dams scenario has relative merits in the cost and operation point of view.

Keywords

Flash flood, Arid regions, Wadi, Hydro-BEAM, TELEMAC-2D, Flood risk reduction

DATABASE MODEL STRUCTURED BY MERISE CONCEPTION FOR PROCESSING FLOOD HAZARD IN MOROCCO

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Abstract

Floods are the natural hazards that produce the highest number of casualties and material damage in the Western Mediterranean. An improvement in flood risk assessment and study of a possible increase in flooding occurrence are therefore needed. In this paper, we present a relational and standardized database model in order to record, analysis and output flood data in Morocco. This inventory is a decision-making tool for the global apprehension of risk. It includes spatial data and attributes. The flood database is structured by Merise logic with a more or less simple schematization of the real world. It is structured in such a way as to evolve with the advancement of the work of capturing flood histories, hydrological and hydraulic calculations or when improvements are made by new models or techniques. It comprises 35 input tables and a dictionary or common data reference structured around 33 tables, facilitating exchanges, communication and deepening of the questioning. The model is implemented in specially designed MS Access application for input and processing data database. The program contains 35 data tables and other tables; 36 forms grouped on tabs and sub-tabs under MS-Access allow the entry and the consultation of the attribute data. This data is used in GIS software via ODBC connections. Join and topology rules are created, presented, and discussed. This model will be compatible with both generic and specialized software for analysis, modelling, visualization and transfer. We then can easily exchange data between software applications and between academic and national institutions.

Keywords

Merise logic, GIS, Flood risk, Flood database, Morocco

NEXT GENERATION OF COASTAL AND URBAN FLOOD MODELLING

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Abstract

The state of the art knowledge and modelling capabilities in coastal flows and coastal flooding modelling have been in a continuous evolution. For a long time, modellers were constrained by the limitations of computation resources, the scarcity of data and the incapacity of codes to handle such complex phenomena. Nowadays, if is more reasonable to tackle simultaneously coastal modelling, (which includes hydrodynamics, tide effects, wind and atmospheric pressure forcing, hurricane and storm surge, tsunami and tsunami-like phenomena, ice dynamics, oil, pollutant and algae spill etc.), with coastal flooding of shore urban area.

In this talk, I will briefly present several key steps which have become necessary to successfully build a coastal model that handles, among other phenomena, wave propagation, surge and urban flooding:

-Pre-processing: that includes data gathering (from data bases, measurements, satellite data, etc.), screening, mesh generation and optimization, buildings and hydraulic works representation etc.

-Code setup and computation management which includes the choice of numerical and physicals parameters, resources management, high-performance computation and parallelism.

-Post-processing of huge result files and generation of flooding maps.

One of the aim of this talk is to show that we are able, for now on, to bridge the gap between oceanography and coastal hydraulic modelling. We are also in a process of bridging the gap between hydraulic modelling and (urban) hydrology. This means that next generation of urban and coastal models are becoming much more as multi-physics and multi-dimension models that handle simultaneously several phenomena of different complexity and time-space scales.

Keywords

Coastal modelling, Urban floods, Multi-physics and multi-dimension models

RECONSTITUTION OF OCTOBER 25TH, 2016 FLOOD IN THE SAQUIA AL HAMRA BASIN THROUGH HYDROLOGICAL-HYDRAULIC MODELING

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Abstract

The Saquia Al Hamra Basin experienced an exceptional flood event from October 25th to November 6th, 2016 causing the failure of Saquia Al Hamra Dam 25 km from the estuary at Laayoune city. In addition, the particular conditions of the silting of the river 5 km from its estuary has caused significant damage in the delta of Foum El Oued on road and touristic infrastructures, agricultural properties and intensive livestock. In order to know the characteristics of these floods and the conditions of their genesis, we sought to reconstruct the event in a context of lack of hydrometric data. The approach taken is based on 1) the geometric, morphometric and physical characterization of watersheds from the DEM and satellite images, 2) production of fairly accurate topographic surveys coupled with field surveys, 3) hydrological and hydraulic modeling using HEC-HMS and HEC-RAS. This work reconstructed the event into a number of sections from upstream to downstream of the basin. Besides, it should be highlighted that precipitation measurements that were recorded on automatic stations by DMN were used to validate the results of the reconstruction. Simulation results are therefore satisfactory and adequately describe the flow conditions in the Saquia Al Hamra Basin. The reconstruction allowed to identify the areas responsible for this event genesis, and to estimate the runoff for the studied sub-basins, the flood extent as well as the maximum flows reached. Thus, the water inflow of the event is estimated to 1.6 billion m3 and the maximum flow has crossed the 3200 m3/s at the dam inlet..

Keywords

Saquia Al Hamra basin, Flood event reconstitution, HEC-HMS, HEC-RAS

HYDRAULIC MODELLING OF OCTOBRE 2011 FLOODS IN EL BAYAD CITY, ALGERIA

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Abstract

Mapping of flood inundation zones has become essential in determining the boundaries of areas vulnerable to flood risk. HEC-RAS software is one of the most used software to model floods and inundations. Validation of the use of this software is necessary to present the final inundation map for the flooded areas.

The City of El Bayad in Algeria experienced a strong flood on 01/10/2011, human and material damages were recorded because of the overflow of Oued Deffa. The latter was captured by the satellite Alsat-2A, a map marked the flooded area was constructed based on these satellite images. In this work we will use the software HEC-RAS to model the flood of October 1, 2011. The main purpose is to compare between the map obtained by the satellite image Alsat-2A and the map obtained by HEC-RAS. In this study we used the ArcGis software to realize the geometry of the region and the final map. The results showed a similarity between the two compared maps which supported the validation for HEC-RAS software to simulate the floods.

Keywords

City of El-Bayad, Inundation, HEC-RAS, Satellite image, Alsat-2A

DELINEATION OF CATCHMENT BOUNDARY IN WADIS' DOWNSTREAM IN SOUTH BATINA, OMAN

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Abstract

Alluvial plains in wadi system are the most urbanized areas in the whole wadi catchment, because of its flat topography and soil types, besides the high probability of having groundwater reservoirs among other factors. This fact increases the risk of flash floods in the downstream areas. Also, flood route within alluvial deposits can be changed dramatically between consecutive flash floods events and even during the same flooding event. It is important to delineate the watershed downstream where the alluvial plain shows slight elevation differences, as well as in the difficult terrain areas in the upstream. To study this issue, the watersheds in South Batina basins in Oman have been delineated using several methods. The digital terrain models SRTM 90m, GDEM and TanDEM-X have been studied and compared to delineate the watershed. A strong match has been proved in the mountainous terrain, while large differences noticed in the plain terrains. Landsat Satellite images between 1972 and 2017 have been studied to monitor the flow routing changes and compared with the digital terrain models. Differential GPS survey has been carried out in one location to define the exact watershed boundary and compare it with boundary derived from DTM models. The study shows the importance of developing flow routing models in the wadi for flash flood risk assessment.

Keywords

Watershed, Flow routing, Landsat, Flash floods

HYDROLOGICAL MODELING OF STORMWATER: POSSIBILITIES AND APPLICATIONS - CASE OF STORM SOFTWARE

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Abstract

With the growing difficulty of managing rainwater, in an ever-changing context dictated by climate change, designers redouble their efforts by inventing tools to better predict these water incomes in terms of both quantity and impact on ecosystems.

Within this approach, the software "STORM" was developed by a German firm that allows in the watershed unit area, identify potential areas for accumulation and collection of rainwater, but also to size the structures to manage them.

This software has been tested in several watersheds in Morocco and has demonstrated that with a combination of several good practices for rainwater harvesting and management, more sustainable, more environmentally friendly and above all cheaper, large investments often used as curative measures after the observation of the damage can be replaced.

Keywords

Rainwater management, STORM, rainwater harvesting structures

COMPOSITE MODELLING APPROACH TO STUDY COMPAUND FLOODING IN COASTAL AREAS

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Abstract

A study has been carried out within the framework of a bilateral project supported by the National Science Fund of Bulgaria and the Ministry of Science & Technologies of the PR of China. Based on a state-of-the-art analysis on the available tools for simulation of coastal flooding in urban & estuarine area a composite modelling approach is suggested, focused on the use of advanced numerical modeling tools, verified by large scale physical model tests, and data from coastal oceanography surveys. Two different numerical tools have been tested: MIKE FLOOD by Bulgarian team and SWASH by Chinese team, for two pilot geographical areas with high risk of coastal flooding: Asparuhovo - Karantina beach in Bulgaria and Beilun city coastal area in China. Flood inundation has been simulated for various scenarios, and relevant water elevation have been calculated and compared for the two different numerical approaches. Results received by both teams have been compared. The strong and weak points of the two approaches have been evaluated. This encourages authors for further research and improvement of the demonstrated approach. Further recommendations on the use of the selected numerical tools, in combination with physical modeling and field observations data (composite modeling approach) are suggested in the paper.
The received numerical results can be used to assist flood mapping and flood risk assessment, and therefore contribute to sustainable environmentally sound solutions for protection of coastal and riverside cities against compound flooding.

Keywords

Digital elevation model, Numerical simulations, Model verification, Field measurement data

CONTRIBUTION TO HYDROLOGICAL MANAGEMENT OF WADI MALEH WATERSHED FOR EROSION AND FLOOD CONTROL DOWNSTREAM FOR URBAN CENTERS AND CITIES PROTECTION

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Abstract

Wadi Mellah watershed is located approximately between the cities of Mohammedia and Khouribga, Morocco. Its outlet is located in the city of Mohammedia and the watershed has an approximate area of 2055 km². The quantification of erosion was performed by the combination of the revised Wischmeir model and transport coefficient.

Nearly 40% of the watershed area has significant erosion rates that are greater than 20t / ha / year, but this rate is alarmingly high above the 70t / ha / yr threshold and affects 8% of the of the watershed area.

The basin required erosion control measures, particularly in areas dominated by bare soil zones laying on clay substrates and high slopes that are mainly located along the banks of the Wadi Zamrine, a tributary of Wadi Maleh. Secondarily, erosion is high in cultivated land on moderate to steep slopes, and in forest lands on friable substrates (Flych) and moderate to steep slopes.

It shall be noted that erosion seriously affects 25,043 ha; that is 12.11% of the catchment area. The losses of land calculated on these zones exceed 50 tons / ha / year.

An erosion management program was implemented and consists in hydrographic network treatment of the priority zones and the reinforcement of the vegetal framework in the forest massifs as well as the improvement of the anti-erosive cultural practices in the cultivation grounds.

Keywords

Erosion assessment, Hydrological simulations, Erosion control measures, Maleh basin

FLOODPLAIN MODELING FOR 1D STEADY /UNSTEADY FLOW: CASE STUDY OF SIDI IFNI WADI

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Abstract

Flood impact is one of the most significant disasters in the world. Causes of floods are due to natural factors such as heavy rainfall, high floods and high tides, etc., and human factors such as blocking of channels or aggravation of drainage channels, improper land use, deforestation in headwater regions, etc. With the increasing use of GIS, HEC-RAS and digital databases in the floodplain mapping and management processes, a simplified one-dimensional model is presented and applied to the Sidi Ifni basin (southern Morocco). The computational procedures were based on 1D energy equation for steady/unsteady flow water surface profile Calculations. The Digital Terrain Model (DTM) was used to create hydraulic model geometry Data. Finally, water surface data was exported from HEC-RAS back into GIS to create flood maps with depths and extents of flooding. Conclusions and recommendations for further improvement are provided.

Keywords

Urban Flood mapping, HEC-RAS, GIS, Floodplain modeling

RISK OF COASTAL FLOOD IN THE AZEMMOUR SITE

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Abstract

The Azemmour site, on North Atlantic coast is very vulnerable as are all Moroccan coasts subject to long ocean swells; indeed, many phenomena occur in this area such as predominant astronomical tide, storm surges. And marine submersions occurring at extreme sea levels. The risk of flooding by the sea is currently high on this coast particularly in areas where coastal dunes undergo anthropogenic disturbances. The Marine submersions occur when specific meteorological conditions atmospheric depression and sea wind) and high coefficients tide gauges concur. They are subject of several planning and information documents.

The Azemmour site has particular configuration. Indeed, degradation of sand dunes chain is observed because of the informal sand exploitation along with natural coastal erosion due to the bathymetric configuration and the continuous evolution of the coastline.This work is part of the approach mentioned above to review the knowledge already acquired and to contribute to the reflection on the phenomena of flooding in near-coastal areas.A numerical modeling of the coastal swell coupled with models for storm surge forecasting is presented. The major parameters will be analyzed along with the forecast simulation results.

Keywords

Risk of coastal flood, The Azemmour site on North Atlantic coast, Numerical modeling of the coastal swell

EVENT MODELING AND SIMULATION OF THE EXTREME HYDROLOGICAL CONTRIBUTIONS OF THE ZAT WATERSHED (HIGH ATLAS, MOROCCO)

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Abstract

Arid and semi-arid regions are often subject to flash floods. One of the most important tools for assessing flood intensity is the modeling of rain events.

In the Tensift watershed, the frequency of past floods and their future predictions require a critical consideration of flood risk. In fact, the frequency of floods is increasing because of climate change, for which modeling of the hydrological behavior of watersheds is inevitable when one is interested in issues related to the management of water resources.

Zat sub-basin is part of to the Tensift watershed where the approach of hydrological modeling is applied. It is located in the center west of Morocco surrounding the imperial city of Marrakech. This basin is characterized by an arid to semi-arid climate in the lowlands and sub-humid in the mountains.

The present study is the first ten minute modeling study carried out on the Zat catchment area. It targets the development of a rain-flow forecast model, applicable for flood weather forecasting through the HEC-HMS platform. The results obtained during the validation of the models were based on the adjustment of the calibration parameters to the best Nash criteria, the Nash coefficient obtained is 87.3%.

This work led to a realistic modeling of the main components of the flow in this watershed. It also highlighted the performance of the HEC-HMS tool for different processes and allowed us to establish a rain-flow forecast model.

Keywords

Hydrological simulations, HEC-HMS, Flood events, Tensift watershed

APPLICATION OF MODELING TOOLS FOR ASSESSMENT OF FLOOD RISK AND ESTABLISHMENT NON STRUCTURAL MITIGATION: CASE STUDY OF MALLEH DAM FAILURE LOCATED UPSTREAM OF MOHAMMEDIA CITY

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Abstract

Mohammedia city experienced frequents floods of Malleh River in the years of 1996, 2001 and 2002 mitigated bythe construction of a dam locatedupstream of the city. Thispaper describes the application of modeling tools for assessment of flood riskand simulation of non-structuralmitigation in case of Malleh damfailure.

This city has the refinery company and central electric coal located in the immediate area of river mouth. Thelower zone of city is occupied by 39636 inhabitants.

In first step we used the bathymetric data of dam reservoir and the river digital elevation model for hydraulic modeling with HEC-RAS. This model allowed us to determine hydraulic hazard andsimulate diffusion waves of dam failure.ArcGis was used tocreate attributesdata of structureinventory atrisk and digitalization roadnetwork using thecityurbanplan. Thistool was used o to map the results of HEC-RAS model and the economic issues and life loss potential.For floodrisk assessment, we used themodel HECLifeSim spatiallydistributeddynamic for estimating potentiallifeloss anddirect economicdamage. In this part of study we used hydraulicdata results of HECRAS model to define imminent hazard and hazard identified relative time and data base of structure inventory established by ArcGis. To simulate evacuation plan, we used the road networks and their classification. The results of this simulation allow us to know the outflow evacuation and destination arrival time and time evacuating by iteration.Finally, themodelingapproach is needed for flood riskassessment and allows engineers toassess thecapacity of non-structuralmitigation measures.

Keywords

HEC-RAS, ArcGis, HECLifeSim, Malleh dam, Dam failure, Risk assessment

SCIENCE-COMMUNITY INTERFACE: CAPACITY BUILDING FOR MANAGING NATURAL DISASTERS OF FLASH FLOODS IN EGYPT, JORDAN, SUDAN AND YEMEN

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Abstract

Many regions in Egypt, Yemen, Jordan and Sudan are subjected to deadly flashfloods and landslides, resulting from intense rainfall in short duration. These countries are in dire need of technical support and national capacities to identify remedial measures that address flash floods unpredictability and lay effective responsive emergency.

Within the framework of UNESCO-Japan Fund-In-Trust Cooperation, the Japanese Government supported the project 'Urgent Capacity Development for Managing Natural Disaster Risks of Flash Floods in Egypt, Jordan, Sudan and Yemen' (2015- 2016). The objective was to reduce flash floods economic losses and fatalities through building national and regional capacities for early warning effective emergency responses. The project produced a repository of best practices of flash floods risk management through a pilot hotspot study in each of the four countries, expandable at the national and regional levels. It included a community awareness program to disseminate the project technical outputs at community level to reduce local communities vulnerability to natural disasters of flash flood risks as an example of science-community interface. Within the campaigns, active and target groups at local level were identified to ensure long terms monitoring and sustainability of the community engagement and action regarding the anticipated flood cycle and impacts. This presentation included the implemented activities towards promoting the concept of flash flood risk management with the involvement of all stakeholders including local authorities, community groups, private sectors. Moreover, the presentation highlights the details of the implemented activities, target groups, material and the achieved results.

Keywords

Managing disaster risk, floods, Community awareness, Science-community interface

FROM ANNOUNCEMENT TO FLOOD FORECASTING: PREPARATION AND CRISIS MANAGEMENT

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Abstract

To deal with extreme conditions (floods, inundation, etc.), and to monitor the hydro-rainfall situation and hydraulic structures for taking the necessary decisions relating to controlled information on any situation, the Hydraulic Basin Agency Bouregreg and Chaouia (ABHBC) has established an automatic monitoring network to acquire and / or transmit information on extreme events such as rainfall and floods. The monitoring network consists of 38 stations covers an area of approximately 20,400 km². These stations are prepared with automatic rain gauges, water level radars in wadis and dams, as well as systems for communications, recording and transmitting hydro-climatological data. The data are recorded and centralized at the headquarters level of the ABHBC. They are recorded using the GEOSCOPE version 7 software to generate status reports automatically and access to any device. The software also allows us to configure the sensors remotely, track their status and that of transmission devices and diagnose.The ABHBC is committed to certifying its measurement network against the standards of the World Meteorological Organization and the ISO 10012 standard in collaboration with the National Meteorological Directorate (DMN).

The ABHBC is also committed to set up a flood forecasting platform. It represents a decision-making tool for forecasting ABHBC territory based on 3 types of data: i) the forecasting of precipitation from DMN; (ii) Regular precipitation measurements via ABHBC network; iii) The Radar Images of the DMN to generate the spatial distribution of the real-time rain measurement. The modeling platform selected for this project is MIKE OPERATION from DHI. It is a modeling framework designed for flood forecasting and operational control.

Keywords

Monitoring network, Flood forcasting, Decision-making tool

FLASH FLOODS MITIGATION AND ADAPTATION IN OMAN

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Abstract
The climate of the country is hot and dry in summer with the exception of southern part of the country where Monsoon climate is experienced during July to September. Most of the rain happens during the winter and early spring. However there are periods of cyclones and thunderstorms where the country receive high intense rainfall and results in flash floods. The floods occur with little warning, causing property damage, community disruption, and at time loss of lives. The main cause of floods is not limited to geology or weather, but also the distribution of human populations near water. The historical floods in Muscat shows that the areas have been flooded several times. Furthermore during the recent years Oman experienced three major cyclones.
Flood mitigation and adaptation has been a priority by the Government of the Sultanate of Oman.The government has taken several efforts in dealing with disaster risk reduction including but not limited to establishment of Hydro-meteorological network, setup guidelines for development in flood prone areas, production of maps showing flood risk zones, establishment of National Committee for Civil Defense (NCCD) to deal with all kinds of disaster including floods, construction of dams, improvement of drainage systems especially in major cities, introduction of flood warning systems and establishment of Multi Hazard National Center. All these structural and non-structural measures resulted in reducing the flood risk of the country.

Keywords
Flash Floods, Mitigation, Structural and non-structural measures

IDENTIFICATION OF POTENTIAL DAM SITES USING GIS AND REMOTE SENSING TECHNIQUES

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Abstract

The surface water is a valuable natural resource for drinking water, domestic uses, livestock and irrigation, especially in arid and semi-arid regions like the Marrakech region. The delimitation of the Province of Marrakesh is located between the longitude (7 ° 59'59 ") West, and the latitude (31 ° 38'02 ") North. It covers an area of 6000 km2. The objectives of this document is to set up a methodology to support decision makers in the water sector in the appropriate choice of dam sites based on the conjoint use of GIS and RS under an Analytical Hierarchy Process. Therefore, we used available data such as the Geological Map, Hydrographic Network, Digital Elevation Model (DEM), Sentinel 2A imagery and Tropical Rainfall Measuring Mission (TRMM) data to achieve the stated objectives.

These data are used to create thematic maps such as; slope, lithology, NDWI, NDVI rainfall, Vegetation, supervised classification, topography, Strahler classification of the Hydrographic network, Hypsometric and precipitation map using geographic information system (GIS) and remote sensing (RS) techniques. The Analytical Hierarchy Process method is applied to weight, classify, and reclassify these maps through ArcGIS 10.3.

Keywords

GIS, Remote Sensing, Dam, Analytical Hierarchy Process

FLASH FLOODS MITIGATION FOR AL KHARJ CITY, KSA

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Abstract

Al Kharj City is located in Al Kharj Governorate in Riyadh Region. The city is considerably enlarged at the expense of neighboring flood plains. The city is under the effect of a group of wadis of total catchment area of about 14200 km2. Daily rainfall exceeded 70 mm at some locations in the catchments. Such rainy storms led to excessive economic losses. Al Kharj municipality established a water passage to convey the flash floods to the city downstream. However the dimensions of the water passage and the culverts constructed at the intersections with roads were not enough. A hydrological study was performed including estimation of 100 yr design storm, delineation of wadis and determining its morphological characteristics and estimation of the 100 yr. maximum flood discharge. Two proposals were discussed. The first was to design the water passage and the culverts to convey the 100 yr. flood using HEC RAS model. For this alternative the flood water will be conveyed to the city downstream without spillage. However it requires enlargement of the water passage, increase of culverts dimensions and land expropriation. The second alternative was to construct series of dams on selected wadis. These dams' storage capacities were chosen to impound the 100 yr floods. This alternative requires proper operation of dams to ensure water releases required to satisfy farms irrigation needs without causing any spillage to the city. Choice of best alternative is contingent to Al Kharj municipality based on cost, social and environmental considerations.

Keywords

100 Year Maximum Flash Flood, Hydrological Study, Hec-Ras Model, Water Passage, Dams

DEVELOPMENT OF FLOOD EARLY WARNING SYSTEM FOR FLASHY WADIES: GASH WADI AS A CASE STUDY; SUDAN

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Abstract

The Gash Wadi, in Kassala State - Eastern Sudan - is a flashy seasonal wadi originates from the Eritrean and Ethiopia highland, and flows only during the period from July to September. The Gash wadi crosses Kassala city, and causes large damage during high floods when frequently breaches into the city. Despite the continuous intensive protection work, yet the city is still under a high risk of flooding. This paper presents a Flood Early Warning System (FEWS) developed for the Gash wadi. The US Army Corps of Engineering, Hydrologic Engineering Center's - Hydrologic Modeling System (HEC-HMS) software was used for rainfall-Runoff modeling. The study used near-real-time Satellite Rainfall Estimate (SRE) data from Tropical Rainfall Measuring Mission (TRMM-3B42RT) to generate the areal-average daily and/or hourly rainfall over the catchment. Absence of ground rainfall data in the upper catchment inside Eritrea makes it very difficult to validate the SRE. New reliable discharge measurements at Gera station (outlet) for the years 2015 and 2016 were obtained for validation of the model. The (HEC-HMS) software was run for daily and hourly intervals. The study suggested a manual type of FEWS for the Gash wadi depending on the forecasted flows from the hydrologic model. The outflow hydrograph from the model is translated into stages using rating curves. A reasonable lead time was obtained. The main function of the proposed FEWS is to issue warning message when water levels exceed threshold values to prevent disastrous flooding.

Keywords

Gash Basin, Rainfall-runoff modeling, FEWS, HEC-HMS, TRMM-3B42RT

URBAN PLANNING AND FLOOD RISK CONTROL IN MOROCCO

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Abstract

As part of the National Strategy for Integrated Risk Management that has been implemented since 2008, to improve the country's resilience to natural risks, the Ministry of National Land Planning Urban Planning, Housing and Urban Policy are committed, through an ambitious program to:

- Covering the entire national land with Maps of Urbanization Suitability as reference documents considering the risk scale of natural disasters when preparing the various urban planning documents, and as a decision support tool and a multi-hazard prevention mechanism for planners, stockholders and local authorities, allowing a long-term and sustainable planning of resilience area.

The considered risks in the context of these Urbanization Suitability Maps are those caused by different natural hazards as severe floods, earthquakes, falling rocks and boulders, landslides, coastal erosion and tsunamis.

- Initiate an ambitious program "Cities and Rivers" which aims to enhance banks and Wadi channels, shifting the land use of such areas in the dynamics of sustainable development while protecting the area against any potential natural risks. It seeks to ensure landscape quality and diverse multifunctional uses of these spaces allowing landscaping reconciling with the city and its river in a logic of resilience and sustainability.The efforts made by the Ministry in the field of flood risk prevention in urban planning will be presented as well as the local experiences of the Urban Agencies on this subject. The outcomes is expected to have high impacts on the scientific research applications as well.

Keywords

Maps of Urbanization Suitability, Urban planning, Flood risk prevention, Resilience

STORMWATER MANAGEMENT THROUGH URBAN DEVELOPMENT MASTER PLAN(SDAU) OF THE GREAT CASABLANCA REGION

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Abstract

The Urban Development Master Plan (SDAU), as an urban planning document, has the main objectives of determining the choices and the management options that must govern the harmonious, economic and social development of a study area of the town. It allows also to determine the new areas for urbanization and the dates from which they can be opened to urbanization by preserving agricultural lands and forest areas whose limits are fixed by regulation. Casablanca Urban Agency presentation will address the solutions proposed by the Casablanca Urban Development Master Plan for stormwater management.

Keywords
Urban Development Master Plan, Stormwater management, Urban planning, Casablanca city

INTEGRATION OF RAINWATER MANAGEMENT INTO LAND -USE PLANNING

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Abstract

Casablanca, similar to other big cities in developing countries, is challenged by a strong urban growth of approximately 320 ha per year. This expansion is reflected in significant pressure on land and consequently impervious surfaces are extension within the city. Therefore, the surface runoff has increased and sometimes it generates breaks in natural rainwater flows.

These land and urban development have globally involved a significant mobilization of natural resources and a transformation of natural ecosystem balance. Meanwhile, we are experiencing the universal phenomenon of climate change resulting in increasing intense rainfall over time.

In order to guarantee an organized and sustainable urban sprawl, it is essential that urban planning programs integrate the resilience of cities in the face of climate change related phenomena that are impacting biodiversity, wetlands, flood-prone areas, zones of ecological interest and natural Talwegs. In order to do this, we must change governance systems by creating new bodies with the scientific and political legitimacy to coordinate all stakeholders to a common interest.

Keywords

Urban planning, Natural resources, Climate change, Flood prone areas, Governance

INTERDISCIPLINARY AND INTERLOCKED SPATIAL-TEMPORAL STUDIES TO ENHANCE EFFICIENCY AND SUSTAINABILITY OF ENVIRONMENTAL MANAGEMENT OF STREAMS IMPACTED BY URBANIZATION (YZERON CATCHMENT, CITY OF LYON, FRANCE)

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Abstract

Watersheds are multidimensional objects and their understanding requires an interdisciplinary approach encompassing also interlocked spatial and temporal scales. The study of the Yzeron's watershed (Rhône tributary, France), under growing pressure from suburban sprawl western the city of Lyon, displays important landcover changes since the beginning of the 20th century, especially a rise of artificialized surfaces and a decline of agricultural surfaces. This induced important hydrological, morphological, physical-chemical and biological functional alterations: e.g. increase of low to medium intensity flooding frequency; introduction, in both surface and hyporheic compartments of streams, of poor quality water from Combined Sewer Overflow (CSO) discharges and urban runoffs (rich in metals, nutrients, PAH and synthetic contaminants as pharmaceuticals, pesticides, detergents with harmful effects on water biocenosis); formation of spectacular incisions upstream and sanding up downstream among other geomorphological misfunctioning; important biological and microbiological impacts in surface and hyporheic compartments. Furthermore, taking into account the multi-century temporal trajectory of the streams and valley bottoms provides key knowledge helping to better understand contemporary morphodynamics. Design a more natural headwater management is needed to better balance flooding, sediment transport and water quality to the benefit of aquatic ecosystem and human wellbeing. Our interdisciplinary approach, which is backed by a conceptual model, allowed us to draw several innovative management guidelines and stress the importance of fluvial geomorphology in interdisciplinary researches of small periurban hydrosystems.

Keywords

Periurban catchment, Urban runoff, Combined sewer overflow, Interdisciplinary model, Sustainable management, Hydromorphological stream typology

URBAN PLANNING DOCUMENTS IN THE TEST OF FLOOD RISK MANAGEMENT: CASE OF THE CITY OF KENITRA, MOROCCO

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Abstract

Moroccan cities have always had a privileged relationship with water (rivers, ponds, watercourses, Talweg ...), which was decisive in their formation and growth. The population dealt with this element to take advantage of it, preserve it and protect itself too.

Since independence, the growth of the cities has been carried out, in many cases, without taking into account the water specificities of the site. Even with the gradual generalization of urban planning, since the 1970s, the management of natural hazards, and floods, in particular, has been almost absent in both reflection and spatial programming. Urban projections were indifferent in flood zones, retention, watercourses pathways and ponds. Suddenly, incidents of flooding have multiplied in several cities (Settat, Mohammedia, Kenitra, etc.) thus generating additional economic and social costs.

This work suggests to study how urban planning, through planning documents, is decisive in the management of flood risks. We tackle this issue through the case of the town of Kenitra, a city built on a marshy site and still in contact with water. We will try to see how the urban planning documents anticipate or not the flood risk management in this city and show how it has been able to cope with water or not to protect itself from its risks.

Keywords

Urban planning document, Flood risk management, City of Kénitra

CLIMATE CHANGE ADAPTATION STRATEGY-TAIPEI'S WENSHAN FLOOD PREVENTION AND DRAINAGE PLAN AS A CASE STUDY

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Abstract

This study investigates the performance of Wenshan drainage system before and after three new hydraulic engineering projects installed between 2015 and 2017 in Wenshan District of Taipei City. Owing to high population density of Taipei and high housing price, Wenshan since 40 years ago had its advantage for land development as a residential area. However, Wenshan District also has a disadvantage of tending for flood inundation due to its hilly landform. Taipei City Government in the last 40 years spared no effort to increase its drainage design capacity. The newly installed hydraulic engineering projects between 2015 and 2017, including: two detention ponds and one diversion tunnel, are aiming to reach the goal of 5-yr design standard of 78.8 mm/hr. A high resolution 2D hydrodynamic model which integrates quadtree and subgrid techniques was employed to evaluate flood inundation before and after the installation and the performance of the three projects. Results show that the flood inundation model demonstrates its capability for accurate simulation through photos comparisons in the validation process and the flood inundation has been substantially improved after the installation of the three projects.

Keywords

Urban drainage, Hydrodynamic model, Flood prevention

EVALUATION OF SHORELINE CHANGE: A CASE STUDY FROM THE WADI AL MAAWIL WATERSHED

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Abstract

In an arid climate, lack of water constitutes a challenge. One solution has been to use storage dams as a tool to facilitate groundwater recharge and provide water for various uses. However, dams cannot be constructed without affecting the environment of the coastal shoreline and its ecological habitats. This study investigates the morphological changes (accretion or erosion) of the coastline along the Wadi Maawil watershed. The Wadi Maawil watershed was dammed in 1991, providing a 10M m3 dam capacity. Images from Google Earth were obtained for 1984, 1992, 2001, 2011, and 2017, and coastlines were digitized. In this study, I used the Digital Shoreline Analysis System (DSAS) to calculate the rate of coastline movement and changes arising from dam construction or anthropogenic changes to the beach. The results show that the shoreline has experienced erosion of up to -1.0 m/yr for 37% of the watershed coast. This loss could result in remarkable coastal change. This study may be used by urban planners as support for the necessity of preserving natural resources and ecological habitats.

Keywords

Wadi Al Maawil, Digital Shoreline Analysis System, Coastal changes

INTEGRATED RESERVOIR SEDIMENTATION MANAGAMENTIN ARIDAND SEMI-ARIDCOUNTRIES UNDER CLIMATE CHANGE

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Abstract

Reservoir sedimentation is one of the most crucial issues for reservoir sustainability in the world (ICOLD 2009, 2018). In many countries, various countermeasures have been implemented to decrease sediment accumulation and loss of storage capacity (Kondolf et al.2014). They are (i) reduce sediment inflow, (ii) route sediments and (iii) sediment removal. Among several updated methodologies, effective and ecofriendly sediment flushing, bypassing and replenishment techniques have been intensively developing in Japan. In arid and semi-arid countries, several key questions are (i) how we can predict sedimentation rate under limited flood events, (ii) how we should select suitable sediment management options under high constraints on water resources management, (iii) how we should consider flow and sediment regime change under climate change. This presentation will summarize the General Report of the Question 100 at the last ICOLD Congress in Vienna, 2018 and discuss suitable management options in arid and semi-arid countries.

Keywords

Reservoir Sedimentation, Reservoir Sustainable Development, Arid Countries

OPTIMIZATION BIAS IN DAM SEDIMENTATION MANAGEMENT

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Abstract

The research transfers for the first time Kahneman's and Tversky's "Prospect theory" from its economic origins towards infrastructure management to demonstrate that the "Optimisation Bias" – a well-known management problem in making projections – influences the longevity of hydropower lakes negatively due to rapid sedimentation. By this, reduced securities in economic, energetic and hydrologic terms for the country on a grand scale are caused. It is strongly assumed that the effect is globally. Japan serves as a showcase as it possesses a long high-tech and damming history as well as a uniquely rich data situation, which, however, has up to now not been analysed regarding the optimisation bias. Large dam datasets from the Japanese National Institute for Land and Infrastructure Management and in-depth information from Kyushu Electric Power for the Mimikawa catchment in the Miyazaki prefecture were evaluated using "Reference Class Forecasting" and "Outside View" derived from the works of Flyvbjerg and Ansar. By applying multiple linear regression and analysing socio-economic as well agrarian and climatic condition change during different dam planning stages, key factors are identified for indicating (and quantifying) deviations of predictions and reality. Based on this, a first try for recommendations for sedimentation projection correction is made. It is expected for dams constructed under both (almost) non-competitive and high-competitive economic conditions to have a higher optimisation bias.

Keywords

Japan, Outside View, Prospect Theory, Longevity, Reference Class Forecasting, Megaproject, Commissioning, Planning

INTEGRATED MANAGEMENT OF FLASH FLOODS IN WADI BASINS CONSIDERING SEDIMENTATION AND CLIMATE CHANGE

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Abstract

Recently, devastating Wadi Flash Floods (WFFs) are frequently happening in arid environment resulting in a great damage, along with social and environmental impacts. For instance, in Oman, severe flash floods occurred and repeated within the last 10 years (e.g. Gonu cyclone, June, 2007; Phet cyclone, June, 2010; Mekunu cyclone, May, 2018), causing huge impact on the human properties and environment. The main objective of this paper is to introduce integrated approach for Wadi Flash Floods management in arid regions. This paper is focusing on understanding the phenomena and developing methodology for WFFs modeling considering sedimentation and climate changes. An integrated approach is established throughout four research frameworks including climate change, rainfall-runoff modeling, sediment yield and transport, and sedimentation and infiltration processes. The detailed field investigation were recently conducted in Oman in 2017 and 2018 to assess the sedimentation and flash floods impacts. Satellite data were analyzed to understand the spatial and temporal variability of rainfall over the arid regions. Some Synthetic Aperture Radar (SAR) data such as Sentinel 1, ALOS PALSAR data were used to quantify sediment variations (spatial erosion and depositions) and wadi morphological changes some wadi basins. The results could be useful to understand the sedimentation impacts on the dam efficiency and consequently to support in proposing sustainable management strategies for the reservoir sedimentation in arid regions.

Keywords

Sedimentation, Sentinel 1 data, ALOS PALSAR , Extreme Flash floods, Satellite based data, InSAR data, Wadi system.

THE CHARACTERISTIC OF SEDIMENT TRANSPORT OF FLASH FLOODS IN ARID REGIONS

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Abstract

Flash flood is one of the most serious disasters in arid countries. On the other hand, arid countries are suffering from water shortage. Flash flood can have potential for water resources if flood water is stored effectively and infiltrates into soil. One of the most effective measures to solve two opposite problems, flood disaster and water shortage is recharge dam. Recharge dam catches floods and promotes groundwater infiltration. However, the mechanisms of the sediment transport of flash floods are poorly understood. Since the flash floods contain many sediments in a rapid stream in a short time, coarse sediment deposits in the reservoir where the flood is stored and fine sediment also leads to clogging of the river bed. This clogging of fine sediment can cause the decrease of infiltration rate gradually.

The purpose of this study is to clarify the characteristic of sediment transport based on the field data such as the gravel size distribution, topographic data and amount of the sediment deposition measured in Wadi Mijlas in Oman. Bed load change was calculated at the upstream of the recharge dam, Serrim Dam in Wadi Mijlas using these data. The model of sediment movement in arid regions was considered. In addict, field infiltration test was conducted in Wadi Mijlas according to the sediment deposition condition in order to understand the mechanism of infiltration characteristic. Based on infiltration test, the influence of the clogging was assessed.

Keywords

Flash floods, Sedimentation, Clogging

MECHANICAL BEHAVIOR OF CONCRETES BASED OF SEDIMENT OF DAM RESERVOIRS IN MOROCCO CASE STUDY: DAM MOHAMED BEN ABDELKRIM EL KHATTAB

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Abstract

The problem of the sediments of dams and reservoirs requires a commitment from the water and environment managers as well as the researchers to develop an economic and technical evaluation of the alternative strategies of management of the sedimentation in the storage tanks waters.

Several techniques are used for dredging such as: Traditional dredging, Flushing Hydrosuction (HSRS) and Trucking. But the cost of the dredging operation remains high, not to mention the environmental impact, which is why the valuation of the sediments of the reservoirs is the safest solution, since the valued products provide us with substitute materials that will relieve Careers and the environment.

Our research aims to open the roads of valorization of the sediments of the Moroccan dams, starting with "Mohamed Ben Abdelkrim Al Kattabi Dam", which is at a siltation rate of 80% To establish a guide "tool of decision support" for the Moroccan manager.

Keywords

Sediments, Dam, Dredging, Siltation, Management, Valorization

RESOURCE POTENTIAL OF RESERVOIR SEDIMENT FOR FUNCTIONAL MATERIAL FOR PURIFYING DRINKING WATER

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Abstract

Securing stable water resource is most important issue in Tunisia under the extension of desertification caused by the global climate change. More than half of the water demand in Tunisia is covered by the surface water resource. Due to the huge amount of soil erosion in the catchment area, sediment accumulates in the reservoirs and reduces the water storage capacity. There is no other way than managing the existing reservoirs. However, dredging, simplest countermeasure against sedimentation in reservoirs has not been carried out because it is quite costly for Tunisia.

On the other hand, the villages in the south area has the quality problem of ground water for drinking water, natural contamination of fluoride. The health problem due to contamination of fluoride, such as dental and skeletal fluorosis, occurs not only in Tunisia, but also in many countries all over the world. The population suffering with fluoride contamination in drinking water all over the world reaches to 10 million at least. For these issues related to the water supply, we offer a solution that can solve both of them. We are developing the Fluoride remover made from Sediment. Capacity of fluoride capture in the media is evaluate with experiment. Required amount of the media was calculated with the consideration of volume of drinking water par capita. Processing costs of each part were estimated based on that of ceramics bricks in Tunisia. Selling price of the fluoride remover was assumed based on the other example of technical cooperation of water purification additives for removing turbidity, that cannot remove dissolved fluoride. In order to cover the dredging cost in the reservoirs in Tunisia with the profit from selling the fluoride remover, the number of beneficiaries of the remover have to be 100 million. That is the part of population suffering from fluoride contamination in groundwater all over the world.

Keywords

Sediment, Reservoir, Processing cost

COUPLED FLOW AND SEDIMENT TRANSPORT IN SHALLOW WATERMODELING DAILY SUSPENDED SEDIMENT LOAD BY USING ARTIFICIAL NEURAL NETWORK AND WAVELET

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Abstract

Problems with flash floods arise not only concerning the flow of water but also concerning the transport of sediments and debris. Particulate and bed-load transport are extremely high during flooding events. Especially in regions under arid and semi-arid climatic conditions bare soil is eroded easily and subsequently transported downstream.

Due to erosion and the settling of particulate matter, the ground surface and course of rivers and of wadis is changing during flooding. Sediments are transported by flowing water, and vice-versa sediments affect flow due to the changing water depth. Both flow and transport appear simultaneously and are coupled. We present a mathematical analytical approach, in which that coupling is considered.

The approach is implemented in a computer model, in which the 2D shallow water equations (SWE) for water height and velocity are coupled with a transport equation for particulate matter and a bed-load equation. The non-linear system of differential equations is solved simultaneously using COMSOL Multiphysics software.

The feasibility of the approach is examined and demonstrated on example geometries and benchmarks. A calibrated model, set-up on basis of the presented approach, can be used to estimate sediment transport during flood events and to identify regions of increased risk of either erosion or sedimentation.

Keywords

Coupled Modeling, Shallow Water Equation, Sediment Transport

MODELING DAILY SUSPENDED SEDIMENT LOAD BY USING ARTIFICIAL NEURAL NETWORK AND WAVELET

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Abstract

The planning and the life service of hydraulic structures, such as dams, are depending on the intensity of daily suspended sediment load (Qs) in rivers. Estimation and prediction of Qs by using artificial neural network has been a subject of different studies in recent years. The present paper presents the accuracy of two methods of computing Qs, namely, artificial neural network (ANN) and coupled wavelet with artificial neural network (WANN) applied at yearly and monthly bases in Eel river at Scotia, California, USA. The performance of these methods were measured by the coefficient of determination (R2), RMSE-observations standard deviation ratio (RSR), The Nash-Sutcliffe efficiency (NSE), and the percent bias (PBIAS) to choose the best fit model. For the Ql and Qs time series in this study, Daubechies wavelet of order 8 (Db8) has been applied following the recommendations given by Rajaee et al. [2009]. An automatic denoising was performed to eliminate any existing noise in the signal Ql, by using soft Donoho and Johnstone's universal threshold with level-dependent estimation of the noise. After denoising the flow discharge Ql, the time series will be subject to ANN model for prediction.

Results show that, over all, the yearly clustering underestimates the suspended sediment load while the monthly overestimates the suspended sediment load. In the other hand, the wavelet transform improved the estimation of the sediment load only on yearly clustering.

Keywords

Daily flow discharge, Clustering, Artificial Neural Network

WATER TABLE RISE IN MUSCAT URBAN AREA, CAUSES AND IMPACTS

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Abstract

Water table rise (WTR) is a serious phenomenon observed in a number of urban areas around the world. It has imposed environmental threats and put public health under risk. WTR endangers the stability and challenges the establishment of engineering structures. WTR occurs in several areas in Muscat, Oman where shallow water has appeared in excavations or at low-lying areas. In this research, we utilized hydrochemical, isotopic and biological analyses to understand the causes of WTR in Muscat. The analyzed samples were collected from groundwater, surface water, sewage system and public network. The chemical analysis of water samples reveals elevated concentration of Ca, Mg, SO4 and Cl ions resulting from carbonate and evaporitic dissolution. This dissolution caused a regional and natural increase of salinity in the area. However, local pockets of low salinity is found aligned with Public Network (PN) infrastructure suggest leak from PN and therefore dilution. Biological analysis shows limited presence of E. Coli encountered only in surface water which eliminates the possibility of septic tanks leak. Water classification based on deuterium and oxygene18 isotopes analysis shows three groups of water: 1- depleted groundwater recharged from prolonged heavy showers and does not interact with public network. 2- Water with isotopic signature clustering around zero suggests mixing with public network, and 3- isotopically enriched water subject to evaporation and is located either on ground surface or at shallower depths. High resolution long-term piezometric records have shown groundwater level fluctuations in response to precipitation and climatic variations. These records along with the isotopic, biological and chemical analyses indicate that WTR is aggravated by localized leak from PN while it is a natural regional phenomenon induced by urbanization. Proper planning that involves better coordination between authorities for future urban developments will tackle urbanization induced WTR. Recommended solutions to alleviate the problem include: digging temporary trenches, improve the public water network infrastructure, monitoring and testing, design and install storm water drainage, use shallow water for different purposes (e.g. recreational areas, construction, irrigation of gardens….etc).

Keywords
Water Table Rise, Muscat, Public Network

FLOODS CONTROL DAMS SURFACE WATER RECOVERY FOR GROUNDWATER ARTIFICIAL RECHARGE : CASE OF SETTAT PLAIN DAMS AND BERRECHID AQUIFER, MOROCCO

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Abstract

This study concerns the examination of surface water recovery options for EL Himer, Mazer and Tamedrost streams in the limestone plain of Settat located in the north center of Morocco. These waters are regulated by two dams (case of oueds EL Himer and Mazer wadi) to protect Berrechid plain and the coastal zones downstream against floods. This recovery can be made through the artificial recharge of the Pliocene aquifer of Berrechid (1500 km2), used to meet drinking water agricultural and industrial water needs of the neighbouring areas.

Assessment of the maximum capacity of artificial recharge of Berrechid aquifer with dams water was made through a thorough analysis of the geologic and hydrogeologic contexts of the area and hydrogeologic modelling. Several simulations were run and showed that the potential for artificial recharge of Berrechid aquifer is rather important, estimated to nearly 75 Mm3/year in the improved wadi reaches with and equipped with weirs, allowing to reduce the velocity of the surface water flow.

Estimations Berrechid aquifer artificial recharge capacity must be confirmed on the ground by measuring the flow water released from the three dams (existing and planned) and water table levels of the aquifer downstream identified suitable areas for groundwater recharge.

Keywords

Morocco, Berrechid, Dams, Flood control, Berrechid aquifer, Hydrogeology, Artificial recharge

INGENUITY OF TRADITIONAL MANAGEMENT OF SURFACE WATER AND GROUNDWATER IN MOROCCO: CASE OF THE MEDINA OF FEZ

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Abstract

The medina of Fez is one of the oldest cities in the world (More of 12 centuries). This medina is characterized by its refined economic, social and environmental organization. Its geographical location in the plateau of Saïs between the Middle Atlas and the foothills of the Rif Mountains gives it a very dense hydrographic network. The site of the medina is at the bottom of a basin where the tributaries of the Wadi Fez gather and meet to drain the Wadi Boukhrareb. The latter divides the medina in two banks, which makes it vulnerable to the risk of floods.

Due to its geomorphological and topographical situation, the Medina of Fez has seen over the centuries the construction of a series of equipment and hydraulic structures (dams, bridges, distributors and canals), to ensure a good and equitable distribution of its water resources and cope with all the probable risks.

Over the centuries and given the historical, political and social transformations experienced by the Fez Medina, these facilities began to deteriorate, followed by a series of disasters (floods, collapses ...).

In this article, we will highlight the role of these ancestral hydraulic infrastructures in order to reduce and / or mitigate the damage caused by the flooding phenomenon that threatens the Medina of Fez constantly, recommending the restoration of these hydraulic facilities because of their heritage importance and the enhancement of Moroccan culture in the management of water resources in the case of shortage or abundance.

Keywords

Fez medina, Vulnerability, Flood risk, Hydraulic structures, Water management

MODELING OF RAINFALL- DISCHARGE RELATIONSHIP BY TANK MODEL, COUPLED WITH KALMAN FILTER. APPLICATION TO THE BOUCHEGOUF WATERSHED (WILAYA OF GUELMA)

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Abstract

Modeling the rainfall-discharge relationship by conceptual models was always a fascinating subject for hydrologists because of its practical importance and complexity. Our study focuses on the Bouchegouf watershed for a daily time step.

This work is divided into two parts, the first was devoted to the simple Tank Model where it was tested by manual calibration, and gave unsatisfactory results. In the second part, the Tank Model is coupled with the Kalman filter which was developed in order to find a solution for the noise problem.

The Model Tank alone is unable to model the rainfall-runoff relationship on the semi-arid region considered in the daily time step, the measurement series have a great problem of errors and sometimes even of reliability, it is for this the Kalman filter is applied to overcome these deficiencies.

The Kalman filter coupled with tank model gave excellent results at the daily time step. Filter coupling is therefore a possible solution for the analysis of uncertainty in conceptual hydrological models. Finally, we have been able to adapt the structure of the tank model to the case of this Algerian watershed..

Keywords

Kalman filter, Rainfall runoffrelationship, Tank Model,

SOIL MOISTURE APPLICATIONS AND DOWNSCALING USING SMOS AND SMAP: REVIEW

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Abstract

During the last few years many scientific studies were interested in soil moisture applications and downscaling using Soil Moisture And Ocean Salinity (SMOS) and Soil Moisture Active Passive (SMAP) satellites that are parts of soil moisture dedicated space missions. In order to review scientific research papers produced recently (the last three years) a methodological and a statistical review called Systematic Mapping Study (SMS) was conducted. The study was based on Scopus Database and the selection criteria of scientific papers are mainly the title, the abstract, the keywords and if necessary the full-paper. The main aim of the study is to answer six research questions using graphs and analysis: publication year, type of documents, satellites, continents, authors, scientific fields and main purpose. Among the main observations: articles are number one documents type with the use of SMOS more than SMAP and most of study areas are in the North America continent. The most eminent authors were detected using a word cloud in order to track the future progression of scientific research in this subject. Another noticeable fact is that the main scientific field of the paper is Hydrology and Land surface models especially hydrological modeling which is a powerful tool in flood forecasting and monitoring. This review is a guiding step that allows to the community to have a brief state of the art about soil moisture applications and downscaling in the last three years with floods as a main application field.

Keywords

Soil moisture, Remote sensing, Microwave, SMOS, SMAP, Hydrology, Floods, Droughts, Systematic Mapping Study

PILOT STUDY OF THE FLOOD FORECAST: CASE OF OUED FES IN MOROCCO

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Abstract

Floods are among the most devastating and frequent natural risks that touch most individuals. Fes city is very threatened by these natural hazards because it develops within the confluence zone of the whole water system of the drainage basin of the Oued Fes. This watershed is assembled of several sub-watershed draining five important Oueds.

Besides and considering the absence of the hydrometric stations, the watershed of Oued Fes manifests a deficiency of limn metric data at the level of the upstream of Oued Fes. Accordingly, the first axis of this paper aims at understanding its hydrological functioning on the basis of the analysis of its physiographic and climatic characteristics. This study will unveil the hydrological answer of the watershed of the Oued Fes and its sub-basins as well as the customization of rainfalls and their intensities.

The second objective of this work rests on the hydrological modelling of the watershed of Oued Fes by the HEC-HMS platform. This study is based on hydrological hazard and the vulnerability most likely risks. To highlight the hydrological hazard, this study is based on the analysis of historical incidents and on the modelling of some hydrological incidents. The obtained results will allow to estimate the floods peak as well as their times of return.

We proceeded afterwards to the hydraulic modelling of the pond by limiting zones vulnerable to foods risks. To do so, we have opted for HEC-RAS platform which has enabled us to make a joint understanding both one-dimensional and bi-dimensional

Keywords

Hydraulic simulation, Floods, Oued Fès, HEC-RAS

FLOOD WARNING SYSTEM DETERMINATION OF FLOODCONTROL

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Abstract

Marrakech city is characterized by a plain from which emerge two small massifs of hills; Gueliz and Koudiat Abid. In the north flows the Wadi Tensift. In the east, Wadi Issil, a tributary of the Tensift Wadi, has always been a threat to the city by its violent floods. The most important flood events of Wadis Issil that occurred in the Marrakech prefecture have resulted in loss of human lives, flooding of agricultural land, collapse of houses and flooding of neighborhoods within the urban area. These phenomena have caused disruption of socio-economic activities. We distinguish two types of floods that are due to inputs from runoff from rural basins upstream: either by sheet runoff and accumulation, or by overflow of Chaabas and Wadis that naturally drain the rainwater within urban area whenever torrential rainfall occurs in the city.

After analyzing the risks of these floods, we concluded that the need for networks and early warning systems is not completely satisfied. The implementation of a warning system is an important element of any strategy of the city's fight against risks, especially floods. This system must ensure better prevention and risk management.

Keywords

Flood warning system, Tensift,Prevention and risk Management

STORMWATER NETWORK MODELLING OF AIN HARROUDA COUNTY, MOROCCO

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Abstract

The risk of flooding is not a new danger. However, exacerbated by the consequences of global warming and changes in land use, this phenomenon has become more and more frequent in our contemporary societies.

Casablanca has experienced uncontrolled urbanization that does not fit in with the size of the network and the increase in waterproofed surfaces. There is also the problem of climate change, which has modified the country's rainfall regime. The combination of these factors has increased the occurrence of flooding at the city level. In this work, we will study the case of Ain Harrouda county because it appears to be the most vulnerable area to flood risk in Casablanca region.

The objective of this work is to carry out a diagnosis of the rainwater network of the Ain Harrouda county. To this end, a network capacity analysis is carried out using numerical modelling using the Mouse software (MOdel of Urban SEwer). This is a latest-generation software that combines MOUSE's hydrological and hydraulic calculation engines and also integrates an Arc GIS geographic information system. Results predict the overflowing of two main pipes of the network. The first section overflow is due to the absence of storm drain outlet and the second section is undersized with regard to the increasing runoff causing the road S107 to be cut.

Keywords

Flood risk, stormwater network overflow, Capacity analysis, Numerical modelling, Ain Harrouda county

ASSESSMENT OF TRMM 3B42V7 SATELLITE PRECIPITATION PRODUCT USING FULLY DISTRIBUTED HYDROLOGICAL MODEL OVER THE BLUE NILE BASIN

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Abstract

The Blue Nile River is one of the most important tributaries of the Nile River as it considered the main source of fresh water to Egypt. Recently, Satellite precipitation products become very popular to estimate rivers flow rates using hydrological models. In this study, the fully distributed Hydrological River Basin Environmental Assessment Model (Hydro-BEAM) is used to assess global high-resolution satellite precipitation product (TRMM 3B42V7) as input precipitation data in the Blue Nile basin. The simulated discharge is calibrated during the period (2001-2003) and is validated during the period (2004-2007) at Khartoum station. In general, the Hydro-BEAM model simulated the Blue Nile Hydrograph based on TRMM3B42V7 product data achieves better agreement, with a Nash-Sutcliffe efficiency coefficient (NSE) value of 0.84 and 0.73, the coefficient of determination (R2) value of 0.96 and 0.72 and the percent bias (Bias) value of -3.79% and -22.69% for both calibration and validation periods. The model used in this study provides a viable tool to assess and predict the availability of water resources under future challenges imposed by climate change or proposed and existing dams construction in upper Nile countries.

Keywords
The Blue Nile, Fully Distributed Hydrological Model, Hydro-BEAM, TRMM3B42V7

ASSESSMENT OF SENTINEL-1 POTENTIAL FOR FLOOD MAPPING IN TROPICAL CATCHMENTS: CASE OF BUJUMBURA FLOODPLAIN, BURUNDI

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Abstract

Tropical environments are the most exposed to fatalities, injuries, damage to properties with economic and interpersonal disruption due to flooding. The present research aims to evaluate the Sentinel-1 C-band SAR data potential for flood mapping in Bujumbura city. To achieve this purpose, three Sentinel-1A IW GRDH images acquired before and after two flash flood events have been integrated. The processing consists in amplitude change detection technique using the VV polarization band of the interferometric wide swath mode to extract post-flood remaining water areas. In order to carry out change analysis, previous and post-events time series data underwent pre-processing operations including radiometric calibration, speckle filter and terrain correction. The area of interest subset images were integrated into a coregistration procedure two by two resulting in new images for change analysis. Derived RGB composite images were used for visual interpretation. Each coregistrated image was classified into non-flooded and flood areas. Flood water bodies were mainly detected in farmlands, around natural water bodies and in the peripheral built-up zones towards the North of the city. The results demonstrate that SAR data can fill the gap of optical images especially related to cloud coverage and the lack of field observation data.

Keywords

Flash floods, Change analysis, Sentinel-1, SAR data, Bujumbura city

STUDY OF THE CHARACTERISTICS OF THE HYDRAULIC JUMP IN THE ABRUPT EXPANSION

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Abstract

The basin of dissipation plays a very important role for the security of the dam and the protection of the environment against flood and the phenomena of erosion and scour downstream of the dam.In the basin of dissipation, the hydraulic jump is of a practical importance in the dissipation of the energy excess.This communication presents a study of the Spatial hydraulic jump and the transitional jump in the energy dissipation basin with abrupt expansion, in particular the main hydraulic characteristics of these two types of hydraulic jump, for example the ratio of the conjugate depthsof each jump which depends on the foot position compared to the expansion section, of the expansion ratio and of the Froude number of the incident flow. Also the study of the symmetry of the Spatial hydraulic jump(S-jump)and the transitional jump (T-jump).The dimensioning of the energy dissipation basin with abrupt expansion depends on these parameters.The study of the ratio y of the conjugate depths of these two jumps shows that for a value of expansion ratio B chosen,y increases with the foot position X1.The minimum value of y is at X1=0 (case of the Spatial jump) and the maximum value of y is reached for the classic jump.ydecreases when B increases.The study shows that the Spatial hydraulic jump and the transitional jump are asymmetric.

Keywords

Flood, Energy dissipation basin, Spatial hydraulic jump, Transitional jump

COUPLED SWAT MODEL AND FLOOD FREQUENCY ANALYSIS IN XEROPOTAMOS UNGAUGED WATERSHED, GREECE

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Abstract

Extreme events such as floods are one of the most dangerous meteorological hazards affecting the Mediterranean countries. Xeropotamos is a typical intermittent Mediterranean river, with high flow during winter and low or no flow during summer. The river discharges in the Aegean Sea, at Ammoudara beach. This area is one of the most important touristic sites in Heraklion city in Crete Island. In this study we used SWAT (Soil and Water Assessment Tool) as a semi distributed physically-based model for flood forecast and protection to study the Xerapotamos ungauged watershed. The model simulates the flow of Xerapotamos river based on Giofyros available data. The two watersheds, Xerapotamos and Giofyros, have similar characteristics regarding geology and climate. Land use data, soil Digital Elevation Model and meteorological data from Giofyros gauging stations were used to build the SWAT model. The predicted values show a good agreement with the observed data, based on qualitative criteria. However, results are not acceptable regarding quantitative criteria such as nash-sutcliff, nevertheless the quantitative criteria are not always reliable for calibration assessment. The SWAT model provides simulated flow used in flood frequency analysis to help predicting extreme events and their returning periods. The results for Log Person III predictions for return periods 20, 100 and 500 years are 25.9 m3/s, 38.9 m3/s and 53.5 m3/s respectively. For the same return periods, the Gumbel method predicts 24.9 m3/s, 34.2 m3/s and 43.4 m3/s. The Log Pearson III predicts higher floods frequency in comparison with the Gumbel distribution.

Keywords

XeropotamosGiofyros, SWAT, Flood frequency analysis, Hydrological model, Gumbel method, Log-Pearson

ANALYSIS OF RAINFALL EXTREM IMPACT ON ANNABA CITY SEWER SYSTEM

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Abstract

Rainfall information is closely linked to the design of rainwater structures. The National Water Resources Agency (ANRH) developed a number of precipitation equations during the years 1980-81 based on measurements from 540 rainfall stations. This study, which was a reference in the field, is still used until now in many studies. It constitutes a regional synthesis of rainfall parameters over the entire territory of Algeria.

Rainfall intensity is changing due to climate change and in many places is increasing significantly. It becomes necessary to check the validity of these equations and to update them if necessary.

In a context of climate change, in order to take into account recent climate changes in Algeria in terms of rainfall. We will check the validity of these equations and update them for 30 rainfall stations in the Seybouse catchment

We will update the intensity-duration-frequency (IDF) curves by testing different statistical models. To identify the impact of such climate variability. Using the SWMM model, we will model an urban rainfall system of Annaba city (Northeastern of Algeria) using the new rainfall equations in order to determine the effect of this climatic variability.

Keywords

Climate change, Rainfall information, IDF Curves, Annaba, Seybouse catchment, SWMM

SYNTHESIS OF RESEARCH WORK ON THE FLOODING PHENOMENON IN THE CITY OF ANNABA (FROM 2005 TO 2018)

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Abstract

Algeria and particularly the city of Annaba are regularly affected by these natural disasters whose effects are intensified by other factors that aggravate them. These dramatic events, with heavy results, are not always linked to exceptional weather situations and occur following seasonal rain episodes and are not exceptional.

In this article we will present the synthesis of several scientific works and several research projects on this theme spread over the period from 2005 to 2018. We will discuss the different aspects of flood analysis, and their evolution in relation to urbanization and climate change. As well as the various observations concerning the evolution of the floods in the city of Annaba.

Various research results will be developed: hydrological analyses, hydraulic simulations and mapping of risk zones. This analysis will concern the behaviour of the sanitation system and the hydrographic network and also a hydrological analysis of extreme events.

The city has become more vulnerable. The rains that cause flooding are getting weaker. A revision of our vision with regard to this phenomenon is necessary within the framework of a global study

Keywords

Flooding, inundtion modelling, Risk evolution, Annaba, Algeria

EVALUATION OF TRMM RAINFALL PRODUCTS ON RUNOFF PREDICTION OVER MELLEGUE BASIN

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Abstract

The use of satellite-based precipitation estimates has become an alternative for many hydrological applications, especially in regions with weak measurement network. The large coverage with high spatiotemporal resolution of these products provide an effective data sources of models inputs. Evaluations of these data in a hydrological modeling is very scarce especially on North African regions. This study explores performances which can be reached using daily rainfall products 3B42V7 of Tropical Rainfall Measurement Mission (TRMM) in a rainfall-runoff simulation. This last was conducted by developing a Multi-Layer Perceptron Neural Network (MLPNN) on Oued Mellegue which is situated in the transboundary (Algeria and Tunisia) Medjerda watershed with a period of four years (2000-2004). Using a grid data with a spatial resolution of 0.25°, the 3B42V7 series selection as inputs for ANN has been carried out with a correlation analysis. Levenberg Marquardt (LM) algorithm with Mean Square Error (MSE) as objective function was used for its rapidity allowing test of many inputs combination with different delay. MLPNN model simulation developed with 3B42V7 rainfall products reached an acceptable performance with a Nash-Sutcliff efficiency (NS) equal to 0.72 during testing phase. Flow peaks are well simulated by the model while low flow are poorly simulated. Also, model generates flow while gauging station is indicating zero values, pointing the problem of false alarms found in rainfall data satellite.

Keywords
Tropical Rainfall Measurement Mission, Rainfall-runoff simulation, Rainfall satellite product.

OVERVIEW OF THE ECONOMIC, SOCIAL AND ENVIRONMENTAL DAMAGES OF FLOODS IN THE SIDI IFNI CITY –MOROCCO

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Abstract

As part of the process of economic, social and human development, interest in the environmental issue is capital in order to reconcile this development with the protection of the environment. In this regard, disaster management also requires more participation from various governments, non-governmental and private agencies and public participation. It involves more effort and time, more budget, equipments, facilities and human resources which leads to integration of flood disaster management for both long term and short term activities. The present work summarizes the economic, social and environmental damages caused by several floods in the Sidi-Ifni city in recent years based on official reports published by state institutions in Morocco and presents an overview on the structured- unstructured measures taken for the prevention of flood risk.

Keywords

Urban floods, Flood control measures, Socio-economic damages, Environment, Sidi Ifni

EVALUATION OF VULNERABILITY TO FLOODING IN JEDDAH, SAUDI ARABIA: THE NEIGHBORHOOD OF ABRUQ AL RAGHAMA AS A CASE STUDY

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Abstract

Among the biggest challenges cities in developing countries face in managing environmental risk is unplanned urban development, which can result in poor construction and building layout in hazardous areas. In this research, we present the case of the Abruq Al Raghama neighbourhood, which is located on Qous wadi in Jeddah (SA) and has experienced severe flooding and loss of life in the past. This neighbourhood has two distinctive parts: the planned part has a grid layout with wide roads and multi-storey buildings constructed of modern materials; the unplanned part consists mostly of one-storey 'traditional' buildings that do not follow building standards and have a haphazard layout. This research has examined both the physical and social/demographic properties of each part to evaluate vulnerability; the sources of data include official data (e.g. remote sensing, DEM and the 2010 SA census at block level) and 290 interviews of householders conducted on-site during 2018. The interviews asked general questions about flooding risk and specific questions about experiences during a 2009 flooding event. The results show that the unplanned part is far more vulnerable to flash-flood hazards because of its weak structures, poor layout, and larger family sizes. During the 2009 event, nearly 80% of homes in the unplanned part were flooded, compared to 25% in the planned part. This vulnerability is compounded by a culture that emphasizes the role of males as decision-makers within the family which limits opportunities for evacuation. In this paper, we present the preliminary analyses of the questionnaire results and discus the implication for risk management.

Keywords

Flood vulnerability, Interviews, Jeddah city

THREE DIMENSIONAL SIMULATION OF A CENTENNIAL FLOOD OF MOHAMMEDIA CITY IN WADI EL MALEH WATERSHED, MOROCCO

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Abstract

Today, the prevention and risks management occupy an important part of public policy activities and are considered as major components in the process of sustainable development of territories. Due to the expansion of IT processes, in particular the geomatics sciences, decision-makers are increasingly requesting digital tools before, during and after the natural disasters in order to well manage the territories. In Morocco, the floods began to be felt more strongly during last two decades, due to population growth and urban development, agricultural, industrial and tourism which entail a growing occupation of vulnerable areas. In the other side, the worsening of extreme phenomena (drought and floods) due to climate change resulting in severe localized storms causing rapid and violent floods. The historic events (on 1996, 2002 and 2010) which struck the city of Mohammedia and having caused the consequent damage to vital infrastructure and private property, require a thorough and rational analyze to well prevent the floods phenomena.

In order to properly assess the flood-risk in the city of Mohammedia and its impact on urban planning, a methodological process has been developed and which is split in two parts. First, a workflow was developed to simulate in 2D a centennial flood which delimits the perimeters of the flood zones and produce the territory Flood-map. Second, an exploration of the heights of the buildings and the 3D visualization of the submerged zones resulting from the simulation of the first part of the process is set up. So, for more precision and simplification of the analysis, architectural zoom was produced in order to view the waters level.

Keywords

GIS, Mapping, Flood, Flood Simulation, Hydraulic Modeling, DEM, HecRAS, Geo-HecRAS, ArcScene, 3D GIS.

IMPACT OF THE MOHAMMEDIA BENSLIMANE LANDFILL ON THE QUALITY OF GROUNDWATER

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Abstract

In the framework of the management and protection of water resources, Morocco has long been committed to a dynamic policy of preservation of natural resources, especially in rural areas, it is important to minimize and improve their resources management. Among these factors, there is the degradation of waste generating leachates which is a concentrated juice of organic and inorganic pollutants. Our work aims to study the environmental impact of the Mohammedia-Bensliman landfill on groundwater resources. To this end, a companion plot of groundwater and surface water was constructed around the landfill. In addition, the characterization of the pollution load of the raw leachate was also carried out in order to better identify the potential danger of rejection on the surrounding environment. The crude leachate analyzed is intermediate, anoxic, diffusing a huge organic and inorganic pollutant load, the value of the BDO5 / COD ratio which is The order of 0.5 indicates a carbon pollution characterized by the biodegradable material. The pH classification and the high levels of bicarbonate suggest the prevalence of the acidogenic phase, which corresponds to the age of the discharge (<10 years). The use of distinct approaches including hydrochemical analysis, analysis, statistics and groundwater quality is influenced by the lithological nature of the underlying geological formation. Indeed, the high concentration of the main ions obtained (chloride, total hardness, bicarbonate), reinforces the mineral charge and therefore the electrical conductivity. The concentrations of heavy metals are low compared to standardized laws.

Keywords

Water resources, Groundwater resources, Landfill, Leachates, Quality, Degradation, Pollutant load.

INTEGRATING CLIMATE CHANGE ADAPTATION IN LOCAL PLANNING: CASABLANCA CITY FLOOD CASE

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Abstract

Climate change (CC) is expected to exacerbate water stress and increase the frequency of extreme weather events, particularly droughts and floods. Casablanca region has undergone several major floods in the past decade, as was the case in November 2010, with a peak of 178 mm of rain, as the half-year rain (DMN). These floods damage the economic capital and reveal the inadequacy of existing infrastructure, as well as institutional, technical and organizational deficiencies to deal with disasters of this magnitude. Our project will start from an initial observation of a certain ignorance of the local responses of adaptation to climate change and their territorialization at the level of the region. This is mainly to define: How are the risks related to floods, due to CC are taken into account in the process of development and planning of Greater Casablanca? How is the action of adaptation to floods and climate change and its mode of governance modeled on the Casablanca territory? Indeed, the metropolis must anticipate the events that occur on its territory, consider them as reference laboratory case for the simulation of future situations and integrate them into development plans in the future. It must not only be prepared to respond to disasters, but also act upstream to reduce existing vulnerabilities and strengthen the resilience of its territory.

Keywords
Planning, Resilience, Governance, Casablanca city

MEASURING TECHNIQUE FOR SEDIMENT TRANSPORT DURING WADI FLASH FLOODS

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Abstract

For the improvement of resilience against flash flood disasters, it is important to measure not only water discharge but also sediment volumes. Monitoring sediment transport rate in wadi basins, however, is not an easy task due to the ephemerality of the wadi flash flood occurrence and the high bed load rate. As a method to get over these difficulties and monitor sediment transport rate, in this study, one surrogate bedload monitoring system called "impact plate" is introduced. This system is installed on the river bed and recording the acoustic and oscillation energy caused by sediment transport to estimate the dynamics of sediment particle movement. The advantages of the system includes the continuous monitoring for long period and the robustness against intensive sediment-laden flow that cannot be measured by other techniques. The presented case study in Japan demonstrates that the impact plate unveils the timing of sediment arrival, the dominant grain sizes, and time series variation of incoming sediment volume during floods. These information should help wadi flash flood prone areas in the view of disaster mitigation by knowing the approach of flash flood, its scale, and the characteristic of the sediment yield in the basin. Furthermore, in the view of water harvesting, this measurement is useful to appropriately plan, design, and operate the recharge dams

Keywords

Impact plate, Surrogate bedload monitoring, Wadi basin, recharge dam, Flood mitigation

IMPACT ANALYSIS OF A PORT DEVELOPMENT ON BEACH STABILITY

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Abstract

Coastal areasare a complex environment that is still poorly understood. This environment is the place which has a permanent conflict between the natural phenomena and the human intervention. The concentration of the human activities in the coastal areas requires a closer look at the problems that may endanger the beach stability, which known for the problem of erosion.

In this study we are interested in the case of Monika beach in Mohammedia on the Atlantic coast of Morocco, where a very sharp change in the coastline has been observed and measured last few years, especially since the construction of the new port. For this purpose, various tools have been implemented in order to better understand the impact of a port structure on coastal dynamics and beach stability. First, it is proposed to evaluate the coastal transit in the bay and then model the evolution of the coastline over time. Finally, the aim of our study is not only to evaluate the erosion of this zone, but also to find the appropriate development or adjustments, via numerical modeling, to mitigate this phenomenon and ensure a beach and neighboring agglomerations.

Keywords

Quantification of longshore transit, Wave propagation, SWAN, Coastline modeling

ASSESSING RESILIENCE TO FLOODS BASED ON PCA IN THREE FLOOD AFFECTED MUNICIPALITIES IN MOROCCO

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Abstract

In Morocco, floods are a recurrent phenomenon and cause damages and loss of property. This hazard presents a major concern for many decision makers. Traditional approaches to managing floods still not sufficient. Indeed, there is a considerable interest in flood resilience as a mechanism for mitigating the impacts on local communities. Despite this needs, developed methods to assess and measuring resilience remain a challenge. Through extensive literature review, several methods proposed are based on measuring baseline characteristics of communities that foster resilience by indicators approaches. In this work, we aim to measure the resilience of three affected coastal municipalities in Northern of Morocco (Fnideq, M'diq and Martil), based on the composite index, using a principal components analysis (PCA). Twenty-one resilience variables related to social, physical, and economical statutes are used to determine PCA components. In this way, only six principal components with variance higher than one are retained, and two measurement schemes (equal and weighted PCA) are adopted to test the influence of weights on the index output. The spatial distribution of the index calculated across the study area was mapped using Geographic Information Systems (GIS). The resulting resilience maps created by both schemes were compared and discussed; thus, the approach can be used to support mitigating planning against floods by selecting the most suitable decision.

Keywords

Resilience, Floods, Composite Index, GIS, PCA, Morocco.

IMPACT OF FLOODS ON SILTATION OF DAMS. CASE STUDY: AL WAHDA DAM ON THE SEBOU BASIN

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Abstract

The phenomenon of floods is always accompanied by the transport and deposition of suspendedmatter. In Morocco, this phenomenon has caused the deposition of sediments in reservoirs andcontinues to cause siltation of almost all large dams. This has been felt very strongly in the last twodecades. The Al Wahda dam, founded in 1991 and located in the Sebou basin in the province ofOuazzane, has a silt filling rate of 3 Mm3 / year. To date the rate of siltation is estimated at 18.5 Mm^3 /year, which is a loss of storage capacity of 10% of the dam.Following intense rainfall events, the Gharb plain has experienced severe flooding (1963, 1973, 1989,1996, 2002, 2008, 2009 and 2010). These destructive events caused significant damage, which ismainly due to the overflows of the Sebou wadi and are caused by: Erosion and solid transport andtheir impacts on the degradation of agricultural soils and the siltation of water reservoirs.Our work deals with the diagnosis and the inventory of the study area to understand the problemcaused by the presence and the increase of the mud in this dam. A preliminary presentation of all thegeomorphological, geological parameters, hydrological and climatic watershed is essential. Thedominant mechanisms and processes that govern this erosive dynamic both on the slopes and withinthe dam will be addressed, as how to clean silts and their recovery.

Keywords

Flood, Climate change, Sediment transport

A STUDY CURRENT WATER USE OF IDRISS I DAM, NORTHERN MOROCCO

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Abstract

Socio-economic development generates a significant increase in water demand in different sectors. It is therefore imperative to control the quantity of water in a regular way, especially when the resources are limited combined with the drought affecting the northern part of Morocco.

The watershed of the Oued Inaouène is one of the most important tributaries of the Sebou river. In its course, the wadi imprints an East-West direction before entering the dam Idriss 1st conceived to recover the waters of this watercourse and those of diversion of the Allal El Fassi dam. This study is based on the recognition of the quantities of water entering the dam in order to properly manage these waters according to needs and distribute them according to the importance of the consumption sector.

The average rainfall recorded is around 500 mm/year and the temperature varies between a minimum in the winter of 1 ° C and a maximum in the summer of 45 ° C. Bab Marzouka is the main station in the watershed with that of Idriss I dam and have a winter regime.The analysis of the hydrometric observations of Bab Merzoukka indicates that the relation height (H) - flow (Q) can be considered univocal as its geometry is stable. The height of 246 cm observed corresponds to the beginning of the filling of the dam. On the other hand, the dam water consumption is currently 12 Mm^3/year in terms of water for food, accompanied by an average water demand of 23.56 Mm^3/month for the Gharb plain irrigation.

Keywords

Oued Inaouène watershed, Idriss 1er dam, Water demand

TRADITIONAL TECHNIQUES OF WATER RESOURCES EXPLOITATION AND FLOOD CONTROL IN ARID ENVIRONMENTS: CASE OF THE OASES OF MAÏDER IN SOUTH-EAST OF MOROCCO

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Abstract

The Maïder oases, located in southeastern Morocco, form fragile and vulnerable ecosystems. These environments are threatened by several natural hazards, including flood and drought phenomena that present major risks that are triggered from time to time.

These spaces distributed in the depressions and alluvial plains of the Maïder watershed frequently experience periods of drought or floods of wadis where they are located. To cope with these two contradictory situations, the former inhabitants were forced to install hydraulic equipment (Khhettaras, Ugug ...) adapted to the nature of the environment, but also to the knowledge of that time, which was exploited for the installation and / or the management of scarcity and abundance of water. These ancestral works and techniques remain useful and effective today.

As a result, this hydraulic heritage requires a refined diagnosis in order to develop a preservation and enhancement plan ensuring the sustainable development of these regions.

This article aims to diagnose this hydraulic heritage and to demonstrate the effectiveness of these different components, concluding with the proposal of ideas for its valuation.

Keywords

Maïder oases, Flood, Drought management, Hydraulic heritage

EXTREME RAINFALL RISKS IN CASABLANCA CITY: OUED BOUSKOURA FLOODS

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Abstract

Oued Bouskoura natural path crossed, in time, the city of Casablanca from east to west, before flowing into the Atlantic Ocean at the old fishing port where the railway station Casa-Port is located today. This watercourse posed problems to decision-makers who were facing the rapid urbanization of the city, which has led to wadi Bouskoura path to disappear, transforming it into a canal, for the reconstruction on its natural course. This channel does not exceed the capacity of 2 m3 / S, which is much lower than the usual flow which reaches 45 m3 / S and therefore, did not prevent, in many rainy years, the increased flow of wadi Bouskoura, to flood the city of Casablanca.

In the new climatic conditions, rainfall has different fluctuations which, relating to types of atmospheric situations, put Morocco under the influence of hot and stable ridges or cool cold valleys. These changes create extreme rainfall, and increase their recurrences and impacts in the new Meridian Atmospheric Circulation (MAC).

Despite all the procedures taken by the authorities of the city of Casablanca, the economic capital of the country is still threatened by the flooding of Wadi Bouskoura, as was the case in 1996 and 2010.

Since the commissioning of the Super Collector West in 2017, we have not yet experienced extreme situations to test it. Will it succeed in protecting the city from floods by virtue of the new frequency of rainfall?

Keywords

Oued Bouskoura, Casablanca floods, Précipitations extremes, Meridian Atmospheric Circulation

STUDY OF THE EFFECTS OF STABILIZED LEACHATE RESIDUES FROM THE CITY OF MOHAMMEDIA'S LANDFILL SITE ON REGIONAL WATERS AND SOILS

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Abstract

The evaluation of pollution generated by residues of the controlled landfill of Mohammedia city at the level of the river ''Oued Nifika'', nearby soil and puddles of leachate from their percolation in the soil, show that the river and the surrounding sheet are still threatened by non-biodegradable inorganic pollution despite the closure of this landfill more than six years ago. These leachate puddles have very high electrical conductivities ranging from 42 to 46 mS / cm and that obtained at the river is about 2.2 mS / cm.

Total nitrogen concentrations are very high in the river water samples compared to the leachate samples. For the same landfill, the results obtained for the metals, compared with those obtained by some previous studies shows that the metallic pollution generated by these metals decreased of the landfill closure. The high COD content (46000 to 48000 mg O2 / l) and BOD (36050 mgO2/l) in the leachate samples reflect the introduction of biodegradable into the puddles of leachate, as well as the removal of biodegradable organic pollutants as the original leachate percolates into the soil before reaching the riveredges.

The metal analysis of soil samples near and far from puddles indicates that the soil seems to be less contaminated by leachate residues.

Keywords

Pollution, Landfill, Leachate, Metals, Surface water, Organic load

POTENTIAL IMPACTS OF GROUNDWATER FLOODING ON URBAN AREAS AND THE ROLE OF REMOTE SENSING AND GIS TECHNIQUES IN PREVENTING IT

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Hassania School of Public Works (EHTP), Morocco

Abstract

Undoubtedly, groundwater constitutes the most significant water resource and one of the most important sources of freshwater as it participates to the sustainable development by supplying potable water. Nevertheless, bad management of this resource in urban areas can lead to a disaster such as groundwater flooding which can pose to human health, the environment and economic activity significant risk like damage, disruption and destruction of the infrastructures, cessation of many services and activities and, above all, people's lives can be turned upside down. Thus, the aim of this research is to give an up to date and a review about the potential impacts of groundwater flooding on urban communities in order to raise awareness about this problem. Furthermore, this study highlights different GIS and remote sensing tools and techniques which enable the early prevention of groundwater flooding and help policy makers, managers, researchers and water decision-makers to take necessary measures to reduce the risks and the hazards associated with groundwater flooding and to establish its alleviation schemes for managing and protect our environment as efficiently and effectively as possible.

Keywords

Groundwater management, Flooding prevention, Hazards, Environment protection

PROTECTION STUDY AGAINST THE FLOODING OF THE CITY OF SIDI KASSI - NORTH EAST ALGERIA

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Abstract

The city of El Tarf experienced one of its most catastrophic floods on 22 and 23 February 2012, with three dead, nearly 7,000 families affected and thousands of hectares of crops devastated. More than 120 mm of rain brought the Seybouse wadi and its tributaries out of bed. Weather aggravated by the melting snow on the surrounding mountains and the discharge of water from the Bouhamdène (Guelma) and Cheffia (El Tarf) dams into the already saturated wadis. The city of sidi kassi is one of the most affected agglomerations despite the flood protection that exists. This flood event marked the memory of citizens.

This paper aims to analyse the flooding phenomenon in the city of Sidi Kassi and to detect why the protection system did not work. Also to hydrologically and hydraulically model the system and propose solutions. Development and urban planning plans during drought periods, which preceded the flood, were the source of protection deficiencies.Moreover, the realisation of such or such protection requires the meeting of a certain number of conditions which most of the time limits the possibilities and the results. It is therefore always necessary to seek the type of protection best suited to the area to be protected by taking sufficient safety margins, because the study methods are not always precise.

Keywords

Flood protection, Urban planning, Sidi Kassi

FLOOD PROTECTION DAMS IN OMAN

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Abstract

The Sultanate of Oman has a combination of high, steep and bare mountains, arid climate and highly variable rainfall that gives one of the highest flood peaks in the world for catchments of comparable size. Time for the occurrence of rainfall to a flood may be measured in minutes. The country has been experiencing a number of cyclonic storms of high intensity since 1977. These storms were particularly tragic for the population in 2002 and 2004, but hit a historical climax in June 2007 with Gonu cyclone. This event caused several high floods resulting in loss of human lives, properties and uncountable damages. To improve flood management, the Ministry of Regional Municipalities and Water Resources has prepared comprehensive studies on flash-flood prone cities and detailed maps illustrating high and medium risk areas in the country. This paper aims to highlight the studies carried out by the Ministry on flood protection dams in the governorates of the Sultanate. Approximately 200 potential sites have been identified. Available flood protection concepts allowed 15 feasibility studies and detail design projects to be carried out in various governorates. A focal point for these assessments was to conduct high level protection and cost–benefit analyses. Establishment of appropriate damage functions was the main challenge during the assessments. Hydrological, engineering and environmental investigations and the related potential conflict are also described. The studies resulted in the construction of three flood protection dams and others are currently in their contracting phase and are going to be constructed shortly.

Keywords

Flood control dams, government's vision, flood management, Flood mitigation

DESIGNING OF JURF DAM IN DUQM ON GEOLOGICALLY COMPLICATED FOUNDATION ROCKS – A CASE STUDY

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Abstract

Duqm is under the pace of large scale economic development and implementation of large scale infrastructure projects has opened new horizons for construction and economic boom in the area. Jurf Dam is one among the two proposed flood protection dams with associated channels designed to attenuate floods due to extreme rainfall events in Duqm area. After an elaborated geological and geotechnical investigations into the dam foundation, various anomalies are observed such as presence of evaporites material like gypsum, occurrence of weathered Shale formation along part of the dam axis, weathering and fractures along the fault plains and extensive fracturing in the foundation rocks. These serious geological defects lead to a geological asymmetry on the left and right abutments and at places along the dam axis, and thus some major difficulties of dam design and construction are encountered. In this paper, the influences of geological defects on the project are analysed, followed by the methods of treatment in the design. Based on the analysis, the treatment methods of the weak rock masses and discontinuities are carefully determined which include pre-loading of Shale formation, grout curtain layout design, and consolidation grouting. They work together to enhance the strength and integrity of the dam foundation. The provision for dewatering during construction in also kept in the tender documents for construction. The emission of H2S gas (hydrogen sulphide) on the western part of the dam axis was also noticed and precautionary measures are suggested for the labours and technicians during construction. It can therefore be seen that the specified foundation treatment results in a technically feasible dam foundation. The proposed treatment methods and concepts in the context can be helpful for similar dam sites in complex geological environments.

Keywords

Flood protection dams, abutments, grout curtain, Shale formation, consolidation grouting

PLAIN MANAGEMENT AGAINST FLOOD OF BOUTELDJA NORTH EAST OF ALGERIA;

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Abstract

Human genius has always sought to better manage, better protect and store water to exploit it in a rational way that meets different needs. When neglecting surface water due to runoff and the lack of sustainable maintenance of orographs, it can change human life to a natural disaster. The plain of Boutheldja is part of El Tarf plain, consisting of farmland suitable for all crops. The purpose of this hydro-agricultural study is to find an adequate solution for the Boutheldja Plain including farmland and water supply boreholes against flooding in the winter season. A rational exploitation of cultivated land is also sought from the diagnosis of the current state of the study area which remains a problem despite the development that has already been done. The sanitation and drainage of agricultural land is a technical solution in the agricultural development of our area in order to exploit agricultural land in a rational way with less flood risk using open drainage ditches or buried pipes. For the protection of the study area against submersion as well as evacuation of excess surface water and groundwater, a complex sanitation system is designed to convey waters to El Kebir wade then to the sea. To increase the efficiency of the operation of the drainage system, it is proposed to clean, calibrate and partially re-profile the existing network of ditches and especially the creation of new open ditches.

Keywords
Cultivated land, FloodPlan management, Runoff

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