EUROAQUAE
Euro Hydro-Informatics and Water Management

Education and Culture
Erasmus Mundus

Professional Practice Reports-Theses

Euro-Aquae Master Course

2nd Generation 2005-2007

Contact:
Professor Ph. Gourbesville - Coordinator
Polytech'Nice-Sophia
University of Nice Sophia Antipolis, France
+33 492 96 51 34 / 38 85 12
gourbesv@unice.fr

MŰEGYETEM 1782 · BTU Brandenburgische Technische Universität Cottbus · Université Nice Sophia Antipolis · Newcastle University · UPC Universitat Politècnica de Catalunya

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The evolution of human activities, in the foreground of climate changes and growing earth population, induces situations more and more complex to manage. The sustainable development of water resources and its management represents today a major challenge. The global aim of management is to avoid or minimize risks of crises in water supply, irrigation, floods, waste water treatment.

In this context, **Hydro-Informatics**, a European concept encompassing progress of modelling technologies and management of capacities, emerges as an essential tool in activities aiming at satisfaction of social and economic requirements.

The main objective of the **Master EuroAquae** is to prepare and train future scientists and engineers in charge of modelling and managing projects in hydro-technologies and environment. These professionals have vocation to assist local, national and international services, and to be involved in consulting activities with private companies.

Supported by the European Commission within **Erasmus Mundus** framework, the EuroAquae consortium awards a *Joint Master of Science (MSc) in Hydro-Informatics and Water Management* from 5 European partner universities.

The Master Course is based on a two-year programme (4 semesters) given to about 40 participants mixing **European and third-country students**. The mobility scheme covers at least 3 locations.

The programme is organized into a pedagogic continuum to provide common knowledge/soft skills (sem.1); acquisition and use of hydro-informatics concepts, methods and tools (sem.2); a thematic specialization: hydro-informatics systems, urban waters management, inland waters management, decision support systems (sem.3); and throughout semester 4, a professional practice or research project finalized by the **production of reports**.

The graduation ceremony was held in Newcastle on 7th September 2007: the 2nd generation of 31 Alumni received the Joint MSc degree from the 5 partner Universities. The present brochure supplies information on Master Projects-Theses of the graduates.

Author: **Yeshitila AYALEW WUBE** | Nationality: Ethiopia

Master Project Title: **Hydrological, Hydraulic and Water Quality Modelling in Arid Catchments**

Academic Tutor: Prof. Janos Jozsa, Budapest University of Technology and Economics, Budapest, Hungary

Professional/Institutional Tutor: Dr. Steven Wade, HR Wallingford, United Kingdom

Abstract:

Change in land use caused by urbanization can result in a change in storm runoff and the type and amount of pollutants transported to receiving waters. This report discusses an integrated use of GIS based data analysis and hydrologic and water quality modeling with respect to a proposal to develop a land in Malta. GIS was used to capture the necessary information to model hydrologic processes. Rainfall Intensity-duration-curves evaluated from data over the period of 12 years were used to generate the design rainfall. The Nash Cascade Model was used to estimate runoff for both short duration event and annual rainfall.

Pollutants load were estimated using the Event Mean Concentration (EMC) approach. The impact of land use change on runoff and pollutant loads was considered. Modeling output provides environmental impact assessment with the necessary information on the construction and post-development conditions.

It is important for flooding to be considered as part of a master planning process to ensure that important infrastructure is not placed at risk. This report discusses a detailed hydrological and hydraulic engineering assessment of flood risk and mitigation options for a development site in Saudi Arabia. GIS study was performed to prepare data for hydrological and hydraulic modelling. Mean Annual Flood for the wadis were estimated based on catchment characteristics such as area, elevation and average annual rainfall. A statistical approach that involves regression equations and growth curves for Saudi Arabia were implemented to generate design hydrographs for different return periods.

The method was observed to be ideal for such ungauged catchments. Hydraulic modelling of flooding was done using TUFLOW (Two-dimensional Unsteady FLOW) to predict flow extent, depth and velocities for current and post development scenarios. Mitigation options included wadi training and provision of flood storage.

Key-Words:

Hydrologic and Hydraulic Modelling, Design Hydrograph, Water quality, Flood Management, Event Mean Concentration, Wadi.

Author: **Viviane BEIRO GONCALVES**	Nationality: Brazil
Master Project Title: **Urban Drainage systems Analysis and Modelling: City of Ripoll (Girona)**	
Academic Tutor: Prof. Manuel Gomez, Technical University of Catalonia, Barcelona, Spain Professional/Institutional Tutor: Javier Hermida, Barcelona, Spain	

Abstract:

Urban drainage systems management is one of the water management fields that benefit from the Hydroinformatics approach.

In the professional practice carried out by the author at SOREA in Barcelona, several applications of drainage systems study and modelling were carried out. The main activities in which the practice was based are described in detail in this report.

The first study was related to the evaluation of the efficiency of stormwater inlets in one catchment of the town of Rubí in Catalonia, which has historically suffered from floods. The study involved estimating efficiency, required number, location, and preliminary cost of inlets in the catchment of the referred location. The methodology applied for this study was developed at the Hydraulics Laboratory of UPC.

The second study is the Drainage Master Plan of the city of Ripoll. This work is still in course and it is a detailed study of the sewer system, including data collection and analysis, characterisation, diagnosis and prognosis of the network through modelling, solution proposals, and economic evaluation of required interventions.

The third study is related to the impact of Combined Sewer Overflows (CSOs) at river Besòs in the sewer systems of the towns of La Llagosta and Santa Eulàlia de Ronçana, which are also composed by other towns nearby that discharge the storm and wastewater totally or partially in these systems. This project involves several professionals of the company and the participation of the author is on data collection and review, hydrologic and hydraulic modelling of the network and water quality modelling of the CSOs discharges. The methodology applied for the water quality modelling is the Urban Pollution Management (UPM) developed in the UK and will include local data collection, water sampling and laboratory analysis of basic water quality parameters and will be a pioneer work for this area, where at this moment there is no data available for the purpose of characterising the contamination charges of the CSOs discharges on river Besòs.

Key-Words:

Urban Drainage Systems, Hydroinformatics, Efficiency of Stormwater Inlets, Drainage Master Plans, Combined Systems Overflows (CSOs), Hydrologic and Hydraulic Modelling, Water Quality Modelling, UPM Procedure.

Author: **Achraj BHANDARI** | Nationality: India

Master Project Title: **Meeting Health Targets in The Ploucnice River Basin in Czech Republic**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Palle Lindgaard Jørgensen, DHI Water & Environment, Copenhagen, Denmark

Abstract:

Aim of our study is how to meet water quality standards in the Ploucnice river basin as given under the Water Framework Directives of European Union. It is important to achieve these target values as diseases related to contamination may constitute a major burden on human health as e.g. stated in the World Health Organisation under the drinking and bathing water guidelines.

Objective: Effort will be made to generate different scenarios to reduce the presence of E. coli in the water bodies in the Ploucnice river basin by means of suggested interventions and calculating the cost of carrying out such interventions. In this way trying to find a cost effective way to improve the water quality to meet the health targets.

Different scenarios which need to be generated are present levels of E. coli concentration, its concentration during high and low water flow regimes, the sources of faecal and other harmful microorganisms, water usage and demand in different activities e.g. industrial, household, irrigation, hydropower, recreation and others. The treatment of water is site specific, where ever the contamination is above the permissible limit set under the water framework directives for drinking water or WHO guidelines for bathing water, treatment and other interventions will be suggested.

Key-Words:

Mike Basin, Hydrological Modelling, Hydrograph, E. coli concentrations, WHO water quality guidelines, Ploucnice river basin.

Author: **Elsa BOTTIUS** | Nationality: France

Master Project Title: **Development of sustainability assessment tools for SUDS in new developments**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Steven Wade, Richard Kellagher, Helen Udale-Clarke, HR Wallingford, United Kingdom

Abstract:

The work presented hereafter has been done in the framework of two projects: “Water cycle management for New Developments (WaND)” and “Effects of climate change on river flow and groundwater recharge”.

The joint probability analysis tool is intended to assist those undertaking an assessment of hydraulic performance of a drainage system that has downstream boundary conditions controlled by either river or tide levels. The outcome of the tool is a distribution of joint return periods.

The infiltration system design tool enables the sizing of soakaways or infiltration trenches for any location in the UK.

The environment assessment tool has two components: water quality and hydraulic performance assessment. The water quality tool is a qualitative approach to assessing the adequacy of the proposed SUDS system in providing treatment to the stormwater runoff from a development. It calculates water quality scores based on information about the relative performance of SUDS components, the type of land use area, and the sensitivity of the receiving water. The hydraulic performance tool assesses the performance of the drainage system of a development against the greenfield behavior of the site (for frequent and extreme events). Performance is measured against peak flow rate, runoff volume and annual volume of infiltration.

River flow time series for the future (2011-2040) have been calculated using six global climate change models, and providing an original method to account for hydrological uncertainty. These data will be utilised to produce drought indicators, in order to identify and characterise droughts. A first indicator has been calculated: the number of days of flows below a threshold. The chosen threshold is Q95 (the flow that is exceeded 95% of the time) calculated for the period 1961-1990. Further calculations will be made.

Key-Words:

SUDS, water quality, hydraulic performance, joint probability analysis, Infiltration systems, climate change, drought indicators.

Author: **Seong Joon BYEON** | Nationality: South Korea

Master Project Title: **Modeling of Bathing Water Quality in Gentofte Commune, Denmark**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia Antipolis, France; Prof. Gyewoon Choi, University of Incheon, South Korea

Professional/Institutional Tutor: Anders Erichsen, Ole Mark, DHI Water & Environment, Hørsholm, Denmark

Abstract:

In order to protect public health, the “EC Bathing Water Directive” was adopted by the European Commission in 2006. It has recently been updated to allow for the improvement of managing practices for bathing waters and to set a standard for providing information to bathers throughout Europe. This has required increasing on-line data and modeling in order to have a direct impact on the determination of the time of expected exceedance of bathing water criteria.

In this study, MOUSE was used to represent a one-dimensional pipe network model simulating the urban drainage system of the Gentofte commune of Denmark. A MIKE 3 FM model was also applied for coastal hydraulics and bacteria advection–dispersion with consideration of biological decay. The final results were presented with good visualization through a horizontal map developed from 3-D analysis. Both models were checked and corrected before running simulations to ascertain stability and better accuracy. After data optimization, the urban drainage model was checked with big rainfall events such as CDS 100 years return period. This was successfully done, and so the model was stable and could be applied for any kind of simulation such as real time forecasting and flood modeling with extreme rainfall.

For the coastal simulations, results of the urban drainage model were extracted to be input for the coastal hydraulic and biological model. At the bathing point, the maximum existing time of bacteria was calculated to be 58 hours in total at Bellevue beach. But sometimes, bacteria could exist nearby the bathing point, which is also dangerous, so the bacteria existing time has been checked in the whole domain. The maximum existing time was found to be 212.5 hours.

The advantages obtained from this study were that understanding about models was improved. A visual checking system was developed instead of the traditional vague classification system and the foundation for being applied for advanced monitoring system for bathing water quality was sufficiently established. In order to better simulate the behavior of bathing water quality, measurements should be improved. Flow of the urban drainage system should be recorded at more points at the major drainage lines to improve drainage system model results and the bacteria concentration should be measured at several points in each bathing zone to better calibrate the coast environmental model. To develop more advanced modeling skill and knowhow, similar studies with different concept is suggested such as for bathing zones with big tidal variations and bathing zones in the rivers or lakes.

Key-Words:

Bathing Water, Coliform, MOUSE TRAP, MIKE 3 FM, Ecolab.

Author: **Yannick CESSES** | Nationality: France

Master Project Title: **Use of spatially varying rainfall in urban flood analysis**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Richard Kellagher, Steven Wade, Chris Counsell, HR Wallingford, United Kingdom

Abstract:

Any modelling approach will always be a simplification of the real word. As a result, it always carries approximations and limitations, and the water industry is constantly looking at ways to improve the representation of the real world and therefore provide greater accuracy and confidence in the results generated.

The DTI SAM project (fev 2006-March 2009) is looking to make significant progress towards a better representation of the real world problem by implementing new procedures and tools to better reflect real storm conditions (the source), improvements to the tools used to represent the above and below ground flow paths (the pathways) and to generate results in terms of consequences on the ground (impacts to receptors). As part of this project, I was involved in the spatially rainfall analysis.

Spatial variability in storms can be large, particularly when large urban areas are being considered over which a thunderstorm may only affect part of the catchment with other parts receiving little or no rainfall during the same time. This spatial variability may have significant consequences on the performance of drainage systems and the capability to take this into account would provide a more realistic real-world representation.

This report summarises the limitations of the usual approaches used by the stakeholders to represent the rainfall in their drainage models, and propose a method and tools to enable the use of spatial rainfall (radar or stochastically generated data), and discusses the design and implementation phases and how the use of spatial varying rainfall will be compared with traditional methods.

This work is ongoing and is programmed to be completed in 2007

Key-Words:

Rainfall, Flood, Storm design, Spatially varying rainfall, Radar and stochastic data, Urban drainage modeling, InfoWorks CS, ArcGIS.

Author: **Kuldeep CHAWLA** | Nationality: India

Master Project Title: **Reservoir Optimisation Using Surrogate Modelling**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Henrik Madson, DHI Water & Environment, Hørsholm, Denmark

Abstract:

This master work is a follow up of a PhD thesis. Traditionally, Reservoir operation is based on heuristic procedures, embracing rule curves and to a certain extent, subjective Judgements by the operator. Water use involves a large number of stakeholders with different objectives with different objectives, and optimisation techniques are expected to provide balanced solutions between often conflicting objectives. Some recent researchers (Ngo, 2006) have used rapid developing computational techniques and have developed advanced optimisation techniques to replace traditional rule curves. These new methods is usually a combination of a Hydraulic simulation model such as MIKE11 and advanced optimisation program like AUTOCAL using techniques such as shuffled complex evolution algorithm. These new techniques have considerable improved the reservoir operations but the main limitation of these techniques is the expensive nature of the Hydraulic models and computation time involved.

In the present master thesis, surrogate modelling techniques such as Artificial Neural Network have been developed to replace partially the Mike11 model. The framework is tested on the Hoa Binh reservoir in the Red River basin, Vietnam considering hydropower production and downstream flood control. Artificial Neural Network model is used to predict the water level at the downstream flood control point in Hanoi based on the discharges at the upstream tributaries and release from the Hao Binh Reservoir. So, Expensive Mike11 model is replaced by cheap surrogate ANN during optimisation which saves some computational time as well. The optimisation is performed in real-time to optimize the 3 day reservoir operations every 6 Hours. The analysis shows that the Artificial Neural Network can be used to replace Mike11 or any other expensive Hydraulic modelling tool and it is inexpensive and computationally faster

Key-Words:

Reservoir Optimisation, Hydraulic Modelling, Surrogate Modelling, Neural Network, Automatic Calibration, AUTOCAL, Shuffled Complex Evolution.

Author: **Jialin CHEN**

Nationality: Taiwan

Master Project Title: **Investigating the Forecasting Skill of a MIKE 21 FM Storm Surge Model using an Ensemble Kalman Filter**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Jacob V. Tornfeldt Sorensen, DHI Water & Environment, Copenhagen, Denmark

Abstract:

The object of the present study is to investigate the forecast skill of a MIKE 21 FM storm surge model. The aim is to use MIKE 21 in its flexible mesh (FM) version together with an approximate ensemble Kalman filter as a storm surge model of tidal gauge data in the North Sea and Baltic Sea system. The existing tidal forecasting system which is set up in Mike21 with bathymetry of fixed grids had been applied for several data assimilation approaches.

Data assimilation in operational forecasting system is an undergoing rapid development. As the limitation of time and computational resources, it requires efficient as well as robust assimilation schemes to support online prediction products. Therefore, a steady Kalman gain approximation is considered. The regularization is designed to simultaneously give a significant speed up of the scheme. The estimation skill is assessed in a 4 week hindcast experiment using a setup of an operational model in the North Sea and Baltic Sea system. Forecast initialization by an Ensemble Kalman filter with steady regularization gave an average improved prediction for a period of 4 days.

The use of the Kalman filter improves the forecast skill and is to be expected to contribute to the existing North Sea and Baltic Sea forecasting system.

Key-Words:

Data Assimilation, Kalman Filter, Tidal Forecasting, Mike21FM.

Author: **Yanyan CHEN**

Nationality: China

Master Thesis Title: **Development and Implementation of a Real-time Flood Inundation Prediction Model after Dyke Breaches**

Academic Tutor: Prof. Dr.-Ing. K.-P. Holz, Prof. Frank Molkenthin, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor: Dr. Heiko Apel, GeoForschungsZentrum (GFZ), Potsdam, Germany

Abstract:

Threat from flood disasters has become one of the leading topics of the century. In recent years, flood disasters occurred frequently all over the world, mostly resulting from dyke failures. In this thesis the development of components of a raster-based flood inundation model after dyke breaches is outlined within the project “Incorporation of a flood inundation model in a real-time flood management system”. The model is based on raster Digital Elevation Models and consists of a two-dimensional diffusive wave approximation for floodplain flow.

One of the developed components is designed to improve model efficiency by cutout sufficient computational domain from an extremely large domain. In order to exclude a 1D river model, one component aims to interpolate breach boundary hydrographs from nearest upstream water gauging station record. The third component implements a search algorithm to identify breach cells, which integrates the inundation model with monitoring and control system.

The model is applied to a 46 km reach of the River Elbe in northeast Germany and sensitivity analysis against change of roughness parameter sets due to different land use types is carried out.

Key-Words:

Flood Inundation, Dyke Breach, Raster-based, Land Use Types.

Author: **Julia CIANCO**	Nationality: Argentina

Master Project Title: **South-Wesses: Tidal flood zone compliance main stage**

Academic Tutor: Prof. Manuel Gomez, Technical University of Catalonia, Barcelona, Spain

Professional/Institutional Tutor: Folahan Ongunyoye, Lee Garrat, Royal Haskoning, Peterborough, United Kingdom

Abstract:

Key-Words:

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Author: **Anna GILEWSKA**

Nationality: Poland

Master Project Title: **Sensitivity analysis on Scheldt Pilot site within Floodsite integrated project - Modeling of hydrology and water quality**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Marnix van der Vat, Adri Verweij, Geert Prinsen, Marjolein Mens WL | Delft Hydraulics, Delft, The Netherlands

Abstract:

This report devotes to work during five months within training program in WL | Delft Hydraulics.

First part of this report deals with evacuation modeling in case of costal flood in Zeeland, The Netherlands within integrated project on flood risk management, task 17 Emergency flood management - evacuation planning. The FLOODsite project covers the physical, environmental, ecological and socio-economic aspects of floods from rivers, estuaries and the sea.

Second part, deals with a hydrological and water quality study concerning the Singapore, Geylang, Kallang and Bukit Timah River, Stamford and Rochor Canal and Marina Bay. The Marina Bay project in Singapore intends to build Marina Barrage across the Marina Channel between the reclaimed lands of Marina East and Marina South. When the project will be completed the Marina Bay and Kallang Basin will turn into a new downtown freshwater reservoir. It will provide water supply, flood control and a new lifestyle attraction.

Task involved:
• Data processing with HYMOS - information system for water resources management
• Recalibration and calculations in SOBEK (1D Flow with RR and RTC module, 1D Flow with 1D WAQ and EM module)
• Calculations in ESCAPE DSS model
• Sensitivity analysis for ESCAPE DSS model
• Comparison EC with ESCAPE DSS model.

Key-Words:

Sobek, Singapore, hydrology, WAQ, EM, RR, RTC, Marina Barrage, HYMOS, ESCAPE, DSS, flood, evacuation, Zeeland.

Author: **Ayyappa Reddy GUDIMETLA** | Nationality: India

Master Project Title: **Distributed Modelling in US Snow Catchments**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Michael B. Butts, DHI Water & Environment, Copenhagen, Denmark

Abstract:

This study will assess the performance of lumped and distributed modeling using different rainfall and temperature inputs. Both Grid and Gauge data are used. Thisstudy is a contribution to Distributed Model Intercomparision Project (DMIP 2)which was formulated by the National Oceanic and Atmospheric Administration's National Weather Service (NOAA/NWS) who recognized the need to infuse new science into its river forecasting capability. The overall goal of the DMIP project is to evaluate the benefit of using distributed modelling and distributed data for improving hydrological simulation and flood forecasting.

This study was carried out on two different catchments; the American and Carson where in both cases the runoff is affected by the snow melt process. While geographically close, their hydrological regimes are quite different due to difference in mean elevation and their locations on either side of Sierran divide (Simpson et al 2004).

Different model structures were selected in Mike 11 (Nam model) and Mike SHE and are evaluated against observed discharge at the basin outlets. The model structures were selected based on the available data. The results indicate that simulations are consistently improving as the model becomes more complicated. i.e., using more spatially distributed data and model structures.

Key-Words:

Hydrological Modelling, Hydrograph, Stream flow forecasting, Distributed Modelling.

Author: **Richa GUPTA** | Nationality: India

Master Project Title: **TUFLOW 2D modelling in Catchment Flood Management Plan**

Academic Tutor: Prof. Janos Jozsa, Budapest University of Technology and Economics, Budapest, Hungary

Professional/Institutional Tutor: Scott Ferguson, Capita Symonds, United Kingdom

Abstract:

An important part of the CFMP process is to understand the impact of flooding on the catchment. We cannot prevent flooding but we can prepare for such events, for example by constructing defenses and removing obstruction from the channel.

For this we develop computer models that help us to understand the damage caused by the flood water and various methods to prevent it by knowing approximately the flood levels and flood extents. For CFMP, for the size and scale, a broad scale model of the river is suitable.

TUFLOW stands for Two-dimensional Unsteady FLOW. This is a computer program that was initially started in Australia as a joint research and development project between WBM Oceanics and the University of Queensland in year 1990. In order to get the flood levels and flood extents data, TUFLOW modelling has been successful over the years. Therefore, to asses both current and future flood risks, which are our main objective, can be achieved by it.

Key-Words:

CFMP (Catchment Flood Management Plan), Broad Scale Modelling, TUFLOW Modelling, Flood levels, Flood extents, Flood risks..

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Author: **Balázs GYORFFY** | Nationality: Hungary

Master Thesis Title: **Analysis of Geothermal Flow at the Spreedreieck Building in Berlin**

Academic Tutor: Prof. Dr.-Ing. K.-P. Holz, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor: Prof. Dr.-Ing. Stavros Savidis, Dr.-Ing. Jens Mittag, GuD Consults, Berlin, Germany

Abstract:

An installation of geothermal probes had been planned to serve part of the energy needs of the Spreedreieck Building being built in Berlin – Mitte.

Due to the amount of energy in demand and the size of the installation numerical simulations were necessary to calculate the prospective effects of the system.

Geothermal simulations carried out by professionals were based on various data sources among which the measurements performed by using a technology called Thermal Response Testing is of primal importance. There are several uncertainties accompanied with the application of Thermal Response Testing and other difficulties with the accurate description of an inhomogeneous, layered soil system containing moving groundwater, like in the case of the Spreedreieck area.

Therefore this work has two main objectives. One is to present an overview about the sate of the art in thermal response testing technologies and methods, and the other is to gain a deeper understanding of coupled flow and heat transport in the environment of a geothermal probe by presenting a parameter study, focusing on the geothermal modeling of the Spreedreieck project.

Overview of geothermal energy and introduction of the used simulation software are also presented.

Key-Words:

Geothermal simulation, Geothermal energy, Thermal Response Test, Borehole Heat Exchanger, Heat transport, Spreedreieck.

Author: **Mohammed Shafiqul ISLAM** | Nationality: Bangladesh

Master Thesis Title: **Design, Analysis and Evaluation of Vacuum Sewer Systems against Gravity Sewer Systems**

Academic Tutor: Prof. Vedrana Kutija, Newcastle University, United Kingdom

Professional/Institutional Tutor:

Abstract:

Sewerage collection system is an important indicator for any civilization. From the long time in sewerage history, the most common type of sewerage collection systems are gravity and pressure system. In last 20 years, a relatively new wastewater collection system, called vacuum system, got acceptance and popularity in certain circumstances in the world. However, there is lack of significant research and study in this field which is hindering the development of this system.

This study attempt to analyze and evaluate different aspects of vacuums sewer system against gravity sewer systems, especially in term of cost. A design procedure for vacuum system has been compiled. From the detail design of same areas with two systems, it is seen that vacuums systems are relatively cheaper in terms of total construction and operation cost point of view. Considering all cost, it is seen that vacuum systems required around 70% installation and operating energy cost compare to gravity systems.

It is also found that excavation cost for vacuums system is around one fourth of the gravity systems. However, manhole in gravity system is relatively cheaper (33%) than the similar components in vacuum system (inspection valves, vacuum valves, division valves and connections). Other costs, like trench filling materials, labour cost, dewater and safety measure cost, are also less in vacuum system compare to gravity system.

It is important note that, the vacuum system required around same (6.5% less) energy cost of gravity system energy cost. As a whole, it can be concluded that vacuums systems are around 30% less costly than gravity system for the study area.

Key-Words:

Two Phase Flow, Vacuum Sewer, Gravity Sewer, Vacuum Valves, Vacuum Station, Inspection Valves, Lift, Excavation, Manhole Cost, Pump.

Author: **Abolghasem KAMKAR ROUHANI** | Nationality: Iran

Master Thesis Title: **Modelling Dam Break Problems using MIKE 21**

Academic Tutor: Prof. Prof. Dr.-Ing. K.-P. Holz, Prof. Dr.-Ing. F. Molkenthin, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor: Prof. Dr.-Ing. R. Hinkelmann, Dipl.-Ing. T. Busse, Department of Water Resources Management and Hydroinformatics, University of Technology Berlin, Germany

Abstract:

Floods resulting from the sudden collapse of a dam (dam-break) are often characterised by the formation of shock waves. The prediction of the dam break flood is vital for the purposes of planning and decision making concerning to dam safety, controlling downstream developments, contingency evacuation planning and real time flood forecasting. Numerical models can be used to predict flood wave propagation due to a dam break and provide the information about the area to be flooded, wave front arrival time, water depth, flow velocity, etc.

The application and comparison of finite difference and finite volume numerical methods used in the established modelling system MIKE 21 are investigated for different kinds of dam break problems. As a result, the capabilities and the limitations of the modelling system for this special and very difficult case of solving the 2-D shallow water equations are determined.

Hydrodynamic modelling of a quasi 1-D case of a dam break is carried out in the first step of this research work. Different kinds of wave heights are simulated on initially wet and dry domains. This quasi 1-D dam break problem is investigated by considering different simulation parameters and case specifications. Consequently, the influences of the mesh resolution and geometric shape, and also numerical scheme on the sharp front and on the overall solution behaviour are analysed, and also the limitation of the modelling system MIKE 21 for the treatment of dry domains is determined. For every dam break case problem, a considerable number of simulations in MIKE 21 were run by changing numerical parameters such as space-step, timestep, and Courant number, and also by changing physical quantities such as friction coefficient and viscosity. The sensitivity of the results to changing these parameters and quantities is briefly investigated.

This study is followed by doing the same investigations for a 2-D dam break problem. The simulations for the 2-D problem are carried out by considering the flow direction either perpendicular or oblique to open boundaries. Consequently, the effect of the flow direction on the simulation results is examined and conclusions are drawn based on the obtained results.

Key-Words:

Numerical Modelling, Finite Difference, Finite Volume, Dam, Break Problems, MIKE 21.

Author: **Olivier LE MOIGN**	Nationality: France
Master Project Title: **Tidal Modelling**	
Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France Professional/Institutional Tutor: Thomas Uhrenholdt, DHI Water & Environment, Singapore	

Abstract:

This report presents three projects I have carried at DHI Singapore during 4 months.

The first one was the study of the impact of land reclamation on an industrial storm and process water system, using MOUSE.

The second was a current modeling on the region of the Philippines, using Mike21fm.

The last one is a worldwide study on the best sites for tidal power plants implementation. It uses a large panel of tools.

Key-Words:

Hydrological Modelling, Tidal Power Plants, Tidal, Sewage Systems.

Brandenburgische Technische Universität Cottbus

Author: **Chi-Yu LI**	Nationality: Taiwan

Master Thesis Title: **Feasibility Analysis of Substituting ANN for Part of FEM Calculation using a 2-D Groundwater Problem as an Example**

Academic Tutor: Prof. Dr.-Ing. K.-P. Holz, Dipl.-Ing. Lars Weber,, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor:

Abstract:

Finite element method (FEM) has a great advantage in irregular boundary problem and global mass conservation for deterministic problems, but it generally takes too much computational resources in matrix operation and in iteration process for nonlinear relationships. A well-trained artificial neural network (ANN) function is able to avoid these kinds of calculation and derive reasonable results, but sometimes it might be difficult to explain the physics inside the problem. The main frame of this work was trying to substitute a well-trained ANN function for part of FEM calculation process as a subsystem to reduce the computational resources.

Basically, mainly two problems, Darcy's flow and Forchheimer's flow, were chosen as examples for FEM representation and iteration substitution individually. The results showed that the ANN could well represent the FEM calculation but it is difficult to conclude that it would be more computationally efficient. The reason comes from the difficulty of neglecting for-loop operation in the well-trained function and the simplified problem itself. Hence, more detailed studies could be done to investigate the approach.

Key-Words:

FEM, ANN, Groundwater, Darcy's flow, Forchheimer's flow.

Author: **Manojkumar MENDPARA** | Nationality: India

Master Project Title: **1D Modelling of the Seine River for Flood Forecasting**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Pierre Bona, DHI Water & Environment, Nantes, France

Abstract:

The occurrence of floods in Europe is difficult to prevent. However, timely forecasts can save human lives and property. The Ministery of Ecology and Sustainable Development via DIREN Ile-de-France has appointed the group DHI (leading partner) / Safege to develop models for flood forecasting along the Seine River and its tributaries. The modelling software MIKE 11 has been set up to forecast the runoff from the catchment areas upstream of Paris as well as the flow and water levels in the rivers Seine, Marne, Yonne, Loing, Ouanne, Beuvron, Cure, Armançon, Serein and Oise.

An advanced updating routine ensures identical conditions in model and nature up to the time of forecast to enhance forecast accuracy. This data assimilation routine also applies an error forecasting functionality to extrapolate deviations into the forecast period and thereby increase short term forecast accuracy further.

The models are being integrated in the existing LISAH system, already applied by DIREN for processing of real-time data. The combined system will be operational from August 2006 and provide accurate forecasts of water level at key locations in Paris and other urban areas to enable timely warning of floods. DHI is the leading supplier of flood forecasting systems world-wide.

DHI is the leading supplier of flood forecasting systems world-wide. Flood forecasting systems based on DHI software are now installed in ten European countries in addition to the many installations in Asia and America. Most of the systems also include DHI's MIKE FLOOD WATCH, which controls the whole forecasting process by importing and checking real-time data, performing forecast calculations, and postprocessing the results into appropriate warnings and information.

Key-Words:

Hydraulic Modelling, Hydrological Modelling, Hydrograph, Flood Forecasting.

Author: **Yidnekachew Dinssa MOREDA** | Nationality: Ethiopia

Master Project Title: **2D Approach to Urban Flood Modelling**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Marc Erlich, Sogreah Consultants, Grenoble, France

Abstract:

Traditional one-dimensional backwater models are inadequate to simulate the spatial behaviour of free surface flows in urban environments and if used, require too many assumptions regarding flow diversions and potential confinement. Advances in the computational speed of computers has facilitated the reality of using two-dimensional flood routing programs to efficiently simulate these complex urban flood environments with accuracy and detail.

TELEMAC, the hydroinformatic system built and used at Electricité de France and distributed by Sogreah Consultants includes a module called Telemac-2D. For a given computational domain, given boundary conditions and a given initial condition, the two-dimensional solver computes the water depth and the depth-averaged velocity vector in the domain. The quality and accuracy of the input data and the numerical scheme determine the quality of the results. TELEMAC-2D uses finite element meshes that allow local refinements of the geometry and enable an accurate description of rivers, shores, roads and levees, etc. to be taken into account for an appropriate urban flooding cause studies so that they can be targeted for improvement.

The aim of the research is validation on the available application examples of TELEMAC-2D System for the development of a pragmatic approach, which can contribute to the preparation of flood risk management plans in urban areas using 2D hydrodynamic models. The French 'Plan Communal de Sauvegarde' (PCS), derived based on the law on modernization of the rescue services, is used to prepare a community to possible flood crisis management by creating the flood crisis management plans to the economic stakes in the urban areas. It is tried to discover to what extent the 2D modelling can contribute to the PCS preparation at the local level for flood risk management. Two application sites have been selected in the Mediterranean region of France. One of the sites is in the city of Nice, an area with high level of flood exposure and the second one is unidentified city in the same Mediterranean region of south France.

Finally, the study will give conclusion and recommendation on the effectiveness of the 2D modelling as decision support tool for flood management and also suggestions are given on the 2D Modelling for better addressing the needs of urban flood management.

Key-Words:

Flooding, TELEMAC-2D, FloodSite, Urban flood modelling.

Author: **K. Vikram Jeet Singh NOTAY** | Nationality: India

Master Thesis Title: **Development of a Density-Driven Subsurface Flow and Transport Model using a Multi-Component Formulation in an Object-Oriented Framework**

Academic Tutor: Prof. Dr.-Ing. K.-P. Holz, Prof. Dr.-Ing. Frank Molkenthin, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor: Prof. Dr.-Ing. Reinhard Hinkelmann, Dipl.-Ing. Mirko Schankat, Technical University, Berlin

Abstract:

Density-driven flow is the flow that is mainly influenced by the density differences in the fluid system. An example of such a flow may be submarine groundwater discharges where freshwater is discharged into the sea in the form of submarine springs. Discharges from such “seeps” can have considerable impact on the quality of the water in the surrounding areas. As a result there is considerable interest in modelling such phenomena. In the past many models have been developed to simulate such phenomena e.g. MUFTE-UG developed at the Technical University of Berlin, which takes a two-phase approach to model density-driven flow.

In the current study, one such attempt at developing a numerical model able to simulate density driven flow using the finite volume formulation has been made. The model has been developed within an object-oriented framework using Java 1.5/ Java 1.6. It is able to simulate one-phase two-component equation for subsurface flow, with the two components being freshwater and salt.

In addition, it is also able to simulate the Mass Balance Equation for Groundwater flow and the Transport Equation in groundwater. Such a model can be extended to be able to solve equations for more than just two components. It can also be coupled to marine reaction processes making it ideal to study those complex marine geochemical tasks.

Key-Words:

Subsurface, Density-driven, Multi-Component, Transport, Numerical Modelling, Groundwater, Java.

Author: **Gonzalo OLIVARES** | Nationality: Chile

Master Project Title: **Hydrological And hydraulic analysis in the urban catchment Riera Blanca, in Barcelona**

Academic Tutor: Prof. Manuel Gomez, Technical University of Catalonia, Barcelona, Spain

Professional/Institutional Tutor: Gustavo Ramón , CLABSA, Barcelona, Spain

Abstract:

The present project corresponds to a study of calibration and validation of a catchment located in the city of Barcelona, Spain. The catchment is called “Riera Blanca” and it has a area of 966,5 ha. It is divided in three main zones; mountain, middle zone and urban zone.

A previous modelization carried out for the catchment was rechecked and adapted for the uses of this new project. The work consisted on the recalibration and adjustment of the hydraulics and hydrological variables. Several changes were made in order to improve the modelization and to obtain better results with higher degree of reliance.

There was an exhaustive task to evaluate the performance of the discretization of the old model in order to improve the weaknesses that it had. To carry out this process all the variables required for the Runoff Model were again adjusted and detailed to improve the quality of the results. At the same time the hydraulics variables considered in the adjustment of the Pipe Flow Model were also improved to characterise the model close to the reality of the physical behaviour of the network.

The results obtained from the simulation showed that the previous calibration might be improved readjusting and giving a high degree of details to the model. Thus, the calibration process and the posterior validation were carried out with a good degree of certainty.

With the results obtained it was possible to assume and define the robustness of the model in order to design the better uses that the model might be used at.

Finally several proposal were exposed to improve the capabilities of the model to ensure its reliability in several uses related with Real Time Control, design and planification of civil works.

Key-Words:

Hydrological Modelling, Runoff Model, Pipe Flow Model, Hydraulics Parameters, Hydrological Parameters, Discretization, Catchments, Sub-catchments, Calibration, Validation, Adjustments.

Author: **Hossein REZAEI** | Nationality: Iran

Master Thesis Title: **Agent-Based Modelling of the Behaviour of Individuals in the Event of a Flood**

Academic Tutor: Prof. Enda O'Connell, Prof. Vedrana Kutija, Newcastle University, United Kingdom

Professional/Institutional Tutor:

Abstract:

Behaviour of individuals prior, during and after a flood is an important factor influencing the level of damage caused by flood event. There are different ways in which people might behave in such an event; based on several reasons such as their culture, gender, age, knowledge and experience of flood, etc. Studying of this behaviour is mainly being done through running numbers of surveying asking people what they did during the event. However, results of these types of surveys are often limited to the specific circumstances in which flood has occurred, characteristics of floodplain, properties and categorisations of people in the event, etc. Therefore, understanding and experiencing different scenarios for various flood properties, floodplain situations and individuals' characteristics would not be practically possible.

Social processes can be simulated in several ways. Mathematical simulation, cellular automata and, neural networks are amongst them. Using these methods will bring an opportunity to make simulations of different social phenomena, and then experience various scenarios based on these simulations; easier, faster, more feasible, cheaper and importantly more ethical compare to making such experiments in reality.

Agents-based modelling, as one of the leading methods of social simulation, appears very practical and useful to build models of individuals' behaviour in case of a flood, where different elements of such event (flood, its environment and people in flood) can be represented in a model individually.

In this work, in one side, floods, their (social) impacts and people in floods are discussed; and on the other side, simulation of social processes in general and agent-based modelling concept specifically are presented. Based on application of this concept, details of a model developed in this work in addition to study of its results are discussed too.

Key-Words:

Agent-Based Modelling, Flood Social Impacts, Individual's Behaviour in Flood, Social Simulation.

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Author: **Paulina Florence SHICONGO MUFETI** | Nationality: Namibia

Master Thesis Title: **Orange River Flood Wave Modeling**

Academic Tutor: Prof. Dr.-Ing. K.-P. Holz, Prof. Dr.-Ing. F. Molkenthin, Brandenburg University of Technology, Cottbus, Germany

Professional/Institutional Tutor:

Abstract:

In understanding river flood dynamics the contribution of numerical models to this field cannot be more emphasized. Numerical modelling is used as a tool to study and understand hydraulic flow behaviour, choose appropriate engineering projects and make predictions about environmental systems behaviours (Cunge, Holly & Verwey 1988). The question that remains is why? The answer is to give timely warning of these environmental systems impacts, occurrences and importance to decision makers. With increasing computer capabilities such as speed and storage space numerical models can results be present in a fast and efficient manner.

This paper explains how a hydraulic model had been constructed for flood wave simulation of the Orange River. The Orange River is one of the most important water resources in Southern Africa. It has a significant role in maintaining human livelihoods, environmental requirements and economic activities such as mining and irrigation. Water availably downstream of the river also known as the Lower Orange is controlled by releases from the Vanderkloof dam. If releases from which take 6 weeks with a discharge of 40m3/s at low flow to reach downstream end are not enough to meet the water demand or releases are very high causing flooding, it can have severe impacts on the human, environmental and economic activities downstream.

Modelling a river with such enormous length of 1400 km passing through a rough terrain with different physical characteristic, and constrains caused by topographical and hydraulic data inadequacies in terms of accuracy and availability provides many challenges to the modeller. The modeller need to understand the river dynamics and the model physical limitations.

The basic model was set up using MIKE 11 modelling software from DHI .The computational domain was chosen based on data availability. The first upstream boundary was set at Vanderkloof dam distance of 0.00 Km and the downstream boundary was set at Brandkaros distance of 13625 Km. Model was calibrated against 2006 flood hydrograph of the Orange River. Model results are represented by applying simulations consisting of time series of water level and discharges. After visual examination of the calibration results, the time shifts and peaks of the computed and measured discharge hydrographs fits reasonably with a correlation coefficient more than 0.90. Therefore it can be concluded that the model can be used as a prediction tool for flood wave propagation of the Orange River.

Key-Words:

Model, Simulation, River dynamics, Numerical model, Flow, Modeling, Flood wave, Hydrograph.

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Author: **Amphavanh SISOUVANH**	Nationality: Laos
Master Project Title: **The Role of Economics in River Basin Management Planning**	
Academic Tutor: Prof. Janos Jozsa, Dr. Istvan Ijjas, Budapest University of Technology and Economics, Budapest, Hungary Professional/Institutional Tutor: Pierre Strosser, ACTeon Innovation, Policy, Environment, Colmar, France	
Abstract:	
Key-Words:	

Author: **Siripen SONGPRASIT** | Nationality: Thailand

Master Project Title: **Potential of Flexible Mesh in 2D Surface Model Coupled with 1D Sewer System Model in Urban Flood Modelling**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Ole Mark, DHI Water & Environment, Copenhagen, Denmark

Abstract:

Urban floods cause devastating to human life and properties. In order to reduce lost and damage the flood prediction is involved in the flood warning and flood rescue process. The traditional 1D sewer system model has a potential to identify the effected area which can be use later for specifying the area of interest in more complex modelling such as 1D-2D couple modelling. Yet, it is inadequate to provide the accurate details at a specific point as the model lacks of geographical information.

On the other hand, single 2D surface model can fully represent the topography but it does not apply to the characteristics of urban area where there is an exchange of water between a sewer system and a surface. Coupled 1D sewer system model and 2D surface model is the state of the art for the urban flood modelling which can depict the exchange of water between the two systems and consequently a model is more realistic and accurate.

The current surface model is based on the implicit finite difference techniques with the variables defined on a space-staggered structured grid. Hence, all the geographical details such as building, street, roundabouts, etc will be illustrated with rectangular cells which do not represent the accurate topography and would effect the flow direction. Whereas the flexible mesh does not only demonstrate better topography but also provide more accurate flow direction, water balance and stable simulation. Moreover, the further potential of flexible mesh is that the element size can be specified according to the complexity of the area which can help refining the optimisation of the Manning's number.

The remarkable disadvantage of coupled flexible mesh modelling is that it consumes a lot of computing time and requires high computer capacity. The data that is used to interpolate bathymetry on the mesh also need to be fine enough to represent topography on the mesh accurately. Applying coupled flexible mesh modelling on an urban area would be an advantage when focusing on the specific area and taking into account all the influential parameters such as roughness parameter, mesh size, bathymetry resolution, drying/flooding/wetting depth, coupling method, computing time, etc.

Key-Words:

Urban flood modelling, Coupled Model, Flexible mesh, Triangular mesh.

Author: **Konstantin VASILYEV** | Nationality: Russia

Master Project Title: **Hydroinformatics Tools and Consultancy Projects**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr Jon Wicks, Halcrow Group Ltd, Swindon, United Kingdom

Abstract:

Hydroinformatics has brought some advantages to the performance of consultancy companies in water-related areas (acceleration of calculations when using finite difference schemes, ability to use fast computers for more precise visualization of floods, increase in precision of calculations).

On the market there are several successful and well–sold Hydroinformatics tools (MIKE water resources family, ISIS package etc). However among the numerous existing Hydroinformatics tools it may be hard to find the one that really fulfils the task required by a particular project in a consultancy company. The flow of projects in a consultancy company is unpredictable, therefore it is hard to develop or find the tool that will be suitable for all the projects that may occur in a consultancy company. Therefore, despite the availability of specialised Hydroinformatics packages, software developers are still in demand in this area. What exactly do they do?

Trying to find an answer to this question, application of such well-known tools as ISIS, Geographic Information System ArcView to Stage 2 Strategic Flood Risk Assessment (SFRA) for Broadlands region in the UK and to Modelling Uncertainty in the Flood extents project is reviewed. It was noted that both of these projects required development of additional pieces of code. In case of SFRA for the Broadlands project more functionality was added to DeltaMapper II and in case of Modelling Uncertainty Project ISIS Simulation Modification Tool was developed. Description of these tools is given in the paper.

Also, it is noted that quite often coupling of different software (1D modelling software with 2D modelling Software, groundwater with free surface water modelling software) is used in order to adjust the existing pieces of code to the needs of a consultancy company. The development of EPANET/COUP conversion tool has been used as an example of coupling that can take place.

As a result it can be said that large Hydroinformatics packages are aimed at basic repeating tasks only and there is still a need to adjust them to particular project of a consultancy company. Only through careful selection of the tools and quite often by adapting them to the task specified or development of a new tool it is possible to fulfil the task and to increase the efficiency of performance of a consultant company. Coupling plays major role in this adjustment.

Key-Words:

Hydroinformatics, Consultancy, Flood Risk Assessment, Uncertainty, Pipe networks, Climate Change.

Author: **Hong Loan VO PHUONG** | Nationality: Vietnam

Master Project Title: **Integrative Approach on Effects of Global Changes on Land-Water Exchanges**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Catherine Freissinet, Dr. Benjamin Graff, Sogreah Consultants, Grenoble, France

Abstract:

Modelling is being used extensively to assist in development of this plan. The model represents the performance of a real system through a series of equations which describe the physical processes that occur in that system. It represents a simplified version of the real world that may be used to predict the behaviour of the modelled system under various conditions;

Model will be used to simulate the potential impact of water movement on the environment and ground water sources in the Annecy lake catchment, during a 20 year meteorological condition. Analytical tools used in this analysis included hydrological process. A simplified methodology for evaluation of storage volumes to manage the surface water runoff can be combined with effective GIS data management system to help users with identification of topographical, hydrological and geographical characteristics of particular development site, MIKE 11 with hydrodynamic model, MIKE SHE model utilized in this study is an integrated (surface and groundwater flows are calculated) model.

A coupling has been developed between MIKE SHE and the MIKE 11 hydraulic modelling system for a discharge in Ire river in Annecy basin. Twenty years period were used for model calibration and validation which were based upon comparisons of observed and simulated discharge and water levels. Results suggested evaluation of the impact based on climate change and human activity in order to explore alternative climate scenarios.

The incorporation between river network in MIKE 11 and water movement under either saturated zone or unsaturated zone will be used to identify potential impacts of discharge at the outlet where connects to the lake use on climate change and human activity.

Key-Words:

Hydrology, Rainfall-runoff Modelling, Overland flow, Mike She.

Author: **Huan YIN** | Nationality: China

Master Project Title: **Breakage risk related to structural deterioration of water mains: Decision support tool for network renewal plan**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Anne-Pierre Darrées, Khaled Odeh, Suez Environment, Le Pecq, France

Abstract:

Distribution networks often account for up to 80% of the total expenditure involved in water supply systems. [Kleiner, Y.; Rajani, B.B. 2000]. It is well understood that water supply systems are deteriorating system. Water mains are exposed to different degrading elements and as a result, they may significantly degrade with time and their breakage rates increase. The deterioration of pipes may lead to structural and functional failure, such as the network hydraulic capacity decrease, water supply disruption and property damages. Indirect and social costs can be added into the total bill from pipe failure as well. Many examples are given such as the loss of industrial production, the loss of confidence in the water utility, accelerating damage to nearby infrastructure assets, contaminant intrusion into the water supply system and so on.

In order to improve the understanding of deterioration process and the evolution of water mains failure, the ability to forecast the pipe burst behaviour in water supply systems is becoming fundamental requirement of proactive planning for investment, replacement and rehabilitation strategies. A decision support tool, which can serve as a diagnostic tool and an optimisation tool coupled with an economic assessment model, becomes essential issue concerned by water utilities decision makers. PREVOIR is developed and improved by the research centre of Suez environment (CIRSEE). PREVOIR introduced a new approach to model the deterioration of buried pipes, using a Weibull survival model. This deterioration model yields the number of failures for each pipe along the desired time interval. The number of failures is then coupled with the failure consequence to obtain the failure risk. The prior pipe list can be generated based on the failure risk and a decision can be made on when to renew a deteriorated pipe, which group of pipes is relatively vulnerable and how to set up annual budget to obtain ILCC object at the end of planning period.

Key-Words:

Water mains, Pipe failure, Deterioration, Pipe breakage pattern, Renewal plan, Statistical methods.

Author: **Cheng ZHANG** | Nationality: China

Master Project Title: **2D Hydrodynamic Modelling On the Erhai Lake**

Academic Tutor: Prof. Philippe Gourbesville, University of Nice Sophia- Antipolis, France

Professional/Institutional Tutor: Dr. Claude Guilbaud, Sogreah Consultants, Grenoble, France

Abstract:

Numerical modelling is being used extensively to assist decision making. It represents real world in a simplified way that may be used to forecastthe behaviour of the modelled system under various scenarios. As a part of the Erhai Lake REA, which is essential for the World Bank loan, a numerical model is required to add the modern tool's value to the environmental assessment field.

For the purpose of building a model which is capable to predict water quality scenarios, an elementary hydrodynamic model is essential. From all the data collected for the REA model, a 2-dimension hydrodynamic model is considered to be appropriate. The Finite Element Method modelling software Telemac2D assisted with other tools from Telemac System and FUDAA platform wasapplied. Many efforts have been made on obtaining and analysis the basic data for numerical model. Computational mesh has been generated from digitized bathymetry data and boundary conditions have been simplified and estimated from reality. Other computation parameters has been modified and applied to Telemac2D and later improved step by step. Some programmed subroutines have been modified to apply source term and wind field. Numerical tracers have been applied to the model in order to enable the possibility of demonstration of advection and diffusion of plume. Solutions of results representation were made and compared in graphs and animations. The tool has shown a strong capability.

Two simulations of one month period were used for the hydrodynamic model construction. Then the model was examined although the deficiency of real data including observed discharge and water levelhas made the calibration and validation of the model incomplete. Results from the model have given reasonable reflection on reality, and enables the improvement once sufficient data could be satisfied. Water quality model would be improved from this first preliminary hydrodynamic model.

Key-Words:

2D Hydrodynamic Modelling, Lake Hydrology, FEM model, TELEMAC.

Author: **Juliana ZONENSEIN**

Nationality: Brazil

Master Thesis Title: **Flood Risk index as a flood management tool**

Academic Tutor: Prof. Manuel Gomez, Technical University of Catalonia, Barcelona, Spain

Professional/Institutional Tutor:

Abstract:

Traditionally, flood risk assessments face difficulties due to the subjective nature of the evaluation and to the inexistence of a standardized methodology, resulting in the simple determination of presence or absence of critical zones. For those reasons, the main objective of this study is the development of a risk assessment procedure that means to overcome such inconveniences. It comprises a multicriteria analysis, represented by a quantitative index, named Flood Risk Index (FRI), ranging from 0 to 100, which is able to conjugate factors related both to the flood properties and to the social-economic characteristics of the people and region affected. Once normalized, each of these factors is operated according to a relatively simple formulation, composed by weighted summations and products.

Therefore, the index constitutes a decision support tool that allows comparison between critical zones or comparison between different alternatives or scenarios for the same zone. The FRI was applied in a case study, in the region of the Joana river basin, in the city of Rio de Janeiro, using, for this purpose, a geographic information system. The results achieved are coherent with the conditions measured by the indicators that compose the index, being, moreover, sensitive to weight variations, which demonstrates its potential for practical application.

Key-Words:

Flood Risk, Index, Multi-criteria, Geographic Information Systems.