Sample PhD Thesis Editing

Civil Engineering (National Taiwan University)

- **A native-speaker of English who has studied this field** edits the English.

Abstract

In this study, a three-–dimensional hydrodynamic and –water quality modelcode was developed to simulatemodel the circulation pattern and the trophic level inof reservoirs with highly variable bathymetry in Taiwan. As rReservoirs in Taiwan are characterized withby the rapid changes in bathymetry and the transient variations of the storage volumes (i.e.; surface elevations), whichthis presents various challenges for the modelers.–

Preliminary model results obtained for the Feitsui Reservoir show that the transient variation of the storage volume iscan be reproduced by the model, aswhereby the dynamic fluctuation of the surface elevation at the dam site is replicatmimicked by the model for a two-year period (fromof 1999 to– 2000). Subsequent tests conducted usingof the codemodel include hydrothermal simulations of the reservoir –to iensure the accurate predictions reproduction –of the spatial and temporal variations of temperature in the reservoir, with particularly focus on matching the thermocline structure during the summer stratification period. Results of the temperature simulation revealshows – that there is –a stratification phenomenon occurreding during summer and early autumn in 1999 and 2000, and subsequently this –lead to anthen the overturn phenomenon happened. The hydrodynamic results derived werewill then be –used to run thedrive a water quality model.

An eutrophication model that can simulateing eight water quality parameteries iwas also developed in this study. Biological variables awere incorporated, including four groups of phytoplankton such as. They are cCyanobacteria, gGgreen aAalgae, dDdiatom, and all the others. The HHhydrodynamic and water quality simulation uses the same grids and time

Comment [CHC1]: CHECK: Are you referring to the same model? Perhaps you can make it clearer here.

steps in order to handle~~deal~~ the geometry of the reservoir. Simulation ~~R~~results ~~of model simulation~~ indicate that~~the~~ the temperature, light, and nutrient are the growth limiting factors ~~o~~for phytoplankton. A ~~N~~new temperature function shows that a bell shape equation is suitable for ~~phytoplankton~~ temperature-~~-~~limiting phytoplankton simulation. Both the field data and model simulation results also show~~ed~~ that ~~the~~ each algae has its~~heir~~ own growing period. It was found that p~~P~~hosphorus is the nutrient limiting factor ~~o~~for most phytoplanktons, except for d~~D~~diatom, which~~.~~ ~~Diatom~~ is controlled by both phosphorus and nitrogen ~~relatively~~. Lastly, the c~~C~~arbon-phosphorus-nitrogen ratio ~~o~~for the four groups of phytoplankton ~~is~~ was made distinct~~different~~ so that~~in order to emphasize~~ the interaction~~ve~~ of nutrients ~~can~~could be emphasized.~~–~~

Comment [CHC2]: CHECK: Are you referring to the complexity of the geometry of reservoir? Please clarify.

Comment [CHC3]: CHECK: Is this function developed by you or someone else? Please clarify.

Keywords: Feitsui Reservoir, eutrophication, three-~~-~~dimensional numerical model, algae dynamics.

CHAPTER 1 INTRODUCTION

1.1 Background

Reservoirs are man-made water ~~-~~bodies and are~~,~~ usually formed by constructing a dam across a flowing river. They are usually built to address one or more specific water needs,~~. These needs~~ ~~includinge~~such as augmenting municipal ~~and~~ drinking water supplies, irrigating agricultural fields~~ irrigation~~, and supplying the industry with~~ial and~~ cooling water supplies.~~,~~ Alternatively, they are also used for power generation, flood control, sports or commercial fisheries, recreation, aesthetics and~~/or~~ navigation purposes.

In contrast to flowing water, reservoirs and lakes were not given much attention~~emphasized~~ in the early years of water quality modeling. This is because~~, with the exception of large navigable systems like the Great Lake,~~ historically, they have not ~~historically~~ been the major focus of urban development, with the exception of large navigable systems ~~like~~such as the Great Lake. Starting in the 1970s, however, it was…

CHAPTER 2 –LITERATURE REVIEW

Comment [WL4]: IDEA: It might help if you were able to reference some text for the literature mentioned in this section.

In the real world, ~~three dimension~~three-dimensional~~al~~ flows can be found~~are occurring~~ everywhere. The ultimate aim of fluid dynamic stud~~y~~ies is to investigate~~produce~~ such ~~a~~ phenomen~~on~~a. With~~Because of~~ the rapid progress and development of computer science and technology, ~~the~~ simulations of such a complex flow~~real world is~~ become~~s~~ possible.~~–~~

The fundamental bases of any ~~CFD (~~Computational Fluid Dynamics (CFD)~~)~~ problem are the Navier-Stokes equations, which define any single-phase fluid flow. ~~The d~~Development of such methods in fluid computation has been progressing over the last few decades~~is lasting all the time~~. Frankel (1950) presented the first version of the successive over-relaxation (SOR) scheme for solving Laplace's equations. Early efforts at solving flows with shock waves adopted~~used~~ either the Lax approach or ~~an~~the artificial viscosity scheme introduced by von Neumann and Richtmyer (1950). Peaceman and Rachford (1955) and Douglas and Rachford (1956) then developed a new family of implicit methods for solving parabolic and elliptic equations in which the sweep directions were alternated and an ~~the allowed~~ unrestricted step size was allowed

~~unrestricted~~. Alternating direction implicit (ADI) schemes w~~as~~ere also developed (Peaceman and Rachford, 1955; Douglas and Rachford, 1956) and were extended to the

CHAPTER 4 –Results of Model Simulation

The hydrodynamic model wa~~i~~s first developed~~modified first~~. ~~In order t~~To ensure that the hydrodynamic model can provide reliable information ~~on~~regarding the physical transport processes ~~information~~ to the water quality system, two~~2~~ years of data ~~of~~ regarding the water level and temperature ~~a~~were used~~used in this model~~. ~~The w~~Water quality data obtained from the administration of Feitsui Reservoir ~~a~~were also used to calibrate~~adjust~~ the model. In addition, t~~T~~he phytoplankton biomass measured in a field survey carried out by Wu (~~Wu,~~ 2000) ~~i~~was used to verify the ecosystem model.

Comment [WL5]: IDEA: This sentence is unnecessary. Readers are aware that a model was developed. Consider removing it.

CHAPTER 5 Summary and Conclusions

5-1 Summary and Conclusions

The main purpose of this study ~~is~~ was to build a ~~three~~

~~dimensional~~three-dimensional numerical model for~~which can deal with~~ a ~~highly variable bathymetry~~ reservoir with highly variable bathymetry. An orthogonal and z-coordinate grid ~~i~~was generated as the physical domain. ~~Some~~ GIS tools ~~a~~were also used to automatically create the mesh. Continuity and~~,~~ momentum equations with hydrostatic assumptions, together with the~~and~~ equation of states were~~is~~ applied to solve the hydrodynamic transportation equations. The mass-balance equation of the water quality state variables ~~a~~were then applied to simulate~~ion~~ the concentrations of phytoplanktons, organic nitrogen, ammonium nitrogen, nitrite-nitrate nitrogen, organic phosphorus, inorganic (ortho) phosphorus, bio-chemical oxygen demand, and dissolved oxygen.

5-2~~3~~ Suggestions for Future Research

~~There are unsolved questions and i~~Improvements ~~which~~ can be ~~done~~carried out in the future ~~in order~~ to g~~et~~ain a more comprehensive in sight into ~~toward~~ the water quality and ecological system of the Feitsui Reservoir.

There are two reasons for the existence of the thermocline~~,~~: one is the increase of air temperature ~~in a period~~, and the other is the temperature

difference experienced between~~of~~ day and night. Even though~~In a matter of fact,~~ the temperature ~~in a day~~ changes with time during ~~a~~the day, ~~but~~ there is only one recorded daily value in the ~~record~~ field data. ~~In this model we o~~Only ~~consider~~ one input temperature was considered per day for this model. This is only~~Its~~ good enough to simulate the long-term thermocline caused by the increase ~~of~~in air temperature~~,~~ and ~~it would~~is ~~but~~ not ~~be~~ sufficient~~good~~ enough to simulate the temperature difference exhibited between~~of~~ the day and night. The hydrodynamic coefficient would be more reliable if the temperature data ~~are~~ were more comprehensive~~delicate~~.