Yearly Report 2008

L a b M a t h - I n d o n e s i a

Date: **15 March 2009**

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Introduction
Since the foundation of **LabMath-Indonesia** at 1st June 2005, this is the third annual report, covering the year 2008.
The mission and ambition of LMI are shortly described as follows.

Mission

LabMath-Indonesia is an independent non-commercial research institute aimed to facilitate the execution of scientific research and to disseminate the results to the community. In order to achieve the aim, LMI advocates and stimulates the use of mathematical modelling and simulation in various disciplines for real-life problems of any kind.

Ambition

In order to fulfil the mission, LMI organises various activities that can be divided into the LMI-Programme, LMI-Research and LMI-Residency.

Besides this, LMI has facilities that support the activities and that can be used on a shared basis.

All the activities will stimulate in their specific way the use of modern modelling & simulation methods. Although mathematical methodology and reasoning are the backbone, the aim is to disseminate the methods and results to students, researchers and practitioners from many disciplines; human resource development is a natural consequence of the activities. For the execution of the activities, close relations and collaboration with national and international scientists and practitioners are vital. Internationalization activities support exchange of students by providing advice and recommendations.

LabMath-Indonesia executes the activities as part of the foundation Yayasan AB, officially recognised and registered by the Ministry of Justice of the Republic of Indonesia, (Menteri Hukum dan Hak Asasi Manusia Republik Indonesia) under number C-85.HT.01.02.TH2006, Dated 9 January 2006.

This report gives account of the activities that are executed in the year 2008 to fulfil the mission and to show the results of the ambition.

Contents

I. LMI-Programme

The LMI-Programme consists of courses of various characters that are organised on a regular basis and of conferences and symposia. The topic and targeted participants will vary depending on the activity.
The LMI-Programme contributes to the mission in terms of Human Resource development, since a primary aim of most course and conference activities is to select and further develop bright young people, providing the 'brainware' for future Indonesian research activities.
In 2008, two **Research Work Shops** were organised. Each one consisted of one (advanced) course week, followed by one project week in which participants execute in the spirit of research training one of a number of projects in a small group. Best performers were awarded with continued activities and coaching for further personal development. The contents of the Research Work Shops were designed and executed by national and international lecturers, taking into account a diverse disciplinary background of targeted participants.
One **Symposium** was organised on the same topic of, and directly following, one of the RWS.
We describe these activities briefly below.

I.1. RWS *Integrated Water Resource Management*

15 - 26 January 2007, 1 week Courses and 1 week Projects (SRO: GeoMath)
Water Resource Management aspects for catchments of rivers were the topic of this RWS. Lecturers came from Indonesia (Dr. Chay Asdak UNPAD Bandung, Dr. Iwan Kridasantausa,Institut Teknologi Bandung) and the Netherlands (Dr. Martijn Booij, Univ. of Twente). In total 18 participants came from 5 institutes and 5 disciplines; see the announcement at the end of the report.

I.2. Symposium *Integrated Water Resource Management*

27 January 2007, 1 day
Following the RWS on the same topic, this symposium attracted 32 participants. The 8 invited lecturers treated a large spectrum of problems and methods; see the announcement at the end of the report.

I.3. RWS *Financial Engineering: The Mathematics of Option Pricing*

6-16 August 2007, 1 week Courses and 1 week Projects
This RWS was executed and jointly organised with UNPAR. Lecturers were from Indonesia (Dr. Ferry Jaya Permana UNPAR, Bandung) and The Netherlands (Dr. Hans van der Weide, TUDelft, and Dr. Michel Vellekoop, Univ. of Twente). In total there were 36 participants from 12 different institutions covering 8 disciplines; see the announcement at the end of the report.

I.4. Buletin Pemodelan Matematika

LabMath-Indonesia wants to promote the application and show the usefulness of mathematical modelling to a large audience, and some of the activities are directed towards secondary schools.
In previous years the initiative was taken to design 'Course Letters' (Lesbrieven), to be distributed as major part in a newly established 'Buletin Pemodelan Matematika'. In 2007 and 2008 no new bulletins appeared. In The Netherlands the contents of the course-letters was used as a start for the design of material for a new secondary school course 'Wiskunde D' on 'modelling'. It is a pity that we were up to now not able to advertise this, originally Indonesian initiative, to Indonesian secondary schools.

II. LMI-Research

LMI-Research consists for a part of strategic research that aims to develop the infrastructure to execute modelling and simulation activities in a specific application domain; design of high-level specific software may be part of that infrastructure.
LMI will actively initiate or participate in the application and the execution of scientific projects acquired from national or international organisations.
Contacts with companies or (governmental) institutions may lead to contract research projects or advisory activities in one of the application domains.
Associate scientist positions can be assigned to execute or supervise part of the research.
The description below starts with an identification of the research areas in which LMI will concentrate its activities in the foreseeable future. Then the specific projects are listed briefly; more details can be found in Annex II, and details about the research topics are described in the (separate) LMI Research PortFolio.

II.1. Strategic Research Orientations (SRO)

All activities of LMI concentrate on mathematical modelling and simulation, motivated by its extreme usefulness in many areas of human activities, in technology and in the study and understanding of nature. Hence, the activities of LabMath-Indonesia are not restricted to a single field or discipline; the emphasis is to actively promote the use of methods and knowledge from the field of (mathematical) modelling and simulation.
In (strategic) research activities, we aim to contribute to the further development of such methods and knowledge. With the almost unlimited number of application areas, a focus for strategic research is required. The focus may change and develop with time.
In 2008 the activities on geo-mathematics and engineering mathematics (including financial engineering) have been actively pursued, although in different ways. Since no activities in Operations Research and Optimization Modelling were executed or are foreseen in the near future, we will concentrate on the two mentioned areas as strategic research orientations that will be developed further.

1. **Geo-Mathematics**

Under this title we assemble activities that have nature itself as topic of research.
Most of this research is carried out by LMI as the main initiator, with the staff of LMI in leading positions.
One topic of focus is on water waves, including coastal aspects which are so vital for Indonesia: flooding of cities, coastal erosion wiping away beaches, and effects of tsunamis on the coast. Environmental water, i.e. rain water and all that happens with it after having reached the earth, has been a topic of much interest this past year, and may stay so for a longer period to come.
In the longer run we aim to have efficient and reliable simulation tools coupled to data assimilation tools, such as online registration of wind, coastal waves, rainfall, evaporation etc, and a modern data base with a layered GI (geo-informatics) system that also includes land-use, human activities and social data.

In the year 2008 we worked on 6 previously granted research projects in the area of surface waves and tsunami modelling and simulation. These projects are aimed to understand extreme water waves, to improve tsunami simulations and to make an inventory of research capacity in Integrated Coastal Zone management. Various major Indonesian university and governmental institutes are involved, and a Dutch university group.
A smaller project was executed to search the Indonesian coast for tsunami waveguiding areas. With several students we continued to develop the new Variational Boussinesq Model and code for tsunami simulations; various versions of this model are developed as the future tool for simulations in hydrodynamic laboratories and for coastal zone and tsunami simulations.
In 2008 we formulated 2 new research applications, both waiting for a decision, in the area of environmental water. In this topic, we aim to advance the mathematical modelling of the total water balance in the Indonesian region, advancing and complementary to Civil Engineering models for river catchments.

2. **Engineering Mathematics**

If the natural sciences constitute the first area from which methods and ideas in mathematical modelling and simulation have been developed, then 'engineering' is certainly the second.
In the broad area of Engineering Mathematics we aim to remain involved in specific areas. However, in view of the necessity to concentrate the limited LMI resources and the choice for geo-mathematics as main application domain, we will restrict our efforts in this direction somewhat, and concentrate on providing high-quality service.
Besides some internal research in the area of optics, LMI was supportive for research executed under the Graduate Residency scheme, dealing with various problems from tribology.
LMI also supported research in Financial Engineering through an internship - awarded for best performance - and a senior scientist position, following the successful RWS on this topic.

II.2. Projects

a. LMI played a leading role in the initiation and formulation of a project submitted in 2007 to RISTEK (Insentif Riset Dasar) and approved for execution:
Extreme Water Wave Modeling: Toward Safety of Sea Transportation
This project is a collaboration with P2MS-ITB (applicant) and University of Twente. The execution started in April 2008; despite good results in 2008, the (expected) continuation of the project is insecure.

b. A one-year UTwente-project executed at LMI in 2007
Tsunami WaveGuiding in Indonesian coastal areas
*w*as continued for the first half year of 2008. (After that, the main executer of this project, Didit Adytia, became formally a PhD student at LMI in an UT-LMI construction.)

c. LMI-research was the motivation to formulate in 2007 a research project for a Dutch NWO-AL project:
Nearshore tsunami modelling and simulations
The project has been granted; the execution started in July 2008 with the PhD-position occupied by a student who was selected to be the best participant in two previous LMI-Research Work Shops.

d. LMI submitted in 2008 a CAPaBLE (Capacity Building) APN Project:
Integrating Indonesian Capacity for Coastal Zone Management
The project was approved, and started in September 2008 for one year.

e. Ongoing LMI-research on tsunamis was the motivation to formulate in 2007 a KNAW Mobility research project:
Aspects of Tsunami Simulations
The project, a collaboration with a seismologist and tsunami-researcher of ITB, has been approved, and the execution started in July 2008, for one year. The project is executed for the major part at LMI, with senior scientists (from the project) working with young students; a RWS (in January 2009) is part of the activities.

f. In 2008 we executed two small projects for MARIN (Maritime Research Institute Netherlands) on
Inverse modelling for wave generation in hydrodynamic wave tanks.
A continuation with one more project in 2009 is assured, a second one is anticipated.

g. In November 2008 we submitted an application for a mobility project to KNAW on environmental water:
Modelling the total water balance in Indonesia
The project is a collaboration with UT Civil Engineering and UT Applied Mathematics, IPB Bogor, BMG Jakarta, and UGM Engineering Yogyakarta. At this moment it is known that the proposal has been granted for execution.

h. At the end of 2008 we initiated the design and formulation of a large research project in the WOTRO/KNAW priority area *'Agriculture beyond Food'*.
The proposal, entitled
Indonesian Environmental Water Flux Modelling,
consists of 3 PhD-projects and a half-time senior researcher, and is formally submitted by UT Civil Engineering, in collaboration with UT Mathematics and ITC in The Netherlands, and IPB Bogor and LMI in Indonesia. The proposal is supported by various Indonesian governmental institutions as stakeholders: Ministry of Environment, Ministry of Agriculture, Ministry of Research & Technology, and the Agency for Meteorology, Climatology and Geophysics.

II.3. LMI-internal Research

Part of the research executed by LMI (staff and resident-students) may not formally belong to an externally granted project, but will contribute to one of the SRO's, or prepares supportive facilities for future activities. In 2008 this concerned some activities in the area of Mathematical Optics (SRO-EngMath), and in the area of *High Performance Computing.*

II.4. Publications and Presentations

In Annex II we list the publications and presentations of work that was (partly) executed at LMI

III. LMI-Residency

Human resource development is supported by LMI in a practical way by contributing to the personal development of bright young students and the further development of senior scientists. To that end, LMI acts as host for young students, scientists and practitioners from Indonesia and abroad, thereby creating an inspiring scientific and international atmosphere.

Internships

Young Indonesian students can execute an Internship at LMI. This is a period of concentrated work on a specific subject. S1 and S2-students or graduates may work on their final project topic, or on a subject that is related to a previous RWS in which they participated and were chosen as one of the best participants. Also a period after graduation can be used as Internship to prepare for going abroad or for taking a job. During the Internships, the students get close supervision, and are trained in doing research, writing papers and giving presentations. If needed, also their English proficiency is improved.

In 2008, BSc graduates / MSc-students Didit Adytia, Aimi Abass, Gulit Widarta, Arnida Latifah, Natalia Marpaung, Hendrik, Rully Charitas, Levina Diansari, Joko Prihantono, Elsa Melfiana, Karina Aprilia, and Nikenasih Binatari, Winkausyar) worked at LMI for a total period of 88 months; some of these projects were quite successful.

International Student Visitorships

LMI stimulates international exchange by acting as host for students from abroad to execute a traineeship or (part of) a project at LMI. Also information is given to interested students from abroad about possibilities to execute such work at other places.

In 2008, two BSc students from UTwente (Rik Bulsink and Mees Beeker) executed their final project on the Indonesian Water Footprint at LMI. Together with the previous RWS on Integrated Water Resource Management, this work gave substantial motivation for the two applications in environmental water later in 2008.
The PhD-student (previously also involved in LMI) Wenny Kristina worked at LMI for a period of two months.

Graduate residency

PhD and Post-doc students can be associated to LMI to execute (part of) their work. This applies in particular when the PhD position is funded by an external (national or international) university institute where the degree will be awarded. In the case of non-university institutes and other organizations, an external supervisor will be involved to award the degree after finishing.

In 2008 Hanung worked for 3 months at LMI preparing for a DIKTI-funded PhD execution at UT, which she cancelled.
In a new construction between LMI and UT, Didit Adytia started in July as joint PhD student with formal appointment and most-time based at LMI.
In the previous construction with UT-Mechanical Engineering, a third PhD student (M. Tauviqirahman) started research in tribology, stationed at UNDIP.

IV. Internationalization

LabMath-Indonesia maintains and constantly extends contacts with Indonesian and international groups for programme activities and research. The contacts and activities make it possible to identify good young Indonesian students who want to go abroad and foreign students who want to visit Indonesia. These contacts and information about international degree-programmes and PhD positions are used to link capacity and demand from both sides.

- As part of the Internationalization activities, LMI provides services to students and staff and to universities to facilitate the bi-directional exchange of students between Indonesian and international universities and institutions. Matching of researchers for collaboration in international research projects is included.
- LMI acts as host since August 2007 of the official Info and Support Office for the University of Twente, Netherlands. This includes that LMI provides professional information about Master programmes and PhD positions for Indonesian students looking for continued education at UTwente. Active collaboration is sought with Indonesian universities for student exchange in both directions and collaboration in education and research.

V. Memberships

The aim to advocate the use of Mathematical modelling and Simulation includes the development of a network of Indonesian scientists who can interact with each other and with international partners.
This is made explicit in the Capacity Data Base under development, but also by attracting institutions and individuals as 'members' of LabMath-Indonesia.

V. Facilities

a. Data-Lab in development

Data are crucial and will become only more important with increasing technology, services etc. It is the aim of LabMath-Indonesia to develop a data base with selected elements of scientific physical data as well of socio-economic data.
Research to transform these data into useful information, for government as well as for private enterprises, could be beneficial in many respects. As a first step in this direction, the technical infrastructure will be developed for physical data; collaborations with other groups and disciplines have been explored and will be developed further.
From the research done in the student projects on the Indonesian water footprint, many data were collected related to this work: weather data, land-use, agricultural production, etc.

b. Capacity Data Base

A Capacity Data Base is under development that will eventually contain information about capacity and interests of scientific groups in Indonesia, and that can be used to match with international partners.
In 2008, as part of the APN project, a start was made to collect capacity in the area of Coastal Zone Management.

c. Supporting Staff

A temporary part-time position supports technical and computer software matters.
Administrative staff has been appointed for secretarial and financial tasks (Mira Melania); by sharing the work with similar work for other activities within Yayasan AB, it is possible to employ them in part-time positions, while at the same time they can organise their total tasks in a most optimal way.
In 2008 the staff member for internationalization was replaced on a temporary basis (by Amanda Nasution).

d. Housing

In April 2008 LMI moved office to a two times larger house in Anatomi 19.
The building of the new estate for LMI started in August 2008, and is expected to finish within one year, in summer 2009.
In 2008 lecture rooms in Bandung at P4TK-IPA and at UNPAR were used for the Research Workshops.

VI. Personnel and Associate Scientists

Since its foundation, Dr. Andonowati acts as the Director of LabMath-Indonesia.
Since March 2007 Dr. Ardhasena Sopaheluwakan is employed full-time and acts as Manager.
Since January 2008 Prof. E. van Groesen acts as Scientific Director.

For the execution of projects of LabMath-Indonesia, junior and senior scientists can be appointed as associate scientist on a temporary basis with a specific purpose.
In 2007 appointments were as senior scientists:

Dr. Wiratmaja Puja (ITB, Bandung)
Dr. Bekar Fajah TK (UNDIP, Semarang)
Dr. Jamari (UNDIP, Semarang)

and as junior scientists:

Rifky Ismail (UNDIP, Semarang)
Made Parwata (ITB, Bandung)

In 2008 additional appointments concerned: as senior scientist

Prof.dr. Sri Widiantoro, (ITB, Bandung)
Dr. Hamzah Latief (ITB, Bandung)
Dr. Ferry Permana (UNPAR, Bandung)
Dr. Ketut Wikantika (ITB, Bandung)

and as junior scientist:

M. Tauviqirahman (UNDIP, Semarang).

VII. Funding and subsidies

At this moment there is no structural funding for the activities of LabMath-Indonesia.
Execution of substantial research activities is possible only if external funding can be obtained.
Support for the execution of Research Work Shops on Financial Engineering was received from the University of Twente, Technical University of Delft, and from Universitas Parahyangan.

VIII. Outlook

In 2008 LabMath-Indonesia developed further to become a research institute that can promote and stimulate the use of Mathematical Modelling and Simulation in Indonesia. LabMath-Indonesia can link the increasingly many other areas and disciplines that use these methods to an ever increasing level of maturity and to new exciting developments in Applied Mathematics.
LabMath-Indonesia can play a role complementary to existing universities and governmental institutions, supporting new developments and interesting research problems for young Indonesian scientists in a flexible up-to-date scientific environment.
However, the lack of structural funding and the need to make the activities sustainable, led to the focussing of the main activities on problems from the natural sciences, in particular on coastal waters and environmental water.

Also in 2008 we received strong moral support from KNAW (Netherlands Academy of Arts and Sciences), and from various universities that were visited and informed about the LMI-role as part of the UTwente-information activities; more and more visitors could be welcomed at the LabMath-office.
For one research application we obtained support from various governmental institutions as stakeholders: BMKG, Ministries of Environment, Ministry of Agriculture and Ministry of Research & Technology.
Collaboration with UNPAD in 2007 and UNPAR in 2008 in executing the summer RWS adds to the picture of a slowly expanding network.

Annex I: List of LMI projects

Below is a list of seven projects in SRO GeoMathematics in which LMI has been involved during the reporting period.

1. SRO GeoMathematics

1.1

Title	**Extreme Water Wave Modeling: Toward Safety of Sea Transportation**
Short description	Climate change is expected to lead to more extreme weather conditions. This may also have as effect that water heights in the Indonesian waters become larger; ships that are designed for calmer water will experience problems and sea transportation may be disturbed. Motivated by the necessity to ensure the safety of sea transportation, research on the extreme wave phenomena has becoming more and more needed. Part of this research is to do with the modeling of extreme wave propagation. Already for several years our research is for a major part related to the study of waves on the surface of a layer of fluid, such as water waves. This has led to publications dealing with various problems that have been tackled by models of varying accuracy. In two recent S3-thesises we have reported about a striking discrepancy between the results of two often used surface wave models, namely the Boussinesq equations (B-eqns for short) and KdV-type of equations (KdV eqns for short). It turned out that wave heights in very nonlinear, extreme wavefields were correctly approximated by the B-eqns but not by the existing KdV eqns. This led us to derive a new KdV-type of equation, called the AB-equation. This AB-eqn has exact dispersion properties and is exact up to second order in the wave height. All investigations so far indicate that this AB-eqn is indeed a much better model than the usual KdV type of equations. It is the aim of this research to further investigate the validity of this AB-eqn by trying to resolve the mentioned discrepancy by showing that for extreme wave fields. This project will support efficient but accurate simulations of extreme waves by validating a recently derived AB-equation; this equation describes more accurately high waves than other known equations of KdV type. It will be shown that the mentioned discrepancy can be resolved and that for extreme wave fields the correct results using the B-eqn can also be correctly obtained by using the simpler AB-eqn. In that process we will study some aspects of large, extreme, water waves (including so-called freak, or rogue waves) from a theoretical and numerical point of view. The knowledge of extreme waves can support the generation of such waves in hydrodynamic laboratories to test ships in extreme weather conditions, and support bad-weather warnings for ships.
Funding	RISTEK (Insentif Riset Dasar)
Period	1 April– December 2008 (ended premature)
Participating groups	ITB, P2MS: Dr. Andonowati, ITB, Oceanography: Dr. N.S. Ningsih UTwente: Prof. E. van Groesen, Dr. O. Bokhove
Applicants / Supervisors	Dr. Andonowati

1.2

Title	**Tsunami WaveGuiding in Indonesian coastal areas**
Short description	This is a continuation of previous activities in 2007. In 2008, the continuation provided the opportunity to extend the design of a FEM implementation of the Variational Boussinesq model, and to simulate a specific case of Tsunami waveguiding in the Indonesian coastal waters of Lampung. The results were presented at several international conferences.
Funding	University of Twente, AAMP
Period	1 January – 31 June 2008
Participating groups	LMI: Dr. Andonowati, Didit Adytia UTwente: Prof. E. van Groesen
Applicants / Supervisors	Dr. Andonowati

1.3

Title	**Nearshore tsunami modelling and simulations**
Short description	This project aims to increase our understanding of various aspects of nearshore tsunami flows using analytical and simulation tools. In particular, we aim to significantly improve predictions of the large spatial variability of tsunami waveheights along the coast. Currently, wave height cannot be calculated accurately enough with the present-day simulation tools. Two major sources of inaccuracies will be investigated, and improvements in our numerical modelling will be validated in several case studies involving actual tsunami data. The first improvement concerns the characteristics of the waves that approach the nearshore region originating from the oceanic excitation region. To that end we will use and further develop a Variational Boussinesq Code (VBC) which fully accounts for dispersive effects and nonlinearity, while remaining computationally efficient. A second source of inaccuracies is caused by interaction of incoming waves with waves reflected from the coast. Computing the details of runup and run-down of waves on the coast is computationally very demanding, and the modelling of the physical processes is bound to be rather rudimentary. It causes, along with the use of (overly) simplified fixed wall boundary conditions, the inaccuracies in modelling reflected waves. By a detailed theoretical and numerical study of run-up and rundown characteristics of waves in their dependence on land topography and friction parameters, we will capture these boundary interactions in socalled parameterized _effective_ boundary conditions (PEBCs) to be imposed at the shoreline. These boundary conditions are of general relevance and can be implemented in any numerical program to approximate the onshore tsunami flow without the necessity to calculate the detailed flooding and drying flows. We will implement the PEBCs in the VBC and consider several specific cases of tsunami propagation in the Indonesian coastal seas. One case will deal with nearshore tsunami waveguiding; this phenomenon may cause locally large enhancement of wave heights due to transversal shallower regions. The ability of our model to capture reflection properties, possibly leading to resonances in closed seas like the Flores Sea, will be investigated. Obliquely incoming and near-tangent flows will be encountered in simulations of tsunami flow through narrow straits and around islands; these case studies will concern the Bali-Lombok region. Finally, improved simulations of flows near the shore will facilitate the capability of structural engineering calculations of wave loading of natural and man-made structures in coastal regions, thus greatly facilitating better design tools for tsunami hazard mitigation measures.

Funding	NWO-AL (Netherlands), 1 PhD-student
Period	2008 – 2011
Participating groups	UTwente: Prof. E. van Groesen, Dr. O. Bokhove; Wenny Kristina LMI: Dr. Andonowati, Didit Adytia
Applicants / Supervisors	Prof. E. van Groesen

1.4

Title	**Integrating Indonesian Capacity for Coastal Zone Management**
Short description	In May 2007 waves of 5 to 7 meter high invaded the shoreline at the south-coast of Jawa, causing casualties and coastal settlements ruined. This exceptional event illustrates the impact on the coastal areas of bad weather conditions that are likely to become custom as an effect of Global Change. This project will contribute to a better Management of Coastal Zones by building an Integrated Capacity from elements that are now isolated at Indonesian institutions. The project will identify and improve the weakest subjects and maintain the integrated capacity. Scientists from Indonesian institutions and from Japan and Netherlands will collaborate. In 2008, after the project was granted, information for the data base has been collected, and the first planned meeting took place. The project will be continued and finished in 2009.
Funding	APN
Period	1 August 2008 – July 2009
Participating groups	LMI: Dr. Andonowati, Dr. Sopaheluwakan ITB, Oceanography: Dr. N.S. Ningshi ITB, Civil Engineering: Dr. Iwan Hardaja BMG, Jakarta: Dr. Dodo Gunawan Hiroshima University, Japan: Prof. Dr. Takao Yamashita UTwente: Prof. E. van Groesen, Dr. J. Mulder
Applicants / Supervisors	Dr. Andonowati

1.5

Title	**Aspects of Tsunami Simulations**
Short description	In a previous KNAW-Mobility Project, 05MP08 'Development of a Variational Boussinesq model for tsunami simulations', supported by a STW-project, basis elements of an accurate, robust tsunami model were developed and implemented in a code with Finite Elements. In a recently granted NWO-AL project, so-called Effective Land-Sea boundary conditions (ELSBc) will be developed to be inserted in the code. In this Mobility Project, some further improvements and extensions of the code will be done as part of the following specific topics. The topics address important aspects that are not well studied yet. They are of direct relevance of tsunami-science in general and for the Indonesian situation in particular; the VBC will be a tool for these investigations. The topics were part of the previous 'ICESWA' Priority-Programme Application 05-LOI-10 to KNAW 1. Tsunami waveguiding. To explain the high variability of tsunami effects on the coast, the phenomenon of Near-coast Tsunami waveguiding has been discovered and published; in 05MP08 cases were simulated above synthetic bathymetry; in this project we will calculate cases above realistic Indonesian bathymetry. 2. Wave-generation from bottom excitations. The VBC can be easily extended to include precise bottom motions. Instead of using the most commonly used (Mansinha-Smylie 1972) method to take the bottom displacement

(instantaneously) as initial water surface elevation, we will simulate the bottom displacement accurately. The research is directed towards the question if displacements above non-flat bottoms will give rise to much more energy input (side-wards directed) into the water than the MS-approximation would provide. If this is indeed the case –as is mentioned in some literature - this will have major effects on the tsunami- generation, and therefore on simulated wave heights.

3. Selection of tsunami scenarios. For an accurate simulation of tsunamis generated by tectonic plate motions, the precise position and character of the bottom motion is essential. This information is rather well known for previous cases, but prediction of possible future cases is difficult. Using tomographic methods, we will identify the most likely places which are close to tsunami-waveguiding prone areas. This will give input of realistic scenarios for tsunami simulations.

In 2008, after granting the project, 5 internship students were attracted to prepare the projects for the RWS to be held in January 2009.

Funding	KNAW Mobility Programme 07Mb11
Period	1 August 2008 – September 2009
Participating groups	LMI: Dr. Andonowati ITB, Geophysical Group: Prof. dr. Sri Widiyantoro, ITB, Tsunami Research Group: Dr. H. Latief, UTwente: Prof. E. van Groesen, Dr. O. Bokhove
Applicants / Supervisors	Dr. Andonowati, Prof. E. van Groesen

1.6.

Title: **Modelling the Total Water Balance in Indonesia (application)**

Short description:

Indonesia faces various severe problems with water. Flooding of rivers in many areas causes great human, social and economic problems during the wet season. In the dry season, but also at several places in the wet season, there is a severe shortage of water for human consumption, industrial and agricultural use and natural vegetation.

Various causes contribute to a worsening of the situation. One is the effect of Climate Change. Projections for South-East Asia show a median warming of 2.5 °C by the end of the 21st century with little seasonal variation (Christensen et al., 2007). Precipitation in South-East Asia is likely to increase for all seasons with a median value of 6-7 % and extreme precipitation events are expected to increase as well (Cruz et al., 2007). Other causes can be attributed to various human actions, such as changes in land-use for urbanization and industrialization, changes in the type of crop growth, deforestation, and changes caused by some of the engineering measures.

All these changes can enhance flood and drought related problems. But the insight in the precise effects is still rather rudimentary and mainly qualitatively. The reason is that it is not easy to determine how and on which time scales water from precipitation influences discharges in rivers, ground water level etc. The aim of this programme is to investigate this aspect in a new way by designing a mathematical model that is complementary to models commonly used in Civil Engineering.

The model we will design will be applicable on smaller areas as well as on larger areas such as river catchments or provinces. The model should make it possible to investigate, for instance, the effects of changes in the type of crop growth on the ground water level. Specifically, the increase of the ground water level if rice production - which requires on average 3000 litres water/kg- is changed into production of cassava - which requires 400 liters water/kg; this seems particularly interesting for Java, where at many places the decrease of the ground water level endangers the availability of water for direct human

consumption and the environment.
The model to be designed will address the interplay between the various components that constitute the total water balance on different spatial scales. This is the balance between, on the one hand, the total precipitation, and on the other hand the evaporation and transpiration (evapotranspiration), the overland runoff, the groundwater flow and the river discharge. An accurate quantification of all components seems impossible since data of river discharges and groundwater flows are poorly known. However, the mathematical model we will design will provide parameter dependent transfer functions between these components, so that changes in one component (such as increased rain intensity, or changes in crop type) will show the effects on the other components (such as ground water level). The validity of the model results will be tested against available field data.
Even with approximate knowledge of the separate contributions to the water balance, the mathematical model is expected to be able to predict the effect of human and natural changes. Therefore, results of the project will contribute to understand some of the effects of Climate Change and change in agricultural productions, and may therefore become helpful for future management, policy and governance aimed at sustainable development of natural resources.

Funding	KNAW Mobility Programme
Period	Submitted November 2008; 1 August 2008 – September 2009 if granted
Participating groups	LMI: Dr. Andonowati, Dr. A. Sopaheluwakan Institut Pertanian Bogor(IPB): Prof.Dr. Hidayat Pawitan Meteorological and Geophysical Agency (BMG, Jakarta), Dr. Dodo Gunawan, UGM, Yogyakarta: Dr. Radianta Triatmadja Sultan Qaboos Univ., Oman: Dr. A. Purnama UTwente: Dr. M.J. Booij, Prof. E. van Groesen
Applicants / Supervisors	Dr. Andonowati, Dr. Booij

1.7.

Title: **Indonesian Environmental Water Flux Modelling (application)**

Short description:

Agriculture beyond Food, …exploring the potential of biomass…(AbF, 2008). Under this title the AbF programme has announced preliminary ideas. This proposal for a research cluster aims to provide scientific support and practical tools for the most basic need for any activity related to agriculture (including biomass): a sustainable policy and management of environmental water.
Environmental water and water for agricultural and human uses are of paramount importance for Indonesia. Despite the abundance of water resources, the amount of freshwater is under severe pressure, and this will likely to become worse because of effects of climate change and pollution. On the other hand, more extreme precipitation and wet spells will lead to more floods. Besides climate impacts, also human interventions such as soil management and land clearing can affect the overall water budget of an area, as is presently experienced in the EMRP area in Kalimantan.
Sustainable water management for agriculture requires a thorough understanding of the underlying water cycle processes, including the non-linear relations which exist between essential quantities such as rainfall, evapotranspiration, soil moisture and river runoff.
The aim of this research cluster is to develop new quantitative analysis tools that explicitly specify such relations in support of sustainable agricultural development of small and large regions.
One model will be developed for quantifying the full water cycle from rainfall, water storage in the soil, to river runoff flowing back in the ocean, using a local or regional balance approach. With this model it will be possible to

	investigate effects of e.g. changes in surface drainage or climate. Another model will investigate the evapotranspiration processes that play a significant role in the total water balance. More accurate spatial and temporal predictions of evapotranspiration based on weather and satellite data will be a concrete outcome that will also be used as a service to the agricultural community. Satellite data will be used and assimilated with ground data to derive rainfall and evaporation. These data will permit an improved spatial and temporal monitoring of drought and wetness states. The research will be executed by a multi-disciplinary team using state of the art methods. The main stakeholders of the project will be regularly informed about progress and their remarks will be used in this project. Among these stakeholders are the Indonesian governmental organizations BMKG (Indonesian Agency for Meteorology, Climatology and Geophysics), the Ministry of Environment (KLH) and the Ministry of Agriculture (Deptan RI).
Funding	WOTRO/KNAW programme 'Agriculture beyond food'
Period	Submitted 8 January 2009; 1 August 2009 – September 2014 if granted
Participating groups	LMI: Dr. A. Sopaheluwakan IPB: Prof.Dr. Hidayat Pawitan, Dr. Satyanto Krido, Dr. M. Ardiansyah UTwente: Dr. Booij, Prof. E. van Groesen ITC: Dr. C. Mannaerts
Applicants / Supervisors	Prof.Dr. Hidayat Pawitan, Dr. Martijn Booij

Annex II: Publications and Presentations

Below the publications and presentations are listed of research that has been executed at LabMath-Indonesia or in close collaboration with LMI.
For this information about the years 2005-2007 see the Yearly Report 2007.

II.1 Publications (in 2008)

- N. Karjanto & E. van Groesen,
  Derivation of the NLS breather solutions using displaced phase-amplitude variables, *Proceedings of the 5th SEAMS-GMU International Conference on Mathematics and its Applications 2007*, 24-27 July 2007, Yogyakarta, eds: Supama e.a.), 2008, pp. 357-368; ISBN: 978-979-95118-9-8.
- E. van Groesen, D. Adytia & Andonowati,
  Near-coast tsunami waveguiding: phenomenon and simulations, *Natural Hazards and Earth System Sciences*, **8**(2008) 175-185.

II.2 Presentations (in 2008)

- E. van Groesen, *Inverse Water Wave Modelling*, (22-07-2008) SIAM Conference on Nonlinear Waves, Rome Italy, 21-24 July 2008
- Andonowati, Mashuri, *Third order calculations for wavegroup evolutions*, (22-07-2008) SIAM Conference on Nonlinear Waves, Rome Italy, 21-24 July 2008
- E. van Groesen, D. Adytia, Andonowati, *Tsunami Waveguiding in an Indonesian Coastal Area,* (18-08-2008) 12th Asian Congress on Fluid Mechanics, 17-21 August Daejeon, South Korea
- D. Adytia, A. Sopaheluwakan, E. Van Groesen, *Tsunami Waveguiding: Phenomenon and Simulation above synthetic bathymetry and Indonesian coastal area*, International Conference on Tsunami Warning (ICTW), Bali, Indonesia, November 12-14, 2008
- E. van Groesen, *Indonesian environmental and coastal water, climate change related challenges*, (20-11-2008) First Bi-regional Science & Technology Policy Dialogue SEA-EU-Net, 19-20 November Paris, Europe
- E. van Groesen, Andonowati, D. Adytia, *Modelling and Simulation in the Coastal Zone area* (17-12-2008) 3rd AIWEST-DR 2008, TDM-RC Banda Aceh, Indonesia

Integrated Water Resource Management

7-18 January 2008, Bandung

Organised by

Laboratorium Matematika Indonesia (LabMath-Indonesia)
www.labmath-indonesia.or.id

In collaboration with
- University of Twente, Netherlands
- Institut Teknologi Bandung
- Universitas Padjadjaran, Bandung

AIM

The aim of the two-week Research Work Shop (RWS) is to provide some background of methods and ideas in Integrated Water Resource Management. For the best performing participants, this may be the start of continued research, guided by one of the lecturers of the RWS.

DESCRIPTION

Water Resources consist of the assembly of rivers, estuaries, fresh water ponds, coastal zone, etc. For a given area the total water balance is determined by perspiration (rain), evaporation, height of water table, water flow into, within and outside the area. This water balance is determined by the landuse (agriculture, urbanization), topography, man-made infrastructures like dams in rivers for energy and drainage in urban areas.
A particular situation for a given area may change because of human interventions and because of natural changes such as changing weather conditions caused by Global Change.
Water resource Management is the assembly of human decisions to influence the existing or expected situation to achieve a certain goal, such as to prevent flooding, or to divide scarce water between land-use and river flow, etc. The description of the water resources at a certain moment, and its prospective change in time is always incomplete and insecure because of lack of data or unforeseeable future developments.
For a sound management it is essential to know the effects of potential measures. For instance, decisions to prevent disasters like flooding should be based on a risk analysis of the event: the occurrence and the effects that have to be weighted according to certain criteria. When all the above mentioned factors are taken into account, one talks about *Integrated* WR Management.
This RWS will introduce aspects of the modelling of the water household and also of integrated management strategies. The modelling leads to knowledge of the effects of changes, and therefore provides decision support for integrated management.

LECTURERS

Dr.Ir. Iwan Kridasantausa, ITB, Indonesia
Dr. Chay Asdak, UNPAD, Bandung
Dr. ir. Maarten Krol, University of Twente, Netherlands
Dr. Ir. Martijn Booij, University of Twente, Netherlands

VENUE: P4TK-IPA, Jl. Diponegoro 12, Bandung 40115.

PROJECTS

A short description of the five projects is as follows.

Project 1 Citarum River

Water Resources Planning and Management play an important role especially in the field of flood control and management. The problems are related to watershed modeling when land use changes occur upstream of the potential flood plain area. As a study case we will consider the Citarum river between Bandung and Jakarta. Field research shows that socio- economic and industrial activities have grown considerably in the past decades. The consequent changes of the upstream region affect hydrological and hydraulic aspects. The over all problems are very complex and require use of many advanced techniques to consider spatial planning, river capacity due to flood management and control. Reliability analysis of the river system due to hydrological variation can be an indicator for decision makers to provide appropriate land use/spatial planning.

Projects 2&3 Model and Basin Intercomparison Project

Changes in climate and land use may have serious implications for the hydrological regime of a river basin and related flooding events and the duration of dry spells. Hydrological models are useful tools to assess impacts of these changes on hydrological regimes and hence may guide water resources planners and managers to deal with these issues. In this project, each group will analyze, develop and apply one specific hydrological model for a specific river basin. This includes drawing a system diagram for the specific model, formulation and implementation of model equations in e.g. Matlab, Excel or Fortran, calibration of the model by choosing appropriate objective functions and validation of the

calibrated model. The results of the different groups will be compared enabling a discussion about different models and their advantages and disadvantages. Moreover, different river basins can be compared to assess the influence of differences in topography, land use and geology on hydrological behaviour.

Project 4. Impacts of changes in climate and land use on flood management

Climate change and changes in land use are likely to affect the hydrology of a river basin. Consequent changes in flooding behaviour should be anticipated by water resources planners and managers. The first step in this impact assessment is the determination of the expected changes in climate and land use including uncertainty in these changes. Next, these changes should be fitted to the river basin of interest using downscaling methods and interpolation techniques. This is followed by hydrological modelling to assess impacts on hydrological behaviour of the river basin. Finally, changes in flood frequency can be assessed and possible measures defined. Some risk based and risk perception based measures are considered as well.

Project 5 Effect of logging practices on rainfall interception loss

Measurements at the Wanariset Sangai on the upper reaches of the Mentaya river, Central Kalimantan showed that evaporation of intercepted rainfall is higher in unlogged forest (11% of total gross rainfall) than in the logged forest (6%) when the number of trees per hectare is halved. In the project we will model the evaporation rate during and after rainfall with an energy balance method. We will study the model to distinguish the contributions to evaporation by advective and radiative energy, and the dependence of the proportion of these contributions on the logging activities.

Integrated Water Resource Management

(Preceded by the Research WorkShop on the same topic from 7-18 January)

19 January 2008, Bandung

Bumi Sawunggaling Hotel, Jl. Sawunggaling 13, Bandung 40116.

Lecturers

Agung Bagiawan Ibrahim, Res.Institute for Water Resources, Bandung
Chay Asdak, UNPAD, Bandung
Iwan Kridasantausa, ITB, Bandung
Jan Yap, CKNet Indonesia
Ir. Martijn Booij, University of Twente, Netherlands
Nining Sarih Ningsih, ITB Bandung
Peter Hehanussa, LIPI Bandung
Suardi Natasaputra, Dinas Pengelolaan Sumber Daya Air, Bdg

Financial support from Centre Christiaan Huygens.

Organised by

Laboratorium Matematika Indonesia
www.labmath-indonesia.or.id

SCHEDULE of the symposium
08:30 - 09:00: Registration
09:00 - 10.15: lectures
- **Implementation of IRWM in Indonesia**
  Jan Yap
- **The effects of catchment and climate change on water management in indonesia**
  Agung Bagiawan Ibrahim

10:15 - 10:45: coffee/tea
10:45 - 12:15: lectures
- **Uncertainty in climate change impacts on peak discharges**
  Martijn Booij
- **Application of a Mathematical Model to Investigate Sedimentation at the Mahakam Estuary**
  Nining Sari Ningsih
- **Presentations of project results of the preceding Research Work Shop**

12:15 - 13:30: lunch
13:30 - 15:00: lectures
- **Ecohydrology, a new approach for sustainable environment management planning**
  Peter Hehanussa
- **Watershed management strategies for flood mitigation: a case study of Jakarta's flooding**
  Chay Asdak
- **TBA**
  Iwan Kridasantausa

15:00 - 15:30: coffee/tea
15:30 - 17:00: lectures and discussion
- **Remarks and comments about the *Integrated* approach towards Water Resource Management**
  Suardi Natasaputra
- Discussion

ABSTRACTS OF LECTURES

The effects of catchment and climate change on water management in Indonesia
Agung Bagiawan Ibrahim

Water resources management is facing managerial problem, catchments and climate changes. Managerial problem can be identified such as institutional problem, working capital and maintenance, coordination among related institution, lack of accountability and the implementation of legitimate law and rules. The climate and catchments change are phenomenon that affect most of the regions in Indonesia. Drought and Floods are two extreme climate events that commonly occur in Indonesia. These events have produced serious problems to water management.

Contributions and knowledge about climate and catchments changes will enhance the feasibility to overcome the water management problems. Without any consideration of current and future climate risks properly it is impossible to achieve actualization of stable water utilization and sustainable manners for the prosperity of the whole people.
The approaches to characterize climate changes in catchments can be done by several methodologies such as the long time series of Standardized Precipitation Index (SPI), the annual maximum duration of negative SPI, and the annual maximum intensity of negative SPI. The observations of critical hydrological parameters such as run-off coefficient, ground water flow and the drought duration can also be used to identify the characterization of climate and catchment changes. The investigation of hydrological parameters on some catchments at the northern part of Central of Java Province shows that there is an increasing on SPI trend, longer drought duration, an increasing catchment drought trend, a decreasing groundwater flow, and an increasing run-off coefficient trend.
The catchments and climate changes at the dry season have caused the water shortage in most of the dams in Java and at the wet season, floods, debris flow and landslide also have caused serious problems in water management. The decrease in water level that occurred at Juanda Dam, Kedung Ombo Dam, Wonogiri Dam and others give impact to fulfilled demand of irrigation, drinking water and electricity generation. For these operational purposes, the Indonesian government had applied the Weather Modification Technology before and at the end of rainy season. The results of the WMT show that there is an increase of inflows and water levels of the reservoirs (Kedung Ombo and Wonogiri). The problem of water resources requires an integrated solution which is to integrate managerial and natural system with the availability of natural resources both quantities and qualities along with social system with resources user as dominant factor.
Therefore, In order to overcome the water management problems, water resources management should be held in integrity through holistic approach and supported by strong institutional system and involving all stake holders and also it needs some policy to reform and setup programs and researches for future development by considering climate change and climate risks.

Uncertainty in climate change impacts on peak discharges

Martijn J. Booij
Water Engineering and Management, Faculty of Engineering Technology, University of Twente, P.O. Box 217, 7500 AE Enschede, the Netherlands - m.j.booij@utwente.nl

It is crucial for flood management that information about the impacts of climate change on peak discharges and the uncertainties herein becomes available. This has been achieved by using information from different Regional Climate Models for different emission scenarios to assess the uncertainty in climate change for the Meuse River in North-western Europe. A hydrological model has been used to simulate flows for current and changed climate conditions. The uncertainty in the hydrological model is assumed to be represented by the difference between observed and simulated discharge and incorporated in the uncertainty analysis through the model parameters. Climate change results in an increase of the 100-year flood of about 30%. This increase is primarily caused by an increase of precipitation in winter. The predictive uncertainty in this impact is about 20% resulting from uncertainties in climate change (about 50%) and uncertainties in hydrological model parameters (about 50%).

Application of a Mathematical Model to Investigate Sedimentation at the Mahakam Estuary

Nining Sari Ningsih[a], Aradea R. Hakim[b], Ayi Tarya[a], and Safwan Hadi[a]
[a]*Research Group of Oceanography, Faculty of Earth Sciences and Technology, ITB,*
[b]*Laboratory of Coastal Oceanography, FITB – ITB*
E-mail: *nining@geoph.itb.ac.id*

In coastal seas including those in the Mahakam Estuary, complicated interactions exist among water motions, sediment transport and bed form changes. Both for scientific and practical reasons it is important to obtain a better understanding of these processes. The Mahakam Estuary environment has been rapidly changing because of the development of its coastal area, such as development of extensive aquaculture or fishing industry (e.g., shrimp pond culture), conversion of mangrove forest, and deforestation upstream locations. This leads to environmental damages and hazardous situations such as salinity intrusion, water shortage in dry season, flooding during the rainy season, and catastrophic beach erosion and disrupted navigation because of the excess of sediment materials. This situation has become even worse since 1998 when the economic crisis occurred in Indonesia.
A mathematical model called as ECOMSED (a coupled three-dimensional hydrodynamics and sediment transport model of HydroQual, Inc., 2002) has been applied to study sedimentation (erosion and deposition zones) at the Mahakam Estuary. This study presents a preliminary modelling of bed level changes in the estuary. An 11-month simulation of bed level changes (March 2005 – January 2006) generated by tides and river discharge variability showed qualitatively that most depositions appear around Muara Badak, Muara Berau, and Muara Bayur, whereas erosions exist mainly around Muara Jawa, Muara Pegah, Muara Kaeli, Muara Pemankaran, and Tanjung Bayur. Meanwhile, alternating zones of deposition and erosion exist around Muara Ilu and Muara Pantuan.
By carrying out further improvement on the simulation, the works carried out in this study hopefully can be used as a valuable tool for management and preservation of coastal zones and estuarine environments in dealing with various problem (e.g., human impact on the Mahakam estuary system, such as conversion of mangrove forests to shrimp pond areas and deforestation upstream locations; erosion and siltation and their implication in morphological evolution and turbidity levels; dredging and relocation of dredged material; dispersion of pollutants, implications of light extinction on biological processes; and maintenance of navigation channels and harbors)
Keywords: a coupled three-dimensional hydrodynamics and sediment transport model, Mahakam Estuary, erosion and deposition zones, bed level changes

Research Work Shop
COURSE WEEK
PROJECT WEEK

FINANCIAL ENGINEERING

THE MATHEMATICS OF RISK MANAGEMENT

4 – 15 August, 2008 Bandung

Organised jointly by

Laboratorium Matematika Indonesia
(LabMath-Indonesia)
www.labmath-indonesia.or.id

and

Universitas Katolik Parahyangan

in collaboration with

- University of Delft, the Netherlands
- University of Twente, the Netherlands

Additional financial support for books for participants is obtained from CICAT TUDelft and the Stichting Universiteitsfonds Twente

AIM AND DESCRIPTION

The aim of the two-week Research Work Shop (RWS) is to provide some background of methods and ideas in Financial Engineering. For the best performing participants, this may be the start of continued research, guided by one of the lecturers of the RWS.

This course aims to provide a thorough mathematical introduction to the modelling of financial derivatives. We start with dynamic models in discrete time for asset prices and derive the mathematical conditions that have to be used in such models to make them realistic representations of markets. Using binomial models, and the powerful concept of markets that are arbitrage-free, i.e. markets in which it is impossible to make riskless profits, we will be able to prove important results concerning the structure of such markets.

We then look at models in continuous time, and we will quickly realize that a realistic model for stock prices should lead to paths which are almost everywhere continuous but almost nowhere differentiable. The analysis of processes with this property is made possible through the use of Ito Calculus, which will be introduced in the course. It turns out that the structural properties that can be derived for the discrete time models mentioned earlier generalize to an astonishing extent in continuous time. This results in the powerful theory of risk neutral pricing, which is the cornerstone of modern mathematical finance.

To be able to use all these concepts, the last part of the course will also discuss in detail how option pricing models can be implemented in practice. The main aim of option pricing models is not to make riskless profits, or use advanced statistical techniques to profit from speculation. The aim of option markets is to provide a service which allows other parties to reduce their financial risk, in a way that is comparable to taking out insurance against possible misfortune. Option pricing theory therefore deals with more than establishing consistent pricing models. It is also essential to derive trading strategies which minimize the risk for the option trader. This leads to deep questions concerning the existence and uniqueness of certain stochastic integral representations for random variables, and financial engineering applications have thus lead to a lot of new mathematical research into such questions.

For some models there are explicit solutions which can be implemented using techniques varying from partial differential equations (such as the Black-Scholes equation) to Monte Carlo simulations under transformed probability measures. Efficient numerical implementation of these methods, and formal proofs of their convergence, form an essential part of mathematical finance and will therefore be discussed on an introductory level in this course too.

Mathematics is often extra exciting when quantitative problems in the real world require not only application of existing mathematical techniques, but the extension of these techniques due to new conditions or model assumptions which are essential for a realistic model. In this course we hope to show you how fruitful the interplay between the theory of stochastic processes and the practice of option trading has been, and to make you enthusiastic for one of the most successful applications of probability theory and functional analysis in modern times.

LECTURERS

Dr. Ferry Jaya Permana, Universitas Katolik Parahyangan, Indonesia
Dr. Hans van der Weide, University of Delft, the Netherlands
Dr. Michel Vellekoop, University of Twente, the Netherlands

PROJECTS

Project 1 : **PRICING AND HEDGING OF ASIAN OPTIONS.** We consider the pricing and hedging problem for an 'Asian option', an option with a payoff that depends on the average of certain asset price values, instead of a fixed end value. The numerical computations for this kind of options are known to be challenging, but many different and

interesting ways to attack the problem have been proposed in the literature. We will focus in particularly on the question what the speed of convergence of these different methods will be.

Project 2 : **INDONESIAN OPTIONS.** In September 2006, the Jakarta Stock Exchange (JSX) introduced the trading of options on stocks of five companies: Telekommunikasi Indonesia Tbk (TLKM), Astra, International Tbk (ASII), HM Sampoerna Tbk (HMSP), Bank Central Asia Tbk (BBCA) and Indofood Sukses Makmur Tbk (INDF). The regulations for trading in these options contain, among others, descriptions of put and call option contracts with the stock of one of the above-mentioned companies as underlying. Since these contracts are rather special, we will refer to them as Indonesian put or call option. In this project we try to find the precise regulations for Indonesian options from information that is officially published by the Jakarta Stock Exchange and use this to try to price and hedge such options.

Project 3 : **ATM FORWARD PERCENTAGE CALL SPREADS.** The ATM Forward Percentage Call Spread is a special type of call option contract in which there is only a pay-off if the price of the underlying asset at a future maturity time is higher than the price at the initial time. In this case the pay-off is 1 euro for every percent of increase of price between those times up to a certain maximum. As such, an ATM Forward Percentage Call Spread is more like a trading strategy. They are not traded on the market, but they are an example of a so-called structured product. In this project we will calculate a price and a replication strategy for an ATM Forward Percentage Call Spread. Using historical and boot-strapped data, we try to get some insight into the risk of the replication strategy.

Project 4 : **BASKET OPTIONS.** Basket options are options whose payoff depends on the value of a basket, i.e. a portfolio of assets. We will consider baskets of futures or forward contracts on different (but related) commodities that mature at the same time. Such basket options are very common in commodity markets. We assume that under the risk neutral measure the prices of the futures follow correlated Geometric Brownian Motions. In recent work, the probability distribution of the price of the basket was approximated by a generalized family of lognormal distributions. We start this project with a study of futures traded at Indonesian markets, and continue with a study of the distribution of sums of correlated lognormal distributions to test the approximation that have been proposed.

VENUE

Mathematics-Computer Laboratory & Lecture Room, FMIPA
Universitas Katolik Parahyangan, Jl. Ciumbuleuit No. 94, Bandung.