First Report 1 June 2005 – 31 December 2006

LabMath-Indonesia

Date: **15 January 2007**

Laboratorium Matematika Indonesia (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.

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Introduction

This is the first report of **LabMath-Indonesia**.
It covers a period of 19 months since the foundation at 1st June 2005 by Andonowati and E. (Brenny) van Groesen.
Next reports will be yearly, covering the previous calendar year.

In this first report we describe the aims and activities in a rather detailed way to make the mission and ambitions clear.
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 that, 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. For the execution of the activities, close relations and collaboration with national and international scientists and practitioners are vital.

LabMath-Indonesia executes the activities as part of the foundation Yayasan AB, founded 1 June 2005 by Dr. B. Kartasasmita and Prof.dr. E. van Groesen, 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 reporting period to fulfil the mission and to show the results of the ambition.

Contents

I. LMI-Programme

The LMI-Programme consists of courses of various character 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 are to select and further develop bright young people, providing the 'brainware' for future Indonesian research activities.

Advanced Courses (typically of one week duration) deal with the introduction of a specific topic at an MSc- level in the basic or natural sciences, engineering and alike.

Research Work Shops consist 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 are awarded with continued activities and coaching for further personal development.
National and international lecturers will design the contents of the Courses and Research Work Shops, taking into account a diverse disciplinary background of targeted participants.

Short courses will introduce a specific technique or software package.
Training courses can be designed in various areas, tailor made depending on demand.

National or International **conferences** and **symposia** give opportunities to discuss scientific progress in a certain field and to support the creation of linkages between people and institutions.

Course letters that show the beauty and power of mathematical reasoning and modelling are designed and distributed freely to secondary schools through the **Buletin Pemodelan Matematika**.

In the reporting period the following activities were initiated and designed by LMI, and organised and executed together with others.

I.1. Advanced Course - Workshop

23 - 27 January 2006, 1 week Workshop (SRO: GeoMath)
Tsunami modelling and development of a new Variational Boussinesq Code.
This is an activity in the KNAW-Mobility Programme between two Indonesian and one Dutch university (see Annex I.1.2).
Except for the scientist directly involved in the KNAW-project (Dr. Nining N. Sarih and Dr. Andonowati ITB, Dr. M. Nurhuda and Dr. A. Suryanto UNIBRAW, Prof. Van Groesen en Ir. G. Klopman UTwente) the workshop was open for a limited number of participants; in total 22 people participated from 10 different institutions. See Annex I for the announcement.

I.2. Research Work Shop

18-27 July 2006, 2 Week Research Workshop (SRO: GeoMath)
Math & Numerical Modelling of Geophysical flows.
This RWS was executed in collaboration with P2MS-ITB and with the universities of the lecturers: Dr. O. Bokhove and Prof. Van Groesen (UTwente, Neth), and Dr. D. Wirosoetisno (Durham, UK).
In total there were 19 participants from 9 different institutions; 5 participants were selected for awards. See Annex I for the announcement.

I.3. Symposium

10 August 2006, 1 Day Symposium (SRO: GeoMath)
Tsunami modelling and Simulations.
The Symposium, in collaboration with P2MS-ITB, consisted of 9 invited lectures and was attended by 32 participants from 9 different institutions. See Annex I for the announcement.

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.
As a first initiative it has been tried to publish an Indonesian version of the Dutch 'Zebra Boekjes'. Unfortunately, the price requested by the Dutch editor was too high to make this possible.

As an alternative the initiative was taken to design 'Course Letters' (Lesbrieven), to be distributed as major part in a newly established 'Buletin Pemodelan Matematika'. In this reporting period, four bulletins have been prepared and distributed. (See website for information and copies of the bulletin). Some of the material is also used for secondary school activities (design of new curriculum course 'Wiskunde D') in The Netherlands.

In the table below, the main information is collected; see Annex II for the first number of the Buletin.

Buletin Pemodelan Matematika

Number and title of math-topic in 'course letter'.	**Volume 1**, **No 1**, September 2005, *Wind waves and Tsunamis I* by G. Jeurnink & E. van Groesen, UTwente **Volume 1**, **No 2**, January 2006, *Coding theory: the mathematics of error correcting* by D. H. Ster, TU/Eindhoven **Volume 1**, **No 3**, June 2006, *Wind waves and Tsunamis II* by Dr. G. Jeurnink & E. van Groesen **Volume 1**, **No 4**, September 2006, *Coding theory: the mathematics of error correcting* (cont'd) by D. H. Ster
Short description	Bulletin for secondary schools, containing 'Lesbrief'/ 'Course Letter' with the topics mentioned above. The bulletin is distributed freely.
Funding	Yayasan AB
Period	Started September 2005 – continued
Participating groups	Collaboration with AAMP-UTwente, various authors in Indonesia and Netherlands
Editorial Board	Dr. Rinovia Simanjuntak (ITB), Dr. Jeurnink (UTwente), Dr. Wono Setyabudhi (ITB), Dr. Andonowati (LMI), Prof. dr. E. van Groesen (LMI).

I.5. Other activities

Some other activities in which staff from LMI was actively involved are listed below.

ICAM05
Staff of **LabMath-Indonesia** was involved in the design, organisation and execution of the International Conference on Applied Mathematics, ICAM2005. The meeting took place 21 – 26 August 2005 in Bandung, in Aula Timur at campus of ITB.
The meeting attracted almost 230 participants who contributed to the scientific part with more than 160 presentations and contributions to the proceedings. Included are 15 invited lecturers from 10 different countries.

Aceh
After the disastrous earthquake and tsunami, various contacts with (the university UNSYIAH in) Aceh has been developed to see if practical support could be given. During ICAM2005 a declaration of support was signed in the presence of the rectors of ITB and UNSYIAH. Besides that, a group of representatives from science and arts has been formed and developed a layout of a Aceh Heritage Tsunami Estate (AHTE), including a museum with components of a science museum and a 'heritage' museum to combine remembrance and information about tsunami disasters and original Aceh culture. Besides that, the estate should contain research institutes that concentrate on the natural resources of the region. Much effort has been put to realise the estate; financial and political aspects play a dominating factor.

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 project are listed which were initiated by LMI; more details can be found in Annex III.

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; the past period activities have been concentrated on the following areas which are chosen 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. Especially we will focus on coastal aspects which are so vital for Indonesia: flooding of cities, coastal erosion wiping away beaches, and effects of tsunamis on the coast.
In the longer run we aim to have efficient and reliable simulation tools coupled to a modern data base with a layered GI (geo-informatics) system that also includes land-use, human activities and social data.

In the reporting period we have been involved (and took the lead) in formulating research applications in the area of tsunami modelling and simulation (also various course activities were dedicated to this topic). These projects were aimed to make it possible to design scientific risk maps for coastal areas based on seismological research of tectonic plates and accurate simulations of resulting tsunamis with detailed run-up and flooding. Various major Indonesian university and governmental institutes were involved, and a number of Dutch university groups. Although the multi-disciplinary projects were not all successful to attract external funding, the

research consortium of the highest quality that we composed with these applications will remain available and new future applications may be more successful.
A smaller project was granted and executed; the research concerned the design of a new numerical model and code for tsunami simulations that is based on basic mathematical principles. Versions of this model will be further developed as the future tool for simulations in the Indonesian archipelago.

2. **Engineering Math for Technology**

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 Technology we will aim to be involved in specific areas. One of them is 'optics', and more generally 'nano-technology'. Using modern advanced simulation techniques, technical restrictions that exist in Indonesia on experimental and production facilities, may partly be reduced.

With that aim we were involved and took the lead in the formulation of a specific project application on bio-chemical sensors. The prospective new contacts that we build partly compensates the fact that this project was not awarded.

3. **Operations Research and Optimization Modelling**

Decision support in certain and uncertain situations can be provided by modern methods from deterministic and stochastic operations research and (robust) optimization modelling. These methodologies can be very useful for many aspects of the Indonesian society, in government, industry and for many societal aspects.
Modern math-based software makes it possible to tackle complicated problems with high dimensional models.
There is a serious lack of high-level mathematical input in the areas were these methods are already used (like industrial engineering and decision support of any kind). **LabMath-Indonesia** will strongly promote and contribute to the development of this area in the near future; several contacts with industry in the reporting period support the necessity of further dissemination.

II.2. Projects

a. LMI played a leading role in the initiation and formulation of a Mobility project submitted to KNAW (Royal Netherlands Academy of Arts and Sciences, Netherlands) in June 2005:
Development of a Variational Boussinesq Model for tsunami simulations
This project was a collaboration between University of Twente and ITB (applicants), and the University of Brawiyaja Malang.
The project was granted and executed, with the final report being made.

b. LMI played a leading role in the initiation and formulation of a project submitted to KNAW (Royal Netherlands Academy of Arts and Sciences, Netherlands) in October 2005. Grants were received to make a detailed application after successful selection of a pre-proposal (Letter of Intent),leading to an extensive project proposal:
Indonesian Coastal Effects of Seismically generated water Waves **(**ICESWA)
This project was a collaboration with University of Twente and ITB (applicants), University of Utrecht and ITC Enschede in Netherlands, and UNIBRAW Malang, UNSIYAH Aceh and BMG-Jakarta in Indonesia.
The project was not granted for execution.

c. LMI played a leading role in the initiation and formulation of a project submitted to RISTEK in May 2006:
Design and fabrication of optical bio-chemical sensors
This project was a collaboration with P2MS-ITB (applicant), physics-ITB, pharmacy Jember and MMM-Jakarta. The project was not mentioned in the published list of granted proposals, but a letter of rejection has not been received yet.

d. LMI played a leading role in the initiation and formulation of a project submitted to UNESCAP in August 2006:
Reducing Uncertainty, Preparing for the Future, in the Jawa-Bali-Lombok area
This project was a collaboration with P2MS-ITB (applicant), geophyiscs-ITB, LIPI-Bandung, LIPI-Jakarta and UTwente. The project was not granted for 'technical' reasons.

e. LMI supported the formulation of two post-doc applications to KNAW in November 2006. If granted, LMI will host the post-doc(s).

II.3. Contract Research

A small project has been executed for MARIN (Maritime Research Institute Netherlands) concerning the design of algorithms that use the logarithmic decrement method for estimating damping properties of ships from measurements.

III. LMI-Residency

To support human resource development and to create and maintain a scientific and international atmosphere, LMI will act as host to provide a home for young students, scientists and practitioners from Indonesia and abroad.

Graduate residency concerns MSc and PhD students who can execute (part of) their thesis work under guidance of LMI; national and international student exchange is included.
This contributes to the aim to support the scientific development of young students.
Although **LabMath-Indonesia** is not aiming to play a direct role in degree programmes of whatever university, good contacts with many universities exist and will be expanded.

In the reporting period one student, Sanne Smit from the University of Twente, executed her practical traineeship of almost 4 months under the umbrella of LMI at P2MS-ITB. She worked on *Tsunami modelling and simulation*, supervised by Dr. Andonowati.

Since summer 2006 plans developed (initiated by Prof.dr. D.J. Schipper, University of Twente) to host Indonesian students at LMI to work under Indonesian supervision on PhD projects that lead to a PhD-degree at UTwente.
For the moment this concerns projects in *Engineering Technology*, but in both countries there is interest to extend this construction to other areas.
Just before the end of 2006, definite contracts were made for two projects, to be supervised by associate scientists of LMI, Dr. Wiratmaja Puja (ITB) and Dr. Jamarih and Dr. Berkas Fajar (Diponegoro, Semarang); the PhD students will be formally employed as junior scientist at LMI.

IV. 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.
The names and institutes mentioned in the description of the activities (research, courses etc) show that in this first period (and partly based on previous activities) a number of groups from various disciplines have been directly involved in the activities of **LabMath-Indonesia**.

In order to give such kind of collaborations a better structure, which itself may lead to more intensified contacts, **LabMath-Indonesia** will soon start to offer the possibility to subscribe to one of the **Memberships** types listed below.

An **Institutional Membership** provides opportunities to staff and their organization to profit from the activities and from the LMI-network. Universities, (local) governments and their institutions, companies, etc can apply for membership.
The profits can consist of free admission to regular course and conference activities for a number of staff members, initial consultancy activities and the use of the existing and expanding network with various universities and companies in Indonesia and abroad. A membership can also naturally lead to some form of collaboration in human resource development or in joint project research.

Special Institutional Memberships can be designed on demand with profits determined by specific wishes of the institute.

Personal Memberships, on invitation, express support for the LMI-activities.

V. Facilities

V.1. 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; collaboration with other groups and disciplines have been explored and will be developed further.

V.2. Capacity data base in development

A **capacity data base** is under development that will contain information about capacity and interests of scientific groups in Indonesia, and that can be used to match with international partners. Most LMI-activities are therefore also aimed to make links with good groups and to try to enlarge and strengthen the network.

V.3. Supporting Staff

A temporary part-time position is available to support technical and computer software matters.
Administrative staff has been appointed for secretarial and financial tasks; 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.

V.4. Housing

Awaiting a more definite housing to be build, in the past period **LabMath-Indonesia** had its office at Cigadung.
Lecture rooms were rented for the course, workshop and symposium activities

VI. Personnel and Associate Scientists

Since its foundation, Dr. Andonowati acts as the Director of **LabMath-Indonesia.** In the reporting period this was the only formal position within the institute.

LabMath-Indonesia will employ permanent scientific staff only in exceptional cases. In 2006 arrangements have been made to employ

Dr. Ardhasena Sopaheluwakan,

starting March 2007.

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 2006 arrangements were made for the following appointments, all related to LMI Residency-activities:

Dr. Diah Chaerani (UNPAD, Bandung)
Dr. Amril Aman (IPB, Bogor)
Dr. Wiratmaja Puja (ITB, Bandung)
Dr. Bekar Fajah TK (UNDIP, Semarang)
Dr. Jamari (UNDIP, Semarang)

VII. Funding and subsidies

At this moment there is no structural funding for the activities of **LabMath-Indonesia**.
Execution of Research activities is possible only if external funding can be obtained.
For promotional activities (Buletin Pemodelan Matematika) and for the Course and Workshop activities, a substantial part of the costs has been covered by incidental subsidies from Yayasan AB.
Possibilities are being explored to find structural financial contributions.

A subsidy from the Dutch Foundation 'Mathematical Physics, Christiaan Huygens' was received to support in particular the collaboration Indonesia-Netherlands in the area of Math Modelling and Simulation.
Financial contributions for executing the Course and the Research Work Shop were received from KNAW and the University of Twente.

VIII. Outlook

This first report shows the attempts to develop **LabMath-Indonesia** into 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.

The positioning as an independent, non-commercial institute that can sustain for many years leads to the task to find structural funding for basic activities. With the construction of being part of Yayasan AB this can be overcome for the moment. Except for looking for support in the form of subsidy from external sources, application for research grants and commercialisation of research results will be part of the effort to reach sustainability.

Annex I : Announcements of LMI-Programme activities

WORKSHOP ON
TSUNAMI MODELLING &
Development of a new
VARIATIONAL BOUSSINESQ CODE

23 - 27 January 2006
INSTITUT TEKNOLOGI BANDUNG

Organised by
Laboratorium Matematika Indonesia
(LabMath-Indonesia)
in collaboration with
Pusat Pemodelan Matematika dan Simulasi (P2MS)
- Institut Teknologi Bandung

AIM

After a brief introduction in general aspects of tsunami generation and propagation, the main aim is to investigate a new 'Variational Boussinesq Method & Code' which should become a major new tool in simulating tsunamis in the Indonesian area. The theory, the numerical implementation and selection of case studies will be investigated in detail.

PROGRAMME LAY-OUT

The programme is very flexible and requires intense participation. In the mornings joint activities are scheduled: some lecturing about major aspects, literature study and discussions. The afternoons will mainly be devoted to reworking the information and starting to develop various numerical implementations. There will be occasional lectures by specialists about related topics.

PARTICIPATION

The workshop marks the start of the execution of a recently funded KNAW-Mobility Programme (SPIN II, 05MP08), with participants:

1. Dr. Nining Sari Ningsih (ITB, Bandung)
2. Dr. Andonowati (ITB, Bandung)
3. Dr. Agus Suryanto (UniBraw, Malang)
4. Dr. M. Nurhuda (UniBraw, Malang)
5. Prof. Dr. E. (Brenny) van Groesen (UTwente, Netherlands)
6. Ir. Gert Klopman (UTwente, Netherlands)
7. Dr. Onno Bokhove (UTwente, Netherlands)

They will be responsible for the detailed programme and for most of the lecturing. *Participation by others is very restricted to secure the workshop atmosphere of the meeting.*

WHO MAY APPLY

Interested students and staff will be considered for participation provided they can indicate that the topic is of direct or future interest for them. As an indication, additional participants can be:

- *Junior or senior scientists (PhD holders)* who are experienced in modelling (theory) or simulation (numerics) of tsunami and/or ocean waves.
- *Students (at least with S1)* who are interested in the topic and want to be considered for further PhD-study in this area.

HOW TO APPLY

Please write a motivation, addressing these aspects, to the address given below.
If accepted for participation, workshop material and coffee/tea and lunches will be provided free of charge. For students *additional funding may be available*.

DEADLINE FOR SUBMISSION: 9 JANUARY 2006
NOTIFICATION FOR ACCEPTANCE: 16 JANUARY 2006

Organization and application for participation:

The workshop is organised by Laboratorium Matematika Indonesia (LabMath-Indonesia) in collaboration with Pusat Pemodelan Matematika dan Simulasi (P2MS) - ITB.

All correspondence should be directed to:
admin@labmath-indonesia.or.id

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LECTURERS
Dr. Onno Bokhove, UTwente, Netherlands
Dr. Djoko Wirosoetisno, Univ. Durham, UK
Prof.dr. E. (Brenny) van Groesen, UTwente, Netherlands
Dr. Andonowati, Institut Teknologi Bandung

Research Work Shop

GEO-MATHEMATICS
MATH & NUMERICAL MODELLING OF GEOPHYSICAL FLOWS

17 - 28 July 2006
Bandung

Note the related meeting:
National Symposium on Tsunami Modelling
1 August 2006, Bandung

Organised by
Laboratorium Matematika Indonesia
LabMath-Indonesia)
www.labmath-indonesia.or.id
in collaboration with

- Pusat Pemodelan Matematika dan Simulasi (P2MS) - Institut Teknologi Bandung
- University of Twente, Netherlands
- University of Durham, UK

PARTICIPATION
Students (with S2 or Masters) and staff from governmental or private universities, and employees of companies can apply for participation.
To profit from the course, participants should have sufficient knowledge in analysis, in particular in ordinary and partial differential equations, and should be familiar with the basic ideas of fluid dynamics. Programming skills (matlab) are needed in the execution of most of the projects. The applications will be critically examined, and at most 20 participants will be allowed to participate.

DEADLINE FOR APPLICATION: 1 July 2006
NOTIFICATION OF PARTICIPATION: before 10 July 2006

FEE AND SUPPORT
For participation a fee is requested of 1.500.000 Rp. This includes the workshop material, lunch and coffee/tea during breaks.
For young students and university staff the fee may be (partly) exempted; please indicate and motivate the amount of support needed in a separate letter, added to the other application documents.

VENUE
Lecture room at Campus of ITB and the computer laboratory of P2MS.

REGISTRATION FORM
Fill out the items below and send this together with CV, updated academic record, letter of motivation and request for financial support (if applicable), to the office of LabMath-Indonesia. This form can be copied as many times as you wish.
Alternatively: provide the details below in the main part of an email, with the documents as attachment, and email to: admin@labmath-indonesia.or.id .

Name:
Position (student/lecturer Univ., other):
Address:
Research Interest:

Tel:
Fax:
E-mail:

Date:
Signature:

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

The RWS deals with large scale geophysical flow problems, such as ocean waves and transport phenomena in the ocean and the atmosphere. The applied mathematical methods that will be treated are of a general nature, hence are also applicable in many other problems in fluid dynamics, optics and other physical/technical sciences.

The introductory lectures treat the topics from a mathematical point of view; these lectures prepare for the five projects, but will also give a wider perspective. For fluid motion, we will derive the governing equations and the various approximations, including numerical schemes. We will discuss in particular ray equations and the shallow water equations (SWE), with which ocean waves, and tsunami propagation, can be modelled. Much attention will be given to flooding and drying. A unified variational point of view to these and other equations will also be presented. The basic equations for transport phenomena, such as for transport of pollutants, will be disoussed. Concepts from dynamical system theory (such as mixing and Lyapunov exponents) will be introduced and shown to be useful for the understanding of the particle motions of the pollutant.

PROJECTS
Four projects will deal with modelling of water waves, in particular investigating flooding and drying (f&d) when waves run onto the coast. One project will deal with transport phenomena.

Project 1 concerns the analytical modelling of f&d. Analytical solutions that are known in the literature will be studied, and new solutions will be sought, for example by extending existing exact solutions using asymptotics. Ryrie's model for obliquely incident waves, Hill's vortex on a beach, and waves over-topping a piecewise-linear dike.

Project 2 concerns the numerical modelling of f&d. First for SWE in one horizontal spatial dimension a numerical solution strategy from the literature has to be selected and implemented (or copied), with special attention for the f&d aspects. The numerical solutions will have to be verified against exact solutions; further experimenting should lead to improved implementations. Reference to a numerical strategy for f&d and a summary of some exact solutions: Onno Bokhove (2005), "Flooding and drying in finite-element Galerkin discretizations of shallow-water equations". Part I: One dimension. *J. Sci. Comput.* 22, 47-82.

Project 3 deals with ray methods to simulate wave propagation through inhomogeneous media when the wavelength is much smaller than the scale of the inhomogeneity. The rays satisfy a set of ordinary differential equations which, once integrated, allows us to reconstruct the wavefronts. This model will have to be implemented in a numerical scheme, with which tsunami wave propagation through a deep ocean will be investigated. Additional attention will be paid to relevant geometrical issues (such as caustics, singularities and catastrophes), depending on the interest and background of the participants.

Project 4 use the variational formulation of water waves to study one or several specific aspects. One aspect is to add dispersion into the SWE, leading to a variational Boussinesq equation. Another aspect would be to incorporate f&d into the variational structure, and or to define 'effective boundary conditions' that approximate the effects of f&d on the incoming and reflected waves at the shore line.

Project 5 will deal with transport phenomena. For a given wind field in the atmosphere (modelled by a constant east-west flow with small time-dependent perturbations), we study the dynamics of particles (eg. pollutants) in this flow. Of particular interest is the meridional (i.e. north-south) transport of particles -- one will see that in certain regimes there are "transport barriers", while in others particles can move freely. The numerical part of the project consists of integration of ordinary differential equations; we will start with the standard Runge-Kutta methods and possibly discuss symplectic (or other "geometric") algorithms at a later stage. After the participants have carried out some numerical experiments, some concepts from dynamical systems (Hamiltonian systems, ergodicity, mixing, Lyapunov exponents, KAM/Nekhoroshev theory, etc) will be discussed to help establish analytical understanding of the numerical results.

PROGRAMME LAY-OUT
During the first week general lectures will alternate with periods of working in small groups on exercises and on one of five projects that will be suggested. This project work will continue during the whole second week with close guidance by the RWS lecturers.
A special session will deal with the 'art' of grant hunting and project writing. Participants will prepare written and oral presentations of their work. Arrangements for further activities will be made if applicable.

AWARD/CONTINUATION
For at most five of the best performing participants, a continued activity will be designed. Such a continuation may consist of further study and own research investigations in a specific topic. Working on the topic will include a period of several months as guest of LabMath-Indonesia in Bandung. During these periods, and as much as possible also during other periods using email for correspondence, tutorial guidance will be provided by one of the lecturers of the RWS. When achievements are good, sooner or later the results will lead to an application for a research grant, to an international publication, and/or to a visit or following a study programme at a university abroad, whatever is possible and desired. The best performing participants will be invited and guided to write a research proposal to be submitted to (inter-) national funding agencies.

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The **Symposium on Tsunami Modelling** aims to bring together people who are interested in the theoretical modelling and numerical simulation of tsunami flows.

The lecturers will present state of the art results on topics related to the subject of the symposium. In particular, results will be presented of a KNAW Mobility Project on the design of a Variational Boussinesq Model with which accurate simulations can be performed.
The symposium takes place at the **Campus of ITB, in the Student Centre.**

Schedule:
09:30 -10:00: registration and coffee/tea

10:00 -12:00 lectures
Danny H. Natawidjaja (geotek LIPI, Jakarta)
Earthquake and Tsunami Hazards along the Sunda subduction Zone
Wahyu Triyoso (geophysics, ITB)
Seismotectonic Activity Modelling around Sunda Arc
Parlahutan Manurung (Bakosurtanal, Jakarta) *TBA*
Eko Yulianto (geotek LIPI, Bandung)
Some importance of Paleotsunami Study in Tsunami Modelling
12:00-13:00 lunch

13:00-15:00 lectures
Hamzah Latief (oceanography ITB, Bandung) *TBA*
Nining Sari Ningsih (oceanography ITB, Bandung)
Preliminary Modelling of Tsunami Flooding Around Bali-Lombok-Sumbawa Coastal Waters
Andonowati (P2MS ITB, Bandung)
The Variational Boussinesq Model
Agus Suryanto (math UNIBRAW, Malang)
A Finite Difference Scheme for Variational Boussinesq Equation
M. Nurhuda (physics UNIBRAW, Malang)
The Development of the New 1D and 2D Variational Bousinessq Code

15:00- 15:30 Break
15:30-17.30 Short Contributions by Participants and Discussion

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Symposium

Tsunami Modelling

10 August 2006
Bandung

Lecturers
Agus Suryanto (math UNIBRAW, Malang)
Andonowati (P2MS ITB, Bandung)
Danny H. Natawidjaja (geotek LIPI, Jakarta)
Eko Yulianto (geotek LIPI, Bandung)
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Wahyu Triyoso (geophysics, ITB)

Financial support from KNAW 05MP08
and Centre Christiaan Huygens

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Laboratorium Matematika Indonesia
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In collaboration with
Pusat Pemodelan Matematika dan Simulasi P2MS, ITB

Work described in the following four abstracts is a result of the execution of a **KNAW Mobility Programme (05MP08)**

The Variational Boussinesq Model

Andonowati[a] & E. (Brenny van Groesen[b]
[a]Centre for Math Modelling and Simulation (P2MS), ITB
[b]University of Twente, Netherlands, [a][b]LabMath-Indonesia

This presentation describes the basic ideas behind a new type of Boussinesq model for the modelling of surface waves. Characteristic of any Boussinesq model is that a dimension reduction is achieved by approximating in one way or another the Laplace problem for the fluid potential that describes the interior fluid motion.
The variational Boussinesq model is based on the observation that the kinematic and dynamic surface equations are in the form of a Hamiltonian system, where the canonical variables are the surface elevation and the surface fluid potential, and the Hamiltonian is the total energy. The kinetic energy part is observed to have the least value when dealing with exact interior fluid motions. Approximating this kinetic energy functional by using a certain vertical profile for the potential that is multiplied with a space dependent new variable, leads to a variational formulation for three consistent coupled equations: the two dynamic surface equations and a third elliptic equation for the additional variable. Even a simple choice for the vertical profile functions leads to a model with good dispersive properties.
As a motivation to look for accurate and efficient Boussinesq models to simulate tsunami propagation, we will illustrate the importance of dispersion in the generation phase of tsunamis, as well as in the consecutive free flow phase above bathymetry.

PRELIMINARY MODELLING OF TSUNAMI FLOODING AROUND BALI-LOMBOK-SUMBAWA COASTAL WATERS

Nining Sari Ningsih[a], Dessy Berlianty[b], M. Al Azhar[a], and Marthina D. Utami [a]
[a]Study Program of Oceanography, GM-ITB, Jl. Ganesha 10, Bandung 40132, Indonesia,
[b]Institute for Marine Research and Observation - Ministry of Marine Affairs and Fisheries

A numerical model was used to study the tsunami propagation and flooding around Bali-Lombok-Sumbawa coastal waters. The model application of tsunami propagation has been developed with the Delft3DFLOW system of WL | Delft Hydraulics, while the flooding one has been developed with 1 dimensional (1D) RUN-UP Model of Stelling (2003).
Numerous tests of simulation were carried out by using initial water displacement based on the hypocenters location of shallow earthquakes causing the sea bottom deformation. All of these hypocenters location were obtained from the US Geological Survey (USGS) and are mostly distributed along the trench. The preliminary simulated results showed that a maximum distance of the run-up occurs at Lombok coast, whereas the minimum one exists at Sumbawa coast because its slope is steeper than the Bali and Lombok coasts.

A finite difference scheme for Variational Boussinesq Equation

A. Suryanto
Mathematics Department, Brawijaya University, Malang, 65144, Indonesia

A variational Boussinesq equation which significantly improves the linear frequency-dispersion characteristics has been derived by Klopman *et al.* (2005) and van Groesen (2006) to describe surface gravity waves over mildly sloping bathymetry including time-dependent bottom. In this study, a numerical code based on this variational Boussinesq equation is developed. The method approximates the first-order spatial derivatives using high-order central difference. For the time derivatives, the fourth-order accurate Adams predictor-corrector is used. Using this code it is shown that the inflow boundary as well as the Sommerfeld transparent boundary conditions can be easily implemented. To eliminate the appearance of undesired short waves, we apply a fourth-order Shapiro filter. The proposed method is used to simulate the experiment concerning harmonic generation in nonlinear wave transformations over submerged bar.

The development of the new 1D and 2D Variational Bousinessq Code

Muhammad Nurhuda
Physics Department, Brawijaya University, Malang, 65144, Indonesia

We present the development of the new variational Bousinessq code, previously formulated by Klopman et al. for Tsunami generation and propagation in the 1D and 2D space. The code is developed using the pseudo spectral- and the finite difference method. The new variational Bousinessq code basically consists of two coupled partial differential equations and one elliptic equation. In using the pseudo spectral method, the spatial derivatives are obtained with the help of the Fast Fourier Transform (FFT), while multiplications between the variables are performed in the spatial coordinates. In order to reduce the number of operations due to multiplication in performing the convolution in the elliptic equation, we applied the bandwidth-limited convolution. In this respect, the effect of bathymetry variations is included by taking into account the spectral components around the central spectrum. This is justified since the spectral components are diagonal dominant. The finite difference method is implemented by approximating the spatial derivatives of the variables in the finite difference scheme. The elliptic equation for problem in 1D space can be easily solved using ordinary routines for sparse matrix. For 2D case, however, we have to apply the conjugate gradient method, because the matrix is not diagonal dominant. Having obtained the solution of elliptic equation, the time step propagation can be recursively performed using 2nd Runge-Kuta method for the initial stage and the predictor corrector method for the rest stages. A comparison of the results obtained by pseudo spectral and finite difference method indicates that both methods are working well. In the case of finite difference method, the accuracy and stability can be enhanced by applying higher order finite difference scheme. Special attention must be devoted when variation of the bathymetry is large, e.g. the presence of underwater mountain whose height is close to the depth of the sea. In this case, simulations using both finer spatial and temporal grids as well as spectral filter are necessary.

Annex II : First number Vol.1, No.1 of Buletin Pemodelan Matematika

LABMATH INDONESIA

BULETIN PEMODELAN MATEMATIKA

Nomor 1, Volume 1, September 2005

DAFTAR ISI

IKUTILAH KOMPETISI PEMODELAN MATEMATIKA !

Kompetisi ini terbuka bagi seluruh pelajar SMA dan diikuti secara berkelompok yang terdiri dari 2 s/d 4 orang. Setiap kelompok dipimpin oleh seorang ketua dan dapat dibimbing oleh seorang guru.

Cara mengikuti kompetisi: kirimkan jawaban kelompok anda terhadap permasalahan matematika yang ada pada setiap penerbitan. Apabila anda mengirimkan paling sedikit 2 jawaban dari 4 permasalahan yang dimuat dalam 4 nomor/edisi (per tahun), anda akan diundang ke ITB untuk mengikuti kompetisi. Jawaban anda boleh ditulis dalam bahasa Indonesia.

Kompetisi ini akan di adakan di ITB pada akhir bulan **Agustus 2006**, bekerjasama dengan Pusat Pemodelan Matematika dan Simulasi-ITB serta Jurusan Matematika, ITB.

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Pusat Pemodelan Matematika dan Simulasi (P2MS) ITB
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Sepatah kata dari redaksi

Buletin ini diterbitkan untuk menumbuhkan minat para pelajar dan guru SMA pada bidang pemodelan matematika. Model matematika sebenarnya telah dipelajari oleh para pelajar sejak mereka duduk di sekolah dasar, misalnya dalam menuangkan soal-soal cerita ke dalam perumusan matematika. Bahkan dalam kehidupan sehari-hari, misalnya ketika mengatur strategi berbelanja dengan jumlah uang terbatas, kita secara tidak sadar telah melakukan pemodelan matematika.

Model matematika adalah pengabstraksian suatu masalah nyata berdasarkan asumsi tertentu ke dalam simbol-simbol matematika. Saat ini model matematika dipandang sebagai suatu alat yang ampuh dan murah untuk mengkaji dan menyelesaikan permasalahan dari berbagai bidang baik sain, teknik, industri, maupun ilmu-ilmu sosial. Kegunaannya sangat luas, mulai dari prediksi dan mitigasi bencana sampai dengan dukungan terhadap pengambilan keputusan.

Mengingat anggaran pemerintah untuk pengembangan teknologi sangat terbatas, sedangkan laboratorium fisik memerlukan modal dan pemeliharaan yang cukup besar, pemodelan matematika dan 'laboratorium matematika' merupakan sarana strategis untuk berkontribusi pada pengembangan sain dan teknologi di Indonesia -- 'science for technology' dan 'technology for science'.

Buletin ini akan diterbitkan 4 kali dalam setahun, yaitu pada bulan September, Desember, Maret, dan Juni. Pada edisi pertama ini, diangkat suatu permasalahan nyata mengenai TSUNAMI dan GELOMBANG AIR. Topik ini akan dituangkan dalam 2 seri, yaitu pada Nomor 1 and 3, Volume 1.

Untuk menjawab tantangan globalisasi dan mengakomodasikan berbagai kontribusi internasional, permasalahan pada halaman 2 and 3 kadang-kadang dikemukakan dalam bahasa Inggris, sebagaimana pada nomor ini. Halaman 1 (berkaitan dengan informasi umum) maupun halaman 4 (berkaitan dengan petunjuk untuk guru) selalu dikemukakan dalam bahasa Indonesia. Mudah-mudahan hal ini juga akan mendorong para pembaca, khususnya pelajar dan guru SMA untuk lebih mampu bersosialisasi secara internasional.

Akhir kata redaksi mengucapkan selamat menikmati dan selamat bekerja ... kami tunggu jawaban anda!

Redaksi

KESEMPATAN TERBATAS

Anda ingin tahu apa yang dikerjakan oleh para matematikawan/wati? Pusat Pemodelan Matematika dan Simulasi, Institut Teknologi Bandung membuka kesempatan terbatas bagi para pelajar, guru SMA dan masyarakat umum untuk terlibat dan berpatisipasi secara langsung dalam aktifitas kami; misalnya bagaimana mengkoordinasi konferensi, seminar rutin, penelitian, dsb.

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Tsunami and wind waves I

Everybody will remember the devastating tsunami 2004, December 26, caused by a sudden bottom motion of tectonic plates near the west coast of Sumatra that put a huge amount of water into motion. Tsunami is a Japanese word (tsu = harbour, nami = (high) wave) for ocean waves of very great wavelength. From the past, the tsunamis near Lisbon (1755), and more recently near Chili (1960) are well-known, but they were less catastrophic. Tsunamis commonly have wave lengths of the order of tens of kilometres, so even in open oceans this wave length is large with respect to the depth of the water; besides that its speed is large. If the tsunami approaches the shallower water near the coast, the speed and wave length decrease, while the amplitude increases which can lead to the devastating results as we have witnessed recently.

津波

Box 1. **On the nature of waves**

When there are no forces like wind or uplift from bottom motions of the ocean, the surface of the water will be flat. (Here and in the following we neglect the curvature of the earth.) If we then disturb this flat surface, the surface will not remain in that static position. Indeed, everyday experience learns that the disturbance will start to flow away, to spread out. We can imagine this as if the water consists of many small water particles, that are densely packed, and which can move between each other without friction (different from sand, which can stay static in certain forms). The disturbance will cause that particles that are higher with respect to their neighbours have larger potential energy and will force its lower neighbours to move. However, since water is (practically speaking) incompressible, they can only move by pushing their neighbours. And so on. The main lesson to be learned form this is the essential role of the (presence of) gravitation, and the fact that motion of the surface does not correspond to a similar motion of the water particles. (Compare with a row of people standing in line, who successively push their neighbour in front of them: the 'push' will travel through the row, but the people stay at their place.)

That is why a gull at sea will be lifted up and down with the waves, without noticeable change in position, just as a ship that meets a tsunami. This exchange of momentum takes place almost without friction, which is why the motion will not die out (very different from the flow of very viscous syrup): the energy of the total water body, put in by the bottom motion, will practically speaking remain constant.

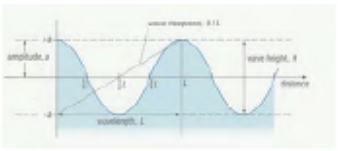
Box 2: **Simplest description of waves: the profile**

To describe a wave means that at each instant we have to describe the water surface. We can take as a reference the flat still water surface, perpendicular to the direction of gravity. If we take the direction of gravity to be the z-axis, the still water surface is a plane (at least when we assume that we neglect the curvature of the earth). Then we can introduce Cartesian coordinates x and y in this plane, and the surface elevation will be described by specifying the height at each point. We will denote this height by $z = \eta$ (η, eta, is the Greek letter 'h' that is often used in mathematics). Then the at an instant the water surface is described by $z = \eta(x, y)$.

To simplify matters in the following, we will from now on restrict to waves that are the same in one direction, say the same in the y direction, so that the surface elevation is described by a function of x only: $z = \eta(x)$; this function specifies the *profile* of the wave.

A simple example is a so-called wave train which has as profile the usual sine-function: say $\eta(x) = a\sin(kx)$ where k is a number (called the wave number), and a is the *amplitude*, and $2a$ the *wave height*.

Because of the periodicity of the sine function, this function is periodic with spatial period $L = 2\pi / k$, the wavelength. See the plot below in which the relevant quantities are illustrated.



3.1. Draw the profile for $k = 1,\ 2,$ and $5/2$. Explain why L is called the wavelength of the wave (profile).

For a tsunami, and other waves, the surface elevation is usually zero outside a bounded interval. As an example of such a 'confined' wave, we introduce just one wiggle of the sine-function, and give it for this lesson a temporary name Single Sine and notation:

$$\mathrm{Sin}(x) = \begin{cases} \sin(x) & \text{for } 0 \le x \le 2\pi \\ 0 & \text{else} \end{cases}$$

3.2. Draw this function and, on the same axis, also the functions $\mathrm{Sin}(x+1)$, $\mathrm{Sin}(x+4\pi)$.

Box 3: **Simplest description of waves: the dynamics**

As said, a *dynamic* description of waves requires us to specify the surface elevation *at each instant*. If we denote the time by t, we get a function of both time and space: $\eta = \eta(x,t)$. In the simplest case, the wave profile just translates with a fixed speed. For instance, consider the dynamics of our Single Sine wave given by

(1) $\eta(x,t) = a\mathrm{Sin}(kx - \omega t)$

At $t = 0$, we recognize the wave profile with amplitude a.

At a specific position, say at $x = 0$, this function describes the surface elevation at that position as function of time,

$$\eta(0,t) = a\mathrm{Sin}(-\omega t).$$

Here, ω (omega, the Greek letter 'w') is called the (angular) *frequency*, and $T = 2\pi / \omega$ is the (time) *period of the wave*.

3.3. Draw $\eta(0,t)$ as function of time.

3.4. Show that $c = \omega / k$ is *the speed of the wave*.

3.5. Show that we can also write $c = L / T$.

This is part I of two course letters that deal with various aspects of waves on the surface of water. In this partI we mainly deal with the most dramatic type of waves, the tsunami waves. In part II we will derive the amplitude amplification of tsunamis that approach the coast , and we will consider wind waves.
.What is actually a tsunami, or more generally, a 'wave'? How can it be that a boat in the ocean will hardly notice a tsunami, despite its large speed. Questions like this will be addressed in Box 1. We have to use, of course, properties of nature itself, namely properties of the flow of water. This information refers to the 'physics' of the phenomenon. The mathematics comes in when we describe in Boxes 2 and 3 how a simple wave can be described with mathematical formulas. The main parameters that are characteristic for waves, are the wave length, speed and amplitude, while for our purposes the (varying) depth of the ocean plays an essential role. In Box 4 we give the basic approximate relation between the speed and the depth for tsunamis, and in box 5 the interpretation of the tsunami travelling towards shallower water.

3.6. Using values for the various quantities that will be motivated in the following box, take $c = 200$ and $L = 5.10^4$. What is the time period of this wave? Draw the surface elevation at $t = 0, t = 20, t = 250$.

Box 4 Tsunami speed changing with depth

In the description in Box 3, the values of k and ω (similarly, the wavelength and wave period) can in principle be described arbitrary. However, in physical reality they are coupled by a specific functional relation. This implies also that in general the wave speed will depend on the wavelength. For waves above a flat bottom, the speed, moreover, depends on the depth of the water layer. The relation is rather awkward (See Box 3A). We will use here only a simplified version, which is valid when we consider wavelengths that are large compared to the depth. For common wind driven waves this is certainly not true on the surface of a deep ocean, but for tsunamis with long wavelengths this is true. For instance, a typical wavelength of a tsunami is 50 km, which is indeed much larger than a depth of 4000 m, which is typical for an ocean.
When we use this so-called shallow water approximation (wavelength large compared to depth), the speed is (almost) independent of the wavelength, and the dependence on the depth is then the simple expression

$$c = \sqrt{gd} \text{ with } g = 9.81 \text{ m/s}^2$$

where g is the acceleration of gravity.

4.1. Remark: We indicated the dimensions of the various physical quantities, which has several advantages. Not only can we interpret the results in their real every day appearance, but dimensions can also be used to give a simple (although not complete) check on the validity of expressions. As an example of this so-called dimension analysis, verify that the dimensions in the relation $c = \sqrt{gd}$ are the same at both sides. Argue that a formula like $c = \sqrt{g/d}$ cannot be true. Is a formula like $c = 7\sqrt{gL}$ possible?

4.2. Draw the graph of c as function of d. Fill out the columns in the table below for the speed in m/s and in km/hr for the given (and other) values of the depth.

Depth	*Speed c*		*Amplitude*	*Wavelength*
in m	In m/s	in km/hr	in m	In km
4000			2	50
1000				
200				
100				
10				
1				

Box 5: Tsunami wavelength and height changing with depth

In Box 4 we have seen how the speed of a wave depends on the depth. This gives us a simple way to predict what happens with a tsunami when it travels over large distances where the ocean depth changes, in particular when a tsunami enters the shallower coastal area.
The idea of the most simple model is that the tsunami is described at each time by the wave form (1) but that we allow the parameters entering this description, especially the amplitude and wavelength (hence k), to change with depth. The value of the frequency (the time period of the wave) remains the same:

(2) $\eta(x,t) = a(d)\,\mathrm{Sin}(k(d)x - \omega t)$

Using the relation $L = Tc(d)$ and the known behaviour of $c = c(d)$, we find $L = L(d)$, and hence $k = k(d)$.

5.1. Plot the graph of the function $L = L(d)$, and fill out the last column of the table (for which you first have to determine T with the data given in the column).

To find the growth of the amplitude of a tsunami that enters shallower water, we need another argument that is based on energy conservation. We will give the details in Part II.
Here we simply state the result, which is that the amplitude is related to the depth according to

$$a^2\sqrt{d} = \text{constant and so } a \sim 1/\sqrt{d}.$$

5.2. Use this result to draw a a as function of depth, and fill out the remaining column in the table.

Remark: Observe that the wavelength of the tsunami becomes much smaller, and the amplitude becomes very large, when the tsunami enters shallower depths. However, our simple model is not valid anymore when the depth is too small, because then bottom friction (causing decay of energy) has to be taken into account and waves may break.

Pembelajaran *SMA*[1] mengenai Tsunami

Materi mengenai Tsunami dalam buletin ini dapat disajikan dalam dua kali tatap-muka di kelas untuk siswa SMA klas 1 dan 2. Naskah ini dapat menuntun para guru SMA untuk melangkah kearah pemodelan matematika. Karateristik naskah ini adalah pembelajaran yang menekankan motivasi; bahkan ketika siswa harus memanipulasi formula yang biasanya cukup membosankan. Tri-logi pembelajaran *State, Model, and Apply (SMA)* suatu masalah nyata akan menciptakan kelas yang hidup dimana setiap siswa dilibatkan dalam masalah yang dibahas. Diskusi terjadi selama pelajaran berlangsung, solusi dibangun bersama-sama untuk permasalahan yang diungkapkan, dan guru menyiapkan diri memberikan umpan balik pada pertanyaan-pertanyaan siswa.

Mengungkapkan bencana Tsunami dalam pelajaran matematika di kelas akan mengundang perhatian setiap siswa. Bagaimana suatu gelombang yang hampir tak-terasa oleh pelaut di laut lepas menjadi gelombang raksasa yang memporak-porandakan. Dalam pemodelan ini pertama kita anggap bahwa gelombang berbentuk *sinusoidal*. Siswa ditantang untuk mengungkapkan variable-variabel mana yang akan digunakan dalam rumus. Tentu saja naskah dalam buletin ini juga mengungkapkan beberapa kesamaan-kesamaan baku dalam teori matematika. Teori yang dikembangkan tidak hanya dapat diterapkan pada Tsunami tetapi juga pada gelombang air yang disebabkan oleh angin. Inilah ciri pendekatan terhadap pembelajaran ini – satu model yang dipelajari dapat diterapkan pada berbagai masalah nyata.

Naskah ini dapat diberikan sebagai pelajaran tambahan pada jadwal mata pelajaran yang telah ada. Siswa diperkenalkan pada suatu topik matematika khusus yang menarik dan diberikan secara interaktif sebagai selingan bagi pelajaran yang rutin. Diskusi yang muncul dapat menghasilkan suatu PR yang dapat direnungkan lebih jauh.

Mengenai naskah Tsunami dalam Buletin ini.

Pelajaran dalam buletin ini merupakan contoh bagi karakteristik pemodelan dalam matematika terapan, antara lain:

- Topik yang dipilih merupakan fenomena fisik yang dikenal; beberapa relasi kuallitatif dasar dikenal dari TV atau surat kabar. Namun ada kesalah-pahaman umum mengenai perbedaan antara kecepatan pada gelombang permukaan dan partikel air. Gelombang permukaan merambat dengan cara yang berbeda dari suatu arus yang membawa keseluruhan air dengan kecepatan tertentu. Hal ini diterangkan pada Box 1.
- Ungkapan matematika dari persoalan dalam naskah ini dimulai dengan gelombang teoritis yang sederhana. Tujuannya adalah untuk mengidentifikasi berbagai besaran dan parameter yang penting, misalnya elevasi permukaan, panjang gelombang, kecepatan dan periode. Identifikasi ini penting untuk melihat hubungan antar parameter tersebut, sehingga terbangun model matematika.
- Menggambar (dengan menggunakan tangan, yang bisa dilanjutkan dengan menggunakan software tertentu) sangat penting untuk mengenali/memahami deskripsi matematika dan mengembangkan ide.
- Siswa barangkali mengalami kesulitan, khususnya mengenai argumentasi fisis dan matematis yang saling terkait (hal penting dalam pemodelan matematika), dan penggunaan berbagai metoda matematika.

Validitas dari model. Meskipun model yang terbangun sangat sederhana, namun model ini tidak terlalu jelek. Bentuk gelombang yang berupa fungsi sinus seringkali merupakan gambaran yang cukup realistis apabila sebuah lempengan tektonik bergerak ke atas sedangkan sebuah yang lain bergerak ke bawah. Parameter yang digunakan di sini, panjang gelombang dari tsunami, dan kedalaman laut cukup realistis. Keterbatasan cukup serius dalam model sederhana ini adalah gerak gelombang yang hanya satu arah. Pada kenyataannya gelombang menjalar ke segenap arah (perhatikan ketika anda melempar batu ke dalam air), dan gelombang akan meluruh karena jumlah energi yang ada dibagikan pada gelombang-gelombang yang puncak-puncaknya membentuk lingkaran dengan jari-jari yang makin membesar (konservasi energi!).

Naskah mengenai Tsunami dalam buletin ini disiapkan oleh Gerard Jeurnink dan Brenny van Groesen, Department of Applied Mathematics, University of Twente, Belanda. Kirimkan tanggapan, komentar, pertanyaaan mengenai tata letak maupun isi buletin ini kepada Dewan Redaksi atau pengarang g.a.mjeurnink@math.utwente.nl dan groesen@math.utwente.nl. Masukan dari anda akan sangat bermanfaat dan berharga dalam perbaikan buletin ini. Buletin, materi penunjang, foto, gambar, maupun presentasi untuk demonstrasi dapat didownload cuma-cuma dari www.labmath-indonesia.or.id/buletin-mm .

Kami mengundang para pembaca untuk mengirimkan naskah berisi permasalahan matematika yang berasal dari masalah nyata untuk dimuat di buletin ini. Contoh penulisan naskah dapat dilihat pada halaman 2 dan 3 di buletin ini. Naskah yang dimuat akan memperoleh imbalan sebesar Rp. 100.000,- dan 25 kopi buletin. Kirimkan naskah versi elektronik anda melalui email admin@labmath-indonesia.or.id

Kirimkan jawaban, saran-saran anda ke
admin@labmath-indonesia.or.id atau ke
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[1] SMA = State, Model, and Apply memiliki pengertian Ungkapkan, Modelkan, dan Terapkan.

Annex III : List of LMI projects

Below is a list of projects in which LMI has been involved during the reporting period. Three projects are in the SRO GeoMathematics and one in the SRO Engineering Math for Technology; one is a Contract Research Project.

1. SRO GeoMathematics

1.1

Title	**Preparation ICESWA:** **Indonesian Coastal Effects of Seismically generated water Waves**
Short description	A pre-proposal was submitted in April 2005. Out of a total of 36 pre-prosals, the submitted pre-proposal was selected in May 2005 to be extended to a full application. The full application contained 8 closely related project-topics; in total 10 PhD projects were formulated, to be executed (mainly) in The Netherlands (4) or in Indonesia (6). Several joint activities and facilities were proposed (among which a data-lab and GPS-stations). From the summary: … The scientific results of the programme will consist of improved insight in the long and short term deformation of the lithosphere (the plates and in particular the plate boundaries), in the identification and characterization of tsunami-generating earthquakes, in the excitation process of tsunamis and flow in closed sea waters, and in the design of robust risk assessment that combines fluid simulation models in a dynamic GI System. Other concrete deliverables will be a variety of modern improved simulation techniques for direct and inverse seismic and water wave propagation and improved methods for data analysis. Direct applicability of the research includes aspects of tsunami early warning, such as the possible detection with GPS of earthquakes by precursor motions. A major contribution to tsunami preparedness will be the capability to design reliable risk maps in a decision support environment that can be used for safer coastal management. To support this, a centre for GIS-data will be established that will serve as an example how an extended GIS (Geo Information System) data base can be organised and managed on a fully Indonesian scale, a necessity for the future design of risk maps for other coastal areas. … The full application was submitted October 2005, for a total amount of 1.618.200 € for four years. In January 2006 the selection committee decided that out of 11 ('excellent') full applications, 4 were selected for funding; ICESWA was rejected for funding.
Funding	KNAW priority programme (for preparing full application) € 32.500
Period	May - October 2005
Participating groups	ITB, P2MS: Andonowati ITB, Oceanography: Dr. Nining Sarih Ningsih, Dr. Hamzah Latief. ITB, Geophysics and Meteorology: Dr. Sri Widiyantoro. ITB, Geodesy, Dr. Hasanuddin Z. Abidin UniBraw Malang: Dr. Agus Suryanto, Dr. M. Nurhuda UNSIAH Aceh, Marine Sciences: Prof. Syamsul Rizal BMG, Meteorological and Geophysical Agency, Jakarta: Dr. Fauzi Bakosurtanal: Dr. Parluhutan Manurung

Applicants/ Supervisors	LIPI: Prof. J. Sopaheluwakan, Dr. Danny H. Natawidjaja TUD, Applied Math: Prof. A. Heemink TUD, Environmental Science: Prof. G. Stelling, Dr. Pietrzak TUD, Satelite Dynamics : Prof. Ambrosius, Dr. Schrama, U. Utrecht, Earth Sciences: Prof. W. Wortel, Prof. Spakman UTwente, Applied Math: Prof. van Groesen, Dr. O. Bokhove, Ir. Klopman ITC: Prof. Stein, Dr. W. Bijker Prof. Van Groesen, Dr. Andonowati

1.2

Title	**RUPTURE JBL:** **Reducing Uncertainty, Preparing for the Future, in the Jawa-Bali-Lombok area**
Short description	The application contained 3 components: scientific seismological and tsunami investigations , tsunami-hazard awareness, and a multi-purpose international meeting. From the summary: For the land area addressed in this project, the Jawa – Bali - Lombok area, there is not yet an adequate active overall fault map. Similarly, the Jawa Trench is an ocean subduction zone that is largely unknown. For these reasons the seismic hazard and tsunami hazard are unknown, making it impossible to calculate reliable earth quake or tsunami risks. The knowledge part of the project aims to reduce this present uncertainty by increasing the seismological knowledge and by simulations of tsunami scenarios with calculations of run-up and flooding. A data base with pre-calculated tsunami events (most coasts in this area is affected within an hour after a subduction earth quake) will become available to be used by the Indonesian agency BMG that is responsible for Tsunami Early Warnings to warn the local governments in the JBL area in case of earth quakes. Both BMG, Bakosurtanal, BPPT, and indirectly the local authorities and the general public, are target groups for this project component. A second component of the project will develop a Multi-Level approach for a large target group for 'awareness'. This target group consists in the initial phase of 5000 secondary school pupils who will be taught by 20 university students about earth quake and tsunami hazards. These school pupils will act as agents who will inform in a natural way their social neighbourhood (family, friends, etc) about awareness issues, thereby enlarging the target group substantially. This approach will be cost-effective, and can be up-scaled after having evaluated the results of this project. The link between these components of the project is provided by the scientists who will design (together with didactic experts) the material for the secondary school pupils and who will train the students who will teach the pupils. A Regional Multi-Meeting will be organised to disseminate the scientific knowledge and the Multi-Level Awareness approach. This meeting will also include a 3 day Tutorial session to contribute to capacity building in natural hazards. This meeting will stress the relevance of the activities for other SEA-countries, in particular Thailand and Malaysia who are most vulnerable for tsunami hazards. The application was submitted August 2006. In December 2006 we were informed that the application was not awarded because of 'technical reasons'.

Funding requested	UNITED NATIONS ESCAP, Multi-donor Voluntary Trust Fund on Tsunami Early Warning Arrangements in the Indian Ocean and Southeast Asia; total requested contribution: 459.470 USD for one year.
Participating groups	ITB, P2MS: Andonowati (applicant) ITB, Oceanography: Dr. Nining Sarih Ningsih, Dr. Hamzah Latief ITB, Geophysics and Meteorology: Dr. Sri Widiyantoro, Dr. Wahyu Triyoso ITB-math: Dumaria, Sumanto LIPI-Bandung: Dr. Hery Harjono, Dr. Danny H. Natawidjaja, Eko Yulianto LIPI-Jakarta: Prof. J. Sopaheluwakan, Deny Hidayati UTwente, Appl Math: Prof. van Groesen, Dr. Bokhove, Dr. Jeurnink, Ir. Klopman LMI: A. Sopaheluwakan
Applicants	Prof. Van Groesen, Dr. Andonowati

1.3

Title	**Development of a Variational Boussinesq Model for tsunami simulations**
Short description	Using a recently derived new variational Boussinesq model, this project aims to design various numerical implementations with the aid of which tsunami calculations can be performed. Effects of bottom excitation by tectonic plate motions and flow from deep ocean to coastal area and run-up should become possible with these codes.
Funding	KNAW Mobility Programme 05MP-08, € 32.200
Period	1 Jan 2006- continuing (March 2007)
Participating groups	ITB, P2MS: Dr. Andonowati, ITB, Oceanography: Dr. Nining Sarih Ningsih UniBraw: Dr. Agus Suryanto, Dr. M. Nurhuda UTwente: Prof. E. van Groesen, Dr. O. Bokhove, Ir. G.Klopman U Sussex, UK: Dr. Djoko Wirosoetisno
Applicants / Supervisors	Prof. Van Groesen, Dr. Andonowati

2. SRO Engineering Math for Technology

Title	**Design and fabrication of optical bio-chemical sensors**
Short description	From the summary: This project brings together expertise in design and fabrication of optical devices with expertise in chemistry to jointly produce optical chemical and bio-sensors. Applications of such sensors will be in various areas, such as health/medicine, agriculture/bio-technology and defence, depending on the sensing layer to be used. In this project we will restrict to applications in the area of Health and Pharmacy. … While the project focuses on the design and fabrication of optical bio-chemical sensors, the execution will show the potential of further future activities, with respect to resulting products, to formation of "brain-ware" and networks, as well as to multi-disciplinary collaboration. …
Funding requested	RISTEK application, Rp. 875,400,000 for 3 years.
Period	Submitted 19 June 2006. No information about rejection has been received yet, but the project was not mentioned in a list of granted project published by RISTEK.

Participating groups	LMI : A. Sopaheluwakan, Dr. H. Uranus Maju Makmur Mandiri Foundation, Jakarta : Dr. Koo Hendrik Kurniawan ITB, P2MS, Andonowati ITB, Physics Photonics Goup : Dr. Iskandar, Dr. Rahmat Univ. Of Jember, Pharmacy : Dr. B. Kuswandi UTwente-math: Van Groesen, Dr. Stoffer UTwente, Integrated Optical Micro Systems: Dr. Hoekstra
Applicant	Dr. Andonowati

3. Contract Research Project

Title	**Estimates of damping coefficients from Measurements of moored ships in irregular waves**
Short description	From the Confidential Technical Report LMIC_06/01 (August 2006) *Task:* Develop algorithms to estimate the damping coefficient from a given time series, using a method called 'logarithmic decrement method', and illustrate the results of the algorithms for a number of specified time series. *Result:* *The Least Square Method and the Logarithmic Decrement Method seem both to be able to estimate the natural frequency and the damping coefficient of moored ships in irregular waves, provided that the motion is described by a second order linear differential equation with white noise process as source. The estimations obtained with the two methods differ only slightly for the given time series.* Estimates of natural frequency and damping coefficient are produced for all 30 given time series.
Funding	MARIN (Maritime Research Institute Netheralnds)
Period	June – August 2006
Supervisors	Prof. Van Groesen, Dr. Andonowati