# Yearly Report 2011

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

**Date:** **11 February 2012**

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**Introduction**
Since the foundation of **LabMath-Indonesia** at 1st June 2005, this is the sixth annual report, covering the year 2011.
The mission and ambition of LMI are shortly described as follows.

**Mission**

*LabMath-Indonesia is an independent non-profit 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 2011 to fulfil the mission and to show the results of the ambition.**
**In most sections, small italic text describes the main underlying ideas, while the regular text concentrates on the 2011 activities.**

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 2011 for the first time an Open Research House was organized, as described below.

### I.1. Open Research House on Coastal Wave Modelling & Simulation,

Month of January 2011

During the whole month January 2011, the aim of the ORH was to provide a pleasant, informal atmosphere in which a mix of young and experienced scientists can communicate with colleague researchers on topics of mutual interest. Although participation is open for all nationalities, this first ORH was especially directed to participants from the ***South-East Asian region***.
Topics for discussion and collaboration can be proposed by the participants. To give some specification of the area of interest, a few test cases have been made available; participants are invited to formulate and share their own test cases or problems to others. Shared interest should lead to ample opportunities for interesting discussions, lectures (series) or demonstrations, the format varying depending on topic and preference.
The period of participation was left as choice: Individuals, or small groups with a mix of young and experienced researchers, can choose the period of participation (the whole month or any part of it) themselves. Proven interest in development or use of standard (commercial) software for relevant problems was required. Depending on interest, and in communication with the participants prior to the meeting, specific *topic-periods* could be formed.

The invitation to participate was directed to Indonesian scientists and students, but was also distributed to neighbouring countries. One 2-week course activity was organized as a 'concentrated' activity. In total 23 people listened to a series of (interactive) lectures by 4 main lecturers: Guus Stelling, Gerbrant van Vledder, Didit Adytia and Brenny van Groesen, and to lectures of most of the other participants. See for more information the website:
www.labmath-indonesia.org/events.

## 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 I, and details about the research topics are described in a (separate) LMI Research PortFolio that is updated regularly:*
*(http://www.labmath-indonesia.org/ResearchPortFolio/).*

### 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 2011 the activities on geo-mathematics have been actively pursued, especially in further developing our own wave simulation codes.

*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 2011 we continued and finished the KNAW mobility project ***Accurate Coastal Wave Modelling and Simulation*;** the Open House described above in I.1 was part of the activities in that project.
We continued with the KNAW post-doc project ***High resolution time-dynamic wave simulations of Tanjung Priok Harbour*.**

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, and concentrate on providing high-quality research and service.*
LMI was supportive for research executed under the Graduate Residency scheme, dealing with various problems from tribology.

## II.2. Projects

*a.* A 1-year mobility project to KNAW, submitted in September 2009 started in summer 2010 and finished October 2011: *Accurate Coastal Wave Modelling and Simulation (09-MP-06)*
The project is executed jointly with ITB staff-members Prof. Dr. Safwan Hadi and Dr. Nining Sarih Ningshi.

*b.* The 2-year KNAW Post-Doc application for Dr. Wiwin Windupranata (part-time researcher at LMI) started in August 2010: *High resolution time-dynamic wave simulations of Tanjung Priok Harbour, Jakarta (09-PD-05)*. In August 2011 a progress report was submitted and the project continued for another year.

## II.3. Publications and Presentations

See Annex II.

# 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 2011 Dwi Fajar Saputri (for 2 months), Meirita Ramdhani (for the full year) continued working at LMI. New students were Ramdan Ririnama, Zulkarnain, Ruddy Kurnia, Amanda Putri, Mourice Woran. In total 36 months. Ruddy was selected to continue for PhD at UT, starting February 2012.

- **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 2011, one BSc student from UTwente working on environmental water (Erwin Vonk) executed his BSc thesis at LMI for 3 months. One USA-student (Andy Schauf) started a 12 month stay at LMI for his MSc-project work in August 2011.

- **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 the Joint PhD-construction between LMI and UT- Applied Mathematics, Didit Adytia as UT-LMI PhD worked for 8 months at LMI (and 4 months at UT).
In the construction with UT-Mechanical Engineering, the 2 PhD students on research in tribology continued their research at UNDIP, while one staff member of UNDIP continued his KNAW post-doc position.

- **Visitors**

In 2011 Wenny Kristina worked for 7 months at LMI for her PhD project. Arnida Latifah (UT-PhD) visited for one month in January 2011. Lie She Liam started in December 2011 a visit of 9 months at LMI to finish his UT-PhD.
Prof Guus Stelling and Dr. Gerbrant Van Vledder visited LMI as lecturer during the Open Research House.

## 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.*

- Also in 2011 LMI acted as host (since August 2007) of the official Indonesia 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.*

## VI. Facilities

### a. Data-Lab and Capacity Data Base

*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. 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.*

### *b*. Supporting Staff

*A temporary part-time position supports technical and computer software matters. Administrative staff for secretarial and financial tasks is shared within Yayasan AB.*

### c. Lawangwangi

*Since August 2009 LMI has its offices in Lawangwangi Art & Science Estate. One large computer room, a staff room and a visitor room, together with rooms for supporting staff, are full-time available for the LabMath activities. For course activities, a large room with adjacent free spaces can be used as lecture room for up to 200 participants, and the large lounge is available for social gatherings, lunches and dinners.*

## VII. Personnel and Associate Scientists

Since its foundation, Dr. Andonowati acts as the Director of LabMath-Indonesia, and since January 2008 Prof. E. van Groesen acts as the Scientific Director.
To support research and supervision, 1 scientists was appointed at a part-time position:

Ms. Dr. Yessi Kurnia, for coastal wave modelling

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.
Appointments as senior scientists:
in 2007:

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

in 2008:

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

in 2009:

Prof.dr. Hidayat Pawitan (IPB, Bogor)

and in 2010:

Prof. Safwan Hadi (ITB, Bandung)
Dr. Nining Sari Ningsih (ITB Bandung)

As junior scientists (working on PhD projects) are appointed:
in 2007

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

in 2008

M. Tauviqirahman (UNDIP, Semarang),
Didit Adytia (LMI).

## VIII. Funding and subsidies

For the execution of the Open Research House travel support for Dr Van Vledder from TUD/Alkyon was much appreciated.

## IX. Outlook

*LabMath-Indonesia as a research institute should develop further to promote and stimulate the use of Mathematical Modelling and Simulation in Indonesia, linking 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 should 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.*

In 2011 the research was focussed on the main area of coastal wave simulations.
Funding in 2011 was received from KNAW (Netherlands Academy of Arts and Sciences) by executing one Post-Doc and one mobility project.

**Annex I: List of LMI projects**

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

**1. SRO GeoMathematics**

1.1

| | |
|---|---|
| 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.<br>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.<br>A second source of inaccuracies is caused by interaction of incoming waves with waves reflected from the coast. 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 the boundary interactions in so-called parameterized effective boundary conditions (PEBCs) to be imposed at the shoreline.<br><br>In 2011 the project was executed at LMI, from 1 August till Feb 2012 by the PhD student Wenny Kristina. |
| Funding | NWO-AL (Netherlands), 1 PhD-student |
| Period | 2008 – 2013 |
| Participating groups | UTwente: Prof. E. van Groesen, Dr. O. Bokhove; Wenny Kristina<br>LMI: Dr. Andonowati, Didit Adytia |
| Applicants / Supervisors | Prof. E. van Groesen |

1.2.

| | |
|---|---|
| Title | **Accurate Coastal Wave Modelling and Simulation** |
| Short description | The project has been executed as described in the proposal. As has been agreed with the KNAW-secretariat, this project was executed side by side with the first year of the KNAW-Post-doc project (09-PD-05).<br><br>The main topics of the execution can be summarized as:<br>▫ The Indonesian researchers visited the Netherlands as scheduled<br>▫ The Indonesian and Dutch researchers supervised various internship positions executed at LabMath-Indonesia.<br>▫ A successful one-month Open Research House was organized in January 2011; during a 2-week course activity, 20 participants followed lectures-courses from Prof Stelling, Van Groesen, Van Vledder and Adytia; most participants presented a short lecture of their own research.<br>▫ During the project period, research concentrated on various topics, in particular<br>o improvement of VB model, and the Finite Element implementation,<br>o improvement of AB model and the hybrid spatial-spectral implementation,<br>o comparison of VBM and AB simulations with measurements at MARIN,<br>o comparison of OVBM with other simulation codes, in particular AB, SWASH and MIKE21. |
| Funding | KNAW Mobility Programme 09-MP-06 |
| Period | Submitted November 2009, approved March 2010, started Summer 2010, Finished October 2011. |

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|---|---|
| Participating groups | LMI: Dr. Andonowati, Dr. W. Windupranata<br>Institut Teknologi Bandung (ITB): Prof.Dr. Safwan Hadi, Dr. Nining Sarih Ningshi<br>TUDelft: Prof.dr. G. Stelling<br>UTwente: Prof. E. van Groesen |
| Applicants / Supervisors | Dr. Andonowati, Prof. E. van Groesen |

1.3.

| | |
|---|---|
| Title | **PostDoc-project: High resolution time-dynamic wave simulations of Tanjung Priok Harbour, Jakarta, Indonesia** |
| Short description | The first progress report in August 2011 summarized the activities till then:<br><br>Based on the research proposal, the main results of the project will consist of<br>▫ analysis of local wind data,<br>▫ development and improvement of large scale spectral wave modelling using the SWAN wave modelling software for Jakarta Bay,<br>▫ time-accurate simulations of waves in- and outside the harbour of Tanjung Priok Harbour, using aFinite Element Variational Bousinesq Model (VBM) that was developed in previous KNAW-projects at LabMath-Indonesia and UT,<br>▫ wave measuring campaign in the Tanjung Priok Harbour area to obtain wave data that can be used to compare with the numerical simulations.<br><br>The main emphasize of the first year was on the simulation of wave climate and the extreme wave for Jakarta Bay area using the SWAN modelling system based on long term local wind data and actual bathymetry.<br><br>In the first year period of the Postdoc Project, the following activities that were executed are summarised:<br>1. Wind data for the last 25 years (1986 – 2010) have been retrieved and stored in a data base.<br>2. Extreme wind events have been analysed to be used to calculate the corresponding large waves.<br>3. The spectral wave model SWAN has been investigated thoroughly: One of the designers of SWAN (Dr. Van Vledder) visited LabMath in January 2011 and lectured for 3 days about advanced and critical use of SWAN.<br>4. Research on SWAN-modelling concentrated on designing and implementing a (new) unstructured grid, which was expected to perform better than the standard structured grid.<br>5. Spectral wave model simulations with SWAN have been executed for extreme events in the west and in the east monsoon; the area of simulations has been taken sequentially for the following domains: a. West Indonesian Domain, b. Java Sea Domain, c. Jakarta Bay, and d. Tanjung Priok Harbour<br>6. Using the wave characteristics as obtained by the spectral modelling, time dynamic deterministic simulations have been performed for the Tanjung Priok Harbour. The VBM code was used for these simulations, but also a recent new code, SWASH (freely available, developed at Delft University, and explained in detail for 3 days by the designer prof Guus Stelling at LabMath in January 2011).<br>7. To obtain measurement data, two field excursions to Tanjung Priok Harbour were organized, and wave measurement data were collected from Indonesian Hydro-Oceanographic Office (DISHIDROS); these data have been used for verification of simulation results.<br><br>In conclusion we can say that all planned activities were executed. An exception is the collection of data by doing our own measurements. Despite much effort during the year, we could not get permission of the Tanjung Priok Harbour authority to perform experiments inside the harbour at the places that are of interest to collect wave data. Instead of that, we did get previous measurement data that were taken in an area outside the harbour basin, which are also useful, but less useful than the data aimed at. |

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|---|---|
| Funding | KNAW Post-Doc Programme 09-PD-05 |
| Period | Submitted October 2009, approved March 2010, start August 2010 |
| Participating groups | LMI: Dr. Andonowati, Dr. Wiwin Windupranata (as Post-Doc)<br>UTwente: Prof. E. van Groesen |
| Applicants / Supervisors | Dr. Andonowati, Prof. van Groesen |

**Annex II: Publications and Presentations**

Below publications and presentations in 2011 are listed of research that has been executed at LabMath-Indonesia or in close collaboration with LMI.

*II.1 Publications (in 2011)*

- E. van Groesen & Andonowati, Fully dispersive dynamic models for surface water waves above varying bottom, Part 1: Model equations, Wave Motion 48 (2011) 657-666
- D. Adytia and E. van Groesen, The variational 2D Boussinesq model for wave propagation over a shoal, International Conference on Developments in Marine CFD, 18 - 19 November 2011, Chennai, India; RINA, ISBN No : 978-1-905040-92-6, p.25-29.
- E. van Groesen & Andonowati, Time-accurate AB-simulations of irregular coastal waves above bathymetry, Proceedings of the Sixth International Conference on Asian and Pacific Coasts (APAC 2011) December 14 – 16, 2011, Hong Kong, China, World Scientific ISBN: 978-981-4366-47-2, pp.1854-1864
- E. van Groesen, T. Bunnik & Andonowati, Surface wave modelling and simulation for wave tanks and coastal areas, International Conference on Developments in Marine CFD, 18 - 19 November 2011, Chennai, India, RINA, ISBN: 978-1-905040-92-6, p. 59-63
- W. Windupranata, A. Rojali, W. Wadman & E. van Groesen, Spectral Wave Modelling of Java Sea on Structured and Unstructured Grid, Proceedings of International Conference on Natural Science 2011, 9 – 11 July 2011, Malang, Indonesia.
- Windupranata, W., Ramadani, M., and E. van Groesen, (2011), Evaluation of Structured and Unstructured Grid on SWAN Wave Modelling of Jakarta Bay, International Delft3D User Meeting, Delft, the Netherlands, 31 October – 1 November 2011.

*II.2 Presentations (in 2011)*

- E. van Groesen, *Modelling & Simulation of Coastal Waves* (17-02-2011) International Conference on Basic Science, Universitas Brawijaya, Malang
- E. van Groesen, *Variational water wave modelling and simulation*, TW-colloqium, University of Twente (24-03-2011)
- E. van Groesen, *Variational water wave modelling and simulation*, JMBC-course, TUDelft (30-03-2011)
- E. van Groesen, *Time accurate simulations of irregular coastal waves,* (16-12-2011) APAC 2011, HongKong
-