



**THE 28TH MEETING OF THE ASEAN SUB-COMMITTEE
ON METEOROLOGY AND GEOPHYSICS
VIENTIANE, LAO PDR
19-21 SEPTEMBER 2006**

INTRODUCTION

1. The Twenty-Eighth Meeting of the ASEAN Sub-Committee on Meteorology and Geophysics (SCMG) was held on 19-21 September 2006 in Vientiane, Lao PDR. The Meeting was chaired by the SCMG Chairperson, Mrs. Sri Woro B. Harijono, Director General of the Indonesia Meteorological and Geophysical Agency.
2. The Meeting was attended by delegates from Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Singapore, Thailand and Viet Nam. Representatives from the ASEAN Secretariat and the invited resource persons from Korea Meteorological Administration (KMA), UNESCO IOC-ITIC and WMO were also in attendance. The list of delegates appears as **ANNEX A**.

AGENDA ITEM 1: OPENING CEREMONY

Opening Address by H.E. Dr. Maydom Chanthanasinh, Vice President of Science, Technology and Environment Agency (STEA), Lao PDR

3. H.E. Dr. Maydom Chanthanasinh, Vice President of Science, Technology and Environment Agency (STEA), Lao PDR, welcomed the delegates to the Meeting.
4. In his address, H.E. Dr. Maydom Chanthanasinh cited the importance of SCMG Meeting where the SCMG members and the sponsoring organisations could meet, deliberate, and share views on the status of progress of ASEAN SCMG projects. The full text of the address appears as **ANNEX B**.

Remarks by Mrs. Sri Woro B. Harijono, Director General of the Indonesia Meteorological and Geophysical Agency and Chairperson of SCMG.

5. Mrs. Sri Woro B. Harijono delivered the Remarks in her capacity as SCMG Chairperson. She expressed her gratitude and appreciation to the Government of Lao PDR for kindly hosting the 28th Meeting of the ASEAN Sub-Committee on Meteorology and Geophysics.
6. In her remarks, she highlighted the progress of a number of projects and programmes since the last Meeting, particularly the ASEAN Specialised

Meteorological Center (ASMC) and the ASEAN Earthquake Information Center (AEIC). She also expressed that participants should use this forum to exchange views and ideas on SCMG activities. The full text of the remarks appears as **ANNEX C**.

AGENDA ITEM 2: ORGANISATION OF THE MEETING

7. The Meeting unanimously elected Mr. Singthong Pathoummady, Director of Division, Meteorological Station Network, Lao PDR, as the Vice-Chairman of the Meeting.
8. The Meeting was requested to submit at least one nomination from each country for the Drafting Committee. The list of the members of the Drafting Committee appears as **ANNEX D**.

AGENDA ITEM 3: ADOPTION OF AGENDA

9. The Meeting adopted the agenda, which appears as **ANNEX E**.

AGENDA ITEM 4: MATTERS ARISING FROM THE 4TH INFORMAL ASEAN MINISTERIAL MEETING (IAMMST)

10. The Meeting took note of the paper of the ASEAN Secretariat on the matters arising from the 4th Informal ASEAN Ministerial Meeting (IAMMST), which appears as **ANNEX F**.
11. The Meeting noted that the new ASEAN Plan of Action on S & T (APAST) 2007-2011 has been endorsed by the 4th IAMMST.
12. The Meeting also noted that one of the flagship projects of COST to support the implementation of APAST 2007-2011 is in the field of environmental and disaster management to be led by Indonesia. Indonesia will develop a more detailed implementation plan on the project for further consideration by SCMG and COST.

Action Line: Indonesia

13. The Meeting noted the suggestion of the Ministers for the Sub-Committees to host their meetings prior to the 12th AMMST scheduled for August 2007, so that any progress in the implementation of the flagship projects and those contributing to APAST could be reported to the Ministers through COST.

AGENDA ITEM 5: MATTERS ARISING FROM THE 52ND MEETING OF COMMITTEE ON SCIENCE AND TECHNOLOGY (COST)

14. The Meeting took note of the paper from the ASEAN Secretariat, which appears as **ANNEX G**.
15. The Meeting noted that COST has endorsed the proposal from COST-Singapore to put several Sub-Committees addressing similar concerns under clusters to promote harmonisation of multi-disciplinary efforts and to effectively utilise limited resources in implementing activities that can enhance visibility of COST programmes and projects.
16. The Meeting requested the ASEAN Secretariat to provide further information on the clustering scheme after the detailed implementation arrangements have been adopted by COST.

Action Line: ASEAN Secretariat

**AGENDA ITEM 6: ESTABLISHMENT OF MONITORING NETWORK OF THE
TSUNAMI EARLY WARNING SYSTEM IN ASEAN**

Agenda item 6.1: Updates on the National Warning Plan

Indonesia

17. The Meeting took note the presentations and the progress report from Indonesia, which appears as **ANNEX H**. The Meeting was informed that the end-to-end project of the Establishment of the Indonesian Earthquake Information and **Tsunami** Warning System has achieved significant progress, especially for the dissemination of the information to the interfacing institutions, responsible for delivering the information to the community at risk. The report also highlighted the importance of Standard Operating Procedures (SOPs) for the operation of **tsunami** warning.

Malaysia

18. The Meeting was informed that Malaysia had hosted 3 international meetings/training courses to strengthen regional and international partnership, networking and capacity building in earthquake and **tsunami** preparedness, namely:
- (i) International Round Table Dialogue on Earthquake and **Tsunami** Risks in Southeast Asia and the South China Sea Region, 27-28 April 2006;
 - (ii) International **Tsunami** Numerical Modelling Training Workshop, 8-19 May 2006;
 - (iii) International IOC-USGS Training Course on Seismology and **Tsunami** Warning, 21-29 August 2006.
19. Malaysia further updated the Meeting that it has deployed 2 **tsunami** detection buoys. A dialogue between Malaysia and the Government of the Philippines is underway for the cooperation in deployment of the third buoy in Philippines waters.

20. The Meeting supported the Action Plan which was an outcome of the International Round Table Dialogue on Earthquake and **Tsunami** Risks in Southeast Asia and the South China Sea Regions and requested Malaysia to coordinate the implementation of those activities relevant to ASEAN. The paper from Malaysia appears as **ANNEX I**.

Action Line: Malaysia

Singapore

21. The Meeting took note of the update from Singapore on the development of its national **tsunami** warning system which comprises 4 components:

- (i) Enhancement of national seismic monitoring system;
- (ii) Enhancement of national tide monitoring system;
- (iii) Development of **tsunami** modelling capability; and
- (iv) Development of a national **tsunami** response plan.

The report appears as **ANNEX J**.

22. Noting the importance of real time seismic and sea level data to enable the timely issuance of **tsunami** warnings, the Meeting urged Members to accord high priority to the regional exchange of such data.

Thailand

23. The Meeting took note of the update from Thailand, which appears as **ANNEX K**. Thailand informed the Meeting of the following, among others:

- (i) Current and future development of seismic monitoring network;
- (ii) Installation of 10 warning towers at southern Thailand in 2006, and the plan to install additional towers in the end of 2006 and after 2008;
- (iii) The plan to deploy 2 DART buoys in the Indian Ocean with support from NOAA and IOC; and
- (iv) Establishment of national database of seismological event and **Tsunami** event in 2006 – 2008.

24. Thailand welcomed the request from Member Countries and agreed to share the data from its seismic and tidal gauges. However, Thailand would like to request technical assistance from the Member Countries on how to share or link the data to other parties.

Action Line: All Member Countries

25. The Meeting noted the difficulties in establishing a centre serving as a regional centre for **tsunami** early warning system in the Indian Ocean due to the complexity of the end-to-end nature of a **tsunami** warning system in the region, as well as the lack of expertise on the diversity of **tsunami**genic earthquake formation in the region. Therefore the Meeting does not support the idea of establishing such a centre.

Agenda item 6.2: **Report of the 2nd Meeting of the Technical Task Force for the Establishment of Monitoring Network of the **Tsunami** Early Warning System in ASEAN, 4-5 April 2006, Brunei Darussalam**

26. The Meeting took note of the report from Brunei Darussalam (presented by the ASEAN Secretariat), which appears as **ANNEX L**.
27. The Meeting was of the view that it is necessary for Member Countries to continue to engage in discussions on the development of their national **tsunami** early warning systems including regional issues on data and information exchange. In this regard, the Meeting agreed with Malaysia's proposal that the Technical Task Force shall continue to meet to address those issues. The Meeting thanked Indonesia for its offer to hold the 3rd Technical Task Force Meeting which is tentatively scheduled in March 2007.
28. The Meeting requested Indonesia to inform SCMG members on the exact date and venue of the 3rd Technical Task Force Meeting when the information is available.

Action Line: Indonesia

29. The Meeting also took note of the contribution of WMO for upgrade of GTS for the establishment of the **Tsunami** Early Warning System, in particular upgrade of GTS in Myanmar to be completed by the end of 2006/early January 2007.
30. The Meeting was pleased to note that Cambodia will be connected to the GTS within the project supported by Japan with the technical support of WMO.
31. The Meeting took note of the follow-up actions at the request of the 2nd Meeting of the Technical Task Force taken by WMO with the coordination of Singapore. The paper appears as **ANNEX M**.

Agenda item 6.3: **UNESCO-IOC-ITIC Presentation on the Products and Services of IOC **Tsunami** Warning and Mitigation Systems for the Pacific and Indian Ocean.**

32. The Meeting took note of the presentation by Mr. Fred Stephenson, Vice-Chair of ICG/PTWS, which appears as **ANNEX N**. The presentation covered, among others, the following areas:

- a. Products and Services of the IOC **Tsunami** Warning and Mitigation Systems for the Pacific and Indian Oceans;
- b. IOC **Tsunami** Teacher; and
- c. The IOC Capacity Building Initiatives.

AGENDA ITEM 7: STATUS REPORT OF PROJECTS AND INITIATIVES

33. The Meeting took note of the matrix of all SCMG projects submitted by the ASEAN Secretariat which appears as **ANNEX O**.

Agenda item 7.1: Ongoing projects

Agenda item 7.1.1: ASEAN Specialised Meteorological Centre (ASMC)

34. The Meeting took note of the update by the ASMC on its recent activities in support of the Regional Haze Action Plan, including its participation at various Regional Meetings on Haze. The report appears as **ANNEX P**.
35. The Meeting noted the on-going initiatives made by the ASMC on the development of the following new products:
 - (i) Regional PSI-like indicators; and
 - (ii) Products for environmental monitoring including land & sea surface temperature, vegetation index, total ozone, rainfall estimation, ocean colour products.
36. The Meeting noted the appreciation of Member Countries to ASMC for its continual efforts in generating useful products for regional haze monitoring.

Agenda item 7.1.2: ASEAN Earthquake Information Center (AEIC)

37. The Meeting took note of the report on the activities of AEIC presented by Indonesia, which appears as **ANNEX Q**.
38. The meeting noted the recent activities of AEIC as follows:
 - Installing new web server to support the dissemination of earthquake information in the form of Short Message Service (SMS);
 - Redesigning the homepage of the AEIC; and
 - Conducting of a training program of the SeiscomP in Jakarta, on 27-29 March 2006, to improve the capabilities of the Member Countries to undertake the data exchange using the Internet.
39. With regard to the issue on the organisational structure of the AEIC, the Meeting was of the view that Indonesia could proceed with establishment of the structure, if needed, without involving other countries.

Action line: Indonesia

Agenda item 7.1.3: **Programme to Address ASEAN Regional Transboundary Smoke (PARTS)**

40. The Meeting noted the progress of the programme as reported by Singapore. The full report appears as **ANNEX R**.
41. WMO informed the Meeting that a small workshop is tentatively planned to be held in Yogyakarta, Indonesia on 13-15 December 2006, to review the current status of air quality measurements in general and in particular of the instruments installed within the framework of the WMO/UNESCAP Trust Fund project, "Support to the Implementation of the Regional Haze Plan of ASEAN Member Countries."
42. The Meeting was informed that Indonesia will undertake an activity entitled "Development of Satellite Ground Receiver Geostationary System", which will provide meteorological parameter data such as: temperature of higher cloud, the height of cloud, temperature of sea level as well as hot spot. The data and information are useful to warn the favourable condition for fire driving force as well as extreme weather. The ASEAN Member Countries are invited for data and information exchange. Indonesia informed the Meeting that activities on FDRS (Fire Danger rating Systems) are now in progress and could contribute to the success of PARTS.

Agenda item 7.1.4: **Rainfall Estimation for Monitoring of High Risk Fire Areas in South East Asia**

43. The Meeting took note of the report on the progress of the project presented by Singapore which appears as **ANNEX S**.
44. The Meeting was informed that funding approval from Japan was still pending and requested the ASEAN Secretariat to follow up with Japan. The Meeting requested each Member Country to nominate two participants to attend the training workshop after Japan has approved the funding.

Action Line: ASEAN Secretariat

Agenda item 7.1.5: **Capacity Building in Seasonal Climate Prediction in the ASEAN Region**

45. The Meeting noted the past training activities under this project highlighted in the report of Singapore, which appears as **ANNEX T**.
46. The Meeting noted that the International Research Institute for Climate and Society (IRI) is considering holding an attachment on climate modelling at IRI for one scientist each from selected ASEAN countries. ASMC will also consult

with IRI on the planning for a training workshop on the methodology and various aspects of regional climate modelling for two participants from each Member Country.

Action line: Singapore

47. The Meeting noted the support expressed by the ASEAN Member Countries on the IRI attachments and training workshop. It requested Singapore to consult with IRI on the criteria for the selection of countries to participate in the attachment programme.

Action Line: Singapore

48. Indonesia informed the Meeting that it had recently conducted a series of training on the uses of some advanced statistical techniques adopted by the MGA as tools for district level short-scale and long-range climate forecasts. The models have been tested and validated in a number of pilot sites.

49. Indonesia offered to arrange a similar training activity for other countries upon request.

Action Line: All Member Countries

Agenda item 7.2: Pending projects

Agenda item 7.2.1: South East Asia Centre for Atmospheric and Marine Prediction (SEACAMP)

50. The Meeting took note of the report of Singapore on SEACAMP, which appears as **ANNEX U**.
51. The Meeting noted the following initiatives to jump start some components of the project:
- (i) The addition of products from a high-resolution (about 10km) South Asian ocean model coupled with a wave model to the SEACAMP website; and
 - (ii) The proposed exchange of sea-level data among some ASEAN Member Countries in connection with the ongoing development of a regional **tsunami** early warning system in Southeast Asia.
52. The Meeting decided that the exchange of sea-level data will be discussed in the 3rd Meeting of the Technical Task Force for the Establishment of Monitoring Network of the **Tsunami** Early Warning System in ASEAN, which will be held in Indonesia next year. The Meeting requested Indonesia to note this decision and include it in the agenda of the next Technical Task Force Meeting.

Action Line: Indonesia

53. Singapore invited Member Countries to provide their comments and feedback on the products available in the SEACAMP website and suggest ways to improve the usefulness of the website content.

Action Line: All Member Countries

54. As funding for the project has not been forthcoming for many years, the Meeting requested Singapore to rescope the proposal or withdraw the project from the list of pending projects.

Action Line: Singapore

Agenda item 7.2.2: **Workshop on Application of Hygroscopic Pyrotechnic in Rainfall Enhancement**

55. The Meeting noted that Thailand will provide the information on the project at a later time.

Action Line: Thailand

56. Indonesia expressed its support to the proposed workshop and informed the Meeting that it is willing to collaborate with Thailand in implementing it. In this regard, Indonesia and Thailand will consult each other on the development of the proposal for the workshop. Meanwhile, Indonesia will forward the initiative to the relevant institution in Indonesia.

**Action Line: Indonesia
Thailand**

57. The Meeting noted the request of WMO for an update on the development of the project proposal, and inform WMO on any supports which will be sought from WMO.

**Action Line: Indonesia
Thailand**

Agenda item 7.2.3: **ASEAN-Japan Cooperation: “Joint Activity in Global Warming and Disaster Mitigation”**

58. The Meeting agreed with the suggestion of the Philippines to rescope the project to ensure its relevance to the current developments, and proposed a tentative title “Joint Activity in Mitigating Disasters Arising from Climate

Change.” The Philippines will circulate the new project proposal to SCMG members for comments by 20 November 2006.

Action Line: Philippines

Agenda item 7.2.4: Remotely Sensed Climate Change Using the GPS in South East Asia Region

59. The Meeting noted the paper submitted by Indonesia on the initiative, which appears as **ANNEX V**. Indonesia informed the Meeting that the GPS network established by the Coordinaton Body for Mapping and Surveying in collaboration with the Meteorological and Geophysical Agency can be applied to provide continuous water vapor estimation for the operational weather forecasting purposes and atmospheric studies.
60. Indonesia encouraged other ASEAN Member Countries to have similar experiments to enhance the development of the climate change monitoring techniques. In the future, when the system is established, the data can be exchanged within the ASEAN region.

Agenda item 7.2.5: ASEAN-ROK Cooperation on Climate Information and Service

61. The Meeting took note of the paper from Malaysia, which appears as **ANNEX W**. The Meeting noted that there is no new development on the project since KMA presented the idea to the 25th SCMG Meeting.
62. In this regard, the Meeting suggested the KMA to confirm whether it is still interested to support the project.

Action line: KMA

63. With regard to the Global NWP products for Southeast Asia and Middle East which have been developed by the KMA and made available in its website (http://www.kma.go.kr/ema/ema03/ra2d_eng_asia.jsp), the Meeting appreciated the progress made by the KMA and further requested Malaysia to be in contact with the International Cooperation Division of KMA via email requesting its assistance in providing the digital data to Member Countries.

Action line: Malaysia

Agenda item 7.2.6: ASEAN-ROK Cooperation Training Workshop for the Use of Numerical Weather Prediction Products

64. The Meeting noted the presentation by the Korea Meteorological Administration (KMA) which appears as **ANNEX X**. The KMA briefed the Meeting on the following:
- a. Introduction to the KMA;
 - b. The plan for the Numerical Weather Prediction (NWP) products training workshop;
 - c. Training programs conducted by the KMA;
 - d. Bilateral and multilateral cooperation between KMA and other Countries or Organisations; and
 - e. NWP system support to the Asian Countries.
65. The Meeting agreed with the new proposed date by the KMA to convene the training workshop on NWP products from 30 October-3 November 2006 in Seoul, Korea. The Meeting noted that the ASEAN Member Countries shall nominate 2 persons for each country as the participants and one person from the ASEAN Secretariat is invited as an observer. The Member Countries are welcome to send additional participants at their own cost.

Action Line: All Member Countries

66. The Meeting further noted that the ASEAN Standing Committee (ASC) approval on the project is expected to be obtained very soon. Once obtained, the ASEAN Secretariat will inform the Ministry of Foreign Affairs and Trade (MOFAT) of Korea so that the release of funds could be made immediately, and KMA could start issuing the invitation letters to ASEAN.

Action Line: ASEAN Secretariat and KMA

67. The Meeting noted that the ASEAN Secretariat will coordinate the implementation of the training workshop on NWP products.

Action Line: ASEAN Secretariat

68. The Meeting expressed its appreciation to the KMA for organising the training workshop and looked forward to more collaborative initiatives between SCMG and KMA.

Agenda item 7.2.7: Development of Tsunami Propagation and Run-up/Inundation Model Capability

69. The Meeting took note of the update on the project provided by Singapore. The paper appears as **ANNEX Y**.
70. The Meeting was informed by the ASEAN Secretariat that the project proposal is currently being reviewed by the ASC and decision is expected

very soon. In this regard, the Meeting requested the ASEAN Secretariat to inform the decision of ASC to the SCMG members as soon as possible.

Action Line: ASEAN Secretariat

Agenda item 7.2.8: **ASEAN-China Training Course on Earthquake Engineering and Earthquake Disaster Mitigation**

Agenda item 7.2.9: **China-ASEAN Joint Workshop on Marine Disaster Reduction and Mitigation in the South China Sea Region**

71. The Meeting was informed by the ASEAN Secretariat that the status of the two project proposals was discussed at the 4th ASEAN-China Joint Science and Technology Committee (ACJSTC) Meeting in Li Jiang, China, on 4-5 September 2006. China informed ASEAN that since the response of the Ministry of Foreign Affairs of China to support the projects was not favourable, China suggested that the proposals be dropped. However, since the two initiatives are still relevant to ASEAN, China agreed with the suggestion of ASEAN that ASEAN and China Earthquake Administration (CEA) repackage the proposals for funding consideration under the ASEAN-China Cooperation Fund. The Meeting requested the ASEAN Secretariat to consult CEA on the repackaging of the proposals.

Action line: ASEAN Secretariat

Agenda item 7.2.10: **Co-operation on Application of Growth Simulation Model with Satellite Remote Sensing and Geographic Information System Techniques for Agricultural Crop Potential Yield Monitoring and Estimating**

72. The Meeting noted the project brief prepared by Thailand, which appears as **ANNEX Z**. The Meeting further took note of the suggestion from Indonesia to focus the project on the meteorological aspect besides the application of the models.
73. The Meeting requested Thailand to develop a full project proposal and circulate it to SCMG Members by 20 November 2006 for comments.

Action Line: Thailand

Agenda item 7.2.11: **Co-operation on Meteorological Early Warning System for Prevention and Mitigation of Agricultural Diseases**

74. The Meeting noted the project brief from Thailand, which appears as **ANNEX AA.**

75. The Meeting requested Thailand to develop a full project proposal and circulate it to SCMG Members by 20 November 2006 for comments.

Action Line: Thailand

Agenda item 7.2.12: **ASEAN Information Network for R&D in Meteorology, Satellite Remote Sensing and Geographic Information System**

76. The Meeting noted the project brief from Thailand, which appears as **ANNEX AB.**

77. The Meeting requested Thailand to develop a full project proposal and circulate it to SCMG Members by 20 November 2006 for comments.

Agenda item 7.2.13: **Application for TMD NWP Global Datasets to LAM Models for the ASEAN Community**

78. The Meeting noted the update from Thailand, which appears as **ANNEX AC.** The Meeting further noted that Thailand would like to withdraw the project to allow other projects with higher priority be undertaken without delay.

79. The Meeting noted the request from Indonesia that it would like to subsume the Thailand's initiative under the new project proposal on Training on Digital Forecasting (to be discussed under Agenda 7.3.2).

Agenda item 7.3: **New Projects**

Agenda item 7.3.1: **The Indian Ocean Dipole Mode, El Nino Southern Oscillation (ENSO) and Monsoon Interactions and their Socio-Economic Impacts on India-ASEAN Nations**

80. The Meeting took note of the project proposal presented by Indonesia, which appears as **ANNEX AD.** The proposal was jointly developed by Indonesia and India following the 5th Meeting of the ASEAN-India Working Group on S & T held in Manesar, India, 21-22 August 2005.

81. The Meeting requested Indonesia to circulate by 20 November 2006 the detailed proposal including the proposed budget to SCMG Members for review and provide comments to Indonesia. Following the receipt of the

comments, Indonesia will revise the proposal. Support for the project will be sought from the ASEAN-India Cooperation Fund and the Government of Indonesia.

**Action Line: Indonesia
All Member Countries**

Agenda item 7.3.2: Training on the Digital Forecast

82. The Meeting took note of the project brief from Indonesia, which appears as **ANNEX AE**.

83. The Meeting requested Indonesia to develop the full project proposal taking into account the outcomes of the training workshop on NWP products to be held in Korea on 30 October – 3 November 2006, and circulate it for comments by SCMG members.

Action Line: Indonesia

Agenda item 7.3.3: The International Training Course on Tsunami and Earthquake Vulnerability Reduction

84. The Meeting noted the paper from Thailand on the convening of the International Training Course on **Tsunami** and Earthquake Vulnerability Reduction, which appears as **ANNEX AF**. The training course, organized by the Asian Seismological Committee (ASCom) and the Thai Meteorological Department, will be held in Bangkok, Thailand, on 7-10 November 2006.

85. With regard to the funding arrangements for the training course, the Member Countries may wish to communicate with the organiser directly for the possibility of sponsorships.

Agenda item 7.3.4: Field Course on Local Scale (District) Climate Forecast Application

86. The Meeting noted the new project brief from Indonesia, which appears as **ANNEX AG**. The project, implemented under the ASEAN-help-ASEAN programme of COST, aims at improving skill in providing and disseminating the climate prediction at district scale in mid 2007. Further details about the Field Course will be provided by Indonesia in due course.

Action Line: Indonesia

87. The Meeting expressed its support to the initiative, and thanked Indonesia for providing full funding support to for the participation of Member Countries in the project.

Agenda item 7.3.5: **Training Course on the Understanding of Earthquake, Tsunami and Mitigation of their Effects**

88. The Meeting noted the project brief from Indonesia on the Training Course on the Understanding of Earthquake, Tsunami and Mitigation of Their Effects, which appears as **ANNEX AH**. The training course, to be implemented under the ASEAN-help-ASEAN programme of COST, will be held in 2007 and aims to improve the understanding of ASEAN seismologists and earthquake specialists on the nature and impact of earthquake and tsunami, and to enable the ASEAN Member Countries to enhance their mitigation programmes to minimise the effect of those natural disasters.

89. The Meeting requested the ASEAN Secretariat to contact with UNESCO-IOC-ITIC, PTWC, USGS and GFZ requesting their support for the Training Course by instructors. The ASEAN Secretariat will communicate with these Organisations following the receipt of names and contact addresses of possible instructors to be provided by Indonesia

**Action Line: Indonesia
ASEAN Secretariat**

90. The Meeting extended its appreciation to Indonesia for the full funding support provided to the ASEAN Member Countries to participate in the Training Course.

Agenda item 7.3.6: **Establishment of an ASEAN Climate Centre**

91. The Meeting noted the project brief from Indonesia on the Establishment of an ASEAN Climate Centre, which appears as **ANNEX AI**.

92. The ASEAN Secretariat informed the Meeting that the establishment of an ASEAN Centre must adhere to the ASEAN policy set by the ASEAN Standing Committee (ASC). Among others, the policy stipulates that the proposed Centre must have a viable financial plan as a basis for ensuring the long-term sustainability of its operations.

93. The Meeting requested Indonesia to develop a full proposal on the establishment of the Centre detailing the functions and roles of the Centre, addressing the policy of the ASC on the establishment of an ASEAN Centre, and ensuring that the roles and activities proposed Centre will not overlap with those of various centres currently existing in ASEAN countries such as ASMC and those under the aegis of WMO.

Action Line: Indonesia

94. The ASEAN Secretariat will provide the Policy on Establishing of an ASEAN Centre to Indonesia.

Action Line: ASEAN Secretariat

95. The Meeting also requested the ASEAN Secretariat to circulate the full proposal, once it is developed by Indonesia, to other relevant bodies in ASEAN (e.g ASEAN Senior Officials on Environment/ASOEN) to get their feedback.

Action Line: ASEAN Secretariat

Agenda Item 7.3.7: Workshop on Climate Applications in ASEAN

96. The Meeting noted the new project brief from Malaysia on the Workshop on Climate Applications in ASEAN, which appears as **ANNEX AJ**. The Workshop is to replace the Roving Seminar which was previously proposed as an extension of the project on Updating of the ASEAN Compendium of Climatic Statistics.
97. The Meeting noted that the Workshop, to be held in 2007 or early 2008, aims to promote effective use of climate data and information in socio-economic activities and enhance capacity in conducting assessments of impacts of extreme climate, climate variability and climate change on various sectors.
98. The Meeting supported the proposal from Malaysia to replace the Roving Seminar with the Workshop, and requested Malaysia to develop a full proposal for submission to a Dialogue Partner for funding consideration.

Action Line: Malaysia

**AGENDA ITEM 8: PROPOSAL FOR THE COOPERATION OF THE
UNESCO IOC ICG/PTWS and ICG/IOTWS WITH THE
SCMG**

99. The Meeting took note of the Concept Paper for the Cooperation of the UNESCO IOC ICG/PTWS and ICG/IOTWS with the ASEAN SCMG, which appears as **ANNEX AK**.
100. The Meeting expressed its appreciation to the UNESCO-IOC-ITIC for the support given to several ASEAN Member Countries in establishing their

National **Tsunami** Early Warning Systems, and its initiatives for capacity building.

101. The Meeting supported the IOC proposal to initiate cooperation and collaboration on mutually beneficial programmes and activities to support the strengthening of **tsunami** warning and mitigation of ASEAN Member Countries. The following areas of cooperation are mutually agreed upon:

- (i) **Tsunami** Warning Operations, including concepts of operation and standard operating procedures, real-time seismic and sea-level monitoring, and decision-making tools to support and enable rapid responses and timely issuance of reliable warnings;
- (ii) Data Sharing of geophysical and oceanographic data streams, and estimated parametric data (such as earthquake hypocenter, magnitude, and sea level **tsunami** observations) to facilitate sub-regional and national earthquake and **tsunami** monitoring operations;
- (iii) Hazard identification and risk assessment, and the preparation of **tsunami** inundation and evacuation maps to support national planning and development, and **tsunami** threat evaluation during a **tsunami** emergency; and
- (iv) Preparedness, Education, and Outreach programmes for stakeholders, including decision-makers, response agencies and the public, and the development of materials to support such activities.

102. The Meeting further requested the Chairman of SCMG to formalise this decision by official letter to IOC-ITIC.

Action Line: Chairman SCMG

AGENDA ITEM 9: OTHERS MATTERS

Agenda item 9.1: ITTIN Website to Promote Investment and Technology Transfer in ASEAN

103. The Meeting took note of the paper presented by the ASEAN Secretariat which appears as **ANNEX AL**. The Meeting encouraged the Member Countries to take advantage of the services provided by the ITTIN website.

Action Line: All Member Countries

Agenda item 9.2: Roadmaps of the Priority Integration Sectors (PIS)

104. The Meeting took note of the paper on Roadmaps of the Priority Integration Sectors (PIS) presented by the ASEAN Secretariat, which appears as **ANNEX AM**.

105. The Meeting noted that some of the pending projects of SCMG could contribute to the Specific Measures of the Agrobased and Air Travel sectors in the Roadmaps. As such, the Meeting encouraged the proponent of the projects to exert efforts on their implementations.
106. The Meeting noted the suggestion of the ASEAN Secretariat that KMA consider supporting a capacity building activity on aviation meteorology to support the specific measure under the Air Travel sector.

**Action Line: ASEAN Secretariat
KMA**

107. The Meeting also noted that in the future SCMG may also consider implementing activities in support of the Fisheries, Healthcare, and Tourism sectors of the PIS.

**Agenda item 9.3: ASEAN Regional Disaster Emergency Response
Simulation Exercise (ARDEX-06)**

108. The Meeting noted the information provided by the ASEAN Secretariat on the activities related to the ASEAN Regional Disaster Emergency Response Simulation Exercise (ARDEX-06), which will be held in Phnom Penh, Cambodia on 25-29 September 2006. The ACDM has invited the SCMG to participate in the ARDEX-06 as an observer. The information paper appears as **ANNEX AN**.
109. The Meeting agreed with the suggestion of the ASEAN Secretariat that the SCMG be represented by SCMG-Cambodia in the ARDEX-06. In this regard, the ASEAN Secretariat will request the ACDM to extend an official invitation to SCMG-Cambodia.

Action Line: ASEAN Secretariat

110. Further consultation will be held internally within the Cambodia-SCMG regarding its participation in the ARDEX-06.

AGENDA ITEM 10: VENUE AND DATE OF THE 29th SCMG MEETING

111. The Meeting agreed that the 29th SCMG Meeting will be held prior to the holding of the 12th AMMST scheduled to be held in August 2007.
112. The Philippines indicated their willingness to host the 29th SCMG Meeting, subject to the approval given by the relevant authority in the Philippines.

113. The Meeting noted that the SCMG Chairman will send a letter to the National COST Chairman of the Philippines requesting the Philippines to confirm its readiness to host the 29th SCMG Meeting.

Action Line: SCMG Chairman

114. The Meeting supported the idea of the ASEAN Secretariat that the hosts of future SCMG meetings (e.g. for the next 5 years) be determined so as to ensure that preparations for organising future meetings can be made in a smoother manner. In this regard, the ASEAN Secretariat will undertake consultations with Member Countries on this matter.

Action Line: ASEAN Secretariat

AGENDA ITEM 11: CONSIDERATION AND ADOPTION OF THE REPORT

115. The Meeting considered and adopted the report of the 28th Meeting of SCMG.

CLOSURE

116. The Meeting was held in the traditional ASEAN spirit of cordiality and solidarity. The Meeting expressed its appreciation to the Lao PDR for the warm hospitality accorded to the participants and the excellent arrangements made, including the local Secretariat support for the Meeting. The Meeting conveyed its appreciation to the Chairman and Vice-Chairman for the excellent manner in which the Meeting had been conducted. The Meeting also expressed its sincere appreciation to the representative of the ASEAN Secretariat, for its invaluable contributions.

**CONCEPT PAPER FOR THE COOPERATION OF
THE UNESCO IOC ICG/PTWS AND ICG/IOTWS WITH
THE ASEAN SUB-COMMITTEE ON METEOROLOGY AND GEOPHYSICS**

Presented to the 28th Meeting of the ASEAN COST Sub-Committee of Meteorology and Geophysics (SCMG), 19-21 September 2006, Vientiane, Lao PDR

By Fred Stephenson (Canada), ICG/PTWS Vice-Chairman

PROPOSAL:

The IOC of UNESCO, through its International Tsunami Information Centre and the Secretariats of the Intergovernmental Coordination Groups (ICG) for the Pacific Tsunami Warning and Mitigation System (PTWS) and the Indian Ocean Tsunami Warning and Mitigation System (IOTWS), working directly with ICG Member States, proposes to initiate cooperation and collaboration on mutually beneficial programmes and activities to support the strengthening of tsunami warning and mitigation of Member States participating to the ASEAN Sub-Committee on Meteorology and Geophysics (SCMG).

BACKGROUND:

Organizational Structure: The ICG/PTWS and ICG/IOTWS are subsidiary bodies of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The ICG/PTWS has been in operation since 1965. The ICG/PTWS is currently comprised of 30 Member States in the Pacific. The International Tsunami Information Centre, located in Honolulu, Hawaii, USA, serves as the ICG/PTWS Secretariat.

Since the 26 December 2004 tsunami, the IOC through its ICG/IOTWS has been leading the effort to organize, coordinate and implement an IOTWS, based on the experience of the PTWS. Currently, 29 Member States comprise the ICG/IOTWS. The efforts are being carried out in coordination with other UN organizations, including the ISDR, WMO, UNDP, UNESCAP and others. The ICG/IOTWS Secretariat is located in Perth, Australia.

The IOC Tsunami Unit, located at the IOC headquarters in Paris and under the direction of the IOC Executive Secretary / UNESCO Assistant Director-General, oversees the global implementation and coordination of tsunami systems, and works through the Secretariats to deliver services to Member States within the specific regions.

Under this structure, most countries would participate to the ICG/PTWS which encompasses the Southeast Asia region, but additionally some countries are also be active in the ICG/IOTWS.

Purpose: The ICG/PTWS acts to coordinate international tsunami warning and mitigation activities, including the timely issuance of tsunami warnings in the Pacific. This includes cooperation in sea level and seismic networks and data sharing, standardization and understanding of tsunami warning criteria, and the issuance of tsunami information according to the PTWS Communications Plan. The Pacific Tsunami Warning Center in Ewa Beach, Hawaii, serves as the operational headquarters of the tsunami warning system. The PTWC, in close cooperation with sub-regional centers in Alaska, USA (West Coast / Alaska Tsunami Warning Center) and Japan (Japan Meteorological Agency, Northwest Pacific Tsunami

Advisory Center) issue international tsunami information for the Pacific. The PTWC and Japan Meteorological Agency are providing interim advisory information for the Indian Ocean (since April 2005) and the South China Sea Region (since April 2006). The messages are advisories to designated national authorities, as each country is individually responsible for issuing warnings and public safety information to its population.

The ITIC monitors and recommends improvements to the PTWS to increase the timeliness and accuracy of tsunami warnings, assists Member States to establish new, or strengthen existing, national and regional tsunami warning systems, facilitates technology transfer through capacity building activities in tsunami hazard risk assessment, tsunami warning and emergency response and preparedness, and acts as an information resource for the implementation of comprehensive national tsunami mitigation programmes.

The ITIC also supports the IOC's global tsunami warning and mitigation system implementation in the Indian Ocean, the Caribbean, and the north Atlantic and Mediterranean.

MOTIVATION:

In order to strengthen capacity building, and to promote the sustainability of mitigation programmes across the entire southeast region, the IOC believes that it is important and critical to engage and build appropriate partnerships at the organizational levels that work on behalf of Member States. We feel that the SCMG within ASEAN is the appropriate level for direct engagement and cooperation for the implementation of durable and effective systems. At the same time, the PTWS and IOTWS promote comprehensive approaches for tsunami risk reduction that involve preparedness and emergency response, and so the Disaster Management section of ASEAN would also be relevant.

To address directly the reduction of earthquake and tsunami hazards, the IOC, through its ITIC, and in cooperation with the government of Malaysia Ministry of Science, Technology and Innovation organized the International Round-Table Dialogue on Earthquake and Tsunami Risks in Southeast Asia and the South China Sea Region, 7-28 April 2006, in Kuala Lumpur, Malaysia. The meeting brought together technical experts from the region and international seismological and tsunami experts to share information of the current risk.

The Action Plan developed by participants provides the primary motivation for the IOC's proposal to the ASEAN SCMG. This Action Plan (attached as Annex I) endorses the building of regional partnerships to ensure a long-term sustainability of an end-to-end system, and involvement of the PTWS, IOTWS, its warning centers, and the ITIC, to assist in efforts to reduce risk through improved seismic and sea level data networks and communications protocols, preparedness, and education.

AREAS OF COOPERATION:

The ITIC, in its capacity as the lead IOC agency currently organizing and conducting capacity building activities in the Pacific and Indian Oceans, proposes to cooperate in the following areas. The activities could include regional and country-specific expert consultations and technical guidance on warning center implementations, training courses, and visiting scientist programmes and study tours to provide hands-on knowledge and experience or facilitate work on specific action projects.

1. Tsunami Warning Operations, including concepts of operation and standard operating procedures, real-time seismic and sea-level monitoring, and decision-making tools to support and enable rapid responses and timely issuance of reliable warnings.
2. Data Sharing of geophysical and oceanographic data streams, and estimated parametric data (such as earthquake hypocenter, magnitude, and sea level tsunami observations) to facilitate sub-regional and national earthquake and tsunami monitoring operations.
3. Hazard identification and risk assessment, and the preparation of tsunami inundation and evacuation maps to support national planning and development, and tsunami threat evaluation during a tsunami emergency.
4. Preparedness, Education, and Outreach programmes for stakeholders, including decision-makers, response agencies and the public, and the development of materials to support such activities.

The ITIC has carried out many activities across the broader Pacific over the last 40 years, and has provided services to IO countries since the 26 December 2004 tsunami. The ITIC proposes to continue these activities in cooperation with the ASEAN SCMG. To the extent possible, we would be happy to contribute our experience and technical resources to existing and pending projects of the SCMG.

Immediate capacity building activities are possible that would build upon the training programmes in seismology, tsunami warning, and numerical modeling that have already been carried out between May and August, 2006 by the IOC ITIC in coordination with the U.S. Geological Survey and expert scientists. Descriptions of these activities are attached in the Annex II to this Concept Paper.

CONTACT INFORMATION:

IOC Contact Information:

Dr. Patricio Bernal
Executive Secretary IOC
Assistant Director-General UNESCO
1, rue Miollis
75732 Paris Cedex 15
France
Phone : <33> 1 45 68 39 83
Fax: <33> 1 45 68 58 12
E-mail : p.bernal@unesco.org

Dr. Peter Koltermann
Head
IOC Tsunami Unit, Tsunami Office
1 Rue Miollis 75732 Paris CEDEX 15,
Phone : <33> 1 45 68 40 15
Fax: <33> 1 45 68 58 10,
E-mail: p.koltermann@unesco.org

ICG/PTWS and ITIC Contact Information:

Dr. Laura Kong
Director
International Tsunami Information Centre
ICG/PTWS Secretariat
737 Bishop St., Ste. 2200
Honolulu, Hawaii 96813
USA
Phone : <1> 808) 532-6422
Fax : <1> 808) 532-5576
E-mail : l.kong@unesco.org

ICG/IOTWS Contact Information:

Tony Elliott
Head
ICG/IOTWS Secretariat
IOC Perth Regional Office
PO Box 1370, West Perth Australia 6872
Phone: <61> 8 9226 0191
Fax: <61> 8 9263 2211
E-mail: t.elliott@unesco.org

ANNEX I.

Reported to the IOC/PTWS-XX1, 3-5 May 2006, Melbourne, Australia

JOINT STATEMENT

International Round-Table Dialogue on Earthquake and Tsunami Risks in Southeast Asia and the South China Sea Region

27-28 April 2006, Kuala Lumpur, Malaysia

Objectives of the Meeting:

1. To assess earthquake and tsunami and vulnerability in Southeast Asia and the South China Sea region
2. To review the level of preparedness and mitigation measures in place and identify gaps/weaknesses
3. To identify opportunities to strengthen regional and international partnerships, networking and capacity building

Attendees to this International Round-Table Dialogue on Earthquake and Tsunami Risks in Southeast Asia and the South China Sea Region represented the countries of the region, including Australia, Bangladesh, Cambodia, China, India, Indonesia, Pakistan, Malaysia, Maldives, Myanmar, Pakistan, Philippines, Singapore, Thailand, Vietnam, tsunami warning centre and disaster preparedness organizations of the Asian Disaster Preparedness Center (ADPC), Japan Meteorological Agency (JMA), University of Hawaii Sea Level Center (UHSLC), and USA Pacific Tsunami Warning Center (PTWC), seismological and tsunami experts from Canada, Northern Ireland, Russian Federation, Turkey, and the USA, the IOC of UNESCO and its Tsunami Unit, the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), the GLOSS Group of Experts, and the International Tsunami Information Centre, and the private sector.

Over a period of one and a half days, Round-Table attendees shared information on the earthquake and tsunami hazards of Southeast Asia and the South China Sea, and the Indian Ocean, discussed the implications of the tsunami hazard on coastal communities and the ways in which to mitigate the earthquake and tsunami hazard in order to save lives and reduce property damage.

Background

In developing an Action Plan, the attendees recognize that arrangements for operation and establishment of international and regional tsunami warning systems are under the leadership of the IOC of UNESCO. IOC coordinates activities globally through tsunami warning and mitigation systems in the Indian Ocean (ICG/IOTWS), the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), and the northeastern Atlantic, Mediterranean, and connected seas (ICG/NEAMTWS), and the long-established ICG/PTWS.

Earthquake and tsunami hazards exist in the Indian Ocean, Andaman Sea, the Philippine Sea, Bohai Sea, East China Sea, South China Sea, Java Sea, Sulawesi [Celebes] Sea, Mindanao Sea, and Sulu Sea. The tsunami travel times across these seas are, in many cases, on the order of only an hour or two and consequently require a dense network of instrumentation and real or near real time data;

In particular, the Twentieth Session of ICG/ITSU [now ICG/PTWS] in October 2005 recognized that the South China Sea region is vulnerable to destructive tsunamis and requested both the PTWC and the JMA provide interim tsunami advisory services for the South China Sea and develop a communication plan for the South China Sea.

Also, the ASEAN Task Force for Tsunami Early Warning identified seismic data (July 2005) and sea level data (April 2006) to be shared amongst Member States to enable the earliest of tsunami warnings.

In addition strong common links exist between the ICG/PTWS and other operational programmes of the IOC and WMO, including the Global Sea Level Observing System (GLOSS), the Global Telecommunication System (GTS), and the global Geostationary Meteorology Satellite System, operated by European Space Agency, the Japan Meteorological Agency, and the US National Oceanic and Atmospheric Administration.

Action Plan

As a result of the Round-Table Dialogue, the following Action Plan was agreed upon:

1. Continue the significant progress on assessing earthquake and tsunami and vulnerability in Southeast Asia and the South China Sea region through the support of national and international research initiatives including historical and paleotsunami assessments.
2. Although substantial progress has been made in some countries with regard to tsunami preparedness and mitigation, there are still some gaps and weaknesses, and the countries within the region should continue efforts to address these shortcomings and to raise the general level of preparedness.
3. Build on the regional partnerships that have been developed and strengthen international partnerships through membership and active participation in ICG/PTWS and/or ICG/IOTWS.
4. Ensure long term sustainability by implementing an end-to-end framework in a multi-hazard context.
5. Urge ICG/PTWS to continue to focus on establishing regional TWS capabilities to cover the South China Sea region.
6. Countries in the region to improve sea level coverage in the South China Sea.
7. Promote the free and open exchange of real time seismic and sea level data and information to be used for national tsunami warning and event monitoring.
8. Southeast Asia and the South China Sea region should utilize or build on the PTWS, IOTWS and other existing organizations and institutions in order to achieve durability.
9. Request each country in the region to provide a 7x24 Tsunami Focal Point to the ICG/PTWS Secretariat, ITIC, to receive tsunami warnings issued by the JMA and PTWC.
10. Countries in the Southeast Asia and the South China Sea region should continue to improve their instrumentation and provide the resulting data and information in real time to PTWC and the JMA.
11. Request the ITIC continue to provide advice on the establishment of National Warning Systems, including especially public awareness and education.
12. Request the WMO and its Member National Meteorological Services continue to support the IOC through warning products and data exchange through its Global Telecommunications System (GTS), and to ensure that the GTS links are adequate for such purposes.
13. Urge capacity building organizations, such as ADPC, to continue their efforts in the region to reduce risk from all disasters, including tsunami.
14. Encourage participation in the PTWS Tsunami Exercise on May 17, 2006.
15. Recommend a follow-up meeting be held in a year's time to report on progress of this Action Plan.

The attendees expressed their appreciation to the Government of Malaysia through the Ministry of Science, Technology and Innovation and UNESCO-IOC for convening and co-hosting the Round-Table Dialogue, and the Organization of Islamic Conference – Commission on Science and Technology, and the International Tsunami Information Centre for co-sponsoring the Dialogue.

The attendees also requested that the Malaysian National Contact to ICG/PTWS report on this meeting at the ICG/PTWS-XXI in Melbourne on 3-5 May, 2006.

ANNEX II.
IOC Capacity Building Activities in support of Indian and Pacific Ocean Countries
During 2005 and 2006

During 2005 and 2006, the IOC organized and conducted a number of activities to develop capacity with countries to conduct and carry out real-time earthquake and tsunami warning. In general, these were carried as regional activities inviting several countries with the goal of supporting national systems. The topics covered were:

- Facilitating the building of detection and evaluation networks, including installation and maintenance
- Training in Tsunami Operations, Procedures, and Decision-making, including Seismic Analysis, Tsunami Warning Centers, Tsunami Emergency Response, and Alert Dissemination
- Training in Numerical Modeling, as means of tsunami risk assessment and the construction of inundation maps
- Development of Education and Awareness materials to support information sharing and increasing the knowledge base.

Philosophy. The IOC views the development of capacity as an investment in the long-term building of knowledge that includes both the “know why” and the “know how” components, and believes that any training should be building networks of people that will work together afterward to improve regional systems. As such, the traditional focus has been to develop both the operational and research capabilities in the ocean science, and related earth science disciplines, with a goal that research techniques will be transferred into improved operations. At the same time, the IOC believes that training programmes must also address other key stakeholders in a holistic way, so that for example, decision-makers and civil society can understand and be proponents for the technical data evaluations and requirements of scientists in warning operations. Finally, because resources are limited, the IOC also seeks to reach the widest audience, and to optimize / eliminate duplication through partnerships directly with countries and organizations to carry out the activities.

The ITIC believes that that most applicable and useful training experience is achieved when actual practitioners who can share both knowledge and practical experience are involved. As such, the ITIC will usually utilize warning and emergency response personnel, scientists and researchers, and national experts as guest lecturers and trainers

Activities. The following activities were carried out in 2005 and 2006:

1. Augmentation and upgrade of IOC Global Sea Level Observing System network to support tsunami warnings. With each station installation by the University of Hawaii Sea Level center, local training on station operation and maintenance is conducted. At the regional level, the IOC GLOSS programme is planning to include tsunami sea level monitoring as a training topic starting in 2007.
2. Augmentation and upgrade of IOTWS Regional Seismic Network, including training as requested by Member States. Seismology and seismic station training has been carried out by the IOC in conjunction with the US Geological Survey. These have been conducted as 1-week trainings on Seismology and Tsunami Warnings in Sri Lanka, Indonesia, Thailand, Malaysia, and the Maldives between April – August, 2006. Trainers have been from India, Indonesia, Japan, USA, IOC, PTWC, and JMA. Altogether, about 150 have attended. Additionally, Seismology and Tsunami Modeling Training was conducted in Ecuador in 2006 (2 weeks, July 2006, participants also from Peru and Colombia)

3. Tsunami Warning Centre and Emergency Response Operations and Standard Operating Procedures
 1. As above for IOC-USGS trainings, and additionally, Tsunami Warning Study Tours through ITIC ITSU Training Programme (2-weeks, January, 2006 for Indonesia and Germany; 1-week, July 2005 for IOTWS Member States; 2-weeks, 16-27 October 2006 for PTWS Member States)
 2. Expert Consultations to Indonesia on Tsunami Warning Center and Emergency Response Standard Operating Procedures, and development of Tsunami Exercises (Sept 2006 to February 2007 by IOC, PTWC, JMA experts)
 3. Training in the use of Graphical Information Systems, such as ESRI arcGIS, for improving decision-making in planning and warning operations, April 2006
4. Training in Numerical Modeling, as means of tsunami risk assessment and the construction of inundation maps (2 weeks, November 2005, Propagation and Inundation, hosted by PHIVOLCS and including ASEAN countries, 2 courses on Propagation, May-June 2006 for IOTWS countries). The last course will have Annotated Course Lectures with videos (UNESCO publication) for use in later trainings.
5. Development of Education and Awareness materials to support information sharing and increasing the knowledge base. New materials include:
 - *TsunamiTeacher* electronic resource kit for Media, Educators, and Government and Private Sector audiences, covers tsunami science and end-to-end comprehensive tsunami mitigation, including tsunami warning systems (available September 2006) and in translation of some language by the end of 2006. Available as DVD resources and by URL on web.
 - Grades 4-6, in cooperation with the Asian Disaster Reduction Center, Kobe, Japan, in Thai and English
 - *Tsunami Warning!* cartoon book describing standard operating procedures for tsunami warnings and tsunami emergency response and evacuation; English and customized/translated for Indonesia, Thailand, Sri Lanka, Maldives



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LIST OF PARTICIPANTS

BRUNEI DARUSSALAM:

Mr. Sallehuddin Haji Ibrahim
Disaster Management Officer
Brunei National Disaster Management Center
Tel: 673 23 80324
Fax: 673 23 80387
Email: sallehuddin_ndmc@brunet.bn

CAMBODIA

Ms. Vannareth Seth
Director
Department of Meteorology
Tel: (855)12 434535
Fax: (855) 23 890034
Email: dom@comnet.com.kh

INDONESIA

Mrs. Sri Woro Budiati Harijono
Chairperson of SCMG
Director General
Bureau of Meteorology and Geophysics (BMG)
Tel: 62 21 654 2983
Fax: 62 21 654 2983
Email: sriworo@bmg.go.id,
sriworo@onebox.com

Prof. Mezak A. Ratag
Director//Research & Development Center//
Bureau of Meteorology and Geophysics (BMG)
Tel: +62 21 65866238
Fax: +62 21 65866238
Email: mezakr@yahoo.com

Dr. MASTURYONO
Bureau of Meteorology and Geophysics (BMG)
Tel: +62 21 4246321
Fax: +62 21 4246703
Email: kig@bmg.go.id

Mr. Bambang Suprihadi
Bureau of Meteorology and Geophysics (BMG)
Tel: +62 21 4246321
Fax: +62 21 4246703
Email: b_supri_hadi@yahoo.com

Mr. LOEGENG RP.
Embassy of Indonesia in Vientiane, Lao PDR
Tel: 020 7614168
Email: tiopanji@yahoo.com

REPUBLIC OF KOREA

Mrs. Kim Jeongsun
Deputy Director
KMA-ROK
Tel: +82 2 836 2385
Fax: +82 2 836 2386
Email: jskim@kma.go.kr

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Mr. Singthong Pathoummady
Director
Meteorological Station Network Division
Department of Meteorology and Hydrology
Tel: (855) 21 215010
Mobile: (856) 20 538 9651
Fax: (856) 21 223446
Email: dmhvte@laotel.com
Singthong_dmh@etllao.com

Mr. Sithanh Southichack
Director
Weather Forecasting and Aeronautical Division
Department of Meteorology and Hydrology
Tel: (855) 21 215010
Fax: (856) 21 223446
Email: dmhvte@laotel.com

Mrs. Bouangeun Oudomchit
Director
Climatological Division
Department of Meteorology and Hydrology
Tel: (855-21) 215010
Fax: (856-21) 223446
Email: dmhvte@laotel.com

Mr. Kongxaysy Phommaxay
Director
Division of International Cooperation
Science Technology and Environment Agency

Tel: 020 5937179
Email: kongsaysy@stea.gov.lao

MALAYSIA

Mme. Leong Chow Peng
Deputy Director General (Application)
Malaysian Meteorological Department
Tel: +603 79 67 8002
Fax: + 603 79 55 0964
Email: lcp@kjc.gov.my

PHILIPPINES

Dr. Nathaniel Servando
Deputy Director
Philippine Atmospheric, Geophysical and Astronomical Service Ad. (PAGASA)
Tel: (632) 434 2537
Fax: (632) 434 2537
Email: ntservando@pagasa.dost.gov.ph

SINGAPORE

Ms. Wong Chin Ling
Head, Business & Corporate Affairs
Meteorological Services Division,
National Environment Agency
Tel: 65 65457194
Fax: 65 65457192
Email: wong_chin_ling@nea.gov.sg

THAILAND

Mr. Thosakdi Vanichkajorn
Deputy Director General
Thai Meteorological Department
Tel: 662 399 2355
Fax: 662 398 9229
Email: ramasoon1@hotmail.com

VIETNAM

Dr. Le Cong Thanh
Deputy Director General
National Hydro-meteorological Service of Vietnam (NHMS)
Tel: 84 48244120
Fax: 84 48260779
Email: lcthanh@netnam.vn

Dr. Nguyen Dai Khanh
Director
Science-Technology and International Cooperation Office
National Hydro-meteorological Service of Vietnam (NHMS)

Tel: 84 48244120
Fax: 84 48260779
Email: icd_hms@fpt.vn

Dr. Ngyn Ngoc Thuy
Director
Institute of Geophysics
Tel: 84 47 56 4360
Fax: 84 48 36 4696
Email: thuynn@igp.vas1.ac.vn

UNESCO

Mr. Fred Stephenson
Vice Chair
Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (IOC-ICG/PTWS)
Tel: 1 250 363 6350
Fax: 1 250 363 6323
Email: stephensonf@pac.dfo-mpo.gc.ca

WMO

Mr. Kuniyuki Shida
Programme Manager
World Meteorological Organization
Tel: +41 22 730 8318
Fax: +41 22 730 8047
Email: kshida@wmo.int

ASEAN SECRETARIAT

Dr. Donald Tambunan
Assistant Director, Head of S&T Unit
ASEAN Secretariat
Tel: 62-21-7262 991 Ext.389
Fax: 62-21-7398 234
Email: donald@aseansec.org

Mr. Emir Rio Krishna
Technical Officer, S&T Unit
Tel: 62-21-7262 991 Ext.439
Fax: 62-21-7398 234
Email: emir@aseansec.org

LOCAL SECRETARIAT

Mr. Nikhom Keosavang
Mr. Manoloth Soukhanouvong
Mr. Bounteum Sysouphanthavong
Mr. Bounseuk Inthapatha
Mr. Villiam Bounlom
Mr. Xaixana Vongsiprasom

Mr. Bounchoum Konemixay
Mr. Sithongma Phanthaphalisith
Mrs. Sinthaly Chanthana
Ms. Chitdavone Southammavong
Mr. Khammoune Kenedara
Department of Meteorology and Hydrology
Tel: (865) 21 215010
Fax: (856) 21 223446
Email: dmhvte@laotel.com

Mr. Bounthala Panyavichith
Mr. Bounyasith Chanthachac
Mr. Paseuth Sehasay
ASEAN Department
Ministry of Foreign Affairs
Tel: (856-21)-415109, Fax: 413268
E-mail:bounthala@mofa.gov.la

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List of Participants (REGISTRATION)

20th Sep. 2006

No.	Name	Country	Agency/ Organization	Telephone	Fax.
25	Mr. Nikhom Keosavang	Lao PDR	DMH	020 2209181	
26	Mr. Manoloth Soukhanouvong	Lao PDR	DMH	020 2208393	
27	Mr. Bounseuk Inthapatha	Lao PDR	DMH		
28	Mr. Villiam Bounlom	Lao PDR	DMH		
29	Mr. Bounteum Sysouphanthavong	Lao PDR	DMH		
30	Mr. Xaixana Vongsiprasom	Lao PDR	DMH		
31	Mr. Bouchoum Konemixay	Lao PDR	DMH		
32	Mr. Sithongma Phanthaphalisith	Lao PDR	DMH		
33	Mrs. Sinthaly Chanthana	Lao PDR	DMH		
34	Ms. Chitdavone Southammavong	Lao PDR	DMH		
35	Mr. Khammoune Kenedara	Lao PDR	DMH		
36	Mr. Kongxaysy Phommaxay	Lao PDR	STEA	020 5937179	
37	Mr. Bounthala Panyavichit	Lao PDR	ASEAN Dept, MOFA		
38	Mr. Bounyasith Chanthachac	Lao PDR	ASEAN Dept, MOFA		
39	Mr. Paseuth Sehasay	Lao PDR	ASEAN Dept, MOFA		