

EXPERT MEETING ON THE DEVELOPMENT OF THE JCOMM GUIDE TO STORM SURGE FORECASTING

Geneva, Switzerland 8-10 February 2006

FINAL REPORT

JCOMM Meeting Report No. 38

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NOTE

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GENERAL SUMMARY OF THE WORK OF THE MEETING

1. OPENING OF THE MEETING

1.1 Opening

1.1.1 The Expert Meeting on the Development of the JCOMM Guide to Storm Surge Forecasting (WWSS-GD) was opened by the chairperson of the Expert Team on Wind Waves and Storm Surges (ETWS), Mr Val Swail, at 9.40 hrs on Wednesday, 8 February 2006, in the WMO headquarters, Geneva, Switzerland.

1.1.2 On behalf of the Secretary-General of WMO, Mr M. Jarraud, and the Executive Secretary of IOC, Dr P. Bernal; the Chief of Ocean Affairs Division of WMO, Mr Edgard Cabrera, welcomed participants to the first meeting of the WWSS-GD. He assured participants of the full support of the Secretariat during the meeting. He concluded by highlighting the importance of an integrated approach to support coastal risk management and a critical need for closer collaboration with WMO Programmes and Commissions.

1.1.3 The chairperson presented a framework for the meeting by outlining the background, objectives and issues to be discussed. He stressed the importance of reviewing the JCOMM-II recommendations, as well as the Expert Meeting on Marine Multi-Hazard Warning Systems (J-MMWS) and the adopted action plan for JCOMM contributions to multi-hazard warning systems, in order to develop the JCOMM Guide to Storm Surge Forecasting, taking into account the existing infrastructures and programmes.

1.1.4 The list of participants in the meeting is given in Annex I.

1.2 Adoption of the agenda

1.2.1 The WWSS-GD adopted its agenda on the basis of the provisional agenda. This agenda is given in Annex II.

1.3 Working arrangements

1.3.1 The meeting agreed on the hours of work and other practical arrangements for the session. The documentation was introduced by the Secretariat, and participants made short introductions of themselves, to facilitate future interactions.

2. REVIEW OF DISCUSSIONS AND RECOMMENDATIONS OF JCOMM-II AND OF RELEVANT JCOMM PROGRAMME COMPONENTS AND ACTIVITIES

2.1 JCOMM-II results

2.1.1 The Secretariat presented an outline of the results of JCOMM-II relevant to the forecasting and warning of storm surges.

2.1.2 The meeting reviewed the following specific items of the ETWS work plan related to storm surges:

- (a) The table of contents for the Guide to Storm Surge Forecasting had been prepared;
- (b) The development of technical advice on wind waves and storm surges was underway and an ongoing activity of the team;

- (c) The development of technical advice and support to Members/Member States on wave and storm surge modelling, forecasting and services, including a review of boundary layer winds, was also an ongoing project of the team;
- (d) A Workshop on Wind Wave and Storm Surge Analysis and Forecasting for Caribbean countries was organized by the Expert Team (ET) and hosted by Canada in Dartmouth in June 2003. JCOMM also co-sponsored the 8th International Workshop on Wave Hindcasting and Forecasting;
- (e) The ET continued to provide advice to Members/Member States on development of wave and surge services;
- (f) A questionnaire was distributed to identify operational storm surge model outputs, with the results to be available online within the dynamic part of the *Guide to Storm Surge Forecasting*. A verification project would be implemented at a later date.

2.1.3 The meeting noted that no request had yet been received for the ETWS to provide expert assistance to the IOC/IHO/WMO Project on Storm Surge Disaster Reduction in the Northern Indian Ocean area. However, it was anticipated that this situation might evolve considerably as a consequence of the Sumatran tsunami disaster of 26 December 2004.

2.1.4 The meeting was informed that priority activities for the team in the intersessional period include preparation of the *Guide to Storm Surge Forecasting*, verification and inter-comparison of existing wave forecasting models in different regions, support as appropriate in establishment of multi-hazard warning systems, and strengthening its activities in training, in close cooperation with capacity building activities.

2.1.5 The meeting recalled that JCOMM-II particularly urged the ETWS to complete preparation of the *Guide to Storm Surge Forecasting* during the intersessional period. It noted that the *Guide* should raise attention to the need for addressing the vulnerability of coastal areas exposed to storm surges, and forecasting not only hazards but risks, which result from a combination of a hazard with a vulnerability. This could be done in chapter "8. Surge Disaster Preparedness" and should take advantage of the existing knowledge and know-how among WMO and IOC Programmes. This would also be in accordance with the increasing practice of NMHSs to use and deliver warning and risk hazard maps.

2.1.6 The expert meeting also reviewed Recommendation 1 (JCOMM-II) on this topic, which provided the formal justification and guidance for the work being undertaken.

2.2 ETWS-I results

2.2.1 The meeting noted with interest the reports by the ETWS chairperson related to marine multi-hazard warning systems.

2.2.2 Mr Val Swail presented an outline of the results of ETWS-I. He started his briefing by outlining the ETWS activities and developments, particularly with extra emphasis relating to storm surges. The briefing outlined the future ETWS developments, noting the importance of forecasting total water level and extreme storm seas. He concluded by informing the meeting that the next International Workshop on Wave Hindcasting and Forecasting would be held in Victoria, Canada, 24-29 September 2006, and will have as its focus the so-called extreme storm seas.

2.2.3 The meeting noted with interest the JCOMM ETWS survey on storm surge data sources and storm surge forecasting systems operated by National Meteorological / Oceanographical Services, that was conducted among WMO Members and through IOC contact points, presented by Ms María Paula Etala. The meeting also noted that twenty countries / services had responded to this section on storm surges. About 75 % of those had operational / pre-

operational models. In addition 75 % also reported regular sea level observations and / or historical records. This was the first time that an overview of operational practice regarding storm surge prediction had been documented. The compilation of the results would enrich the group's expertise and provide a reference point to guidance for members. The current state-of-the-art in operational storm surge forecast and prediction methods were described. Existing hindcast databases were enumerated. Unfortunately, the survey could not reach all involved institutions, particularly in reference to data acquisition and management. For future updates, the mechanisms of the enquiry might be revised. For instance, GOOS relevant programmes (GLOSS, GRAND, etc.) could be contacted in addition to local contact points to widen the scope of the information gathered.

2.3 Expert Meeting on Marine Multi-Hazard Warning Systems

2.3.1 The Secretariat outlined the results of the Expert Meeting on Possible JCOMM Contributions to the Development and Maintenance of Marine Multi-Hazard Warning Systems (J-MMWS). The meeting noted that the J-MMWS had developed and agreed on a range of possible contributions of JCOMM, through its Programme Areas and component Expert Teams, to multi-hazard warning systems, within the areas of expertise of the Commission. In developing these proposals, the J-MMWS recognized that they would be addressed to a number of specific audiences and targets, including:

- (i) The planned symposium on multi-hazard early warning systems (Geneva, May 2006);
- (ii) The Executive Councils of WMO and IOC;
- (iii) The GEO working group on tsunamis;
- (iv) The IOC ICGs for the different TWSs;
- (v) The WMO NDPM Programme;
- (vi) National Agencies involved in the provision of marine hazard warnings;
- (vii) IPY legacy.

2.3.2 The meeting noted that the J-MMWS had adopted an action plan for JCOMM contributions to multi-hazard warning systems, which is given in Annex III. The meeting was informed that these actions were divided into two different categories. The first set of actions is those that are immediately feasible and would be undertaken by JCOMM within the next two years. The second set of actions includes those that JCOMM could offer as a contribution to marine multi-hazard warning systems, with additional resources.

2.4 Other WMO Programmes

2.4.1 The meeting noted with interest the reports by the Chiefs of the WMO Programmes related to storm surges. The discussions that followed each presentation highlighted a number of issues, ideas, proposals and recommendations that could form the basis for the development of the annotated table of contents for the JCOMM Guide to Storm Surge Forecasting.

WMO Tropical Cyclone Programme

2.4.2 The WMO Tropical Cyclone Programme purposes and objectives were presented by Ms Nanette Lomarda (WMO Secretariat). TCP's goals are to encourage and assist its Members to:

- Provide reliable forecasts of tropical cyclone tracks and intensity, and related forecasts of strong winds, quantitative forecasts or timely assessments of heavy

rainfall, quantitative forecasts and simulation of storm surges, along with timely warnings covering all tropical cyclone-prone areas;

- Provide forecasts of floods associated with tropical cyclones;
- Promote awareness to warnings and carry out activities at the interface between the warning systems and the users of warnings, including public information, education and awareness;
- Provide the required basic meteorological and hydrological data and advice to support hazard assessment and risk evaluation of tropical cyclone disasters; and
- Establish national disaster preparedness and prevention measures.

2.4.3 The meeting was informed that capacity building is a main priority for the TCP. A number of capacity building workshops and training courses were organized by TCP, especially in developing countries to facilitate the transfer of knowledge and technology intended to improve the institutional efficiency of the NMHSs and lead to the provision of better tropical cyclone and associated flood and storm surge forecasts.

2.4.4 The meeting recalled the ongoing series of joint JCOMM-TCP training workshops on wave and storm surge forecasting. The workshops were designed to enhance local capacity and enable countries exposed to tropical cyclones to run their own marine hazard warning services. Three such workshops have been held in the Southeast Asian region, and a fourth workshop is planned by late 2006 in Manila.

WMO Hydrology and Water Resources Programme

2.4.5 Mr G. Arduino outlined the WMO Hydrology and Water Resources Programme, emphasizing the work that has been taken to develop the Manual on Flood Forecasting and Warning. He also stressed the importance of sharing the information related to this Manual with the group of experts on storm surge forecasting. He concluded informing the meeting that an item will be included in this Manual related to storm surge and its role as a boundary condition to river flood. The meeting agreed to collaborate with an expert from SCHAPI in order to avoid duplicate efforts and information.

Sea level data and metadata

2.4.6 Mr P. Kerhervé presented the outcomes of the IOTWS-I intersessional WG- 2, held in Paris on 8 March 2005. The meeting noted that the lack of a standard for the presentation of sea level data exchanged on the GTS has resulted in multiple formats being used in different systems. The meeting also noted that the specifications of code figures are not described formally in WMO or IOC manuals. The lack of standards for the presentation of data has made it difficult for data processing centres to capture and decode the sea level data in real time. The Sea Level Working Group recommended the use of the WMO code form FM 95 CREX to present the sea level data as the CREX code form is table driven, flexible, human readable and easily converted to FM 94 BUFR. Amendments to the CREX code form required to present the different types of data, e.g additions of new sequences, can be prepared in collaboration with the CBS Expert Team on Data Representation and Codes.

2.4.7 The Sea Level Working Group recommended that the metadata for all sea level and tide stations be managed by an operational system such as the WMO Publication No. 9, Vol. A – observing stations. The procedures for its updates should be carried out and maintained consistently by a responsible agency. The IOTWS-I intersessional WG-2 noted that the bulletins including sea level data are mostly non-existent in the WMO Publication No. 9, Vol. C1 - catalogue of meteorological bulletins, and this could hamper the distribution of the bulletins on the GTS.

2.4.8 The WMO Information System (WIS) is an overarching approach to meet information exchange requirements of all WMO Programmes. WIS will ensure interoperability of information systems between WMO Programmes and outside of the WMO community. The WIS approach for the interoperability is the development of a WMO Profile of the ISO 191xx series of standards for defining, describing and managing geographic information, starting with the development of the WMO Core Profile of the ISO 19115 Metadata Standard for the discovery of data. The use of the ISO 191xx series of standards for the access and use of the data will be further considered.

2.4.9 The meeting noted the development of a new edition of the Guide on World Weather Watch Data Management. The Guide is being designed for electronic publication. The meeting agreed that the JCOMM Guide to Storm Surge Forecasting should include links to the Guide on World Weather Watch Data Management when referring to WWW procedures and practices, such as the procedures to update the WMO Publication No. 9, Vol. C1 - catalogue of meteorological bulletins.

3. REVIEW OF EXTENDED OUTLINE FOR THE DRAFT GUIDE PREPARED BY THE EXPERT CONSULTANT BASED ON THE AGREED TABLE OF CONTENTS

3.1 Dr Tad Murty presented an extended outline for the table of contents of the Guide to Storm Surge Forecasting. He suggested some improvements to the approved table of contents during JCOMM-II, and proposed a new format more practical than theoretical.

3.2 Professor Igor Lavrenov also presented a proposal for a table of contents. The meeting, based on both suggestions, discussed each section in order to develop a new table of contents.

4. FURTHER DEVELOPMENT OF SPECIFIC CONTENT FOR EACH SECTION AND SUB-SECTION OF THE GUIDE

4.1 Based on information and extensive discussions under the preceding agenda items, the meeting developed and agreed on the table of contents for the Guide, considering its scope and objective. The meeting agreed to contribute towards the development of the sections and sub-sections. The meeting assigned responsibilities related to the writing of each section and sub-section. The meeting also agreed on the level of detail and content being developed.

4.2 Some effort was devoted to further developing the sections during the meeting time itself. A revised annotated table of contents and the names of the experts responsible for producing the drafts of the sections and sub-sections of the Guide are given in Annex IV. A detailed annotated table of contents was developed and it will be distributed to the authors.

5. PREPARATION OF A JCOMM STORM SURGE GUIDE IMPLEMENTATION PLAN

5.1 On the basis of the proposals developed and discussed under agenda item 4, the meeting adopted an implementation plan for the preparation of the JCOMM Guide to Storm Surge Forecasting. The meeting set the following time frame for producing the Guide:

- End of June 2006: Experts responsible for the sections and sub-sections of the Guide (see Annex IV) would submit their input to Mr Val Swail with a copy to the WMO Secretariat.
- First week of July 2006: The WMO Secretariat would compile the input and prepare the first draft of the Guide to be distributed to the expert meeting for comments and reviews.
- The first draft of the Guide will be circulated to the participants and to other reviewers as appropriate. The reviewers' comments should be sent to the Secretariat with copy to Mr Val Swail by the end of August 2006.

- Dr Tad Murty, in light of the comments received, will revise the first draft with the cooperation of the authors if needed. A second draft will be submitted to the Secretariat by the end of October 2006. At this stage the Secretariat, Mr Val Swail and Dr Tad Murty will decide if an expert meeting with the group is needed.
- End of December 2006: A final draft of the Guide will be submitted to the Secretariat. At this stage, a meeting with the Secretariat, Mr Val Swail and Dr Tad Murty would be scheduled if needed.
- January or February 2007: A final draft of the Guide will be submitted to the ETWS-II (proposed to be held in Melbourne) for review and approval by the entire team.
- End of June 2007: The Guide will be edited linguistically. The final layout and format will be prepared and reviewed by the Secretariat, Mr Val Swail, Dr Tad Murty and Professor Igor Lavrenov. Printing will be handled by the WMO Secretariat.

6. REVIEW OF WWSS-GD session report and action items

6.1 The meeting reviewed, revised and adopted the final report of the session, including the annotated table of contents and the implementation plan.

7. CLOSURE OF THE SESSION

7.1 The Expert Meeting on the Development of the JCOMM Guide to Storm Surge Forecasting (WWSS-GD) closed at 13.30 hours on Friday, 10 February 2006.

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AGENDA

- 1. OPENING**

- 2. REVIEW OF DISCUSSIONS AND RECOMMENDATIONS OF JCOMM-II AND OF RELEVANT JCOMM PROGRAMME COMPONENTS AND ACTIVITIES**
 - 2.1 JCOMM-II results
 - 2.2 ETWS-I results
 - 2.3 Expert Meeting on Marine Multi-Hazard Warning Systems
 - 2.4 Other WMO Programmes (DPM, TCP, Hydrology)

- 3. REVIEW OF EXTENDED OUTLINE FOR THE DRAFT GUIDE PREPARED BY THE EXPERT CONSULTANT BASED ON THE AGREED TABLE OF CONTENTS**

- 4. FURTHER DEVELOPMENT OF SPECIFIC CONTENT FOR EACH SECTION AND SUB-SECTION OF THE GUIDE**

- 5. PREPARATION OF A JCOMM STORM SURGE GUIDE IMPLEMENTATION PLAN**

- 6. CLOSURE**

ACTION PLAN FOR JCOMM CONTRIBUTIONS TO MULTI-HAZARD WARNING SYSTEMS

Action	Responsibility	Timeline	Result of action
WILL DO NOW			
Tsunamis, cyclones and storm surges			
Work with all ICGs for TWSs to develop CREX code for SL data transmission in real-time on the GTS	DMPA in coordination with OPA (GLOSS)	May 2006 (for approval by CBS)	Code form published and in operation
Develop and publish QC standards for real-time GTS transmission of SL data	DMPA in coordination with OPA (GLOSS)	May 2006	Published QC form in operation
Cooperate with IHO and IMO to coordinate the provision of maritime safety information (MSI) related to tsunami warnings	SPA (ETMSS)	Late 2006	Update JCOMM, IHO and IMO guidance and regulation materials to incorporate tsunamis related to tsunamis
Contribution to OceanTeacher (include module on applications of data to marine hazards)	DMPA in coordination with IODE, SPA, OPA	2006	Local capacity building
Maintenance of guides on wave and storm surges	SPA (ETWS)	Ongoing	Input to JCOMM NDPM and other relevant programmes guidance materials related to marine hazards
Maritime safety and others			
Review and develop linkages with ongoing IPY projects	Co-presidents	2006-07	Improvement of observations, data delivery and ensurance of marine safety during and after IPY
Update guidance material related to maritime accidents	SPA (ETMAES)	Late 2006	Improve provision of services in response to marine accidents
Update guidance and regulation materials related to MSI	SPA (ETMSS, ETWS)	Ongoing	Improve description of sea state in MSI
Update guidance and regulation materials related to MSI in polar regions (including improved coordination, dissemination, information content, guidance material)	SPA (ETMSS, ETSI)	Ongoing	Enhance provision of MSI in polar regions
In cooperation with IMO and IHO, define boundaries for new Metareas covering the Arctic Ocean; define responsibilities for dissemination of Metocean MSI for all polar regions	SPA (ETMSS, ETSI)	Late 2006	Enhancement of marine safety operations in polar regions; contribute to update of IMO regulations
Develop standards for ice hazard warning in text bulletins	SPA (ETMSS, ETSI)	Late 2006	Update of JCOMM guidance and regulation materials
Development of web-portal for polar operational information, including warnings (possibly on the basis of Polarview proposal)	SPA (ETSI, ETMSS)	Prior to IPY and follow-up	Single-point access for MSI for IPY participants and ongoing applications (post-IPY)

Action	Responsibility	Timeline	Result of action
Develop presentation and dissemination models for sea ice and icebergs; update and extend existing guidance material for sea ice	SPA (ETSI)	Ongoing	Update to WMO Publications
Definition of objects (including graphical presentation) for met-ocean parameters within ECDIS (and future open formats) in liaison with IHO and ISO	SPA (ETSI, ETMSS), co-presidents	May 2006 for sea ice; ongoing for other parameters	Update to IHO catalogue; provision of JCOMM documentation
OFFER TO DO (subject to requirements and resources)			
Archive of data of extreme wave events	DMPA (ETMC) in collaboration with IODE and SPA	Long-term (2007+)	Improve way models handle extreme wave events; input to risk assessments
Archive of data of storm surge events	DMPA (ETMC) in cooperation with SPA, OPA	Long-term (2007+)	Partly for risk analysis (frequency of occurrence); model validation
E2EDM - implementation of prototype in a multi-hazard environment (perhaps as work with WIS)	DMPA	2007	Demonstration project
DBCP offer to support DART Consortium (issues include real-time GTS data reporting, deployment, potential multi-purpose buoys, code format, QC)	OPA (JCOMM co-president to provide Consortium contact details)	May 2006	Integration into global ocean observing system; increased efficiency of deployment facilities; evolution towards multi-use platforms
Observational network analysis (what assets are available) of data to contribute to marine hazard warnings	OPA	2006-07	Interactive data base sortable by application
Upgrade and expansion of GLOSS stations for real-time multi-hazard warnings	OPA (GLOSS)	2006-07	Enhancement of multi-hazard warning systems
Work with IPY participants to identify requirements for sustained marine polar observing systems	OPA	2007-09	Enhancement of multi-use observing system; improved global coverage
Long-term maintenance of required marine polar observing systems	OPA	2009	Enhancement of multi-use observing system; improved global coverage
Continued SL training including maintenance of gauges and use of data (archiving, access and multi-hazard applications)	OPA (GLOSS)	ongoing	Local ability to use SL data; long-term health of GLOSS network
Training for applications of ocean data to multi-hazard warning systems	OPA, SPA	Ongoing	Enhance local capacity to use ocean data
Improve coordination with IMO/MEPC	SPA (ETMAES)	Ongoing	Metocean support to IMO Regional Response Centers such as REMPEC
Integrate MAES capabilities into RSMCs framework	Secretariat	Ongoing	Creation of MAES RSMCs
Develop project to provide information (including improved reception) to non-	SPA	2007-09	Improved MSI dissemination systems

Action	Responsibility	Timeline	Result of action
SOLAS vessels and coastal users			for non-SOLAS vessels (especially off West Africa and Bay of Bengal)
Provide climatology on sea ice hazards (iceberg propagation, sea ice/old ice boundaries) and other marine hazards	SPA (ETSI and others), DMPA (ETMC)	2007	Improve model validations; input to risk assessments
Ensure capacity building elements on storm surges are incorporated into existing projects (e.g., SEACAMP, WIOMAP, MILAC); liaise with TCP regarding CB (especially with RSMCs)	SPA (ETWS)	2007	Enhance local capacity through MILAC, WIOMAP, SEACAMP
Continuation of workshops in collaboration with WMO/TCP (work with TCP RSMCs to extend and expand to all tropical cyclone areas)	SPA	2006 then ongoing	Enhance local capacity in storm surge, sea state and wind wave analysis and forecast

ANNOTATED TABLE OF CONTENTS

Guide to Storm Surge Forecasting

The objective of the Guide is to produce a simple, usable, manual for use in developing an operational storm surge forecasting capability, and not a theoretical textbook. The Guide will discuss physical and numerical aspects of storm surge forecasting and include numerous examples of storm surge forecast applications. The anticipated length of the Guide is approximately 150 pages.

1. Introduction and General considerations (Dr Tad Murty)

Oceanographic Aspects of Storm Surges, including ice; Meteorological Aspects of Storm Surges; Factors contributing to disastrous surges; Methods of Storm Surge Prediction; Empirical Methods; Numerical Methods; Statistics models.

2. Storm Surge physics (Professor Igor Lavrenov)

Meteorological Input; Oceanographic Inputs; Location specific inputs (Ms María Paula Etala); Hydrological Input; Tide-Surge Interaction (Ms María Paula Etala); Surge-River Interaction; Surge-Wind Wave Interaction and Setup (Dr Tad Murty); Storm Surge-Ice Interaction; Bottom friction.

3. Basic Equations and Methods of Solutions (Dr Tad Murty)

Formulation of the Storm Surge Equations; Computational Stability; Staggered and Nonstaggered Grid Schemes; Finite Differencing of Time Derivative; Treatment of Open Boundaries; Treatment of complex coastal boundaries; Treatment of the Nonlinear Advective Terms; Moving Boundary Models and Inclusion of Tidal Flats; Finite Element Schemes; Coastal Inundation.

4. Input and Output parameters (Mr Hans de Vries; Contributions: Mr Denis Paradis, Professor Igor Lavrenov (ice), Dr Jang-Won Seo, Ms María Paula Etala (tides) and Mr Masakazu Higaki).

Accuracy of meteorological input required; Strength and weakness of existing wind models; Accuracy of oceanographic input required; Accuracy of location specific inputs required; Accuracy of hydrological input required; Accuracy of ice input required; Output parameters.

5. Storm Surge Prediction Models

Operational 2D Models (Ms María Paula Etala) and 3D Models (Dr Tad Murty); Merits and Limitations of Operational Models (Ms María Paula Etala); Research models (3D, ...) (Dr Tad Murty; Contribution: Mr Hans de Vries (data assimilation)); Merits and Limitations of Research Models (Dr Tad Murty); Ensemble forecast (Mr Hans de Vries).

6. Model validation and forecast verification (Mr Val Swail + ?)

Model validation; Forecast verification.

7. Regional forecast scenarios (Dr Kevin Horsburgh)

- 7.1 Introduction (Dr Kevin Horsburgh)
- 7.2 Tropical Cyclone generated Storm Surges
 - 7.2.1 Introduction (Dr Kevin Horsburgh)
 - 7.2.2 NW Pacific (Dr Jang-Won Seo and Mr Masakazu Higaki)
 - 7.2.3 SW Pacific (Mr Graham Warren ?)
 - 7.2.4 Central E Pacific (Hawaii ?)
 - 7.2.5 N Atlantic including Caribbean (NHC ?)
 - 7.2.6 W Australia (Mr Graham Warren ?)
 - 7.2.7 SW Indian Ocean (Mr Doug Scott ? and Mr Denis Paradis)
 - 7.2.8 Bay of Bengal / Arabian Sea (Dr Tad Murty)
- 7.3 Extratropical Cyclone generated Storm Surges
 - 7.3.1 Introduction (Dr Kevin Horsburgh)
 - 7.3.2 North Sea (general case) (Mr Hans de Vries)
 - 7.3.3 Argentina (estuary case) (Ms María Paula Etala)
 - 7.3.4 Baltic Sea (Enclosed Seas case) (Professor Igor Lavrenov)
- 7.4 Storm surge in the Arctic seas and seas covered by ice (Professor Igor Lavrenov)

8. Storm Surge Statistics (Mr Val Swail)

9. Storm Disaster Preparedness (Dr Philippe Dandin ?)

ACRONYMS AND OTHER ABBREVIATIONS

BUFR	Binary Universal Form for the Representation of meteorological data
CBS	Commission for Basic Systems
CREX	Character form for the Representation and EXchange of data
ET	Expert Team
ETWS	Expert Team on Wind Waves and Storm Surges
GEO	Group on Earth Observations
GLOSS	Global Sea Level Observation System
GOOS	Global Ocean Observing System
GRAND	GOOS Regional Alliances Networking Development
GTS	Global Telecommunication System (WWW)
ICG	Intergovernmental Coordination Group
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOTWS	Indian Ocean Tsunami Warning and Mitigation System
IPY	International Polar Year
ISO	International Organization for Standardization
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
J-MMWS	Expert Meeting on Possible JCOMM Contributions to the Development and Maintenance of Marine Multi-hazard Warning Systems
NDPM	Natural Disaster Prevention and Mitigation
NMHS	National Meteorological and Hydrological Service
SHAPI	Service Central d'Hydrométéorologie et d'Appui à la Prévention des Inondations
TCP	Tropical Cyclone Programme
TWS	Tsunami Warning and Mitigation System
WIS	WMO Information System
WG	Working Group
WMO	World Meteorological Organization
WWSS-GD	JCOMM Guide to Storm Surge Forecasting
WWW	World Weather Watch