WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY

# EXPERT TEAM ON WAVES AND COASTAL HAZARDS FORECASTING SYSTEMS FOURTH SESSION

Paris, France, 3 – 6 April 2013

## *FINAL REPORT*

**JCOMM Meeting Report No. 103**

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## NOTES

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**Regulation 43 (WMO-No.15)**

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

**Regulation 44 (WMO-No.15)**

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of that body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9 (5).



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**C O N T E N T S**

## GENERAL SUMMARY OF THE WORK OF THE SESSION

## 1 OPENING OF THE SESSION

### 1.1 Opening

1.1.1 The fourth session of the Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH; formerly the Expert Team on Wind Waves and Storm Surges, ETWS) of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was opened by Dr Kevin Horsburgh, ETWCH chairperson, at 0930 hrs on Wednesday 3 April 2013, in Room VII at the headquarters of UNESCO, Paris, France.

1.1.2 Dr Horsburgh welcomed all participants in the session, and welcomed newly appointed members of ETWCH through the 4th session of JCOMM (JCOMM-4, May 2012, Yeosu, Korea). He noted that the main goal of this session was to review the JCOMM-4 decisions relevant to the Team's work, in particular the JCOMM intersessional workplan (2012-2017) in contribution to WMO and IOC's long-term goals.

1.1.3 The list of participants is provided in ***Annex I***.

### 1.2 Adoption of the agenda

1.2.1 The Team adopted its agenda for the session, which is provided in ***Annex II***.

### 1.3 Working arrangements

1.3.1 The Team agreed its working hours and other practical arrangements for the session. Following the usual practice of JCOMM meetings, the meeting (including the documentation) was conducted in English only. All documents and information were provided through the meeting web site: http://www.jcomm.info/ETWCH4.

## 2 GUIDANCE AND REQUIREMENTS FROM JCOMM AND WMO-IOC

*Decisions of WMO governing bodies relevant to ETWCH activities*

2.1 Dr Boram Lee, WMO Secretariat, reported on the relevant decisions to the work of Services and Forecasting Systems Programme Area (SFSPA), which were made at the 64th session of the WMO Executive Council (June 2012, Geneva, Switzerland): At the 4th session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM-4, May 2012, Yeosu, Republic of Korea), all Groups and Teams including the ETWCH were re-established with revised Terms of References. All the decisions, resolutions and recommendations of JCOMM-4 were adopted through the *WMO Resolution 2 (EC-64) – Report of the fourth session of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology*.

2.2 The Team noted the request of WMO Executive Council to all technical commissions, including JCOMM, to align their activities to Quality Management System (QMS) principles, considering that QMS is primarily a management tool to ensure customer focus, corrective and preventive action, and continuous improvement of products and services. Building on the successful and ongoing JCOMM QMS pilot project implemented by

the Australian Bureau of Meteorology, it was decided at JCOMM-4 to develop competency requirements for marine meteorology and oceanography through an ad hoc Task Team on Marine Competency Requirement (http://www.jcomm.info/TT-MCR), following the Recommendation 5 (JCOMM-4). The Team noted with interest the plan of this Task Team to prepare and submit the first draft to the JCOMM Management Committee for its 10th session (7-10 May 2013, Paris, France), and agreed to provide input to the Services and Forecasting Systems Coordination Group (SCG) for the internal review of the draft requirement document for the part of Team's expertise, once submitted by the ad hoc Task Team ***(Action; all members led by K.Horsburgh, when the draft document is submitted and not later than December 2013)***.

2.3 The Team took note of WMO's ongoing efforts for, and progress in, the establishment of the Global Framework for Climate Services (GFCS). It recalled that contributing to GFCS implementation for marine and coastal communities was recognized as a programmatic priority of the parent organizations of JCOMM, and that a number of Teams' activities are directly related to various GFCS components. The Team agreed to continue its efforts, along with implementing its intersessional workplan, in supporting marine and coastal services for hazard forecasting and related climate study. The following components of the intersessional workplan, while not excluding other relevant activities, were identified as the direct and immediate contribution to the GFCS implementation:

- Developing a GFCS component for coastal inundation forecasting and warning, through CIFDP [Project #14 of the SFSPA workplan 2012-2017],

- Establishing a storm surge climatology and contribution to the JCOMM-WCRP Coordinated Wave Climate Projection (COWCLIP) [Project #8 of the SFSPA workplan 2012-2017].

*Outcomes and Decisions of JCOMM-4 and SCG-7 relevant to the work of ETWCH*

2.4 The Team recalled the list of priority activities endorsed at JCOMM-4 (May 2012, Yeosu, Republic of Korea) that relate directly to the work of the Team, as follows:

- Maintain and update technical documentation (and their dynamic parts), including the Guide to Storm Surge Forecasting (WMO-No. 1076), Guide to Wave Analysis and Forecasting (WMO-No. 702), and relevant parts of the Manual on the Global Data Processing and Forecasting System (GDPFS, WMO-No.485);

- Continue supporting Members/Member States to develop and implement the National Sub-Projects of the Coastal Inundation Forecasting Demonstration Project (CIFDP, http://www.jcomm.info/CIFDP). This work further aims to provide advice for regional and national forecast/warning systems for coastal meteorological/oceanographic hazards;

- Support Members/Member States in establishing Extreme Wave datasets and storm surge climatologies;

- Extend cooperative activities with IOC Working Group on Tsunamis and Other Hazards related to Sea Level Warning and Mitigation Systems (TOWS-WG) for multi-hazard approach;

- Lead research efforts for coordinated wave climate projection (COWCLIP).

- Maintain and update requirements documents for ocean applications, including WMO Rolling Review of Requirements (RRR) and Statements of Guidance (SoG);

- Continue leading the wave forecast verification scheme (http://www.jcomm.info/wave), and support verification/evaluation activities through the Pilot Project on Wave Evaluation and Test (PP-WET, http://www.jcomm.info/WET);

- Continue supporting the Storm Surge Watch Scheme (SSWS), including training workshops on storm surge and wave forecasting (JCOMM/TCP training workshop series);

2.5 Dr Kevin Horsburgh, ETWCH chairperson, provided a brief summary of the agreed workplan of the Team for the intersessional period 2012 – 2017 (http://www.jcomm.info/SPAWP), which was introduced to and reviewed by the JCOMM SCG at its 7th session (SCG-7; 4-6 March 2013, Tokyo, Japan), noting that it remains as a dynamic document for necessary update. The identified "projects" to be led by the Team include:

- Project #8: Wave and Surge Climate Services

- Project #9: Implement recommendations from JCOMM Storm Surge Symposium

- Project #10: Develop and update guidance documents

- Project #11: Wave Forecast Verification

- Project #12: Wave measurement Evaluation and Test

- Project #14: Coastal Inundation Forecast Demonstration Project (CIFDP)

The "Projects" to be implemented by other teams' leadership, and with the Team's input are:

- Project #2: Observational Requirements

- Project #4: Ocean Extremes Monitoring System

- Project #13: Capacity Development

- Project #20: Catalogue on Met-Ocean Object Class for ENC and e-Navigation

2.6 The Team reviewed the identified deliverables, timelines and milestones for those projects, and agreed to implement those projects in a collective manner among the Team members and with related Teams, Groups and Programmes. The related decisions are described under agenda items 3 and 4.

## 3 KEY INTERSESSIONAL ACTIVITIES

### 3.1 Technical advice for marine meteorological and oceanographic services

*Guide to Wave Analysis and Forecasting (WMO-No. 702)*

3.1.1 The Team recalled the discussion at JCOMM-4 recognizing the value of the Guide to Wave Analysis and Forecasting (WMO-No.702) and other relevant technical guidance publications, and the request to revise this publication before JCOMM-5 in 2017.

3.1.2 Dr Thomas Bruns provided a brief report consolidating proposed changes to the current version of WMO-No.702. The Team reviewed those changes, and agreed on the work for revision as follows ***(Decision;*** and see ***Annex III*** for further details**)**:

- Dr Thomas Bruns would act as overall editor for the revised Guide and would take responsibility for any forewords and/or preface;

- Preface would include a short description on updates since the 1998 edition, and an elaborated description of users/audience of the Guide WMO-No.702;

- Chapter 1 would be reviewed and edited with additional material on wave spectra (F. Ocampo-Torres) ;

- Chapter 2 would be reviewed and edited as necessary (T. Bruns with input from V. Swail);

- Chapter 3 would be reviewed and edited as necessary (H. Tolman and J. Bidlot);

- Chapter 4 would be revised with additional material on Canadian dynamic fetch and parametrictropical cyclone methods (D. Greenslade with input from S. Desjardins);

- Chapter 5 would be reviewed and edited as necessary (J. Bidlot and H. Tolman);

- Chapter 6 would be revised with additional material on ensembles and data assimilation (D. Greenslade and A. Saulter);

- Chapter 7 would be incorporated in chapters 1, 3 and 5;

- Chapter 8 would be reviewed and revised as necessary, particularly for the terms/glossary (F. Ocampo-Torres with input from V. Swail on PP-WET);

- Chapter 9 would be removed (V. Swail to check for relevant material that could be used in other chapters);

- Dr Diana Greendlade would provide a final proofread, following internal and external review.

3.1.3 The Team expressed its appreciation to the members volunteering for this work, and agreed on the following schedule ***(Decision and Action)***:

- April 2013 — To identify editors for each chapter (see paragraph 3.1.2). T.Bruns to distribute an editable version of the Guide (WMO-No. 702) to editors;

- July 2014 — To start internal review of updated chapters, and agree on external reviewers;

- October 2014 — Peer review;

- January 2015 — Final version ready for proof-reading;

- March 2015 Proofread version acceptable for WMO Publications.

3.1.4 To ensure timely implementation of this plan, the Team requested the WMO Secretariat to provide necessary support, particularly for; 1) internal Team review and final revision of the updated chapters (in 2014); 2) supporting the Team to organize and conduct a peer review of the revised WMO-No.702 (in 2015) ***(Action; WMO Secretariat in coordination with T.Bruns; following the timeline described in para 3.1.3)***.

3.1.5 The Team agreed on the need to develop a dynamic part of the Guide (WMO-No. 702) for; 1) those parts requiring frequent and regular update; and, 2) describing up-to-date practices, procedures and specification that would help users to improve wave forecasting and hindcasting activities. Following the cases for other Manuals and Guides, the Team agreed to conduct a survey to collect information on the currently existing wave forecast services and related activities.

3.1.6 The Team, after discussion, agreed on the outline of a questionnaire as reproduced in ***Annex IV***. The Team noted with appreciation that Ms Paula Etala would finalize the questionnaire and analyze the collected information to become a dynamic part of the Guide (WMO-No.702) ***(Action; P.Etala; following the timeline described in paragraph 3.1.7)***. The Team requested the WMO Secretariat to provide necessary support for communication and collection of responses, in conducting this survey for JCOMM Members ***(Action; WMO Secretariat; following the timeline described in paragraph 3.1.7)***.

3.1.7 The Team agreed on the following schedule to conduct a survey for JCOMM Members on wave forecasting and related activities, as follows ***(Decision)***:

- May 2013 Comments from Team members on structure and content of questionnaire to be provided to P. Etala (questionnaire should reflect the fact that not all centres run their own wave models);
- July 2013 Final version of questionnaire to be sent to forecast centres of JCOMM Member countries and the European Centre for Medium-Range Weather Forecasts (ECMWF);
- Dec 2013 Evaluation of the returned questionnaires;
- Dec 2014 Set up of a Wiki for communication amongst editors, password protected.

3.1.8 The Team emphasized the importance of regular update for those dynamic parts of official publications, once developed. In this context, the Team expressed its appreciation to Ms Paula Etala to be in charge of regular review to determine and take actions for the update of the dynamic part of WMO-No.702 during the intersessional period ***(Action; P.Etala; upon the establishment of a dynamic part and ongoing).***

*Guide to Storm Surge Forecasting (WMO-No.1076)*

3.1.9 The Team recalled that a Guide to Storm Surge Forecasting (WMO-No.1076) was published in 2011. The current version of this Guide included a dynamic part (http://www.jcomm.info/SSguide), based on a survey in 2005 on storm surge operational models and data. The Team noted and agreed on the need to conduct a new worldwide survey to update information on currently available storm surge forecasting systems.

3.1.10 Ms Paula Etala presented proposed questionnaires for all JCOMM Members, designed with objectives of; 1) updating the dynamic part of the Guide (WMO-No.1076), http://www.jcomm.info/SSguide; and, 2) providing baseline datasets to contribute to the task of the establishment of a storm surge climatology. The questionnaire would comprise three parts: (a) a request to catalogue and document storm surge numerical forecasting systems, operational practices, and regular validation procedures; (b) a request for information on data bases obtained from surge model hindcasts, methods of analysis or reanalysis, and the climatological information therein; (c) a request for an inventory of observational data for storm surges and related climatology. The Team reviewed and agreed on the draft questionnaires as reproduced in ***Annex V*** , with further amendment to be made by responsible members ***(Decision)***.

3.1.11 The Team noted with appreciation that Ms Paula Etala would finalize the questionnaire and analyze the collected information to become a dynamic part of the Guide (WMO-No.1076) ***(Action; P.Etala; following the timeline described in paragraph 3.1.11)***. The Team agreed on the following schedule to conduct a survey for JCOMM Members, and requested the WMO Secretariat to provide necessary support for communication and collection of responses ***(Action; WMO Secretariat; following the timeline described in paragraph 3.1.11)***:

- May 2013 Comments from Team members on the questionnaires to be provided to P. Etala;
- July 2013 Final Version of questionnaire to be sent to all JCOMM Members;
- Dec 2013 Evaluation of the returned questionnaires;
- Sep 2014 Analysis of responses and proposed update to the dynamic part of the Guide (http://www.jcomm.info/SSguide) to be compiled. Update of the dynamic part to be completed subsequently.

3.1.12 The Team agreed that Dr Kevin Horsburgh, in coordination with all Team members, would regularly review the contents of the dynamic part of the Guide (WMO-No.1076) against the published Guide ***(Action; K.Horsburgh with input from all members; ongoing during the intersessional period)***.

*White Paper on forecasting dangerous sea states*

3.1.13 Regarding the sea state in marine weather information for the Global Maritime Distress and Safety system (GMDSS), the Team noted that currently the majority of Issuing Services providing Maritime Safety Information (MSI) for GMDSS provide information on the significant wave height only, generally using the Douglas scale. Considering that many accidents have occurred in coastal or open seas due to sea state, where significant wave heights were far below the thresholds fixed for the vessels, the Team agreed on the need for significant improvement to address the complex (e.g. crossing seas) or unusual (e.g. steep sea, risk of abnormal or freak waves, breaking wave intensity) sea state. Key parameters and related thresholds, if any, should be defined to provide more useful information for the safety of vessels and crews in complex and dangerous seas, in association with the ship masters, owners and manufacturers. The provision of improved sea state products should then be promoted among the Issuing Services and the WMO recommendations and guidelines updated accordingly.

3.1.14 In this regard, the Team noted the request made at JCOMM-4 to ETWCH and the Expert Team on Maritime Safety Services (ETMSS) to continue developing proposals to include information on complex sea states as well as associated terminology in weather and

sea bulletins to be disseminated through SafetyNET and NAVTEX, of which the respective amendment should be made in the WMO Manual on Marine Meteorological Services (WMO-No. 558) as well as the Catalogue on MetOcean Object Classes and Attributes, once they are agreed by Members of WMO and the International Maritime Organization (IMO) following the established procedure.

3.1.15 The Team noted with interest the presentation by Mr. Nadao Kohno on methods currently under development in the Japan Meteorological Agency (JMA) for forecasting of dangerous sea states. In particular, work has been carried out on topics of multiple wave trains, and wave-current interactions. The Team agreed that these initiatives would form a very important contribution to the development of improved wave forecast guidance.

3.1.16 The Team therefore agreed to continue its efforts to draft a white paper on this issue, during the intersessional period **(*Action; lead A.Saulter with input from all members; first consolidated edition by 13th Waves Workshop, October 2013, and a final edition by January 2014*)**. It should address the key elements which could be considered as contributing to potentially dangerous sea states, including discussion on development requirements for standardized forecasts.

### 3.2 Contribution to climate services for waves and surges

*Extreme Wave Dataset*

3.2.1 Mr Val Swail provided a report on the activities during the past intersessional periods and plans regarding the development of the Extreme Wave Data Set (EWDS). The Team recalled the discussion at JCOMM-4 on the initiative of ETWCH in collaboration with the JCOMM Expert Team on Marine Climatology (ETMC) to develop and maintain the EWDS, requesting ETMC and ETWCH to revisit and possibly restructure the project with a simpler (less costly to implement) initial design and product (action 7.2.11 of JCOMM-4).

3.2.2 The Team noted ETWCH's cooperating role for this task, while Mr Scott Woodruff of the ETMC would lead the development of the EWDS, including; 1) scanning the in situ archives at the USA National Oceanographic and Climatic Data Centers (NODC and NCDC), the USA National Data Buoy Center (NDBC), the International Comprehensive Ocean-Atmosphere Data Set (ICOADS, USA), and the Integrated Science Data Management (ISDM, Canada); and, 2) independently scanning the Global Collecting Centres (GCCs) data sets in the United Kingdom and Germany.

3.2.3 Mr Swail also noted that; 1) the International Association of Oil and Gas Producers (OGP) Metocean Committee has also expressed interest in scanning their own databases, which contain comprehensive records of wave observations; and, 2) Oceanweather, on behalf of Environment Canada, has scanned, and continues to scan, the GlobWave altimeter data base and is developing a global data set from that, which can be included in EWDS. Oceanweather made a presentation to the GlobWave User Consultation Meeting November 8 in Lisbon recommending that a mechanism be considered for the ongoing scan of the altimeter database for contribution to the EWDS.

3.2.4 The Team noted that scans were presently being carried out on behalf of Environment Canada for all Canadian and US in situ data bases, and that the GlobWave altimeter scans have already been completed. In addition, the Global Collecting Centre in the United Kingdom has also completed a scan of its in situ data base. The results of these scans will be extremely useful in developing a simple design for an effective data set of extreme waves. The Team noted and agreed with the direction proposed by ETMC, and requested Mr Val Swail to work with ETMC to develop a proposal for the proposed scanning projects for US and Canadian data ***(Action; V.Swail in coordination with S.Woodruff; by***

***July 2013)***, and agreed to provide review and comment on the proposal ***(Action; F.Ocampo-Torres and H.Tolman; October 2013)***. The Team requested Mr Swail and Mr Woodruff to prepare a presentation at the fourth Workshop on Advances in Marine Climatology (CLIMAR-4, tentatively scheduled for Asheville, USA, in the 1st quarter of 2014) on the progress ***(Action; V.Swail and S. Woodruff; by 1st quarter of 2014)***.

*Joint JCOMM-WCRP project on Coordinated Ocean Wave Climate Projections*

3.2.5 The Team recalled that JCOMM and the World Climate Research Programme (WCRP) had jointly supported the initiation of the Coordinated Ocean Wave Climate Projections (COWCLIP, http://www.jcomm.info/COWCLIP), through its first workshop held at the headquarters of WMO from 11 to 13 April 2011.

3.2.6 Mr Val Swail provided an outline of COWCLIP, which aims to generate wave climate projections (ultimately of global extent) and aid comprehensive assessments on their cascading uncertainty, by:

- Providing a systematic, community-based framework and infrastructure to support validation, intercomparison, documentation and data access for wave climate projections forced from CMIP5 datasets;

- Describing best practices for regional wave climate projections, and ;

- Engaging interests of the wave community into the wider climate community and ultimately developing coupled wind-wave Atmosphere-Ocean global climate models to support quantification of wind-wave driven feedback in the coupled climate system.

3.2.7 The Team noted that the phase 1 of COWCLIP was completed in 2012 with the publication of a manuscript (in Nature Climate Change) detailing inter-comparison of the first community ensemble of global wave climate projections. Noting considerable limitations of the phase 1 dataset in quantifying the source of variance between available studies, as the ensemble spanned different emission scenarios, the Team agreed with the outline of COWCLIP phase 2 for more designed approach using CMIP5 derived datasets. The Team welcomed a plan to present COWCLIP activities to the 13th International Workshop on Wave Hindcasting and Forecasting (http://www.waveworkshop.org. See also item 3.4) by organizing a session on wave climate and a parallel meeting on COWCLIP review ***(Decision & Action; V.Swail and M.Hemer; October 2013)***, and encouraged the members to participate in and support the COWCLIP activities and review.

### 3.3 Operational wave forecast verification

*JCOMM Wave Forecast Verification*

3.3.1 Dr Jean Bidlot provided a briefing on the status of the Wave Forecast Verification Project (WFVP) and plans of the Wave Forecast Verification Scheme (WFVS). Since its first establishment in 1995, the ETWCH has continued to implement the operational WFVP as a priority to provide a mechanism for benchmarking and assuring the quality of wave forecast model products that contribute to applications, such as safety of life at sea, ship routing, and, in general, the GMDSS. The project has expanded to include 17 participants, many running global wave forecast systems, with different wave models, different wind forcing, and different model configurations (see Project #11 of SFSPA workplan 2012-2017).

3.3.2 The Team noted the deliverable of WFVP - the actual data as collected and made available to all participants by ECMWF – of which monthly statistical summaries could be found at the JCOMM Wave Forecast Verification page (http://www.jcomm.info/Wave) as well as on the wave forecast verification pages of ECMWF (http://www.ecmwf.int/products/forecasts/d/charts/medium/verification/wave/intercomparison/).

3.3.3 The Team noted with satisfaction that centres engaged in wave forecasting benefit from WFVP in the same way as weather centres benefit from the exchange of forecast verification scores. The Team also noted ongoing efforts to expand the verification to include 1-D and 2-D spectral quantities, satellite quantities, and to investigate the continued development of spatial inter-comparison techniques for wave forecasts in cooperation with the European Space Agency's GlobWave Project.

3.3.4 The Team expressed its appreciation to ECMWF for its continuing support to maintain the JCOMM WFVP. The Team encouraged agencies that collect marine meteorological data to push their data to the GTS to facilitate their inclusion in the project. The Team also encouraged the participating agencies in WFVP to provide model spectra at selected locations, in order to extend the verification to spectral data ***(Action; participating agencies in WFVP; ASAP and ongoing)***.

3.3.5 Dr Bidlot reported that an extension of WFVP to using satellite based observations has been running as part of the ESA GlobWave Project under the Wave Forecast Verification Scheme (WFVS). Originally, the scheme was opened to all participants of the WFVP but it took longer to implement than envisaged, and only recently eight centres were included in the reporting (there is a dedicated report for each participant). At the 3rd GlobWave Steering Committee meeting (8 November 2012, Lisbon, Portugal), it was agreed that although the GlobWave project ended by November 2012 the WFVS would be extended for another 12 months, albeit with very limited resources for development. It is hoped that by doing so, the participants will be given more time to appraise the suitability of the verification reports. The Team noted that the other main component of GlobWave, namely the web portal to access a central place for quality controlled altimeter and SAR wave data will still be maintained by IFREMER, including the different tools to manipulate the data.

3.3.6 The Team agreed that one of the main issues in the WFVS was the model data gathering and the delays in getting participants to join. Moreover, the verification is only looking at evaluating models where altimeter data are available (not a true spatial comparison of the model fields as originally envisioned). It was therefore suggested that the model gathering should be moved to an operational centre for a few selected parameters with strict format specification. The match-up (collocation) software developed for GlobWave and the satellite data from IFREMER could be used to re-create what WFVS has achieved. Moreover, direct comparison of the model fields could be produced.

3.3.7 The Team agreed that the operational wave forecasting centres would greatly benefit from coordinated efforts to gather model fields for verification purposes. Having model fields under an agreed format would help with the match-up to any available observations (e.g. GlobWave data and software), as well as direct model field intercomparison and studies. The Team, considering that ECMWF is already the WMO lead center for deterministic NWP verification, requested members to: 1) discuss with ECMWF to add a wave component to the ECMWF system ***(Action; WMO Secretariat in consultation with members; ASAP)***; and, 2) explore other ways to underpin data gathering effort. For the latter, the Team noted with appreciation a possibility to use the NOAA Operational Model Archive & Distribution System (NOMADS) OPeNDAP server, and requested the members to further explore ways and associated plans ***(Action; H.Tolman, J.Bidlot; April 2013)***.

3.3.8 The Team noted with concern that the long-term future of WFVS (in GlobWave) and the WFVP to a certain extent was yet to be decided. The Team encouraged its members to further discuss and present plans during the forthcoming meeting of Waves In Shallow water Environment (WISE, 21-25 April 2013, College Park, USA), including the possibility of migrating the verification and reporting software ***(Action; J.Bidlot, H.Tolman and other contributing members; April 2013)***.

*ETWCH-DBCP activity for Wave measurement Evaluation and Test*

3.3.9 The Team recalled a workshop on in situ wave measurement technology (October 2008, New York, USA; http://www.jcomm.info/WaveBuoys) with participation of ETWCH (formerly ETWS), DBCP and many experts on in situ wave observations and applications. The results of this workshop included the initiation of a joint DBCP-ETWS (now ETWCH) Pilot Project on Wave measurement Evaluation and Test (PP-WET; http://www.jcomm.info/WET), approved by both the JCOMM Data Buoy Cooperation Panel (DBCP) and ETWCH, and subsequently by JCOMM at its 4th session (May 2012, Yeosu, Republic of Korea). The PP-WET has provided a guideline for continuous testing and evaluation of operational and pre-operational wave measurement systems, in support of a wide range of applications, including the monitoring of extreme wave events for disaster risk reduction, wave modelling, and the calibration and validation of satellite wave measurements.

3.3.10 The Team received a progress report by Mr Val Swail, co-chair of the PP-WET Steering Committee. While expressing some concerns about the continued involvement of some participants, the Team expressed its satisfaction and appreciation for agencies (from Canada, India, Norway, Republic of Korea, United Kingdom and USA) participating in the Project. The Team noted, in particular, the critical importance of active involvement by the US National Data Buoy Center (NDBC) to understanding the apparent systematic difference between the wave measurements from Canadian and US buoy networks, and encouraged the NDBC to closely coordinate with the PP-WET Steering Committee and Environment Canada for co-deployment and further analysis ***(Action; NDBC in coordination with PP-WET Steering Committee; ASAP)***.

3.3.11 Noting the great potential benefit for the wave community from PP-WET, the Team agreed to promote the PP-WET widely, to extend the level of participation to more countries and agencies. In that regard, the Team expressed its satisfaction with the plan to organize a special session on wave measurement evaluation during the upcoming 13th Waves Workshop, October 27 to November 1, 2013, Banff Canada (http://www.waveworkshop.org), and a PP-WET project meeting prior to the Workshop.

3.3.12 While not exclusive, the Team agreed with the PP-WET participants on the immediate priority activities for PP-WET, in addition to those in the above paragraphs, as follows:

- Compare an existing NDBC 6m NOMAD buoy containing all historical sensor and payload packages, and a Directional Waverider buoy;

- Evaluate additional wave drifters, including dual-sensor comparison of Global Positioning System (GPS) sensor in 3m discus or 6m NOMAD hull;

- Operate the Datawell MK2 waverider buoy alongside a buoy operated by United Kingdom (e.g. K-5);

- Co-locate a directional waverider (DWR) with the laser array (LASAR) at the Norwegian offshore platform Ekofisk;

- Continue Canadian co-locations including another 6m NOMAD buoy location;

- More directional spectral intercomparisons

3.3.13 The Team agreed that guidelines on the best practices for reliable, high-quality spectral wave measurements, including directional spectra, should be developed based on the experience and lessons from PP-WET. The Team suggested that the PP-WET Steering Committee work with the DBCP Task Team on Moored Buoys (TT-MB) to consider metadata setup for wave measuring systems other than moored and drifting wave buoys ***(Action; PP-WET Steering Committee; ASAP and ongoing)***. The Team also suggested exploring the relevance to the ongoing efforts regarding wave energy as a potential source of funding and deployments ***(Action; K.Horsburgh and V.Swail; ongoing)***.

## 3.4 Support for storm surge research and development, including follow-up to the JCOMM 2007 Scientific and Technical Symposium on Storm Surge

*ESA eSurge project*

3.4.1 The Team reviewed a report by Dr Kevin Horsburgh on the ESA-funded eSurge project (http://www.storm-surge.info), and a report by Dr Georg Umgiesser on the eSurge-Venice project. eSurge was initiated as a Data User Element (DUE) Project running between 2011-2014, aiming to support storm surge systems, their services, engineers and scientists by facilitating the widespread user uptake and application of advanced information products from ESA and other Earth Observation missions. In doing so, eSurge was to facilitate an integrated approach to storm surge, wave, sea-level and flood forecasting as part of a wider optimal strategy for building an improved forecast and warning capability for coastal inundation. The project has made significant progress in building the database/portal and populating that with surge events from the areas of interest. Progress has also been made in the retracking of coastal altimetry signal. The report stated that the project entered Phase 2 in April 2013, attempting to use blended tide gauge and altimetry data to initialize storm surge models.

*International Workshops on Wave Hindcasting and Forecasting, and Coastal Hazard Symposia*

3.4.2 The Team noted that the 13th International Workshop on Wave Hindcasting and Forecasting and 4th Coastal Hazards Symposium (http://www.waveworkshop.org), co-sponsored by Environment Canada, the Canadian federal Program of Energy R&D and JCOMM, would take place in Banff, Canada, from 27 October to 1 November 2013, with the objectives of:

- providing a forum for the exchange of ideas and information related to wind, wave, and storm surge hindcasting and forecasting, including modelling, measurement and past and future states of the climate;

- coordinating ongoing R&D initiatives;

- discussing priorities for future research and development.

3.4.3 The Team noted that an invitation for papers was extended for research and operational aspects of wave and storm surge hindcasting and forecasting, including: operational forecasting; regional hindcasts; storm surge climatology; data collection and instrumentation; data assimilation into numerical models; wave-current interaction; wave-ice interaction; shallow water and nearshore effects; wind fields for wave hindcasting or

forecasting: extremal analysis; case studies, past and future climate trend and variability. The Team noted, in particular, the theme sessions for the Workshop were established to directly align with the priorities of ETWCH as follows:

- *Theme Session Waves - "Forecasting Dangerous Sea States"*: theoretical, numerical, laboratory or operational applications dealing with forecasting of hazardous wave conditions such as crossing seas, unusually steep waves, rapidly developing seas and rogue waves;

- *Theme Session Coastal hazards - "Storm Surge Forecasting"*: theoretical, numerical, or operational applications dealing with storm surge modelling and forecasting, especially inundation modelling, and including the use of satellite products.

3.4.4 The Team took note of special sessions during the Workshop, on the following topics that are directly linked to the ETWCH intersessional workplan:

- Risk Analysis – Don Resio

- Wave Measurement Evaluation – Bob Jensen

- Advances in Storm Surge Modelling - Kevin Horsburgh

- Sea Level – Scott Hagen/Mike Salisbury

- COWCLIP – Mark Hemer

- Forecasting Hazardous Sea States – Hendrik Tolman

The Team expressed its appreciation to Mr Swail, Workshop Chair, and the experts contributing to the workshop organization. The Team invited all members to consider additional special sessions which might respond to their priorities and provide suggestions Mr Val Swail ***(Action; all members; ASAP)***.

3.4.5 The Team also noted the plans for associated meetings related to the ETWCH workplan, in conjunction with the Workshop, including:

- COWCLIP Review Meeting, 2 November 2013

- PP-WET Project Meeting, 26 October 2013

- Oil and Gas Producers (OGP) Metocean Committee 28 – 31 October 2013 (to be confirmed)

3.4.6 The Team emphasized that this series of Workshops and Symposia have played a significant role in the scientific development of wind wave, storm surge and coastal applications, as well as in providing scientific and technical support for JCOMM through ETWCH. The Team agreed to continue Team's effort during the intersessional period to ensure their continuity of the Workshop and Symposium ***(Decision)***. The Team noted with appreciation that some members, including USA and UK, would consider co-sponsorship for and/or hosting of the future Workshops and Symposia.

*Partnerships with the IOC Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG)*

3.4.7 The Team recalled the discussion at JCOMM-4 (May 2012, Yeosu, Republic of Korea), to extend an invitation to the IOC Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to collaborate with JCOMM through ETWCH in dealing with the full spectrum of multi-hazard monitoring, warning and preparedness issues.

3.4.8 The Team also recalled some prior discussion and decisions on this issue at the 5th TOWS-WG session (February 2012, Tokyo, Japan), that a joint working group of JCOMM and TWS/TOWS could be established to investigate scope and areas of collaboration for mutual benefit, and to propose a set of actions to allow such collaboration to develop. The Team noted several areas of mutual interest for both ETWCH and the tsunami community, including 1) scientific and technical support for modelling of coastal inundation; and 2) associated training and education. The Team requested Dr Mikhail Entel to lead the discussion with the chairperson of TOWS-WG to further explore potential areas for collaboration ***(Decision and Action; M.Entel; ongoing)***.

*Enhancing Regional Capabilities for Coastal Hazard Forecasting*

3.4.9 The Team noted the report from Dr Kevin Horsburgh on the pilot project on Enhancing forecasting capabilities for North Indian Ocean Coastal Flood Forecasting, initiated as a follow-up to the recommendations of the 1st JCOMM Storm Surge Symposium (October 2007, Seoul, Republic of Korea; http://www.jcomm.info/JCOMM2007SSS).

3.4.10 At the 2nd Advisory Workshop on enhancing the forecasting capabilities for North Indian Ocean Storm Surges (IIT-D storm surge model upgrade; 11-15 February 2011, Delhi, India; http://www.jcomm.info/SSIndia2), the international experts (scientific advisory committee) - comprising several members of ETWCH - reviewed the current status/performance of operational storm surge forecasting model (IIT-D Model) in the North Indian Ocean (NIO) region, the mid-term plan for upgrades and provided necessary scientific and technical advice. The workshop also decided on the future course of action in view of collaborating and linking with related international programmes and projects, such as the JCOMM-CHy Coastal Inundation Forecast Demonstration Project (CIFDP) and the ESA eSurge project.

3.4.11 The Team noted with satisfaction that many of the recommendations have been acted on: The IIT-Delhi working group demonstrated enhanced model performance of IIT-D Storm Surge Model, in both hindcast and operational mode, and operational approaches for handling the interaction of storm surge with tides and wind waves. Specific further recommendations resulting from this workshop included inclusion of open boundary tides; collaborative effort to improve the observational network in the region; development of a simple ensemble forecast scheme; and encouragement of data exchange amongst the NIO countries.

3.4.12 The Team noted that the project would be completed with its final workshop in the 4th quarter of 2013, in order to; 1) ensure delivery of the agreed model modifications; 2) establish the framework for ongoing involvement of ETWCH with forecasting developments in the region (possibly via aspects of CIFDP); and, 3) increase access to sea-level data in the region. The Team agreed to continue its support through participating members to the scientific advisory committee (K.Horsburgh, V.Swail, H.de Vries and D.Resio) until its completion ***(Decision)***. The Team requested Dr Horsburgh to finalize the Workshop plan in coordination with the regional working group and the Secretariat ***(Action; K.Horsburgh, B.Lee, S.Dube; ASAP)***.

3.4.13 The Team noted, in particular, India's national initiative to improve capabilities for integrated modelling, following the recommendations of this project. The "National Workshop

on Storm Surge and Coastal Inundation Modeling over North Indian Ocean" (11 February, 2013 at India Meteorological Department (IMD), New Delhi, India) delivered 22 recommendations the most significant of which was implementation of an integrated coastal inundation modeling system to become semi-operational by IMD with the active co-operation of the Indian National Centre for Ocean Information Services (INCOIS) and IIT-Delhi, from October 2013. The Team observed that these developments aligned well with the objectives of the Coastal Inundation Forecasting Demonstration Project (CIFDP), and the forthcoming final workshop of the project, and encouraged the Indian national agencies to coordinate with JCOMM and ETWCH where possible, in order to ensure successful implementation of this initiative with benefit from/to the relevant regional CIFDP Sub-Project in Bangladesh (CIFDP-B) and other work of ETWCH.

*Follow-up Event to the 1st JCOMM Scientific and Technical Symposium on Storm Surges*

3.4.14 The Team noted that a number of activities had been initiated and achieved resulting from the 1st JCOMM Storm Surge Symposium (October 2007, Seoul, Republic of Korea; http://www.jcomm.info/JCOMM2007SSS) with regard to storm surge applications. Several activities following the JCOMM2007SSS recommendations were planned for the intersessional period (see Project #9 of the SFSPA Workplan 2012-2017).

3.4.15 The Team agreed that the 2nd JCOMM Storm Surge Symposium should be organized during the intersessional period as a matter of priority, to provide a forum for recent developments in storm surge applications and to contribute to improved guidance / technical support for national agencies through the established JCOMM framework including the Guide to Storm Surge Forecasting (WMO-No.1076) ***(Decision)***. The Team noted with appreciation an indication by the Australian Bureau of Meteorology that they may be able to host this Symposium in the 4th quarter of 2014 or 1st quarter of 2015 in Australia; this offer is subject to budgetary confirmations (May 2013) for the Bureau's programme. As an alternative, H. Tolman suggested that US NOAA National Centers for Environmental Prediction (NCEP) may also be able to offer a venue. The Team agreed to decide on the organizational outline for the Symposium by September 2013 ***(Action; K.Horsburgh to lead, with D.Greenslade, H.de Vries, G.Umgiesser, V.Swail; by September 2013)*** and requested the Secretariat to plan for the necessary support in due course ***(Action; WMO Secretariat with input from IOC Secretariat; ASAP and until 2015)***.

3.4.16 The Team noted some themes for sessions of the Symposium, including; 1) Advances in storm surge modeling and forecasting; ; 2) fully coupled model systems including enhanced coupling between atmosphere, waves, storm surge, ice as well as links to ocean models and boundary conditions (link to the Expert Team on Operational Ocean Forecasting System; ETOOFS); and, 3) sharing best practices and monitoring progress in storm surge applications. The Team requested all members to propose themes and issues to be discussed at the Symposium, for consideration by the organizing/scientific committees of the Symposium once they would be established ***(Action; all members; by September 2013)***.

## 3.5 WMO Coastal Inundation Forecasting Demonstration Project

3.5.1 The Team received with interest a report by Mr Val Swail, co-chair of the Steering Group of the WMO Coastal Inundation Forecasting Demonstration Project (CIFDP: http://www.jcomm.info/CIFDP. See also Project #14 of SFSPA Workplan 2012-2017). The Project was initiated in 2009, as a framework for national implementations to demonstrate how coastal inundation forecasting products could be improved and effectively coordinated with warning services provided by the National Meteorological and Hydrological Services (NMHSs). This process has been facilitated primarily by the JCOMM and WMO Commission

for Hydrology, in cooperation with a consortium of experts and related institutions of excellence in the field of storm surge, wave and hydrological flooding in order to deal with coastal inundation issues from the viewpoint of the Total Water Level Envelope (TWLE). CIFDP has been implemented through its National Sub-Projects launched for countries meeting the essential requirements, with a view to applying the developed best practices to the respective regions, and under the overall governance of the CIFDP Steering Group (PSG, comprising metocean / hydrological / social experts) to which the Team has been providing major input on behalf of JCOMM.

3.5.2 The Team noted with pleasure the rapid development and expansion of the Project, raising visibility and influence in the discussions of WMO governing bodies, JCOMM session and related programmes. As of March 2013, progress in the following National Sub-Projects was noted:

a) *CIFDP-B (Bangladesh):* Phase 1 was essentially complete, pending the completion of documentation. Funding has been obtained for Phases 2 to 4, from USAID through WMO. Phase 2 – system design – was scheduled to begin with a kick-off meeting in May 2013, in Dhaka, Bangladesh.

b) *CIFDP-DR (Dominican Republic):* A Definitive National Agreement (DNA) was signed by the responsible agencies in the Dominican Republic. Remaining Phase 1 activities were the completion of the National Capacity Assessment, Terms or Reference and members of the National Coordination Team, an updated Sub-Project Plan, and arrangement of external funding support for Phases 2 to 4.

c) *CIFDP-F (Fiji):* A stakeholders workshop for the Fiji sub-project was held 18-21 February, 2013, in Nadi, Fiji (http://www.jcomm.info/CIFDP-FSW). A DNA was developed, for signature of responsible Ministers. Terms of Reference for the National Coordination Team (led by the Fiji Meteorological Service; FMS) were also agreed. Funding for Phase 1 was provided by Korea International Cooperation Agency (KOICA) through WMO. Ongoing work included the development of a National Capacity Assessment, and to arrange funding for Phases 2 to 4.

d) *CIFDP-S (Shanghai):* The PSG at its 4th meeting (22-23 February 2013, Nadi, Fiji; http://www.jcomm.info/CIFDP-PSG-4) endorsed the establishment of Shanghai as a Sub-Project, and agreed that the CIFDP-S could achieve tangible results in the near future based on the commitment of the Shanghai Meteorological Bureau (SMB) and the participation of other related national authorities. The overall project implementation would be made through national resources. The PSG requested the Secretariat to take all necessary measures to facilitate the communication and support for CIFDP-S initiation and implementation.

e) *CIFDP-I (Indonesia):* Progress has been made in the national consultation for an Initial National Agreement (Phase 0), and an initial investigation for required technical development against the planned activities/projects of the Indonesia Meteorology Climatology and Geophysics Agency (BMKG) for sea-state and hydrological modelling, in the effort to identify an appropriate arrangement for the national agreement. The PSG agreed that a National Sub-Project for Indonesia (CIFDP-I) should be established as soon as the initial consultation and planning is accomplished.

f) *CIFDP-SA (South Africa):* A National Sub-Project for South Africa (CIFDP-SA) was proposed by the South African Weather Service (SAWS). The PSG agreed

to continue consultation with SAWS for the future development of a project concept and plans.

3.5.3 The Team noted linkages of related programmes and projects with CIFDP, including the WMO SSWS, Severe Weather Forecasting Demonstration Project (SWFDP), ESA eSurge project, and the WMO Working Group on Societal and Economic Research Applications (WG-SERA) (see also the discussion under item 5). The Team also noted that other relevant research and development activities, such as the EU FP7 project on Increasing Resilience through Earth Observation (IncREO) eWorld Digital Elevation Model (DEM), could be of interest to CIFDP, once the project outcomes become available.

3.5.4 The Team understood the significant requirements for human resources in supporting CIFDP, for the PSG and for the WMO/JCOMM Secretariat, to coordinate the increasing number of CIFDP National Sub-Projects. The Team suggested that the PSG should consider an efficient way of distributing experts' time and involvement, as well as Secretariat's time ***(Action; by ETWCH, CIFDP PSG and WMO Secretariat; ASAP and ongoing)***. In this context, the Team appreciated the addition of several ETWCH members, to those who were already members of PSG, who expressed interest in supporting and advising on the implementation of various National Sub-Projects. The Team encouraged the CIFDP Steering Group (PSG) to work with these members for planned activities ***(Action; by CIFDP PSG and M.Entel, D.Greenslade, F.Ocampo-Torres, N.Kohno, K.Horsburgh, A.Kortcheva, G.Umgiesser; ASAP and ongoing)***. The Team also suggested that the PSG would maximize the use of existing practices in related areas on various scales (local, national and regional) in research and development for integrated warning products on natural coastal disasters, for gathering information on national capacities and for utilizing expert resources.

3.5.5 While noting the essential component of capacity development / technology transfer in CIFDP implementation, the Team noted that there is opportunity for improved integrated and coordinated service delivery for coastal inundation even in countries with advanced modelling capability. The Team therefore suggested that the CIFDP framework could be considered not only for the developing countries but for all countries with issues of coastal inundation.

## 4 PLANS FOR ACTIVITIES DURING THE INTERSESSIONAL PERIOD

4.0 Under this agenda item, the Team reviewed its intersessional workplan and identified specific deliverables / expected outcomes based on the discussion under agenda item 3. In doing so, the Team identified the following deliverables across all ETWCH-related "projects" of the SFSPA workplan 2012-2017. The Team requested all members leading/participating in "projects" to review and update the plan accordingly, where necessary ***(Action; all members participating in "projects" of the SFSPA Workplan; ASAP and ongoing)***.

### 4.1 Coordination for system/information development

*CIFDP project implementation*

4.1.1 The Team noted that the developed procedure and demonstration systems for coastal inundation forecasting/warning through National Sub-Projects of CIFDP would be the major outcome of JCOMM/ETWCH in assisting Members / Member States to improve their service capabilities. The Team agreed to continue supporting this line of activities as discussed under agenda item 3.5.

*Extreme wave dataset*

*4.1.2* The Team recalled the discussion under agenda item 3.2 on this topic, and agreed to continue its effort in coordination with ETMC. The Team suggested exploring additional sources to populate the dataset, and to consider linking with the dynamic part of the Wave Guide (WMO-No.702) once the revised Guide and the dataset are developed.

*Storm surge climatology and associated dataset*

4.1.3 The Team agreed that the planned survey on storm surge operational models and data (see paragraphs 3.1.9 to 3.1.12) could initiate development ofthe storm surge climatology and a global dataset. In order to help JCOMM Members to provide useful information for this purpose, the Team agreed to prepare a set of examples and guidelines for responding to the designed questionnaires (see ***Annex V***) ***(Action; K.Horsburgh, P.Etala, M.Entel, H.Tolman; May 2013)***, for both extra-tropical and tropical regions. The Team also suggested that the effort should take into account related activities such as post-cyclone analyses that are available at national and regional scales.

4.1.4 Meanwhile, the Team noted the need to refine the methods needed to develop the storm surge climatology. It therefore agreed to draft a paper on a proposed scope and plan (e.g. initiate from tide gauge measurements, then incorporating model hindcasts in the future) and present it at the 4th CLIMAR Workshop in April 2014 ***(Action; K.Horsburgh, G. Umgiesser, H.de Vries, M.Entel, N.Kohno; December 2013 for drafting and April 2014 for presentation)***. The paper could also consider a plan to establish a global database, possibly by using / linked with the ongoing efforts such as the eSurge database (Surge Event Analysis and Repository Service; SEARS). The Team also requested Dr Kevin Horsburgh to explore ways to coordinate with the Joint CLIVAR-CCl-JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) ***(Action; K.Horsburgh; ongoing)***.

*Support for ESA eSurge development, and potential applications*

4.1.5 Recalling the discussion under agenda item 3.4, the Team agreed that the eSurge outcome could benefit a wide range of users, and invited all members to promote within their own organisations the eSurge concept, and provide feedback to the eSurge project management team. ***(Action: all members; ongoing)***.

## 4.2 Guides and relevant publications

*Guide to Wave Analysis and Forecasting (WMO-No. 702)*

4.2.1 The Team noted that the revised Wave Guide (WMO-No.702) would be the main outcome of the Team's intersessional work (see paragraphs 3.1.1 to 3.1.8, as well as ***Annex IV***), and agreed to carry out the agreed actions as a matter of priority.

*Guide to Storm Surge Forecasting (WMO-No.1076)*

4.2.2 Considering that the Storm Surge Guide (WMO-No.1076) was newly published in 2011, the Team agreed to focus on the worldwide survey (see paragraphs 3.1.9 to 3.1.12, as well as ***Annex V***) and regular update of the dynamic part (http://www.jcomm.info/SSguide) during the intersessional period.

4.2.3 The Team noted with appreciation a proposal by Mr Nadao Kohno and Dr Mikhail Entel to develop a section on wave setup to be included in the dynamic part of the Storm

Surge Guide. It also discussed unusual events such as “meteo-tsunamis” that should be considered for inclusion in the dynamic part of the Storm Surge Guide The Team requested Dr Kevin Horsburgh, as the responsible member to review this Guide, to work with members to decide on the overall structure and contents of the dynamic part ***(Action; N.Kohno, M.Entel, SH.You, K.Horsburgh; by August 2014 for wave setup description and ongoing for structure/contents review)***.

*Input to WMO Manual on Marine Meteorological Services (WMO-No.558) and WMO Guide to Marine Meteorological Services (WMO-No.471)*

4.2.4 The Team took note of the discussion at the 4th session of ETMSS (27 February – 2 March 2013, Tokyo, Japan) regarding the WMO Manual on Marine Meteorological Services (WMO-No.558) and WMO Guide to Marine Meteorological Services (WMO-No.471), to review overall structure of WMO-No.558 and WMO-No.471 in view of making a recommendation for a new structure of those mandatory publications without duplication and/or potential conflict in the contents (see Project #15 of SFSPA Workplan). In the meantime, the WMO Secretariat and Expert Teams were requested to keep reviewing and monitoring required updates of those two publications as they stood. The Team agreed to provide necessary input to the continuing process for review and revision within the Team’s areas of expertise ***(Action; by all members led by S.Desjardins; upon request during the intersessional period)***.

4.2.5 The Team also noted that the white paper on forecasting dangerous sea states (see paragraphs 3.1.13 to 3.1.16) would provide the basis for consideration on update/revision of WMO-No.558. The Team therefore requested the contributing members to the white paper to work with ETMSS, once the white paper is finalized, for the following procedure to update the WMO-No.558 and WMO-No.471 as appropriate, and for the communication with the Issuing Services ***(Action; lead A.Saulter with input from all members; after the finalization of the white paper and continuous for liaison with ETMSS)*** .

*Input to Global Data Processing and Forecasting System (GDPFS, WMO-No. 485)*

4.2.6 The Team recalled its contribution to the revised Global Data Processing and Forecasting System (GDPFS, WMO-No. 485) for wave forecasting / verification and storm surge related operations. Noting the importance of this publication in the operational work of the National Meteorological and Hydrological Services (NMHSs), the Team agreed to continue its efforts to provide advice and input upon request ***(Action; by members and WMO Secretariat led by K.Horsburgh, J.Bidlot, SH.You; upon request during the intersessional period)***.

*Input to WMO Rolling Review of Requirements (RRR) process*

4.2.7 The Team noted that the WMO Commission for Basic Systems (CBS) established the Inter-Programme Expert Team on the Observing System Design and Evolution (IPET-OSDE) as successor of the Expert Team on Evolution of the Global Observing Systems (ET-EGOS), in charge of the WMO Rolling Review of Requirements (RRR). The first session for IPET-OSDE was planned in July 2014. Noting that the ETOOFS would take the lead to review of RRR and Statement of Guidance (SoG) for marine/oceanographic aspects (see Project #2 and part of Project #10), the Team agreed to coordinate with ETOOFS, in advance to providing input to IPET-OSDE, and prepare harmonized and consolidated comments avoiding potential conflicts ***(Action; by K.Horsburgh in coordination with G.Brassington, G.Liu and A.Mafimbo; by July 2014)***.

*Contribution to IPCC 5th Assessment Report*

4.2.8 The Team recalled the discussion at JCOMM-4, that identified COWCLIP as a direct contribution to the implementation of the Global Framework for Climate Services (GFCS), through its input to the IPCC 5th Assessment Report with the results of coordinated intercomparisons of global wave projections between international research groups. The Team also noted that the COWCLIP intercomparison would provide better understanding of uncertainty within the community ensemble of wave climate projections. In this context, the Team agreed to continue taking a lead in coordinating this activity during the interesessional period, with a view to including wave information in greater detail in the IPCC Fifth Assessment Report (AR5) ***(Decision)***. The Team also requested Dr. Anna Kortcheva to identify potential contributions to COWCLIP through the EU-FP7 IncREO project ***(Action; A.Kortcheva; ASAP)***.

## 4.3 Capacity Development and related training

4.3.1 The Team recalled the JCOMM Capacity Development Principles agreed at JCOMM-4, stating that the JCOMM Capacity Development (CD) should be implemented by the respective Programme Areas (PAs) and included in their respective workplans. The Team noted that a number of projects within the SFSPA workplan include CD elements, including the direct contribution of ETWCH.

4.3.2 The Team emphasized the strong CD aspects of the CIFDP, through technology transfer/sharing for coastal inundation forecasting and warning, and welcomed the increasing participation of developing countries in developing CIFDP National Sub-Projects. The Team noted that identification and efficient use of resources (both finance and experts' time) would be critical to carry out CD and training activities, therefore suggested that the funding proposals of each CIFDP National Sub-Project should include training component strongly linked with the ongoing activities that are relevant to the operational coastal inundation forecasting, such as the series of JCOMM-TCP in-region training workshops on wave and surge forecasting.

4.3.3 The Team noted with satisfaction the successful conduct of the 8th JCOMM-TCP training Workshop on Storm Surge and Wave Forecasting (SSW-8; http://www.jcomm.info/SSW8) in Nairobi, Kenya, from 19 to 23 November 2012. This was the first training opportunity for South and East African countries on wave and surge modelling. Highly qualified participants from Kenya, Madagascar, Mauritius, Mozambique, Namibia, Seychelles, South Africa and Tanzania enjoyed a 5-day training programme including hands-on training on WAVEWATCH III, IIT-D Storm Surge Model, JMA Storm Surge Model and Meteo-France Surge Model. The Team expressed its appreciation to participating members to this workshop, Dr Hendrik Tolman and Mr Nadao Kohno for their contribution. The Team noted that this workshop has provided opportunities for developing countries to obtain and operate wave and storm surge models, therefore agreed to continue supporting the Workshop by providing experts/trainers ***(Decision and Action; Members with support from WMO Secretariat; ongoing)***. The Team noted that a more structured follow-up should be planned to provide in-depth training for each model and to provide opportunities to support experts in the region. In this regard, the Team suggested that the WMO Secretariat explore ways to develop/enhance links with related training activities, such as NOAA training programmes (e.g. African Desk), WMO fellowship, and NCEP/UMD Waves Winter School ***(Action; WMO Secretariat with input from member; ASAP and ongoing)***.

4.3.4 The Team noted that development and maintenance of technical guidance material is a fundamental component of CD, and therefore agreed to continue efforts in

developing and updating the mandatory publications (Manual and Guides) under the Team's purview ***(Decision)***. The Team also requested the Secretariat and members participating in CD activities to continue documenting and archiving educational material (with elaborated information on target/users for each material, where possible) to be used for pre-study, in-session and distance training, and to explore available resources to develop and utilize e-learning material (e.g. MetEd) ***(Action; Secretariat and experts; ongoing)***.

### 4.4 Workshops, conferences and meetings

4.4.1 Based on the discussion under agenda items 3 and 4, the Team identified the following workshops/scientific conferences and meetings that are directly related to the work of the Team, while not excluding other plans and opportunities:

- 13th/14th Waves Workshop and 4th/5th Coastal Hazard Symposium (October 2013, and 2015, respectively); see paragraphs 3.4.2 to 3.4.6;
- 2nd JCOMM Storm Surge Symposium (2014/2015); see paragraphs 3.4.14 to 3.4.16
- Meetings of Waves In Shallow water Environments (WISE, annual)
- 2nd Australian wind-waves symposium (4-5 June 2013)
- Workshop on Advances in Marine Climatology (CLIMAR)
- Workshop on Advances in the Use of Historical Marine Climate Data (MARCDAT)

4.4.2 The Expert Team on Marine Climatology (ETMC) organizes two related series of workshops on marine climatology, Workshop on Advances in Marine Climatology (CLIMAR) and Advances in the Use of Historical Marine Climate Data (MARCDAT), alternating every two years. The Team noted that the 4th CLIMAR Workshop was planned to be held in April, 2014, in Asheville, NC, hosted by the US National Climatic Data Center (NCDC). The Team agreed that it would be appropriate to include contributions to the 4th CLIMAR workshop (CLIMAR-4) on wave and storm surge climate related activities. The Team endorsed the suggestion that Mr Val Swail would represent the ETWCH perspectives as a member of the CLIMAR-4 Organizing Committee ***(Action; V.Swail; immediate and ongoing until April 2014)***, and requested all members to provide ideas on topics or papers for a special session at CLIMAR-4 to be convened by Mr Swail ***(Action; all members; ASAP)***.

## 5 INTERACTION WITH OTHER JCOMM TEAMS/GROUPS, AND EXTERNAL PROGRAMMES

5.0 The Team discussed the issues requiring collaboration and coordination with other Teams, Groups and programmes. Not excluding other entities, the following teams/groups/programmes were identified that require specific actions and consideration by the Team during the intersessional period:

### 5.1 Teams and Groups of JCOMM

5.1.1 Based on the discussion under agenda items 3 and 4, the Team identified the following Teams/Groups and issues to be considered for the intersessional activities:

- ETMSS (development of forecast guidance on crossing and complex sea states, and review and update as appropriate to WMO-No.471 and WMO-No.558);

- ETOOFS (ocean extremes monitoring system (Project#2 of the SFSPA Workplan 2012-2017) and coordination for JCOMM input to RRR process);

- Data Buoy Cooperation Panel (PP-WET implementation);

- ETMC (extreme wave dataset including wave summaries in ICOADS);

- Global Sea Level Observing System (GLOSS; development of storm surge climatologies as a measure of risk assessment for marine hazards: K.Horsburgh to continue act as focal point ***(Action)***).

## 5.2 Programmes of WMO and IOC

5.2.1 Based on the discussion under agenda items 3 and 4, the Team identified the following groups and programmes directly linked to the Team's work during the intersessional period:

- WMO Disaster Risk Reduction (DRR) Programme (CIFDP implementation, and JCOMM input to Multi-Hazard Early Warning System; K.Horsburgh to continue act as focal point ***(Action)***) ;

- WMO SWFDP (see paragraphs 3.5.3 and 5.2.3);

- IPET-OSDE (input to RRR and SoG: wave measurement requirements. See paragraph 4.2.7.);

- WMO Education and Training Programme (Development of e-learning modules, training events) ;

- ETCCDI (see paragraph 5.2.2);

- WMO Tropical Cyclone Programme (WMO SSWS, JCOMM-TCP Training Workshops on wave and storm surge modelling);

- IOC TOWS-WG and regional Tsunami Warning Systems (see paragraphs 3.4.7 and 3.4.8).

5.2.2 The team noted that JCOMM was a partner in the ETCCDI, representing the marine component of this activity. At present, the JCOMM members of this Team are Scott Woodruff (US, representing ETMC), Xiaolan Wang (Canada), and Kevin Horsburgh (UK, representing ETWCH). JCOMM has proposed three specific activities as its contribution to the work of ETCCDI as noted below:

- Investigation of climate indices and trends from the ICOADS data base, especially near coasts, as a complement to, and comparison with, existing land-based activities within ETCCDI;

- Contribution from the COWCLIP project on historical and projected future changes in wave climate, and associated databases;

- Contribution from the storm surge climatology activities of ETWCH, in particular in the initial stages, on historical data bases and climate analysis of sea level measurements including the GLOSS network.

5.2.3 The Team noted with pleasure that, through the 8th JCOMM-TCP workshop on wave and storm surge modelling (November 2012, Nairobi, Kenya), JCOMM/ETWCH has facilitated the implementation of SWFDP RA I, by providing a training session on WAVEWATCH III on the domain of Lake Victoria, using available bathymetry data (supported by Kenya Meteorological Department). The Team expressed its appreciation to Dr Hendrik Tolman for his contribution, and suggested that the effort could continue to ensure the countries in this region could widely benefit from the available technology and resources beyond the current SWFDP plan. In this context, the Team requested the WMO Secretariat and Dr Tolman to continue coordination with the WMO Education and Training programme and the NOAA/CPC African Desk to implement in-depth training for African experts on model implementation, and to continue providing technical advice for national operation of wave forecasting in the JCOMM context ***(Action; WMO Secretariat, H.Tolman; ASAP and ongoing)***.

## 5.3 Other programmes and projects

5.3.1 Based on the discussion under agenda items 3 and 4, the following agencies and projects were identified, while not excluding other global and national initiatives, as having direct links with the Team's work during the intersessional period:

- ECMWF
- ESA eSurge
- ESA GlobWave
- MYWAVE
- Wave modelling project of the National Oceanographic Partnership Program (NOPP)
- IncREO (see paragraph 5.3.2)

*5.3.2* Dr Anna Kortcheva introduced the EU FP7 IncREO, part of which would deliver high quality hazard climatologies for storm surges and high waves over the coastal areas of France and Bulgaria, in contribution to Climate Service information as well as to improving operational marine forecasting and early warning systems (http://info.meteo.bg/projects/IncREO/index.php?glaven=overview&ez=EN). The Team noted that the outcome of this project, particularly the downscaled reanalysis of meteorological surface field, would provide useful information for various applications for operational warning in the respective region, and would contribute to build best practices. The Team encouraged Dr Kortcheva and other team members leading the relevant activities to share information and experience for synergies, along the progress of the IncREO project.

## 6 ANY OTHER BUSINESS

*JCOMM Web Pages relevant to ETWCH*

6.1 The Team reviewed the status of the relevant parts of the JCOMM SFSPA web pages (http://www.jcomm.info/SFSPA). While acknowledging the limited resources available for the maintenance of the web pages, the Team noted that further improvement could be made to the current structure to highlight information frequently required by readers. In this regard, the Team proposed to add direct links on the main SFSPA page to principal outcomes of the SFSPA Teams including ETWCH, such as; 1) Manuals and Guides under

the purview of ETWCH and other Teams, 2) highlighted activities of the Team for Capacity Development ***(Action; Secretariat; ASAP)***. The Team further requested Dr Georg Umgiesser to coordinate a review of the ETWCH-relevant pages in JCOMM web site and provide comments and proposals for improvement ***(Action; G.Umgiesser with input from all members; by December 2013)***.

## 7 CLOSURE OF THE SESSION

### 7.1 Adoption of the report

7.1.1 The Team reviewed and approved the draft final report, including actions and recommendations as recorded in this Report.

### 7.2 Closure

7.2.1 In closing the meeting, the ETWCH chairperson, Dr Kevin Horsburgh, expressed his appreciation to all members for their active participation and contribution to the intersessional implementation, which would enable substantial progress in achieving the goals set by JCOMM-4.

7.2.2 The fourth session of the Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH-4) closed at 1330 hours on Saturday 6 April 2013.

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**Annex I**

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**Annex II**

## AGENDA

(as agreed at ETWCH-4, 3-6 April 2013, Paris, France)

**1 OPENING OF THE SESSION**

**1.1 Opening**
**1.2 Adoption of the Agenda**
**1.3 Working Arrangements**

**2 GUIDANCE AND REQUIREMENTS FROM JCOMM AND WMO-IOC**

**3 KEY INTERSESSIONAL ACTIVITIES**

3.1 Technical advice for marine meteorological and oceanographic services
3.2 Contribution to climate services for waves and surges
3.3 Operational wave forecast verification
3.4 Support for storm surge research and development, including follow-up to the JCOMM 2007 Scientific and Technical Symposium on Storm Surge
3.5 WMO Coastal Inundation Forecasting Demonstration Project

**4 PLANS FOR ACTIVITIES DURING THE INTERSESSIONAL PERIOD**

4.1 Coordination for system/information development
4.2 Guides and relevant publications
4.3 Capacity Development and related training
4.4 Workshops, conferences and meetings

**5 INTERACTION WITH OTHER JCOMM TEAMS/GROUPS, AND EXTERNAL PROGRAMMES**

5.1 Teams and Groups of JCOMM
5.2 Programmes of WMO and IOC
5.3 Other programmes and projects

**6 ANY OTHER BUSINESS**

**7 CLOSURE OF THE SESSION**

7.1 Adoption of the report
7.2 Closure

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**Annex III**

**DRAFT TABLE OF CONTENTS FOR GUIDE TO WAVE ANALYSIS AND FORECASTING (WMO-NO. 702)**

(as agreed at ETWCH-4, 3-6 April 2013, Paris, France)

**Editor: Thomas Bruns**

**Introduction**

Has to be adapted to the new concept of a printed edition and a supplemental *Dynamic Wave Guide*.

**Chapter 1 - An Introduction to Ocean Waves**
(Francisco Ocampo Torres: editor)



**Chapter 2 – Ocean Surface Winds**
(Thomas Bruns : editor with contribution from Val Swail)

To include sections on
1. TC parameterization
2. dynamic fetch
3. swell arrival forecasting

**Chapter 5 – Introduction to Numerical Modelling**
(Jean Bidlot with Hendrik Tolman:editors)



**Chapter 6 – Operational Wave Models**
(Diana Greenslade and Andy Saulter:editor with contributions from Jean Bidlot and Hendrik Tolman))

**Chapter 7 – Wave Data, Observed , Measured and Hindcast**
(Francisco Ocampo Torres: editor with contribution from Val Swail)



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**Annex IV**

## DRAFT QUESTIONNAIRES FOR FORECAST CENTRES RUNNING OPERATIONAL WAVE MODELS

(as agreed at ETWCH-4, 3-6 April 2013, Paris, France)

### FORM 1

**Identification**

Member state/territory :
Name of contact :
Mailing address :
Telephone :
Fax :
E-mail :
Web site:

Does your Service use numerical wave models for operational or pre-operational† forecast activities?

**If yes, please complete the columns in the table below for each forecast application. Sample responses are provided in the table for guidance. If more than three applications exist please use another sheet.**

☐ We agree that the information we provide in this table may be published on a JCOMM-website

| | ***Forecast Sample*** | ***Forecast Application #1*** | ***Forecast Application #2*** | ***Forecast Application #3*** |
|---|---|---|---|---|
| ***Name of Model*:** | WAM-Atlantic | | | |
| ***Type/Generation of Model*:** WAM, WW3, SWAN or other (please specify) | WAM 4.0 | | | |
| ***Model physics:*** Deep and/or shallow water, other properties (please specify) | deep and shallow | | | |
| ***Spectral resolution:*** Frequencies / directions | 30 / 36 | | | |
| ***Grid type, spacing*:** Regular (lat-lon), polar stereographic or other (please specify) | regular 0.5°x 0.5° | | | |
| ***Model area*:** Global or regional (please specify geographical frame) | North Atlantic 30-75N ; 69W-30E | | | |
| ***Source of wind information*:** Name of atmospheric model, level of wind forcing, spatial resolution, type of coupling | DMI HIRLAM 10m surface winds, 15km resolution, one-way coupling | | | |
| ***Wave-current-coupling:*** Name of ocean circulation model, if any | | | | |
| ***Data used for wave assimilation, if any :*** Satellite data (RA, SAR), buoys | RA | | | |
| ***Forecast period and interval:*** | T+0 to T+54 (1hr) | | | |
| ***Ensemble Prediction ?*** (please specify number of members and source of atmospheric input, if any) | no | | | |

| | | | | |
|---|---|---|---|---|
| ***Digital Products***<br>wind (speed and direction), 2-D spectra, ,<br>integrated spectral parameters (just specify categories like total sea, wind sea, number of swell systems or other type of partitioning the wave spectrum) | Wind,<br>drag coefficient,<br>Integrated parameters (total sea, wind sea and swell) | | | |
| ***Format of digital products***<br>GRIB, NetCDF, BUFR, ASCII or other | GRIB | | | |
| ***Verification***<br>Participation in the Wave Forecast Verification Projekt (WFVP) or other publication (please specify) | WFVP | | | |
| ***Archiving of digital products***<br>Time of availability, forecast period and interval | 2 years<br>T+0 to T+54 (6hr) | | | |
| ***Availability of hindcast data***<br>Time span, space and time resolution<br>if different from forecast model | Since 2007<br>1°x 1°, 12hr | | | |
| ***Graphical products*** | Hourly charts and animation of plots of winds, significant wave height, swell height, mean wave period, dominant wave period and swell period | | | |
| ***Are the products freely available?***<br>Please note any restrictions | Yes. For non-commercial use only. | | | |
| ***General Applications (by your institution)***<br>Maritime weather forecasts, gale warnings or other (please specify) | | | | |
| ***Special Applications (by your institution)***<br>Ship routeing, offshore consultancy or other (please specify) | Ship routeing | | | |

**FORM 2**

**Identification**

Member state/territory :
Name of contact :
Mailing address :
Telephone :
Fax :
E-mail :
Web site::

Does your Service produce hindcast wave data bases using numerical wave models?

**If yes, please complete the columns in the table below for each hindcast wave data base. Sample responses are provided in the table for guidance. If more than three applications please use another sheet.**

☐ We agree that the information we provide in this table may be published on a JCOMM-website

| | ***Hindcast Sample*** | ***Hindcast Application #1*** | ***Hindcast Application #2*** | ***Hindcast Application #3*** |
|---|---|---|---|---|
| ***Name of Model*:** | | | | |
| ***Type/Generation of Model*:** WAM, WW3, SWAN or other (please specify) | | | | |
| ***Model physics:*** Deep and/or shallow water, other properties (please specify) | | | | |
| ***Spectral resolution:*** Frequencies / directions | | | | |
| ***Grid type, spacing*:** Regular (lat-lon), polar stereographic or other (please specify) | | | | |
| ***Model area*:** Global or regional (please specify geographical frame) | | | | |
| ***Time period :*** | | | | |
| ***Source of wind information*:** reanalysis or operational, Name of atmospheric model, level of wind forcing, spatial resolution, type of coupling | | | | |
| ***Data used for wave assimilation, if any :*** Satellite data (RA, SAR), buoys | | | | |
| ***Wave-current-coupling:*** Name of ocean circulation model, if any | | | | |
| ***Digital Products*** wind (speed and direction), 2-D spectra, , integrated spectral parameters (just specify categories like total sea, wind sea, number of swell systems or other type of partitioning the wave spectrum) | | | | |
| ***Format of digital products*** GRIB, NetCDF, BUFR, ASCII or other | | | | |
| ***Graphical products, if any*** | | | | |
| ***Statistical products, if any*** | | | | |
| ***Validation (please specify)*** | | | | |

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**Annex V**

## DRAFT WORLDWIDE SURVEY ON STORM SURGE OPERATIONAL MODELS AND BASIC DATA

(as agreed at ETWCH-4, 3-6 April 2013, Paris, France)

### 1. QUESTIONNAIRE ON OPERATIONAL AND PRE-OPERATIONAL NUMERICAL STORM SURGE MODELS (DRAFT)

| **Identification** | | | |
|---|---|---|---|
| Member state/territory:<br>Name of contact:<br>Mailing address:<br>Telephone:<br>Fax:<br>E-mail:<br>Web site: | | | |
| Does your Service use operational or pre-operational† numerical ocean models for storm surge *forecast* activities?<br>**If yes, please complete the columns in the table below for each different forecast application. If more than three applications please use another sheet.** | | | |
| | ***Application #1*** | ***Application #2*** | ***Application #3*** |
| ***Name of Model*:** | | | |
| ***Type of Model/Operation mode*:**<br>*a) approach (depth-averaged, full baroclinic, other)*<br>*b) inundation*<br>*c) coupling (ice, atmosphere, river-runoff)*<br>d) *any other features to note* | | | |
| ***Discretization:***<br>*a) horizontal grid type*<br>*b) spacing*<br>c) *vertical coordinate, if any* | | | |
| ***Type and source of information at ocean boundaries:***<br>*a) tide*<br>*b) surge*<br>***c)** other ocean forcings* | | | |
| ***Area:*** | | | |
| ***Atmospheric forcing:***<br>***a)** source of information*<br>***b)** type of information (wind/ wind stress, other)*<br>***c)** spatial resolution*<br>***d)** update frequency*<br>***e)** downscaling* | | | |
| ***Real time use of observations, if any:***<br>*a) data assimilation*<br>*b) corrections*<br>***c)** other* | | | |
| ***Forecast period and cycle:*** | | | |
| ***Products:***<br>*a) description (text, graphical)*<br>*b) interval* | | | |
| ***Applications:***<br>***a)** water level forecasts*<br>***b)** hindcasts*<br>***c)** currents*<br>***d)** drift calculations*<br>***e)** flood*<br>***f)** other* | | | |

| | | | |
|---|---|---|---|
| ***Model Verification:***<br>*a) methods*<br>***b)*** *time period/frequency*<br>***c)*** *links/references* | | | |
| ***Is the model freely available/open source? Please note any restrictions*** | | | |

† Pre-operational models are those which are in the final stages of development before implementation, for example in parallel testing with existing operational models. This survey is not intended to capture experimental models.

## 2. QUESTIONNAIRE ON HINDCASTED STORM SURGE DATA BASES (DRAFT)

| **Identification** | | | |
|---|---|---|---|
| Member state/territory:<br>Name of contact:<br>Mailing address:<br>Telephone:<br>Fax:<br>E-mail:<br>Web site: | | | |
| Does your Service produce *hindcasted* storm surge data bases using numerical models?<br>**If yes, please complete the columns in the table below for each hindcast storm surge data base. If more than three applications please use another sheet.** | | | |
| | ***Application #1*** | ***Application #2*** | ***Application #3*** |
| ***Name of Model*:** | | | |
| ***Type of Model/Operation mode, if different from operational*:**<br>*a) approach (depth-averaged, full baroclinic, other)*<br>*b) inundation*<br>*c) coupling (ice, atmosphere, river-runoff)*<br>d) *any other features to note* | | | |
| ***Discretization, if different from operational:***<br>*a) horizontal grid type*<br>*b) spacing*<br>c) *vertical coordinate, if any* | | | |
| ***Type and source of information at ocean boundaries, if different from operational:***<br>*a) tide*<br>*b) surge*<br>***c)*** *other ocean forcings* | | | |
| ***Area, if different from operational:*** | | | |
| ***Atmospheric forcing:***<br>***a)*** *source of information(reanalysis/operational)*<br>***b)*** *type of information (wind/ wind stress, other)*<br>***c)*** *spatial resolution*<br>***d)*** *update frequency*<br>***e)*** *Downscaling* | | | |
| ***Use of observations, if any:***<br>*a) data assimilation*<br>*b) corrections*<br>***c)*** *other* | | | |

| | | | |
|---|---|---|---|
| ***Time period:*** | | | |
| ***Digital Primary Products:***<br>*a) description*<br>*b) interval* | | | |
| ***Statistical Products:*** | | | |
| ***Validation:***<br>*a) methods*<br>***b)*** *links/references* | | | |
| ***Are the data or the climatology available/published? Please note any restrictions*** | | | |

## 3. QUESTIONNAIRE ON MEASURED STORM SURGE DATA BASES (DRAFT)

| **Identification** | | | |
|---|---|---|---|
| Member state/territory:<br>Name of contact:<br>Mailing address:<br>Telephone:<br>Fax:<br>E-mail:<br>Web site: | | | |
| Does your Service maintain data bases of water levels, including storm surge data?<br>**If yes, please complete the columns in the table below for each storm surge data base. If more than three data bases please use another sheet.** | | | |
| | ***Data base #1*** | ***Data base #2*** | ***Data base #3*** |
| ***Stations / locations*:** | | | |
| ***Parameter/s*:** | | | |
| ***Interval:*** | | | |
| ***Instrument/s:*** | | | |
| ***Metadata included:*** | | | |
| ***Period:*** | | | |
| ***Storage Media (digital / analogic):*** | | | |
| ***Statistical parameters, climatology:*** | | | |
| ***Please provide links and/or references, if available:*** | | | |
| ***Please describe which coastal areas may be prone to storm surges in your territory:*** | | | |
| ***Please mention any other institutions in your country holding storm surge data bases and/ or conducting research on storm surges*** | | | |
| ***Are the data or the climatology available/published? Please note any restrictions*** | | | |

**Annex VI**

## LIST OF ACTIONS AGREED AT THE SESSION

| Item | Action | By whom | When/target |
|---|---|---|---|
| 2.2 | Provide input to SCG for the internal review of the draft competency requirements for marine/oceanographic services, for the part of Team's expertise | All members led by K.Horsburgh | when the draft document is submitted and not later than December 2013 |
| 3.1.3 | Complete the revision of the Guide to Wave Analysis and Forecasting (WMO-No.702) following the agreed timeline | Responsible editors led by T.Bruns | Ongoing and until March 2015 |
| 3.1.4 | Provide necessary support for internal review, final revision and peer review for revised WMO-No.702 | WMO Sec. coordinating with T.Bruns | Ongoing and until March 2015 |
| 3.1.6 | Finalize the questionnaire for wave analysis and forecasting, and analyze the collected information after the survey | P.Etala with input from members | Following timeline in para 3.1.7 |
| 3.1.6 | Provide necessary support for communication and collecting responses for the survey for wave analysis and forecasting | WMO Sec. coordinating with P.Etala | Following timeline in para 3.1.7 |
| 3.1.8 | Regularly review and determine on actions for update of the dynamic part of WMO-NO.702 | P.Etala | Upon the establishment of a dynamice part and ongoing |
| 3.1.11 | Finalize the questionnaire for storm surge modelling and data, and analyze the collected information after the survey | P.Etala | Following timeline in para 3.1.11 |
| 3.1.11 | Provide necessary support for communication and collecting responses for storm surge modelling and data | WMO Sec. coordinating with P.Etala | Following timeline in para 3.1.11 |
| 3.1.12 | Regularly review and determine on actions for update of the dynamic part of WMO-NO.1076 | K.Horsburgh | Ongoing |
| 3.1.16 | Draft a white paper on forecasting dangerous sea state | A.Saulter with input from all members | 1st draft by October 2013, final edition by January 2014 |
| 3.2.4 | Develop a proposal for the proposed scanning project for US and Canadian data for EWDS | V.Swail, S.Woodruff | July 2013 |
| 3.2.4 | Review and comment on the ETWS scanning proposal (above) | H.Tolman, F.Ocampo-Torres | October 2013 |
| 3.2.4 | Present scanning plan/proposal at CLIMAR-4 | V.Swail, S.Woodruff | 1st quarter 2013 |
| 3.2.7 | Organize a session on wave climate during the 13th Wave Workshop, as well as a parallel meeting on COWCLIP review | V.Swail, M.Hemer | October 2013 |
| 3.3.4 | Push data for WFVP to the GTS | Participating agencies collecting marine meteorological data for WFVP | ASAP and ongoing |
| 3.3.4 | Provide model spectra at selected locations | Participating agencies in WFVP | ASAP and ongoing |

| Item | Action | By whom | When/target |
|---|---|---|---|
| 3.3.7 | Discuss with ECMWF to add a wave component to the ECMWF system | WMO Secretariat in consultation with members leading WFVP | ASAP |
| 3.3.7 | Explore ways and associated plans to use the NOAA Operational Model Archive & Distribution System (NOMADS) OPeNDAP server, to underpin data gathering effort for WFV | H.Tolman, J.Bidlot | April 2013 |
| 3.3.8 | Discuss and present plans for the long-term future of WFVS, ), including the possibility of migrating the verification and reporting software | H.Tolman, J.Bidlot | April 2013 |
| 3.3.10 | Closely coordinate with the PP-WET Steering Committee and Environment Canada for co-deployment and further analysis | NCBC in coordination with PP-WET Steering Committee | ASAP |
| 3.3.13 | Consider metadata setup for wave measuring systems other than moored and drifting wave buoys | PP-WET Steering Committee, DBCP Task Team on Moored Buoys | ASAP and ongoing |
| 3.3.13 | Explore the relevance of PP-WET activities to the ongoing efforts regarding wave energy as a potential source of funding and deployments | V.Swail, K.Horsbugh | ongoing |
| 3.4.4 | Consider additional special sessions for 13th Wave Workshop and 4th Coastal Hazard Symposium, and provide suggestions Mr Val Swail | All members | ASAP |
| 3.4.8 | Lead the discussion with the chairperson of TOWS-WG to further explore potential areas for collaboration | M.Entel | ongoing |
| 3.4.12 | Finalize the plan for wrap-up workshop of NIO storm surge project | K.Horsburgh, B.Lee, S.Dube | ongoing |
| 3.4.15 | Decide on the organizational outline for the 2nd JCOMM Storm Surge Symposium | K.Horsburgh to lead, D.Greenslade, H.de Vries, G.Umgiesser, V.Swail | September 2013 |
| 3.4.15 | Plan for the necessary support for the organization of 2nd JCOMM Storm Surge Symposium | WMO Secretariat with input from IOC Secretariat | ASAP and until 2015 |
| 3.4.16 | Propose themes and issues to be discussed at the 2nd JCOMM Storm Surge Symposium | All members | September 2013 |
| 3.5.4 | Consider an efficient way of distributing experts' time and involvement, as well as Secretariat's time | CIFDP PSG, WMO Secretariat, ETWCH | ASAP and ongoing |
| 3.5.4 | Consider working with additional ETWCH members to advise on implementation of CIFDP National Sub-Projects | CIFDP PSG, M.Entel, D.Greenslade, F.Ocampo-Torres, N.Kohno, K.Horsburgh, A.Kortcheva, G.Umgiesser | ASAP and ongoing |

| Item | Action | By whom | When/target |
|---|---|---|---|
| 4.0 | Review and update the respective parts of the SFSPA workplan 2012-2017, and provide updates | members participating in 'projects" of SFSPA workplan 2012-2017 | ASAP and ongoing |
| 4.1.3 | Prepare a set of examples and guidelines for responding to the designed questionnaires for storm surge modelling and data | K.Horsburgh, P.Etala, M.Entel, H.Tolman | May 2013 |
| 4.1.4 | Draft a paper on a proposed scope and plan for developing storm surge climatology, and present it at CLIMAR-4 | K.Horsburgh, G.Umgiesser, H.de Vries, M.Entel, N.Kohno | December 2013 (draft), April 2014 (presentation) |
| 4.1.4 | Explore cooperation with ETCCDI for development of storm surge climatology | K.Horsburgh, | Ongoing |
| 4.1.5 | Promote within their own organisations the eSurge concept, and provide feedback to the eSurge project management team | All members | Ongoing |
| 4.2.3 | Consider/develop potential addition to the SS guide (e.g. wave setup, "meteo-tsunami") and decide on the overall structure and contents of the dynamic part | N.Kohno, M.Entel, SH.You, K.Horsburgh | August 2014 for wave-setup description, ongoing for structure/contents review |
| 4.2.4 | Provide necessary input to the continuing process for review and revision of WMO-No.558 and WMO-No.471, within ETWCH areas expertise | S.Desjardins, with team input | Upon request (by ETMSS) |
| 4.2.5 (also 3.1.13 to 3.1.16) | Work with ETMSS to update WMO-No.558 and WMO-No.471, based on the white paper on forecasting dangerous sea states | S.Desjardins, with team input | After finalization of white paper and ongoing |
| 4.2.6 | Continue to provide advice and input to the review/update of WMO-No.485, upon request | K.Horsburgh, J.Bidlot, SH.You, WMO Secretariat | Upon request |
| 4.2.7 | Coordinate with ETOOFS to harmonize JCOMM input to WMO Rolling Review of Requirements (RRR) | K.Horsburgh, in coordination with G.Brassington, G.Liu, A.Mafimbo | Continuous until July 2014 |
| 4.2.8 | Identify potential contributions to COWCLIP through the EU-FP7 IncREO project | A.Kortcheva | ASAP |
| 4.3.2 | Continue to support training at JCOMM-TCP training workshops on wave and storm surge modelling | Members with support from WMO Secretariat | Ongoing |
| 4.3.2 | Explore ways to develop/enhance links between the JCOMM-TCP training workshop on wave and storm surge modelling, and related training activities | WMO Secretariat with input from members | ASAP and ongoing |

| Item | Action | By whom | When/target |
|---|---|---|---|
| 4.3.3 | Participate in Capacity Development activities to continue documenting and archiving educational material (with elaborated information on target/users for each material, where possible) to be used for pre-study, in-session and distance training, and to explore available resources to develop and utilize e-learning material | Secretariat and experts | Ongoing |
| 4.4.2 | Represent the ETWCH perspectives as a member of the CLIMAR-4 Organizing Committee | V.Swail | Ongoing and until April 2014 |
| 4.4.2 | provide ideas on topics or papers for a special session at CLIMAR-4 to be convened by Mr Swail | All members | ASAP |
| 5.1.1 | Act as JCOMM/ETWCH focal point to GLOSS | K.Horsburgh | Ongoing |
| 5.2.3 | continue coordination with the WMO Education and Training programme and the NOAA/CPC African Desk to implement in-depth training for African experts on model implementation, and to continue providing technical advice for national operation of wave forecasting in the JCOMM context | WMO Secretariat, H.Tolman | ASAP and ongoing |
| 6.1 | Modify/update the JCOMM SFSPA web pages relevant to ETWCH activities | WMO Secretariat | ASAP and ongoing |
| 6.1 | Coordinate a review of the ETWCH-relevant pages in JCOMM web site and provide comments and proposals for improvement | G.Umgiesser with input from all members | December 2013 |

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**ANNEX VII**

## ACRONYMS AND OTHER ABBREVIATIONS

| | |
|---|---|
| BMKG | Indonesia Meteorology Climatology and Geophysics Agency |
| CD | Capacity Development |
| CHy | WMO Commission for Hydrology |
| CIFDP | WMO Coastal Inundation Forecasting Demonstration Project |
| COWCLIP | Joint JCOMM-WCRP Project on Coordinated Wave Climate Projection |
| DBCP | Data Buoy Cooperation Panel |
| DEM | Digital Elevation Model |
| DNA | (CIFDP) Definitive National Agreement |
| DRR | Disaster Risk Reduction |
| EC | (WMO) Executive Council |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| EWDS | Extreme Wave Data Set |
| ET | Expert Team |
| ET-EGOS | (WMO CBS) Expert Team on Evolution of the Global Observing Systems (replaced with IPET-OSDE) |
| ETCCDI | Joint CLIVAR-CCl-JCOMM Expert Team on Climate Change Detection and Indices |
| ETMC | (JCOMM) Expert Team on Marine Climatology |
| ETMSS | (JCOMM) Expert Team on Maritime Safety Services |
| ETOOFS | (JCOMM) Expert Team on Operational Ocean Forecast System |
| ETWCH | (JCOMM) Expert Team on Waves and Coastal Hazards Forecast Systems |
| ETWS | (JCOMM) Expert Team on Wind Waves and Storm Surges (re-named to ETWCH) |
| GCC | Global Collecting Centre |
| GFCS | Global Framework for Climate Services |
| GDPFS | (WMO) Global Data Processing and Forecasting System |
| GLOSS | Global Sea Level Observing System |
| GMDSS | Global Maritime Distress and Safety System |
| GTS | Global Telecommunication System |
| ICOADS | International Comprehensive Ocean-Atmosphere Data Set |
| IncREO | EU FP7 project on Increasing Resilience through Earth Observation |
| IOC | Intergovernmental Oceanographic Commission (of UNESCO) |
| IIT-D | India Institute of Technology Delhi |
| IMD | India Meteorological department |
| INCOIS | Indian National Centre for Ocean Information Services |
| IPET-OSDE | (WMO CBS) Inter-Programme Expert Team on the Observing System Design and Evolution |
| ISDM | Integrated Science Data Management (Canada) |
| JCOMM | Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology |

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|---|---|
| JMA | Japan Meteorological Agency |
| KOICA | Korea International Cooperation Agency |
| MAN | JCOMM Management Committee |
| MSI | Maritime Safety Information |
| NCDC | National Climatic Data Center (USA) |
| NCEP | (US NOAA) National Centers for Environmental Prediction |
| NDBC | National Data Buoy Center (USA) |
| NMHS | National Meteorological and Hydrological Service |
| NODC | National Oceanographic Data Center (USA) |
| NOPP | National Oceanographic Partnership Program (USA) |
| OGP | Oil and Gas Producers |
| PA | Programme Area |
| PP-WET | (DBCP-ETWCH) Pilot Project on Wave Evaluation and Test |
| PSG | (CIFDP) Project Steering Group |
| QM | Quality Management |
| QMS | Quality Management System |
| RRR | (WMO) Rolling Review of Requirements |
| RSMCs | Regional Specialized Meteorological Centres |
| SAR | Synthetic aperture radar |
| SAWS | South African Weather Service |
| SCG | (JCOMM) SFSPA Coordination Group |
| SFSPA | (JCOMM) Services and Forecasting Systems Programme Area |
| SMB | Shanghai Meteorological Bureau (China) |
| SoG | (WMO RRR) Statement of Guidance |
| SSWS | (WMO) Storm Surge Watch Scheme |
| SWFDP | (WMO) Severe Weather Forecasting Demonstration Project |
| TCP | WMO Tropical Cyclone Programme |
| TOWS-WG | (IOC) Working Group on Tsunamis and Other Hazards related to Sea Level Warning and Mitigation Systems |
| ToR | Terms of Reference |
| TWLE | Total Water Level Envelope |
| WCRP | World Climate Research Programme |
| WFVP | (JCOMM) Wave Forecast Verification Project |
| WFVS | Wave Forecast Verification Scheme |
| WG-SERA | (WMO) Working Group on Societal and Economic Research Applications |
| WMO | World Meteorological Organization |
| WMO-No. 471 | Guide to Marine Meteorological Services |
| WMO-No. 485 | Global Data Processing and Forecasting System |
| WMO-No. 558 | Manual on Marine Meteorological Services |
| WMO-No.702 | Guide to Wave Analysis and Forecasting |
| WMO-No.1076 | Guide to Storm Surge Forecasting |

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