



JOINT WMO/IOC TECHNICAL COMMISSION FOR
OCEANOGRAPHY AND MARINE METEOROLOGY

FIFTH MEETING OF THE WMO COASTAL INUNDATION FORECASTING DEMONSTRATION PROJECT (CIFDP) STEERING GROUP

Geneva, Switzerland, 14 – 16 May 2014

FINAL REPORT

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NOTES

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE MEETING

1.1 Opening

1.1.1 The 5th Meeting of the WMO Coastal Inundation Forecasting Demonstration Project Steering Group (CIFDP-PSG-5) was opened by the Co-chairs of the Project Steering Group (PSG), Drs Don Resio and Val Swail, at 0930 hours on Wednesday 14 May 2014, at the conference room 7L of the WMO Headquarters, Geneva, Switzerland.

1.1.2 At the start of the afternoon session of the same day, Dr Xu Tang, Director of the WMO Weather and Disaster Risk Reduction Services Department, expressed his appreciation to all participants for their contribution to the project and for attending the meeting. Dr Tang emphasized the importance of the CIFDP in realizing the impact-based forecasting and risk-based warning within the operational service framework of WMO, particularly to ensure coastal safety against natural disasters, and applauded the efforts made by the Group and associated programmes.

1.1.3 The list of participants is provided in [Annex I](#).

1.2 Approval of the agenda

1.2.1 The Group adopted its agenda for the meeting based on the provisional agenda that was prepared by the WMO Secretariat. This agenda is provided in [Annex II](#).

1.3 Working arrangements

1.3.1 The Group agreed its working hours and other practical arrangements for the session. Following the usual practice for JCOMM meetings, the meeting (including the documentation) was conducted in English only, and all documents and information were provided through the meeting web site: <http://www.jcomm.info/CIFDP-PSG-5>.

2. REVIEW PROGRESS OF SUB-PROJECTS

2.0 The Group recalled its [Terms of Reference](#) (ToR), that the PSG should review progress of Sub-Projects in each phase, and provide recommendations to relevant WMO Technical Commissions (Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, JCOMM; and WMO Commission for Hydrology, CHy) regarding the following steps of the project implementation. In this regard, the Group reviewed the status and issues of all ongoing and planned/proposed Sub-Projects and made decisions and recommendations as described in the following paragraphs.

2.1 Indonesia Sub-Project (CIFDP-I)

2.1.1 The Group reviewed the outcome of the Indonesia Stakeholders Workshop for CIFDP (CIFDP-ISW, Jakarta, Indonesia, 3 – 6 December 2013. see <http://www.jcomm.info/CIFDP-ISW>). The Group noted that this Workshop was the kick-off of the national Sub-Project of CIFDP in Indonesia (CIFDP-I) as a results of the prior national

consultation process (Focused Group Discussions: FGDs), and will synergize the national plan to develop a portal for marine climate data and information (Marine Integrated Data and Analysis System: MIDAS).

2.1.2 The Group congratulated the Government of Indonesia and the Agency for Meteorology Climatology and Geophysics (BMKG) on the successful launch of Phase 1, and expressed its appreciation for the willingness to carry out the Project through national resources and through interactive mechanisms at national and international levels. The Group noted the agreed scope of the CIFDP-I, at the Stakeholders Workshop, as follows:

- Lead for National Coordination Team (NCT) and Technical Implementation: BMKG
- Area of implementation:
 - two domains of Jakarta and Semarang.
- Forecast time frame for Coastal Inundation Forecasting System for Indonesia (CIF-I):
 - Initially agreed for 0 to 144 hours, to be reviewed by PSG and BMKG during Phase 1.
- Process to be developed through CIFDP-I:
 - Routine forecasts on inundation for operational management.
 - Threshold based criteria for warnings (review threshold selection on frequent basis).
 - May consider developing specific products in direct communication between operational managers and provincial governments.
 - To make the best use of existing tsunami/earthquake warning mechanisms for threshold-based events, normal forecast mechanisms for routine forecasts.
 - Hindcasts and validation studies may be carried out in parallel with the CIFDP-I, to provide important information for vulnerability and risk analysis.
- Proposed elements for initial CIF-I system design, to be reviewed through Phase 1:
 - Waves – Operational implementation of WAVEWATCH III for entire Indonesia domain, with nested SWAN along north shore of Java
 - Tides – implement tidal prediction scheme, either from model (TBD) or tide tables
 - Implement simple river model (to be decided) for relevant catchment areas for Jakarta, Semarang
 - Predict rainfall using combination of QPF, radar and TRMM
 - Access operational SSHA product from the Australian Bureau of Meteorology
 - Integrate individual contributions into inundation forecast through the Flood Early Warning System (FEWS)

2.1.3 The Group recalled that, relating to the proposed elements for initial CIF-I system design described above, the BMKG requested the WMO to facilitate organizing training activities for WAVEWATCH III and FEWS. The Secretariat agreed to continue coordinating with the US/NOAA and Deltares to seek ways to conduct such training sessions, if possible, during Phase 1 (**Action**).

2.1.4 The Group noted that, during the Stakeholders Workshop, national and local requirements and expectations of the Indonesian stakeholders (including provincial governments) were often found to be exceeding the scope of CIFDP. For example, while service offering in month to decadal time scales is not the primary focus of the CIFDP in general, national stakeholders in Indonesia expressed their needs for long term water level prediction combined with projection of land subsidence in order to make efficient contingency planning and infrastructure investment. The Group agreed that a clear strategy

should be applied to the continuous dialogue with users and stakeholders, throughout the implementation of CIFDP-I, in view of clarifying the immediate and secondary outcome/benefit of CIFDP-I as well as building common understanding on the project's direction. The related discussion and decisions are summarized under agenda item 3.3.

2.1.5 Based on the discussion on related subjects, the Group agreed on the following recommendations to the National Coordination Team (NCT) for CIFDP-I:

- To prioritize required technical tools (forecasting models) considering the issues at demonstration sites, based on the discussion at the Stakeholders Workshop (e.g. tide height forecasting, wave forecasting, FEWS – immediate need);
- To clearly/define the scope of CIFDP-I, expected outcome, and primary issues to be addressed within CIFDP-I;
- To explore ways to improve understanding of other issues (e.g. sea level rise/subsidence) in linkage with relevant activities/programmes;
- (Considering that range of requirements/expectations is large) To assist users to improve understanding on main causes of inundation in their areas of interest, in view of clarifying the expected outcome/benefit of CIFDP-I (through user interaction guideline for CIFDP).

2.1.6 The Group noted that the NCT for CIFDP-I plans to complete Phase 1 and request PSG's review by October 2014. The Group requested the Secretariat to develop a plan to conduct the Phase 1 review in the proposed time frame, in coordination with the CIFDP-I NCT (**Action**).

2.2 Fiji Sub-Project (CIFDP-F)

2.2.1 The Group reviewed the progress in the CIFDP Sub-Project for Fiji (CIFDP-F) against the plan agreed at the Fiji Stakeholders Workshop for CIFDP (CIFDP-FSW, Nadi, Fiji, 18-21 February 2013: See <http://www.icomm.info/CIFDP-FSW>) and the [CIFDP Implementation Plan](#) (JCOMM Technical Report No.64). The Group recalled that, since the 4th meeting of PSG (22-23 February 2013, Nadi, Fiji: <http://www.icomm.info/CIFDP-PSG-4>), the NCT for CIFDP-F and the PSG had completed all requirements for Phase 1. The Group appreciated and encouraged the Government of Fiji for its firm support and willingness for the Project, and reaffirmed its positive review upon the CIFDP-F Phase 1 (Decision) noting the following outcomes:

- Definitive National Agreement (DNA):
 - signed in June 2013, by Prime Minister's Office, Ministry of Works and Transport (for the leading role/work of Fiji Meteorological Service, FMS) and Ministry of Provincial Development and Disaster Management.
- National Coordination Team (NCT) formed with Terms of Reference agreed, as part of DNA.
- Detailed Project Plan with [National Capacity Assessment \(NCA\)](#) completed in December 2013, and published as JCOMM Technical Report No.71.
- [User Requirements Plan for Fiji for Phase 1](#) completed, and published on CIFDP web site as dynamic document (to be updated in each Phase of implementation).

- Preparation for Funding arrangement for Phases 2 to 4 in progress (see paragraph 2.2.3)

2.2.2 The Group noted the outcome of the Interdisciplinary Experts Forum for CIFDP-F held from 7 to 10 October 2013 in Nadi, Fiji (<http://www.jcomm.info/CIFDP-F-IEF>), where: 1) focused user and stakeholder consultation took place, to complete the User Requirements Plan for CIFDP-F Phase 1; 2) review progress in National Capacity Assessment (NCA) and updated the status of availability on data and technologies, and; 3) initial System Design for a Coastal Inundation Forecasting system for Fiji (CIF-F) was discussed. The Group noted with satisfaction that several members of PSG had completed the [System Design for a CIF-F](#), in consultation with the NCT for CIFDP-F and regional partners including the Secretariat of the Pacific Community / Applied Geoscience and Technology Division (SPC/SOPAC), which is now published as JCOMM Technical Report No.74. The Group reaffirmed its endorsement for this System Design (Decision), and agreed that the CIFDP-F is ready to move onto Phase 2, from the second half of 2014 upon the availability of funding.

2.2.3 The Group took note of the ongoing discussion with the government of Australia and other potential donors, through the WMO secretariat, regarding the funding for CIFDP-F Phases 2 to 4. The Group noted that consideration for a funding proposal to the Australian Agency for International Development (AUSAID) would be considered in January 2015 following the agency's working cycle. Meanwhile, the Group noted with satisfaction that the Australian Bureau of Meteorology has made progress in its national storm surge project which would facilitate the technical support for CIFDP-F in terms of providing and sharing boundary conditions and operational forecasts for waves, tides and Sea Surface Height Anomaly (SSHA), following the agreed System Design. The Group agreed that the Secretariat, PSG and NCT for CIFDP-F would continue exploring funding opportunities including the AUSAID proposal in progress, particularly for intermediate funds for initiation of Phase 2 in 2014 (**Action**). In parallel, the Group requested the NCT to plan the implementation of Phase 2, in consultation with the Secretariat and PSG (**Action**).

2.2.4 The Group considered that, in consideration of the System Design for CIF-F, the contribution of flash flood to coastal inundation could be improved through improved forecasting and warning through the regional Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (SWFDDP). The Group therefore recommended that the implementation of SWFDDP could explore improved operational warning for flash flood (for Fiji), and coordinate the use / cascading of forecasting products with CIFDP-F (**Recommendation**).

2.3 Dominican Republic Sub-Project (CIFDP-DR)

2.3.1 The Group reviewed the status of the CIFDP sub-project for Dominican Republic (CIFDP-DR), in particular, emerging requirements and evolution of the general direction of this sub-project made since the 4th PSG meeting in February 2013.

2.3.2 The Group noted that, while the PSG has been working closely with the NCT in an attempt to respond to the PSG requests (made at the 4th PSG meeting) to meet the requirements to complete Phase 1, the requirements had evolved to extend the scope of the project into "one-island approach", including Haiti in the technical applications. The Group also noted with interest that the Government of the United States, through the WMO Voluntary Cooperation Programme (VCP) expressed its interest to provide some funds for the implementation of "one-island project for coastal inundation forecasting", when a project plan and funding proposal would be submitted through the established process.

2.3.3 The Group also noted the discussion and conclusions made at the [36th session of the Hurricane Committee](#) of the WMO Regional Association IV (North America, Central America and the Caribbean): the Regional Specialized Meteorological Centre for Tropical Cyclone (RSMC-TC), US National Hurricane Center presented on its current storm surge forecasting methods in the US and its plans for new storm surge graphical products in 2014 and new storm surge watches and warnings during 2014 and 2015. These products were currently planned to be provided for US Gulf and East Coasts, however, the RSMC agreed that it could examine feasibilities for its support for forecasting on an extended domain including RA IV countries if they desire. The RSMC would also pursue options for technical support, for example, through the CIFDP framework. The Hurricane Committee and the WMO Tropical Cyclone Programme (TCP) agreed to convene a workshop on storm surges in early 2015 and prior to the 2015 Hurricane Committee Meeting, in cooperation with the WMO Marine Meteorology and Oceanography Programme (MMOP).

2.3.4 Taking into account those recent developments, the Group decided to re-scope the DR Sub-Project according to these emerging requirements and regional interest (**Decision**). The associated discussion and decisions are recorded under agenda items 2.5 and 5.

2.4 Bangladesh National Sub-Project (CIFDP-B)

2.4.1 The Group reviewed the progress in CIFDP-B against the plan for Phase 2 implementation, which is detailed in the [CIFDP Implementation Plan](#) (JCOMM Technical Report No.64). The Group congratulated the NCT and System Developer for CIFDP-B for the significant progress, and endorsed the progress report as reproduced in [Annex III](#) (**Decision**).

2.4.2 The Group noted in particular the outcomes of the meeting of the NCT for CIFDP-B, held from 16 to 18 February 2014 in Dhaka, Bangladesh (<http://www.jcomm.info/CIFDP-B-NCT>), where; 1) the intermediate outcome of the Coastal Inundation Forecasting (CIF-B) model (upgraded JMA-MRI Storm Surge model upon the agreed System Design) was presented to the NCT; 2) a training session on the CIF-B model was conducted for the forecasters and operators of the Bangladesh Meteorological Department (BMD); 3) in-depth discussion was conducted in detail among the technical partners of the NCT on the data flow and sharing scheme for operation CIF-B; and, 4) user consultation was conducted on the requirements for coastal inundation forecasting/warning and related services. The Group reaffirmed that continuous training and user consultation are the key elements for successful implementation throughout all Phases of CIFDP implementation. The Group agreed that the CIFDP Implementation Plan should be reviewed and revised, if/where needed, to ensure that similar practice should be made in all Sub-Project at appropriate times (**Decision**). The Group also requested the System Developer for CIFDP-B and the NCT to update the project plan according to the decisions made at the NCT meeting (**Action**).

2.4.3 The Group noted that the NCT meeting for CIFDP-B was held in conjunction with the Work Package 1 meeting of the [EU FP7 Resilience-Increasing Strategies for Coasts - toolKIT](#) (RISC-KIT), which included a case study on a Bangladesh coastal site (Sandwip island). The Group noted that this case study would complement the decision-making support through the CIF operation, by using an advanced framework developed by European institutions (Coastal Risk Assessment Framework: CRAF), and the user component of CIFDP-B NCT and EU RISK-KIT WP1 would be shared through these joint activities. The Group noted benefits from parallel activities of common goals, in delivering final outcome and benefit to the users in Bangladesh; that the CIFDP-B would clearly demonstrate the benefit of improved forecasting through the local application for coastal risk

assessment by RISC-KIT, and the RISC-KIT would benefit from the technical development and data sharing achieved by the national framework of the CIFDP-B. The Group noted that such a collaborative arrangement with scientific communities should also be encouraged in other Sub-Project implementation (**Recommendation**).

2.4.4 The Group reviewed a proposed testing exercise of the pre-operational CIF-B system ("table-top exercise"), to be conducted in September 2014 with the national agencies of Bangladesh that have roles in the response and preparation on disasters, as described in [Annex IV](#). As the first simulation exercise in Phase 2, to be followed by more realistic exercises in Phases 3 and 4, this should be conducted with objectives; 1) to build common understanding among agencies on how the responsible agencies should interact and respond in an assumed situation; and, 2) to test the pre-operational system and identify its strength and weakness. The Group agreed that this exercise would promote preparedness by testing policies, plans, and systems for CIF. The Group suggested that the plan should include a clear process for evaluation and feedback mechanism, in particular, and agreed on the proposed plan as reproduced in [Annex IV \(Decision\)](#). The Group agreed that this plan could be used as a model for other Sub-Project implementation, and requested the Co-Chairs and the Secretariat to include it in the CIFDP Implementation Plan (**Action**).

2.4.5 Based on the discussion on the related subjects, the Group agreed on the following recommendations to the NCT and to the System Developer for CIFDP-B:

- The high-resolution GIS tools used by the RSMC-Miami (National Hurricane Center) could be applied in the development of CIF-B. The PSG requested the Secretariat to discuss with the RSMC-Miami to share necessary data for this purpose (**Action**).
- The PSG requested the System Developer to conduct comparison run between the existing operational storm surge model and updated CIF-B model (current version), during the tropical cyclone season. The cases used for the training in February 2013 could be used for this purpose (**Action**).
- Continuous and enhanced user consultation should be carried out, for identification and development of inundation forecast and warning products (**Recommendation**).

2.5 Newly Proposed Sub-Projects

2.5.0 The Group recalled its [Terms of Reference](#) (ToR), that the PSG should work with the WMO Secretariat in initiation of Sub-Projects, by reviewing the initial requirements and providing advice to WMO Technical Commissions (JCOMM and CHy). To this end, the Group reviewed the proposals forwarded to the Secretariat and the Group for new Sub-Projects, and made decisions as detailed in the following paragraphs.

Shanghai (CIFDP-S)

2.5.1 The Group recalled that the Shanghai Meteorological Service (SMS) had submitted its plan to implement a CIFDP Sub-Project for Shanghai, to the 4th PSG meeting in 2013. The Group noted that, while the technical development/implementation is under way within SMS, the official launch of CIFDP-S Phase 1 had been delayed due to the transition of the management for China Meteorological Administration (CMA) and SMS. The Group, taking into account that the SMS has sufficient technical expertise to carry out the early steps of Phase 1, agreed that the PSG support and advisory activities should be decided upon the request of SMS on the official actions. The Group agreed that, in the meantime, the key players in the implementation of CIFDP-S could be involved officially or unofficially in the similar activities of other Sub-Projects (**Recommendation**).

South Africa (CIFDP-SA)

2.5.2 The Group recalled a proposal to initiate a Sub-Project for South Africa (CIFDP-SA), made by the South African Weather Service (SAWS), as a cascading activity of the Severe Weather Forecasting Demonstration Project (SWFDP) RA I. It considered that, as of this date, SAWS has not communicated its plan on the initiation of a Sub-Project, and agreed that the PSG actions on this plan should be on hold until further communication with SAWS.

Caribbean (CIFDP-C)

2.5.3 Recalling a brief report on the status of the Dominican Republic Sub-Project (CIFDP-DR) and new requirements for the future direction, as noted under item 2.3, Dr Don Resio presented a proposed plan for transition of the CIFDP-DR to CIFDP-C (Caribbean) as follows:

- The Sub-Project will be implemented for the Caribbean region, including Haiti and other Small Islands, CIFDP-C, through the leading technical contribution by the RSMC-TC Miami (US National Hurricane Center);
- The existing component and progress so far on the domain of Dominican Republic will become a beta project for CIFDP-C, with the consideration on the Haiti domain as well. Momentum and progress in the previous CIFDP-DR should be maintained to the greatest extent possible;
- The RSMC-TC, in collaboration with the PSG and other partners (to be clarified during the project implementation) needs to move forward within a fixed time window.

2.5.4 The Group carefully reviewed the implications of the above plan, and agreed that this new approach would ensure the maximum synergies of regional and national efforts, as well as the benefit of this new direction not only for the Dominican Republic but also for all other Caribbean Members. The Group approved the transition of CIFDP-DR to CIFDP-C (**Decision**), and requested its members to revise the Sub-Project outline, timeline and milestones in coordination with the decisions made at the RA-IV Hurricane Committee on the requirements for regional requirements (see also paragraph 2.3.3) (**Action**).

2.5.5 The Group also requested its members and the Secretariat to develop a new proposal for funding, taking into account the working progress of a CIFDP-DR proposal, and consult with potential donors (**Action**). Taking into account the present expression of interest from the WMO VCP, the Group agreed that such a proposal could primarily address the implementation of a beta project for CIFDP-C in Dominican Republic and Haiti, to be extended to the entire Caribbean region.

2.5.6 The Group emphasized that, as the Sub-Project would be implemented with a new approach, the CIFDP-C should be more interactive and inter-connected with entire PSG as with other ongoing Sub-Projects (**Recommendation**).

3. REVIEW OF AND FUTURE DEVELOPMENT FOR THE PROJECT

3.0 The Group recalled its [Terms of Reference](#) (ToR), which includes “regular review and update of the Project Concept and Implementation Plan”. In this regard, the Group conducted the following activities and made decisions accordingly, as described in the following paragraphs.

3.1 Project concept, implementing strategy and implementation plan

3.1.1 The Group reviewed the CIFDP Concept, which was reviewed and approved at its 4th meeting of the PSG in 2013. It reaffirmed that the Concept should provide a high level description of the Project in a compact style, including the final goal(s), benefit, and implication for commitment. . The Group agreed to keep the Concept unchanged from the 2013 edition, until the review at its 6th meeting in 2015 (**Decision**).

3.1.2 The Group recalled the general implementing strategy for CIFDP, endorsed at the 4th Session of JCOMM (23-31 May 2012, Yeosu, Republic of Korea), as follows, and agreed to keep it as it stands until the review at its 6th meeting in 2015 (**Decision**):

- The Project would be implemented under each regional/national Sub-Project, launched for a country that meets the essential requirement for initiating a national agreement between national institutions with relevant responsibilities, and the provisional establishment of a National Coordination Team (NCT) that includes operator(s) of the NMHS;
- The Project would be designed based on users' perspectives and requirements, considering only existing and available open source techniques. Final products of the Demonstration Project should be operated and maintained by a national operational agency which has the responsibility/authority for storm surge warning and flood warning;
- The developed procedure/best practice through a Sub-Project should be applicable to other (neighbouring) countries with common issues and interests, and should be closely linked to and cooperating with related projects and activities, such as the regional Severe Weather Forecasting Demonstration Project (SWFDP) in building a “cascading forecasting process” to produce services for coastal zones.

3.1.3 The Group reviewed the [CIFDP Implementation Plan](#) (JCOMM Technical Report No.64), as revised following the recommendations of its 4th meeting (February 2013, Nadi, Fiji). Noting that this publication is the reference document for CIFDP implementation, and the working document that should reflect the rapidly evolving status of the Project, the Group agreed to revise this document based on developments in the various Sub-Projects throughout the year and taking into account the decisions taken during the meeting (**Decision**). The Group requested the Co-chairs and the Secretariat to publish electronically the 2014 revision of the Implementation Plan by June 2014 (**Action**). The Group noted in particular the revision on the process for phased review of each Sub-Project, including the requirement for clearly defined outcomes, and agreed on appropriate measures to be taken by the PSG with respect to the decisions at PSG's review of each Sub-Project. The Group recalled that a detailed project plan for each Sub-Project should be developed and updated based on the updated Implementation Plan as the framework/guidelines (**Recommendation**).

3.2 Technical Recommendation: Forecast System Concept for CIFDP

3.2.1 The Group recalled that the document “Technical Recommendations: Forecast System Concept for CIFDP” provided the overall technical framework for all Sub-Projects under the CIFDP, outlining the recommended approach for forecasting coastal inundation due to a combination of factors which may include storm surge, ocean waves, tides, sea surface height anomalies and river flooding. The specific approach to forecasting will vary for

each Sub-Project, depending on the nature of the forecast problem in that country, within the specified framework.

3.2.2 The Group, based on the discussion on the technical development (including recommendations on potentially suitable forecasting tools) for each Sub-Project, reviewed the Technical Recommendation that was agreed at its 4th meeting (22-23 February 2013, Nadi, Fiji), and revised it as reproduced in [Annex V \(Decision\)](#). The revision included the addition in the conceptual diagram to include a processes for interpretive forecasting/warning and user feedback; and the modification of the forecast framework to encompass a broader range of forecast time scales with associated deliverables. This would facilitate the synthesis of forecast information over time scales required to meet stakeholder needs ranging from emergency response through longer term risk mitigation. The Group requested the Secretariat to make the revised document available on the CIFDP web site (<http://www.jcomm.info/CIFDP>: "Documents") (**Action**).

3.3 Guidance on interaction with users

3.3.1 The Group recalled that, based upon the current CIFDP Implementation Plan, the User Requirements Plan (URP) is a basic document for each Sub-Project regarding the dialogue with users and identification of user requirements. The URP for each Sub-Project is developed based on the results of the CIFDP User Requirements questionnaires, and updated through subsequent user consultations on an opportunistic basis.

3.3.2 Based on the discussion of progress in Sub-Projects under agenda item 2, the Group agreed that a guideline/brief on consistent and harmonized user interaction in the CIFDP Context would be beneficial, in terms of; 1) communicating benefits and impacts of CIFDP implementation; 2) collecting and compiling user requirements and feedback to newly demonstrated system and products, and; 3) strategic means for dialogue with users (immediate users and end users). The Group agreed to develop the first draft of such a guideline by June 2014, to be reviewed and applied by all NCTs from the second half of 2014 (**Action**).

3.4 Linkage with related programmes

3.4.1 Taking into account the respective status for each country implementing the Sub-Projects of CIFDP, the PSG discussed on establishing/enhancing linkages with related programmes and projects with CIFDP. The following activities were identified, while not excluding other activities, for continuing efforts for coordination to ensure synergies in strengthening national capacities under the respective Sub-Projects:

- Related activities by Teams and Groups of JCOMM and CHy, in particular, JCOMM Expert Team on Waves and Coastal Hazard Forecasting Systems (ETWCH, for all Sub-Project – see also item 4.2);
- WMO Working Group on Societal and Economic Research Applications (WG-SERA, for all Sub-Projects – see also item 4.2);
- The Associated Programme on Flood Management (APFM) in the framework of the Flood Forecasting Initiative (FFI, for all Sub-Projects – see also item 4.2);
- Storm Surge Watch Scheme (SSWS) for RA V (for CIFDP-F and CIFDP-I), RA IV (for CIFDP-C) and for RA II (for CIFDP-B);

- WMO Severe Weather Forecasting Demonstration Project (SWFDP) for RA V (for CIFDP-F and CIFDP-I), RA II (for CIFDP-B);
- ESA eSurge (in general and particularly for CIFDP-B);
- EU FP7 Resilience-Increasing Strategies for Coasts - toolKIT (RISC-KIT, for all Sub-Projects);
- EU-funded SPREP project EU-funded on Waves and Coast (WACOP, for CIFDP-F);
- Planned SPC proposal to the World Bank under the Facility for Disaster Reduction and Recovery (GFDRR) for an “operational wave forecasting for early warning systems, southern Viti Levu, Fiji” (for CIFDP-F).

3.4.2 The Group noted that those already-identified and potential partners could develop joint activities contributing to / benefit from the CIFDP (e.g. training and education, technology sharing, capacity assessment, etc.). In this context, the Group welcomed the ongoing discussion to coordinate activities of the APFM/FFI and CIFDP where the implementing country/area were overlapped, and encouraged to pursue this direction **(Recommendation)**. Relevant discussion is also recorded under agenda item 4.2.

Tropical Cyclone Programme and Regional Storm Surge Watch Scheme (SSWS)

3.4.3 The Group recalled that the operational forecasting and warnings developed through CIFDP Sub-Projects, as well as the associated (national) procedure and best practices, should be the technical component of the respective regional SSWS, and should be considered within the Tropical Cyclone Regional Operating Plans for storm surge warning.

3.4.4 The Group took note of a recommendation endorsed at the 16th session of the WMO Regional Association V (May 2014, Jakarta, Indonesia), to extend the mandates of the RA V Tropical Cyclone Committee (TCC) to other severe weather and related events, and to establish a TCC task team on coastal inundation including storm surges. The Group welcomed that the Regional Association and WMO Tropical Cyclone Programme expressed its intention to make further effort toward the regional Storm Surge Watch Scheme (SSWS) through this initiative. In the meantime, the Group considered that this initiative should be closely coordinated with the JCOMM, CHy and NCTs of the respective CIFDP Sub-Projects, in view of enhancing regional coordination to apply best practices developed through – particularly CIFDP-I and CIFDP-F, while avoiding any duplication or redundancy. In this context, the Group agreed on the following comments to the RA V TCC **(Recommendation)**:

- It should be noted that all CIFDP Sub-Projects are initiated upon the request by a country who meet the initial requirements, and under direct guidance of JCOMM and CHy through the PSG.
- Support of relevant regional activities are welcome and encouraged, in the context of supporting PSG guidance and national implementation, and to share best practices among neighbouring countries.
- The regional bodies of the WMO TCP should place its priority in seeking best ways to share and apply best practices developed through CIFDP Sub-Projects in the region, including CIFDP-I and CIFDP-F.

Post-Haiyan assessment and recommendations

3.4.5 The Group received a report by Dr Paul Davies, on the expert mission to the Philippines and Vietnam to assess the current capacity and capability of the National Meteorological Service (PAGASA) and requirements of the relevant authorities, after the Typhoon Haiyan event, carried out from 7 to 16 April 2014. The Group noted the following assessments and recommendations made by the mission team, that are directly related to the CIFDP framework/activities:

- The most catastrophic damages, especially in the Philippines, were caused by storm surges combined with strong wind. The Team identified the following problems amplifying the vulnerability in coastal zones to storm surges:
 - Storm surge hazard maps and inundation information was of low resolution;
 - Limited capacity and capability to forecast the extent and speed of the storm surge;
 - People didn't understand what a storm surge was, were caught unaware by the severity of the surge and struggled to protect themselves against the impact;
 - Communication and dissemination systems, networks and processes failed in places during and after Haiyan;
 - Some people chose to ignore warnings for fear of losing properties to looters and some chose to take action by evacuating to safe centres that were not resilient to the storm surge.
- The most outstanding requirement to improve coastal resilience was to develop and improve a risk-based storm surge warning system. On top of forecasting skills, improvement in the information delivery was identified as one of the most urgent issues:
 - Storm surge hazard maps and inundation information should be reviewed, developed and communicated;
 - Storm surge forecasting and warning services should be improved, developed and tested for effectiveness with national, provincial and local users;
 - Warnings should use layman's language, emphasising risk and impacts;
 - Resilience against future surges should be strengthened by developing and enforcing building protocols, evacuation procedures and operating standards;
 - Improve awareness by developing and implementing an effective education and communications strategy.

3.4.6 The Group emphasized that developing a storm surge forecast and warning service in isolation without considering other hazards would result in an inefficient and ineffective warning service; therefore a holistic, interdisciplinary and fully integrated approach to warnings should be made from the early stage of post-Haiyan recovery effort. In this context, the Group noted that countries including the Philippines and Vietnam have already called for projects like CIFDP on various occasions. It agreed that the lessons learnt from CIFDP implementation would greatly benefit the ongoing process, and to respond to the requests of those countries where appropriate and feasible (**Action**).

3.4.7 The Group considered that these ongoing collective efforts for post-Haiyan recovery would provide opportunities for accelerated developments of storm surge / coastal inundation forecasting and warning systems. Meanwhile, it noted that one of the largest gaps in the entire chain of warning lay in the education and communication planning to enhance understanding of the impacts and risks associated with storm surge. In this regard, the Group took note of the case for the SWFDP, which has been implementing a series of

training on technical and communication/delivery aspects jointly in close collaboration with the WMO Public Weather Service (PWS). The Group agreed that the training activities within the CIFDP framework should consider coordinating with the PWS in view of implementing the WMO Strategy for Service Delivery and its Implementation Plan, possibly in the form of engaging relevant experts in the planning and conduct of training exercises. The Group also emphasized that the coastal inundation warning should be able to communicate with users and general public on impacts, instead of phenomena, including a probabilistic approach ("likelihood") (**Recommendation**).

JMA/WMO Workshop on Effective TC Warning in Southeast Asia

3.4.8 The Group received a brief report from Mr Jamie Rhome, on the results and conclusions made at the [JMA/WMO Workshop on Effective TC Warning in Southeast Asia](#) (11-14 March 2014, Tokyo, Japan) and following activities to improve storm surge warning system. The Group noted that, while the requirements for real-time forecasting for tropical cyclone and/or storm surge vary across countries/regions, a common requirements was for improvement in information delivery. The Group noted with appreciation examples of active regional support by JMA/RSMC-Tokyo for real-time forecasting and warning support for storm surges for those NMHSs in the RA II (Asia), upon request; and plans of NHC/RSMC-Miami to extend its regional support for storm surge forecasting support (see also items 2.3 and 2.5: CIFDP-C).

3.5 Communication and outreach

3.5.1 The Group reviewed the related communication and outreach activities for CIFDP, including the project website (<http://www.jcomm.info/CIFDP>), brochure (2012 update) and presentations/briefings at scientific and technical fora, and advised on points for future improvement and opportunities. The Group noted with satisfaction that the CIFDP has been increasingly well recognized through the governing body meetings and technical advisory meetings of WMO, as well as through the relevant scientific fora. The Group agreed that, in order to maintain consistency in the general reporting on CIFDP, a "reference" presentation and documents should be developed and regularly updated through PSG's review. The Group requested the Secretariat to compile a reference presentation and poster as soon as possible (**Action**). The Group also requested the Secretariat to update and maintain a list of CIFDP outreach (including the reports to governing bodies and related programme meetings, scientific presentations, etc.) (**Action**).

3.5.2 The Group briefly reviewed the current version of CIFDP web site (<http://www.jcomm.info/CIFDP>), and noted that most information was up to date. The Group requested all members to review the web pages under this address, and provide the Secretariat with suggestions and input to update the contents (**Action**).

3.5.3 The Group considered that, while the current version of the Brochure has been useful for introducing CIFDP to NMHSs, it could be updated with appropriate format and contents specifically for potential donors and contributors. The Group noted with appreciation the offer for assistance from the WMO Media Officer to review and revise the brochure, and requested the Secretariat to publish new edition of the brochure by the 4th quarter of 2014 (**Action**).

3.5.4 The Group also noted that, for the general public, social media is the most widely used means for communication, and recommended to make use of / provide contents on coastal inundation and CIFDP activities to social media maintained by WMO and national operational centres as frequently as possible (**Recommendation**).

3.5.5 The Group also agreed that, as each Sub-Project has been making rapid progress, a “fact sheet” could be developed to share information and experience with other countries that are interested in initiating similar activities and applying the results in their countries. For this purpose, the Group agreed to develop a template for such information in coordination with the WMO Media Officer, to be reviewed by the PSG during the intersessional period (**Action**).

4. MANAGEMENT ISSUES

4.1 Funding: resources for general management and Sub-Project implementation

4.1.1 The Group recalled that a National Sub-Project of CIFDP should be implemented by either national resources or external funding support from donor agencies. The National Coordination Teams (NCTs), in coordination with the WMO Secretariat if required, are to identify financial and in-kind resources required for the Sub-Project implementation. The WMO Secretariat is responsible for supporting the PSG activities, and if required and feasible, for providing seed-funding for the initiation of a Sub-Project. The Group agreed to keep this CIFDP general financial model as a matter of principle (**Decision**).

4.1.2 The Group noted with appreciation that the Secretariat had successfully raised funding for the implementation of CIFDP-B (for the entire implementation cycle, WMO Funds-in-Trust from USAID) and for CIFDP-F (for Phase 1 through WMO Funds-in-Trust from KOICA, and in process for Phases 2-4). The Group also noted that the CIFDP-I is being implemented with national resources, in addition to the seed funding for initiation from the WMO Secretariat.

4.1.3 The Group requested all NCTs to take a more proactive role in identifying resources for the Sub-Project Implementation (**Action**).

4.2 Work of the Project Steering Group (PSG)

4.2.1 The Group reviewed its current [Terms of Reference \(ToR\)](#), in view of ensuring efficiency of the Group’s main role of providing guidance as well as overseeing all Sub-Projects. It agreed that close collaboration with the relevant groups, teams and programmes should be strengthened to carry out these key functions; in particular, the JCOMM Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH) and WMO Working Group on Societal and Economic Research Applications (SERA). In this context, the Group agreed to the amendment in its ToR as described in [Annex VI](#) (**Decision**).

4.2.2 The Group reviewed its current membership. As the project has become mature and extended, the Group noted the need to set clear guidelines for renewal of membership on a regular basis, and agreed on the following guiding principles, to be applied as of the year 2014 (**Decision**):

- The overall process for the selection of members and chair(s) should follow the normal practice of WMO, particularly those concerning the working groups and teams of WMO Technical Commissions. That is, the recommendation for chair(s) would be endorsed by the Presidents/Co-Presidents of JCOMM and CHy, and both leadership and membership would be regularly reviewed and revised as necessary. The proposal and recommendations for membership and leadership of PSG would be prepared by the current chair(s) and members of the PSG, in consultation with the WMO Secretariat.

- The initial term of the members and chair(s) of PSG is two years, and can be renewed for a maximum of another two terms (four years).
- (A) member(s) should be nominated and selected in consideration of the areas of expertise required for the work of PSG, relevant capacity (including the assurance of the availability of the nominee(s) to allocate time for the required/assigned responsibilities) and leadership. Other general points of consideration, e.g., geographic balance, gender, expertise in other WMO priority areas, may be considered only if there are plural nominees of similar level of qualification.

4.2.3 Based on these principles, the Group reviewed and agreed on the membership as reproduced in [Annex VI](#), to be effective for the term 2014-2016 (two years) until the next review at the seventh PSG meeting that would provisionally be held in 2016 (**Decision**). The Group agreed that this list would be sent to the Presidents of JCOMM and CHy for endorsement (**Action**).

4.2.4 The Group re-emphasized the importance of close working relationship with key expert groups of related WMO programmes, and encouraged the JCOMM/ETWCH, APFM/FFI, steering group of the SWFDP and WG-SERA to identify a member from each group to be active as a liaison, or as ex-officio of the PSG, to become a member of PSG (**Recommendation**). In particular, the Group expressed its hope to enhance two-way interaction with related projects including SWFDP and APFM/FFI, through cross-representation in the steering groups (**Recommendation**).

4.2.5 The Group recalled the principles for operation that were agreed at the 4th PSG meeting (February 2013, Nadi, Fiji) for the work of PSG, as follows:

- In coordination with the WMO Secretariat, the two co-chairs would oversee the work of the PSG, including input/guidance to all Sub-Projects' implementation, phased review and report to WMO bodies/meetings;
- All PSG members would carry out distributed responsibilities to support/advise Sub-Project implementation. The indicated Members of the PSG for each Sub-Project, selected in consideration of the areas of expertise for Members, should take the main responsibility for consolidating technical advice, phased review and other required input to the implementation of respective Sub-Projects, for the final agreement and decision of the whole PSG. The list should remain flexible and be updated/modified at the regular meetings of the Group, or by the agreement of all PSG Members during the intersessional period.

4.2.6 The Group agreed to keep the above principles for operation for the work of the PSG (**Decision**), and agreed on the distributed responsibilities for PSG members as reproduced in [Annex VII \(Decision\)](#). The Group, noting that a large part of the PSG's work to provide technical guidance and review of all Sub-Projects has been carried out in close collaboration with the JCOMM/ETWCH, expressed its particular thanks to the ETWCH members. It noted that such a collaborative work arrangement would continue for those ongoing and planned Sub-Projects, and acknowledged the arrangement for collaborating ETWCH members to provide guidance to CIFDP Sub-Projects, also noted in [Annex VII](#).

5. ANY OTHER BUSINESS

Management and Secretariat support for CIFDP Steering Group and Sub-Projects

5.1 The Group discussed the overall operating framework of the CIFDP. It noted the importance of the WMO Secretariat in carrying out the work of the CIFDP including its Sub-Projects, in order to achieve the necessary levels of consistency and communication. In this context, the Group unanimously recommended that a single coordinator among the Secretariat staff be identified to be responsible for implementation of the CIFDP and all of its Sub-Projects, as well as the required interaction with other related WMO programme and groups. Furthermore, the Group recommended that Dr Boram Lee, who already has carried out these activities for most of the supporting activities for the PSG and Sub-Projects should be in charge of all CIFDP activities (**Recommendation**). The Group requested the Co-chairs to communicate with the WMO Secretariat to convey this recommendation, and take necessary measures to confirm such an arrangement as soon as possible (**Action**).

6. CLOSING

6.1 The Group reviewed and approved the list of actions prepared by the Secretariat (reproduced as [Annex VIII](#)). The final report of the meeting (this report) was compiled by the Secretariat after the meeting, and published by May 2014.

6.2 The Group agreed that the 6th meeting could be convened in conjunction with an activity associated with a sub-project implementation in 2015. The Group requested the Secretariat to explore feasibility to make such an arrangement (**Action**).

6.3 The 5th Meeting of the WMO Coastal Inundation Forecasting Demonstration Project Steering Group (CIFDP-PSG-5) was closed at 1600 hours on Friday 16 May 2014.

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Annex II

AGENDA

(as agreed at CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

1 ORGANIZATION OF THE MEETING

- 1.1 Opening
- 1.2 Approval of the agenda
- 1.3 Working Arrangement

2 REVIEW PROGRESS OF SUB-PROJECTS

- 2.1 Indonesia sub-project (CIFDP-I)
- 2.2 Fiji sub-project (CIFDP-F)
- 2.3 Dominican Republic sub-project (CIFDP-DR)
- 2.4 Bangladesh sub-project (CIFDP-B)
- 2.5 Newly proposed sub-projects

3 REVIEW OF AND FUTURE DEVELOPMENT FOR THE PROJECT

- 3.1 Project concept, implementing strategy and implementation plan
- 3.2 Technical Recommendation: Forecast System Concept for CIFDP
- 3.3 Guidance on Interaction with Users
- 3.4 Linkage with related programmes
- 3.5 Communication and outreach

4 MANAGEMENT ISSUES

- 4.1 Funding: resources for general management and sub-project implementation
- 4.2 Work of PSG

5 ANY OTHER BUSINESS

6 CLOSING

- 6.1 Adoption of the action items and decisions of the meeting
 - 6.2 Dates and place of the sixth PSG meeting
 - 6.3 Closure of the meeting
-

CIFDP-B Progress Report

(Submitted by System Developer for CIFDP-B, S.H.M. Fakhruddin,
approved at CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

This progress report describes the progress of the Coastal Inundation Forecasting Demonstration Project (CIFDP) - Bangladesh to date based on the system development report (JCOMM Technical Report No.75) and implementation plan CIFDP-B. The SD report has been considered as the baseline for progress monitoring. The project has focused on integrating the forecasting models already in operational use as modular components which can be easily replaced or updated as more enhanced versions become available. The modelling components were developed and adapted to fit in an open, flexible and easily extendable forecasting system; the future coastal inundation forecasting system. The new system is expected to underpin a significant improvement in flood disaster management in coastal areas. The following report describes the development of CIFDP-B.

1. Inter-agency Coordination

Through CIFDP-B, a National Coordination Team (NCT) meeting and several bi-lateral meetings with stakeholders (such as Department of Disaster Management (DDM), Cyclone Preparedness Programme (CPP), Bangladesh Navy, Bangladesh Inland Water Transport Authority (BIWTA) etc.), a strong network and commitment has been developed to facilitate coastal inundation forecasting and its applications. The CIFDP-B National Coordination Team (NCT) meeting was held at the BMD Headquarters, Dhaka, Bangladesh on 16-18 February 2014. The main objectives of the meeting were to review the system design and user requirement plan; to note and discuss the progress of CIFDP-B implementation based on the system design; data availability to enhance CIF and establish a sharing mechanism; and to discuss user perspectives and requirements to provide feedback on current forecast capacities through the CIFDP-B User Requirements Plan (URP). It was agreed that the next CIFDP-B-NCT meeting will be held in September 2014, tentatively, from the 21st.

2. Data Collection for System Enhancement

A detailed data availability and collection process is ongoing. Data for the topography, DEM, land use and other GIS data has been procured from the Water Resources Planning Organization (WARPO) and utilized for existing model development. In the last NCT meeting detailed discussions on tidal data was presented and a procedure for collection of those data was discussed. For example:

Tidal Data

- BIWTA – Have 10 automatic stations of which 6 are working (Char Mamtaz, Kutubdia, Tiger point, Kalapara, Hatia). These data are available from 2002 onwards but not in real time. Data is collected on a monthly basis to monitor ship navigation. Predicted tidal data is available on a yearly basis using empirical models. BIWTA has 45 manual gauges. Data needs to be purchased according to the organization's policy. A request could be made to the Ministry of Shipping for access free of cost to this data.
- Bangladesh Navy: 1 automatic station in Chittagong at Naval HQ with data from 1992 onwards. This data could be accessed free of cost via formal communication from BMD to the Bangladesh Navy.
- Chittagong Port Authority- has 5 automatic tide stations and 50 years' data available. Predicted data uses UK models and has had reliable results.
- Mongla Port Authority- 1 automatic tide station

- SoB: 1 tide station at Rangadia. Data available from 1993 onward. (6 second interval)
- A discussion was conducted with BIWTA about the possibility to provide communication equipments to provide the data in real time to BMD. CIFDP will consider this to access real time data from major auto tidal gauges of BIWTA or other organizations.

Bathymetry Data

- Bangladesh Navy: covers up to the continental shelf 35 nm. Updates data regularly. Different scale maps available. No digital data provided to client but through discussions with HQ, pilot area (Sandwip) data could be requested. Bangladesh has a bathymetry map on a scale of 1:250,000
- BWDB has some projects (i.e. Meghna Estuary Study, Phase II (MES II, 1998-99), IPSWAM (2008)) where some bathymetry data is collected. Data access would be difficult as owned by private company.

Topography Data

- IDMS project of SoB will develop high resolution topography map as well as 1:5000 scale maps for 4 divisions (Chittagong, Rajshahi, Shylhet and Khulna). A request could be made to SoB to conduct the survey in coastal areas first so that data could be used in pre-operation testing.
- Flood Action Plan (FAP) has 19 projects, updated land elevations on a 300 m grid DEM. This data already been collected from WARPO
- DEM with 50 m x 50 m resolution based on the FINNMAP land survey, FAP 19-National DEM (1952-64), and projects of the Bangladesh Water Development Board (i.e. Khulna Jessore Drainage Rehabilitation Project, 1997; Beel Kapalia project, 2008; and Beel Khuksia project, 2004). A request could be made to BWDB to access the data.
- ICRD Database of WARPO contains socio economic data for the coastal area. This database will be purchased under the project.

3. Storm Surge Modeling

An interface has been developed and installed at BMD to estimate parametric values from existing model and other guidance available at BMD. At present three guidance- JTWC, RSMC New Delhi and GSM data of JMA automated in the system. BMD requires support to automate additional sources of parametric values. This could ensure the appropriate parametric input for running storm surge model at BMD in a user friendly environment. The updated storm surge model which included wave in total water, astronomical tides and inundation schemes has been successfully installed at BMD and nine staffs of BMD has been trained on the model setup, interpretation and generation of products. A training session was organized for 15-17 February 2014 at the BMD Headquarters, for the meteorologists of BMD. This training was conducted by Mr Nadao Kohno, Japan Meteorological Agency, on the ongoing development of the Bangladeshi Coastal Inundation Model, which is based on the JMA-MRI storm surge forecasting model and includes components for tidal and wave effects. A further upgraded model combined with the river simulation component will be introduced by September 2014. Based on the responses from the trained forecasters and meteorologists, it was found that, in addition to the training on model operation, training on the forecasting (purpose, procedure, targets, etc.) would be required to ensure successful delivery of the CIFDP outcome.

Under the RISC-KIT project of EU, JMA-MRI model will be integrated into Delft-FEWS platform. For this a 'pre-adapter' and post-adapter has been developed. System Developer attended the Pre-adapter training in Deltares in March 2014 to develop the 'pre-adapter' and

'post-adapter' for JMA-MRI model. In July there will be model integration training in Deltares.

4. River Modeling

The current JMA-MRI model doesn't incorporate the river model component. A shallow water equation for the 2D flood model (such as Gustavo et al. 2012; Bates et al, 2010; Li and Duffy, 2011) based on existing DEM has been customized and will be handed over to BMD in September.

5. User Requirements

The user requirement report was presented in the NCT meeting in February and circulated to all members for comments (if any) by April 2014. DDM has recommended that the Disaster Management Committee (DMC) structure at District, Upazilla, Pourashva, Union and City Corporation levels are key institutions for ensuring comprehensive disaster risk reduction and management at local level. These structures bridge the gap between government and the community by supporting resilience building of communities and institutions throughout Bangladesh. Thus capacity building of DMCs is essential. These initiatives could be more effective if the DMCs are formed at village and ward level for effective community integration directly into disaster management.

6. System Testing

A table-top simulation guideline has been developed (Appendix-B) for discussion in the PSG meeting. It was found during the NCT meeting that CPP has strong capabilities to conduct full scale simulation exercises in coastal areas but at this stage the project is looking to conducting a table top simulation, also known as a room demonstration, to get a picture of how the organizations interact and respond and their roles and responsibilities. It was also noted that there is a strong need for the education of end users on the meaning and impact of warning/forecasting information. Many NCT members pointed out the need to extend and improve the dissemination of warning information in different user sectors. One of the suggestions was to establish more direct links between the BMD and the local user-representing authorities, which would need to be considered within the national structure of emergency response.

7. RISC-KIT

The Work Package 1 meeting of the EU FP7 Resilience-Increasing Strategies for Coasts - toolKIT (RISC-KIT), which included a case study on a Bangladesh coastal site (Sandwip island) that will complement the decision-making support through the CIF operation by using an advanced framework developed by European institutions (Coastal Risk Assessment Framework: CRAF). The project concept and work plan were introduced to the national stakeholders, followed by the user consultation and interview to better understand specific end-user requirements for the Bangladeshi coast. The user components of CIFDP-B NCT and EU RISK-KIT WP1 are to be shared through these joint activities. Benefits from parallel activities of the common goal were highlighted: for example, CIFDP-B and RISC-KIT will complement each other in delivering final outcomes and benefits to users in Bangladesh, CIFDP-B will clearly demonstrate the benefit of improved forecasting through the local application for coastal risk assessment by RISC-KIT, and the RISC-KIT will benefit from the technical development and data sharing achieved by the national framework of the CIFDP-B. For Bangladesh's national stakeholders, a clear direction for current and future improvement needs to be demonstrated through a streamlined and collaborative implementation of the CIFDP-B, RISC-KIT and other development projects, from user requirement identification,

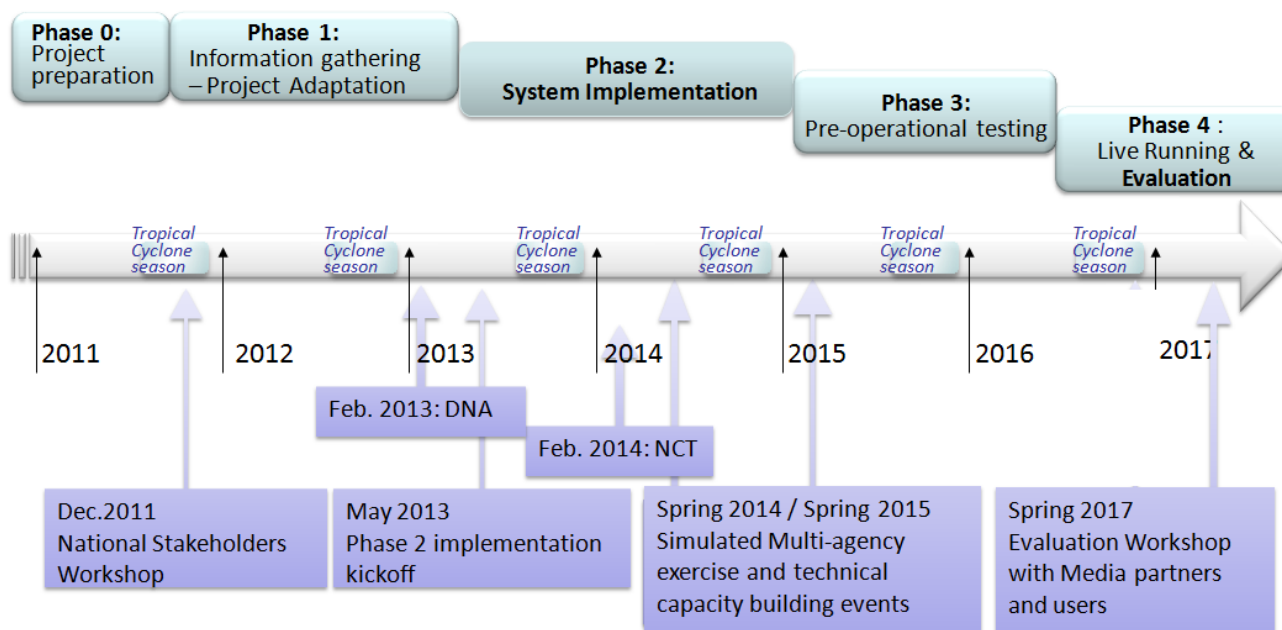
technical development for forecasting, analysis of the impacts and community response and preparedness.

8. Other Initiatives

The concept of CIFDP has been highly appreciated by many of Typhoon and cyclone inundation risk countries. Recently, the GEF funded "Economy-Wide Integration of Climate Change Adaptation and DRM/DRR to Reduce Vulnerability in Samoan Communities" proposal has incorporated the CIFDP concept to implement in Samoa. The concept and progress has been presented in forty sixth session of ESCAP/WMO Typhoon Committee, 10-12 February, Bangkok, Thailand. Countries like Philippines, Vietnam appreciated the efforts of CIFDP in Bangladesh and other countries and would like to have similar program in their countries and requested for storm surge and inundation modelling training. CIFDP-B progress has been presented in 41st Session of WMO/ESCAP Panel, 2-6 March 2014, Dhaka, Bangladesh. The Panel noted that, the ongoing and planned implementation of CIFDP-B would be based on the System Design for a Coastal Inundation Forecasting (CIF) System for Bangladesh (JCOMM Technical Report No.75), with focus on the identified user requirements and technical requirements that are articulated in the NCA and URP; in particular, the technical feasibility and adaptability to national operational systems that could serve to meet the user requirements. CIFDP-B has been presented in the "The role of science in good-enough disaster risk assessment" 24 –26 February 2014, Universidad de le Salle, Bogotá, Colombia. The national tsunami warning centre in Colombia (DIMAR) requested similar models in their coast to predict coastal inundation. A follow up meeting was held with British Embassy in Bogota who is keen to support this activity for Colombia. The CIFDP concept has been presented in eSurge Training in Applying EO Data to Storm Surge Modelling and Forecasting Training, 20-21, Cork, Ireland. Recently a poster on CIFDP has been presented to EGU general assemble 2014.

9. Timeline for CIFDP

The Phase 2 of CIFDP started in May 2013 with the system development and planned for ending in December 2014 with testing of the system developed under CIFDP to make a pre-operational system ready. The overall timeline for the CIFDP shown in the figure below.



Annex IV

DRAFT PLAN - Coastal Inundation Forecasting Table-Top Exercise for Bangladesh

(Submitted by System Developer for CIFDP-B, S.H.M. Fakhruddin,
approved at CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

GLOSSARY

Primary Participating Agencies

These are the primary agencies expected to participate in the table-top exercise. A list of such agencies is shown in the Paper under section VII.

Agencies “Inside” Table-top Exercise Boundary

Agencies participating in the table-top exercise that have a role in generation, dissemination and response to cyclone disaster response.

Agencies “Outside” Table-top Exercise Boundary

Agencies that are not participating in the table-top exercise yet, in reality, could have a role in a cyclone disaster response.

Activity Center

An activity center is a location of the table-top exercise. There will be only one activity center for this table-top exercise (Probably the Meeting room of BMD HQ).

Script

A script is a description of a situation that will be included as part of the scenario or during the exercise. As the table-top exercise will be orchestrated, master scripts will be prepared in advance and distributed to Participating Agencies before the Briefing Meeting.

Scenario

A scenario is a packet of information that includes hotspot maps, possible risk maps, scripts describing the national situation and regional situation, etc.

Logbook

A form to be used by all Participating Agencies during the exercise to document communications relevant to the exercise.

Outbox

One collective outbox will be established at the activity center for use by all Participating Agencies at the activity center. Communications directed to agencies “outside” the boundary will be placed in this outbox.

Inbox

An agency specific inbox will be established for each Participating Agency. Simulation Facilitators will respond to communications in the outbox, and these responses will be placed in the respective agency inbox.

COASTAL INUNDATION FORECASTING- TABLE-TOP EXERCISE

Background

The meeting of the National Coordination Team (NCT) for the WMO Coastal Inundation Forecasting Demonstration Project for Bangladesh (CIFDP-B), held in Dhaka, Bangladesh from 6 to 18 February, 2014, agreed that a table-top exercise should be conducted in preparation of the actual event, in order to simulate institutional interaction and responses, and to test the acceptability/adaptability of the operational Coastal Inundation Forecasting (CIF) system that is under development and to be operated by the Bangladesh Meteorological Department(BMD).

This paper is developed by the CIFDP-B System Developer, Dr S.H.M. Fakhruddin, in consultation with the WMO Secretariat and the CIFDP Steering Group, to provide details on the scope, goals and objectives, format and scenario for the table-top exercise.

Objective

The table-top exercise is designed to test:

- BMD capacity: Current capacity of BMD to generate accurate and reliable information based on situation; and validates capability to disseminate the warning message to relevant agencies within country, its districts and unions and local jurisdictions according to the established national procedure.
- Coordination and communications: The interagency cooperation and communication to understand the forecasts information transform to response by each agency and validate organizational decision-making processes about public warnings and evacuations.
- Disaster Plan Viability - Planning system of the Cyclone Preparedness Programme (CPP) to activate evacuation process and first response, followed by the, identification of areas for improvement in the local disaster management response plan.
- Awareness Promotion - Information products / results of the Simulation Exercise, after review by the CIFDP Steering Group and publication by WMO, will be shared widely within the Bangladesh Department of Disaster Management.
- Measure Exercise Design against Standard Design Model - It has been said "practice make perfect". By test a scenarios of disaster situation will enhance future performance management applications.
- Identify the modes that would be employed to notify and instruct the public.
- Assess the elapsed time until the public would be notified and instructed.

Conditions for Implementation of the Exercise

1. Commitment of support from involved agencies (i.e. Department of Disaster Management, (DDM); Cyclone Preparedness Program (CPP), Department of Agriculture Extension (DAE), Local Government, etc) for allocation of personnel time, full involvement, and commitment.
2. Each Agency will have their respective coordination and disaster response arrangements in place, or enhanced as appropriate prior to the table-top exercise.

Methodology and Processes

Note: All participants should bring their own laptop computers if possible, for the duration of the exercise.

1. The table-top exercise is a desktop exercise with the purpose of providing a practice field for warning generation, communication, coordination, chain of command, and standard operating procedures. There will be no actual mobilization of personnel or information to public during the exercise. However, all coordination and preparatory procedures should be followed as much as possible.
2. The table-top exercise will be fully orchestrated, i.e. the scenario will be prepared in advance and shared with all Participating Agencies before (and at) the Briefing Meeting. The scenario will include among others: script describing national and regional situation, script describing regional and international situation, weather forecast, current cyclone track, intensity, landfall, possible inundation map, graph of rainfall, cyclone shelter locations and capacity, etc.
3. Facilitators may introduce additional inputs throughout the exercise to stimulate action within the general intent of the scenario. Additional inputs may be introduced verbally, or provided in a written form.
4. Evaluators will be assigned at each Participating Agencies'. There will be also people to play roles as affected by cyclone disaster.
5. After the exercise and with inputs from the Evaluators, an Evaluation Meeting will be held to provide an opportunity for participants to evaluate strengths and weaknesses of the responses by each agency. The Evaluation Meeting will address specific evaluation topics. Results and recommendations will be recorded to further improvement of the overall system.
6. NCT members will have to pre-determine the operating "boundaries" of the exercise. Agencies operating as part of the exercise will be identified as "inside" and all others will be defined as "outside" the boundaries of the exercise. Inputs will engage all agencies and institutions participating in the exercise. Examples might include designation of military, customs, or immigration agencies as "outside" the boundaries of the exercise. The list of all agencies participating in the exercise ("inside" the boundaries) will be finalized in the NCT meeting. This list will be distributed again at the Briefing Meeting during the exercise.

Scenario

As indicated above, a scenario is a packet of information that includes master scripts, severe weather forecast, Forecasts from Joint Typhoon Warning Center (JTWC), WMO Regional Specialized Meteorological Center (RSMC) in India, possible inundation scenarios and facilities with longitude and latitude, graphs of rainfall, etc. We will design a scenarios based on severe cyclone storm (signal number 10 or 11).

Roles and Responsibilities of Participants

Participating Agencies

Participating Agencies will perform normal functions and standard operating procedures to respond appropriately and efficiently to the inputs, as though it were a real situation. At a minimum, participating agencies would include the following:

- i. Bangladesh Meteorological Department (BMD)
- ii. Department of Disaster Management (DDM)
- iii. Cyclone Preparedness Program (CPP)
- iv. Department of Agriculture Extension (DAE)
- v. Deputy Commissioner (DC) Office
- vi. Upazila Chairman
- vii. Prime Minister Office
- viii. Department of Fisheries
- ix. Survey of Bangladesh (SoB)
- x. Bangladesh Water Development Board (BWDB)
- xi. Water Resources Planning Organization (WARPO)
- xii. Bangladesh Navy
- xiii. Bangladesh Coast Guard
- xiv. Port Authority
- xv. Roads and Highway
- xvi. Department Livestock
- xvii. NGOs

Regional

- i. WMO RSMC India
- ii. RIMES

International

- i. WMO

Simulation Facilitators - total 2 persons

There will be two Simulation Facilitators assigned at the activity centre. Simulation Facilitators will facilitate the conduct of the exercise by monitoring the whole conduct of the exercise, introducing additional inputs during the course of the exercise to stimulate action, and facilitating the work of the Simulation Evaluators. See "Guidelines for Simulation Facilitators". System Developer together with one person from BMD could work as facilitator.

Simulation Evaluators - total 2 persons (1 for EWS and 1 for Response)

Participating Agencies involved with the table-top exercise should select two Simulation Evaluators to effectively evaluate the exercise. Criteria for Simulation Evaluators include: knowledge of forecast generation and generation of products; knowledge of the national and regional mechanisms; no association with an agency involved with the exercise; ability to provide comment and feedback to individuals/agencies involved with the exercise in a constructive manner. Possibilities would include representatives from NGO groups, international institutions, universities, or expert consultants. See "Guidelines for Simulation Evaluators".

PSG Roles in Simulation

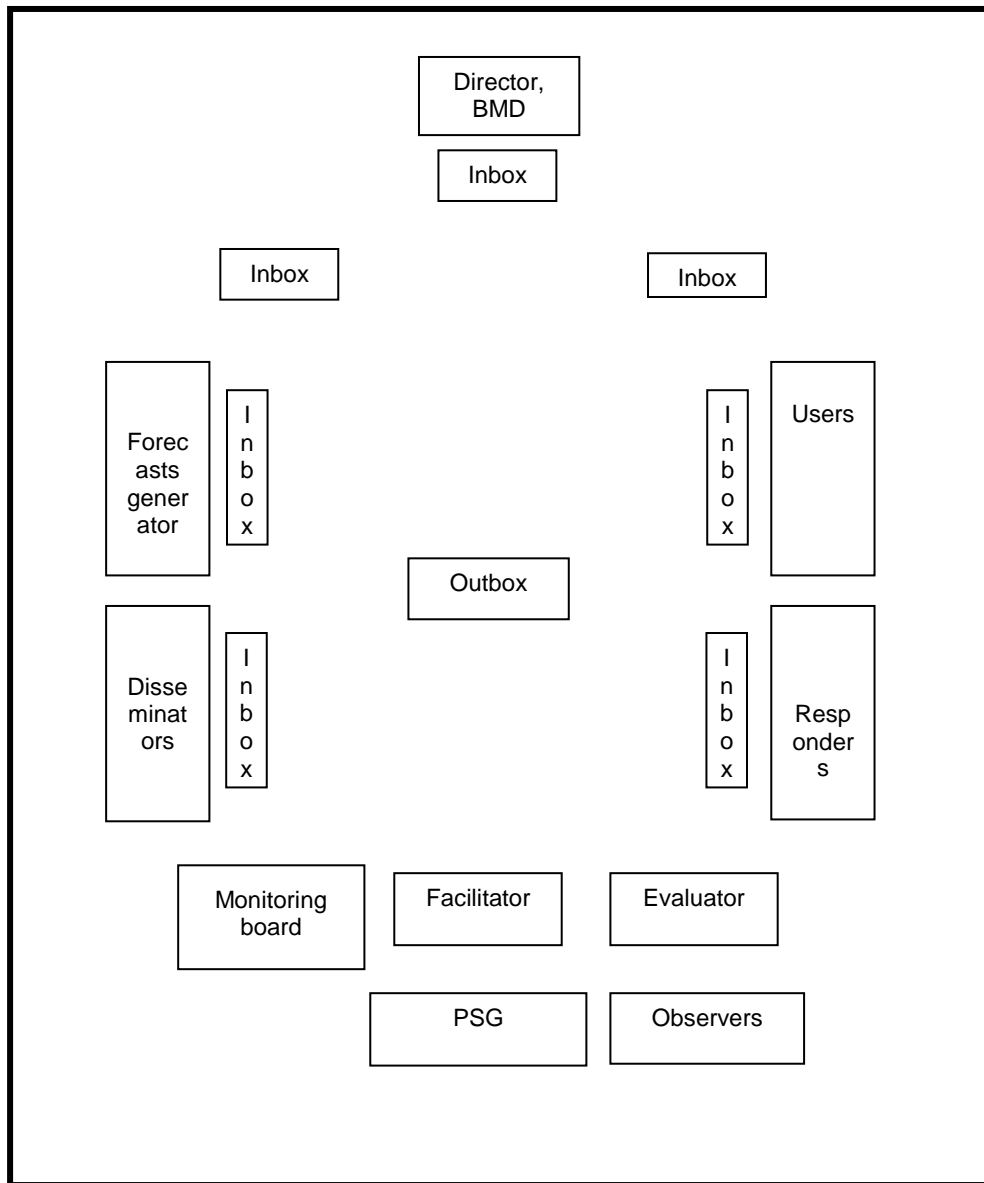
The PSG will assist in providing additional information for development of the scenario to complement the final scripts, such as severe weather forecast, generation of possible inundation scenarios etc. PSG will also review the result before it officially published.

Simulation Exercise Observers

Simulation exercise observers are welcome. Permission must be obtained from BMD/NCT.

Proposed Layout

The following is the proposed layout for the table-top exercise.



* Information required implementing the table-top exercise:

1. National Standing Order on Disasters (SOD)/Standard Operation Procedures (SOPs) for roles and responsibilities
2. Danger Level Guidelines
3. Designation of Focal Point from each Agencies
4. Scenario

RULES FOR COASTAL INUNDATION FORECASTING- TABLE-TOP EXERCISE

1. The simulation exercise will start at 09:00 and end at 17:00. All participants are asked to be in place promptly at the start of the exercise. The simulation will last for 1 day only. BMD will be mostly involved for their system testing to generate and disseminate the warning. The whole event will use compressed time. For purposes of the table-top exercise, participants can make decisions and create realistic responses to the scenario on behalf of their agencies. However, this should be done with discretion, and the exercise conducted in good faith.
2. All correspondence associated with the exercise will be typed, and complete with routine stamps, signatures, and letterheads, as though it were a real situation. The only exception to this is responses prepared by a Simulation Facilitator to communications directed to agencies “outside” the boundaries of the exercise. If the communication is directed towards another Participating Agency “inside” the boundaries of the exercise, the communication should be placed in the “inbox” of this Participating Agency.
3. If correspondence needs to be sent to agencies “outside” the exercise, it will be placed in an “outbox”. Simulation Facilitators will draft responses to the “outbox” correspondence and place in agency specific “inboxes”. These responses may be handwritten. Participating Agencies are expected to periodically check and respond to communications placed in their “inbox”.
4. Each primary Participating Agency should record all agency communications and responses in the logbook provided by the Simulation Facilitator. A copy of the Logbook will be provided to the assigned Simulation Evaluator at the end of the day.
5. Simulation Evaluators will monitor and evaluate the exercise. Simulation participants should not interact in any way with the Simulation Evaluators. The Evaluators will quietly and unobtrusively observe the exercise.
6. Nametags will be distributed at the Briefing Meeting by the Simulation Facilitators. Please ask the Participating Agencies to write their name, agency, and function on the nametag and wear it throughout the duration of the exercise.
7. There will be challenge each other's assumptions; open and honest dialogue and feedback is essential so that we can act on what is learned, and the participants respond to the situation based upon knowledge, current plans and procedures (this way gaps can be identified).

GUIDELINES FOR PARTICIPATING AGENCIES

1. Participating Agencies will perform normal functions and standard operating procedures to respond appropriately and efficiently to the inputs, as though it were a real situation.
2. All the participating agencies need to apply their own institutional mandate and policy for disaster response as noted in National SOD.
3. Participating agencies should strictly follow the rules of the table-top-exercise.
4. One or two representative from each organization will participate in the table-top exercise.
5. Participants are requested to provide open and honest dialogue and feedback so that we can act on what is learned, and the participants respond to the situation based upon knowledge, current plans and procedures (this way gaps can be identified).
6. Before the exercise each participating organization requested to share their own roles and responsibilities specific to coastal inundation to the facilitators.

GUIDELINES FOR SIMULATION FACILITATORS

1. You will meet with other Simulation Facilitators and with Simulation Evaluators during the Briefing Meeting for additional clarification of your functions.
2. At the Briefing Meeting, you will be given Logbooks, one collective “outbox”, and an “inbox” for each Participating Country and Agency. Prior to the start of the exercise, place the collective “outbox” and agency specific “inboxes” in specific locations at the activity center (see Proposed Layout) and bring to the attention of all personnel in the room. Provide each Participating Country and Agency with a Logbook form for recording actions.
3. Follow scripts and inputs as provided.
4. If necessary, generate additional inputs to stimulate action within the general intent of the scenario.
5. After introducing an input, inform the appropriate Simulation Evaluator to advise.
6. Prepare and respond to communications placed in the “outbox” (addressed to non-participating agencies “outside” the boundaries of the simulation). Create realistic responses to the communications and place in relevant “inbox”. If at all possible, type your responses (bring a laptop with printer or use computer facility). If this is not possible, handwritten responses are acceptable.
7. After creating a realistic response to a communication placed in the “outbox”, and placing in the agency specific “inbox”, notify the appropriate Evaluator.
8. At the end of the day, collect a copy of the Logbooks from each Participating Agency as a record for your use in evaluating responses.

GUIDELINES FOR SIMULATION EVALUATORS

1. You will meet with other Simulation Evaluators and with Simulation Facilitators during the Briefing Meeting for additional clarification of your functions.
2. Please do not interact or interfere with the simulation exercise participants. Quietly and unobtrusively observe the activities.
3. You will be asked to follow the response to specific inputs, and will be called/notified by the Simulation Facilitator when additional input is introduced into the exercise.
4. Observe the response to the input and follow closely. Take notes on the following:
 - Which agency was asked to respond to the input? Was this the appropriate agency?
 - Was the response and outputs appropriate for the input?
 - Was a “closure” reached on the response?
 - Was the response completed in a timely manner?
 - How was the coordination both internally within a country and among agencies/countries?
 - What could have been done better (even if it is being done well, there are always ways to improve), and how could we improve?
5. You will be asked to observe and evaluate several inputs at one time. Move around to observe interactions as needed.
6. Check the “outbox” frequently for outputs related to the inputs assigned to you for evaluation.
7. Be prepared to give recommendations at the Evaluation Meeting for strengthening cyclone forecasts and response and potential follow-up activities.

SCENARIOS

A Severe Cyclonic Storm warning issued by the RSMC to BMD at 1100 hrs, possible landfall with sustained winds of approximately 185 KPH in Gusest/Squalls. Sea will be remaining very high. Maritime ports of Chittagong, Cox's Bazar and Mongla have been advised to keep hoisted warning signal no. Four.

Under the peripheral influence of the storm, the coastal districts of bhola, patuakhali, barisal, chandpur, borguna, pirozpur, jhalokathi, bagerhat, khulna, satkhira and their offshore inlands and chars are likely to experience gusty/squally wind speed 60-80 kph or more from early night tonight. The low lying areas of these coastal districts are likely to be inundated by wind driven surge of 3-5 feet height above normal astronomical tide.

All fishing boats and trawlers over North Bay have been advised to remain in shelter till further notice.

Inject-1:

At 1600 hrs the updated bulletin mentioned that the Cyclonic Storm likely to intensify further and move in a northerly director and cross Khulna- Barisal coast by evening tomorrow. Maximum sustained wind speed within 74 KMS of the storm centre is about 200 KPH rising to 220 KPH in gusts/ squalls. Sea will remain very high.

Maritime port of mongla has been advised to keep hoisted great danger singal no. Ten (r) ten. The coastal districts of bhola, barisal, patuakhali, borguna, pirozpur, jhalokathi, bagerhat, khulna, satkhira, jessore and their offshore islands and chars will remain under great danger singal no. Ten (r) ten.

Under the influence of the storm, the coastal districts of cox's bazar, chittagong, noakhali, feni, laxmipur, bhola, barisal, patuakhali, borguna, chandpur, pirozpur, jhalokathi, bagerhat, khulna, satkhira, jessore and their offshore islands and chars are likely to experience heavy/ very heavy rain accompanied by squally wind speed up to 220 kph with the passage of the storm.

The low-lying areas of the coastal districts of bhola, barisal, patuakhali, borguna, chandpur, pirozpur, jhalokathi, bagerhat, khulna, satkhira, jessore and their offshore islands and chars are likely to be inundated by storm surge of height 15-20 feet above normal astronomical tide.

It is expected devastation as a result of storm surge. The people need to evacuate immediately to safe place and one hospital near the shore need to evacuate immediately.

FORECAST SYSTEM CONCEPT FOR COASTAL INUNDATION FORECASTING DEMONSTRATION PROJECT (CIFDP)

(as revised following the discussion at the CIFDP-PSG-5,
14 – 16 May 2014, Geneva, Switzerland)

The WMO Coastal Inundation Forecasting Demonstration Project (CIFDP) focuses on facilitating the development of effective forecasting and warning systems for coastal inundation, based on robust science and observations. In particular, CIFDP implementation will create synergies with the ongoing regional and global programmes and activities; and provide technical requirements to develop the regional Storm Surge Watch Scheme (SSWS) in basins subject to tropical cyclones and storm surges, jointly with (fluvial) flood events over a range of time scales appropriate to meet user needs around the world. Although the CIFDP focuses on operational time scales ranging from “nowcasts” to forecast times of about a week, it is important that this program provide seamless predictions and services that can help meet the needs of a wide range of stakeholders and that can interface effectively with other prediction programs (Figure 1). In many areas of the world, these additional time scales provide information critical to contingency planning, national and international humanitarian response, and decision-making for mitigation planning.

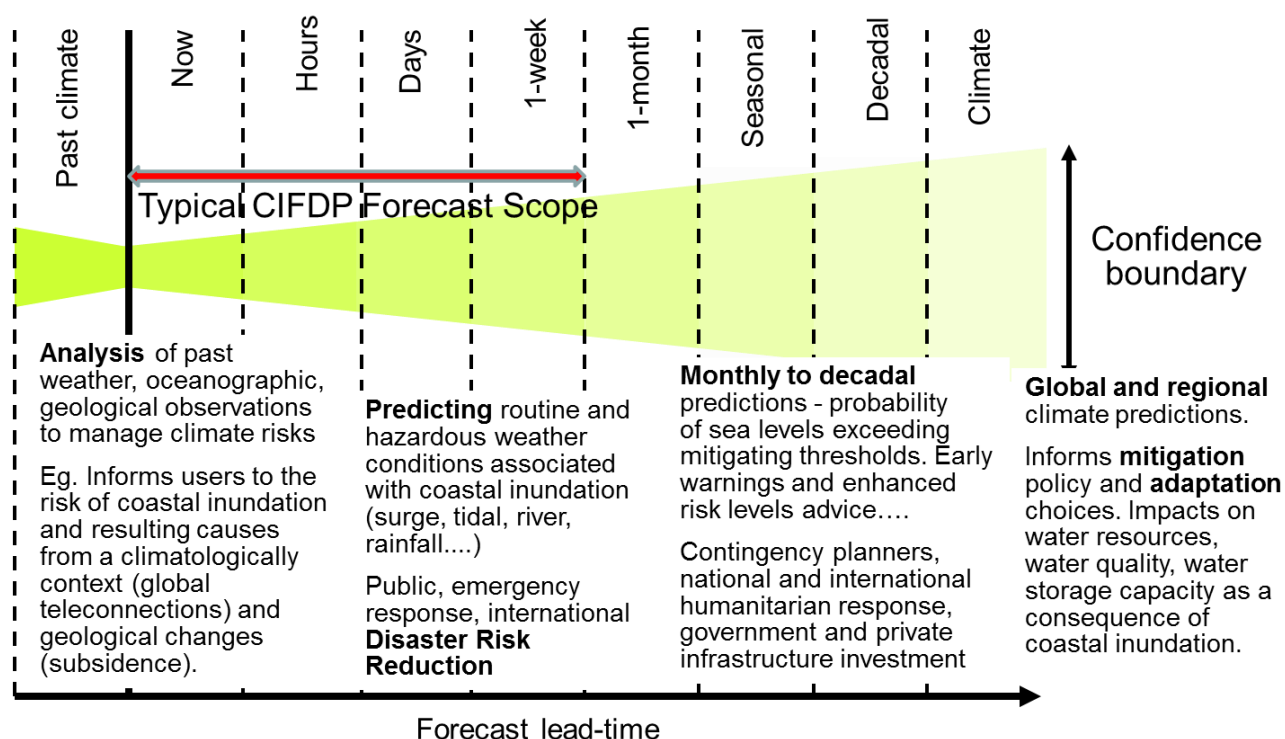


Figure 1: Typical forecast scope in the implementation of CIFDP, in the temporal range of service offerings for meteorological, hydrological and oceanographic information for decision making.

A diagram for the overall forecast system is shown in Figure 2, representing recommendations adopted by Project Steering Group (PSG) during its 5th meeting (14 – 16

May 2014, Geneva, Switzerland). As can be seen here, information obtained from (a) responsible national / regional agency(ies), such as the Regional Specialized Meteorological Centre (RSMC) including products produced by the Severe Weather Forecasting Demonstration Project (SWFDP) in regions where this is applicable, is used as the basis for these forecasts, including 1) regional atmospheric models (providing winds, pressures, and precipitation), 2) inputs from large-scale ocean circulation and wind-wave models (providing information on large scale sea-surface height anomalies and on waves generated outside the region) 3), a coastal inundation model (using information from wind wave and wind stress, tidal and large-scale-anomaly), and 4) hydrological models to handle inflow into the coastal domain from rivers and streams when basin rainfall can be a significant contributor to coastal flooding. All of these dynamic models must be set upon a digital terrain model which includes bathymetric and topographic information at an appropriate accuracy and resolution. The goal of this system of models is to be able to provide accurate forecasts of coastal inundation from oceanographic and/or hydrological phenomena, resulting from severe hydro-meteorological events, in different areas around the world, including (1) storm surges produced by direct wind and wave forcing, (2) wave set-up from large swell events, and (3) high river/stream flows, acting independently or in combination, interacting with sea-level variations, e.g. from tides and/or sea surface height anomalies, in coastal areas.

Wind forcing for the overall modelling system comes from tropical-cyclones and other wind systems. For the case of tropical cyclones, a parametric model of winds within the moving tropical cyclone vortex is developed from a forecast set of storm characteristics. A typical set of these are listed below:

1. Storm track;
2. Storm intensity (usually defined by the pressure differential between the centre of the tropical cyclone and the peripheral pressure);
3. Storm size (usually defined in terms of the radius to maximum wind for wind field estimation);
4. Forward speed of the storm; and
5. Optional terms to refine the wind distribution along the radials of the storm (for example: the Holland B parameter, double exponential forms, etc.)

Given that it has been clearly shown in several test cases that a purely deterministic forecast can severely under-predict surge levels in very large areas, these parameters should be varied to encompass the uncertainty inherent in tropical cyclone forecasts; and the entire forecast system should be run for those derived storms. Forecasts of winds other than tropical cyclones will be derived from a combination of global and regional numerical weather prediction (NWP) models.

While all sub-projects will be developed under the common framework described in Figure 2, each will be unique depending on the primary causes of coastal inundation in the country, and the specific user requirements identified in the User Requirements Plan. As a result, customized forecast and warning interpretive products will be identified and developed for each sub-project separately in consultation with the local user community, coordinated by the National Coordination Team (NCT).

Interaction between system subcomponents:

Information on tides, large-scale sea-surface height anomalies and waves propagating into a regional area will be obtained from models run on scales appropriate to those processes. This will provide necessary information along all of the regional-scale model boundaries.

Within the regional model, wind stresses and pressure fields for each forecast are input to the surge and wave models at time intervals appropriate to resolve the physics/processes within these models and will be combined with the effects of wave, tidal and large-scale forcing from larger-scale models to forecast the total inundation levels. The wave and surge models can be either loosely or tightly coupled, depending on the specific application and modelling system found to be effective in an area. In areas located on very shallow near-shore slopes, a reasonable approximation to the forecast surge may be obtained without needing to run a wave model, since the contribution by wave radiation stresses tends to be small compared to the direct wind-driven tides in such areas. In cases where the wave contribution is small and neglected, a constant value, representing the typical contribution to the overall surges levels due to the wave fields, should be added to the overall forecast surge to avoid under-predicting critical flooding. For much of the globe, a value of 0.3 – 0.5 m might suffice for this purpose – bearing in mind that such an approximation is definitely inappropriate for regions with steep slopes (such as found in many island areas where waves are often a dominant forcing mechanism for surges).

The inundation model should also be coupled to hydrological models in locations where coastal inundation may be caused by riverine flooding, either independently or in combination with increased coastal water levels associated with storm surge, waves, tides or sea surface height anomalies. For coastal areas it is very important that the inundation model have a capability to consider flooding and drying (i.e. inundation) within its numerical framework. The inundation model should include a loose or tight coupling to a hydrological model which provides the input conditions at the upstream boundary of the inundation model domain. The hydrological model could be set up to run independently in areas where flows are not influenced by backwater effects due to coastal or tidal inundation; however, it will likely be important to consider both contributions to flooding in some coastal regions. A key question to be addressed by the in-country technical team (National Coordination Team) is the dynamic nature of the moving boundary between the incoming river/stream flows into the coastal model domain when the hydrological and inundation models are coupled.

A critical part of the CIFDP effort will be to provide evidence that the forecast system is suitably validated. This will require; 1) a comparison of modelling system performance relative to available observations in past events; 2) a demonstration that the system is suitably robust to maintain functionality for the complete range of storms (extreme events) and boundary conditions critical to inundation in an area; 3) a demonstration that the system is capable of providing information needed by local stakeholders and that this system adequately addresses the uncertainty in the forecast inundation; and, 4) an exercise in an operational mode of the forecast system including interactions with stakeholders. The performance acceptance criteria will jointly be developed and utilized by the National Coordination Team (NCT) and Project Steering Group (PSG).

Integration of observations into the operational service system:

In order for the overall inundation system to function effectively, be objectively assessed and to improve its accuracy and value through time, it will be critical to include a set of observations (both *in situ* and remotely sensed, real-time and non-real time) into the overall system. These measurements should include information on conditions prior to, through and after the different inundation events. Pre-inundation information is essential to improved forecasts of the event which generates inundation and to evaluate which models in an ensemble are tracking better with the developing scenario. Other pre-inundation information required is a suitable database of digital bathymetric and topographic information, which should be updated periodically, especially in deltaic regions. Data taken during the event are necessary to enable quantitative comparisons between the modelled inundation being generated by the hydro-meteorological forcing and the inundation response to this forcing. It is also important in enabling updated warnings in rapidly changing situations. These

measurements should include both forcing functions (winds, pressures, rainfall, waves, etc.) and response functions (water level, stream discharge, etc.). Finally, post-event measurements (inundation duration, rate of post-storm inundation abatement, high-water marks, damage surveys, etc.) will be critical to understand and guide on-site recovery efforts and to quantify relationships between inundation and its consequences. It should also be noted that continuous, long-term measurements will be important to establish the overall climatology of extremes in this area and to detect any long-term changes which are occurring.

Information Technology (IT) Architecture:

Underpinning any seamless end to end forecasting and warning service is the Information technology required to support it. A meteorological service, or other implementing agency, should be prepared to meet the minimum requirements to run the developed system operationally. This may require a multi-faceted approach, with sufficient computing power and bandwidth to drive deterministic and/or ensemble based models and future fully integrated environmental prediction models, an application layer to integrate the data together, perhaps through a GIS system or cloud, and a visualization layer to provide a platform that enables collaborative decision making. Appropriate personnel to operate and maintain the computing and communications resources are also a minimum requirement for the forecasting agency.

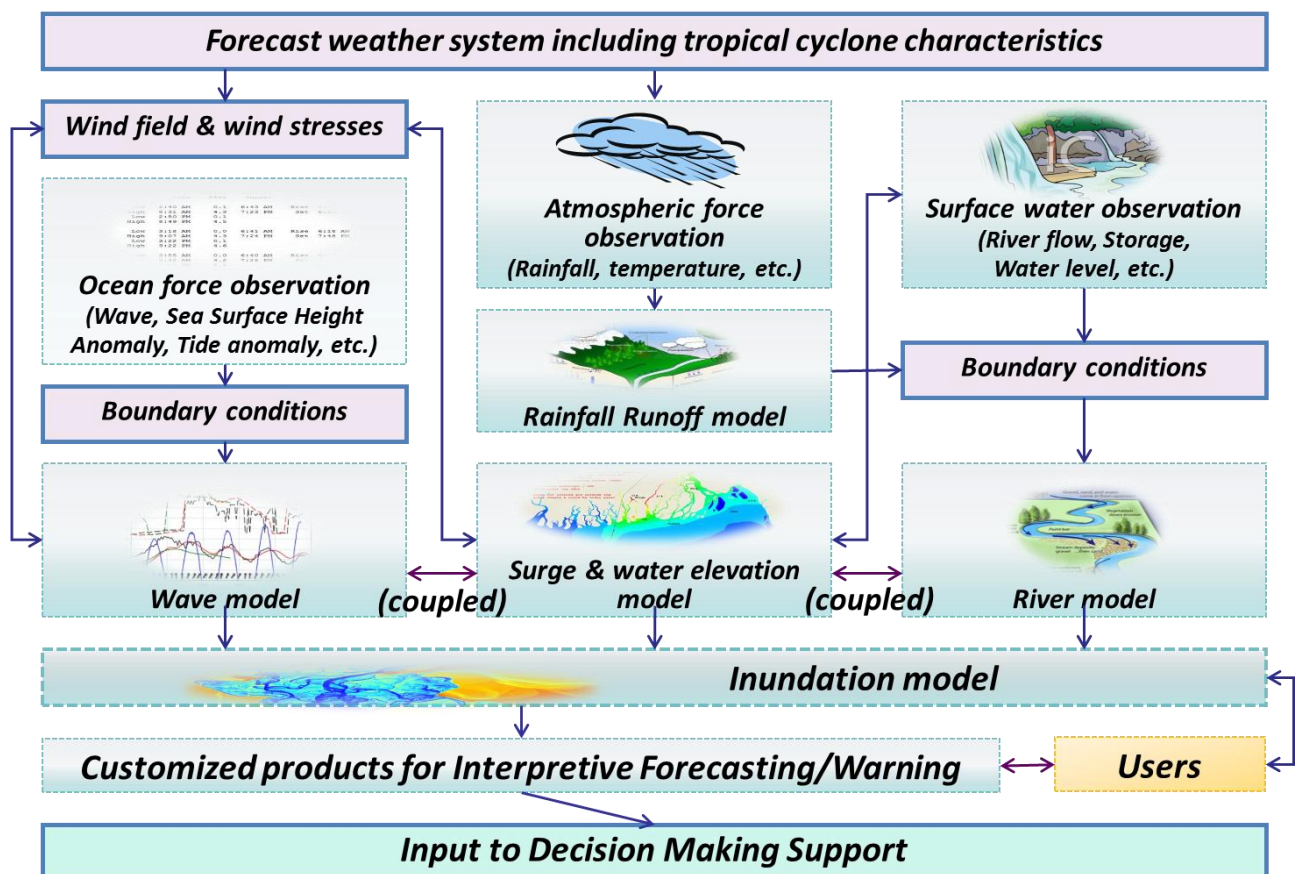


Figure 2: Conceptual diagram of forecast systems recommended for application within the CIFDP effort

Annex VI

TERMS OF REFERENCE FOR THE CIFDP STEERING GROUP

(As agreed at the CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

The CIFDP is under the oversight of the Project Steering Group (PSG) for overall project planning, implementation, review progress and reporting. The **PSG** works closely with the WMO Secretariat and with the Sub-project National Coordination Teams (NCTs) to ensure that each Sub-Project is implemented in line with the overall Project Framework that was endorsed by the WMO Congress and its technical commissions including the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) and Commission for Hydrology (CHy).

The **PSG** works with the **WMO Secretariat** in:

- regular review and update of the Project Concept, Implementation Plan and Technical Recommendation: Forecast System Concept;
- initiation of Sub-Projects, by reviewing the initial requirements and providing advice to the countries and WMO technical commissions (JCOMM and CHy);
- reviewing progress of Sub-Projects in each phase, and providing recommendations to JCOMM and CHy regarding the following steps of the Sub-Project implementation;

The **PSG** works closely with each **Sub-Project National Coordination Teams (NCTs)**, in:

- selecting technical solutions for the storm surge, wave and hydrological forecasting and operation, which meet the national and regional capabilities and requirements;
- providing guidance to the development and implementation of Sub-Project Plan, including technical development as well as stakeholder interactions and consultations;
- developing modalities for interactions with, and input from, associated projects;
- issuing the final review report on the Sub-Project and preparing recommendations to be transmitted to the relevant bodies.

The **PSG** is comprised of experts on coastal inundation (e.g. storm surge, wave and hydrological modelling and forecasting) and associated areas (e.g. service delivery and social science).

The **PSG** collaborates with the **JCOMM Expert Team on Waves and Coastal Hazard Forecasting Systems (ETWCH)**, by working closely with at least one ETWCH member for each Sub-Project implementation, to address technical aspects of metocean modelling and operational coastal hazard forecasting and warning.

The **PSG** collaborates with the **WMO Working Group on Societal and Economic Research Applications (WG-SERA)**, by making a linkage with at least one SERA member for each Sub-Project implementation, to address user requirements and socio-economic aspects.

The ToR as well as the membership of the PSG are regularly reviewed and updated as necessary at each PSG meetings.

Membership

- Dr Donald Resio (**co-chair**) – Hydrometeorological modelling and forecasting expert
 - Mr Val Swail (**co-chair**) – Meteorological modelling and forecasting expert
 - Dr Linda Anderson-Berry - Social science expert
 - Dr Paul Davies - Hydrometeorological modelling and forecasting expert
 - Dr Monika Donner - Hydrological modelling and forecasting expert
 - Mr Nadao Kohno - Metocean modelling and forecasting expert
 - Dr Paula Etala - Meteorological modelling and forecasting expert
 - Dr S.H.M Fakhruddin - Hydrological modelling and forecasting expert
 - Mr Jamie Rhome – Meteorological modelling and forecasting expert
 - Mr Deepak Vatvani – Hydrological and metocean modelling expert
-

Annex VII

DISTRIBUTED RESPONSIBILITIES OF PSG AND JCOMM/ETWCH MEMBERS IN SUPPORT OF NATIONAL SUB-PROJECTS

(As presented and agreed at the CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

The CIFDP is implemented through each sub-project initiated by a country. The PSG is to provide guidance to the NCT of each sub-project through the implementation, and to review progress of the sub-projects in each phase. The PSG is expected to provide reports and recommendation to the relevant WMO bodies that support/guide the CIFDP, with respect to the general direction and implementation of the Project.

In order to efficiently carry out the Group's work with increasing demands of countries for CIFDP implementation, the distribution of tasks among the PSG members is suggested as follows;

- In coordination with the Secretariat, the two co-chairs will oversee the work of the PSG, including input/guidance to all sub-projects' implementation, phased review and report to WMO bodies/meetings.
- The PSG member for social science (Anderson-Berry) will work with a representative of WG-SERA, for each sub-project, to document and provide input to the User Requirements Plan
- The indicated members of PSG for each Sub-project will take the main responsibility for consolidating technical advice, phased review and other required input to the implementation of respective Sub-projects, for the final agreement and decision of the whole PSG. The list will remain flexible and can be updated/modified – those members with similar expertise could alternate upon their availabilities for specific tasks:

Sub-Project	PSG Members of main responsibilities	Supporting ETWCH members	Note for consideration
Bangladesh	Kohno, Donner	Horsburgh	<ul style="list-style-type: none"> • Fakhruddin: System Developer – not to consider for phased review • Technical implementation being carried out with contribution by JMA
Fiji	Rhome, Donner	Entel	<ul style="list-style-type: none"> • Leadership in technical contribution by Regional Partners (SPC/SOPAC, J.Kruger) • In process for Australian funding/initiative, cooperating with BOM (Entel)
Indonesia	Vatvani, Davies	Horsburgh	<ul style="list-style-type: none"> • NCT (BMKG) requested training for FEWS and WAVEWATCH III – seeking direct engagement of NOAA and Deltares
Shanghai (in preparation)	Davies, Etala,	Horsburgh	<ul style="list-style-type: none"> • Consideration: to engage experts with experience of Shanghai MHEWS project

Caribbean	Rhome, Etala	Ocampo-Torres	<ul style="list-style-type: none">• Leadership/contribution by NOAA/NHC (Rhome)• To carry out review/renewal of project implementation as “One-Island approach”
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The task allocation will be continuously reviewed and updated as required.

Annex VIII

LIST OF ACTIONS, DECISIONS AND RECOMMENDATIONS
(as agreed at the CIFDP-PSG-5, 14 – 16 May 2014, Geneva, Switzerland)

item	Actions / Decisions / Recommendations	By whom	With whom	By when
Indonesia National Sub-Project (CIFDP-I)				
2.1.3	To consult with Deltares and US/NOAA for WAVEWATCH III and FEWS training for BMKG	Secretariat	BMKG	ASAP
2.1.4 3.3	To prepare information / guidance on the scope of CIFDP-I, and on user interaction (regarding the CIFDP requirements and expected outcomes)	PSG	Secretariat, NCT	ASAP/not later than September 2014
2.1.5	(Recommendations) To consider: <ul style="list-style-type: none"> To prioritize required technical tools (forecasting models), considering the issues at demonstration sites, based on the discussion at the Stakeholders Workshop (e.g. tide height forecasting, wave forecasting, FEWS – immediate need) To clearly/define the scope of CIFDP-I, expected outcome, and primary issues to be dealt within CIFDP-I To explore ways to improve understanding other issues (e.g. sea level rise/subsidence) in linkage with relevant activities/programmes (Considering that range of requirements/expectations is large) To assist users to improve understanding on main causes of inundation in their areas of interest, in view of clarifying the expected outcome/benefit of CIFDP-I (through user interaction guideline for CIFDP) 	NCT	PSG, Secretariat	
2.1.6	To plan for Phase 1 review (including financial requirements for system implementation as well as meeting(s))	PSG, Secretariat	NCT	ASAP/not later than September 2014
Fiji National Sub-Project (CIFDP-F)				
2.2.1	(Decision) To approve Phase 1 completion			
2.2.3	To continue identifying funds for implementation (Phases 2-4)	Secretariat		ASAP
2.2.3	To plan for Phase 2 implementation	NCT	Secretariat, PSG	3 rd quarter 2014

2.2.4	(Recommendation) SWFDDP to explore improved operational warning for flash flood (for Fiji)			
Bangladesh National Sub-Project (CIFDP-B)				
2.4.1	(Decision) Endorsed CIFDP-B progress report, with detailed timeline			
2.4.2	(Decision) To conduct table-top exercise for CIFDP-B Phase 2, and make similar practices in all other sub-projects	All NCTs and System Developers		
2.4.4		NCT and System Developer for CIFDP-B		ASAP
2.4.2	To update the project plans for other sub-projects accordingly			
2.4.3	(Recommendation) To explore opportunities for collaborative arrangement with scientific communities, in all sub-projects' implementation			
2.4.4	To update table-top exercise plan to clearly include evaluation and feedback mechanism	CIFDP-B System Developer		ASAP
2.4.5	To request the US/NHC for the use of data for high resolution GIS	Secretariat		May 2014
2.4.5	To conduct comparison run between the existing operational storm surge model and updated CIF-B model (current version), during the tropical cyclone season, and provide report	CIFDP-B System Developer	BMD	January 2015
2.4.5	(Recommendations) To consider <ul style="list-style-type: none">User interaction, identification and development of inundation forecast and warning products			
Caribbean Sub-Project (CIFDP-C)				
2.5.4	(Decision) to make transition from CIFDP-DR to CIFDP-C (Caribbean), including the existing DR Component as beta-project, interconnecting/interacting with the entire CIFDP Framework			
2.5.4	To set timeline and milestones in coordination with the decisions made at the RA-IV Hurricane Committee on the requirements for regional requirements	PSG	US/NHC	ASAP/not later than June 2014
2.5.5	To update and submit a funding proposal for CIFDP-C beta project (DR and Haiti), based on the revised scope and plans	PSG	Secretariat	ASAP

2.5.6	(Recommendation) to implement CIFDP-C in a more interactive and inter-connected way with beta project (DR and Haiti), based on the revised scope and plans	PSG	Secretariat	ASAP
Project Framework and Management				
3.1.1	(Decision) To maintain the CIFDP Concept 2013 edition, until the next review at the 6 th meeting (2015)			
3.1.2	(Decision) To maintain the CIFDP general implementing strategy, until the next review at the 6 th meeting (2015)			
2.4.2 2.4.4 3.1.3	To finalize revised CIFDP Implementation Plan (JCOMM Technical Report No.64) according to the conclusions of the meeting, and publish it as 2014 update	PSG (Co-chairs)	Secretariat	June 2014
3.2.2	To revise and finalize CIFDP Technical Recommendation (e.g. scope of CIFDP system and expected deliverables in the forecasting scale), including conceptual diagram of forecasting systems (to include process for interpretive forecasting/warning and user feedback) and a chart on seamless forecasting service (with indication on primary and secondary foci of CIFDP implementation), and publish a new version on the CIFDP web site	PSG (Co-chairs)	Secretariat	June 2014
3.3.2	To draft and review a guidance/brief for user interaction on; 1) communicating benefits and impacts of CIFDP implementation; 2) collecting and compiling user requirements and feedback to newly demonstrated system and products, and; 3) strategic means for dialogue with users (immediate users and end user).	PSG (P.Davies)	Secretariat	June 2014
3.4.2	(Recommendation) to enhance two-way interaction with related projects including APFM/FFI.			
3.4.4	(Recommendation & action) To deliver comments for RA IV Tropical Cyclone Committee on a proposed establishment of Task Team on Coastal Inundation including Storm Surges (TT-CISS), in view of close consultation with the CIFDP Framework	Secretariat	TCP Secretariat	ASAP
3.4.6	(Decision) to respond to requirements of the Philippines and Vietnam, when requested and where feasible			

3.4.7	(Recommendation) CIFDP training and associated implementation to be closely coordinated and collaborated with PWS, including the interpretation and communication on products	PSG	Secretariat	continuous
3.4.7	(Recommendation) to communicate with users & general public on impacts, instead of phenomena, including a probabilistic approach ("likelihood")			
3.5.1	To compile reference presentation / reference poster on CIFDP general framework	Secretariat, PSG		ASAP
3.5.1	To update and maintain a list of CIFDP outreach (including the reports to governing bodies and related programme meetings, scientific presentations, etc.)	Secretariat	PSG, NCT	ASAP & continuous
3.5.2	To review and provide suggestions/input for update of CIFDP Web Site (http://www.jcomm.info/CIFDP)	PSG	Secretariat	June 2014
3.5.3	To review and revise the Brochure (currently, 2013 update), primarily targeting potential donors	Secretariat	WMO Public Relations	ASAP/September 2014
3.5.4	(Recommendation) To make use of social media maintained by WMO and national operational centres			
3.5.5	To develop a template for a fact sheet on sub-projects	Secretariat	PSG	ASAP (for review by CIFDP-PSG-6)
4.1	(Decision) to keep general financial model, as described in the CIFDP Concept			
4.1.3	NCTs to take more active role in resource identification	NCTs	PSG, Secretariat	Continuous
4.2.1	(Decision) to update and publish revised ToR			
4.2.2	(Decision) agreed on the guiding principles for PSG membership			
4.2.3	To send revised list of PSG members for endorsement of JCOMM and CHy presidents	PSG Co-chairs	Secretariat	ASAP
4.2.4	(Recommendation) To identify liaison or ex-officio: reps. of ETWCH, SWFDP, APFM/FFI, WG-SERA	Relevant groups of WMO programmes/projects	PSG	
4.2.4	(Recommendation) to enhance two-way interaction with related projects including SWFDP and APFM/FFI, through cross-representation in the steering groups			

4.2.6	(Decision) To keep the principles for operation for the work of the PSG, as agreed at CIFDP-PSG-4			
4.2.6	(Decision) To update the distributed responsibilities for PSG members, and associated JCOMM/ETWCH members			
5.1	(Recommendation) To confirm a single project coordinator for overall CIFDP			
5.1	To confirm a single project coordinator arrangement	Co-chairs/PSG	Secretariat	ASAP
6.2	To prepare and organize PSG-6, considering planned activities in sub-projects and related events (e.g., Waves Workshop, SSS 2015)	Secretariat		2015

ACRONYMS AND ABBREVIATION

APFM	Associated Programme on Flood Management
AUSAID	Australian Agency for International Development
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BMKG	Indonesian Meteorological Climatological and Geophysical Agency
BOM	Bureau of Meteorology (Australia)
BWDB	Bangladesh Water Development Board
CHy	WMO Commission for Hydrology
CIF	Coastal Inundation Forecasting
CIF-B	Coastal Inundation Forecasting system for Bangladesh
CIF-I	Coastal Inundation Forecasting System for Indonesia
CIF-F	Coastal Inundation Forecasting system for Fiji
CIFDP	WMO Coastal Inundation Forecasting Demonstration Project
CIFDP-B	CIFDP Bangladesh Sub-project
CIFDP-C	CIFDP Caribbean Sub-project
CIFDP-DR	CIFDP Dominican Republic Sub-project
CIFDP-F	CIFDP Fiji Sub-project
CIFDP-F-IEF	Interdisciplinary Experts Forum for CIFDP-F
CIFDP-FSW	Fiji Stakeholders Workshop for CIFDP
CIFDP-I	CIFDP Indonesia Sub-project
CIFDP-ISW	Indonesia Stakeholders Workshop for CIFDP
CIFDP-S	CIFDP Shanghai Sub-project
CIFDP-SA	CIFDP South Africa Sub-project
CMA	China Meteorological Administration
CPP	Cyclone Preparedness Programme
CRAF	(RISC-KIT) Coastal Risk Assessment Framework
DAE	(Bangladesh) Department of Agriculture Extension
DC	(Bangladesh) Deputy Commissioner
DDM	(Bangladesh) Department of Disaster Management
DEM	Digital Elevation Model
DIMAR	Dirección General Marítima (National Maritime Authority; Colombia)
DMC	Disaster Management Committee
DNA	(CIFDP) Definitive National Agreement
DRM/DRR	Disaster Risk Management / Disaster Risk Reduction
EGU	European Geosciences Union
EO Data	Earth Observation Data

ESA	European Space Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
ETWCH	(JCOMM) Expert Team on Waves and Coastal Hazard Forecasting Systems
EU-FP7	The Seventh European Union Framework Programme
EU RISC-KIT WP	EU RISC-KIT Work Packages
EWS	Early Warning System
FAP	(Bangladesh) Flood Action Plan
FEWS	Flood Early Warning System
FFI	Flood Forecasting Initiative
FGD	(Indonesia) Focused Group Discussions
FMS	Fiji Meteorological Service
GEF	Global Environment Fund
GFDRR	(World Bank) Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
GSM	Global Spectral Model
HQ	Headquarters
ICRD	(Bangladesh) Integrated Coastal Resources Database
IDMS	(Bangladesh) Improvement of Digital Mapping System
IPSWAM	(Bangladesh) Integrated Planning for Sustainable Water Management
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JMA-MRI	Japan Meteorological Agency - Meteorological Research Institute
JTWC	Joint Typhoon Warning Centre
KOICA	Korea International Cooperation Agency
KPH	Kilometres per Hour
MES	Meghna Estuary Study
MHEWS	Multi-Hazard Early Warning System
MIDAS	(Indonesia) Marine Integrated Data and Analysis System
MMOP	WMO Marine Meteorology and Oceanography Programme
NCA	(CIFDP) National Capacity Assessment
NCT	(CIFDP) National Coordination Team
NERC	(United Kingdom) Natural Environment Research Council
NGO	Non-Governmental Organization
NHC	(United States) National Hurricane Center
NMHS	National Meteorological and Hydrological Service

PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PSG	(CIFDP) Project Steering Group
PWS	(WMO) Public Weather Service
QPF	Quantitative Precipitation Forecast
RA	(WMO) Regional Association
RIMES	Regional Integrated Multi-hazard Early Warning System
RISC-KIT	(EU FP7 Project) Resilience-Increasing Strategies for Coasts – toolkit
RSMC-Miami	(United States) National Hurricane Center
RSMC-TC	(WMO) Regional Specialized Meteorological Centre for Tropical Cyclone
SAWS	South African Weather Service
SD Report	(CIFDP) System Development Report
SMS	Shanghai Meteorological Service
SoB	Survey of Bangladesh
SOD	(Bangladesh) Standing Order on Disasters
SOP	Standard Operation Procedures
SPC	Secretariat of the Pacific Community
SOPAC	(SPC) Applied Geoscience and Technology Division
SPREP	Secretariat of the Pacific Regional Environment Programme
SSHA	Sea Surface Height Anomaly
SSS	(JCOMM) Storm Surge Symposium
SSWS	(WMO) Storm Surge Watch Scheme
SWAN	Simulating Wave Near-shore (Model)
SWFDDP	(WMO) Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (in RA V)
SWFDP	(WMO) Severe Weather Forecasting Demonstration Project
TC	Tropical Cyclone
TCC	(WMO) Tropical Cyclone Committee
TCP	(WMO) Tropical Cyclone Programme
ToR	Terms of Reference
TRMM	Tropical Rainfall Measuring Mission
TT-CISS	Task Team on Coastal Inundation including Storm Surges
URP	User Requirement Plan
USAID	United States Agency for International Development
US/NOAA	US National Oceanic and Atmospheric Administration
VCP	Voluntary Cooperation Programme

WACOP	(EU-funded project) Changing Waves And Coasts in the Pacific
WARPO	(Bangladesh) Water Resources Planning Organization
WG-SERA	(WMO) Working Group on Societal and Economic Research Applications
WMO	World Meteorological Organization

