Development and Implementation of the Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) Project

Santo Domingo, Dominican Republic, 7-9 September 2016

FINAL REPORT OF THE INITIAL PLANNING MEETING

November 2016

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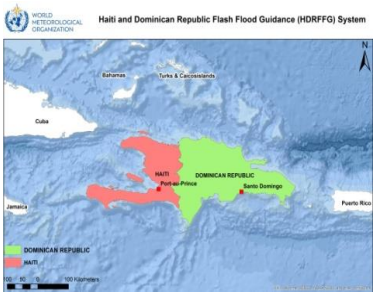
1. Background



In the Caribbean region, flash floods account for a significant portion of the lives lost and property damages that result from flooding. Given that flash floods can occur at any time or place with disastrous results, there is an urgent need to prioritize efforts that aim to improve early warnings capabilities. Improvements help society cope with flash flood threats by enabling the mandated national authorities to undertake appropriate measures, thereby contributing to protecting the population at risk from the disastrous effects of flash floods.

As part of WMO's Flood Forecasting Initiative and on the basis of a 4-party Memorandum of Understanding signed by the World Meteorological Organization (WMO); US NOAA National Weather Service; the Hydrologic Research Center (HRC), San Diego, USA; and U.S. Agency for International Development/Office of U.S. Foreign Disaster Assistance (USAID/OFDA), the signatories have established a cooperative initiative for the Flash Flood Guidance System with Global Coverage Project. To attain global coverage, specific projects are planned and carried out on a regional basis with countries that have committed in writing to participate actively in the implementation and operation of the forecast system.

2. Introduction and Opening of the Meeting

Based on correspondence received from the Dominican Republic and Haiti expressing the desirability and need for the establishment of a regional flash flood guidance system, the initial planning meeting was organized by the WMO. The meeting was hosted by the Oficina Nacional de Meteorología (ONAMET) of Dominican Republic, allowing participants the opportunity of visiting the premises of the ONAMET to see operational weather analysis and forecasting capacities, capabilities and infrastructure of the ONAMET. This tour provided an excellent opportunity for the participants to receive first-hand information on weather analysis and forecasting, hurricane forecasting, Nowcasting, weather observation network, and connection to the Global Telecommunication System (GTS). All participants expressed their deep appreciation to the ONAMET for its hosting of the initial planning meeting and for providing a valuable visit of the ONAMET facilities.

In opening of the initial planning meeting, the representatives of ONAMET, WMO, and Hydrologic Research Center (HRC) highlighted the importance of improving the timely delivery of flash flood information and guidance to the populations at risk and in the importance of fostering stronger partnerships among countries in the region to strengthen national capabilities to forecast and warn populations at risk from flash flooding and other hydrometeorological hazards. Although the core aspects of the project focus on the implementation of technology and scientific approaches undertaken mainly by the countries' National Meteorological and Hydrological Services (NMHSs), it was highlighted that the guiding indicator for the ultimate success of the project is the effectiveness of the outreach to citizens and reducing their risk of being affected by flash floods in a disastrous way.

In her opening remarks, Ms Gloria Maria Bienvenida Ceballos Gomez, Director General of ONAMET and the Permanent Representative of Dominican Republic with WMO, highlighted the value of

regional cooperation particularly given the impacts of climate variability and change on infrastructure and the need for early warning systems to help reduce the risks from hydrometeorological hazards, to promote sustainable development, and to attain and maintain economic prosperity. She also emphasized the need for the international exchange of data and information for improving forecasting and early warning, stressing that severe weather events do not confine themselves to national borders. She emphasized that floods/flash floods are extremely devastating hydrometeorological hazards in Dominican Republic, affecting millions of people each year and mostly caused by the tropical storms from May to November. Mr Claudio Caponi welcomed all participants on behalf of Secretary General of WMO and recalled the objectives of the meeting and its expected results and welcomed the participants to provide their active inputs into shaping this important regional Flash Flood Guidance System project. He also thanked the ONAMET for all its efforts including hosting the meeting, thereby helping to make a positive atmosphere for the meeting. Ms Theresa Modrick, HRC, expressed her appreciation to ONAMET for hosting the initial planning meeting and thanked all participants for attending the meeting. She provided background information on the establishment of the global Flash Flood Guidance System with the initial project being was implemented in the Central America Region in 2004 after Hurricane Mitch destroyed the region, causing thousands of deaths and inflicting heavy economic losses. She stated that HRC is very pleased to develop and implement a regional Flash Flood Guidance System in Haiti and Dominican Republic in collaboration with its partners.

3. Organization of the Initial Planning Meeting

The meeting was attended by the representatives of National Meteorological and Hydrological Services (NMHSs) from Haiti and Dominican Republic as well as WMO and HRC. The list of participants is provided in Annex 1, while the annotated workshop agenda is given in Annex 2.

In depth information was provided by WMO and HRC to participants of the Initial planning meeting on the objectives and deliverables of the Flash Flood Guidance (FFG) system, its conceptual and operational set-up, and products to be delivered. The Project Brief and the Implementation Requirements documents, which had been provided in advance of the workshop to participants, are attached as Annexes 3 and 4, respectively.

4. Proceedings of the Initial Planning Meeting

Country Presentations

Experts from each country provided in-depth presentations on the current situation of their national services related to hydrometeorological forecasting capabilities, practices and development plans. The presentations are available on the WMO website (www.wmo.int/ffgs)[1]. The presentations revealed the similarities and differences that exist among the countries regarding their capabilities to deliver weather and flood forecasting and early warnings, especially for those pertaining to flash floods. Countries do not presently have dedicated systems including the use of hydrological modelling to specifically address the provision of flash flood forecasts and warnings.

Mr Wagner Rivera (DR) provided an overview of the Weather Service (ONAMET) of Dominican Republic. He stated that topography of DR is quite diversified from flatland in the east to the very high mountain peak in the west. He said that headquarters of ONAMET is located in Santo Domingo and there are four regional weather forecast offices across the country. After explaining the ONAMET administration structure, he showed the meteorological observation network that comprises synoptic,

[1]The cited material for the Haiti and Dominican Republic Flash Flood Guidance project can be located by referring to the activities of the Flash Flood Guidance System within Floods/Flood Forecasting heading under the Hydrology and Water Resources Programme:http://www.wmo.int/pages/prog/hwrp/flood/ffgs/index_en.php.

climatologic, agrometeorological, and aeronautical stations. He also stated that one weather Radar is located in Punta Cana, but he noted that it has not been operational over the last five years, while there is one radiosonde station.

He articulated that Smart Met meteorological data processing and visualization software is used for the visualization of meteorological diagnostic and prognostic products, while that global and mesoscale numerical prediction models such as GFS, NGM, MM5, WINDGRIDS, and UKMET are used for the weather forecasts. He continued by showing some weather analysis and forecasts products such as precipitation, satellite images, and bulletins provided by the ONAMET. He explained that the Dominican Republic is under the influence of the frontal system, convection and tropical storms such that frontal system is dominant from November to April, while deep convection occurs along the Inter Tropical Convergence Zone (ITCZ), emerging into Mesoscale Convective Complexes (MCC) that produce heavy rainfall, causing flash floods and floods. Then, he showed various flood and flash flood images caused by the MCCs. He provided information on the influence of the tropical storms in the Dominican Republic, that occur during the three month period from June to November, inclusive.

He concluded his presentation, presenting a case study on the occurrence of flash floods during 8-10 July 2013 in which Hurricane Chantal hit the Dominican Republic. He depicted Flash Flood Guidance (FFG) charts, indicating very low FFG values in the eastern part of this country. Then, he continued to depict Average Soil Moisture (ASM) charts from 8 July at 18 UTC to 10 July 18 UTC, showing spatial and temporal changes in top soil moisture over time. Finally, he showed 6-hr Global Hydro Estimator (GHE) satellite precipitation indicating that precipitation with a core 100 mm precipitation value propagated from south west to north east, causing saturation of top soil moisture, resulting in low FFG values, and producing quite high values up to 60mm /6hr of Immanent Flash Flood Threat (IFFT) in the sub-basins of eastern Dominican Republic where flash floods occurred.

Mr Israel Acosta Lantigua (DR) of the National Institute of Water Resources and Management (INDRHI) provided an overview of the hydrological forecasting in Dominican Republic. He said that the Institute was created in 1965 and is responsible for surface and ground water management and showed the network of hydrological stations distributed in the river basins. He stated that Hydrologic Forecast Division (DPH) of Department of Hydrology of INDRHI is responsible for the operation of the early warning system stations (SAT). Within the scope of the hydrological network modernization project, extensive training was provided for the sustainability, as well as some hydrological modeling. He explained the rehabilitation of some telemetric stations and articulated that INDRHI is responsible for precipitation and hydrometric data collection, while ONAMET is responsible for precipitation observation. He showed precipitation forecast and tropical depression forecast track charts and satellite images. He explained the SUTRONWIN weather information network work station that is used for data processing and visualization. He mentioned that a number of products such as hydrological maps, precipitation maps and bulletins are distributed to the clients such as departments of the INDRHI, ONAMET, Emergency Management Agency, Ministry of Agriculture and Hydro-power generators. He explained the hydrological information system, consisting of hydro-desktop, hydro-server, data acquisition and data processing, and modelling. He concluded his presentation by explaining that they need a) to improve inter-institutional cooperation to exchange data and information to cope with natural disasters; b) to support research in meteorology, hydrology, and climatology; and c) to modernize the hydro-meteorological network.

Mr Luis Osoria Lara from the Emergency Operations Centre (COE) gave an overview of COE, mentioning that it was established in 2002 and responsible for the coordination and preparation of disaster responses. He stated that the mission of COE is to make plans and coordinate all activities in joint operation among the national institutions for disaster mitigation and response from the declaration of alert to support provincial states to minimize the effects efficiently and effectively. He further stated that objectives of COE is to provide timely responses, collect information to make them

available to the decision makers, and coordinate joint response efforts with other national organizations. He concluded his presentation showing administrative structure of COE and its decision making process for the responses.

Mr Pierre Karly Jean Juene (Haiti) provided an overview of Hydrometeorological Service of Haiti (UNHYMET) that was established by regrouping of National Meteorological Service and National Water Resources Service. He stated that National Meteorological Service has 8 forecasters, 13 observers, and one technician, while National Water Resources Service has 7 hydrologists and 3 climatologists. He further said that data collection is under the responsibility of Geo-Spatial Information Centre (CNIGS) and National Observatory of Environment and Vulnerability (ONEV), while non-governmental organizations also collect and process data. He provided information on the provision of international funds for the strengthening of the hydrometeorological services in Haiti and that the Canadian government provided CAN$ 6.5 million to support Climate Services to reduce vulnerability in Haiti, and the World Bank provided US$ 5 million fund to support the project entitled strengthening hydrometeorological services. He explained that the goal of the Hydrometeorlogical Service is to provide timely and accurate public weather services in Haiti to save lives and prevent property damages and coordinate with national and international organizations, including WMO. Finally, he mentioned a number of regional initiatives in which UNHYMET was engaged in enhancing the hydrometeorological and climatological services in Haiti and in the region.

SWFDP and FFGS Linkages

Mr Sayin informed the participants about the Severe Weather Forecasting Demonstration Project (SWFDP) of WMO, its objectives and goals, progress of SWFDP Regional Subprojects in different areas of the world including development of SWFDP for Caribbean (SWFDP-Caribbean). He also briefed participants on the potential expansion of SWFDP to cover many areas of the world within the next 5 years for the benefit of the developing countries including especially the least developed countries (LDCs) and Small Island Developing States (SIDSs). He also highlighted efforts being undertaken to integrate the SWFDP-Southern Africa with Southern Africa Region Flash Flood Guidance (SARFFG) project and prospects of potential linkages and integration of SWFDP-SA with SARFFG.

He stated that for Haiti and the Dominican Republic satellite precipitation estimations would be made using geostationary and polar orbiting satellites were adjusted by using in-situ precipitation observations. These would be the primary precipitation source. Quantitative Precipitation Forecasts (QPFs) from a high resolution numerical weather prediction model (also known as a Limited Area Model) covering specific domains within the project region would also be needed. He noted that in other regions use was being made of Limited Area Models to estimate Forecast Mean Areal Precipitation (FMAP) for each sub-basin and Forecast Flash Flood Threat (FFFT) to enhance, for example the SARFGS warning capabilities.

Participants discussed the importance of having high resolution limited area numerical weather prediction model products over areas where hazards of flash flooding exist and where populations and infrastructure are at risk. Participants also discussed in detail the merits and benefits of the linage of HDRFFG and SWFDP-Caribbean projects.

Local Data Requirements and Outline of Hydrometeorologist Training

Ms Modrick (HRC) expressed her gratitude to the experts and senior government officials for her invitation to participatie in the initial planning workshop for the HDRFFG system. She also expressed her appreciation to WMO and ONAMET for having organized the meeting. In the following sessions, after explaining the role of Hydrologic Research Center (HRC) as FFG system developer, she presented scientific and technical aspects of the Flash Flood Guidance System (FFGS). These were

given at the introductory level and included an overview of the general concept of the FFGS, causes of flash flood events, flash flood guidance definitions, soil moisture model parameterization, snow model, satellite precipitation estimation and bias adjustment, threshold runoff, and data requirements for HDRFFG.

Ms Modrick explained the importance of using local data in the FFGS to calibrate model parameters. She also emphasized the importance of participating countries in providing their available historical hydrometeorological data to HRC and in making real-time precipitation data accessible; otherwise, only global data with coarse resolution would be used. The importance of the use of real-time precipitation data to bias-adjust satellite precipitation estimates was also stressed. She reviewed the various data types required for the FFGS, such as: precipitation, soil data, vegetation cover, evaporation, temperature, discharge, stream/river (locations) network, and quality controlled digital elevation data. Note that the data requirements for the project are provided in Appendix B of Annex 4 of this document.

Ms Graham (HRC) explained the flash flood hydrometeorlogist training programme in detail. She stated that training was an integral part of the project, and extensive training would be provided to the participating countries` forecasters. She showed the schematic diagram outlining the FFGS hydrometeorologist training programme, which is contained in Appendix A of Annex 4 of this report. She articulated that it consisted of five steps:

- Step 1 introductory regional workshop;
- Step 2 eLearning hydrometeorologist training;
- Step 3 specialized training at HRC;
- Step 4 regional operations training workshop; and
- Step 5 regional operational sustainability workshop.

She further articulated that when the training was completed, forecasters should be confident and competent to use FFGS products for flash flood forecasting and the provision of early warnings.

Overview of FFGS Products and Use

Ms Graham and Ms Modrick presented an overview of HDRFFG and FFGS products, respectively. They explained definitions of the products and provided information on the scientific and technical background of them:

- Global Hydro Estimator (GHE) precipitation, which is produced by US National Oceanic and Atmospheric Administration (NOAA), using Infrared (IR) channel (10.5 micrometre) of geostationary meteorological satellites, has 4 x 4 km spatial resolution;
- Micro Wave adjusted Global Hydro Estimator (MWGHE) precipitation, which is estimated by correcting GHE precipitation with Micro Wave satellite precipitation;
- Gauge Mean Areal Precipitation (Gauge MAP), which is estimated by using in-situ observations obtained from the WMO GTS network;
- Merged Mean Areal Precipitation (Merged MAP), which is derived from the best available mean areal precipitation estimates from GHE precipitation or MWGHE precipitation or Gauge MAP or Radar estimated precipitation.

They indicated that the Merged MAP is the bias adjusted precipitation product to be ingested into FFGS models; namely the SNOW 17, Sacramento Soil Moisture Accounting (SAC-SMA) and Flash Flood Threat models. The Forecast Mean Areal Precipitation (FMAP) is generated from the numerical weather prediction Limited Area Models (LAM), such as ALADIN and WRF. They continued by explaining other FFGS products, namely:

- Average Soil Moisture (ASM), which indicates upper soil (20-30 cm) water content, including free and tension water;
- Flash Flood Guidance (FFG), which is an amount of actual rainfall that may cause bankfull flow conditions at the outlet of a sub-basin for a given duration (e.g., 1, 3, or 6 hours); and
- Three Flash Flood Threat (FFT) products, which indicate the possibility of flash flood occurrences at the outlet of a particular sub-basin, consist of Imminent Flash Flood Threat (IFFT), Persistence Flash Flood Threat (PFFT), and Forecast Flash Flood Threat (FFFT).

The presentation of Mr Sayin built upon their presentation by demonstrating the operational capabilities of the Black Sea and Middle East Flash Flood Guidance (BSMEFFG) system and use of the derived products. He also provided an overview of verification results for the BSMEFFG system for the years of 2013 and 2014.

Facilitated Discussions

Mr Sayin provided an overview of the purposes of the workshop indicating that the main objective of the Flash Flood Guidance System was to build capacity of the NMHSs to help society cope with hydrometeorological hazards particularly those of flash floods. The workshop would also allow an opportunity to present and discuss the needs for flash flood forecasting in Haiti and Dominican Republic, including dissemination procedures and coordination between the National Meteorological and Hydrological Services and the Disaster Management Agencies. He provided information about the WMO Flood Forecasting Initiative, stating that FFGS was in-line with the WMO Flood Forecasting Initiative objectives, and he also outlined the global FFGS implementation strategy.

Mr Sayin articulated the roles of WMO with respect to the development and implementation of the HDRFFG system, stating that WMO was the primary liaison with the NMHSs for the development and implementation of the project and its associated training programme. Further, the project is designed to provide support for establishing closer collaborations and coordination between NMHSs and Disasters Management Authorities and to enhance regional collaborations and cooperation.

Mr Sayin outlined the roles and responsibilities of NMHSs and Regional Centre in the HDRFFG project. NMHSs had the following responsibilities: to provide historical data to the project developer, HRC; to provide in-situ data to the Regional Centre; to participate in the flash flood hydrometeorological training programme; to issue flash flood warnings and disseminate them to their national Disaster Management Authority; and to cooperate with the Regional Centre on the HDRFFG system issues. Then, he cited the roles and responsibilities of the Regional Centre as being: to communicate effectively with WMO, HRC and NMHSs on the HDRFFG system activities; to have computer hardware and software capabilities and good computer network connections; to monitor routinely availability of the HDRFFGS products; and to conduct flash flood validation studies. Detailed information about roles and responsibilities of NMHSs and RC are provided in Annex 4 and Appendix A in this document.

Mr Sayin provided a brief overview of the organizational and managerial aspects of the project, reiterating the roles and responsibilities of the NMHSs and the Regional Centre. He then introduced the concept of a Project Steering Committee (PSC) and its composition, indicating that each participating country would be represented on it, as well as HRC, OFDA/USAID and the RC. Details of the PSC are found in Annex 5, while the implementation requirements are provided in Annex 4 of this document.

Interest of the Participating Countries

During the facilitated discussions, participants asked a number of questions about the FFGS products and system operations. After clarifications were made by HRC and WMO, all participants from Haiti

and Dominican Republic indicated agreement that implementation of the FFGS would be very useful for their countries particularly given the importance and value of issuing flash flood warnings. As well, such implementation was seen as being an important contribution to enhancing their national capabilities and would also help foster closer regional cooperation on disaster risk reduction. Participants from Haiti and the Dominican Republic indicated that they wanted to participate in the project, subject to seeking concurrence of their respective government authorities. To facilitate communication of interest in the project, sample Letters of Commitment was provided in English, Spanish and French to the participants. They can be found in Annex 6.

Offer of the Regional Centre

Mr Miguel Campusano, Deputy Director of ONAMET, expressed the willingness of the Dominican Republic NMHS to host the Regional Centre for the HDRFFG project, saying, as well, that Dominican Republic may need assistance from WMO and HRC for the implementation and operation of the system. All participants were pleased with the kind offer of Dominican Republic to host the Regional Centre. Representatives of WMO and HRC ensured him of their organizations support for the successful implementation of the project.

Project Implementation Plan

Mr Sayin explained the project implementation plan, showing the major tasks, milestones, and schedule. Delegates were kindly asked to send their Letter of Commitment to WMO by the 31th of October 2016 to allow project implementation to proceed. Delegates agreed on the project implementation plan, saying that they would do their utmost to comply with the plan. The HDRFFG System implementation plan is provided in Annex 7 of this document.

Closing of the Planning Workshop

Closing remarks were made by WMO, HRC, and the representatives of Haiti and Dominican Republic. Thanks were also extended to all attendees for their active participation in the workshop and spirited involvement in the discussions, which contributed to the successful conclusion of the workshop.

5. Conclusions from the Initial Planning Meeting

1. There was agreement among participants that **the development and implementation of the HDRFFG system** will significantly improve the capabilities of the NMHSs of Haiti and the Dominican Republic to produce timely and accurate warnings of flash flood induced hazards, thereby contributing to disaster risk reduction by saving lives and reducing property damages.

   Participants discussed the concept and expected results of the HDRFFG project and agreed that it was consistent with the global aspect of the Flash Flood Guidance system and its regional implementation projects. The objective of the Haiti and Dominican Republic Flash Flood Guidance project is to contribute towards reducing the vulnerability of the region to hydrometeorological hazards, specifically flash floods, by developing and implementing a Flash Flood Guidance System to strengthen regional capacity to develop timely and accurate flash flood warnings.

2. Participants agreed that the official name of this initiative will be **Haiti and Dominican Republic Flash Flood Guidance (HDRFFG)** project. This name will be used in all documents and communications.

3. Workshop participants noted that the FFGS has a global aspect and that it is being implemented as a component of the WMO Flood Forecasting Initiative (WMO-FFI). The intent

is that the implemented FFGS will be fully integrated into the day-to-day operational activities of the National Meteorological and Hydrological Services responsible for the provision of flash flood early warnings.

4. Participants agreed in principle on the following core elements of this regional project:

    - General concept and technical approach chosen to provide Flash Flood Guidance;
    - Roles and responsibilities of the dedicated Regional Centre and the National Meteorological and Hydrological Services for project implementation;
    - Project governance including the roles of all partners;
    - Guiding principles for the implementation of the HDRFFG; and
    - Concept of Operations.

    All items listed above are provided in the Project Brief document, which is Annex 3, and in the Implementation Requirements document, which is Annex 4. These are also supplemented through the discussions and conclusions arising from the initial planning meeting held in Santo Domingo, Dominican Republic, on 7-9 September 2016.

5. With regard to the governance of the project, participants agreed on the structure and interim terms of reference of a **Project Steering Committee** (PSC) as attached as Annex 5 to this report.

6. To enable the effective functioning of the PSC, the participants agreed that participating countries should designate, through their permanent representative with WMO and after consultation with his/her hydrological advisor, *focal points* and *alternates* in serving on the PSC, with the expectation that these designates would serve throughout the duration of the project.

7. The participants agreed that once government approvals to participate in the HDRFFG project had been obtained, Letters of Commitment (LoC) of the participating countries should be signed by the permanent representatives with WMO and sent to WMO. It is proposed that wherever feasible, the letters should reach WMO not later than **November, 2016** (see draft Letter of Commitment in Annex 6).

8. Participants noted with appreciation the offer of the NMHS of the **Dominican Republic** to provide services as the **Regional Centre** for the project within the terms of reference as described in the “Implementation Requirements” document. The offer was discussed in detail and was accepted unanimously by all country representatives. Additional correspondence from the NMHS of the Dominican Republic will be required to confirm its offer of hosting the Regional Centre.

9. WMO and HRC will work with the NMHS of the Dominican Republic to assist it in establishing the functionality of the Regional Centre, to facilitate data transfer for project implementation, and to provide forecast products to participating countries.

10. WMO requested HRC, the Regional Centre, and the participating countries to develop at the earliest direct communication links to facilitate project implementation.

11. Participants recognized that the **incorporation of local data and information** are necessary to enhance system reliability, accuracy and effectiveness in the provision of flash flood early warnings.

12. With a view to a timely implementation of the project, the participants agreed to comply as much as possible with data requirements specified in Appendix B of Annex 4 such that the following data will be transferred to HRC through the regional centre, which is responsible for data exchange between the HDRFFG developer (HRC) and NMHSs:

    - Historical hydrometeorological data since May 2012 to present;
    - Soil data, vegetation cover and stream network;
    - Metadata of hydrometeorological stations; and
    - Quality controlled Digital Elevation Model (DEM) data.

13. Participants noted the data and information requirements of the project at the global, regional and local levels. Based on the presentations and discussions during the workshop, the required data, metadata and related information will be specified and documented in a Requirements Document that will be sent to all focal points by HRC together with data and information questionnaires. The feed-back information from focal points should reach the Hydrologic Research Center (HRC) and the Regional Centre respectively according to the implementation plan (Annex 7), which had been agreed upon at the Initial Planning Meeting.

14. Participants agreed that the establishment of the system is a collaborative endeavour, based on the continuous feedback between development and testing, and between the Regional Centre and the two participating countries. Participants recognized also that a successful design and reliable operation of the HDRFFG requires high quality data provided in a timely manner to the Regional Centre. The real time data of selected hydrometerological stations needs to be transferred to the Regional Centre as per the plan of implementation through WMO GTS and/or ftp services and/or other means.

15. To facilitate system implementation, it was agreed that data, metadata and related information needs to be transferred to the Regional Centre as soon as they become available within the timelines to be specified in the updated Requirements Document. The Regional Centre will establish promptly a dedicated and secured ftp server to ensure safe data transfer.

16. Subject to the fulfilment of commitments by the NMHSs, WMO in collaboration with HRC and the Regional Centre will strive to deliver beta-versions of first regional products by March 2017.

17. Participants agreed on the proposed milestones for the **implementation plan** that are attached as Annex 7 to this report.

18. Participants noted that WMO, within the limitations of available resources, will provide overall project coordination and necessary support to activities that lead to the successful implementation of the project. This includes, inter alia, the development and provision of training programmes that will be undertaken by the Regional Centre, HRC, and WMO.

19. Participants noted that there is a great benefit for the concurrent implementation of the Severe Weather Forecasting Demonstration Project-Caribbean (SWFDP-Caribbean) and HDRFFG projects in the region such that two projects can be linked to exchange data and products such as Quantitative Precipitation Forecasts (QPFs) of the high resolution numerical weather prediction model to enhance flash flood early warning capabilities.

ANNEX 1

Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) Project

INITIAL PLANNING MEETING
7-9 September 2016, Santo Domingo, Dominican Republic

List of Participants

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ANNEX 2

Development and Implementation of the Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) System

7 – 9 September 2016, Santo Domingo, Dominican Republic

INITIAL PLANNING MEETING

ANNOTATED AGENDA

Day 1

09:00–09:30 Registration of participants
09:30–09:45 Opening remarks by Director General of ONAMET
09:45–10:00 Welcome speech by WMO
10:00–10:15 Welcome speech by HRC
10:15–10:30 Overview and purpose at the workshop (*WMO*)
10:30–10:45 Photo Session

10:45 - 11:15 Tea Break

11:15-11:45 Role of WMO and Introduction to the global Flash Flood Guidance (FFG) System (*WMO*)

11:45-12:15 Role of HRC and Introduction to the FFGS concept *(HRC*)

12:15–12:30 Roles of USAID/OFDA and NWS *(USAID/OFDA, NWS*)

12:30-14:00 Lunch

14:00-15:00 Country-presentations on flash flood issues – forecasting and warnings and their use in disaster management (*NMHSs*)

- The nature of the flash flood problem(s) and their impacts
- Roles of various agencies (in forecast development and dissemination of warnings)
- Role of disaster management agencies with respect to flash floods, including urban flash floods, and landslides
- Linkages of NMHS to disaster management agencies
- Capability of using current data and models to provide forecasts and warnings for flash floods (remotely sensed, in-situ data, Numerical Weather Prediction (NWP) modelling)

15:00-15:30 Overview of previous HDRFFG Project and its Products *(HRC)*

15:30-16:00 Tea Break

16:00-16:30 Example of FFGS Regional Implementation: Black Sea and Middle East Flash Flood Guidance (BSMEFFG) System *(WMO)*

16:30 Working Visit to ONAMET (TBC)

Day 2

09:00-09:15 Summary of Day 1

09:15-10:00 Overview of FFGS products (*HRC*)

10:00-10:30 Overview of the development of the FFGS Products (*HRC*)

- Precipitation and Bias Adjustment
- Soil Moisture Model Parameterization
- Threshold Runoff Estimation
- Flash Flood Guidance
- Flash Flood Threat

10:30-11:00 Tea Break

11:00-12:00 Overview of the development of the FFGS Products (*HRC*) (Continued)

12:00:12:30 Flash Flood Hydrometeorlogist Training Programme (*HRC*)

12:30-14:00 Lunch

14:00-14:30 Demonstration of an Operational FFG System and Validation: Black Sea and Middle East Flash Flood Guidance (BSMEFFG) System *(WMO)*

14:30-15:00 Severe Weather Demonstration Project-Caribbean (SWFDP-Caribbean) (*WMO)*

15:00-15:30 FFGS Operational Concept (HRC)

15:30-16:00 Tea Break

16:00-16:30 Data Requirements for the FFGS Implementation *(HRC)*

16:30-17:00 Discussion on Availability of Historical and Real-Time Data from Participating NMHSs (All)

19:00 Welcome Dinner (TBC)

Day 3

09:00-09:15 Summary of Day 2

09:15-09:30 Organizational and Management Aspects of the Project *(WMO*)

09:30-10:00 Responsibilities of the Regional Centre and NMHSs *(WMO)*

10:00-10:30 National and regional professional and technical capacities needed for project operations – Discussion *(All)*

10:30-11:00 Tea Break

11:00-11:30 General discussion and expression of intent of countries to participate in the project, continued *(All)*

11:30-12:00 Next steps and work plan (*HRC*)

12:00-12:30 Review of decisions and recommendations (*All*)

12:30 – 14:00 Lunch

14:00-14:30 Final remarks and closing of the workshop (*All)*

------End of Workshop------

ANNEX 3

Development and Implementation of International and Regional Flash Flood Guidance (FFG) and Early Warning Systems

Project Brief

HAITI AND DOMINICAN REPUBLIC FLASH FLOOD GUIDANCE (HDRFFG) SYSTEM

SUMMARY

The purpose of this project is the development and implementation of regional flash flood guidance and early warning systems. The approach will entail development of regional technology, training, protocols and procedures to address the issues of mitigating the impacts of flash floods and the application of such a system allowing the provision of critical and timely information by the National Meteorological and Hydrological Services (NMHSs) of the participating countries.

To accomplish this, the World Meteorological Organization (WMO) will cooperate with the Hydrologic Research Centre (HRC), San Diego, USA to implement a flash flood guidance and early warning system designed along the lines of similar systems that have been made operational in different parts of the world. In cooperation with a designated Regional Centre, normally located within one of the participating countries, the project will be executed by the participating national hydrometeorological services with the HRC providing technical assistance in cooperation with NOAA/National Weather Service for the system implementation and training; and WMO providing technical backstopping and supervisory services including Monitoring & Evaluation of the project. USAID/OFDA is providing funding support for the project.

Specifically the countries to be included in the project are proposed to be the followings: **Haiti and Dominican Republic.**

Based on estimation of rainfall from satellite imagery and available gauges, the system will provide the NMHS of each participating country with an estimate of the precipitation amount and an indication (guidance), based on physically-based hydrological modelling, as whether it would generate a bankfull discharge(e.g., minor flooding) at the outlets of small, flash flood prone basins throughout each country. The NMHSs will integrate local knowledge from other sources (their national networks, observers report, etc.) to validate the guidance and issue as required a warning through channels proper to each country

Technical assistance includes the development and implementation of the flash flood guidance and warning system as well as research and development into system enhancements, including inclusion of infrared and microwave technology for satellite rainfall estimates, as needed for the different implementations, and training and capacity building on system operations and applications to disaster risk reduction (i.e., an end-to-end system approach). The approach will provide a tool for each country within the specified region to access the data and information needed to develop alerts and warnings for flash floods.

The main objective of this project is, therefore, to contribute towards reducing the vulnerability of the region to hydrometeorological hazards, specifically flash floods, by developing and implementing a flash flood guidance system to strengthen regional and national capacity to develop timely and accurate flash flood warnings.

1. Beneficiaries

In many areas of the world, flash floods are a regular phenomenon accounting for loss of human life and significant economic and social damages, adding up to hundreds of millions of Euros for a single event. Flash floods can affect not only mountainous and hilly rural areas with sparse settlements but also major urban areas. In addition, an increase in their frequency and magnitude is anticipated as a consequence of climate change. Implementation of a flash flood

guidance system would provide benefits to all societal and economic stakeholders of each country.

A key benefit of the proposed system is that it is capable to provide early awareness of impending local flash flood threats for all potentially vulnerable communities. A true value of the system will be to provide rapid assessments of the potential of flash floods allowing improvement of the early warnings for the occurrence of a flash flood and therefore allowing for more rapid mobilization of response agencies.

The system implementation also provides capacity building and cooperation for effectively mitigating disasters from flash floods. Training and capacity building will be a strong component of the implementation of this program. There will be opportunities in cross-training of hydrologists and meteorologists from countries within the region and with different backgrounds and skills in hydrometeorology, which forms the basis of flash flood detection and prediction.

The availability of the system guidance products will also help to improve the way flash flood events on trans-boundary Rivers are addressed, encouraging international technical cooperation and regional cooperation in preparing public awareness campaigns and response strategies.

Primarily aiming to improve national service delivery capabilities to deal with flash flood threats, the implementation of the flash flood guidance system will also provide the opportunity for enhancement of regional collaboration of disaster mitigation and response agencies and improvement of community awareness of flash flood hazards threat and mitigation.

Training programs will be designed to include NMHSs to develop strong scientific and technical capabilities to use the FFG system and further to include disaster management agencies where the responsible agencies will be involved in system validation programs which will require determinations of where flooding did or did not occur. The issuing of warnings based on flash flood guidance and flash flood threat products will conform to establish national practices, if existing; alternatively the project could provide support to a national dialogue for their development. The establishment of such criteria requires understanding of the hydrometeorological processes and prediction uncertainties, as well as capabilities of the population to take effective action. Such a process will encourage the national agencies to interact with local communities both in establishing such criteria, and in regular reviews of their effectiveness. The responsible agencies will need to design awareness campaigns for both municipal agencies and the public at large concerning the interpretation of flash flood warnings and effective action strategies (i.e., what to do in when flash flood warnings are received). To be effective, this effort will require input from local community representatives (emergency response agencies and the public at large). Maintaining these public awareness campaigns and information distribution as ongoing efforts required to reduce flash flood casualties will be needed.

The flash flood guidance system functions at one level as a disaster mitigation tool by mitigating loss of life and livelihoods, and by rapidly targeting disaster response agencies to potential problem areas. On another level it can be used to provide maps of flash flood probabilities, threats and decision-aiding for imminent actions. These maps can be used to provide a risk assessment tool and guidance concerning the development of infrastructure – that is, as a guide to where special care should be taken in the design and locations of particular facilities as the population expands to live in flash-flood prone areas.

All these agencies will be involved in system validation programs which will require determinations of where flooding did or did not occur. To be effective, this effort will also require input from local community representatives (emergency response agencies and the public at large).

2. Sector-Level Coordination

Through the project partners representing the technical aspects of the system implementation and operation will be brought together with agencies in disaster risk reduction to develop a detailed work plan that will enable operational engagement of technical and disaster risk reduction agencies for implementation of the system.

The work plan for disaster risk reduction will address activities such as joint training programs and public outreach and awareness programs. This effort will provide the opportunity for enhancement of regional collaboration of disaster risk management agencies and improvement of community awareness of flash flood disaster threat and mitigation. Training programs will be designed to include NMHSs and the disaster management agencies.

3. Technical Design

Flash floods are a hydrometeorological phenomenon that requires integration of meteorology and hydrology in real time and ingestion of local information and expertise for reliable warnings. The system design aims to allow for both. This system will serve as a catalyst to develop protocols in line with regional and country norms pertaining to other event warnings. The system allows that even within a region different countries will develop their own manner of system configuration and use adapted to local requirements as a tool for developing flash flood warnings and watches together with other local timely information.

Important technical elements of the Flash Flood Guidance and Warning System are the development and use of a bias-corrected satellite precipitation estimate field, high-resolution numerical weather prediction model outputs (where available), and physically-based hydrological modelling to determine flash flood guidance and flash flood threat. These system elements can now be applied anywhere in the world. Real-time estimates of high resolution precipitation data from satellite are now routinely available globally (and can be further enhanced with locally available radar estimates of precipitation). Global digital terrain elevation databases and geographic information systems may be used to delineate small basins and their stream network topology anywhere in the world. In addition, there are global soil and land cover spatial databases available to support the development of physically-based soil moisture accounting models (see Flowchart in Figure 1). The real-time satellite precipitation estimates needed to drive the regional systems on a global scale (using global data provided by NOAA and the WMO) will be developed first followed by the development of specialized products.

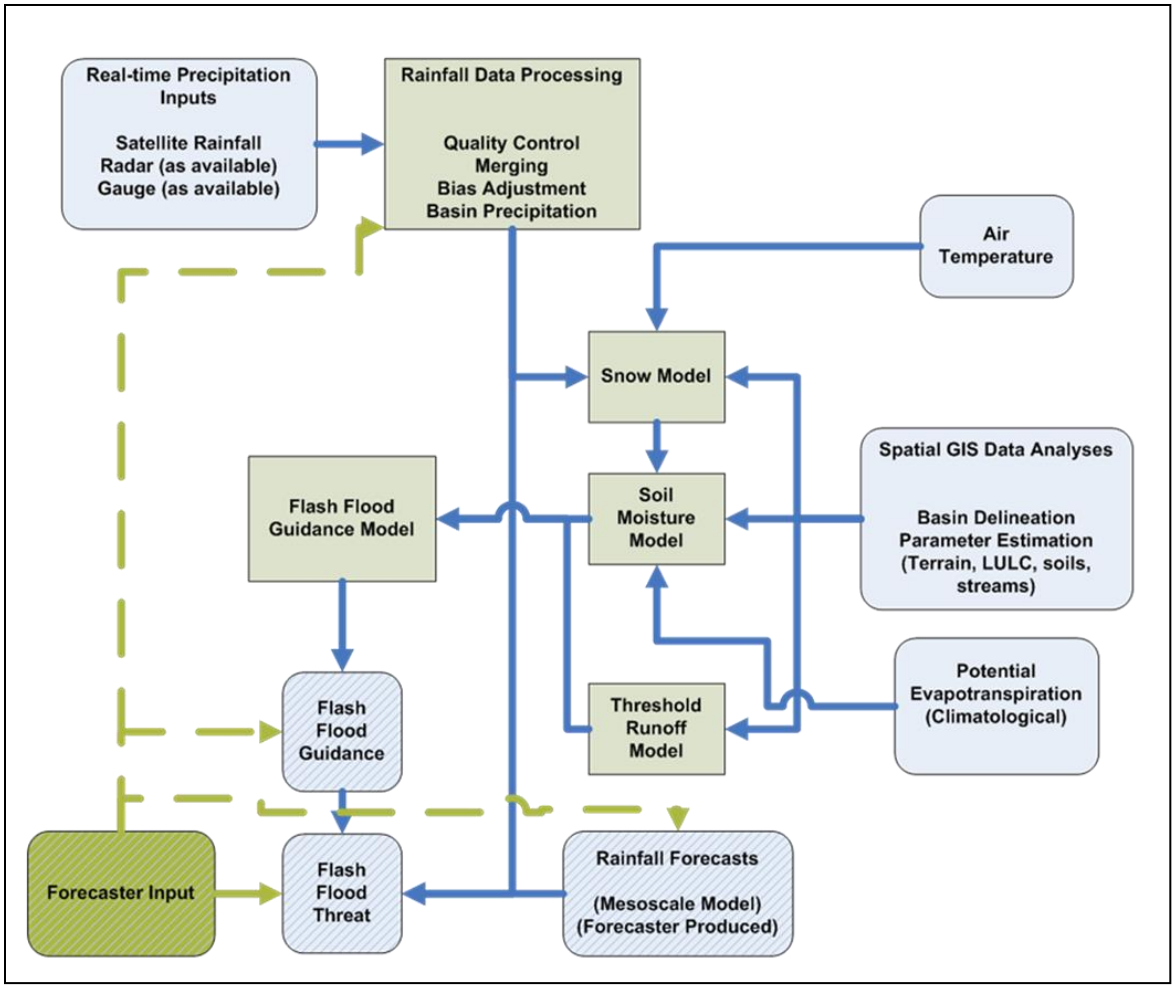

Figure-1 Schematic Flowchart of the Flash Flood Guidance System

The system allows the NMHSs to use local nowcast/short-term-forecast methods they wish to use to issue the warnings, including (and strongly recommended) local forecaster adjustments. The system design allows this coupling with the existing or developing NMHS approaches on a national or even local scale.

System flexibility and system capability to engage local forecasters should help greatly towards the development of regional/local protocols for integration within existing warning dissemination systems.

The system will provide evaluations for the threat of flash flooding over time scales of hourly to six hours and for sub-basins on the order of 150 sq. km. on average. Given the computational burden and depending on available computational resources, it is very likely that the most valuable lead times for system use will be up to 6 hours. Efforts might also be undertaken through the application of numerical weather prediction model outputs to extend the range of threat prediction to 24 hours.

4. Implementation Approach

The system design is such that it allows for efficient global data ingest and it supports regional cooperation among NMHSs. The design is characterized by distributed operations and functions. Several centres of computation and product dissemination will support the operational functions of the NMHSs through the timely provision of data, software, hardware and training. The overall organizational structure is shown in Figure-2.

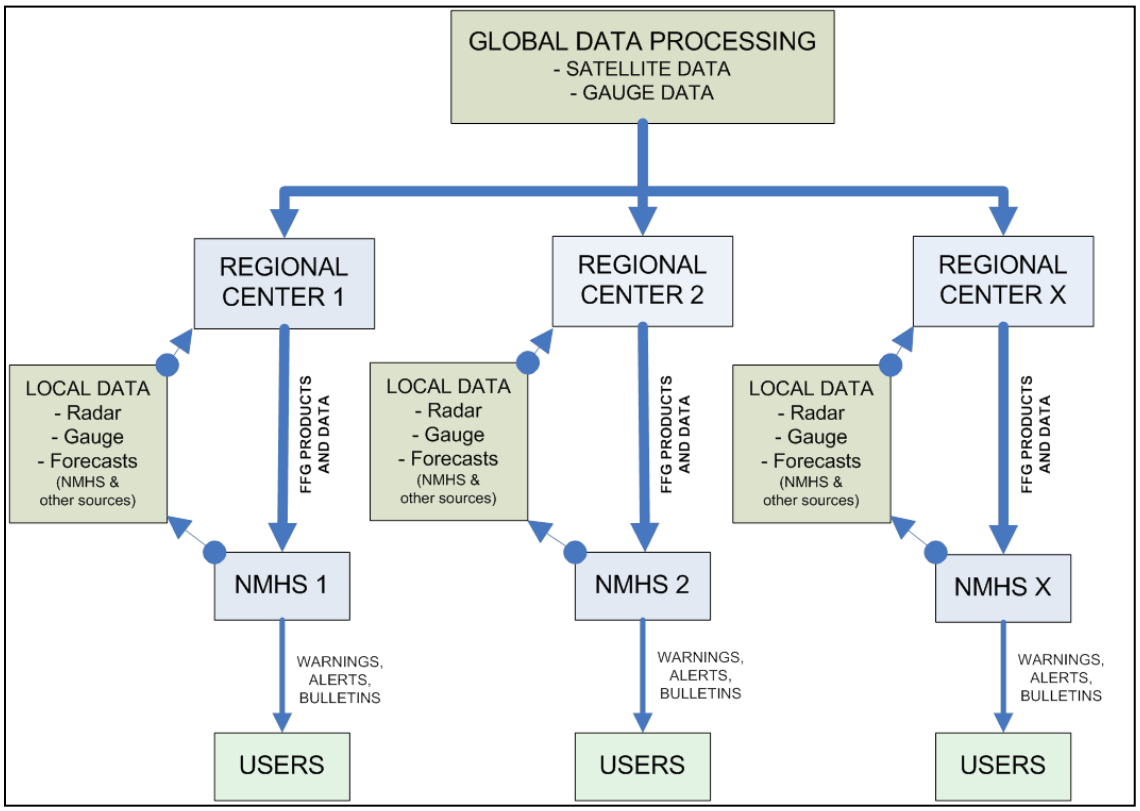

Figure-2: Flash Flood Guidance and Warning System as a distributed system of computer hardware, data and information to support NMHSs worldwide.

The interface with global information is the link to real-time global satellite precipitation estimates and global in situ observations will be through one or more of the World Meteorological Organization (WMO) Global Centres.

All requisite real-time data (global, regional, and local) are ingested at servers located at the Regional Centres where the FFG software is installed. Graphical and text products are then provided to the participating countries through a secure internet connection.

It is necessary to designate a focal institution (most probably an NMHS or an existing Regional Centre with proven scientific and technical capabilities) and with existing communications and infrastructure capabilities to support a Regional FFGS centre.

Key operational Regional Centre responsibilities are:

- Disseminate real-time country graphical products from the FFGS for the NMHSs in the region;
- Collect available real-time local meteorological data for ingest to the FFGS for the development of regional products;
- Support regional flash flood operations by;
    - Provide regional validation of products and formulation of plans for improvements, and
    - Provide communications for system analyses to NMHSs of the region.
- Provide communications of regional system modifications necessary to system developers;
- Develop a historical archive of the system products;
- Support WMO and developers with regional training of NMHS representatives; and,
- Provide routine maintenance and IT support for the FFGS server.

NMHSs functions pertaining to the use of the flash flood guidance and warning system will include: country hydrometeorological analysis using the system products and information and other local products and information; country modifications of the regional-centre flash flood guidance and precipitation nowcasts on the basis of within-country most-recent data and information; development of local flash flood watches and warnings; monitoring of system performance (availability and effectiveness) and feedback to the regional centre; and links to within-country disaster management agencies for effective disaster risk reduction. Resources of country NMHSs will determine the actual configuration and type of software used in each case, given the provision of within-country baseline software and links to regional centre facilities as discussed previously.

It is expected that the products available from the Regional Centre will be adequate to support a range of processing capabilities at the NMHSs, from those that can be performed on a PC with Excel software to those that support interactive graphical generation of products. This provision will allow the NMHSs of all the countries to develop real time flash flood forecasts and watches/warnings using the global-data information and their local data and information. There will also be a provision for countries that are willing to share local real-time data to produce graphical products and updated guidance information for their areas to complement the locally produced products with the baseline configuration mentioned.

One key to sustainability is confidence in a reliable, accurate system. To accomplish this, reliability evaluations will be included in the concept of operations.

5. Transition and Exit Strategy

Upon completion of the project, each country within the region will have access to the flash flood guidance and early warning system data and products via the internet. The required data will be accessed and processed through the regional facilities. At the country level only a PC and internet connectivity will be required to access the data and products required to evaluate potential flash flood threat, making the system very sustainable. The regional centres will be selected based on resource requirements to ensure appropriate access to the required data and maintenance capacity.

Much of the effort to ensure sustainability of the flash flood guidance and early warning system will be through training and cooperative development efforts. This approach is intended to ensure ownership and full operations responsibility. In addition, a concept for the operation of the system within the existing operations protocols of the countries will be outlined for each country during training. A User Guide will be developed for the Regional Centre for system operations and maintenance.

6. Project Implementation

Project implementation is based on the basis of a Project Implementation Plan (PIP) that will be discussed during the initial regional planning meeting. The Plan will provide information with regard to essential requirements and criteria that need to be met for the successful implementation of the project. These requirements include: Availability and accessibility of critical input data and information including geo-spatial information, historical and near real-time meteorological and hydrological data, basic institutional infrastructure and technical/professional expertise of participating meteorological and hydrological services.

The PIP including awork plan will be discussed during the initial planning meeting with principal stakeholders and beneficiaries of the project.

7. Institutional status

In February 2009, WMO signed a Memorandum of Understanding (MoU) with USAID, HRC, and NOAA on the implementation of the Flash Flood Guidance System with global coverage project. In June 2012, the MoU was renewed until the end of 2017. Funding is available from USAID as the principal donor organization.

As a result of the expression of interest of participating countries in the Haiti and Dominican Republic Flash Flood Guidance System, an initial planning meeting has been arranged. This meeting will allow:

- Country experts to see first-hand the technical components of the FFG system;
- Country experts to assess the potential utility of adopting such a system within their operations;
- Understanding of the requirements of national centres and the regional centre;
- Understanding of national implementation requirements including professional staff;
- Understanding of the regional and national primary data collection required for the initiation of the project; and
- Countries to consider the overall project and whether each wishes to commit to undertaking and supporting the implementation of the project in the Region.

Should countries wish to commit to the implementation of the project, countries would then decide on their national centres and the regional centre.

WMO in collaboration with financial, technical and regional partners now plans to organize the initial planning meeting where interested countries through the Permanent Representatives of WMO Members and their Hydrological Advisors or designated alternates are expected to discuss all aspects of the proposed project and eventually express whether they commit to

participate and cooperate in the project activities and provide technical information that is critical for the successful implementation of the project in the region.

Aside from the commitments made by participating national agencies, it will be essential to have full details available on issues such as in-kind contributions through infrastructure and personnel, areal information specifying the area(s) to be covered by project activities in the region, availability of supporting data and information including geospatial and historical hydrometeorological information. Likewise, the governance of the project and the roles and responsibilities of national participating centres and a Regional Centre will be on the agenda of discussion with expected recommendations and decisions to be made during the meeting. This will be compiled through information received from countries and services on the basis of a Requirements Document to be developed.

The project will be phased over a period of several years that will be determined during the initial planning meeting, with the bulk of the development and implementation activities occurring during the first year to two years. The remaining years of the project will focus on training, system operations/evaluation and validation of system outputs to ensure on-going sustainability.

ANNEX 4

GLOBAL FLASH FLOOD GUIDANCE SYSTEM

Implementation Requirements

Regional Implementation Requirements for the Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) System

Document Purpose

This document provides guidance to project participants, in particular National Meteorological and Hydrological Services (NMHSs) on minimum requirements with respect to professional capabilities, availability of data and information as well as computational and communication infrastructure to implement a **Flash Flood Guidance System (FFGS)** with global coverage. In addition, the document provides information of the functions of the Regional Centre and NMHSs leading to the delivery of flash flood guidance products on regional and national levels.

These requirements reflect a system that provides timely and useful data and information based on robust communication infrastructure in a form that is consistent with the operations in place in many of the National Meteorological and Hydrological Services (NMHSs) throughout the world. Of primary importance is to establish a system that becomes part of NMHS operations and is used as the primary tool by these services for providing flash flood alerts/warnings to the appropriate agencies and/or the public.

Overview of the FFGS

The primary purpose of the FFGS is to provide real-time informational guidance products pertaining to the threat of potential flash flooding. The system is designed to address the reduction in devastation caused by flash floods in terms of reductions in the loss of life, suffering and property damage. The system provides the necessary products to support the development of warnings for flash floods from rainfall events through the use of remote sensing-based rainfall estimates (primarily satellite).

The system products outputs are made available to forecasters as a diagnostic tool to analyze weather-related events that can initiate flash floods (e.g., heavy rainfall, rainfall on saturated soils) and then to make a rapid evaluation of the potential for a flash flood at a location. The system empowers users with readily accessible observed data and products and other information to produce flash flood warnings over small flash flood prone basins. The system is designed to allow the addition of experience with local conditions, incorporate other data and information (e.g., Numerical Weather Prediction output) and any last minute local observations (e.g., non-traditional gauge data), to assess the threat of a local flash flood. Generally, evaluations of the threat of flash flooding are done over hourly to six-hourly time scales for sub-basins from 100 - 150 km^2 in size.

Important technical elements of the FFGS are the development and use of a precipitation gauge-based bias-corrected satellite precipitation estimate field and the use of hydrologicalmodelling. The system then provides information on rainfall and hydrological response, the two important factors in determining the potential for a flash flood. The system is based on the concept of **Flash Flood Guidance** and **Flash Flood Threat.** Both indices provide the user with the information needed to evaluate the potential for a flash flood, including assessing the uncertainty associated with the data.

The flash flood guidance approach to developing flash flood warnings rests on the comparison in real time of observed or forecast rainfall volume of a given duration and over a given catchment to a characteristic volume of rainfall for that duration and catchment that generates bank full flow conditions at the catchment outlet. **Flash Flood Guidance** (FFG) is that characteristic rainfall volume for the given duration over the small catchment that generates bank full flow conditions at the catchment outlet. FFG is updated in time based on current soil water deficit (as determined by antecedent soil moisture conditions), rainfall, evaporation, and

groundwater losses. If the observed or forecast rainfall volume exceeds the FFG of the same duration, this excess is termed the **Flash Flood Threat (FFT)** and flooding at or near the catchment outlet may be likely.

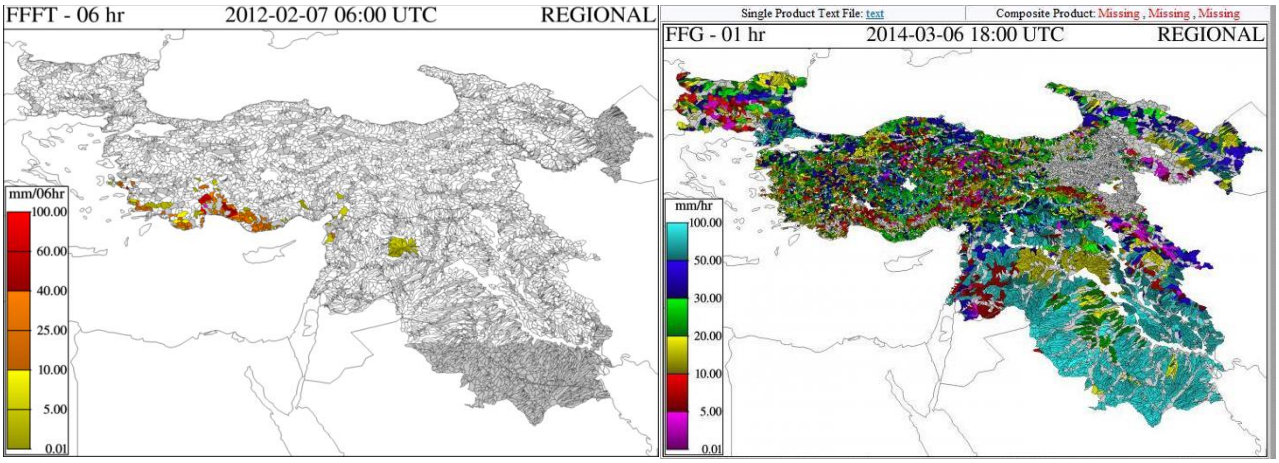

Figure-1:6hr-Flash Flood Threat and 1-hr Flash Flood Guidance for BSMEFFG

Global Flash Flood Guidance System Program Background

The purpose of the Global FFGS (GFFGS) program is the development and implementation of regional flash flood guidance and early warning systems. The approach entails development of infrastructure on a global scale to then support the development and implementation of regional flash flood guidance projects comprising of technology, training, protocols and procedures components to address the issues of mitigating the impacts of flash floods.

Regional flash flood guidance and early warning systems are designed based on programs in Central America, Southeast Asia, Black Sea Middle East and Southern Africa. The project approach is to provide a tool for each country within a specified region to access the data and information needed to develop alerts and warnings for flash floods. The main objective of this project is, therefore, to contribute towards reducing the vulnerability of people around the world to hydrometeorological hazards, specifically flash floods, by developing and implementing flash flood guidance systems to strengthen regional capacity to develop timely and accurate flash flood warnings.

The data and information part of the requirements also provides guidance with respect to the selection of areas/basins on national level that can be covered with a flash flood guidance system based on the availability of critical data and information.

Implementation of this program is in concert with the World Meteorological Organization's Flood Forecasting initiative guided by the Hydrology and Water Resources Branch of the Climate and Water Department of WMO. In the context of this initiative, the World Meteorological Congress has endorsed the implementation of a Flood Forecasting Initiative. A goal of this initiative is to develop and implement programs that encourage hydrologists and meteorologists to work together towards the improvement of operational flood forecasting services.

The GFFGS program is being accomplished under the Memorandum of Understanding (MoU) noted below[2] through funding by the U.S. Agency for International Development/Office of U.S. Foreign Disaster Assistance (USAID/OFDA).

The system design is such that it allows for efficient global data ingest and support of regional cooperation among NMHSs. The system design is characterized by distributed operations and functions on global, regional and national levels. Centres of computation and product dissemination will support the operational functions of the NMHSs through the timely provision of data, ancillary information, software, hardware and training. A schematic of the global-regional-national system is shown in Figure-1.

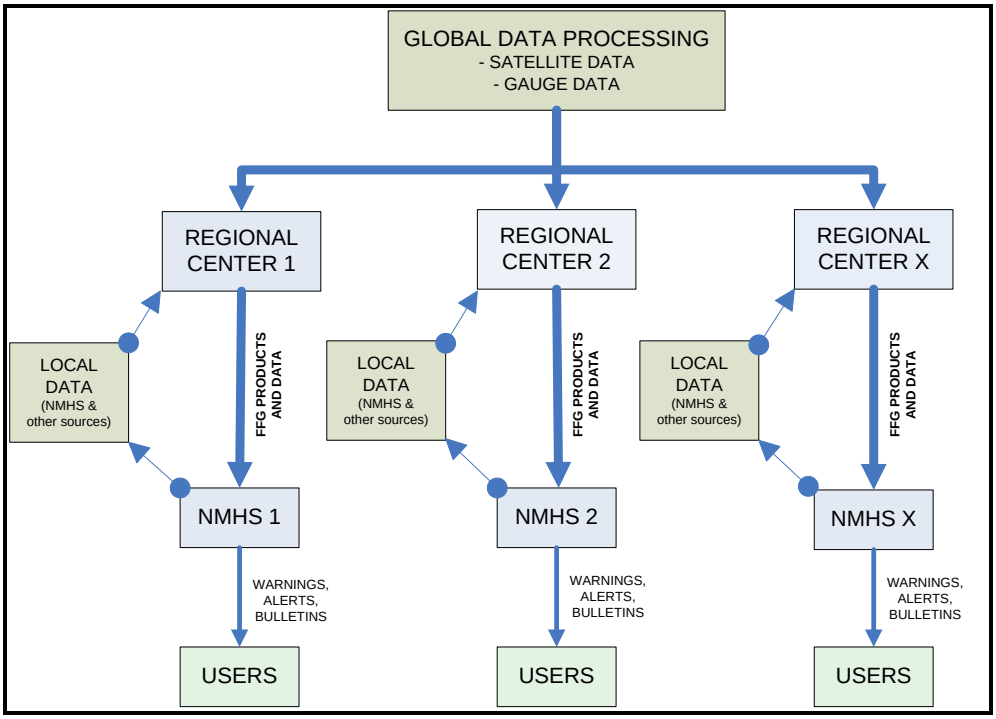

Figure-2: GFFG System Schematic – Global Implementation

Implementations of regional projects are achieved through the development of an interface with the global core and with the RegionalCentres. The global data core link to real-time global satellite precipitation estimates will be through the U.S. National Oceanic and Atmospheric Administration/National Environmental Satellite, Data and Information Service (NOAA/NESDIS). If required, global in situ observations will be provided through one or more of the World Meteorological Organization (WMO) GlobalCentres (Washington, DC; Moscow; and Melbourne)

[2]MoU "Establishing a Cooperative Initiative among the World Meteorological Organization, Hydrologic Research Centres, U.S. National Oceanic and Atmospheric Administration/National Weather Service and the U.S. Agency for International Development/ Office of U.S. Foreign Disaster Assistance for the Flash Flood Guidance System with Global Coverage Project"

and Regional Telecommunication Hubs including Bangkok, Beijing, New Delhi and Tokyo. The primary functions of the global data ingest and processing core are to:

- Provide global data ingest and quality control;
- Access global meteorological information to supplement data collected at the regional level as needed;
- Maintain correspondence with the Regional Centres; and
- Implement computational system changes.

The Regional Centres will require ***appropriate communications*** and ***infrastructure facilities*** to support operations. The proposed responsibilities of the Regional Centres are outlined in Appendix A.

In summary, the Regional Centres responsibilities are to:

- Disseminate real-time detailed country graphical products and/or data for the NMHSs in the region;
- Provide routine regional hydrometeorological analysis;
- Provide communications for system analyses to NMHSs of region;
- Provide communications of regional system modifications necessary to developers;
- Provide regional flash flood hazard information;
- Provide regional *validation of products* and formulation of plans for improvements;
- Provide daily *guidance discussion* to NMHSs from a regional perspective;
- Collect available *real-time meteorological data* for the development of regional products;
- Provide *regional training* of NMHSs representatives;
- Provide, if necessary, a *computational platform* for country scale real-time computations and modifications of flash flood guidance products for those NMHSs that lack adequate computational capabilities;
- Provide routine *maintenance and IT support*; and
- Develop *a historical archive* of the system products.

NMHS functions pertaining to the use of the flash flood guidance and warning system include:

- Develop country *hydrometeorological analysis* using the system products and information and other local products and information;
- Develop country adaptations of the flash flood guidance and precipitation nowcasts on the basis of within-country most-recent data and information;
- Develop local *flash flood watches and warnings* as required;
- Provide *data and information* to the Regional Centres (based on regional agreements);
- Monitor system (products) performance (availability and effectiveness), conduct country *verification studies* and feedback to the Regional Centres; and
- Communicate with user agencies for effective disaster risk reduction.

Resources of country NMHSs will determine the actual configuration and type of software used in each case, given the provision of within-country basic software and communication links to Regional Centres facilities.

It is expected that the products available from the Regional Centres will be adequate to support a range of desk top computer-based processing capabilities at the NMHSs, from using simple spreadsheet software to those computational facilities that support interactive graphical generation of products (much like the capability of the Regional Centres). This provision will allow the NMHSs of participating countries to develop near real-time flash flood guidance and warnings.

Data and Information Requirements

To ensure that the FFGS provides the highest quality data and information to forecasters, various historical and real-time hydrometeorological data and other information are required in order to develop, implement and operate the flash flood guidance systems. Historical data and information are needed for the development of the system and calibration of the models. Real-time data are needed for system operations. Terrain and other spatial-database information are used to delineate the small catchments for which flash flood guidance will be computed, to calibrate the models and to operationalize the flash flood guidance information.

It cannot be emphasized enough that quality data and information are needed to provide the optimum system for use by forecasters for the development of flash flood warnings.

Data and information needs are detailed in Appendix B. Appendix C is a survey of automatic rain gauges and weather stations. This information is important to fully understand the current status of these systems.

Resource Requirements

Personnel

The system is designed to be used operationally and jointly by meteorologists and hydrologists. The following expertise is recommended at the Regional Centres and country levels for the primary users, mainly the system operators. Recommended minimal available expertises are given in Table-1.

Table-1: Minimal personnel Equipment for Regional Centre and NMHSs

Area of Expertise	Regional Centres	NMHSs
Have a meteorological and/or hydrological technical background.	Both meteorological and hydrologicalforecast expertise.	Either meteorological and/or hydrological forecast expertise.
Have experience in operational weather and/or hydrological forecasting specific to the region or country.	Priority	Priority
Have experience in weather-related hazard emergency management operations	Priority	Priority

Area of Expertise	Regional Centres	NMHSs
Have experience in or knowledge of quantitative analysis of satellite-based rainfall estimates.	Priority	Preferred
IT capability for server system administration, network connectivity, and product availability.	Priority	Preferred

Both the Regional Centre and the country NMHS should operate on a round-the-clock basis either continuously year-round or at the minimum during seasons with significant flash flood risk.

Computers and Communications

High performance servers with the LINUX operating system will be run at the Regional Centres through the project. The country NMHSs are required to have current-generation PCs and an internet connection with periphery devices in order to access products from the internet. On the other hand, the Regional Centre will need hi-speed internet service and, potentially, access to GTS/WIS.

Appendix A

Regional Centres Roles and Responsibilities

Operations Overview – Regional Centres

The Regional Centres (Centres) play a critical role for the sustained operations of the Flash Flood Guidance System with global coverage (FFGS) within the region. The Centres will be the focal point for access by the countries (including their own) to data, information and products required to make rapid decisions with regards to flash flood threats. The Centres will also play a role in training (or providing guidance) and with hydrometeorological analyses within the region. The Centres will also be responsible for maintaining the server nodes of the FFGS. The Centres is essentially the organization at which all regional data and knowledge exist for the successful operation of the FFGS in the region. Accordingly, the Centres role in the FFGS process requires a higher standard of computational infrastructure and professional expertise than that of the NMHSs of participating countries within the region. As with the NMHSs, the schedule for performing their specific operations is based on specific operational requirements as well as the current or anticipated flash flood hazard.

Responsibility for global data ingest and for regional information and communications (e.g., highlighting particularly vulnerable areas within the region, regional hydrometeorological analyses), training and regional coordination of flash flood guidance and warning operations, as well as regional FFGS validation lies with the Centres. NMHSs will work with the Centres in developing flash flood guidance/warning protocols that are appropriate at national level and consistent for the region and mode of FFGS operation, as well as by their particular links to within-country users (e.g., disaster management agencies). Responsibility for flash flood guidance and warnings as well as disaster preparedness and coordination with disaster management/response agencies lies with the country.
The Regional Centres will play a key role in the development of regional protocols and operational requirements and in defining any design requirements specific for that region. To do this the Centres will need to coordinate inputs from the countries during all phases of implementation.

Regional Centres Operational Roles and Responsibilities

The Centres will maintain and operate the Regional Linux server which computes and disseminates regional and country FFGS products (text and/or images). In meeting its responsibility to maintain the base node of the FFGS system, the Centres will have the following roles, responsibilities, and operations to the extent possible:

- As needed, the Centres will develop and maintain a local database of contributed, real-time input products from participating NMHS agencies and make available those products to the automated acquisition processes of the FFGS Computational Server. This will require that the Centres work with the countries to develop a set format of the data to be transferred to the Centres for use developing this real-time database that feeds the FFGS;
- Centres forecasters will work directly with the country forecasters in evaluating and applying the FFGS products and will provide critical hydrometeorological expertise where required;

- Where appropriate, the Centres will be available for the briefings and discussions needed to properly evaluate flash flood potential using the FFGS tool. The Centres forecasters will work with the country forecasters to ensure that they understand the weather forecasts and to provide consistency, including evaluating and interpreting the applicability of current and forecast precipitation events;
- The Centres will evaluate the FFGS products from a regional perspective and will communicate this perspective to the countries as appropriate. The Centres will ensure consistency of FFGS products throughout the region;
- The Centres will provide regional and national validation of system results and will advise the countries of the presence of noted biases in system outputs;
- Where appropriate, the Centres will coordinate the issuance of consistent flash flood watches and warnings (as applicable) using the FFGS tool as well as other information and tools available;
- The Centres will provide routine training/workshops on system operations, product interpretation and development, product verification, etc. to country forecasters; and
- The Centres will coordinate with the global data processing Centres in matters of data flow and communications or for conveying information regarding potential improvements that will affect the region products.

Centres System Management/Maintenance Roles and Responsibilities

Even though the FFGS servers are designed to be fully automated, there will always remain a critical need for ongoing observation and quality control of its processing tasks and data products. This requires expertise from two basic categories: systems administration and operational quality control of the data products. Skills in both areas of expertise are needed to properly monitor and confirm the overall performance of the system. This can be fully achieved only through the cooperative efforts of both IT Staff and Forecasters. In fulfilling its system maintenance responsibilities, the Centres need to perform the following activities:

- Maintain Network Connectivity and Data Availability – This relates primarily to the systems administration efforts of IT staff. Of concern are potential problems related to internet and/or GTS service availability, network cabling, switches, or any one of numerous hardware and security issues related to the servers themselves. The assessment and correction of potential problems relating to any of these areas requires specific technical skill and an understanding of the systems and technologies involved;
- Product Quality Control – This relates to the function of the forecasters at the Centres. Their expertise in hydrology and meteorology is required to properly understand the relative quality of the FFGS input and output products at any given time. Accordingly, Centres forecasters must perform quality control procedures on the data and outputs and determine whether or not any perceived problems are the result of a parametric shortcoming, a failure in one of the FFGS models, or if it might relate to the quality or availability of the real-time input data that drives the system; and
- Operational Process Monitoring – In order to successfully fulfill the specific responsibilities of IT staff and forecasters identified above, both groups must engage in a necessarily cooperative effort of routine and systematic review of system processing activity. This involves regular inspection of system image products, data products, status indicators and log files as a means to confirm the proper operation and health of the system while maintaining a keen familiarity with the status quo in order to immediately recognize any deviation from it.

Training Responsibilities

The Centres will be directly involved in the various training programs during implementation and operations. Training programs can involve both Centres staff and country staff. Regional representatives will be equipped to play a fundamental part in the training of country staff, especially during system operations. The primary purpose of training is for Centres representatives to familiarize themselves and develop a level of competency in the FFGS basics (physical principle, components, operation, and validations), product interpretation and use, and collaboration for prediction and warning. Particular emphasis for the Centres will be placed on validation, operations, trouble shooting and maintenance, data management, communications, realistic scenarios, and preparedness for unusual circumstances or errors. Usual training programs involving Centres (and country) personnel are noted below.

Regional Workshops

An initial and final (operations) workshops are held in the region to introduce hydrologists and meteorologists to a variety of topics including the hydrometeorology of flash floods, basic system design including products, overview of the required data and information needed for system development and operations, system validation, and concept of system operations.

The operations workshop will be held after system implementation and other training programs have been completed. This workshop will be conducted at the Centres and will provide additional training for NMHS representatives from all countries within each region. The system overview and hands-on demonstrations will include presentations by the trained Centres representatives. The focus of this workshop is too identify and plan for country specific flash flood scenarios using the FFGS in addition to synthesizing coordination protocols for operations and communications between the Centres and NMHS staff. An interactive component during the operations workshop allows for a demonstration of the system. Collaboration will involve an accounting of regional and national considerations depending on geography, climate, and communications or other hardware/structural capability.

Hydrometeorologist Training Program

The main focus of this training program is to familiarize meteorologists and hydrologists with the complex interrelationships between atmospheric moisture, low level features, and geomorphology that can result in storm-specific enhancement of precipitation efficiency and increase a given precipitation event's chances to produce a flash flood. The online Hydrometeorologist courses for meteorologists and hydrologists focus specifically on supporting the Flash Flood Guidance systems by providing the necessary tools to assist in the forecast of flash floods. This training is available online to all FFG users.

Online Interactive Training Program

This program provides virtual simulations of the FFGS software functions in interactive and demonstration modes. A collection of flash flood case studies from around the globe will be developed using FFGS software and archives from implemented flash flood guidance systems. Learners will be required to forecast flash flood events using the available information. Centres staff will work together with country staff to accomplish the simulator training.

Hands-on Training

This training will be conducted when the FFGS computational and communications components are in place and operational. Centres and country representatives from the region will receive hands on training simulating daily operations and developing validation programs for each region through close contact with their colleagues in the NMHSs in their region. It is expected that this type of training, perhaps more than any other, will develop a core of professional Hydrometeorologists with flash flood forecasting specialization that will be key for the sustainability and increase effectiveness of the FFGS system both regionally and within each country. In addition these professional Hydrometeorologists will utilize their hands-on experience to train regional and in-country forecasters. This will further increase the sustainability and effectiveness of the FFGS systems into the future.

Regional Training – System Installation and Maintenance

Training will be scheduled during system installation for Centres representatives and prepare them to guide NMHS representatives in operational use of the FFGS system. This training will include the assurance for ingesting required real time inputs (e.g., radar, gauge and satellite rainfall estimates), testing system performance during operation, data archival and restoring functions, and communication components. This training will be accomplished in system administration training program during system installation and implementation at the Centres.

Ongoing Training

An ongoing regional training program involving the Centres will be developed to maintain proficiency with system operations, ensure continued system validation, and ensure continued system use and ownership. This will involve continual engagement with the community of users. Tools will be developed to build capacity to improve the system and handle more complex contingency scenarios (e.g. key data missing, failure in “normal” operations, communications, or other such events).

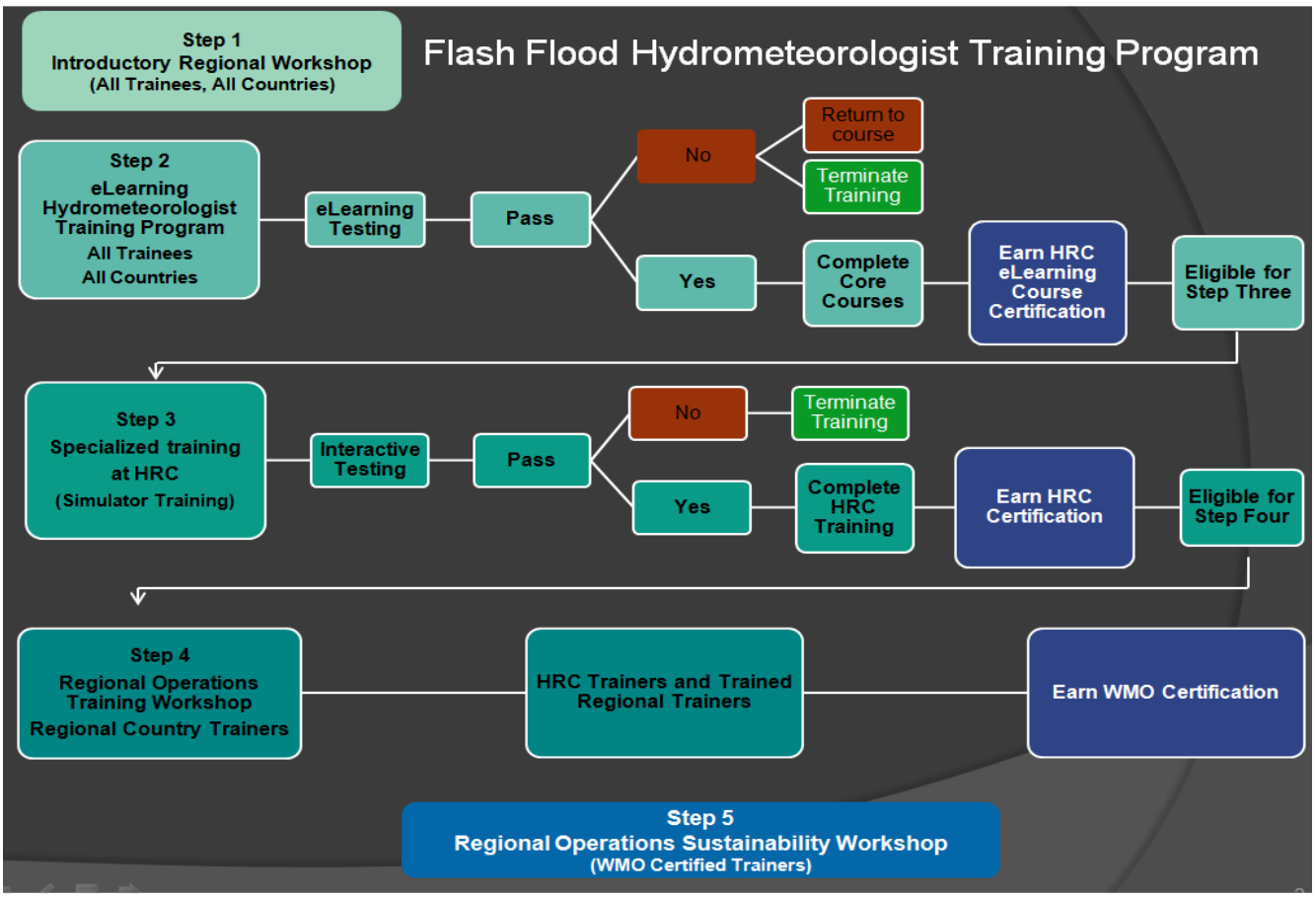

Figure-1: Flash Flood Guidance System Hydrometeorologist Training Programme

Appendix B

Data Requirements

For the development and operation of Flash Flood Guidance System, local historical and/or climatological hydrometeorological and geomorphologic, and real-time data are required. They are used for, among others, model parameterizations, calibrations, bias adjustments. Use of the higher resolution spatial and temporal local data in the FFG models is critical for the system performances. At the absence of local data, they will be obtained from international organizations like soil data from FAO (Food and Agricultural Organization). Therefore, participant countries are advised to collect, arrange and provide the following data types in required formats, depending on the availability of them.

A. NMHS Capacity Information

Institutional capacities, responsibilities:

- Hydrometeorological observation network, data processing and visualization tools;
- River and flash flood forecasting and early warning tools;
- Nowcasting tools;
- QPE/QPF tools and models;
- IT capabilities; and
- Organization structure (forecasting department, regional offices etc.,).

B. Spatial GIS Data, Maps

- Digital terrain elevation data (quality controlled);
- Stream network;
- Lakes/reservoirs/wetlands;
- Soil type, texture and depth;
- Vegetation cover, and land usage; and
- Monthly climatological maps of precipitation, temperature and potential evapotranspiration.

C. Spatial GIS Data, Maps

Channel cross-sectional Information for natural channels with drainage areas less than 2,000 km^2. The following hydrometeorological data, 5-20 years in record length, preferable in digital format:

- Precipitation (hourly, daily, monthly), covering at least past 5 years as much as available;
- Surface air temperature (hourly, daily, monthly);
- Top soil moisture (daily, weekly, monthly);
- Streamflow discharge for local streams with drainage areas less than 2000 km^2 (hourly, daily, monthly);If streamflow discharge data are unavailable, stream stage data (hourly, daily, monthly) and associated stage-discharge curves (rating curves), also for local streams;

- Snow depth, snow water equivalent (SWE) and snow coverage (hourly, daily monthly);
- Flood frequency analysis (regional and local);
- Flash flood occurrences (regional and local);
- Stream geometry studies for small streams;
- Climatological precipitation and flood studies; and
- Karst flow measurement studies.

If above data are unavailable, such hydro-meteorological and climatological data as monthly precipitation; surface air temperature; pan-evaporation/evapotranspiration; soil moisture; streamflow; radiation; wind and humidity; snow depth and coverage and SWE should be provided.

D. Real-Time Data Requirements

FFG system uses real-time meteorological observations in WMO SYNOP format that are disseminated through WMO GTS, including the following parameters, among others:

- Precipitation;
- Surface temperature, humidity, wind speed/direction, pressure, solar radiation;
- Snow depth and SWE; and
- Soil moisture.

Besides the synoptic reports, if additional hydrometeorological observations are available, that would be transferred to the regional centre through ftp services, may improve the system performances.

Appendix C

NMHS Observation Network Metadata Requirements

The following metadata for the rain gauges, weather stations, and stream gauges are to be provided:

- Geographical locations (latitude and longitude in decimal degrees);
- Elevation in meters;
- Type of stations and WMO station numbers(synoptic, climate);
- Current operational status (Automatic, Manuel);
- Observation interval (hourly, 3-hourly, 6-hourly etc);
- Available sensors (Precipitation, Temperature, Humidity, Soil Moisture, Dew Point, Snow, SWE etc.);
- Total number of stations and number of synoptic stations that reports to GTS;
- Data transmission type (HF/VHF radio, wide area network, GPRS, satellite etc.);
- Data quality control applied (y or n); and
- Existing database (Oracle, Informix etc.).

ANNEX 5

Project Steering Committee (PSC)

Preamble: The Project Steering Committee (PSC) provides overall governance of the project and its related activities throughout the duration of the project. Its membership and the terms of reference would be confirmed and amended as deemed necessary during the first constituting session of the PSC.

1. Standing Core Members of the PSC

PSC consists of the following NMHSs focal points or their alternates of the Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) project and partner organizations.

Table-1 Composition of Steering committee

Organization	No of Representatives
Regional Centre, Dominican Republic	1
Haiti	1
Development Partner (HRC)	1
Donor (USAID/OFDA)	1
WMO	1

Additional experts/representatives are to be invited by the PSC as needed on an ad-hoc basis, and observers may also be invited by the PSC to participate in meetings.

2. Terms of Reference

The (intermediate) principle terms of reference of the PSC are as follows:

- Ensure smooth and timely implementation of project activities and achievement of the project purpose and its expected outcomes based on regular summary reports from national centres and the regional centre;
- Provide technical and administrative guidance to the implementation of the project;
- Establish an adequate *monitoring and evaluation* (M&E) system for the project and implement findings from the M&E process;
- Review and update the *project implementation plan* (PIP);
- Promote benefits of the project on national and regional levels;
- Facilitate links with other regional and national relevant projects, including Severe Weather Forecast Demonstration Project –Caribbean (SWFDP- Caribbean) and Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) project;
- Ensure cross-sector linkages with relevant national and international organizations; and
- Seek additional expertise and financial support to supplement project activities.

3. Communication

Meetings of the Project Steering Committee will be initially organized annually. In addition, tele-conferences may be organized on a tri-semester basis or as needed to monitor project progress and solve upcoming issues. Other communication means of the PSC will include a dedicated e-mail list and/or a web-based e-forum. Operational communication will be established between the Regional Centre and country focal points (NMHSs) and the technical development partner (HRC).

4. Guiding Principles for the HDRFFG Implementation

The guiding principles listed below provide an overall framework for the implementation of the HDRFFG and may be specified in more detail by the first session of the Project Steering Committee (PSC):

- Data providers remain owners of data. Data provided to the Technical Development Partner (Hydrologic Research Center, HRC), will be used solely for the purpose of building up the regional FFG components and such data will not be re-distributed other than to the national centres that provided the data and the dedicated Regional Centre that will provide regional services;
- Equal, non-hierarchical access to data and information generated by the project for project partners and beyond are consistent with Resolution 40 (WMO CG-XII) WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities (https://www.wmo.int/pages/about/Resolution40_en.html) and Resolution 25 (WMO CG-XIII) Exchange of hydrological data and products (https://www.wmo.int/pages/about/Resolution25_en.html);
- Services provided by the technical development partner (HRC) and the Regional Centre are of an advisory nature; and
- Full responsibility for provision of national flash flood guidance and warnings remains with the participating NMHS.

ANNEX 6

Letter of Commitment
(SAMPLE – DRAFT)

To be addressed to the Secretary-General of WMO

Subject: **Letter of Commitment regarding the Haiti and Dominican Republic Flash Flood Guidance (HDRFFG) project**

Dear Mr Taalas,

Reference is made to the planning workshop on the HDRFFG project in Santo Domingo, Dominican Republic from 7 to 9 September 2016, which was organized by World Meteorological Organization (WMO) in cooperation with Hydrologic Research Center (HRC) and co-organized and hosted by the Agency for Meteorology, Oficina Nacional de Meteorología (ONAMET) with funding from USAID/OFDA.

I am pleased to learn about the successful outcomes of this workshop and its conclusions which constitute a milestone in the implementation of this important project.

In this regard I would like to reconfirm the commitment of (country) participation in all project activities aiming towards the achievement of the project objectives to the benefit of (country) and the Haiti and Dominican Republic region as a whole.

I would also like to inform you that (name) has been designated as the focal point and (name) as alternate in all project related activities. The designated officer will represent the country in the Project Steering Committee. Their coordinates are given below.

Focal Point

Name:
Function/Role
Address
Phone
E-mail

Alternate

Name:
Function/Role
Address
Phone
E-mail

It is my pleasure to inform you that we have designated (institution) to act as a National Centre that will be responsible for the implementation of the project at the national level.

I would like to express our appreciation for the efforts so far undertaken by WMO, NOAA National Weather Service, and the HRC, as well as the generous financial support of USAID/OFDA.

Let me assure you of our full support and cooperation with the WMO Secretariat and the project partners in the successful implementation of this project.

Yours sincerely,
Name of PR

Carta de compromiso
(MODELO – PROYECTO)

Dirigida al Secretario General de la OMM

Asunto: Carta de compromiso relativa al Proyecto de guía para crecidas repentinas para Haití y República Dominicana

Estimado señor Taalas:

Me es grato referirme a la reunión de planificación inicial del Proyecto de guía para crecidas repentinas para Haití y República Dominicana, celebrada en Santo Domingo (República Dominicana) del 7 al 9 de septiembre de 2016, y organizada por la Organización Meteorológica Mundial (OMM) en cooperación con el Centro de investigación hidrológica (CIH), y en la que la Oficina Nacional de Meteorología (ONAMET) ejerció de coorganizadora y anfitriona, con fondos aportados por la Oficina de Asistencia para Desastres en el Extranjero de la Agencia de los Estados Unidos para el Desarrollo Internacional (USAID/OFDA).

Constato con agrado que este taller ha tenido resultados satisfactorios y que sus conclusiones constituyen un hito en la ejecución de este importante proyecto.

A este respecto, quisiera reiterar el compromiso de (país) de participar en todas las actividades relacionadas con el proyecto que conduzcan al logro sus objetivos en beneficio de (país) y en el conjunto de la región de La Española.

Deseo comunicarle asimismo que se ha designado a (nombre) como coordinador y a (nombre) como suplente para todas las actividades relacionadas con el proyecto. El funcionario designado representará al país en el Comité Directivo del proyecto. Sírvase encontrar, a continuación, sus datos de contacto:

Coordinador
Nombre:
Función/cargo:
Dirección:
Teléfono:
Correo electrónico:

Suplente
Nombre:
Función/cargo:
Dirección:
Teléfono:
Correo electrónico:

Me complace informarle de que hemos designado a (institución) para que actúe como Centro Nacional y se encargue de la ejecución del proyecto a nivel nacional.

Quisiera expresar nuestro agradecimiento a la OMM, al Servicio Meteorológico Nacional de la Administración Nacional del Océano y de la Atmósfera (NOAA) y al CIH por la labor que han realizado hasta la fecha, así como a USAID/OFDA por su generoso apoyo financiero.

Permítame asegurarle que la Secretaría de la OMM y los asociados en el proyecto contarán con nuestro apoyo y cooperación plenos para la ejecución satisfactoria de este proyecto.

Le saluda atentamente.

Nombre del Representante Permanente

Promesse de soutien
(EXEMPLE – PREMIÈRE VERSION)

À adresser au Secrétaire général de l'OMM

Objet: Promesse de soutien relative au Projet de système d'indications relatives aux crues éclair en Haïti et en République dominicaine (HDRFFG)

Monsieur Taalas,

Je me réfère à la réunion initiale de planification du projet HDRFFG, tenue à Saint-Domingue, en République dominicaine, du 7 au 9 septembre 2016, qui était organisée par l'Organisation météorologique mondiale (OMM), en collaboration avec le Centre de recherche hydrologique (HRC) et le service météorologique dominicain (ONAMET), et accueillie par ce dernier grâce au soutien financier du Bureau de l'Agence des États-Unis pour le développement international chargé de l'assistance en cas de catastrophe (USAID/OFDA).

J'ai pris connaissance avec intérêt des conclusions de cet atelier particulièrement utile, qui marquent une étape importante de la mise en œuvre de ce grand projet.

À cet égard, j'aimerais confirmer que (*nom du pays*) s'engage à participer à l'ensemble des activités menées dans le cadre de ce projet en vue d'atteindre les objectifs fixés pour (nom du pays), ainsi que l'île d'Hispaniola dans son ensemble.

Je souhaite également vous informer que (*nom de la personne*) a été nommé(e) coordonnateur/coordonnatrice et (*nom de la personne*) suppléant(e) pour toutes les activités liées au projet. Le responsable désigné représentera le pays au sein du Comité directeur du projet. Ses coordonnées, ainsi que celles du/de la suppléant(e), sont les suivantes:

Coordonnateur/Coordonnatrice

Nom:
Fonction/Rôle:
Adresse:
Téléphone:
Courriel:

Suppléant(e)

Nom:
Fonction/Rôle:
Adresse:
Téléphone:
Courriel:

J'ai le plaisir de vous informer que nous avons confié à (*nom de l'institution*) le rôle de centre national chargé de la mise en œuvre du projet à l'échelle nationale.

Je tiens à remercier l'OMM, la NOAA, par le biais du Service météorologique national des États-Unis (NWS), et l'HRC, des efforts qu'ils ont déployés jusqu'à présent, ainsi que l'USAID/OFDA pour son généreux soutien financier.

Soyez assuré de notre soutien sans réserve au Secrétariat de l'OMM et aux partenaires du projet, ainsi que de notre collaboration en vue d'assurer la réussite de ce projet.

Veuillez agréer, Madame, Monsieur, l'expression de ma considération distinguée,

Nom du Représentant permanent

ANNEX 7

Tentative Implementation Plan

TASK NAME	2016 Months				2017 Months											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Initial Planning Meeting	■															
Letters of commitment and points of contact provided		■														
Server Purchase			■													
Obtain static and historical hydromet data			■	■	■	■										
Obtain real-time data information - data availability/access					■											
Training Workshop - Step 1 (Steering Committee Meeting #1)						■										
National/Regional Centers complete online courses - Step 2				■	■	■										
Complete 1st version of the system			■	■	■	■	■									
Regional Center develop and provide real-time data format and tools (ftp)					■	■	■									
Regional Center and participating countries to collect real-time data					■	■	■									
Complete operational training at HRC - Step 3									■							
Steering Committee Meeting #2											■					
Onsite system installation at Regional Center													■			
Follow-up operational workshop														■		
Steering Committee Meeting #3 (Step 4 training)																■