WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

MEETING OF THE PROJECT STEERING GROUP ON CBS SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT

GENEVA, SWITZERLAND, 14-16 DECEMBER 2005

FINAL REPORT

Executive Summary

The CBS Severe Weather Forecasting Demonstration Project Steering Group was formed to guide in the planning of the Project and to advise the Chair of the CBS OPAG on Data-Processing and Forecasting System. Its membership of 9 persons well represented all geographical regions of the world as well as programme specialties related to the Global Data-Processing and Forecasting System that are important to the process and tasks of severe weather forecasting. It met on 14 - 16 December 2005 at WMO Headquarters, Geneva, Switzerland.

Numerical Weather Prediction (NWP) systems have become increasingly relevant and indeed essential to the severe weather forecasting process, with a growing number and variety of sophisticated outputs, currently available from NWP producing centres, which could be beneficial to severe weather forecasting to many National Meteorological and Hydrological Services (NMHS). The Severe Weather Forecasting Demonstration Project was being organized as potentially a series of regional subprojects whose scope is to explore and test the usefulness of the products currently available from NWP centres, or products which could be readily made available from current NWP systems of global and regional meteorological centres, with the goal to improving severe weather forecasting services in countries where sophisticated model outputs are not currently used. The principal focus of the project is on the phenomena of heavy precipitation that could cause serious flooding, and strong destructive winds.

The Project Steering Group established an Overall Project Plan, decided to develop, and then provided input for a guidebook for the planning of regional subprojects, as well as developed a list of suitable regional subprojects. In order to assess suitable regional subprojects, the Steering Group clarified further the general terms and criteria for participating centres, and applied them with the following additional considerations: high likelihood of success (to test the Overall Project Plan); potential for greatest benefits; nature of the risk/threat of severe weather; timing of high risk season relative to lead time required for planning and implementation; meeting of project criteria; actual capacity at participating centres; and costs and availability of funds. From among the possible regional subprojects, it decided to recommend one most suitable for implementation in 2006, with duration of approximately one year, as well as additionally two other next most suitable regional subprojects for consideration in 2007, pending the success of the subproject to be implemented in 2006.

The Project Steering Group recommended the following regional subproject most suitable for implementation in 2006, which is envisaged to possibly involve the following participants:

- NMHSs: Botswana, Madagascar, Mozambique, Tanzania, Zimbabwe;
- Regional Centres: Pretoria, La Réunion, ACMAD;
- Global Centres: Exeter, Washington, ECMWF.

Given that the season when severe events are likely to occur is from November to May, there should be sufficient time left for the preparation of the subproject, including the provision of essential preparatory training, in order to start the field phase in November 2006.

1 Opening of the meeting *(Agenda item 1)*

1.1 The Meeting of the Project Steering Group on the CBS Severe Weather Forecasting Demonstration Project opened at 9:30 a.m. on Wednesday 14 December 2005 at WMO Headquarters, Geneva, Switzerland. Mr Jean-Michel Rainer, Acting Director of the World Weather Watch Department, opened the meeting on behalf of Secretary-General of WMO.

1.2 Mr Rainer noted to the Steering Group that Numerical Weather Prediction (NWP) systems have become increasingly relevant and indeed essential to the severe weather forecasting process, with a growing number and variety of sophisticated outputs, currently available from NWP producing centres, which could be beneficial to severe weather forecasting to many National Meteorological and Hydrological Services (NMHS). The Severe Weather Forecasting Demonstration Project was being organized as a regional project whose scope is to explore and test the usefulness of the products currently available from NWP centres, or products which could be readily made available from current NWP systems, with the goal to improving severe weather forecasting services in countries where sophisticated model outputs are not currently used. The principal focus of the project is on the phenomena of heavy precipitation that could cause serious flooding, and strong destructive winds. As well, it was noted that a WMO Workshop was held in Toulouse (October 2004) to develop the general terms and considerations for a Severe Weather Forecasting Demonstration Project, including its goals, the roles of participating centres, and criteria for participation.

1.3 In order to establish clearly an overall project plan, as well as to identify and specify suitable regional demonstration projects, to establish their relative priorities, and to decide which regional project would be the most suitable for implementation in 2006, it was noted that the membership of the Steering Group very well represented all geographical regions of the world, as well as programme specialties related to the Global Data-Processing and Forecasting System (GDPFS) which are important to the process and tasks of severe weather forecasting, with the task is to steer the Demonstration Project to enhance severe weather forecasting through effective use of products of NWP centres to improve the forecasting processes at NMHSs of less advanced countries.

1.4 The Chairman of the Steering Group, Mr Bernard Strauss, expressed his appreciation of the remarks made on behalf of Secretary General of WMO, and undertook the programme of work according to the agenda.

2 Organization of meeting *(Agenda item 2)*

2.1 Approval of agenda.

2.1.1 The meeting adopted the agenda given in Appendix I.

2.2 Agreement of working arrangements

2.2.1 The meeting agreed on its working hours, organization and work schedule.

2.2.2 There were 12 participants at the meeting as indicated in the list of participants given in Appendix II.

3 Introduction – Severe Weather Forecasting Demonstration Project (SWFDP) *(Agenda item 3)*

3.1 The meeting was informed of the background and supporting documentation for the Demonstration Project including the decisions of WMO Constituent Bodies. CBS Management

Group (2003) proposed a demonstration project, involving EPS, other NWP models, nowcasting, interpolation techniques involving, through voluntary participation, a major RSMC, developing NMHS(s), and disaster management agencies. Such a demonstration project would use a cascading approach to provide greater lead-time for severe weather warning. Executive Council (EC-LVI, 2004) encouraged CBS to continue to develop standards or recommended practices for weather forecasting, which could be an outcome of a demonstration project. A WMO Workshop on Severe and Extreme Events Forecasting was held (Toulouse, October 2004), where general terms for such a Severe Weather Forecasting Demonstration Project were developed. Such a project will be built on existing capabilities and be developed with a view to ensure sustainability. Performance measures will need to be established prior to the start of the project.

3.2 CBS-XIII (2005) agreed with the goals of the demonstration project(s) as follows:

- to improve the ability of NMCs to forecast severe weather events;
- to improve the lead time of alerting of these events;
- to improve interaction of NMCs with Disaster Management Civil Protection Authority (DMCPA) before and during events;
- to identify gaps and areas for improvements;
- to improve the skill of products from GDPFS centres through feedback from NMCs.

3.3 CBS-XIII agreed that the DPFS programme should coordinate the implementation of two types of projects; one that is aimed at improving the forecasting of the severe weather associated with Tropical Cyclones, and another project focusing on improving heavy precipitation/strong wind forecasts (not associated with Tropical Cyclones).

3.4 CBS-XIII invited the Secretary-General to circulate the proposal to the NMHSs to seek voluntary participation in the demonstration project(s). It requested the Chairperson of the OPAG/DPFS, in consultation with the Rapporteur on the Application of NWP to Severe Weather Forecasting, to select participating centres. Once the participating centres were determined, implementation details of the demonstration project(s) would be developed with involvement of the participating centres.

3.5 The Executive Council (EC- LVII, 2005) agreed that the Demonstration Project on Severe Weather Forecasting is to be developed with the goal to enhance the use of NWP products, and that the implementation of a project of one-year duration should consider, in particular, participation by developing countries, and begin in 2005.

3.6 A Demonstration Project Steering Group was established to advise the Chair of the OPAG on DPFS on the planning of the Severe Weather Forecasting Demonstration Project.

4 Review the Terms of Reference for the Demonstration Project Steering Group *(Agenda item 4)*

4.1 The meeting reviewed and agreed to its terms of reference which are given in Appendix III.

5 Review the Overall Project Plan including the specifications and criteria for suitable demonstration projects and participating centres, implementation, and evaluation *(Agenda item 5)*

5.1 The meeting reviewed the Overall Project Plan for the Severe Weather Forecasting Demonstration Project (SWFDP) and found it very thorough as presented. The Steering Group decided that a specific project timetable should be developed outside of the general Overall Project Plan and be made a required part of the planning of each regional subproject. The meeting felt that as much as possible the document as well as the Project Steering Group should motivate

participation by candidate centres and leadership particularly from regional and national meteorological centres.

Requirements for Training

5.2 Preparatory training is required to support the implementation of the demonstration project, and should be tailored specifically for each regional subproject, with contributions from all participating centres.

5.3 For each of SWFDP's regional subprojects a training programme needs to be designed that will enable the participating Regional centres and NMCs to utilize the global and regional forecast guidance to its full extent, and to further the capacity building amongst the participants in the project. Regional Centres will assume a central role in such training, since they will provide the link in the cascading process between the global centres and the NMCs. In particular, the use of ensemble forecast guidance from the global and regional NWP systems will be novel forecast guidance to NMCs and will need to be introduced through an training process. In addition, NMCs will relate directly with disaster management experts of the DMCPAs. These are the end users of the forecast information and some additional training will be required at the regional and national level to ensure that the recipients of the final warnings and alerts appreciate the nature of the probabilistic and deterministic information and the uncertainties associated with deterministic forecasts.

5.4 It is expected that the SWFDP preparatory training programme will be coordinated by the WMO in collaboration with the Regional Centres. To the extent feasible, the training will be coordinated with the existing WMO training activities. Some additional funds may be required to meet the objectives of the SWFDP in this regard.

5.5 Feedback in the cascading process should be provided routinely in relation to both forecast as well as observed severe weather events, to capture both cases of missed forecasts as well as false alarms.

5.6 Evaluation of the national warning service provided by the NMHS should involve the users, i.e., the national disaster management and civil protection authority/agency (DMCPA). This aspect should be of direct concern for the PWS programme, while the DPFS programme would expect to respond to the requirements of PWS for data-processing and forecast products.

5.7 The Project Steering Group noted that the project requires dedicated effort by staff at the participating centres. In particular, this aspect could be most important and demanding at the level of the NMC, and in some developing countries the existing capacity may be inadequate to accommodate the effort required. Cooperation among participating centres is encouraged with the view to build capacity where it is needed, since the benefits are anticipated for all participating centres.

5.8 The meeting also noted that the candidate global and regional centres have already finalized their respective programmes for 2006 and may not be able to commit additional resources to the demonstration project. However, in general, the representatives of global centres present indicated their support to the Demonstration Project.

5.9 It was recognized that the costs for participation need to be considered, and additional funding may be required for a successful implementation of a regional subproject.

5.10 The Project Steering Group decided that the development of regional subprojects would require a general guidance document in a number of areas for their planning, and this would be contained in a "guidebook" for the planning and design of a regional subproject. It was envisaged that considerable detail might be required in some areas such as: process, actions required for the

preparation of a regional project, and defining the project evaluation component of the project. This matter was addressed in Item 7 of the agenda.

5.11 It was noted that “nowcasting” tools are in principle needed in the provision of effective weather warning services. Such tools, for example based on real-time radar data, are not always available in developing countries. The SWFDP has the principle goal to enhance the use of existing products from GDPFS centres, even in the context that “nowcasting” tools could be unavailable at some NMHSs.

5.12 The Project Steering Group felt that since EC-LVII (2005) has instructed that one regional subproject be started immediately and carried out in 2006, the success of this single subproject would be particularly important, from the perspective of the goals of the Demonstration Project, as well as in testing and refining the framework for developing and implementing other regional demonstration subprojects in the future.

5.13 The Project Steering Group concluded that a process is needed to conclude which regional subproject would be the first to be implemented. The factors to be considered include:

- High likelihood of success (to test the Overall Project Plan);
- Potential for greatest benefits;
- Nature of the risk/threat of severe weather;
- Timing of high risk season relative to lead time required for planning and implementation;
- Meeting of project criteria;
- Actual capacity at participating centres;
- Costs and availability of funds.

5.14 The Project Steering Group agreed to the Overall Project Plan which is found in Appendix IV.

6 Identification of suitable regional subprojects, and their relative priorities *(Agenda item 6)*

6.1 The meeting reviewed and clarified the statements of the general organization of the cascading process, the roles of each participating global, regional and national meteorological centres, and the criteria and other general considerations for centres to participate in a regional demonstration subproject. The relevant aspects will be incorporated into a guidance document for planning of regional subprojects (see Agenda Item 7), which will be finalized by the Project Steering Group.

General organization of the three-level cascading process

6.1.1 The SWFDP implies a co-ordinated work between three types of DPFS centres. A regional subproject should logically involve at least one Global centre and one Regional centre and a small number of NMHSs in the area of responsibility of the Regional centre.

6.1.2 According to the conclusions of CBS-XIII, the SWFDP should aim at applying the cascading approach in three levels:

a) Global NWP centres to provide available NWP products, including in the form of probabilities;
b) Regional centres to interpret information received from global NWP centres, run mesoscale models to refine products, liaise with the participating NMC;
c) National centres (NMCs) to issue alert, advisory, severe weather warning; to liaise with disaster management authorities; and provide feedback for the evaluation of the project.

Roles of each centre

6.1.3 In the framework of the cascading process specific tasks are attributed to the various centres participating to the SWFDP depending on their level in the cascading process.

6.1.4 According to the recommendations of CBS XIII, the responsibilities of the participating centres can be defined as follows:

Global NWP Centres:

a) provide a range of NWP products over area covered by the project for the duration of the SWFDP: deterministic models (e.g. limited area models where available), and EPS output relative to the probability of extreme weather.

Regional Centres:

a) interpret information received from global NWP centres, develop diagnostics products/guidance material on potential of severe weather based on EPS products (timeframe 3-5 days ahead of time); make the information available to participating NMC(s);
b) as it gets closer to event, run limited area model to refine products, confirm potential for severe/extreme weather, provide more detailed information (36-48H);
c) establish communications between regional centre and participating NMC;
d) perform the evaluation of cascading approach from regional centre perspective;
e) provide feedback to participating global NWP centres.

The various participating NMCs:

a) liaise with disaster management and civil protection agencies;
b) establish contacts with above agencies prior and during event;
c) interpret information received from Regional Centres and assess diagnostics products against available information and make adjustments as required;
d) apply nowcasting techniques;
e) issue alert, advisory, warning as appropriate;
f) perform evaluation of cascading approach from a forecaster perspective;
g) Provide feedback to regional centre on usefulness and skill of products;
h) Get feedback from users.

Criteria for participation

6.1.5 Based on the requests by CBS-XIII regarding the criteria for participation, and to ensure successful application of the cascading process, participating meteorological centres should meet the requirements listed below:

Global NWP centres:

a) Commit to provide agreed upon information during duration of the subproject;
b) Consider feedback from users as appropriate;
c) Provide a contact person for the subproject
d) Contribute to preparatory and ongoing training for participating NMCs and Regional centre(s), as required.

Regional centres:

a) Ability to interpret, use and evaluate products from Global NWP centres;
b) Ability to run limited area model over region considered;
c) Contribute to preparatory and ongoing training for participating NMCs, as required;
d) Provide a lead person for the duration of subproject.

The participating National centres (NMCs):

a) Adequate communication bandwidth for Internet access (minimum of 64 kbps recommended);
b) Operational and real-time access to satellite data and observations from ground stations;
c) Adequate telecommunication system to receive/transmit information;
d) Appropriate computing equipment to perform required data-processing;
e) Provision of forecasters, who meet WMO standard training for meteorologists, and with relevant experience, to participate during the field and evaluation stages of the subproject;
f) Provision of a lead person for duration of subproject;
g) Commitment to establish liaison with disaster management and civil protection agencies within their country;
h) Contribute to training of users at the national level, if required.

6.1.6 In addition to the preceding technical criteria more general criteria have to be taken into consideration:

a) Regional centres and NMCs would be from same region, and be able to communicate in a common language;
b) Must be in area where severe weather is encountered;
c) Ability and commitment to participate in the evaluation of the experiment: criteria, indicators, and etc.; The project must be sustainable: use of existing capacity, on-going commitment of participating centres, on-going assessment of usefulness and skill.

6.2 Consequences of the involvement of the centres in the SWFDP

6.2.1 The acceptance to participate to the SWFDP can result in an increase of the workload for the people in charge of operational forecasting especially in the selected Regional centre and NMCs: the developers to implement new products before starting the experimentation and the forecasters to scrutinize the products and prepare the feedback during the experimentation.

6.2.2 The activity of the forecasters on duty, related to the SWFDP, will be particularly important when a severe weather event is likely to occur; nevertheless in order to maintain a satisfactory level of vigilance it would be important to implement a day-to-day feedback mechanism which ensures that every centre examines carefully the information received from “upstream” in the cascading process.

6.2.3 The evaluation of the SWFDP will require the archiving of all the products relative to the weather events which will occur during the experimentation and to prepare for each of one a special report. This implies a common work of the centres at the three levels of responsibility.

6.3 General considerations for the choice of participating countries

6.3.1 The first step for the choice of the participants consists in selecting group of NMCs with respect to the following considerations:

- the NMCs belong to the same geographical area,
- there is at least one RSMC or NMC, having the capacity to run operationally a limited area model covering the geographical area,
- the geographical area is regularly affected by the same type of severe weather during a given period of the year.

6.3.2 Among the proposed criteria the commitment to establish liaison with disaster management and civil protection agencies within their country is of particular importance. Indeed the management of a severe weather warning service needs a close co-operation between the NMHS

and the civil protection agency in order to define the critical thresholds, to define the way to transmit the warnings and to report after the event.

6.3.3 It is desirable that data from meteorological radars be available in real-time for the application of nowcasting techniques which are a real advantage to monitor the evolution of heavy precipitation during a severe weather event.

6.4 Identifying suitable regional subprojects

6.4.1 According to the recommendations of CBS-XIII, two types of severe weather events should be considered for the implementation of regional subprojects in the framework of SWFDP:

- severe weather associated with tropical cyclones,
- heavy precipitation/strong winds (not associated with tropical cyclones).

6.4.2 The Project Steering Group considered in detail and with great care possible regional subprojects which could be chosen for implementation in 2006 or 2007 and their relative priorities. It set up a list of seven suitable subprojects and proposed participating centres, three related to events associated with Tropical Cyclones and four with events not associated with Tropical Cyclones. The list is given in the Annex to this paragraph. In the process the guidance given by CBS-XIII was taken into account. In particular, the Regional capability to apply the cascading process of transferring the forecast information from global and regional centres to the NMCs and the DMCPAs was seen as the primary criteria. Since the lead-time for setting up the Regional Subproject is only in the order of a few months, to the best of their knowledge the Steering Group gave weight to existing infra-structures, available human resources, telecommunication links and established contacts with civil protection authorities. In addition, the timing of the seasonal occurrence of severe weather in the Regions was taken into account.

6.4.3 For practical reasons the Project Steering Group recommended that the first implementation should address one regional subproject only. It is important that the setting up of the first regional subproject can be given as much attention as required from the Steering Group and the WMO Secretariat, and therefore no attempt should be made to set up two projects in parallel at this stage. Lessons learned from a successful demonstration subproject in one Region should provide an excellent basis for setting up follow-up projects in other Regions. The Steering Group stressed that the proposed Subprojects all address aspects of severe weather with high societal impact which would justify their initiation in later stages of the Demonstration Project.

6.4.4 Considering that forecasting of Tropical Cyclones is already dealt with by existing WMO programmes or activities, the Group recommended that the SWFDP start with a severe weather subproject not specifically associated with Tropical Cyclones.

6.4.5 The subproject recommended for the first implementation would involve the following participants:

- NMHS: Botswana, Madagascar, Mozambique, Tanzania, Zimbabwe;
- Regional Centres: Pretoria, La Réunion, ACMAD;
- Global Centres: Exeter, Washington, ECMWF;

Given that the season when severe events are likely to occur in this region is from November to May, there should be sufficient time left for the preparation of the subproject in order to start the field phase in November 2006.

6.4.6 After the implementation of the first regional subproject, and depending on the experience gained, two additional subprojects could then be set up in parallel in the next stage. The Project Steering Group recommended the following additional subprojects for the next stage of the Demonstration Project:

- Severe weather mainly associated with Tropical Cyclones:
  - NMHS : Cambodia, Laos, Philippines, Thailand, Vietnam;
  - Regional Centres: Hong Kong China, Shanghai/Beijing, Tokyo;
  - Global Centres : Exeter, Seoul, Tokyo, ECMWF;

- Severe weather not specifically associated with Tropical Cyclones:
  - NMHS : Chile, Paraguay, Peru, Uruguay;
  - Regional Centres: Buenos Aires, Brasilia ;
  - Global Centres : CPTEC, Offenbach, Washington, ECMWF.

6.4.7 It should be stressed that, while these are firm recommendations regarding the choice of the geographical areas, the lists of participating centres are only indicative and can be modified depending on requirements and further considerations of the relevant Regional Associations.

6.4.8 The Project Steering Group sought additional information from the Secretariat (RCD Department) of the current situation for Eastern European (Eastern RA VI: Balkans, Caucus regions) and Central Asian (Western RA II) countries in relation to possible subprojects where NMHSs could meet the criteria for participating national meteorological centres. The meeting was informed of a regional strategic plan for RA VI, and was provided the Final Report on the Second Meeting of the Directors of NMSs of Countries in Central Asia (Almaty, Kazakhstan, 27-28 2004). The meeting took note of this information, and agreed that consideration of a regional subproject in this region should be given at a future stage of the Demonstration Project, when all the necessary information regarding the position of participating centres with respect to the CBS agreed criteria would be available.

6.4.9 In order to gain the full value of each subproject it is important that all the feedback information is collected, synthesized, and an evaluation report prepared. The lessons learned from this subproject would be vital for the successful conducting of future subprojects in the next stages. The Project Steering Group recognized that required resources would not be available from participating centres and therefore recommended that additional funds be found to hire a consultant to perform this evaluation task.

7 Input to the development of a guide for planning regional subprojects
(Agenda Item 7)

7.1 The Project Steering Group decided that in order to provide a guiding framework for the design and planning of a specific regional subproject, i.e. a project implementation plan for each subproject, it would develop a “guidebook” which would provide as much detailed guidance as possible, without overly limiting the specific terms of each regional subproject. Each regional subproject team would use the guidebook for its planning, implementation and execution.

7.2 The Project Steering Group developed a basic table of contents for the guidebook as well as some text for its key components. A number of the sections of the guidebook will include text from the Overall Project Plan, or from this Report of the Meeting of the Project Steering Group. In addition the Steering Group developed some additional text as input to a first draft of this “SWFDP Guidebook on Planning Regional Subprojects”. This text can be found in Appendix V. The WMO consultant will proceed to produce a first draft of the SWFDP Guidebook.

7.3 The Project Steering Group developed a list of milestones in relation to the one regional subproject that it has recommended to initiate in 2006, that being for southeastern Africa, in the case of severe weather forecasting of events not specifically associated with tropical cyclones. The milestones are found in the annex to this paragraph.

8 Any other business *(Agenda item 8)*

8.1 There was no other business.

9 Closing *(Agenda item 9)*

9.1 The meeting was closed at 16:30, 16 December 2005.

Annex to paragraph 6.4.2

List of Recommended Regional Subprojects with NMHSs/Centres for possible participation in the SWFDP (16 December 2005)

A. Heavy precipitation and strong winds, mainly associated with Tropical Cyclones

A1 - RA II

NMHS	Regional Centre	Global NWP Centre
Vietnam	Tokyo	ECMWF
Philippines	Shanghai/Beijing	Seoul
Laos	Hong Kong, China	Tokyo
Cambodia		Exeter
Thailand		

TC season: February – November

A2 – RA V

NMHS	Regional Centre	Global NWP Centre
Fiji	Nadi	ECMWF
Samoa	Darwin	Melbourne
Vanuatu		Exeter
Cook Islands		
Tonga		

TC season: December – May

A3 – RA IV – Central America

NMHS	Regional Centre	Global NWP Centre
Guatemala	Miami	ECMWF
Honduras		NCEP
Belize		Exeter
Nicaragua		
Costa-Rica		
Salvador		
Panama		
Dominican Republic		
Haiti		

TC season : June – November

B. Heavy precipitation/flash flooding and strong winds, not specifically associated with Tropical Cyclones

B1 – RA I - Subtropics

NMHS	Regional Centre	Global NWP Centre
Botswana	Pretoria	ECMWF
Zimbabwe	La Réunion	Exeter
Mozambique	ACMAD	NCEP
Madagascar		
Tanzania		

Severe weather season: November – May

B2 – RA I - Tropics

NMHS	Regional Centre	Global NWP Centre
Tanzania	Nairobi	ECMWF
Uganda	ACMAD	Offenbach
Kenya		NCEP
		Exeter

Severe weather season: March – May; October – December

B3– RA III

NMHS	Regional Centre	Global NWP Centre
Venezuela	Brasilia	ECMWF
Ecuador		CPTEC (Brazil)
Colombia		Offenbach
Guyana		NCEP
Suriname		
Bolivia		
Peru		

Severe weather season: November – May

B4 – RA III – Mid-latitudes

NMHS	Regional Centre	Global NWP Centre
Chile	Brasilia	ECMWF
Paraguay	Buenos Aires	CPTEC
Peru		Offenbach
Uruguay		NCEP

Severe weather season: May – August; December – February

Annex to paragraph 7.3

Required milestones and associated dates for PSG regional subproject recommended for first implementation

1. The recommended subproject is envisaged to possibly involve the following participants:
   - NMHS: Botswana, Madagascar, Mozambique, Tanzania, Zimbabwe;
   - Regional Centres: Pretoria, La Réunion, ACMAD;
   - Global Centres: Exeter, Washington, ECMWF;

Given that the season when severe events are likely to occur is from November to May, there should be sufficient time left for the preparation of the subproject in order to start the field phase in November 2006.

2. The following milestones and dates are proposed, for implementation in 2006:
   - Draft project plan submitted to PSG: May 2006
   - Kick-off meeting (incl. definition of success criteria) July 2006
   - Completion of preparatory training for participants, possibly in conjunction with COF (DMC-Harare) October 2006
   - Field phase Nov. 2006 – May 2007
   - Mid-term review February 2007
   - Final evaluation report submitted to PSG October 2007

APPENDIX I

AGENDA

1. Opening of the meeting

2. Organization of meeting

   2.1 Approval of agenda
   2.2 Agreement of working arrangements

3. Introduction – Severe Weather Forecasting Demonstration Project (SWFDP)

4. Review the Terms of Reference for the Demonstration Project Steering Group

5. Review the Overall Project Plan including the specifications and criteria for suitable demonstration projects and participating centres, implementation, and evaluation

6. Identification of suitable regional subprojects, and their relative priorities

7. Input to the development of a guide for planning regional subprojects

8. Any other business

9. Closing

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APPENDIX II

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APPENDIX III

Severe Weather Forecasting Demonstration Project

Project Steering Group

Draft Terms of Reference
(version 01.10.05)

1. Finalize and approve the Project specifications and the criteria of participating centres in the Project.

2. Decides on the Severe Weather Forecasting Demonstration Project to be implemented in 2006.

3. Provides guidance and review of progress of the Project as required.

Notes:

1) Chairman of the Project Steering Group is the Chair of the CBS OPAG on DPFS, Mr Bernard Strauss (France).

2) Exchanges/discussions to be conducted by e-mail as much as possible, with one meeting at the Project decision stage (December 2005), and one tentative meeting at the evaluation stage (Q2/Q3 2007).

APPENDIX IV

SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT

THE OVERALL PROJECT PLAN

(16 December 2005)

1 WHY A DEMONSTRATION PROJECT ON SEVERE WEATHER FORECASTING?

1.1 Co-operative Work in the Framework of the GDPFS

1.1.1 The aim of the Severe Weather Forecasting Demonstration Project (SWFDP) is to demonstrate how co-operative work among meteorological centres can be further implemented in order to enhance the forecasting process of several types of severe weather and to improve the warning services at the NMHSs.

1.1.2 The Global Data-Processing and Forecasting System's (GDPFS) organization is a three-level system which carries out various functions at the global, regional and national levels. In addition to this organization, several GDPFS Centres are officially entrusted with the responsibility of providing NMHSs with specialized products (i.e. for medium range forecasts, tropical cyclones, and long-range transport of radiological pollutants in emergency response). Nevertheless, for severe weather events which can cause many casualties and damage, enhancing the exchange of existing products or readily adaptable products among GDPFS centres with some NHMSs is desirable.

1.2 Introducing new products and training

1.2.1 During the last decade the skill of NWP models has continuously improved for all forecast ranges and the technique used in the Ensemble Prediction System stands out as an efficient way to provide the forecaster with alternative scenarios or probabilistic forecasts. Initially designed for medium-range global forecasting, this technique is also an efficient way to take into account the various sources of forecast errors (initial state, boundary conditions, model) even for short-range and for limited area forecasting.

1.2.2 Owing to the high computational cost of the EPS technique implying multiple model runs, only a limited number of GDPFS centres are able to operationally implement such systems. Moreover, with respect to severe weather forecasting, several GDPFS centres provide the forecaster with elaborated products such as maps of potential vorticity, convection indices, etc. A SWFDP will provide the opportunity to encourage operational forecasters to utilize and experiment with standard or newly developed products and procedures, which have already been introduced in GDPFS centres and which could be relevant to a number of NMHSs that have not yet used or applied them.

1.2.3 Despite the increasing number of GDPFS centres that run limited-area NWP models, not all forecasters benefit from the recent progress of the NWP techniques nor from the training necessary to efficiently use the large numbers of products available from GDPFS centres.

1.3 The context of the THORPEX research and development programme

1.3.1 The Fourteenth World Meteorological Congress launched in 2003 a 10-year international research and development programme called THORPEX (The Observing System Research and

Predictability Experiment) to accelerate improvements in the accuracy of one-day to two-week high impact weather forecasts.

1.3.2 This programme, which aims to improve the skill of the weather forecasts especially for the case of high impact weather events by taking advantage of the probabilistic forecasts, will experiment with new techniques and products. In this context the implementation of regional severe weather forecasting demonstration projects offers a real opportunity to prepare many NMHSs and all GDPFS centres implement and benefit from the outcomes of the THORPEX research and development programme.

2 THE GOALS OF THE SWFDP

2.1 According to the recommendations of the CBS-XIII (2005), the goals of the SWFDP are the following:

- to improve the ability of NMCs to forecast severe weather events;
- to improve the lead time of alerting of theses events;
- to improve interaction of NMCs with DMCPA before and during events;
- to identify gaps and areas for improvements;
- to improve the skill of products from GDPFS Centres through feedback from NMCs.

(DMCPA – disaster management and civil protection authorities)

3 THE FRAMEWORK FOR REALIZING BENEFITS OF THE SWFDP

3.1 Implementation and experimentation of a cascading process for forecasting centres

3.1.1 The SWFPD will implement a cascading forecasting process implying the participation of selected centres chosen within a geographical area affected by an agreed type of severe weather event. The cascading process aims to ensure the real-time distribution of the relevant available information produced by (originated at) both a Global Centre(s) and a Regional Centre(s) to selected NMHSs. Moreover it is necessary to continue the cascade by making the final authoritative products of hazardous conditions (advisories or warnings) produced by the NMHSs available to the final users such as local Services in charge of hydrology and/or local Disaster Management and Civil Protection Agencies (DMCPA).

3.1.2 A near real-time evaluation will be conducted, based on observations of the meteorological parameters collected at local meteorological stations as well as information gathered on the impacts of the severe weather phenomena as reported by DMCPA Services. This evaluation of the performance of the cascading process will then be provided as feedback to the participating centres to further fine tune the process itself.

3.2 Training of the forecasters before the experiment

3.2.1 Some initial training has to be undertaken prior to the experimentation phase of the SWFDP. Indeed, the forecasters of the NMHSs assigned to the SWFDP project need to know how to optimally utilize the various products coming from the Global Centre(s) and the Regional Centre(s) in the framework of severe weather forecasting (e.g. presentation of EPS products and probabilistic forecasts, special guidance for selected severe weather events, synthesised satellite images, etc.).

3.2.2 Practically speaking there is no need to provide in-depth information on the way the products are produced, but it is essential to emphasize how the products should to be used by the

forecaster in front of a potentially dangerous weather situation. The presentation of case studies will also be indispensable.

3.2.3 It would be expected that the staff assigned to the SWFDP project at the centres involved would maintain close working relationships, whereby “training” and consultations are an ongoing aspect of the routines of the demonstration project.

3.3 Evaluation and conclusion at the end of the project

3.3.1 At the end of the experimentation period of the order of one year (or more if the expected severe weather phenomena or events need a longer time to be well included in the demonstration) a complete evaluation of the project has to be undertaken. The main part of this evaluation consists of a complete assessment about the skill of the forecasts and especially to the ability of the NMC to fulfil the requirements expressed by the responsible civil protection authority. The evaluation must assess how the enhanced severe weather forecasting process of the SWFDP has improved on missed cases of severe weather and reduced the number false alarms. It would be highly beneficial that the NMHS/NMC and the responsible civil protection authority be involved in the evaluation.

3.3.2 The evaluation should also include an assessment on the relevance of the products exchanged among the participating GDPFS and national centres, and of the organization of the whole cascading process, including the near real-time feedback.

3.3.3 Finally, the evaluation of the SWFDP should identify the shortcomings and to propose improvements in order to ensure the sustainability of the cascading process organization among the selected GDPFS and national centres as well as to facilitate an extension of the system to other NMHSs of the same geographical region.

4 THE THREE PHASES OF THE SWFDP PROJECT

4.1 The Severe Weather Forecasting Demonstration Project consists in the implementation of one or preferably several specific regional subprojects dedicated to severe weather forecasting, each exchanging relevant products and experience among selected GDPFS and national centres at the three levels of responsibility.

4.2 The SWFDP project can be divided into three phases as follows:

4.2.1 **Phase I**: **Overall Project Planning**. This phase includes the preparatory work necessary to prepare the project specifications, the list of types of products to be exchanged and the work of the Project Steering Group (PSG) to identify the possible participating centres and to select suitable regional subprojects according to the geographical area, the type of severe weather and the chosen period for the experimentation.

4.2.2 **Phase II**: **Regional Subproject Implementation Planning and Execution**. This phase begins with the preparation of the detailed specifications (data and products to be exchanged, performance measurements, reviewing and reporting) allowing the participants (representatives of the participating GDPFS and national centres) to develop the specific subproject implementation plan and to manage its implementation and then to carry out the experimentation itself which is likely to last about one year.

4.2.3 **Phase III**: **Regional Subproject Evaluation and Conclusion**. This phase includes the analysis and the evaluation of the entire subproject as well as contributing to the evaluation of the overall SWFDP with respect to the goals proposed initially. This phase gives the opportunity to identify gaps and deficiencies, and areas for improvement in order to ensure a sustainability of the

organization tested during the regional subproject and to provide improved specifications for other similar regional subprojects.

4.3 It has to be noted that the Phase II and Phase III are specific to each regional subproject and will be repeated for each of the selected subproject. From the point of view of the project management, it is clear that the overall SWFDP project begins with the first step of the Phase I and ends after completion of the last Phase III of the selected regional subprojects. It is clear also that each selected regional subproject of the SWFDP will have its own date of beginning and date of completion.

5 IDENTIFICATION OF THE VARIOUS STEPS INSIDE THE PHASES OF THE SWFDP

5.1 Preparatory work

5.1.1 The preparation of the overall project planning is assumed by a consultant working in close consultation with the Chairman of the CBS OPAG on DPFS, the CBS Rapporteur on Applications of NWP in Severe Weather Forecasting, and the WMO Secretariat.

5.1.2 The aim of the overall project planning and the specifications of the SWFDP is to define the framework of the regional sub-projects to be implemented (responsibilities of the various GDPFS and national centres, list of data and products to be exchanged, criteria for the selection of participating countries to a subproject, minimum technical means needed, evaluation components) in order to allow the Project Steering Group to select candidate countries and set relative priorities for suitable subprojects.

5.2 Review by the Project Steering Group (PSG) and identifying candidate GDPFS and national centres

5.2.1 The PSG is responsible for finalizing the document that will be sent to the Presidents of the WMO Regional Associations to seek their reaction and agreement to the identified GDPFS and national centres to participate in the regional subprojects.

5.3 Selection of the GDPFS and national centres, setting priorities and planning for the regional subprojects

5.3.1 After reception of the agreement or counter-proposal(s) with supporting information from the Presidents of Regional Associations, the PSG examines the suitability of the candidate centres according to the criteria established for the participation and selects groups of GDPFS and national centres (each group is a subproject) and establishes their relative priorities. This task marks the achievement of the Phase I of the SWFDP.

5.3.2 In close cooperation with the selected groups of the participating Centres, the PSG defines and approves the general planning proposed by the participating Centres; then taking into account the nature of the severe weather phenomena and the geographical area, it determines the suitable starting and ending dates for the regional subprojects.

5.4 Implementation of the first regional subproject and initial training

5.4.1 The centres participating in a regional subproject have to nominate one responsible person from their respective centres (Global, Regional and National). In order to make easier the relationships between the various actors of the regional subproject it is important for the participating centres to agree to the nomination of one individual (Chairperson) who is responsible for the Regional Subproject.

5.4.2 The Subproject Chairperson plans and documents the Regional Subproject, including the details of the cascading process, products to be exchanged, including those provided to the end users, and the method for performing the continuous evaluation, assisted by a consultant provided by WMO Secretariat, and with the assistance of the Regional Rapporteur for GDPFS (member of the Regional Working Group for Planning and Implementation of the World Weather Watch Programme).

5.4.3 Taking into account the time necessary to implement the cascading process, the nature of the severe weather event and the recommendations of the PSG, the Subproject Chairperson sets the starting and ending dates of the experimentation period.

5.4.4 The centres participating to a Regional Subproject organize a kick-off meeting gathering responsible people and forecasters of the NMHSs assigned to the subjproject. This meeting should give the opportunity to define in detail the cascading process and the duties of the Centres, to train the forecasters of the NMHSs how to use efficiently the products and to specify the continuous evaluation procedure.

5.5 Experimentation and continuous evaluation

5.5.1 A continuous evaluation procedure has to be developed and implemented in order to check that the cascading process works well, that the agreed data and products are made available and examined by the forecasters.

5.5.2 In the case of the occurrence or high likelihood of the specified severe weather event the concerned NMHS will inform the Regional and Global Centres involved so that all the relevant products relative to this event could be archived. The preparation and the management of the distribution of the forecasts/warnings to the users (Hydrological Services, DMCPA Services and media) remains under the exclusive responsibility and authority of the NMHS.

5.5.3 The whole documentation (data, guidance, special products, bulletins) elaborated during the event has to be archived by the relevant NMC(s) in order to be able to prepare a comprehensively documented report.

5.5.4 Shortly after the severe weather event a report will be prepared to assess the relevance of the forecast products and the efficiency of the warnings. This report should be elaborated with the co-operation of the end users who are in the important position to assess the services provided the NMHS.

5.6 Conclusion of the regional subproject

5.6.1 After about one year of experimentation the evaluation of the regional subproject will be performed by the participating centres and provided to the PSG for consideration, and for further reporting to CBS.

5.6.2 An optional regional meeting could be organized (if possible with the participation of the member of the PSG representing the relevant Regional Association) in order to draw and share the conclusions of the regional experiment, identify the gaps and define the actions needed to transform the experimental procedures into regular operational procedures. This step marks the end of a regional subproject.

5.6.3 The Chairs of the PSG and of the Regional Subproject should play an important part in encouraging the participating Centres to continue to perform operationally the co-operative procedures and to maintain the operational cascading process beyond the demonstration project.

5.7 Final evaluation of the SWFDP

5.7.1 The PSG in cooperation with the Chairs of the Regional Subprojects will prepare a synthesis document containing a review of the various actions undertaken in the framework of the SWFDP, an analysis of the outcomes and a list of recommendations which will be transmitted to the relevant WMO bodies.

6 THE DEMONSTRATION PROJECT STEERING GROUP (PSG)

6.1 Establishment of a Severe Weather Forecasting Demonstration Project Steering Group

6.1.1 A PSG is established with a chairman served by the Chairman of the CBS OPAG on DPFS. It comprises experts from the various Regional Associations and the CBS Rapporteur on Applications of NWP in Severe Weather Forecasting. The role of the PSG is to define the demonstration project, to select the candidate centres for the regional subprojects, to follow closely the progress of each of these subprojects and to draw conclusions after the achievement of the whole SWFDP. The terms of references of this PSG will be reviewed and adopted at the its first meeting.

6.2 Tasks of the PSG

6.2.1 The PSG examines the preparatory work elaborated for the SWFDP and finalizes the Overall Project Plan, and the set of criteria to be fulfilled by the candidate centres for setting up regional subprojects.

6.2.2 The PSG selects the participating centres for the implementation of regional subprojects and finalizes the various regional subproject planning.

6.2.3 The PSG follows up the progress of the Regional Subproject(s). Regular reports are expected from the regional subprojects, at a minimum of once every 4 months.

6.2.4 The appropriate member of the PSG is invited to participate in the organization, planning and implementation of the Regional Subproject.

6.2.5 The PSG is responsible for issuing a final report on the SWFDP and preparing recommendations to be transmitted to the relevant WMO bodies.

7 TECHNICAL ENVIRONMENT

7.1 General remarks

7.1.1 GDPFS Centres already exchange a large amount of products either in the framework of established WMO responsibilities or by bilateral agreement. It is clear that the implementation of a Regional Subproject has to be performed essentially with the existing products elaborated by Global and Regional Centres. Nevertheless the setting up of Regional Subprojects should be an opportunity for the introduction of new products well suited to enhance severe weather forecasting.

7.1.2 As a consequence of the previous remark, the implementation of a cascading process is likely to cause an additional workload in the Regional Centres in order to prepare and introduce new products and in the NMHSs in order to make them available on the forecaster’s desk.

7.2 Transmission of data and products

7.2.1 The transmission of the relevant data and products should be performed by using the existing means and mainly the GTS which allows to ensure the sustainability of the implemented procedure after the completion of the subproject.

7.2.2 Nevertheless the use of the Web/Internet is strongly encouraged to make the products available in the NMHSs wherever the GTS does not offer the required capability, insofar as the SWFDP represents an experiment of limited duration. It has to be checked that the bandwidth for accessing the Web in the NMHSs is large enough to visualize quickly the various pages.

7.3 Preparation of the feedback from the NMHSs

7.3.1 In order to evaluate the efficiency of the cascading process, it will be important to know the real usefulness of the products and how often they are beneficial for enhancing severe weather forecasting. The evaluation of the efficiency of the forecasts needs also to collect the feed back from the DMCPA in order to assess the number of successful and missed forecasts as well as the false alarms. All these data have to be collected as soon as possible after the occurrence of a severe weather event.

7.3.2 It is important to minimize the workload required to prepare the feedback information after the event. To this aim it is recommended to define special forms containing a limited number of input data which can be easily stored in a tabular form according to an agreed standard (*.xls file for example).

8 THE ROLE OF THE GDPFS CENTRES AT THE VARIOUS LEVELS

8.1 The Global Centre

8.1.1 The Global Centre provides the other Centres essentially with medium range products which include not only guidance from a deterministic global model but also the general products which can be obtained by means of EPS.

8.1.2 The Global Centre strives to produce probabilistic products specially adapted to the concerned severe weather event.

8.1.3 The Global Centre is responsible for the evaluation of the efficiency of products dedicated to medium range severe weather forecasting taking into account the feedback provided by the other Centres.

8.2 The Regional Centre

8.2.1 The Regional Centre transmits (if necessary) to the selected NMHSs the relevant products issued from the Global Centre ; the model fields can be also reduced to fit the relevant geographical area.

8.2.2 The Regional Centre provides the NMHSs with its own interpretation of the medium range guidance, including EPS products ; If there is a possible choice between several scenarios, one of them leading to severe weather, the Regional Centre can specify the most likely scenario and indicate the objective reasons for its choice.

8.2.3 - The Regional Centre provides the NMHSs with the NWP guidance for the short range, as frequently as possible, including special products (or relevant satellite pictures) adapted to the severe weather event, .

8.2.4 It would be highly desirable, in the framework of the SWFDP, to issue a special bulletin summarizing the interpretation of NWP products with respect to severe weather over the responsibility area of the NMHSs

8.2.5 The Regional Centre is responsible for the evaluation of the efficiency of its own interpretation of EPS products as well as its NWP guidance.

8.3 The National Meteorological Centre

8.3.1 The NMC interprets the guidance provided by the Global Centre and the Regional Centre. This guidance can be compared with the guidance provided by a NWP model running in the NMS in order to provide the users with a final forecast.

8.3.2 In the case of an expected severe weather event, the NMC elaborates special bulletins and warnings as agreed with the end users (hydrological services, DMCPA, media…).

8.3.3 When severe weather occurs, the NMC maintains a close co-operation with the end users in order to provide them with the most recent forecasts and to help them manage the potential crisis situation.

8.3.4 The NMS also informs the end users when the severe event and its hazardous consequences are going to end.

8.3.5 After the event the NMC collects the information about the consequences of the event from DMCPA services and prepares as soon as possible a report about the severe weather event (including efficiency of the NWP guidance, opportunity of the warning, leading time, seriousness of the consequences …). NMC also archives the whole documentation (charts, bulletins, images …) about the event.

8.3.6 The NMC elaborates a synthetic document reporting about the weather event containing a set of data ready to be used (according to an agreed format) and sends them to the Regional Centre.

9 INVOLVEMENT OF WMO SECRETARIAT

9.1 Initialization of the SWFDP

9.1.1 The Secretariat of WMO, with the assistance of a consultant to prepare necessary documents, initializes the SWFDP and proposes to the PSG a general framework for the development of the SWFDP.

9.1.2 It assists the PSG with the task of finalizing the Overall Project Plan and the specifications for the choice of the participating centres.

9.2 Ongoing work of the SWFDP

9.2.1 The WMO Secretariat facilitates and participates in the various meetings of the SWFDP (e.g. PSG, Regional Subproject).

9.2.2 It coordinates the work to be done for collecting and distributing the general information about the development of the SWFDP.

9.2.3 At the end of the project, the WMO Secretariat assists the Chairman of the CBS OPAG on DPFS: to inform the relevant WMO bodies about the outcomes of the SWFDP, and to make

proposals to facilitate the sustainable operational implementation of the cascading process beyond the demonstration project.

10 TIMETABLE AND MILESTONES FOR THE SWFDP

10.1 In the planning of a specific regional subproject, its implementation plan must include a timetable for the major milestones, including associated dates of completion:

- Draft subproject plan submitted to PSG;
- Kick-off meeting (incl. definition of success criteria);
- Completion of preparatory training for participants;
- Field phase (start and end dates, approx. 1 year duration);
- Mid-term review;
- Final evaluation report submitted to PSG.

APPENDIX V

Development of the "SWFDP Guidebook on Planning Regional Subprojects"

1. This appendix contains input provided to the development of the "SWFDP Guidebook on Planning Regional Subprojects.

2. The following main headings of a Table of Contents was developed and proposed by the Project Steering Group (PSG):

- Purpose of the Guidebook
- General Introduction
  - Objectives
  - Cascading process
  - Expected benefits
- Preparation of a regional subproject
  - Subproject approval
  - Setting up of management structure
  - Designation of responsibilities of participants
  - Subproject plan
- Required milestone dates
- Examples of Products for Exchange (for all participating centres)
- Evaluation and reporting (for all participating centres)
  - Proposed template for reporting

3. The Project Steering Group developed the following texts as input to some sections of a first draft of the "SWFDP Guidebook on Planning Regional Subprojects":

Preparation of Regional Subproject

Subproject approval

WMO Secretariat: 1) seek consent of RA President, 2) to the heads of participating centres and request their commitment;

Setting up of management structure

Composition of the management team:

- Chair of the subproject;
- Lead (contact) persons at each of the participating Global, Regional and National Centres;
- Project Steering Group (PSG) contact point;

Steps for the designations

- WMO Secretariat request RA president for designation of subproject chairperson;
- PSG chairman: designate contact point from PSG;
- Subproject chairperson: requests each of the participating centres for designation of lead contact person;

(N.B.: supporting documentation to be provided by WMO Secretariat as required, e.g. web page)

Designation of responsibilities of participants

(refer to Overall Project Plan)

Subproject plan

- Required milestones
  - Draft subproject plan submitted to PSG
  - Kick-off meeting (incl. definition of success criteria)
  - Completion of preparatory training for participants
  - Start of the field phase
  - Mid-term review
  - Submission of a final report to PSG

- Technical preparation
  - Finalize:
    - Lists of products
    - Evaluation procedures
  - Check required supporting infrastructure:
    - Telecommunications
    - Data-processing and storage capabilities (depending on types of products)

- Planning of Meetings required
  - Kick-off meeting
  - Preparatory Training: to be organised by WMO Secretariat leveraging with existing training programmes
  - Other meetings as required

- Costs
  - Subproject management to provide costing for Meetings and training
  - PSG to review costing

Example of Products for Exchange

1 Introduction: General organization of the three level cascading process

1.1 The SWFDP implies a co-ordinated work between three types of DPFS centres. It should logically involve one Global centre, one Regional centre and a small number of NMSs in the area of responsibility of the Regional centre.

1.2 According to the conclusions of the CBS-XIII, the proposed SWFDP is an excellent way to apply the cascading approach in three levels:

- Global NWP centres to provide available NWP products, including in the form of probabilities;
- Regional centres to interpret information received from global NWP centres, run limited-area models to refine products, liaise with the participating NMC;
- NMCs to issue alert, advisory, severe weather warning; to liaise with disaster management authorities; and to contribute to the evaluation of the project.

1.3 Each centre will be required to tailor the list of products to the requirements of the particular Regional Subproject.

2 Roles of each centre

2.1 In the framework of the cascading process specific tasks are attributed to the various centres participating to the SWFDP depending on their level in the cascading process.

2.2 According to the recommendations of the CBS XIII, the responsibilities of the participating centres can be defined as follows:

2.2.1 Global NWP Centres:

Commit to provide a range of NWP products over area covered by the project for the duration of the SWFDP): deterministic models, EPS output such as extreme weather index, probability precipitation/wind exceeding a certain threshold.

2.2.2 Regional Centres:

a) Early (medium-range) alert: interpret information received from global NWP centres, develop diagnostics products/guidance material on potential of severe weather based on EPS products (timeframe up to 7 days ahead of time); make the information available to participating NMC(s);
b) Short-range severe weather guidance: as it gets closer to event, run limited-area model to refine products, confirm potential for severe/extreme weather, provide more detailed information (36-48h);
c) Establish communications between regional centre and participating NMC;
d) Perform the evaluation of cascade approach from regional centre perspective;
e) Provide feedback to participating global NWP centres.

2.2.3 The various participating NMCs:

a) Liaise with disaster management and civil protection authorities;
b) Establish contacts with above agencies prior and during event;
c) Interpret information received from Regional Centres and assess diagnostics products against available information and make adjustments as required;
d) Apply nowcasting techniques;
e) Issue alert, advisory, warning as appropriate;
f) Perform evaluation of cascade approach from a forecaster perspective;
g) Provide feedback to regional centre on usefulness and skill of product;
h) Get feedback from users.

2.2.4 A list of the types of forecasts and products to be exchanged in the framework of the SWFDP for severe weather not associated with Tropical Cyclone SWFDP is given in the Annex A attached to this Appendix, and for severe weather associated with Tropical Cyclone SWFDP in Annex B attached to this Appendix.

Evaluation and reporting involving the participating centres (exchange of information for purposes of evaluation)

1. Information for the purposes of evaluation will be required to be relatively brief in order to ensure that it is completed on a regular basis. It is proposed that evaluation is done in the form of a questionnaire (template in Annex C attached to this Appendix) to ensure consistency and allow rapid completion. The questionnaires are completed first at the NMCs and then passed on to the regional centres to add to the evaluation and to the global centres for information and comments.

2. It is envisaged that evaluation is structured as follows:

- NMSs will complete questionnaires on a daily basis recording:
    - Observed severe weather events
        - Start and end times
        - Weather elements and severity;
        - Warnings issued to users for such events
            - Lead-time of earliest warning;
            - If probabilistic, give details;
            - Weather elements;
            - Severity.

    - Which information was used to help issue warning?
        - Guidance bulletin from regional centre?
        - Limited-Area Model forecast from regional centre?
        - EPS information from global centre?
        - Deterministic model forecast from global centre?
    - Any feedback from users.
- Regional centre should have the opportunity to add comments to the evaluation by the NMSs.
- Synthesis of evaluation information will need to be compiled, and resources for this task will need to be included in project planning.

Annex A - Example of Products for non-TC SWFDP

1. Data and products issued from the Global centre toward the other centres.

1.1 Products should be provided in graphical form via Internet web pages for rapid display and dissemination, and may also be made available by other methods (eg ftp).

a) Current deterministic NWP fields up to 7 days at 6h intervals (may be 12h intervals after 3 days).

Recommended products include:

- Charts to depict the large-scale flow (eg. 500hPa , 700 hPa, 850 hPa geopotential height, upper air winds, MSLP, 850hPa temperature,)
- Surface weather elements (eg. 6-hour accumulated precipitation, surface (10m) wind-speed)

b) Probabilistic forecast products based on EPS:

- probability of severe weather events such as precipitation and wind higher than given thresholds;
- spaghetti plots, e.g.
  - 500hPa geopotential height (in extra-tropics)
  - precipitation and wind higher than given thresholds
- stamp maps (eg. Streamlines (tropics), windspeed, accumulated precipitation);
- representative members of a classification of weather pattern (clustering or tubing) (optional product depending on ability of global centre);
- severe weather risk index (eg. Extreme Forecast Index) (optional);
- dispersion diagrams (plumes and EPSgrams) for weather elements at specific locations.

2. Data and products issued from the Regional centre toward the NMC

Products should be provided in graphical form via internet web pages for rapid display and dissemination, and may also be made available by other methods (e.g. ftp).

2.1 Toward the NMSs

a) Interpretation of products from the Global centre and issue of commentary (severe weather bulletin), containing (as required);
   - interpretation of EPS products,
   - severe weather forecast.

b) Current deterministic Limited Area Model fields up to 2 days at 6-hour intervals;

Products could include, for example:

- Charts to depict the large-scale flow (eg. 500hPa, 700hPa, 850 hPa geopotential height, upper air winds, MSLP, 850hPa temperature, tropopause height)
- Surface weather elements (eg. 6-hour accumulated precipitation, surface (10m) wind-speed and gusts (if available), 2m temperature, 850hPa specific humidity)
- maps of potential vorticity or height of specified PV surface;
- vertical velocity;
- maps of convective indices such as CAPE, Lifting Index, helicity…,

c) Relevant satellite images (where NMSs do not have satellite receiving capability);

d) Special products derived from satellite images (eg derived precipitation or images annotated with guidance notes);

Note: Frequency of products and minimum products set for daily distribution should be decided at the kick-off meeting.

2.2 Toward the Global Centre

Copy of severe weather bulletins for information.

3. Data and products issued from the NMS(s)

3.1 Toward the users (hydrological services and/or DMPCA services).
Products should be agreed in the planning stage of the project according to the needs of the users, but might typically include:

a) Warning bulletin in case of severe weather, including information on probability;
b) Outlook bulletin for potential threats ahead;
c) Additional specific maps (if necessary).

3.2 Toward the Regional Centre

a) Acknowledgement of the severe weather bulletin;
b) Near-real-time information on events (including false alarms and non-forecast events).

Annex B - Products for Tropical Cyclone SWFDP

1. Data and products issued from the Global centre toward the other centres.

1.1 Products should be provided in graphical form via Internet web pages for rapid display and dissemination, and may also be made available by other methods (eg ftp).

a) Current deterministic NWP fields up to 7 days at 6h intervals (may be 12h intervals after 3 days).

Recommended products include:

- Charts to depict the large-scale flow (eg. 850, 700, 500, 200hPa wind flow and relative humidity and 500hPa geopotential height, MSLP, surface streamlines)
- Charts to assist with forecasts of tropical cyclone formation, movement and intensification (e.g. 850, 200hPa relative vorticity and convergence, 850-400hPa deep layer mean flow, 850-200hPa vertical wind shear, vertical motion)
- Surface weather elements (eg. 6-hour accumulated precipitation, surface (10m) wind-speed)

b) Probabilistic forecast products based on EPS:

- surface or 850hPa vortex track charts
- tropical cyclone position fix and track forecast spread (strike probability)
- probability of precipitation and wind higher than given thresholds;
- tropical cyclone formation probability
- spaghetti plots, eg.
  - 500hPa geopotential height (in extra-tropics)
  - precipitation and wind higher than given thresholds
- stamp maps (eg. Streamlines (tropics), windspeed, accumulated precipitation);
- representative members of a classification of weather pattern (clustering or tubing) (optional product depending on ability of global centre);
- severe weather risk index (eg. Extreme Forecast Index) (optional);
- dispersion diagrams (plumes and EPSgrams) for weather elements at specific locations.

2. Data and products issued from the Regional centre toward the NMC

2.1 Toward the NMSs

a) Interpretation of products from the Global centre and issue of commentary (tropical cyclone formation probability, possible movement or intensification scenarios), containing (as required);

- interpretation of EPS products,
- tropical cyclone formation probability, precipitation or severe wind forecasts.

b) Current deterministic Limited Area Model fields up to 2 days at 6-hour intervals;

Products could include, for example:

- Charts to depict the large-scale flow (eg. 850, 700, 500, 200hPa wind flow and relative humidity and 500hPa geopotential height, MSLP, surface streamlines)
- Charts to assist with forecasts of tropical cyclone formation, movement and intensification (e.g. 850, 200hPa relative vorticity and convergence, 850-400hPa deep layer mean flow, 850-200hPa vertical wind shear, vertical motion)
- Surface weather elements (eg. 6-hour accumulated precipitation, surface (10m) wind-speed)

c) Relevant satellite images (where NMSs do not have satellite receiving capability);

d) Special products derived from satellite images (eg derived precipitation or images annotated with guidance notes);

2.3 Toward the Global Centre

Copy of bulletins for information.

3 Data and products issued from the NMS(s)

3.1 Toward the users (hydrological services and/or DMPCA services).

Products should be agreed in the planning stage of the project according to the needs of the users, but might typically include:

a) Outlook bulletin for potential tropical cyclone formation, Tropical cyclone Alert or Watch containing possible tropical cyclone movement or intensification scenarios;
b) Tropical Cyclone Warnings;
c) Additional specific maps (if necessary, e.g. forecast track maps, strike probability).

3.2 Toward the Regional Centre

a) Acknowledgement of the severe weather bulletin;
b) Near-real-time information on events (including false alarms and non-forecast events).

Annex C – Sample Template for the questionnaire for gathering data on severe weather observations and forecasts for the purpose of evalution

TEMPLATE OF THE EVALUATION FORM
SEVERE WEATHER EVENT FORECAST OR OBSERVED

Part to be filled by the NMHS

Event Number: |__|__|

Type of event: |__| **1: Heavy Precipitation, 2: Strong wind, 3: ……..**

Severe Weather Observed **(to be filled even if no severe weather has been forecast)**

- **Start of the event:** |__|__|__|__|__|__| **at** |__|__|__|__| **U.T.C.**
- **End of the event:** |__|__|__|__|__|__| **at** |__|__|__|__| **U.T.C.**
- **Maximum observed value:** |__|__|__|__|__|__| **Unit**
  (According to the event:
  accumulated precipitation or gusts)
- **Information from the Users: short text explaining the consequences and possibly some figures (number of interventions, casualties, damages, etc…)**

Severe Weather Forecast / **(to be filled even severe weather did not occur)**

- **Time of warning issuing:** |__|__|__|__|__|__| **at** |__|__|__|__| **U.T.C.**
- **Start of the event:** |__|__|__|__|__|__|
- **End of the event:** |__|__|__|__|__|__|
- **Maximum forecast values:** |__|__|__|__|__|__| **Unit**
  (According to the event:
  accumulated precipitation or gusts)
- **Probability (if warning established** |__|__| **%**
  with help of probabilistic forecast)
- **Mark for usefulness of regional centre SW guidance: A - B - C - D ***
- **Mark for usefulness of Global centre SW guidance : A - B - C - D ***
- **Comment including information on usefulness and applicability of used tools**

*** A = Very useful (basis of the warning, B Useful (aided guidance confidence),**
C = Neutral (did not alter forecast), D = Negative (misleading)

TEMPLATE OF THE EVALUATION FORM
SEVERE WEATHER EVENT FORECAST OR OBSERVED

Part to be filled by the Rgional Centre

Event Number: |__|__| recorded on |__|__|__|__|__|__| at |__|__|__|__| U.T.C.

by NMHS ----------

Type of event: |__| 1: Heavy Precipitation, 2: Strong wind, 3: ……..

Evaluation of the Regional Centre Severe Weather bulletin

- **Mark for SW bulletin pertinence 2 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 1 days ahead: A - B - C - D ****

Comments about the value of the short range guidance and the probabilities attached to forecast value of the weather elements:

Evaluation of the Global Centre products

- **Mark for SW bulletin pertinence 1 day ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 2 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 3 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 4 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 5 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 6 days ahead: A - B - C - D ****
- **Mark for SW bulletin pertinence 7 days ahead: A - B - C - D ****

Comments about the value of the medium and short range guidance given by the products issued from the global centre, including EPS products and associated probabilities.

** A = Very good forecast, B Relatively good forecast, C = Relatively poor forecast, D = Wrong forecast