

**WORLD METEOROLOGICAL ORGANIZATION**

**COMMISSION FOR BASIC SYSTEMS**

**SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP)**

**THE OVERALL PROJECT PLAN**

**UPDATED 22 April 2010**



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### 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 phenomena, which in turn would improve the warning services provided by 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. The GDPFS is an underpinning feature for weather forecasts and warning services in all WMO Members. 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 forecasting, tracking and forecasting 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 and use 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 Numerical Weather Prediction (NWP) models has continuously improved for all forecast ranges and the technique used in the Ensemble Prediction System (EPS) 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 or 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 to 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 these events;
- to improve interaction of NMCs with Disaster Management and Civil Protection Authorities (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.

2.2 The CBS-Ext.(06) stressed the need to work with civil protection authorities and media organizations to improve delivery of severe weather warning services to end users. Subsequently, the Public Weather Services (PWS) and DRR aspects have been integrated into the SWFDP.

## **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 SWFDP 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 Near real-time verification and 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, such as those reported by DMCPA services, or news services. This evaluation of the performance of the cascading process, including the quality of the NWP and guidance products, will then be provided as feedback to the participating centres to further fine tune the process and products 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.). Similarly, training is required in service delivery principles and practices including user focus, communication skills and user satisfaction assessment.

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 be used by the forecaster when facing 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 at the end of the experimentation period 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 FOUR 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 four 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, including a training programme, 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.** 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.

**4.2.4 Phase IV: Regional Subproject Long-term Sustainability and Future Developments.** This phase includes long-term sustainability of the benefits gained and a process of continual improvement. This phase gives the opportunity to continuously take advantage of future capability and technology developments, and to foster broadening of activities in synergy with other WMO programmes. In this phase, the responsibility for management, including seeking funding, lies with the Regional Association, while the PSG continues to be informed of developments and to provide advice as appropriate.

**4.3** It has to be noted that the Phase II, III and IV 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 after completion of Phase III of the selected regional subprojects, the responsibility becomes that of the Regional Associations. It is clear also that each selected regional subproject of the SWFDP will have its own date of beginning and date of completion of Phase III and transitioning to Phase IV.

## **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 subprojects 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, giving 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.

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 subproject. 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 in the efficient use of the products and in service delivery aspects 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 a 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 cooperation of the users who are in the important position to assess the services provided the NMHS.

5.5.5 Following the agreed period for the experimentation and continuous evaluation, this is the end of Phase II of the project, and Phase III should commence. The management team could decide to maintain the daily functions, while Phase III is being carried out.

#### 5.6 Conclusion of the experimentation phase 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 the experimentation phase 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 cooperative procedures and to maintain the operational cascading process beyond the demonstration project.

## 5.7 Final evaluation of the experimentation phase of the SWFDP

5.7.1 The PSG in cooperation with the Chairpersons 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. At this point, this is the end of Phase III and the transition to Phase IV.

## 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 chairperson served by the Chairperson 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.

### 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 3 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 to 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.

7.2.3 The data communication problems that can prevent NMCs from receiving the relevant products have to be identified. Alternate communication means such as dedicated satellite distribution (EUMETCAST, in Africa, for example) should be investigated.

## 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. For this purpose, the evaluation of the efficiency of the forecasts needs to include the feedback from the DMCPA, the media and the public. 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 Ensemble Prediction Systems (EPS). These EPS-based products can extend lead time of anticipating conditions that risk the development of severe weather.

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 could suggest suitable existing satellite imagery and satellite based products that are helpful in assessing global products and for use in nowcasting.

8.1.4 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; in case of 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 The Regional Centre indicates existing satellite imagery and satellite based products that are used for nowcasting purpose.

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.

8.2.6 The Regional Centre could facilitate the flow of all forecasting guidance information to all participating Centres in the SWFDP through a dedicated, password protected, Web site and portal. Ideally, this Web site would be maintained on a 24/7 basis.

## 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 users (hydrological services, DMCPA, Media...).

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

8.3.7 During severe weather events the NMC exchanges relevant information on warnings with participating NMHSs and RSMC.

8.3.4 The NMC also informs the 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, need for the warning, usefulness 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 RSMC.

8.3.7 The NMC implement a practical verification system for forecasts and warnings, including creating a baseline for measuring improvements over time.

8.3.8 The NMC provides RSMC and Global Centres with the feedback on NWP outputs and other guidance products.

8.3.9 In order to optimize the efficiency of the procedures related to Public Weather Services and Disaster Risk Reduction activities to be implemented in collaboration with the users, it is desirable that the NMHSs:

- a. develop a communication strategy and plan to ensure effective response when warnings are issued;
- b. develop mechanisms and facilitate user's (media, DMCPA and the public) feedback for assessment of warning services including developing severe weather impact and risk information at the national and international levels to:
  - identify and segment major stakeholders involved in different aspects of emergency preparedness and response activities nationally and regionally (e.g. humanitarian agencies);
  - mapping of operational emergency preparedness and response decision processes and actions in the participating countries that would require meteorological information for decision and/or support; mapping of decision processes span both national as well as humanitarian agencies providing support to the countries;
  - identify requirements for meteorological products and services, including requirements on information content, format, preferred lead-times, communication and dissemination procedures and any technical advisory services needed to ensure the products and services are understood and appropriately used by the target users;
- c. develop products and services to meet the requirements for meteorological products and services expressed by the users involved in operational emergency preparedness and response;
- d. organize interaction with Media;
- e. develop training tools to facilitate communication with the DMCPA and the Media, including understanding of their respective models of operation, capabilities and limitations;
- f. prepare and strengthen, as appropriate, guidelines to stress exchange of information on warnings between participating NMHSs, and between NMHS and RSMC;

- g. establish a methodology for documentation of experiences.

8.3.10 As the access to the guidance and to various products is essential, the NMC needs to review and identify possible data communication problems and investigate alternate means (e.g. EUMETCAST broadcast) to ensure timely access to the data provided by Global Centres and RSMC in the framework of the SWFDP.

## **9. ROLE AND RESPONSIBILITIES OF WMO SECRETARIAT**

### **9.1 Initialization of the SWFDP**

9.1.1 The Secretariat of WMO, with the assistance of a consultant, prepares 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 Management Team).

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 experimentation phase of the project, the WMO Secretariat assists the Chairperson 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 long-term sustainable operational implementation of the cascading process beyond the experimentation phase of the project.

### **9.3 Disaster Risk Reduction (DRR) assessment**

9.3.1 When considering the initiation of SWFDP subprojects, due consideration should be given to the analysis of Disaster Risk Management (DRM) institutional capacities and receptivity to engage with NMHS provided by the DRR programme;

9.3.2 DRR coordinated projects (such as the Southeast Asia and the Central America and the Caribbean projects) could provide opportunities for initiation of SWFDP subprojects to build the technical capacities of the NMHS, in collaboration with Regional Associations. Particularly for these projects, funding for technical capacity development could be raised through concrete proposals and presentation to potential donors. In this regard, cooperation for development of such proposals would be sought between DRR and the PSG;

9.3.3 Upon request by the PSG, the DRR Programme could assist with development of DRR strategies at national and regional levels on a project-by-project basis.

## **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.