



GFDRR

Global Facility for Disaster Reduction and Recovery

Strengthening Weather and Climate Information and Decision-Support Systems (WCIDS)

Report of Stakeholders Consultations and Program Launch

**World Bank, Washington, D.C.
April 25th – May 6th 2011**

Table of Contents

Summary	3
I. Consultation Notes	5
A. World Bank Stakeholders	6
B. Donor Partners and External Experts	8
II. Program Launch May 5 th 2011	10
III. Outcomes and Next Steps	12
A. Global Weather and Climate Enterprise	12
1. Overview	12
2. Access to Global Information	12
3. Business models	12
4. Case Studies	12
B. Capacity Building and Technical Assistance	13
C. Portfolio development and Operations	13
IV. Expected Results (end CY 11)	13
V. Expected Results (Mid-term 3-5 years)	14
VI. Appendix I Two-Pager WCIDS	15
VII. Appendix II – Agenda Launch	17
VIII. Appendix III – Outline of Global Overview	18

Summary

The Importance of weather, climate and hydrological information is growing due to the need to serve more elaborate societal needs, minimize growing economic losses from natural hazards and help in adaptation to climate change. This information and services are delivered by National Meteorological and Hydrological Services (NMHSs) which in many countries are weak and need considerable support. Responding to this need the GFDRR/FUE in partnership with ARD and TWI has launched the Program on Strengthening Weather and Climate Information and Decision-Support Systems (WCIDS). The Program aims to help the Bank and client countries in three ways by providing analytical support and knowledge management of weather and climate information systems and services; building capacity and providing technical assistance to World Bank teams through workshops, training sessions, and advisory services; and facilitating portfolio development and operations in priority countries.

Two weeks of consultations were held with World Bank and external stakeholders and experts with the objective of identifying and initiating the preparation of WCIDS activities. Following these consultations, a Bank-wide launch of WCIDS took place on May 5, 2011.

Jürgen Vögele, Director of ARD opened the WCIDS launch meeting describing some of the global drivers currently affecting food security and highlighting the importance of an integrated perspective on agriculture, water, health and disaster reduction. He pointed out that amongst these drivers, weather and climate information were critical for informed decisions across many World Bank programs. **David Rogers** presented an overview of the Global Weather and Climate Enterprise and the importance of a demand-driven approach to services. Also described were the recent advances in regional and national warning services, which have highlighted the importance of cross-border cooperation and multi-agency cooperation to deliver coherent warning services. He highlighted opportunities to build on the investment in the global observing and modeling system by developed countries to more effectively strengthen the capacity of developing countries, many of which still have very limited capability to deliver weather, water and climate services that meet the demand of the public and national economic sectors. **Vladimir Tsirkunov** pointed out that despite growing importance of this public sector, in many countries, however, the capacity to deliver weather and climate services degraded during the last 15-20 years due to underfunding and neglect. He described the current Bank activities in strengthening weather and climate information which show increase of analytical support and investments in recent years particularly in ECA and LAC. Practical cases of analytical support and hydromet modernization investments were presented as well as the first lessons learnt in the process. The main objective and expected results of the GFDRR Program on Strengthening WCIDS were presented and discussed.

Participants from AFR, ARD, ECA, SA, MENA, TWI and other units expressed their support for the Program, presented planned or on-going activities in their unit and provided recommendations how to target next steps of the program.

Overall, the consultative process and launch (i) confirmed weaknesses in the delivery of weather and climate services in many developing countries and the growing interest from the client countries to improve services; (ii) identified a need to provide targeted technical support to regional (AFR, SA, EA, MENA) and sectoral (ARD, ENV, TWI) teams in scaling up Bank's assistance and (iii) identified several priority support areas and countries where feasibility studies and project preparation aimed at strengthening early warning systems and WCIDS could be initiated. The external stakeholders and experts helped identify opportunities for donor cooperation, opportunities to strengthen training and highlighted areas where the global weather and climate enterprise needs to improve to support NMHSs in World Bank client countries.

I. Consultation Notes

The formal launch of the GFDRR Program on Strengthening Weather and Climate Information and Decision-Support Systems (WCIDS) took place on May 5th 2011.. The launch was preceded by two weeks of consultations with World Bank and external stakeholders and experts with the objective of identifying and initiating the preparation of WCIDS activities. These discussions were formulated around the two-pager description of the program (Appendix I)

The WCIDS program is formed around three groups of activities:

1. Analytical Support and Knowledge Management
2. Capacity Building and Technical Assistance to World Bank teams
3. Portfolio development and operations in World Bank priority countries

The main partners and stakeholders within the Bank are GFDRR, teams from the regions (AFR, EA, ECA, LAC, MENA, SA), ARD, URB, ENV and Water anchors. Expected external partners and stakeholders include WMO, ISDR, global and regional forecasting and climate centers and National Meteorological Services, which wish to partner support efforts.

The initial 12 month program is to:

- Prepare a global overview of the status and development trends of weather and climate information and decision-support systems;
- Identify and develop innovations in the use of weather and climate information to resolve identified key client risk mitigation issues;
- Prepare a flexible yet structured approach to investment in WCIDS for risk management, including rationale, approach, and costing;
- Support this structured approach through training courses, which illustrate good practices;
- Develop a network of WCIDS experts available to World Bank project teams and client countries in WCIDSs and NMHSs strengthening;
- Launch pre-feasibility studies and projects for strengthening Early Warning Systems (EWSs) and WCIDSs

The 3-5 year program is to:

- Increase the flow of investments to support strengthening EWSs and WCIDSs;
- Improve quality of weather and climate services (i.e., better forecasts and early warnings, better integration of WCIDS in Disaster Risk Management);
- Meet best expectations of counterparts and partners;
- Mainstream WCIDS in agriculture, water resources, energy, climate adaptation;

- Contribute to development and fine-tuning global financial mechanism to support EWSs and WCIDSs, e.g. within the scope of climate adaptation/mitigation instruments.

The results of the consultations:

- Plan of activities and expected deliverables were discussed with stakeholders;
- Specific activities to support delivery of weather, climate and hydrological information in Africa, East Asia, South Asia and MENA were identified;
- An overview of global weather and climate enterprise was shared with World Bank Stakeholders;
- Specific recommendations to strengthen the program team were made, including the Core team and extended team, additional needs of skills and experience, and new consultants; allocation of funding for project teams, analytical support and TA, project identification and preparation, and advocacy within the Bank. These issues will be further discussed with GFDRR management

A. World Bank Stakeholders

Consultations were held with various World Bank internal stakeholders with country, region or sector responsibilities to identify specific needs and opportunities that could be addressed by the WCIDS program.

Detailed input was provided from the Pacific island region of East Asia, which has active programs in disaster reduction and recovery. Their observations are typical of many countries and regions. The Western Pacific is impacted by tropical cyclones, flash floods, floods, wind storms and tsunamis. The WMO regional infrastructure for tropical cyclone warning is well-developed, ongoing regional training and recent investment to improve tsunami warning and response capacity may be starting points for a more comprehensive approach to improving weather, climate and hydrological information relevant to the mitigation of the impact of floods and related hazards. Several issues were highlighted by GFDRR staff in the region:

- There has been a steady decline in the capacity to observe, forecast and warn of pending disasters in many countries in the region. This limits their capacity to provide adequate lead times for flood warnings. Improving lead times could be particularly helpful in reducing loss of lives and livelihoods.
- In many countries meteorology and hydrology are in separate organizations with often poor interaction despite the importance of meteorology for the management and safety of water resources;
- Many island states have very limited capacity to support their public infrastructure resulting in insufficient budget to support meteorological and hydrological services at an adequate level for public safety;

- Maintaining qualified staff in some countries is also an issue for continuity of operations of warning services, especially where there are career opportunities elsewhere;
- It is not clear how comprehensive are the current needs assessments and whether these should be updated;
- While there are many projects in the region, they are not sustainable and a new approach is needed.

In other regions, World Bank teams had similar observations indicating the need to strengthen weather and climate services and in particular to increase their capacity to work more effectively with other sectors.

Consultations with the agricultural sector TTLs (e.g., SA, EAP and AF) highlighted interest in value-added agriculture-weather and agriculture-climate products and services. The importance of developing agriculture-weather products and services in parallel with strengthening weather and climate services was discussed. At the outset of initiative to strengthen weather and climate services, partnerships between weather, climate and agricultural communities (e.g., extension, farmers) should be established. This applies to all weather and climate sensitive sectors, including the public, disaster management, agriculture, water management, and health. It was suggested that joint capacity building training programs need to be developed that include WB staff, client NMHSs and sector experts.

In summary, these discussions with GFDRR and other stakeholders identified the following:

- GFDRR would like the program to focus on 5 or 6 countries or groups of countries (regions) with clear deliverables that can be achieved within 12 months. Priority should be given to countries or regions that would involve cross-sectoral support, for example, water and agriculture, in addition to disaster reduction and recovery (GFDRR priority countries);
- Highest priority would be given to those countries or regions where funding for the implementation of weather and climate service improvements could be identified, such as those with access to IDA or TF funds such as the Pilot Program for Climate Resilience (PPCR);
- Weaknesses in service delivery were cited as a frequent problem; particularly the lack of engagement of NMHSs with client and users. There is a need for much closer cooperation between users and providers of services with greater emphasis on demand-driven services. Even where considerable investments are made by WMO and donors, services still do not appear to meet users' expectations.
- Access to data and information is a problem due to declining capacity in some regions and countries and restrictions on access in others;
- Current working relations with external partners are not very effective and need strengthening;
- The need to strengthen the knowledge base of World Bank staff;
- The need to improve donor coordination instruments.

It was agreed that the World Bank should scale up its support to NMHSs by

- Establishing an Advisory Role to convince government of the high societal and economic significance of weather, climate and hydrological information
 - Making meteorological and hydrological agencies the center of support
- Helping NMHSs to raise their profile within the government using results of economic assessments and analytical work
- Identifying priority investment needs and facilitate financial support by building partnerships with national decision makers and donors to highlight importance of NMHSs services,
- Developing Modernization of NMHSs projects “packaged” within larger sector initiatives in disaster reduction, water resources management, agricultural and public health projects
- Creatively using of new financial instruments of climate adaptation for NMHSs support (e.g. PPCR)

B. Donor Partners and External Experts

Discussions were held with the Finish Meteorological Institute, UK Met Office, NCEP, IRI and Rockefeller Foundation on ways to increase the effectiveness of bilateral and multilateral donor interventions. The Finish government is making significant investments in NMHSs in countries of priority interest to Finland. In many cases these countries correspond to World Bank priority countries. Rockefeller and the Bill and Melinda Gates Foundation are making investments in Africa to strengthen the observing capacity of NMHSs with the aim of strengthening information support to small-holder farmers and improving the reliability and access to insurance and other financial products. The UK Met Office, along with other developed countries, has supported a voluntary contribution program at WMO aimed at strengthening the weakest NMHSs.

There was general agreement that greater transparency would be a first step to increasing the effectiveness of donor support and wherever possible mechanisms should be developed to increase opportunities for synergy between donors. This would also include sharing of assessments that might help accelerate investment in weather and climate services.

The WCIDS team consulted with a small group of available external experts to address several key questions about the weather and climate enterprise and to help identify good practices that could be shared, adapted and implemented in client countries to strengthen and improve the utility of weather and climate information in weather and climate sensitive sectors.

Several key issues were addressed:

- How to strengthen developing countries' access to high quality global numerical weather and climate products?
- How to engage the global centers to encourage a consensus opinion on how to proceed?
- Testing different business / operating models for NMHSs?
- Critical observations;
- Education and training needs.

The external experts confirmed that despite the sharing of key parameters between the global modeling centers and developing countries' NMHSs, more could be done to make this process sustainable. Currently data and information are provided a by-product of a national need, or as a part of demonstration projects, which are not considered operational. The external experts and WCIDS team agreed to explore various mechanisms to address this issue by, in the first instance, discussing with the appropriate WMO bodies responsible for the global modeling centers.

NMHSs operate different business models depending on government requirements. Models include wholly government supported public sector services from a single source, such as the US National Weather Service; a mixed model involving contractual arrangements negotiated with government agencies that require services and additional budget support from contracted services to the private sector; government owned commercial sector businesses; and government outsourced weather services operated by private companies. Sustaining a modernization program generally requires an increase in operating and maintenance (O & M) budgets of the NMHSs. Therefore an appropriate business model that can ensure that these costs are met is needed.

Observations of the environment are essential to understand current and past conditions and to provide weather and climate forecasts and outlooks. These data inform farming practices and insurance schemes, provide real-time monitoring of stream flows, snow pack information. Investment in observing networks generally constitutes a large fraction of a modernization program budget. Renewal of an in situ network may also provide the necessary data to create a spatially coherent climatology of rainfall data with only a few years of station data, providing these data are combined with satellite information. The net effect is that despite the decline in observing networks partial restoration of climate fields (for precipitation and daily minimum temperatures) is possible, which is essential to baseline many climate applications.

If radar data are limited or not available, it is also possible to develop effective nowcasting techniques using satellite and in situ methods. These techniques will be explored in more detail by the WCIDS team.

The discussions with external experts also identified the importance of training in meteorological and climatological techniques as well as in the provision of specific services to users. It was recognized that both users and providers needed training to fully-benefit from modern meteorological and climatological methods.

II. Program Launch May 5th 2011

The WCIDS program was formally launched on May 5th (see appendix II for the agenda).

Jürgen Vögele, Director of ARD opened the launch meeting describing some of the global drivers currently affecting food security and highlighting the importance of an integrated perspective on agriculture, water, health and disaster reduction. He pointed out that amongst these drivers, weather and climate information were critical for informed decisions across many World Bank programs.

David Rogers presented an overview of the Global Weather and Climate Enterprise¹, highlighting the importance of the demand-driven approach to services, which is increasingly the focus of many modern meteorological services. He described how the entire system is interlinked with data communicated and shared between countries to create the global observing system, which enables models to assimilate data to predict the evolution of the atmosphere on a global and regional scale. He described the importance of ensuring that products from the major global modeling centers are available to developing country NMHSs so that the latter have the best available information to initialize their own models or analyses. It was pointed out that despite this huge global investment in global observations and modeling (exceeding US\$6-8 billion), many countries have very limited capacity to deliver weather, water and climate services that meet the demand of the public and national economic sectors. Also described were the recent advances in regional and national warning services, which have highlighted the importance of cross-border cooperation and multi-agency cooperation to deliver coherent warning services.

Vladimir Tsirkunov described the current Bank activities in strengthening weather and climate information included recent work in Central Asia. He pointed out that NMHSs are a small but important public sector with budgets in the range of 0.01-0.05% of national GDP. The importance of weather, climate and hydrological information is growing due to the need to serve more elaborate societal needs, minimize growing economic losses and help adaptation to climate change. NMHSs in many countries, however, have seen their capacity to deliver these services degrade during the last 15-20 years. In general, this has occurred through underfunding resulting from social and economic reforms and military conflicts. This underfunding has led to:

Deterioration of observation networks and outdated technology

¹ Rogers and Tsirkunov's presentation can be found at:
<http://community.worldbank.org/pg/file/382122/read/802669/ppt-weather-and-climate-enterprise-services-presentationlaunch-wb-5-may-2011>

- Lack of modern equipment and forecasting methods
- Insufficient Research & Development support
- Erosion of a workforce, lack of trained specialists
- Poor quality of services

As a result countries have suffered an increase of “excessive” economic losses, increase risks, and loss of lives, which could have been avoided. Inadequate NMHSs capacity and lack of basic observational infrastructure are major obstacles for improvement of service delivery.

The generic issues and lessons learned from the past and current hydromet modernization programs were described. These include:

- Links with clients are often poor and their needs are not known to the NMHSs
- Fundamental change in NMHSs business model, which supports better service provision, is an ultimate objective of modernization with the users’ needs driving the process rather than IT or technology developments.
- Generic problems of public sector in developing economies (low salary, lack of flexibility and uncertainties)
- Sustainability of investment is major problem, and sustainability considerations must be explicitly included in the process of designing investments
- Need for development of a systemic and integrated (NMHS-wide) “end-to-end” approach that removes bottlenecks and inefficiencies in the NMHSs’ systems
- There are no universal or quick solutions to improve NMHSs’ services. A flexible design and long term engagement (10 years +) is required.
- There is a lack of international experience in how to build or modernize NMHSs with no comprehensive guidelines on how to use the new globally available Numerical Weather Predictions and other products and design an up to-date hydromet system
- Better coordination between donors is highly desirable, including strengthening partnerships with WMO, ISDR, donors, international financial institutions, and others
- Approaches include: assessments/feasibility studies and policy dialog; building government and World Bank country units commitment; identifying and implementing investment projects, improving services delivery, saving lives, reducing losses and improving business environment
- Instruments – Loans, grants and co-financing with a few self-standing projects in major countries; and inclusion as components of broader projects in DRM, agriculture, WRM, and regional projects

Representatives of AFR, EA, ECA, MENA, GFRDRR, Water, and Agriculture anchors responded by articulating some of their needs for weather, water and climate information, highlighting in

some cases where past problems have limited the effectiveness of program implementation, and identifying several priority support areas and countries where WCIDS support is desirable.

III. Outcomes and Next Steps

A. Global Weather and Climate Enterprise

1. Overview

The consultative process provided additional ideas for the global weather and climate enterprise study creating a sharper focus and greater reliance on case studies that can be used as templates to support modernization activities (See Appendix III).

2. Access to Global Information

During the consultation process, it was proposed that one way to address the issue of greater access to global NWP and climate products was to discuss the matter collectively with the global centers through the WMO Working Group on Numerical Experimentation (WGNE). This issue will be addressed to the WMO secretariat in the first instance for their opinion on how to proceed.

3. Business models

Various independent efforts are underway to quantify the positive and negative benefits of different business models. These include an internal World Bank effort; a contract with a Consultant to quantify the UK Met Office business model and explore other approaches; the Rockefeller and Bill and Melinda Gates Foundation study aimed at developing a business model for agricultural information with the Kenyan Meteorological Department and other stakeholders; and wider consultation within the weather and climate services community.

4. Case Studies

The discussions with stakeholders and external experts led to suggestions for a series of case studies that would be useful in informing World Bank activities in the weather and climate services sector. Case studies have been initiated in:

- Use of weather and climate information in WB agriculture programs
- Good practice in institutional strengthening between national entities – Ministries of agriculture, health, environment and transportation, for example. Experience in Africa will be emphasized
- The development and implementation of Multi-Hazard Early Warning Systems and how good practice could be applied to modernization programs in developing countries
- Utilization and training in new techniques in observing to exploit the synergy between space-based remote sensing and in situ observations. An example from Ethiopia.
- Best practices and guidelines for modernization programs based on the Central Asia regional hydromet modernization program

- Training and Education good practices in support of the delivery of demand-driven weather, climate and hydrological services
- Quantification of the social and economic benefits of Severe Weather Forecasting Demonstration Projects with the aim of expanding and deepening the approach.

B. *Capacity Building and Technical Assistance*

- Provide technical assistance to the World Bank teams dealing with WCIDS and NMHSs
 - Review of GFDRR and WB portfolio to identify operations which may need assistance
- Launch regular interactions with regions and teams (EA, SA; LAC, MNA, AFR, anchors), and a WCIDS website with supporting documentation
- Facilitate access of DRM, ARD and other interested WB teams to NOAA and National Weather Service facilities and best practices
- Develop training modules and good practices for GRM Regional coordinators and World Bank TTLs
- Support of sector specific activities through interactions with users
- Partnerships with leading forecasting centers (NCEP, etc) and WMO to support training of staff from NMHSs and the users of their services.

C. *Portfolio development and Operations*

The consultative process with regions and teams identified the following promising projects:

- Africa – Ghana, Burkina Faso, Togo, Mozambique (other target countries in Africa are under discussions and will be identified in 2-3 months),
 - assistance to water resources management and disaster reduction in Zambezi and Volta River basins
- East Asia – Vietnam, Lao, Cambodia, Pacific region
- South Asia – Nepal

MENA – Yemen, Djibouti

The consultation also identified the need to support PPCR (Yemen, Nepal, Mozambique, Zambia and other countries); to provide technical support for project preparation and implementation; and to test and apply good practices identified in analytical and capacity building activities of the Program.

IV. *Expected Results (end CY 11)*

- Operational action plan designed to assist GFDRR/WB to scale up investment and development support in the sector;

- Innovative practices in using weather and climate information for improving EWSs and reducing disaster risk (e.g., knowledge application connector web portal);
- Network of WCIDS experts available to provide assistance to WB project teams and client countries in WCIDS and NMHSs strengthening;
- Pre-feasibility studies and projects launched to support strengthening EWSs and WCIDS (existing GFDRR and WB portfolio are respectively, the first and the second priority);
- First draft of global overview of status and development trends of weather and climate information and decision-support systems;
- Draft training courses and good practices for analytical support and investing in WCIDS and NMHSs;
- GFDRR and WB portfolio review.

V. Expected Results (Mid-term 3-5 years)

- Increased flow of investments to support strengthening EWSs and WCIDSs;
- Improved quality of weather and climate services, better forecasts and early warnings, better integration of WCIDS in DRM;
- Reduced economic losses attached to weather events
- High rate of satisfaction with services provided by the Program expressed by recipients (GFDRR/WB teams and NMHSs);
- Evidence of mainstreaming of WCIDSs in sectoral operations in agriculture, water resources, energy, climate adaptation;
- More effective partnerships;
- Global financial mechanism supporting EWSs and WCIDSs as a part of global climate adaptation/mitigation instruments

The WCIDS team is planning to discuss with GFDRR management how to achieve these results taking into account operational procedures (procurement), budget and staffing constraints, operational modalities with WB teams.

VI. Appendix I Two-Pager WCIDS



Reducing Vulnerability to Natural Hazards

GFDRR has established a Program to Strengthen Weather and Climate Information and Decision-Support Systems to help implement the Hyogo Framework for Action 2005-2015 (HFA). Among HFA's five priority actions is "to identify, assess, and monitor disaster risks and enhance early-warning systems." Weather hazards and related events such as hurricanes, heat waves, cold waves, windstorms, floods, and droughts jointly cause more economic damage and loss of life than other natural disasters. In recent decades such damage has shown a growing trend, and climate change may make such events even more dangerous. Strengthening weather and climate information and decision support systems will be a key aspect of implementing the priority to enhance early warning systems highlighted under the Hyogo Framework.

Weather and Climate Information and Decision-Support Systems (WCIDSSs) should serve as triggers or entry points in end-to-end early-warning systems (EWSs) that deliver outlooks, forecasts and warnings for weather hazards and their impacts. Major advances in observation, analysis and prediction of high-impact weather and climate events have been achieved by some countries and are available to all. Today, nowcasting to 48-hour forecasts, on spatial scales of a few kilometers, can provide timely and accurate warnings of flash floods, river floods, tornadoes, storm surges, hurricane tracks and landfalls, and air-quality emergencies. Effective EWSs building on such information have substantially reduced deaths and injuries from severe weather events. Mortality from these events has declined significantly in the United States in recent years because its EWS is continually improving: mortality from tornadoes fell by 45 percent and injuries by 40 percent from 1986 to 1999 thanks to more timely warnings that enabled people to take shelter. Global five-day forecasts have accuracy comparable to two-day forecasts of 25 years ago. There is increasing evidence of predictability of some extreme weather events seven to ten days in advance.

WCIDSSs are usually managed by public entities: National Meteorological Services or National Hydrometeorological Services (NMSs). In many cases a single agency provides weather, water and climate-related services, and sometimes ocean, seismic and other services as well. In some cases, hydrological

Strengthening Weather and Climate Information and Decision-Support Systems

services are housed in distinct agencies but in all cases, hydrological services work collaboratively with national weather services. Jointly, NMSs constitute a global network coordinated by the World Meteorological Organization (WMO). In developed countries, this network is today taking advantage of recent advances in scientific and technical capabilities to better meet the changing needs of society; agencies are deploying state-of-the-art observing and computing systems, re-aligning to deliver services better fit for their purposes, and making substantial investments in training and recruitment. Agencies are emerging from these processes with increased capacity to save lives and mitigate damage from weather events.

The gap between the most-capable and the least-capable NMSs continues to widen. In contrast to agencies in developed countries, NMSs in many developing and least-developed countries lack the capacity and the capability to access recent scientific and technical advances. Such agencies have limited observing networks, little experience in using numerical weather prediction, few opportunities for training, and have recurrent difficulty retaining their best-qualified staff. These circumstances weaken service delivery. The poor weather information services provided in these countries often make early warnings impossible, and lack of warning in turn leads to economic damage and loss of life that could have been avoided. Often, remote communities in which weather-, water- and climate-related vulnerabilities are largest suffer from the absence of even a minimal level of meteorological or hydrometeorological service, with no access to competent warnings enabling informed decision-making.

Strengthening WCIDSSs is important for climate adaptation and sustainable development. WCIDSSs provide a basis for climate change assessments and help develop cost-effective adaptation to weather and climate extremes. WCIDSSs also identify risk-aversion solutions by providing weather and climate forecasts and other information products. These are broadly used for decision-making in agriculture, water resources management and irrigation, transport, public health, and environmental management, among other sectors.

Current EWS portfolio: Through its Disaster Risk Reduction Mainstreaming Program, GFDRR already provides ex-ante assistance to developing countries to strengthen their WCIDSS and EWS capacities. Nearly two-thirds of projects supported by GFDRR focus on upgrading NMSs to improve emergency forecasts and early warnings. In addition, GFDRR works closely with the WMO, supporting countries to assemble necessary climate observations and climate-modeling capacity to design adaptation policies. GFDRR's partnership with the Intergovernmental Authority on Development's Climate Prediction and Applications Centre (IGAD-ICPAC) helps to build climate observation and climate modeling capacities in the national meteorological and hydrological agencies of East Africa.

While support for WCIDSSs and early-warning systems already plays an important role in the GFDRR portfolio, there are additional opportunities to introduce best practices in the development of WCIDSSs and integration of WCIDSSs into end-to-end EWSs, and to build capacity within disaster risk management (DRM) teams to design and implement modern WCIDSSs within the scope of the GFDRR portfolio.

The GFDRR Program for Strengthening WCIDSSs will mainstream development of modern, sustainable, service-oriented weather and climate information systems into the GFDRR and World Bank portfolio. The Program will work as a service center providing analytical, advisory and implementation support for GFDRR/World Bank teams.

The Program will be based on three pillars: Analytical Support and Knowledge Management, Capacity Building and Technical Assistance, and Support to Portfolio Development and Operations.

- ▶ **Analytical Support and Knowledge Management:** This program pillar will build analytical knowledge of weather and climate information systems through reviews of WCIDSS development trends on global, regional and national levels, assessment of knowledge available for sector application, and analysis of

how to achieve sustainability of WCIDSSs and increase their societal value. Reviews will draw on input from a network of experts drawn from NMSs and international, academic, and private sector organizations.

- ▶ **Capacity Building and Technical Assistance:** The Program will assist country clients, GFDRR and World Bank teams working on DRM, climate change adaptation and other objectives where WCIDSS capacity plays an important supporting role. Workshops, training sessions and study tours will be prepared and direct consultations and advisory assistance provided to interested teams. Outputs may include: (i) training courses and materials; (ii) agreed good practices for investment in WCIDSS and NMSs; (iii) identification of innovative practices in using weather and climate information for improving EWSs and reducing disaster risk.
- ▶ **Portfolio Development and Operations:** A special project preparation facility for development of EWS and WCIDSS projects (or major components under broader programs) will be launched. The Program will provide support to GFDRR/World Bank teams who identify major opportunities to advance the DRM agenda by strengthening WCIDSS. Project preparation funds will be allocated for promising or innovative project proposals.

More information on Strengthening Weather and Climate Information Systems Program is available on the GFDRR WCIDSS webpage
<http://www.gfdr.org/gfdr/WCIDSS>

Strengthening WCIDSS Program Contact:

Vladimir Tsirkunov

Program Coordinator, Strengthening Weather and Climate Information and Decision-Support Systems Global Facility for Disaster Reduction and Recovery
E-mail: vtsirkunov@worldbank.org
Tel: +1(202) 458-2326

January 2011

GFDRR is able to help developing countries reduce their vulnerability to natural disasters and adapt to climate change, thanks to the continued support of its partners: ACP Secretariat, Australia, Bangladesh, Belgium, Brazil, Canada, Colombia, Denmark, European Commission, Finland, France, Germany, Haiti, India, Ireland, Italy, Japan, Luxembourg, Malawi, Mexico, Netherlands, New Zealand, Norway, Saudi Arabia, Senegal, Spain, South Africa, South Korea, Sweden, Switzerland, Turkey, United Kingdom, United States, Vietnam, Yemen, IFRC, UNDP, UN/International Strategy for Disaster Reduction and The World Bank.

VII. Appendix II – Agenda Launch

<p>Global Facility for Disaster Reduction and Recovery</p> <p>Strengthening Weather and Climate Information and Decision Support Systems</p> <p>LAUNCH</p> <p>Thursday, May 5, 2011 2 p.m. to 5 p.m. Room: JB1-075</p>		
<p>AGENDA</p>		
2:00 - 2:15 pm	Opening remarks	Juergen Voegele - ARD Michel Matera – GFDRR
2:15-2:35pm	<p>Global weather and climate “enterprise”</p> <ul style="list-style-type: none"> - <i>Global, regional, national perspective</i> - <i>Addressing sectoral needs and improving service delivery</i> - <i>Sustainability and business models</i> 	David Rogers
2:35- 3.00 pm	Bank activities in the sector	Vladimir Tsirkunov Lucy Hancock
3:00 - 3:15pm	WCIDSS – program objectives, proposed approach and activities	Vladimir Tsirkunov
<p><i>Afternoon Tea</i></p>		
3:30-4:00pm	<p>World Bank sectoral and regional perspectives</p> <p><i>(ARD, Water, GFDRR, ENV, Regions)</i></p>	
4:00-5:00pm	Brainstorming how to maximize support to our client countries, WB operational units and programs	

VIII. Appendix III – Outline of Global Survey

Strengthening Weather and Climate Information and Decision Support Systems

Acknowledgements

Contents

Executive Summary	20
Introduction	20
Part I. The Growing Need for Weather and Climate Information to Support Sustainable Development ..	20
Part II. The Global Weather and Climate Enterprise –	20
Infrastructure	20
National Meteorological and Hydrological Services	21
World Meteorological Organization	21
Global Modeling Centers	21
Global Data Centers and Telecommunications	22
Regional Centers	22
Private Sector Services	23
Service Delivery	24
NMHSs Services	24
Early Warning Systems – a special case	24
Business Models – connecting services to production	24
Part III. Potential Opportunities and Solutions	25
Investment Mechanisms	25
Role of Developed Country NMHSs	25
Supporting the Mission of Global and Regional Centers	25
Strengthening Human Capital in Weather, Water and Climate Services	25

<u>Strengthening Client – NMHS relations in Developing Country NMHSs</u>	25
<u>New Business Models</u>	26
<u>Investment in developing Country NMHSs</u>	26
<u>Improving Education and Training Programs</u>	27
<u>Mainstreaming Weather, Water and Climate Information Services in WB Portfolios</u>	27
<u>WB Priorities for National Investment</u>	27
<u>Part IV. Case Studies</u>	27
<u>End-to-End Business Solutions for Kenya Agriculture</u>	27
<u>Shanghai Multi-Hazard Early Warning System Project</u>	27
<u>Severe Weather Forecast Demonstration Projects</u>	28
<u>Managing Climate Risk</u>	28
<u>CAHMP Preparation and Implementation</u>	28
<u>References</u>	28

Executive Summary

{A two to four page summary.}

Introduction

The purpose of this report is to provide guidance to World Bank staff and development partners on the weather and climate information and decision support systems relevant to Bank supported activities. The report has four parts. Part I is an overview of the World Bank identified needs for weather and climate information and observed short-comings. Part II provides a brief summary of the salient components of the global weather enterprise, and how each of these components relate to each other. It identifies the strengths and weaknesses of this system, particularly in the delivery of weather and climate information in developing countries. Part III of the report focuses on potential opportunities and solutions to strengthen weather and climate information and decision support systems. Part IV illustrates some of the opportunities through selected case studies.

The report is result of a combination of desktop analyses based on existing documentation as well as the convening of experts to address particular problems. It aims to engage the World Bank's partners to help ...

The Growing Need for Weather and Climate Information to Support Sustainable Development

This section of the report summarizes the need for weather and climate information for specific regions, countries and sectors. While not exhaustive, it provides a comprehensive overview of the World Bank's perceived need for improved weather and climate information with specific examples from some regions, countries and sectors.

Part II. The Global Weather and Climate Enterprise –

Infrastructure

{This section will provide a brief and succinct description of all of the components that comprise the global weather enterprise; its strengths, its weaknesses; the comparative position of regions, developed and developing countries, the role of various bodies that support this enterprise. The purpose of this is to inform primarily WB TTLs. Only necessary detail will be included. Various sections can be completed by different teams.}

National Meteorological and Hydrological Services

{A brief description of the purpose of NMHSs (perhaps based in part on the role and operation of the NMHSs). The emphasis here is on being brief, just sufficient to inform those who don't understand what NMHSs do.}

Leading Meteorological Services

{Describe the specific capacity of some of the leading meteorological services and the role they play in assisting developing countries. Specific examples could be used here, which will be sidebars in the final report. It is important that we do not focus on one country solutions but on broad engagement.}

Sources: UK MO, MeteoFrance, NWS, Env Canada, FMI, CMA, Germany, etc.

Activity: UK MO will lead this part of the study and invite participation from above and others at their discretion.

Developing Country Meteorological Services

{Discuss general limitations and capabilities. How have they been helped in the past, what has worked what has not. Make sure the issue of human resources is identified adequately here. It will be addressed in a separate section. Some discussion of known strategies could be included here; for example, WMO RA I strategy. This section is not intended to be completely comprehensive since that will require a country-by-country assessment. Must involve NMHSs from developing countries, preferably those with some capacity to lead programs in their own regions.}

Sources: Recent bank studies in Africa, WMO, recent bank studies in Asia; documented Bank priorities

Activity: Desk Study - start with compilation of what we know. Seek input from WMO; other Met Service experts representing different regions and perspectives. Possibly initiate several assessments with NMHSs in WB priority countries to anchor this section. This will depend on available resources.

World Meteorological Organization

{A brief description of the role of the governing body and how it contributes to development and can support WB initiatives. This should also consider the role of other international bodies that have a role; for example, ISDR, UNEP, UNESCO. This should focus on the current situation. An opportunity to discuss new roles will be included in the solutions section and should be informed by the analysis developed for this document.}

Source: WMO

Activity: Desk study

Global Modeling Centers

{This section will describe how the Global NWP centers work and what kind of information is available to client countries and what is available to all NMHSs. Two things are particularly important here. The development of global mesoscale models with resolution of the order of 16km and multi-model ensembles. The implications are that global models could provide NWP support to national centers

and those centers could shift investment to other areas; the success of multi-model ensembles to provide measures of forecast uncertainty means that, for the foreseeable future, multiple centers will be needed, each advancing its codes independently. The focus of most modeling centers is on a limited set of meteorological service clients; in the case of Europe, its members. Each center also provides a limited set of model data for non-member use, but generally only provides operational support for a particular region on a project basis. The exact details of who does what, and how is this supported need to be described as the basis for proposing specific solutions. What NWP services could be provided to developing countries now and in the near future (within 5 years)? What would be the incremental cost of providing these services? The solutions section will pick up on this.}

Source: NCEP (NWS), ECMWF, UKMO, JMA, Roshydromet, CMA, WMO, etc...

Activity: Initiate discussion with several leading centers starting with NCEP. Discuss with NCEP the possibility of convening a meeting of leading experts from global modeling centers. Develop a series of demonstrations (case studies) of capability including the WMO SWFDPs.

Global Data Centers and Telecommunications

{A large component of these is the satellite data and satellite data assimilation centers. Their roles should be called out explicitly because it is one of the largest cost drivers of whole enterprise and largely invisible to most users. Satellite-based remote sensing of the earth is a corner stone of the global numerical weather prediction system. The data from these systems are provided freely and are maintained by a few leading countries. It is unlikely that there will be changes in policy restricting data from meteorological satellites. Satellite data assimilation in numerical models has contributed substantially to NWP improvements. We also need to discuss the sharing of existing data sets and the telecommunication requirements to share data and information securely.}

Source: {need input from NMHS data centers and need someone from satellite community on our team to advise on this. It is not likely we need to touch this, just be aware of the huge investment and payoff from that investment. This should also involve WMO since WIS is a major new development that will affect the exchange of data and information globally.}

Activity: Desk study

Regional Centers

{snapshot of the various existing and planned regional centers, which provide different specialized support to national centers. The solutions section will include innovation. There are many different kinds of regional centers. Some of these are closely aligned with NMHSs, others are not. We should try to identify good practices.}

Weather

FMI is supporting development of Meteo Alarm equivalent application in Southern Africa – lightning detection network. Will utilize MASA as implementing agency...

Climate

{we need input from organizations, such as the IRI and similar entities, which provide climate services to developing countries in collaboration with national centers, including NMHSs. How this fits into the GFCS needs to be understood. Also how these are resources.}

Training

Meteorology related professional training is an ongoing task of the WMO Regional Meteorological Training Centers (RMTCs) hosted by NMHSs or universities. The principal purpose is to provide technical expertise to the staff of NMHSs. In addition, universities provide degree courses and short courses in related fields. Techniques exist for blended and distance learning, which can reach many students, efficiently and cost effectively.

New courses are being developed and implemented, including how to work with users (e.g., FMI).

{need to look at university educational programs, blended learning, as well as regional hydromet and climate training centers. Business training should also be addressed to the extent that it currently exists for NMHSs' staff}

Work with established communities – WMO how to get climate predictability tools, how to bring climate information into existing institutional programs, developing curricula with universities... Case studies...

WMO Regional training center strengthening in Tashkent – by FMI. There will be a user focus on this...

Sources: WMO, Reps of WMO regional centers, University of Reading, Met U. St Petersburg, Nanjing U., U. Oklahoma, American Meteorological Society, IRI, etc.

Activity: **Desk study.** If we have the resources, this could be done by convening a meeting, but in the first instance we should focus on gathering data for a desk study. It is not obvious who has the best knowledge on this, but in a case we should start with WMO.

Private Sector Services

{The role of the private sector in delivering services is growing and the primary means of delivering specialized services in the US, for instance. Competition with NMHSs with a mandate to recover cost or provide a return on government investment creates a complex service environment. Private sector capacity to innovate is increasing, but with it the opportunity to create a complex and confusing market place for information services. This may result in greater social inequities as quality information becomes more restricted (there are some examples of this already).

The internet enables users to access weather and climate information from many sources, often without provenance, and usually not from the local NMS. Many NMHSs perform poorly in this environment. This section should document current private sector practices. Later we will discuss potential ways to strengthen NMHSs in this environment.}

Sources: UK, NZ, France, Norway, South Africa

Activity: {not sure of the best approach yet}

Service Delivery

NMHSs Services

{Briefly describe the range of services provided by NMHSs including public services as well as bespoke services. It will be important to show multi-sectoral benefits from NMHS services, possibly targeting WB operations in WRM, agriculture, transport, health, climate adaptation}

Early Warning Systems – a special case

{This is called out explicitly because of its importance to the WB. The experience of Shanghai Met Bureau is particularly valuable here because of the system that they have created and their experience of partnering with other government agencies to make the warning system work effectively. The lessons learned here should be quantified and opportunities to develop similar systems elsewhere should be explored}

Source: SMB, WMO

Activity: convene a meeting in Shanghai to study the CMA system.

Business Models – connecting services to production

{Summarize the current business models that are used by NMHSs. How they are structured and the benefits and weaknesses of the different systems E.g., UK, South Africa, France, Norway, Finland, New Zealand and US. It will look at mix of institutional, financial, structural and economic issues in NMHSs and may also add cost benefit assessment of NMHSs activities. Another angle may be to look at the whole global system but this will be a major challenge; yet the latter may provide justification for global financial support.

The development of appropriate business models is a key element of development trends in NMHSs, so should be considered here. Factors to be considered include decrease in government spending and an expectation to increase commercial revenue; more services are being outsourced with lower budgets and more limited expectations for public services.

A later section will discuss future models and new practices, so this part should focus on current practice only}

Source: UK, France Norway, Finland US, New Zealand, South Africa, Kenya, China, Brazil, World Bank, WMO

Activity: Convene a meeting or conduct a desk study involving representatives of NMHSs in these countries.

Part III. Potential Opportunities and Solutions

Investment Mechanisms

{What investment is needed and what are the potential sources of that investment. Mechanisms such as PPCR will be described briefly}

Source: World Bank

Approach: Internal WB activity

Role of Developed Country NMHSs

{There exists very well-developed forecast and warning systems based on S&T in leading countries and the benefit of these developments is largely limited to those regions (WMO regions) responsible for this development and often only to the country responsible for the development. That this level of development is of a very high standard so that critical weather systems are well-forecast and, in general, appropriate and timely action is possible. Here we should describe how to share this expertise more effectively? Who pays the incremental costs? And what are the implications for the development of meteorological services in poorer countries?}

In the past, the Bank's efforts to improve meteorological services for development have focused on the specific needs of client countries, often drawing on the capacity of developed country Meteorological Services to assist in modernization programs. However, the expertise of the leading meteorological services could go well beyond assistance in a modernization program to a long-term relationship that provides continuous support to a country or region. At present this is done on a project by project basis, usually with funds from a donor country and can be sustained only for as long as the donor continues to provide support. Another approach should be possible providing an appropriate business model can be developed. This section should also consider cooperation versus competition. }

Supporting the Mission of Global and Regional Centers

{Propose mechanisms to offset the incremental costs of providing more comprehensive information tailored to specific national needs}

Strengthening Human Capital in Weather, Water and Climate Services

{Propose mechanisms to increase the human capacity of NMHSs. For example, through creation of cooperative institutes with universities (discussion with Robert Marten from Rockefeller); much more comprehensive investment in distance learning programs (a suggestion from Maurice ..., PR of Burundi, for example, is to support blended learning programs with universities such as Reading; financial incentives)}

Strengthening Client – NMHS relations in Developing Country NMHSs

{At the national level, many developing countries despite past investment fall far short of the most developed services. There are several reasons. The absence of sufficient sustained financial investment has resulted in the deterioration of the means of forecast production – observing systems,

numerical models, modern forecast workstations, poor telecommunications limiting access to external sources of data.

This has also affected service delivery since without adequate products, customers have limited access to weather and climate information or they find sources outside of the traditional national sources, nowadays through the internet, which can make available products generated beyond national borders. This weakness is further compounded by the inability to attract and pay highly qualified staff.

Here we should develop and articulate an evidence based approach to assist NMHSs work with clients in other government ministries whose portfolios of weather, water and climate sensitive – agriculture, water resources, health, energy, transportation. The aim is to help convince clients of the need to support the O&M costs of NMHSs that provide client-specific products and services}

New Business Models

{Governments are outsourcing more and more public services. This is a trend that is beginning to affect NMHSs. There is a growing private sector and academic sector that together with the government services form the “Weather Enterprise”. There are, as yet untried, opportunities for public-private partnerships to develop more innovative services. Revenue will be an increasingly important component of NMHS operations and therefore good business practices will need to be developed and enforced. New roles for international governance organizations need to be considered. This section should propose some new approaches that can be tested}

Investment in developing Country NMHSs

{What should this investment emphasis? Is it universal or specific to a particular country? Should a modernize program in a developing country try to emulate their sister institutions in developed countries by seeking investment to develop very comprehensive services, which would need to be staffed by high skilled scientists and technicians and would require huge investment in computational and intellectual resources? Or could we, instead, develop an approach that focuses on the specific needs of customers and clients for weather and climate information; taking much more advantage of the huge investment in the global weather enterprise that already exists? Can we find ways to strengthen critical elements of a national infrastructure; and start to address education and training region by region? The latter cannot be separated from the lack of incentive to work in meteorological services, which in many developing countries are relatively low paid professions. This must all be done within the framework of an appropriate business model, which can sustain these services. It is likely that each service will need a specific model; however, each will have common elements needed to ensure the sustainability of the service. See other sections for more guidance}

Source: developing country NMHSs, various WMO strategy documents

Activity: Convene meeting, probably should be WMO led activity involving representatives of developing countries' services.

Improving Education and Training Programs

{Related to the human capital section: this section focuses on what kind of training is needed by NMHSs' staff and by their clients to improve delivery of services and to improve the uptake of those services.}

Mainstreaming Weather, Water and Climate Information Services in WB Portfolios

{Describe how the WCIDSS unit will work within the Bank, how it will interact with programs and with external entities}

WB Priorities for National Investment

{List the priority countries for Bank investment with an explanation of why}

Part IV. Case Studies

{What opportunities exist to demonstrate some of the elements of the approach proposed in this study?}

End-to-End Business Solutions for Kenya Agriculture

{An ongoing project in Kenya is looking in detail at potential business models to more effectively deliver weather and climate information to clients in the agricultural sector while maintain the public goods ethos needed to help subsistence farmers. This should be fully documented here along with other models that may be applicable elsewhere. The project could engage in testing and evaluation of the approach proposed for Kenya. It could also be adapted and applied to Central Asia}

Source: Gates Foundation, Rockefeller Foundation, NetHope/Accenture, Kenya Met Department

Activity: Document ongoing project in Kenya and WB engage if invited.

Shanghai Multi-Hazard Early Warning System Project

The Shanghai Meteorological Bureau (SMB) of the China Meteorological Administration (CMA) has had the challenge of dealing with the derivative hazards caused by high impact weather in a city of more than 22 million people. Even relatively modest weather events can trigger heavy losses due to the high population density and critical economic activities. For example, a heat wave triggers affects the power supply sometimes causing power outages, facility failures and fires, water consumption increases, construction is affected, food security is threatened, food yields drop, vehicle breakdowns increase traffic jams, and heat stress increases the risk of heart attacks or strokes with a resulting impact on hospital and clinical facilities.

Weather services must anticipate derivative impacts in order to prevent the magnification of the consequences. Stakeholders further “down the chain” such as flood control, agriculture, traffic and health services require guidance about the likely impact of the disaster so that they can take effective and timely actions in response.

SMB works very closely with its stakeholders. They are partners, for whom, specific impact forecasts are developed to meet their unique needs. Traditional weather forecasting operations follow a fixed

schedule; however, high impact weather is often short-lived and greater attention has been paid to the timeliness of the forecast for the specific event.... {more to be added}

{Utilize the infrastructure developed by CMA in Shanghai to provide initial training to WB TTLs. Document this training with feedback from WB. Support training of disaster managers in SE Asia to determine the possibility of developing similar systems in other countries.}

Source: SMB

Activity: training for WB TTLs and SE Asia country disaster managers; analysis of training

Severe Weather Forecast Demonstration Projects

{Assess the value of current SWFDPs and based on this propose new initiatives}

Managing Climate Risk

{A case study form Ethiopia}

Source: IRI

Activity Desk study focused on ways to improve rainfall estimates necessary for improved climate information

CAHMP Preparation and Implementation

{Track the CAHMP implementation to document and improve the modernization process}

Source: WB

Activity: Desk study: Document and track the ECSSD CAHMP

References