WORLD METEOROLOGICAL ORGANIZATION

Report of the Meeting of the

Task Force on Socio-Economic Applications of

Public Weather Services

15-18 May 2006

Geneva, Switzerland

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INTRODUCTION

1. The first meeting of the Task Force on Socio-Economic Applications of Public Weather Services was held in Geneva, Switzerland, from 15-18 May, 2006. The Task Force was established by the Secretary General in response to a range of statements and requests by the WMO constituent bodies and in particular, the Executive Council (see Appendix III). The purpose of the Task Force is to provide WMO with recommendations and guidance for assisting the National Meteorological and Hydrological Services (NMHSs) to more fully assess and enhance the socio-economic benefits of weather, climate and water information through their use by the full range of user communities.

2. The Task Force is composed of experts from information user and provider communities and the WMO Secretariat. Each Task Force member has extensive experience in the application of weather, climate, and water services to either the public and/or other users, including agriculture, health, energy, economic aspects of weather and related services, and hazard risk management. The Task Force is chaired by Dr. Donald Wilhite, Director of the National Drought Mitigation Center at the University of Nebraska-Lincoln, U.S.A. A complete list of Task Force members is included in the Appendix I of this meeting report.

3. The programme for the Task Force meeting is included in Appendix II. The first two days of the meeting were devoted to presentations by members of the Task Force representing the user and provider sectors. Subsequent days were directed at identifying existing decision-support tools and their application in key user sectors, developing an action plan and timetable for deliverables, reviewing and redefining the terms of reference for the Task Force (see Appendix III), and reviewing the final report of the Task Force meeting and the delivery timetable. Below is a summary of the principal discussion items that resulted from Days 1 and 2.

USER SECTOR SUMMARY: DAY 1

4. Each Task Force member from a user sector gave a brief presentation of how their particular sector uses the weather, climate, and water information provided by NMHSs. This was the focus of the meeting on Day 1.

5. One of the challenges faced by the Task Force is to determine what level of interaction exists between the users and the providers of information. It was clear from the presentations and discussions that in many cases users of information speak a different language from providers. Users' knowledge of the types of data and information that are available, the types of products that can be provided, and the technological or scientific constraints that may have impact on their application to new products or decision support tools are limited by the level of interaction with NMHSs. Users may know what information is required but due to costs may not seek access to such information. In some cases, lack of access to data has prevented an economic assessment of its 'value' to the user. The availability of the data is often associated more with the policy of providing data than technical or scientific constraints.

6. One of the intended outcomes from the work of the Task Force is the development of an action plan to enhance interaction between users and providers so that NMHSs can better meet the user needs. An important part of that process is for the NMHSs to find better ways to communicate the appropriate levels of uncertainty in the information to the user community.

Key Discussion Points

7. The key points gleaned from the user sector presentations and discussions are presented below.

8. The Task Force will identify examples where interactions between NMHSs and user sectors have been successful. The lessons learnt from these success stories will provide valuable guidance for use by NMHSs. There will be value in showing that these lessons can be applied to the same sector in other countries or transferred to other sectors. The case of Electricité De France (EDF) from the energy sector and its collaboration with Météo-France France is a good example of successful collaboration. Another successful case noted was the three-way collaboration between the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Agriculture (USDA), and the University of Nebraska in the preparation of the U.S. Drought Monitor and other products. The methodology used in the preparation of the U.S. Drought Monitor has the potential to be exported to other drought-prone regions with appropriate modifications. An additional benefit of this methodology is that it requires interaction between multiple ministries and users because it relies on a variety of climate and water indicators and indices in its assessment of drought severity and spatial extent. The information on these indicators is usually located in several ministries. The Joint Agricultural Weather Facility (JAWF) was also noted as a successful longstanding collaboration between NOAA and the USDA. Another example worth noting is the development of an integrated climate risk management approach for malaria early warning in southern Africa, which has included regional and national services in Provider-User interactions. It is also a good example of a user led initiative.

- These examples should be highlighted and used to promote increased collaboration in other settings.

- These successful collaborations could be presented as case studies at the international conference scheduled for Madrid in March 2007.

9. Task Force members emphasized the importance of creating end-to-end-to-end system as a means of involving stakeholders in identifying the requirements for products, their development and incorporating feedback from users in product revisions. One of the actions of the Task Force is to identify more examples of successful end–to-end-to-end systems.

10. It was noted by Task Force members that NMHSs and the products and services that they can provide need to be more visible in many countries. If users are not aware of the existence of NMHSs, the services they provide, or how the data and information available can be used to improve decision making and reduce weather and climate-related risk and impacts, then the NMHS is not fulfilling a vital component of its role and responsibility.

11. The Task Force members were informed of WAS*IS (Weather and Society—Integrated Services), a program undertaken at the National Center for Atmospheric Research (NCAR) in the United States. WAS*IS is aimed at sensitizing early career meteorologists to some of the tools, models, language, and analytical techniques of social scientists. The program will have long term impacts in improving understanding of the socio-economic benefits of weather, climate, and water information.

12. Task Force members noted the need for additional research on the value of information to user sectors and on the key ingredients of decision-support tools and the appropriate delivery channels to users.

13. The importance of developing and sustaining a two-way dialog between NMHSs and users was emphasized. Users must be consulted early in the development of any risk-based decision support tools and training needs to be provided to users so they fully understand how to apply these tools in the decision making process. Essential ingredients of effective weather information products include relevancy, reliability, timeliness, diversity of dissemination channels, and consistency.

14. NMHSs must place greater emphasis on evaluating behavioral change associated with new decision support tools in various sectors. Examples of successful tools that have reduced risk through the modification of behavior would be excellent examples for the Madrid conference.

15. The Task Force noted that fragmentation of responsibilities in the weather, climate, and water sectors hinders risk-based management and the communication of information. Many organizations are involved in monitoring, forecasting, impact assessment, regulation, and resource management with respect to weather, climate, and water. The importance of a single point of contact for the media within NMHSs who possesses good communication skills is essential. This person must be able to effectively summarize information, put it into proper perspective and express it in terms that users will understand.

16. Early warning systems must be integrated and provide information to decision makers at critical decision points. Critical decision points for various user groups should be determined through open communication with a wide range of sectors. Case studies where this has been achieved could be examples for presentation in Madrid.

17. An interesting question was raised with regards to the value of regional centers in promoting greater interaction between NMHSs and users. Regional centers, by providing a critical mass of knowledge, capability and experience could be very cost effective and, if sustainable, could be valuable in the long term.

18. The Task Force also noted the importance of documenting the lessons learned from failures in the interactions between NMHSs and various user sectors as instructive in the development of future models.

The Use of Weather, Climate, and Water Information by Sectors

19. A final component of the Day 1 agenda was an open discussion of the use of weather, climate, and water information by sector. This session was chaired by Herbert Puempel, Chief of Aeronautical Meteorology at WMO. The members of the Task Force were invited to reflect on questions focusing on strengths, weaknesses, opportunities, and threats for NMHSs as providers of weather, climate, and water information to different sectors of society and industry.

20. Some concern was expressed that some user communities are not well informed or aware of the economic value of weather-related information for their activities. Similarly, some providers know even less about the way in which these user communities operate, where weather information becomes part of their decision making process, and the true underlying user requirements.

21. The example of two national ministries cooperating on a long-term basis (U.S. Department of Agriculture and the National Weather Service) was presented as an example of a longstanding relationship with mutual immersion of experts in the processes of the partner organization. This partnership has produced excellent results. The weakness of this system, however, was described as a dependence of adequate funding levels simultaneously for both organizations to support this partnership.

22. Experience from user-oriented applied research projects such as THORPEX highlighted that full understanding of the processes both users and providers of information required years of dedicated work. In a public service environment, organizations right up to the ministerial level need to be reminded to support and enhance this process.

23. Whenever commercial activities were undertaken by NMHSs to supplement their income, market forces did a lot to contribute to a cultural change required to fully respect the customer's requirements and give them priority over "well established procedures and practices", which may regard a customer as a distraction rather than an economic benefactor of the organization.

24. All participants saw value in the concept of embedding the meteorological expert in the operations of a client organization to generate a well-focused and customer-minded service. However, this "emissary" ran the risk of being looked upon suspiciously by the traditional staff and suspected of "going native", if they prioritized customer requirements.

25. Mutual training was seen as a viable means of achieving this user orientation and optimal deployment of information. One participant summarized the organization and legal prerequisites for this paradigm shift as follows:

- Legislation needs to be introduced to provide a solid legal basis for commercial operations by NMHSs—the often practiced approach of a half-hearted commercialization of a state-run body is dangerous;
- Where government bodies interact, partnerships need to be formalized and regulated;
- The best way to ensure a complete and open information exchange is to go for a "push and pull" solution, where requests are issued and products brought to the attention of the users;
- The technological basis has to be of the highest standard and represent the state-of-the-art;
- Continued education and training, both in science and technology, as well as in business and management techniques are indispensable; and
- In order to ensure satisfaction, quality management procedures based on user-oriented verification metrics and evaluation of products must be standard practices.

PROVIDER SECTOR SUMMARY: DAY 2

26. An overview of the operation of NMHSs was provided by Dr. John Zillman. He described in general terms how they function from observations to the provision of services and how these functions extend from atmosphere to water. Each of the 187 WMO Members has some form of national meteorological or hydrometeorological service. This presentation helped to place into context the role of NMHSs and how users connect to these services. A summary of this discussion is included as Appendix IV in this report.

Key Discussion Points

27. The key points gleaned from the provider sector presentations and discussions included:

28. The development of the Global Earth Observation System of Systems (GEOSS) is an opportunity to better deliver services to users in multiple sectors. The socio-economic

benefits of applications of meteorological and hydrological products through GEOSS should be an important consideration.

29. There are many weather/climate sensitive sectors that do or could benefit from improved decision support tools to help mitigate risk. The losses associated with these sectors are sometimes not well documented. The societal value of the information available from NMHSs is under-appreciated by governments as is the role this information could play in sustainable development, the alleviation of poverty, and the mitigation of the impacts associated with natural disasters. Governments do not recognize the inherent societal value of the information that is/can be provided by National Meteorological and Hydrological Services.

30. NMHSs need to put more emphasis on services which translate into greater involvement and interaction with users. Users must be consulted in the early stages of product definition and development through testing of products, including training on the application of these products.

31. There is a significant opportunity to demonstrate further the socio-economic benefits of meteorological and hydrological products and services in the area of disaster mitigation. Economic losses from hydro-meteorological natural hazards are increasing significantly and these disasters have the attention of governments and policy makers. Investments in NMHSs can reduce losses of life and property as well as loss of productive capacity through development of more timely and reliable early warning and delivery systems resulting in improved mitigation actions and preparedness planning. Improvements in water management, food security, health, and energy sectors can also be demonstrated.

32. Identifying success stories for decision support tools in various sectors could lead to the replication of these applications in other countries and/or sectors.

33. NMHSs have added value for users when products can be customized for specific application (e.g., interactive web-based tools that allow users to generate maps with options for time period, index or indicator, or overlays of political or hydrological boundaries).

34. Evaluation of uses and potential application of product by monitoring web hits (numbers and user type) can be an extremely effective mechanism to document product use and popularity. An on-line survey to acquire user feedback is also an effective means of gathering information on product use and application.

35. Some excellent lessons have been learned by the Hong Kong Observatory concerning efforts to target specific user groups, conduct regular briefings, and review sessions.

36. Key requirements outlined for effective weather information service include relevancy, reliability, timeliness, diversity of dissemination channels, and consistency.

37. Establishment of targeted strategic alliances between ministries and/or user groups is an effective mechanism to address the complexities associated with issues such as improving drought management.

Addressing and Bridging the Gap

38. Following presentations by users and providers, an open discussion on addressing and bridging the gaps was led by David Rogers, Advisor, Atmospheric Research Programme, with Mannava Sivakumar, Chief of the Agricultural Meteorology Division, serving as rapporteur. A summary of this discussion is provided below.

39. Four principles presented for bridging the gap between providers and users of weather, climate, and water information were:

- Move more towards a focus on meeting user needs
- Recognize that "one shoe doesn't fit all"- users and their requirements are varied
- Implant a range of bridging techniques depending on users and their needs
- Make use of existing mechanisms and bridges

40. Potential gaps between the suppliers and consumers of meteorological and hydrological services fall into a few categories. The following two general areas were discussed by the Task Force:

- Expectations
- Technical Communication and Influence

Gap in Expectations

41. A fundamental issue in many countries is the lack of understanding of the respective roles of the supplier and the consumer of meteorological and hydrological products and services. In the past, the traditional NMHS was satisfied with providing a set of products that they considered necessary to provide general forecasts and little effort was made to go beyond this to understand the specific needs of the consumers of these products. As NMHSs became aware of the potential to supply consumers with products of greater utility, a gap developed in the understanding of the "value" of the product.

42. One of the issues raised was that often the users have to pay for weather and climate data and that there is often a lack of evidence that there are definite payoffs to the user from the data provided. The increasing availability of free information services through the Internet that cross national boundaries also undermines this local market for data because users will access information wherever it is available and for the lowest cost, especially given the uncertainty in the "value" of the information. Effectively, this creates a widening gap between national suppliers and consumers resulting in a reduction in the use of national data and ultimately a reduction in the support for the concept of maintaining state-sponsored observing networks. The perception of the utility of the information from the perspectives of the supplier and consumer vary considerably.

Gap in Technical Communication and Influence

43. On the supply side, technical advances have increased the potential for new products and services, especially in the use of probabilistic information, which can be used to convey uncertainty in a forecast and provide more useful information to assess risk. However, on the consumer side the availability of technically advanced products has had only a limited impact and only with the most sophisticated users, such as those engaged in electricity generation and supply. The necessary steps to educate users and to include users in the development of these products and services have not accompanied the availability of this new type of information.

44. The influence gap exists because users have few, if any opportunities to influence the way products and services are developed, particularly where the principal supplier is a government institution. The example of the need for reductions in the error in the daily temperature forecast to reduce the cost of electrical generation was cited. This problem is

not a high priority for research in predictability in most countries because scientific interest rather than social benefit is the driver.

Bridging the Gaps

45. One way to address the supply and demand problem surrounding data related products and services is through more constructive and open dialogue with the users as to the different uses for the data that are provided to them and how the NMHSs can assist them in the clear identification of such uses.

46. It is also recognized that in some traditional sectors such as agriculture, there is a clear recognition of the utility of weather and climate information while in some sectors this is not so evident. Clearly, this calls for greater interaction with different sectors in the identification of their specific needs for information and products.

47. One of the ways of bridging the gaps is to emphasize the Millennium Development Goals (MDGs) to which all countries are committed; NMHSs should be seen as development partners to achieve the MDGs. This may be used as an example to develop new ways of delivering services through a partnership rather than a traditional suppler-consumer relationship. In this case all of the partners have some responsibility for the decisions made that utilize the environmental information. {The phrase "Community of practice" has been used to describe the involvement of all the stakeholders in the decision process inclusive of the information providers and decision makers – this was not discussed during the session}

48. NMHSs could project themselves as "Societal Services", implying that the services and products from NMHSs serve all the different segments of the society.

49. There is also a clear niche for "new services" in the light of several emerging issues related to weather and climate. Identification of gaps in such services could bring more recognition to NMHSs.

50. Providing useful services and products to the end users requires constant education and training for the staff of NMHSs.

51. Experience in some countries shows that unreasonable user expectations of services and products from NMHSs might usefully be lowered to more realistic levels.

52. Through more effective demonstration projects or extension pilot projects, it should be possible to show the value of products and services from NMHSs.

53. In most countries, the public is not empowered or educated enough to demand improved products and services from NMHSs. If this obstacle can be overcome, services could be delivered in the development framework which would help mitigate the adverse consequences of high impact weather, water and climate events.

54. One of the effective ways of bridging the gap is to integrate the meteorologist in the user community as it is done with the presence of meteorologists in the World Agricultural Outlook Board of the United States Department of Agriculture (USDA).

55. Clear identification of the core NMHSs partners in the delivery of their products and services, and a paradigm shift in the way in which these services should be delivered could help promote NMHSs more effectively.

56. Strategic/institutional changes may also be needed to bridge the gap.

57. There is a need to identify the priorities for the least developed countries (LDCs) in their provision of better social services. NMHSs in the developed world should be strongly encouraged to interpret products and make them available to LDCs so that they can operate effectively with minimal resources.

58. Members of the task force emphasized a clear need to better demonstrate how the services provided by NMHSs justify the expenditure of public funds (i.e., cost/benefit ratio) at current or increased levels. NMHSs must show a greater commitment to providing this information.

EXISTING DECISION SUPPORT TOOLS

59. Numerous decision support tools are available that clearly demonstrate the application of meteorological and hydrological information to many sectors, including agriculture, energy, health, water management, and development. Some of these tools were demonstrated during the Task Force meeting. For example, climate information has been widely used to predict infectious disease epidemics. Some of the tools used to predict malaria in Africa were presented as one case study. The U.S. Drought Monitor is widely used in the United States by water and other natural resource managers as well as by policy makers. One of the important lessons learned with this weekly product is the value of collaboration between NOAA, the U.S. Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska.

TASK FORCE CONCLUSIONS AND RECOMMENDATIONS

60. Based on its work, the Task Force made the following conclusions and recommendations to the WMO Secretariat.

(i) The Task Force should serve on a continuous basis, and take a phased or stepwise approach to identify potential mechanisms for addressing the critical "Provider-User" issues. The challenge for the Task Force is complex because of the diversity of the users and providers, NMHSs' capacities, and national policies in private and public partnerships on providing public and tailored weather, climate and water information.

(ii) The Task Force supports the WMO strategy to engage relevant UN and other international organizations.

(iii) The Task Force expects to contribute to the work of the EC (LVII) Working Group on the Evolution of NMHSs and WMO.

(iv) The Task Force expects to serve as an advisory body to the WMO Secretariat in its support for the EC Working Group defined above

(v) The Task Force will focus on Provider-User issues across scientific and technical WMO Programmes.

(vi) As a consequence of (v), and due to the necessary scope of the involvement of other WMO Programmes in addition to the PWS Programme, the Task Force agreed that the "Task Force on Socio-Economic Applications of Meteorological and Hydrological Services" would better reflect this collaborative nature and proposed the change in its title.

(vii) In line with the statement 3.4.1.7. of the general summery EC LVII, the cross cutting work of the Task Force will be coordinated and supported through the Public Weather Services Programme.

(viii) The outcomes of the work of the Task Force will feed into th e WMO Strategic Plan as well as the Education and Training Programme.

(ix) The Task Force expects to play a strategic advisory role in fostering enhanced institutional relationships between the providers (NMHSs) and user communities.

(x) The composition of the Task Force will be dynamic and inclusive of additional sectors (e.g. tourism, disaster management, transportation) as required.

(xi) The Task Force will pay particular attention to the needs of the least developed countries and will ensure the participation of these countries in its future work.

(xii) The Task Force is prepared to actively engage with the planning of the upcoming WMO International Conference on the Socio-Economic Benefits of Weather, Climate and Water Services in Madrid in 2007, and the outcomes resulting from this conference.

(xiii) The Terms of Reference for the Task Force will be amended to include "Keep under review activities within the GEOSS Societal Benefit Areas relevant to the mandate of this Task Force".

(xiv) The Task Force will consider providing inputs to the White Paper being developed by the THORPEX SERA Working Group for the Madrid Conference.

(xv) As an outcome of this meeting, the Task Force developed a preliminary Action Plan as shown below.

TASK FORCE ACTION PLAN

61. The following actions were identified by the Task Force.

(a) The draft report to be circulated by the Task Force chair and C/PWS to Task Force members by **June 9** for input and comments.

(b) Members' comments and inputs returned to C/PWS by **June 30**.

(c) The final report to be distributed by **July 20, 2006**.

(d) Develop and distribute to members a draft format with criteria for the inventory of decision support tools and practices, and case studies examples of best practice. (**Action: Bruce Stewart, 20 July**).

(e) Members of Task Force will provide to C/PWS the initial input to inventories of existing decision support tools and practices (**Action: All members, 31 October**), to be finalized (**Action: Don Wilhite and C/PWS, 15 December**)

(f) Members of the Task Force will identify and forward to C/PWS potential case studies as best practices and lessons learned in provider and user interactions and procedures. (**Action: All members, 31 October**) to be edited and finalized. (**Gerald Fleming to edit and C/PWS to finalize, 15 December**).

(g) Based upon the inventory and case studies, members of the Task Force will identify essential elements common to successful Provider-User interactions. (**Action: All members, June 2007**), for a preliminary analysis and summary of these common elements to be made. (**Action: Pai-Yei Whung, July 2007**). The document will be sent to the C/PWS.

(h) The Task Force will seek to ensure that resources are put in place to carry out adequate gap analysis, building on the material collected in the inventory of decision support tools and case studies.

(i) The Task Force will provide initial material and guidance to the Secretariat for developing training, education and capacity building materials to enhance the Provider-User interactions. (**Action: All members, June 2007**).

(j) Secretariat to brief EC-LVIII on the work of the Task Force and encourage the Council to ask for a short initial guidance document (to be drafted by John Zillman) for the 15th Congress on measures for enhancing socio-economic applications of meteorological and hydrological services. (**Action: C/PWS, John Zillman, December 2006**).

(k) Members of the Task Force will update the inventory on decision support tools and case studies on a continuous basis. (**Action: All members**).

APPENDIX I

PARTICIPANTS AT THE MEETING OF THE TASK FORCE ON SOCIO -ECONOMIC APPLICATIONS OF PWS

(Geneva, 15-18 May 2006)

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APPENDIX II

MEETING OF THE TASK FORCE ON SOCIO-ECONOMIC APPLICATIONS OF PWS

(Geneva, 15-18 May 2006)

Programme

Monday, May 15

0900-0930	**Opening** Secretary-General Don Wilhite, Director, U.S. National Drought Mitigation Center and Task Force Chair
0930-1000	**Background, objectives and expected outcomes of Task Force Meeting, Introduction of Task Force Members** Haleh Kootval, Chief, Public Weather Services Programme, WMO
1000-1030	*Coffee Break*
1030-1115	**Drought Monitoring, Mitigation, and Preparedness in the United States: An End to End Approach** Don Wilhite, NDMC, University of Nebraska
1115-1200	**Theme: Requirements for and Use of Weather, Climate, and Water Information by Sectors** 1) Jeff Lazo, Societal Impacts Programme of Weather Forecasting, National Centre for Atmospheric Research 2) Antony Spalton, International Federation of Red Cross and Red Crescent Societies (IFRC)
1200-1330	*Lunch*
1330-1500	**Requirements for and Use of Weather, Climate, and Water Information by Sectors** (continued) 3) Laurent Dubus, EDF Research and Development: Representing the Energy Sector 4) Bruce Stewart, President of Technical Commission for Hydrology: Representing Water Resources Sector 5) Pai-Yei Whung, Office of International Research Programme, Agricultural Research Unit, U.S Department of Agriculture: Representing the Agriculture Sector

6) Gerald Fleming, Chair of the OPAG on PWS: Representing the Media Sector

1500-1530 *Coffee Break*

1530-1615 **Requirements for and Use of Weather, Climate, and Water Information by Sectors** (continued)

7) Stephen Connor, International Research Institute for Climate and Society, Columbia University: Representing the Health Sector

8) Vladimir Tsirkunov, The World Bank: Representing Development and NMHSs

1615-1700 **Open Discussion on the Use of Weather, Climate, and Water Information by Sectors**

Moderator and Rapporteur: Herbert Puempel, Chief of Aeronautical Meteorology, WMO

1700-1715 **Wrap-up, Review of Day 1: Chair**

1715 **Adjourn**

Tuesday, May 16

0900-1030 **Theme: Providers of Weather, Climate, and Water Information**

1) John Zillman, Immediate Past President of WMO

2) Tang Xu, Shanghai Meteorological Bureau, Chinese Meteorological Administration

3) Roman Vilfand, Hydrometeorological Centre of Russian Federation

1030-1100 *Coffee Break*

1100-1230 **Providers of Weather, Climate, and Water Information** (continued)

4) Mnikeli Ndabambi, South African Weather Service

5) Kang Thean Shong, Malaysian Meteorological Department

6) C.C. Lam, Hong Kong Observatory

1230-1400 *Lunch*

1400-1445 **Addressing the Gap between Providers and Users of Weather, Climate, and Water Information**

John Zillman

1445-1530	**Bridging the Gap between Providers and Users of Weather, Climate, and Water Information**
	Bruce Stewart
1530-1600	*Coffee Break*
1600-1700	**WMO Programmes: Weather, Water, Climate: Response to Requirements and Gaps**
	Haleh Kootval (C/PWS) WMO;
	Wolfgang Grabs, Chief, Water Resources, WMO;
	Mannava Sivakumar, Chief, Agricultural Meteorology, WMO;
1700-1745	**Open Discussion on Addressing and Bridging the Gap**
	Moderator: David Rogers, Advisor, Atmospheric Research Programme, WMO
	Rapporteur: Mannava Sivakumar (C/AGM) WMO
1745-1800	**Wrap-up, Review of Day 2: Chair**
1800	**Adjourn**

Wednesday, May 17

0900-1030	**Existing Decision-Support Tools and their Application in Key User Sectors: Identifying Gaps and Needs**
	(Brief presentations by IFRC, Media, Water and Energy sectors followed by open discussion)
1030-1100	*Coffee Break*
1100-1230	**Existing Decision-Support Tools and their Application in Key Sectors: Identifying Gaps and Needs** (continued)
	(Brief presentations by Development, Agriculture, Health, and Socio-economic sectors followed by open discussion)
1230-1400	*Lunch*
1400-1530	**Developing an Action Plan for Bridging the Gap Between Providers and Users of Weather, Climate, and Water Information**
	Discussion leaders: Don Wilhite and Haleh Kootval
1530-1600	*Coffee Break*

1600-1730	**Developing an Action Plan for Bridging the Gap Between Providers and Users of Weather, Climate, and Water Information** (continued)
1730-1745	**Wrap-up, assignment for Day 4 (Prototype Education and Training Tools for NMHSs): Chair**
1745	**Adjourn**

Thursday, May 18

0930-1030	**Identification of Prototype Education and Training Tools for Use by NMHSs** Discussion leaders: Tang Xu, Gerald Fleming, Stephen Connor and Don Wilhite
1030-1100	*Coffee Break*
1100-1200	**Identification of Prototype Education and Training Tools for Use by NMHSs** (continued)
1200-1230	**Contribution of the Task Force to the WMO International Conference on Social and Economic Benefits of Meteorological and Hydrological Services, March 2007** Discussion leader: Yinka Adebayo, Strategic Planning, WMO
1230-1400	*Lunch*
1400-1530	**Follow-up to the work of the Task Force in the Preparation of Tools by Chair with Inputs from Task Team Members**
1530-1600	*Coffee Break*
1600-1730	**Review and Adoption of the Task Force Report**
1730	**Closure**

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APPENDIX III

PURPOSE AND TERMS OF REFERENCE

Task Force on Socio-Economic Applications of Public Weather Services

PURPOSE

The Task Force is established to provide WMO with recommendations and guidance for assisting NMHSs to more fully assess and enhance the socio-economic benefits of weather, climate and water information through the full range of user communities.

BACKGROUND

The Task Force derives its Mission in response to:

Public Weather Services Programme

- EC-LVII's (The Council) request to assist Members in the evaluation and demonstration of the social, environmental and economic benefits of their public weather services through elaboration of methodologies and guidance (EC-LVII, para. 3.4.1.7)

Natural Disaster Prevention and Mitigation Programme

- Identify and implement mechanisms to incorporate the input of the user community for the development of relevant and useful products and services of NMHSs (EC-LVII, para. 3.4.9.2)

Preparation of the 7th Long Term Plan

- The emphasis on the importance of the social and economic benefits of meteorological and hydrological services in the 7th Long Term Plan (EC-LVII, para. 7.14)

Economic and Social Value of NMHSs

- The Council's consideration of the role and operation of NMHSs, which states that social and economic studies should highlight the value of public weather services, as these were the primary concern of NMHSs (EC-LVII, para. 8.2.10)

Capacity-Building and Modernization

- The Council's expressed need to examine how best to assist developing countries, especially LDCs and their agreement that capacity-building should assist NMHSs to respond to societal needs (EC-LVII, para. 8.2.11)

International Conference

- The Council's agreement to hold the WMO International Conference on the Societal and Economic Benefits of Weather, Climate and Water Services, scheduled for March 2007 and to promote the better appreciation of the relevant social and economic benefits through the participation of decision-makers, user-groups, development planners, economics and social scientists (EC-LVII, para. 8.2.23)

Enhanced Integration

- The Council's recognition that enhanced integration of WMO Programmes and NMHSs' activities were critical to the improvement of service delivery of WMO and NMHSs in the areas of particular relevance to society (EC-LVII, para. 11.5.7)

Linkage to needs of, and benefits to, society

- The importance of clearly demonstrating that WMO and the broader institutional meteorological and related community, particularly the NMHSs, are addressing the need of, and providing social and economic benefits, to society (EV-LVII, para. 11.5.10)

- The Council's encouragement of the promotion of socio-economic benefit studies and the sharing of best practices that could be helpful in demonstrating the linkage to societies' needs (EC-LVII, para. 11.5.13)

Communication and Advocacy

- The Council's agreement that WMO and NMHSs would be well-served by a proactive strategic communication policy that would seek to inform, advise and influence decision-makers, users and the general public of the role and contribution of WMO and NMHSs which were of benefit to society (EC-LVII, para. 11.5.16)

COMPOSITION

The Task Force is composed of experts from the relevant communities and the WMO Secretariat.

MODE OF OPERATION

The challenge for this Task Force is complex because of the diversity of the users and providers, NMHSs' capacities, and national policies in private and public partnership on providing public and tailored weather, climate and water information. Therefore, this Task Force should serve on a continuous basis, and take a phased or stepwise approach to identify potential mechanisms for addressing the critical NMHSs' Provider-User issues.

The Task Force developed a work plan to implement the Terms of Reference as follows.

TERMS OF REFERENCE

1. The Task Force will assess opportunities to improve the interactions between the providers of weather, climate and water information and the users of these products and services.

2. Members of the Task Force will continue to build an inventory of the existing decision-making tools, which incorporate weather, climate and/or water information.

3. The Task Force will assemble case studies of the use of weather, climate and water information in decision making together with assessments of the related social and economic values.

4. Based upon a gap analysis, inventory of decision support tools, and case studies, the Task Force will develop a plan to provide WMO with recommendations and guidance. These should be aimed at assisting NMHSs to more fully assess and enhance the

socio-economic benefits of weather, climate and water information through the full range of user communities.

5. The Task Force will monitor the implementation of the plan and refine it as more experience is gained.

6. The Task Force will contribute to the development and preparation of the WMO International Conference on Social and Economic Benefits of Weather, Climate and Water Services to be held in 2007.

7. The Task Force will keep under review activities within the GEOSS Societal Benefit Areas relevant to the mandate of this Task Force.

8. The Terms of Reference will be reviewed and amended as required.

APPENDIX IV

The National (Hydro) Meteorological Service (NMS)

All 187 Members of WMO maintain some form of national meteorological and hydrological service system of which the primarily-government funded National Meteorological Service or National Hydrometeorological Service (both denoted by the acronym NMS) is usually the central component. The NMSs and, where they exist, the separate National Hydrological Services (NHSs) and National Oceanographic Services (NOSs) together span the earth system domains of atmosphere, land and surface water, and ocean and the "end-to-end" components of the total service system from observation through research, modelling and prediction to service provision with the vital final stage of service application residing with the diverse user communities.

Although the role of the public sector (i.e., the National Meteorological and Hydrological Services (NMHSs)) relative to the other players in the total national meteorological and hydrological service system (including especially private sector service providers, the media and the academic sector) varies from country to country, in general the NMHSs are the providers of the "basic systems" and "basic services" (i.e. the "public good" components of the system) while "special services" are usually provided by the private sector or by the NMHSs on a cost-recovery or commercial basis. The NMHSs carry the important additional responsibility of serving as the principal mechanisms for coordinating their countries' participation in the international meteorological and hydrological programmes of WMO.

The national arrangements for meteorological and hydrological service provision and application have always been regarded by WMO as the responsibility of its individual Members. The influence of globalization and changing attitudes to the respective roles of the public and private sectors have, over the past few decades, and especially since the establishment of the PWSP (Public Weather Services Programme) focused a lot of attention in WMO fora on the role and operation of NMHSs. Of particular importance have been the 1999, 2003 and 2005 Statements by the Executive Council on the role and operation of NMSs and the 1999 Geneva Declaration of the Thirteenth World Meteorological Congress.

The societal benefit from the provision and application of meteorological and related services is dependent on the quality and effectiveness of all components of the national meteorological and hydrological service system but especially on the structure and functioning of the interface between the provider NMHSs and the diverse range of user communities. While some NMHSs structure their service delivery in terms of the nature of the service (e.g., past, present and future information, including especially warnings of future events, advice, and investigation), others in terms of such broad service categories as "weather", "climate", "water" and "other" and still others in terms of major user sectors (e.g., public, media, aviation, marine, agriculture, health, environment, natural disaster reduction, ….) or charging category (free, cost-recoverable or commercial) or a combination of all of these, the structure of the user side of the interface is exceedingly complex and in a continuous state of flux as the information needs of individuals, households, businesses, governments and other weather-, climate- and water-sensitive sectors of society evolve in response to technological progress and social and environmental change.

Although there is not a complete match between the international (WMO) and national programme structures because of the inherent diversity among countries, the WMO Programme structure largely reflects, and provides an effective global coordination framework for, the various elements of the national meteorological and hydrological service system, especially the basic components of operation of the NMS. At the user interface, this particularly involves the four components of the Applications of Meteorology Programme (AMP) and the World Climate Applications and Service Programme (WCASP) as well as the service-focused components of the Hydrology and Water Resources Programme (HWRP).

The strong user focus of the NMS model of meteorological service provision has, in recent years, been taken up in the design of the GEOSS (Global Earth Observing System of Systems) concept, albeit the various essential elements of the total service system linking observations through to user sectors that are built into established WMO systems such as the World Weather Watch (WWW)/AMP and the Global Climate Observing System (GCOS)/WCP arrangements have not yet been clearly identified for earth system services as a whole.

APPENDIX V

Summary of Task Force Member Presentations

Collaborative Program on the Societal Impacts and Economic Benefits of Weather Information
Jeffrey K. Lazo

This talk focuses on approaches to assessing the communication, perception, use, and value of weather forecasts. Most if not all of the concepts discussed are applicable to weather and climate information. A range of social sciences (such as economics, psychology, sociology and communications) offer tools that could significantly enhance the effectiveness and societal benefits of weather, water, and climate information. Many of these benefits may be realized regardless of any potential improvement in the technical quality of this information. For instance, a better understanding of the economic concept of public goods and the characteristics of weather information could significantly improve understanding of the optimal roles of public and private provision of weather, water, and climate information. As another example, methods from psychology and risk communication such as mental modeling could be used to understand the source of gaps in information flow between the weather forecast generation and end-users.

Activities of the NCAR Societal Impacts Program (SIP) are attempting to develop a baseline of understanding of societal impacts and benefits of weather information. The US Sector Sensitivity Assessment uses historical economic and weather data to model and assess the economic impact of weather variability on economic productivity. The Household Valuation Study is using non-market valuation tools to assess households' sources, perceptions, uses, and values for current and improved weather forecasts in a national study. The Weather and Society Integrated Studies workshops (WAS*IS) aim to encourage the integration of social science methods with the weather community. And finally a suite of SIP Information Resources are being developed to support the societal impacts-weather community including a digital library, weather damage databank, internet resources source listing, a society/weather community newsletter and newsgroup.

In related efforts, the Societal and Economic Research and Applications (SERA) working group of the WMO THORPEX program is defining social science research foci of a major international meteorological research program. Many of the recommended research foci are related to identifying user needs and improving applications of weather information including communicating uncertainty, development of verification methods for ensembles, marginal benefits of high impact forecasts, developing protocols for user engagement, and better understanding of use of current forecast products.

Requirements for and Use of Weather, Climate, and Water Information: The Media Sector
Gerald Fleming

Media represents a multi-faceted challenge to meteorology. In the first place, it sometimes must be seen as a user; at other times it is more correct to represent it as a channel to end-users. The situation is complicated by the very different institutional arrangements that have developed between the meteorological and broadcast communities.

Broadcasters think differently to scientists; their work is driven by creative instincts rather than rationale. Each of the media (TV, Radio, Web, Print) is driven by different strengths (imagery, quality of voice, quality of writing, design etc etc), and these have little to do with the quality of the underlying message. The things that matter to meteorologists (accuracy, scientific rigour) are meaningless to the media.

The challenge to the meteorological community is to match the undoubted quality of weather information produced with an equal quality of presentation. The viewer or listener will have little appreciation of the underlying value of a forecast (will not be easily able to distinguish good from bad) but will be guided by the quality of presentation above all else. We let down the value of our information if we do not present it well.

Requirements for and Use of Weather, Climate, and Water Information in the Energy Sector

Laurent Dubus

The energy efficiency of a country has important impacts on its economic and social development. The energy sector includes both renewable and non-renewable resources, and covers a wide range of activities, from energy resources exploration, extraction and production, to electricity production, transport and distribution. An optimal and cost effective management of the energy sector is so crucial for a nation's economy, and has many impacts on other activities, like health or tourism for example.

The energy sector is highly dependent on climate conditions, whatever the particular field of activity, the production means, and the timescale. In developed countries, it is probably one of the most important users of Earth observation products and weather and climate forecasts. Extreme events such as heat waves or cold waves, wind storms or floods can of course have dramatic consequences on the production means or the electrical grid of a country. But "normal" day-to-day weather variations also have impacts on load level and energy production, transport and distribution management, as well as energy prices. A –1°C extra temperature anomaly in winter in France corresponds for example to an extra production need of 1400 MW, equivalent to the production of one nuclear reactor. In addition to short-term and medium-term management processes, climate archive data and future climate scenarios are necessary for long-term supply planning and production units dimensioning. Reliable weather forecasts and climate information - past, present and future - are therefore crucial to reduce the uncertainty in supply and demand forecasts, as well as market dynamics, in order to manage the risks associated with them, at all timescales from a few minutes to a century.

Due to the high complexity of energy systems management, it is important that energy companies or agencies and NMHS collaborate closely in an interactive mode. The level of weather, climate and water information that is needed in the energy sector can be high, and implies to master complex information such as ensemble forecasting for example. People from the energy sector have to deal with very diverse problems, and then can not always get involved enough in meteorology, climate and hydrology. It is therefore often necessary to have an intermediate between the user and the NMHS. This intermediate can be either a specific service of the energy company, or of the NMHS. User's training and regular information is also an important point, to ensure an up to date knowledge of products and services, and identify potential future development of interest for the sector.

Introducing meteorological and hydrological forecasts, which are often probabilistic, into decision tools which have to deal with many information and constraints can be difficult. Therefore, the sooner the weather, water and climate info is taken into account is the better. This especially applies to countries or companies where weather dependent decision support tools are not yet available, or when new generation tools are developed.

Requirements for and Use of Weather, Climate, and Water Information by Users: The Health Sector
Stephen Connor

Stephen Connor suggested the need for a process of climate information delivery and climate risk management in climate sensitive sectors. He gave an overview of a number of climate sensitive diseases which have been identified by WHO as candidate diseases for climate driven early warning systems. He then went on to describe recent work on malaria in Africa which has used climate information in a four stage integrated approach to disease monitoring and surveillance: vulnerability assessment, seasonal climate forecasting, environmental monitoring, and epidemiological case surveillance.

Using the example of epidemic malaria in Botswana, Connor demonstrated evidence that seasonal climate forecasting can offer lead times of 4-5 months warning of peaks in high malaria years. Followed by rainfall monitoring which gives 1-2 months lead times. The four stage model has been seen as exemplary within the SADC region and in collaboration with WHO other countries are beginning to adopt similar practices for epidemic preparedness, planning and response. Connor then outlined opportunities for supporting this approach elsewhere in Africa and Latin America.

A note of concern was expressed regarding capacity development requirements, issues of sustainability and accountability in less developed countries. This raised the question of how to balance investments in climate services and their user's capacity. Economies of scale can be achieved at regional/sub-regional levels – but these tend to lack investment from member states – have less accountability and as a result may be less sustainable.

Providers of Weather, Climate, and Water Information: The Malaysian Meteorological Department
Kang Thean Shong

Malaysian Meteorological Department (MMD) is the government agency tasked to provide weather and climate related services and seismic activities in the country. It maintains a technically advanced observation station network, including automatic weather stations, upper air and radar stations, meteorological satellites data receiving and processing facilities and seismic and tsunami detection network to support monitoring of weather development, environment conditions and seismic activities in the country.

One of the major tasks of MMD is to issue timely meteorological information and forecasts for general public, community, disaster management agencies, aviation, defence activities, tourism, offshore oil and gas operation, water resources, agriculture and power sectors. It provides early warnings on the occurrences of adverse weather phenomena and dangerous sea conditions in the Malaysian region to the public, affected communities and relevant agencies involved in disaster prevention and mitigation in timely manner. MMD also provides immediate information on earthquake events and possible occurrences of tsunami that would affect the country to the public, media and relevant government agencies involved in disaster mitigation. These services provided will help to enhance the socio-economic activities of the country and prevent and mitigate the impacts of natural disasters.

MMD promotes public awareness on the importance and usefulness of meteorological and seismological information. It would like ensure that its customers and users could utilize its services and products, especially severe weather and tsunami warnings, effectively with optimal beneficial. It welcome feedback and comments and would endeavour to fulfill the expectations and requirements of its customers and users. MMD conduct various activities

to improve public awareness of its services and to maintain close rapport and communications with its clients and users. It welcomes and receives study visits from schools, institutes of higher learning, government agencies and other organizations. Its staffs are also actively involved in scientific and disaster related exhibitions in national, state and district levels. Every month, different divisions of the department would invite their customers and users to visit the department so that the officers could better understand their expectations and requirements, answer any enquiry and explain the department's capability and limitations to fully fulfill their expectations and requirements. There is a close rapport and communications between MMD and other government agencies that require the meteorological services and the media. Every year, MMD endeavours to organise get together or briefing session with the media.

An efficient delivery system for meteorological information is very essential and critical. Thus MMD utilizes every available communication systems to deliver its information to its customers and users in a timely manner. To ensure severe weather and tsunami warnings can reach the targeted community, especially over rural areas, with sufficient lead times, MMD try to enhance partnerships with community and religious leaders, media, telephone operators and other related disaster management agencies.

Maximizing the Effectiveness and Socio-economic Benefits of Weather Products and Services – the Hong Kong Experience
C.C. Lam

The key requirements for effective weather service are relevancy, reliability and timeliness of weather information, diversities of dissemination channels, as well as consistency of information across various channels. To maximize the effectiveness and socio-economic benefits of weather products and services, a "bottom-up" strategy based on users' needs and requirements should be taken in the design and implementation of weather products and services. The prevailing state of meteorological science, the available technological means of communication and the expectation of users should also be taken into account. Users' needs and requirements can be collected through regular liaison meetings, review meetings, seminars and briefings. Priority in resource allocation should be given to those areas which contribute most to the safety and well-being of the society.

Different strategies for the provision of weather information to different groups of users, namely the public, government users and socio-economic sectors, are adopted to suit their specific needs and purposes. The development of innovative applications and services with the integrated use of Geographic Information Systems (GIS) and meteorological information may assist users to make better informed decisions.

The mechanism of product launching may consist of (i) collection of users' views and comments starting from the design process; (ii) partial launch of beta version on the Internet website or making available prototype of the product to the target users for comments; and (iii) a full launch of the product through diversified dissemination channels with update frequency and format of presentation appropriate to the strength of the dissemination channels and level of intended audience. Accompanied with the product launch should be a publicity campaign comprising a press conference and the follow-up media interviews. Training sessions and briefings should also be provided to target users to promote their intelligent use of the product. Examples for demonstrating the Hong Kong experience in the development of weather products and delivery of weather services include the launching of lightning location information, wind gust information, probability forecast of tropical cyclone signal change to public transport operators, and the provision of special weather service to local windsurfing team in Olympic Games. They are used to illustrate how user

requirements are responded; what levels of detail, data format and dissemination channels are adopted; how users in the process are involved; how the new product or service is promoted and what the user feedbacks are.

Capacity building for continuous professional improvement of meteorological services staff and public education for increasing user capability in the optimized use of weather information will contribute to the overall effectiveness of weather products and services in the long run. Public education and outreach activities conducted by meteorological services can effectively promote user understanding of the nature of weather hazards and the best services that could be provided by the meteorological services with available resources and the contemporary state of meteorological science and technology, thereby narrowing the gap between user expectation and service outcomes. Partnership with universities, non-governmental organizations and the media will increase the effectiveness of public education by reaping the benefit of collaborative synergy.

Providers of Weather, Climate, and Water Information: The South African Weather Service
Mnikeli Ndabambi

Summary of inputs

Areas to be considered for developing countries (especially in Africa)

- Diversity and high illiteracy due to large rural areas and poverty.
- Diversity in technical capabilities of weather services including poor communication links in some areas.
- High population growth rate.
- Difficulties when trying to get contributions from NMHSs.

Key inputs on social and economic benefits

The NMHSs spend significant time and energy acquiring and analysing data with the aim of producing quality product. The evidence of success in producing quality products has been observed over many years. It is therefore necessary to ensure effective recognition and use of such quality products and services to the benefit of diverse users globally.

In addressing the socio economic applications, the following should be kept in view:

- Understanding of historic exposure to weather hazards.
- Use of media as medium of both dissemination of information and educational purposes. This should include usage of media as a feedback channel from users in an attempt to understand more of user needs, expectations and the level of understanding (includes understanding of uncertainties). This will demand close partnership with media. Success report from NMHSs must be encouraged by creating reporting channel/window in WMO web site.
- Efficient collaborative approach when issuing warnings and advisories by bodies that are forced to work with each other due to the relationships between their fields (bodies like Met Centres, hydrological Centres, ocean Centres etc).

- Having started in the working environment, social and economic factors should be part of staff development, this will ensure long term paradigm shift in this regard because staff will have more understanding of user expectations and functioning.

Providers and Users Sectors of Hydrometeorological Information in Russia
Roman Vilfand

One of the main problems (on the part of users) of hydrometeorological information (HMI) is failing to understand the real possibilities of the providers of hydrometeorological information (HMI). The excessive expectations of users, that the skill score of the forecasts is close to 100%, very often lead to the disappointment and to further refusal of contacts with hydrometeorologists. The second problem of the users (at least in Russia) is inability of the users to take into account the HMI for best achieving the goal and also negative attitude of many users toward the probability forms of weather forecasting.

Problems of the providers of the hydrometeorological information in Russia, in particular at the Hydromet Center of Russia, are associated with:

- lack of knowledge of algorithms (rules) of the use of the output information by a user. Not infrequently one can meet a meteorologist with the opinion that this knowledge is not needed;

- use of jargon and formats of products that users do not understand. Recent contacts with the supervisors of the Russian railway (RRW) have showed that the terms: “rain at times”, “icy condition on roads” (“ice-covered ground”) are not completely taken into account by users in making economic decisions.

There are several (about ten) private firms, which publish weather forecasts on the Internet, but these forecasts are not official and the methods used to produce these forecasts are unknown.

The following types of forecasts are prepared in the Hydromet Center of Russia:

1. 1-5 day weather forecast in 89 subjects of the Russian Federation (RF);

2. 1-5 day weather forecast in cities of Russia;

3. 1-5 day weather forecast in any region or a point of the Globe;

4. Weather forecast for ten days in Russian regions (including resorts) and over the World;

5. Weather forecast for the next month in regions;

6. Air temperature and wind velocity forecast for seas of Russia and the World;

7. Information about the formation and development of tropical cyclones and the historical information about the tropical cyclones for the last 35 years;

8. Information about unfavorable and significant (natural) weather events and abrupt weather changes during the previous day over the territory of the RF;

9. Information about the temperature and precipitation extremes during the previous day in Russia and in the World;

10. Agrometeorological reviews for Russian agricultural regions:

- About the actual and expected agrometeorological conditions for particular crops and crop groups;
- Forecast of the ripening times of winter grain-crops and spring crops;
- Forecast of productive soil moisture storage for the spring;
- Forecast of winter grain-crops wintering and their condition by the vegetation beginning on the territory of the RF;
- Forecast of the optimal terms of sowing and harvesting of crops;

11. Survey of actual hydrometeorological situation on seas;

12. Forecast of the formation of extreme hydrometeorological events on seas (gales, rough sea, storm surges, harbor seiches, ships icing, anomalous ice conditions);

13. Ice forecasts (ice extent, ice thickness, and ice period duration);

14. Water temperature data in resorts of Russia and foreign countries;

15. Forecasting and warning of coming adverse meteorological conditions promoting accumulation/dissipation of detrimental impurities in the atmosphere with a lead time of 1-3 days;

16. Forecast of prevailing air mass transport in the atmosphere from the region or in the region of the object; meteorological regime defining the conditions of dissipation of detrimental impurities in a point or a region;

17. Forecast of the water regime of rivers and water reservoirs, the forecast of floods, development of spring flooding, dates of rivers break up;

18. Forecast of fire risks for the nearest 3-5 days in Russian regions.

In Russia, according to the studies, carried out by Roshydromet jointly with World Bank, the following weather dependent sectors were defined.

1. Energy
2. Water management
3. City economy
4. River transport
5. Civil aviation
6. Forestry
7. Agriculture
8. Gas industry

Meteorological service includes: provision of the information on the state of the atmosphere (which is often divided into meteorological and climatic phenomena and air quality) and in some extent on the state of the ocean, land surface and inland waters.

This service consists mainly of 5 large groups:

- information on the past conditions based on historical data;
- information on the current state of the atmosphere, ocean and surface waters;
- forecasts delivery, including warnings about unfavorable meteorological conditions, general and specialized forecasts, long-range seasonal and item-annual climate change forecasts and forecasts of possible anthropogenic climate change in future;
- consultations on meteorological, hydrological and oceanographic sciences and their application to the needs of the community;
- conducting studies of the particular scientific problems related to the atmosphere, ocean and inland waters.

Conclusion

1. The all prognostic bodies of the Russia Hydrometeorological Service (the same is true to the NHMS of other countries) are doing all their best to deliver the various qualitative hydrometeorological information to the users including timely warming about different significant weather phenomena with the purpose of prevention of the loss of life and mitigation of the economic damage.

2. The assessment of the delivered prognostic hydrometeorological information given by the users sectors is one-sided, subjective judgment.

3. User "feedback mechanism" with a forecaster at present is the weakest link of this chain. As a rule the forecaster doesn't know how effective his forecasts are and what decisions are taken by a user on the basis of his recommendations. To solve this problem it is necessary to implement special studies and to establish additional links in the information chain: forecaster-user who would be able to present information needed both for a forecaster and the end user of forecasts.

4. A great number of users do not take into account weather forecasts in planning of their activity, do not provide consultations on detailed estimation of prognostic characteristics and they only can give qualitative subjective assessments of the forecasts.

   Education of the users in correct use of the forecasts and their optimum application in the process of decision-making are not carried out.

   Many users receive prognostic information over the telephone/fax, some users take this information from Mass Media and from Internet. In the absence of the forecasts the majority of the users orient themselves on the current weather and their own imaginations on the expected changes that very frequently is the cause of the big socio-economic losses.

5. In Russia, at present, more than 300 private and state institutions earn money from the hydrometeorological information, and the number of their clients increases yearly by 15-20% (percents). The annual turnover of this sector of economy constitutes about 30 million dollars below its potential capacity 200-300 million dollars. Such a gap between actual and potential earnings can be explained first of all by the fact that the majority of the potential users up till now have a poor notion about the role which

an accurate weather forecast can play in their production. Private business ignores this information not to save money but because of uninformed managers and administrators.

6. According to the Meteoagency of Roshydromet only 1% of all the organizations, the activity of which directly depends on the influence of weather, buy the detailed specialized forecasts. Nevertheless the number of users paying for hydrometeorological information steadily increases.

Weather, Climate and Water Information for Agricultural Applications
Pai-Yei Whung

Weather, climate and water (WCW) information is critical for agriculture in two key areas; i.e. Risk Assessment (e.g. potential spread for plan and animal disease s, and invasive species), and Agricultural Production System Management (e.g. crop and rangeland planning and production prediction).

The suite of agricultural services provided by NMHS has been mainly focusing on the information needed for agricultural production systems, and much less on risk assessment. One of the main purposes of this talk, in additional to presenting the use of WCW in agricultural production management, is to highlight a couple of examples for applying weather, climate and water information for agricultural risk assessment.

Agricultural risk assessment is equally important as agricultural production management in sustaining a healthy agricultural system. For example, without a mitigation strategy, the potential global impacts of agricultural risks (e.g. wheat stem rust, avian influenza) extends beyond agricultural production because of its implications on trade and other economic and health issues associated with epidemics.

Examples for applying WCW information for **Agricultural Production Systems**:

1. Crop planning.

Seasonal climate information (e.g. seasonal temperature, humidity, soil temperatures) were used by the U.S. Southeast Climate Consortium to provide early spring planting forecasts for peanuts.


Early peanut planting being forecast

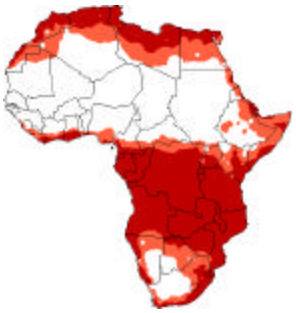
Irrigation scheduling for water use efficiency.

ARS developed a water use efficiency system for arid areas (e.g. southwest of U.S., Middle East, North Africa); including a weather sensor for wind speed, air temperature, relative humidity, and solar radiation.

Examples for applying WCW information for **Agricultural Risk Assessments** are:

2. Early warning for invasive species.

***P. truncatus*(Giant Grain Borer)**



Giant Grain Borer was introduced from Mexico to Africa in late 1990, and was threatening the grains supply in Africa. The International Institute for Tropical Agriculture, jointly with the Danish Institute for Agriculture Science, developed a climate simulation model for an early warning system of the potential spread/growth of giant grain borer for a pest management strategy to mitigate the borer, and reduced the loss of grains. The borer is extremely sensitive to temperature and humidity and tends to spread south during the warm seasons. Advanced and more precise climate forecasts will result in a more accurate Borer Risk Assessment model. This will improve the effectiveness in pest management in Africa, and enhance the food supply security.

3. Plant diseases spread risk assessment

Citrus canker and wheat stem rust can potentially cause severe damage in citrus and wheat production, respectively, in the U.S. Citrus canker was introduced to the U.S. during the 2004- 2005 hurricane seasons. Wheat stem rust was identified in 1999 in Uganda (Ug99),

and has not reached the U.S. However, the Consultative Group for International Agricultural Research estimated a potential spread of wheat stem rust (e.g. Africa, Middle East, South Asia) could cause a 19% reduction in the total world production of wheat. One of the primary transport mechanisms for the plant diseases is through wind. Collaborations between agricultural scientists and meteorologists will significantly improve the wheat stem risk assessment map and provide an early warning system for potential mitigation.

. A **Success Story** for a joint NMHS and Department of Agriculture; NOAA and USDA Joint Agricultural Weather Facility (**JAWF**). The **U.S. Drought Monitor** is another success story between providers and users; including **NOAA, USDA, and National Drought Mitigation Center (NDMC)**, University of Nebraska.

The JAWF is a cooperative effort between the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. The World Agricultural Outlook Board (WAOB) in USDA has the operational responsibility for monitoring and analyzing the impact of global weather on agriculture. The current contribution from USDA and NOAA to JAWF is approximately 2 to 1. As a result of more than 20 years of collaborative effort, JAWF is providing a suite of agricultural products including the short-term tactical agricultural weather products (e.g. routine and special agricultural assessments, Weekly Weather and Crop Bulletin, and enhanced regional weather data), and the long-term strategic agricultural weather products (e.g. USDA crop and live stock supply and demand estimates, and crop planting recommendations).

The general WCW information required for agricultural risk assessments and agricultural production management are improved temporal and spatial resolutions combined with 7-day, 14-day, 30-day, and seasonal forecasts in temperature, humidity, precipitation, wind speed and direction, and soil moisture and temperature, where possible. The specific requirements for each agricultural product are highly tailored, and can be provided to the Secretariat, if needed.

The agricultural community can benefit by putting more emphasis on the use of WCW information for Agricultural Risk Assessment to provide early warning systems to prevent biological disruptions in agricultural production and trade.