CWRR

CENTRE FOR
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RESEARCH

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DELIVERABLE 11.2

END-USERS
LEVEL OF SERVICE REQUIREMENTS

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2nd Workshop Outcomes

End users Level of Service Requirements

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1 Introduction

The 2nd end-users workshop was held on 23rd June in Helsinki as part of the "European Workshop on New tools for Flood Forecasting and Warning" held in the Unitas Conference Centre from 22nd to 23rd June. The overall objective was to report and discuss the achievements of the CARPE DIEM, MANTISSA and MUSIC European Projects. At the 1st end-users discussions, in Düsseldorf (27th and 28th May 2003) a large, formal meeting of end-users and researchers was arranged. In this, all of the research teams made formal presentations of their progress and results to the end-users. Then, all of the end-users made prepared presentations introducing their organizations and outlining their main problems and comments on the researchers presentations. This was judged to be the best way to introduce all the end-users to all the researchers. In contrast to this format, the 2nd end-users workshop was organized as a series of simultaneous small group round-table discussions between end-users and researchers. This was intended to facilitate dialogue and maximize the communication potential and was planned and organized by M.Bruen.

2 Objectives of discussions with end-users:

The objectives of the 2nd end-users' workshop were:

- To have a substantial dialogue between project researchers and end-users.
- To produce conditions that facilitate this dialogue and especially for participants not accustomed to speaking at large meetings.
- To especially promote contributions and feedback from actual or potential end-users.

To this end all of the participants at the "European Workshop" were given the opportunity to attend the round-table sessions. So a larger group than just the formal project "end-users" participated. Of the 84 participants registered for the "European Workshop" 40 participated in the round table discussions, Table 1 (excluding the organizer M. Bruen and the Carpe Diem coordinator, P. Alberoni). In addition to project researchers and end-users this included some members of the projects' steering committees. Of the 40 participants, 15 were end-users and 8 were Workshop "observers", who may be potential end-users.

TABLE 1 Round Table Discussions: Composition of Groups					
Group 1	*Group 2*	*Group 3*	*Group 4*	*Group5*	*Group 6*
Room 9	*Room 11*	*Room 10*	*Room 13*	*Room 14*	*Room 15*
Mr. B. Parmentier	Mr. T. Joyce	Dr. B. Vehvilainen	Dr. D. Rezacova	Mr. H. Pohjola	Dr. J. Bech
Dr. W.E. Grabs	Mr. T Carballo	Mr. A Nex	Mr. N. Outhwaite	Dr. A Redder	Dr. S. Wang
Ms. K. Leech	Dr. J. Niwinski	Mr. P. Rodriguez	Dr. J. Cunillera	Mr. E. Sprokkereef	Mr. P. Calla
Mrs. K. Hajtasova	Prof. M. Brilly	Prof. E. Todini	Prof. P. Burlando	Mr. A. Burton	Prof. P.E. O'Connell
Mr. R. Keranen	Prof. A. Holt	Mr. I. Karro	Dr. R. Hannesen	Prof. G. Pegram	Prof. I. Tsanis
Mr. A Johansson	Mr. M. Sandev	Mr. J. Danhelka	Mr. P. Kaiser	Dr. P. Källberg	Dr. M.J. Willis
Dr. S. Kraemer	Mrs. C. Edlund	Dr. M. Grum		Mr. H. Puranen	Prof. C. Collier

Note: the Rapporteurs are the first name in each group (underlined)

3 TOPIC: Flood forecasting & Warning

The topic for discussion at the round-table sessions was the very general theme of the meeting "Flood forecasting and warning". Any issue of concern to either the end-users or researchers in each group could be raised at each discussion. However, as an aid to the Rapporteurs in focusing their groups (or starting a discussion if the group was slow to start) a number of sub-themes/key-words had been identified as important, they were

1. Current Problems / Solutions

- Technical: Data / Modelling
- Operational

2.Dealing with uncertainty and risk

- How to present uncertainty / tools needed to deal with it?
- Warning levels
- False Alarm Rate vs. Probability of detection
- Public attitude to risk

3. Future Requirements

- New instrumentation / New technology
- Specifications, resolution, accuracy, timing
- Training / Education

The Rapporteurs were instructed to use these if necessary. Following a recommendation from the floor, it was recommended that all discussion groups start with theme 1, but that some then discussed theme 2 and some theme 3.

4 Methodology / Procedures

The organization of the round-table discussions was loosely based on a technique used by large organizations for "brain-storming" and consists of the following elements:

1. The participants were divided into six small groups (in this case from 6 to 7 people in each group). The allocation was carefully done to ensure as wide as possible a mix of backgrounds and nationalities in each group. (Table 1) There was balance in numbers between end-users and researchers in each group.

2. Each group was assigned a Rapporteur who was briefed on the procedure, prior to the session. These were Mr. B. Parmentier (Carpe Diem, Ireland), Mr. T. Joyce (OPW, Ireland), Dr. B. Vehvilainen (Finnish Environment Institute), Dr. D. Rezacova (Inst. Atmospheric Physics, Czech Republic), Mr. H. Pohjola (Carpe Diem, Finland), Dr. J. Bech (Catalan Met. Service). Note that the majority of Rapporteurs are end-users, to give them real ownership of the process and to emphasize that their input is valued.

3. Each group was assigned to a separate small room, specially prepared so that each participant had a number of cards and a marker pen in front of them when they sat down.
4. The Rapporteur introduced the general topic for discussion and asked each participant to introduce themselves to the group. The Rapporteur then invited participants to write their contributions, ideas, problems on the cards, one idea per card. In some cases, participants preferred to state their contribution verbally and discuss it with the group before committing it to the card.

5. Every idea / contribution was accepted and the Rapporteur mounted the cards on the display board or wall in the room, Figures 1 and 2.

Figure 1 Discussion in Group 3

Figure 2 Discussions in Group 4

6. Participants were invited to take and fill more cards if they had more contributions

7. When sufficient cards have been filled, the Rapporteur assisted in grouping the contributions into major themes, Figure 3, and invited comments/discussions on these.

Figure 3 Arranging ideas by themes

8. When the group was satisfied that all their main ideas on the topic have been given, the Rapporteur noted the major themes on a report card and proceeded to the next discussion topic.

9. All groups managed to discuss two topics fully in the time available and some groups managed three.

10. The door of the room remained open during the discussions, so others were able to visit to observe the discussion in any group, or take part in it. In this particular case, there was minimal movement between groups.

11. After the round-table discussions, all of the participants reconvened as a single group in the main hall and each Rapporteur delivered a short (5 to 10 minute) summary of the major themes emerging from each group. These are listed below.

5 Summary of results

In all, 79 ideas, comments, suggestions, questions emerged from the discussions of the 6 groups. While there is some overlap between some of these, this serves to emphasize their importance and relevance since they emerged independently from more than one group.

The some of the main ideas/suggestions are itemized in summary form below to give an idea of the range of results. More details of the discussions in the individual groups are given in the Appendices.

5.1 Current Problems

Problems in models:

- Soil moisture modelling within models not sufficient, it should be remotely sensed for use as initial conditions for hydrological models, e.g. by Satellite.

5.2 Data problems

- Accuracy of Radar observation of precipitation must be improved.
- Availability of radar data should be improved.
- Satellite estimates of rainfall and snow may be useful.
- Flash floods should be considered at different scales to large scale floods
- Stop the decline in investment in observing instruments. Radar should not be used as a justification for reducing numbers of rain gauges, nor for cutting back on any planned expansion of network. The rain gauges may be particularly useful in extreme events when the power supply to the radar may be interrupted.
- Use of historical data-sets for post event analysis is useful
- The whole flood forecasting chain should be made more consistent
- Decision makers should provide information on how long it takes to make decisions in an emergency situation

5.3 Future Requirements

- There are still problems in implementing existing technology and tools
- BETTER DATA i.e. obtaining good quantitative radar data is still an issue
- Dual polarisation products will be useful

- Forecasters should be trained in the use of new technology and new techniques.
- New technology should be investigated
- Communications systems (for/during flood management) should not rely on phone networks, which may not be available during a severe storm event, but should use radio links.
- More radar coverage in mountainous areas, prone to flash floods, was suggested, although it was acknowledged that these are areas in which radar has some difficulties.
- Satellite sensing of precipitation was suggested and systems for combining these with radar information and with information from other types of sensors.
- The widening gap in technology between the developed and developing world was noted.
- Even within Europe, there are large differences in technology and capability. Education programmes which provide exposure to and experience with state of the art systems are useful, (e.g. possible role for EU Marie Curie programme)
- It was estimated that 10 years of works would be required to obtain significant progress in forecasting precipitation for local (convective?) storms.
- Commercialisation of services and charges for data are hindering research
- Need an automatic system to detect severe errors in data, or missing data effects, in an operational system
- Need a clear, objective and structured plan for alert management
- Suggest running two management systems (e.g. for flood control reservoirs etc.) in parallel: (i) a purely automatic system, with no provision for operator override and (ii) a manual system. Their performance could be compared and lessons learned.
- Different types of end-user require different types of forecast. Some do not require probability information and some do. Know your end-user!
- Joint workshops with end-users recommended, to clarify how the uncertainty is calculated. Even some deterministic modellers should learn how this is done.
- 1 hour and 3 hour lead-time forecasts is what is usually required but even 15 min lead time forecasts would be useful in certain applications.
- Methods for post-event checking previous forecasts are required.
- Too many different data formats with consequent delays in utilisation, not only between countries, but also even between agencies within a single country. Standardisation is required.
- Trans-border networks of radar would be useful
- There are “Health and Safety” aspects to floods, which may be used as additional justification for investment in measuring network.
- Acknowledge value of microwave links.
- In practice, the complete decision making support system for managing flood hazards is not well coordinated. For instance, those making decisions on investment (or cutbacks) in the observing network are not involved in the operational forecast loop and are thus more remote from perception of the consequences of their financial decisions. These decision makers’ responsibilities should include elements of dealing with the consequences of floods.
- Decision makers are generally one of three types [elected, local volunteer, professional] and this effects how decisions are made and what information is required.
- We require real-time 2-dimensional flood inundation modelling
- We should to build a bridge between meteorologists and hydrologists.
- We should make the best use of our experiences of past floods, e.g. to improve modelling
- We need to improve quality control of all types of precipitation data
- We need to improve precipitation type discrimination including snow
- We need better specification of rainfall observations to meet specific end-users purposes.
- Require an improved data-base about ground data, perhaps including intensive field campaigns
- Require an improved forecast of the snowmelt period in spring.

- Possible mitigation actions should be considered in relation to flood forecasting capabilities.

5.4 Societal Impacts

- Require improved flood maps, vulnerability maps.
- Make the public aware of flood forecasting process (capabilities and limitations?)
- Explore the willingness of the public to pay for data (warning systems)

5.5 Uncertainty & Risk

- Awareness of uncertainty is low
- There is poor visualisation of vulnerability
- Taylor-made forecasts are required [different for different end-uses]
- Production of flood-risk maps is useful for promoting awareness of risk and also are of interest to the Insurance community (but may affect property values)
- Trust is based on track record and a belief in reliability.
- Extreme floods are not always caused by extreme precipitation [e.g. mudslides blocking channel or debris blocking channel or bridge arch.]
- Education of local media/journalists on how warning systems work and what the problems are will help promote sympathetic and informed reporting of either successes or failures.
- Teach the correct meaning of terms used. Both to the general public and also to professionals from different, but relevant, disciplines.
- The real end-user is the person who gets flooded and uncertainty and risk should be presented to them in an understandable manner. We need to understand how people treat uncertainty in flood forecasts. The questions the public ask are “Should I leave my home?”, “When should I leave?” “How bad will it be?”
- There is a need to make decision makers aware of uncertainty
- We need to understand if people feel secure behind existing flood protection schemes and do not react to warnings.
- Require a cascade of different warnings (including a pre-warning) with different levels of confidence
- Form of forecast should be improved to include probability information.
- Improve access to data, not just dissemination of the results of research projects, but also access to their raw data.
- Issue warnings in a manner in which their quality can be assessed afterwards
- The final decision makers need specific tools to fully utilise flood forecasts/warnings

6 Conclusions from Round table discussions

The round table format provided a forum in which the concerns, comments and suggestions of end-users could be discussed and recorded. The number and character of the resulting suggestions and comments listed above confirm that, despite current progress, much remains to be done in all aspects of flood warning and especially in ensuring operational use of research outputs. I think that participants emerged from these discussions with a broader knowledge of not only the problems, but also the range of potential practical uses for the technical outputs of the research projects involved.

7 Overall conclusions: End-users levels of service requirements.

Taking both end-users meetings together and identifying the issues which arose independently in both meetings allows us prioritise the requirements of end-users. In both meetings end-users were complimentary in relation to the scientific methods and progress presented to them. However, their requirements for the future extended way beyond technical improvements:

7.1 Technical:

- The required forecast lead time depends on the individual situation, application and available mitigation options and there is a wide variety of requirements.
- The accuracy, reliability and availability of radar products should be improved
- A measure of uncertainty or quality should accompany all products, modeling and forecasts (e.g viz. COST717 documents on data quality)
- Transboundary (International) collaboration is acknowledged and encouraged.
- The use of continuous simulation hydrological models (which keep track of soil moisture) should be encouraged and the use of 2-D models developed.

7.2 Education & Training:

- Tools are required for the visualisation and use of the quality or uncertainly information to be provided with products or forecasts.
- Training is required in the use of these tools and the additional quality information provided.
- More collaboration between scientists in the forecast chain should be encouraged, especially between meteorologists and hydrologists.

7.3 Communication with the Public

- There should be efforts to educate the public and press about the nature of flood warnings and of the balance to be struck between false alarms and probability of detection of major events. If the public have a better understanding them their response to actual warnings ad their tolerance of flase alarms will be improved. These efforts could include, direct contact, courses, workshops, an appropriate web-site etc. Account should be taken of the highly skewed nature of public attitudes to risk.
- The public must be told that Floods, landslides etc. are natural hazards and that there are always risks of their occurring. Moreover there are limits to the control and to the warnings that science can produce.

7.4 General

- New technologies are not substitutes for rain-gauges, but should be part of a multi-sensor approach.
- The importance of considering the whole forecast chain together, including post-flood remediation, forensic analysis etc. was emphasized.

- Climate change was mentioned but no firm statements emerged from the discussions, so end-users may not be as aware of its implications as they should.

8 Acknowledgements

The author is grateful for the willing and conscientious assistance of the Rapporteurs (Mr. B. Parmentier, Mr. T. Joyce, Dr. B. Vehvilainen, Dr. D. Rezacova , Mr. H. Pohjola, Dr. J. Bech), all of whom undertook the task without knowing what it involved and who performed it well.

Appendix A : Participants and Organisations involved in End-users Round Table Discussions

	Organisation	First name	Family name	Country
1	Catalan Met Service	Dr Joan	Bech	Spain
2	University of Ljubljana, FGG	Professor Mitja	Brilly	SLOVENIA
3	University College Dublin	Dr. Michael	Bruen	Ireland
4	ETH Zurich	Professor Paolo	Burlando	Switzerland
5	University of Newcastle	Mr Aidan	Burton	UK
6	SMHI Sweden	Peter	Calla	Sweden
7	University of Salford	Prof. Chris	Collier	UK
8	Catalan Meteorological Service	Dr. Jordi	Cunillera	Spain
9	Czech Hydrometeorological Institute	Mr. Jan	Danhelka	Czech Republic
10	Swedish Meteorological & Hydrological Institute (SMHI)	Mrs Cristina	Edlund	Sweden
11	World Meteorological Organisation (WMO)	Dr Wolfgang Erich	Grabs	Switzerland
12	PH Consult APS	Dr. Morten	Grum	Denmark
13	Slovak Hydrometeorological Institute	Mrs. Katarina	Hajtasova	SLOVAKIA
14	AMS GEMATRONIK	Dr Ronald	Hannesen	Germany
15	University of Essex	Professor Anthony R	Holt	UK
16	Swedish Meterorological and Hydrological Institute	Mr Ake	Johansson	Sweden
17	Office of Public Works	Mr. Timothy	Joyce	Ireland
18	Austrian Red Cross Headquarters	Mr Peter	Kaiser	Austria
19	Swedish Meteorological & Hydrological Institute (SMHI)	Mr. Ilmar	Karro	Sweden
20	Vaisala Oyj	Mr Reino	Keranen	Finland
21	University of Hannover	Professor Stefan	Kraemer	Germany
22	SMHI Sweden	Per	KÃ¥llberg	Sweden
23	Forestry Commission Scotland	Ms. Kim	Leech	Scotland
24	Wallingford Software	Andrew	Nex	UK
25	Verbundplan GmbH	Dr. Mr. Janusz	Niwinski	Austria
26	University of Newcastle	Prof. Enda	O'Connell	UK
27	Environment Agency (UK)	Mr. Nigel	Outhwaite	UK
28	University College Dublin	Mr. Benoit	Parmentier	Ireland
29	University of Kwazalunatal	Prof. Geoff	Pegram	South Africa
30	Finnish Meteorological Institute	Mr Heikki	Pohjola	Finland
31	Kemijoki Oy	Mr Hannu	Puranen	Finland
32	Emschergenossenschaft/ Lipperverband	Dr. Axel	Redder	Germany
33	Institute of Atmospheric Physics	Dr. Daniela	Rezacova	Czech Republic
34	Clavegueram de Barcelona (CLABSA)	Mr. Pablo	Rodriguez	Spain
35	Czech Hydrometeorological Institute	Mr. Marjan	Sandev	Czech Republic
36	Advanced Research Partnership	Mr. Daniel	Spagni	UK
37	Institute for Inland Water Management and Waste Water Treatment (RIZA)	Mr Eric	Sprokkereef	The Netherlands
38	Dipartimento di Scienze della Terra & Geologico Ambientali	Prof. Ezio	Todini	Italy
39	Technical University of Crete	Professor Ioannis	Tsanis	Greece
40	Met Eireann	Dr. Shiyu	Wang	Ireland
41	Finnish Environment Institute	Dr. Bertel	Vehvilainen	Finland
42	Rutherford Appleton Laboratory	Dr M J	Willis	UK
43		Dr. T	Carballo	

Appendix B : Notes of Rapporteur from Group 1

Rapporteur: Mr. Benoit Parmentier

General comment on high quality of workshop.

Future Requirements
There are problems in implementing existing technology and tools
New technology, radar water level recorders (?)
Communications systems should not rely on phone network, which may not be available during a severe storm event, but should use radio links.
More radar coverage in mountainous areas, prone to flash floods, was suggested, although it was acknowledged that these are areas in which radar has some difficulties.
Satellite sensing of precipitation was suggested and systems for combining these with radar information and with information from other types of sensors.
Satellite sensing of soil moisture for initialisation of hydrological models.
Downscaling of ECMWF products would be useful.
The widening gap in technology between the developed and developing world was noted.
Even within Europe, there are large differences in technology and capability. Education programmes which provide exposure to and experience with state of the art systems are useful, (e.g. EU Marie Curie programme)
It was estimated that 10 years of works would be required to obtain significant progress in forecasting precipitation for local (convective ?) storms.
Even 15 min lead time forecasts would be useful in certain applications.
Commercialisation of services and charges for data are hindering research

Uncertainty and Risk
Awareness of uncertainty is low
There is poor visualisation of vulnerability
Taylor-made forecasts are required [different for different end-uses]
Production of flood-risk maps is useful for promoting awareness of risk and also are of interest to the Insurance community (but may affect property values)

Appendix C : Notes of Rapporteur from Group 2

Rapporteur: Mr. Tim Joyce

This group can up with a series of questions.
What is the true starting position for a forecast ?
What is the difference between an operational and research flood forecasting system ? (in performance or in components)
How reliable is present day research radars ?
1 hour and 3 hour lead time forecasts is what is usually required.
Is radar more reliable than NWP ?
Methods for post-event checking previous forecasts are required.

Data
Too many different data formats with consequent delays in utilisation, not only between countries, but even between agencies within a single country. Standardisation is required.
Transborder networks of radar would be useful
Radar should not be used as a justification for reducing numbers of raingauges, nor for cutting back on any planned expansion of network. The raingauges may be particularly useful in extreme events when the power supply to the radar may be interrupted.
There are "Health and Safety" aspects to floods, which may be used as additional justification for investment in measuring network.
Acknowledge value of microwave links.
In practice, the complete decision making support system is not well coordinated. For instance, those making decisions on investment (or cutbacks) in the observing network are not involved in the operational forecast loop and are thus more remote from perception of the consequences of their financial decisions. These decision makers' responsibilities should include elements of dealing with the consequences of floods.
Decision makers are generally one of three types [elected, local volunteer, professional] and this effects how decisions are made and what information is required.

Media / End-user issues.
Trust is based on track record and a belief in reliability.
Extreme floods are not always caused by extreme precipitation [e.g mudslides blocking channel or debris blocking channel or bridge arch.]
Education of local media/journalists on how warning systems work and what the problems are will help promote sympathetic and informed reporting of either successes or failures.
Teach the correct meaning of terms used. Both to the general public and also to professionals from different, but relevant, disciplines.
The real end-user is the person who gets flooded.

Appendix D : Notes of Rapporteur from Group 3

Rapporteur : Dr. Bertel Vehvilinen

Need an automatic system to detect severe errors in data, or missing data effects, in an operational system
Need a clear, objective and structured plan for alert management
Suggest running two management systems (e.g. for flood control reservoirs etc.) in parallel: (i) a purely automatic system, with no provision for operator override and (ii) a manual system. Their performance could be compared and lessons learned.

Future requirements:
Different types of end-user require different types of forecast. Some do not require probability information and some do. Know your end-user !
Joint workshops with end-users recommended, to clarify how the uncertainty is calculated. Even some deterministic modellers should learn how this is done.

Appendix E : Notes of Rapporteur from Group 4

Rapporteur: Dr. Daniella Rezecova

Current Problems / Solutions
Flash floods should be considered at different scales to large scale floods
Stop the decline in investment in observing instruments
Use of historical data-sets for post event analysis is useful
The whole flood forecasting chain should be made more consistent
Decision makers should provide information on how long it takes to make decisions in an emergency situation

Uncertainty / Risk
There is a need to make decision makers aware of uncertainty
We need to understand how people treat uncertainty in flood forecasts.
We need to understand if people feel secure behind existing flood protection schemes and do not react to warnings.

Future requirements
We require real-time 2-dimensional flood inundation modelling
We need to build a bridge between meteorologists and hydrologists.
How do we make the best use of our experiences of past floods ?

Additional comments from Daniel A. Spagni (UMIST)

It was an interesting group as it included the Environment Agency which has an elaborate system of flood warning and the Red Cross which is the last in the chain of end-users.

-We should distinguish clearly between providing data and providing operational solutions. The latter has not received the attention it deserves.

- An important justification for rain gauge networks is their role in calibrating the radar. From the Mantissa project it is clear that microwave links could also play a role in radar calibration.

-forecast lead times should be linked to the accuracy, timeliness, the type of flood (flash flood) and the response time of the emergency services

-standardisation for data, modelling, warning, etc. and quality control need to be linked. It would also be useful if some details on how to go about it are included.

-the section on societal impact should be expanded. In group 4 a lot of these issues came to the fore eg post-flood care, remediation, impact of changes in land use, climate change (which does not appear in the current list of issues!)

-Although politicians and the public expect scientists to provide responses to everything the tendency to spin and oversell the data and the analysis are very dangerous and can kill. We should say clearly that natural disasters/chaotic behaviour are a normal part of the (re)balance of the ecosystem/biosphere and there is a limit to the control which we can exercise on them.

Appendix F : Notes of Rapporteur from Group 5

Rapporteur: Mr. Heikki Pohjola

Problems in models :
Soil moisture modelling within models not sufficient, it should be remotely sensed for use as initial conditions for hydrological models.

Data problems
Accuracy of Radar observation of precipitation must be improved.
Availability of radar data should be improved.
Satellite estimates of rainfall and snow may be useful.

Future requirements
BETTER DATA !
i.e. good quantitative radar data
dual polarisation products will be useful
Forecasters should be trained in the use of new technology and new techniques.

Uncertainty and risk
Uncertainty and risk should be presented to the end-user in an understandable manner.
The questions the public ask are “Should I leave my home ?”, “When should I leave?” “How bad will it be?”
Has anyone investigated the publics’ attitude to this type of risk?
Do ensembles contain the entire range of possibilities ? Answer No!

Appendix G : Notes of Rapporteur from Group 6

Rapporteur: Dr. Joan Bech

Future Requirements

Data

We need to improve quality control of all types of precipitation data
We need to improve precipitation type discrimination including snow
We need better specification of rainfall observations to meet specific end-users purposes.

Modelling

Require an improved data-base about ground data, perhaps including intensive field campaigns
Require an improved forecast of the snow-melt period in Spring.
Possible mitigation actions should be considered in relation to flood forecasting capabilities.

Societal Impacts

Require improved flood maps, vulnerability maps.
Make the public aware of flood forecasting process (capabilities and limitations ?)
Explore the willingness of the public to pay for data (warning systems)

BETTER DATA !

i.e. good quantitative radar data
dual polarisation products will be useful
Forecasters should be trained in the use of new technology and new techniques.

Uncertainty

Require a cascade of different warnings (including a pre-warning) with differen levels of confidence
Form of forecast should be improved to include probabililty information.
Improve access to data, not just dissemination of the results of research projects, but also access to their raw data.
Issue warnings in a manner which can be assessed afterwards
Use information from past events to improve the performance of models (FAR, COR)
The final decision makers need specific tools to fully utilise flood forecasts/warnings

SUMMARY (by Joan Bech)

This document is a summary of the work done during the End Users Round Table, listing the contributions on the different issues.

Members: apart from the original members, Table 1 above, Prof. C. Collier joined the group as a floating member.

TOPICS

Two different topics were tackled: 1) future requirements and 2) uncertainty of risk.

FUTURE REQUIREMENTS (14 contributions clustered in 3 groups):

Precipitation related:
- Increase time resolution of radar volumes above 5' (with a high number of elevations)
- Get more detailed specifications about end user´s requirements about precipitation observations
- Improve QC
- Better snowmelt detect snowfall/accumulation
- Improve precip type discrimination

Catchment/modelling:
- Intensive field campaigns to collect ground data
- Enhance survey methods for a better description of the catchment
- Better forecast on the snowmelt period in spring
- Hydrological model type specification

Societal impacts:
- Mitigation actions
- Improve flood maps to assess more precisely local vulnerability
- Increase the public awareness and efective communication
- How much are user´s prepared to pay for the data?

The importance of the data flow was remarked and it was mentioned the example of the recent change in the UK policy, where it has been made an important effort to built a national data base incorporating all data observations of UKMO and research projects and made available free of charge for research groups.

UNCERTAINTY RISK (9 contributions clustered in 3 groups)

Pre-warning stage:
- Use probabilistic flood forecasts based in 8-10 days meteorological forecasts.

Warning:
- Flood forecasts should be specified in probabilistic form.
- Public access to data (e.g., USA have real time radar on TV)
- Reflect radar rainfall estimations uncertainty

Post-event:
- Improve the analysis of the performance of forecasts models (considering correct harm rate, false alarm rate, ...)
- Enhance the overall post-event analysis (forecast, warning procedure, response, ..)
- Need to take into account decisions maker attitude

A general comment was made about the need to increase education and training in all parts of the flood warning chain. Besides the differences in catchments and climate behaviour (for example, Mediterranean small catchments with complex topography and torrential regimes in front of larger catchments in flat terrain in central and northern Europe).