The EMMA Project - Operational Phase

Introduction

The main ideas of the EMMA (European Multiservice Meteorological Awareness) project have already been presented in the 2002 and 2004 issues of the European Forecaster. Graphical maps with awareness levels will be displayed on a common website to inform the public of imminent danger due to severe weather. Possible additional sources of information about mitigating risk will then be given by links to the websites of the National Meteorological Services.

Figure 1. Example of Meteoalarm output.

The operational implementation of this project is expected by the end of 2006. The EMMA system by then will get its new operational name and will be baptised as “METEOALARM”. However, several issues still need to be addressed with well worked solutions before the system becomes fully operational.

Partners

The range of EMMA partners has been enlarged since the start of the project. At the 26th Eumetnet Council, the National Meteorological Services from the following countries agreed to participate and contribute to the EMMA system:

Austria	Finland	Hungary	Luxembourg	Spain
Belgium	France	Iceland	Netherlands	Sweden
Cyprus (1)	Germany	Ireland	Norway	Switzerland
Denmark	Greece	Italy	Portugal	UK

Visibility

This European map with integrated information on warnings and alert levels demonstrates the benefits of efficient and clearly visible co-operation between the National Meteorological Services involved, particularly in situations when significant media attention is focused on meteorological events.

The integration of the "vigilance map" into the French media has shown that there is a demand for standardised and consistent information particularly during extreme weather events. 'Standardised' in this sense means that key elements of the message should not change from one event to another and that the general public, relevant authorities and the media are all well informed in a clear way. Messages are well structured and can be understood without further explanation within seconds by the majority of people. Further information is conveniently accessible and provided for those customers/users who need more specific details.

In general terms, cases relating to extreme weather tend to be underestimated during the forecast period and overestimated in the reporting phase during and immediately after the event. There is then often less media interest in a later phase when damages have been assessed and measures are proposed to politicians. The storm that hit parts of northern Europe in December 1999 ('Lothar') is a prime example. Only a few hours before the event it was not possible to get the necessary attention of the public because the information did not contain easily understandable advice.

Impact – the hazard chain

In the last few years a general trend in research projects, risk management and new warning systems from the more advanced weather services has been observed. Pure warnings are related to a more integrated approach of impact related information systems.

Public authorities have been interacting more directly which each other on a more competent and higher level, thereby closing gaps in the chain comprising mitigation, prevention (e.g. land planning measures), forecast warnings and alerts, damage assessment and relief efforts. To make this chain work and to minimise damage with the most efficient use of public funds, each part of the chain has to interact with the other in an optimised way. Warning systems have to know about the impact of weather to be informative and relevant for practical measures to be put into place.

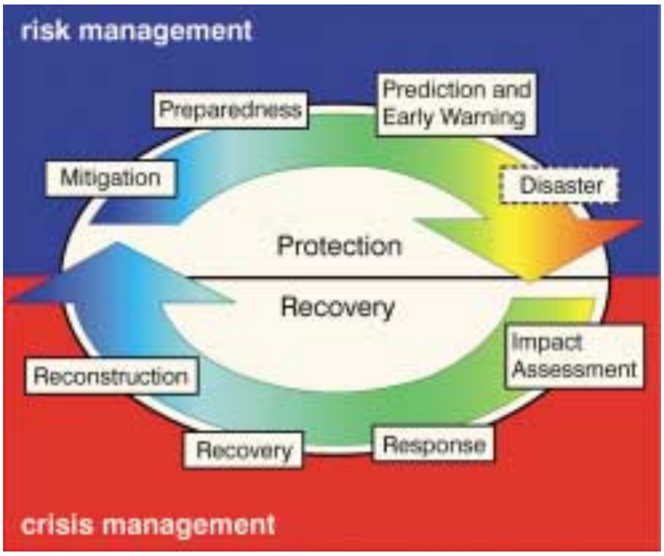

Figure 2. Integrated approach for warning systems.

Meteorological information and warnings have traditionally been based on fixed thresholds for one parameter, often with a fixed time scale, e.g. precipitation rate over 24 hours. This traditional approach makes evaluation of the quality of forecasts easy and homogenous for a given area with climatic homogenous conditions.

On the other hand, weather related damage and catastrophes are only indirectly dependent on parameter related thresholds. They are mostly linked to extreme values of a certain parameter in a given area or a critical combination of more than one parameter. By looking at area related occurrences, one comes to the conclusion that the impact of an extreme weather event is more important and relevant than references to fixed thresholds.

A good example is wind speed. In built-up areas away from coastlines, wind speeds are usually low and winds of 90 km/hr are likely to cause large amounts of damage. Over the exposed coasts of northwest France or in mountainous areas, winds of 90 km/hr would not usually result in any damage at all.

The same is true for precipitation or amounts of fresh snow. For areas in which large amounts of precipitation are common, the natural eroded landscape, architectural design, human behaviour and other damage related features are highly adapted to extreme precipitation events.

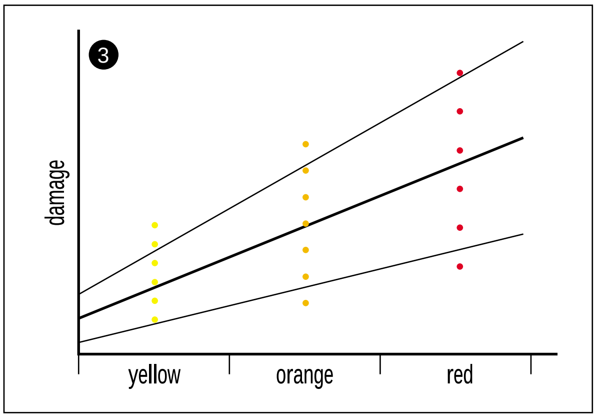

Figure 3. Schematic relationship between damage and warning levels for fixed threshold levels

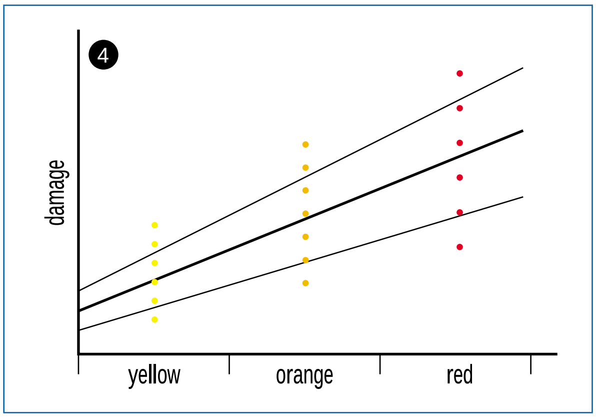

Figure 4. Schematic relationship between damage and warning levels for threshold levels dependent on return periods

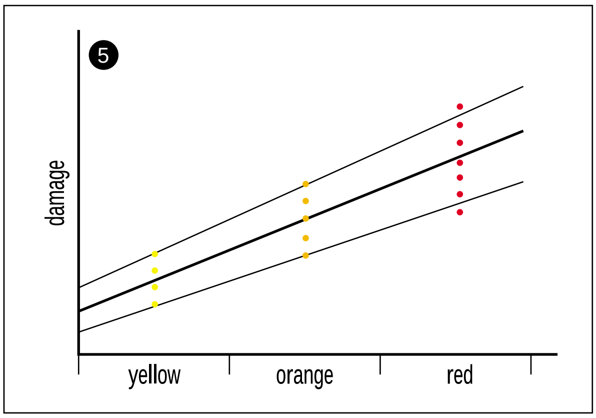

Figure 5. Schematic relationship between damage and warning levels for impact related threshold levels

It is suggested that return periods can provide a very good first guess for the choice of warning thresholds. A natural lower limit is a value that will not cause any damage. So would a well-sheltered area, for example, experience any damage at all if a 10-year event with wind speeds of 40 km/hr wind speed were to occur?

The principle of return periods can therefore be a very elegant and useful method to extend pure meteorology towards the impact of weather driven events and give at the same time, the needed flexibility to find thresholds for climatically very different areas.

If two adjacent but climatically different areas need to be warned with consistent information, the method of return periods allows the use of two different threshold values, relating to upper and lower limits of a precipitation event, to provide a comparison of warning levels for both areas. The advantage of this system is not only the much closer connection to the impact of the warning, but also the more direct connection to how this information is transmitted to the public by the media. A typical question from journalists after an extreme rainfall event is: When was the last time we had that amount of rain?

If values for meteorological parameters are static, the correlation between damage and warning level is weak, depending on climatic zones and preparedness for certain types of danger like wind for example.

Return periods used as a basis for the definition of warning levels give a closer correlation between warning situations and damage, as climatic features of an area are placed on a relative scale.

A foreseeable impact provides the best basis for warnings, but is the most difficult to assess. Basis for these calculations are the number of people exposed to a certain danger, the behaviour or the mitigation possibilities for certain damage types and the return periods of extreme meteorological events in a given area.

Finding thresholds

With journalists often directed towards the “interesting”, “other than normal” and the exaggerated, it is important that information related to extreme events is based on well established, reliable and easily understood concepts with quantitative elements available. The Richter scale for earthquakes provides a good example. Without any other additional information, the number on the Richter scale gives a clear first indication of the severity of an event and a first guess on the possible extent of damage.

In the case of meteorology, a similar system is still missing and the perception of the work of the Meteorological Services in the public domain suffers considerably from that fact. If warnings were correct, but recommendations have not been followed in cases of extensive damages, it is often the warning which is blamed after the event to have been unclear, incoherent or insufficient.

In many cases of very extreme events, users do not have a clear picture of how severe the event will be. Therefore the necessary measures of prevention or recommendations given do not have the impact that they should have.

Recommendations

The evolution from pure warnings towards a system that also incorporates impact related information has proceeded successfully within the more advanced weather services. However recommendations accepted by both sides are only slowly becoming part of the system.

It is an ongoing discussion with many questions still open between different meteorological services about how far meteorological services should go into providing advice or recommendations. In many cases clear legal implications are attributed to different warnings or alert levels. In some cases the National Meteorological Service is not allowed to give any behaviour advice by its ministers. In these situations perhaps stronger co-operation with other authorities at a national level should be established. These legal aspects very much depend on the local situation and the parameters concerned.

On the other hand if a given system is defined not only by weather driven impact parameters but also by certain types of recommendations, then this system would be more resilient in its practical usage as it can be read from different perspectives in a coherent and meaningful way.

The trick here lies in finding definitions for the different warning or alert states which are flexible enough to be employed in different legal environments and, at the same time, are sharp and concise enough to give clearly distinctive levels for the different types of response needed by the customers/public.

At the same time, the type of mitigation necessary can be a good starting point for the definition itself, when typical scenarios of the last few years are borne in mind. Another possible solution is to use types of recommendations for different warning levels internally as a definition aid at one Met Service, while the official wording is issued by the relevant authorities.

Take large events like Lothar (1999), the Oder floods (2002), the heat wave of 2003 or Hurricane Katrina (2005). In each case hundreds or thousands of casualties and/or billions of Euros in damage were caused in a very short time. In each of these cases recommendations issued by the responsible authorities were not understood and followed, or adequate structures in the hazard chain were not available.

It became clear to authorities, that the understanding of these warnings needed a certain education and training of the public prior to the events, as opposed to the moment when the warnings were issued.

Police officers in New Orleans were able to communicate the seriousness of the situation in 2005 after very time consuming discussions, only after they had asked people resisting evacuation to write their social security numbers on their arms in order to facilitate the identification of corpses.

In all of the cases mentioned above, the common theme was that such severe events had not been experienced within peoples short memory and therefore responses were inadequate. An optimised application of the hazard chain from mitigation to relief efforts may have considerably reduced the damage and loss of life.

The basic fact therefore is less about issuing actual warnings and recommendations, but much more about how these warnings and recommendations are understood according to the different elements in the hazard chain when delivered to the final customer, the individual and the general public.

Obviously a distinctive class for these very extreme events is needed in order to cope with events where the result of well understood warnings lead to optimum damage limitation.

Harmonisation across countries

The principle of subsidiary is one of the very successful and basic principles within in the EU and makes sense whenever local effects have to be dealt with by local means and the best decisions are linked to the needs of the basic citizen.

When it comes to large scale events like Lothar, the Oder floods, the heat waves or Katrina, local experience and local memories are less helpful because similar events have often occurred too far in the past to be used successfully in a rapidly changing world. The missing public awareness and preparedness was in all of these cases one of the most important factors relating to the amount of damage and the magnitude of the impact.

Public preparedness for such cases can only be achieved with the help of a media defined danger scale for severe weather events. Warning values could then repeated automatically for future events in the same way that the Richter scale is used for earthquakes, thereby indicating how really extreme and unusual the uppermost level will be.

The same regional and inter-regional scale applies for any relief efforts; in all of these cases, assistance and damage relief measures could only be coordinated with larger scale relief structures, either national or international.

It becomes clear then, that especially in the case of very extreme events, much can be learned from other relatively recent events in other parts of Europe or the world, as these events have received extensive media coverage and the losses (both financial and human) have been understood by all. Media coverage and experiences learned from Lothar for example, should help disaster prevention not only in the countries where the storm occurred, but in all countries where similar events are possible.

A meaningful harmonisation of warning thresholds across Europe should therefore be promoted so that all participants in the hazard chain gain a homogenous understanding. It is also essential to promote the ideas for outcomes at the upper end of the scale, which on a regional level in an individualised scale would be hard to communicate. Public preparedness for the very extreme events can only be achieved if the media are not seen as a predator who follows his own interests by generating sensationalist quotes at the cost of scientific truth, but rather as an strategic partner to combine images of extreme events in one area with recommendations and greater awareness for warning schemes in other areas of Europe.

The interest for the media in a homogenised warning scheme lies in the quality of a reference point which a Europe-wide or an international danger scale can provide; the physics and details of the Richter scale are not known to every journalist and TV consumer, but the value of such a scale can be clearly seen in terms of how difficult information is potrayed through its useage.

The results from the Salzburg meeting, November 2005

The experts at the Salzburg meeting felt it necessary to create a matrix wide enough to host the individual national legal concepts, but at the same time stringent and concise enough to transport the ideas and concepts we consider to be common sense in meteorological terms.

Considering all the efforts that had been made during the EMMA I phase and the collection of experiences during the events of the last year, a proposal was made to the Expert group at the EMMA meeting in Salzburg, November 2005. It contains the four different approaches which can be used to define a danger scale from either the side of the producer of warnings (i.e. the National Meteorological Services) or the people exposed to these events.

What had been said about the hazard chain as an visual expression of the individual needs and duties of the different actors in the public sector producing warnings and steering relief efforts is expressed in this matrix in a quantitative way (see Figure 6). The two left-hand columns are defined by the meteorology, the third one by the physical conditions of the environment where the event is happening and the fourth one is directed as advice to the general public. The way it is formulated should be general enough to accomodate individual and regional recommendations and legal procedures but sharp enough at the same time to contribute significantly to the definition of the different events.

If one starts in the bottom right-hand corner of the matrix (4th level of the 4th column) it becomes understandable as to what the system is aiming at: in very extreme events, very unusual measures suggested or imposed by the responsible authorities should be followed in order to save lives in situations rarely or never experienced before. Preparing for this moment is one of the main tasks of the whole scheme.

Drastic events with casualties and general damage can also occur in the orange range, but they would be local and more regionally limited. In such cases, the best way to minimise damage would be to keep informed and act on the recommendations of the authorities.

In the yellow range, damage can be easily avoided by not pursuing dangerous activities like sailing, mountaineering or other selected outdoor activities.

Another way to define the different levels is via the frequency of occurrence of severe weather in the past and extrapolating the usage of the necessary warnings into the future. Seen from this perspective the scheme becomes based on meteorological events and is easier to grasp with data familiar to meteorologists. Lothar wind speeds in the hardest hit areas and the precipitation associated with the Oder floods would with no doubt fall into the “Red” category.

What is necessary here is a definition of the area where area related parameters are relevant. The size proposed and accepted at the Salzburg meeting was 300 000 km^2, (approx. half of France) covering thereby an area large enough to be responsible for the really large events. The area size does not imply that the event covers the whole area, but that this level would be used only once a year on a region of this size.

The meteorological thresholds are rather free for the different providers in the different climatic zones, as long as they fit with the other criteria and make sense in a warning context.

Common sense is a subjective measure, but a very helpful tool. Not every rare event is therefore worth a warning: very high temperatures, occurring only once in ten years in northern Scandinavia might be rare, but do not cause any damage and would not result in any warnings within such a scheme (although a warning service to specific customers could be employed).

Time scales of the events also define the way to incorporate them into the system. A storm lasting for only a few hours would count as one event and one usage of the warning level in the statistics. A heat wave lasting for more than ten days would need to count as one event, such as in 2003, with the necessary measures taken.

To further sharpen the ideas and mutual understanding of the usage of the warning levels it was proposed to prepare three cases of each partner from the last ten years, which would fit into the red category. These case studies and discussions about them could be the beginning of a long series of an extreme event catalogue helping to define commonly what we all want to achieve in the years to come.

The Future

The start of a new system like Meteoalarm offers Europe a unique chance to enter a new relationship with the public through the media. Several precautions have to be taken with similar steps: even if there is a high potential for large scale attention a new system needs a high degree of promotion at the beginning. The collaboration of the weather services could thereby be made visible in circumstances when meteorological information is essential and makes the news headlines.

	Thresholds (examples only, all values area related)	Used how often? per region (approx. 300 kkm²) for area related parameters	Damage	What to do?
Green			- - -	Usual phenomena
Yellow	> 60 km/h	> 30 per year	Exposed objects (avoidable)	Caution with exposed activities
Orange	> 90 km/h	1 to 30 per year	General damages (not avoidable)	Keep informed in detail
Red	> 130 km/h	Less then 1 year	Extreme damage on large areas (not avoidable, even in otherwise safe places)	Follow order of authorities under all circumstances Be prepared for extraordinary measures

Figure 6. Awareness level matrix

Special care should be given to the implementation phase and the period immediately after it. Any changes after the launch should be avoided, but there will inevitably be some very urgent ones that will need to be implemented with minimal delay. There will be a lot of information about the new warning system and this will need to be managed by the Meteoalarm consortium.

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