

## **WHERE WE GO FROM HERE: POLICY AND RESEARCH**

### **RECOMMENDATIONS**

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*...flash floods... present only narrow windows of opportunity, in some cases very narrow..." [They] "...are considered by many to be acts of God beyond human ability to prevent" (Stewart, this volume).*

#### **1. Flash flooding is becoming increasingly significant**

Flash flood vulnerability is increasing. While technological innovations make real-time data commonplace in many areas, and forecasting models increase leadtime, every year flash floods take more lives and cause greater damage. Flash floods, other than those associated with post-hurricane rains, tend to affect small areas and have mostly local effect. However, deaths and property losses are very high per unit area affected. The main contributors to increasing vulnerability are the location, type, and value of human activity. Increasing human population, rising affluence in many regions, and changing lifestyles, mean that human activities are expanding into more flash flood prone areas. In particular, these activities include recreational and leisure activities in addition to sprawling growth in urban areas.

Flash floods are different from slow-rise floods. Few people are injured in flash floods. More people are killed relative to slow-rise flood events. But, there is no clear definition as to what constitutes such flooding. Fortunately, there appears to be some agreement within broad parameters as set out in our first chapter that they are sudden, small scale with high damage potential. They have both physical and social dimensions. There are other hazards that share many characteristics with flash floods and some of these have been reviewed in the volume. Landslides and debris flows have

wide impacts and in December, 1999, as noted in the paper by Larsen, et. al., more than 30,000 people were killed in Venezuela. We are more frequently seeing events like the one in Caracas where a series of days of heavy rainfall followed by one extremely intense rain, has catastrophic effects. We must learn from the recent catastrophes to reduce future vulnerability in Venezuela and elsewhere.

## **2. No area is completely safe from flash flooding**

There are a variety of causal mechanisms for flash floods, partly because of their small scale. For example, flash floods may result from narrow natural drainage channels, urban drainage problems, or simply very heavy rain in the area flooded. No area is completely safe from the threat of flash flooding, although the severity and frequency would vary greatly. Increased urbanisation and subsequent reduction in permeable surfaces turns small events into disasters due to the inadequate drainage and rapidly increased runoff.

Attention should be devoted to identifying and avoiding high risk areas - or at least to making them safer through appropriate planning and mitigation. Warning systems and emergency planning are important approaches where the risk cannot be avoided completely - but they should not provide a false sense of security. The connection between detection and response needs a great deal of strengthening. Even those communities with integrated networks of streamgages and raingages face catastrophic losses if messages are not received or responded to promptly by those in harm's way.

## **3. Warning systems and preparedness offer the only practical approach**

Unfortunately, despite existing efforts to avoid hazardous areas, much development and activity is entirely dependent on warning systems and preparedness, which offer the only practical approach in many if not most situations. They are therefore not surprisingly the most widely used approach to flash flooding. During the NATO Advanced Studies Institute, on which this volume is based, there was some disagreement among Institute participants over whether much warning system improvement was possible in the US. We believe that while some areas have state of the art high performing systems, most do not and without constant attention will fall further and further behind what is possible and desirable.

However, warning systems are no panacea. They are no substitute for effective landuse planning - although they are always a desirable complement for handling the residual risk. With flash flooding there is never enough time, and failures with loss of life and disruption are all too frequent.

*“A different philosophy is emerging in the engineering profession, aiming to take into account not only technical and economic reliability, but also environmental risks and social equity” (Ganoulis, this volume).*

## **4. The application of existing knowledge**

Globally, there is enormous potential in terms of improving warning systems through the application of existing knowledge. Taking a broad view rather than focusing on specific cases, there are few places where warning systems would not benefit from either further research or the application of existing knowledge.

The NATO ASI participants are deeply involved with flash flood mitigation. However, many of us work in communities where flash floods are a very low priority. We need to work toward bringing awareness, warning, and emergency preparedness and response to the attention of decisionmakers and politicians. While we have a long way to go before we can promise that all flash floods will have accurate forecasts with adequate leadtimes, what we DO know needs be applied. Keeping community leaders and vulnerable citizens informed is an ongoing continuous process. Maintaining state of the art tools and strategies is becoming more difficult due to the frightening speed with which technology and society are changing.

## **5. Research needs**

Targetted research is needed in areas where there are clear knowledge gaps or where existing research may be outdated or of questionable relevance. Priority research areas would include:

- informal networks
- vulnerability to flash flooding
- detailed impact data
- flash flood warning dissemination
- scale issues
- legal liability issues
- application of IT
- extending the available time and making use of information technology
- the implications of European integration - likely to mean better cooperation and standardisation

## **6. Policy needs and directions**

The longest running, most successful warning systems in the US have been run by authorities with taxation powers and strong political support such as large cities or regional flood districts who can make the systems integral to their operations. Processes are needed to ensure that the various groups of local emergency managers, and law enforcement personnel involved in the warning task cooperate. These groups must also cooperate with political leaders and others involved in all aspects of community safety, risk management, business continuity and so on - there should be an emphasis on local responsibility as the time issue and local nature of flash flooding leave little alternative.

High priority policy areas would include:

- community leaders' awareness
- land use planning in an era of deregulation
- the distinction between rich and poor countries
- need for constant review and improvement(how?)
- means to measure success - needs constant attention and effort
- targetting public education and dialogue

## 6.1 PUBLIC EDUCATION

Flash flood warnings themselves do not save lives and property, but the responses individuals make based on those warnings do. During minor events, the simple act of being more aware while driving in the rain may help people to make better decisions, thus improving their safety. In major events, the public response may need to be much more dramatic, such as evacuating a village or climbing to higher ground when in a deep river canyon. Public education of the threat due to flash floods and proper safety rules must be an on-going campaign as part of the overall flash flood warning system. Half of all the people killed in US floods are motorists, so the population living where a flood actually occurs is only a fraction of the pool of people who may be affected by that flood.

*"...education and preparedness remain critically important tools in the reduction of flash-flood deaths and injuries, especially for motorists"* (Henson, this volume).

## 6.2 RICH AND POOR COUNTRIES

Many countries have strong institutions and technical-scientific capacity. Flash flood management and warnings can be based on these. However, in many poor countries, such institutions are frequently very weak or almost non-existent, so efforts to manage flash floods must take this into account or face failure. In most countries concentrating efforts on building local capacity and self reliance may be most effective.

*"It is essential to favor...the creation and application of preventative measures, the development of a culture of disaster prevention, and the fight against poverty. In countries like Mexico, natural calamities become social calamities on account of poverty"* (Vázquez Conde et. al., this volume).

## 6.3 APPLICATION OF MODERN INFORMATION TECHNOLOGY - THE OK-FIRST EXAMPLE

Technology and all aspects of communication media are changing at a breathtaking speed. We cannot predict what opportunities it will bring – only that there will be many unanticipated opportunities and problems. Warning systems must be designed to take advantage of information technology and be able to adapt to the inevitable future development. Perhaps the most outstanding example of the application of modern

information technology and management to warnings is the Oklahoma Mesonet discussed by Ken Crawford and Dale Morris.

*“As a result of operational successes on May 3 1999 and during many other situations, OK-FIRST has become a catalyst for change in many local governments. Local officials are now empowered to close bridges during floods, save property in wildfires, improve evacuations after hazardous spills, and protect audiences at outdoor events...”* (Crawford and Morris, this volume).

*“It is the author’s opinion that technology will never replace what people contribute to the process, and that people are the most critical component of a local flood warning system”* (Stewart, this volume).

*“the most notable byproduct of this technology [IT] may be the worthwhile partnerships that have evolved”* (Stewart, this volume).

## **7. The next ten years: dilemmas and possibilities**

Reflecting on the work of this volume, we are struck by how far flash flood mitigation has moved over the last decade. We also note that many of the same fundamental issues remain – some of them are framed slightly differently but they still remain challenges. Advances in knowledge and experience must find their way into policy and operational changes. As this happens a range of dilemmas and potential conflicts become evident. The flash floods can be better identified, but the problems are growing as fast, if not faster than our knowledge. The fatal nature of flash floods is well documented, but development interests seem increasingly powerful and short-term economic interests almost inevitably prevail. Environmental monitoring and flood prediction have improved but the decision-making and dissemination needed for effective warning and response seem to lag further and further behind. Sophisticated but untried warning systems can be traded off against further development of hazardous areas and so on.

Perhaps such dilemmas suggest that a refocusing of our efforts is needed: the flash flood problem has to be considered as part of a broader socio-economic process. Dealing with aspects in isolation is often necessary for practical reasons. Part of achieving any progress involves the bigger picture and longer term planning.

Flash flood warning systems can perform well. But they are no substitutes for risk identification and minimisation. There is never enough time and there are always people who will not be reached or who ignore warnings.

The next ten years hold possibilities for great improvements in flash flood management and mitigation. The flash flood problem may need to be reconceptualised, to make it unambiguously clear that it is qualitatively completely different from other types of flooding. Other possibilities seem most likely to emerge from truly interdisciplinary efforts between hydrologists, meteorologists, social scientists and others committed to flash flood mitigation. We took large strides toward implementation of this important work in Ravello in 1999.

*“In a changeable world, the best solutions from the past are not the best for the future and we ask for more flexible and adaptable solutions” (Brilly, this volume).*