FRONT COVER:

A satellite radar image showing the flooding in southern France in January 1994 The magenta areas are fields under water on 12 January along the course of the River Rhone in Provence, which had burst its banks. The colours in the image were formed by combining ERS-1 SAR Fast Delivery images from 3 January (unflooded) as red, 12 January (flooded) as green and a ratio of the two as blue. Fast delivery SAR can be made available within 24 hours of acquisition

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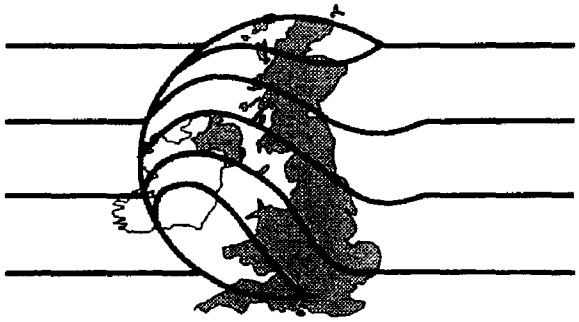

NATURAL HAZARDS AND REMOTE SENSING

Edited by

G. Wadge

Proceedings of a conference held on 8/9 March 1994 at the Royal Society, London, UK entitled

"Natural Hazard Assessment and Mitigation: the Unique Role of Remote Sensing"

Organised by G.Wadge (NUTIS, University of Reading), J.B.Williams (Natural Resources Institute), M.V.Jones (Meteorological Office) and C.M.Oppenheimer (University of Cambridge) on behalf of the Science, Technology and Engineering Working Group of the UK IDNDR Committee.

Meeting sponsored by the Royal Society, the Royal Academy of Engineering and the Geological Remote Sensing Group of the Geological Society. The proceedings are sponsored by the Natural Environment Research Council and National Remote Sensing Centre Ltd.

The Royal Society

A United Kingdom contribution to the IDNDR

1994

THE ROYAL ACADEMY OF ENGINEERING

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PREFACE

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"Natural Hazards and Remote Sensing" is a more succint title for the proceedings of the open discussion meeting held on 8/9 March, 1994 at the Royal Society in London which was called "Natural Hazard Assessment and Mitigation : the Unique Role of Remote Sensing". The meeting, attended by an international audience of about 100, consisted of 14 oral presentations, all of which are represented here, and 3 poster presentations (Girault, White and Willis) which are here too. Also, I have included a glossary of, largely acronymic, terms from the disaster and remote sensing fields, together with a fairly comprehensive table of remote sensing satellites and their uses for disaster applications previously compiled by Louis Walter.

The papers in this book, demonstrate several valuable, operational applications of remote sensing techniques to hazard assessment and disaster mitigation. Read, for example, Mike Longworth's fascinating account of the workings of a tropical cyclone warning system in Vanuatu and you will see that although the use of the meteorological satellite data to track the cyclones is vital, it is an almost incidental element in his story because it works, whereas some of the other operational components of the warning system do not. On the other hand, many of the papers hint at the frustration felt by people who sense the tremendous potential of remote sensing for operational use, but who cannot put it into practice because the data are not appropriate for the job; they are too costly or too slow at arriving. This is particularly true with applications not using the meteorological satellites. I think most people came away from the meeting feeling that remote sensing had much more to offer the disaster community than had been realised in the past, and that this technology will grow in importance in the second half of the IDNDR. Some of the factors in this growth will be :

* A new generation of sensors will find many more hazard applications, including
  - operational satellite radars with their all-weather capabilities;
  - satellite microwave mapping of rainfall ;
  - very high spatial resolution optical sensors on satellites, particularly valuable for relief work;
  - radar interferometry for ground movements and DEM generation.

  Increased lobbying for new sensors relevant to natural hazards is beginning; much of the data currently used are surrogate for that really required.

* For those applications that cannot receive data directly, the supply of appropriate remotely sensed data over the international computer networks will be required to both speed delivery and to provide uniform standards of high level products. EOSDIS is the first such attempt to provide data in this way, though it will not be operational for some years to come and even then will not be universally accessible.

* The successful LARST model of simple, independently operational computer systems for hazard warning and mitigation in developing countries must be built upon and extended to new data sources. The vital, operational link between the outputs from these systems and the people who must act upon them is being increasingly recognised.

* Research efforts to develop new hazard monitoring applications involving the commercially-run, medium resolution satellites such as Landsat have been inhibited by the expense of their data products and the slowness of delivery (relative to the life cycle of the hazard events). The disaster community needs from the remote sensing suppliers

new, more flexible, data products emphasising smaller, customised scene size and location and faster acquisition/delivery turnaround.

* Remote sensing is a technology capable of unifying the different scientific disciplines concerned with natural hazard assessment and mitigation. Many disasters are complex mixtures of primary and secondary hazardous processes (e.g. tropical cyclones, flooding and landslides) which can benefit from this unitary vision. There is a need to extend some of the successful international arrangements and protocols for warning and forecasting within the meteorological community, as exemplified by the WMO, to the geological hazards, where there is much less of a tradition in forecasting.

Acknowledgements

The initial idea for the meeting came from the Science, Technology and Engineering Working Group of the UK IDNDR committee, and I am grateful for the support of Professor Julian Hunt and Dr. Anne McLaren, Chair of that Group. Miss Linda Cook of the Royal Academy of Engineering and particularly, Ruth Cooper, of the Royal Society, together with her colleagues, helped organise the logistics of the meeting. Jim Williams, Martin Jones and Clive Oppenheimer worked hard to make the meeting worthwhile intellectually, and Mrs Jane Brookling provided her excellent secretarial skills. Finally, I would like to thank the Royal Society, the Natural Environment Research Council and the National Remote Sensing Centre Limited for their financial support of the meeting and this book.

DISCUSSION

Discussions of specific points raised by presentations are reported after individual papers in this volume. More general discussion of the policy, politics and organisational aspects of remote sensing for natural hazards and and disasters took place at the ends of sessions on both the 8th and 9th of March and these are reported here. The 3 sessions of the meeting were chaired by G. Wadge, Sir John Knill and J.B.Williams, with M.V. Jones, J.B.Williams and C.M. Oppenheimer as rapporteurs.

8th March

Mr. Solway (Inst. Civil Engineers) pointed out that natural hazard warnings could be received in a country in ways other than through its official channels, e.g. via a satellite broadcast such as CNN or the BBC World Service, and this was often unacceptable to the country's authorities. Prof. Hunt (Met. Office) explained that the UK Met. Office does consult national meteorological services in connection with the World Service. Dr. Walter (NASA) thought that the situation was considerably better in meteorology than in earthquake and volcano warnings and gave two examples of widely publicised predictions which had caused problems. He asked whether the WHO might be able to extend its well-proven capabilities to a wider field.

Dr. Soeters (ITC) pointed out the interdisciplinary requirements, e.g. to link historical records of landslides with rainfall records in order to draw susceptibilty maps. Prof. Wadge (NUTIS) said that some well-developed cities (e.g. Hong Kong) do have such systems in place, but there was a need to focus on cities with major satellite shanty towns on steep terrain. Prof. Hunt urged the transfer of systems developed in the research environment to appropriate operational agencies, despite reluctance from the researchers. Dr. Lockwood (USGS) was concerned at cases where multiple sources of advice had led to confusion and advocated some kind of international filtering. Dr. Walter said it was the political dimension that held things up, and that scientists should regard it as part of their job to overcome poitical foibles. He again pointed to WMO as a shining example. Prof. Hunt found the idea of extending WMO an interesting one and noted that its member nations are represented by the meteorological services rather than by Ministers, as in most other intergovernmental organisations.

Prof. McDowell was concerned that information was not getting to those who have to make decisions and do the work. There is a danger that information is filtered, losing detail, as it gets closer to the level of action. Prof. Coppock (Carnegie Trust) drew attention to the difference in this regard between the USA and Bangladesh. With respect to the question of a Geophysical Data Centre, he suggested ICSU might be able to provide a link between national agencies. Prof. Hunt was encouraged that information had in fact got through to the people of Bangladesh and that thousands of lives had probably been saved. He pointed out that ICSU is a research organisation, and drew a parallel between earth sciences now and meteorology in the 1850s when techniques of detection and communication were emerging and a disaster had highlighted the need for an operational warning organisation. He thought an intergovernmental meeting, as had been held in 1855, was needed.

Dr. Harris (Univ. North London) deplored the brief and broadbrush treatment of warnings by CNN, which may be the result of political limitations of transboundary broadcasting The value of interpretation of data by, for example, the professional meteorologists was eroded by such treatment. Prof. Hunt pointed out the difference between the USA, where meteorological information provided by the government service is interpreted by the private sector, and the UK, where the Met. Office is responsible for core forecasting, but also for interpretation. It was up to governments to teach their people to rely on appropriate sources of information.

Dr. Browitt (BGS) defended earth scientists in that seismologists do have free exchange of data and a World Association and have developed some protocols, although there is no money for a central organisation to extend awareness. Volcanologists also seem to be increasingly

well-organised. Cases of public confusion had arisen from the multi-disciplinary nature of some disasters. It would be beneficial to create a nucleus organisation to consider secondary effects and develop multi-disciplinary protocols. Dr. Soeters thought there was a need for national services to map susceptibility to secondary effects, and this would help to identify quickly where real-time predictions were required.

Dr. Robson had heard little so far about planning for disaster, from the point of view of civil administrations. They should be asked what information the planners need. Dr. Soeters felt that susceptibility mapping was a good start for planning, e.g. the location of roads and hospitals, and this could be done without waiting for further data.

9th March

Dr. Williams thought that remote sensing rightly focused attention on the fact that many natural disasters were part of wider patterns that required global, planetary management, but that the narrower responsibilities at the national and regional levels were still poorly defined. Prof. Wadge, looking to the medium-term future, saw great promise in the very high spatial resolution spaceborne sensors now being planned. He also urged people to think of what data they would want and to lobby for new sensors and data delivery systems to enable them to be obtained. Dr. Walter pointed out that several studies and groups were working to define the remote sensing needs of the disaster community. These included: an Italian Space Agency meeting in 1993; a Japanese (NASDA) book, currently being translated into English; an ESA/ITC workshop in 1995 and Japanese lobbying of CEOS for hazards to be placed on their agenda.

Professor Coppock urged us to realise that we must be aware of the limitations of remotely sensed data in terms of its quality, quantity and their uncertain use in operational models. Dr. Williams argued for the organic, operational strategy with regard to remote sensing - get something working where it is needed, allow local enthusiasm for a working system to generate new ideas and understand shortcomings and research improvements. When helping to organise this meeting Dr. Williams had found it very difficult to get disaster management /aid agency people interested in a meeting on a remote sensing topic like this; it was a subject about which they were deeply sceptical. Dr. Walter said that a major factor contributing to that scepticism is that disaster management people are largely concerned with relief and Dr. Williams added that it was often difficult to sustain programmes between disasters. Both Dr. Cherlet (FAO) and Prof. Wadge cited cases of prevention and monitoring programmes becoming top priority: at FAO and the UK IDNDR 1993 conference. However, Cdr. Childs (World Memorial Fund) pointed out that it is only in the aftermath of major disasters that substantial monies reach the aid agencies and this leads to an emphasis on relief spending (for example, only 2% of ODA's budget goes into disaster reduction and prevention) What was needed was a change in peoples' attitudes to the funding of disaster aid.

Dr. Williams argued that as Dr. Belward's talk on fires showed, one of the chief agents of disaster is war. Indeed, in some instances it exacerbates or even triggers "natural" disasters. Hence the arms trade to the developing countries was one of the main barriers to disaster mitigation. Remote sensing again comes into its own as one of the few ways of findng out what is happening on the ground in areas of crisis and war.

M.V. Jones, J.B.Williams, C.M Oppenheimer and G.Wadge