DRM

world institute for
disaster risk management

BOARD OF THE SWISS
FEDERAL INSTITUTES
OF TECHNOLOGY

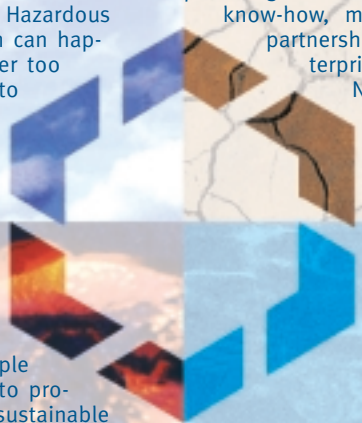
Virginia Tech

***DRM** is a network for applied research, implementation, and dissemination in the field of disaster risk management. It is an initiative of the Board of the Swiss Federal Institutes of Technology and Virginia Polytechnic Institute and State University in conjunction with the ProVention Consortium of the World Bank.*

Every managing executive in the public or private sector has a duty to ensure appropriate risk management in his area of responsibility. Hazardous events of natural or technological origin can happen anywhere and at any time. It's never too early to integrate risk management into corporate governance - but it may often be too late.

DRM marshals resources for collaborative activities in applied research, research applications, and professional practice to reduce disaster risks in vulnerable communities throughout the world.

The objective of DRM is to enable people to anticipate disasters and take action to protect life and property, and to ensure sustainable social and economic development. Its activities include supporting the pursuit of an optimal balance between disaster risk reduction, risk-sharing mechanisms, and management of residual risks in the face of limited resources.



DRM achieves its aims by filling knowledge gaps, providing a clearing-house for information, building know-how, mobilizing resources, and forging partnerships with governments, private enterprises, international agencies, and NGOs.

DRM works with a wide range of international organizations and institutions whose common objective is disaster risk reduction for public safety and sustainable development.

Even when reliable and cost-effective technologies are available for early warning, disaster prevention and mitigation, many governments, especially in developing countries, lack an adequate institutional framework in which to apply them.

Natural and technological disasters often cause substantial damage to life and property, infrastructures, cultural heritage, and the ecological basis of life. Indirect losses in terms of business interruption, loss of production, and loss of services often exceed losses due to direct physical damage. Developing countries are affected more severely, often suffering a dramatic decline in GNP.

Increased losses from disasters
Disaster losses have increased dramatically over the past two decades. This has resulted from changes in the pattern of hazard occurrence and from increased vulnerability of a growing population. With greater pressure to exploit marginal lands and accommodate more people in urban areas, the potential for future disasters continues to expand. To develop effective and efficient tools and strategies for disaster risk assessment and risk reduction, it is necessary to understand the factors contributing to those risks. Natural hazard events often precipitate subsequent technological failures, and dependency on tightly coupled technological systems can increase the potential for catastrophic failure and disaster. Natural and technological disasters also threaten the ecological basis of life through long-term environmental damage.

Decline in financial support
"Aid continues to fall. From US$ 55.4 billion in 1996, global humanitarian assistance plunged to US$ 48.3 billion in 1997. Aid now amounts to little more than 0.2% of donor GNP – the lowest ever. The Organization for Economic Cooperation and Development's (OECD) Development Assistance Committee (DAC) has described the decline as discouraging and frustrating. DAC donors allocate 1.4% of government spending to aid. In 1992 when overseas development assistance (ODA) peaked, the average spent on aid was more than 2% of government budgets, and over the period 1975 to 1985, the figure remained steady at an average of 1.8%." (International Federation of Red Cross and Red Crescent Societies: World Disasters Report 1999.)

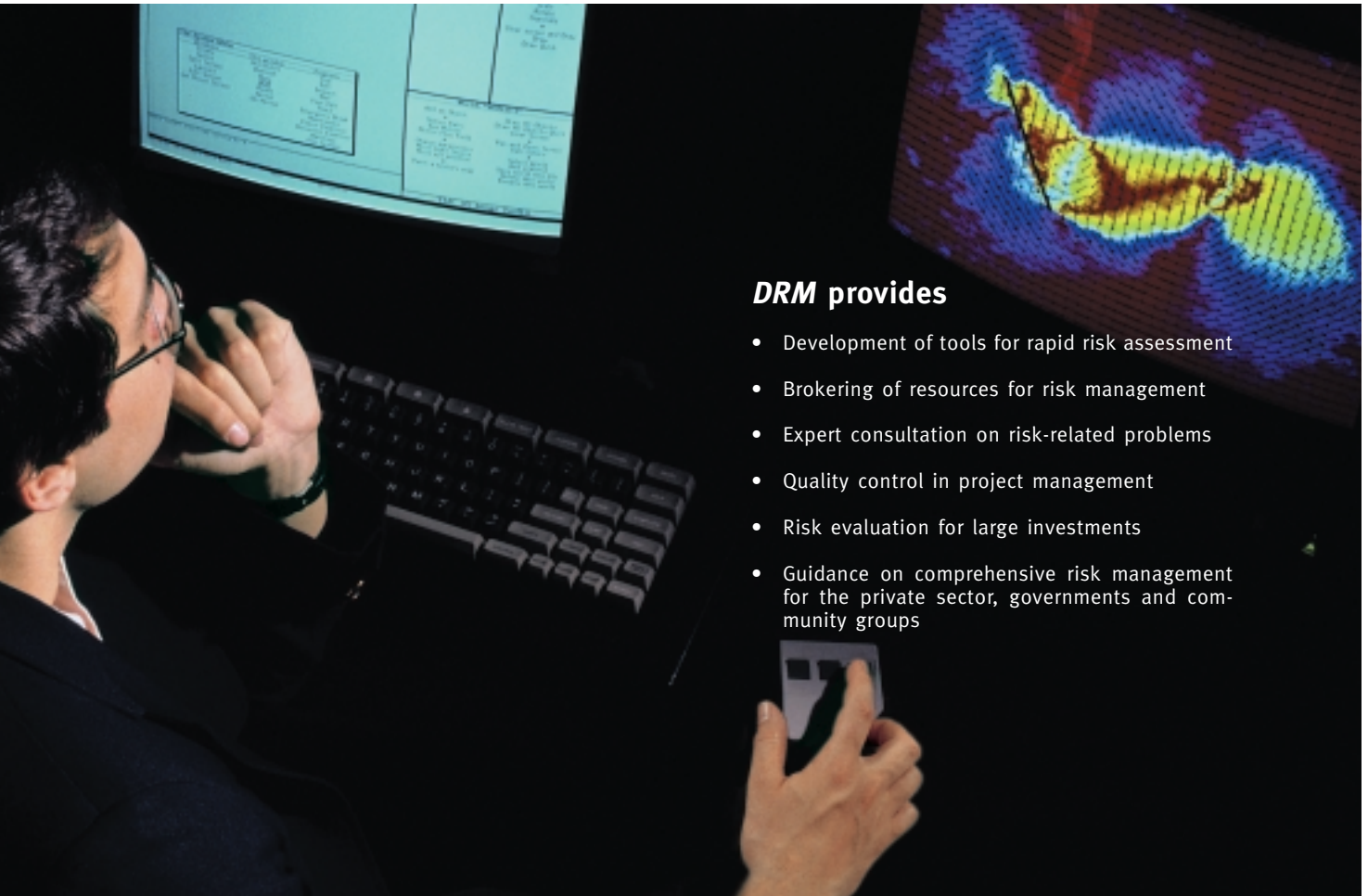
The integration of knowledge, policy and finance is necessary to meet the challenge of natural and technological hazards.
***DRM** brings together key institutions of the governmental sector, the private sector, civil society, and the research community to reduce global disaster risks.*

Every DRM project will involve organizations and institutions of the disaster-prone countries in order to strengthen local capabilities.

DRM will cooperate extensively with government agencies such as the Swiss Agency for Development and Cooperation (DEZA) and the public agencies of disaster-prone countries. DRM will also work actively with non-governmental organizations and the private sector. From the private sector, Swiss Re has undertaken to support the DRM initiative.

DRM *provides interdisciplinary and intersectoral support for prevention strategies, implementation techniques, education, and know-how dissemination in relation to man-made technological risks and to natural disasters.*

Required: implementation techniques
A great deal of technical know-how is available. The main need is for integration of sectoral results and modeling into multidisciplinary systems and implementation-oriented approaches and tools. The vast body of knowledge distributed around the world (dissemination is increasingly being performed by institutes in developing countries) needs to be gathered together in an open network.

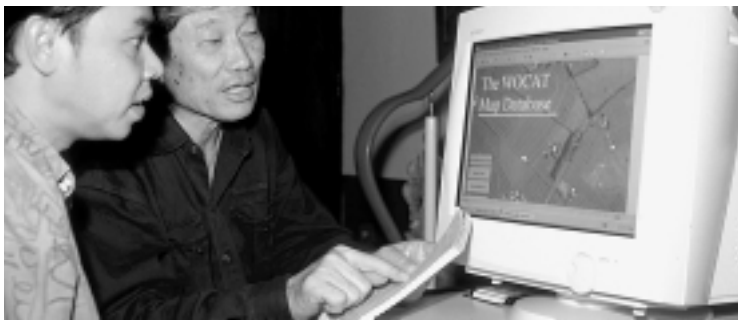


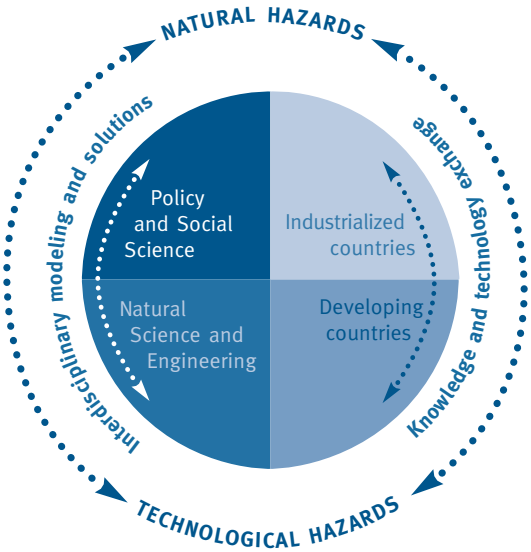
DRM provides

- Development of tools for rapid risk assessment
- Brokering of resources for risk management
- Expert consultation on risk-related problems
- Quality control in project management
- Risk evaluation for large investments
- Guidance on comprehensive risk management for the private sector, governments and community groups

The devastating consequences of recent disasters are an indicator of the need to improve the development and implementation of technologies and methods for disaster prevention and preparedness.

Decentralization
Although local capabilities in developing countries have substantially increased within recent years, a great deal of knowledge and experience on disaster risk reduction has been accumulated in the developed countries. The fact that it has not been widely applied to developing countries indicates a severe problem in the transfer and application of science and technology. The disaster risk reduction program by DRM will develop regional relations and strategies for disaster prevention in a larger context. DRM will channel support for building mitigation research and implementation capacity in local institutions in disaster-prone developing countries.





Disaster Risk Management and Development Planning
The DRM will take an active role in the ProVention Consortium on Natural and Technological Catastrophes of the Disaster Management Facility of the World Bank. DRM will focus resources on the priority areas of the Consortium:

- poverty and vulnerability
- environmental services to reduce disasters
- expansion of access to mechanisms for risk transfer and financing

DRM will strive to advance the knowledge base and develop tools for the effective application of disaster risk management in development planning and investment.

Education
Just as in other environmental programs, the cost recovery and benefits of disaster risk reduction are not immediately obvious, nor are links to sustainability. A significant effort needs to be made to address education and training needs. DRM will contribute to a joint training network.

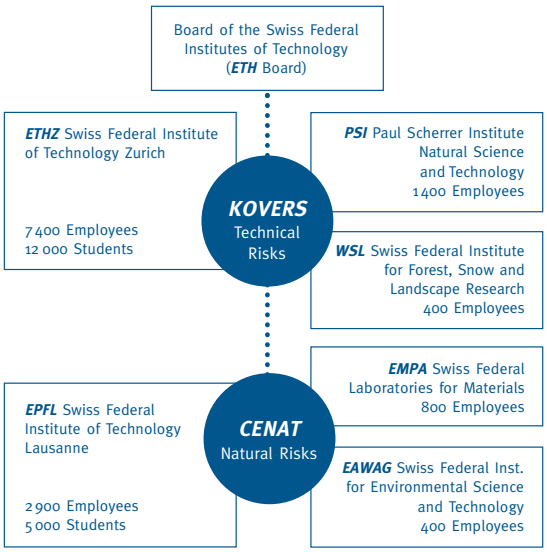
The Swiss Federal Institutes of Technology and the Swiss universities and institutes of applied science form a well established network. These research centers have outstanding expertise and extensive international experience.

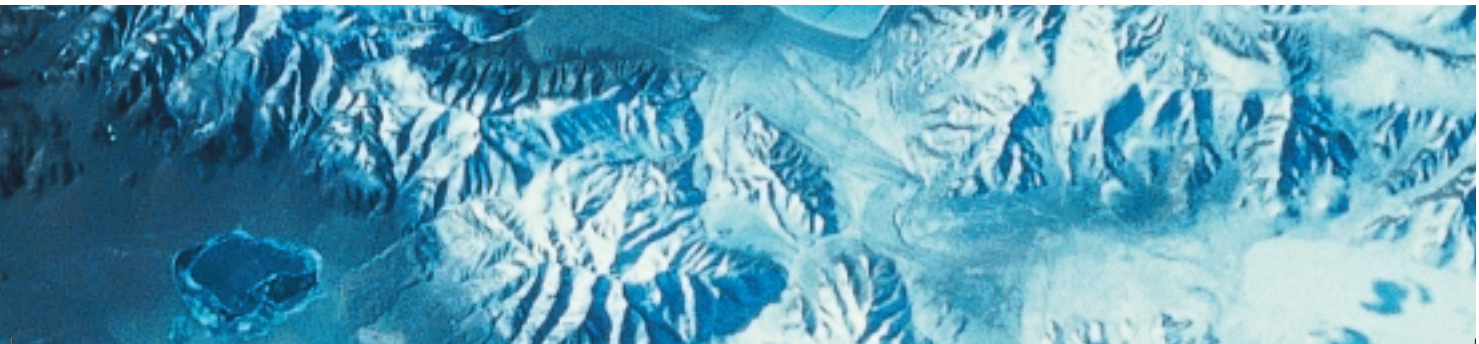
Swiss Federal Institutes of Technology (ETH)
The six institutions of the ETH domain include two research centers operating in the fields of natural and man-made risk management: CENAT and KOVERS. Both centers rely in addition on Swiss universities and institutes of applied science. CENAT will coordinate contacts between the Swiss research community and DRM.

Natural risks: CENAT
The Natural Hazards Competence Center CENAT was founded by the ETH Board in 1996 to bring together existing potentials in natural science, engineering science and socio-economic science within the ETH domain and the Swiss universities and institutes of applied science. It is also associated with the Pôle Grenobloise d'Etudes et de Recherche pour la Prévention des Risques Naturels. The pooled resources of these institutes cover a wide field of hazard and risk management:

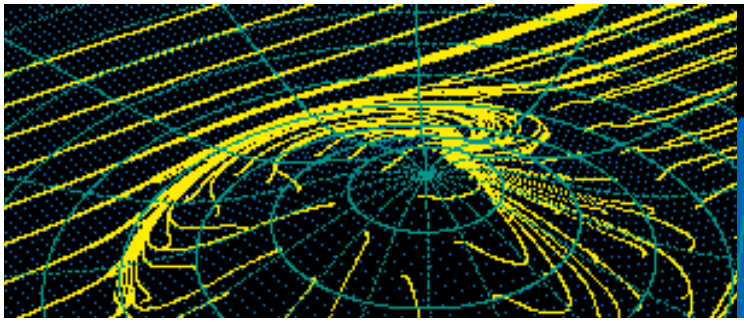
Hazard assessment, physical process studies, event triggering, hazard mapping, numerical simulation, event probability studies, GIS (Geographic Information Systems) techniques
- Institute of Cartography, ETH Zurich
- Swiss Federal Institute for Snow and Avalanche Research, SLF, Davos
- Institute of Geography, University of Berne

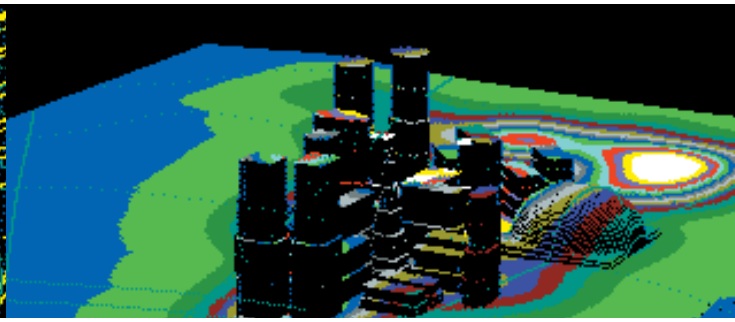
Seismic behavior, earthquake-resistant construction, retrofitting, building codes (buildings, bridges, dams)
- Institute of Structural Engineering, Earthquake Engineering and Structural Dynamics, ETH Zurich
- Institute for Reinforced and Prestressed Concrete, ETH Lausanne
- Institute of Geophysics, Swiss Earthquake Center, ETH Zurich
- Centre d'Etude des Risques Géologiques (CERG-UNIGE), University of Geneva





Process studies for rockfall, glaciers and permafrost, snow, avalanches, slope movements, hydrology of unstable terrain, debris flow, floods, wind, hail, geological hazard, drought
- Institute of Geotechnical Engineering, ETH Zurich
- Laboratory of Hydraulics and Glaciology, ETH Zurich
- Institute of Rocks, Foundation and Soil Mechanics, ETH Lausanne
- Laboratory of Geology, ETH Lausanne





- Swiss Federal Institute for Forest, Snow and Landscape Research, WSL Birmensdorf
- Swiss Federal Institute for Snow and Avalanche Research, SLF, Davos
- Land and Water Use Laboratory, ETH Lausanne
- Institute of Geography, ETH Zurich
- Institute of Hydraulics and Energy, Hydraulic Constructions, ETH Lausanne
- Institute of Geology, University of Fribourg
- Centre d'Etude des Risques Géologiques (CERG-UNIGE), University of Geneva
- University of Applied Sciences, Rapperswil

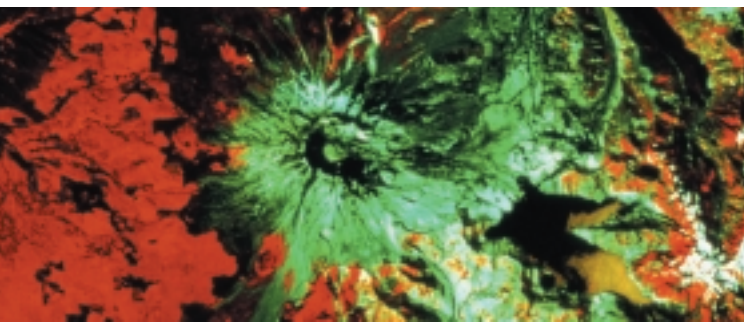
Bush and forest fires, ecological impact studies, sustainability, soil erosion, risk analysis and management, forest hydrology, climate and vegetation, forest as rockfall and avalanche protection
- Swiss Federal Institute for Forest, Snow and Landscape Research, WSL Birmensdorf
- Department of Forest and Wood Science, ETH Zurich

Socio-economic studies, public perception, political strategies, risk management
- Institute of Economic Research, University of Lugano
- Institute for Economic Research, ETH Zurich

Climate change, modeling of variability and predictability of climate, satellite monitoring
- Laboratory for Atmospheric Physics, ETH Zurich
- Institute of Geography, University of Berne
- Institute of Geography, University of Fribourg

Technical risks
Modeling and software development for assessment, evaluation, management and representation of technical risks for process industries and storage, power generation technologies (including nuclear safety), transportation of hazardous materials, waste management, complex infrastructure systems; integration of the GIS (Geographical Information Systems) and GPS (Geographical Positioning Systems) technologies into Integrated Decision Support Systems (IDSS); life cycle analysis (LCA), sustainability, cost optimization, legal/regulations-related issues; research, training, university education, consulting engineering and design, security, financial and socio-economic risk management-related issues.
- KOVERS (Competence Center for Technical Risks ETH) including Paul Scherrer Institute, ETH Zurich and EAWAG Dübendorf
- Center for Security Studies, ETH Zurich
- Institute for Economic Research, ETH Zurich
- Risk Lab, ETH Zurich
- Swiss Federal Institute for Snow and Avalanche Research, SLF, Davos
- University of Applied Sciences, Rapperswil

Virginia Tech is the leading science and technology institution of the Commonwealth of Virginia. The university links basic research in the natural and social sciences and engineering to applications in the service of public safety and social protection.



Virginia Tech has broad, multidisciplinary capability and experience in natural and technological disaster management. In the geological sciences the University supports the Virginia Tech Seismological Observatory and the Center for Water Resources Research. In engineering the university supports the Center for Environmental and Hazardous Materials Studies, and Virginia Tech is the lead institution for the Wind Hazard Mitigation Consortium, an organization of 10 U.S. research universities active in wind engineering research. Issues of critical infrastructure protection are addressed in the work of the Virginia Tech Center for Transportation Research, the Center for Power Engineering and the Center for Wireless Telecommunications. Associated with the University is the Waste Policy Institute which assists the Department of Energy in the management of hazardous waste materials. Scientific and technical research findings are translated into meaningful policy consideration through the work of the Center for Public Administration and Policy and the Center for Housing Research. Research applications, training and outreach related to international development are supported and coordinated at the University by the Office of International Research and Development. The Virginia Cooperative Extension Service has also played an active role in disaster damage assessment and public information for disaster mitigation, preparedness and response in Virginia.

Virginia Tech Seismological Observatory
The Virginia Tech Seismological Observatory maintains a seismic instrumentation array in Virginia and is a primary center for the study of the seismicity of the southeastern United States. The Observatory has prepared seismic risk maps for the Commonwealth and the region as well as detailed studies of historical seismicity.

The Center for Water Resources
The Center for Water Resources has evaluated the flood hazard throughout the Commonwealth and has been instrumental in the evaluation of mitigation techniques and risk reduction measures associated with flood insurance.

The Center for Environmental and Hazardous Materials Studies
The Center for Environmental and Hazadardous Materials Studies has taken a leading role in environmental hazard assessment and environmental remediation. The Center has also contributed to environmental hazard awareness and risk communication.

Center for Energy and the Global Environment (CEAGE)
CEAGE combines the resources of faculty members and students from six departments at Virginia Tech to address global problems of energy and sustainable developement. Research activities are currently focused on global warming resulting from the use of fossil fuels for power generation and transportation. Consequences of climate change and changing patterns of risk are also considered by the center.

As a land grant university Virginia Tech has extensive experience in technology transfer related to local and regional economic and social development.

The Virginia Tech Center for Transportation Research
The Virginia Tech Center for Transportation Research is leading cutting edge research in highway transportation safety related to the "Smart Road" research facility. The Center has pioneered the development of post-disaster traffic management and control techniques.

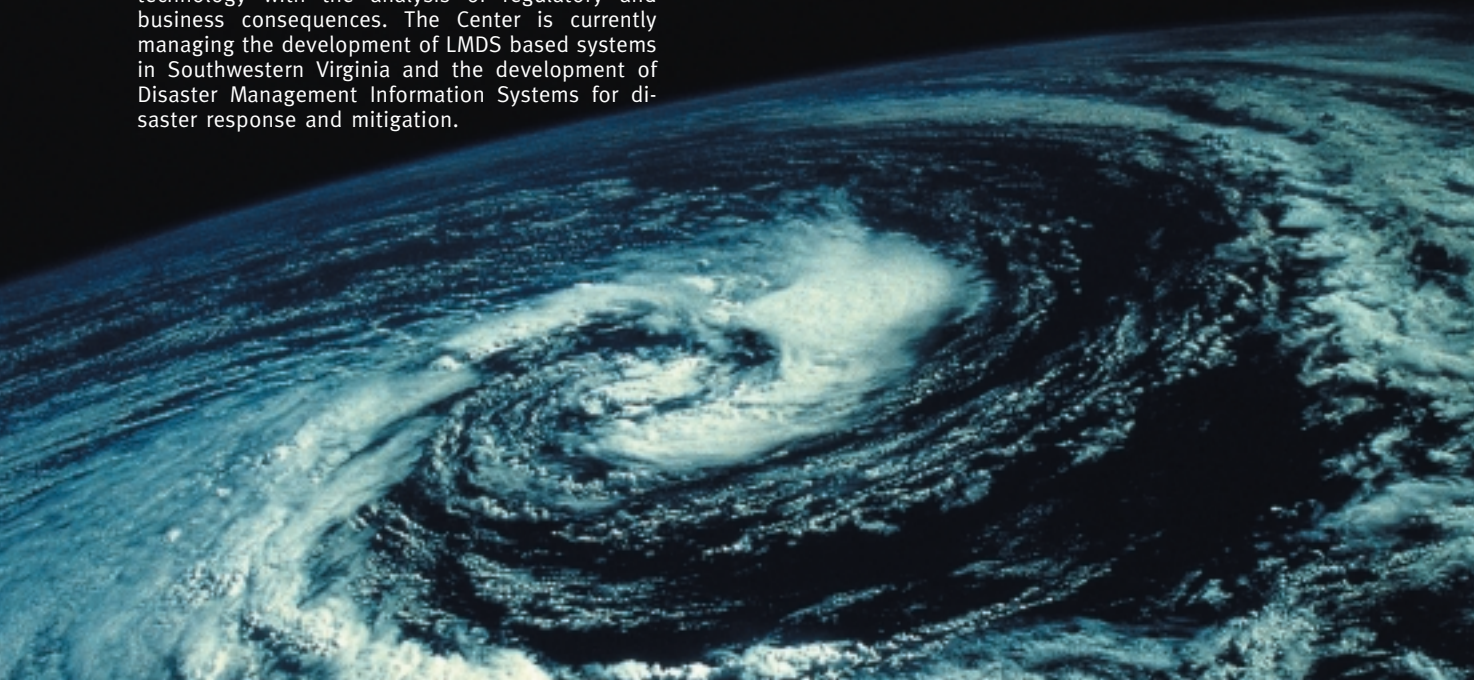
International Institute for Critical National Infrastructures
The International Institute for Critical National Infrastructures is a multi-national, multi-university consortium to bring about integrated development of the three critical infrastructures: electric power networks, communications networks and computer networks which are essential for the functioning of modern societies. The institute has initiated research on assessment, control and restoration of the electric power grid following catastrophic disturbances and on innovative technologies for defense against catastrophic failures of complex interactive power networks. The founding members of the Institute are Virginia Tech, Institut National Polytechnique de Grenoble, Hong Kong University, Hong Kong Polytechnic and EnerSearch, Sweden.

The Center for Wireless Telecommunications
The Center for Wireless Telecommunications combines the development of new telecommunications technology with the analysis of regulatory and business consequences. The Center is currently managing the development of LMDS based systems in Southwestern Virginia and the development of Disaster Management Information Systems for disaster response and mitigation.

The Center for Public Administration and Policy
Faculty members of the Center for Public Administration and Policy have led key policy review for the Federal Emergency Management Agency and carried out research on the structure of organizations tasked with emergency response responsibilities.

The Waste Policy Institute
The Waste Policy Institute is associated with the University in the Virginia Tech Corporate Research Center. The Institute plays a major role in environmental remediation and public safety related to the nuclear energy and weapons industries.

Financial Risk Management Center (FRMC)
FRMC is a center of the Department of Finance of the Pamplin College of Business at Virginia Tech. The center provides a source of timely scholarly research and education on major issues related to the global market for derivatives, including futures, forwards, swaps and options. In both research and education the center's activities bring together leaders from academe, government and business to address key issues and problems associated with financial risk. Securetization of risk is a topic of critical importance to disaster risk management.



*The affiliated institutions of the **DRM** network are committed to knowledge development, transmission, and application in the field of disaster risk reduction and sustainable development.*

University of Texas at Austin (USA)
The *Department of Civil Engineering* has strong graduate programs in both Civil and Environmental Engineering. A number of centers and laboratories provide the facilities and staff to support research activities in disaster risk management related disciplines, like the Center for Research in Water Resources (CRWR), Center for Transportation Research (CTR), Construction Industry Institute (CII), Ferguson Structural Engineering Laboratory (FSEL), Geotechnical Engineering Center (GEC), Center for Energy and Environmental Resources (CEER), Construction Materials Research Group (CMRG), Environmental Solutions Program (ESP), International Center for Aggregates Research (ICAR).

London School of Economics (UK)
Centre for the Analysis of Risk and Regulation. The LSE has established the Centre for the Analysis of Risk and Regulation in recognition of the need for basic, interdisciplinary research in the area of risk management and risk regulation. This need is reflected in a growing academic interest from a number of disciplines regarding the analysis of processes underlying risk production, perception, management and regulation. It is also both a response to shifting corporate and governmental responsibilities and to the evolution of professional practice in risk management and regulation.

A significant part of the Centre's activities will be aimed at facilitating knowledge exchange between different organizations, fostering cross-fertilization regarding professional risk management and regulatory practices and creating an independent community of knowledge in this field that intersects economic sectors, professional backgrounds and disciplinary boundaries.

Max Planck Institute (Germany)
The *Global Fire Monitoring Center (GFMC)* located at Freiburg University monitors, forecasts and archives information on vegetation fires (forest fires, land-use fires, smoke pollution) at global level. The information thus generated supports decision-makers at national and international levels in evaluating fire situations or precursors of fire which potentially endanger humans or may negatively affect the environment.

George Washington University (USA)
Institute for Crisis, Disaster and Risk Management
The Institute organizes interdisciplinary research in engineering, social and behavioral science, public health and emergency medicine. The Institute also provides graduate level instruction at the masters and doctoral levels. George Washington University collaborates with Virginia Tech in the Joint Center for Disaster and Risk Management.

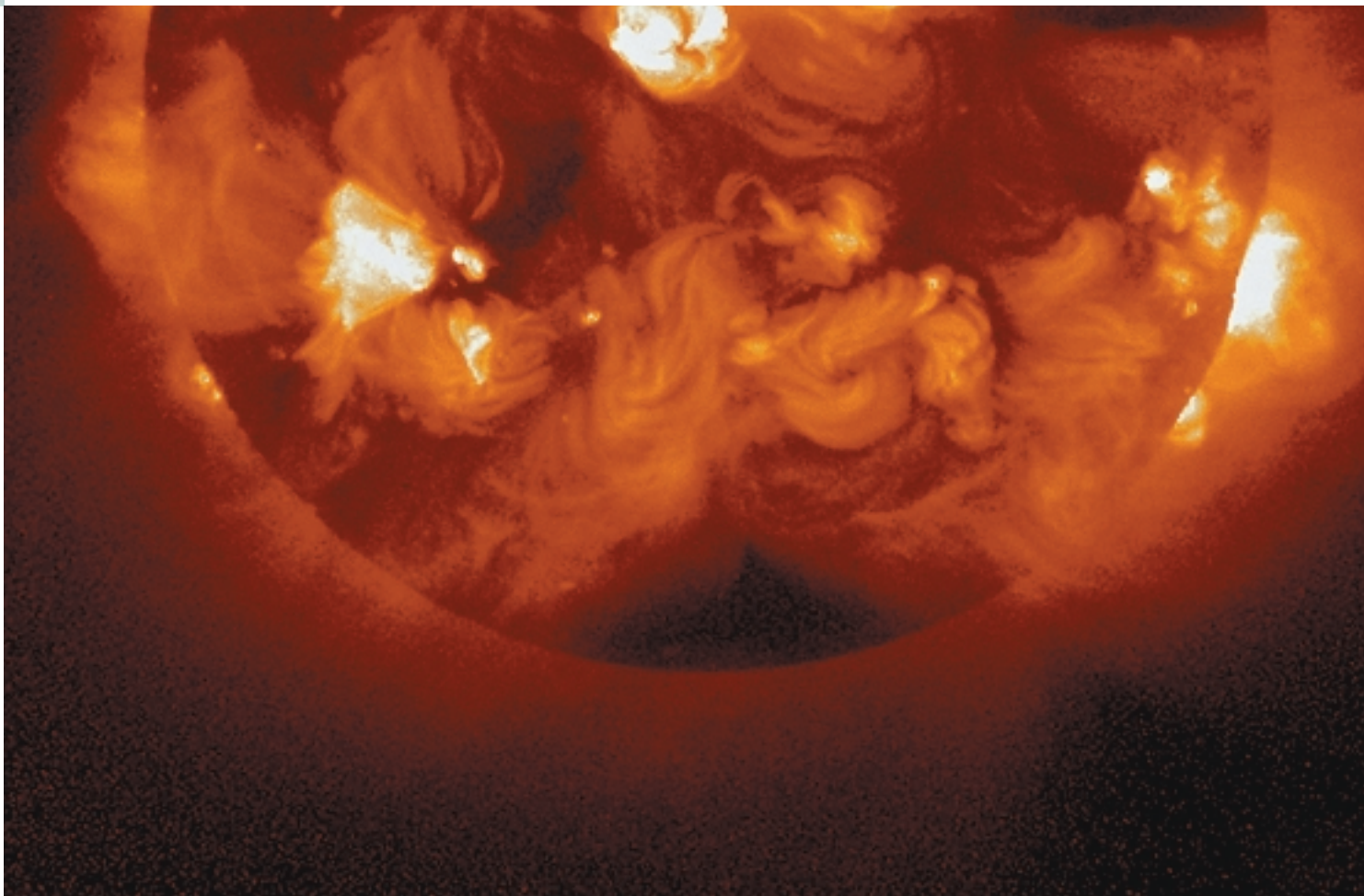
Bogazici University (Turkey)
Kandilli Observatory and Earthquake Research Institute. The Earthquake Research Institute and the School of Engineering are actively involved in a range of hazard and vulnerability assessment activities throughout Turkey. Urban loss estimation methodologies have been developed and applied. Current work is focused on the reconstruction following the August 1999 Kocaeli earthquake and risk reduction measures for the Istanbul region.

University of Buenos Aires (Argentina)
Center for Research and Transfer of Appropriate Technology (CITTA). The Center has taken a leading role in the development of architectural and urban planning techniques for the reduction of disaster risk. Recent work in conjunction with the World Bank has focused on the reduction of consequences of urban flooding in Argentina.

University of Hong Kong (China)
The *Department of Electrical Engineering* is actively involved in the analysis of system reliability for electric power systems and in research for the protection of critical infrastructure systems from natural and technological hazards. The university is also the location of internationally recognized expertise on landslide hazard reduction.

Yokohama National University (Japan)
Center for GIS Applications for Disaster Reduction. The Department of Urban Engineering and Architecture has taken a leading role in the development of Geographic Information Systems for the analysis of natural hazards exposure and vulnerability. Analytical tools are also under development for damage evaluation and reconstruction planning.

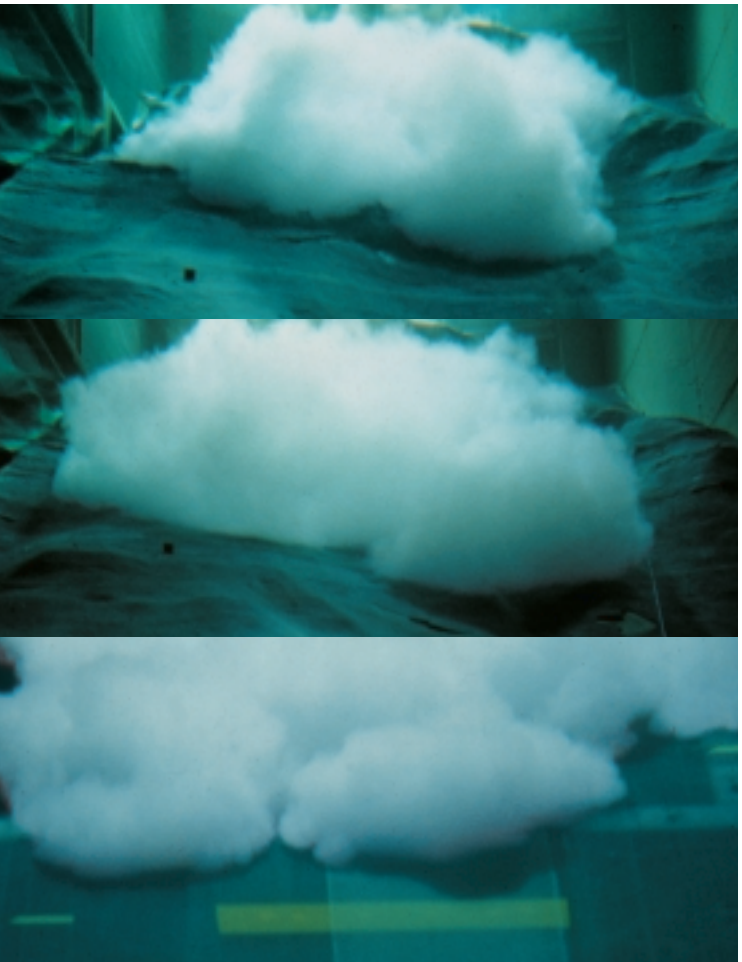
National Center for Disaster Prevention CENAPRED (Mexico)
CENAPRED is the coordinating agency for disaster management in Mexico. The national center works closely with the National University of Mexico (UNAM) on disaster risk and vulnerability analysis and on the study of the impacts of disasters in Mexico and Latin America.



***DRM** will move beyond traditional post-disaster response to develop integral risk management and to elaborate a culture of sustainable risk reduction harnessing both governments and the private sector.*

DRM will contribute to this paradigm shift by providing scientific bases, application tools and the necessary operational framework to allow evolution toward sustainable risk management and to address the above-mentioned key natural and man-made risks across the board.

DRM will focus on an integrated strategy of risk management both for natural and man-made technical risks: assessment of hazards and their characteristics in spatial and time scales, analysis of the vulnerability of civil engineering structures and of complex societal systems, integrated assessment of risk at local, regional and national levels, and design of risk mitigation and management strategies.



Key efforts of DRM will be to provide support for a culture of risk perception, public awareness and mitigation of risks, for the development of new methods in multidisciplinary investigation of complex, interacting natural and technical phenomena, the development of accurate risk scenarios, the improved capacity to forecast the occurrence of large-scale events and of the associated damage patterns, as well as the evaluation of the ability of our societies to contain the long-term effects of disasters. Support for the implementation of effective and comprehensive outreach programs, with education and technology transfer components at all levels, is also of primary importance.

Social and economic development requires new strategies in risk management and risk prevention. The disasters of the last few years have demonstrated that attainable security in natural hazards management remains limited despite existing effective preventive measures. Increasingly intensive land use and the fact that natural hazards protection is limited by financial, security-technical and ecological barriers are creating a need for an ‘integrated risk management and sustainable risk prevention culture’. Comprehensive and interdisciplinary risk management and risk prevention strategies in areas exposed to different types of natural hazards must be based on integrated, professional hazard and risk assessment. The prevention and mitigation measures that have to be taken are driven by the technical, socio-economic and ecological vulnerability of the various systems — which calls for a profound knowledge of the event-dynamics of disasters (process-oriented research).

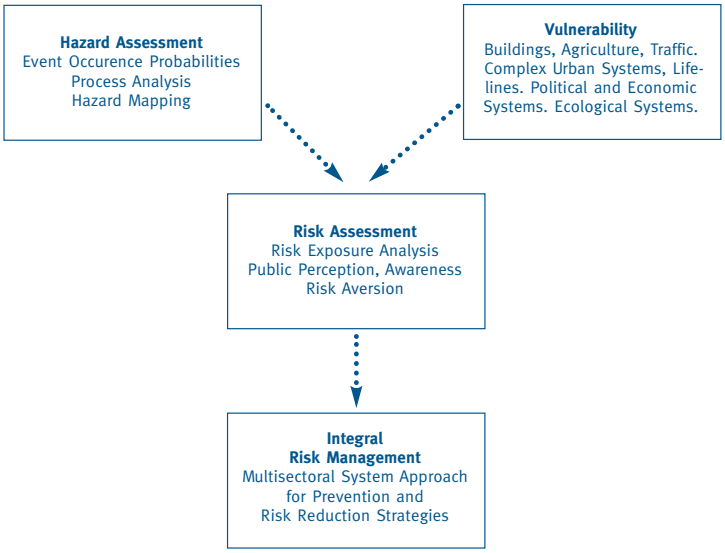
The involvement of the technical, natural, social, and economic sciences is equally necessary. Sustainable management of natural hazards needs intensified inter- and trans-disciplinary research and well defined implementation strategies. Thus knowledge transfer will be an important goal of DRM. An increasing number of developing countries have attained basic know-how and implementation techniques that can be applied by other countries with similar exposure, including industrialized countries. The transfer of methods and approaches to solutions in the area of technical and natural risks also needs to be better understood.

Science, education, industry, and politics have to face up to this challenge and support this difficult decision-making process with adequate research, knowledge, the development of practical tools and insurance and legislation strategies.

It is a fact that public awareness of natural disasters is generally low and therefore progress in risk prevention and mitigation is based mostly on the harm experienced by the people directly affected. This applies not only to investments in risk prevention and mitigation measures but especially to legislation, standardization and governmental implementation, and control. The creation of tools which increase public awareness, together with broadly-based education programs, has to be one of DRM's principal goals.

Four “modules” for efficient disaster prevention and mitigation need to be considered. These modules focus on different but complementary questions. They identify key issues and corresponding research needs and will lead to specific research and development projects.

The risk management model



Module 1: Hazard assessment
Natural hazards result from the interaction of three distinct elements:

1. Physical systems at different geographic levels (e.g. slopes, river basins, mountains)
2. Triggering factors (precipitation, temperature variations, earthquakes)
3. System reactions (floods, mass instabilities, ground movements)

Natural hazards interact at different spatial and temporal levels, varying from the local and regional to the international scale. So far, individual hazards and physical processes have been, and will continue to be, studied individually as this is the core activity of most research institutes. DRM therefore supports the multidisciplinary understanding and integrated analysis of different physical processes acting on the same physical systems. A similar model can be depicted for technical hazards.

Module 2: Vulnerability
(From objects to complex systems and ecology)
Modern risk management requires a qualitative and quantitative evaluation of the vulnerability of the objects and systems at risk. Special attention has to be drawn to overall societal vulnerability. Vulnerability evaluation is the key component of risk assessment and risk management. Cost-benefit or cost-effectiveness analysis of prevention measures, for example, can be performed only on the basis of a quantitative evaluation of possible damage to structures, whole systems, the environment and society. In the natural hazards field, vulnerability is a concept still lacking clear scientific definition and a methodology that allows rigorous quantification. This is especially true of indirect damage costs (e.g. damage to society, loss of market share due to destruction of production facilities, etc.), and of cost estimates of damage to the cultural heritage and to environmental systems. Progress must be made and agreement reached on methodologies in order to ensure a comprehensive approach to vulnerability assessment covering the full range of hazards. This has to be applied to structures, complex facilities (e.g. traffic lines) and whole societal systems (e.g. a city), cultural heritage and environmental systems.

Module 3: Risk assessment methods
Risk assessment consists of a coordinated methodological effort to understand the potential effects of natural hazards on human activities and on the environment. It also characterizes their probability of occurrence as conditioned by the intrinsically uncertain nature of such events. The ultimate goal is, however, to develop techniques that allow the most appropriate allocation of available resources to optimize the protection of a number of assets while minimizing the costs incurred. A comprehensive list of assets that risk assessment is expected to address will therefore include human life, primary infrastructures and urbanized areas, industrial and productive settlements, economic activities and, last but not least, environmental preservation. This means developing techniques that provide an integrated view of risk analysis, thus addressing the question of compound risks. Moreover, such techniques are required to supply the assessment on different space and time scales, thus providing the basis for a selective strategy of risk management which is ultimately aimed at formulating targeted mitigation policies.

Module 4: Integral risk management
Risk management and risk prevention are the operational outflow of risk assessment, including also hazard assessment and vulnerability, and are thus part of an adjustable circuit. Means and measures have to be implemented for sustainable and optimized use. The necessary system approach links all its elements and players in a network. This requires the development of tools for overall risk mitigation. The development of measures and methods to support prevention and intervention activities (monitoring, registration, forecasting, early warning, decision-supporting tools for prevention and for frontline decisions, regional emergency management systems, etc.) becomes particularly important.

DRM's objective is to foster through scientific research a move away from the current reactive (defense against) and sectoral approach toward a risk management that integrates all relevant natural hazards and technical risks. DRM will provide support for this goal by closing interdisciplinary knowledge gaps which hamper our society's ability to rationally assess risk, reduce vulnerability and allocate resources. One challenge facing DRM will be the need to bring together practical needs and

research in order to scrutinize different intervention and mitigation schemes and the various combinations and inter-relationships of these interventions, and to optimize cost-benefit ratios, thereby helping to introduce the philosophy of sustainability into risk management as well.

The goals of risk management are then to link all elements and players of the system in a network, and to develop tools for risk mitigation based on strategies of prevention and event management (intervention, recovery), knowledge transfer, education and decision-making techniques. Sustainable management of natural risks means maintaining and enhancing environmental quality, maintaining and enhancing people's quality of life, fostering resilience and responsibility on a local community level, recognizing that sound local economics are essential and, finally, ensuring intergenerational equity.

DRM is building a long-term strategy to guide project development. Priorities are based on demand from disaster-prone communities and the efficient application of DRM capabilities.

Dealing with natural, technical and financial risk on a local, regional, national and even global scale requires a systematic approach. Hazard assessment, vulnerability analysis and risk assessment are the basis for an integral risk management process. Integral risk management makes use of the complete set of prevention, intervention and recovery strategies to look for the most cost-effective risk reduction measures. Limiting measures and strategies to prevention, intervention, or recovery would lead only to partially optimized sets of measures. Many key elements within this overall system approach are still lacking and research efforts are needed to gain adequate knowledge.

Project Summaries

1. **Vulnerability of critical infrastructures**
   Concepts and tools are required for a reliable vulnerability assessment of our large stock of existing civil engineered structures and industrial facilities as well as for new objects subjected to natural and man-made hazards. Concepts to reduce vulnerability or its effects (technical or organizational measures, insurance strategies, etc.) have to be developed.

2. **Vulnerability of the habitat**
   Technologically developed societies rely on the proper functioning of complex technical, economic, ecological and political systems. Habitat vulnerability deals with damage scenarios in built-up areas such as towns and suburbs, infrastructure networks such as transportation, energy (oil, gas, electricity) and communication networks and their impact on society and the economy.

3. **Interaction of risks with societal systems**
   Man-made risks and natural hazards bring about potentially negative consequences for the economy and society as a whole. Reduced availability and quality of natural resources, damage to industrial facilities and service centers, etc., result directly in economic losses. Distribution conflicts, perceived individual insecurity, disputes over social values, etc., may arise and

create tensions in the societal and political system. Risk management has to rely on public welfare, taking individual risk perception, risk aversion, acceptable risk levels, residual unknown risks, etc., into account. Understanding the vulnerability of societal system enables efficient relief and recovery strategies to be established.

4. **Vulnerability of ecological systems**
   The potential vulnerability of ecosystems by man-made and natural hazards lacks clear definitions. Biotic systems are always changing. However, sudden catastrophic events may exceed the individual limits of tolerance and hence disadvantage organisms and change habitats. Knowledge and understanding of adaptation and survival strategies are lacking and thus management strategies to protect systems are needed.

5. **Design of monitoring systems**
   Risk is defined as a product of the three components hazard, values exposed to risk and vulnerability. Values at risk are people, structures, life-lines, societal and ecological systems. All three components are extremely time-dependent, and risk, therefore, is not a constant value but is changing in time. Tools to monitor the risk evolution process are very important.

6. **Public risk perception and awareness**
   The willingness to pay for risk reduction measures is closely related to risk perception and awareness. Man-made and natural risks are perceived differently. Risk aversion plays an important role. An integral system approach for prevention and recovery strategies has to rely on these effects. Corresponding strategies have to be developed.

DRM *is organized to facilitate interaction of public and private organizations, academic and research institutions and potential beneficiaries.*

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Meetings & Workshops (2-4 p.a.)
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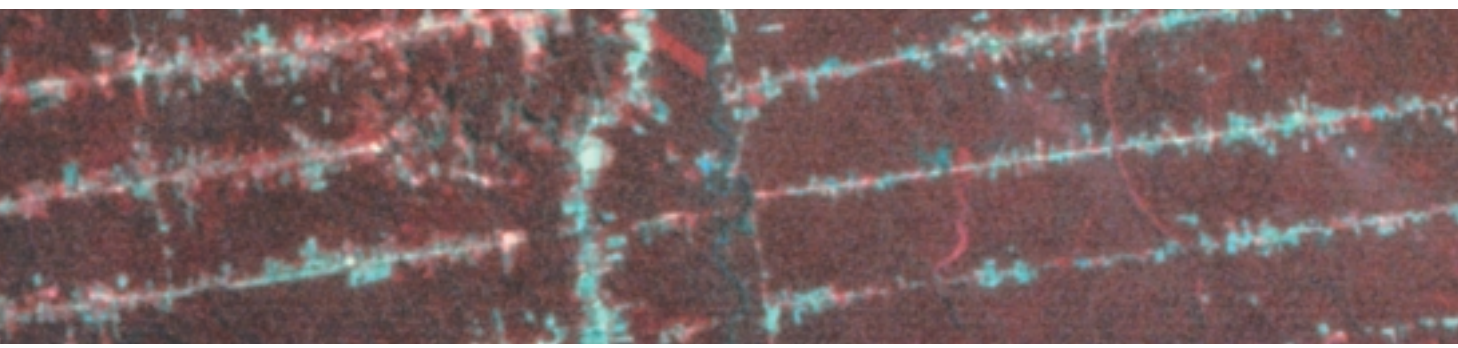
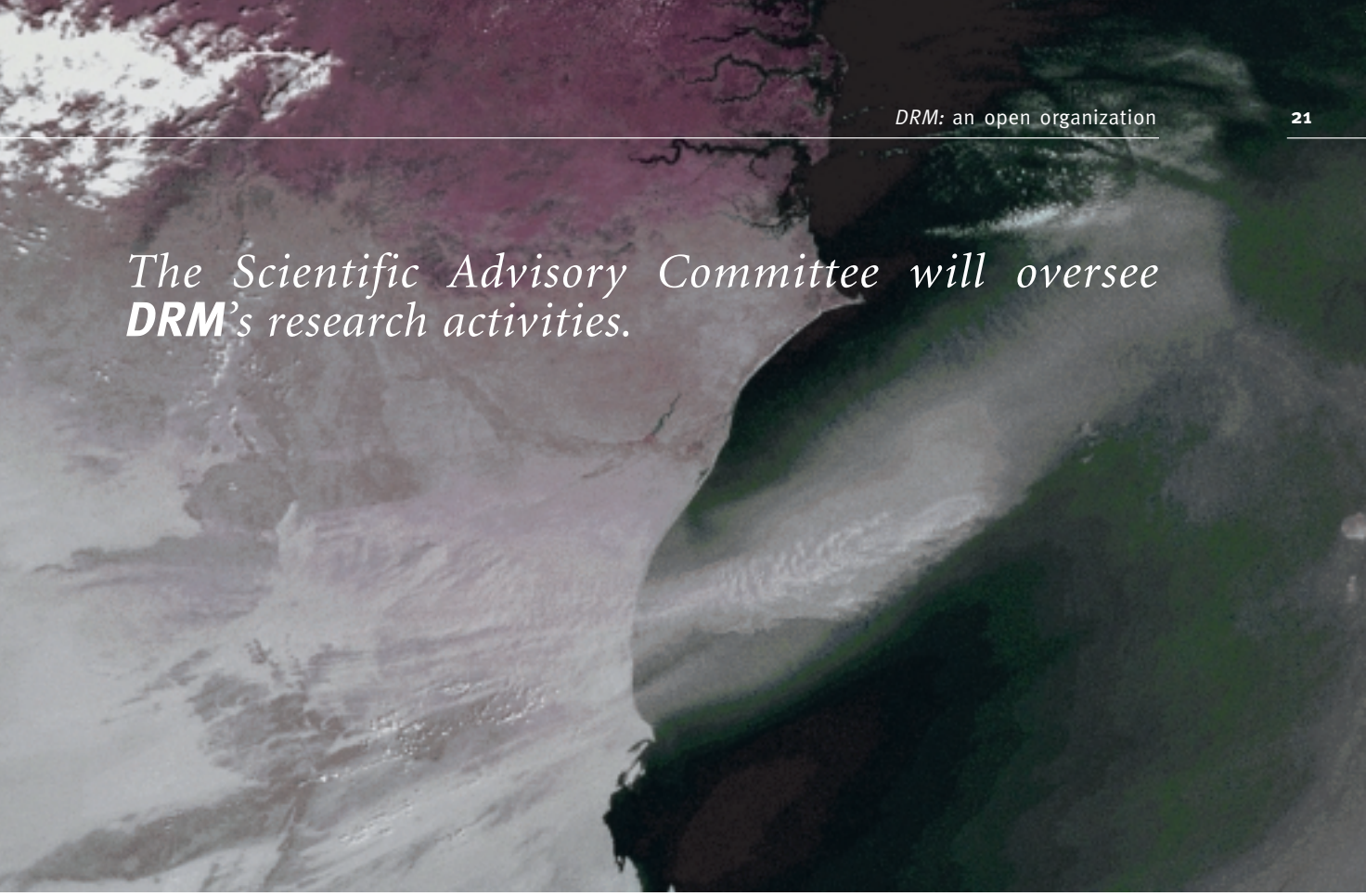
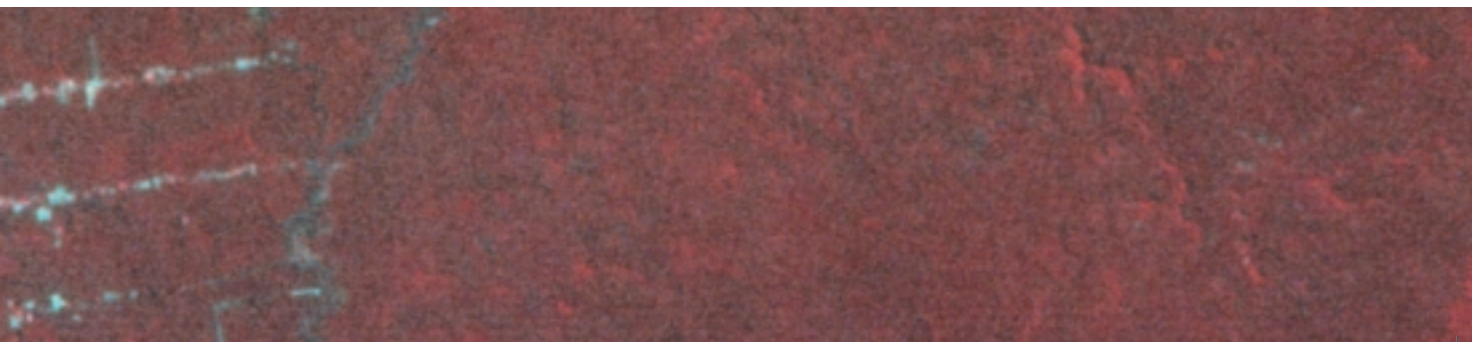


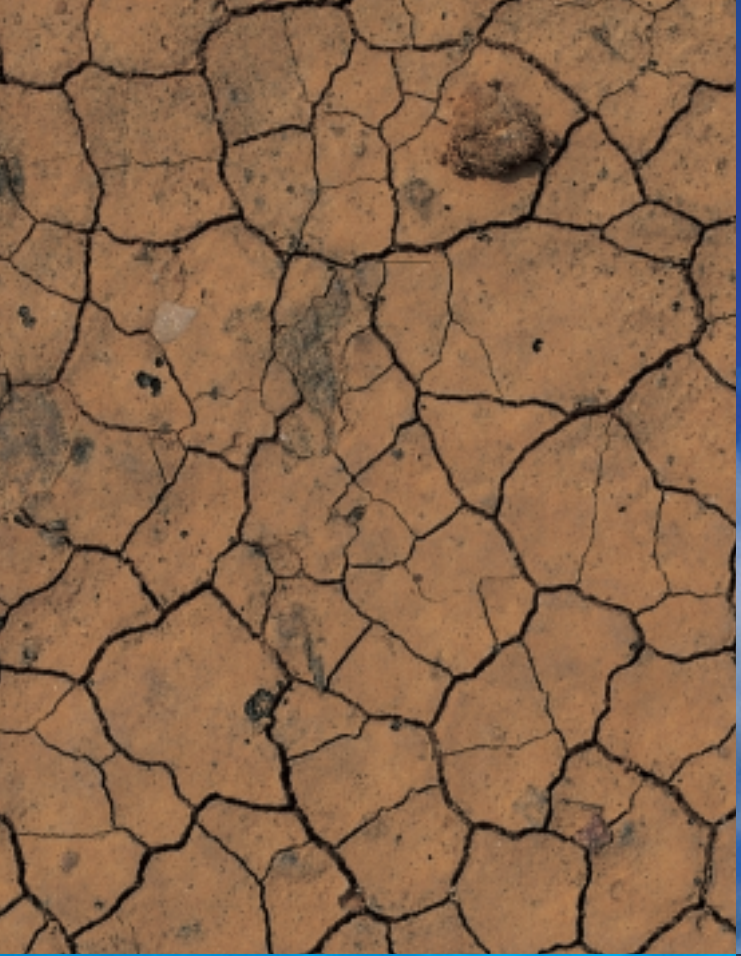


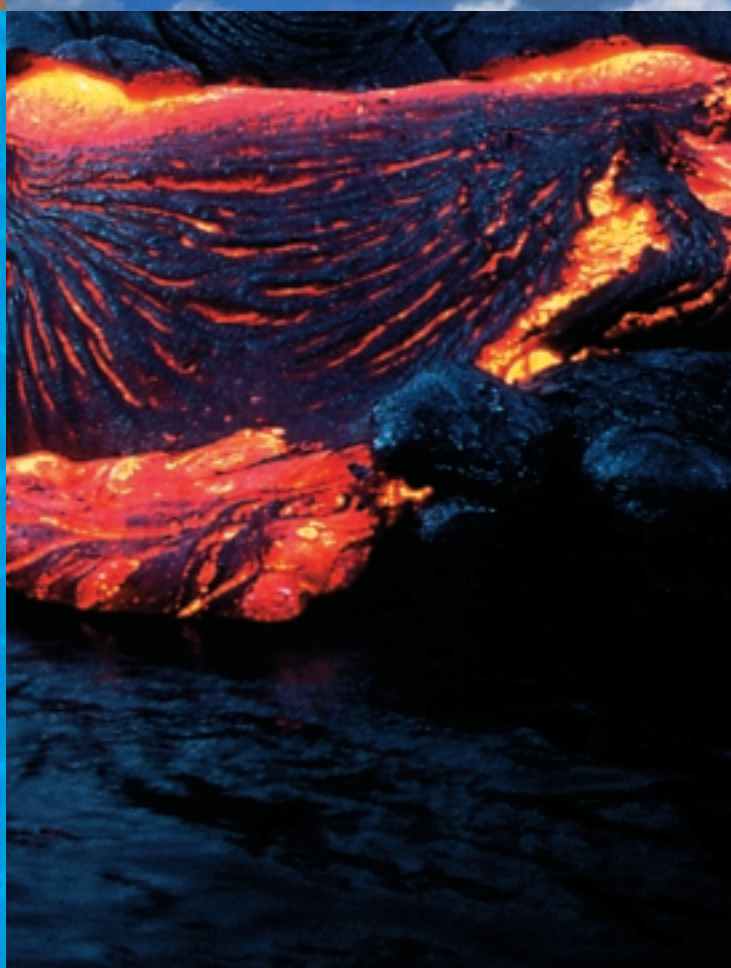
The Scientific Advisory Committee will oversee ***DRM****'s research activities.*

The Board of Directors and the Scientific Advisory Committee will be enlarged in line with growing sponsorship and participation.

The Scientific Advisory Committee will be responsible for quality control and review of project methodology and products. It will also provide overall scientific guidance to the Institute.







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