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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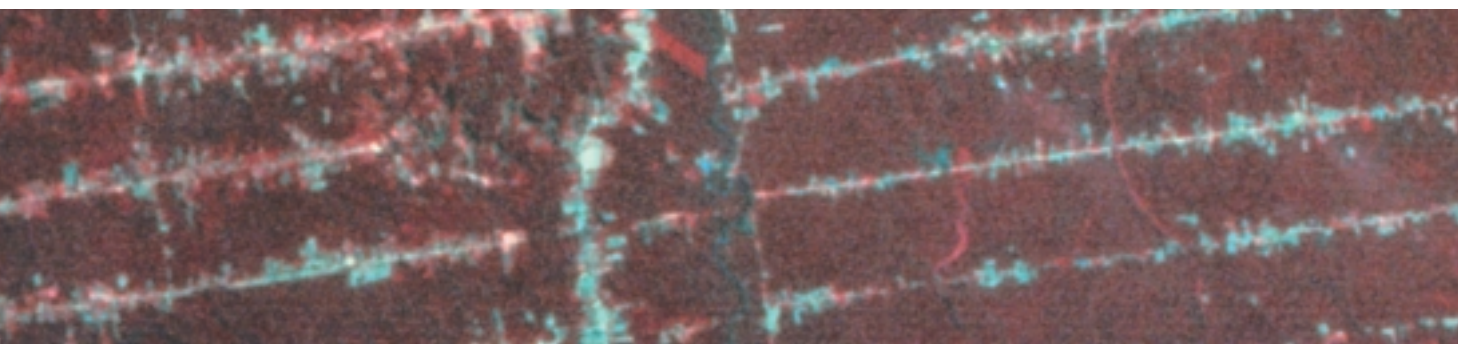
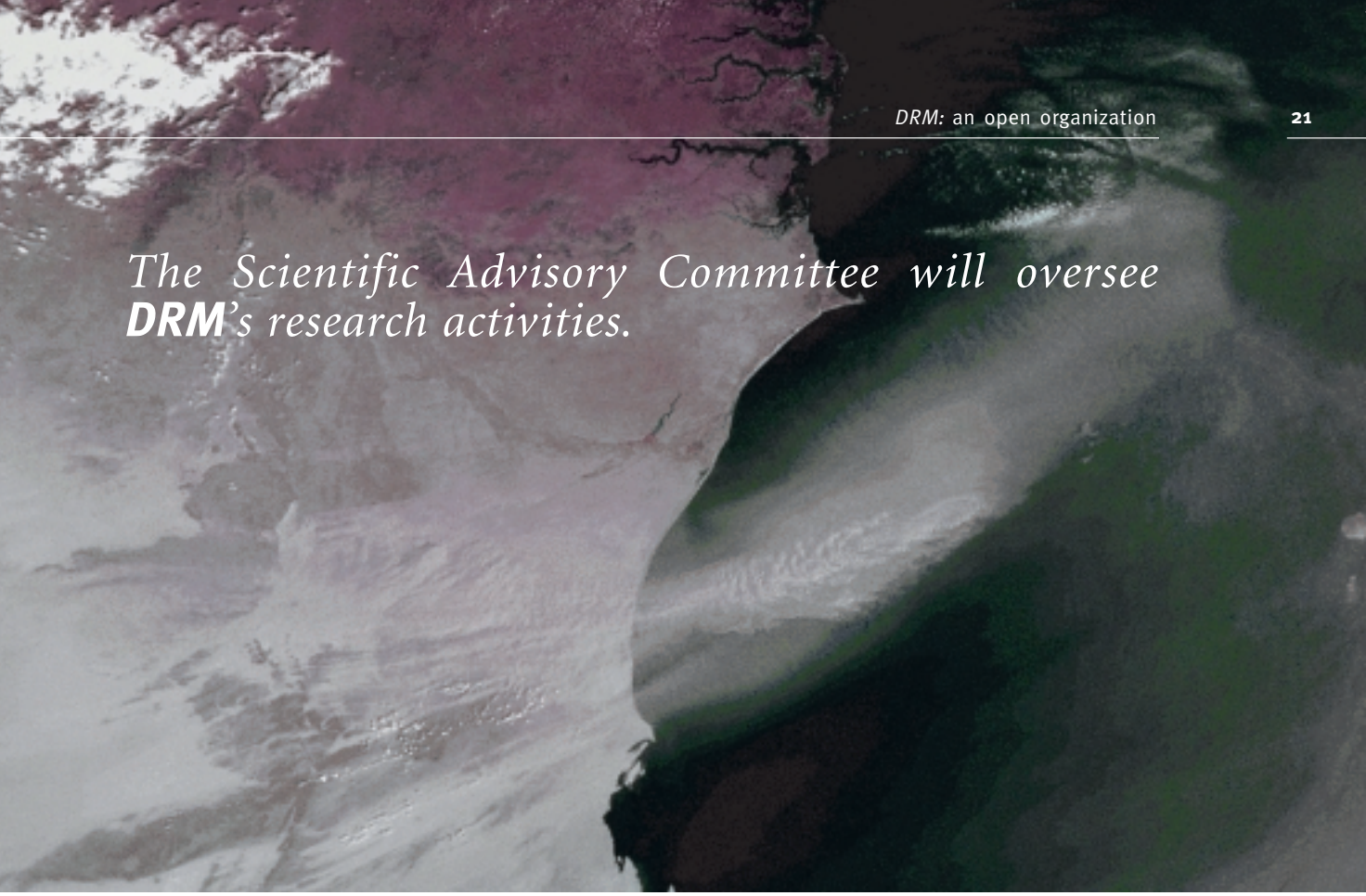
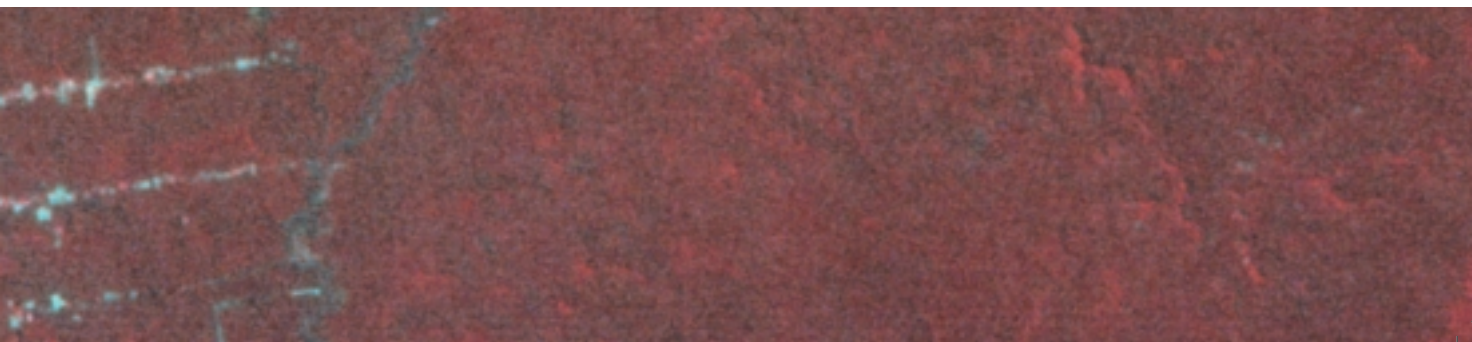


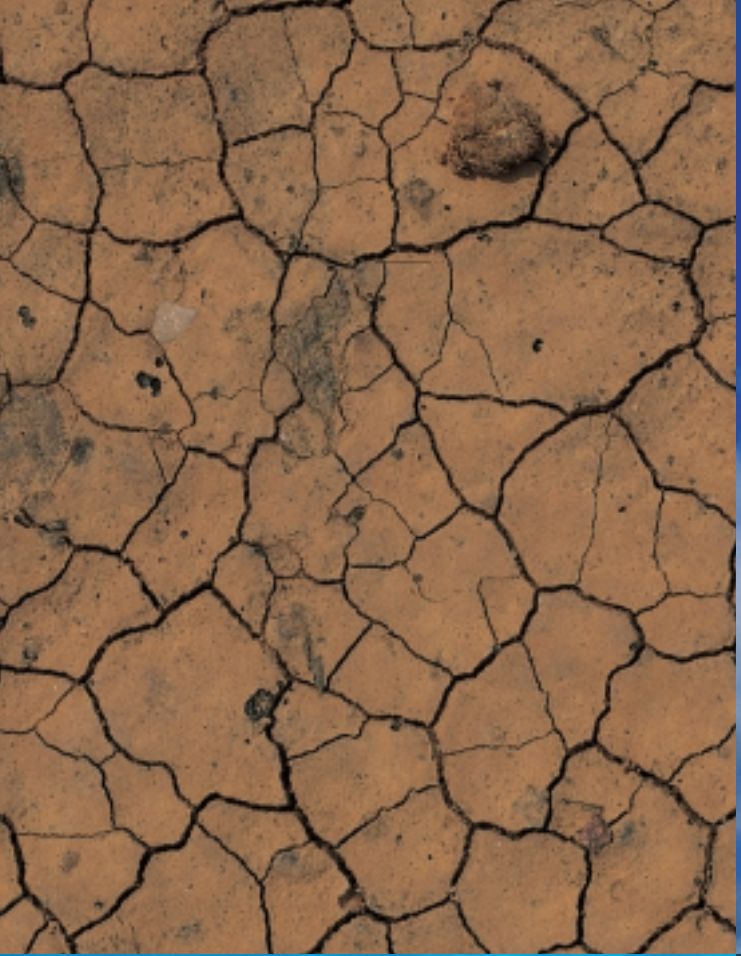


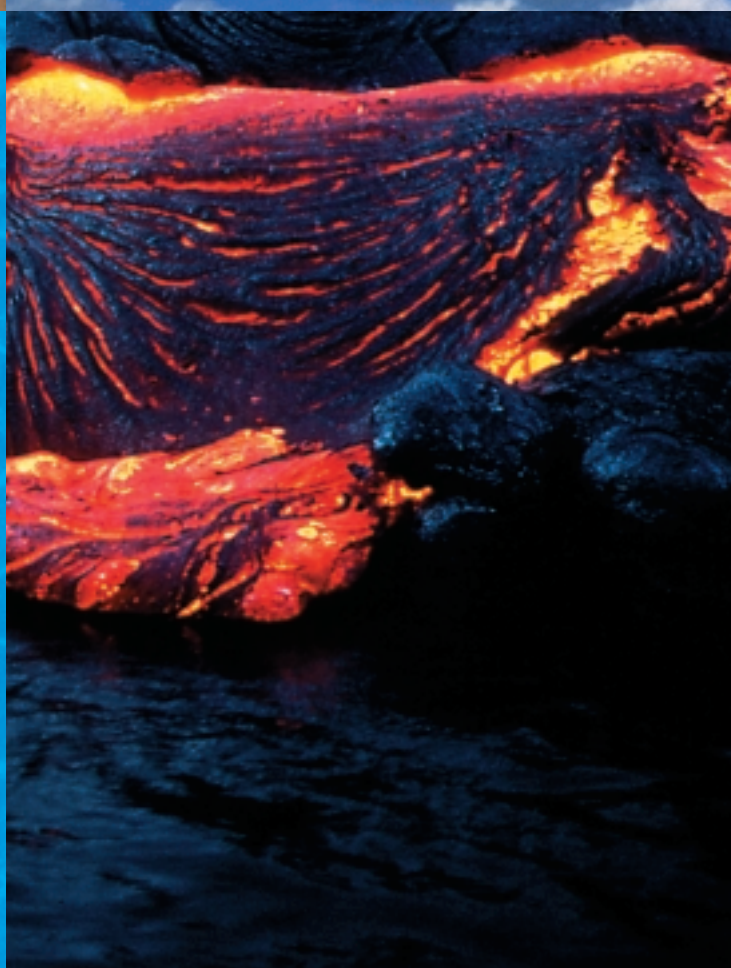
The Scientific Advisory Committee will oversee ***DRM****'s research activities.*

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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