



Monitoring landslides and assessing landslide hazards and risk with earth observation technology

The MORFEO team

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Every year slope failures cause deaths and huge economic damage in Italy, a European country most exposed to landslide hazards and risks. In July 2003, ASI, the Italian Space Agency, asked the Italian scientific and engineering communities to design a prototype of a system for the best exploitation of Earth Observation data and technology to help civil defence authorities manage landslide problems. To respond to this challenging request, we formed a multidisciplinary team with experience on (i) landslide identification and mapping, (ii) landslide monitoring and modelling, (iii) landslide hazards assessment and risk evaluation, (iv) civil defence response and crisis management, (v) remote sensing technology covering the spectrum from optical to microwaves (vi), analysis and integration of optical, multi-spectral and radar images, (vii) data fusion and information assimilation techniques, (viii) geodetic and topographic surveys, and (ix) GIS technology. The team is constituted by four research Institutes of the Italian National Research Council, three University Departments, and a SME with consolidated experience in aerospace, satellite and remote sensing technology. Design of the proposal was divided in three phases. During the first phase, we: (i) critically analyzed previous attempts to exploit remote sensing technology for landslide identification and mapping and for landslide monitoring; (ii) we identified the potential users of the system, including their needs and basic requirements; (iii) we defined individual deliverable and their specifications; (iv) we identified four main scenarios for the system, including prevention and forecast, warning and alert, event and crisis, and post-crisis; (v) and we designed a high level model of the system, including a preliminary design of its engineering implementation. The second phase of the project was dedicated to the critical analysis of the scientific and technical literature on topics related to the design and the implementation of the system. During this phase we produced reports on: (i) landslide monitoring and modelling techniques;

(ii) the state of the art of EO and of non-EO products and technologies for landslide studies; (iii) techniques and methods for the optimal interpretation and integration of EO and non-EO products and technologies for landslide investigations; (iv) landslide cartography and GIS, and (v) the space segment and infrastructure. The third phase was dedicated to the design of a pilot project aimed at designing a high level structure of the system. The proposed pilot project is composed of five sub-projects, for: (i) the development of knowledge and expertise for the best exploitation of remote sensing technology, combined with surface and sub-surface investigations, for the identification, mapping and monitoring of landslides and the associated hazards and risk; (ii) the design and the preliminary implementation of individual modules of the system; (iii) the integration and the validation of the system; (iv) the demonstration of the system; and (v) the training and dissemination activities. Research activities will focus in particular on: (i) improving our understanding and present capabilities of recognizing, mapping and monitoring of landslides of different types and in various physiographical environments using a combination of space and airborne sensors and technologies; (ii) developing innovative models for near real time forecast of landslide occurrence; (iii) improving methods and techniques for landslide hazard assessment and risk evaluation; and (iv) exploiting remote sensing information for the production of thematic maps useful for the identification and mapping of landslides, the assessment of landslide hazards, and the evaluation of landslide risk. Research activities, model validation and system demonstration will be conducted in four pilot areas in Italy. The MORFEO Proposal was finalised and submitted to ASI in October 2004, and then approved in December 2004. This work was supported by the Italian Space Agency.

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