DAM/MR/0104/2

DAMOCLES

DEBRISFALL ASSESSMENT IN MOUNTAIN CATCHMENTS FOR LOCAL END-USERS

Contract No EVG1 - CT-1999-00007

**COORDINATOR'S MANAGEMENT REPORT
FOR THE FIRST ANNUAL REPORT
WITH ATTACHED CONTRACTOR
AND ASSISTANT CONTRACTOR
PROGRESS REPORTS FOR THE PERIOD
1 March 2000 – 28 February 2001**

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Project web site : **http://damocles.irpi.pg.cnr.it/**

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COORDINATOR'S MANAGEMENT REPORT

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1.1 OBJECTIVES OF THE REPORTING PERIOD

This report covers the period 1 March 2000 – 28 February 2001. The main project objectives were:

(i) Project start-up (from 1 March 2000).

(ii) To carry out the work of the first year of the project, at the workpackage level and, as appropriate, with integration between workpackages.

(iii) To ensure the involvement of the project end-users.

All the objectives have been successfully achieved.

1.2 SCIENTIFIC/TECHNICAL PROGRESS

1.2.1 Gantt Chart

The project Gantt Chart is attached. At this stage there is no change from the version in the project proposal.

1.2.2 Resources Used

A comparison of the originally planned and actual use of manpower resources is shown in Table 1. Several partners are contributing more than originally envisaged (but without requiring additional EC funding). The low manpower use by the University of Newcastle is explained in Section 1.4.

A comparison of the originally planned and actual use of financial resources is shown in Table 2.

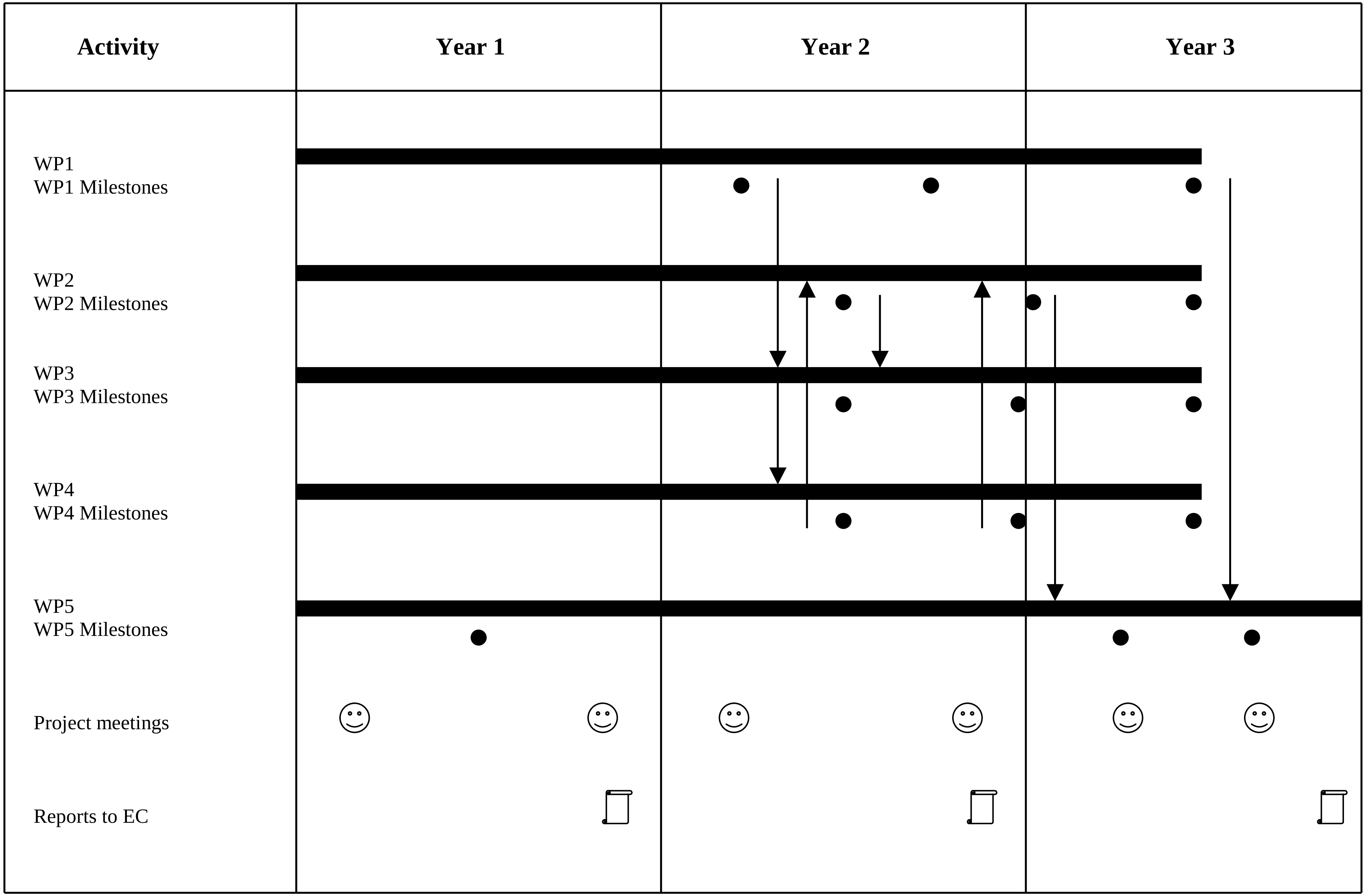
The underspend which is evident has three main causes:

(i) The low use of manpower by the University of Newcastle, which implies low spending also under other budget headings. As explained in Section 1.4 there is no overall loss of manpower to the project and the Year 1 underspend will be compensated for by higher expenditure in Years 2 and 3.

(ii) The low use of additional personnel by the University of Padua, which implies low spending also under other budget headings. There will be greater use of this manpower resource in Years 2 and 3.

(iii) The subcontractors for the University of Milan-Bicocca were unable to present their invoices in Year 1. Their fees will therefore be charged in Year 2.

Gantt Chart for the DAMOCLES Project



Vertical arrows indicate exchanges between workpackages at the times indicated by the milestones.

Table 1 Manpower resources used during Year 1 and comparison with the originally planned use

WORK PACKAGE	YEAR 1 RESOURCE USE IN PERSON-MONTHS FOR PARTNER									TOTAL
	1-UNEW		2-UNIBICO		3-CNR-IRPI	4-UNIPD		5-CSIC-IPE	6-IGME	
	Add*	Perm*	Add*	Perm*		Add*	Perm*			
Coordination	2	1								3
WP1	0	0	3	9	0	0.5	2.5	30.5	10.5	56
WP2	0	0	3	11	4.5	0	0	1	0	19.5
WP3	0	0	0	0	0	4.5	21	1	0.35	26.85
WP4	5	1	0.5	0.5	0	0	0	0.5	0	7.5
WP5	0	0.5	0.5	0.5	1	0	0.5	1	0.5	4.5
Total Use for Year 1	7	2.5	7	21	5.5	5	24	34	11.35	117.35
Original Planned Use for Year 1	17	3	8	7	3	11	18	25	2	94

*Add = additional personnel; Perm = permanent personnel

Table 2 Financial resources used during Year 1 and comparison with the originally planned use

EXPENDITURE TYPE	YEAR 1 EXPENDITURE IN EUROS FOR PARTNER							TOTAL
	1-UNEW		2-UNIBICO	3-CNR-IRPI	4-UNIPD	5-CSIC-IPE	6-IGME	
	Coord*	Proj*						
Actual Total	3,810	37,576	77,377	35,767	38,448	124,647	28,999	346,624
Original Planned Total	7,624	97,048	118,220	31,846	67,511	126,250	25,335	473,834
Actual EC Claim	3,810	37,576	77,377	17,883	38,448	48,612	14,500	238,206
Original Planned EC Claim	7,624	97,048	118,220	15,923	67,511	49,238	12,668	368,232

* Coord = DAMOCLES coordination; Proj = Newcastle project

1.2.3 Highlights of Progress in Each Workpackage

Much of the first year's project work has been concerned with data assembly for the preparation of thematic maps and for the development and application of the three project models:

- GIS hazard assessment model
- small basin debris flow model
- basin scale landslide sediment yield model.

Full details of the work are given in the attached partner reports. The main achievements for each workpackage are summarised as follows.

WP1 Development of functional relationships for debris flow behaviour derived from field data and existing databases

(i) Basic data (maps, morphometric data) have been compiled for sites in the Central Spanish Pyrenees (the contrasting geologies of the Upper Aragón and Gallego river basins on the one hand and the Benasque valley on the other) and the Italian Alps (Lombardy and Bolzano) for studying and predicting the spatial distribution of debris flows. (Pyreneen Institute of Ecology, Geomining Technical Institute, University of Milan-Bicocca, University of Padova)

(ii) A discriminant data analysis has been completed for the Pyrenees study area, to define the main factors that contribute to the triggering of debris flows. (Pyreneen Institute of Ecology)

(iii) Methodologies for assessing debris flow volumes and volume magnitude/frequency relationships have been developed using debris flow data from the Autonomous Province of Bolzano. (University of Padova)

(iv) The characteristics of debris flows on scree slopes and of very large debris flows from complex slides have been analyzed to develop empirical relationships for evaluating debris flow magnitude, velocity and runout distance. Data have been collected from 170 alluvial fans and analysed for the development of procedures for the automatic identification of active basins likely to generate debris flows. (University of Milan-Bicocca)

WP2 Development of a GIS hazard assessment methodology using field data, available databases and model developments

(i) Regression models have been developed for predicting the spatial probability of debris flow occurrence as a function of geomorphological variables. Using these models, debris flow susceptibility maps have been generated for the Pyrenees and Lombardy study areas. (Pyreneen Institute of Ecology, University of Milan-Bicocca)

(ii) A major storm which affected the Valsassina area in Lombardy on 28 June 1997 has been characterized in terms of rainfall (including detailed radar data), a landslide inventory and the geological/geomorphological data for the area. (University of Milan-Bicocca)

(iii) A comprehensive review of rockfall simulation models has been completed and a GIS technology for aiding the automatic evaluation of rockfall hazard has been tested. As a result the three-dimensional STONE model has been developed to simulate the fall of boulders down a slope. STONE uses thematic data to generate spatially distributed information useful for assessing rockfall hazard at the regional and local level. A successful test has been completed for a 600-km^2 area in the southern Italian Alps, the first time that a deterministic rockfall hazard zonation has been carried out for such a large area. (University of Milan-Bicocca, CNR-IRPI Perugia)

WP3 Development of a small basin debris flow impact model using field data and a physically based modelling approach

(i) GIS techniques have been used to obtain the digital terrain model and thematic maps for two study basins (Rio Lenzi in the Autonomous Province of Trento and Rio Rudan in the Veneto Region). (University of Padova)

(ii) The Rio Lenzi debris fan has been surveyed with the high precision needed to support modelling in which topography determines debris flow movement and deposition. (University of Padova)

(iii) Initial development and testing of the debris flow channel routing model have been carried out. Ultrasonic sensors have been installed in the Rio Rudan to provide data on debris flow bore depth and velocity. (University of Padova)

(iv) Field measurements to support the application of the debris flow impact model in the Spanish Pyrenees, and a search for an appropriate test site, have been initiated. (Pyreneen Institute of Ecology, Geomining Technical Institute)

WP4 Application of a physically based, basin scale, landslide erosion and sediment yield model to land use and climate scenario analysis for selected sites

(i) A specification was prepared for selecting the focus sites in the Central Spanish Pyrenees and Lombardy for application of the SHETRAN landslide erosion and sediment yield model. Sites have been selected at Valsassina (203 km^2) in Lombardy and the Ijuez basin (45 km^2) in the Pyrenees. The necessary data are being assembled but SHETRAN has already been tested using the supplied topographic data and hypothetical realisations of the remaining inputs. (University of Newcastle, University of Milan-Bicocca, Pyreneen Institute of Ecology)

(ii) The first validation of the SHETRAN landslide model has nearly been completed for a site in the eastern Spanish Pyrenees, providing experience and a basis on which to carry out the DAMOCLES applications. (University of Newcastle)

WP5 Dissemination of the project deliverables via training courses, workshops, implementation by end-users and placement of demonstration material on a web site

(i) The DAMOCLES project web page has been set up at http://damocles.irpi.pg.cnr.it/. (CNR-IRPI Perugia)

(ii) A web-based GIS software has been installed for the internet distribution of landslide inventory and hazard maps generated by the project. This is a versatile system in which the number and type of thematic layers that can be accessed changes with spatial scale. (CNR-IRPI Perugia)

(iii) The project coordinator has met all the end-users to ensure their involvement in the project. (Section 1.5)

(iv) All the partners have contributed material to the website and liaised with the end-users.

1.2.4 Workpackage Integration

The principal areas of integration are

- integration of the modelling approaches in WP2, WP3 and WP4;
- integration of the functional relationships from WP1 with the models;
- integration of the end-users within the project (covered in Section 1.5).

Integration of modelling approaches

The three modelling approaches are summarized in Table 3. Workpackage 2 applies discriminant analysis to define the main factors that contribute to the triggering of debris flows (eg land use and geology). Regression analysis between these factors and observations of debris flow occurrence then provides a model for predicting the spatial probability of debris flow occurrence as a function of the factors. Application of the model within a GIS which maps the factors enables a debris flow susceptibility map to be generated at a regional scale. Two methods of representing spatial distribution are being compared: by pixel (a convenient approach for computation, used by the Pyreneen Institute of Ecology) and by geomorphological unit, such as a small basin (a geomorphological approach, used by the University of Milan-Bicocca).

Workpackage 3 is developing a numerical model for predicting the movement of a given debris flow along a channel (accounting for the effects of structures such as check dams and bridges and of changes in channel geometry) and the impact of the debris flow in terms of sediment deposition on debris fans, i.e. at a local scale. Workpackage 4 applies the existing SHETRAN numerical landslide model to simulate the sediment yield caused by shallow landslides at the basin scale as a function of climate and land use.

These modelling approaches provide complementary outputs. Their integration will provide a more coherent approach to debris flow hazard assessment and will widen the applicability of each, compared with using them separately. Table 4 summarizes their integration. Because the GIS regional hazard assessment model is essentially based on a correlation between recorded debris flow occurrence and geomorphological and land use characteristics, its relevance is limited to the climatic conditions characterizing the period of record. If the climate changes, the model correlation may no longer apply. SHETRAN, however, can investigate patterns of debris flow occurrence for possible scenarios of future climate and land use. It can therefore provide a new “virtual ground truth” of debris flow occurrence, which can be used to calibrate the GIS model for the future conditions. The GIS model also does not predict the impact of debris flows, only their probability of occurrence. The local scale debris flow model of WP3 therefore provides the means of investigating in detail the hazard (in terms of sediment deposition) at sites identified from the GIS analysis as requiring attention (eg where it is planned to build a road or new infrastructure). Similarly, SHETRAN can be used to predict the basin scale sediment yield as a function of debris flow occurrence (eg to determine reservoir sedimentation).

Table 3 The DAMOCLES models

WORK PACKAGE	WP2	WP3	WP4
MODEL TYPE	**Discriminant analysis**	**Numerical model**	**Numerical model**
MODEL OUTPUT	**Regional hazard assessment map (debris flow probability)**	**Local debris flow impact as function of debris flow characteristics**	**Basin scale sediment yield impact as function of climate and land use**

Table 4 Integration of the DAMOCLES models

MODEL	ROLE IN INTEGRATED APPLICATION
Regional hazard assessment	**Based on correlation between recorded debris flow occurrence and geomorphological and land use characteristics (for past climate)**
Local debris flow impact	**Can investigate in detail the hazard at sites of interest, including sites identified in the regional scale map**
Basin scale impact	**Can investigate landslide erosion and sediment yields for climate and land use scenarios, including revised basis for regional hazard assessment for future altered conditions**

Integration of debris flow relationships with models

Workpackage 1 provides data and process relationships which form the basis of, or which improve, the model developments in workpackages 2 to 4. Development of the GIS hazard assessment model requires data on the spatial distribution of debris flows and the controlling factors to be used in the discriminant analysis. The local scale debris flow model needs information on debris flow characteristics as its input. SHETRAN requires functional relationships for debris flow behaviour to improve its current rule-based description of debris flows. To ensure that their needs are met, the modelling groups liaise with the data collection groups, providing a list of the model requirements, the desired quality of the data and how the data should be collected. Standard means of archiving and presenting the data are being discussed between the project partners.

1.3 MILESTONES AND DELIVERABLES

As indicated in the Gantt chart, the only milestone due to be reached during the reporting period was the setting up of the project web site at month 6. This milestone was successfully reached, as reported in Section 1.2.3.

The good progress with the STONE rockfall model is worth highlighting, as the model is a project deliverable. The model and its successful test represent an important first in the subject. In addition, though, STONE is being tested further by the Lombardy Region Geological Survey: if the test is satisfactory the Survey will include rockfall hazard assessment by STONE as one of the thematic inputs for estimating hazard and risk in the Lombardy Region.

1.4 DEVIATIONS FROM THE WORK PLAN AND/OR TIME SCHEDULE

The University of Newcastle's research associate for the project did not take up his position until October 2000. The time taken to make the appointment represents a delay in the Newcastle programme, which was originally due to start in month 1 of the project. However, a revised programme is in place to make up the lost time. Also the delay does not represent any overall loss of manpower to the project since the available funding does not anyway support a full time appointment for the full length of the project. The appointment will simply continue longer into the project than would otherwise have been possible.

1.5 COORDINATION BETWEEN PARTNERS AND COMMUNICATION ACTIVITIES

The principal means for reviewing progress and coordinating activities are the project progress meetings. A start-up meeting was held in Milan during 4-5 April 2000 to provide an early start to the project. A copy of the minutes has been submitted to the EC. At the meeting a Consortium Agreement produced by the University of Newcastle was tabled. This defines the various responsibilities of the partners and has subsequently been accepted by all the partners.

The first progress meeting was held at Zaragoza during 25-27 October 2000 and a copy of the minutes has been submitted to the EC. The meeting showed that good progress was being made and provided an opportunity to discuss the integration of workpackages as described in Section 1.2.4.

Between the progress meetings partners are required to circulate short "bullet-point" reviews of progress at two-month intervals, as a way of keeping each other informed of what is being achieved.

The project coordinator has held meetings with all the end-users:

- the Lombardy Region Geological Survey, the Veneto Regional Agency for Environmental Protection and the Autonomous Province of Trento at the end of the start-up meeting;

- the Land and Urban Planning Directorate, Aragón, at the start of the first progress meeting.

These meetings provided an opportunity to thank the end-users for their support of the DAMOCLES project, to stress the importance of their involvement for ensuring that the project produces practical deliverables and to document the interests of the end-users in terms of project outputs. The minutes of these meetings have been circulated to all partners.

Several of the partners have presented talks on DAMOCLES activities or thematically related work at a number of conferences and meetings. These are documented in Section 2 of the full Year 1 report. A number of conferences are being examined as occasions for making the project results available to the scientific community. These include the European Geophysical Society Annual General Assemblies (especially the 2003 assembly which will be held jointly with the American Geophysical Union and which follows the end of the project), an International Workshop on Debris-Flow Investigation and Mitigation (Kazakhstan, August 2002) and the Third International Conference on Debris-Flow Hazards Mitigation (Davos, Switzerland, September 2003).

1.6 DIFFICULTIES IN MANAGEMENT AND COORDINATION

There are no difficulties to report.

APPENDICES

Progress reports by:

- University of Newcastle upon Tyne, UK
- University of Milan-Bicocca, Italy
- CNR-IRPI, Italy
- University of Padova, Italy
- Pyreneen Institute of Ecology, Spain
- Geomining Technical Institute, Spain.