



Earth Observation Initiative in former homeland of South Africa in support to EU activities on land degradation and integrated catchment management.

SIXTH FRAMEWORK PROGRAMME

Cooperation (INCO)

PRIORITY A.2.1 A.2.3

PRIORITY TITLE: Rational use of natural resources

SPECIFIC SUPPORT ACTION

Final Activity Report

Period 1st January 2006 – 30th June 2007



GRS

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Section 1 – Project Objectives and major achievements during the period

1. Project Objectives

1.1. Strategic objectives

EO-LANDEG is a FP6 Specific Support Action (SSA) which aim is to develop a pilot initiative to promote, at international level, an attractive study area in the former bantustan of Transkei, South Africa, with the perspective to monitor and propose conservation measures to combat land degradation, soil erosion, stress on ecosystem and water resources, and their integration to technical assessments, economic productivity and poverty alleviation. Transkei is one of the poorest and most disadvantaged former homelands in South Africa where natural resources (vegetation, wetland, water, soil and vulnerable spring ecosystems) are being depleted, due in particular to natural changes (climate variation straddling over semi-humid to semi-arid in places and rapid geomorphologic changes) but also to inadequate agricultural practices and techniques of water utilisation, overgrazing, and mismatching between resource and population spatial distribution.

1.2. Technical objectives

Objective 1: Setting up the pilot site. Relevance of existing data and on-going research:

The first objective of EO-LANDEG is to consolidate local expertise, monitor on-going research and facilitate accessibility to spatial data and exploitation of the results with the participation and support of stakeholders. This consolidated set-up will represent the core of the Earth Observation Initiative around which strategy workshops, need analyses, decision making, information and dissemination activities will take place. Several South African and European research teams are presently active in the former Transkei area. Their work encompasses a wide variety of actions addressing problems like landuse, natural resources, service delivery, self governance and rectifying the problems created by the past political situation.

Objective 2: Assessing Earth Observation and monitoring tools: Remote sensing simultaneously covers several monitoring parameters and allows measuring changes and speed of changes of the natural environment. This activity is dedicated to setting up of a working group on land-use remote sensing and its application on assessment and monitoring of land and ecosystem degradation, desertification, erosion, utilisation and protection of natural resources in Transkei. The relevance of different techniques of assessment using several remote sensing approaches and types of images are to be discussed. Of special interest is the analysis of newly developed innovative observation tools that are still in needs of application in the estimation of reserves of natural resources: radar, radar interferometry (INSAR), imaging spectroscopy, very high spatial resolution...

Objective 3: Dissemination and promotion of the EO-LANDEG initiative: The objectives here are to demonstrate the exploitation of the results of the Transkei Pilot Earth Observation Initiative to the international scientific community, local stakeholders and policy makers, to test EO-LANDEG as an educational tool at school and university level as well as at local community level, to promote the team and to position itself as a partner in a future EU consortium. EO-LANDEG will be able to provide a site-based model as a research platform and information management system to be compared with, or applied to, regions in Europe and Africa.

1.3. The project vs. state of the art

It appears that a lot has been done by the scientific community in general in terms of land degradation, desertification, loss of biodiversity... The assessment of Earth Observation and monitoring tools has shown that EO is a commonly used approach in these domains.

Earth Observation is of particular relevance in global initiatives such as the United Nation Convention to combat Desertification and Drought (UNCDD) and the United Nation Convention on Biological Diversity (UNCBD). Many studies using remote sensing techniques come in support to these initiatives. The EO-LANDEG initiative hence has a strong remote sensing component by which several temporal parameters can be assessed.

Most promising techniques like imaging spectroscopy are however to be developed in assessing and mapping land-degradation related parameters, in particular in vegetation species and soil nature and composition. Very high spatial resolution sensors also bring a new dimension and give access to socio-economic spatialised parameters that were not possible to take into account formerly.

The EO-LANDEG initiative however innovates as it considers EO not only as an assessment and monitoring tool, but also as an educational instrument to combat land degradation and alleviate poverty, with the involvement of local communities in a historically disadvantaged area.

1.4 Objectives for the reporting period, work performed and achievements

1.4.1. Managerial activities

Consortium Management activities were carried out on a regular basis. The **Consortium Agreement** was signed by all parties at the early stage of the project.

Periodic Activity Report, Periodic Management Report and Periodic Report Executive Summary have been prepared and issued for the period 01/01/2006 to 31/12/2006. These reports have been accepted by the Commission.

External relation and promotional activities took a large place in the project, with the implementation and regular updating of the **project web site**, the production of a **Data Use Agreement** manual for data covering the pilot initiative area. The Data Use Agreement describes data availability, location and access rights. A particular attention was paid to liaison with stakeholders, South African organisations as well as practical organisation and logistics for **workshops** and **field trips**. Two **letter of information** (June 2006 and June 2007) were issued a Consortium members participated in the FP6 Information Day on Earth Observation in Theme 6, organised in January 2007 at Brussels

1.4.2. Support activities

The aim of the project is to promote, at international level, a pilot site in the former bantustan of Transkei, a poverty stricken region in South Africa, with the perspective to monitor and propose conservation measures to combat land degradation, soil erosion, stress on ecosystem and water resources, and their integration to technical assessments, economic productivity and poverty alleviation.

In order to reach this goal three technical objectives have been defined with measurable deliverables.

Objective 1: Setting up the pilot site, relevance of existing data and on-going research.

This phase of the project started end of February 2006 with the first reconnaissance field visit to the site and a **Consortium inception phase meeting** with the three teams involved. During this trip stakeholders (scientific and decision makers) and local communities were visited and data was gathered. Stakeholders like the Department of Science and Technology, Department of Water Affairs and forestry, Department of Agriculture, Department of Education, Universities, Environmental research

organisation play a crucial role in the project. They have expertise on the study area, are the custodian of many years of observations, understand the need of the population and actively interact with the society and the research communities.

An audit of existing research, projects and available data related to the project and the catchment area then followed. The results of this research were presented in several documents: data archives (spatial data base), **Metadata Catalogue** accompanied with the Data Use Agreement.

The main achievement of objective 1 was to collect enough data and information at catchment scale in order to assess the feasibility of promoting the pilot site at international level. The first objective of EO-LANDEG to consolidate local expertise, monitor on-going research and facilitate accessibility to spatial data and exploitation of the results was therefore achieved.

Objective 2: assessing EO and monitoring tools.

This objective has been addressed by i) defining and describing land degradation parameters that could be monitored through EO techniques; ii) inventorying existing EO resources that could fill the monitoring needs; iii) reviewing existing or foreseeable approaches to access these parameters through EO resources; iv) describing some land degradation models that use combination(s) of parameters accessible through EO and other relevant information.

Regarding the very large amount of material published in this domain, an extensive review would have been unrealistic and the project tried to have a comprehensive view of the EO capabilities with respect to the South African situation and to review the possibilities offered by the newly developed sensors.

A workshop in the Eastern Cape has been organised to present the project and discuss EO techniques for land degradation with invited scientists. The workshop aimed at putting together scientists and stakeholders and exchanging views. Despite that, apart from the project participants, no European scientists attended the workshop (see 1.5) this event has been a good opportunity to exchange with stakeholders and scientists in charge of conservation measure involving local communities. It has also been an invaluable opportunity to establish the South African partnership for a possible FP7 project submission.

The field visit has shown how remediation and conservation measures can be undertaken with the active involvement of local communities.

The second objective of EO-LANDEG in assessing of EO and monitoring tools was achieved, despite lacking involvement of European scientist outside the project. Efforts will continue to improve this situation, in particular in view of FP7.

Objective 3: Dissemination and promotion

The ultimate goal of the project is to propose the pilot site with a strengthen research team as a platform for a larger European project (FP7). Dissemination and promotion has to be done a various levels in order to get the major South African and European stakeholders involved. The third objective is therefore to promote EO-LANDEG at various levels.

This objective already been well addressed by positioning the research team in the South African research framework with the support of the main stake holders, especially the **Department of Science and Technology (DST)**. The education part of the project (dissemination at university, school and community) was very welcome by several organizations and NEPAD and will be a major parameter and initiative that the team can bring to a new FP7 project.

Two project flyers wre issued in June 2006 and 2007 and distributed to potentially interested scientists in EU (mailing list) and were distributed to stakeholders in South Africa mailing and/or printed copies.

The project team met several organisations in SA and in Europe during the reporting period and gave a presentation: DST in South Africa, the GFZ-Potsdam in Germany, the Royal Museum for Central Africa, Tervuren, Belgium. Many EU organisations (European Union DG) were also visited and more is planned for 2007 during a study tour.

A pilot school was selected for a preliminary contact (the Khanya high school in Wittlesea district).

Dissemination and promotion made the core of the project activity regarding this objective.

3 major activities took place during the reporting period:

- An **interactive demonstration set** was prepared as an educational tool for University level (Deliverable D8);
- A **school and community response** to awareness and education events was carried out (deliverable D9)
- A **workshop** was organised in EU (Brussels) in May 2007 on land and ecosystem degradation and Earth Observation monitoring (Deliverable D10). A monitoring strategy was proposed during this workshop. The **workshop proceedings** (Deliverable D11) and **proposal for a FP7 partnership** (Deliverable D12) were issued at the end of the workshop.

1.5 Difficulties encountered and corrective actions undertaken

The main problem encountered during this period was in contacting and attracting European scientists to the project and its workshop. Despite a well targeted mailing list of EU scientists to be contacted, very few positive replies were received and none was able to attend the November workshop organised in the Eastern Cape. A corrective action was undertaken with the decision to organise a supplementary workshop in Europe, but here again, the result was poor and the workshop had to be eventually cancelled.

Section 2 – Workpackage progress of the period

1. WP 0-2

1.1. WP0-2 objectives

Management of project external relation and promotional activities

1.2. Progress toward objectives

This second managerial activity relates to scientific liaising networking, workshop organisation and technology transfer and information dissemination to SA, European and African partners.

The first activity of WP02 was to build a web site with all relevant information on the project (**Deliverable D1**): objectives of project, data available, team composition, workshops, executive summary. This was started in February 2006 and the site was launched in May 2006. It has been regularly updated. The final website will be **Deliverable D 13** and is due in June 2007.

The second activity of WP02 was to contact the various institutions holding the spatial data on the catchment and get access to data, copyrights, ownership. It was carefully dealt with strong managerial control and utilisation agreements. This was achieved in **Deliverable D 4** that was produced in July 2006.

The third activity of WP02 was to establish relations with major South African and European Union players in order to promote EO-LANDEG at the National level.

Three major **Milestones** have been achieved:

The project web site was implemented and visited by several institutions after release. The website is also linked to the SA website SASRA of the Department of Science and Technology which is the official SA support and exchange forum place to all SA FP6 initiatives and future FP 7.

Close relations have been built with the SA Department of Science and Technology which has brought their strong support to the initiative. DST has a country wide action to initiate, promote and support Frame work programme action and encourage South African participation. They have a representative at the South African Embassy in Brussel. In May 2006 the team went to Brussel to present the project to the Dr Mandi Mzimba – Minister for Science and Technology at the South African Embassy in Brussels and to other EU delegations: Mrs Maria Yeroyanni – European Commission, DG Research, Desertification and Land degradation, Prof Ines Minguez – Scientific officer, European Commission, DG Research, International Scientific Co operation (INCO), Mr Gilles Ollier, European Commission, DG Research, Earth Observation, Mr Daniel Deybe - European Commission, DG Research, Earth Observation.

A workshop was organised in November 2006 in the study area with invited guess from SA: scientists, engineers, decision makers. European participants could unfortunately not attend. The workshop ran over three days with various presentations on the different aspects of the projects and a field trip to the Macubeni rehabilitation site.

On going assistance was provided by GRS to GSC in contacting and informing potential stakeholders and scientists about the project. A one day workshop was organised in Grahamstown at GRS to facilitate the consortium partners (BRGM, GCS and GRS) in networking with local scientists working within the chosen study area (Macubeni).

a Workshop was organised in EU on land and ecosystems degradation and Earth Observation monitoring. The Workshop took place on June 11th, 2007, at the South African Embassy in Brussels. The workshop was organised thanks to the support of Mr. Daan du Toit, Senior Science and Technology Representative for South African Mission to the European Union

1.4 List of deliverables

| Del. no. | Deliverable name | Work-package no. | Date due | Actual/Forecast delivery date | Estimated indicative person-months *) | Used indicative person-months *) | Lead contractor |
|----------|--------------------|------------------|--------------|--|---------------------------------------|----------------------------------|-----------------|
| D1 | Project web site | WP0-2 | 31/01/2006 | Open in February 2006 | | | CGS |
| D4 | Data use agreement | WP0-2 | 30/6/2006 | Together with Deliverable5, finalized in October 2006, submitted in 2007 | | | CGS |
| D13 | Final web site | WP0-2 | 30 June 2007 | 30 June 2007 | | | CGS |

1.5 List of milestones

| Milestone no. | Milestone name | Workpackage no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---------------|------------------------------|-----------------|------------|-------------------------------|-----------------|
| M0-2-1 | Project web site implemented | WP0-2 | 31/01/2006 | Implemented in February 2006 | CGS |

| | | | | | |
|--------|--------------------|-------|-----------|--|-----|
| M0-2-2 | Data use agreement | WP0-2 | 30/6/2006 | finalized in October 2006, submitted in 2007 | CGS |
|--------|--------------------|-------|-----------|--|-----|

2. WP 1

2.1 WP1 objectives

To consolidate local expertise, monitor on-going research and facilitate accessibility to spatial data and exploitation of the metadata.

To consolidate the core of the Earth Observation Initiative around which strategy workshops, need analyses, decision making, some information and dissemination activities.

2.2 progress towards objectives

A Consortium inception phase workshop and a five day orientation field trip was organised from the 27th February to the 3rd March 2006 in the Mzimvubu catchment and the results were presented in **Deliverable D3**. The inception phase had the following objectives:

- Assess the regional geomorphological framework of the study area and the effect of various lithological formations in controlling the formation of soil, the drainage, surface water, groundwater and erosion;
- Assess the different land use types and forms of land degradation in the study area;
- Meet the various organisations (stakeholders, universities, and consultants) involved in land use, land degradation or environmental research in the catchment;
- Source all recent spatial data and reports;
- Team building exercise for the consortium (BRGM, CGS and GRS) and inception phase meeting.

The Mzimvubu catchment was historically divided into two territories, before the abolition of the apartheid regime, i.e. the Transkei (homeland) and the former Republic of South Africa.

This led to two different farming practices, the result of which can still be seen on satellite images. Images clearly distinguish the region north-east of Queenstown occupied by commercial farming with grassy grazing grounds from the Qoqodala – Ku Zingqutu – Vaalbank area which is characterized by communal settlement practicing subsistence farming. Deep erosion and land degradation is mostly reported in the former homeland areas.

The field trip has clearly enhanced this difference between commercial farming which consists of large farms with grassy plains for cattle and sheep grazing and subsistence farming in the former homeland which consists mostly of shrubs and maize plots.

A GTZ-funded pilot project is currently in place in the small (10 x 10 km) catchment of Macubeni, north of Lady Frere. The local community gets its water from a dam which is heavily silted as a result of strong erosion.

The project, run by local consultants (MAFA, a research team from the Rhodes University in Grahamstown and ATS consulting engineering firm in Queenstown) has several objectives:

- Academic: modeling of erosion, land degradation and silting in the dam
- Social: local population awareness, soil rehabilitation and conservation measures
- Rehabilitation: test and monitor different techniques of combating land degradation and soil loss

The project has shown that human activities increase natural erosion processes either through ploughing and leaving the land fallow or through overgrazing on wetlands.

One of the causes of the degradation has been identified as the Lapesi bush (invasive bush). Nothing grows around this bush and the grass disappears leaving the soil barren.

A remediation is proposed that consists of removing the Lapesi bush and enclosing the cleared area to avoid grazing so the grass can re-establish itself.

Another main activity of workpackage WP1 was the audit of the on-going research and the building of the meta-data catalogue and spatial database. This activity started in February 2006 and was completed in July 2006 and the results were presented in **Deliverable 5**.

The building and supervision of the metadata catalogue was a major task. Standardisation of the metadata had to be defined with organisations outside South Africa, especially EU teams working on similar problems and to be in line with INSPIRE initiative as well as the GEOSS initiative. The meta-data and example of spatial data available can be consulted on the website.

Spatial data over the catchment area have already been collected by several research institutes. All local research organisations involved in the catchment area have been contacted for information, data location and possible collaboration on a state-of-the-art analysis of research. Data have been evaluated to identify gaps in coverage, quality, specific problems not addressed, and relevance to rational natural resource via earth Observation.

On-going research projects in Transkei are presently addressing the following general problems and have been monitored in the present activity:

- Land degradation and sustainable management of semi-humid/semi-arid vulnerable ecosystems associated to water table fluctuations, springs and wetlands with good geological records to assess natural changes but few historical data to address human impact.
- Integrated water management at basin scale, also addressing transboundary issues: between hydrological domains as well as between Lesotho and South Africa. This mountain to coast catchment is characterised by variation in elevation, rainfall, ecosystem and land use.

A list of relevant on-going research and institutions in charge is given as follow:

- Mapping land degradation evolution in WMA 12. The research is done by the Council for Geoscience and the Department of Geography Rhode University Grahamstown and will be completed by end of 2007. It is an assessment and monitoring of land degradation in WMA 12, using remote sensing and geographic information systems (GIS).
- Erosion and land degradation processes: a comparison between WMA 12 in Eastern Cape and Reunion Island. The research is collaboration between the University of Reunion, the Council for Geoscience and ESA TIGER programme and will be completed by end of 2008. It has for objective the development of methodologies for land degradation mapping using a combination of radar, interferometry and optical remote sensing. Methodologies will be tested both on Reunion Island and in Mzimvubu catchment.
- Land use and economic development of WMA 12. This programme has been carried out by Coastal and Environmental Services Joint Venture for the Department of Water Affairs and Forestry. It was completed in 2006 and proposed the development of a Strategic Environmental Assessment (SEA) for the Zone of Afforestation Potential in WMA 12, Eastern Cape.
- Land erosion and re-habilitation in Macubeni. This GTZ-funded pilot project is run by Rhodes University in Grahamstown and ATS consulting engineering firm in Queenstown. The test area is the small catchment of Macubeni, north of Lady Frere, and includes modelling of ero-

sion, land degradation, dam silting, local population awareness, soil rehabilitation and conservation measures.

- Agricultural strategies, soil conservation and land care. This programme is run by the Technical Services of the Department of Agriculture. It is an on-going action and provides leadership to teams of Engineers, Soil Conservation experts and those who are involved in the Land-care projects funded from grants by the National Department of Agriculture.
- Water development strategy at National, Provincial and Local levels and groundwater research needs in the Eastern Karoo Basin. This collaborative research project was done by the Water Research Commission, Department of Water Affairs and Forestry, Groundwater Africa, Council for Geoscience, and SRK. It was completed end of 2006. It addresses the problem of identification and prioritization of research needs in the Eastern Karoo Basin and development of a strategy to improve groundwater knowledge in poorly understood geohydrological environments.
- Mzimvubu River Development. This is a major project for the development of the catchment area. The work is planned by the Department of Water and Forestry and will be implemented by Eastern Cape Socio Economic Consultative. The project is in its infant stage and will address development around four strategic programmes: agriculture and forestry, water storage and transfer, hydropower and tourism.
- Aquifer conceptualisation of catchment scale, WMA 11 & 12. It is a Water Research Commission project co-sponsored by the Department of Water Affairs and Forestry and executed by SRK, Council for Geoscience, Groundwater Africa, Rhodes University and Fort Hare University. It will be completed in 2008. It looks at flow conceptualization, recharge and storativity determination in Karoo aquifers, with special emphasis on the Eastern Cape (Mzimvubu to Keiskamma WMA) and Kwazulu-Natal Province (Mvoti to Umzimkulu WMA).
- Geological and hydro-morpho-structural analysis for groundwater potential in WMA 12. This project was commissioned by the Department of Water Affairs and Forestry and the first phase was completed in 2005. This on-going research is a geological and hydro-morpho-structural analysis for groundwater potential in rural water-stressed areas in the Mzimvubu to Keiskamma Water Management Area.
- A software tool to assess the sustainability of water schemes. This NORAD – assisted project was completed in 2005 and the programme is still being tested on study cases. It is developed for the sustainable Development of Groundwater Sources under the Community Water and Sanitation Programme in South Africa.

Meetings with stakeholders and feed back from them were major **Milestones** of the project. Not all stakeholders were available for a workshop so a presentation was compiled and each stakeholder was visited individually between May and July 2006. The metadata catalogue, the spatial data base and the on-going research were presented and discussed for improvement. The main stakeholders are:

- Department of Science and Technology
- Department of Water Affairs and Forestry
- Department of Agriculture
- Water Research Commission
- Department of Environment
- Department of Education
- Universities
- Department of Development Planning
- Working for Wetland Group and various NGO's (ecosystems, societal audits, health) and consultants in Environment.

On going assistance was provided by GRS to GSC with the audit of existing research, projects and available data related to the project and the catchment area. This provided input to the meta-data cata-

logue. Communication was maintained with local stakeholders in the project (mainly universities). Available spatial data of the study area was compiled in readiness for WP3 (Interactive demonstration data set).

2.4 List of deliverables

| Del. no. | Deliverable name | Work-package no. | Date due | Actual/Forecast delivery date | Estimated indicative person-months *) | Used indicative person-months *) | Lead contractor |
|----------|---|------------------|------------|--|---------------------------------------|----------------------------------|-----------------|
| D3 | Consortium inception meeting with field trip and report | WP1 | 28/02/06 | 27/04/2006 | | | CGS |
| D5 | Metadata catalogue and spatial data-base | WP1 | 30/06/2006 | Finalized in October 2006, submitted in 2007 | | | CGS |

2.5 List of milestones

| Milestone no. | Milestone name | Workpackage no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---------------|----------------------------|-----------------|------------|-------------------------------|-----------------|
| M1-1 | Workshop with stakeholders | WP1 | 30/06/2006 | June 2006 | CGS |

3. WP 2

3.1 WP2 objectives

To assess relevance of different techniques of monitoring using different remote sensing approaches and types of images

To assess the applicability of newly developed innovative observation tools in the estimation of reserves of natural resources: radar, radar interferometry (INSAR), imaging spectroscopy, very high spatial resolution, etc.

To set up of a working group on land-use remote sensing and its application on assessment and monitoring of land degradation, desertification, erosion, utilisation and protection of natural resources

3.2 progress towards objectives

These objectives has been addressed by i) defining and describing land degradation parameters that could be monitored through EO techniques; ii) inventorying existing EO resources that could fill the monitoring needs; iii) reviewing existing or foreseeable approaches to access these parameters through EO resources; iv) describing some land degradation models that use combination(s) of parameters accessible through EO and other relevant information. The results are presented in **Deliverable D7**.

A review of different types of land degradation (erosion, salinisation, organic matter loss, soil compaction, landslide, soil contamination, loss of biodiversity, soil sealing, mining) and relevant indicators was performed.

In parallel, a review of the main existing EO sensors and their characteristics was carried out, including: sensor type (optical, radar), spectral range and number of bands, spectral resolution, stereo capabilities, revisit capabilities, ground resolution, etc.

An extensive compilation of relevant scientific literature was undertaken to highlight the different EO and image processing techniques that can be used, or have the potential to be used, in monitoring surface parameters relevant of land degradation processes.

These include:

- Parameters accessible through digital image processing:
 - Vegetation monitoring: various parameters on nature and status of vegetation,
 - Soil monitoring: moisture content, roughness, soil composition and mineral abundance, soil contamination, salinisation
 - Soil protection monitoring: crop residues
 - Population density monitoring
- Quantitative morphology parameters accessible through digital processing of DEMs:
 - Slopes: angle, curvature, length, aspect...
 - Drainage: drainage network, density, hierarchy, drained area, flow accumulation...
- Parameters accessible through image interpretation and/or processing:
 - Tillage direction
 - Gully and channel erosion features
 - River and dam sediment load
 - Irrigated areas
 - Sealed soils
 - Parcel map

The study in particular highlights that newly developed techniques, i.e. high spectral resolution (imaging spectroscopy) and very high spatial resolution can bring an invaluable contribution to land degradation assessment and monitoring, giving (quantitative) access to parameters previously out of reach through EO.

Regarding land degradation processes, all these parameters can be grouped in different categories according to their evolution in time:

- Permanent factors include nature, composition and mechanical properties of soils, slopes angle, aspect and curvature and all geomorphologic parameters, nature and density of the drainage pattern, geological and structural context.
- Semi-permanent or progressive factors are represented by factors evolving in time and include vegetation, land use and land cover, deforestation, agricultural practices, hydro-climatic conditions, anthropogenic factors (population distribution density and pressure on its environment...), soil moisture content, etc.
- Triggering or aggravating factors correspond to sudden events, the occurrence of which may destabilize natural equilibrium and trigger or aggravate the degradation process. These include exceptional climatic event, floods, earthquakes and other natural disasters together with man-induced impacts.

According to the parameter to be monitored, the fulfilment of the requested monitoring frequency will rely on the revisit capability of the EO instrument(s) selected for this monitoring and on the climatic conditions (cloud cover) prevailing over the monitored area. When accessible, the study paid attention to the revisit capabilities of most of the sensors described.

Eventually a review of land degradation models based on the use of Earth Observation has been performed.

The report proposes a monitoring strategy based on a multi-date, multi-scale, multi-sensor approach.

A workshop was organized on the 21 – 23 November 2006, near Queenstown in the middle of the study area. Participants were from BRGM, Council for Geoscience, GRS, CSIR, Department of Water Affairs and Forestry, Khanya rural school, Macubeni engineer. The workshop ran over three days with various presentations on the different aspects of Earth Observation techniques applied to land degradation and integrated catchment analysis. A field trip was organized to the Macubeni rehabilitation site where various actions for combating land degradation are being tested. The results of the workshop are reported in **Deliverable D6**. European participants could unfortunately not attend.

3.3 Deviations from the project workprogramme

The main problem encountered during the project was in contacting and attracting European scientists to the project and its workshops. Despite a well targeted mailing list of EU scientists to be contacted, very few positive replies were received and none was able to attend the November 2006 workshop organised in the Eastern Cape. A corrective action was undertaken with the decision to organise a supplementary workshop in Europe, but here again, the result was poor and the workshop had to be eventually cancelled.

Possible explanations for this initially unexpected difficulty could be:

- a) The domain of EO in land degradation has been already largely addressed by the scientific community (see for instance the Conference “Remote Sensing and Geoinformation Processing in the Assessment and Monitoring of Land Degradation and Desertification” organised in Trier (Germany) in 2005). Due to a possible inadequate presentation of the EO-LANDEG initiative, it could have been felt as one more redundant project in this field.

Corrective action: i) to insist on the innovative concept of using EO as an educational tool to combat land degradation and alleviate poverty, with the involvement of local communities in a historically disadvantaged area; ii) to address scientists interested in socio-economic and educational aspects of land degradation. These actions did not get expected results.

- b) Budgetary constraints did not allow EO-LANDEG to invite (travel and accommodation fees) selected European Scientists to the Eastern Cape workshop.

Corrective action: no corrective were made possible in the project frame

3.4 List of deliverables

| Del. no. | Deliverable name | Work-package no. | Date due | Actual/Forecast delivery date | Estimated indicative person-months *) | Used indicative person-months *) | Lead contractor |
|----------|--|------------------|------------|---|---------------------------------------|----------------------------------|-----------------|
| D6 | Technical workshop with working group invited scientists | WP2 | 31/12/2006 | Workshop held on 21 – 23 November 2006 Report submitted (e-mail) on December 6, 2006 | | | BRGM |

| | | | | | | | |
|----|---|-----|------------|------------|--|--|------|
| D7 | Report on monitoring strategy and integrated water management at basin scale based on EO techniques | WP2 | 31/12/2006 | 30/06/2007 | | | BRGM |
|----|---|-----|------------|------------|--|--|------|

3.5 List of milestones

| Milestone no. | Milestone name | Workpackage no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---------------|--|-----------------|------------|-------------------------------|-----------------|
| M2-1 | Technical workshop with working group invited scientists | WP2 | 31/12/2006 | 21-23 November 2006 | BRGM |
| M2-2 | Report on monitoring strategy | WP2 | 31/12/2006 | 30/06/2007 | BRGM |

4. WP 3

4.1 WP3 objectives

Demonstration of the exploitation of the results of the Transkei Pilot Earth Observation Initiative to local stakeholders, the policy makers and the international community by organising a seminar and field trip in the study area

Testing EO-LANDEG as an educational tool at school and university level as well as at local community level

Promotion and positioning of the EO-LANDEG initiative as a partner in a future EU consortium

4.2 progress towards objectives

The team has identified similar or complementary research initiatives in Europe and Africa via a network programme that made use of personal contacts in Europe, mobilising DST national contact points and the NEPAD action planning committee in South Africa and keeping the SA scientific community informed. A presentation of EO-LANDEG has been compiled and visits by the three partners to selected European research institutions will be organised.

As part of the school and community based education, a school was visited in August 2006: Khanya school in Wittlesea, 40 km from Queenstown, where the team demonstrates Earth Observation techniques applied to map reading and natural resources evaluation.

An interactive demonstration set was prepared as an educational tool for University level (Deliverable D8)

Demonstration Set

All the digital data collected was collated and structured into a digital spatial atlas for dissemination to any interested parties (mainly Universities, appropriate schools and those involved in the soil erosion project in Macubeni).

The data was compiled using TNTMips software to create an interactive archive of all the data available for the study area, including the intermediary and final stages of the soil erosion models. TNTAtlas software enables any interested user to run the Atlas (no software purchase is necessary), and provides a range of tools from simple viewing and querying of data (requiring a minimum amount of skill) to complex analysis procedures (only for those with a GIS or remote sensing background). It must be noted that this is a data dissemination tool not a fully fledged image processing system, but is one that has proved to be a huge value in assisting decision makers and has worked very well in education at both university and school level. Hyperlinks are embedded in the Atlas to allow the viewing of field photographs and related documents.

Data incorporated into the Atlas includes the following:

- Elevation Data:
 - DEM (30 m, 50m, & 90m)
 - Slopes, Aspect & Sun shaded DEM
 - Contours & Spot Heights
- Satellite Imagery:
 - Aster 2002: composite & classification
 - Landsat ETM (February 2001); Landsat TM (April 1989) & Landsat MSS (November 1972): colour composites, Normalised Vegetation Index; Principal Components composite (PC1,2,3); classifications
 - SPOT 5 (2006): colour composites
- Rainfall, Geology and Soils
- Drainage data: raster & vector, including the results of watershed analyses
- Toposheets: 1:50 000 raster scans
- Topo-vectors: vector data digitized from the 1: 50 000 Toposheets; including:
 - Roads, railways, air transport
 - River & water features (natural & man made)
 - Settlement features: buildings, built-up areas, Landuse, line structures (power lines etc.) and others
- Boundary information: historic boundaries, municipalities, local study area information (e.g. settlement names)
- Ward level 2001 census data: examples include population density, access to services (water, energy, sanitation), employment, income and transport
- Field data: sample sites and photographs
- Soil Models: All steps and results of the two different soil models run on the data

Practical Demonstration at University

The educational tool developed will be implemented at the University of Fort Hare, Alice. This University not only is the closest university to Macubeni, but, being a historically disadvantaged university, draws many of its' students from the Eastern Cape including villages and towns near the study site. In addition to this, the University runs the only dedicated Honours degree in Applied Remote Sensing and GIS in the country. The modules comprising this course are:

- GIS 501: Introduction to Remote sensing (7 weeks)
- GIS 502: Remote Sensing of the Environment (6 weeks)
- GIS 503: GIS for Decision Support (6 weeks)

- GIS 504: Applied Project Work (9 weeks)

(A more detailed outline of the course and a summary of student numbers since the inception of the course in 2001 are provided in Appendix 1 of Deliverable D8).

The data and knowledge provided by this project has led to a restructuring of the Applied Remote Sensing module to incorporate a greater emphasis on land degradation and soil erosion remote sensing and modelling. The demonstration set and soil modelling procedures have formed the basis for the development of a three week Applied Project as part of the Applied Project Work (GIS 504) and the inclusion of a new course component (Land Degradation Monitoring and Soil Erosion Modelling) into module 502 (Remote Sensing of the Environment). Materials have been developed using the soil modelling techniques used in the study site and the data collected have been developed into a project, whereby students will utilise newly acquired SPOT imagery of the study area to implement the soil models and prepare comparisons between the different imagery and assessment of the model results.

A field trip has been organised from August 14th to August 16th to the study area – Macubeni. Planned activities include the collection of ground data for use in land cover mapping (from the existing satellite imagery), modelling of erosion and verification of soil erosion model results. The participants of the trip will be the Honours students, M Thompson (land cover mapping expert), L Ngcofe (CGS), C Tyson (GRS), B Dube (GRS) and S Vuso (Masters Student).

A **school and community response** to awareness and education events was carried out in the middle of the study area.

School response

Several schools were visited during the course of the project in 2006. One of them, the Khanya School was selected for the demonstration and information campaign with response from the learners. The main objective of this initiative was to introduce the learners and educators to the topography and geology of their proximal environment via demonstration of Earth Observation techniques and ground truthing in the vicinity of the school. The purpose was also to show the pupils that the area has developing tourism potential while pristine ecology can be protected. The Khanya school is in the middle of a stressed area characterised by shortage of water and natural resources. Dongas and erosion gullies and scars have developed in the low land areas.

The demonstration was done over two days and was attended by 1750 learners from 11 different schools in the region. The EO-LANDEG team made several demonstrations of geological and Earth Observation techniques. Because of several logistical problems encountered at the beginning, like electricity cuts, the large number of attendants compared to what it was expected, the need for a sound system, projection facilities etc... the demonstrations were done outdoor and the crowd was eventually split into various working groups. This is the first type of visit and development program that was ever encountered into the region of Whittlesea and the District Director from Department of Education in Whittlesea conveyed his appreciation for the information and program that were presented. He requests that our participation as a research organisation in collaboration with the European Community to continue in such initiative for prosperous relationships and partnerships between the communities, schools and various sectors.

Community response

Another vital component of the response to information and awareness was the involvement of the community in order to gather their perspectives on land degradation and its effects.

In order to understand the overall environmental and socio-economic problems, interviews were conducted to establish perceptions about land degradation history and its current status. Field survey and house hold interviews were conducted in Qoqodala, (in the Great Kei catchment) in order to gain a holistic nature of the problem within the study area. The questionnaire was designed to stimulate con-

variation rather than elicit precise response. The respondents recognised that there have been a decrease in natural vegetation and grassland while euryops increase. Awareness of such factor came from 56.3% of interviewed local community while 34% of interviewees did not recognise shrubs as an encroaching species depleting vegetation and grassland, with 9.4% of the interviewees not aware of changes happening to their environment. The general perception amongst the members of the community is that land degradation led to the loss of fertility and production of the land which means less food for them and their families.

A major activity of this WP during the reporting period was the organization of a Workshop in EU on land and ecosystem degradation and Earth Observation monitoring. As a result of WP2, a monitoring strategy was proposed during this workshop.

The Workshop took place on June 11th, 2007, at the South African Embassy in Brussels. The workshop was organised thanks to the support of Mr. Daan du Toit, Senior Science and Technology Representative for South African Mission to the European Union

The workshop was organised in two sessions

A technical session with presentation on the work carried out during the course of the project, including:

- EO-LANDEG Project introduction;
- Presentation of the pilot site and available data;
- Earth Observation in land degradation assessment and monitoring – Proposal for a monitoring strategy;
- Land degradation demonstration set for integration into university education;
- A specific study of Earth Observation analysis in the Qoqodala area;
- EO-LANDEG follow up – Views for a future South Africa EU partnership;
- South Africa and Council for Geosciences involvement in the development of South African Earth Observation satellite

A general informal session to discuss further activities, including FP7 ones took place in the afternoon.

The workshop proceedings (Deliverable D11) and proposal for a FP7 partnership (Deliverable D12) were issued at the end of the workshop.

3.4 Deviations from the project workprogramme

The main problem encountered during the project was in contacting and attracting European scientists to the project and its workshop.

The field trip and practical demonstration at the University has to fit in with the time schedule of the Honours Year programme, and at the relevant point in the programme. The University year runs according to two semesters: February to June (Semester 1) and end of July to November (2nd Semester). During the first semester the GIS module (503) and the Introduction to Remote Sensing module (501) are run. Both of these modules are pre-requisites for the last two modules and must be completed before embarking on the Remote Sensing of the Environment and Applied Project Work. As such, the incorporation of the results of this project and dissemination of information to the University can only be included in the second semester. All materials (demonstration set, project materials and data) have been prepared and the field trip logistics have been organised and invoiced. All that remains to be done is the actual course and field trip. The field trip will take place from 14th August to 16th August. The course will occur throughout that week (13th to 17th August), and the student's projects will continue until the beginning of September. A report back on the field trip will be provided by the end of August.

4.4 List of deliverables

| Del. no. | Deliverable name | Work-package no. | Date due | Actual/Forecast delivery date | Estimated indicative person-months *) | Used indicative person-months *) | Lead contractor |
|-----------------|--|-------------------------|-----------------|--------------------------------------|--|---|------------------------|
| D8 | Dissemination at University level | WP3 | 28/02/2007 | 26/03/2007 | | | GRS |
| D9 | Report on school and community response | WP3 | 30/04/2007 | August 2007 | | | CGS |
| D10 | Workshop in EU on land and ecosystem degradation and EO monitoring | WP3 | 30/04/2007 | 11/06/2007 | | | BRGM |
| D11 | Workshop proceedings | WP3 | 30/06/2007 | August 2007 | | | BRGM |
| D12 | Network proposal | WP3 | 30/06/2007 | August 2007 | | | BRGM |

4.5 List of milestones

| Milestone no. | Milestone name | Workpackage no. | Date due | Actual/Forecast delivery date | Lead contractor |
|----------------------|--|------------------------|-----------------|--------------------------------------|------------------------|
| M3-1 | Practical demonstration at the University completed and report on the success at the workshop | WP3 | 28/02/2007 | End august 2007 | GRS |
| M3-2 | Presentation at school and community level completed and report of success at workshop | WP3 | 30/04/2007 | 08/06/2007 | GRS-CGS |
| M3-3 | Workshop with identified EU teams involved in EO and land and ecosystem degradation convened in Europe to decide about future research | WP3 | 31/05/2007 | 11/06/2007 | BRGM |

Section 3 – Consortium management

Consortium management tasks included:

- Project co-ordination (technical and financial) and management activities : project management, liaising with EU, achievement of working group activities
- Achievement of Consortium and Data Use Agreement
- Control of editing activities

The work consisted in day-to-day management activities. 3 project meetings were held (March 2006, Eastern Cape, June 2006, Brussels, November 2006, Eastern Cape) to discuss project issues and progress. One final project meeting was held (June 2007 in Brussels), to discuss further project issues and prepare reports.

The Consortium Agreement was issued at the early stage of the project and signed by the three participants. A Project Handbook (Quality Assurance Plan, following the ISO 9002 standard requirements) was issued and distributed to the participants.

The participant contribution ran as expected and no deviation from planned activities was noticed.

Section 4 – Other issues

Not applicable