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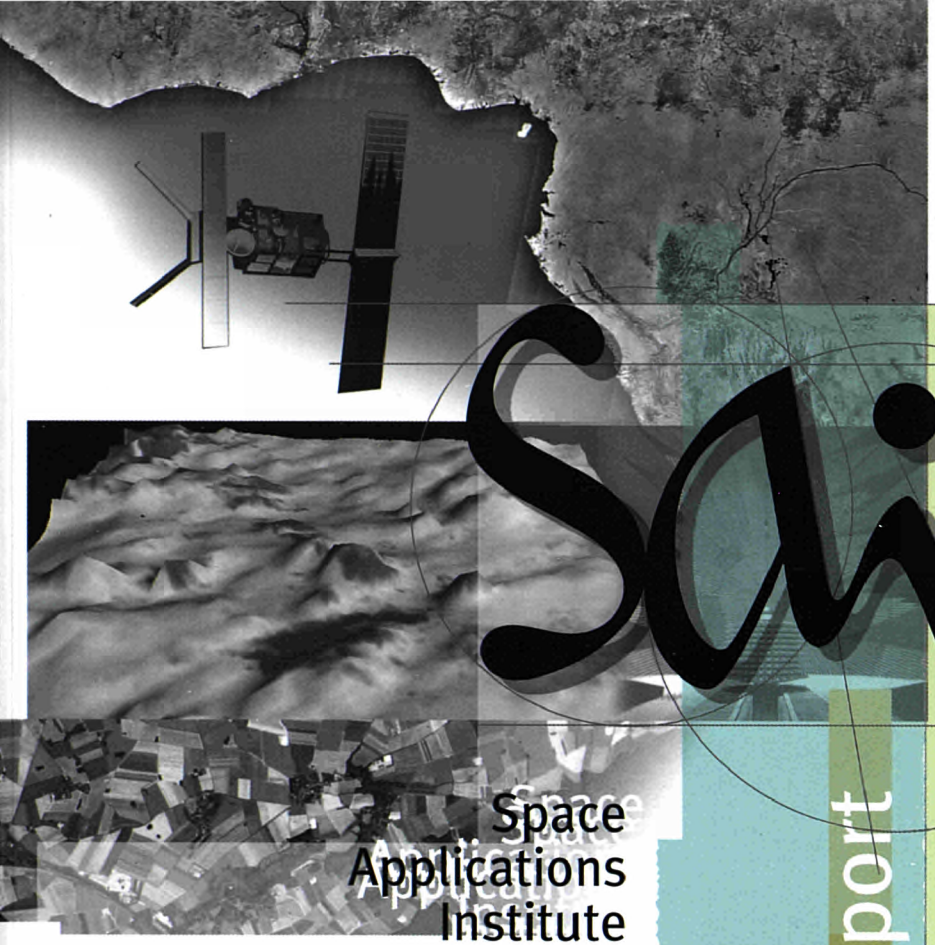

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Space Applications Institute

Spatial Information Services

Annual Report 98

JOINT RESEARCH CENTRE
EUROPEAN COMMISSION
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ANNUAL REPORT 1998

SPACE APPLICATIONS INSTITUTE

Spatial Information Services

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Space Applications Institute

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FOREWORD

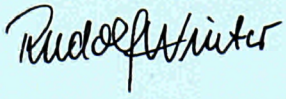
Prof. Rudolf Winter
Director

1998 was a turbulent year for the Space Applications Institute, as it was for the whole Joint Research Centre. 1998 marked the end of the Fourth Framework Programme. In early 1998, with the new Director General taking up duties, the Joint Research Centre re-defined a new mission, and so did the Space Applications Institute. The new mission of the JRC highlights the need to provide demand-driven scientific and technical support for the conception, implementation and monitoring of EU Policies. The Joint Research Centre saw a re-organisation of its Institutes. The Space Applications Institute has pro-actively participated in this process. The six thematic Units have been re-organised and some renamed. New activities were prepared. Other activities have been brought to an end according to original plans, and activities which continue from the Fourth to the Fifth Framework Programme have been streamlined and adapted to meet the challenges of the new JRC and SAI mission statements. In general, a concentration of smaller activities has taken place and larger projects have been formed. These meet clearly defined spatial information needs derived from EU Policies.

SAI has prepared and received acceptance for 11 institutional projects, covering a wide range of activities, including agricultural monitoring, global environmental monitoring, integrated coastal zone management, monitoring of the European landscape, the synergy of Earth Observation with satellite navigation and satellite communication, the development of technologies to detect and position anti-personnel landmines, the Centre for Earth Observation, the harmonisation and standardisation of geographic information, the monitoring of air quality, and the assessment of risks and damage caused by natural hazards.

SAI has long recognised that information derived from space-based systems is most valuable when combined with other sources of data and information. Furthermore, the Institute recognises that the true value of any information is for it to get into the hands of decision makers who need synthesised information based on a strong scientific and technical foundation. To this end, the Institute is increasingly developing expertise in spatial information management. This increased engagement in this domain led to the addition of the sub-title Spatial Information Services to the Institute's name.

This annual report presents the thematic activities carried out during 1998 in the Space Applications Institute and the results achieved. I believe that the work presented here shows a considerable value to be gained from exploiting space for the benefit of Europe's policy makers. I would also like to thank the 230 staff, students, visitors and in particular all SAI partners in the EU member states and world-wide who helped making these achievements possible, and who contributed giving the Institute an excellent reputation within Europe and beyond.



CONTENTS

INTRODUCTION

THE SPACE APPLICATIONS INSTITUTE

Situated in Ispra, Italy, the Space Applications Institute is part of the Directorate General Joint Research Centre of the European Commission. It consists of a multidisciplinary team of approximately 200 researchers, principally from the 15 Member States of the European Union. The Institute is divided into six units:

- Technologies for Detection and Positioning; Anti-personnel Mines — TDP
- Environment and Geo-Information — EGEO
- Agriculture and Regional Information Systems — ARIS
- Global Vegetation Monitoring — GVM
- Marine Environment — ME
- Strategy and Systems for Space Applications — SSSA

MISSION

The primary mission of SAI is to develop and promote the use of space derived data and geo-spatial data from other sources in the service of EU policies, especially those relating to agriculture, fisheries, transport and anti-fraud. SAI also seeks to make the best use of information from space systems, to maximise the return from European investments in space and to help the Union reinforce its role in international action on the environment and sustainable development.

The Technologies for Detection and Positioning; Anti-personnel Mines Unit

http://www.tdp.sai.jrc.it

The mission of the TDP Unit is to support the European Commission in its action against anti-personnel mines. The unit is involved in the design and implementation of advanced tools and processes to speed up civilian demining while supporting demining related issues such as personnel safety and cost reduction. The unit is also concerned with the assessment and implementation of adapted tools to support EU environmental and security policies. Further activities will include the development of advanced tools to be used in monitoring environmental degradation of coastal areas due to ship traffic and in monitoring natural and man-made hazards.

The Environment and Geo-Information Unit

http://www.egeo.sai.jrc.it/

The mission of the EGEO Unit is to carry out research and development work on the use of Remote Sensing for environmental purposes focusing on the natural environment of Europe and the changes in the urban environment. Special emphasis is placed on monitoring forests, watersheds and desertification processes. Research is performed in the development of advanced methods in image and data processing such as automatic classification, advanced visualisation, and the harmonisation and interoperability between GIS and Remote Sensing data catalogues and systems.

The Agriculture and Regional Information Systems Unit

http://www.aris.sai.jrc.it

The mission of the ARIS Unit is to provide demand-driven scientific and technical support for the conception, implementation and monitoring of the policies of the European Union related to agriculture, agri-environment, spatial information, and natural hazards. It carries out activities related to the Common Agricultural Policy in the areas of agricultural statistics and systems of management, verification and control, known as the MARS project. However, new activities are being defined in response to the challenge of a European sustainable agriculture which has to be environmentally sound, and the driving force of a rural policy.

The Global Vegetation Monitoring Unit

http://www.gvm.sai.jrc.it/

The mission of the GVM Unit is to track change in the distribution and condition of the world's vegetation. Key actions specifically address the information needed for the implementation of EU environmental treaties and conventions. These include the development of methods to reduce uncertainties in inventory, mapping and monitoring of global land cover types; the development and testing of methods to identify significant events heralding land cover change and to determine their impact; the development, evaluation and implementation of tools and techniques for the analysis of both optical and microwave satellite data; and the contribution to the specification of a dedicated observation system that will meet the requirements for a global environmental information system.

The Marine Environment Unit

http://www.me.sai.jrc.it

The mission of the ME Unit is to develop, demonstrate and validate methodologies for the use of data from space and airborne platforms in applications related to the marine environment. Activities include research in fields, such as the mixing processes involved at the near surface layer of marine and limnic waters, indirect absolute calibration and validation of space sensors, and marine phytoplankton biomass and productivity. The unit aims to develop an end-to-end operative system that will provide high quality spatial products and integrated tools to support policies on sustainable exploitation of marine resources, prevention and control of water quality, and decision support in the management of coastal areas.

The Strategy and Systems for Space Applications Unit

http://www.ceo.org

The mission of the SSSA Unit is to develop and test integrated strategies where space-derived information can be used to help develop, implement and monitor EU policies. The activities of the unit are focused on the application of data and information from satellites and they include the development and operation of on-line information systems for space and spatial data, information and services; the development of integrated spatial information services combining Earth Observation, communication and navigation data; the development of Earth observation applications in support to EU policies and EC services, with particular reference to the Regional, Transport, Environment and Common Foreign and Security policies; and the development of strategies leading to a sustainable Earth Observation industry in Europe.

http://www.sai.jrc.it

ORGANISATION

Directorate

Director
Rudolf Winter

Deputy Director
Jean Meyer-Roux

Scientific Assistant
Josef Aschbacher

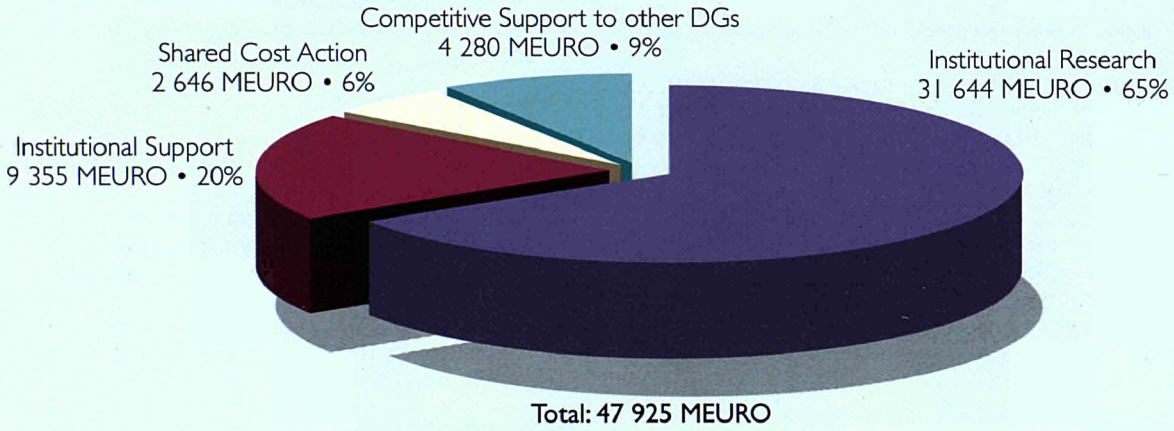
Administration
Raymond Crandon

Unit	Head of Unit	Sector	Head of Sector
TDP • Technologies for Detection and Positioning; Anti-personnel Mines	*Alois J. Sieber*	• Civilian Demining • Environmental Security • Experimental Facilities	*John Dean* *Dario Tarchi* *Giuseppe Nesti*
EGEO • Environment and Geo-Information	*Jacques Mégier*	• Advanced Methods (AMS) • Forest and Catchment Studies (FORECAST) • Mediterranean Ecosystem Monitoring (MECOM)	*Ioannis Kanellopoulos* *Sten Folving* *Stefan Sommer*
ARIS • Agriculture and Regional Information Systems	*Jean Meyer-Roux*	• Geographic Information and Spatial Applications (GISA) • Monitoring Agriculture with Remote Sensing (MARS) • Natural Hazards • Informatics Support	*Alessandro Annoni* *Olivier Léo* *Guido Schmuck* *Michel Amsellem*
GVM • Global Vegetation Monitoring	*Alan S. Belward*	• Applied Microwave Remote Sensing • Forest Ecosystems • Grassland and Savannah Ecosystems • Science and Technology for Applied Optical Remote Sensing • Information Systems	*Gianfranco De Grandi* *Frédéric Achard* *Jean-Marie Grégoire* *Michel Verstraete* *Tim Richards*
ME • Marine Environment	*Peter Schlittenhardt*	• Remote Sensing - Data Assimilation • Remote Sensing - Data Elaboration	*Walter Eifler* *Nicolas Hoepffner*
SSSA • Strategy and Systems for Space Applications	*Peter N. Churchill*	• INFEO Development and Operation • Information Extraction and Optimisation • New Systems Development • Satellite Communications and Navigation Systems and Services • Strategy Development for Space	*Jacques Stakenborg* *Carlo Lavalle* *Michel Millot* *Michalis Ketselidis* *Neil Hubbard*

RESOURCES

FINANCES

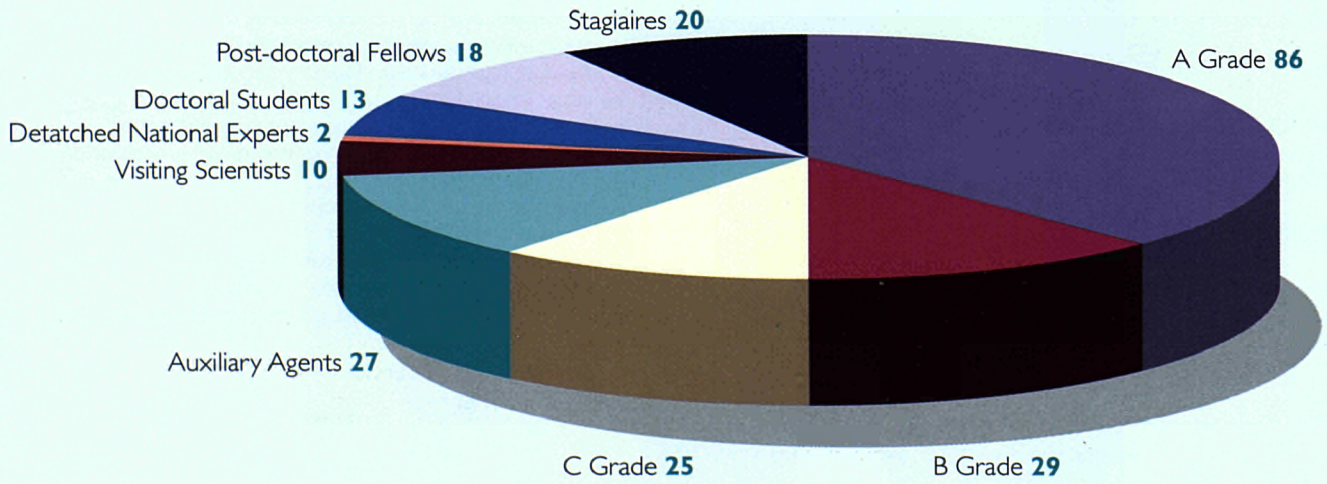
SAI finances its work through the institutional, or direct action, budget and by means of competitive activities. The direct action budget of SAI is, as for the whole of the JRC, negotiated for the duration of a Framework Programme, or four years. A work programme for the JRC is proposed by the Commission and put forward for a joint decision by the Council of Ministers and the European Parliament. A complementary part of the budget derives from competitive activities whereby SAI staff, together with external partners, submit proposals which go through a standard selection procedure. In particular, in 1998 the SAI activities were funded through the direct actions of the Fourth Framework Programme and through competitive activities, by 85% and 15% respectively. The latter included both the participation in shared cost action projects and scientific and technical support to the Commission.



Total: 47 925 MEURO

STAFF

As of December 1998, a total of 230 employees worked for the Space Applications Institute. More than 200 of them are scientific staff while 27 work either in the administrative support group or in secretarial support of the scientific units. There has been a slight increase by 10% with respect to last year's overall figures. However, SAI has more or less reached its target staff figure that is needed to carry out the work demanded within the institutional activities. In general, any additional recruitment will therefore be of temporary nature, and will be financed through competitive income such as Shared Cost Actions or Competitive Support to the Commission.



HIGHLIGHTS

1998

January

- Launch of the EC EarthWatch working group

February

- Monitoring Desertification in the Mediterranean Basin started

March

- GVM group in Brazil doing field experiments on forest fire monitoring
- First images from VEGETATION sensor on board SPOT
- Kick off meeting of the 98 Controls with Remote Sensing: 13 Member-States, 100 control sites and 250 000 farms over Europe

April

- Eurocourse for the National Administration Controls with Remote Sensing, Toulouse
- Working party meeting: FAO/ECE Temperature and Boreal Forest Resource Assessment 2000
- BASYS-62 on pelagic fluxes in the Baltic Sea

May

- Third SAI Users' Seminar, Baveno
- The Baveno initiative launched
- Work started with Eurostat on MURBANDY for DG XVI and EEA

June

- Publication of the European Soil Map v. 3.28
- Fourth EC GIS workshop, Budapest
- Workshop at Expo98 on Earth Observation for Oceans & Coasts, Lisbon
- Delivery of OLISTAT results: accurate estimates of the total number of Olive trees in Portugal, Spain, France and Italy are provided to DG VI
- Multi-country Forestry Programme (PHARE) workshop

July

- PIERS 1998 workshop, Baveno
- End of inflight acceptance of the VEGETATION instrument
- World Fire Web network launched; first node in Vietnam

August

- Publication of the CD-ROM "Information from Space"
- Launch of the European Soil Database at the 16th World Congress of Soil Science in Montpelier

September

- Inauguration of the SAI Building, Gemello I
- FUEGO II started
- GIS Planet 98 European Day: The Role of the European Commission on the GI market
- Validation of the global land-cover map is finalised
- ARIS unit put in charge of Controls with Remote Sensing
- A strategic view of GIS research and development for Europe 2nd edition, published
- Launch of the OLIAREA and OLIYIELD projects
- Launch of the MINI-SITES project: use of scattered samples to produce operational rapid area estimates
- Fisheries Information and Analysis System (FIAS) meeting
- CAMELEO workshop on strategies of ecosystem characterisation, Morocco

October

- Demining Technologies International Exhibition, Workshops & Training Seminars, Ispra
- Deforestation's hotspots report published
- Regulation 2366/98 of the Commission makes compulsory the use of GIS and orthophotos for the management and the controls of olive tree subsidies
- Conclusion of Orthocontrol definition study with DGVI, to establish quality control procedures for orthocorrection of satellite and airborne imagery

November

- International network on Test & Evaluation Facilities for Demining Technologies, Ispra
- Fifth Technical conference on Controls with Remote Sensing, Venice
- 12th CEOS Plenary, Bangalore
- Global Rain Forest Monitoring project conference
- DESIMA workshop on Decision Support for Integrated Coastal Zone Management
- Press releases on SAI activities: Financial Times, RTE, RAI, New Scientist, BBC World, BBC Radio

December

- Fifth Framework Programme approved by Council of Ministers
- New Surface Albedo algorithm completed for EUMETSAT
- European Earth Observation Industry and Market Snapshot 1998 study completed
- INFEO system passed its system acceptance and testing
- Documentary about the CEO Programme was broadcast on EURONEWS
- Final results of the LACOAST project
- Final results of the ATLAS project
- First flood meeting on the Oder catchment with participants from the Czech Republic, Germany and Poland
- The CEO Programme completed its Design and Implementation phase

1999

January

- ASTRON Information Day
- SPACE VEGETATION software development started
- Workshop and meeting with the European Topic Centre on Marine and Coastal Environment

February

- SAI & Swedish National Space Board workshop
- Fifth Framework Programme Launch conference, Essen
- Workshop on Virtual Interoperability Laboratory, Ispra
- VEGETATION fully operational; data available
- IGBP - DIS landcover working group meeting
- First issue of the new monthly MARS bulletin with crop yield forecasts only

March

- SAI and EUMETSAT bi-lateral meeting, Darmstadt
- IPTS & SAI workshop on Mediterranean countries
- JRC Launch Conference, Ispra
- TerraSAR Workshop
- Eurocourse: Use of SAR data within the controls with Remote Sensing, Ispra
- Industrial meeting on Machine Vision in Remote Sensing Image Comprehension, Ispra
- 1999 Kick off meeting of Controls with Remote Sensing
- Delivery of OLIAREA results: objective and accurate estimates of the total areas under olive trees in Portugal, Spain, France, Italy and Greece are provided to the DG VI

April

- MARS Project - 10 years of demand-driven technical support conference, Brussels
- Workshop on GPS and parcel area measurements in the frame of IACS, Ispra
- CAMELEO workshop on Satellite Image Processing for Long-term Change Detection, Florence
- Has EO found its customers? workshop, Ispra

May

- Fourth SAI Users' Seminar
- Baveno Space Forum meeting
- Development of applications from the European Soil Database

June

- International Ocean Colour Co-ordinating Group workshop
- Second flood meeting on the Oder catchment with participants from the Czech Republic, Germany and Poland
- IUFRO conference on Remote Sensing and Forest Monitoring, Rogow
- Fifth EC-GIS workshop organised jointly by SAI and DGXIII, Luxembourg

July

- IGARSS 1999; co-organised with SAI, Hamburg

August

- Climate Change Summer School, Dundee

September

- The 1999 EUMETSAT Meteorological Satellite Data Users Group, Copenhagen
- Joint FAO & EC meeting on the development of the European Soil Information System
- Workshop on European Watershed Management, Ispra
- International workshop on Applications of Remote Sensing to the Management of River Catchment Areas and their Coastal Margins in the Mediterranean and Black Sea, Ispra
- Second International BRDF Workshop, Ispra
- MEDCOAST workshop
- The Seventh Design and Implementation phase Steering Committee (DISC), Brussels

October

- SPACE - VEGETATION software available
- Workshop on Criteria and Indicators for Sustainable Forest Management and Bio-diversity, University of Reading, UK

November

- 13th CEOS plenary, Stockholm
- Sixth conference on Controls with Remote Sensing
- Course on Remote Sensing of the oceans, Thailand, co-organised with SAI
- European Soil Forum

December

- Extension of European Soil Database to include countries of the Mediterranean and the former Soviet Union
- Presentation of final results of the MODEM project

Room-related wall piece created by Christina Ohlmer for the entrance hall of the Space Applications Institute.

http://www.ruf.uni-freiburg.de/bildkunst/artists/ohlmer

FIELDS OF ACTIVITY

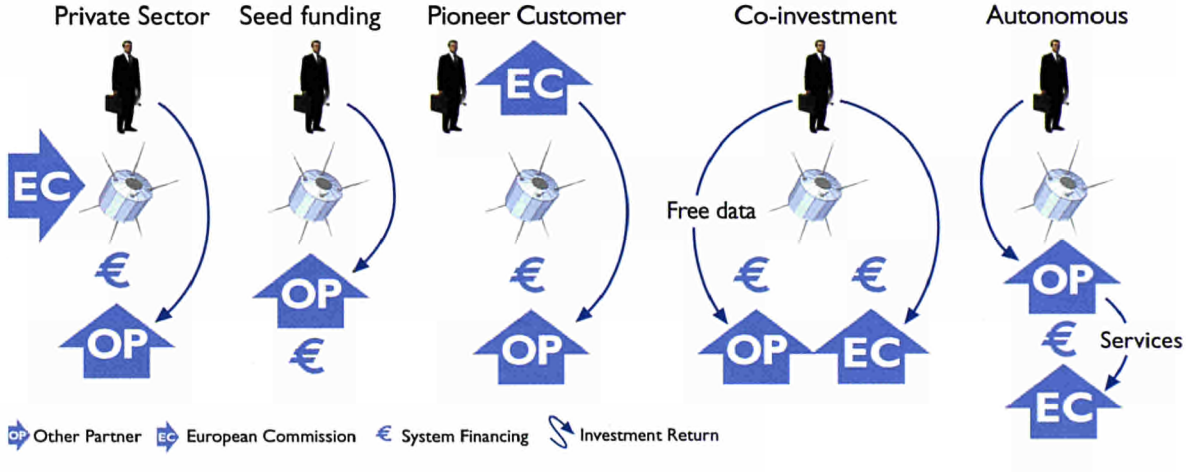
Given that the EU is amongst the largest purchasers of data services in Europe, it is uniquely placed to play a fundamental role in developing this market, both as a pioneer customer and by supporting the development of data derived information services. This was indeed advocated by industry, which specifically recommended a "two-step approach" as a phased means of establishing self sustaining markets. This constitutes a way to ensure the continuity of service, given a regular and adequate provision of new systems, which is the responsibility of industry and other organisations. In the longer term, once the market is consolidated, it will be industry's role to deliver data services to customers on a commercial basis. However, industry will only be able to do this if it has clear indications as to the market stability and size. Here the Commission could provide a significant contribution by accurately expressing Europe's requirements for EO and corresponding services with a related estimate of the annual value of those services; this expression being divorced from any perception of the ability, or otherwise, of EO technology to supply those services. On the basis of this assessment, the challenge to industry will be to improve the quality, timeliness and cost of those services whilst developing a profitable business. Industry needs also appropriate financial engineering instruments enabling it to take the risks associated with the development of any new advanced technologies.

Direct quote from: The European Union and Space - Fostering Applications, Markets and Industrial Competitiveness; Communication for the Commission to the Council and the European Parliament, 4th December 1996 (COM(96)617final).

	Demand	Supply
Case 1 Regional Development	• EU supports poorer regions being left behind in the development of the single market • Plan to use geospatial information to perform analyses of the components of the European territory, to assess new urban or rural perspectives, and produce cartographic illustrations which reflect actual policy proposals • The Common Transport Policy requires geospatial and environmental impact information to plan and implement trans-European networks	• Information required during project planning, implementation monitoring and policy assessment • Information required on land cover, land cover change, and land cover quality for artificial surfaces and natural surfaces • High spatial resolution imagery required (1-30m)
Case 2 Land Resources Management	• CAP: Pressure on the EC to focus on environmental protection and rural development • DGVI is the most active user of satellite-derived EO information within the Commission with activities such as crop yield predictions and monitoring of eligibility of claims for fraud control	• New requirements: crop type data, agro-environmental monitoring • Increased demands may arise for improved sensors: data acquisition reliability, data delivery, spectral and spatial resolution
Case 3 Environmental Conventions	• Increasing concern on global change issues and major UN Conventions • The Commission is developing a longer term climate/energy strategy for carbon sources and sinks, greenhouse gases, ozone depletion • The Commission has framed a Community Biodiversity Strategy • In the future, a key factor may be the provision of an independent European source of Earth Observation information	• Need for global monitoring at a resolution of 500m to 1km, with the ability to distinguish between major classes of vegetation, classify forests and measure forest condition. Regional monitoring with a resolution of 10m to 30m to identify crops and measure areas is also required • It is necessary to improve ground infrastructure in order to support the storage, handling and dissemination of large volumes of data
Case 4 Environmental Indicators	• Eurostat and the European Environment Agency are currently undertaking major initiatives to develop appropriate indicators, which will be used as a tool for policy formulation and policy implementation • DGXI is currently establishing procedures under which Member States can meet their obligations in setting up and protecting Special Areas of Conservation within the NATURA 2000 network of protected areas	• To identify environmental indicators from EO data, there are measurements mainly on an annual basis • Resolution requirements call for a scale of 1:25,000 once a year covering regions or specific sites located throughout Europe whereas a scale of 1:5,000 is necessary on specific occasions to monitor sites of particular interest
Case 5 Security and Risks & Hazards	• Within the Common Foreign and Security Policy, there is a need to monitor the Union's political borders, to collect intelligence outside the Union, to monitor nuclear installations, and organise civil protection • The service should be under European control, be independent, but capable of interoperability with national and non-European data sources, and provide continuous high-resolution monitoring of key events	• Need for data in near real time. Strategic needs require information for planning and potentially for long-term monitoring of a situation. Tactical information is required for control and management associated with the immediate response to a hazard • Reliability of data acquisition and delivery is of paramount importance if services rely on such data for control and management purposes

Main findings of the analysis of supply and demand.

Participation scenarios



A study was conducted to identify whether the information needs of European Union policies justify a potential involvement of the European Commission in future Earth Observation missions. It focused on aspects of EC policies, programmes and activities which have a strong geospatial or environmental component. The study was three-fold: analysis of demand, analysis of supply, and investigation of potential roles & funding scenarios.

Analysis of Supply and Demand

The starting point was to understand the current relevance and future development of EU policies in respect to geospatial and environmental information needs up to a time horizon of 2005-2010. This was achieved by a series of consultations with selected DG Units and the evaluation of related policy documentation. All information was grouped in five cases showing where potential demand could most effectively be satisfied using satellite-derived EO services. Some general issues occurred on all cases, namely the expansion to the East, an increasing environmental concern, the need for harmonised pan-European information and for operational, continuous long-term monitoring. The second part of the study looked at existing and planned missions and defined preliminary mission requirements for these five cases. First there was an analysis of the contribution which spaceborne Earth Observation could make to satisfy the aforementioned information needs. The results were elaborated into parameters, which are recognisable from an Earth Observation perspective. Each of the five cases is addressed in order to consider the potential of Earth Observation contribution and to evaluate its importance.

Potential Roles and Funding Scenarios

Finally the study identified potential roles of the EC in matching demand and supply and considered possible future funding and partnership scenarios. Despite its leadership in Earth Observation with the launch of ERS, SPOT and Meteosat and value-added services, Europe seems to have been lagging behind in addressing applications of high spatial resolution data as opposed to its overseas competitors. An effort concertation of space agencies, the industry and potential customers, in particular the European Commission, is required in order to co-ordinate activities on a European level, to offer competitive, operational supply of space data and thus place Europe in a prime position in this strategic market. Five scenarios have been developed regarding the potential involvement of the Commission in future Earth Observation missions, namely Private Sector Financing, Seed Funding, Pioneer Customer Model, Co-investment Model, Autonomous Model. A two-phase implementation approach with a gradual decrease of EC involvement is considered most appropriate. During the first phase the Commission is involved based on a Pioneer Customer Model and, after the market matures, industry takes a funding role in the Private Sector Financing mode.

Contact
Josef Aschbacher
Neil Hubbard

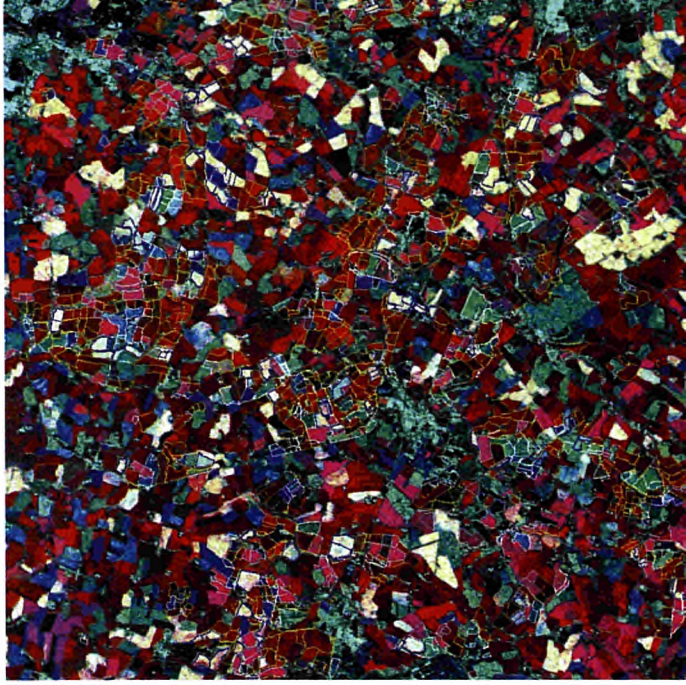
Selected Further Reading

Aschbacher, J., Churchill, P.N., Malingreau, J.P., Morris, R., EU Geospatial and Environmental Information Needs. Document 1 Policy Assessment; JRC Publication No. EUR18107 EN (1998).

Aschbacher, J., Churchill, P.N., Sawyer, G., Scott, Z., Morris, R., Martin-Dupont, F., EU Geospatial and Environmental Information Needs. Document 2: EO Contribution; JRC Publication No. EUR 18108 EN (1998).

Aschbacher, J., Churchill, P.N., Schreier, G., Inglis, K., Morris, R., Vass, P., EU Geospatial and Environmental Information Needs. Document 3: Potential Involvement of the EC in Future EO Missions; JRC Publication No. EUR 18109 EN (1998).

Aschbacher, J., Churchill, P.N., Vass, P., EU Geospatial and Environmental Information Needs. Document 4: Study Overview; JRC Publication No. EUR 18110 EN (1998).



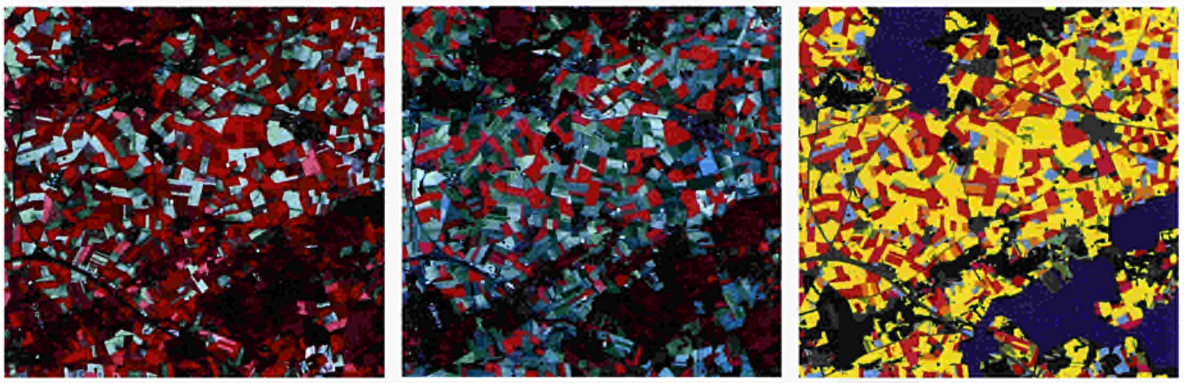
In addition to Monitoring Agriculture with Remote Sensing, MARS has further developed to Managing Agriculture with Remote Sensing to reinforce the synergy between MARS STAT, statistical applications, and MARS PAC, applications for the management and control of the Common Agricultural Policy, and to encompass new projects, such as Olistat, counting olive trees, and Oliarea, estimates of the area under cultivation. The key to the success of MARS lies on a sound balance between direct support, operational activities requiring independent and European advice such as quality checks and applied research. For instance, the controls with Remote Sensing were co-funded by 50 per cent by the Commission for the last time in 1998. Most of the EU Member States will continue this operation in 1999 while DG VI has requested that the JRC manage the technical co-ordination and support to the Member States. Thus, the sustainable development of controls includes continual innovation, such as the use of SAR data and very high resolution spaceborne imagery, better adaptation to local contexts, and good evaluation of the groups of methods and practices developed in the Member States themselves. MARS can be used to promote improvement and information exchange among Member States, and to ensure regulation consistency.

Contact
Olivier Léo

Rapid Area Estimates and Yield Prediction

This activity supplied DG VI with early estimates of crop area changes from the previous year using spaceborne data over a sample of 60 sites of 40km by 40 km. A total of 168 scenes were acquired including 31 Landsat TM, 9 IRS LISS, 128 SPOT XS. The area change estimates are based on the interannual variation measured starting from multi-temporal image analysis. A number of improvements were adopted including a better repartition of the imagery and the adaptation of the system to process IRS LISS data. This activity reached the end of the period covered by the Council Decision n° 94/753/CE and is now considered to be in a stand-by period whilst different frame sampling approaches and the use of Remote Sensing will be tested. A further ground survey was associated to each site providing ground truth data for the validation of the 1998 results and for the creation of a reference list. Abnormal cropping conditions were also detected

The crop yield analysis includes results from agro-meteorological indicators and from NDVI and surface temperature derived from low resolution data covering the European Union and 23 neighbouring countries and allowing the study of eight major kinds of crops (wheat, barley, maize, rape seed, sunflower, sugarbeet, potato, field peas). A new element introduced in 1998 was a similarity analysis of the indicators at regional level to better deal with the residual uncertainty of crop yield formation at a given moment of the year. NDVI results were also improved by integrating CORINE land cover data. All these were included in the MARS bulletin which reached its sixth year of publication (http://www.ais.sai.jrc.it/marsstat/bulletin). In 1998, it was published 6 times during the key period of crop growth with intermediate updates on customer demand.

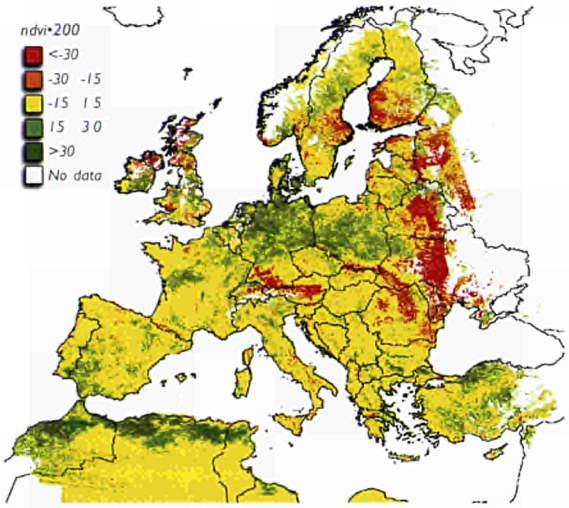


SPOT XS, RGB 321 from Melun, France (from left to right): 6-Aug-98, 10-May-98, and classified image issued from the two showing crop area change.

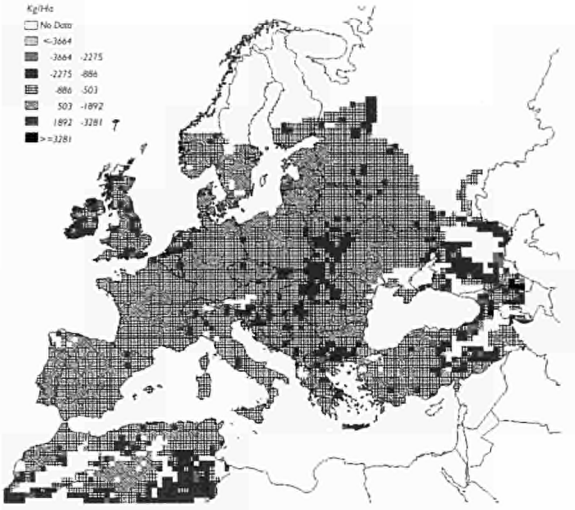
Contact
Giampiero Genovese

MARS area, yield and production estimates at EU 15 level, end of October 1998; results for 1998 taken from MARS bulletin n°6; results for 1997 available from EUROSTAT; yield figures are rounded to 100 kg.

Crops	Area (x Mio ha)			Yield (t/ha)			Production (x Mio t)		
	1997	1998	%98/97	1997	1998	%98/97	1997	1998	%98/97
Cereals (total)	38.075	37.736	-0.9	5.4	5.5	2.3	205.37	208.52	1.53
Soft wheat	14.02	14.15	1.0	6.2	6.6	5.1	87.47	92.81	6.1
Durum wheat	3.22	3.20	-0.7	2.3	2.7	20.4	7.28	8.71	19.5
Barley	11.91	11.69	-1.9	4.4	4.5	0.8	52.59	52.02	-1.1
Grain maize	4.36	4.26	-2.2	9.0	8.5	-5.3	39.03	36.15	-7.4
Other cereals	4.56	4.43	-2.8	4.2	4.2	2.0	19.00	18.83	-0.9
Dried pulses (total)	1.96	2.08	6.2	3.0	3.1	2.8	5.96	6.51	9.2
Field peas	1.198	1.204	0.5	3.8	3.9	2.9	4.54	4.70	3.4
Other dried pulses	0.762	0.905	18.8	1.9	2.0	7.4	1.42	1.81	27.6
Oil seeds (total)	5.81	6.26	7.8	2.6	2.4	-4.2	14.9	15.34	3.2
Rape seed & bird rape seed	2.78	3.14	12.8	3.1	3.0	-5.1	8.69	9.31	7.0
Sunflower	2.33	2.32	-0.7	1.8	1.6	-10.5	4.24	3.77	-11.1
Other oil seeds	0.692	0.808	16.8	2.8	2.8	0.7	1.92	2.26	17.6
Rice	0.425	0.425	-0.2	6.4	6.6	1.7	2.74	2.78	1.5
Potato	1.41	1.41	0.6	34.0	33.2	-2.4	47.85	46.95	-1.9
Sugar beet	2.12	2.17	2.0	57.0	54.7	-4.0	120.98	118.42	-2.1
Green maize	3.98	3.64	-8.5						
Temporary grasses & perennial green fodder	14.77	14.79	0.2						
Fallow land & set aside	8.26	8.26	0.0						



NDVI map produced from NOAA AVHRR data. Maximum Value Composite absolute differences 1997-1998.

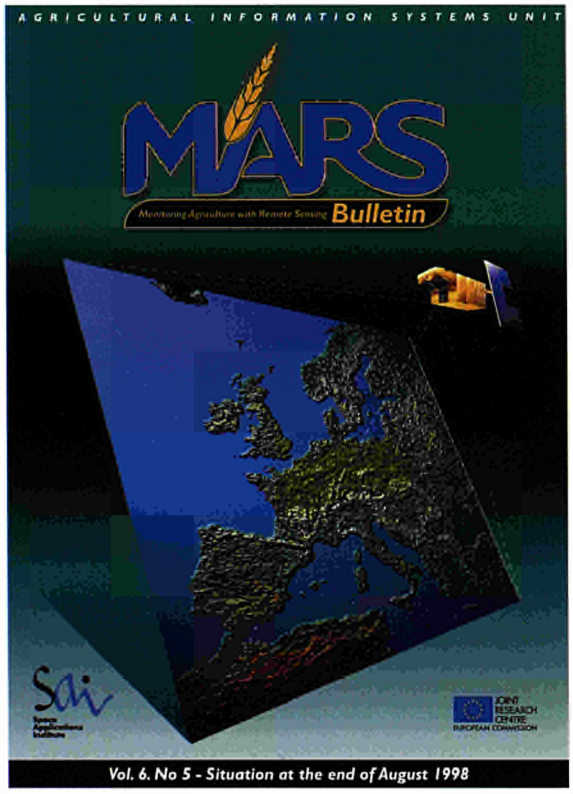


A simulation on wheat storage as published in the MARS bulletin.

Control with Remote Sensing of area-based subsidies

In 1998, all Member States except Sweden and Luxembourg participated in this programme. Approximately 248,000 applications were controlled using Remote Sensing. For the 100 control sites to be checked, the Commission purchased more than 700 satellite images from four image providers. These images were then delivered to some 20 main contractors in the Member States for analysis and interpretation. Last year, after five years of Control with Remote Sensing, the DG VI proposed that the activity be fully transferred to the Member States. From 1999 onwards, the Commission will only finance image acquisition.

In the autumn of 1998, DG VI and the JRC agreed to transfer to the latter the responsibility for providing technical support to the Member States. As a consequence, the JRC has been fostering a team to guarantee this service with activities such as the publication of a common call for tender, quality control on a subset of control sites, and follow-up on national contractors. The team is also exploring the use of SAR data as a complementary tool. From the list of sites proposed by the National Administrations for checks, the JRC has selected a sub-sample of ten sites for a complete quality control. The purpose of this activity is to assess the work by applying a series of well-defined checks and appraise the specific results achieved by the national contractors. The reports prepared by the JRC are distributed to the National Administrations and the Commission alike.



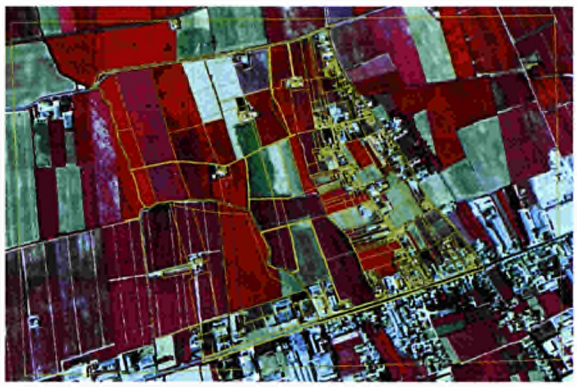
	1992	1993	1994	1995	1996	1997	1998	Total
No. Member States	11	11	10	13	13	12	13	
No. sites	30	44	56	86	90	78	104	488

Number of participating Member States and sites controlled with satellite imagery.

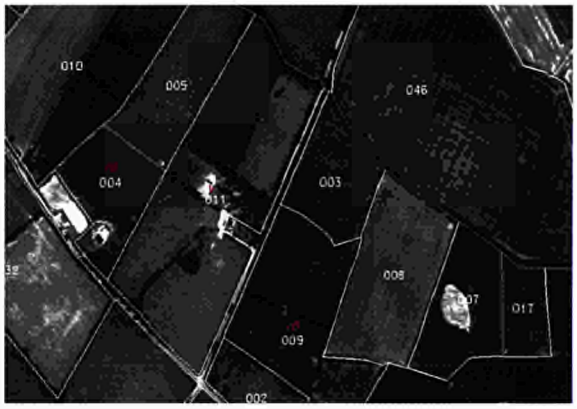
Contact
Tore Tollefsen

	1992	1993	1994	1995	1996	1997	1998	Total
Landsat TM	88	63	90	155	127	139	166	828
SPOT PAN	10	40	50	53	60	53	54	320
SPOT XS	100	122	232	287	330	242	309	1622
IRS PAN	-	-	-	-	-	12	13	25
IRS LISS III	-	-	-	-	-	33	36	69
ERS SAR	-	-	7	6	33	111	106	263
Radarsat SAR	-	-	-	-	-	4	41	45
Total	198	225	379	501	550	594	725	3172

Number of satellite images acquired for the programme from 1992 to 1998.



Example use of Compact Airborne Spectrographic Imager (CASI) data in the control with remote sensing program. The image is a false-colour composite at 1 m resolution, acquired in July 1998. A part of the cadastral map for the area in Northern Italy is overlaid. Note how effective very high resolution data is in delineating the field boundaries and distinguishing between various crop types and non-agricultural land use. Further note that some errors in the cadastral boundaries are easily highlighted. The apparent within-field heterogeneity also points to potential use of this data as a source of information for precision farming practices.



Land Parcel identification system in Ireland, for referencing IACS subsidy applications, developed by the Ministry of Agriculture, Food & Forestry. Cereals parcels are identified one per parcel (e.g. 008); forage parcels are declared in a production block. The orthoimage base (1m pixel) was created specifically for the project and is a feature in 8 EU Member States IACS management systems.

Land parcel identification systems

The Integrated Administration and Control System (IACS) activities are focused on aspects of the implementation concerning area-based subsidies and agricultural parcel identification, particularly GIS data management and orthoimage production as a reference base. Commission Regulation 3887/92 Art 3 makes it clear that identification of farmers´ fields should operate at the level of the agricultural parcel, rather than ownership or other units for which the farmer may not be familiar with. The regulation allows that another unit may be used as a means of identification: the cadastre, or even production block, better known by the French term *îlot*. It is also common to find-cadastral systems which group references to identify an agricultural parcel; and therefore the cadastre is usually a more detailed, albeit more complex, identification system than the production block approach. Eleven Member States (A, DK, D, F, GR, IRL, L, NL, P, FIN, S) have explicitly adopted the option of identification via a production block. To these eleven Member States could be added the UK where a production block is applied, as temporary sub-divisions of identifiers are permitted. Of the cadastral-based systems, Spain and Italy use the cadastre as a reference, but even there the declaration process often sub-divides cadastral parcels. Only Belgium has chosen an identification system that gives a true one-to-one relation between the agricultural parcel and the identifier.

Olive trees : the Olistat and Oliarea Projects

The Olistat project is a large area survey, undertaken by the European Commission with direct technical control from within the MARS project, with the primary objective to lay out as soon as possible a reliable estimate of the number of olive trees for each Member State concerned (Spain, France, Italy, Greece, and Portugal). This estimate was to be made with a confidence interval of approximately 2 per cent of the estimate and at a 95 per cent confidence level. It is important to note that all trees capable of being used in a productive capacity were included in the survey, at the specific instructions of the DGVI. The project had in essence six phases starting with aerial photography acquisition at an average scale of 1:40,000 and subsequent definition of a systematic sample design at two levels at the zone of interest, for each Member State. This was followed by computer aided photo-interpretation of the number of olive trees and field visits, for between 10 and 20 per cent of the sample plots, so as to eliminate confusion between olive trees and other woody species in the photointerpretation process, and to determine the proportions of multiple-trunk and young trees. Finally, there was a series of extrapolations to national levels using statistical estimators. Four of the projects proceeded much as planned, producing national-level results by the April 1998 deadline; the fifth (Greece) was completed in November 1998. The quality assurance programme, run by the JRC at the end of the project execution stage, has globally confirmed the results proposed by the contractors.

A crucial role played by the JRC was in the monitoring and technical management of the project execution. The primary goal of this monitoring was to ensure the successful completion of the projects, by identifying problems and agreeing on solutions at an

Results by Member State, after JRC Quality Assurance.

Member State	Abundance Index	Total Difference Estimator	Δ%	Confidence Interval	Young trees
Italy	*169.1M*	*224.7M*	*+33%*	*+/- 3.4%*	*32.1M (14.3%)*
Spain	*209.9M*	*299.5M*	*+43%*	*+/- 4.2%*	*50.1M (16.7%)*
Portugal	*44.8M*	*71.14M*	*+59%*	*+/- 4.6%*	*5.3M (7.5%)*
France	*2.838M*	*5.69M*	*+100%*	*+/- 11.4%*	*0.71M (12.5%)*
Greece (provisional)	*153.9M*				

early stage. The frequent and open meetings, at which the participation of the relevant Member State administrations was welcomed, helped ensure homogeneity of method and execution, as well as reassure all parties that appropriate strategies for the counting of trees - and the production of estimates - were being adopted. On the other hand, the post-project Quality Assurance programme provides additional assurance to the Commission that the contractors had applied correct, homogeneous and rigorous procedures during the course of the project.

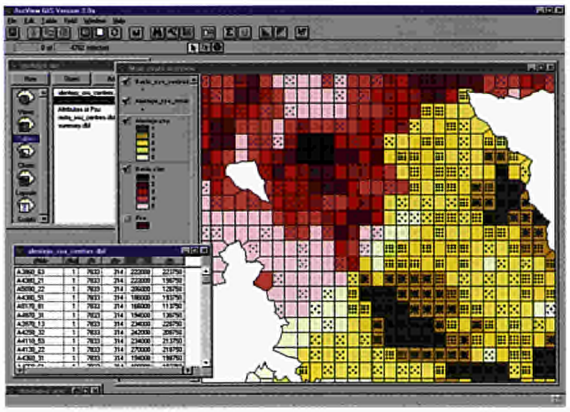
Following on from Olistat, the JRC proposed a method using the sample plot database to estimate the area covered by olive trees in each Member State. The Oliarea project, started in November 1998, will use the point location data, stored in databases created during the photointerpretation of the 75,000 sample plots, in an automated GIS application, running under ArcView. The application is based upon five parameters, namely the minimum distance between trees, an internal and external buffer zone to determine agronomic area within and around the managed parcel respectively, a fixed area for each dispersed tree, and the Voronoi polygon, i.e. the attribution to each tree in a managed parcel of the neighbouring land within the parcel.

Contact
Simon Kay

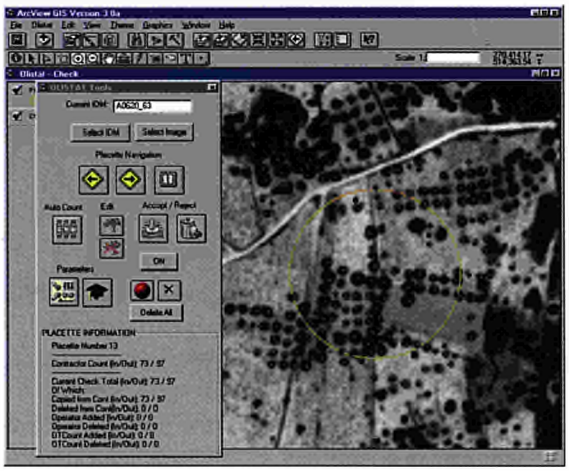
Olive tree and Vineyard Registers

Close support was provided to DG VI and to the Member States, mainly for the implementation of the olive-tree registers in Greece and Portugal, but also its updating or its management in relation to other parcel identification systems. At the request of DG VI, technical visits between the five Mediterranean Member States were organised by the JRC, to illustrate concretely the solutions chosen by different administrations for the management and the control of the regulations in these sectors. Visits organised in Italy and France in 1997 were a success and complementary visits were organised in Spain and Portugal in 1998.

Contact
Laurence Bories



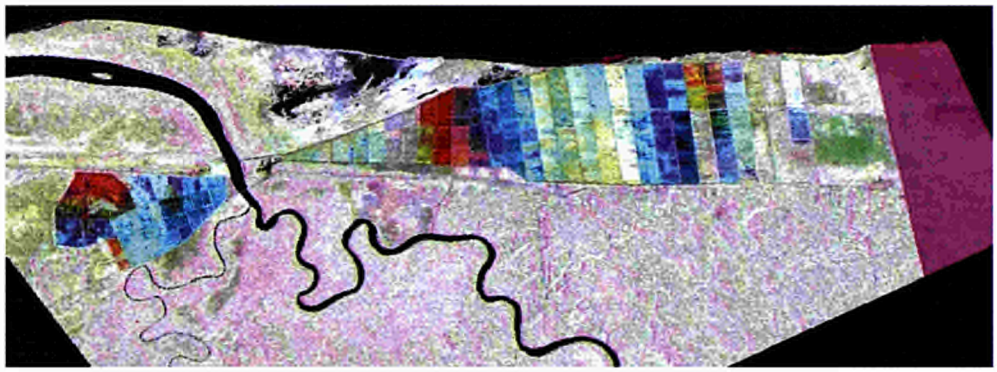
Sample plot positions (points) inside sample unit boundaries (shaded polygons); derived from data delivered by an Olistat contractor in Tragsatec, Portugal. Sample plots outside the zone of interest (e.g., top right) were not included in calculations. Sample units of darker densities represent strata with a higher expected density of trees.



CAPI check for a sample plot in Portugal. This interface was developed for the Olistat Quality Assurance programme at the JRC, and accesses directly contractors' results for on-screen comparison. The sample plot is the circle in the image, photointerpreted trees are identified with purple symbols.

	1995	1996	1997	1998
No. control sites	*86*	*90*	*78*	*104*
Satellite images	*1300*	*1410*	*1255*	*1540*
Control with RS	*9925*	*11585*	*10385*	*12500*
Quality control	*100*	*300*	*300*	*300*
Total	*11325*	*13295*	*11940*	*14340*

Cost of satellite image purchase, analysis and quality control (in KECU). Satellite image purchases have been completely funded by the Commission.



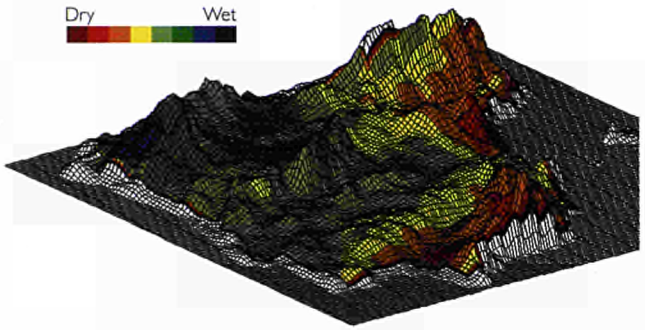
SPOT 4 image composite for a rice-growing area in equatorial South-America (a), with a corresponding multi-temporal RADARSAT fine mode image composite (b). The SPOT image was the best in a series of attempts, but still suffers from small clouds and haze over the eastern part of the area. The different colours in the RADARSAT composite reflect the different crop growth stages of the rice paddies, and nicely contrast with the surrounding tropical forest and coast. For instance, the blue colour highlight areas with are sown between the first and second SAR image acquisitions. Red areas contained mature rice on the first acquisition date, and are re-sown afterwards.

New Sensors and Methods

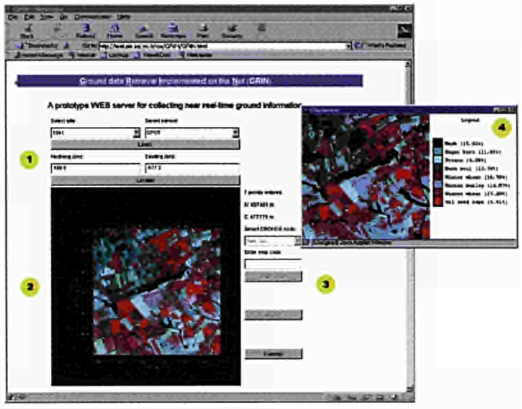
The main fields of activity regard the use of SAR data for operational assessment and monitoring of agricultural crop areas, the re-engineering of the rapid area estimates project and the evaluation of the use of data from new sensors in agricultural and agro-environmental applications. More specifically, SAR data have successfully been used in combination with optical data and other co-located geographical and environmental data to detect the various growth stages of cereals for significantly large production areas whereas ongoing research work focuses on error budgets associated with the use of SAR data in area estimation. To address alternative sampling strategies of area estimates at the scale of the Member States, a prototype WWW server was developed. Such a system would support timely availability of actual ground survey results, and proper management and storage of these data for subsequent use in the image analysis. Finally, the potential of super spectral data in current agricultural and environmental monitoring applications has been investigated. An obvious advantage is the better discrimination of crop types in single images and consequently cost effectiveness owing to a smaller number of images necessary to produce reliable crop maps for control or area estimation. Efforts to use the superspectral data for the reliable extraction of crop parameters, such as leaf area index and chlorophyll-A content, turns out to be more difficult than originally expected.

Interferometric ERS-2 SAR composite over the Great Driffield site showing coherence in red, intensity in green and intensity difference in blue. The orange-reddish fields are winter cereals seed beds, which have high coherence and relatively low backscattering for both dates. The grey-greenish fields are winter oil seed rape, which are decorrelated due to crop development that does not yet result in a big change in backscattering. Other colours indicate grass land or ploughed fields, which may have different vegetation and soil roughness types.

Contact
Guido Lemoine



A new technique has been developed to assess large-scale soil moisture patterns from ERS Scatterometer data. The soil moisture retrieval technique has been validated with an extensive data set of gravimetric field measurements from the Ukraine. It was found that water content in the first meter of the soil may be estimated with an accuracy of about 5 % volumetric units if ERS Scatterometer data are combined with soil knowledge. In Mediterranean climates such information could be used to point out, at a very early stage during the year, where water shortcomings may occur during the summer months.

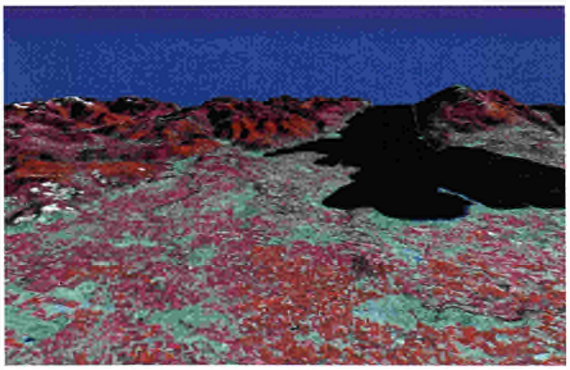


A screenshot of the GRIN (Ground data Retrieval Implemented on the Net) prototype WWW application. The client runs the application in a browser, and can select the latest image data for the area of interest (1). Data is then displayed in the relevant projection system (2). For selected points in the image, the user can enter crop labels (3) and submit these to the server data base. With the ground data entered for the site, a classification product can be generated (4). This allows the user to inspect whether enough ground data was collected. The use of the system will be further tested in 1999. The application makes use of the latest technology in WWW software (Java', ION') a sophisticated visual data analysis software package (IDL') and standard ODBC links to the server databases.

MARS Project Test Site

Within the framework of its institutional mission of application research, and technical support to the European Commission, the MARS Sector launched a project with the aim to set up a test site for instrument experimentation and methods development using aerial photography, digital airborne camera imagery and CASI imagery, high resolution spaceborne data, and experimenting with ortho-correction and GPS equipment, and DTM production and validation. The test site covers an area of 30 km by 50 km in size and is situated on the western side of Lago di Garda in Northern Italy. Both the terrain and land use, with classes such as olive trees, vineyards, small scale arable, and large scale arable, are suitable for the purposes of the Common Agricultural Policy. At present photogrammetric block triangulation tests are being performed in order to optimise orthocorrection methodology on available imagery. Experimentation on this site will continue to permit considerable gain in the collection of reference data, accumulation of results, and possible comparisons. It will also be useful for the organisation of seminars and training courses, and external pilot project proposals.

Contact
Pär Åstrand



SPOT 4 false colour composite showing perspective view of the Lago di Garda test site area; acquisition date 6-Aug-98.

Selected Further Reading

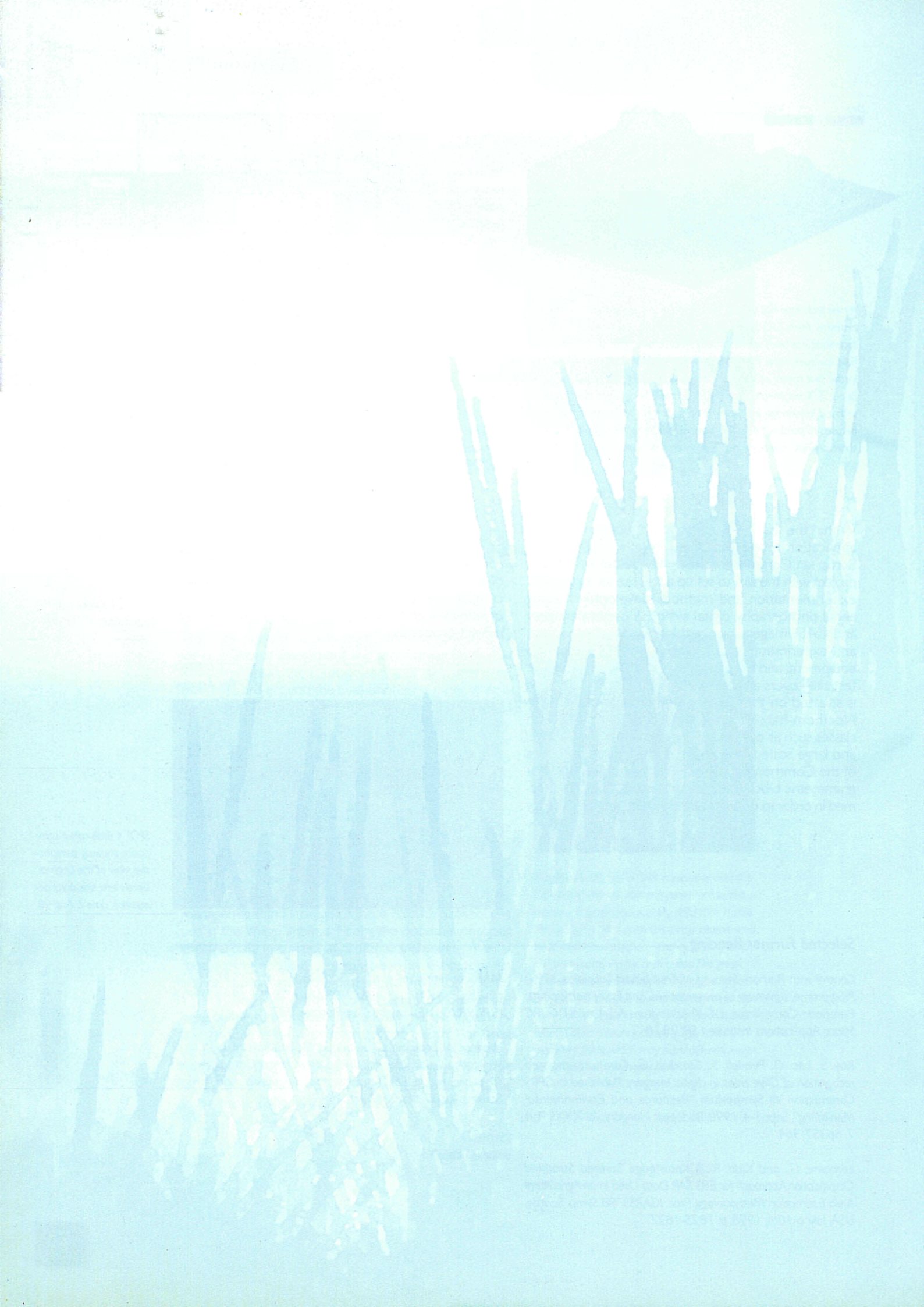
Control with Remote Sensing of Area-based Subsidies 1997; Programme, summary of presentations and list of participants; European Commission, DG VI Agriculture A 1-4 and DG JRC Space Applications Institute - SP.I.98.28

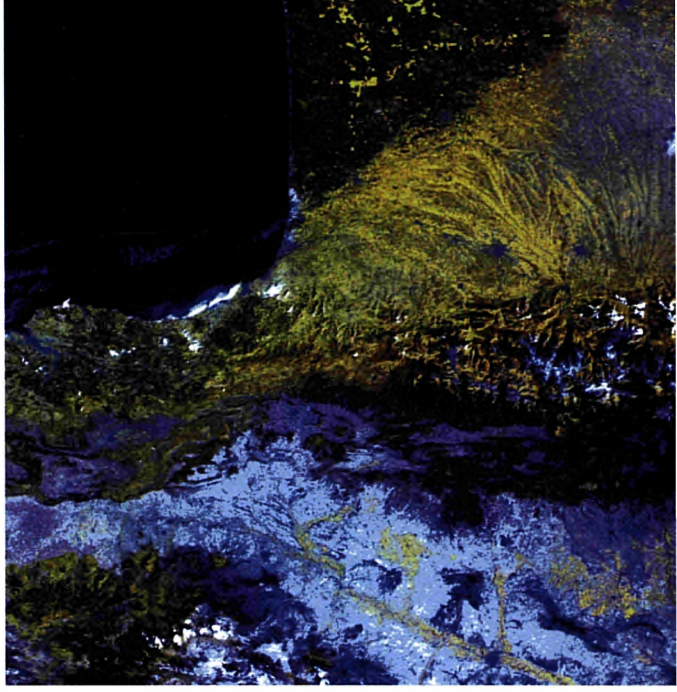
Kay, S., Léo, O., Peedell, S., Giardino, G., Computer-assisted recognition of Olive trees in digital imagery, Published in ISPRS Commission VII Symposium "Resource and Environmental Monitoring", Sept 1-4, 1998, Budapest Hungary, Vol XXXII Part 7, pp357-364.

Lemoine, G., and Kidd, R., A Knowledge Steered Stratified Classification Approach for ERS SAR Data Used in an Agricultural Area Estimation Methodology, Proc. IGARSS '98 Symp. Seattle, USA, July 6-10th, 1998, p. 1825-1827.

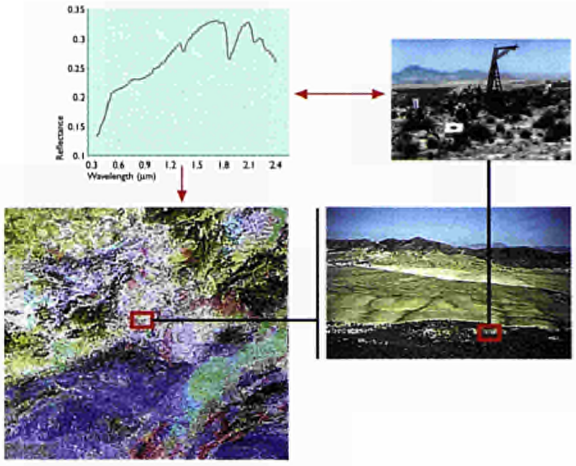
MARS bulletins Vol 6, n° 1 (S.P.I. 98.18), n° 2 (S.P.I. 98.35), n° 3 (S.P.I. 98.49), n° 4 (S.P.I. 98.66), n° 5 (S.P.I. 98.92) n° 6 (S.P.I. 98.131), European Communities, JRC.

Wagner, W., Lemoine, G., Borgeaud, M., and Rott, H., A Study of Vegetation Cover Effects on ERS Scatterometer Data, scheduled for publication in IEEE Transactions of Geoscience and Remote Sensing, Vol 37, No. 2 (March 1999)

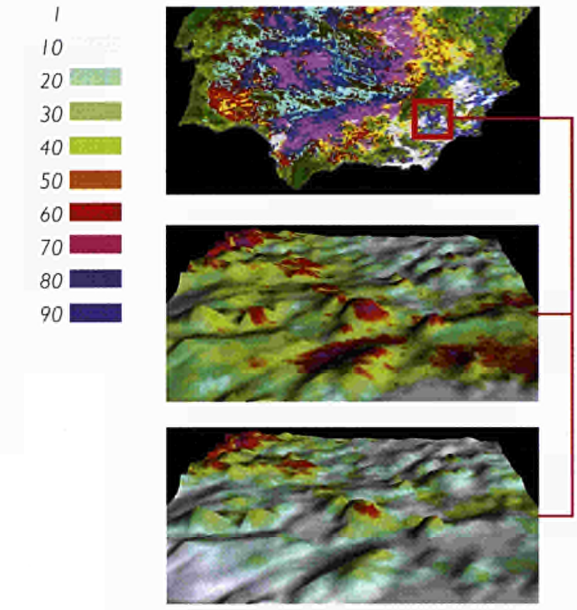




Two main activities were undertaken within European Landscape Environment, namely monitoring of soil and vegetation degradation in the Mediterranean basin, and monitoring of watersheds and forests in Europe. The first activity is related to the need of the countries around the Mediterranean basin where soil and vegetation degradation is triggered by strong anthropogenic pressure coupled with highly variable arid to semi-arid or sub-humid climatic conditions. The European Parliament has emphasised the urgency of the problem requesting from the Commission to adopt the criteria and objectives in accordance with the anti-desertification measures defined by the UN Conference on Environment and Development. In the context of the International Convention to Combat Desertification (UN-CCD), and specifically its Regional Implementation Annex for the Northern Mediterranean, the European Parliament explicitly asks for the preparation of a programme for data collection, information and observation on a systematic basis. The second activity consists of two major research projects which started in 1998. They support the development of monitoring tools on a landscape scale, and contribute to the sustainable development of European rural regions. The first study focuses on watershed management, an issue which has become extremely important during the last years. The second study deals with another international priority, that of the development of criteria and indicators for assessing and monitoring the biodiversity of European forested areas.



Regional mapping and monitoring of soil and vegetation degradation relies on a bottom-up approach linking field measurements, environmental modelling and spaceborne Earth Observation data.



Green vegetation cover in the Guadalentin river catchment as derived from spectral unmixing of NOAA AVHRR data. Mediterranean ecosystems are characterised by high seasonal and interannual vegetation dynamics. Regular observations over long periods are required to identify long-term trends of degradation.

Monitoring of Soil and Vegetation Degradation in the Mediterranean Basin

Decrease in permanent semi-natural vegetation cover and hence acceleration of surface runoff and erosion have been identified to be major driving forces leading to land degradation and desertification. This interaction of processes implies reduction in potential land productivity and therefore constitutes a significant environmental and socio-economic threat. To quantify, monitor and predict desertification, there is a need to develop regional indicators related to the spatial variability, extension and temporal dynamics of land degradation processes, and to establish a standardised evaluation of satellite-derived information for the definition of such indicators. Thus a comprehensive standardised method for monitoring land degradation throughout the Mediterranean basin is being developed, based on the application of an integrated bottom-up approach from field measurements to multiple scale Earth Observation and modelling. In particular, this includes defining and evaluating fundamental criteria for the selection of monitoring sites and identification of minimum data requirements for the operational implementation of long-term monitoring while trying to establish an integrated processing chain from raw high resolution Earth Observation data to georeferenced image maps. Additional research is conducted to set up and implement a processing chain for medium resolution satellite data, such as NOAA AVHRR, at regional scale including the application of spectral unmixing techniques. Meanwhile research work includes defining and setting-up of a regional GIS accommodating multi-source and multi-scale data from test site to region level for ecosystem change analysis and interpretation as well as for interfacing between Earth Observation monitoring and modelling scenarios in the context of degradation risk assessment. Finally regional modelling scenarios for ecosystem functional processes are being developed in order to establish a fully operational monitoring system, allowing for future developments such as new types of Earth Observation data and algorithms.

The conceptual development of a satellite observatory for Mediterranean land degradation monitoring integrates international research projects which are considered important pilot studies towards the first implementation of a pre-operational environmental monitoring system with test sites in Spain, France, Sardinia, Sicily, Peloponnese and Crete. To extend the monitoring approach to the southern Mediterranean area, a working group was formed including three

International partnership and competitive projects

Project name	Duration	Funding programme	Region
CAMELEO	**1998-2000**	**EC, INCO-DC**	**North Africa**
DeMon 2	1996-1999	EC, Environment and Climate,	European Mediterranean
MEDALUS III	**1996-1999**	**EC, Environment and Climate,**	**European Mediterranean**
MoDeM-RSM	1998-1999	EC, Competitive Support to DG XII/D2	Mediterranean Basin

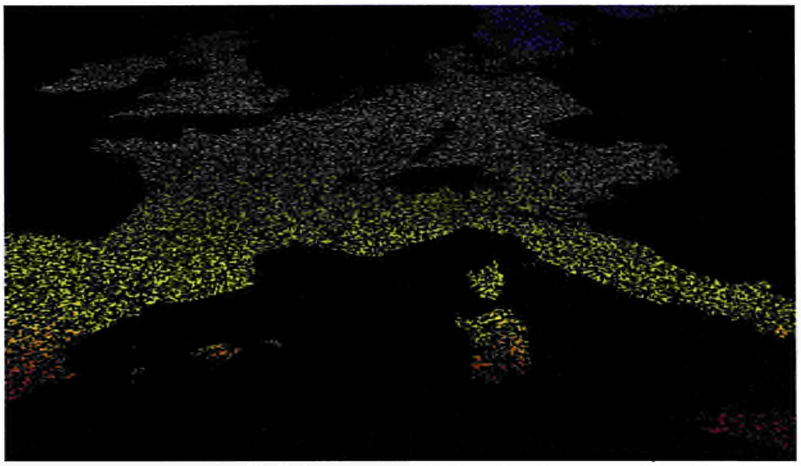
European and four North African partners. This consortium brings together researchers from Algeria, Egypt, Morocco, Tunisia, Italy, France and of the JRC and has defined a joint project named CAMELEO (Changes in Arid Mediterranean Ecosystems on the Long-term through Earth Observation). In this context co-operation with OSS (Observatoire Sahara Sahel) for North Africa and ACSAD (Arab Centre for the Studies of Arid zones and Dry lands) has started. Finally a study contract regarding the Demonstration of an Integrated Concept for Monitoring Desertification in the Mediterranean Basin Based on Earth Observation Methods (MoDeM-RSM) has been awarded by DG XII-D2 to support the EU activities to implement the UN CCD.

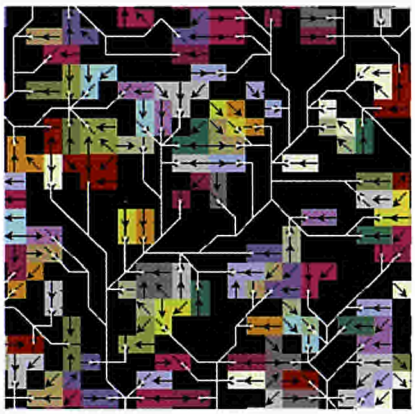
Contact
Stefan Sommer

European Watersheds

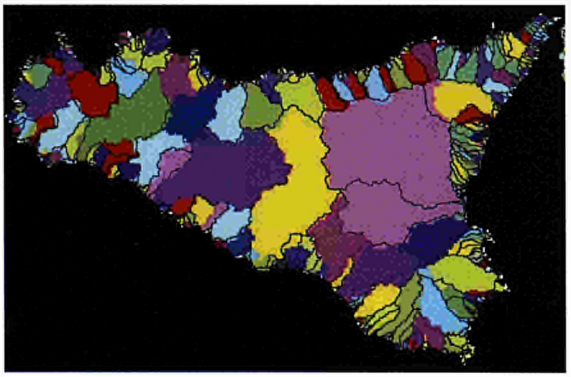
Watersheds are becoming the most important reference area for environmental planning and monitoring. Since watersheds are physical units in the landscape, based on long-term geomorphological development which ultimately determine the hydrological conditions on the surface, it is obvious that many aspects of environmental planning should respect landscape surface structures. The all too frequent flooding catastrophes of recent years clearly indicate the need for careful modelling of different kinds of impact, such as hydrological and geomorphological, induced from any sort of man made changes in the landscape. The latter includes for example, changes in land use, new developments in transport networks and the erosion mitigation installations. Methods for automatically extracting watersheds from digital terrain models have been implemented and tested using terrain models at various resolutions. The European headwaters, or first order watersheds in Europe, were delineated using a 1-kilometer resolution terrain model. This allowed the extraction of mountain headwaters. When combined with CORINE Land Cover data, the main land cover types in each watershed could be mapped according to elevation. This part of the study was carried out to give support to the FAO European Forestry Commission's Working Party on the Management of Mountain Watersheds. It provided the basis for assessing the potential frequency of flooding in mountain headwaters. The study has also included an examination of the influence of scale and resolution by looking at the results derived from digital terrain models of different resolutions (i.e., 1 km, 250 and 50 m.). At a general European monitoring level the results are comparable, however at very local scales an accurate terrain model is a necessity.

Contact
Sten Folving





The headwaters of Europe showing the model used for detecting and mapping the many thousands of small initial watersheds in the landscape.



The Sicilian watersheds mapped using the same method but two different digital terrain models. The colours represent watersheds derived using 50 metre resolution; solid lines show the result using a 250 meter digital model.

European Forests

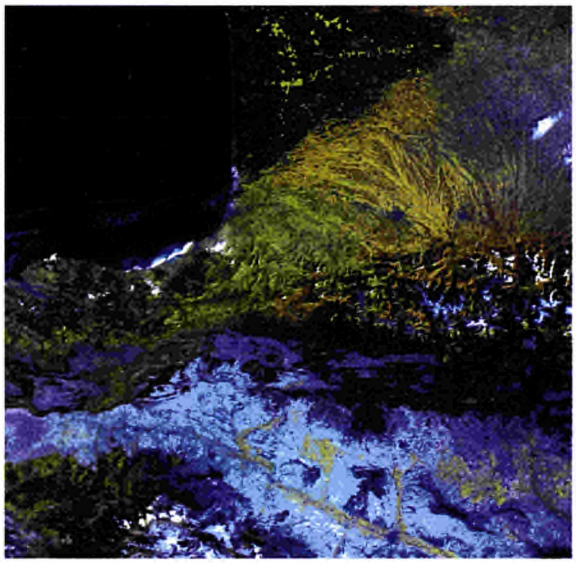
Forests constitute one of the most typical land cover classes in Europe. Approximately 30 percent of the European land surface is covered by forest or forest-like vegetation. Part of the forestry research programme in 1998 was directly linked to the watershed studies since forest cover constitutes a major regulator of run-off especially in the mountainous and hilly regions of rural Europe. Forests are also among the most important renewable natural resources. There is, therefore, a continuous need for tools and methods to monitor forest growth conditions. Forests (regardless of whether they are shrub-like in the Mediterranean or more uniform tree plantations in temperate and Boreal Europe) play a dominant role in creating biodiversity, both at the local level of individual forest stands and at the regional level in creating diversity in the landscape. In the FIRS Project new methods were developed to describe and monitor the structural diversity of forests in the rural landscape. The development of these monitoring tools has been undertaken in close co-operation with research consortia, in particular led by VTT in Finland and GAF in Germany. An in-house developed software package SILVICS, is being used to analyse the structural composition of satellite imagery thus adding an additional element to the multi-spectral classification of data. The software's classification procedures have been implemented as part of the national forestry inventory of Ireland, for which eight forest classes were distinguished with an accuracy ranging from 97% (young Spruce - using minimum distance method) to 76% (open Spruce - using neural networks).

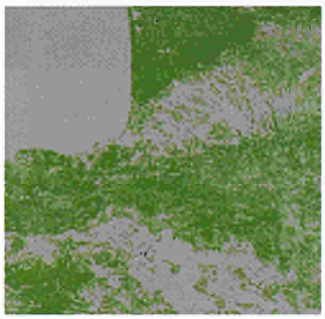
Contact
Sten Folving
Pam Kennedy

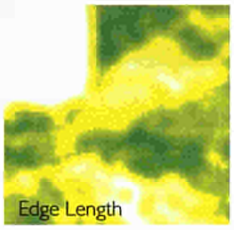
The working concept for the assessment of European forest diversity. The in-house developed image analysis has been adopted to the application within the three main bio-diversity categories.

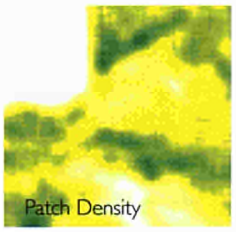
Forest Diversity		
1. Composition	**2. Structure**	**3. Development**
Identity: *Stand Type* ***Stand Age*** *Stand Density*	***Spatial Pattern:*** *Number, Size* ***Fragmentation*** *Shape*	***Changes:*** *Clearange / Growth* ***Composition*** *Structure*
Classification	**Spatial & Textural Analysis**	**Change Detection**

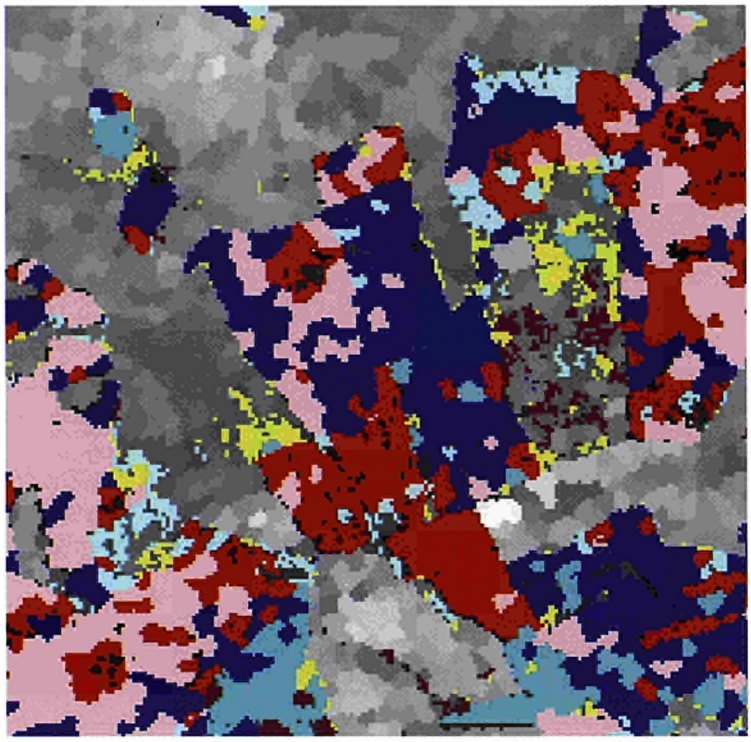
A medium resolution RESURS image from the French-Spanish border has been classified into a forest/non-forest map. The forest mask has been used to derive two different bio-diversity indicators, edge and patch density.











Landsat TM-derived forest map showing eight classes for spruce, pine, and coniferous trees. Methods for deriving very accurate forest species maps have been developed for the Irish National Forest Authorities using the in-house developed software package SILVICS.

Selected Further Reading

Sommer S., Hill J. & Mégier, J., The potential of remote sensing for monitoring rural land use changes and their effects on soil conditions. In: Agriculture, Ecosystems & Environment 67,2-3, pp. 197-209, Elsevier Science B.V., 1998

Brundu G., Camarda I., Satta V., Sommer S. & Aru A., Characterisation and Change Monitoring of Semi-natural Vegetation Communities in Sardinia. In: Proceedings of the 27th International Symposium on Remote Sensing of Environment, June 8-12, 1998, Tromsø, Norway, pp.664-667.

Preissler H., Bohbot H, Mehl W. & Sommer S., MedSpec - A Spectral Database as a Tool to Support the Use of Imaging Spectrometry Data for Environmental Monitoring. Presented at the 1st EARSeL WORKSHOP on IMAGING SPECTROSCOPY, 6 - 8 October 1998, Remote Sensing Laboratories, Zurich, Switzerland, Proceedings in print.

Escadafal R., and Mégier, J., 1998: CAMELEO a concerted research effort to develop validated desertification monitoring techniques in Northern Africa. Proceedings of the International Symposium Satellite-Based Observation: A Tool for the Study of the Mediterranean Basin. Tunis, 23-27 November 1998, CNES edition.

Sommer, S., Mégier, J., Lacaze, B., and Kirkby, M., 1998, Demonstration of an Integrated Concept for Monitoring Desertification in the Mediterranean Basin Based on Remote Sensing Methods - The MoDeM – RSM Project. Proceedings of the International Symposium Satellite-Based Observation: A Tool for the Study of the Mediterranean Basin. Tunis, 23-27 November 1998, CNES edition.

Du Breil de Pontbriand, L., Flies R., Folving, S., Kennedy, P., and Päivinen, R. 1998. EFICS (European Forest Communication and Information System) – Networked statistical and georeferenced forest information. In: Proceedings to 'Resource Technology '98 Nordic – World of Information', Rovaniemi, Finland, June 8-12, 1998.

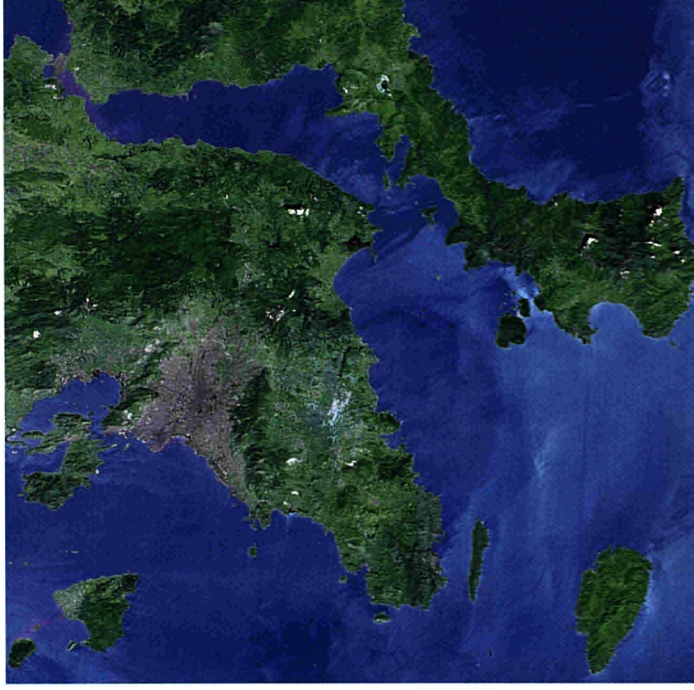
Häme, T., Ansersson, K., Lohi, A., Köhl, M., Päivinen, R., JeanJean, H., Spence, I., Letoan, T., Quegan, S., Estreguil, C., Folving, S., and Kennedy, P., 1998. Validated forest variable maps and estimates across Europe using multi-resolution satellite data: Results of the first phase of the FMERS study. 27th International Symposium on Remote Sensing of the Environment, Tromsø, Norway.

Bertolo, F., Folving, S., Mégier, J., and Paracchini, M. L. 1998. Integrated use of RS-data for assessing environmental risks from coastal industrial plants: examples from Sicily. In proceedings to: EARSeL/NSEOG Symposium "Operational Remote Sensing for Sustainable Development", Enschede, The Netherlands, 11-14 May 1998.

Paracchini, M.L., Folving, S. and Bertolo, F. 1998. Identification and Classification of European Headwaters. In proceedings to Twenty-first Session of the European Forestry Commission Working Party on the Management of Mountain Watersheds, Marienbad, Czech Republic, 6-9 October 1998.

Nielsen, N., and Häusler, T. 1998. Forest diversity from remote sensing: Possibilities and limitations. (Poster Paper) In Proceedings of the 1998 European Congress of the International Association for Landscape ecology, Myerscough College 3-5 September 1998.

URBAN MONITORING IN SUPPORT TO REGIONAL DEVELOPMENT



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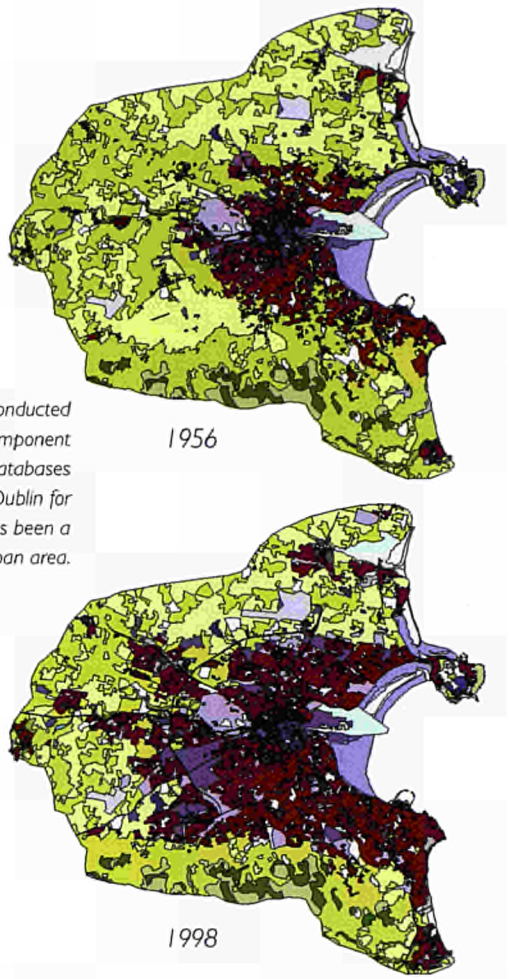
There is a growing need for better housing and additional recreational amenities such as parks or sports facilities in most European cities. At the same time, several such cities suffer from an alarming population influx and lack of space. In fact, they may be reaching their sustainability limits under the current spatial organisation of the urban landscape. This issue is high on the agenda of the European Environmental Agency and the Commission. Such political motivations, together with widespread interest from scientific, industrial and public sectors of the European society, have increased the demand for reliable, standardised information on urban areas in the form of statistics, geo-referenced databases and maps. Nevertheless, it is currently very difficult to monitor and compare the dynamics of urban change in different Member States of the European Union in a way that would provide a useful source of information for urban planning strategies in Europe while targeting regional development policies effectively. Studies that rely on data collected at very fine detail have generated an overwhelming volume of information which is difficult to process into a synoptic view of the European urban landscape. Moreover, such data sets are often collected with different methods and standards and, therefore, cannot be combined. Earth Observation data, on the other hand, are consistent in space and time and well suited for studies on a continental scale. The Space Applications Institute has launched two projects, MURBANDY (Monitoring Urban Dynamics) and ATLAS (Statistical Atlas of Urban Agglomerations in Europe), which use Earth Observation data to provide information on urban areas in Europe.



An example of work conducted within the CHANGE component showing land use databases developed for the city of Dublin for 1956 and 1998. There has been a dramatic increase in the urban area.

Monitoring Urban Dynamics

The overall objective of MURBANDY is three-fold. First, it aims to establish an EO-based procedure to monitor how European agglomerations change over time, and then to develop a number of urban and environmental indicators which will help understand their dynamics and their impact on the environment. Finally scenarios of urban growth at annual intervals are elaborated. The cities considered in the MURBANDY project are: Algarve, Helsinki, Porto, Bilbao, Iralklion, Prague, Bratislava, Lyon, Ruhr, Brussels, Marseilles, Setubal, Dresden, Milan, Sunderland, Dublin, Munich, Tallinn, Göteborg, Nicosia, Veneto, Grenoble, Palermo, and Vienna.

The project encompasses three interrelated components: CHANGE, UNDERSTAND, and FORECAST. The CHANGE component involves measuring changes in the spatial extent of urban areas and in urban structure over a period of approximately 40 years. The end products of this component are three historical land use databases and a reference land-use database for selected cities in Europe. In the UNDERSTAND component a number of environmental indicators are developed in order to measure the sustainability of urban and peri-urban areas in 5 out of the 15 selected cities. Indices such as the theoretical ecological footprint and the potential carrying capacity of the urban and rural area supporting it are produced. These will further allow deriving the sustainable development potential of an area; in other words the urban landscape with surrounding agricultural and forested areas. Within the FORECAST component urban growth scenarios for a number of cities are developed, using state of the art urban dynamics models.

Contact
Carlo Lavalle
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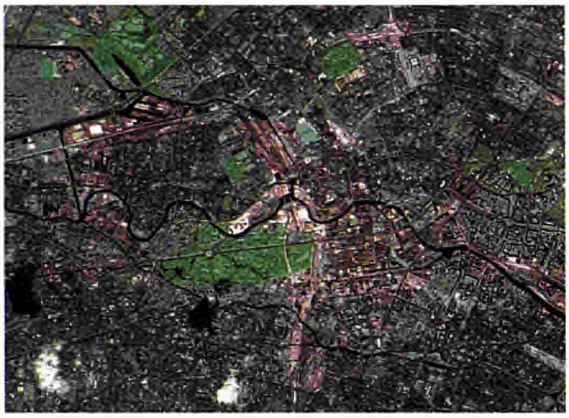

Fusion of IRS-1C LISS III and PAN data from Berlin, Germany; acquisition date 9-May-97; 5-m spatial resolution.

IRS-1C derived land use map of Berlin, Germany in accordance with the EUROSTAT CLUSTERS nomenclature; original map scale 1:25000.

Statistical Atlas of Urban Agglomerations in Europe

The project was designed to serve the increasing demand, at European level, for quantitative, standardised and revisable information on urban areas, in the form of statistics, geo-referenced databases and maps. Thus the main goal of ATLAS was to establish a geo-statistical information system on urban agglomerations in Europe containing mainly cartographic data on land use, derived from remotely sensed imagery. Furthermore, the project aimed to investigate the extend to which the requirements of the European Statistical Office (EUROSTAT) for information over urban areas, can be met by using very high resolution remotely sensed imagery.

The study focused on two major cities in the European Union: Athens and Berlin. Land use maps for both cities were produced, in accordance with the CLUSTERS nomenclature and in a common Geographical Information System format to enable them to be used directly in modelling and analysis activities such as the derivation of environmental indicators, area inventories and statistics, and time trend analysis. Nominal areas of 40km by 40km for Athens, and 50km by 50km for Berlin, were mapped. The main source of satellite imagery was multi-spectral and panchromatic data from the Indian Remote Sensing Satellite, IRS-1C, at a spatial resolution of 23 and 5.8 metres respectively. In addition, 2-metre resolution panchromatic imagery from the KVR-1000 camera system, on board the Russian Cosmos spacecraft was used for change detection analysis. Two acquisition dates were selected, covering an area of 10km by 10km. Land use maps were produced applying advanced pattern recognition approaches and were further refined by integrating ancillary data mainly derived from cartographic reference maps and field surveys. These provided information on functional land use classes, such as commercial financial activities, public services and cultural sites, and on linear features such as roads and railway lines. During the course of the project all necessary procedures, from data processing to analysis and quality control were defined, which will permit similar studies on change monitoring to be conducted more efficiently in the future and provide a useful and updateable source of land use information for urban planners.

Contact
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Selected Further Reading

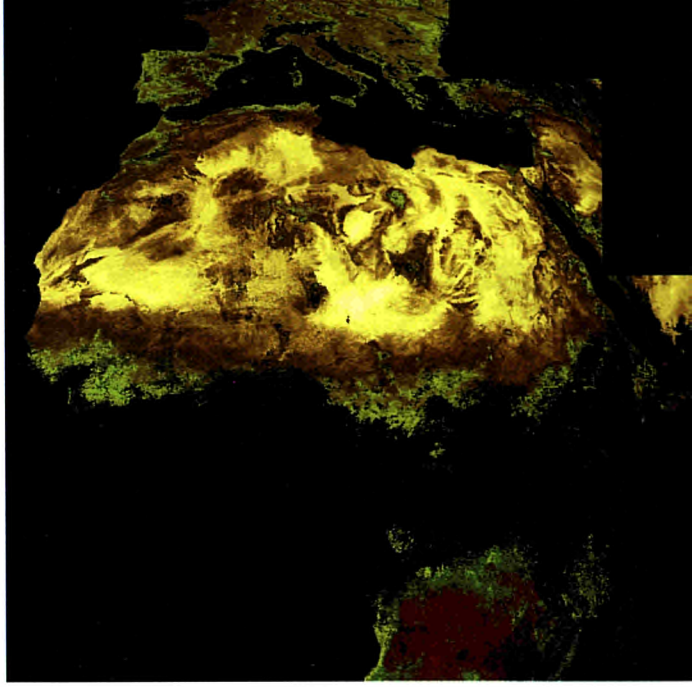
Benediktsson, J. A., and Kanellopoulos, I., Classification of multisource and hyperspectral data based on decision fusion, IEEE Transactions on Geoscience and Remote Sensing, vol. 39, no. 3. 1999.

Ehrlich, D., Annoni, A. and Lavalle C., 1988. Monitoring the sustainability of Europe's urban areas - The MURBANDY project. In Proceedings of the 27th International Symposium on Remote Sensing of Environment, June 8-12, 1988, Tromsø, Norway, pp. 388-391.

Kanellopoulos, I., Wilkinson, G. G., and Moons, T., Machine Vision and Advanced Image Processing in Remote Sensing, Springer-Verlag, Berlin-Heidelberg. (to be published in May 1999).

Pesaresi, M., and Kanellopoulos, I., Robust automatic recognition system of man-made areas using morphological segmentation and very-high resolution remotely sensed data, Image and Signal Processing for Remote Sensing IV, Serpico, S. B., Proceedings of SPIE Vol. 3500, pp. 268-277, 1998.

Pesaresi, P., and Kanellopoulos, I., Detection and Urban features using morphological based segmentation and very-high resolution remotely sensed data, Machine Vision and Advanced Image Processing in Remote Sensing, Kanellopoulos, I., Wilkinson, G. G., and Moons, T., Springer-Verlag, Berlin-Heidelberg, pp. 271-284. (to be published in May 1999).



There is an increasing demand for global environmental information by the EC's Services, arising from policies such as environment and development co-operation as well as in EC commitment to a growing number of international conventions and treaties. The state of the world's vegetation cover is of particular importance. For example, DGXI requires monitoring systems to support its work on the preparation of the International Forest Convention and for its work implementing the Convention on Biological Diversity. DGVIII needs information for its environmental protection programmes associated with the International Desertification Convention and for the forest management programmes run throughout the Afro-Caribbean-Pacific countries. DGs IA and IB both are concerned with forest management programmes in the Commonwealth of Independent States and S.E. Asia / Latin America respectively. Collectively these DGs call for global-scale monitoring of change in the world's vegetation to support policy formulation and to assess policy impact. Indeed such perceived information requirements were a major consideration behind EC involvement in the VEGETATION sensor on the SPOT4 satellite, successfully launched in March of 1998. Some of the first images from this important new sensor are presented in this chapter. The global perspective gained new significance in December 1997 when the EU signed the Kyoto Protocol to the UN Framework Convention on Climate Change. By signing this, the European Union has a commitment to reduce its yearly carbon dioxide and other greenhouse gas emissions by 8%, compared to 1990 levels. Compliance will be judged from 2008 to 2012, though the EU [...]

[...] will have to make demonstrable progress by 2005. Some human-induced land use changes (particularly deforestation and biomass burning) significantly contribute to the release of carbon dioxide into the atmosphere. The reverse processes of afforestation and reforestation can be exploited to lock carbon in the biosphere for prolonged periods. The Kyoto Protocol specifically calls for information on afforestation, deforestation and reforestation. Monitoring these processes in the Tropical regions has been a key part of SAI's TREES project since the early 1990s. This year for example the TREES project published a first set of maps highlighting the Earth's tropical deforestation hot spots. The impressive results of the Global Rain Forest Mapping (GRFM) project are also reported. This work shows the enormous potential of spaceborne Earth Observation for detailed analysis of our environment. Though these processes are global in scale and impact it is equally true that they take place on a local level. Summing locally occurring phenomena to provide a global picture is at the heart of a new initiative, the World Fire Web. 1998 saw the installation of the first nodes of a system that will eventually lead to near real-time monitoring of fire throughout the world. The legal and economic implications of environmental treaties call for reliable and accurate information. This in turn calls for development of the right analysis tools. New approaches to data analysis are pointing the way to derivation of quantitative information concerning for example measurement of the fraction of absorbed photosynthetically active radiation. Derivation of quantitative information from Earth Observation data is also the goal of the MAUVE project. Begun in 1998 the project aims at developing and assessing the quality of UV radiation maps derived from satellite data. The importance for Europe of maintaining space-based systems for environmental monitoring in the post-Kyoto context is currently the subject of debate by other Commission Services, European space agencies and industry. The opening rounds of this discussion took place during the SAI's annual users meeting in Baveno, during May 1998. Our work in 1998 and that of the coming years will help in the definition, design and implementation of any such system.

A New Source of Information on the Global Environment

The VEGETATION programme was initiated by the French Space Agency CNES, and carried out through a partnership between France, Belgium, Sweden, Italy, and the European Commission (DG XII and JRC-SAI). The VEGETATION instrument was successfully put into orbit onboard the SPOT 4 Satellite on 24th March, 1998, and the in-flight acceptance tests were completed on 1st July. Since then, data have been made available to research teams of the Preparatory Programme by the central processing Centre CTIV, based in Mol (Belgium).

The Space Application Institute has been involved in the VEGETATION programme since its inception, especially by voicing the users needs, both from within the services of the Commission, and from the scientific community in various parts of the world. Access to data by local users, often EC services (JRC, DG IA, IB, VI, VIII, XI, XII among others) received special attention in 1998. The SAI's Agriculture and Rural Information Systems Unit and Global Vegetation Monitoring Unit, with the agreement of the VEGETATION programme and the technical

The exceptional quality of the images produced using VEGETATION data. ©CNES

support of CNES, began development of pre-processing software for local receiving stations. Derivation of vegetation indices optimised to the VEGETATION instrument characteristics was also a major achievement. There was also a cost-benefit analysis on the fast delivery of data from the central processing facility with satellite communications. Improving access to data from the central processing facility for specific categories of users will continue to be addressed by the SAI in the framework of the VEGETATION 2 mission.

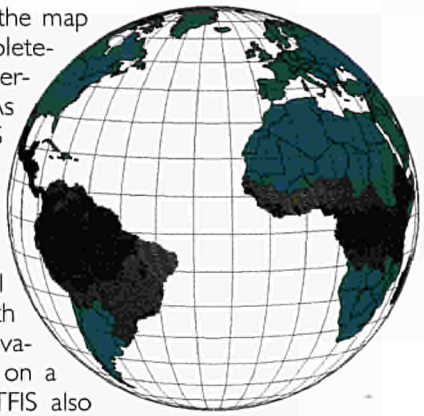
Contact
Etienne Bartholomé

Tropical Forest Mapping and Monitoring

The TREES II project, now in its third year, continued the development of a prototype information system for monitoring tropical forests at a pan-tropical scale. In 1998 particular effort was made with respect to DGVIII's ECOFAC regional project in Central Africa. Moreover the project published its first quantitative estimation of forest resources in an article on forest area statistics in the journal Environmental Conservation, and also published a detailed report on the Identification of deforestation hot spot areas in the humid tropics. A strategy to measure the forest area change in the Tropics during the 1992-1997 period (so-called satellite high resolution data activity) was put into place and contacts established in South America, Africa and S.E. Asia to ensure that the project benefits from local knowledge and expertise.

The TREES project uses coarse resolution satellite imagery for the day to day monitoring of forest condition, and during 1998 the project began the analysis of over 1000 1-km resolution scenes acquired from the ATSR-2 sensor on ERS-2 satellite. Preliminary evaluation of data from the VEGETATION sensor began too, and these will be integrated into the TREES projects analysis process next year. However measurement of forest change calls for the use of much higher resolution data sets. Mapping all the world's tropical forests with such data would be both hugely expensive and very time consuming. To ensure timely delivery of information on forest area and to reduce costs the project invested a great deal of effort in building a state of the art sampling scheme: a hexagonal tessellation grid. Using this grid as a basis for a statistically conditioned sample more than 230 high-resolution images from the Landsat and SPOT satellites have been acquired. The emphasis has been placed on the so called hot spots. These are parts of the tropical forests deemed to be most at risk.

The project continued to release new tropical forest maps. The Central Africa map was published in early 1998, and following peer review, the map covering South America was completely re-worked and an advanced version is now ready for publication. As well as paper maps, the TREES project provides access to the information in digital form via a bespoke GIS, the Tropical Forest Information System (TFIS). TFIS allows users to analyse the tropical forest maps in conjunction with other spatial data sets such as elevation, and non spatial data. Work on a deforestation risk model within TFIS also continued, and the system has been expanded via the acquisition of new data sets. As in previous years the project supported an on-site TFIS within DGXI in Brussels. Preliminary discussions also began with DGs VIII and IB to consider adapting the TFIS to serve their information requirements. The TFIS manager is closely involved in the International Consultation on Research and Information Systems in Forestry (ICRIS). The experience gained with development of TFIS is also being fed into an international effort on Forest Information Systems under the auspices of the International Consultation on Research and Information Systems in Forestry (ICRIS).



The hexagonal tessellation grid.

Contact
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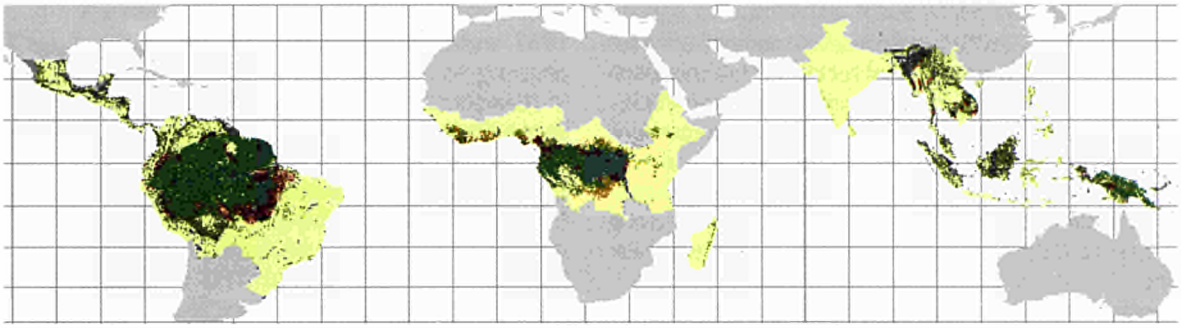
Hugh Eva (S.America) • Philippe Mayaux (Africa)
Hans-Jürgen Stibig (SE Asia)

Global Rain Forest Mapping

Tropical forests are universally recognised to be the primary reservoir for the biological diversity of our planet. They also play a key role in the atmosphere - biosphere exchange processes, and represent a huge carbon pool, a point of major relevance to the implementation of the Kyoto Protocol. In 1998 this vital Earth ecosystem was for the first time observed globally with unprecedented spatial detail. This milestone in information concerning our planet's resources is part of the Global Rain Forest Mapping project (GRFM), an international co-operative effort launched in 1995 by Japan's space agency NASDA with NASA's Jet Propulsion Laboratory and with the SAI's Global Vegetation Monitoring Unit. The ambitious goal set by the GRFM project is to map the entire tropical rain forest at a resolution of 100 m at two times of the year. The two dates account for the dynamics of important natural phenomena, such as flooding. The sheer size and complexity of the project (some 13,000 radar images covering some 50 million km2) demands international co-operation. As part of this international effort GVM was responsible for the management and data processing of cover over Africa. Asia was the responsibility of



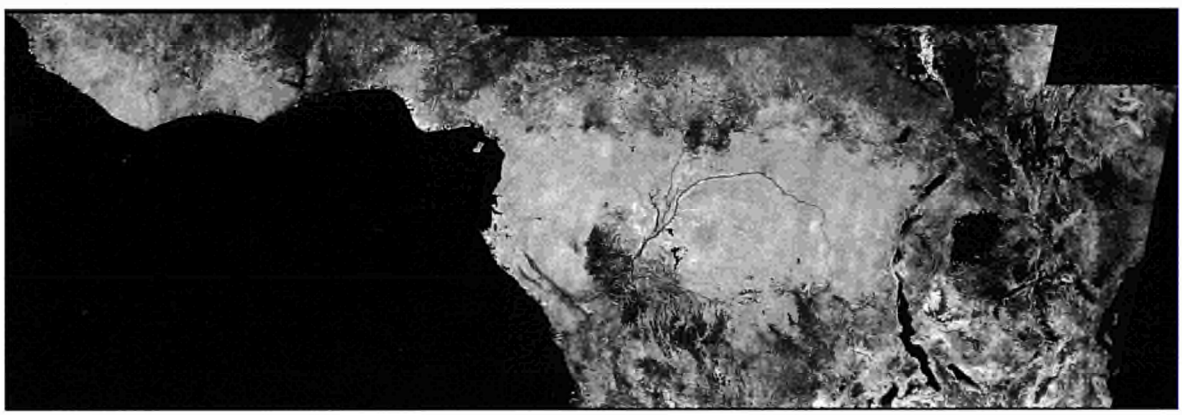
The hot spots of the world.

NASDA and the NASA looked after South America. The most relevant characteristics of the GRFM Africa mosaics are the georeferencing accuracy and radiometric calibration. Using techniques developed in-house the GVM team have produced mosaics with an internal geometric consistency in the order of 100m. Using external control points derived by high precision geodetic measurements along the coastlines an absolute georeferencing accuracy of 300 m was finally reached. A similar technique was also used to achieve an optimisation of the radiometric calibration errors. By the end of 1998 the GRFM project had assembled the thousands of radar images into maps. The science teams had developed new techniques for the automatic analysis and interpretation of these large data sets. This new GRFM product complements the previously produced Central Africa Mosaic derived from ERS-1 radar imagery. Together these unique products are being analysed to provide new maps of swamp forest and lowland rain forests in Africa and will be integrated into the Tropical Forest Information System developed by TREES.

Contact
Gianfranco De Grandi

Global Scale Monitoring of Vegetation Fires

Throughout 1998 improvements were made to the Global Fire Product. This is a global map of daily fire occurrence over a 21-month period starting in April 1992. Whilst this product provides a unique picture of global fire patterns, it is an historical data set. The data handling and data processing loads inherent in any global scale observing system are so great that delay between time of satellite overpass and creation of the fire map is inevitable. To get a near real-time picture of global fire patterns the SAI developed the concept of the World Fire Web network. This is an Internet based distributed processing network, for the derivation of global active fire occurrence maps from AVHRR data. The global coverage is achieved using a network of receiving stations. Satellite data are processed immediately on-site, using the Fire Processor developed by the GVM Unit. The result is a set of co-ordinates providing the geographical location of detected fire events occurring in the region covered by the receiving station. The co-ordinates alone represent a huge reduction in data volume when compared to the original satellite image. This much smaller amount of data can easily be transmitted over Internet links between receiving stations. Each node in the network runs software, provided by GVM, that automatically collects fire information from the rest of the network, and recon-



The processing of the Central and West Africa mosaics are composed of some 4,000 SAR images; for each acquisition period (January and November 1996). Several data layers are produced carrying radiometric and textural information and spanning several spatial scales (from 100 m to 1.6 Km pixel size).

structs the global maps on-site. Each copy of the product is checked for consistency, and made available to users via the World-Wide-Web, in near real-time.

Based on past experience with active fire detection GVM staff were invited to be part of a European consortium examining the possibilities of a space based system for the detection of fires throughout the Mediterranean. GVM is providing input to the system concerning algorithm development. The FUEGO project began towards the end of the year, and could ultimately provide Europe's fire fighters with a near-real time alarm system to help deal with the extensive fires in the region. Active fires are an important gauge of human activity, and often herald land cover change. Yet in the context of global environmental monitoring the mapping of burnt areas and the measurement of the amount of biomass burnt are equally important. Indeed in terms of the assessment of greenhouse gas emissions and aerosol production from biomass burning they are more important. Recognising this, the SAI has begun to examine a range of approaches to burnt biomass estimation and to burnt scar mapping. In 1998 research concentrated on the combined use of SAR and optical data. Given the dense clouds of smoke associated with most vegetation fires, the all weather capabilities of radar systems offer tangible advantages over the optical systems where fire studies are concerned. A first test was performed in a savannah ecosystem of West Africa (Ghana) in collaboration with Copenhagen University's Institute of Geography. Results showed the great potential of SAR data for fire scar mapping, but confirmed that the successful interpretation of these data still relies on the availability of at least some optical imagery. This research line will be further developed during the FRACTAL experiment (Fire Regional Assessment and Carbon Tracking in Arhnem Land) which will take place in Northern Australia in June 1999 and will also support the fire scar algorithm development foreseen in the FUEGO project.

Contact
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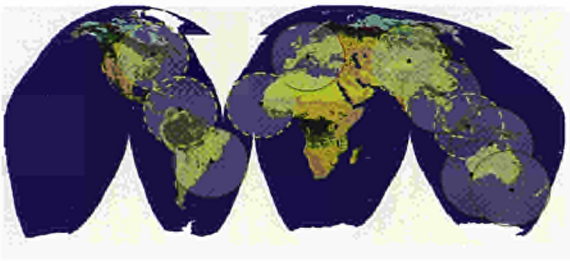
Cesar Carmona-Moreno

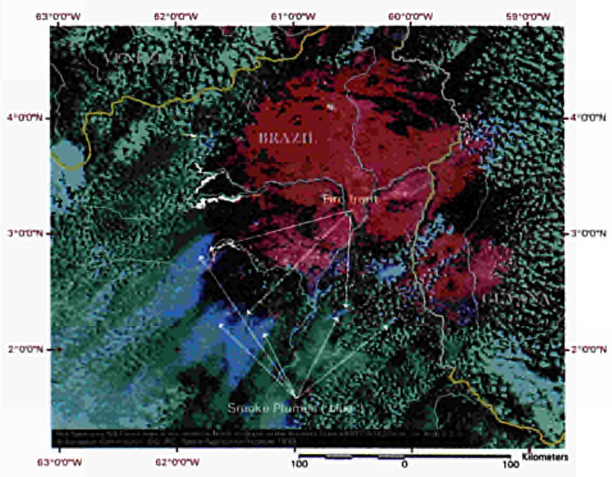
Estimating Surface Albedo and Optimising Spectral Indices

Data from the geostationary satellite Meteosat spanning more than a decade have been archived by the European organisation for the exploitation of meteorological satellites (EUMETSAT). These data collected at half-hour intervals over the entire Earth disk as seen from the Greenwich meridian offer considerable potential for the study of the anisotropy of the coupled surface-atmosphere system. If correctly processed they can provide the opportunity to document changes in surface albedo. In addition to the benefits for improved weather and climate models, changes in surface albedo may well indicate land cover change, particularly in environmentally sensitive regions such as the desert margins. Working in close collaboration with EUMETSAT the Space Applications Institute has developed and tested an algorithm for estimating surface albedo from the Meteosat data. An additional benefit of solving the coupled surface-atmosphere radiation transfer problem is an estimate of the spatial and temporal distribution of aerosols. This will lead to improved processing and analysis of data from range of sensors operating at optical wavelengths, and the availability of such information over land surfaces will be of great benefit for those studying atmospheric transport mechanisms.

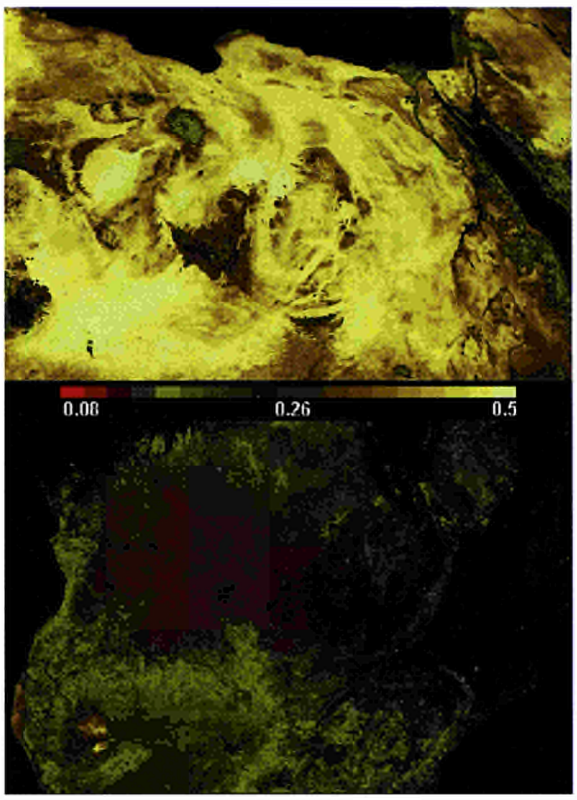


At the end of 1998, the prototype version of the World Fire Web network was running four regional nodes: Brazil, Mediterranean Basin, Southeast Asia (both continental and insular) and Australia. Nodes in Canada, Venezuela, Senegal, Indonesia and Mongolia will be added in 1999, and the functionality will be increased to include the mapping of burnt areas.

Complementary work at SAI in 1998 has also lead to improved spectral indices. These constitute a convenient tool to analyse large Remote Sensing datasets, and to derive precise information on the state and evolution of land surfaces from radiation measurements obtained from space platforms. The next generation of satellites offers new opportunities for the quantitative assessment of land properties and



Testing the algorithms that underpin the World Fire Web involves in-situ monitoring of fires using a portable receiving station. This system was also used in March 1998 to provide local information on fire distribution to the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA). During that period exceptional burning activity occurred in the northern fringes of the Amazon Basin, in the Roraima State of Brazil. The GVM team was able to document this extreme fire event in real-time, providing the JRC Directorate in Brussels and the SAI in Ispra with information on the fire's spread within only a few hours of the satellite overpass.



An image from the prototype algorithm which has been developed to estimate surface albedo from Meteosat data.

Results obtained with the Optimised Vegetation Normalised Index (OVNI) using data collected over Sicilia by the VEGETATION sensor.

their changes, provided suitable tools are available to fully exploit these data. The creation of accurate and reliable information on the basis of these indices, however, requires the optimisation of the tools both to the particular task at hand and to the specific sensor being used. In 1998 a set of optimal indices were derived to estimate the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) from space measurements, for various sensors including the GLI/ ADEOS-II, VEGETATION/SPOT and MERIS/ ENVISAT instruments.

Contact
Michel Verstraete • Bernard Pinty • Nadine Gobron

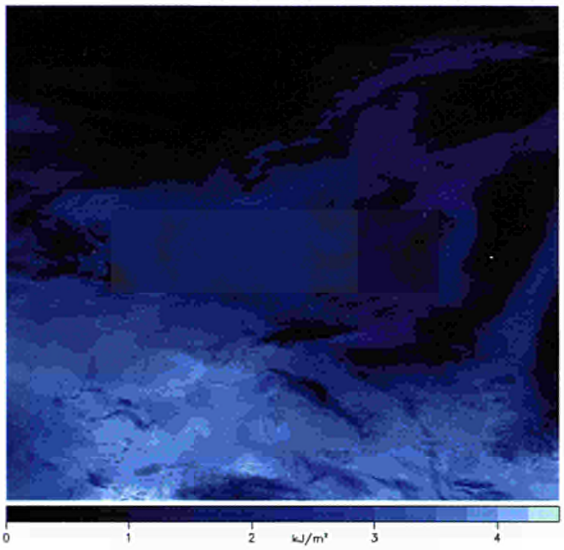
Mapping UV doses and dose rates

One direct consequence of stratospheric ozone depletion is to increase the intensity of the ultraviolet radiation reaching the surface of the Earth. This is of concern as the enhanced radiation is potentially harmful to human health (skin cancer, cataract) and the environment, in particular to vegetation and aquatic biosystems. The European MAUVE project aims at developing and assessing the quality of UV radiation maps derived from satellite data. In this framework, SAI is working on a methodology that uses GOME and Meteosat data to produce maps of the UV doses and dose rates, at the European scale and with a spatial resolution of 0.050. The modelling takes into account the total ozone column, scattering by aerosols and clouds, the surface albedo, and elevation. The maps can represent different doses and dose rates, adapted to various impact studies (skin cancer, effect on vegetation). It has been demonstrated that the maps can be produced for periods back to 1984, potentially enabling trend studies. In the second phase of the project, the quality and accuracy of the results will be thoroughly assessed by comparison with reference ground measurements and inter-comparison with other types of UV maps developed by the MAUVE partners.

Contact
Jean Verdebout

The Baveno Manifesto

On 19th May 1998 the Space Applications Institute held its annual Users' Meeting in Baveno, Italy. During the meeting European space agencies and related organisations (BNSC, CNES, DLR, EARSC, EC, ESA and EUMETSAT) met informally to examine the implications various European policies have for space activities. This meeting was part of a process of growing co-operation between different actors in the European space sector, and in the context of existing designs for European EO co-operation exemplified by ESA's Living Planet programme. A common vision was expressed that Europe could and should strengthen the environmental information input to the policy making, policy development and policy implementation processes. The establishment of global environment information systems was seen by all participants as particularly significant in the context of the Convention on Climate Change and especially the Kyoto Protocol. The participants believed that there is a need for an independent information service that is internationally accepted, and that may be used for example to support prevention and mitigation strategies dealing with greenhouse gas emissions/sinks. They also recognised that the desirability of ensuring independence of access, and equally importantly analysis, of global environment data and information needs to be addressed across the European political spectrum. At subsequent meetings the original participants were joined by the Italian space agency, ASI, who also endorsed the initiative, and together all parties agreed on a common document, the Baveno Manifesto.



UV dose over Europe on 15 April 1997.

The SAI has been actively involved in the development of the Baveno initiative from its inception, and will continue to take part. Throughout 1998 SAI's research provided the Services of the Commission with information on the state of the world's tropical forests, on the incidence and impact of fire around the globe. Significant progress towards state of the art algorithms for analysis of data from the most recent sensors (notably VEGETATION) and for the next generation of satellites was made. SAI's global environmental monitoring research will continue to focus on using space technologies to strengthen the environmental information input to the policy making, policy development and policy implementation processes of the EC. In the spirit of the Baveno Manifesto future emphasis will be given to the response of the Commission to the Kyoto Protocol.

Contact
Alan Belward

Selected further reading

Achard F., Eva H., Glinni A., Mayaux P., Richards T. and Stibig H.J. 1998, Identification of deforestation hot spot areas in the humid tropics, TREES Series B, N°4, EUR 18079 EN, European Commission, Luxembourg, 100pp

Barbosa P.M., Pereira, J.M.C. and Grégoire, J-M., 1998, Compositing criteria for burned area assessment using multitemporal low resolution satellite data Remote Sensing of Environment, 65, 38-49

Diner, D. J., Beckert, J. C., Reilly, T. H., Ackerman, T. P., Bruegge, C. J., Conel, J. E., Davies, R., Gerstl, S. A. W., Gordon, H. R., Kahn, R. A., Martonchik J. V., Muller, J.-P., Myneni, R. B., Pinty, B., Sellers, P.J. and Verstraete M. M. 1998 Multi-angle Imaging SpectroRadiometer (MISR) Instrument Description and Experiment Overview, IEEE Transactions on Geoscience and Remote Sensing, 36, 1072-1087

Dwyer E., Grégoire, J-M. and Malingreau, J.P., 1998 A global analysis of vegetation fires: Spatial and temporal dynamics. Ambio, 27, 175-181

Eva H., and Lambin, E.F. 1998. Remote Sensing of biomass burning in tropical regions: Sampling issues and multisensor approach, Remote Sensing of Environment 64, 292-315

Eva H., Malingreau, J. P., Gregoire, J.M, Belward A. S., and Mutlow, C.T. 1998, The advance of burnt areas in central africa as detected by ERS-1 ATSR-1, International Journal of Remote Sensing 19, 1635-1637

Grégoire J-M., B. Glénat, P. Janvier, E. Janodet, A. Tournier and J.M.N. Silva, 1998, Fire activity in the Guiana Shield, the Orinoco and Amazon basins during March 1998. Publication of the European Commission, Joint Research Centre, Ispra, Italy, EUR 18091 EN

Govaerts, Y. and Verstraete, M. M., 1998, Raytran: A Monte Carlo Ray-Tracing Model to Compute Light Scattering in Three-Dimensional Heterogeneous Media, IEEE Transactions on Geoscience and Remote Sensing, 36, 493-505

Martonchik, J.V, Diner, D. J., Kahn, R. A, Ackerman, T. P., Verstraete, M. M., Myneni, R. B., Pinty, B and Gordon, H.R., 1998, Techniques for the Retrieval of Aerosol Properties Over Land and Ocean Using Multi-Angle Imaging, IEEE Transactions on Geoscience and Remote Sensing, 36, 1212--1227

Martonchik, J. V., Diner, D. J., Pinty, B, Verstraete, M. M., Myneni, R. B., Knyazikhin, Y, and Gordon, H. R., 1998, Determination of Land and Ocean Reflective, Radiative, and Biophysical Properties using Multi-Angle Imaging, IEEE Transactions on Geoscience and Remote Sensing, 36, 1266-1281

Mayaux P., Achard F. and Malingreau, J.P., 1998, Global tropical forest area measurements derived from coarse resolution maps at a global level: a comparison with other approaches. Environmental Conservation, 25, 37-52

Pinty, B. and Verstraete, M. M., 1998 Modeling the scattering of light by homogeneous vegetation in optical remote sensing, Journal of the Atmospheric Sciences, 55, 137-150

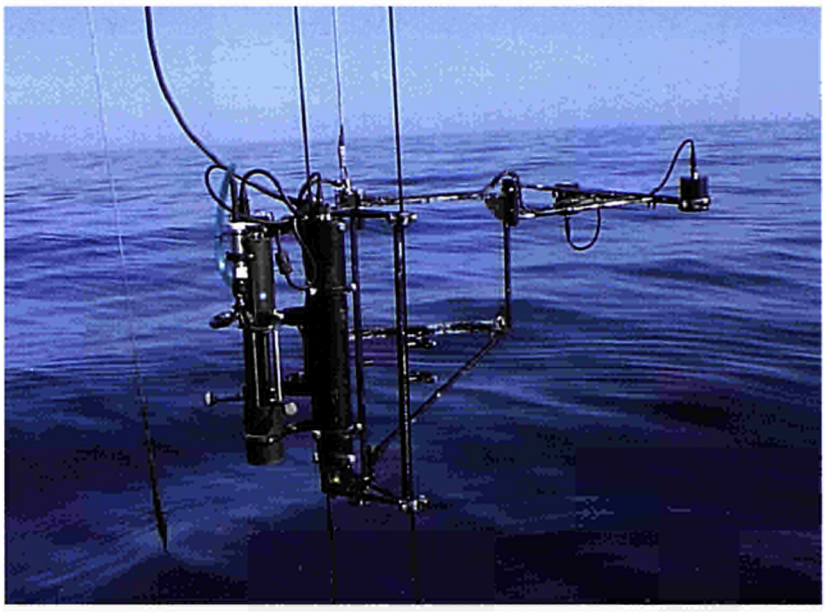
Pinty, B., Verstraete M. M., and Gobron, N., 1998, The Effect of Soil Anisotropy on the Radiance Field Emerging from Vegetation Canopies, Geophysical Research Letters, 25, 797-800

Rosenqvist, A. 1998, The Global Rain Forest Mapping Project by JERS-1 SAR, International Archives of Photogrammetry and Remote Sensing, 31, 594-598

Simard, M., De Grandi, G.F., Thomson, K.P.B. and Benie G.B., 1998, Analysis of Speckle Noise Contribution on Wavelet Decomposition of SAR Images, IEEE Transactions on Geoscience and Remote Sensing, 36, 1953-1964

MARINE ENVIRONMENT AND COASTAL ZONES

The coastal environment is traditionally a centre of important economic activities, exchange and settlement, hosting 60% of the human population and two thirds of the world's major cities, each with more than 1.6 million people. Accordingly, the need for a community strategy on an integrated planning and management of the coastal zones has been identified as a priority issue by several communications of the Commission Directives and Programmes. In many of these programmes, monitoring capabilities that meet the dynamics of coastal bio-physical processes are strongly required by the scientific and managerial community for the development of a decision support system on coastal zone management. Taking this into consideration and owing to significant advances in radiometric sensitivity, as well as in computer technology and communication networks, satellite Remote Sensing techniques and particularly the measurement of ocean colour can provide useful and usable information concerning specific coastal research and operations. The objective of the Space Applications Institute is to develop an end-to-end operational system that will provide high quality spatial products and integrated tools to support policies on sustainable exploitation of the marine resources, prevention and control of the water quality.



Ocean Colour Calibration and Validation

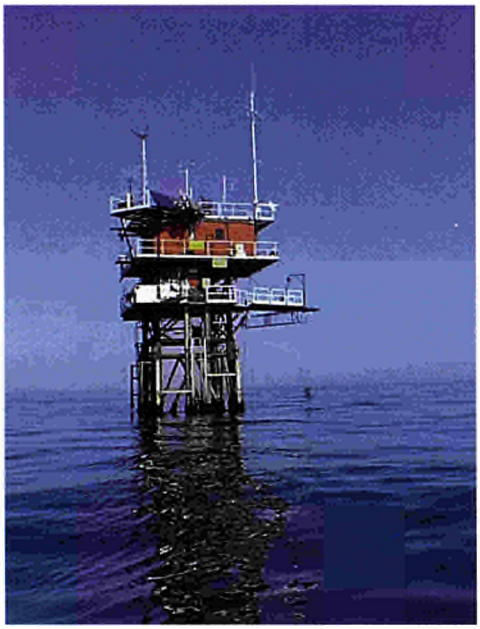
Within the COASTS project (Coastal Atmosphere and Sea Time-Series), atmospheric and marine measurements are periodically performed from Acqua Alta, an oceanographic tower belonging to the Italian National Research Council, located in the North Adriatic Sea, off the Venice lagoon. This activity aims at supporting calibration and validation programs of ocean colour satellite sensors data, such as SeaWiFS, MOS, and OCTS, and has become relevant part of the CEVEx and COLORS projects of the European Commission. In a joint project with NASA, vicarious calibration exercises for the operating SeaWiFS sensor have been carried out by applying a simple atmospheric model to images taken over the North Adriatic Sea from January to July 1998. The images were characterised by different atmospheric and marine conditions, and different sun-sensor geometry. Derived SeaWiFS vicarious correction factors for pre-launch calibration coefficients, show values of about +3% at 412 nm and between -3% and -5% at 443, 490, 510, 555 and 670 nm. The application of the derived correction factors in the processing of sample SeaWiFS images, has shown agreement within 20% between in situ and satellite derived normalised water leaving radiance at 490 and 510 nm.

Contact
Giuseppe Zibordi

Bio-Optical signatures in Coastal Waters

In almost 85 % of the situations, waters at the platform site can be classified as Case 2 waters according to the discriminating limit proposed by Bricaud and Morel (1987) based on the relationship between reflectance at 550 nm and Chlorophyll a (+ pheopigments) concentrations. According to these data, empirical relationships between some selected reflectance ratios and Chl a have been developed for this area. The algorithm, commonly adopted for SeaWiFS to retrieve chlorophyll concentrations in oceans, systematically overestimates the chlorophyll concentration in the N. Adriatic Sea, in particular in the range 0.1-1.0 mg m-3. An increase in absorption by dissolved and particulate matter in the blue part of the spectrum may partially explain the general overestimation of Chl a observed in the processed scenes at this coastal site. The measurement program is still ongoing and has particularly been addressing SeaWiFS and MOS validation during this last year. Further data analysis will help defining the inter-annual variability at the site as well as allowing a validation of the bio-optical algorithms presently under development using this first two years data set.

Contact
Jean-Francois Berthon



The Acqua Alta Oceanographic Tower.

Correction for Tower-shading Effects

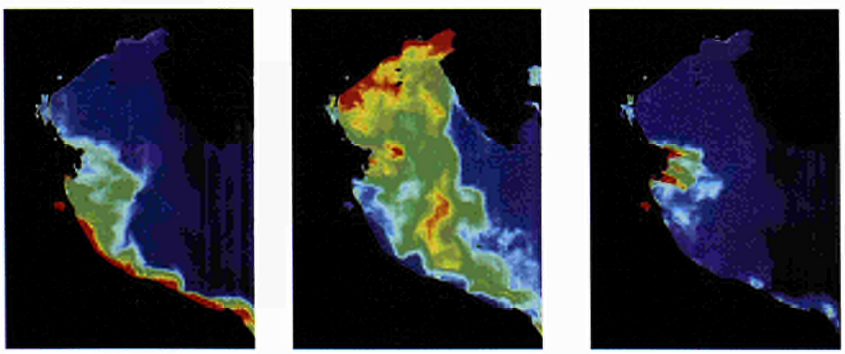
In-water radiance and irradiance measurements made from the oceanographic tower can be perturbed by the tower's shadow. A shading-error correction scheme based on experimentally and theoretically validated Monte Carlo generated look-up tables has been developed and applied to underwater optical data collected in the vicinity of the Aqua Alta tower. The proposed correction scheme, while developed on particular geometrical and environmental parameters characterising the tower can be in principle extended to handle the correction of shaded data acquired from other deployment structures and to provide quantitative information on extreme conditions and on minimal shade-free deployment distances.

Contact
John Doyle

Ocean Colour Inversion Methodology for Coastal Waters

A three component model, which allows maximum variability of the non-chlorophyllous components, was developed allowing the retrieval of chlorophyll, total suspended matter and dissolved organic matter (yellow substance). The methodology is based on the non-linear optimisation of the water-leaving radiance above the sea surface, represented as a function of the sun zenith angle in air and the concentrations of each optically active components. The algorithms are currently applied in the frame of the Environment and Climate Programme, a multi-partner project of the Commission, aiming at the development of an Integrated Coastal Analysis and Monitoring System (ICAMS), and the derivation of water quality indicators at three European sites. Most of the reflectance models for oceanic waters account for elastic processes, which contribute to the diffuse reflectance without modifying the wavelength of the incident and emitted light. On the contrary, inelastic or transpectral processes are associated with a specific redistribution function of the quality and the quantity of light. A study has demonstrated that the absolute reflectance in case II (i.e., turbid) waters is little affected by Raman scattering, as well as the reflectance from the bottom. fluorescence from chlorophyll is much more significant affecting the elastic reflectance up to 150% in the red part of the spectrum. The fluorescence of the yellow substances can also be significant in the blue part of the spectrum, being thus detrimental to the use of blue/green reflectance ratios in the standard chlorophyll algorithms.

Contact
Nicolas Hoepffner
Mark Dowell

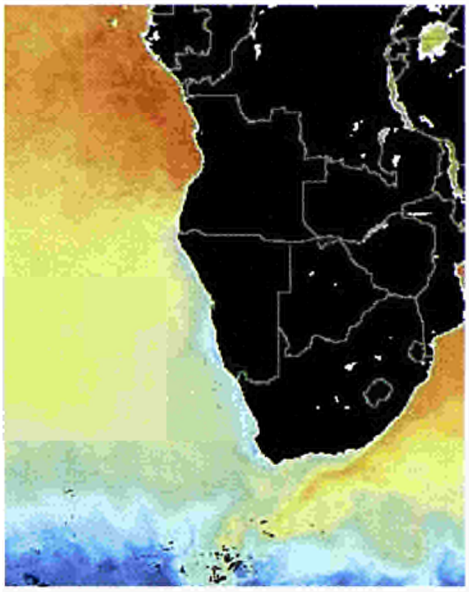


Geophysical variables retrieved from remotely sensed ocean colour data in European waters using the inversion model. From left to right: Clorophyll, Sediments, Yellow Substance.

Support to Fishery Management

The objectives of this activity are to develop appropriate methodologies for improving the sustainable management of small pelagic fish based on the identification and quantification of key environmental conditions that influence fluctuations in their recruitment and distribution. The test areas are the Benguela upwelling and the Angolan current system, where large fluctuations in small pelagic fish catch rates have been observed in the last decades having important economic and social implications in the countries involved. The study is really multidisciplinary, grouping several partners in a shared cost action project called ENVIFISH, whereby a retrospective analysis of fisheries, satellite, oceanographic and meteorological data covering the last 15 years is carried out. The analysis focuses firstly on the identification and examination of biological processes and patterns that could influence the distribution and recruitment of small pelagic stocks and secondly on an integrated analysis of the small pelagic fisheries in the area. ENVIFISH is based on existing, quality controlled data and does not require further data acquisition. For instance the ME existing database of more than 18,000 satellite images of Sea Surface Temperature (SST) from 1982 to 1997 is being used in ENVIFISH in the form of weekly and monthly composites. This is a unique time series of SST, which has so far never been examined in the context of fisheries science.

Contact
Leo Nykjaer



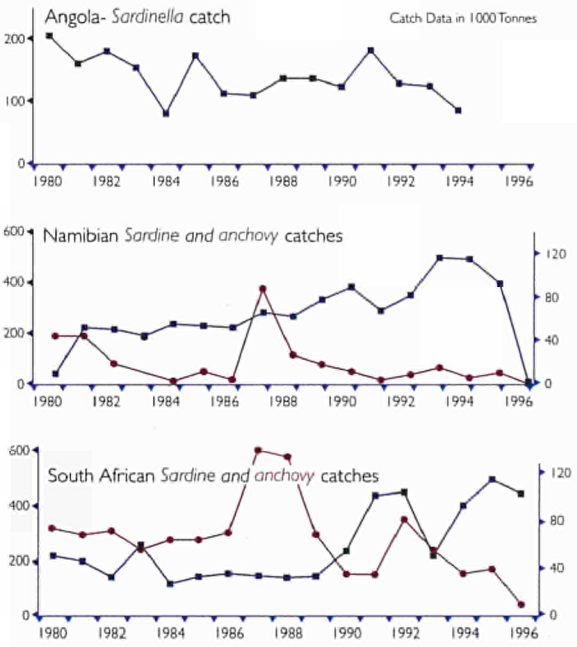
An example of a weekly SST image.

Decision Support for Integrated Coastal Zone Management

The DESIMA project aims to support Coastal Zone Management applications through an improved integration and use of various information sources and tools. It is funded by the Centre for Earth Observation programme and supports the harmonisation and standardisation efforts on a European level in the field of coastal information systems. The main objective of DESIMA is to design and develop a prototype version of a distributed information system of which the main innovative features are the on-line access to data, with user interface allowing catalogue query and on-line data retrieval and transfer to the user; the on-demand data processing, application dependent, allowing delivery of high level information suited to the user needs rather than low level sensor information; the distributed architecture with remote data sets and remote processing; and the Web-based user interface. The prototype version of the information system has been implemented in collaboration with MATRA Systems & Information, ACRI, HR Wallingford & Satellite Observing Systems. The DESIMA information system is based on client-server architecture using Object Oriented Technology. The use of CORBA (Common Object Request Broker Architecture) as the skeleton and C++ and Java as programming languages ensures a stable and well-supported system.

Contact
Wolfram Schrimpf

Catch of small pelagic fish data show strong interannual variability



Satellite Data Assimilation Strategy for Realistic Upwelling Simulation

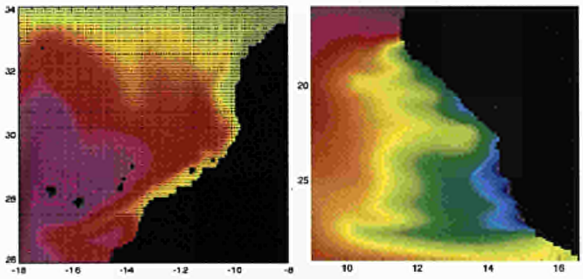
Physical simulation to study upwelling processes in coastal areas was conducted using a three-step one-way nesting method. The large-scale simulation is done in the North Atlantic basin at a 1o by 1o grid. Intermediate windows with a resolution of 1/3o by 1/3o are then nested using initial and boundary conditions from the Atlantic run. The same procedure is used in regional upwelling windows (in a resolution of 1/10o by 1/10o).

Contact
Mohamed Ouberdous

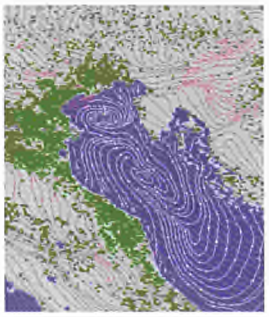
A Coupled Ocean-Atmosphere Model for Coastal Management

A limited area ocean-atmosphere model, consisting of non-hydrostatic atmospheric models and three-dimensional primitive equation hydrodynamic hydrostatic ocean, with a complex parameterisation of physics, is developed in order to analyse and predict temporally and spatially highly variable conditions in coastal zones. Two models interactively exchange boundary conditions at sea surface level, at horizontal scales that are less then 10km, giving the possibility to get a more accurate description of processes controlling the interaction between the sea and the atmosphere. The model can be used to make analyses and forecast of oceanographic and atmospheric parameters in the coastal zone, like the prediction of the sea level height leading to the flooding of coastal areas, or the direction and the intensity of currents and surface winds in coastal areas. The model is tested on case studies in the North Adriatic Sea.

Contact
Sdran Dobricic
Walter Eifler



Sea Surface Temperature: Moroccan and Namibian upwelling system simulation in fine-resolution windows (1/10o by 1/10o) by nesting method after large-scale simulations.



Ocean currents field in the Northern Adriatic and the wind field driving it. Black streamlines indicate the direction of ocean currents at 20m depth, red streamlines indicate the direction of the surface wind and green shade display the agricultural land use.

Selected Further Reading

Berthon, J.-F., Zibordi, G., Grossi, S., Van der Linde, D., Targa, C., 1998. The CoASTS time series of bio-optical measurements in the North Adriatic Sea: an analysis with a view to interpretation of satellite colour data in coastal waters. In: Ocean Optics XIV, Proc. SPIE.

Demirov, E., Eifler, W., Ouberdous, M. and Hibma, N., 1998. A 3-D finite volume free surface model for ocean simulations on parallel computers. In: Proceedings of the third International Conference on Hydroinformatics, Copenhagen, Denmark, 24-26 August 1998, Babovic & Larsen (editors), A.A. Balkema, Rotterdam, Brookfield.

Dowell, M. D., 1998. Optical characterisation and reflectances modelling in Case II waters: quantitative tools for investigations of coastal environments. Ph.D. thesis in Oceanography, University of Southampton, pp. 191.

Dowell, M. D., and Hoepffner, N., 1998. Generic algorithm for retrieving optically active components and differential phytoplankton biomass. In: 3rd ADEOS Symposium, Sendai International Centre, Sendai, Japan.

Doyle, J.-P., and Zibordi, G., 1998. Corrections of oceanographic tower-shading effects on in-water radiance and irradiance measurements. In: Ocean Optics XIV, proceedings SPIE.

Ouberdous, M., Demirov, E., Eifler, W., Villacastin, C., 1998. A study on Northwest Africa coastal upwelling area satellite data, modelling and data assimilation. In: proceedings of the Fifth International Conference on Remote Sensing for Marine and Coastal Environments, San Diego, California, 5-7 October 1998.

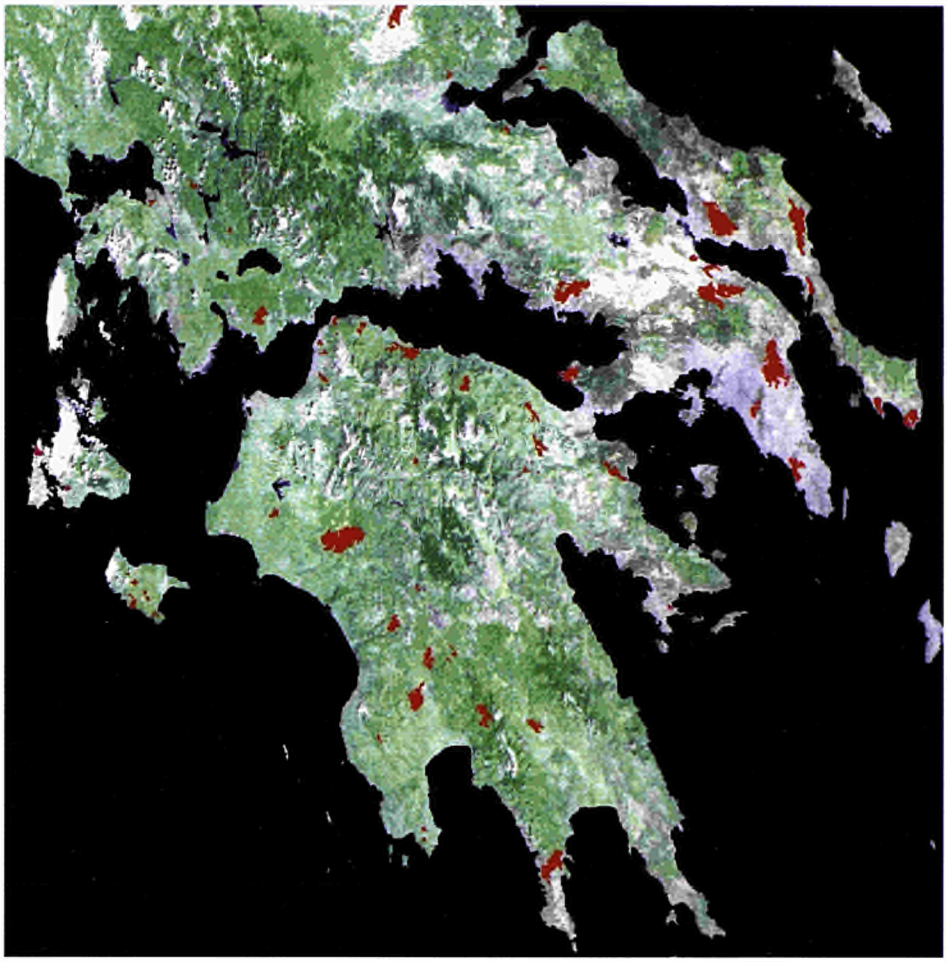
Ouberdous, M., Eifler, W., Villacastin, C., Nykjaer, L., 1998. Data assimilation of remote sensed sea surface temperature on the Atlantic basin and a nested window via a hydrodynamic model. In: Proceedings of the third International Conference on Hydroinformatics, Copenhagen, Denmark, 24-26 August 1998, Babovic & Larsen (eds), A.A. Balkema, Rotterdam, Brookfield.

Schrimpf, W., Iovanovitch, P., and Schlittenhardt, P., 1998. Distributed information system supports coastal zone community. In: Ports of Europe 1999, Ed. Mc Millan Scott, Nov. 1998.

Sturm, B., and Zibordi, G., 1998. SeaWiFs vicarious calibration using a simple ocean-atmosphere model and in situ measurements. In: Ocean Optics XIV, Proc. SPIE.

Recent local and transnational disasters have demonstrated to the European Commission and the Member States of the European Union the paramount importance of efficient risk management. In order to complement existing management practices in the prevention and post-crisis phase by using Earth Observation derived information, the Space Applications Institute implemented pilot projects on different natural hazards such as forest fires, floods, droughts, landslides, and coastal storms. These activities were co-ordinated with the concerted European STRIM programme (Space Techniques for Major Risk Management), whereby SAI is in charge of the overall technical co-ordination and support activities.

Contact
Guido Schmuck



RESURS MSU-SK-derived map product showing fires in Greece from July 1997 to mid-August 1998. The estimated burnt area is about 97,960 hectares.

Forest Fires

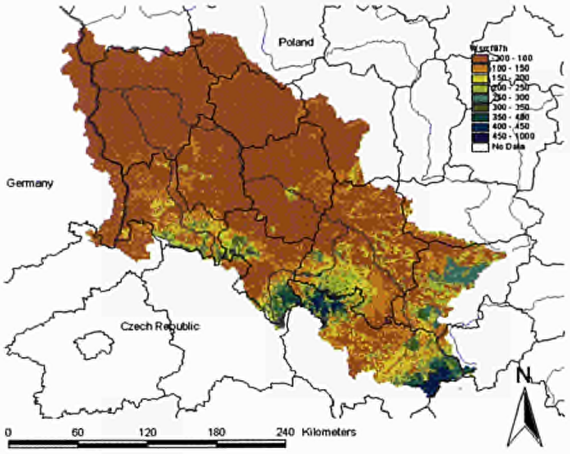
Forest fire activities included those prior to the fire (prevention phase/ fire risk assessment) and those after the fire (damage evaluation phase / burnt area mapping and fire damage assessment). The assessment of forest fire risk is performed from several perspectives. Three types of indices (structural, dynamic, and integrated) are being developed. Structural indices that take into account static factors such as vegetation type (fuel), topography, population etc. are derived to determine first, the probability of a fire event occurring, and second, the likely damage that a fire would cause. Two dynamic indices, one derived from the analysis of evolution of the NDVI over forested areas and a second one derived solely from meteorological data, will be computed for the whole Mediterranean basin. An advanced or integrated index, which takes into account structural and dynamic factors, is also under development. Burnt area mapping and forest fire damage assessment are performed with the use of high and medium spatial resolution remotely sensed data with a spatial resolution that ranges from 20 to 200 m. Several image processing methods based on either spectral separability or change detection are being tested. Once the burnt area has been mapped, the evaluation of the damage is performed by overlaying the burnt mask on a landcover/landuse database. The CORINE landcover database is used at the European scale to maintain a homogeneous criterion in the evaluation of damage among different countries.

Contact
Jesus San - Miguel

Floods

The flood activities are divided in those prior to and after the flood event: flood risk assessment and flood extend mapping and damage assessment. The highest emphasis is put on pre-flood and post-flood activities related to trans-national catchments like the Meuse and Oder. Besides the need for monitoring a flood during a crisis it is obvious that flood prevention is a major issue. Can floods be prevented? Is rainfall the only cause for a flood? Is there an interrelationship between flood frequency and specific European Union policies? In order to answer these questions, improved and as far as possible physically based models are needed for a better understanding of the causal mechanisms associated with extreme floods. Therefore, one of the activities of the Natural Hazards sector is the development of modelling tools to assist in the assessment of the influence of landscape factors contributing to the flooding problem, such as land use changes. In a first attempt, the physically-based LISFLOOD model is under development for simulations of floods in large European drainage basins. Full basin-scale simulations have been carried out, such that influences of land use, spatial variations of soil properties and spatial precipitation differences are taken into account. The input parameters for the LISFLOOD model are topography, precipitation amounts and intensities, antecedent soil moisture content, land use type and soil type. Processes simulated are precipitation, interception, snowmelt, evapotranspiration, infiltration, percolation and capillary rise, groundwater flow and surface runoff. The user can choose both the spatial and temporal resolution of the model. Outputs of LISFLOOD are timeseries of discharge at user defined catchment outlets and sub-outlets to produce flood-hydrographs. Furthermore, final maps of the (water-)source areas of the flood, total rainfall, total interception, total evapotranspiration, total infiltration can be produced. Post-flood activities concentrated on detecting flooded areas from SAR imagery and combining this information with land use and digital elevation data to find flood depths and calculate land use statistics in flooded areas.

Contact
Arie De Roo

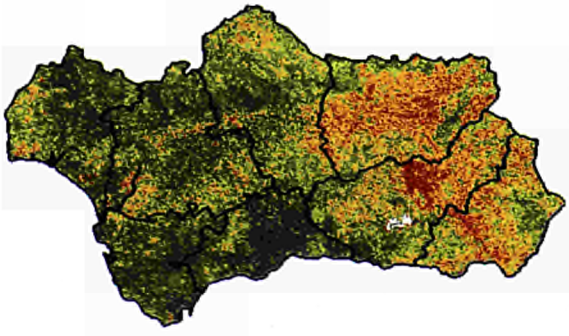


Flood source areas for the Oder flood 1997.

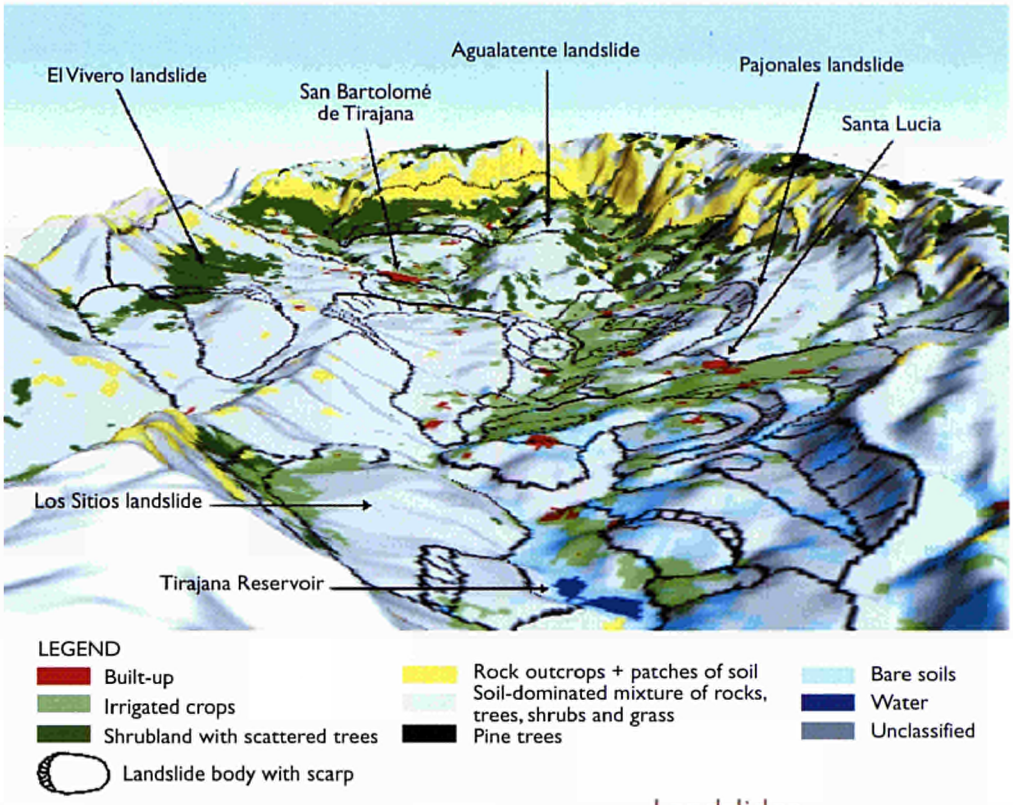
Droughts

In 1998 activities have been concentrated on the development and testing of algorithms and tools for drought monitoring and impact assessment using Remote Sensing. Two approaches were tested and possibilities for an implementation in an operational environment were evaluated. The first approach uses indices derived form satellite data to monitor the condition of the vegetation cover. A second, process-based approach uses a combination of meteorological, environmental and satellite data in a model of the surface energy balance using indicators such as the evaporative fraction which is a measurement of the amount of energy used for evaporation of water and transpiration by the vegetation. This indicator is a physically defined quantity and directly related to the water availability at the surface.

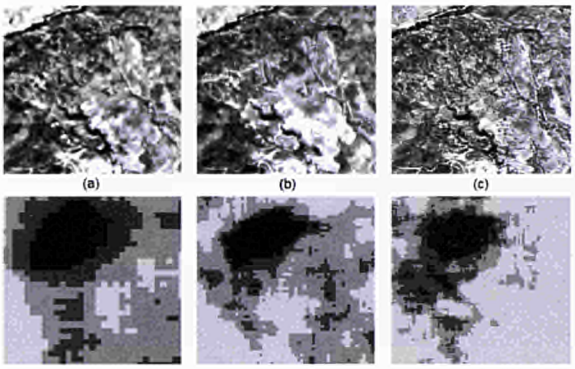
Contact
Jürgen Vogt



An example of the Vegetation Condition Index (VCI) for the region of Andalusia in Spain, during three selected ten-day periods from the beginning of March to the end of April for 1989 and 1992. Colours vary from red, signifying serious water stress, to yellow or brown, and light to dark green, signifying good vegetation conditions. The images show the difference between the relatively humid spring of 1989 and the beginning of a prolonged drought in 1992.



Land cover classification from Landsat TM data on Canary Islands. Crop irrigation on old landslides may result in local re-activation of slope movement affecting also built-up areas.



Texture spectrum-based segmentation of SPOT Pan image (a), IRS-1C Pan image (b) and ATM visible image (c) at 10, 5 and 3m resolution respectively. On lower images, darker areas represent higher landslide hazard.

Landslides

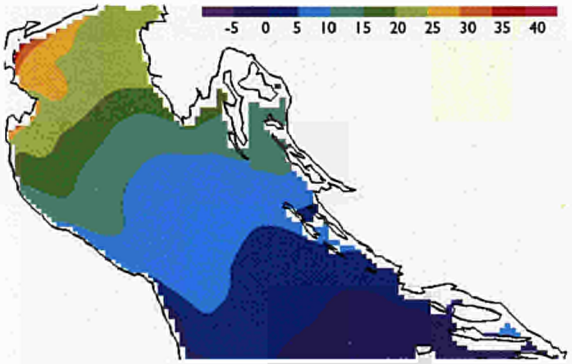
In 1998 research work extended to non-Mediterranean regions. Research on application of image segmentation techniques to both panchromatic and multispectral remotely sensed imagery at various spatial resolution scales for landslide recognition and hazard assessment in SE Spain progressed as planned. An EU competitive project, called Runout, in the framework of the Environment and Climate Programme, was initiated in collaboration with other European laboratories to investigate hazard from large-volume and long-runout landslides. In this project, land use change maps for a mountainous area on Canary Islands were generated using multitemporal Landsat TM data. These maps together with a DEM also produced for this area are being analysed in collaboration with the University of Las Palmas, Spain, to evaluate the land use impact on slope instability. In addition, within the aforementioned project, in collaboration with CNR-IRPI of Padua and Ferrara University, Italy, an active landslide in Veneto, Italy has been selected to be used as a case study for the ongoing research on using image processing for landslide monitoring from optical data. Until very high spatial resolution spaceborne imagery becomes available, this investigation will be conducted using simulated multi-temporal products from scanned aerial photographs. Geomorphologic information from image-derived texture will also be integrated in the hazard analysis chain.

Contact
Javier Hervas

Coastal Storms

The description and forecasting of natural processes in coastal zones, require high spatial and temporal resolution data in order to meet the current demand in sectors such as industry, traffic, tourism, and environmental protection. Pollution and coastal flooding due to sea level height change constitute the main threats for the coastal zone. Spaceborne data not only provide a unique way of collecting information regarding the state of these environmental variables but they may also be used for the initialisation of numerical models to get a better picture of the coastal zone environment and to forecast its evolution. A limited area ocean-atmosphere model has been developed using a two-way simultaneous coupling of two existing three-dimensional primitive equation hydrodynamic ocean and atmospheric models, with complex physical parameterisations. The ocean model calculates the sea surface temperature which is used for the calculation of surface fluxes in the atmospheric model. Surface fluxes of momentum and heat together with the short wave radiation calculated by the atmospheric model are used as the surface forcing in the ocean model. The non-hydrostatic option in the atmospheric model gives the possibility to simulate ocean and atmospheric processes with horizontal scales of a size less than 10km. Using high spatial resolution, the coupled ocean-atmosphere model can provide detailed analysis and forecasts of natural processes, such as the risk of a coastal area to be flooded due to coastal storms. The coupled model capability to forecast the sea level height, the sea surface temperature and ocean currents, has been tested in the North Adriatic Sea. Case studies show significant impact of the resolution in the atmospheric forcing on the simulation of oceanographic features. The comparison of model results with in situ measurements shows that the coupled model is able to qualitatively and quantitatively forecast spatially and temporally highly variable oceanographic features a few days in advance.

Contact
Wolfram Schrimpf



Instantaneous sea surface elevation (cm) simulated by the coupled ocean-atmosphere model for the 5th November 1994 case study.

Selected further reading

Dobricic S., Eifler W., Demirov E. , Coupled limited area ocean-atmosphere model for coastal zone studies: Model development and application to the Adriatic, EUR 18140.

De Roo, Price, D.A., Schmuck, G., 1998, Simulating the Meuse and Oder floods using the LISFLOOD model. In: Modellierung des Wasser- und Stofftransports in grossen Einzugsgebieten. Proceedings Giessen Meeting November 1998. Under review.

Hervás, J. and Rosin, P.L., 1998, Semi-automatic texture segmentation of remotely sensed imagery for landslide hazard assessment. Annales Geophysicae, Vol. 16, Suppl. IV, C 1215.

San Miguel-Ayanz, J., Annoni, A., Schmuck, G., and Meyer-Roux, J., 1998, Forest fire monitoring and damage assessment in Mediterranean landscapes through the integration of remote sensing and GIS techniques, ECO BP'98 International Sysmposium on Resource and Environmental Monitoring: Local, Regional, Global, held on Sept. 1- 4 in Budapest, Hungary.

Vogt, J.V., Viau, A.A., Beaudin, I., Niemeyer, S., Somma, F., 1998, Drought Monitoring from Space Using Empirical Indices and Physical Indicators.- Proc. Int. Symp. on 'Satellite-Based Observation: A Tool for the Study of the Mediterranean Basin', 23-27 Nov. 1998, Tunis, Tunisia, 7 pp.

DETECTION AND POSITIONING OF ANTI-PERSONNEL LANDMINES

Effective mine action requires proactive assessment and planning, solid diplomatic skills, good political instincts, resourceful management, competent logistics. However, success will require not only widespread adherence to the Ottawa Convention and a more focused and co-ordinated effort on the part of the international community in demining and assistance to mine victims, but also more effort to develop and employ new technologies. Only then will we be able, all together, to overcome the global scourge of landmines within the next 10 to 15 years. The JRC provides the central clearing house for all Anti-personnel Landmine (APL) related technical projects, technical advice and support to Commission services; it maintains appropriate databases; it constitutes the technical liaison for collaboration with external partners, especially in the areas of mine field survey and close detection of landmines thanks to its high quality research activities. In addition, it is especially focusing on topics, such as the selection of standards for the verification and specification of mine action technologies; the establishment of an international network of test and evaluation facilities; the facilitation of in-field demonstration experiments; and the design and development of modern information management tools. Recently a conference was organised in Ispra, Italy, as part of a series of international events. This was a first review of previous initiatives and provided a unique forum for communication between the user community (deminers and mine inflicted countries), industry, research organisations and donors. The TDP unit (Technologies for Detection and Positioning; Anti-personnel mines) has undertaken a series of projects: MINETEST. [...]

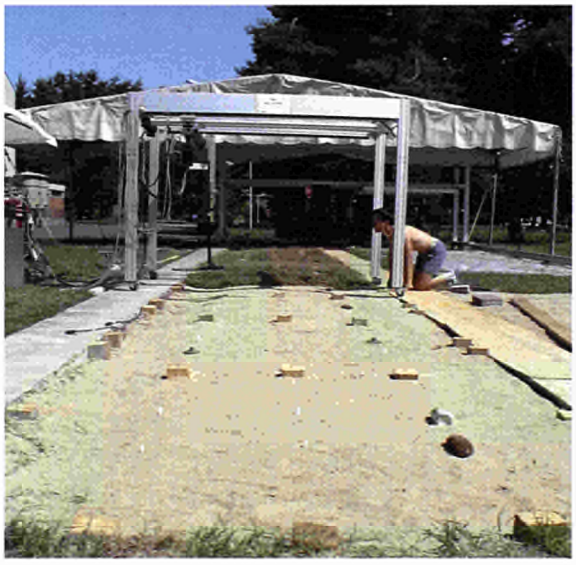
[...] MINESIGN, SIGEX, MIMEVA, SEARCH, and ARIS. It has also established extensive test facilities including the European Microwave Signature Laboratory (EMSL) and the European Optical Goniometric (EGO) facility. Finally, to address the needs in civilian demining, the JRC has added a clean test field to allow the measurement of targets in controlled conditions and a new facility, the Karl Friedrich Gauss Laboratory, in which metal detectors and demining systems can be assessed in virtually ideal conditions.

Validating Demining Projects

The MINETEST project provides access to standard, independent facilities to verify, validate and benchmark sensors and systems for civilian demining projects. The main aim is to support the Commission's ESPRIT shared cost action projects related to civilian demining R&D. These facilities are well proven and cover all spectral ranges of interest with respect to sensors envisaged for detection and identification of anti-personnel landmines. In particular, a test frame is used to support open air measurements principally by radar, optical and infra-red sensors. The Karl Friedrich Gauss Electromagnetic Laboratory is primarily used for low frequency test to evaluate the performance of metal detectors against reference targets. The European Microwave Signature Laboratory (EMSL) is used to establish reference characteristics of the targets used to evaluate the sensors offered for test mainly in microwave. The European Goniometric Facility (EGO) aims to establish characteristics of targets used to evaluate sensors mainly in the optical and infrared ranges. Further resources are provided to assist with the design of experiments and the collection of data to validate the performance of the sensors and systems under test. In addition there has been a series of technical workshops addressing user needs, standardisation issues, and the use of Geographic information systems for the management of civilian demining programmes.

Opening Session of the conference Demining Technologies International Exhibition, held in Ispra, Italy.

The Karl Friedrich Gauss laboratory: a new test facility.



Assessment of a prototype multi-sensor mine detector system.

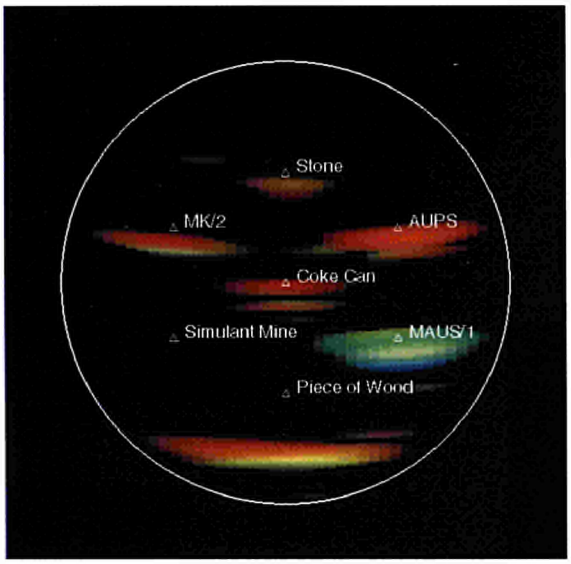
Measuring Anti-personnel Landmine Signature

In the MINESIGN project the responses of targets to incident radiated energy are investigated and the results are related back to the physical characteristics of the targets. At a later stage a series of characteristics are being established for a range of targets, environments, and detector classes, including magnetic anomaly detectors, metal detectors, surface penetrating radar (SPR) with 3D imaging capability, optical and infrared systems including polarimetric systems. Apart from the aforementioned facilities, a linear synthetic aperture radar (LISA) is used to establish reference responses of targets to radar systems in an outdoor environment. By means of a searchable database, registered users have access to such signature data together with additional information related to demining actions and field practices. Within this project, several activities were undertaken including the identification of buried landmines using Radar Polarimetry, measurements of mine signatures, complex permittivity measurements of vegetation and soil, and development of optical and infrared techniques for anti-personnel mine detection.

To identify buried landmines using Radar Polarimetry, a system based on a forward-looking radar which synthesises a two dimensional aperture was tested at the EMSL and an algorithm that is able to focus images of objects embedded in a homogenous ground was developed. It was possible to form images which are virtually free of any geometric distortion owing to refraction. Radar signatures of the buried objects can only be obtained, for the time being, when the ground is homogeneous and the contrast between the object and the surrounding medium is reasonably high. In order to maximise the identification capabilities, the system operates in a fully polarimetric mode. Individual radar images for each polarisation are combined and examined. The results are the polarimetric signatures corresponding to each target in the image.

To discriminate between real mines and, for example, mine-like stones, it is necessary to be aware of the difference in signatures, or characteristic features in the radar return of these objects. The symmetrical shape of man made objects such as anti-personnel landmines often gives specific cross-polarisation patterns, which cannot be detected if irregular objects such as stones are present. The results show that there is a possibility to apply and develop models of surface penetrating radar for mine detection. The efficiency of the technique depends on system parameters such as the antenna, the waveform, and dynamic range, and is related to the target and environmental conditions such as the dielectric contrast, soil moisture, surface roughness and clutter. Experiments were conducted with the Linear SAR system for a number of mines and mine-like objects buried at different depths in dry sand.

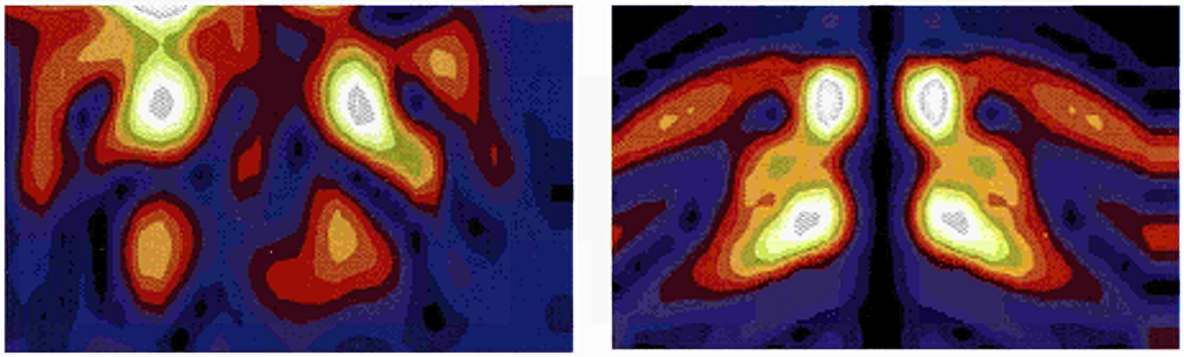
Mines placed on sand with defined surface roughness for measurement in the EMSL.



Polarimetric signatures of three anti-personnel landmines, a coke can, a stone, and a piece of wood buried in dry sand at a depth of 15 cm. The frequency range used in the measurement is 1.5 to 9.5 GHz. The size of the two dimensional synthetic aperture was approximately 2m by 2m.

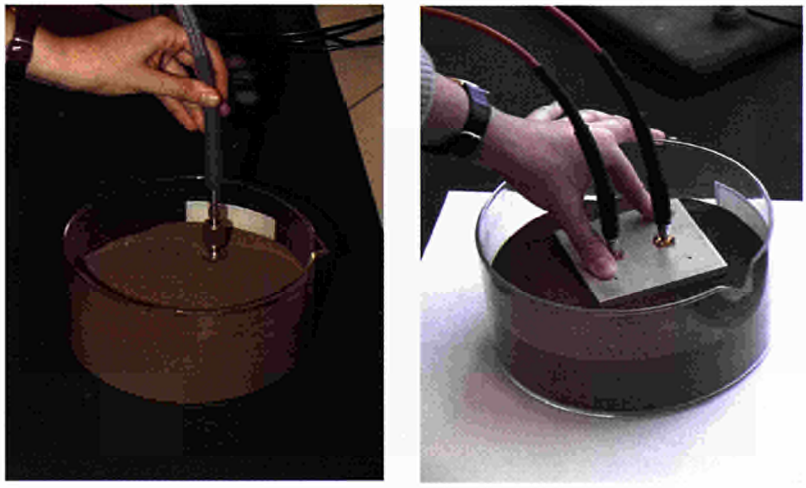
On the other hand it is also necessary to know the dielectric properties of an object and the surrounding medium, which in demining consists of vegetation and soil. There has been some development of permittivity measuring systems in the EMSL to support work on the radar properties of vegetation. Soil is a complex mixture of mineral and organic material containing trapped air and water. This complexity makes analysis difficult. Therefore the ability to measure electromagnetic characteristics in real-time can bring important benefits to the application of radar to mine detection. Many attempts have been made to empirically predict soil permittivity as a function of parameters like moisture, texture, geo-chemical composition and temperature. The results show that moisture content is a dominant parameter. In the EMSL, two approaches using frequency domain measurements were employed: the open-ended coaxial probe, and the ring resonator. With the open-

ended coaxial probe technique, the complex permittivity of the material is derived from the reflection coefficient measured at the open probe-tip to material interface. The method is particularly suited for soft soils, which make good contact with the probe-tip. The ring resonator technique measures the transmission coefficient of an L-band micro-strip ring resonator probe, which is placed in contact with the soil. The micro-strip probe consists of a thin, circular shaped conductor strip on a dielectric substrate with a ground plane. The permittivity of the material can be found from the first resonant frequency and the Q-factor of the transmission coefficient.



Recognition of mines may be possible from the analysis of the radar return and from symmetry properties. Result obtained for a target 9 cm diameter and 3 cm height buried 5 cm deep showing position on the horizontal axis and time on the vertical axis (left). A corresponding Finite Time Domain Technique (FDTD) simulation (right).

To improve the understanding of physical characteristics of mines, mine-like objects and the environment in the optical and infrared range, a series of measurements started at the European Goniometric facility and the Radiometry Laboratory. The mines were placed on a background of dry sand but were not buried. Other objects are usually distinguished thanks to their characteristic absorption bands. APLs were analysed in the EGO goniometer using a high resolution CCD camera (SBIG 8) and a narrow band IR filter centred at 750 nm. Images were collected over a range of azimuth and zenith angles. This work examines the potential benefits that may result from narrow band spectral processing of an image. The same facility was used in the measurement of the Bidirectional Reflectance Distribution Function (BRDF) of certain selected natural backgrounds such as sand and soil in dry and humid states and with rough and smooth surfaces in the 400 - 2400 nm and 400 - 1100 nm ranges respectively. The BRDF is measured at various illumination angles and the resulting reflectance function is often wavelength dependent. In the thermal infrared, reflectance and emittance of targets has been measured using a wide-band 6-20 μm detector. The effect of some other objects in the detector field of view (FOV) such as debris or a metallic trip wire is part of ongoing research work to determine whether infrared sensor can be useful in close-in mine detection. These measurements were made with and without a source of illumination. Outdoor test measurements have been made as part of a study the long term variation of soil surface and sub-surface temperature in the range 8-13 μm. The solar irradiance and the surface and sub-surface temperature at a depth of 8 cm were measured continuously for several weeks and the relationship between these parameters was observed. Further verification of atmospheric transmittance measurement procedures was also undertaken during the same period.



Measuring soil permittivity at the EMSL the open-ended coaxial probe technique (left), and the ring resonator technique (right).

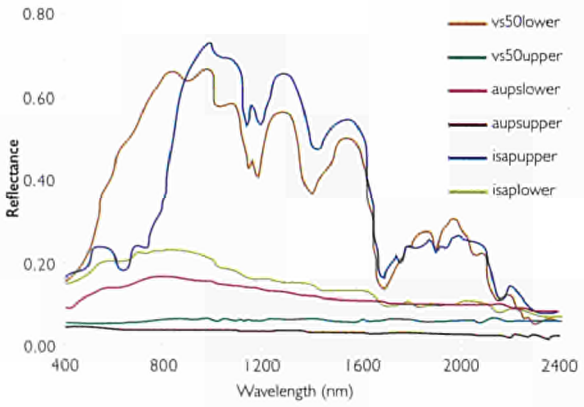
Signature Exploitation

The SIGEX project aims to identify significant resources of EU research institutes and industry which could be used to accelerate civilian demining R&D programmes. When collecting APL signature data, a series of variables should be recorded including environment characteristics, types of mines and clutter, placing of mines, weather conditions, physical parameters, range of measurements and accuracy. Formats to store and transmit these data will be defined and published to simplify future use. The team started to develop a number of standard agreements for the provision or exchange of APL signature data to R&D teams working on humanitarian demining R&D in the context of ESPRIT and national programmes. This will form the framework which will allow data re-use. A catalogue of available landmine signature databases and ongoing projects developing such data, with the conditions under which the data may be made available is being established. Finally the team started to manage the validation, and brokerage service for the dissemination of landmine signature data to selected R&D projects on civilian demining. The work involves consultation with a wide range of organisations working both inside and beyond the European Union since this world-wide problem needs wide ranging international collaboration.

Mine Imitations for In-field Evaluation

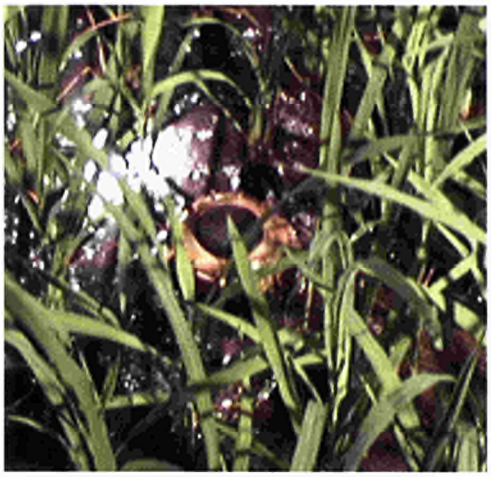
The MIMEVA project investigates the applicability of various approaches to the design of surrogate (non-explosive) mine-like targets for use in evaluation of developed equipment. Initially a list of prime threats is being established. This is based on the geographic area selected by the EC as the preferred area where the first field tests of the resulting sensor systems can be conducted. The comparison of benefits and limitations of different methods for replicating landmines includes investigating available surrogates as well as considering alternative construction methods. We are working closely with a demining consultant to ensure that the proposed models reflect all critical areas of the real target characteristics. The design will be validated by comparison of surrogate signatures with those of live mine targets.

Mine types used in the experiments showing from left to right: VS50, AU PS AS, Israel n.4



Reflectance spectra of the mine types above.

An example of the Bidirectional Reflectance Distribution Function of a sand target in the thermal infrared range (6-20μm).



Narrow band image of VS50 APL in rice crop.

Search for New Technologies

There is a range of sensor technologies and systems which are currently used in industrial and research processes which may also have potential applications to civilian demining either as primary sensors or as back-up sensors in a multi-sensor system. The SEARCH project has been undertaken to identify, through a tendering process, organisations in possession of such sensors and which are mature enough to allow independent testing to be undertaken. The JRC will provide access to test facilities for verification, validation and bench-marking of the selected systems and equipment for the detection and identification of anti-personnel landmines. It is foreseen to assess four sensors at our test facility. After evaluation, two systems will be taken for assessment in a mine affected area to allow real terrain and environment effects to be introduced. Finally the results of the tests will be disseminated for revision and to allow consideration for further action to translate the equipment into a fieldable component.

Action for Research and Information Support in Civilian Demining (ARIS)

This is a network of excellence, which the JRC is facilitating on behalf of DGXIII, to help improve the effectiveness of R&D activities in demining technologies. It is open to end-users and RTD teams from industry, universities and research centres with relevant technology goals in the area of humanitarian demining R&D and will co-ordinate research, training and technology transfer policies. It will achieve this through a number of actions including the ARIS Journal and web site (http://www.demining.jrc.it/aris) to enhance communications by identifying publications related to humanitarian demining, stimulating information exchange and assisting planning. Moreover seminars and technical workshops will be organised to develop collaboration between research teams and industry and link R&D teams to the end-users. Specialist committees have been formed to define a future strategies demining and to identify R&D needs and opportunities. The overall mandate is to encourage the development of synergy between the teams working in this field and to improve the effective use of the R&D funding.

Contact
John Dean

Assessment of mine targets at the EGO (left), and EMSL (right).

Selected Further Reading

Dean, J.T., Sieber, A.J., Plans of the EC and Support Activities at the Joint Research Centre, Ispra, Italy, Sustainable Humanitarian Demining: Trends, Techniques and Technologies, Humanitarian Demining Information Centre at James Madison University. 1998. (Summary of proceedings of the International workshop on Sustainable Humanitarian Demining, Zagreb, Croatia, September 30 - October 2 1997).

Fortuny, J., An Efficient Three Dimensional Near Field ISAR Algorithm Using the Method of Stationary Phase, IEEE Trans. on Aerospace and Electronic Systems, pp. 1261-1270, Oct. 1998.

Fortuny-Guasch, J., and Sieber, A. J., Three-Dimensional Synthetic Aperture Radar Imaging of a Fir Tree: First Results. IEEE Trans. on Geoscience and Remote Sensing, to appear in the issue of March 1999.

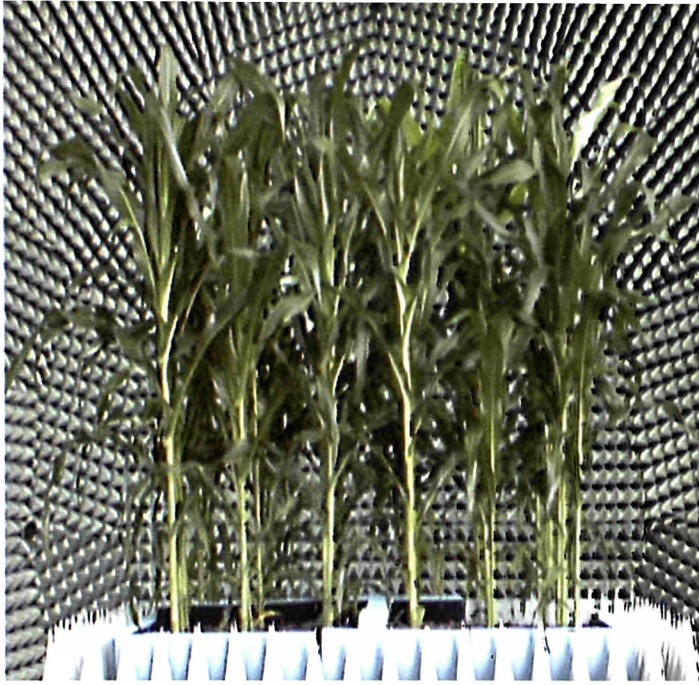
Franchois, A., New techniques for mine field survey and close-in detection, Proceedings of the Forum on the Problems of Peace and War: After the Mines: Aspects and Problems of Humanitarian Demining, 8-9 Oct. 1998, Florence, Italy, in press. Invited paper.

Olyslager, F., Fortuny, J., Franchois, A., Nesti G., and Sieber, A.J., Numerical and measurement based study of the Resonance frequency technique to detect anti-personnel mines; Proceedings of the International Conference on High Power Electromagnetics - EUROEM'98, Tel-Aviv, June 1998, in press.

Olyslager, F., Fortuny-Guasch, J., Franchois, A., Nesti, G., and Sieber, A.J, Numerical and Measurement Based Study of the Resonance Frequency Technique to Detect Anti-Personnel Mines, Proceedings of the 11th Conference on High Power Electromagnetics, EUROEM'98. Tel Aviv, Israel, June 14-19, 1998.

Olyslager, F., Franchois, A., Fortuny, J., Nesti, G., and Sieber, A.J., Techniques based on the wideband time response to detect anti-personnel mines, Proceedings of the PIERS Workshop on Advances in Radar Methods, Baveno, July 1998, in press.

Sieber, A.J., (editor) Proceedings. Demining Technologies - International Exhibition, Workshops and Training Courses, 29 September - 1 October 1998, JRC, Ispra Italy.



The TDP Unit provides appropriate tools which allow the optimisation of sensors and algorithms supporting actual fields of applications. The unique tools used for these assessments include the European Microwave Signature Laboratory (EMSL), the Linear Synthetic Aperture radar (LISA) and the European Goniometer (EGO). The EMSL and LISA both operate in the radar spectrum from around 0.5 GHz to beyond 20GHz. EGO operates in the Optical and near infra red regions.

The work of the Unit has been applied to a wide range of practical problems during the year. Techniques that have been investigated include application of

- *radar polarimetry;*
- *polarimetric radar interferometry; and the*
- *bi-directional reflectance distribution function (BRDF) in the optical and near infra-red region of the electromagnetic spectrum.*

Some examples of the application of these techniques are summarised in the following paragraphs.

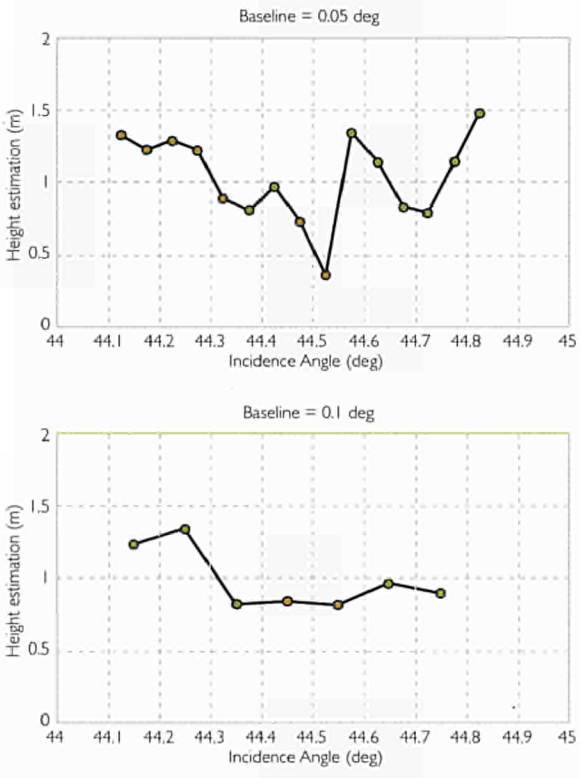
Radar Polarimetry

The European Microwave Signature Laboratory (EMSL) participates to a project called Research Network on Radar Polarimetry Theory and Applications. The motivation for establishing a specific research network on Polarimetry is that, although this particular scientific application has been rapidly expanding in fields such as weather prediction and telecommunications, it has not attained its full potential yet. In part this is due to the lack of a coherent and structured polarimetric theory. This project is financed by the European Commission DGXII/G-2 through the Training and Mobility of Researchers Programme (TMR) and hence training of young researchers is an underlining objective of all projects. The collective scientific resource available within Radar Polarimetry Network offers unique opportunities for young scientists to acquire knowledge in the theory and application of polarimetric methods.

Contact
Giuseppe Nesti

TMR Network on Radar Polarimetry
http://www.dlr.de/NE-HF/projects/TMR/

Deutsches Zentrum für Luft- und Raumfahrt, Germany
University of Essex, UK
Danish Defence Research Establishment, Danmark
Universitat Politecnica de Catalunya, Spain
Modélisation-Optimisation-Théorie-Simulation Mathématique, France
Institut de Recherche et d'Enseignement Superieur aux Techniques de l'Électronique, France
Daimler Benz A.G., Germany
Fluid Gravity Engineering Limited, Scotland
Joint Research Centre of the European Commission, Italy



Retrieved height as a function of the incidence angle for the baselines of 0.05 and 0.1 degrees in S-Band.

Canopy Height Estimation Using Polarimetric Interferometry

Canopy height estimation, and hence biomass, is one of the most important applications of Polarimetric Interferometry. At the EMSL, an experimental campaign was carried out. The main objective was to validate the technique experimentally in a controlled environment. A number of vegetation samples including maize, rice and fir trees were measured using a wide-band polarimetric radar. Vegetation is modelled as a multi-layer random volume with different scattering mechanisms. First, polarimetric backscatter is acquired from two closely spaced viewing angles. Then a polarimetric decomposition into orthogonal scattering mechanisms is applied. Interferometry is subsequently used to retrieve the phase centres from each scattering mechanism. Finally, the height is simply derived from the phase centre difference.

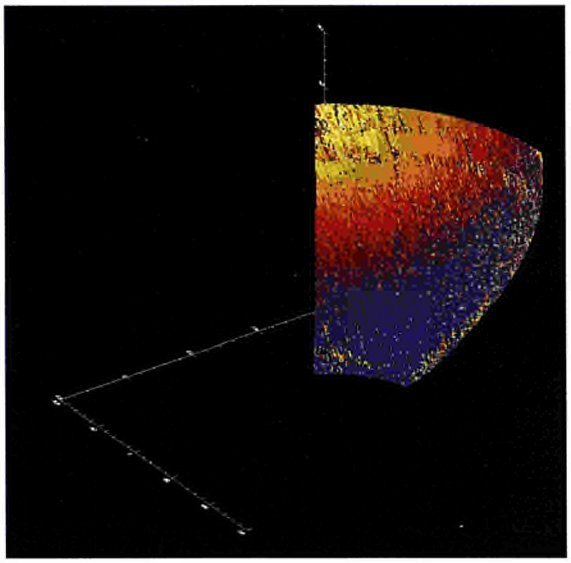
Contact
Joaquim Fortuny Guasch

Environmental Monitoring

In collaboration with a team from the Cold Research Centre, Kiruna, Sweden, an extensive use of radar and optical systems for the analysis of snow properties in North Europe was proposed in view of the Fifth Framework Programme. Furthermore, in collaboration with a team from the Finnish Geodetic Institute (FGI), the Biodirectional Reflectance Distribution Function (BRDF) of certain agricultural crops (rye and barley) was measured with different row spacing in the EGO goniometer. The study aims to improve the interpretation of airborne and spaceborne data of arctic rye and barley fields. The preliminary results show that rye and barley have different spectral BRDF during the growth period. Finally, as a complement to the Institute efforts on forest fire monitoring, a set of measurements of burnt forest materials was accomplished in the EGO in the visible and near infrared. With this preliminary set of data it was possible to evaluate the improvement of forest fire assessment through BRDF measurements and spectral changes to be used as a complimentary tool to disaster management.

Contact
Brian Hosgood

A target of rye prepared for BRDF measurements in EGO.



First differential interferogram of the dam between the measurements acquired in June and August. Colours indicate relative displacements ranging from 0 (blue) to about 2.5 cm (yellow). As expected maximum displacement occurs at the upper central portion of the structure while the foot of the dam is not moving.

Structural Change Monitoring Using SAR Interferometry

Further to the well-known success of Differential SAR Interferometry to quantitatively monitor ground displacement, the EMSL team suggested that this technique could be applied to monitoring very small deformation of structures such as buildings or bridges as a complement to conventional measuring tools. Following a positive feasibility test performed at the EMSL on a small artificial target, a new demonstration experiment on a real structure was conducted using the outdoor portable Linear SAR (LISA) system with a view to validating the technique in real operational conditions. The selected target is the Ridracoli barrage in Romagna, Italy. The barrage is a double curved concrete structure. Its crest stands almost 100 m above ground and it is about 400 m long. The water level in the basin can vary by more than 50 m, producing in combination with the seasonal temperature variation an overall deformation of the barrage structure. Measurements were repeated at 7 different dates in the period from June to September. A number of differential interferograms were generated corresponding to different deformation conditions of the barrage. The results are in accordance with those derived from the monitoring system installed on the barrage.

Contact
Dario Tarchi

Selected Further Reading

Cloude, S. R., Fortuny, J., lopez, J.M., Sieber, A.J., Wide-Band Polarimetric Radar Inversion Studies for Vegetation Layers, IEEE Trans. Geosci. Remote Sensing, in press.

Nesti, G. et al., Phase Shift and Decorrelation of Radar Signal Related to Soil Moisture Changes, Proceed. of 2nd ESA Workshop on Retrieval of Bio- and Geo-physical Parameters from SAR Data for Land Applications, ESTEC, Noordwijk, The Netherlands, 21-23 October 1998.

Tarchi, D., Ohlmer, E., Sieber, A.J., Monitoring of Structural Changes by Radar Interferometry, Springer-Verlag New York Inc., Res Nondestr Eval, 9: 213-225, 1997.

Rudolf, H., Tarchi, D., Sieber, A.J., Combination of Linear and Circular SAR for 3D Features, IGARSS'97, IEEE International Geoscience and Remote Sensing Symposium, Singapore, Aug-97.

The proposals of Agenda2000 represent a solid framework for the integration of minimum environmental concern into Europe's agricultural and rural policy, providing efficient instruments to reconcile agriculture with environmental objectives. In addition, the enlargement of the European Union and the increasing complexity of trans-national issues that policy makers face highlighted the importance of adequate spatial data and tools to translate these data into responsible decision-making. This can be done efficiently and cost-effectively only if form, content, quality, and accessibility of Geographic Information (GI) is harmonised and guaranteed. SAI's experience in these fields and its commercially independent position in Europe confer on the Institute its leading role in the creation and management of pan-European spatial databases. Moreover they have always constituted the requisites for the Space Applications Institute to become a technical co-ordination point to support and direct the growth of a commercial Geographic Information System (GIS) market in Europe. The following subsections describe some of the SAI activities related to spatial information and services, namely the creation of pan-European harmonised databases and systems, the support to EU industry for interoperability of GIS, the assistance in the definition and implementation of the European Geographic Information Infrastructure, the set-up and co-ordination of Thematic Networks, and the Geographic Extensions outside the European Union.

Contact
Alessandro Annoni

Geographic Information & GIS

The new Eurostat-GISCO (GIS of the Commission) architecture has been equipped with a new logical data model and preparative steps were undertaken for a two-year implementation of Geo-Data Server technology. The definition and development of the GIS system for protected areas in the framework of Natura2000 recently started with the aim to adopt the GISCO model. At the same time, support was provided to DG XIII for the definition and the creation of the European Geographic Information Infrastructure (EGII) through various measures, including workshops and SAI staff participation in the High Level Working Party for the GI2000 initiative, Towards a European Policy Framework for Geographic Information. The Pan-European Link for Geographic Information (PANEL-GI) project, started in 1998 aiming to improve the networking between Central and Eastern and European Union partners. The Space Applications Institute was also involved in increasing the interoperability of GIS systems participating in the GIS Interoperability Project Stimulating the Industry in Europe (GIPSIE) in support to DG III to stimulate the involvement of the European GI community in the world-wide OpenGIS specification process and thus increase the European GIS industry's competitiveness. In order to maintain an adequate technical background on technology evolution, the SAI has been involved in OpenGIS Consortium activities, chairing the Request For Proposals for Feature Identity & Relationships. Moreover it increased the collaboration with the European Umbrella Organisation for Geographic Information (EUROGI), the spanning association of the National Geographic Associations for GI.

As part of its ongoing support contract with DGIII, the SAI performed a number of tasks in 1998. In particular it established and moderated an on-line high-level discussion group of 60 GIS experts, to review the document A Strategic View of GIS Research and Development for Europe (published in 1997). The second edition (1998) provides a final statement on GI and GIS projects in the Commission's Fourth Framework Programme and looks ahead to areas requiring continued attention and funding in the coming Fifth Framework Programme. It is expected that this will become a regular activity, with future editions documenting the continuing involvement of the EC in funding GI and GIS projects for Europe. Moreover it conducted a survey of over 200 GI/GIS projects funded by the EC to establish the extent and role of GI/GIS in the various RTD Programmes of the EC. The scope being to identify the synergies that exist between the various programmes in the area of GIS and to highlight any aspects of GIS technology that may need particular attention in the forthcoming Fifth Framework Programme and the identification of contact points within the RTD programmes. The importance and long term role of GIS in the research programmes and policies of the European Commission will also be established. The DG3GIS WWW Site (http://ams.emap.sai.jrc.it/dg3gis/) was set-up and designed to provide an overview of the current state of research and development in the field of GIS within the European Commission Research Programmes. The site includes summaries of EC funded projects directly related to GIS/GI, categorised by subject and research programme, details on the annual EC GIS workshops organised by DGIII and JRC, information on our publications, GIS Events listings, links to other WWW sites (GIS/GI related, European Commission pages and others), a search engine and contact details.

Contact
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Catchment Information System

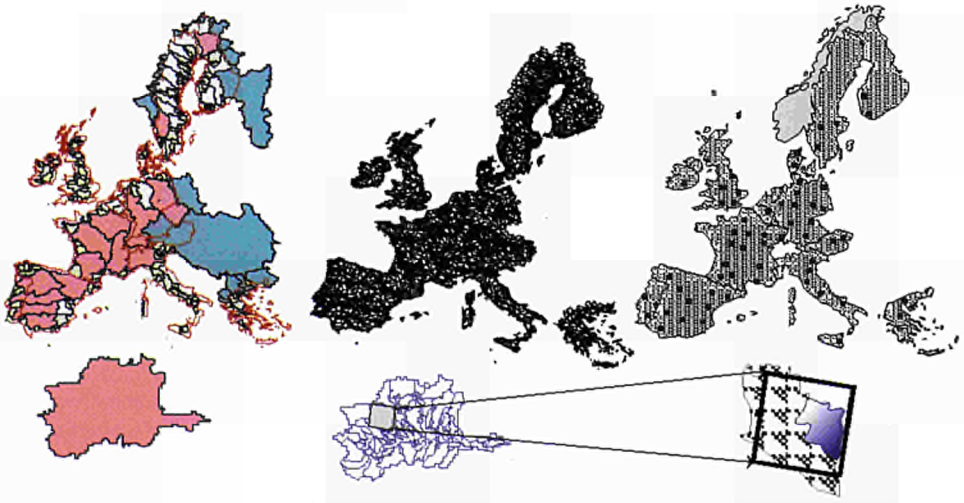
In response to an increasing concern for the state of the environment and the effect of human activities, it was decided to investigate the impact of agricultural activities on environmental conditions. Many phenomena and parameters of interest are mainly related to the hydrologic cycle. Consequently, the suitable entity to perform agro-environmental studies is the catchment. Following a conception phase for a Catchment-based Information System (CIS), a feasibility study was performed in 1998. The purpose of this study was to provide the design parameters for the implementation of such an information system. The principal CIS methodological approach focused on a multi-level hierarchical system of catchments, and a set of sample catchments for the investigation of agro-environmental issues. Catchment levels 1 to 3 are designed to completely cover the area of interest. The data available for those levels rely on generalised information with global coverage at a scale of 1:250,000 or less. Typical examples are the Corine Land Cover and the European Geographic Soil databases. Catchments at levels 4 and 5 are only defined as a sample of the population of all catchments. The sample catchments are defined in detail and the analysis related to CIS applications is performed for selected sample catchments. Across the area of interest (e.g., the EU15 Member States), a reserve set of catchment samples is defined based on the systematic distribution of a potential sample within a grid of equal-area cells. For generic CIS applications, a subset of samples is drawn from the reserve set. The actual sample is defined following a stratification of the area of interest. The stratification parameter depends on the requirements of the issue to be analysed. Global estimates for the area of interest are obtained from integrating the results obtained from the samples. An initial set of 18 CIS applications was defined during the feasibility study.

Contact
Roland Hiederer

Agro-Meteorology

In 1998, the main activities included the management and development of the meteorological database to build an archive covering the 1975-1998 period for the whole European continent, including Maghreb and Turkey. A data distribution policy is also under implementation to distribute the information to the various services of the Commission. Moreover research was conducted on the use of numerical weather model parameters as input to crop growth modelling, and on the development of agro-environmental information services, such as crop production suitability assessment, using components of the Crop Growth Monitoring System (CGMS). The Space Applications Institute participated to the TACIS project to implement a crop production monitoring system in Russia and undertook the overall management of the SuGrAm support group for agrometeorology to advise on the research activities with the relevant European expertise. Last but not least, 1998 marked the beginning of a collaboration with National Meteorological Services of the Members States (EUMETNET) and with international meteorological organisations (ECMWF, EUMETSAT) which aimed to link the Commission's needs in meteorological data to the relevant expertise from meteorological organisations.

Contact
Jean Michel Terres

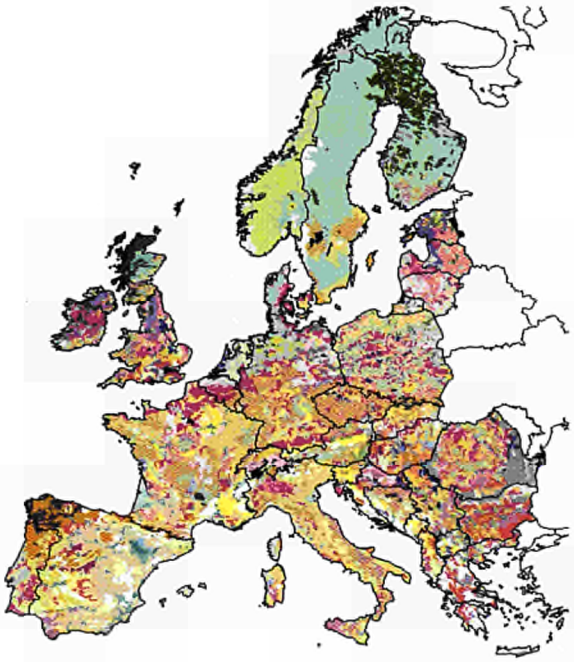


Catchment hierarchy.

European Soil Bureau (ESB)

The European Soil Bureau (ESB) was created in 1996 as a new body within the European Commission. It is hosted by the Space Applications Institute. Its aim is to carry out scientific and technical duties in order to harmonise soil information relevant to Community policies for the benefit of the related Directorates General, the European Environment Agency and concerned institutions of the Member States. The activities on soils focused on establishing a well-defined European Soil Information System (EUSIS) available within the European Soil Bureau by the end of 1998. It consists of a Soil Geographical Database of Europe (SGDBE) with an information content corresponding to a scale of 1:1,000,000. It integrates several information layers, covering the European Union, the EFTA countries, and the Central and Eastern European countries. The main components of EUSIS are: the Soil Geographical Data Base of Europe (SGDBE) at a scale of 1:1,000,000 (version 3.28); the Soil Profile Analytical Data Base of Europe (SPADE); the Hydraulic Properties Data Base of Europe (HYPRES); and the knowledge database (Pedotransfer Rules). In addition, 1998 saw the start of the third party contract with the Italian Ministry of Environment for the realisation of the Italian Soil Information System. Support was provided to DGXI for the revision of the Sewage Sludge Directive, and to the Palestinian Authority for the establishment of the Soil Bureau for the Occupied Territories. Finally the first meeting of the Regional Soil Surveys of the European Union was organised.

Contact
Luca Montanarella

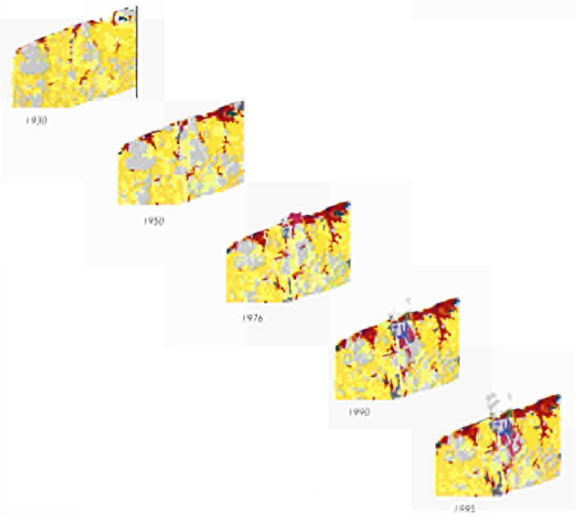


Soil Geographical Database of Europe at a scale of 1:1,000,000.

Land Cover and Land Use

As co-leader of the European Topic Centre for Land Cover (ETC/LC), the Space Applications Institute is responsible for the Research and Development of new applications. In this framework, a study was launched to investigate the use of CORINE Land Cover (CLC) as a basic layer for non-point source emission assessment. The integrated assessment of emission at the scale of continental catchments requires appropriate methods for the estimation of the agricultural contribution. Hence, different methods to collect agricultural data are compared over large river basins. The CORINE nomenclature is used to standardise the transfer of information between administrative and catchment levels. The project LACOAST (Land Cover Changes on European Coastal Zones) was a contribution to test the methodology for the CLC database and to update it at a European level. However, its objective is to assess changes on land cover and land use in the coastal zone, and as such it is to be a tool for the Integrated Management of the Coastal Zones Programme of DG XI. The data collection phase has been completed and validation started, with preliminary results to be published in the EEA-EU98 Report. It is interesting to note that introducing time as a dimension in the land cover database, increases the analysis potential as it integrates socio-economic information and identifies the land cover and land use driving forces. Methodology studies related to these subjects were launched in order to make the analysis at regional level. Regarding land cover changes assessment, a technical and methodological guide for the updating of CORINE Land Cover database was published in 1998.

Contact
Vanda Perdigão



Land Use Changes in Belgian coastal zones (1930-1995).

Spatial analysis and statistics

The expertise of the Space Applications Institute in the field of Spatial Analysis covers a wide range of issues from sampling schemes for accuracy assessment of thematic land-cover data to multi-temporal spatial analysis. In 1998, SAI provided technical support to various projects regarding sampling schemes, developing estimators and testing their accuracy, establishing quality control of results, studying the optimal size of sampling units, and using of global tessellations to sample satellite images. Examples include projects such as OLISTAT (estimation of the number of olive trees per Member State), OLIYIELD (estimation of yield per olive tree from objective measurements), and FRA2000 (Global Vegetation Monitoring). For Eurostat, work was done to combine geographic sampling and Remote Sensing techniques. In addition, several feasibility studies were carried out in preparation to potential future information needs. These studies included, on one hand, the integration of new data sets with existing analysis techniques, and, on the other hand, the exploitation of the potential of relatively new pattern recognition techniques using existing data sets. This resulted in an improved way of mapping population and potential rural diversification as well as in new methods for robust change detection techniques from satellite images and land-cover databases, respectively. Software tools were developed to translate explicit user objectives and requirements into unambiguous pattern recognition parameters.

Contact
Javier Gallego

Geographic extensions

Regarding co-operation with countries outside the borders of the European Union, the SAI provided technical support to EC DG IB, External Relations, for the implementation of the SARI (Satellite Assessment of Rice) project in Indonesia and also supported the technical formulation of the ISEAM (Information System on Environment and Agriculture) project in Central Asia within the TACIS Multi-Country Programme. The RESMANMED (RESource MANagement in karstic areas of the coastal regions of the MEDiterranean) project is in the phase of implementation in collaboration with Mediterranean partners from Turkey, Malta and Lebanon, within the DG XII INCO-DC Programme. The SAI collaboration with the Observatoire du Sahara et du Sahel (OSS) continued and the co-operation agreement between the two institutions was renewed. The main point of co-operation concerned the development and installation of the Space OSS software for pre-processing of NOAA AVHRR data. In the Mediterranean area, the SAI collaborated with the Plan d'Action de la Mediterranée for the formulation of a large regional project on Coastal Zone Management. The SAI input to the project should be the realisation of a LaCoast Mediterranée, extension and adaptation of the LACOAST methodology for Mediterranean coastal areas. The Med-Crop initiative of building an advanced agricultural information system for the Mediterranean gained support from the Euro-Mediterranean Forum for Agriculture and Food Industry organised in Capri, Italy in September. Collaboration continued with the Environment and Remote Sensing Institute of Harare, Zimbabwe through the realisation of a pilot project on crop area and production estimation.

Contact
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Thierry Nègre

Selected Further Reading

Perdigão, V., and Annoni, A., 1997. Technical and methodological guide for updating Corine land-cover data base, EUR 17288 EN.

Meyer-Roux, J., 1998. A Catchment-based information system. In: Proceedings of the Third SAI Annual Users Meeting, 19-20 May 1998, Baveno, Italy.

Finke, P., Hartwich, R., Dudal, R., Ibanez, J., Jamange, M., King, D., Montanarella, L., Yassoglou, N., 1998. Georeferenced Soil Database for Europe. Manual of Procedures, EUR 18092 EN.

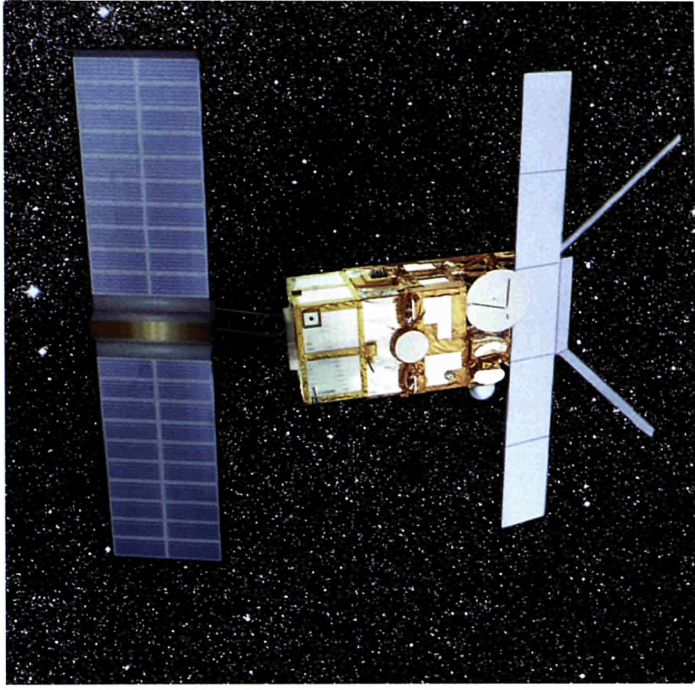
Rijks., D., Terres, J.M., Vossen, P., 1998. Agrometeorological applications for regional crop monitoring and production assessment. Accounts of the EU support group on Agrometeorology (SuGrAm) 1991-96. EUR 17735 EN, 1998, 516p.

Annoni A., Ehrlich, D., Smits, P., and Montanarella, L., Data sets for sustainable management of Europe's regions, in: Proceedings 4th EC - GIS Workshop, Budapest, Hungary, 24 - 26 June 1998.

Munro, A., A strategic view of GIS research and technology development for Europe, 2nd Edition, EUR 18126 EN.

McNaughton, H., and Fullerton, K., Handbook of GIS project summaries, EUR 17717 EN.

SYNERGY OF EARTH OBSERVATION WITH SATELLITE COMMUNICATIONS AND SATELLITE NAVIGATION



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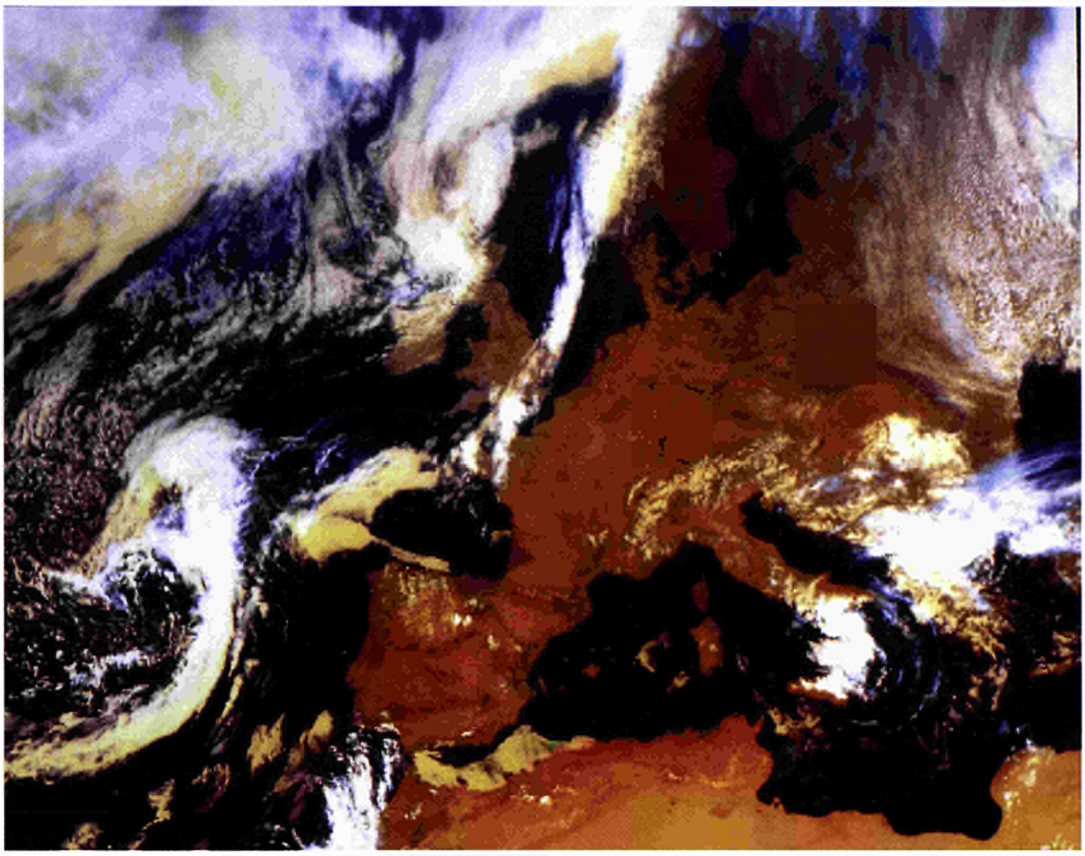
Recent developments in satellite technology such as rapid data dissemination and precise geolocation can significantly facilitate the use of Earth Observation. Satellite communications can improve the access to and dissemination of remotely sensed data. As an example, broadcasting meteorological data to 1000 users via satellite can be more cost-effective than transmitting it 1000 times via conventional networks. Moreover, the use of satellite navigation data can improve the accuracy of the results obtained from studies based on Earth Observation data. For instance, it is possible to calculate the navigation satellite signal delay due to atmospheric water vapour and this, in turn, can be integrated with meteorological data to ameliorate the quality of rainfall forecasts.



The ASTRON Project

ASTRON (Applications on the Synergy of satellite Telecommunications, eaRth Observation and Navigation) started as a spin-off of the CEO programme. It aims to investigate the synergy between the three space technologies with a view to introduce innovative and sustainable services and applications based on the convergence of digital satellite information. ASTRON finished its 2-year pathfinder phase at the end of 1998 and is hereinafter one of the strategic projects of the Space Applications Institute.

As the mandate of the Space Applications Institute within the European Commission is expanding from Remote Sensing to also cover Satellite Communications and Satellite Navigation, more applications are investigated where combined use of the three space technologies can develop and demonstrate sustainable ,integrated space applications. In addition, the Institute collaborates with the other space related General Directorates in order to provide technical / scientific support, and achieve complementarity of effort. Information exchange with European and national space agencies is regular while the same is also true with space segment providers, EO data providers and industry.

In 1998, ASTRON produced a number of documents and supported three studies undertaken by European industrial groups:

- A market perspective for ASTRON: Benefits for Europe from integrating Space technologies.
- Distribution of meteorological data via satellites.
- Distribution of data from the Vegetation archive via satellites.

The results of the aforementioned tasks establish the baseline of the work to follow. This work will be undertaken by the Space Applications Institute in close collaboration with European space agencies, the European industry, providers of EO data, providers of satellite communication services, user organisations and research institutions. ASTRON work will not focus on technology developments, apart from setting up technology demonstrators. Emphasis will rather be given to the development and demonstration of sustainable integrated space applications. In addition, work will be undertaken to analyse and understand the space applications market, and also the advances in space technology and available services, particularly focusing on European developments.

Contact
Michalis Ketselidis

Synergy of Earth Observation with Satellite Communications and Satellite Navigation.

Selected Further Reading

Synergy of Earth Observation and Satellite Communications - A potential market perspective; S.P.I. 98.155.

Synergy of Earth Observation and Satellite Communications - Feasibility Study 1: Distribution of meteorological data over satellite; S.P.I. 98.156.

Synergy of Earth Observation and Satellite Communications - Feasibility Study 2: Distribution of data from the Vegetation archive; S.P.I. 99.62.

Satellite Communications Survey - Systems & Applications; release 2, Report, EUR 18146 EN.

Overview of Current and Planned Spaceborne Earth Observation Systems; the Report - Missions, Instruments, Orbits, Products, Indicative Costs; Report, EUR 18673 EN.

Overview of Current and Planned Spaceborne Earth Observation Systems; the Handbook - Scenarios of Integrated Space Applications (Satcoms and EO); Report, EUR 18672 EN.

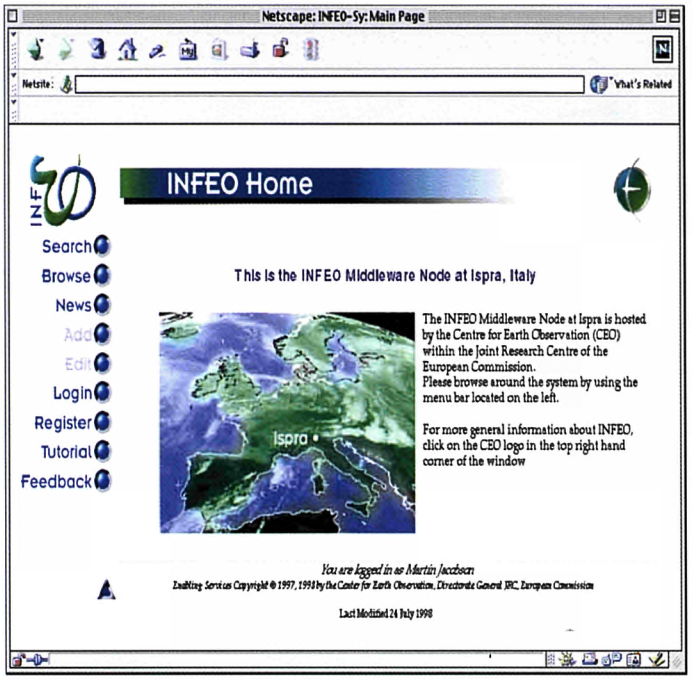
Inventory of projects, with a European dimension, where Satellite Communications are used for Earth Observation applications; Report, EUR 18675 EN.

Space Compendium 98 (all space projects that the EC funded in the Fourth Framework Programme; Report (available in June 1999).

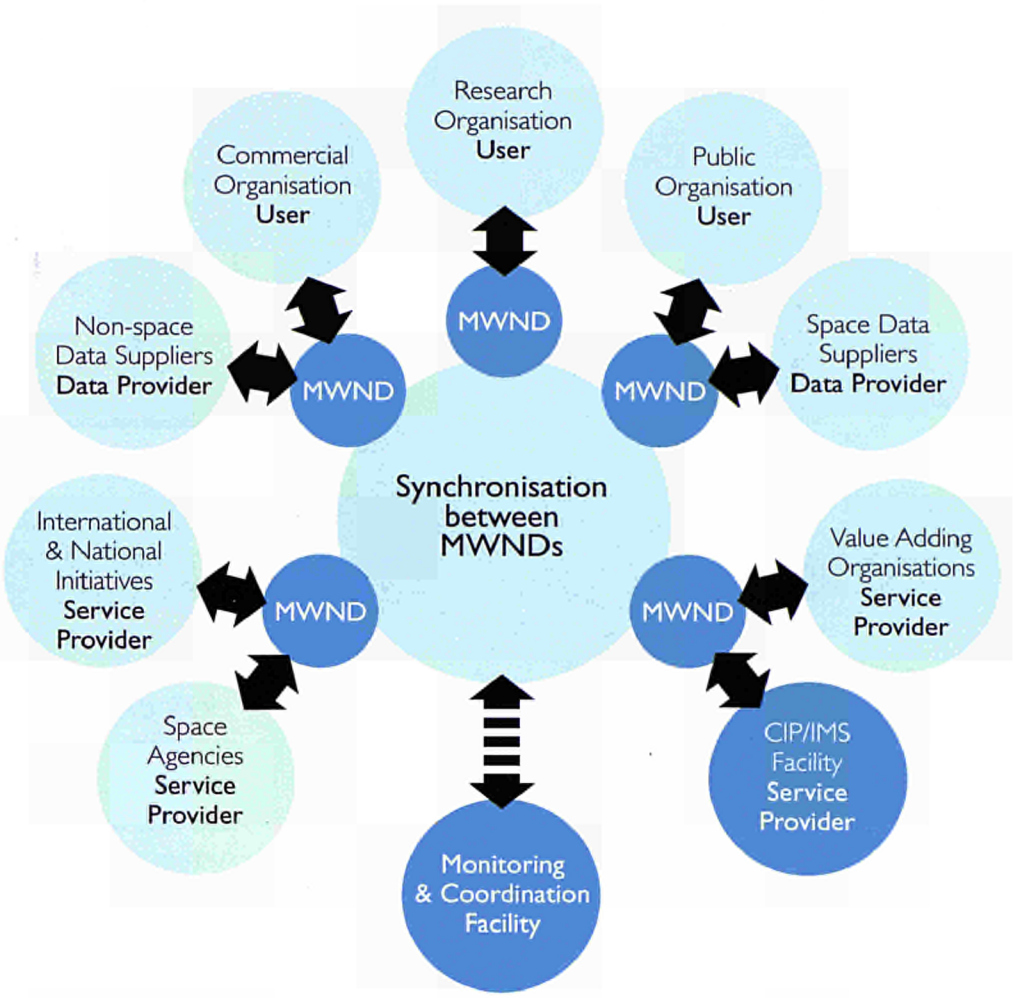
Satellite Navigation Survey - Systems & Applications; Report, (available in June 1999).

ASTRON Information Day (19 Jan 1999): Workshop Proceedings S.P.I. 99.22.

EARTH OBSERVATION DATA VIA INTERNET



Despite the wealth of Earth Observation data, information and services, potential customers are often unaware of their existence, since there is no single information system which is capable of searching and finding these services. In September 1995 the first version of a system to provide the exchange of and accessibility to meta data and information about Earth Observation, data and services was developed and released for public use. This system was developed by the Centre for Earth Observation (CEO), and was called the European Wide Service Exchange (EWSE). EWSE has been an Internet based virtual marketplace for EO data and services.



Context Diagram for the INFEO identifying the following entities: users, user interfaces; Middleware Nodes (MWND); Monitoring and Co-ordination Facility (MCF); Data provider; and CIP/IMS facility. Items which have been developed by or for the INFEO system are darker.

European Wide Service Exchange

A search for information on the EWSE (European Wide Service Exchange) can be carried out in a number of different ways: by free text, by keyword or by location (on the map of the globe). Organisations or individual users, registered with the EWSE, can also be found via alphabetical lists or via the Tradeshow, where organisations are arranged by thematic area. Since its release, the EWSE has continually been improved and updated. A snapshot of the EWSE in December 1998, showed that it now contains over 3,000 registered users, over 900 registered organisations and 700 EO products.

Information on Earth Observation

Between 1996 and 1998 a more advanced system called Information on Earth Observation (INFEO) was developed. In addition to EWSE, INFEO allows the user to search catalogues all over the world. INFEO is a distributed data and information system, allowing service providers to advertise their data, information and services, and customers to search for them. The INFEO search can be based on a combination of geographic, temporal or thematic criteria. The user can for example, search for all data over Ispra on 31 December 1998 or all data that show volcanic eruption. He does not have to specify the satellite or sensor, or having to know in which catalogue the relevant data is held. This search capability is facilitated by the catalogue interoperability protocol (CIP). This protocol, a profile of Z39.50, defines the semantics of a search query. It is developed in the context of an international collaboration with members of CEOS.

INFEO will be made publicly available in the first part of 1999. INFEO consists mainly of a Middleware Node which is a central point for delivering services (CIP search, CIP ordering, announcements, and advertisements) to users. MWNDs will be distributed across Europe. Providers can hold their own data and specific customised interfaces to it. The second version with synchronised MWNDs will be released at the end of 1999. INFEO will act as a one-stop shop by providing an interoperable search capability that allows users to search remote catalogues world-wide simultaneously through a single user interface. Providers can be connected to INFEO either via a CIP gateway, or by an on-line advertisement on a MWND linked to their own web home page. The CEO offers data providers all software free-of-charge and provides installation support to link their catalogue to INFEO.

The CEO team, with the support of key European experts, undertook the system specification work of INFEO. Following system specification INFEO proceeded into the architectural design, implementation, integration and testing stage. This work has being undertaken by contracting European organisations, under the management of a technical team within the CEO at the JRC Ispra. The CEO has also been involved in a number of initiatives to improve the data accessibility to non-space data sources. A survey of data owners who are interested in the sharing of non-space data was made through the publication in the Official Journal of the European Commission. Important data providers in Europe have been contacted while preparations to connect their catalogues to INFEO have been made. Studies have been launched to connect the meteorological products of the European Centre for Medium-term Weather Forecasting (ECMWF) and environmental catalogues of the European Environment Agency (EEA).

Contact
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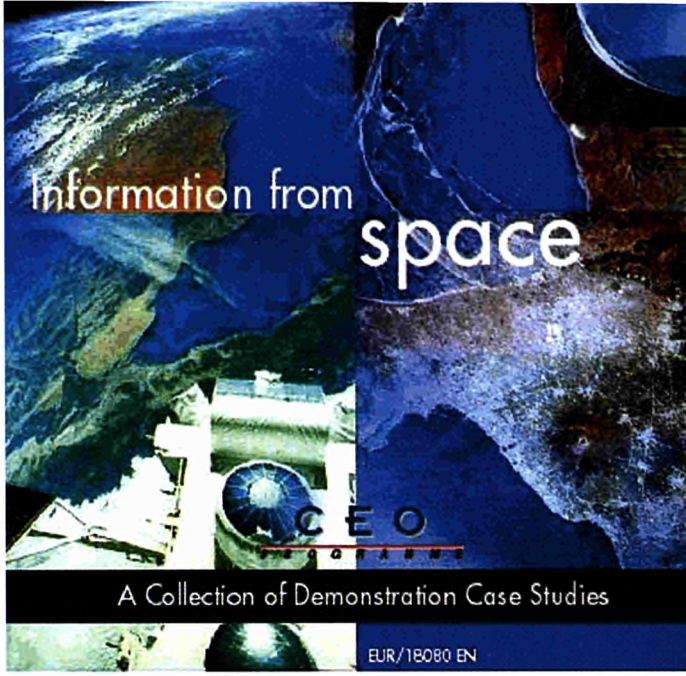
Michel Millot

Selected Further Reading

Catalogue Interoperability Protocol (CIP) Specification; Release B; CEOS/WGISS/PTT/CIP - B 2.2, 1996.



The main goal of the CEO Programme has been to encourage the wider use of Earth Observation data. As a result of the CEO activities during the last three years, a wide range of potential customers are now more aware of the benefits of this information source to their professional activities. According to the CEO Market Snapshot study conducted in 1998, the market and structure of the European EO value adding industry have changed considerably over the last four years. In 1994, the lack of market awareness was considered to be the main hindrance for industry growth. Now the availability of data and information on an operational basis is regarded as the major constraint. The successful implementation of GIS is still one of the major market drivers. This will get a further burst with the introduction of the very high resolution satellite data. There are also indicators which show a transformation into a more healthy and competitive EO industry in Europe. The core EO Industry including data suppliers, value adding companies, consultancies, software development and integration companies, and training organisations, has grown steadily by approximately six per cent annually in the period from 1994 to 1997, and the growth rate is expected to be even higher for 1998. The commercial markets have shown significant annual growth rates of 18 %, and now account for 32% of the total market. The telecommunications industry is the single most important contributor, principally for mobile phone cell planning. According to these first results of the Market and Industry Snapshot 1998 study, the total revenue for 1997 nearly matches the optimistic projection made in a similar study conducted in [...]

[...] 1994 despite assumptions, such as the availability of very high resolution data, not having been realised. Although the industry is still fragmented and dominated by small companies, it is evident that big companies are becoming bigger at the expense of smaller value adding companies. The boundaries between data supply, value-adding and consultancy are often no longer valid as companies expand their range of services. More customer organisations and intermediate service providers are adding EO products to their portfolio of activities. It is foreseen that major growth will occur outside the traditional EO industry boundaries.

Increasing the number of EO customers

During 1998, the use of Earth Observation was further promoted in the European market with the implementation of customer segment studies, initiatives in marketing, product development & promotion, and education & training. Last but not least, a CD-ROM was produced with 160 demonstration case studies.

The four customer segment studies conducted for the CEO in 1998 focused on the following commercial sectors: agribusiness, the maritime industry, water management, and digital mapping. For each of these, the characteristics of the segment were defined, and the potential benefits for the companies using EO information were investigated. These requirements were subsequently associated with current and near-future EO products. As part of these studies, information documents for potential customers were also produced. Of the nine customer segments the CEO has targeted, land navigation, mobile telephony, cell planning and agribusiness are already adopting EO products. Markets for other fields, such as insurance, tourism and shipping are more speculative at present. For these sectors, potential new product development activities with the CEO Programme have been identified and are currently in progress.

Product development and marketing initiatives support organisations to further develop or tailor existing products in response to the needs of specific groups in order to attract new customers. This work builds upon the information requirements obtained from customer segment workshops and from complementary work already undertaken by the contractor. These projects included the production of a detailed marketing plan for the product or service developed. Thirteen contracts were awarded; six of them started in autumn 1997 and the remainder in 1998.

A collection of demonstration case studies was produced in a user-friendly CD-ROM entitled Information from Space, in five languages. These allow potential customers to review projects that have already been completed and get information on costs and previous customers. They are thus able to evaluate the usefulness of EO data, information and products relevant to their own particular professional interest. Customer response was extremely positive, and many representatives from the Education community have expressed their wish to use the material for demonstration at schools and universities.

The potential of EO data was more widely presented with the CEO Education and Training initiatives. Organisations in Europe were invited to suggest education and training activities for Earth Observation professional users. In the first round of contracts starting in 1997, nine projects were funded, while in 1998, another 14 projects followed. These projects were extremely successful, given the interest expressed by both the trainees and contractors themselves.

Application demonstration projects initiated.

Project Acronym	Thematic Area	Customer EC Service
LACOAST	*Land Cover Changes in European Coastal Areas*	*DGXI, EEA*
SEARRI	*Monitoring of Agriculture in SE Asia*	*DGIB, DGVI, DGXI*
FMERS	*Forest Monitoring in Europe with Remote Sensing*	*DGVI*
ATLAS	*Statistical Analysis on Urban Agglomerations in Europe*	*DGXVI, EUROSTAT*
DESIMA	*Decision Support System for Coastal Areas*	*DGIB, DGXIV*
MURBANDY	*Monitoring Urban Dynamics*	*DG XVI, VII, EUROSTAT*

Developing the Industry

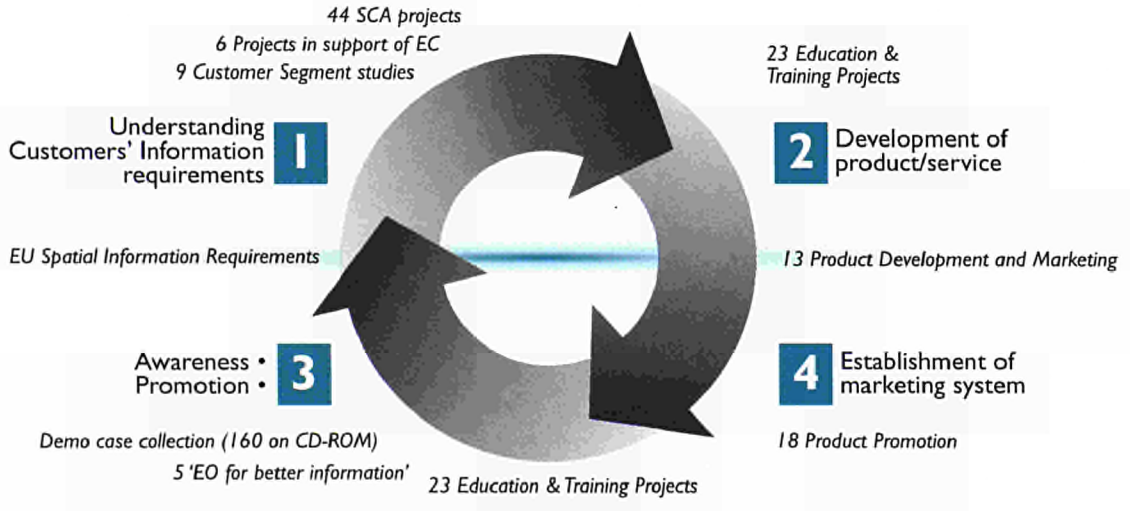
The shared-cost mechanism of the Environment and Climate Specific Programme was the main means employed by the CEO Programme to involve organisations from the participating countries in demonstrating pre-operational applications to potential customers. Each of these projects had to involve a potential customer of information derived from Earth Observation data. Customers in this context could come from scientific, commercial or governmental organisations. The customer role was to define the requirements for information, and to validate the results generated.

The two Calls for Proposals released, resulted in the funding of 46 shared cost and concerted actions. Over 400 organisations across Europe were involved, of which about 100 were small or medium size enterprises. These projects will help customers in domains as diverse as the provision of health care and the environmental protection of ski resorts. Projects funded under the first Call, have only been running for approximately one year. Most of the projects selected under the second call have yet to start. However, there has already been some benefit from these contracts: European organisations have undertaken considerable networking activities, and have learnt to work together. This includes the value adding industry and research organisations working together to enable technology transfer. The language of the European Earth Observation industry has also changed, mainly focusing on customers and their requirements.

To encourage the development of new applications, the following two new application feasibility studies are being conducted: Monitoring of Inland and Coastal Waters, and Characterisation of Aerosols over Land for Air Quality Monitoring, Radiation Mapping and Atmospheric Corrections of Satellite Data. These studies, among other initiatives, aim to help bridge the distance between the customer and the state-of-the-art of Earth Observation.

In order to investigate the potential of Earth Observation information to support policies at a national and European scale, a number of application demonstration projects were initiated. The results of the LACOAST, FMERS, ATLAS and MURBANDY projects have now been used as a basis for a new project EUROLAND, which will serve the requirements of DGVI (Agriculture), DGXI (Environment, Nuclear Safety and Civil Protection), DGXVI and the European Spatial Development Perspective (ESDP). DESIMA will continue, and form the basis of a large European coastal monitoring project serving DGXI. SEARRI has formed the basis of a new project, SARI, which is funded by DGIb (External Relations).

Contact
Neil Hubbard



Selected Further Reading

Churchill, P., Feedback from a Small Planet, Innovation & Technology Transfer, 5/98, September 1998.

Maracci, G., Il programma CEO, MondoGIS, 11, June 1998.

ANNEX

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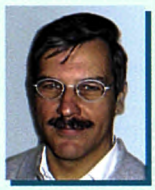

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ACRONYMS

ACSAD	Arab Centre for the Studies of Arid Zones and Dry Lands
ADEOS	Advanced Earth Observation Satellite
APL	Anti-Personnel Landmine
ARIS	Action for Research and Information Support in Civilian Demining
ARIS	Agriculture and Regional Information Systems
ARSENAL	Advanced Remote Sensing AppLications
ASTRON	Applications on the Synergy of Satellite Telecommunications, Earth Observation and Navigation
ATLAS	Statistical Atlas of Urban Agglomerations in Europe
AVHRR	Advanced Very High Resolution Radiometer
BNSC	British National Space Centre
BRDF	Bidirectional Reflectance Distribution Function
CAMELEO	Changes in Arid Mediterranean Ecosystems on the Long-term through Earth Observation
CAP	Common Agricultural Policy
CAPI	Computer Aided Photo Interpretation
CASI	Compact Airborne Spectorgraphic Imager
CASOTS	Combined Action to Study the Ocean Thermal Skin
CCD	Charge Coupled Device
CEMAGREF	Centre d'Études de Machinisme Agricole du GREF (Génie Rural des Eaux et Forêts)
CEO	Centre for Earth Observation
CEOS	Committee on Earth Observation Satellites
CEVEX	Concentration on European Validation Experiments for Coastal/Shelf Water Remote Sensing
CFSP	Common Foreign and Security Policy
CGMS	Crop Growth Monitoring System
CIP	Catalogue Interoperability Protocol
CIS	Catchment-based Information System
CLC	CORINE Land Cover
CLUSTERS	Classification for Land Use Statistics, EUROSTAT
CNES	Centre National d'Études des Télécommunications, France
CNRS	Centre National de la Recherche Scientifique
CoASTS	Coastal Atmosphere and Sea Time Series
COLORS	Coastal Region Long-term Measurements for Colour Remote Sensing Development, Calibration and Validation
CORBA	Common Object Request Broker Architecture
CORINE	Co-ordination of Information on the Environment
CORSA	Cloud and Ocean Remote Sensing around Africa
CTIV	Centre de Traitement des Images VEGETATION
CZCS	Coastal Zone Colour Scanner
DAIS	Digital Airborne Imaging Spectrometer
DEM	Digital Elevation Model
DEMON-2	Desertification Monitoring - an Integrated Approach to Assess and Monitor Desertification Processes in the Mediterranean Basin
DESIMA	Decision Support for Integrated Coastal Zone Management
DG	Directorate General
DLR	Deutsches Zentrum für Luft und Raumfahrt
DTM	Digital Terrain Model
EARSC	European Association of Remote Sensing Companies
EARSeL	European Association of Remote Sensing Laboratories
EC	European Commission
ECMWF	European Centre for Medium Range Weather Forecasting
ECOFAC	Conservation et Utilisation Rationnelle des Écosystèmes Forestiers en Afrique Centrale
ECU	European Currency Unit
EEA	European Environment Agency
EEA	European Environmental Agency
EFICS	European Forest Information and Communication System
EFTA	European Free Trade Association
EGEO	Environment and Geo-Information unit
EGII	European Geographic Information Infrastructure
EGO	European Goniometer
ELSA	European Laboratory for Structural Assessment
EMSL	European Microwave Signature Laboratory
ENAMORS	European Network for the Development of Advanced Models for the Interpretation of Remote Sensing Data
ENRM	Environment and Natural Resources Management
ENV	Environment and Climate
ENVIFISH	Environmental Conditions and Fluctations in Recruitment and Distribution of Small Pelagic Fish Stocks
ENVISAT	Environmental Satellite
EO	Earth Observation
EOS	Earth Observing System
ERS	European Remote Sensing Satellite
ESA	European Space Agency
ESB	European Soil Bureau
ESPRIT	European Union Information Technology Programme
ETC/LC	European Topic Centre for Land Cover
EU	European Union
EUMETNET	National Meteorological Services of the Members States
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUROGI	European Umbrella Organization for Geographic Information
EUROSTAT	Statistical Office of the European Communities
EUSIS	European Soil Information System
EWSE	European Wide Service Exchange
FACOSI	Facility for the Automated Construction of Optimized Spectral Indices
FAO	Food and Agricultural Organization
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation

FARSITE	Fire Area Simulator
FDTD	Finite Time Domain Technique
FGI	Finnish Geodetic Institute
FIRE	Fire In Global Resources and Environment Monitoring
FLIERS	Fuzzy Land Information from Environmental Remote Sensing
FMERS	Forest Monitoring in Europe with Remote Sensing
FOFEM	First Order Fire Effect Model
FOV	Field Of View
FRACTAL	Fire Regional Assessment and Carbon Tracking in Arhnem Land
FUEGO	Early Forest Fire Detection Programme
GAF	Gesellschaft für Angewandte Fernerkundung
GELOS	Global Environmental Locator Service
GI	Geographic Information
GIPSIE	GIS Interoperability Project Stimulating the Industry in Europe
GIS	Geographic Information System
GISCO	GIS of the Commission
GIST	Generic Information Server Toolkit
GLI	Global Imager
GOME	Global Ozone Monitoring Experiment
GPR	Ground Penetrating Radar
GPS	Geographical Positioning System
GRFM	Global Rain Forest Mapping
GRIN	Ground Data Retrieval Implemented on the Net
GVI	Global Vegetation Index
GVM	Global Vegetation Monitoring
HYPRES	Hydraulic Properties of European Soils
IACS	Integrated Administration and Control Systems
ICAMS	Integrated Coastal Analysis and Monitoring System
ICRIS	International Consultation on Research and Information Systems in Forestry
IDL	Interactive Development Language
IEEE	Institute of Electrical and Electronics Engineers
IGARSS	International Geoscience and Remote Sensing Symposium
IGBP	International Geosphere-Biosphere Programme
IGN	Institut Géographique National
IKSO	International Kommission zum Schutz der Oder
INFEO	Information on Earth Observation
INPE	Instituto Nacional de Pesquisas Espacial, Brazil
IRS	Indian Remote Sensing Satellite
ISEAM	Information System on Environment and Agriculture
ISIS	Institute for Systems, Informatics and Safety
ISPRS	International Society for Photogrammetry and Remote Sensing
JERS	Japanese Earth Remote Sensing Satellite
JRC	Joint Research Centre
LACOAST	Land Cover Changes on European Coastal Zones
LAI	Leaf Area Index
Landsat	Land Remote Sensing Satellite
LISA	Linear Synthetic Aperture Radar
LISS III	Linear Imagining Scanning Sensor III
MARS PAC	Monitoring Agriculture with Remote Sensing Common Agricultural Policy Sector
MARS STAT	Monitoring Agriculture with Remote Sensing Statistical Sector
MARS	Monitoring & Managing Agriculture with Remote Sensing
MAST	Marine Science and Technology
MAUVE	Mapping UltraViolet in Europe
MAVIRIC	Machine Vision in Remotely-sensed Image Comprehension
ME	Marine Environment
MEDA	Mediterranean Actions
MEDALUS	Mediterranean Desertification and Land Use
MERA	MARS and Environmental Related Activities
MERIS	Medium Resolution Imaging Spectrometer
METEOSAT	Meteorological Satellite
MIMEVA	Mine Imitiations for In-field Evaluation
MINESIGN	Measurement of Mine Signatures for Civilian Demining and R&D Support
MINETEST	Mine Detection Systems Test and Evaluation
MISR	Multi-angle Imaging Spectro-Radiometer
MMR	Modular Multi-band Radiometer
MoDeM-RSM	Mediterranean Basin Based on Earth Observation Methods
MOS	Modular Opto-electronic Scanner
MURBANDY	Monitoring Urban Dynamics
MWND	Middleware Node
NASA	National Aeronautics and Space Administration, USA
NASDA	National Space Development Agency, Japan
NDVI	Normalised Difference Vegetation Index
NGO	Non-Government Organization
NIR	Near Infrared
NNW	Neural Network
NOAA	National Oceanographic and Atmospheric Administration
OCEAN	Ocean Colour European Archive Network
OCTS	Ocean Colour and Temperature Scanner
ODBC	Open Data Base Connectivity
OLIAREA	Estimate of the Area of Olive Trees per Member State
OLISTAT	Estimate of the Number of Olive Trees per Member State
OLIYIELD	Olive Tree Yield Statistics
OSS	Observatoire du Sahara et du Sahel
OVNI	Optimised Vegetation Normalised Index
PAAGE	Project on Agriculture and AGri-Environment
PANEL-GI	Pan-European Link for Geographic Information
PSU	Primary Sampling Unit
RADARSAT	Radio Detection and Ranging Satellite
RESMANMED	Resource Management in karstic areas of the coastal regions of the Mediterranean

RESURS MSU-E	Russian Satellite Narrow Swath Instrument
RSI	Radarsat International Inc.
RTD	Research and Technological Development
SAI	Space Applications Institute
SAR	Synthetic Aperture Radar
SARI	Satellite Assessment of Rice in Indonesia
SATCOMS	Satellite Communications
SATNAV	Satellite Navigation
SCA	Share Cost Action
Sea WIFS	Sea Wide Field Sensor
SEARCH^2	Search for New Technologies for Mine Search
SEARRI	SE Asia Radar Rice Investigation
SGDBE	Soil Geographical Database of Europe
SIGEX	Signature Expoitation
SILVICS	Satellite Image Land Vegetation Integrated Classification System
SMA	Spectral Mixture Analysis
SME	Small or Medium Size Enterprise
SOS	Satellite Observing Systems
SPACE	Software for Processing AVHRR data for the Communities of Europe
SPADE	The Soil Profile Analytical Data Base of Europe
SPOT P	Système pour l'Observation de la Terre Panchromatic Mode
SPOT XS	Système pour l'Observation de la Terre Multispectral Mode
SPR	Surface Penetrating Radar
SSSA	Strategy and Systems for Space Applications
SST	Sea Surface Temperature
SSU	Secondary Sampling Unit
STRIM	Space Techniques for Major Risk Management
TDP	Technology for the Detection and Positioning of Mines
TFIS	Tropical Forest Information System
TIR	Thermal Infrared
TM	Thematic Mapper
TMR	Training and Mobility of Researchers
TREES	Tropical Ecosystem Environment Observation by Satellite
UN-CCD	United Nations - Convention to Combat Desertification
UN-ECE	United Nations - Economic Commission for Europe
UN-FCCC	United Nations - Framework Convention on Climate Change
VALUE	Valorization and Utilisation for Europe
VCI	Vegetation Condition Index
VEGETATION	VEGETATION instrument on-board SPOT-4
VIGIS	VEGETATION Interest Group in SAI
VIS	Visible
VTT	VTT Automation, Finland
WCMC	World Conservation Monitoring Centre
WFW	World Fire Web
WRI	World Resources Institute
WWW	World Wide Web

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