PLAN D'ACTION POUR LA MEDITERRANEE

Première Réunion des Points Focaux du CAR/TDE

Palerme, 9-11 septembre 1994

RAPPORT DE LA PREMIERE REUNION ORDINAIRE DES POINTS FOCAUX DU CAR/TDE

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TABLE DES MATIERES

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INTRODUCTION

1.   Les Parties Contractantes de la Convention de Barcelone, au cours de leur Huitième Réunion Ordinaire tenue à Antalya du 12 au 15 octobre 1993 ont décidé à l'unanimité d'établir un nouveau Centre d'Activités Régionales pour la Télédétection de l'Environnement (CAR/TDE) dans le cadre du PAM selon la proposition du Gouvernement Italien.

2.   A la suite de cette décision, le nouveau Centre, de concert avec l'Unité de Coordination du PAM et les autres CAR, a travaillé afin de déterminer l'orientation de ses activités pour contribuer aux objectifs du PAM et remplir son mandat .

3.   Des contacts immédiats ont été établis avec les Parties Contractantes et la désignation des Points Focaux a été sollicitée parceque considérée comme prioritaire.

4.   Suite à ces contacts, la Première Réunion des Points Focaux du CAR/TDE a eu lieu à Palerme du 9 au 11 septembre 1994.

Participants

5.   Tous les Points Focaux désignés ainsi que tous les PAM/CAR ont été invités à participer à la Réunion. Les Points Focaux, ou leurs représentants, des pays suivants ont participé à la Réunion: Albanie, Croatie, Egypte, Espagne, France, Grèce, Israel, Italie, Libye, Malte, Maroc, Tunisie, Turquie et Union Européenne. Les représentants de trois Centres d'Activités Régionales du PAM ont aussi pris part à la Réunion (voir l'annexe I pour la liste des participants).

Point 1 de l'ordre du jour.   Ouverture de la réunion

6.   Mr Michele Raimondi, directeur du CAR/TDE, a ouvert la réunion et accueilli les participants.

Mr Ferruccio Marri Caciotti au nom du Ministère Italien des Affaires Etrangères a souhaité la bienvenue aux participants et a souligné l'importance que le Ministère donne aux activités du centre au bénéfice du PAM.

Mr Lucien Chabason, coordinateur du PAM, tout en remerciant les autorités nationales et locales pour leur hospitalité, a réitéré l'intérêt de l'introduction des technologies de télédétection pour le Plan d'Action pour la Méditerranée. Il a souligné le fait que de telles activités pourraient représenter une excellente base de coopération permettant de mener à bien des activités conjointes entre les CAR, les institutions nationales et internationales, du fait que les méthodologies de télédétection permettent de mettre en valeur les résultats de la plus part des activités du PAM. Toutefois, il a insisté sur la nécessité de faire en sorte qu'au cours de la mise en oeuvre d'activités spécifiques, l'expérience déjà acquise dans les différents pays, dans l'application des techniques de télédétection, soit prise en considération afin d'éviter le risque de double emploi et le gaspillage des ressources. Il a conclu en rappelant aux participants que le rôle fondamental des Points Focaux exigeait d'eux tous les efforts pour optimiser les ressources disponibles et en assurant que l'Unité de Coordination était prête à faire tout le possible pour soutenir le CAR/TDE dans l'accomplissement de ses tâches.

7.   Mr. Arturo Spataro, Assesseur des Travaux Publics de la Province de Palerme, a souhaité la bienvenue aux participants au nom de M. Francesco Musotto, Président de la Province de Palerme. Il a souligné la grande satisfaction du gouvernement local d'abriter un centre aussi important et il a assuré les participants qu'aucun effort ne sera ménagé afin d'aider le centre dans l'accomplissement de son rôle international dans le cadre du Plan d'Action pour la Méditerranée.

Point 2 de l'ordre du jour. Cadre et objectif de la réunion

8.   Mr Raimondi a brièvement rappelé les circonstances qui ont conduit à la désignation du Centre en tant que Centre d'Activités Régionales et les activités consécutives accomplies.

9.   Mr Civili, fonctionnaire de première classe du PAM, a rappelé brièvement aux participants la structure du PAM, ses composantes ainsi que le rôle du CAR/TDE dans ce cadre. Mr Civili a aussi rappelé le fait que cette réunion était la seule des Points Focaux à avoir lieu avant la réunion conjointe des Comités socio-économique et scientifique et technique du PAM (janvier 1995) et la Neuvième Réunion des Parties Contractantes (juin 1995). Par conséquent, cette réunion représentait la seule possibilité qu'avaient les Points Focaux d'approuver le programme d'activités pour 1996-1997 à soumettre à l'approbation des Parties Contactantes.

Point 3 de l'ordre du jour. Election du bureau

10.   Les participants ont élu à l'unanimité les membres suivants:

Président: Mr Chokri Turki (Tunisie)

Vice-Président: Mr Ferruccio Marri Caciotti (Italie)

Rapporteur: Mme Anna Spiteri (Malte)

Point 4 de l'ordre du jour. Approbation de l'ordre du jour et organisation des travaux

11.   Les participants ont examiné l'ordre du jour provisoire ainsi que l'organisation des travaux proposée (UNEP(OCA/MED WG 83/1) qui a été adoptée sans aucun changement (voir annexe II).

Point 5 de l'ordre du jour. Programme et activités du CAR/TDE pour les années 1994/1995

12.   Mr Raimondi a présenté le document UNEP(OCA)/MED WG.83/3 contenant une description des activités achevées et en cours depuis la désignation du centre comme CAR. Il a aussi présenté la structure du CTM et son rôle dans le cadre du PAM. Quelques diapositives présentant des images télérelevées ont été projetées pour démontrer les nombreuses possibilités de cette technique.

5.1. Activités du CTM dans la région méditerranéenne

13.   Mr Raimondi a présenté le projet dénomé COSMOS, actuellement en cours, qui développe une méthode pour recueillir des informations sur les problèmes principaux de l'environnement afin de définir des paramètres à suivre par l'utilisation des techniques de télédétection. Cette présentation a été suivie par une discussion intéressante avec les différents représentants des Pays participants. Il a souligné que cette activité peut contribuer à celles de l'Observatoire Mediterranéen.

14.   Mr Roberto Ligi, au nom du CTM, a présenté le projet en cours dénomé MARE (Evaluation des Ressources Marines) qui a pour but entre autres d'identifier les relations entre les caractéristiques hydrologiques et la distribution des pigments comme la chlorophylle, utiles à l'évaluation du stock de pêche.

15.   Mr Raimondi a souligné que les résultats de ces activités, développées dans le cadre de programmes autres que ceux du PAM, pouvaient être mis a disposition du PAM.

16.   Les participants à la réunion ont été invités à visiter la station de télécommunications et de télédétection à Scanzano où ils ont eu l'occasion d'assister à des démonstrations des activités de recherches en télédétection du CTM.

5.2. Activités du CAR/TDE dans le cadre du PAM.

17..   Mme Monique Viel, CAR/TDE, a présenté un projet en cours sur la classification et le suivi de la végétation dans la région méditerranéenne.

18.   Mme Sabina Carnemolla, CAR/TDE, a présenté le projet RAIS (Remote Sensing Activities Inventory System) qui a pour but la création d'un répertoire des Centres des pays riverains de la Méditerranée engagés dans des activités de télédétection.

19.   Mme Viel a présenté les activités actuelles du CAR/TDE dans le cadre des PACs et décrit les termes de coopération avec les autres CARs concernant les projets en cours en Albanie, à Sfax (Tunisie) et Fuka (Egypte).

20.   Mr Raimondi a conclu la présentation en rappelant l'importance donnée à la télédétection dans le document Agenda 21 pour la Méditerranée qui sera soumis à la conférence MED 21 de Tunis en novembre prochain.

21.   Mr Raimondi a aussi décrit brièvement les activités de formation réalisées au cours des années 1993 - 1994.

22.   Une description détaillée des activités présentées aux points 5.1 et 5.2 est jointe en annexe III de ce rapport.

23.   Après la présentation des activités du CAR/TDE, plusieurs délégués ont exprimé leur satisfaction pour le travail réalisé par le Centre. En particulier, le Point Focal français a considéré le projet sur la classification de la végétation en Méditerranée très utile. Il a remarqué qu'en dehors de l'étude de l'écosystème végétal

méditerranéen et la surveillance de la couverture végétale, l'étude pourrait être bien appliquée à la surveillance de l'état phytosanitaire, des zones atteintes par la sécheresse et du stress hydrique de la végétation pendant la saison chaude, l'étude de la régénération des zones brulées et l'analyse de la situation aux différentes saisons.

Point 6 de l'ordre du jour. Définition des domaines de coopération possibles dans le cadre du PAM.

24.   A ce point de l'ordre du jour, plusieurs points focaux ont brièvement décrit les activités en cours dans leurs pays à l'échelon national et international. Un résumé de ces exposés se trouve à l'annexe IV de ce rapport.

25.   Les participants ont pris note des expériences spécifiques de chaque pays pouvant fournir des indications utiles à la formulation des recommandations pour les activités de 1996 - 1997 du CAR/TDE.

Point 7 de l'ordre du jour. Recommandations pour les années 1996 - 1997.

26.   Mr Raimondi a présenté le document UNEP(OCA)/MED WG83/4 contenant le projet de recommandations pour les activités de télédétection à mener dans le cadre du PAM pour les années 1996 -1997.

27.   Mr Raimondi a rappelé aux participants qu'ils devaient approuver une série de recommandations à transmettre à la réunion conjointe de janvier 1995 des Comités socio-économique et scientifique et technique et, ensuite à la réunion des Parties Contractantes de juin 1995.

28.   Après un long débat, les Points Focaux ont approuvé les recommandations, en annexe V du présent rapport.

Point 8 de l'ordre du jour. Questions diverses.

29.   Le représentant de Malte a informé la Réunion que l'Association Européenne des laboratoires de Télédétection (EARSEL) tiendra sa prochaine assembée Générale et son séminaire à Malte en mai 1996. Ceci peut représenter une occasion favorable pour CAR/TDE et les Points Focaux de participer activement à la conférence d'EARSEL. Le thème de la réunion sera centré sur la Méditerranée et permettera aux scientifiques européens et méditerranéens de la télédétection de discuter ensemble des problèmes d'intérêt commun.

30.   Mr Raimondi a indiqué brièvement la participation du CTM CAR/TDE à un projet d'assistance au gouvernement de Malte et à un projet conjoint avec la société "Satellite Observing System" (RU) pour l'utilisation du satellite ERS-2 dans le contrôle de la pollution marine par les hydrocarbures.

Point 9 de l'ordre du jour. Adoption du Rapport.

31.   La Réunion a adopté à l'unanimité son rapport le dimanche 11 septembre 1994.

Point 10 de l'ordre du jour. Clôture de la réunion.

32.   Le représentant de l'Israël au nom de tous les participants a remercié le Directeur du CAR/TDE, le Président, le Vice-président, le Rapporteur et tout le personnel pour le bon déroulement de la réunion.

33.   Mr Turky a remercié CAR/TDE pour l'efficace organisation de la réunion et les autorités locales pour leur bienvenue aux participants.

34.   Mr Civili a remercié CAT/TDE et a souligné l'importance de la télédétection pour l'observation et l'étude de l'environnement. Il a relevé l'importance de la coopération entre des Points Focaux. Il a exprimé la fierté du PAM d'avoir un nouveau Centre auquel il a souhaité tout le succès possible.

35.   Mr Raimondi a remercié tous les participants pour leur venue et a exprimé sa volonté de continuer l'effort commun vers une coopération plus étroite.

36.   Après l'échange habituel de courtoisie, le Président a déclarée la réunion terminée le dimanche 11 septembre à 11,45 heure du matin.

ANNEXE I

LIST OF PARTICIPANTS.

LISTE DES PARTICIPANTS

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COORDINATING UNIT FOR THE MEDITERRANEAN ACTION PLAN
UNITE DE COORDINATION DU PLAN D'ACTION POUR LA MEDITERRANEE

UNEP/COORDINATING UNIT FOR THE MEDITERRANEAN ACTION PLAN (MAP) UNITE DE COORDINATION DU PLAN D'ACTION POUR LA MEDITERRANEE

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**REGIONAL ACTIVITY CENTRES FOR THE MEDITERRANEAN ACTION PLAN
CENTRES D'ACTIVITES REGIONALES DU PLAN D'ACTION POUR LA
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ANNEXE II

ORDRE DU JOUR

1. Ouverture de la Réunion

2. Contenu et objectifs de la Réunion

3. Election du Bureau

4. Adoption de l'Ordre du Jour et organisation des travaux

5. Programme et activités du CAR/TDE pour les années 1994-1995
   5.1 Activités du CTM dans la Région Méditerranéenne
   5.2 Activités du CAR/TDE dans le cadre du PAM

6. Définition des domaines de coopération dans le cadre du PAM

7. Recommandations pour les activités du CAR/TDE pour les années 1996-1997

8. Questions diverses

9. Adoption du Rapport

10. Clôture de la Réunion

ANNEXE III

ACTIVITIES OF CTM - RAC/ERS

ACTIVITES DU CTM - CAR/TDE

(Presented Transparencies)

(copie des transparents présentés)

TABLE DES MATIERES

CTM
Centro di Telerilevamento Mediterraneo

CENTRO DI RICERCA PER IL TELERILEVAMENTO

REMOTE-SENSING RESEARCH CENTER

SEDE LEGALE/*HEAD OFFICE* : PALERMO

SEDE OPERATIVA/*OPERATIVE CENTER* : SCANZANO (PA)

THE COMPANY .

THE CTM - CENTRO DI TELERILEVAMENTO MEDITERRANEO IS A CONSORTIUM

SHAREHOLDERS ARE:

- TELESPAZIO spa 51% (IRI/STET GROUP) ·

- ESPI spa   49% (FINANCIAL HOLDING OF THE SICILIAN REGION GOVERNMENT)

THE CTM CAPITAL IS OF 3.5 MILLIARDS LIRE
                        (2.3 MILLION US$)

HEADQUARTERS ARE LOCATED IN PALERMO

OPERATIONAL FACILITIES ARE BASED IN THE SPACE TELECOMMUNICATION AND REMOTE SENSING STATION OF SCANZANO (45 KM FROM TOWN)

CTM

FINALITIES

CTM HAS BEEN CONSTITUTED IN ORDER TO:

❑ CREATE THE STRUCTURE OF A REMOTE SENSING CENTRE

❑ DEVELOPE MULTIANNUAL RESEARCH PROGRAMMES ON REMOTE SENSING TECHNOLOGIES AND METHODS

CTM

ACTIVITIES

❑ REMOTE SENSING DATA ACQUIRING, ARCHIVING AND PROCESSING

❑ REMOTE SENSING AND CONVENTIONAL DATA INTEGRATION

❑ MODELLING OF PHENOMENA RELATED TO ENVIRONMENTAL CHANGES

❑ EXPERIMENTATION AND PILOT PROJECTS

❑ GEOGRAPHIC INFORMATION SISTEMS APPLICATIONS

❑ TRAINING AND ASSISTANCE

CTM

STRUCTURE

THE CTM CAN RELY ON:

- ❑ SATELLITE DATA ACQUIRING ANTENNAS

- ❑ SATELLITE DATA PRE-PROCESSING AND ARCHIVING SYSTEMS

- ❑ DATA PROCESSING FACILITIES

- ❑ SATELLITE TELECOMMUNICATION SYSTEMS

THE CTM HAS BEEN CONCEIVED AS A POLE OF A WIDER NETWORK OF SATELLITE AND CONVENTIONAL DATA ACQUISITION AND PROCESSING FACILITIES, LINKED TOGETHER BY MEANS OF SATELLITE TELECOMMUNICATION AND LOCATED AT:

- ✦ FUCINO STATION
- ✦ MATERA CENTER
- ✦ ROME CENTER

EACH ONE OF THEM CAN AVAIL ITSELF OF THE TECHNICAL RESOURCES OF THE OTHER ONES.

CTM

CTM

TLR

TLR

Fucino Station

Matera Centre

Rome Centre

Scanzano Station

CTM

TLC
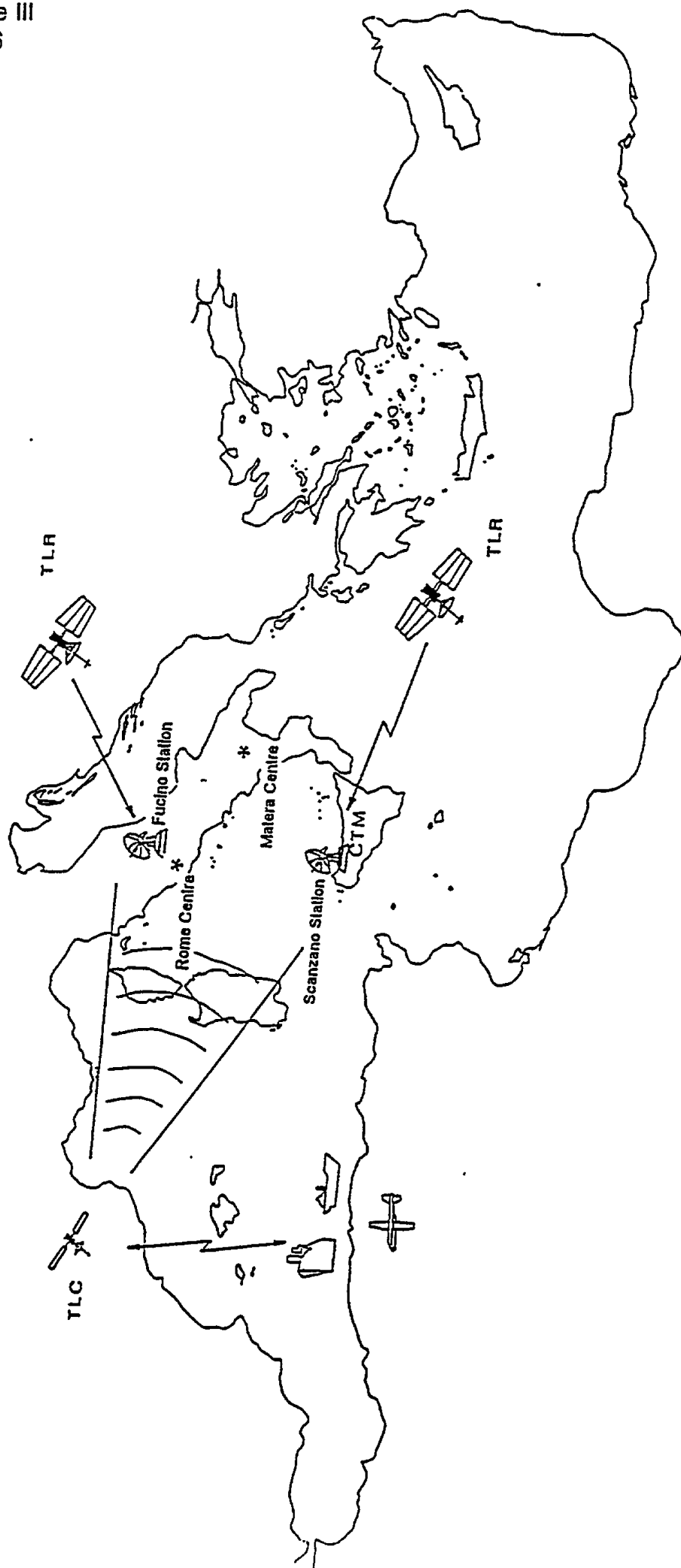
HISTORY

IN **1985**, IN THE OCCASION OF THE FOURTH ORDINARY
MEETING OF THE CONTRACTING PARTIES
TO THE BARCELONA CONVENTION FOR THE PROTECTION
OF THE MEDITERRANEAN ENVIRONMENT

THE **PROPOSAL FOR THE INSTITUTION OF
A REMOTE SENSING CENTRE** DEVOTED TO THE
OBSERVATION OF THE MEDITERRANEAN BASIN WAS MADE:

- BY THE <u>ITALIAN MINISTER FOR ENVIRONMENT</u>

- AS A <u>CONTRIBUTION BY ITALY</u> TO THE MEDITERRANEAN
  ACTION PLAN OF THE UNITED NATIONS ENVIRONMENT
  PROGRAMME (MAP/UNEP)

CTM

RAC/ERS
MAP/UNEP

IN THE EIGHTH MEETING OF THE CONTRACTING PARTIES (OCTOBER 1993, ANTALYA-TURKEY), **ALL THE MEDITERRANEAN COASTAL COUNTRIES AND THE EUROPEAN COMMUNITY FINALLY APPROVED** THE ITALIAN PROPOSAL, PRESENTED BY THE ITALIAN MINISTRY FOR FOREIGN AFFAIRS, SO **THE CTM BECAME <u>REGIONAL ACTIVITY CENTER FOR ENVIRONMENT REMOTE SENSING(RAC/ERS) IN THE MEDITERRANEAN AREA</u>**

IN THE FRAMEWORK OF MAP/UNEP INITIATIVES, THE CTM RAC/ERS WILL CO-OPERATE WITH THE OTHER MAP CENTRES LOCATED IN:

☐ <u>FRANCE</u> : PLAN BLEU - BP/RAC

☐ <u>CROATIA</u>: PRIORITY ACTIONS PROGRAMME - PAP/RAC

☐ <u>MALTA</u>: REGIONAL MARINE POLLUTION EMERGENCY CENTER - REMPEC

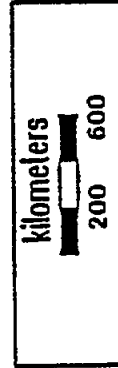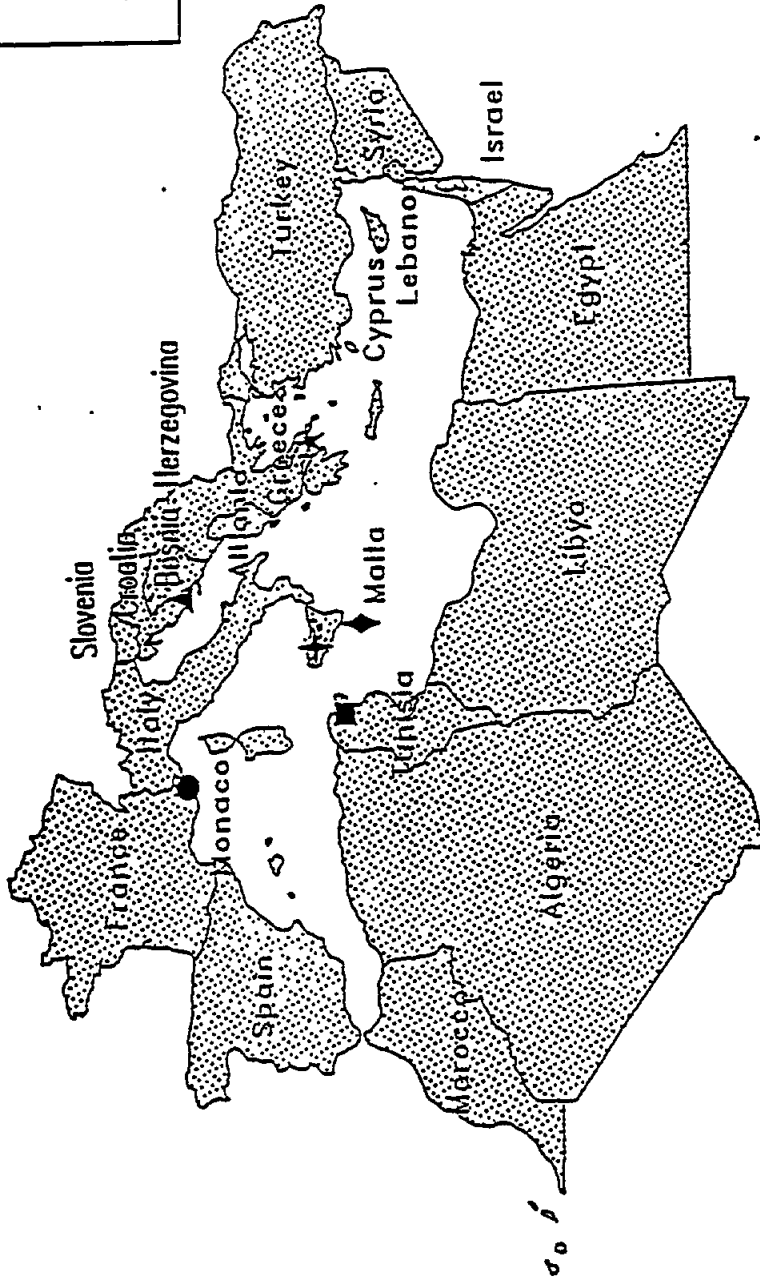☐ <u>TUNISIA</u>: SPECIALLY PROTECTED AREAS - SPA/RAC

CTM

Mediterranean Action Plan

Legend

✳	MED UNIT
●	BP/RAC
◆	REMPEC
■	SPA/RAC
◀	PAP/RAC
✚	ERS/RAC

kilometers

200   600

RAC ERS

IN THE ROLE OF RAC/ERS OF MAP/UNEP, THE CTM IS ENTRUSTED, AMONG THE OTHERS, WITH :

* MONITORING AND STUDYING OF THE MEDITERRANEAN ENVIRONMENT THROUGH THE USE OF REMOTE SENSING TECHNIQUES, AS WELL AS DISSEMINATING AND EXCHANGING INFORMATION AMONG THE MEDITERRANEAN COASTAL STATES

* ASSISTING ALL THE COASTAL COUNTRIES WITH TECHNICAL SUPPORT AND COOPERATING WITH THEM IN THEIR INITIATIVES BASED ON THE USE OF REMOTE SENSING, PREVENTING DUPLICATION AND WASTE OF RESOURCES

* CARRYING-OUT OF THE COASTAL AREAS MANAGEMENT PROGRAMMES (CAMPS) IN THE PRESENTLY STUDIED AREAS OF:
  ALBANIA
  EGYPT (FUKA MATROUH)
  TUNISIA (SFAX)
  AS WELL AS IN THE FUTURE ONES

* PARTICIPATING AND CONTRIBUTING - ALSO IN COOPERATION WITH OTHER RACs - TO REGIONAL PROJECTS OF MAP AND OTHER INTERNATIONAL ORGANIZATIONS TOWARDS THE SUSTAINABLE DEVELOPMENT OF INDIVIDUAL COUNTRIES AND THE MEDITERRANEAN AS A WHOLE

* ARRANGING TRAINING COURSES AND MEETINGS FOR TECHNICAL REPRESENTATIVES OF COASTAL COUNTRIES

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Centro de Teledetección Mediterráneo

United Nations Environment Programme
Mediterranean Action Plan
RAC/ERS
Regional Activity Centre for Environment Remote Sensing

OUTLINE

REMOTE-SENSING:

A NECESSARY TOOL FOR EFFECTIVE ENVIRONMENT MONITORING

The term "Remote-sensing" means the techniques and methods used to acquire and process information about an object which we wish to observe and study, without getting physically in touch with it.

The space remote-sensing technology makes use of orbiting satellite platforms on which are installed "sensors" devoted to acquire information about observed objects (targets): ground surface, atmosphere, sea and so on.

As a matter of fact, sensors receive the electromagnetic energy which the object reflects or emits in the field of visible, infrared or microwaves frequencies.
These sensed informations, converted into digital format, are then trasmitted to ground stations where they are acquired through parabolic antennas and recording systems; then they are processed and used for studies or analysis, as well as being displayed or rendered as images for a direct view.

Remote-sensing satellites, depending on orbit parameters and onboard instrumentation, allow us to observe the same part of the ground surface with a stated time period: for instance every half an hour in the case of Meteosat meteorological satellite (orbiting 36.000 km high), every 16 days as far as the Landsat satellites are concerned (orbiting 700 km high).

Repetitive observation, as well as the full overlay of different images acquired in subsequent times, allow a permanent monitoring of the conditions and modifications of targets, and consequently of environmental phenomena.

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The smallest dimensions that can be identified (geometric resolution) mainly depend on the type of sensor and the satellite running orbit.
For example the SPOT satellite (880 km high) allows us to obtain a 10 m resolution, that is to identify square objects with a 10 m side, while NOAA-TIROS satellite gives about 1 km resolution and Landsat satellite a maximum of 30 m resolution.

The satellite remotely sensed "scenes" cover about 180 km by 180 km for Landsat, 60 km by 60 km for SPOT, 2700 km each side for NOAA-TIROS, about one emisphere for Meteosat.

Such features are greatly important if we need to survey a wide area at the same instant (synopticity).
No other technique can obtain comparable results, airborne photogrammetry, for instance, due to its proper characteristics, could not cover in the same instant such extended areas.

The analysis of remote sensing data allows, furthermore, the identification and classification, with great precision, of significant parameters, as water surface temperature, sea colour, sea roughness, and so on.
As a matter of fact , it should be considered that sensors, which operate in different frequency bands of the electromagnetic spectrum (visible, infrared, microwaves) give us the possibility of a deep analysis of data and, consequently, of images thus identifying the type and characteristics of the monitored object with greater precision than human eye, which only operates in the visible spectrum.

On the other hand, all satellites which operate in visible and infrared spectrum, are not capable of observing the earth surface with some particular weather conditions, such as in presence of cloud coverage, while satellites equipped with microwave sensors onboard, as the european satellite ERS-1, can operate even under adverse atmospherical conditions.

As to the applicational point of view, it must be said that satellite remote sensing gives a digital representation of the observed area, useful to create a geographical-referred basis upon which can be overlaid - graphically and using computer-aided technologies (i.e. GIS) - further environmental thematic information (administrative boundaries, density of built-up areas, pollution rates and so on) .

So it becomes clear that remote sensing data may be usefully used both as a direct information source and as a reference system where conventional data can be read in an updated context :

- by overlaying the existing digital maps and remote sensing images, properly geocoded, variations in environmental conditions can be estimated, suggesting the need for further ground investigations or for priority in maps uptodating, which is a complex and expensive operation where the best results have to be searched for;

- through phenomena which are revealed in remote sensing images (water or atmosphere transparency, for instance), omogenous areas can be identified, as well as the extention of related phenomena (i.e. pollution) can be better evaluated, where otherwise measured data are only available in few places in which needful samplings have been carried out.

It is in this way that satellite remote sensing is usefully applied to many environmental managment and control actions .
In fact remote sensing data can be used, completed by other conventional information (in situ remarks, mapping statistics), to face several problems, that range from the creation and managment of natural reserves, to caves monitoring, to land use and protection, to the crops production assessment and so forth.
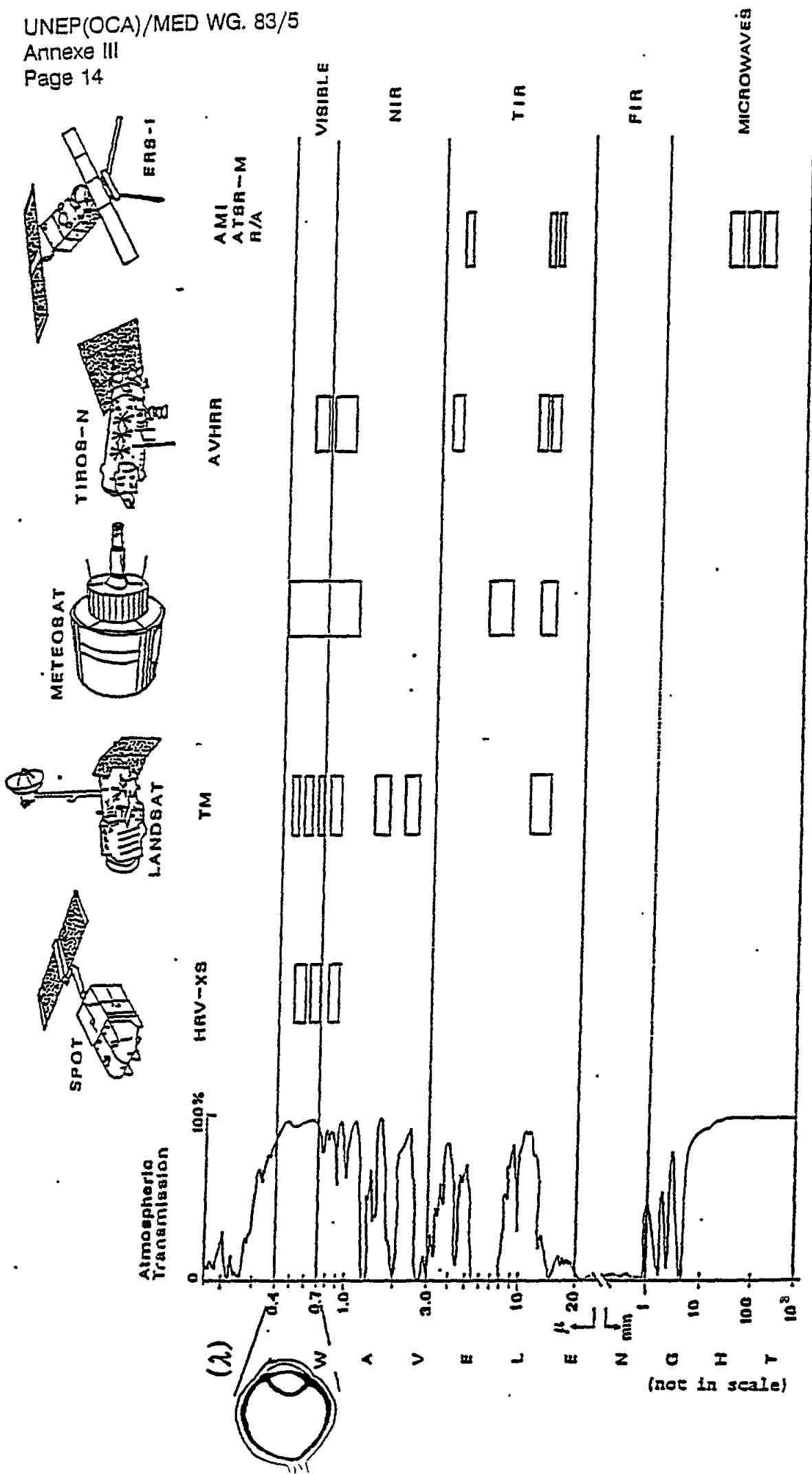
Among the available information coming from the analysis of remote sensing data, must be included updated indications on localization and extention of industrial and built-up areas that cause anthropic pressure and potentially modify the environmental balance.
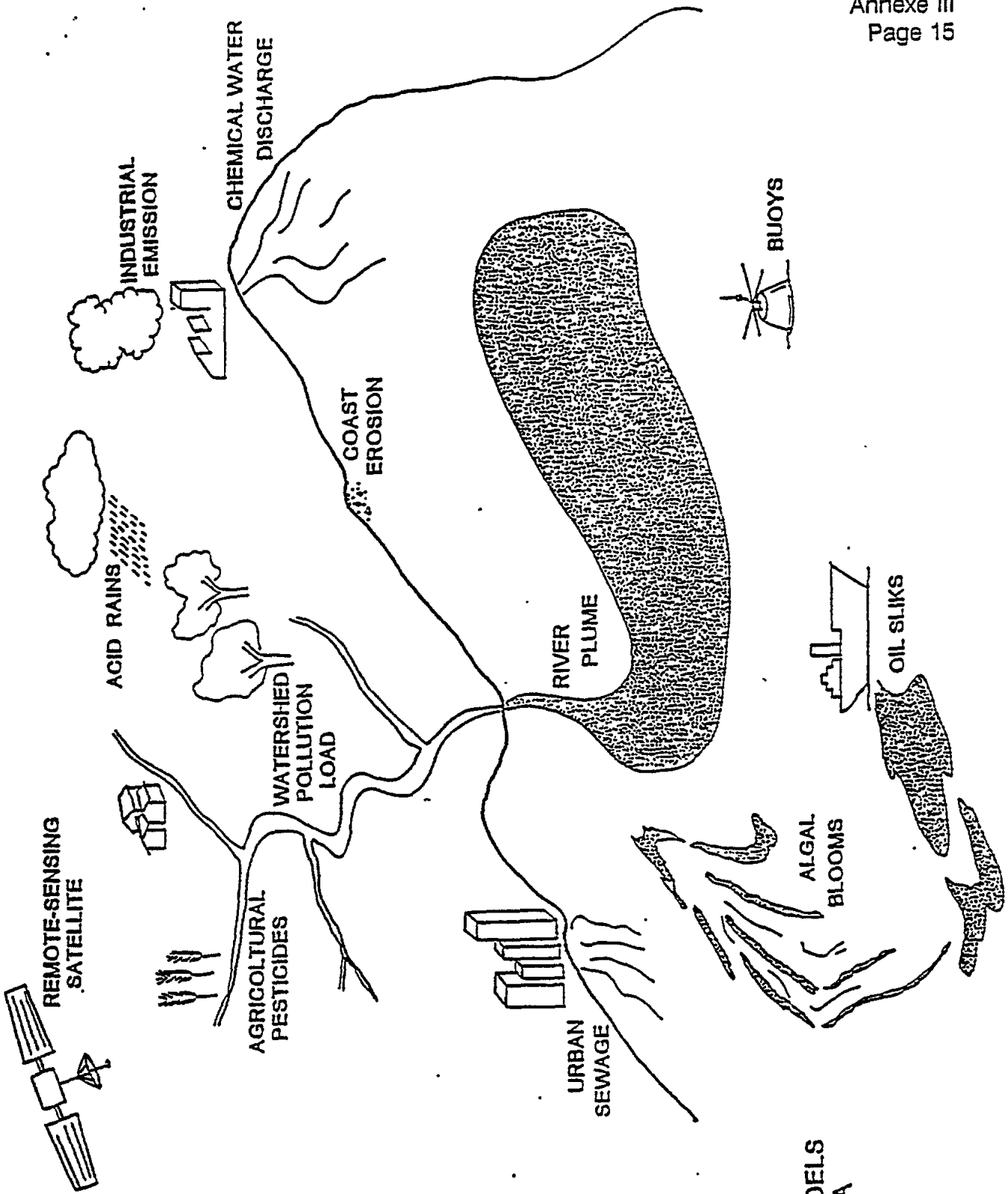
It can be also noticed the civil structures growth (roads, railways, dams) and the land cover (cultivated, forested or bare areas) and the possible presence of degradation phenomena (deforestation, soil erosion, vegetation cover changes) can be identified as well.

Moreover, the use of remote sensing allows us to obtain data on erosion phenomena, orography alterations, watercourse diversion, and to receive information about the water current dynamics and the sea transparency near the coast.

As far as air conditions are concerned, the industrial smokes, the ozone layer and so on can be also identified and analized.

In all these fields great scientific efforts are being made and increasing researches aim at strengthening - through remote sensing - the effective understanding of environmental conditions and changes. As a result a great number of applications are fully and usefully operational worldwide.

CHEMICAL WATER DISCHARGE

INDUSTRIAL EMISSION

BUOYS

COAST EROSION

ACID RAINS

RIVER PLUME

OIL SLIKS

WATERSHED POLLUTION LOAD

REMOTE-SENSING SATELLITE

ALGAL BLOOMS

AGRICOLTURAL PESTICIDES

URBAN SEWAGE

REMOTE SENSED DATA

sea colour
sea surface temperature
sea roughness
wave height
wind direction
pedology
geology
geomorfology
land use
....

CONVENTIONAL DATA

geographic data
statistic data
socio-economica data
laboratory analysis
in situ investigations
hydrological data
....

SEA WATER QUALITY
SEA WATER CIRCULATION MODELS
EUTROPHICATION PHENOMENA
SEA WATER POLLUTION
DESERTIFICATION
COASTAL EROSION
HYDRODYNAMIC MODELS
....

COSMOS

CRITERIA FOR AN OPERATIONAL SETTING UP OF A MEDITERRANEAN OBSERVATION SYSTEM

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MANY ATTEMPTS

HAVE BEEN AND ARE BEING MADE

IN ORDER TO

CONCEIVE, PLAN, CARRY OUT

MULTI-DISCIPLINARY OBSERVATORIES

OF THE MEDITERRANEAN REGION,

WICH IS A VERY SIGNIFICANT TEST AREA

CTM

THE GOAL OF A

REGIONAL ENVIRONMENTAL OBSERVATORY

COULD BE:

TO RENDER GLOBAL UPDATE INFORMATION

ON THE ENVIRONMENTAL BALANCE AND DYNAMIC,

TAKING INTO ACCOUNT THE HUGE NUMBER OF

CONNECTIONS

LINKING CAUSES AND EFFECTS

WICH IS:

GREATLY COMPLEX, EXPENSIVE AND TIME

CONSUMING

CTM

............MULTI-DISCIPLINARY

OBSERVATORY..................

?

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OUR APPROACH IS:

TO CLEARLY INDIVIDUATE

FEW BUT SIGNIFICANT PARAMETERS

TO BE MONITORED

THAT CHARACTERIZE THE ENVIRONMENT

AS FUNDAMENTAL INDICATORS OF A SYSTEM

WHICH LINKS THEM EACH OTHER

THROUGH EVEN COMPLEX CONNECTIONS

TO THIS PURPOSE

THE REMOTE SENSING TECHNIQUE

MIGHT UNDOUBTELY PLAY

AN EFFECTIVE ROLE

BY PROVIDING ITS ADVANCED TOOLS AND APPLICATIONS

AT PRESENT *CTM* IS CARRYING OUT A PROGRAM

NAMED *COSMOS*

OPEN TO ANY INTEGRATION

FROM SEVERAL APPROACHES

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COSMOS.

CRITERIA
FOR AN
OPERATIONAL
SETTING UP
OF A
MEDITERRANEAN
OBSERVATION
SYSTEM

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THE SYSTEM IS CONCEIVED TO GRANT:

- SYNOPTIC SURVEY AT REGIONAL SCALE

- REPETITIVE OBSERVATION

- LOW COST SERVICE

- HOMOGENEUS MEASUREMENTS AT REGIONAL SCALE

- COMPARABLE INFORMATION AT REGIONAL SCALE

- FULL SPACE COVERAGE OF THE REGION

- SYNTHETIC DATA AT REGIONAL SCALE

- GENERAL DIRECTIONS FOR FURTHER EITHER LOCAL OR PUNCTUAL INVESTIGATIONS

- FUNDAMENTAL INFORMATION THAT ALLOW THE PLANNINIG AND DEVELOPING OF ACTIVITIES OF REAL COMMON INTEREST AT MEDITERRANEAN SCALE, TO BE CARRIED OUT USING REMOTE SENSING TECHNIQUES

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STEPS FOR THE IMPLEMENTATION OF THE SYSTEM

A) ANALYSIS OF **LOCAL/NATIONAL PRIORITY NEEDS** CONCERNING ENVIRONMENTAL CONDITIONS AND CHANGES

B) IMPLEMENTATION OF A **MATRIX:**
   "ENVIRONMENTAL/ANTHROPIC COMPONENTS
   IMPACT CAUSES"

C) APPLICATION OF A **METHOD** FOR FILLING IN THE MATRIXES

D) IDENTIFICATION OF **ENVIRONMENTAL INDICATORS** OF PRIORITY REGIONAL INTEREST TO BE MONITORED

E) SELECTION OF MONITORING TOOLS

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UTILIZATION OF SATELLITE DATA FOR MARINE

RESOURCES EVALUATION IN THE

MEDITERRANEAN BASIN

(*MARE* PROJECT)

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RATIONALE

Technical reasons

FISH SHOALS CANNOT. BE OBSERVED DIRECTLY BY EXISTING EARTH OBSERVING SATELLITES

DIFFERENT OBSERVABLE SURFACE CONDITIONS CAN BE RELATED TO. THE PHYSICAL, CHEMICAL AND BIOLOGICAL PROCESSES RELEVANT TO REPRODUCTIONS, NATURAL FLUCTUATION AND MOVEMENTS OF FISH POPULATION

OBJECTIVES

UNDERSTANDING OF THE LOCAL RELATIONSHIP BETWEEN SATELLITE DETERMINED PARAMETERS AND BIOLOGICAL DISTRIBUTION PARAMETERS

DEFINITION OF SYNTHETIC INFORMATION USEFUL TO SUPPORT:
- CAPTURE AND SURVEILLANCE OF COMMERCIAL FISHERIES
- PLANNING, DEVELOPING AND MANAGEMENT OF FISHERY ACTIVITIES

EVALUATION OF THE TRUE POTENTIALITY OF THE AVAILABLE REMOTE SENSING DATA INTEGRATED WITH OTHER INFORMATION

METHOD

OBSERVATION OF PHYSICAL SEA SURFACE PARAMETERS AND STUDY OF THE RELATIONSHIP OF THESE OBSERVATIONS TO THE PRESENCE OF MARINE RESOURCES

Hypothesis

1) THE AREAS WITH HIGH PROBABILITY OF PRESENCE OF FISHERY RESOURCES ARE STRONGLY RELATED TO AREAS WITH HIGH PRIMARY PRODUCTIVITY

2) BIOLOGICAL DISTRIBUTION RESPONDS TO THE PRESENCE OF FRONTS, MESOSCALE EDDIES AND OTHER DYNAMIC FEATURES

THE ACTIVITY

THE ACTIVITY IS PLANNED IN THREE PHASES:

1) HISTORICAL DATA ANALYSIS IN ORDER TO INDIVIDUATE THE SPATIAL AND TEMPORAL DISTRIBUTION OF PRIMARY PRODUCTIVITY AND THE POSSIBLE CORRELATION WITH GEOPHYSICAL AND OCEANOGRAPHYCAL FACTORS WHICH INFLUENCE ITS VARIABILITY

2) VERIFICATION OF THE RELATIONSHIP DEFINED IN THE FIRST PHASE UTILIZING NEW SATELLITE DATA AND IN-SITU DATA EVENTUALLY ACQUIRED WITH AD-HOC CAMPAIGNS

3) INDIVIDUATION OF SYNTHESIS INFORMATION AND EXPERIMENTATION OF A DISSEMINATION SERVICE

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SATELLITE OBSERVATIONS

DIRECT OBSERVATIONS	INSTRUMENT	INDIRECT OBSERVATIONS
Ocean Color data	CZCS Sea WiFS	Clorophyll concentration Marine primary productivity
Sea surface temperature maps	NOAA-AVHRR	Dynamic features (frontal boundaries, upwelling areas, filaments)
Microwave backscatter data	ERS-1 scatterometer	Sea surface wind Sea waves

SATELLITE DATA HAVE CHARACTERISTICS OF HOMOGENEITY, RIPETITIVITY AND OBSERVATION OF GREAT AREAS SUCH TO BE COMPLEMENTARY TO THE GROUND OBSERVATIONS

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SELECTED TEST AREAS

1 ADRIATIC SEA

2 SICILY CHANNEL
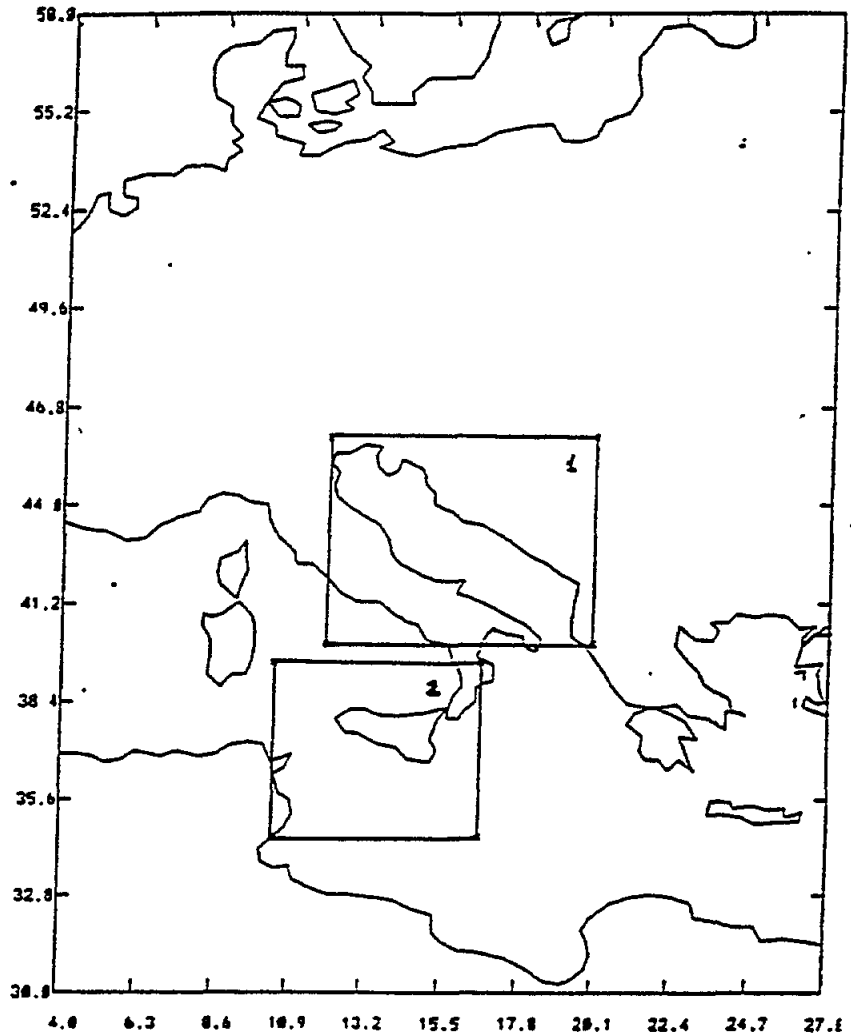
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DEVELOPMENT OF THE FIRST PHASE

1) iNDIVIDUATION OF SEA AREAS WITH WELL-DEFINED CHARACTERISTICS (PERSISTENT PATTERNS OF NUTRIENTS)

2) HISTORICAL ANALYSIS CONSIDERING THE FOLLOWING SATELLITE INSTRUMENTS:

CZCS (Ocean Color)
AVHRR (Sea Surface Temperature)
ERS-1 (Scatterometer)

3) SELECTED PERIOD: 1985-1986 (CZCS STOPPED THE ACQUISITION IN JUNE 1986)

4) INTERPRETATION TAKING INTO ACCOUNT THE RELATIONSHIP BETWEEN PRIMARY PRODUCTIVITY AND THE FACTORS WHICH INFLUENCE ITS VARIABILITY:

THERMAL FRONTS
BATIMETRY
WIND STRESS
UPWELLING AND OTHER COLD WATER AREAS
WAVE CHARACTERISTICS

5) VALIDATION AND CALIBRATION CONSIDERING IN-SITU EXISTING OCEANOGRAPHIC DATA

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RESULTS

<u>Short Term</u>   (Jan.-Mar. 1995)

RELATIONSHIP BETWEEN SPACE-TEMPORAL VARIABILITY OF HIGH PRODUCTIVITY AREAS AND POSSIBLE CAUSES

INDIVIDUATION (WITHIN THE TEST AREAS) OF AREAS WITH STRONG PRESENCE OF NUTRIENTS AND STUDY OF THE CORRELATION WITH SEA SURFACE TEMPERATURE PATTERNS

OBSERVATION AND STUDY (IN SICILY CHANNEL) OF AREAS WITH PERSISTENT PATTERNS LIKE COLD WATER FILAMENTS (RICH OF NUTRIENTS)

<u>Medium Term</u>

SET'UP OF A MODEL OF PRIMARY PRODUCTIVITY FOR SELECTED AREAS

<u>Long Term</u>

EXTENSION OF THE DEVELOPED METHODOLOGY OUT OF THE TEST AREAS, POSSIBLY IN THE OVERALL MEDITERRANEAN SEA

USE OF THESE RESULTS IN AN OPERATIONAL CONTEXT, CONSIDERING THE LAUNCH OF THE FUTURE SEAWIFS OCEAN COLOR INSTRUMENT

CONSTITUTION OF A NETWORK FOR THE DISSEMINATION OF SIGNIFICANT INFORMATION IN · SUITABLE FORMAT FOR IMMEDIATE EXPLOITATION BY FIELD OPERATORS

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CLASSIFICATION ET CONTROLE

DE LA VEGETATION MEDITERRANEENNE

SUR LA BASE DE DONNEES SATELLITAIRES

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OBJECTIFS PRINCIPAUX

❑ CLASSIFICATION DE LA VEGETATION DE LA MEDITERRANEE BASEE SUR L'EVOLUTION PLURIANNUELLE DE SON ACTIVITE PHOTOSYNTHETIQUE MESUREE PAR SATELLITE.

❑ CREATION D'UNE BASE DE DONNEES UTILE POUR LE CONTROLE CONTINU DE LA VEGETATION.

$$\Rightarrow$$

❑ CREATION D'UN INSTRUMENT PERMETTANT DE:
    ▼ DEFINIR LES PRINCIPAUX TYPES DE COUVERTURE VEGETALE (NATURELLE ET CULTIVEE)
    ▼ ANALYSER DE MANIERE RAPIDE TOUTE VARIATION, A COURT TERME ET A LONG TERME, ENREGISTREE PAR LE COUVERT VEGETAL

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MOTIFS

◻ AUGMENTATION DES PHENOMENES DE DEGRADATION DE LA VEGETATION NATURELLE EN MEDITERRANEE

◻ BESOINS DE PLUS EN PLUS CROISSANT D'UNE GESTION RATIONNELLE DES RESSOURCES VEGETALES NATURELLES ET CULTIVEES EN MEDITERRANEE

$$\Rightarrow$$

NECESSITE

◻ DE DEFINIR LA STRATIFICATION DE LA COUVERTURE VEGETALE

◻ DE SUIVRE LE COMPORTEMENT DANS LE TEMPS DES COMMUNAUTES VEGETALES.

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INTRODUCTION DE LA TELEDETECTION
DANS L'ETUDE DE LA VEGETATION.

❑ METHODES TRADITIONNELLES (mesures in situ et modélisation successive) IMPLIQUENT UN INVESTISSEMENT DE TEMPS ET D'ARGENT ELEVE.

❑ AU TRAVERS DE LA REPONSE RADIOMETRIQUE (ENERGIE LUMINEUSE RESTITUEE) D'UNE PLANTE, ON PEUT:
  ▼ CONNAITRE:
    ● SON EFFICACITE PHOTOSYNTHETIQUE
    ● SON COMPORTMENT AU COURS DE L'ENTIERE SAISON DE CROISSANCE

  ▼ ENREGISTRER:
    ● SA REACTION AU STRESS ET/OU AUX CONTRAINTES METEOROLOGIQUES (RADIATION · SOLAIRE, TEMPERATURE ET DISPONIBILITE HYDRIQUE)

❑ DES 1980, DEVELOPPEMENT DE RECHERCHES SUR L'UTILISATION DU SATELLITE POUR L'ETUDE DE LA VEGETATION

❑ LES SATELLITES DE LA SERIE NOAA SONT CONSIDERES LES MEILLEURS POUR CE TYPE DE RECHERCHES / CARACTERISTIQUES:
  ▼ INSTRUMENT DE MESURE RADIOMETRIQUE TRES PRECIS
  ▼ FREQUENCE ELEVEE D'ACQUISITION (2 FOIS PAR JOUR)
  ▼ ACQUISITION DE VASTE COUVERTURE TERRITORIALE A CHAQUE PASSAGE (2600 x 2600 KM)
    EXEMPLE: STATION DE SCANZANO (SICILE):
    IMAGE = 4000 KM (LAT.)x5000 km (LONG.)

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QUELQUES CARACTERISTIQUES
DES SATELLITES NOAA

❑ RESOLUTION GEOMETRIQUE
▼ 1.1km (format d'acquisition LAC: Local Area Coverage) pour les images acquises au Nadir;
▼ 4 km (format d'acquisition GAC: Global Area Coverage) pour les images enregistrées et acquises successivement en Virginie ⇒ elaboration GVI (15-30 km) .

❑ RADIOMETRE AVHRR (Advanced Very High Resolution Radiometer) ANALYSE ET MESURE CINQ BANDES DU SPECTRE LUMINEUX

▼ canal 1: 0.58-0.68 µm (visible)
▼ canal 2: 0.725 -1.1 µm (proche infrarouge)
▼ canal 3: 3.55- 3.93 µm (infrarouge thermique)
▼ canal 4: 10.3-11.3 µm (infrarouge thermique)
▼ canal 6: 11.5 -12.5 µm (infrarouge thermique)

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INDICE DE VEGETATION

☐ LA PARAMETRISATION DE LA REPONSE RADIOMETRIQUE EST
FAITE PAR LE CALCUL D'INDICES DE LA VEGETATION, COMME
LE NDVI (Normalized Difference Vegetation Index) :

$$\frac{canal2 - canal1}{canal2 + canal1}$$

☐ NDVI FLUCTUE entre -1 et +1

☐ NDVI = 0.1 ≅ SOL NU

☐ NDVI = 0.2 ≅ ACTIVITE PHOTOSYNTHETIQUE MINIMALE

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POURQUOI UTILISER L'INDICE DE VEGETATION

☐ INTENSITE ET "FORME" DU CYCLE ANNUEL DU NDVI VARIENT EN FONCTION DE L'ESPECE VEGETALE

$$\Longrightarrow$$

CLASSIFICATION ET STRATIFICATION DE LA VEGETATION

▼ DIFFICULTE: CYCLES SIMILAIRES POUR DIVERSES ESPECES VEGETALES (IMPOSSIBILITE DE DISCRIMINATION)

$$\Longrightarrow$$

▼ NECESSITE D'UNE VALIDATION C'EST A DIRE UN CONTROLE DES ESPECES EN SE BASANT:
  ● INTEGRATION D'INFORMATION CARTOGRAPHIQUES EXISTANTES (VEGETATION, UTILISATION DU SOL)
  ● EXAMEN SUR LE TERRAIN DE ZONES ECHANTILLONS ET DEFINITION DE L'ESPECE LA PLUS REPRESENTEE (DONT LA REPONSE SPECTRALE EST DOMINANTE)

☐ INTENSITE ET EVOLUTION DU CYCLE ANNUEL DU NDVI D'UNE MEME ESPECE VARIABLE EN FONCTION DES CARACTERISTIQUES CLIMATOLOGIQUES DE L'ANNEE D'OBSERVATION.

$$\Longrightarrow$$

UTILISATION COMME CONTROLE DES VARIATIONS

▼ DIFFICULTE: REPRESENTATIVITE DE LA CLASSIFICATION / UNE ANNEE D'OBSERVATION ?

▼ DEFINITION D'UN CYCLE ANNUEL MOYEN BASE SUR L'INTEGRATION DE PLUSIEURS ANNEES D'OBSERVATION. CYCLE SERVANT SUCCESSIVEMENT DE REFERENCE POUR LES ACTIVITES DE CONTROLE CONTINU.

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1987 ITALY NDVI PROFILES
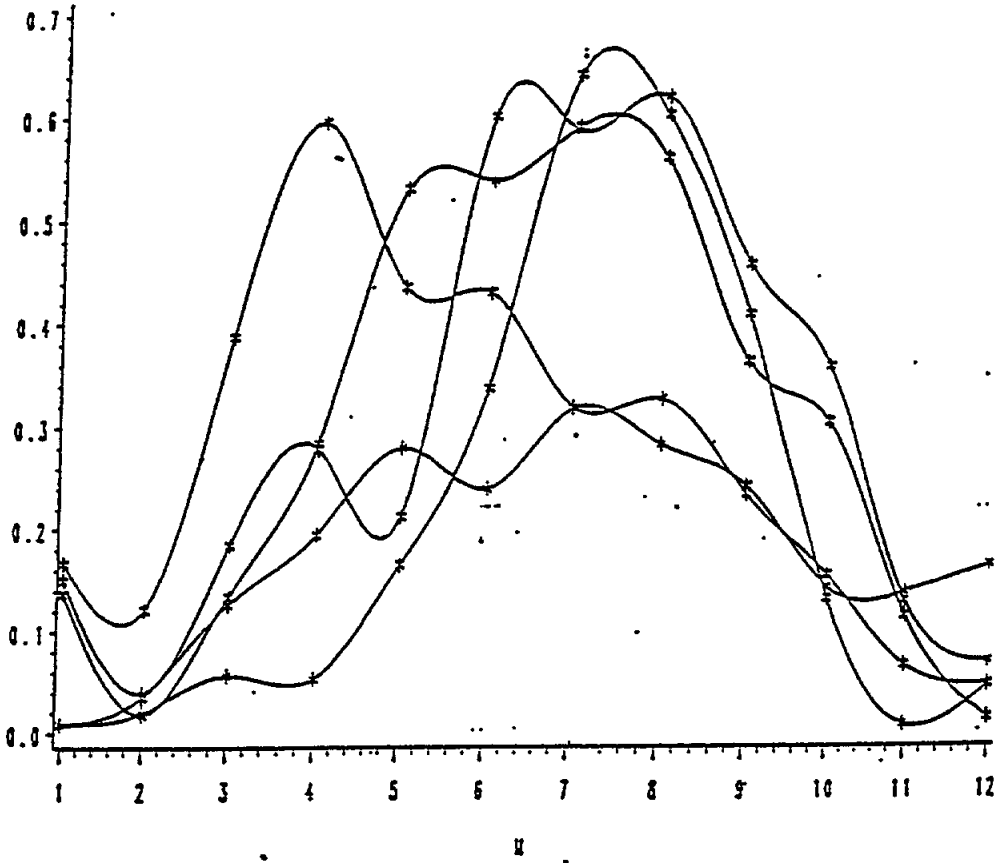
Appennino Ligure Alpi Liguri
Rice Cultivation Milan Sub-urbs
Fiora Plain
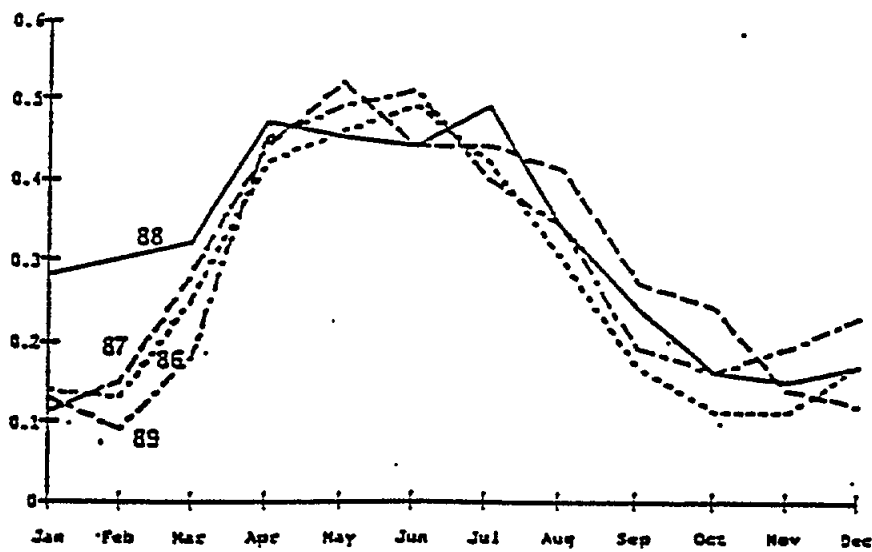
Single year monthly 1986/89 NDVI profiles for Po valley agricultural area.

FROM BENEDETTI et al 1983

ARTICULATION DU PROJET

☐ EXTENSION GEOGRAPHIQUE
   LES PAYS COTIERS DE LA MEDITERRANEE

☐ PHASES DU PROJET.

▼ I. ITALIE
   ● PREMIERE CLASSIFICATION DEJA REALISEE SUR L'ELABORATION DES DONNEES JOURNALIERES DE NDVI SUR QUATRE ANNEES D'OBSERVATION (1986-1990, 1600 IMAGES NOAA).
   RESULTAT: CARTE PRODUITE A ECHELLE 1:1.000.000 AVEC IDENTIFICATION DE 17 CLASSES DE VEGETATION.

   ● AMPLIFICATION SUR HUIT ANNEES D'OBSERVATION (1986-1993), RI-ELABORATION D'UNE CLASSIFICATION ET PRODUCTION D'UNE CARTOGRAPHIE A 1:1.000.000.

   ● VALIDATION DE CETTE CLASSIFICATION:
   - <u>RELEVES IN SITU:</u>
     DETERMINATION SUR DES ZONES ECHANTILLONS (3 KM x 3 KM) DES ESPECES DOMINANTES
     RECONNAISSANCE DES ESPECES VEGETALES ET DE LEUR STRATIFICATION EN FONCTION DE L'ALTITUDE
   - <u>COMPARAISON AVEC CARTOGRAPHIE EXISTANTES:</u>
     UTILISATION DU SOL A 1:250.000 (1960-1970)
     VEGETATION A 1:1000.000 (1992)

FIN ACTIVITE: DECEMBRE 1994

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▼ II. BASSIN MEDITERRANEEN

● ELABORATION DE NDVI JOURNALIER SUR UNE ANNEE
(1992 o 1993)

● RESULTAT: PREMIERE CLASSIFICATION AVEC
ATTRIBUTION DE LA LEGENDE / RESULTATS OBTENUS
EN ITALIE ET INFORMATIONS DISPONIBLES PROVENANT
DES AUTRES PAYS.

● DISPONIBILITE DES DONNEES POUR TOUT PAYS QUI LE
DEMANDE

● FIN ACTIVITE: MAI 1995

CETTE PREMIERE CLASSIFICATION BASEE SUR UNE ANNEE
D'OBSERVATION DOIT ETRE CONSIDERER COMME LE PREMIER
PAS VERS LA MISE AU POINT D'UN SYSTEME DE
CONNAISSANCE ET DE CONTROLE.

☐ NOM DONNE AU PROJET : DAPHNE

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MEDITERRANEAN

*R*EMOTE SENSING

*A*CTIVITIES

*I*NVENTORY

*S*YSTEM

**NOTE: THE INVENTORY IS STILL IN PROGRESS
SINCE BASED ON QUESTIONNAIRES RETURNED
TO RAC/ERS WITHIN JULY 1994**

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MEDITERRANEAN

Remote sensing
Activities
Inventory
System
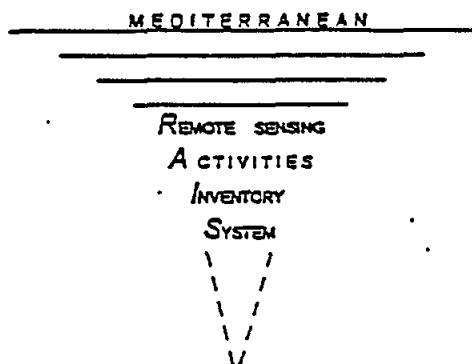
THE RAC/ERS' MANDATE

RECEIVED BY ALL THE MEDITERRANEAN COASTAL COUNTRIES AND THE EU

CONSIST IN CONTRIBUTING TO THE MEDITERRANEAN ACTION PLAN

BY:

❑ IMPLEMENTING ACTIONS BASED ON REMOTE SENSING TECHNIQUES FOR THE OBSERVATION AND STUDY OF THE MEDITERRANEAN ENVIRONMENT

❑ PROMOTING THE HOMOGENIZATION OF INITIATIVES IN THIS FIELD

❑ ENHANCING CO-OPERATION AND SYNERGIES AMONG THE COASTAL COUNTRIES THEMSELVES

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<u>MEDITERRANEAN</u>

*R*EMOTE SENSING
*A*CTIVITIES
*I*NVENTORY
*S*YSTEM

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TO FULFIL THIS TASK

● RAC/ERS HAS FIRST OF ALL TO KNOW:

◆ ALREADY CARRIED OUT OR PRESENTLY ONGOING AND PLANNED ACTIVITIES ALL OVER THE MEDITERRANEAN REGION

◆· EXISTING AVAILABLE EQUIPMENT AND EXPERTISE

◆ PRIORITY DEMANDS OF COASTAL COUNTRIES

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MEDITERRANEAN

Remote sensing
Activities
Inventory
System
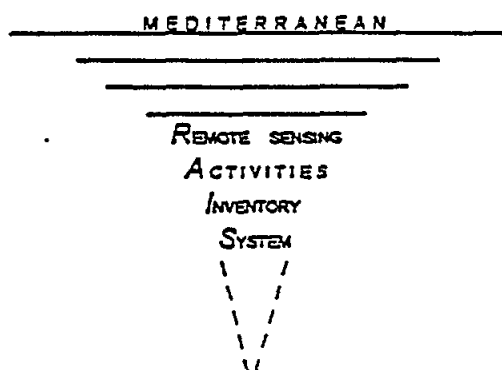
THE "RAIS" PROJECT HAS BEEN CONCEIVED JUST TO ALLOW THE RAC/ERS TO PERFORM THE FOLLOWING TASKS:

COGNITION

TO KNOW WHO IS DOING WHAT AND WHERE IN ORDER TO:

☐ AVOID DUPLICATION AND WASTE OF RESOURCES

☐ GATHER UPDATED AND COMPLETE INFORMATION ABOUT EXISTING REMOTE SENSING APPLICATIONS AND DATA IN ANY AREA TO BE MONITORED

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MEDITERRANEAN

REMOTE SENSING
ACTIVITIES
INVENTORY
SYSTEM

COOPERATION

◆ TO FAVOUR THE ACCESS TO THE DIFFERENT EXPERIENCES OF THE CENTERS AS WELL AS TO THE CARRIED OUT APPLICATIONS AND AVAILABLE EQUIPMENT

◆ TO MERGE THOSE INFORMATION AND DATA IN ORDER TO:

❑ PUT THE BASIS FOR THE DEVELOPMENT OF A POSSIBLE INTEGRATED PROJECT COVERING THE WHOLE MEDITERRANEAN REGION

❑ TO SUPPORT THE WIDENING OF THE EXISTING PROJECTS

CTM

MEDITERRANEAN

Remote sensing
Activities
Inventory
System

ASSISTANCE

AIMS AT PROVIDING:

❏   THE EXCHANGE OF KNOWLEDGES

❏   MUTUAL SUPPORT IN SPECIFIC TECHNICAL FIELDS

❏   JOINT PLANS FOR PROFESSIONAL GROWTH

❏   EDUCATIONAL ACTIVITIES

❖

CTM

MEDITERRANEAN

Remote sensing
A'ctivities
Inventory
System

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● *IN ORDER TO SUPPORT THE RAC/ERS IN IMPLEMENTING THE ABOVE*

MENTIONED FUNCTIONS,

MED-U, RACs, FOCAL POINTS AND CENTERS

SHOULD:

● ☐ ENLIVEN THE FLOW OF INFORMATION CONCERNING "REMOTE
SENSING" INTO/FROM THE RAC/ERS

☐ APPLY TO RAC/ERS.FOR CONSULTATION WHENEVER A NEW
MONITORING PLAN SHOULD BE SET UP

CTM

MEDITERRANEAN

Remote sensing
Activities
Inventory
System
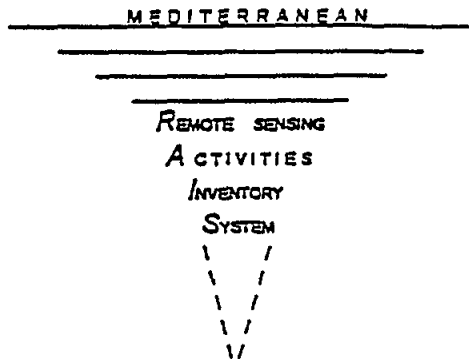
SYSTEM'S ARCHITECTURE

The system is structured as follows:

DATA BASE IMPLEMENTATION:

DATA COLLECTION THROUGH THE SETTING UP OF A QUESTIONNAIRE MAILED TO THE REMOTE SENSING CENTERS BASED IN THE MEDITERRANEAN COASTAL COUNTRIES

DATA RECORDING AND MANAGEMENT IN ORDER TO GROUP AND SYNTHESIZE INFORMATION ON:

- CARRIED OUT APPLICATIONS
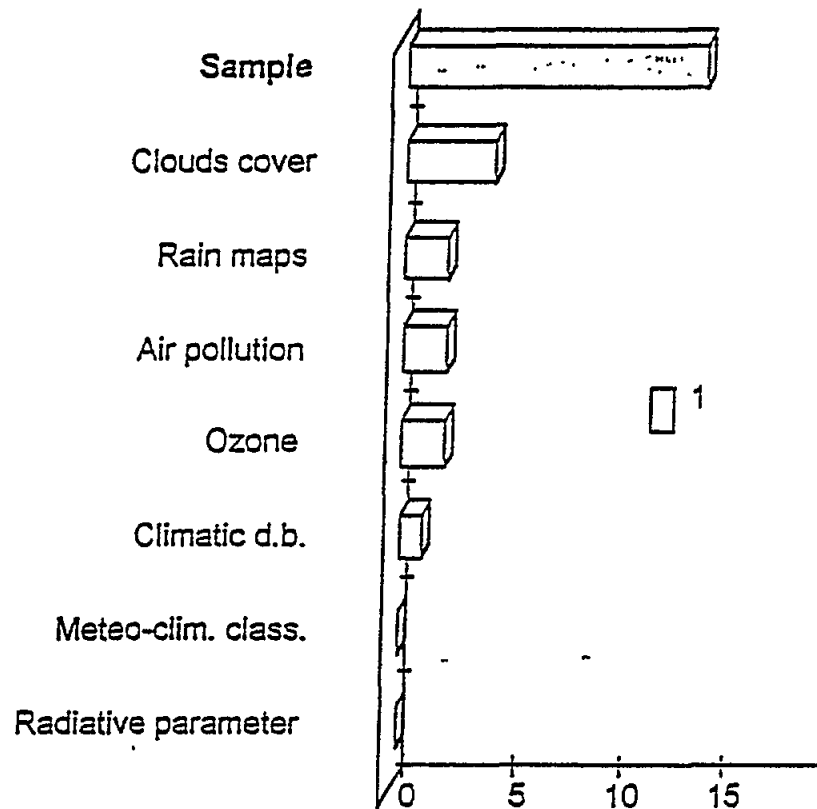
- ACQUIRED EXPERIENCES

- AVAILABLE SKILLS

- AVAILABLE EQUIPMENT AND FACILITIES

DATA DIFFUSION:

THE INVENTORY IS ACCESSIBLE TO THE WHOLE MEDITERRANEAN COMMUNITY WHILE IT IS CONTINOUSLY UPDATED DUE TO THE FLOWING IN OF INFORMATION FROM THE COOPERATING PARTIES
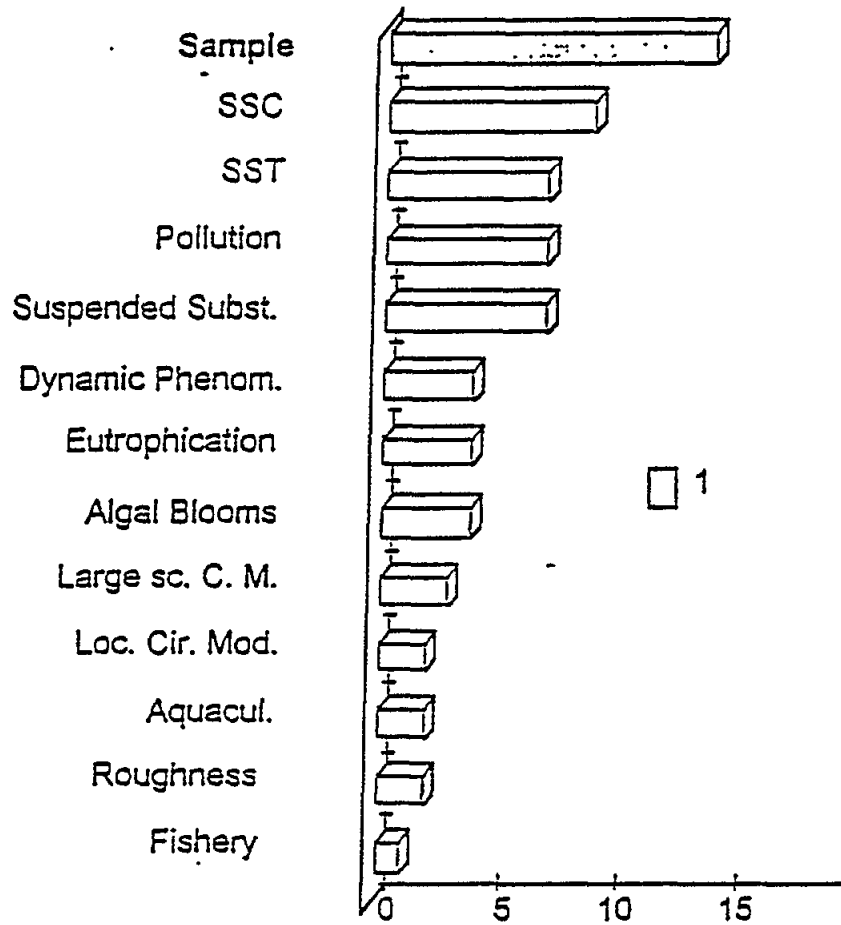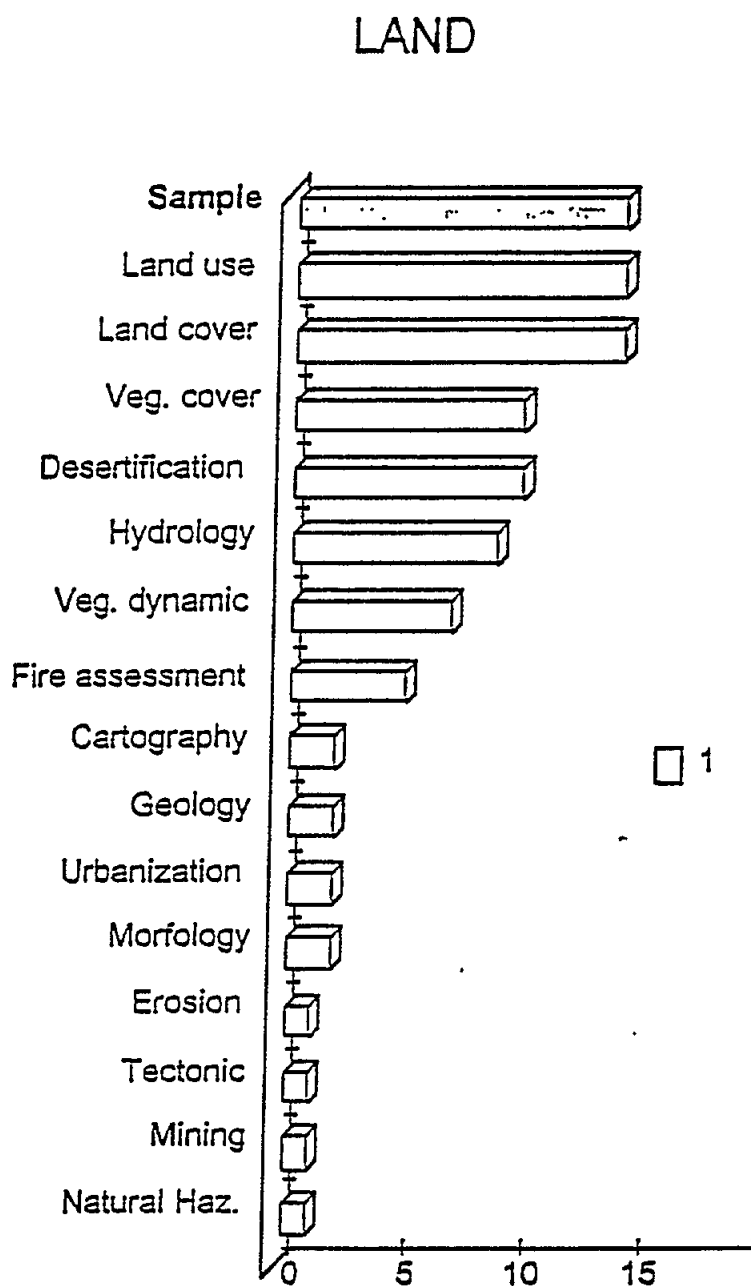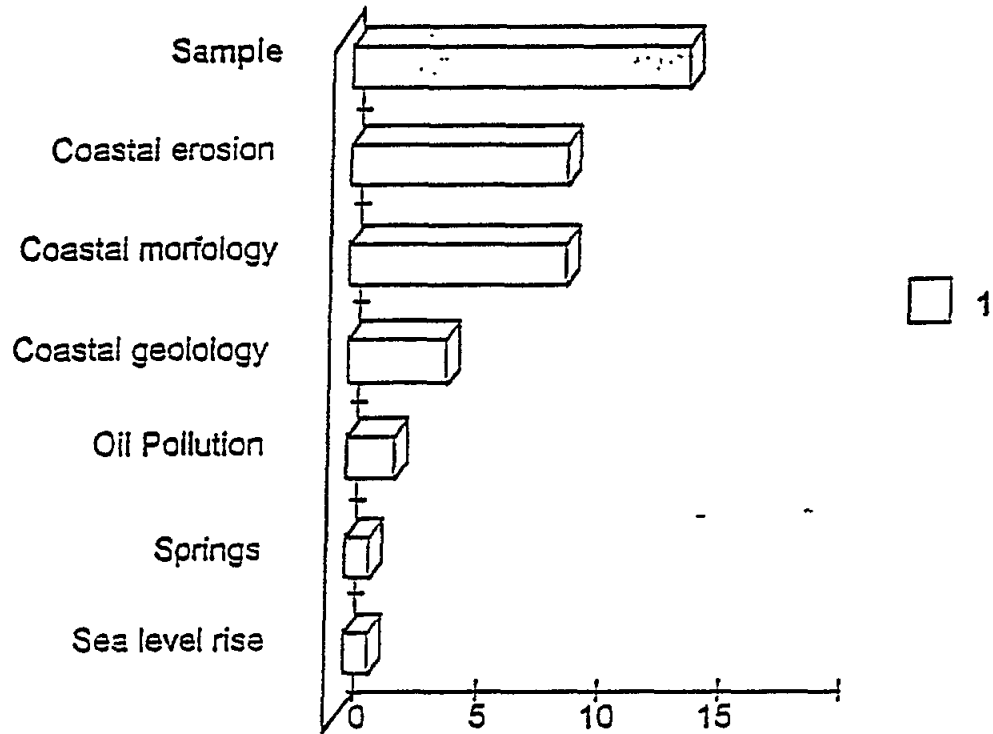
CTM

ATMOSPHERE

- Number of Centers involved in each research area (with reference to the 14 questionnaires already collected)

SEA

- Number of Centers involved in each research area (with reference to the 14 questionnaires already collected)

LAND

- *Number of Centers involved in each research area (with reference to the 14 questionnaires already collected)*

COAST

- Number of Centers involved in each research area (with reference to the 14 questionnaires already collected)

CAMP/PAC

COASTAL AREA MANAGEMENT PROGRAM

PROGRAMME D'AMENAGEMENT COTIER

CTM

CAMP/PAC
COASTAL AREA MANAGEMENT PROGRAM
PROGRAMME D'AMENAGEMENT COTIER

- PROGRAMMES REALISES DANS DES ZONES COTIERES PARTICULIEREMENT <u>VULNERABLES</u> OU <u>DEGRADEES.</u>SUR LA BASE D'ACCORDS ENTRE <u>LES ETATS INTERESSES ET LE MAP</u>,

- LES DIVERSES ACTIVITES / TRAVAIL ET RECHERCHES
    - ◆ DES REPRESENTANTS DU MAP

    - ◆ DES DIFFERENTS CENTRES D'ACTIVITES REGIONALES

    - ◆ D'EXPERTS NATIONAUX ET INTERNATIONAUX.

- DUREE MOYENNE DE DEUX ANS.

CTM

CAMP/PAC

- LES SUJETS PRINCIPALEMENT ABORDES ET DEVELOPPES SONT:

  - ETUDES DE CARACTERE GENERAL
    - ▼ Analyse systémique et prospective pour la définition de scénarios développement/environnement;

    - ▼ Introduction d'instruments légaux et institutionnels pour la protection de l'environnement;

    - ▼ Définition des impacts possibles sur les écosystèmes dus à des changements climatiques prévisibles;

  - ETUDES DE DETAIL/
    - ▼ aux problèmes environnementaux plus aigus

  - PROPOSITION DE PLAN D'AMENAGEMENT DE LA ZONE COTIERE.

- UNE PLACE FONDAMENTALE:
  - A LA FORMATION

  - A LA MISE EN PLACE DE METHODOLOGIES

⟹ DONNER LES MOYENS ET LES POTENTIALITES POUR D'AUTRES INTERVENTIONS DE CE TYPE A L'INTERIEUR DU PAYS.

CTM

CAMP/PAC

- LES PREMIERS PAC/CAMPS COMMENCES A LA FIN DE 1990 ET AUJOURD'HUI TERMINES SONT CEUX DE:

  - BAIE D'IZMIR (TURQUIE)
  - ILE DE RHODES
  - BAIE DE KASTELA (EX-YOUGOSLAVIE)
  - COTE SYRIENNE.

- LES PAC/CAMPS ACTUELS SONT CEUX DE:

  - COTE ALBANAISE.
  - FUKA-MATROUH (EGYPTE)
  - SFAX (TUNISIE)

CTM

ROLE DU CAR/TDE (RAC/ERS).

☐ PROMOUVOIR LE ROLE DE LA TELEDECTION COMME INSTRUMENT D'ETUDES ET DE CONNAISSANCES

☐ CONTRIBUER A UNE MEILLEURE CONNAISSANCE DES DYNAMIQUES DES TRANSFORMATIONS DE L'ENVIRONNEMENT.

☐ ETUDIER ET SUGGERER DES SYSTEMES DE CONTROLE CONTINU DE L'ENVIRONNEMENT, NECESSAIRES POUR UNE MEILLEURE GESTION ET UNE PLUS EFFICACE PROTECTION.

☐ LES INTERVENTIONS DE CAR/TDE SONT:
   ▼ PLANIFIEES EN ACCORD AVEC L'UNITE DE COORDINATION D'ATHENES (MEDU)

   ▼ REALISEES EN COLLABORATION AVEC LES AUTRE CENTRES D'ACTIVITES REGIONALES.

CTM

PAC ALBANIE

☐ SUJET:

◆ DEFINITION DES CHANGEMENTS MACROSCOPIQUES DE LA LIGNE COTIERE AU TRAVERS DE LA TELEDETECTION.

☐ POURQUOI:

◆ LIGNE DE RIVAGE ALBANAIS FORTEMENT SOUMIS A DES MOUVEMENTS DE REGRESSION OU DE PROGRESSION.

◆ CONTROLE NECESSAIRE SURTOUT DANS L'OPTIQUE DE FUTURS AMENAGEMENTS COTIERS, EN PARTICULIER TOURISTIQUE.

☐ BUT:

◆ DEMONTRER L'UTILITE ET LES POTENTIALITES DE LA TELEDETECTION A HAUTE RESOLUTION

◆ VERIFIER L'AMPLEUR ACTUELLE DES MODIFICATIONS DE LA LIGNE DE RIVAGE

◆ FOURNIR DES DONNEES A JOUR

◆ INTRODUIRE DES EXPERTS ALBANAIS A L'UTILISATION DE LA TELEDETECTION

◆ MISE AU POINT EVENTUELLE D'UN SYSTEME DE CONTROLE PERIODIQUE SUR BASES DE DONNEES SATELLITAIRES A HAUTE RESOLUTION.

CTM

PAC ALBANIE

❒ ZONE TEST:
   ◆ LAGUNE DE KARAVASTA
   ◆ EMBOUCHURES DES FLEUVES SEMANI ET SHKUMBIN.

❒ METHODOLOGIE:
   ◆ ANALYSE D'IMAGES SPOT PANCHROMATIQUE (RESOLUTION AU SOL:10M) PRISES A INTERVALLE DE DIVERSES ANNEES (1988- 1993)

   ◆ CARTOGRAPHIES EXISTANTES

   ◆ COMPARAISON / SIG (Système d'information Géographique) DE LA LIGNE DE RIVAGE RELEVEE SUR LES DIFFERENTS SUPPORTS

❒ COLLABORATION:
   ◆ CEPP (COMMITTEE OF ENVIRONMENTAL PRESERVATION AND PROTECTION)

   ◆ INSTITUT D'HYDROMETEOROLOGIE DE TIRANA.

   ◆ PAP/RAC (PROGRAMMES D'ACTIONS PRIORITAIRES)
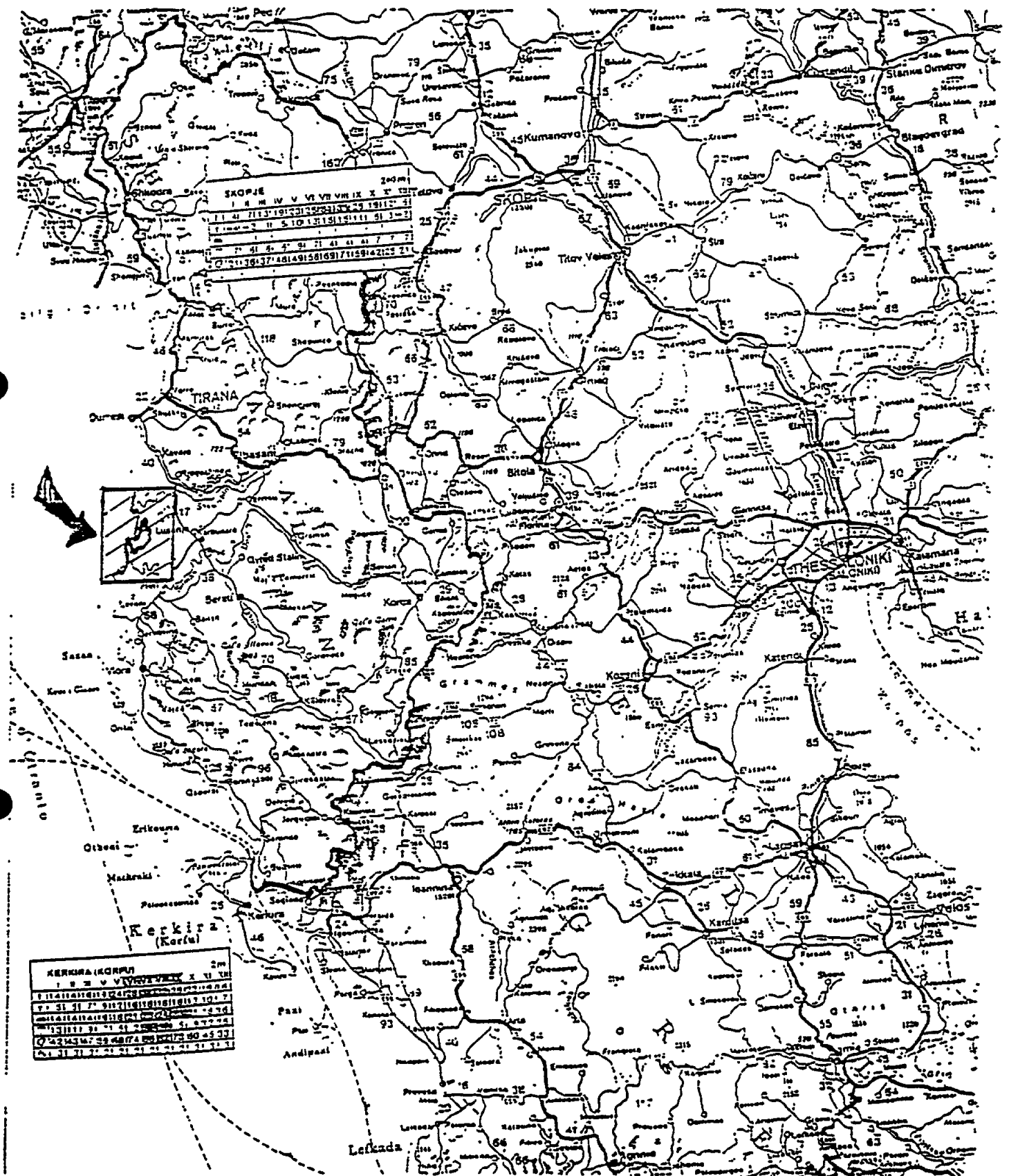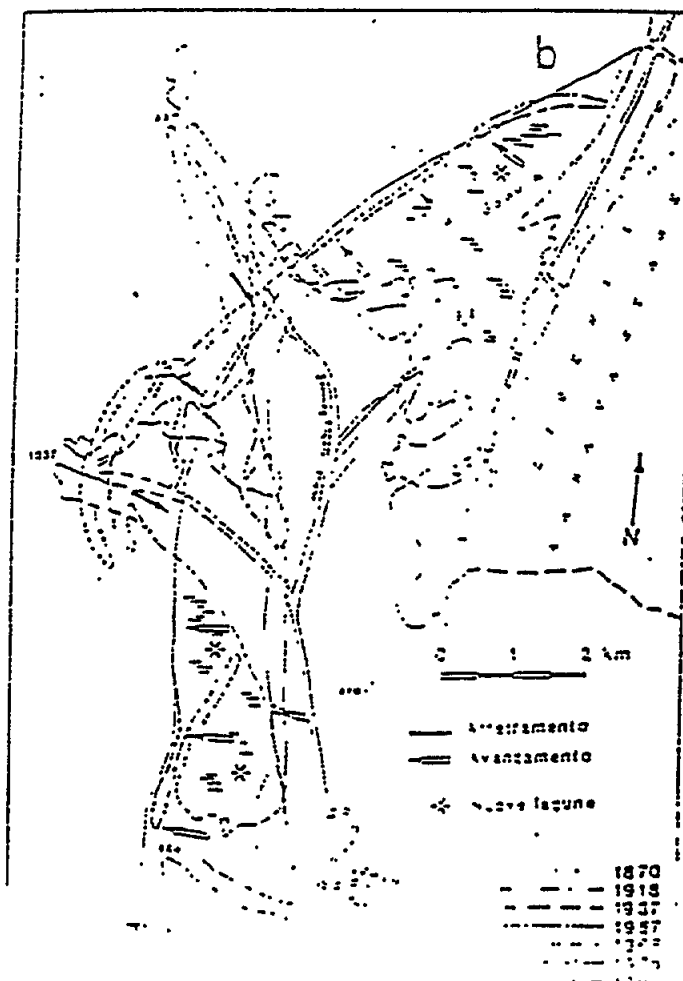
❒ FIN PREVU DU PROJET: FEVRIER 1995

CTM

IMAGE SPOT
juillet 1992

Embouchure du fleuve Semani:
variations entre 1870 et 1990

(de Boçy, 1994)

PAC FUKA-MATROUH
(OUEST EGYPTE)

☐ SUJET:

- ◆ CONTRIBUTION DE LA TELEDETECTION A L'ETUDE DE L'EROSION DES SOLS ET AUX PROBLEMES DE LA DESERTIFICATION.

☐ POURQUOI:

- ◆ AUGMENTATION DE LA SEDENTARISATION DES TRIBUS NOMADES

- ◆ AUGMENTATION DE LA DEMANDE EN TERRES AGRICOLES

- ◆ ZONE PARTICULIEREMENT ·FRAGILE (CLIMAT SEMI-ARIDE) AVEC SUPERFICIES CULTIVABLES NATURELLEMENT FAIBLES.

- ◆ PROCESSUS DE DEGRADATION DES SOLS (SALINISATION, EROSION EOLIENNE ET HYDRIQUE) "IN ATTO".

☐ BUT:

- ◆ INTRODUIRE UNE METHODOLOGIE INTEGREE D'ETUDES DU SOL / DEFINITION DES UNITES DE TERRE BASEE SUR LES CARACTERISTIQUES GEOMORPHOLOGIQUES, PEDOLOGIQUES ET DE LA VEGETATION DU TERRITOIRE.

- ◆ FORMER DES EXPERT EGYPTIENS SUR CETTE METHODE, EN PARTICULIER SUR L'INTERPRETATION DES DONNEES SATELLITAIRES

- ◆ FOURNIR DE NOUVELLES DONNEES SUR LES CARACTERISTIQUES DE CE TERRITOIRE PAR L'ANALYSE D'IMAGES SATELLITES A HAUTE RESOLUTION (LANDSAT).

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PAC FUKA-MATROUH
(OUEST EGYPTE)

❏ ZONE:

- ◆ZONE DE FUKA-MATROUH (100 KM COSTA x 30 KM)

❏ METHODOLOGIE

- ◆ ACQUISITION ET ANALYSE D'IMAGES LANDSAT

- ◆ DEFINITION DES UNITES DE TERRE (PREMIER NIVEAU)

- ◆ TRANSFERT DES DONNEES INTERPRETEES DANS LA BASE DE DONNEES CREE PAR PAP/RAC

- ◆ INTEGRATION AVEC DONNEES PRELEVEES SUR LE TERRAIN (erosion du sol)

❏ COLLABORATION

- ◆ EEAA (EGYPTIAN ENVIRONMENTAL AGENCY AFFAIRS)

- ◆ REMOTE SENSING LABORATORY OF UNIV ALEXANDRIA

- ◆ PAP/RAC EXPERTS

❏ FIN PREVU DU PROJET: AUTOMNE 1995

CTM

PAC SFAX

☐ IDEES-GUIDE DU PROJET:

♦ APPLICATION DE LA METHODE SUIVIE PAR COSMOS (OBSERVATOIRE)

$$\Rightarrow$$

▼ DETERMINATION DES PARAMETRES OU COMPOSANTES A ETUDIER
▼ EXEMPLES D'APPLICATION DE LA TELEDETECTION EN SE BASANT SUR DES IMAGES CONTENUES DANS NOS ARCHIVES OU ARCHIVES DU CENTRE DE TELEDETECTION TUNISIEN

♦ ESSAI D'INTEGRATION AVEC LA METHODOLOGIE SUIVIE PAR PLAN-BLEU

☐ COLLABORATION (A DEFINIR)

♦ ANPE (AGENCE NATIONALE POUR LA PROTECTION DE L'ENVIRONNEMENT)/ FORMATION DE DEUX EXPERTS TUNISIENS (JUIN 1994)

♦ CENTRE NATIONAL DE TELEDETECTION - TUNIS

♦ PLAN BLEU

☐ FIN PREVU DU PROJET: HIVER 1995-1996

CTM

AGENDA 21
FOR THE MEDITERRANEAN REGION

AGENDA 21
IN WHICH MORE THAN 150 STATES COMMITTED THEMSELVES IN RIO,
EXPRESSES
A WORLDWIDE CONSENSUS AND A POLITICAL INVOLVEMENT
TO INTEGRATE
ENVIRONMENT AND DEVELOPMENT RELATED MATTERS
AND TO MAKE
SUSTAINABLE DEVELOPMENT
A REALITY OF THE 21ST CENTURY

THE STRATEGIES, WHICH HAVE TO BE IMPLEMENTED BY THE
GOVERNMENTS
IN ORDER TO ACHIEVE THE OBJECTIVES OF AGENDA 21 ,
MUST BE ARMONIZED
WITHIN THE FRAMEWORK OF AN INTERNATIONAL COOPERATION
TO BE COORDINATED BY THE UNITED NATIONS

THE MEDITERRANEAN COASTAL COUNTRIES ARE A GOOD EXAMPLE
OF AN ECOREGION
LIKELY TO CONSTITUTE A PILOT AREA FOR A
REGIONAL REVIEW
OF THE DECISIONS TAKEN IN RIO ON A WORLDWIDE SCALE

CTM

CONFERENCE "MED 21"

ON SUSTAINABLE DEVELOPMENT IN THE MEDITERRANEAN REGION

TO BE HELD IN TUNIS 1 NOVEMBER 1994

FIRST MEETING OF A PREPARATORY COMMITTEE OF THE

CONFERENCE "MED 21"

TUNIS 16 - 20 MAY

DOCUMENT MED 21/PC/2 10 APRIL 1994 :

DRAFT OF AGENDA 21 FOR THE MEDITERRANEAN REGION,

REPORTS,AMONG THE OTHERS, THE FOLLOWING STATEMENTS :

....- AT THE SCALE OF THE MEDITERRANEAN REGION, THE STATES SHOULD: - DEVELOP INVENTORY AND FOLLOW UP MECHANISM THROUGH THE REMOTE SENSING OF THE MAIN MEDITERRANEAN AGROSYSTEMS; -........ (PAGE 29)

'....INDIVIDUAL STATES OF THE MEDITERRANEAN SHOULD: - ESTABLISH, DEVELOP AND MAINTAIN INFORMATION SYSTEMS, OR OBSERVATORIES, IN ORDER TO EVALUATE AND MANAGE THE COASTAL REGIONS AND THE EXPLOITATION OF THEIR RESOURCES;.....(PAGE 36)

....AT THE LEVEL OF THE MEDITERRANEAN REGION: - DATA RELATING TO REMOTE SENSING SHOULD BE SUPPLIED TO THE STATES AND COLLECTIVITIES. ......(PAGE 58)

...AT THE LEVEL OF THE MEDITERRANEAN REGION, THE FOLLOWING MEASURES SHOULD BE CONSIDERED:
- TO ENSURE WIDER DISSEMINATION OF THE AVAILABLE TOOLS OF MEASURING (OBSERVATOIRES, REMOTE SENSING) AND ORGANIZE WORKSHOPS WITH THIS RESPECT, IN EACH COUNTRY OR FOR A GROUP OF COUNTRIES IN ORDER TO MAKE THEM MORE ACCESSIBLE TO INDIVIDUALS, NGOs, YOUTH AND EDUCATORS. .....(PAGE 82)
- THE MEDITERRANEAN COUNTRIES SHOULD MAKE AN INVENTORY OF INFORMATION SOURCE USEFUL TO SUSTAINABLE DEVELOPMENT, ENHANCE CAPACITIES AND MECHANISMS OF ACCESSING TO, PROCESSING AND EXCHANGE OF INFORMATION IN THE PERSPECTIVE OF MEDITERRANEAN OBJECTIVES MOBILIZING THE SEVERAL HOLDERS OF INFORMATION. .... (PAGE 83)

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A STRATEGIC LAND MANAGEMENT PLANNING SYSTEM FOR MALTA

THE PROJECT IS AIMED AT
PROVIDING
THE PLANNING AUTHORITY OF MALTA
WITH
THE TECHNICAL ASSISTANCE NECESSARY TO DEVELOP
A DYNAMIC SYSTEM FOR LAND MANAGEMENT PLANNING
OF THE MALTESE ISLANDS AS AN INTEGRAL PART OF THE NATIONAL
PLANNING PROCESS.

THE PROJECT RELIES ON THE TECHNICAL EXPERTISE
THE CTM CAN COUNT ON
TO PROVIDE A FRAMEWORK
FOR THE VARIOUS SOURCES OF INFORMATION
REQUIRED TO DEVELOP LAND MANAGEMENT POLICIES
TO ENSURE A SUSTAINABLE DEVELOPMENT APPROACH
TO THE MANAGEMENT OF THE ISLAND'S RESOURCES

THE TOOLS OF THE PROJECT WILL CONSIST OF TECHNIQUES SUCH
AS REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS.

THE RESULTING SYSTEM WILL ALLOW
THE DEVELOPMENT OF PROCESSES
FOR THE CONSTANT MONITORING OF ENVIRONMENTAL CHANGES
IN THE MALTESE ISLANDS
AND SERVE AS A REFERENCE FOR SIMILAR INITIATIVES
IN THE MEDITERRANEAN

CTM

TRAINING COURSES

1993: TWO-MONTH TRAININING COURSE IN ITALY FOR TWO
EGYPTIAN EXPERTS

1994: ONE-WEEK TRAINING COURSE IN ITALY FOR TWO TUNISIAN
EXPERTS

CTM

TRAINING COURSE

ON

REMOTE SENSING TECHNIQUES AND APPLICATION

Attendants: Mr T. Gargouri
Mrs S. Krichen

Italy, 20 - 24 June 1994

1. *Fundamentals of remote sensing*
1.1 Phisical principles ·
1.2 Space platforms and their orbits
1.3 Sensors on satellites
1,4 Data acquisition and dissemination
1.5 Principles of image processing

2. *Cartography*
2.1 General aspects
2,2 Geographic maps and their classification
2.3 Rectification of remotely sensed images

3. *Case studies on remote sensing applications*
3,1 Observation and study of coastal conditions and changes
3.2 Monitoring of sea circulation and conditions in coastal areas
3,3 Monitoring of marine pollution
3.4 Protected areas mapping: a georeferred data base

CTM

TRAINING COURSE

ON

REMOTE SENSING TECHNICS AND METHODOLOGIES

Attendants: Mr Khalid M. A. Dewidar
Mr Gaber M.Hassan

Italy, 8 March - 4 May 1993

TRAINING COURSE CONTENTS

MODULE: REMOTE SENSING

Contents: 1. FUNDAMENTALS OF REMOTE SENSING
       1.1 Physical principles
       1.2 Space platform and their orbits
       1.3 Sensors on satellites
       1.4 Data acquisition and dissemination
       1.5 Principles of image processing

       2. OCEANOGRAPHIC APPLICATIONS OF REMOTE SENSING
       2.1 Reflective spectral region: the ocean colour
       2.2 Emissive spectral region: sea surface temperature
       2.3 Microwave spectral region:
          2.3.1 Passive sensors: the radiometer
          2.3.2 Active sensors: SAR, altimeter, scatterometer

MODULE: CARTOGRAPHY

Contents: 1. General aspects
       2. Geographic maps and their classification
       3. Rectification of remotely sensed images

MODULE: SOFTWARE ERDAS

Contents: - ERDAS 7.5
       - ERDAS IMAGINE 8.0.1
       - Some concepts of ERDAS IMAGINE:
         Virtual Room, Virtual LUT, Geographic Links, Dinamic
         Mosaic, On-line Help.
       - Applications "hand-on", Image Rectification, Spatial
         Modeller, Map Composer, others\applications.

1

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MODULE: SOFTWARE ARC/INFO

Contents: - Spatial data
- Geographyc data
- Coverages: description and drawing
- Data base automation
- Map features
- Projection management
- ARC command
- ARCEDIT
- ARCPLOT
- Data conversion
- TIN
- AML (ARC Macro Language)

MODULE : TRAINING ON THE JOB

Contents: 1. TRAINING WITHIN AN OPERATIVE PROJECT
1.1 Basis of processing of NOAA satellite
1.2 Processing of NOAA infrared images
1.3 Interpretation of NOAA infrared images aiming to identify thermal fronts
1.4 Final products generation

2. SUPPORT AND FIRST ACTIVITIES IN THE ELABORATION OF THE PROJECT "APPLICATION OF REMOTE SENSING IN THE FIELD OF COASTAL EROSION"
2.1 Bibliographic analysis on application od remote sensing in the field of coastal erosion
2.2 Analysis of some high resolution images (LANDSAT-TM) in order to evidentiate various features on the coast
2.3 Analysis of different algorithms for bathymetric determination in shallow waters through remote sensing techniques
2.4 Processing of multi-temporal series of high resolution images on a test. area where bathymetric maps are available
2.5 Digitization of bathymetric maps
2.6 Comparison of various output
2.7 Drawing up of an activity report

The training programme has also included visits to the Scanzano telecommunication and remote sensing Station (CTM operative Center) and to Telespazio Fucino Station, the first in the world for space communication functions and equipments; contacts have been promoted with the University of Palermo and with experts in the field of remote sensing applied to the environment observation and study.

2

CTM

SAR (SYNTHETIC APERTURE RADAR) MONITORING OF THE MEDITERRANEAN SEA

A JOINT PROPOSAL BY

CTM - CENTRO DI TELERILEVAMENTO MEDITERRANEO
(RAC/ERS - MAP/UNEP),
FIS-FOUNDATION OF INTERNATIONAL STUDIES - MALTA
(OPA - OPEN PARTIALLY AGREEMENT, COUNCIL OF EUROPE),
SOS - SATELLITE OBSERVING SYSTEMS - UK.

THE OBJECTIVE IS TO IMPLEMENT A SYSTEMATIC PROGRAMME
OF SAR MONITORING
OF SELECTED AREAS IN THE MEDITERRANEAN REGION
TO ASCERTAIN:

i) THE EFFECTIVENESS OF SATELLITE RADAR IMAGERY
IN ASSESSING THE LEVEL OF SURFACE POLLUTION
ESPECIALLY FROM OIL DISCHARGES .

ii) THE PRESENCE, EVOLUTION AND DISSIPATION OF
NATURAL FEATURES
SUCH AS OCEAN FRONTS, EDDIES AND INTERNAL WAVES

iii) THE FEASIBILITY OF ENHANCING THE RADAR EFFECTIVENESS
THROUGH THE ADDITION OF INFORMATION
ON SURFACE TEMPERATURE AND COLOUR
DERIVED FROM OTHER SATELLITE SENSORS..

CTM

FUTURE REVOLUTION IN REMOTE SENSING ACHIEVEMENTS

DUE TO THE OPENING OF NEW TECHNOLOGICAL FRONTIERS
(THE US GOVERNMENT RECENTLY HAS MADE STUDIES CARRIED OUT IN THE
FRAMEWORK OF DEFENCE PROGRAMMES AVAILABLE FOR COMMERCIAL USES)
AND GEO-POLITICAL FRONTIERS (OF WESTERN EUROPE),
A NEW GENERATION OF SATELLITES IS OPENING UP.
THE FIELD OF REMOTE SENSING TO A REAL REVOLUTION

1997: "EYEGLASS GLOBAL IMAGERY INFORMATION SYSTEM" - USA
ELIO-SYNCHRONOUS ORBIT 700 KM HIGH
RESOLUTION: 1 METER AT NADIR
PANCHROMATIC BAND
STEREOSCOPIC SHOTS

1995: "WORLDVIEW"- USA
ORBIT 470KM (ON SHUTTLE)
3 METERS RESOLUTION PANCHROMATIC (SCENES 6 X 6 KM)
15 M RESOLUTION, 3 BANDS VISIBLE/INFRARED, SCENES 30 X 30 KM

1995: SEAWIFS - SEASTAR - USA
1 KM RESOLUTION
8 BANDS VISIBLE
MAINLY DEVOTED TO OCEANOGRAPHIC STUDIES

1995: MOMS-2P - DEUTSCHE AEROSPACE
ORBIT 400 KM (MIR - PRIRODA, RUSSIA)
4 BANDS VISIBLE
1 PANCHROMATIC BAND STEREO
GEOMETRIC RESOLUTION 5,5 - 16,5 M

1974-1994: PRIRODA - RUSSIA
KFA-3000 CAMERA - 2 M RESOLUTION
KFA 1000 CAMERA - 5 M RESOLUTION
MK4 CAMERA - 4 BANDS VIS/NEAR IR, 8 M RESOLUTION
KATE - 200 CAMERA - 3 BANDS VIS/NIR, 20 M RESOLUTION
ORBIT 240/270 KM - MISSION LENGTH 30 DAYS - WORKING TIME 17 DAYS

SOVINFORM SPUTNIK
TK-350: 10 M RESOLUTION PANCHROMATIC, SCENES 180 X 270 KM
KVR-1000: 2 M RESOLUTION, COLOUR/PANCHR, SCENES 40 X 40 KM

CTM

ANNEX IV

PRESENTATION REPORTS OF FOCAL POINTS

DOCUMENTS DE PRESENTATION DES POINTS FOCAUX

Report on National Remote Sensing Activities in Egypt

First Meeting of Focal Points
(Palermo, Sept.,1994)

M.El-Raey

Remote sensing activities in Egypt started as early as 1972 by the establishment of the Remote Sensing Center at the Academy of Scientific Research and Technology in Cairo. Since then the center has carried a number of large scale projects on the national and international scales.

As early as 1983, it became evident that it is necessary to establish multidisciplinary education in remote sensing and its applications with particular emphasis on environmental studies. The Institute of Graduate Studies of University of Alexandria has launched a program in Environmental Studies on the postgraduate level centered around remote sensing and information systems . The educational system has found a strong support through the high need for well qualified cadres in the Egyptian market. In addition to other environment courses, the program involves remote sensing courses on three levels:

a-   Descriptive applications: for all first year multidisciplinary graduates.

b-   Image processing theory and techniques: for students of physical and technological background.

c-   Advanced remote sensing and geographic information systems and applications: for a number of selected advanced M.Sc. students.

The Remote Sensing Laboratory at University of Alexandria has utilized 486 microcomputers, however, upgrading to use a Silicon Graphics Workstation with advanced ERDAS/ARC/INFO Software on a network, is in progress. (Both financial and technical support is needed here).

The Laboratory has been mainly concerned with environmental problems with special emphasis on coastal areas. The following projects have been completed or are in progress at this time:

(1)   Impact of Sea Level Rise Over the Governorate of Alexandria.

The project aims at assessing impacts of SLR over the governorate by using remote sensing techniques to classify land use over the coastal area, and using topographic and ground based socioeconomic data in a GIS to produce multilayered geographic maps.

A quantitative assessment of impact on each sector (population, beaches, agricultural land, industrial land, archeological sites, ,...) has been obtained. A program to update results is now in progress.

(2)   Monitoring of Coastal Erosion at Rosetta Promontory.

The objective of this work was to develop and use a technique to determine rates of erosion of the Rosetta promontory and compare it to ground based measurements.

Satellite images and aerial photographs of the years 1972,1976,1977,1978,1983,1985,1991, were analyzed for changes using principal component analysis. Results were found in complete agreement with ground- based observations and revealed high erosional rates. The technique was found very effective, and is usable for future monitoring and for other coastal areas.

(3)   A Contingency Plan for Protection of Ras Mohamed Coastal Area (on the Red Sea).

The main objective of this study is to use remote sensing and GIS technique to identify, classify and assess topographic features of Ras Mohamed protected area at the tip of Sinai Peninsula, and its associated coral reefs.

Results identified various types of coral reefs and produced coastal sensitivity maps of the area.

A suggested contingency plan for protection of the area against oil spills is presented.

(4)   Bathymmetry, Water Quality Assessment and Change Analysis of Lake Manzala.

The main objective of this study is to estimate and assess changes of Lake Manzala near Suez Canal.

Old maps, aerial photographs and recent satellite images were registered using well identified control points. Changes of the area from 1922 to 1993 were analyzed. Bathymmetric estimation was carried out based on correlations to ground observations. Water quality conditions in various parts of the lake, were determined.

(5)   Change Detection and Bathymmetric Studies of Lake Burullus.

The objective of this study is to use satellite images and ground based bathymmetric measurements to determine and assess changes, water budget and environmental conditions in and around Lake Burullus.

Results indicated the validity and effectiveness of the technique for bathymmetric analysis.

(6)   Correlation of Ground Surveys With Satellite Data of Marine

Pollution in Abu-Kir Bay.

The main objective of this work is to assess the capabilities and validity of satellite images to predict marine pollution.

Cross correlations of accurate ground observations of various pollutants in the bay, with various channels of Landsat (MSS) images taken simultaneously, were carried out. Empirical relationships were derived.

(7) Remote Sensing of Marine Pollution Near Alexandria.

The objective of this work is to identify and assess location, extension and possibly types of marine pollution around Alexandria.

Results have indicated several hot spots. A change detection analysis, using change vector technique, is in progress to assess changes of pollution conditions and   effectiveness of control measures.

(8) Study of Waterlogging Problems Over the Coast of Alexandria.

Waterlogging problems have been noticed to increase over many areas of the coast. Increased urbanization with out proper sewage systems, salt water intrusion, excessive surface irrigation and lack of awareness of water shortages are most important reasons.

The objective of this work is to carry out a change detection analysis to identify, assess and estimate areas of waterlogging. The impact on urban development of the area is in progress.

In addition, there are a number of other projects concerned mainly with coastal zone problems of the Mediterranean region.

Contribution of the Joint Research Centre ISPRA, Institute for Remote Sensing Applications, to environmental issues in the Mediterranean Basin.

1. MONITORING OF THE MARINE ENVIRONMENT.

   The main actions concern:

   <u>Coastal Upwelling</u> (main area investigated up to now is off the North West Atlantic Coast of Marocco)
   * spatial and temporal time series of sea surface temperature
   * primary productivity estimation

   <u>Ocean Colour European Archive Network</u> (OCEAN Project) in collaboration with the European Space Agency
   * exploitation of sea colour data from the CZCS satellite sensor up to June 1986 (end of life of CZCS)
   * network of institutes working on ocean colour
   * contribution towards the use of future ocean colour data (in particular Seawifs sensor to be launched in 1995)

2. GLOBAL CHANGE IN THE MARINE ENVIRONMENT.

   The main actions are:

   * primary productivity and ocean-atmosphere carbon cycle
   * marine bio-geochemical processes and their role in global oceanic chemical interactions
   * modelling of marine transport processes
   * biological primary productivity
   * air-sea interface
   * numerical modelling of major controlling processes

3. MEDITERRANEAN LAND DEGRADATION MAPPING AND DESERTIFICATION MONITORING.

   The general objectives are:
   * mapping and continuous monitoring of vegetation and soil conditions in the Mediterranean Basin and in particular in the Mediterranean Member States of the European Union
   * identification of the extension and time dynamics of degradation and desertification processes

The "natural" mediterranean landscapes under threat or process of degradation (because of human pressure and misuse of the land) are complex areas where vegetation (often with less than 50% ground coverage),soils and parent rock outcrops are simultaneously present.

Methods and operational satellite data are now available (Landsat Thematic Mapper from 1984, SPOT4 to be lauched in 1997) to precisely map those areas (maximum scale 1/100,000 to 1/50,000) in terms of vegetation abundance and soil conditions (from well developped soils to degraded, severely degreaded and irreversibly eroded soils).

Time series of more than 10 years are now existing and authorise the monitoring of on going processes and the detection of abnormal situations, provided a series of well chosen "desertification control areas" are set up and folowed around the Mediterranean Basin.

The set up and monitoring of this network of control areas could be a valid contributon to the "Observatory for the Mediterranean" discussed and proposed by RAC/ERS-Palermo.

This monitoring exercise must of course be imbedded in the continuous (in space and time) monitoring of the Mediterranean Basin (based on distinct criteria) with NOAA AVHRR data.

TRAVAUX DE TELEDETECTION SPATIALE
REALISES AU MINISTERE DE L'ENVIRONNEMENT EN FRANCE.

THEME : Variation de l'indice de végétation sur l'ensemble du pays,

- aux 4 saisons : - connaître la localisation, la répartition. l'importance et les variations de la phytomasse comme aide à la réflexion pour une politique nationale de la verdure. Etat phytosanitaire. stress hydrique. régénération des zones brûlées.

- à des dates voisines de deux étés : - repérer la localisation et l'importance relative de la sécheresse.

THEME : Littoral : - découpage du territoire en écozones. occupation du sol à deux dates (5 ans d'écart ou plus) sur une profondeur de 20 km par tranche d'éloignement par rapport à la côte. matrice d'évolution par catégorie, projections

- Nature physique du linéaire côtier.
- Caractéristique des eaux côtières sur une bande de 5 km : profondeur, turbidité, végétation aquatique.
- Essai de substitution de la télédétection à l'inventaire permanent du littoral (IPLI) réalisé par interprétation de photos aériennes et abandonné en raison des coûts et délais. Recherche d'une nomenclature raccordable à l'IPLI et à Corine-Land Cover développée aux niveaux 4 et 5.
- Observation périodique des estuaires et deltas.

THEME : Planification écologique : - Occupation du sol pour la planification écologique du territoire par région ou département.

THEME : Parcs Nationaux et Régionaux : - Découpage du territoire en écozones, examen de l'adéquation des limites administratives existantes ou en projet avec les limites écologiques. repérage des zones remarquables ou sensibles à protéger

- Occupation du sol et son évolution (friches notamment)
- Indice de végétation en fonction des catégories d'occupation du sol
- Intégration des résultats dans un SIG
- Types de végétation liés à la date de fonte du couvert neigeux en montagne.

THEME : Déprise agricole : - Etat et évolution des friches en fonction de l'occupation du sol précédente. de l'environnement paysager et du type de végétation (bruyères. genêts, fougères, broussailles, landes...) sur les friches.

THEME : Zones humides : - Etat et évolution par catégorie
- Zones de concentration d'étangs :
    * état et évolution de l'occupation et de l'humidité du sol du proche bassin versant,
    * caractéristiques de l'eau : profondeur selon la nature des fonds, turbidité minérale et organique. végétation aquatique au-dessus, au dessous et aux abords de l'eau, température de surface : typologie des étangs selon ces caractéristiques

- Caractéristiques de l'eau des golfes et grands étangs saumâtres.

THEME : Zones inondables et drainage dans le bassin de débordement des fleuves :
- Surface des zones inondées et terres imprégnées d'eau en fonction de l'occupation du sol. drainage et réseaux d'écoulement. Utilisation pour la cartographie des zones inondables et constructibles.

THEME : Lit majeur et élargi des grands fleuves, zones aquatiques liées :
- Etat et évolution des unités paysagères, de l'occupation et de l'humidité du sol. végétation aquatique. géomorphologie. repérage des zones riveraines sensibles ou à problèmes.

THEME : Incidences du drainage : - A partir d'images enregistrées avant et après les travaux, observations des changements d'occupation et d'humidité du sol, et de qualité de végétation.

THEME : Foret

- dépérissement - repérer les zones atteintes (à plus de 15 ou 20 %) et évaluer l'importance des dégâts pour l'ensemble des feuillus et pour les résineux répartis en classes d'âge, au moyen de l'indice de végétation étudié à plusieurs dates à la même époque
- Mitage de la forets à proximité
des zones urbanisées

- Forct dunaire et sur zones érodées

- Régénération sur les zones brûlées - bien observée sans qu'il soit possible de distinguer les espèces.

- Repérage des seuils critiques de risques d'incendies - de juin à septembre au rythme de la semaine ou de la décade, au moyen de l'indice de végétation, de la température au sol, de l'indice hydrique, pour mieux répartir les moyens de lutte et d'observation du sol détaillée sur le couvert végétal.

- Niveau d'inflammabilité potentielle de la végétation et modélisation de la propagation du feu - Etablies en fonction du point de départ de l'incendie, de la sensibilité de la végétation au feu, de la force et de la direction du vent, de la pente et de l'orientation (MNT) ainsi qu'à partir de l'occupation détaillée du couvert végétal.

THEME : Zones d'habitat potentiel pour certains types de faune (ou de flore) - Etablies en fonction des catégories d'occupation du sol, des voies de communication, des points d'eau, de la pente et de l'altitude et de l'orientation... Essais concluants pour les anatidés, les cervidés, la bécasse.
- Base de sondage pour procéder à des comptages au sol.

THEME : Aide à la gestion intégrée de l'occupation du sol et de la faune sauvage et de la flore : - A partir de l'occupation du sol et des données localisées disponibles sur la faune et la flore et d'un MNT :
* contrôle de l'adéquation des ZNIEFF * et de leurs limites
* contrôle de l'adéquation des limites des zones protégées
* base de sondage pour constater l'utilisation effective des habitats
potentiels,
* aide à la gestion coordonnée de l'occupation du sol et de la faune et de la flore.
* (ZNIEFF : Zones Nationales d'Intérêt Ecologique pour la Faune et la Flore).

THEME : Etude des paysages pour aide à la gestion - Extraction des éléments d'un paysage à partir d'une image satellite et d'un MNT pour obtenir l'occupation biophysique du sol en 3D et rechercher les éléments linéaires, les types de couverts et formations végétales, les zones humides, les différences de richesse de végétation, les zones de transition, les secteurs d'ouverture directionnels, ...

- A partir de changements observés dans le temps et d'un MNT , essai de modélisation des mutations à l'aide de modèles de contagion de pixels déterministes ou probabilistes pour expliquer et prévoir l'évolution en fonction des substrats, des routes, des formes de développement urbain, ...

- Conséquences de l'abandon d'activités minières.

THEME : Etude rapide des grandes inondations accidentelles - Comparaison de situations normale et de crise sur les endroits atteints dans les délais les plus brefs.

THEME : Aide à l'élaboration d'un plan de prévention des risques naturels par bassin versant - cartographie des zones à risque de glissement de terrain et d'inondation par commune en zone accidentée à l'aide d'images et d'un MNT.

THEME : Repérage des zones à risque d'accident hydrogéologique par sous-bassin versant, en milieu accidenté méditerranéen - Interprétation à des fins hydrogéologiques de plusieurs images avec un MNT. Recherche de la densité et de la qualité du couvert végétal de la pente et de l'orientation des parcelles, du drainage et de la perméabilité des sols et des signes d'érosion dus au ruissellement.

THEME : Evaluation, suivi et constat d'impact des grands travaux d'équipement - Aide à la localisation des ouvrages, aide à l'évaluation de l'impact probable (zones critiques et sensibles, vue globale comparative de variantes, franchissement des écozones)

- Géomorphologie, aptitude des sols, repérage des gisements de matériaux de construction à proximité

- Unités paysagères et occupation biophysique et qualité du sol sur les zones ou couloirs susceptibles de recevoir les ouvrages

- Evaluation de la consommation des différentes catégories d'occupation du sol et du couvert végétal, et rareté relative du tapis végétal entamé par rapport au voisinage, impact paysager en 3D

- Renseignements sur la dynamique de la végétation à moyen terme : zones agricoles en voie d'abandon, zones à risques d'érosion ...

- Repérage des espaces urbanisés à proximité pour les problèmes de bruit et de risque, et des directions dominantes du parcellaire agricole pour réduire les frais de remembrement ultérieurs

- Dans le cas de constat d'impact réel, vérification de l'adéquation de l'étude d'impact classique, de l'exécution de l'étude d'impact classique, de l'exécution des mesures compensatoires et des effets induits à proximité de l'ouvrage.

THEME : Evaluation des atteintes à l'intégrité de l'espace et de son compartimentage par les équipements linéaires - Recherche des paramètres d'encombrement et de division de l'espace par les réseaux.

THEME : Ecosystèmes des grandes agglomérations de 100.000 habitants et plus - Etat et évolution des zones urbaines réparties selon l'homogénéité suivant une nomenclature d'occupation biophysique du sol en 50 catégories environ tenant compte :

* de l'association et des parts relatives en bâtiments, végétation, voies de communication (indices de végétation et minéralisation, filtres)...)
* de l'ancienneté et de la nature des matériaux des bâtiments
* de la forme et de la hauteur des bâtiments.

- Les résultats mis sous forme de fichier géocodé sont destinés à être fusionnés avec d'autres données exogènes sur SIG pour :

* aider à la gestion de l'environnement urbain de l'agglomération
* constituer une série d'indicateurs d'environnement urbains (ratios liés à la densité, la proximité ...)
* surveiller les changements et chantiers dans l'occupation du sol, élaborer des scénarios et projets de développement et aménagement.

- Répartition, intensité et diffusion de la <u>pollution atmosphérique</u> (aérosols et températures) selon différentes situations climatologiques.

משרד המדע והאמנויות
הסוכנות הישראלית לנצול החלל
THE MINISTRY OF SCIENCE AND THE ARTS
ISRAEL SPACE AGENCY

REMOTE SENSING IN ISRAEL - 1994

YAHEL

FINAL REPORTS

JUNE 27 - 28. 1994
HERZLIA, ISRAEL

CONTENTS

Note: The reports are arranged in the order of their presentation at
      the Remote Sensing in Israel - 1994 conference.

FOREWORD

Satellite remote sensing is a unique tool for gathering data needed to monitor and understand the processes going on in our planet's biosphere which are of crucial importance to the future of mankind. Satellite imagery for environment, agriculture and land resources monitoring and management is of growing importance even for small countries such as Israel.

The promotion of satellite remote sensing and the development of applications by users in Israel, have a high priority on the Israel Space Agency (ISA) agenda. In the framework of our programme to advance this important subject, the ISA Ground Station has been receiving the French Spot satellite data since 1991 and will be receiving the European ERS-1 satellite by the end of this year. Furthermore remote sensing is included as one of the subjects in the agreement for cooperation signed recently between ISA and CNES.

This conference, reporting on Spot applications pilot projects conducted in Israel under a joint ISA/Spot-Image programme demonstrates the uses of Spot Imagery in subjects of interest to Israeli users and is very important for increasing user awareness and interest and development of the satellite remote sensing field in our country.

I would like to express the appreciation of the Israel Space Agency to the efforts made by Spot Image and by the YAHEL researchers, towards the success of this conference.

Dr. Marcel Klajn
ISA Director

Landuse and urban density mapping using remotely sensed data: the case study of Haifa, Israel.

Maxim Shoshany and Eran Wechsler
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Introduction

Analysis and mapping of landuses and landcovers represent one of the most dynamic fields of remote sensing applications (Townshend, 1990). In urban regions, for example, Weber and Hirsh (1992) have assessed urban life qualities and Gomarasca et al. (1993) monitored longterm changes in the built up areas. In the rural-urban fringe Jensen and Toll (1982) detected development of residential areas; Quarmby and Cushnie (1989) monitored changes in the use of agricultural lands. Recent developments of methodologies for recognizing landuses have moved from the classical multispectral approach to techniques utilizing spatial and temporal information. Gong and Howarth (1992) for example , developed frequency- based contextual classification for landuse identification. Jewell (1989) for example , used temporal changes in reflectance for differentiating between types of landcovers.

The use of remote sensing methodologies for estimating urban densities is well described in the literature. Most of these works were based on manual interpretation (see review in Lindgreen, 1985). Individual objects such as buildings and chimneies were mapped and counted. The results were shown to be of high accuracy relative to census data. However, manual interpretation requires long tedious processes thus limiting the size of the regions which could be monitored. Only in few works there was an attempt to map densities throught the use of satellite images and computerized techniques. Results reported by Forster (1985) and Keersmaecker (1990) have indicated difficulties in achieving good results due to the relatively low resolution of those images.

The Metropolitan area of Haifa represents one of the most complex spatial composition of landuses together with massive expansion during the last decade due to the large immigration waves. The objective of this study was the development of computerized methodologies for differentiating between commercial/ industrial and residential areas, for identifying areas belonging to different urbanization stages and for mapping different urban densities.

Haifa : description of the region

The Mount Carmel and Haifa region is characterized by high natural variability with wide range of urban patterns both in mountainous and flat areas . On its boundary, Haifa is surrounded by shorelines, rural areas, natural reserves, ports, industrial areas and fields. The population in the area is over 250,000 people representing wide range of socio-economic classes, from the lower classes living mainly in the lower parts of the Carmel Mountain to the much higher socio-economic classes living in the neighborhoods located at the upper parts of the mountain. Various building types are represented , from the Turkisch times, British Mandate, neighborhoods built for the high immigration waves of the 1950's and the expansion of different types of neighborhoods during the last three decades both in the Mountain area and in the Haifa Bay area. Soffer and Kipnis (1980) recognize seven major stages in the urban development of Haifa (up to 1978) : 1. prior to 1855; 2. 1855-1908; 3. 1909-1929; 4. 1930-1948; 5. 1949-1962; 6. 1963-1970; and 7. 1971-1978. Two types of urbanization processes have taken place during these stages: infilling processes , where the built areas were expanded within the city boundaries and and intermittent building, where new neighborhoods were established outside of these boundaries. Those urbanization processes can be inferred and analyzed from the map provided by Soffer and Kipnis (1980) giving a classification of areas in Haifa according to their corresponding stage of development. Commercial and industrial areas were developed in different locations around the port and the CBD has been moving from the down-Town (Sub-quarter no. 62) to Hadar region (Sub-quarter no. 32) and then few of its functions were moved the Chek-Post area.

Remote sensing data calibration and geometric rectification

Three SPOT images were provided for our study within the framework of the Yahel project of the Israeli Space Agency:
- a panchromatic SPOT images of 10 x 10 meters resolution acquired on the 4th of October 1992.
- a multispectral SPOT images of 20 x 20 meters resolution acquired on the 4th of October 1992.
- a multispectral SPOT images of 20 x 20 meters resolution acquired on the 20th of January 1993.
The multispectral images represent the end of the summer with the highest effect of vegetation drying and the middle of the winter with high growth of young vegetation.

The images were calibrated using a linear regression of the following form:

$$R[\lambda]_k = a[\lambda] + b[\lambda] * DN [\lambda]_k$$

where $R[\lambda]_k$ is the spectral reflectance measured in the field and $DN [\lambda]_k$ is the digital number recorded in the image for the corresponding calibration sites.

The reflectance in the field (fig.1) was measured using a CROPSCAN radiometer with eight spectral channels (Table 1).

Table 1 : The spectral channels of the CROPSCAN radiometer

Channel no.	1	2	3	4	5	6	7	8
Spectral half power width (in nanometer)	447-473	491-521	546-570	624-652	670-702	690-722	746-774	797-829

The coefficients $a[\lambda]$ and $b[\lambda]$ provide the correction of the radiometric effects of the atmosphere and the gain and offset of the corresponding spectral SPOT channels.

Figure 1 : Spectral reflectance of vegetation and soil as measured in the field
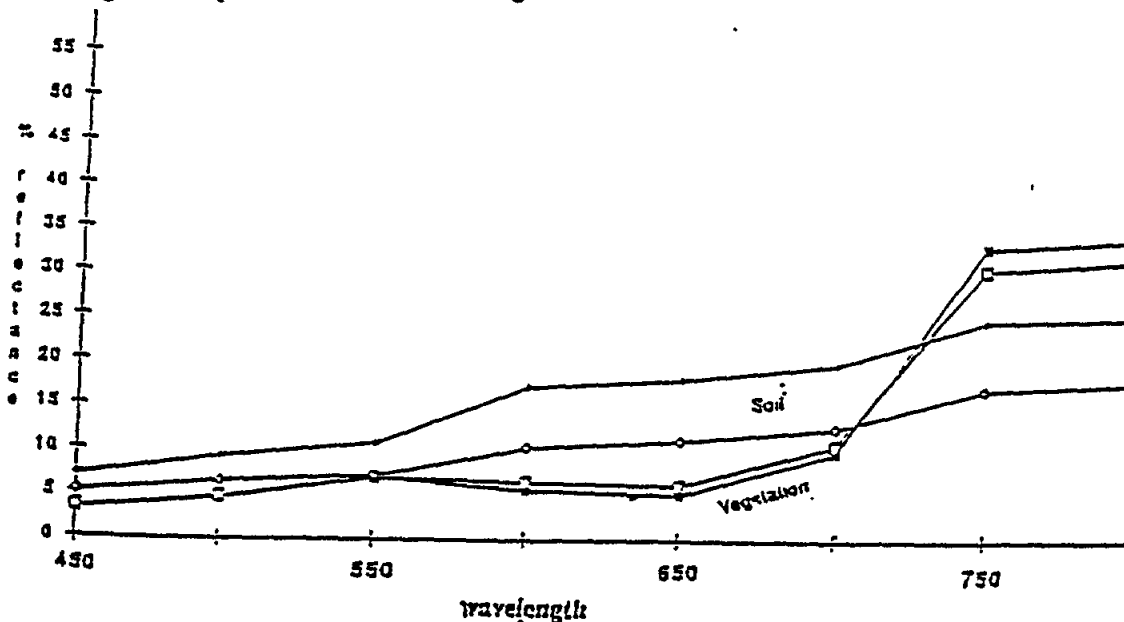
The geometric rectification was conducted using 60 control points derived from 1:50,000 scale maps. The root mean square (RMS) error of 1.5 pixels which was achieved provided sufficient accuracy for the present study.

Using a combination of texture parameters derived from the multispectral data and the panchromatic data it was possible to derive an image allowing good differentiation between commercial / industrial areas and residential areas (fig. 8).

Figure 8 : An image formed by the fusion of data derived from SPOT multispectral and panchromatic data.
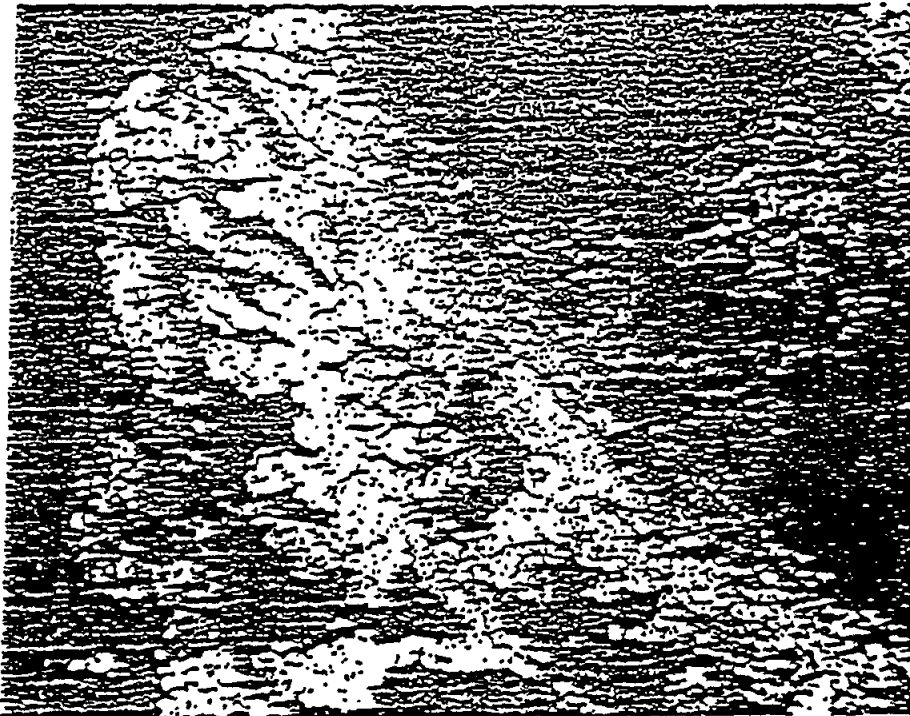
Summary and conclusions

This study provides a new framework of three folded relationships between characteristic urban patterns, their floor area densities and their indicators. Within this framework important, geographical information concerning the spatial distribution of urban patterns and densities can be identified , mapped and analyzed. The good results obtained from the empirical assessment of these relationships in Haifa area with its wide variability of urban patterns suggest that the multiscale textural parameter developed and the urban - image density model formalized based on this parameter may facilitate a wider generalization of these relationships within the context of urban geography. For this purpose there is a need to further extend the empirical basis of this work including wider range of scales and pattern types existing in other regions of the world.

Acknowledgment

Data processing

The methodology developed here was based on the search for a combination of spectral and textural features which will allow the differentiation between the following landuse types:

1. Commercial / industrial areas

2. Residential areas with the separation between different urban densities and major phases of the urbanization processes.

For this purpose there were calculated 24 layers representing textural features (Gotlieb and Kreitzig. 1989) from the individual channels. reflectances differences between the summer and the winter and various ratios between channels.

The effect of the different textural processing can be demonstrated by analyzing the differences between the images given in figures 2 and 3. It is possible to observe for example that the refineries area have disappeared in figure 3. thus indicating that it has a characteristic spatial signature.

Figure 2: Texture image derived from the seasonal reflectance differences

Figure 3 : Texture image derived from ratios between channels.

Additional processing of the panchromatic data was needed for allowing the
determination of urban densities. Since buildings have relatively higher reflectance than
their surrounding (e.g: roads. vegetation) and as a result of shadowing, their appearance
in the panchromatic SPOT image is relatively clear . For allowing a computerized
discrimination between the built objects and background the image was firstly enhanced
in the spatial frequency domain and then the brightness values of built objects and
'background' were characterized. The enhancement was achieved by applying a high -
pass filter over the image: every pixel was convolved using a kernel of the following
type (ERDAS, 1992):

$$
\begin{array}{ccc}
-1 & -1 & -1 \\
-1 & 9 & -1 \\
-1 & -1 & -1
\end{array}
$$

In this way the brightness differences between the buildings and their background were
sharpened. An investigation of the brightness histogram of the enhanced image showed
that the built objects had then much higher values than those of the background.
Consequently a binary image was formed where background pixels were assigned a
value of 0 and pixels with brightness characteristic to built objects were assigned a value
of 1. Examination of the resulting image (fig. 4) relative to an aerial photography have
indicated that over 96% of the buildings were discriminated. Other objects such as
segments of roads were found to be present in the image in less than 2% of the total
image.

Figure 4: The image formed by applying the high pass filter on the panchromatic SPOT
image.
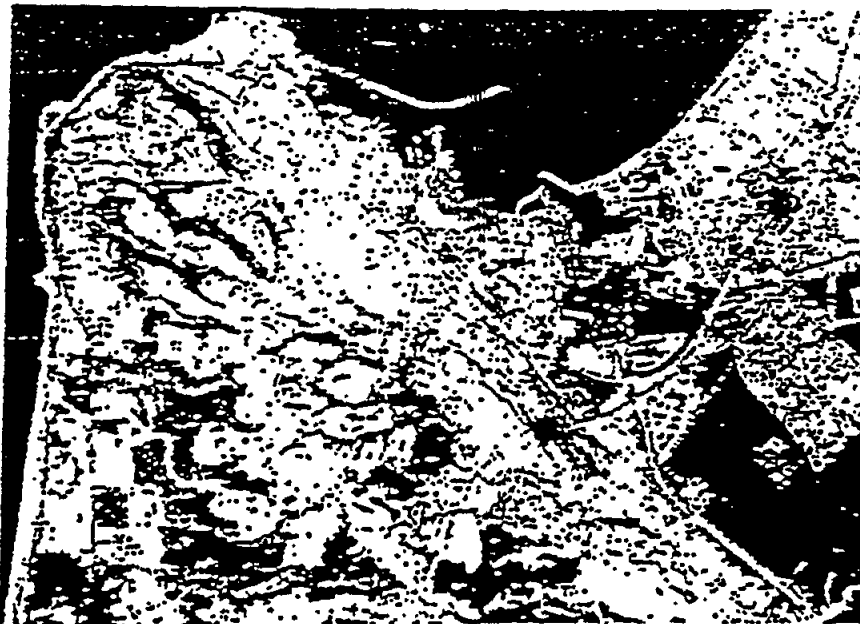
Urban density is inherently a scale dependent phenomena (Degani, 1975; 1977): assuming urban areas to represent spatial heterogeneity of landuse and landcover, their density will vary with the size and location of the area under consideration. The density changes then according to the urban structure and patterns which govern the heterogeneity of the cities, towns and metropolitan areas. While different patterns may have similar densities in a specific scale, it is hypothesized here that the magnitude and way of change of the density with changing the scale are strongly linked to the type of urban pattern .

Since pixels belonging to built objects were assigned a value of 1, the image density corresponding to the projected urban density was determined in the following way:

$$D_{i,j} = 100 * \frac{\sum_{k=i-m/2}^{k=i+m/2} \sum_{l=j-m/2}^{l=j-m/2} B_{k,l}}{m^2}$$

where $D_{i,j}$ is the image density (in precentage) at the pixel position i,j , $B_{k,l}$ is the binary image value given in the image formed following the use of the high pass filter and m is the image window size.

Using this equation for 9 different window sizes between 5x5 and 21x21 pixels, there were formed 9 urban density images (Figure 5a-b).

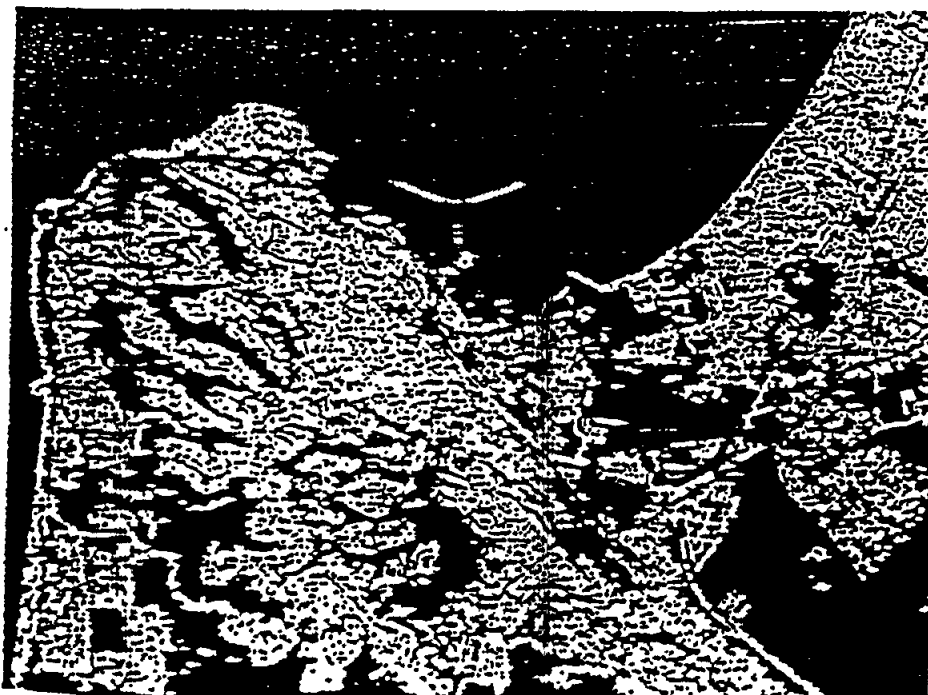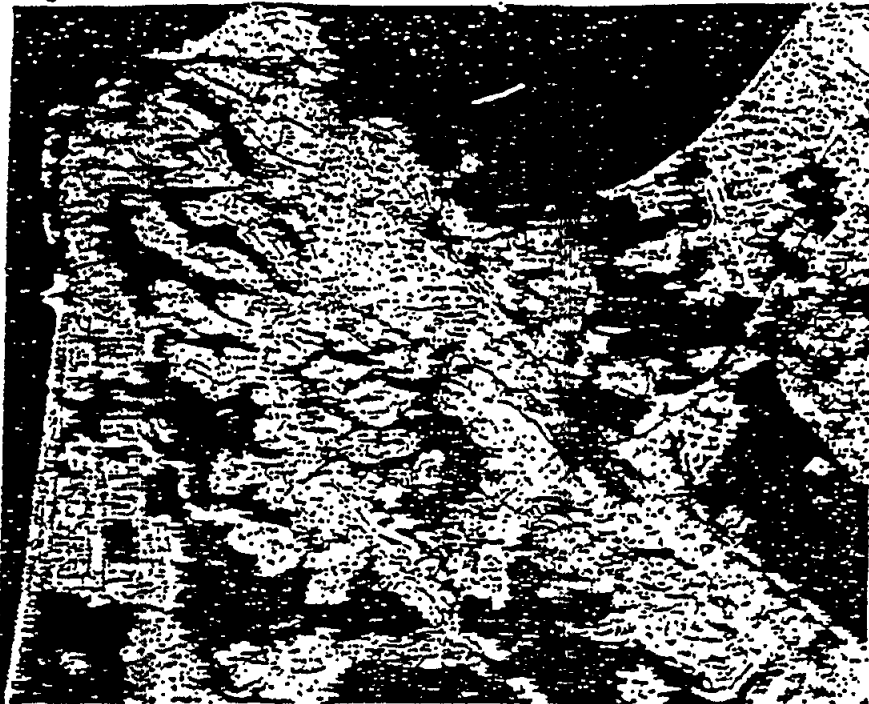Figure 5a: Image density formed with a 7x7 pixels window.

Figure 5b: Image density formed with a 21x21 pixels window.

The Haifa Municipality is recording the urban areas in three categories: dwelling, industrial/ commercial and governmental. Annual tax payments provide the basic data source, and Population Census (last one was conducted in 1983) and local surveys which are taken every few years allow the assessment of the accuracy of the Municipality data. The urban density data is provided by the geographical grouping of the data records for sub-quarters regions . This process is performed by the Department for Statistics and Information of the Municipality

For allowing the integration of image density with data sources the polygons of the sub-quarters in Haifa sub-quarter Map had to be rasterized (according to the SPOT image pixel size) and both sources had to be georeferenced.The map was georeferenced using the coordinates mesh-points marked on the map with an RMS error of 20 meters.The positional inaccuracies are of negligible magnitude considering the objectives of this work.

Results

Assessment of a scatterdiagram of Sub-quarters (fig.6) according to their texture value indicate that it is possible to differentiate three clusters. These clusters represent Sub-quarters with a majority of buildings from the same urbanization stage (Soffer and Kipnis, 1980). Cluster A is characterized by areas built before 1930 , those including Haifa's CBD and parts of its margins. This cluster have the highest range of densities and highest rate of change of texture values. Clusters B represent areas built mainly between 1930 and 1948 with lower distributions of both floor area density and of the homogeneity factor. Cluster C includes areas built mainly since 1949 representing a major change in the relationships between urban densities and their corresponding patterns. In these regions limited range of floor densities between low and moderate values were found to be characterized by wide range of texture values representing high variability of urban patterns. It is therefore possible to conclude that the texture

parameterization used contains important geographical information regarding urban patterns and their change between stages of the urbanization processes. An expression containing a parameter representing the multiscale changes of the texture values was then used for modelling the urban-image density relationships . The resulting model was found to be highly significant (fig. 7).

Figure 6 : A scatterdiagram of Sub-quarters according to their corresponding density (y-axis) and texture (x- axis) values.
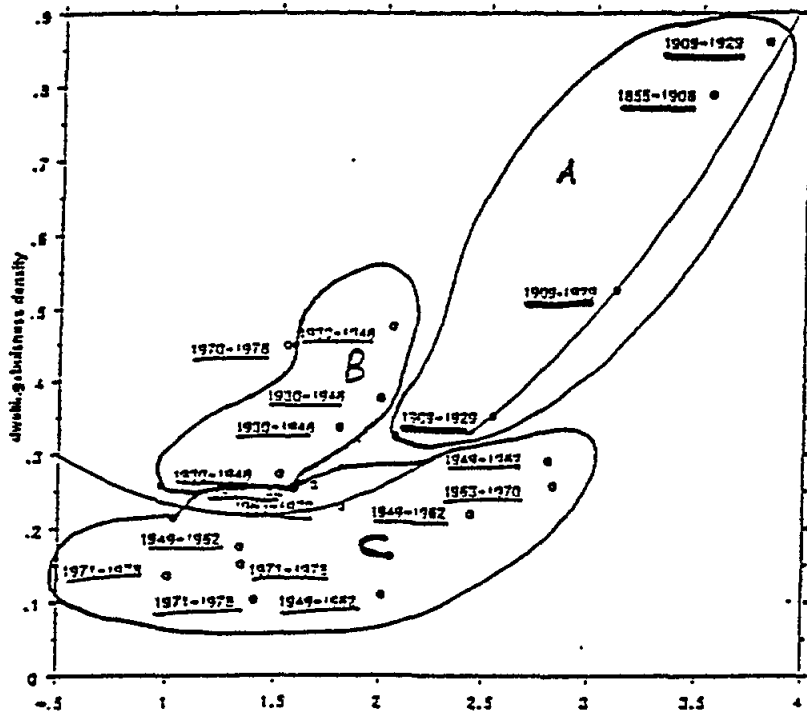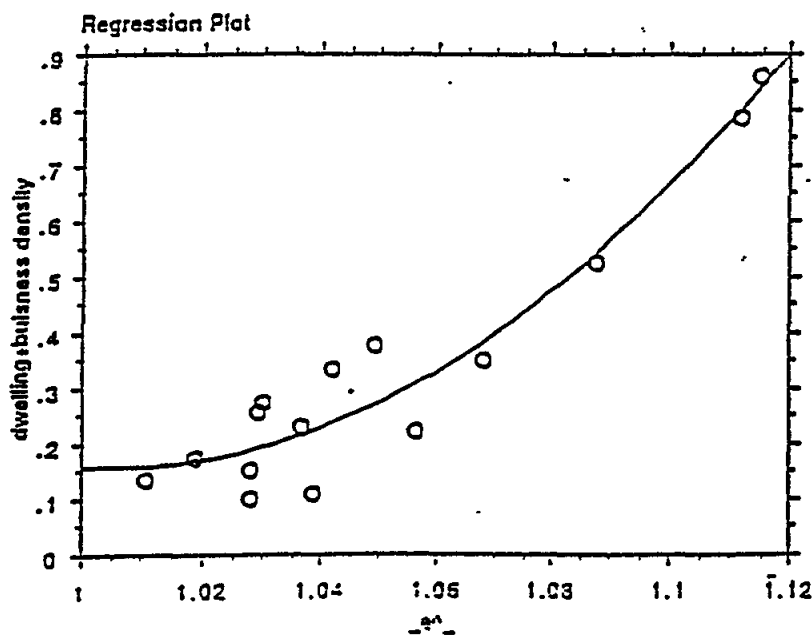

Figure 7 : Urban - Image density model

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Airborne hyperspectral remote sensing in Italy

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ABSTRACT

The Italian National Research Council (CNR) in the framework of its "Strategic Project for Climate and Environment in Southern Italy" established a new laboratory for airborne hyperspectral imaging devoted to environmental problems. Since the end of last june 1994, the LARA (Laboratorio Aereo per Ricerche Ambientali - Airborne Laboratory for Environmental Studies) Project is fully operative to provide hyperspectral data to the national and international scientific community by means of deployments of its CASA-212 aircraft carrying the Daedalus AA5000 MIVIS (Multispectral Infrared and Visible Imaging Spectrometer) system. MIVIS is a modular instrument consisting of 102 spectral channels that use independent optical sensors simultaneously sampled and recorded onto a compact computer compatible magnetic tape medium with a data capacity of 10.2 Gbytes. To support the preprocessing and production pipeline of the large hyperspectral data sets CNR housed in Pomezia, a town close to Rome, a ground based computer system with a software designed to handle MIVIS data. The software (MIDAS-Multispectral Interactive Data Analysis System), besides the data production management, gives to users a powerful and highly extensible hyperspectral analysis system. The Pomezia's ground station is designed to maintain and check the MIVIS instrument performance through the evaluation of data quality (like spectral accuracy, signal to noise performance, signal variations, etc.), and to produce, archive, and diffuse MIVIS data in the form of geometrically and radiometrically corrected data sets on low cost and easy access CC media.

2. INTRODUCTION

Hyperspectral imaging offers a powerful tool for significant advancement in the understanding of our Earth and its environment. The Mediterranean Area is characterized by high diversity of topography, lithology, soils, microclimates, vegetation, sea water characteristics, resulting in a range of various ecosystems, and Remote Sensing techniques, especially imaging spectrometry, appear to have the potential for providing data for environmental studies at regional or even global scales on this part of the world. The Italian National Research Council (CNR) established a new laboratory for airborne hyperspectral imaging devoted to environmental studies. The airborne laboratory is mainly equipped with the AA5000 MIVIS instrument, that with 4 spectrometers designed to collect radiation from the earth's surface in the Visible (20 channels), Near-IR (8 channels), Mid-IR (64 channels), and Thermal-IR (10 channels) can be considered a second generation imaging Spectrometer developed for use in Environmental Remote Sensing studies across a broad spectrum of scientific disciplines.

Simultaneous multispectral imaging in the wide range from Visible to Thermal-IR regions of the spectrum, with a high spectral resolution and high number of channels, required the use of leading edge technologies for optics, detectors, signal processing electronics and data recording. For MIVIS, where the combination of high spectral resolution in the Mid-IR region of the spectrum, with good sensitivity in the Thermal-IR region, some difficulties in system design had to be solved. The most effective approach to producing such a system was the use of a mechanically scanned optical system with a detector for each spectral band and with the use of a common Field Stop for all channels. In this way it was also solved the pixel aligning problem that generally affects other hyperspectral instruments that use more spectrometers.

Channel spectral bandwidths and locations are chosen to meet the needs of scientific research for advanced applications of remote sensing data. Through knowledgeable application of the system and analysis of the data collected, MIVIS can make significant contributions to solving problems in many diverse areas such as geologic exploration, land use studies, mineralogy, agricultural crop studies, energy loss analysis, pollution assessment, vulcanology, and forest fire management. The broad spectral range and the many discrete narrow channels of MIVIS provide a fine quantization of spectral information that permits accurate definition of absorption features from a variety of materials, allowing the extraction of chemical and physical information of our environment. The availability of a such hyperspectral imager, that will operate mainly in the Mediterranean area, at the present represents a unique opportunity for those who are involved on environmental studies and land-management to collect systematically large-scale and high spectral/spatial resolution data of this part of the world. Nevertheless, MIVIS deployments will touch other parts of the world, where a major interest from the international scientific community is present.

During last July 1994 a MIVIS test deployment has been carried out in Sicily in cooperation with national and international institutions on a variety of sites, including active volcanoes (Mt. Etna and Eolian Islands), coastlines (Gela, Acireale, Taormina), ocean (Messina Straits and Marsala lagoon), vegetated areas (Mt. Etna slopes), waste discharges (Acireale), and archeological sites (Selinunte, Alesa and Acireale).

3. MIVIS SYSTEM

The MIVIS technical characteristics are:

- *102 spectral bands: simultaneously sampled and recorded*
- *Spectral coverage: -20 bands from 0.43 - 0.83 µm,*

  8 bands from 1.15 - 1.55 µm,

  64 bands from 1.985 - 2.479 µm,

  10 bands from 8.21 - 12.7 µm.
- *Two built in reference sources thermally controlled in the range 15°C below and 45°C above ambient temperature*
- *Spatial registration of all spectral bands due to a common field stop optical design (2.0 mrad IFOV)*
- *Sample rate (angular step): 1.64 mrad*
- *Digitized Field of View (FOV): 71.059°*
- *12 bits data quantization*
- *Pixels per scan line: 755*
- *Scan rotational speeds: 25, 16.7, 12.5, 8.3 and 6.25 scans/sec*
- *Computer aided data quality check for all 102 channels in real time*
- *Thermally compensated optical-mechanical design*
- *Large dynamic range: 1200°C maximum scene temperature*
- *Computer interfaced data recording system. VHS cassette media (10.2 Gbytes capacity)*
- *Built in aircraft Position and Attitude Sensor (PAS) using a GPS receiver, a roll/pitch gyro and a flux gate compass for aircraft heading sensor. Real time aircraft roll correction (±15°)*
- *Simple operator interface using a touch screen display and menu system*
- *Built in system monitors: Moving Window image on CRT, and oscilloscope*
- *Automatic built in subsystem testing*
- *Scan head size 67 x 52 x 71 cm*
- *Electronics size 103 x 48 x 64 cm*

The complete scanner system consists of an electro-optical sensor assembly (Scan Head/Spectrometer) and four electronics chassis interconnected by electrical cables. The Scan

Head/Spectrometer component is mounted to have a clear opening through the aircraft skin to the ground below. The electronic chassis components are mounted within a standard rack inside the aircraft cabin for access by the system operator. Data from the sensors is amplified in the spectrometer and passed to the electronics where it is digitized, combined with ancillary data and recorded. The electronics chassis contain the operator interface, the GPS receiver and other supporting subsystems. The principle MIVIS subsystem components are:

- *Scan Head and Spectrometer*
- *Moving Window Display and Monitor*
- *Digitizer*
- *VLDS (Very Large Data Store) Tape Recorder*
- *Power Distributor*

Three of the MIVIS subsystems contain embedded control computers that supervise and monitor operations for which that subsystem is responsible. Commands and status information is passed between these three subsystems through a local communication network. System startup automatically initiates a series of self tests to verify that the system is ready for use.

The Scan Head consists of the optical elements comprising the primary collecting telescope, a rotating scan mirror, the motor-encoder assembly, two controlled thermal references, and an Invar^R steel and aluminum structure. The structure holds these components, maintains their critical dimensions, shields the optics from stray radiation, and provides the interface to the spectrometer. The scene energy collected by the scan mirror is focused by a paraboloid and directed onto the IFOV defining aperture. Energy passing though the aperture is collimated and reflected out of the scan head to the spectrometer. The two reference sources contained within the scan head are viewed once per scan mirror revolution.

The Spectrometer accepts the collimated energy from the Scan Head and divides it into 4 optical ports. Each port contains a diffraction grating, imaging lens, detector array and preamplifier electronics. Each spectrometer port uses optical materials, coatings and detectors that are optimized for its specific wavelength region of operation. Selectable electronic gains and/or optical attenuations are implemented in the spectrometer to maximize SNR for a wide range of input radiance levels. The optical attenuation system allows to record scene temperatures up to 1200°C without electronics saturation. The output of the spectrometer is 102 electrical signals, each from a different detector, representing, as already seen, a segment of the spectrum between 0.43 and 12.7 μm.

The Moving Window Display (MWD) contains a display monitor CRT assembly, a waveform monitoring oscilloscope, and a DC to AC power inverter. The principal function of this unit is to provide a visual real time image of the scene being recorded to the operator. This function serves to assess areal coverage, monitor the system integrity and provide an estimate of data quality. The MWD is capable of operating in either real time during the data collection, or after flight in data playback. The display monitor receives RS-170 or CCIR video from the digitizer and the CRT displays video data from one or two video channels. Display functions are controlled by touch screen menu selections from digitizer system component. The oscilloscope provides a functional check for operator, and represents a system maintenance tool. The inverter provides from the 28 volt DC aircraft power the 115 volt 60 Hz AC power for use by the VLDS data recorder and the MWD CRT.

The principle Digitizer function is to provide 102 channels of analog to 12 bit digital conversion, format this data and write it to tape. This process is synchronized to the scan mirror rotation by signals from the optical encoder on the motor. The Digitizer is also the location for peripheral functions which are designed to accomplish important system features. All Digitizer functions are supervised by an embedded computer and control software. The Digitizer contains the Touch Screen which is the principal interface to the instrument. Touch screen operation, supervised

by an embedded control computer, is based on a matrix of infrared light beams that match optical detectors cross the screen. When the operator's finger touches the screen a horizontal and vertical infrared light beam is interrupted and an appropriate action is taken. The touch screen and display menu concept makes the control and monitoring of a such complex instrument relatively simple. Menus are presented on the screen to the operator, identifying what action will occur when a designed area on the screen is touched.

The MIVIS Menu System displays on the touch screen a series of nineteen different menus organized into three levels: Level 1 Menu (Scanner Operation), Level 2 Menus (4 further menus), Level 3 Menus (12 further menus). These 3 levels differ by their significance to the system operator. Data collection and recording are done using level 1 menu. All routine operator adjustments to the system are accomplished in either level 1 or level 2 menus. Level 3 menus control less frequently needed system parameters such as special setups, diagnostic tests and other maintenance functions. The MIVIS system configures itself upon startup optimizing all adjustable parameters to meet most application needs without operator intervention.

The Digitizer, after operator selection, formats data to the MWD for a video image of one or two of the acquired channels. The unit continuously monitors the data quality for all channels, examining for high and low out of range condition, and low signal level. This information is presented to the operator on the touch screen in the form of a matrix of 102 numbers (one for each channel). The matrix indicates the Dynamic Range status of each channel. The channel number will be blank if the channel has no Over Range, Under Range, or Low Signal errors. The channel number will be illuminated when any of the above mentioned dynamic range errors occur. When one or more channels are affected by dynamic range errors, touching a selection on the touch screen, information on Data Number values and ranges relative to that channel(s) are showed, allowing the operator to adjust parameters to solve the problem. If the system determines that a channel is not present, that particular channel number will be displayed in reverse video.

The functionality of the entire system is checked upon startup through a series of Built In Tests (BIT) initiated from the Digitizer. The status of other MIVIS subsystems is monitored by Digitizer, and reported to the operator by messages on the touch screen. Some tests of the BIT sequence continuously follows key MIVIS functions and notify when the MIVIS system is ready to operate and if some critical or not critical error is occurring.This status information is also included into information recorded onto the data tape.

The Position and Attitude Sensor (PAS) is a peripheral function supervised by the Digitizer. The PAS system is composed of a gyroscope for roll and pitch sensing, a flux gate compass to sense aircraft heading, and a GPS receiver for location, track, speed, time, date, height, etc. Data from these sensors is sampled, time-correlated and recorded on the data tape, and used by ground processing system to remove distortions caused by aircraft motions and/or terrain relief. Correction of aircraft roll ($\pm15°$) is performed in real time to take advantage of the high precision of PAS. The remaining corrections are done by the data processing system after flight.

The MIVIS system records all data for post flight analysis by an image processing system. The VLDS recorder is a digital magnetic tape drive using helical scan technology and tape cassettes similar to the home VCR. It enables MIVIS to store a large quantity of data (10.2 Gbytes per cassette) at high speed. A buffered version of VLDS is used because it contains internal memory allowing data transfers at different scan speeds. Up to 240 minutes of data (dependent on scanner speed) can be stored per tape cassette, and a new cassette can be loaded into the recorder in approximately 15 seconds. Tape operations are controlled through a SCSI interface, making the recorder compatible with ground based computer systems that also use this standard.

The MIVIS system operates entirely from 28 volt DC aircraft power. The Power Distributor is the interface between this input power and the remaining MIVIS system components. The input power is converted to other voltages and distributed to other MIVIS chassis. Isolation of critical circuits from other MIVIS components as well as the aircraft power systems is the responsibility of the Power Distributor. This chassis contains circuit breakers, relays, power converters, electrical filters, and engineering data monitors. Certain high power functions such as the scan motor control and reference source control circuits are also located in this subsystem. Operation of the motor and reference control circuits as well as communication with the remaining MIVIS system components are supervised by an embedded computer.

4. MIDAS SYSTEM

The MIDAS system has been developed to efficiently preprocess, analyze and visualize MIVIS data, and is written for portability to a large number of computer platforms. It has been designed for use on a wide variety of UNIX workstations that support X-Window System and the Application Visualization System (AVS) graphical programming environment. LARA project hosted MIDAS software on a UNIX Silicon Graphics SGI 4D/420VGXT based in Pomezia in a configuration that is sintetically listed below:

- *Two 40 MHz CPUs*
- *128 Mbytes of main memory*
- *Four 1.1 Gbytes IPI high-speed disks*
- *Two 1.2 Gbytes SCSI disks*
- *VLDS helical scan cartridge tape system*
- *Two 8 mm Exabyte tape drives (5 Gbytes capacity each)*
- *One 8 mm Exabyte tape drive (10 Gbytes capacity)*
- *1/4 inch cartridge tape drive (150 Mbytes capacity)*
- *Kodak Model XL-7700 film recorder*

A MIDAS Production Processor handles data ingestion, standardized processing, reformatting, archiving and dissemination. Raw data from MIVIS are ingested with the VLDS helical scan cartridge tape system and backuped on the 10 Gbytes 8mm Exabyte tape, while preprocessing, archiving, dissemination, and alternative data ingestion is via the two 5 Gbytes 8 mm Exabyte tape drives and the 1/4 inch cartridge tape drive.

The big capacity of this particular hardware and software configuration is the use of a flexible three-dimensional data structure that allows to rapidly move information from high speed disks to memory, so that arbitrarily large data volumes may be processed or interactively visualized (30 frames/sec) without regard to memory limitations. This allows a sensitive compression of times for ingestion, reformatting, validation and preprocessing of MIVIS data before their distribution. In fact, all modules in MIDAS handle hyperspectral data in the Volume Image Management System (VIMS) format greatly improving the system performance. MIDAS organises data into volume elements (voxels), rather than rasters, and uses the voxel bricking (an extension of the planar processing pixel tiling) reducing the disk thrashing problem.

MIDAS functions to preprocess MIVIS data include radiometric calibration, filtering of eventual systematic noises introduced into MIVIS data during recording, geometric and atmospheric corrections. The radiometric calibration uses the MIVIS internal references sources and the more recent calibration data from test bench. The Internal Radiometric Calibration (IRC) computes radiance values for the reflected energy bands (1-92) by using the following equation:

$$R_i = (R_0 - REF_i) / (F*G*A)$$

where R_i represents the internally corrected radiance value (Watt/cm^2/ster/micron), R_0 the observed raw data number (DN), REF$_1$ the reference body DN, F the scale factor (DN/radiance), G the gain selected value (1, 10, 1000), and A is an attenuation factor (0.4-1.0). The term (F*G*A) is constant for each band for the entire flightline. For the thermal IR (channels 93-102) the IRC uses a different algorithm where the user must select a minimum temperature value (T_{min}), used as zero in the output image, and a sensitivity value (TperDout), used to scale the results. The temperature for each pixel is computed using the following expression:

$$DNO_i = C + (DN_i - REF_1)^* D$$

where DNO$_i$ represents the output DN and DN$_i$ the input DN for pixel i, REF$_1$ the DN of the first internal reference black body, and C is equal to

$$C = (T_1 - T_{min}) / TperDout$$

while D is equal to

$$D = TperDref / TperDout$$

where

$$TperDref = (T_2 - T_1)/(REF_2 - REF_1)$$

letting T_2 and T_1 the temperatures (°C), and REF$_2$ and REF$_1$ the DN, for each scan line, of the two internal reference bodies.

The atmospheric effects on the sensed radiance at the detector are wavelength dependent, and due to the presence of various scattering and absorption media. These effects depend upon aircraft altitude, the sensor scan angle, the solar geometry, and the spatial distribution of the scattering and absorptive media. The atmospheric correction algorithms provided by MIDAS offer a generic correction capability and may be driven by either LOWTRAN, MODTRAN or user provided atmospheric models. The output of the IRC adjustments could be used as input of the Path Radiance Corrections (PRC) to correct the calibrated values taking into account the solar illumination conditions, the sensor geometry and the atmospheric attenuations and sky irradiance. To applied the PRC to MIVIS data MIDAS is planned to receive a VIMS file of polynomial coefficients that are used to correct data from atmospheric effects. The polynomial coefficients, function of the position of the pixels across the scan line, can be estimated by user's specific codes or by standard atmospheric models. The expression used by MIDAS to correct data from atmospheric effects is the following:

$$R_p(\lambda,c) = a_1(\lambda,c)^* R_c(\lambda,c)^2 + a_2(\lambda,c)^* R_c(\lambda,c) + a_3(\lambda,c)$$

where R_p represents the path radiance corrected data for each band (λ) and for every cross track pixel number (c), R_c the IRC calibrated radiance, and a1, a2, a3 are the sky brightness coefficients. The Spectral Reflectance Normalisation (SRN) correction can be applied to the PRC output as a vector normalization, dividing the PRC radiance by the estimated solar irradiance for each spectral window.

The geometric correction rectifies images to eliminate the panorama distortions due to scanner geometry and effects introduced by perturbations in position and attitude of the airborne platform. For this last operation MIDAS uses GPS and inertial references (gyro and flux gate compass) data recorded for each scan line into MIVIS data. MIDAS allows two possible choices for geometric corrections: Simplified Airborne Scanner Image Rectifications (SASIR) or Position Attitude System Image Rectifications (PASIR).

The SASIR algorithm corrects the image from distortions due to scanner geometry, and taking into account the average aircraft velocity, terrain clearance and crab angle. The algorithm assumes a rotating mirror-based scanner whose mirror axis is parallel to both the Earth's surface and the aircraft fusolage. The Earth is assumed flat and no pitch, roll and yaw variations are taken into account.

The PASIR algorithm corrects MIVIS data using inertial sensors supplied data as aircraft pitch and roll based on a gyro outputs and yaw angles based on a flux gate compass outputs, GPS info, sensor characteristics, scan rate, and average terrain altitude. The PASIR approach to generate a rectified image is to project the unrectified image in an arbitrary coordinate system, using both the platform attitude estimates and the sensor characteristics. For each scan line in the unrectified image, the position of the sensor is estimated and the intersection of the pointing vector defined by the look direction and the target plane, is calculated. Pixels are assigned in the output space on a choice within nearest neighbour, bilinear or cubic interpolation techniques. The PASIR geometric correction allows an estimate of missing pixels on the ground.

Besides MIVIS data production, MIDAS offers to users a very powerful system for hyperspectral image processing. Hyperspectral data manipulation requires an analysis system with a high level of interactivity to handle and visualize large volumes of data. MIDAS, as mentioned, handles data with a highly flexible three-dimensional voxel structure for storage, implementing data transfer for both visualization and computation independently of image size. This data structure allows to optimize computation in each spatial dimension and the spectral dimension. Furthermore, algorithms included in MIDAS provide all the standard functions of a software dedicated to image processing, but more, offer software tools to analyze data in the spectral domain and allow the possibility to develop new algorithms for particular user's analysis.

5. SICILY LARA 1994 DEPLOYMENT

During the second half of last July 1994 LARA Project in the framework of final MIVIS/MIDAS testing and tuning held a MIVIS test deployment in cooperation with national and international institutions on a variety of Sicilian sites. The deployment was successful and more than 56 Gbytes of MIVIS data were collected in almost 5 hours of VLDS recording time.

This first MIVIS deployment besides its testing purposes it was also an opportunity offered to the scientific community to obtain MIVIS data on selected test sites. The surveyed sites, the proposing institutions, and the scientific objectives are sintetically listed below.

	SITE(S)	INSTITUTION(S)	SCIENTIFIC OBJECTIVES
1)	Mt. Etna, Vulcano, Stromboli	JPL (Pasadena, CA USA), CNR/IIV (Catania), CNR/GNV (Roma), CNR/CSGDSA (Pisa), ING (Roma), OGUM (Modena), Roma University, Palermo University	Geological mapping and measurement of active volcanic phenomena.
2)	Mt. Etna slopes	CNR/IROE (Firenze)	Beech-wood canopy studies.
3)	Messina Straits	CNR/CST (Messina)	Sea currents dynamics and physical characteristics.
4)	Gela	CNR/IROE (Firenze), Catania University	Coastline pollution.

5) Marsala Lagoon   Palermo University   Algae bloom studies.

6) Acireale, Taormina   Catania University   Coastline pollution, waste
                                                     discharges and archeological
                                                     studies.

7) Selinunte, Alesa   CNR/Comitato Nazionale   Archeological studies.
                         Scienza e Tecnologia dei
                         Beni Culturali,
                         Palermo University

    During MIVIS data acquisition a contemporaneous ground data acquisition campaign has been carried out for most sites. For the surveys on volcanic areas CNR/IIV offered its ground support logistics in making measurements of plume SO_2 with its portable COSPEC instruments, while JPL, CNR/CSGDSA, ING, OGUM, and the University of Palermo people launched radiosondes to measure H_2O profiles, used anemometers for wind speeds, a GER portable spectrometer to measure ground radiances, radiation thermometers and thermocouples for measurements of ground temperatures. CNR/IROE deployed by helicopter its FLIDAR instrument contemporaneously with MIVIS on Gela's coastline and on Mt. Etna's beech-woods. CNR/CST and the University of Palermo made sea truths measurements with scientific boats on the Straits of Messina and inside/outside the Lagoon of Marsala.

    After the Sicily 1994 MIVIS deployment an evaluation of MIVIS inflight performances has been done for thermal channels making statistics on a portion of the ocean West of Stromboli Island (6771 pixels). In Figure 1 is reported the inflight SNR while in Figure 2 the inflight NEΔT is shown.
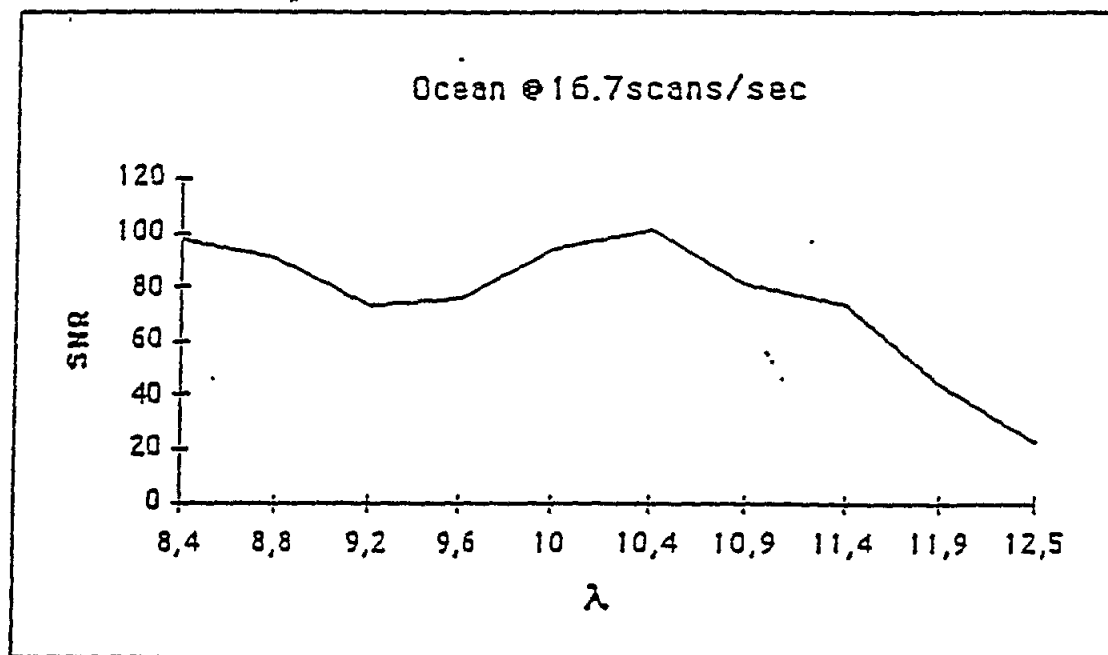

Figure 1 - Inflight SNR computed for the 10 MIVIS thermal channels on a portion of ocean target (6771 pixels), West of Stromboli Island.
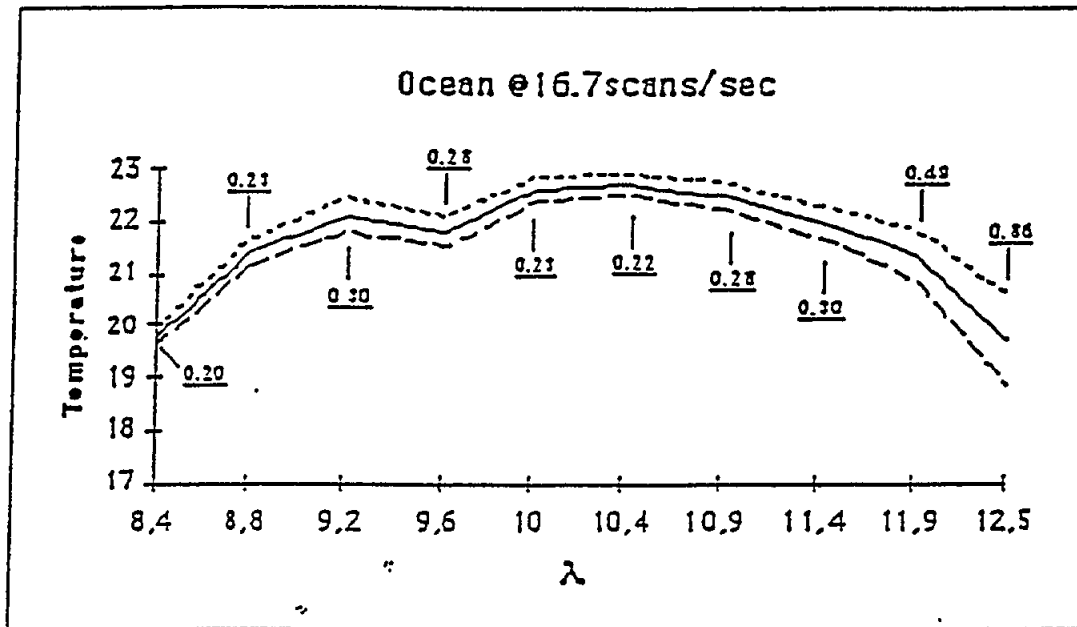
Figure 2 - Inflight NEΔT (underlined numbers on the plot) computed for the 10 MIVIS thermal channels on a portion of ocean target (6771 pixels), West of Stromboli Island.

Selected scenes of the Sicily 1994 MIVIS data will be extracted for general distribution under request starting from the end of 1994.

<u>6. REFERENCES</u>

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2. TASC Company, *MIDAS Data Center User's Manual*, 2 volumes., 1993.

- Libya is located on the southern side of the Mediterranean Sea with a long coastal line that extends to about 2000 km from the Tunisian border in the west to the Egyptian border in the east.

- Libya is a relatively very vast country. Its area is about 1.7 million sq.km with a population approximately 4 million. Due to its geographical location and diversity, and due to the limited manpower and human resources, Libya find itself obliged to use remote sensing techniques for assessing, studying, monitoring, and evaluating its natural resources and its environment.

- In the late 80's two remote sensing centres were established namely :

  1.   Libyan Remote Sensing Centre and Space Science
  2.   Biruni Remote Sensing Centre

- These Centres are equipped with relatively modern facilities to carry out their tasks

- The Centres are actively involved in the following :

  1.   Projects on land use and land cover classifications

  2.   Projects of civil engineering nature such as helping to select the routes of gas and huge water pipelines, and new rail road lines

  3.   Projects on deliniation of potential hydrologic reservoirs in the south of the country

  4.   Studying and evaluating the illegal deforestation in cooperation with the Technical Centre of Environmental Protection

  5.   Evaluating the urban expantion on the limited rich soils

  6.   Studies on the search and classification of good agriculture soils

  7.   etc.

- In Libya the Technical Centre for Environmental Protection (TCEP) is responsible to follow up and address all the environmental issues. TCEP is the focal point for RAC/ERS, TCEP is ready to support and cover all local expenses for any project that will be carried out in cooperation with RAC/ERS, to name few of the projects that can be carried out but not limited to the following:

  1.   Sea Water Intrusion
  2.   Deforestation and desertification monitoring
  3.   Under ground water depleation
  4.   Oil spilis and ship cleaning
  5.   Crop inventory and prediction
 6.   Coast line management
  7.   Etc.

- These projects can be carried out together and it is foreseen
  that RAC/ERS to help in training and giving consultation on
  procedures and methodology that be followed in these projects.

- These procedures and methodologies should be unified within
  all Mediterranean countries in order to help develop common
  data base for all countries, this information and experience
  can be shared and exchanged among expertise and organizations
  of Mediterranean countries.

المركز الوطني للاستشعار عن بعد
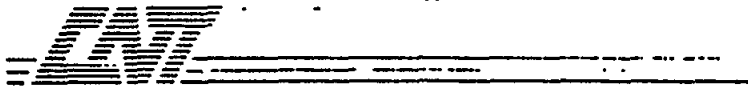
CENTRE NATIONAL DE TELEDETECTION

QU'EST CE QUE LA TÉLÉDÉTECTION ?

La télédétection recouvre l'ensemble des techniques mises en œuvre pour l'étude de la surface de la terre ou l'atmosphère en utilisant les propriétés des ondes électromagnétiques émises, réfléchies ou diffusées par les différents corps observés.

La télédétection spatiale consiste à exploiter les données recueillies par satellites d'observation de la terre (LANDSAT, SPOT, NOAA)... en vue d'en extraire des informations physiques, biologiques et humaines. Ces images apportent une vue d'ensemble sur de vastes territoires et permettent, grâce à leur répétitivité, de suivre l'évolution de certains phénomènes telles la désertification, la pollution, l'utilisation des terres, l'urbanisation...

Modèle numérique de terrain sur la région de Béja issu d'un couple SPOT-XS
© CNES 1987 SPOT-XS - © ISTAR 1990
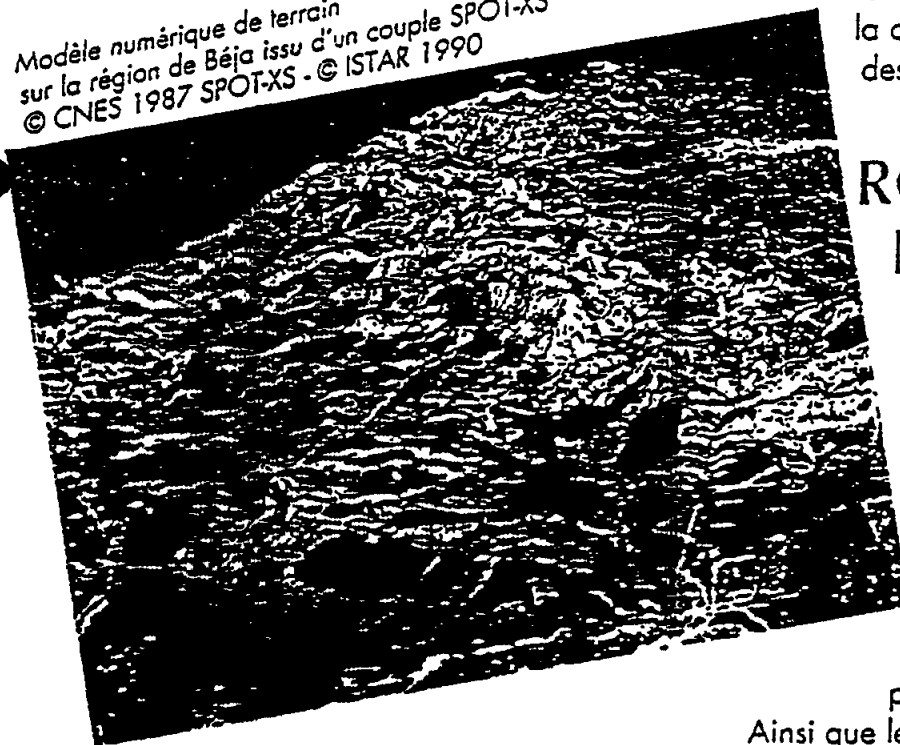
ROLE DU CENTRE NATIONAL DE TÉLÉDÉTECTION

Le Centre National de Télédétection, créé en Juillet 1988, est un établissement public à caractère industriel et commercial. Il a pour mission de définir, développer, soutenir et valoriser l'utilisation de la télédétection au profit des projets d'envergure nationale.

Ainsi que le décrit la loi N° 88-83 du 11-7-1988, il doit notamment :

- participer à l'élaboration d'une politique nationale

Presentation of Tunisia - Exposé de la Tunisie

en matière de télédétection de nature à préserver les intérêts économiques, sociaux, culturels et stratégiques;

- acquérir, distribuer, traiter et archiver sans monopole ni restrictions des données en matière de télédétection;

- offrir des prestations de service à la demande;

- promouvoir la formation et le perfectionnement du personnel des services administratifs concernés par la télédétection;

- apporter son concours dans la recherche ciblée sur les projets d'envergure nationale utilisant la télédétection et effectuer des expertises en cas de besoin.

Le Centre National de Télédétection est également habilité à adhérer aux organismes internationaux de télédétection.

Par la réalisation de ses missions, le CNT s'attache à répondre aux besoins d'un grand nombre de départements nationaux convaincus de l'apport de cette technique et soucieux de l'introduire parmi leurs méthodes d'investigation. Pour sa mise en place, le CNT a bénificié
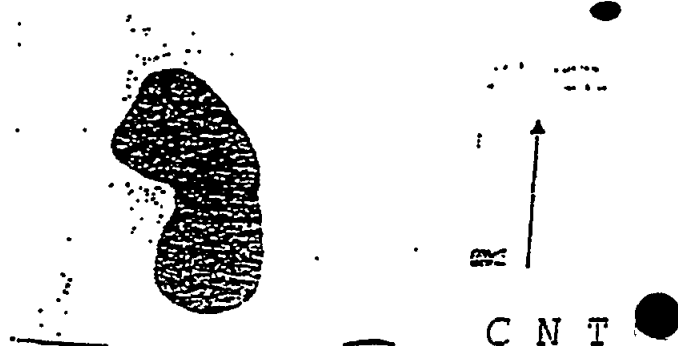
Carte d'isodensité du réseau hydrographique
Région de Béja

d'important moyens humains et matériels acquis sur le budget national mais aussi d'une large contribution de la coopération scientifique et technique française, notamment en matière d'équipements, de formation et de soutien à la réalisation de projets.

Par son action au sein du Centre Régional de Télédétection de l'Afrique du Nord, le CNT contribue au développement de la télédétection au niveau nord-africain dans des projets d'intérêt commun.

Salle de calcul du Centre National de Télédétection

Presentation of Tunisia - Exposé de la Tunisie

LES MOYENS DU CNT

Le CNT dispose d'une équipe de spécialistes en traitement et interprétation des images spatiales qui s'appuient, pour leurs travaux d'études et de développement, sur des stations de traitements d'images : système informatique performant munis de processeurs images et de logiciels adaptés.

Le choix des équipements du CNT a été basé sur une conception matérielle type ateliers spécialisés (traitement images, géométrie, cartographie, édition...) reliés par réseau local. Outre ces ateliers destinés à la réalisation des projets, le CNT dispose également :

- de stations de traitement d'images destinées à la formation,

- d'une station d'archive numérique et d'une base de données images ; accessible via le réseau de télécommunication, cette dernière offre aux utilisateurs le catalogue de toutes les images disponibles au CNT.

Par ailleurs, un centre de documentation a été mis en place ; il regroupe une centaine d'ouvrages de base et une trentaine de titres de périodiques spécialisés enrichis chaque année par de nouvelles acquisitions.

Un service permet l'exploitation de ce fond documentaire de référence en la matière par tous les utilisateurs de la télédétection.
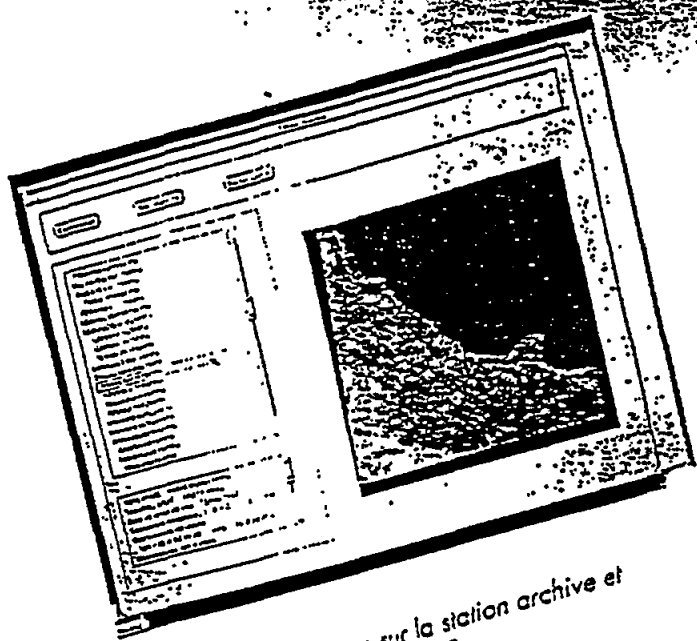
Consultation sur la station archive et distribution - STADIS -

Etude de la pollution chimique dans le Golfe de Gabès © CNES 1990 - Distribution SPOT-IMAGE - Traitement CNT
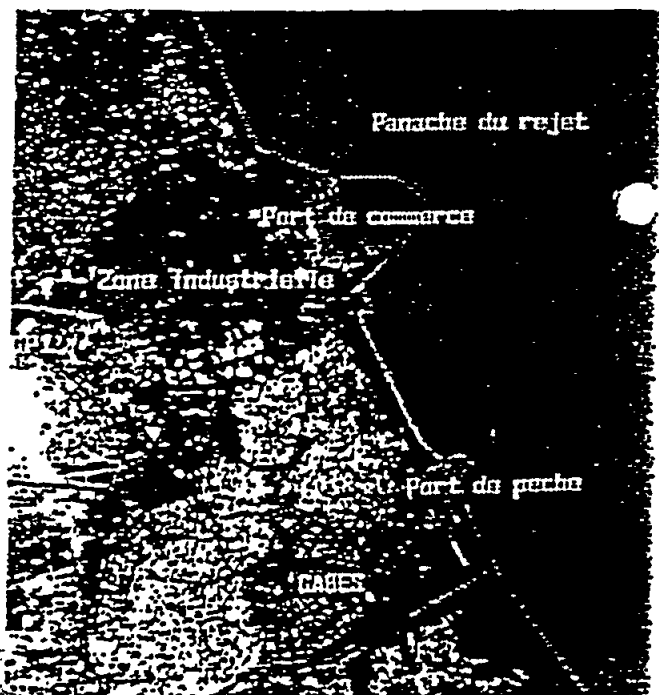
Carte des états de surface - Région de Menzel Habib. - © CNES 1990

LES ACTIVITÉS DU CNT

Les projets en cours de réalisation au CNT ont été définis en étroite concertation avec ses partenaires nationaux ; ces projets sont relatifs à des thèmes de première priorité pour le développement du pays : environnement, gestion des eaux de surface, urbanisme...

Environnement :

La télédétection permet la cartographie des zones difficilement accessibles tel le milieu marin. Dans le golfe de Gabès, les images SPOT et LANDSAT ont permis la cartographie de la zone côtière et la mise en évidence de la disparition de couvert végétal d'un des milieux halieutiques les plus riches du pays.
Le recours aux images satellites pour l'étude de la désertification se justifie par la nécessité de disposer de données synoptiques et répétitives pour une étude dynamique des phénomènes. Ainsi, dans la région de Menzel Habib, des images d'archive LANDSAT et des images SPOT

plus récentes ont permis d'étudier l'évolution du paysage sur une période de 10 années. Cette étude dégage les effets des différents projets de mise en défens entrepris par le Ministère de l'Agriculture et permet de mieux adapter les mesures de protection dans le cadre du plan de lutte contre la désertification.

Urbanisme :

L'imagerie satellitaire est un outil privilégié pour la cartographie de l'occupation du sol en milieu urbain.
Conduite sur la région du Grand Tunis, premier pôle urbain du pays, l'étude rétrospective de l'évolution urbaine sur les dix dernières années s'inscrit dans le cadre de la révision du Plan Directeur de l'Urbanisme.

Etude de la pression urbaine sur les terres agricoles dans la région de Tunis
© CNES 1990 - Distribution SPOT-IMAGE
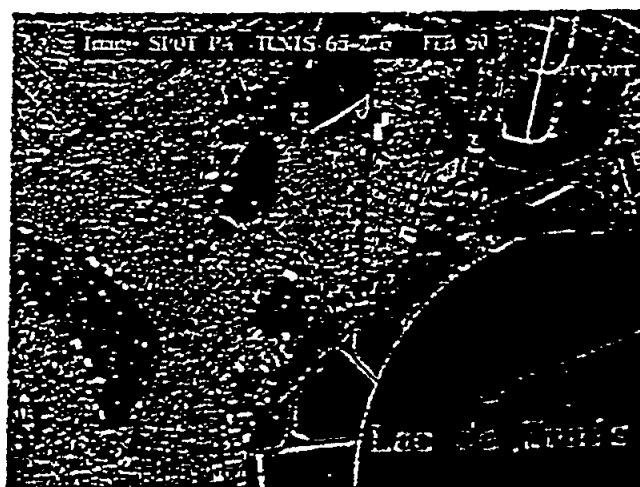
Presentation of Tunisia - Exposé de la Tunisie

Gestion des eaux de surface :

Les produits dérivés des images satellitaires tels Modèle Numérique du Terrain, cartes des pentes... permettent une étude des bassins versants et conduisent à l'établissement de carte des zones vulnérables à l'érosion, première étape dans l'identification de sites potentiels pour l'implantation de retenues collinaires. Cette première étude sur la région de Béja est extensible à d'autres sites de la Tunisie et s'inscrit dans le cadre de la lutte contre la sécheresse en zone semi-aride.

Calamités naturelles :

La possibilité de programmation urgente du satellite SPOT a permis la disponibilité d'images couvrant les zones sinistrées à la suite des inondations qui ont affecté le Centre et le Sud de la Tunisie en Janvier 1990.
Une étude comparative de ces images avec celles acquises en Juin 1988 a débouché sur la cartographie exhaustive des dégâts causés par les inondations. En seconde phase, l'étude des bassins versants sur les images SPOT contribuera à la révision de la carte des zones vulnérables aux inondations.

FORMATION

De part sa mission, le CNT contribue au développement de la télédétection par l'initiation et la formation des utilisateurs en organisant :

- des séminaires, journées "porte ouverte"... destinés à la sensibilisation des décideurs aux apports de la télédétection dans leur domaine,

- des ateliers de travail ciblés sur des thèmes en rapport avec les projets initiés par le CNT. D'une durée moyenne de quinze jours, ces ateliers permettent l'initiation d'ingénieurs, techniciens, chefs de projet... aux techniques de traitement et d'interprétation des images spatiales. Ils comportent en général des exposés de cas, des travaux pratiques sur systèmes de traitements d'images et des sorties de contrôle terrain.

RECHERCHE

La contribution du CNT au développement de la recherche se traduit par l'accueil et le co-encadrement d'étudiants ou élèves ingénieurs sur des sujets définis en concertation avec les établissements d'enseignement supérieur.

Atelier de travail "Télédétection et occupation du sol"
Tunis, Décembre 1988

Thank you Mr. Chairman,

I would like to express my gratitude to the RAC/ERS for this meeting, which I believe would bring about essential contributions to the fulfillment of MAP activities, and I hope further success would be achieved at the subsequent meetings.

Environmental informations and data systems definitely make prompt and considerable scientific and technical provisions at almost every phase of decision-making, particularly at national development plans.

The Mediterranean countries, in this connection, are preliminarily in need of convenient and timely environmental information and data systems when they are making their coastal areas management plans. Thanks to the RAC/ERS for its attempts to meet this need.

I firmly believe that a cooperation of this kind will, at the same time, create close ties and maintain a friendly atmosphere full of love and peace towards the solution of environmental problems of the Mediterranean Basin.

To this end, various methods should be developed to enhance further cooperation and realize much faster exchange of information and data among the Mediterranean countries.

Additionally, larger number of courses, whose subjects would be aspects of data collection such as remote sensing techniques and evaluation systems like Geographic Information Systems, together with their applicability, could be arranged to assist a higher number of attendants. This, I am sure, will make further contributions to the desired level of success.

Presentation of Turkey - Exposé de la Turquie

Yet, political and economic decision-making has not been fully integrated with the environmental dimension in Turkey, which, however, is an issue considered to be foremost and is under scrutiny of public interest. We are expecting the seemingly independent and disconnected activities to be incorporated and integrated with the planned activities of the Ministry of Environment of Turkey.

The Ministry, under these circumstances, has been trying to re-assess the existing environmental situation and make the required plannings. Henceforward, the feasibility of "Environmental Inventory and Information System" has been set up so that system exchange could be realized and facilitated among national and international information and data systems.

Besides, a Geographic Information System to integrate and utilize the data collected from various sources is underway. The Ministry will, then, be able to give access, through this data bank, to all necessary information, to any organisation submitting request.

The Turkish Ministry of Environment evidently intends to take the principles, experience and competence of CTM as a guideline to its performance in Turkey. Our co-activities with RAC/ERS and the training sevices which we can greatly make use of will be to the benefit of Turkey in accelerating the realization of the planned activities. Thus, the "Environmental Management Plans" , which are symbols of a new concept will be prepared and founded on a more realistic and solid base.

Thank you!

ANNEXE V

RECOMMANDATIONS

1.   remercier l'Italie et le CTM pour le soutien financier et technique donné à CAR/TDE durant les années 1994-1995; et demander la poursuite de ce soutien indispensable pour les années 1996-1997;

2.   ·confirmer l'importante contribution que les techniques de la télédétection peuvent fournir au développement des activités scientifiques et socio-économiques du PAM, en ajoutant une dimension dynamique aux observations, aux études, aux planifications et au contrôle des situations et des changements de l'environnement du bassin méditerranéen;

3.   souligner la nécessité d'une étroite collaboration entre les autres CAR du PAM et le CAR/TDE en introduisant, de manière appropriée, les techniques de la télédétection dans le développement des programmes approuvés (par exemple, contribué à la gestion des zones protégées, à l'étude des tendances socio-économiques, à l'Observatoire Méditerranéen, au contrôle de déversements d'hydrocarbures, à la gestion intégrée des aires côtières et marines, etc) afin de valoriser les objectifs et les résultats de tels programmes;

4.   demander à CAR/TDE de proposer, en collaboration avec les Points Focaux et suivant les circonstances, l'assistance à la mise en oeuvre d'utilisations pratiques des techniques de la télédétection pour la surveillance de paramètres relatifs à la pollution côtière et marine;

5.   demander à CAR/TDE de participer et de contribuer, aux projets régionaux du PAM et d'autres organismes internationaux qui conditionent le développement durable de chaque pays aussi bien que de toute la région Méditerranéenne et intéressant les changements climatiques, la biodiversité et les risques naturels;

6.   demander au CAR/TDE de développer des méthodologies qui associent télédétection, Système d'Information Géographique et modèles mathématiques, pour étudier des problèmes caractéristiques des pays méditerranéens, notamment dans la préparation d'Etudes d'Impact, concernant:
   - l'evaluation *a priori et a posteriori* des impacts des grands projets
   - l'identification de stratégies pour la gestion de zones terrestres et marines
   - l'identification des impacts transfrontaliers

7.   demander au CAR/TDE de diffuser et échanger avec les pays méditerranéens l'information concernant la disponibilité de données de télédétection, le développement de logiciels, et tout développement relatif à ces sujets;

8.   demander au CAR/TDE d'oeuvrer à la mise en oeuvre d'une méthode et d'une stratégie pour la standardisation de la collecte et de l'analyse de données qui pourraient permettre l'établissement d'une "base d'information" commune à tous les Pays méditerranéens;

9.   demander à CAR/TDE de contribuer à des projets des programmes actuels et futurs des PAC (concernant l'érosion côtière, l'utilisation du sol, les risques sismiques, la planification intégrée, l'implications des changements climatiques, les aires spécialement protégées, etc.);

10.   demander au CAR/TDE de continuer le développement de l'étude de la méthode dénomée "COSMOS";

11.   demander au CAR/TDE de coopérer avec le CAR Plan Bleu dans la mise en place et le développement de l'Observatoire Méditerranéen en utilisant les techniques de télédétection;

12.   demander au CAR/TDE de poursuivre le développement du projet sur la classification et le suivi de la végétation dans la région Méditerranéenne par l'utilisation de la télédétection;

13.   demander au CAR/TDE de poursuivre son travail pour la préparation et la mise à jour du Répertoire des Centres de Télédétection en Méditerranée;

14.   demander au CAR/TDE d'organiser durant les deux années 1996-1997 des cours de formation sur les techniques de la télédétection et ses applications qui peuvent démontrer leur utilité pour le développement durable de toute la Region Méditerranéenne;

15.   demander au CAR/TDE de convoquer régulièrement des Réunions des Points Focaux.