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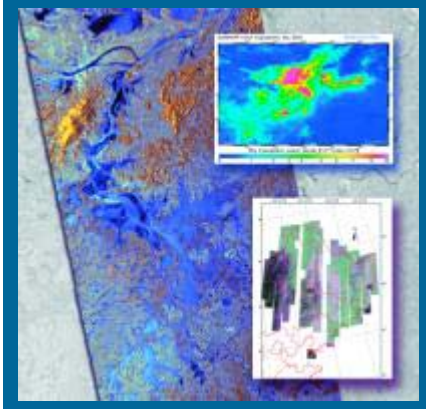
January 2006



Proceedings of the
2005 Dragon Symposium

Dragon Programme Mid-Term Results

27 June 1 July 2005
Santorini, Greece

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Overview of EO activities in the Institute for Space Applications and Remote Sensing of the National Observatory of Athens (ISARS/NOA)

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Several projects relating to the use of Earth Observation (EO) technology for environmental sustainable studies have been carried out at ISARS/NOA. The main activities are devoted to Space Research, Space Applications, Image Processing and Image Analysis. Other EO related activities comprise the operation of receiving stations, systematic collection, processing and archiving of earth observation data and the production and provision of information and services to the citizens and decision makers interested to know about the state of Earth's environment and its dynamics.

The current activity encompass studies relating to:

- Natural resources monitoring and mapping, emphasising on forest ecosystems, biodiversity and air quality.
- Natural hazards assessment, emphasizing on forest-fire management systems, monitoring of earthquake and geophysical phenomena.

Specific image processing capabilities have been developed at ISARS/NOA for processing and analysing optical and SAR imagery in order to produce higher-level complex image products, such as differential interferograms, daily SST and NDVI products, texture/kernel based classifications of protected biotopes and air pollution maps. Research has also been conducted for the development of artificial intelligence processing tools dealing with analysis of very fine spatial resolution satellite imagery in urban planning, land use mapping and land use/land cover change studies, and assessment of air pollution load and transport over big agglomerations.

Overview of EO activities in the Institute for Space Applications and Remote Sensing of the National Observatory of Athens (ISARS/NOA)

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Το Ινστιτούτο Διαστημικών Εφαρμογών και Τηλεπισκόπησης του Εθνικού Αστεροσκοπείου Αθηνών (ISARS/NOA) έχει πραγματοποιήσει σειρά προγραμμάτων που αφορούν στην αξιοποίηση τεχνολογίας παρατήρησης της γης (Earth Observation - EO) σε περιβαλλοντικές εφαρμογές. Οι κύριες δραστηριότητες επικεντρώνονται σε έρευνα για το Διάστημα, Διαστημικές Εφαρμογές και Επεξεργασία και Ανάλυση εικόνας. Άλλες δραστηριότητες ΕΟ περιλαμβάνουν την λειτουργία σταθμών λήψης, την συστηματική συλλογή επεξεργασία και αρχειοθέτηση δεδομένων παρατήρησης της γης και την ανάπτυξη και προμήθεια πληροφοριών και υπηρεσιών σε πολίτες και αρμόδια όργανα λήψης αποφάσεων που ενδιαφέρονται για το καθεστώς και την δυναμική του περιβάλλοντος.

Η συγκεκριμένη δραστηριότητα περιλαμβάνει μελέτες και έρευνες που αφορούν σε:

- Παρακολούθηση και χαρτογράφηση φυσικών πόρων με έμφαση στα δασικά οικοσυστήματα, την βιοποικιλότητα και την ποιότητα του αέρα.
- Ανάλυση περιστατικών φυσικών καταστροφών, με έμφαση σε συστήματα διαχείρισης δασικών πυρκαγιών, παρακολούθηση σεισμών και γεωφυσικών φαινομένων.

Στο Ινστιτούτο Διαστημικών Εφαρμογών και Τηλεπισκόπησης του Εθνικού Αστεροσκοπείου Αθηνών (ISARS/NOA) έχουν αναπτυχθεί εξειδικευμένες εφαρμογές επεξεργασίας εικόνας για επεξεργασία και ανάλυση οπτικών και SAR εικόνων και με στόχο την δημιουργία υψηλότερου επιπέδου σύνθετα προϊόντα εικόνας, όπως διαφορικά συμβολογραφήματα interferograms, ημερήσια SST και NDVI προϊόντα, ταξινομήσεις βασισμένες στην υφής/kernel προστατευόμενων βιότοπων και χάρτες ατμοσφαιρικής ρύπανσης. Έρευνα έχει επίσης διεξαχθεί για την ανάπτυξη εργαλείων επεξεργασίας τεχνητής νοημοσύνης για ανάλυση δορυφορικών εικόνων πολύ υψηλής χωρικής και σε εφαρμογές που αφορούν στον αστικό σχεδιασμό, την χαρτογράφηση χρήσεων γης, τον εντοπισμό αλλαγών χρήσης/ κάλυψης, την αξιολόγηση ατμοσφαιρικής ρύπανσης και μεταφορών σε μεγάλα αστικά κέντρα.

NATIONAL OBSERVATORY OF ATHENS

INSTITUTE FOR SPACE APPLICATIONS AND REMOTE SENSING

"Overview of EO activities in ISARS/NOA"

C. KONTOES N. SIFAKIS

The DRAGON Meeting, 11-12 October 2004, Athens

ISARS/NOA - REMOTE SENSING GROUP

The **National Observatory of Athens** is the oldest research center in Greece, established in 1846 when the first astronomical observations commenced. NOA is a public entity supervised by the General Secretariat of Research and Technology, Ministry of Development.

N.O.A. is composed of four Institutes:

- *Institute for Space Applications and Remote Sensing (ISARS)*
- *Institute of Geodynamics*
- *Institute of Astronomy and Astrophysics*
- *Institute for Environmental Research and Sustainable Development*

ISARS is the most recent of the four Institutes and was founded in 1955 but in 1990 expanded its activities into Space and Earth observation.

ISARS/NOA - REMOTE SENSING GROUP

SYNTHESIS OF THE REMOTE SENSING GROUP AT ISARS

- Permanent Researchers
- Research assistant staff specialised in Remote Sensing and Geo-sciences
- Technical staff experienced in electronics and informatics, supporting image acquisition and processing activities and system administration
- Post-graduate students, carrying out research work in the framework of their PhD (geodesists and environmental scientists)

ISARS/NOA - REMOTE SENSING GROUP

ACTIVITIES

- Providing **remote sensing services** to end users involved in the domains of environmental management and natural hazard assessment relevant to the GMES concept
- Pursuing research on the integration of new generation satellite imagery
  - in natural resources monitoring and mapping, emphasising on forest ecosystems, biodiversity and air quality
  - Natural hazards assessment, emphasizing on forest-fire management systems, monitoring of earthquake and geophysical phenomena.
- Development of algorithms for optimal exploitation of radar and optical satellite data of various spatial resolutions

ISARS/NOA - REMOTE SENSING GROUP

EARTH OBSERVATION APPLICATIONS

- Environmental crisis management systems (*Forest fires, earthquakes and volcanic activity*). Natural hazard assessment and mitigation by continuous monitoring through optical and radar data
- Assessment and modelling of *Crust deformations* in Greek territory due to earthquake and volcanic activity by SAR interferometry
- Tracking of *Air pollution* over big cities and industrial areas
- Mapping of natural resources for sustainable development (*Spatial indicators for Nature conservation, ISLA-Monitoring and water management, ATLAS Urban statistical mapping*)
- Methodological developments and algorithms for integrating the new generation very high resolution satellite imagery in *Urban planning and land use mapping*

ISARS/NOA - REMOTE SENSING GROUP

H/W and S/W FACILITIES

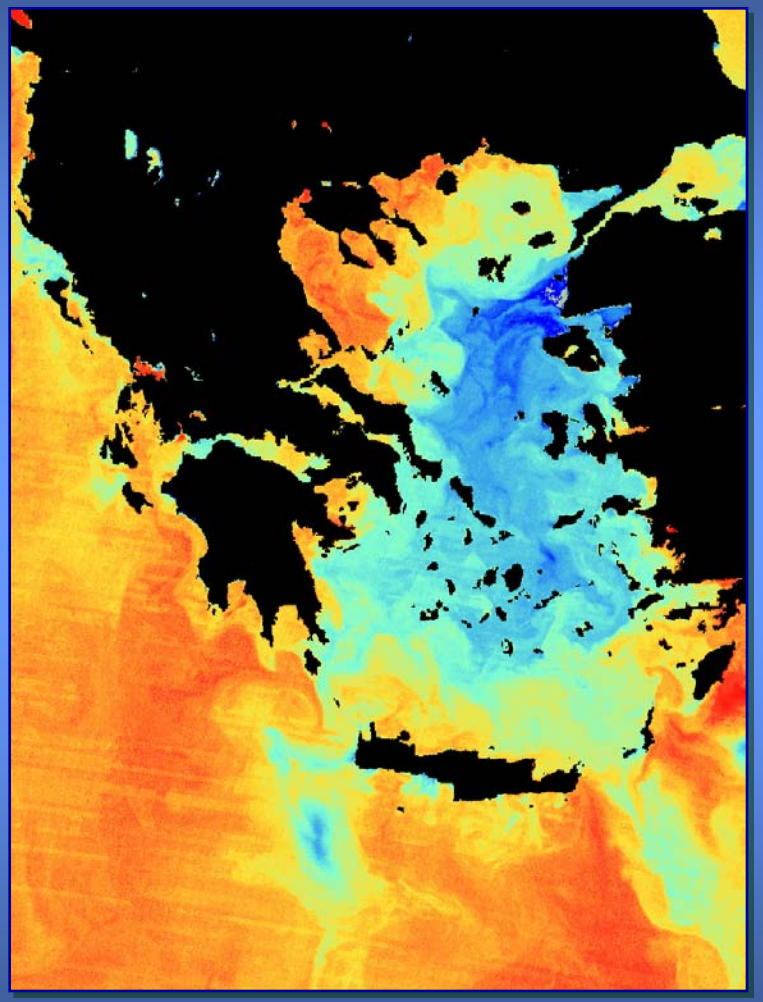
- **Satellite image receiving stations** are operated by the Institute for Space Applications and Remote Sensing
  - **NOAA/AVHRR receiving station**
  - **Meteosat receiving station**
  - **SeaWiFs receiving station**
- The collected data are routinely processed, archived and distributed on a daily basis and after specific user requests (e.g., Service NCMR, NAGREF)
- Raw image data as well as processed imagery are advertised on the Institute's web site and can be provided trough internet and ftp connections to third parties (e.g., authorities, universities, value adding companies, etc.)
- Data processing is done by specialised commercial and in house developed SW packages to produce value-added products, such as:
  - Geometrically corrected and map projected images
  - Radiometrically calibrated images
  - Sea surface and Earth surface temperature maps, Normalized difference vegetation index maps, Maximum vegetation composite maps, etc.

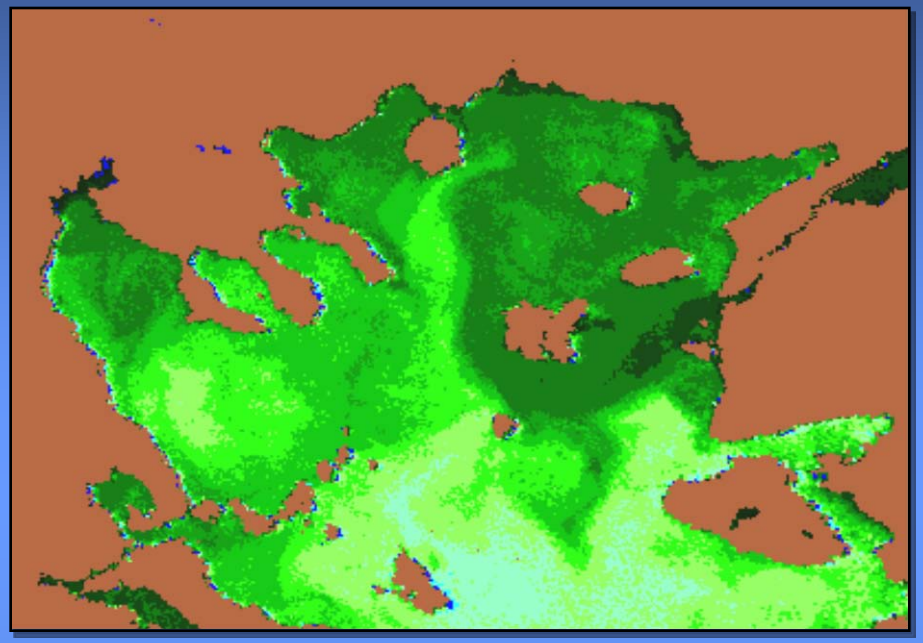
ISARS/NOA - REMOTE SENSING GROUP

CO-OPERATION

- The Institute co-operates in the International, European and National context in the framework, e.g., of EU and bilateral collaboration projects
  - National funded projects
  - EU projects funded in the framework of the FP 4, FP 5 and FP 6
  - Projects funded by the LIFE-Environment Program
  - ESA funded projects
  - Bilateral collaboration projects (Collaboration with German, Italian, French organisations)
  - ...
- International Collaboration has been established with:
  - ESA, DLR, CNES (SAR, air quality, environmental indicator assessment)
  - IPGP/Jussieu Paris VI (geophysical modeling and geophysical hazards)
  - NRC (oil spill monitoring)
  - NASA (atmospheric studies)
  - JRC (environmental mapping/urban planning)
  - EEA, EUROSTAT (Land Use/Land Cover mapping)
  - Value Adding Companies in Greece, Holland, Spain, Italy

ISARS/NOA - REMOTE SENSING GROUP

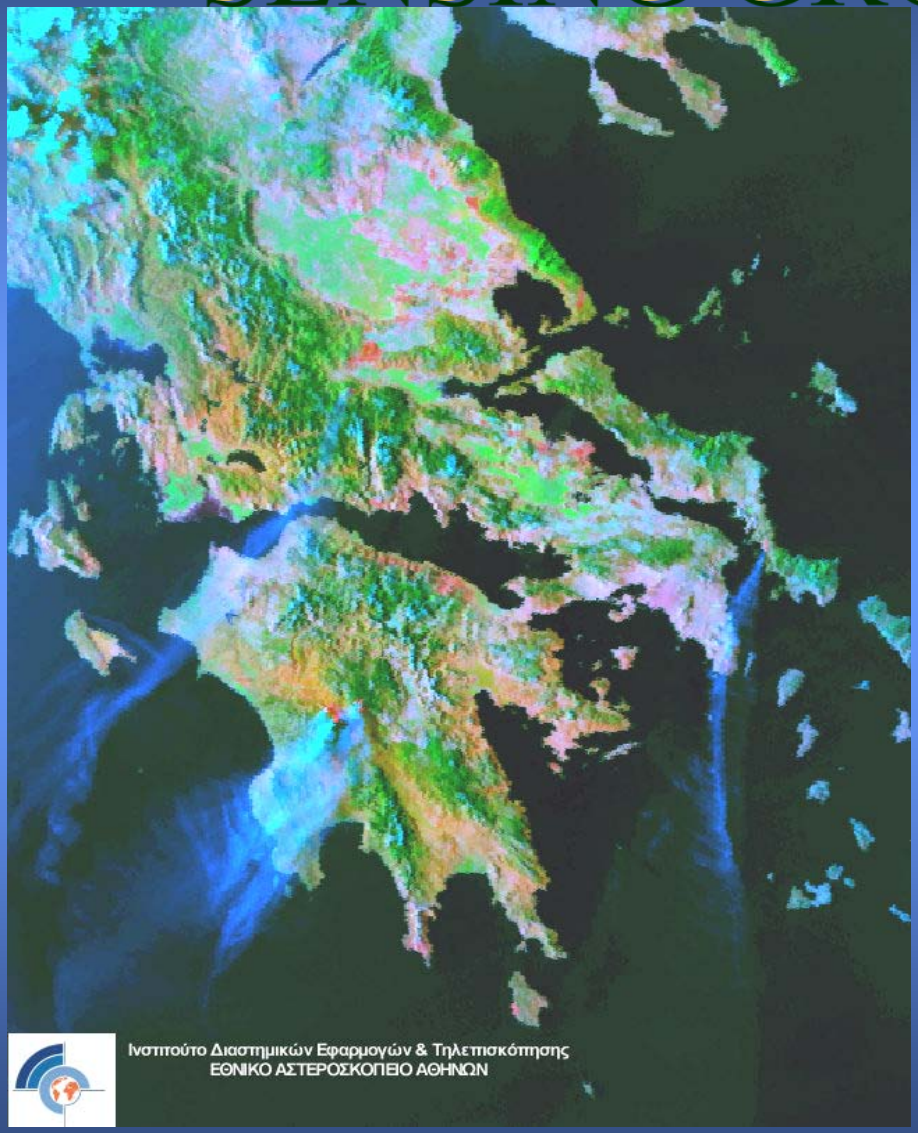


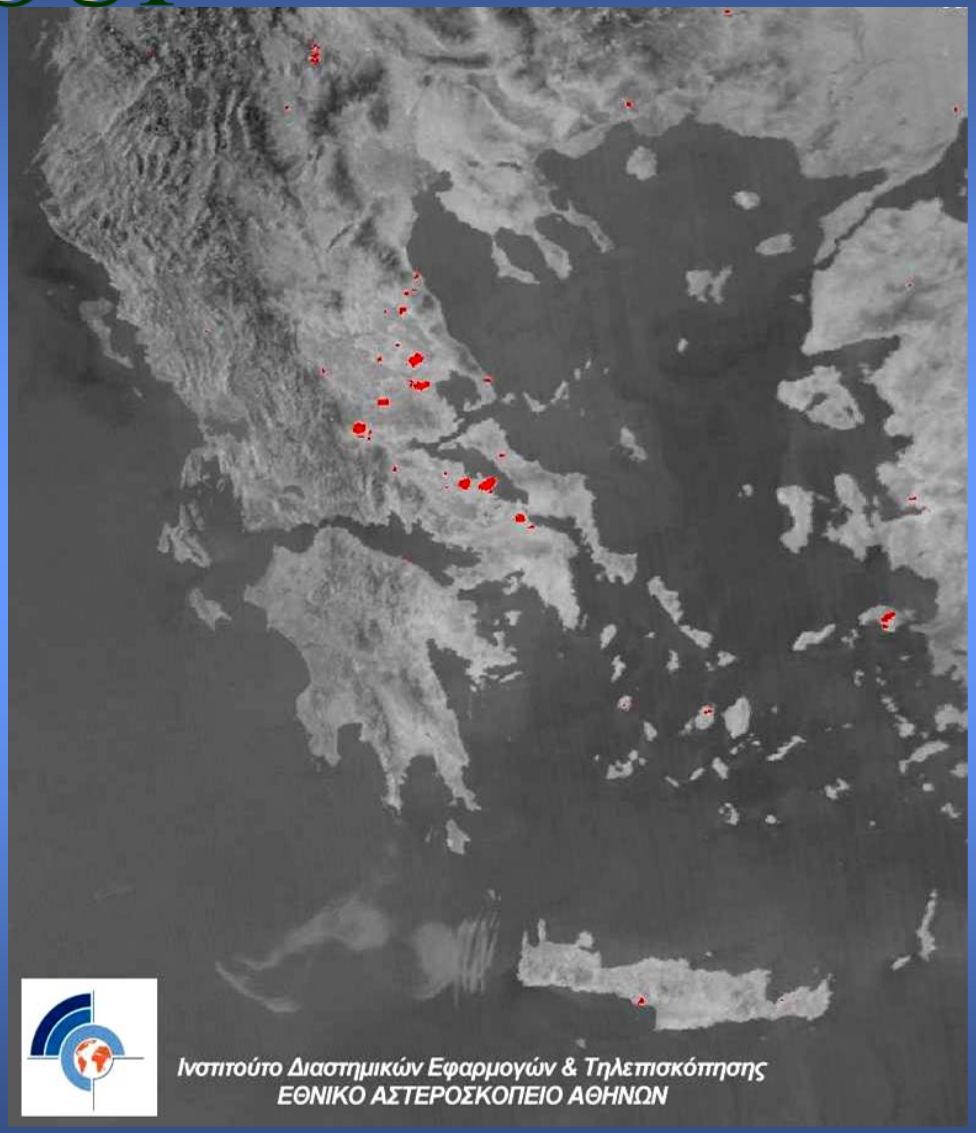


SST and Phytoplangton maps for fisheries management

AVHRR and SEAWIFS data, ISARS/NOA Receiving Stations

ISARS/NOA - REMOTE SENSING GROUP

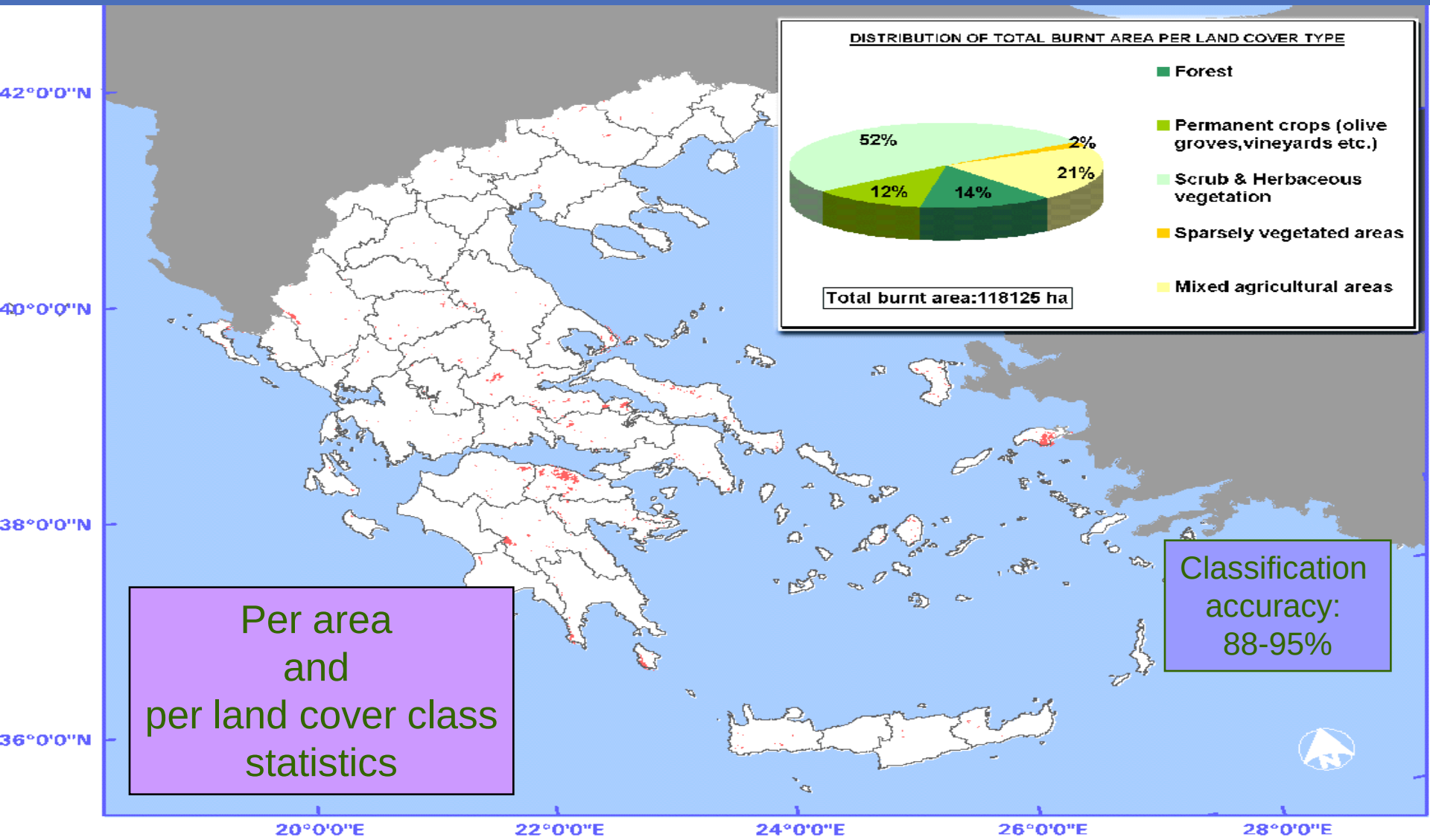




Daily observation of smoke plumes and localisation of important active fires

Assessment of fire consequences

Distribution of burnt areas in the totality of the country



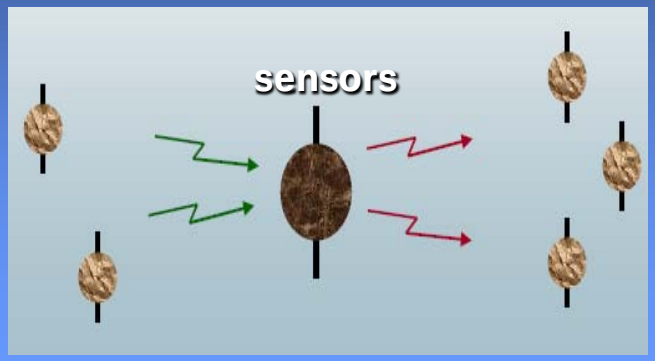
Per area
and
per land cover class
statistics

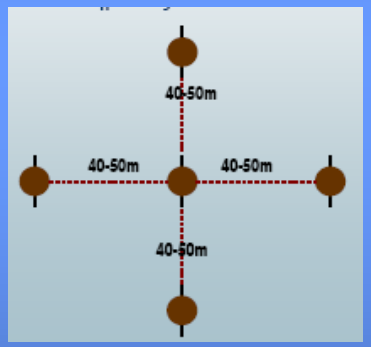
Classification
accuracy:
88-95%

ISARS/NOA - REMOTE SENSING GROUP

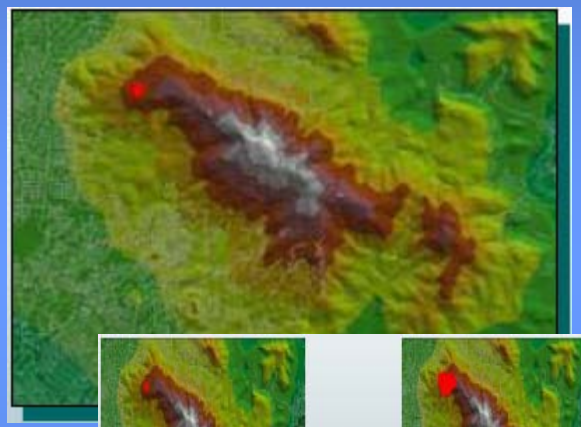
OPERATIONAL SYSTEM SUPPORTING DECISION MAKING IN FOREST FIRE FIGHTING

GSRT PROJECT 2004-2006: 2.5 M€





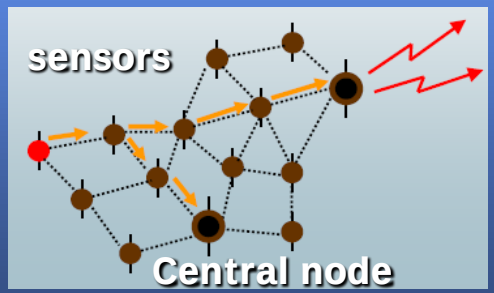
Sensor network Architecture



Forest Species

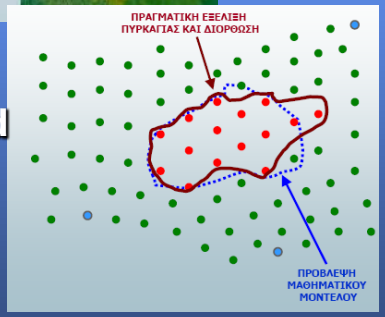
Forest Biomass Assessments

Forest Fire Modeling



To Operations Center

Model Validation and Refinement

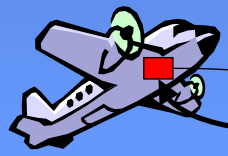


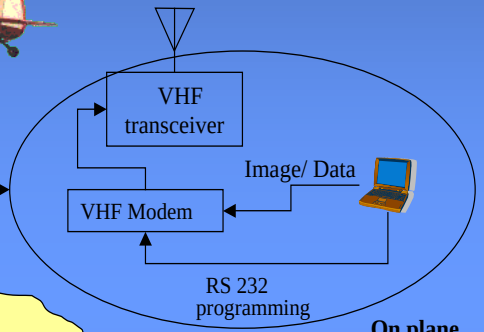
PARTNERS

NTUA, ISARS/NOA, CMT, MARAC, ZOE, MoA, GSCP, FIRE BRIGADES

ISARS/NOA - REMOTE SENSING GROUP

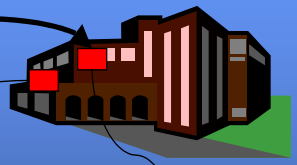
Assessment of ground and airborne detection techniques for forest fire mitigation/Project SITHON GSRT 2004-2006: 1.6 M€

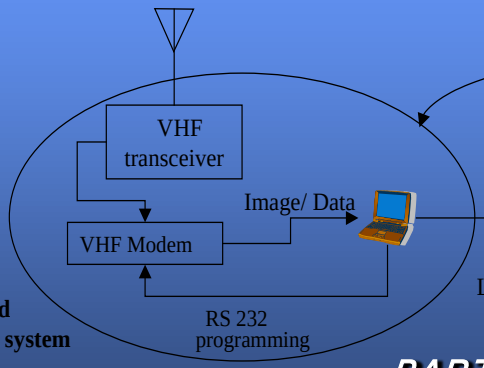




On plane AGCL unit

VHF channel

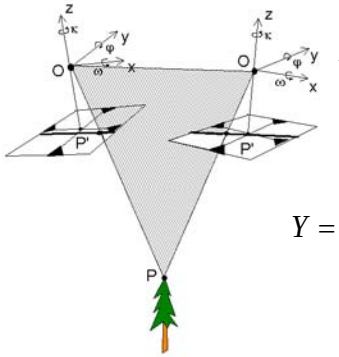




Ground AGCL system

LAN/ Internet

Control and management center



$$X = X_0 + (Z - Z_0)\frac{(x - x_0)R_{11} + (y - y_0)R_{21} - cR_{31}}{(x - x_0)R_{13} + (y - y_0)R_{23} - cR_{33}}$$

$$Y = Y_0 + (Z - Z_0)\frac{(x - x_0)R_{12} + (y - y_0)R_{22} - cR_{32}}{(x - x_0)R_{13} + (y - y_0)R_{23} - cR_{33}}$$

PARTNERS

NAGREF, ISARS/NOA, AUTH, UOA, AEROPHOTO, TELENET, MoA, FIRE BRIGADES

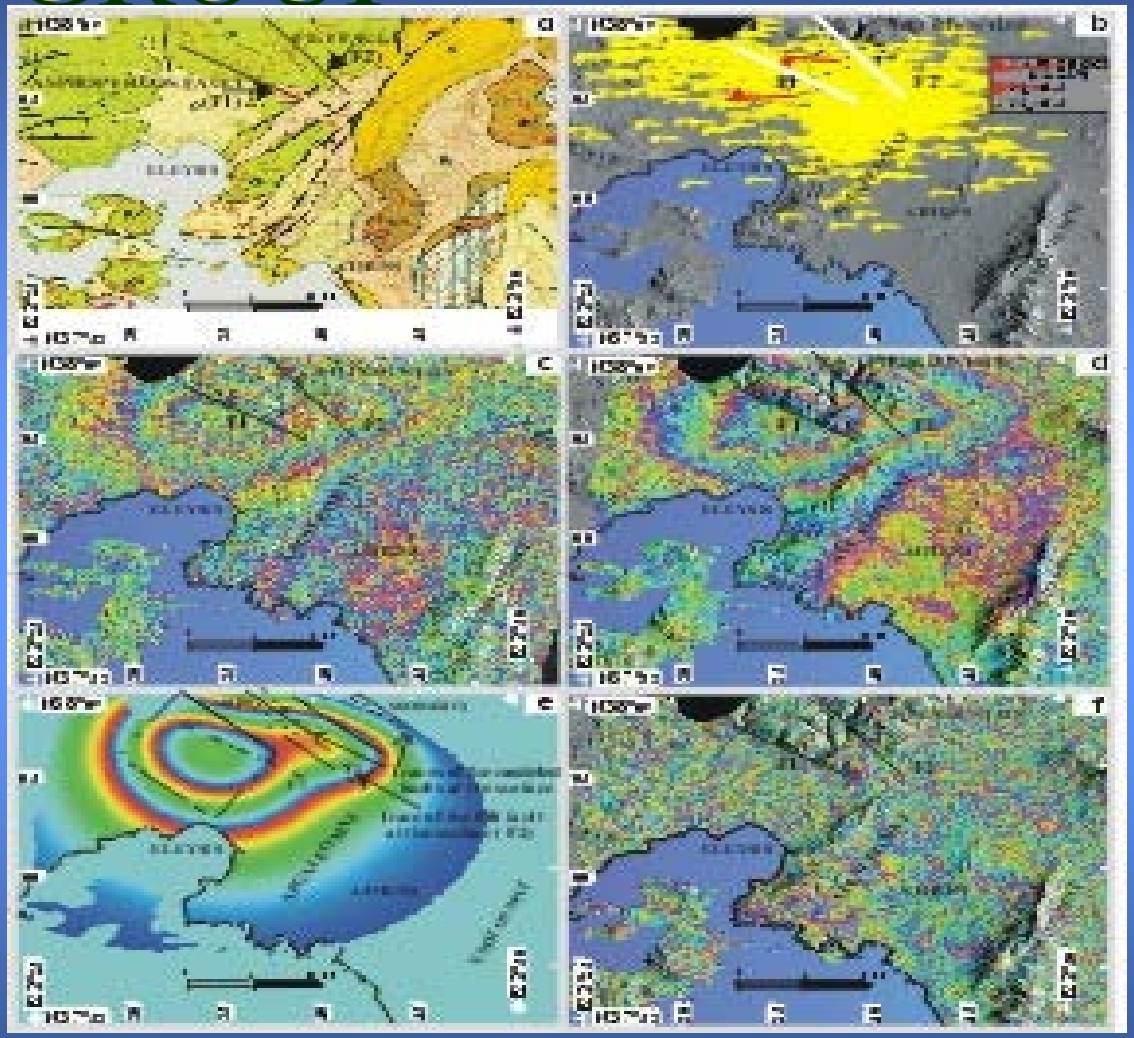
ISARS/NOA - REMOTE SENSING GROUP

ERS 2 SAR Interferometry

Permanent Scatterers

Geophysical Hazards

Crustal Deformations and Micromovements



THE ATHENS 1999 EARTQUAKE

ISARS/NOA - REMOTE SENSING GROUP

ERS 2 SAR Interferometry

Permanent Scatterers

Geophysical Hazards

Crustal Deformations and Micromovements

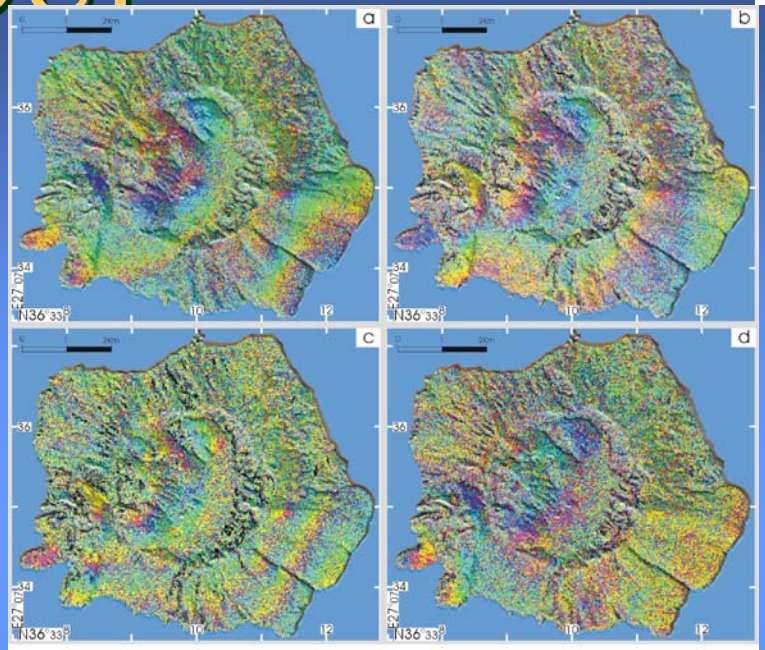


figure 2

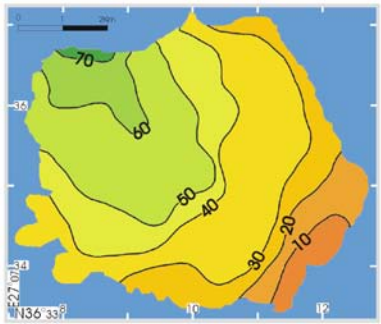


figure 3

THE NISYROS VOLCANO STUDY

ISARS/NOA - REMOTE SENSING GROUP

INTEGRATED COMPUTATIONAL ASSESSMENT OF URBAN AIR QUALITY VIA REMOTE OBSERVATION SYSTEMS NETWORK

2001-2004: 2.5 M€

Air quality mapping using satellite imagery

Industrial pollution

Urban pollution

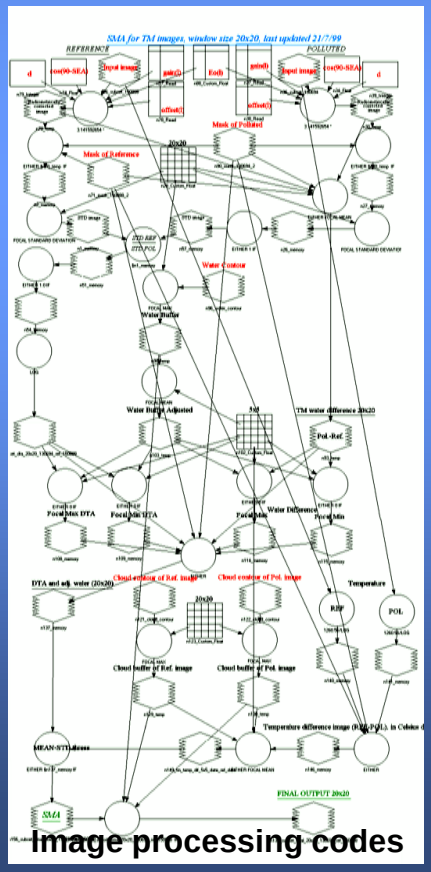
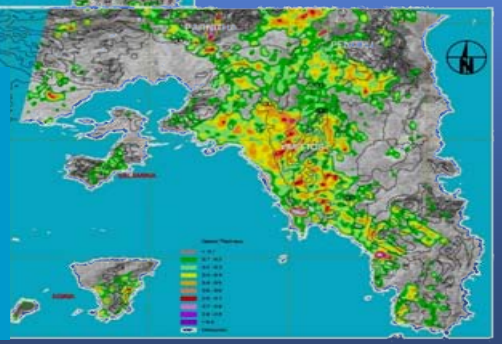


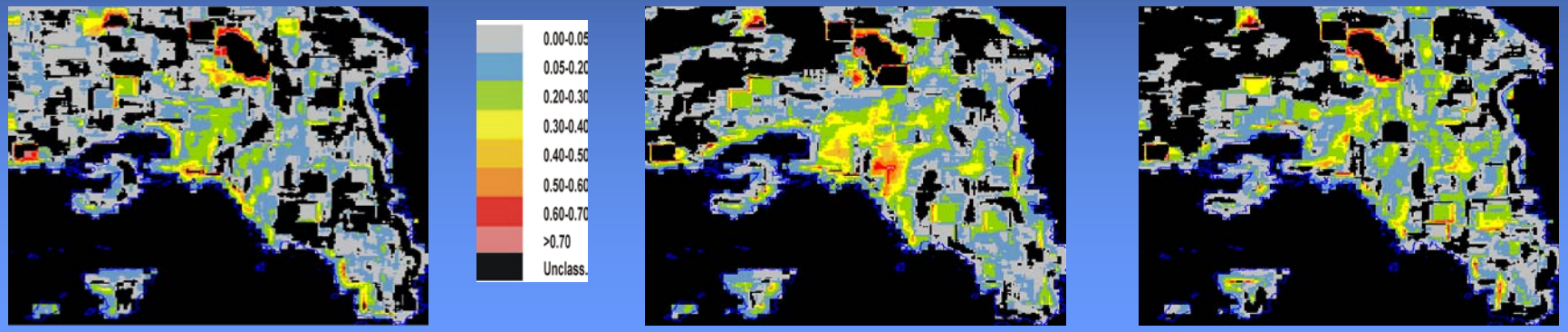
Image processing codes

Objective: Fusion of environmental information from HSR remote sensing observations, ground measurements and pollution transport models in order to minimise uncertainty in health impact assessment and optimise decision-making related to pollution control



ISARS/NOA - REMOTE SENSING GROUP

USE OF ENVISAT MERIS DATA FOR AEROSOL RETRIEVAL OVER ATHENS



We investigated the potentiality of MERIS data to produce aerosol optical thickness maps over Athens. We validated the results against actual aerosol concentration data measured precisely over the locations of the air quality monitoring stations. The correlation to PM10 concentrations measured at these stations was high (R^2=0.86) suggesting that the application of the DTA algorithm on MERIS data (whenever available and cloud free) could be used to depict aerosol concentration related information (especially during pollution conditions).

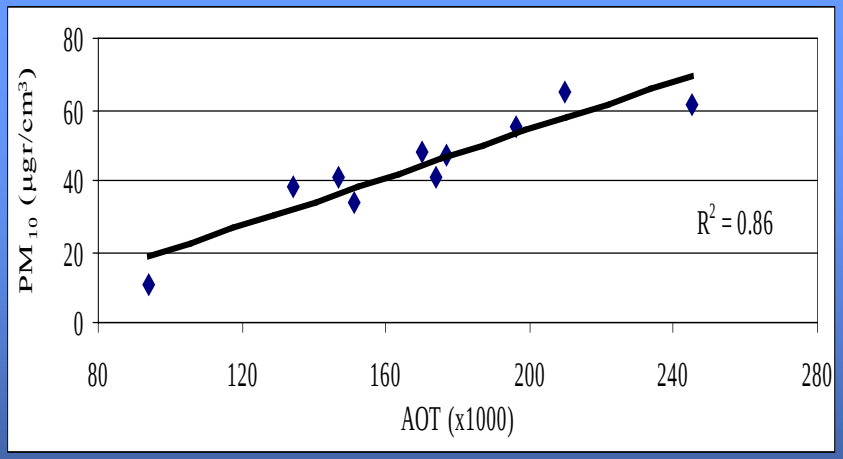


Figure 2. Scatter-plot of MERIS AOT values vs. PM_{10}

This research was performed under the ESA AO1495 project

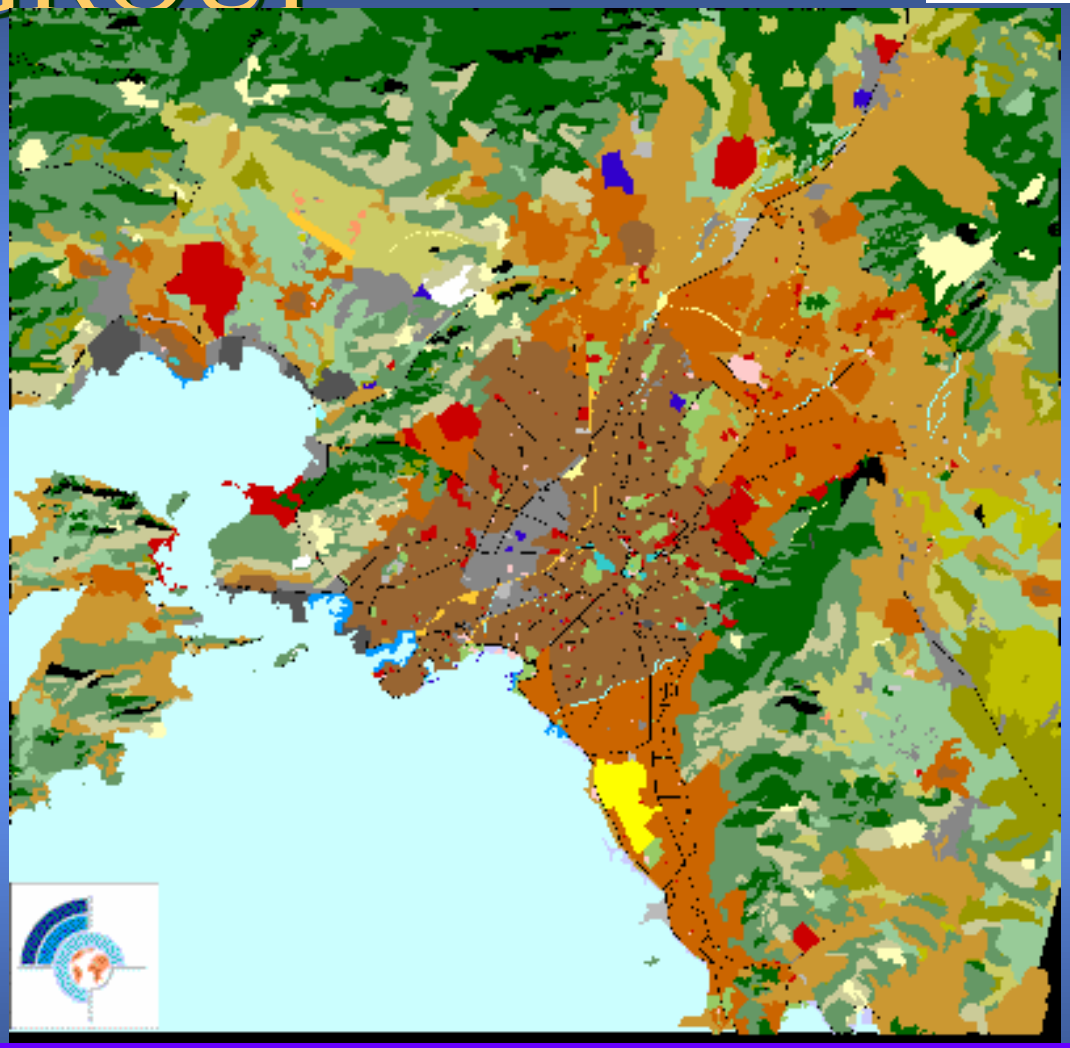
ISARS/NOA - REMOTE SENSING GROUP

LAND USE Mapping in Urban Agglomerations

EUROSTAT CLUSTERS nomenclature

Very High Spatial Resolution Imagery (1-5m)

Texture/object based advanced pattern recognition



STATISTICAL ATLAS OF LAND USE CLASSES IN ATHENS

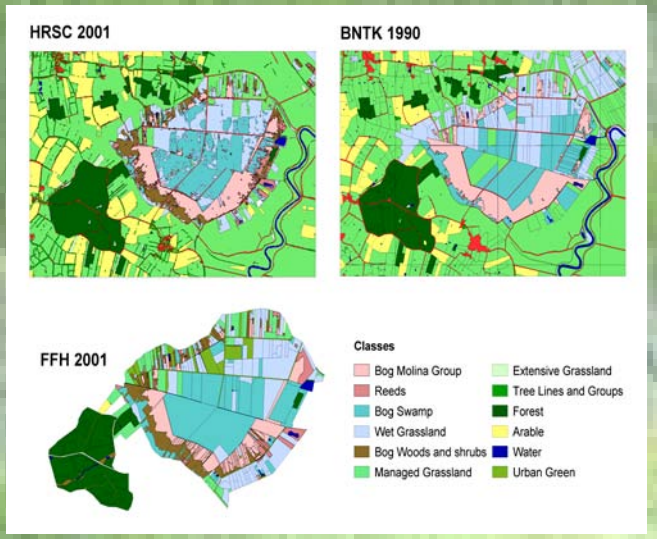
ISARS/NOA - REMOTE SENSING GROUP

SPATIAL INDICATORS FOR EUROPEAN NATURE CONSERVATION

2001-2004: 3 M€

8 European Partners from:

DE, GR, FR, AU, UK, SL, Estonia.



Objective: To develop and test a coherent spatial indicator system based on multi-sensor satellite data and GIS to accomplish monitoring and management tasks in the context of NATURA 2000 and further.

End users: Regional Authorities, Forest Departments, Environmental Information Centres, the EEA, the EC.