



Land cover and land cover change detection at national scale: An example from Greece

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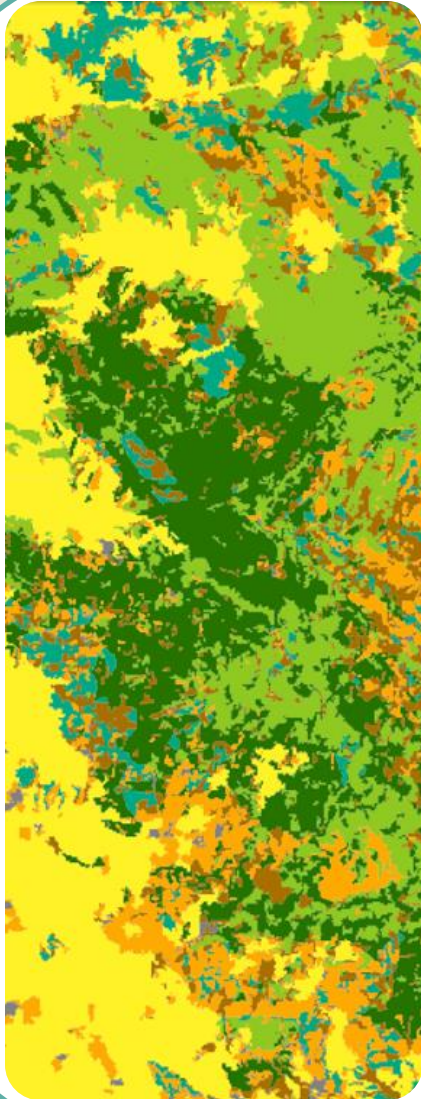
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Working Group:

Anastasia Polychronaki, Georgia Galidaki, Eleni Dragozi, Chara Minakou, Konstantinos Dimitrakopoulos, Maria Tompoulidou, Miltos Meliadis, Eleftheria Vrania

Prague, 18 June 2013

motivation



- ✓ *Mapping and monitoring land cover is the **basis** for the identification and assessment of the human imposed stresses to the natural environment*
- ✓ ***Lack of** reliable land cover **spatial** information*
- ✓ *Available data often remain **scattered and inaccessible**, hindering the process of land cover mapping*
- ✓ *Availability of **modern** computational **methods** and reliable means of mapping and spatial analysis, such as Remote Sensing, GEOBIA and Geographic Information Systems (GIS)*
- ✓ *Opportunity to produce an **independent** land cover product.*

rationale

The creation of up to date maps to support sound decision-making for:

- ✓ *planning,*
- ✓ *developing, and*
- ✓ *coordinating actions related to the protection of forests and the environment in general.*

objectives

Land cover mapping and Land cover change detection:

- ✓ *national land cover map of **2007**, and further spatial analysis per region and elevation zone*
- ✓ *national land cover map of **1987** , and further spatial analysis*
- ✓ *national land cover change **between 1987 and 2007** map , and further spatial analysis*
- ✓ *Focus on protected areas*

presentation outline

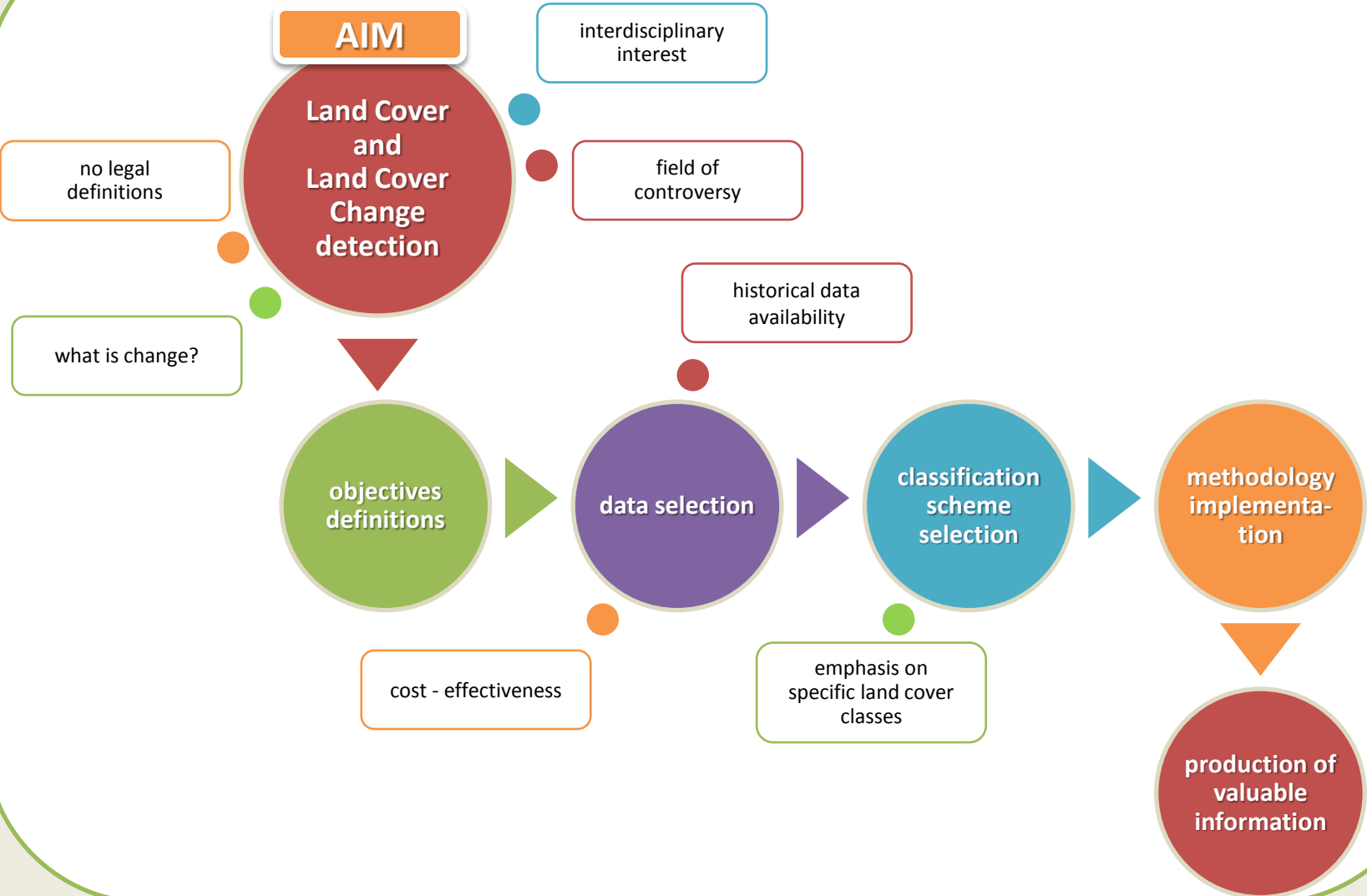
DEVELOPMENT

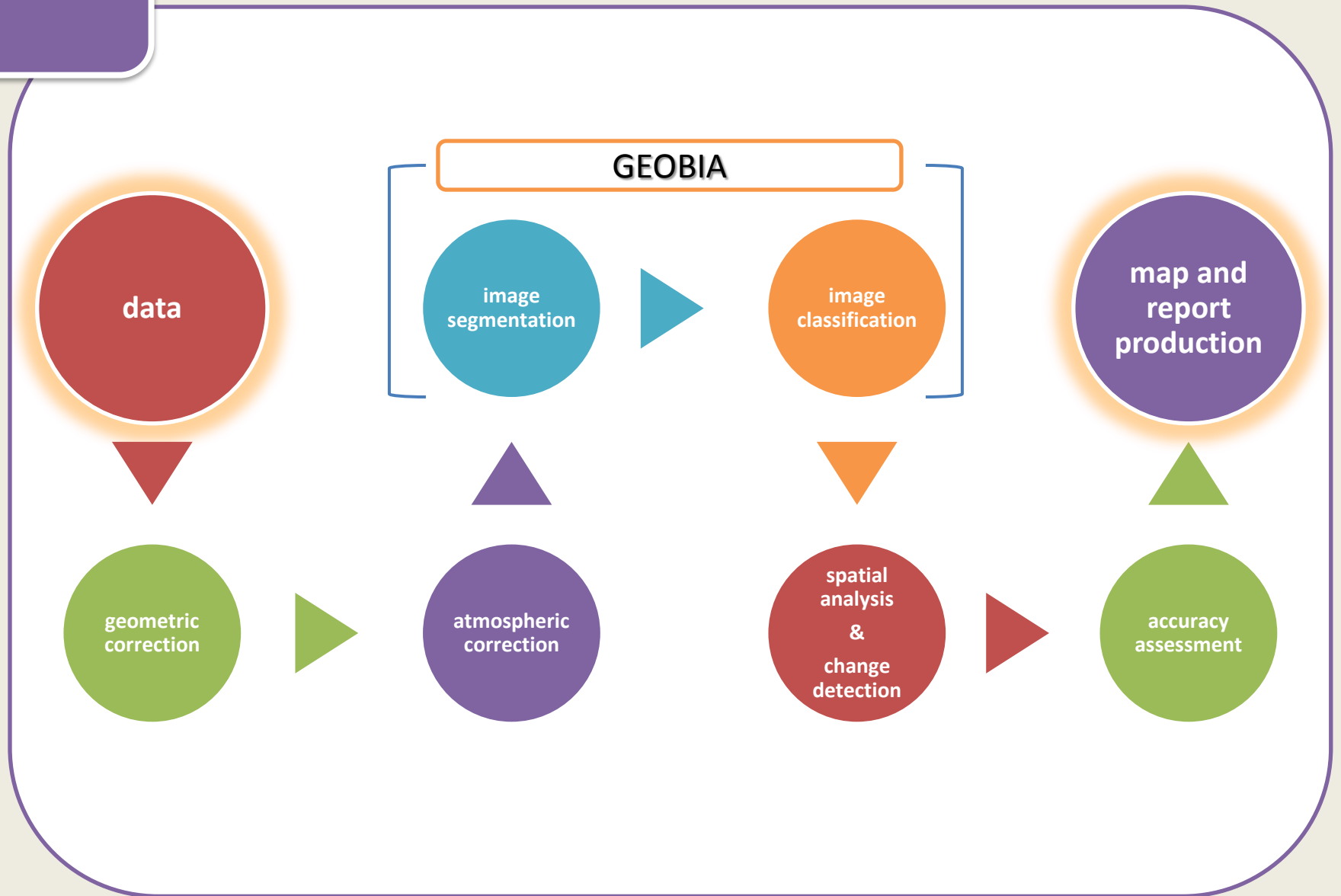
METHODOLOGY

PRODUCTS

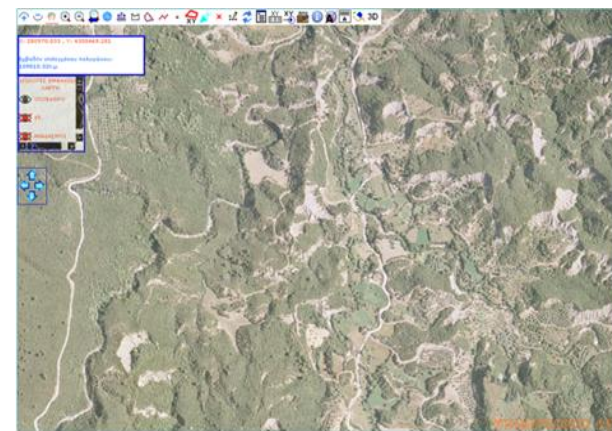
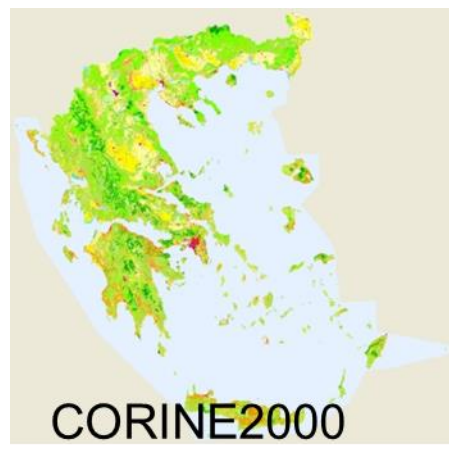
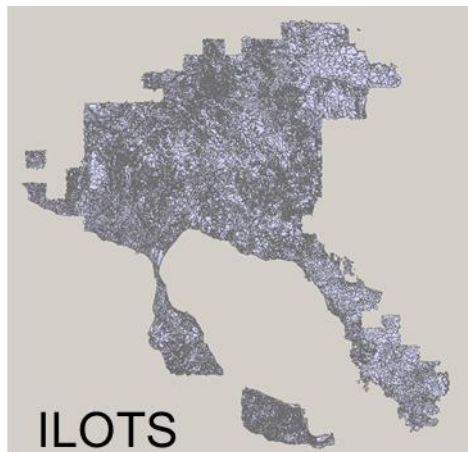
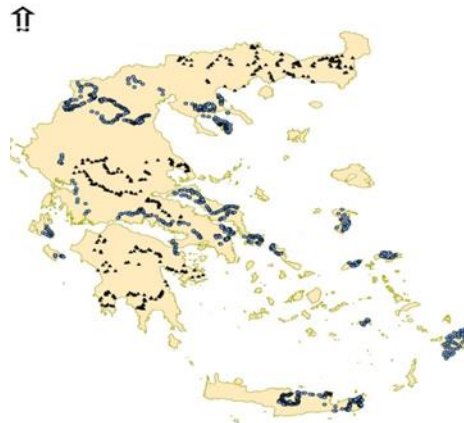
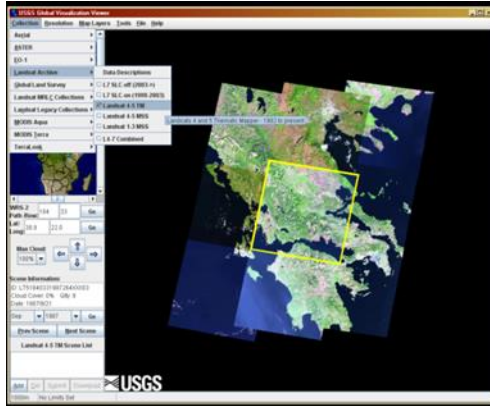
CONCLUSIONS

development

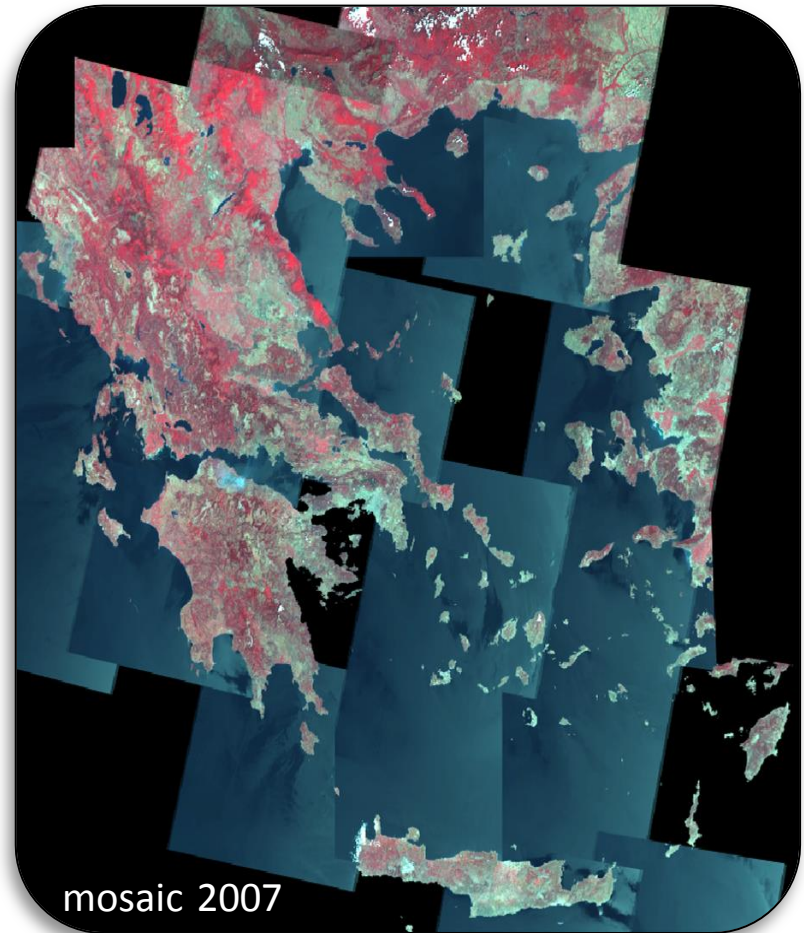
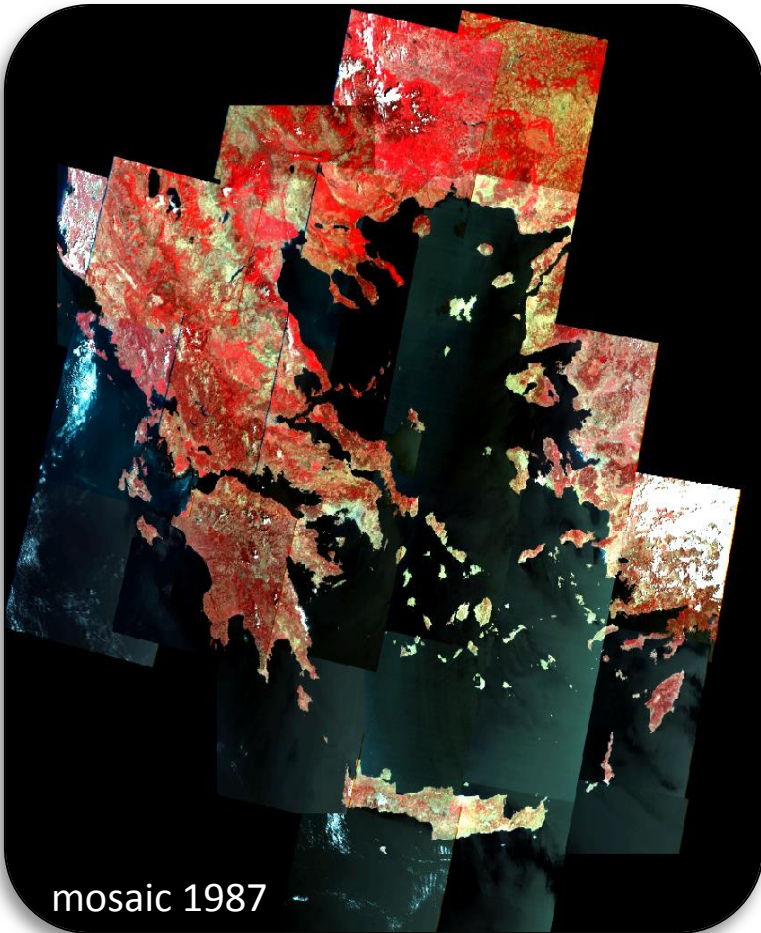




- LANDSAT TM satellite imagery & KTHMATOLOGIO aerial-photos
- A 28m Digital Elevation Model
- CORINE LAND COVER map (1990 & 2000) & LPIS (2007)
- administrative and environmental boundaries
- 1.376 reference data from field survey (WWF team & volunteers)
- LUCAS reference data



27 images for each reference year



1st level: agricultural / non agricultural

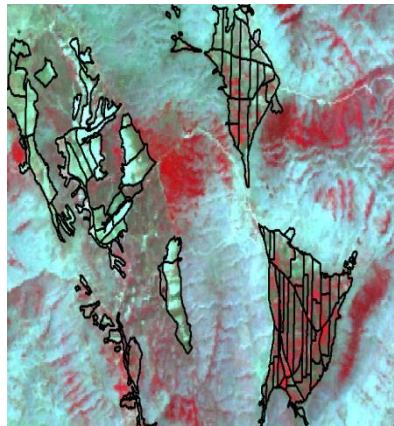
CLC for wetlands and agricultural - LPIS for agricultural

2nd level: remaining land cover classes

homogeneity criteria



CORINE 2000



LPIS - ILOTS 2007

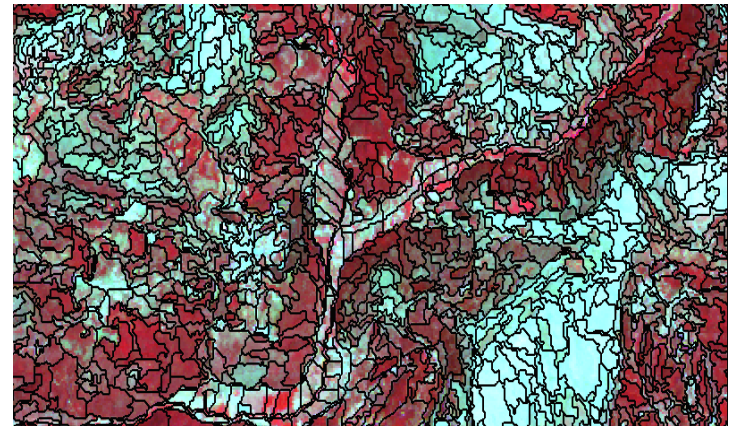


image objects

GEOBIA - Land Cover classification

methodology

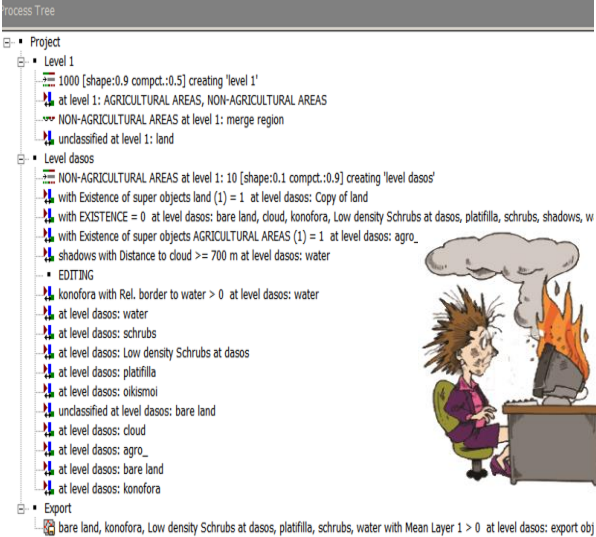
Land Cover classification scheme

- conifer forest
- broadleaved forest
- maquis
- shrubland
- low vegetation
- agricultural land
- bare land (exposed ground, settlements, snow)
- burned areas
- water bodies

GEOBIA – classification model

- **1** object based classification model

- tuned based on field data and applied **102** times

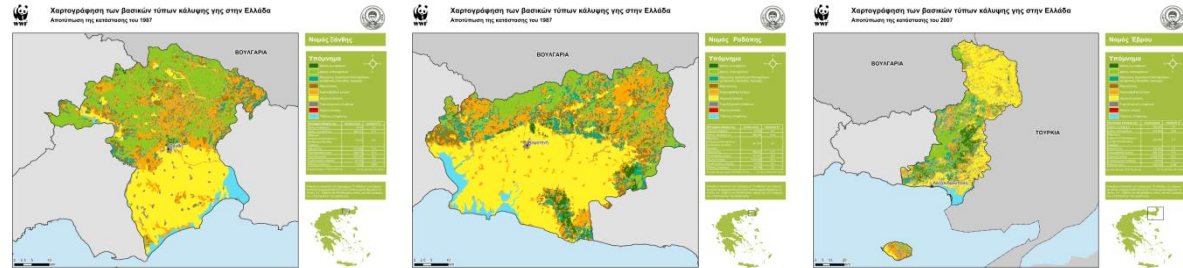


Process Tree

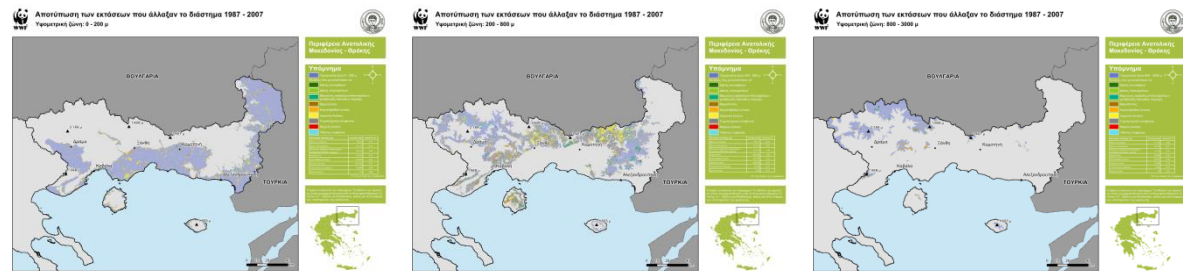
- Project
 - Level 1
 - 1000 [shape:0.9 compact:0.5] creating 'level 1'
 - at level 1: AGRICULTURAL AREAS, NON-AGRICULTURAL AREAS
 - NON-AGRICULTURAL AREAS at level 1: merge region
 - unclassified at level 1: land
 - Level dasos
 - NON-AGRICULTURAL AREAS at level 1: 10 [shape:0.1 compact:0.9] creating 'level dasos'
 - with Existence of super objects land (1) = 1 at level dasos: Copy of land
 - with EXISTENCE = 0 at level dasos: bare land, cloud, konofora, Low density Schrubs at dasos, platifilla, schrubs, shadows, w
 - with Existence of super objects AGRICULTURAL AREAS (1) = 1 at level dasos: agro_
 - shadows with Distance to cloud >= 700 m at level dasos: water
 - EDITING
 - konofora with Rel. border to water > 0 at level dasos: water
 - at level dasos: water
 - at level dasos: schrubs
 - at level dasos: Low density Schrubs at dasos
 - at level dasos: platifilla
 - at level dasos: olkismoj
 - unclassified at level dasos: bare land
 - at level dasos: cloud
 - at level dasos: agro_
 - at level dasos: bare land
 - at level dasos: konofora
 - Export
 - bare land, konofora, Low density Schrubs at dasos, platifilla, schrubs, water with Mean Layer 1 > 0 at level dasos: export obj



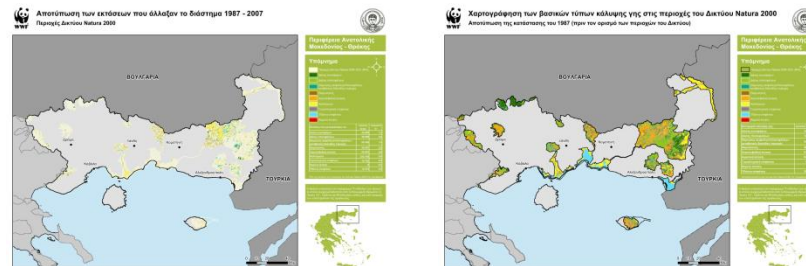
basic analysis:
county/prefecture
level



stratified by terrain
elevation zone (3 CLASSES
– 0-200m, 200-800m,
>800m):
region level

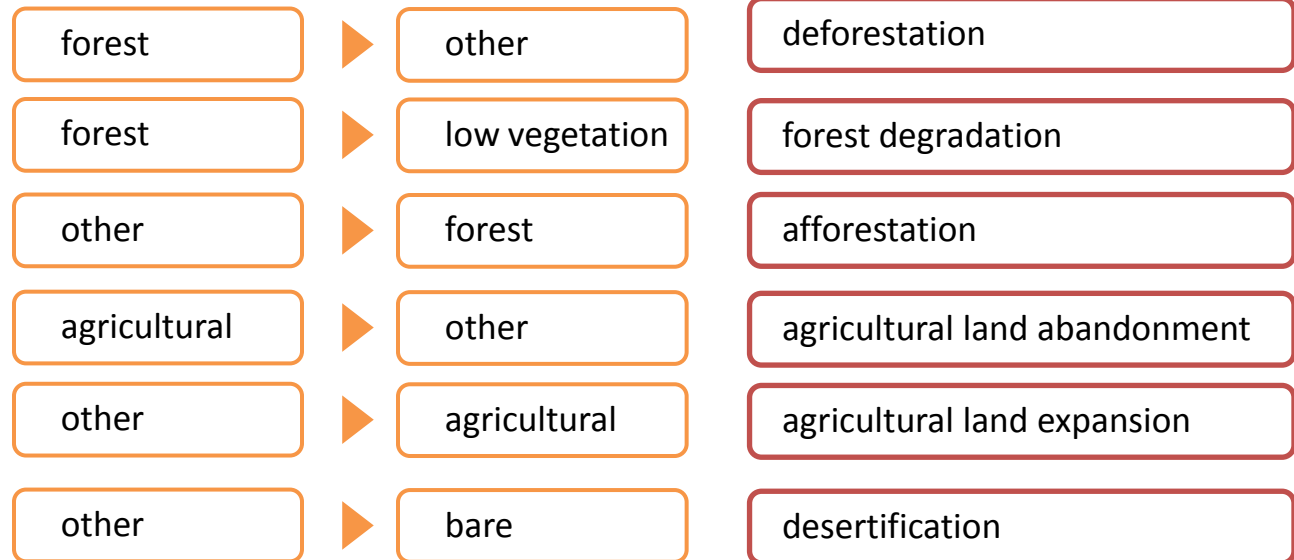


areas under national and
international
environmental protection
regimes:
protected area level

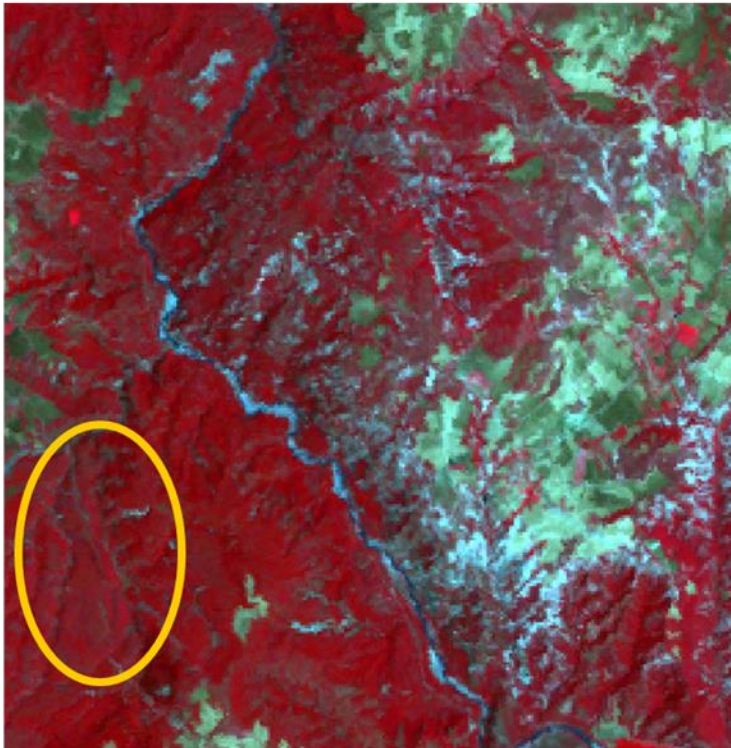


- map difference
- in all 3 levels
- investigation of specific trends

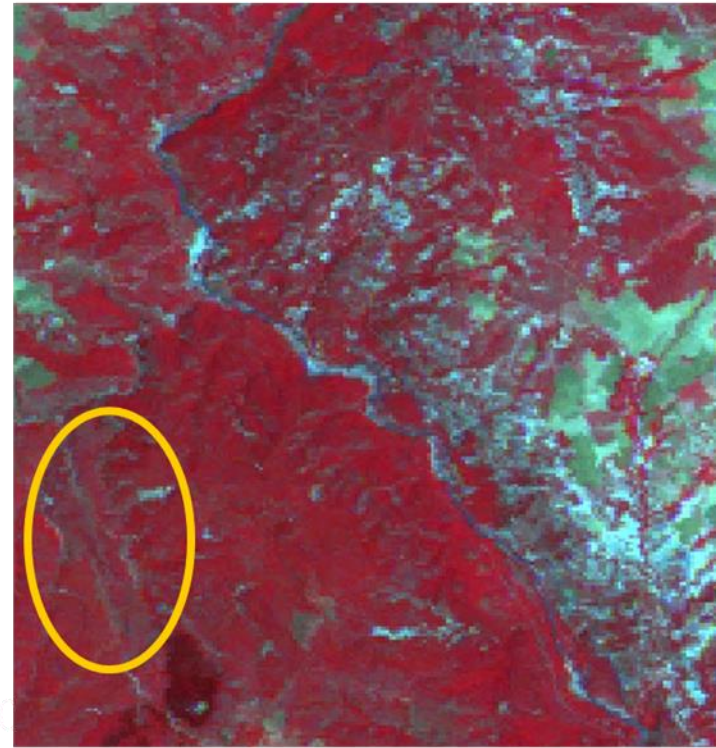
trend



Differences in image quality

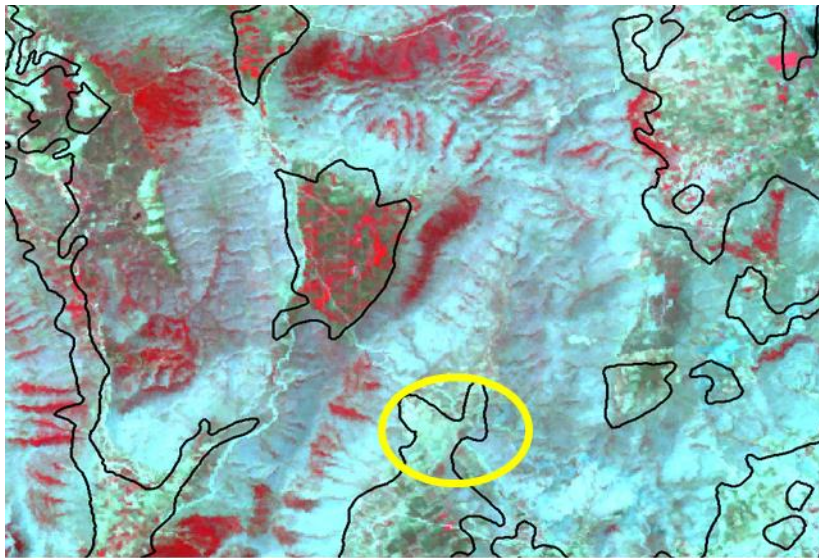


LANDSAT 1987

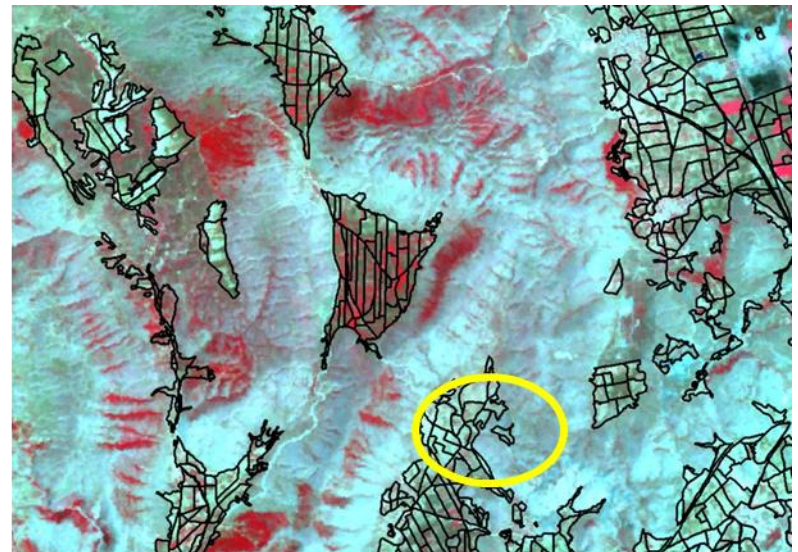


LANDSAT 2007

Differences in the Minimum Mapping Unit and the geometric accuracy of ancillary data



CORINE 1990



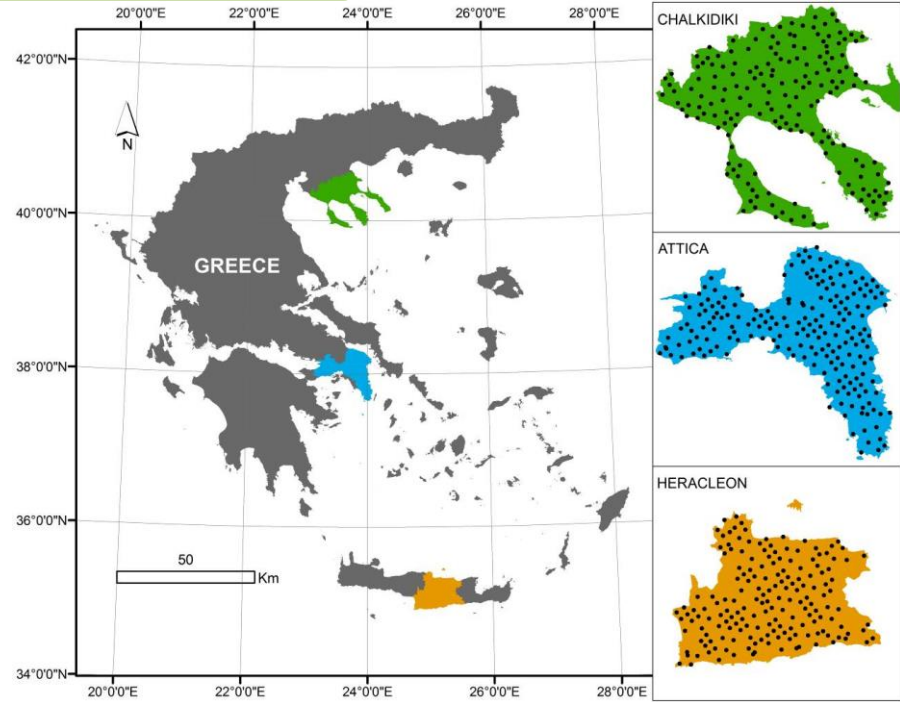
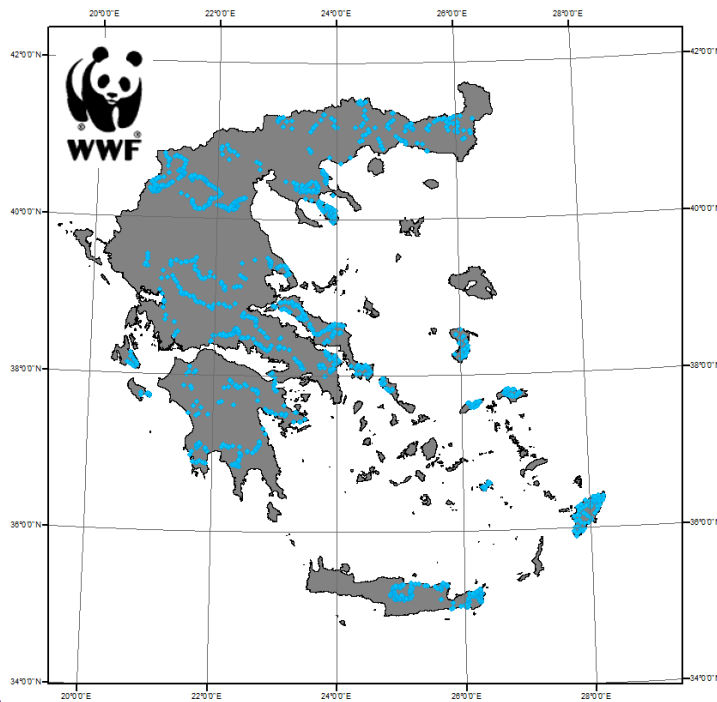
ILOTS (2007)

reference data

field survey

LUCAS
Land use/cover area
frame survey

Overall accuracy between **76%** and **91%**,
subject to area and assessment method



multi stage processing to accommodate....

error identification and correction

methodological adaptations based on continuously changing collaborator's preferences

and to put up with ...

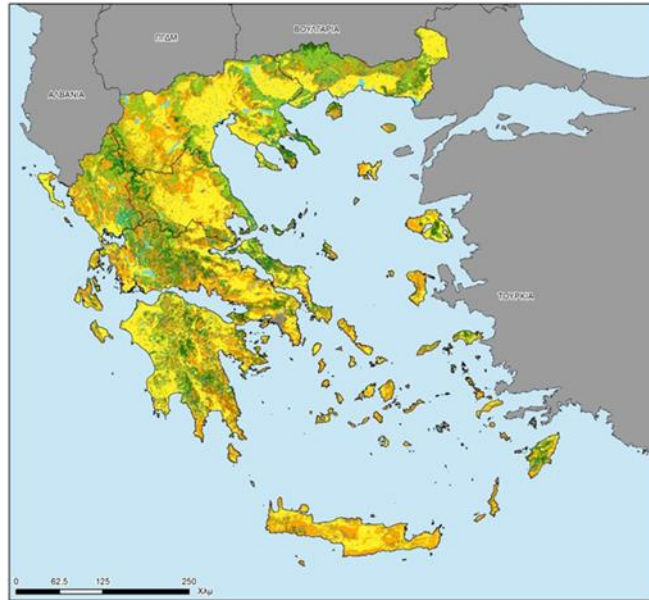
incompatibility of base maps

rapid changes during the course of study (Peloponnese fires)

conflicts due to interdisciplinary interest

symbolology, cartography, imagination!

National level land cover maps for 1987 & 2007



1987

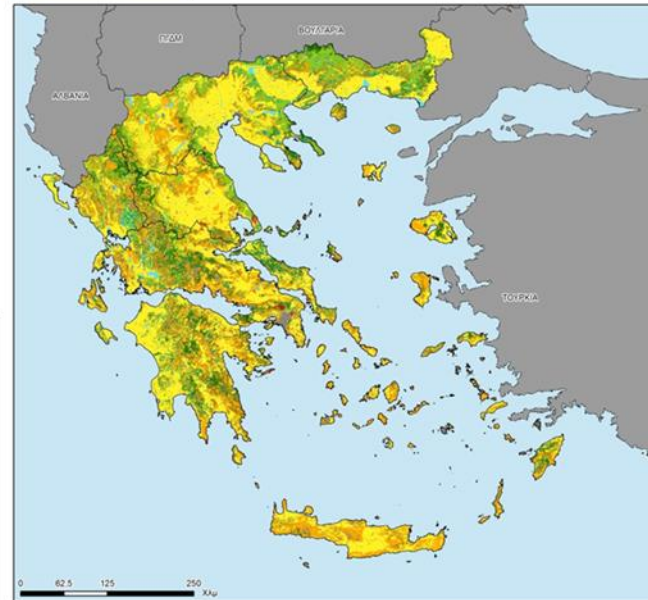
Αποτύπωση των βασικών τύπων κάλυψης γης στην Ελλάδα για το έτος 1987

Το Μέλλον των Δασών



Υπόμνημα

- Δάσος κωνοφόρων
- Δάσος πλατυφύλλων
- Θερμοκρακί, σποραιοειδή/κωνοφόρα/μεικτά/ελαία, δασοβιοσφαιρική περιοχή



2007

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- Θαλασσοτόπος
- Εκτός γεωργίας, βλάστησης
- Γεωργική έκταση
- Αστική κάλυψη
- Καμένη έκταση
- Υδάτινη επιφάνεια

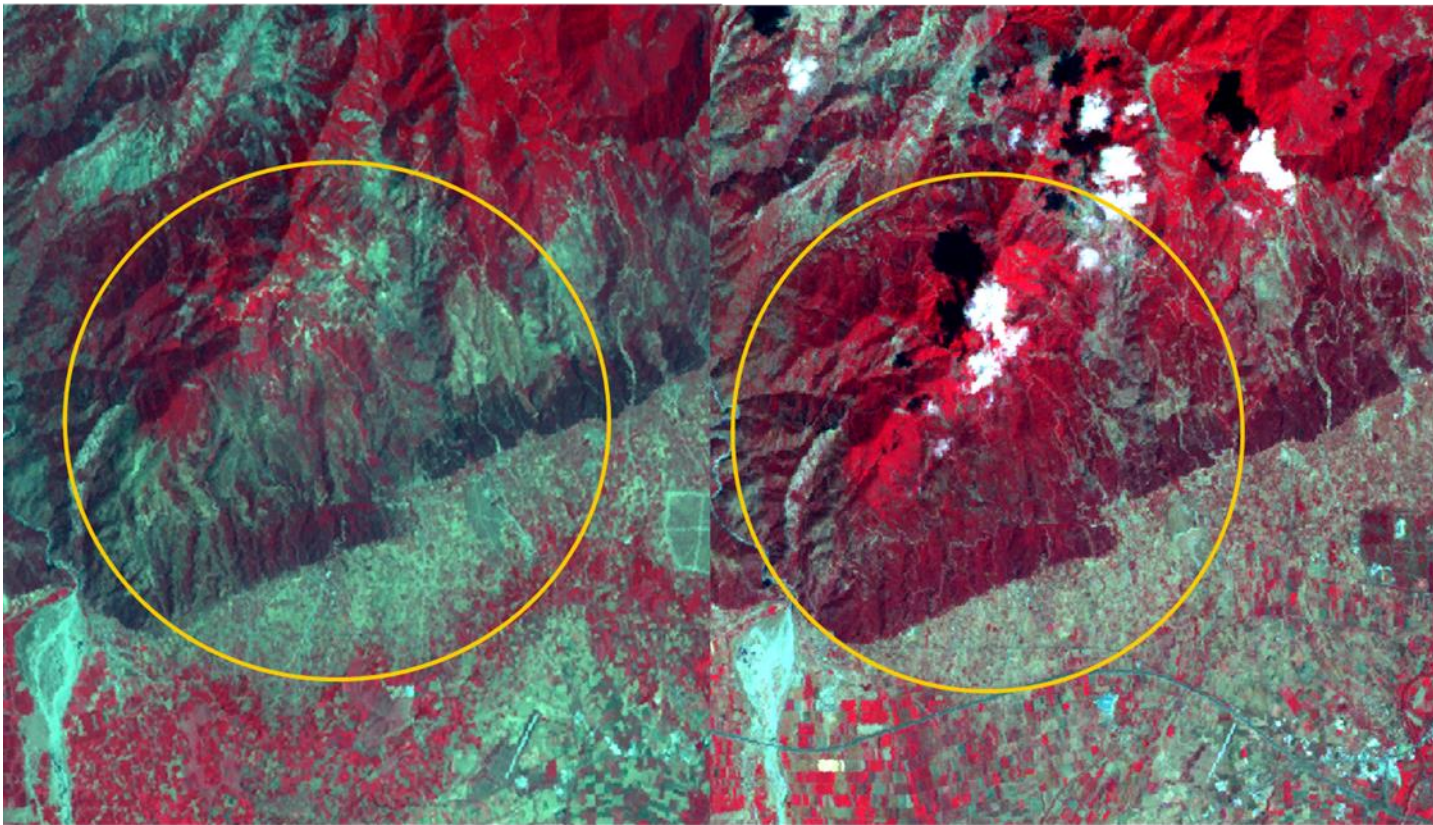
Πηγή: Εργαστήριο Δασικής Διαχειριστικής και Τηλεπισκόπησης, ΑΠΘ
Μάιος 14 2007

Σύνταξη χάρτη: Εργαστήριο Δασικής Διαχειριστικής και Τηλεπισκόπησης, ΑΠΘ



Ο παρών χάρτης αποτελεί προϊόν του προγράμματος "Το Μέλλον των Δασών" (The Future of Forests) που υλοποιείται στο πλαίσιο της Πράξης "ΕΠΙΧΕΙΡΙΣΙΑ ΔΑΣΩΝ ΚΑΙ ΤΗΛΕΠΙΣΚΟΠΗΣΗ" (Forest Management and Remote Sensing) του ΕΠΙΧΕΙΡΙΣΙΑΚΟΥ ΠΡΟΓΡΑΜΜΑΤΟΣ "ΑΝΑΠΤΥΞΗ ΚΑΙ ΑΝΤΑΓΩΝΙΣΤΙΚΟΤΗΤΑ ΤΗΣ ΚΑΤΑΣΤΡΟΦΗΣ" (Development and Competitiveness of the Disaster Management Programme) της Γενικής Γραμματείας Έρευνας και Τεχνολογίας.

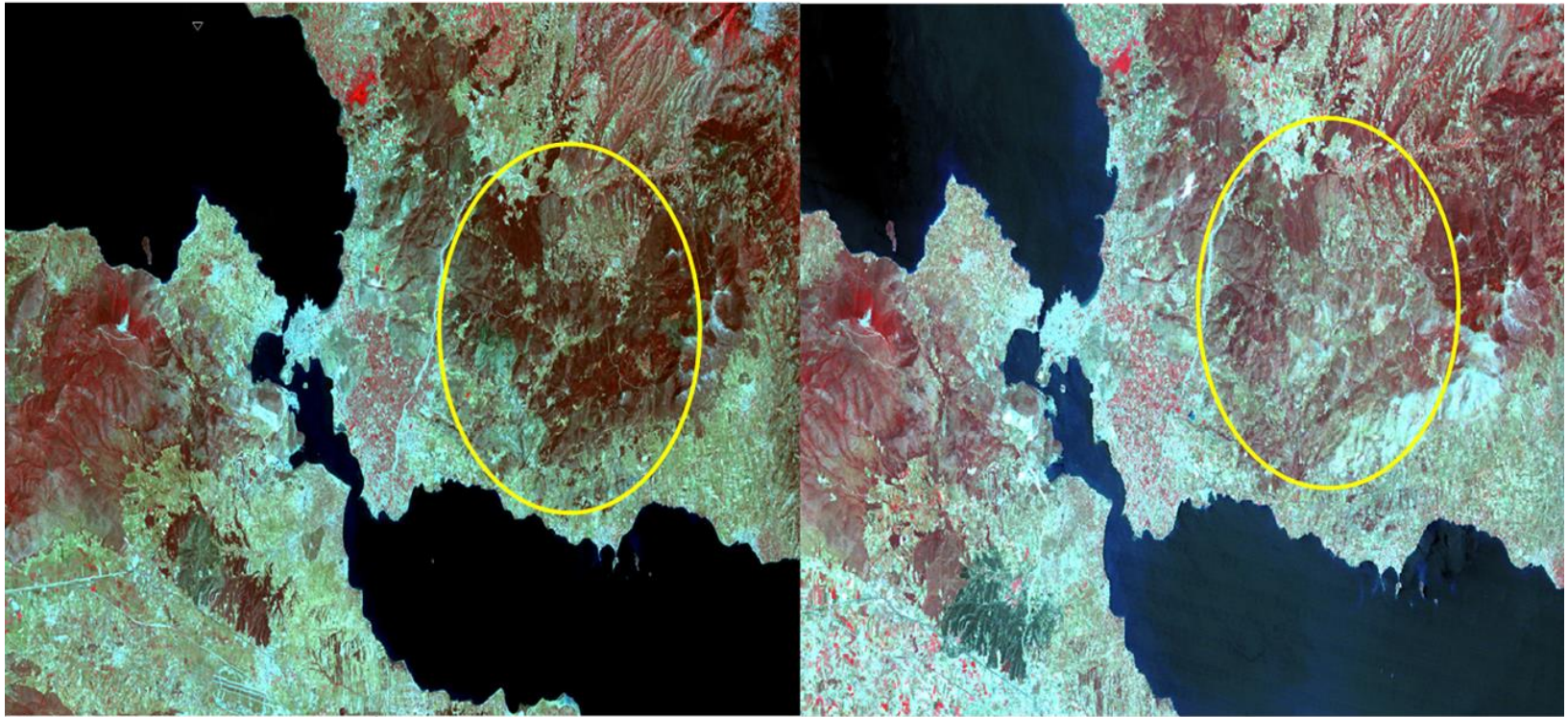
FOREST GROWTH (Rodopi)



1987

2007

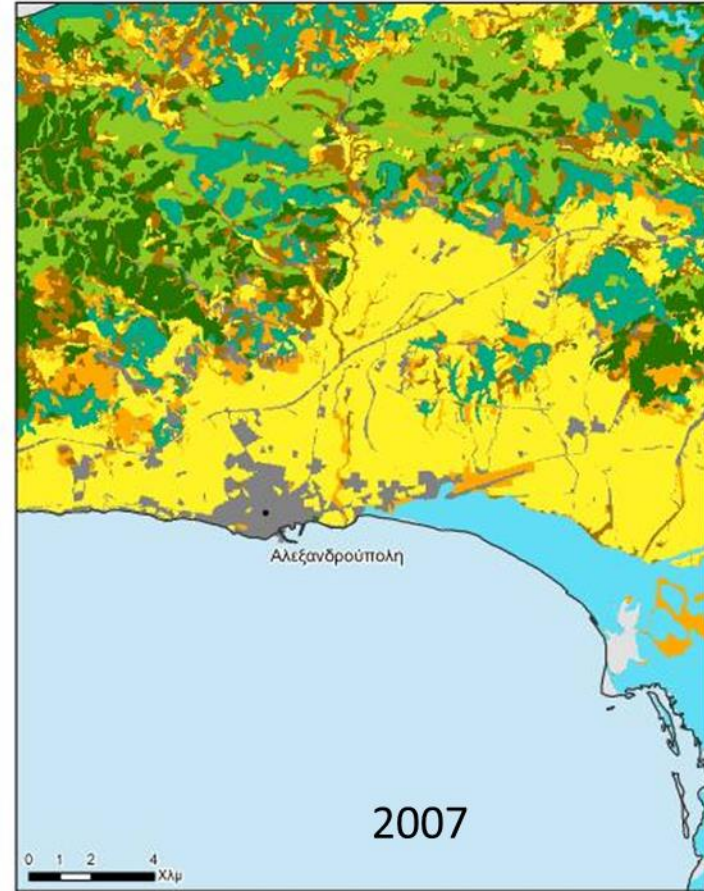
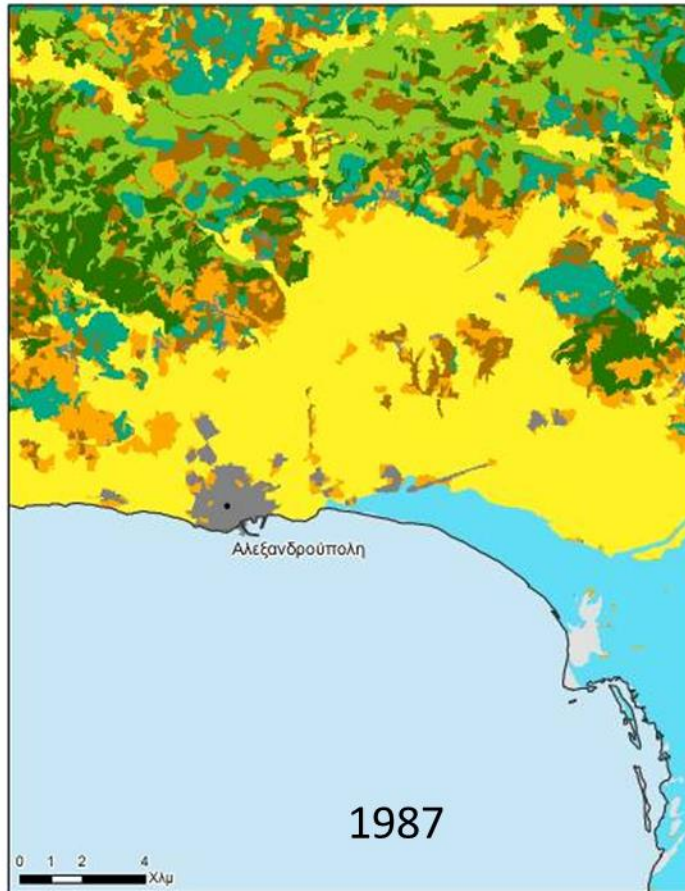
FOREST REDUCTION (Evia)



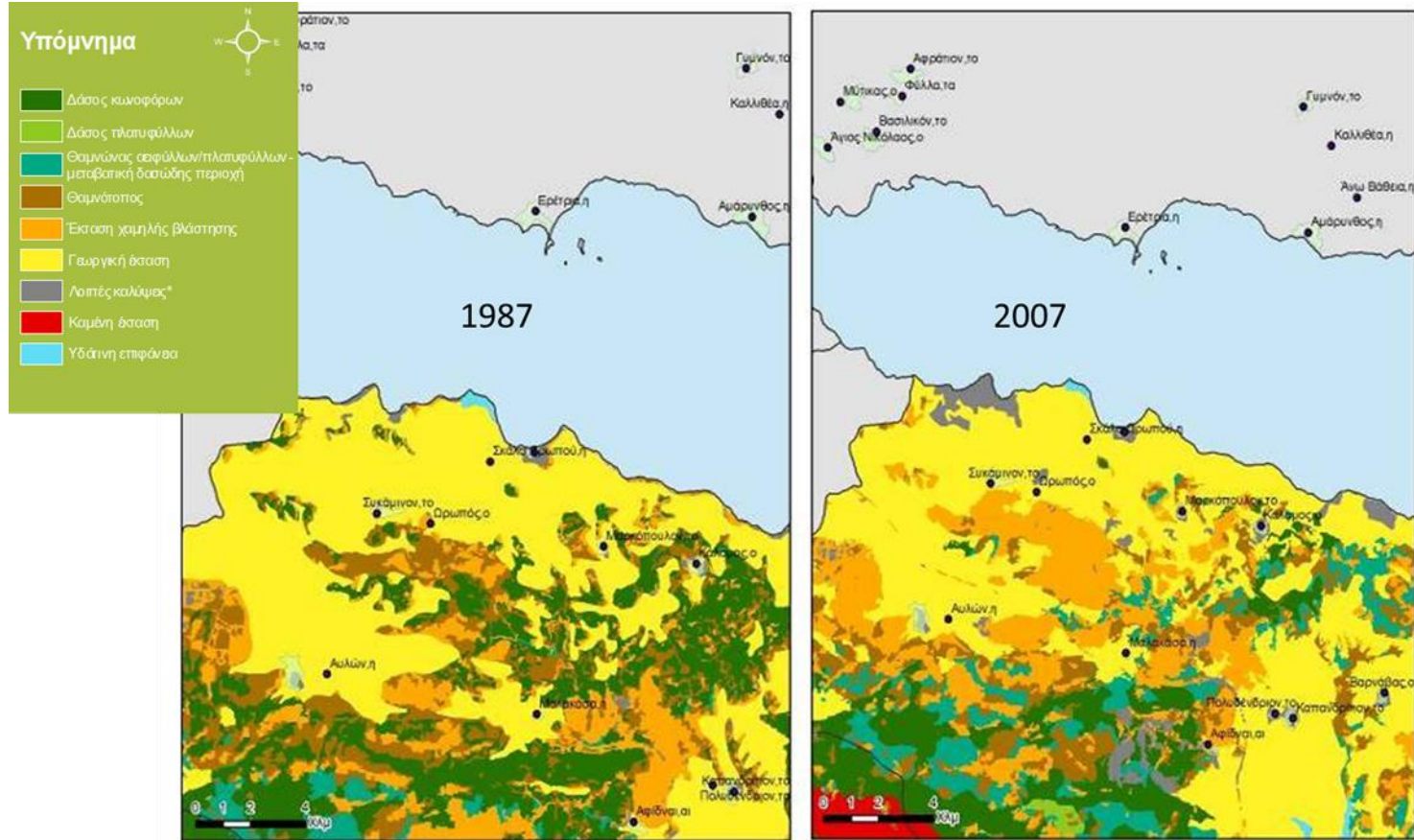
1987

2007

Locate areas of change (3)

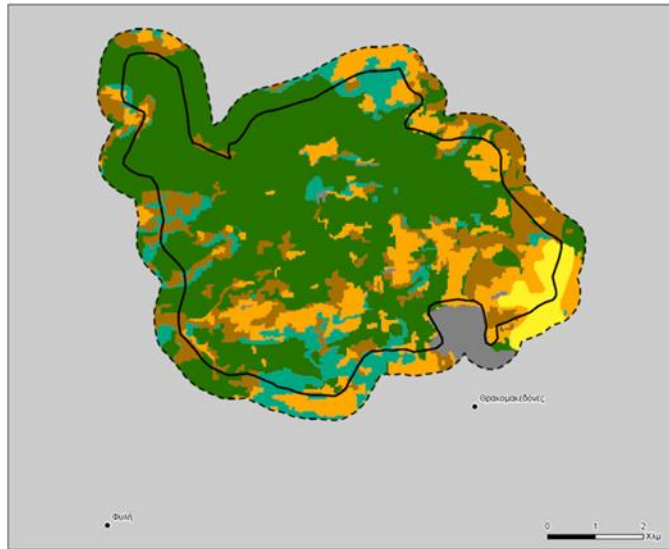


Locate areas of change (4)



Focus on protected areas

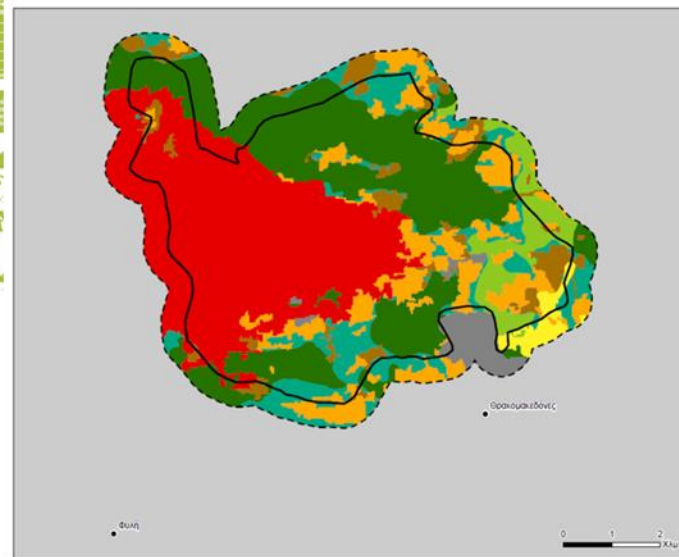
WWF Χαρτογράφηση των βασικών τύπων κάλυψης γης στους Εθνικούς Δρυμούς
Αποτύπωση της κατάστασης του 1987



Εθνικός Δρυμός Πάρνηθας



WWF Χαρτογράφηση των βασικών τύπων κάλυψης γης στους Εθνικούς Δρυμούς
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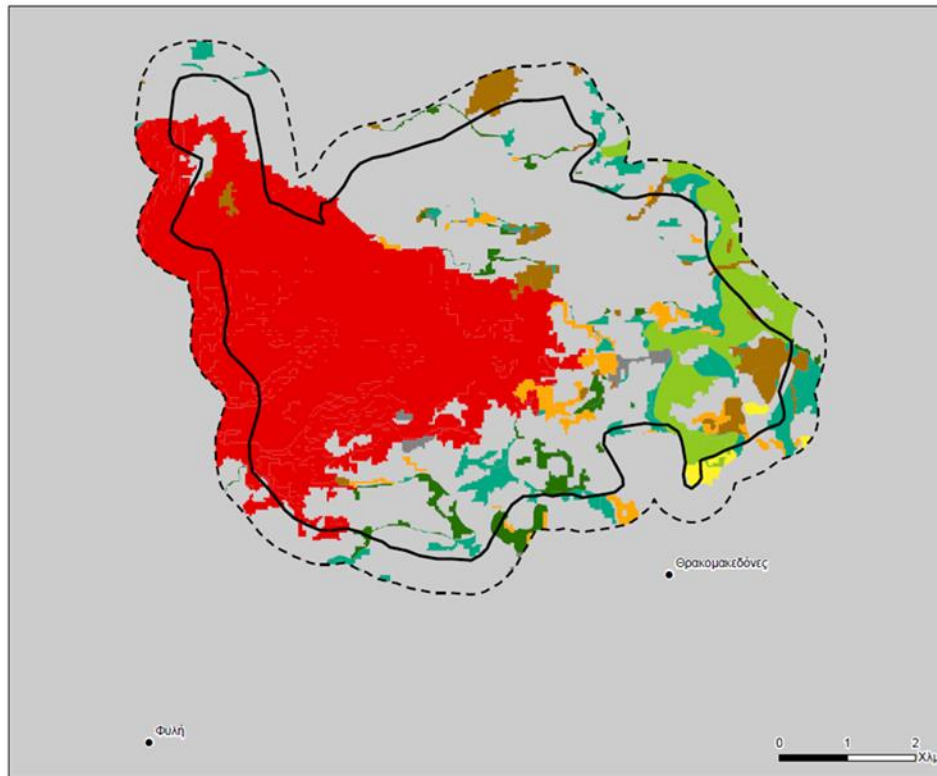


Εθνικός Δρυμός Πάρνηθας





Αποτύπωση των εκτάσεων που άλλαξαν το διάστημα 1987 - 2007 στους Εθνικούς Δρυμούς



Εθνικός Δρυμός Πάρνηθας

Υπόμνημα

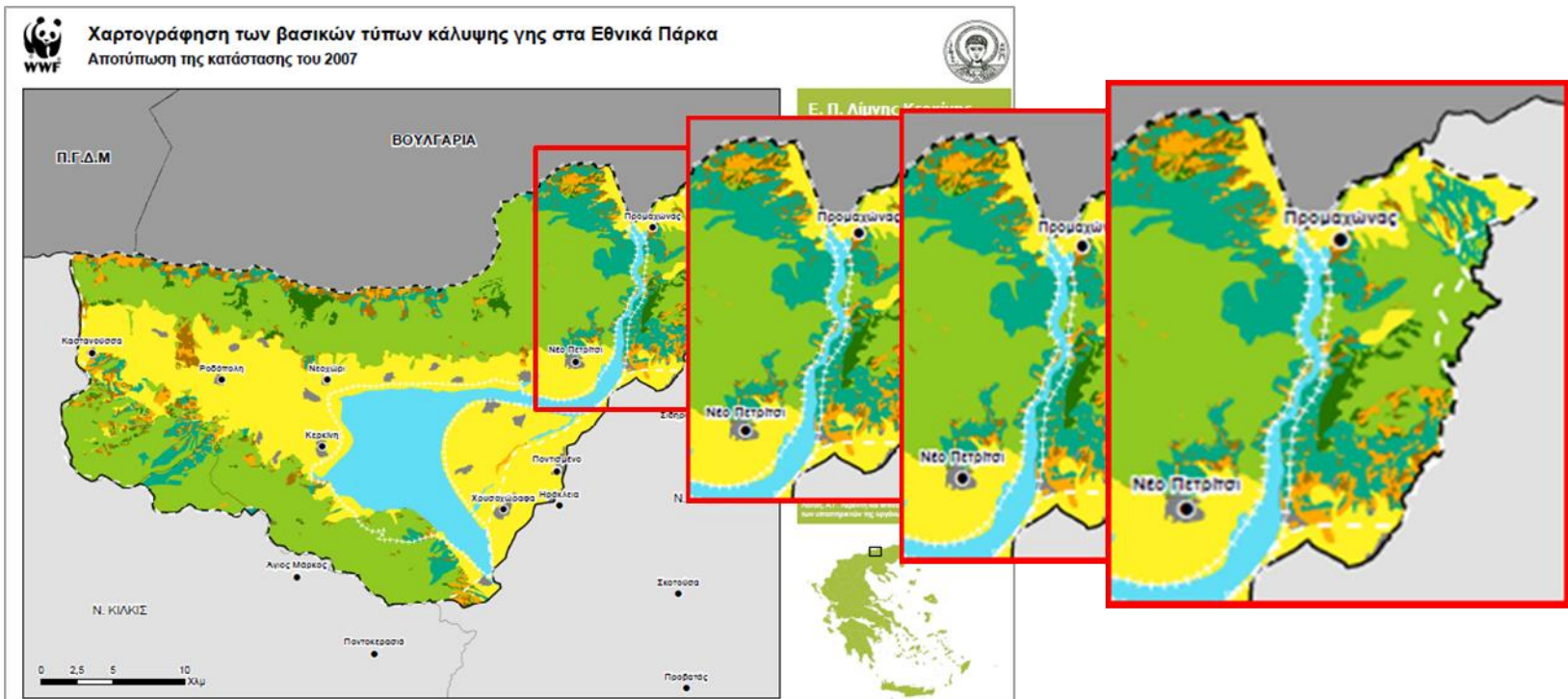
- Εθνικός Δρυμός
- Γεωμετρική ζώνη (500μ)
- Εκτάσεις που μεταλλάχσαν σε:
 - Δάσος κωνοφόρων
 - Δάσος πλατυφύλλων
 - Θαλασσίως αναβλύσει/καταρράκτη - μεθυστικές δασικές περιοχές
 - Θαλασσίως
 - Χερσοβελώνη έκταση
 - Καλλιέργεια
 - Γεωργική/αγροτική επιφάνεια
 - Καμένη έκταση
 - Υδάτινη επιφάνεια



Εκτάσεις που μεταλλάχσαν σε:	Ακέραια έκταση (2007)	Ποσοστό % από την έκταση του 1987
Δάσος κωνοφόρων	846	0,5
Δάσος πλατυφύλλων	1.466	0,9
Θαλασσίως αναβλύσει/καταρράκτη - μεθυστικές δασικές περιοχές	1.066	0,4
Θαλασσίως	1.166	0,8
Χερσοβελώνη έκταση	992	0,6
Καλλιέργεια	199	0,1
Γεωργική/αγροτική επιφάνεια	322	0,2
Καμένη έκταση	10.014	66,4
Υδάτινη επιφάνεια	8	0,0
Συνολική έκταση Εθνικού Δρυμού	39.100	100%

Η δράση εντάσσεται στο πρόγραμμα "Το Μύλλον των Δασών", το οποίο συγχρηματοδοτείται από το Κοινωνικό Ταμείο Ι.Σ. Αθήνα, Α.Υ. Γαλιψής και Μεσοδοκιμή, καθώς και από εισφορές των υποστηρικτών της αρχήλασης.





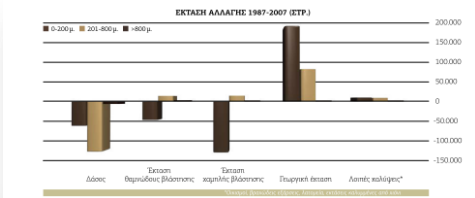
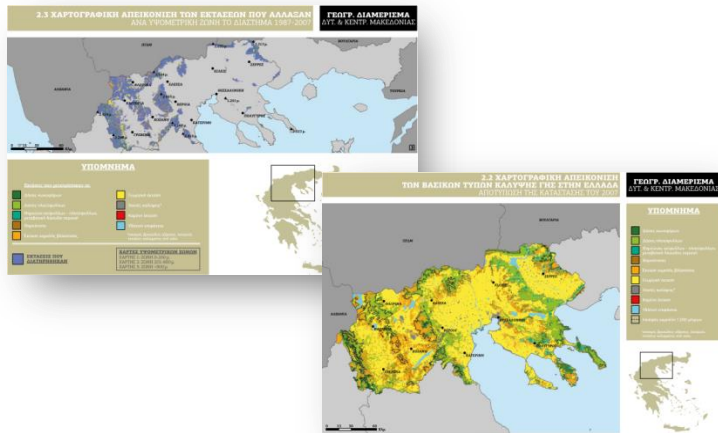
In total 956 maps and respective reports

products

ATLAS

maps

reports



ΣΧΗΜΑ 8.1 Κατηγορίες κάλυψης γης και έκταση αλλαγών (1987-2007) ανά υψομετρική ζώνη στο γεωγραφικό διαμέρισμα των Νήσων Αιγαίου.

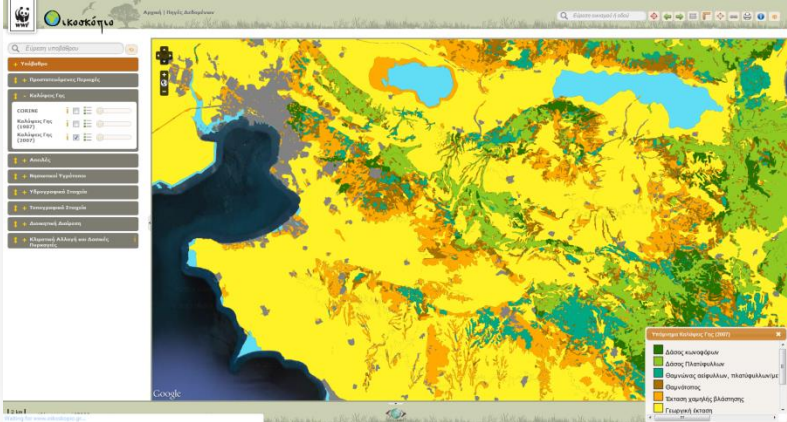
ΠΙΝΑΚΑΣ 2
Βασικές τάσεις αλλαγών μεταξύ 1987 και 2007

ΕΥΝΟΛΟ ΚΟΡΑΕ		2007				
	Δάση	Θερμάδας βλάστηση	Ψυχράδας βλάστηση	Κρύα βλάστηση	Έπιφ. / Τροπικές	
1987	Δάση	1.265.600	1.029.310	656.666	40.625	
	Θερμάδας βλάστηση	826.781	-	2.367.007	N/A	
	Ψυχράδας βλάστηση	445.635	1.268.085	-	2.061.154	
	Κρύα βλάστηση	480.629	N/A	5.895.621	-	
	Έπιφ. / Τροπικές	N/A	N/A	540.293	N/A	

*Τύπος κάλυψης που δεν ερωτεύθηκε

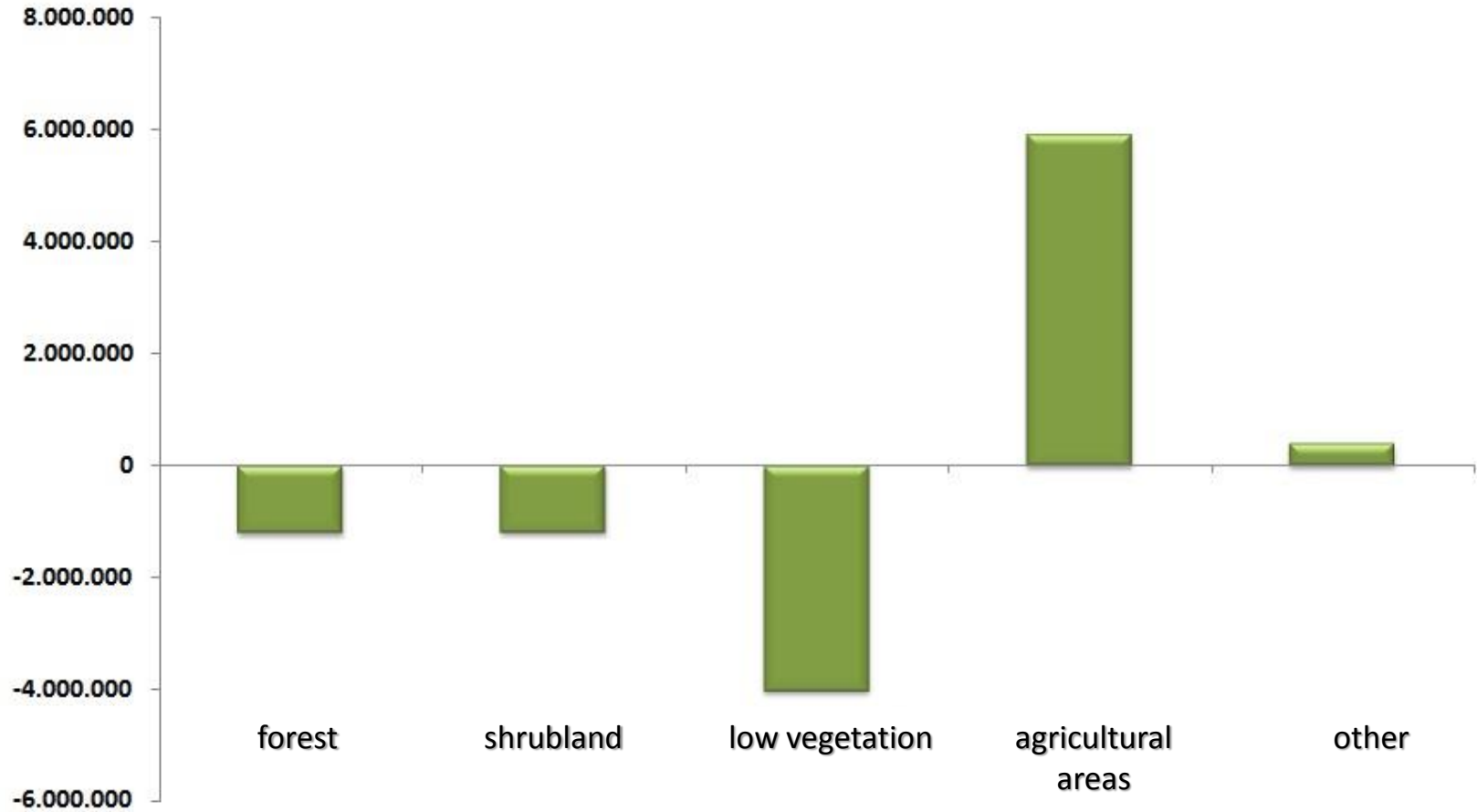
OIKOSKOPIO

www.oikoskopio.gr



products

general trends revealed



(str)

(1str = 0.1ha)

challenges in ...

DEVELOPMENT



IMPLEMENTATION



VALUE

... in products

conclusions

development

*The appropriate **combination** of objectives, data and methodology...*

Implementation

*...the **standardized** methodological approach and the systematic way of analysis within a GIS environment...*

products

...contributed in the production of integrated 3 year-turnover maps:

- ✓ *National Land Cover map of 2007*
- ✓ *National Land Cover map of 1987*
- ✓ *National Land Cover Change map between 1987 and 2007*

value

...which:

- *cover the gap in national land cover data,*
- *enable multitemporal monitoring of the Greek forests as well as trends they exhibit, and*
- *provide valuable experience for future studies (**capacity building**)*

value because of...

INNOVATION

CONTRIBUTION

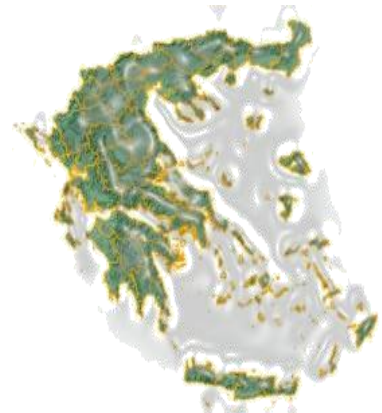
EXPERTISE

- ✓ *Production of two products at National level that are comparable between them*
- ✓ *Production using advanced automated classification methodology based on GEOBIA*
- ✓ *Accuracy assessment of the products using data collected by extensive field surveys*
- ✓ *Focus on protected areas using multi-temporal data of the same origin and scale*

contribution

VALUE

- ✓ *cover gap in accessible national Land Cover spatial data*
- ✓ *make possible multi-temporal study of the Greek forests and the trends they exhibit*
- ✓ *contribute to the sound management for the protection and conservation of protected areas, forests and the natural environment in general*
- ✓ *can be used as an end product as well as base map for a variety of studies. For example make possible the generation of useful conclusions when combined with other other data such as ecological, statistical, etc.*



VALUE

expertise

- ✓ *gain and 'loss' of expertise*
- ✓ *transferable methodology to allow mapping in future date(s)*
- ✓ *option to update maps, based on new available auxiliary data (updated LPIS, new protected areas)*
- ✓ *option for further spatial analysis and information generation based on demand*

- ✓ **Latsis, Leventis and Bodosakis foundations:** *funding*
- ✓ **Lab of Forest Management and Remote Sensing, School of Forestry and Natural Environment:** *Methodology development and mapping implementation*
- ✓ **WWF Greece:** *Methodology development, fieldwork interpretation of the results*
- ✓ **WWF US – Conservation Science Unit:** *Contribution in establishing the project implementation framework*
- ✓ **Local authorities and national experts:** *data contribution and interpretation of the results*
- ✓ **Scientific :** *Expert interpretation of results, analysis of trends, policy proposals*
- ✓ **LEICA, USGS, EU-CORINE:** *data providers*
- ✓ **QUERCUS:** *data uploading in www.oikoskopio.gr*

- ✓ **9th EARSeL Forest Fire Special Interest Group workshop**, 15-17 October 2013, Coombe Abbey, Warwickshire, UK <http://www.earsel.org/SIG/FF/9th-workshop/>
- ✓ **GEOBIA 2014**, 21-23 May 2014, Thessaloniki, Greece <http://geobia2014.web.auth.gr/>

***Thank you
For
Your attention***

