Monitoring of natural and agricultural resources

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Main activities of the team

- Research & application
- Education & training
- Networking & communication

Capacity

- Staff
  - 11 permanent
  - 22 on contract
  - external collaborators
  - postgraduate students
- Analytical chemistry laboratory
- Mobile field survey unit
- Geographic Information laboratory

Thematic areas

- Inventory and monitoring of agricultural pressures
  - crops identification, water consumption, aquacultures
- Inventory and monitoring of resources
  - water, soil, vegetation
- Environmental impacts
  - basin level, transboundary
  - SEIA, valuation of agricultural water, state of wetland ecosystem
- Responses to reverse impact
  - measures, actions, awareness
  - seaweed to improve soil quality, wetland restoration

Education & Training

- Undergraduate courses and dissertations
- Postgraduate courses and theses
  - Collaboration in inter-disciplinary courses
- Awareness & communication
  - Training workshops and seminars in the framework of various scientific projects
  - e-Learning
  - Scientific support and interaction with related bodies & institutions
  - Communication with media
  - Publications

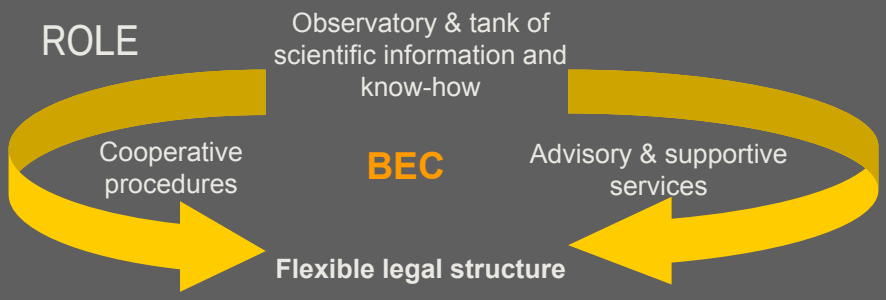
Networking

- International collaboration with:
  - Joint Research Center of the EU
  - European Space Agency
  - University of Florida
  - University of Sofia, Space Institute of Sofia
  - University of Tirana
  - School of Agriculture of Skopje
- Balkan Environment Center
  - Advisory and supportive services in the framework of the transboundary cooperation related to natural environment's issues

Balkan Environment Center

Identity: Non Profit Organisation founded in 2007

ROLE



Balkan Environment Center

SERVICES

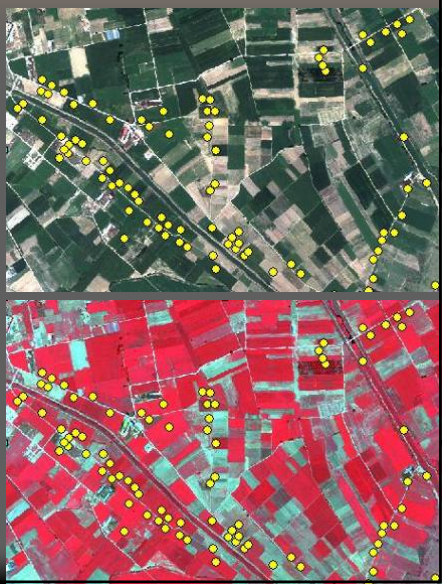
- Collection and assessment of quantitative & qualitative data, through innovative monitoring tools (telemetry, remote sensing, satellite etc.)
- Help-desk for transfer and exchange of data & know how for the support of the regional structures as well as related bodies from Greece and other Balkan countries
- e-Learning and training
- Support of a transboundary scientific network through Memorandum of cooperation

Recent projects

Agricultural resources
(water, soil, vegetation)

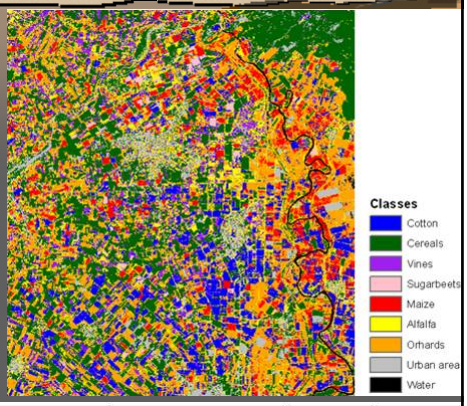
Mapping crops...

- Aim:
  - Identify crop type -> map
  - Estimate area -> table
- Data:
  - Satellite images in visible and infrared
  - Sample sites in the field (GPS)



...Results

- Crops map



- Table with total results and statistics

Καλλιέργεια	ΤΟΕΒ Αμπελώνα Ανοικτό	ΤΟΕΒ Αμπελώνα Κλειστό	ΤΟΕΒ Τυρνάβου	ΤΟΕΒ Αγ. Σοφίας
Έτος 1996				
Βαμβάκι	4500	4900	657,5	3859
Μηδική	800	1500	607,5	251
Καπνός	50	200		
Τεύτλα	350	500	101	700
Καλαμπόκι	200	1000	739	924,5
Ελιές				
Αμυγδαλιές	30	700		1257
Λοιπές δενδρώδεις καλλιέρ.	440	2120	2857,5	2935
Αμπέλια	150	1600	2763,5	638
Κηπευτικά - μποστανικά	510	1330	384,5	2498,5
Λοιπές καλλιέργειες	820	150	54,5	3859
Σύνολο Αρδευόμενων	**7850**	**14000**	**8165**	**13063**

Evaluation of crop damages

- Natural disasters (frost, hail, flood, drought)
- Vegetation indices
- Field surveyed samples

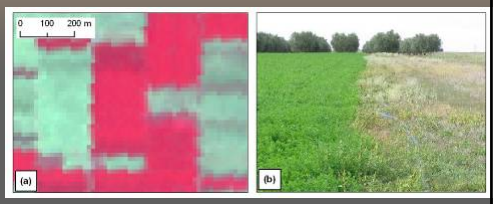
NDVI

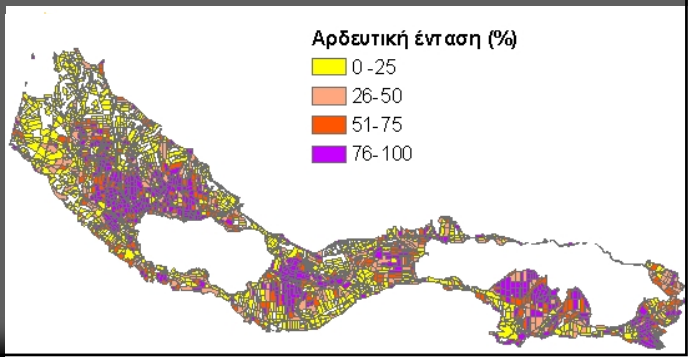
Frost effected wheat in N. Greece

Damage categories

Mapping irrigated land

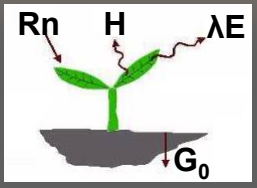
- Middle infrared -> wetness index NDWI
- Map of irrigated areas ->
- Map of irrigation intensity (% of area)

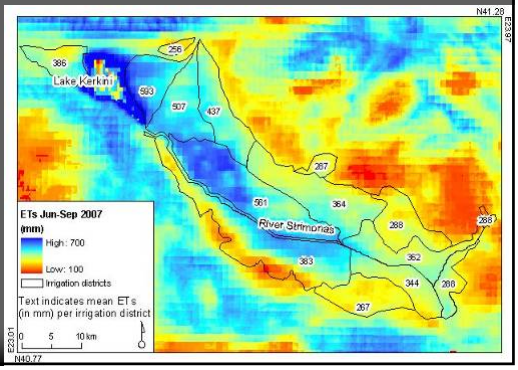




Agricultural water use…

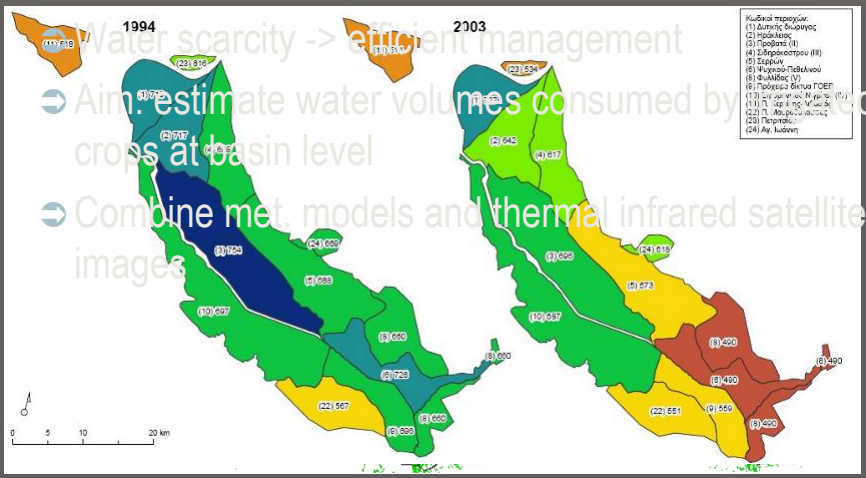
- SEBAL: surface energy balance equation
- Input: satellite images (visible, near-middle-thermal infrared) and meteorological data
- Output: map of actual evapotranspiration (ETa)





…Agricultural water use

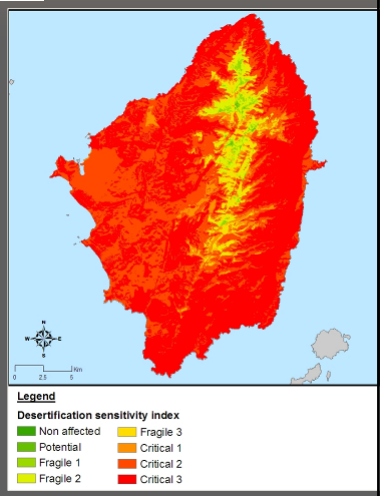
- Water scarcity -> efficient management
- Aim: estimate water volumes consumed by irrigated crops at basin level
- Combine met. models and thermal infrared satellite images



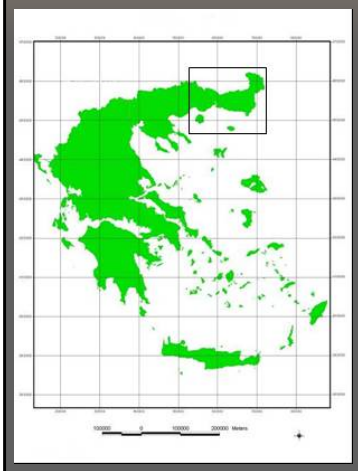
Programme INTERREG IIIB
ARCHIMED
ARCHIPELAGO MEDITERRANEO
Sharing a common sea, Sharing a common future

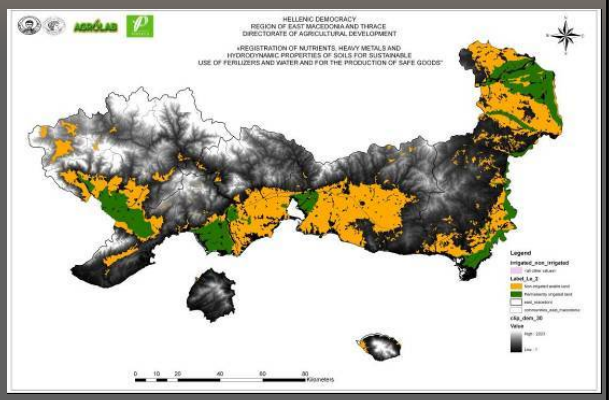
MOONRISES
INTEGRATED MONITORING SYSTEM
FOR DESERTIFICATION RISK ASSESSMENT

- Integrated System for Monitoring and Assessment of Desertification Risks
- Objective: Recording, monitoring and prediction of desertification risks in Greek and Italian Regions
- Tools: fieldwork, models, sensitivity indicators, GIS, Satellite Remote Sensing, GPS



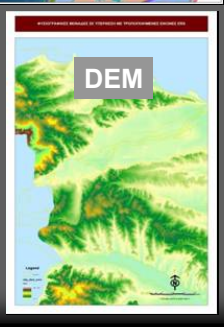
Soil mapping

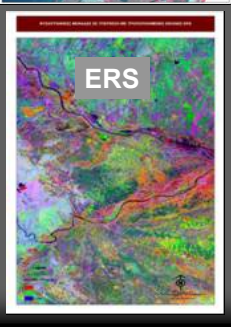


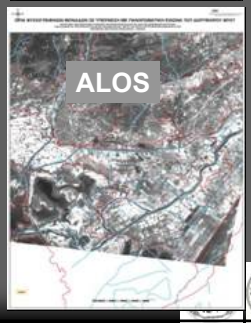


300.000 ha – 30 months

Physiographic analysis







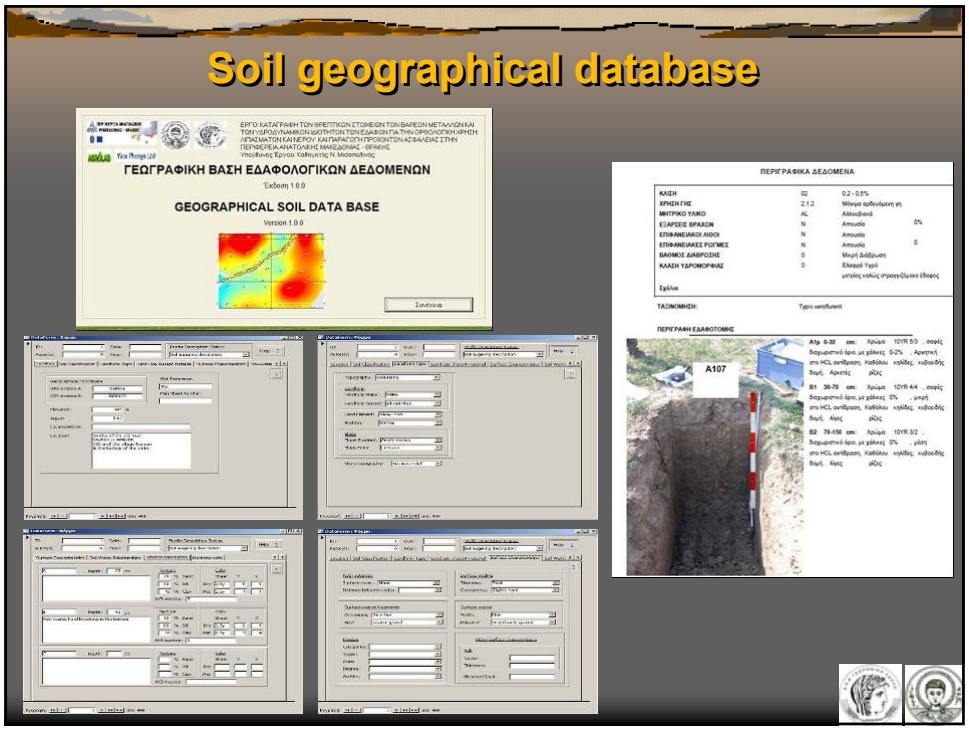
Soil sampling

- 900 soil profiles
- 3.000 soil samples
- Analyzed for 20 properties

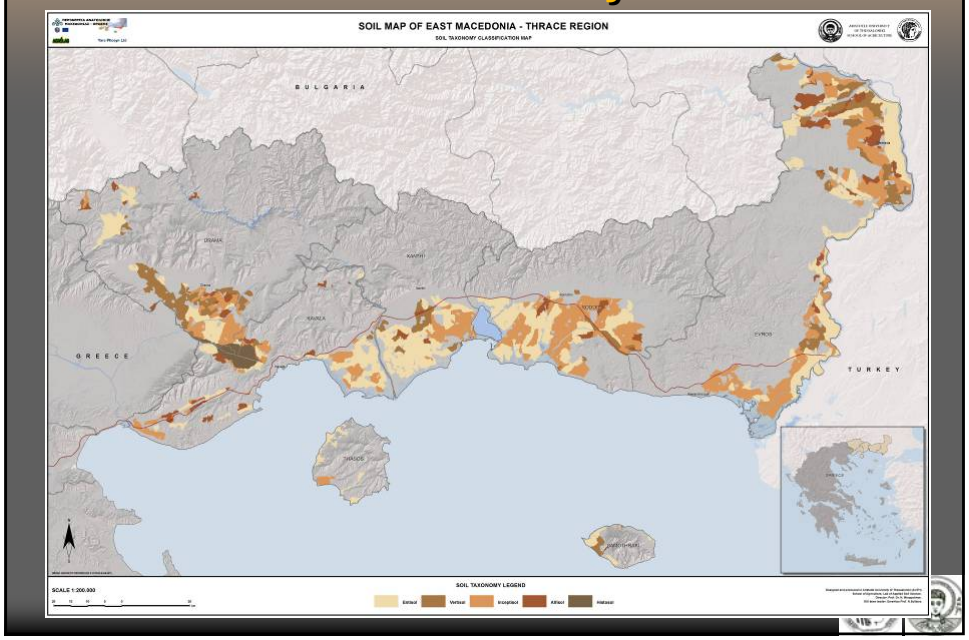
Soil sampling

- 5.000 bore holes
- 15.000 soil samples
- Analyzed for 22 properties

Soil geographical database

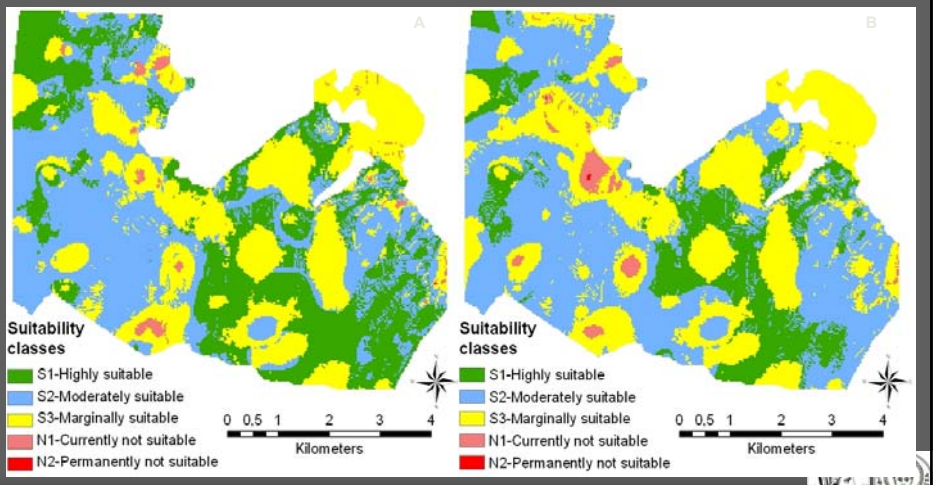


Soil taxonomy

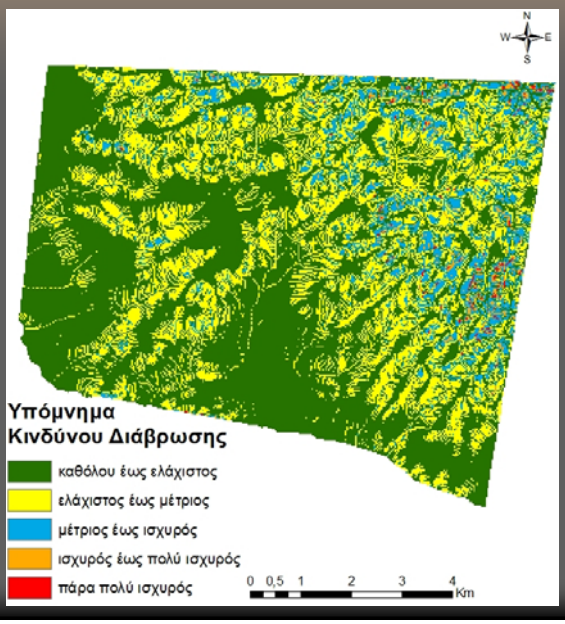


Qualitative land suitability evaluation for crops using GIS

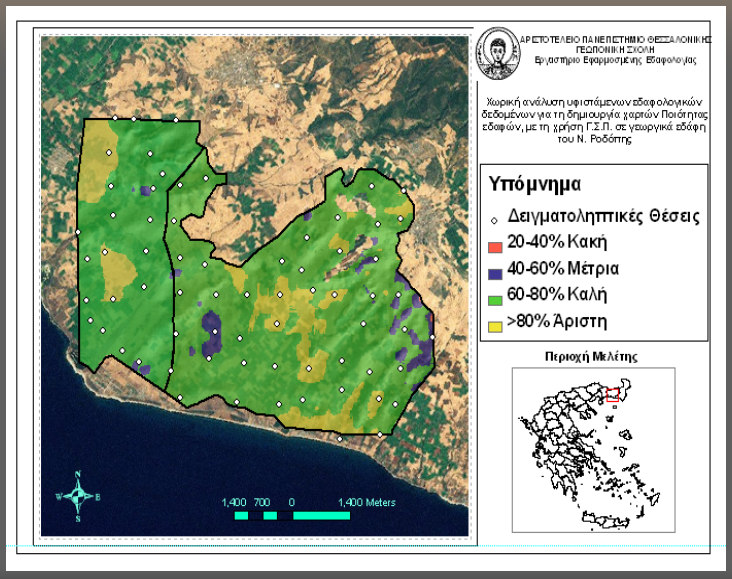
maize (*Zea mays* L.) and wheat (*Triticum* spp. L.)



Soil erosion risk assessment

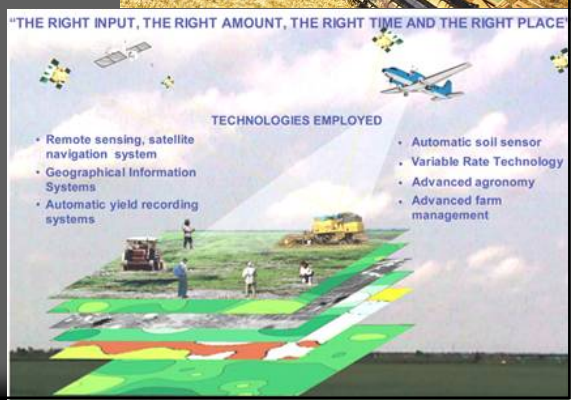


Soil quality maps



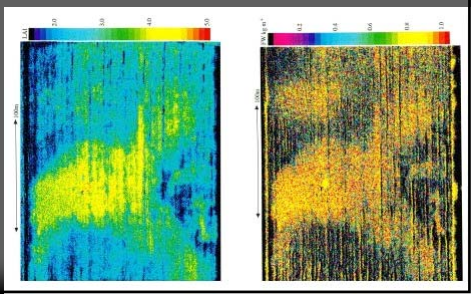
Precision farming

- Within field variability -> specific management
- Technologies used:
  - Remote sensing
  - GIS
  - GPS

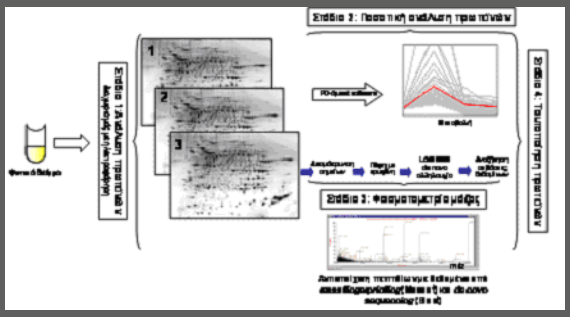


…Precision farming

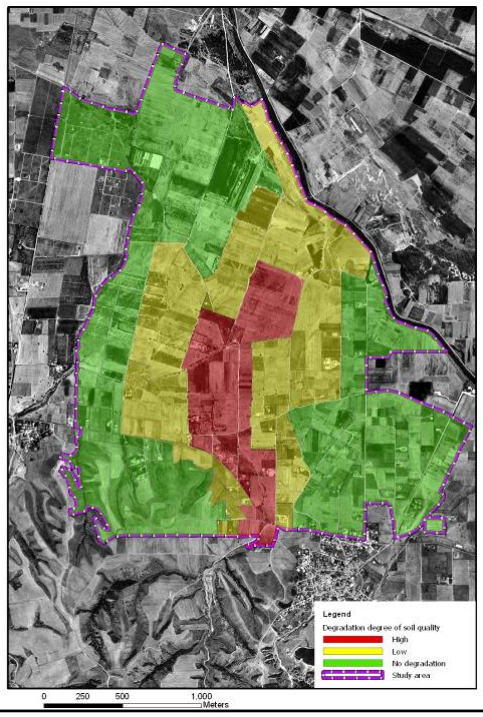
- Satellite and terrestrial remote sensing
- Wavelengths: red, near infrared, red edge
- Vegetation indices



Designation and Standardization of peaches origin using Molecular Analysis, Soil Quality and GIS



- Impact of soil quality and climate on quality characteristics of peaches
- Construction of a geodatabase for determining regional characteristics



Soil quality degradation due to leachates' overflow of sanitary landfills of solid waste in Tagarades, Thessaloniki

Recent projects

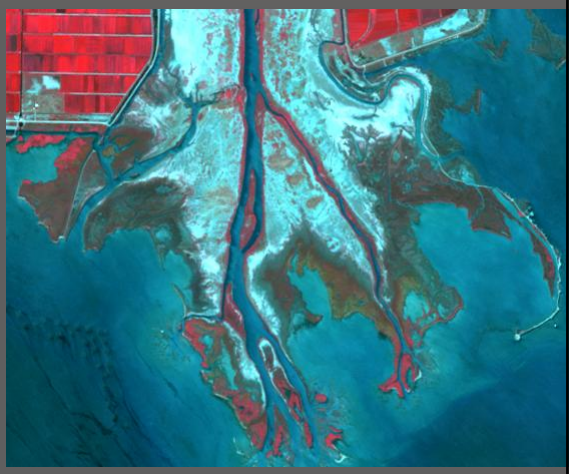
Coastal zone and wetlands

Mapping mussel farms

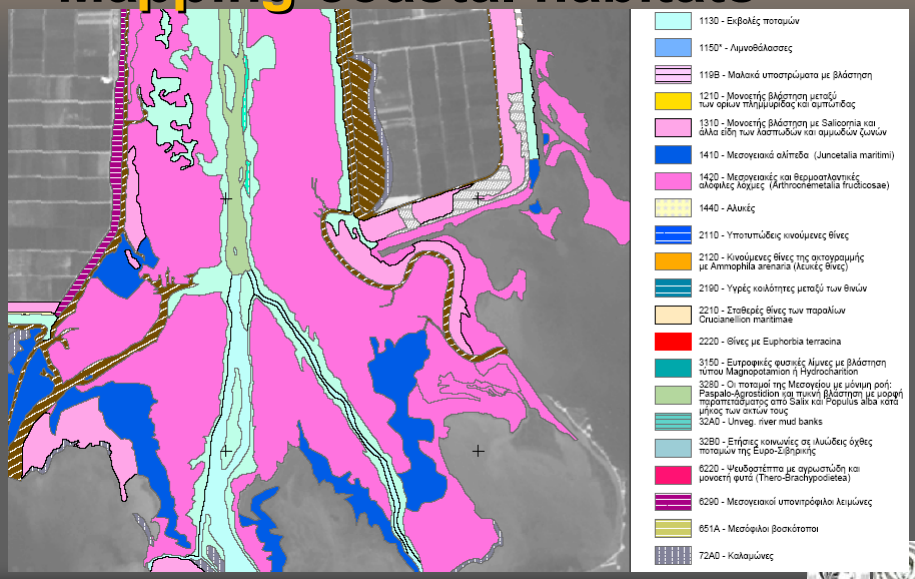
- Environmental pressure
- Satellite images in microwave and field survey
- Results:
  - Location, area, density of mussel farms

Mapping coastal habitats

- Materials:
  - ALOS AVNIR-2 Satellite image
  - Natura 2000 map
  - Sampling areas
- Process:
  - Image classification
  - Computer Assisted Photo-interpretation
- Temporal trends:
  - Habitat changes
  - Landscape metrics

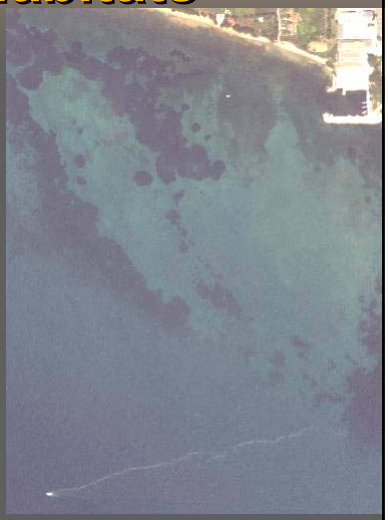


Mapping coastal habitats

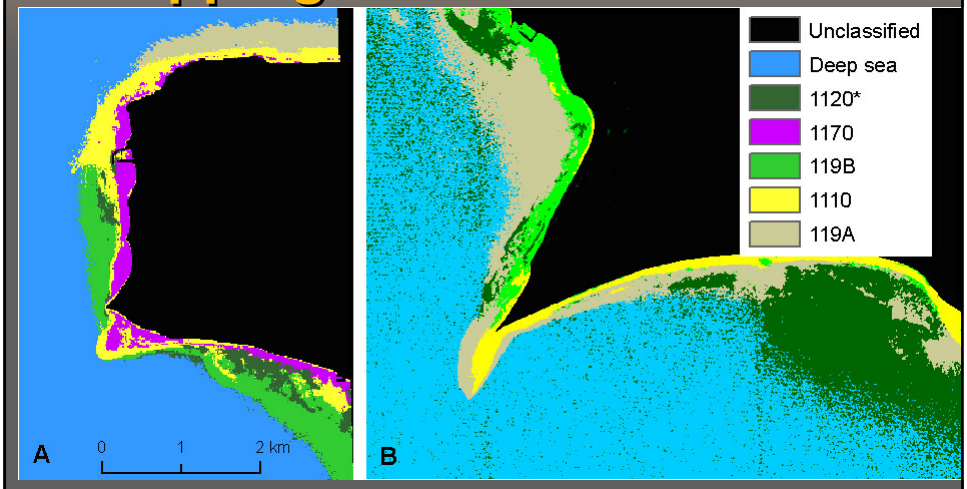


Mapping marine habitats

- Materials and instruments:
  - WorldView-2 satellite image
  - RoxAnn echo-sounder
  - In-situ data
- Process:
  - Digital image enhancement
  - Spectral classification
- Results:
  - Location and extents of marine habitats
  - Posidonia Oceanica



Mapping marine habitats



Aggelochori site

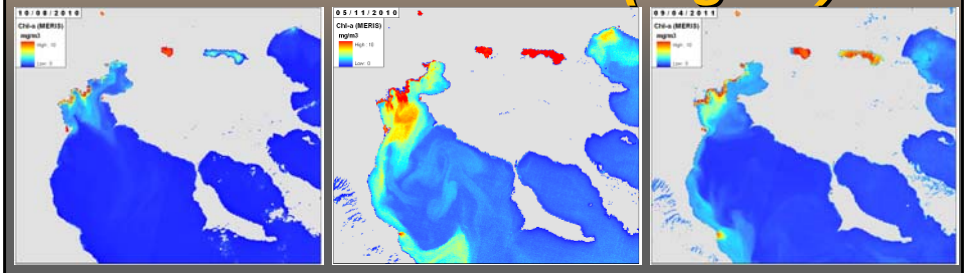
Epanomi site

Products: State

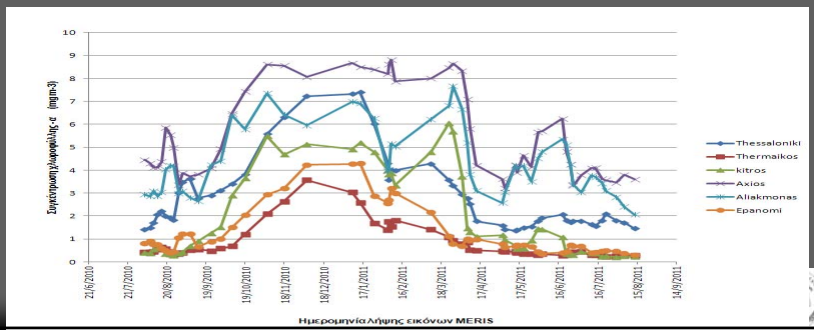
Water quality parameters

- Input data:
  - MODIS (Terra/Aqua) satellite images
  - MERIS (Envisat) satellite images
- Methods:
  - Absorption coefficient in 8 bands (blue, green, TIR wavelengths)
  - Neural networks
- Result:
  - Maps of Chl-a, TSM, SST
  - Time series, video and graphs

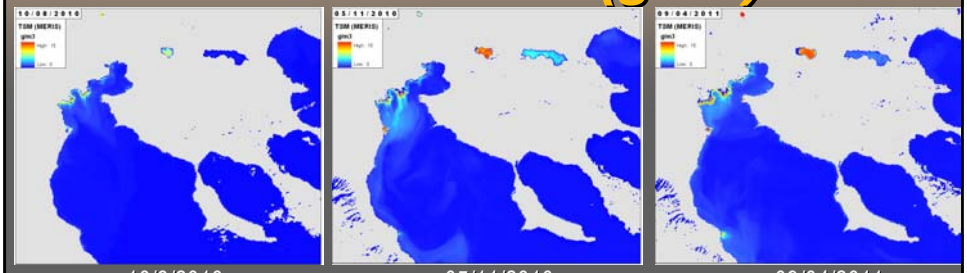
Time series of Chl-a (mg/m^3)



10/8/2010 05/11/2010 09/04/2011



Time series of TSM (g/m^3)



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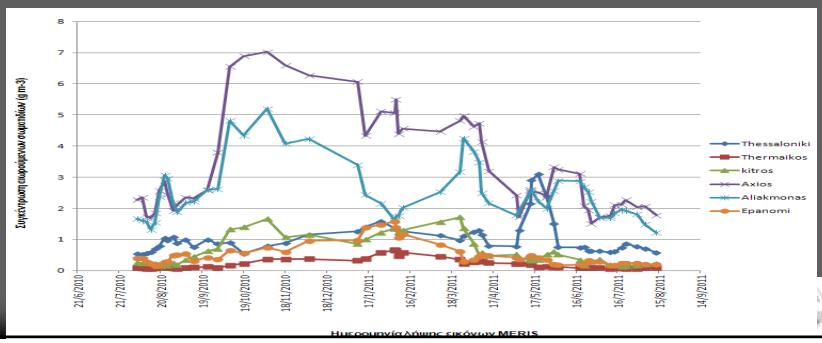
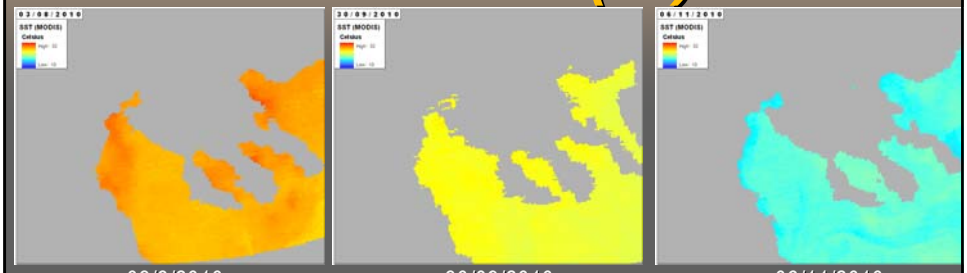


Time series of SST (ºC)



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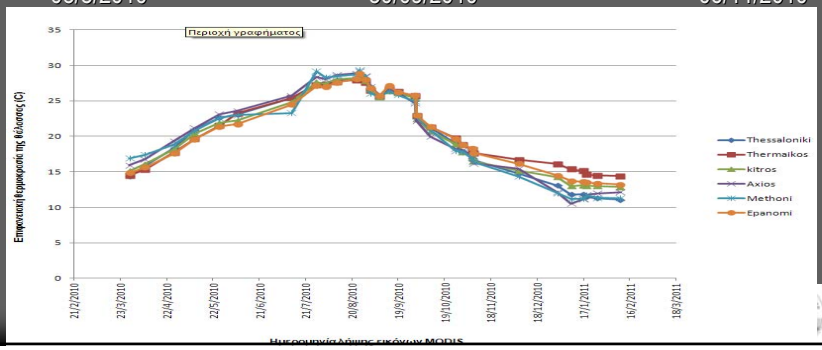
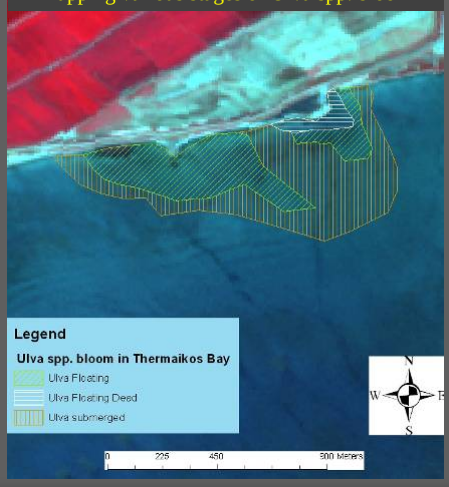


Mapping macroalgae…

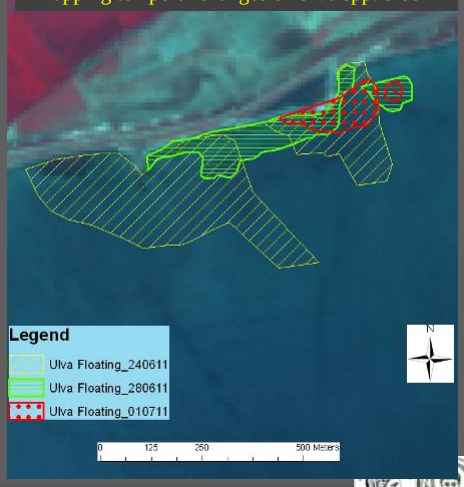
- Satelite images: Worldview-2, SPOT 4, LANDSAT 5
- UAV with spectroradiometer for spectral signatures
- Robotic airboat with GPS for delineation

…Mapping macroalgae

Mapping various stages of Ulva spp. bloom

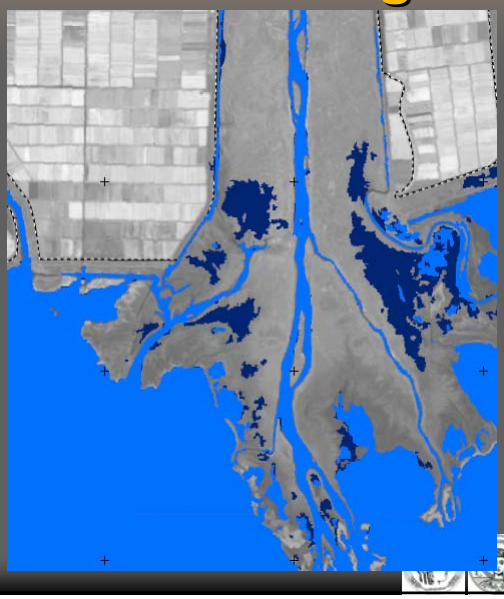


Mapping temporal changes of Ulva spp. bloom



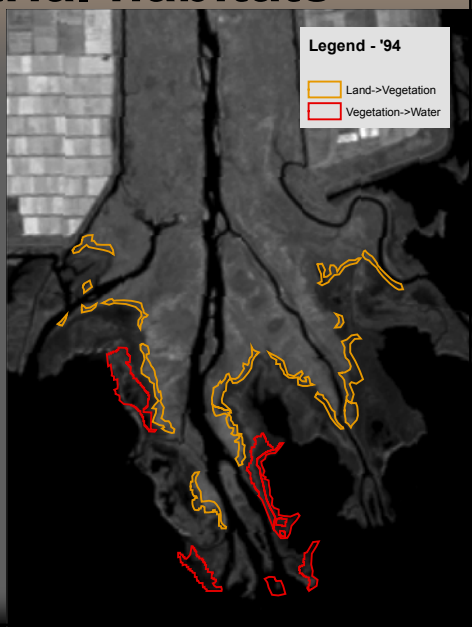
Seasonal water level changes

- Materials:
  - Sampling points
  - Radar images
- Methods:
  - Filtering
  - Thresholding σ^0
- Describes:
  - Water extents at high and low tide
  - Inundated vegetation



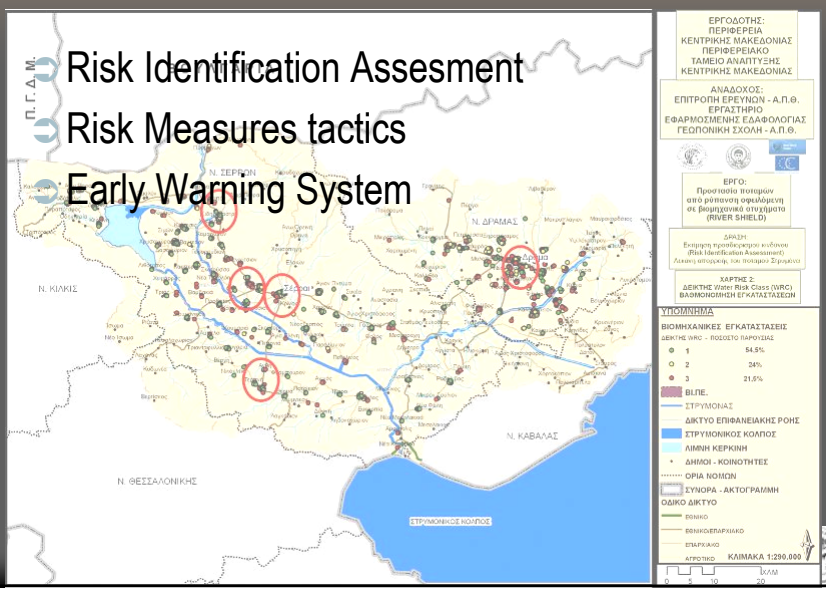
Loss of terrestrial habitats

- Materials:
  - SPOT 1994
  - SPOT 2004
- Methods:
  - thresholding of NIR band
  - change detection
- Describes:
  - terrestrial habitats loss
  - due to erosion and low discharge of sediment



River-Shield: Protecting Rivers from Industrial Accidents

- Risk Identification Assesment
- Risk Measures tactics
- Early Warning System



MyWater project

Merging Hydrologic models and EO data
for reliable information on Water

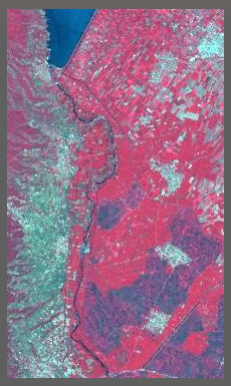
MyWater

Merging Hydrologic models and EO data for reliable information on Water

- MyWater is an FP7 Collaborative project, which started January 2011 and will end December 2013
- The following tools and services will be developed:
  - Catchment models that are able to simulate the horizontal and vertical hydrological processes based on EO input data;
  - Web-based data services for obtaining, sharing and publishing data;
  - Technological MyWater platform to help users managing the data and evaluating the model results in a comprehensible way;
  - Support and training services fitted to the needs of the different users.

Land Use Land Cover maps

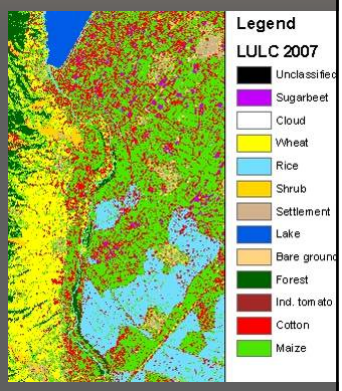
- Inputs:
  - Envisat MERIS or Terra MODIS (scale 1:1M)
  - ALOS AVNIR-2, Landsat TM, or SPOT 4 HRV (scale 1:50k)
  - Training points from field survey
- Methods:
  - spectral classification
  - object-oriented classification
  - knowledge-based editing



Land Use Land Cover maps

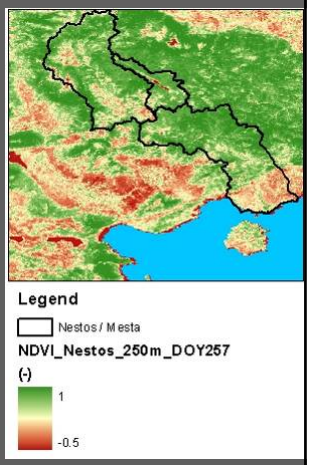
Deliverable:

- LULC map for 5 sites
- = 5 maps at 1:1M or 5 maps at 1:50k



Leaf Area Index maps

- Inputs:
  - ALOS AVNIR-2, Landsat TM, or SPOT 4 HRV (scale 1:50k)
  - MERIS or MODIS (scale 1:1M)
  - Training and validation points from field survey
- Methods:
  - customized NDVI-LAI models
  - merging with LAI_{MODIS} product

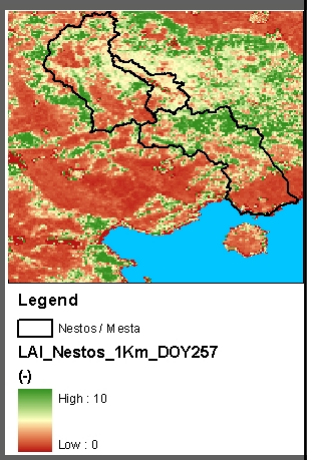


LAI maps

Deliverable:

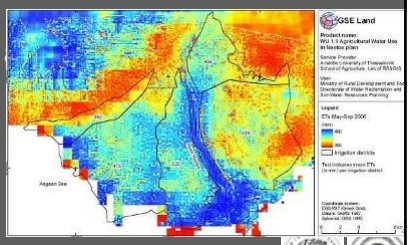
- LAI map for 5 sites, <u>every 2 months</u>

= 30 maps at 1:50k or 1:1M



Actual Evapotraspiration maps

- Inputs:
  - MODIS 8-day composites: ρ, VI, LST (675 images total)
  - Landsat TM images (2-4 per site)
  - Daily meteorological data (T, RH, Wind, Rin, sunshine, rainfall)
- Methods:
  - ITA-water tool (GSE Land, 2009), improvement of SEBAL model
  - resolution merge

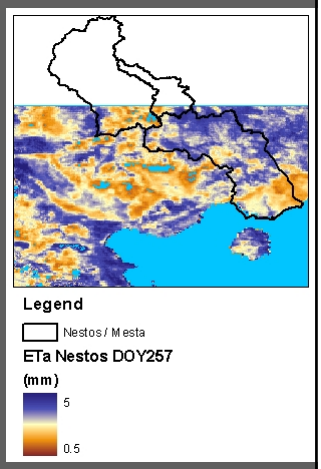


ETa maps

Deliverable:

- ETa maps for 5 sites, <u>every 8 days</u>

= 225 maps at 250m



Soil moisture maps

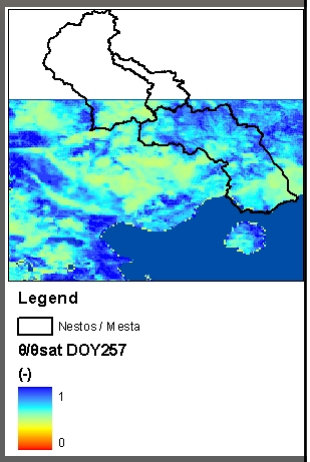
- Inputs:
  - Λ_{MODIS} from ITA-water tool
  - θ_{sat} from WP4
  - Rootzone depth from WP4
  - Training points from field survey
- Methods:
  - $\theta/\theta_{sat} = \exp((\Lambda-1)/0.42)$ [-] (Bastiaanssen et al., 2003)
  - $\theta = \theta_{sat} * \exp((\Lambda-1)/0.42)$ [cm3/cm3]
  - $SM_{rz} = \theta$ * rzdepth [mm]
  - SM_{top} from SAR images for validation

Soil moisture maps

Deliverable:

- SM_{rz} maps for 5 sites, <u>every 8 days</u>

= 225 maps at 250m and 20 maps at 30m

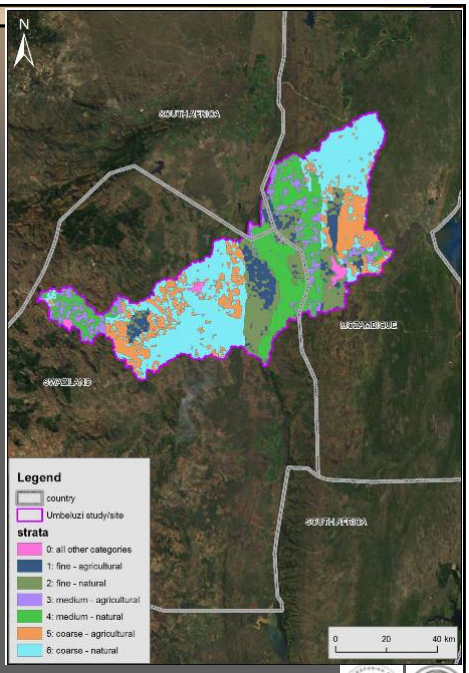


Field surveys in MyWater

- Collection of in-situ “ground truth” data
- Development period: training of algorithms
- Implementation period: validation of results

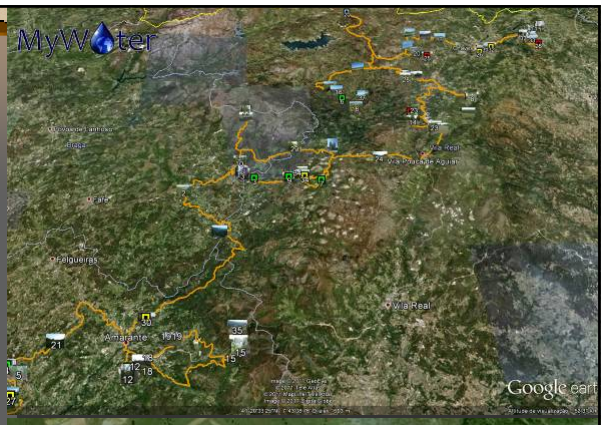
Design

- Sample design
  - stratified random sampling
  - strata from LULC and soil texture
- Sufficient number of sample sites
  - variability of LAI, SM, LULC
  - subplots for each sites



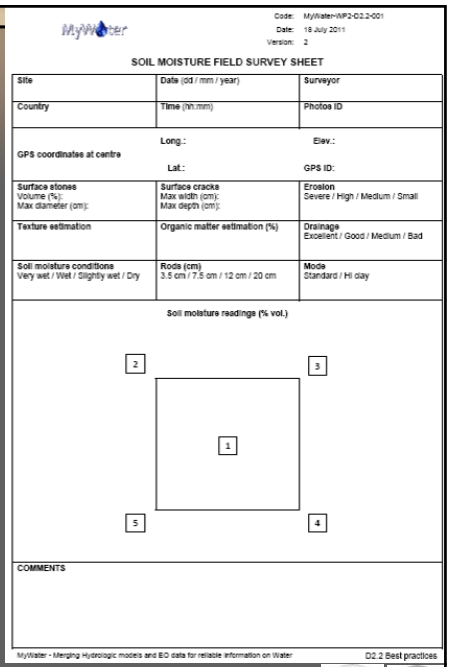
Design

- Optimum route
  - navigate to sample sites
  - minimize costs
- Google Earth imagettes around each sample site
  - navigation close to sample site
  - change its location if inaccessible



Design

- Contemporary with EO data
  - simultaneous order of images
- Protocols for field survey
  - high quality
  - comparable measurements
  - transfer of know-how
  - LAI, SM and LULC



MyWater

Code: MyWater-WP2-D2.2-001
Date: 18 July 2011
Version: 2

SOIL MOISTURE FIELD SURVEY SHEET

Site	Date (dd / mm / year)	Surveyor
Country	Time (hh:mm)	Photos ID
GPS coordinates at centre	Long.: Lat.:	Elev.: GPS ID:
Surface stones Volume (%): Max diameter (cm):	Surface cracks Max width (cm): Max depth (cm):	Erosion Severe / High / Medium / Small
Texture estimation	Organic matter estimation (%)	Drainage Excellent / Good / Medium / Bad
Soil moisture conditions Very wet / Wet / Slightly wet / Dry	Rods (cm) 3.5 cm / 7.5 cm / 12 cm / 20 cm	Mode Standard / Hi clay

Soil moisture readings (% vol.)

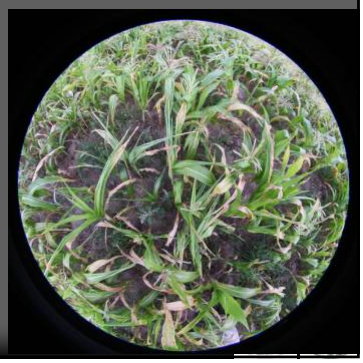
2 3 1 5 4

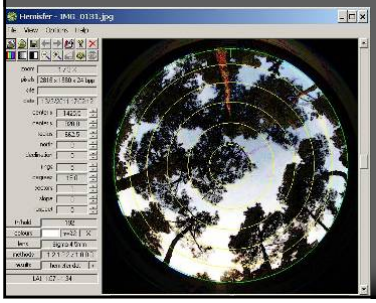
COMMENTS

MyWater - Merging Hydrologic models and EO data for reliable information on Water D2.2 Best practices

LAI measurements

- Photos with hemispherical camera
- Software for processing photos:
  - gap fraction, incoming light
  - thresholding or classification





Soil moisture measurem

- FieldScout TDR 300 soil moisture meter
  - estimates dielectric of soil -> related to volumetric water content
- 3.5, 7.5, 12 or 20 cm rods depending on the depth of surface soil
- Software for downloading and managing measurements

The LCD screen displays: Current measurement, rod length, number of readings, and running average.

Nestos field survey

- 1st Field survey in Nestos (July 2011)
- 29 sites in 3 days

Tamega field survey

- 1st Field survey in Tamega (Sep 2011)
- 37 sites in 4 days

Umbeluzi field survey

- 1st Field survey in Umbeluzi (April 2012)
- 25 sites

Field survey results

- Site ID
- Longitude WGS84
- Latitude WGS84
- Date
- Time
- Photos ID
- LULC
- LULC description
- Slope / Aspect
- LAI estimation (-)
- Comments
- Soil description
- Surface stones
- Surface cracks
- Erosion
- Texture estimation
- Organic matter estimation (%)
- Drainage
- Soil moisture conditions
- Rods (cm)
- Soil moisture readings (% vol)
- Comments

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