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**

- Observatory & tank of scientific information and know-how
- Advisory & supportive services
- Cooperative procedures
- Flexible legal structure

**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

Evaluation of crop damages

- Natural disasters (frost, hail, flood, drought)

- Vegetation indices

- Field surveyed samples

Frost effected wheat in N. Greece

Damage categories

Table with total results and statistics

<table>
<thead>
<tr>
<th>Crop</th>
<th>TOEB Agenias</th>
<th>TOEB Thessaloniki</th>
<th>TOEB Ath. Salis</th>
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<td>Barley</td>
<td>13065</td>
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</tbody>
</table>
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

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

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
Mapping marine habitats

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

Water quality parameters
Time series of Chl-a ($mg/m^3$)

Time series of TSM ($g/m^3$)
Time series of SST (°C)

Mapping macroalgae...

- Satellite 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

Materials:
- Sampling points
- Radar images

Methods:
- Filtering
- Thresholding $\sigma^0$

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

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**River-Shield: Protecting Rivers from Industrial Accidents**

- Risk Identification Assessment
- Risk Measures Tactics
- Early Warning System
MyWater project

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, every 2 months
- = 30 maps at 1:50k or 1:1M
Actual Evapotraspiration maps

- Inputs:
  - MODIS 8-day composites: \( p, V\), 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, every 8 days
  - 225 maps at 250m
Soil moisture maps

Inputs:
- \( \Lambda_{\text{MODIS}} \) from ITA-water tool
- \( \theta_{\text{sat}} \) from WP4
- Rootzone depth from WP4
- Training points from field survey

Methods:
- \( \theta / \theta_{\text{sat}} = \exp((\Lambda - 1)/0.42)) \) [-] (Bastiaanssen et al., 2003)
- \( \theta = \theta_{\text{sat}} \times \exp((\Lambda - 1)/0.42) \) [cm\(^3\)/cm\(^3\)]
- \( SM_{rz} = \theta \times rz\text{depth} \) [mm]
- \( SM_{\text{top}} \) from SAR images for validation

Deliverable:
- \( SM_{rz} \) maps for 5 sites, every 8 days
  - 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 site
**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

- Contemporary with EO data
  - simultaneous order of images
- Protocols for field survey
  - high quality
  - comparable measurements
  - transfer of know-how
  - LAI, SM and LULC
**LAI measurements**
- Photos with hemispherical camera
- Software for processing photos:
  - gap fraction, incoming light
  - thresholding or classification

**Soil moisture measurements**
- FieldScout TDR 300 soil moisture meter
  - estimates dielectric of soil \( \rightarrow \) 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
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

<table>
<thead>
<tr>
<th>Field Survey Results</th>
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<tbody>
<tr>
<td>Site ID</td>
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<tr>
<td>Longitude WGS84</td>
</tr>
<tr>
<td>Latitude WGS84</td>
</tr>
<tr>
<td>Date</td>
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<td>Time</td>
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<td>Photos ID</td>
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<tr>
<td>LULC</td>
</tr>
<tr>
<td>LULC description</td>
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<tr>
<td>Slope / Aspect</td>
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<tr>
<td>LAI estimation (-)</td>
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<tr>
<td>Comments</td>
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<tr>
<td>Soil description</td>
</tr>
<tr>
<td>Surface stones</td>
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<td>Surface cracks</td>
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<td>Erosion</td>
</tr>
<tr>
<td>Texture estimation</td>
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<tr>
<td>Organic matter estimation (%)</td>
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<tr>
<td>Drainage</td>
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<tr>
<td>Soil moisture conditions</td>
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<tr>
<td>Rods (cm)</td>
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<tr>
<td>Soil moisture readings (% vol)</td>
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<tr>
<td>Comments</td>
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</tbody>
</table>
Contact

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