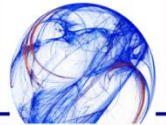

Mapping of Olive Oil Mill Wastes through Geoinformation Technologies

N. Papadopoulos

***Lab of GeoSat ReSeArch
IMS, FORTH***



GeoSat ReSeArch



Lab of Geophysical-Satellite Remote Sensing and Archaeoenvironment



European Union
European Regional
Development Fund



HELLENIC REPUBLIC
Ministry of Education and Religious Affairs
General Secretariat for Research and Technology



HELLENIC REPUBLIC
MINISTRY FOR DEVELOPMENT & COMPETITIVENESS



regions at the centre of development

Co - financed by the Hellenic Republic and the European Union - European Regional Development Fund,
in the context of the O.P. Competitiveness and Entrepreneurship (OPC II) and the R.O.P. Attica, R.O.P. Macedonia - Thrace

***Workshop on 4-Dimensional and High-Definition Geophysics
KIGAM, Daejeon, South Korea
December 11th-12th 2014***

Publications

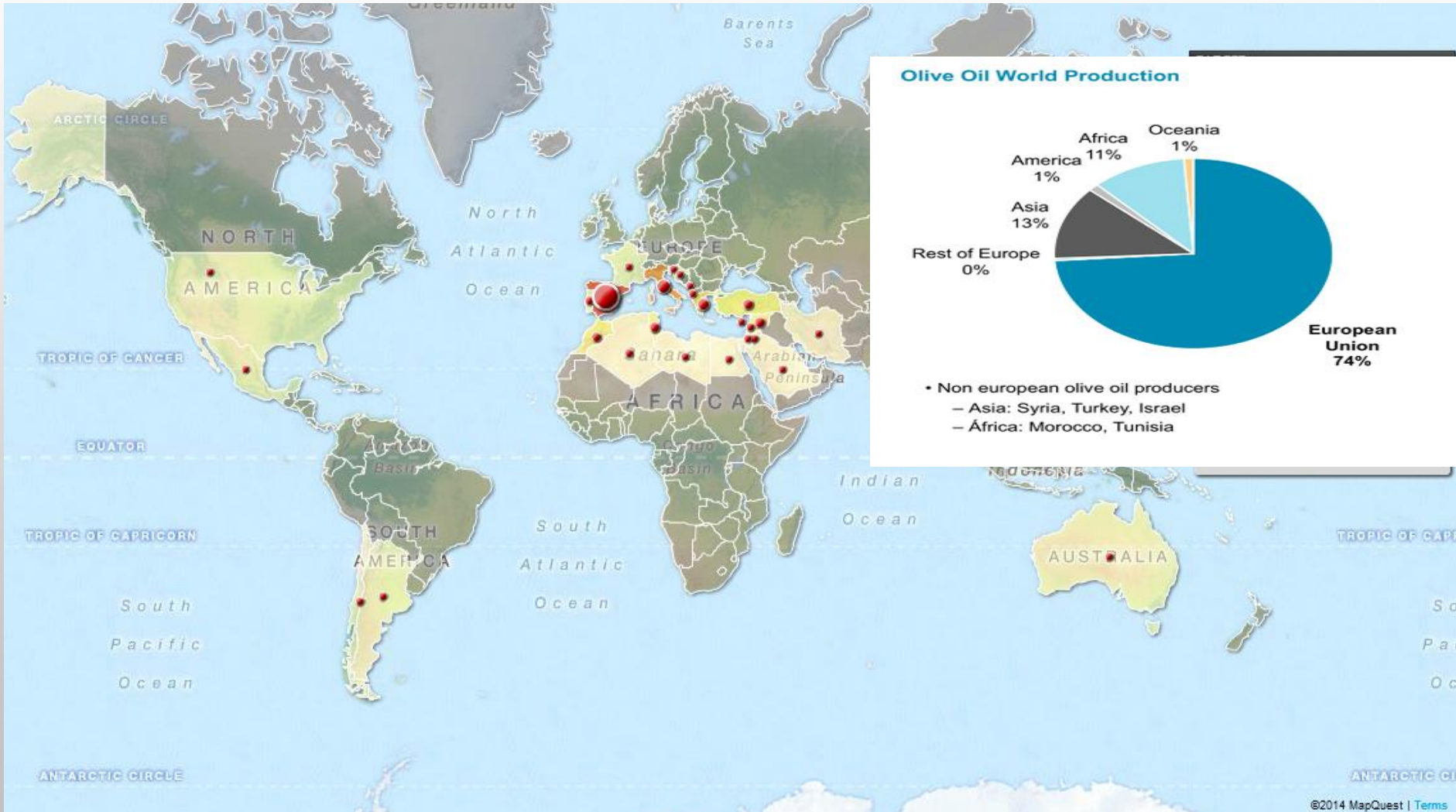
1. **ERT pollution monitoring in areas of olive oil mills' wastes (OOMW): Preliminary results from a disposal site in Crete (Greece)** by Nikos Papadopoulos and Stefanos Chatziathanasiou. *GELMON 2011 workshop, Vienna.*
2. **Olive-oil mill wastewater transport under unsaturated and saturated laboratory conditions using the geoelectrical resistivity tomography method and the FEFLOW model** by P. Seferou & P. Soupios & N. N. Kourgialas & Z. Dokou & G. P. Karatzas & E. Candasayar & N. Papadopoulos & V. Dimitriou & A. Sarris & M. Sauter, *Hydrogeology Journal, 2013, DOI 10.1007/s10040-013-0996-x*
3. **Monitoring of Olive Oil Mills' Wastes using Electrical Resistivity Tomography Techniques** by Simyrdanis Kleanthis, Papadopoulos Nikos, Kirkou Stella, Sarris Apostolos and Tsourlos Panagiotis *Second International Conference on Remote Sensing and Geoinformation 2014, 7-10 April 2014, Paphos, Cyprus*
4. **Mapping of Olive Oil Mills' Wastes (OOMW) through Electrical Resistivity Tomography: A case study from Alikianos site in eastern Crete (Greece)** by Nikos Papadopoulos, Pantelis Soupios, Jung-Ho Kim, Kleanthis Simirdanis, Stella Kirkou, Panagiotis Tsourlos. *20th European Meeting of Environmental and Engineering Geophysics Athens, Greece, 14-18 September 2014*
5. **Development of automated satellite remote sensing and ground spectroscopy techniques for monitoring olive oil mill waste disposal areas in Crete-Greece** by Dimitrios D Alexakis, Apostolos Sarris, Chariton Kalaitzidis, Nikos Papadopoulos, Pantelis Soupios, *submitted to Sensors*
6. **GEODIAMETRIS: AN INTEGRATED GEOINFORMATIC APPROACH FOR MONITORING LAND POLLUTION FROM THE DISPOSAL OF OLIVE OIL MILL WASTES** by Dimitrios D. Alexakis, Apostolos Sarris, Nikos Papadopoulos, Pantelis Soupios, Maria Doula, Victor Cavvadias, Sideris Theocharopoulos. *Second International Conference on Remote Sensing and Geoinformation 2014, 7-10 April 2014, Paphos, Cyprus*
7. **Time lapse ERT monitoring of Olive-oil mills' wastes (OOMW) using simulation and experimental data** by S. Kikrou, P. Tsourlos, N. Papadopoulos, P. Soupios and J-H Kim. *20th European Meeting of Environmental and Engineering Geophysics Athens, Greece, 14-18 September 2014*

Worldwide Olive Oil Production

The olive oil production industry represents an important activity worldwide

Based on the average production the last 6 years (2007 to 2013)

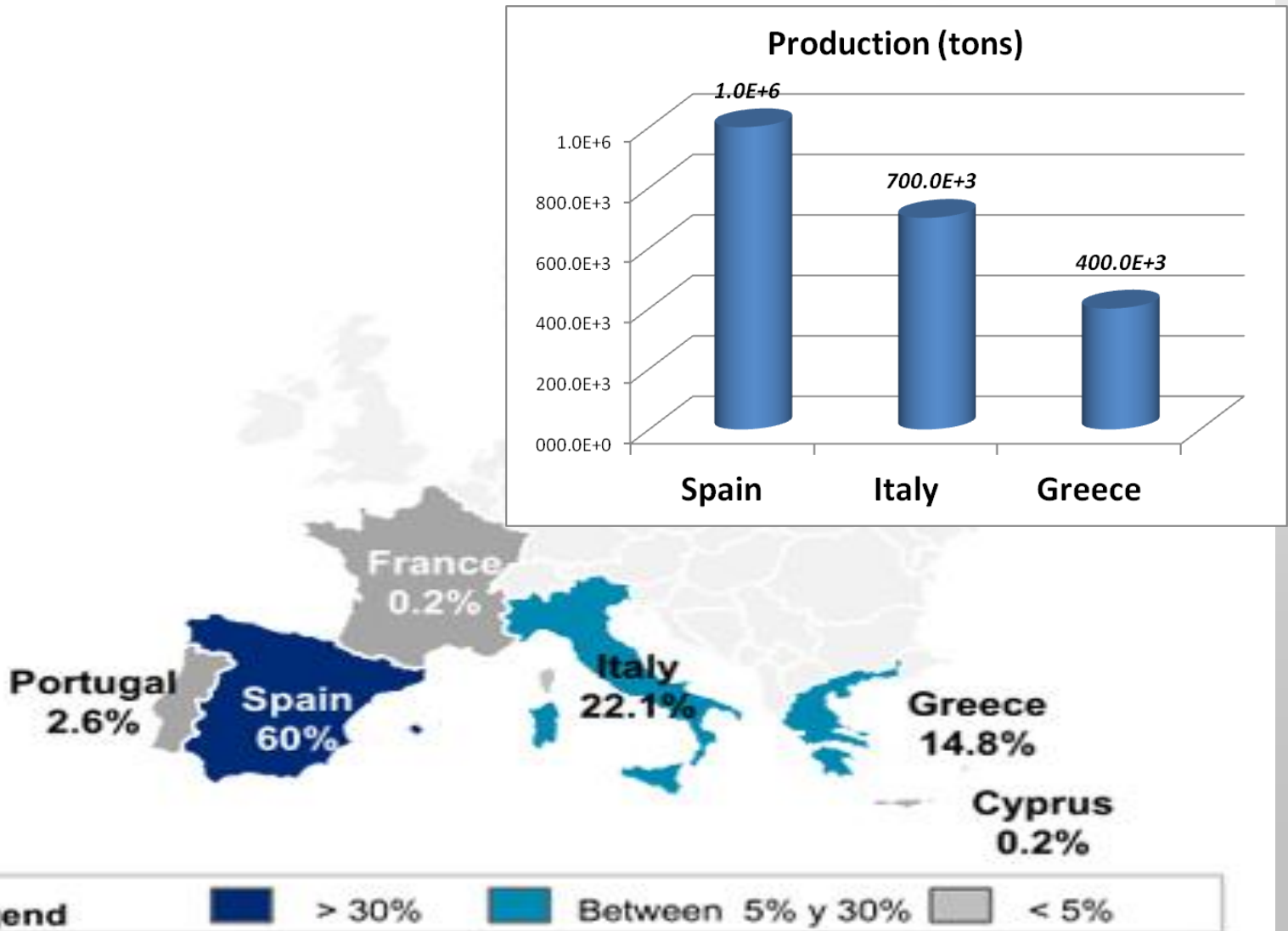
➤ Annual Olive Oil Production:
~ **3 million tons**



Worldwide Olive Oil Production

European Union Olive Oil production.

<http://www.intercountries-exchanges.com>



Olive Oil Production Process



Harvesting



Pressing



Bottling



Olive Oil Mills' Wastes (OOMW)

huge waste production in a relatively short time

1 of ton olive oil production → ~1.5 ton dry organic pollutants

Physico-chemical characteristics

- Dark brown color, foul-smelling and turbid liquid
- Includes emulsified grease
- High Biochemical Oxygen Demand (BOD-40-95 g/l)
- High Chemically Oxygen Demand (COD-50-180 g/l)
- Phenolic compounds (<700 mg/Kg)
- High organic content (proteins & sugar, <55%)
- Acid PH (<6)
- **Conductive material (<5 Ohm-m)**



Disposal of OOMW

Main Methods

- **Evaporation ponds**
- Disposal in soil and torrents
- Incineration given the high organic load (fuels cost, gas emissions)



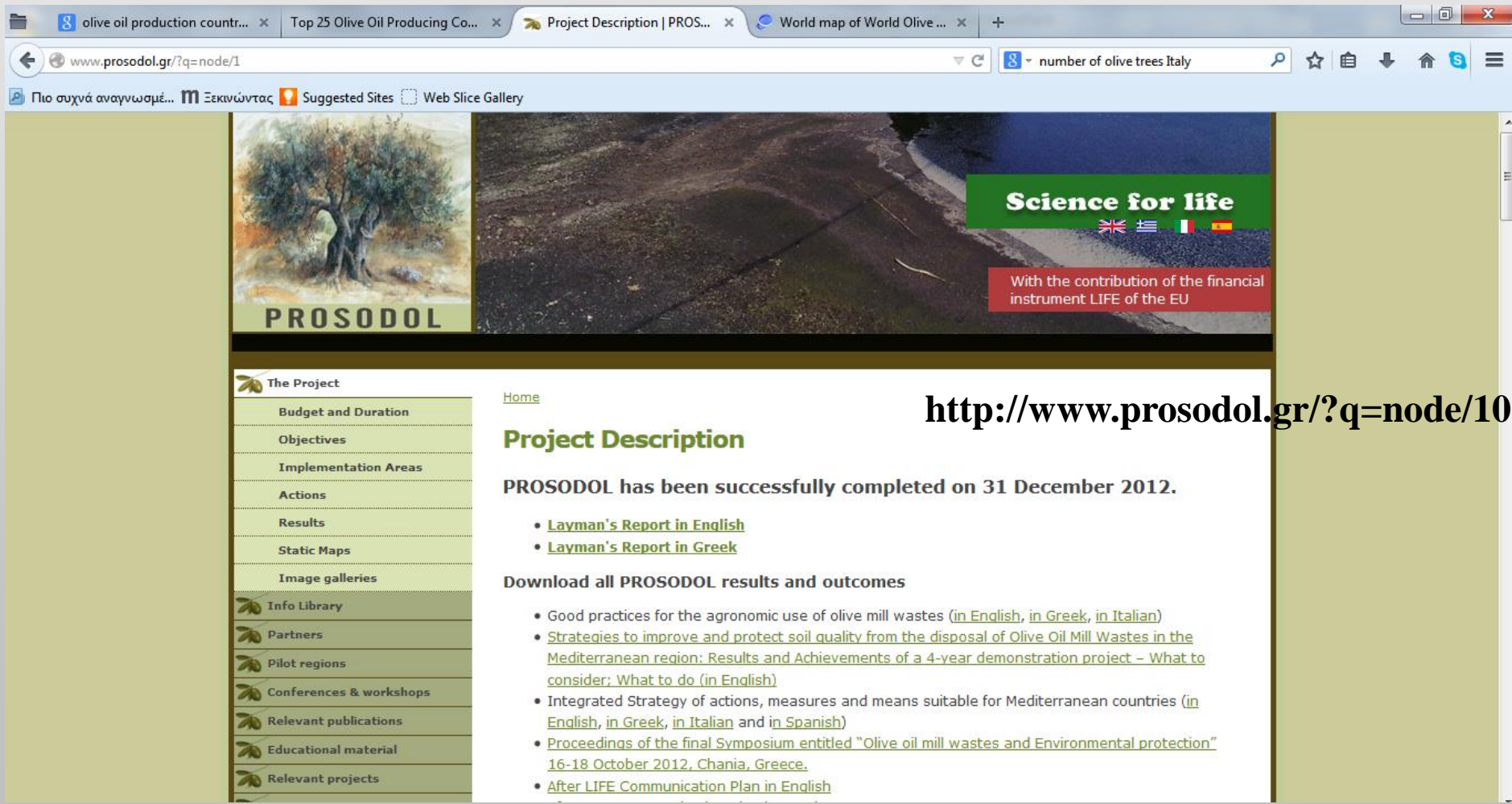
- **OOMW are toxic due to their phenolic compounds**
- **The presence of OOMW in soil causes phytotoxic and antimicrobial effects, while in rivers decreases the dissolved oxygen content**
- **The long-term deposition of OOMW can lead to future serious degradation of soil and groundwater quality**

PROSODOL Project

Main Objective

Manage and treat OOMW prior disposal

The development and implementation of technologies to protect and improve degraded soils with the use of zeolites and bioremediation methodology



The screenshot shows a web browser displaying the PROSODOL project website. The browser's address bar shows the URL www.prosodol.gr/?q=node/10. The website features a header with a banner image of an olive tree and a field, with the text "Science for life" and "With the contribution of the financial instrument LIFE of the EU". Below the banner, there is a navigation menu on the left and a main content area. The main content area displays the "Project Description" section, which states that the PROSODOL project has been successfully completed on 31 December 2012. It lists two reports: "Layman's Report in English" and "Layman's Report in Greek". Below this, there is a section titled "Download all PROSODOL results and outcomes" which lists several documents and reports available for download.

<http://www.prosodol.gr/?q=node/10>

The Project

- Budget and Duration
- Objectives
- Implementation Areas
- Actions
- Results
- Static Maps
- Image galleries

Info Library

- Partners
- Pilot regions
- Conferences & workshops
- Relevant publications
- Educational material
- Relevant projects

Home

Project Description

PROSODOL has been successfully completed on 31 December 2012.

- [Layman's Report in English](#)
- [Layman's Report in Greek](#)

Download all PROSODOL results and outcomes

- Good practices for the agronomic use of olive mill wastes ([in English](#), [in Greek](#), [in Italian](#))
- Strategies to improve and protect soil quality from the disposal of Olive Oil Mill Wastes in the Mediterranean region: Results and Achievements of a 4-year demonstration project – What to consider; What to do ([in English](#))
- Integrated Strategy of actions, measures and means suitable for Mediterranean countries ([in English](#), [in Greek](#), [in Italian](#) and [in Spanish](#))
- [Proceedings of the final Symposium entitled "Olive oil mill wastes and Environmental protection" 16-18 October 2012, Chania, Greece.](#)
- [After LIFE Communication Plan in English](#)

GEODIAMETRIS

**INTEGRATED GEOINFORMATICS TECHNOLOGIES FOR
TIME-LAPSE MONITORING OF LAND POLLUTION FROM
DISPOSAL OF OLIVE-OIL MILL WASTES (OOMW)**

GeoDIAMETRIS Partners

Department of Natural Resources & Environment
Technological Educational Institute of Crete
Project Coordinator



Laboratory of Geophysical – Satellite Remote Sensing & Archaeo-environment
Institute for Mediterranean Studies (I.M.S)
Foundation for Research & Technology (F.O.R.T.H.)



Soil Science Institute of Athens
Hellenic Agricultural Organization-DEMETER



Department of Geophysics
School of Geology - Aristotle University of Thessaloniki (AUTH)



Korea Institute of Geoscience and Mineral Resources
Goelectric Imaging Laboratory



Dept. of Earth and Environmental Sciences
Rutgers University



KRIPIS –PEFYKA:

Environment and Natural Disasters: New methods to evaluate and improve the quality of the environment and to cope with natural disasters

Objectives

- The development and application of innovative methods, experimental devices and numerical tools to analyse, monitor, protect and improve the quality of the natural and urban environment
- The study, prediction and confrontation of natural disasters and the impact of the climate change

Concept of Mapping OOMW

GPS Mapping



Satellite Remote Sensing



Soil sampling



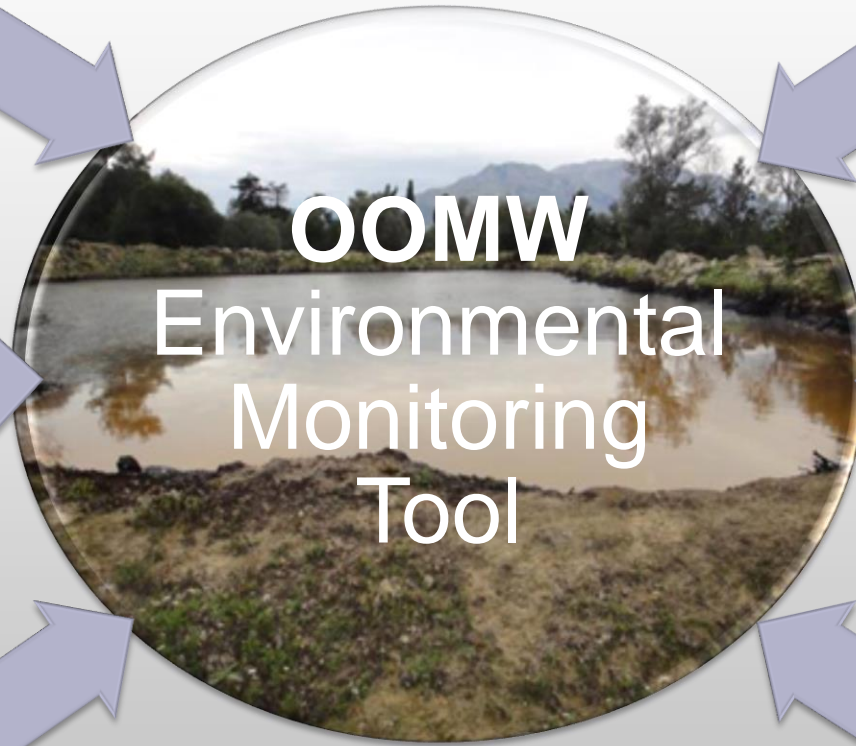
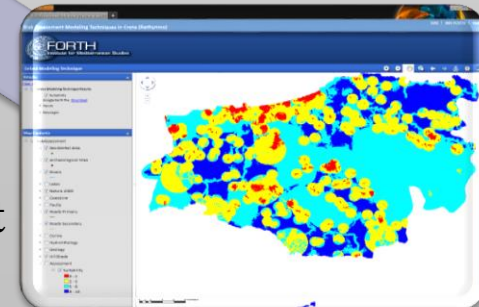
Chemical Analyses



Geophysical Monitoring



GIS Risk Assessment Modeling



Area of Application - CRETE

- Crete contributes approximately 5% to the total world olive oil production



**GPS Mapping for Recording
the current Situation of Olive
Mills and OOMW Disposal
Sites**

GPS Mapping – Web Data Base

- Olive Oil Facilities – Mills: **More than 540**

The screenshot displays the GeoDIAMETRIS web application interface. The browser address bar shows the URL `geodiametris.ims.forth.gr/?q=en/node/1782`. The page title is "GeoDIAMETRIS" with the subtitle "Integrated Geoinformatic Technologies for Time-lapse Monitoring of Land Pollution from the Disposal of Olive-Oil Mills Wastes". The navigation menu includes "Home", "Olive oil mills waste disposal areas", "Olive oil facilities", and "Current Status".

The main content area is titled "Olive oil facilities" and features a map of Crete. The map shows several locations marked with red and yellow circles, indicating the number of olive oil facilities. The locations and their facility counts are:

Location	Facility Count
Kissamos	100
Chania	59
Rethimnon	11
Heraklion	223
Malia	28
Ierapetra	35

Below the map, there is a table with columns for "Date", "Municipality", and "Prefecture". The visible data rows are:

Date	Municipality	Prefecture
Achlada	Μαλεβιζίου	Ηράκλειο

The right sidebar contains the FORTH logo (Institute for Mediterranean Studies) and the Technological Educational Institute of Crete logo. The bottom of the screen shows the Windows taskbar with various application icons and the system tray displaying the date and time: 6:36 πμ, 10/12/2014.

GPS Mapping – Web Data Base

- OOMW Disposal Sites: **More than 1000**

The screenshot displays the GeoDIAMETRIS web application interface. The main heading is "GeoDIAMETRIS" with the subtitle "Integrated Geoinformatic Technologies for Time-lapse Monitoring of Land Pollution from the Disposal of Olive-Oil Mills Wastes". The page title is "Olive oil mills waste disposal areas".

The central feature is a satellite map of Crete, Greece, showing several disposal sites marked with colored circles and numbers: 84 (yellow), 60 (yellow), 3 (blue), 19 (yellow), 129 (red), 513 (red), 87 (yellow), and 149 (red). The map includes navigation controls and a scale bar (20 km).

Below the map is a table with the following data:

Date	Near location	Municipality	Prefecture
05/11/2010	Αχλαδέες	Μυλοποτάμου	Ρέθυμνο

The right sidebar contains the FORTH logo (Institute for Mediterranean Studies) and the Technological Educational Institute of Crete logo. The bottom of the screen shows a Windows taskbar with various application icons and a system tray with the date 10/12/2014 and time 6:40 πμ.

GPS Mapping – Web Data Base

- OOMW Disposal Sites: **More than 1000**

olive oil productio... x jazz radio - Αναζή... x Smooth Jazz on JA... x Απόψεις | Η ΚΑΘ... x dropbox - Αναζήτ... x 2Γ_Τεχνική_έκθεσ... x Olive oil mills was... x

geodiametris.ims.forth.gr/?q=en/node/1

number of olive trees Italy

Πιο συχνά αναγνωσμέ... m Εκκινώντας Suggested Sites Web Slice Gallery

GeoDIAMETRIS

Integrated Geoinformatic Technologies for Time-lapse Monitoring of Land Pollution from the Disposal of Olive-Oil Mills Wastes

Home Olive oil mills waste disposal areas Olive oil facilities Current Status

Olive oil mills waste disposal areas

Map Satellite

Google Imagery ©2014 TerraMetrics 10 km Terms of Use Report a map error

Date	Near location	Municipality	Prefecture
05/11/2010	Αναλαδές	Μυλοποτάμου	Ρέθυμνο

achlades 1

FORTH
Institute for Mediterranean Studies

TECHNOLOGICAL
EDUCATIONAL
INSTITUTE OF CRETE

EN 6:44 πμ
10/12/2014

GPS Mapping – Web Data Base

- OOMW Disposal Sites: **More than 1000**

The screenshot displays the GeoDIAMETRIS web application interface. At the top, the browser address bar shows the URL `geodiametris.ims.forth.gr/?q=en/node/1`. The page header includes the site logo and the tagline "Integrated Geoinformatic Technologies for Time-lapse Monitoring of Land Pollution from the Disposal of Olive-Oil Mills Wastes". A navigation menu lists "Home", "Olive oil mills waste disposal areas", "Olive oil facilities", and "Current Status".

The main content area is titled "Olive oil mills waste disposal areas" and features a Google Maps interface. A map shows a disposal site with a yellow pin. A popup window displays the site name "gergen 9" and its coordinates: $35^{\circ} 7' 53.7816'' \text{ N}, 24^{\circ} 57'$. A black arrow points from this popup to a detailed information window on the right. This window contains the following data:

- Date: Thursday, April 29, 2010
- Area operation: NAI
- Near location: Πινύ
- Municipality (Kalikratis): Ρεθύμνης
- Municipality (Kapodistrias): Δ. ΑΡΚΑΔΙΟΥ
- Prefecture: Ρεθύμνο

Below the text is a photo gallery showing a landscape with a river and trees. At the bottom of the page, a table lists disposal sites with columns for "Date", "Near location", and "Municipality". The first row shows "achlades 1" with a date of "05/11/2010", near location "Αγλαδές", and municipality "Μυλοποτάμου".

Date	Near location	Municipality
05/11/2010	Αγλαδές	Μυλοποτάμου

Satellite Remote Sensing for the Identification of OOMW Disposal Sites

Satellite Remote Sensing

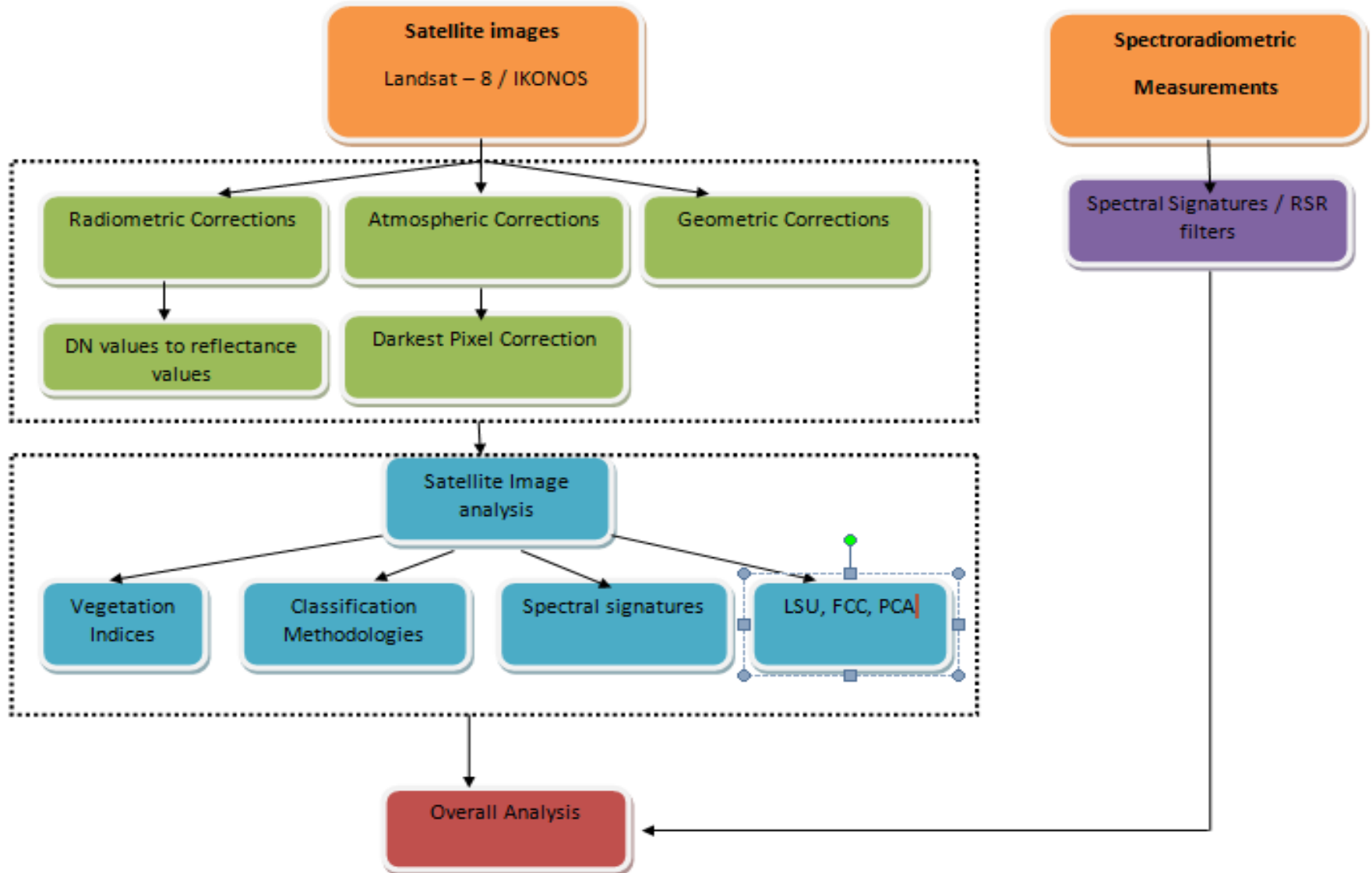
Landsat 8: 11 bands with spatial resolution of 30m on the visible spectrum and 15m for the panchromatic band

IKONOS: 0.8m panchromatic & 4m multispectral

	Satellite Image	Area	Date of Acquisition
1	Landsat 8	Western Crete	12/07/2013
2	Landsat 8	Western Crete	06/08/2013
3	Landsat 8	Western Crete	23/04/2013
4	Landsat 8	Eastern Crete	21/07/2013
5	Landsat 8	Eastern Crete	30/09/2013
6	Landsat 8	Eastern Crete	02/05/2013
7	IKONOS	Western Crete	27/07/2006
8	IKONOS	Western Crete	27/07/2006
9	IKONOS	Western Crete	20/03/2007

Satellite Remote Sensing

Processing



Satellite Remote Sensing

False Color Composites

FCC RGB- 321

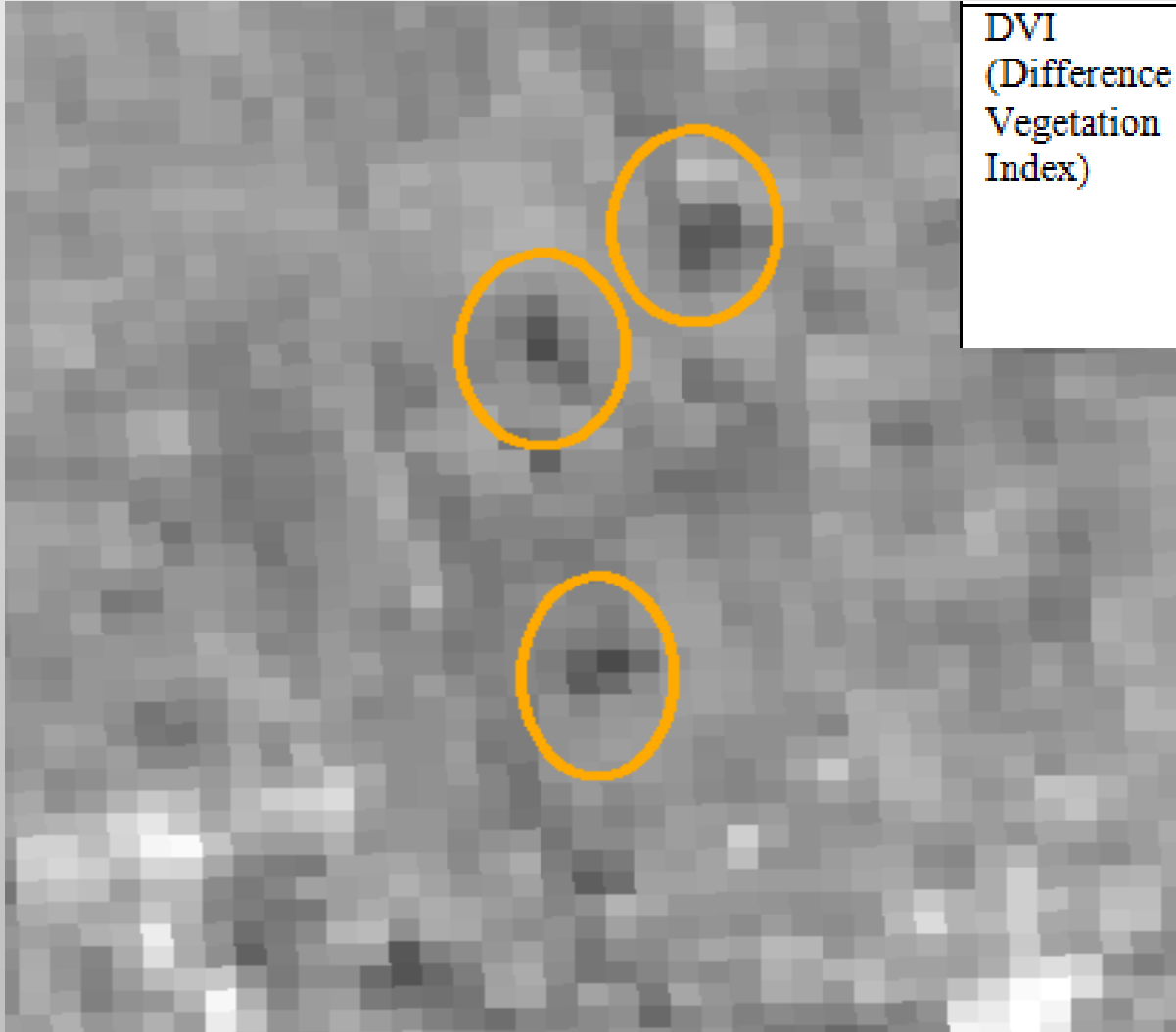


FCC RGB- 541



Satellite Remote Sensing

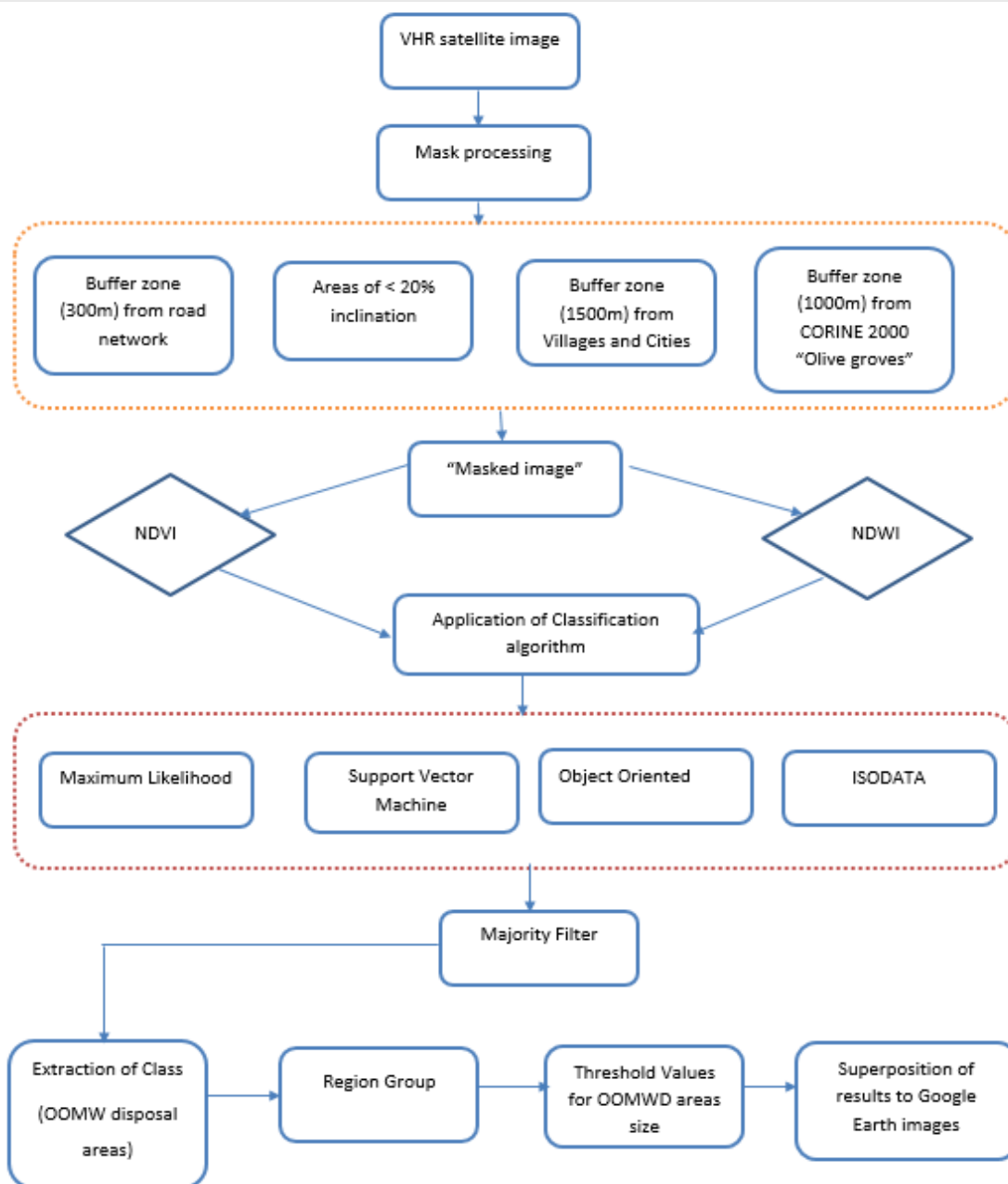
Vegetation Indices



DVI
(Difference
Vegetation
Index)

$$P_{NIR} - P_{RED}$$

Satellite Remote Sensing



Semi-automatic Methodology for the Detection of OOMW Disposal Areas

1. Spatial mask the satellite images based on certain environmental and anthropogenic parameters (*proximity to roads/villages, low inclination, corine land use maps*)
2. Application of different classification algorithms (*object oriented, ISODATA, Maximum Likelihood*)
3. Application of certain threshold values to classification products

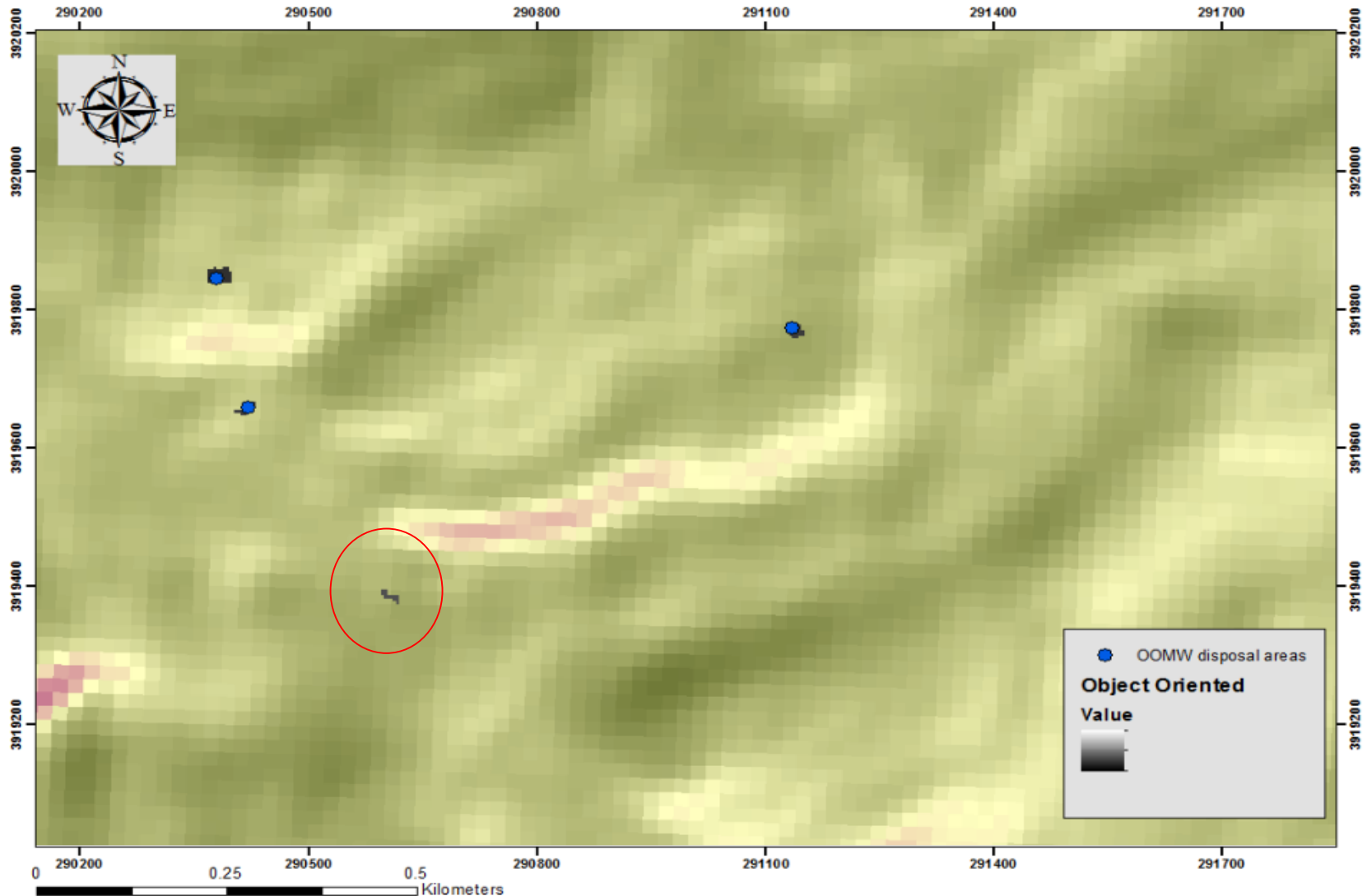
Satellite Remote Sensing

Semi-automatic Methodology for the Detection of OOMW Disposal Areas



Satellite Remote Sensing

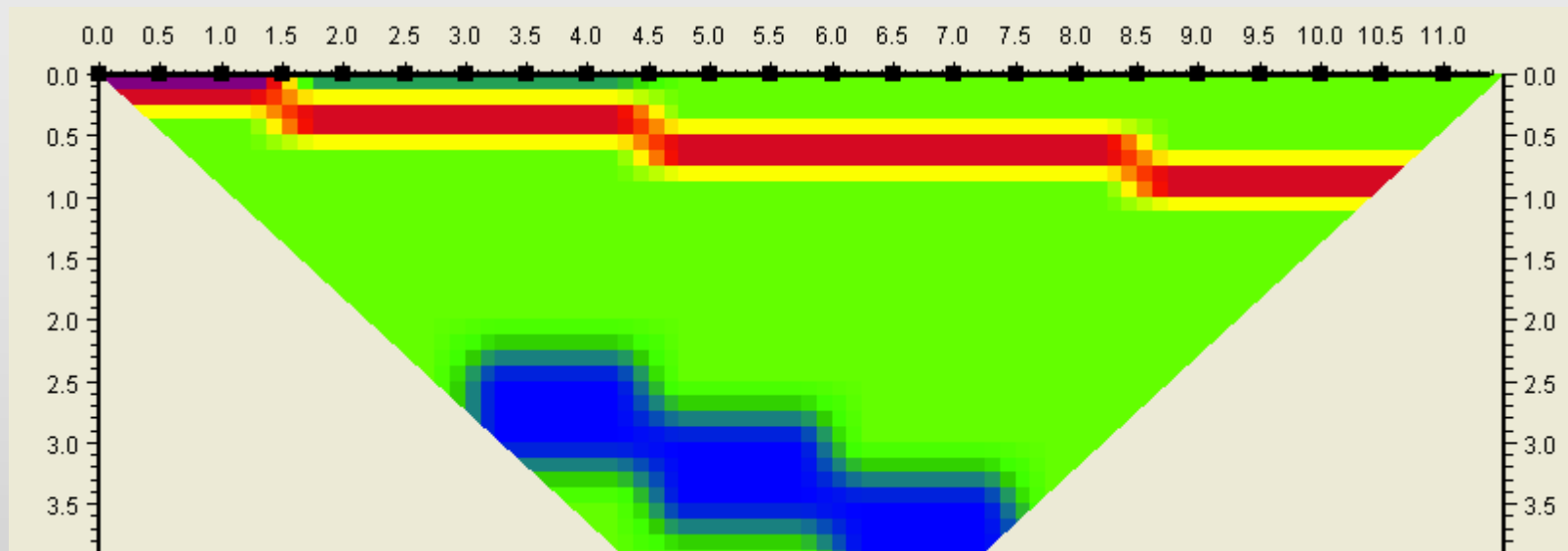
Semi-automatic Methodology for the Detection of OOMW Disposal Areas



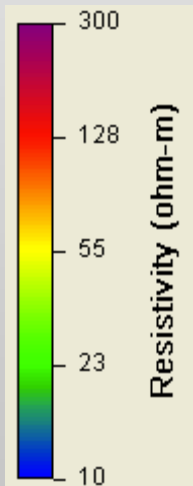
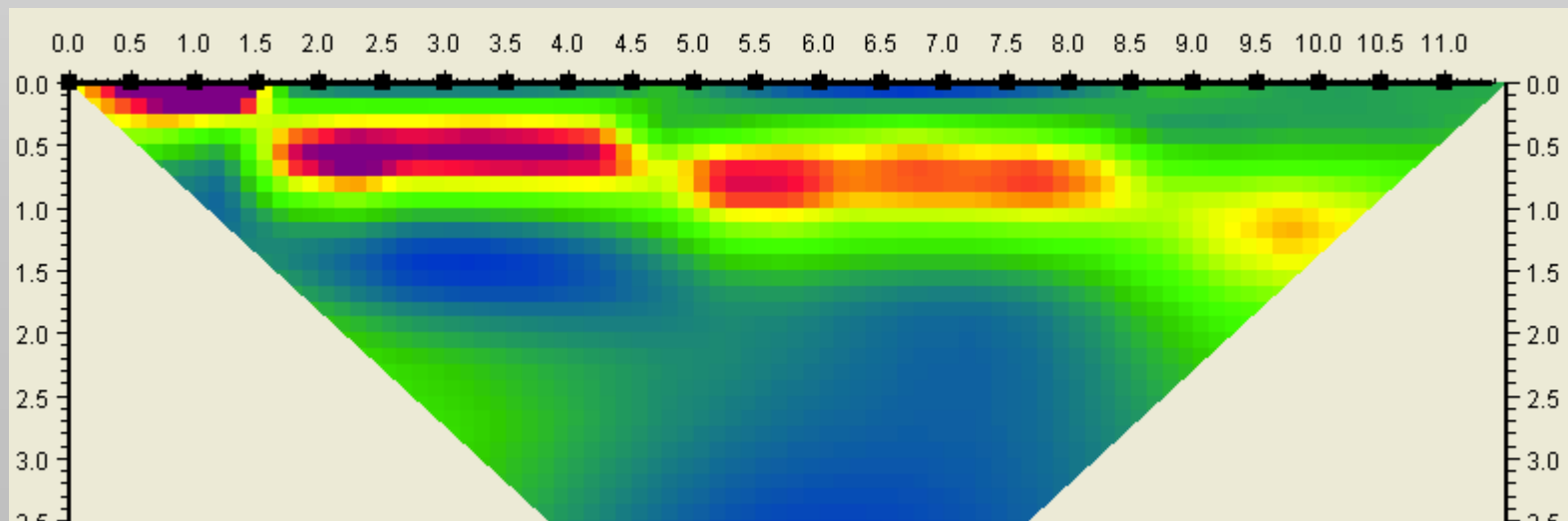
Geophysical Mapping & Monitoring

Synthetic Surface ERT Modeling

Original Model

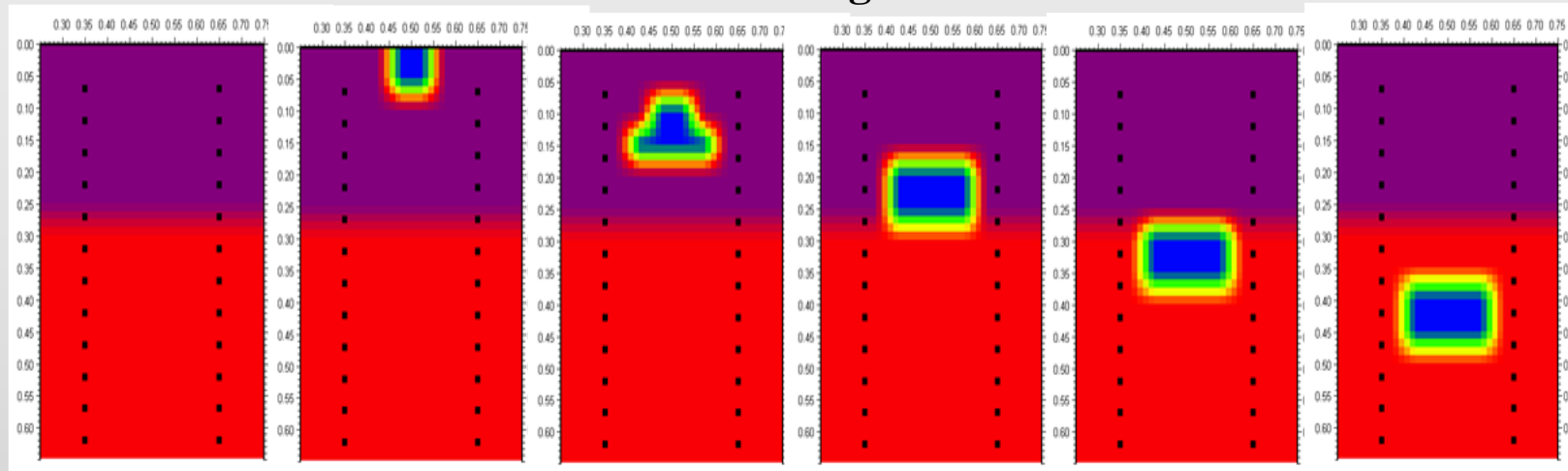


2-D inversion model

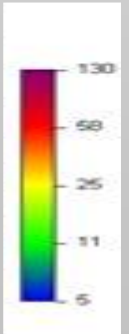
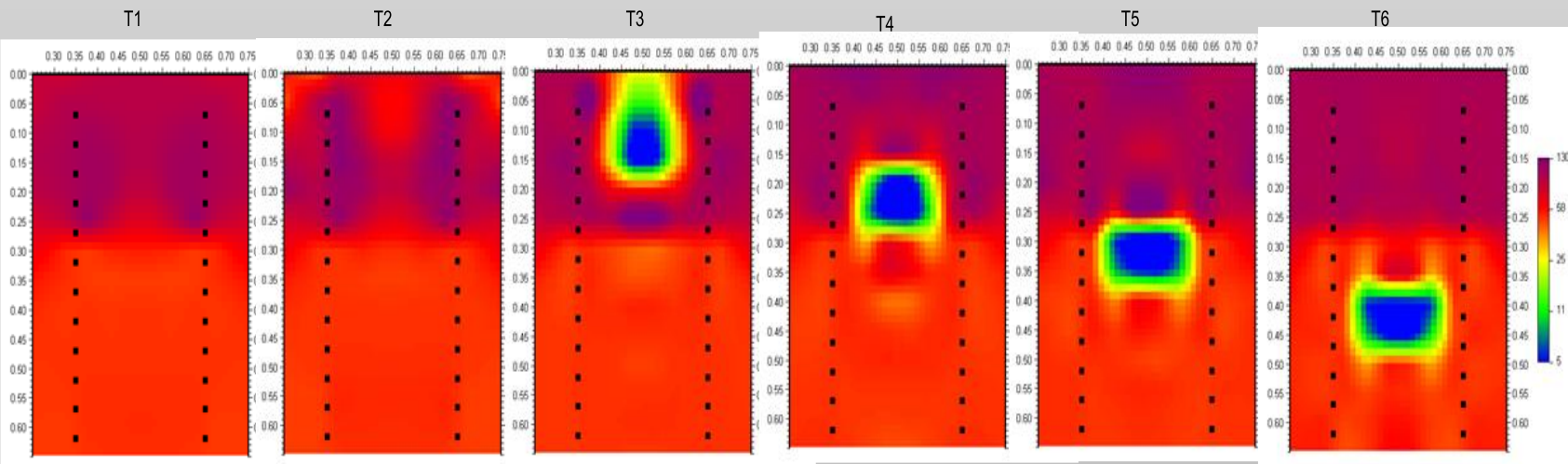


Synthetic Crosshole ERT Modeling

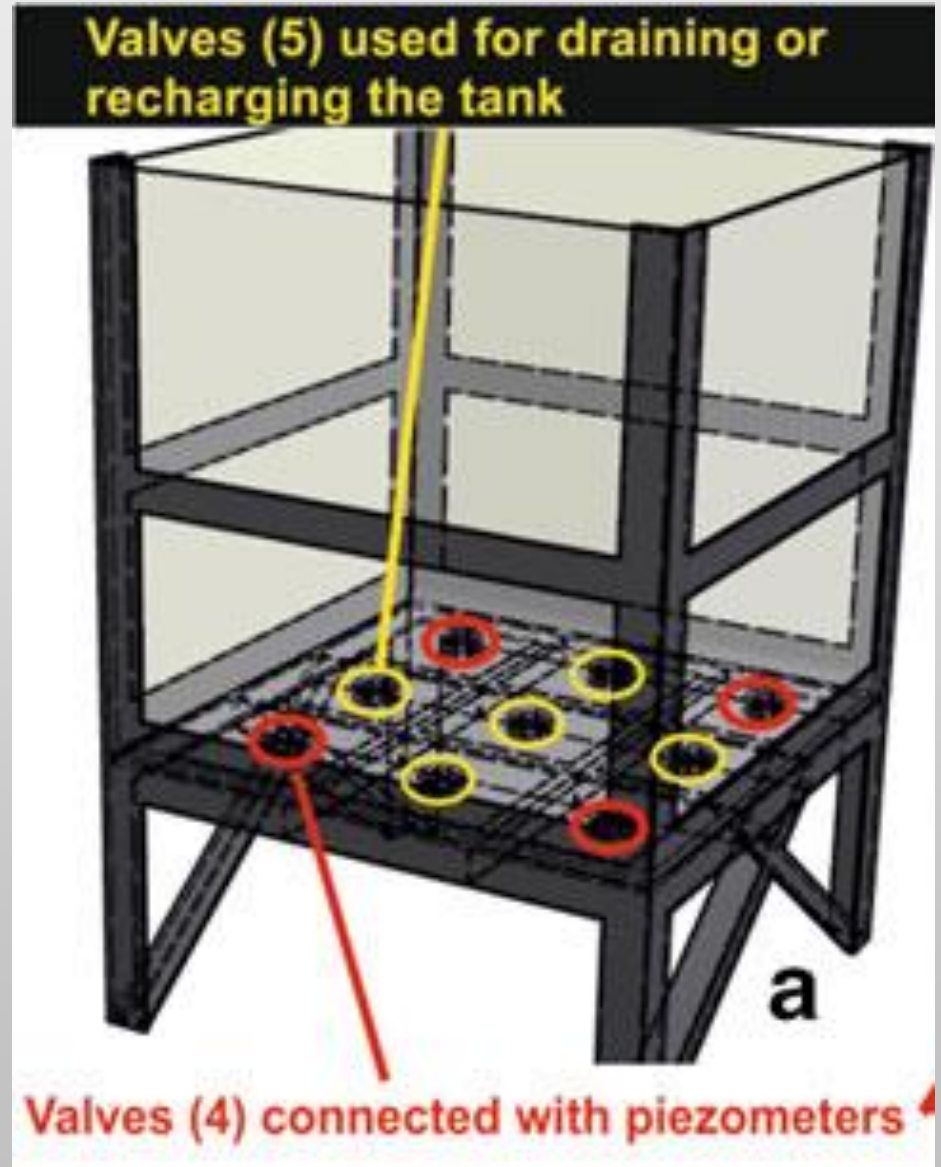
Original Model



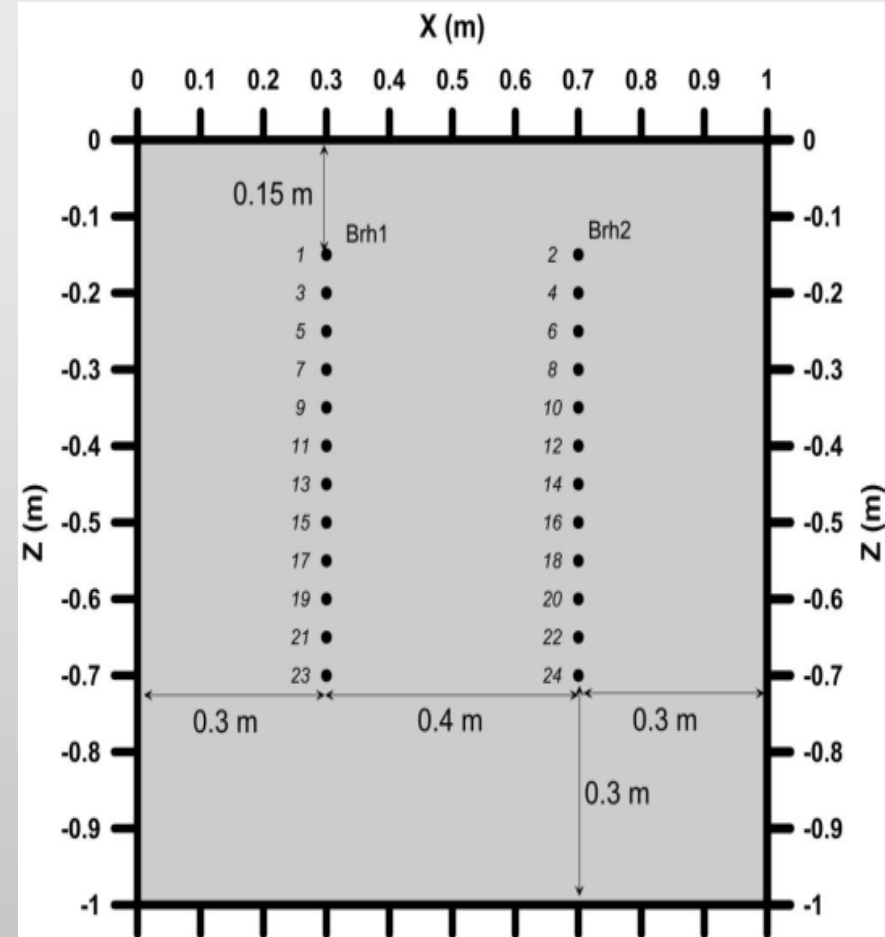
4-D inversion models



Controlled ERT Tank Experiments – First Trials



Controlled ERT Tank Experiments – First Trials



Fine-grained material

Vertical flow of OOMW in an unsaturated-saturated environment

77 crosshole ERT phases every 15min

Table 1 Physico-chemical analysis of OOMW sample

Parameter	Value
pH	4.77
DO (dissolved oxygen), mg/L	0.22
EC (electrical conductivity), mS/cm	7.6
Phenols, mg/L	80
COD (chemical oxygen demand), g/L	22.3
Viscosity, mPa.s at 40 °C	93
Density, kg/m ³ at 20 °C	1,004.3

Controlled ERT Tank Experiments – First Trials

4-D inversion

Resistivity ratios

1/5

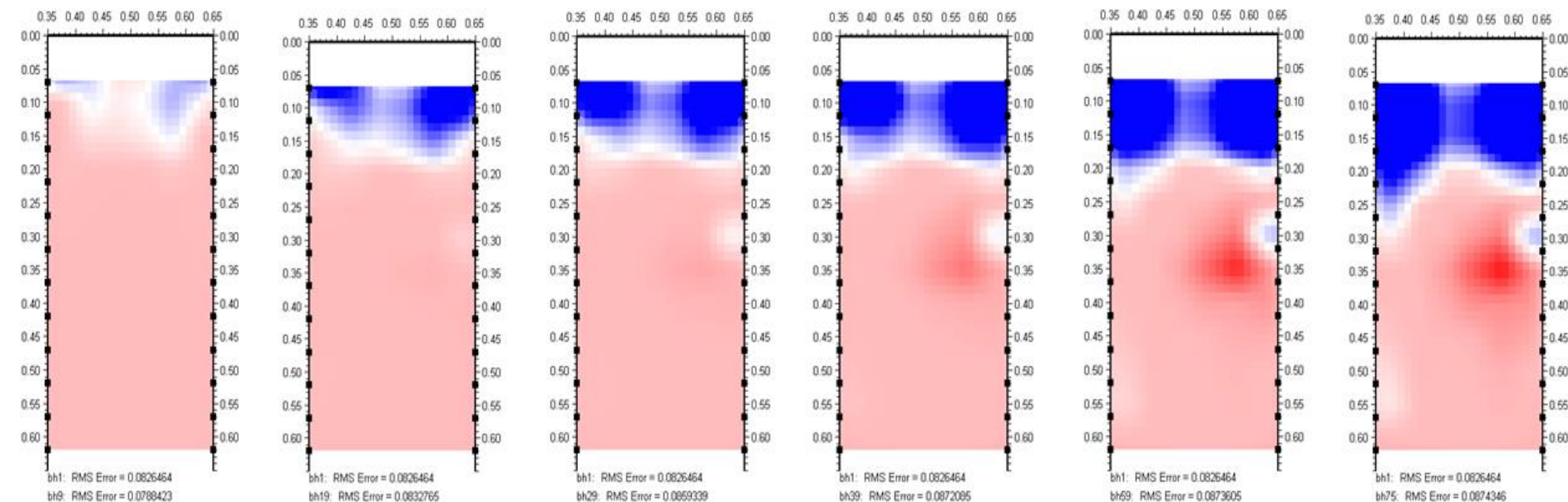
1/10

1/15

1/20

1/30

1/38



Test Sites for Geophysical Monitoring & Mapping



Methods

ERT



Methods

GPR



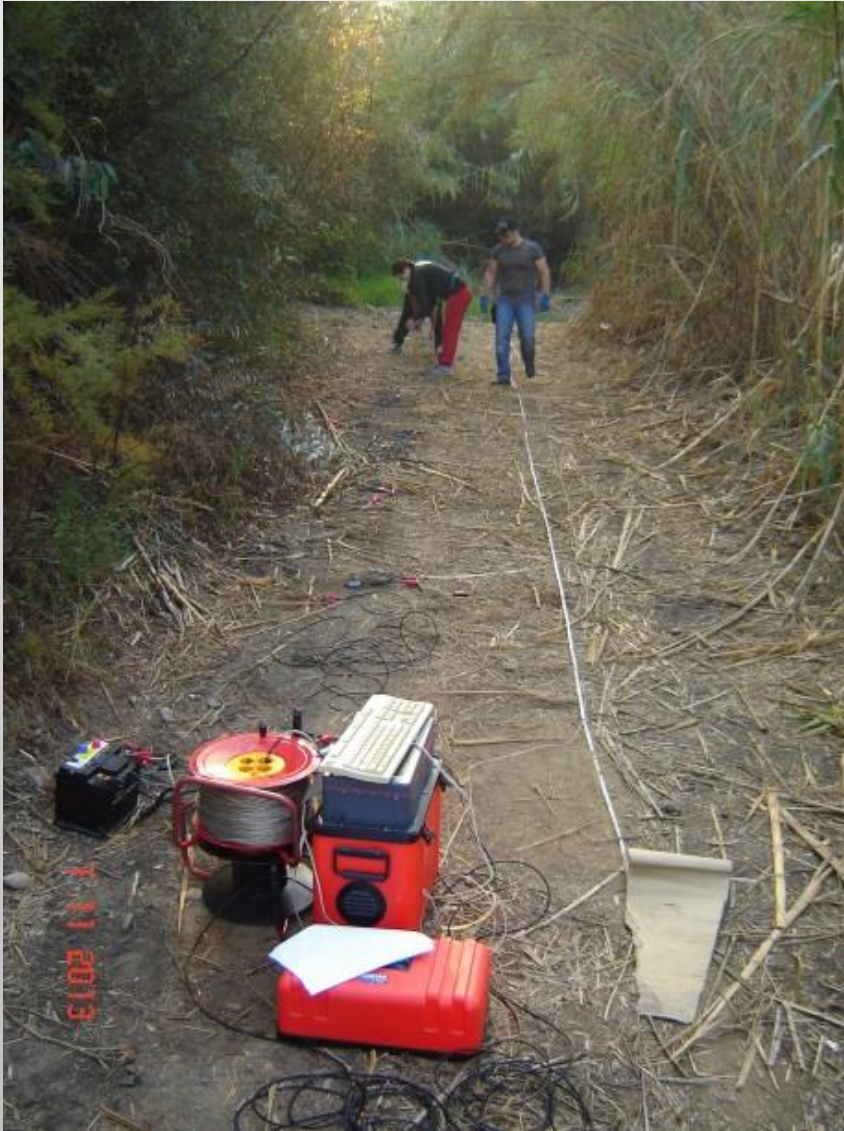
Methods

EM



Methods

Seismic



Methods

SIP

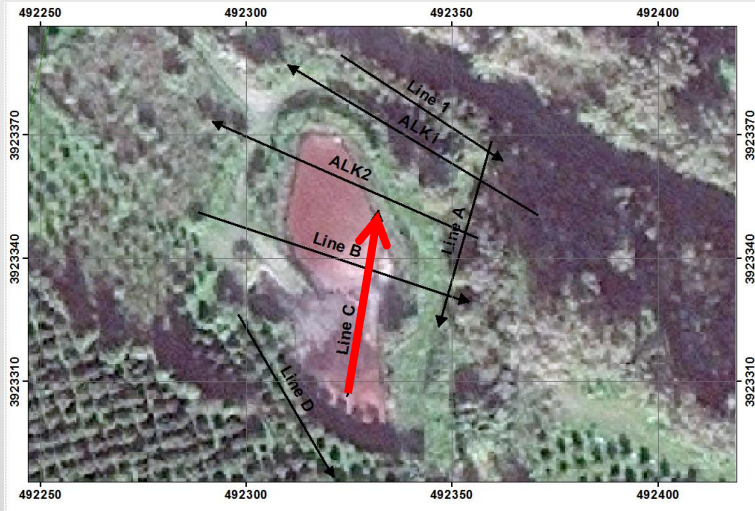


Methods

Self Potential

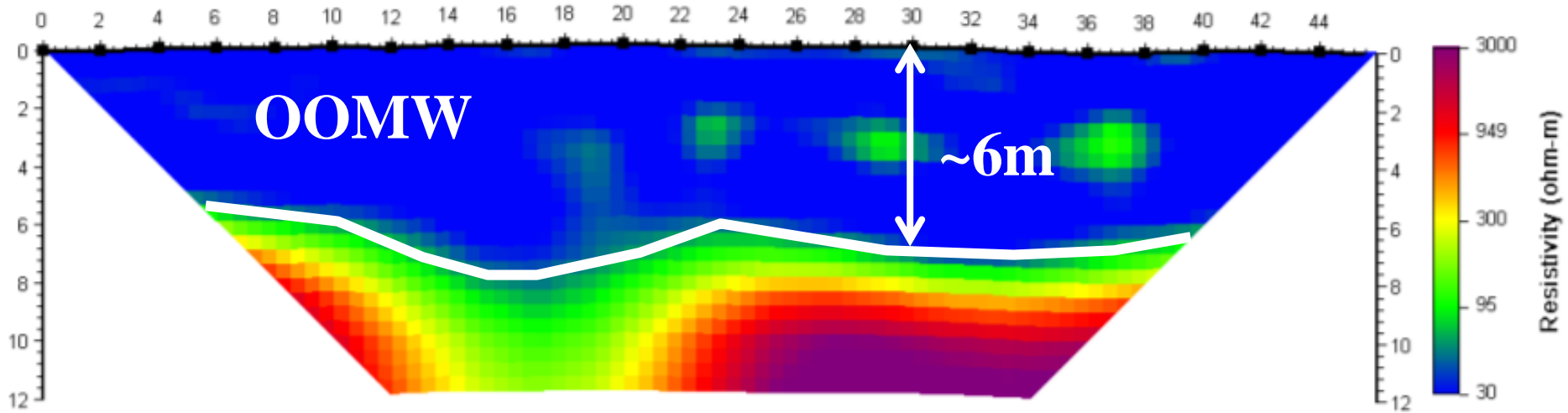


ERT Results – Alikianos: Line C

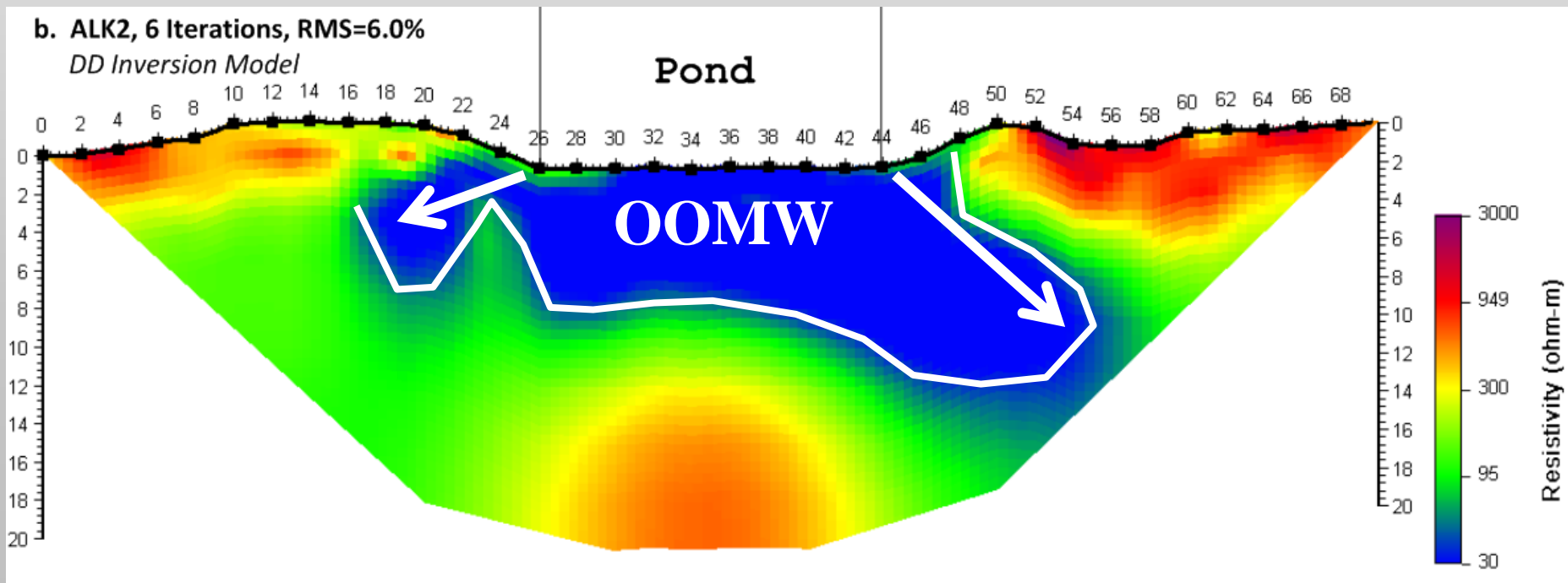
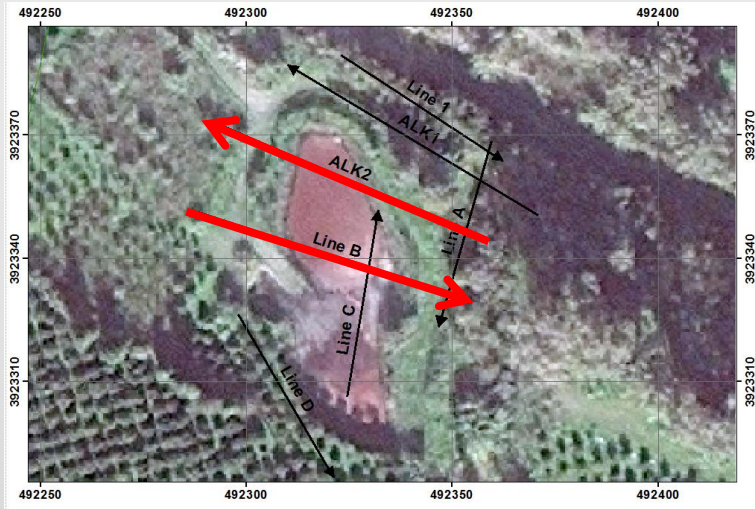


a. Line C, 6 Iterations, RMS=1.8%

WS+DD Inversion Model



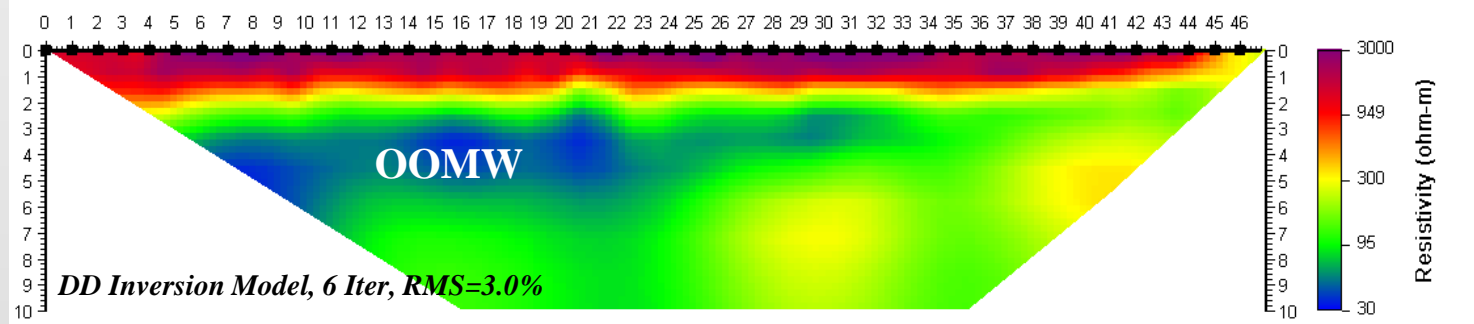
ERT Results – Alikianos: Lines ALK2 & B



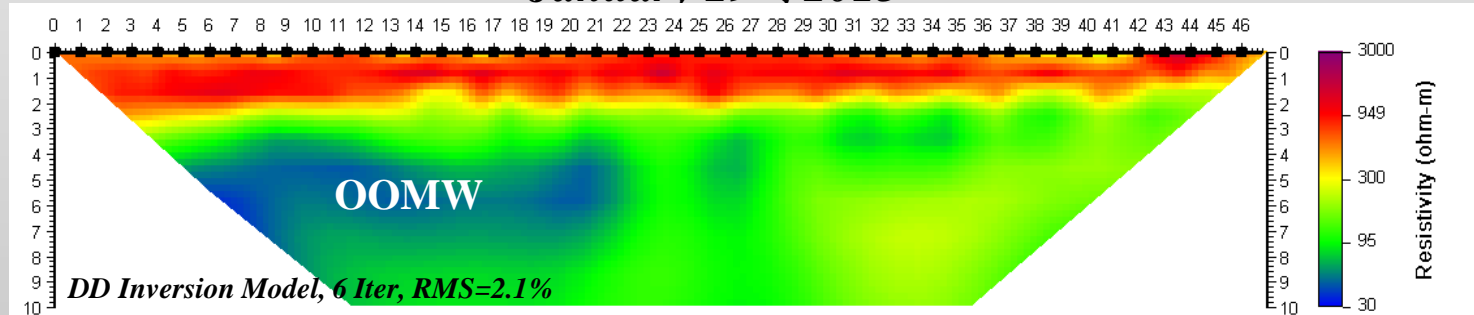
ERT Monitoring Results – Alikianos: Line 1



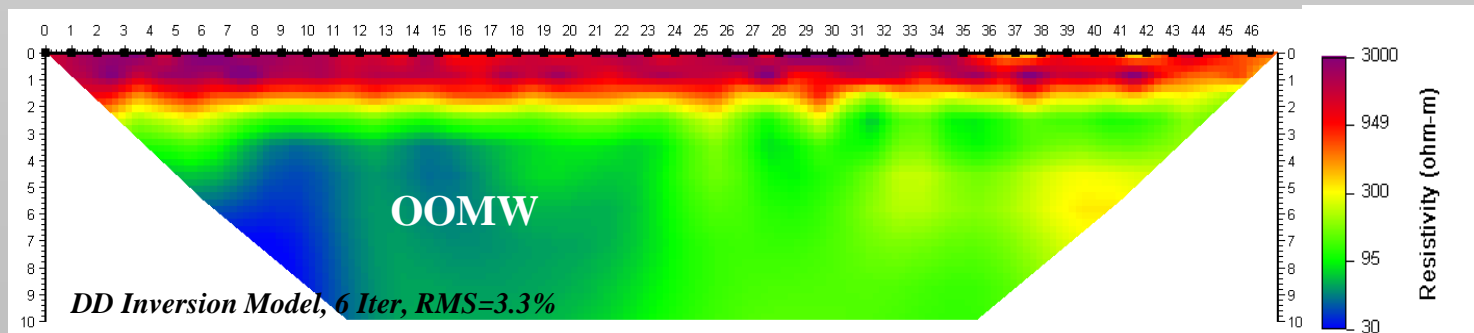
June 8th, 2013



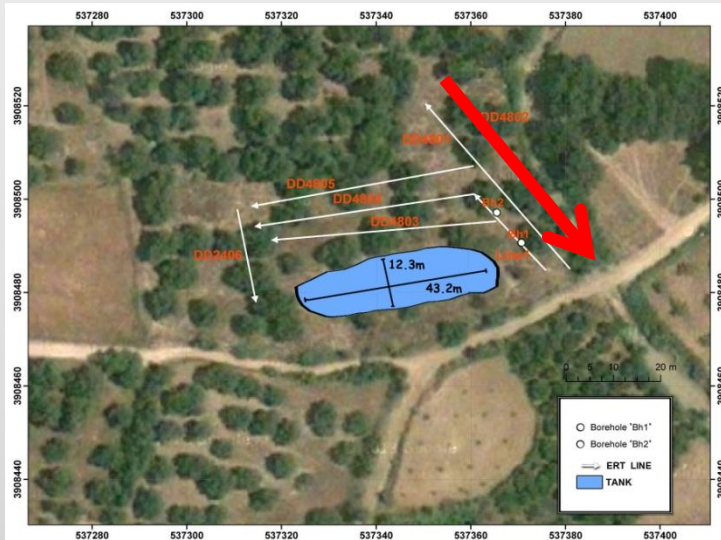
January 29th, 2013



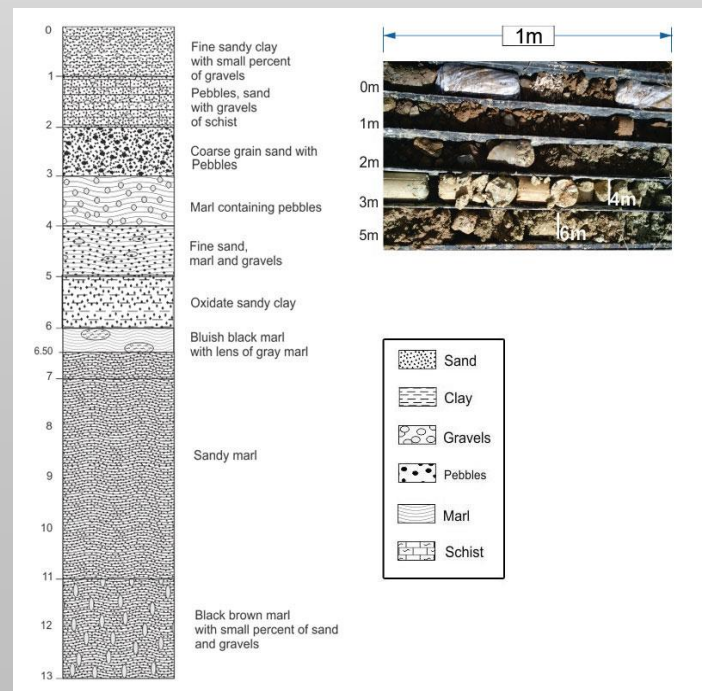
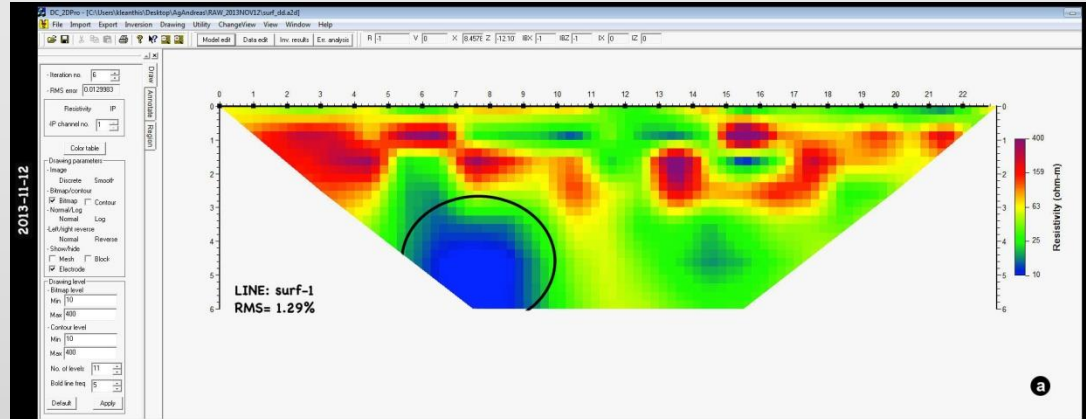
April 30th, 2014



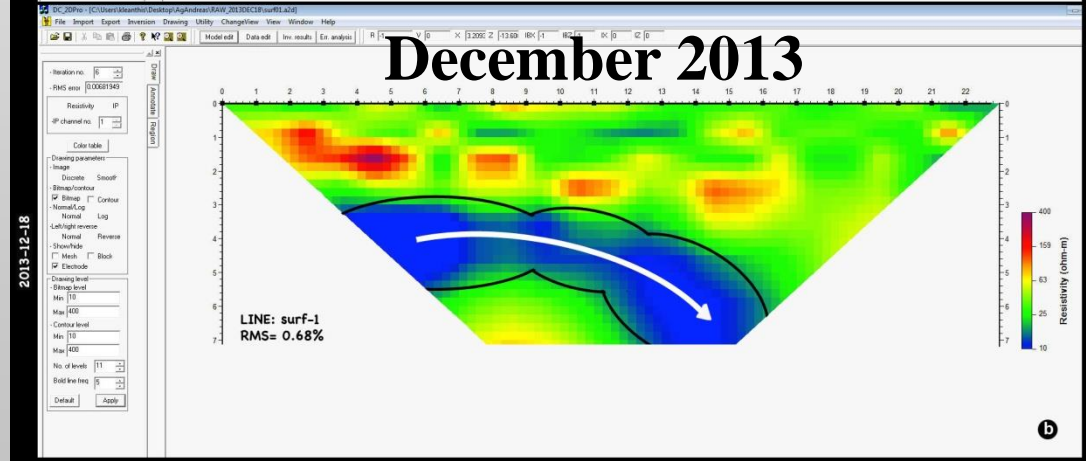
ERT Results – Ag. Andreas: Line 1



November 2013

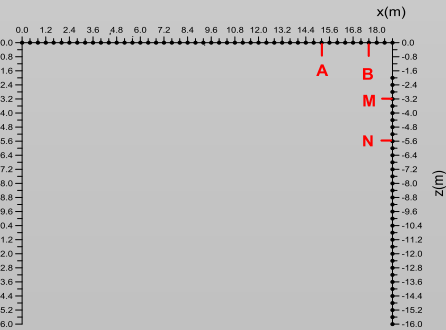
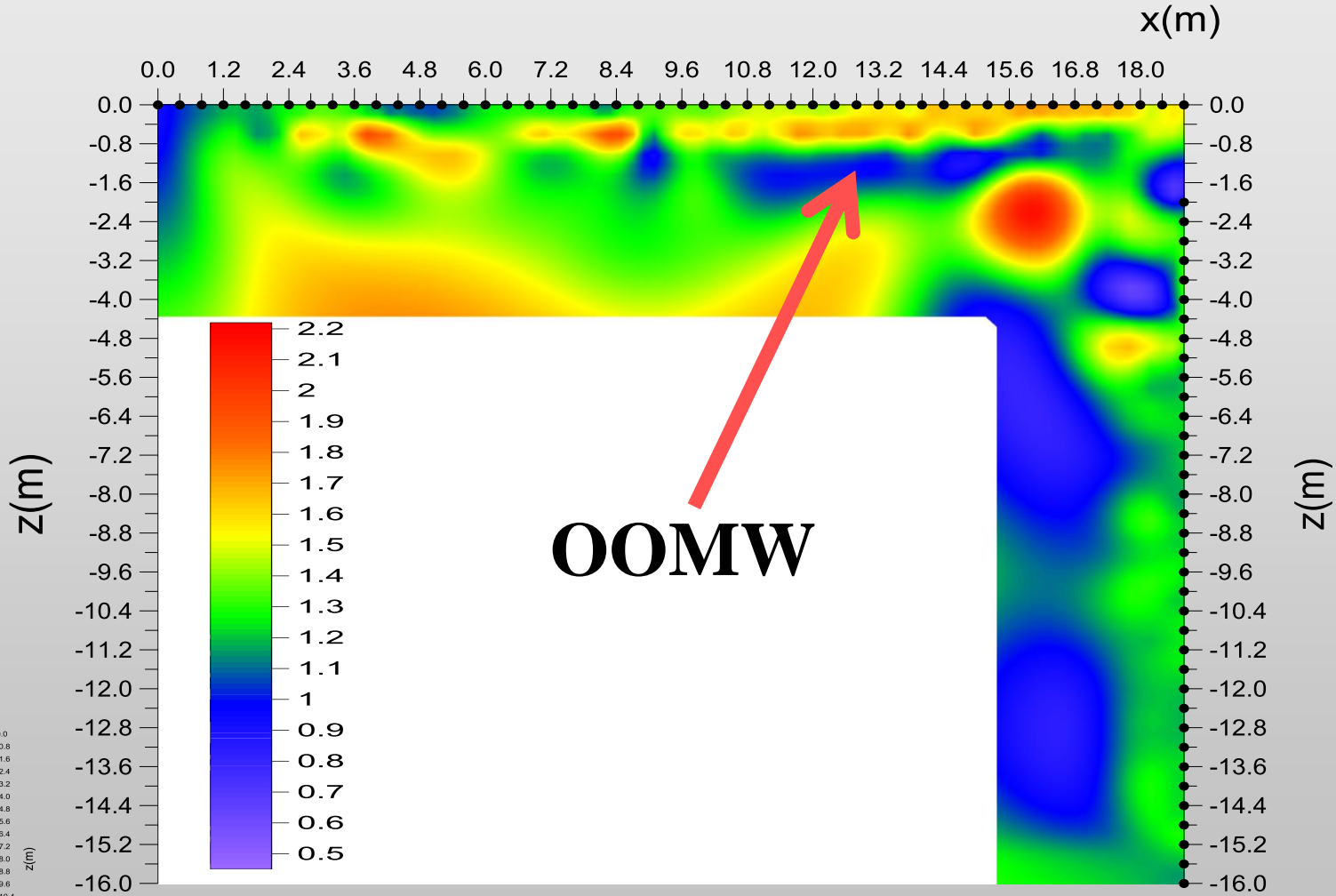


December 2013



ERT Results – Roustika: Surface-to-Borehole

T2 RMS error:4.2%



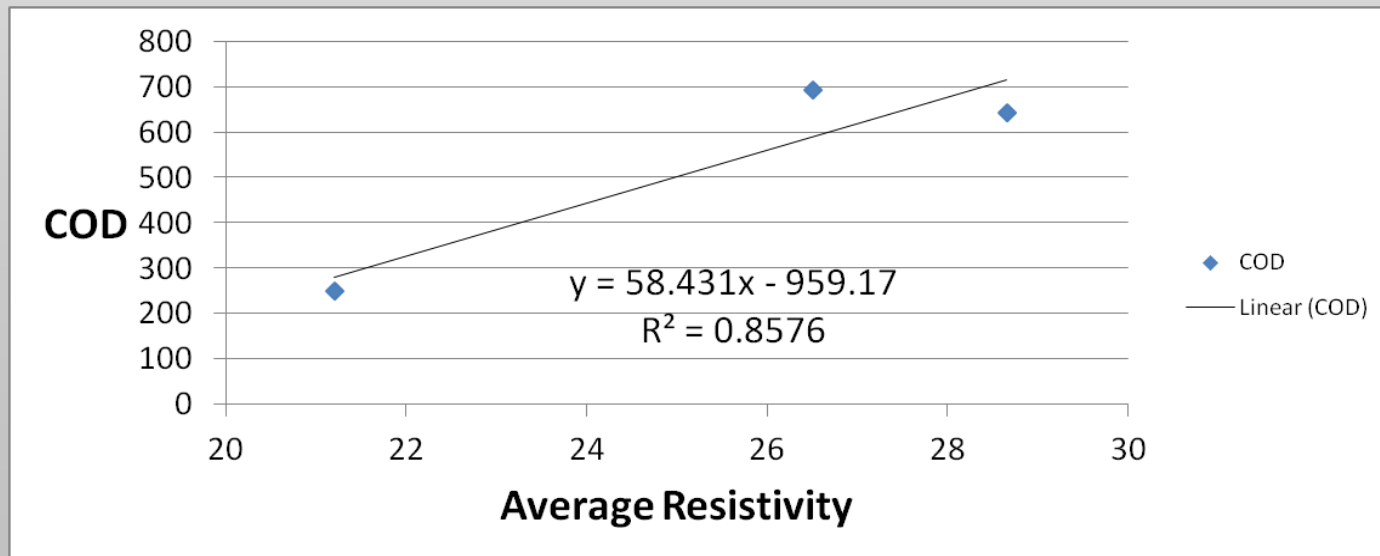
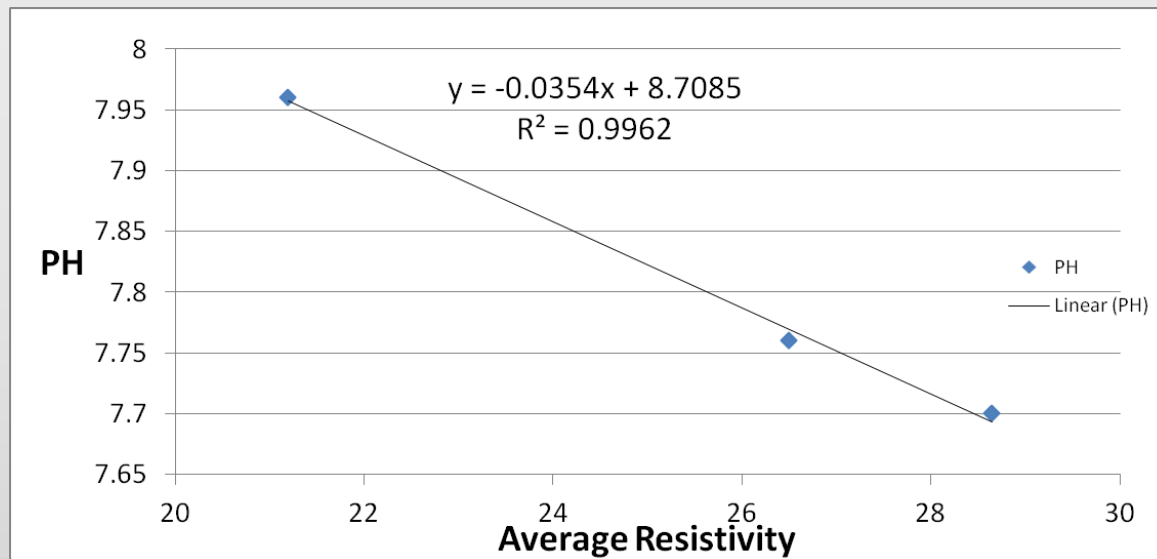
Sampling and Chemical Analysis

Soil Sampling



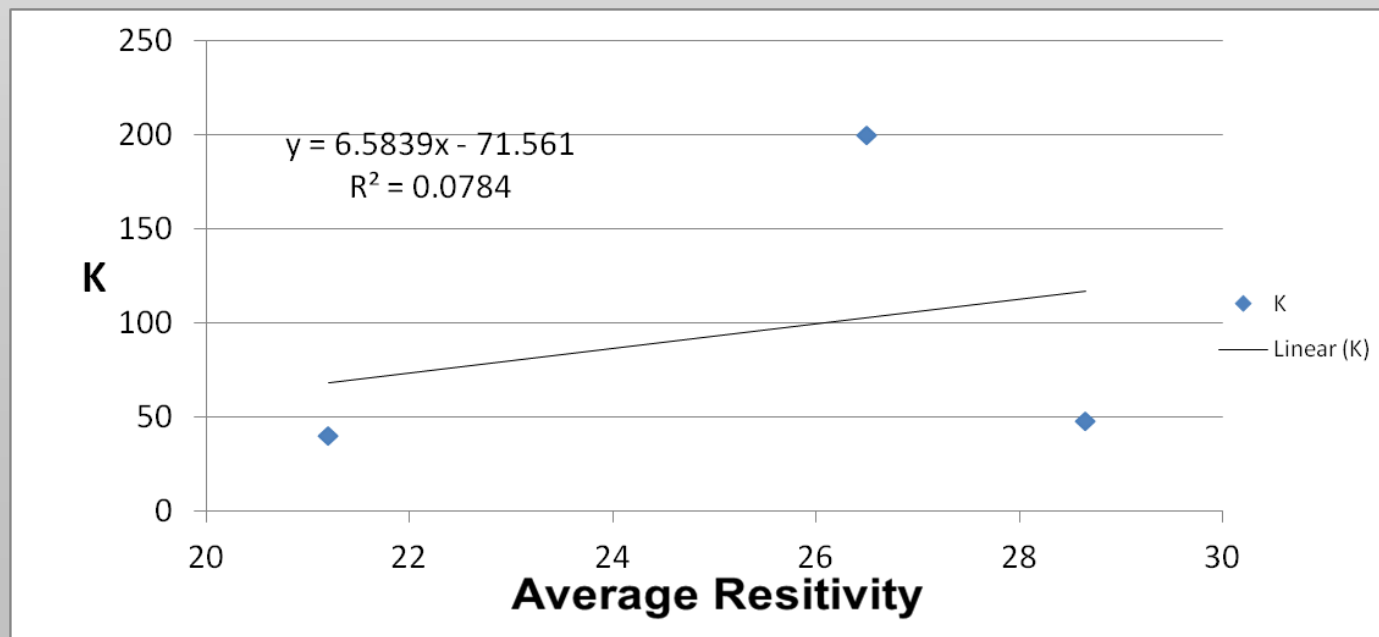
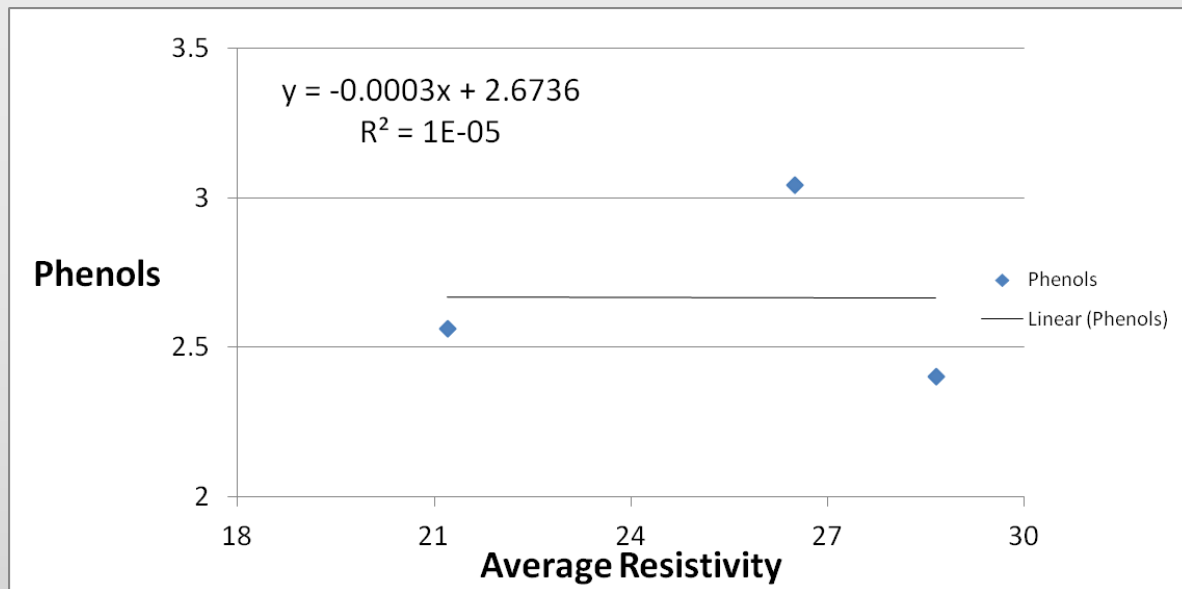
Correlation geophysical-geochemical parameters

	Febr. 11	Mar. 11	May. 11	July. 11
Γ2	7/2/11	16/3/11	11/5/11	19/7/11
Level initial, cm		67	155	165
Level after pumping, cm		72.00	250.00	180.00
pH		7.76	7.70	7.96
EC, μS/cm		1689.00	1550.00	1850.00
EC, S/m		0.17	0.16	0.19
EC, Ohm-m		5.92	6.45	5.41
Phen, mg/L		3.04	2.40	2.56
COD, mg/L		691.67	642.00	250.00
Ni, mg/L		BDL	BDL	BDL
Cu, mg/L		BDL	BDL	BDL
Mn, mg/L		0.90	0.70	0.00
Zn, mg/L		0.07	0.05	0.06
K, mg/L		200.00	48.00	40.00

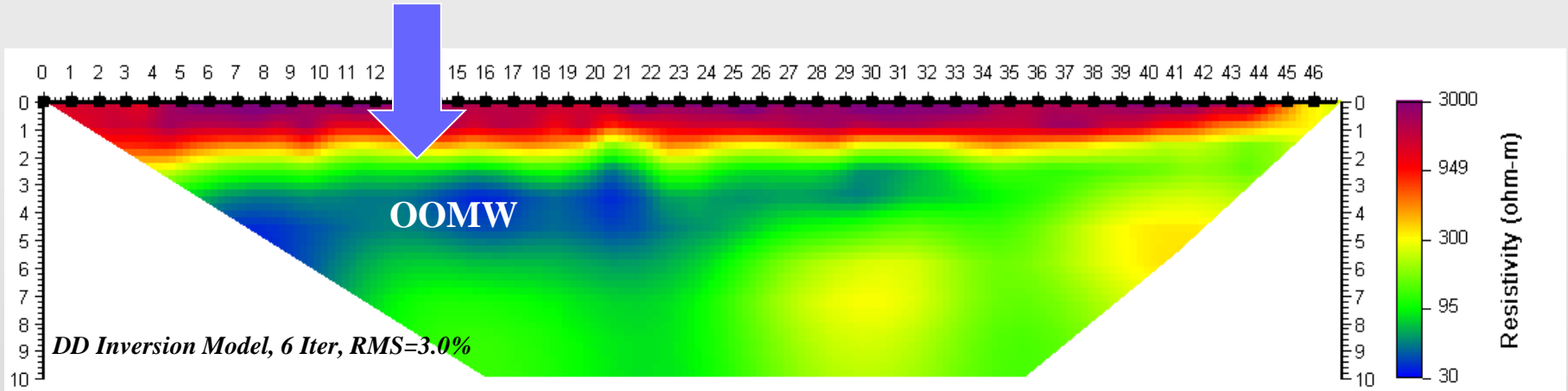


Correlation geophysical-geochemical parameters

	Febr. 11	Mar. 11	May. 11	July. 11
Γ₂	7/2/11	16/3/11	11/5/11	19/7/11
Level initial, cm		67	155	165
Level after pumping, cm		72.00	250.00	180.00
pH		7.76	7.70	7.96
EC, μS/cm		1689.00	1550.00	1850.00
EC, S/m		0.17	0.16	0.19
EC, Ohm-m		5.92	6.45	5.41
Phen, mg/L		3.04	2.40	2.56
COD, mg/L		691.67	642.00	250.00
Ni, mg/L		BDL	BDL	BDL
Cu, mg/L		BDL	BDL	BDL
Mn, mg/L		0.90	0.70	0.00
Zn, mg/L		0.07	0.05	0.06
K, mg/L		200.00	48.00	40.00



Field Verification – Alikianos Line 1



Web based GIS Risk Modeling and Assessment

Risk Assessment Modeling Techniques in Crete (Rethymno)

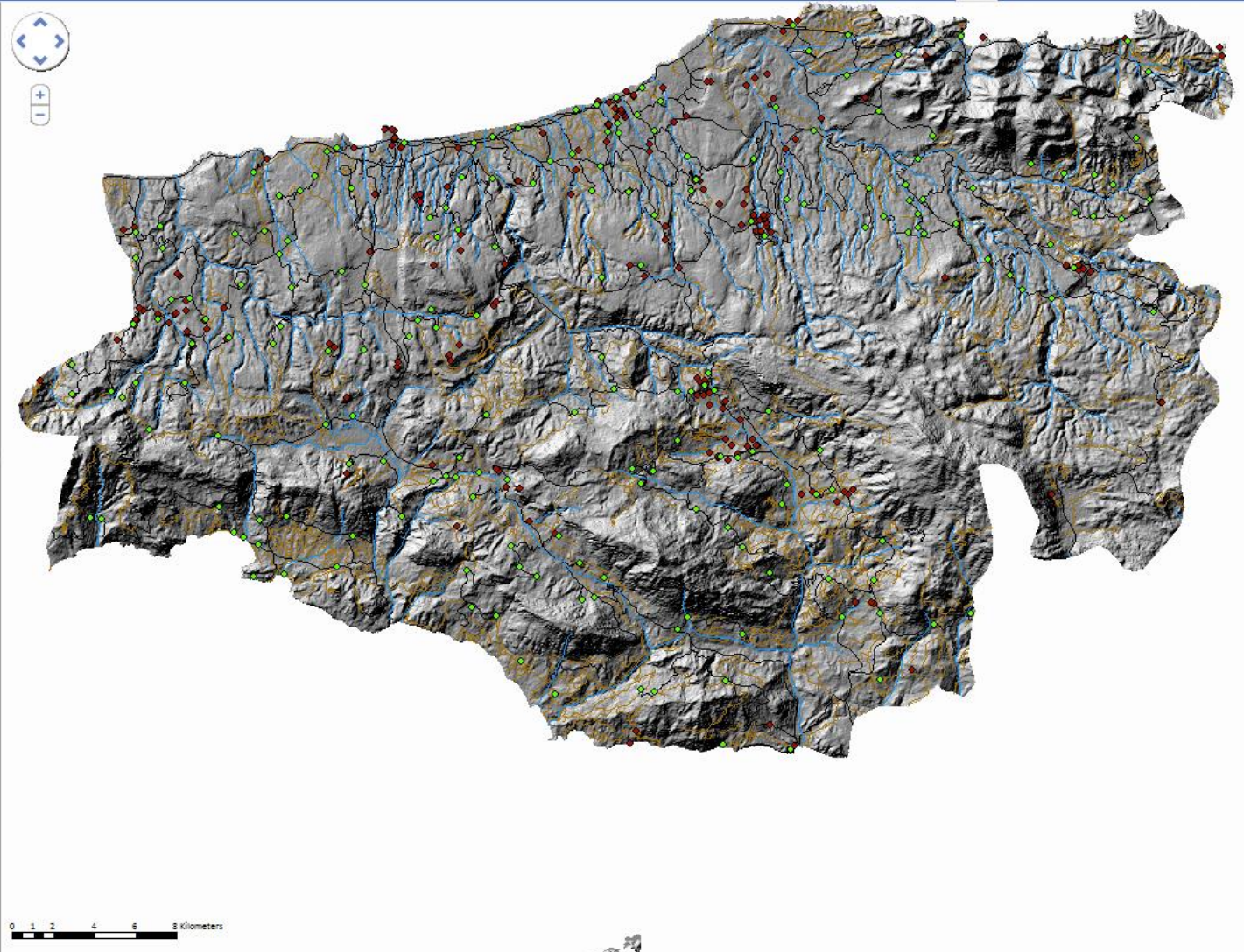


Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment

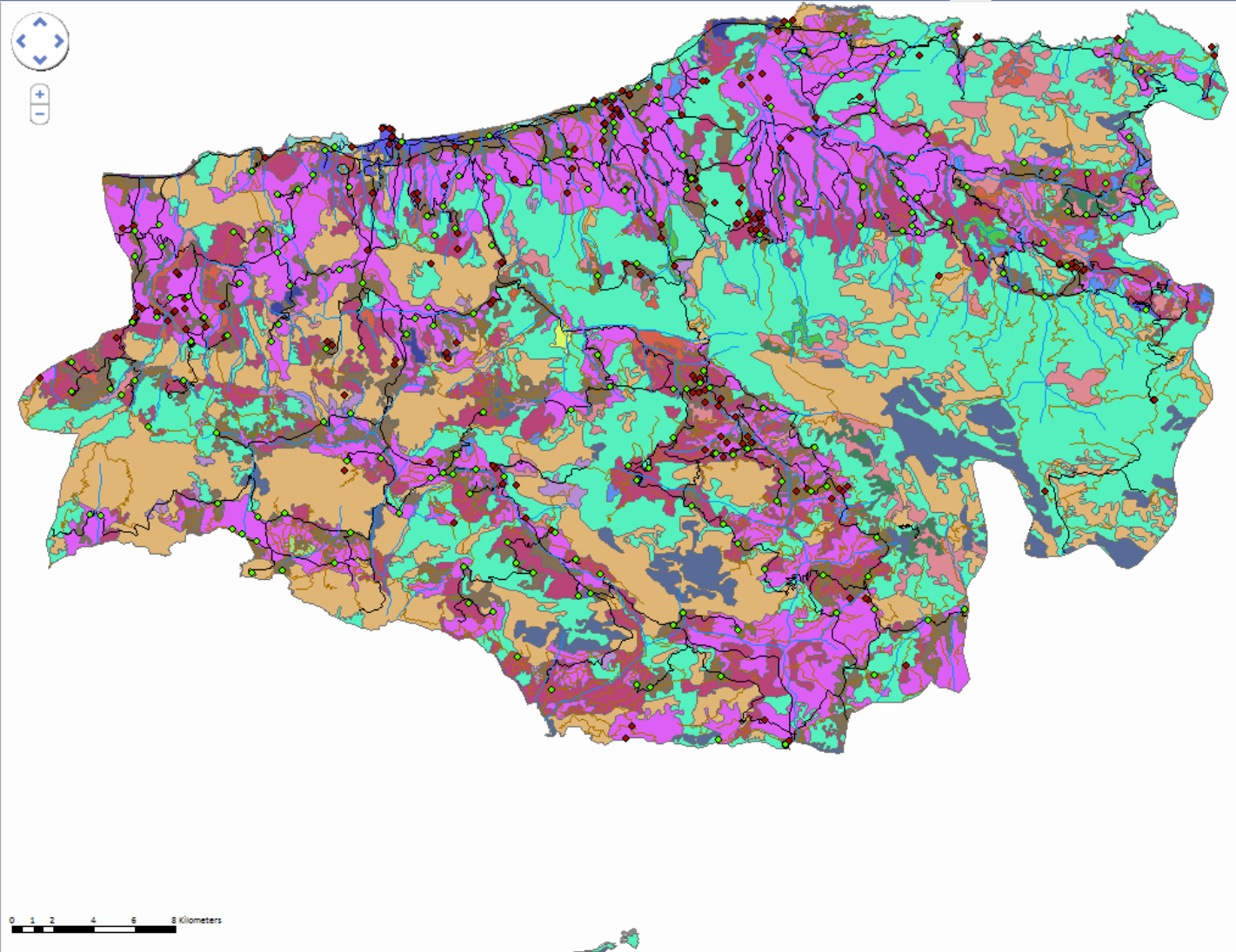


Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

- Results
- Map Contents
- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Beaches, dunes, sands
 - Broad-leaved forest
 - Complex cultivation patterns
 - Coniferous forest
 - Discontinuous urban fabric
 - Fruit trees and berry plantations
 - Industrial or commercial units
 - Land principally occupied by agricul
 - Mineral extraction sites
 - Mixed forest
 - Natural grasslands
 - Non-irrigated arable land
 - Olive groves
 - Pastures
 - Port areas
 - Sclerophyllous vegetation
 - Sparsely vegetated areas
 - Sport and leisure facilities
 - Transitional woodland-shrub
 - Vineyards
 - Hydrolithology



Risk Assessment Modeling Techniques in Crete (Rethymno)

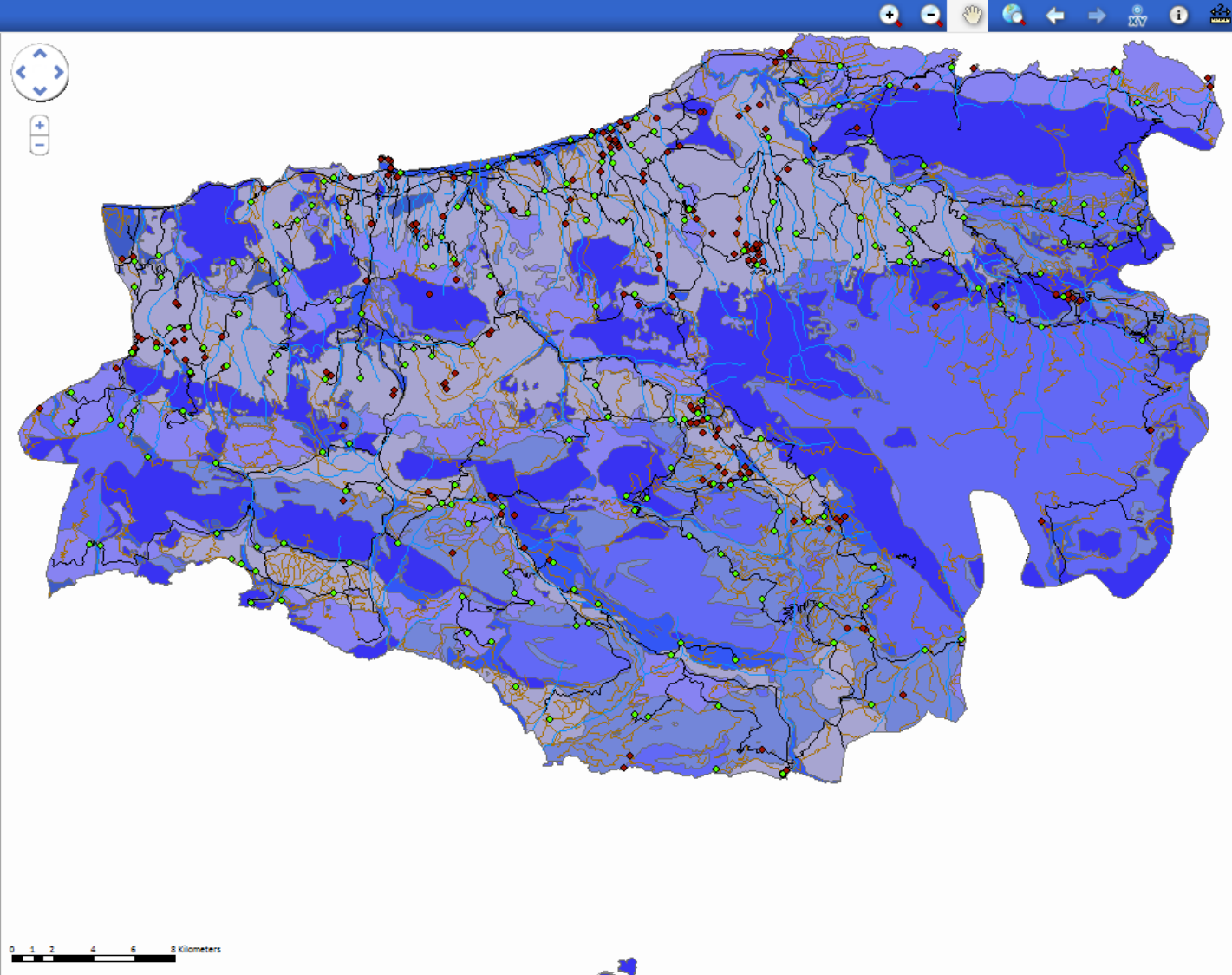


Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Granular mainly alluvial deposits of var
 - Granular non-alluvial deposits of low to
 - Karstic formations of high to moderate p
 - Karstic formations of moderate to low pe
 - Miocene-Pliocene deposits and moderat
 - Practically impermeable formations of Ic
 - Practically impermeable or selective circ
 - Geology
 - HillShade
 - Assessment

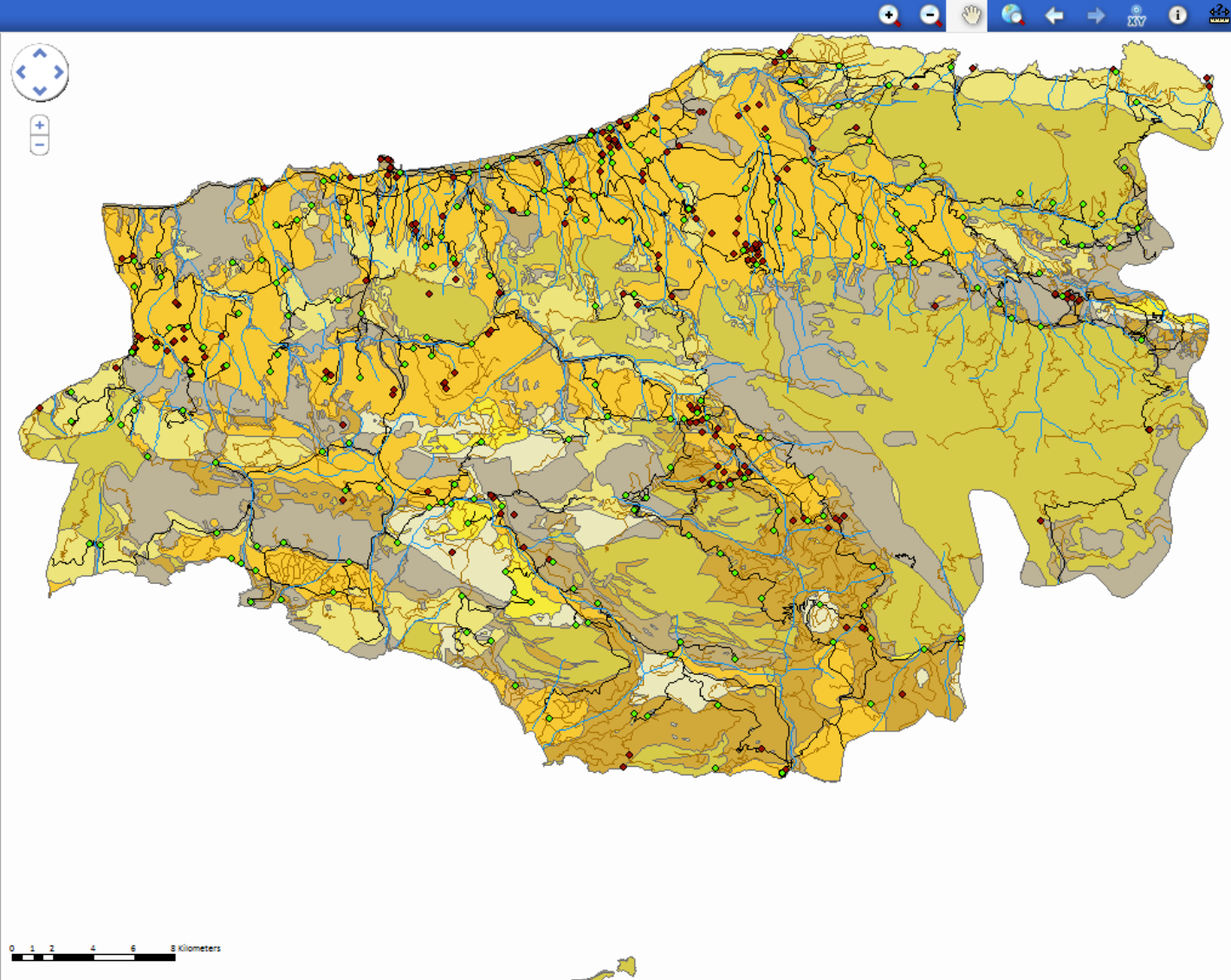


Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

- Results
- Map Contents
 - RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - Alluvial
 - Deposits
 - Dolomites
 - Flysch
 - Gneiss
 - Limestones
 - Marls-Marly limestones
 - Metamorphic rocks
 - Ophiolites
 - HillShade
 - Assessment



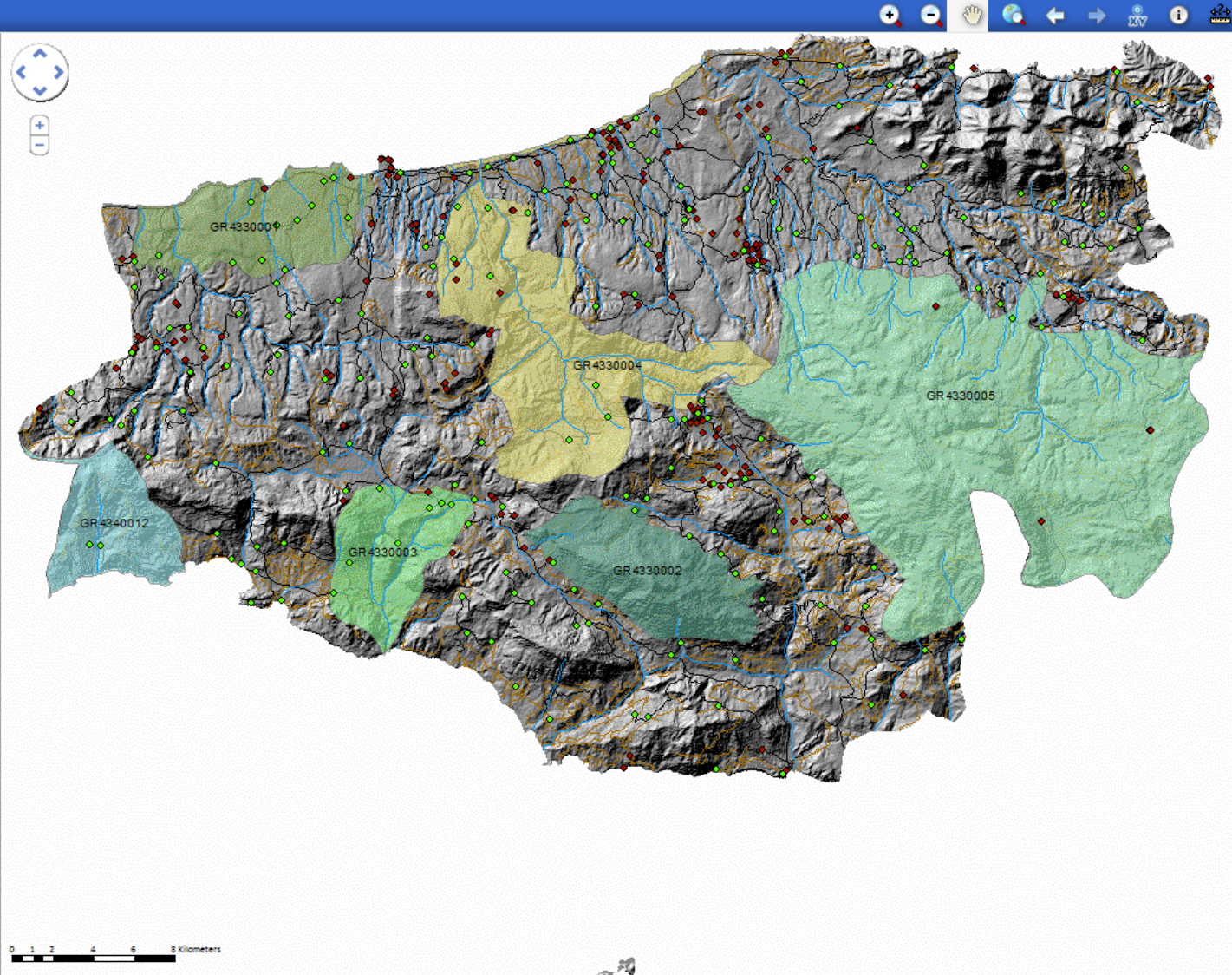


Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment



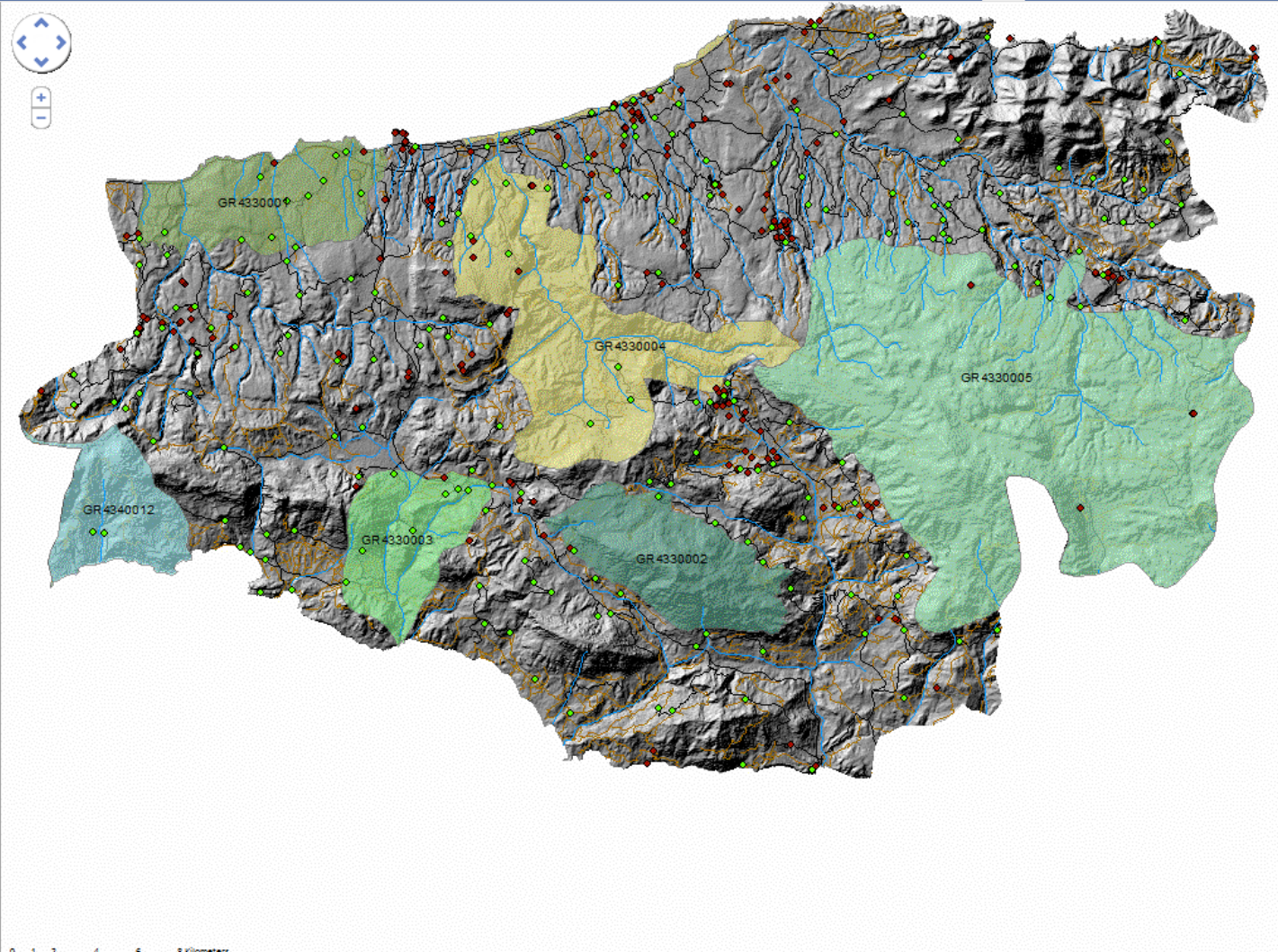


Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment

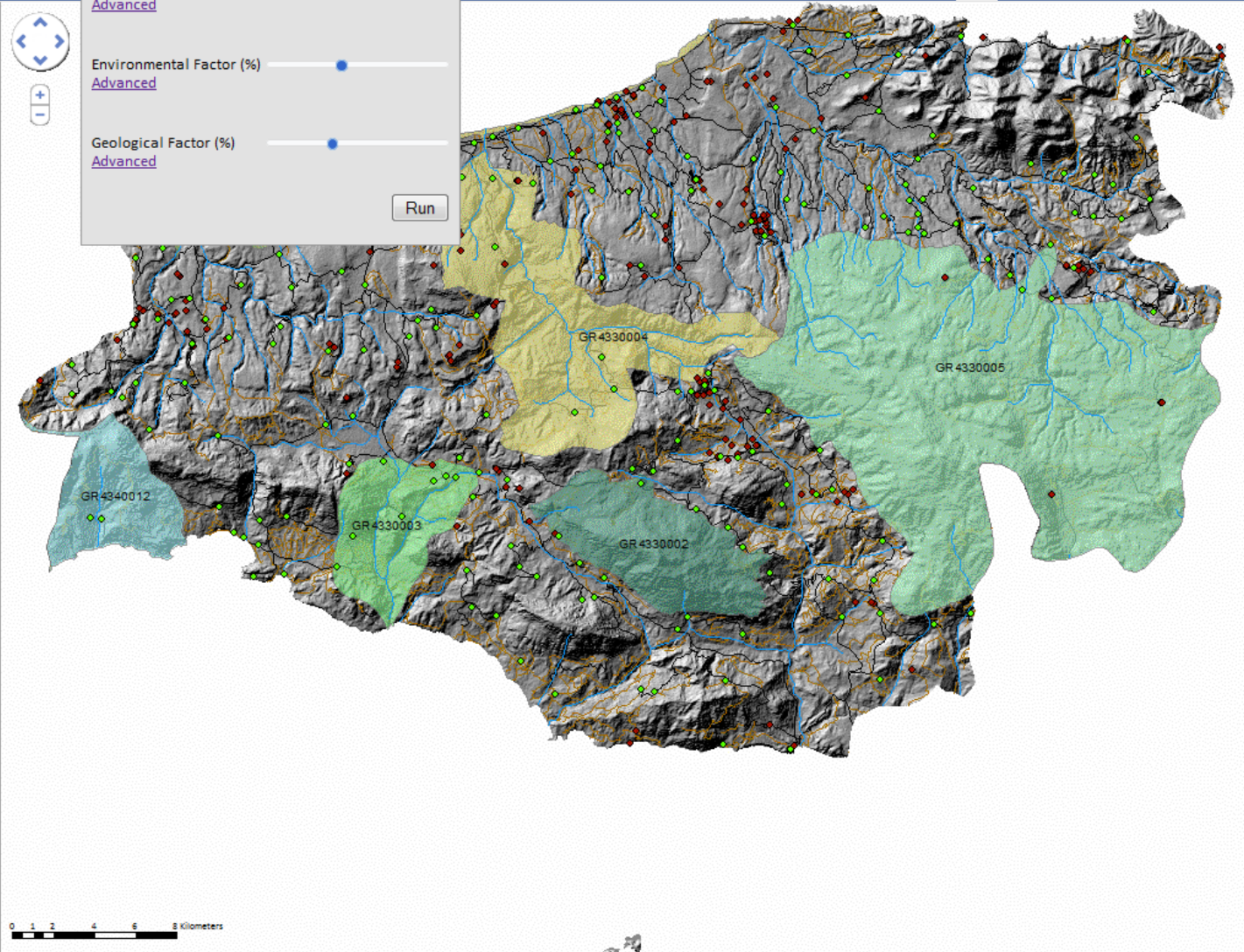
Select Modeling Technique

Modeling Technique: Weighted Overlay

Anthropogenic Factor (%) [Advanced](#)

Environmental Factor (%) [Advanced](#)

Geological Factor (%) [Advanced](#)



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment

Select Modeling Technique

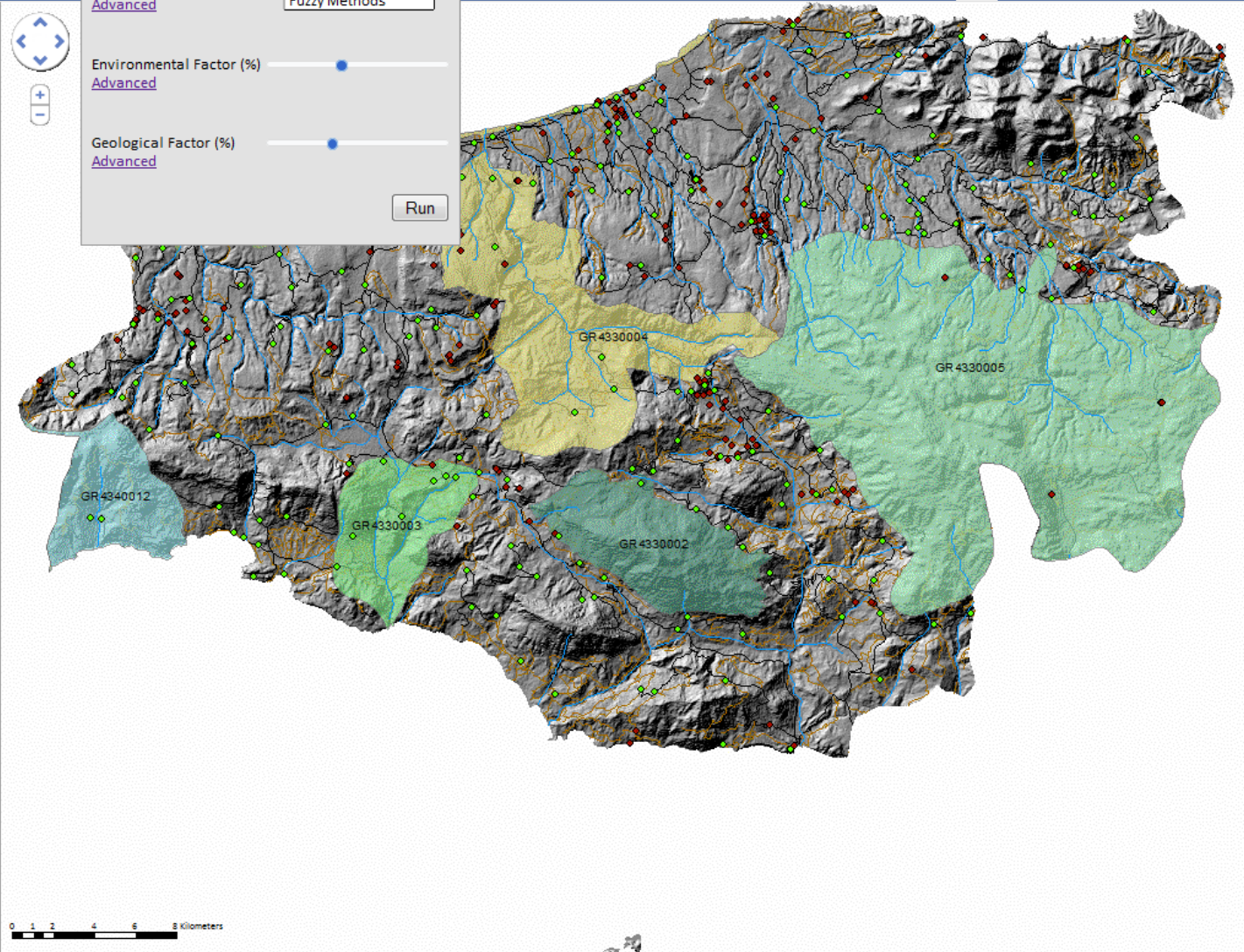
Modeling Technique: Weighted Overlay

Anthropogenic Factor (%): AHP

Environmental Factor (%): Advanced

Geological Factor (%): Advanced

Run





Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment

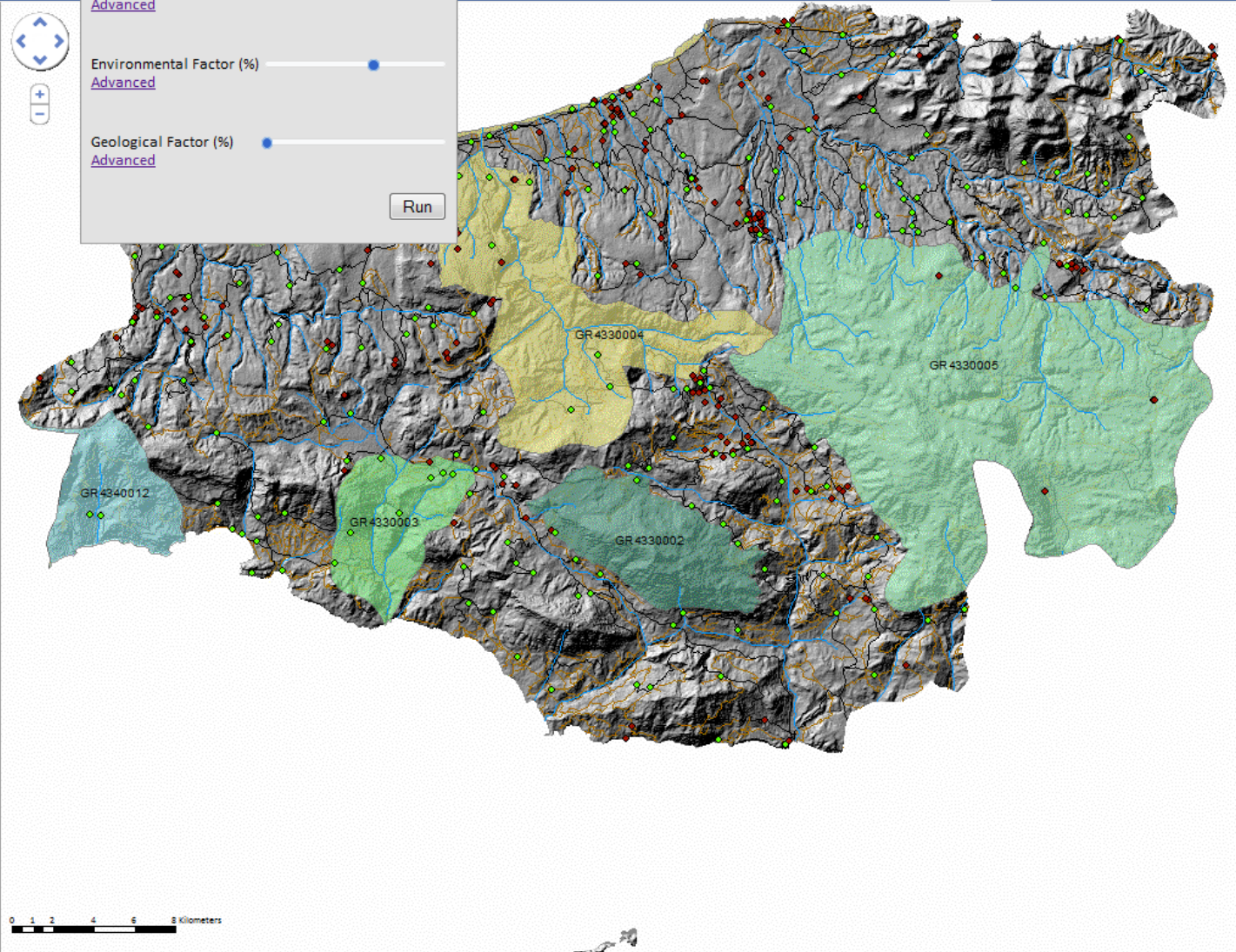
Select Modeling Technique

Modeling Technique: Weighted Overlay

Anthropogenic Factor (%) [Advanced](#)

Environmental Factor (%) [Advanced](#)

Geological Factor (%) [Advanced](#)



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment



Select Modeling Technique

Modeling Technique: **Weighted Overlay**

Anthropogenic Factor (%) [Simple](#)

Residential Area (%)

Roads Main (%)

Roads Secondary (%)

Environmental Factor (%) [Simple](#)

Slope (%)

Archaeological Site Area (%)

Lake Area (%)

River Area (%)

Natura Area (%)

Coast Line (%)

LandUse - Corine (%)

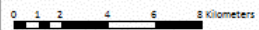
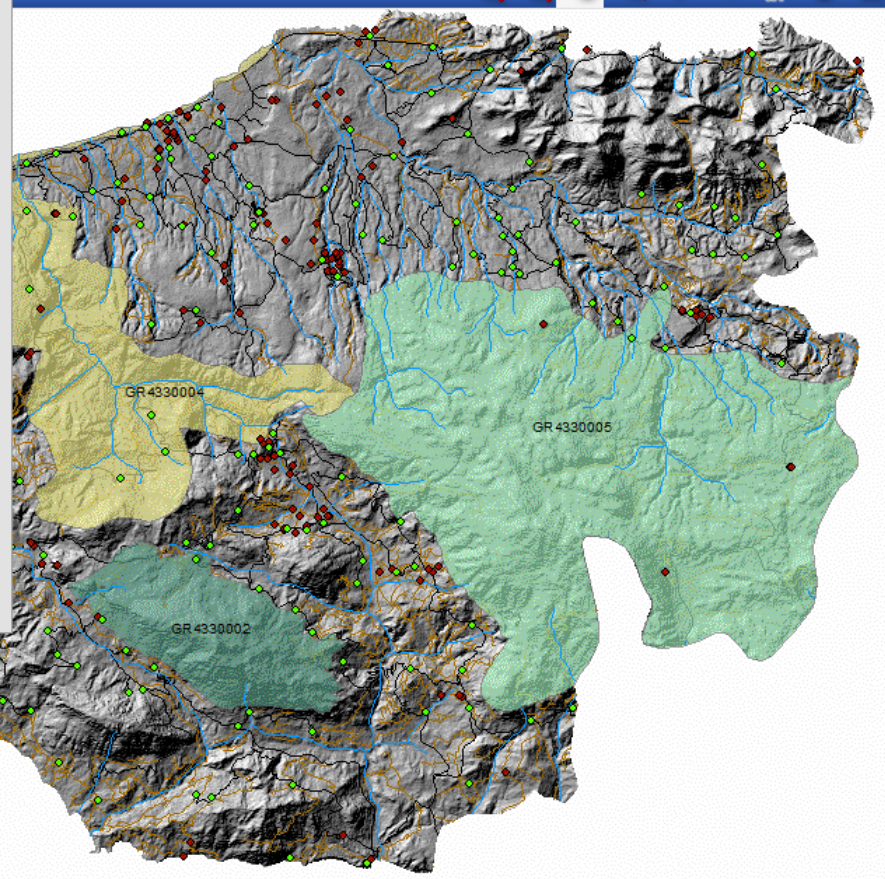
Geological Factor (%) [Simple](#)

Hydrolithology (%)

Geology (%)

Faults (%)

Run



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment



Select Modeling Technique

Modeling Technique: Weighted Overlay

Anthropogenic Factor (%)

[Simple](#)

Residential Area (%)

Roads Main (%)

Roads Secondary (%)

Environmental Factor (%)

[Simple](#)

Slope (%)

Archaeological Site Area (%)

Lake Area (%)

River Area (%)

Natura Area (%)

Coast Line (%)

LandUse - Corine (%)

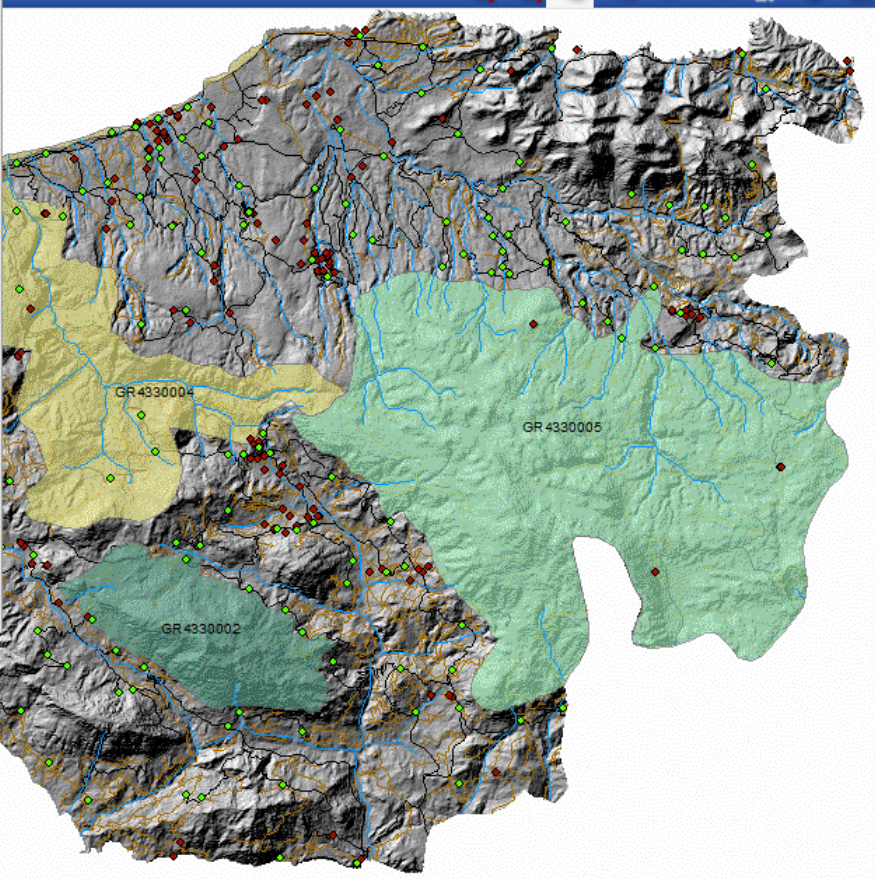
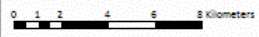
Geological Factor (%)

[Simple](#)

Hydrolithology (%)

Geology (%)

Faults (%)



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

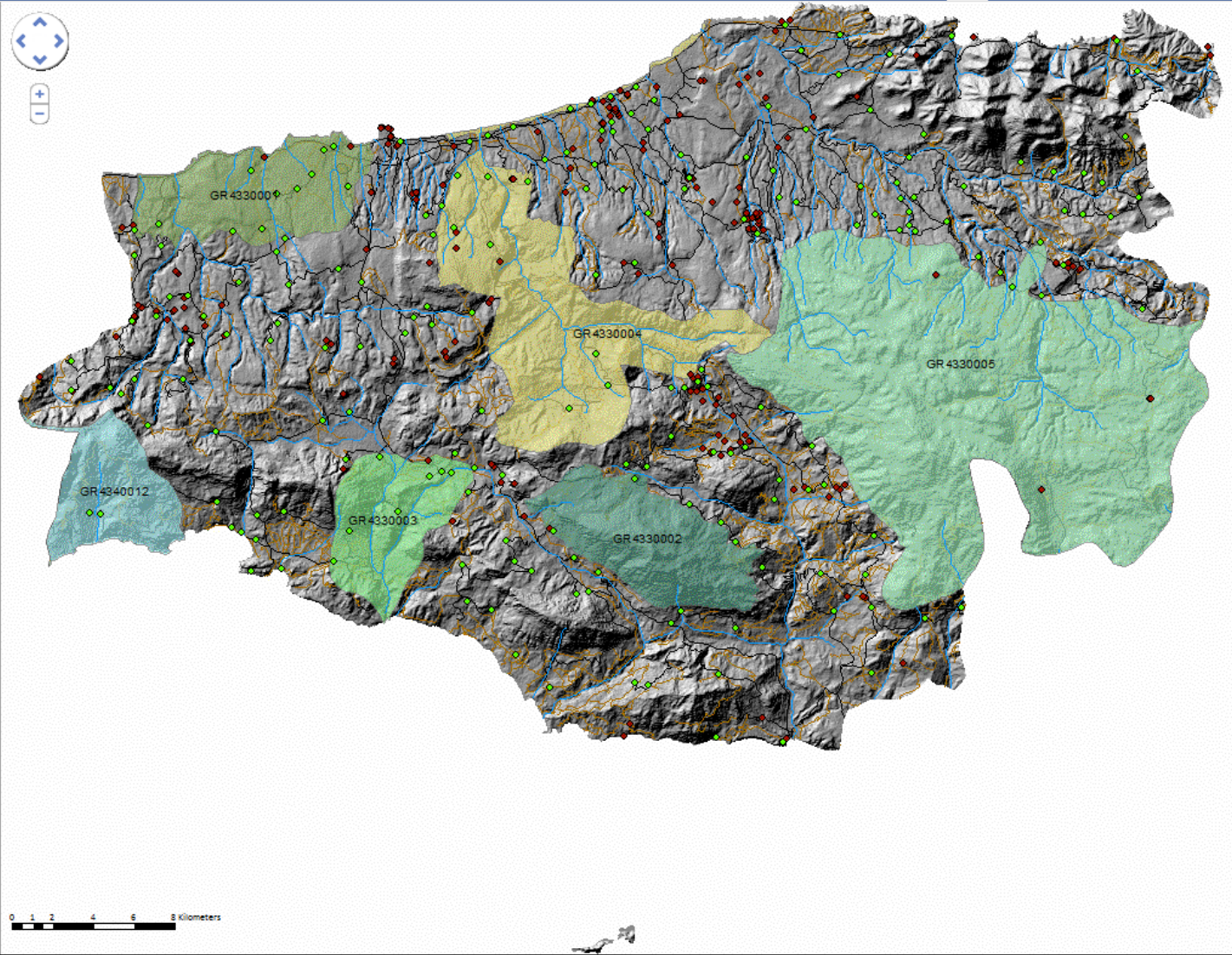
Results

[Clear All](#)

Submitted Select Modeling Technique [Cancel](#)

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

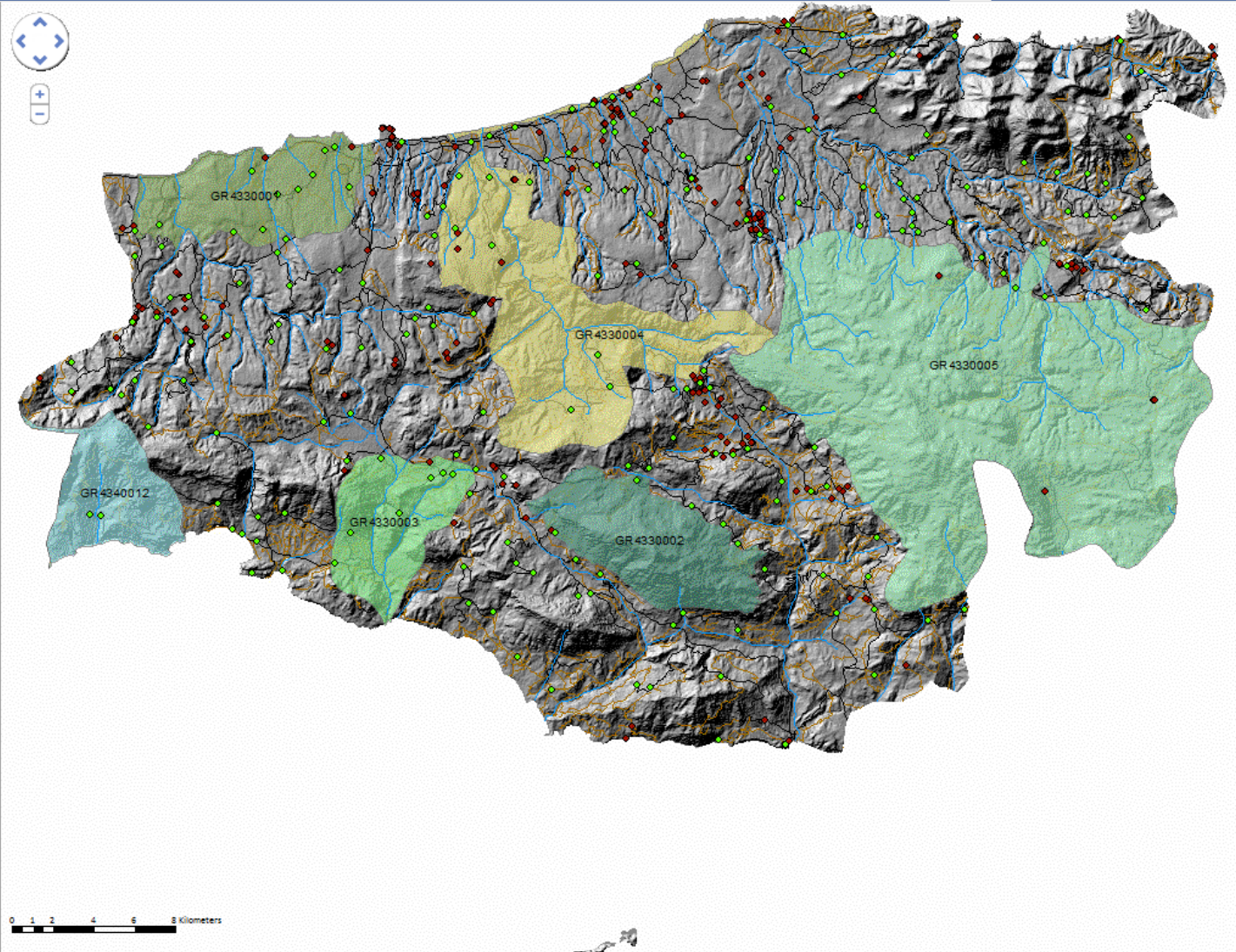
[Clear All](#)

Executing Select Modeling Technique [Cancel](#)

- Inputs
- Messages
 - Submitted.
 - Executing...
 - Executing (Assessment): Assessment WO 57 702
 - Start Time: Fri Aug 17 15:03:12 2012

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - GR4330001
 - GR4330002
 - GR4330003
 - GR4330004
 - GR4330005
 - GR4340012
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment





Select Modeling Technique

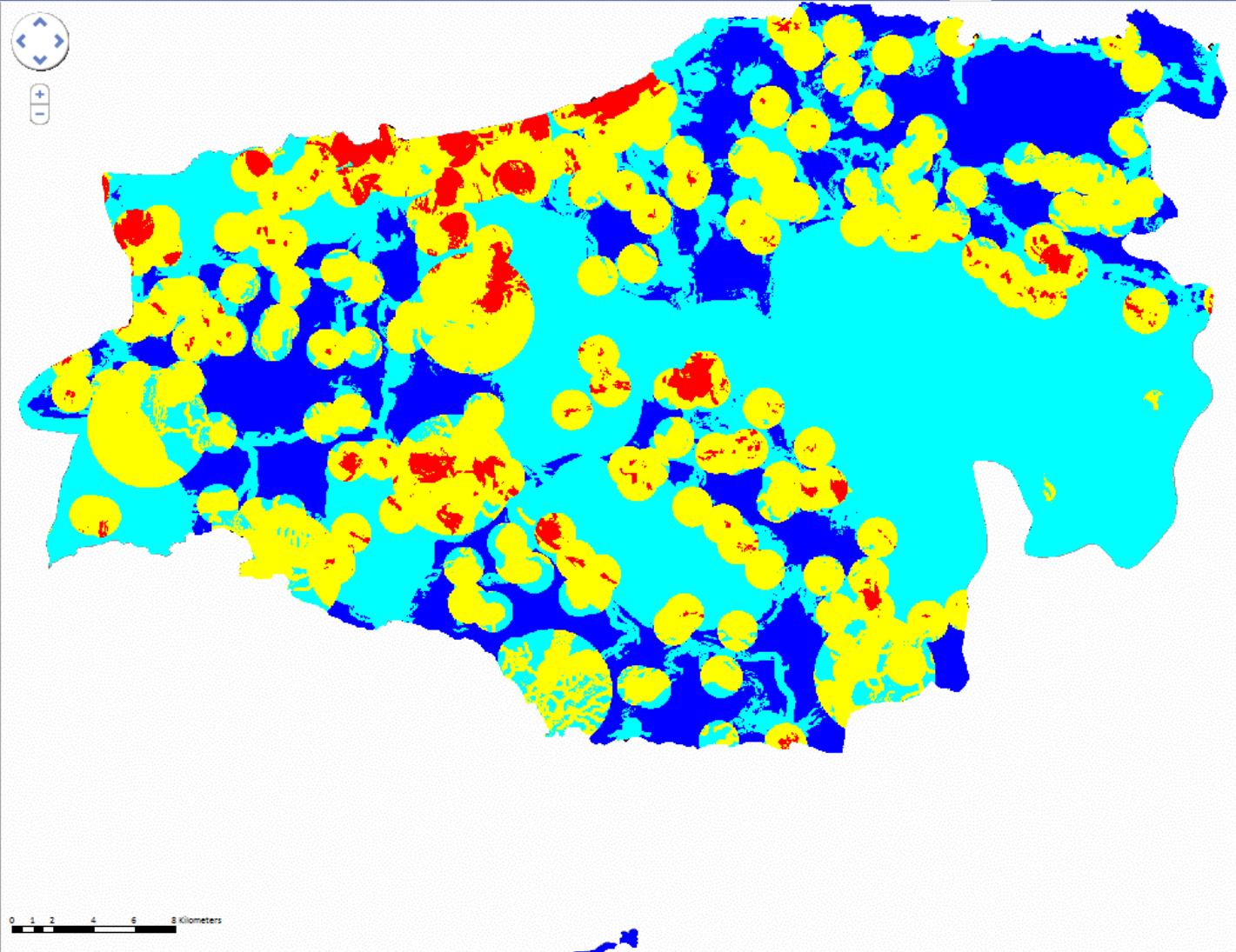
Results

[Clear All](#)

- Select Modeling Technique Results
 - Suitability
 - Google Earth file [Download](#)
 - Inputs
 - Messages

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment
 - Suitability
 - 0 - 2
 - 2 - 5
 - 5 - 8
 - 8 - 10



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

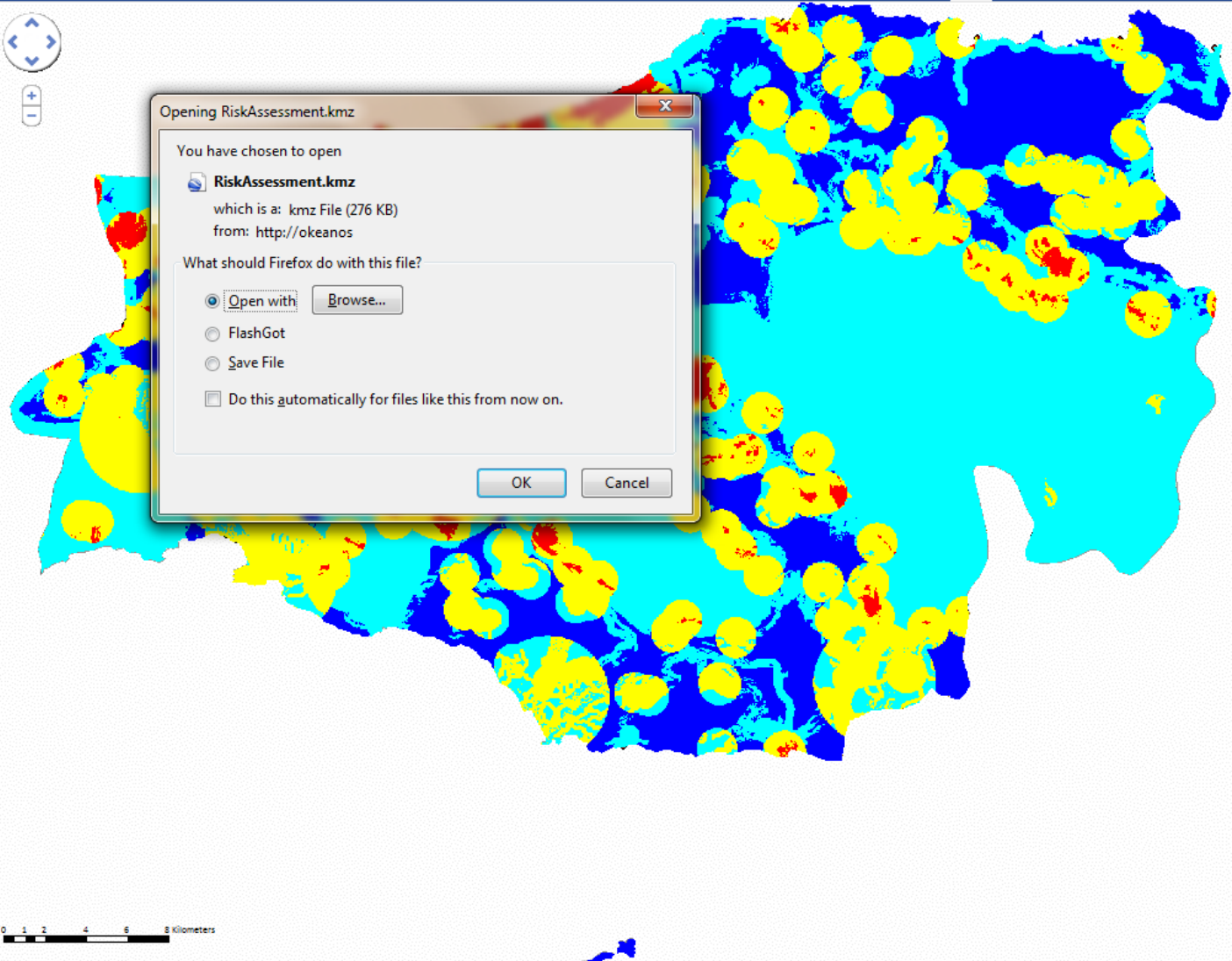
Results

[Clear All](#)

- Select Modeling Technique Results
 - Suitability
 - Google Earth file [Download](#)
 - Inputs
 - Messages

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment
 - Suitability
 - 0 - 2
 - 2 - 5
 - 5 - 8
 - 8 - 10



Opening RiskAssessment.kmz

You have chosen to open

RiskAssessment.kmz
which is a: kmz File (276 KB)
from: http://okeanos

What should Firefox do with this file?

- Open with [Browse...](#)
- FlashGot
- Save File
- Do this automatically for files like this from now on.

[OK](#) [Cancel](#)

▼ Search

Search

ex: pizza near NYC

Get Directions History

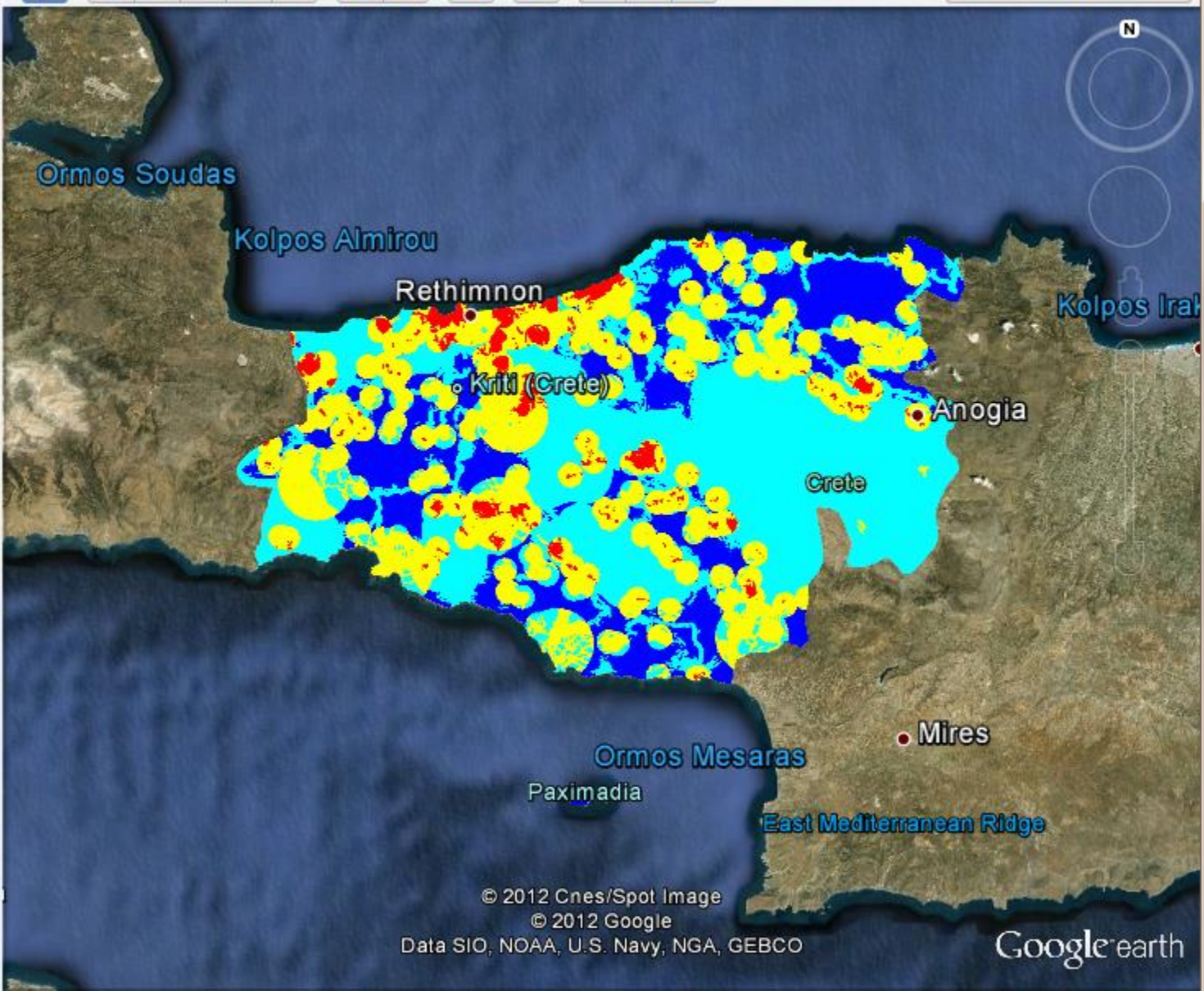
▼ Places

- My Places
 - Sightseeing Tour
 - Make sure 3D Buildings layer is checked
- Temporary Places
 - Risk Assessment - Suit...
 - Risk Assessment - S...

Navigation controls: Home, Back, Forward, and a search input field.

▼ Layers Earth Gallery >>

- Primary Database
 - Borders and Labels
 - Places
 - Photos
 - Roads
 - 3D Buildings
 - Ocean
 - Weather
 - Gallery
 - Global Awareness
 - More



Sign in

© 2012 Cnes/Spot Image
 © 2012 Google
 Data SIO, NOAA, U.S. Navy, NGA, GEBCO



Select Modeling Technique

Results

[Clear All](#)

- Select Modeling Technique Results
 - Suitability
 - Google Earth file [Download](#)
 - Inputs
 - Messages

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment
 - Suitability
 - 0 - 2
 - 2 - 5
 - 5 - 8
 - 8 - 10

Select Modeling Technique

Modeling Technique: **AHP**

Anthropogenic Factor (%) [Simple](#)

Residential Area (%)

Roads Main (%)

Roads Secondary (%)

Environmental Factor (%) [Simple](#)

Slope (%)

Archaeological Site Area (%)

Lake Area (%)

River Area (%)

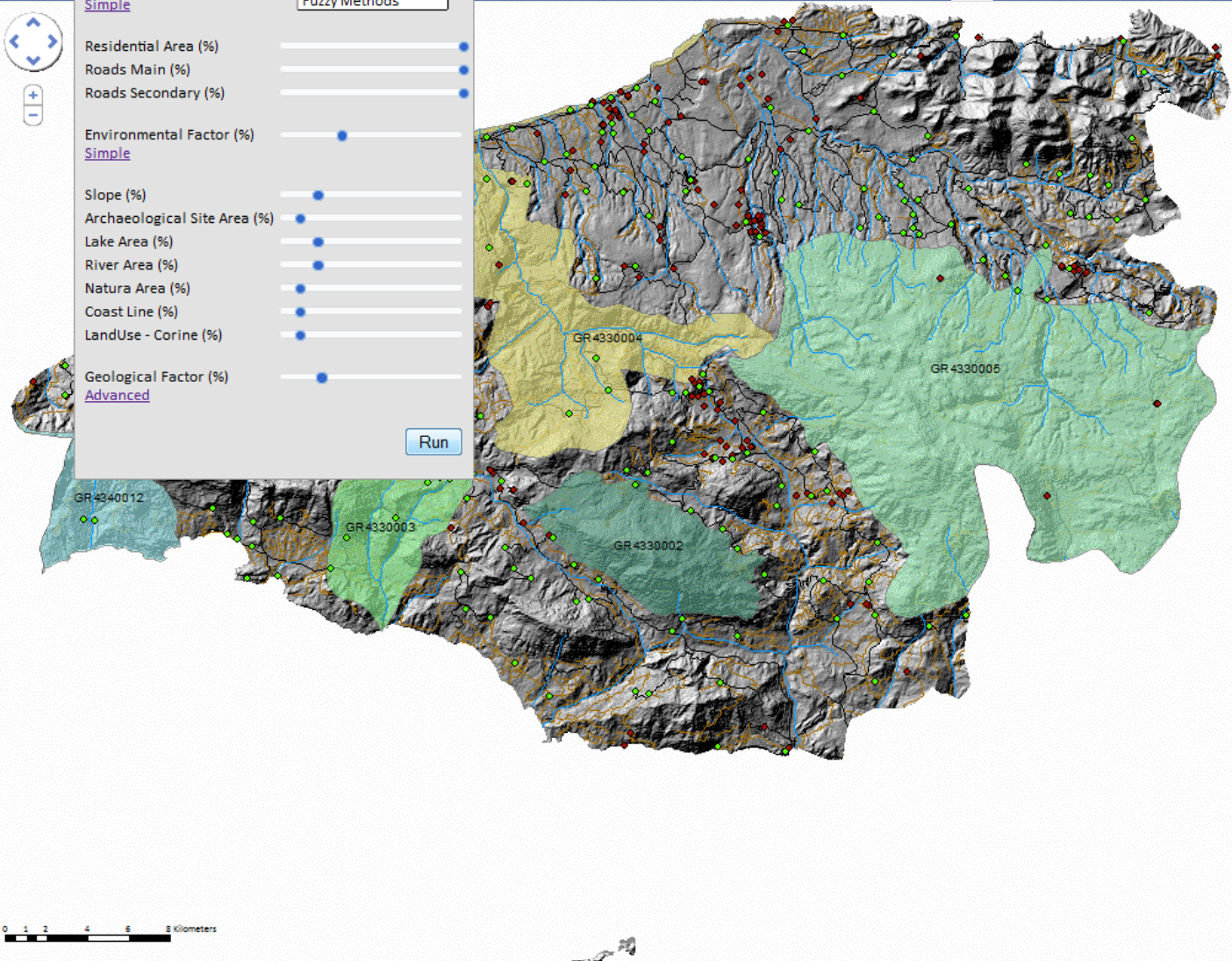
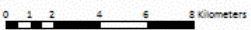
Natura Area (%)

Coast Line (%)

LandUse - Corine (%)

Geological Factor (%) [Advanced](#)

Run





Select Modeling Technique

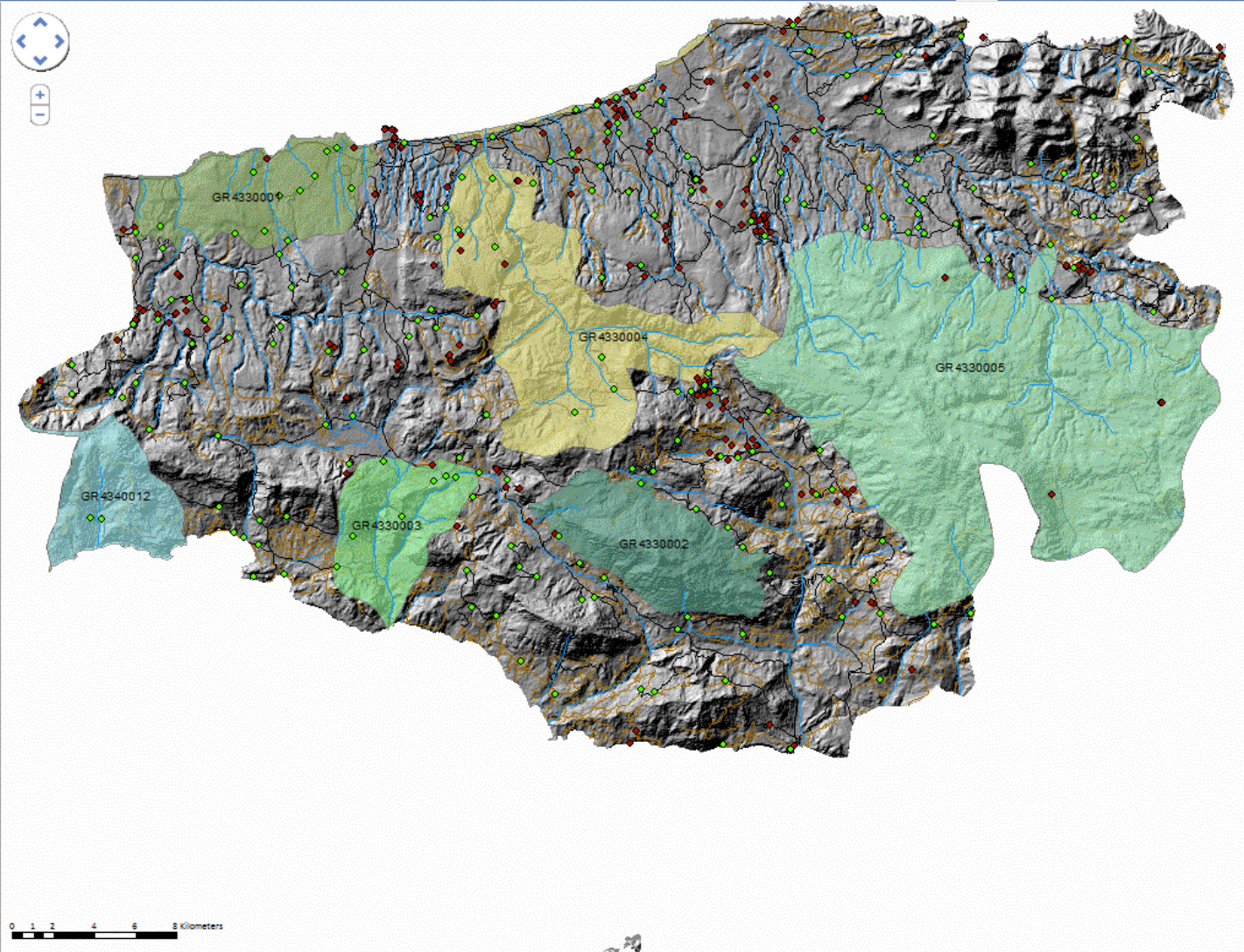
Results

[Clear All](#)

- Submitted Select Modeling Technique [Cancel](#)
 - Inputs
 - Messages
- Select Modeling Technique Results
 - Suitability
 - Google Earth file [Download](#)
 - Inputs

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment
 - Suitability
 - 0 - 2
 - 2 - 5
 - 5 - 8
 - 8 - 10



Risk Assessment Modeling Techniques in Crete (Rethymno)



Select Modeling Technique

Results

[Clear All](#)

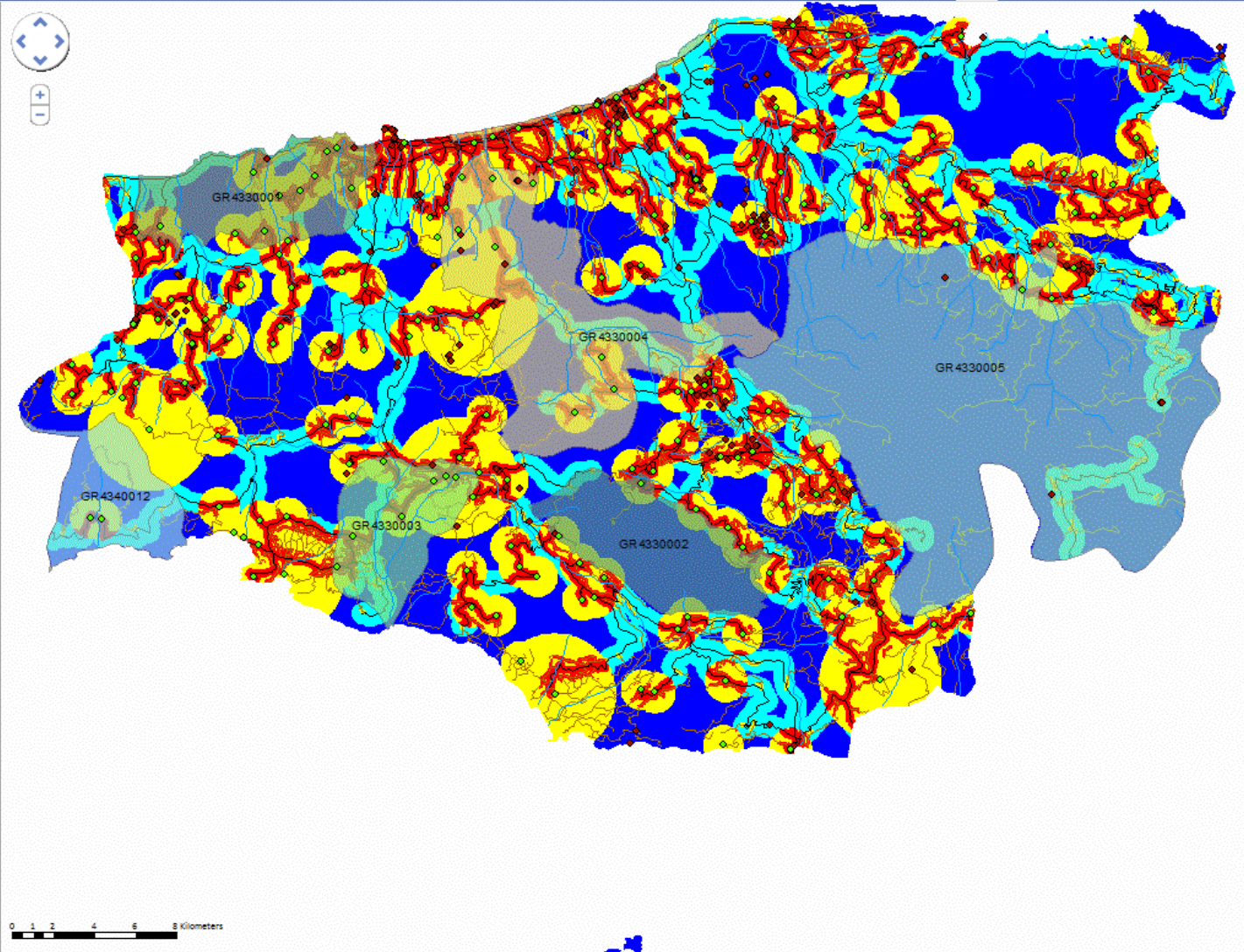
Executing Select Modeling Technique [Cancel](#)

Inputs

- Modeling Technique: AHP
- Anthropogenic Factor (%): 65
- Residential Area (%): 34
- Roads Main (%): 33
- Roads Secondary (%): 33
- Environmental Factor (%): 21
- Slope (%): 20

Map Contents

- RiskAssessment
 - Residential Area
 - Archaeological Sites
 - Rivers
 - Lakes
 - Natura 2000
 - CoastLine
 - Faults
 - Roads Primary
 - Roads Secondary
 - Corine
 - Hydrolithology
 - Geology
 - HillShade
 - Assessment
 - Suitability
 - 0 - 2
 - 2 - 5
 - 5 - 8
 - 8 - 10



감사합니다





regions at the centre of development

Co - financed by the Hellenic Republic and the European Union - European Regional Development Fund,
in the context of the O.P. Competitiveness and Entrepreneurship (OPC II) and the R.O.P. Attica, R.O.P. Macedonia - Thrace

This work was performed in the framework of the PEFYKA project within the KRIPIS Action of the GSRT. The project is funded by Greece and the European Regional Development Fund of the European Union under the NSRF and the O.P. Competitiveness and Entrepreneurship.