

Online Analysis of Remote Sensing Data for Agricultural Applications

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Motivation

- Exploit Big Earth Observation (EO) Data
 - Various Sensors, Various Platforms
 - Various Spatial, Spectral, Temporal properties
- Make EO data a mainstream
 - Numerous (new) users
 - Easy, ready-to-use geospatial products
- Goal: Geospatial Information,
Create Accurate Maps

Problem to Solve

- Easy access to EO data archives
- Process Multimodal data from various sensors
- Develop efficient Services
- Offer validated Products
 - Direct processing and analysis of data, online wherever needed
 - Efficient spatiotemporal modelling and monitoring (agriculture, urban environment, natural disasters, crisis management and assessment)

Problem to Solve

Agricultural Applications

- Crop monitoring
- Precision farming
- Creation of accurate agricultural maps
- Validated products and agricultural maps
 - Site-specific decisions
 - In time
 - Regardless of the areal extent or the ease of physical access

- Rasdaman Array DBMS for data storage
- OGC WCPS interface standard
- GeoExt/OpenLayers javascript libraries

Developed Platform (I)

- **RemoteAgri Web GIS System**
 - Visualization Services
 - Analysis Services
- Utilizes the Landsat 8 dataset
 - Open Data
 - Multispectral, multitemporal satellite imagery
 - Fairly good spatial resolution (30m/pixel)
- Landsat 8 raw data are downloaded, stored and pre-processed automatically

Developed Platform (II)

- Core functionality
 - Rasdaman Array DBMS
 - OGC WCPS interface standard
- Key features
 - Vegetation Detection
 - Canopy Estimation
 - Water Stress Estimation
- Fully covers Greek territory with Landsat 8 imagery
 - New dataset every - apprx. - 16 days
 - 40 scenes per dataset, averaging apprx. 80GB uncompressed

RemoteAgri WebGIS System

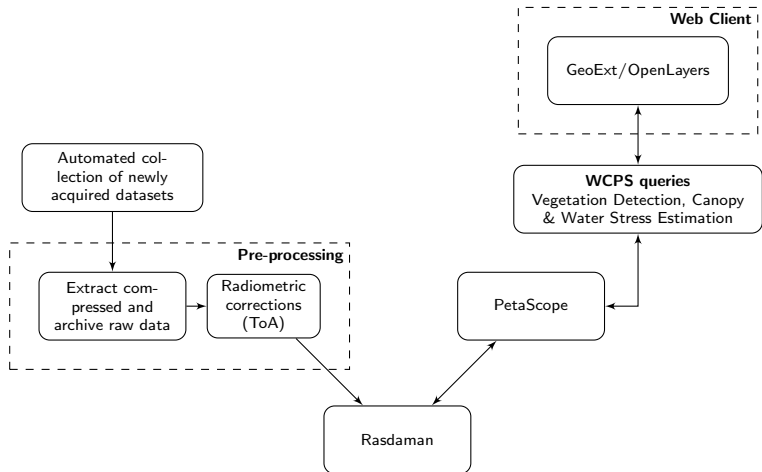


Figure: The components of the *RemoteAgri* WebGIS system.

Automated Collection & Preprocessing subsystems

- Automated acquisition through Web Harvesting
- Archive and extract compressed data
- Preprocessing to convert to ToA reflectance
- Ingestion in rasdaman

Implementation Details (II)

Rasdaman

- Storage of Landsat 8 multispectral data
- Suitable data types definition
- Array types defined with open bounds

Implementation Details (III)

Web Client

- OpenLayers library
- GeoExt library
- Client side scripts
 - User interaction
 - Metadata search
 - Construction of WCPS queries
 - Communication with the Server

Developed Agricultural Queries

→ WCPS interface standard

- Vegetation Detection
- Canopy Estimation
- Water Stress Estimation

Vegetation Detection

- Calculates NDVI Index
- Creates binary map that distinguishes vegetation from soil and urban environment

Canopy Estimation

- Further classification based on NDVI
- Zoning the different canopy levels
- Monitor vegetation health and growth

Water Stress Estimation

- At satellite temperature values
- Converted to Celsius Degrees
- Color map that distinguishes different temperature levels
- The higher the temperature the higher the probability of water stress in **irrigated** croplands
- Must be interpreted in close correlation with the Canopy Estimation query

Use Case Scenario

- An agricultural association
 - Overall state of crops
 - Ability to provide site-specific information
- Irrigated croplands in Axios Delta area in Central Macedonia
 - Rice summer crops (70%)
 - Cotton and corn crops follow

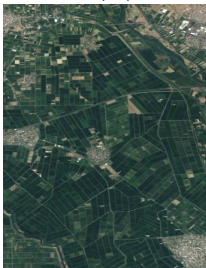
Results (I)



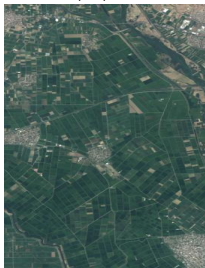
a. 24/6/2013



b. 10/7/2013



c. 26/7/2013

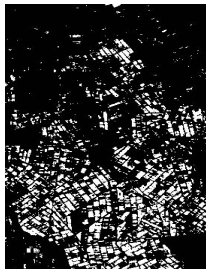


d. 11/8/2013

Results (II)



a. 24/6/2013



b. 10/7/2013



c. 26/7/2013

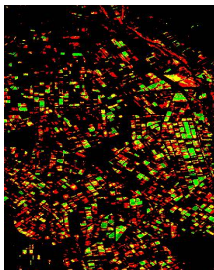


d. 11/8/2013

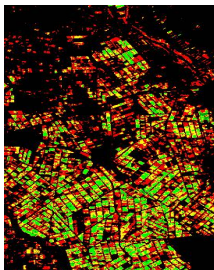
Use Case Scenario(II)

- Canopy Estimation
 - Crop vigour and state
 - Site-specific decisions
 - Vegetation life cycle monitor

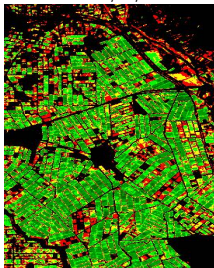
Results (III)



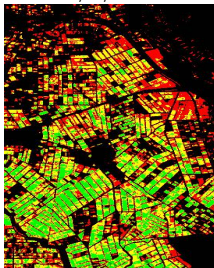
a. 24/6/2013



b. 10/7/2013

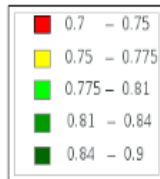


c. 26/7/2013

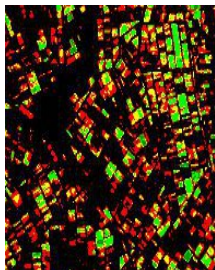


d. 11/8/2013

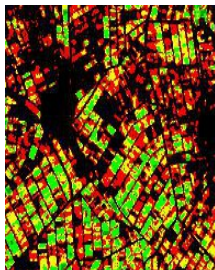
Canopy Estimation



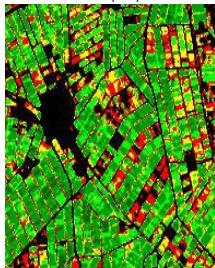
Results (IV)



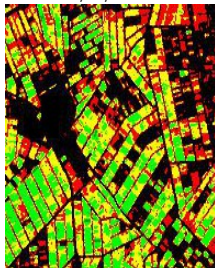
a. 24/6/2013



b. 10/7/2013

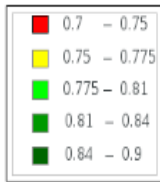


c. 26/7/2013



d. 11/8/2013

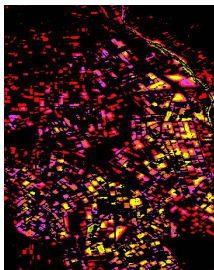
Canopy Estimation



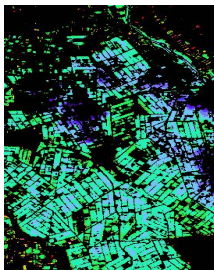
Use Case Scenario (III)

- Water Stress Estimation
 - Temperature Map
 - Information about irrigation failures
 - Examine if other factors are responsible for high temperature

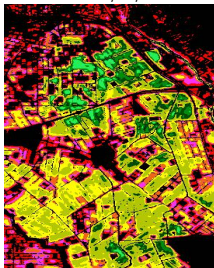
Results (V)



a. 24/6/2013



b. 10/7/2013

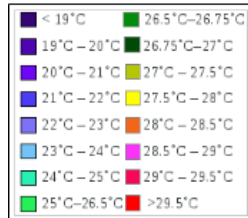


c. 26/7/2013



d. 11/8/2013

Water Stress



Conclusion & Future Perspectives

- Demonstrated the combination of various FOSS technologies
- Presented a robust framework with real time analysis potential
- Bulk ingestion of geodata from various sensors
- Further development of the Web Client
- Incorporation of other OGC interface standards
- Location based services

Thank You!

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Questions
?

RemoteAgri WebGIS

- `ikaros.survey.ntua.gr/remoteagri`
- Demonstration purposes
- RemoteAgri Walkthrough

RGB

The screenshot displays a web-based GIS application interface. The main map area shows a satellite-style view of agricultural land with various fields and roads. The interface includes a 'Layers' panel on the left, a 'Results' panel on the right, and a 'Legends' panel at the bottom left.

Layers Panel:

- Thematic Levels
 - Base Layers
 - ESRI
 - Bing Aerial/With Labels
 - Blue Marble
 - Greek Cadastral
 - OpenStreetMap
 - Google Physical
 - Google Satellite
 - Google Streets
 - Base
 - Google Hybrid
 - Maps
 - Water Stress
 - Canopy Estimation
 - Vegetation Detection
 - RGB 654
 - RGB 543
 - RGB
 - Vectors

Results Panel:

Available Tasks

View RGB	<input type="checkbox"/>
View RGB 543	<input type="checkbox"/>
View RGB 654	<input type="checkbox"/>
Vegetation Detection	<input type="checkbox"/>
Canopy Estimation	<input type="checkbox"/>
Water Stress	<input checked="" type="checkbox"/>

Continue

Legends: Google

Map data ©2014 Google Imagery ©2014 TerraMetrics | Terms of Use | Report a map error

RGB 543

The screenshot displays a web-based GIS application interface. On the left, the 'Options' panel shows a 'Layers' list with 'Thematic Levels' and 'Maps' sections. Under 'Thematic Levels', 'Base Layers' includes options like 'ESRI', 'Bing Aerial/WithLabels', 'Blue Marble', 'Greek Cadastral', 'OpenStreetMap', 'Google Physical', 'Google Satellite', 'Google Streets', 'Base', and 'Google Hybrid'. Under 'Maps', 'Water Stress', 'Canopy Estimation', 'Vegetation Detection', 'RGB 654', 'RGB 543', 'RGB', and 'Vectors' are listed. The 'RGB 543' option is selected. The main map area shows a satellite view of a rural landscape with a large red rectangular overlay. On the right, a 'Results' panel is open, displaying 'Available Tasks' with a list of tasks and their status:

Available Tasks	
View RGB	<input type="checkbox"/>
View RGB 543	<input type="checkbox"/>
View RGB 654	<input type="checkbox"/>
Vegetation Detection	<input type="checkbox"/>
Canopy Estimation	<input type="checkbox"/>
Water Stress	<input checked="" type="checkbox"/>

A 'Continue' button is located at the bottom of the 'Results' panel. The map includes a 'Legends' section at the bottom left and a 'Google' logo. At the bottom right, there is a small text box: 'Map data ©2014 Google Imagery ©2014 TerraMetrics | Terms of Use | Report a map error.'

RGB 654

The screenshot displays a web-based GIS application interface. The main map area shows a satellite view of a rural landscape with a large rectangular area highlighted in green and purple, indicating a specific analysis or data overlay. The interface includes several panels:

- Options Panel (Left):** Contains a 'Layers' section with 'Thematic Levels' and 'Base Layers'. Under 'Thematic Levels', 'RGB 654' is selected. Under 'Base Layers', 'Google Hybrid' is selected. A 'Maps' section is also visible with 'Water Stress', 'Canopy Estimation', 'Vegetation Detection', 'RGB 654', 'RGB 543', 'RGB', and 'Vectors' listed.
- Results Panel (Right):** Titled 'Results', it lists 'Available Tasks' with checkboxes: 'View RGB', 'View RGB 543', 'View RGB 654', 'Vegetation Detection', 'Canopy Estimation', and 'Water Stress'. A 'Continue' button is located at the bottom of this panel.
- Map Area:** Shows a satellite view of a rural landscape with a large rectangular area highlighted in green and purple. The map includes labels for various locations such as Loukas, Anadolio, and Chalstra.
- Google Maps Logo:** Located at the bottom left of the map area.

Vegetation Detection

The screenshot displays a GIS application interface. On the left, the 'Layers' panel shows a list of layers under 'Thematic Levels' and 'Base Layers'. The 'Vegetation Detection' layer is selected. A central map shows a satellite view of a rural area with a black and white overlay indicating detected vegetation. A 'Results' panel on the right lists available tasks with checkboxes:

Results	
Available Tasks	
View RGB	<input type="checkbox"/>
View RGB 543	<input type="checkbox"/>
View RGB 654	<input type="checkbox"/>
Vegetation Detection	<input checked="" type="checkbox"/>
Canopy Estimation	<input type="checkbox"/>
Water Stress	<input checked="" type="checkbox"/>
Continue	

Canopy Estimation

The screenshot displays a web-based GIS application interface. The main map area shows a satellite view of a rural landscape with a central rectangular overlay of a canopy estimation map. The canopy map uses a color scale from green (low canopy) to red (high canopy). The interface includes a 'Layers' panel on the left, a 'Results' panel on the right, and a toolbar at the top.

Layers Panel:

- Thematic Levels
 - Base Layers
 - ESFI
 - Bing Aerial/WithLabels
 - Blue Marble
 - Greek Cadastral
 - OpenStreetMap
 - Google Physical
 - Google Satellite
 - Google Streets
 - Base
 - Google Hybrid
 - Maps
 - Water Stress
 - Canopy Estimation
 - Vegetation Detection
 - RGB 654
 - RGB 543
 - RGB
 - Vectors

Results Panel:

Available Tasks

View RGB	<input type="checkbox"/>
View RGB 543	<input type="checkbox"/>
View RGB 654	<input type="checkbox"/>
Vegetation Detection	<input type="checkbox"/>
Canopy Estimation	<input type="checkbox"/>
Water Stress	<input checked="" type="checkbox"/>

Continue

Water Stress Estimation

The screenshot displays a GIS application interface for water stress estimation. The main map shows a satellite view of a rural area with a central zoomed-in view of a specific region. The zoomed-in view shows a complex pattern of colors (red, yellow, green, blue) representing different water stress levels. The interface includes a 'Layers' panel on the left, a 'Results' panel on the right, and a central map area with a zoomed-in view of a specific region.

Layers Panel:

- Thematic Levels
 - Base Layers
 - ESFI
 - Bing Aerial/WithLabels
 - Bing Marble
 - Greek Cadastral
 - OpenStreetMap
 - Google Physical
 - Google Satellite
 - Google Streets
 - Base
 - Google Hybrid
 - Maps
 - Water Stress
 - Canopy Estimation
 - Vegetation Detection
 - RGB 654
 - RGB 543
 - RGB
 - Vectors

Results Panel:

Available Tasks

View RGB	<input type="checkbox"/>
View RGB 543	<input type="checkbox"/>
View RGB 654	<input type="checkbox"/>
Vegetation Detection	<input type="checkbox"/>
Canopy Estimation	<input type="checkbox"/>
Water Stress	<input checked="" type="checkbox"/>

Continue

The End
!