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

Technologies

- 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

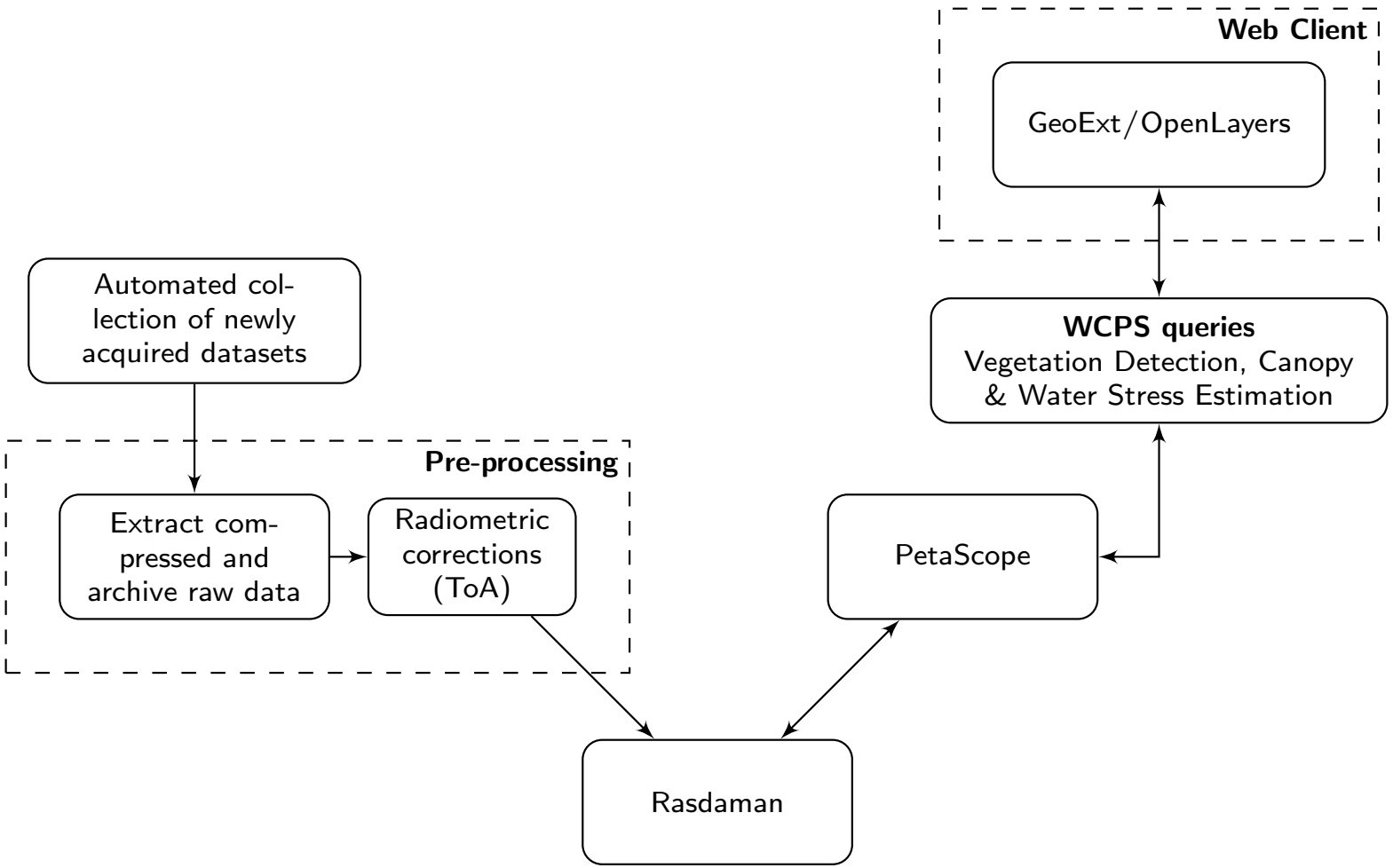


Figure: The components of the *RemoteAgri* WebGIS system.

Implementation Details (I)

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

Implementation Details (IV)

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)

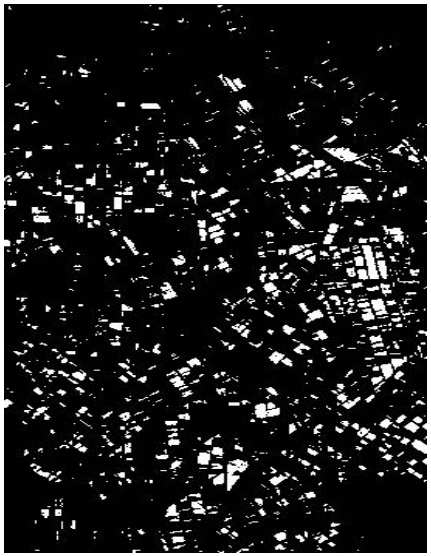
a. 24/6/2013

b. 10/7/2013

c. 26/7/2013

d. 11/8/2013

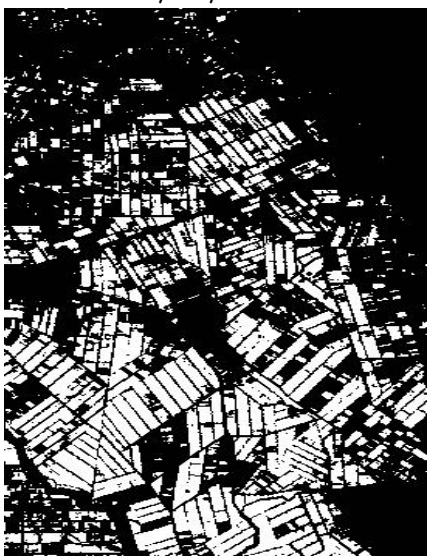
Results (II)



a. 24/6/2013

b. 10/7/2013

c. 26/7/2013

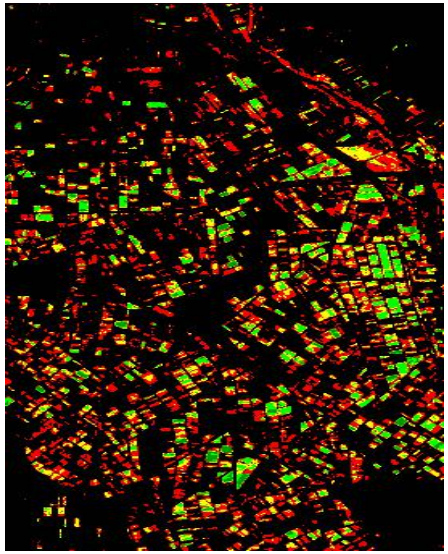


d. 11/8/2013

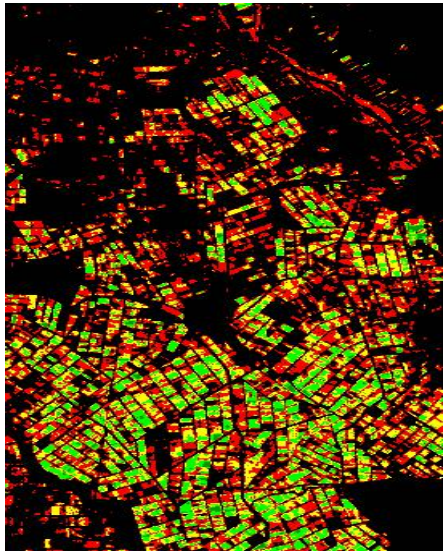
Use Case Scenario(II)

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

Results (III)



a. 24/6/2013



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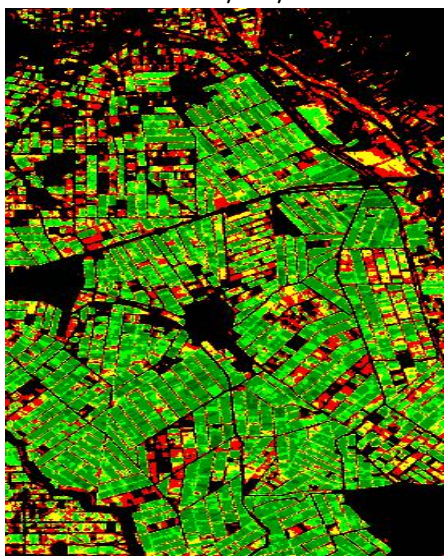

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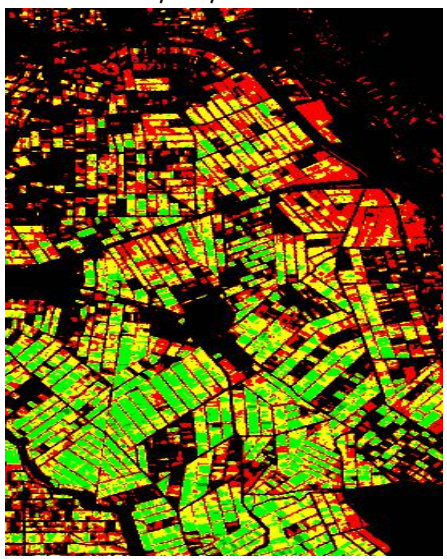
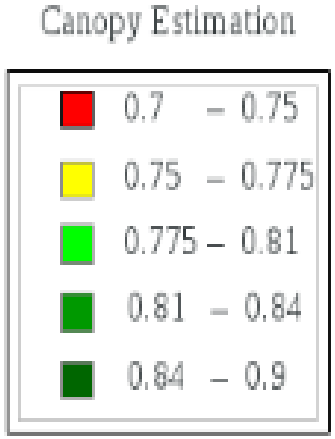
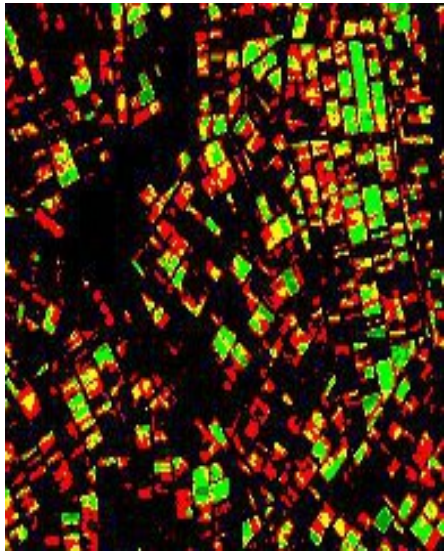


d. 11/8/2013



Results (IV)



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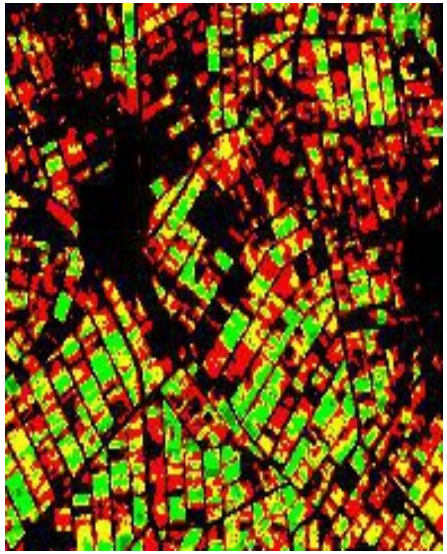
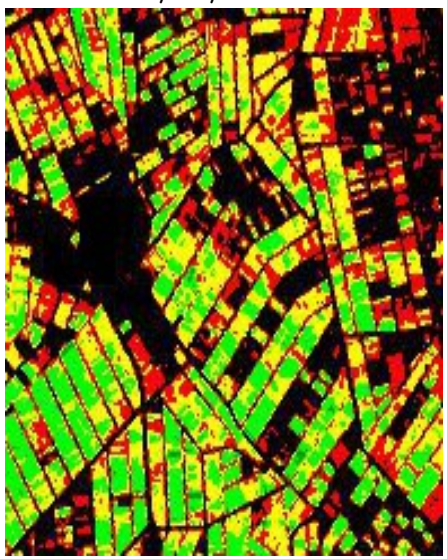


b. 10/7/2013

c. 26/7/2013



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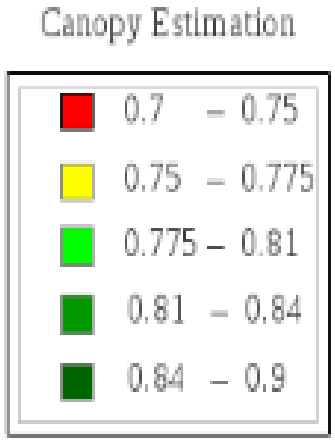
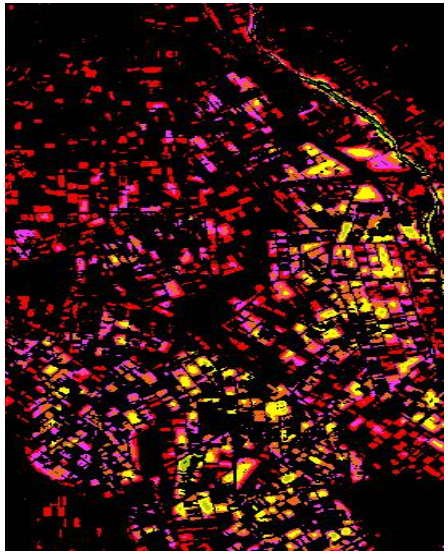


Use Case Scenario (III)

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

Results (V)



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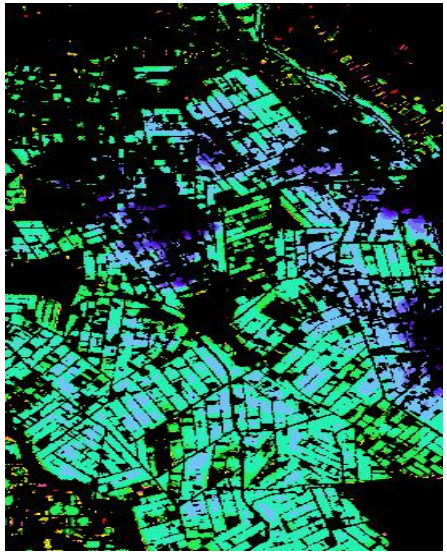

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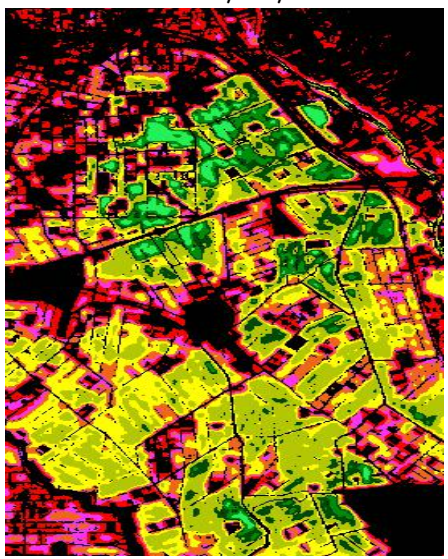

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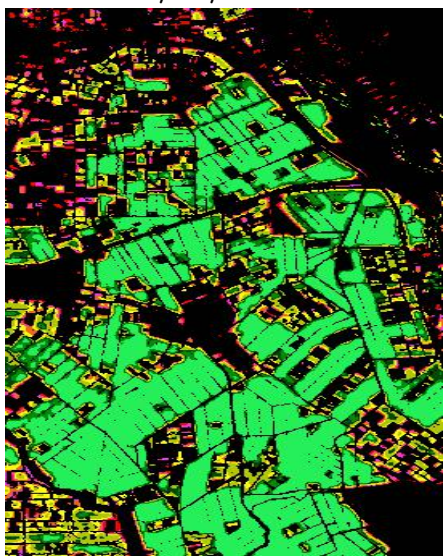

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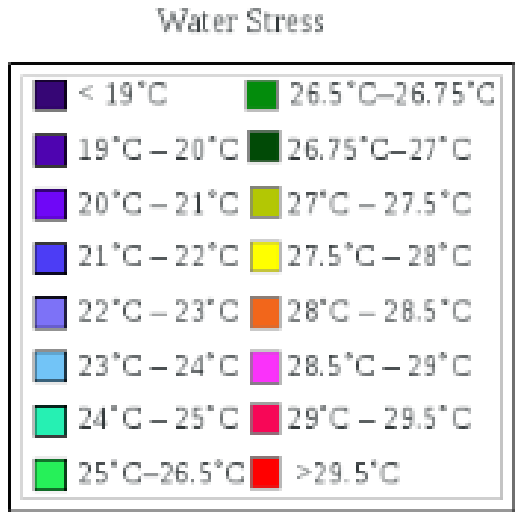

Conclusion & Future Perspectives

- 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

Questions
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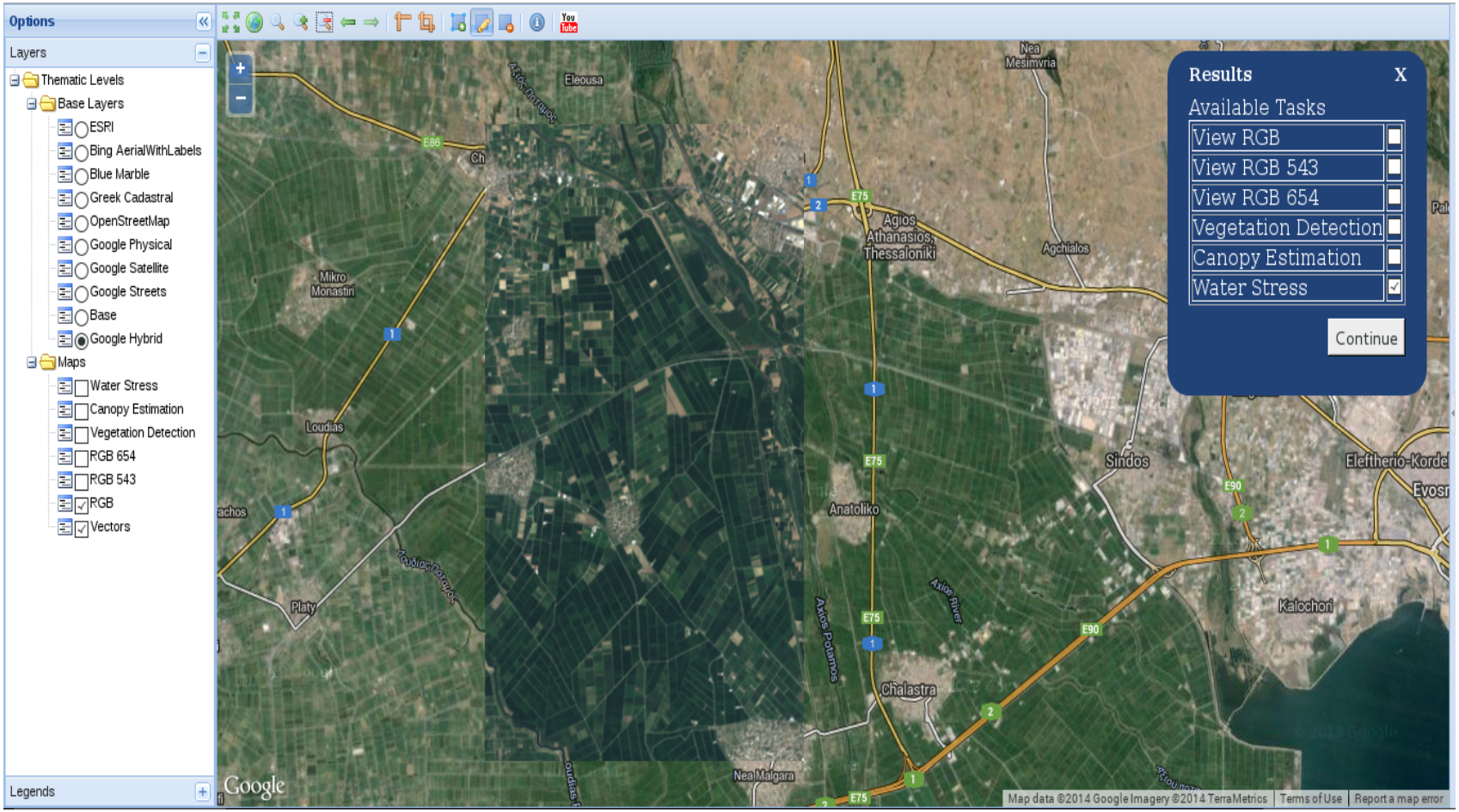
Demo

RemoteAgri WebGIS

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

Demo

RGB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Google Hybrid
Maps
Water Stress
Canopy Estimation
Vegetation Detection
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RGB 543
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Legends
Results
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View RGB
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Water Stress
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Eleftherio-Korde
Evosm
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Chalastra
Nea Malgara
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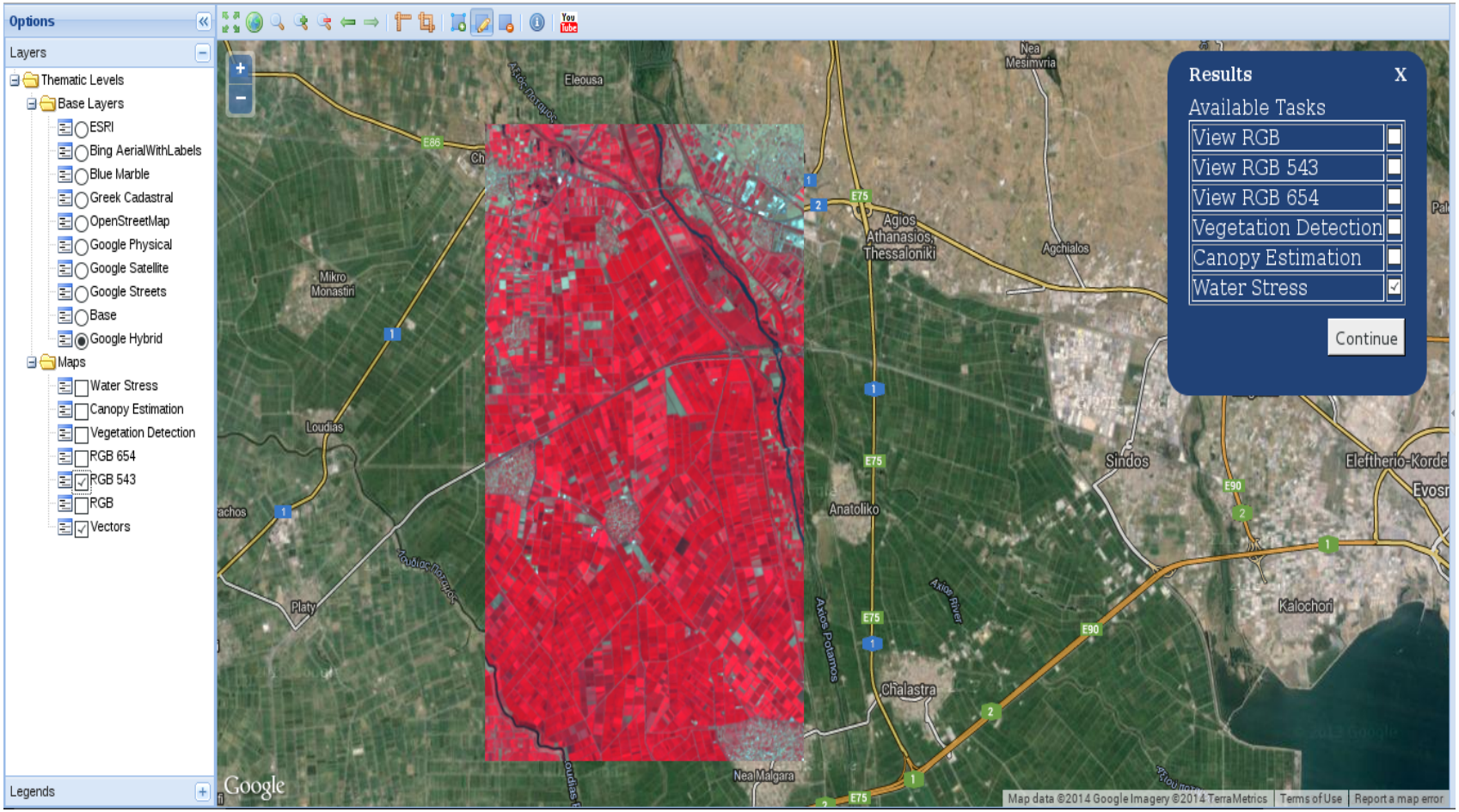
Report a map error

Demo

RGB 543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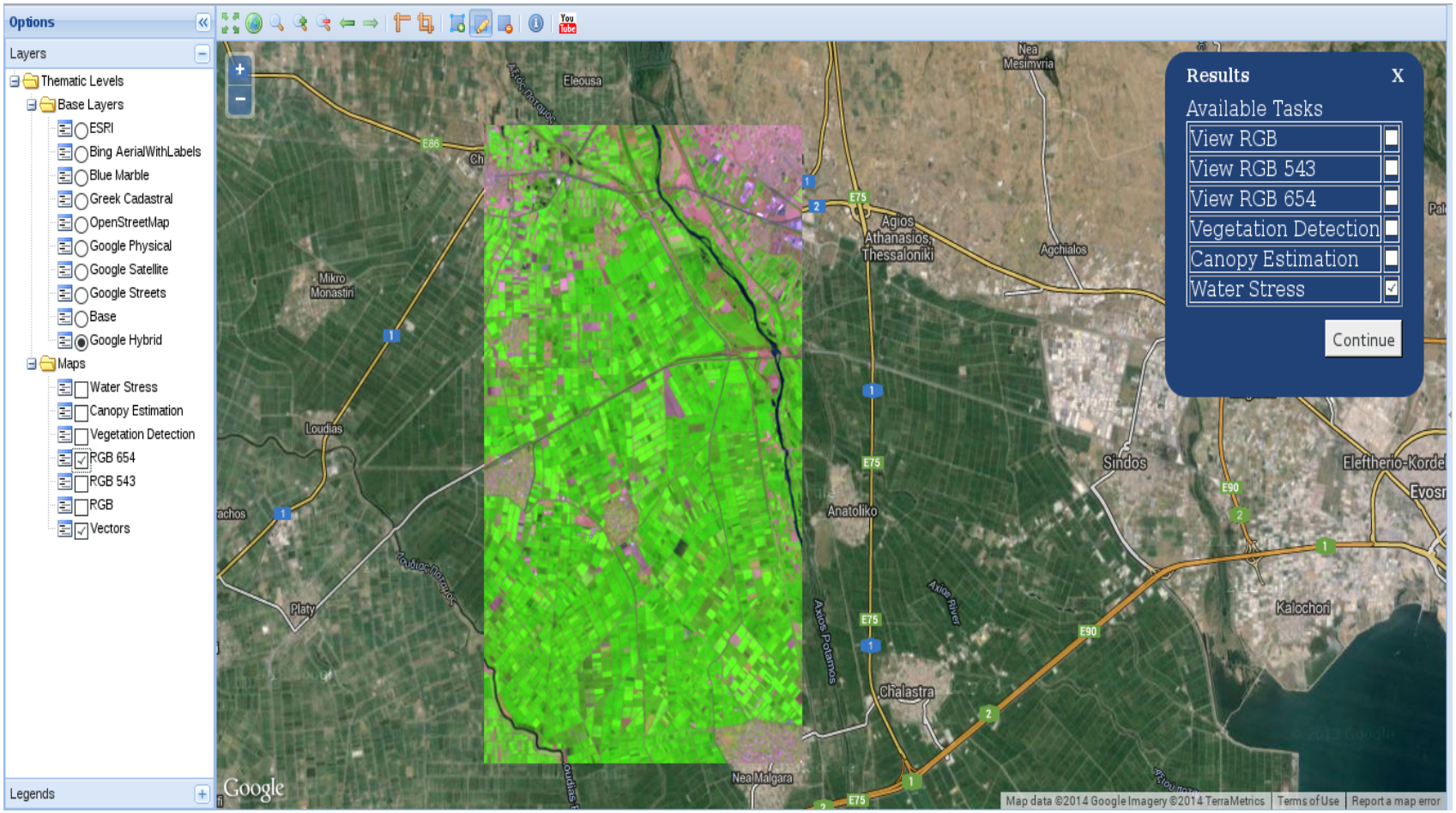
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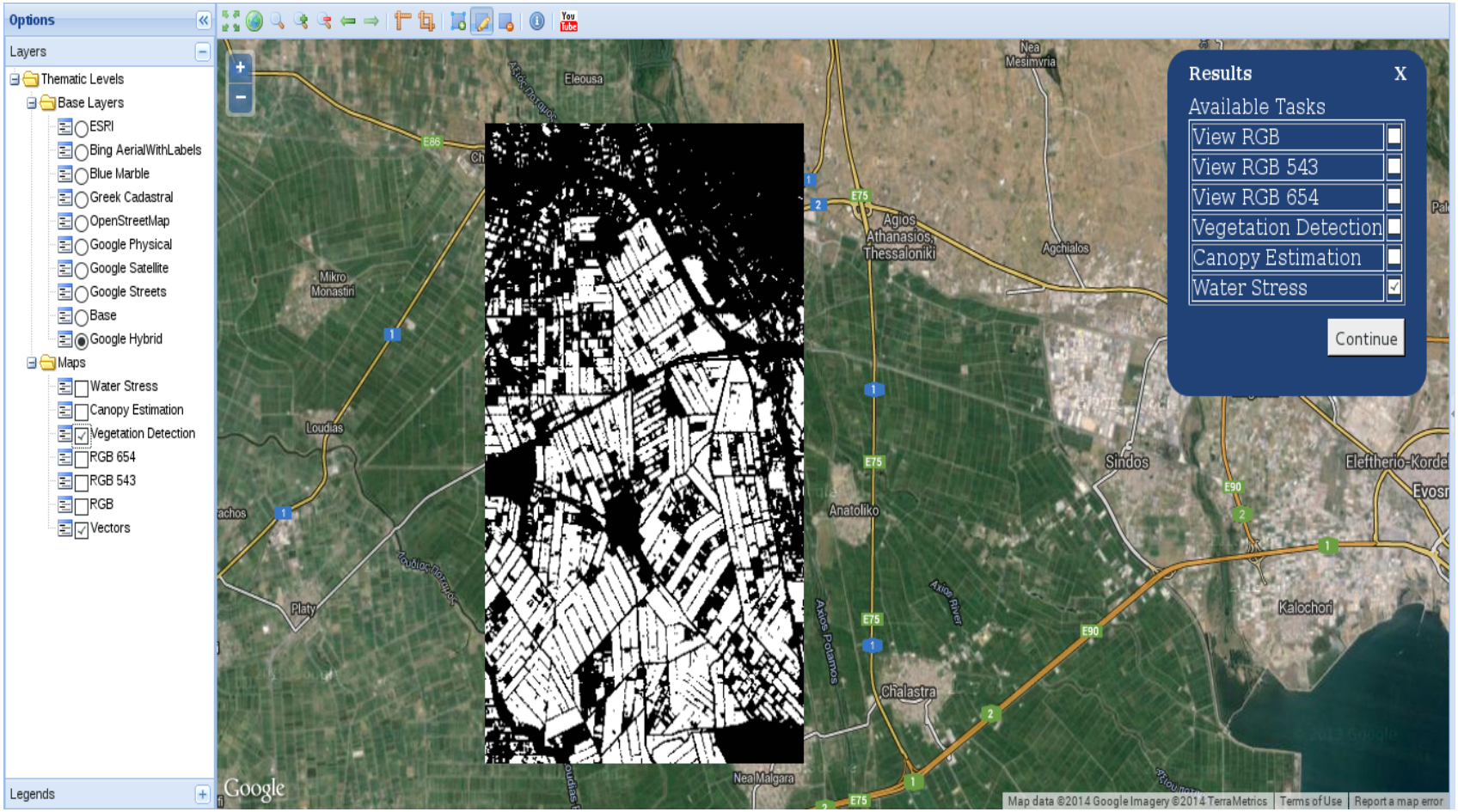
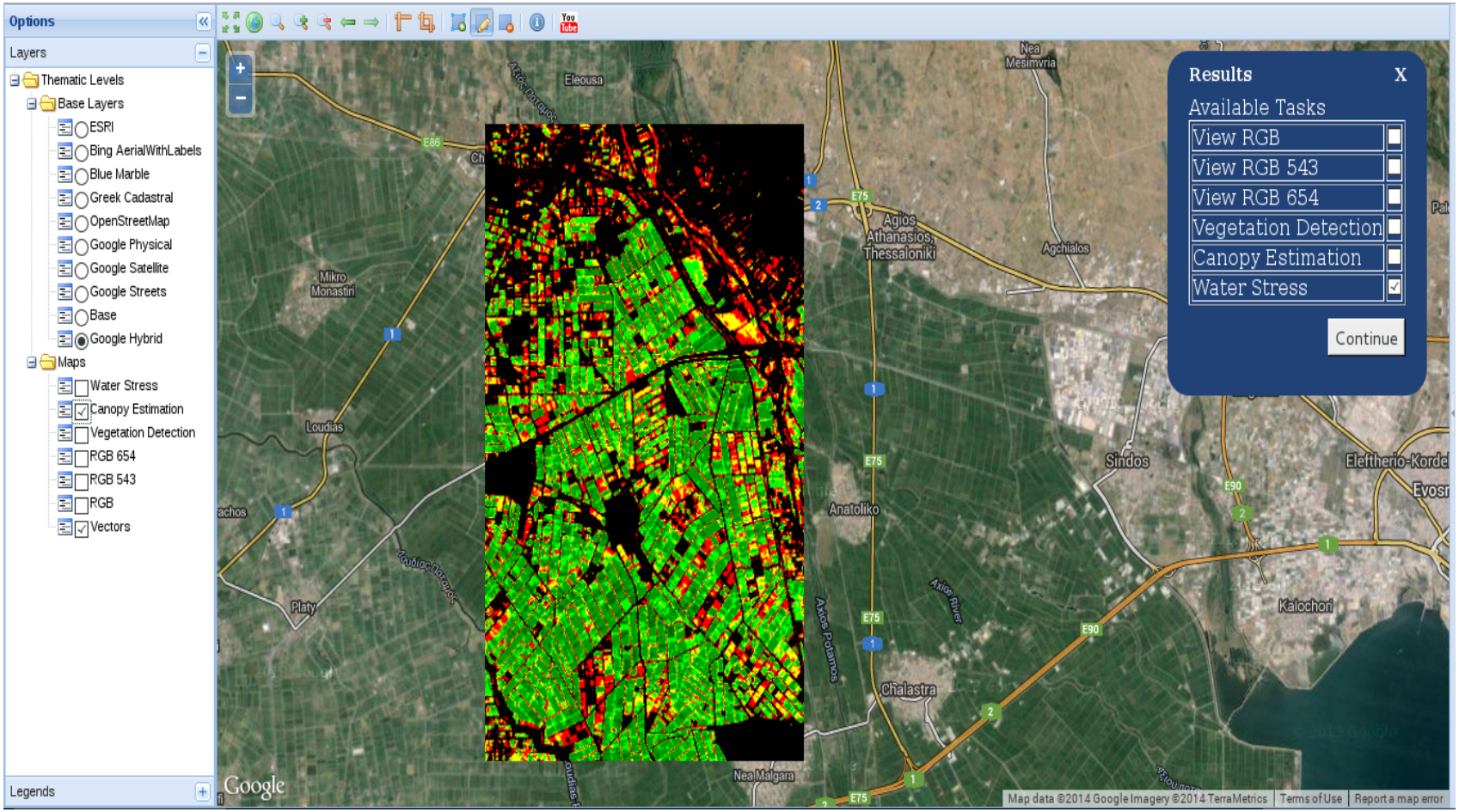
Demo

Vegetation Detection



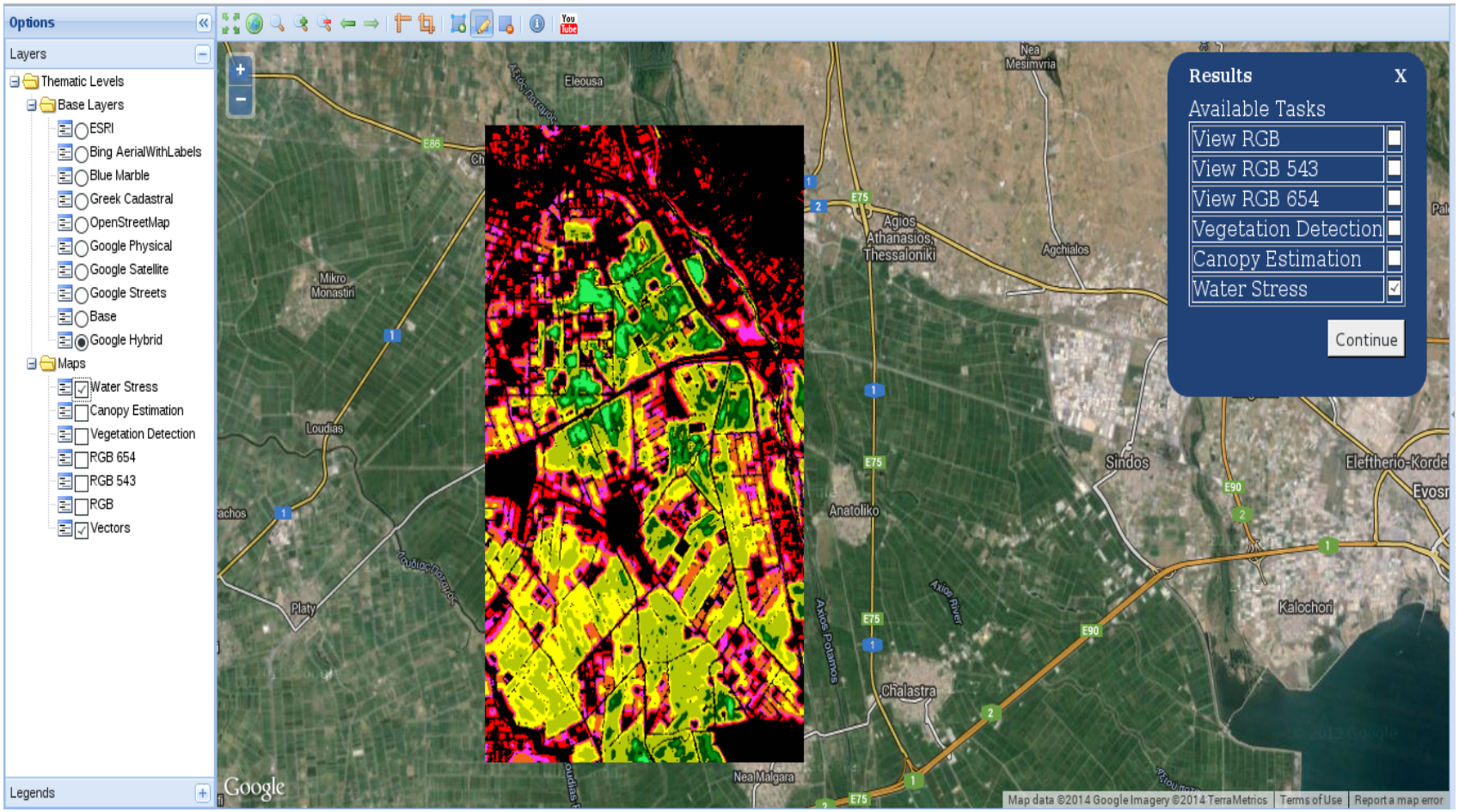
Demo

Canopy Estimation



Demo

Water Stress Estimation



The End
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