Scalable Geospatial Services for Time Series & Value-added Maps in Agriculture and Water Quality Monitoring

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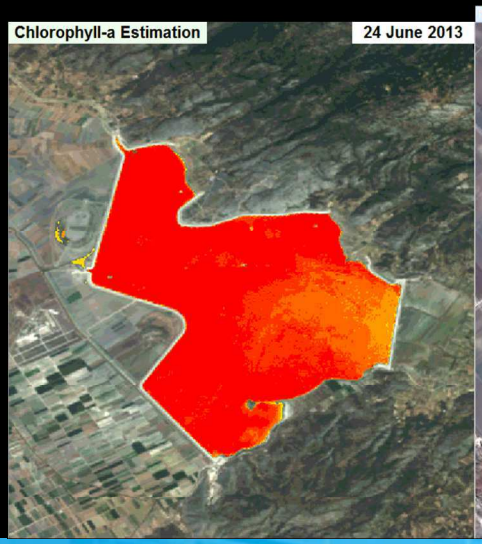


esa 2016 conference on big data from space
research, technology and innovation
European Space Agency
esa European Space Agency

Motivation

Handle and process EO big data from

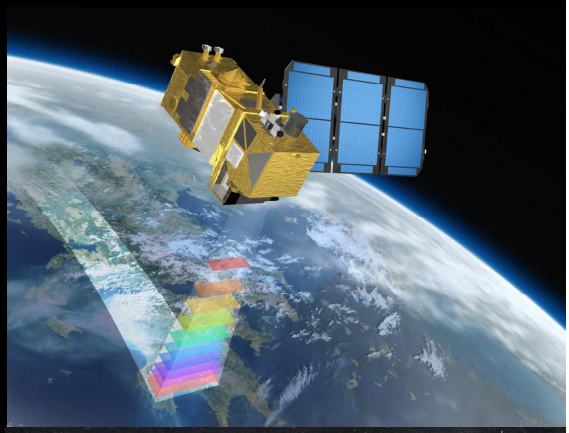
- ✓ *Various Sensors (spectral, spatial, temporal resolution)*
- ✓ *Platforms (satellite, airborne, in-situ)*

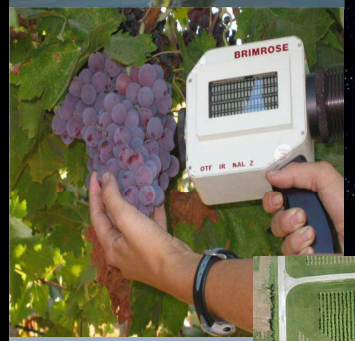
Make EO data a mainstream

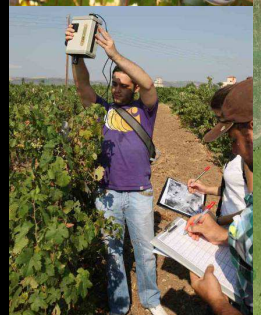
- ✓ *Different kind of users*
- ✓ *Both Experts & End-users*

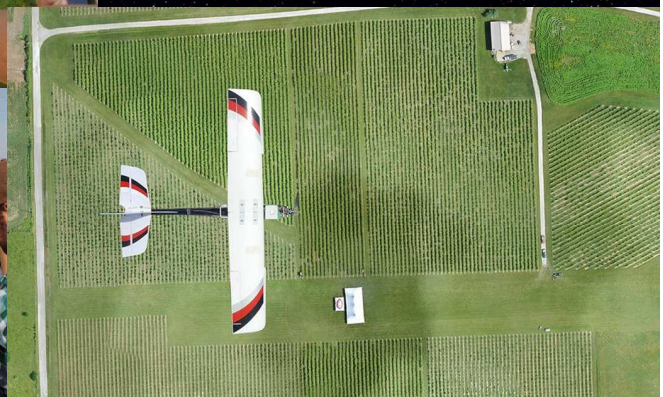
Current Challenges

- ✓ Automation
- ✓ *Exploit multi-modal data for analytics*
- ✓ *Exploit entire archives for analytics*
- ✓ *Validation*









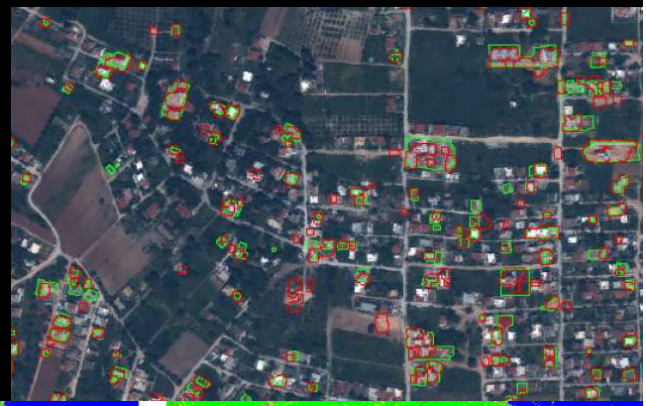
Problem to Solve

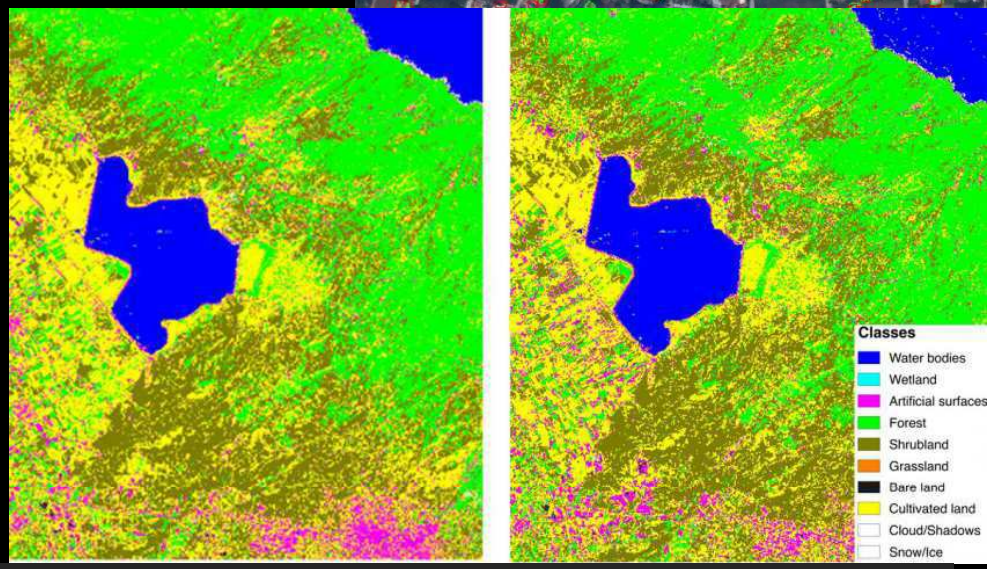
Expand standard remote sensing approaches ***e.g.,:***

- ✓ *Classification*
- ✓ *Change Detection*

❖ ***Fuse*** *Data with Time Series analysis*

❖ *Formulate more* ***constrained*** *problems*





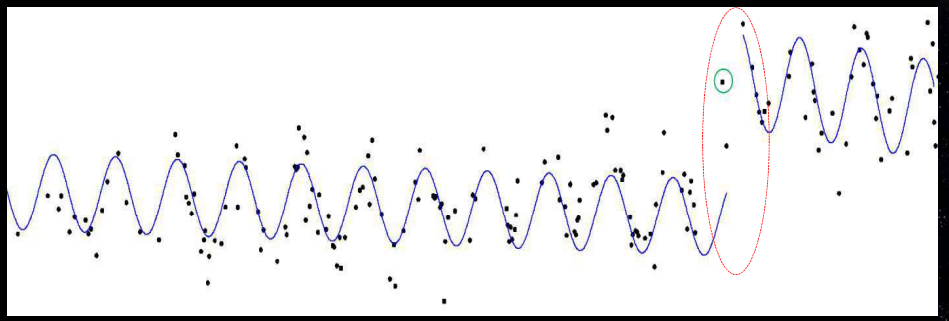
- ✓ Yu et al., *2016*. A new approach for land cover classification and change analysis: Integrating backdating and an object-based method, *Remote Sensing of Environment*
- ✓ Ju and Masek, *2016*. The vegetation greenness trend in Canada and US Alaska from 1984–2012 Landsat data, *Remote Sensing of Environment*
- ✓ Zhu, et al., *2015*. Generating synthetic Landsat images based on all available Landsat data: Predicting Landsat surface reflectance at any given time. *Remote Sensing of Environment*.
- ✓ Zhu and Woodcock, *2014*. Continuous change detection and classification of land cover using all available Landsat data, *Remote Sensing of Environment*

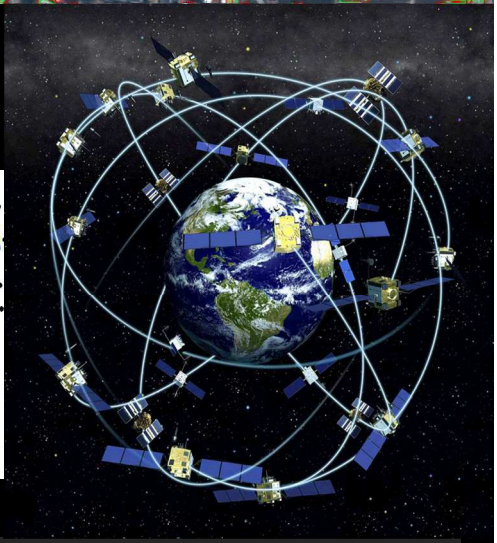
Problem to Solve

Expand standard remote sensing approaches

- ✓ *Integrate multi-modal data*
- ✓ *Execute various software modules on distributed systems*

❖ *Robust Analytics*





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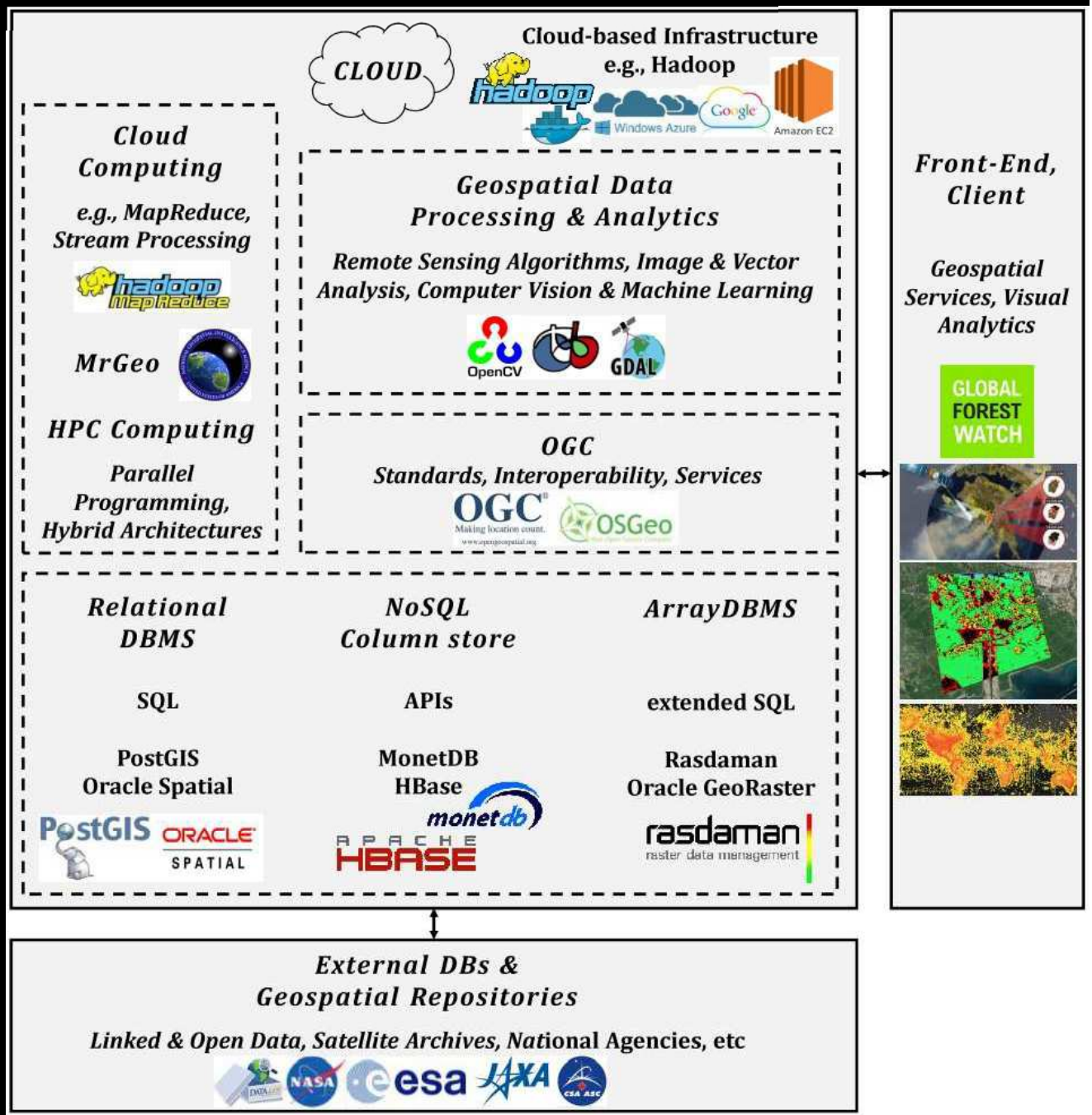
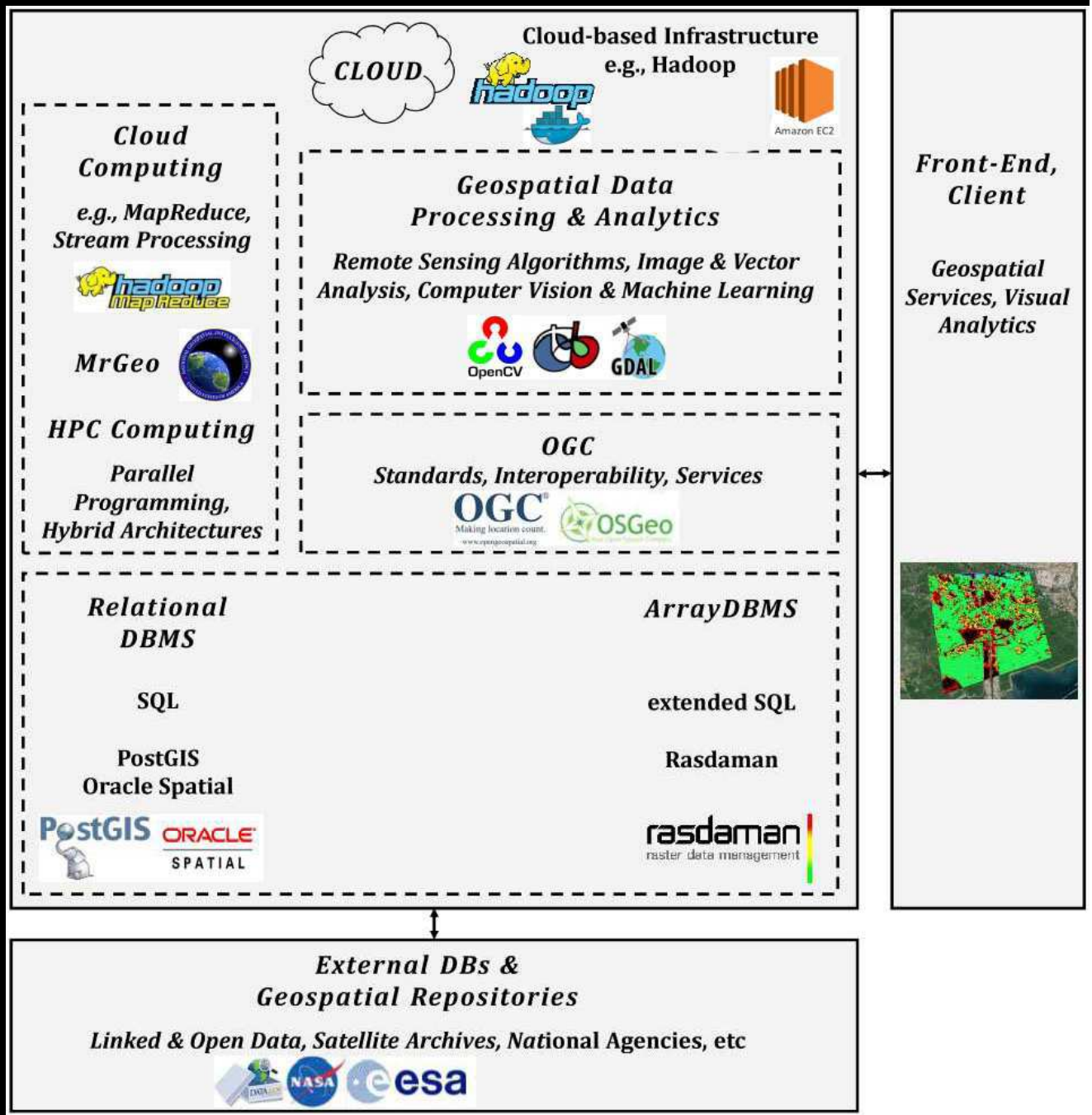
Dominating Architecture

- ✓ *Repositories*
- ✓ *Cloud-based Infrastructures*
  - *Databases*
  - *Processing Models*
- ✓ *Web Services*
- ✓ *Geospatial Maps*



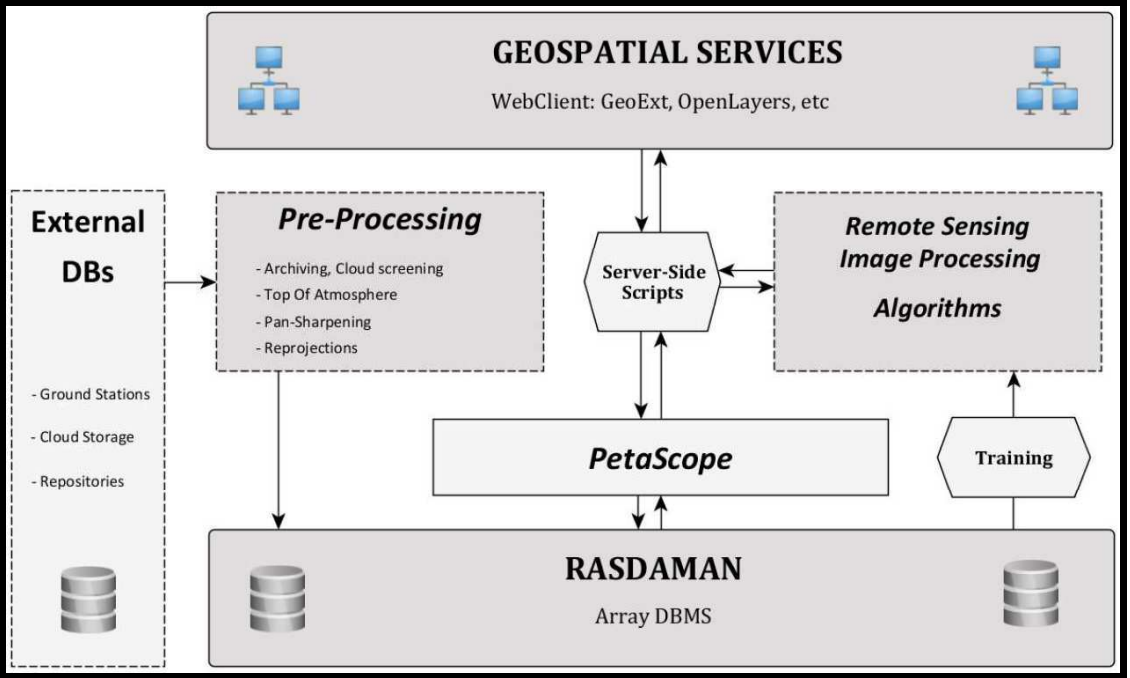
Our Approach

- ✓ *EO Datasets*
  - *Sentinels*
  - *Landsat*
  - *RapidEye*
  - *Pleiades*
  - *Worldview-2/-3*
- ✓ *Databases*
  - *Rasdaman*
- ✓ *Geospatial Services*
  - *Canopy Greenness*
  - *Chlorophyll-a Maps*
  - *Land Cover Mapping*
  - *Time series*



Our Approach

- ✓ *Multi-sensor EO datasets*



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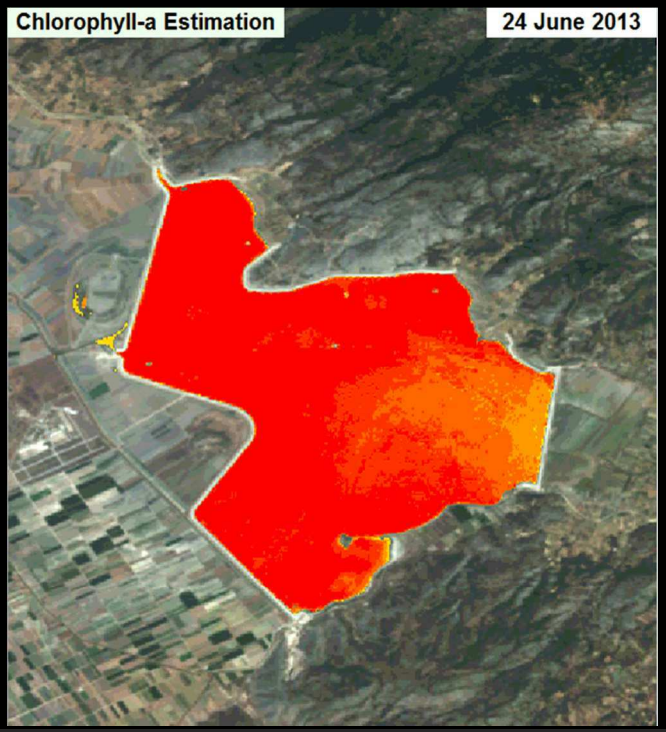
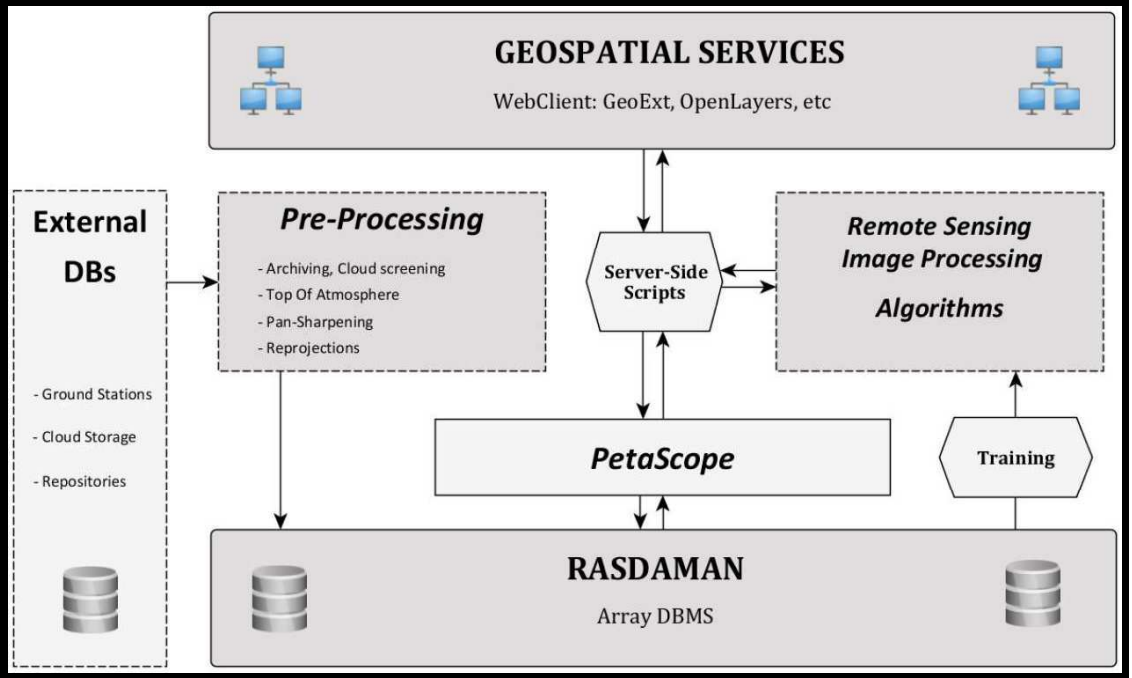
- ✓ Karmas et al., *2016*. Big Geospatial Data for Environmental and Agricultural Applications, Yu and Guo (eds.), *Big Data Concepts, Theories and Applications*, Springer International Publishing Switzerland.

Our Approach

- ✓ *Multi-sensor EO datasets*
- ✓ *Applications:*
  - *Water Quality Monitoring*





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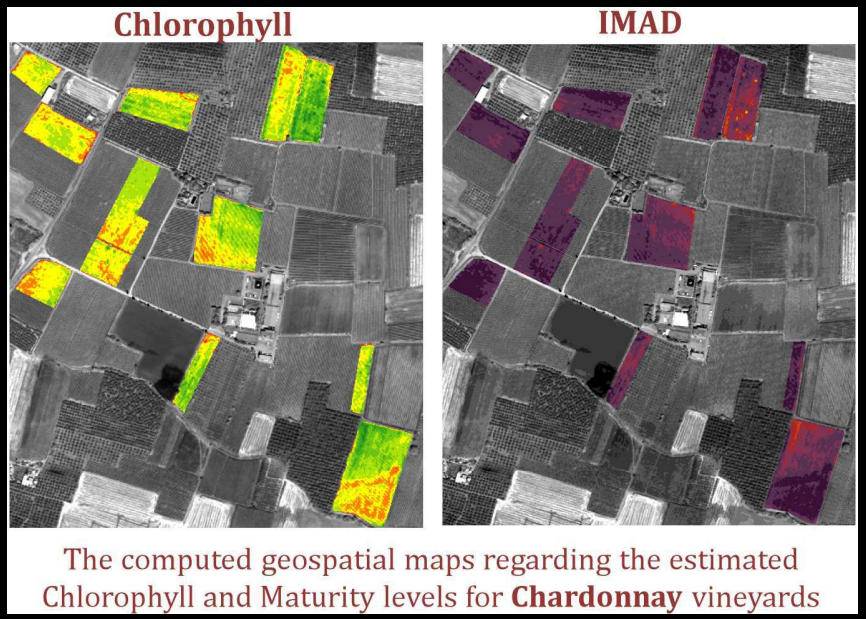
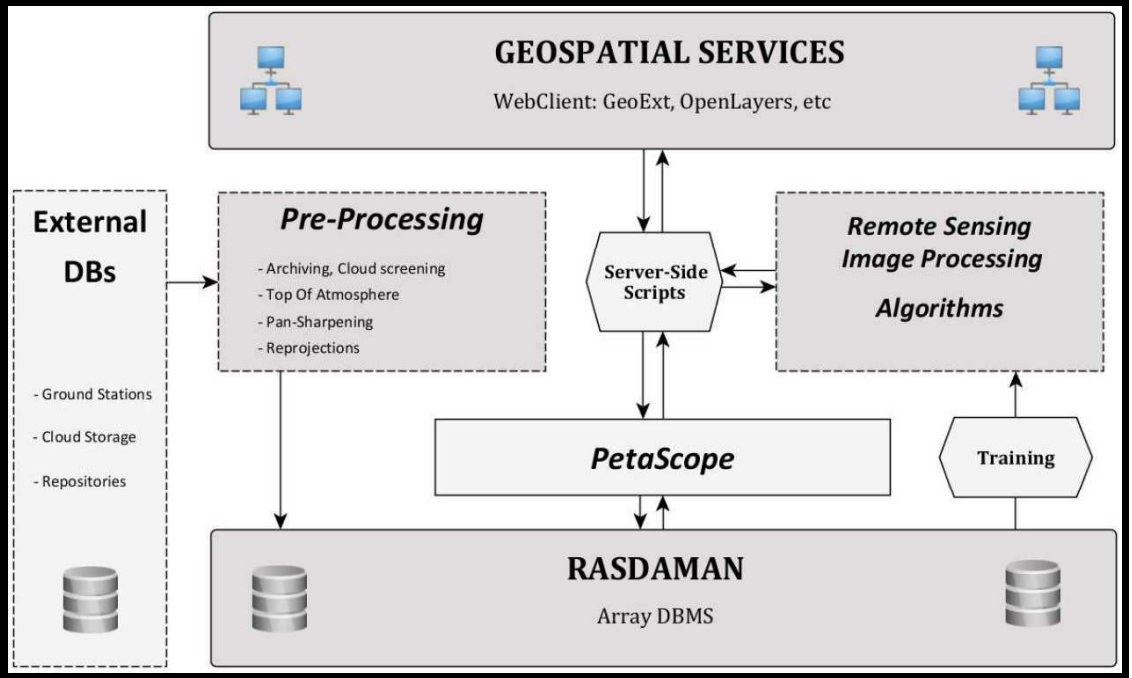
Our Approach

- ✓ *Multi-sensor EO datasets*
- ✓ *Applications:*
  - *Precision Agriculture*



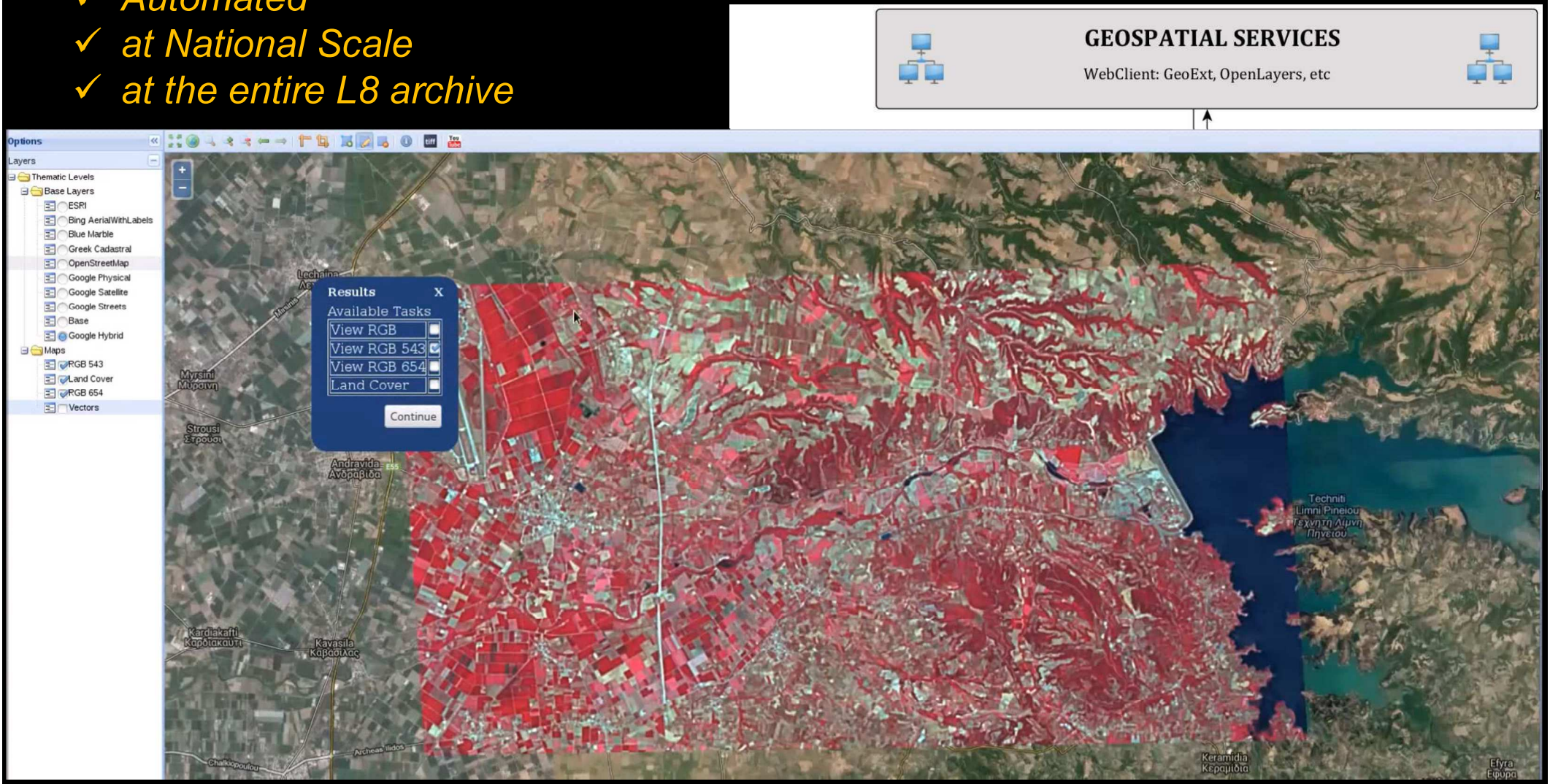
The computed geospatial maps regarding the estimated Chlorophyll and Maturity levels for **Chardonnay** vineyards



- ✓ *Kandylakis and Karantzalos, **2016**. Precision viticulture from multitemporal, multispectral very high resolution satellite data, ISPRS Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences.*
- ✓ *Karantzalos et al., **2015**. RemoteAgri: Processing Online Big Earth Observation Data for Precision Agriculture, **European Conference on Precision Agriculture**, pp.421-428*

Our Approach

- ✓ *Online, on the server-side **Land Cover Mapping***
- ✓ *Automated*
- ✓ *at National Scale*
- ✓ *at the entire L8 archive*



✓ *Karantzalos et al., **2015**. A Scalable Geospatial Service for Near Real-Time, High-Resolution Land Cover Mapping, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*

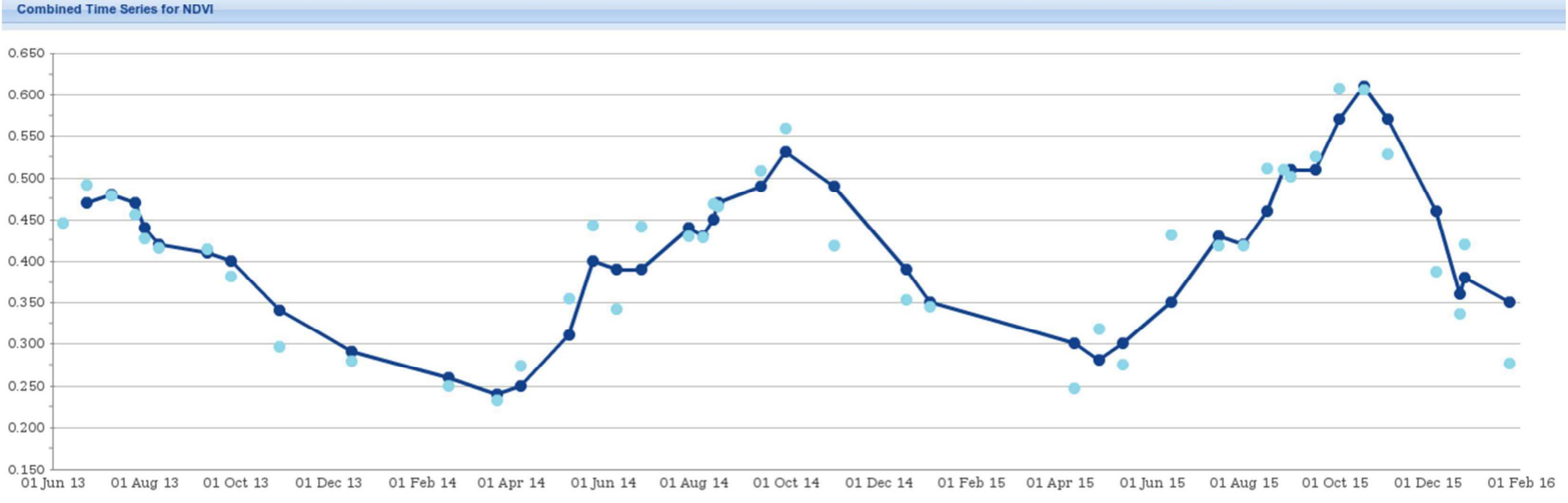
Time Series from Multi-Sensor Archives

- ✓ *One 4D datacube (i) per sensor, (ii) per path-row/ tile*
- ✓ *Specific WCPS queries (process/ algorithm/ index) per sensor*
- ✓ *Merging multi-sensor intermediate results*
- ✓ *Statistical analysis on derived observations*
- ✓ *Delivering Multi-sensor Time Series*

EO Datasets

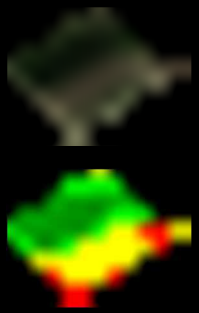
- *Sentinels*
- *Landsat*
- *RapidEye*
- *Pleiades*
- *Worldview-2/-3*

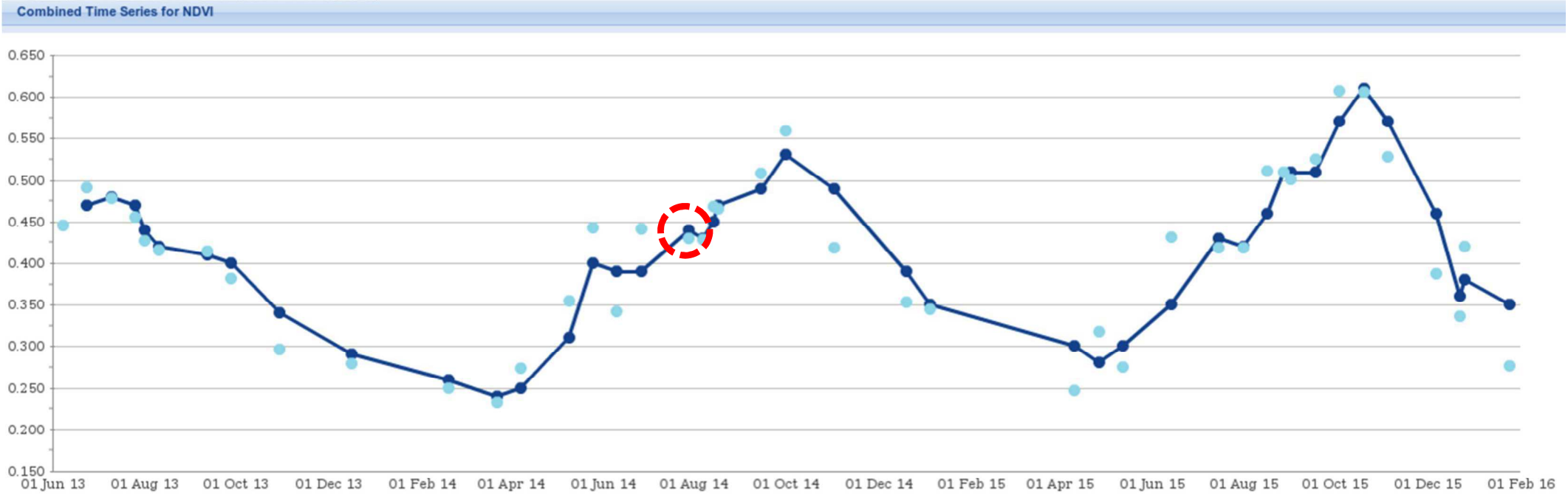
Time Series
from multi-sensor data



Time Series
from multi-sensor data

Landsat 8
29 July 2014





Time Series
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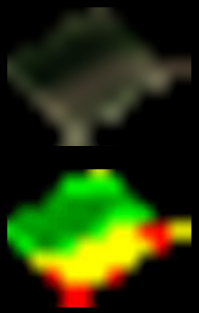
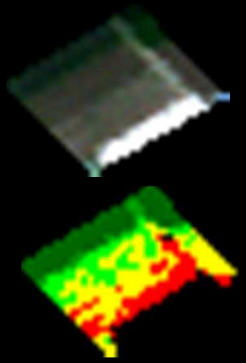
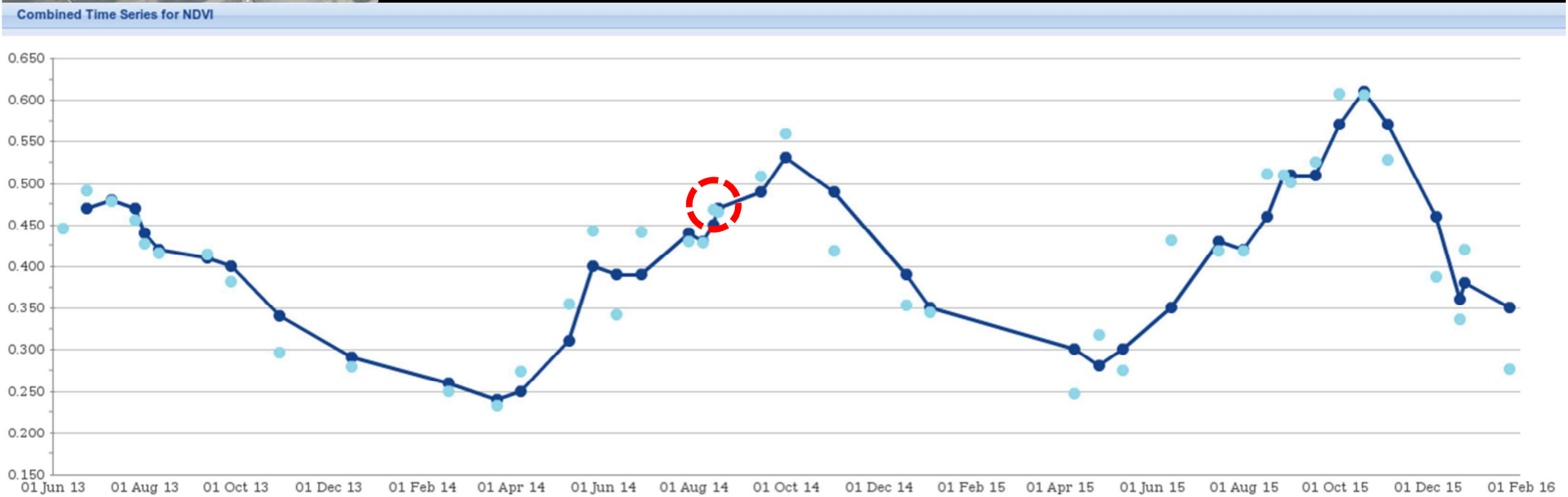


RapidEye
17 Aug 2014





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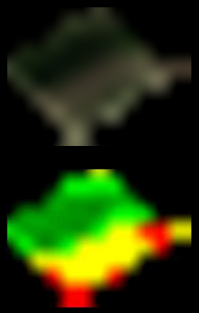

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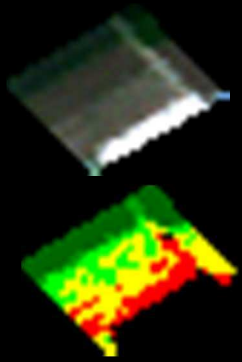
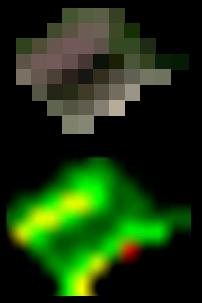
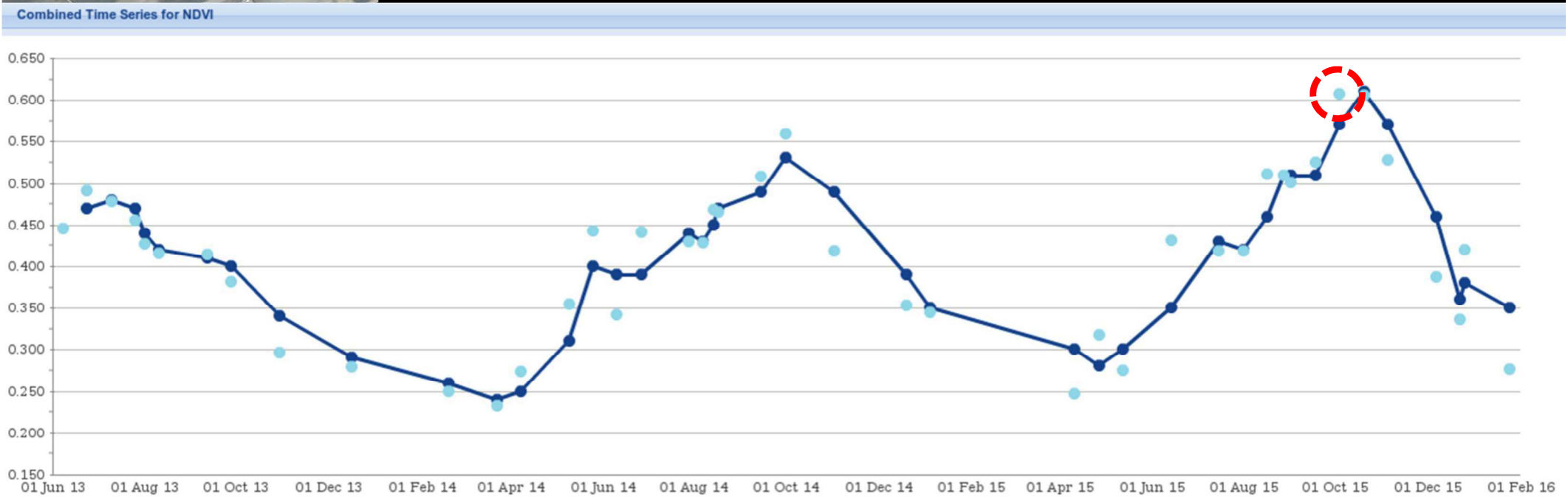


Landsat 8
4 Oct 2015





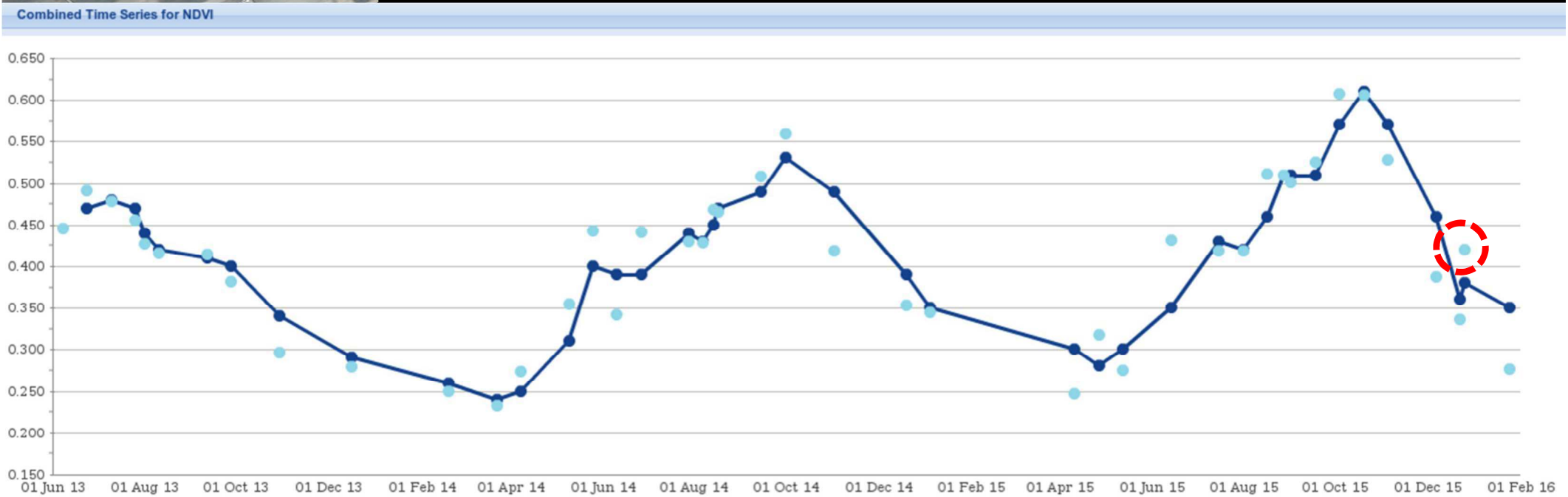
Time Series
from multi-sensor data

Landsat 8
29 July 2014

RapidEye
17 Aug 2014

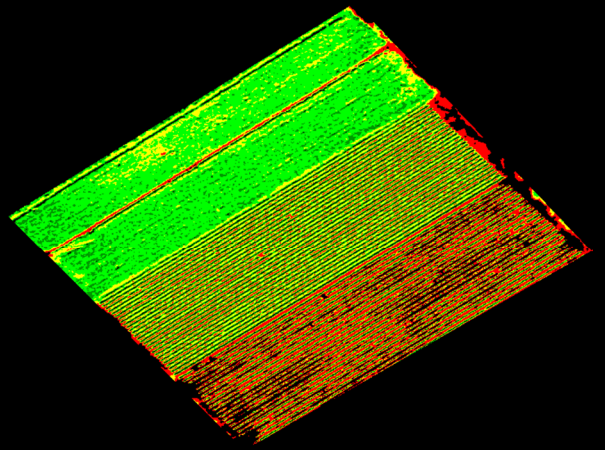
Landsat 8
4 Oct 2015

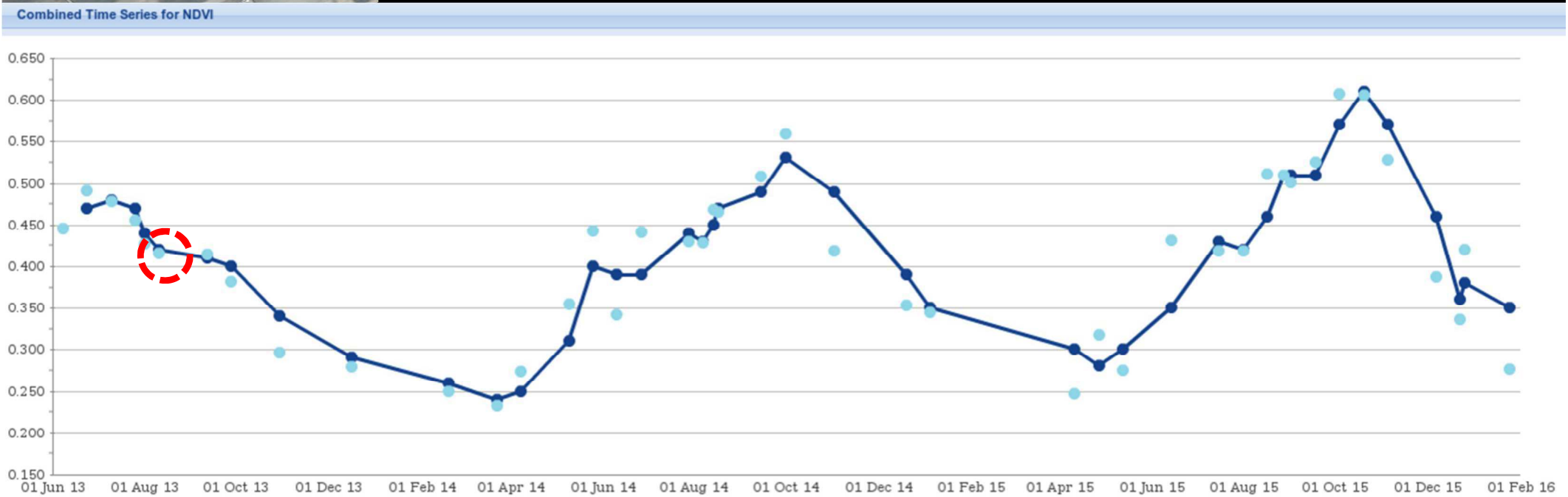
Sentinel-2
26 Dec 2015



Time Series
from multi-sensor data

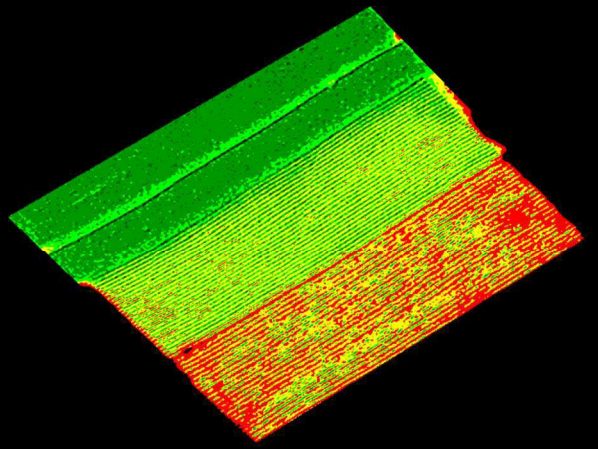
Worldview-2
1 Aug 2013

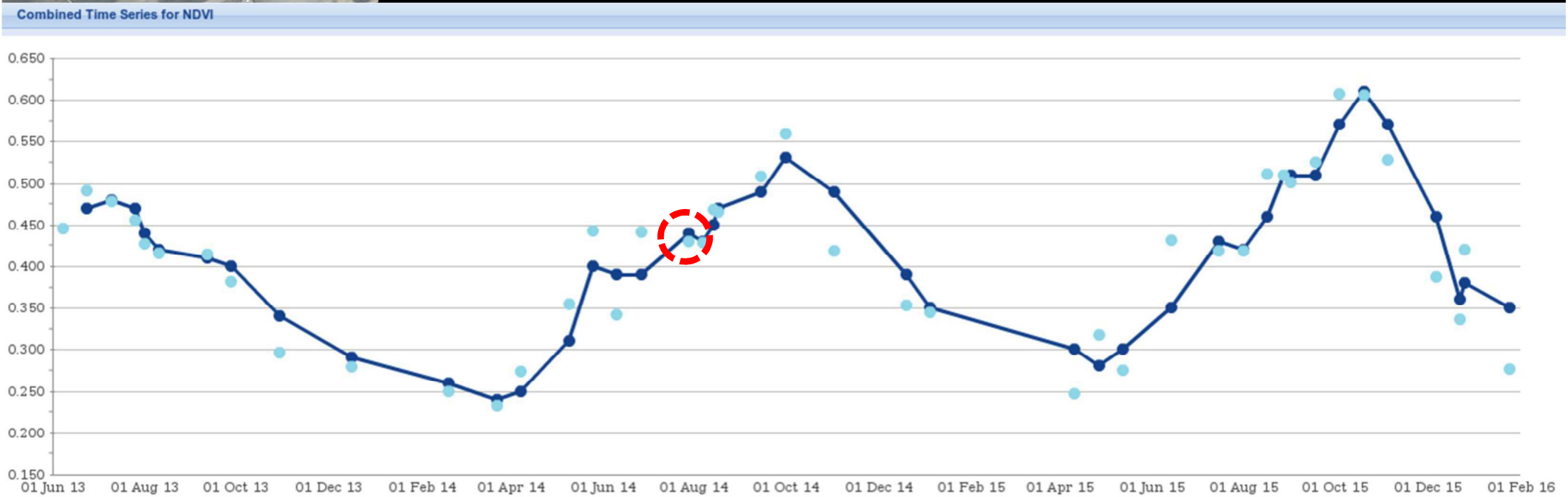




Time Series
from multi-sensor data

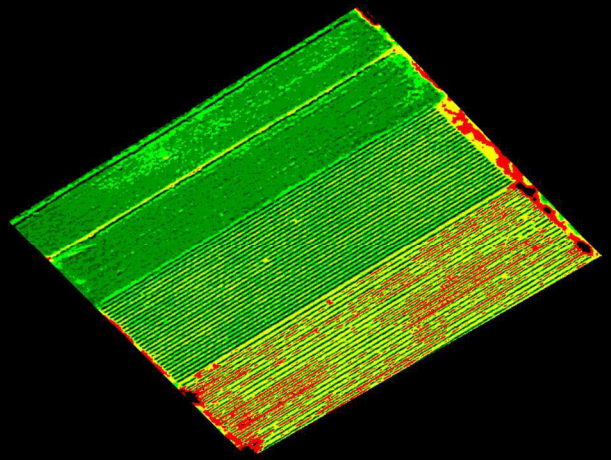
Pleiades
7 Aug 2014

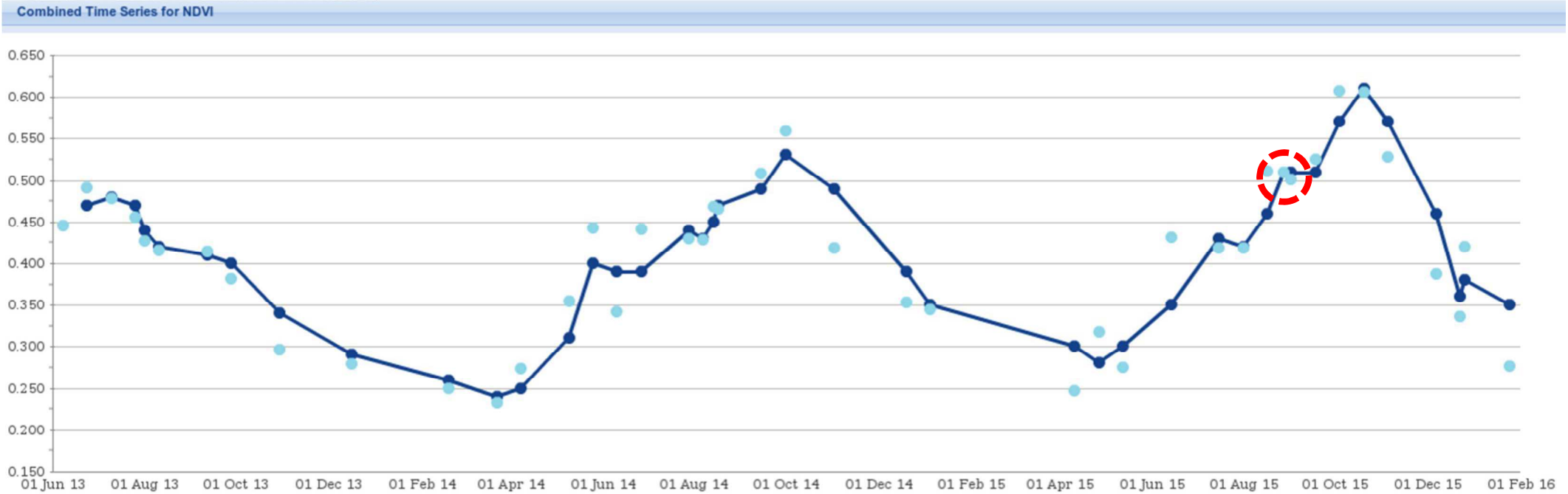




Time Series
from multi-sensor data

Worldview-2
28 Aug 2015

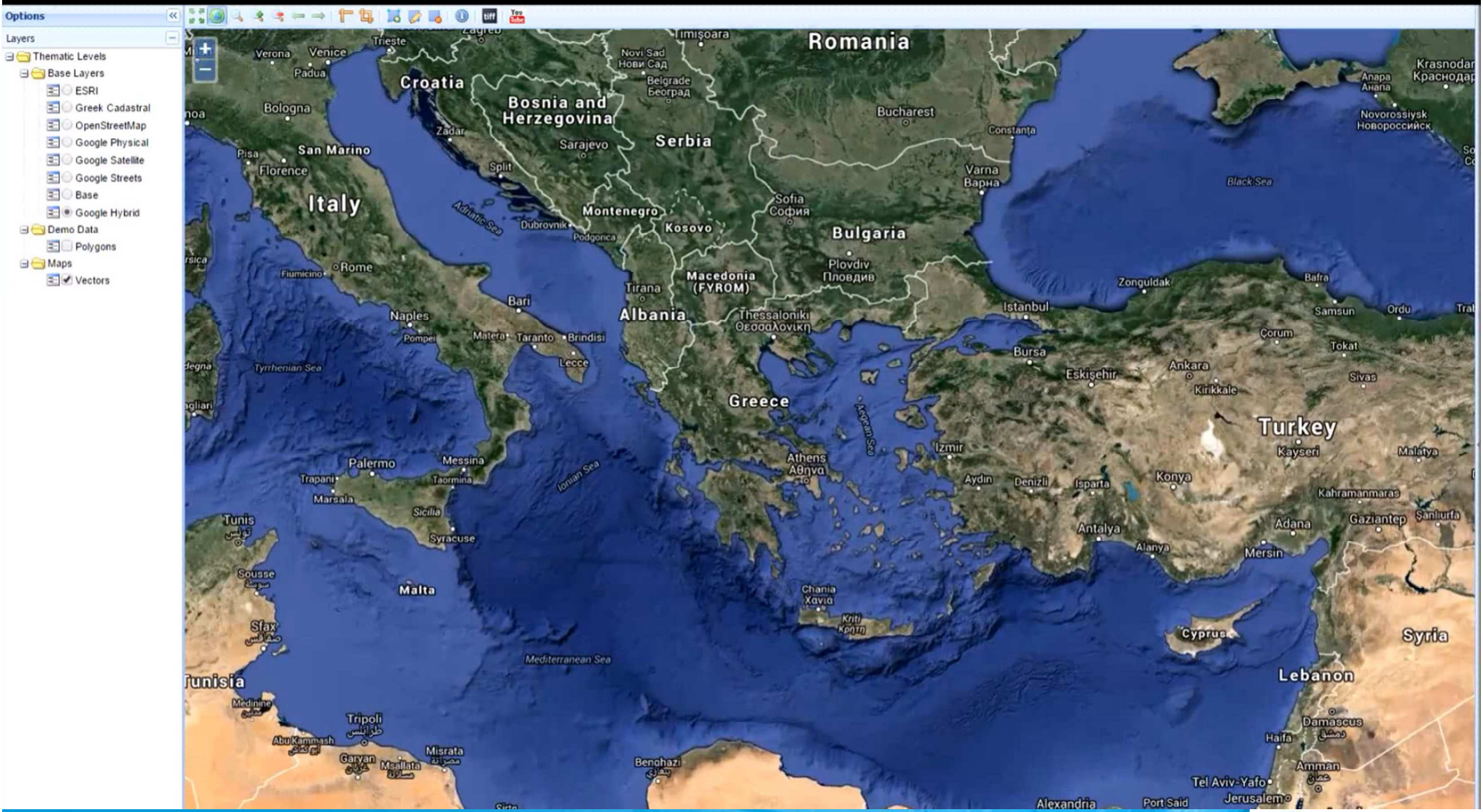




Demos here:

https://youtu.be/XHWEwhOihns

http://users.ntua.gr/karank/research.html



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Thank You - Gracias