Automated classification of land cover for the needs of CAP using Sentinel data.
A proactive approach.

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Farmers’ Organizations
- 70 Coops
- 150 K Farmers
- 0.75 B € Turnover
- 0.5 M ha Area

Neuropublic
- Gaia Cloud Platform
- AgriTech Know-How
- AgriTech Solutions
- Smart Farming

Piraeus Bank
- No 1 GR
- Contract Farming
- AgriCard
- Young Farmer loans

founded in 2014
...as joint partnership of...

ICT industry
Banking services
Agriculture Cooperatives
The shareholders legacy to the coalition
Digital service provider

GAIA SOCIETY
Electronic Agricultural Society
The added value of networking
GAIA Society: information services such as online rural encyclopedia, synchronous and asynchronous e-Learning, education and training certification, social networking tools and collaborative discussions.

GAIA INFARM
Intelligent Services for Agricultural Production
When intelligence meets farming
GAIA Infarm: decision support tools, monitoring and sensing systems in farms, management of natural resources, control applications, automation of agricultural crop and livestock facilities, diffusion and knowledge discovery services on precision farming and integrated production management.

GAIA SUBSIDY
Services for Subsidies and fulfillment of regulatory obligations
Get the most out of subsidies
GAIA Subsidy: services that assist farmers and their organizations with the fulfillment of their obligations in the framework of the CAP and national legislation.

GAIA COMMERCE
Electronic Commerce of Agricultural Products
Promote and sale your products in the most profitable way
GAIA Commerce: e-commerce services for contractual agriculture, basket of agricultural products, auction of agricultural products, and third-party services for the evaluation and certification of producers, processors and products.

GAIA MANAGEMENT
Services for financial management and monitoring
Creating a sustainable agri-business
GAIA Management: business management, business intelligence, information management and administration services for the evaluation of business plans, feasibility studies, cash planning and VAT refund.
GAIA’s involvement in the Aid Application Scheme

92 Farmer Service Points (FSP) certified as AID Application assistants to the beneficiaries

GAIA is certified as the coordination & support body (2014-2020)
Supporting Farmer using Data – Advisory Services

Weather Forecast  Field Sensors  Proximity Sensing  Remote Sensing  Farm Data

Data

Data fusion
Data assimilation
Data interpolation

Facts

How much water and when?
When do I have to spray?
What is the risk level?
What is the precise type and the exact amount of fertilizers needed?

Advice

Eligibility status? Parcel crop group?
Coupled payments & greening requirements?
Which choices to make?
Which financial instruments to use?
How can I support my business?

Farmer

Training  Support
IoT and Cloud Infrastructure for Agricultural Monitoring

large scale agricultural areas

Atmospheric Soil Data

GAIA Cloud

Data Collection

Data Analysis

Decision Making

Data Fusion

Satellite

RPAS

Sensors

Weather

Other sources

GAIA Smart Farm & GAIA Subsidy (CAP)

API

Farmer

Other Platforms

Sentinel-2

- Sort revisit
- HR
- MS
- Open

IoT GAIA Sense
The role of Sentinels

Subsidies control

On-the-fly automated cross checks of parcels declaration (proactive control):
• Reducing errors in the location of parcels
• Discouraging false claims

Full scale automatic compliance cross checks (post-declaration control):
• crop-wise in terms of modelling and time windows
• Allows better risk analysis, less RFV, more effective controls
• Reducing overall error rates

Smart Farming Services

Sentinel can be used for the multitemporal extraction of vegetation, soil and water indices and the monitoring of the phenological growth.

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Multi-Temporal Object-based Monitoring
Cloud based services that integrate earth observation data with Image Processing, Machine Learning, Spatial Modeling

Vegetation – Soil – water Indices at parcel level, for (single or multi) crop growing period
Indices in Agricultural Monitoring
Indices allows us to visualize the behavior of specific crops at parcel level through time.

Temperature data for area Leukonas - Prespes

Rainfall data for area Leukonas - Prespes

Extracted Indices patterns agree with phenological growth for the specific crop (beans)

Multitemporal Visualization of the Prespa area, for the growth period, using indices values (R=NDVI, G=NDWI, B=SAVI)
Land Cover Classification using +Indices

PHASE 1: Indices (i) extraction using atmospherically corrected bands (b)

PHASE 2: Descriptor Extraction for each object per Image

At the classification process, we want to create models that perform a mapping between different object properties

e.g. Parcel Location, EO Indices, PGS, Soil -> Crop.

PHASE 3: Model Creation (data driven)

That process has 4 main phases:

PHASE 4: Crop estimation for other parcels using the data-driven input -output model(s)
## Land Cover Classification using Indices

### TRAIN SET

<table>
<thead>
<tr>
<th>Crop</th>
<th>Cover (ha)</th>
<th>Parcels No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>545</td>
<td>498</td>
</tr>
<tr>
<td>Stone fruits</td>
<td>367</td>
<td>364</td>
</tr>
<tr>
<td>Legumes</td>
<td>158</td>
<td>142</td>
</tr>
<tr>
<td>Maize</td>
<td>229</td>
<td>164</td>
</tr>
<tr>
<td>Trees</td>
<td>244</td>
<td>210</td>
</tr>
<tr>
<td>Fallow</td>
<td>354</td>
<td>358</td>
</tr>
<tr>
<td>Pasture</td>
<td>1,976</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,873</strong></td>
<td><strong>1,816</strong></td>
</tr>
</tbody>
</table>

Total Area (ha): 282,600  
Agricultural Areas (ha): 53,580
## Land Cover Classification using Indices

### Test Set

<table>
<thead>
<tr>
<th>Crop</th>
<th>Cover (ha)</th>
<th>Parcels No.</th>
<th>Acc. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>2,164</td>
<td>4611</td>
<td>90%</td>
</tr>
<tr>
<td>Stone fruits</td>
<td>2,400</td>
<td>5045</td>
<td>81%</td>
</tr>
<tr>
<td>Legumes</td>
<td>1,344</td>
<td>1588</td>
<td>87%</td>
</tr>
<tr>
<td>Maize</td>
<td>2,917</td>
<td>3823</td>
<td>57%</td>
</tr>
<tr>
<td>Forest Trees</td>
<td>549</td>
<td>894</td>
<td>61%</td>
</tr>
<tr>
<td>Fallow</td>
<td>3,258</td>
<td>8744</td>
<td>65%</td>
</tr>
<tr>
<td>Pasture</td>
<td>1,167</td>
<td>51</td>
<td>78%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,799</strong></td>
<td><strong>25,264</strong></td>
<td><strong>74%</strong></td>
</tr>
</tbody>
</table>
Two back-end web services that rely on EO-S2 data:
• Polygon, time period -> Times series of indices, Estimated Crop Pattern
• Polygon, time period -> Crop classification

That allows:
• On-the-fly automated cross checks of parcels declaration (proactive control)
• Full scale automatic compliance cross checks (post-declaration control - locate the outliers)
• Crop monitoring – Smart farming (Advices based on Facts)

Plus Smart Farming data:
• Digital data (Valid Train set).
• Other type of data describing soil and atmospheric conditions (better mapping).
Next steps:
• Period 2017 – 2018: Subsidy and Smart Farming services for 16 large scale areas (pilot sites) and for 15 significant crops.
• Collaboration for specific sites and crops with the partners of DataBio H2020 project (3 years from 2017 to 2020).
• Enrich the modelling process with more Descriptors (SL1 + L8).
• Deep Learning (for specific time windows using VHR data).
• Big Data Analytics (Outliers)

Thoughts - Discussions:
• IACS will take advantage of other Cloud Platforms (Food Security).
Thank you for your attention
Any questions?

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