WP5: GEO-PRODUCT FROM SPACE-BORNE AND IN-SITU DATA PROCESSING AND INTEGRATION

Speakers: F. Javier García-Haro and Dimitris Stavrakoudis

Task 5.1 Leader: Ioannis Gitas (AUTH)
Task 5.2 Leader: Francesco Holecz (SARMAP)
Task 5.3 Leader: F. Javier García Haro (UVEG)
Task 5.4 Leader: Filomena Romano (CNR-IMAA)

Main Contributors *(In no particular order....)*:

Dimitris Stavrakoudis, Hara Minakou, Ioannis Gitas...... (AUTH)
Manuel Campos, Goncal Grau, Javier Garcia Haro...... (UVEG)
Francesco Holecz, Massimo Barbieri, Luca Gatti..... (SARMAP)
Simone Pascucci, Stefano Pignatti, Angelo Palombo....... (CNR-IMAA)
Elisabetta Ricciardelli, Francesco di Paola, Mariassunta Viggiano, Filomena Romano.... (CNR-IMAA)
Lorenzo Busetto, Mirco Boschetti, Luigi Ranghetti...... (CNR-IREA)

- ✓ **Introduction: WP Objectives and workplan**
- ✓ Task 5.4 - Meteorological variables
- ✓ Task 5.3 - Crop bio-physical parameters and phenology
- ✓ Task 5.2 - Crop detection and spatial variability
- ✓ Task 5.1 - ERMES Data archives

WP Leader: Javier García

Time Span: Months 4-33

Main Objectives of the WP5

- ✓ Objective 1: **setting up of ERMES EO** and in situ data archives *(Task 1)*
- ✓ Objective 2: To develop the **EO/meteo data processing chains** for generation of products related to:

  i) **crop detection** and **field variability** maps *(Task 2)*

  ii) **crop bio-physical** parameters and **phenology maps** *(Task 3)*

  iii) **meteorological variables** retrieval and forecast *(Task 4)*

Work Plan for Months 18-36

		Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17
Task	Deliv	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
T5.1	D5.2	ERMES data and products catalogue v1							✓										
	D5.3							ERMES data and products catalogue v2										✓	
T5.2	D5.5	Processing chain for "Crop detection and spatial variability" v1														✓			
	D5.7	Report on Processing chain for "Crop detection and spatial variability" v1														✓			
T5.3	D5.9	Processing chain for "Crop bio-physical parameters and phenology" v1														✓			
	D5.11	Report on Processing chain for "Crop bio physical parameters and phenology" v1														✓			
T5.4	D5.13	Processing chain for "Meteorological variables" v1															✓		
	D9.15	Report on Processing chain for "Meteorological variables" v1															✓		

Workplan of WP5 in months 18-36 with reference to expected deliverables

- ✓ Work on Products catalogue update
- ✓ Improvement of processing chains (where necessary)

- ✓ Introduction: WP Objectives and workplan
- ✓ **Task 5.4 - Meteorological variables**
- ✓ Task 5.3 - Crop bio-physical parameters and phenology
- ✓ Task 5.2 - Crop detection and spatial variability
- ✓ Task 5.1 ERMES Data archives

Task Leader: Filomena Romano (CNR-IMAA)

Time Span: Month 5-33

Activities in Months 18-36

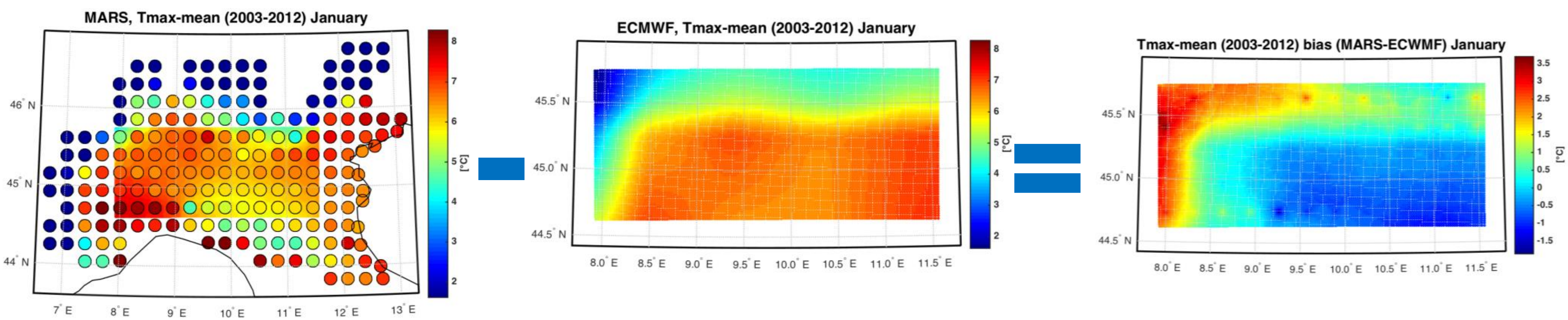
- ✓ Update and fine tuning of the first prototype v0 of the ERMES Meteorological Archive (MA) (2003-2015) (obtained by interpolating European Centre Medium Weather Forecast (ECMWF)-ERA-interim data for the 3 ERMES areas
- ✓ Update and fine tuning of the first prototype v0 of the ERMES Near Real Time (NRT)-Processing Chain (PC) (obtained by interpolating ECMWF-TIGGE data);
- ✓ Update of the Forecast Processing Chain (FPC) by using data from the WRF (Weather Research and Forecasting) model to produce daily forecast maps for each day of forecast (from present to present + 6).

Meteorological Parameters	**NRT meteorological maps (2016)**	**Meteorological Archive (2003-2015)**
TMax	Calibrated with MARS data	Calibrated with MARS data
TMin	Calibrated with MARS data	Calibrated with MARS data
WS	Calibrated with MARS data	Calibrated with MARS data
PCum	No calibration	No calibration
Rad	No calibration	No calibration
RhMax &RhMin	Determined on a daily dataset of RH with 6-hour steps (from 00GMT to 18GMT)	Determined on a daily dataset of RH with 3-hour steps (from 00GMT to 21GMT)

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

Meteorological archive and NRT

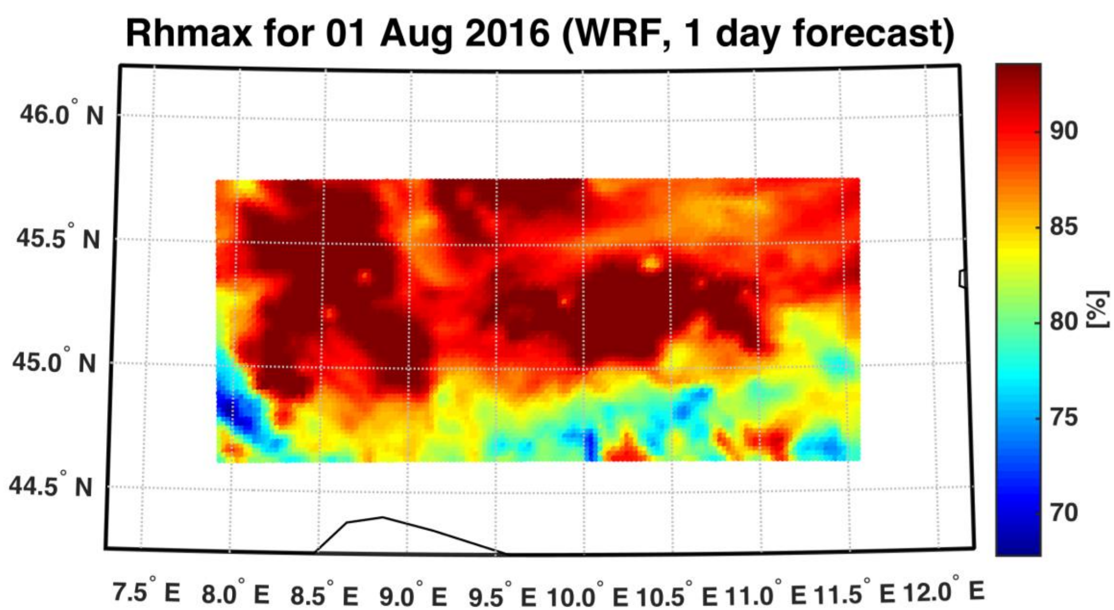
- ✓ The observed bias in some meteorological variables (in prototype v0) was corrected based on the recalibration with MARS (Monitoring Agricultural ResourceS) dataset, derived from ground stations, at 25 km resolution grid
  - ✓ computation of monthly calibration coefficients on the 25 km grid re-sampled on the 2 km - ERMES grid was done for the 3 regional areas.



Example of Retuning/intercalibration for determining Tmax calibration coefficient

Forecast processing chain updates

- ✓ Update of FPC: using data from the WRF (Weather Research and Forecasting) model to produce daily forecast maps for each day of forecast for the Italian study area.
- ✓ Calibration against GMS data. It was done with near real time Ground Meteo Stations data available on line from the Regional Environmental Protection Agency of the Lombardy region.



- ✓ Introduction: WP Objectives and workplan
- ✓ Task 5.4 - Meteorological variables
- ✓ **Task 5.3 - Crop bio-physical parameters and phenology**
- ✓ Task 5.2 - Crop detection and spatial variability
- ✓ Task 5.1 - ERMES Data archives

Task Leader: F. Javier García Haro (UVEG)

Time Span: Month 5-33

Objectives

✓ Implementation of dedicated **data processing chains for the generation** of the following products.

Regional Products

- **EP_R2: Phenological maps** (Responsible: CNR-IREA)

  Dates of the main phenological events (e.g., flooding dates, sowing dates, flowering dates) from MODIS vegetation indexes time series (MOD13Q1/MYD13Q1)

- **EP_R3: Biophysical parameters:** (Responsible: UVEG)

  Aggregation of LAI from operational biophysical products (VGT/Proba-V; MODIS)

Local Products

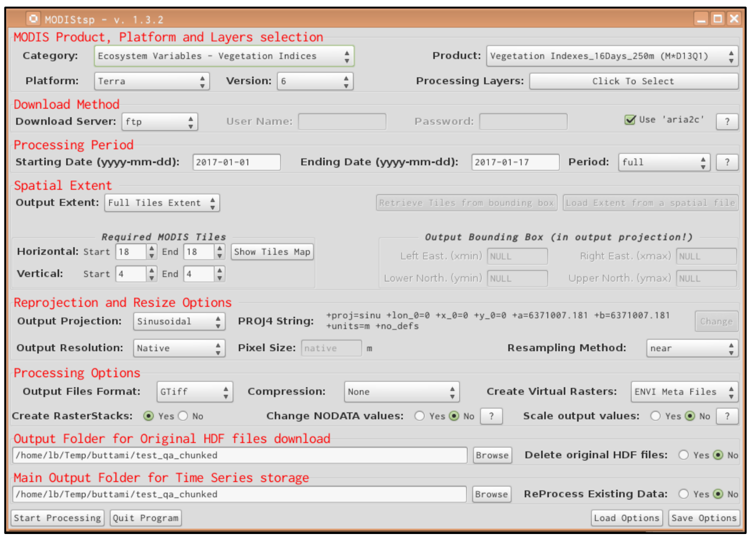
- **EP_L4: Biophysical parameters** (Responsible: UVEG)

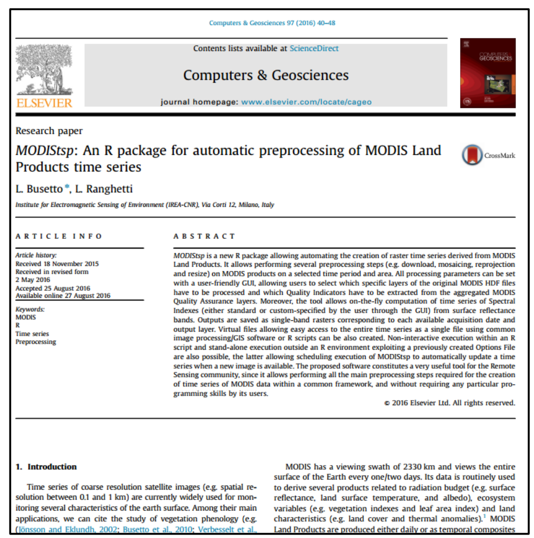
  Decametric resolution LAI maps, derived from Optical EO data (Landsat, Sentinel-2) aimed both for crop monitoring purposes, and as input recalibration data for Local modelling simulation

Phenological maps (EP_R2)

Activities in Months 18-36

- ✓ **Revision and fine tuning** of the first prototypes of the processing chains
  - ✓ Improving the **automation** of ERMES MODIS processing and post-processing routines
    - Final development of the **MODIStsp** tool for preprocessing of MODIS time series (https://github.com/lbusett/MODIStsp - Manuscript published on "*Computers and Geosciences*")
    - Open source "R" package – foreseen future release on CRAN





Computers & Geosciences 97 (2016) 40–48

Contents lists available at ScienceDirect

Computers & Geosciences

journal homepage: www.elsevier.com/locate/cageo

ELSEVIER

Research paper

MODIStsp: An R package for automatic preprocessing of MODIS Land Products time series

L. Busetto*, L. Ranghetti

Institute for Electromagnetic Sensing of Environment (IREA-CNR), Via Corti 12, Milano, Italy

ARTICLE INFO

Article history:
Received 18 November 2015
Received in revised form
2 May 2016
Accepted 25 August 2016
Available online 27 August 2016

Keywords:
MODIS
R
Time series
Preprocessing

ABSTRACT

MODIStsp is a new R package allowing automating the creation of raster time series derived from MODIS Land Products. It allows performing several preprocessing steps (e.g. download, mosaicing, reprojection and resize) on MODIS products on a selected time period and area. All processing parameters can be set with a user-friendly GUI, allowing users to select which specific layers of the original MODIS HDF files have to be processed and which Quality Indicators have to be extracted from the aggregated MODIS Quality Assurance layers. Moreover, the tool allows on-the-fly computation of time series of Spectral Indexes (either standard or custom-specified by the user through the GUI) from surface reflectance bands. Outputs are saved as single-band rasters corresponding to each available acquisition date and output layer. Virtual files allowing easy access to the entire time series as a single file using common image processing/GIS software or R scripts can be also created. Non-interactive execution within an R script and stand-alone execution outside an R environment exploiting a previously created Options File are also possible, the latter allowing scheduling execution of MODIStsp to automatically update a time series when a new image is available. The proposed software constitutes a very useful tool for the Remote Sensing community, since it allows performing all the main preprocessing steps required for the creation of time series of MODIS data within a common framework, and without requiring any particular programming skills by its users.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Time series of coarse resolution satellite images (e.g. spatial resolution between 0.1 and 1 km) are currently widely used for monitoring several characteristics of the earth surface. Among their main applications, we can cite the study of vegetation phenology (e.g. (Jönsson and Eklundh, 2002; Busetto et al., 2010; Verbesselt et al.,

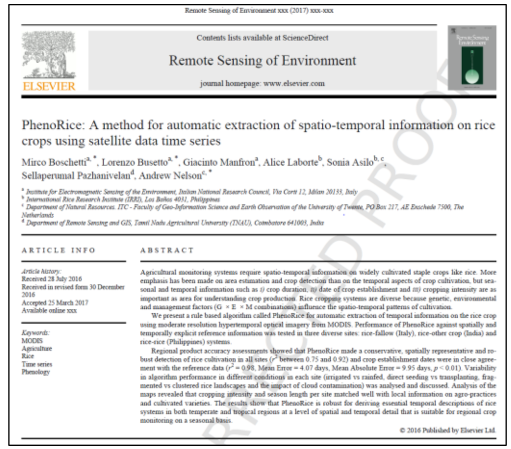
MODIS has a viewing swath of 2330 km and views the entire surface of the Earth every one/two days. Its data is routinely used to derive several products related to radiation budget (e.g. surface reflectance, land surface temperature, and albedo), ecosystem variables (e.g. vegetation indexes and leaf area index) and land characteristics (e.g. land cover and thermal anomalies).[1] MODIS Land Products are produced either daily or as temporal composites

Front-end GUI and first page of manuscript concerning the MODIStsp tool

Phenological maps (EP_R2)

Activities in Months 18-36

- ✓ Further development of the **PhenoRice algorithm** for phenological mapping from MODIS time series (Manuscript published on "*Remote Sensing of Environment*")
    - Bug correction on dates retrieval in multiple rice seasons areas; Removal of occasional *outliers;*
    - Improvements on algorithms' flexibility, user friendliness and **automation**;
    - Further testing of the algorithm on **European and Extra-European** rice areas;
    - Attempts to improve detection rates on areas sowed in dry conditions were not successful
- ✓ **PhenoRice** is now a stable and accurate algorithm for rice monitoring !
- ✓ Future work planned on applications at continental/global scale in collaboration with SARMAP/IRRI (International Rice Research Institute)

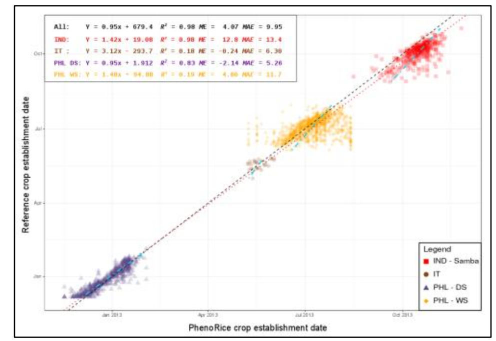

Remote Sensing of Environment

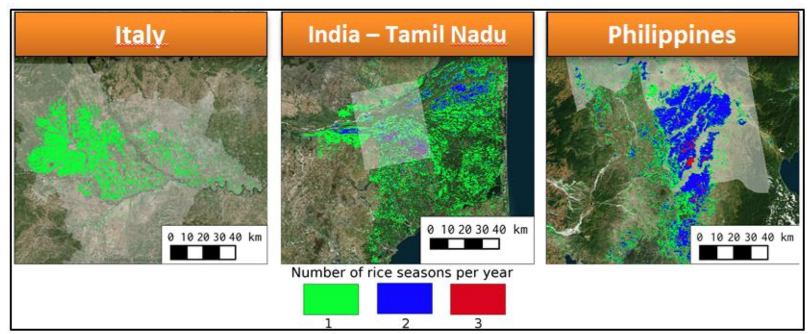
PhenoRice: A method for automatic extraction of spatio-temporal information on rice crops using satellite data time series

Mirco Boschetti, Lorenzo Busetto, Giacinto Manfron, Alice Laborte, Sonia Asilo, Sellaperumal Pazhanivelan, Andrew Nelson

ARTICLE INFO

ABSTRACT



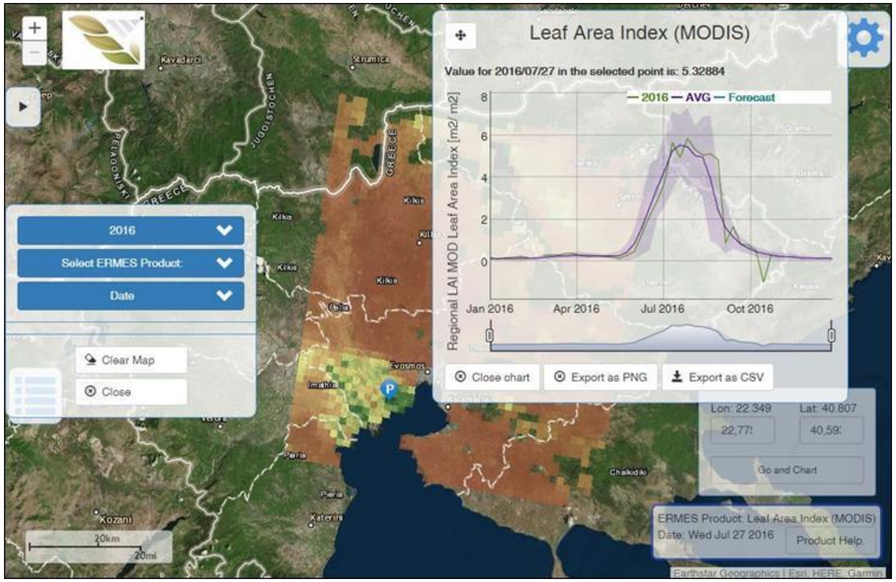


First page of manuscript concerning the PhenoRice Algorithm and examples of results in ERMES and other study areas

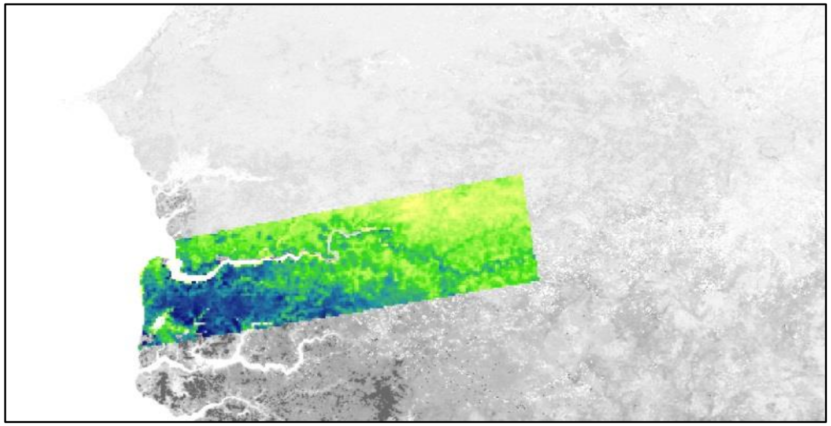
Multitemporal Biophysical parameters maps (EP_R3)

Activities in Months 18-36

- ✓ Revising and fine tuning the first prototypes of the processing chains
  - ✓ Quality assessment during validation phase provided good results. No significant changes were performed in the processing chains
  - ✓ Automation of procedures to create also LAI maps for the extra-European test sites: 1) Gambia and 2) Senegal River Valley



Example LAI time series for a pixel in Greece



Example LAI map for Gambia

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

Multitemporal High Resolution LAI maps (EP_L4)

Activities in Months 18-36

- ✓ Revising and fine tuning the first prototypes of the processing chains
  - ✓ <u>Prototyping of LAI Sentinel-2A processing chain</u>: Using multitmeporal SPOT-5 and Landsat during 2015
  - ✓ <u>Preparation of Sentinel 2A data:</u> Development of a dedicated processing chain (searching, downloading and atmospheric correction)
  - ✓ <u>Generation of LAI maps in 2016</u>: Multi-sensor approach to produce Landsat (7 & 8) and Sentinel 2A in NRT
  - ✓ <u>Constant NRT collection of field LAI data:</u> through pocketLAI smartApp (UMIL) and sharing between partners to allow on-the-fly quality checking and fine tuning

Remote Sensing of Environment 187 (2016) 102–118

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Multitemporal and multiresolution leaf area index retrieval for operational local rice crop monitoring

Manuel Campos-Tabern
Francesco Nutini[c], Alber

[a]Departament de Física de la Terra i Term
[b]Image Processing Laboratory (IPL), Unive
[c]Institute for Electromagnetic Sensing of t

ARTICLE INFO

Article history:
Received 2 May 2016
Received in revised form 16 September
Accepted 1 October 2016
Available online xxxx

Keywords:
Crop monitoring
Rice
Leaf area index (LAI) retrieval
PROSAIL
Smartphone
Gaussian process regression (GPR)
Landsat
SPOT5 Take5

remote sensing

MDPI

Article

Multitemporal Monitoring of Plant Area Index in the Valencia Rice District with PocketLAI

Manuel Campos-Taberner [1,*], Francisco Javier García-Haro [1], Roberto Confalonieri [2], Beatriz Martínez [1], Álvaro Moreno [1], Sergio Sánchez-Ruiz [1], María Amparo Gilabert [1], Fernando Camacho [3], Mirco Boschetti [4] and Lorenzo Busetto [4]

1 Department of Earth Physics and Thermodynamics, Faculty of Physics, Universitat de València, Dr. Moliner, Burjassot 46100, València, Spain; j.garcia.haro@uv.es (F.J.G.-H.); Beatriz.Martinez@uv.es (B.M.); alvaro.moreno@uv.es (A.M.); Sergio.Sanchez@uv.es (S.S.-R.); m.amparo.gilabert@uv.es (M.A.G.)
2 Department of Agricultural and Environmental Sciences—Production, Landscape, Agroenergy, Cassandra Lab, Università degli Studi di Milano, Via Celoria 2, 20133 Milan, Italy; roberto.confalonieri@unimi.it
3 EOLAB, Parc Científic Universitat de València, Catedrático A. Escardino, 46980 Paterna, Spain; fernando.camacho@eolab.es
4 Institute for Electromagnetic Sensing of the Environment, Italian National Research Council, Via Bassini 15, 20133 Milan, Italy; boschetti.m@irea.cnr.it (M.B.); busetto.l@irea.cnr.it (L.B.)
* Correspondence: manuel.campos@uv.es; Tel: +34-963-543-256; Fax: +34-963-543-385

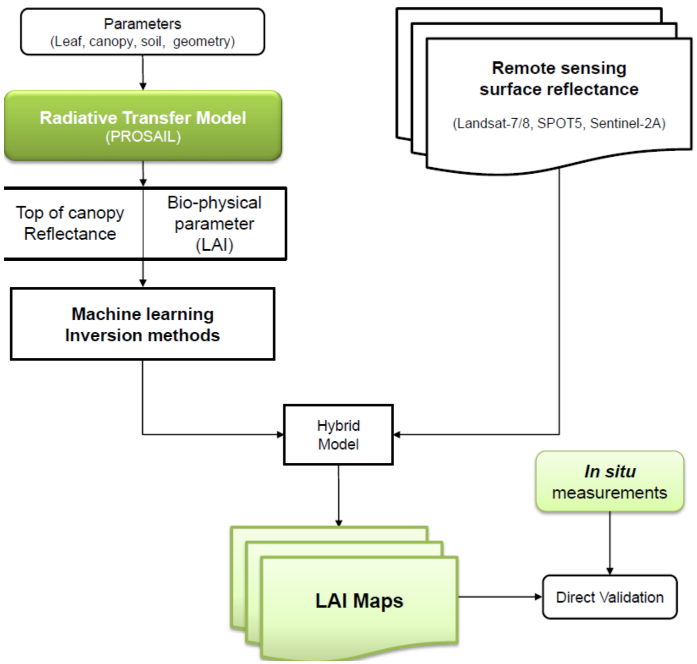
Academic Editors: Agnes Begue, Clement Atzberger and Prasad S. Thenkabail
Received: 14 December 2015; Accepted: 18 February 2016; Published: 1 March 2016

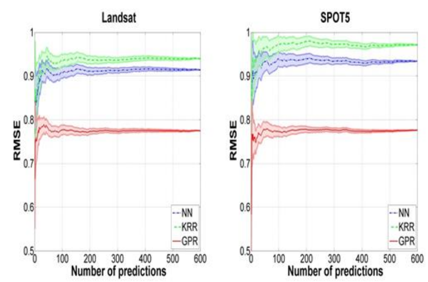
Abstract: Leaf area index (LAI) is a key biophysical parameter used to determine foliage cov
and crop growth in environmental studies in order to assess crop yield. Frequently, plant canop
analyzers (LAI-2000) and digital cameras for hemispherical photography (DHP) are used for indire
effective plant area index (PAI_{eff}) estimates. Nevertheless, these instruments are expensive an
have the disadvantages of low portability and maintenance. Recently, a smartphone app calle

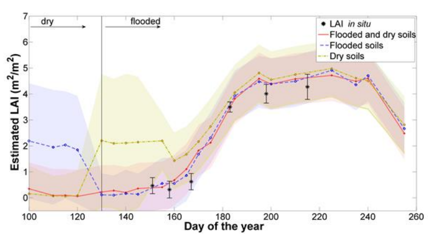
Multitemporal High Resolution LAI maps (EP_L4)

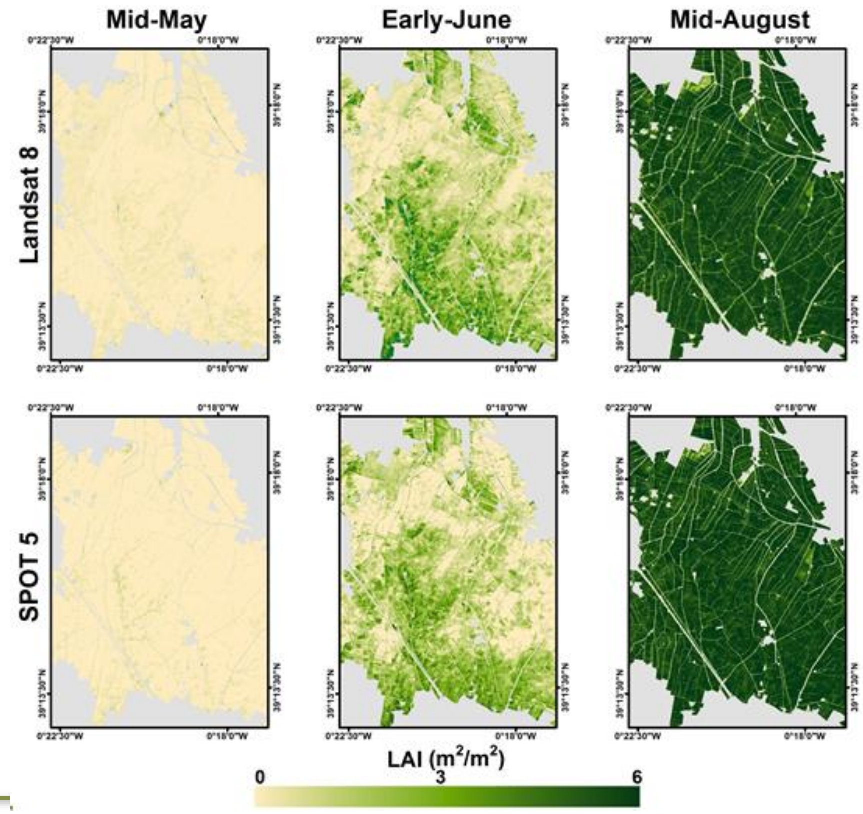
- ✓ Machine learning non parametric inversion of PROSAIL: GPR outperformed NN
- ✓ Optimal selection of parameters: Robust against flooded condition of soil background
- ✓ Good consistency between SPOT-5 & Landsat multitemporal LAI maps

(Manuscript published on "*Remote Sensing of Environment*")



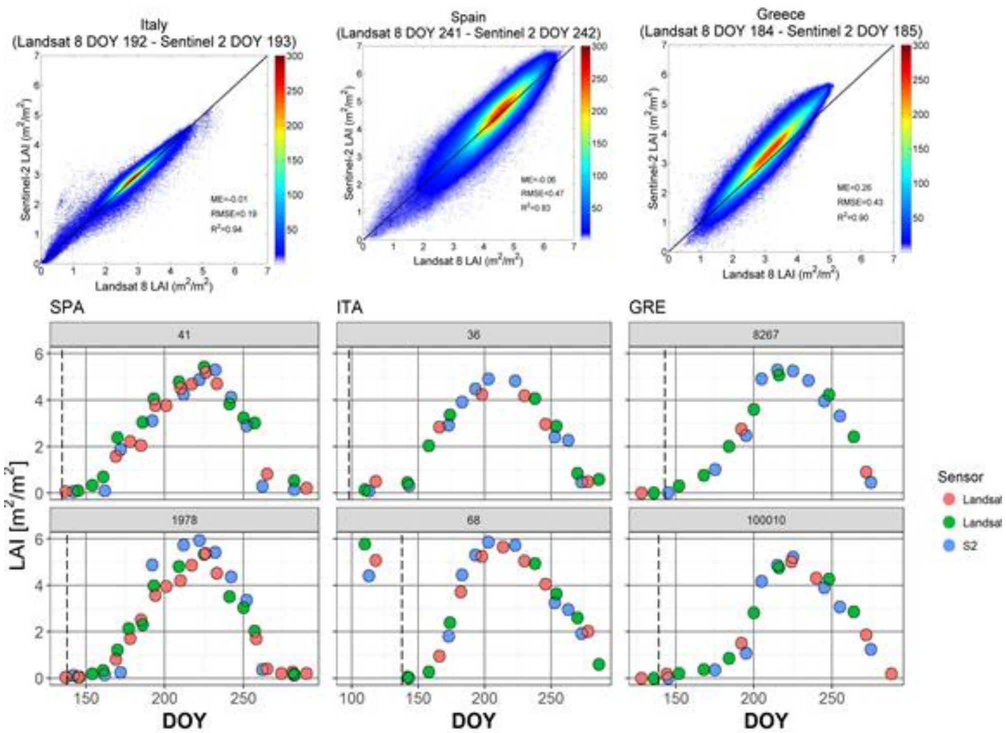


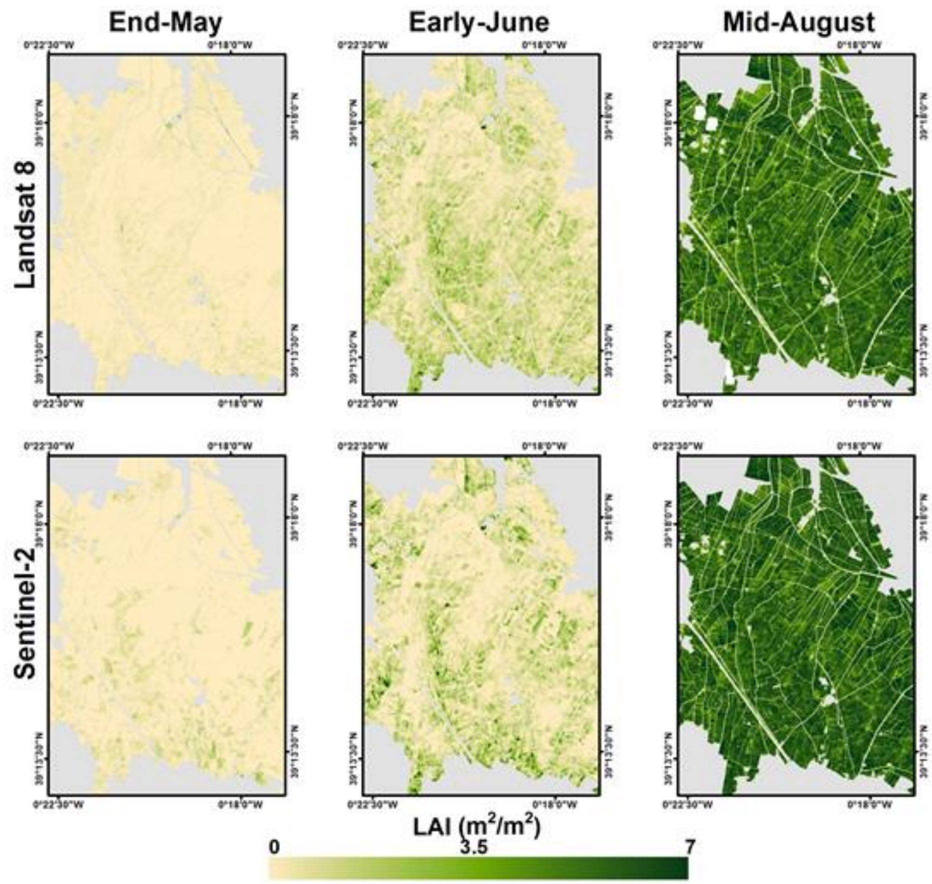




Multitemporal High Resolution LAI maps (EP_L4)

✓ NRT generation of LAI maps during 2016: Generation of a dense temporal by exploiting the high spatial consistency between Sentinel-2 and Landsat estimates (Manuscript published on "*Remote Sensing*")





- ✓ Introduction: WP Objectives and workplan
- ✓ Task 5.4 - Meteorological variables
- ✓ Task 5.3 - Crop bio-physical parameters and phenology
- ✓ **Task 5.2 - Crop detection and spatial variability**
- ✓ Task 5.1 - ERMES Data archives

Task Leader: Francesco Holecz (SARMAP)

Time Span: Month 5-33

Objectives

✓ Implementation of dedicated **data processing chains for the generation** of the following products.

REGIONAL:

- **EP_R1: Rice Crop Maps** (Responsible: SARMAP)

LOCAL:

- **EP_L2: Soil/biomass Constant Pattern Maps** (Responsible: CNR-IMAA)
  - Persistent within-field spatial variability mainly related to drivers such as the soil texture, soil carbon/minerals content and biomass indexes.

- **EP_L3: Seasonal Pattern Maps** (Responsible: AUTH)
  - In-season within-field spatial variability of rice crops through analysis of Very High Resolution EO data

NEW LOCAL PRODUCTS IN 2016 SEASON:

- **EP_L7: Seasonal Homogeneity Maps** (Responsible: SARMAP)
  - In-season within-field spatial variability of rice crops through VHR SAR data

- **EI_L7: Flood Maps** (Responsible: SARMAP)
  - Periodic monitoring of flooding conditions through high and very high resolution SAR data

Rice crop extent (EP_R1)

- ✓ Raster maps related to the effective **cultivated area** during the season **for the regional study areas** of Italy, Greece and Spain. The product is complemented by the detection **rice seasonal dynamics** in the same areas.

ERMES PRODUCT	
Code	EP_R1
Name	Rice Crop Extent
Responsible	SARMAP/CNR
Description	Map of the distribution of Rice in the three **Regional** study areas
Minimum Mapping Unit	- Full resolution Raster Map: @ original EO data input resolution - 1.5 Km Raster Map obtained from aggregation of higher resolution cells, reporting Fractional cover/total area of rice in each cell.
Time Step	**Required:** Once a year **Foreseen:** Once a year **Fail Proof Backup:** use of a previous year(s) map
Timeliness	**Service Requirements:** As soon as possible (e.g., July) **Foreseen:** July **Fail Proof Backup:** August

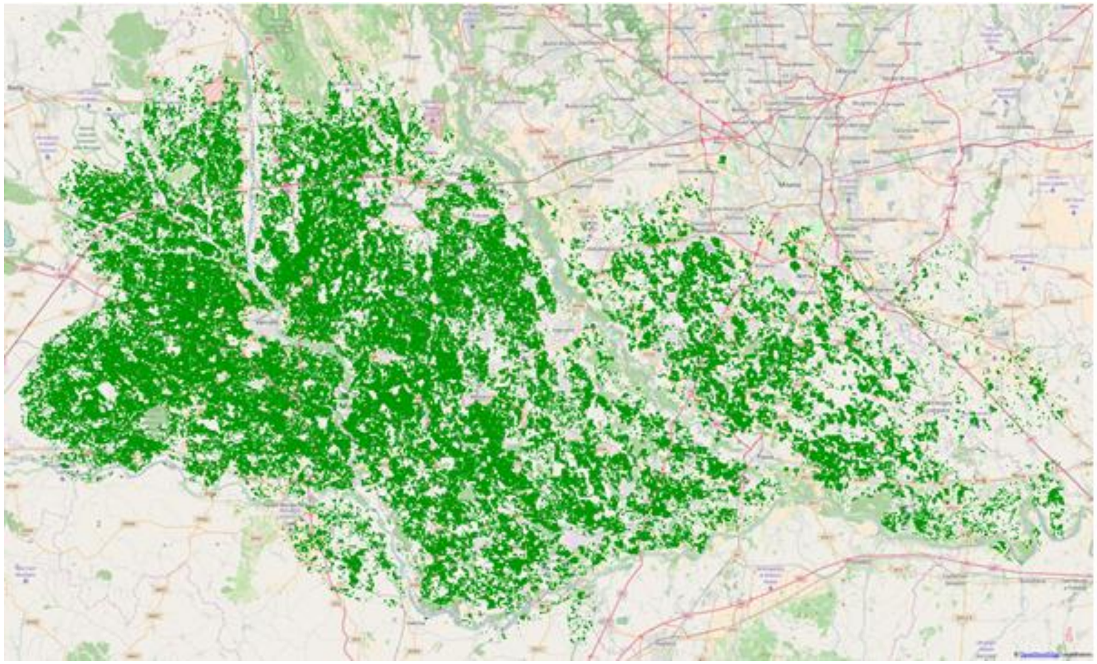
Rice crop extent (EP_R1)

Activities in Months 18-36

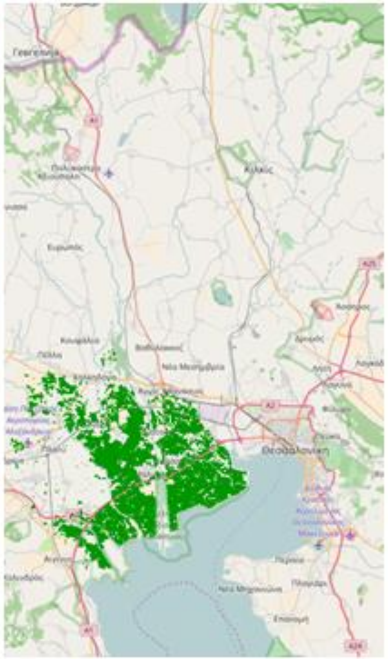
- **Revising and fine tuning** the first prototypes of the processing chains for rice crop mapping
  - ✓ Sentinel-1A VV/VH intensity data: Implementation of a **temporal smoothing algorithm** to improve SAR signature interpretation aimed at rice area detection and start of season identification
  - ✓ Improvement of the **Multi-temporal Speckle** filter algorithm
  - ✓ Software upgrade for downloading and processing **Sentinel-2A data**
  - ✓ **Integration of SAR and Optical (Landsat-8 and Sentinel-2A)** data to improve the rice product accuracy
  - ✓ Use of Sentinel-1A VV **coherence time-series**
  - ✓ **Overall speed-up** of the processing chain, which was mandatory due to the huge amount of data

- **Development of new products**
  - ✓ Use of COSMO-SkyMed 3 m resolution data to detect **spatial and temporal variability within rice fields**
  - ✓ Rice field seasonal **flood maps** from Sentinel-1A (20 m resolution) and COSMO-SkyMed (3 m resolution)

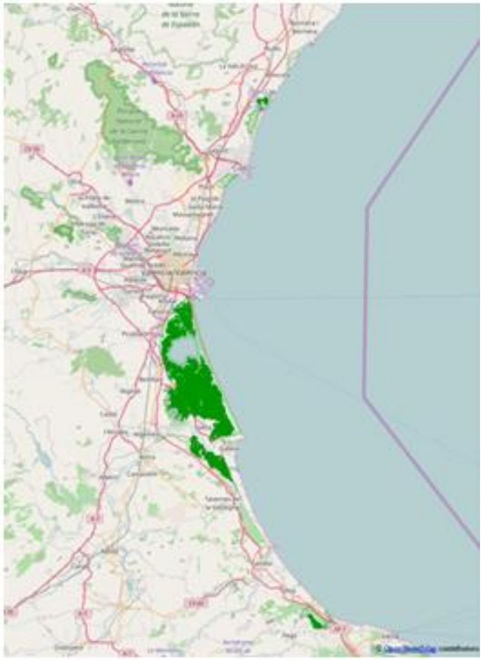
2016 rice area maps



Italy



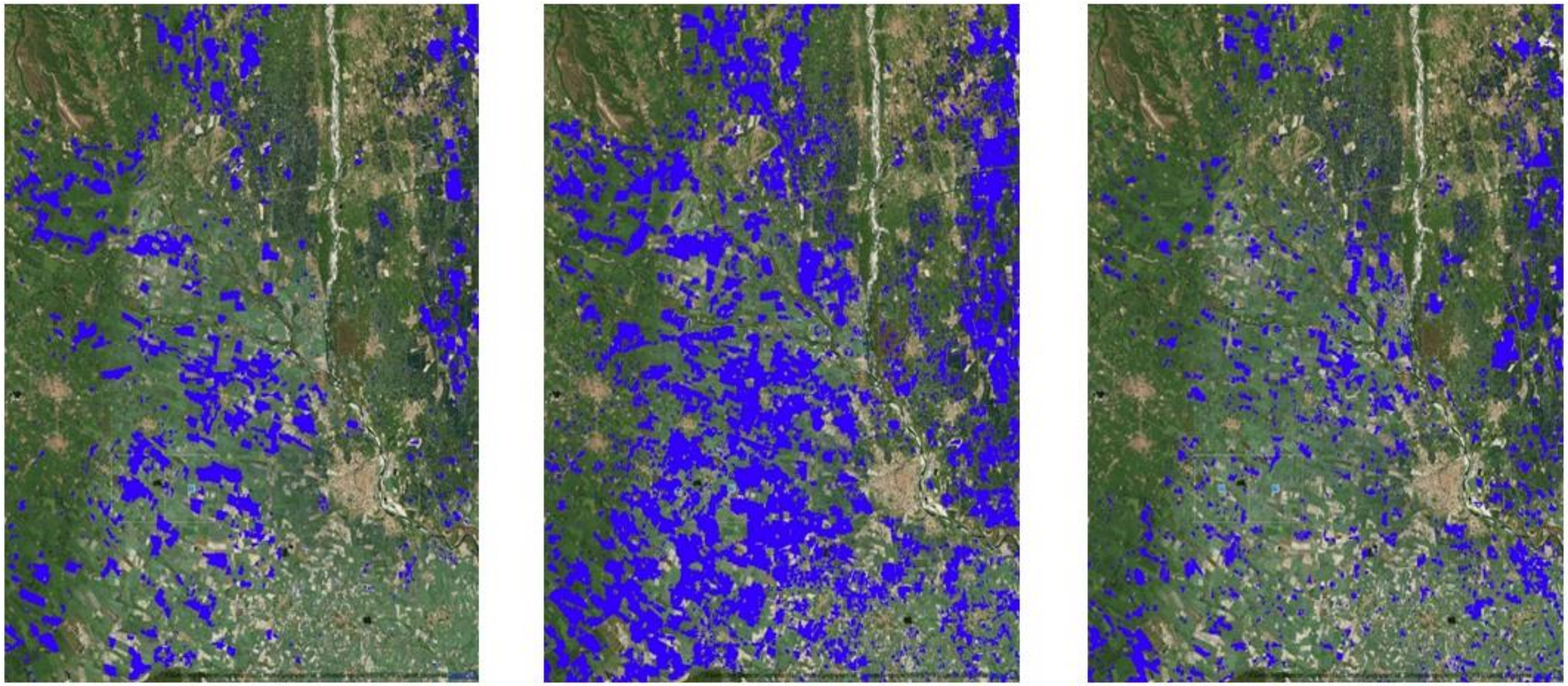
Greece



Spain

Seasonal flood maps (EI_L7)

- ✓ Initially produced **using Sentinel-1A SAR** data after IPLA explicit request
- ✓ Useful to monitor spatial and temporal variations in irrigation practices (ecological/environmental impact)
- ✓ Based on analysis of temporal profile of SAR backscattering



Rice flooded fields (blue colored) in the «Baraggia» region (IPLA study area) as detected from Sentinel-1A
Left to right: 14 April, 8 May, 13 June 2016

Seasonal flood maps (EI_L7)

- ✓ Methodology extended to X-band VHR SAR data from Cosmo-SkyMed (3 m) for all countries

28/04/2016

06/05/2016

14/05/2016

22/05/2016

Example of seasonal flood maps from Cosmo-SkyMed in Greece

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

SAR-based homogeneity maps (EP_L7)

- ✓ New product developed by SARMAP and experimentally used during the 2016 season
- ✓ Based on VHR X-band SAR images from Cosmo-SkyMed (3 m)
- ✓ Relative Sigma Nought signal (with respect to parcel's average value) → Categorisation into **5 classes** (much lower, lower, average, higher, much higher)
- ✓ Interpretation depends on the part of the season:
  - During **sowing/flooding** stage: (much) lower classes denote better flooded areas
  - **Before panicle initiation**: (much) higher classes represent areas where rice is growing better (faster biomass increase)
  - **After panicle initiation:** (much) lower classes represent better (more homogeneous) areas
- ✓ Additional product showing temporal change: **5 classes** (highly decreasing, decreasing, about equal, increasing, highly increasing)
- ✓ All products produced in NRT and uploaded in UJI server/Local Geoportal

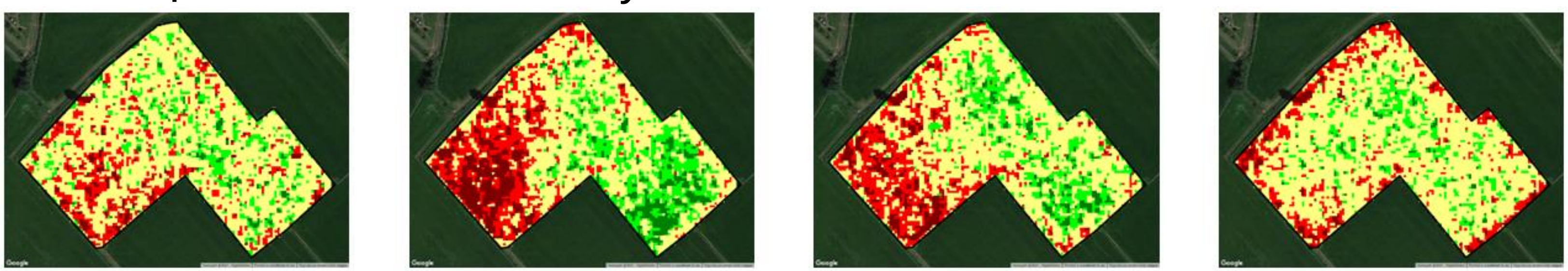
SAR-based homogeneity maps (EP_L7)

✓ Useful to monitor Within field problems in germination due to: soil and oscillation in temperature

Single date SAR signal return

- Very low
- Low
- About mean
- High
- Very high

19th Apr | 5th May | 21st May | 6° June



Example of homogeneity maps for the Italian rice area

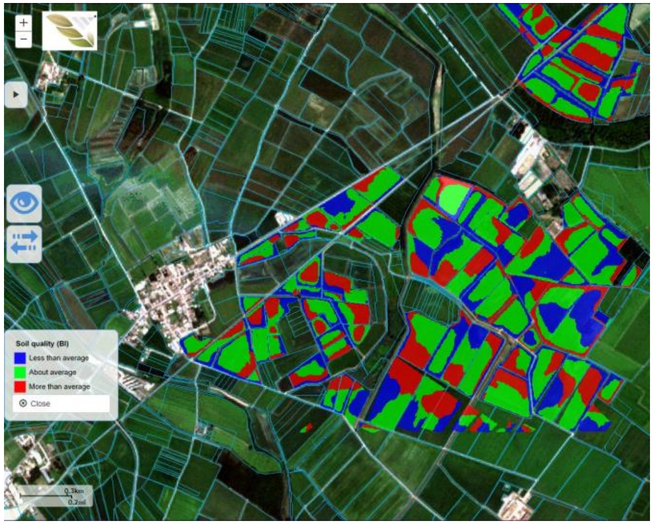
Soil and Biomass constant pattern maps (EP_L2)

- ✓ Aimed at highlighting constant anomalies at sub-parcel level, which affect/may affect rice production
- ✓ Derived from **SPOT** (HR1) [Italy] and **Landsat** (LS) [Greece & Spain] inter-annual time series of images (i.e. winter images for bare soil and summer images for biomass)
- ✓ Considered constant over the years: produced once during the ERMES project

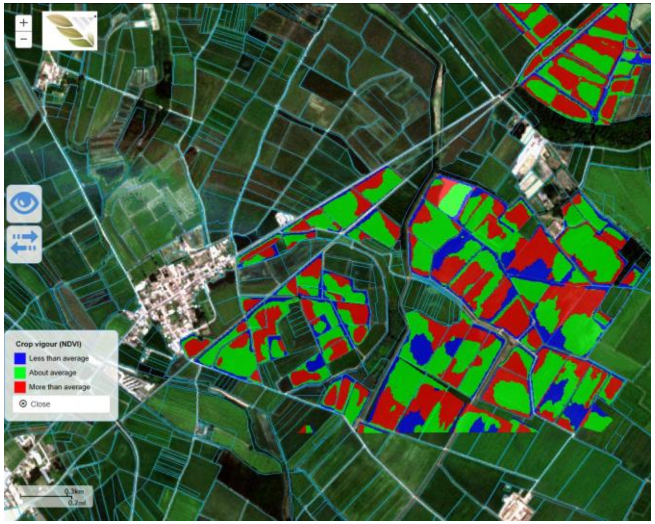
Activities in Months 18-36

- ✓ Revising and fine tuning the first prototypes of the processing chains
  - Calculation of the **Z-score spatial normalization**
  - Validation: quantitative and qualitative
  - Improved, more understandable legends
- ✓ Improved version created in April 2016, after partners from the three local study areas provided new shapefiles with corrected parcel boundaries
- ✓ Soil and vegetation patterns **available in Local Geoportal separately**, along with their intersection

Example of 2016 constant pattern map in Local Geoportal (Italian local study area using SPOT 2003-2014 time-series)



Soil Quality



Crop Vigour

Intersection

Seasonal pattern maps (EP_L3)

- **Aimed** at creating high resolution raster maps of within-field spatial variability (relatively to each parcel's average state), starting from satellite images
- Maps aimed at providing useful info for farm management (e.g., poor emergence, nitrogen deficiency, etc.) and to be directly **exploited for supporting Variable Rate Technology fertilisation** practices

Seasonal pattern maps (EP_L3)

Activities in Months 18-36

✓ **Major overhaul** of processing chain. For each available HR image, the corresponding EP_L3 product consists of three interrelated and complementary products:

1. **A vegetation index map** (MSAVI2), related the crop's current biomass content; MSAVI2 selected on the basis of analysis of 2015 field data
2. **A normalised Δ image**, which illustrates each pixel's deviation from its parcel's average state
   - Δ image produced according to a normalisation procedure, using a scaling function ($\tanh$) to reduce the effect of evident outliers (e.g., field boundaries)
3. **A categorisation of the Δ image** into three classes (average, below and above average), produced by means of an unsupervised clustering procedure
   - Advanced fuzzy clustering scheme (fuzzy C-means clustering, FCM)
   - Advanced framework for identifying whether only one cluster (homogeneous parcels) or two/three (multimodal distributions) should be created for a given parcel

Seasonal pattern maps (EP_L3)

Vegetation Index (MSAVI)

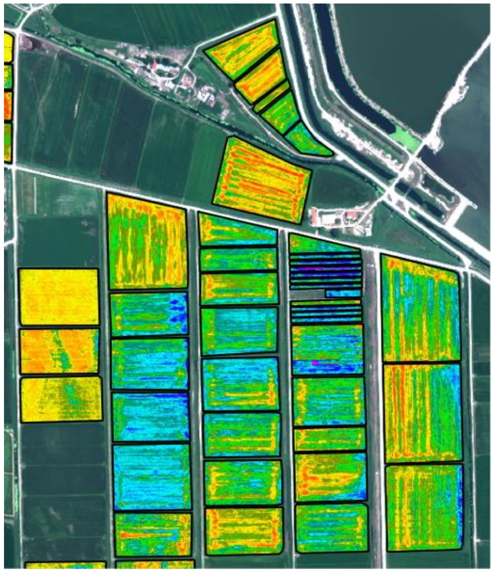
- ≤−0.1
- 0.0
- +0.1
- +0.2
- +0.3
- +0.4
- +0.5
- +0.6
- +0.7
- +0.8
- +0.9
- +1.0

Field Variability [%]

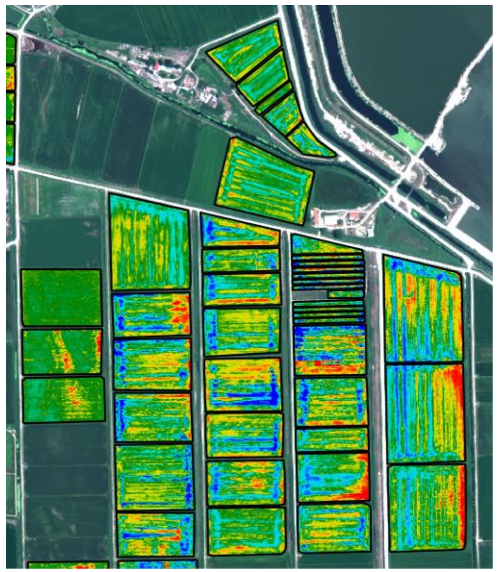
- ≤ −50%
- −40%
- −30%
- −20%
- −10%
- Average
- +10%
- +20%
- +30%
- +40%
- ≥ +50%

Field Variability [Classes]

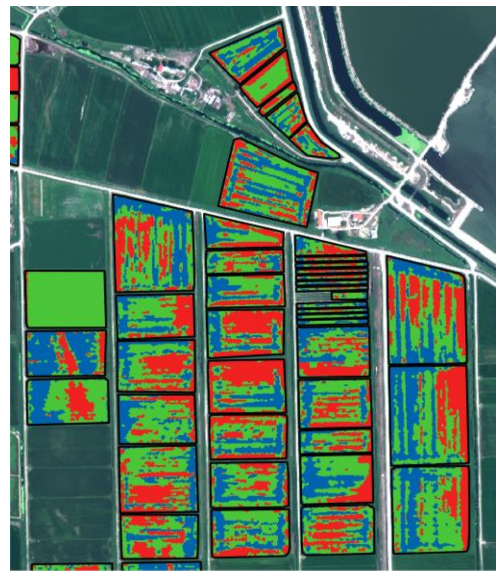
- Less than average
- Average (biomass)
- More than average
- Cloud/Shadow



MSAVI map
Absolute parcel status; comparison with neighbouring parcels



Δ_{MSAVI} map
Relative within-parcel variability



Cluster map
Use with VRT machinery

Seasonal pattern maps (EP_L3)

Activities in Months 18-36

✓ **Major overhaul** of processing chain. For each available HR image, the corresponding EP_L3 product consists of three interrelated and complementary products:

1. **Automation of processing chain**, from atmospheric correction to computation of clustering and deployment to UJI ftp server.

2. **Creation of revised and homogeneous legends**

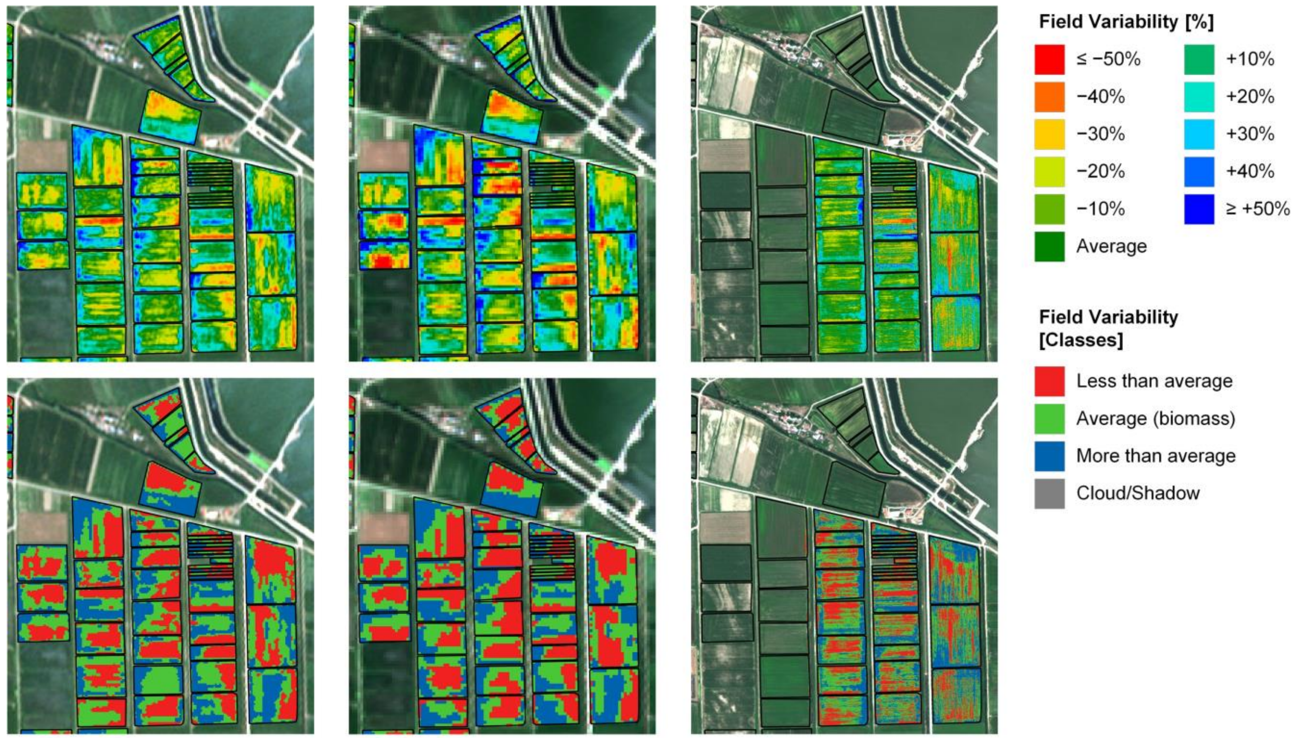
Automated processing chain **finalised before 2016 growing season**. All products have been produced and exploited in NRT during 2016

Seasonal pattern maps (EP_L3)

Activities in Months 18-36

✓ EP_L3 products created using images:

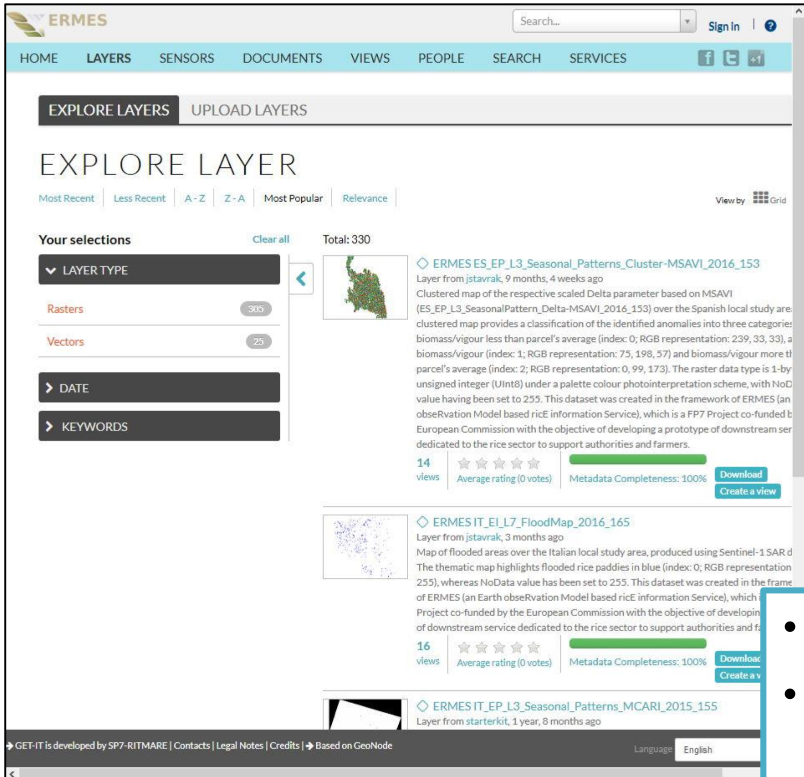
- **RapidEye** (5 images for each of the 3 countries; official products)
- **Sentinel-2** (in all 3 countries; for comparison purposes)
- **Drone/Sequoia** camera (Greece only; for comparison purposes)

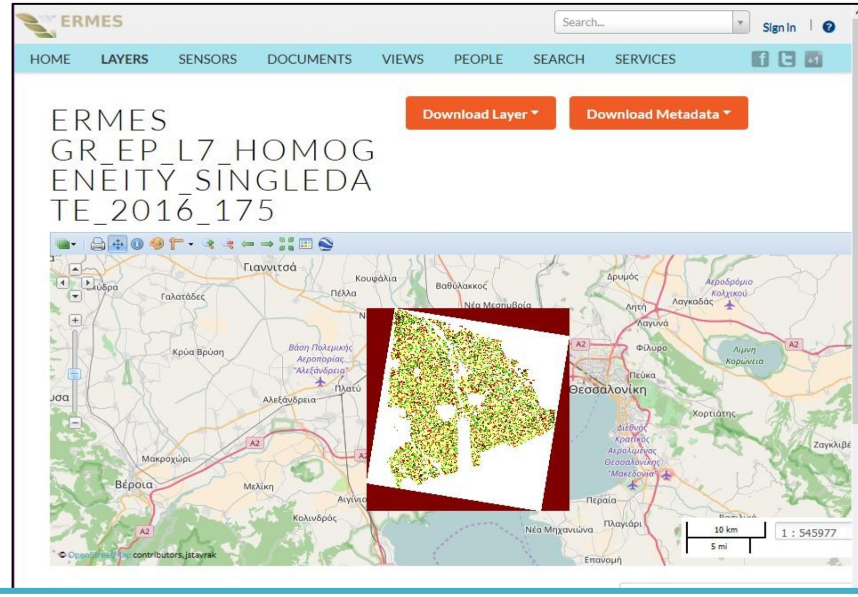


RapidEye (02/07/2016) | Sentinel-2 (03/07/2016) | Sequoia [Drone] (27/09/2016)

- ✓ Introduction: WP Objectives and workplan
- ✓ Task 5.4 - Meteorological variables
- ✓ Task 5.3 - Crop bio-physical parameters and phenology
- ✓ Task 5.2 - Crop detection and spatial variability
- ✓ **Task 5.1 - ERMES Data archives**

GET-IT
Discovery/Download





http://get-it.ermes-fp7space.eu/

- Development finalised before M18
- Data uploaded at the end of 2015 demonstration and during 2016 in NRT
- The catalogue now contains a total of
  - 305 raster layers
  - 25 vector layers
- Discoverable by INSPIRE compliant metadata and downloadable according to data policy

- ✓ Big effort for:
  - ○ Completing the processing chains update/fine-tuning before the 2016 growing season, learning from the first year validation activities and results
  - ○ Producing and disseminating all products at NRT; exploited by users for demonstration purposes
  - ○ Making processing chains robust for operational use
- ✓ Sentinel-2A data incorporated into processing chains (LAI maps – EP_L4, rice extent maps – EP_R1)
- ✓ New local SAR-based products developed and experimentally tested:
  - ○ Seasonal flooding conditions monitoring (EI_L7)
  - ○ Seasonal homogeneity maps (EP_L7): complementing seasonal patterns maps

Processing chains **successfully tested** among the biggest rice producers in EU and two African countries.

Thank you for your attention !