WP9: SERVICE DEMONSTRATION

Speaker: Lorenzo Busetto (CNR-IREA)

Main Contributors

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Mirco Boschetti, Lorenzo Busetto, Alberto Crema, Francesco Nutini, Luigi Ranghetti , Daniela Stroppiana - **IREA**
Roberto Confalonieri,Valentina Pagani, Tommaso Stella, Carlo Gilardelli, Ermes Movedi - **UMIL**
Ignacio Miralles, Carlos Granell, Sven Casteleyn - **UJI**

PRESENTATION OUTLINE

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

- ✓ **Introduction: WP Objectives and workplan**
- ✓ Tasks 9.1/9.2: Service application in Europe
- ✓ Task 9.3: Service application Outside Europe
- ✓ Final Remarks

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

WP Leader: Lorenzo Busetto

Time Span: Months 13 - 34

Main Objectives of the WP

- ✓ Performing the **overall service demonstration** during rice growing seasons 2015 and 2016 through:

  1) Test of the **processing chains and data/information flow**

  - EO data/product and in-situ data acquisition
  - ERMES EO and modelling products generation

  2) Provide **information and tools** to end-users:

  - ERMES Geoportal and smart app
  - Customized dissemination of information to users

- ✓ Service Demonstration on 2015 and 2016 rice seasons constituted ERMES Milestones IV and V, which achievement was foreseen for Months 24 and 34

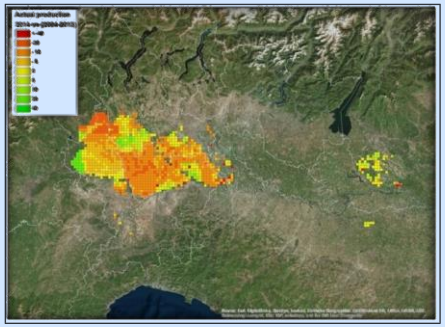
ERMES DEMONSTRATION: KEY CONCEPTS

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

Generation of products and Information

- **Rice maps ; Flooding Maps** (EP_R1) — *WP5*
- **Phenology maps** (EP_R2) — *WP5*
- **Meteo maps** (EP_R5) — *WP5*
- **Regional Blast Risk alert** (EI_R2) — *WP6*
- **LAI maps** (EP_R4 – EP_L4) — *WP5*
- **Constant patterns maps** (EP_L2) — *WP5*
- **Seasonal patterns maps** (EP_L3) — *WP5*
- **Local Biotic risks; Development stage** (EI_Lx) — *WP6*
- **Yield estimation** (EI_R2) — *WP6*
- ***AgriNotebook* smart app** — *WP7*

Deployment

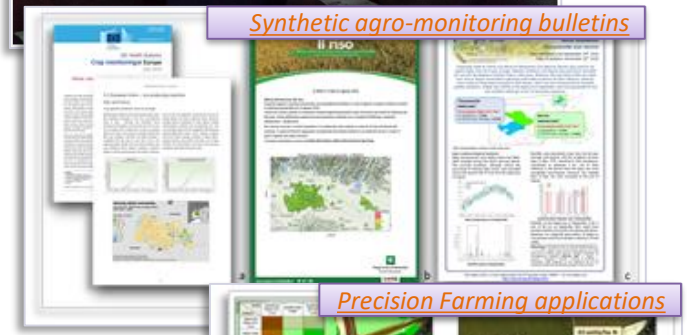


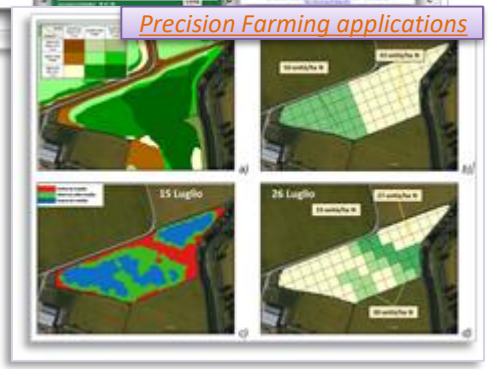
Regional Service

ERMES GEOPORTALS *WP7*

Local Service

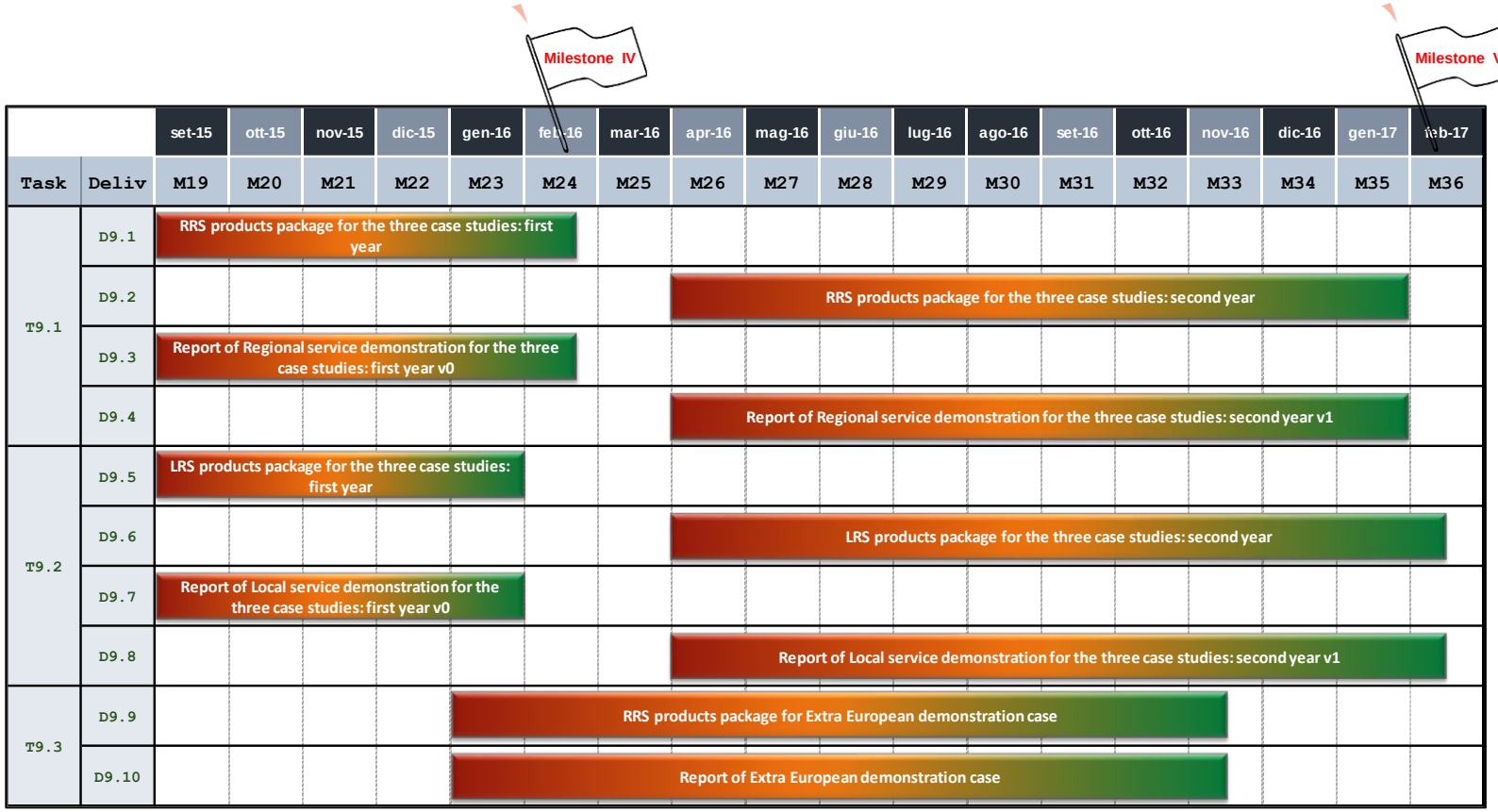
Dissemination and Exploitation





WP9: SERVICE DEMONSTRATION - SECOND REPORTING PERIOD

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE



Workplan for months 18-36 with reference to expected deliverables and Milestones

- ✓ Conclusion of first year of demonstration → Milestone IV
- ✓ Second year of demonstration (including Extra-European areas) → Milestone V

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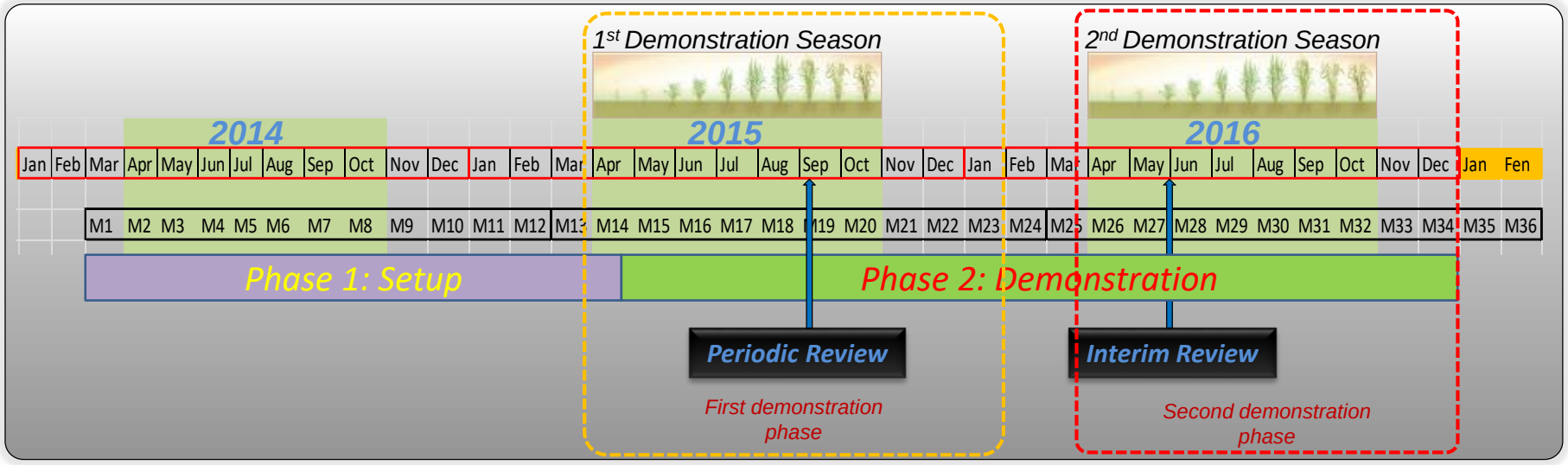
Task 9.1: Service Application at Regional Scale

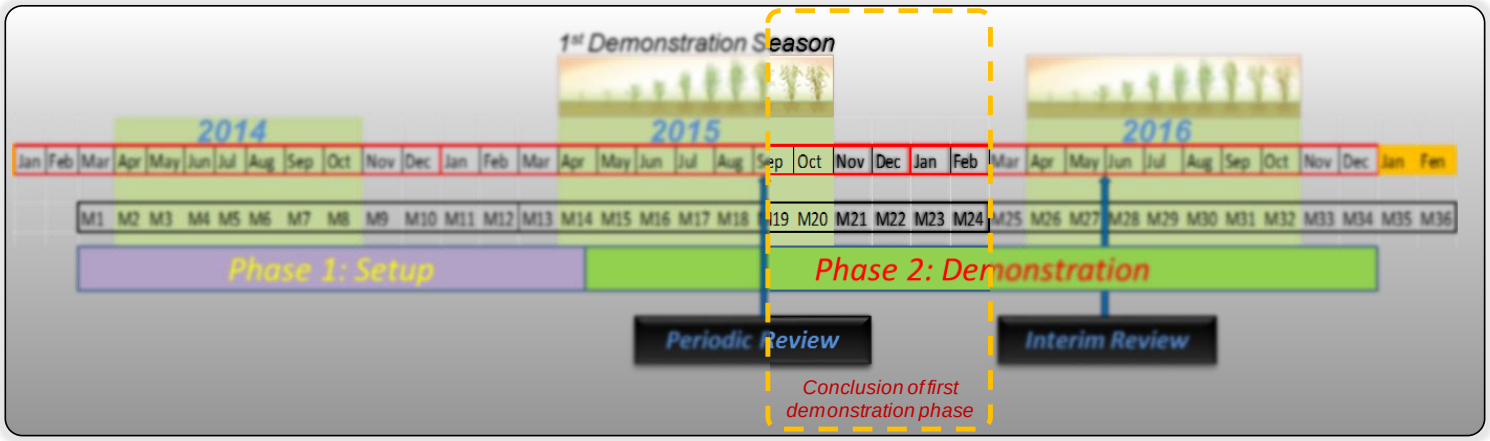
Task Leader: Valentina Pagani (UMIL)
Time Span: Month 13 - 34

Task 9.2: Service Application at Local Scale

Task Leader: Dimitris Stavrakoudis (AUTH)
Time Span: Month 13 - 34



M18-23: CONCLUSION OF THE FIRST DEMONSTRATION PHASE – RICE SEASON 2015



1) Finalization of ERMES regional and local products for 2015

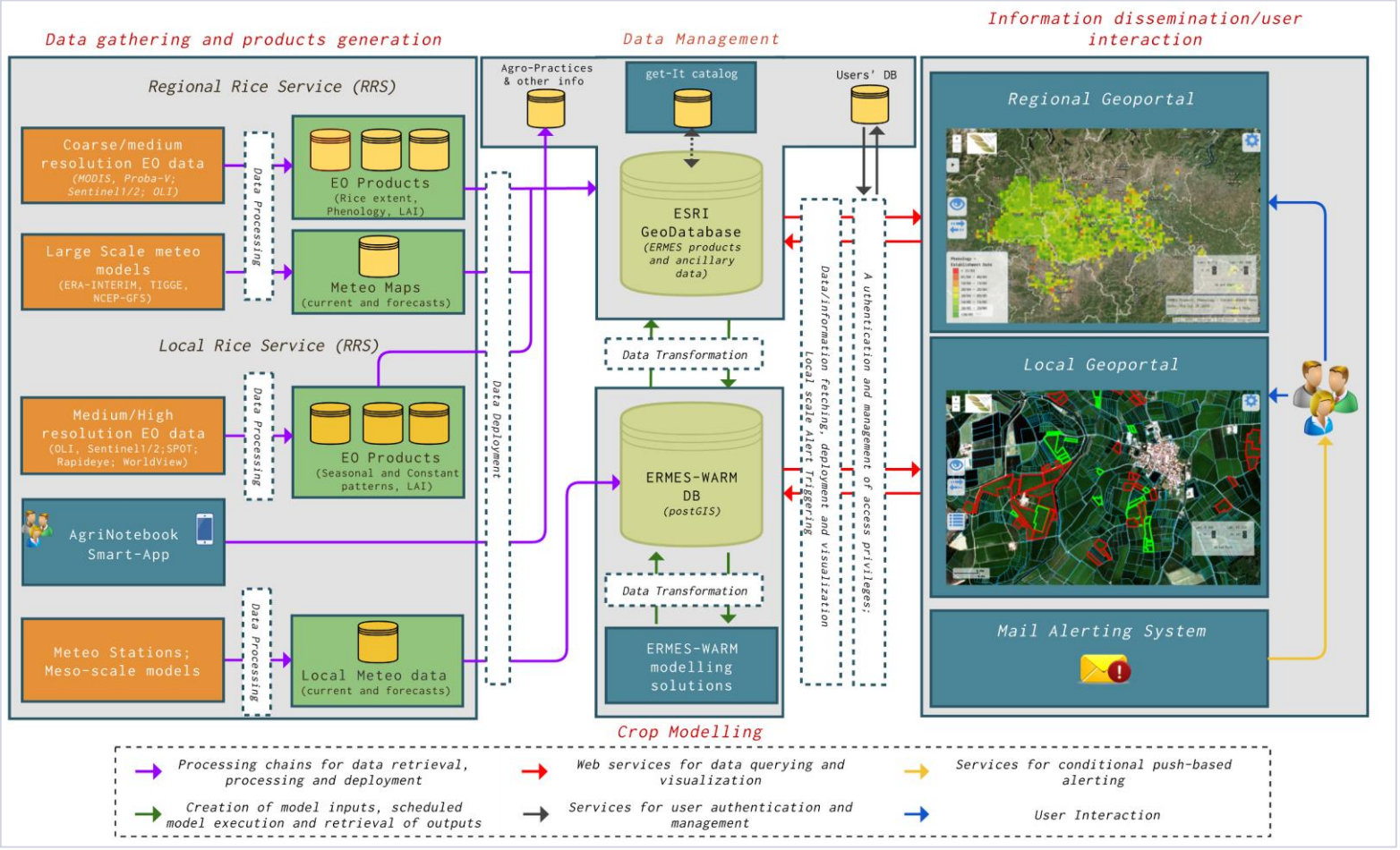
2) Demonstration and promotion of the developed services

3) Collection of feedback from users

- ✓ *Information for tuning/improving processing chains (e.g., Regional Meteo and Modelling; Seasonal Patterns; …)*
- ✓ *Better understanding of user's needs and expectations*
- ✓ *Extension of the users' base (e.g., new users IPLA, JRC, Agrinos….)*

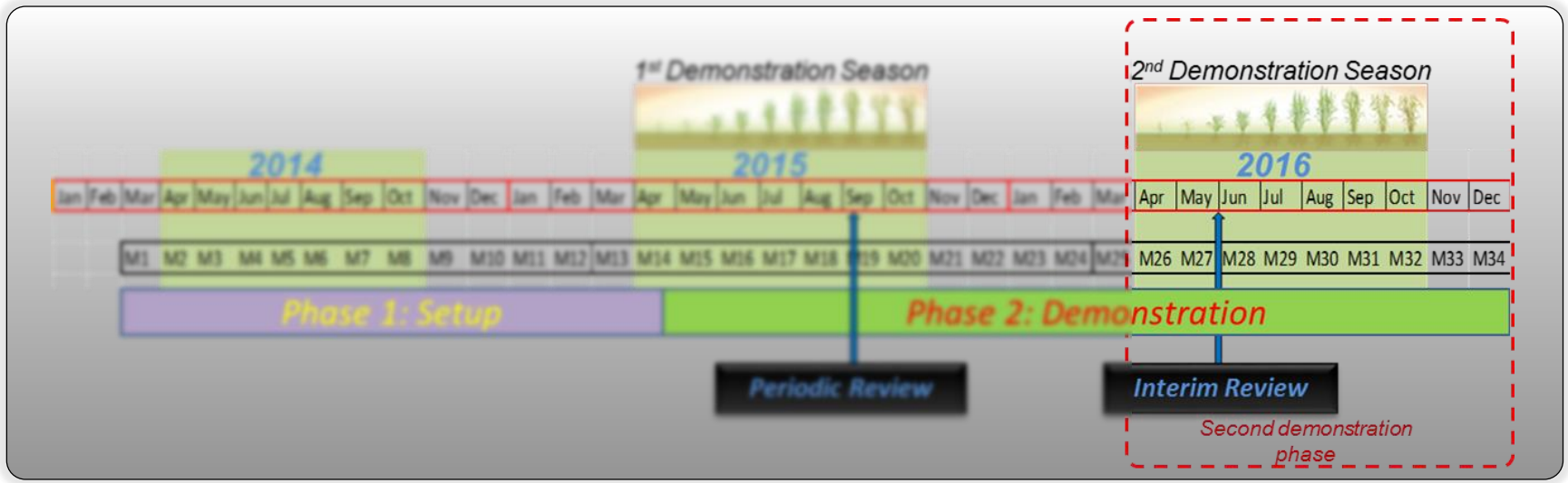
SERVICE DEMONSTRATION IN EUROPE

OUTCOME: OPERATIONAL ERMES MONITORING SYSTEM



All pieces of the «puzzle» in place for 2016 !

M25-34: SECOND DEMONSTRATION PHASE – RICE SEASON 2016



1. ***Operational Near Real Time generation of all products*** *(including some "new" ones)* ***and deployment through geoportals***
2. ***Exploitation of products/services for high-end applications***
3. ***Dissemination to end users***

PRESENTATION OUTLINE

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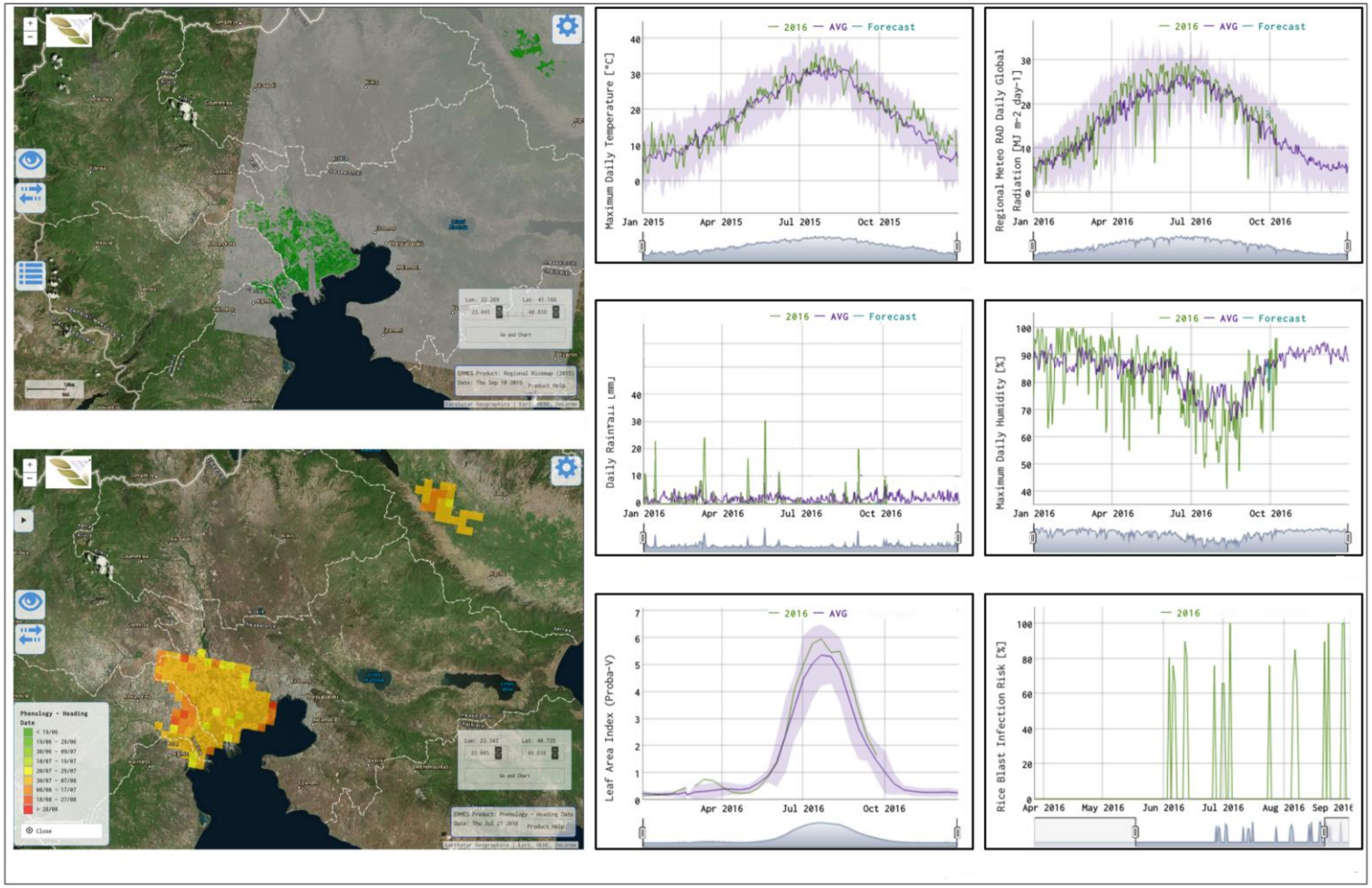
TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

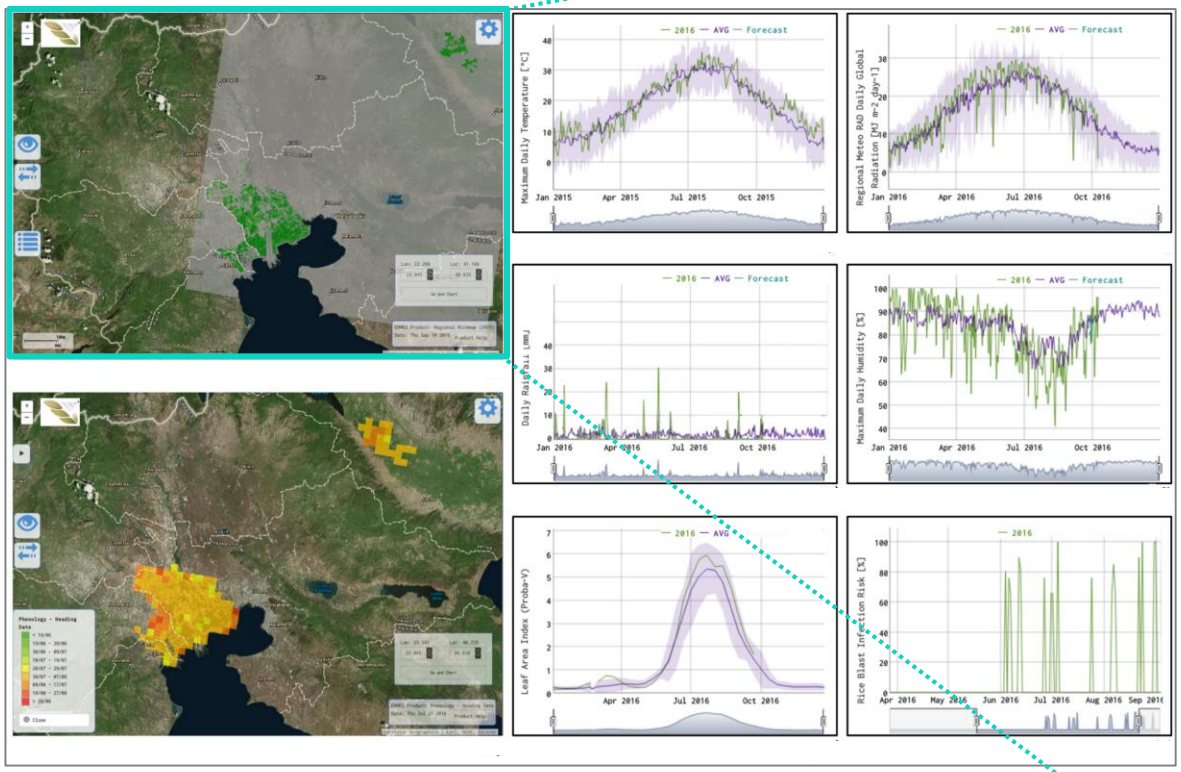
REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Interface of ERMES Regional Geoportal and examples of provided information

TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

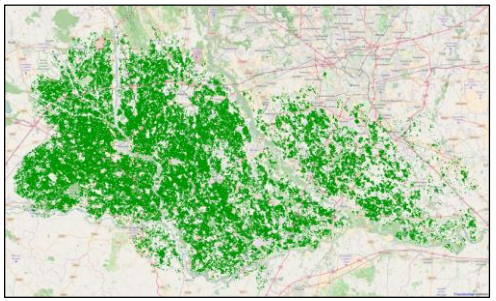
REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT

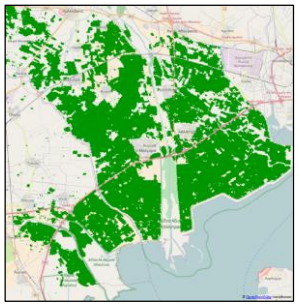


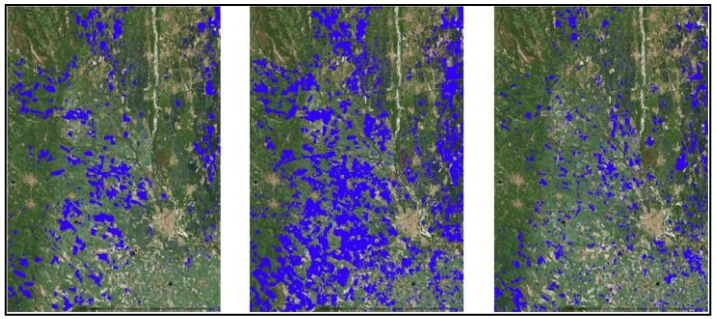
Rice maps ; Flooding Maps (WP 5) *WP5*
(EP_R1)

Rice crop maps (30 m resolution)

Periodic Maps of flooding conditions



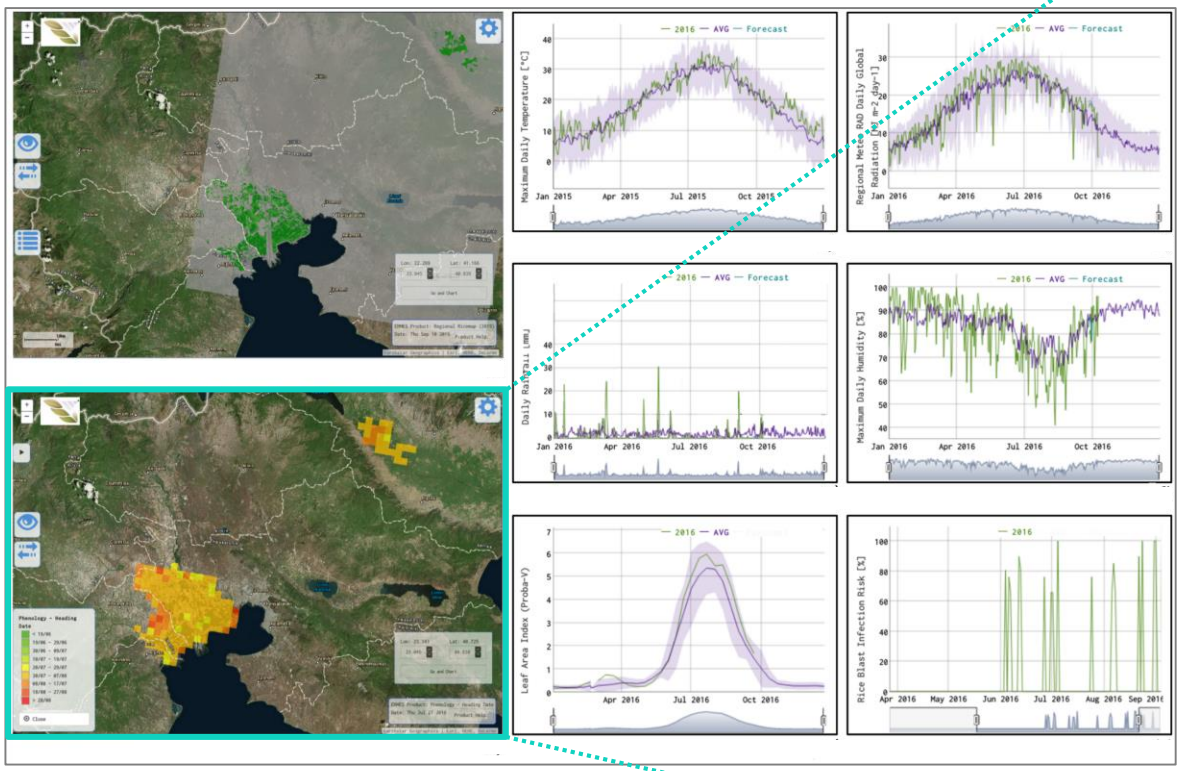




NRT estimation of rice cultivated area
Interannual variations in rice area
Spatio-temporal changes in irrigation schemes

TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

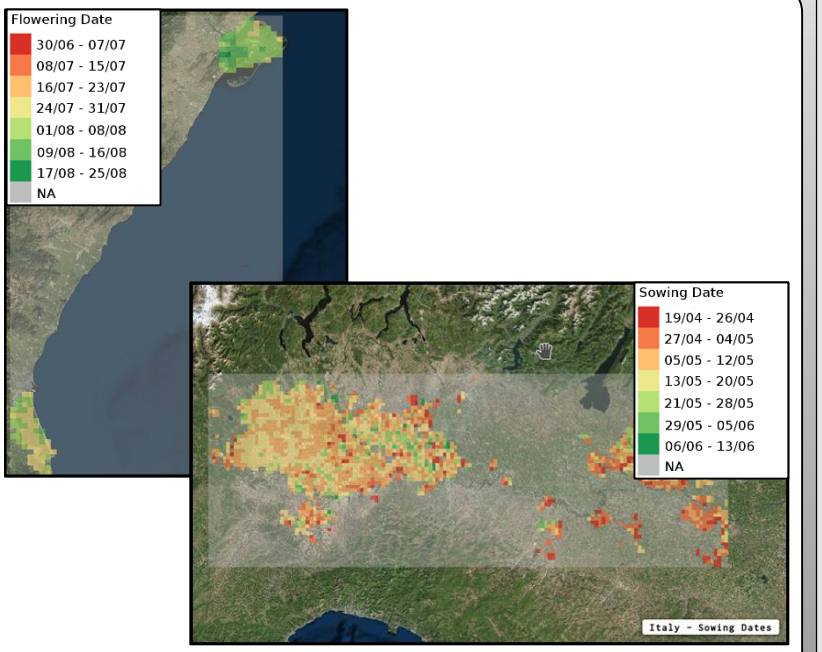
REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Phenology maps (WP 5)
(EP_R2)

WP5

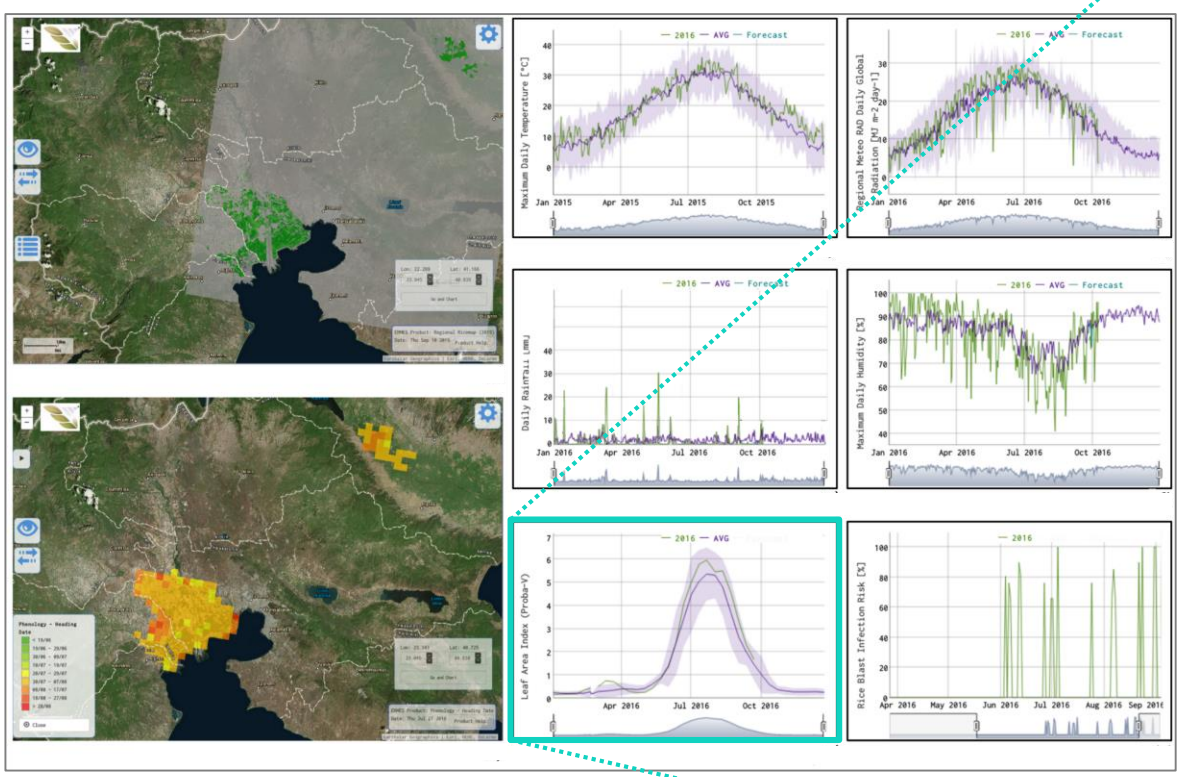
Sowing and Flowering dates maps
(2x2 km)



Identification of key phenological stages and anomalies
Inputs for regional modelling

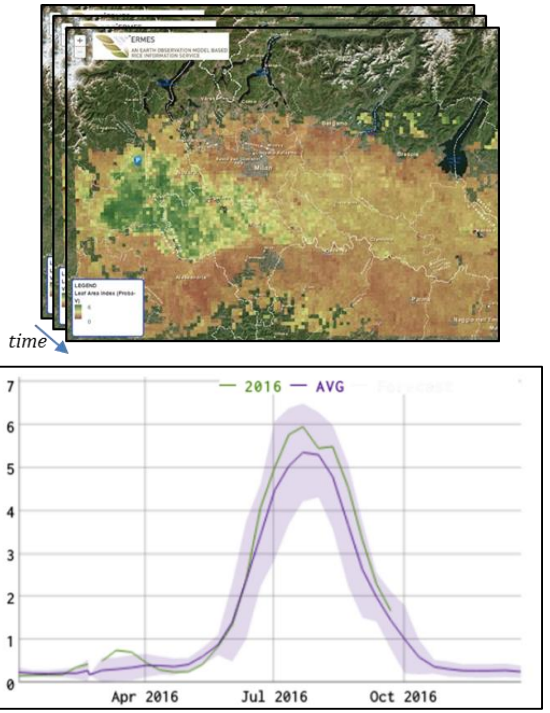
TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Leaf Area Index maps (WP 5)
(EP_R3)
WP5

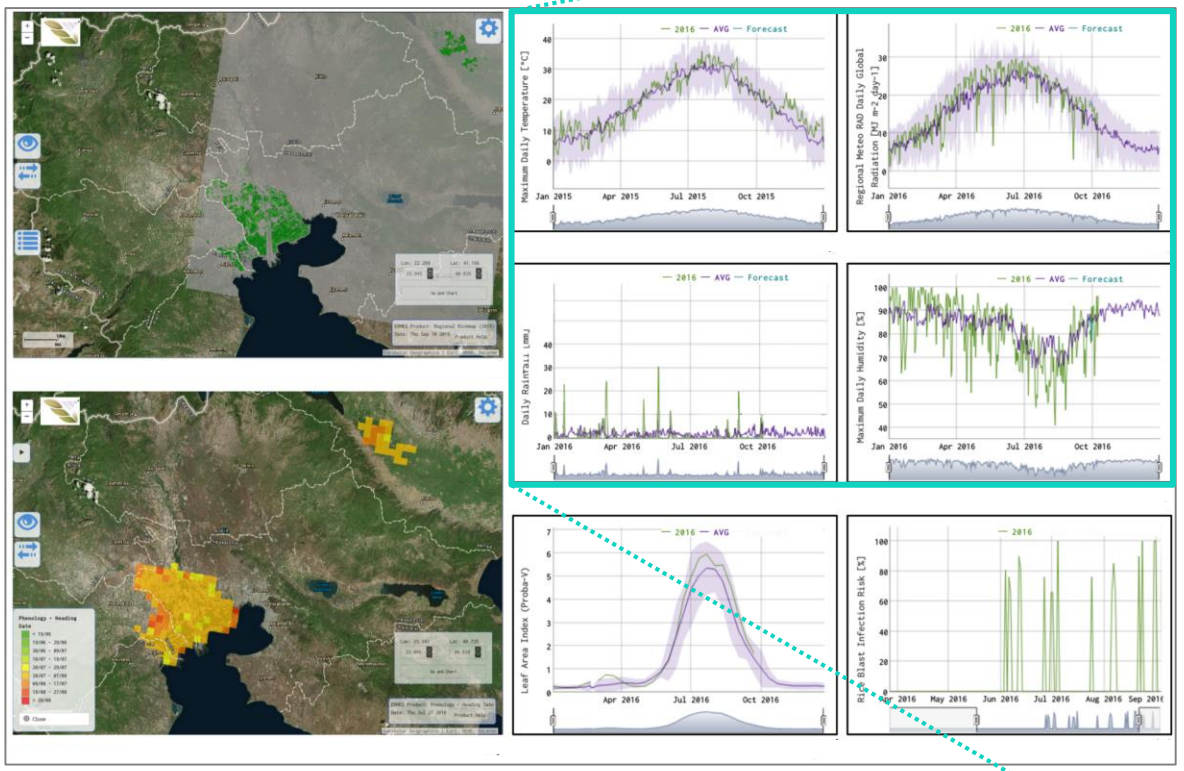
Decadal maps from MODIS/PROBA-V
(2x2 km)



Anomalies in crop growth
Inputs for regional modelling

TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

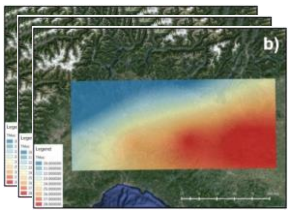
REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT

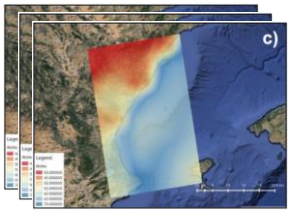


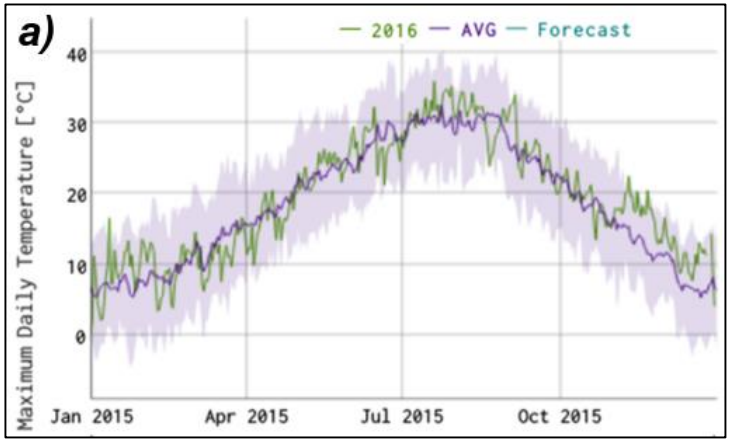
Meteorological Maps and Forecasts (WP 5)
(EP_R4)

WP5

Daily maps of P, Tmax, Tmin, Precipitation, Humidity, Wind Speed, radiation (2x2 km)



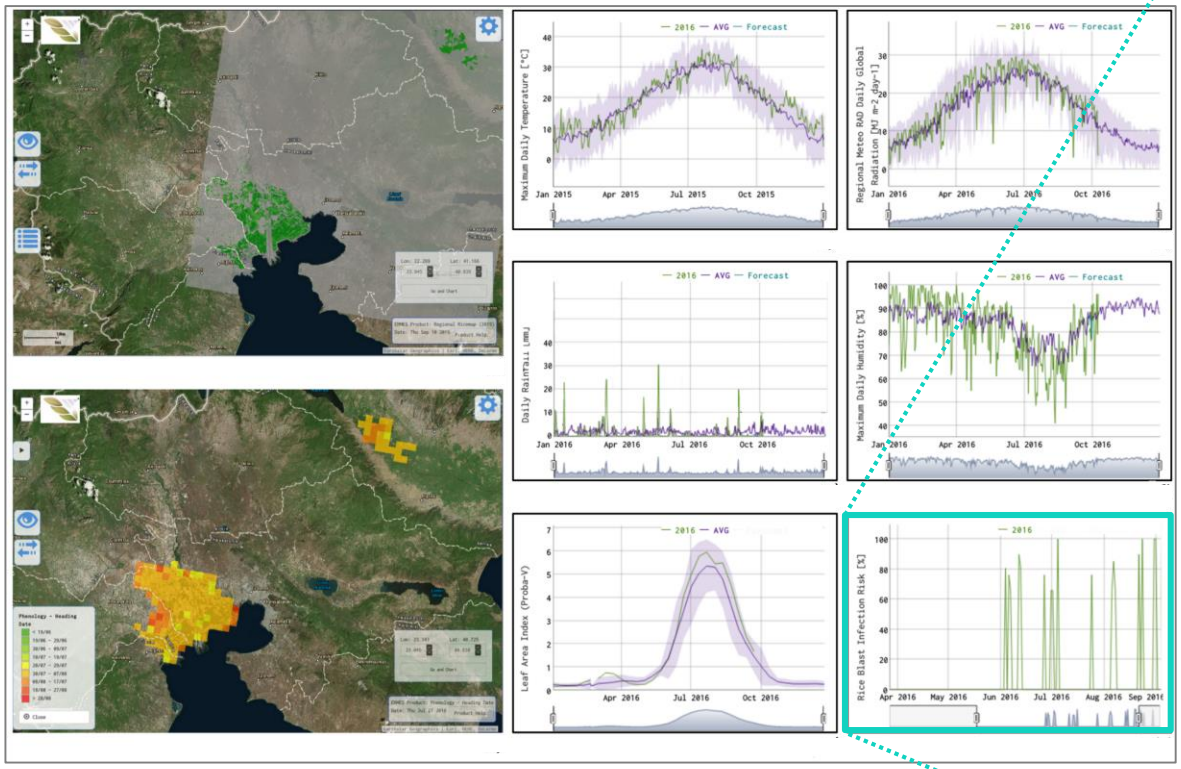




Anomalies in weather conditions; Inputs for regional modelling

TASK 9.1: SERVICE APPLICATION AT REGIONAL SCALE

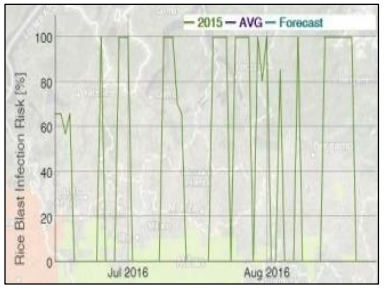
REGIONAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT

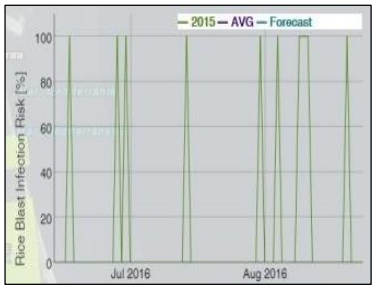


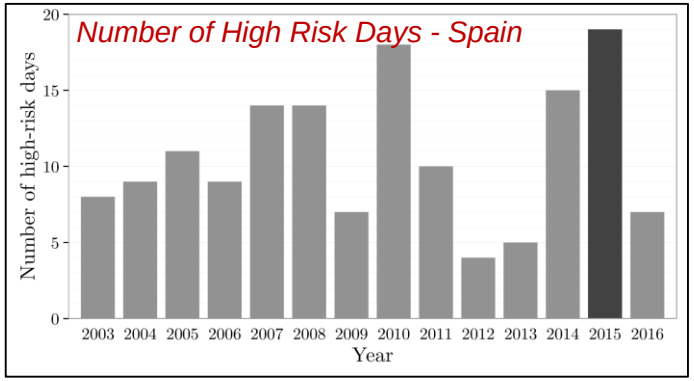
Potential Risk of Rice Blast Infection (WP 6)
(EI_R3)
WP6

Daily risk maps – Modelling Results

Uses Meteo, Phenology and LAI maps as inputs !







Forecasting high-risk periods
Qualitative analysis on impact on yield

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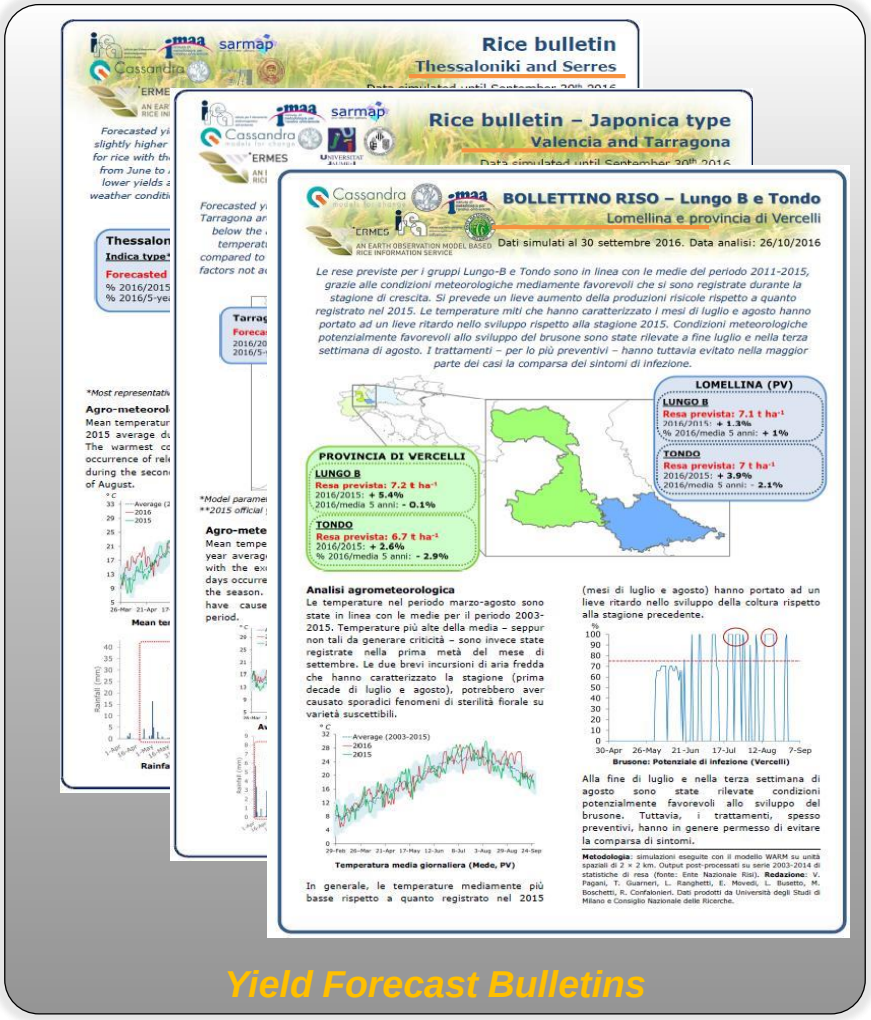
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

REGIONAL RICE SERVICE – HIGH-END APPLICATIONS

Yield Forecast Bulletins

- Agro-monitoring bullettins, analyzing the on-going season and providing yield forecasts for selected varieties and rice districts
- ERMES Meteo, Phenology and LAI maps used as inputs in regional modelling solution
- Statistical postprocessing of modelling outputs and official statistics
- Two releases in Italy for ENR (at Flowering and Harvesting); One release for Spain and Greece



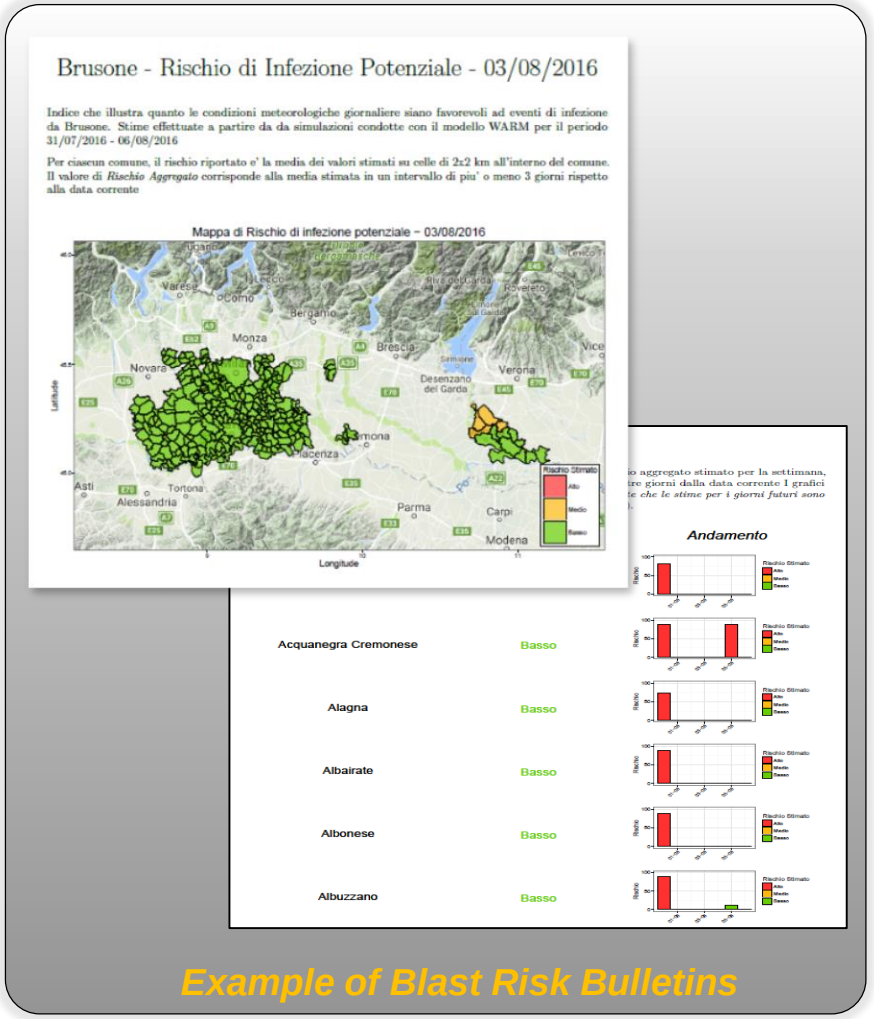
Yield Forecast Bulletins

REGIONAL RICE SERVICE – HIGH-END APPLICATIONS

Blast Risk Bullettins

- Automatic generation from ERMES modelling outputs
- Aggregation at municipality level and weekly time step
- Daily deployment of rice blast risk bullettins on website of **Plant Health Service of Lombardy Region**

ERSAF
ENTE REGIONALE PER I SERVIZI ALL'AGRICOLTURA E ALLE FORESTE

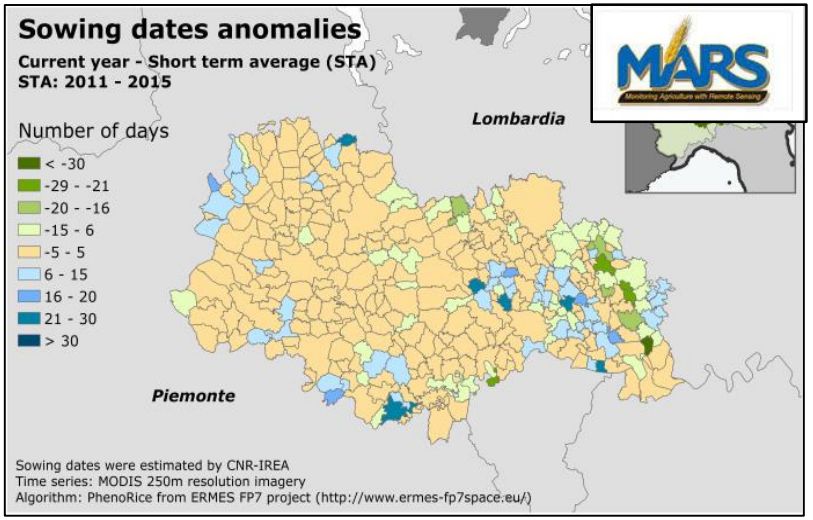


Example of Blast Risk Bulletins

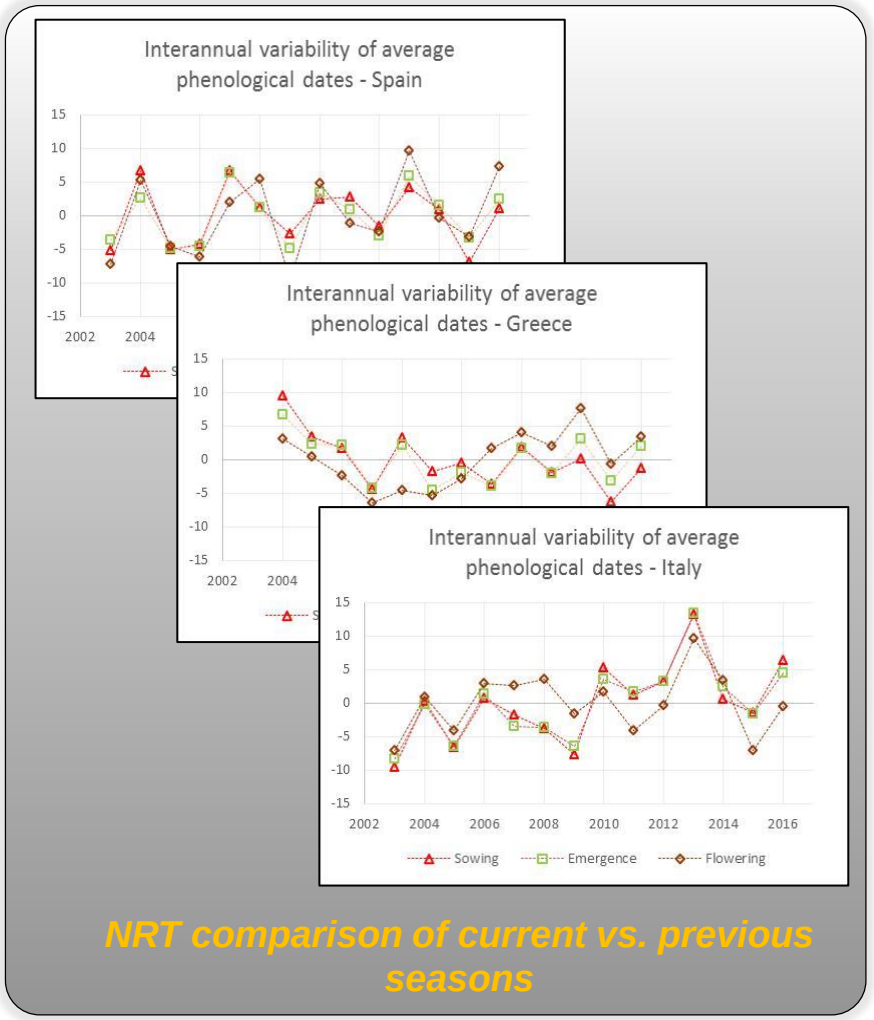
REGIONAL RICE SERVICE – HIGH-END APPLICATIONS

Phenological development analysis

- Comparison of on-going season with LTA data → Highlights of anomalies
- Data exploited by JRS-MARS to issue their 2016 agro-monitoring bulletins



https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol24-no7.pdf



NRT comparison of current vs. previous seasons

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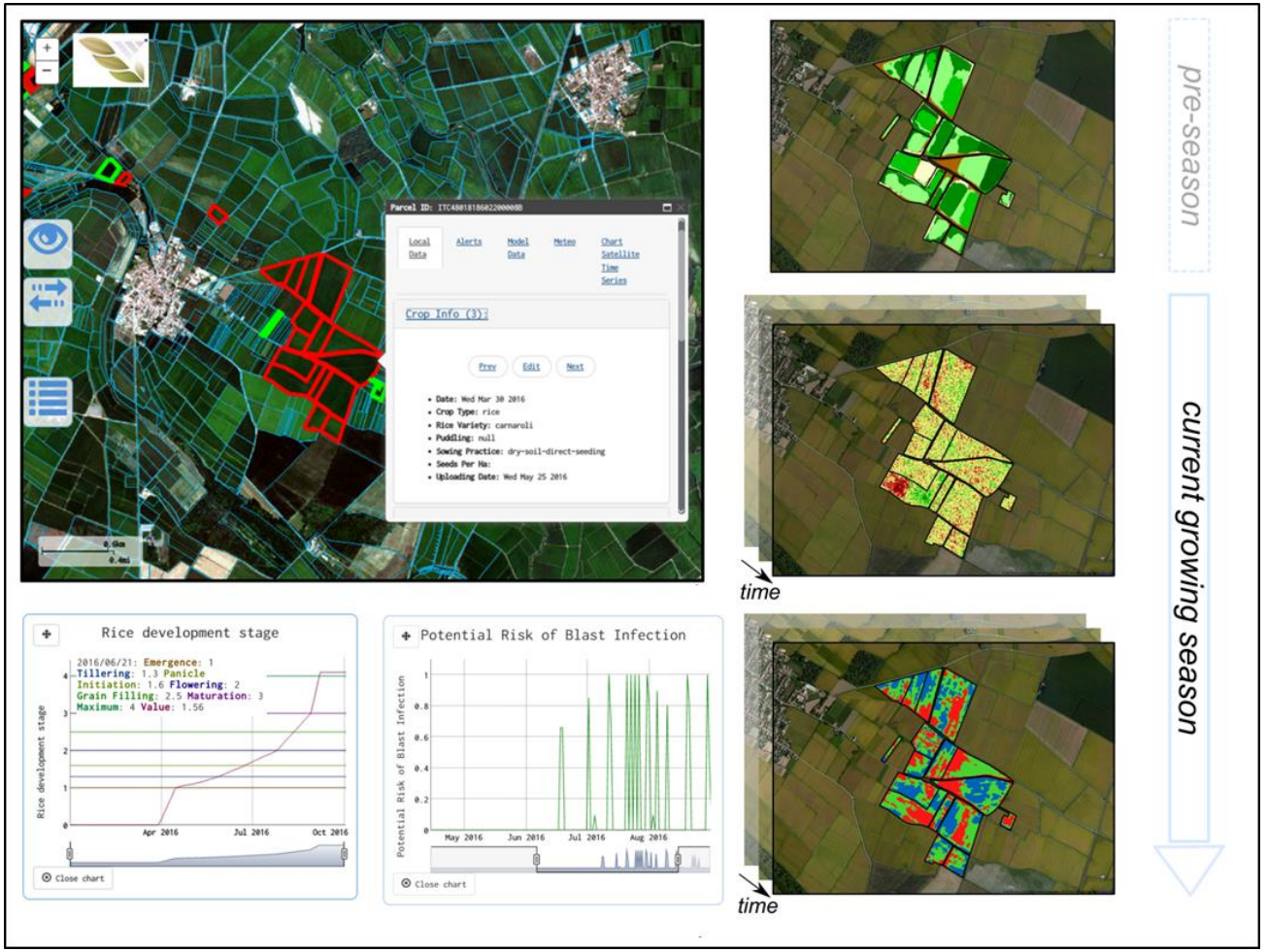

Interface of ERMES Local Geoportal and examples of provided information

TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

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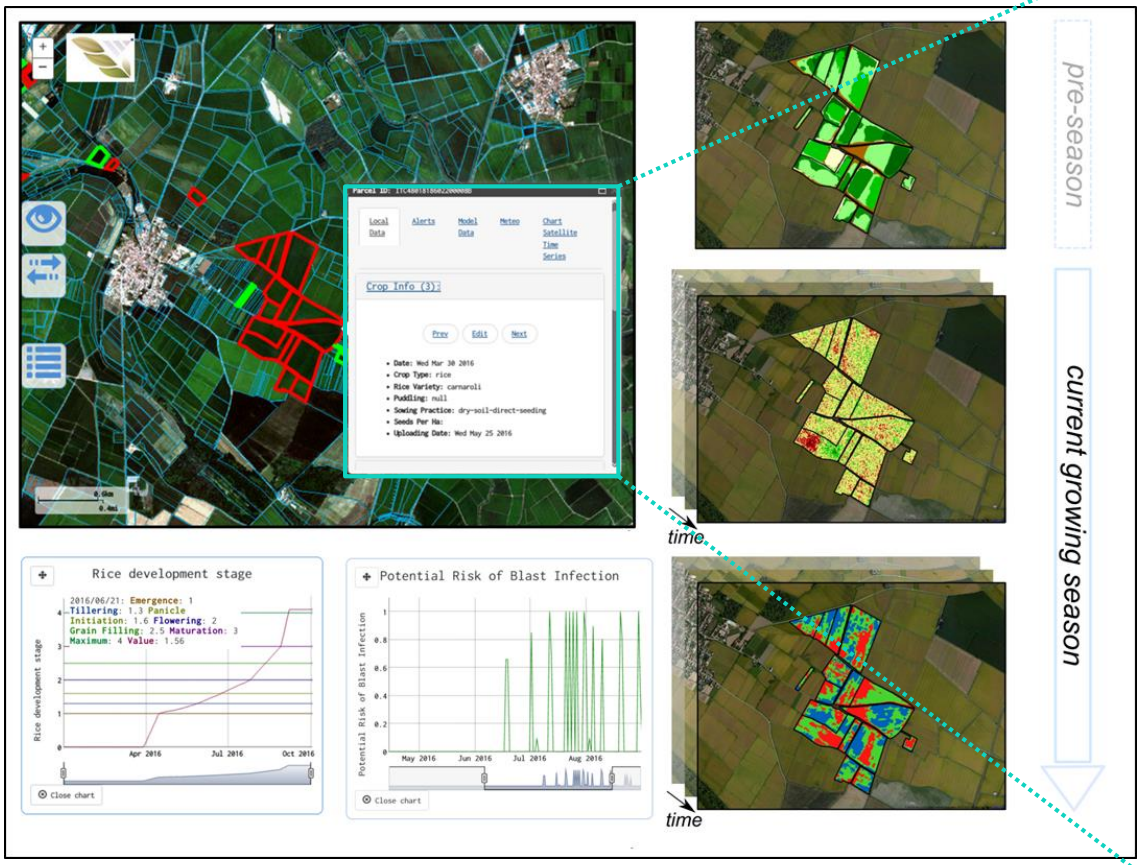
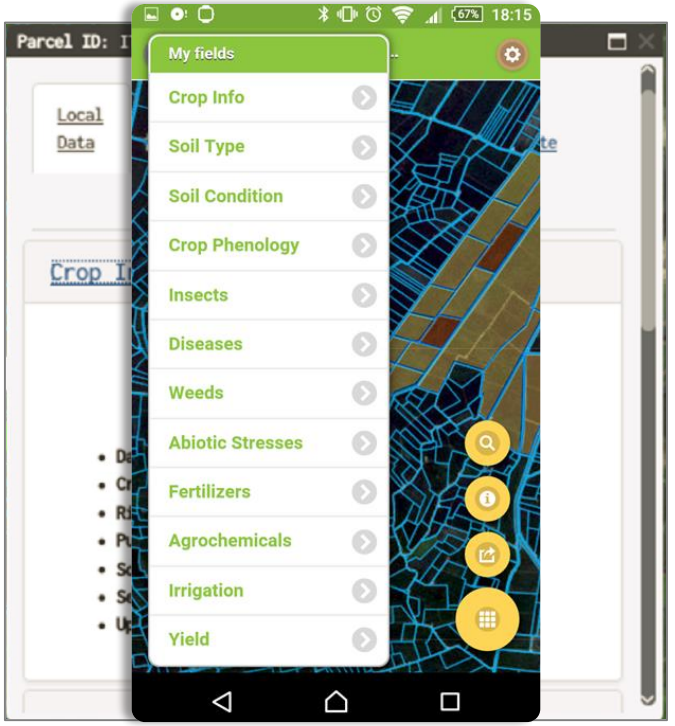


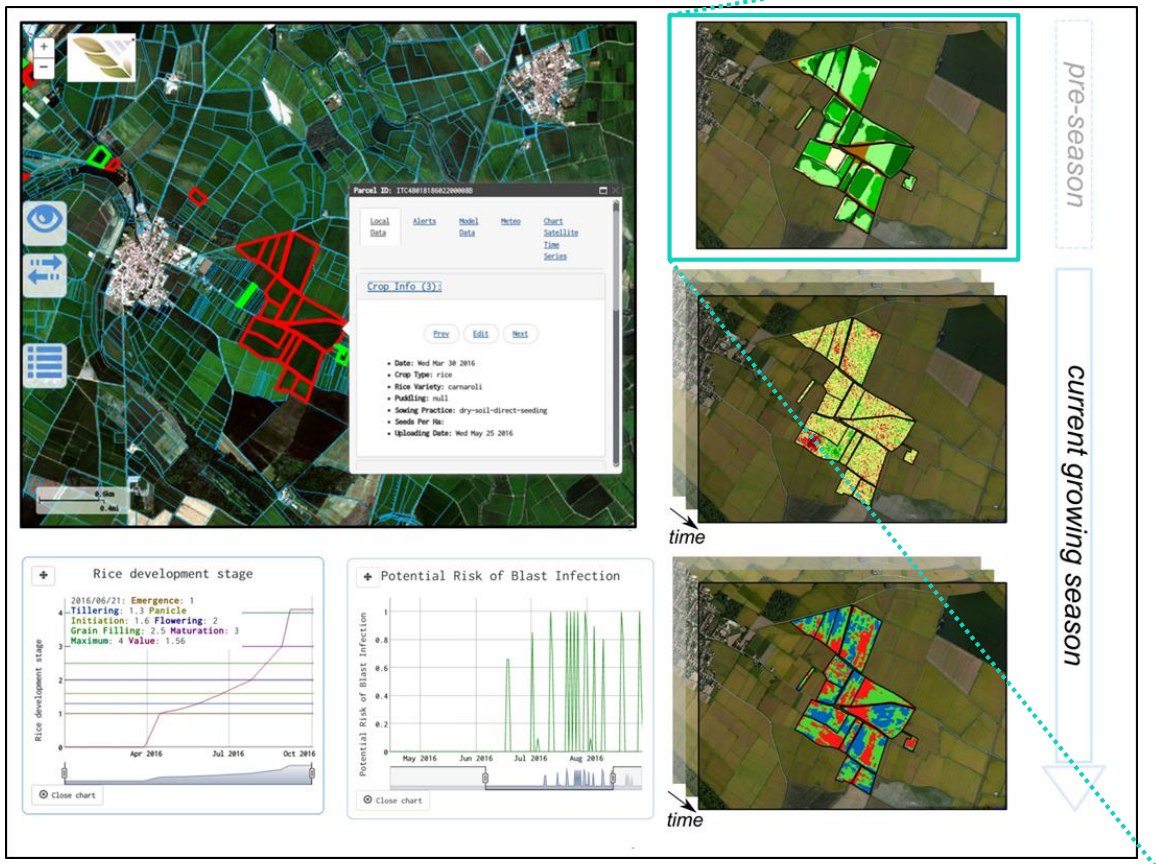
AgriNotebook smart app WP7



Information collected by farmers/field operators retrievable in web interface and used as input for crop modelling

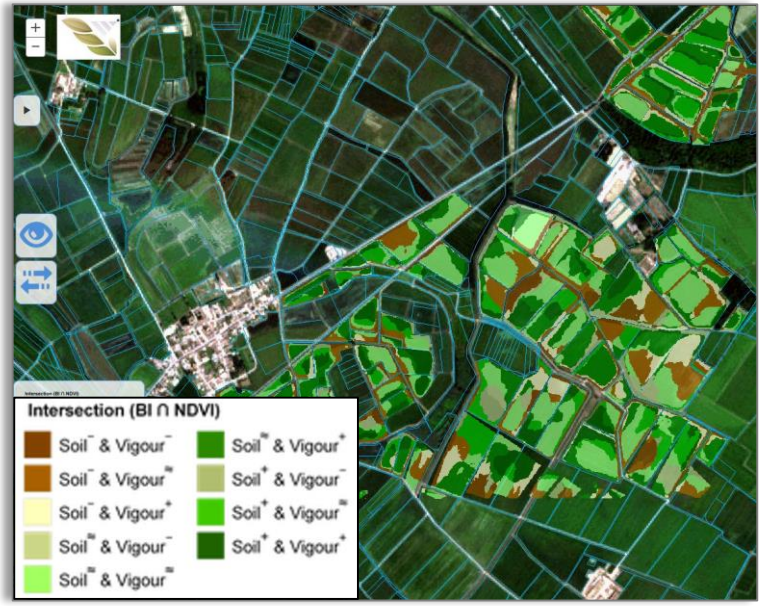
TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Constant pattern maps
(EP_L2)
WP5

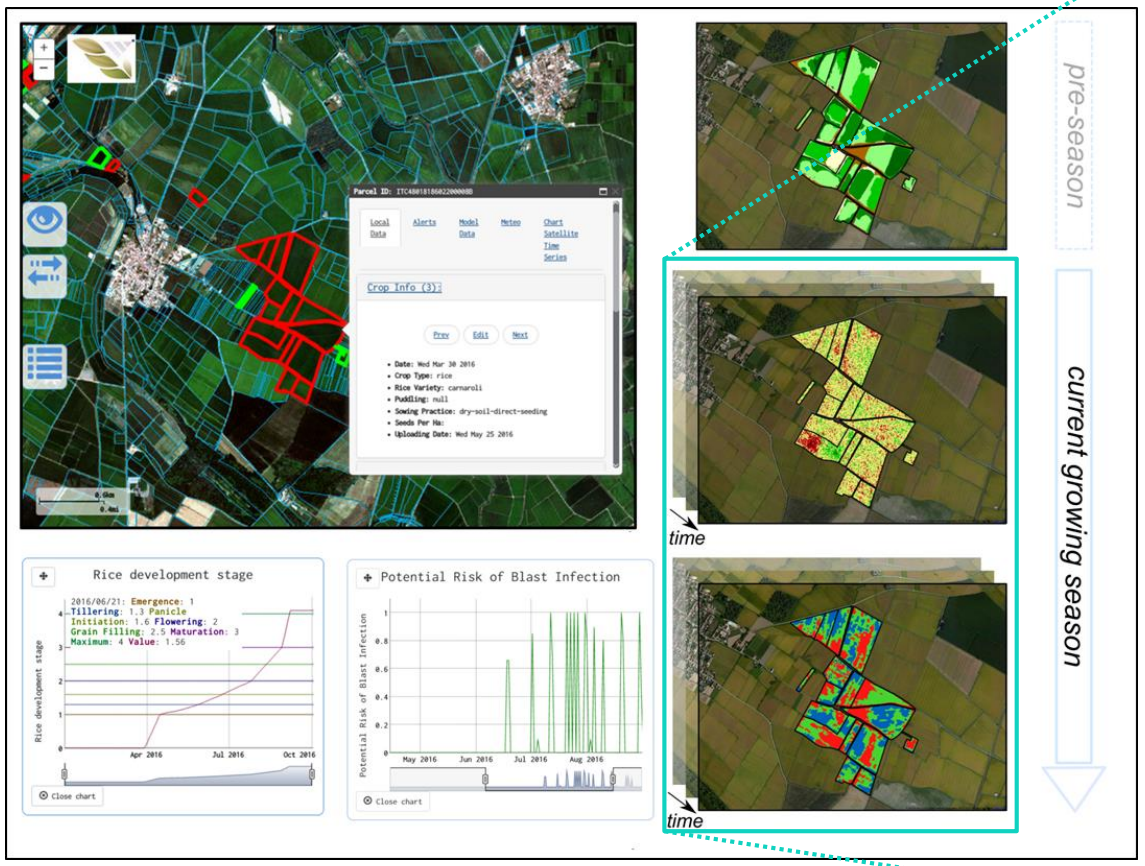
Based on the analysis of archive satellite images



Highlight intrinsic variability of single rice parcels, causing constant yield differences on different years

TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

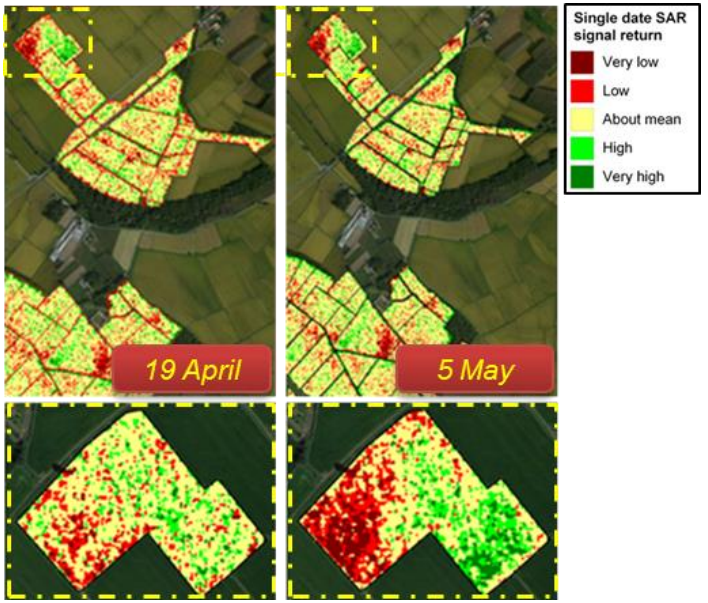
LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Seasonal pattern maps
(EP_L3; EI_L7)
WP5

Based on the analysis of satellite Images acquired in **critical moments of the season**

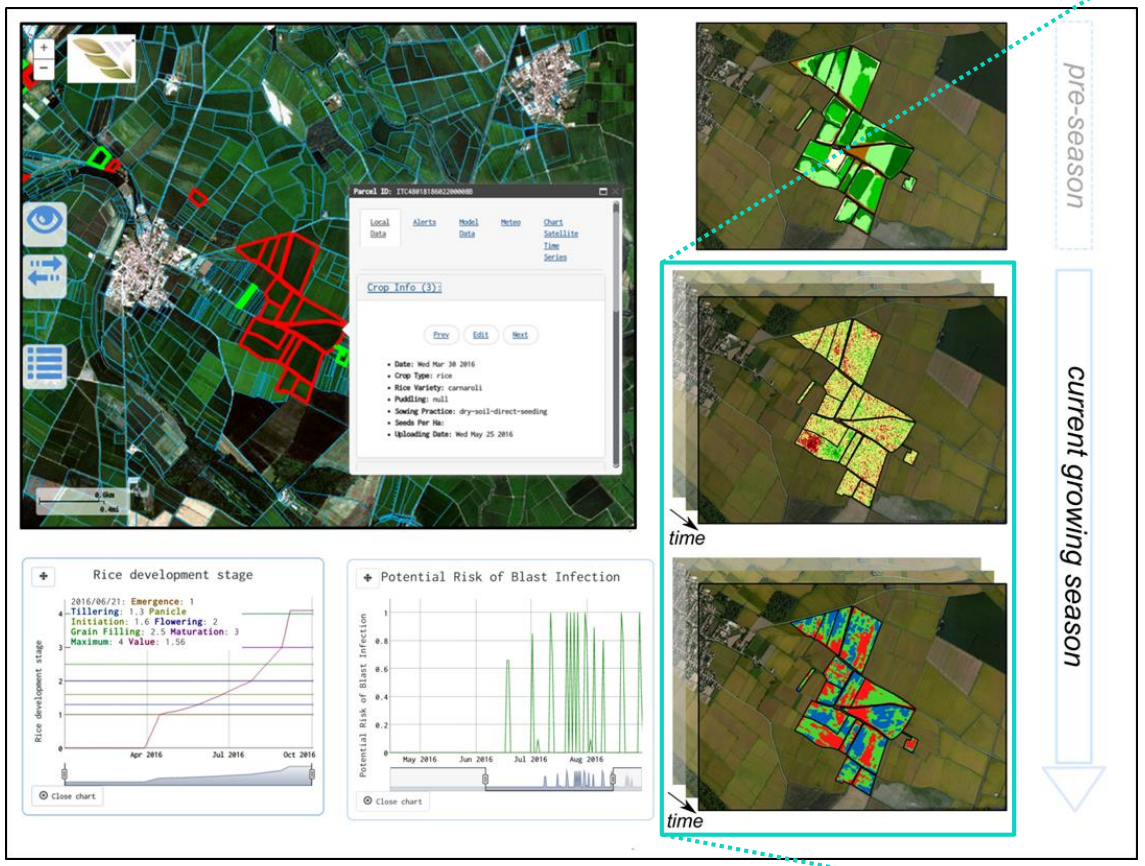
«Early» season → High-Resolution SAR (CSK – 3m)



Highlight problems related to bad germination/other early season problems

TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

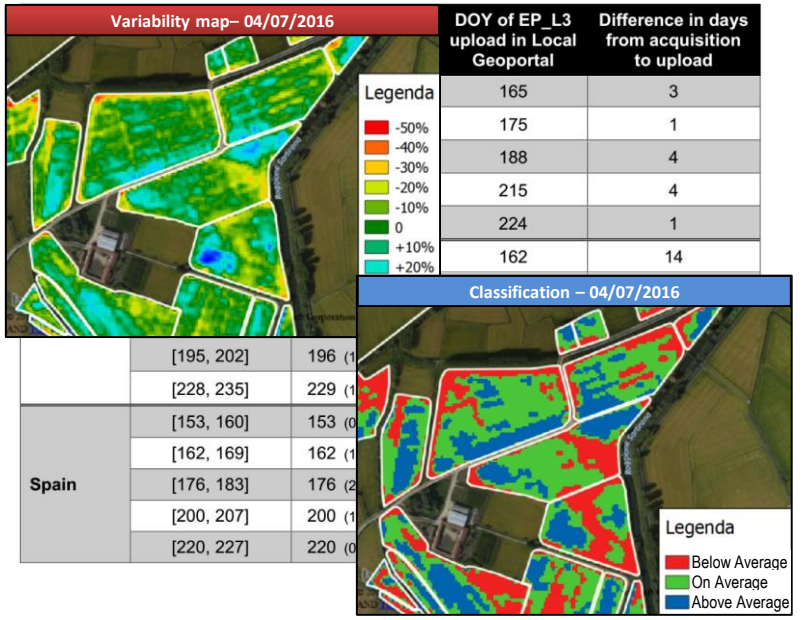
LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Seasonal pattern maps
(EP_L2)
WP5

Based on the analysis of satellite Images acquired in **critical moments of the season**

«Late» season → High-Resolution optical (RapidEye)

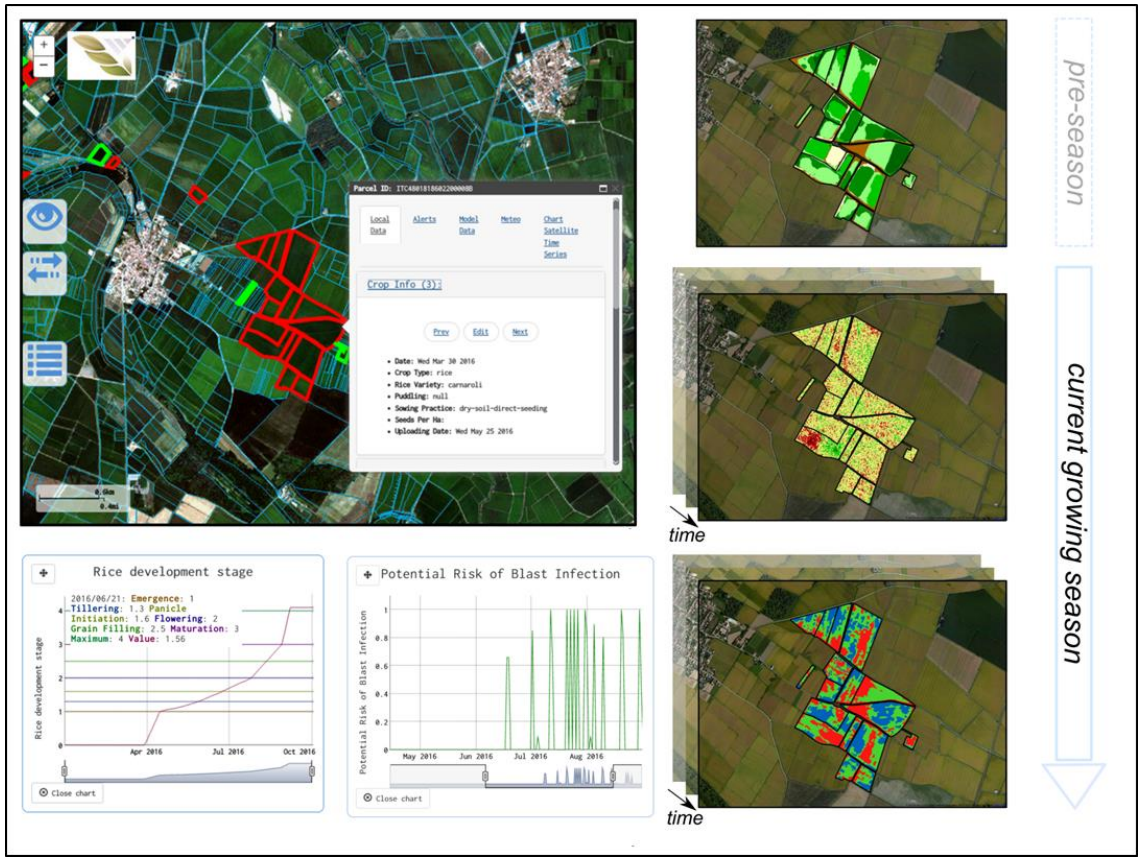


		DOY of EP_L3 upload in Local Geoportal	Difference in days from acquisition to upload
	[195, 202]	196	
	[228, 235]	229	
Spain	[153, 160]	153	
	[162, 169]	162	
	[176, 183]	176	
	[200, 207]	200	
	[220, 227]	220	
		165	3
		175	1
		188	4
		215	4
		224	1
		162	14

Highlight variability in crop biomass / nutritional status

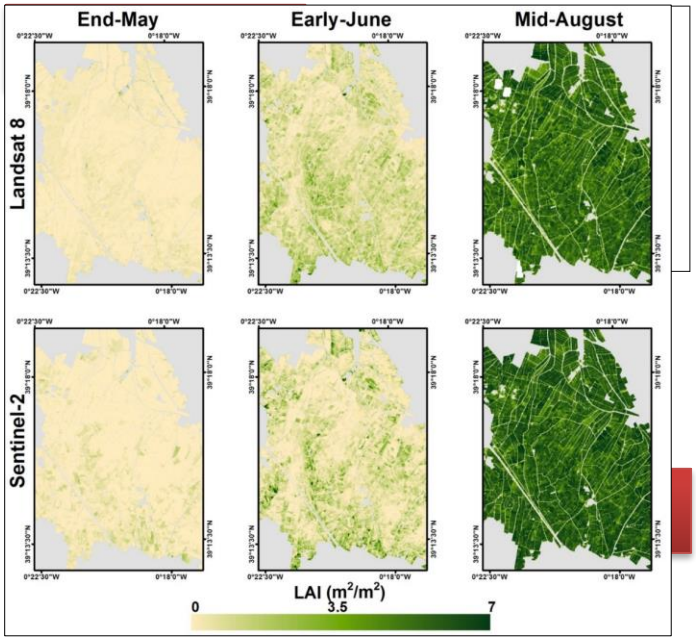
TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



LAI maps
(EP_R4 – EP_L4)
WP5

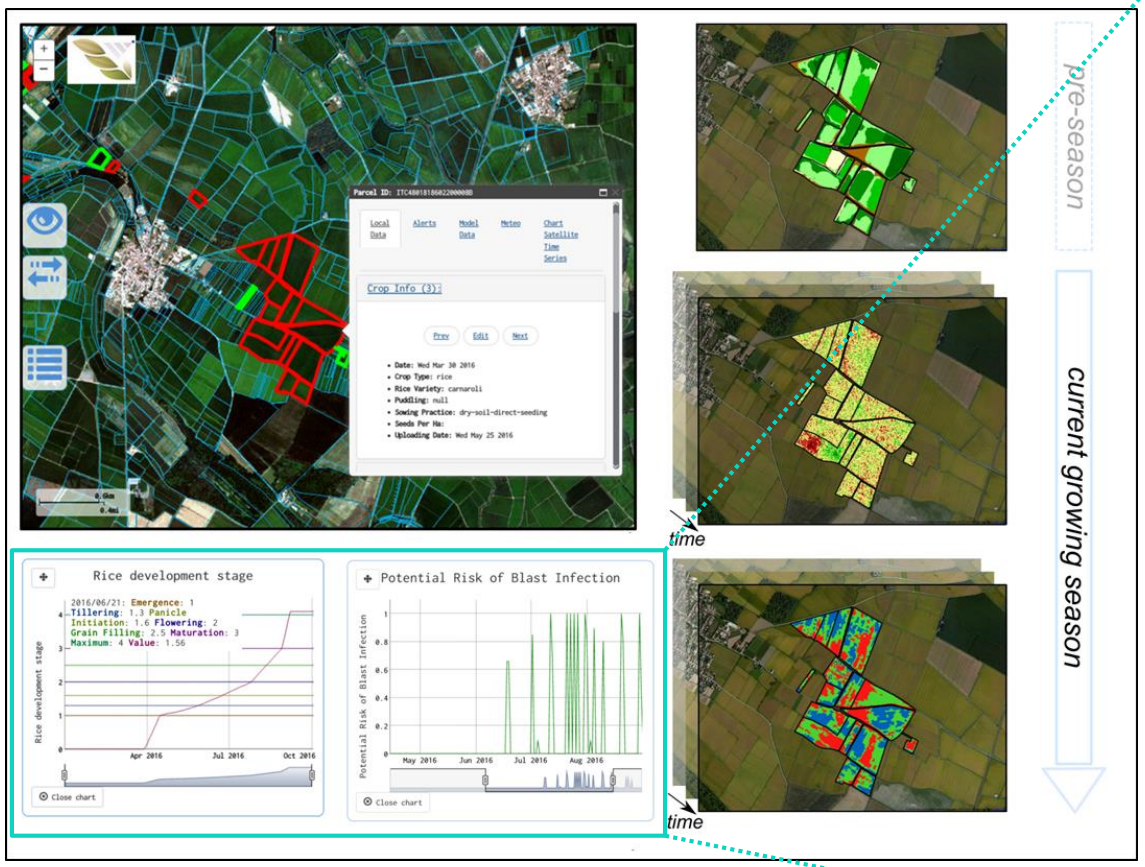
Dense time series of HR LAI maps from OLI/Sentinel-2



Highlight effect of diseases/other damages
Inputs for local modelling

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

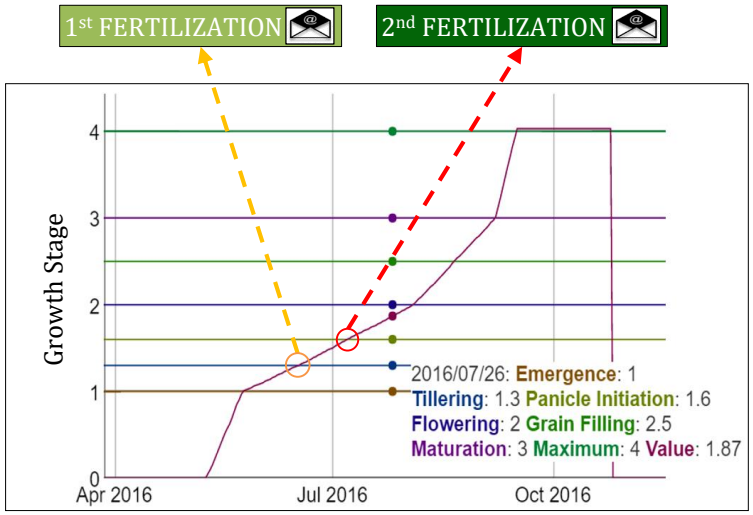
LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Local Biotic risks; Development stage
(EI_Lx)

WP6

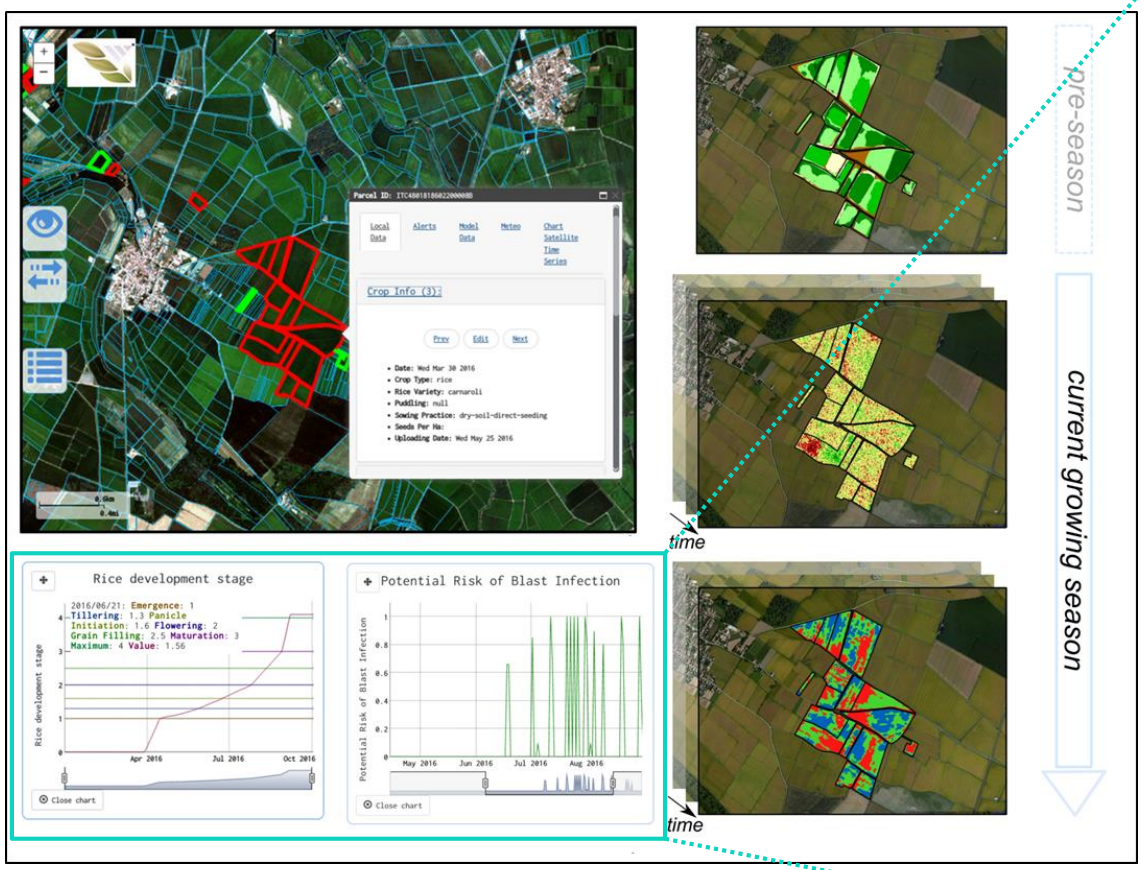
Model outputs for each field can be visualized in the ERMES GeoPortal and are used to issue mail alerts



Mail alerts can be sent upon reaching the most suitable moments for nitrogen ferilization

TASK 9.2: SERVICE APPLICATION AT LOCAL SCALE

LOCAL RICE SERVICE – PRODUCTS GENERATION AND DEPLOYMENT



Local Biotic risks; Development stage
(EI_Lx)
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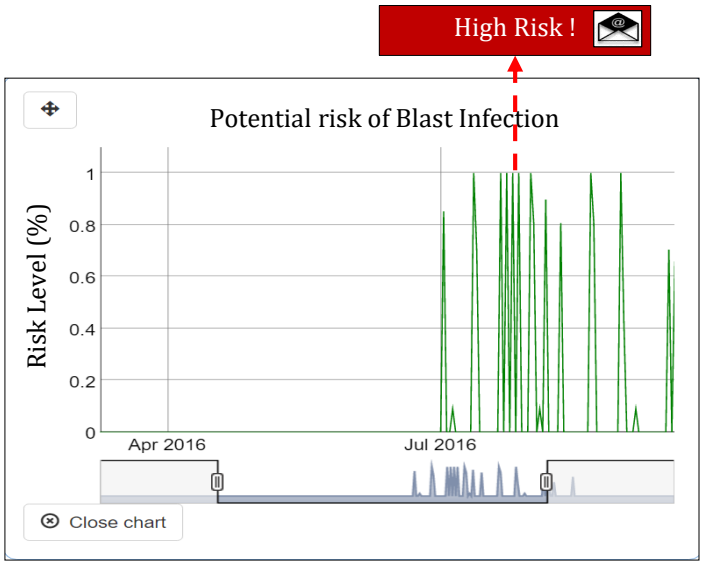
Model outputs for each field can be visualized in the ERMES GeoPortal and are used to issue mail alerts



Mail alerts can be sent upon detection of high-risk periods for rice blast infection

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LOCAL RICE SERVICE – EXPLOITATION OF PRODUCTS/SERVICES FOR HIGH-END APPLICATIONS

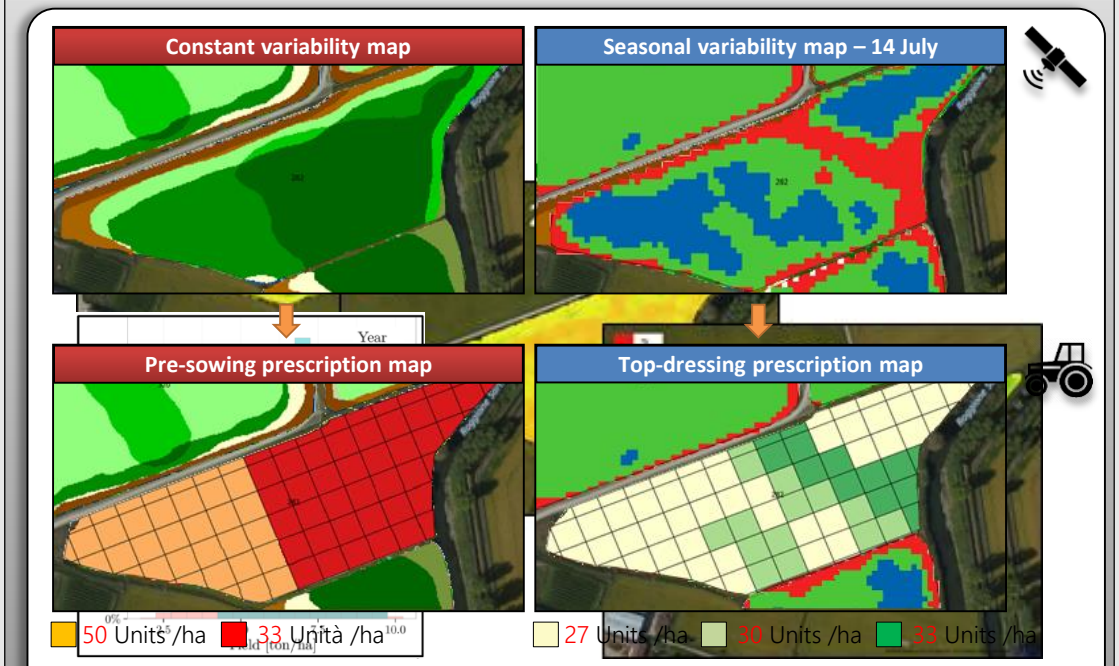
Support for Variable Rate Fertilization

- ERMES variability maps (constant and seasonal) were transformed in **prescription maps to be used as inputs for** variable rate fertilization techniques (Precision Agriculture)

- 2015 and 2016 experiments demonstrated that managing fields based on prescription maps generated from ERMES products allows **a more rational use of fertilizers**, **allowing to achieve a better homogeneity in final yield and/or a reduction of fertilization costs**.

Support for pre-sowing and top-dressing fertilization
Italy 2015-2016

In 2015 and 2016 several rice fields were managed with different levels of Nitrogen fertilization based on ERMES variability maps



From Constant/Seasonal Patterns to prescription maps

LOCAL RICE SERVICE – EXPLOITATION OF PRODUCTS/SERVICES FOR HIGH-END APPLICATIONS

Support for Variable Rate Fertilization

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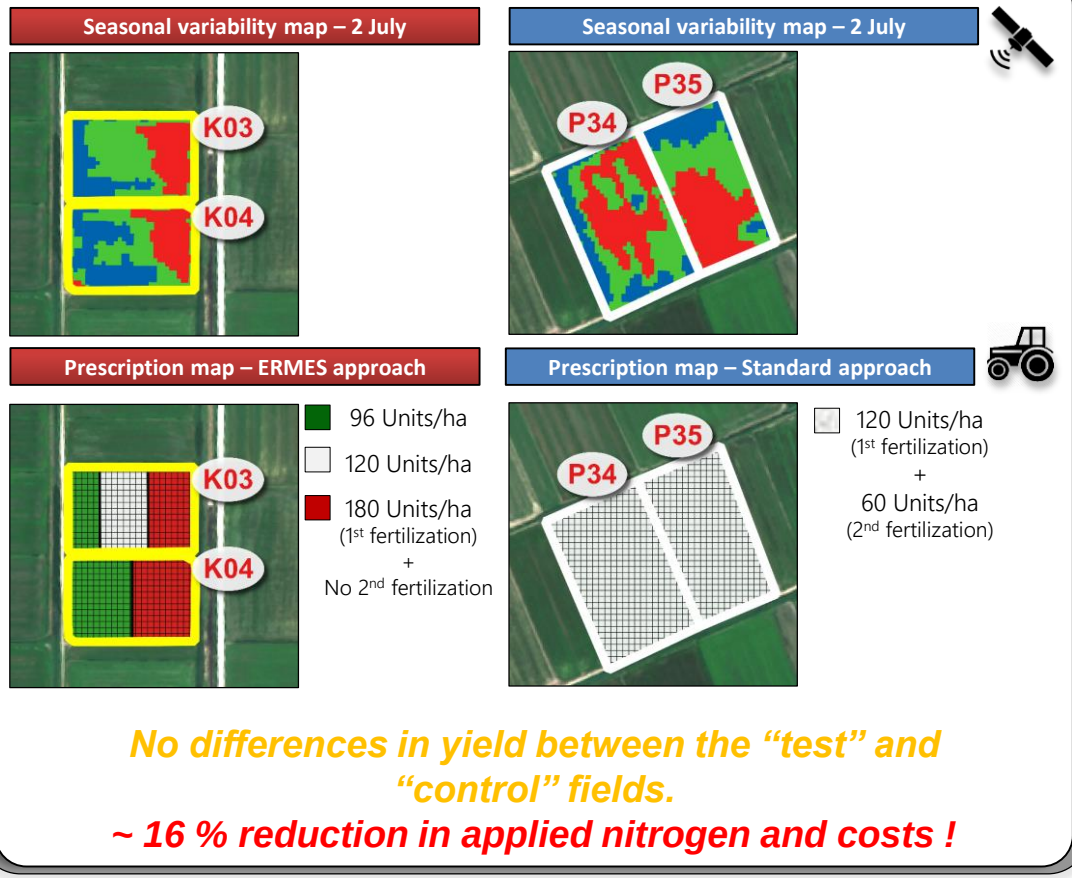
Support for fertilization rationalization
Greece 2016



No differences in yield between the "test" and "control" fields.

~ 16 % reduction in applied nitrogen and costs !

SERVICE DEMONSTRATION IN EUROPE

INTERACTION AND DISSEMINATION WITH END USERS AND STAKEHOLDERS

- Demonstration strongly linked with **user interaction and dissemination activities** (WP 3 and WP 11)
- Constant work during the season with ERMES end users (in particular, farmers), to illustrate the main products and **help them in their exploitation**;
- Dissemination to other potentially interested stakeholders at the end of the season (**ERMES Open Days**)

ERMES dissemination: towards already involved and potential end users and stakeholders !

PRESENTATION OUTLINE

- ✓ Introduction: WP Objectives and workplan
- ✓ Service Demonstration in Europe
  - ✓ *Task 9.1: Service application at regional scale*
  - ✓ *Task 9.2: Service application at local scale*
- ✓ Task 9.3: Service application Outside Europe
- ✓ Final Remarks

TASK 9.3: SERVICE APPLICATION OUTSIDE EUROPE

Task Leader: Francesco Holecz (SARMAP)
Time Span: Month 22-34

Objectives

✓ Generate some of the ERMES regional products in the extra-European study areas : Senegal River Valley (Collaboration with AfricaRice) and Gambia (collaboration with IFAD)

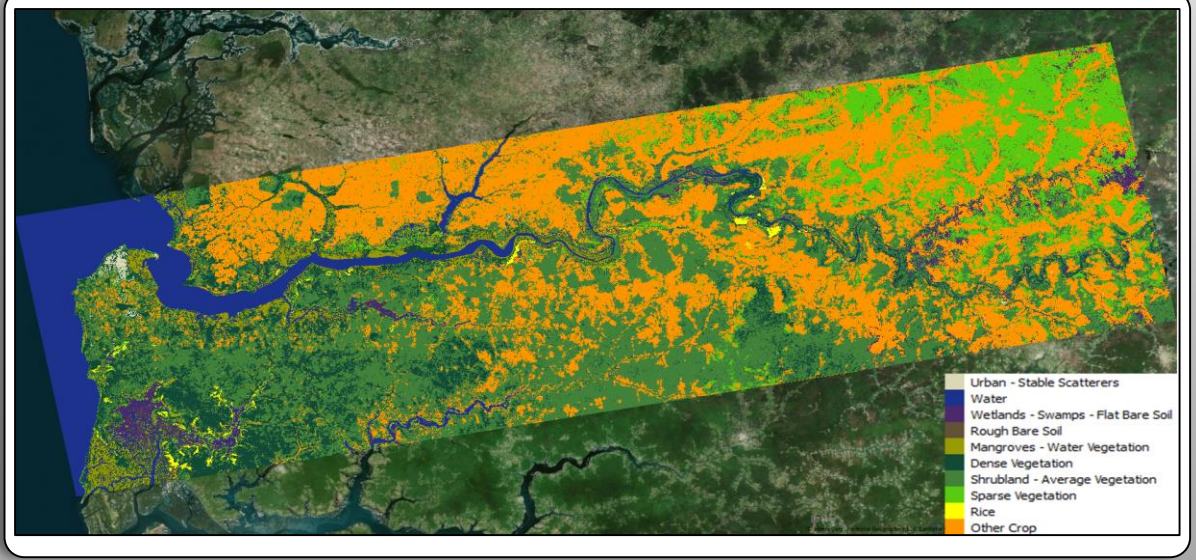
Deployed products

1. **Rice/Land cover maps** for the two study areas from Sentinel data;
2. Rice **Phenological maps** for the Senegal River Valley area, for the 2003-2015 period;
3. **NDVI and LAI** maps for the 2003-2016 period;
4. **Meteorological maps** for the 2003-2015 period;

Rice/Land cover maps

- Even basic information about crop distribution at national scale is **lacking**
- Sentinel 1 data offer a very **efficient and cost effective solution** for rice/agricultural mapping;

Land Cover Map 2016 – The Gambia



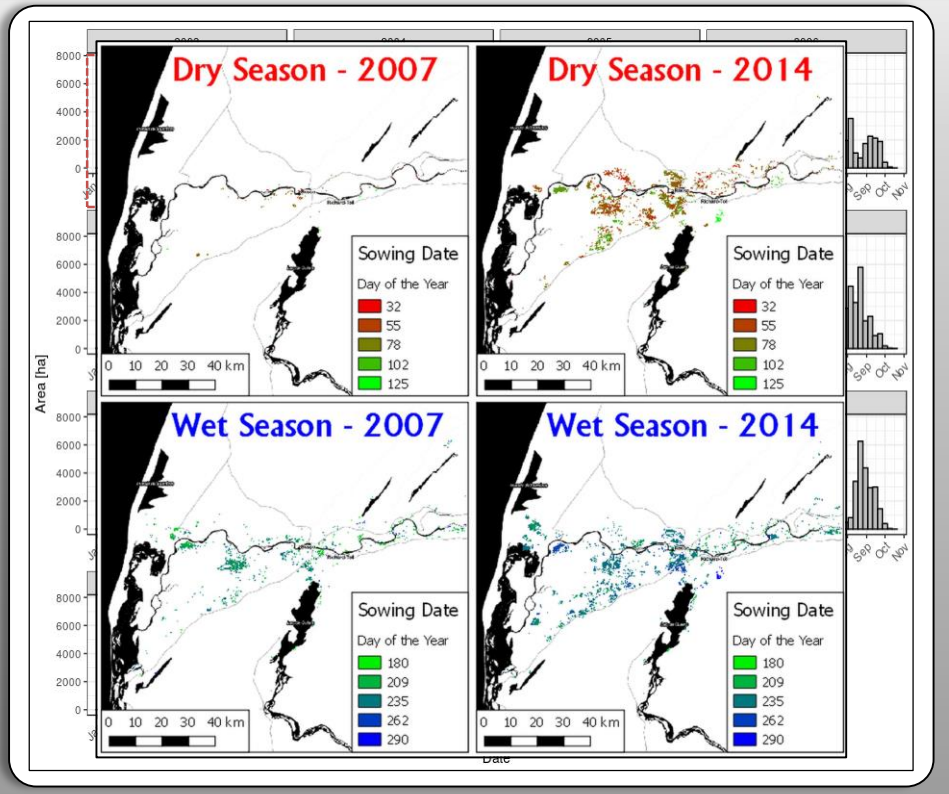
Validation against field observation provided by Gambia Ministry of Agriculture – Accuracy > 85 % on Rice detection

Phenological maps

- PhenoRice analysis on the full MODIS archive clearly highlight **variations in agricultural practices**

- Strong implications on **food security** issues, particularly if accounting **climate change** → topic of strong scientific and «institutional» interest

Phenology maps 2016 – Senegal River Valley



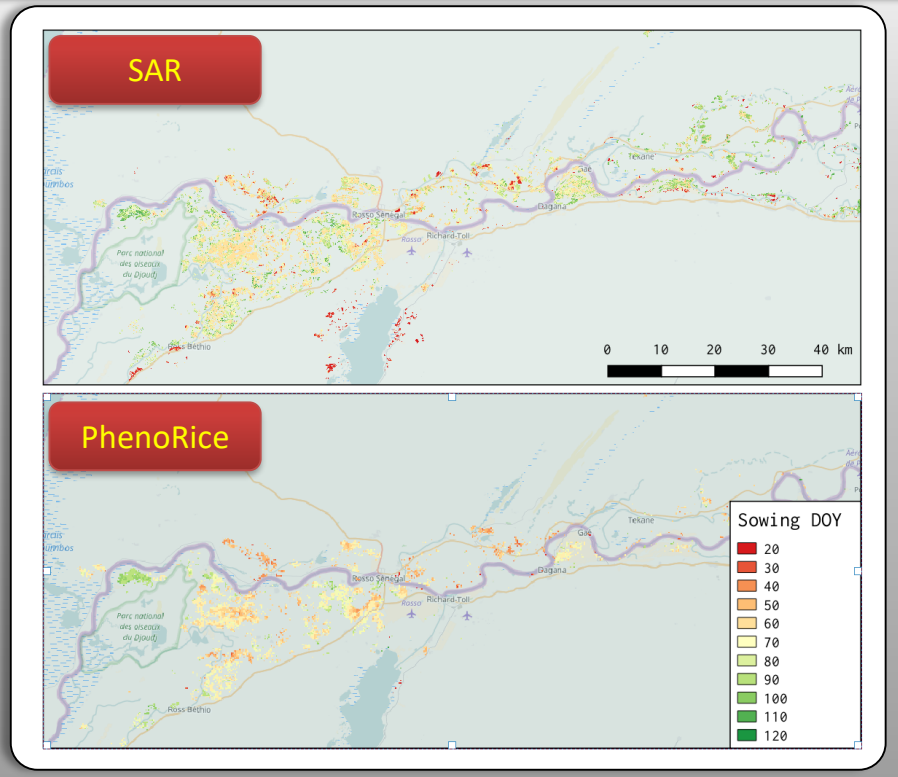
Clear switch from Wet to Dry season cultivation

Phenological maps

- Phenological maps derived from Sentinel-1 are again **coherent** with PhenoRice results (but have much higher spatial resolution)

- **Complementarity** between results of MODIS-Phenorice (for LTA analysis) and Sentinel-1 (for present/future analysis) can be exploited for developing **services in extra-European markets** (e.g., for insurance sector and/or governments or ONGs)

Phenology maps 2016 – Senegal River Valley



Comparison with MODIS PhenoRice analysis – high comparability in both areas and number of seasons

PRESENTATION OUTLINE

ERMES
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FINAL REMARKS

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

- ✓ From a technical point of view, ERMES demonstration activities were very successful:
  - Problems observed during the first year of demonstration were **solved before the 2016 rice season**, resulting in more reliable modelling results.
  - Automation of processing chains for products' generation and model running allowed to **generate in Near Real Time all the foreseen products**, with only few glitches.
  - Products and services supplied to ERMES users in the second year were characterized by a good **accuracy and timeliness**.
- ✓ High-end **added value products** derived from the ERMES portfolio were **successfully integrated** by regional and local end users **within their workflows**.
- ✓ Dissemination activities highlighted a generally **positive appreciation of the proposed products and their usefulness** and an interest for future use.

These results testify (and are due to) the **strong operationality of the developed services**, which candidates as a useful and cost-effective tools to support agro-monitoring and crop management activities.

ERMES
AN EARTH OBSERVATION MODEL BASED RICE INFORMATION SERVICE

THANKS FOR YOUR ATTENTION !

Rice/Land cover maps

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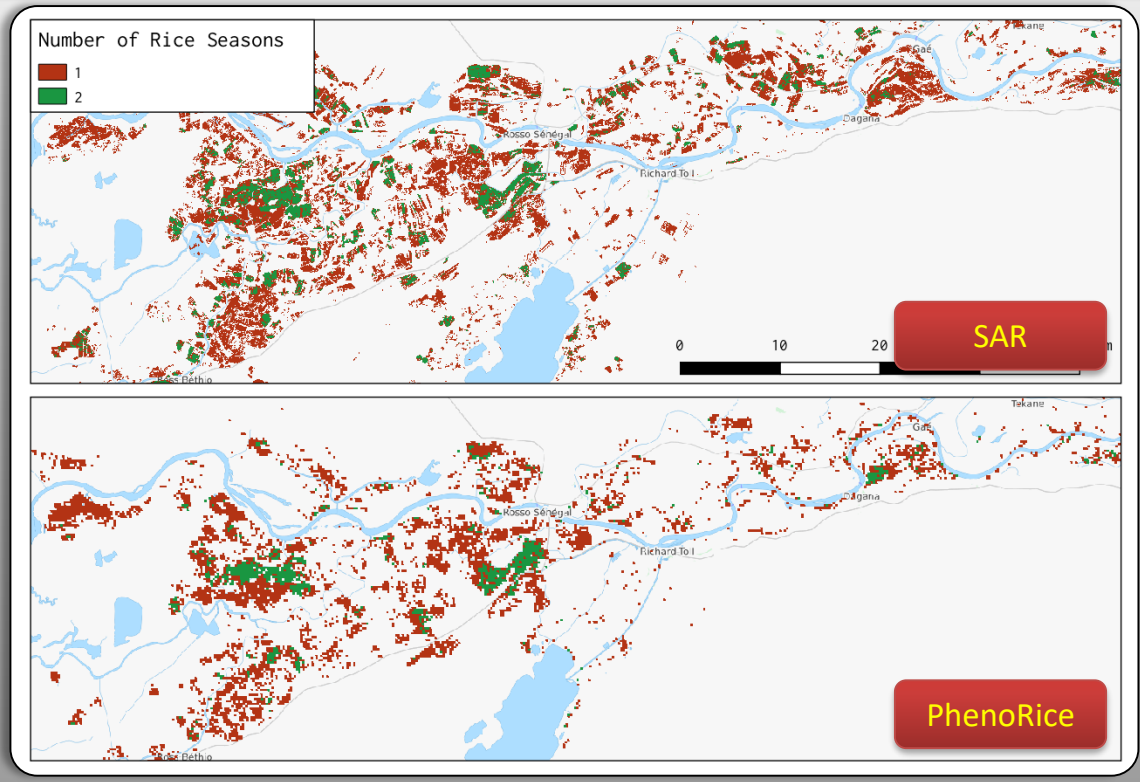
Rice Map 2016 – Senegal River Valley



Comparison with MODIS PhenoRice analysis – high comparability in both areas and number of seasons