WP6: GEO-INFORMATION FROM CROP MODELLING AND EO PRODUCT ASSIMILATION

Speaker: Roberto Confalonieri (UMIL, Cassandra lab)

Task 6.1 Leader: Francesca Orlando (UMIL)
Task 6.2 Leader: Tommaso Stella (UMIL)
Task 6.3 Leader: Carlo Gilardelli (UMIL)

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

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✓ Introduction: WP Objectives and work plan

✓ Task 6.1 - Model customization for regional application

✓ Task 6.2 - Model customization for local application

✓ Task 6.3 - EO data assimilation

WP Leader: Roberto Confalonieri
Time Span: Months 5-34

Main Objectives of the WP6

- ✓ Objective 1: **Crop model customization** to meet user needs at **regional** (Task 1) and **local** (Task 2) scale

- ✓ Objective 2: **Assimilation of EO derived products** through the definition and implementation of algorithms for **automatic recalibration** and **forcing** of model parameters (Task 3)

Work Plan for Months 19-34

Task	Deliv	set-15 M19	ott-15 M20	nov-15 M21	dic-15 M22	gen-16 M23	feb-16 M24	mar-16 M25	apr-16 M26	mag-16 M27	giu-16 M28	lug-16 M29	ago-16 M30	set-16 M31	ott-16 M32	nov-16 M33	dic-16 M34	gen-17 M35	feb-17 M36
T6.1	D6.2	Customised model for regional rice monitoring v1																	
	D6.4							Report on Customised model for regional rice monitoring v1											
T6.2	D6.6	Customised model for high resolution monitoring system at local scale v1																	
	D6.8									Report on Customised model for high resolution monitoring system at local scale v1									
T6.3	D6.10			Tool to assimilate EO information in WARM v1															
	D6.12						Report on Tool to assimilate EO information in WARM v1												

Work plan of WP6 in months 19-34 with reference to expected deliverables

✓ **Refinement of modelling solutions** for regional and local application

✓ **Extending the EO assimilation tool** for automatic calibration

✓ Introduction: WP Objectives and work plan

✓ Task 6.1 - Model customization for regional application

✓ Task 6.2 - Model customization for local application

✓ Task 6.3 - EO data assimilation

Task Leader: Francesca Orlando
Time Span: Months 5-34

✓ **Objective**: Developing a version of WARM suitable for the project activities at regional scale

- Identification of the **most suitable approach for each process**, considering sources of **uncertainty** related to **data** (EO products, management, weather) **availability at regional scale**

✓ **Target products**:

1. **Yield forecast/estimate** [end users: policy makers of **regional authorities** (e.g., ENR - IT) and branches of the **private sector** (traders and milling industries, KANAKAS SA - GR; insurance companies, Cattolica Assicurazioni - IT)]

2. **Risk alert** [end users: **regional authorities** (e.g., Regione Lombardia - IT), **insurance companies** (Cattolica Assicurazioni - IT)]

✓ **Final version (v1)** of the ERMES-WARM regional modelling solution **released**

✓ **Deliverables:**

- D6.2: Customized model for regional rice monitoring v1

- D6.4: Report on customized model for regional rice monitoring v1

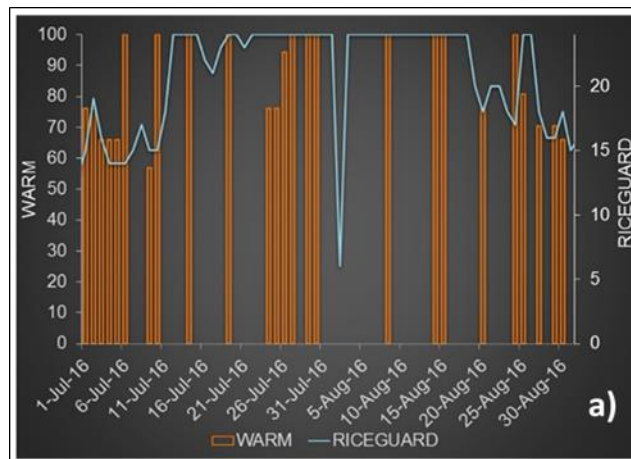✓ **Differences compared to the v0:**

- Inclusion of the final version of the EO assimilation tool

- Elimination of the micrometeorological model

- The infection model can be run autonomously

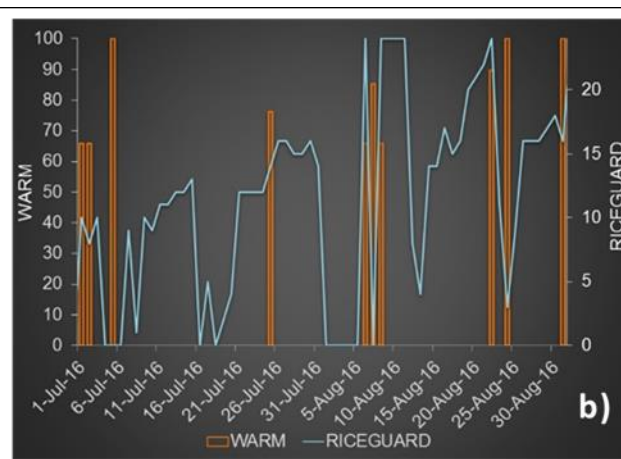- Radiation data are now "measured"

- Improvement of parameterizations
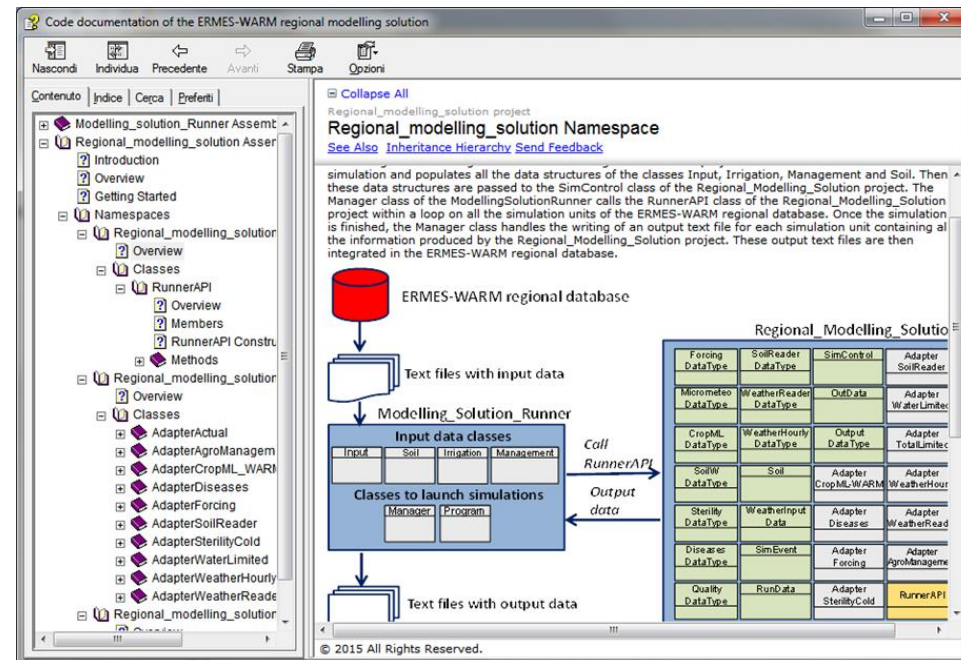
✓ **Potential infection**
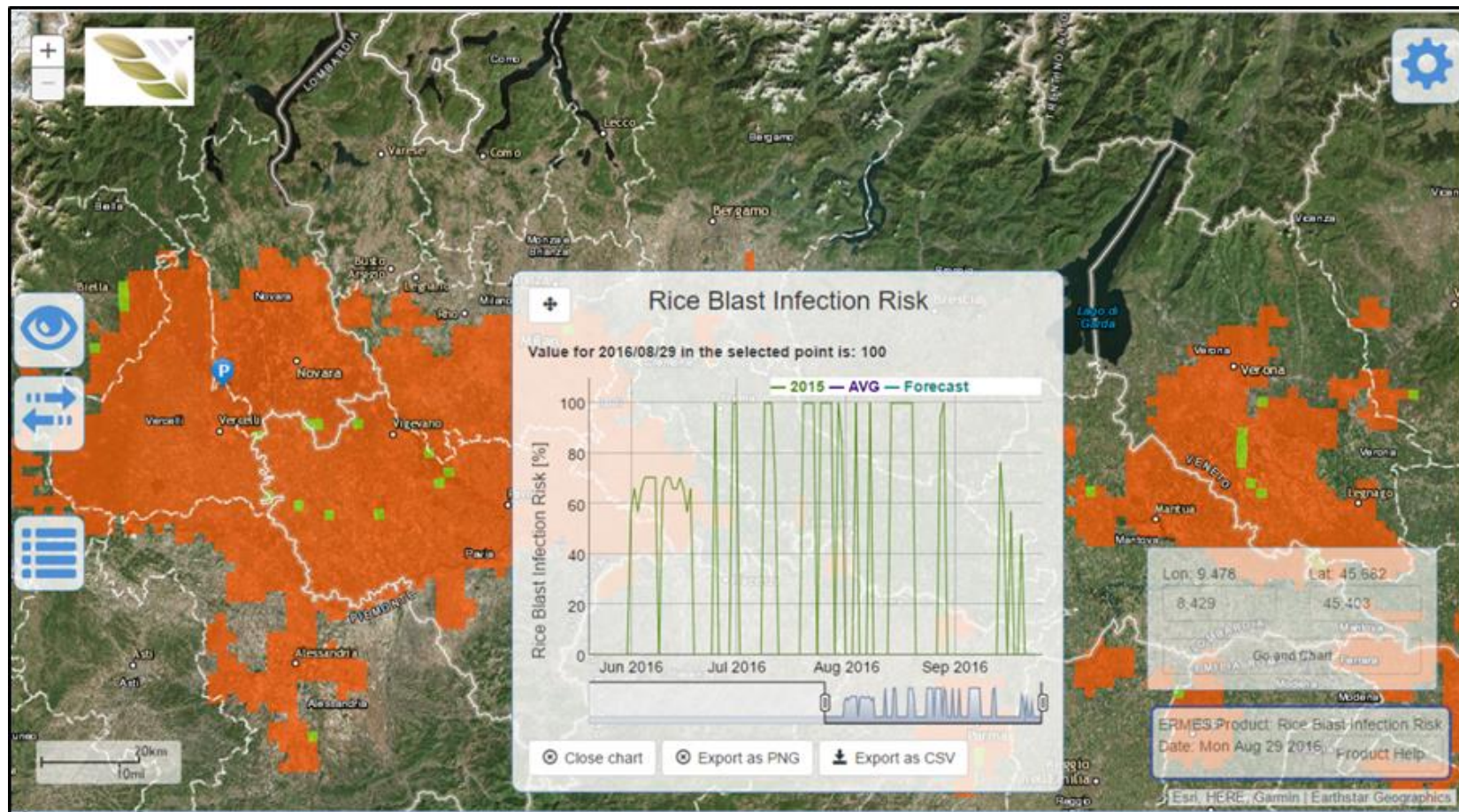
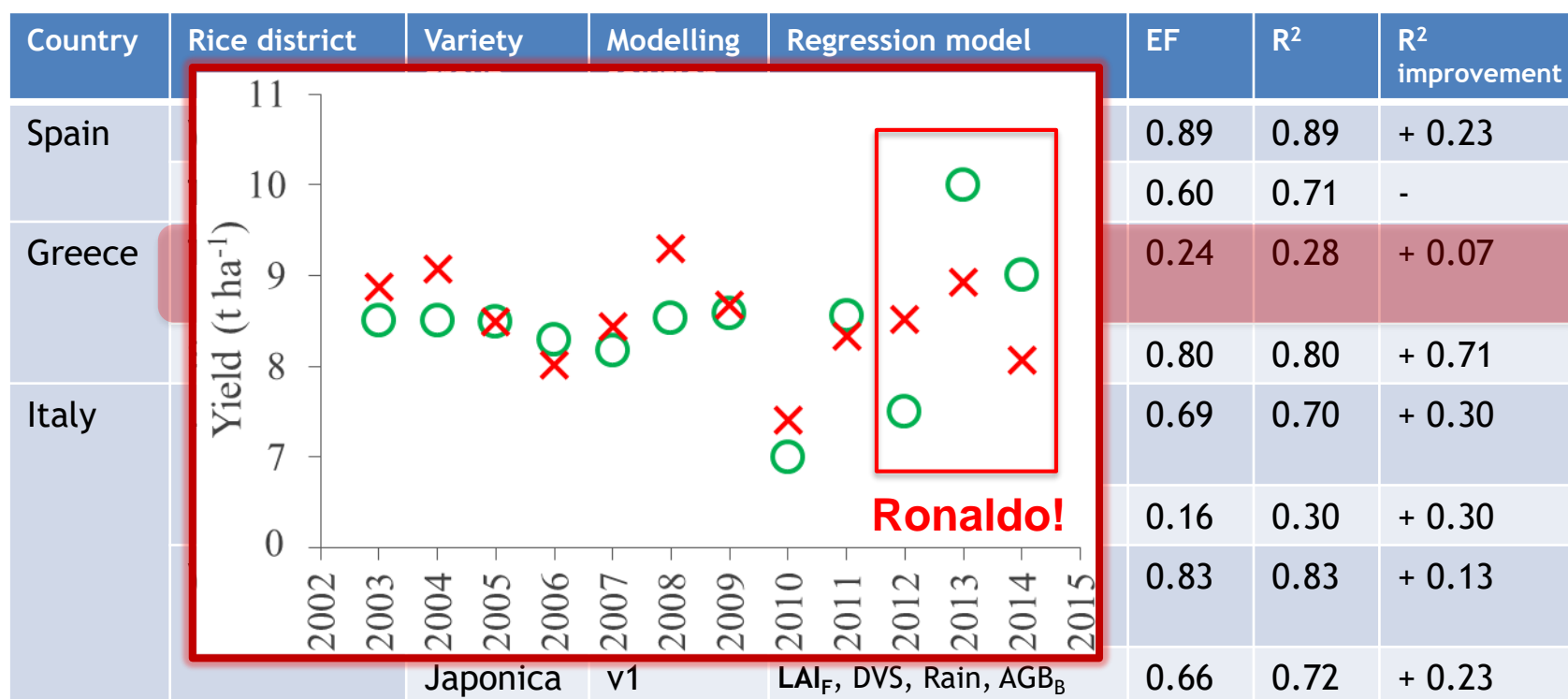✓ **Potential infection - Comparison with (EU-FP7) RiceGuard sensors**

Villipenta (Italy)   Thessaloniki (Greece)

ERMES-WARM
RiceGuard sensors

✓ For the Italian site, information were **validated also by National Rice Authority**

WP6 - TASK 6.1: MODEL CUSTOMIZATION FOR REGIONAL APPLICATION

ERMES

AN EARTH
OBSERVATION
MODEL BASED
RICE INFORMATION
SERVICE

✓ **Yield forecast: good results!**

• Room for improvement in Thessaloniki (tropical japonica) and Lomellina (japonica)

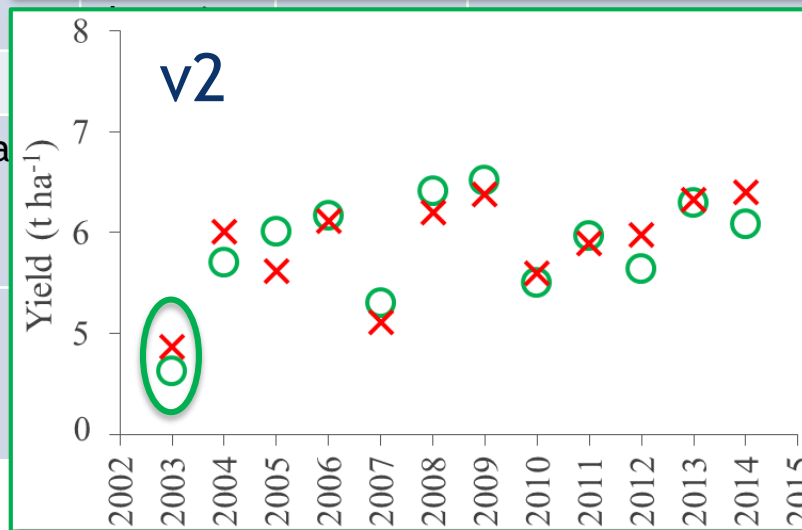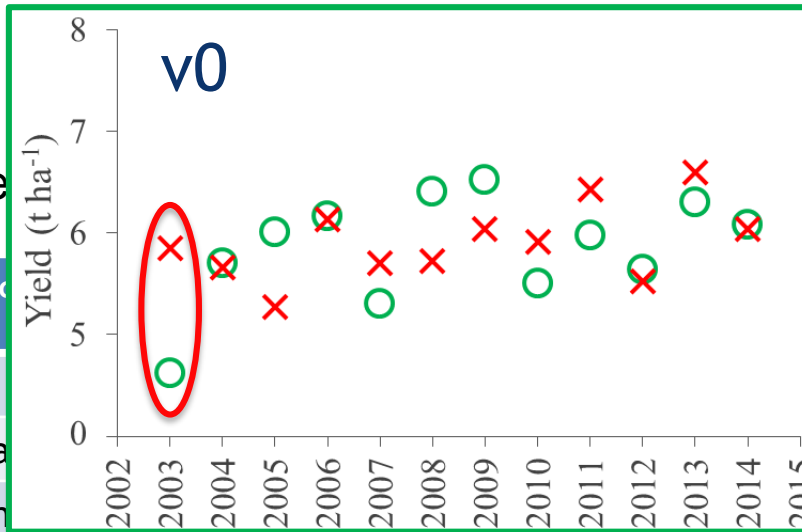| Country	Rice district	Variety	Modelling	Regression model	EF	R²	R² improvement
Spain					0.89	0.89	+ 0.23
					0.60	0.71	-
Greece					0.24	0.28	+ 0.07
					0.80	0.80	+ 0.71
Italy					0.69	0.70	+ 0.30
					0.16	0.30	+ 0.30
					0.83	0.83	+ 0.13
		Japonica	v1	LAI_F, DVS, Rain, AGB_B	0.66	0.72	+ 0.23

Ronaldo!

✓ **Yield forecast**

- The key role

Country	Rice distric		EF	R²	R² improvement
Spain	Valencia		0.89	0.89	+ 0.23
	Tarragona		0.60	0.71	-
Greece	Thessalon		0.24	0.28	+ 0.07
	Serres		0.80	0.80	+ 0.71
Italy	Lomellina		0.69	0.70	+ 0.30
			0.16	0.30	+ 0.30
	Vercelli		0.83	0.83	+ 0.13
			0.66	0.72	+ 0.23

✓ **Yield forecast - Bulletins**
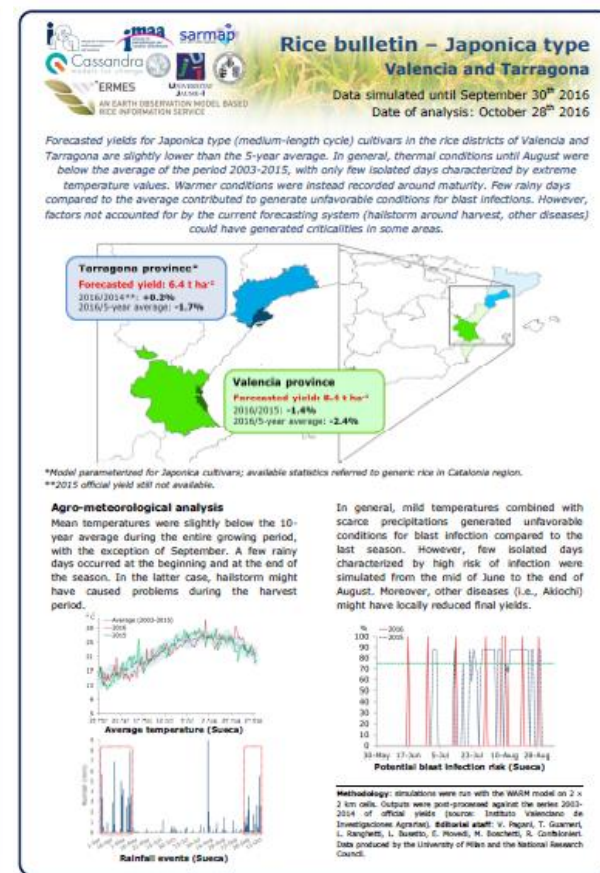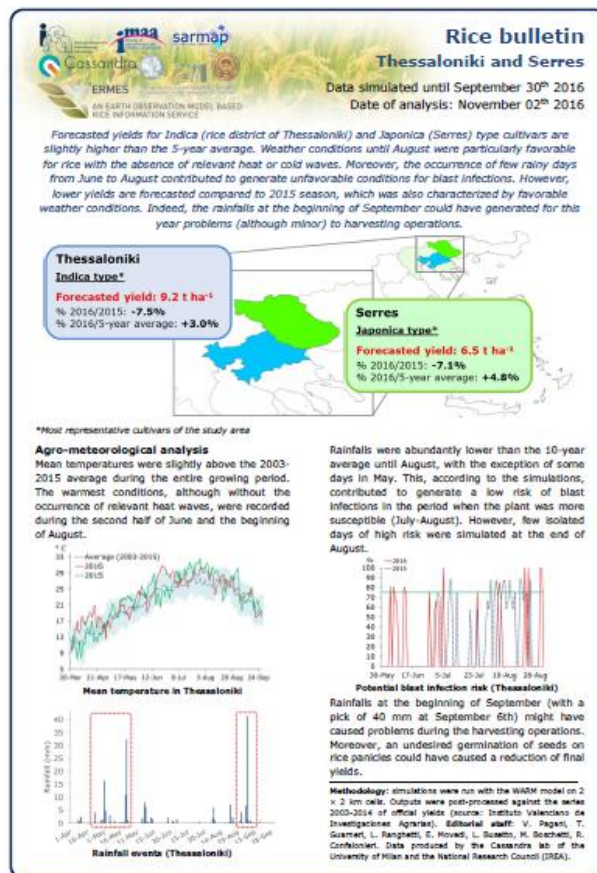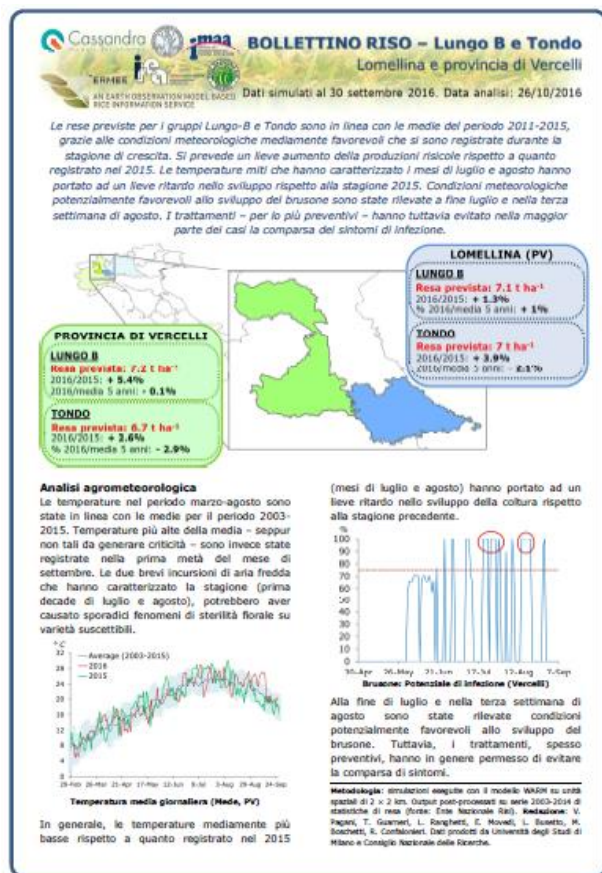
✓ **Yield forecast: comparison with MARS system (e.g., Italy)**

Adm. level: NUTS0 (**Italy**)
Time series: **1995-2013**
Crop: **rice**

Regressors: LAI_{Pot}, LAI_{Cold}, $YIELD_{Cold}$, AGB_{Pot}
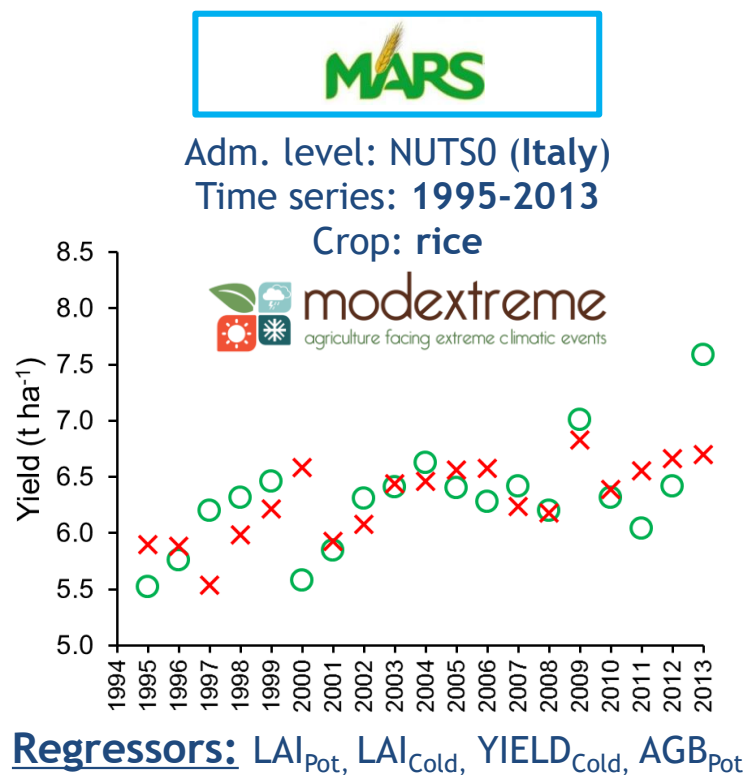
R² = 0.26
RRMSE = 6.5%
R² (technological trend) = 0

Adm. level: NUTS2 (**Vercelli**)
Time series: **2003-2014**
Crop: **rice – *Indica* type**

Regressors: LAI, $GLAI_R$, LAI_R, $Yield_R$
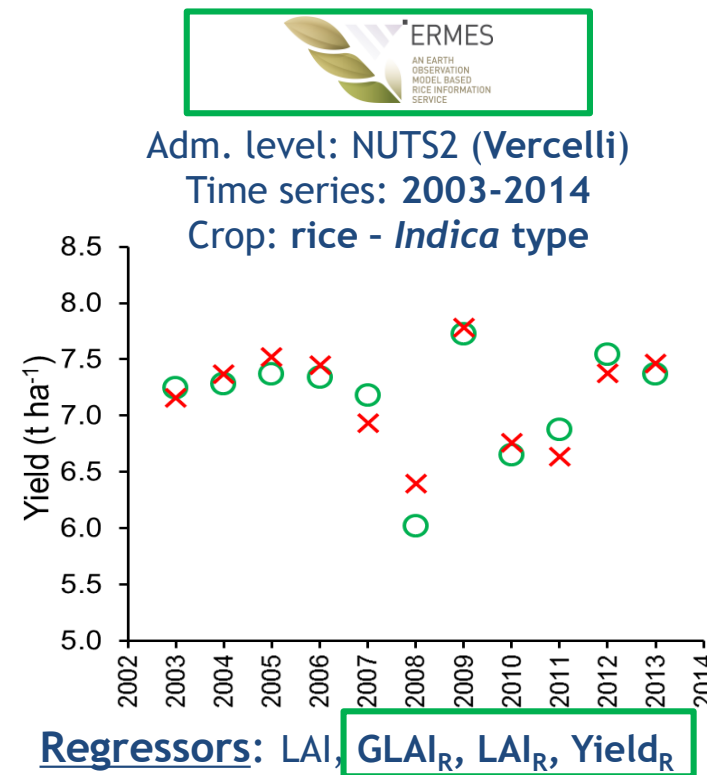
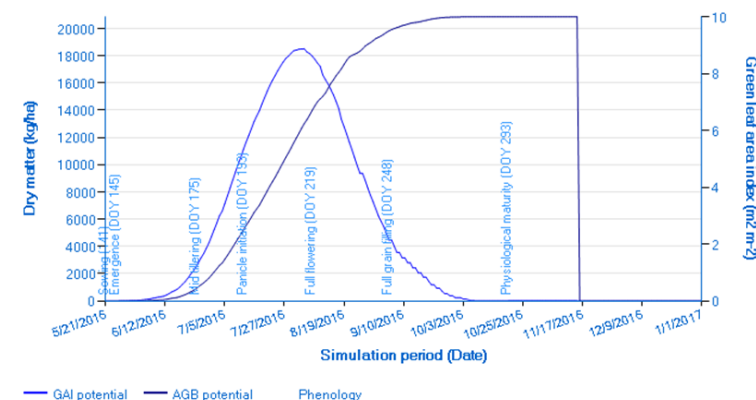**R² = 0.83**
RRMSE = 2.5%
R² (technological trend) = 0

✓ Introduction: WP Objectives and work plan

✓ Task 6.1 - Model customization for regional application

✓ Task 6.2 - Model customization for local application

✓ Task 6.3 - EO data assimilation

Task Leader: Tommaso Stella

Time Span: Months 5-34

✓ **Objective**: Developing a version of WARM suitable for high resolution simulations at local scale (field)

- Identification of the **most suitable approach for each process**, considering sources of **uncertainty related to data** (EO products, management, weather, soil, irrigation) **availability at local scale** (not always possible to use the most sophisticated/demanding approach in operational contexts, even at farm scale)

✓ **Target products**:

1. **Management support** (e.g., **time for top-dressing fertilization**; **risk alert** for blast) [end users: **farmers** (strong demand in all countries)]

2. **Potential production** and analysis of **yield gap components** [end users: **insurance companies** (e.g., Cattolica Assicurazioni - IT)]

✓ **Final version (v1)** of the ERMES-WARM local modelling solution **released**

✓ **Deliverables:**

- D6.6: Customized model for high resolution monitoring system at local scale v1

- D6.8: Report on customized model for high resolution monitoring system at local scale v1

✓ **Differences compared to the v0:**

- Inclusion of the final version of the EO assimilation tool

- Elimination of the micrometeorological model

- The infection model can be run autonomously

- Radiation data are now measured

- Improvement of parameterizations

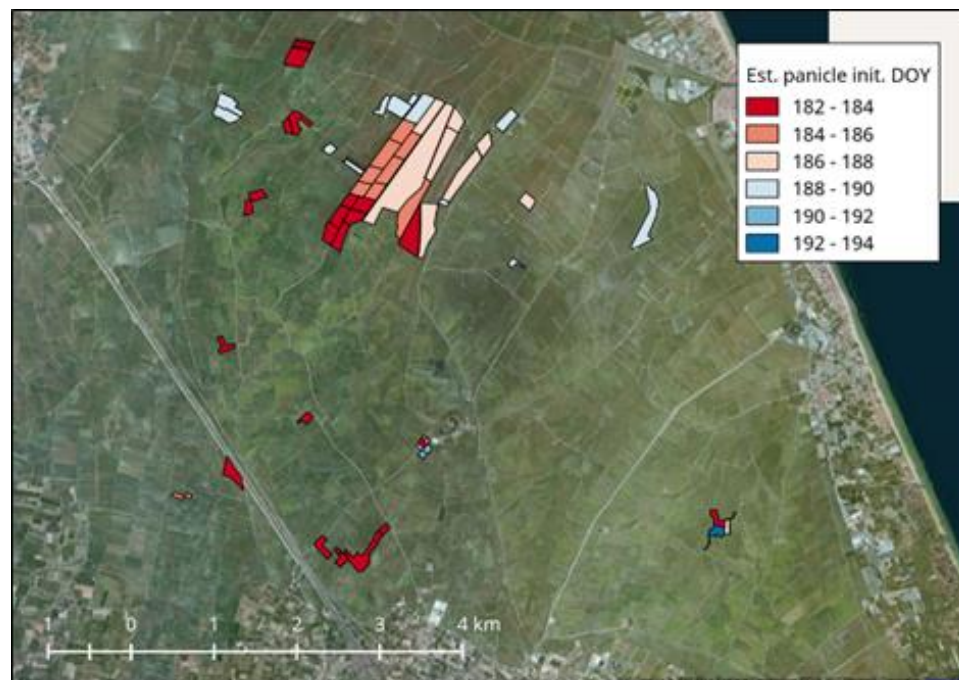✓ Simulation of **phenological stages**

- Crucial information to **support management practices**
  - o **Measured Vs simulated** DVS data (2014, 2015, 2016 seasons)
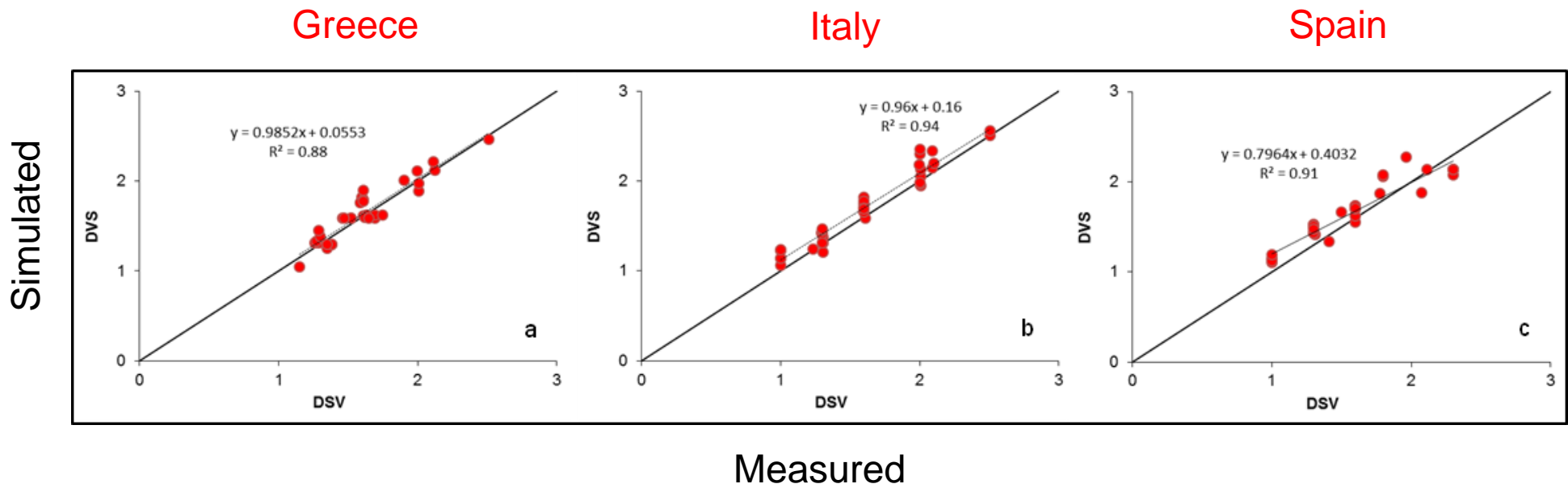
Greece   Italy   Spain
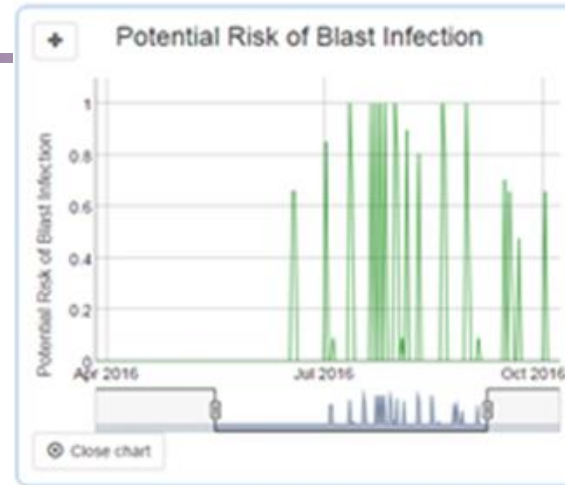

Measured

✓ Simulation of **phenological stages**

   • Crucial information to **support management practices**

      ○ **Top-dressing fertilization** at panicle initiation (examples for Spain and Greece)
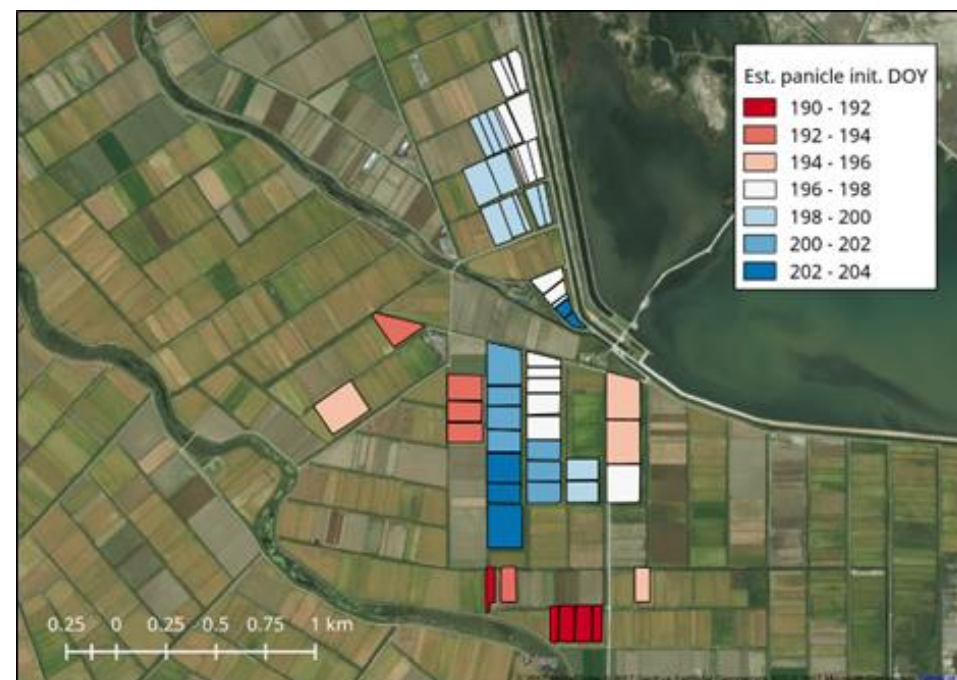
✓ **Risk alert** (e.g., Italy)

✓ **Final yield estimate** (e.g., Spain and Greece)
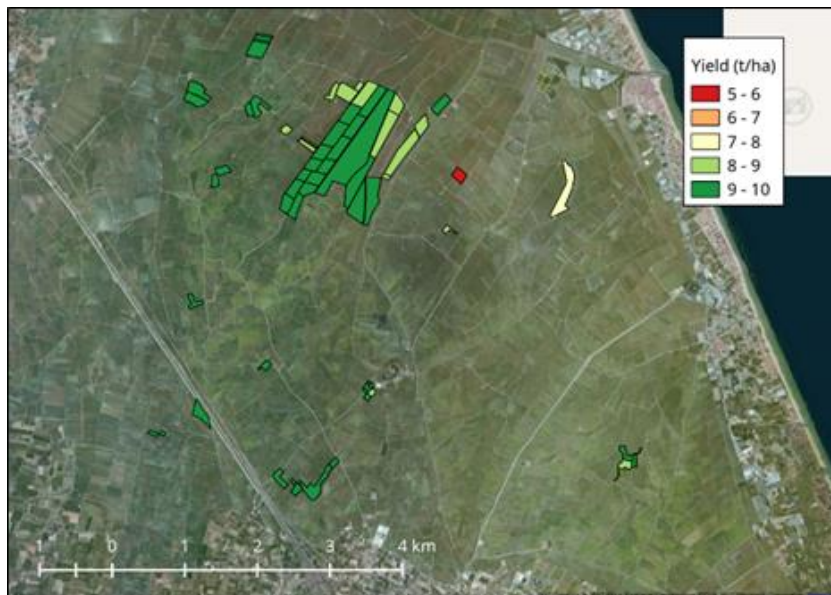
✓ Introduction: WP Objectives and work plan

✓ Task 6.1 - Model customization for regional application

✓ Task 6.2 - Model customization for local application

✓ Task 6.3 - EO data assimilation

Task Leader: Carlo Gilardelli

Time Span: Months 5-28

✓ **Objective**: Developing a **software component** allowing **EO data assimilation** in both the ERMES versions of WARM (regional and local)

- **Forcing** (updating) model state variables using exogenous information

- **Automatic recalibration** of model parameters using exogenous information to calculate an objective function
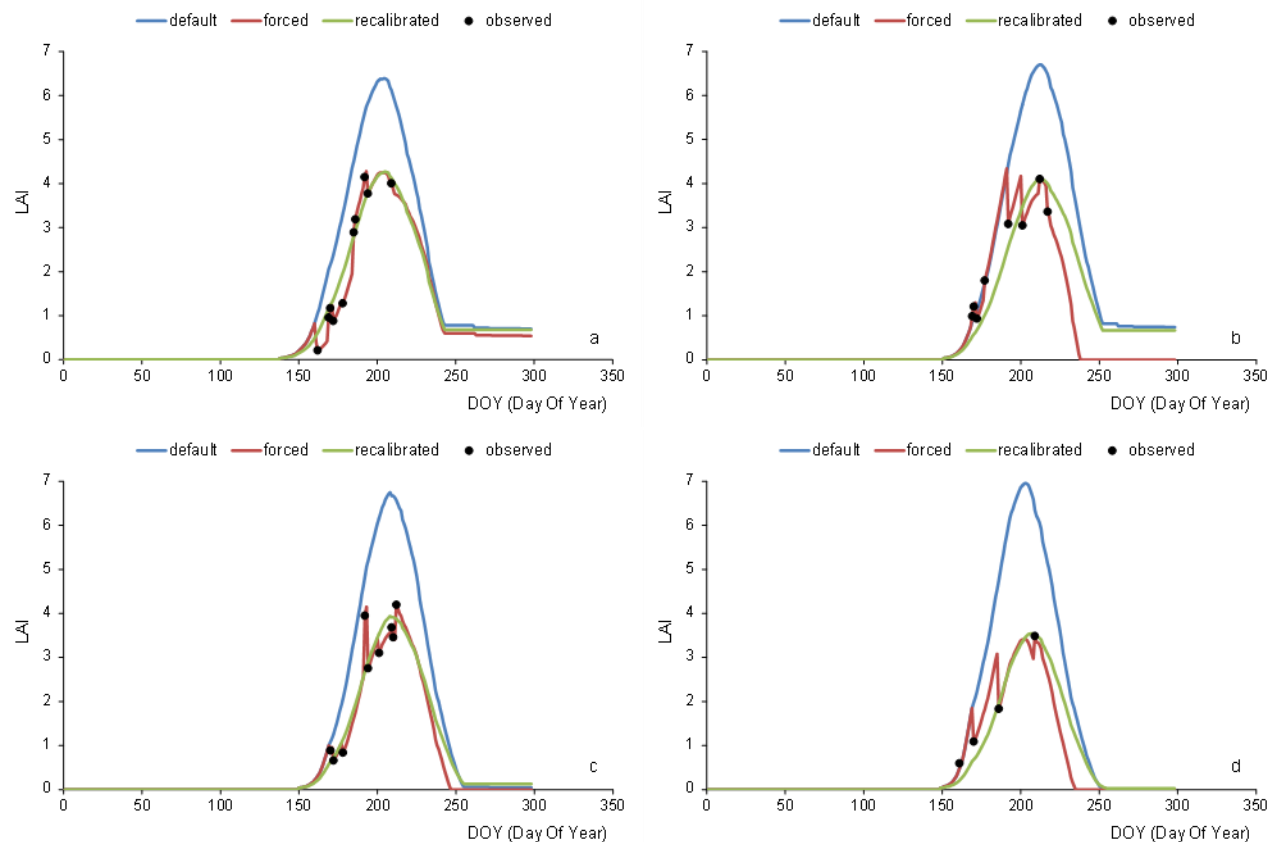
✓ **Target products**:

The same of Tasks 6.1 and 6.2

- The EO tool is used to decrease the uncertainty of the ERMES modelling solutions

✓ **Final version (v1)** of the EO assimilation tool **released**

✓ **Deliverables:**

- D6.10: Tool to assimilate EO information in WARM v1

- D6.12: Report on Tool to assimilate EO information in WARM v1

✓ **Differences compared to the v0:**

- The component has been fully extended with EO assimilation approaches based on recalibration of model parameters

About UNIMI.Forcing

UNIMI.Forcing

forcing

Development: C. Gilardelli, E. Movedi, R. Confalonieri
Programming: E. Movedi, R. Confalonieri

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VERSION 1.0

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Help

Code doc

Ok

UNIVERSITÀ DEGLI STUDI DI MILANO

Cassandra
models for change

✓ **Forcing (re-initialization) and recalibration** (e.g., local, Spain)

✓ **Forcing (re-initialization) and recalibration**

    o **Yield estimates always improved when EO data were assimilated** (e.g., local, Italy, 2014)

Parametrization	Modelling solution	MAE	RMSE	RRMSE	CRM
Japonica early	Default	1.01	1.16	20.5	0.17
Japonica early	Forced	1.32	1.4	24.7	0.23
Japonica early	Recalibrated	0.7	0.88	15.6	-0.12
Japonica medium	Default	0.49	0.81	13.3	0.07
Japonica medium	Forced	1.05	1.24	20.4	0.17
Japonica medium	Recalibrated	0.46	0.57	9.37	0
Japonica late 'Carnaroli'	Default	0.55	0.61	12.4	0.11
Japonica late 'Carnaroli'	Forced	1.55	1.56	31.7	0.31
Japonica late 'Carnaroli'	Recalibrated	0.46	0.55	11.3	-0.08
Indica medium	Default	1.36	1.51	25.5	0.06
Indica medium	Forced	0.95	1.16	19.7	0.1
Indica medium	Recalibrated	0.89	1.02	17.2	0.11
Indica late	Default	0.8	1	15.2	0.12
Indica late	Forced	0.7	0.79	11.9	0.08
Indica late	Recalibrated	1.3	1.45	22.1	0.18

✓ **Sample results shown for Tasks 6.1 and 6.2 include EO assimilation**

Many thanks for your kind attention