Sistemi di supporto per la gestione di comprensori irrigui, primi risultati del progetto MOSES

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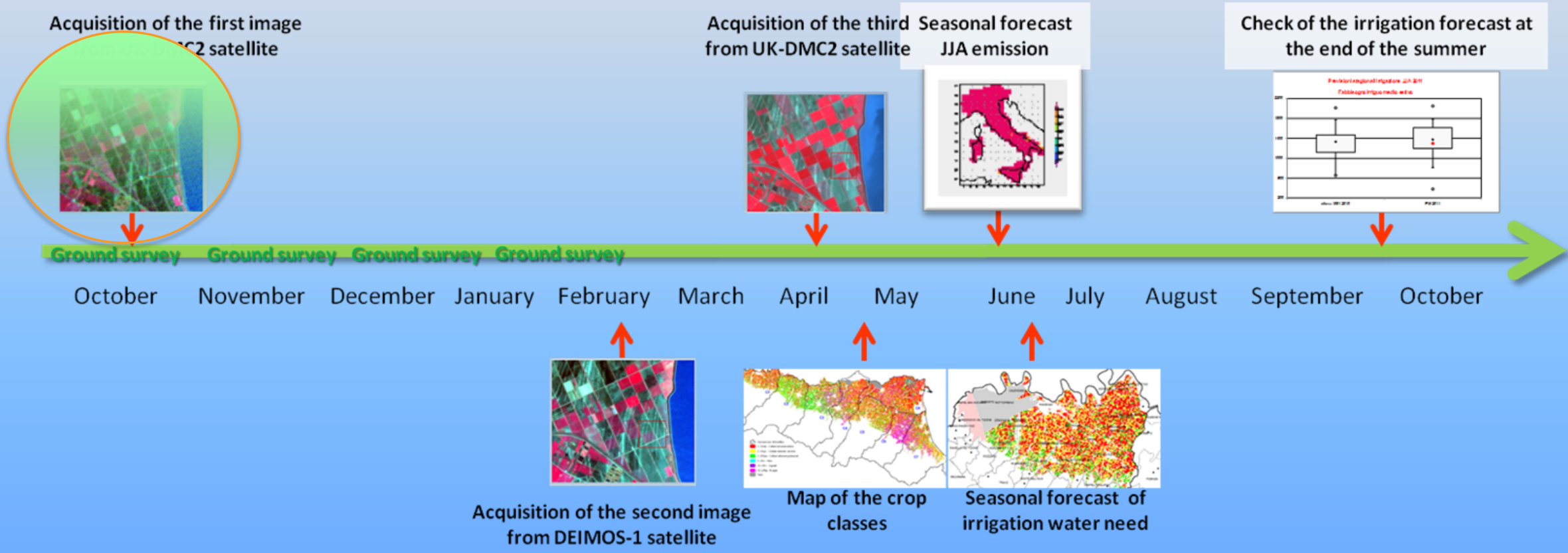
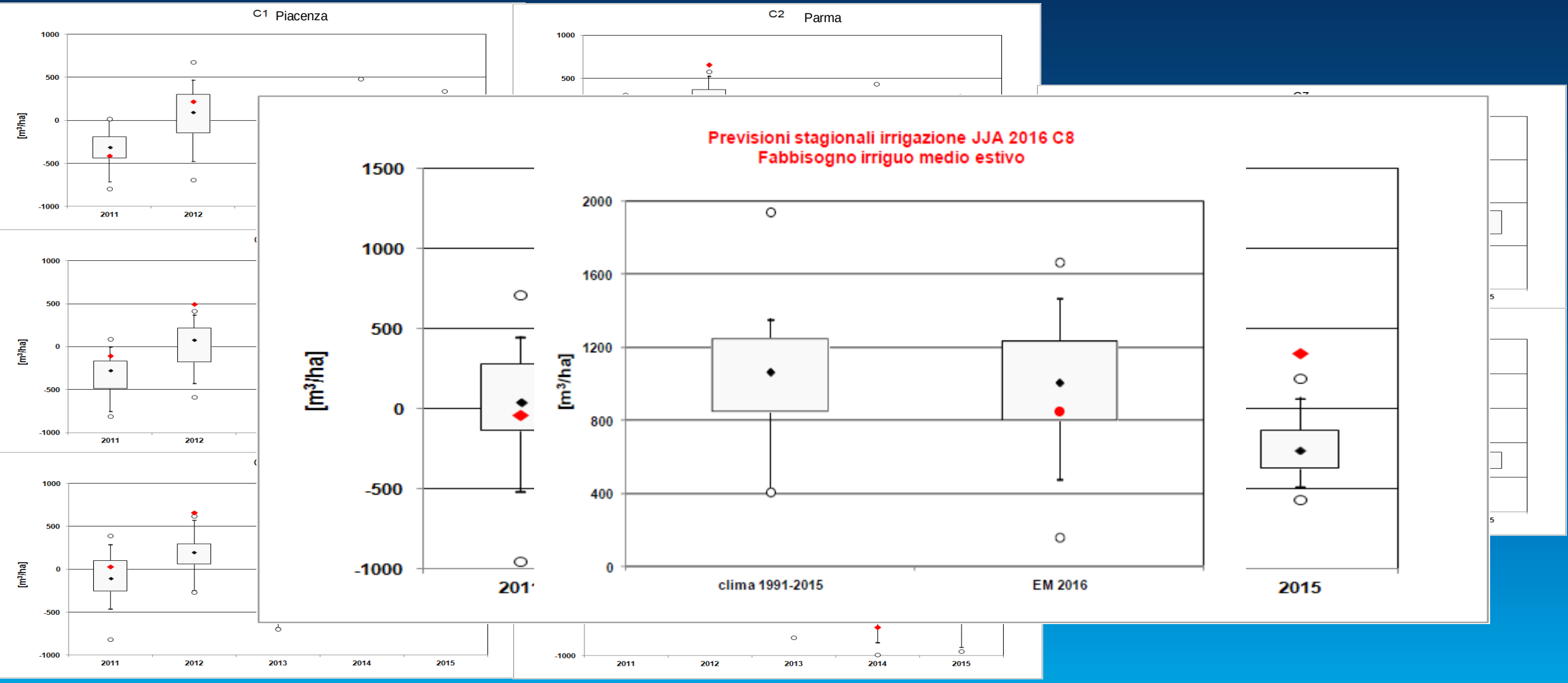
- **Servizi climatici**, una novità nel panorama meteorologico
- Integrano i modelli climatici con i dati per fornire supporto alle decisioni nelle attività civili ed economiche (**adattamento** ai cc)
- Dal 2009 sotto l'egida dell'Onu-Omm esiste una comunità mondiale sul tema (Global Framework for Climate Services, www.wmo.int/gfcs) che individua le aree prioritarie di **applicazione** dei servizi climatici in
  - **Agricoltura** e sicurezza alimentare, Riduzione dei **rischi** da disastri, **Energia**, **Salute**, **Acqua**
- In Europa dopo numerose iniziative preparatorie è stata lanciata nel 2016 la "European Research Area for Climate Services" (www.**ERA4CS**.eu) cui partecipano per l'Italia Cnr e Cmcc

iCOLT – mappa le colture dal 2008 e dal 2010 prevede il fabbisogno irriguo all'inizio dell'estate!



iColt - previsioni stagionali di irrigazione- Risultati



- **iColt** integra i dati da satellite con quelli della rete meteo e le previsioni stagionali tramite modellistica ed è quindi un interessante esempio di **servizio climatico**
- Il servizio fornito ai **consorzi di bonifica** risulta utile ai loro scopi e migliora le loro capacità di gestione del servizio e della risorsa idrica
- Il sistema deriva dalla nostra esperienza quasi ventennale in diversi **progetti europei di ricerca** applicata su meteorologia e clima (per esempio FP6 ENSEMBLES)
- Sulla base del lavoro svolto da Arpae e con l'integrazione di numerosi altri **partner** tecnici regionali ed europei è stato concepito il progetto europeo H2020 MOSES, finanziato e in pieno svolgimento (2015-2018)

MOSES - Managing crOp water Saving with Enterprise Services

- *MOSES aims at putting in place and demonstrate at the real scale of application an **information platform** devoted to planning of irrigation water resources, to support water procurement & management agencies (e.g. reclamation consortia, irrigation districts, etc.).*

Its main goals are:

- ❖saving water
- ❖improving services to farmers
- ❖reducing monetary and energy costs

Implementation of European Innovation Partnerships (EIP) Water objectives.

The project, among others, contributes to the following thematic priorities:

- ***"flood and drought risk management"***
- ***"decision support systems and monitoring"***
- ***"water governance"***

specifically, it addresses the ***"design and implementation of new arrangements for cooperation (including public-private partnerships and business opportunities)"***

MOSES Framework and Organization

- ***16 partners: environmental agencies, universities, research institutes, space associations, water consortia, irrigator associations, SME & industries (5 European countries, 1 African)***
- ***3 stake-holders***
- ***4 Demonstration Area located in: Italy, Spain, Romania and Morocco***

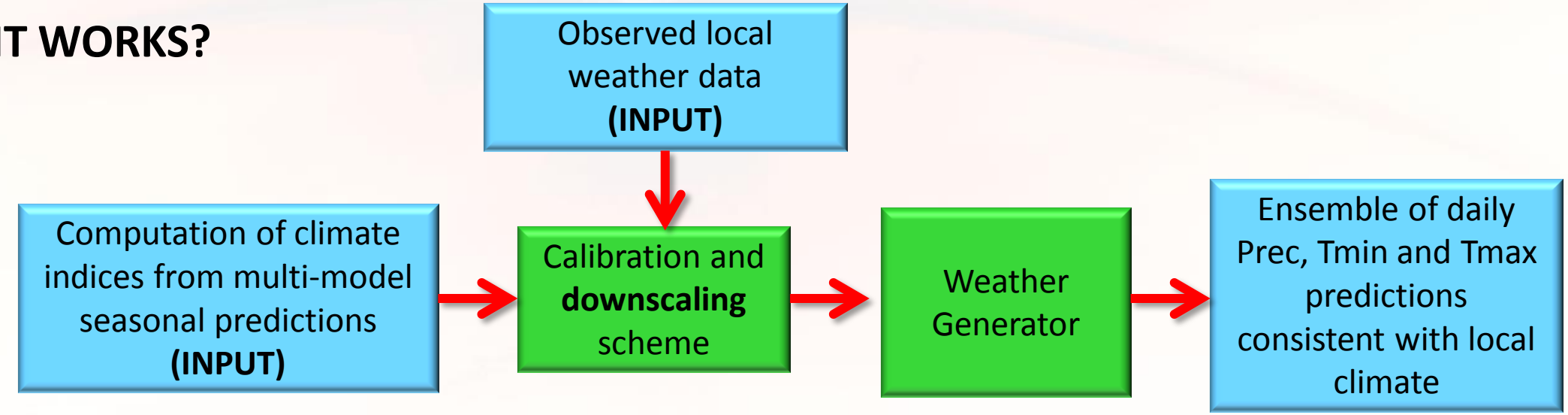
- *Core Activities: Project management, Scientific and Demo Areas coordination*
- *Partners points of strength and roles identified*
- *Researchers, Stake-holders and end-user involvement*

MOSES Seasonal Forecast Module (by ARPAE, ANM & AEMET)

WHAT IS IT?

A procedure that takes as input multi-model seasonal predictions and produces an ensemble of daily values of precipitation and minimum and maximum temperature for the next coming season consistent with local climate.

HOW IT WORKS?



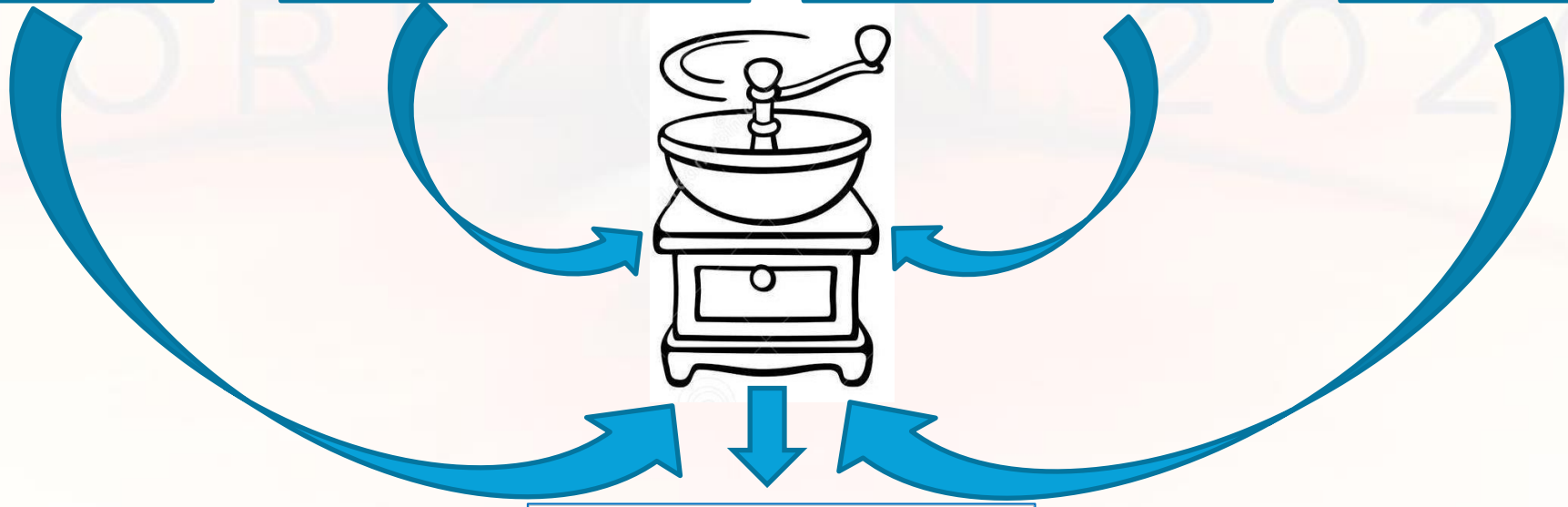
Seasonal Forecasting Module calibration and downscaling

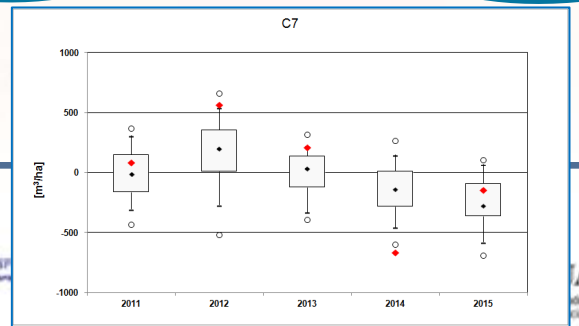
DEFAULT: quantile mapping of hind-casted climate indices on obs. indices

Italian DA[1]: multi-model linear regression
Pavan and Doblas-Reyes (2013)

Rumanian DA: CCA
Busuioc et al., (2006, 2008)

Spanish and Moroccan DA: Analogue
Ramos et al (2012), Petisco (2008)

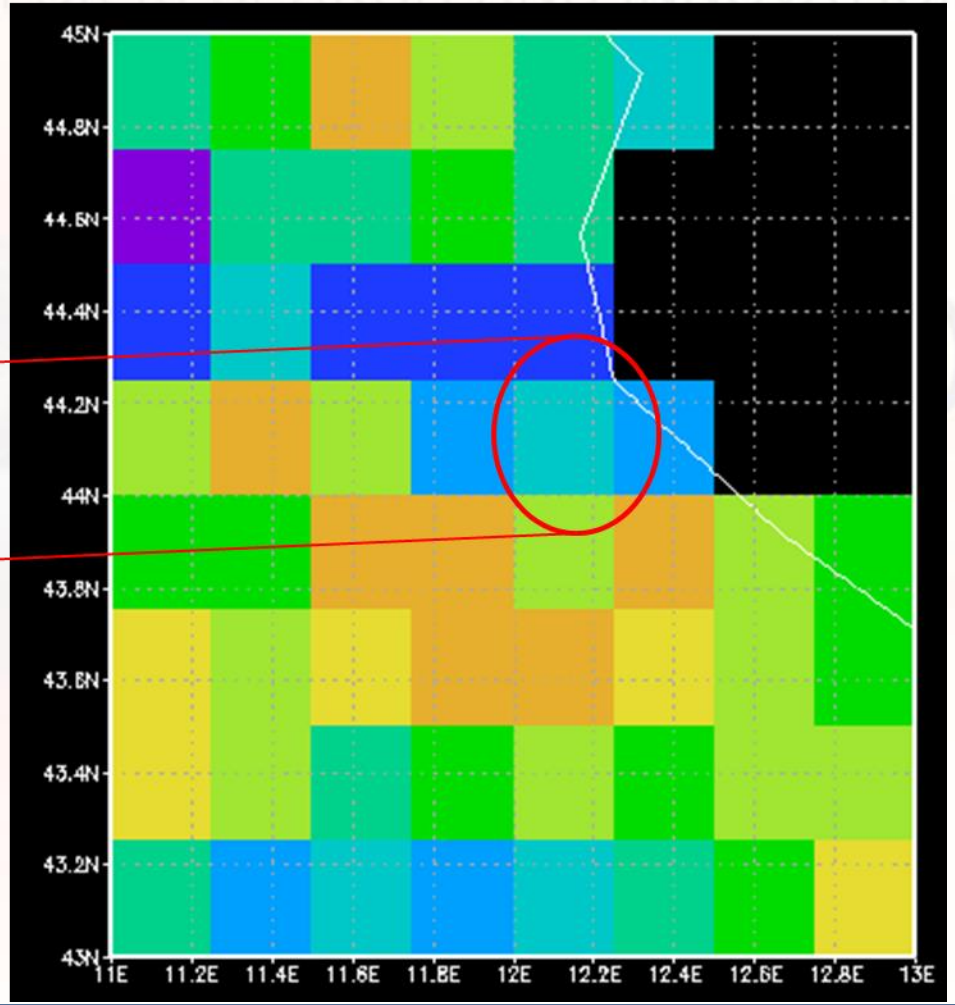




(1) Demonstration Area

Italian DA calibration and downscaling scheme

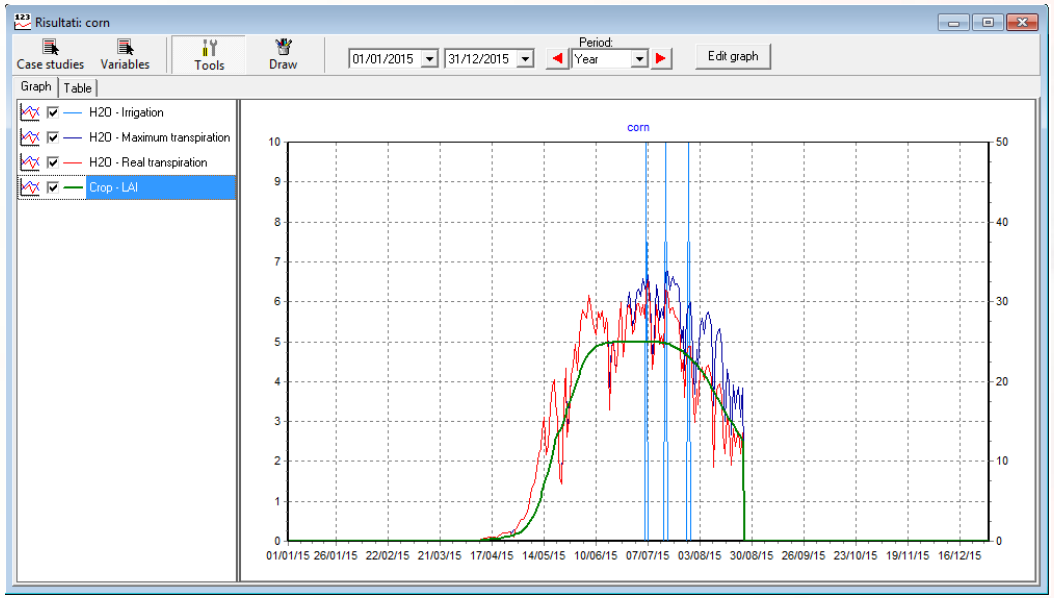
DA ITALY
San Vittore – Fiumicello
ERG5 gridded dataset (5 km)



E-OBS Seasonal Forecast (30 km)

MOSES Water Balance Module

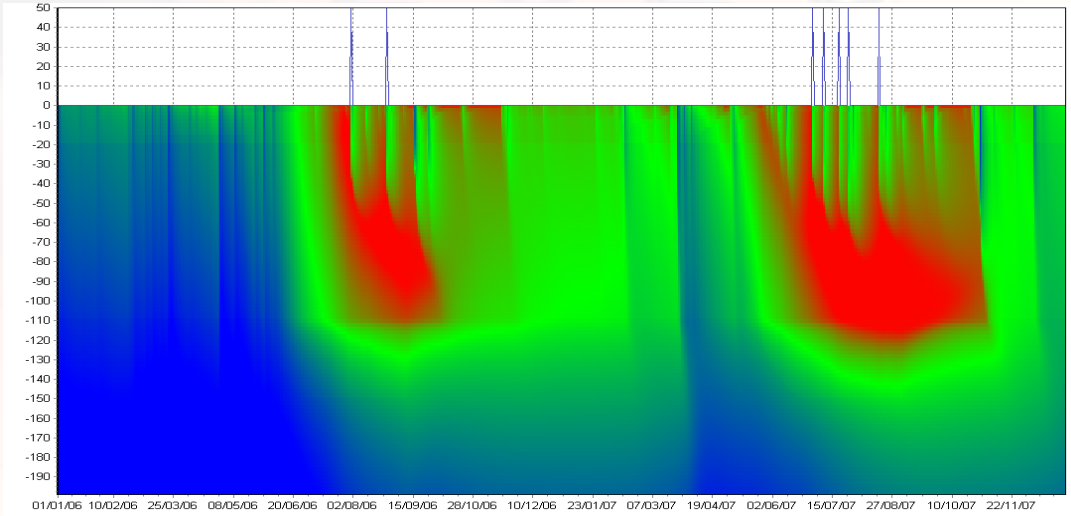
(by ARPAE)



Output example: LAI and irrigation – 1 year

Ref. www.tinyurl.com/criteriamodel

- ***Soil water balance**: numerical model (based on Richard's equation) and empirical model*
- ***Crop and roots development model** (phenology)*
- ***Evaluation functions** (potential and actual ET, capillary rise…)*
- ***Water stress and irrigation***



Output example: soil moisture and irrigation – 2 years

MOSES Early Crop Mapping Module (by ARPAE & SERCO)

Decision tree crop development stages

CLASS GRID CODE[2]	TYPE	W1	W2	W3
		mid Oct / mid Nov	Feb	Apr
3	*alfalfa*	veg	senescence	veg
3	*meadow*	veg	veg	veg
2	*annual fodder grass*	very scarce veg or no veg	veg	veg
2	*winter crops*	very scarce veg or no veg	veg	veg
1	*summer crops*	no veg	no veg	no veg

Satellite images[1] processing steps

- ✓ *Conversion to TOA reflectance*
- ✓ *Cloud Masking*
- ✓ *Masking of not Agricultural Areas*
- ✓ *Clipping*
- ✓ *NDVI Mapping*
- ✓ *Layer Stacking*

} *Pre-processing*

- ✓ *Decision tree classification*
- ✓ *Spectral Angle Mapper (SAM) classification*

(1) Preferably at high spatial, spectral and temporal resolution (e.g. Sentinel 2)
(2) Functional classes

1.

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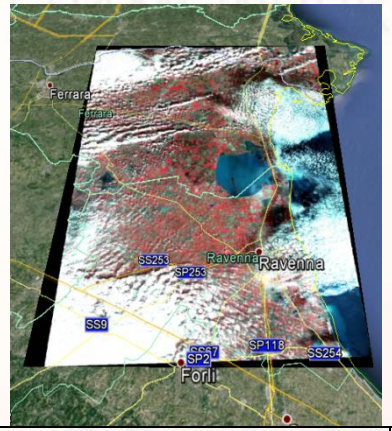

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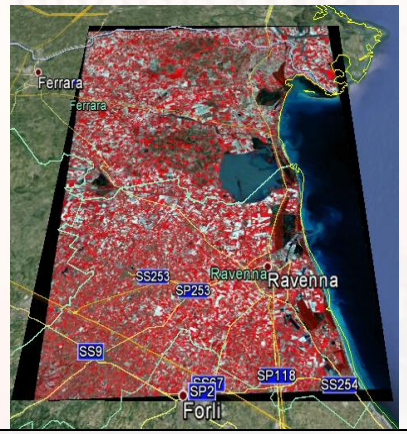

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Early Crop Mapping Module Processing Steps

1. Satellite Image Selection (Landsat)
2. Cloud masking
3. NDVI computation

2.

3.

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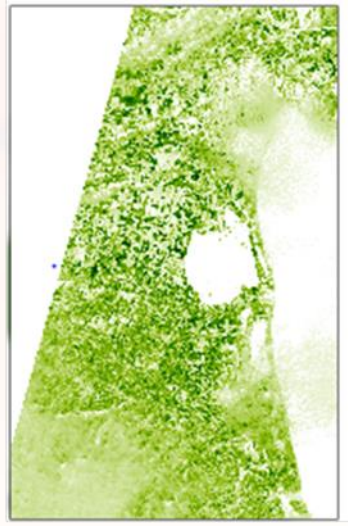

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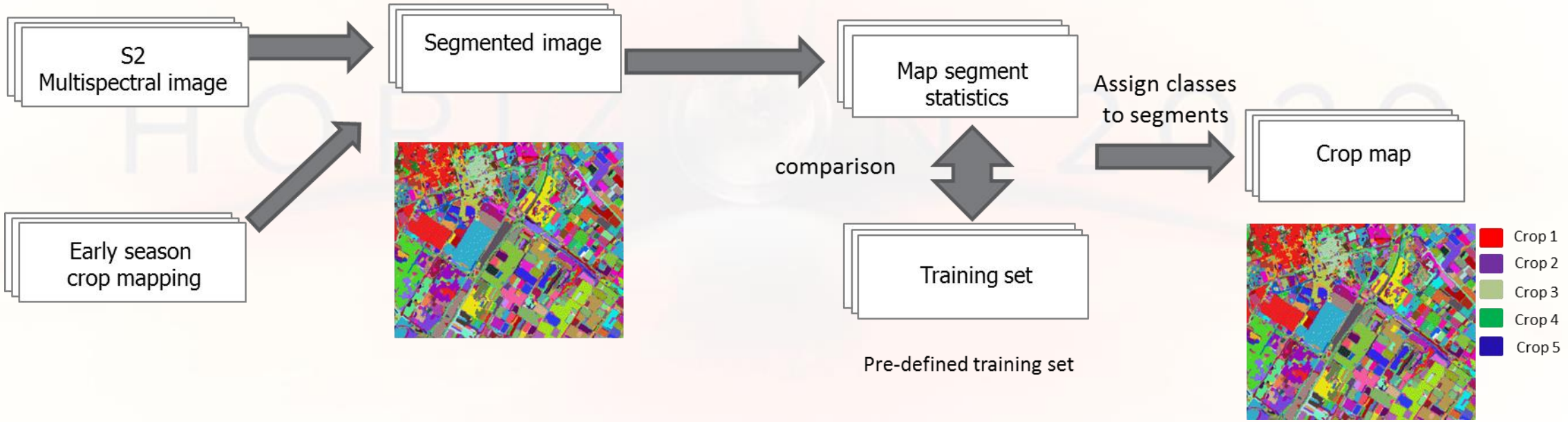
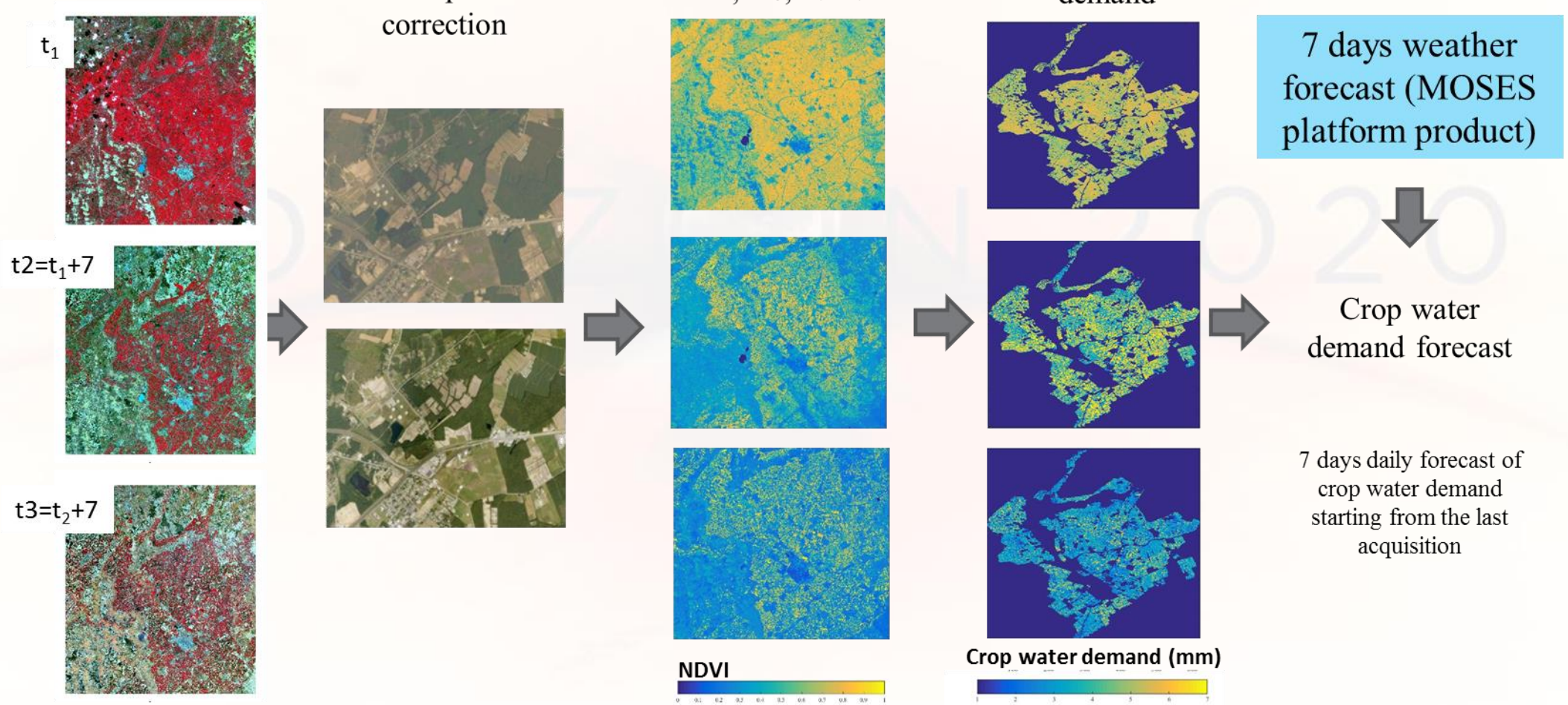
MOSES In-season Monitoring Module (by DUT)

In season monitoring by means of Remote sensing techniques

- Platform built to exploit the full potential of Sentinel 2 data - high spatial, spectral and and temporal resolution (10-20 m, 5 days)
- 15 days temporal frequency crop mapping
- Using consolidated methodologies for the frequent (7 days) monitoring of:
  - Crop status
  - Crop water demand
- Integration of weather forecast and crop coefficients by RS to produce short term (7 day) crop water demand forecast.

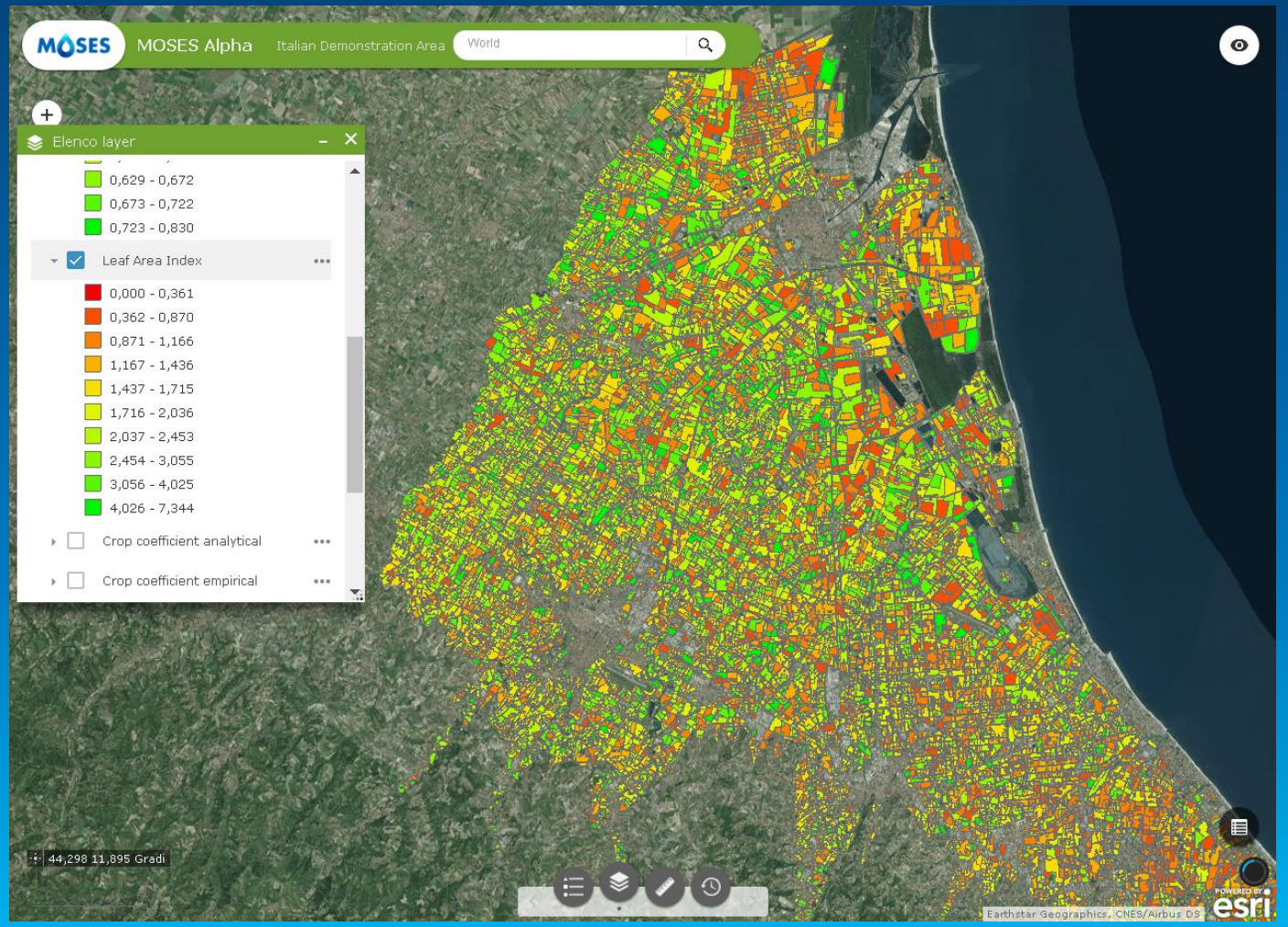
In season crop mapping




t1
t2=t1+7
t3=t2+7
Atmospheric correction
Crop status : LAI, Kc, NDVI
Crop water demand
NDVI
Crop water demand (mm)
7 days weather forecast (MOSES platform product)
Crop water demand forecast
7 days daily forecast of crop water demand starting from the last acquisition

Prodotti MOSES (prima applicazione 2016 su CBR)

- Early Crop Mapping
- Crop coefficient (K_c)
- Leaf Area Index (LAI)
- Crop Evapotranspiration
- Crop Water Demand (CWD)



Italian Demo Area - Irrigation Water Management Scenery

Seasonal Water Allocation Plan *(Level 1) (*)*

Water procurement (CER)/allocation (CBR) is normally planned on-demand for the whole season, based on annual crop mapping (**) and seasonal irrigation forecasting

In-season Water Delivery *(Level 2)*

In-season water delivery (***) at district level is based on crop status and crop water demand monitoring as well as irrigation forecast on dekadal and weekly basis

Water Distribution *(Level 3)*

Water supply is decided at farmer level based on crop water demand/ irrigation forecast provided by existing services (e.g. Irriframe)

MOSES Information Products

- Annual Crop Mapping
- Seasonal Irrigation Forecast

- Dekadal Crop Status Monitoring / Water Demand Forecast
- Weekly Crop Water Demand Monitoring /Irrigation Forecast

- Dekadal Crop Water Demand Forecast
- Weekly Irrigation Forecast

(*) Hierarchical Management Levels have been identified at the stage of requirement collection; in the case of he DA-IT, CBR is as a 1st degree Reclamation Consortium whereas CER is a 2nd degree

(**) With the meaning of classification of crop functional groups

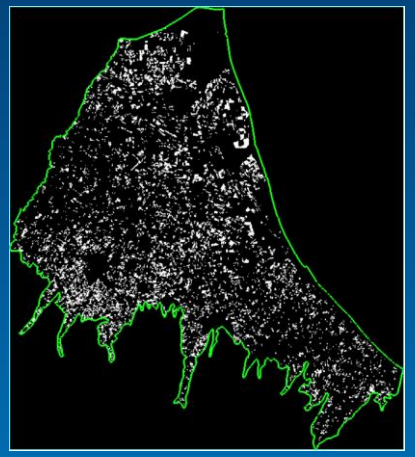
(***) Water conveyance (CER) also depends on weather forecast

New! LET – dal 2016 individua i campi realmente irrigati

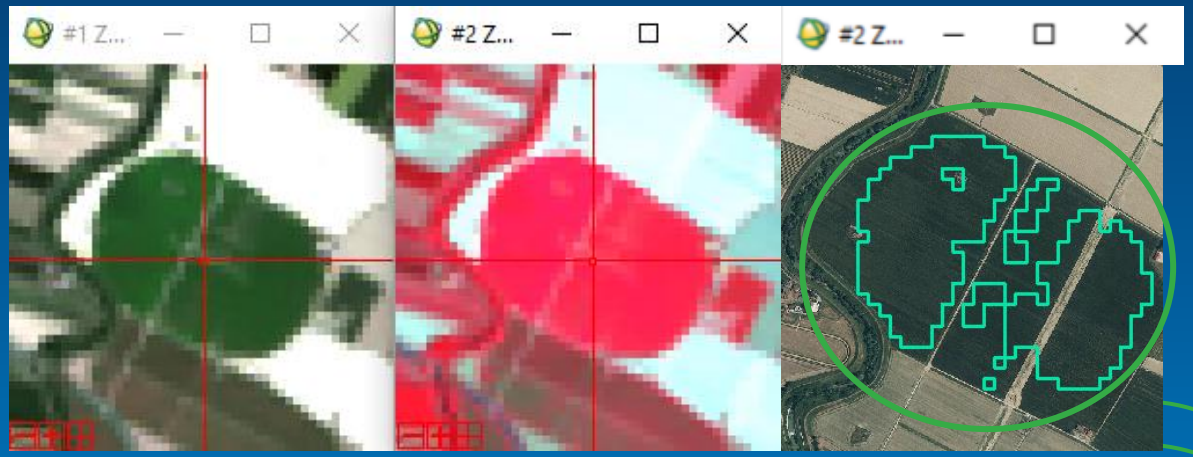
download*

* L8 data are available to download within 24 hours of reception

processing
(calibration, masking, classification…)

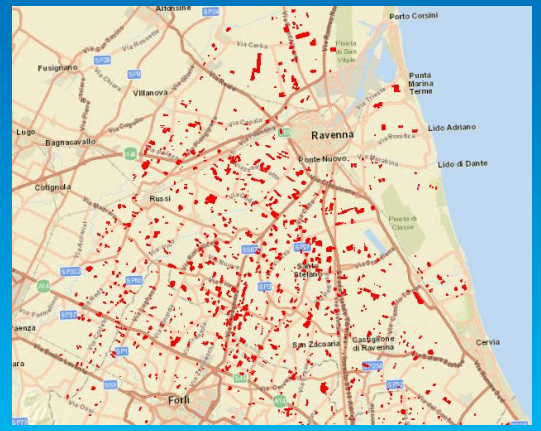


detection of irrigated fields

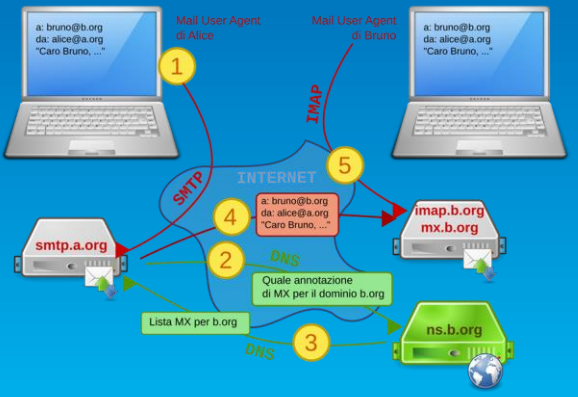


L8 image - 27/08/2016

georeferenced map



data exchange (e-mail) with the final user



field inspections

Grazie per la pazienza!

www.arpae.it
www.moses-project.eu