SMARTIES

Real time smart irrigation management at multiple stakeholders' levels

Marco Mancini
marco.mancini@polimi.it
ww.fest.polimi.it
DICA, Politecnico di Milano

KICK-OFF METTING – 22 April 2020

PROJECT PARTNERS

Participant No	PI name	Organisation	Country
1 (Coordinator)	Marco Mancini, C Corbari, G:Ravazzani, A. Ceppi,M. feki, I. Ben sharfi, N. paciolla, G. Lombardi	Politecnico di Milano (POLIMI) **Sub Contract ANBI** (M.Gargano, A. Battilani, C. Truglia)	Italy
2 Partner 1	Gabriele Dono, G. Branca R. Cortignani,	Università degli studi della Tuscia (UNITUS) **Sub contract** CREA-MIPAF R. Zucaro	Italy
3 Partner 2	Francesca de Lorenzi	CNR - ISAFOM	Italy
4 Partner 3	Raffaele Salerno A Perotto	Meteo operations Italia (MOPI)	Italy
5 Partner 4	Diab Yeaser	Aswan University **Sub contract:** Egyptian association for sustainable development EASD, Othman Elshaikh	Egypt
6 Partner 5	Josè Sobrino	University of Valencia (UVEG)	Spain
7 Partner 6	Josè Albiac	Centro de Investigación y Tecnología Agroalimentaria (CITA)	Spain
8 Partner 7	Ahmad Albitar	Centre d'Etudes Spatiales de la BIOsphère (CESBIO)	France
9 Partner 8	Kaniska Mallick	Luxembourg Institute of Science and Technology (LIST)	Luxembourg
10 Partner 9	Kamal Labbassi	Chouaib Doukkali University (UCD)	Morocco
11 Partner 10	Slaheddine Khlifi	Ecole Supérieure des Ingénieurs de Medjez El Bab (ESIM)	Tunisia
12 Partner 11	Mohamed Hachicha	Institut National de Recherches en Génie Rural, Eaux et Forêts (INRGREF)	Tunisia
13 Partner 12	Rajouene Majdoub	Institut Supérieur Agronomique Chott Mériem (ISA)	Tunisia
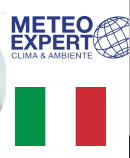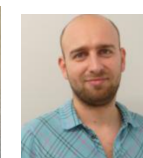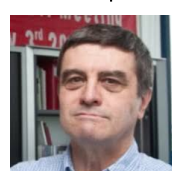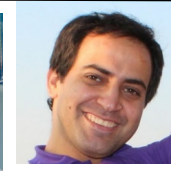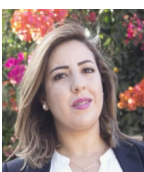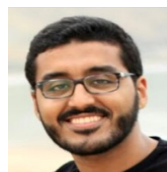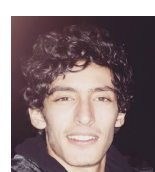
Kick Off Meeting schedule

- **10:30 – 11:10**:

- Introduction by project coordinator
- consortium agreement , financial national admiration rules
- project partnership and main objectives

11:10 – 11:30:

partner presentation

11:30 – 12:00:

- **discussion on** project main points,
- organization on next thematic groups meetings

SMARTIES MAIN OBJECTIVE & APPROACH

Improve farm & irrigation district water use efficiency & farm profitability developing a web GIS operational real-time irrigation management system
for: i) parsimonious and precise irrigation, ii) optimizing exact water use and relative water productivity, iii) integrating farm analysis into irrigation district ones

Different Partner's Models → homogenized outputs → same irrigation strategy → common indicators.

The SMARTIES system will be designed to be used:

i) **in real time mode** during the irrigation season to support irrigation strategy for weekly and seasonal forecast;

ii) **in an off line mode**, *before* the irrigation season, as an interactive simulator of irrigation and crop yield strategy under seasonal forecast conditions supporting crop and irrigation decision strategy and the irrigation water policies impacts.
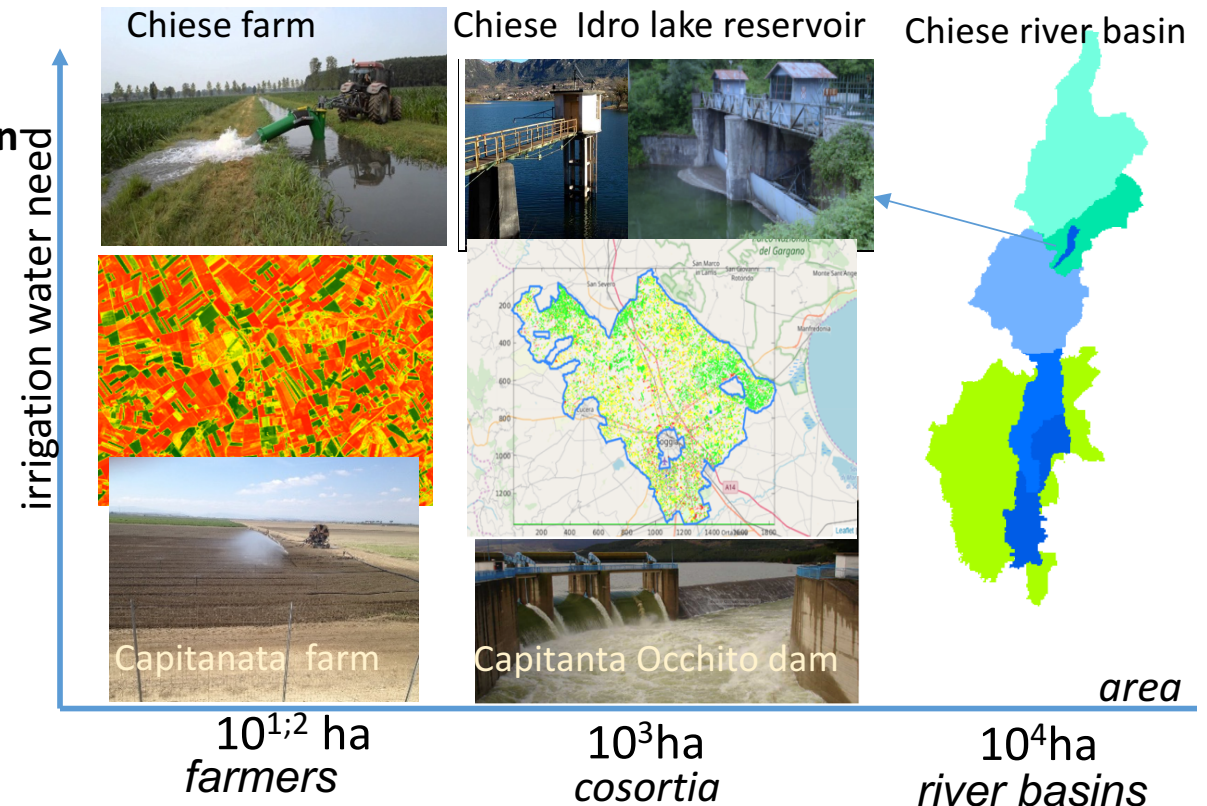
Chiese farm   Chiese Idro lake reservoir   Chiese river basin

Capitanata farm   Capitanta Occhito dam

irrigation water need

area

$10^{1;2}$ ha
farmers

10^3 ha
cosortia

10^4 ha
river basins
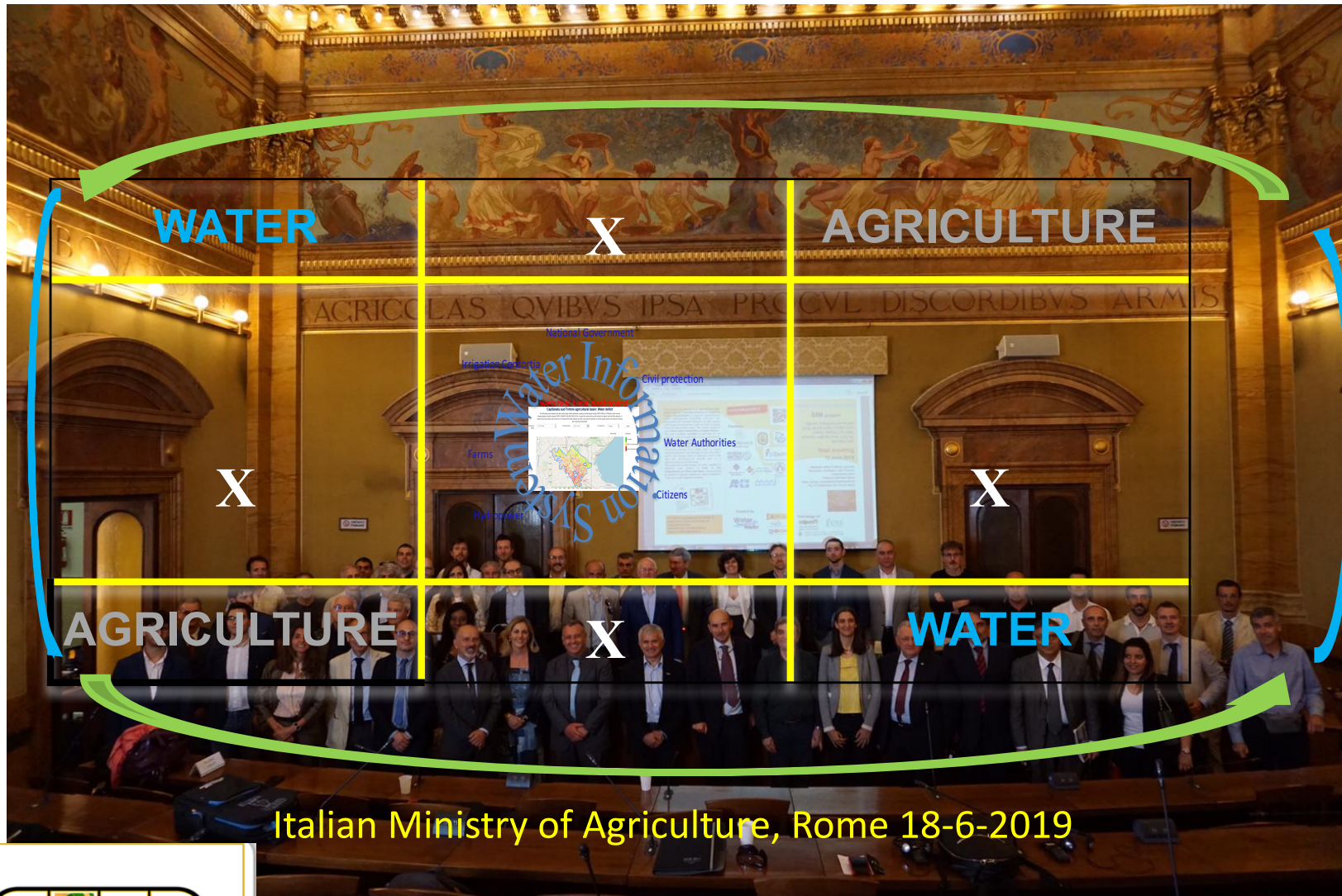
Italian Ministry of Agriculture, Rome 18-6-2019

Initial State

Remote sensing (LST+SM)

Ground monitoring

SM

now t

+
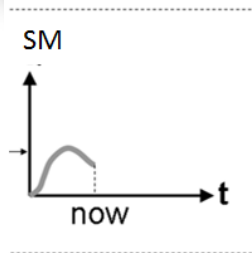
Hydrological - Crop Modeling and Satellite data

+
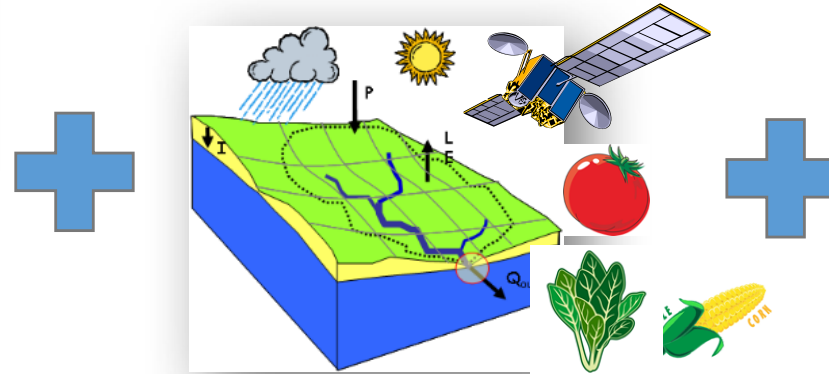
Meteorological Forecast
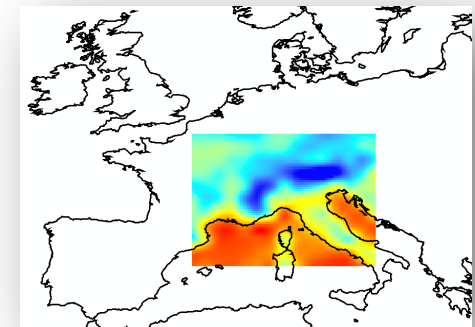
MONITORING AND FORECAST IRRIGATION WATER NEED FOR SINGLE FARM FIELD AND CONSORTIUM /WATER AUTORITY AREA

Management at farm scale

SM

future t

t0+72 hour

Observed Precipitation   Irrigation 2012   Irrigation PREGI
Simulated SM 2012   Simulated SM PREGI   stress index
surplus index
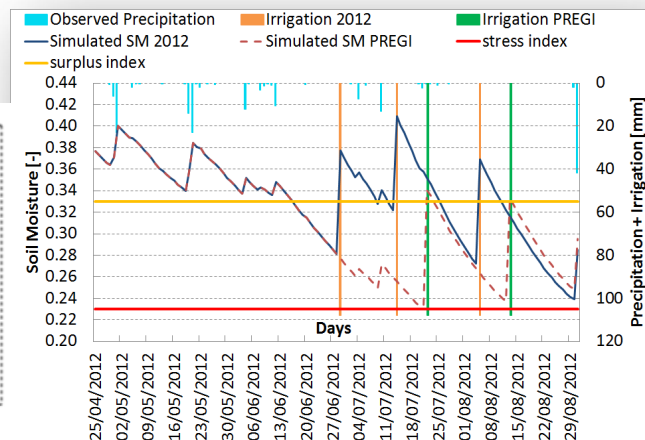
Management at irrigation consortium scale
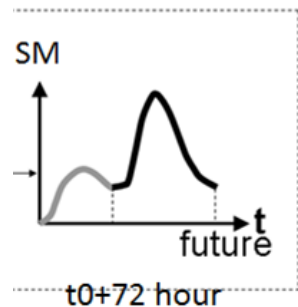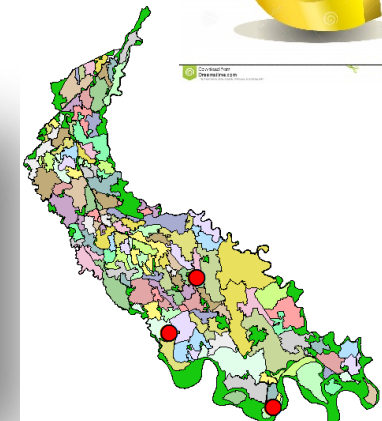
The SMARTIES WORK PROGRAMME:
from field to consortium area FROM SIM.polimi.it to SMARTIES

POLITECNICO DI MILANO

GROUND MONITORING (WP1)

PR2/4 40cm

NUMERICAL ENGINE (WP2)

hydrologic hydrulic crop model

soil moisture and irrigation water need : mapping and pixel wise

	0.06
	0.14
	0.22
	0.30
	0.38

WP1 METEOROLOGICAL FORESCAST

IRRIGATION Practice INFRASTRUCTURE

SATELLITE MONITORING (WP1)

(LANDSAT – SENTINEL) Vegetation and LST

Legend
FVC
0.00 - 0.1
0.16 - 0.3
0.31 - 0.4
0.46 - 0.6
0.60 - 0.7
0.73 - 0.8
0.84 - 1.0

**WP3
WEB Irrigation water needs monitoring forecast & management**

Observed and forecasted Soil Moisture

**WP4
ECONOMY FARM & DISTRICT**

Water productivity

$$EWP = \frac{Gross\ margin}{AWU} = \frac{€/ha}{m^3/ha}$$

Economic profitability

	Scenario	
1 = Water savings	3%	(% of 2015 Effective AWU)
2 = CY increased	2%	(% of 2015 CY at Average 2015 CP)
3 = Depreciation savings	2%	(% of technical duration of irrigation system)
4 = Energy cost savings	4%	(% of lifting and pressure costs)
		labor for maintenance irrigation sytem
		e consortium price for m³/ha)

STAKEHOLDERS LISTENING TO & SYSTEM DESIGN DIFFUSION

SMARTIES Kick Off , April 22, 2020

Location and Stakeholders	Irrigation sources and practices	Crop type
Southern Italy, Capitanata irrigation consortium (300 km²) Two farms (600 ha each)	On demand water distribution from the consortium aqueduct or from private wells (fresh water) Irrigation is by drip or sprinkler	Irrigated: vegetables –winter; tomatoes, Rainfed: wheat-summer, olives, vineyards
Northern Italy: GardaChiese Irrigation consortium (495 km²), One farm (600 ha)	Water withdrawal from the Chiese river supplied by Idro Lake and also from Garda Lake Fixed turned water distribution rules Surface and sprinkler irrigation	Irrigated: maize, corn, melon
Spain: Riegos del Alto Aragon irrigation consortium (130,000 ha)	1000 Mm3 of water withdrawal from four dams with 750 Mm3 of storage sprinkler but also surface irrigation	Cereals and alfalfa
Morocco: The irrigated area of Doukkala (125,000 ha), in the plain of Oum Er-Rabia river	irrigation from Al Massira reservoir, distributed on requests by farmers in turned interval, surface irrigation technique	Cereal dominance (wheat 45% of total area), industrial crops such as sugar beets, and forage crops (20%)
Tunisia: irrigated area of Mejez el Bab in the lower Valley of Wadi Mejerda	saline aquifer, irrigation water quality (about 2 g/l of salts coming from Wadi Mejerda river)	Cereal, legumes
Egypt: Governorate of Luxor (47'212 acres), land fragmentation	7 days on turn Average farm 200 km2	cultivation of sugarcane, local beans, wheat and maize,

SMARTIES Gantt

10 March 2020

9 march 2023

Month/Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
WP0																		
WP1																		
WP2																		
WP3																		
WP4																		
WP5																		
Deliverables						1.3, 5.1						0.3						0.1,2.2,2.4, 5.2
Milestones						1						2,3						5
Meetings	M	E	E			P			P			M,A						P,E
Risk Management												R						

Month/Description	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP0																		
WP1																		
WP2																		
WP3																		
WP4																		
WP5																		
Deliverables						2.3,4.1												0.2, 1.1, 1.2, 2.1, 3.1,3.2, 3.3, 3.4, 4.2, 5.3,5.4
Milestones						6												7,8,4
Meetings						M,A	E										E	M,E
Risk Management						R												

The duration of WP1 and WP2, in addition to WP0, is from the the beginning of the project (Month 0) to the end (Month 36) due to the presence of two type activities: the first is the reanalysis of past situation for calibration and validation of the models, the second refer to the real time system functioning.

P= progress meetings one-to-one between project coordinator and partners; M=meetings between all the partners; A=Meetings with advisory board ; E= meetings with end users; R=Risk of project failure Report

PARTNER/s coordinator meetings   **and case studies**

(Case study description: model, practices, economics remote sensing , stakeholders needs, partner/s activities, Server database storage

Researcher and student visits and exchange

Thematic group meetings
(remote sensing , hydrology , irrigation management , agronomy, economics)

plenary mid term meeting

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (in months)
0.1	Mid Progress report	0	POLIMI	R	PU	18
0.2	Final report	0	POLIMI	R	PU	36
0.3	Meetings minutes between project partners on risk management	0	POLIMI	R	PU	12
1.1	Consistent data base of meteorological, hydrological, radiometric data, crop biomass and yield data for each case studies for a reanalysis period and real-time data	1	ESIM	R	PU	36
1.2	Consistent time series for a reanalysis period and real time for each study area: i) albedo; ii) LST, iii) LAI and fractional cover, iv) water stress index, v) SM	1	UVEG	R	PU	36
1.3	data management plan for Horizon2020 Pilot on Open Research Data	1	POLIMI	DEM	PU	6
2.1	daily and seasonal meteorological forecast maps	2	MOPI	R	PU	36
2.2	evapotranspiration, soil moisture and irrigation water requirements maps from both FEST-WEB and STIC model for the case studies	2	LIST	R	PU	18
2.3	dataset of stress threshold values for irrigation scheduling	2	CNR-ISAFOM	R	PU	24
2.4	yield estimates from coupled hydrological and crop models	2	CESBIO	R	PU	18

3.1	irrigation strategy definition and tests	3	POLIMI	R	PU	36
3.2	operative web dashboards for the case studies	3	POLIMI	OTHER	PU	36
3.3	simulator tool	3	POLIMI	OTHER	PU	36
3.4	water indicators	3	POLIMI	R	PU	36
4.1	on-farm economic indicators assessment of the net benefits related to crop production using conventional and parsimonious irrigation for selected crops	4	UNITUS	R	PU	24
4.2	water user associations and irrigation district economic indicators assessment of the benefits related to crop production using conventional and parsimonious irrigation for selected crops	4	UNITUS	R	PU	36
5.1	Case studies end-users needs definition	5	UCD	R	PU	6
5.2	list of diffusion activities	5	UCD	DEC	PU	18
5.3	list of diffusion activities	5	UCD	DEC	PU	36
5.4	Exploitation plan for SMARTIES dashboard patent	5	POLIMI	DEC	CO	36

Communication activities

| Communication activity (Measurement of success)	Potential users						Aim
	Farmers	Irrigation consortia	Water authorities	Citizen scientist	Scientific community		
SMARTIES open access **dashboard** (stakeholders feedbacks)	X	X	X			X	to provide stakeholders and all the project partners with information on project progress. Reports, news, social media, photos and videos will be linked.
SMARTIES Website (counting traffic)	X	X	X	X	X	X	to provide stakeholders and all the project partners with information on project progress. Reports, news, social media, photos and videos will be linked.
Onsite Courses (counting attendants, satisfaction survey)	X	X	X	X			will be held by the project partners to explain the functioning of the developed dashboard discussing the theoretical aspects and through demonstrations of field experiments in the different case studies
online course	X	X	X	X	X	X	MOODLE course/quiz
Organization of project workshops (counting attendants)	X	X	X	X	X	X	to present the project tool and its performance to a vast assembly of users both the scientific aspects as well as the economic aspects, and an interactive demonstration the real-time dashboard
Number of attending conferences					X		project partners will present results at scientific conferences.
Articles in scientific Journals (number)					X		project partners will report their results (with at least 5 open access papers).
newsletter (mailing lists)	X	X	X	X	X	X	a quarterly report on project progress and relevant updates
Newspaper articles (number articles)	X	X	X		X	X	Newspaper articles of project main results.
Project video showcase (number of views)	X	X	X	X		X	To reach all the stakeholders with a direct way
Database (users)					X		Give access to project database to external researchers in the Horizon 2020 Pilot on Open Research Data
Social media (likes, followers)	X	X	X	X	X	X	Social media platforms will be used to create general awareness for the project (Facebook, Twitter…)

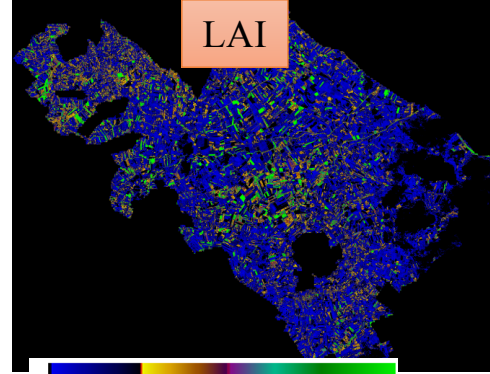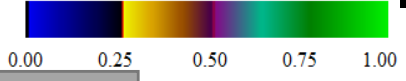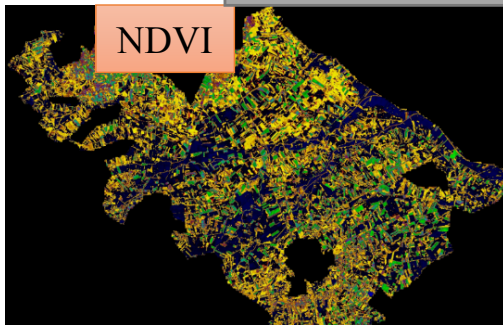# Satellite data supporting Hydrological model
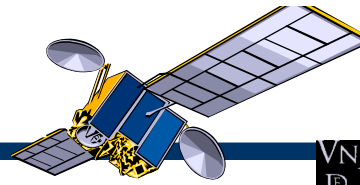
5 june 2017

SENTINEL-2 MSI
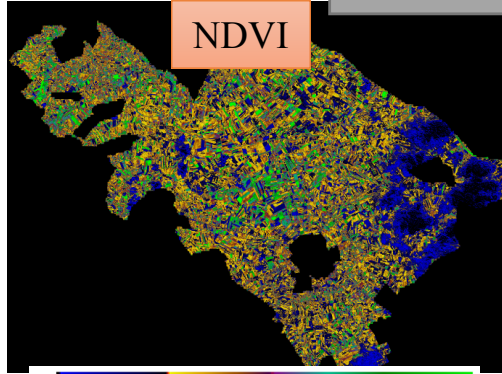
NDVI
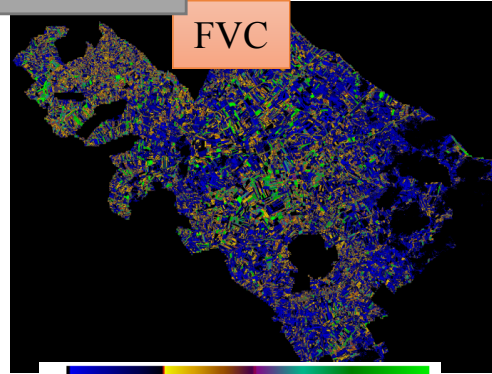
FVC

LAI

Sobrino and all 2017
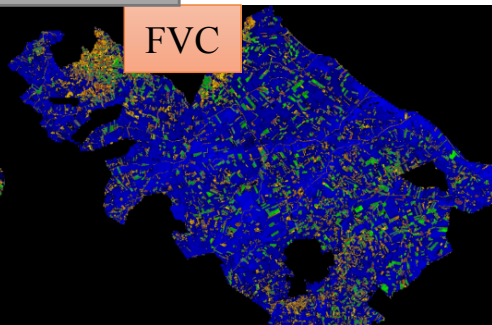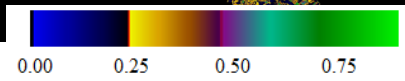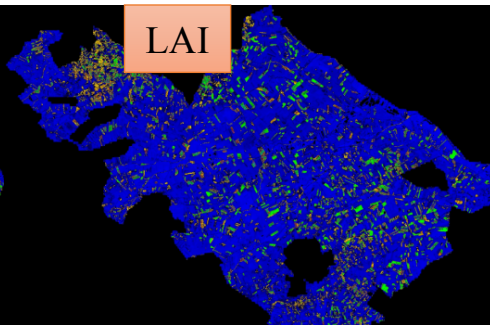
copernicus
obseruing the earth

esa

Near real time images

DATA integration IMPROVES revisit time

LANDSAT-8 OLI/TIRS
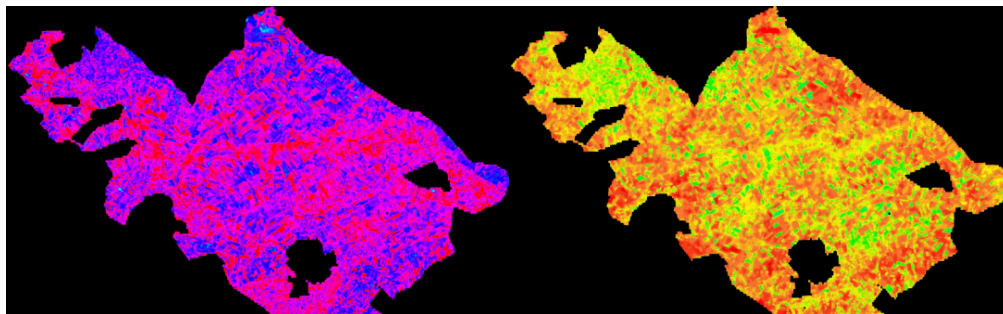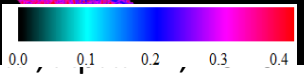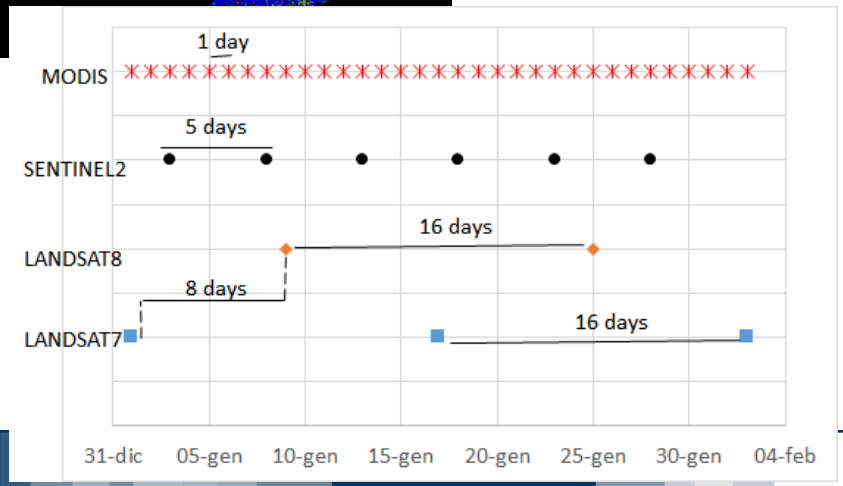
NDVI

FVC

LAI

NASA

Albedo

LST

POLITECNICO DI MILANO
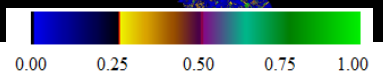
the approach

The SMARTIES system combines **different models** as crop-soil-water-balance, meteorological forecast and economic models, based on each partner's and local end users' experience -→ **the same irrigation strategy → homogenized outputs → common indicators**

- *the tools*
- **irrigation and agronomic strategy** at field scale: water amount and timing;
- **crop grow and hydrologic model** for water/thermal stress on crop productivity
- **Salinity/reused water:** water quality/quantity issue;
- economic analysis **of parsimonious irrigation and agronomic strategy** ;
- dynamic **actual transpiration and evaporation** ;
- **satellite land surface temperature data and/or soil moisture** for soil moisture hydro model update;
- **Satellite soil moisture into meteo forecast**
- **Satellite data fusion and downscaling**
- **satellite** fraction Cover, Leaf Area Index for quasi real time cultivated area identification and parametrization