# IRIDA

# Innovative Remote and Ground Sensors, Data and Tools into a decision support system for agriculture water management

Coordinator:
**CEBAS-CSIC (Spain)**

Partners
UniCT (Italy)
IAS-CSIC (Spain)
NMA (Roumania)
Experis (Spain)
CREA (Italy)
NIBIO (Noray)

Water JPI
WaterWorks2015 Cofunded Call
8 May 2018, Larnaca

# CONSORTIUM DESCRIPTION

| ACRONYM | TOPIC | Coordination | Partners |
|---|---|---|---|
| **IRIDA** | **2** |  |  |
| **Innovative Remote and Ground Sensors, Data and Tools into a decision support system for agriculture water management** | | **big-data analysis; evapotranspiration; irrigation scheduling; plant water status; soil water status; weather forecasts** | |

| PRINCIPAL INVESTIGATOR | INSTITUTION | COUNTRY |
|---|---|---|
| **Diego Intrigliolo** | **Agencia Estatal Consejo Superior de Investigaciones Cientificas - CEBAS** | **Spain** |
| Gema Rodriguez | Experis | Spain |
| Luca Testi | Agencia Estatal Consejo Superior de Investigaciones Cientificas - IAS | Spain |
| Simona Consoli | University of Catania | Italy |
| Giancarlo Roccuzzo | Consiglio per la Ricerca in Agricoltura e l'Annalisi dell'Economia Agraria | Italy |
| Elena Mateescu | National Metereological Administration | Romania |
| Johannes Deelstra | Bioforsk- Norwegian Institute for Agricultural and Environmental Research | Norway |

# Talk index

- Scientific and technological progress
- Collaboration, coordination and mobility
- Stakeholder/industry engagement
- Dissemination of the results
- Identified problems or specific risks

# General goal

- The **general objective** is to develop and validate new procedures for determining ET and soil and plant water status. The obtained results are incorporated into a modular DSS capable to provide end-users recommendations for:

  - 1) on-farm irrigation scheduling in semi-arid and humid regions of Southern and Northern Europe, respectively
  - 2) prediction of soil water moisture for the humid Northern Europe mixed agriculture and forestry areas.

# Specific objectives

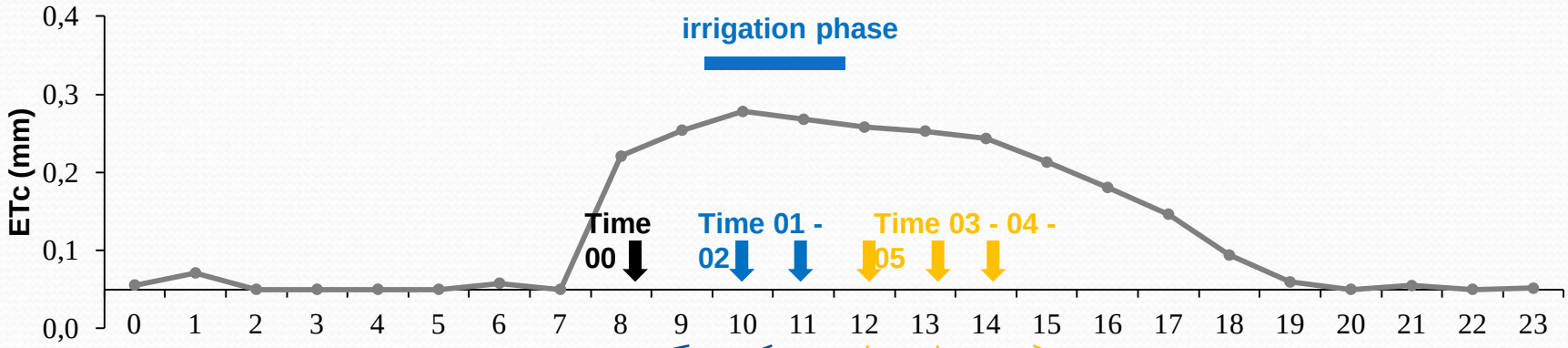
**Soil water status**. To determine the usefulness of innovative procedures for determining soil moisture temporal dynamics 3D micro-electrical and geophysical Electrical Resistivity Tomography (**UniCT and CREA**)

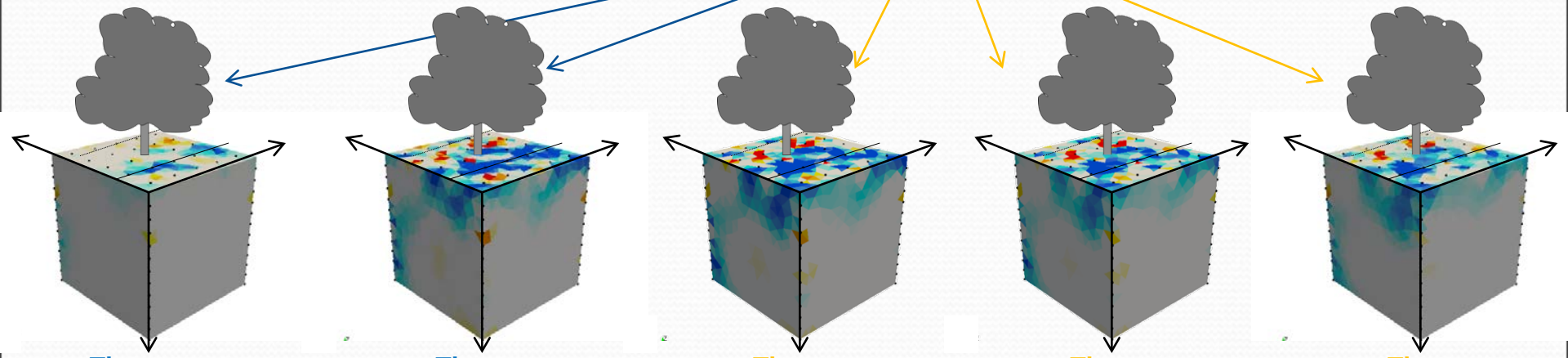
**Plant water status.** To develop a new robust low-cost sap flow sensor and To design a procedure for mapping the spatial variability of water status (**IAS-CSIC and CEBAS-CSIC**)

To integrate the obtained sensors data and model predictions into a modular DSS to be commercialized by **Experis**

**Remote sensing.** To integrate vegetation indexes and surface energy balance procedures derived from multispectral and thermal satellite and UAV images into a soil water balance routine (all partners).

# Soil-root interactions by ERT



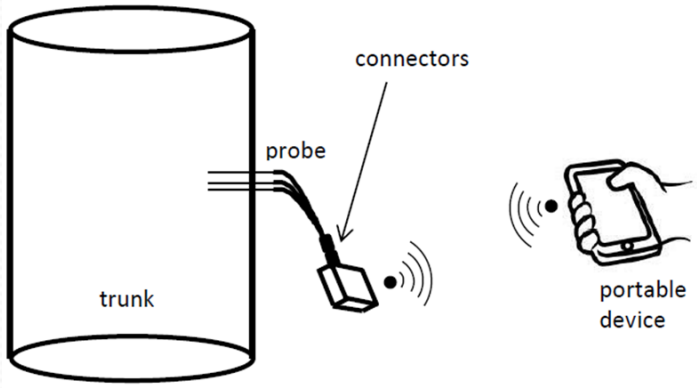
Time 01 | Time 02 | Time 03 | Time 04 | Time 05

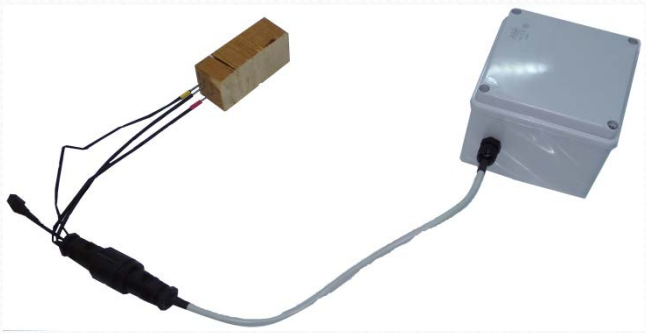
# Soil-root interactions by ERT

- The obtained results are very useful to visualize patterns of soil moisture dynamics and to design more efficient irrigation technologies (such as: PRD and sub-surface)
- For irrigators application, the current technology is still to complex for being applied at commercial level

# New simplified sap flow sensor

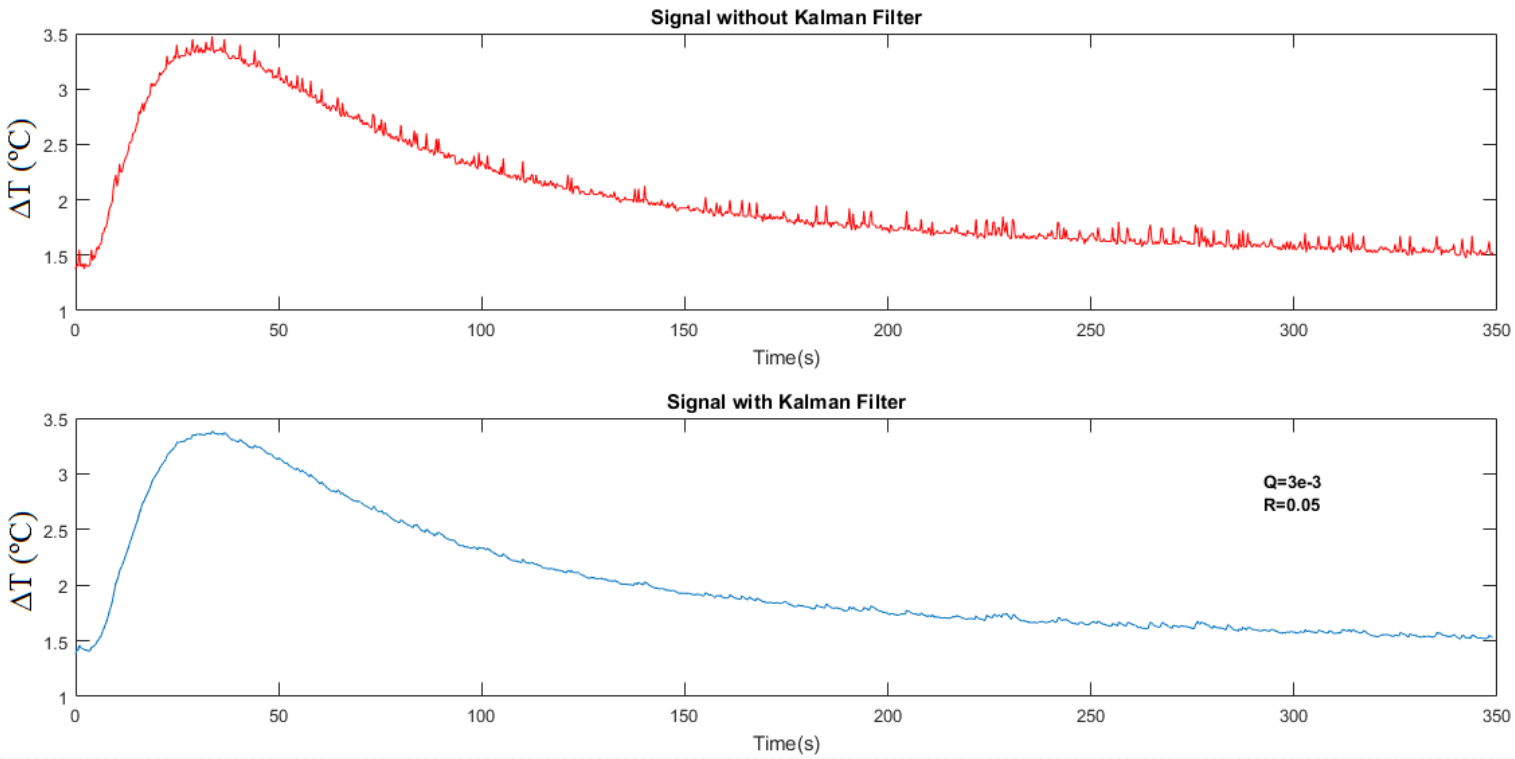
- Existing devices to measure sap flow velocity are complex and expensive.
- It has been developed lightweight, battery powered, rugged and relatively cheap device for the measurement of the convective sap velocity in trees



# New simplified sap flow sensor

- The sensor has beeen tested in laboratory conditions and will be demonstrated in a commercial peach orchard this season

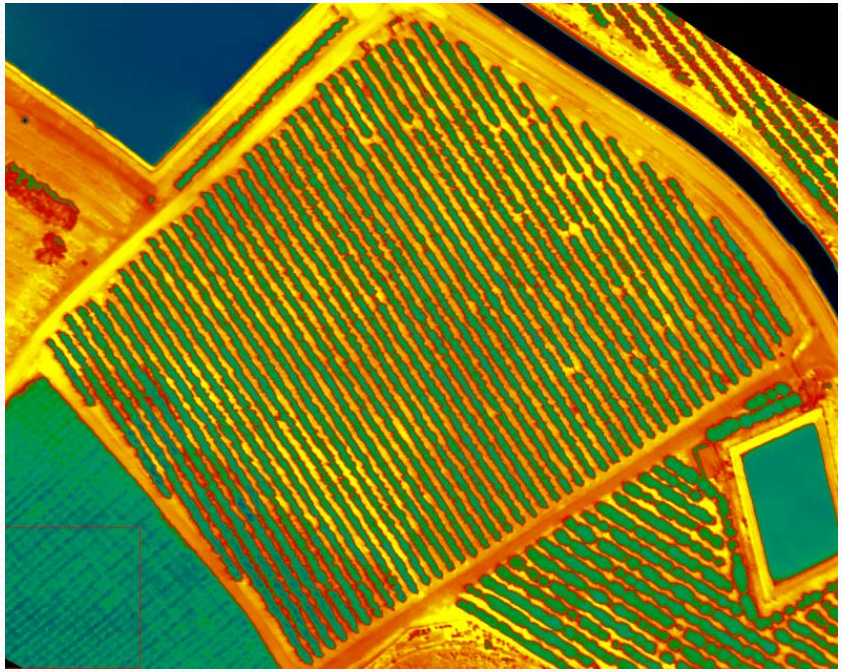


# Mapping variability in water status

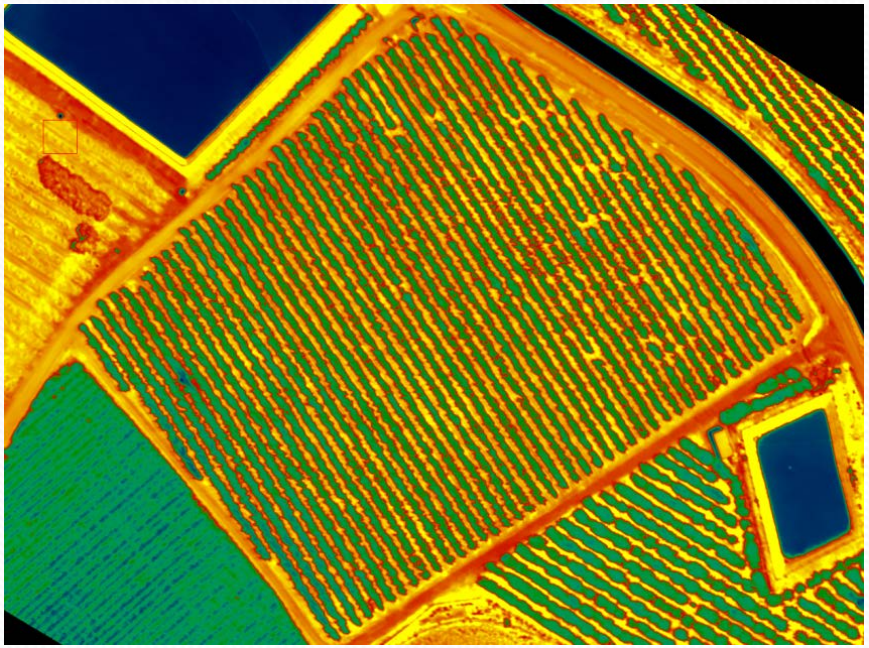
- Data from 2 seasons were collected and new index was derived


# Mapping variability in water status

August 1st (Just after irrigation)

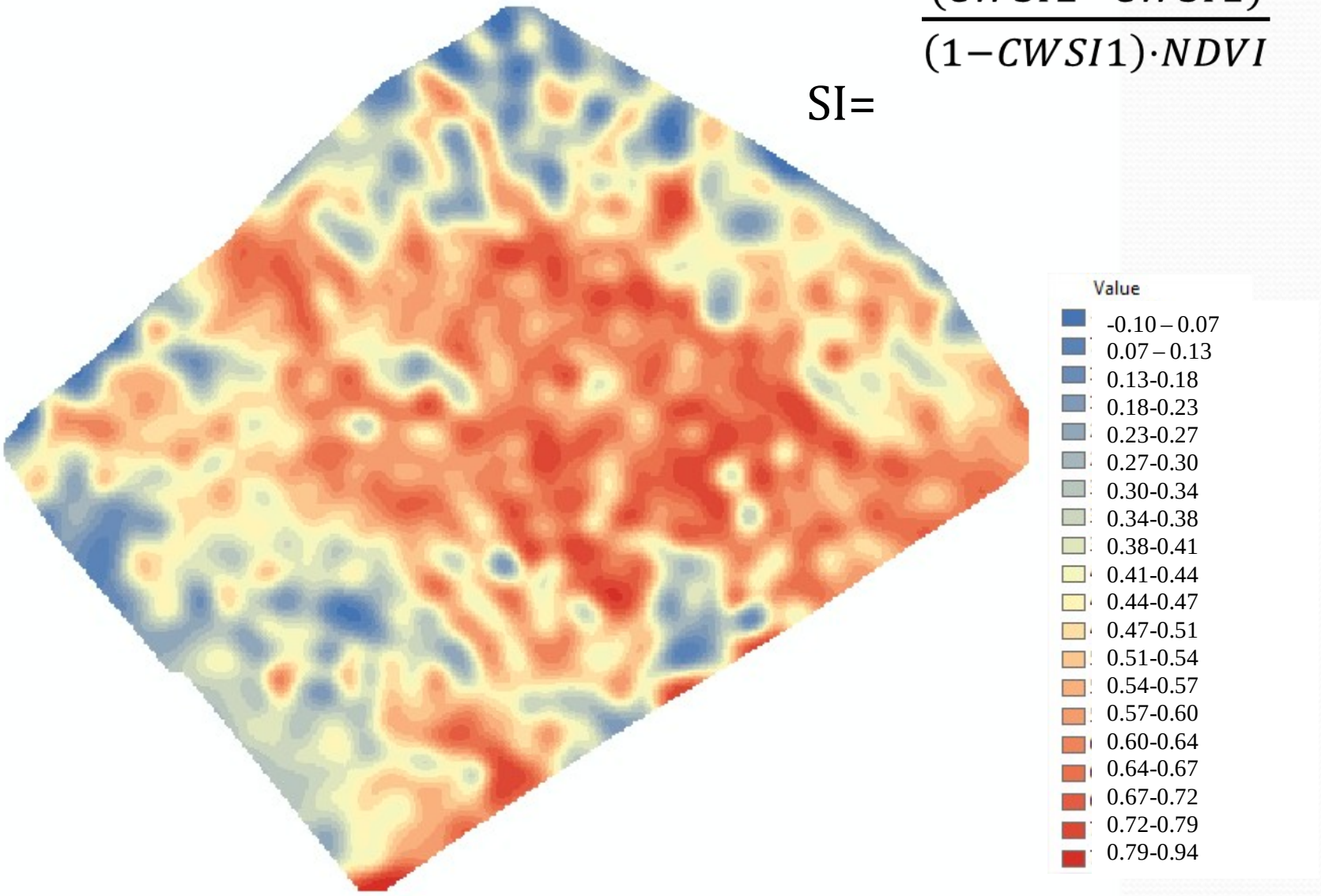


August 4th (After 4 days of withholding irrigation)



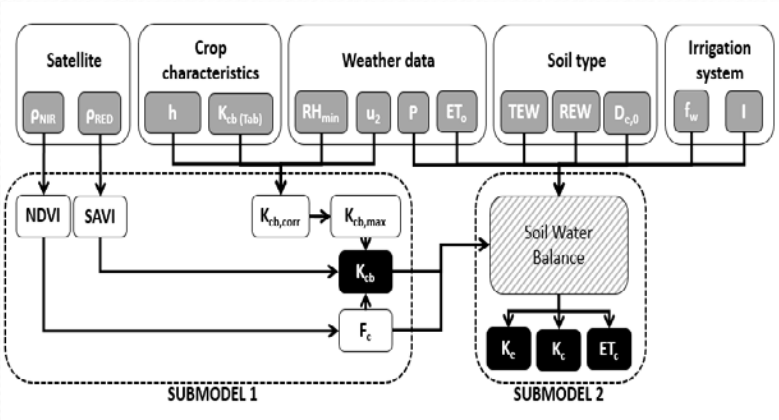
# Mapping variability in water status

$$SI = \frac{(CWSI2 - CWSI1)}{(1 - CWSI1) \cdot NDVI}$$

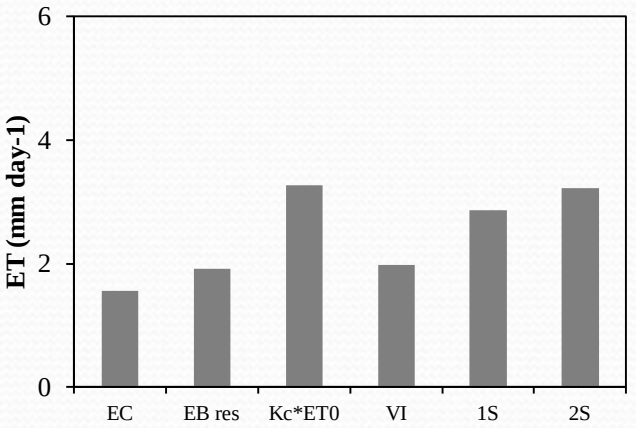


# Determining ET and Kc from remote sensing

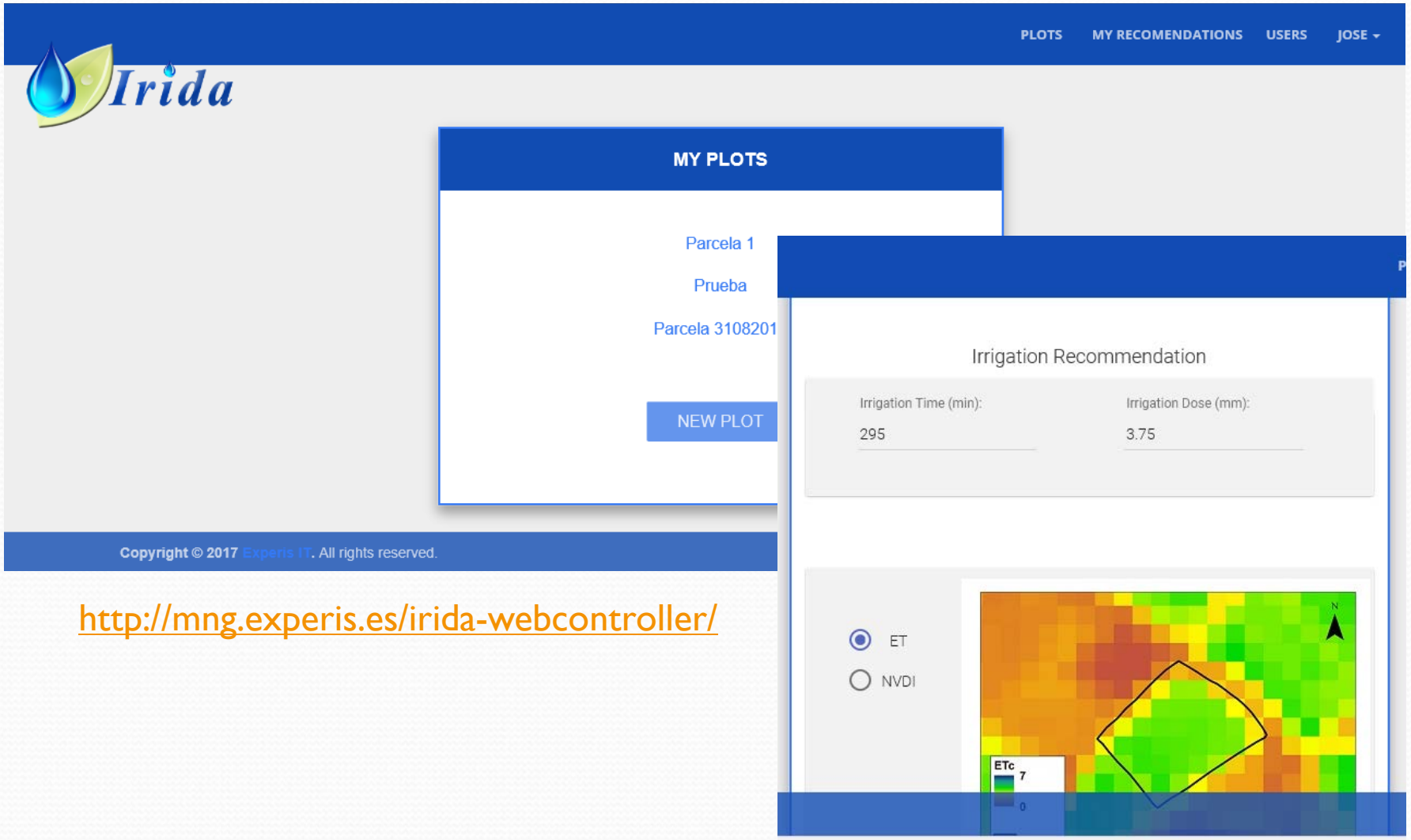
- Sentinel-II images can be used to derive NDVI based empiric ET values. The model routine has been incorporated into the IRIDA DSS




- Landsat and UAV thermal images are used to derive latent heat from a surface energy balance. The data obtained are used to improve Kc data base



# The IRIDA Decision Support System for Irrigation




http://mng.experis.es/irida-webcontroller/

# Talk index

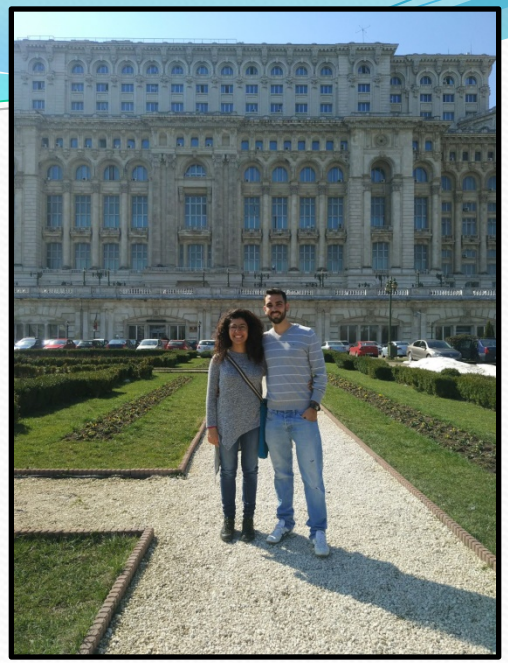
- Scientific and technological progress
- **Collaboration, coordination and mobility**
- Stakeholder/industry engagement
- Dissemination of the results
- Identified problems or specific risks

# Collaboration and coordination

| N° | Date | Location | Attending partners | Purpose and main issues |
|---|---|---|---|---|
| 1 | 20/05/2016 | Rome (Italy) | All | Kick-off meeting. Setting up the technical work to be carried out |
| 2 | 05/07/2016 | Skype | All | Follow-up for the technical work |
| 3 | 06/09/2016 | Skype | All | Follow-up for the technical work |
| 4 | 11/11/2016 | Skype | All | Follow-up for the technical work |
| 5 | 02,03/03/2017 | Cordoba (Spain) | All | Presentation of the results obtained and organization for the 2017 field work |
| 6 | 07-09/03/2018 | Catania (Italy) | All | Presentation of the results obtained and organization for the 2018 |

# Mobility

- A researcher (Dr. Daniela Vanella) was engaged with a one year contract by UNICT within the IRIDA project.
- One Master of Science study has been carried out in Norway by Timon Weitkamp, student at the Wageningen University, The Netherlands (WUR). The title of the thesis was "Soil physical characteristics, hydrological flow paths and the water balance. An assessment for a small agricultural catchment in Norway, as simulated by DRAINMOD".
- A researcher from CEBAS-CSIC (Juan Miguel Ramírez Cuesta) has carried out a short-term research period within CREA and UNICT during September to December 2017. The main objective for this short-term scientific mission was to learn new remote sensing techniques for estimating crop water requirements and crop nutritional status at the farm and regional scales.



# Talk index

- Scientific and technological progress
- Collaboration, coordination and mobility
- **Stakeholder/industry engagement**
- Dissemination of the results
- Identified problems or specific risks

# Stakeholder industry engagement

- 8 seminars with stakeholders were carried out in Spain, Italy and Romania
- Engagement with private companies like FutureWater, Widhoc and Irritec was carried out
- Potential clients of the IRIDA DSS were identified in Italy and Spain and are listed in Deliverable 5.2
- Relevant stakeholders were idenftified in all countries and are listed in Deliverable 5.2
- A survey was designed to identify the DSS user's mains needs
- CEBAS-CSIC contacted with the CSIC technology transfer unit for possible creation of joined spin-off with Experis for commercializing the DSS.
- Funding for supporting the commercialization of the results have been requested to a regional call (F. Seneca, Proof of Concept)

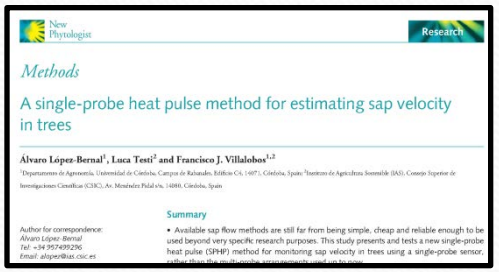
# Talk index

- Scientific and technological progress
- Collaboration, coordination and mobility
- Stakeholder/industry engagement
- **Dissemination of the results**
- Identified problems or specific risks

# Scientific dissemination

## Publications in SCI Journals with IRIDA acknowledgements

- López-Bernal, Á., Testi, L., Villalobos, F.J., 2017. A single-probe heat pulse method for estimating sap velocity in trees. *New Phytologist* 216:321-329
- Maestre-Valero, J.F., Testi, L., Jiménez-Bello, M.A., Castel, J.R., Intrigliolo. 2017. Evapotranspiration and carbon exchange in a citrus orchard using eddy covariance. *Irrigation Science* 35:397–408
- There are 4 others publications under review


New Phytologist

Research

*Methods*

A single-probe heat pulse method for estimating sap velocity in trees

Álvaro López-Bernal[1], Luca Testi[2] and Francisco J. Villalobos[1,2]

[1]Departamento de Agronomía, Universidad de Córdoba, Campus de Rabanales, Edificio C4, 14071, Córdoba, Spain; [2]Instituto de Agricultura Sostenible (IAS), Consejo Superior de Investigaciones Científicas (CSIC), Av. Menéndez Pidal s/n, 14080, Córdoba, Spain

Summary

Author for correspondence:
Álvaro López-Bernal
Tel: +34 957499296
Email: alopez@ias.csic.es

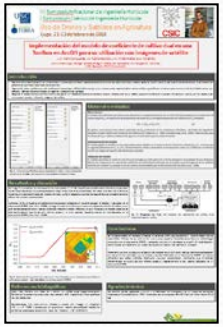
- Available sap flow methods are still far from being simple, cheap and reliable enough to be used beyond very specific research purposes. This study presents and tests a new single-probe heat pulse (SPHP) method for monitoring sap velocity in trees using a single-probe sensor.


Acknowledgements

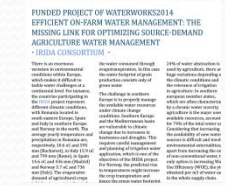
This work received support from the European Commission and Ministerio de Economía y Competitividad in the frame of the collaborative international consortium IRIDA financed under the ERA-NET Cofund WaterWorks 2014 Call (PCIN-2015-259),

## Presentations in scientific conferences

- 1. Cirelli G.L., et al. 2017. Esperienze di tecniche di irrigazione deficitaria. Ecoscienza N.1, pp- 82-83
- J.M. Ramírez-Cuesta, et al. V. 2017. Water stress quantification for a peach orchard by integrating CWSI with the METRIC energy balance model using thermal and hyperspectral images of high spatial resolution. XVII Congreso Asociación Española de Teledetección.
- R. Barneveld, et al. High spatial resolution mapping of top soil moisture content. Poster presentation at the Euromediterranean Research Basin (ERB) seminar at Sopron, Hungary. 31.8.17.
- J. Deelstra. Flow processes and subsurface drainage systems. Presentation at the Euromediterranean Research Basin (ERB, ) seminar at Sopron, Hungary.
- R. Barneveld, et al.. Hva sier satelitter om jordas vanninhold – erfaringer fra IRIDA prosjektet.. Poster presentation at the NIBIOs miljøkonferanse 2017: Naturens tålegrenser - muligheter og utfordringer. 21- 22/11/17.
- A. Popescu, D. Alexandru, "Simulation of agricultural production based on corn crop irrigation in the period 1 April to 31 August 2012 using the model AQUACROP developed by FAO" NMA Annual Scientific communication
- A. Nerţan, et al. , Actual evapotranspiration estimation using surface energy balance equation and LANDSAT8 satellite data, NMA Annual Scientific communication
- D Vanella., et al . (Applicazioni di tecniche di tomografia di resistività elettrica a supporto dell'irrigazione per il monitoraggio delle interazioni suolo-pianta. Convegno - Attualità dell'Idraulica Agraria e delle Sistemazioni Idraulico-Forestali al cambiare dei tempi. Palermo.
- D Vanella et al. (2017). Application of electrical resistivity tomography to monitor the soil-root interactions under deficit irrigation. 36° Convegno Nazionale del Gruppo Nazionale Geofisica della Terra Solida (GNGTS).
- .



Award for the best communication


FUNDED PROJECT OF WATERWORKS2014
EFFICIENT ON-FARM WATER MANAGEMENT: THE MISSING LINK FOR OPTIMIZING SOURCE-DEMAND AGRICULTURE WATER MANAGEMENT
• IRIDA CONSORTIUM •

# Talk index

- Scientific and technological progress
- Collaboration, coordination and mobility
- Stakeholder/industry engagement
- Dissemination of the results
- **Identified problems or specific risks**

# Problems and specific risks

- Some partners had significant delays in receiving funding for the project execution. But the technical activities were carried out because the institution advanced some funding
- The company Innovati, originally involved in the proposal, was bought by Experis. But the main researchers remained in place
- Technical delays in deriving the new sap-flow sensor because the sub-contracting to the Un. of Extremadura for electronics was delayed to administrative procedures. The sensor has now been developed and will be tested
- Risk of failure in connecting with the relevant end-users. Field days will be carried out at the end of the season to showcase the project results
- The activities and collaboration should be continued after the project end. Partners have applied for further funding to H2020 SC2 call, Interreg-Atlantic, PRIMA, JPI WW2018, Life, National level.

# IRIDA

# Innovative Remote and Ground Sensors, Data and Tools into a decision support system for agriculture water management

Coordinator:
**CEBAS-CSIC (Spain)**

Partners
UniCT (Italy)
IAS-CSIC (Spain)
NMA (Roumania)
Experis (Spain)
CREA (Italy)
NIBIO (Noray)

Water JPI
WaterWorks2015 Cofunded Call
8 May 2018, Larnaca