AGADAPT

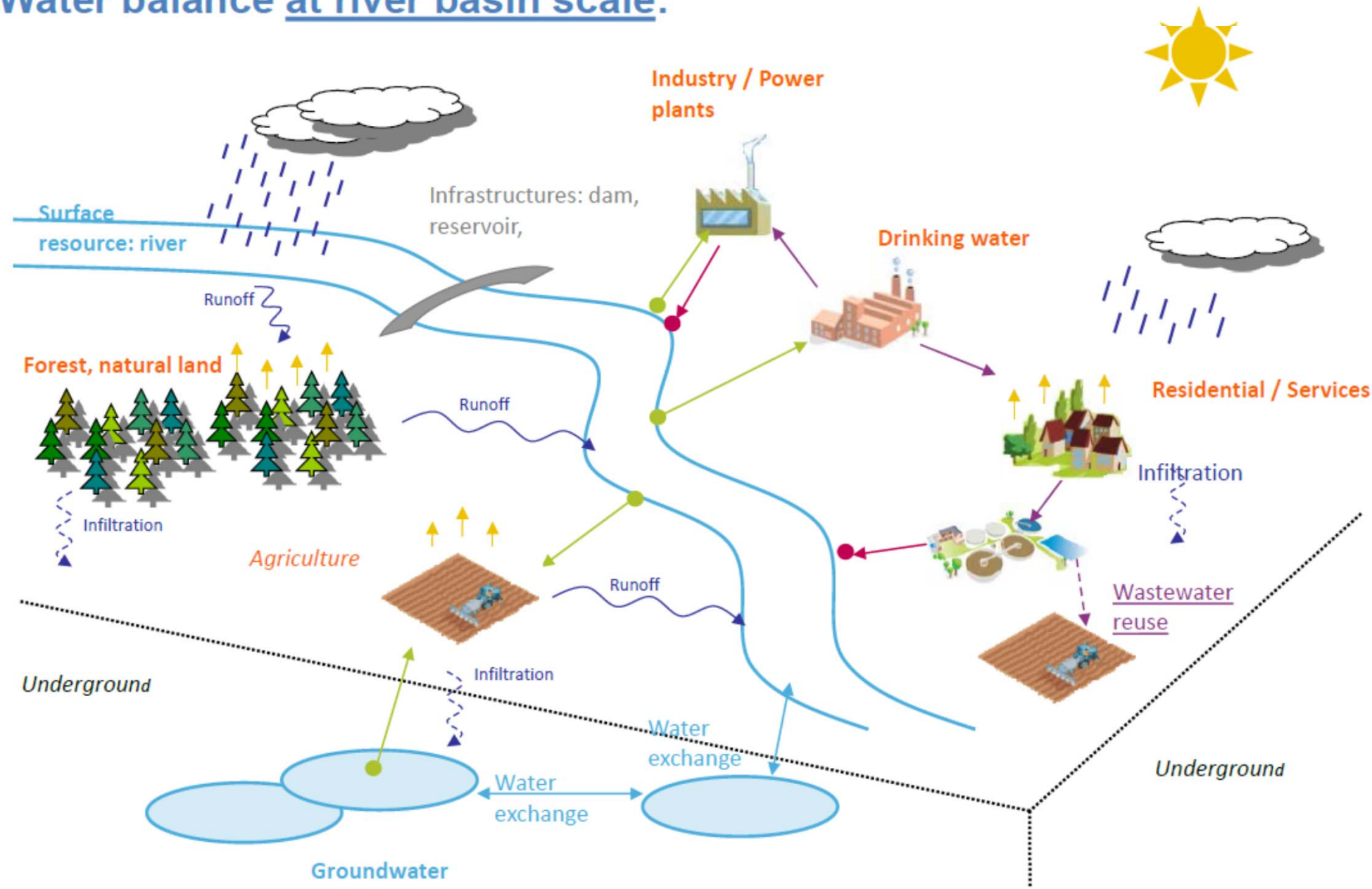
Adapting water use by the agriculture sector

Climate-KIC

AGADAPT

Final review meeting : Orsay 25-06-2014

Water balance at river basin scale:



- Stronger plant water need
- Increase in drought occurrence and severity
- Increasing need (domestic, industrial, environment preservation)

AGADAPT

- Improve Irrigation efficiency (The exact amount at the right time)
- Consider additional reuse water as an additional resource
- Better land planning (infrastructure, sharing rules, reduction of losts, sustainable use of water

Global change impact on available water for the agricultural sector

AGADAPT: Main objectives WP1

Development of improved forecast module of soil moisture and plant water status.

Use this improved prediction to better scheduling of irrigation.

Partners involved:

-Forschungszentrum Julich GmbH, Germany

-Technical University of Valencia. Spain

-Meteo France

-INRA, France

JÜLICH FORSCHUNGSZENTRUM

UNIVERSIDAD POLITECNICA DE VALENCIA

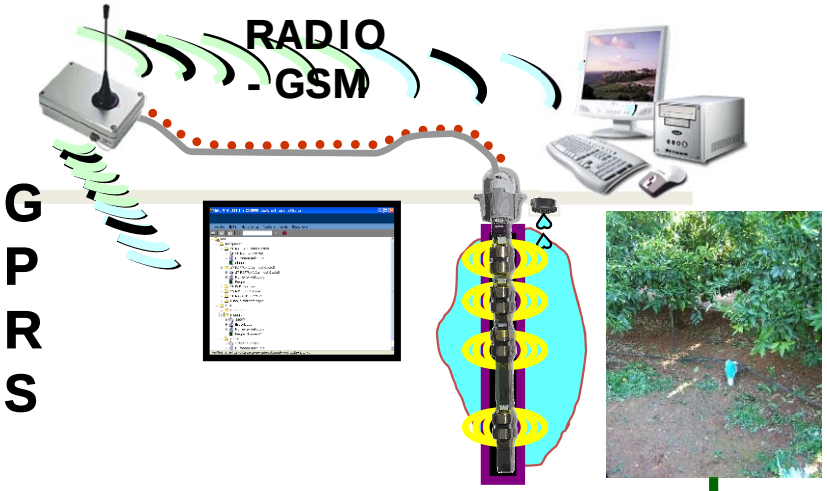
METEO FRANCE
Toujours un temps d'avance

Objectives

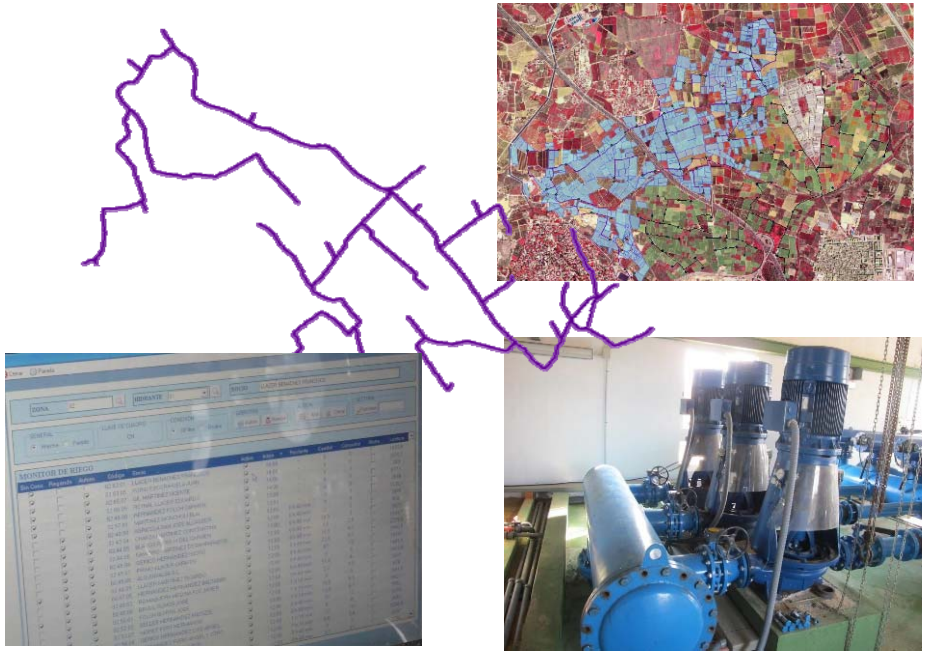
eit Climate-KIC

AGADAPT

AGADAPT: Overview approach



Real-time Measurement



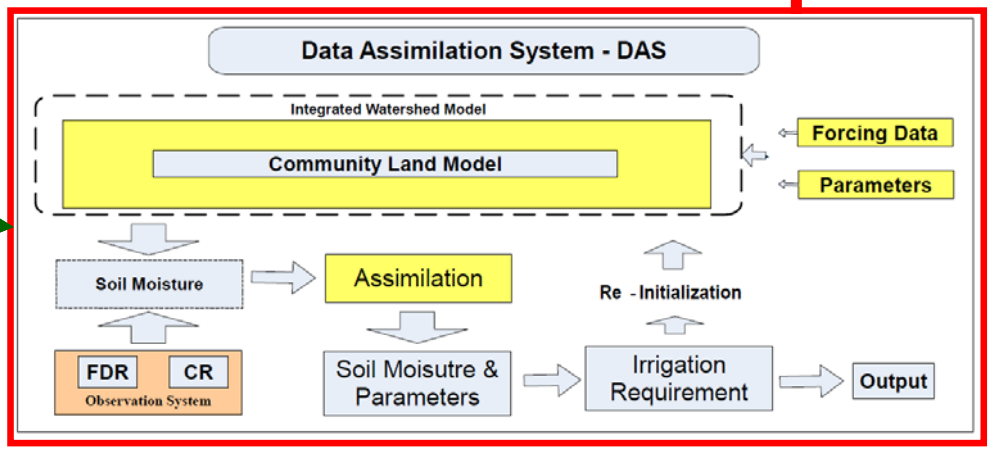
Irrigation time setting system (SCADA)

METEO FRANCE

Toujours un temps d'avance

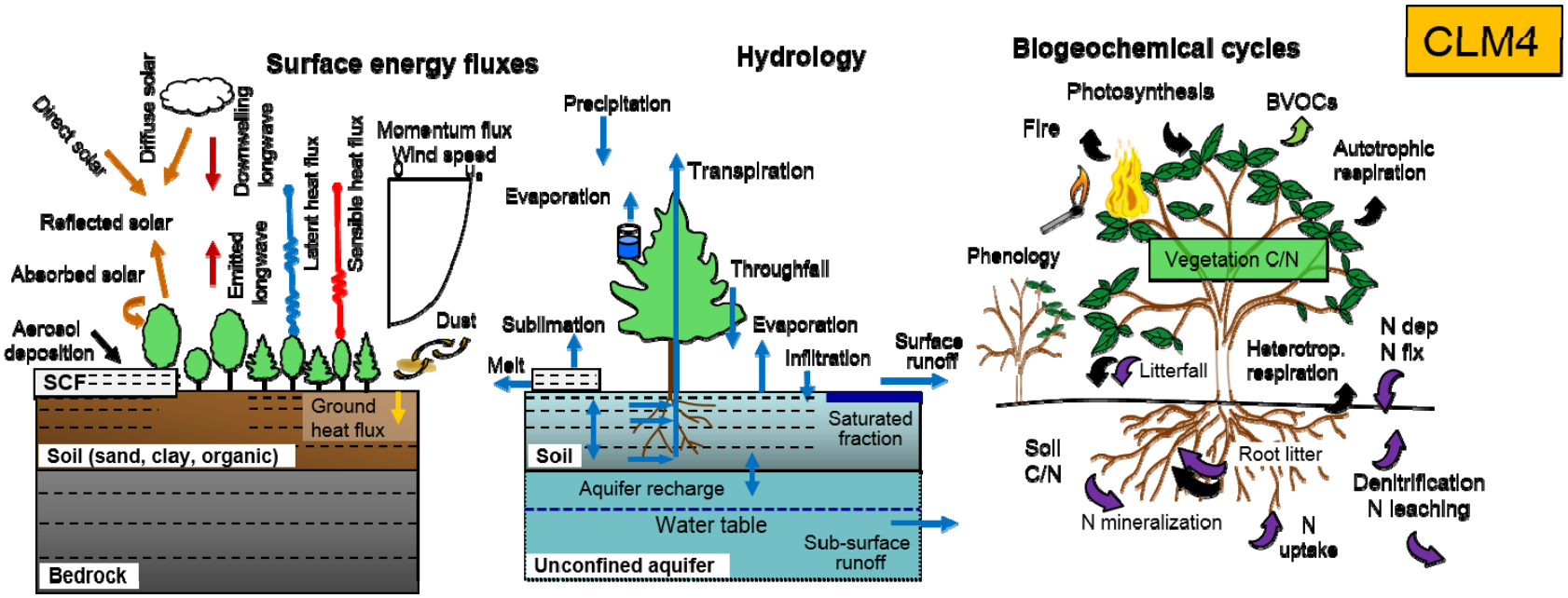
Real-time Weather Forecast

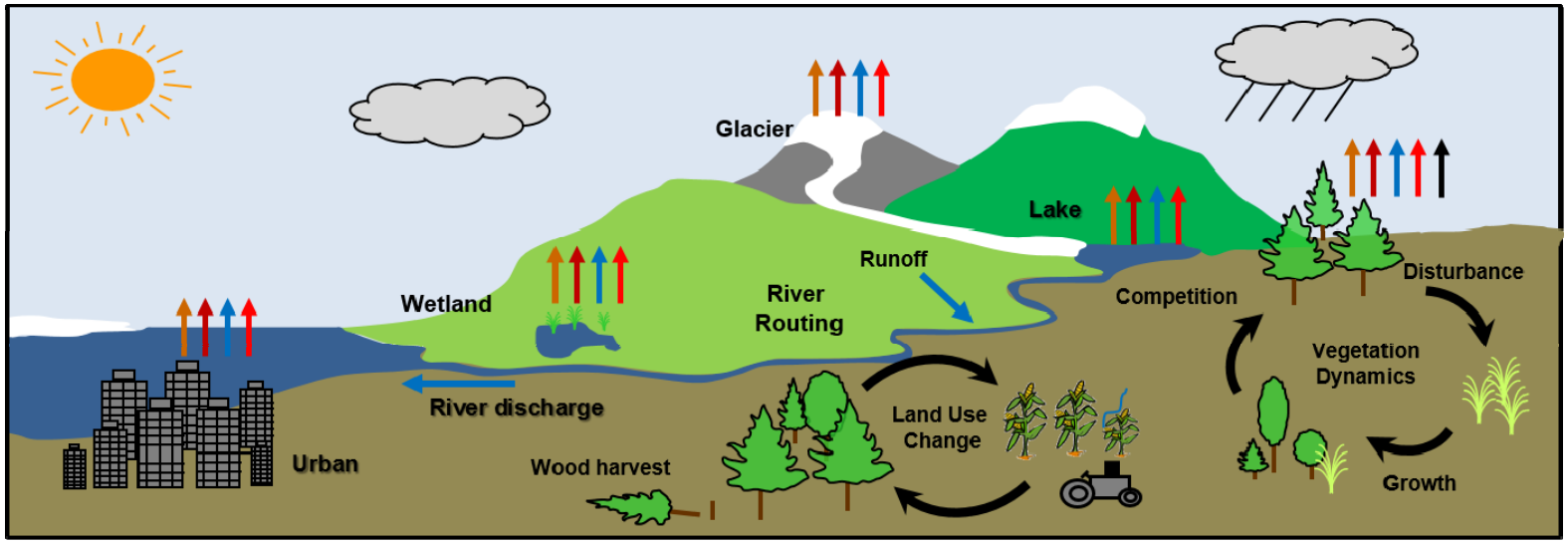
Irrigation Time Estimation



Model and Assimilation System

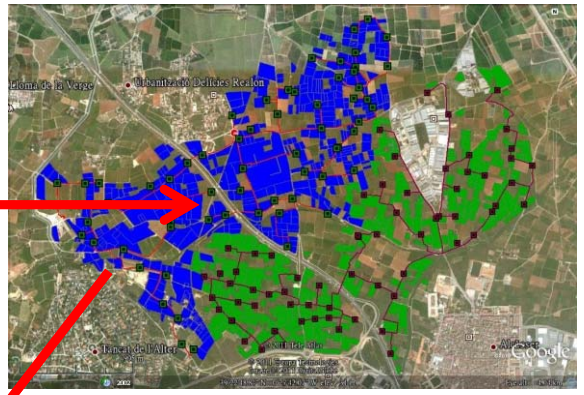
AGADAPT: Land surface model



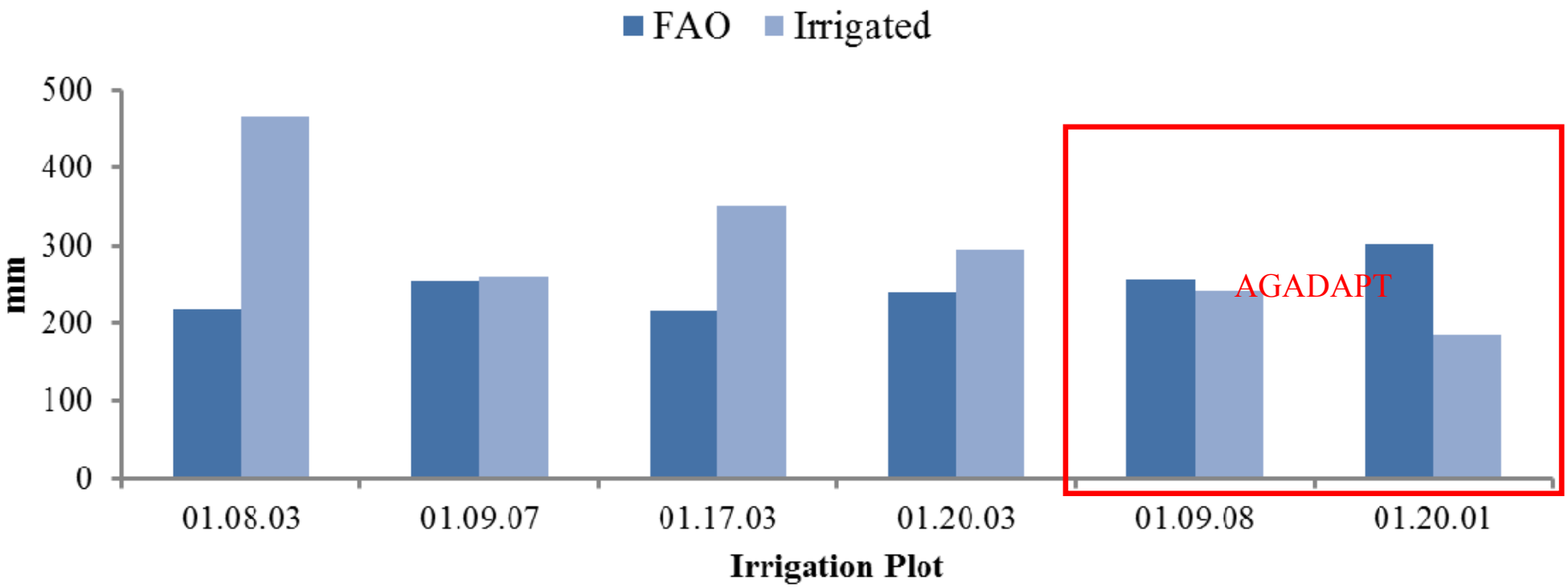


http://www.cesm.ucar.edu/models/cesm1.2/clm/

AGADAPT: Field site Picassent

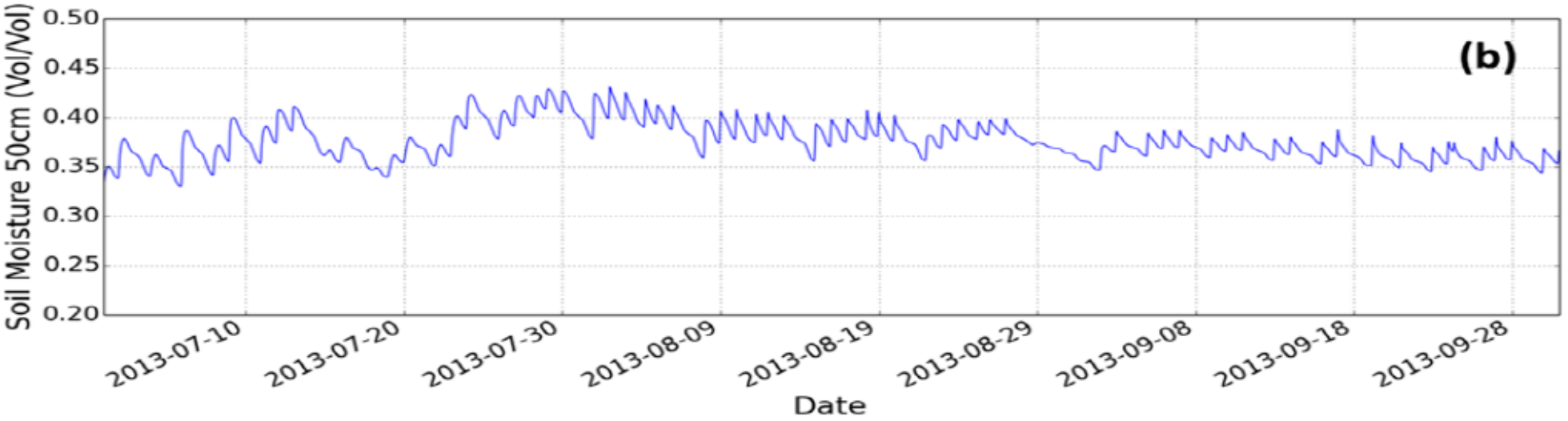


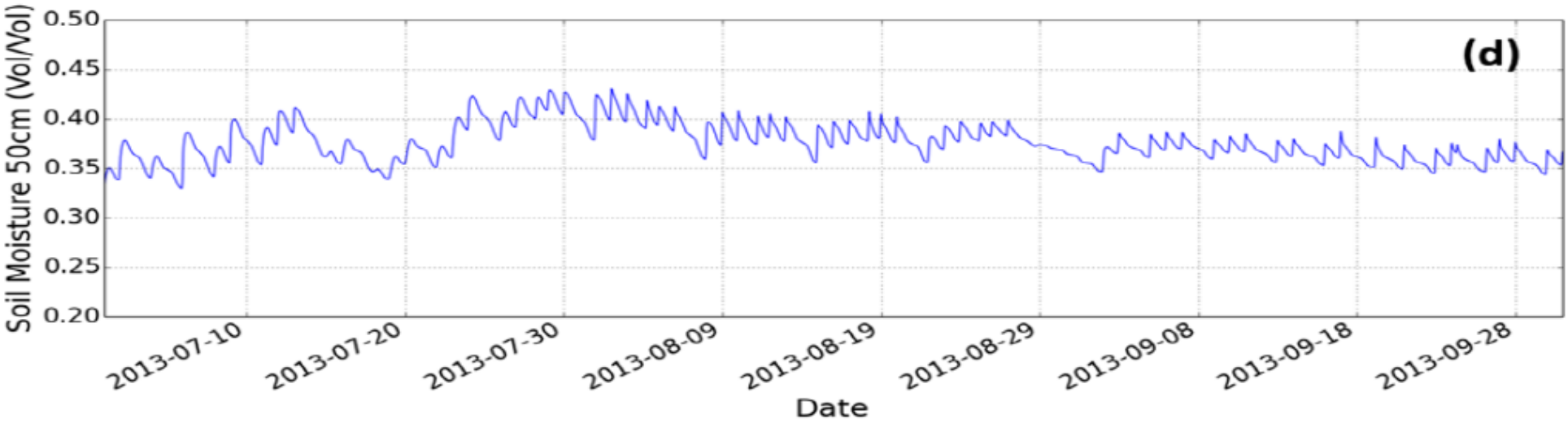
AGADAPT: Applied irrigation



CLM-irrigated fields: ca. 30% less irrigation

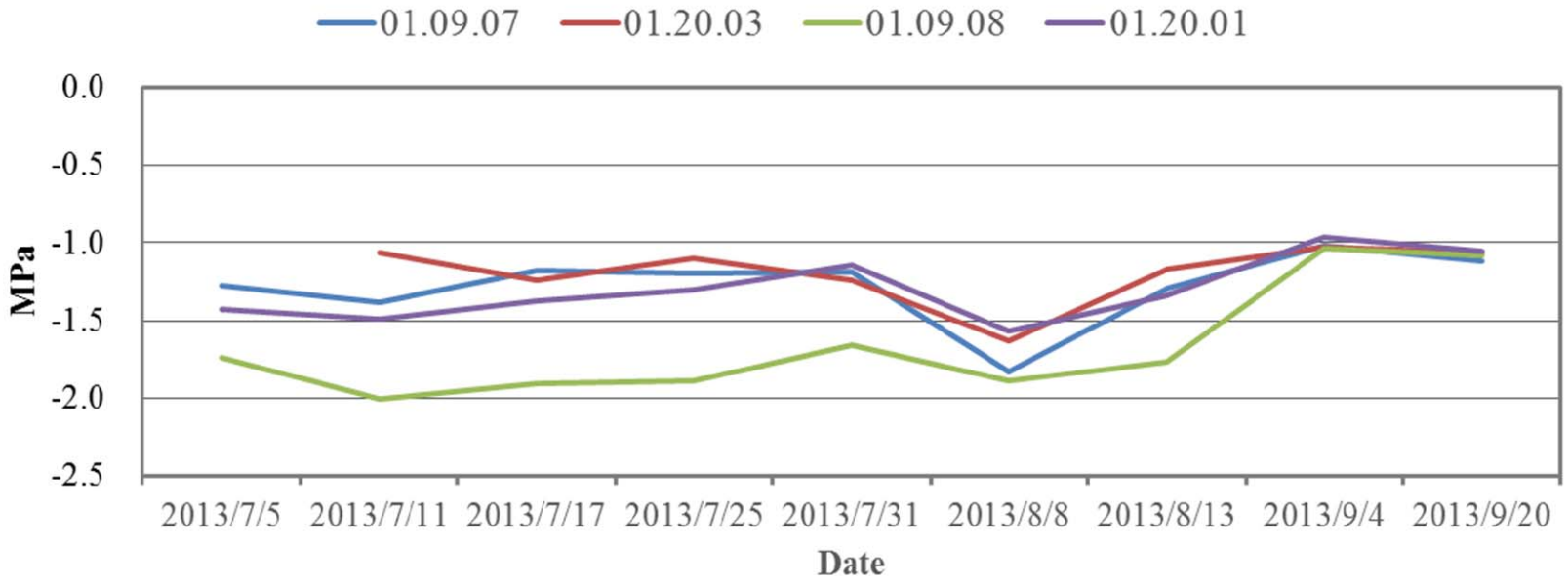
AGADAPT: Soil moisture evolution at 50cm CLM-irrigated fields





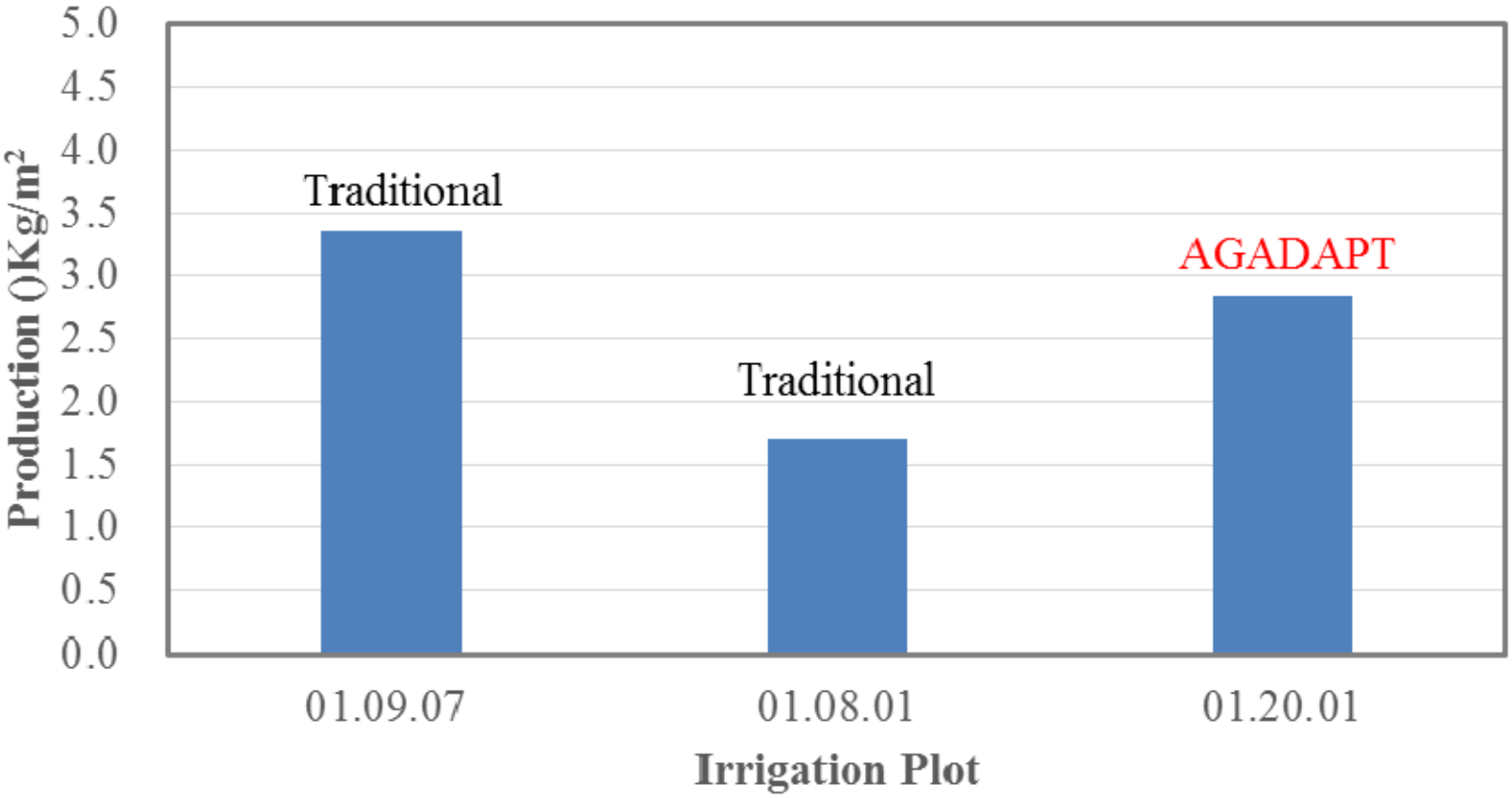
AGADAPT: Stem water potential data

Nine times during irrigation period (noon), 12 samples per irrigation plot.



AGADAPT: Production data

Measured at end of season for only three of the six plots.



AGADAPT: Android Application

Application works at parcel level.

Real-time information for farmers.

Web environment: PC, smartphone, tablet.

Water need provided by server, other parcel-specific data editable by farmers.

Dissemination

AGADAPT Innovation Project

Improve Irrigation Efficiency

Development of an Apps for real time irrigation schedulig

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Instituto de Ingeniería del Agua y Medio Ambiente

Centro Valenciano estudios sobre Riego

ivia instituto valenciano de investigaciones agrarias

WP 1. General Context of irrigation strategies

1. Different type of crops
   - **Horticultural crops**. Typically irrigated by flooding in open air crops and by dripping in greenhouses. New trends to apply dripping in open air crops. Rotation practice.
   - **Herbaceous crops**. Typically irrigated by sprinklers. New trends to apply drip irrigation, more efficient. Fallow practice.
   - **Woody crops.** Typically irrigated by flooding. Fast change to dripping. Account for canopy diameter growing.

2. Different water resources available
   - **Surface water** , taken from a river. Need to be stored in large reservoirs. Usually distributed by canals. Cheap water
   - **Groundwater,** withdrawn by pumps. Can be applied directly or stored in ponds. Distributed by canals or by pressurized pipes. Expensive water
   - **Recycled or desalinated water.** Still more expensive. Usually is directly applied by pressurized pipes

WP 1. General Context of irrigation strategies

3. Different irrigation systems

- **Flooding.** By canals. Long irrigation periods (months). Weather predictions are relevant
- **Sprinklers**. By pumping. Medium irrigation period (weeks). Weather predictions are desirable
- **Dripping.** By pumping. Short irrigation periods (days). Weather predictions not relevant

4. Different irrigation managements

- **Parcel level.** Each farmer controls the water and fertiliser applied to their own plots. Control devices must be installed at water intake.
- **WUA level.** Water is distributed to many parcels in a large area, using a common conveyance network. Old canals and ditches has become in Spain in large pipe networks, controlled by SCADA systems, with hundreds and sometimes thousands of valves to open and close. Now water delivered can be totally controlled, but optimisation is still a challenge.
- **Basin level.** Irrigation water volumes are assigned and constrained (if case) at this level, affecting to other decision levels in case of scarcity.

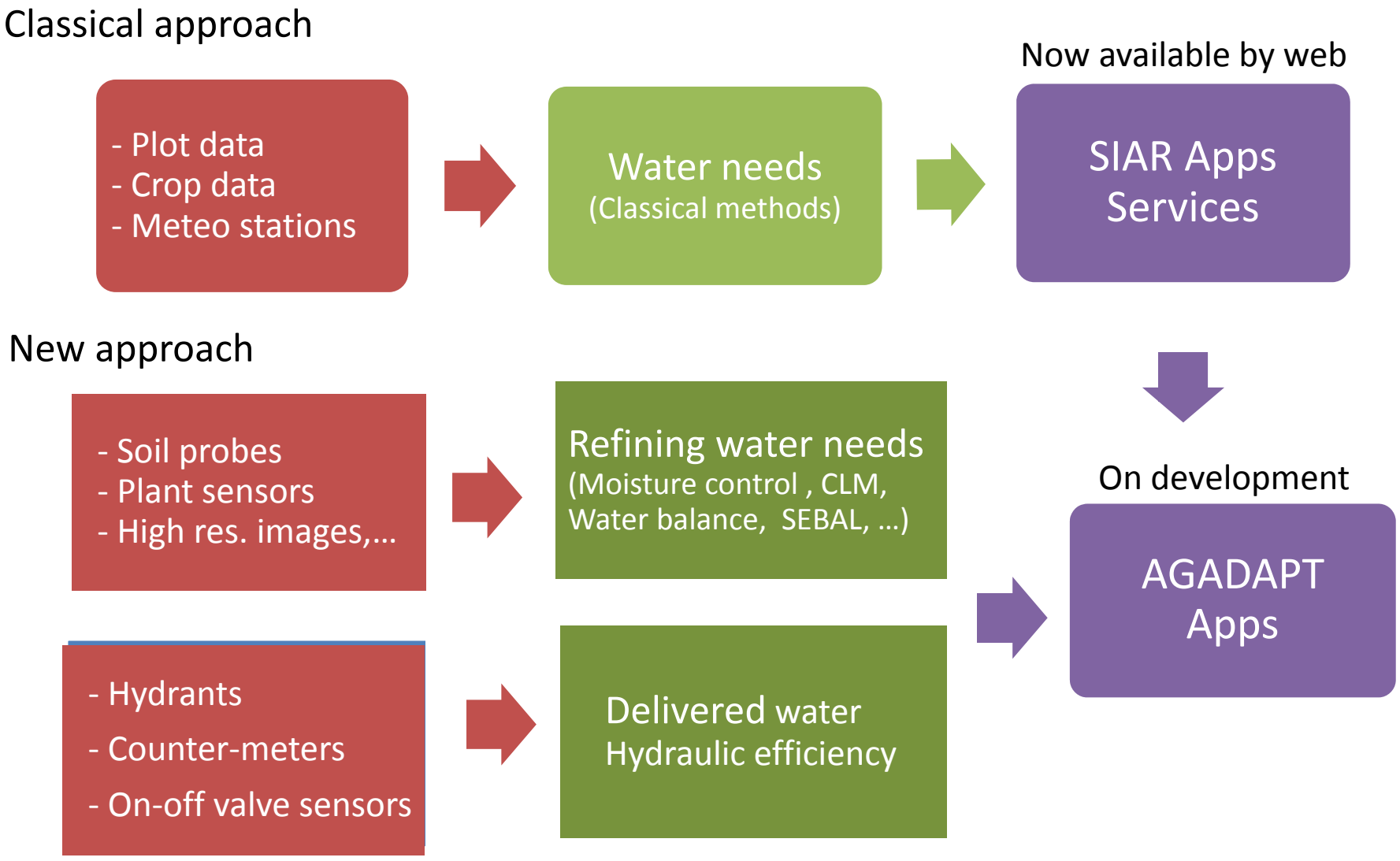
WP 1. General Context of irrigation strategies

5. Different irrigation strategies

- **Farmer criteria.** Traditional farmer expertise has been in the past the best approach to manage water properly. But new irrigation systems are out of scope of expertise and needs new methodologies to be applied.
- **FAO method.** Based on the type of crop, meteorological data as ETo and empirical tests, the amount of water to be applied in the coming days is determined.
- **Soil moisture.** The water needs are determined basically by insuring that soil moisture is inside a given range. Must be combined with other data. On development
- **Plant stress.** Some sensors of new generation can determine the stress of plant at a given time. It's expensive, and the response time are too large. On development
- **Satellite images**. Different technologies must be overlapped to get enough spatial and temporal resolution. Expensive and hard to process. On development
- **RDI.** Water needs are determined by following the phenological development of the plant, to reduce water without affecting the yield. On experimental status.

WP 1.4 Water management policies and optimisation

At parcel level



WP 1.3 Water management policies and optimisation

At WUA level

Parcel level

Plots + crops + WSs + Probes → Water needs (per parcel & per day)

Hydrant level

Hydrants /intakes → Flow rates (depending on pressure, wear, pipe size, drippers,..) → Theoretical irrigation times

Network level

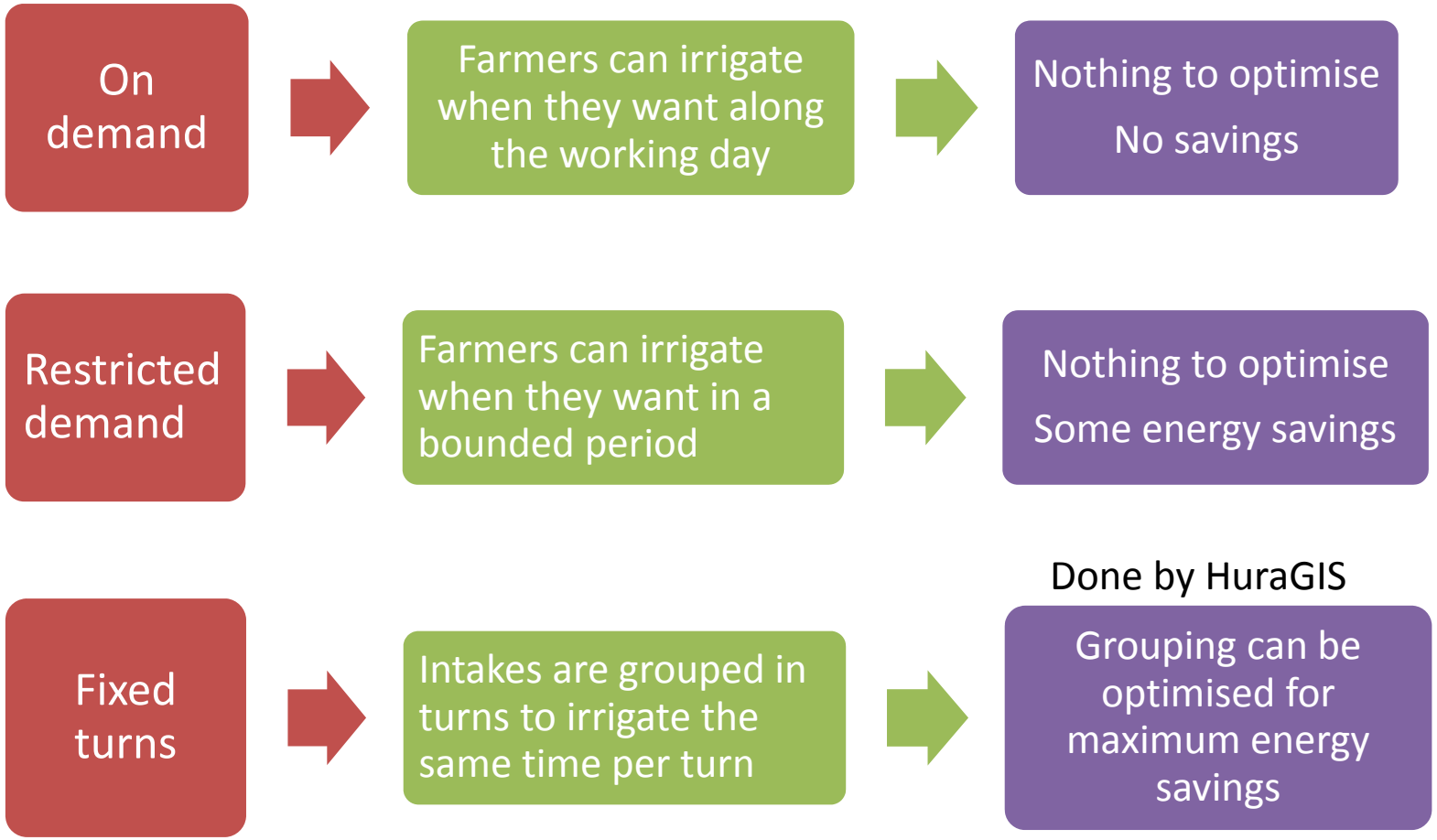
Hydraulic network + irrigation scheduling → Delivered water Hydraulic efficiency (per parcel)

Done by HuraGIS

WP 1.3 Water management policies and optimisation

At WUA level

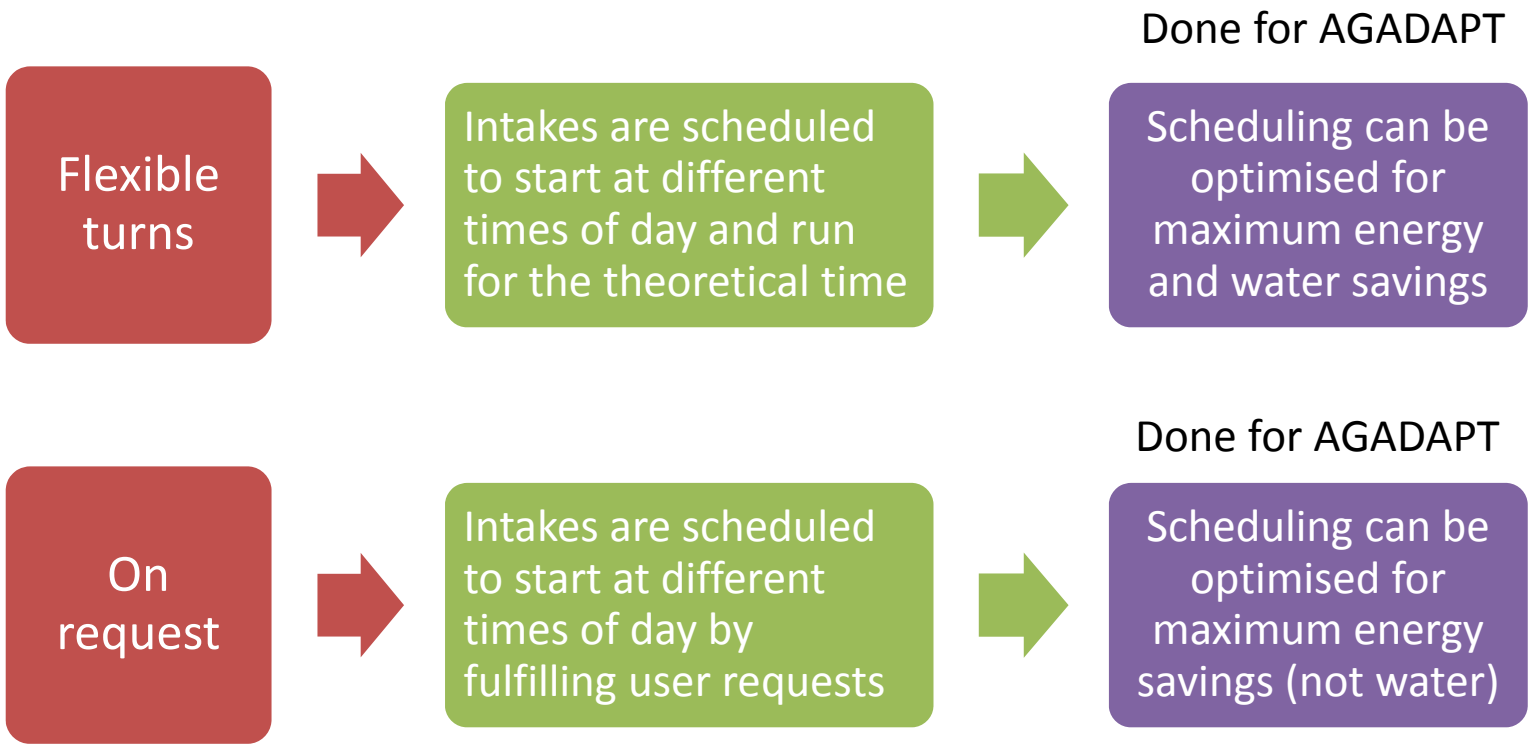
Irrigation strategies



WP 1.3 Water management policies and optimisation

At WUA level

Irrigation strategies



WP 1.4. Apps for water management at parcel level

Main features

- The apps will be **addressed to farmers and will work at parcel level**. It will manage all parcels the farmer is owner or responsible
- The goal will be **provide information to the farmer in real time** about the crop water needs, the irrigation scheduling programed to the coming days, the water really delivered up to now, the hydraulic efficiency, etc. It will provides other data such as historic meteorological data, weather forecasts, soil moisture, plant stress, ...
- The apps will work on **a web environment**, and could be run in a **PC** or a **mobile** device.
- The user will have capabilities to **declare and edit all data** concerning their parcels. In future some wizards will help to do that. The **water needs** will be determined **by the server**, using all the available information. However the **user could make a request** to the managers to change the scheduled irrigation plan.

WP 1.4. Apps for water management at parcel level

Entities for the DB

- **User Profiles**
  - Permissions, scope, …
- **Users**
  - Personal data, …
- **Parcels**
  - Geographical data, cadastral ID, surface, soil texture, particular crop data, ..
- **Crops**
  - Type, variety, seasons, …
- **Counter meters**
  - Geographical location, hydrant from, technical data, ..
- **Meteorological Stations**
  - Location, sensors, resolution, technical data,..
- **Moisture probes**
  - Type, sensibility, measuring depths, …

WP 1.4. Apps for water management at parcel level

Associations between entities

- **Users – Profiles**
- **Users – Plots**
- **Plots – Crops**
- **Weather station – Plot**
- **Soil moisture probe – Plot**
- **Counter meter – Plot**

Associations with Time series data

- **Weather station – Historic data**
- **Plot - Weather forecasting**
- **Soil moisture probe – Historic data**
- **Plot – Needs of water**
- **Counter Meter – Delivered water**
- **Plot – Phenologic development of crop**

WP 1.4. Apps for water management at parcel level

Capabilities

- **Management of entities, declaring its properties and associations (user)**
- **Capture, treatment and storage of historic data (automatic by server)**

- **Weather forecasting (from a web service)**
- **Estimation of water needs for the coming days (from server)**
- **Irrigation scheduling foreseen for the coming days (from server)**
- **Managing irrigation requests from user**

- **Show historic info about meteorological data**
- **Show historic info about soil moisture**
- **Show historic data about water needs (by time or aggregated)**
- **Show historic data about water delivered (by time or aggregated)**
- **Show historic data about water efficiency**
- **Show historic data about crop development and yield**

WP 1.4. Apps for water management at parcel level

Communication strategy (I)

- **AGADAPT Parcel Apps is addressed to farmers as end users, becoming a very large potential market**
- **AGADPT Parcel Apps joints information from different sources (farmers, weather stations, local sensors, SCADA of the hydraulic system, etc). Just combining all this data is possible to use efficiently water for agriculture**
- **AGADPT Parcel Apps will need the assistance of IT people to communicate servers with different sources of information, which means an option to create start-ups**
- **AGADPT Parcel Apps allows the user to modify the irrigation scheduling foreseen by request. So users can optionally use their expertise to control the crop growing**
- **AGADPT Parcel Apps don't solve the problem of optimise the use of water and energy at the WUA level. The hydraulic network and pumping system are not taken into account**

WP 1.4. Apps for water management at parcel level

Communication strategy (II)

- **HuraGIS WUA Apps is addressed to managers of WUA, a common farmer association in Mediterranean countries (more than 800 in Spain)**
- **HuraGIS WUA Apps allows to estimate the water needs for all plots of the irrigated area. It can also compare needs with real delivered water to determine the hydraulic efficiency at the level of parcel.**
- **HuraGIS WUA Apps allows to optimize the use of water and energy at WUA level, for different irrigation strategies. It can determine the best irrigation scheduling**
- **HuraGIS WUA Apps will run on the server site, and can provide information to AGADAPT Parcel apps, on water needs, delivered water, next irrigation programs, etc**
- **HuraGIS WUA Apps can contribute also to create new start-ups in charge to build the hydraulic models, to implement optimisation algorithms, to maintain server information, etc**

WP 1.4. Apps for water management at parcel level

Communication strategy (III)

- **AGADAPT Web Page can be a forum to show how the application works and the results obtained in the particular site of Picassent**
- **The new algorithms developed in HuraGIS has been presented in the 7th IWA Conference on Water Efficiency 2013. They has been published in Agricultural Water Management.**
- **Results will be disseminated in future conferences**
- **Former results obtained in AGADAPT will be continued in FIGARO project.**

AGADAPT Parcel Apps

First beta version of

FarmCrop Apps for Android

UNIVERSIDAD POLITECNICA DE VALENCIA

Instituto de Ingeniería del Agua y Medio Ambiente

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Angel Jiménez
Fernando Martínez

AGADAPT Parcel Apps

Main features

- **AGADAPT parcel is an Apps addressed to those farmers that want to apply the latest technologies in growing up their crops using the maximum efficiency in the water use**
- **Information from different sources, such as meteorological data or soil moisture data concerning to their plots, can be checked by farmers at any time from a smart phone**
- **The Apps provides also additional information about the optimal water needs, computed using the FAO method or agro-climatic advanced models such as CLM**
- **A data server is in charge to collect continuously in real time all the information required by farmers and by the agro-climatic models. It also allocates the optimal water scheduling proposed by models**
- **Finally the farmer can have the option to assume the recommendation or modify it by sending a different order to the automatic programmer or to the manager in charge of the network operation**

AGADAPT Parcel Apps

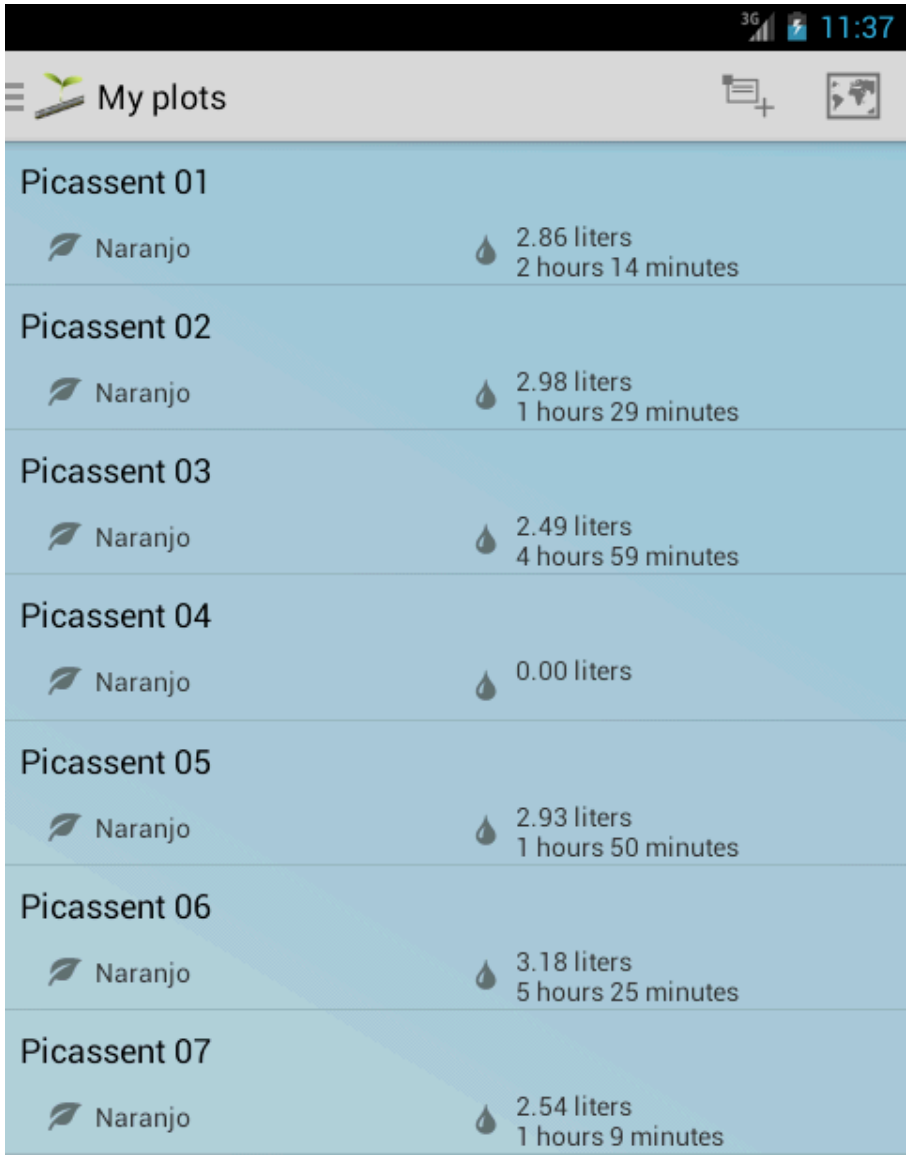
Login

- **The Apps has been named by now “FarmCrop”**
- **A logo hast been designed which join the outbreak of a plant with a dripper irrigation line**
- **At first the user has to be identified with a login (test) and a password (…)**
- **After pressing Enter the connection with the data server is stablished if user is recognised**

AGADAPT Parcel Apps

First screen

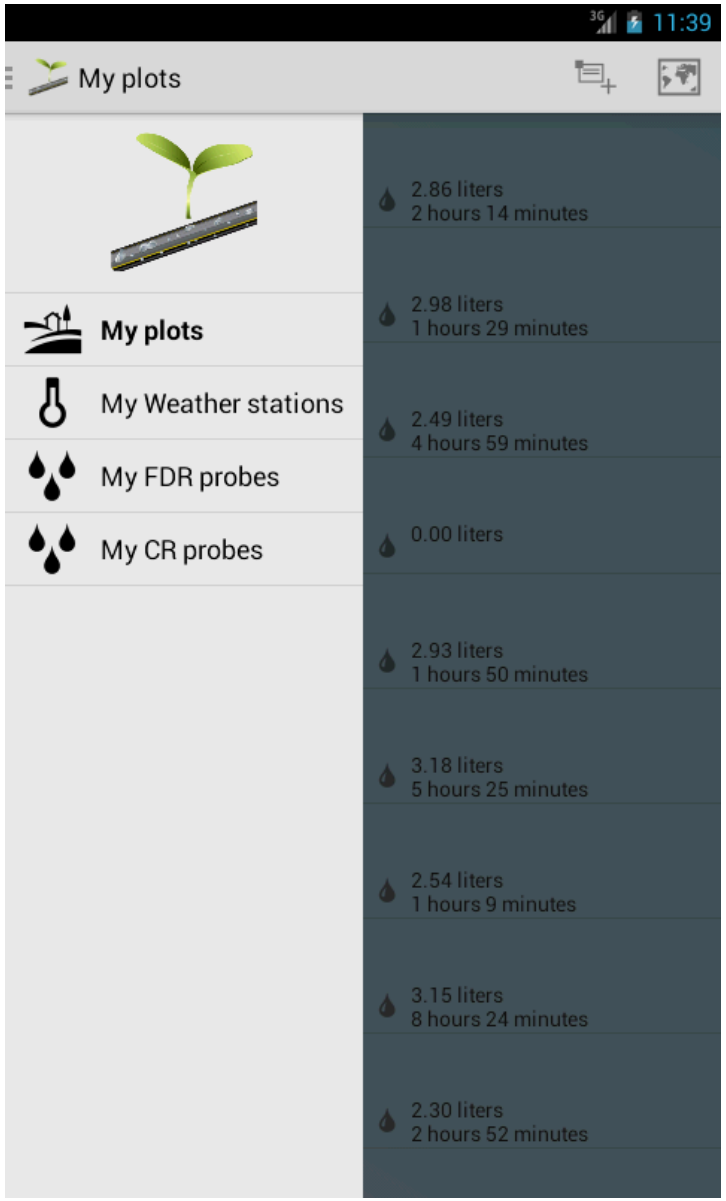
- **After login the first screen is shown**
- **It provides directly the water to be supplied to each plot declared by user on the next week**
- **Both the amount of water and the irrigation time are provided simultaneously**
- **The recommended water has been computed using agro-climatic models and real and forecasted data stored in the data server**



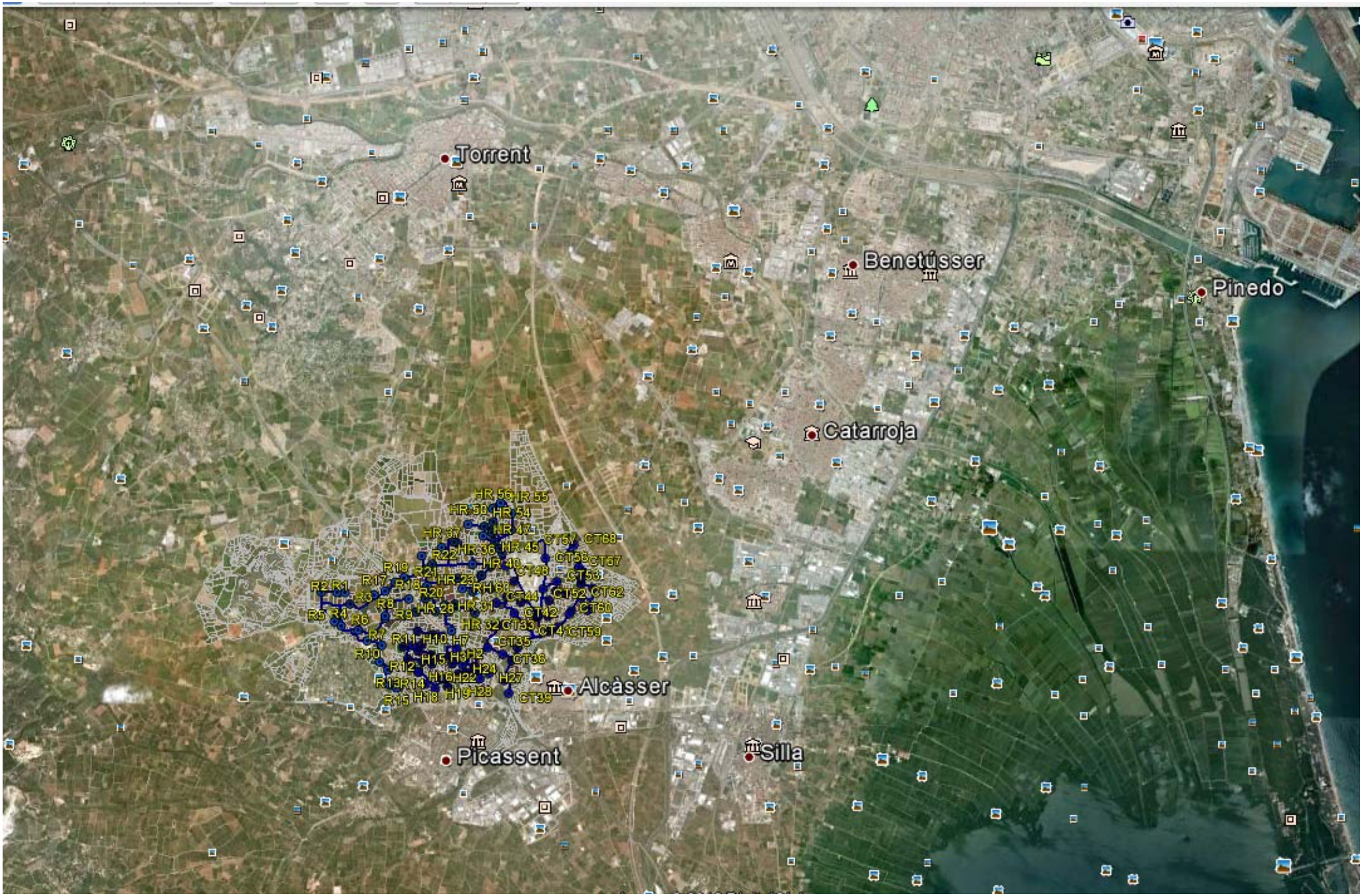
AGADAPT Parcel Apps

Main menu

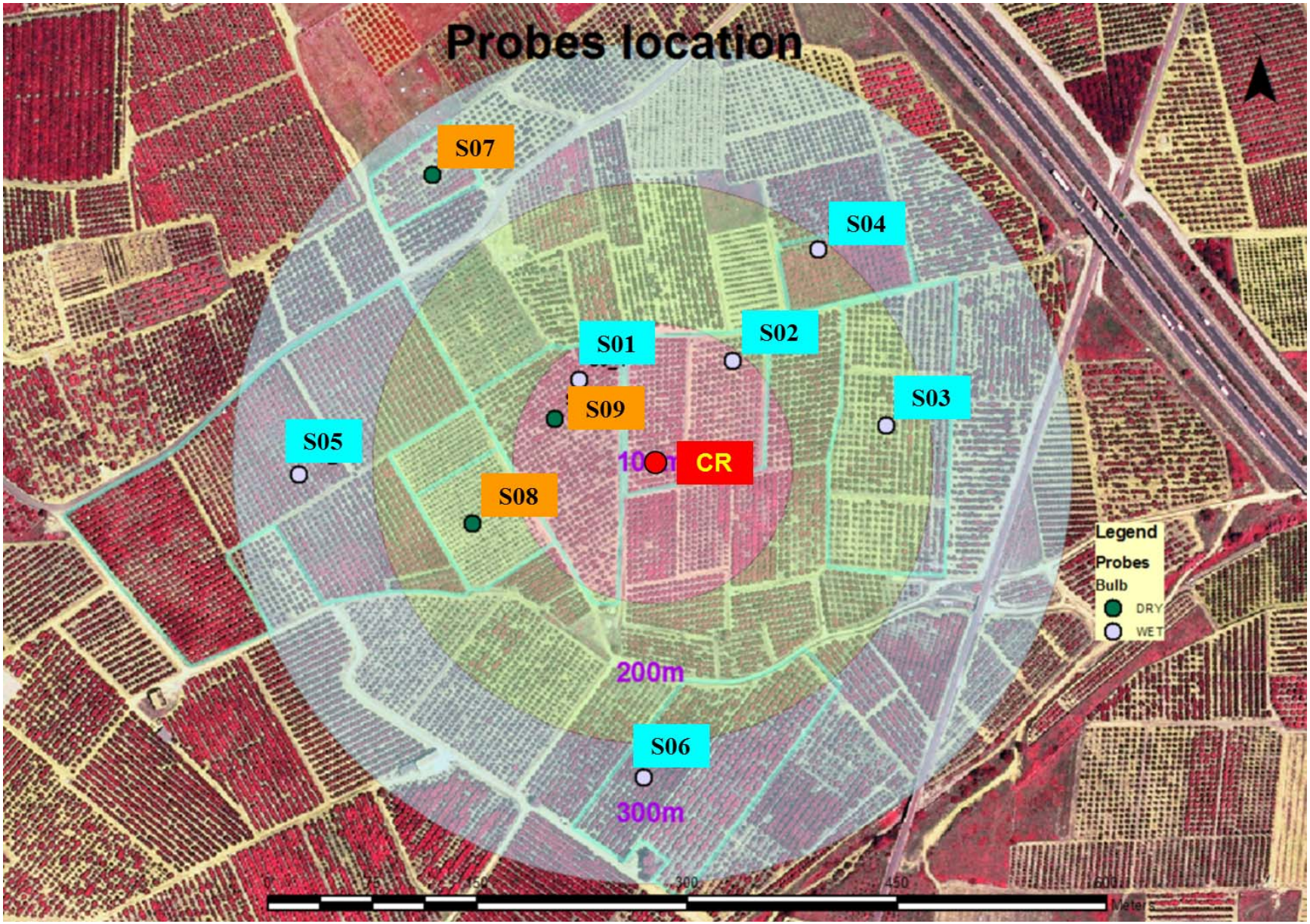
- **A side menu can be deployed to check and edit the different items declared by the farmer**
- **By now the items considered by the Apps are:**
  - **Plots or parcels**
  - **Weather stations**
  - **FDR probes**
  - **CR probes**
- **In future hydrants or other sensors could be added**



Location. Sector XI Picassent (Valencia)



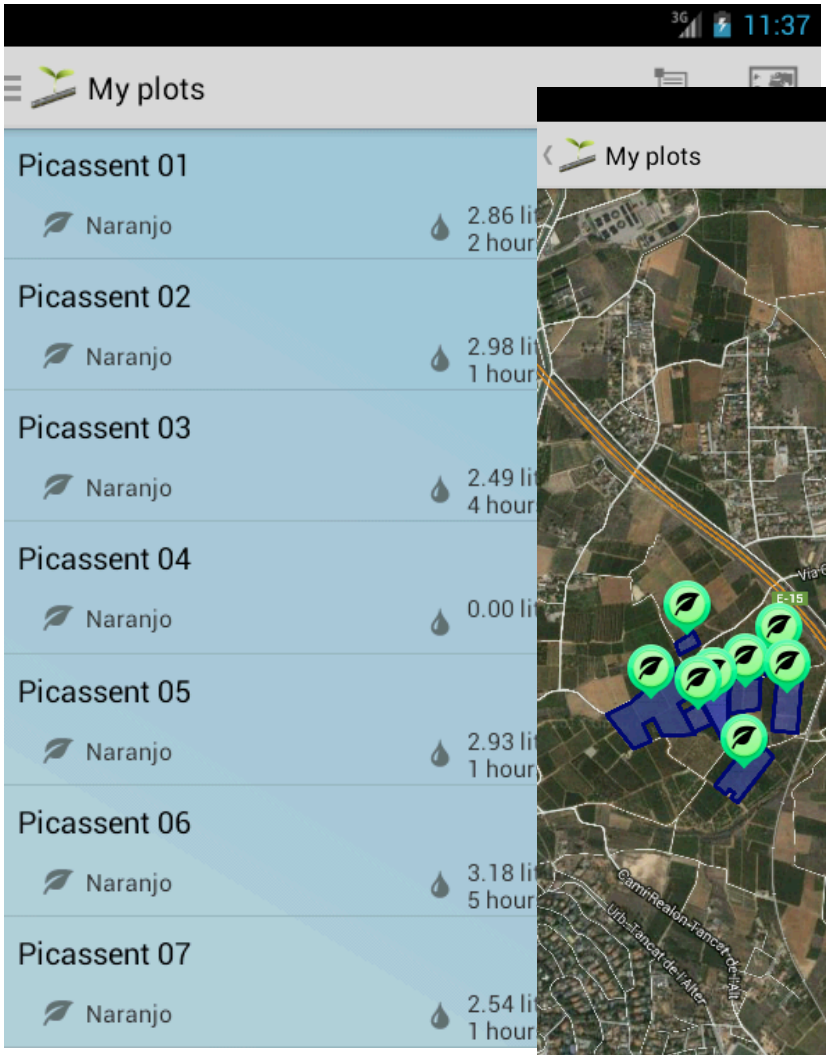
AGADAPT Parcel Apps

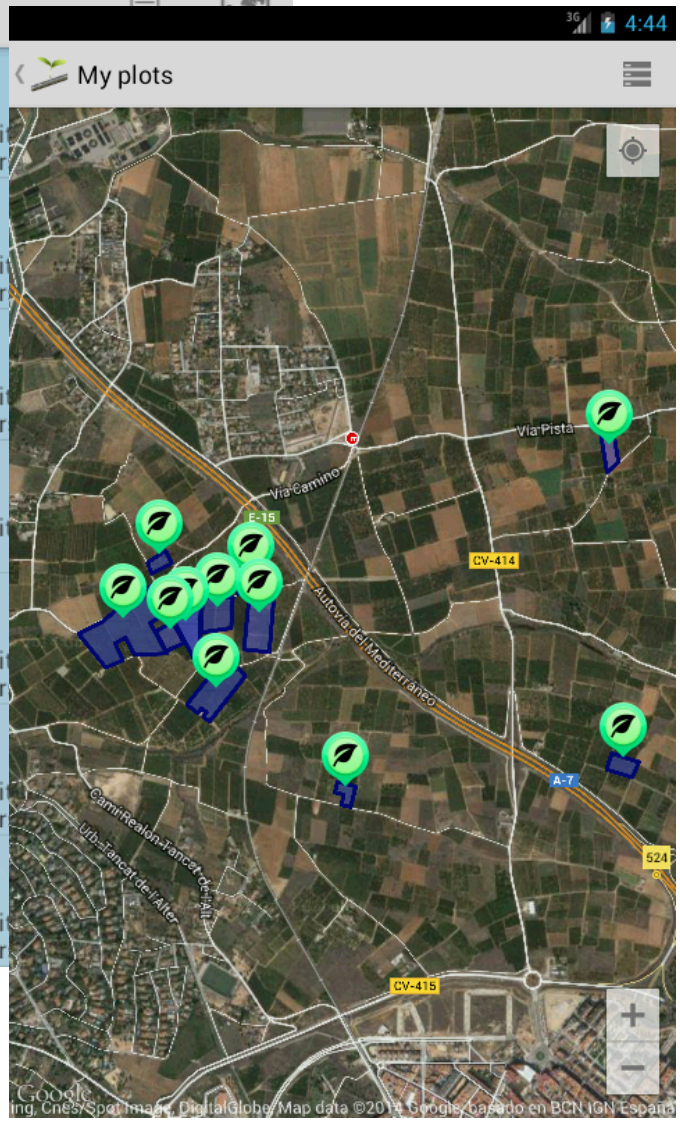


AGADAPT Parcel Apps

Plots

- **When my plots is chosen, the list of all declared plots is displayed agains, showing the water needs per plot**
- **Alternately the location of all plots can be shown in a map**

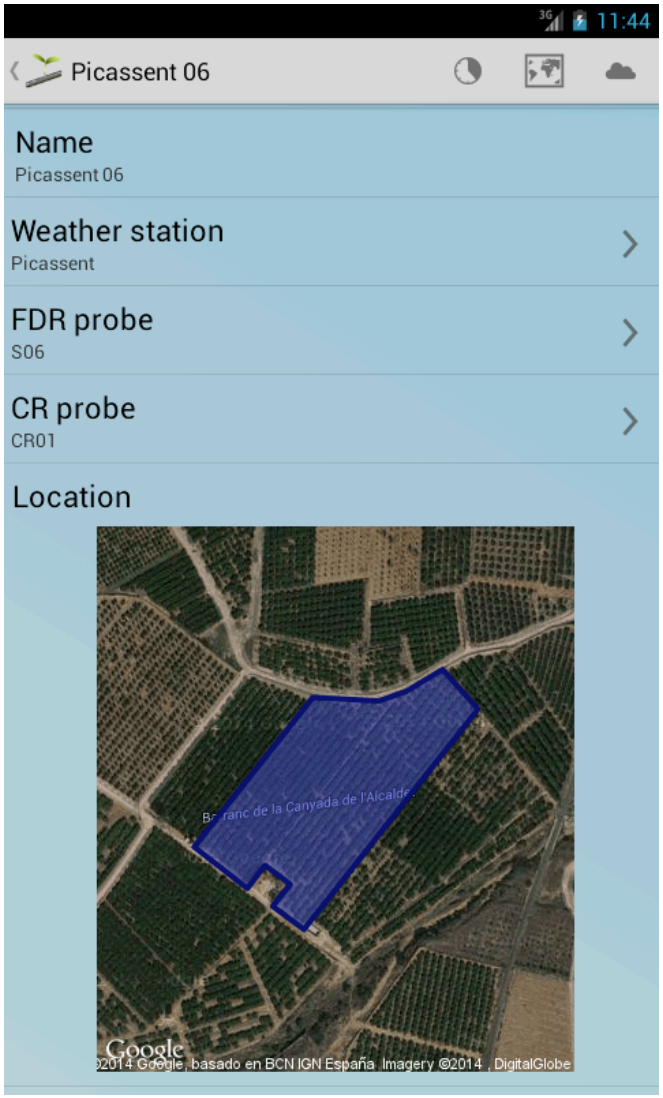


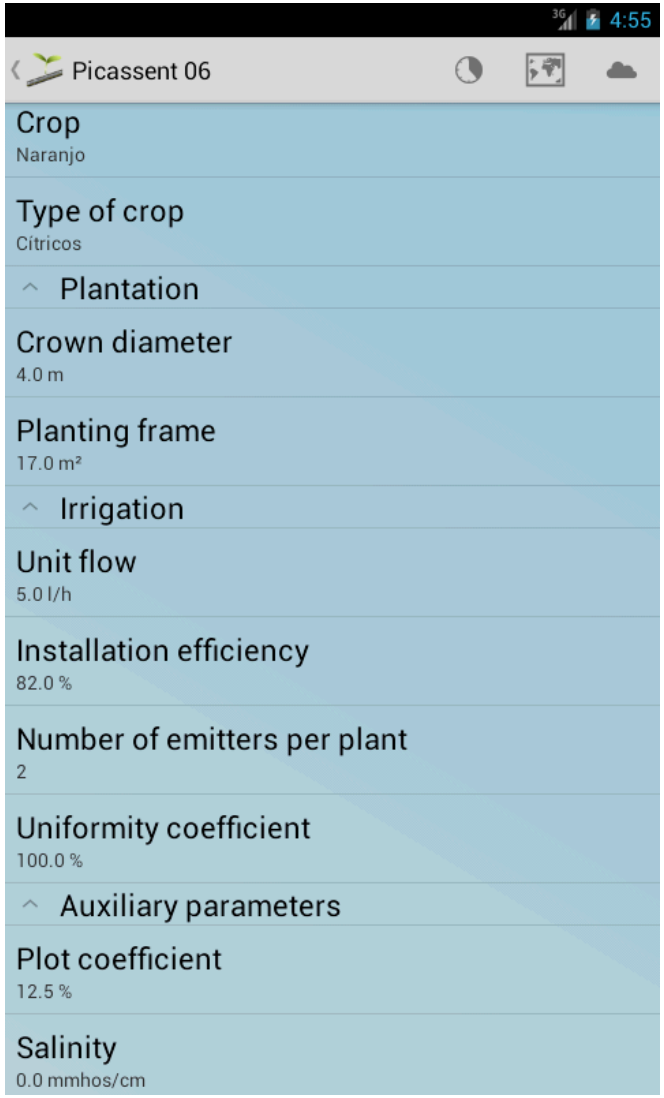


AGADAPT Parcel Apps

Plot details

- **By clicking on any plot, more details about its parameters, the associated probes and the plot layout are shown**

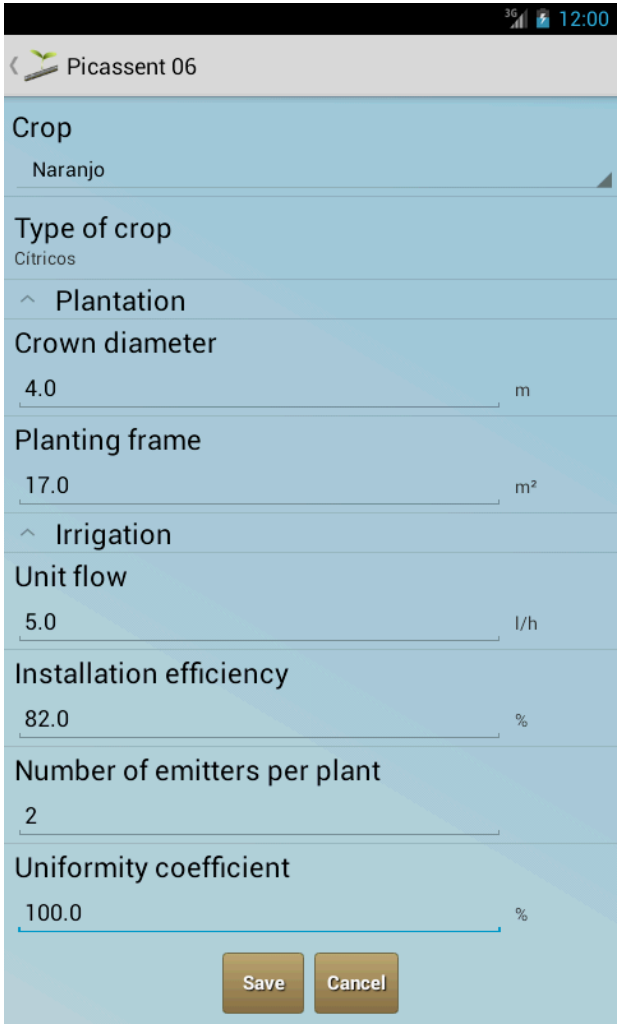


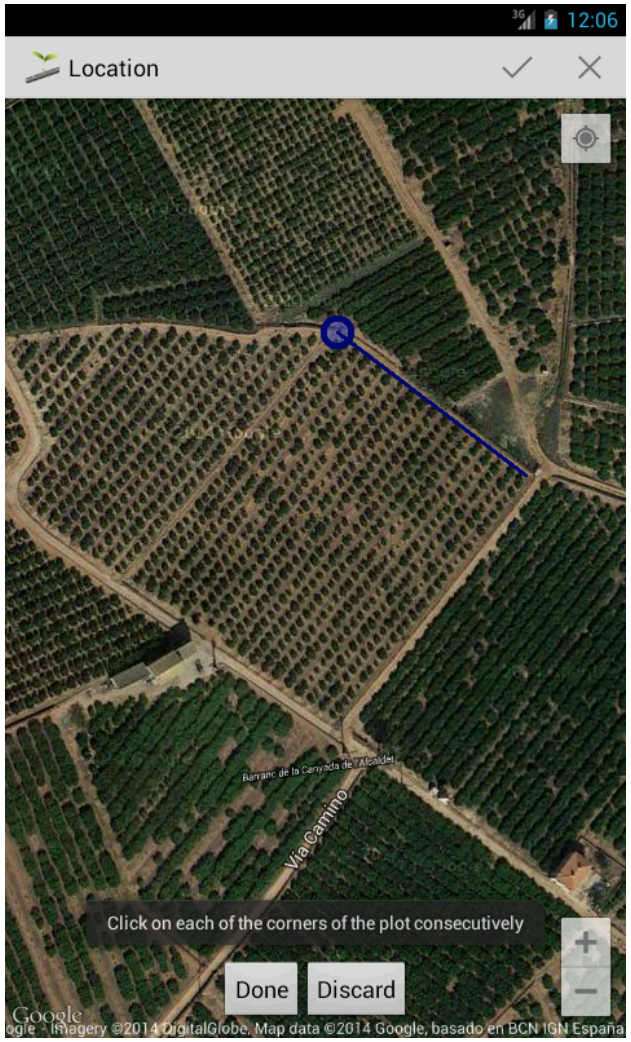


AGADAPT Parcel Apps

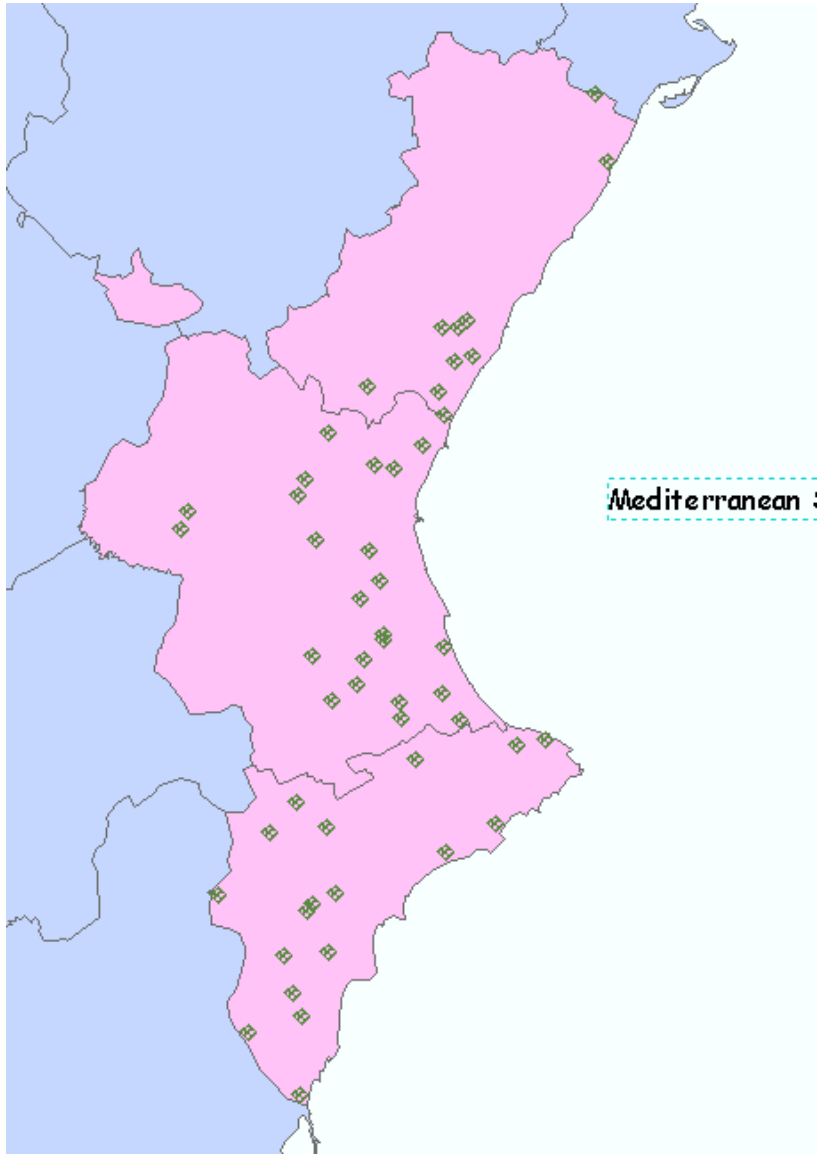
Plots edition

- **User can create, delete and edit as much plots as he want**
- **By editing a plot, the layout can be drawn directly by user over the background and all its parameters can be defined or changed**
- **Plots are also associated by user with the available probes and weather stations previously declared**





AGADAPT Parcel Apps



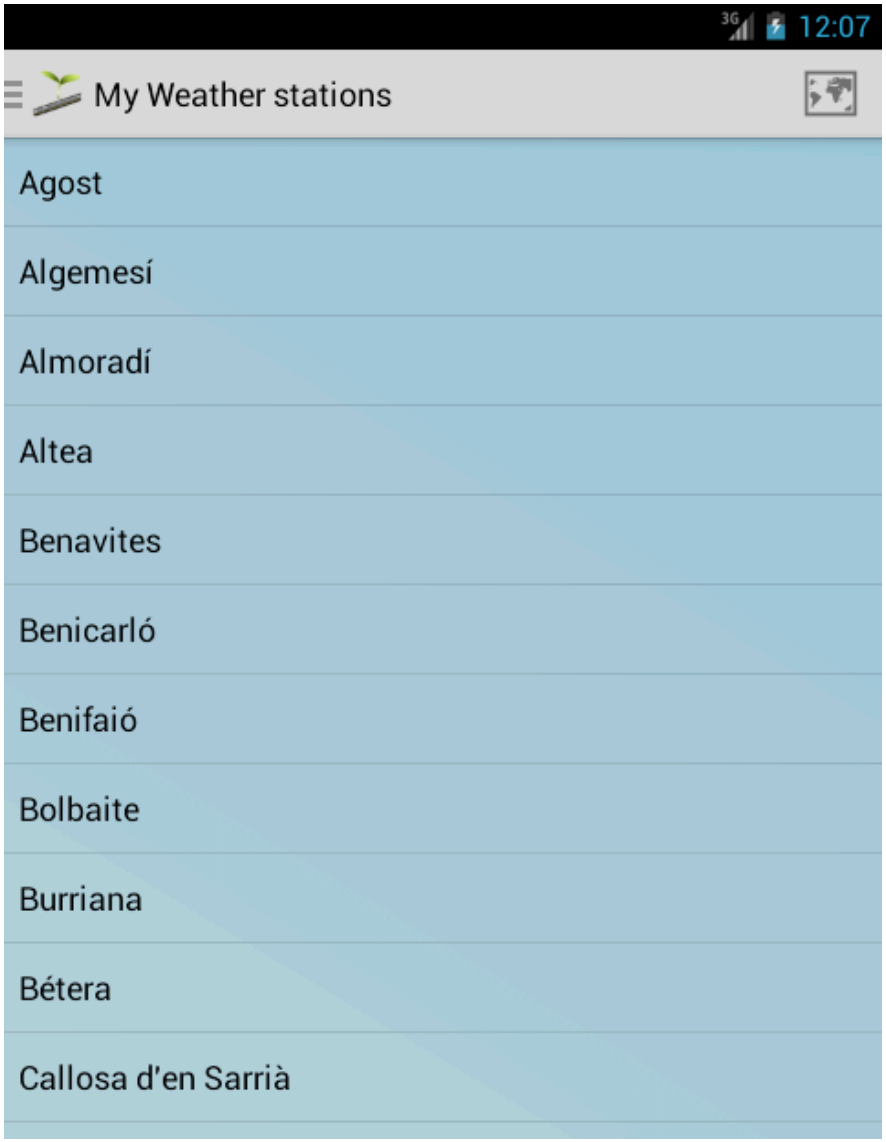
Meteorological Stations

http://www.ivia.es/estacion/datos

AGADAPT Parcel Apps

Meteorological Stations

- **By choosing weather stations a list of the WS maintained by the Irrigation Service of IVIA (Valencian Institution) is shown**
- **All meteorological data provided by this WS are captured from the IVIA data service and allocated in the data sever that provides info to the Apps**
- **By clicking on any WS from the list, graphs for different meteorological variables are provided**



AGADAPT Parcel Apps

Meteorological Stations

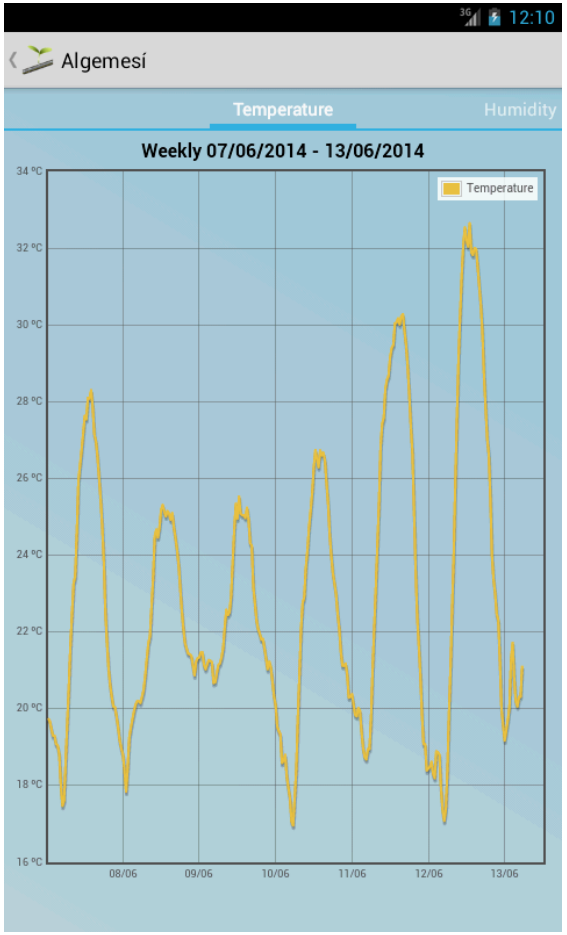
- **Alternatively the user can click the button in the upper bar of previous screen to show the geographic location of all available WS**
- **The map can be zoomed. Also the current location can be shown**
- **By clicking any icon the same graphic data are reached**

AGADAPT Parcel Apps

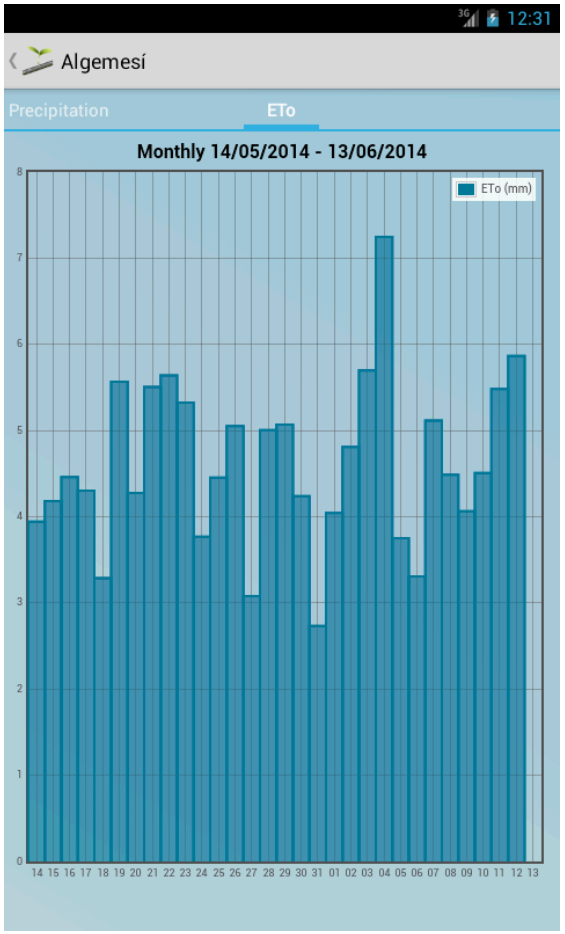
Meteorological Stations

- **Some graph series of the meteorological variables for the last week at Algemesí WSt are shown**

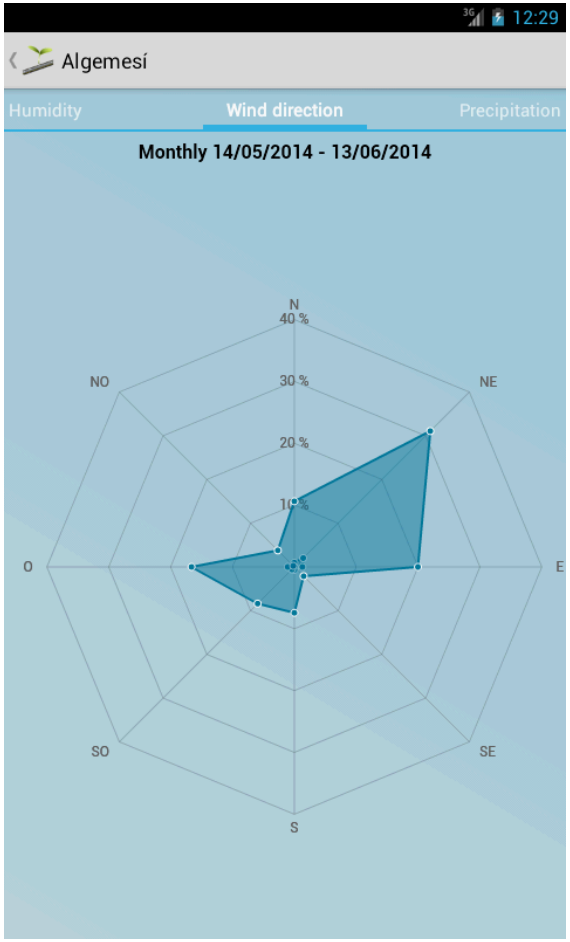
Temperatures



ETo



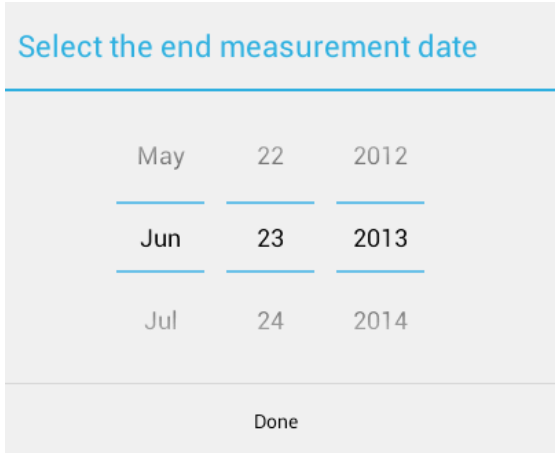
Wind



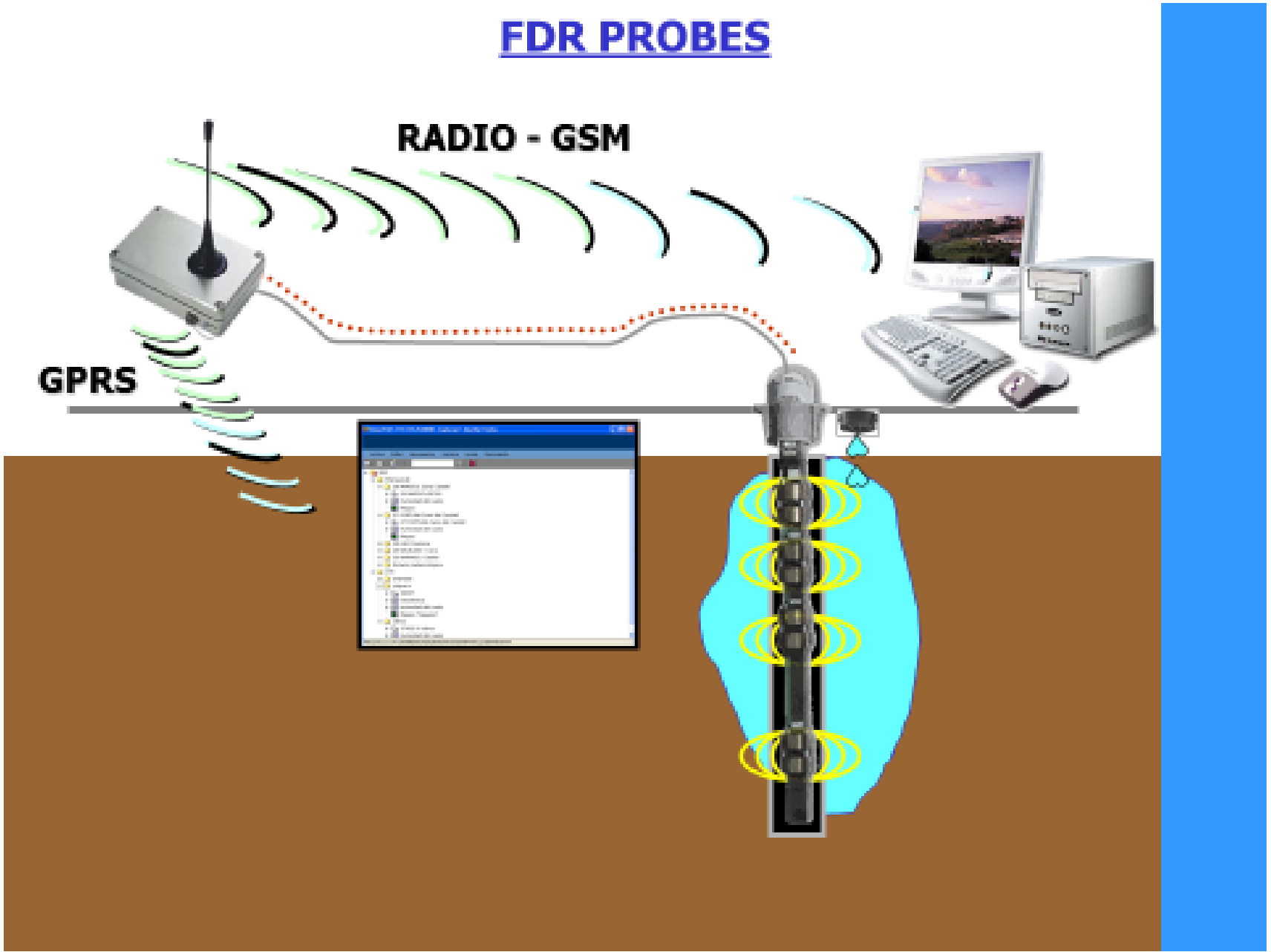
AGADAPT Parcel Apps

Meteorological Stations

- **Other options for displaying the graph series of meterological data include:**
  - **Show air humidity and pluviometry data**
  - **Change the scope of the graph from one week (default) to one day, one month or one year**
  - **The resolution of graph is decided automatically depending on the graph scope and on the resolution of the available data**
  - **Besides the average values, the maximum and minimum daily values are shown as well**
  - **Overlap some graphs such as ETo and rainfall**
  - **Ask about meteo values for any past period chosen from a calendar on a daily, weekly, monthly or annual basis**



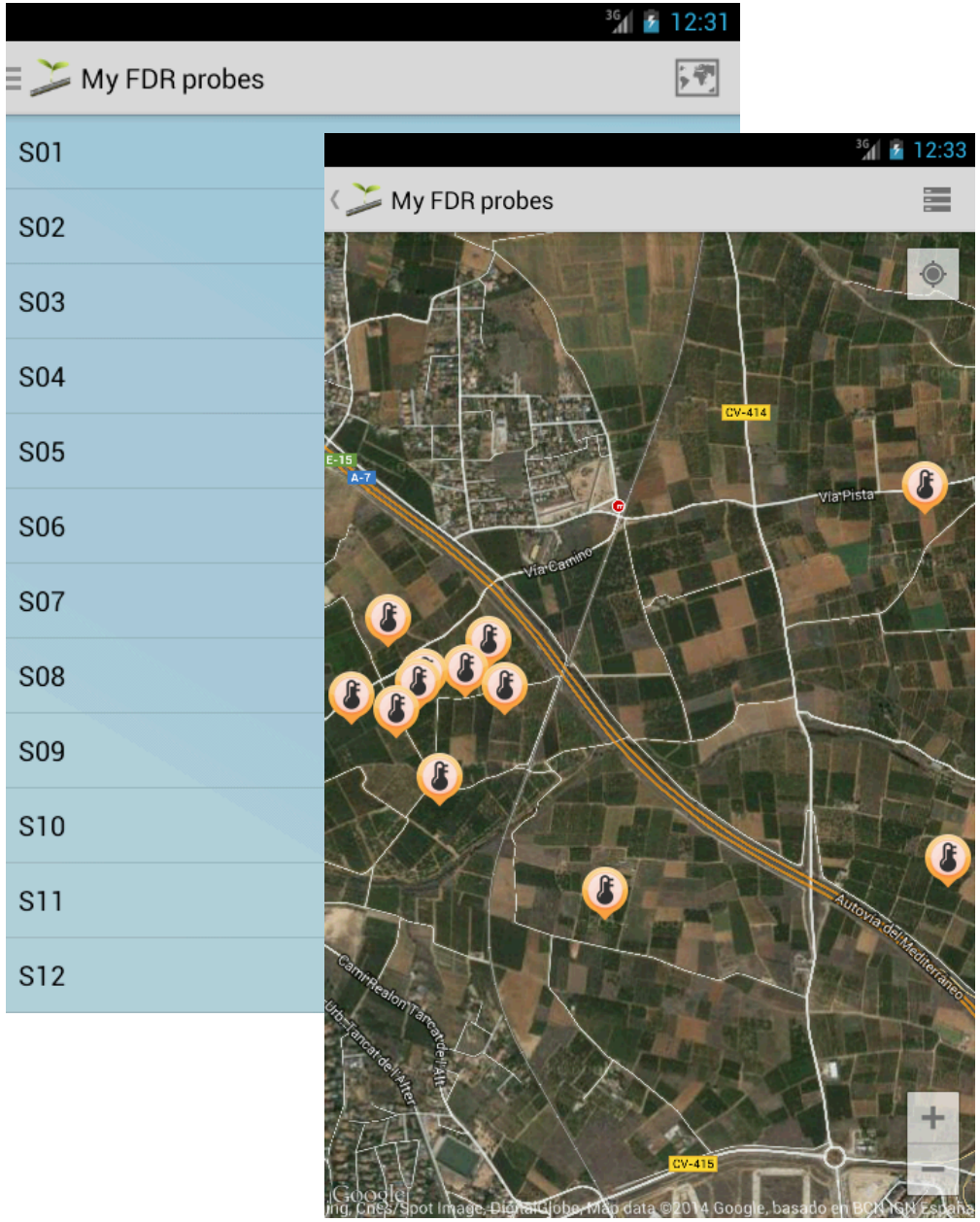
AGADAPT Parcel Apps



AGADAPT Parcel Apps

FDR probes

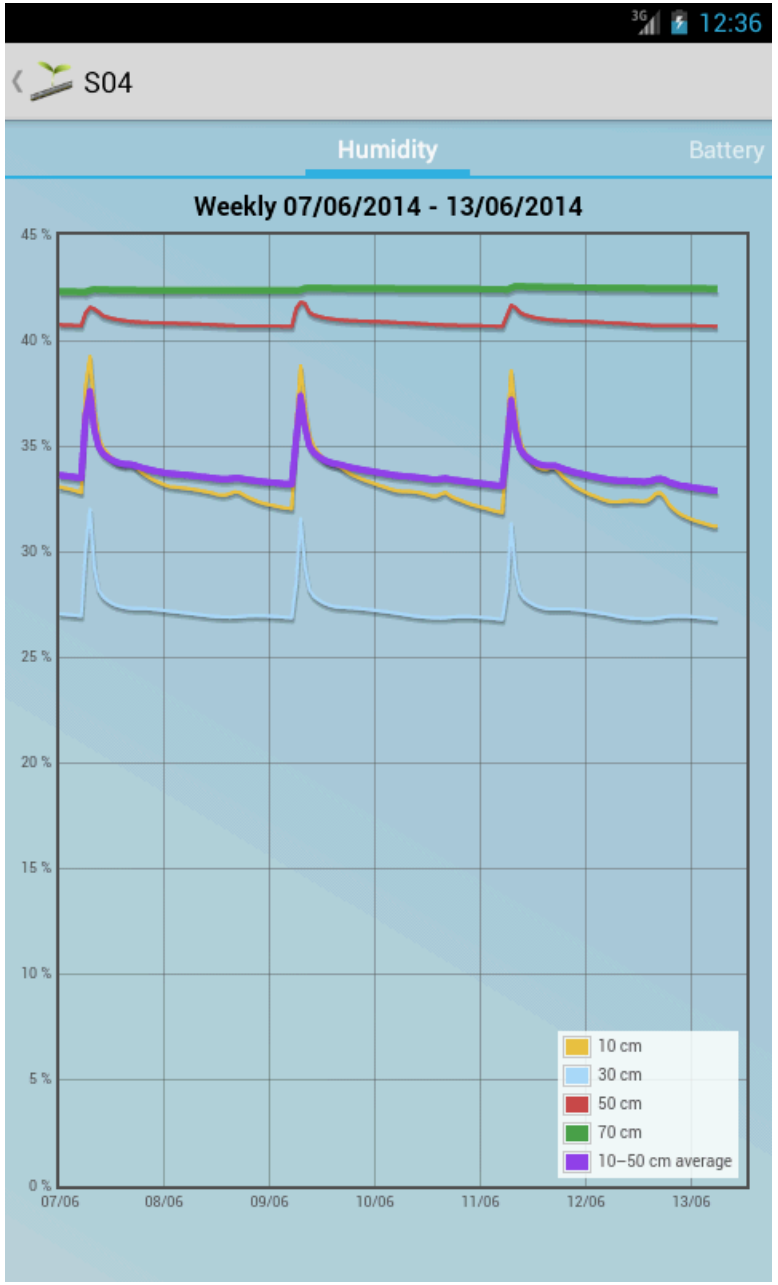
- **By choosing FDR probes , the list of the 12 moisture sensors used in the AGADAPT project are shown**
- **Alternately, their geographical location on the Picassent test site can be show, using Google maps as background**
- **By clicking on any entry of the list or on any chosen icon, the data of the probe are shown**



AGADAPT Parcel Apps

FDR probes

- **For the chosen FDR probe, a multiple graph is displayed showing the soil moisture at 10 cm (yellow), 30 cm (light blue) ad 50 cm (red) depths**
- **The moisture at these tree depths is averaged (purple) to provide the values used for taking decisions**
- **An additional graph show the moisture at 70 cm (green) that inform about the importance of the percolation, according the soil texture**
- **Other graph show the status of the probe battery**



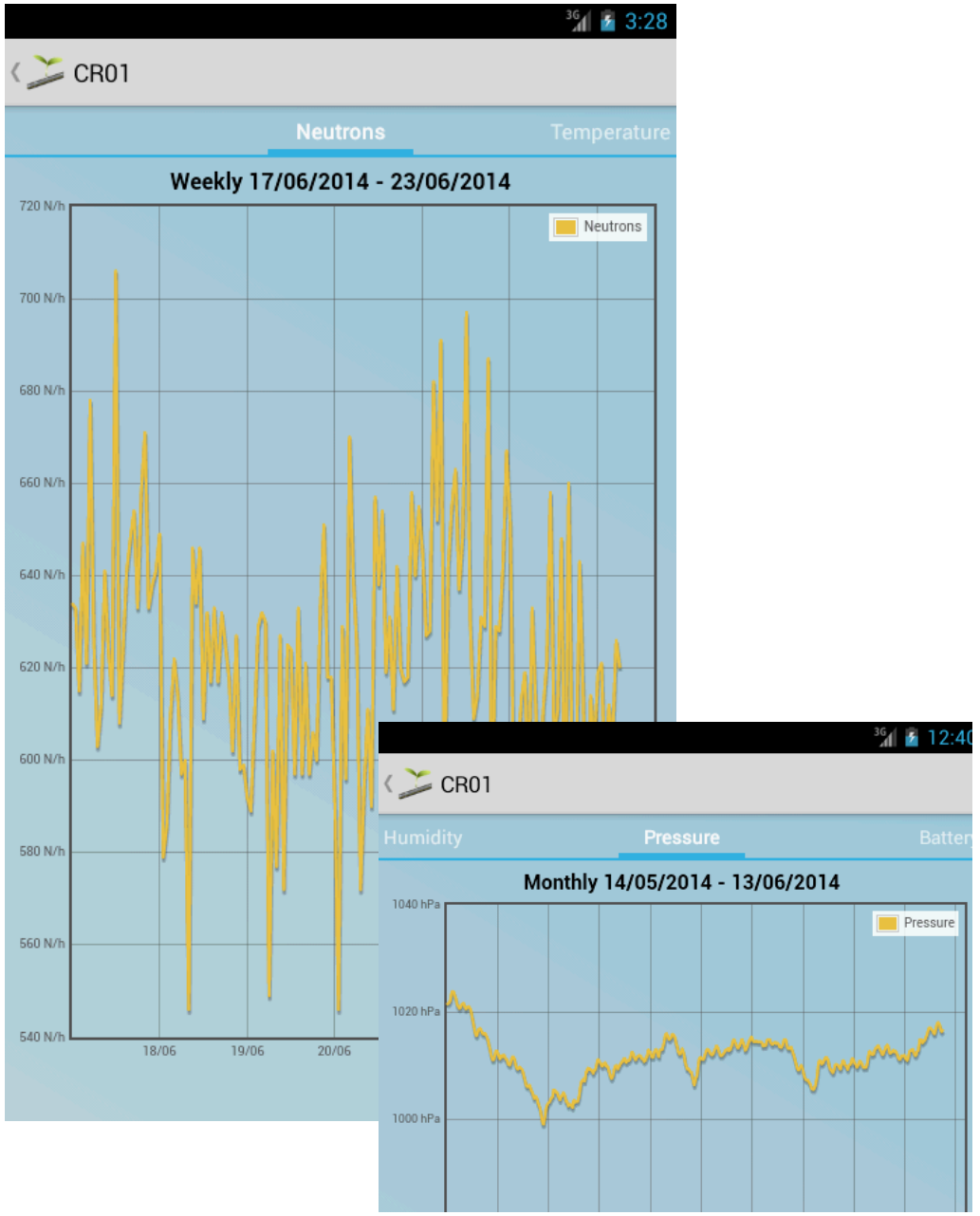
AGADAPT Parcel Apps

CR probe

AGADAPT Parcel Apps

CR probe

- **For the CR probe tried because the AGADAPT project, the following data are collected in the data base and shown in different graphs:**
  - **Neutron counts per hour**
  - **Atmospheric pressure**
  - **Air humidity**
  - **Battery status**



AGADAPT Parcel Apps

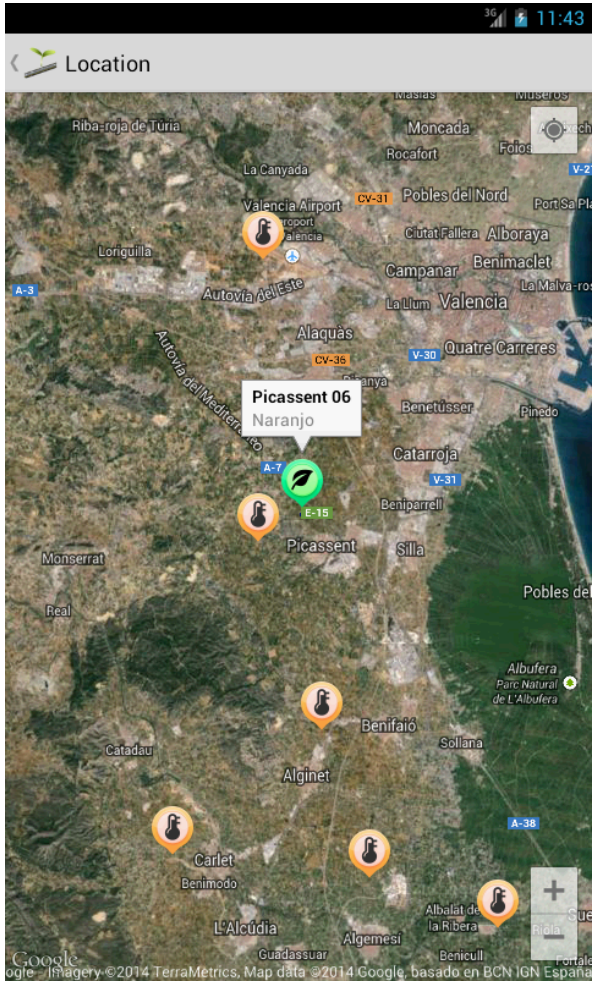
Weather forecast

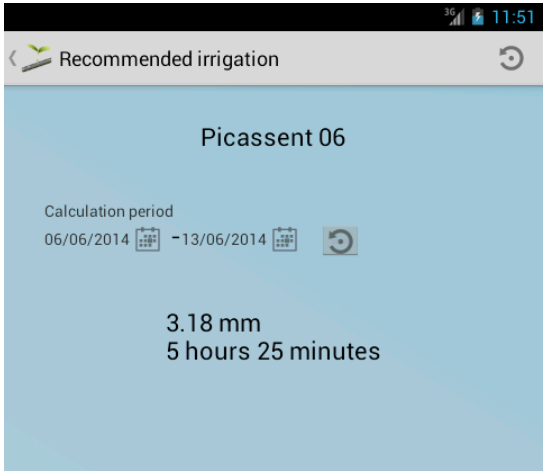
- **Using the geographical coordinates of the plot, local weather forecasts can be obtained from Open Weather API, a public service free of charge for simple queries**
- **By clicking on the bar button**  **forecasts every 3 hours for 5 days or daily for up to 16 days are given**
- **By deploying a given day in the list of daily data, details for forecasts every 3 hour are shown**
- **By now, forecasts are not saved as historical data**

AGADAPT Parcel Apps

More info on Plots

- **On the plot screen, by clicking on the map button in the upper bar, the location of the plot is shown, surrounded by the available weather stations**
- **By clicking on the time button in the upper bar of a plot, more details about the computed water needs are shown**





AGADAPT Parcel Apps

More job to be done

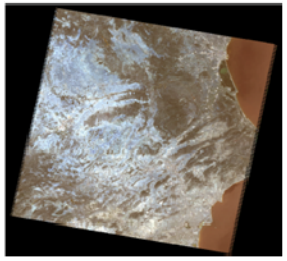
- **At this time the Apps only use the FAO method for citrus to determine the water needs**
- **Connection with other servers to show the results obtained by CLM method is still pendent, but can be integrated with low effort**
- **Links to other meteo stations and other weather forecasting is still to be implemented.**
- **The option to connect with a server to process Landsat images and provides ET by SEBAL method is being developed**
- **Other improvements about the Apps usability are still to be finished such as compare in graphs data coming from different sources (water needs vs water provided, weather forecast vs meteor station data, etc), in order to involve the user in the DSS.**

AGADAPT Parcel Apps

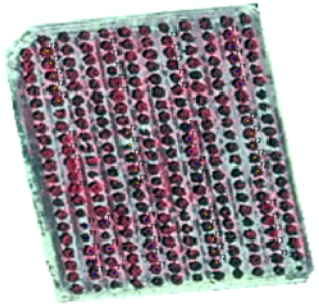
Incorporación de datos de partir de imágenes

Nivel	Resolución espacial (ancho píxel)	Resolución temporal	Necesidades de riego	Vigor	Estrés hídrico
I	Baja (500- 1000 m)	Alta (1 día)	Cuenca hidrográfica	Cuenca hidrográfica	No
II	Media (10-120 m)	Media (3-15 días)	Comunidad Regante/Parcela	Comunidad Regante/Parcela	No
III	Alta (0.15- 1 m)	Baja	Parcela	Parcela/Árbol	Sí (Térmico)

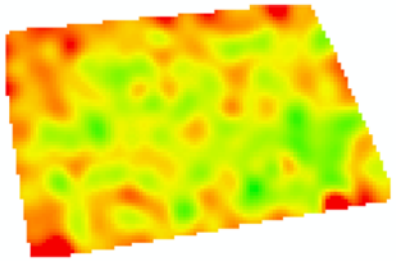
Meteosat



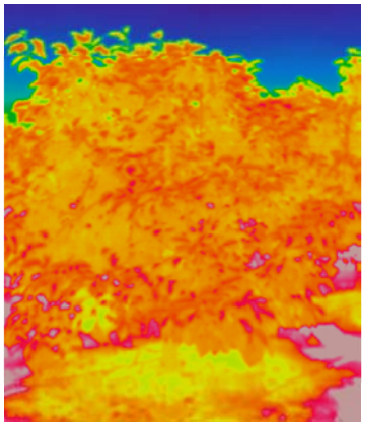
Landsat



Plan nacional de ortofotografía aérea (infrarojo cercano)



Fotografía térmica (avión no tripulado)



Fotografía térmica (cámara de mano)