WEAM4i
Water & Energy Advanced Management For Irrigation

Innovation on demand forecasting

Summary

Agriculture sector is accountable for 30% of the total water consumption in Europe, but reaches up to 70% of total water consumption in several European southern countries. In recent years, most of the efforts have been focused on water efficiency, but without taking care of energy aspects, resulting - in some cases - on a significant increase in energy consumption, combined with a scenario of increasing energy costs throughout Europe.

The **WEAM4i** project has addressed these challenges by developing an on-line crop water demand projection ICT tool that combines crop water demand (quantified by satellite observation) with a weather forecast to project future crop water needs to determine the optimal irrigation time balancing crop water needs and energy costs.

During the **WEAM4i** project duration several case studies have been developed at the local irrigation level to test and validate the **WEAM4i Smart Irrigation tool**. The case studies areas are located in Germany, Spain and Portugal, each with its own climate, unique irrigation production system and energy rules.

The demonstrations proved that the water demand can be projected successfully. This brings a new innovative solution to the toolbox of irrigator communities, consultants and decision makers across Europe and around the world to tackle the challenges of energy smart irrigation.

Innovation on demand forecasting

Water demand can be estimated using different techniques, crop tables and past experiences are commonly used. But why not ask the plant itself? By using the latest satellite technology, it is now possible to quantify actual crop water, growth and mineral status operationally. This means that actual crop status information can be obtained daily and can be aggregated into solutions that upgrade agricultural crop management by providing tools to monitor:

- Growth (production and projection in biomass and yield)
- Water (consumption and projection of future need)
- Minerals (Nitrogen content in plants)
- Alerting services (deviations from expectations)
- Production projection (what to expect at the end of season)
- Historic analysis (evaluation for planning and improved management)

Challenges:

- To optimise production while reducing the operational expenditure related to energy and water resources.
- To present an operational solution in an easily understandable and accessible tool.

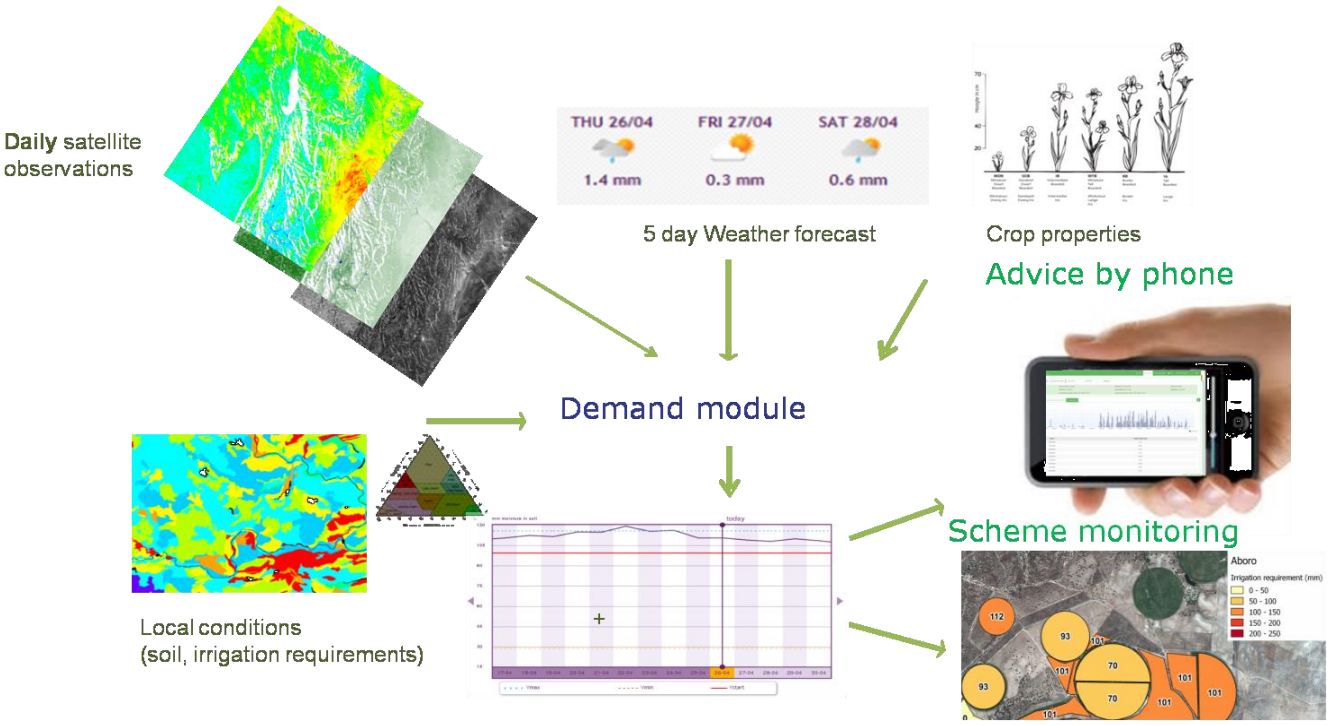
Description of the case studies

Three demonstration areas have been selected in Spain, Portugal and Germany, with different irrigation technologies, water management practices and regulations where demonstration activities covered at 2 growing seasons.

The demonstration site in Spain is located in the Ebro Valley, North Eastern Spain, in the Comunidad de Regantes del Canal de Bardenas. The considered area is the Monte Saso sector, belonging to the Irrigation District V. There are two demonstration sites in Portugal. The first one is the Odivelas irrigated perimeter, benefiting approximately 12.362 ha, located in the basin of the Sado river, near Ferreira do Alentejo. The second one is located in the Sado River Basin in Montes Velhos near Beja. The command area is about 5000 ha, of which 1800 is served by a pressurized system and the rest the water us supplied by gravity. The demonstration site in Germany is located in the Northeast of Lower Saxony, Germany. The predominant technology to apply the irrigation water is by 300 – 700 m flexible windable pipeline from a reel wagon. That is equipped with one gun- spray-jet at the tubes end, with a working width of 70 m, and driven by hydraulic power. This system is at the time used at about 95 % of the fields in Lower Saxony.

Description of the Solution

The proposed solution combines satellite quantified crop water needs with the weather forecast in order to deliver irrigation advice using an online interface and Smartphone application. The basis of the solution is the actual crop water demand. This is quantified using Earth Observation: satellites circling the earth which make daily measurements, or pictures, of the Earth including vegetation and crops. Part of these measurements can be related to actual plant status with respect to growth, water and minerals.



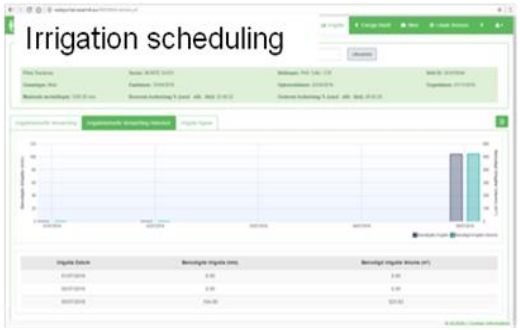
Combining these measurements with soil and crop information, make it possible to calculate and thus quantify crop status information. This includes the calculation of growth (production in kg/tones), water (use and need in mm) and nutrients. When combined with the weather forecast the soil moisture depletion

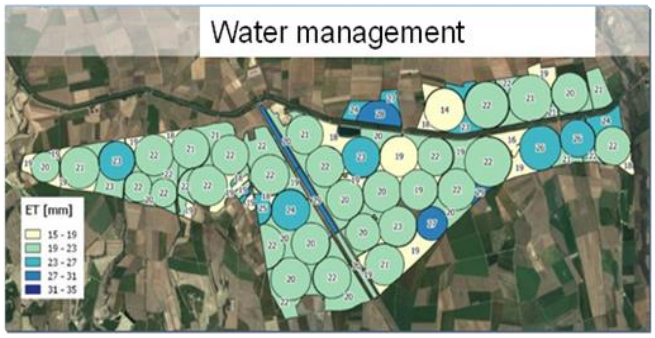
can be calculated and thus the time until crop water stress will occur can be projected. Knowing the exact time when this moment will occur allows the irrigator to decide when to irrigate: at this exact time, earlier or later, allowing maximum flexibility when it comes to the management of water, infrastructure and energy. The information provided by the solution allows better management, monitoring and evaluation at the field and irrigation scheme scale. At the field scale, individual farmers can use the tools per field while at the irrigation scheme an overview of the entire system is constantly updated.

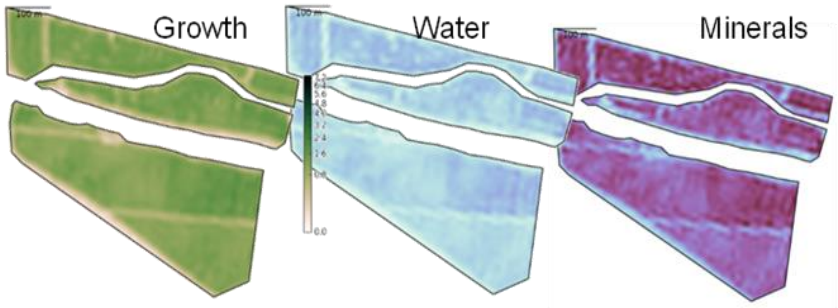
Results

The Demand Forecast Module was validated during 2 growing seasons in the different study areas and showed that it can be used to optimize water resources and irrigation management:

- ➔ The module correctly identifies fields where crops are experiencing water stress.
- ➔ The module estimates the right amount of water required in each field taking into account the soil moisture, the crop growing status and the type of crop (crop per drop maximisation).
- ➔ The module provides operational irrigation advice allowing for optimal irrigation scheduling.
- ➔ The module proves a valuable management tool providing spatial insight at the field and scheme level regarding crop growth, water consumption and need.







Learned lessons, conclusions, and perspectives

1. The soil moisture can be projected accurately, thus allowing accurate irrigation advice and optimal water resources management.
2. The results were promising showing the validity of the proposed methodology and tool for the optimal management of irrigation systems. However, data availability and organisational barriers might hinder the adoption of the optimal strategies.

3. As future work, the proposed approach must be coupled with decision support tool for the optimization of the operation of hydraulic systems, such as HydrOptim, that will transform crop water requirements into actual irrigation advice.

The crop water demand forecasting ICT tool is part of eLEAF`s FieldLook suite that puts all the data you need to optimise production and water management at your fingertips. Whether you want to keep an eye on your crops from your office desktop or on your mobile device anywhere in the world, with FieldLook you can monitor all your fields at once.

Compare crop and irrigation performance on different fields or analyse one specific field's over the past years. Identify problem areas as soon as they emerge for timely damage mitigation. FieldLook provides a helicopter view so you can prioritise action for those areas that need attention. It saves time, inputs and increases your output.

The weather forecasts where provided by METEOSIM focusing on the development of mesoscale and microscale weather simulation models aimed at wind energy, air quality and other meteorologically sensitive industries.

The system Module integration in the WEAM4i platform is realised by ADASA and HISPATEC which has been providing technological solutions for the agricultural sector 25 years to help you go further.

The mobile solution was developed by HYDROLOGIC which provides water stakeholders with reliable information, simulation models, in-depth water knowledge and tools for solving water problems.

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