Nytt inom behovsstyrd Bevattning

25/1 2013

Dahn Rosenquist

Agenda

- Projekt Water Bee: behovsstyrd bevattning
- Automatisk övervakning/rapportering vattenuttag

A scientific approach to irrigation scheduling

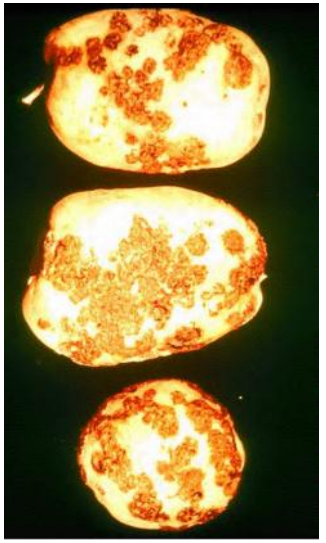
Dr Andrew J. Thompson, Cranfield University

a.j.thompson@cranfield.ac.uk

Why is irrigation scheduling important?

➢ improve yield and quality

- too much irrigation reduces yield (anoxic stress, loss of N, disease, poor soil structure)
- too little irrigation causes stress, poor growth, poor quality
- deficit irrigation can increase fruit quality and harvest index



➢ avoid waste of water (water/energy/labour)

- losses to drainage
- surface evaporation from soil
- excessive transpiration

➢ environmental damage

- leaching pesticides and nitrogen to water courses
- salinisation of soils
- depletion of water in aquatic ecosystems

Irrigation scheduling: four approaches

1. Soil inspection and farmer judgment:

Feeling

Kicking

Intuition

Your judgement may be good, but do you really know how much water your soil will hold, or when the crop will start to get stressed?

Irrigation scheduling: four approaches

2. Water balance calculations

ΔSMD (soil moisture deficit) = (Precipitation + Irrigation) – (Drainage + ET_C)

Crop evapotranspiration (ET_C) =
crop coefficient x potential evapotranspiration (ET_o)

<u>Widely used, but:</u>
Does not monitor actual soil moisture conditions and inaccuracies are cumulative

Drift can be corrected with soil moisture sensors

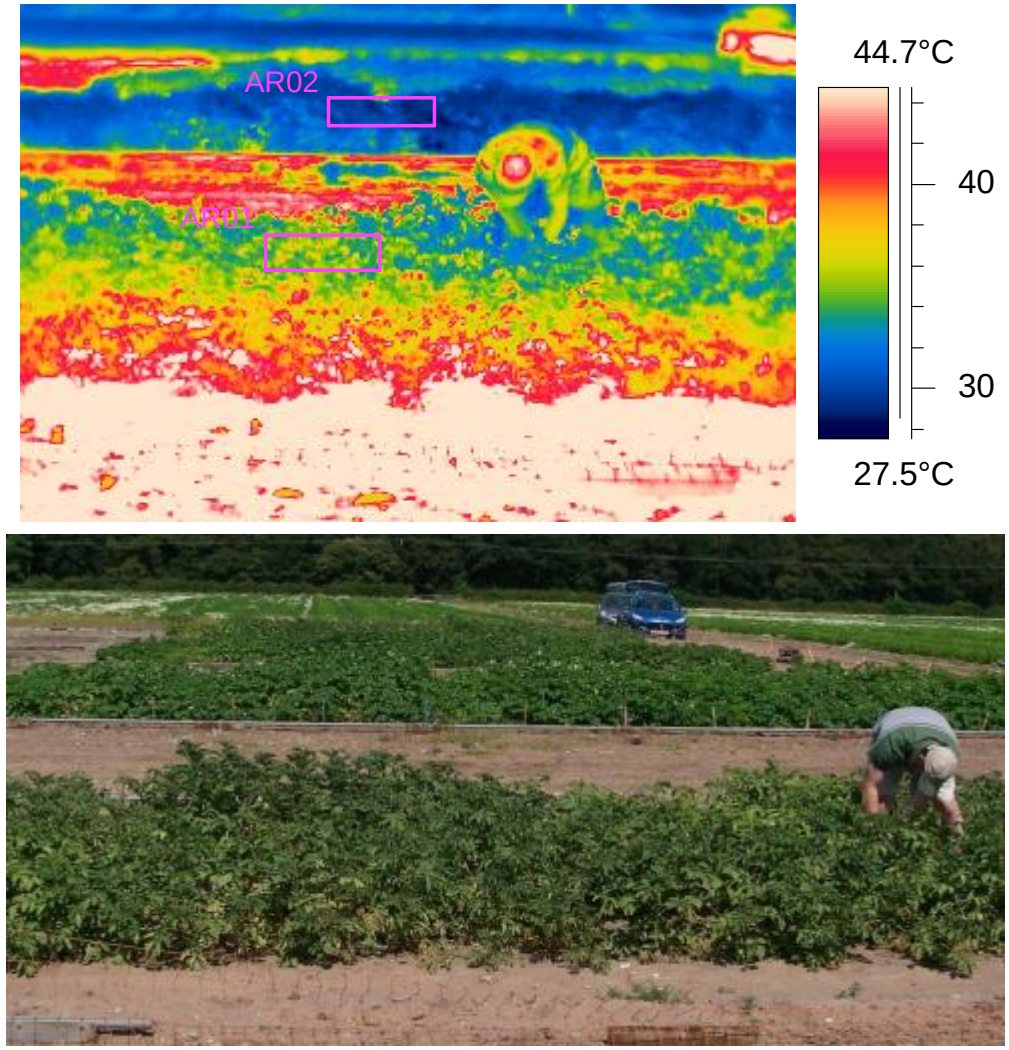
Irrigation scheduling: four approaches

3. Crop monitoring:

- thermal imaging
- leaf thickness
- leaf wetness
- stem flow

Determines when to irrigate (but usually too late), but not how much.

Not well established



Irrigation scheduling: four approaches

4. Direct monitoring of soil water content

Portable soil moisture probes

- expensive and time consuming to collect data
- few data points

In situ soil moisture probes

Potential for accurate and continuous data collection at low cost

This approach used in WaterBee

Irrigation scheduling: four approaches

4. Direkt mätning av markens vatteninnehåll

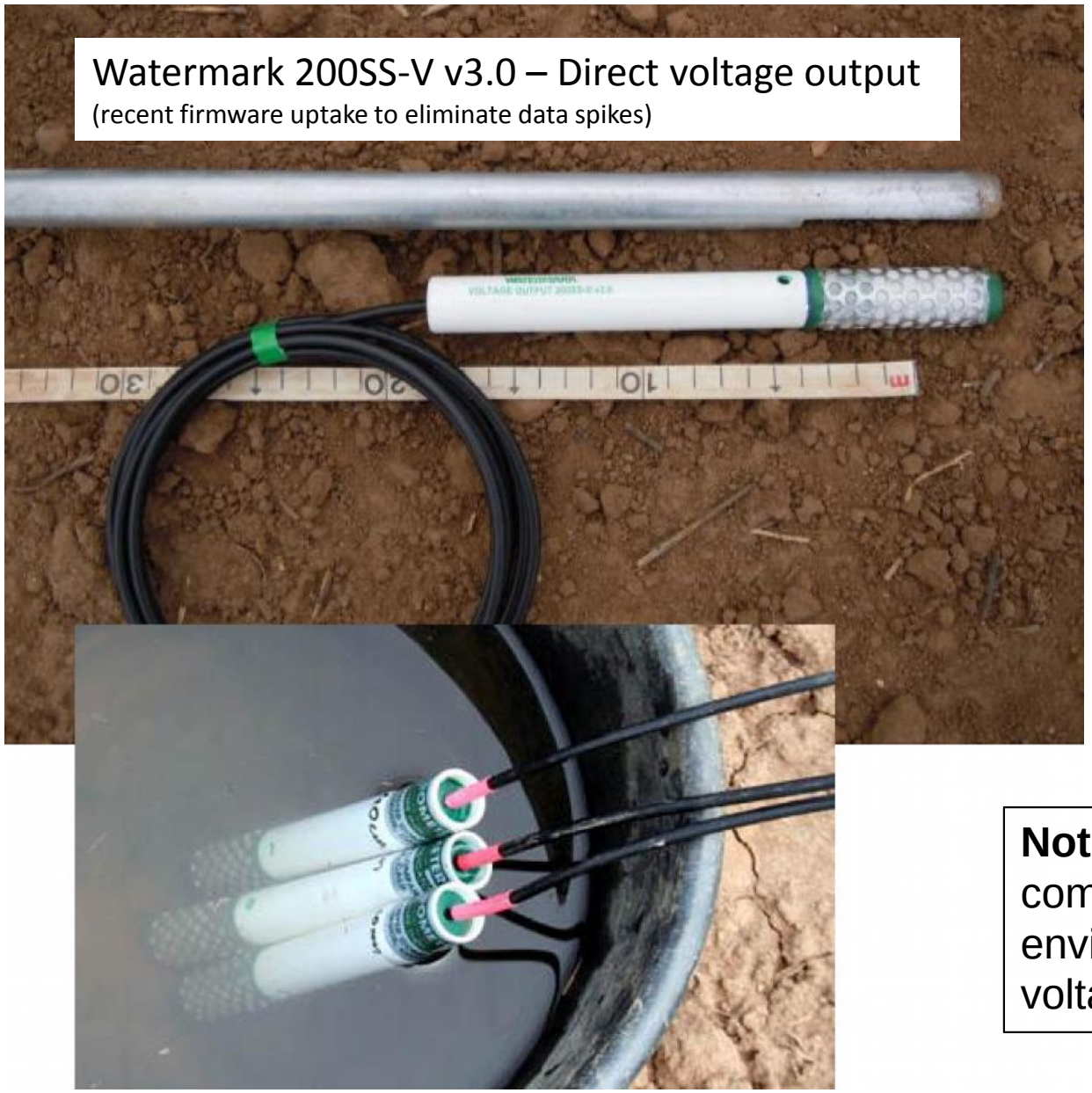
Principer:

- Det finns en nivå när vattenunderskottet börjar inverka på växtens förmåga att transpirera och växa.
- Bevattning ska sker när markvattnet sjunkit under denna gräns

Fyra huvudfrågor att lösa

1. Hur mycket fuktighetsdata behövs för att bestämma vattenunderskottet?
2. Hur ska man effektivt samla in data?
3. Vilken nivå på vattenunderskottet ska trigga start av bevattning?
4. Vad är en optimal bevattningsgiva?

Choice of sensors for WaterBee: Watermark granular matrix sensor

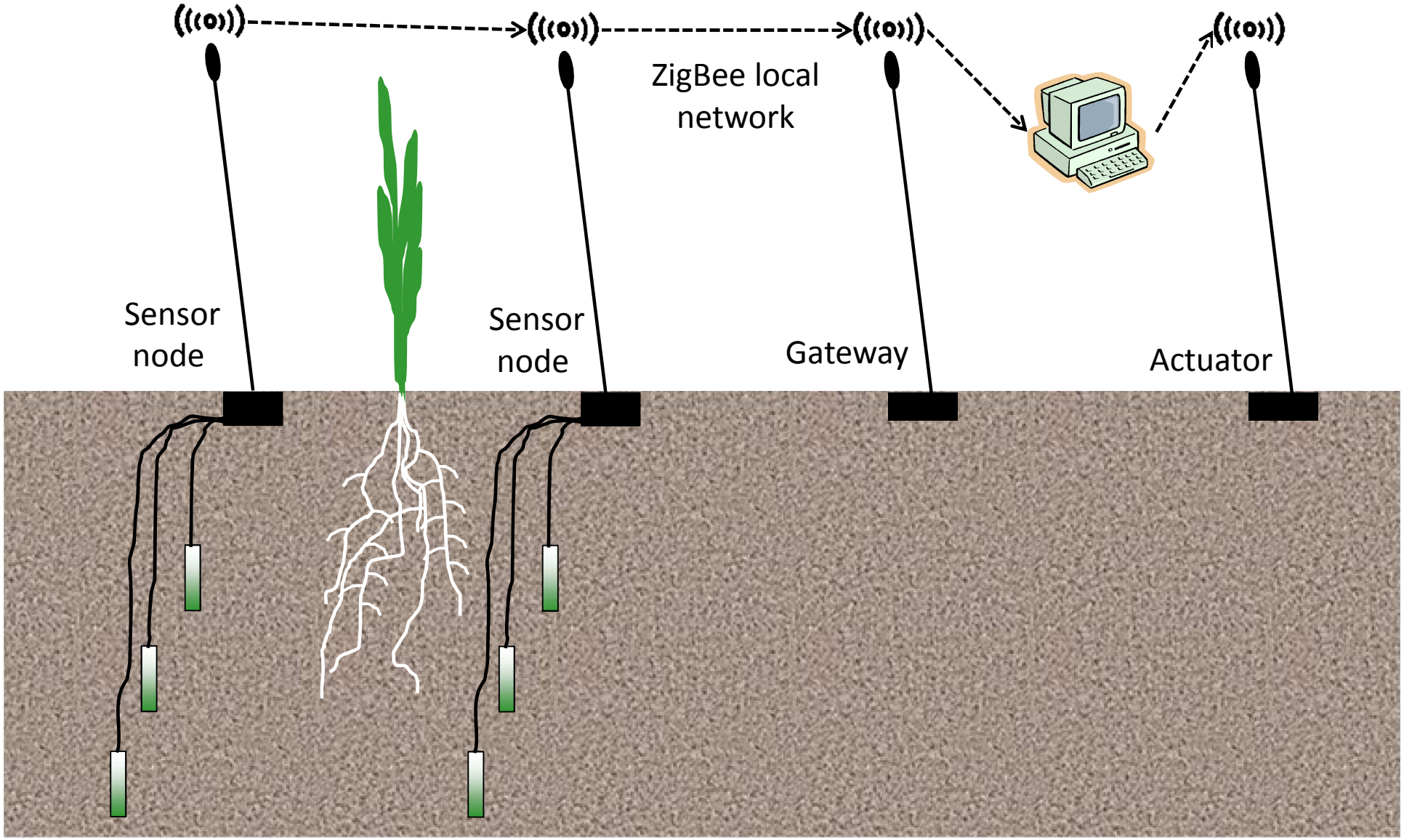


- lower cost
- suitable range of water potentials: 0 to –240 kPa
- well established reliable performance in scientific literature
- robust, long lived

- relatively slow response, suited to gradual changes in soil moisture

Note: WaterBee system is compatible with any other environmental sensors with a voltage output.

Basic architecture of WaterBee system

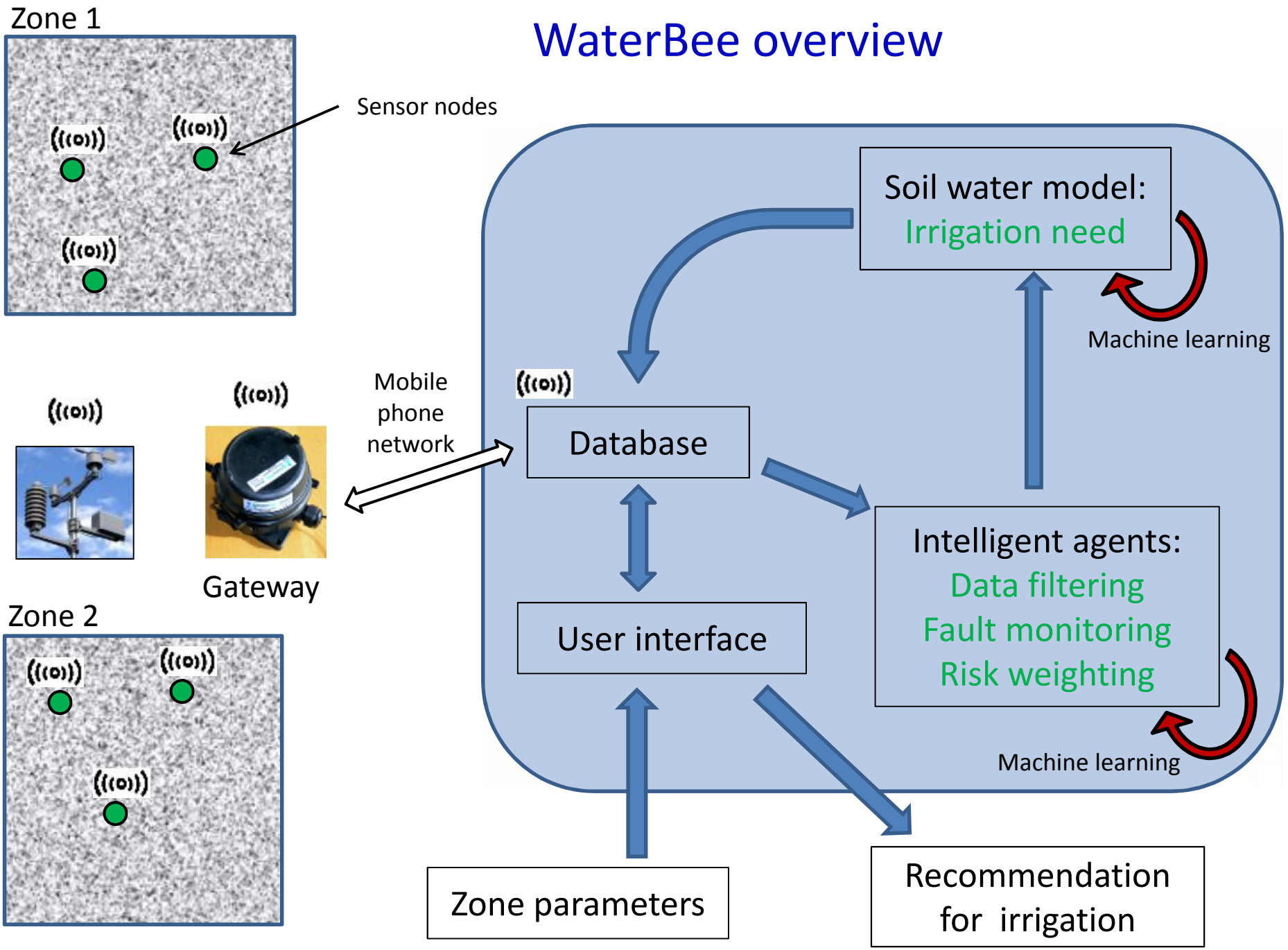


Using multiple sensors to increase accuracy

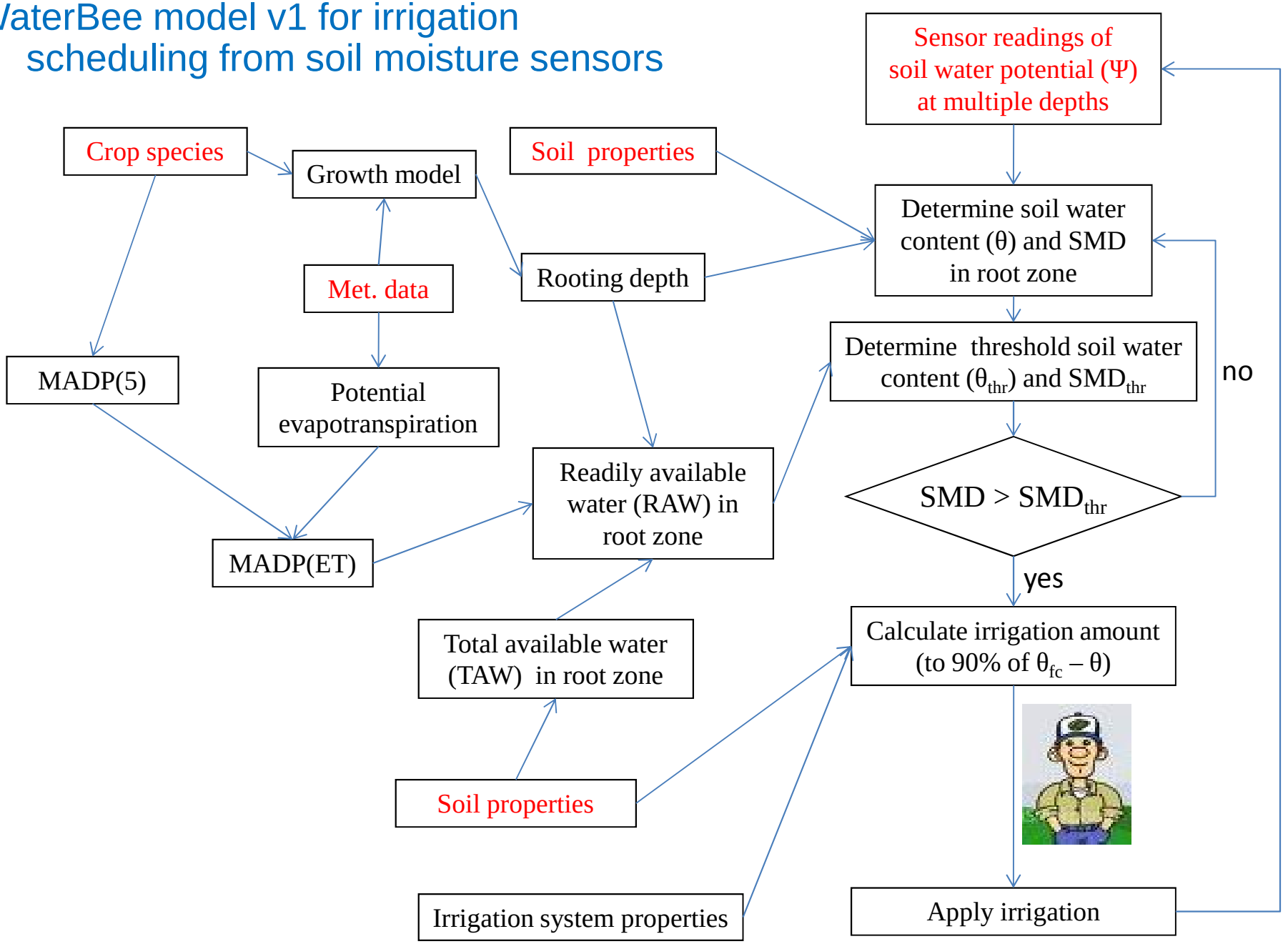
- Single sensors – prone to variation due to manufacture, installation and soil properties
- Wireless sensor networks ideally suited to multiple sensor systems
- Multiple sensors can be used to:
  - reduce error (averaging and data filtering)
  - monitor vertical distribution of soil water in the root zone
  - differential irrigation in different zones (e.g. within a field or farm)

- Compromise between single expensive/accurate sensor and multiple low cost sensors

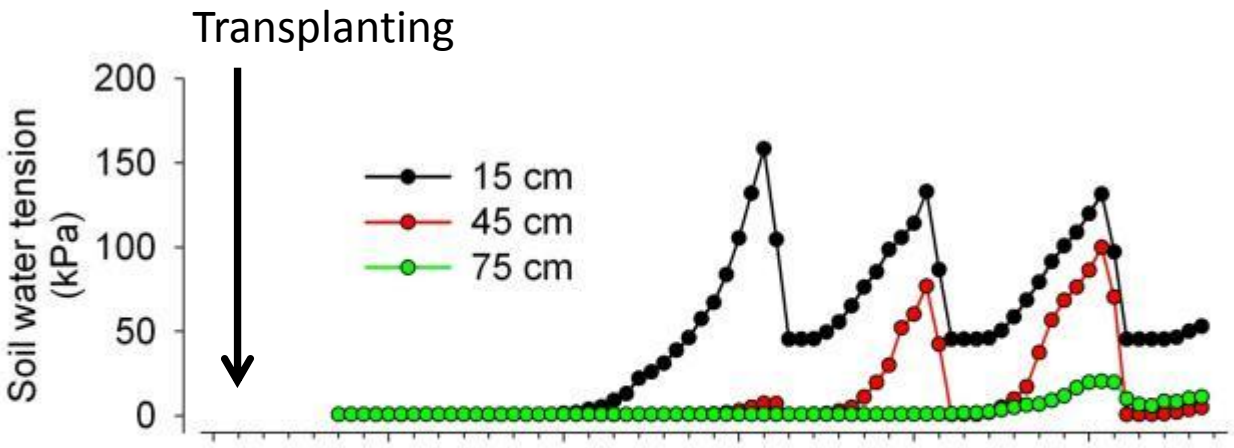
WaterBee overview

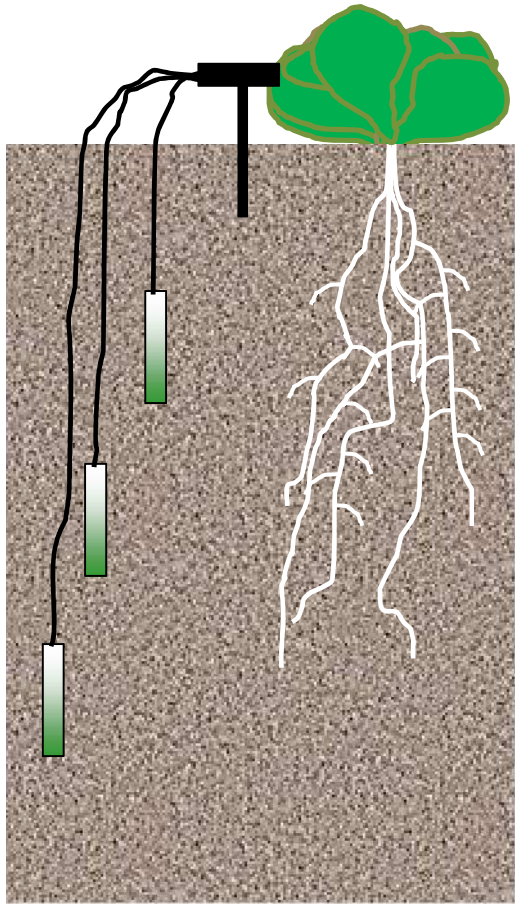


WaterBee model v1 for irrigation scheduling from soil moisture sensors



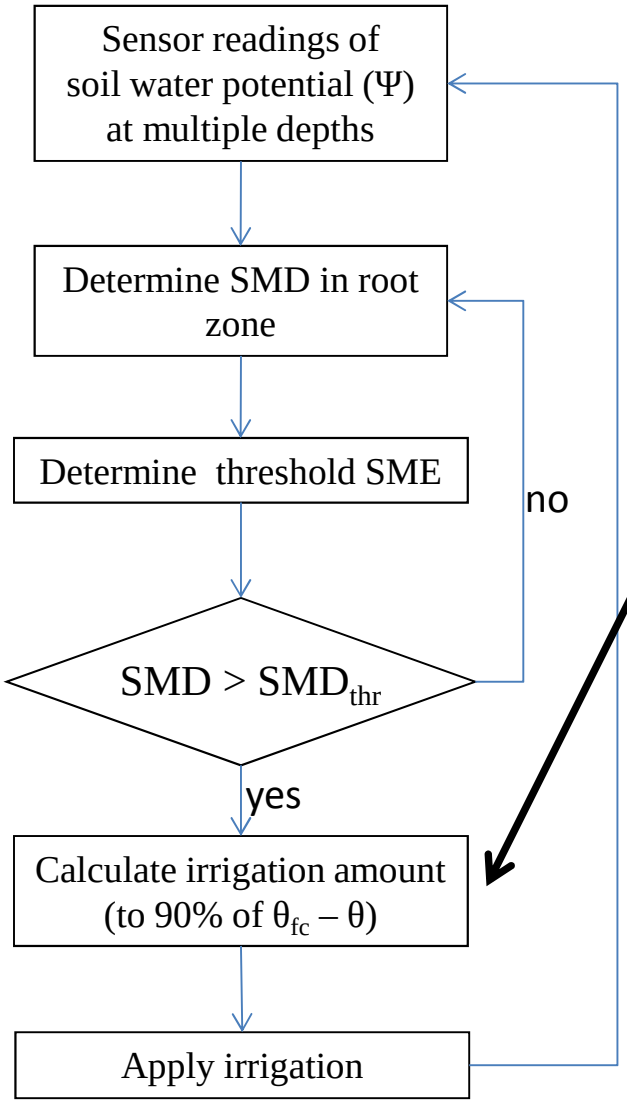
Data from running WaterBee model v1: Wellesbourne 2010 Cabbage (wired)





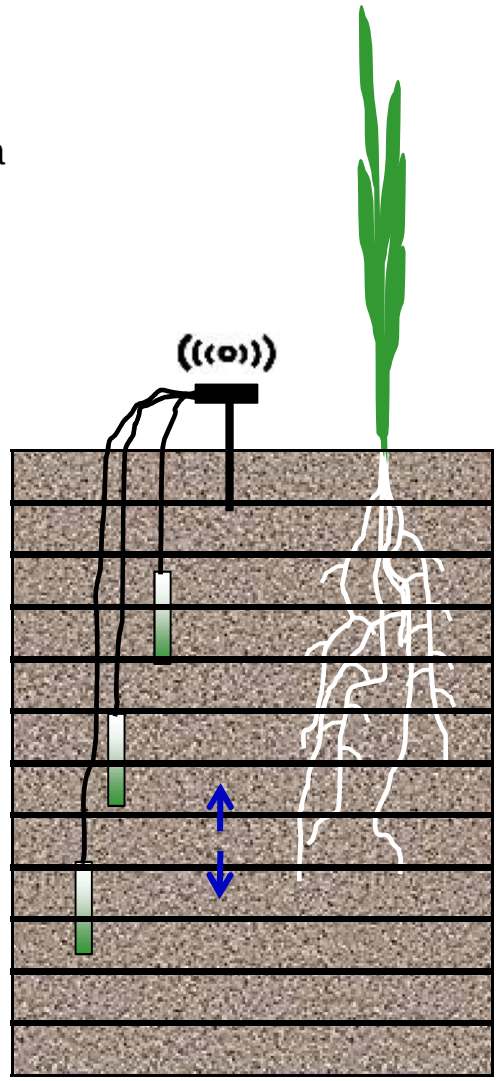
A novel predictive, dynamic model for irrigation scheduling

WaterBee model v1



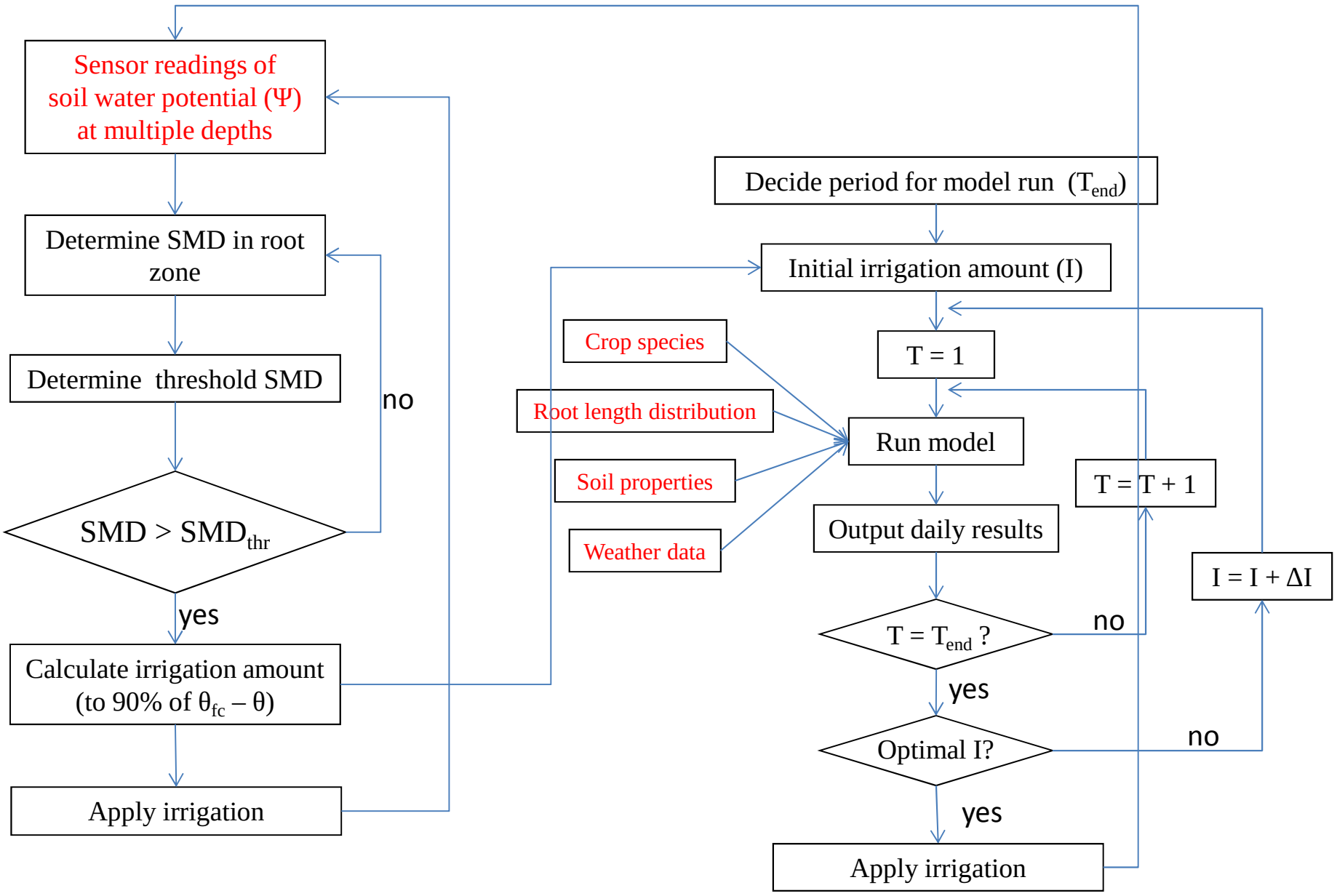
New predictive model:

Optimise irrigation amount by using a model that predicts **future** soil water content in each soil layer after an irrigation/rainfall event by calculating soil water movements



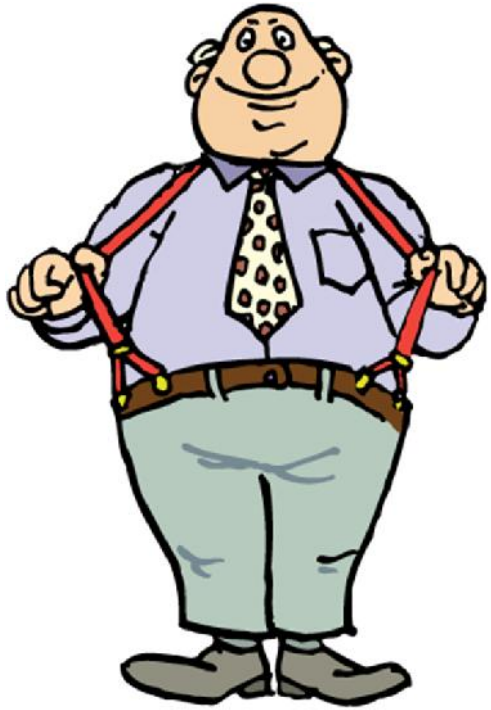
Yang et al (2009) J. Hydrology **370**:177-190

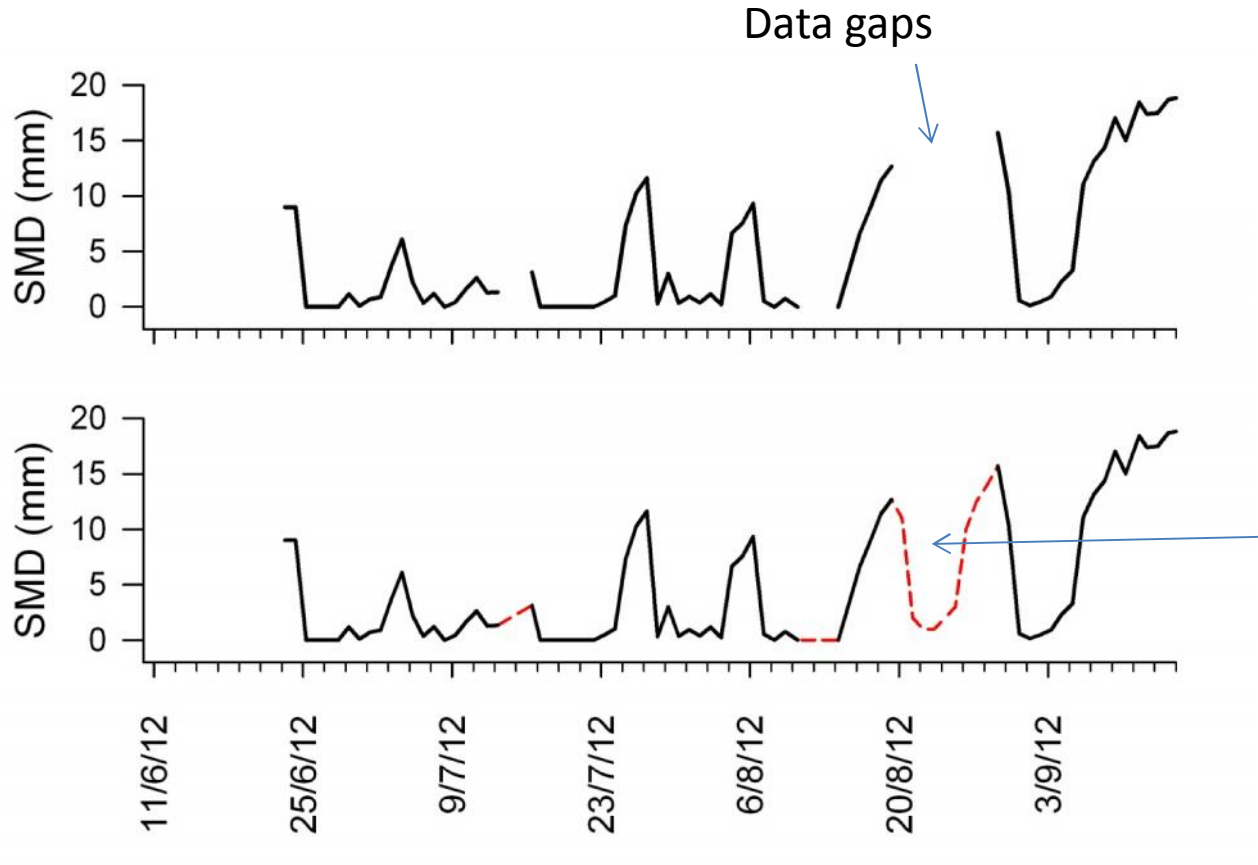
A novel predictive, dynamic model for irrigation scheduling



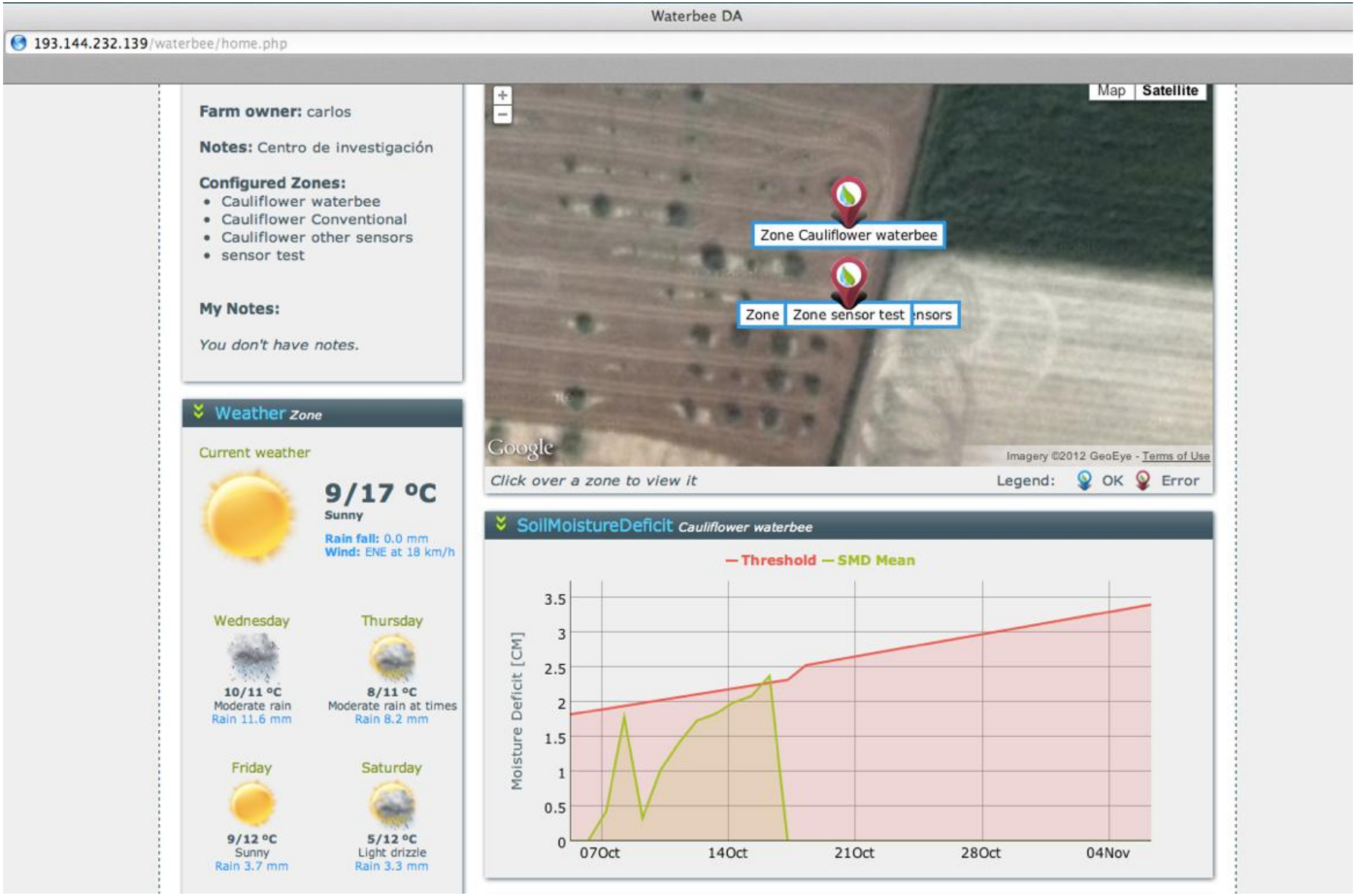
A robust scheduling system: belt and braces

any data gaps from soil sensors are filled by
(a) predictive model
(b) water balance calculation





Användare gränssnitt

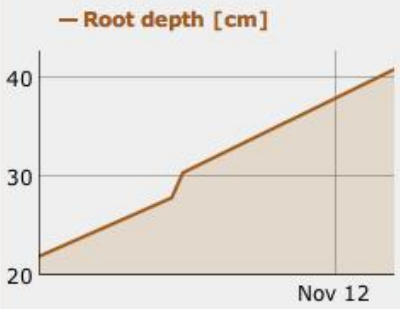


Användare gränssnitt

waterbee

Crop manager: Waterbee1

Zone notes:



Crop: Cauliflower

Soil: Loam

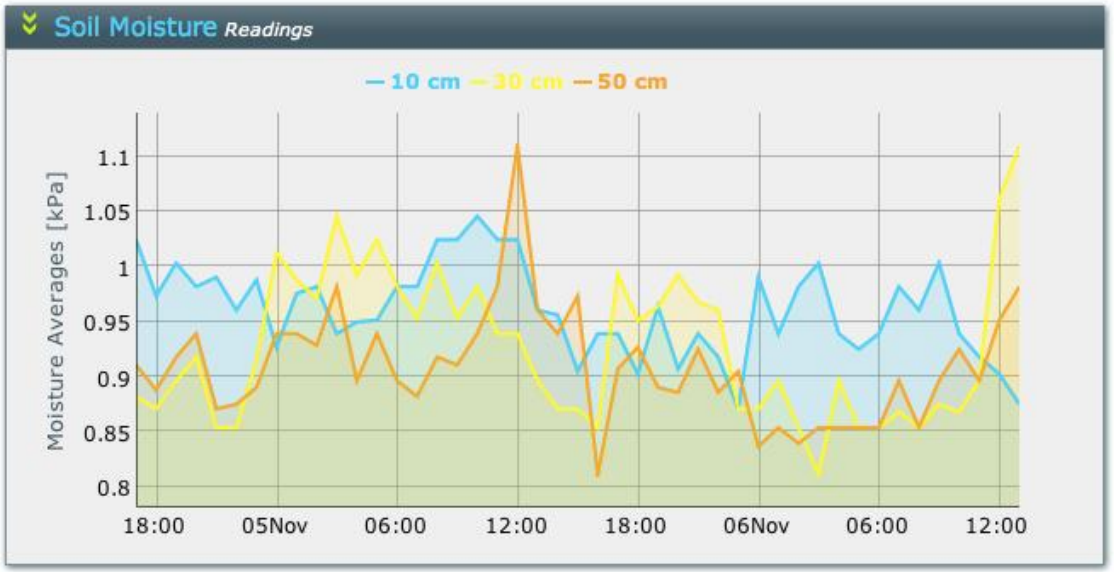
Soil Clay: 19.71 %

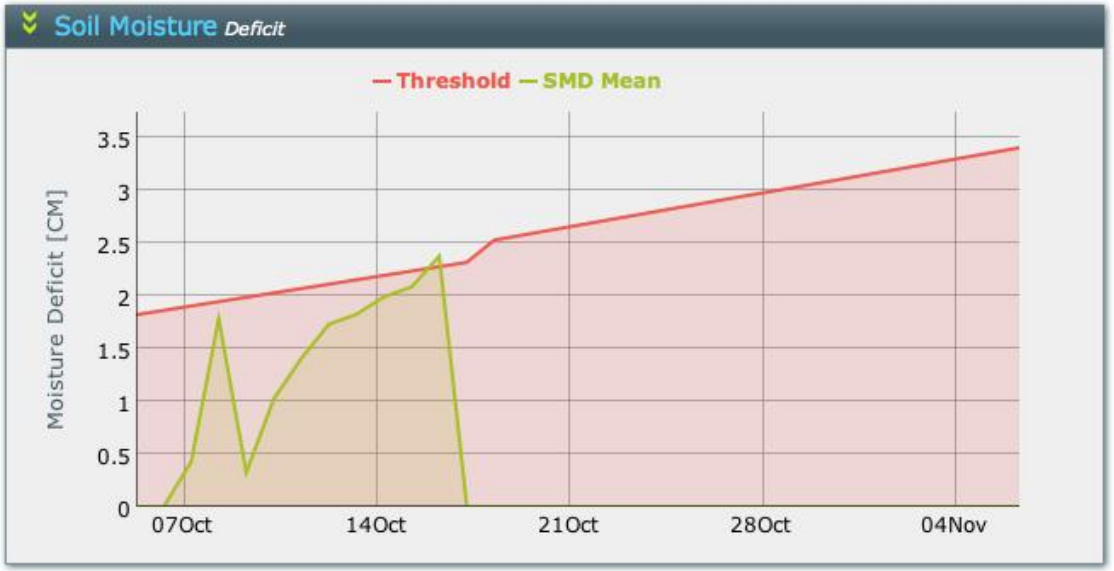
Soil Sand: 48.13 %

Avg. Ref. Trans: 2

Organic content: 1

Bulk Density: 1.6

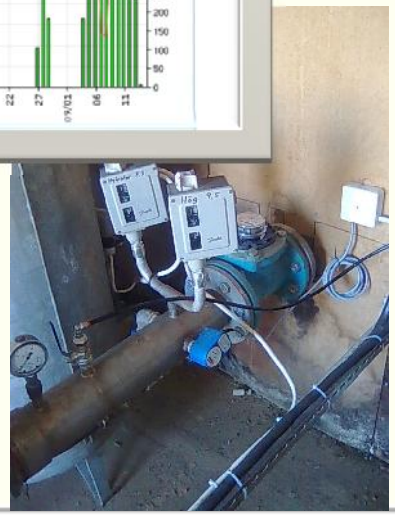




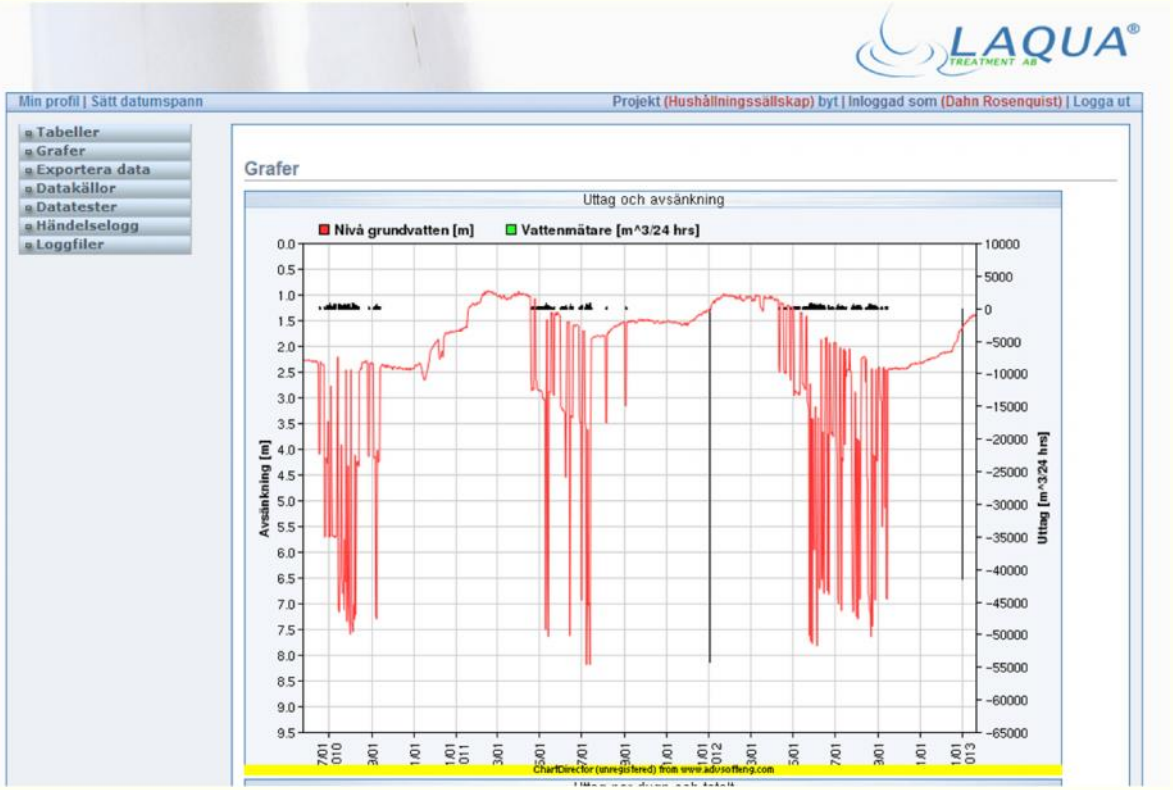
iPhone

Laqua Portal

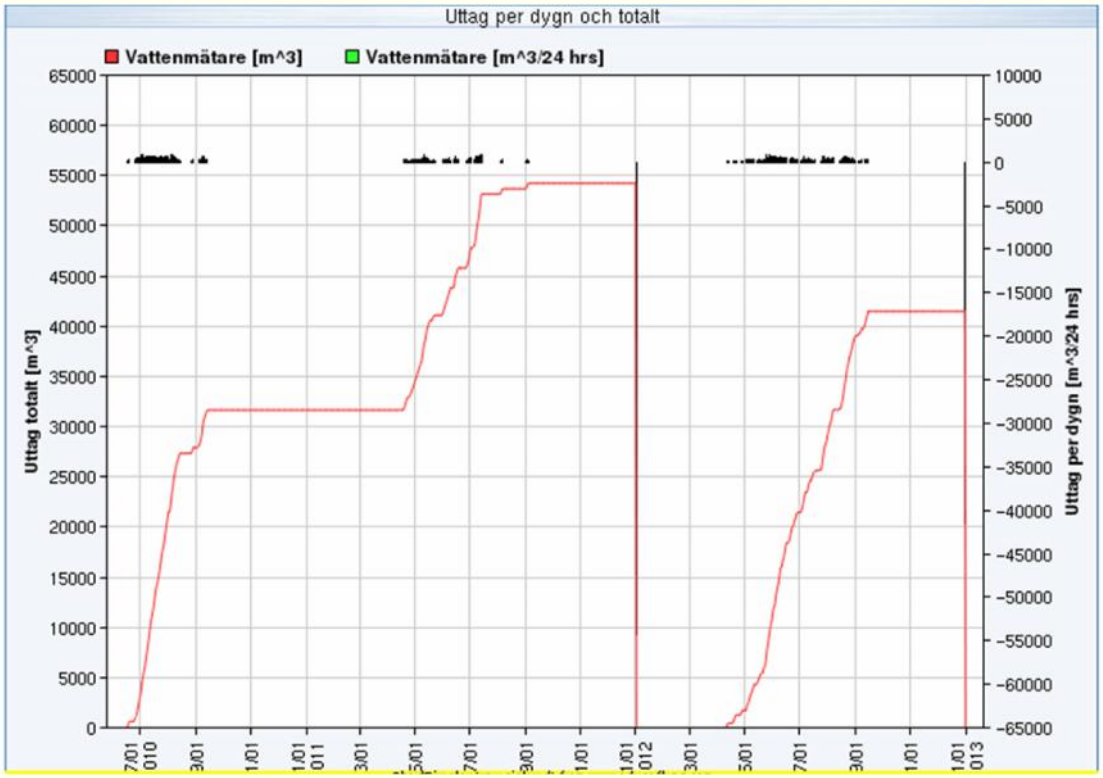
Fjärrövervakning av vattenuttag



Avsänkning 2010-2013



Total uttag 2010-2013



TACK!

Dahn Rosenquist

Laqua Treatment AB

Yngsjö

dahn@laqua.se

044 350803 0708 885735

www.laqua.se

www.waterbee.eu