



**Western Cape  
Government**

Agriculture

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# The FruitLook website: promoting increased water use efficiency in irrigation

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Sustainable Resource Management  
Elsenburg  
21 November 2012

# Fruitlook

**A spatial approach to assess and improve water use efficiency of vineyards and deciduous fruit orchards in the Western Cape**

Andre Roux, Caren Jarmain (UKZN) and Annemarie Klaasse (eLeaf)

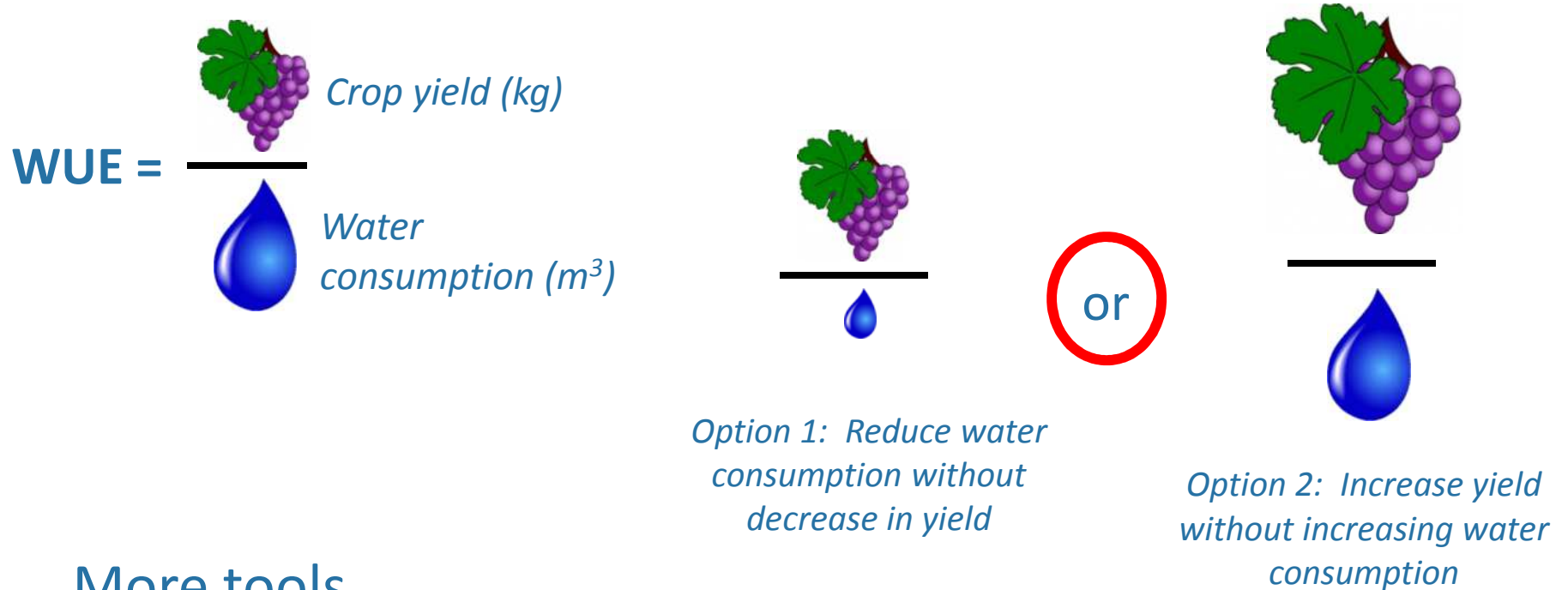
[andrerr@elsenburg.com](mailto:andrerr@elsenburg.com)



# Need

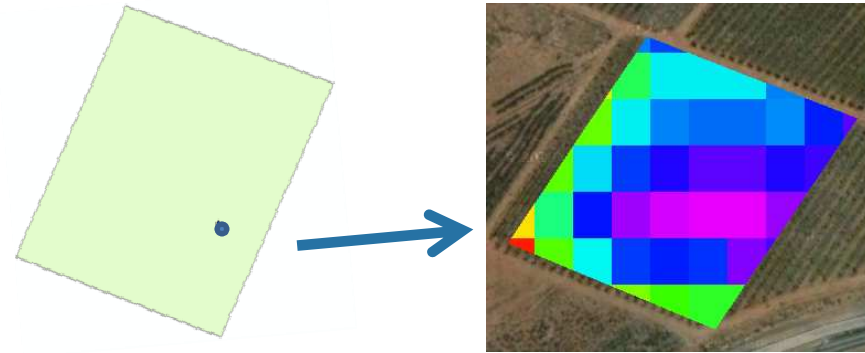
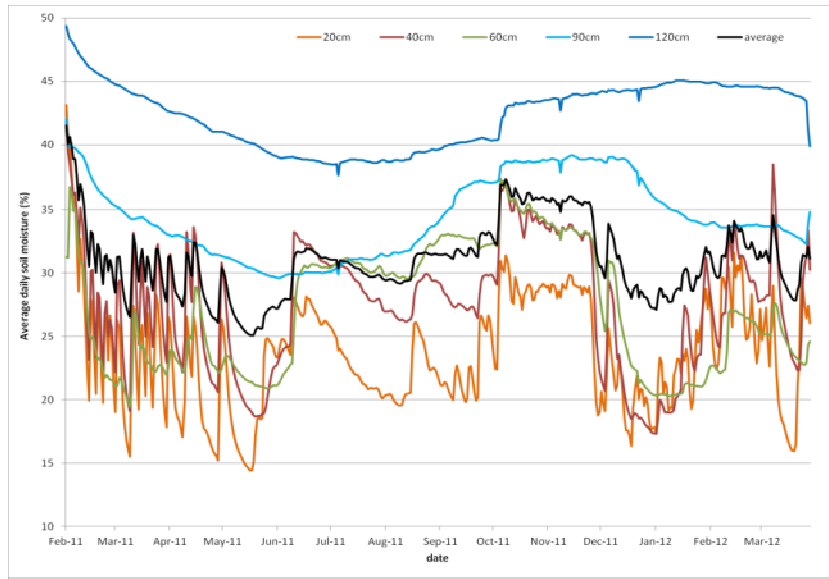
Improve efficiency of resource use

- National Water Act (1998): “*water should be used more efficiently*”
- Mitigate impacts of climate change



More tools...

# Current solutions



Soil moisture measurements, Stem water potential:

- Frequent updates (e.g. every hour, daily)
- One point only (not necessarily representative of block)



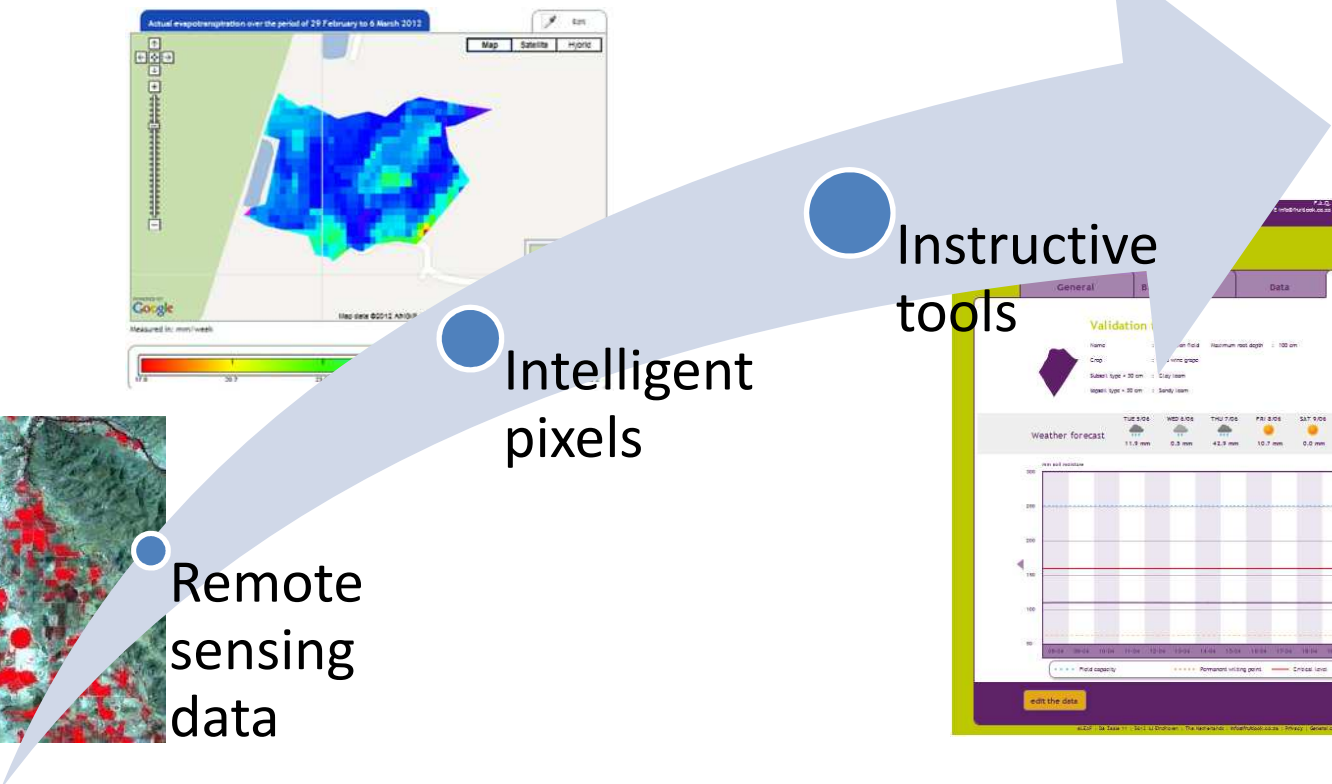
Aerial photography

- High spatial detail
- Only once or twice during season



# Fruitlook solution

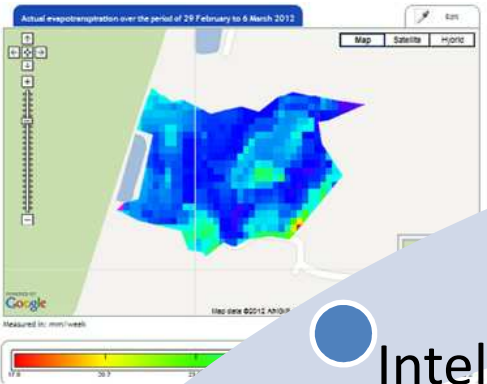
- Complementary to current solutions
- Spatial, quantitative, repetitive, unbiased
  - Satellite based (Electromagnetic spectrum)
- Energy balance NOT water balance approach




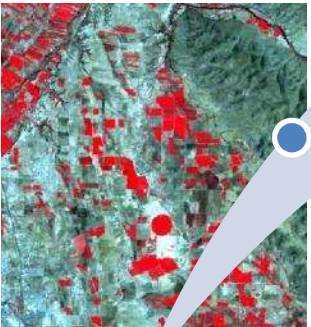
Remote sensing data

Intelligent pixels

Instructive tools



Actual evapotranspiration over the period of 29 February to 6 March 2012

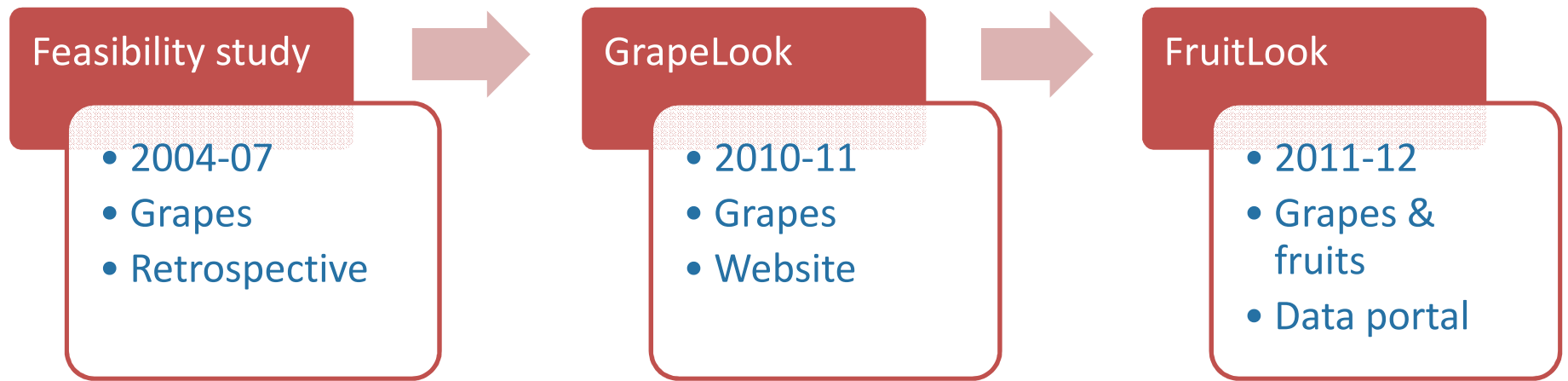


Validation	General	Data	Advice
Name	Location	Maximum red depth	100 mm
Crop	Planting date		
Soil: type < 20 cm	Clay: mm		
Soil: type < 80 cm	Sand: mm		

Weather forecast

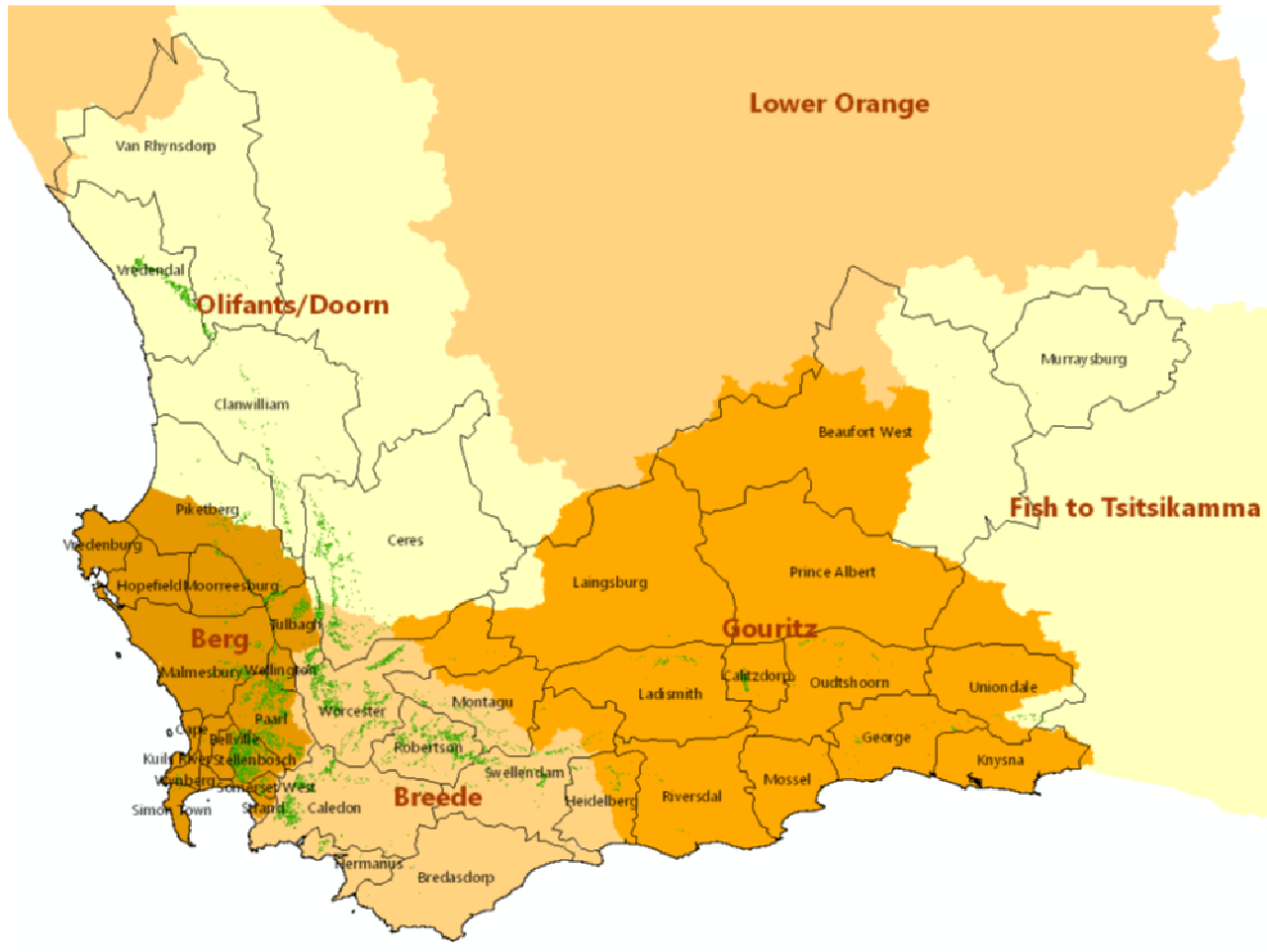
TUE 9:00	WED 9:00	THU 7:00	FRI 8:00	SAT 9:00
11.0 mm	0.0 mm	41.9 mm	10.7 mm	0.0 mm

edit the data

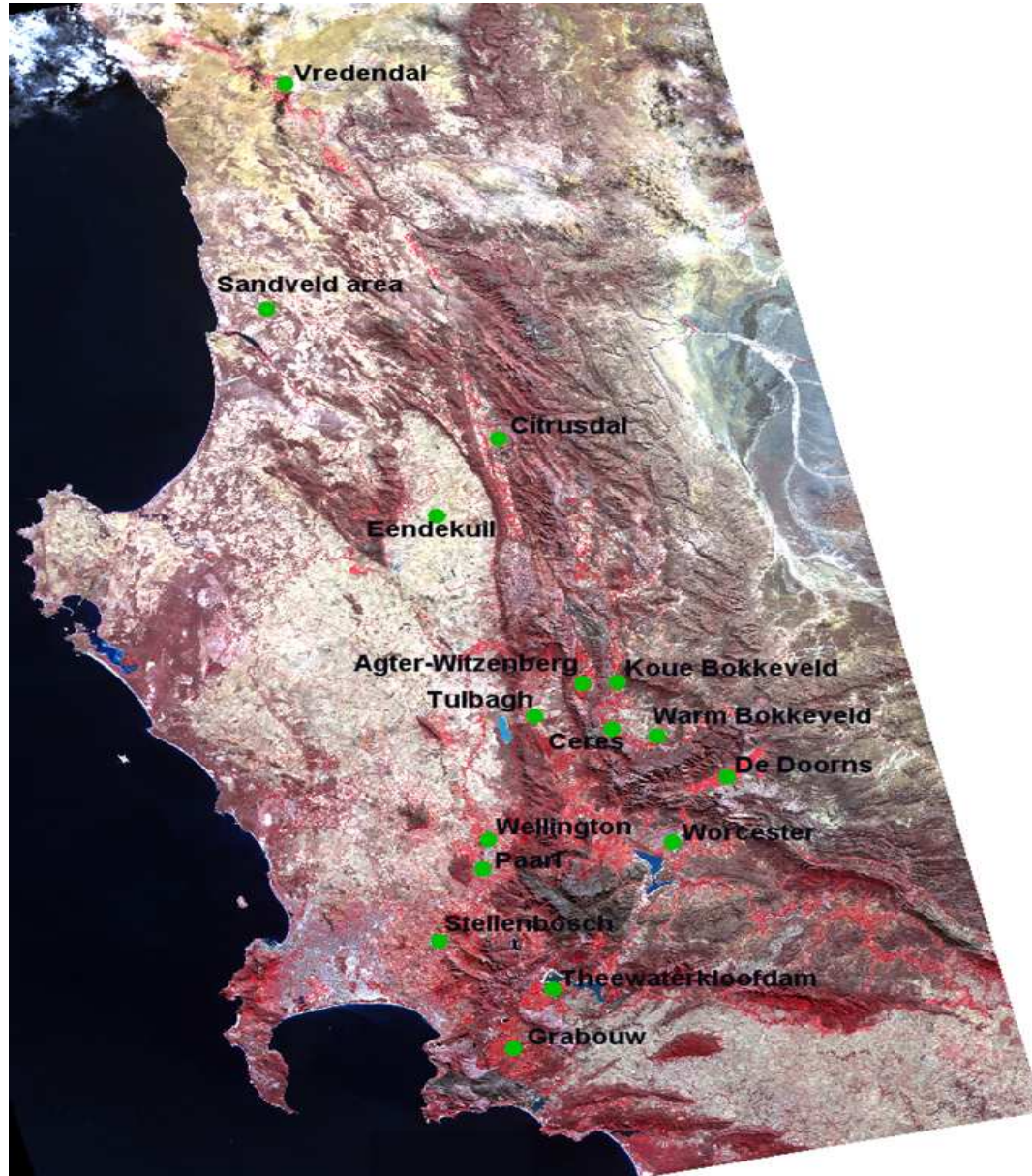


Fruitlook goal...to demonstrate an operational service providing crop water, nutrient and growth information to fruit and grape farmers in the Western Cape of South Africa

- to improve water use efficiency
- to reduce input costs



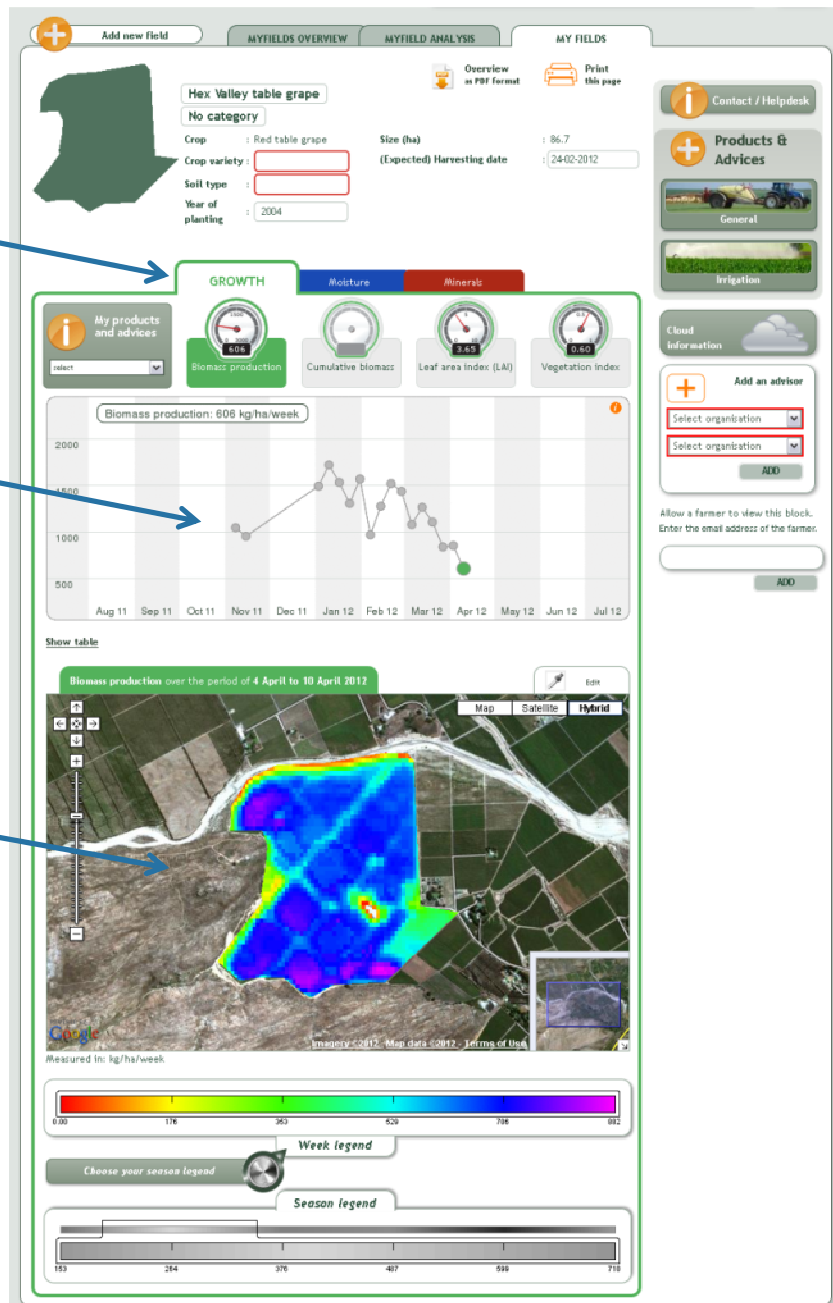
# Fruitlook study area



8 parameters

Change over time

Change in space



### Parameter maps (weekly updated):

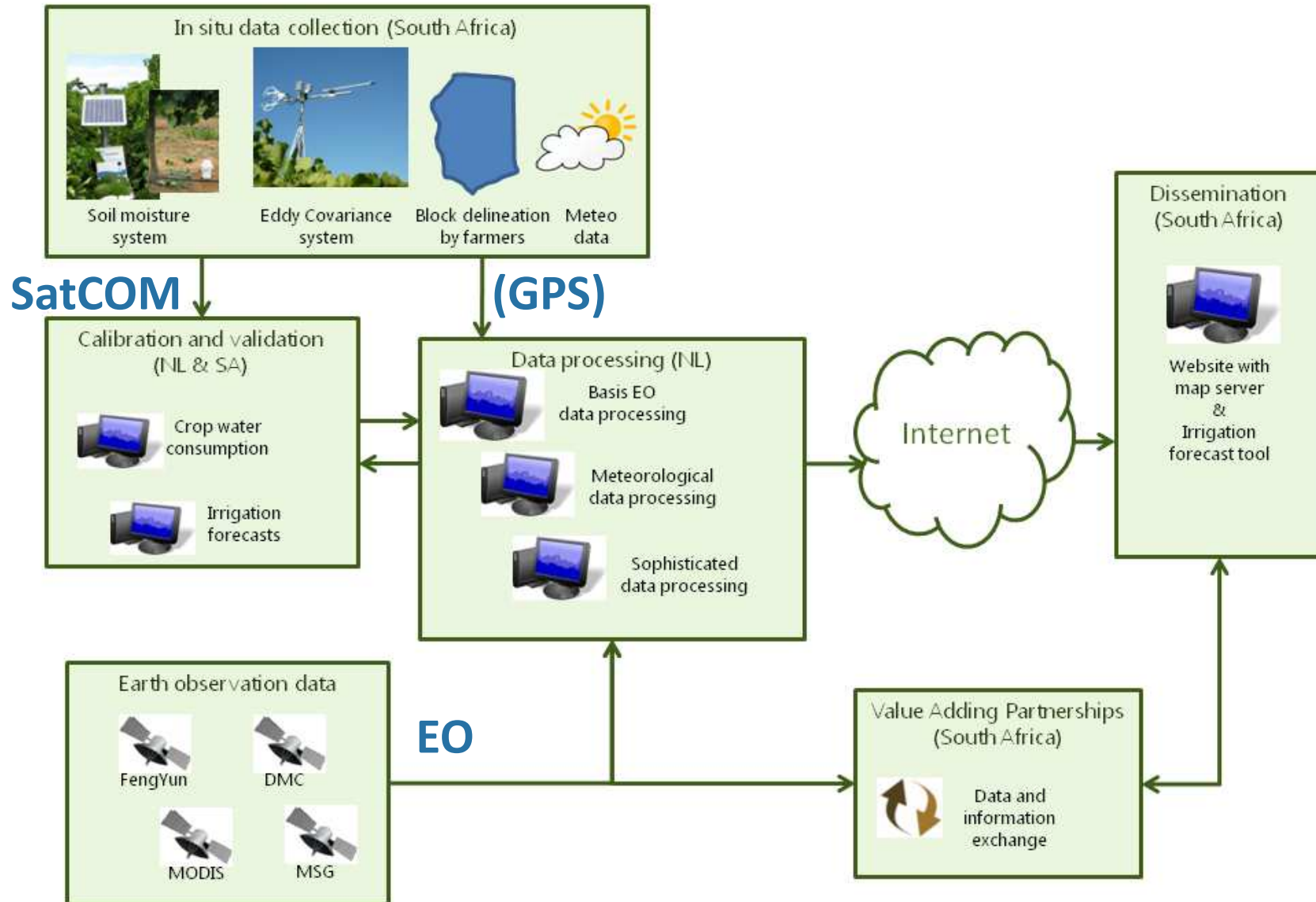
- Actual evapotranspiration
- Evapotranspiration deficit
- Crop factor
- Biomass production
- Biomass water use efficiency
- Leaf Area Index
- Nitrogen content (plant)
- Nitrogen content (top leaf)

### Forecasts:

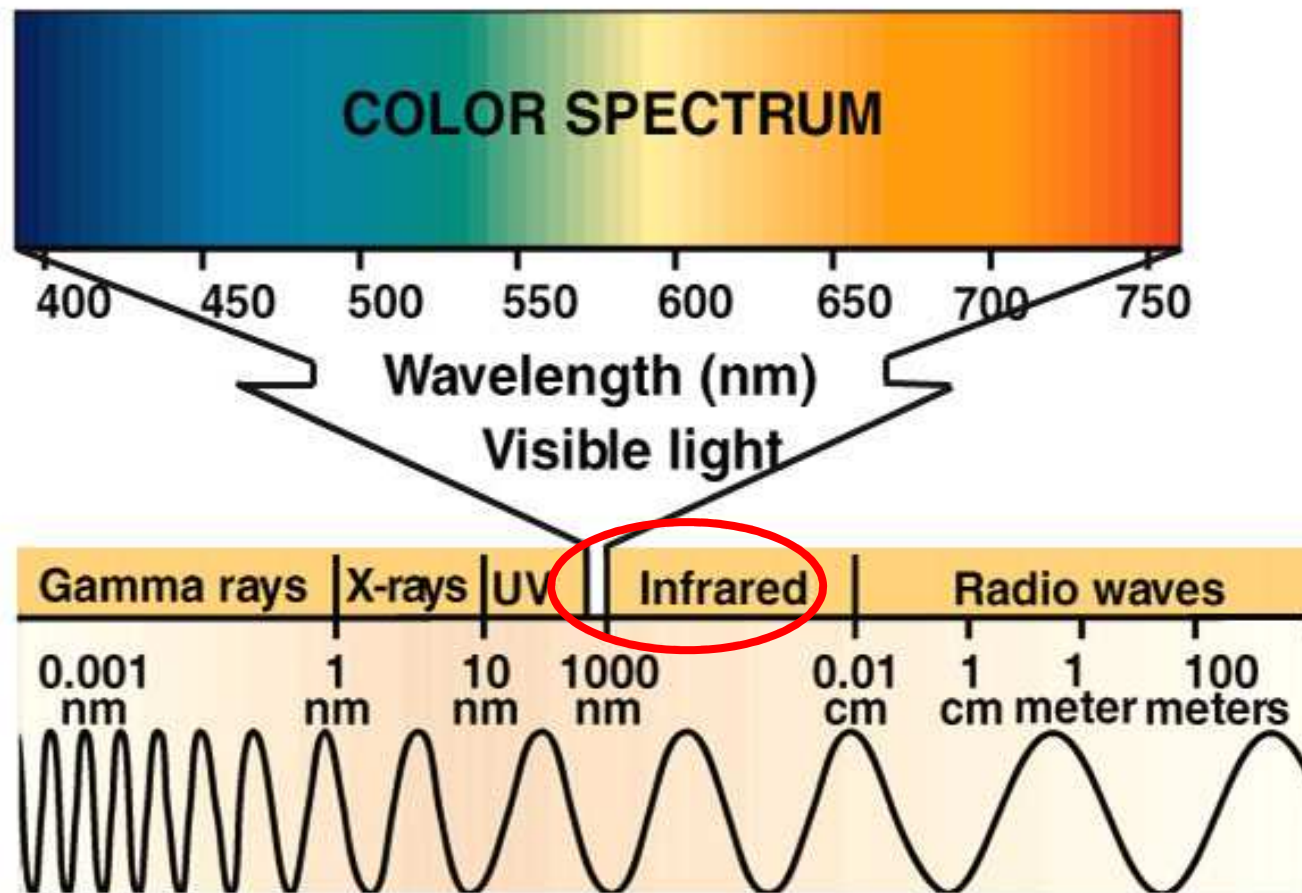
- Soil moisture content

**Parameter data is created without any input from the farmer!**

# FruitLook system

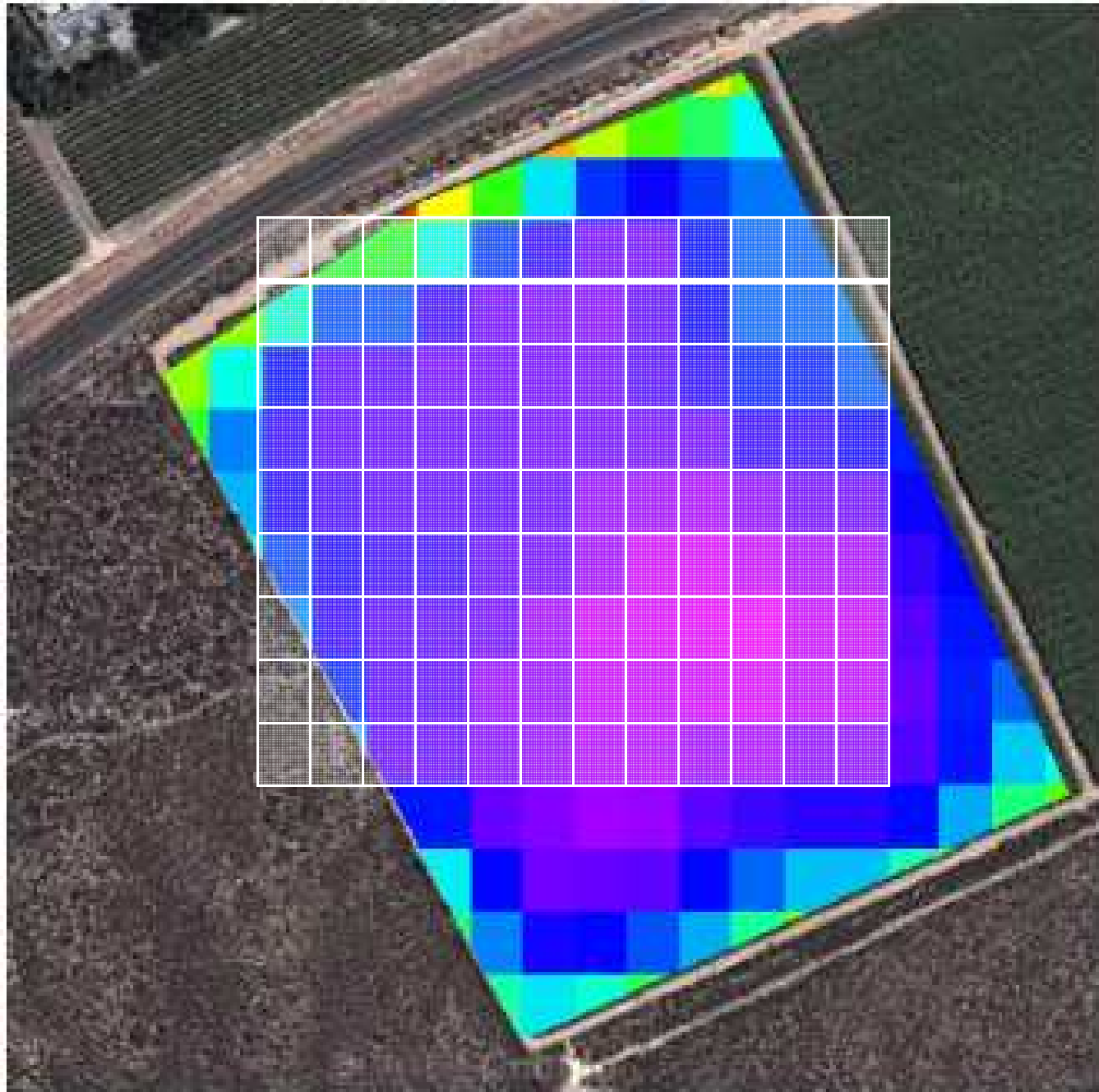


# The electromagnetic (EM) spectrum - *More than the eye can see...*

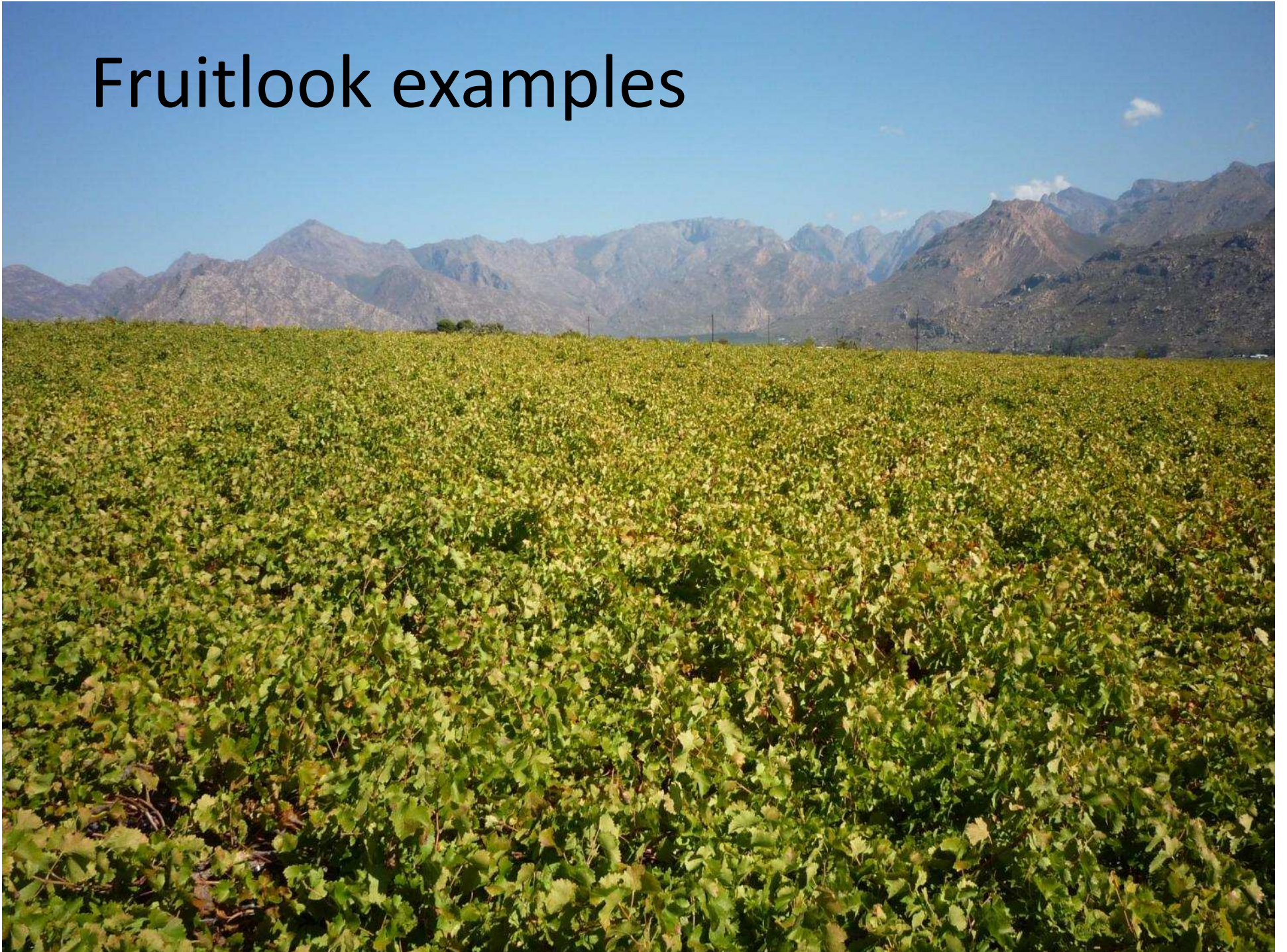


***An image of a surface and its surface temperature – spot the differences...***



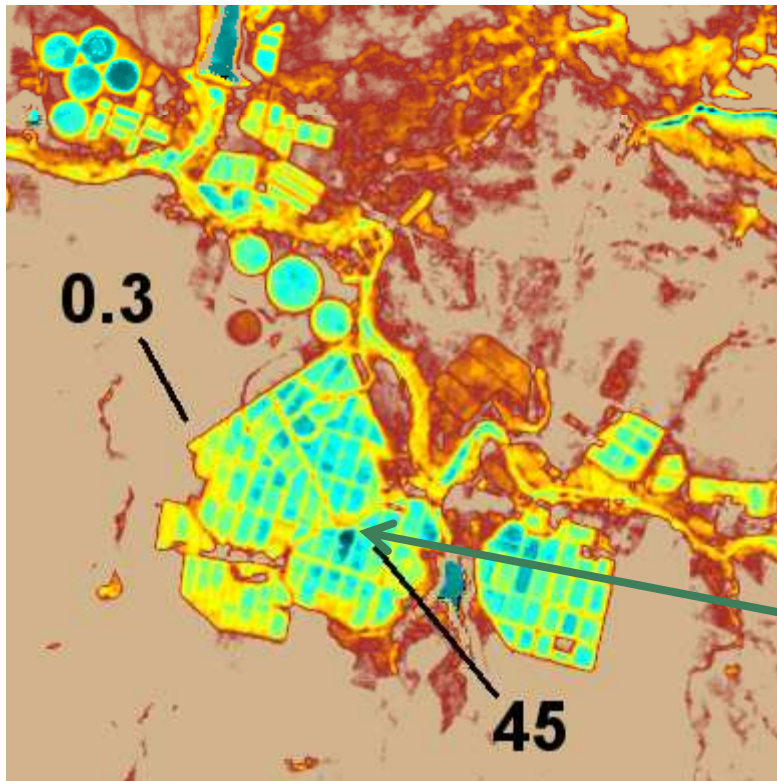
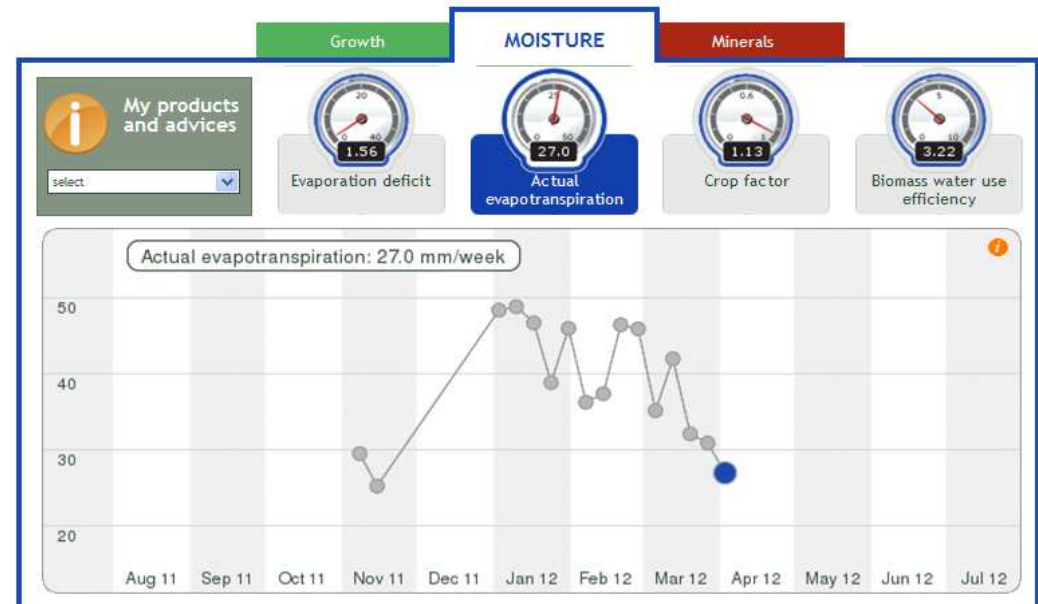


# Fruitlook examples



# Example 1: Evapotranspiration, Irrigation

Farmer Bennie checks the performance of his irrigation system



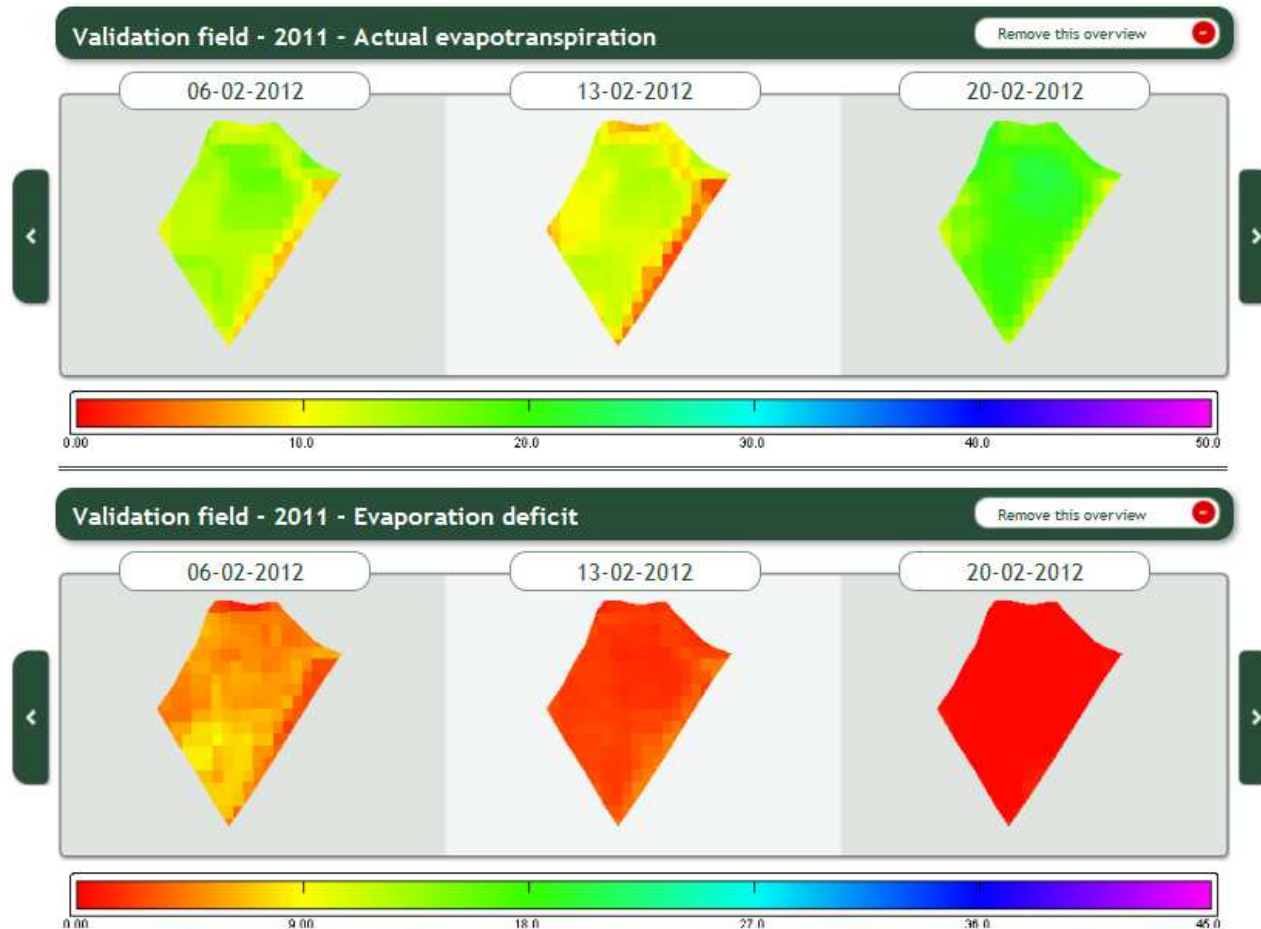
Irrigates 65 mm/week

As actual evapotranspiration is 45 mm/week, his irrigation efficiency is  $45/65 = \sim 70\%$

Spot with very high  $ET_{act}$  : irrigation leakage?

# Example 2: Evapotranspiration, Irrigation

Farmer Wilhelm evaluates and plans his irrigation applications



*Farmers with fixed weekly irrigation schedule can evaluate if they are running into a deficit over time / over irrigating*

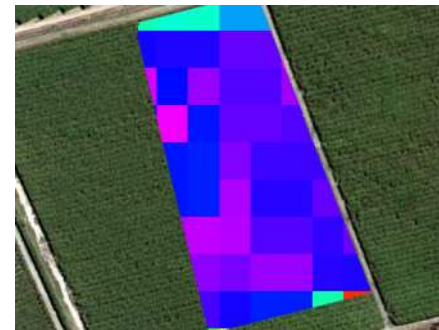
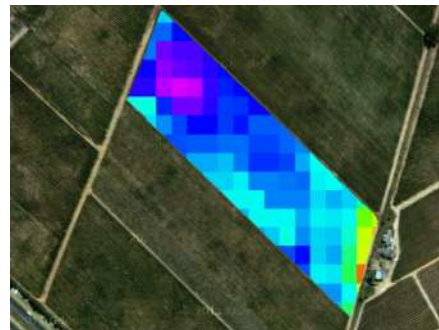
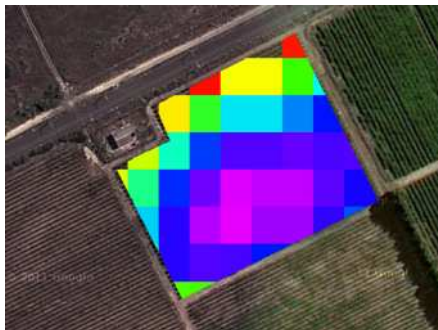
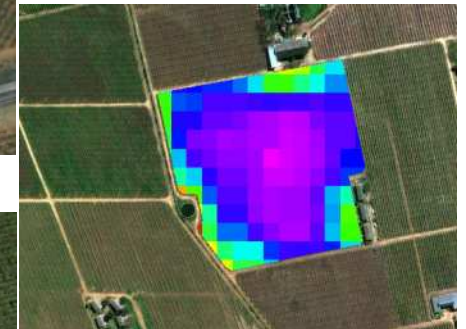
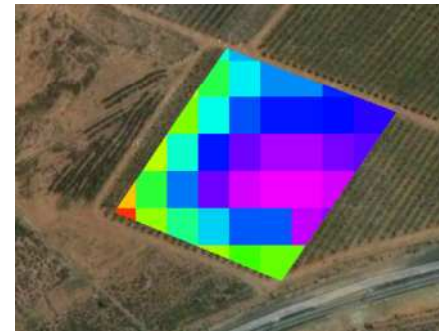
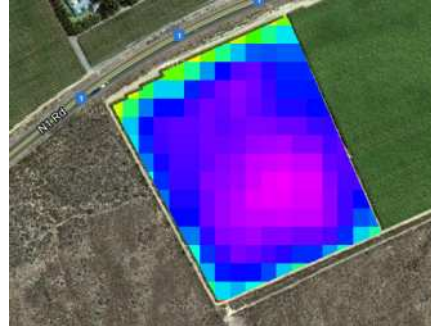
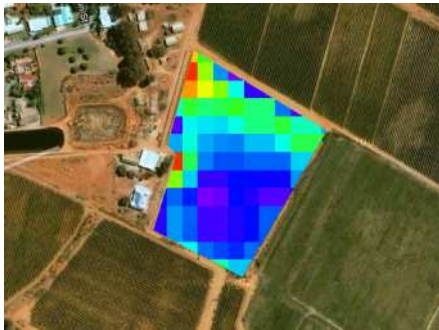
# Example 3: Evapotranspiration, ETdeficit

## Consultant Needs

Checks FruitLook.co.za weekly

Phones farmer when action is required (e.g. high evapotranspiration deficit in specific block)

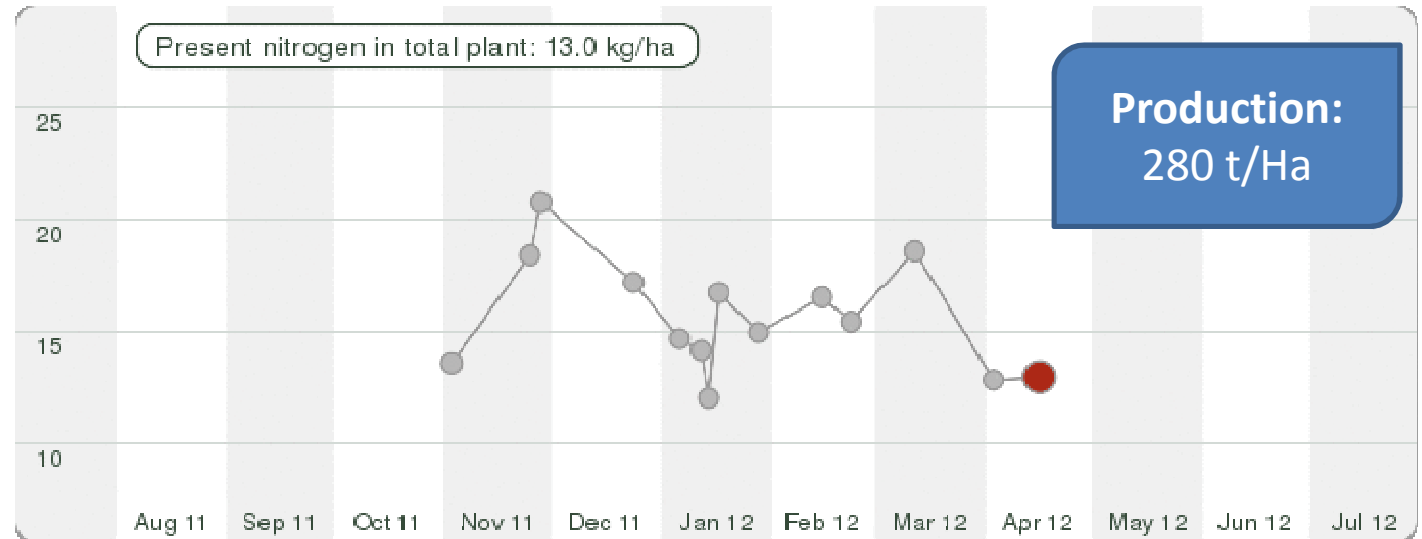
- *Long term contact with farmer*
- *Knows all about farm (soil, cultivars, trellis system, irrigation system and schedule) and farmer (objectives, management style)*
- *Strong expertise on irrigation planning*



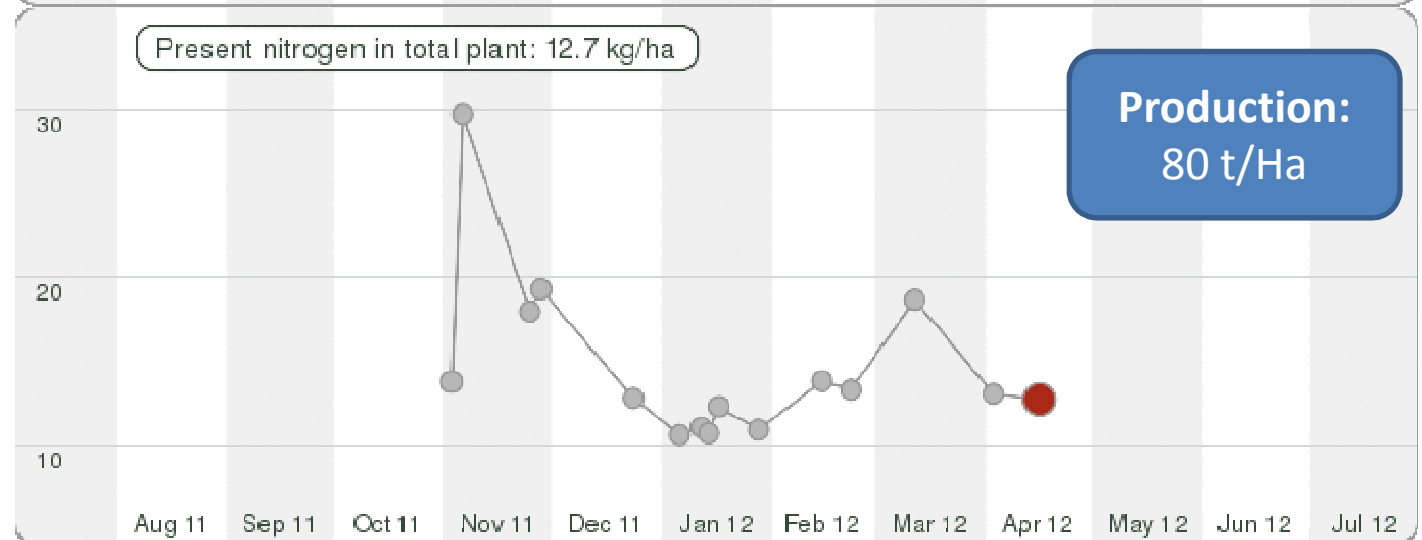
# Example 4: Yield variation and Nitrogen

Consultant Piet investigates differences in yield and possible impact of Nitrogen

*Slow releasing N*



*Fast releasing N*



# Example 5: Benchmarking for sustainable farming

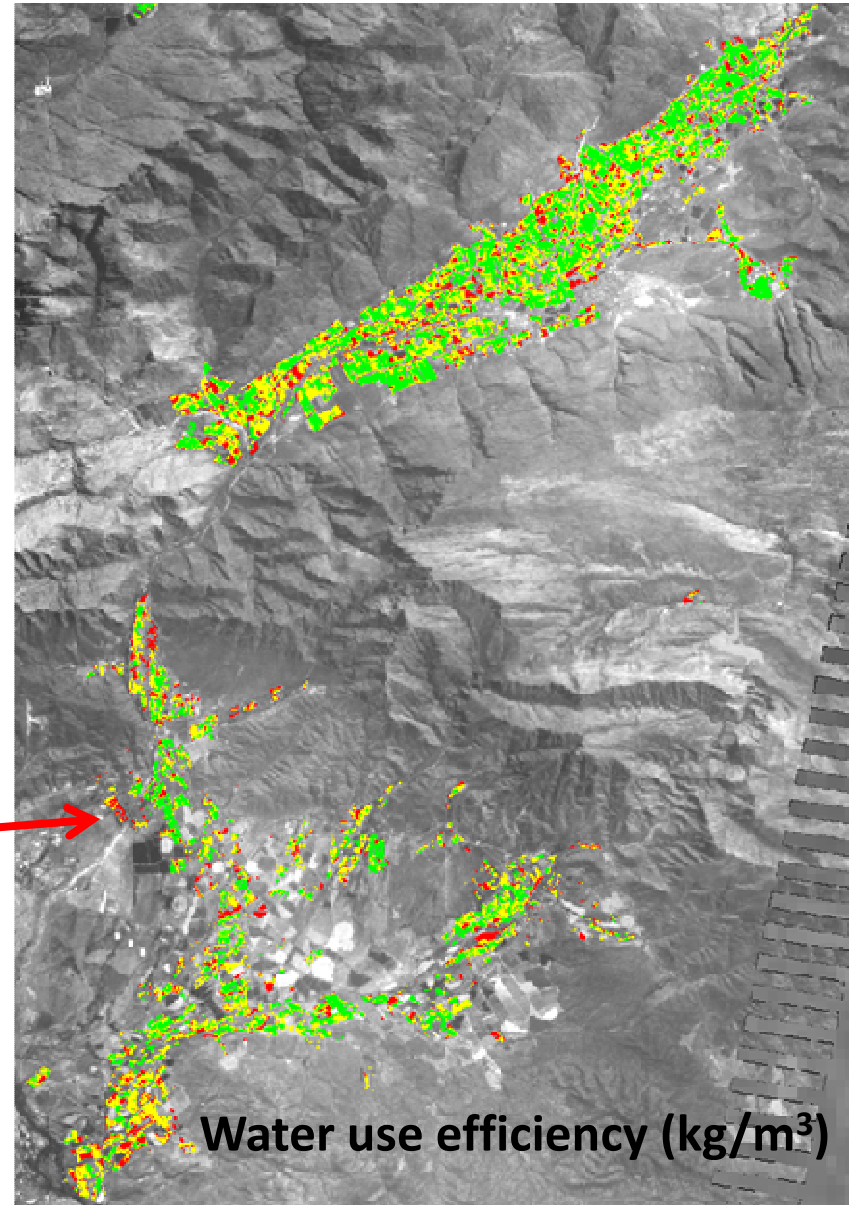
Evaluating water use efficiency of crops produced against benchmarking standards set for crops, cultivars and regions

Red areas - low

Yellow - normal (average)

Green - above average

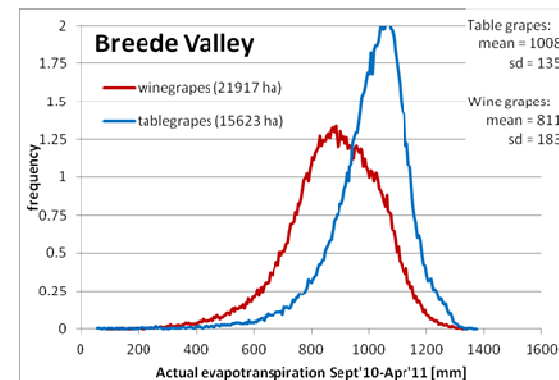
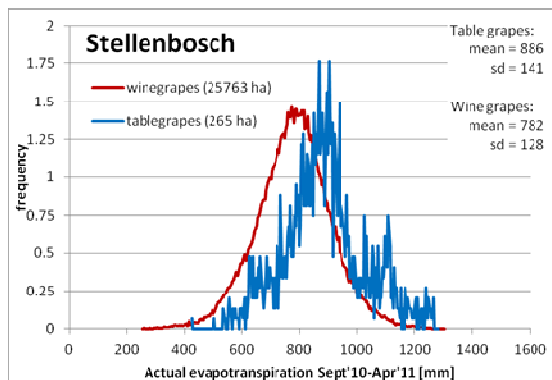
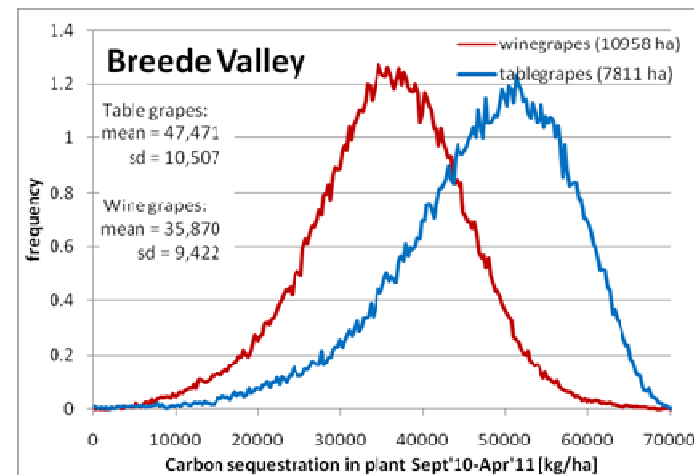
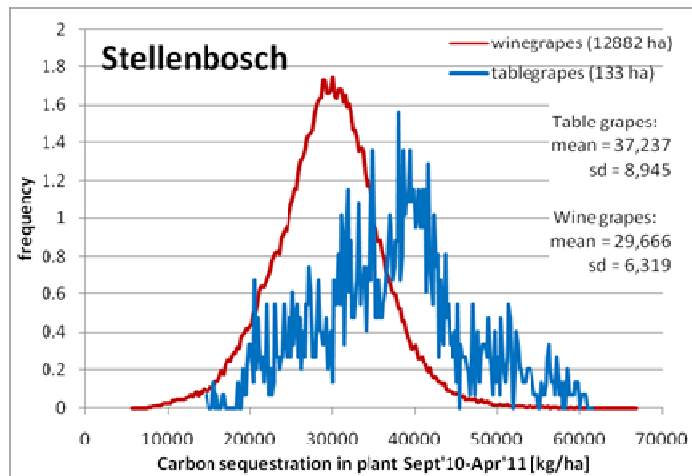
improvements



Water use efficiency (kg/m<sup>3</sup>)

# Example 6: Carbon sequestration and water foot-printing

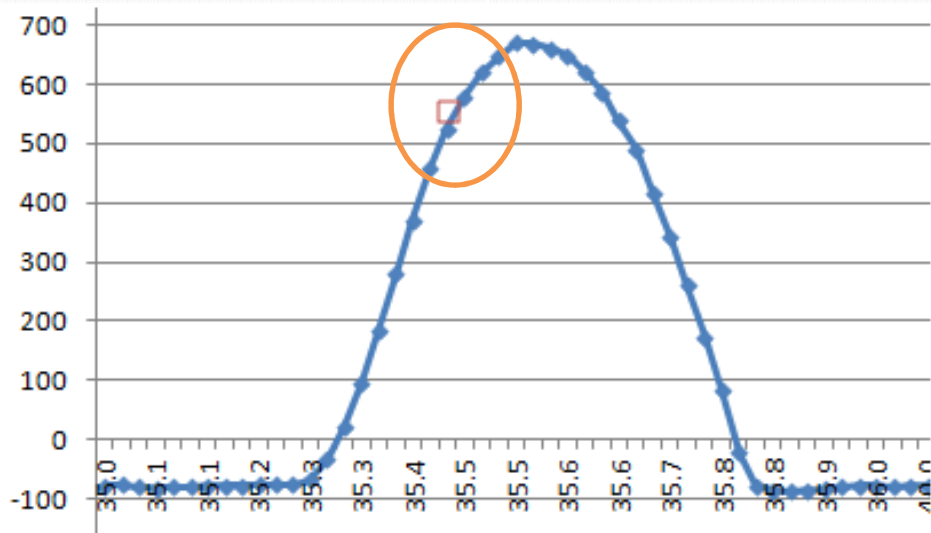
Exporter determines the carbon sequestered to produce fruit crops and crop water footprint



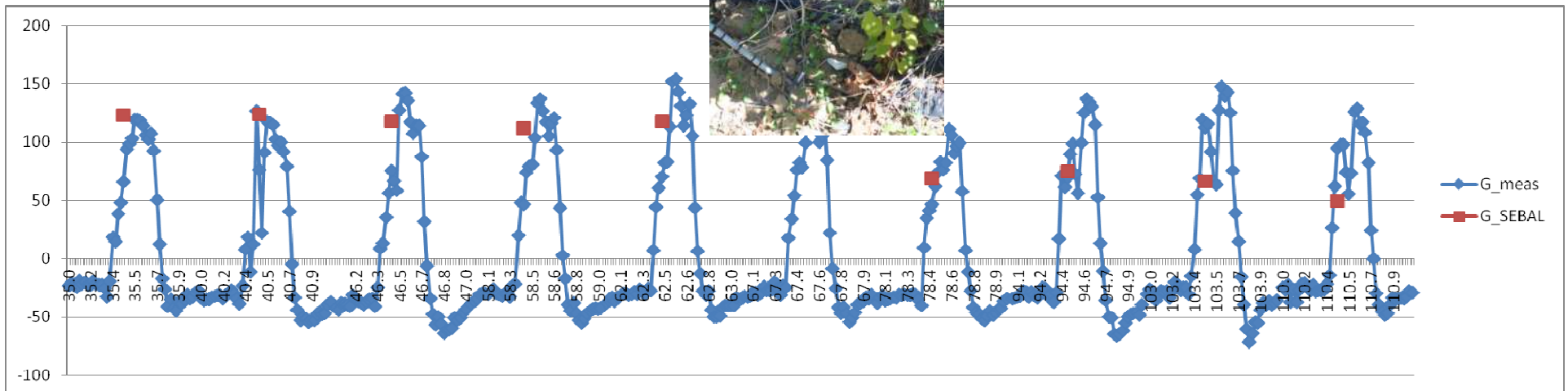
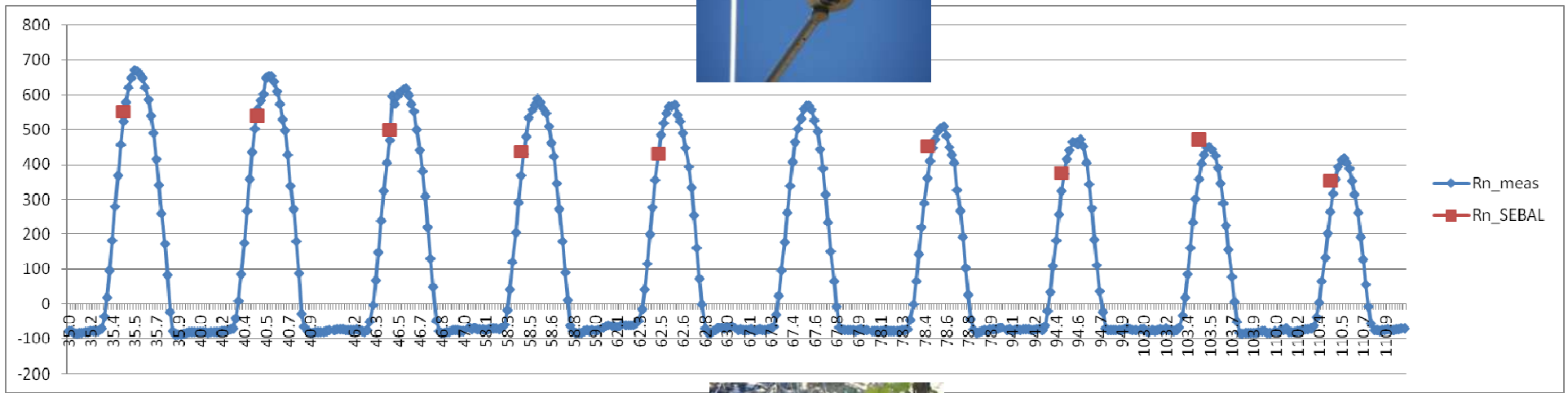
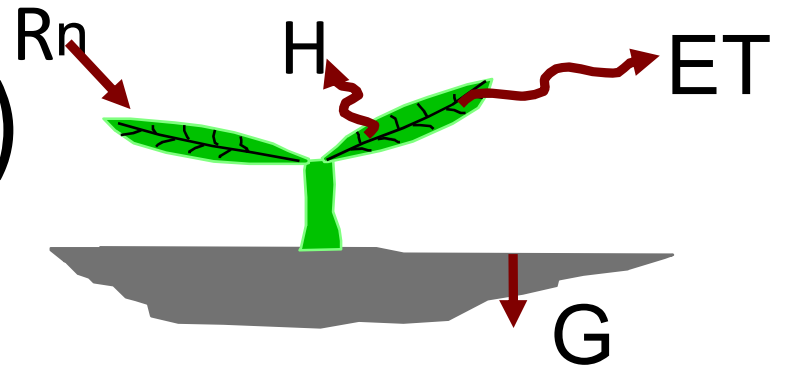
Seeing is believing ?



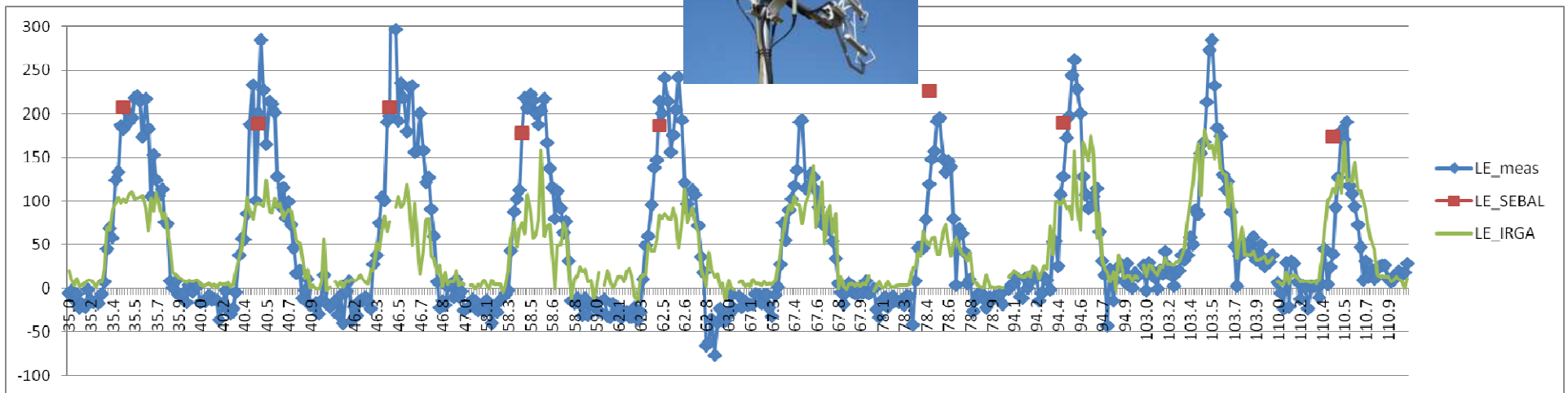
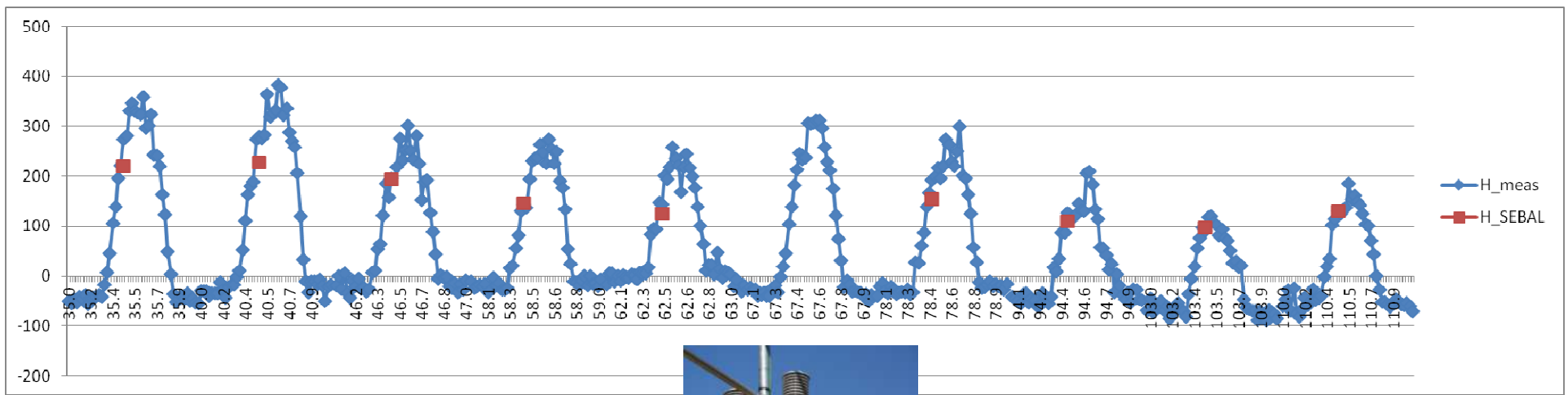
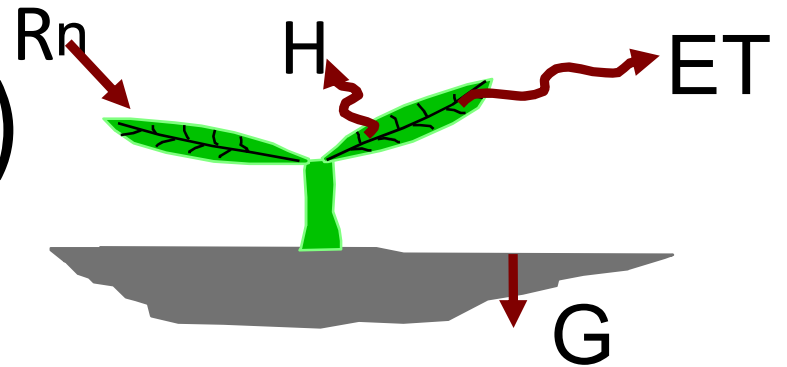
# Time & Space – sample / see



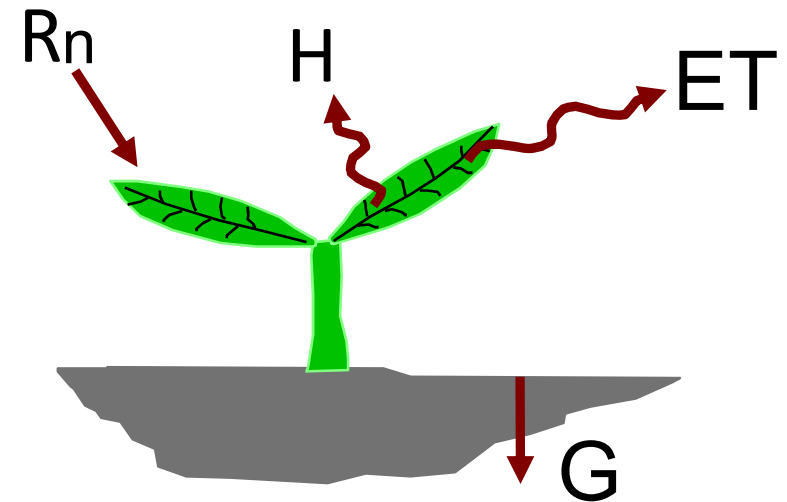
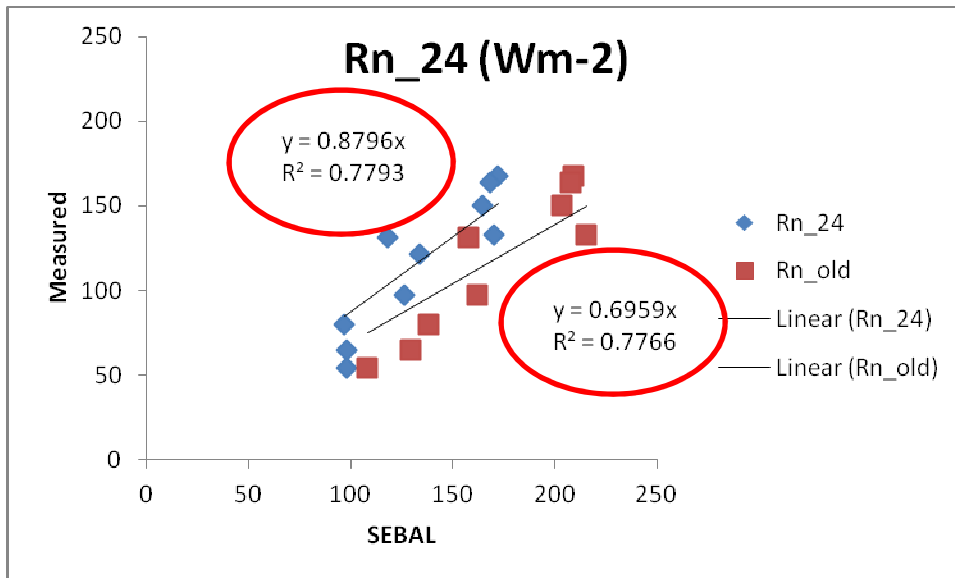
# Comparison energy (i)



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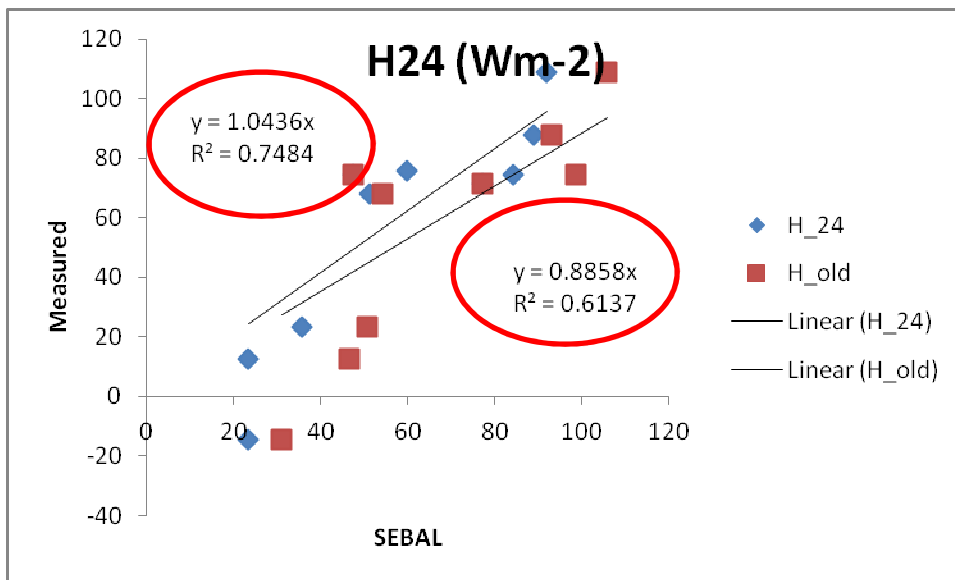


# Comparison energy fluxes (24hr)

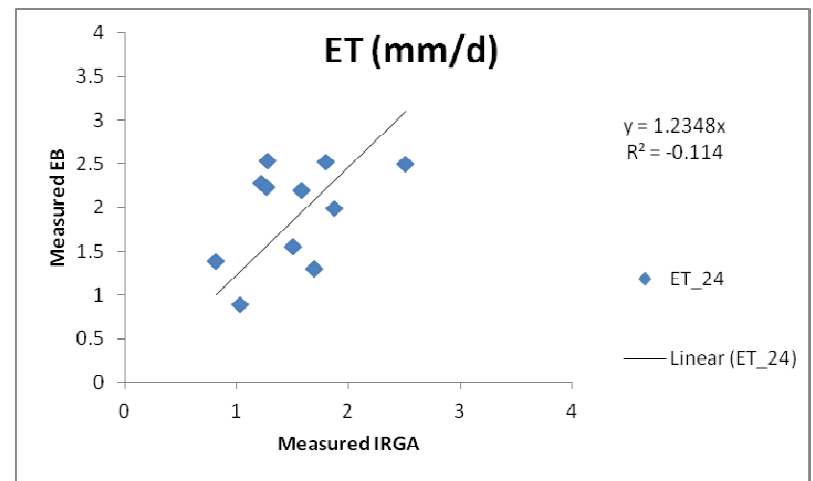
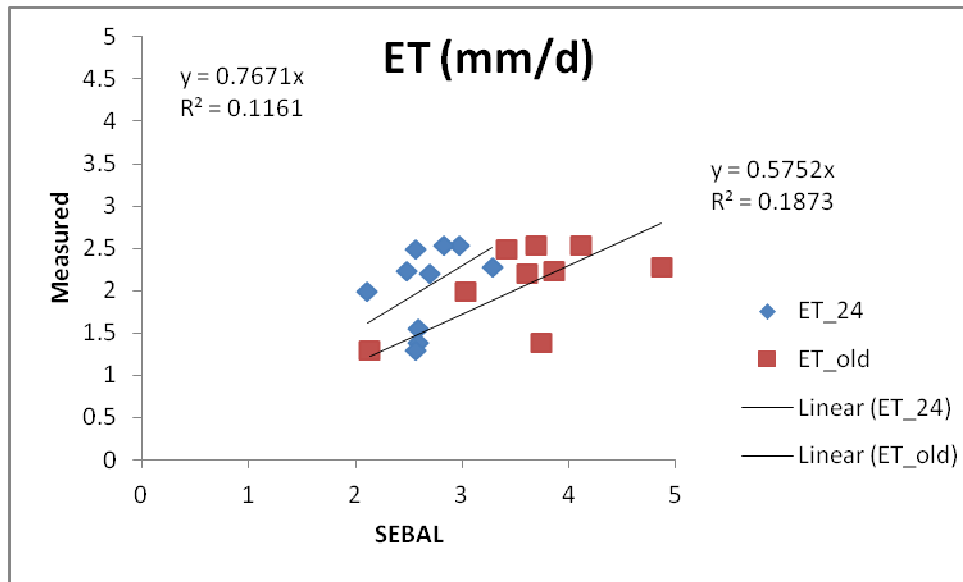
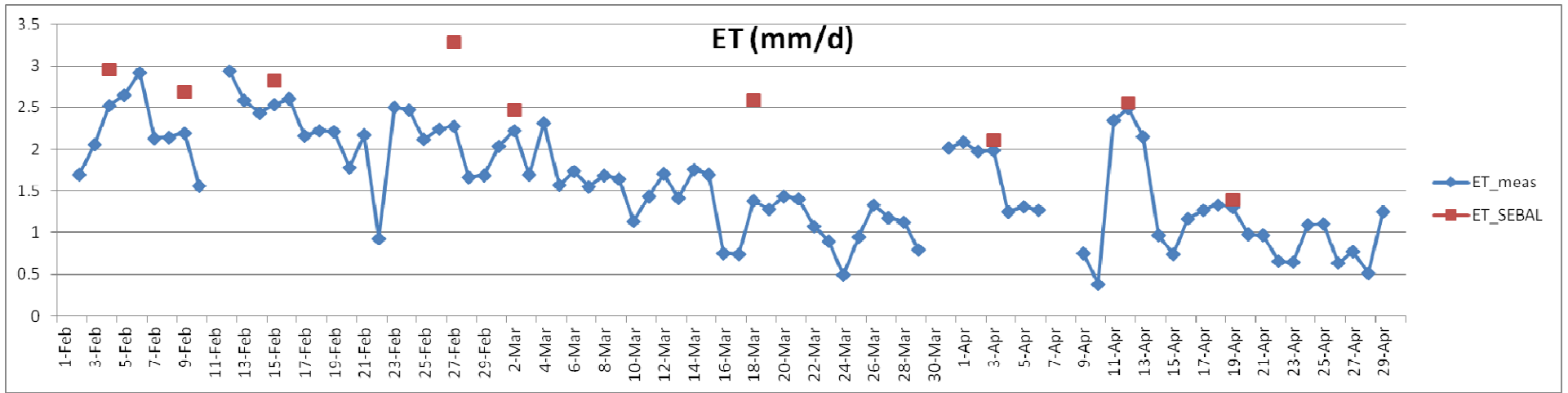


Standard FAO equation  
for net radiation does  
not work in Western  
Cape province!

→ New equation for Rn (net  
radiation)

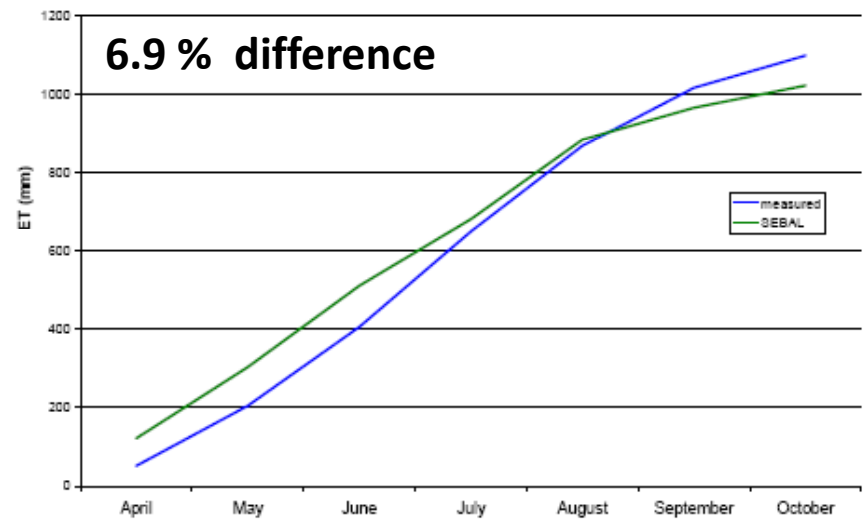
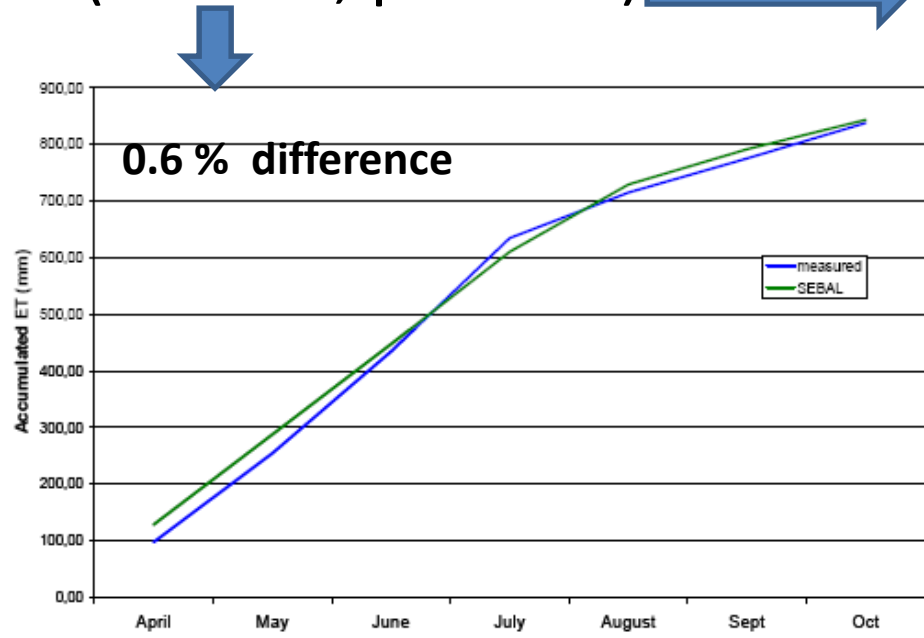
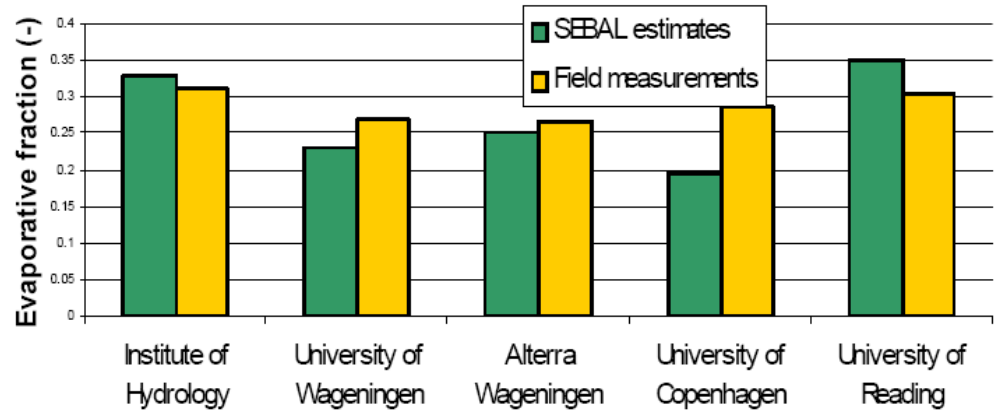


# Comparison ET



# International

- Rainfed grapes (Spain)
- Irrigated grapes (Brazil)
- Irrigated grapes (Turkey)
- Irrigated fruit trees (California)  
(almond, peaches)



## Retrospective study

Bastiaanssen et al. (2008) 'Thermal-Infrared Technology for Local and Regional Scale Irrigation Analyses in Horticultural Systems'

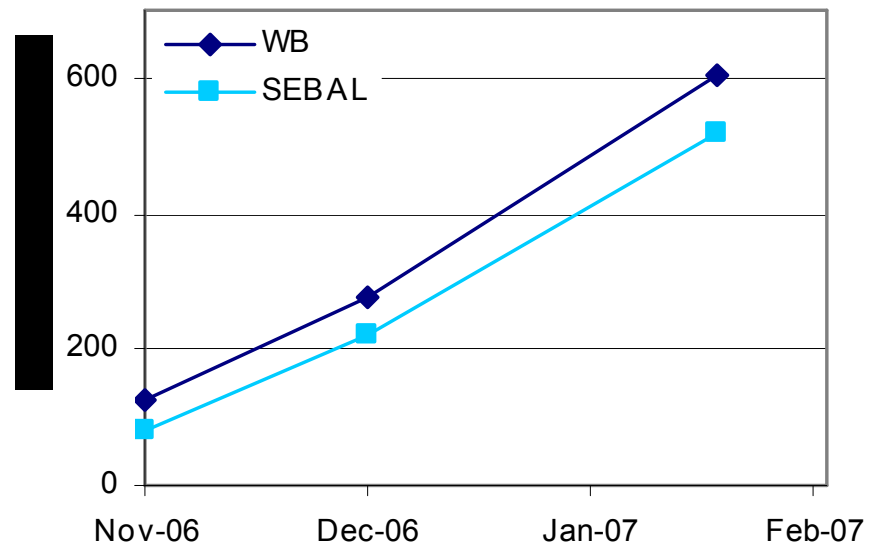
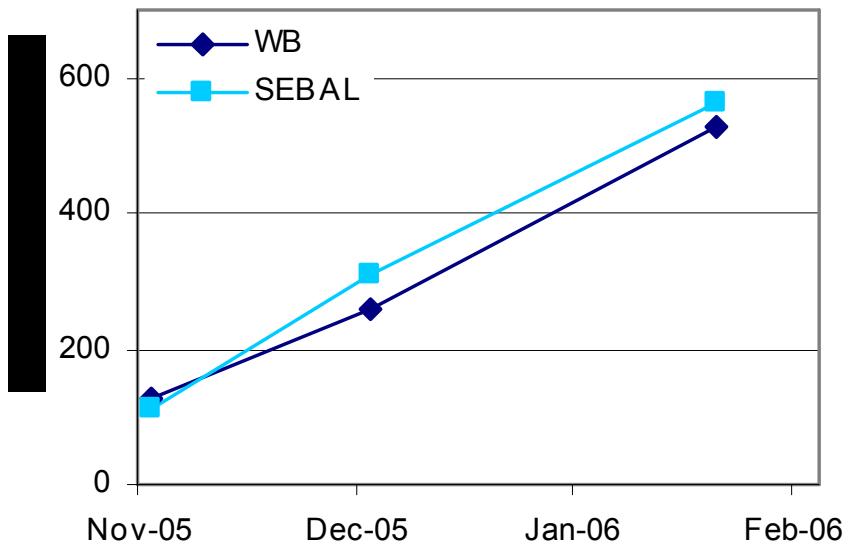
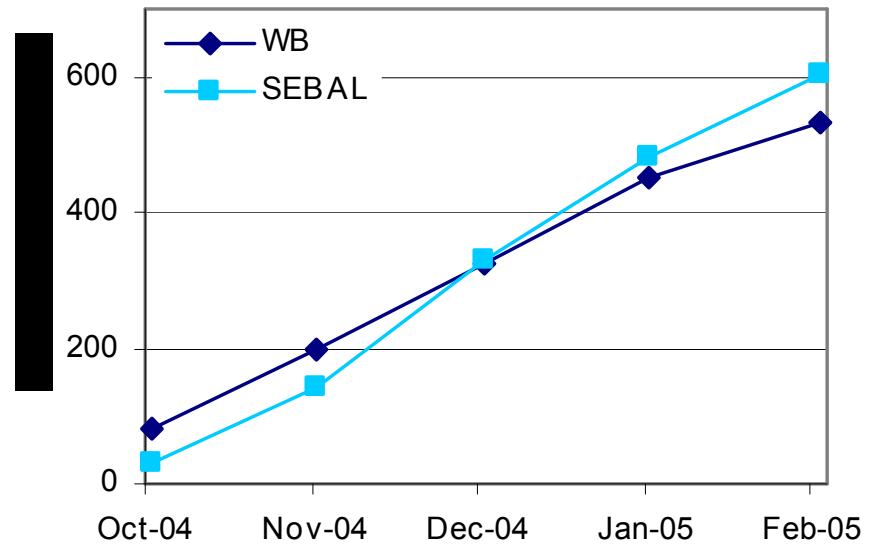
Table 2. Summary of SEBAL-based estimates of evaporative fraction (latent heat/net available energy) in grapes and comparisons to field measurements.

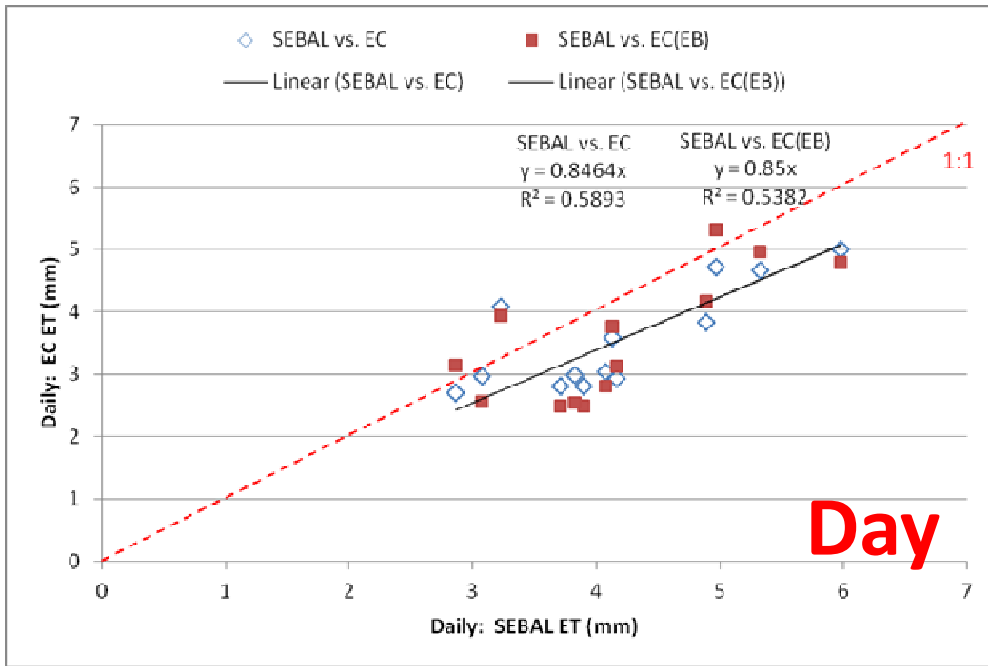
Grape type	Location	Date	Evaporative fraction		
			Measured	SEBAL	Difference (SEBAL- measured) (%)
Rainfed wine grape	Spain	12 June 1991	0.25	0.32	24.6
Rainfed wine grape	Spain	29 June 1991	0.27	0.26	-3.8
Irrigated wine grape	Brazil	9 August 1998	0.81	0.84	3.6
Irrigated wine grape	Brazil	24 November 1999	0.82	0.80	-2.5
Irrigated table grape	Turkey	26 June 1998	0.52	0.48	-8.0
Irrigated table grape	Turkey	29 August 1998	0.77	0.73	-5.3
Average			0.57	0.57	0.0

Bastiaanssen et al. (2008) 'Thermal-Infrared Technology for Local and Regional Scale Irrigation Analyses in Horticultural Systems'

# Validation of SEBAL ET results against ET estimates from water balance measurements in the Hex Valley

## Retrospective study





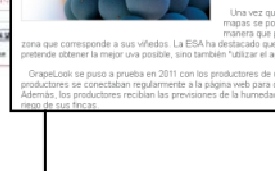
Seasonal ET	SEBAL ET	Measured ET
Total (mm)	320.5	251
Average (mm)	4.2	3.3
Difference (SEBAL vs. measured)		21.7 %

SEBAL ET compared against ET from eddy covariance (Crimson red)  
 Difference in ET result of SEBAL overestimation in net radiation  
 ➔ recalculation



# International attention

- Article on Earthzine.org
- Article in magazine of the South African Irrigation Institute SABI
- Article in farmer magazine of South Africa Landbouweekblad
- Radio broadcast : Radio RSG, July 1, 2011
- TV interview: The KykNet channel, June 21, 2011
- Paper and presentation at IAF Congress in CapeTown
- ESA web article: "Satellites can help to grow the perfect grape":
- International Business Times : "And Now, Satellites Help Vineyard Irrigation"
- Innovaticias (Spanish): "Los satélites de la ESA ayudan a obtener la mejor cosecha de uva"
- Inovação Tecnológica (Portuguese): "Uvas vigiadas do espaço produzem melhores vinhos"
- VinoVinoVino (Japanese): "衛星とGoogle Mapsをつかった畑の水管理予測システム試験"
- Centre of Earth Observation and Digital Earth (Chinese): "欧空局卫星观测信息辅助葡萄农艺"





## Draw fields/areas

Ceres, ZA

Search in map

Enter your zip or streetname and place.

Draw GPS coordinates Shapefile

Map Satellite Hybrid



Size in ha: 406.9

Distance to last point: 3034 meter

Remove field

Give the field's name

Ceres - Du Toits (Gouda pas) \*

Give the field's category

None

Add an advisor to your field

Choose organisation

Of which season would you like to receive data?

2011

Other stone fruit

Price indication (ZAR): 44759.00



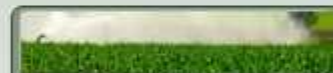
Contact / Helpdesk



Products & Advices



General



Irrigation

Description	Field(s)	Price
-------------	----------	-------



Ceres - Du Toits (Gouda pas)  
 Season: 2011  
 Crop: Other stone fruit

Ceres - Du Toits (Gouda pas) ZAR 44.627,00

**Total excl. VAT: ZAR 44.627,00**  
 VAT: ZAR 8.479,13  
**Total incl. VAT: ZAR 53.106,13**

The price of the basic package growthparameters for blocks is calculated with the prices below.

0 or more hectare :

**R 110,-- per hectare**

You can provide a gift code when finalising your order.

Enter your coupon code (case sensitive):

FREE-INTRODUCTION

Activate code

I agree with the [terms](#) \*

Back to shopping cart

Order




## Order procedure > Check personal data and payment

Please check the data below carefully before you finish the order.

Company name: UKZN                      Address: Stellenbosch 1  
First name: Caren                      Postal code: 7600  
Infix:    City: Stellenbosch  
Last name: Jarmain                      Country: South Africa

[edit data](#)

Description	Field(s)	Price
 Ceres - Du Toits (Gouda pas) Season: 2011 Crop: Other stone fruit	Ceres - Du Toits (Gouda pas)	ZAR 44.627,00
Giftcode Discount / FREE-INTRODUCTION		ZAR -44.627,00
<b>Total excl. VAT: ZAR</b>		<b>0,00</b>
VAT: ZAR		0,00
<b>Total incl. VAT: ZAR</b>		<b>0,00</b>

The price of the basic package growthparameters for blocks is calculated with the prices below.

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You can provide a gift code when finalising your order.

I agree with the [terms](#) \*

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[Order](#)



Contact / Helpdesk



Products & Advices



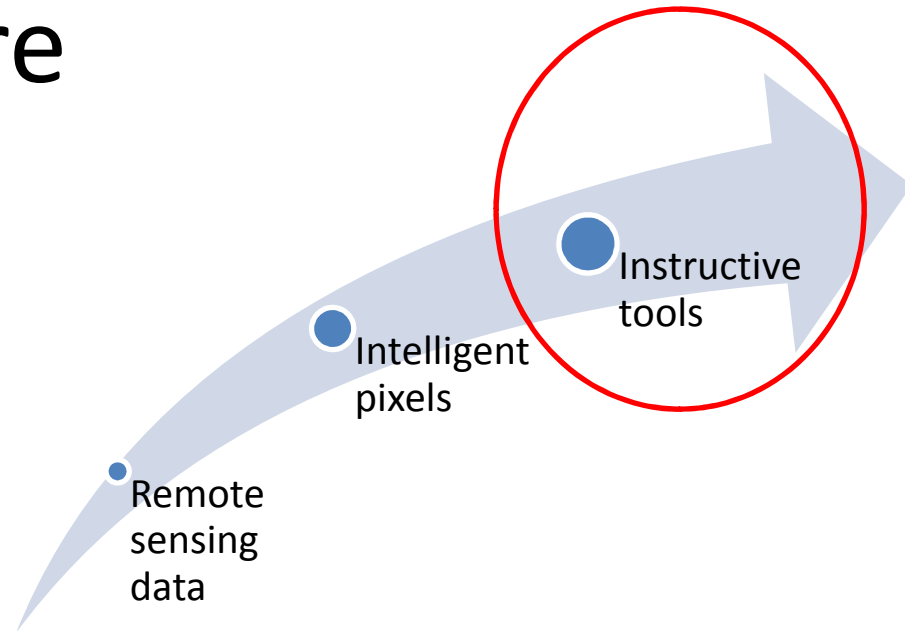
General



Irrigation

# Fruitlook Future

- Continue Fruitlook
  - Fully operational
  - Being used
  - Of use – relevant tools
  - (Affordable)
- More time for new technology to be adopted
- Show complimentary use of data sets





Thank you