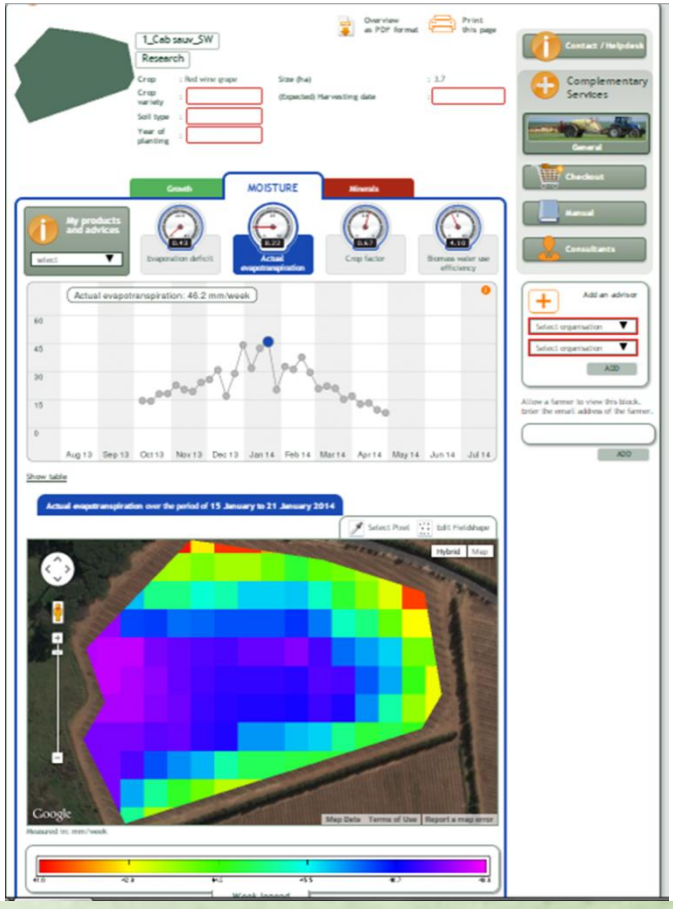
ICID2015
26th ERC & 66th IEC

FruitLook: A spatial approach to assess and improve water use efficiency of vineyards and deciduous fruit crop orchards in South Africa



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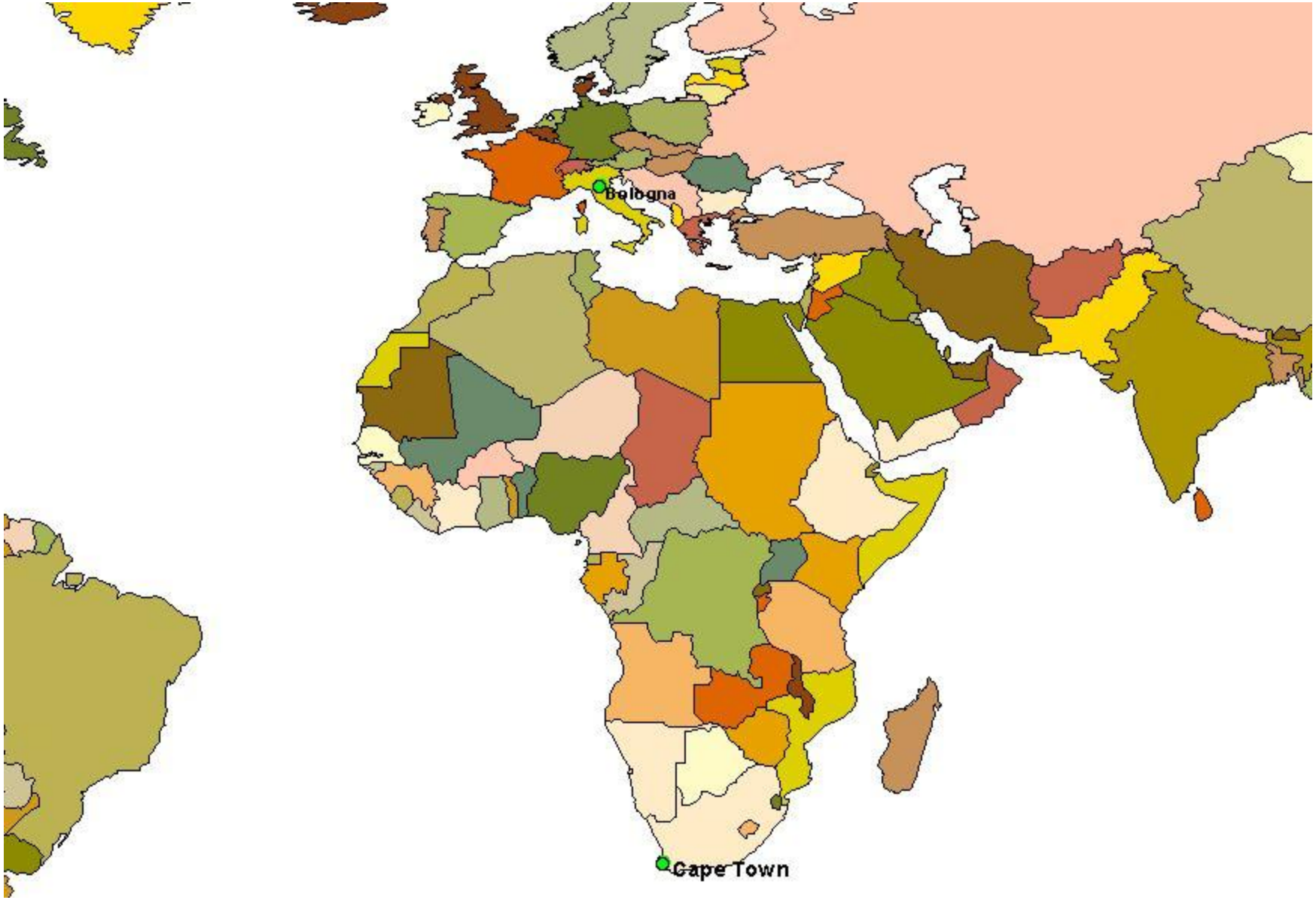
WESTERN CAPE DEPARTMENT OF AGRICULTURE
STELLENBOSCH
SOUTH AFRICA

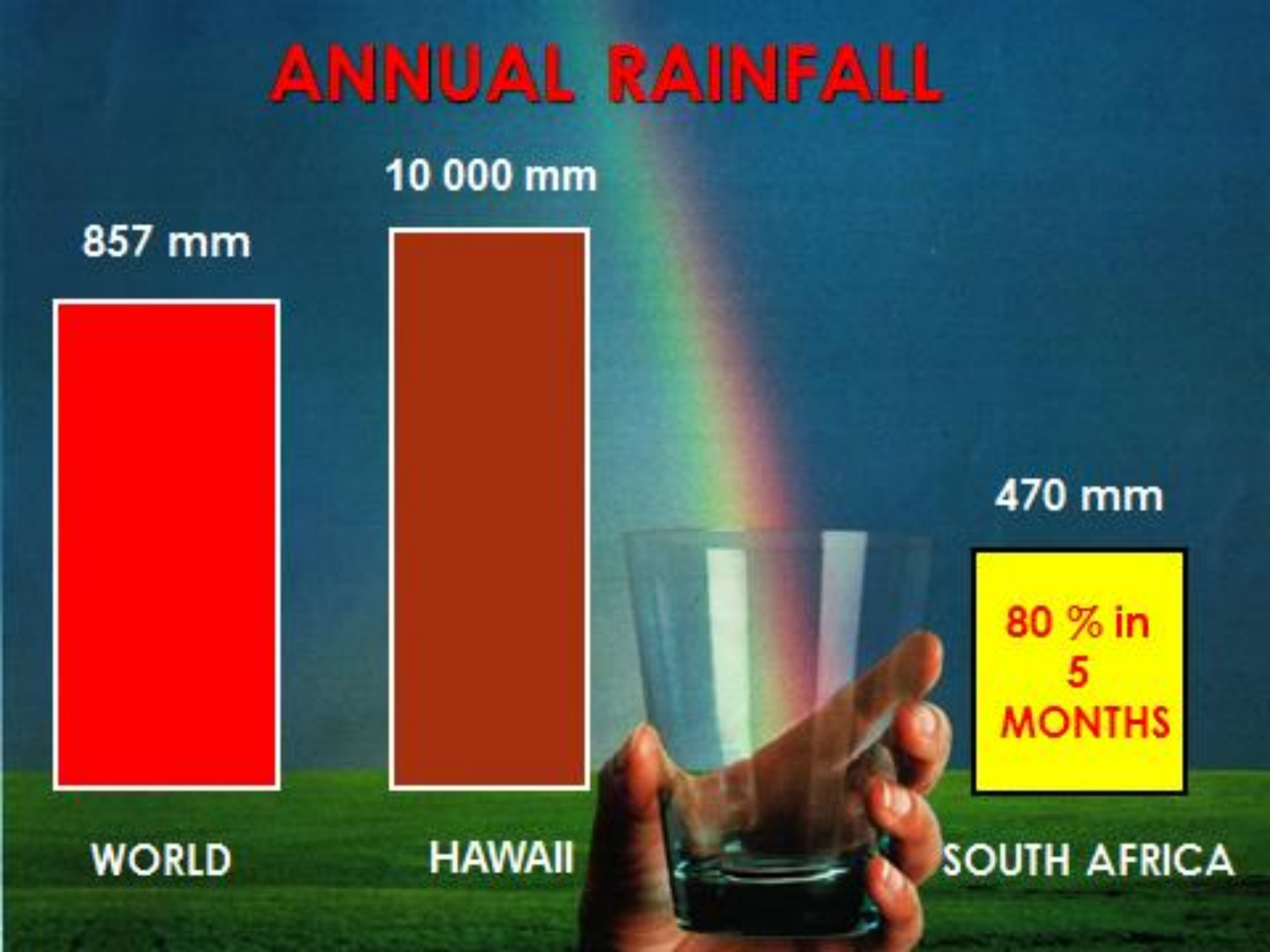
ICID2015
26th ERC & 66th IEC

Summary of Presentation

1. Water situation in Western Cape Province
2. The need to monitor actual crop water use
3. Introduction to FruitLook
4. Results of the FruitLook project
5. Way forward

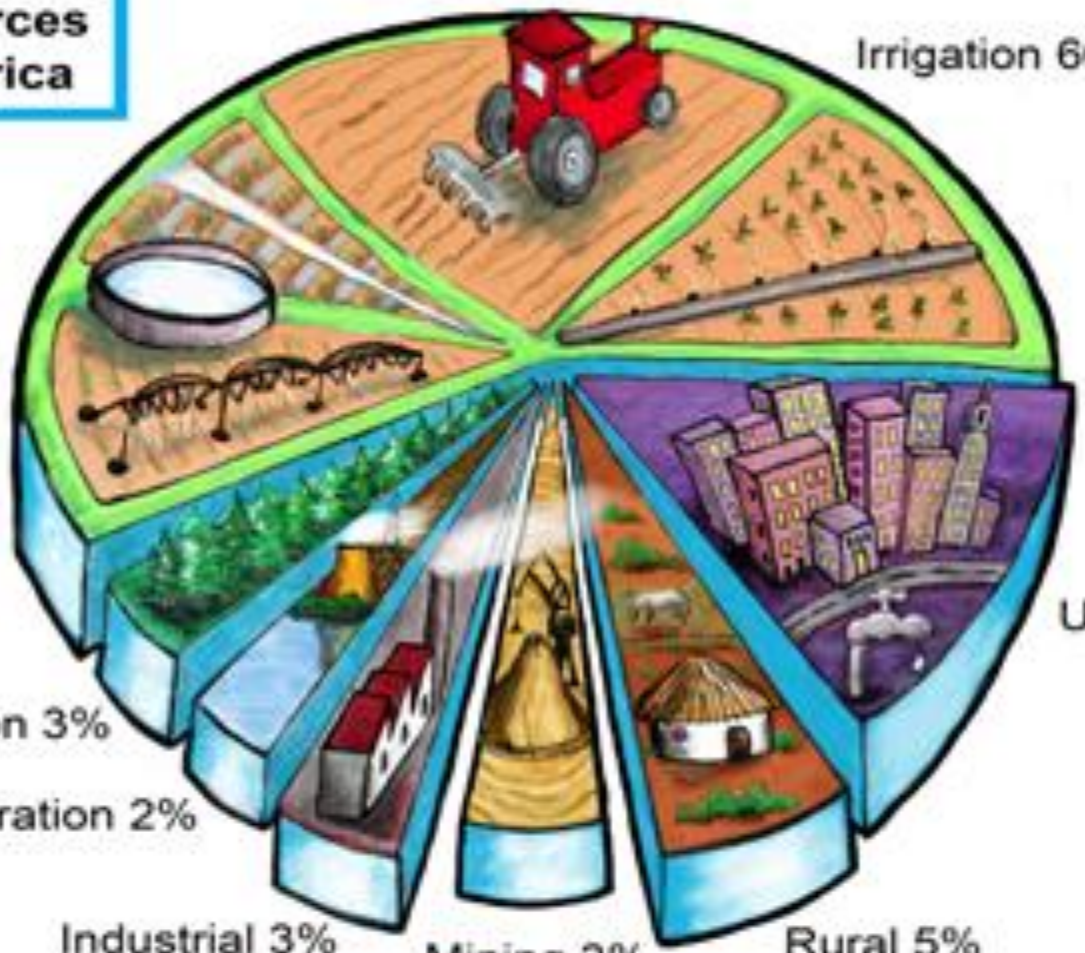

Bologna
Cape Town

ANNUAL RAINFALL



EXISTING WATER USE

How we use our water resources in South Africa




GLOBAL
WARMING

FruitLook Objective

Limited water resources (climate change, competing sectors)

Economically important grape/fruit sector (export, livelihood)

Water - You can't manage what you don't measure

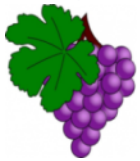
It is imperative to measure crop water use

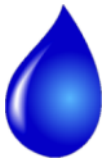
in order to achieve high water productivity and food security

We need to:

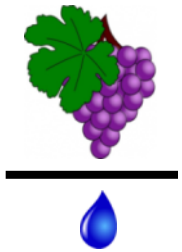
Improve efficiency of resource use

- Increase the current irrigation area with same water allocation
- Mitigate the possible impacts of climate change

WUE =  *Crop yield (kg)*

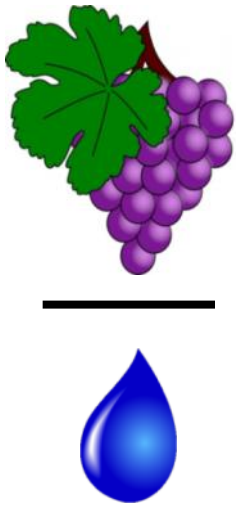


Water consumption (m^3)



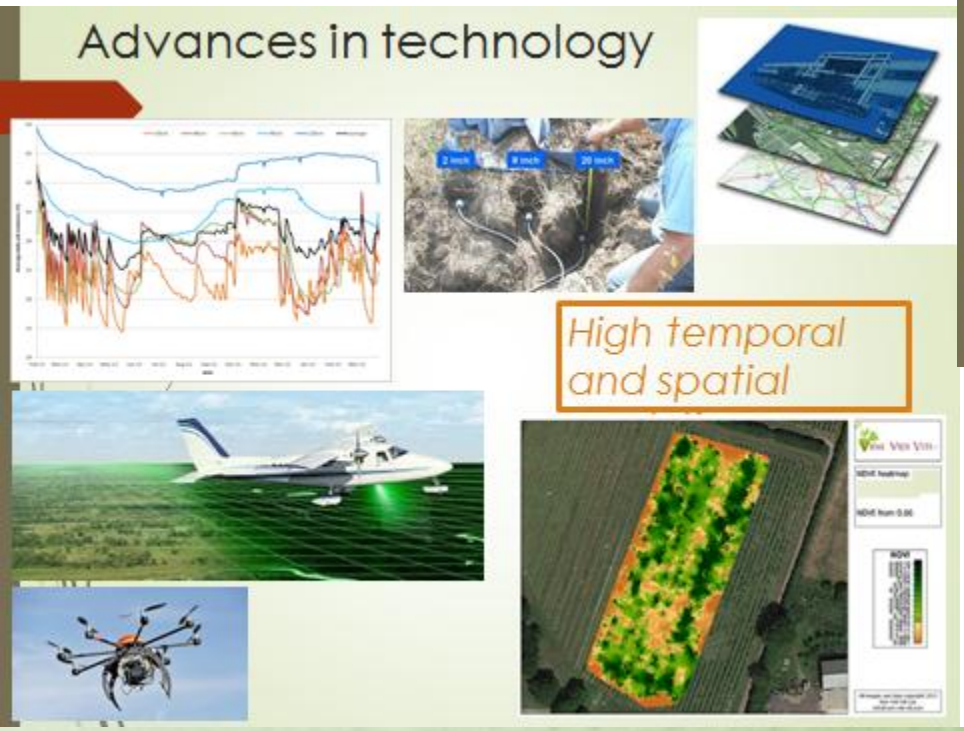
Option 1: *Reduce water consumption without decrease in yield*

or



Option 2: *Increase yield without increasing water consumption*

FruitLook: A spatial approach to assess and improve water use efficiency of vineyards and deciduous fruit crop orchards in South Africa …

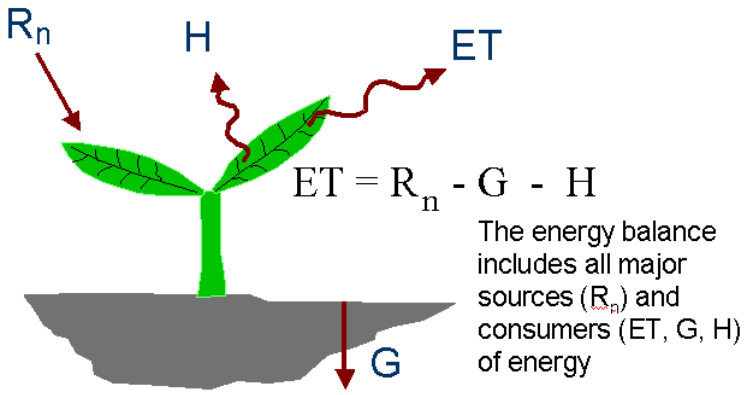


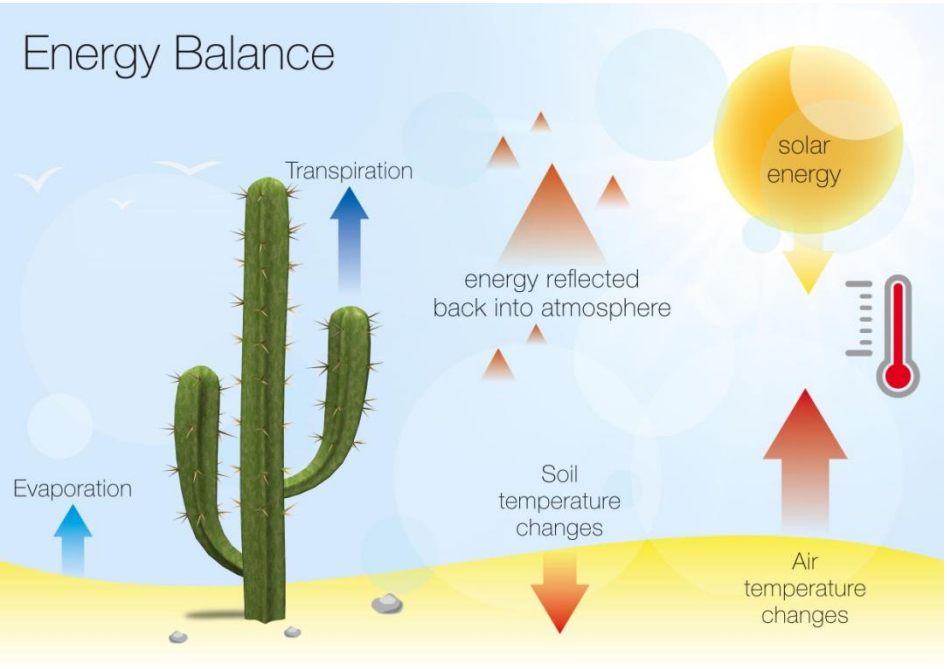

INTSHONA KOLONI WES-KAAP
WESTERN CAPE

Surface Energy Balance Algorithm for Land (SEBAL)

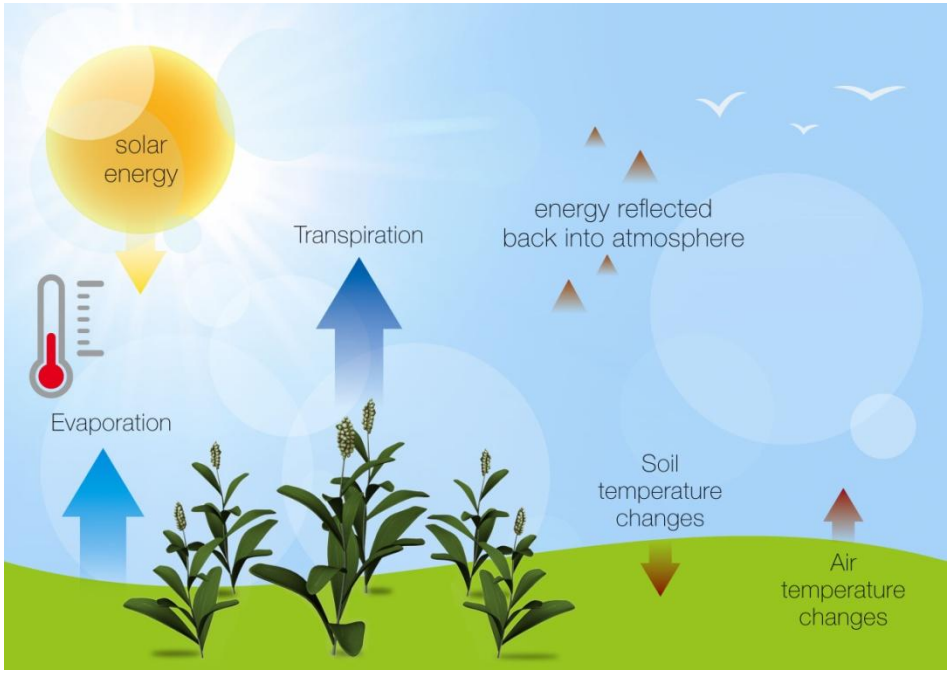
Satellite imagery and meteorological information is used to solve energy balance

- ET is calculated as the “residual” of the energy balance





Desert surface



Irrigated surface

FruitLook History

Feasibility study
- 2004-07
- Grapes
- retrospective

GrapeLook
- 2010-11
- Grapes
- website

FruitLook
- 2011-12
- Grapes & fruit
- Data portal

FruitLook 2.0
- 2012-13
- 2013-14
- 2014-15
- 2015-16
- Grapes & fruit
- Data portal

Funding in the pilot project stage (2010/11):

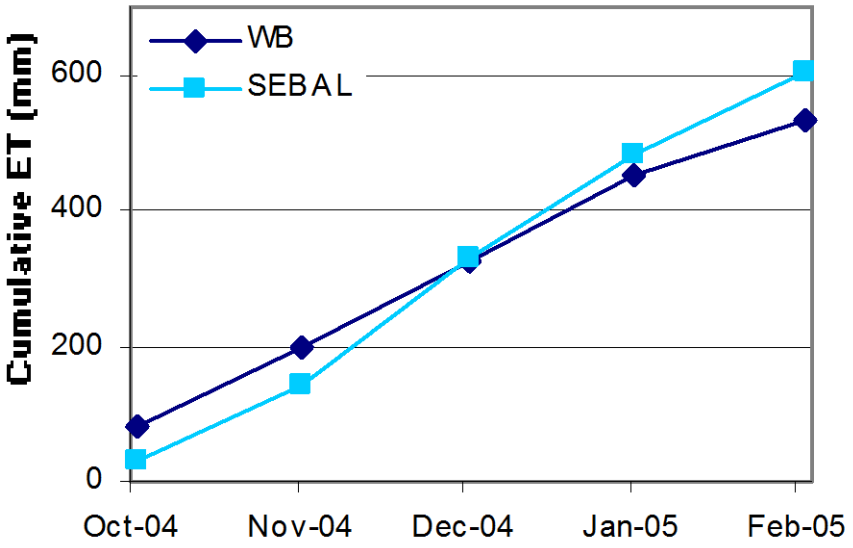
- Western Cape Department of Agriculture
- Department of Agriculture, Forestry and Fisheries
- ESA Integrated Applications Program (IAP)
- Dutch Embassy
- HORTGRO (horticultural farmer organization)

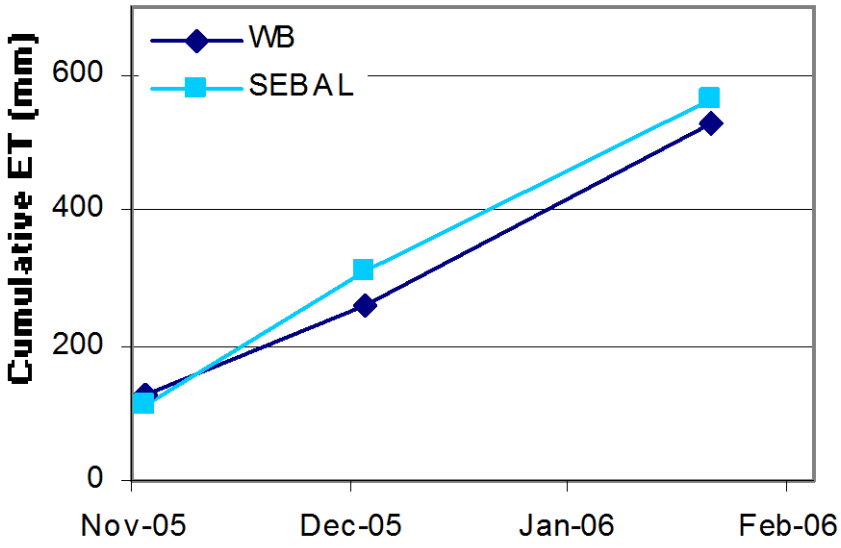
Current funding (since 2011/12):

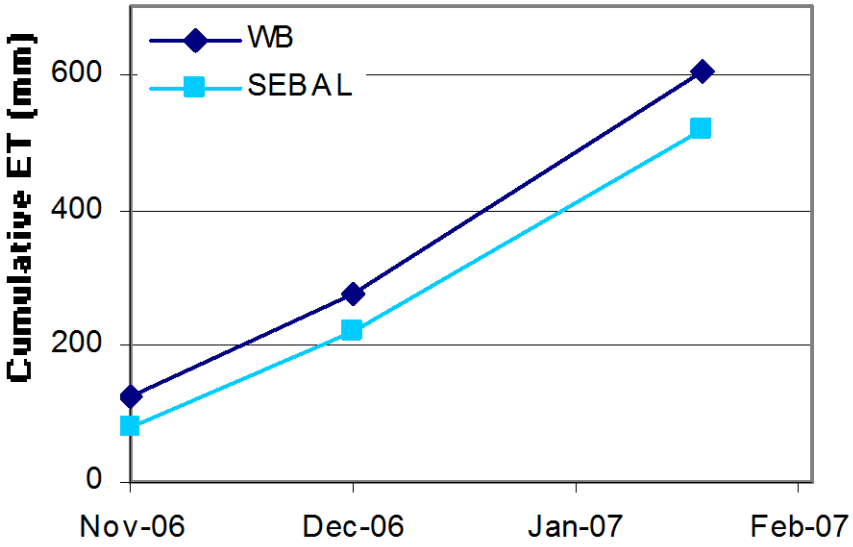
- Western Cape Department of Agriculture

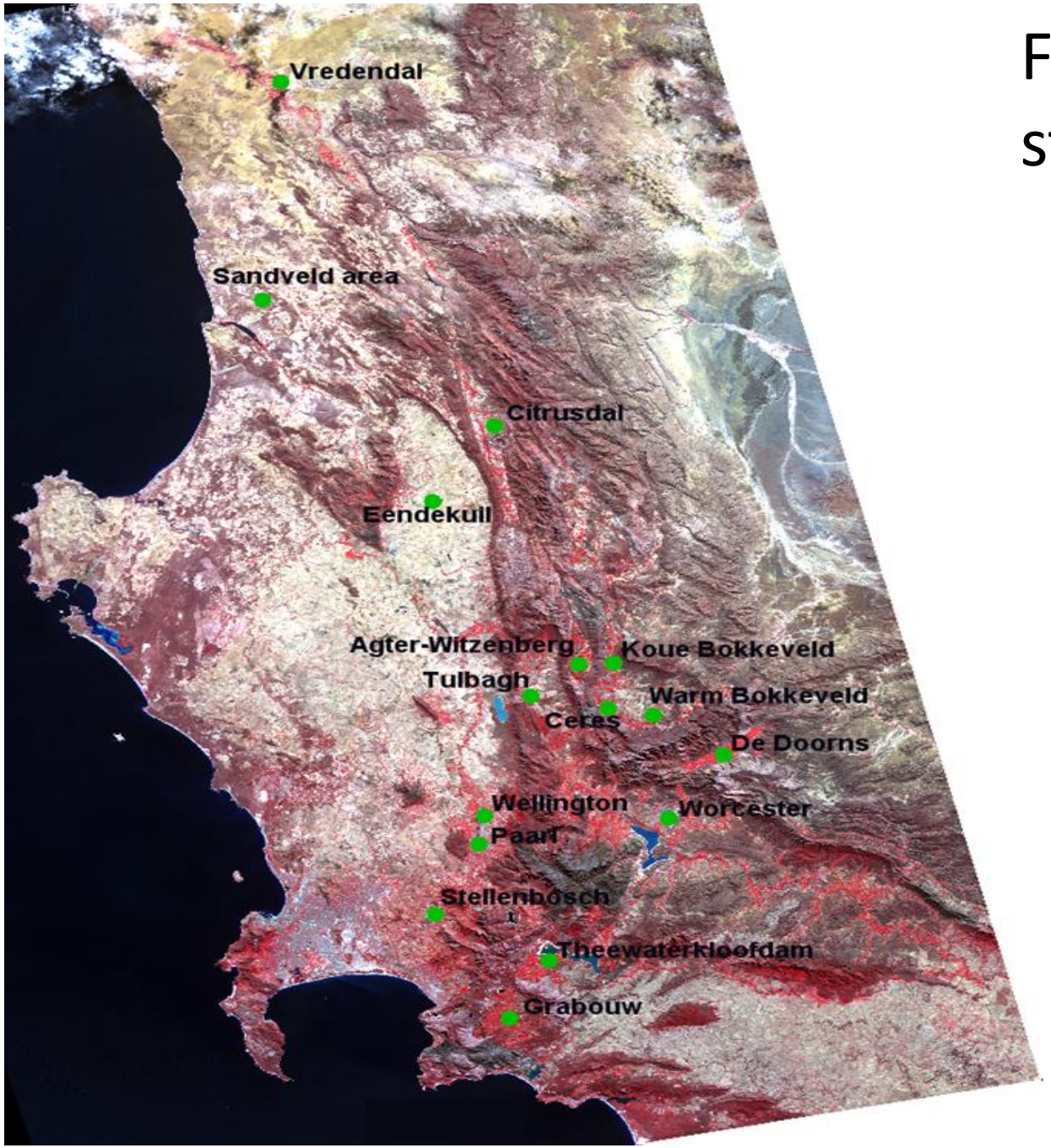
Validation of SEBAL ET results against ET estimates from water balance measurements in the Hex River Valley

Initial Retrospective study





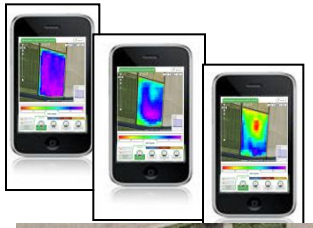




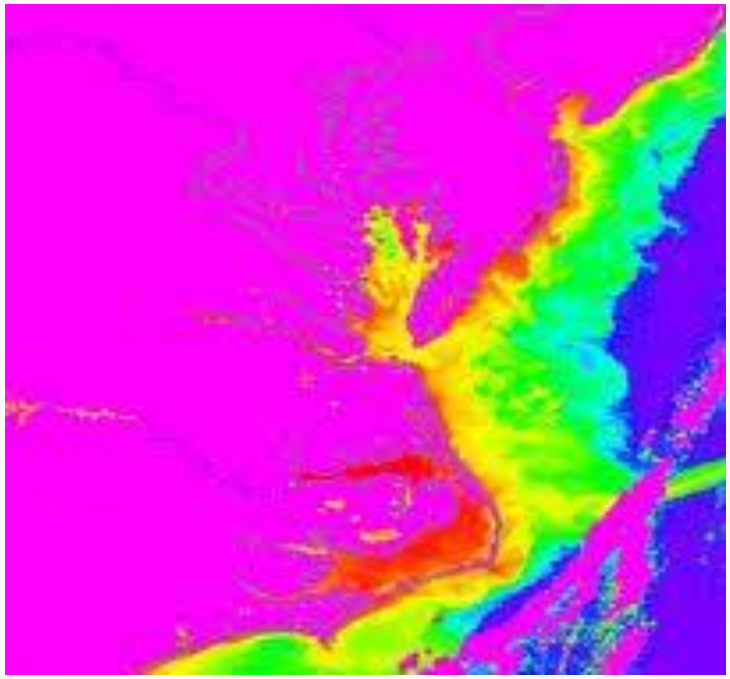
Fruitlook study area

Data availability areas

FruitLook is front end of the Technology Leap

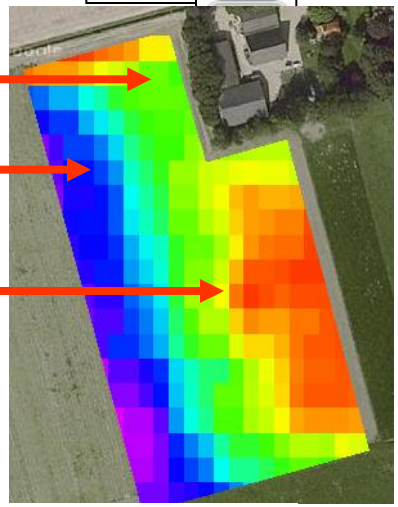


20th Century Technology

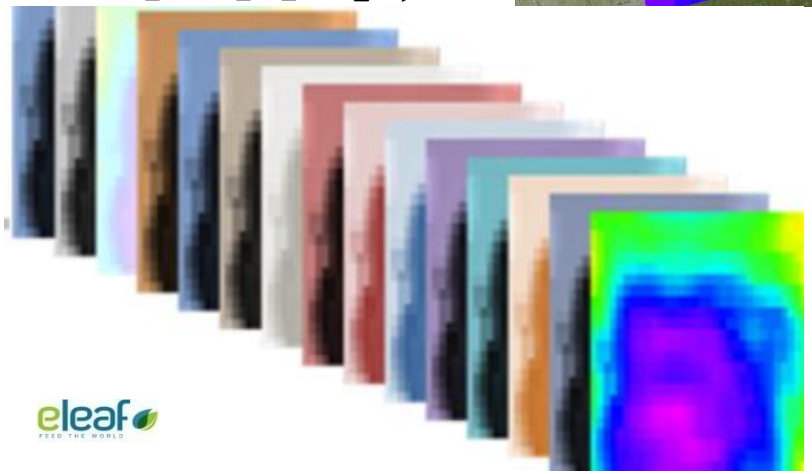


NDVI delivers:
1 image monthly or ad hoc, providing 2 subjective data components (growing well or not well), high calibration time and costs to get derivative data

21st Century Technology



Biomass Accumulation
Biomass Potential
Biomass Deficit
Biomass water productivity
Evapotranspiration – mm/ha/week
Evapotranspiration deficit
Leaf Area Index
Fractional Vegetative Cover
N in entire plant
Yield Observation



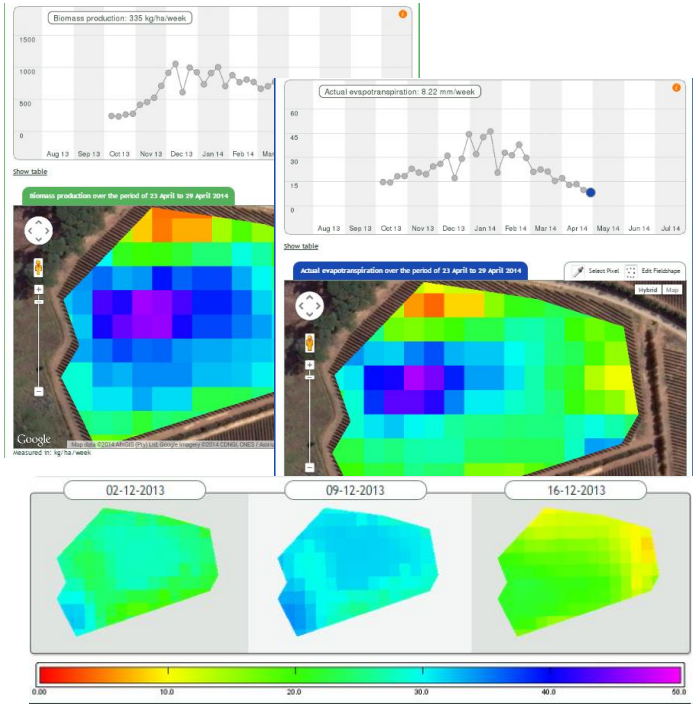
Pixel Intelligence delivers
1 data **set** weekly (imagery & daily weather derived) with <45 objective processed data components reading the metabolism of the plant in its environment

Process

Satellite image taken on e.g. day 4

SEBAL

Maps for a 7
Day period (day 1-7)
Available on day 8
(few exceptions)



Day

1	2	3	4	5	6	7	8	9	10	11	12	13	14

Instantaneous Meteo → Daily Meteo → Weekly Meteo

Instantaneous EB → Daily EB&ET → Weekly ET

FruitLook overview

- Web portal containing spatial, remote sensing derived data
- Growing seasons (35 weeks):
  - 2015/16 ongoing
  - 2014/15
  - 2013/14
  - 2012/13
  - 2011/12
  - 2010/11
- Weekly time interval
- Area:
  - WC Deciduous Fruit producing areas

9 weekly updated growth data components

MOISTURE:

- Actual evapotranspiration
- Evapotranspiration deficit
- Crop factor
- Biomass water use efficiency

GROWTH:

- Biomass production
- Leaf Area Index
- NDVI

MINERALS:

- Nitrogen content (plant)
- Nitrogen content (top leaf)

- 20 x 20 meter pixels

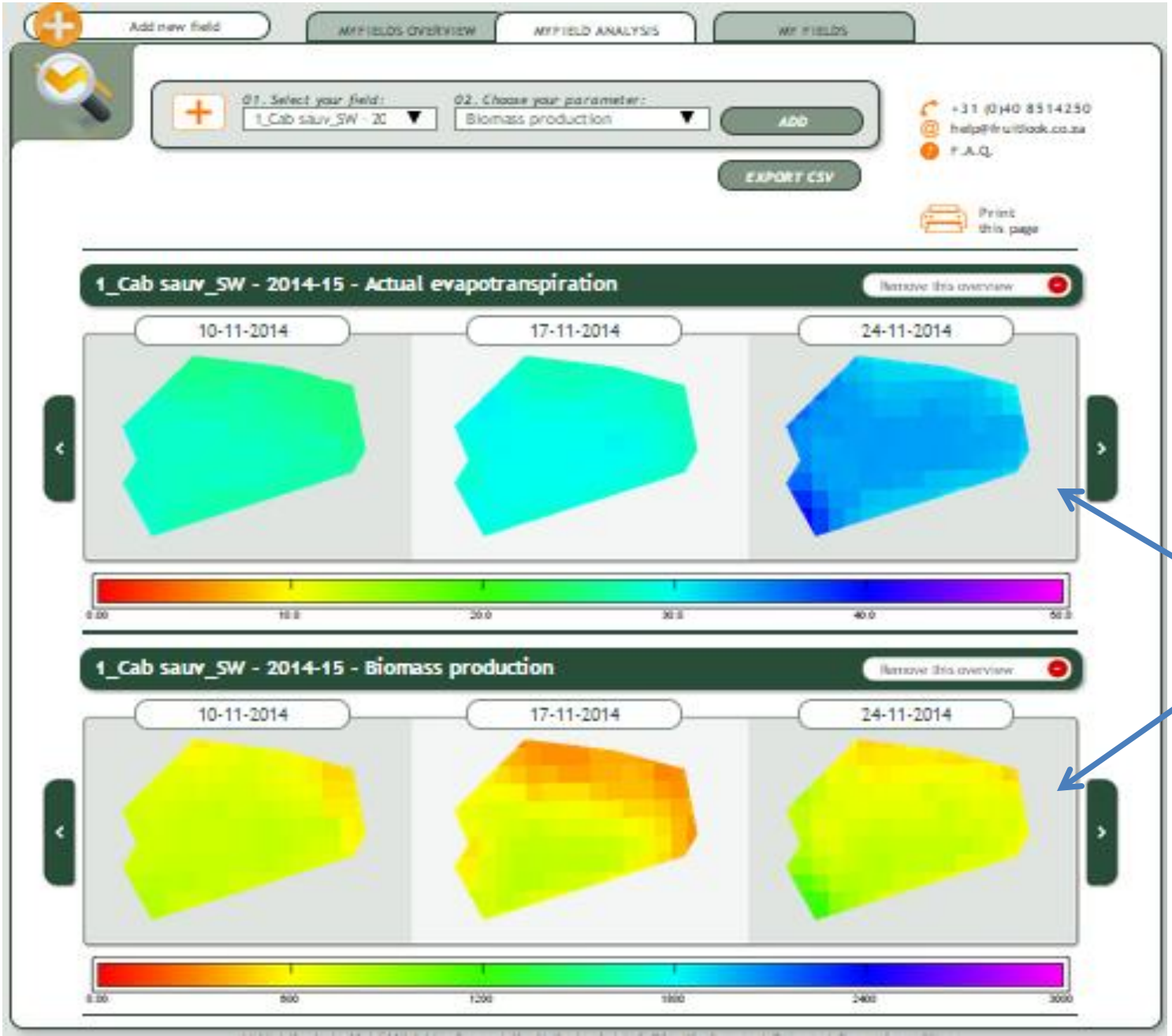
Change in time

Change in space

Various “maps” Related to growth, water, minerals

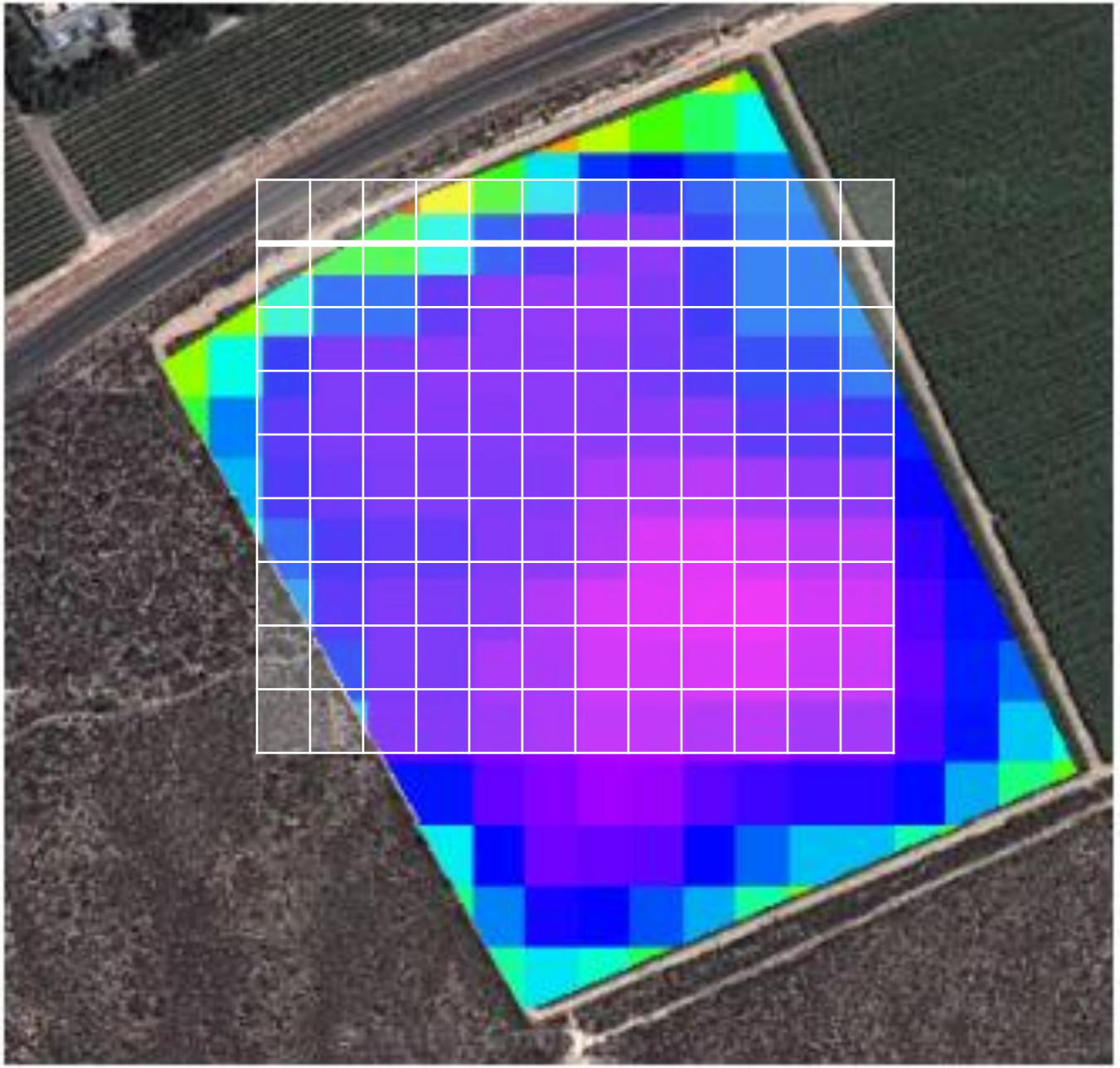
Data components are created without any input from the farmer!

FruitLook.co.za



Compare

Spatial distribution of actual crop water use (ET) in table grape vineyard



FruitLook users: Webportal data

- Focus on deciduous fruit and grape sector
  - Also some other users (invasives, natural veld, citrus)
- Growers/producers
  - Smaller to larger farms
- Farm managers
- Cooperative technical managers / advisors
- Consultants to fruit industry
- Researchers/students
- Environmental organizations - WWF

FruitLook use

- **Area covered by FruitLook:**

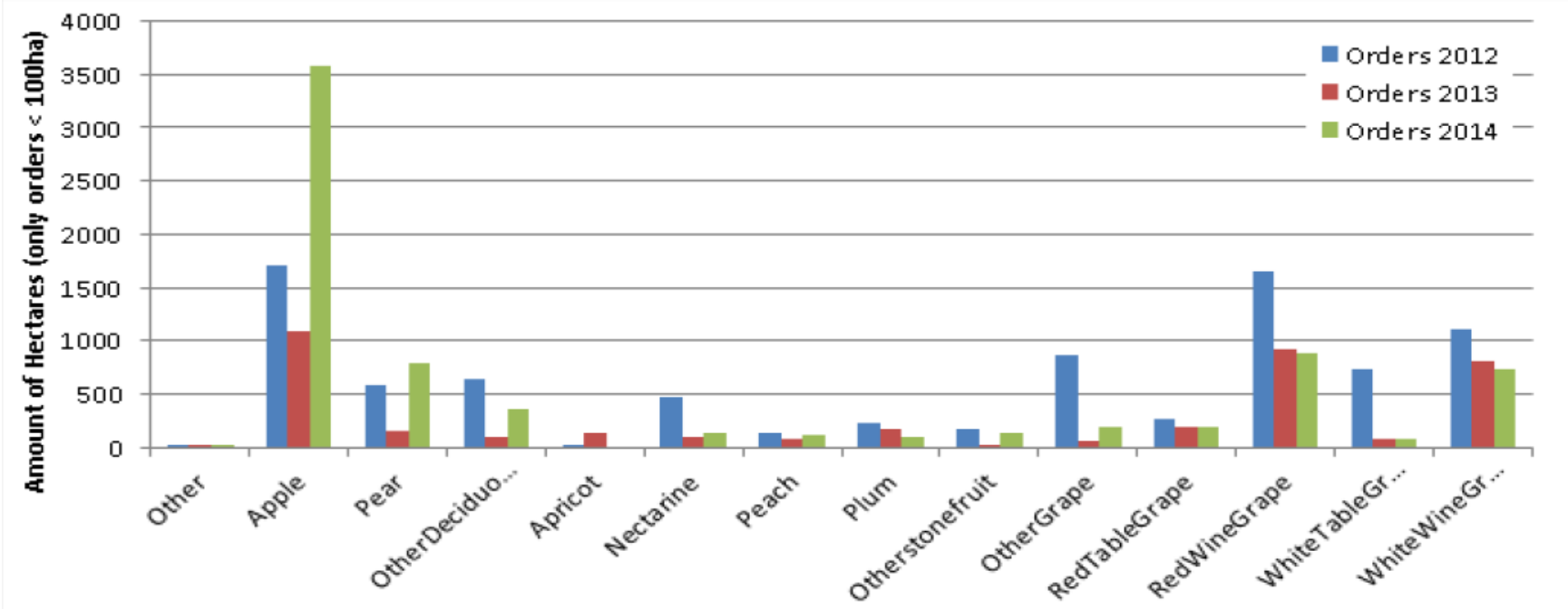
  161 807 ha

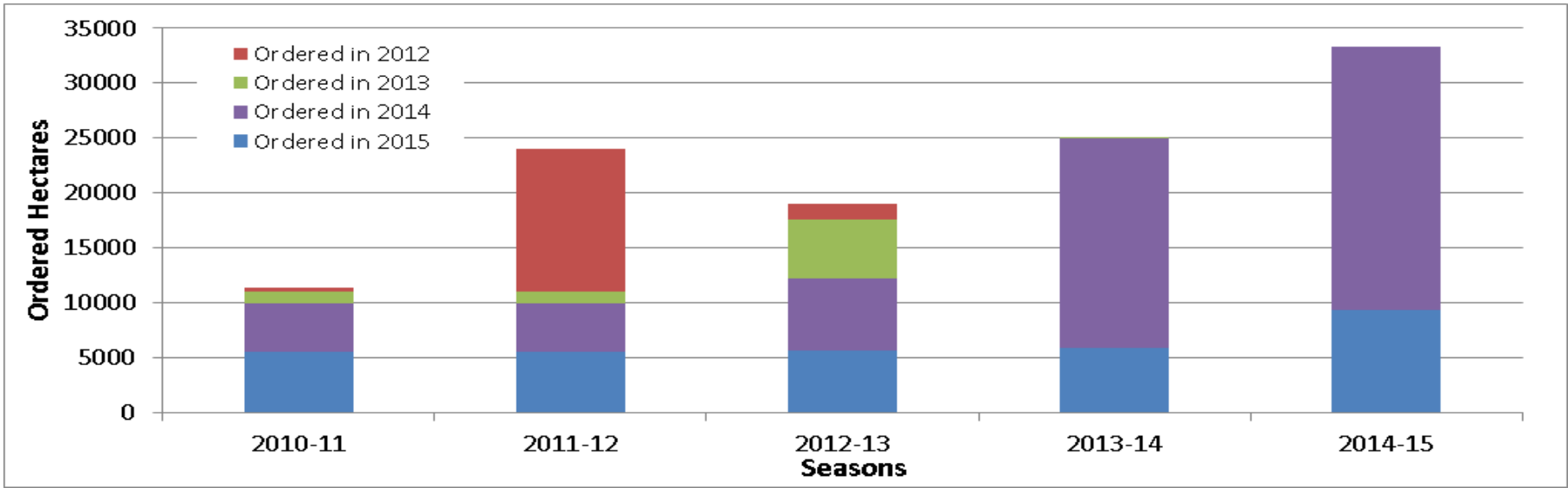
- **Area and fields ordered in 2014/15: <25 ha**
  - 2014/15 season: 6 872 fields covering 12 920 hectares – 8% of area covered
  - Historical: 5 149 fields covering 9 784 hectares

- **Total area ordered in 2014/15 season:**

  68 844 ha of which 33 310 ha were for the current season and 35 534 ha historic data

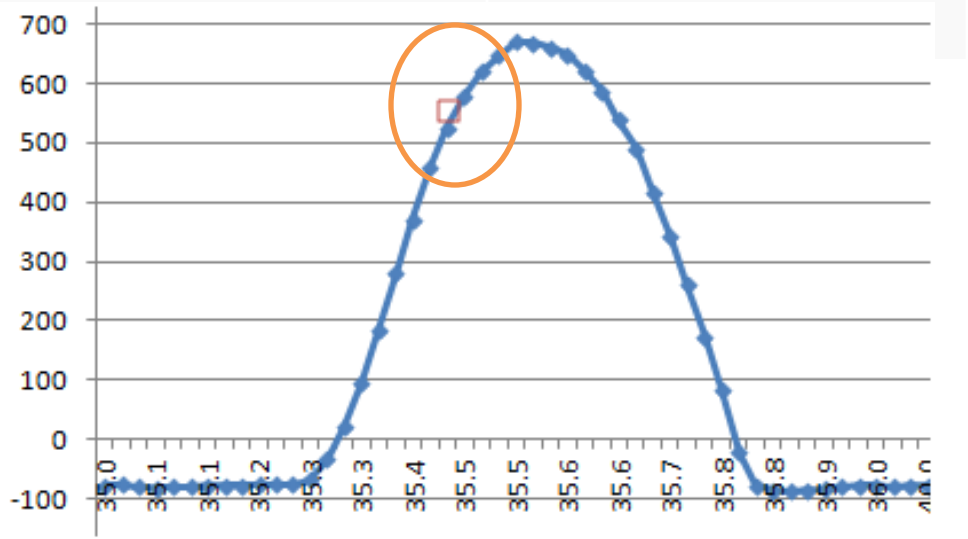
FruitLook use



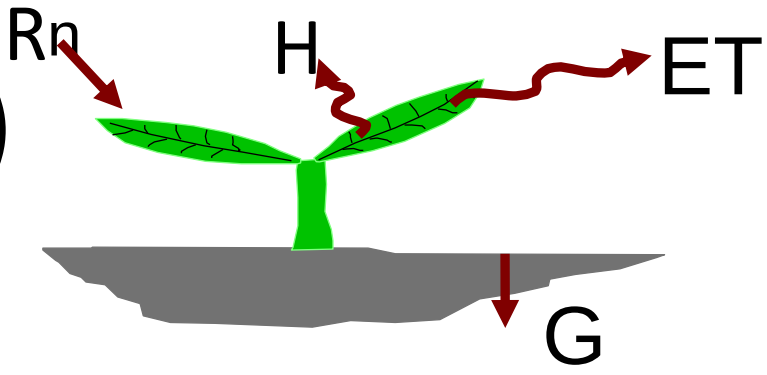


Seeing is believing ?

Time & Space – sample / see

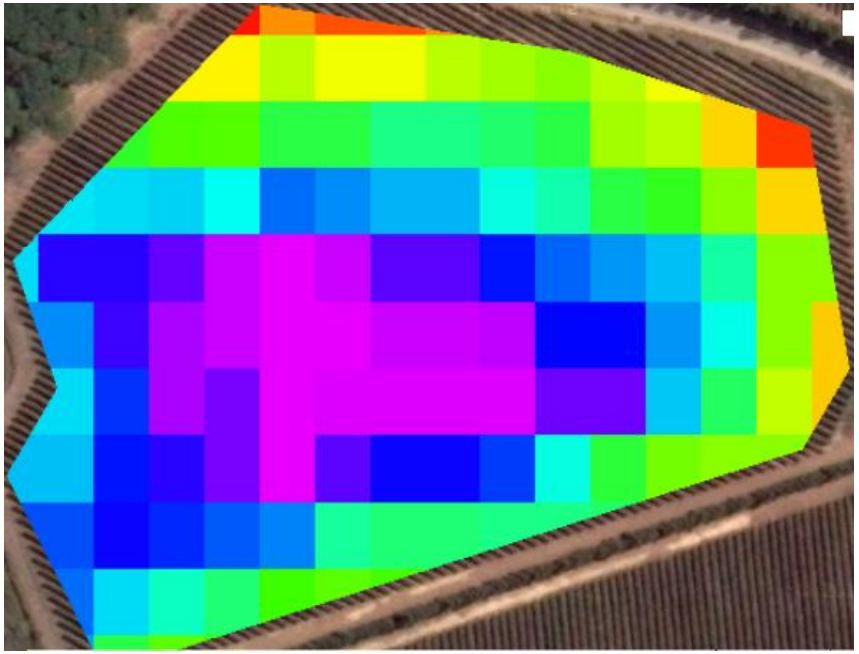


Comparison energy (i)



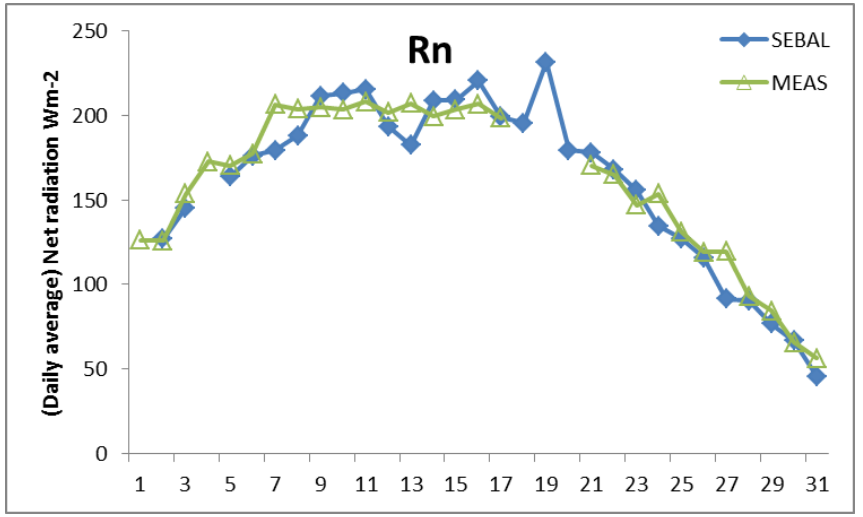
Data accuracy / comparison

Qualitative ("trend matching")



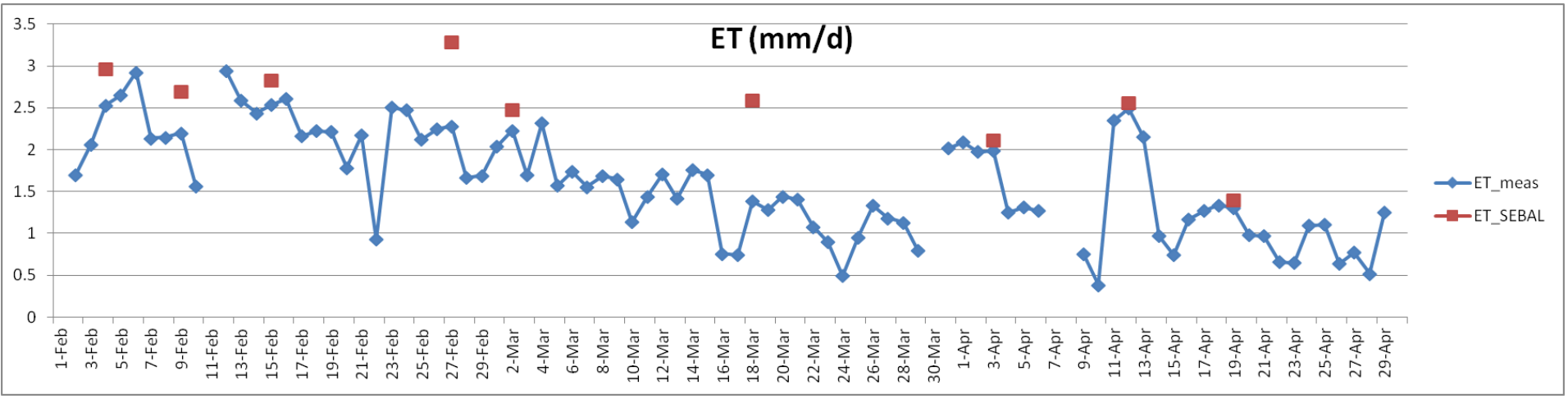
Match trends in spatial data with trends that can be observed

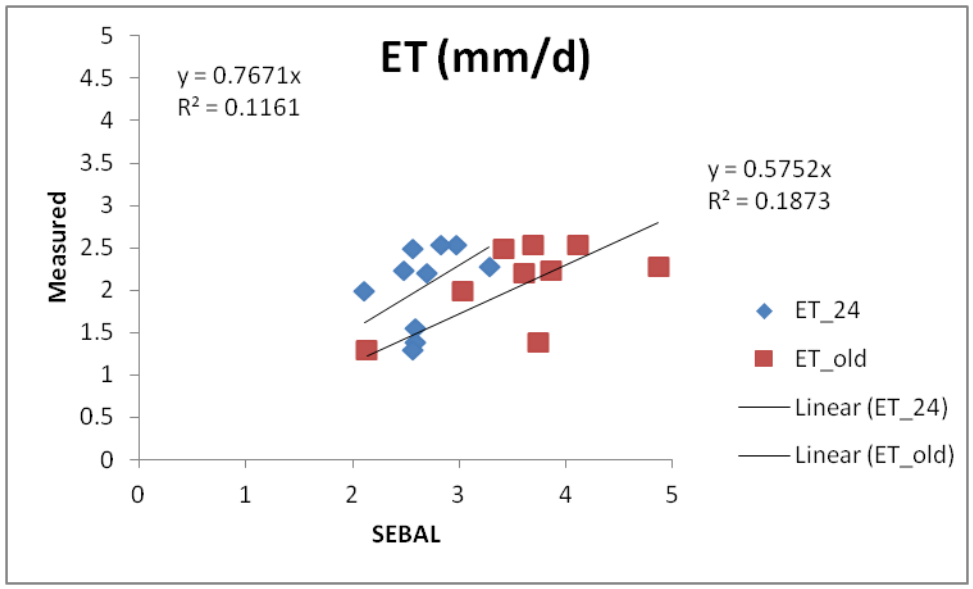
Quantitative ("value matching")

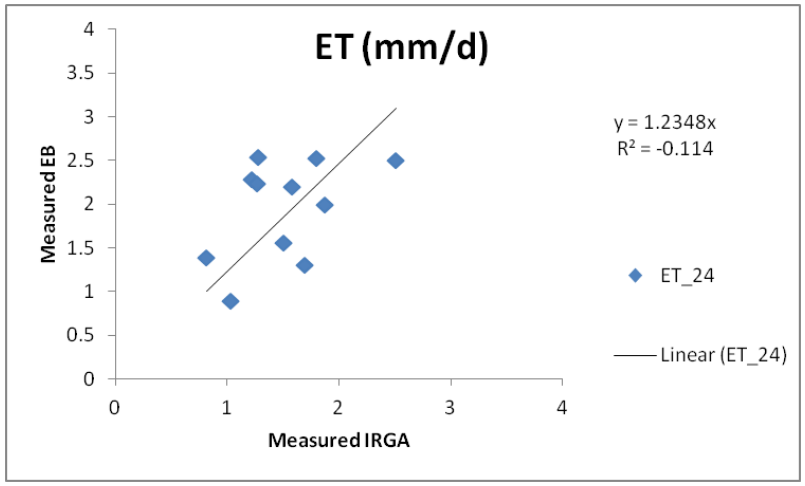


Match data with that observed (not only results, but also components of equations)

Comparison ET



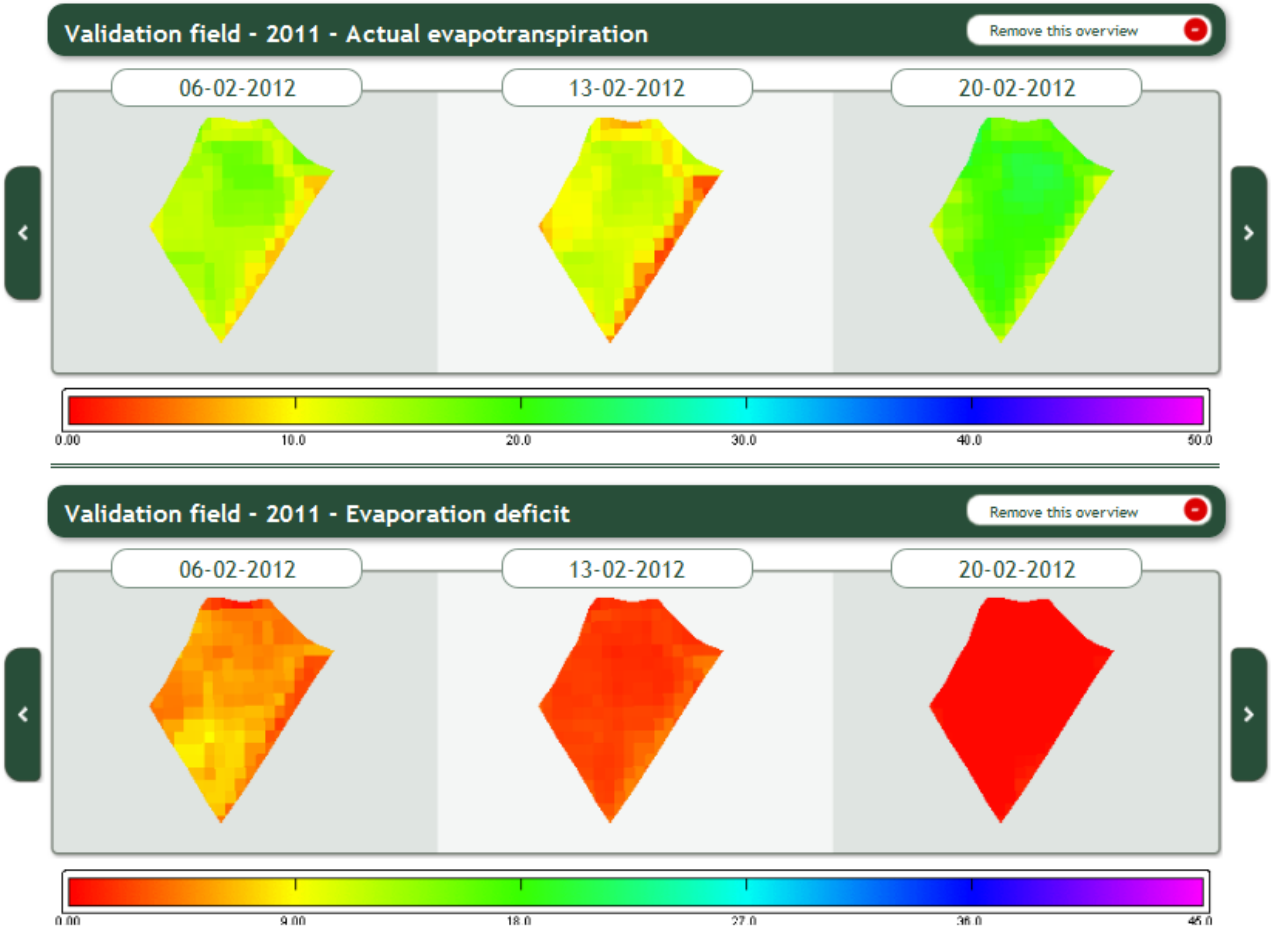




- Applications of FruitLook data

Evapotranspiration vs Irrigation

Evaluation and planning of irrigation applications



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

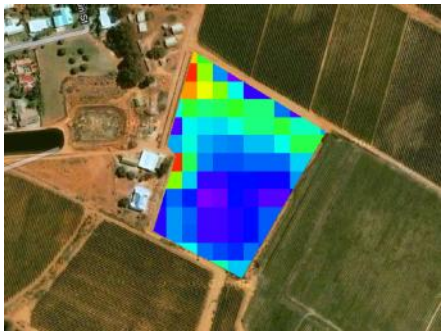
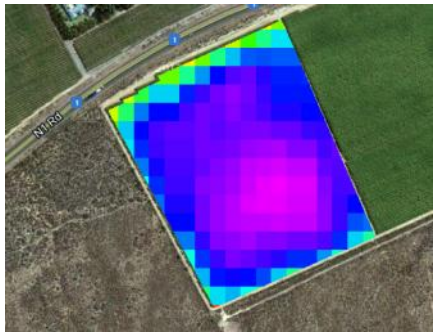
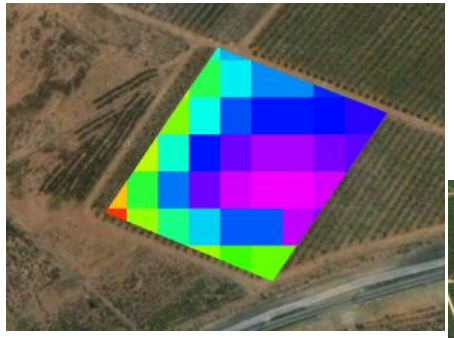
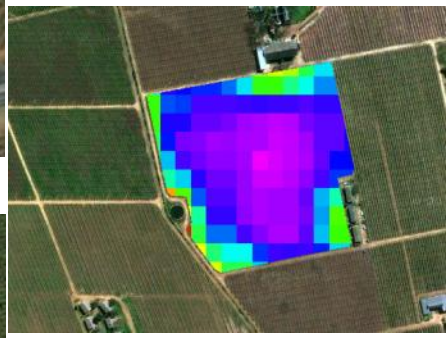
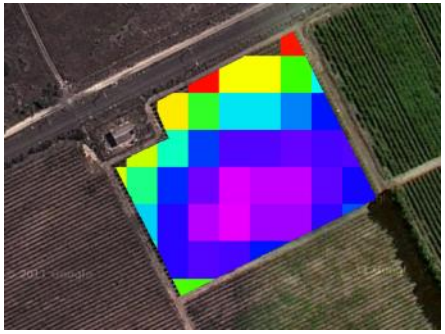
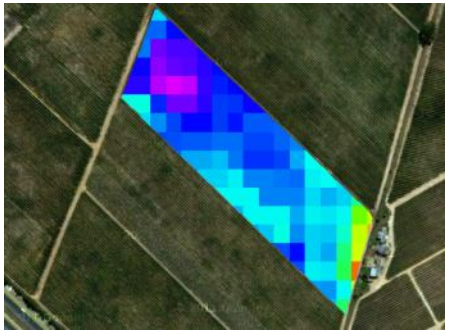
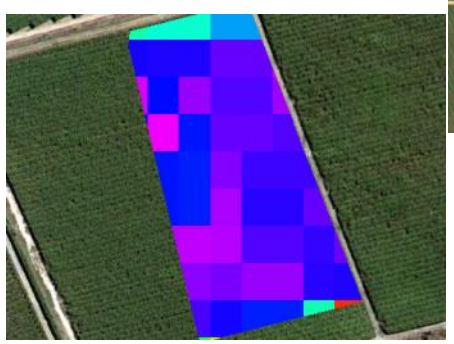
Evapotranspiration, $ET_{deficit}$

Tool for Consultants

- *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*

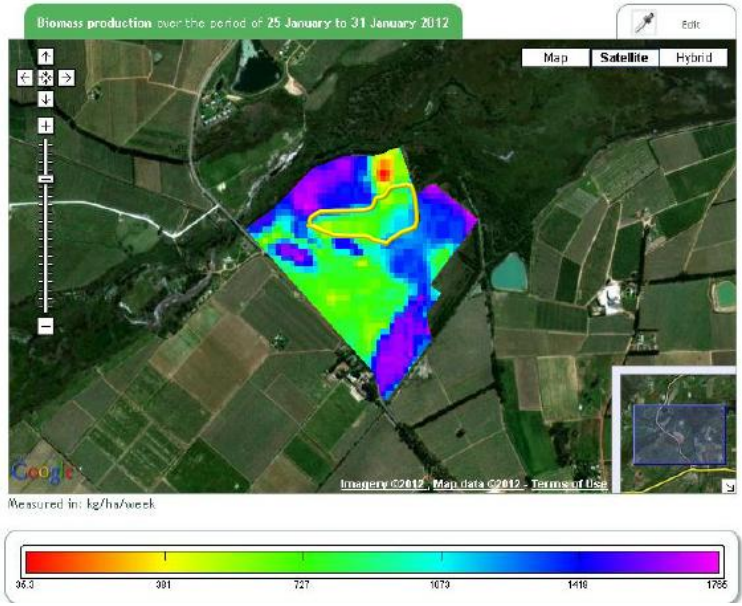
Checks www.fruitLook.co.za weekly

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

FruitLook example of use: Spatial pattern + field visit

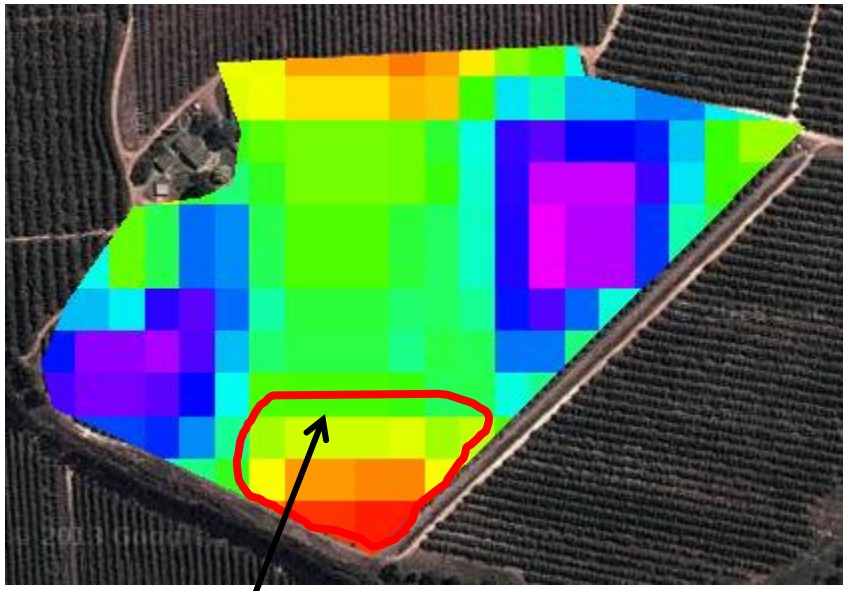
- Heterogeneity and decrease in biomass production
- Field investigation
- Disease identification and treatment



Example: Disease management

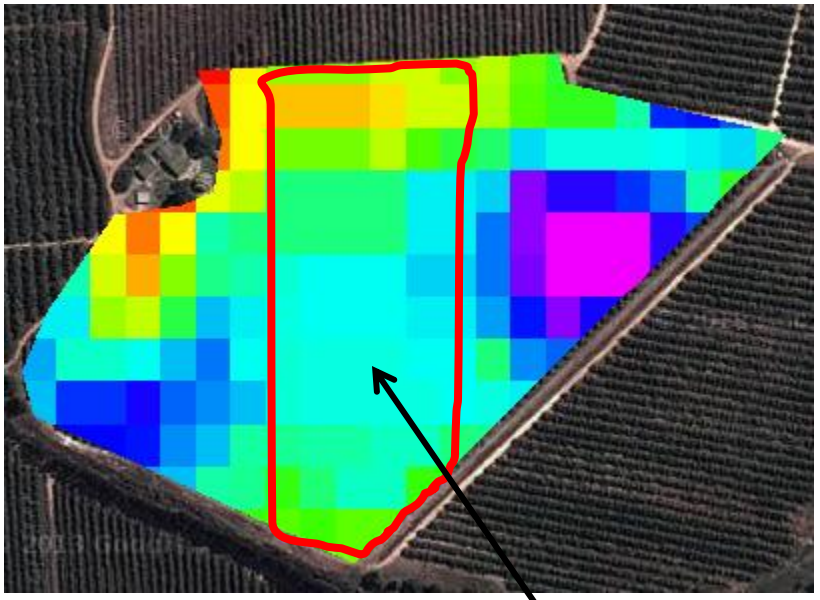
2011

Biomass production over the period of **14 December to 20 December 2011**



2012

Biomass production over the period of **12 December to 18 December 2012**



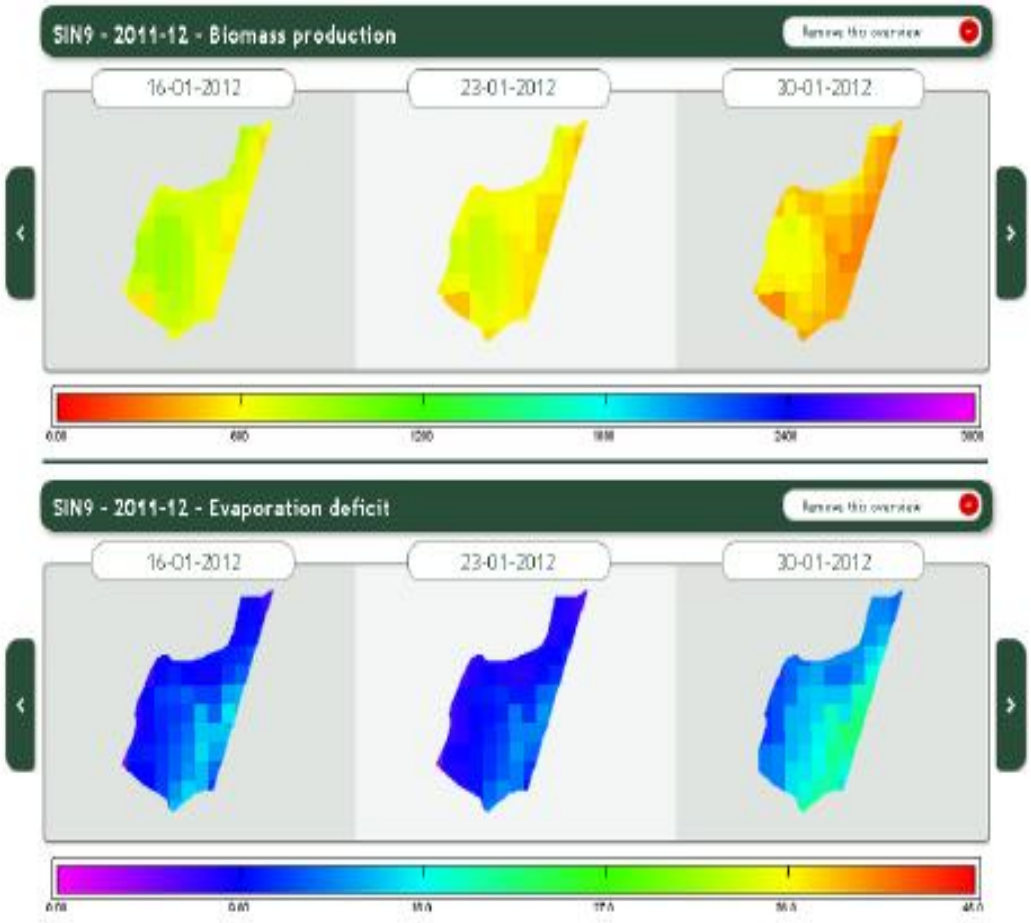
Block E26 more uniform after treatment

1) Identification of area with poorer biomass growth
2) Strategic soil sampling of these areas to analyse for nematode presence
3) Treatment of affected areas only

Strategic treatment saved 75-80%

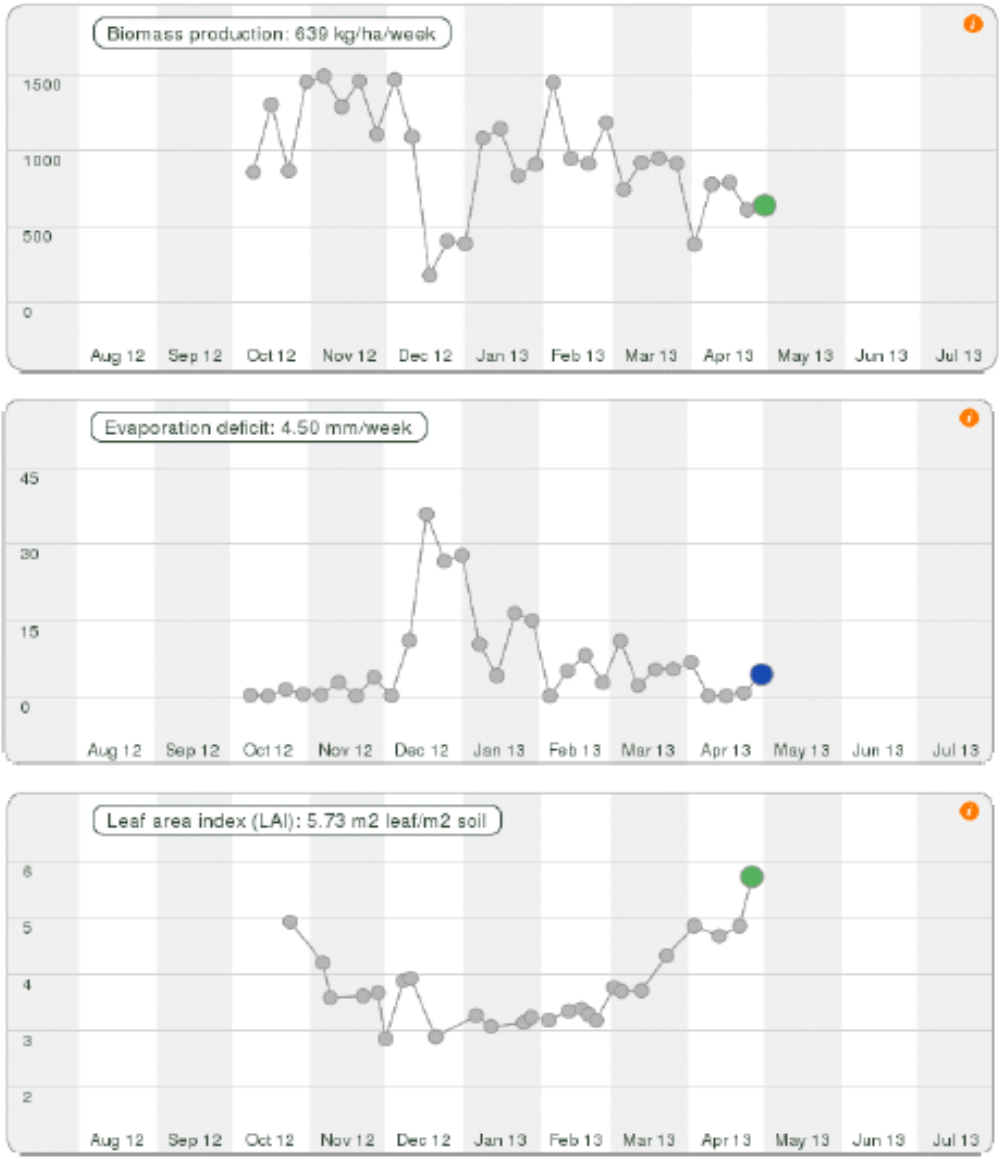
FruitLook example of use: Spatial + seasonal patterns

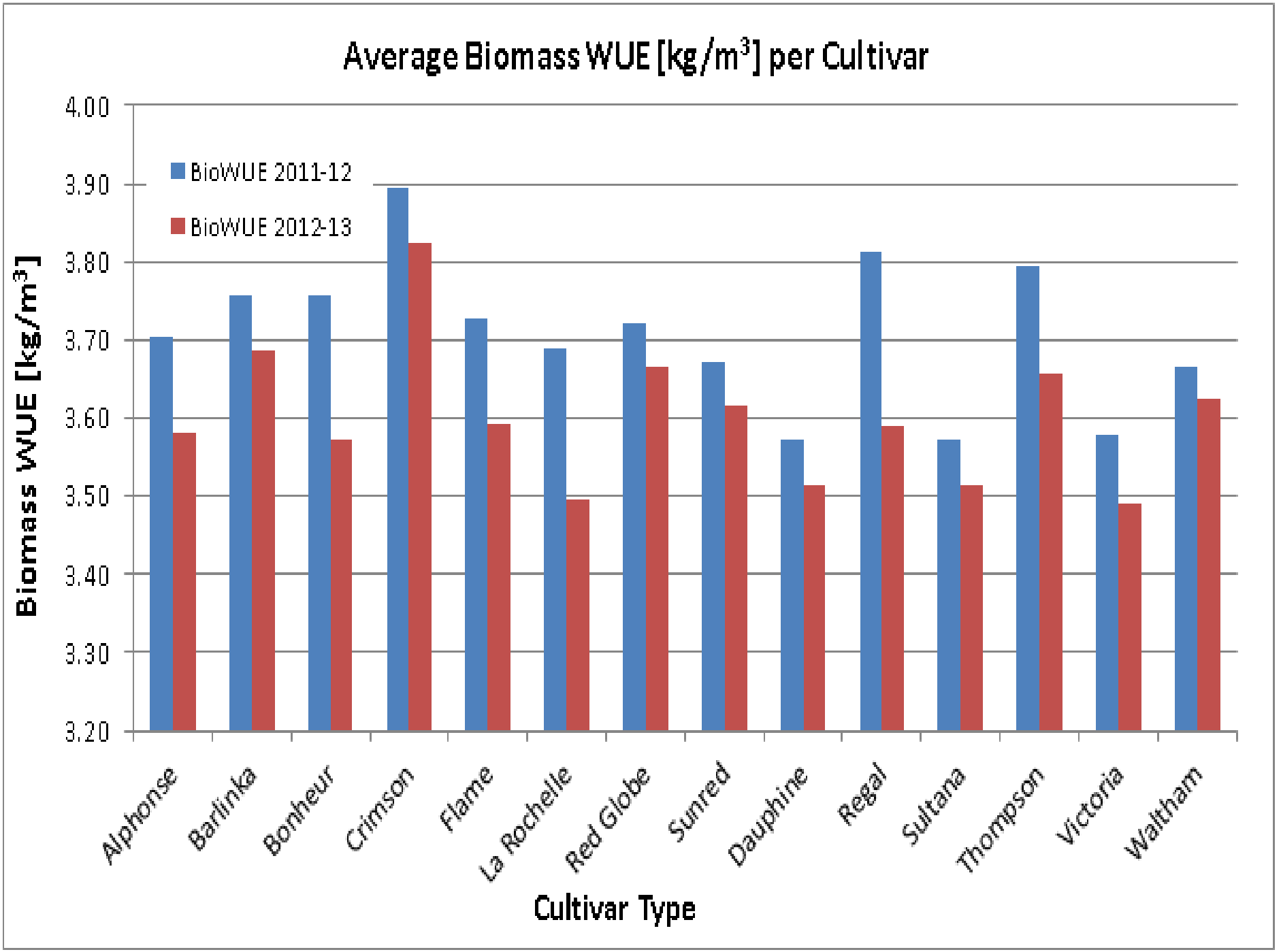
- Spatial pattern in ET deficit
- Seasonal pattern
- Evaluate moisture probe placement



FruitLook example of use: Seasonal spatial data

- Spatial pattern in ET deficit
- Field knowledge on irrigation
- Evaluate seasonal irrigation




Average Biomass WUE [kg/m3] per Cultivar
BioWUE 2011-12
BioWUE 2012-13
Biomass WUE [kg/m3]
4.00
3.90
3.80
3.70
3.60
3.50
3.40
3.30
3.20
Alphonse
Barlinka
Bonheur
Crimson
Flame
La Rochelle
Red Globe
Sunred
Dauphine
Regal
Sultana
Thompson
Victoria
Waltham
Cultivar Type

- Cost of providing FruitLook data

Cost to run FruitLook

Appoint eLeaf on an annual basis (pay them in €)

Purchase DMC satellite images (pay them in £)

Exchange rate not working for us !!

Annual cost (35 weeks) is €197 000

Validation and marketing € 42 000

Total cost € 239 000 per irrigation season

FruitLook Objective

Expected benefits by

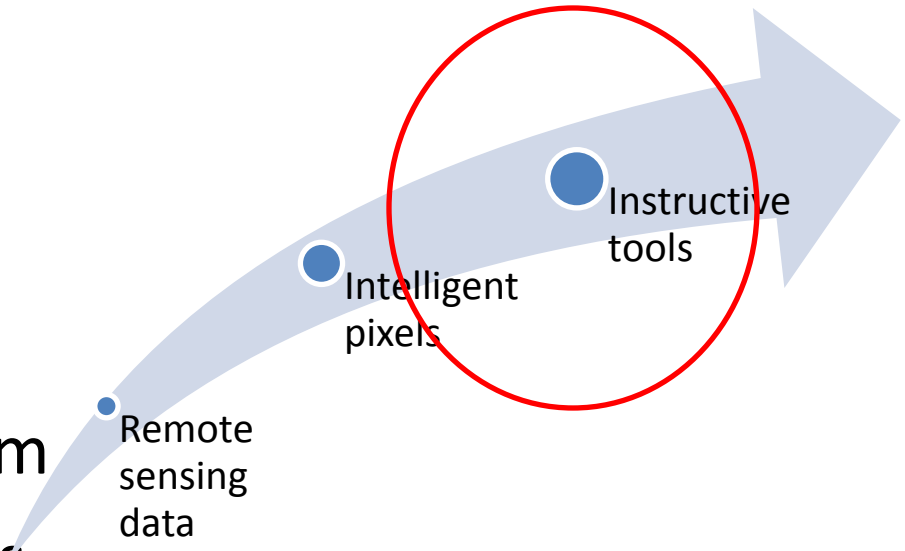
1) increasing revenues with 10% (yield); and

2) decreasing costs (water, fuel, fertilizer and chemicals) with 10 %:

Wine grapes:	€ 264 /ha
Table grapes:	€ 1 512 /ha
Deciduous fruit trees:	€ 1 612/ha

Future purchasing cost of FruitLook: € 30/ha per season

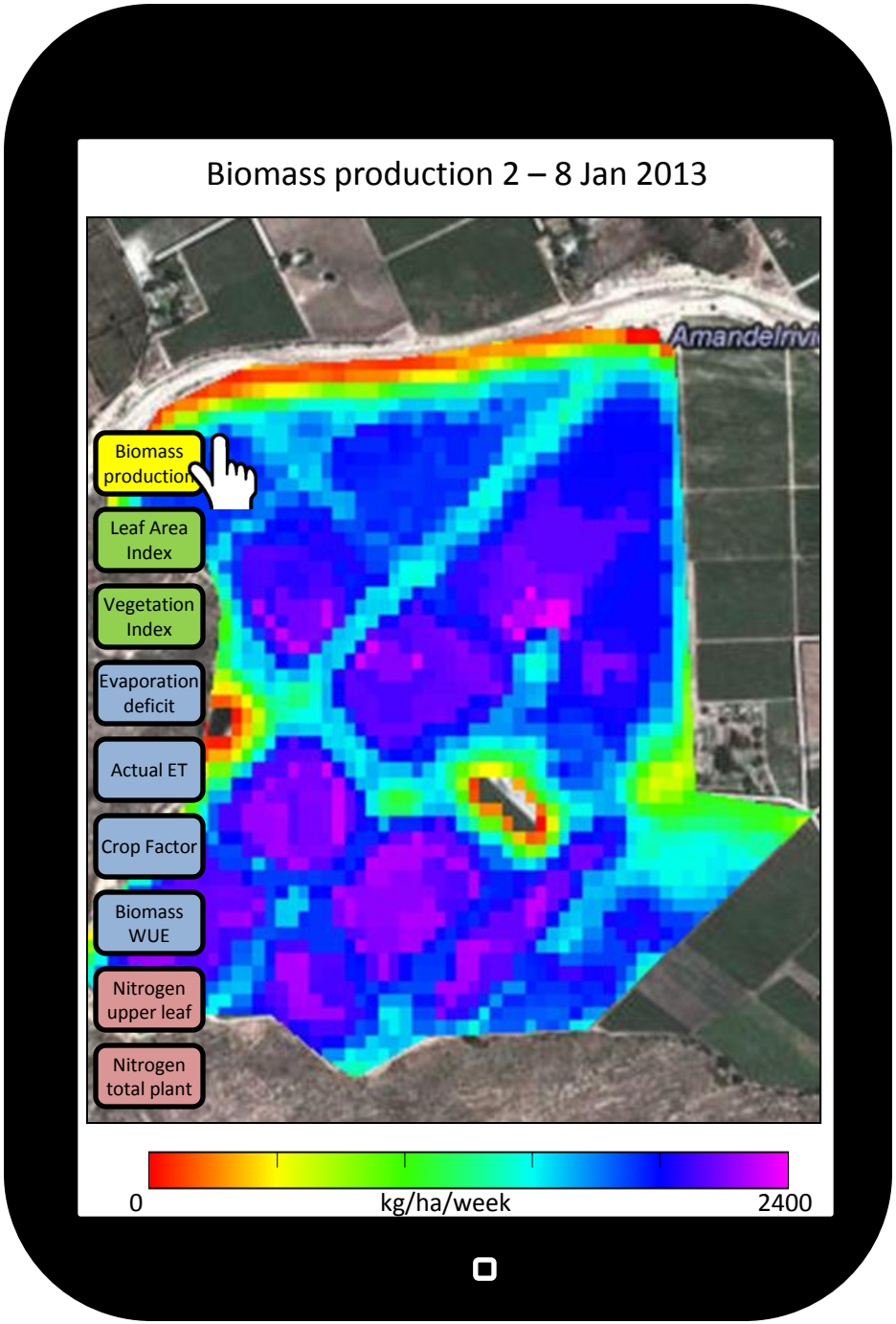
Fruitlook Future



- Continue Fruitlook
  - Fully operational system
  - Being used by irrigators
  - Development of relevant tools by users
  - Affordable – move towards self sustaining project
- Develop applications to provide information to registered users via their cell phones

FruitLook questionnaire: 2015

	0%	0-10%	10-20%	20-30%	>30%	No Answer
Reduction in energy costs	22.2%	18.5%	18.5%	0%	14.8%	25.9%
Increased yields	22.2%	18.5%	14.8%	7.4%	7.4%	29.6%
Reduction in irrigation water application	22.2%	11.1%	22.2%	11.1%	11.1%	2.2%
Increase of efficient water management	11.1%	7.4%	25.9%	14.8%	22.2%	18.5%



Provide FruitLook information to registered users via their cell phones

In closing…

- FruitLook can assist irrigators to optimise irrigation water use
- Can assist farmers to mitigate the impacts of climate change
- Various other uses of the data provided weekly
- This data can contribute towards sustainable and environmental friendly farming practises

- Data can be obtained from the web portal www.fruitlook.co.za

Thank you, any questions?