



Getting useful information for almond producers from Precision Agriculture sensing technologies

Rob Bramley

CSIRO, Waite Campus

AGRICULTURE AND FOOD
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Dr Rob Bramley

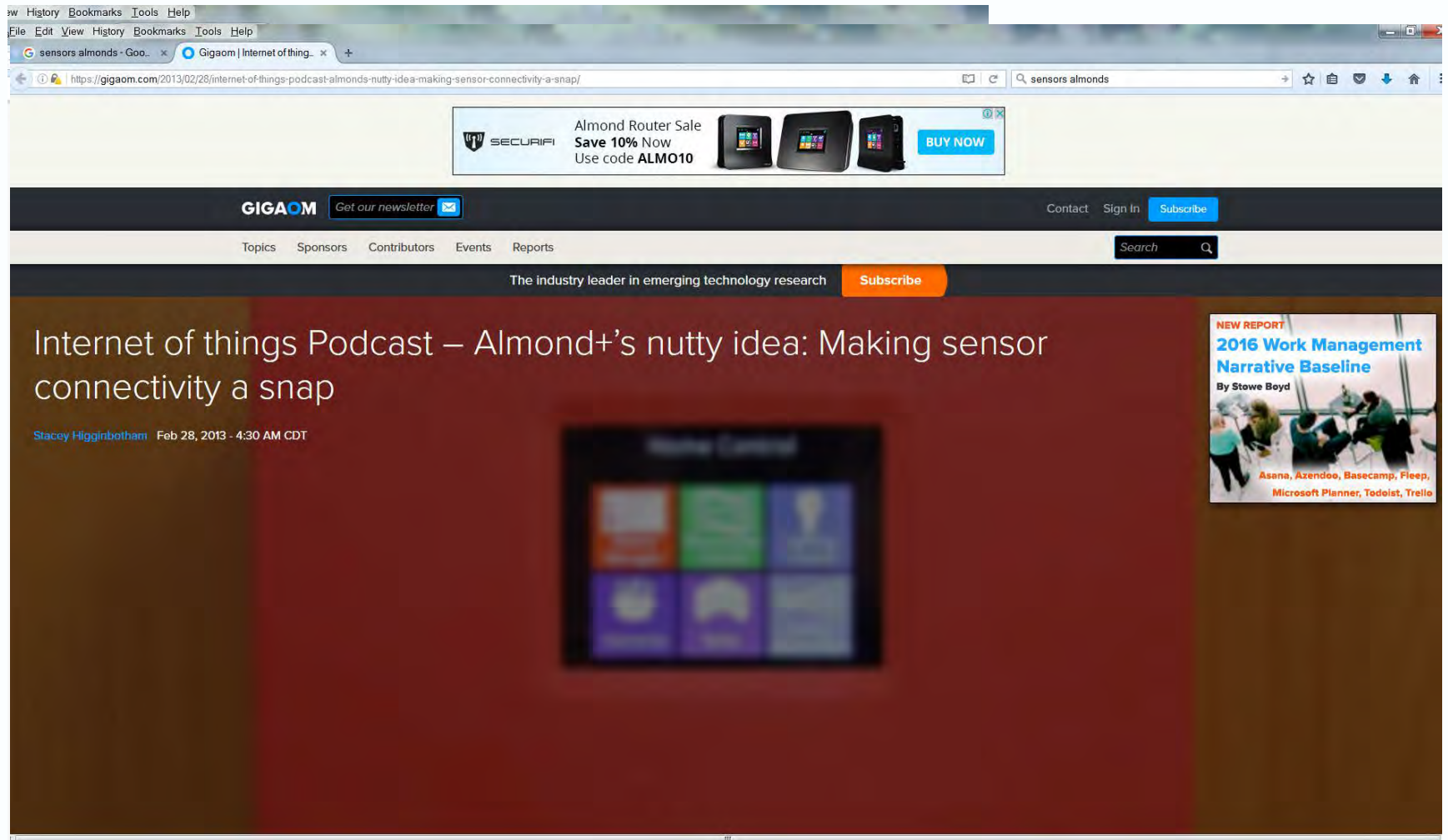


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CSIRO Agriculture & Food

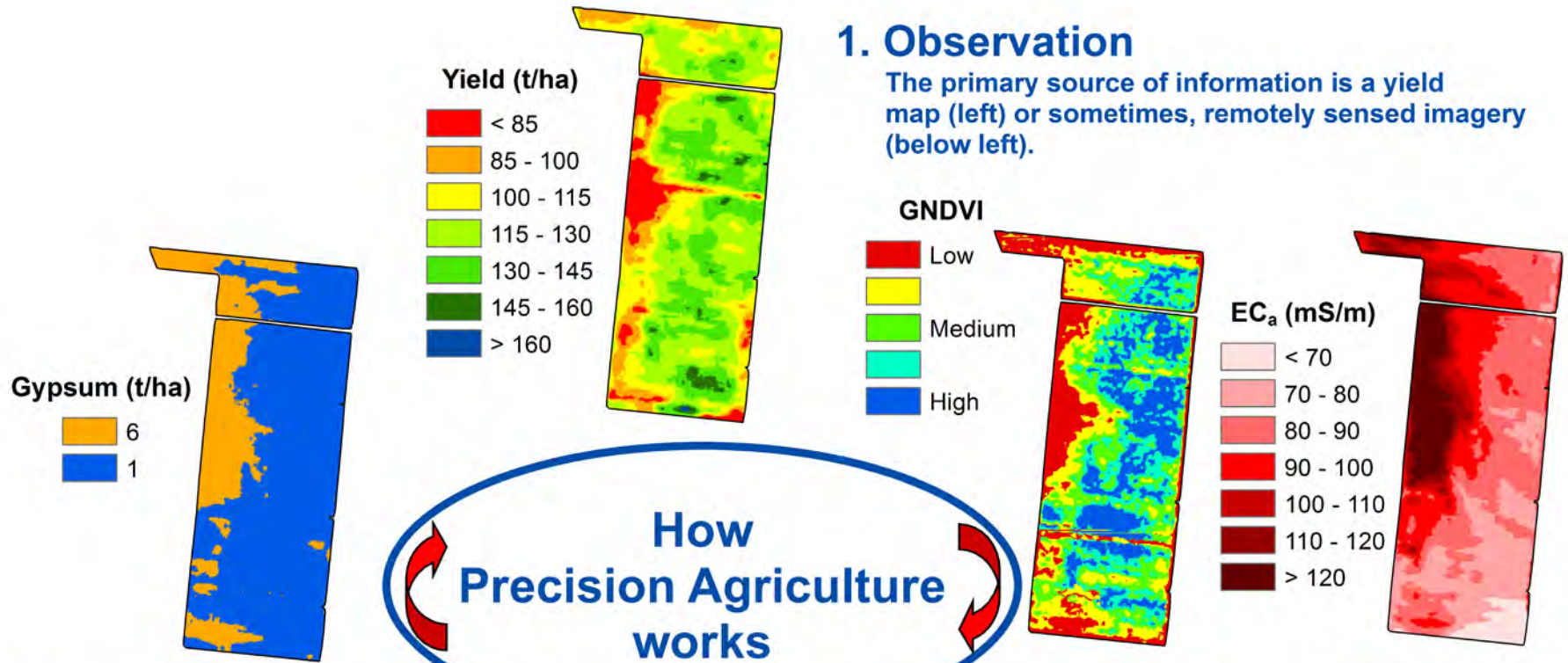
Dr. Rob Bramley is a Senior Principal Research Scientist in CSIRO's Agriculture Flagship and is the Site Leader for CSIRO Waite Campus in Adelaide. He has worked as a soil chemist, on land-use sustainability issues, and since 1996, has had a primary research focus on Precision Agriculture and the management of variability in agricultural production systems. He has just completed a significant multi-agency Precision Agriculture project in the Australian sugar industry and, since 1999, has been a pioneer in the development of Precision Viticulture for winegrape production systems, now leading a newly funded project on within-vineyard yield-grape quality interactions. He is the author of over 290 research articles including 46 in refereed international journals and has spoken on Precision Agriculture at numerous international conferences around the world.

Google 'sensors almonds'



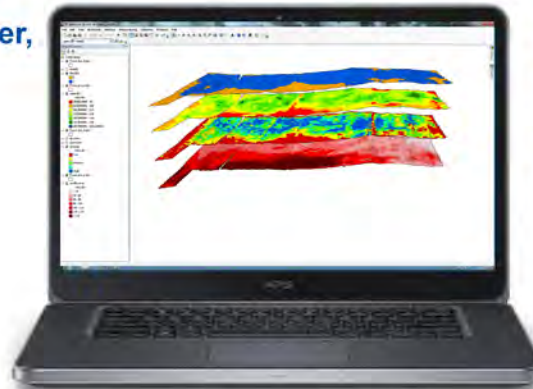
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3. Targeted management

eg variable rate application of fertilizer, soil ameliorants, irrigation water, agrochemicals, crop ripeners, or selective harvesting, etc...



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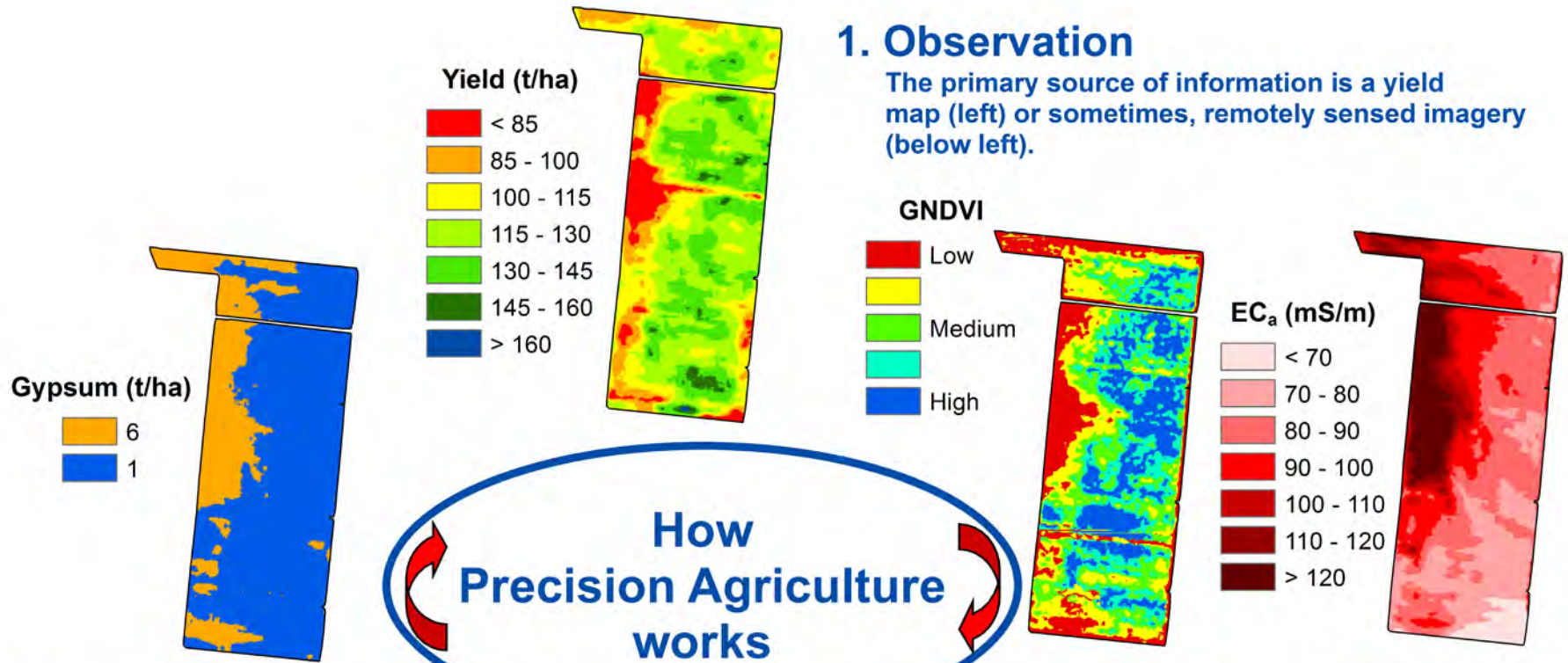
2. Evaluation and interpretation



JACKRABBIT

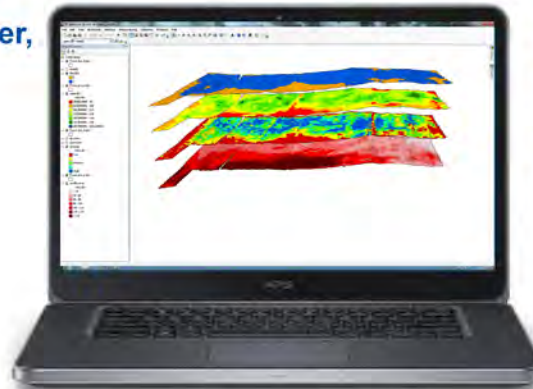
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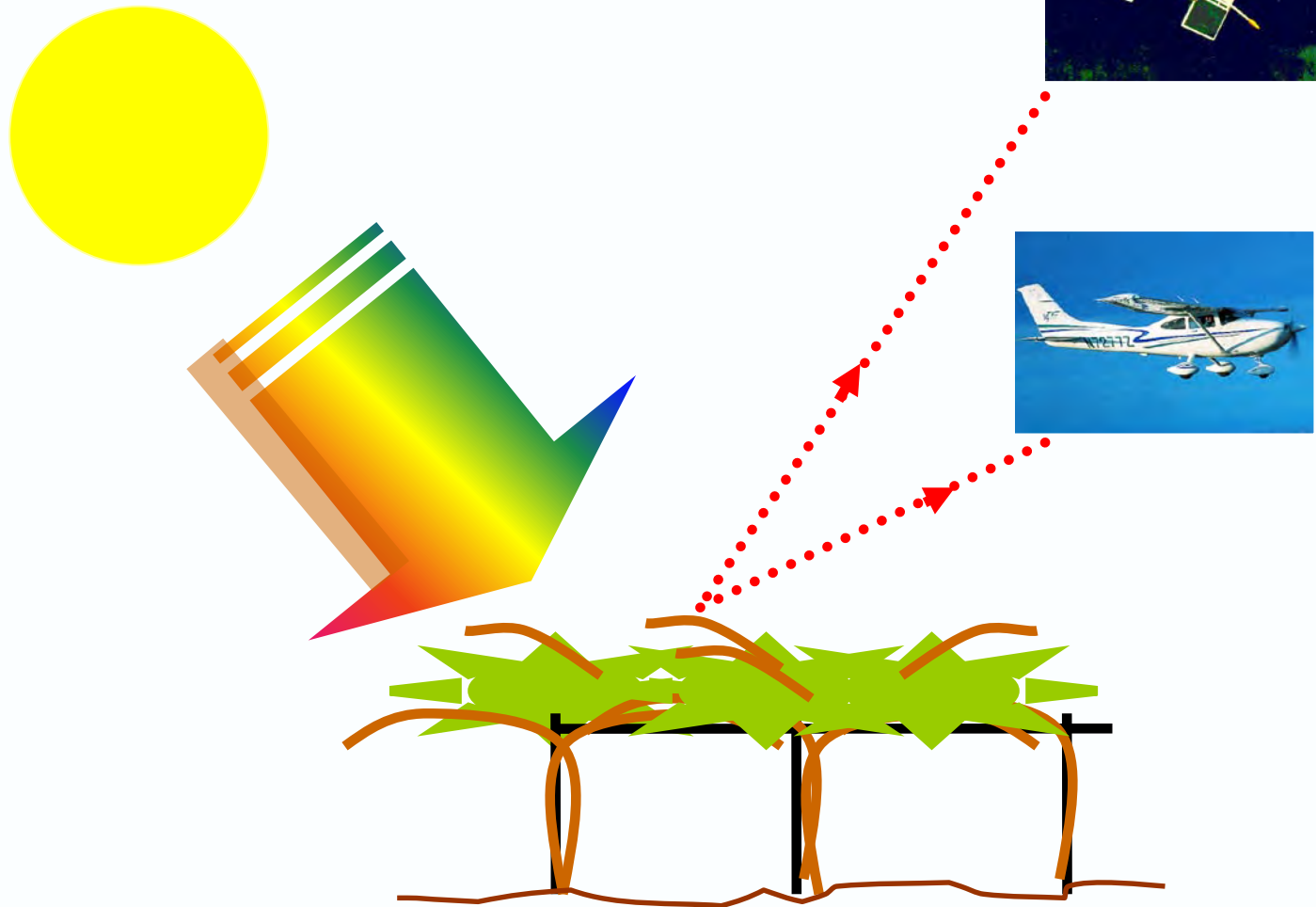


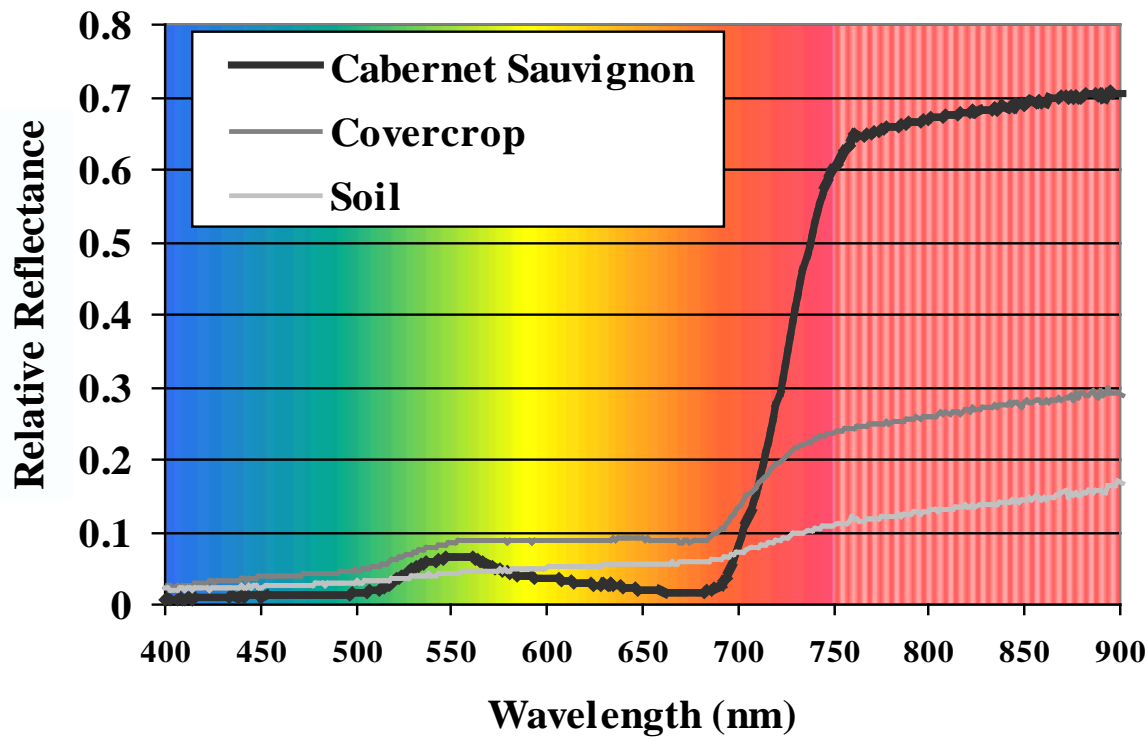
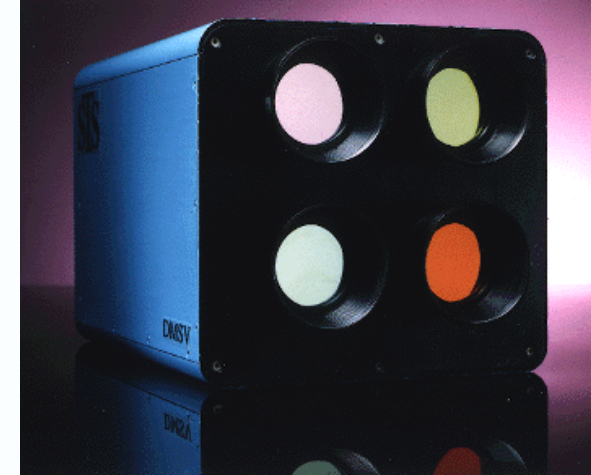
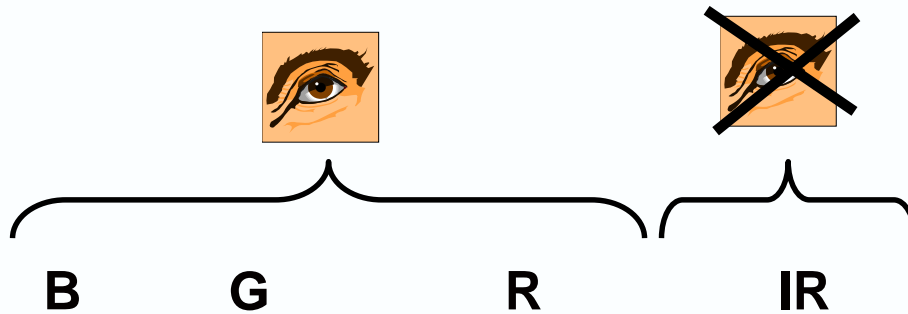
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2. Evaluation and interpretation

Optical Remote Sensing

relies on the link between
canopy & productivity





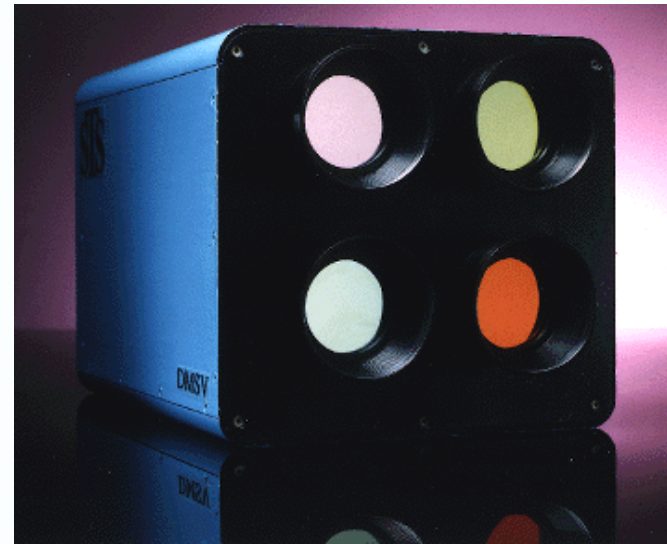
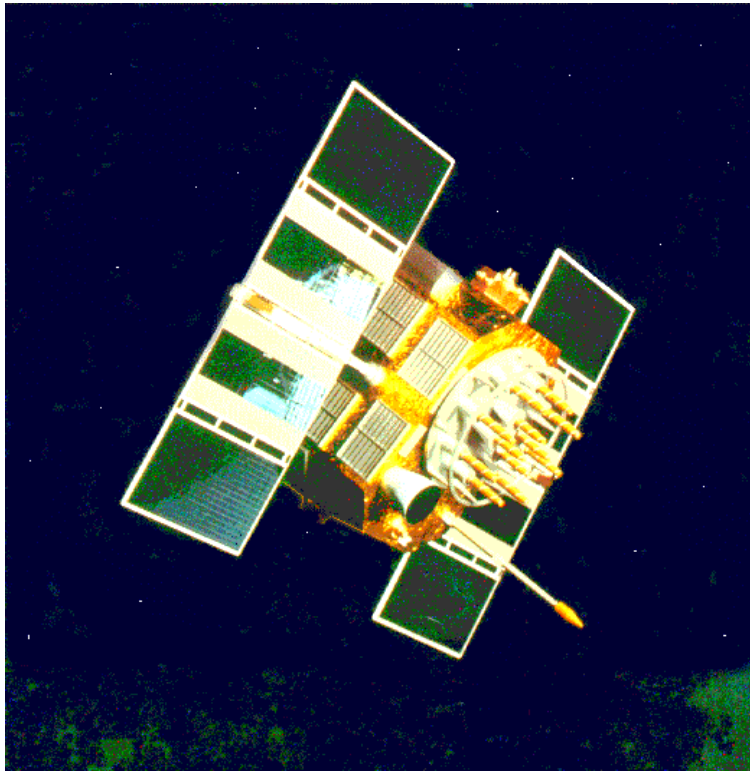
$$NDVI = \frac{IR - R}{IR + R}$$

$$GNDVI = \frac{IR - G}{IR + G}$$

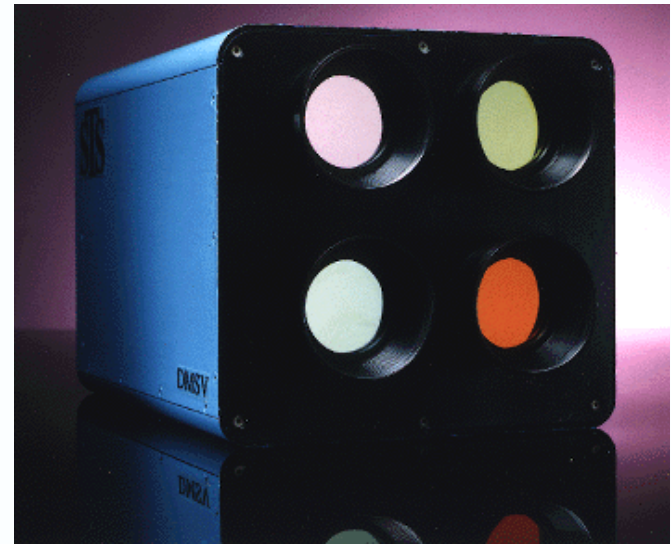
$$PCD = \frac{IR}{R}$$

$$'Vigour' = \frac{G}{R}$$

Remote sensing in viticulture / horticulture



Remote sensing in viticulture/horticulture



Valdez et al. (2012) Prediction of leaf area in almonds by vegetation indices. Comp. Elect, in Ag. 85, 24-32

San Joaquin Va

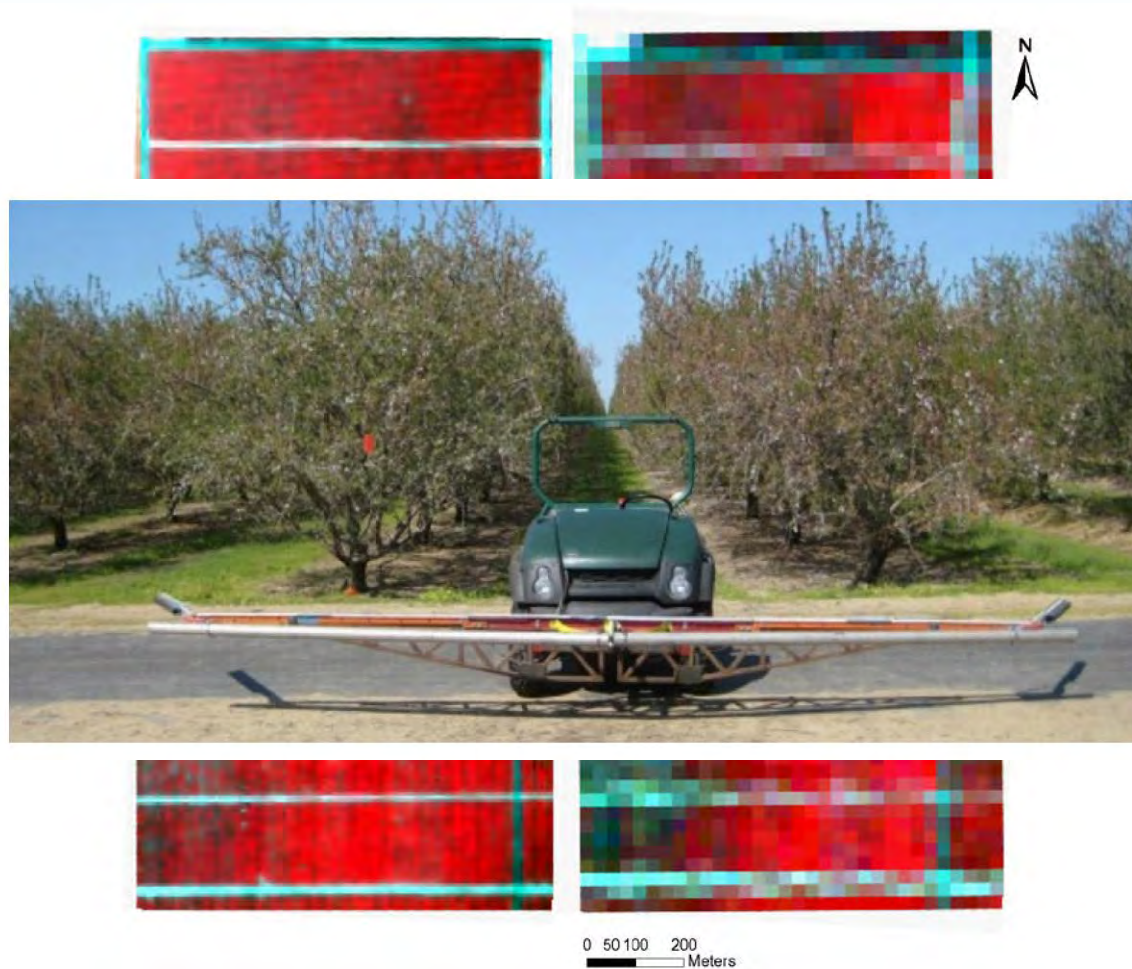


Fig. 3. Color infrared composites of MASTER, GSD 7.2 m, (a, c) and Landsat, GSD 30 m, (b, d) images of the Belridge (a, b) and Spur Dynamics (c, d) orchards.

Drones / UAVs – Yamaha RMax



www.goodfruit.com



www.bloomberg.com

Drones / UAVs



Apple's Pro vision fails to plug into the future

DAVID SWAN
CONSUMER TECH

Apple's confused MacBook Pro event shows that perhaps the company no longer understands what the word "Pro" means.

The latest upgrade of the laptops isn't just confusing — these computers have no idea who they're for.

The company's latest keynote was supposed to reinvigorate its adoring fan base after making it wait years for a revamped MacBook Pro.

Instead it just doled out disappointment, with the company ditching traditional USB ports, the Magsafe magnetic charging port, and the SD card and HDMI slots in favour of four USB-C ports.

The new machines aren't upgradeable either — the first MacBook Pros to be sold where you're stuck with the memory you buy at checkout. To add insult to injury the new price tag is pretty hefty.

Creative professionals — designers, writers, coders, et al — use things like USB flash drives, SD cards, and HDMI cables to plug into external displays. For these power users who rely on this tech every day to do their jobs, the USB-C equivalents in some cases don't even exist yet. Good luck finding a USB-C thumb drive, for example.

I like progress, even when it's difficult. I was a defender of the company's "courageous" move to remove the headphone jack in its iPhone 7 range. Curiously the headphone jack is left intact in the MacBook Pro range. After spending a significant portion of its iPhone 7 keynote talking about why the headphone jack should be removed, Apple has silently left it in its latest laptops, the one outdated port it reckons deserves to stay.

Perhaps most damning of all is the notion I could walk into an Apple store to buy the company's latest iPhone and its latest MacBook Pro, spending thousands of dollars to have what is supposedly the best, most forward-looking technology — and the iPhone won't even plug into the MacBook Pro. That's

professionals anymore. What seemed like genius timing for Apple's event — held just days after a similar showcase from arch rival Microsoft — now seems like a misstep. Microsoft's line-up was genuinely interesting, it's trying things. It's updating Windows 10 with what it's calling a "Creators Update", including the addition of new 3D creation tools.

It's releasing a high-end "Surface Studio" all-in-one desktop system that boasts a new input device called the "Surface Dial", an accessory that lets Surface users twist it to do things like pick colours in Paint.

What's Apple's MacBook Pro innovation, for which Apple fans have been waiting years? That'd be the Touch Bar, a weird compromised feature that offers little in the way of anything useful, and instead seems like a tacky add-on. Years ago, Apple went all-in with its touchscreen iPhone, with rumours that next year's iPhone 8 will even feature just a full touchscreen with no bezel, instead incorporating the fingerprint sensor into the screen itself.

The iPhone won't even plug into the MacBook Pro

In another sign of inconsistency the latest MacBook's main display isn't touch-enabled at all, a move that will likely drive creatively minded customers into Microsoft's arms.

Worse, despite Apple's insistence Touch Bar is a "breakthrough interface", it announced a new MacBook Pro that doesn't have it.

It's now selling two MacBook Pros with a Touch Bar — a 13" and 15" model, as well as a 13" model that has a slower processor and no Touch Bar. So, if I'm in the market for a new powerful MacBook Pro, will I buy the fully fledged high-end Touch Bar MacBook Pro, or save a few hundred dollars and get one without it? Which model is for me as a "Pro", if any?

Follow the leader as new drone follows your moves

CHRIS CASHIN
GADGETS

DJI's foldable Mavic Pro is a take-anywhere drone. At just 743g and less than 20cm long, you no longer need the whole boot to carry a consumer drone.

Being a DJI drone, the Mavic doesn't compromise on quality, either. The Hong Kong-based drone maker came to prominence in 2014, when a DJI Phantom 2 took stunning video flying over the erupting Bardarbunga volcano in Iceland. I wasn't flying over volcanoes in Sydney, but I did manage some high-quality video and 12mp stills, thanks to the Mavic's 4K camera, which shoots video at 30 frames per second and 12-megapixel stills.

This is an easy drone to unfold. Two arms open from the sides and the other two rotate 180 degrees. They effortlessly click into place and the hinge mechanisms feel firm. You don't need to install the propellers each time, as they fold away compactly. But you can remove them and there's no need to rotate the propellers into position. You can also slot in a microSD card to capture media, clip on the battery and press the big button on top (twice).

Fast follower

If you've flown drones before, you might think you've run out of things to do but you would be wrong. The Mavic has an increasingly popular feature called follow-me where you can set the drone to automatically trail you and shoot video as you cycle. There's also subject tracking, where it locks on to an object and keeps it in frame.

Those of us who live in the burbs are limited by regulation but if you have a farm or a large property, there are endless things you can try, such as have a Mavic follow you from above as you drive a tractor around. Speed it up, shove it in Microsoft Hyperlapse

DJI Mavic Pro foldable drone

FEATURES

- Foldable high quality DJI drone
- Fast (up to 64km/h), radio range 7km
- Vision positioning with GPS
- Control with console and/or phone



- Excellent flight control
- Smooth high resolution 4K footage
- Smart flying features, sensors



- Can be buffeted by wind
- Fragile gimbal system
- Foldability adds cost

Rating
8/10

Certified operators left up in the air over new rules

Just who is the public campaign to further toughen drone rules targeting? People such as photographers who take aerial shots with lightweight drones? Ordinary consumers who fly exactly the same drones under

who commercially shoot drone footage of action sports. The three bodies want the rules tightened and have conscripted crossbench senator Nick Xenophon, who says the rules need revisiting.

To be certified, you need an RPA (remotely piloted aircraft) operator's certificate, which costs about \$6400 overall. CASA charges \$1400 to assess

same sub-2kg drones would, especially when complete novices, pose an equal or greater safety risk than lightweight commercial operators. That's if your overwhelming control is safety.

The campaign comes across as just targeting lightweight commercial operators and not bothering about amateurs. That's inconsistent and

broke, which stopped plans to shoot more footage and try follow-me and subject tracking. In this instance, Karma has a more flexible gimbal system. You can remove it and use the camera manually with a hand controller called Karma Grip.

It may be susceptible to gusts but the Mavic doesn't feel like a lightweight drone. DJI says it travels up to 64km/h in sport mode. To me it felt like it was slic-



Price
\$1699 \$2199
With combo pack



Maturity required to sell and prosper

RENE SUGO
OPINION



Australia is a vast land with a small population. We have a "can-do" attitude and this has bred a swag of successful global businesses, including BHP Billiton, Freelancer and Atlassian. However, I think we can all agree, the number of multinational businesses that have originated from here would deem us a "small fish" on the world stage. Could the reason be in our entrepreneurs' frame of mind?

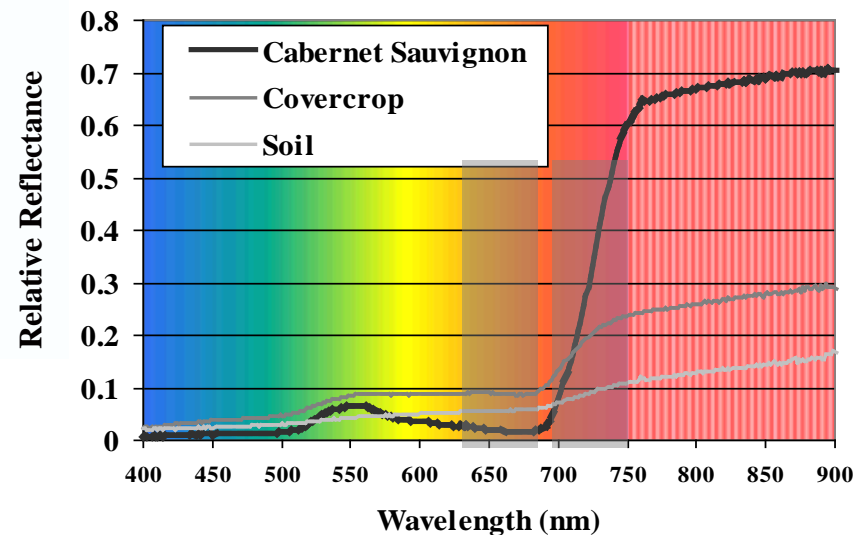
We are successful entrepreneurs and are developing a start-up ecosystem that is uniquely Australian. As a result, according to the 2015 Startup Muster Report, 3 per cent of Australian start-ups sold to a foreign purchaser. This number is anticipated to increase to 12 per cent in coming years.

Australian businesses aim high and yet, unlike business people in other countries, many of our entrepreneurs do not start their business with the intention of pragmatically selling it when the time is right. Our entrepreneurs tend to build their business and then stay with it for the long haul. We don't chop and change, many stay at the helm of their business until they retire. This stoicism was once admirable, but seems more like folly in the 21st century. As a consequence, when the conversation is raised and an offer is put on the table, many Australian business founders are confounding to deal with.

It seems our business owners find it difficult to remain detached from the business transaction. Perhaps it's the lack of exposure to a large volume of

Drones / UAVs – lots of traps for young players

- Just because the sensor platform is a drone does not mean that the sensor is any good !
- Lots of start-up businesses have emerged offering remote sensing services using drones and/or selling the equipment to those interested in self-service.
- Many of these use cheap, 'off-the shelf' digital cameras
 - Most of these are broadband
 - Beneficial remote sensing requires narrow band filters
- Is there a point of difference ?
- Do you have time ?
- R + M is potentially a big cost
- Toys for boys !



Proximal sensors - Greenseeker



Proximal sensors – Crop Circle



Crop Circle – from the side



Crop Circle – above the canopy



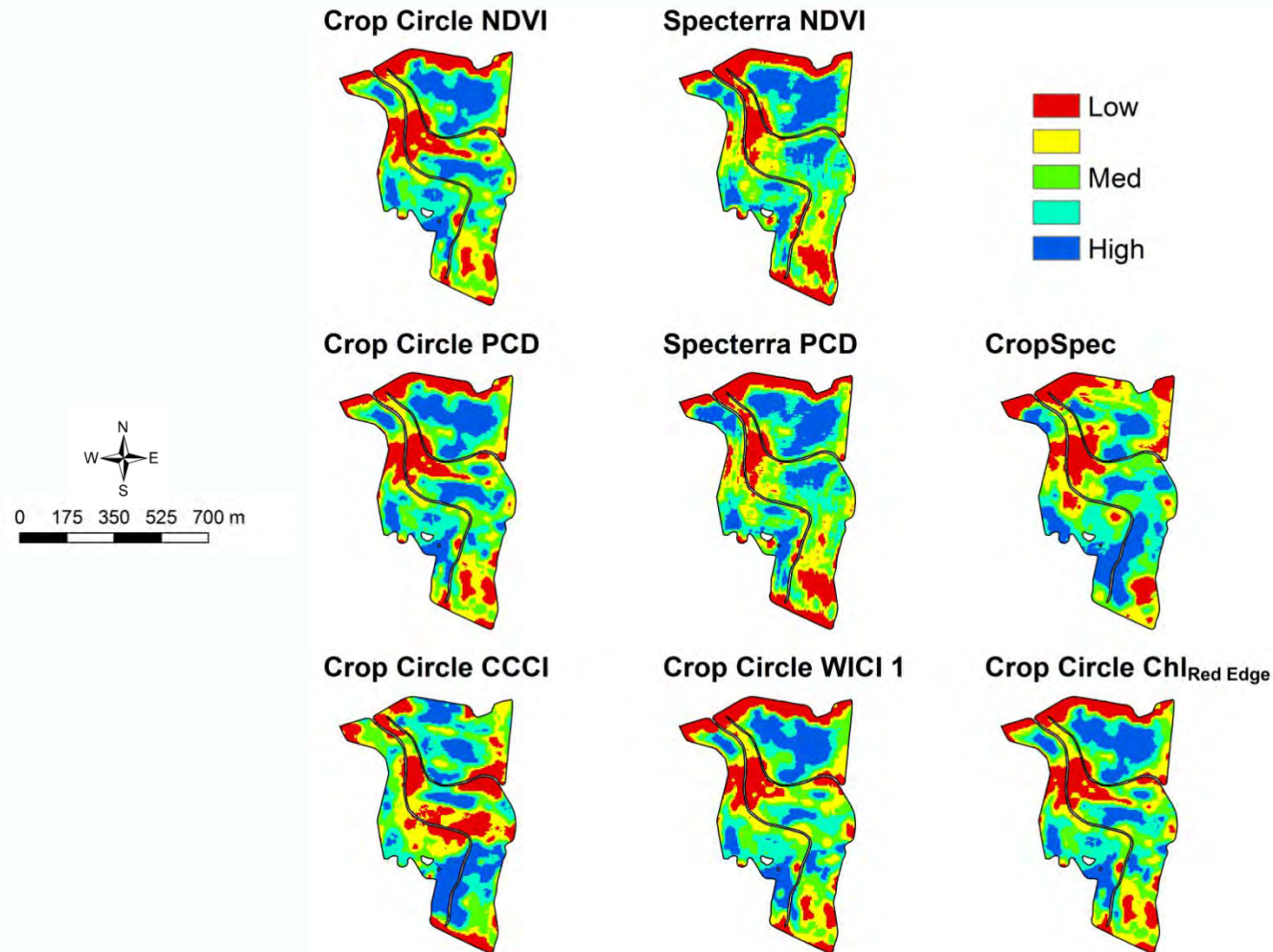
CropCircle - barley



TopCon CropSpec



A grains example – mid-north of SA, 2012

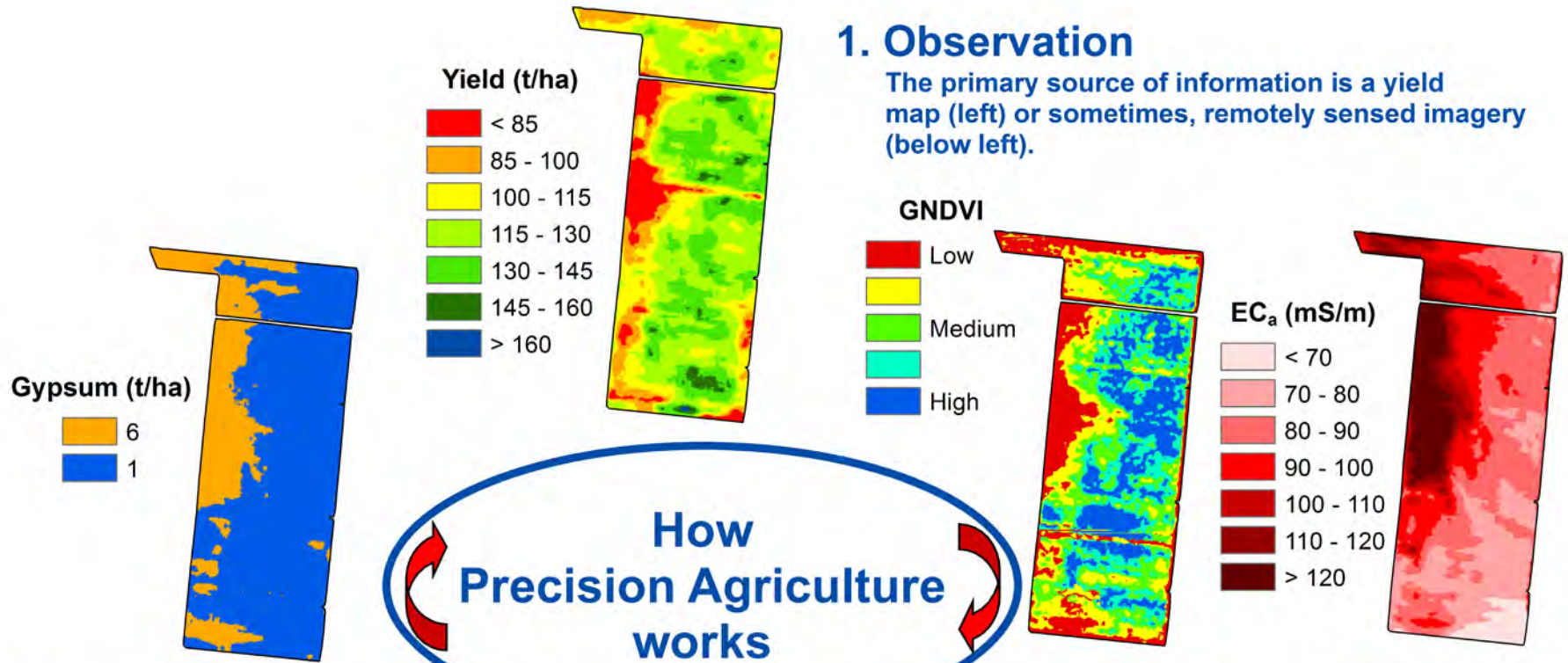


Summary – NDVI and similar indices

- There is nothing new about this stuff !
- G, R, IR-based indices (NDVI, GNDVI, PCD, etc...) give you essentially the same information
- Remote sensing generally uses passive sensors, whilst most proximal sensing (eg Greenseeker) uses active sensors
 - Nonetheless, NDVI, GNDVI or PCD sensed by any of them gives essentially the same information
- Whilst it is true that the camera never lies, you cannot regard it as offering the truth unless you understand what it is showing !
 - Ground-truthing is essential (why is that area low vigour ?)
 - You cannot make prior assumptions about what these sensors are going to tell you about – moisture availability, disease, etc...
 - All they do is provide relative information about the amount of photosynthetically active biomass (ie canopy size / health)

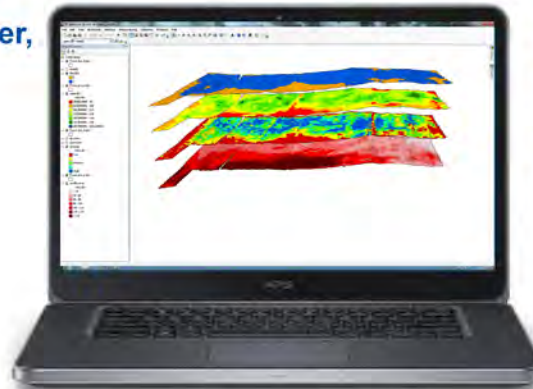
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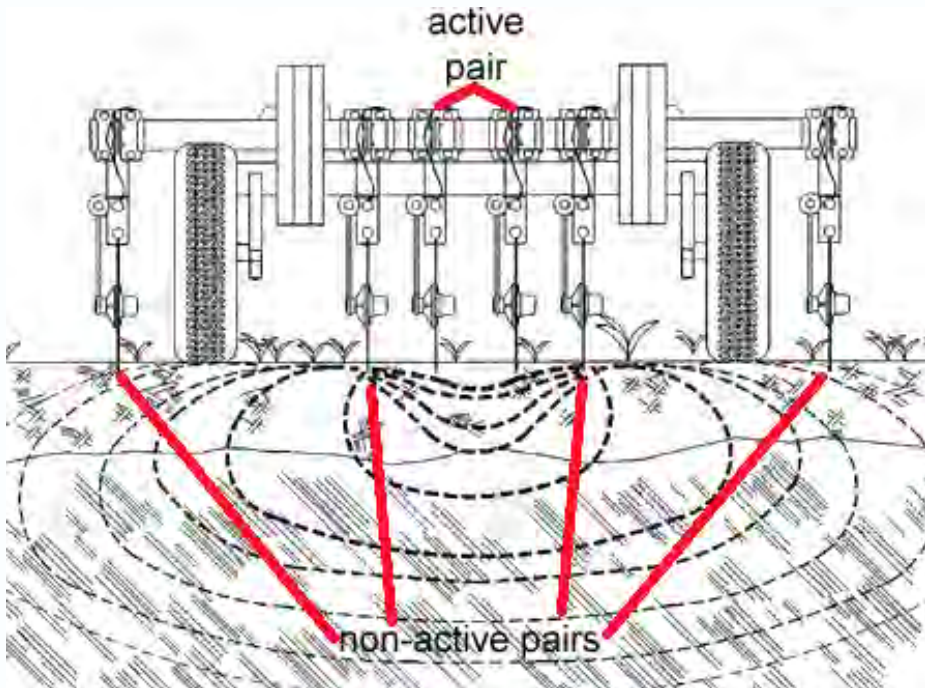
EM38 (Geonics, Canada)



- Measures electrical conductivity.
- Very widely used for soil sensing for PA worldwide.
- Does not require contact with soil.



Veris 3100 (Veris Technologies, USA)



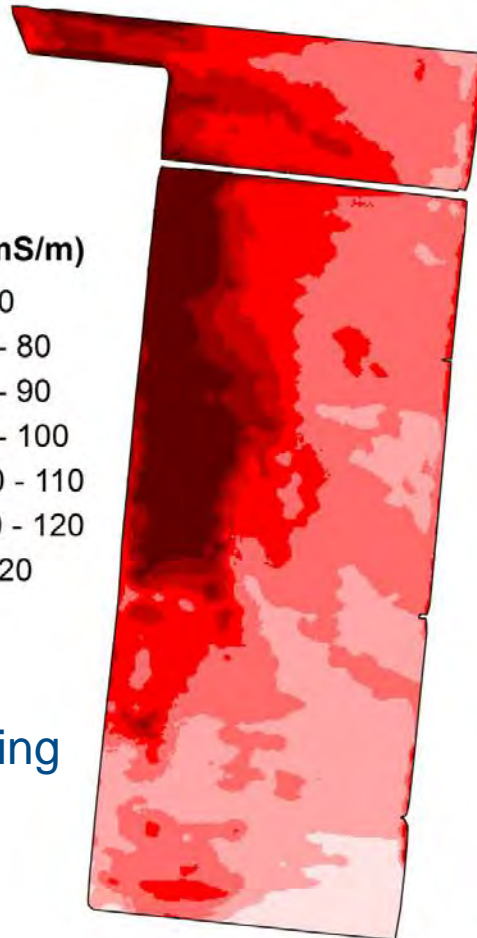
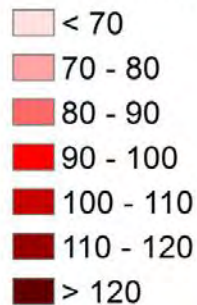
- **Measures electrical resistivity.**
 - Resistivity = $1/\text{conductivity}$
- **Sensor depends on good contact with soil.**
 - Can be a problem in dry conditions
- **NB 'tillage'**

EM38 vs VERIS – Burdekin, post-harvest

EM38 MK2 DD (0-75 cm) - 6 July 2011

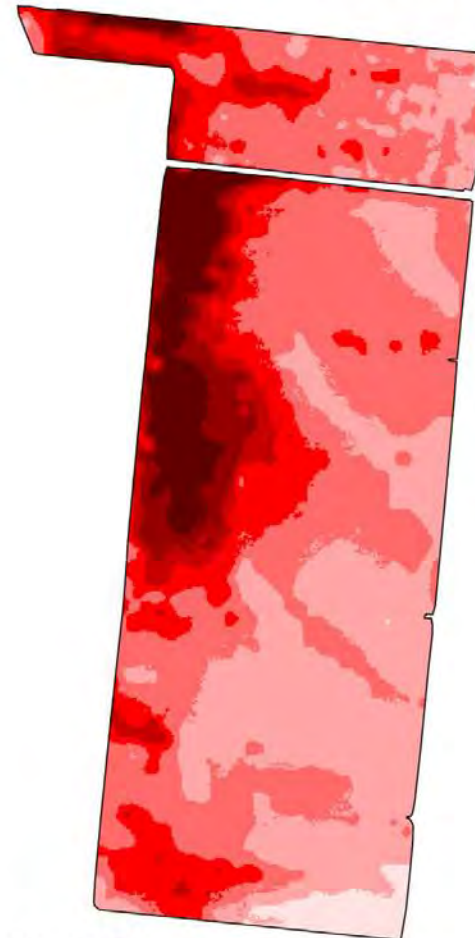
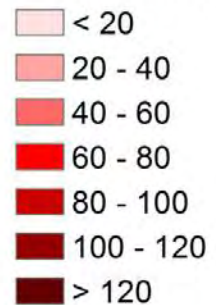
VERIS (0-90 cm) - 11 August 2011

EC_a (mS/m)



- 5.5 m spacing
- ~ 9 km/h
- 1 Hz

EC_a (mS/m)



- 15 m spacing
- ~ 20 km/h
- 1 Hz

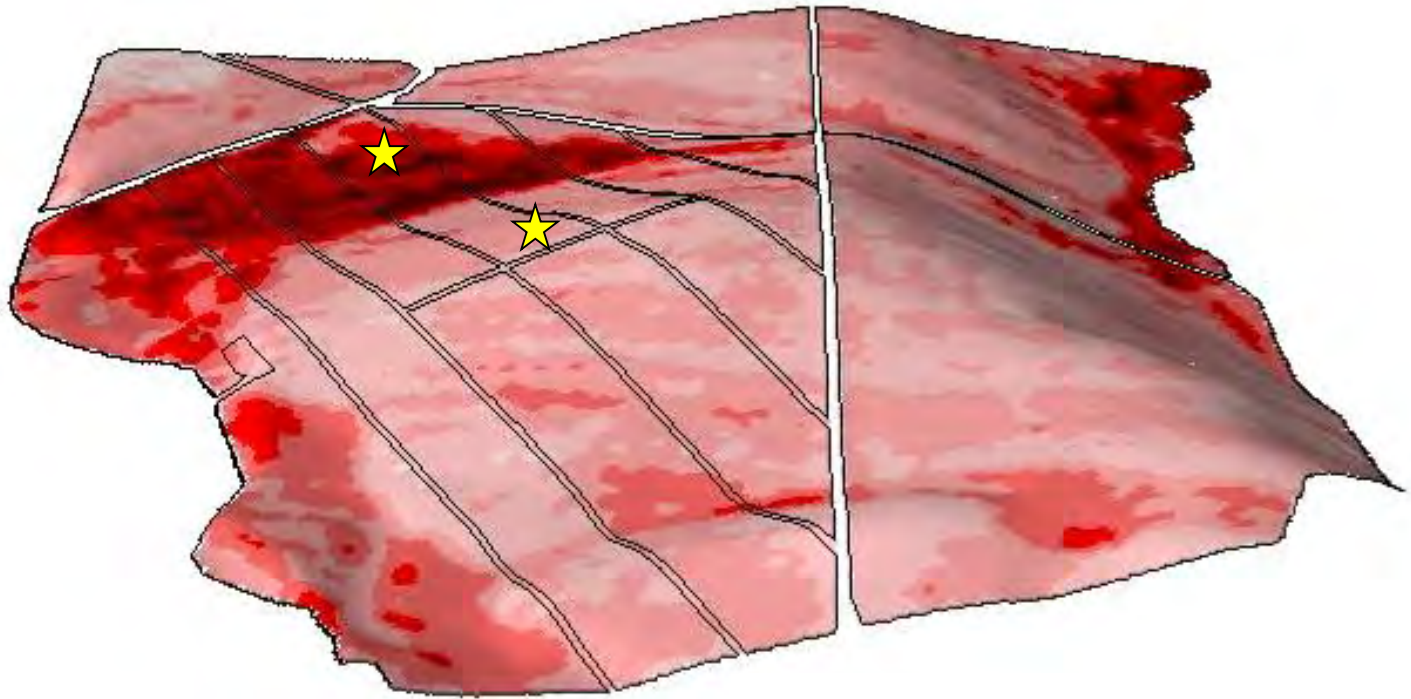


0 75 150 225 300 375 Metres

EM38 and RTKGPS survey – soil and elevation

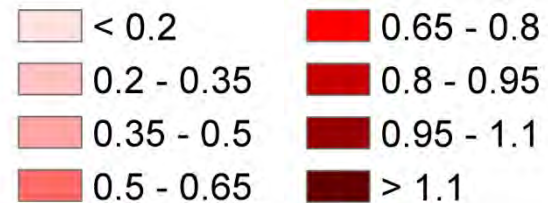


EM38, elevation and a changing soil profile



Elevation range = 29.2m

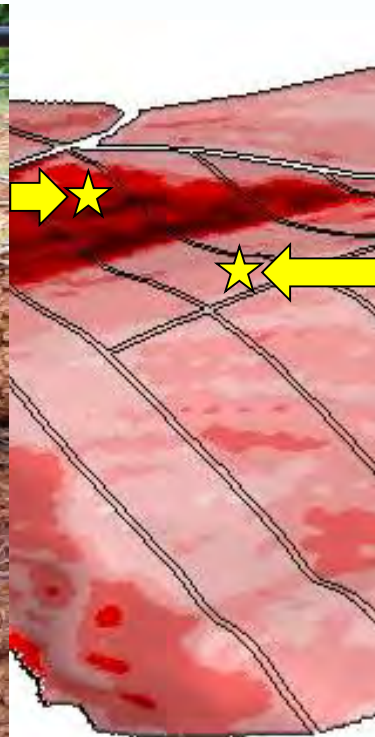
Apparent electrical conductivity
EM38 horizontal (dS/m)



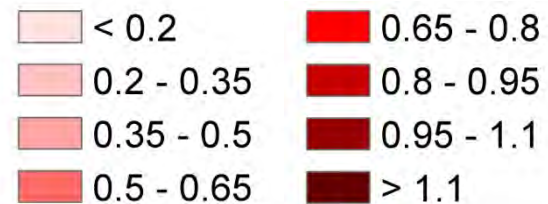
EM38, elevation and a changing soil profile



Elevation range = 29.2m



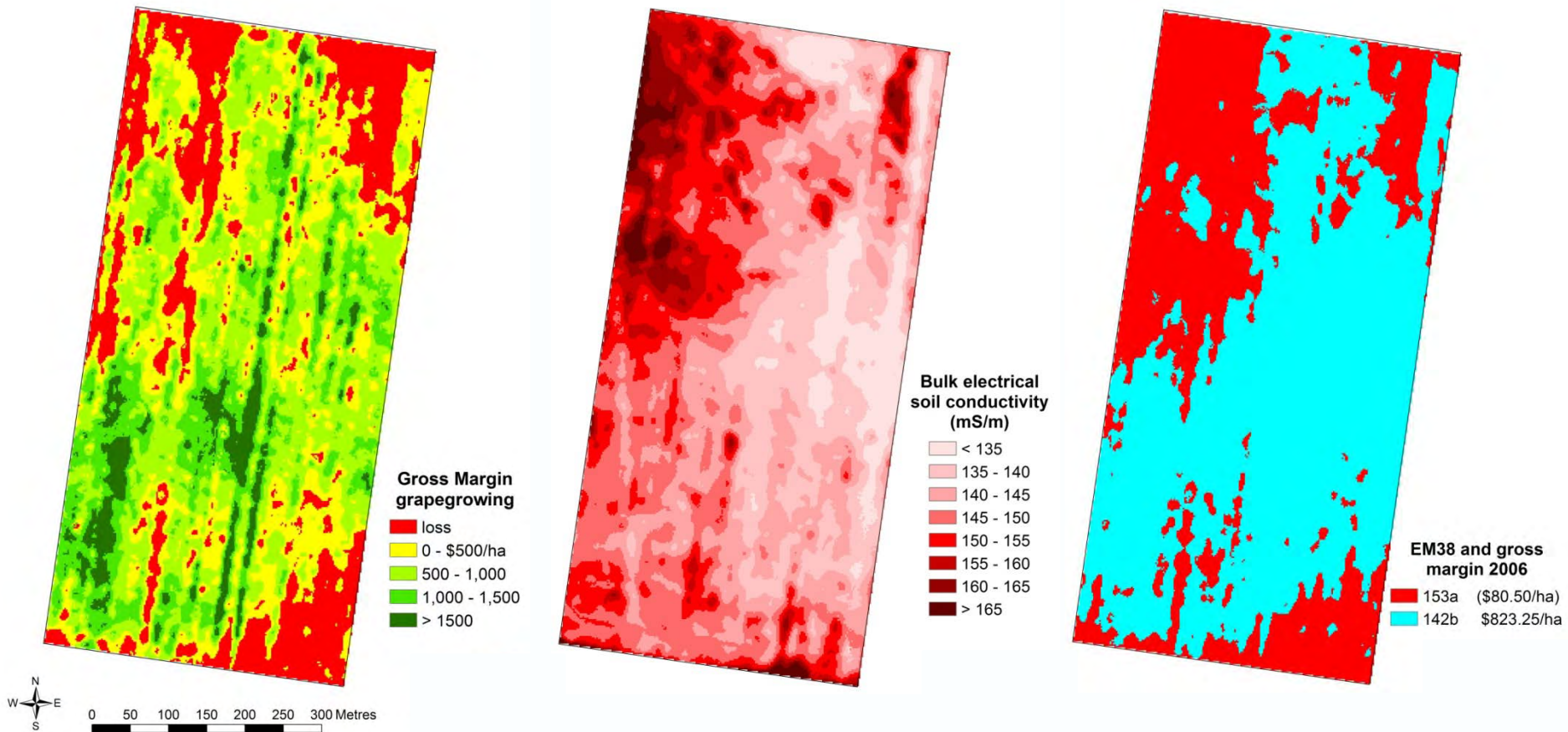
EM38 horizontal (dS/m)



Electromagnetic soil survey has been used for many years

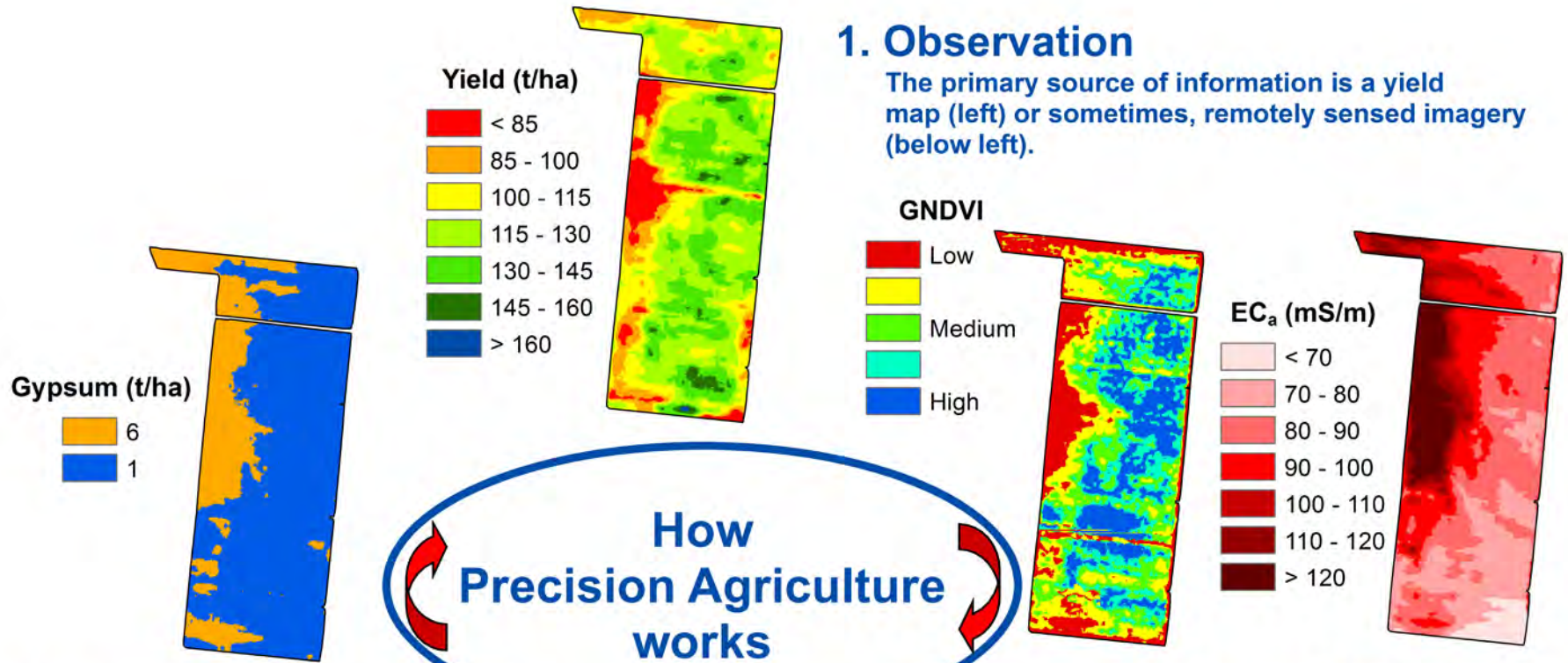
- How it works is well understood, as are the soil properties that it responds to:
 - Salinity
 - Clay content (and mineralogy)
 - Moisture
- You can not make *a priori* assumptions as to what it will tell you for any individual survey.
 - Ground truthing (including laboratory analysis ?) is required for this.
 - If someone tells you it will sense soil pH or mineral N content, they don't know what they are talking about (although these things might correlate with something it can sense).

A powerful incentive for adoption



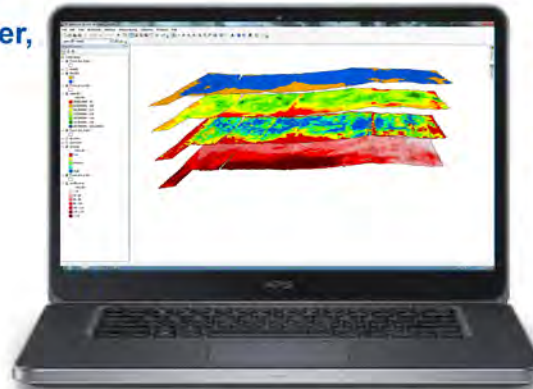
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2. Evaluation and interpretation

Thermal monitoring for irrigation decision making



Trees and GPS systems do not go well together



Thank you

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