Satellite and drones for water and nitrogen decisions

Author: Toni Somes

Innovative growers could soon be using data from drones and satellites to make better-informed farm-management decisions as the technology becomes increasingly more affordable and refined for agriculture.

GRDC-funded research by Deakin University's Centre for Regional and Rural Futures (CeRRF) has been investigating drones and satellite technology for monitoring crop performance to improve nitrogen use and water management decisions.

Irrigation engineer Dr John Hornbuckle, who has led the research, says advances in aerial data collection, combined with software improvements and satellite accessibility, meant there was now an unprecedented level and depth of information available for use on-farm.

'Information collected from drone and satellite-based platforms can now be used to gain new insights into the effects of water and nitrogen management on plant growth,' Dr Hornbuckle says. 'From there growers can develop strategies to maximise yields across the farm, based on analysing the best and worst-performing areas.'

Speaking at a recent GRDC Update in southern New South Wales, Dr Hornbuckle said the automation and simplification of data collection from drones and satellites was increasing the uptake of the technology by growers.

'In the past 18 months, there has been a significant increase in the use of drones globally and this has been driving innovation including the collection of high-resolution agricultural data. Additionally, new satellite data from the recently launched Sentinel 2 satellite, which incorporates a range of (lightwave) bands more suited to monitoring canopy nitrogen content, namely red edge bands, has become freely available across Australia.

Figure 1. Associate Professor John Hornbuckle believes data collected via drones and satellite platforms has the capacity to improve on-farm cropping decisions. PHOTO: Cox Inall Communications

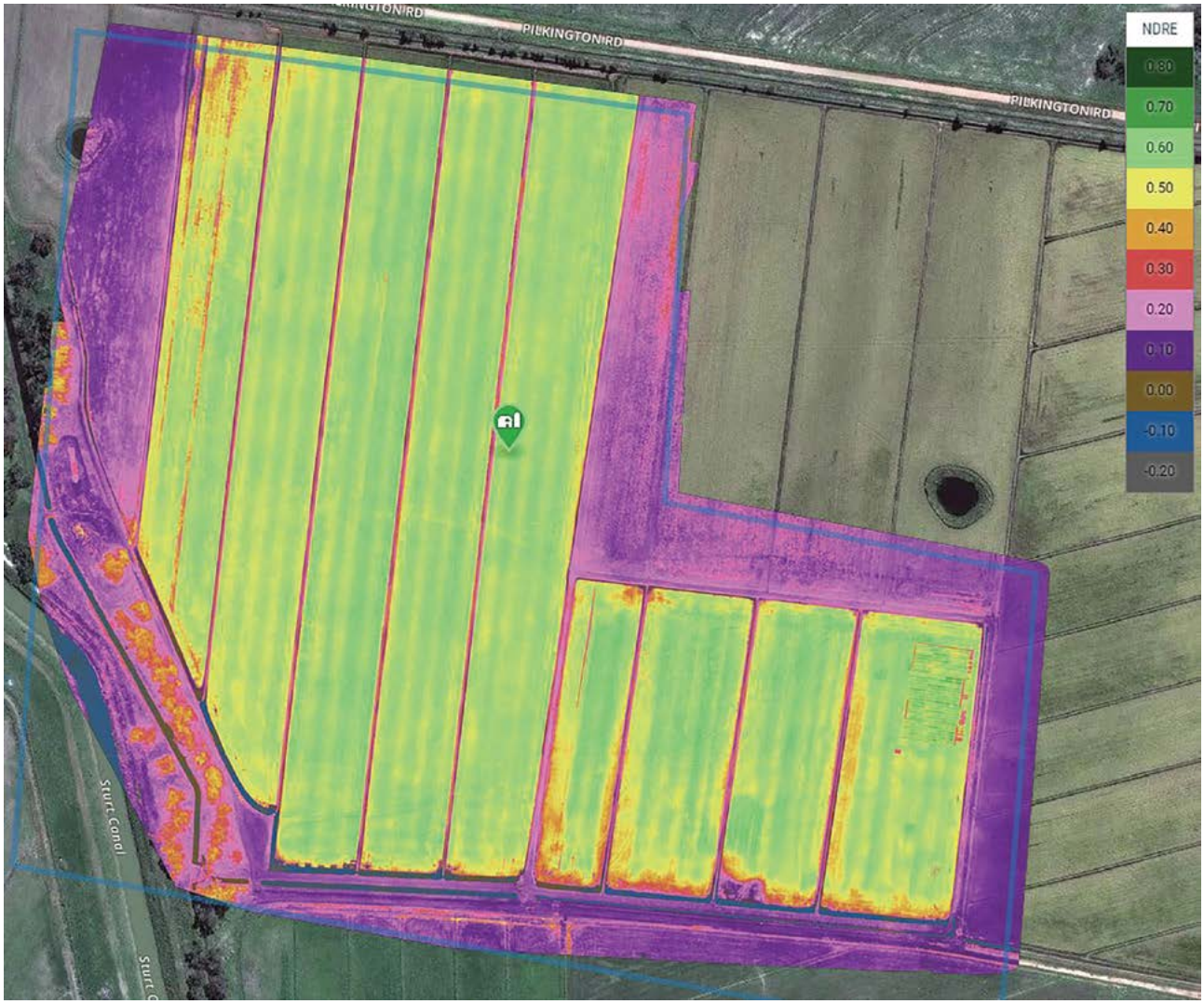

Figure 2. High-resolution multispectral drone data, in this case NDRE, shows the impact of non-uniform top-dress spreading. The non-uniform spreading pattern can be seen running up and down the bays. IMAGE: John Hornbuckle

'These two rapidly changing monitoring platforms offer the potential for grain growers to gain insights into their crops' performance, which had previously been unavailable for everyday growers.'

Drone data

Dr Hornbuckle says low-cost, drone-based platforms have taken off worldwide, with global drone companies releasing drones suited to agricultural monitoring costing under $2000. He says this is coupled with advances in developing apps, which allowed fully automated drone flights to collect very high-resolution aerial data (sub 5-centimetre pixels) and process the information.

Drones kitted out with multi-spectral and thermal cameras are now collecting aerial data, such as normalised difference vegetation index (NDVI) and/or normalised difference red edge (NDRE) data, which has proved useful in monitoring variability issues associated with water and nitrogen in crops.

Satellite data

Dr Hornbuckle says freely available satellite data from the Landsat and Sentinel platforms also collected multi-spectral data, which could be used for irrigation water management when combined with on-ground weather station networks.

IrriSAT, developed by Dr Hornbuckle and research partners CSIRO and the New South Wales Department of Primary Industries, with funding from the Cotton Research and Development Corporation, is now available as a cloud-based app using Google Earth to provide irrigators with water management information to help with irrigation scheduling and crop productivity benchmarking.

The IrriSAT app provides access to IrriSAT crop water use data, which, coupled with weather and crop water use forecasts, can enable irrigators to track their soil-moisture deficit and better manage irrigation schedules, as well as identify and investigate water use differences within and between paddocks.

Using drones for nitrogen management

'One of the major advantages of using a low-cost drone platform is the ability to take images when you want. You don't have to wait for a scheduled plane flight or a satellite overpass,' Dr Hornbuckle says.

'If you want an image before, during or after an irrigation, you can collect this data on the spot. The second major advantage is the high resolution of these images compared with traditional satellite or plane-based platforms. In contrast to traditional free satellite images, which generally are low resolution, drone-based data is generally around 5 to 10cm, allowing individual plant data to be collected, (with) potential benefits for identifying weeds and allowing impacts of events such as soil compaction from wet harvests to be seen in collected images. Additionally, cloud cover does not obscure image capture, which is sometimes an issue with satellite imagery.'

Using satellite data for water management decisions

Dr Hornbuckle says decisions on irrigation scheduling were well suited to more coarse-resolution satellite data, as generally irrigation systems in broadacre production systems were unable to deliver variable water requirements at an individual plant level.

'IrriSAT automatically combines both satellite data and on-ground weather station data and provides this information back to growers through a cloud-based interface,' he says.

'This information is automatically updated daily and provides daily crop water use information to growers, which can be used for irrigation scheduling and tracking total crop water use across a growing season.'

More information:

John Hornbuckle, Centre for Regional and Rural Futures, Griffith, 0429 862 920, j.hornbuckle@deakin.edu.au

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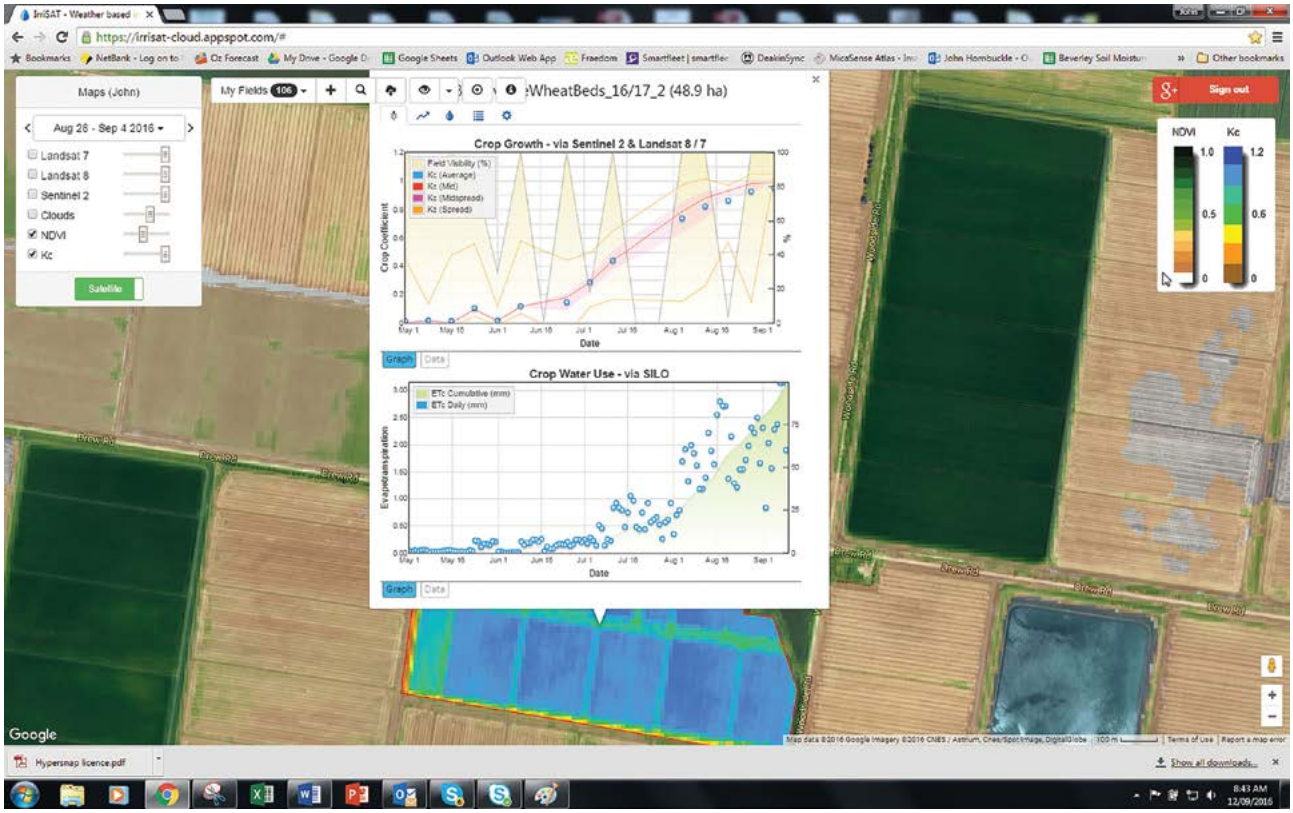

Figure 3. IrriSAT showing crop water use variability across bays in a field and total field water use. IMAGE: John Hornbuckle