



UNIVERSITY
OF SOUTHERN
QUEENSLAND

Centre for
Agricultural Engineering

Sensing tools and model-based control for autonomous surface and adaptive variable-rate irrigation



Australian Government
Department of Agriculture
and Water Resources



CRDC
COTTON RESEARCH AND
DEVELOPMENT CORPORATION



Sugar Research
Australia™



Dairy
Australia



tia
TASMANIAN
INSTITUTE OF
AGRICULTURE

Introduction

Water availability and labour are often the most limiting factors in broadacre cropping productivity. Through CRDC, SRA, Dairy Australia and Rural R&D for Profit funding, USQ has developed automated, site-specific surface and pressurised irrigation systems. These systems integrate software and hardware, including low cost sensors, optimisation control software and actuation systems to automatically analyse field data and start and stop site-specific irrigation events for surface and overhead irrigated cotton, surface irrigated sugarcane and overhead irrigated dairy pasture.

1. Yield-based irrigation optimisation - VARIwise

Variable-rate irrigation hardware on centre pivot and lateral move irrigation machines enables site-specific application of irrigation water to meet the spatially variable crop water requirements. Developing irrigation prescription maps is typically labour-intensive and existing approaches may not optimise yield as they only use weather, soil or plant data in isolation.

USQ has developed the irrigation control system 'VARIwise' that automatically:

- analyses weather, soil and plant growth imagery measurements
- links sensor and imagery data with a crop model
- determines spatial irrigation requirements that produce the maximum end-of-season yield or water productivity

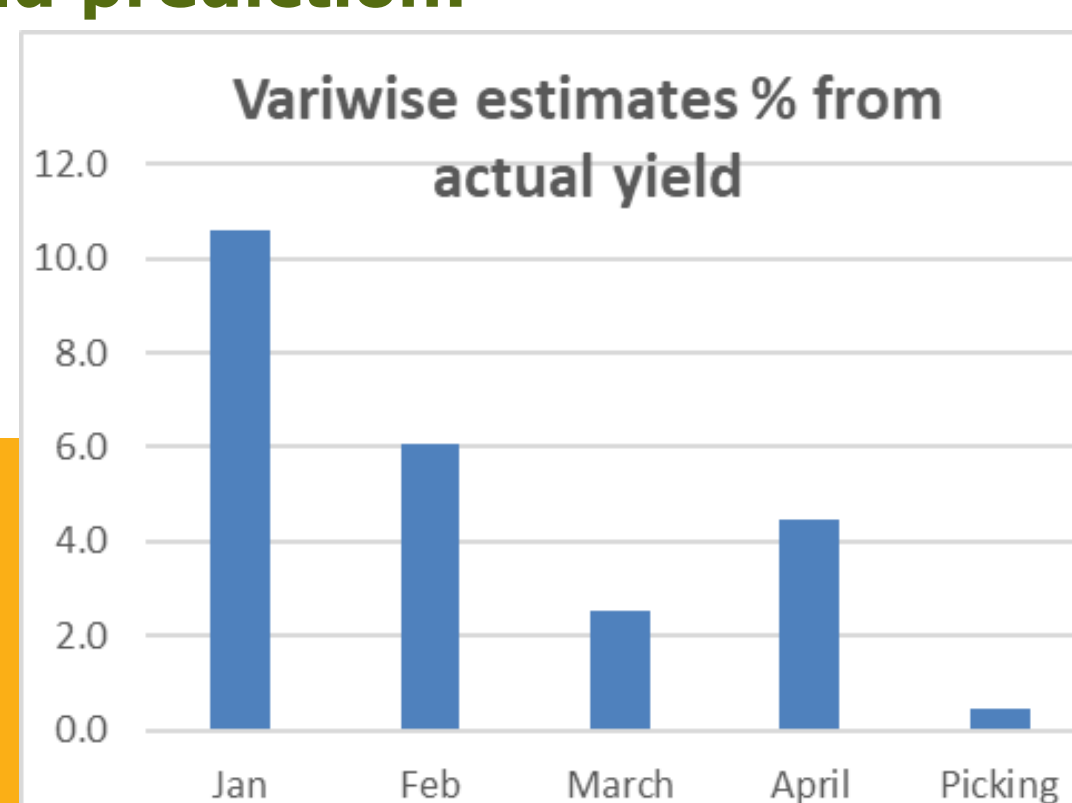
VARIwise is being evaluated on variable-rate centre pivot irrigated cotton in Jondaryan, QLD and dairy pasture in Tasmania. CottonInfo extension officers are evaluating using VARIwise for yield prediction from UAV imagery data. The error in yield prediction decreased from 2.4 to 0.9 bales/ha with the addition of the plant imagery information to the model and the yield prediction accuracy ranged from 1 to 15%.

Implementation of this system of irrigation has led to yield improvements of 4 to 11% and water savings up to 12%.

Variable-rate irrigation system and prescription map:



UAV data collection for yield prediction:



Source: The Cotton Tale September 2018

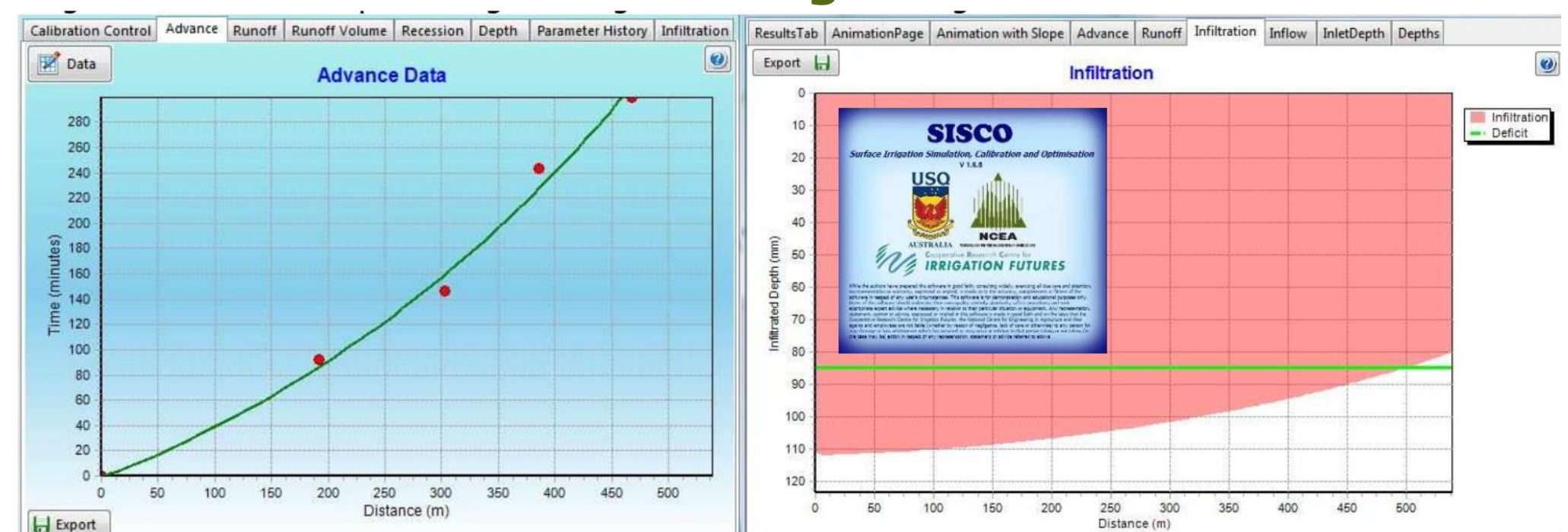
2. Surface irrigation optimisation - SISCO

Surface irrigation occurs on over 90% of irrigation systems in cotton but is labour intensive to monitor for optimisation. Optimising water productivity requires precise measurement of:

- advance rate of the irrigation water front
- time for the water to reach the tail drain

USQ has developed a model SISCO that simulates the infiltration of water along furrows based on measured advance rates and flow rates. This tool has been commercially delivered through Irrimate™ and cotton consultants.

SISCO model for surface irrigation simulation:

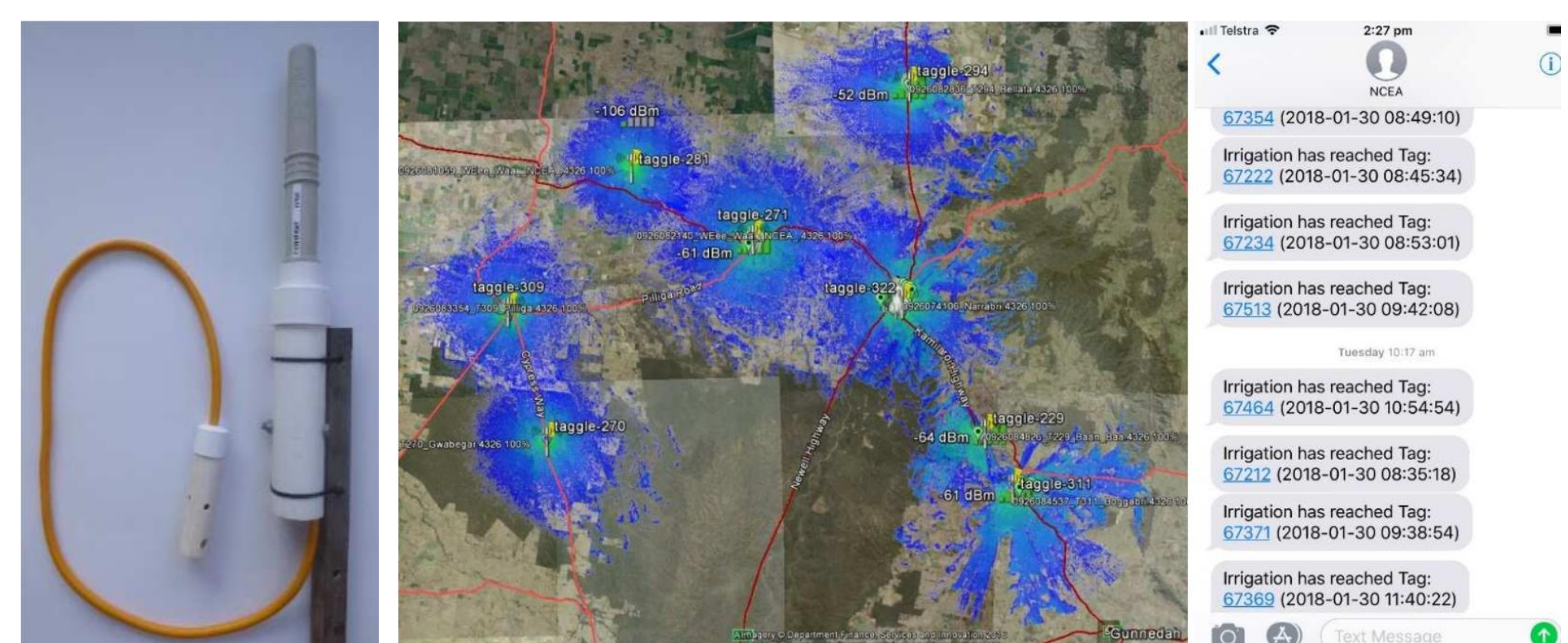


3. Irrigation sensing tools

USQ has developed a range of novel, inexpensive technologies to modernise traditional broad-acre furrow, lateral move and centre pivot irrigation systems. These measure crop and irrigation parameters, and transfer data to provide growers with irrigation control from smartphones and tablets. Specific USQ-developed tools are:

- Single point wireless advance rate sensor with SMS alerts and automated resetting
- Low cost wireless rain gauge
- Wireless channel height sensor
- Advance rate sensing from UAV images
- In-season yield prediction from UAV images

Advance rate sensor and locations shown in App:



A/Prof. Joseph Foley, foley@usq.edu.au
Dr Malcolm Gillies, malcolm.gillies@usq.edu.au
Dr Alison McCarthy, mccarthy@usq.edu.au

CRICOS QLD00244B NSW 02225M TEQSA:PRV12081