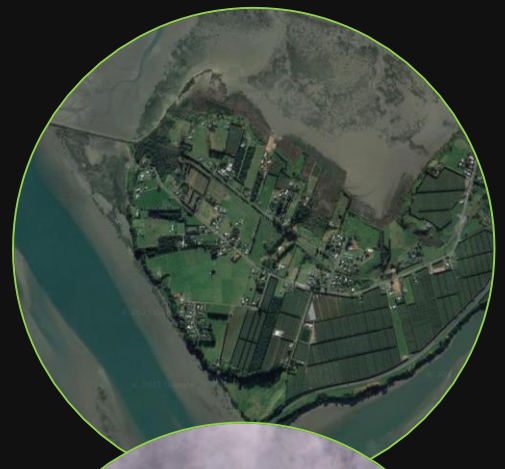

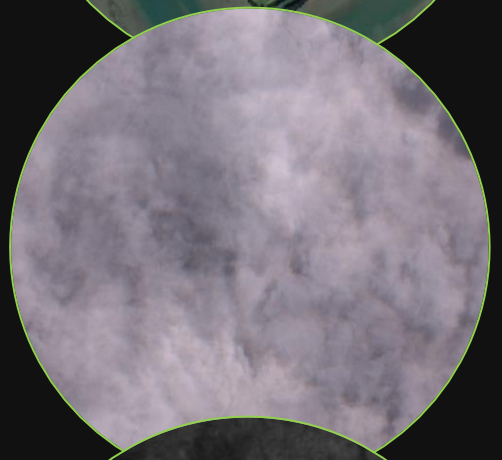

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Optimising irrigation in kiwifruit orchards using microwave remote sensing

Istvan Hajdu

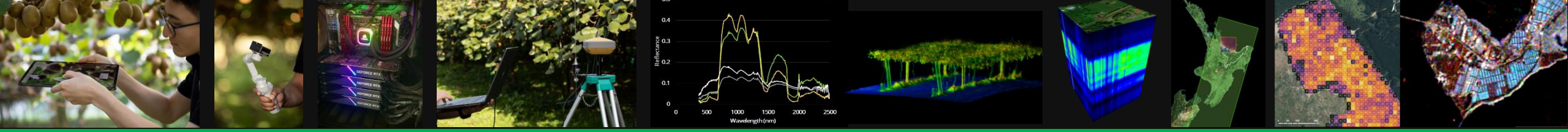
Ian Yule

Andrew Wood

Ash Neilson

National Science Challenges | OUR LAND AND WATER | Toitū te Whenua, Toiora te Wai

eResearch NZ 2022
9-11 FEBRUARY, CHRISTCHURCH & ONLINE



Proximal Sensing





Remote Sensing





Advanced Analytics and Modelling




Senior Management



Project and Commercialisation Management


PlantTech Research Institute

Project summary and motivation

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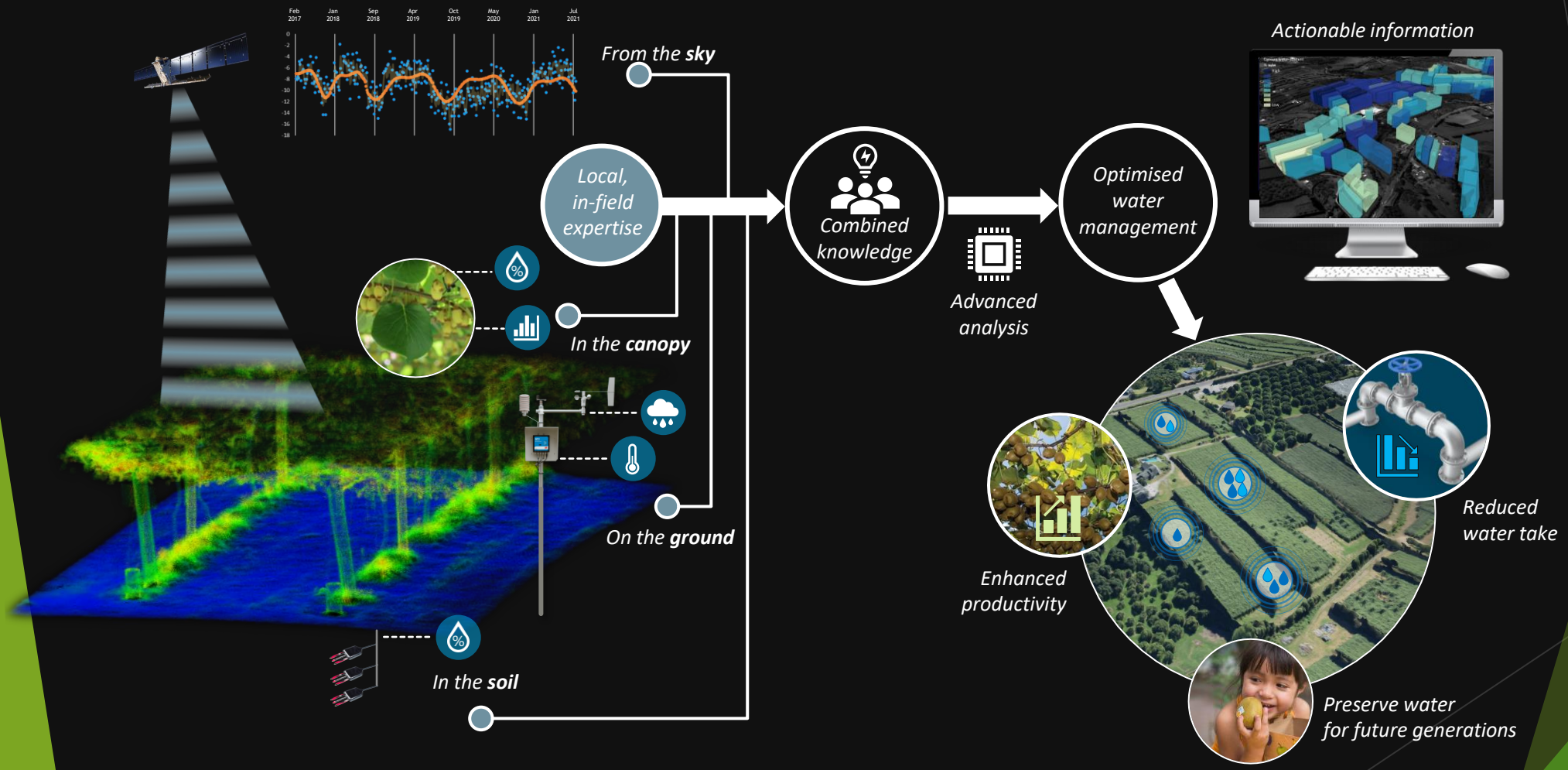

- Sustainable management of land and water
- Increasing pressure on growers
- Leaf water content is an important growth and health indicator
- Maximising the use of rainfall and preventing water stress
- Tailor management to changing land climate
- Promising future of radar satellites

National SCIENCE Challenges

OUR LAND AND WATER

Toitū te Whenua, Toiora te Wai

Project members

Rural Professional: Ash Neilson (RICADO Group)

Project Team:
Colin Jenkins and Andrew Wood (Ngai Tukairangi Trust),
Phillip Green and John Huntingdon (RICADO Group),
Istvan Hajdu and Ian Yule (PlantTech)

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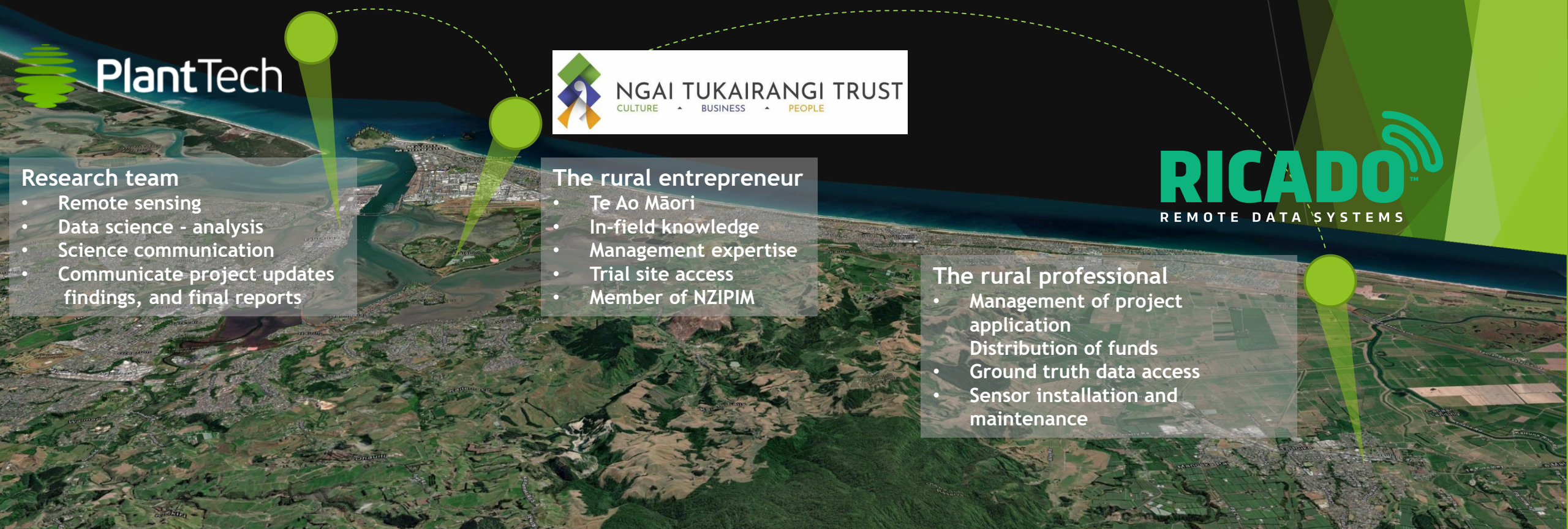
NGAI TUKAIRANGI TRUST
CULTURE BUSINESS PEOPLE

RICADO™
REMOTE DATA SYSTEMS

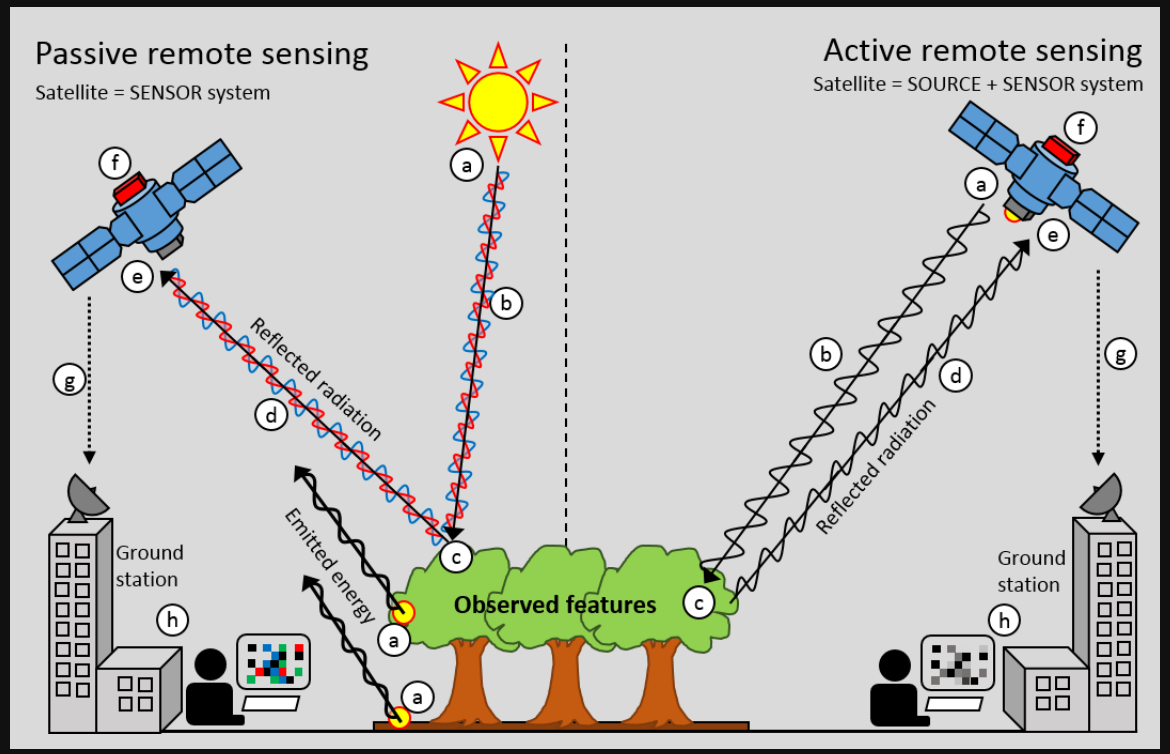


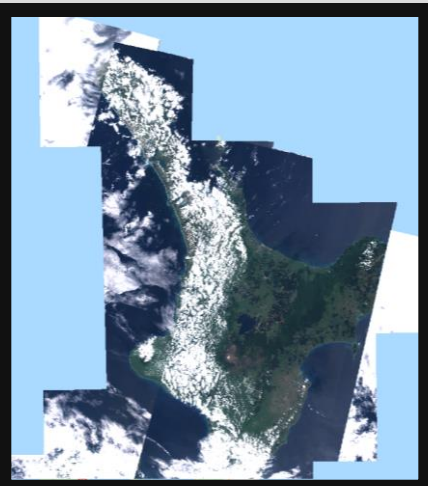
Research team
- Remote sensing
- Data science - analysis
- Science communication
- Communicate project updates findings, and final reports

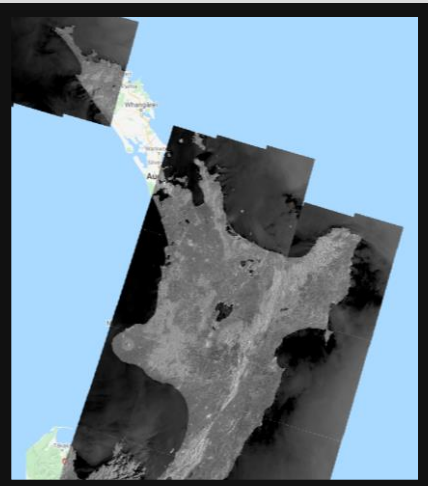
The rural entrepreneur
- Te Ao Māori
- In-field knowledge
- Management expertise
- Trial site access
- Member of NZIPIM

The rural professional
- Management of project application
  Distribution of funds
- Ground truth data access
- Sensor installation and maintenance

Remote sensing 101

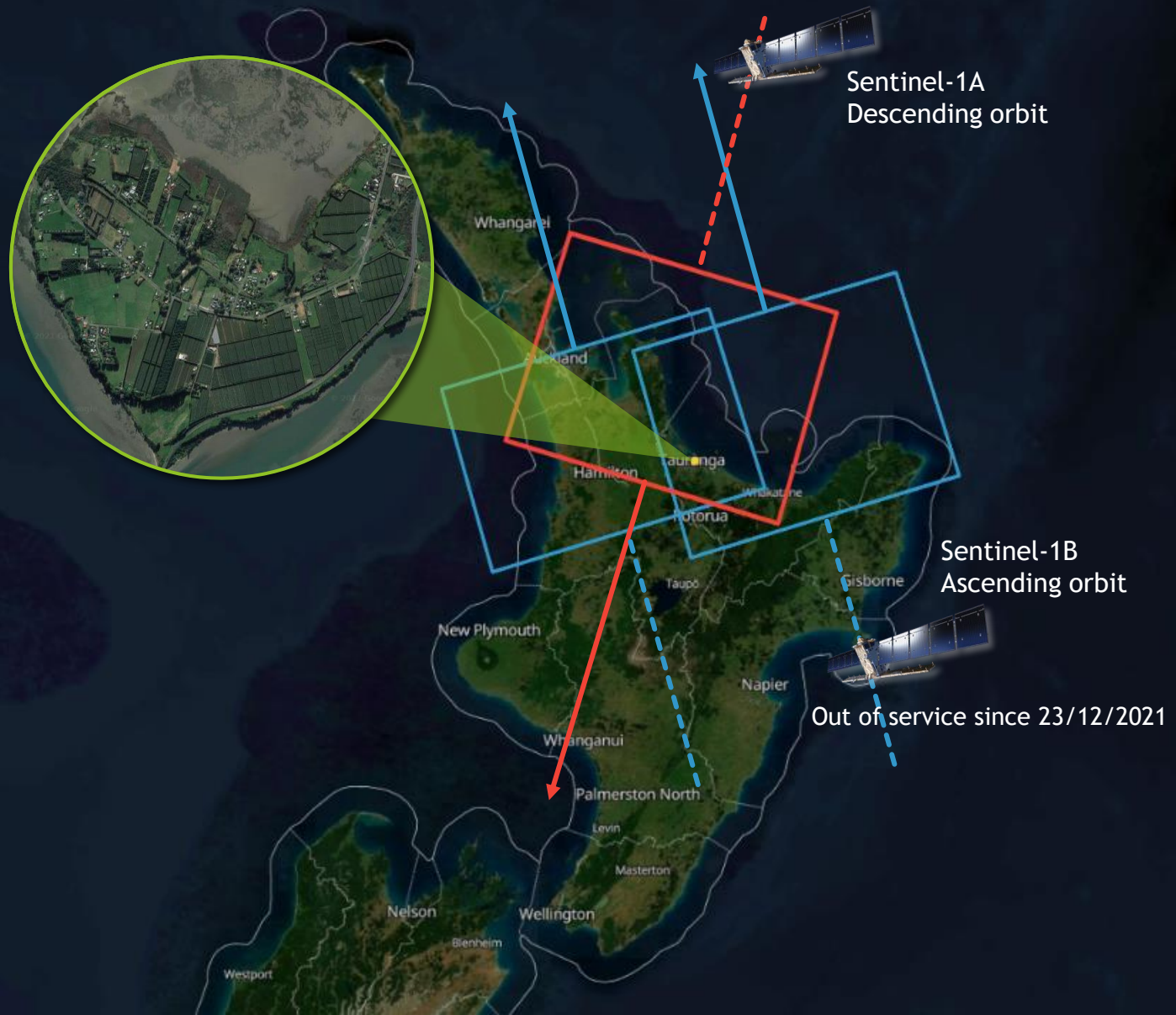






- source of energy (a)
- propagation of energy (b)
- interaction (c)
- radiation towards sensor (d)
- detection of electromagnetic signal (e)
- generation of sensor data (f)
- transmission of data to Earth (g)
- interpretation of data (h)

Sentinel-1 footprints



- A constellation of two satellites
  - Sentinel-1A (April 2014) & Sentinel-1B (April 2016)
- C-band SAR (Synthetic Aperture Radar)
- 10x10m pixel spacing
- Weather independent observations
- Day and night operation
- Frequent revisits
  - November 2021 – 8 captures
  - December 2021 – 6 captures

SAR – known features, processes and unknowns

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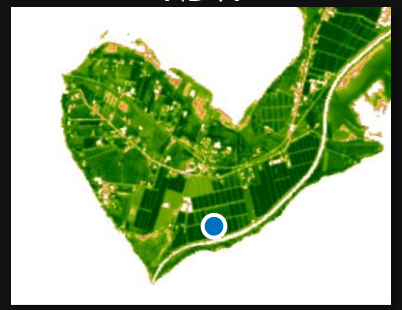
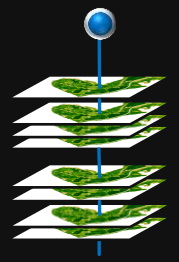
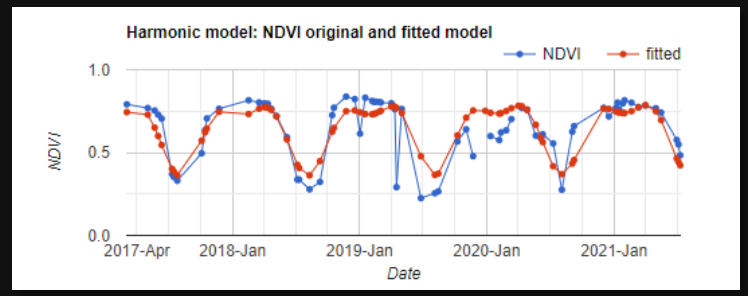
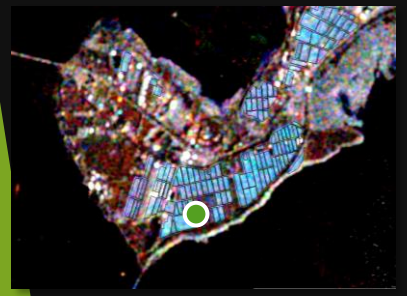
- Timeseries to track kiwifruit development cycle
- Optical vs microwave data

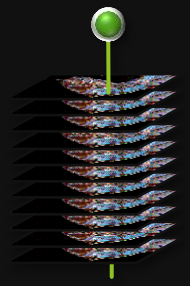
Sentinel-2
NDVI

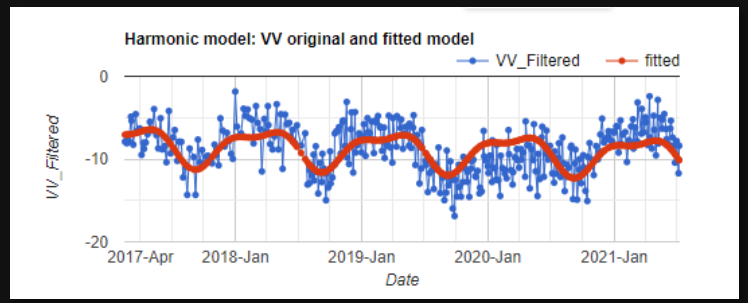






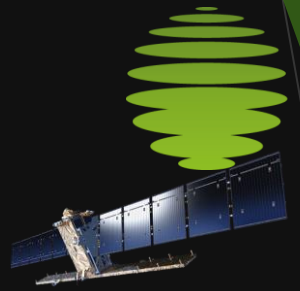


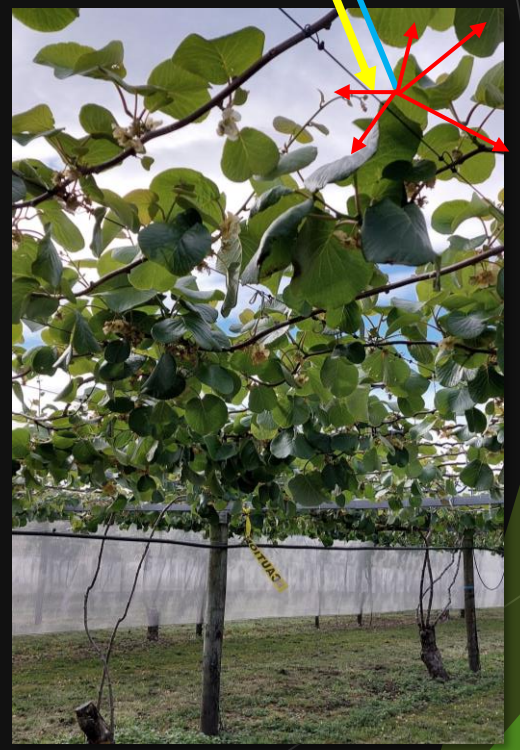




Sentinel-1
SAR – VV backscatter

However…





- Dielectric properties – water
- Leaves
- Canes
- Fruit
- Wiring
- Structural elements
- Texture / roughness
- And more…

(E_s - scattered electromagnetic field, E_i - incident electromagnetic wave intensity, E_r - received energy)

Example of a Sentinel-1 SAR image

Investigating interactions and relationships

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Input	Factors and processes	Relationships

Synthetic Aperture Radar (SAR)

Polarisation / incidence angle / wavelength

Canopy and SAR signal interaction

Canopy water Content (CWC)

Physiological parameters / structure / above ground plant components

Plant water uptake

Soil Moisture (SM)

Measurement depth / frequency / sensor accuracy

Infiltration

Rainfall and irrigation

Frequency / amount

1

2

3

GIS

Weather data - Tauranga Airport AWS

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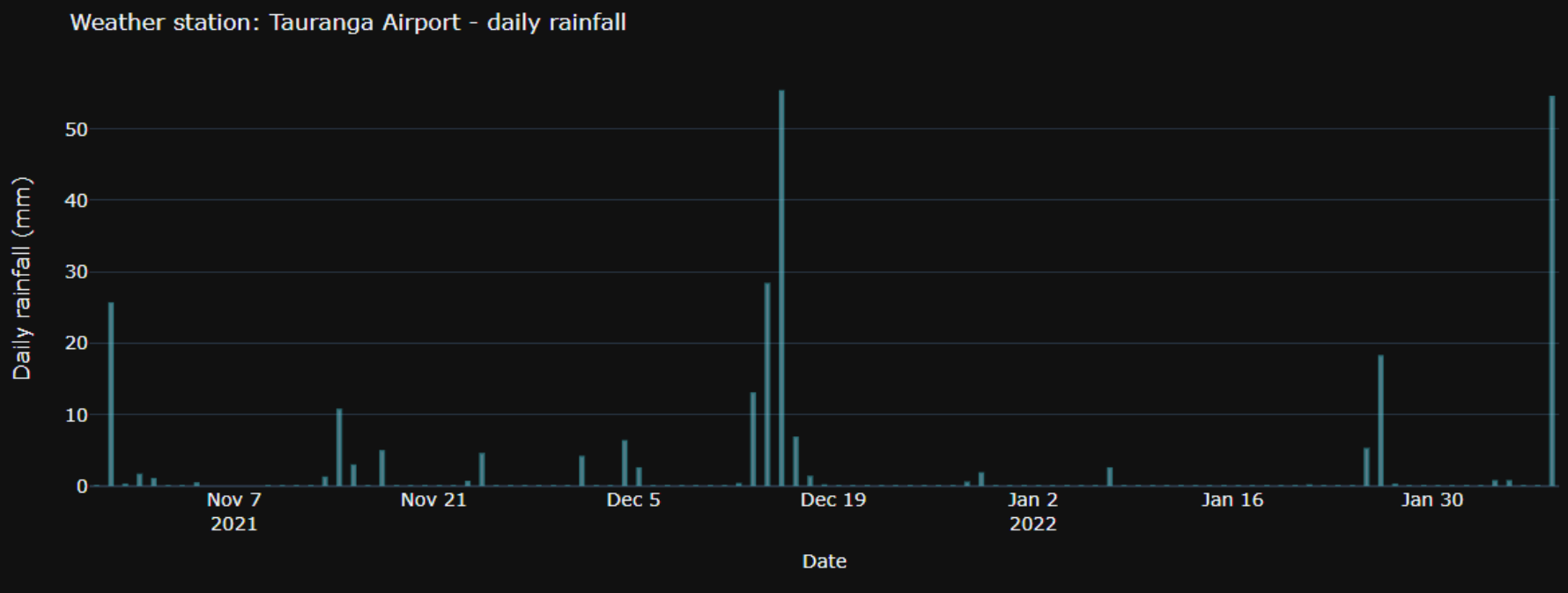
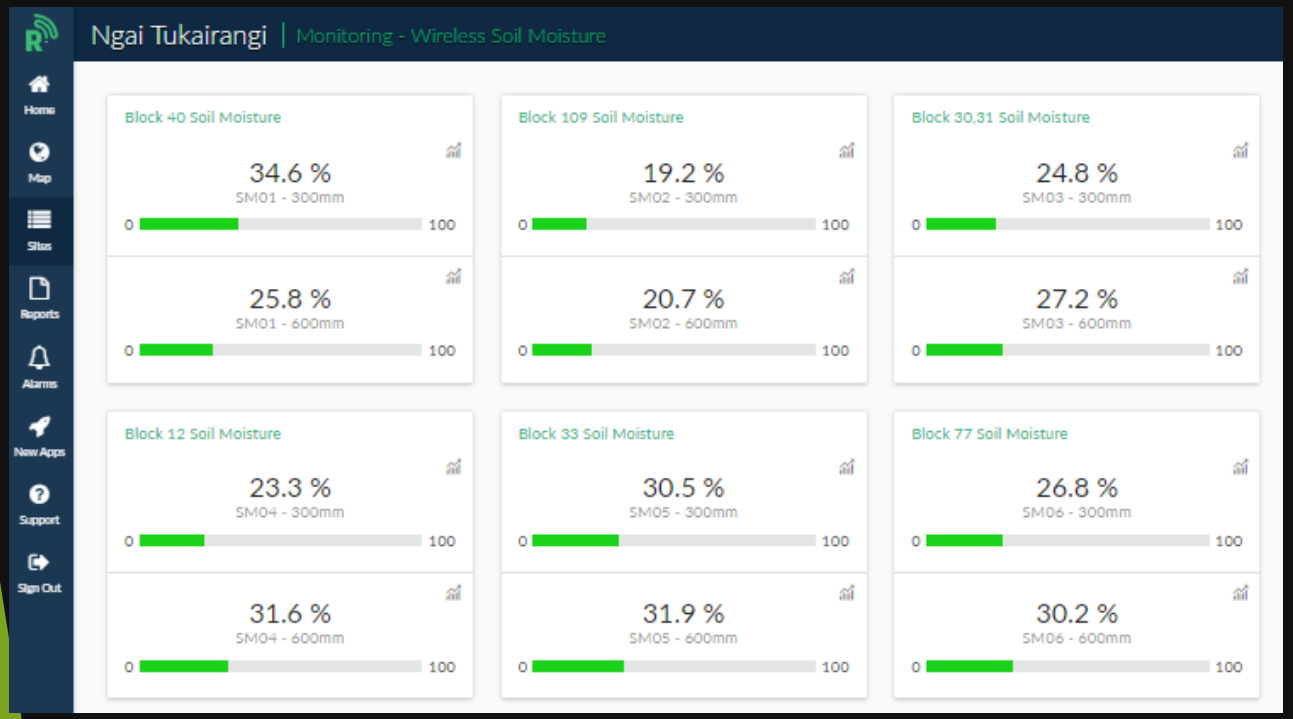
- Daily rainfall from a MetService weather station
- Access NIWA's CliFlo database via R
  - a web system that provides access to New Zealand's National Climate Database

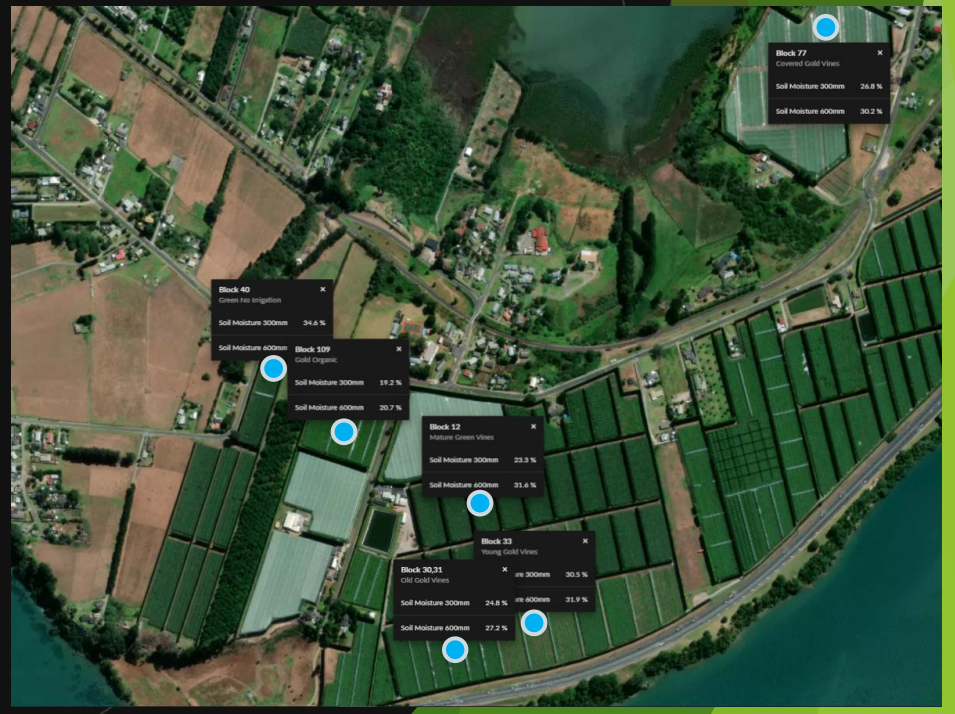


Soil moisture data

- Access through RICADO's interactive data hosting facility
- TEROS 10 soil moisture sensors
- 2 soil depth from 6 blocks
  - HW-GA, irrigated and not irrigated blocks
  - hail net and no hail net
  - Young and mature vines



TEROS 10
SOIL MOISTURE SENSOR



Soil moisture and rainfall events

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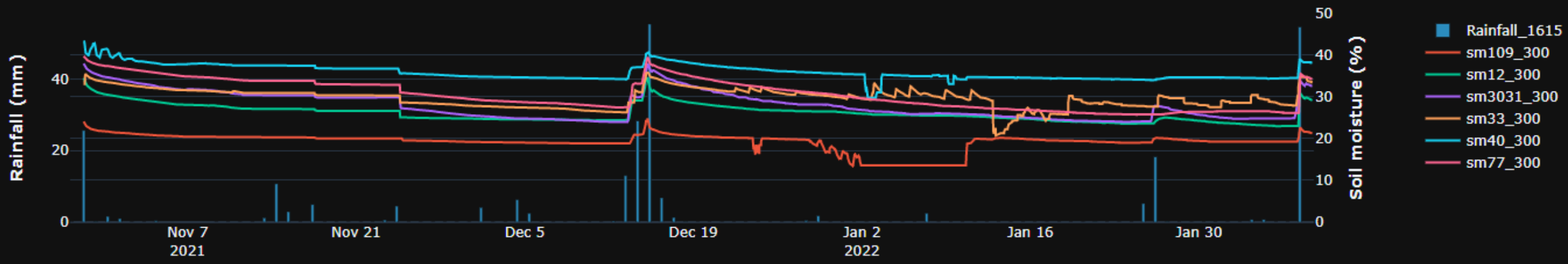
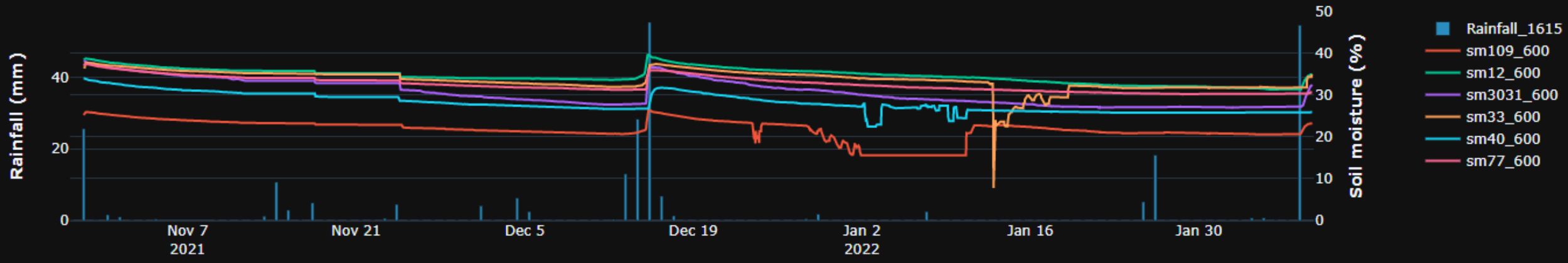
Soil moisture at the 300 mm depth



Soil moisture at the 600 mm depth



Leaf sampling at Matapihi - relative CWC (%)

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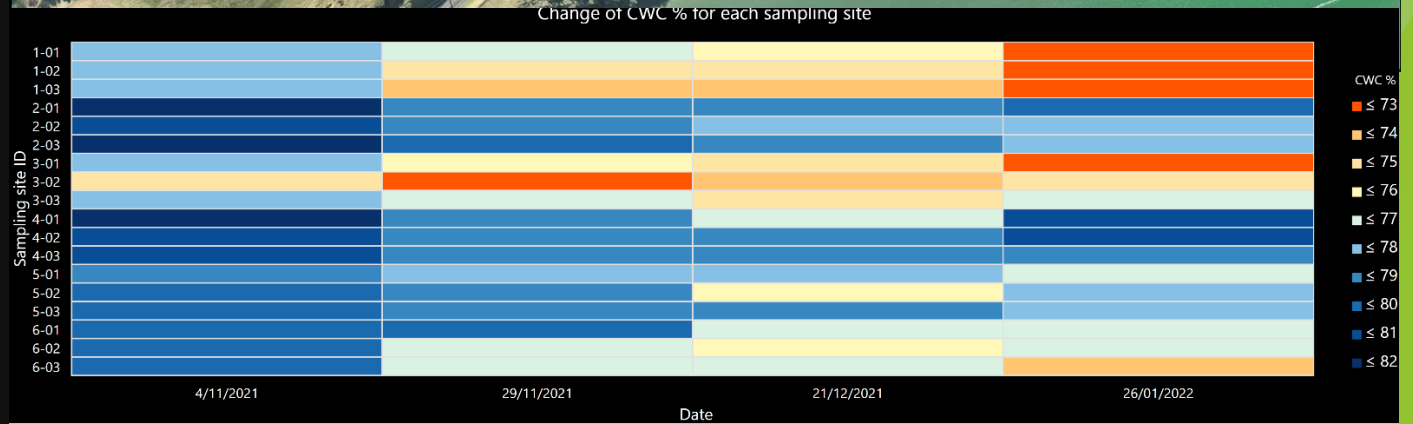

- 20 leaves picked at each of the 18 sites
- 4 sampling campaigns completed
- Bulk sample analysed for dry matter and water content

Soil moisture and CWC

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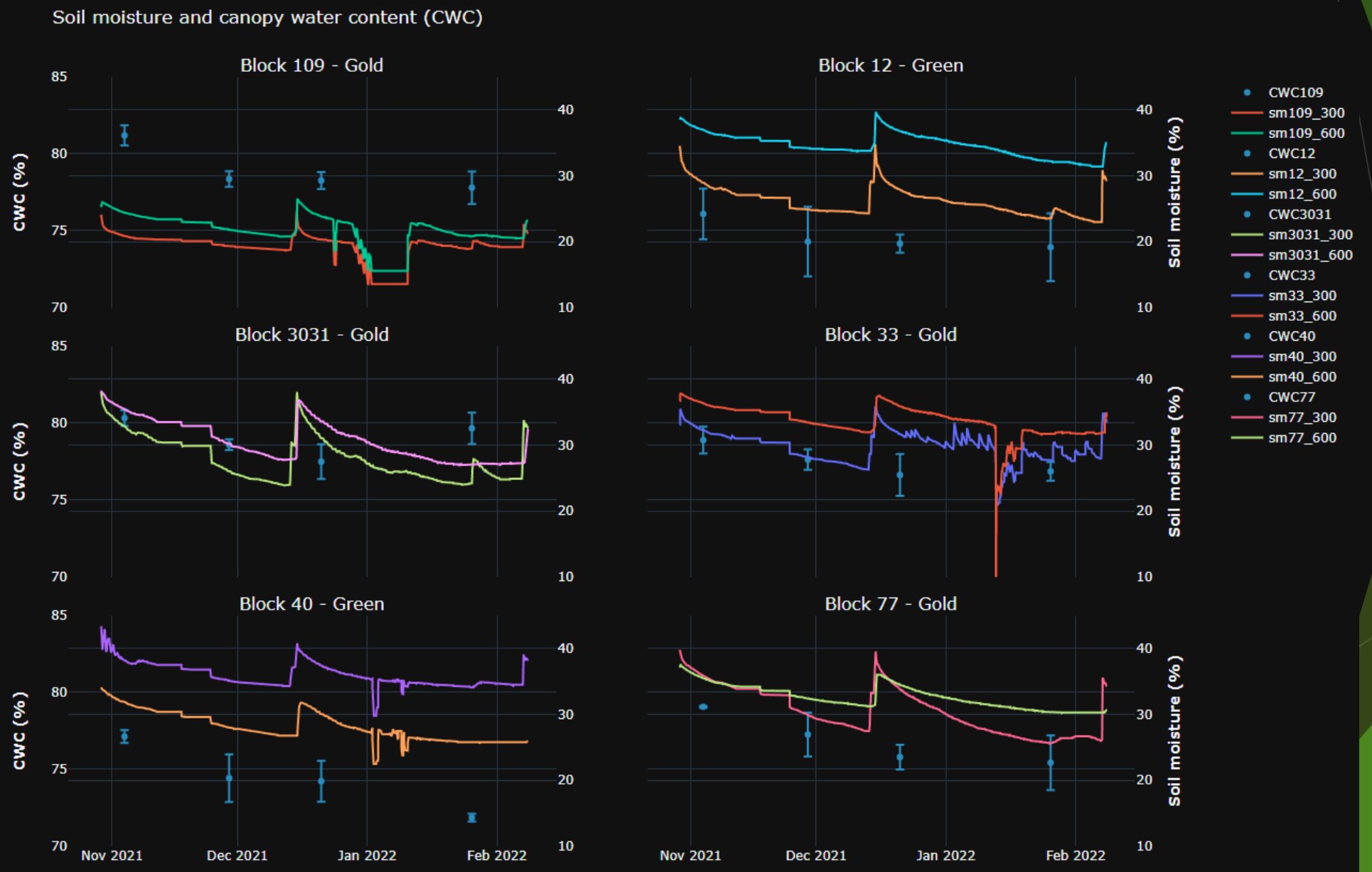

Spatial CWC predictions – preliminary results

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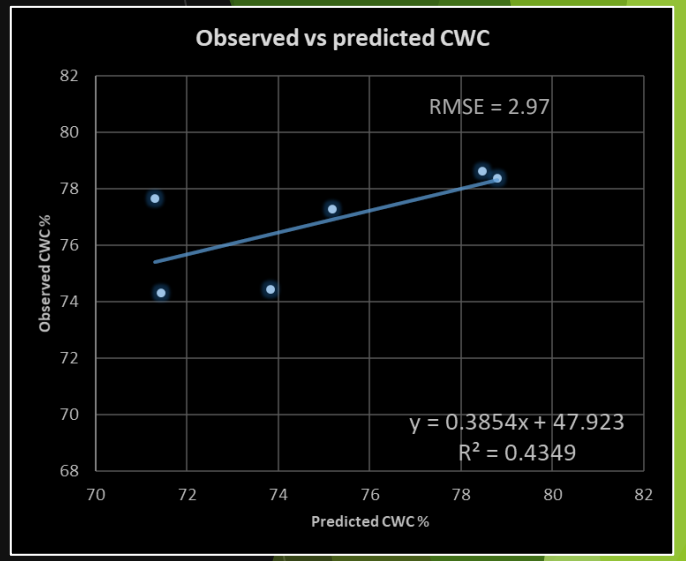
Ground truth

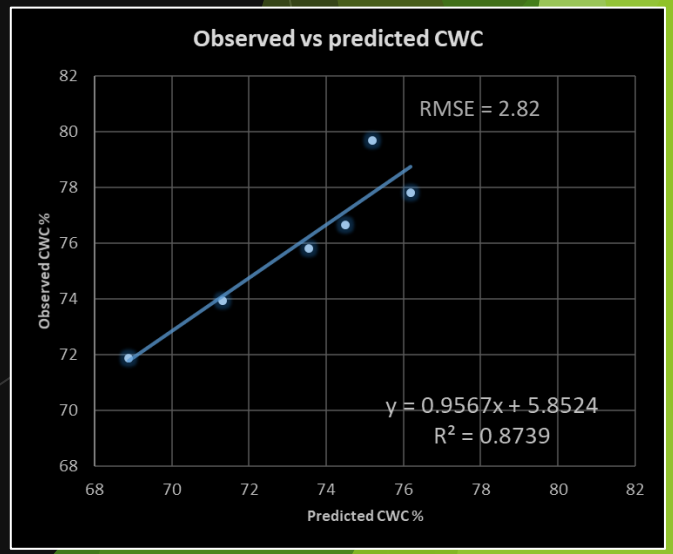
Prediction

Evaluation – at block level

26/11/2021



21/12/2021



What have we learnt so far and what's next?

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- CWC is following the soil moisture traces as expected
- SAR is sensitive to biomass – follows the canopy development cycle
- Indications of SAR being sensitive to CWC – correction needed for biomass
- SAR can penetrate through hail netting
- Feedback from the growers
  - Higher soil moisture and CWC variability than expected
  - Soil moisture data has been informing decision making
  - *"We might learn something new about the land that we know so well"* -

    Andrew Wood, orchard manager
- Next steps:
  - Finish data collection season - improve modelling
  - Dashboard development – grower friendly interface
  - Move from a small scale trial to a national scale monitoring system

Thank you for your attention!

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www.planttechresearch.com

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