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GeoNOW 2024

How to make Earth Observation more mainstream in Agriculture in Australia

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CSIRO Agriculture and Food (A&F) Program on a Page (POP)

CSIRO A&F aspires to be the catalyst in Australia's agri-food and fibre ecosystem, an enabler of innovation to support farm production and post-farm value addition and a key driver behind a sustainable future for Australia's agri-food and fibre sectors.

- **Prosperous farms**: *create crop and livestock farming systems that adapt, endure, & thrive*.
- **Transforming agricultural production**: *technologies and interventions that increase sustainable farm production*.

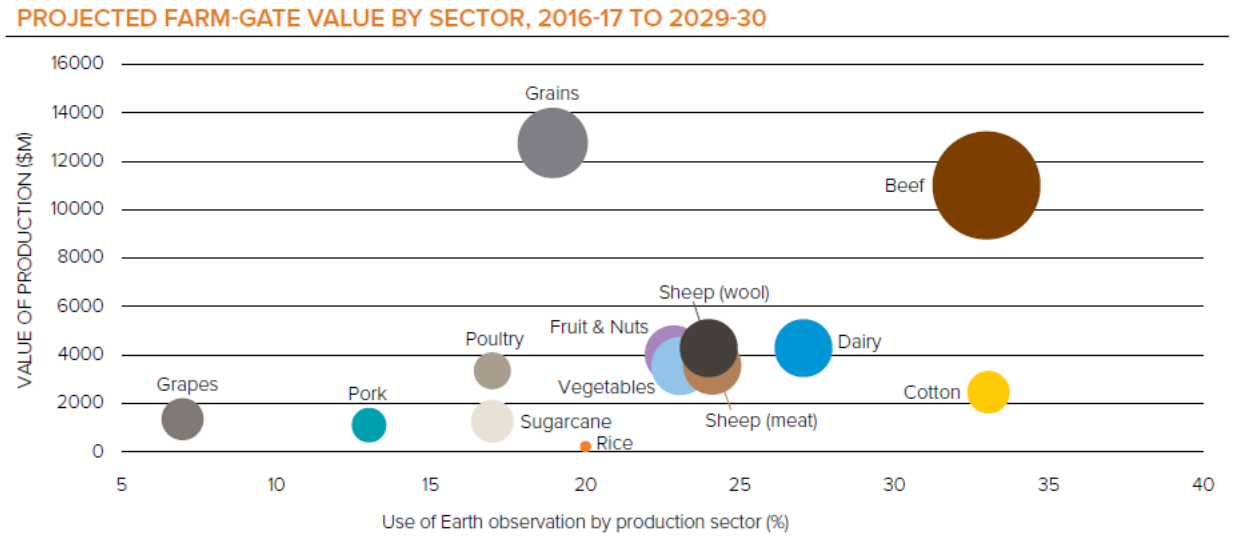
→ **Digital farm**: integrate farm intelligence for management decisions to create credible, cutting edge, and widely used digital tools, technologies and services for a profitable, resilient and sustainable Australian agriculture.

- **Protection of agricultural & environmental systems from high consequence biosecurity threats**.
- **Climate Adaptation**: design more climate resilient and adaptive farming systems.

EO contributes to Australia's agriculture

- Agriculture represents 2.2% of Australia's GDP.
- Despite a government budget of ~ 73.6 m$ per year, EO contributes 10 times (~750 m$ by 2025) to agriculture.
- This is less than 1% of the anticipated 100 b$ revenue from agriculture by 2030.

FrontierSI Harvesting the benefits of Earth Observation (2020)

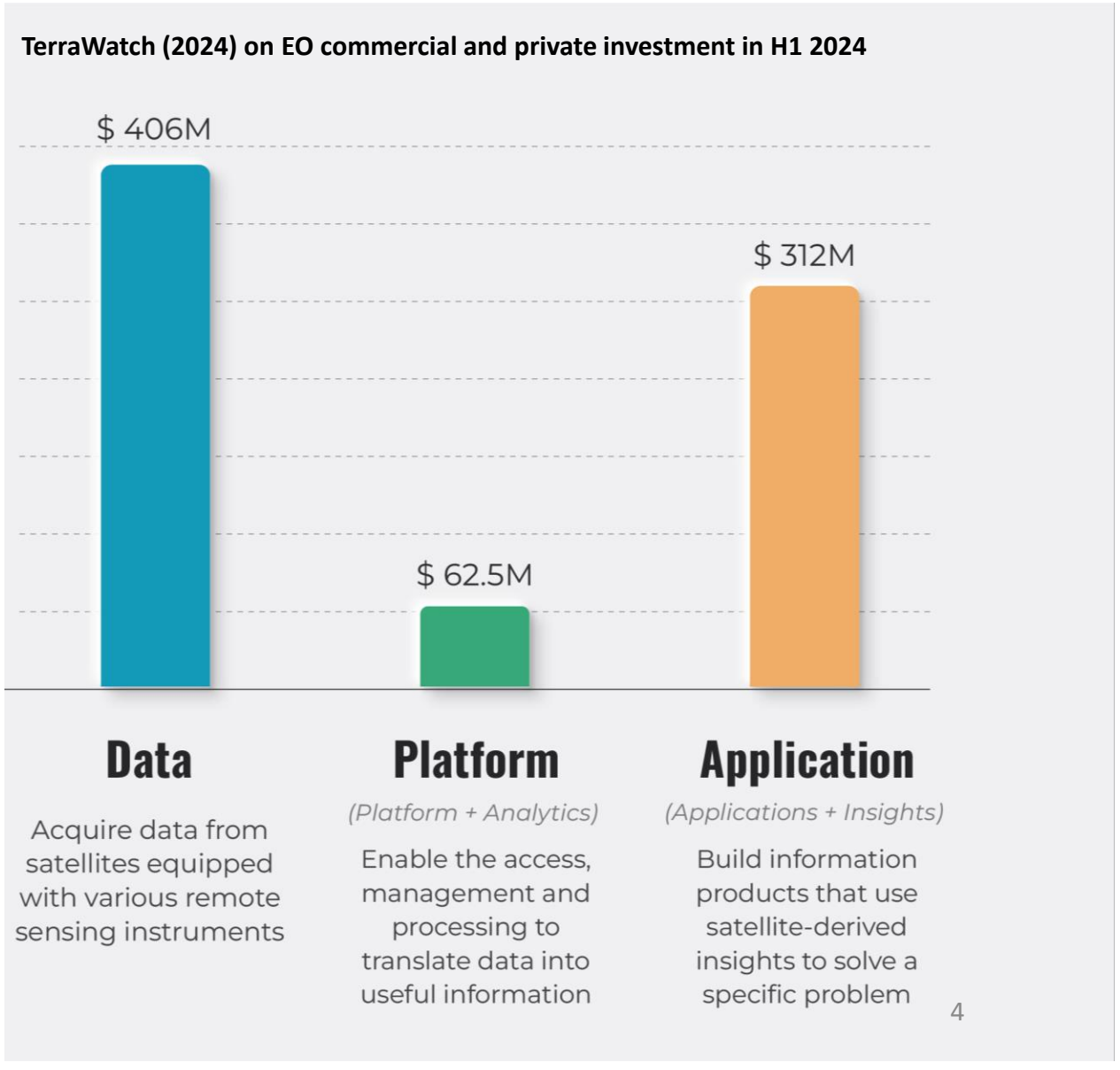


- Value proposition for digital transformation in Grains and Beef has not been reached.

Applications + Insights receive more investment than Platform + Analytics

- We need Data, Platform, Analytics, and Insight to develop an Application e.g. Pixels → Reflectances → N indicator → N concentration.

- Existing analytics and platforms are mostly customized, project-based consultancies.



CSIRO A&F have delivered applications into the same use cases as the ag-tech industry

Soil moisture prediction

- GDD, planting dates, vegetative growth.
- Soil moisture can vary more by depth than within field at the same depth.

N precision recommendation

AI can outperform existing N management in N optimal rate prediction when used with extensive historical database of crop and climate information.

Field boundary

Yield prediction

Crop type identification

What have CSIRO A&F learnt

- An application needs EO data + model + ground measurements.
- An uptakable application needs EO data from different sensors + model + ground measurements + a delivery pathway that generalize across space, time and customer.
- EO is only one (emerging) piece of the puzzle.

So far, EO is not mainstream in agriculture in Australia

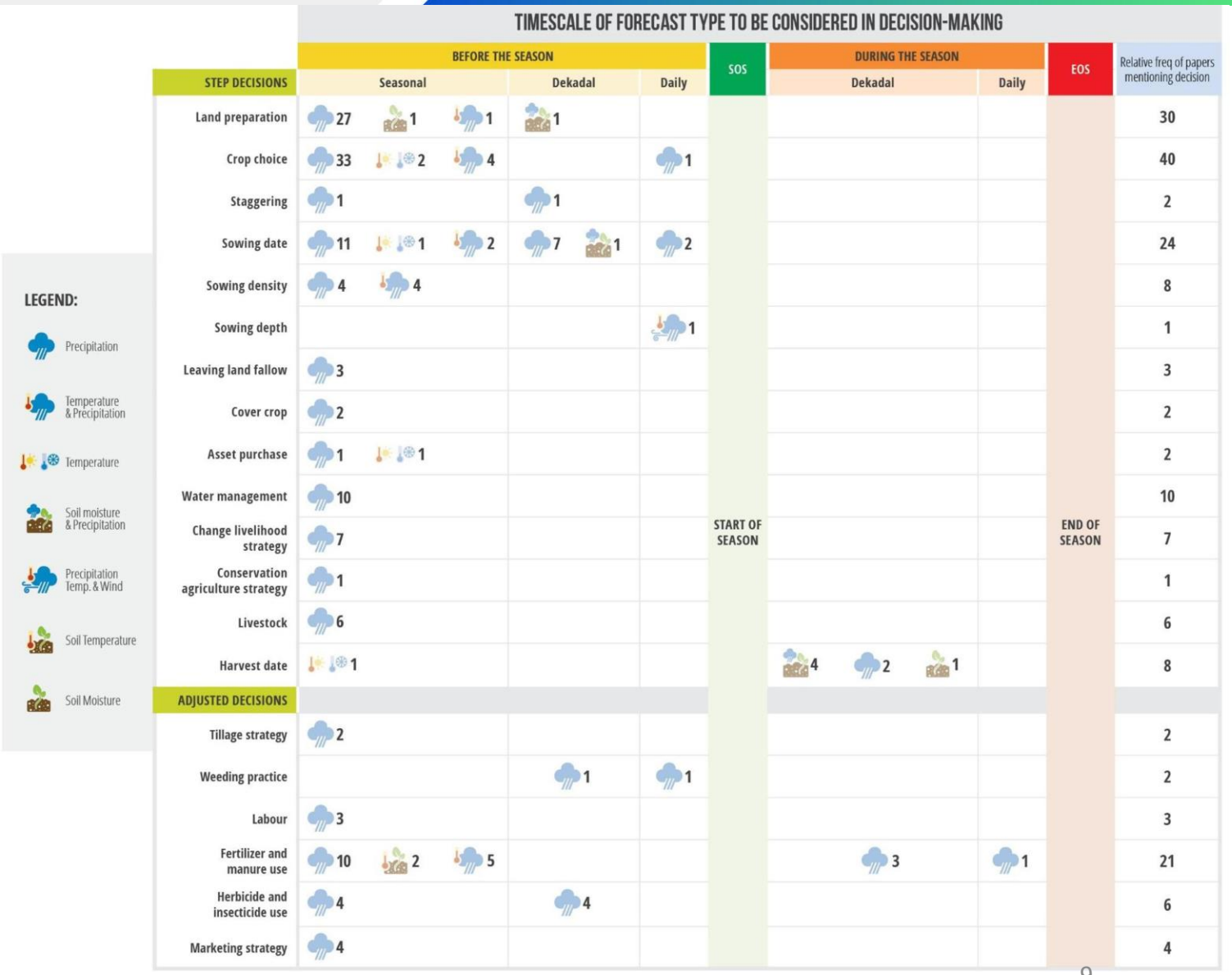
Decisions	Required information: available from EO	Required information: what really is happening
Irreversible: BEFORE start of growing season Crop choice (Summer/ Winter crop) Seed stock Crop insurance plan Land preparation/ Fallow Sowing density/ depth Sowing date/ Staggering Feed level Herd size	Rainfall Air temperature Soil temperature Soil moisture Soil nutrient Previous crop map Field boundaries	Traditional weather forecast Soil testing Agronomic data Agricultural experiments Market intelligence Local knowledge and experience

Variable matters (the What)

Decisions	Required information: what is available from EO	Required information: what really is happening
Adjustable: throughout growing season Harvesting date Fertilizer application Irrigation plan Pesticide/ Herbicide Tillage Weeding/ Pruning Labor/ Machinery/ Fuels Forage production Crop marketing	Rainfall Air temperature Soil temperature Soil moisture Crop (biotic or abiotic) stress Crop temperature Crop phenology Crop nutrient	Traditional weather forecast Soil testing Crop scouting Yield monitoring Agricultural experiments

Time matters (the When)

- Seasonal forecast the most important for the irreversible decisions.
- Dekadal (10 days prior) forecast is important for the adjustable decisions.
- Few decisions can be made with daily/ near real time info. One exception is damage assessment.



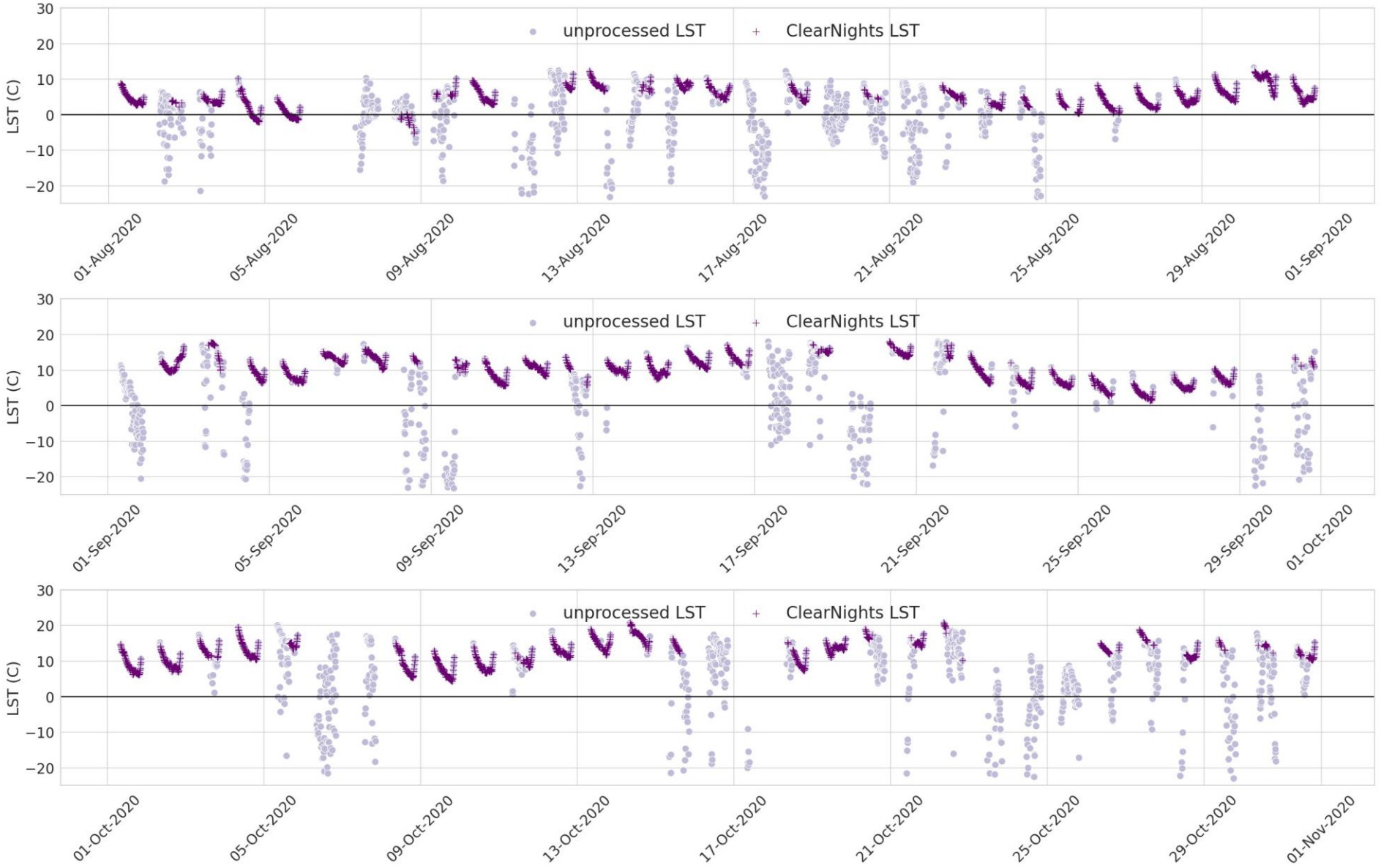
Born et al. (2021) **Fig 1**

Points of reconciliations between agriculture and geospatial data

- Ag data are unstructured, sparse in space and time and scarce in quantities.
- Linkages and harmonization between different formats of geospatial data (vector, point, raster/ gridded) require measurements on the ground AND observations from space.
  - More EO data does not mean better quality or more analysis ready data e.g. characterize urban heat island (UHI) and crop stress from Land Surface Temperature (LST).
  - Spatial mismatch between scale of measurement and scale of observation e.g. crop biophysical and biochemical quality from hyperspectral.

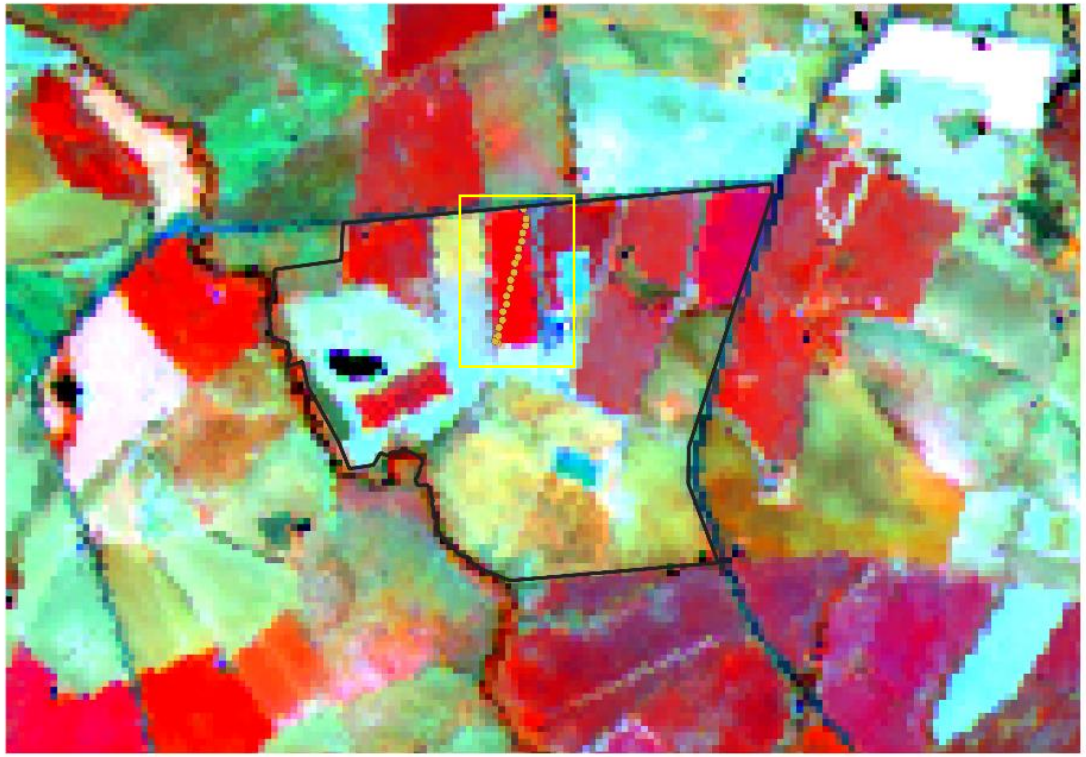
Urban heat island and crop stress from Land Surface Temperature (LST)

An outlier detection problem

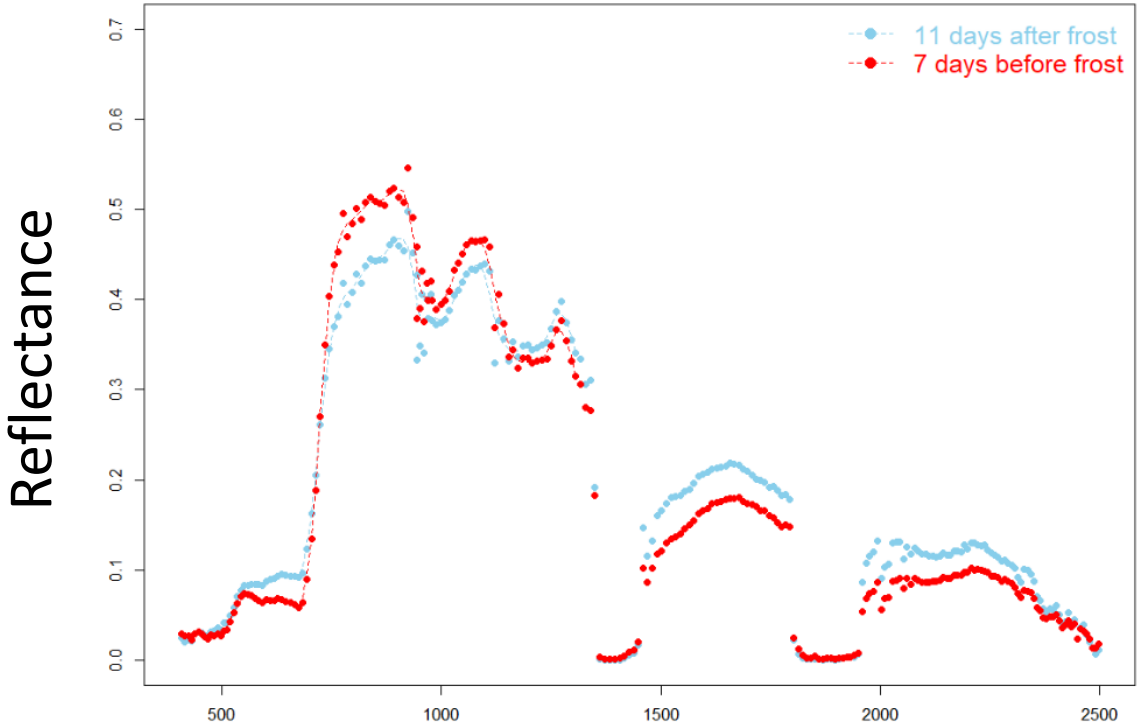


Crop quality indicator from hyperspectral reflectances

A data-model fusion problem



Post stress event (EnMAP November 5)



Managing Australian agricultural land use competition in a net-zero future (Ag2050)

- Ag2050 takes on SDG 2030 goals but pushes the boundaries in an Australian context.
- In the face of the challenges from a growing population and climate change, Australia has made multiple nature-related commitments to preserve biodiversity, combat climate change, and conserve natural habitats.
- A geospatial projection of gaps between the food, fibre and forestry demands of Australia's growing population and trade-dependent agricultural economy and the resources required to meet these commitments is critical.

Where do CSIRO A&F go from here

Analysis-ready Data

A DaaS (Data as a Service) company needs 50 engineers + 10 PhDs to provide Analysis-ready Data and a viable and stable profit stream.

Decision-ready Insight

CSIRO A&F have maybe 10+ engineers and 50+ scientists capable of deriving Digital Farm insight to all components of the agriculture decision matrix.

A cloud-optimized, analysis-ready data structure across scales, sources, regions and time is as much a science and data science problem as a data engineering problem. It is also NOT an Australian problem.

Towards a new business model of delivering R&D in Smart Agriculture

THANK YOU