Operational Satellite Analytics for National Crop Phenology Mapping and Winter Crop Classification

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AAGI Analytics for the Australian Grains Industry

ABSTRACT

This workstream of the **AAGI-UQ-RD-SIA – Foundational analytics for satellite image analysis and yield and quality prediction** project operationalises satellite analytics and data assets initiated under CropPhen (UOQ2002-010RTX) and the ARC Linkage CropVision project (LP190100240). Using UQ Productive Paddock Boundaries (PPB) as the spatial framework, it delivers national-scale workflows for seasonal peak imagery, canola flowering, wheat/barley phenology and 2019–2025 winter crop classification. Reusable Python/GEE pipelines, documented code and AAGI-accessible data layers now support broader EO–AI farming-systems analysis and future translation.

1 PROJECT FOCUS

Develop operational satellite workflows that provide earlier and more consistent **paddock-level crop growth and crop-type information** across Australian grain regions.

Key applications

- National phenology monitoring
- Winter crop-group mapping
- PPB-based field analytics
- In-season monitoring and downstream yield/quality modelling.

Precision agriculture | OFE trials | Industry decision-making

2 OPERATIONAL PHENOLOGY PIPELINES

Peak imagery
Sentinel-2 spectral bands and vegetation indices extracted around seasonal NDVI peak.

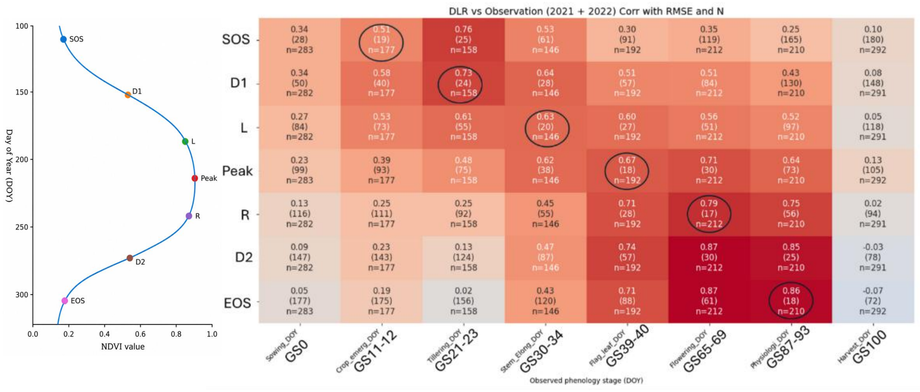
Canola flowering
Automated flowering detection from seasonal Sentinel-2 spectral trajectories.

Wheat & barley phenology
Double Logistic Regression (DLR) applied to NDVI time series to estimate key crop growth stages.

Deliverables: reusable Python/GEE code, automated pipelines and user guidance.

3 PHENOLOGY MAPPING & VALIDATION

DLR-derived growth-curve features showed good agreement with observed wheat and barley growth stages.

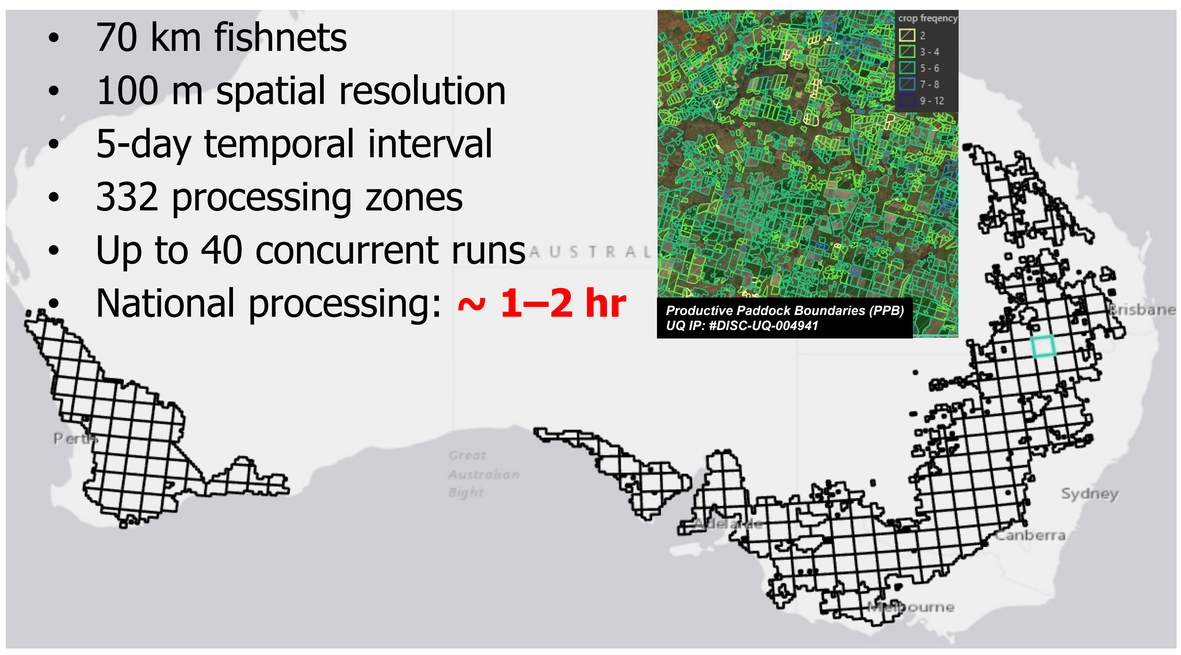


Correlation: 0.51–0.86

Temporal difference: 17–24 days

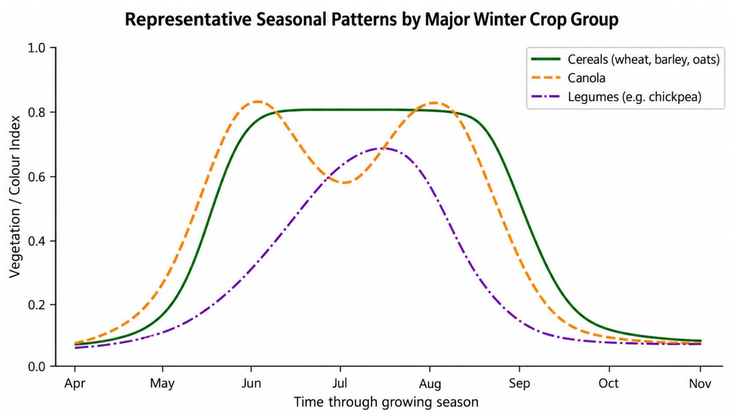
4 NATIONAL-SCALE PROCESSING

- 70 km fishnets
- 100 m spatial resolution
- 5-day temporal interval
- 332 processing zones
- Up to 40 concurrent runs
- National processing: **~ 1–2 hr**



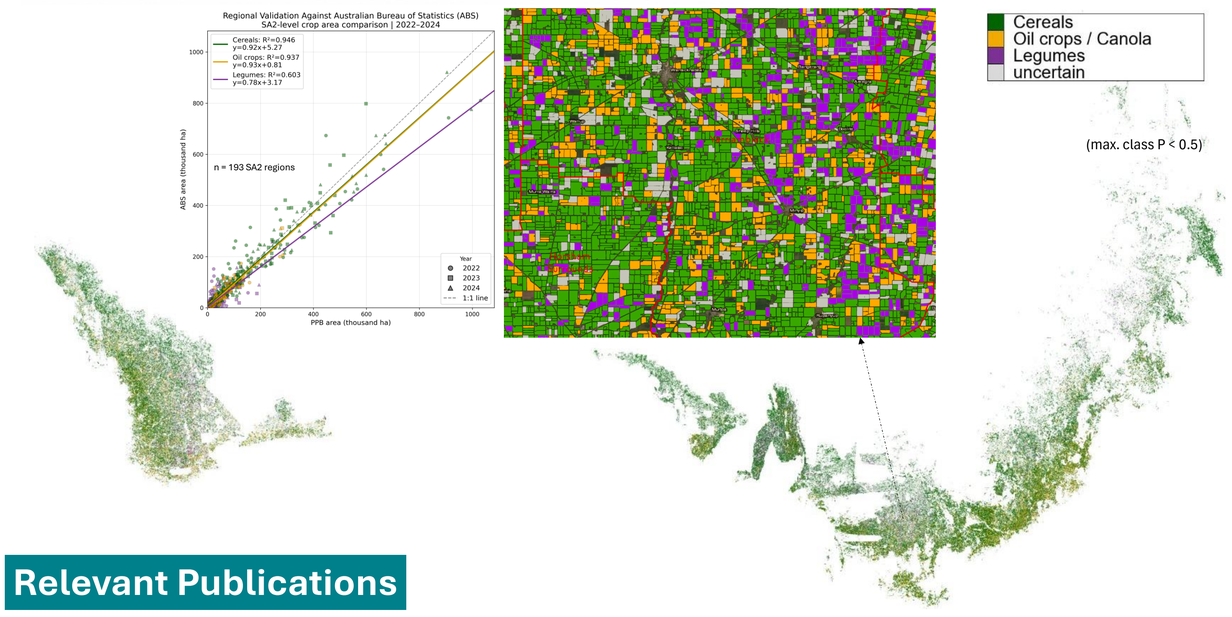
- PPB provides consistent paddock-scale units for national EO analytics. The workflow supports PPB-level estimation of key seasonal stages for wheat, barley and canola.
- CropVision-origin workflows are operationalised through SIA, with resulting data layers accessible through AAGI for wider EO–AI analyses.

5 2019–2025 WINTER CROP CLASSIFICATION



Paddock-level performance	
Cereals	F1* = 0.93
Canola	F1 = 0.80
Legumes	F1 = 0.64
ROC AUC	**= 0.89 - 0.93**

* F1 score (1 = best): balance of precision and recall



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6 IMPACT & TRANSLATION

Impact
Earlier and more consistent paddock-level crop intelligence for in-season monitoring, national-scale research and downstream modelling.

Translation
Automated pipelines, documented code and user guidance support internal deployment, reuse across future EO applications, and integration with yield and grain-quality modelling

Difference
The PPB-based framework provides a common, scalable spatial and analytical foundation for operational crop intelligence.

Relevant Publications

Zhao, Y., Jiang, R., Brider, J., Chapman, S., & Potgieter, A. (2025). Characterizing wheat and barley growth and phenology using multi-spectral remote sensing for site-specific precision agriculture. *in silico Plants*, 7(2), diaf013. https://doi.org/10.1093/insilicoplants/diaf013

Xie, Z., Zhao, Y., Jiang, R., Zhang, M., Hammer, G., Chapman, S., ... & Potgieter, A. B. (2024). Seasonal dynamics of fallow and cropping lands in the broadacre cropping region of Australia. *Remote Sensing of Environment, 305*, 114070. https://doi.org/10.1016/j.rse.2024.114070

Jiang et al., in preparation, The Productive Paddock Boundary Framework: A New Paradigm for Multi-Temporal Paddock-Scale Agricultural Land-Use and Cropping-Dynamics Intelligence in Australia. *Remote Sensing of Environment*

GRDC Grains Research & Development Corporation | Adelaide University | Curtin University | The University of Queensland Australia

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