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Advances in satellite technology and AI for crop monitoring: from data to action in agriculture

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Background:

Globally, crops are monitored through initiatives such as the GEOGLAM crop monitor program. These crop monitoring systems help inform FAO responses to emerging crises in agricultural production. Grain marketers and buyers are interested in similar data, and a suite of organisations now offer digital services to provide information related to crop area plantings and the likely crop yield. At finer field-scales, this explosion of digital products about crop production are not as well utilised. We explore some of the recent advances in digital technology, and discuss how, with the help of AI, information is on the cusp of transitioning to actionable or decision ready data.

Objective:

Some 13,000 satellites have been scheduled to launch in the next two years. Agricultural regions are now surveyed with a wide range of optical and radar satellites, of varying resolutions.

It has been recognised that a satellite platform, and an earth observation (EO) signal alone are not sufficient to manage crops or understand production trends. Analytical methods have been developed to create bespoke analytics, with machine learning, to generate useful metrics to monitor crop health, growth and productivity. Some of these methods can cope with cloud, others can generate insights beyond the visible spectrum, and use the Near Infrared (NIR) and Short-Wave InfraRed (SWIR) components of the spectrum.

While satellites can provide useful insights into production, they do not provide the industry with analytical ready data, or decision ready data. For example, it is difficult to align a management action directly to an NDVI score of 0.7 on a canola crop, captured 1 week into flowering. The management action must be contextualised with other information.

To address this concern, agricultural scientists are merging satellite technology with conventional crop models and ground-based sensors for soil moisture and weather. Others are using satellite information to create bespoke analytics to assess production trends over longer term time horizons, to detect the impact of drought, war, or the impact of a new crop on a production system.

Methods and Results:

Here, we demonstrate how crop models can be merged with satellite information to monitor the impact of Canola on wheat yields in Western Australia.

Other examples include how leaf area index can be derived from a satellite and used to inform a crop model to forecast production.

A final example explores how earth observation technology can be used to detect anomalies in crop growth. These techniques were deployed into Ukraine to illustrate how the current conflict affected production.

Conclusions:

Crop monitoring and modelling platforms are evolving at speed. The advances in satellite technology, machine learning and AI enable production systems to be monitored with precision. However, the industry is still grappling with how to make best use of this technology. Emerging technologies will allow space technology for agriculture to transition from providing data and a signal to an action. Ultimately, these multi-sensor systems will create decision ready data for the agricultural sector.