Satellite-based Real-time Monitoring of Peanut Fields Using Multispectral and Synthetic-aperture Radar Imagery

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Previous studies have shown the utility of remotely-sensed multispectral imagery and vegetation indices derived from the imagery (such as Normalised Differential Vegetation Index - NDVI) for monitoring of peanut growth status. Applications include assessing within- and between-paddock biomass variability and predicting yield. This data is useful for growers managing in-field variability, and for processors managing operational logistics and financial forecasting. However, peanuts grown in Australia, and globally, are grown in areas where there is frequent cloud cover. This limits the applicability of satellite-based multispectral imagery for operational monitoring as the chance of a cloud-free capture on a required date are low. In contrast to multispectral imagery, synthetic-aperture radar (SAR) imagery is not limited by cloud cover. This paper assesses multiple uses of SAR imagery for peanut operations. A time-series of freely-available Sentinel-1 SAR images for the 2018-2019 season was obtained for this purpose, covering more than 50 peanut fields in the Bundaberg coastal cropping region located in south-eastern Queensland. The radar imagery was highly correlated with the limited cloud-free multispectral imagery from the Sentinel-2 platform over the same time period, with a significant correlation between multispectral NDVI and combinations of radar bands on multiple dates (r= 0.87) observed. Time-series growth profiles from the SAR data were also derived and assessment was made of their ability to estimate the crop emergence characteristics, actual harvest dates, and prediction of pod yield. Our results highlight the possibility for SAR data being used to replace multispectral data when the latter has limited availability due to presence of cloud cover on target peanut fields.