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## **In-season crop classification using optical remote sensing with random forest over irrigated agricultural fields in Australia**

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Timely classification of crop types is critical for agronomic planning in water use and crop production. However, crop type mapping is typically undertaken only after the cropping season, which precludes its uses in later-season water use planning and yield estimation. This study aims 1) to understand how the accuracy of crop type classification changes within cropping season and 2) to suggest the earliest time that it is possible to achieve reliable crop classification. We focused on three main summer crops (corn/maize, cotton and rice) in the Coleambally Irrigation Area (CIA), a major irrigation district in south-eastern Australia consisting of over 4000 fields, for the period of 2013 to 2019. The summer irrigation season in the CIA is from mid-August to mid-May and most farms use surface irrigation to support the growth of summer crops. We developed models that combine satellite data and farmer-reported information for in-season crop type classification. Monthly-averaged Landsat spectral bands were used as input to Random Forest algorithm. We developed multiple models trained with data initially available at the start of the cropping season, then later using all the antecedent images up to different stages within the season. We evaluated the model performance and uncertainty using a two-fold cross validation by randomly choosing training vs. validation periods. Results show that the classification accuracy increases rapidly during the first three months followed by a marginal improvement afterwards. Crops can be classified with a User's accuracy above 70% based on the first 2-3 months after the start of the season. Cotton and rice have higher in-season accuracy than corn/maize. The resulting crop maps can be used to support activities such as later-season system scale irrigation decision-making or yield estimation at a regional scale.

**Keywords:** Landsat 8 OLI, in-season, multi-year, crop type, Random Forest