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# National-scale crop yield estimation based on biomass and climate-driven stress indices

Yang Chen (1), Randall Donohue (2), Tim McVicar (2), Franz Waldner (3), Gonzalo Mata (4), Noboru Ota (4), Alireza Houshmandfar (4), Kavina Dayal (5), and Roger Lawes (4)

(1) CSIRO Data61, Goods Shed North, 34 Village St, Docklands, VIC 3008, Australia, (2) CSIRO Land and Water, GPO Box 1700, Canberra, ACT 2061, Australia, (3) CSIRO Agriculture and Food, 306 Carmody Rd, St Lucia QLD 4067, Australia, (4) CSIRO Agriculture and Food, Underwood Ave, Floreat WA 6014, Australia, (5) CSIRO Agriculture and Food, College Rd, Sandy Bay TAS 7005, Australia.

Climate-induced national crop-yield fluctuation is expected to increase under climate change and should be included in studying crop yield variability across national and global scales. In this study, remote sensing technologies have been deployed to assess the spatial and temporal variabilities of biomass production using a radiation use efficiency approach. We developed a semi-empirical model to estimate the yield of the three major crop types in dryland Australia by integrating biomass with Stress Indices (SI) related to drought, heat, and frost. We identified crop-specific SI for critical phenological stages (e.g. anthesis and grain filling) to explain the impact of high spatial heterogeneities in the ecology and environment on the actual grain yield across the country. Our model explained 84, 69 and 79% of the observed variability at field-scale with root mean square error (*RMSE*) of ∼0.4, 0.4 and 0.5 t/ha for canola, wheat, and barley, respectively. At 250 m pixel level, it reduces the error rate by at least ∼13% for wheat, compared with two benchmarking models currently available for large-scale simulations, including the harvest function and a carbon turnover model. The finding enhances the predictive capacity of RS-based models for crop yields across a highly variable landscape and climate by incorporating climate-driven SI into the simulation. This study provides new insights into the next generation of agricultural systems models, knowledge products and decision support tools that need to operate at various scales.