Towards dynamic continental estimation of irrigated areas and water use

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Abstract: Irrigation agriculture accounts for around 65% of Australia's water consumption and generates 23% of the total value of agricultural production. Despite their importance, the year-to-year geographic distribution and water use of many important irrigated areas remains uncertain. We advance a methodology to map irrigated areas on a year-to-year basis at the regional/continental scale. The region in which the methodology was implemented, the Murray-Darling Basin (MDB) in Australia, possess biophysical characteristics, spatio-temporal climate variability and irrigation practices that makes identification of irrigated areas challenging. The methodology used training samples from Landsat TM/ETM+ reflectance data and monthly time-series of remotely-sensed observations from the MODerate resolution Imaging Spectroradiometer (MODIS). The covariates included in the classification model characterised the monthly dynamics and rates of change of: (i) the vegetation phenology via the recurrent and persistent fractions of photosynthetically active radiation ($fPAR_{rec}$ and $fPAR_{per}$, respectively); (ii) water use via remotely-sensed estimates of actual evapotranspiration (ET_a), precipitation (P) and the difference between ET_a and P. Observed agreement – in terms of the kappa coefficient – for correctly classified pixels in the training sample was 96%. Independent comparisons of yearly irrigated area estimates showed linear relationships with Pearson's correlation coefficients (*r*) generally greater than 0.7 for: (i) reported areas (e.g., Figure 1); (ii) areas with available metered water withdrawals; and (iii) estimates of agricultural yields. The Random Forest model approach and other techniques and data are available to extend this mapping to other areas with complex irrigation practices.

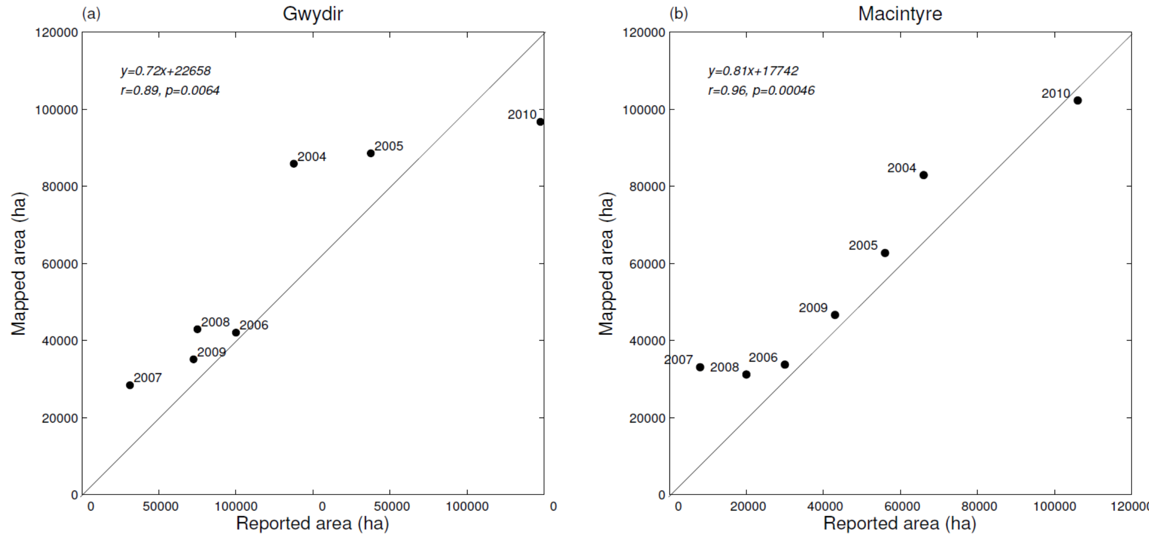

Figure 1. Scatter plots of irrigated areas in the (a) Gwydir and (b) Macintyre valleys reported in the Cotton Yearbook 2011 versus mapped irrigated areas per water-year (where, for example, 2010 corresponds to the water-year 2010/11). The equation represents a one-degree polynomial fit to the data. Also shown are the Pearson's correlation coefficients (*r*) and *p*-values for both datasets.

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