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Nodal Network Modelling by Integrating Remote Sensing Derived Actual Evapotranspiration with Spatial Water Balance in a Demand Driven Irrigation System

Kaleem Ullah (1), Mohsin Hafeez (1,2), Josh Sixsmith (1), and Ralph Faux (1)

(1) International Centre of Water for Food Security (IC Water), Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW 2678, Australia. Phone: +61 2 69332989 Fax: +61 2 6933 2647 (mullah@csu.edu.au), (2) Cooperative Research Centre for Irrigation Future (CRC IF), Locked Bag 588, Wagga Wagga, NSW 2678, Australia

The long-term sustainability of water for agriculture is in doubt in many regions of the world. The major withdrawals of water are for agriculture, industry, and domestic consumption. Irrigated agriculture is major consumer of fresh water, but a large part of the water devour for irrigation is wasted due to poor management of irrigation systems. Improving water management in irrigated areas and assessment of irrigation performance are critical activities for this endeavour. These activities are needed not only to improve water productivity, but also to increase the sustainability of irrigated agriculture and improving the irrigation efficiency. The improvement of the water use efficiency entail the complete understanding of various components of water balances such as rainfall, surface water, groundwater and evapotranspiration (ET).

Evapotranspiration is the overriding aspect of water balance at farm to catchment scale. Many models have been used to measure the Evapotranspiration rate, either empirical or functional. The major disadvantage of this approach is that most methods generate only point values, resulting in estimates that are not representative of large areas. These methods are based on crop factors under ideal conditions and cannot therefore represent actual crop ET. Satellite remote sensing is a powerful mean to estimate ET over various spatial and temporal scales. The use of remote sensing techniques to estimate ET is achieved by solving the energy balance thermodynamics fluxes at the surface of the earth.

For improved irrigation system management and operation, a holistic approach of integrating remote sensing derived ET from SAM-ET (spatial algorithm for mapping evapotranspiration) algorithm, for Australian agro-ecosystem with spatial water balance by using nodal network model was applied to evaluate agricultural water management in Coleambally Irrigation Area (CIA), New South Wales, Australia. It covers approximately 79,000 ha of intensive irrigation and comprise of number of secondary and tertiary canals. In order to capture the spatial variability, CIA has been divided into 22 nodes based on direction of flow and connectivity. All hydrological data of inflow (i.e. surface water supplies, tubewells pumping, rainfall and capillary upflow) and outflow components (i.e. actual Evapotranspiration, deep drainage, and surface outflow) were measured for all established nodes of CIA.

Accurate maps of various agriculture crops using high spatial resolution satellite images (ALOS/AVNIR) was developed for each cropping season. Landsat 5 TM satellite images were used to estimate seasonal actual ET and the results were compared with the data obtained from Eddy Covariance flux tower. Initial results from nodal network water balance model are very promising and provide a deep insight about the spatial variation in crop water demand for each node within the CIA. The results also provide a practical way forward for improving the water use efficiency at node scale.