# Comparison study on mapping of ET in the low Murrumbidgee Catchment with remotely sensed satellite data: Examples from National Airborne Field Experimentation

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Spatial knowledge of land surface evapotranspiration is of prime interest for environmental applications, such as optimizing irrigation water use, irrigation system performance, crop water deficit, drought mitigation strategies and accurate initialisation of climate prediction models especially in arid and semiarid catchments where water shortage is a critical problem. The recent drought in Australia and concerns about climate change has highlighted the need to manage water resources more sustainable especially in the Murrumbidgee catchment which utilizes bulk water for food production. This study focused on estimation of daily actual evapotranspiration in Coleambally Irrigation Area (CIA) area, using the SEBAL model applied to a remote sensing TERRA/MODIS, NOAA AVHRR 18 and Landsat 5 TM sensor during different satellite over pass days in National Airborne Field Experimentation (NAFE) campaign, lasted over 3 weeks (October 6 to November 23, 2006). All ground truth data for calibration of model was collected during the field campaign, such as soil moisture, surface roughness, skin and soil temperature, and vegetation water content.

Satellite remote sensing is a powerful means to estimate Actual Evapotranspiration (ETa) over various temporal and spatial scales, which ranges from individual pixels to an entire raster image that may cover a whole river basin. These techniques have become increasing popular since 1990 due to the relatively low cost of data collection. Different methods have been developed to estimate evapotranspiration by combining satellite images and ground meteorological data for large areas, from empirical approaches such as the simplified relationship to complex methods based on remote sensing data assimilation along with SVAT models (Dominique et al., 2005). The complexity of these methods depends on the balance between the empirical and physically based modules to solve the energy budget from image overpass time to daily and up to monthly.

In this study, Surface energy balance algorithm for land (SEBAL) was applied for an estimation of actual evapotranspiration over two key study areas i.e. the Yanco area (3000 km2) including Coleambally Irrigation Area (CIA) and Murrumbidgee Irrigation Area (MIA, about 5000 km2) in the low Murrumbidgee Catchment. SEBAL is an intermediate approach using both empirical relationships and physical parameterizations which was developed in Spain (Bastiaanssen 1995). SEBAL is a thermodynamically based model, which partitions sensible heat flux and latent heat of vaporization flux. Semi-empirical relationships are used to estimate emissivity, roughness length from NDVI. Water consumption of large irrigation systems has been addressed also with NOAA-AVHRR or MODIS data in California, Spain, Indian, China and Pakistan. Combinations of Landsat 7 ETM+ and NOAA are found in Chemin and Alexandridis (2001).

Results showed that actual ET estimated from NOAA AVHRR 18 was always

overestimating (range from 11.5% to 59.3%) as comparison to Eddy system (on average 37%) during the image acquisition dates. However, for the same image acquisition dates, TERRA/MODIS ET ranges from 9.8% lower to 14.3% higher than the Eddy system. Landsat 5 TM modeled ET results were comparable to the Eddy Covariance system having a minor error of 4.78%, -6.87% and -1.21%, respectively. It was proven possible to simultaneously use SEBAL for different sensors with the combination of high spatial and temporal resolution to estimate ET spatial distribution characteristics; though the accuracy of NOAA-AVHRR derived result is not ideal. The Landsat ET results in this study match very well with the Eddy system. Considering the lack of high spatial resolution thermal satellite and need of time-series ET dynamics, the MODIS data could be used to provide seasonal actual ET for regional studies. The combination of MODIS and Landsat can be a better choice for future ET study at regional or catchment scale, but further study need to be conducted to integrate to provide both high spatial and temporal ET. Estimation of actual ET from TERRA MODIS in combination with Landsat imagery indicated relatively good accuracy and potential for use in the water balance and water productivity analysis at the catchment level. In future, the ET will be modeled from high resolution thermal data and the results will be compared with the optical satellite imagery results to find out uncertainty in up-down scaling modeling for ET estimation.

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