Estimation of Land Surface States and Fluxes Using a Land Surface Model Considering Different Irrigation Systems

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BACKGROUND

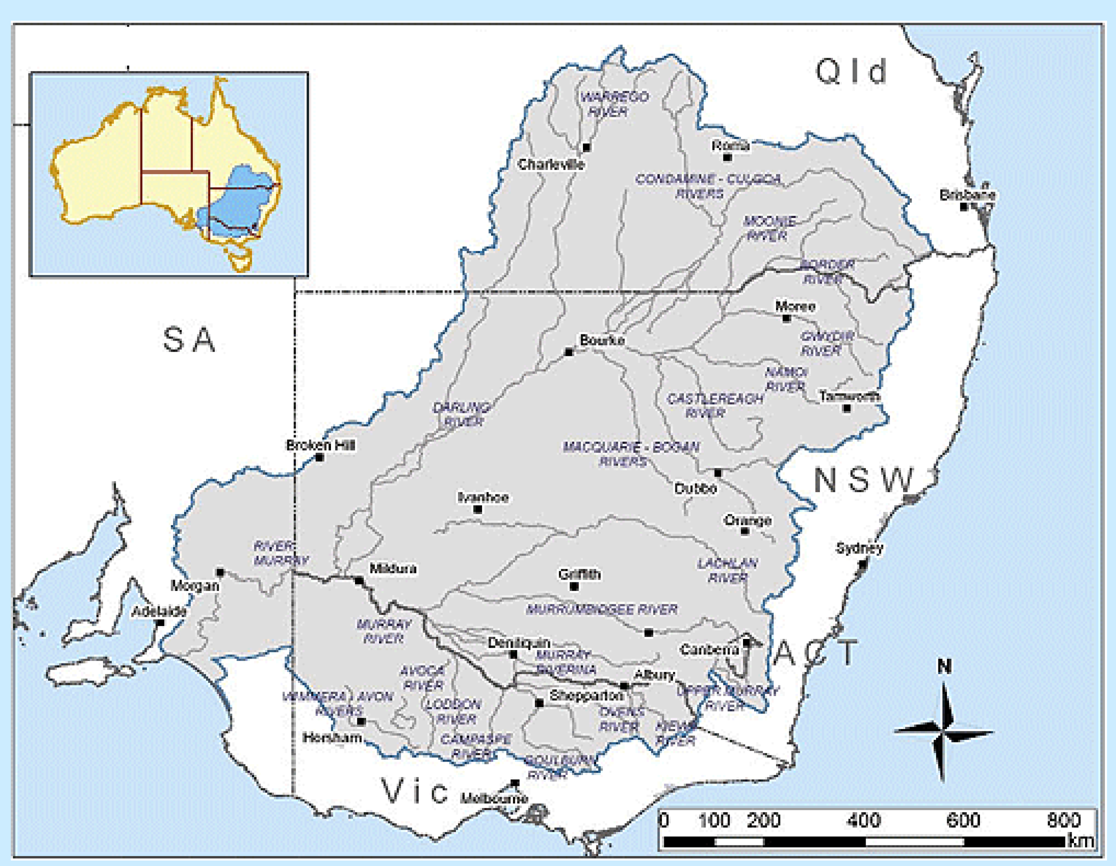
- The exchange of water and energy between land surface and atmosphere largely influence global weather patterns to further affect our communities.
- The regional climate system and the hydrologic cycle can be significantly influenced by agricultural land management by altering the exchanges of heat and water between land and atmosphere.
- In particular, there have been studies to show agricultural irrigation managements affect regional climates and hydrology by modifying the water cycle at land surface.

OBJECTIVES

- To incorporate practical irrigation schemes into land surface models of the NASA Land Information System (LIS)
- To apply the tool to estimate the impact of irrigation on land surface states and fluxes

STUDY SITE

- The Murray-Darling Basin, Australia
  - About 14% of Australia's landmass (1,059,000 km^2)
  - The area of irrigated agriculture in 2005-6 was 1.65 million ha (65% of Australia's irrigated land)
  - Produces the highest value and largest volume of irrigated enterprises in Australia
  - 75% of the all water used in irrigation in Australia
  - Over 50 % of all water used in Australia



Location map of the Murray-Darling basin.

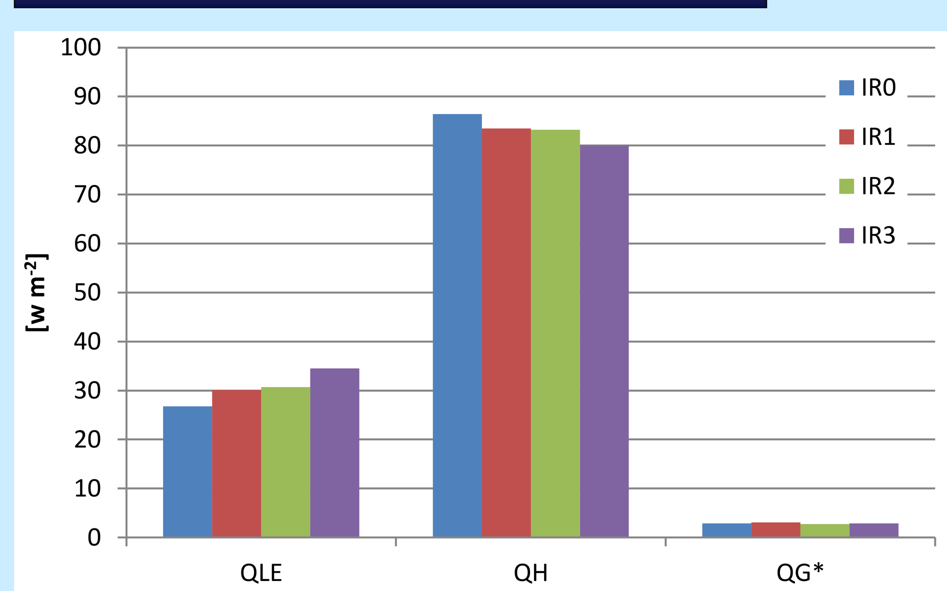
DATA COLLECTION

- NCEP GDAS data: 2.5°×2.5° latitude/longitude grid
- TRMM: supplemental forcing sources (0.25°×0.25° grid over the latitude band 50° N-S)
- The USGS landcover: 24 vegetation types, indices 3 and 4 (irrigated cropland)
- FAO soil data : sand-, clay-, and silt-fraction maps
- GTOPO30: elevation parameters

CONFIGURATIONS

Irrigation type	Flood irrigation	Sprinkler irrigation
. 0 for non-irrigation experiment . 1 for flood irrigation . 2 for drip irrigation . 3 for spray irrigation	. Irrigation trigger coefficient: 0.25 (default) . Irrigation time in local time . Irrigation frequency: 0 (Auto-irrigation scheme) or irrigation intervals in days	. Irrigation trigger coefficient: 0.1 (default) . Irrigation off coefficient : 0.2 (default) . Average sprinkler application rate: 5.0 in mm hr^{-1} (default)

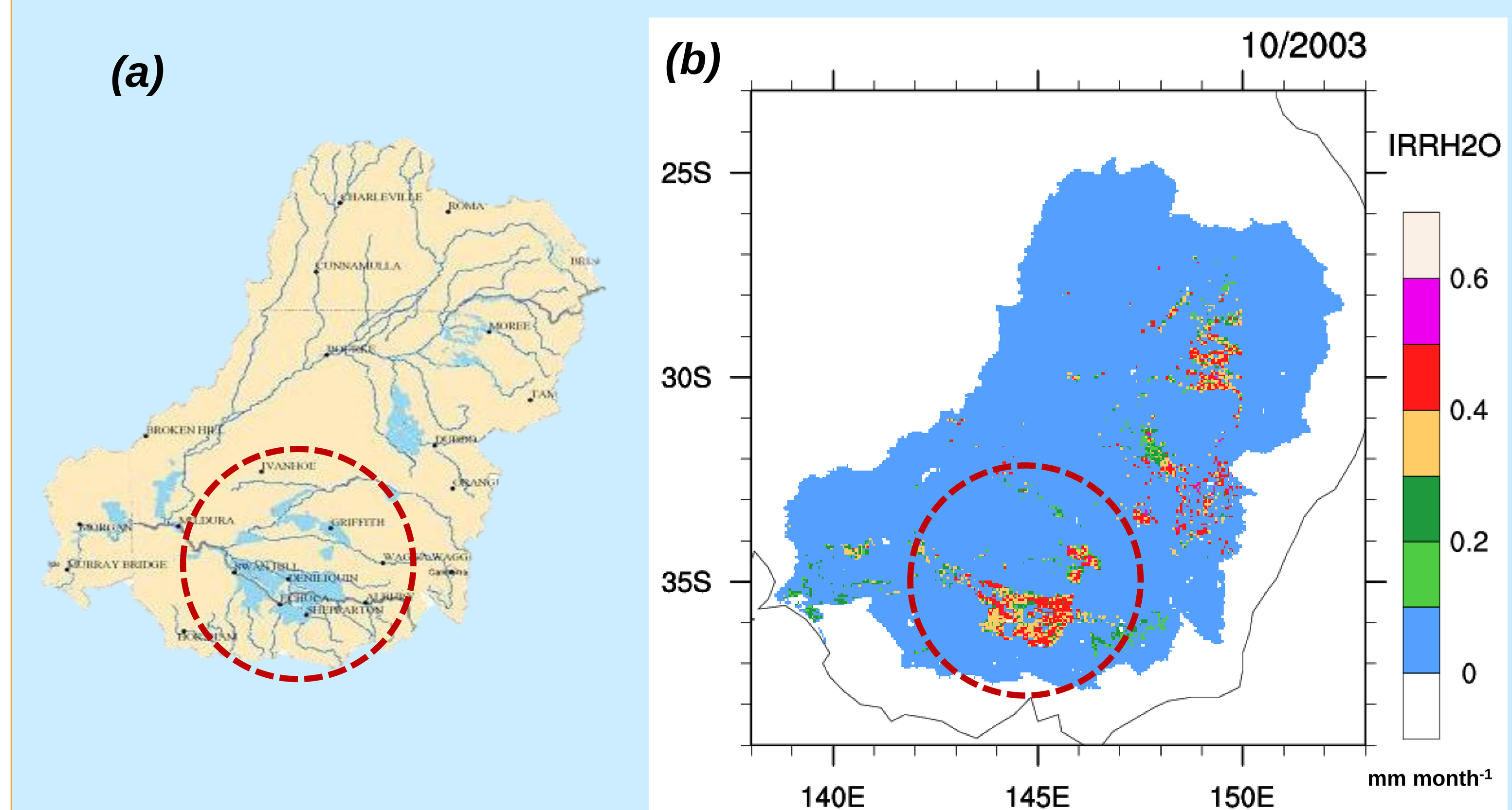
RESULTS



IR0: non-irrigation, IR1: flood irrigation, IR2: drip irrigation, and IR3: spray irrigation.

Mean energy budget components averaged over the entire Murray-Darling basin and entire year (July 2002 to June 2003). QLE: Sensible heat flux in W m^{-2} QH: Sensible heat flux in W m^{-2}, QG: Ground heat flux in 0.1 W m^{-2}.*

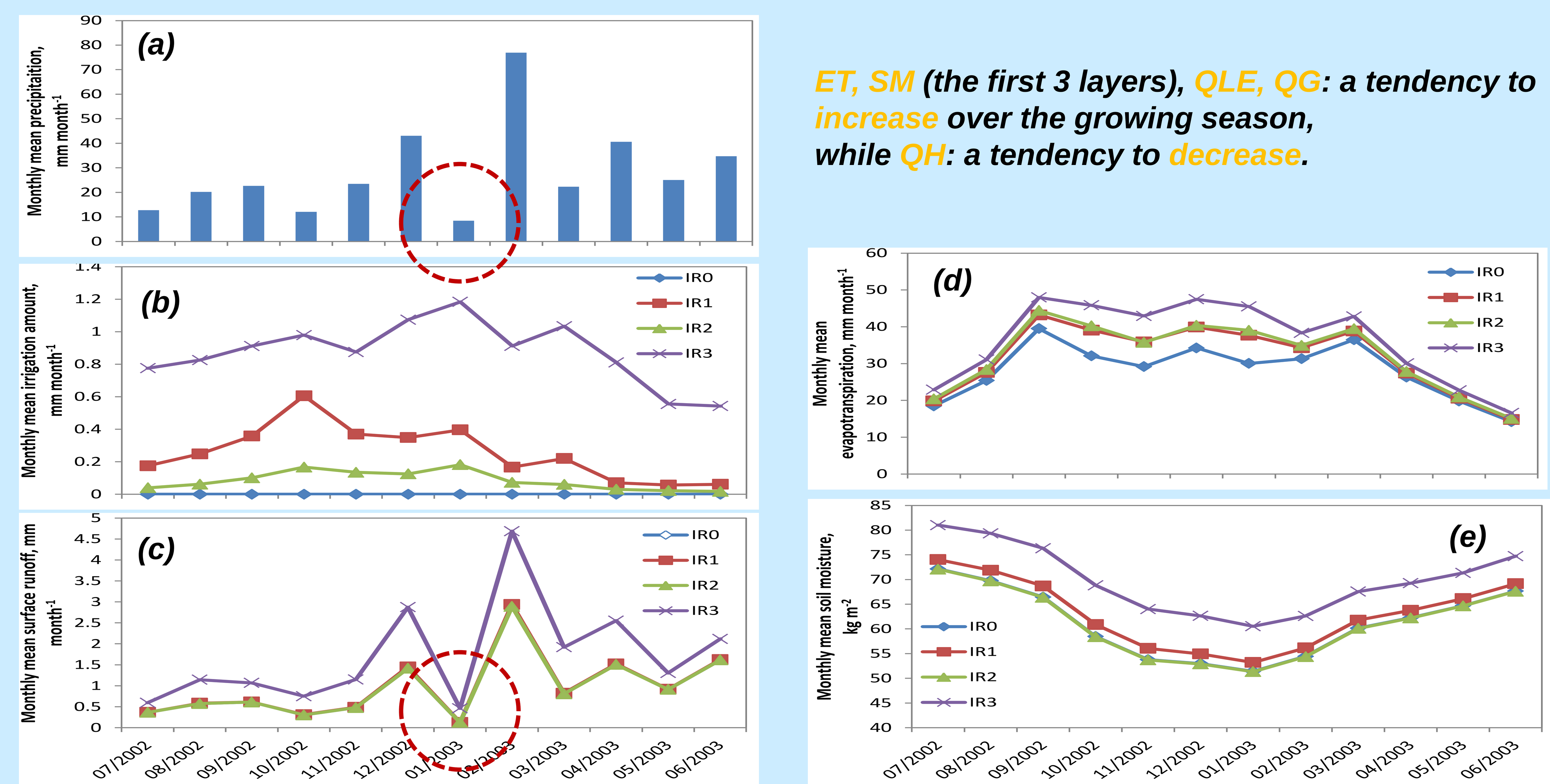
RESULTS



Irrigation amounts between July 2002 and June 2003 were simulated as 3 622, 837, and 7 648 GL for IR1, IR2, and IR3, respectively.

Estimated Irrigation amounts between July 2002 and June 2003 were approximately 7 800 GL.

Major irrigation districts in the Murray-Darling basin: (a) observed (adapted from Murray-Darling Basin Commission, 2005) and (b) simulated districts. IRRH2O: irrigation amount in mm month^{-1}.



ET, SM (the first 3 layers), QLE, QG: a tendency to increase over the growing season, while QH: a tendency to decrease.

Monthly mean (a) precipitation, (b) irrigation amount, (c) surface runoff, (d) evapotranspiration, and (e) soil moisture. Soil moisture is depth mean between surface and 0.6m deep. IR0: non-irrigation, IR1: flood irrigation, IR2: drip irrigation, and IR3: spray irrigation.