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 systems 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 management affects regional climates and hydrology by modifying the water cycle at land surface.

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
- GTOP030: elevation parameters

OBJECTIVES

- To incorporate practical irrigation schemes into land surface models of the NASA Land Information System (LIS) land
- 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 km²)
- The land area irrigated 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 all water used in irrigation in Australia
- Over 50% of all water used in Australia

RESULTS

- 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


<table>
<thead>
<tr>
<th>Irrigation type</th>
<th>Flood irrigation</th>
<th>Sprinkler irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 for non-irrigation experiment</td>
<td>Irrigation trigger coefficient: 0.25 (default)</td>
<td>Irrigation trigger coefficient: 0.1 (default)</td>
</tr>
<tr>
<td>1 for flood irrigation</td>
<td>Irrigation time in local time</td>
<td>Irrigation off coefficient: 0.2</td>
</tr>
<tr>
<td>2 for drip irrigation</td>
<td>Irrigation frequency: 0 (Auto-irrigation scheme) or irrigation intervals in days</td>
<td>Average sprinkler application rate: 5.0 in mm hr⁻¹ (default)</td>
</tr>
<tr>
<td>3 for spray irrigation</td>
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</tbody>
</table>

Irrigation amounts between July 2002 and June 2003 were 3,622, 837, and 7,800 QL for IR1, IR2, and IR3, respectively. Estimated irrigation amounts between July 2002 and June 2003 were approximately 7,800 QL.

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.