Murray Darling Basin
Regional Hydroclimate Project

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The Murray-Darling Basin (MDB) Regional Hydroclimate Project has been ongoing since 2002. It's objectives are:

- Produce and compile research quality datasets of the energy and water budgets in the MDB.
- Improve the understanding and modelling of the dynamics of the coupled water, energy and carbon cycles in the MDB, a developed semi-arid zone basin.
- Improve predictive tools for water management, including real-time forecasting products for use by water agencies in the MDB.
- Strengthen interaction between the climate research community and decision-makers.

This poster presents past and present projects that have contributed to these objectives.

The Australian Water Resources Information System

http://www.bom.gov.au/water/about/wip/awris.shtml

The Bureau of Meteorology water division is collating and disseminating national water information for the Australian federal government. As part of this task they are developing AWRIS, an online information system that collates and disseminates information about river flows, groundwater levels, reservoir storage volumes, water quality, water use, water entitlements and water trades from more than 200 water sources across Australia. The system will evolve and expand over 10 years..

Water Information Research and Development Alliance

http://www.csiro.au/partnerships/wirada.html
Contact:Dr John Sims (John.Sims@csiro.au)

The Bureau of Meteorology water division has formed a partnership with CSIRO to deliver new science and technology that will enable the Bureau to undertake real-time interactive analysis of water information and begin using advanced methods for forecasting of water availability and floods across Australia. The research being conducted covers many fields including data interoperability, hydrologic modelling, water accounting, and water resource assessment.

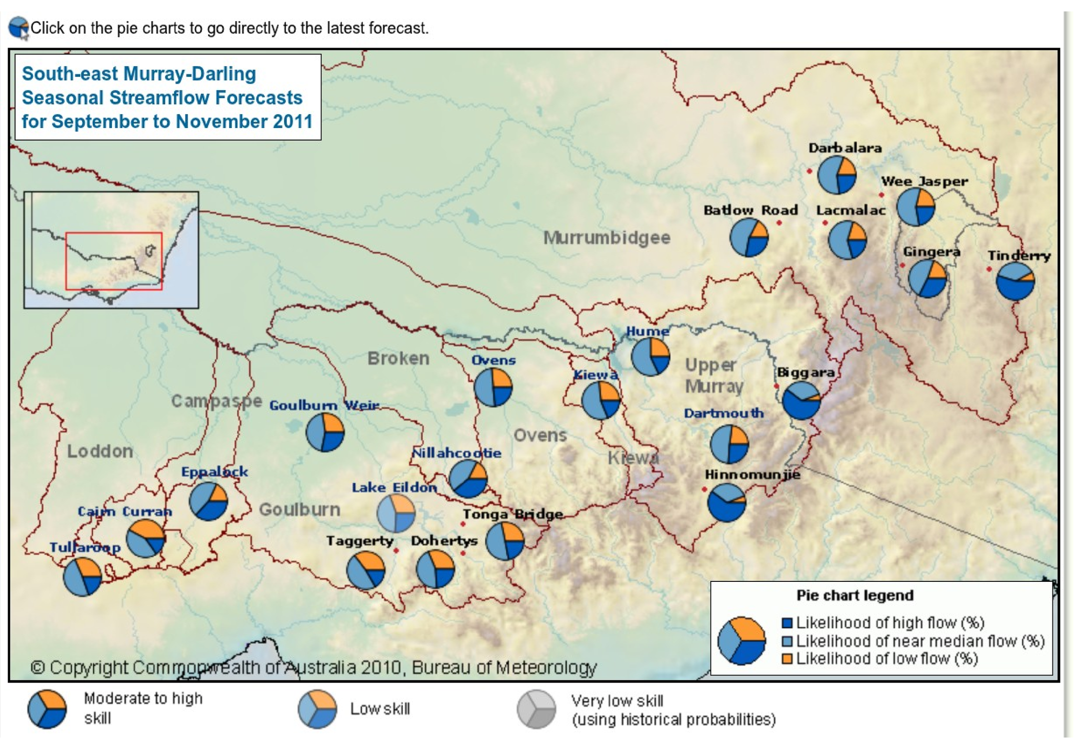

Figure 1:Seasonal streamflow forecasts for selected catchments in the southern MDB (http://www.bom.gov.au/water/ssf/index.shtml accessed 5 Oct 2011). The statistical approach is based on the Bayesian Joint Probability modelling system. The model uses statistical relationships between climate indicators, past catchment conditions and historical rainfall and streamflow at a site to forecast its future streamflow.

Australian Airborne Cal/val Experiment for SMOS

http://www.moisturemap.monash.edu.au/aaces/
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With the European Space Agency's (ESA) Soil Moisture and Ocean Salinity (SMOS) satellite successfully launched on 2nd, Nov. 2009, the first long-term space-borne passive microwave observations at L-band (~1.4 GHz) have become available. This project used in-situ and airborne data to evaluate the SMOS soil moisture retrievals.

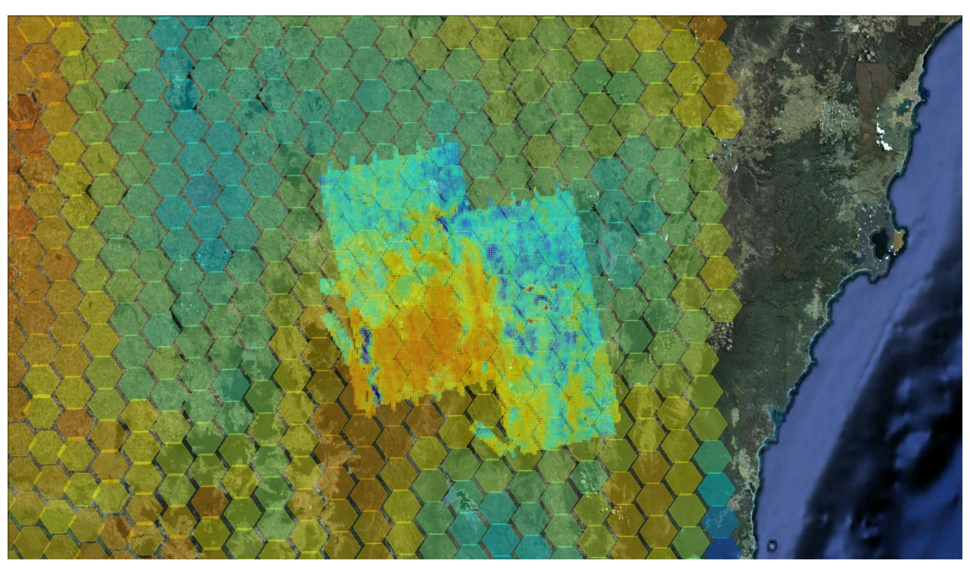

Figure 2: Aircraft data overlayed on SMOS L1c grid. H polarisation: 18 Feb 2010

Regional Climate Modelling

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The Climate Change Research Centre at UNSW has several projects focused on various aspects of the climate of the MDB. Using regional climate modelling as the primary tool (Other regional climate modelling has also been conducted at CSIRO and BoM) they have explored the impact of CO_2 on the terrestrial surface energy balance via the down-regulation of stomatal conductance. Multiple realisations with a regional climate model show the clear impact of increasing leaf level CO_2 on the transpiration, particularly when sufficient moisture is available. A high resolution regional climate simulation has also been performed covering 1985 to 2008. This simulation is being used to investigate the land – atmosphere interactions in the basin, including how these interactions differ across the basin, how they change in time and what role they play in the development and sustenance of drought.

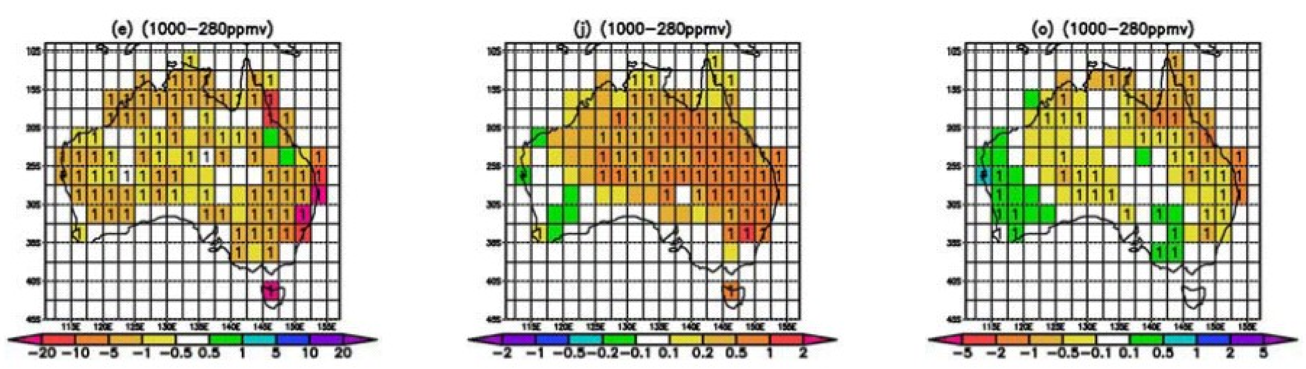

Figure 3: Monthly average changes in (e) transpiration (W m-2), (j) canopy temperature (ºC) and (o) rainfall rate (mm d-1) for changes in leaf-level CO2: 1000-280 ppmv. Averages are taken over 51 realizations for each of the three Januarys in the wet case. Changes that are statistically significant at a 95% confidence level are marked with "1". From Cruz, F.T., A.J. Pitman, J.L. McGregor & J.P. Evans (2010), Contrasting regional responses to increasing leaf-level atmospheric carbon dioxide over Australia., J. Hydrometeorol., 11(2), 296-314.

Other regional climate work includes investigations of the mechanisms causing the diurnal cycle in precipitation over the MDB, investigating changes in the Forest Fire Danger Index (FFDI) and it's constituent variables, examining the spatial extent of the Australian snowfields and how the maximum snow extent is changing in time.

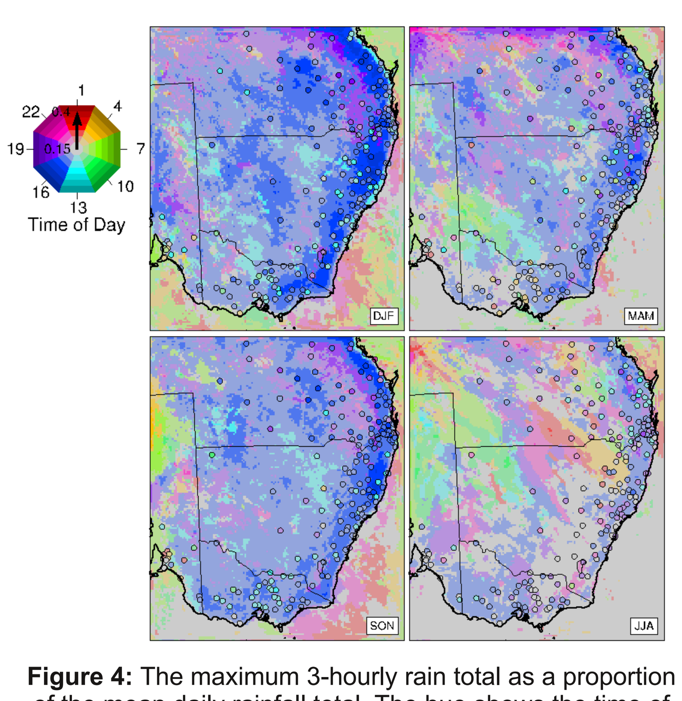

Figure 4: The maximum 3-hourly rain total as a proportion of the mean daily rainfall total. The hue shows the time of day of the maximum (i.e. the accumulated precipitation in the 3 hours preceding that time). The saturation/intensity indicates the proportion of the mean daily rainfall (i.e. grey indicates that less than 15% of the daily rain fell in the maximum 3 hour accumulation, a uniform distribution through the day is 12.5% each 3 hours). The coloured circles indicate the timing and strength of the 3-hourly maximum observed at stations throughout the domain.

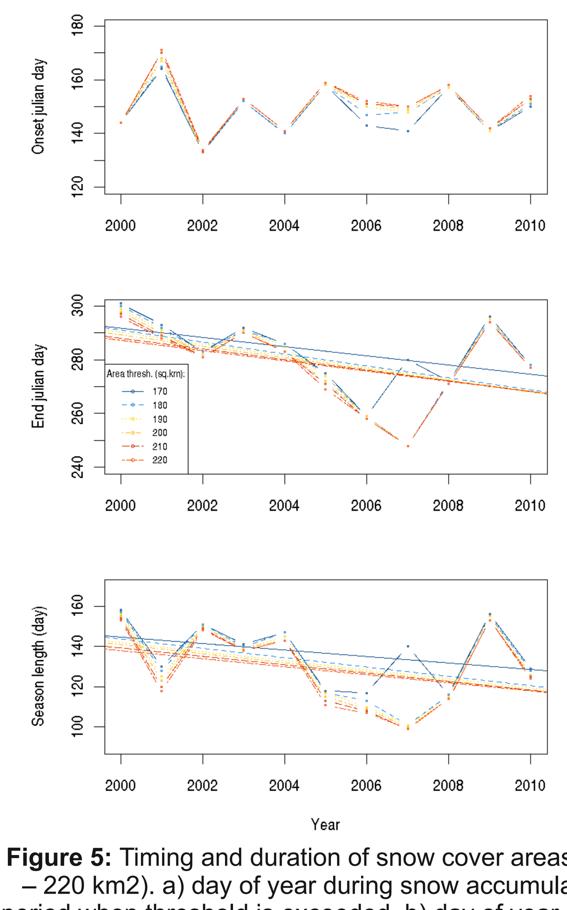

Figure 5: Timing and duration of snow cover areas (170 – 220 km2). a) day of year during snow accumulation period when threshold is exceeded, b) day of year during snow melt period when threshold area disappears and c) duration in days when snow cover area is maintained. Linear trend lines for snow cover areas of between 170 and 220km2 are shown, all of which are statistically significant to at least the 90% level.

South Eastern Australian Climate Initiative

http://www.seaci.org/
Contact: seaci@csiro.au

Investigated the causes and impacts of climate change and climate variability across south eastern Australia, including the MDB. Research was led by CSIRO and the Bureau of Meteorology. Some key findings include:

- Rainfall reduction of the on-going drought is linked to Mean Sea level Pressure and Sub-Tropical Ridge (STR) Intensity increases.
- STR intensity has increased with global warming.

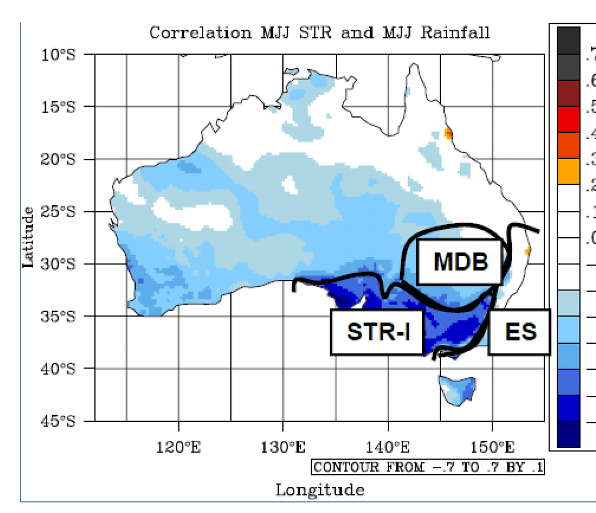

Figure 6: Colours show the correlation between the May-June-July Sub-tropical ridge intensity and rainfall. South-east Australia is divided into three regions with different large-scale climate influences dominating. The three regions are the northern MDB, the Eastern Sea-board and an area with a strong influence of the sub-tropical ridge intensity. From Timbal, B. (2009) Theme 1 highlights., SEACI annual science meeting, Canberra, Australia, 28-30 April.

- Seasonal climate predictions were improved though upper limit of predictability may be ~30% of variance.
- Developed Bayesian joint probability modelling approach for probabilistic predictions of seasonal streamflows.
- While both the tropical Pacific (ENSO) and the tropical Indian (IOD) ocean influence the inter-annual rainfall variability, at decadal time scales the Indian ocean dominates.

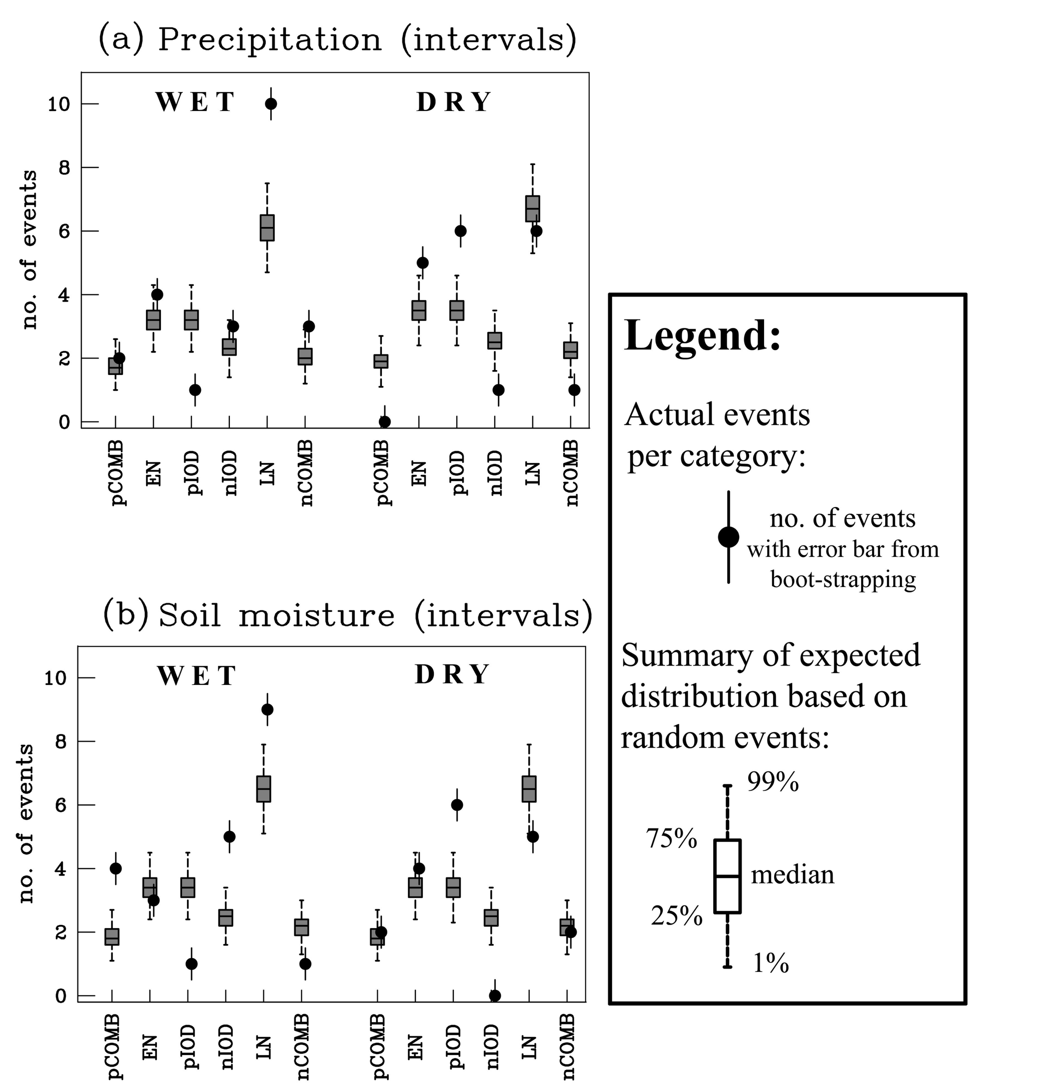

Figure 7: Circles (with corresponding boot strapped error bars) indicate the actual number of events in the given ENSO–IOD category that are associated with wet and dry conditions based on (a) precipitation and (b) lower-layer soil moisture over the MDB for the period 1900–2006. Dry and wet conditions are dependent on upper and lower intervals, respectively. To determine whether the event frequency is unusual, for each category, a boot strapping technique is used to generate an expected distribution based on random events using all years. The box-and-whiskers plot summarizes this expected distribution. If the error bar of the actual event does not overlap with the box or whisker, then the number of event is significantly different from a sample based on all years at the 98% confidence level. From Ummenhofer, C. C., A. S. Gupta, P. R. Briggs, M. H. England, P. C. McIntosh, G. A. Meyers, M. J. Pook, M. R. Raupach, and J. S. Risbey, 2011: Indian and Pacific Ocean influences on southeast Australian drought and soil moisture. Journal of Climate, 24, 1313-1336. Figure 14.

Science Steering Committee:
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