eWater CRC

Ms Jeanette Radcliffe
Committee Secretary
Senate Standing Committee on
Rural and Regional Affairs and Transport
PO Box 6100
Parliament House ACT 2600

Email: rrat.sen@aph.gov.au

Dear Ms Radcliffe,

Submission on Climate Change and the Australian Agricultural Sector
(Please note that this submission has been forwarded electronically to the above email address, with the original sent by mail)

I would like to thank you for the invitation to the eWater CRC to provide a submission to the Senate Standing Committee in relation to Climate Change and the Australian Agricultural Sector.

Both myself and my colleagues from eWater CRC would be happy to meet with the Committee to discuss the submission, or to provide further, more detailed, written information.

In the first instance all enquiries should be directed to myself via:

Email: gary.jones@ewatercrc.com.au
Phone: 02 6201 5167

Yours sincerely,

Prof Gary Jones
Chief Executive

Climate Change and the Australian Agricultural Sector

Submission to the Standing Committee on Rural and Regional Affairs and Transport

by eWater Cooperative Research Centre

8 February 2008

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Acknowledgements

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If quoting from this document, please acknowledge eWater CRC as the source.

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Our Submission

The eWater CRC is at the forefront of Australian scientific research into the potential effects of climate change on water and vegetation resources in agricultural landscapes, as well as on rivers, wetlands and urban water systems. The CRC has the scientific capacity to provide input into this enquiry on issues relating to future water availability in agricultural catchments and how agricultural vegetation is likely to respond to changing climatic conditions. Our definition of agriculture covers intensive irrigation systems, rain-fed broad-acre cropping and grazing farms, and extensive grazing system.

Our submission raises a number of scientific issues that we believe will be of importance in the Committee's deliberations.

Changes in the availability of water will determine how agricultural productivity will be affected by climate change.

Among all the climatic variables that may change over time, changes in precipitation are by far the most important in Australia's production systems. Retrospective trends of precipitation received in the last decades show that southern Australia is receiving less and northern Australia more precipitation. This trend is also seen in a variety of prospective climate models.

The relationship between rainfall and water availability is not simple or straight-forward

A decrease in catchment precipitation of 10% may lead to a decrease in catchment runoff in the order of 20% to 30%, due to complicated non-linear relationships between the factors. For cropping systems, the effects of changes in the seasonality of rainfall can be just as important as changes in overall (annual) precipitation (see Appendix A and B). Atmospheric evaporative demand (as measured by pan evaporation) is decreasing; this is primarily driven by a widespread reduction of wind speed for the majority of the Australian continent (see Appendix C). Consequently, past and future analysis of agricultural water availability needs to include assessments of precipitation and all variables known to physically govern catchment run-off (soil type, vegetation, slope, etc) and evaporation rates (i.e. radiation, humidity, wind speed, air temperature and vegetation attributes).

Rising CO_2 levels are already affecting vegetation productivity and will increasingly do so.

The effect of rising atmospheric CO_2 concentrations on vegetation growth in agricultural zones, generally, is to increase vegetation productivity for a given amount of available water (i.e. precipitation). This 'CO_2-fertilisation' effect will go some way to counteracting decreases in productivity if precipitation decreases over time. This effect is already evident in satellite imagery, which show that increases in vegetation cover have occurred over the past 2-3 decades, sometimes even in places where precipitation has declined.

The effect of climate change on vegetation will be variable.

The response of vegetation to climatic changes will not be uniform but will vary depending on vegetation type, local contexts and how the climate changes. There are no simple, generic rules about how vegetation will change. There is some evidence indicating that enhanced CO_2 concentration will increase the productivity of long-lived, deep-rooted species (e.g., perennial vegetation) more than short-lived species (e.g., annual grasses and crops). Potential implications of this are that tree-based cropping systems may become relatively more productive than current, and that woody weed control may become increasingly important.

Introducing eWater

eWater CRC is a cooperative joint venture which is working across Victoria, NSW, Queensland, South Australia and ACT to support the ecologically and economically sustainable use of water and river systems. With a core of collaborative research in hydrology, ecology and related disciplines, we are building the next generation of forecasting and decision tools for the water management industry.

eWater's tools, and research are particularly relevant to those who are involved in managing all or part of rivers, water supplies, wetlands, catchment runoff and salinity, urban waters, monitoring programs or catchment restoration programs.

eWater comprises project teams made up of practical natural resource managers, scientists, researchers and modellers from our partner organisations. One third of the teams are in the early stages of developing the eWater tools. Most of the rest are researching the underlying science needed for the tools. And as well, a few teams are researching uncertainty, risk, and emerging issues such as the effects of climate change, and one group is developing water-education courses that can be studied via the web.

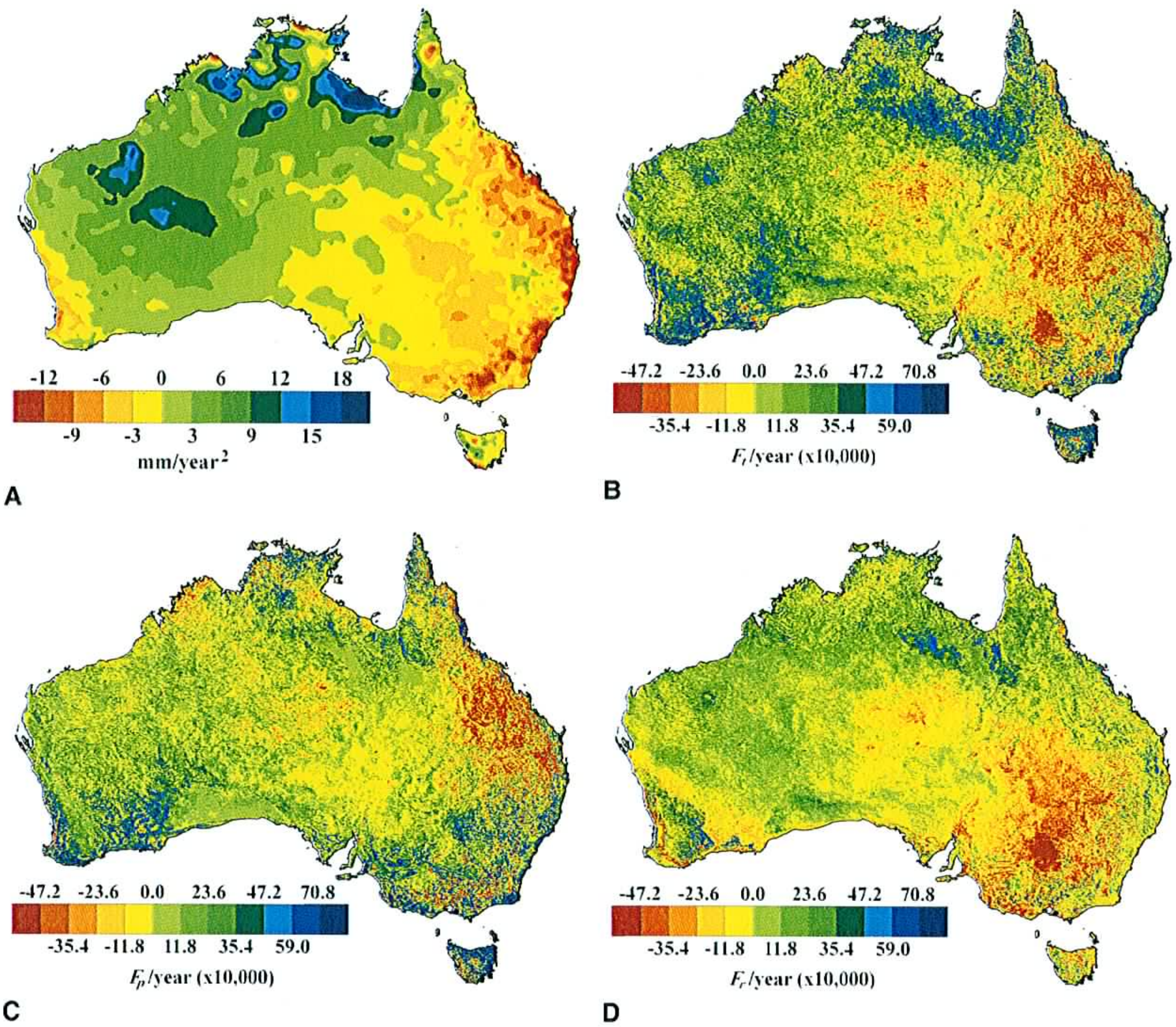
Some eWater products are currently being tested in 'Application Projects'. These products were initiated during the days of our forerunners, the CRC for Catchment Hydrology and the CRC for Freshwater Ecology, which ran for 12–13 years each. Held in very high regard, those two CRCs merged and expanded to form eWater CRC.

Highlight outcomes of the CRC's work to date include:

- Australian Water Resources assessment (wetlands) (2005)
- Developed Australian Benchmark tool for simulating and designing urban stormwater systems (MUSIC)
- Living Murray environmental flows program
- Snapshot of the Murray-Darling Basin water quality
- the Cap on MDB water extractions — environmental issues.

eWater is led by Chief Executive Professor Gary Jones and a small executive management team, and is governed by a nine-member Board chaired by Mr Don Blackmore, formerly Chief Executive of the Murray-Darling Basin Commission.

APPENDIX A. Annual Trends in Australian Precipitation and Vegetation Cover, 1981-2006.



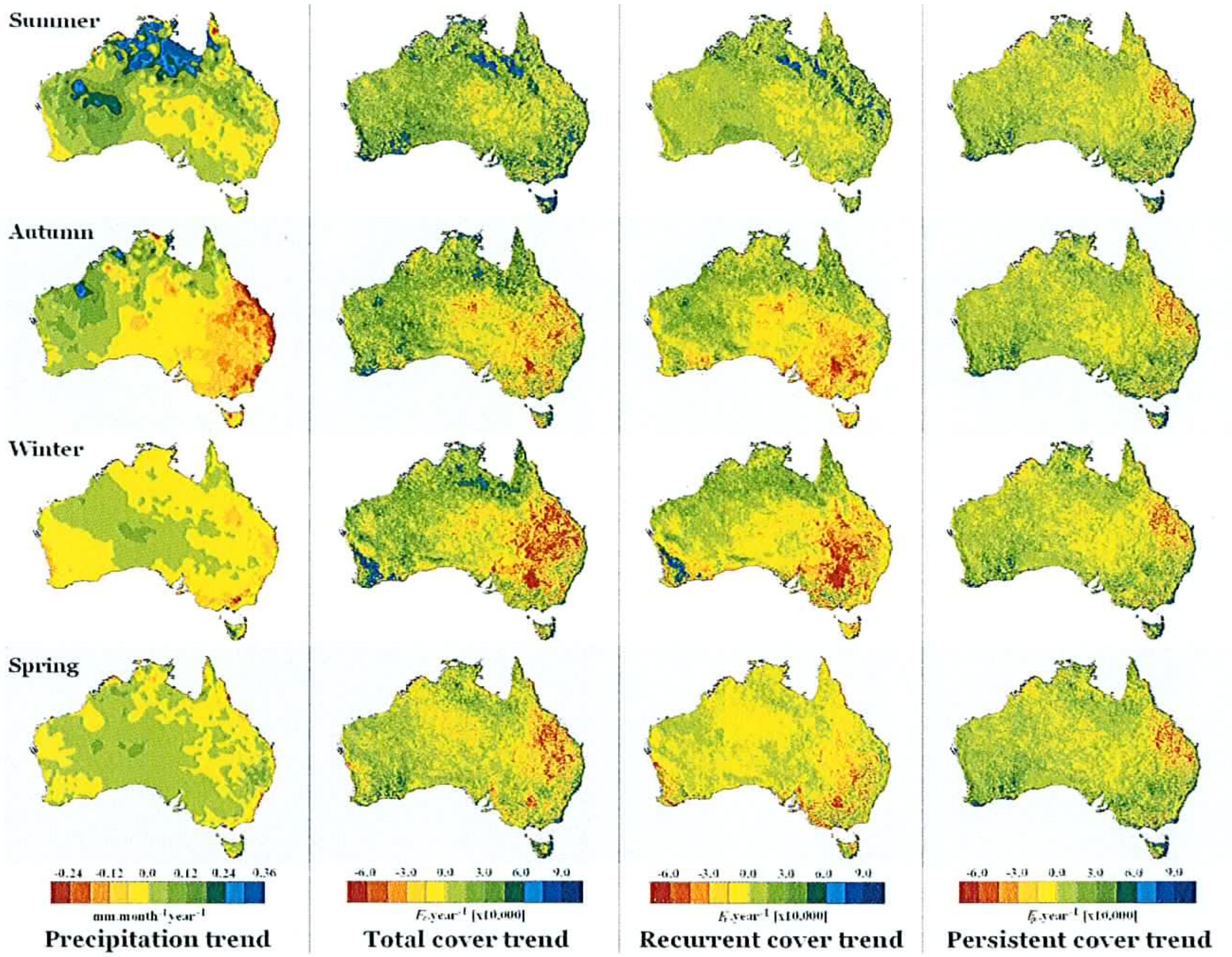
The above figure shows the geographic distributions of annual trends in precipitation (*P*) and vegetation cover (*F*) from 1981-2006. In plot A are the yearly trends in *P*. The Australian average annual trend in *P* is 1.28 mm/yr^2 (note that changes in *P* are distributed unevenly across the county). Plots B, C, and D contain yearly trends in total (F_t), persistent (F_p), and recurrent (F_r) vegetation cover, respectively. The Australian average annual trend in F_t is 0.0007/yr (up 7% over the 26 year period), in F_p is 0.0010/yr (up 21% again from the 1981 baseline), and in F_r is -0.0003/yr (down 7% from the baseline).

Vegetation cover here has been derived from satellite imagery. It is measured as fractional cover and ranges between 0 and 1.00. Fractional cover is closely related to sunlight absorption, transpiration rates, and vegetation productivity. Persistent cover is the component of total cover that originates from species that are active year-round and that display relatively little seasonal variation in canopy structure. Recurrent cover is the component of total cover that originates from species that operate in continuous (often annual) cycles of activity and dormancy. Persistent vegetation approximately equates to non-deciduous perennial vegetation, and recurrent vegetation approximately equates to annual, deciduous, and ephemeral vegetation. In cropping systems, recurrent cover represents annual crops.

The observed trends in vegetation cover, and particularly F_t, are primarily responses to changes in total precipitation. Within this overall response however, the regional patterns and the differential responses of F_p and F_r are further determined by: 1) changes in the seasonality of precipitation; 2) which functional vegetation type (e.g., persistent vs. recurrent) is dominant to start with; 3) the restrictions imposed by land use on which functional types are free to change; and 4) localised topographic and soil factors.

Source: Donohue, R.J., McVicar, T.R. and Roderick, M.L. (2008) Climate-related changes in Australian vegetation cover as inferred from satellite observations for 1981-2006. Global Change Biology. (*In Preparation*).

APPENDIX B. Seasonal Trends in Australian Precipitation and Vegetation Cover, 1981-2006.

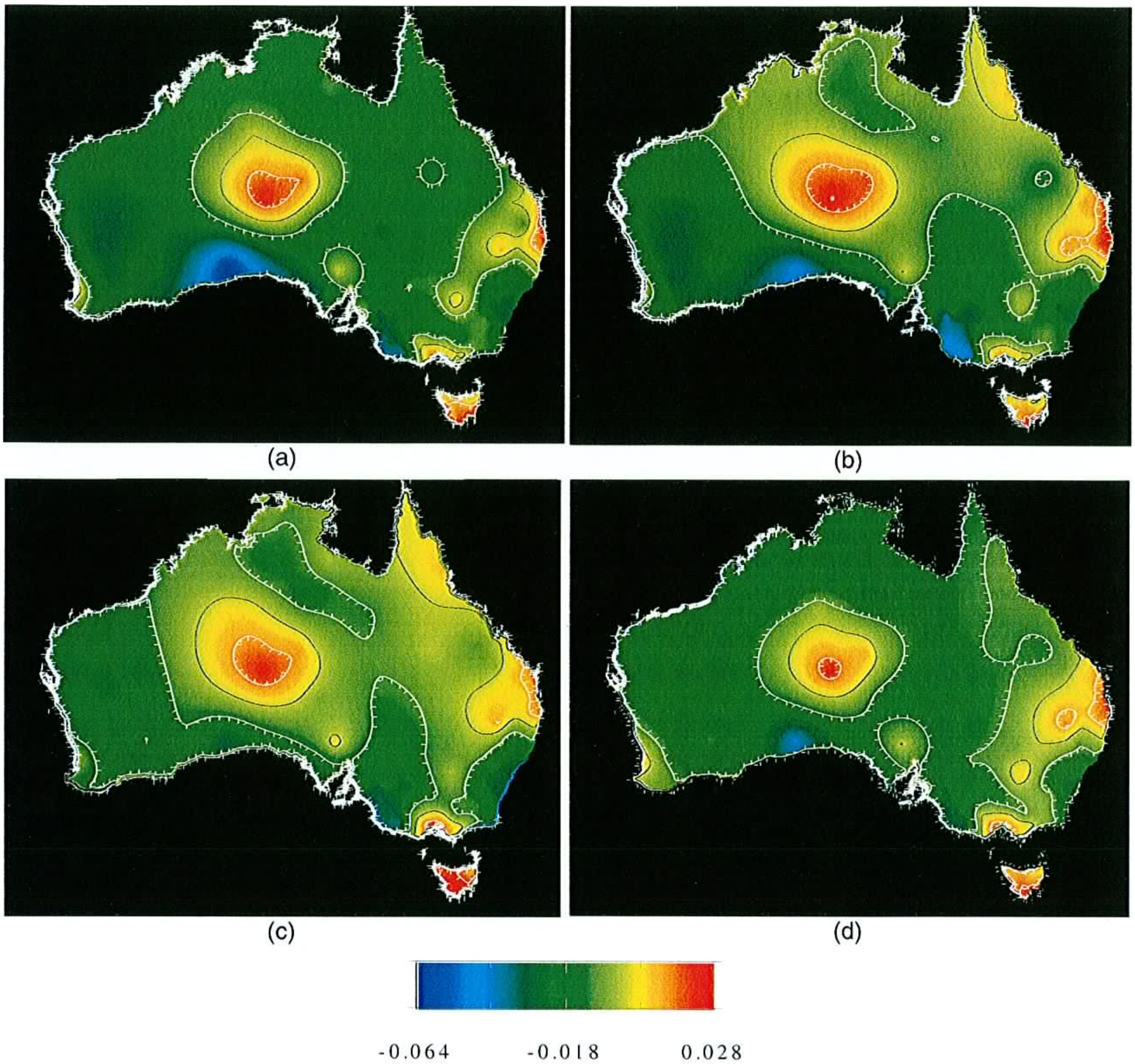


The seasonal trends in precipitation (*P*) and in total (F_t), persistent (F_p), and recurrent (F_r) vegetation cover are shown in the above figure (see Appendix A for explanations of these terms). These trends are for the period 1981-2006 and have been derived from meteorological stations for *P* and from satellite imagery for *F*. Some noteworthy points are:

- widespread, and sometimes substantial, increases in summer rainfall—especially in the north and west of the continent;
- considerable declines in autumn rainfall in the east but increases in the west;
- generally small changes in winter and spring rainfall;
- widespread increases in summer vegetation cover, even throughout arid interior;
- decreases in autumn and winter total and recurrent cover in eastern Australia in response to lower autumn rainfall;
- substantial increases in total and recurrent cover in the Western Australian wheat belt in response to higher autumn rainfall there; and
- generally uniform changes in persistent cover across the seasons, with a general increase across the southern half of the continent.

Source: Donohue, R.J., McVicar, T.R. and Roderick, M.L. (2008) Climate-related changes in Australian vegetation cover as inferred from satellite observations for 1981-2006. Global Change Biology. (*In Preparation*).

APPENDIX C. Seasonal Trends in Australian Wind Speed, 1975-2006.



The above figure shows the seasonal trends of wind speed (*u*) for: (a) summer (DJF); (b) autumn (MAM); (c) winter (JJA) and spring (SON) for 1975-2006. All units are m s^{-1} a^{-1}; and the black line shows where the trend is 0.0 m s^{-1} a^{-1} (i.e., where it changes between positive and negative). The white lines show were the trends change from being non-significant to significant at the P = 0.05 level, with the white barbs being in the direction of significance.

Using all available *u* observations from terrestrial anemometers over Australia from 1975-2006, we generated interpolated surfaces of *u*. Averaging over all Australia the seasonal *u* trend ranges from -0.006 m s^{-1} a^{-1} to -0.013 m s^{-1} a^{-1}; with the annual trend being -0.009 m s^{-1} a^{-1}. Annually over 57% of the Australian land-surface exhibits *u* trends that are negative and significant (at the P = 0.05 level), with the less than 2.1% of Australia having positive and significant *u* trends. The *u* trends calculated here show good agreement with site-level data from 41 stations across Australia (annual r^2 value is 0.51), and these trends are in agreement with a range of other *u* trends reported from other global mid-latitude locations.

Source: McVicar, T.R., Van Niel, T.G., Li, L.T., Roderick, M.L., Donohue, R.J. and Rayner, D.P. (2008) Wind speed climatology and trends for Australia, 1975-2006: the stilling phenomenon. Geophysical Research Letters (*In Preparation*).