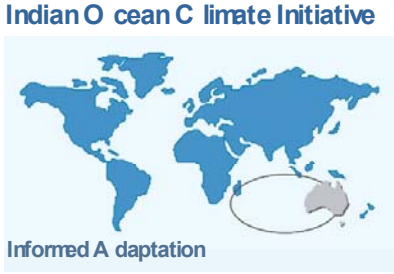
LARGE WEATHER PATTERNS AND CLIMATE TREND - PATH TO BETTER UNDERSTANDING



IOCIP hears reports on Phase1research - A program foundation

Phase1 of IOCI's current research program ends in December. It is creating a new base from which to explore the program's key questions:

- How is our climate changing?
- What is causing the change?
- What is our climate now?

The research phase beginning in 2005 will explore changes in large scale weather systems affecting the South -West. This will give a powerful means to study trends and causes and to interpret climate model results.

Phase 1 therefore, is examining and selecting various descriptors of large scale weather patterns suitable for study as potential indicators of a changing climate regime.

Phase 1 has also been testing analytical tools for use in the next phase of study. This testing has included high resolution climate models, statistical methodology and mapping techniques.

IOCIP 19 showed that a good foundation is in place to pursue the future research plan. ⌘

Global circulation change and rainfall decrease

IOCIP 19 presented a diversity of material on global circulation which reinforced the association between the 70s changes in circulation and observed change of South West rainfall regime.

The meeting also heard several new insights into these changes (see inset at left), and possible causes. Natural variability (below) and the Enhanced Greenhouse Effect (next page) remain as likely prime contributors through impact on the large scale circulation.

Local influence from land clearing (below) is not discounted. ⌘

Southward shift of the upper atmosphere's westerly jetstream over southern Australia

Dr. Carsten Frederiksen reported to IOCIP 19 on comparative studies of July's atmospheric circulation in the southern hemisphere before and after the reduction in South West mean rainfall.

Comparisons for the periods 1949-68 and 1975-94 identified significant changes. These included a southward shift and a 20 per cent reduction in strength of the westerly jetstream in the upper atmosphere over southern Australia.

The observed circulation changes are associated with a reduction in the north-south temperature gradient across the area. In this respect they appear to be consistent with global warming.

The changes are important. The strength of the temperature gradient, and of the jetstream, are major drivers in development of the mid-latitude low-pressure disturbances responsible for much of SWWA's winter rainfall.

Studies for IOCI by Frederiksen and Frederiksen have found that cyclogenesis, i.e. the development of such low pressure systems, was around 33 per cent weaker over the southern Australian region in 1975-94 compared with 1949-68. This is consistent with the reduction in rainfall over SWWA.

The studies also found that the centre of the dominant storm track had shifted eastward, downstream from WA. ⌘

Multi-decadal Natural Variability

Phase 1 studies with the CSIRO Mk 3 model have revealed mechanisms by which the Southern Ocean can generate natural feedbacks and contribute to sustained dry trends or runs such as observed currently in SWWA. Models indicated that such runs could last over periods of 20 to 70 years. ⌘

Land Clearing

Professor Andy Pitman of Macquarie University has been researching the potential climate impacts of land clearing. He is in dialogue with IOCI.

Having modelled the potential impact of the full post-settlement clearing Pitman et al conclude -

We find strong evidence that observed changes in rainfall and temperature over SWWA can be partially explained by the large-scale land clearing change.

IOCI Stage 1 reported that land clearing may be a factor and saw need for such research as Prof. Pitman's. However, IOCIP is of the opinion that evidence shows the main causes of observed change are related to changes in global circulation since the 70s. ⌘

New Greenhouse Projections

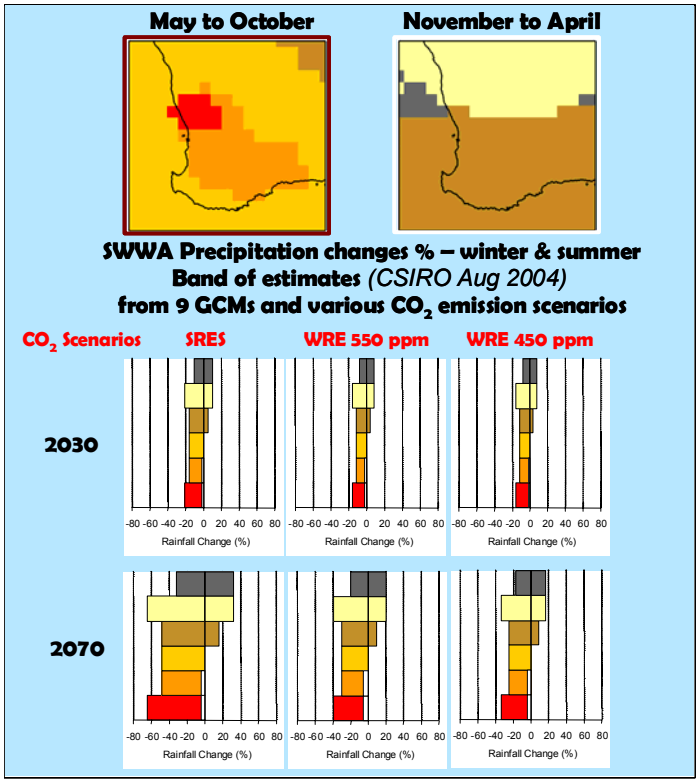
At IOCIP 19, CSIRO tabled updated model projections of South West rainfall change under alternative scenarios of future carbon dioxide emissions.

From 19 international global and regional climate models, 9 were selected as best representing present climate patterns.

These simulations give results based on SRES emission scenarios and also on optimistic WRE scenarios (450ppm and 550 ppm stabilisation level of CO_2 in atmosphere), all drawn from the IPCC's *Third Assessment Report, 2001.*

The updated projections, for all scenarios, indicate a decrease in winter rain across the region.

This work will be discussed more fully and precisely in December's Phase 1 report. ⌘



Water agencies and AGO study runoff change

On Day 2 of IOCIP19 the water agencies, CSIRO and AGO convened a workshop to review results of an application of IOCI research in study of future impacts of climate change on water yield of the Stirling catchment.

The prime intent of this workshop was to - *"Progress scoping of hydro-climate research required in SW WA "*

Workshop outcomes, examining an integrated science response, will be reported elsewhere.

Here we report Dr. Bryson Bates on the subject of managing in uncertainty.

-Technical Corner -

Importance of Winds

Investigations were undertaken to test the validity of coarse and fine scale representations of rainfall in climate models to be used in Phase 2.

These studies showed that sea surface temperatures, alone, provided insufficient forcing to reproduce past rainfall fluctuations, and changes in the pattern of winds are important.

When past observed winds were imposed upon a fine-scale climate model, it was able to reproduce both the year-to-year variability and the long-term decline in winter rainfall.

This was an important outcome for future IOCI research methodology using fine-scale climate models. It confirmed the importance of adequately simulating the large-scale circulation before attempting to simulate rainfall and also aligns with past findings from statistical downscaling research of IOCI. ⌘

How significant is Antarctic Sea Ice?

Dr. Ian Smith presented various reconstructions of the historic extent of Antarctic sea ice over the period before and after the S/West rainfall decrease.

Dr. Smith suggested that an apparently large sea-ice decline after 1950 may have been responsible, in part, for the change in large-scale atmospheric circulation and winds that accompanied S/West rainfall decline. He also suggested that the sparse observations of actual sea ice extent prior to 1973 may have hampered attempts to simulate the climate at high latitudes before this time using only sea surface temperatures.

Given the above link between winds and rainfall, the role of sea ice warrants further investigation. ⌘

Checking sensitivities to data inaccuracies

At IOCIP 19 there was recognition that many projects had of necessity made use of re-analysis data, whether NCEP or the more recent ERA40 data.

IOCIP19 resolved that the Phase 1 report will include brief review of data related limitations of research findings. ⌘

New tools and rejected tools

The Phase 1 Report will report a wider range of tools and methodologies than covered in this bulletin.

Reporting will cover unsuccessful as well as successful approaches. ⌘

Dr Bates opened with this quotation:

"Our knowledge of the climate system will ALWAYS suffer from significant uncertainty because of its open, complex, and heterogeneous character and the long time scales involved."

von Storch & Stehr

He listed four classes of uncertainty-

- Forcing uncertainty
- Model uncertainty
- Parameter uncertainty
- Inherent uncertainty

Dr. Bates proposed use of scenario analysis in dealing with uncertainty and listed the following benefits of such analysis –

reveal vulnerabilities to climate change;

identify need for contingency plans;

focus attention on decision points where alternative actions can be taken to prevent or mitigate undesirable events or facilitate favourable outcomes;

develop policies and plans that are robust across a range of plausible futures;

build adaptive capacity for coping with surprises (low probability, high impact);

integrate various kinds of data in a consistent manner (e.g., hydro-climatic data, land-cover history, etc);

increase awareness of environmental uncertainties (what don't we know?);

accelerate organizational learning by exposing biased view-points and entrenched convictions. ⌘

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