Indian Ocean Climate Initiative

Informed Adaptation

How our temperatures have changed

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Climate Note 2/05 (August) in a series outlining observed climate changes or variations over recent decades in south-west Western Australia.

Observed changes since 1910

The annual mean temperature averaged over all of WA has increased by a little over 0.8°C since 1910, as indicated by National Climate Centre analyses such as those shown in this document. This rise compares with a global average increase of 0.6°C (plus or minus 0.2°C) over the 20th century, as determined by the Intergovernmental Panel on Climate Change (IPCC) in 2001.

Figure 1(a) shows the areas where the rise has been strongest, in the west of the State and in the east Kimberley.

Daily minimum temperatures have increased by slightly more than the maxima overall, about 0.9°C compared with 0.7°C. There are some areas, however, where the maxima have shown the stronger rise.

Observed changes since 1950

As indicated in Figure 2, most of the temperature rise has occurred since 1950. The statewide average rate of warming from 1950-2004 has been almost 0.14°C per decade, even though some areas in the north-east have cooled over this period (Figure 1(b)). The maxima have increased by almost as much as the minima.

Figures 3 and 4 overleaf show the seasonal trends of maximum and minimum temperature. Winter and spring have experienced the most warming and summer the least. In fact summer maxima have decreased since 1950 over much of the State. Some areas near the south coast have seen decreasing maxima and increasing minima in all four seasons.

Summary

Temperatures in WA have increased since 1910 by about 0.8°C, close to the global average increase. Most of that warming has occurred since 1950. Daily minimum temperatures have increased by more than the maxima. The warming has been stronger in some parts of the state than in others, while some areas in the north-east have even cooled slightly over more recent decades as rainfall has increased. Averaged over the State, the warming since 1950 has been greatest in winter and spring and least in summer. There is strong evidence that the changes have been due to a combination of natural and human causes. Prominent among the latter is the enhanced greenhouse effect, which has also affected prevailing wind directions, cloud cover and rainfall. Model projections for a future with increased greenhouse gas concentrations indicate accelerated temperature rises which would have much stronger impacts than those experienced to date.

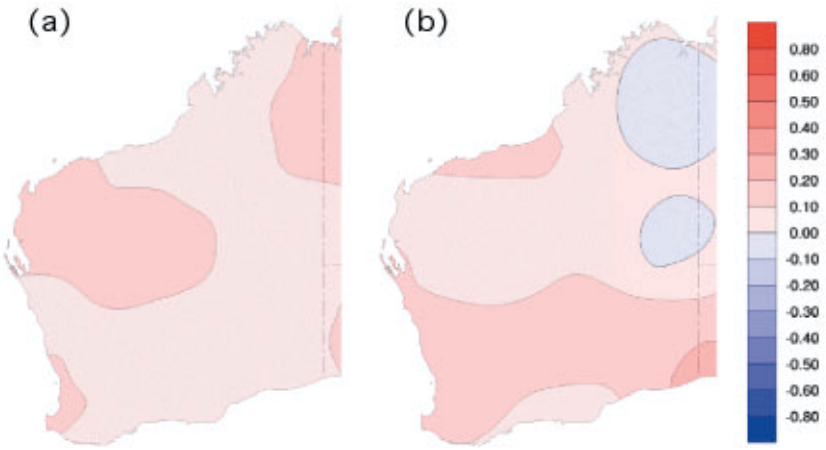

Figure 1: Trend in mean temperature (°C/10yrs) (a) 1910-2004 (b) 1950-2004.

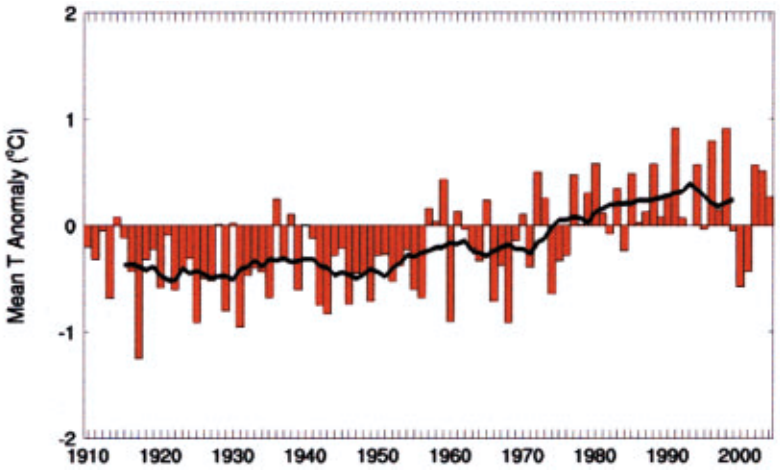

Figure 2: WA's annual mean temperature anomaly (base 1961-90).

What caused the changes?

The IPCC indicated in its Third Assessment Report (2001) that the global warming over the 20th century was very unlikely to have been entirely natural in origin. Model simulations can explain most of the post-1950 warming as the result of increased greenhouse gas concentrations, partly countered by greater concentrations of sulphate aerosols, both due to human activities.

Over WA, the enhanced greenhouse effect is most likely responsible for much of the observed warming. Natural causes have also contributed to the temperature changes, while other human influences such as changes in land cover may have played a part in some areas.

Temperature changes on a local scale can easily result from human activities in the area. Urbanisation, for example, tends to warm the immediate vicinity through a variety of physical changes affecting the energy balance near the surface. In calculating average temperature changes over a wider area such as WA, care has been taken to avoid any biases from urban warming, by basing the analyses on data largely from non-urban stations with long periods of high-quality record.

The pattern observed over WA during the more recent period, with cooling in the north-east and reduced maxima in areas near the south coast, is consistent with the observed rainfall increase in the north and altered wind patterns in the south reflecting the increased influence of high pressure systems south of the State. These changes themselves are likely to be the result of both natural variability and human activities and are the subject of continuing research. Atmospheric circulation patterns are known to have altered significantly in recent decades over much of the globe.

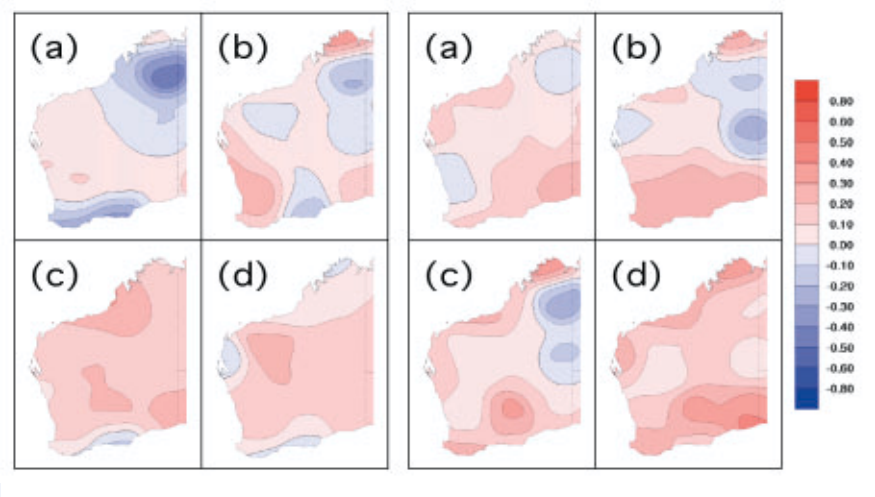

Figure 3: Trend in mean daily maximum temperature 1950-2004 (°C/10 years) (a) summer; (b) autumn; (c) winter; (d) spring.

Figure 4: Trend in mean daily minimum temperature 1950-2004 (°C/10 years) (a) summer; (b) autumn; (c) winter; (d) spring.

What are the implications?

The effects of temperature changes in WA to date have been partly obscured by the more obvious impacts of changing rainfall. Nonetheless, temperature changes have contributed to the reduction in water supplies in the south-west, while the increasing incidence of very hot days and the decreasing incidence of frosts have already had biological consequences of commercial and environmental significance.

Importantly, the changes so far remind us that our climate is not stationary and we as a community need to incorporate this into our planning decisions. Much greater impacts are to be expected from larger temperature increases.

What can we say about the future?

Natural temperature variability will continue, superimposed on the long-term trend that results from human activities.

Model-based projections with increasing greenhouse gas concentrations indicate a trend of accelerated temperature rises over most of the globe. The projected rises span a broad range, due to shortcomings in climate modelling and uncertainties about future human behaviour that will influence the composition of the atmosphere.

Projections on a regional scale carry greater uncertainty than the global projections. CSIRO Atmospheric Research in 2001 produced a set of projected variations across Australia for a range of standard (SRES) emission scenarios. These show temperature rises averaging between 0.1 and 0.85°C per decade from 1990 to 2070 over parts of north-west WA and from about 0.1 to 0.65°C per decade in the south and in areas nearer the coast. The strongest projected rises are in summer.

For further information

The IOCI website www.ioci.org.au has additional material and links. For further information and updates on the temperature trend analyses follow the www.bom.gov.au menu. For detail and updates on future projections see www.dar.csiro.au. Visit www.ipcc.ch for a more global view.

IOCI - A partnership between the WA Government, CSIRO and the Bureau of Meteorology, supporting informed decision-making on climate variability and change in WA. (c/- Department of Environment)
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