TRENDS IN EXTREME WEATHER EVENTS: AUSTRALIA AND GLOBALLY, PAST AND FUTURE

SUMMARY

In recent years there has been an almost global increase in extreme high maximum temperatures and extreme precipitation, and a decrease in extreme low minimum temperatures. In Australia disaster events have increased, notably severe storms and floods. Tropical cyclones may have become more severe, however records since the satellite era are still too short to determine whether their frequency has changed. Storms north and south of the tropics (extra-tropical) have generally increased in frequency globally and in Australia.

Most climate models indicate that in many places global warming is likely to increase the frequency and duration of extreme events such as heavy rains, droughts and floods. In future, summer heatwaves are likely to become more common in Europe and by 2030, most of Australia is expected to have 10 to 50 per cent more summer days over 35°C, and 20 to 80 per cent fewer frosts. Tropical cyclone frequency may change in some regions and peak winds and rainfall rates may increase. The combined influence of increasing sea-level rise and stronger tropical cyclones could result in coastal flooding over much larger areas in the tropics.

New record extreme events occur each year somewhere in the world, but the World Meteorology Organization has reported an increase in the number of extremes in recent years (WMO, 2003). There has been an almost global increase in extreme high maximum temperatures and a decrease in extreme low minimum temperatures, and extreme precipitation has increased since at least 1946 (Frich *et al*., 2002).

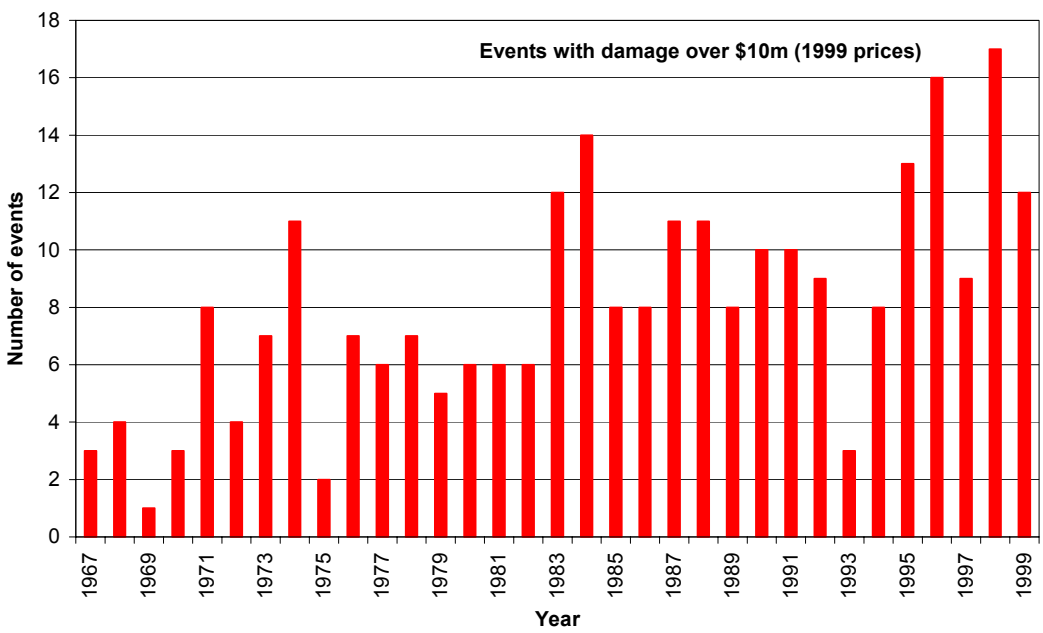

Figure 1: Number of natural disasters in Australia with damage over $10 million (1999 prices) from 1967-1999 (BTE, 2001).

In Australia since the 1960s, there has been a significant increase in the total number of disaster events, notably severe storms and floods (Figure 1). Generally the frequency of extreme hot events (e.g. hot days, hot nights, heat waves) has increased in Australia since 1957, and the frequency of extreme cold events (e.g. cold days, frosts, cold snaps) has decreased (Collins *et al*. 2000).

Tropical cyclones may have become more severe but, because the background trend is weak compared to the year-to-year variability, it is not clear whether the number has increased (IPCC, 2001; Munich Reinsurance, 2004). The number of tropical cyclones shows no significant trend in the Southern Hemisphere since 1969 (Kuleshov, 2003), and in the Australian region there has been little change in cyclone numbers or intensities since 1981, when data are most reliable. Extra-tropical storms have generally increased in frequency globally and in Australia (IPCC 2001, Lim and Simmonds 2002). From 1910 to the mid- to late-1990s, heavy rainfall events have increased in areas of eastern Australia but decreased in the southwest (Hennessy *et al.* 1999, Haylock and Nicholls 2000).

Projecting future weather extremes is difficult due to their small spatial and temporal scale, but simulations of extreme temperature events are possible and regional climate models can simulate tropical cyclones. Most climate models indicate that in many places global warming is likely to increase the frequency and duration of extreme events such as heavy rains, droughts and floods. Summer heatwaves are likely to become more common in Europe (Schär *et al*., 2004) and by 2030, most of Australia may have 10 to 50 per cent more summer days over 35°C, and 20 to 80 per cent fewer frosts (CSIRO, 2001).

Tropical cyclone frequency may change in some regions and peak winds and rainfall rates may increase (IPCC, 2001). Tropical cyclone rainfall rates near Australia may increase, but there is uncertainty about location changes (Walsh and Ryan, 2000).

Climate models suggest more intense storms and fewer weak storms in the northern hemisphere winter (Carnell and Senior, 1998). Increases in the intensity of extreme rainfall are simulated where average rainfall increases, or decreases slightly (IPCC, 2001). Projections of extreme winds in the Australian region suggest increases in winter off the southeast coast and increases in summer off the northwest shelf, and mean winds generally increasing across the continent in summer and increasing over the northern half of the continent in winter (Hennessy *et al*., 2004, McInnes personal communication).

The combined influence of increasing sea-level rise and stronger tropical cyclones could result in coastal flooding over much larger areas in the tropics. The community is becoming more vulnerable to flooding due to increasing coastal population (Abbs and McInnes, in preparation).

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