

Correspondence

The Editor
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Dear Sir,

Recent trends in tropical cyclone maximum intensity data in the Australian region

The frequency distribution of tropical cyclone maximum intensity, or more specifically minimum central pressure, is frequently employed as a basis for the assessment of the risk of cyclone-generated wind gusts or storm surge in coastal areas. Holland (1981) in a critique of the Australian region cyclone data base has noted a sharp decline in cyclone central pressure in the decade up to 1979. Cyclone central pressure data during the period July 1959 to June 1986 have been examined in order to isolate the nature of such trends in the post-satellite era.

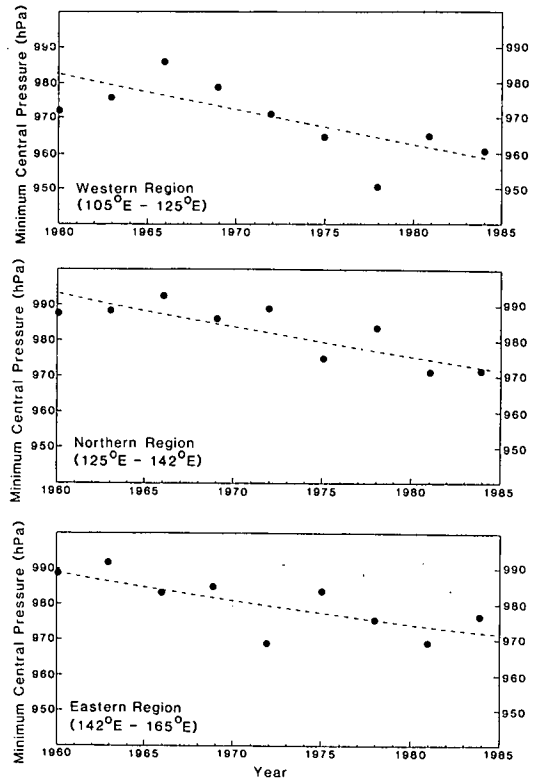
The minimum pressure allocated to each tropical cyclone in the Australian region was extracted from Lourensz (1981) up to June 1980, and from Rooney (1981), Lynch (1982), Bate (1983), Thom (1984), Kuuse (1985) and Kingston (1986) for the latter period. The data were first divided into three regional areas — Western (105° east–125° east), Northern (125° east–142° east) and Eastern (142° east–165° east). These roughly correspond to the three warning areas of responsibility except that for convenience in data extraction and to make the three areas of comparable size, all of the Gulf of Carpentaria was included in the Northern region. Discrete three-year averages were then calculated for each area.

The results are plotted in Fig. 1, where a downward trend in the average minimum central pressure is apparent in each of the three regions. A statistical test for trend (Kreyszig 1970) showed that in all three cases the null hypothesis (i.e. no trend) had to be rejected at the 5 per cent significance level. The magnitudes of the trend (as predicted by the regression or trend lines between 1960 and 1984) are -22, -19 and -18 hPa respectively for the Western, Northern and Eastern regions.

If the data in Fig. 1 were the result of direct observation then one would be compelled to attribute the downward trend in central pressure to a climatological tendency to more severe cyclones. However, this is not the case. Only rarely is cyclone central pressure directly observed in the Australian region, even when a cyclone crosses the coast. In most instances

central pressure is allocated after interpretation of satellite and/or radar data, or by extrapolation of the surface pressure field. A more plausible explanation is that improved observations networks and facilities such as the geostationary satellite plus better analysis techniques (e.g., that of Dvorak 1975) have led to the allocation of lower central pressures to tropical cyclones in the

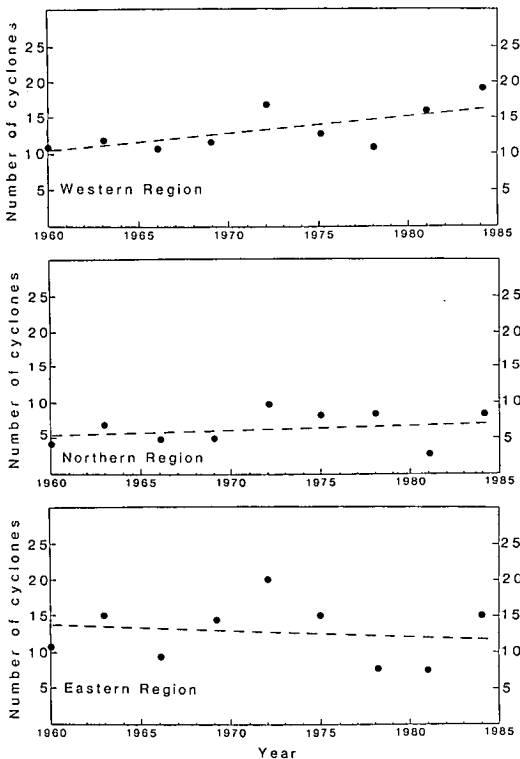
Fig. 1 Discrete three-year averages of minimum central pressure allocated to tropical cyclones in three subdivisions of the Australian region during the period July 1959 to June 1986. (Dashed lines are least squares lines of best fit.)



Australian region. Of course the possibility of some climatological contribution to the trend cannot be dismissed out of hand. However this would imply the presence of a climatological trend in atmospheric parameters controlling cyclone intensity — to prove or disprove this would require further study.

Holland (1981) noted a decrease of 10 hPa in average minimum central pressure of Australian region cyclones in the period 1969-1979 compared to those prior to 1969. He also found that cyclones with 'ground truth' observations had minimum central pressures on average about 10 hPa lower than other cyclones. This he attributed to a bias in satellite interpretation which appeared to be confined mainly to his Eastern region (east of 135°E) data. But in spite of an apparent lack of such bias in the Western region, central pressures there have continued to decline. In eight seasons since June 1979 the average minimum central

Fig. 2 Discrete three-year total numbers of tropical cyclones in three subdivisions of the Australian region during the period July 1959 to June 1986. (Dashed lines are least squares lines of best fit.)



pressure in the Western region has been 960 hPa compared to 969 hPa during the seventies.

In Fig. 2 the numbers of tropical cyclones during the same period are shown for the three regions. Only the Western region shows a statistically significant trend (positive). This is possibly due to the sparseness of data in the Indian Ocean compared to the other two basins during the early sixties when satellite observation of tropical cyclones was in its infancy. Cyclone numbers were found by Holland (1981) to have increased steadily in the forty years prior to 1975. Figure 2 indicates that the numbers curves may now have reached a plateau, an effect also evident in data presented by Nicholls (1985). It is reasonable to expect this, since the all-embracing view of the geostationary satellite makes it unlikely that any tropical cyclone will go undetected.

Whatever the cause(s), these trends should be of major concern to those using minimum pressure data as a basis for cyclone and storm surge risk assessment in northern coastal areas. Continuing biases of the magnitude indicated in Fig. 1 may be expected to have a significant effect on design wind gust or storm surge levels depending on the period of data record used.

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