

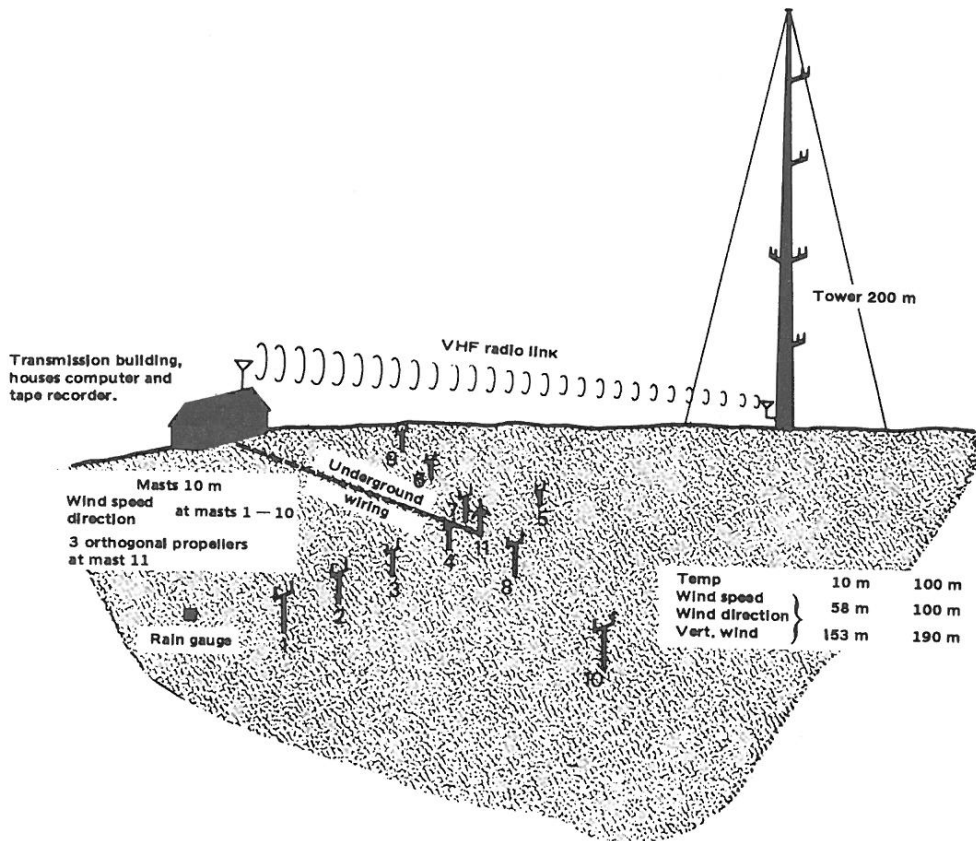
THE VERTICAL WIND SPEED PROFILE IN
THUNDERSTORM GUST FRONTS

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Introduction

Laboratory measurements of velocity profiles in density currents differ markedly from those in boundary layers. There is a velocity maximum at about one sixth the height of the layer and above this level the velocity falls away to zero at the top of the layer.

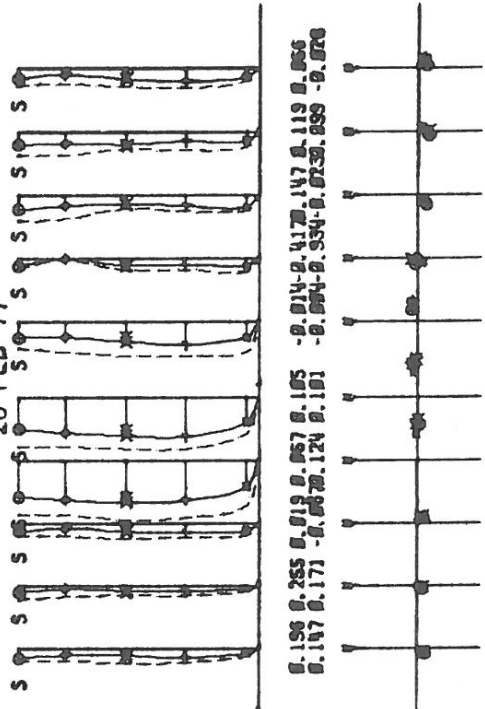
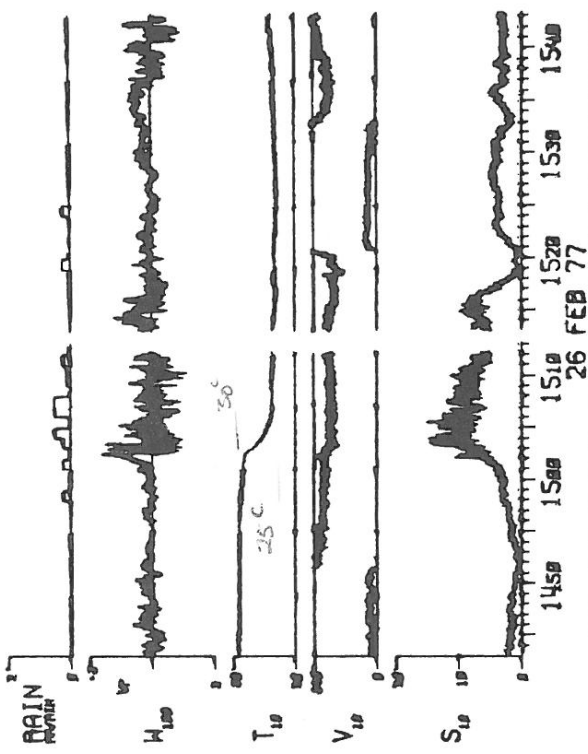
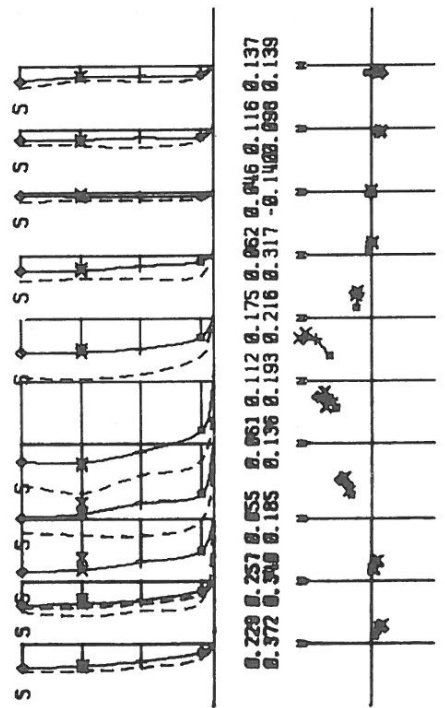
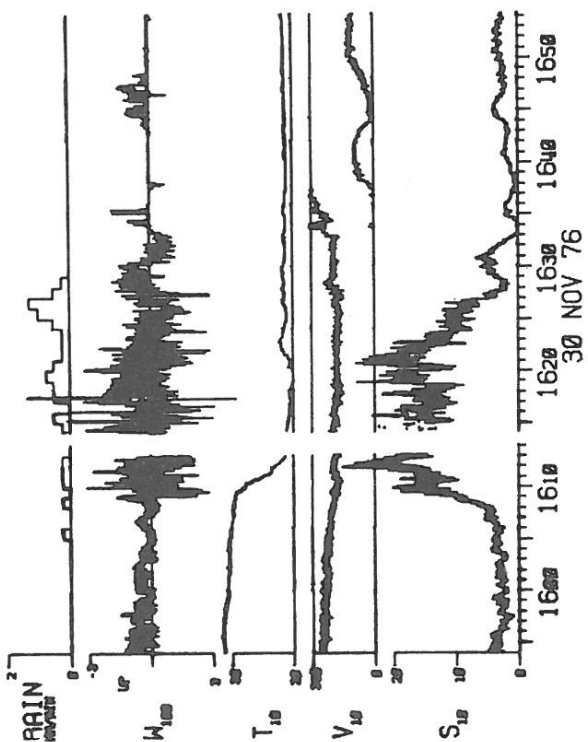
Thunderstorm gust fronts are caused by density currents in the atmosphere. Is there an atmospheric effect comparable to the velocity maxima observed in the laboratory?



Bald Hills

We obtained a number of windspeed profiles measured during the passage of gust fronts over a radio transmitting tower at Bald Hills, a suburb of Brisbane. Anemometers were installed at approximately 50 m intervals on the 200 m tower and in a 10 m horizontal T array near its base. Data were recorded at 1 second intervals on magnetic tape.

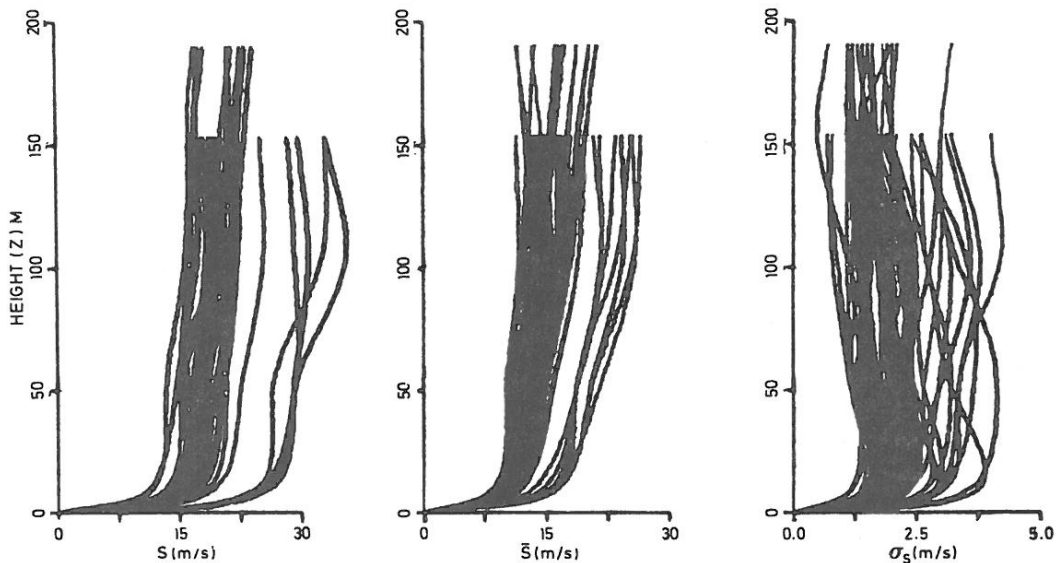
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During the 1976-77 thunderstorm season seven gust front passages were observed at Bald Hills. Time histories of some of these are shown. The velocity profiles shown are profiles of:

- (a) 6 minute mean wind speed (solid line)
- (b) 3 second peak gust observed during each six minute period (dotted line)

The peak observed 10 m gust of 26 m/s corresponds to a return period of about 4 years for the Brisbane area.

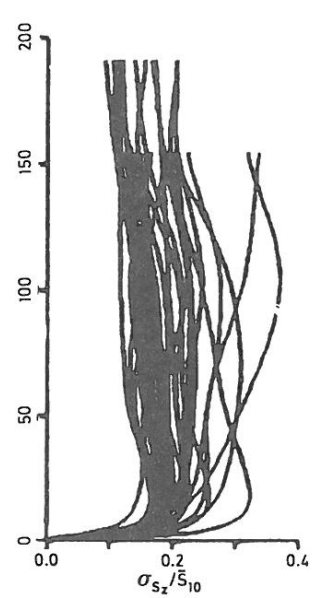
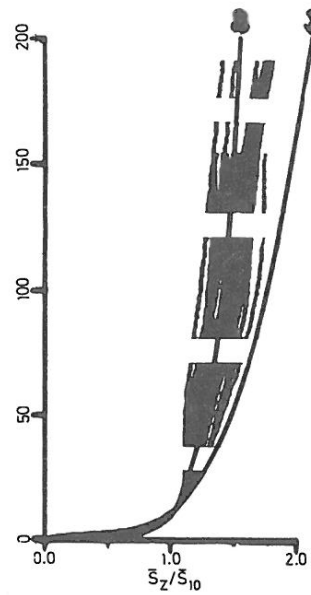
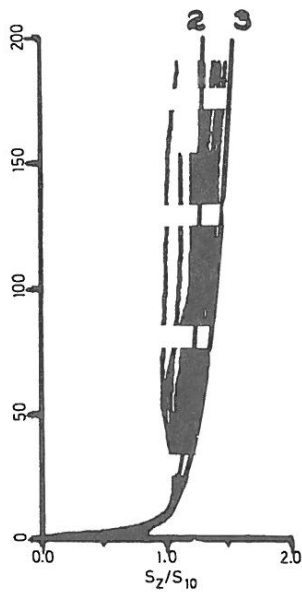
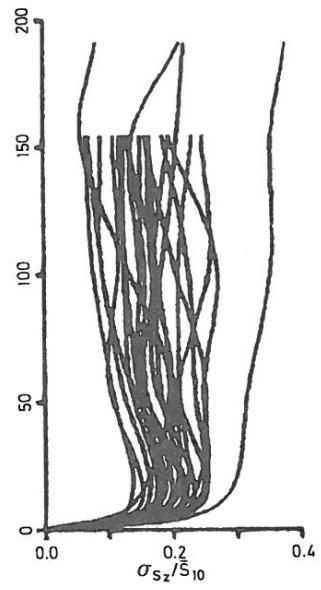
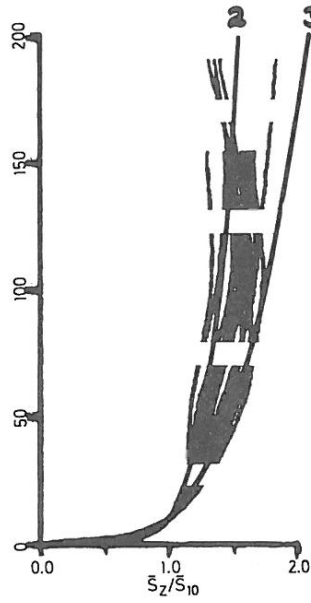
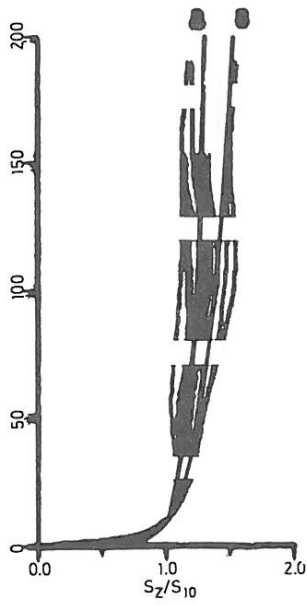


When all the stronger wind speed profiles ($\bar{S}_{10} > 8.5$ m/s) are plotted together it may be seen that the strongest winds occur in profiles with maxima at the 100 m level.

All cases when either the peak wind speed profile or the mean wind speed profile showed a maximum near the 100 m level were plotted on one graph in a non-dimensional form (i.e. divided by the speed at the 10 m level) and the remaining cases in a separate graph.

Overlaid on these two figures the design wind speed profiles for terrain categories 2 and 3. (The Bald Hills site is intermediate between these two categories).

The profiles which do not have maxima fall within the two design curves shown but some of the profiles with maxima exceed the design wind speed profile by 10 to 15% over the height range between 50 m and 150 m. This may be a significant factor in extrapolating 10 m anemometer records in areas where peak wind speeds occur in thunderstorm gust fronts.



all cases as on page 3
all divided by 10 metre level