

Correspondence

Some evidence for a mesoscale thermal circulation at The Salt Lake, New South Wales

Dear Editor,

This is a short correspondence to place on the record some results from a continuing study of a mesoscale thermal circulation at The Salt Lake, a relatively small (70 km²) dry salt lake in northwestern New South Wales (30°.05'S, 142°.08'E) (Fig. 1).

In common with other dry salt lakes in central Australia, The Salt Lake exhibits a characteristic thermal 'signature' within the overall landscape, having much cooler daytime surface temperatures and warmer nocturnal temperatures than the surrounding environment. This thermal differentiation appears to arise from albedo and thermal conductivity effects associated with the lake surface and underlying sediments. Surface radiative temperatures across The Salt Lake and the surrounding landscape determined by field and

polar orbiting (NOAA-9) satellite observations show marked variation, with the salt crust remaining up to 16K cooler than the surrounding sand country during the day and up to 8K warmer at night. That this thermal forcing can provide a horizontal pressure sufficiently strong to induce air motion is confirmed by analysis of hourly output from a network of anemographs which were established around the perimeter of The Salt Lake during a five-month period in the autumn and winter of 1986.

Plots of horizontal divergence derived from the anemograph network show an extremely regular pattern of nocturnal near-surface (height = 2.5 m) convergence (lake warm) and daytime divergence (lake cool), a pattern which is enhanced when data are stratified for anticyclonic synoptic conditions with weak regional pressure gradients (~24 per cent of total hourly observations) (Fig. 2). Calculations of near-surface vorticity using the same data set show no systematic patterns of cyclonic and anticyclonic vorticity. This is not surprising given the scale of feature being investigated.

Fig. 1 Location map of The Salt Lake, New South Wales. The positions of the anemograph sites are also shown.

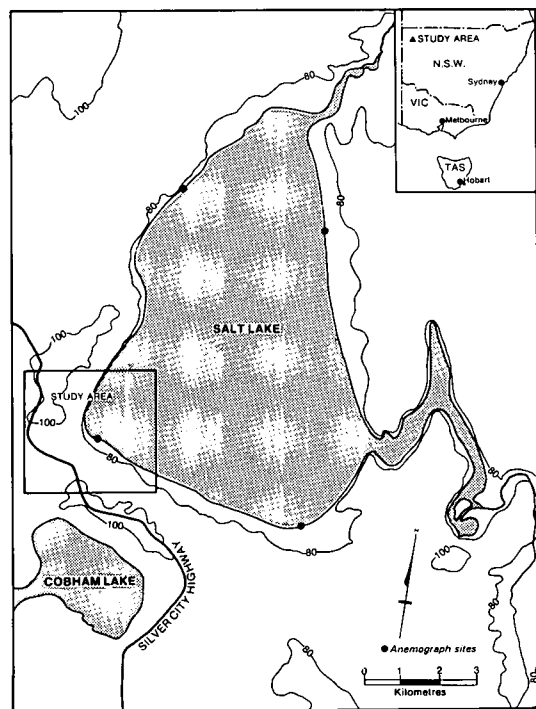


Fig. 2 Mean diurnal plot of near-surface horizontal divergence (stratified data) calculated from all anemograph sites. Hourly standard deviations are also shown.

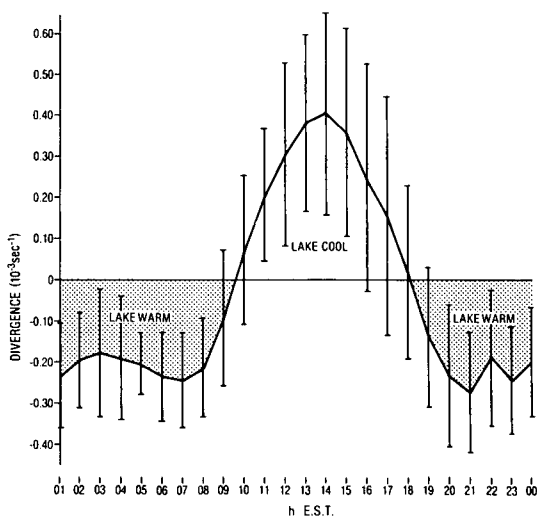


Fig. 3(a) 0000-0300 h wind roses for the anemograph sites (stratified data).

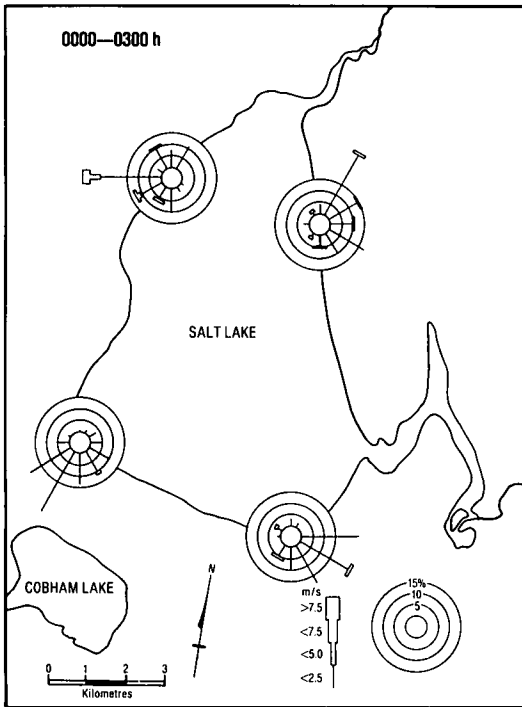
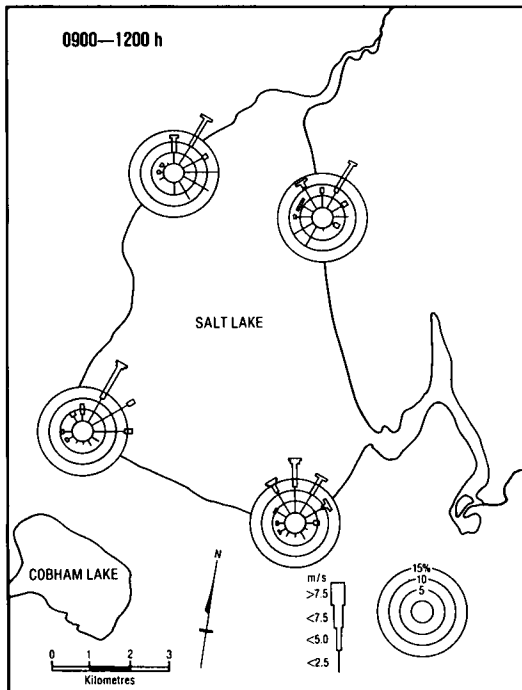


Fig. 3(b) 0900-1200 h wind roses for the anemograph sites (stratified data).



Figures 3(a) and (b), again using stratified data, show typical nocturnal and daytime wind roses for the different anemograph sites and provide further evidence of the presence of a diurnally reversing airflow at the surface. During the 0000-0300 h time period (Fig. 3(a)) all sites exhibit a well developed offshore flow. This is unlikely to be a simple drainage flow since relief in the locality is very subdued (the maximum variation in relief within a 30 km radius of The Salt Lake is ~25 m). The 0900-1200 h wind roses (Fig. 3(b)) all show evidence of a daytime onshore flow superimposed on a regional northeasterly airflow. To more clearly show the lake effect, work is currently underway to extract the regional component from the wind roses using wind data from nearby stations.

Although The Salt Lake acts to deform the regional airflow for much of the time, detailed analysis of the data indicates that a well-developed, diurnally reversing, radial circulation would only appear to operate less than 10 per cent of the time. However, that a diurnally reversing thermal circulation can operate under certain conditions at The Salt Lake is confirmed by pilot balloon analysis of winds aloft and by mesoscale modelling of airflow. Indications are that the circulation will be much more strongly developed over lakes of much larger dimensions than The Salt Lake and this is where research is currently focussed.

A mesoscale circulation over dry salt lakes has not previously been described in the literature and may have some important environmental and climatic implications in the Australian context. A number of journal articles are forthcoming, including a detailed climatology of the circulation at The Salt Lake, an analysis of surface energetics responsible for surface temperature variation at The Salt Lake (concentrating on the study area shown in Fig. 1), and a detailed analysis of the circulation using a mesoscale airflow model. The latter work is a joint study with W. Physick, CSIRO Division of Atmospheric Research.

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1 All times are Eastern Standard Time = Universal Co-ordinated Time + 10 hours.