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Atmospheric Boundary Layer

TOTAL SOLAR ECLIPSE OF 16 FEBRUARY 1980 AND THE VERTICAL PROFILES OF ATMOSPHERIC PARAMETERS IN THE LOWEST 200M

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Vertical profiles of air temperature, wind and humidity at Raichur ($16^{\circ}12'N$ & $77^{\circ}21'E$) in the lowest 200m of the atmosphere are presented for the period 15-18 February 1980. The effect of the total solar eclipse, on 16 February 1980 is seen in the lowering of air temperature in the entire air column which persisted for a few hours.

Keywords: Atmospheric Boundary Layer; Vertical Profiles; Air Temperature; Tethersonde

INTRODUCTION

IN the present note, the authors present vertical profiles of air temperature, wind and humidity upto a height of 200m at Raichur ($16^{\circ}12'N$ & $77^{\circ}21'E$) during the period 15-18 February 1980. The shadow of the moon passed across the Indian peninsula and Raichur was selected as one of the places for carrying out several experiments. At this place, the eclipse began at 14h 25.2m IST on 16 February and ended at 16h 54.6m IST with second and third contacts observed at 15h 43.7m and 15h 46.4m IST respectively.

METHODS OF OBSERVATION

The data presented in this report were obtained by means of a tethersonde system, (*Make: A. I. R. Inc. U.S.A.*) which consists of a blimp-shaped balloon, an airborne telemetry package housing dry and wet bulb thermistors, pressure, wind speed and direction sensors, a ground station and an electric winch (Fig. 1). The accuracies of sensors in tethersonde (*Model: TS-IA-I*) are $\pm 0.5^{\circ}C$ for air temperatures, $\pm 1mb$ for pressure, $\pm 0.25m/s$ for wind speed and $\pm 5^{\circ}$ for wind direction as per manufacturer's specifications. The ground station (*Model: AS-2AR*) resolves the signals from the airborne telemetry package into two channels—a time-multiplex one which contains information from all sensors and the other one which gives continuous information from one selected sensor only. Further, the ground station processes the data with the help of a built-in microcomputer and then sends to several output devices such as an internal strip-chart recorder, a visual display unit and a printer to print the displayed data.

Before taking each ascent, ground tests were carried out to check the dry bulb temperature and wet bulb depression, wind speed and direction and the differences were found to be within the accuracy limits of the system. The pressure sensor is adjusted to a convenient value which indicates ground pressure and as the instrument package moves upward, it gives the differential pressure which can be related to the height of the balloon. The visual display unit displays data frames which consist of data from all sensors at a rate of the one frame in 24secs.

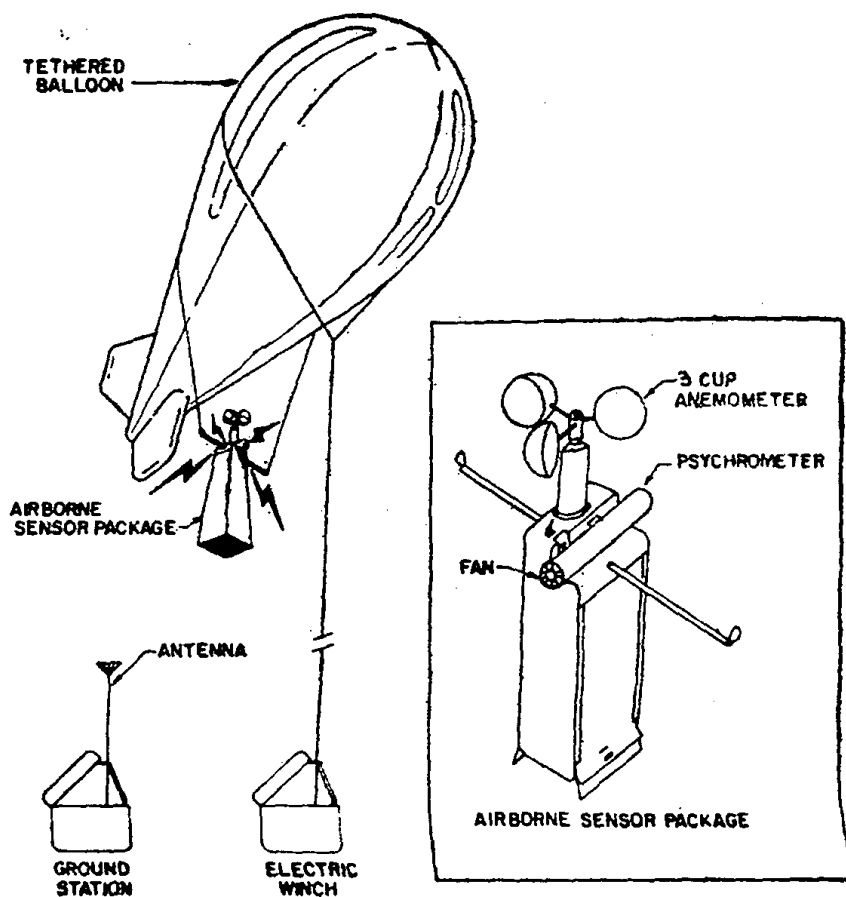


FIG. 1. Tethersonde system.

RESULTS

Figs. 2 to 4 show vertical profiles of dry bulb temperature, wind speed and direction and relative humidity upto a height of 200m. These observations were collected twice daily between 0700 and 0800hr in morning and between 1945 and 2115hr in night. Due to the operational problems it was not possible to take an ascent during the eclipse time. One of the important features observed in the vertical profiles is the lowering of air temperature, throughout the air column by about 1.5°C on 16 February 1980, a few hours after the eclipse (Fig. 2). This figure clearly reveals that above

50m, day-to-day temperature variations are relatively small in the morning on all days and also on 15th and 17th in the early night hours. However, a drop in temperature on the eclipse day appears to be clearly due to the effect of the solar eclipse. Soon after the totality the air temperature near the ground level showed a lowering of about 3 °C. As seen from Fig. 2, the 17th morning profile shows no such deviation in the general pattern suggesting that a perturbation appears in the air temperature

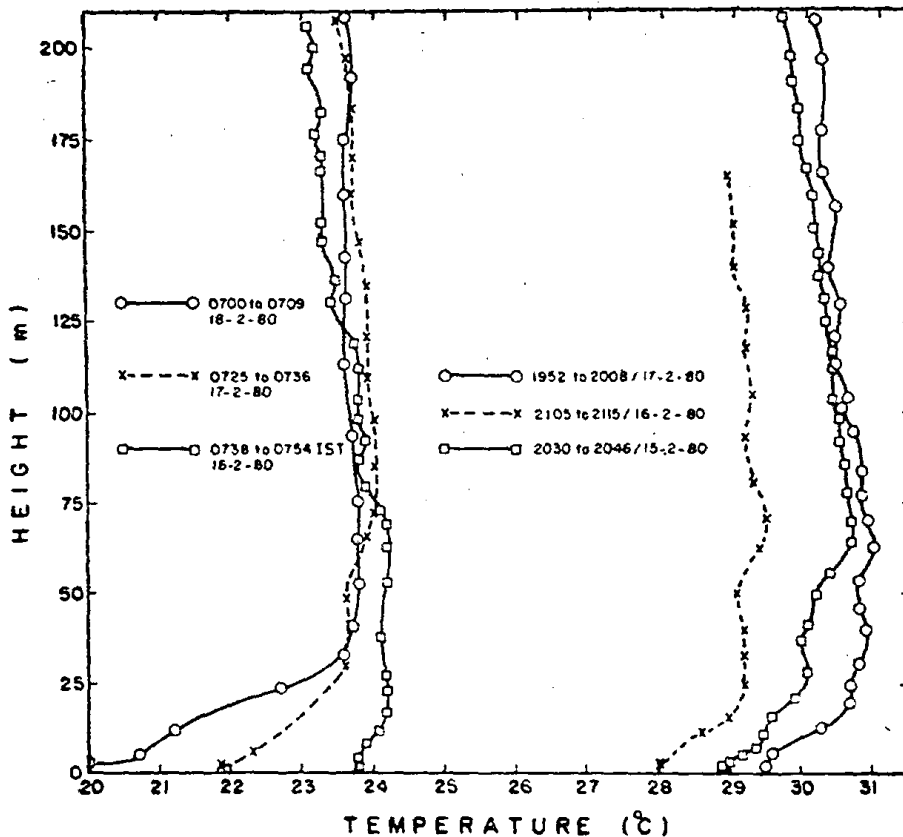


FIG. 2. Vertical air temperature profiles.

associated with the solar eclipse and its effect persists for a few hours only. In all, the profiles of the relative humidities in the air column are higher in the morning compared to those in the night (Fig. 3). Fig. 3 shows a slight increase by about 5 per cent in relative humidity on the night of 16 February which may be partly due to the lowering of air temperature and partly due to the advection of moisture into the region. The 16th morning and evening ascents show relatively higher winds above 100m which are predominantly south-southeasterly whereas the winds observed on the other days are weak (Fig. 4). Winds in the early hours of day are found to vary in both speed and direction from day-to-day compared to the winds in the early hours

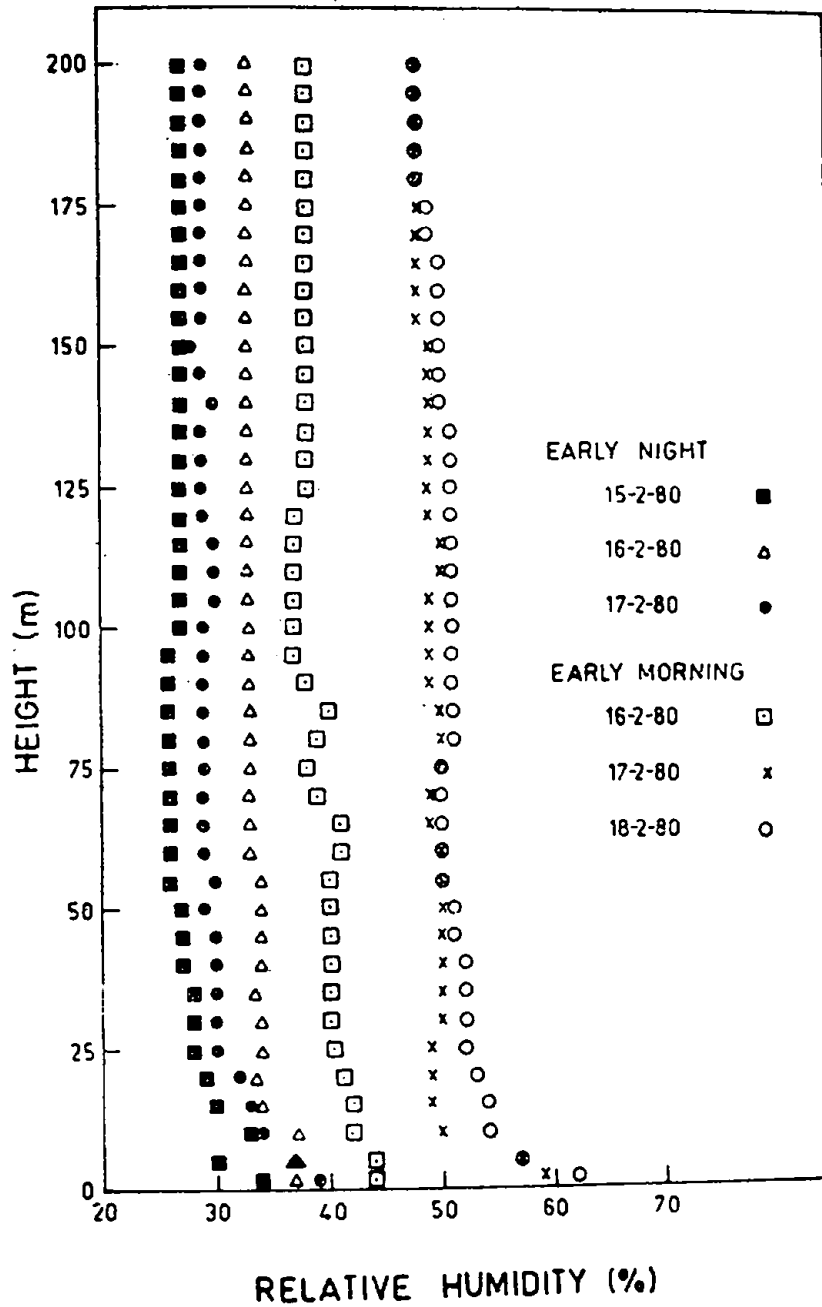


FIG. 3. Relative humidity profiles.

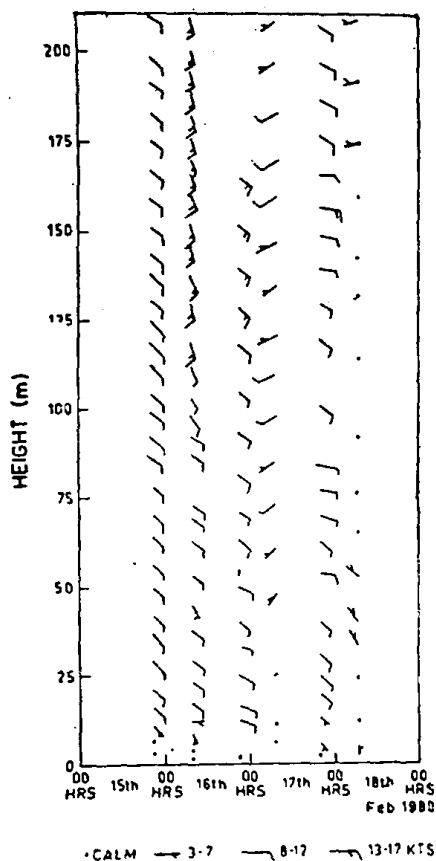


FIG. 4. Wind profiles.

of night. Fig. 5 shows the variations in surface air temperature, the heights of ground level inversions and the average temperature gradients in the inversion layers. The morning temperature inversions are relatively strong and these are associated with weak winds. One may expect moisture convergence under stable conditions. This along with general cooling of the atmosphere in the early hours of the day account for higher relative humidity during morning ascents.

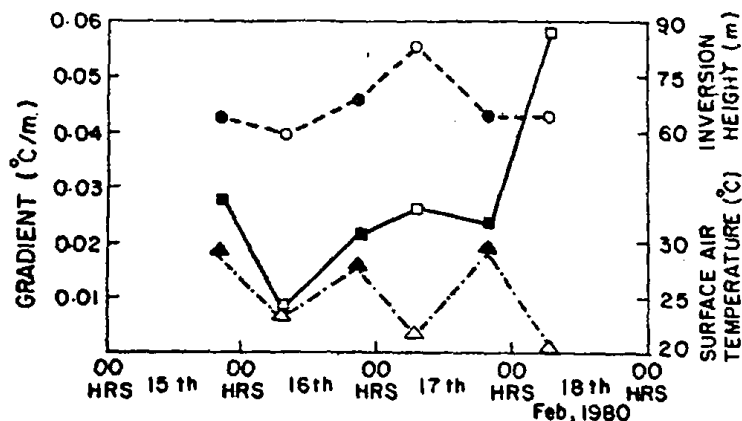


FIG. 5. Characteristics of ground level inversions (O --- O height, □ — □ gradient, Δ — Δ surface air temperature).

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