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NATURE OF THE LOW-LEVEL INVERSION AND THE ROLE OF THE WESTERN GHATS IN MODIFYING AIR MASS STRATIFICATION WITHIN 500 KM OF THE WEST COAST OF THE PENINSULA

1. During the International Indian Ocean Expedition (IIOE), extensive meteorological data were collected over the Arabian Sea during the period 26 June to 10 July 1963. It is proposed to discuss in this note data for 26 June to see if they throw any light on the nature of the low-level inversion over the west Arabian Sea and for 8 and 9 July to get an idea about the role of the Western Ghats in modifying air mass stratification within about 500 km of the west coast of the Peninsula, these days being free from any major synoptic influences over the areas concerned below 500mb level.

2. Details of the data —

26 June 1963 — Dropsondes data for four locations in the west Arabian Sea are available, two of them being along the same latitude, one 2° east of the other (Fig. 1a); the data of the other two soundings are given in Fig. 1 (b). An aircraft also flew at approximately 500 m over the Arabian Sea on 26 June from Bombay to Aden (Colon 1964; Fig. 4a of Desai 1968 b).

It will be seen from Fig. 1(a) that while at 12°N, 52°E, inversion began from the sea-surface, at 12°N, 54°E it began at a height of 70 mb above the surface. At the other two locations (Fig. 1 b) also, the inversion began above the sea-surface. It will be seen from the figures that at 12°N, 54°E and northeastwards, there was air with high humidity and nearly dry adiabatic lapse in a shallow layer. Above the inversion, there was air with nearly dry adiabatic lapse upto about 600 mb at 12°N, 52°E and in a layer 100-200 mb deep at the other three places. Temperatures at Aden at 1130 GMT on the day were 33, 25, 13 and—9°C at 1000, 850, 700 and 500 mb; there was thus no large difference in temperature at Aden and at 12°N, 52°E between 900 and 600 mb.

From the aircraft data near 500-m level, it is seen that near 12°N, 52°E wind was 226°/8 kt and over the area from 12°N, 54°E to 15°N, 60°E mainly SW'ly/40 to 25 kt, speed decreasing northeastwards.

Considering wind and temperature observations over the four locations along with the synoptic charts, it would appear that while at 12°N, 52°E there was continentals air from the surface upwards with stable conditions upto 910 mb, at the other

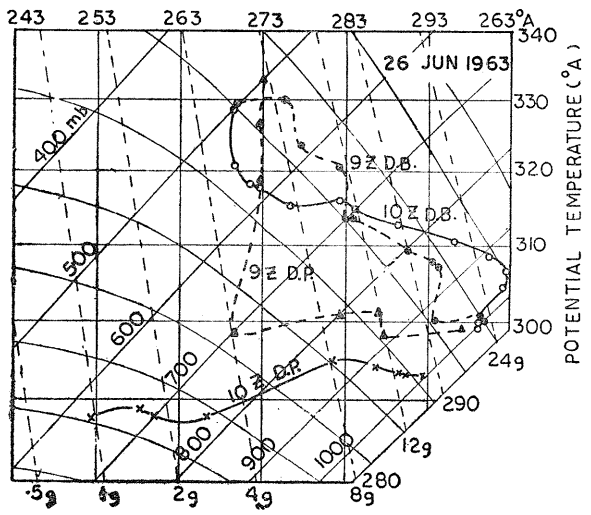

Fig. 1 (a)
Dropsonde ascent at locations 12°N, 52°E (10Z) and 12°N, 54° E (09Z)

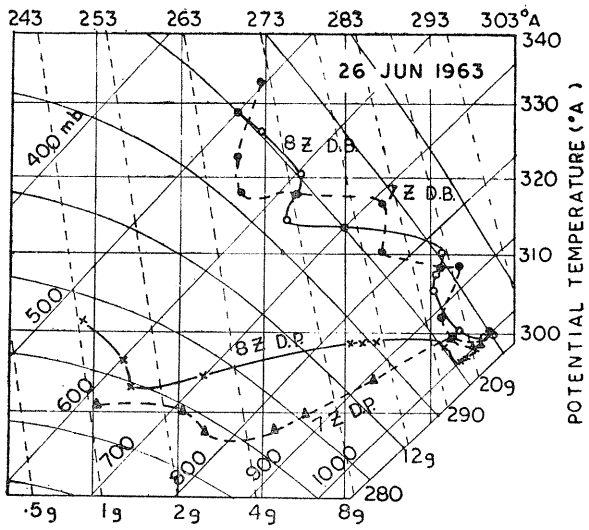

Fig. 1 (b)
Dropsonde ascent at locations 13°N, 57°E (08 Z) and 15° N, 59° E (07 Z)

three places, there was moist unstable air in the surface layers and continental air above with an inversion between the two air masses. It would appear that at 12°N, 54°E and northeastwards the low-level inversion was probably an airmass one, warmer drier continental air spreading over the cool moist air of oceanic origin, *i.e.*, the deflected trades air. Extensive stratocumulus over the Arabian Sea with tops near the base of the inversion and absence of precipitation reported by Colon (1964), can be understood on the basis of the inversion as being due to airmasses (Desai 1966 a).

It is seen from dropsondes data of 2 and 4 July 1963 (Colon 1964; Desai 1968 b–Figs. 4 b and 4 c for the 2nd and Figs. 1 and 3 for the 2nd and 4th respectively of Desai 1970) that the characteristic airmass stratification of the type between 12°N, 54°E and 15°N, 59°E also existed at other places except on the 4th near 19°N, 69°E where the same was disturbed by a cyclonic vortex.

8 and 9 July 1963 — Although there were three sounding on each of the two days, data for only two for each day have been given in Figs. 2 and 3 as the third location at 14°N, 67°E on the 8th was too far south of 18°N and at 15°N, 70°E on the 9th was further north of 12-13°N because the influence of the Ghats to the east would be shown better by the soundings being near about the same latitude.

The data in Figs. 2 and 3 show the characteristic airmass stratification as on 26 June. There were two inversions between 959 and 944 mb and 897 and 827 mb at 18°N, 66°E, and between 850 and 820 mb and 780 and 735 mb at 18°N, 71°E on the 8th (Fig. 2). The base of both inversions was raised as the Ghats were approached, the second location being about 200 km from them.

It will be seen from Fig. 3 that while at 12°N, 67°E the base of the isothermal layer was at 882 mb, it was raised to 817 mb at 13°N, 72°E the Ghats being only at a distance of about 300 km.

Thus in both these cases, the depth of the moist layer was increased and the base of the inversion raised as the Ghats were approached. The monsoon was weakening in terms of rainfall on the west coast after the 7th and the influence of the Ghats was not so pronounced as it might have been under active or strong monsoon conditions. There were no major synoptic features over the area in levels below 500 mb to cause raising of the inversion base.

3. The discussion of the dropsondes data indicates the following —

(*a*) When warm continental airmass moves over the colder sea-surface and the deflected trades airmass is absent the inversion develops from the surface; it, however, develops above the sea-surface when the deflected trades current is present. The low-level inversion would thus appear to be an airmass one, the warm continental air spreading over the cool deflected trades current.

(*b*) Within about 500 km of the west coast of the Peninsula south of about 20°N, low-level inversion of the same type as in (a) was also noticed; the depth of the moist layer was increased and the base of inversion raised as the Western Ghats were approached.

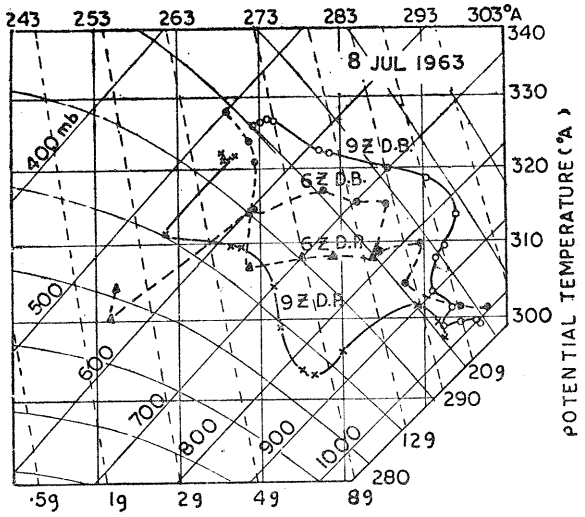

Fig. 2. Dropsonde ascent at locations 18°N, 66°E(09 GMT) and 18°N, 71° E (06 GMT)

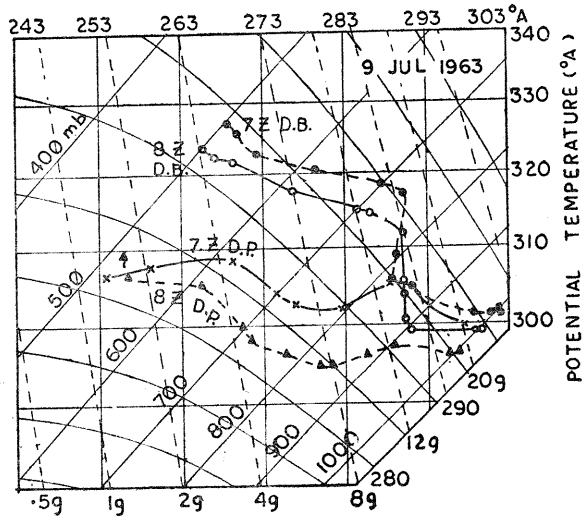

Fig. 3. Dropsonde ascent at locations 12°N, 67°E(08 GMT) and 13°N, 72°E (07 GMT)

The view advanced by the author (Desai 1966 a, b; 1967 a, b; 1968 a) about the nature of the low-level inversion over the Arabian Sea and the role of the Western Ghats in increasing the depth of the moist layer is supported by the data presented in this paper. On the west coast, the depth of the moist current is about 6·0 km when the monsoon is active or strong (Desai 1967 a, b). It is no wonder that the depth of the moist layer over the west Kathiawar-Kutch-Sind coast does not increase and remains about the same as over the Arabian Sea west of about 68°E (Fig. 2 of Ramage 1966) as there are no orographic barriers across the path of the monsoon current over the coast north of 20·5°N.

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