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551.508.822 (547)

# Further examination of the anomaly in the radiosonde data of Ahmedabad

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**सार** —पूर्ववर्ती अध्ययन में अहमदाबाद के रेडियोसौन्डे आंकड़ों में क्रमबद्ध त्रुटियों की ओर ध्यान आकर्षित किया गया था। जिसके परिणामस्वरूप बम्बई-अहमदाबाद-जोधपुर क्षेत्रों में दाब-पवन के संबंध में गम्भीर विसंगतियों का पता चला। तब से हमने 1965-1982 की 18 वर्षों की अवधि के लिए 3 स्टेशनों के मासिक माध्य वायुविज्ञानीय आंकड़ों का परीक्षण किया है। इस अध्ययन से पता चलता है कि अहमदाबाद के रेडियोसौडे आंकड़ो में क्रमबद्ध प्रकृति की विसंगतियां 1976 के लगभग अन्त से आरंभ और तब से निरन्तर बनी रही जिनकी ओर ध्यान नहीं गया। यह दिखाया गया है कि सारे वर्ष के दौरान बम्बई और जोधपुर की तुलना में अहमदाबाद के ऊपर सांउडिंग से मूल्यांकित किए गए ऊपरी क्षोभमण्डलीय तापमान अधिक है जो कि जलवायु विज्ञान के विपरीत है।

इस बात की संभावना का परीक्षण किया गया है कि अहमदाबाद में प्रेक्षित तापमान में विसंगति स्थानीय थर्मल पावर स्टेशन से उष्मा के उत्सर्जन के कारण होती है, यह कार्य पावर स्टेशन पर स्तम्भ (स्टैक) से उत्सर्जकों के विच्छक उठान का परिकलन करके किया गया है। यह दिखाया है कि उत्सर्जक 500 मीटर से ऊपर तापमानों पर किसी प्रकार कोई लक्षित प्रभाव नहीं डाल सकते। इसलिए यह निष्कर्ष निकाला गया है कि प्रेक्षित असंगत तापमानों का कोई भौतिक वास्तविकता नहीं है।

ABSTRACT. In the preceding paper attention was drawn to systematic errors in the radiosonde data of Ahmedabad leading to serious anomalies in the pressure-wind relationship in the Bombay-Ahmedabad-Jodhpur sectors. Since then we have examined the monthly mean aerological data of the three stations for the 18-year period 1965-1982. The study has revealed that anomalies of a systematic nature in the radiosonde data of Ahmedabad set in from about the end of 1976 and have persisted unnoticed since then. It is shown that throughout the year, the upper tropospheric temperatures over Ahmedabad as evaluated from the soundings are higher than those of Bombay and Jodhpur which contradicts climatology.

The possibility that the observed temperature anomaly over Ahmedabad may be caused by heat emission from the local thermal power station has been examined by calculations of plume rise of the emissions from the stacks at the power station. It is shown that the emissions cannot have any noticeable effect on the temperatures above 500 metres. It is, therefore, concluded that the observed anomalous temperatures have no physical reality.

## 1. Introduction

In the preceding paper (Ananthakrishnan & Soman 1989) we have drawn attention to a serious anomaly in the radiosonde data of Ahmedabad that has persisted unnoticed over a period of several years. This anomaly came to light while examining the aerological data of Indian stations for the years 1978, 1979 and 1980. For the three stations Bombay, Ahmedabad and Jodhpur which lie nearly along the same meridian, we noticed that the pressure-wind relationships show large discrepancies. A critical examination of the data showed that the upper air temperature data of Ahmedabad evaluated from the aerological soundings are systematically too high at all tropospheric levels, the errors being of the order of 3° to 5° C in the upper troposphere and 1° to 3° C in the lower troposphere. We considered it to be of interest and importance to trace the origin of this anomaly. For this purpose we undertook an examination of the monthly mean aerological data of the three stations, Bombay (B), Ahmedabad (A) and Jodhpur (J) for the 18-year period 1965 to 1982. We have also examined the possible influence of the local thermal power station as a causative factor for the anomaly.

## 2. Examination of the aerological data

The monthly mean temperature data of the three stations at standard isobaric levels were plotted as time series for the four months January, April, July and October. It was noticed that the positive anomalies in the upper air temperatures of Ahmedabad had set in around the end of 1976 and have continued since then. The magnitude of the positive anomalies progressively increases with elevation leading to a situation in which the upper tropospheric temperatures over Ahmedabad are higher than those of Bombay and Jodhpur for all the months of the year. This is illustrated with the temperature time series of the three stations at the four levels 850, 500, 300 and 200 mb for the months of January and July shown in Figs. 1 (a & b). Climatologically, in January tropospheric temperatures below 200 mb decrease from south to north while in July the temperature gradient is in the reverse direction. In both these months the upper tropospheric temperatures over Ahmedabad should lie between those of Bombay and Jodhpur. From the figures it may be noted that this is not the case after 1976.

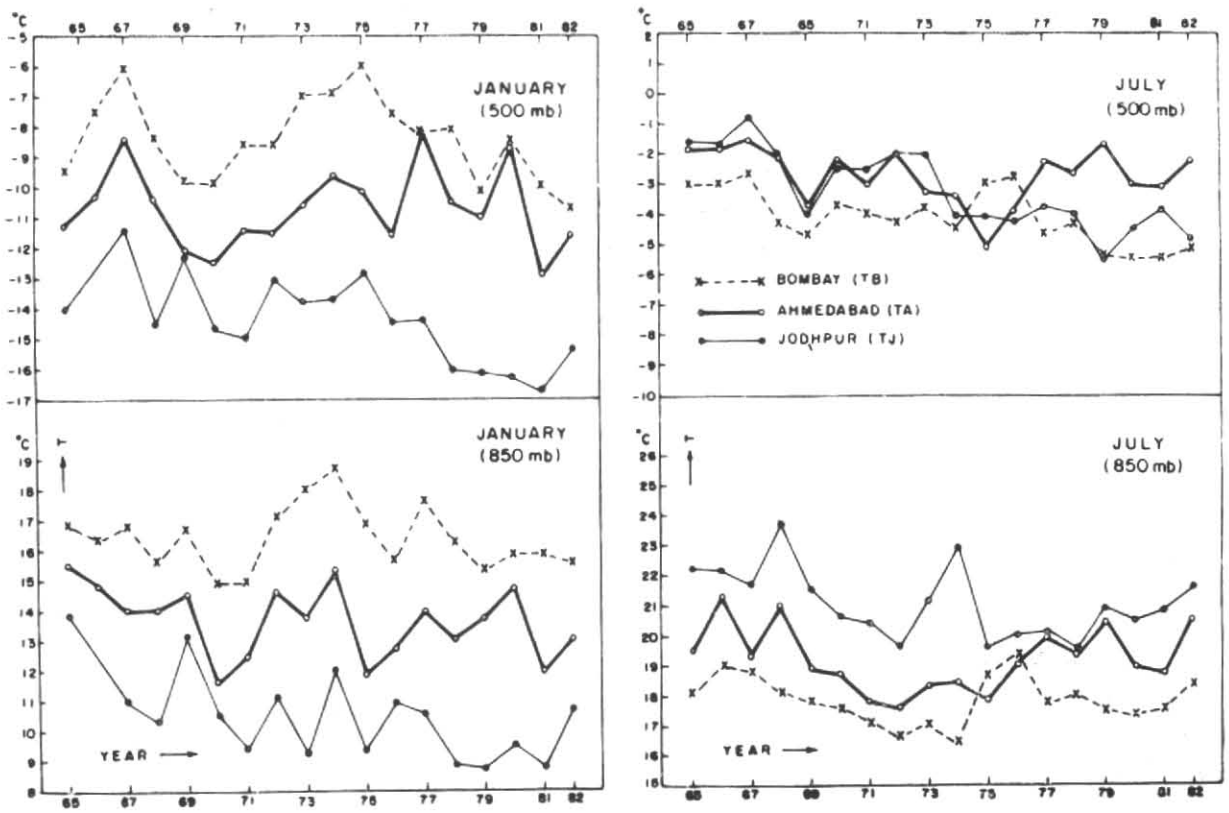


Fig. 1 (a). Mean monthly temperature (in °C) at 850 and 500 mb levels over Bombay, Ahmedabad and Jodhpur for January and July (1965-1982)

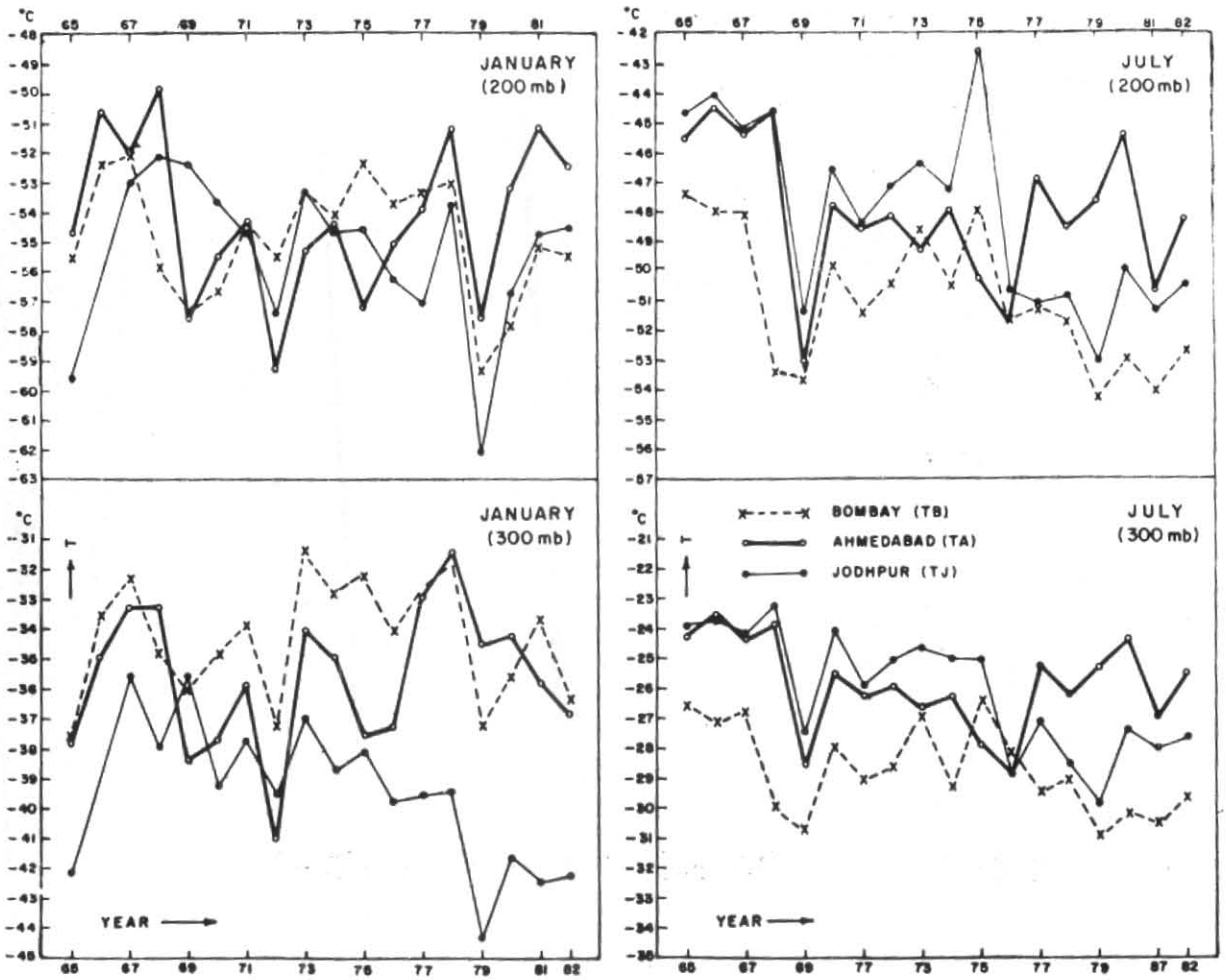


Fig.1(b). Mean monthly temperature (in °C) at 300 and 200 mb levels over Bombay, Ahmedabad and Jodhpur for January and July (1965-1982)

The horizontal temperature differences at standard isobaric levels between station pairs B/A and A/J calculated from the observed vertical shear of the zonal winds show only small year to year variations while large fluctuations are noticed in the corresponding temperature differences obtained from the radiosonde data. The deviations are around 2° to 5° C after 1976 and are in opposite directions in the two sectors, which indirectly corroborates the anomalous high temperature over Ahmedabad revealed by the radiosonde temperature data of the three stations.

Fig. 2 shows the ratio of the monthly mean zonal geostrophic wind ($u_g$) to the actual mean zonal wind ($u$) at 300 and 200 mb levels for the months of January and July in the B/A and A/J sectors for the period 1965-1982. This ratio should be positive and may be expected to fluctuate around the value of unity. The large deviations after 1976 may be noted. Again, the opposite nature of the deviations in the B/A and A/J sector is highlighted. Notice that in the A/J sector the ratio $u_g/u$ for July is systematically negative after 1975 showing incompatibility between winds and pressure gradients (violation of Buys Ballots' Law).

Prior to 1968-1969 different types of radiosonde instruments were in operation at the three stations. Part of the inconsistency noticed during the period 1965-1969 may be attributable to this cause. Since 1969 the same type of audio-modulated radiosonde instruments manufactured and calibrated at the instruments division of the IMD are in operation at all the stations. Approximate consistency in the performance of the instruments at the three stations is found for the period 1969-1975.

### 3. Influence of the thermal power station

In the previous paper we had stated that the thermal power station at Ahmedabad where about 4000 tons of coal are burnt daily is located to the westsouthwest of the radiosonde station. The approximate distance between the two locations as now ascertained is about 3 km. To evaluate the possible influence of the heat emission from the power station on the upper air temperatures as measured by the radiosonde ascents, we have made a detailed examination of the fuel burning for the period 1971-1986. Although there has been systematic increase in the amount of coal burnt, no abrupt increase has taken place around 1976 when the thermal anomaly over Ahmedabad has set in.

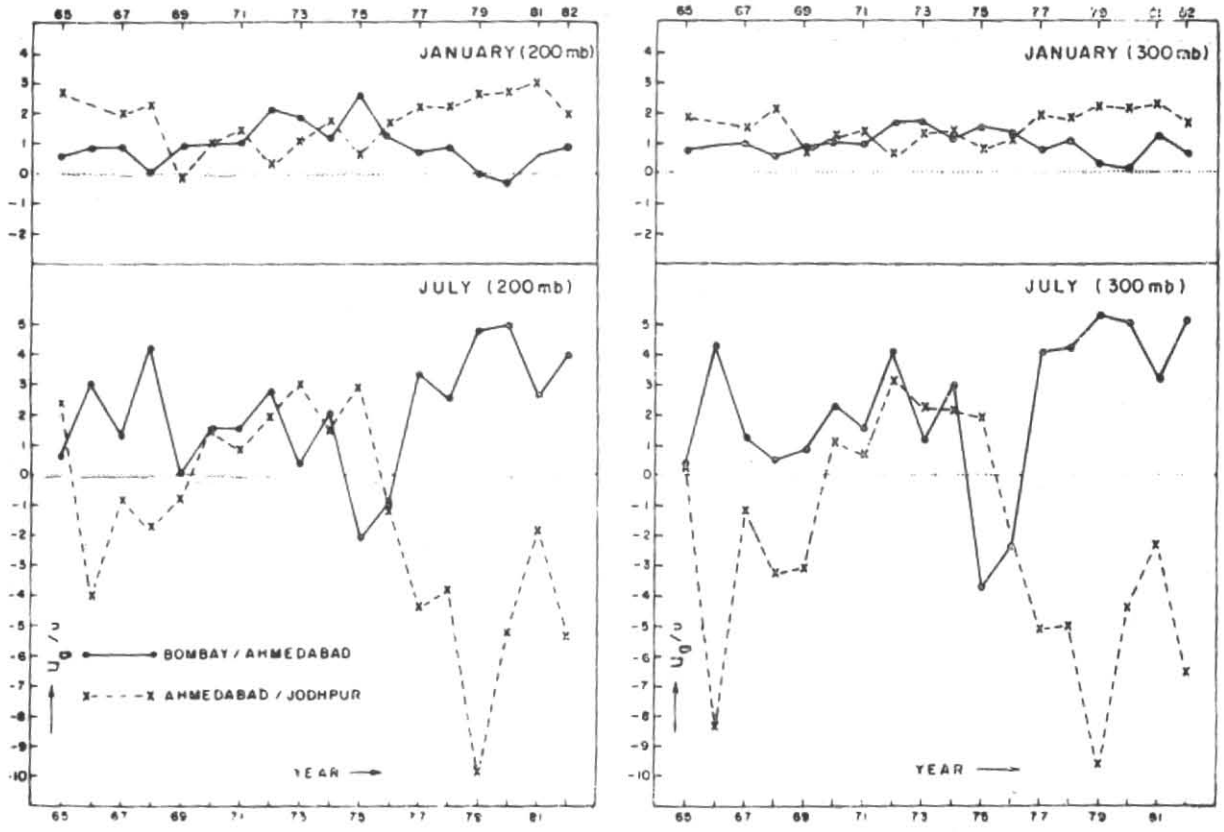


Fig. 2. Ratio of the monthly mean geostrophic zonal wind ($u_g$) to the actual mean zonal wind ($u$) at 300 mb and 200 mb levels for the months of January and July in the Bombay/Ahmedabad and Ahmedabad/Jodhpur sectors (1965-1982)

We have also examined this matter by calculating the plume rise at the thermal power station in two ways :

(*a*) by evaluating the plume rise at the individual stacks,

(*b*) by considering the power plant complex as a single extended heat source.

The methodology used in the calculations is originally due to Briggs (1975) and is also available in recent WMO publications (Hanna 1982; Golitsyn and Phillips 1986). Our calculations show that no significant effect of the thermal power station can extend above 300 to 500 m from the ground level. This is also in conformity with the findings of Fortak (1980) who made an experimental study of meteorological impact of anthropogenic heat emissions on the planetary boundary layer. As such, the large and persistent positive anomalies in the upper air temperatures over Ahmedabad cannot be attributed to the thermal power plant. The cause of the anomaly has to be sought for elsewhere.

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