

Fluxes of Sensible & Latent Heat over the Arabian Sea During MONEX-79

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Fluxes of sensible and latent heat over the Arabian Sea during 2-14 June 1979 are studied using MONEX-79 data. Daily variations of the sensible and latent heat fluxes over the region are significant. A sudden increase is noticed in the fluxes from 11 to 12 June, as a result of strengthening of the near surface wind field in the region of study associated with the formation of an atmospheric vortex over the southern Arabian Sea.

Eventhough the existence of the Asiatic summer monsoon is primarily due to differential heating of land and sea, it is believed that, atleast partially, the fluctuations in the monsoon activity may depend on the air-sea interactions occurring over the North Indian Ocean¹⁻⁴. The energy exchanges between the Arabian Sea and the monsoon air have considerable influence on the monsoon flow and the synoptic weather patterns over India⁵. In the present study, sensible and latent heat fluxes across the surface of the Arabian Sea during MONEX-79 were examined and discussed the daily variations related to the synoptic weather situations.

Data on sea surface temperature, dry bulb temperature, dew point temperature and wind speed for this investigation were obtained from the MONEX data set⁶. During MONEX-79, ships occupied 4 stations (st A: 7°N, 64.5°E; st B: 4.7°N, 66.7°E; st C: 7°N, 69°E; and st D: 9.2°N, 66.7°E) to collect data at different synoptic hours 00, 06, 12 and 18 GMT from 2-14 June 1979. For each station, daily averages for all the above parameters were computed.

The fluxes of sensible heat (H_s) and latent heat (H_L) over the Arabian Sea are obtained from the bulk aerodynamic formulae:

$$H_s = \rho C_p C_H (\bar{T}_o - \bar{T}_a) \bar{U}_a$$

$$H_L = \rho L C_E (\bar{e}_o - \bar{e}_a) \bar{U}_a$$

where ρ is density of air ($\rho = 1.2 \times 10^{-3} \text{ g. cm}^{-3}$); C_p is specific heat of air at constant pressure ($C_p = 0.24 \text{ cal. g}^{-1} \text{ deg}^{-1}$); L is latent heat of evaporation at sea surface ($L = 585 \text{ cal. g}^{-1}$); $\bar{T}_o$ and $\bar{T}_a$ are average temperatures of sea surface and the air at 10 m level respectively; $\bar{e}_o$ and $\bar{e}_a$ are saturated vapour pressure and vapour pressure of the air at 10 m level respectively; $\bar{U}_a$ is average wind speed at 10 m level; and C_E and C_H are the exchange coefficients of water vapour and sensible heat respectively.

Values of C_E for different wind speeds and stabilities given by Bunker⁷ were used. The same values were used for C_H also because the total heat budget of the oceans resulting from the assumption of equal coefficients will be very small since the sensible heat exchange over the ocean is small compared to the latent heat flux and radiational transfer⁸.

Daily variations of sensible heat flux for sts A, B, C and D are presented in Fig. 1. Maximum value for all stations is on 12 June 1979 except for st D where it is on 13 June 1979. In general the values range from 0.7 to 8.5 mW.cm^{-2} during the present study. These values are somewhat higher than those reported^{1,8}. The maximum values of sensible heat flux in this region are

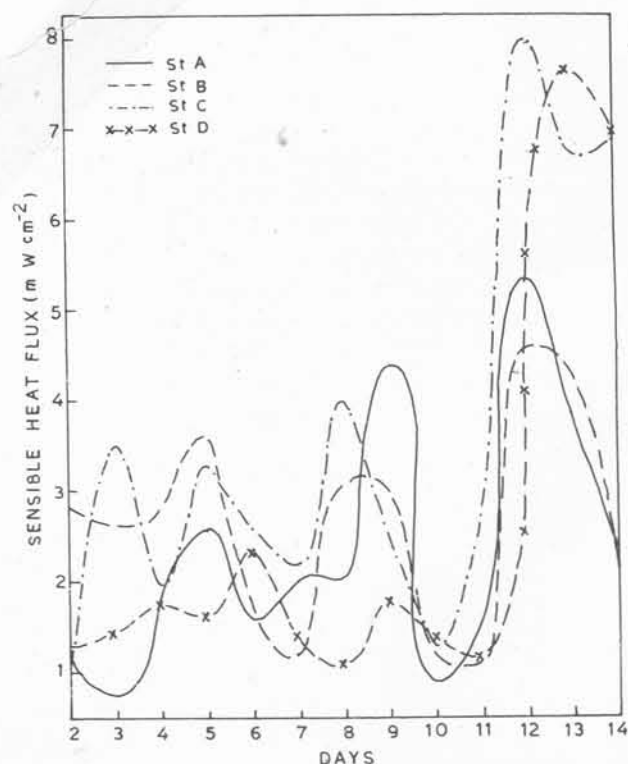


Fig. 1—Daily variation of sensible heat flux

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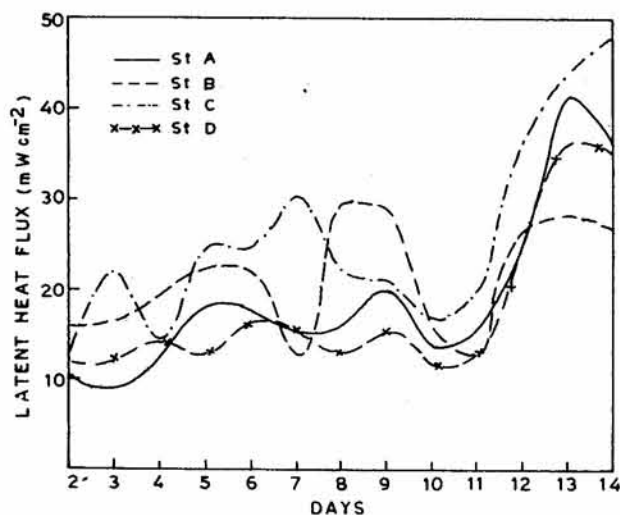


Fig. 2—Daily variation of latent heat flux

mainly due to much warmer sea than the air and due to strong monsoon trade winds. The latent heat flux (Fig. 2) shows a maximum on 13 June 1979 at sts A and D, 2 maxima, one on 8 and other on 13 June 1979 at st B and a maximum on 14 June 1979 at st C which is mainly due to strong trade winds.

The sensible heat flux, on the average, is only about 13% of the latent heat flux between the Arabian Sea and the atmosphere. The latent heat flux values on an average are 9 to 47.5 mW.cm^{-2} . Daily variations of average fluxes [(a) sensible heat, (b) latent heat and (c) sensible plus latent heat] over the region are presented in Fig. 3. There are 3 maxima and minima observed in the variation of the average total fluxes, in which the maximum on 13 June is very prominent. These are compared with the synoptic situations and observed that the minima are due to the amplification and extension of ridge over the southern Arabian Sea. The first 2 maxima are due to the influence of trough of low pressure extended over the southeast Arabian Sea. The prominent third maximum is due to the result of a strengthening of the near surface wind field in the region of study associated with the formation of an atmospheric vortex over the southern Arabian Sea⁹

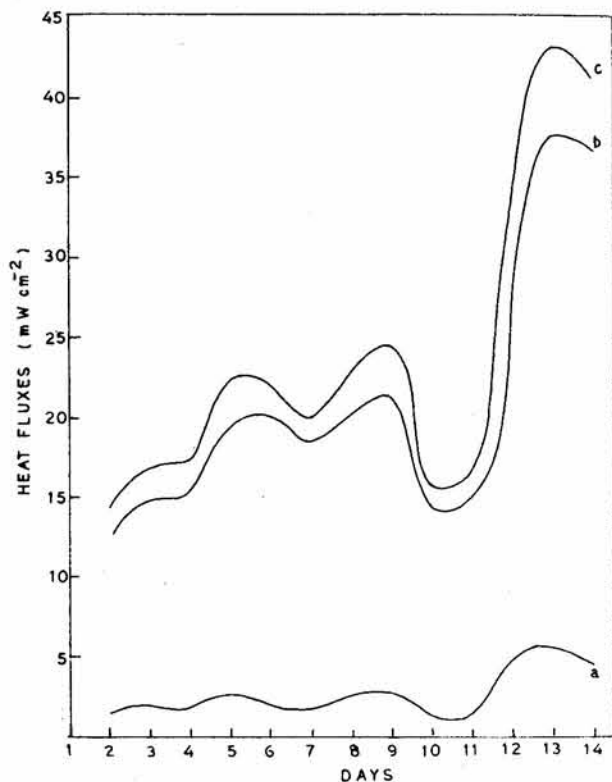


Fig. 3—Daily variation of average fluxes

and due to strong thermal instability (temperature difference between sea and air is more than 3°C).

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