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# DIEL VARIATIONS OF HEAT FLUXES ACROSS THE AIR-SEA INTERFACE FROM THE BAY OF PORT BLAIR

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ABSTRACT

The heat fluxes of sensible and latent heat over the Bay of Port Blair in August and September, 1988 based on the surface meteorological data collected over a period of 24 hrs in each month at an interval of 1 hour have been represented on the time scale. The latent heat throughout the 24 hrs of the day was positive during August and the air layer remained below saturation level. During September latent heat transfer was from air to sea (ie. negative) during the period 0700 - 1500 hrs indicating that condensation has taken place. This was supported by the observation of drizzling during the period with saturated condition of the air layer in the latter month. During the day time hours in both months, the relative humidity range was from 70 to 98%. Probably the high water vapour content in the air gets heated up higher than the sea surface. This may be one of the possible reasons for the transfer of sensible heat from air to sea surface during daylight hours. During the rest of the hours of the day the transfer of heat was from sea surface to air in both the months.

The observations of fluctuating parameters viz., sea-surface-temperature, barometric pressure, wind speed and direction over a diel period of 25 hrs were transformed into three cascade waves, ie. the diurnal wave, semi-diurnal wave and quarter diurnal wave which oscillated over the steady value of the respective parameters. The transformation was based on the choice of sixteen ordinates of each of the parameters equidistantly placed in the diel period. The amplitudes of the waves decreased in the order of diurnal, semi-diurnal and quarter diurnal for both air-temperature and sea-surface-temperature. The semi-diurnal wave exceeded the diurnal wave in amplitude in the case of pressure. The amplitude of semi-diurnal wave of wind speed was found higher than that of the diurnal wave in September.

## INTRODUCTION

Exchange of latent heat and sensible heat across the air-sea interface is important for the heat balance studies of the atmosphere. Based on climatological parameters of the northern Indian Ocean, the heat fluxes across the sea were observed in the Indian Ocean by a few authors during the IIOE (Ramanadham and Murty, 1970).

## MATERIALS AND METHODS

Diurnal observations of meteorological parameters were made at an interval of 1 hr onboard FORV *Sagar Sampada* from the Bay of Port Blair during August and September, 1988.

The parameters observed onboard the vessel were sea surface temperature (SST) (using bucket thermometer), temperature of Dry Bulb and Wet Bulb, barometric pressure and wind directions and speed. During August, the observations were started at 1800 hrs on 11-8-1988 and closed at 2400 hrs on 12-8-1988. During September, the observations were started at 1800 hrs on 29-9-1988 and the observations were wound up at 2400 hrs on 30-9-1988. In both the months, observations were made from the same area when the vessel was anchored.

## RESULTS

The parameters of sea surface temperature, barometric pressure and wind speed were analysed for their wave nature by adopting the sixteen ordinate scheme (Murty, 1987) and the dominant wave forms were determined. The sensible heat and latent heat were calculated from the parameters SST, Dry Bulb and Wet Bulb temperatures by adopting the bulk aerodynamic formulae (Hasternath and Peter, 1978).

$$QE = \rho \, Le \, Cd \, (es - ea) V$$

$$QS = \rho \, CPCD \, (TS - TQ) V$$

QS - sensible heat transfer between ocean and atmosphere,

QE - latent heat transfer between ocean and atmosphere,

CD - drag coefficient (dimensionless),

CP - specific heat of air at constant pressure,

ea - vapour pressure of air, (10m above the sea-surface),

es - Saturation vapour pressure of air, (10 m above the sea surface),

Le - latent heat of evaporation at the sea surface,

Ta - temperature of air,

Ts - sea surface temperature,

V - scalar wind speed (m/s),

p - density of air (1.175 kg $m^{-3}$).

The value of C is taken as 1.4 x $10^{-3}$ for low wind speeds (less than 10 m per second) according to Bunker (1976). In the above equation the effect of salinity on the saturation vapour pressure corresponding to SST was considered. The correction factor was as follows:

For salinity 35‰ $e_s = 0.98\ e_{d5}$ at the same temperature, where $e_d$ is the saturated vapour pressure over distilled water (Letestu, 1966). The latent heat and sensible heat variation during the day were also analysed for the wave pattern in them by subjecting that data to the sixteen ordinate scheme referred to above.

The sea surface temperature (Figs. 1 and 2) was maximum at about 1800 hrs and minimum at about 0600 hrs. The diurnal wave was predominant in determining the total value of the SST during both the months. In the case of barometric pressure, (Figs. 3 and 4) the diurnal and semidiurnal waves are effective in determining net values of pressure. In the case of wind speed (Figs. 5 and 6) during August, the diurnal wave was predominant whereas in September the semidiurnal wave was predominant.

During August, in the case of latent heat, the diurnal wave dominated the total variation whereas in September, the diurnal and semidiurnal waves were equally contributing to the total variation. In the case of sensible heat (Figs. 9 and 10), the diurnal and semidiurnal waves were predominant in the latter month in determining the total diel variation of sensible heat. The average values of the sensible heat flux and the latent heat flux during the noon period for August were 36.62 $Wm^{-2}$ and 84.8 $Wm^{-2}$ and the averages for September were found to be -18.2 $Wm^{2-}$ and -20.62 $Wm^{-2}$ respectively. The Bowen's ratio at about noon was found to be about 43% during August and 90% during September indicating that both sensible heat and latent heat were equally important in the heat exchange from the Bay of Port Blair at least during these months. The sensible heat and latent heat during September were negative during the

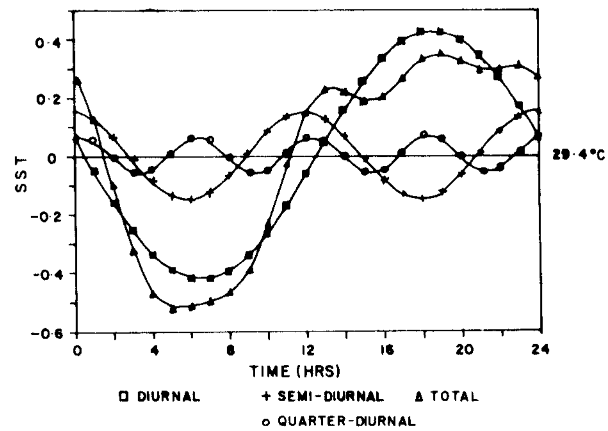


Fig. 1. Diurnal variations of SST during August, 1988.

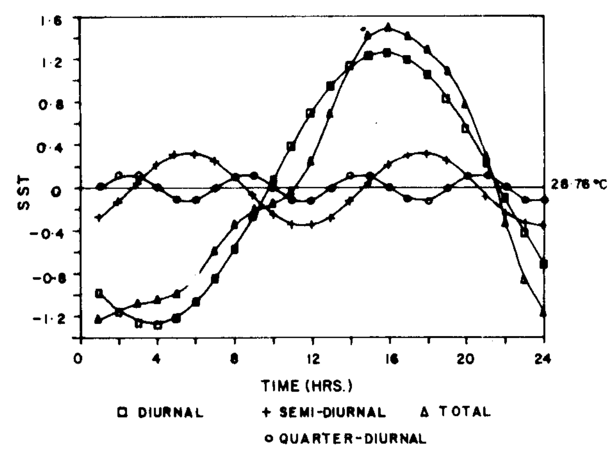


Fig. 2. Diurnal variations of SST during September, 1988.

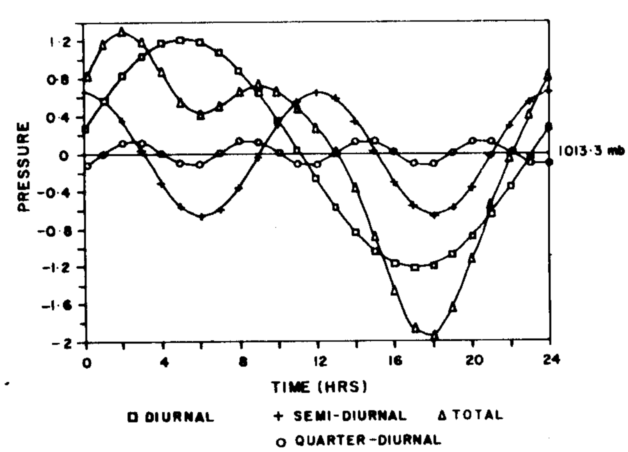


Fig. 3. Diurnal variations of pressure during August, 1988.

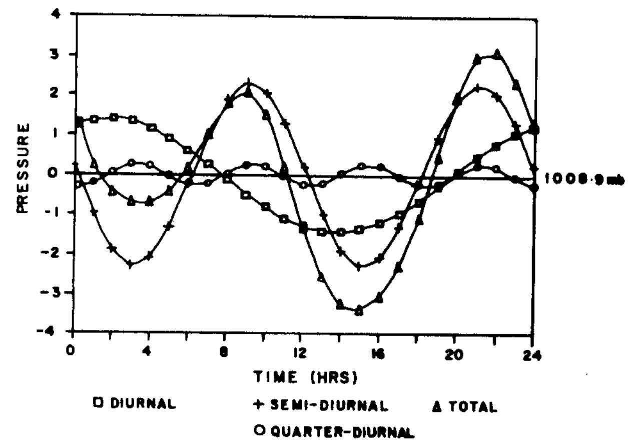


Fig. 4. Diurnal variations of pressure during September, 1988.

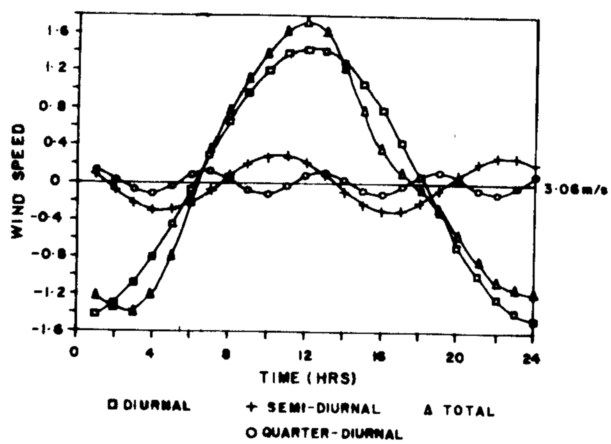


Fig. 5. Diurnal variations of wind speed during August, 1988.

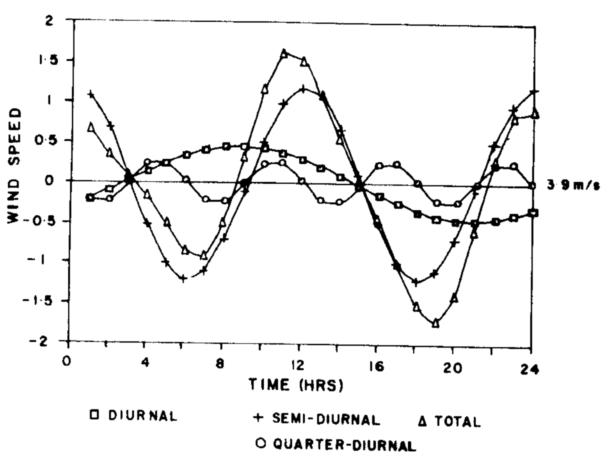


Fig. 6. Diurnal variations of wind speed during September, 1988.

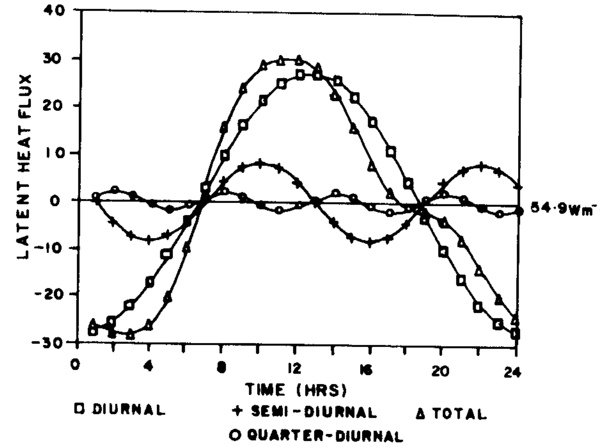


Fig. 7. Diurnal variations of latent-heat flux during August, 1988.

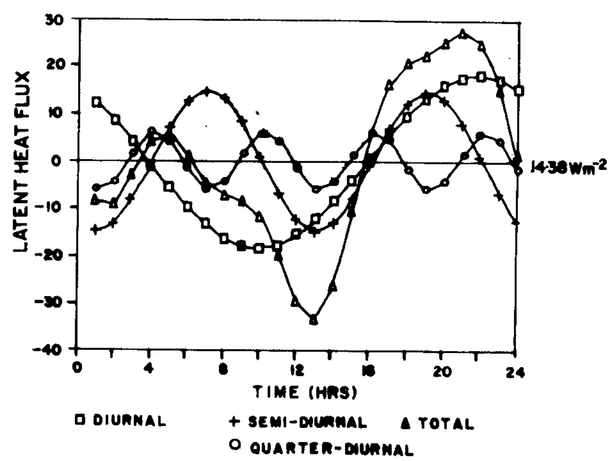


Fig. 8. Diurnal variations of latent-heat flux during September, 1988.

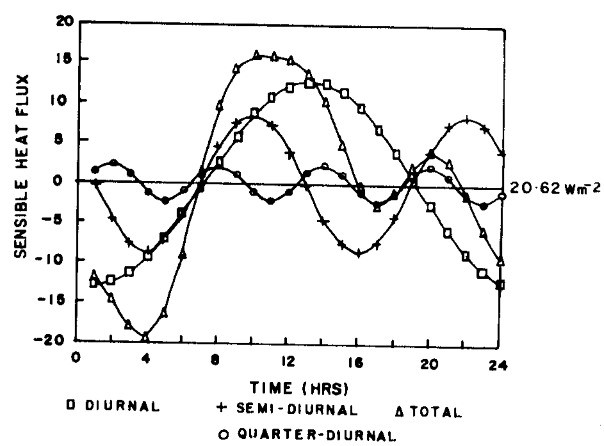


Fig. 9. Diurnal variations of sensible-heat flux during August, 1988.

noon period indicating that the heat flow was from air to sea surface. During this period the reverse of evaporation (condensation) was taking place (Fig. 8). During the same period the sky was overcast with drizzling quite often indicating that the air had reached almost saturation condition.

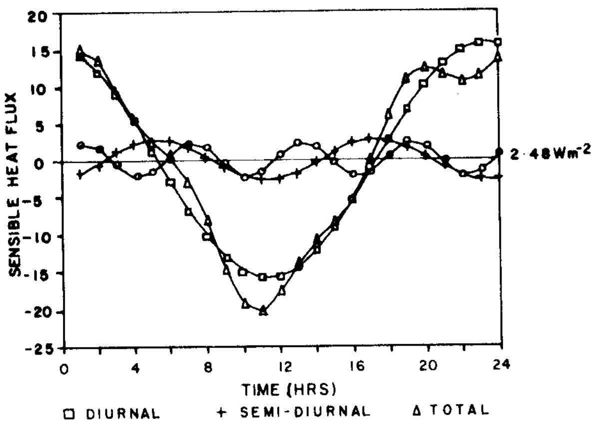


Fig. 10. Diurnal variations of sensible-heat flux during September, 1988.


## Summary

The spot observations on air-sea interaction parameters were observed for a diurnal period from the Bay of Port Blair and the analysis indicated the relative importance of latent heat and sensible heat which were exchanged between the sea water and air above it (August and September, 1988). The relative analysis revealed the dominant wave forms in the parameters.



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