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## ESTIMATION OF SOIL HEAT FLUX AT THIRUVANANTHAPURAM DURING NE-MONSOON AND WINTER PERIOD

1. Information about soil heat flux improves the calculation of minimum air temperature for frost and fog forecasting. Estimation of heat flux from soil temperature measurements gives a better understanding of the gain or loss of heat by the atmosphere at critical points during the diurnal exchange. Utilizing the three hourly experimental data of soil and air temperature during NE-monsoon (7 to 14 November 1993) and winter period (21 January to 4 February 1994), an attempt has been made to examine the subsoil and surface temperature characteristics at Thiruvananthapuram.

2. The experimental site is about 33 m above mean sea level and belongs to soils of laterite landscape developed under tropical climate with alternate wet and dry seasons having a mean annual rainfall of 1800 to 2800 mm and mean annual temperature of 27°C. The soil thermometers used for measurement are mercury-in-glass thermometer, as per the specification given by the India Meteorological Department (Raman 1970). The soil temperatures were measured every three hours starting from 0000 IST at the surface and at 5, 10, 20, 30 and 50 cm below the ground. Air temperatures were also measured at the screen height (122 cm) above soil surface.

3. From the experimental data we found that, during day time, intense solar radiation is absorbed by the soil which warms the ground surface more than the layers beneath, resulting in temperature gradient between the surface and subsoil on one hand, surface and air layers near the ground on the other. The mean pattern of the wave during NE-monsoon period is shown in Fig. 1.

3.1. During NE-monsoon period the ground surface starts heating after sunrise at a rate of 0.4°C/hr and gains maximum value of 1.6°C/hr at noon. At 5 cm depth initial rate of heating is 0.6°C/hr and attains maximum of 0.56°C/hr at noon. During winter period the ground surface starts heating initially at a rate of 0.7°C/hr and attains maximum value of 2.7°C/hr at noon. At 10 and 20cm depth, the thermal wave is seen between 09.00 and 15.00 hr. At 30 and 50 cm depth, the thermal wave is seen between 12.00 and 21.00 hr respectively. As the wave propagates slowly into the ground, it seems to get damped. There is a

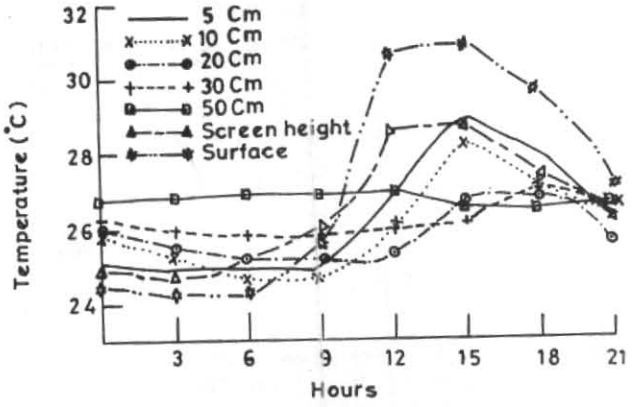



Fig. 1. Diurnal variation of soil temperature during NE-monsoon period

tendency for the amplitudes to decrease with depth and at 30 and 50 cm the amplitude is practically zero.

3.2. Temperature range and time lag worked out for NE-monsoon period did not show much difference from that for winter and hence not discussed here. The time lag observed/computed for winter is about 1hr/2hr 30min at 5cm depth, 2hr 30min/4hr 6min at 10cm, 8hr 15min/9hr 21min at 20cm, 12hr/13hr 8min at 30cm and 23hr 45min/23hr 3min at 50 cm depths.

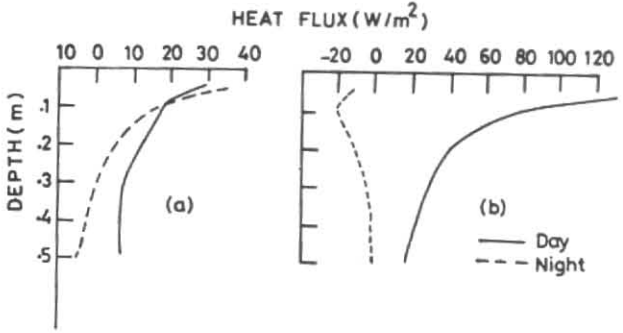
3.3. The rate of heat flow in the soil depends on the strength of the mean temperature gradient. The soil heat flux ($G$) can be written as (Oke 1978),

$$G = -Ks \frac{\nabla Ts}{\nabla Z}$$

where,

$Ks$ — the thermal conductivity of the soil ($Wm^{-1}K^{-1}$). $\nabla Ts$ — the mean change in soil temperature at mean change in depth $\nabla Z$.

3.4. Heat flux computed at various depths with respect to the ground surface are shown in Figs. 2 (a & b). The analysis reveals that the soil heat flux does not show any systematic pattern with depth. Figs. 2 (a & b) show that the radiation absorbed from the sun decreases with depth. Beyond 20 cm depth, the soil does not seem to be much affected by the diurnal variations. Heat flux computed for NE-monsoon period is lower than that of winter indicating the influence of soil moisture in controlling the flow of temperature within the soil.




Figs. 2 (a & b). Soil heat flux for each depth with respect to the ground during (a) NE-monsoon and (b) winter period

**References**

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*25 July 1994. Modified 3 July 1995*