NET RADIATION AT SOME STATIONS IN THE STATE OF PARAÍBA

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Introduction

Net radiation is an important parameter in several methods of estimating water loss from the surface. Measured net radiation data is not often available and several equations have been suggested for the estimation of net radiation or its component parameters. Linacre (1968) has suggested various equations for the computation of net radiation .Karuna Kumar and Rao (1985) have used his procedure for the study of net radiation distribution in India. In many parts of NE Brazil net radiation information is not available. Results of a study of net radiation at some stations in Paraiba state based on Morton's (1983) approach are reported in this paper.

Materials and Methods

Mean monthly values of air temperature, vapour pressure and global radiation at six stations in the state are used in this study.
The zenith value of dry season clear sky albedo is given by

$$a_{zd} = 0.26 - 0.0012 P_A \left(\frac{p}{p_s}\right)^{0.5} \left[1 + \left|\frac{\phi}{42}\right| + \left|\frac{\phi}{42}\right|^2\right] \qquad (1)$$

$$0.11 \le a_{zd} \le 0.17$$

P_A is the mean annual precipitation in mm ,ϕ is the latitude and p and ps are the station pressure and 1013 mb respectively.
The zenith value of clear sky albedo (a_z) is obtained as follows

$$a_z = a_{zd}$$

$$0.11 \le a_z \le 0.5\left(0.91 - \frac{V_d}{V}\right) \qquad (2)$$

$$c_0 = V - V_d \qquad 0 \le c_0 \le 1$$

Where V_d and V are the actual and saturation vapour pressures.
Clear sky albedo is then computed from the following expression

$a_0 = a_z$ {[exp(1.08)-(2.16((cos z)/□)+sin z) exp(0.012 z)] /[1.473(1-sinz)]} (3)

Where 'z' is the zenith distance of the Sun at noon.
The mean albedo 'a' is given by

$$a = a_0\left[s + (1-s)\left(1 - \frac{z}{330}\right)\right] \qquad (4)$$

Where S is the sunshine ratio.
Net long wave radiation loss from the surface (L_n) is computed as follows
The proportional increase in downward long wave radiation due to clouds (ρ) is

$$\rho = 0.18\left[(1-c_2)(1-s)^2 + c_2(1-s)^{0.5}\right]\frac{p_s}{p} \qquad (5)$$

$$c_2 = 10\left(\frac{V_d}{V} - s - 0.42\right) \text{ and } \quad 0 \le c_2 \le 1.0$$

Using ρ, V_d and T, L_n is computed as

$$L_n = \varepsilon\sigma(T+273)^4 x \left[1 - \left(0.71 + 0.007 V_d \frac{p}{p_s}\right)(1+\rho)\right] \qquad (6)$$

$$L_n \ge 0.05\varepsilon\sigma(T+273)^4$$

Net radiation is then obtained from the expression

$$R_n = R_s(1-a) - L_n \qquad (7)$$

Where R_s is the global radiation.

Results and Discussion

Monthly values of net radiation at the selected stations are given in Table1 Ratios of net long wave and net radiation to global radiation are evaluated and results for Patos are shown in Table 2.

Maximum and minimum values of net radiation are 354ly/day and 168 ly/day respectively. Values of albedo are derived from expressions involving solar

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zenith distance at noon , mean annual precipitation, vapour pressure and the sunshine ratio and its variation during the year is rather irregular. Maximum values are noticed in June or July and the minimum values in March. Maximum values of the ratio Rn/Rs occurred in March at all the stations .In this month Rn is also the maximum at all the stations except Aria. The ratio Rn/Rs varied between 42% and 67%. Maximum and minimum values of net long wave radiation loss are 143 ly/day and 56 ly/day respectively .The ratio Ln/Rs ranged between 13% and 30%. The ratios of net long wave and net radiation to global radiation noticed in this study agree with those reported for other tropical stations (Kowal and Kassam 1973,Kassam and Kowal 1975,Subrahmanyam and Karuna Kumar 1985).

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Station/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Patos	250	310	328	285	212	170	168	211	250	279	264	244
S.Gonçalo	296	319	354	313	272	211	215	271	309	341	315	285
Monteiro	264	286	304	281	227	197	200	256	279	295	259	245
J. Pessoa	326	329	344	313	255	240	236	275	303	340	330	309
C. Grande	265	288	294	259	219	194	196	225	256	287	280	254
Areia	290	297	307	284	214	217	207	248	274	314	293	258

Table 1. Net radiation at the selected stations (cal. cm^{-2}. day^{-1})

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R_s	507	513	525	482	433	394	402	491	533	561	546	504
a	0.267	0.215	0.193	0.207	0.265	0.288	0.287	0.279	0.262	0.249	0.263	0.269
L_n	122	93	96	97	106	111	119	143	143	142	138	125
R_n	250	310	328	285	212	170	168	211	250	279	264	244
R_n/ R_s	0.50	0.60	0.62	0.59	0.49	0.43	0.42	0.43	0.47	0.50	0.48	0.48
L_n/ R_s	0.24	0.18	0.18	0.20	0.24	0.28	0.30	0.29	0.27	0.25	0.25	0.25

Table 2. Solar radiation (R_s), Net radiation (R_n) and Net long wave radiation(L_n) at Patos.