

A comparative study of radiation data from Nimbus-II

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ABSTRACT. Values of outgoing longwave radiation for the Indian area during the period 16 May to 28 July 1966 have been compared with the data of radiometersonde ascents from Delhi, Jodhpur and Calcutta. It is found that the Nimbus and radiometersonde data are in good agreement.

1. Introduction

Early experiments to measure reflected solar radiation and emitted infrared radiation from the earth-atmosphere system, were flown on Explorer VII and several Tiros satellites. Reliable results were, however, obtained only for outgoing long wave radiation flux, computed from measurements of infrared radiation in the 8 to 12 microns band. The data coverage over Indian area was limited due to spacecraft recorder limitations.

The Medium Resolution Infrared Radiometer (MRIR) flown on Nimbus II measured electromagnetic radiation emitted and reflected from the earth and its atmosphere in five selected wavelength intervals. One of these channels measured the emitted long wave length infrared energy from 5.0 to 30.0 microns. The field of view of the scanning of the radiometer was about 2–5 degrees. It enabled a spatial resolution of 50 km near the sub-satellite point to about 110 km at a nadir angle of 40 degrees. The measurements of the outgoing infrared radiation from this channel were continuously controlled by an onboard calibration system and were therefore accurate within ± 2 per cent.

2. Data

Radiation measurements for the entire globe were made by Nimbus II during the period 16 May to 28 July 1966. Measurements between 40° latitudes were made near local noon during day and near local mid-night at night. From these measurements Raschke (1968) computed average values of the outgoing longwave radiation flux for five sub-periods of 15 days each.

During this period, 51 radiometersonde ascents were made at three stations in India: New Delhi, Jodhpur and Calcutta, in connection with the Rajasthan Desert Project in collaboration with the University of Wisconsin, U.S.A. The

ascents over Delhi and Jodhpur were taken thrice a week during the premonsoon season. These were discontinued at Jodhpur from the month of July and the frequency of ascents at Delhi reduced to once a week. Two ascents a week were commenced at Calcutta from July. The time of all these ascents was after sunset at about 8 P.M. and in a large number of cases data were obtained upto 50 mb and above. There were only seven ascents during this period, which terminated below 100 mb.

To compare the radiometersonde and satellite observations, the values of outgoing long wave radiation over Delhi, Jodhpur and Calcutta were picked out from the 15-day average maps prepared by Raschke and the values of the upward fluxes at the top-most level of the radiometer soundings were averaged for these periods. The values for 16-31 May and 1-15 June were also compared with the Tiros IV radiation data obtained from the 5-day average charts presented by Krishna Rao (1966) in the study of the monsoon over India during 1962. The results are presented in Table 1. In this table, the values of outgoing long wave radiations are given in langleys/min. and the figures in bracket represent the number of days for which radiometersonde ascents and Tiros IV data were available.

3. Discussion of the results

3.1. *May 16-31, 1966*—It will be seen that the values of the longwave outgoing radiations at the top of the atmosphere obtained from Nimbus II and radiometersonde ascents over Delhi and Jodhpur are very close to each other. The values from Tiros IV measurements are however 20-25% lower. Gupta (1965) computed the outgoing long wave radiation over India during the premonsoon season, using the Elsasser radiation diagram and

TABLE 1
Longwave outgoing radiation at the top of the atmosphere during May to July 1966

Station	16-31 May 1966		Tiros IV (1962)	1-15 June 1966		Tiros IV (1962)	16-30 Jun 1966		1-15 July 1966		16-28 Jul 1966	
	Nimbus II	Radiometer- sonde ascents		Nimbus II	Radiometer- sonde ascents		Nimbus- II	Radiometer- sonde ascents	Nimbus II	Radiometer- sonde ascents	Nimbus II	Radiometer- sonde ascents
Delhi	.420	.410(6)	.35(10)	.435	.441(7)	.33(10)	.340	.291(6)	.405	.402(2)	.330	.332(2)
Jodhpur	.435	.452(8)	.36(10)	.445	.429(7)	.33(10)	.360	.375(5)	.425	—	.350	—
Calcutta	.425	—	.30(15)	.330	—	.26(10)	.270	—	.305	.236(4)	.300	.323(4)

these were in fairly good agreement with the measurements of long wave radiation by Tiros IV.

3.2. *June 1-15, 1966*—The radiometer-sonde and Nimbus II values are similar but the Tiros IV values are again 20-25% lower.

3.3. *June 16-30, 1966*—Data for Tiros IV are not available. The Nimbus II and radiometer-sonde values are in good agreement over Jodhpur. The slightly lower values over Delhi obtained by radiometer-sondes, may be attributed to the cloudy sky conditions at the time of the four ascents during the period.

3.4. *July 1-15, 1966*—While the values over Delhi agree, over Calcutta the values from the radiometer-sondes are low. This can again be attributed to the afternoon/evening cloudy skies over Calcutta, during the period, whereas, the 15-day average values from the Nimbus II measurements correspond to midday and midnight observations.

3.5. *July 16-28, 1966*—Over Calcutta, the average of radiometer-sonde values is slightly higher than the Nimbus II values. This may be ascribed to the fact that 3 out of the 4 ascents terminated below 100 mb.

4. Conclusions

1. There is good agreement between radiometer-sonde ascents and Nimbus II measurements of outgoing longwave radiation flux over Delhi, Jodhpur and Calcutta. The Nimbus II values generally agreed within $\pm 5\%$ of the radiometer-sonde values, except over Delhi during 16-30 June and over Calcutta during 1-15 July, when the radiometer-sonde values were 15-20% lower. The possible reason for this is the occurrence of clouds over these stations at the time of the ascents.

2. Kuhn (1968) has recently discussed the results of outgoing long wave radiation measurements from Nimbus II and radiometer-sonde measurements over six Antarctic stations, during the same period. He found that the two values agree within ± 2 per cent. The results presented here confirm that Nimbus II measurements over the tropics are also in agreement with the radiometer-sonde measurements.

3. The observation of outgoing long wave radiation from Tiros IV, for the 8-13 microns band are 20-25 per cent lower which confirms the observation of Raschke (1968) that the radiation measurements by earlier satellites were affected by instrumental degradation.

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