Non-uniform dissipation of the Antarctic ozone hole

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Fig. 2 shows a plot of the daily means of total ozone at South Pole (Amundsen-Scott) and Syowa for the six consecutive months September-February for 1940 onwards up to 1990. For the South Pole, data were available only from about the middle of October. The hole magnitudes, expressed as negative percentage deviations from the final recovery level in November-December, are indicated in Fig. 2 and given in Table 1. However, these refer to total ozone only. Vertical profiles show that the percentage decrease was much larger (in some years, almost 100%) in the 12-20 km region (Koshy et al., 1988; Hofmann et al., 1989). The minimum values (DD) shown in Table 1 mostly represent the residual tropospheric and upper stratospheric ozone (Stolarski et al., 1990).

The following features may be noted:

(i) The percentage drops at Syowa are generally lesser (by a few per cent) than those at South Pole probably because Syowa is farther away from the main vortex centre (the pole itself?).

(ii) The final recovery levels are chosen somewhat subjectively but do seem to vary a lot from year-to-year, probably due to a quasi-biennial oscillation (Garcia and Solomon, 1987).

(iii) The 1983 ozone hole was the weakest but only by a slight per cent, as compared to earlier and
TABLE 1
Antarctic ozone depletions at South Pole and Syowa

<table>
<thead>
<tr>
<th>Year</th>
<th>S. Pole (90°S)</th>
<th>Syowa (69°S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base level (DU)</td>
<td>Min (DU) % drop</td>
</tr>
<tr>
<td>1985</td>
<td>325</td>
<td>150</td>
</tr>
<tr>
<td>1986</td>
<td>400</td>
<td>180</td>
</tr>
<tr>
<td>1987</td>
<td>325</td>
<td>125</td>
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<tr>
<td>1988</td>
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<td>210</td>
</tr>
<tr>
<td>1989</td>
<td>325</td>
<td>140</td>
</tr>
<tr>
<td>1990</td>
<td>300</td>
<td>140</td>
</tr>
</tbody>
</table>

Later years. The absolute value (—210 DU) was larger than the ones for other years, but the base level (400 DU) was also higher.

In 1986, 1987 and 1990, the South Pole ozone recovered rather smoothly from mid-October to mid-November. However, in 1985, 1988 and 1989 there were large fluctuations during the recovery. South Pole can go out of the hole but only in the end stages. Hence, in between fluctuations are probably indicative of changes in the strength of the hole. At Syowa also, there were very large fluctuations. Some of these should be edge effects; but some might be due to hole strength fluctuations. Some events are very spectacular. In November 1985, South Pole showed large fluctuations in the early part and Syowa in the later part. In October 1986, South Pole showed no variations; but Syowa showed a very sharp rise during 18-21 October, followed by a gradual fall in the next 30 days. In October-November 1988, the fluctuations at South Pole and Syowa were similar except for a phase difference of ~5 days (Syowa occurring earlier). The November 1989 fluctuations at South Pole were not accompanied by fluctuations at Syowa. In 1990, South Pole ozone hole recovered steadily from mid-October to mid-December, but Syowa showed large fluctuations throughout this period.

Fig. 1. Map of the Antarctic continent and peninsula with locations of some international observatories (T—Terra Nova, P—Palmer, E—Eights, H—Halley, B—Byrd, SP—South Pole, McMurdo, TH—Thiel, S—Syowa)

Fig. 2. Total ozone daily means at South Pole (90°S) and Syowa (69°S, 74°E) during Sep, Oct, Nov, Dec and Jan, 2 years of next year, for 1989 and 1990. The base levels and ozone changes from the same to the minimum levels (generally in October) are indicated.

Fig. 3 (a-g). Total ozone values for Aug-Dec 1988 at: (a) South Pole (the dashed curve is for TOMS 30-50°S minimum value), (b) Syowa (69°S, 74°E), (c) Palmer (79°S, 140°W), (d) McMurdo (78°S, 167°E) with TOMS values (dashed lines) appropriate to these locations, (e) and (f) show McMurdo ozone for 12-20 km and 18 km respectively. (g) 18 km temperatures at McMurdo.

Fig. 4. Total ozone values for Aug-Dec 1987 at South Pole, Syowa and McMurdo and ozone at 12-20 km and 18 km and temperature at 18 km at McMurdo.

3. The 1988 ozone hole

Since the discovery of the Antarctic ozone hole by Farman et al. (1985), considerable effort has gone into the detailed study of this phenomenon. Krueger et al. (1987, 1988) presented TOMS observations for the 1986 and 1987 Antarctic ozone holes. Krueger et al. (1989) and Schoeberl et al. (1989) compared the 1988 Antarctic ozone hole with previous years' depletions. In 1986, 1987, 1988, 1989 and 1990, balloon/dosage measurements of ozone and temperature were made at McMurdo station (78°S, 168°E). Halley et al. 1987, 1989; Deshler et al. 1990 (a & b), Deshler and Hofmann 1991). Also, Lubis and Frederick (1990) reported column ozone measurements for 1986-1989 from Palmer station (65°S, 64°F). Thus, for the 1988 event data can be compared for four widespread locations (full dots in Fig. 1). Fig. 3 shows the plots. Fig. 3(a) (full lines) shows a plot for total ozone at South Pole. The dashed curve shows TOMS values of minimum ozone poleward of 30°S as reported by Krueger et al. (1989). Fig. 3(b) shows total ozone at Syowa. Figs. 3 (c & d) (full lines) show total ozone at Palmer station (Lubis and Frederick 1990) and McMurdo station (Deshler et al. 1990 & b). The dashed lines show the TOMS values appropriate to these locations. Fig. 3(e) shows ozone content in the 12-20 km region. Fig. 3(f) shows ozone at 18 km altitude and Fig. 3(g) shows the 18 km temperature, all above McMurdo.

The following features may be noted:

1. Fig. 3(g) shows very little fluctuations of the ozone hole up to 20 October 1988, in the TOMS as well as South Pole data. Thus, the ozone hole was fairly constant during this period. Syowa shows very large fluctuations, indicating that the location was in and out of the ozone hole frequently. The Syowa peak in late September and early October almost matches with a similar peak 2 days later at Palmer and 2-3 days earlier at McMurdo. However, the other prominent peaks at Syowa are not reflected at Palmer or McMurdo. The larger fluctuation at McMurdo during 22-31 October is explained by Deshler et al. 1990 (b) as movements of the vortex back and forth over McMurdo.

2. The most spectacular feature is the large ozone decrease at South Pole during 29 October-7 November and the subsequent recovery.
later years. The absolute value (~10 DU) was larger than the ones for other years; but the base level (400 DU) was also higher.

In 1986, 1987 and 1990, the South Pole ozone recovered rather smoothly from mid-October to mid-November. However, in 1985, 1988 and 1989 there were large fluctuations during the recovery. South Pole can go out of the hole but only in the end stages. Hence, in between fluctuations are probably indicative of changes in the strength of the hole. At Syowa also, there were very large fluctuations. Some of these should be edge effects, but some might be due to hole strength fluctuations. Some events are very spectacular. In November 1985, South Pole showed large fluctuations in the early part and Syowa in the later part. In October 1986, South Pole showed no variations; but Syowa showed a very sharp rise during 18-21 October, followed by a gradual fall in the next 30 days. In October-November 1988, the fluctuations at South Pole and Syowa were similar except for a phase difference of ~5 days (Syowa occurring earlier). The November 1989 fluctuations at South Pole were not accompanied by fluctuations at Syowa. In 1990, South Pole ozone hole recovered steadily from mid-October to mid-December; but Syowa showed large fluctuations throughout this period.

### Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>S. Pole (90°S) Base level (DU)</th>
<th>Min. DU drop</th>
<th>% drop</th>
<th>Syowa (65°S) Base level (DU)</th>
<th>Min. DU drop</th>
<th>% drop</th>
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<td>1985</td>
<td>350 150</td>
<td>57</td>
<td>325 175</td>
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<tr>
<td>1990</td>
<td>300 140</td>
<td>53</td>
<td>375 170</td>
<td>55</td>
<td></td>
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</tr>
</tbody>
</table>

### Fig. 1

### Fig. 2
Total ozone daily means at South Pole (90°S) and Syowa (65°S, 37°E) during Sep., Oct., Nov., Dec. and Jan., Feb. of next year, for 1985-1989 and 1990. The basic levels and percentage drops from the same up to the minimum levels (generally in October) are indicated.

### Fig. 3a (g)
(a) Total ozone values for Aug.-Dec. 1988 at: (1) South Pole (the dashed curve is for TOMS 30°S-90°S maximum values), (2) Syowa (65°S, 37°E), (3) Palmer (55°S, 149°W), (4) McMurdo (78°S, 167°E) with TOMS values (dashed lines) appropriate to these locations. (c) and (f) show McMurdo ozone for 12.20 km and 18 km respectively, (g) 18 km temperature at McMurdo.

### Fig. 4
Total ozone values for Aug.-Dec. 1987 at South Pole, Syowa and McMurdo and ozone at 12, 20 km and 18 km and temperature at 18 km at McMurdo.

### 3. The 1988 ozone hole

Since the discovery of the Antarctic ozone hole by Farman et al. (1985), considerable effort has gone into the detailed study of this phenomenon. Krueger et al. (1985, 1987) presented TOMS observations for the 1986 and 1987 Antarctic ozone holes. Krueger et al. (1989) and Schoeberl et al. (1989) computed the 1988 Antarctic ozone hole with previous years’ depletions. In 1986, 1987, 1988, 1989 and 1990, balloon-borne measurements of ozone and temperature were made at McMurdo station (78°S, 167°E), (Hughson et al. 1987, 1989; Deshler et al. 1990, a & b), Deshler and Hofmann 1991). Also, Lubin and Frederick (1990) reported column ozone measurements for 1986, 1989 from Palmer station (65°S, 149°W). Thus, for the 1988 event data can be compiled for four widely spread locations (full dots in Fig. 1). Fig. 3 shows the plots. Fig. 3(a) (full lines) shows a plot for total ozone at South Pole. The dashed curve shows TOMS values of minimum ozone poleward of 30°S as reported by Krueger et al. (1989). Fig. 3(b) shows total ozone at Syowa. Figs. 3(c & d) (full lines) show total ozone at Palmer station (Lubin and Frederick 1990) and McMurdo station (Deshler et al. 1990, a & b). The dashed lines show the TOMS values appropriate to these locations. Fig. 3(e) shows ozone content in the 12-20 km region. Fig. 3(f) shows ozone at 18 km altitude and Fig. 3(g) shows the 18 km temperature, all above McMurdo.

The following features may be noted:

1. Fig. 3(a) shows very little fluctuations of the ozone hole up to 20 October 1988, in the TOMS as well as South Pole data. Thus, the ozone hole was fairly constant during this period. Syowa shows very large fluctuations indicating that the location was in and out of the ozone hole frequently. The Syowa peak in late September and early October almost matches with a similar peak 2 days later at Palmer and 2-3 days earlier at McMurdo. However, the other prominent peaks at Syowa are not reflected at Palmer or McMurdo. The larger fluctuation at McMurdo during 23-31 October is explained by Deshler et al. 1990(b) as movements of the vortex wall back and forth over McMurdo.

2. (2) The most spectacular feature is the large ozone decrease at South Pole during 29 October-7 November and the subsequent recovery.
In their detailed study of vertical profiles of ozone, Deshler et al. [1990 (a & b)] mention that ozone depletion was caused by a sink between 12-20 km and measurements at that level in the vortex (McMurdo) displayed ozone layering and exchange of ozone rich and poor. Deshler et al. (1990a) suggest that in the 12-20 km layer, most of the fluctuations seen in Fig. 3 are probably of such an origin. However, some changes could be due to changes in the altitude of the ozone hole itself. Deshler et al. (1990a) mention that the 1988 event corroborates earlier suggestions that regions of ozone depletion are related to temperatures relative to the formation of polar stratospheric clouds. Fig. 3(g) shows the temperature at 18 km over McMurdo. The temperature was about -80°C up to mid-September and then rose steadily to about -50°C, which is interpreted as the vortex wall reaching McMurdo. From 21 October onwards, the temperature remained above -35°C but small temperature variations match the large ozone variations. On day 300 (26 October) and day 315 (10 November), the 18 km ozone level at McMurdo was very low, almost comparable to that of late September. But the temperatures on these days (-54°C and -40°C) were much higher than the September and temperatures (-64°C). It would thus seem that low stratospheric temperatures are not the sole guiding factors controlling ozone changes.

4. The 1989 ozone hole

Fig. 5(a) and 5(b) shows the plots for the 1989 event where data for South Pole, South Pole and McMurdo were plotted. South Pole showed a structure during recovery, viz., peaks on 10 November and 16 November. This event is one of the largest ever recorded. On these dates, South Pole values were low. -35°C and the recovery continued up to early December. In contrast, Palmer ozone had already recovered to ~350 DU by 6 November. Thus, the ozone hole had left the South Pole region. The 10 November peak was the first time since measurements began that the ozone hole reached the South Pole region. Palmer and McMurdo. It would be interesting to confirm the shift from TOMS data for grid points above these locations separately. Palmer ozone did not extend to November. In October, McMurdo total ozone showed an increase during the period 284-290 which was reflected in the ozone in the 12-20 km region as also in ozone and temperature at 18 km. The feature was seen a few degrees south of Palmer and probably a few days earlier at Palmer, probably indicating displacement of the vortex back and forth.

5. The 1986, 1987 and 1990 ozone holes

For these events, data were available for South Pole, South Pole, McMurdo and some TOMS data (Deshler and Hofmann 1991, Newman et al. 1991). Fig. 6(a) shows the plots for 1986. At South Pole, the hole seems to have disappeared by 16 November but recovered partially by 3 December and dissipated. At South Pole, there was an enormous increase during 17-22 October (from 200 DU to 300 DU) which was not seen elsewhere at South Pole or at McMurdo. Thus, during 17-22 October, the ozone hole must have moved away from South Pole, towards South Pole and McMurdo. From 22 October to 4 November, South Pole ozone decreased from ~240 DU to 240 DU while McMurdo ozone increased rapidly from 200 DU to 400 DU. Thus, the ozone hole swang back to the South Pole region, away from McMurdo and South Pole. Thus, large increases along the 180°-0° meridians seem to have occurred. In the latter half of November, ozone at South Pole and McMurdo increased to ~275 DU on 3 December while South Pole ozone remained high. This ozone hole seems to have covered South Pole and McMurdo. Whether this covered McMurdo also cannot be checked due to data availability. However, Palmer temperature in October showed similar variations indicating that McMurdo was often in and out of the ozone hole vortex.

Fig. 4 illustrates the 1987 event. At South Pole, the formation and subsequent dissipation of the ozone hole was fairly smooth. During 24-27 November, the ozone level remained at ~325 DU. However, in South Pole, the ozone level was lower than South Pole values and similar to those at Syowa. Their polar orthographic plot for 29 November 1987 shows that the Palmer and McMurdo axe plotted. South Pole showed a structure during recovery, viz., peaks on 10 November and 16 November 1987 of 275 DU and 350 DU respectively. On these dates, Syowa values were lower, ~252 DU and the recovery continued to 4 December. In contrast, Palmer ozone had already recovered to ~350 DU by 6 November. Thus, the ozone hole had left the South Pole region. McMurdo showed aided towards Syowa. It would be interesting to confirm the shift from TOMS data for grid points above these locations separately. Data for McMurdo do not extend to November. Data for McMurdo do not extend to November. In October, McMurdo total ozone showed an increase during the period 284-290 which was reflected in the ozone in the 12-20 km region as also in ozone and temperature at 18 km. The feature was seen a few degrees south of Palmer and probably a few days earlier at Palmer, probably indicating displacement of the vortex back and forth.

6. Conclusions

The Antarctic ozone hole dissipation is not uniform. Apart from the displacements and distortions of the vortex during the course of the dissipation when the
In their detailed study of vertical profiles of ozone, Deshler et al. [1980 (a & b)] reported that ozone depletion was caused by a sink between 12-20 km and measurements at the edges of the vortex (McMurdo). They also displayed ozone layering and exchange of ozone rich and poor air across the vortex well in the 12-20 km layer. Most of the fluctuations seen in Fig. 3 are probably of such an origin. However, some changes could be due to changes in the height of the ozone hole itself. Deshler et al. (1990) mention that the 1988 event corroborates earlier suggestions that regions of ozone depletion are related to temperatures sensitive to the formation of polar stratospheric clouds. Fig. 3(g) shows the temperatures at 18 km at McMurdo. The temperature was about 80°C up to mid-September and then rose steadily to about 90°C which is interpreted as the vortex wall reaching McMurdo. From 21 October onwards, the temperature remained above 85°C but small temperature variations match the large ozone variations. On 30 May (26 October) and day 315 (10 November), the 18 km ozone level at McMurdo was very low, almost comparable to that of late September. But the temperatures on these days (54°C and 40°C) were much higher than the September end temperatures (64°C). It would thus seem that low stratospheric temperatures are not the sole guiding factors controlling ozone changes.

4. The 1989 ozone hole

Fig. 3(a) shows the plots for the 1989 event where data for South Pole, McMurdo and McMurdo are plotted. South Pole showed a structure during recovery, viz., peaks on 10 November and 16 November 1989 of 275 DU and 300 DU, respectively. On these dates, Syowa values were lower, ~25 DU and the recovery continued until 22 November. In contrast, Palmer ozone had already recovered to ~350 DU by 6 November. Thus, the ozone hole had left the South Pole region and shifted southwards towards Syowa. It would be interesting to confirm the shift from TOMS data for grid points above these locations separately. Data for McMurdo do not extend to November. In October, McMurdo total ozone showed an increase during the month (~284-290) which was reflected in the ozone in the 12-20 km region as also in ozone and temperature at 18 km. The feature was seen a few days earlier at Syowa and probably a few days earlier at Palmer, probably indicating displacement of the vortex back and forth.

5. The 1986, 1987 and 1990 ozone holes

For these events, data were available for South Pole, Syowa and McMurdo only and some TOMS data for Syowa and McMurdo only and some TOMS data (Deshler and Hofmann 1991, Newman et al. 1991). Fig. 3(c) shows the plots for 1986. At South Pole, the hole seems to have disappeared by 16 November but reappeared partially by 3 December and dissipated later. At Syowa, there was an enormous increase during 17-22 October (from 200 DU to 430 DU) which was not seen either at South Pole or at McMurdo. Thus, during 17-22 October, the ozone hole must have moved away from Syowa, towards South Pole and McMurdo. Between 22 October and 4 November, Syowa ozone decreased dramatically, reaching 100 DU. On 6 November, McMurdo ozone increased rapidly from 240 DU to 400 DU. Thus, the ozone hole swung back to the Syowa region, away from McMurdo and South Pole. Thus, large displacements along the 180°-40° meridians seem to have occurred. In the latter half of November, ozone at McMurdo remained at ~275 DU on 16 November ~275 DU on 3 December while Syowa ozone remained below 300 DU. Thus, a weak ozone hole seems to have covered South Pole and Fig. 3. Whether this covered McMurdo also cannot be checked as data are not available for McMurdo. The temperature and temperature in October showed similar variations indicating that McMurdo was often in and out of the ozone hole.

Fig. 4 illustrates the 1987 event. At South Pole, the formation and subsequent dissipation of the ozone hole was fairly smooth. During 24-27 November, the ozone level at South Pole was ~150 DU and remained at that level until 9 December and later rose to ~250 DU. In contrast, Syowa showed very large fluctuations, probably indicating encounters with the vortex wall. Particularly interesting is the level during 27 November-3 December when South Pole ozone had receded to ~275 DU but Syowa ozone decreased from ~400 DU to ~230 DU. This would imply that the ozone hole still existed but shifted from South Pole towards Syowa. Unfortunately, there are no McMurdo data to check such a movement. Krueger et al. (1986) showed a plot of TOMS observations for latitudes south of 30° S which we have reproduced in Fig. 4. During this period, the levels were lower than South Pole values and similar to those at Syowa. Their polar orthographic plot for 29 November 1987 shows that the polar anomaly probably formed an elongated oval which seems to miss South Pole but encompasses McMurdo and Syowa. Although this might have been misleading mainly due to distortions and displacements of the ozone hole vortex. At McMurdo, a peculiar feature occurred during 4-20 October, when the ozone level rose from ~150 DU with two peaks on 12 October and 17 October. Similar peaks occurred in ozone and temperatures in the region of McMurdo or Syowa. Hofmann et al. (1989) attributed these fluctuations to entrainment and exit of McMurdo from the vortex well. The feature was not reflected in the TOMS values appropriate for Palmer or even by Hofmann et al. (1989).

Fig. 5(c) shows the plots for 1990. The ozone hole dissipation at South Pole was more or less smooth. Syowa showed violent fluctuations, ozone level reaching above 300 DU on 3 November. This was obviously due to Syowa going out of the ozone hole. Similar fluctuations were seen at McMurdo but not on the same dates. In particular, McMurdo conditions increased considerably (from 175 DU to 300 DU) from 19 September (day 264) to 23 September (day 270). Surprisingly, the increase was not seen in 12-20 km range or at 18 km, but the 18 km temperature showed a similar increase. The increase was due to McMurdo going out of the vortex but due to mid-latitude latitude, all levels were well above 20 km (Deshler and Hofmann 1991).

6. Conclusions

The Antarctic ozone hole dissipation is not uniform. Apart from the displacements and distortions of the vortex during the ozone hole dissipation, the
vortex shape may change from circular to an elongated oval and may even tilt so that some layers may be out of the vortex while some layers may still be in [Krueger et al., 1989, Deshler et al. 1990 (a & b)], the ozone hole strength may increase (i.e. ozone layer may decrease) again for a few days during recovery. Also, the displacements may not be necessarily from east towards west (from Antarc- tic continent towards Antarctic Peninsula) but may be in other directions also. The displacement may not be steady in any one direction. It may make the ozone hole come back over the South Pole and change strength before finally disappearing.

These characteristics of the ozone hole are not surprising. Though ozone depletion is mainly of chemical origin (Chlorine chemistry. Solomon 1988, Anderson et al. 1989), changes in other parameters like temperature and water vapour (which affect the polar stratospheric clouds) and nitrogen oxides could be important (Turco et al. 1989). Also, the dynamic situations which set up conditions favourable for the chemical depletions are dependent on vertical motions which would be affected by wave structures which would disturb, displace and/or modify the circumpolar vortex (Krueger et al. 1989, Newman et al. 1990). Ozone layering caused due to exchange of ozone rich and poor air across the vortex wall in the 12-20 km layer has been demonstra- ted by Deshler et al. [1990 (a & b)]. It would be interesting to study these features in greater detail by using TOMS data at various latitude-longitude grid intervals on a daily basis.

Acknowledgements

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References


Maurer (1994), 45, 59-64

Fourier analysis of weekly soil moisture at Pune

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(Received 12 September 1994, Modified 24 May 1995)

ABSTRACT

The weekly soil moisture data collected at Central Agriculture Observatory (CAOGM), Pune during 1989-1990 have been subjected to Fourier analysis. With normal data the amplitudes for waves of period 7 days are 8.1 cm of water for first harmonic and decrease slowly with higher order harmonics. The values for fourth harmonic range from 0.01 to 0.2 cm of water only. However, the highest amplitude for the second year years 1989, 1989 and 1989 is found to vary between 0.45 to 1.5 cm of water irrespective of soil depth. Under normal conditions the maximum soil moisture value was the soil surface (0.5 cm depth) occurs on 15 September at 30 cm depth, the soil moisture maximum occurs on 24 September, a delay of 9 days.

Use the four soil depths considered thereby, the first, second and third harmonics represent respectively 1987 and 1989 and normal data. The change in soil moisture pattern after June and October due to occurrence of southwest and northeast monsoon is well reflected.

Keywords — Soil moisture, Fourier analysis, Soil-climate, Soil moisture cycles.

1. Introduction

The soil moisture under bare soil condition like the soil temperature, varies in a nearly regular pattern reflecting the annual cycle of rainfall. This cycle, however, is somewhat modified due to the intra-seasonal variation of rainfall caused by different synoptic situations. The observed soil moisture variation for various depths at the Agroclimatic station have shown that the pattern is not a symmetrical one. Considerable variation is produced by the occasional thunder showers in the pre-monsoon season and the intra-seasonal variation of rainfall during southwest monsoon season.

Small but irregular fluctuations of meteorological and agrometeorological parameters are normally reduced by averaging the data series. However, the averaging (over periods, 10 years) reduces, but does not eliminate, these deviations, particularly for soil related parameters down through the soil profile (Carson 1961). In such cases, the averaged data may be used as means of Fourier analysis, reducing the soil moisture versus time curves to a series of Fourier coefficients. These coefficients give an objective description of the variation with depth of the amplitude of the soil moisture wave and the time location of soil moisture extremes. Several scientists (Pearce 1958, Pearce and Cold 1959, Carson 1962) have reported that the annual cycle has been of various meteorological and agrometeorological parameters is fairly well described by the first harmonic alone. On the other hand, others have also reported that the first harmonic alone is not sufficient to describe the annual cycle (Lettau 1954, Kinniann and Kubach 1972) and that the effect of higher harmonics have to be considered. In this study, an attempt has been made to represent the observed observed variation of soil moisture from that of predicted one from first five harmonics for some selected years, viz., 1984, 1985 and 1987 and 1989 which have gaged either excess, normal or deficient rainfall. The effect of higher harmonics have also been consid- ered for representing the actual observed variation by analysed of normal soil moisture.