

MILLSTONE HILL MEASUREMENTS AND TGCM SIMULATION FOR THE 30 MAY 1984 ANNULAR SOLAR ECLIPSE

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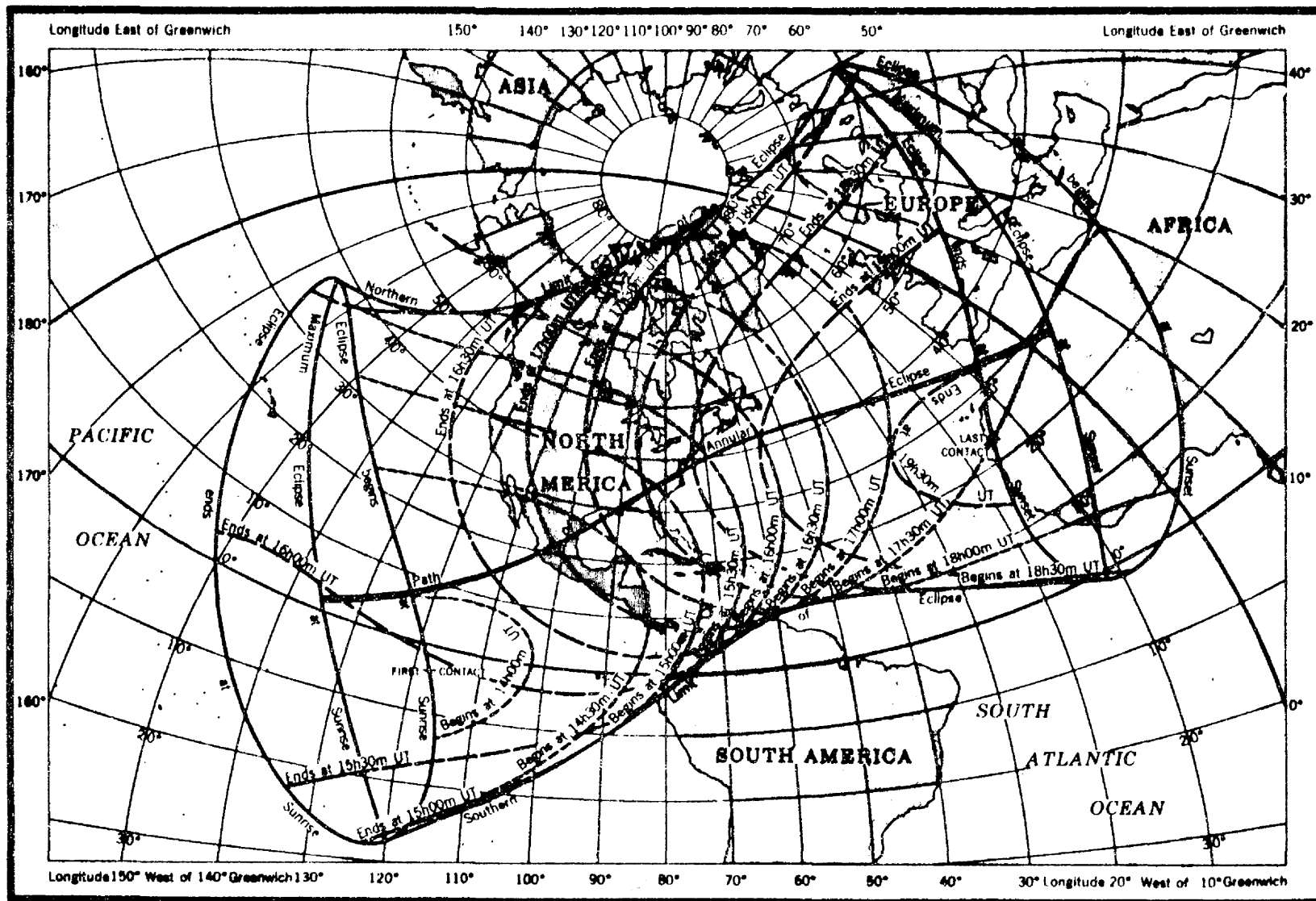
On 30 May 1984, the Millstone Hill incoherent scatter radar was operated to gather data on the effects of the annular solar eclipse on the structure and dynamics of the ionosphere and thermosphere. The eclipse path was about 3 deg. south of Millstone which experienced a maximum obscuration of 86% at about 1705 UT. Both the zenith and steerable antennas at Millstone were used in the experiment to collect data on the temporal evolution of the eclipse effects. This experiment represented the first opportunity at Millstone to collect data during an eclipse in the absence of a major magnetospheric disturbance which had previously made the unravelling of eclipse effects difficult. In addition, the configuration of the experiment and analysis of the data included a detailed examination of the effects on the neutral atmosphere. A major catalyst for this study was the opportunity to compare the results with the predictions made from the Thermospheric General Circulation Model (TGCM) at NCAR, as a calibration point for the model. The plans for the experiment were formulated at the February 1984 Incoherent Scatter Data Users Workshop; the Arecibo and Sondrestrom radars also participated as part of a radar chain experiment. The analysis of the data from these stations is in progress; this paper presents the initial results from Millstone Hill.

The observations, confirming the TGCM predictions, indicate a drop in electron density by 60% at the peak obscuration time in the altitude range 130 - 250 km. At higher altitudes, a smaller decrease (14%) is observed, in contrast to the model predictions and the difference is due to assumed flux boundary conditions. Although a difference in mean electron temperature exists between model and temperature, a good agreement is found in the relative drop (~25%) during the eclipse. Within somewhat large fluctuations it is possible to discern a 50° K drop in the exospheric temperature measurements as predicted from the TGCM.

From three dimensional ion drift measurements across the eclipse path a neutral wind velocity, governed primarily by the meridional component, of about 50 m/sec at eclipse time is observed. Within the uncertainties of the measurements, little change in the winds is observed prior to and following the eclipse, and the results are similar to previous summer day observations where a reversal occurs near 1400 EST. Electric fields derived from the data indicate magnitudes of the order of 1 mV/m or less, primarily north-westward except between 1530 and 1730 U.T. where the field is south-eastward. While the TGCM predicted similar overall wind magnitudes and directions as observed, it has been difficult to verify the convergence of wind perturbations onto the eclipse

path as would be expected and as indicated by the model. This is because of geometric considerations of the ion drift vectors relative to the eclipse path, and because of the sensitivity of the radar measurements in the F-region to both the meridional and zonal components. It is nonetheless possible to state that the overall dynamic behavior predicted by the TGCM is consistent with the observations.

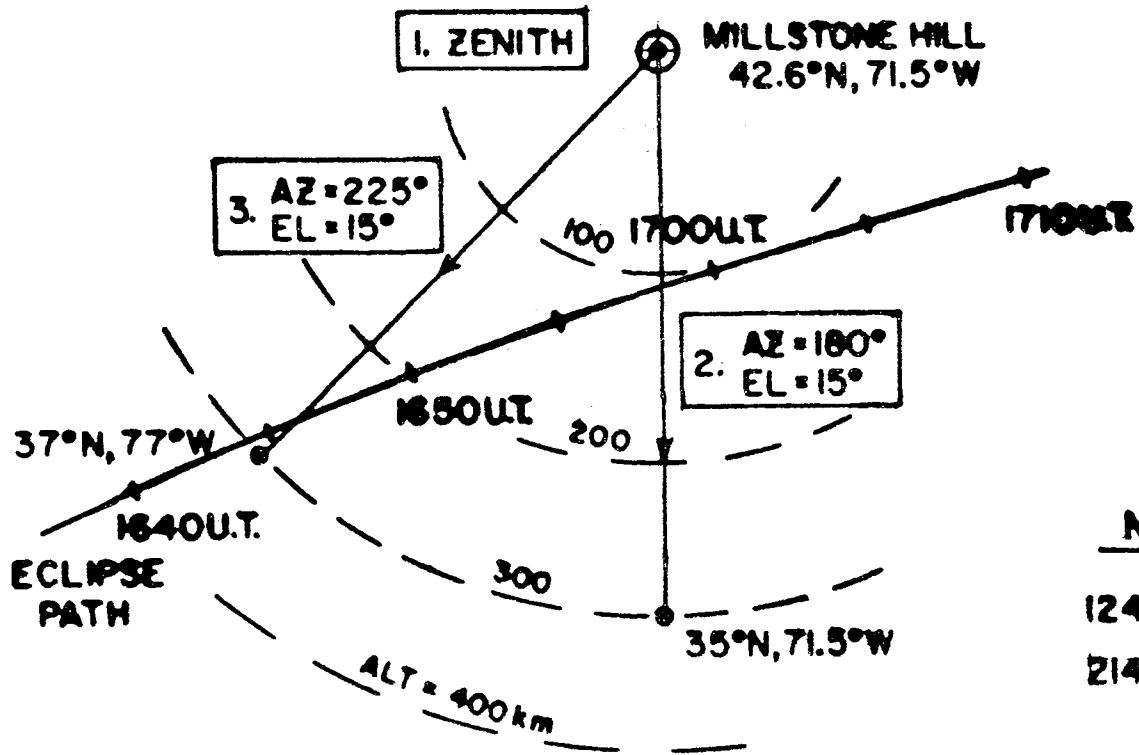
ANNULAR SOLAR ECLIPSE OF 1984 MAY 30



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Figure 1.

30 MAY, 1984



U.T.	K_e
0	3
3	3
6	4
9	4
12	2
15	3
18	3
21	3

NORTHWARD SCANS

1240 U.T. $V_i = 20 - 30 \text{ m/sec}$

2140 U.T. $V_i = 30 - 40 \text{ m/sec}$

↓
 $E_x \sim 1 - 2 \text{ mV/m}$

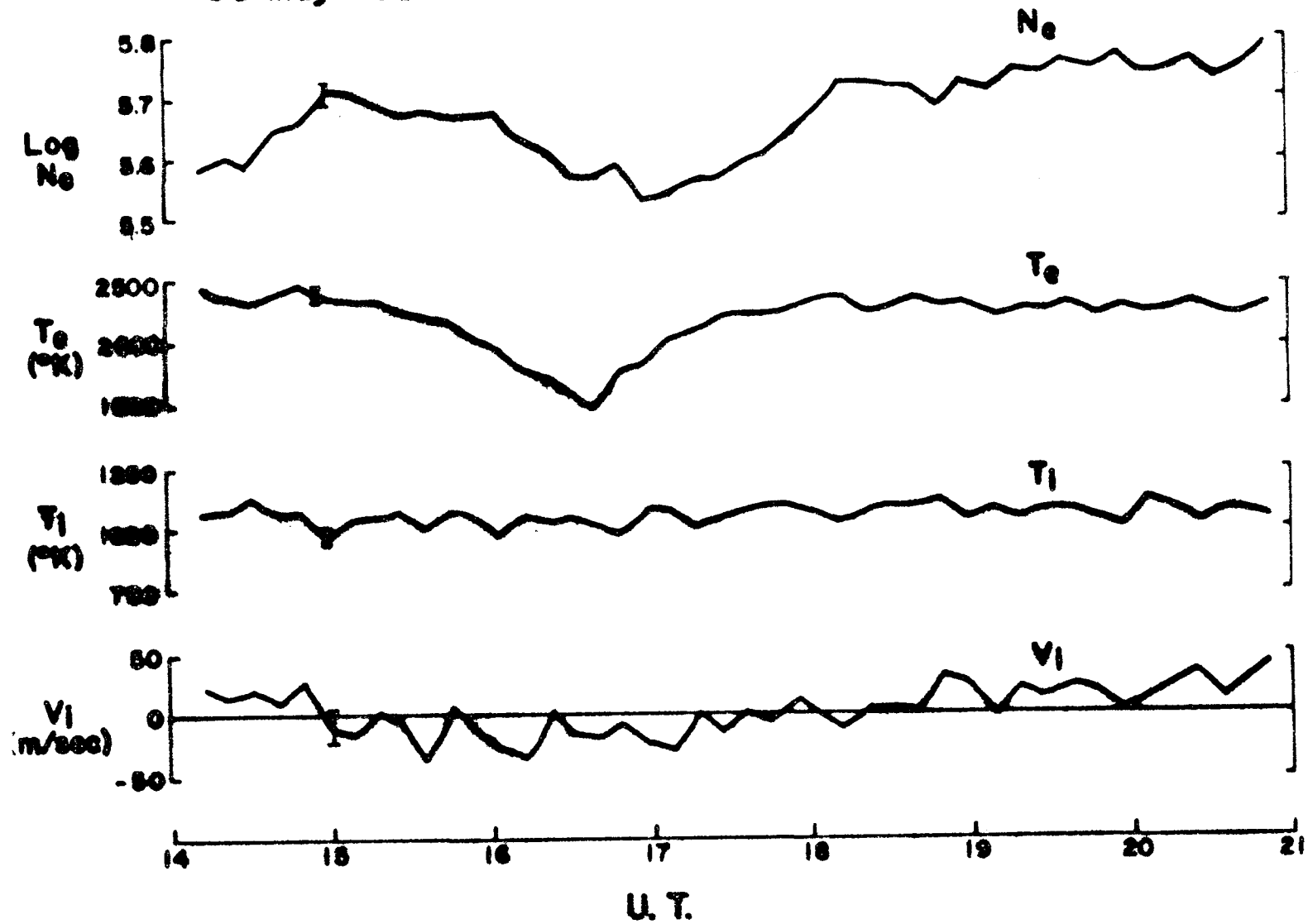
418

Figure 2.

Millstone Hill
30 May 1994

300km

$Az = 225^\circ$
 $EI = 15^\circ$



419

Figure 3.

420

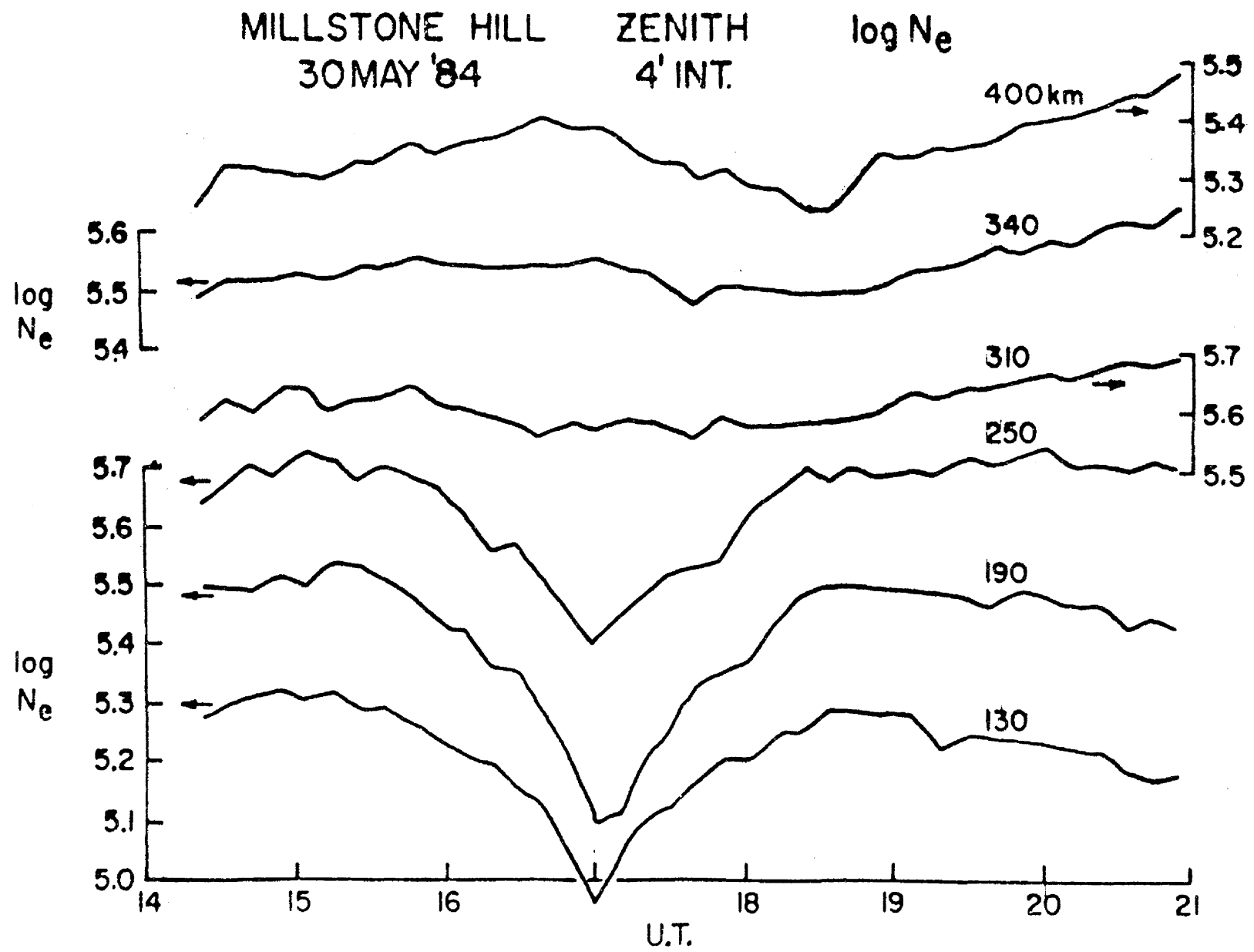
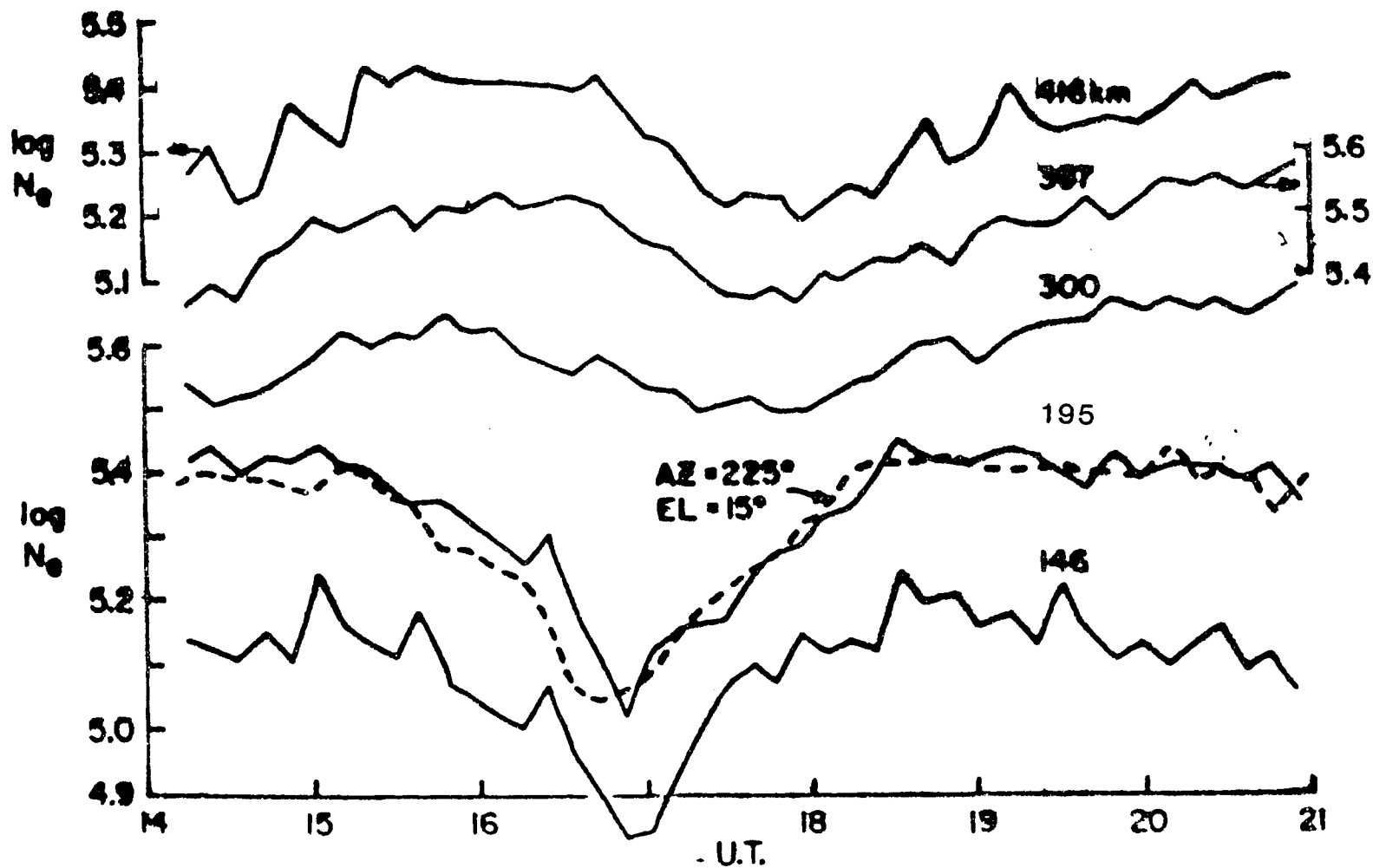


Figure 4.

MILLSTONE HILL
30 MAY '84

AZ = 180°
EL = 15°



421

Figure 5.

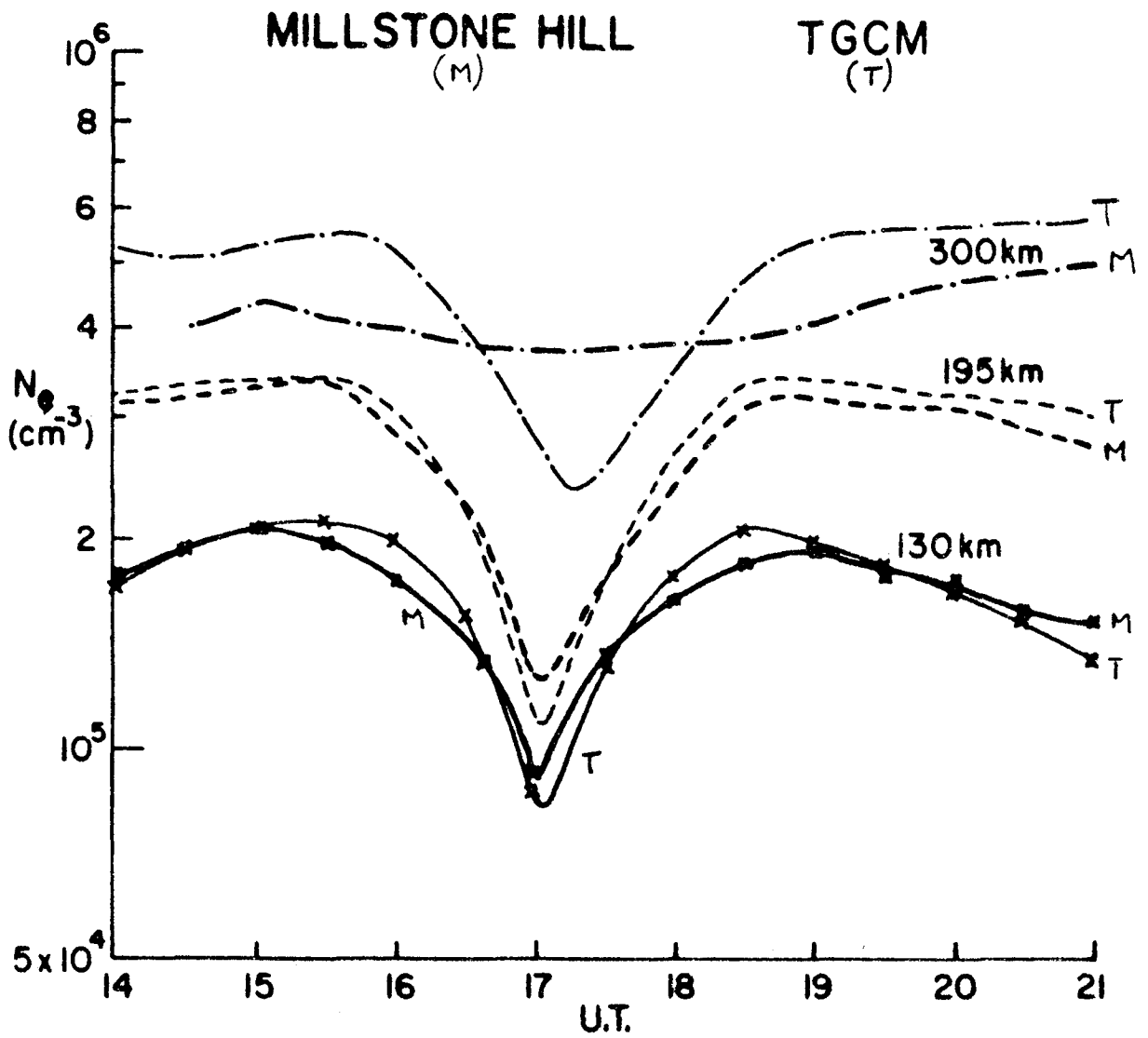
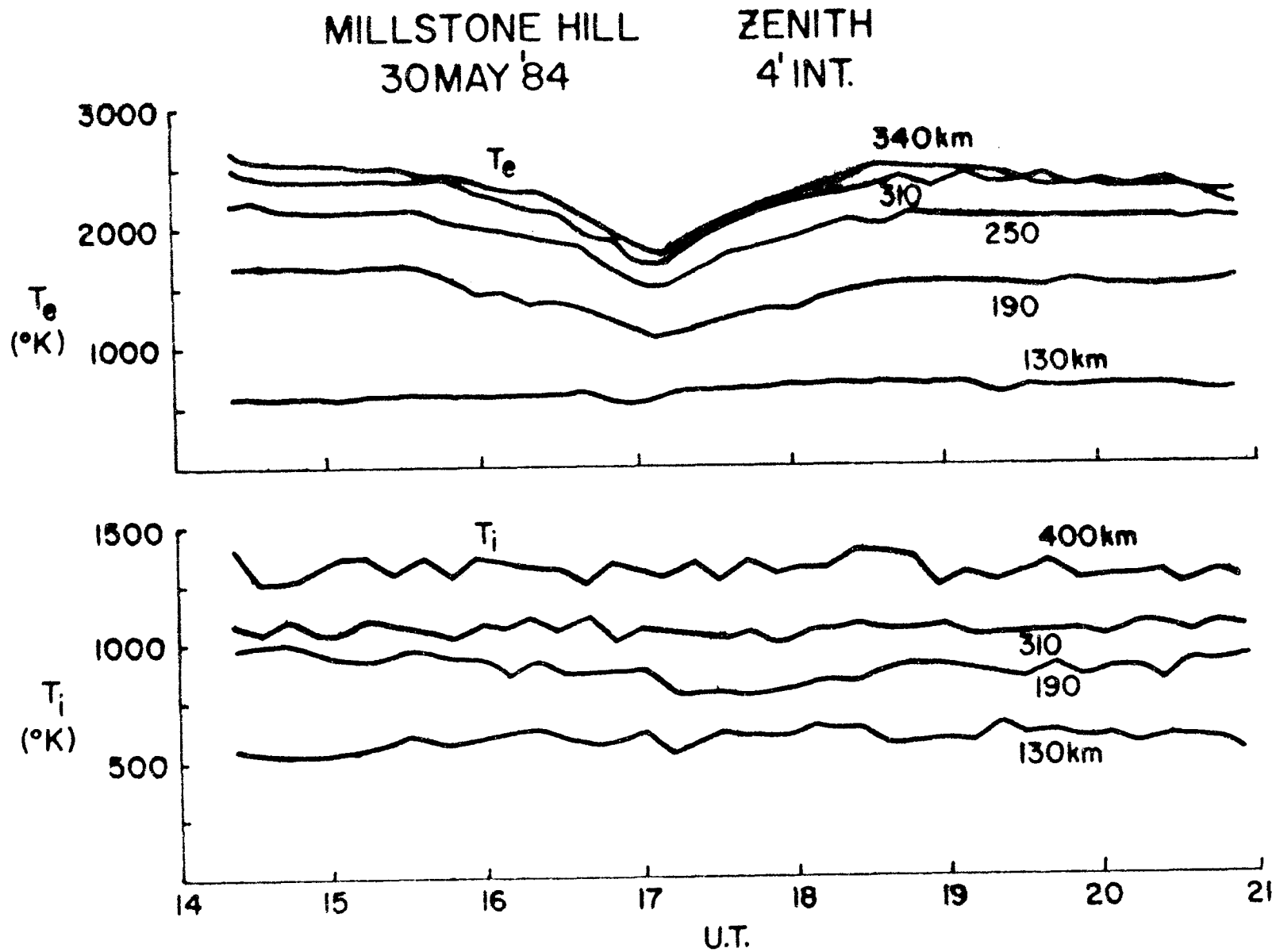


Figure 6.



423

Figure 7.

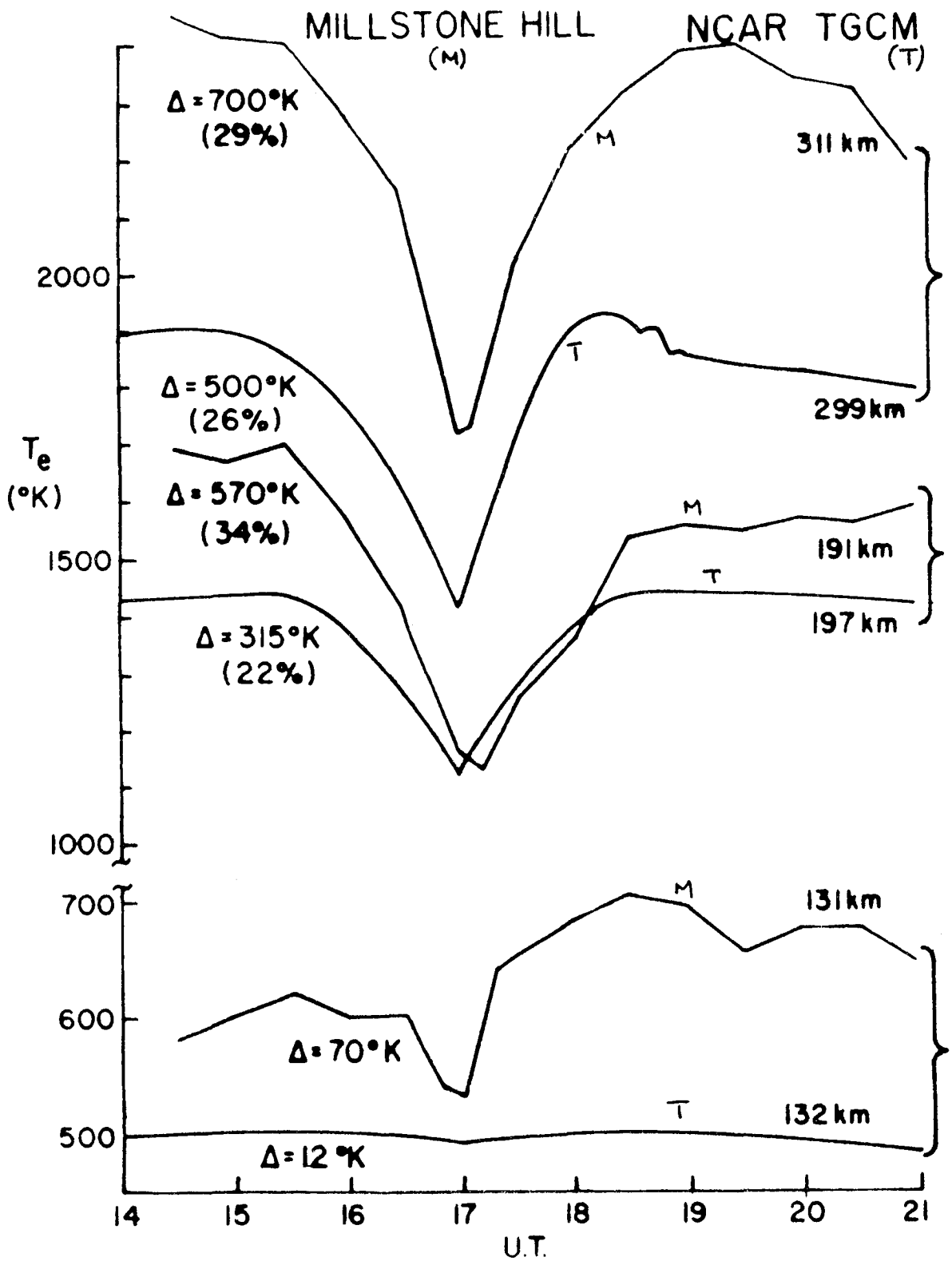
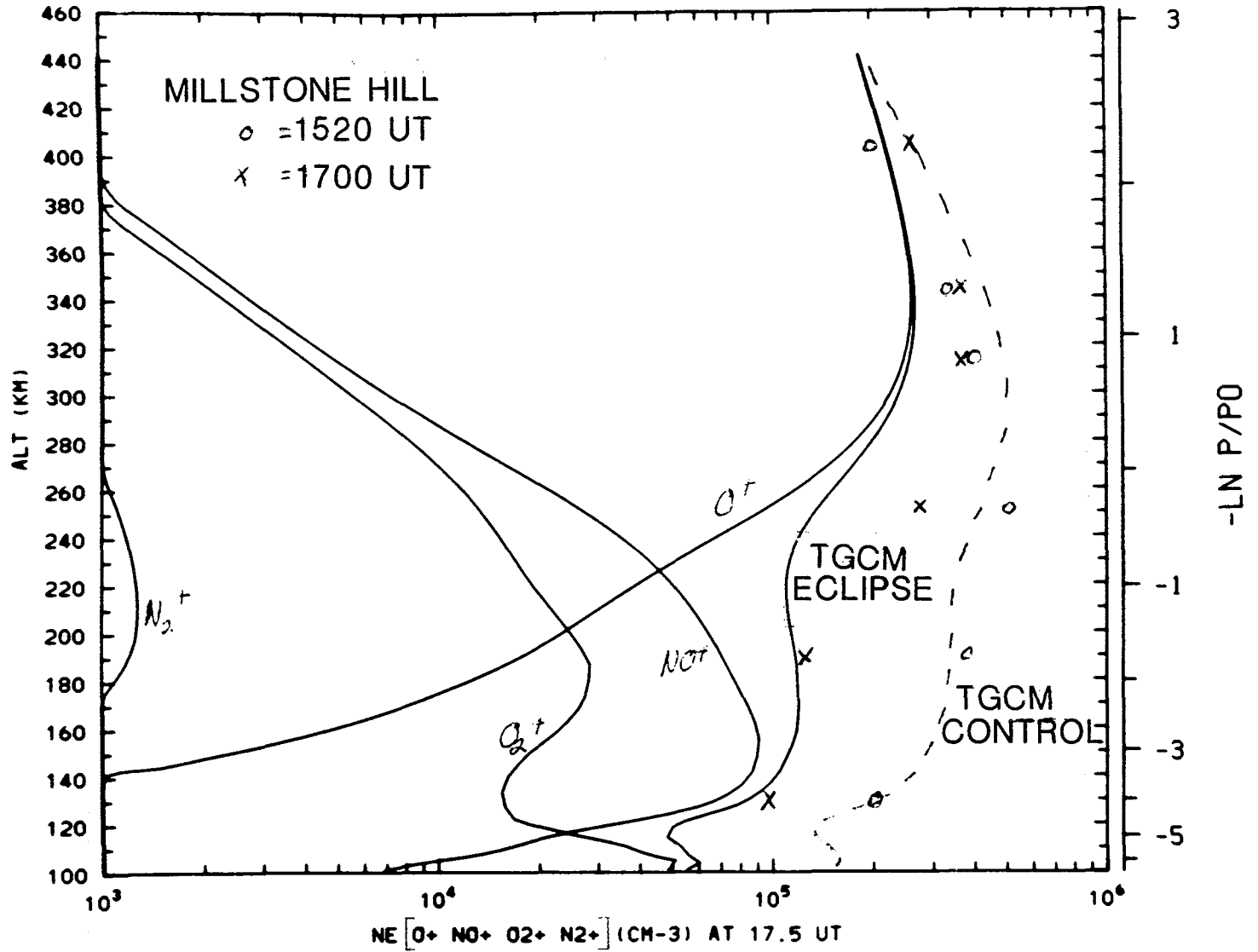


Figure 8.

84151 MEAS E TGCM MILLSTONE ECLIPSE6



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Figure 8a. NCAR TGCM update.

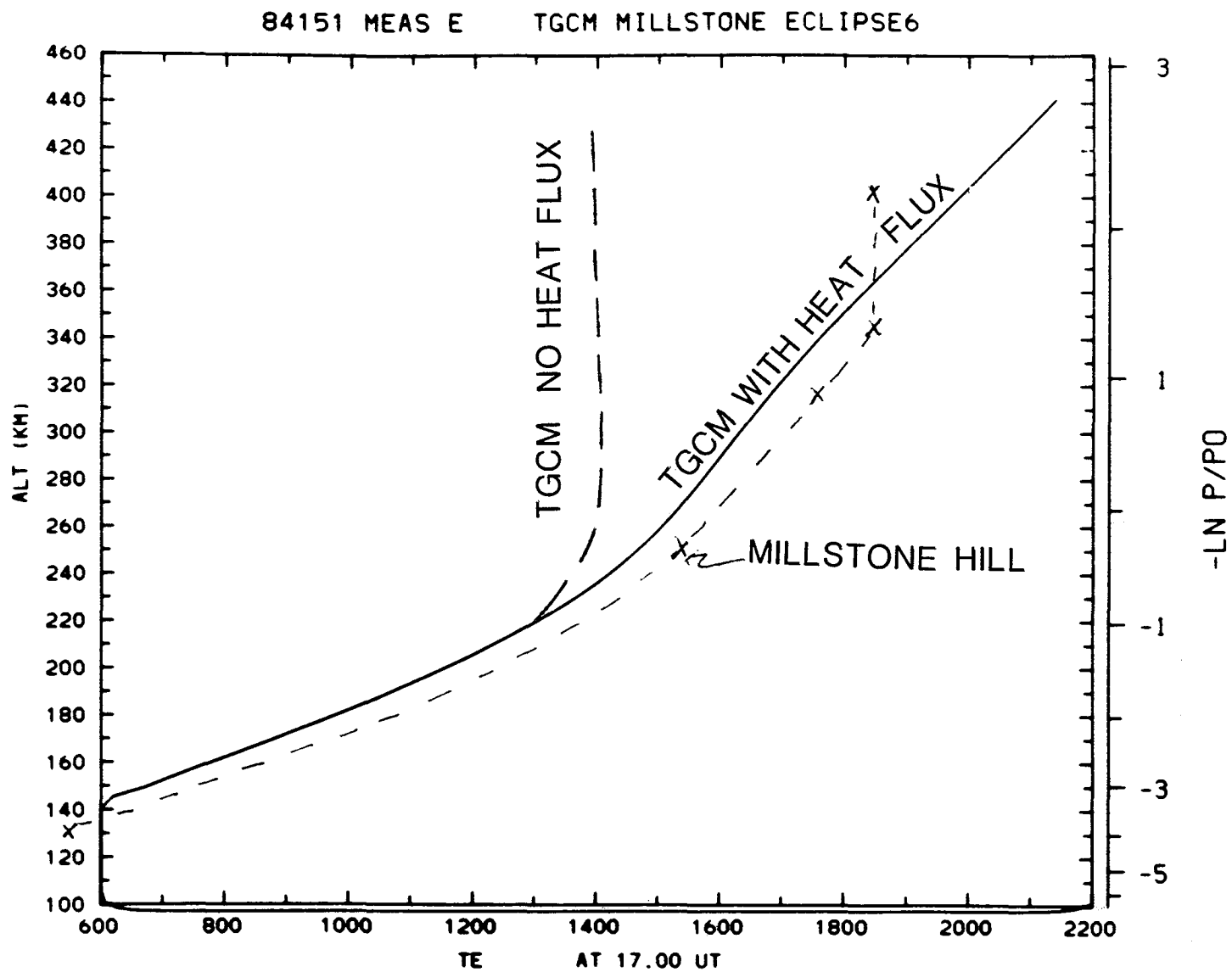


Figure 8b. NCAR TGCM update.

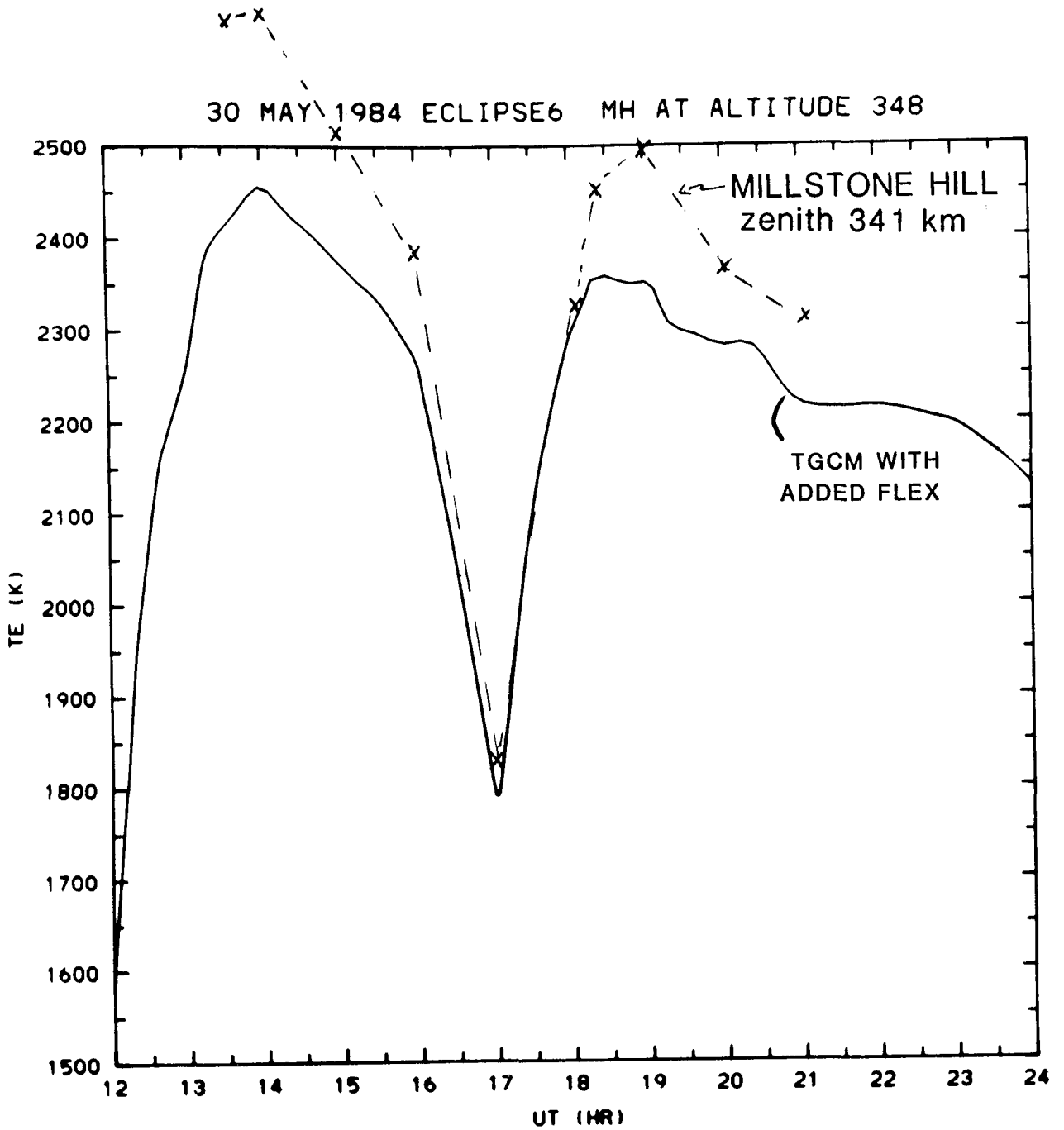


Figure 8c. NCAR TGCM update.

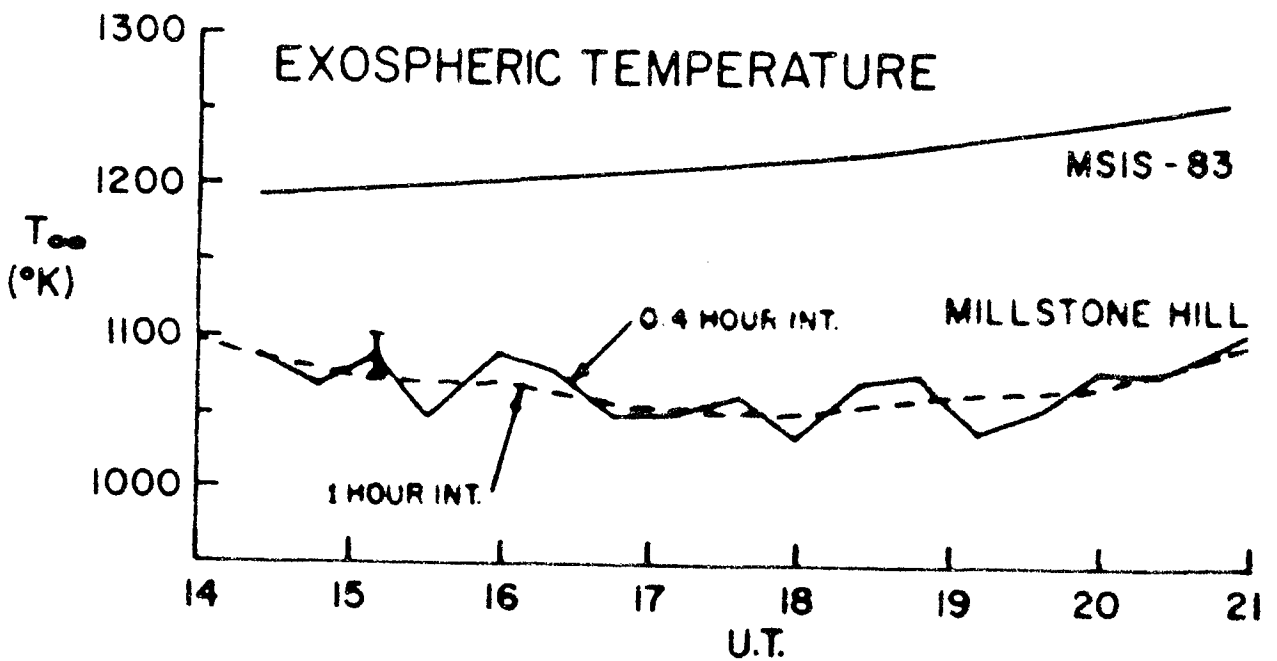
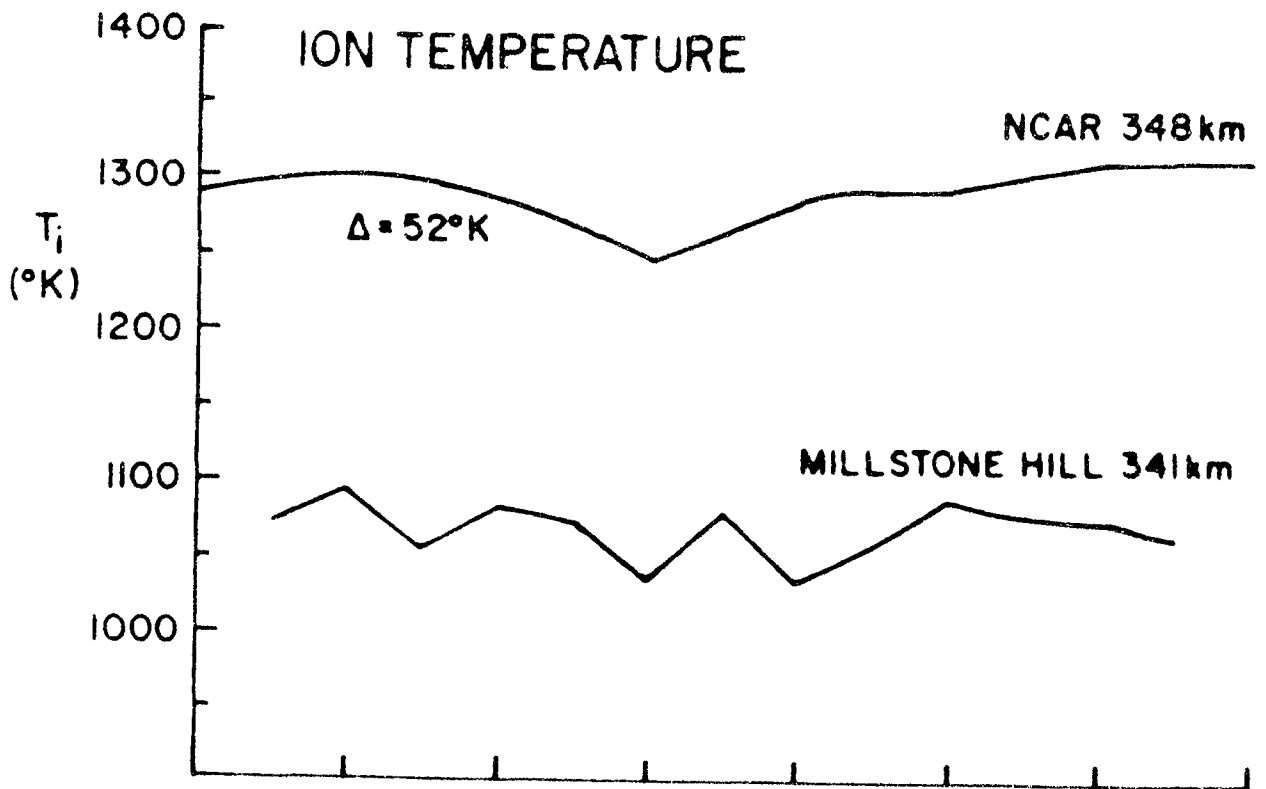


Figure 9.

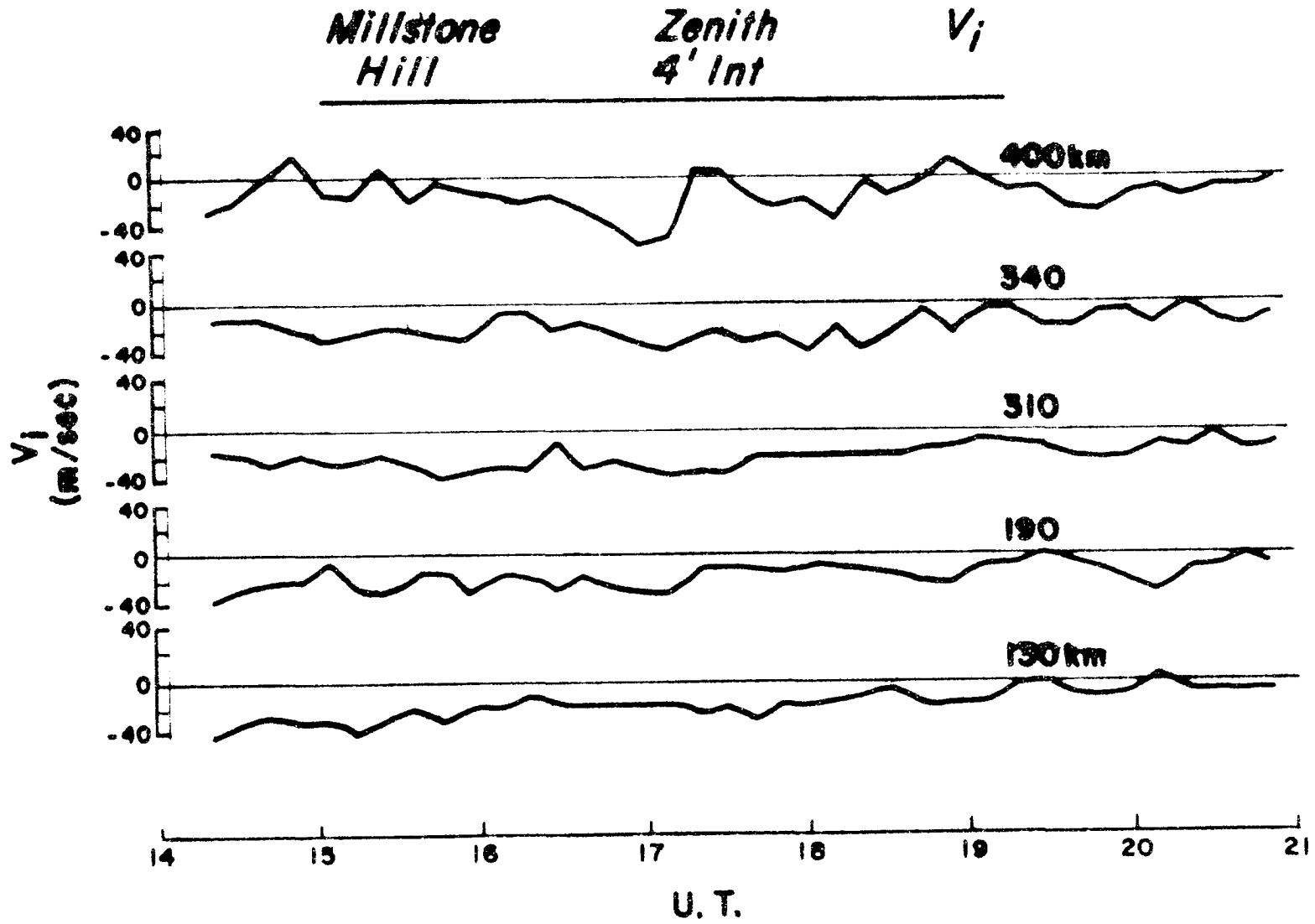
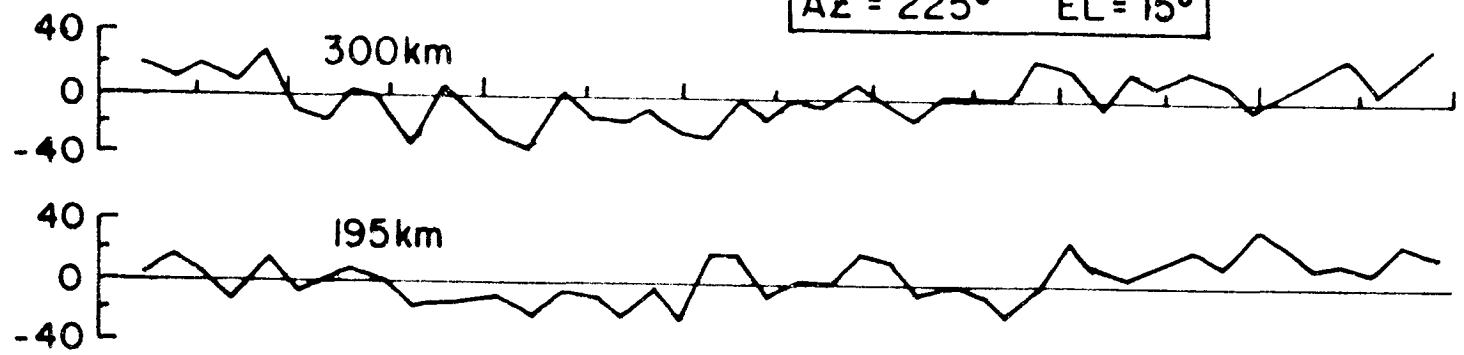


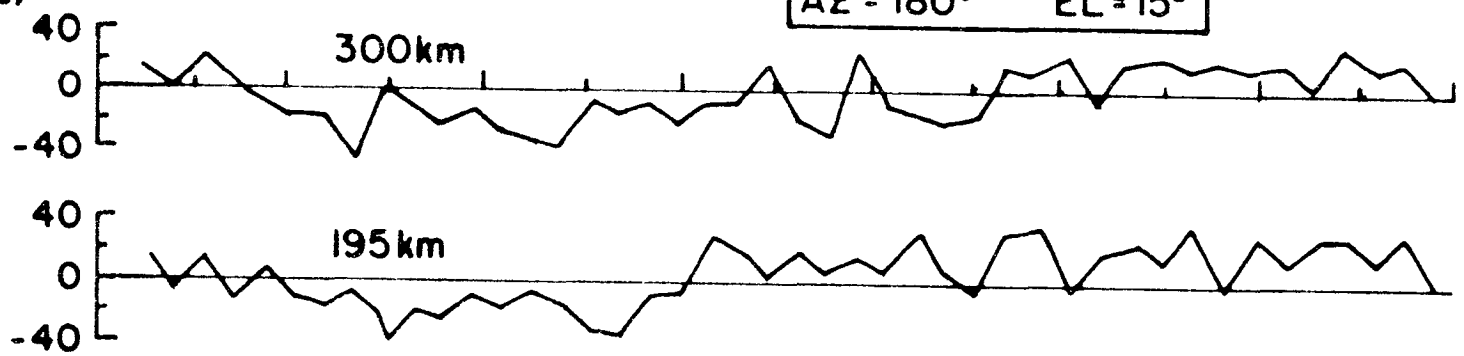
Figure 10.

MILLSTONE HILL V_i
30 MAY '84

AZ = 225° EL = 15°



AZ = 180° EL = 15°



430

V_i
(m/sec)

14 15 16 17 18 19 20 21
U.T.

Figure 11.

DERIVATION OF NEUTRAL WINDS

$$V_I \text{ (ZENITH)} \quad -0.95 V_{\text{DIFF}} = -0.29 V'_N + 6 E_X + 1.5 E_Y$$

$$V_I \text{ (S, } 15^\circ\text{E)} \quad -0.54 V_{\text{DIFF}} = -0.16 V'_N - 17 E_X + 0.8 E_Y$$

$$V_I \text{ (SW, } 15^\circ\text{E)} \quad -0.4 V_{\text{DIFF}} = -0.12 V'_N - 12 E_X + 15 E_Y$$

WHERE $V'_N = V_N - 0.25 U_N$

U_N, E_X : EASTWARD POSITIVE

V_N, E_Y : NORTHWARD POSITIVE

$U, V = \text{M/SEC}$ E : MV/M

Figure 12.

MILLSTONE HILL 30 MAY '84

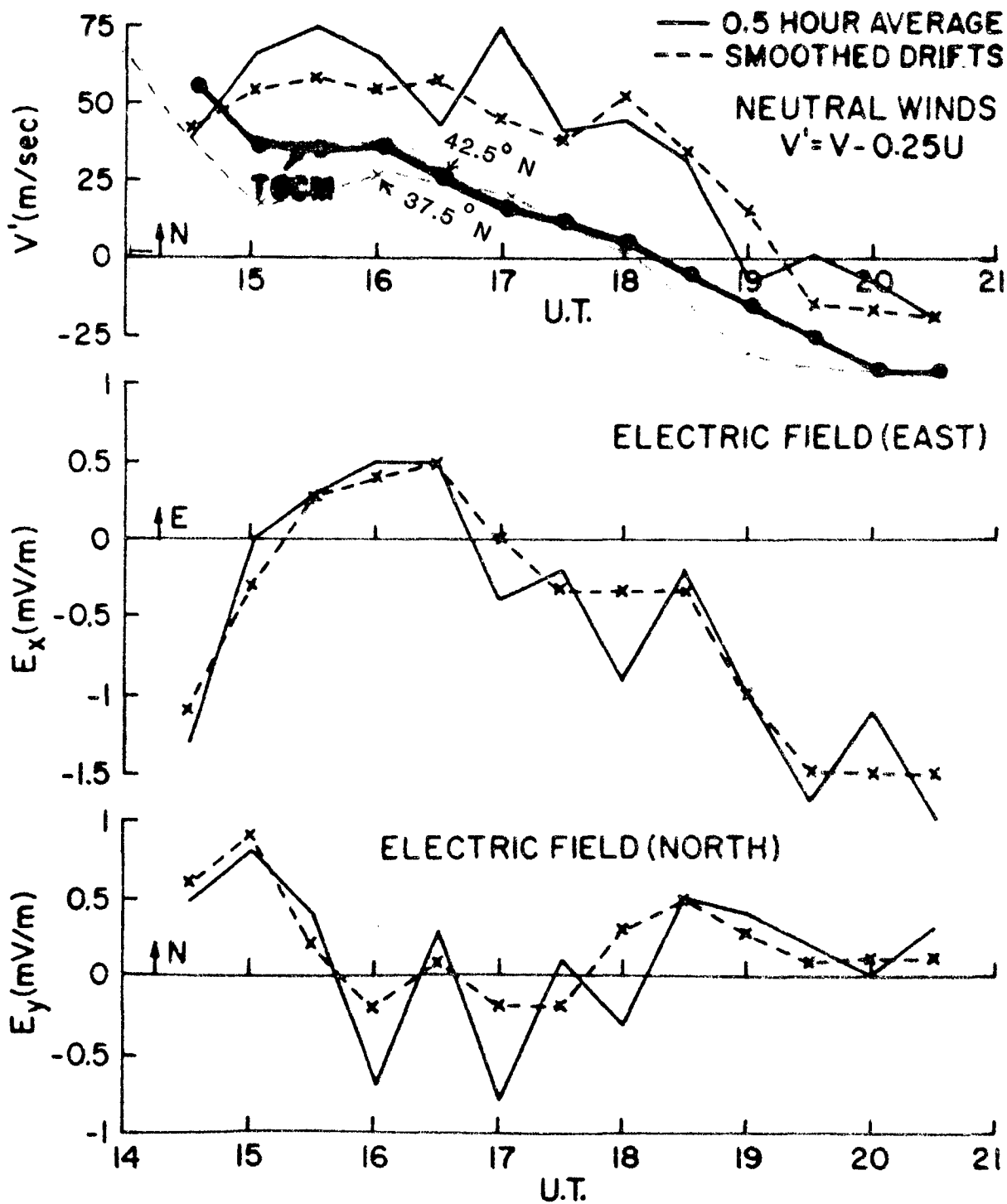


Figure 13.

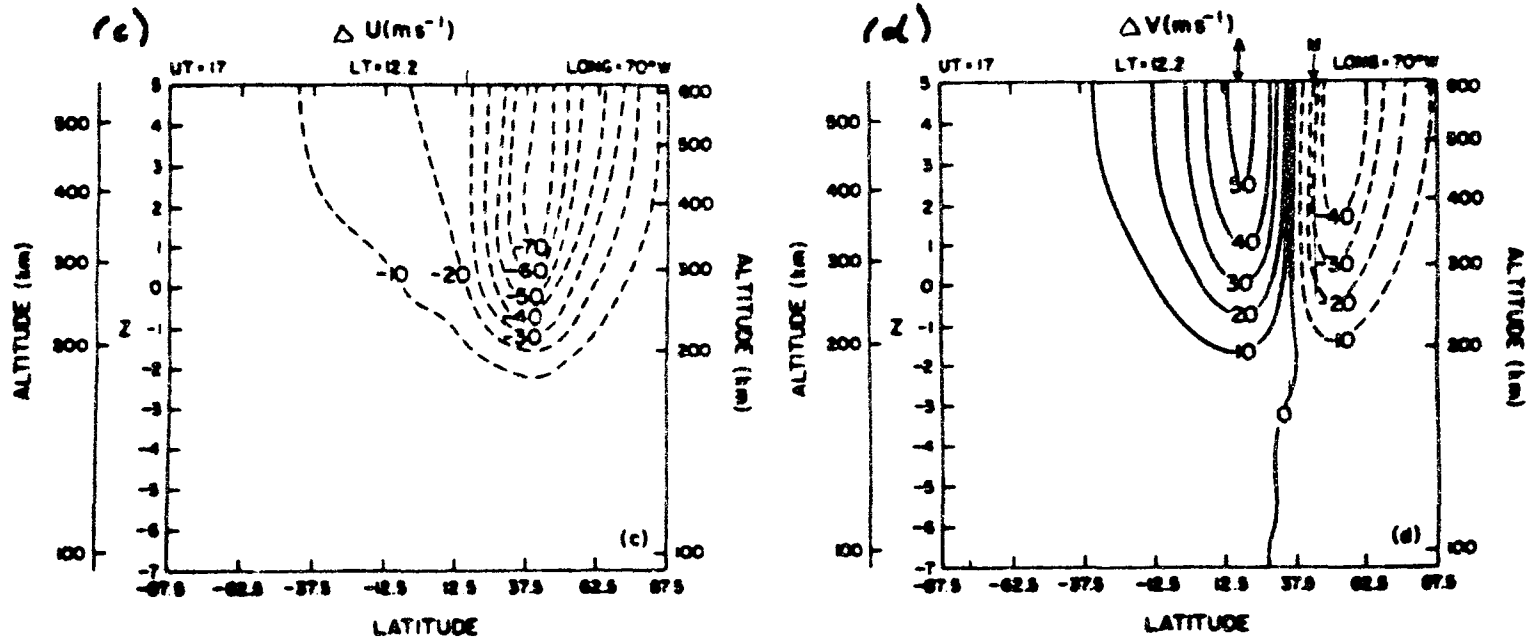


Figure 14. NCAR TGCM predictions of Neutral Wind Perturbations for Eclipse - 17 U.T.

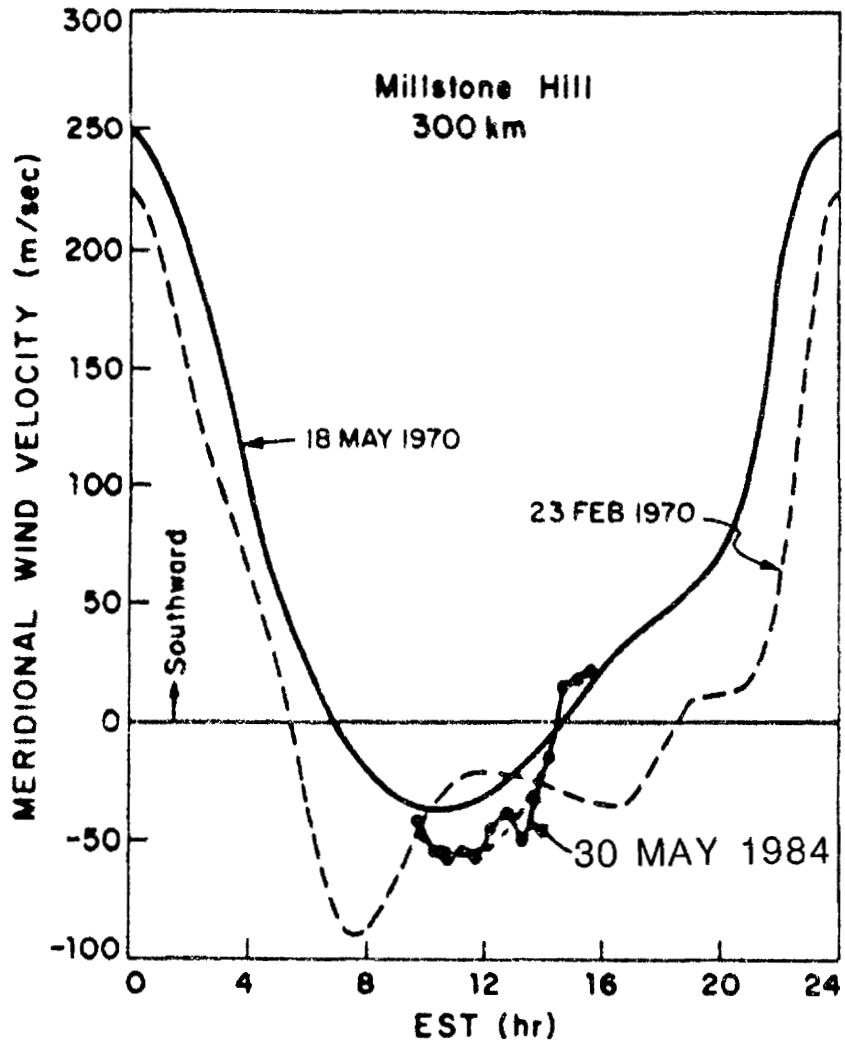


Figure 15.

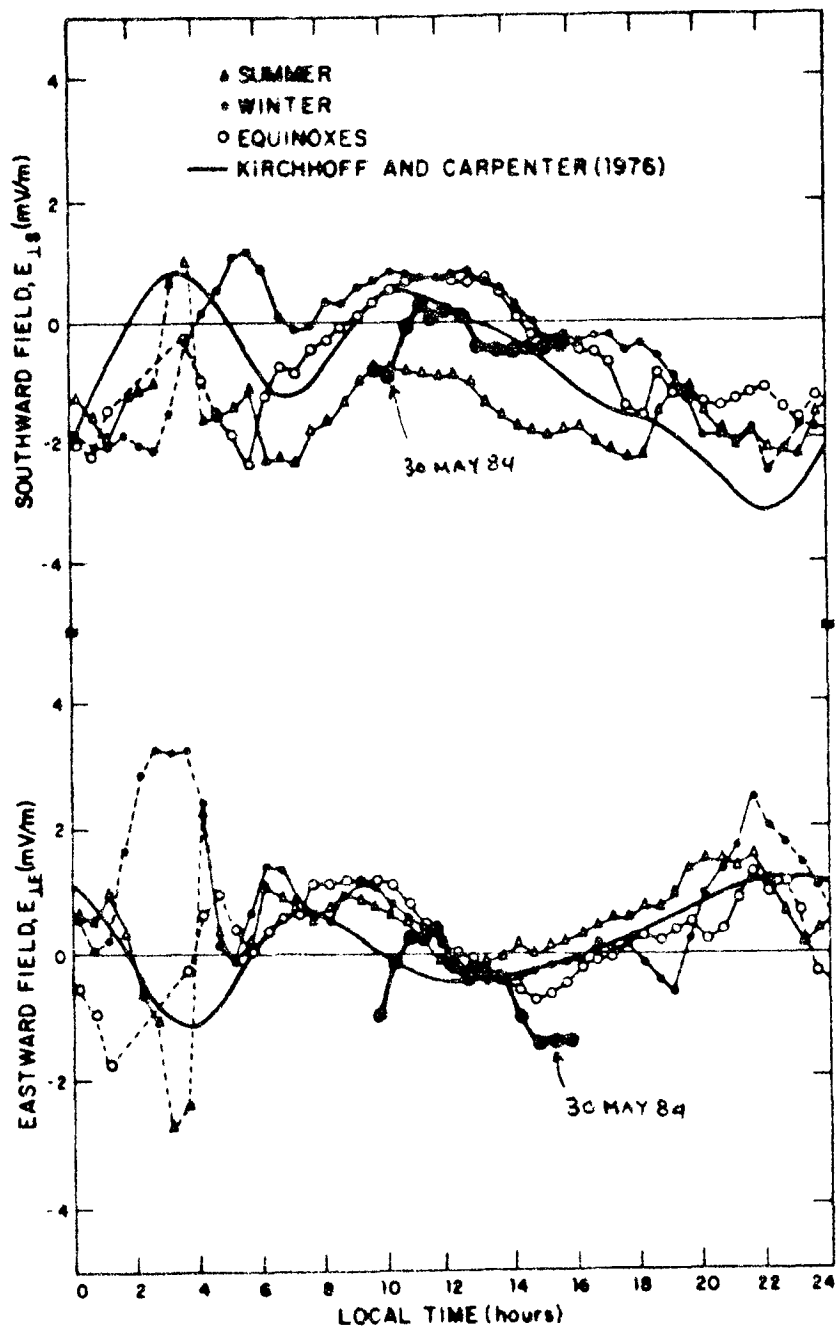


Figure 16.

SUMMARY

		<u>NCAR TGCM</u>	<u>MILLSTONE HILL</u>
$\frac{\Delta N_E}{T_E}$	130 KM	61%	55%
	200 KM	68%	62%
	300 KM	56%	14%
$\frac{\Delta T_E}{T_E}$	130 KM	2%	12%
	200 KM	22%	34%
	300 KM	26%	29%
$\frac{\Delta T_\infty}{T_\infty}$		~5%	~4%
V-0.25U	300 KM 17 UT	+ 20 M/SEC (N) (42.6°N)	+45 M/SEC (N) (42.6-35°N)
	E-FIELD		< 1mV/M EASTWARD 15-17 UT SOUTHWARD 16-18 UT

Figure 17.

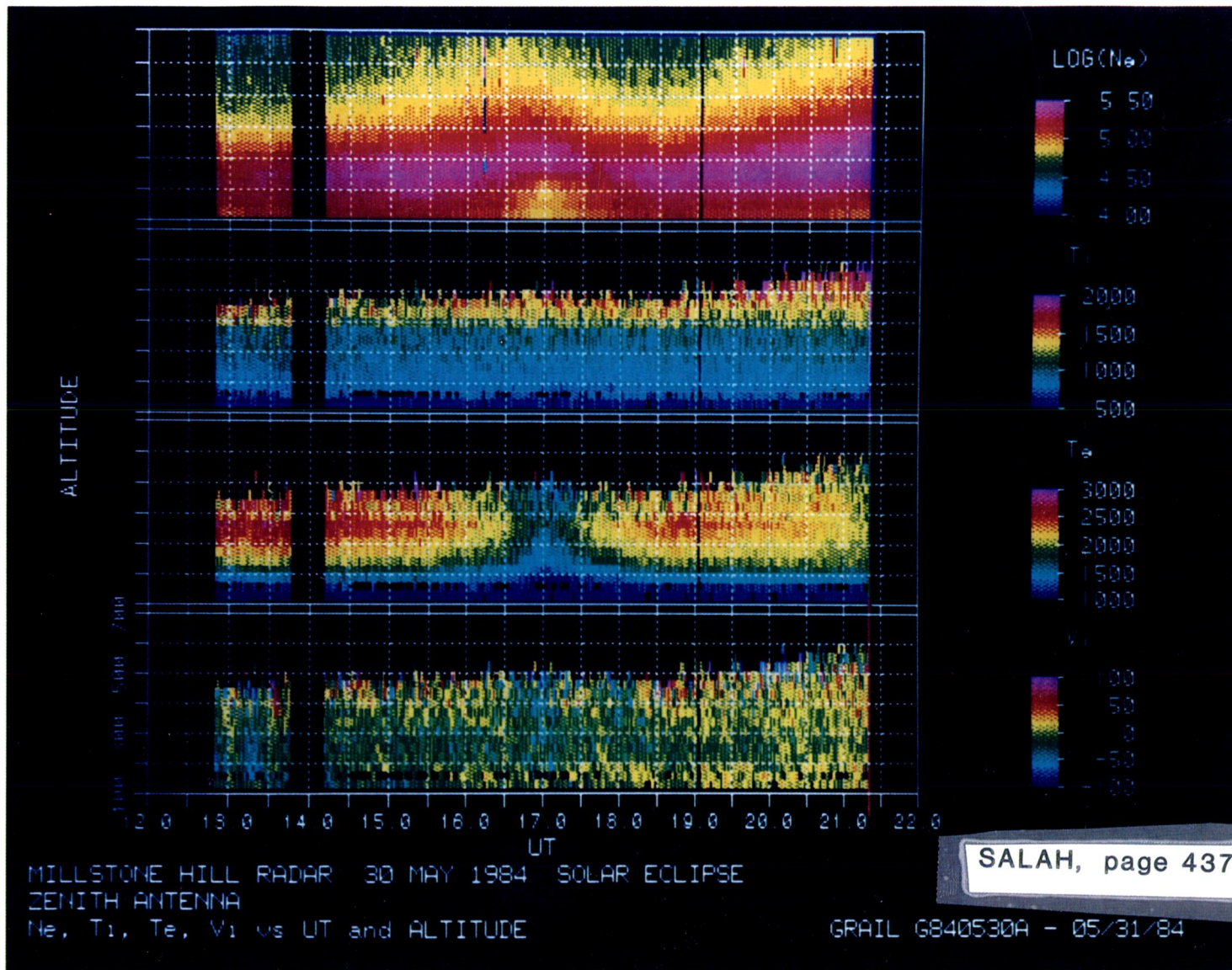


Figure 18.

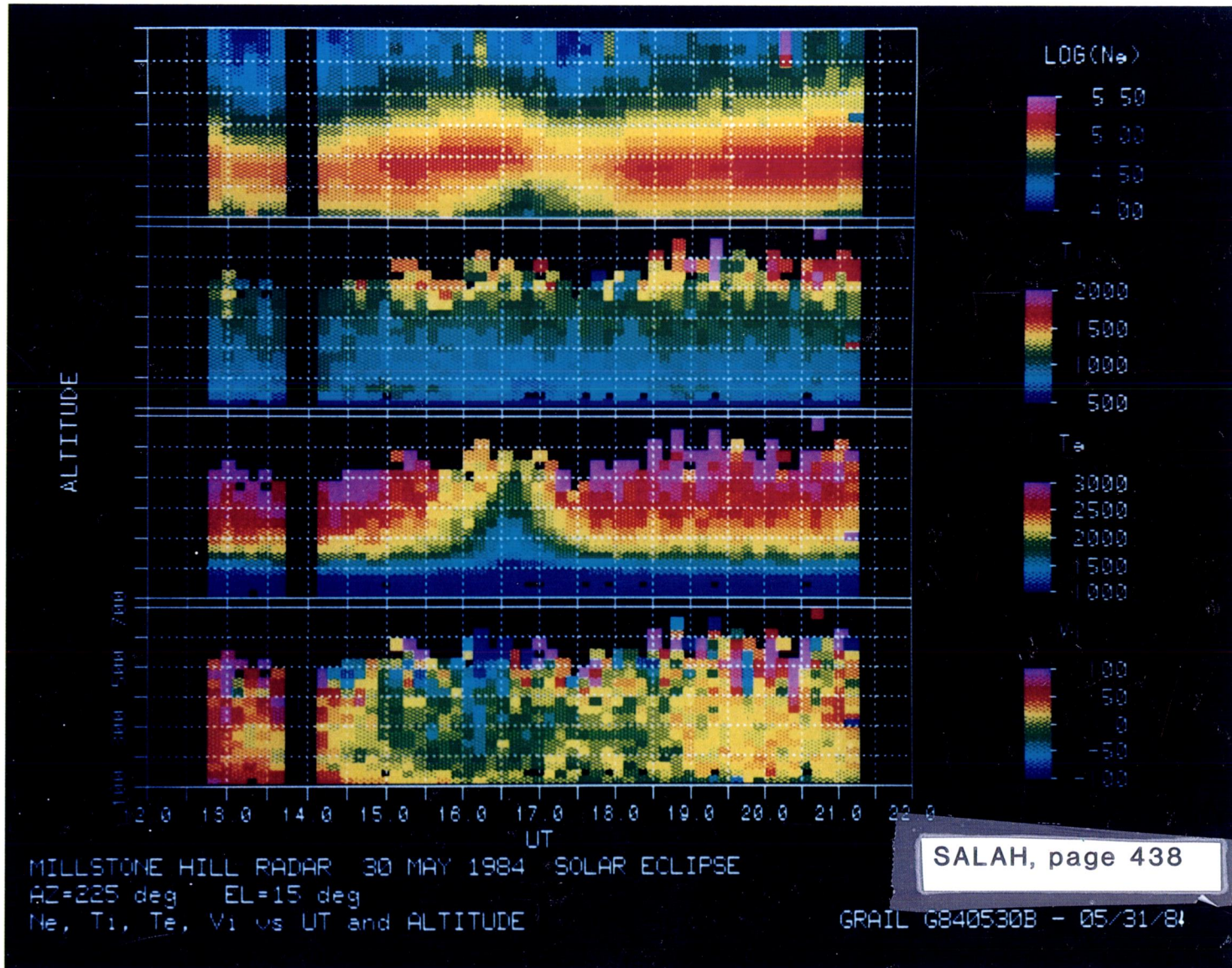


Figure 19.