

ATOMIC NITROGEN DENSITIES NEAR THE POLAR CUSP

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The Neutral Atmosphere Composition Spectrometer (NACS) on board the Dynamics Explorer-2 spacecraft sampled several major and minor thermospheric gases including atomic nitrogen. We present here a selection of passes over the polar cusp that provide a quantitative measure of the increase of N densities due to soft particle precipitation occurring in this region. Increases in N densities are frequently observed, but are smaller than accompanying increases in N₂ densities. Our observations support earlier studies suggesting that 1) N densities increase more rapidly than O densities during periods of high solar EUV flux and 2) N densities are larger in the summer hemisphere than in the winter hemisphere. A series of passes in February 1983, late in the lifetime of DE-2, indicated N densities at 2000 km altitude which were a factor of ≈ 2 larger near the southern cusp than near the northern cusp.

TABLE I

Atomic nitrogen densities in or near the polar cusp late in the lifetime of DE-2.

ORBIT	DATE	$F_{10.7}$	Kp	CUSP	ALTITUDE (km)	DENSITY (cm^{-3})
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Northern Hemisphere

8543	83047	91.9	4	Y	236	6.4×10^6
8553	83048	94.2	3	Y	238	6×10^6
8562	83048	94.2	3	N	186	1.1×10^7

Southern Hemisphere

8436	83040	125.3	3+	Y	236	1.4×10^7
8514	83045	94.1	3	N	230	1×10^7
8551	83048	94.2	4-	Y	205	2.4×10^7
8574	83049	99	3	N	199	2.8×10^7

10/ 2/84

DE-B NACS

ORBIT NO. : 1630

MASS : 30 40 14 4

PROCESSED : 7/17/83

SYMBOL : \$ A N 4

MAF KEY : D 81325 56817325 81325 58785299 B NACS COMP2001

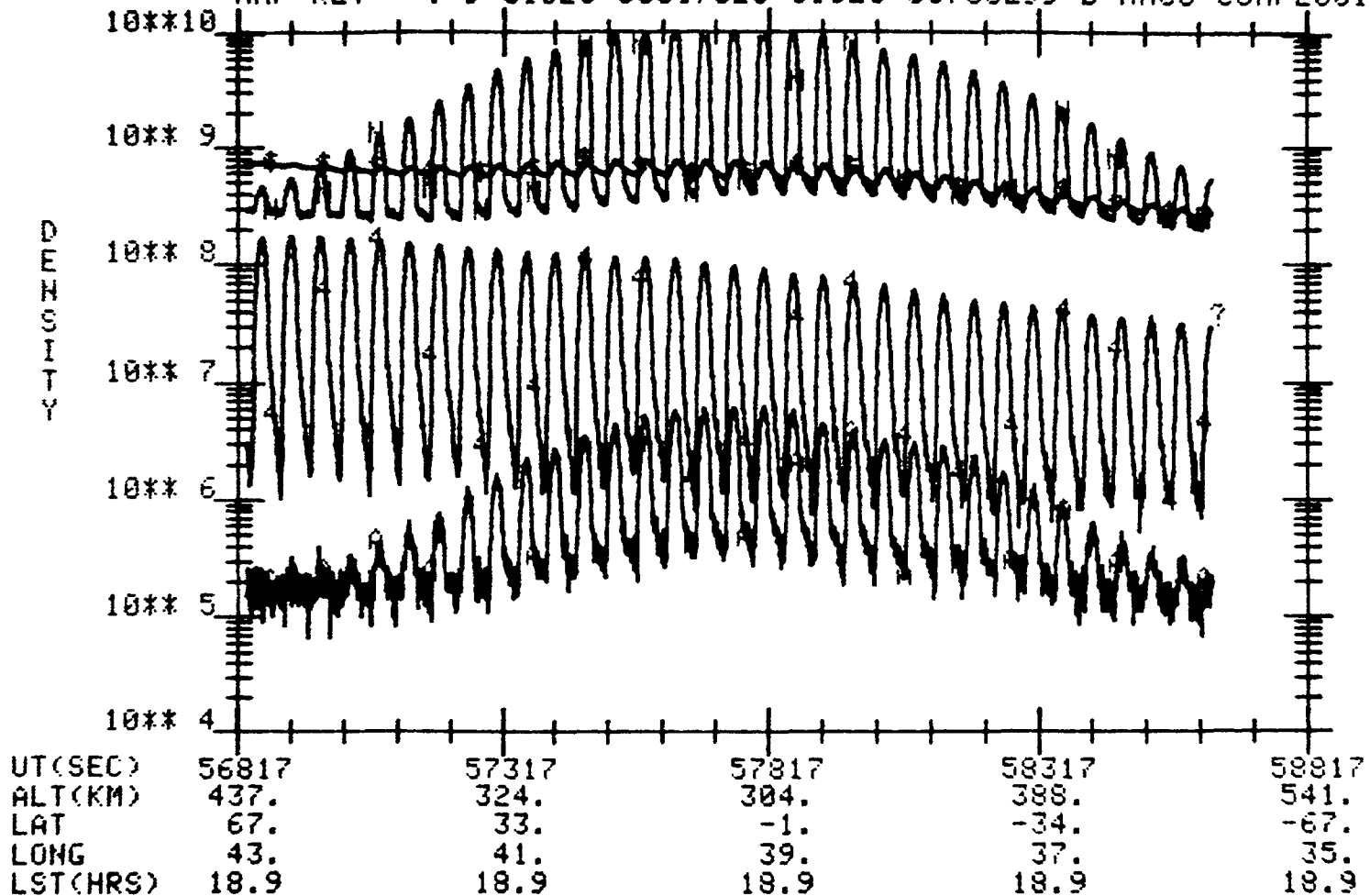


Figure 1. Ion source number densities of NO, Ar, N₂ and He measured by the Neutral Atmospheric Composition Spectrometer (NACS) of the Dynamics Explorer-2 satellite on orbit 1630, November 21, 1981. Number densities are plotted on a logarithmic scale as a function of universal time (UT). Also shown on the abscissa are satellite altitude, geographic latitude and longitude, and local solar time.

10/ 2/84

DE-B NACS

ORBIT NO. : 1632

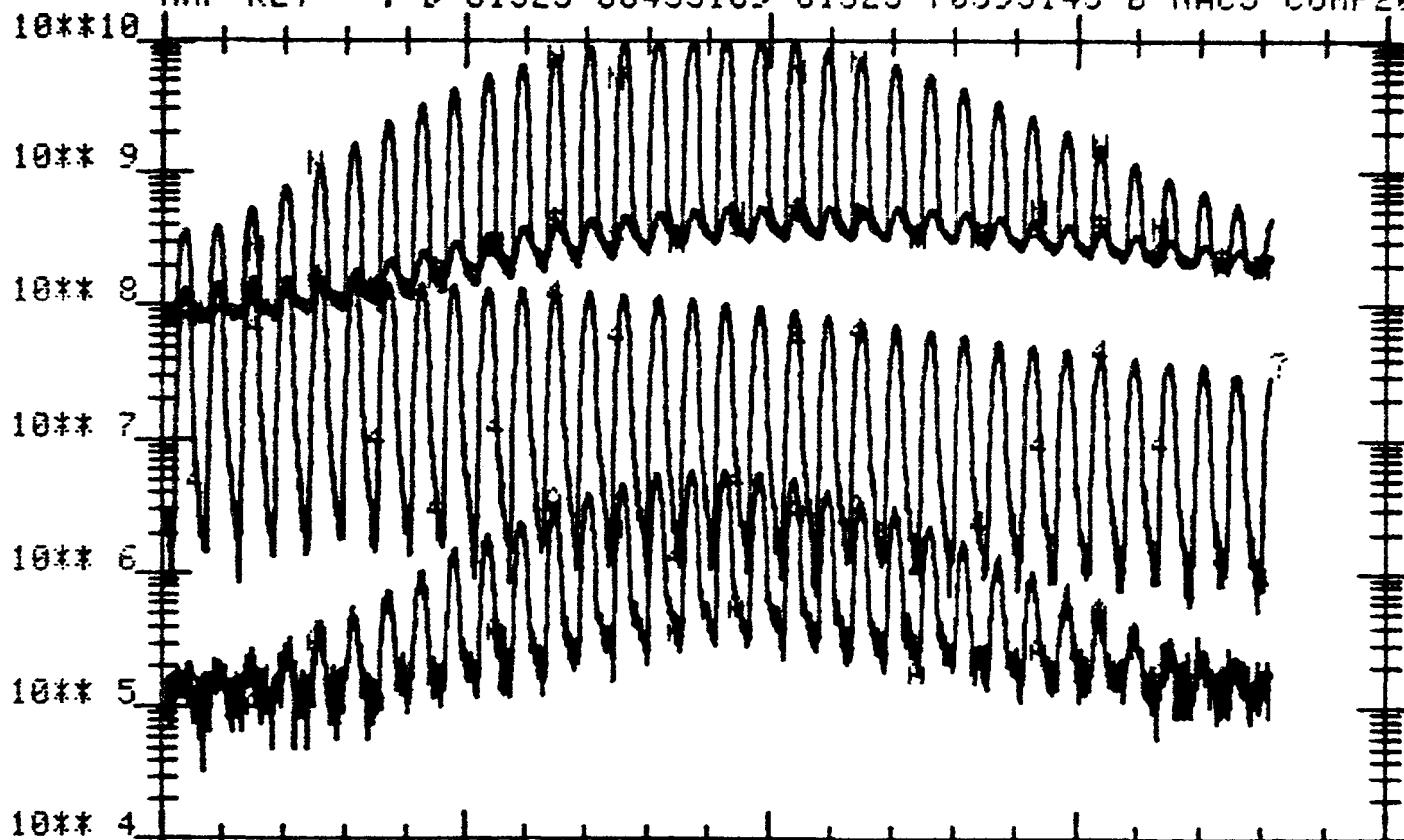
MASS : 30 40 14 4

PROCESSED : 9/10/84

SYMBOL : \$ A N 4

MAF KEY : D 81325 68433169 81325 70393143 B NACS COMP2001

DENSITY



UT(SEC)	68433	68933	69433	69933	70433
ALT(KM)	434.	323.	304.	390.	544.
LAT	66.	33.	-1.	-35.	-67.
LONG	-5.	-7.	-9.	-11.	-14.
LST(HRS)	18.9	18.9	18.9	18.9	18.9

Figure 2. Ion source densities of NO, Ar, N₂, and He for orbit 1632 of DE-2, run on November 21, 1981, as in Figure 1.

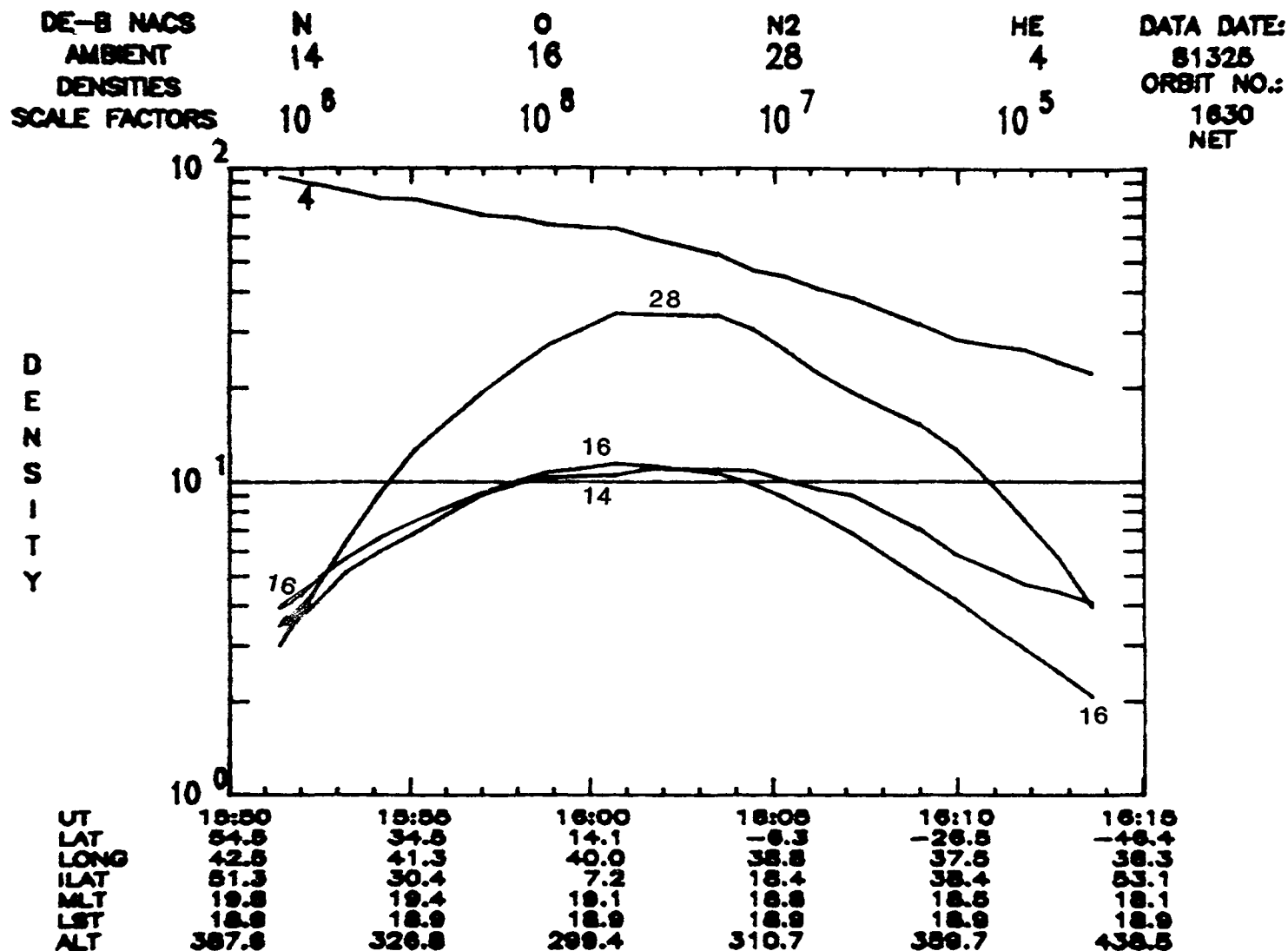


Figure 3. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 1630, November 21, 1981. Number densities are plotted on a normalized logarithmic scale as a function of universal time. The densities shown in the graph are to be multiplied by the appropriate scale factor shown at the top of the figure to give the correct ambient densities.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^6

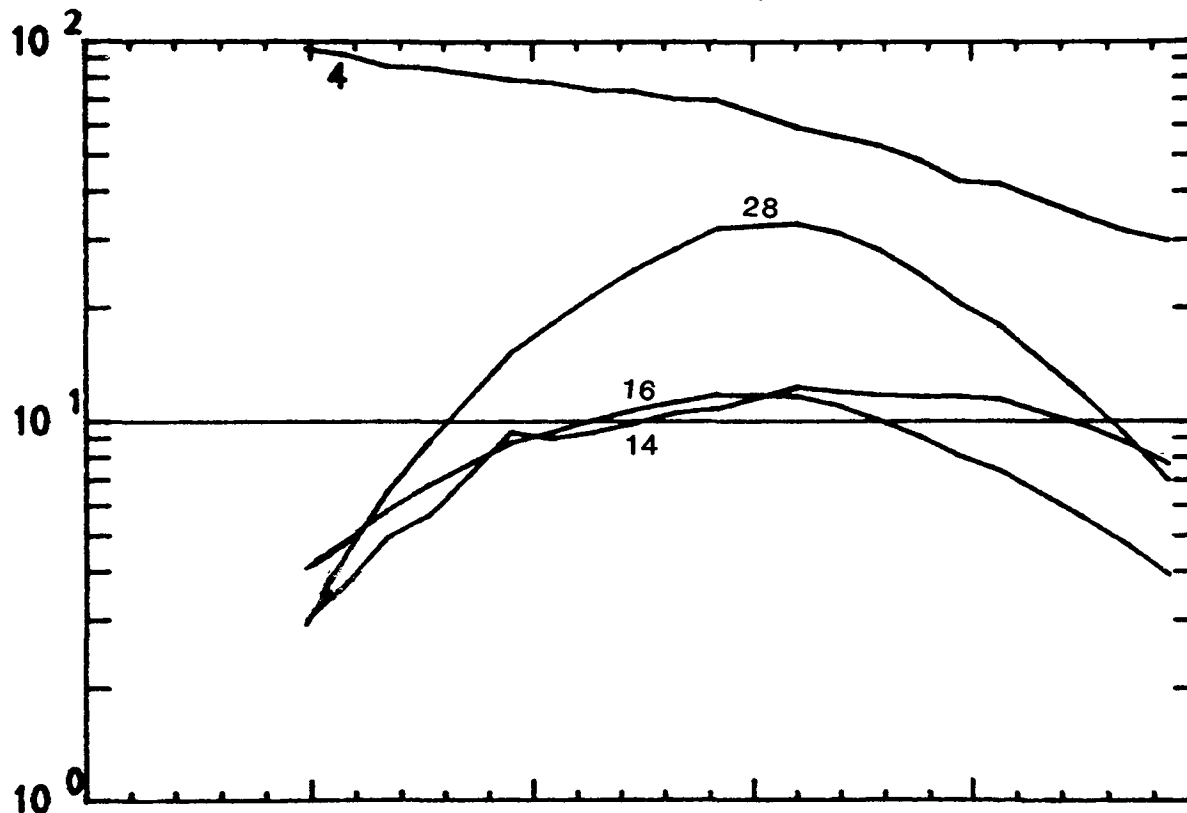
O
16
 10^8

N₂
28
 10^7

He
4
 10^5

DATA DATE:
81325
ORBIT NO.:
1632
NET

D
E
N
S
I
T
Y



UT	19:00	19:05	19:10	19:15	19:20	19:25
LAT	68.5	48.5	28.6	8.2	-12.2	-32.3
LONG	-5.2	-8.4	-7.6	-8.9	-10.1	-11.4
ILAT	68.5	48.4	25.5	12.1	25.1	38.4
MLT	20.8	19.6	19.2	18.9	18.6	18.4
LST	18.9	18.9	18.9	18.9	18.9	18.9
ALT	443.7	365.5	314.2	298.5	322.0	381.3

Figure 4. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 1632, November 21, 1981, as in Figure 3.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^5

O
16
 10^7

N₂
28
 10^7

He
4
 10^5

DATA DATE:
82212
ORBIT NO.:
5426
NET

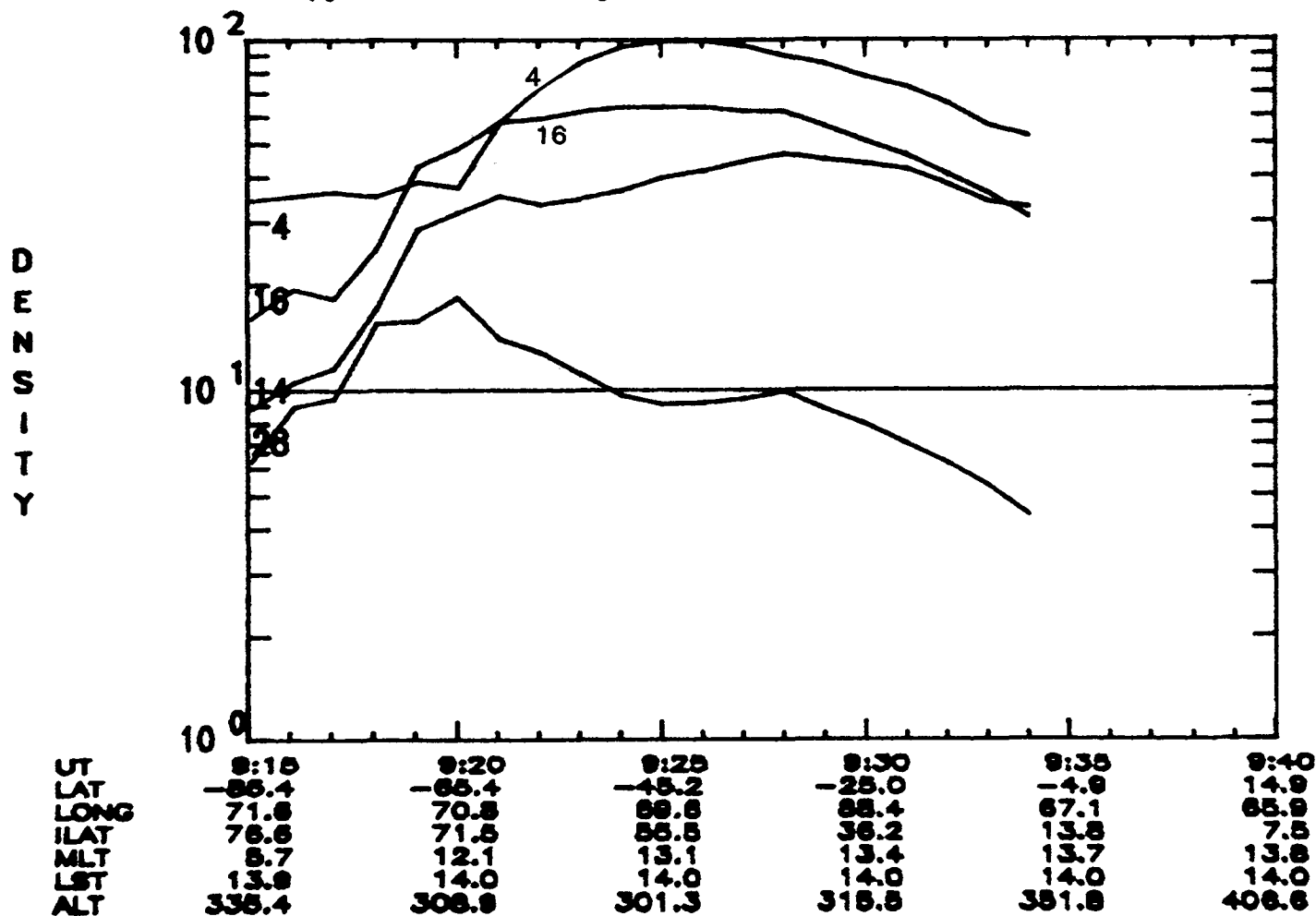


Figure 5. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 5426, July 31, 1982, and in Figure 3.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^6

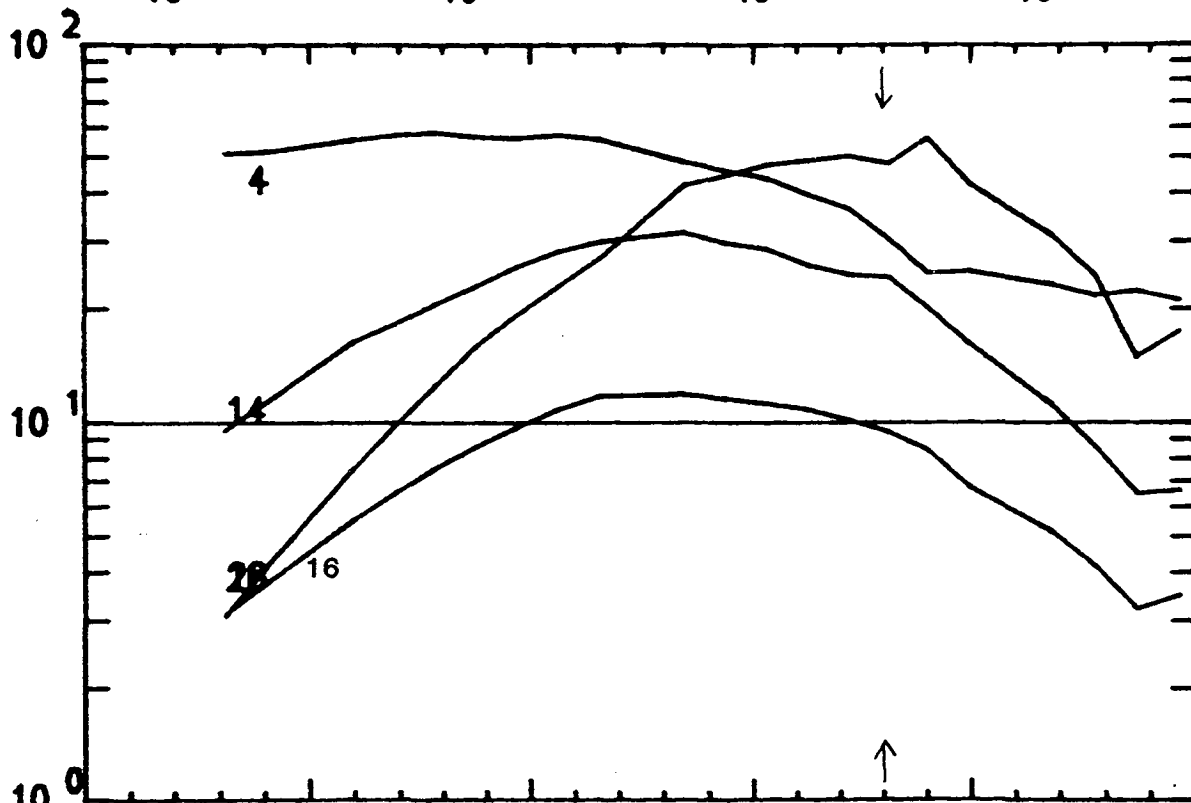
O
16
 10^8

N₂
28
 10^7

He
4
 10^5

DATA DATE:
81254
ORBIT NO.:
574
NET

D
E
N
S
I
T
Y



UT	10:20	10:25	10:30	10:35	10:40	10:45
LAT	2.1	21.7	41.8	62.0	82.3	77.6
LONG	18.4	14.1	12.9	11.6	10.4	170.9
ILAT	16.0	17.3	38.8	80.2	78.9	74.2
MLT	11.4	11.7	12.1	12.8	18.6	20.9
LST	11.4	11.4	11.4	11.4	11.4	23.4
ALT	490.8	399.2	337.3	311.0	321.8	366.7

Figure 6. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 574, September 11, 1981, as in Figure 3.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^6

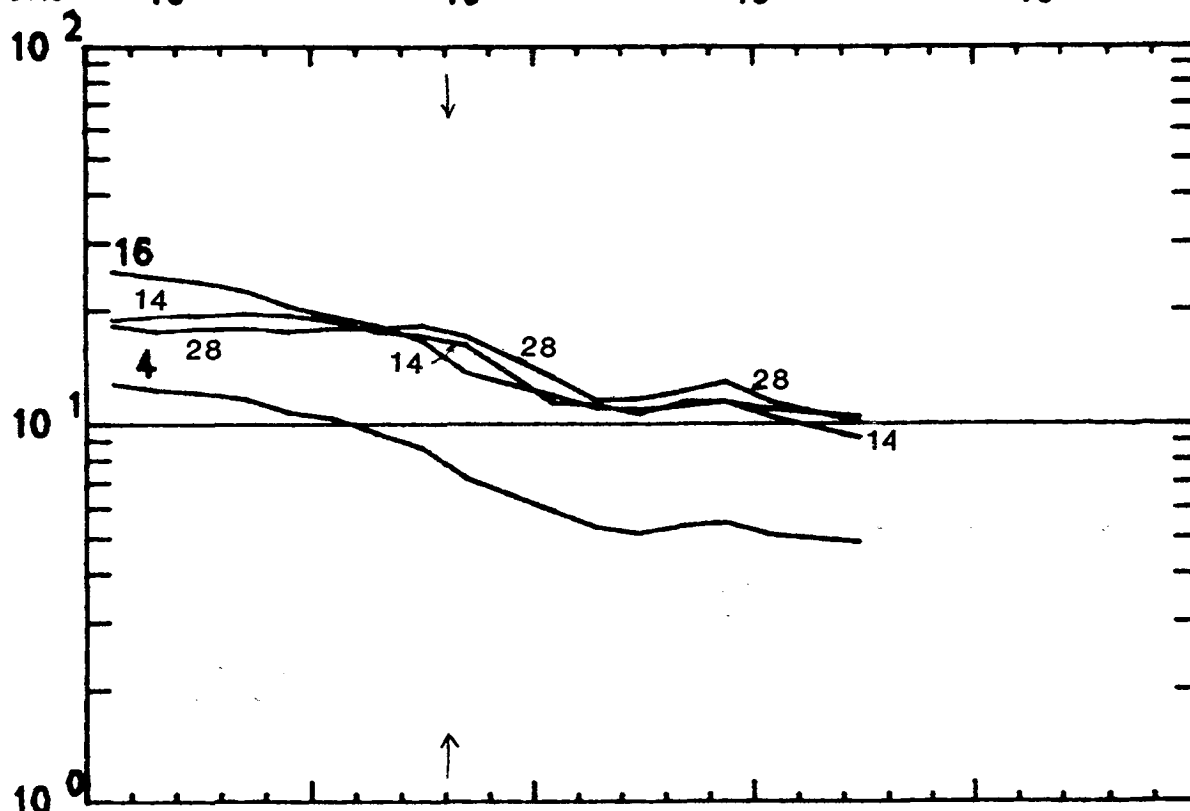
O
16
 10^8

N₂
28
 10^8

He
4
 10^6

DATA DATE:
83040
ORBIT NO.:
8436
NET

D
E
N
S
I
T
Y



UT	23:38	23:40	23:45	23:50	23:55	24:00
LAT	-39.9	-60.2	-60.4	-79.4	-59.3	-59.3
LONG	156.1	156.3	157.2	20.7	19.7	19.7
ILAT	40.6	59.9	73.9	69.8	58.2	58.2
MLT	13.4	14.1	16.1	21.6	23.6	23.6
LST	13.0	13.0	13.0	1.0	1.0	1.0
ALT	228.7	232.0	236.2	245.2	252.1	252.1

Figure 7. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 8436, February 9, 1983, as in Figure 3.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^6

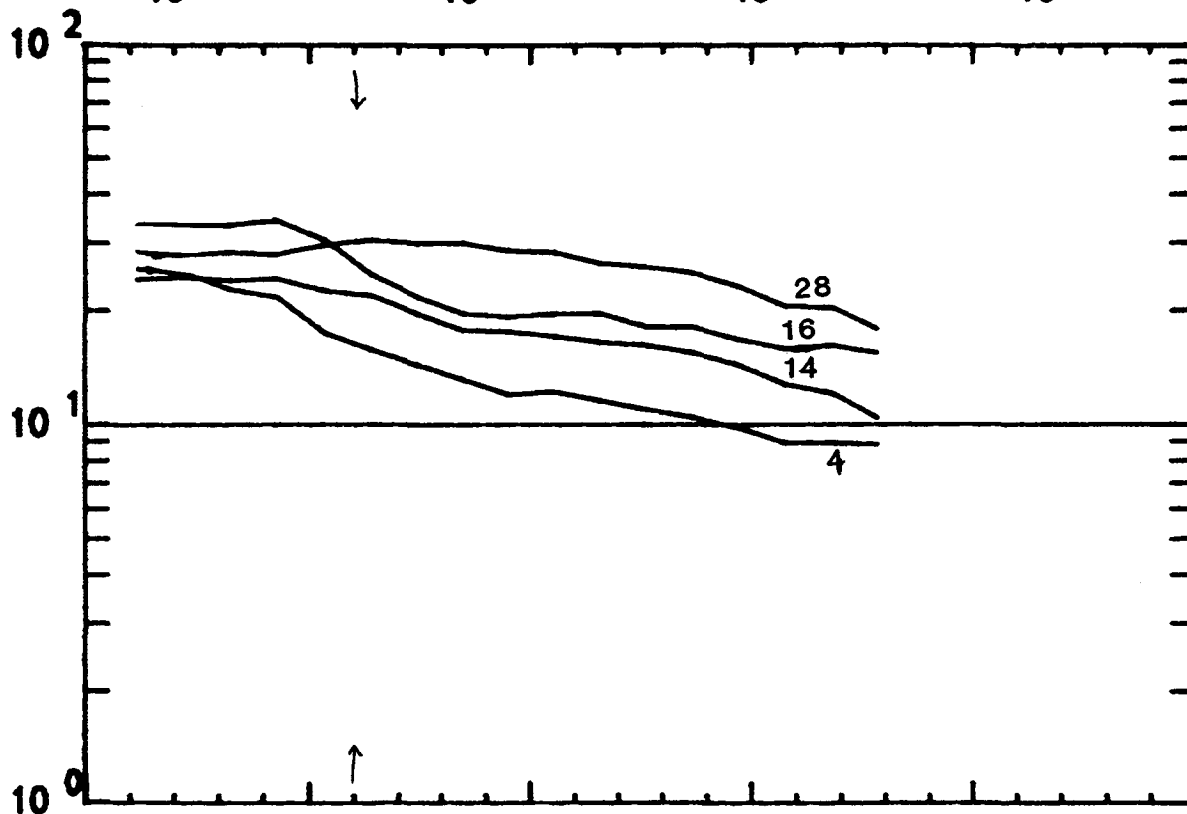
O
16
 10^8

N₂
28
 10^8

HE
4
 10^6

DATA DATE:
83048
ORBIT NO.:
8551
NET

D
E
N
S
I
T
Y



UT	2:45	2:50	2:55	3:00	3:05	3:10
LAT	-38.2	-58.6	-78.9	-80.8	-80.8	-40.4
LONG	180.3	149.1	148.1	-34.1	-34.9	-38.1
ILAT	49.0	70.9	83.1	86.1	49.8	38.0
MLT	12.9	13.5	17.4	23.1	23.9	.1
LST	12.8	12.8	12.8	.5	.5	.5
ALT	194.8	203.6	213.0	220.4	224.7	226.8

Figure 8. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 8551, February 17, 1983, as in Figure 3.

DE-2 NACS
AMBIENT
DENSITIES
SCALE FACTORS

N
14
 10^6

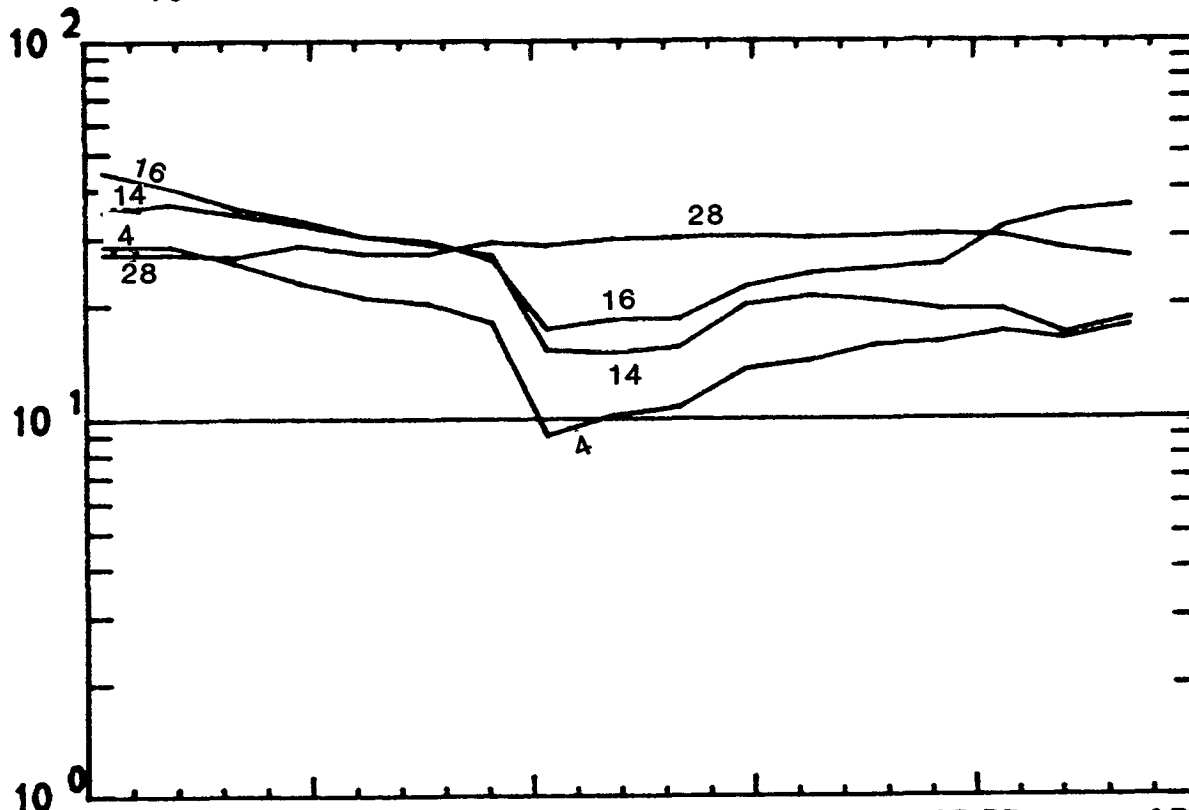
O
16
 10^8

N₂
28
 10^8

He
4
 10^6

DATA DATE:
83049
ORBIT NO.:
8574
NET

D
E
N
S
I
T
Y



UT	12:45	12:50	12:55	13:00	13:05	13:10
LAT	-84.9	-78.3	-84.4	-64.1	-43.8	-23.4
LONG	-1.1	-2.1	175.4	174.9	173.7	172.5
ILAT	52.4	64.4	77.2	70.3	50.8	29.8
MLT	11.7	10.7	6.3	2.2	1.3	.9
LST	12.4	12.5	.4	.4	.4	.4
ALT	186.1	194.5	200.4	202.7	202.3	201.3

Figure 9. Ambient number densities of N, O, N₂, and He determined from DE-2 NACS data for orbit 8574, February 18, 1983, as in Figure 3.