N87-20686

THE GRAM-III MODEL

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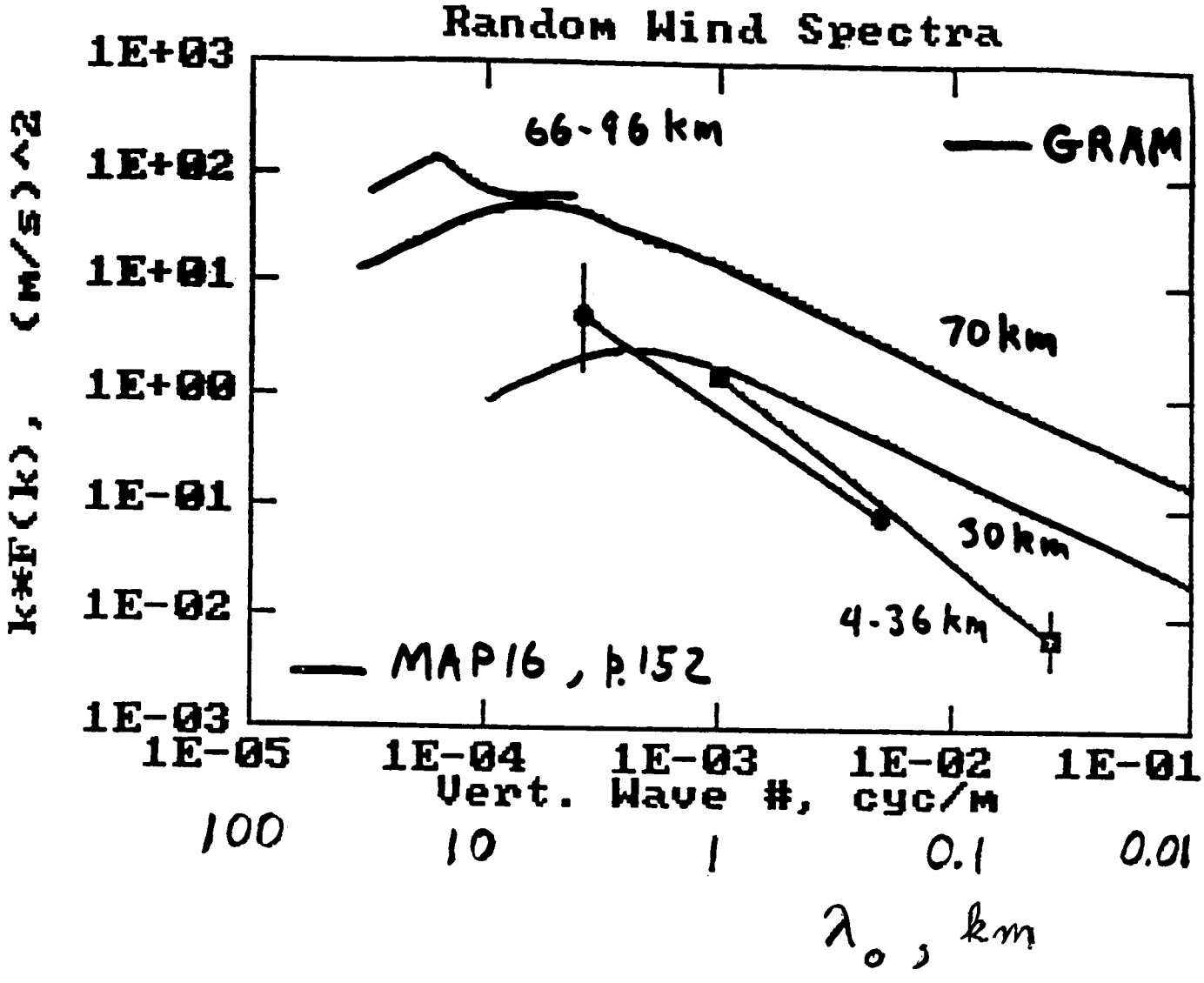
The GRAM is under continuous development and improvement. GRAM data were compared with Middle Atmosphere Program (MAP) predictions and with shuttle data (Blanchard).

An important note: Users should employ only step sizes in altitude that give vertical density gradients consistent with shuttle-derived density data. Using too small a vertical step size (finer than 1 km) will result in what appears to be unreasonably high values of density shears but what in reality is noise in the model.



$$\rho(z+\Delta z) = r_\rho(\Delta z)\,\rho(z) + \beta\,\sigma_\rho\,w_z$$

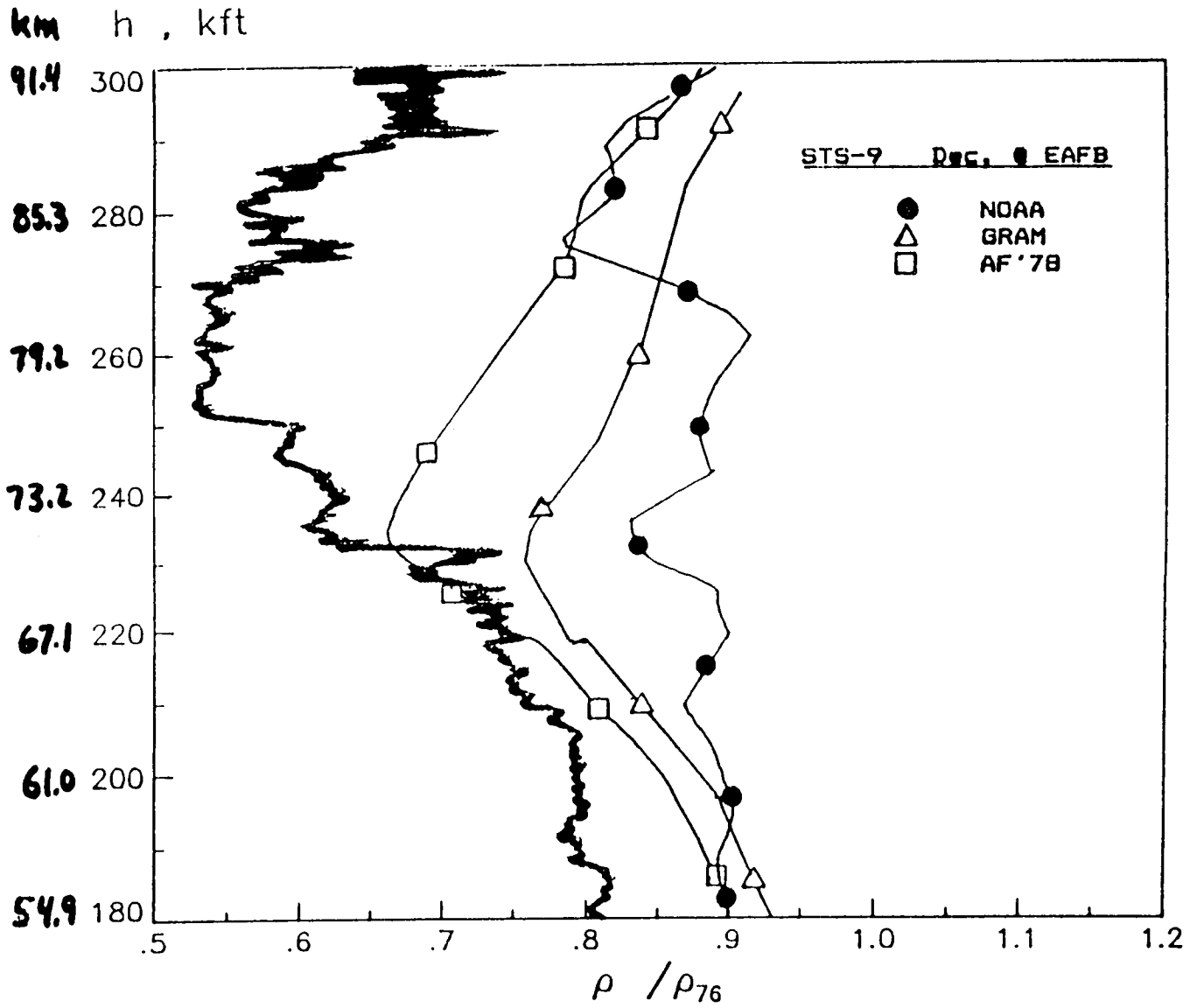
$$\beta = \sqrt{1 - r_\rho^2(\Delta z)}$$

$$r_\rho(\Delta z) = e^{-\Delta z / L}$$

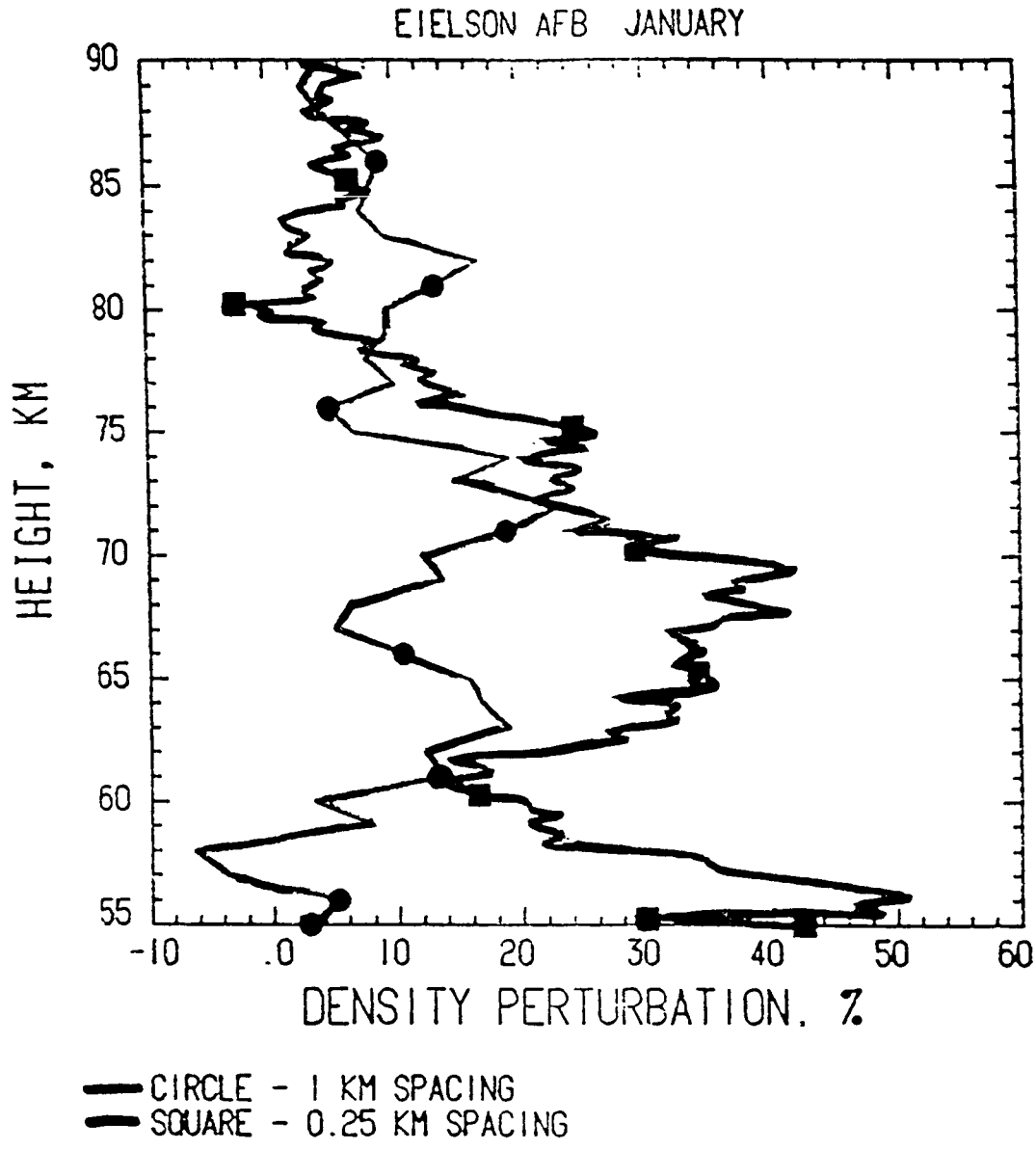
$$\Delta\rho = \rho(z+\Delta z) - \rho(z)$$

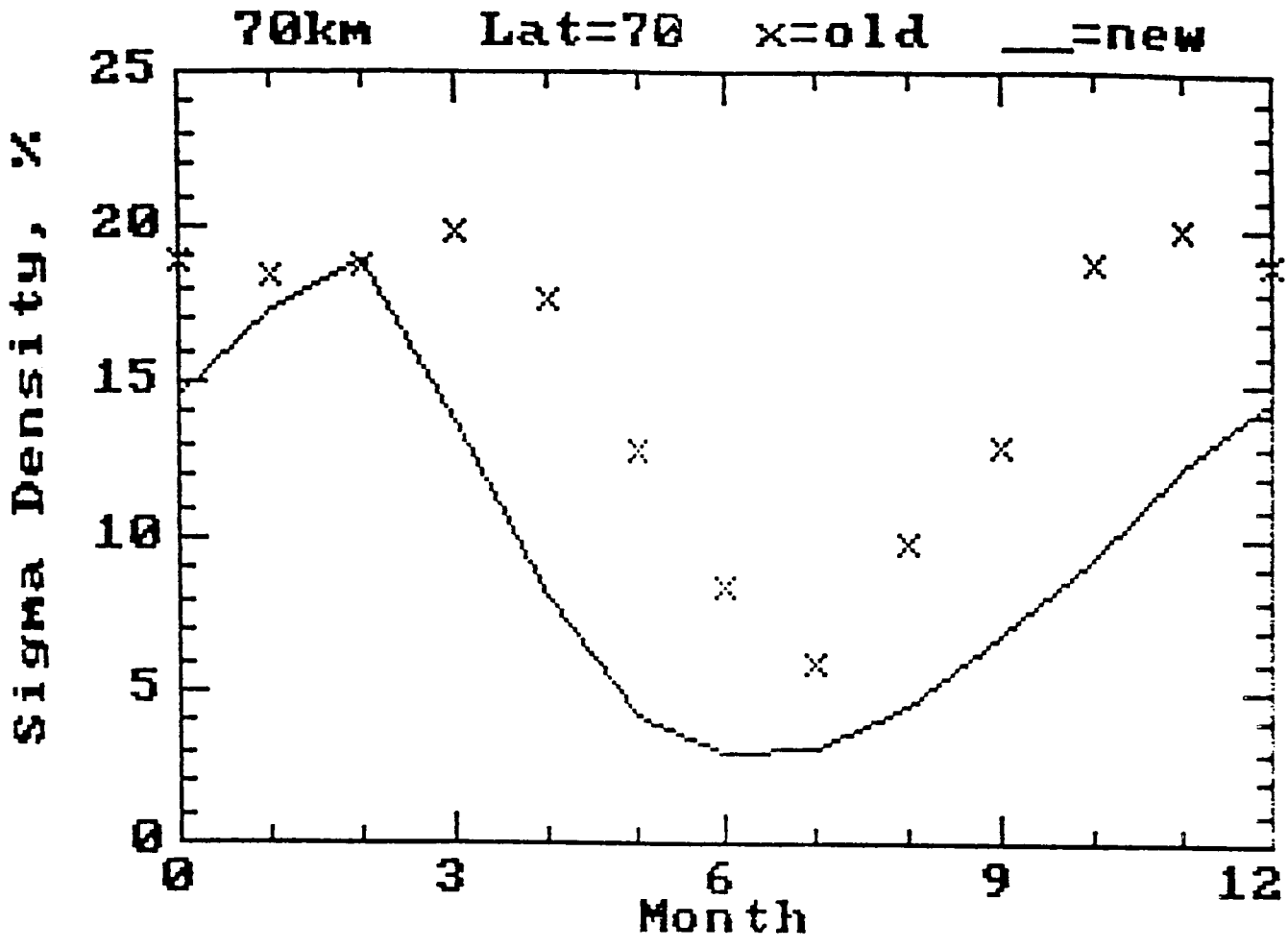
$$\left.\begin{aligned} \overline{(\Delta\rho)^2} &\to 2\sigma_\rho^2\,\Delta z / L \\ \overline{(\Delta\rho/\Delta z)^2} &\to 2\sigma_\rho^2 / \Delta z\, L \end{aligned}\right\} \quad \Delta z / L \to 0$$

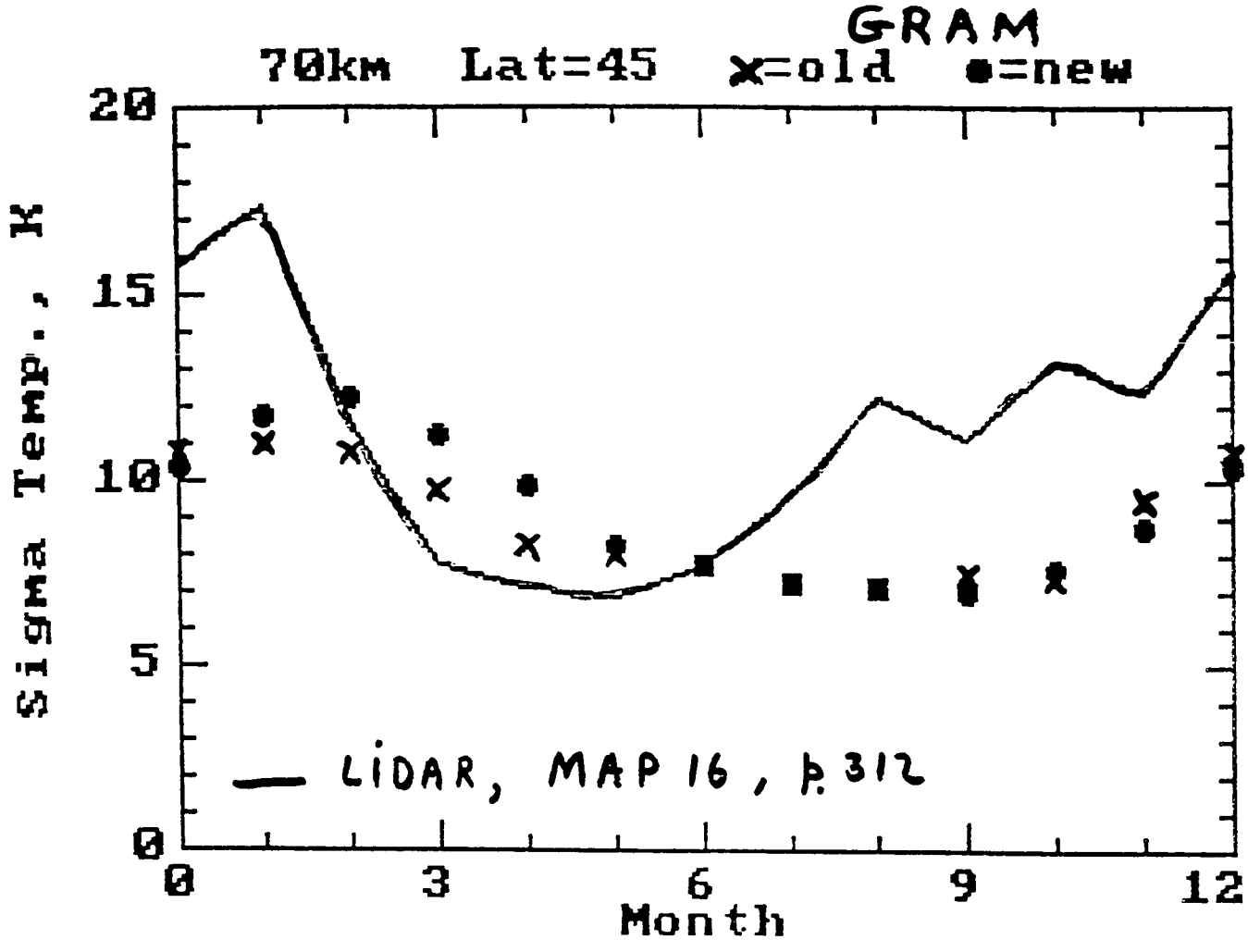
$$E_\rho(k) \sim k^{-2} \qquad kL \to \infty$$

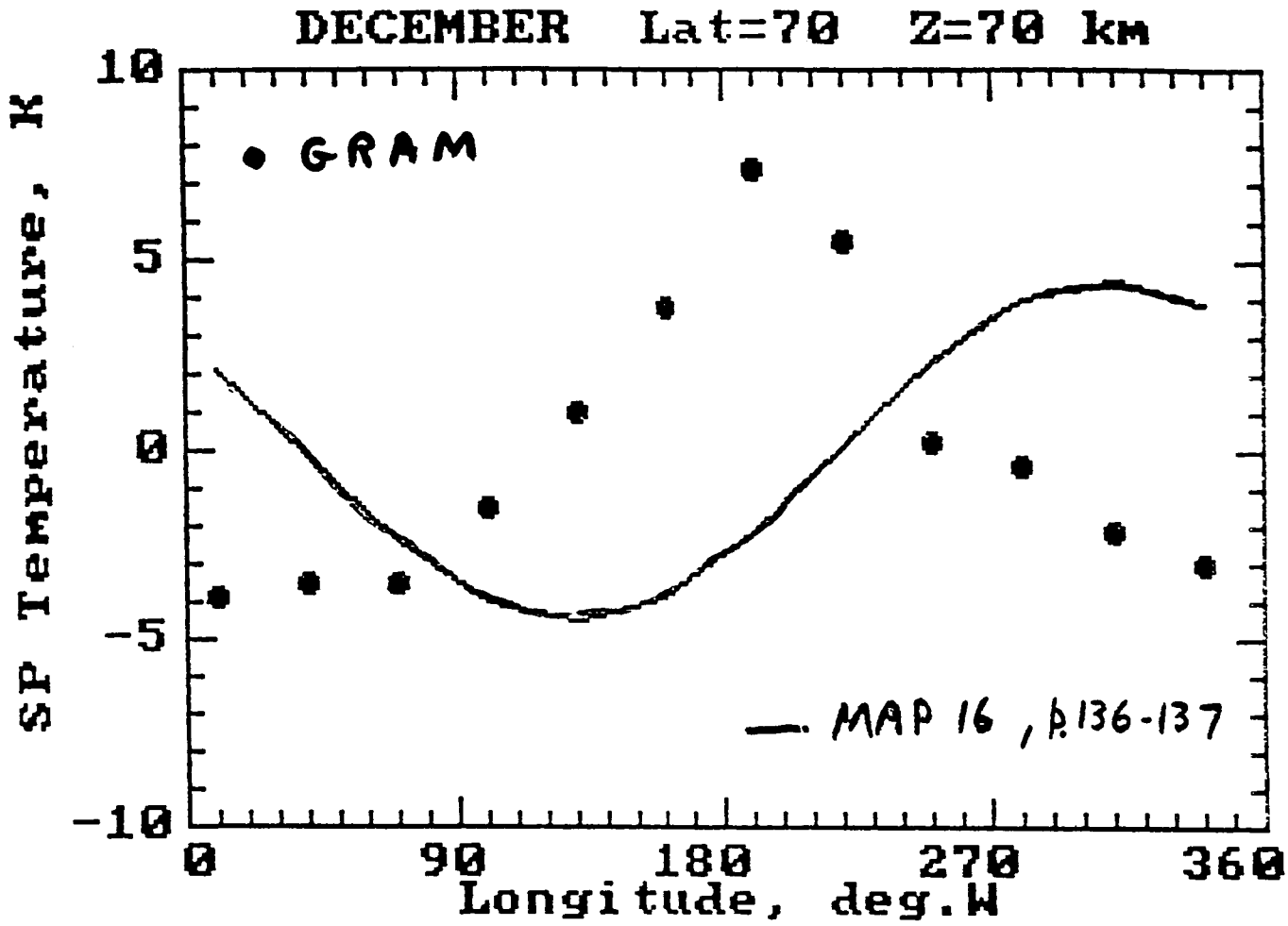


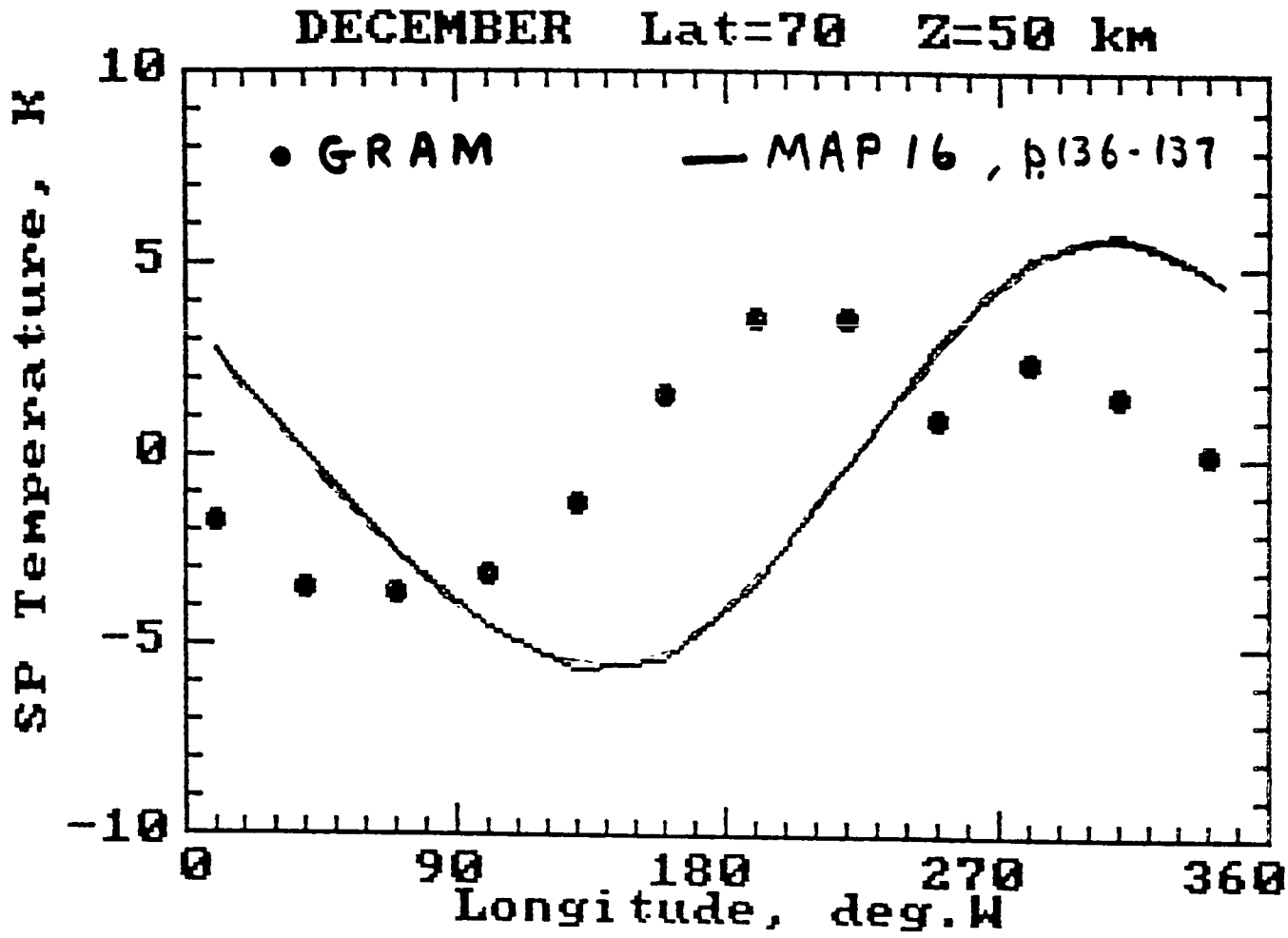
COMPARISONS BETWEEN SHUTTLE DERIVED AND ALTERNATE SOURCES

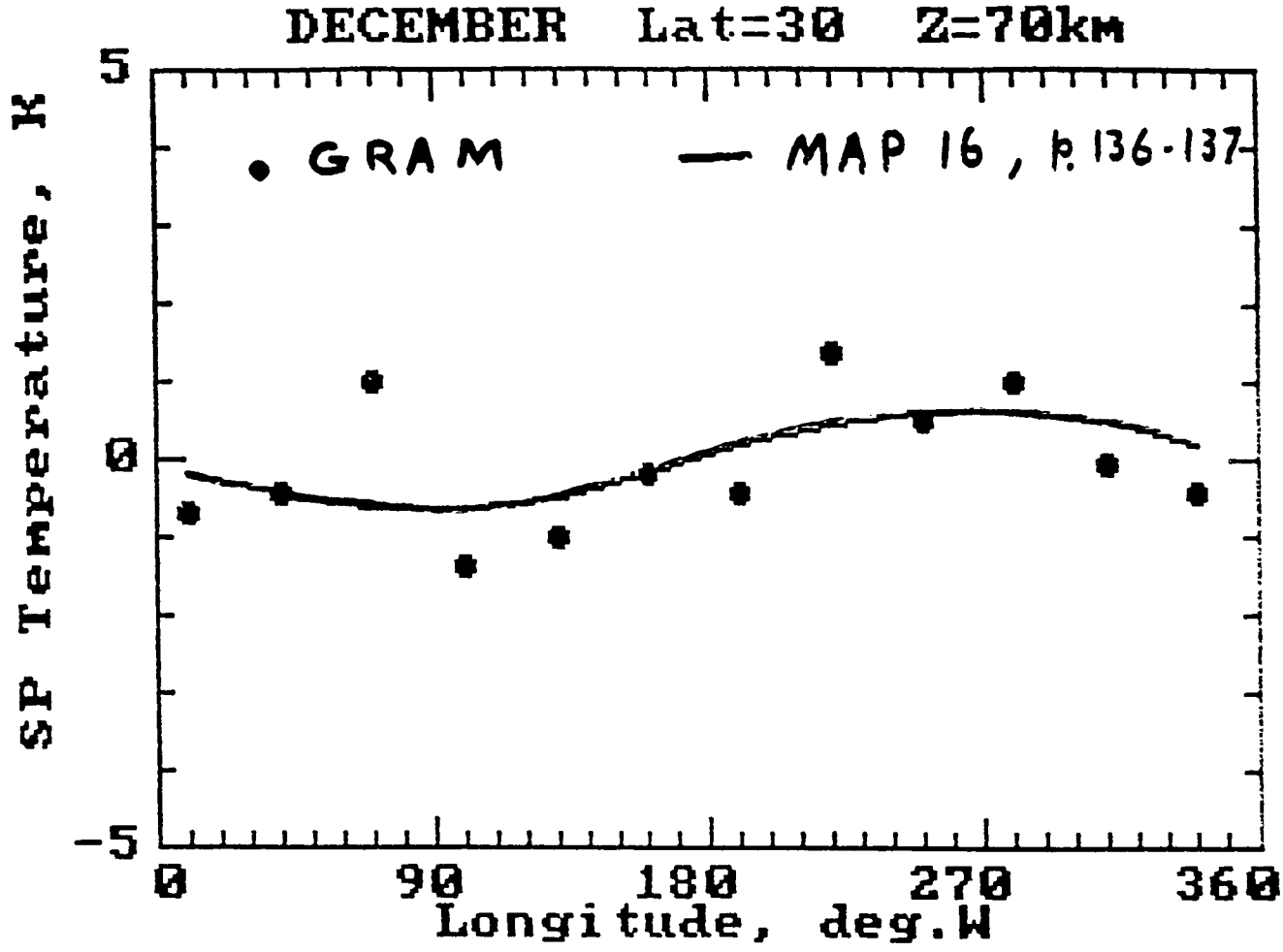

EIELSON AFB JANUARY
HEIGHT, KM
90
85
80
75
70
65
60
55
-10
.0
10
20
30
40
50
60
DENSITY PERTURBATION, %
CIRCLE - 1 KM SPACING
SQUARE - 0.25 KM SPACING

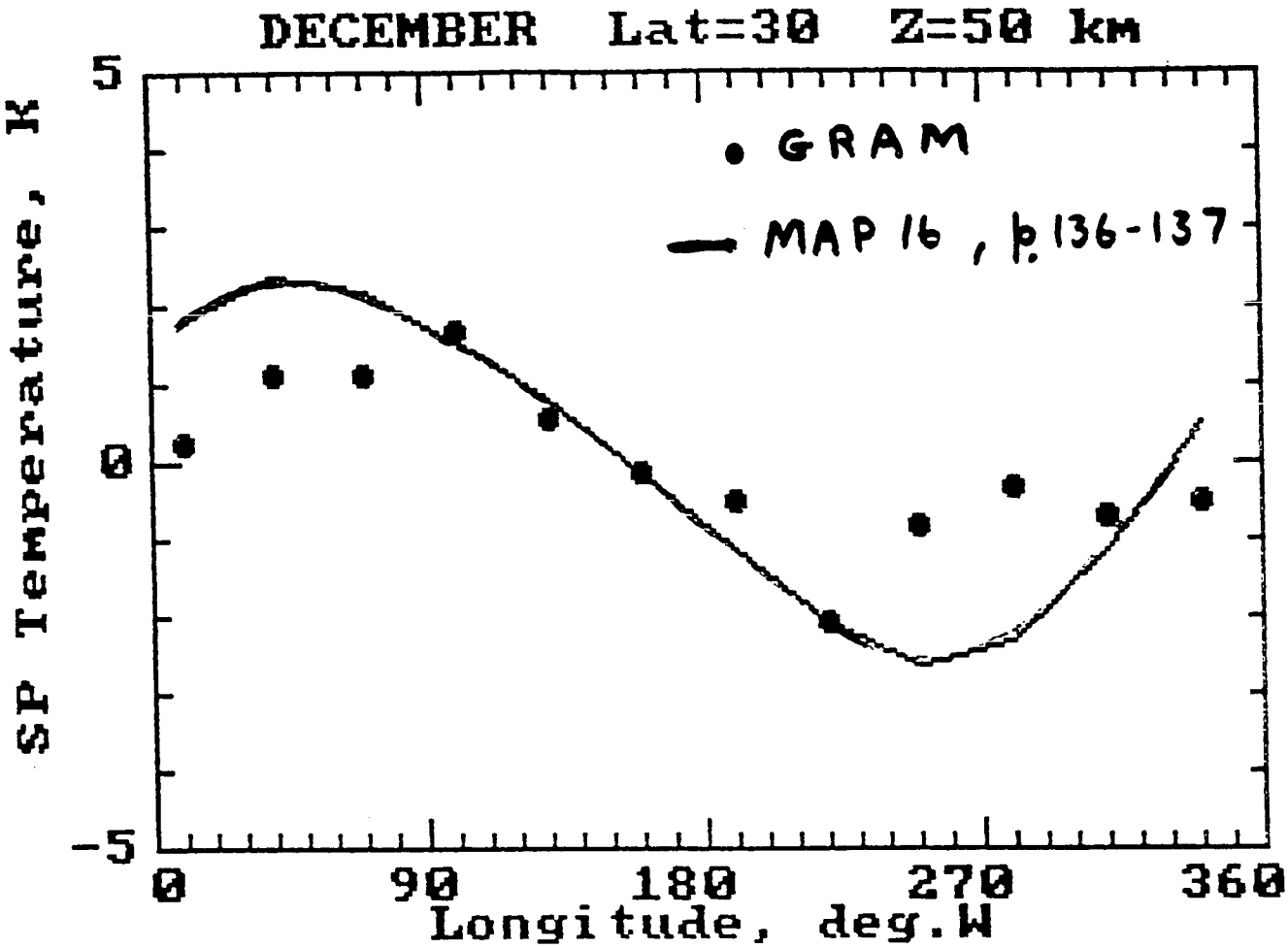

70km Lat=70 x=old ___=new
Sigma Density, %
25
20
15
10
5
0
0
3
6
9
12
Month

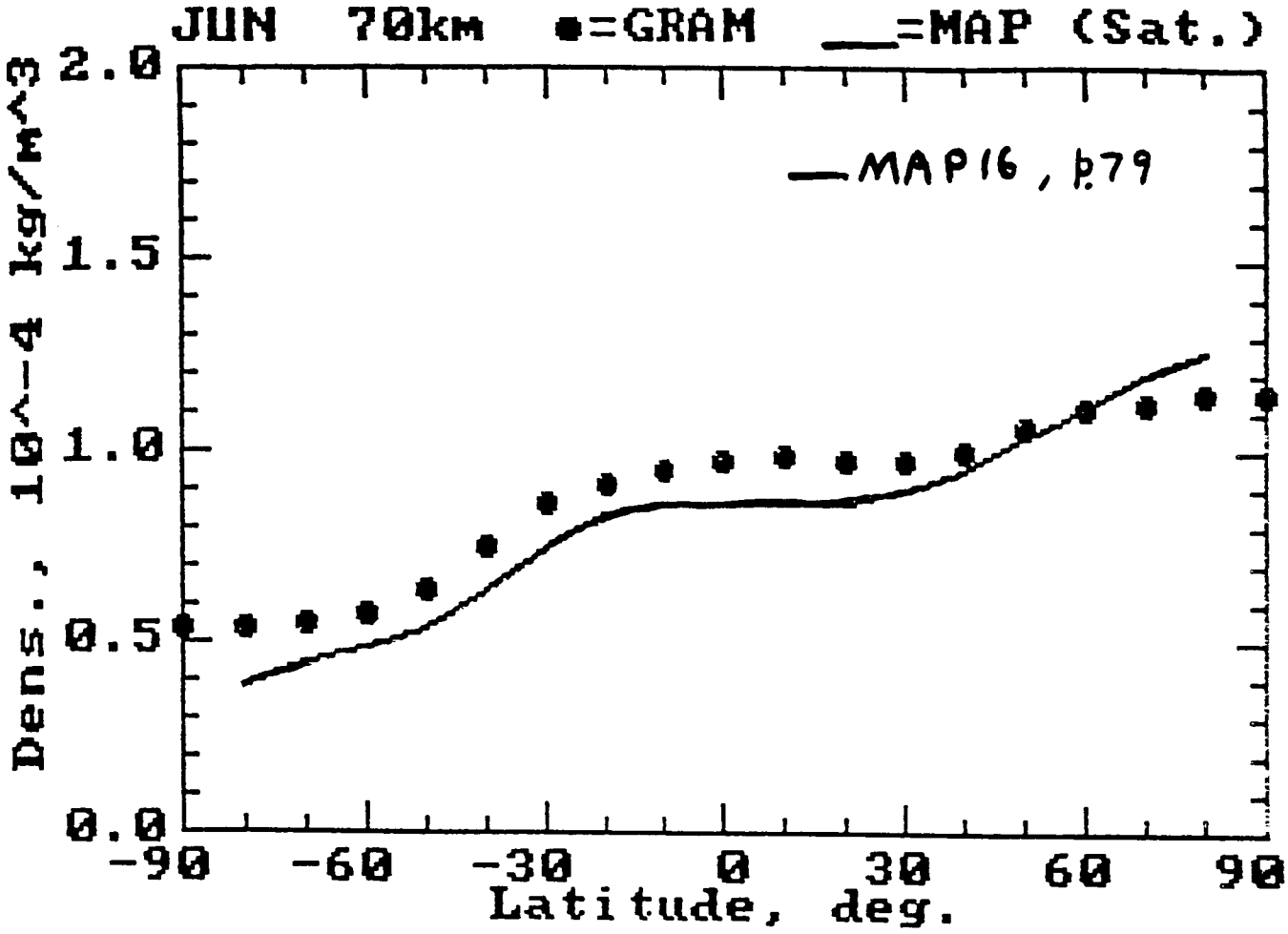

GRAM
70km Lat=45 x=old ●=new
Sigma Temp., K
20
15
10
5
0
0
3
6
9
12
Month
LIDAR, MAP 16, p.312

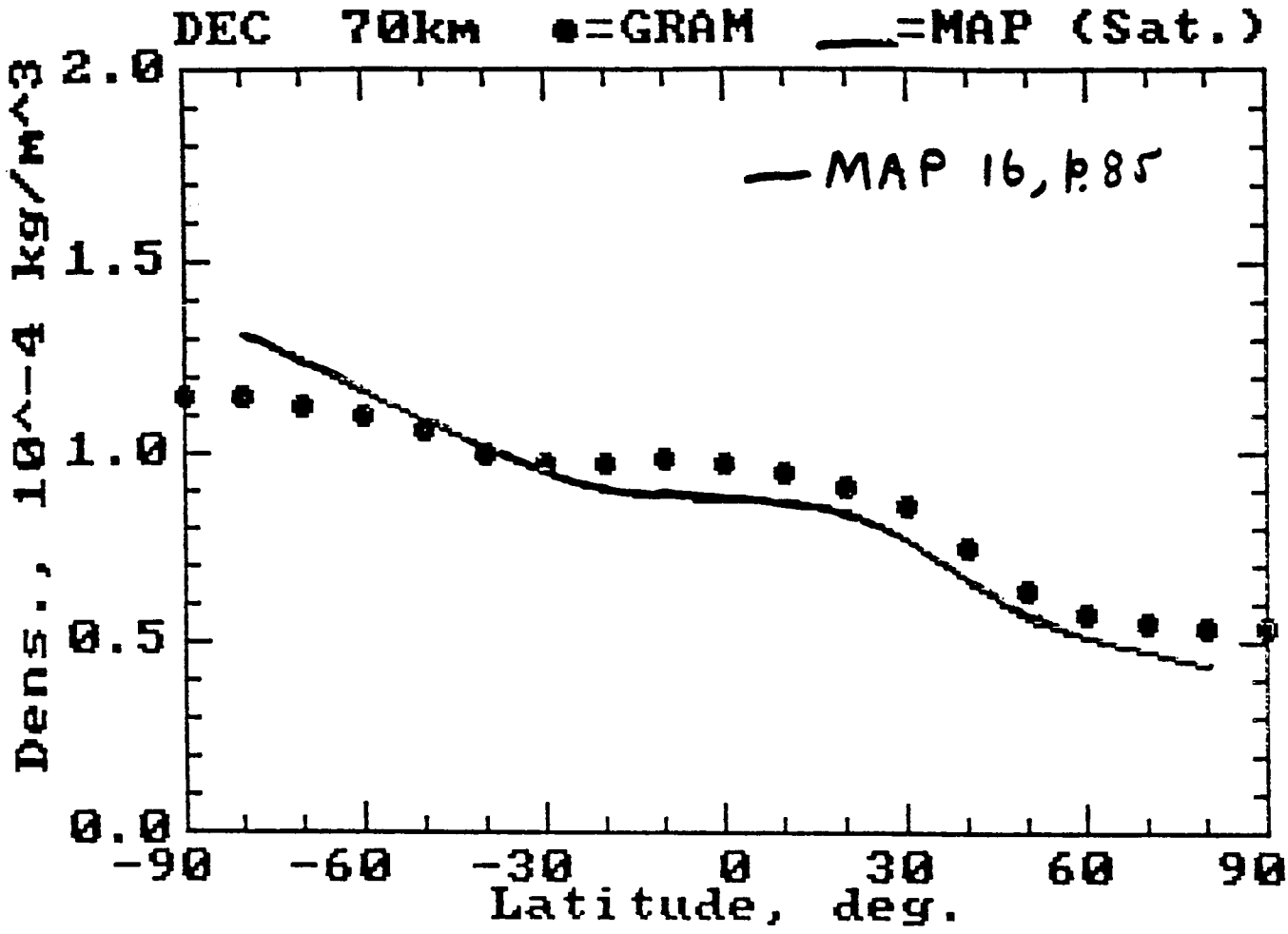

DECEMBER Lat=70 Z=70 km
10
5
0
-5
-10
SP Temperature, K
GRAM
MAP 16, p.136-137
0
90
180
270
360
Longitude, deg.W

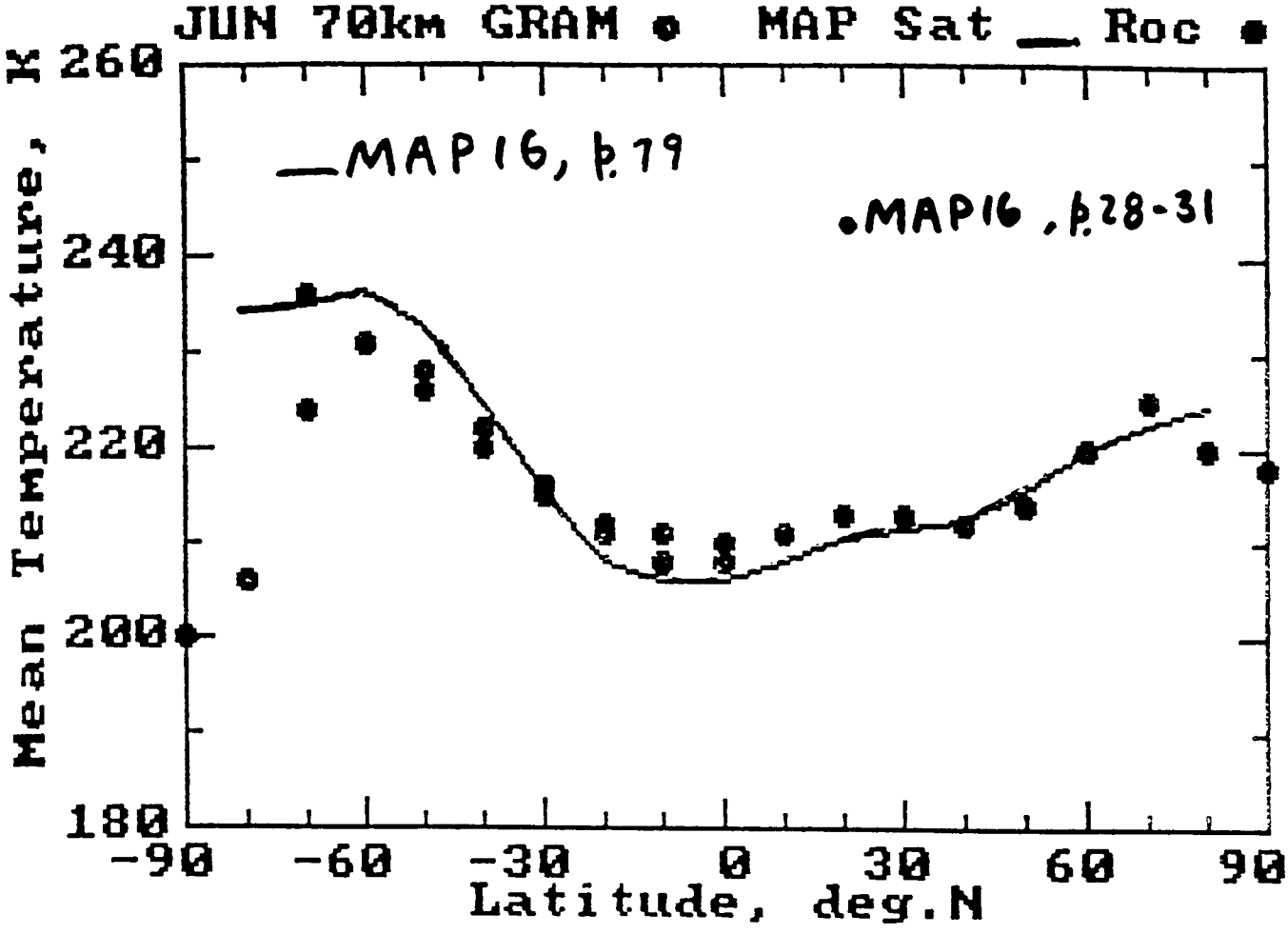

DECEMBER Lat=70 Z=50 km
• GRAM
— MAP 16, p136-137
SP Temperature, K
10
5
0
-5
-10
0
90
180
270
360
Longitude, deg.W

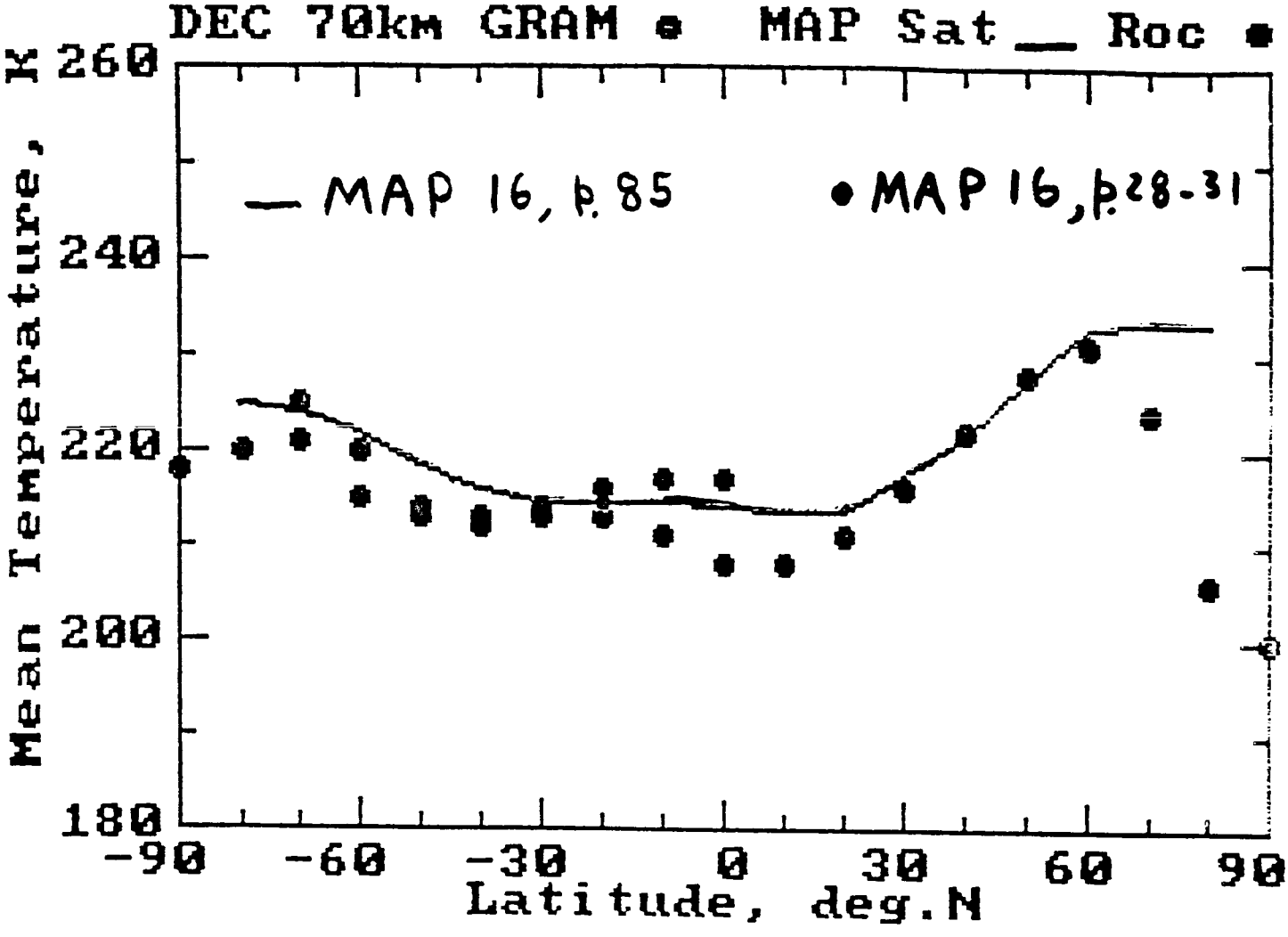

DECEMBER Lat=30 Z=70km
GRAM
MAP 16, p. 136-137
SP Temperature, K
5
0
-5
0
90
180
270
360
Longitude, deg.W


DECEMBER Lat=30 Z=50 km
GRAM
MAP 16, p.136-137
SP Temperature, K
5
0
-5
0
90
180
270
360
Longitude, deg.W


JUN 70km ●=GRAM ___=MAP (Sat.)
—MAP16, þ79
Dens., 10^-4 kg/m^3
2.0
1.5
1.0
0.5
0.0
-90
-60
-30
0
30
60
90
Latitude, deg.


DEC 70km ●=GRAM ___=MAP (Sat.)
—MAP 16, p.85
Dens., 10^-4 kg/m^3
2.0
1.5
1.0
0.5
0.0
-90
-60
-30
0
30
60
90
Latitude, deg.


JUN 70km GRAM ● MAP Sat ___ Roc ●
MAP16, p.19
MAP16, p.28-31
Mean Temperature, K
260
240
220
200
180
-90
-60
-30
0
30
60
90
Latitude, deg.N


DEC 70km GRAM • MAP Sat — Roc •
— MAP 16, p. 85
• MAP 16, p. 28-31
Mean Temperature, K
260
240
220
200
180
-90
-60
-30
0
30
60
90
Latitude, deg.N

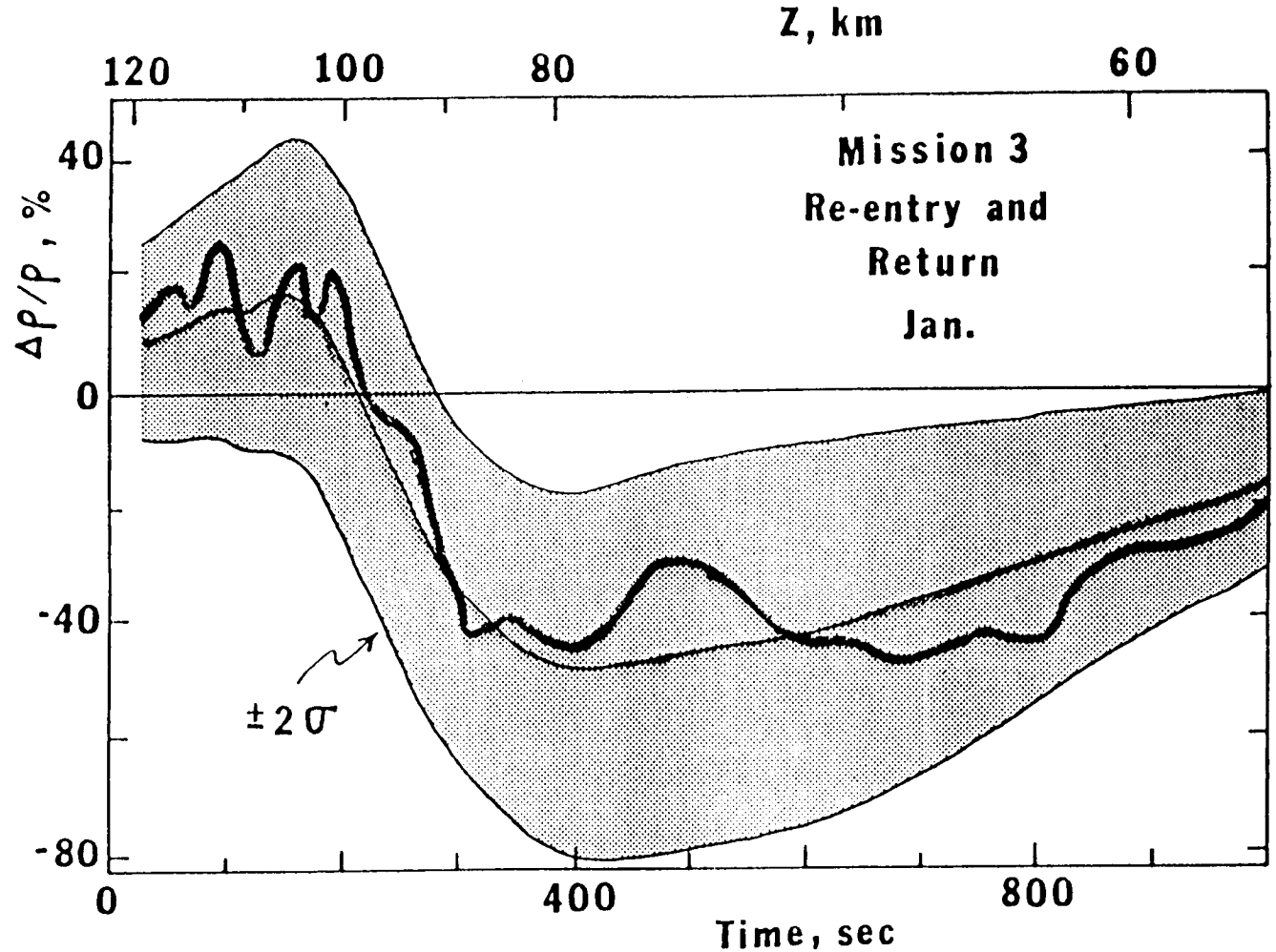


Figure 10.6 Density along a January mission 3 (Vandenburg polar orbit) re-entry and return trajectory. Density deviations are with respect to the 1962 U.S. Standared Atmosphere Graph symbolism as in Figure 10.2.

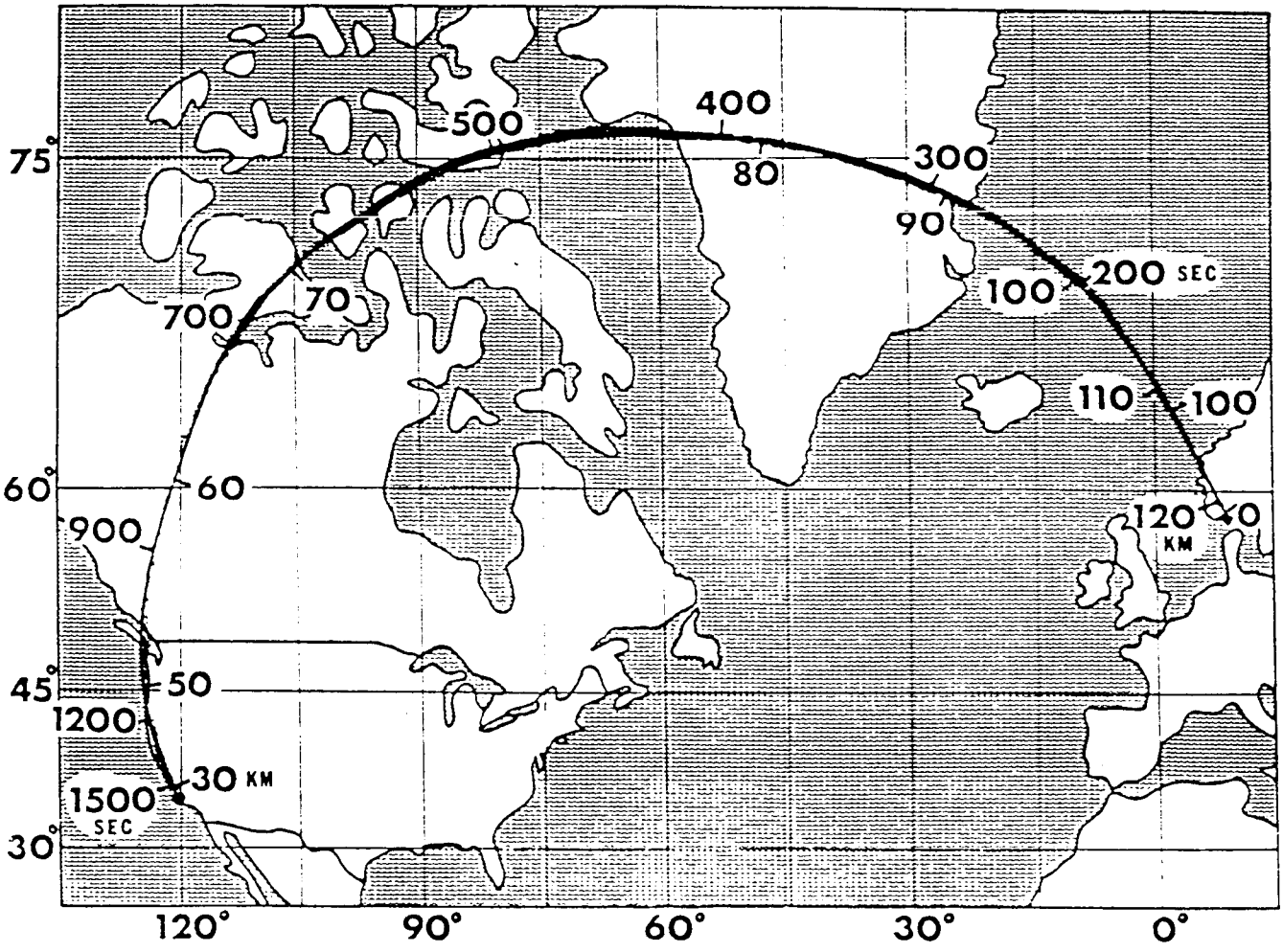


Figure 10.5 Ground plot of the re-entry and return trajectory for mission 3, a 104^{o} inclination polar orbit launched from and returning to Vandenburg AFB. The altitude in km is plotted on the inner side of the orbital plot and the time in seconds is plotted on the outer side.