1W

X-601-72-195

NASA TM X-65917

WORLD MAPS OF PREDICTED ELECTRON INTENSITIES FOR THE ITOS-A/NOAA-1 SPACECRAFT

E. G. STASSINOPOULOS

(NASA-TM-X-65917) WORLD MAPS OF PREDICTED ELECTRON INTENSITIES FOR THE ITOS-A/NOAA-1 SPACECRAFT E.G. Stassinopoulos (NASA) Jun. 1972 14 p CSCL 03B N72-27357 Unclas G3/13 34060

JUNE 1972

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

World Maps of Predicted Electron Intensities for the ITOS-A/NOAA-1 Spacecraft

Updated world maps of constant intensity contours were produced for the ITOS satellite at the 1463 km altitude level. These maps were constructed in a manner similar to that described by Stassinopoulos (1969). However, a nominal trajectory (circular, inclination 79°, altitude 1463 km) was then used to determine the fractional lifetime within the different intensity regions, the approximate number of passes per day through these regions, and the average exposure-duration per pass. Several flight path segments were superimposed on the maps to indicate the trajectory pattern and to permit comparison with true flight path data.

Positional B and L calculations were performed with the new ALLMAG program by Stassinopoulos and Mead (1972), in conjunction with their modified version of McIlwain's INVAR routine (Hassit and McIlwain, 1967). Out of the seven geomagnetic field models contained in ALLMAG, model #3, (POGO 10/68) (Cain and Langel, 1968) was selected for the B and L calculations. This model was preferred because it is a "space" model (it is constructed entirely from satellite data) and it has a smaller temporal divergence than the only other "space" model, POGO 8/69 (Cain and Sweeney, 1970) (#4 in ALLMAG). The field coefficients were calculated for the epoch 1970.0. Although this date lies outside the data range of the model, it is close enough to yield an acceptable approximation; but it would not be advisable to use the secular variation terms for times that are several years removed from the data range. According to Mead (1972), there are definite limitations in the use of the time derivatives contained in the current models.

The electron fluxes were computed with Vette's (1966) old AE2 environment model of 1964 which was updated in the inner zone ($1.1 < L < 2.0$) with regards to the artificials by exponentially decaying the Starfish electrons with the Stassinopoulos and Verzariu (1971) lifetimes to the Teague and Stassinopoulos (1972) cut-off times, at which the fluxes are expected to have reached approximately natural background levels. The outer zone fluxes were not modified or adjusted to reflect solar cycle variations. Thus, significant changes in the intensity levels and the spatial distribution of the trapped particle population between solar minimum and solar maximum have not been accounted for. However, since the AE2 model describes the environment as it existed back in 1964 at solar minimum, it is reasonable to assume that the positions of the depicted outer-zone intensity contours (the high latitude curves and the "horns") most likely approximate the environment at the next solar minimum in 1974.

A comparison of the calculated intensities with ITOS-A/NOAA-1 flight data, dated March 1970, with the time averaged model shows an apparent reduction in the volume occupied by these intensity levels at the time of the measurement. It also shows an increase in the population at the altitude level of the spacecraft (1463 km) in the area between the "horns" and the magnetic equator. Specifically, a shift of the outermost isointensity contours towards lower latitudes is observed and the break between inner and outer zone disappears (is filled up). These changes are to be expected since it is well known that the radiation in this region of space is highly time variable.

The uncertainty in the flux values is about a factor of 3. It derives from the model and the updating process. The error in contour plotting may be as large as ±2° in latitude and ±3° in longitude.

References

Cain, Joseph C., and Robert A. Langel, The geomagnetic survey by the Polar Orbiting Geophysical Observatories OGO-2 and OGO-4 1965-1967, GSFC Report X-612-68-502, Greenbelt, Maryland, 1968.

Cain, Joseph C., and Ronald E. Sweeney, Magnetic field mapping of the inner magnetosphere, J. Geophys. Res., 75, 4360-4362, 1970.

Mead, Gilbert D., Secular change of geomagnetic conjugate points, preprint, 1972.

Hassitt, A., and C. E. McIlwain, Computer programs for the computation of B and L (May 1966), Data Users' Note NSSDC 67-27, National Space Science Data Center, Greenbelt, Maryland, May 1967.

Stassinopoulos, E. G., World Maps of Constant B, L, and Flux Contours, NASA Special Publication SP-3054, 1969.

Stassinopoulos, E. G., and Gilbert D. Mead, ALLMAG, GDALMG, LINTRA: Computer Programs for Geomagnetic Field and Field-Line Calculations, NASA-GSFC, National Space Science Data Center Publication NSSDC 72-12, February 1972.

Stassinopoulos, E. G., and P. Verzariu, General Formula for Decay Lifetimes of Starfish Electrons, J. Geophys. Res., 76, 1841-1844, 1971.

Teague, M., and E. G. Stassinopoulos, The Limits for the Decay of Starfish Electrons, A.G.U.-Transactions, Fifty Third Annual Meeting, EOS, 53, 469, 1972.

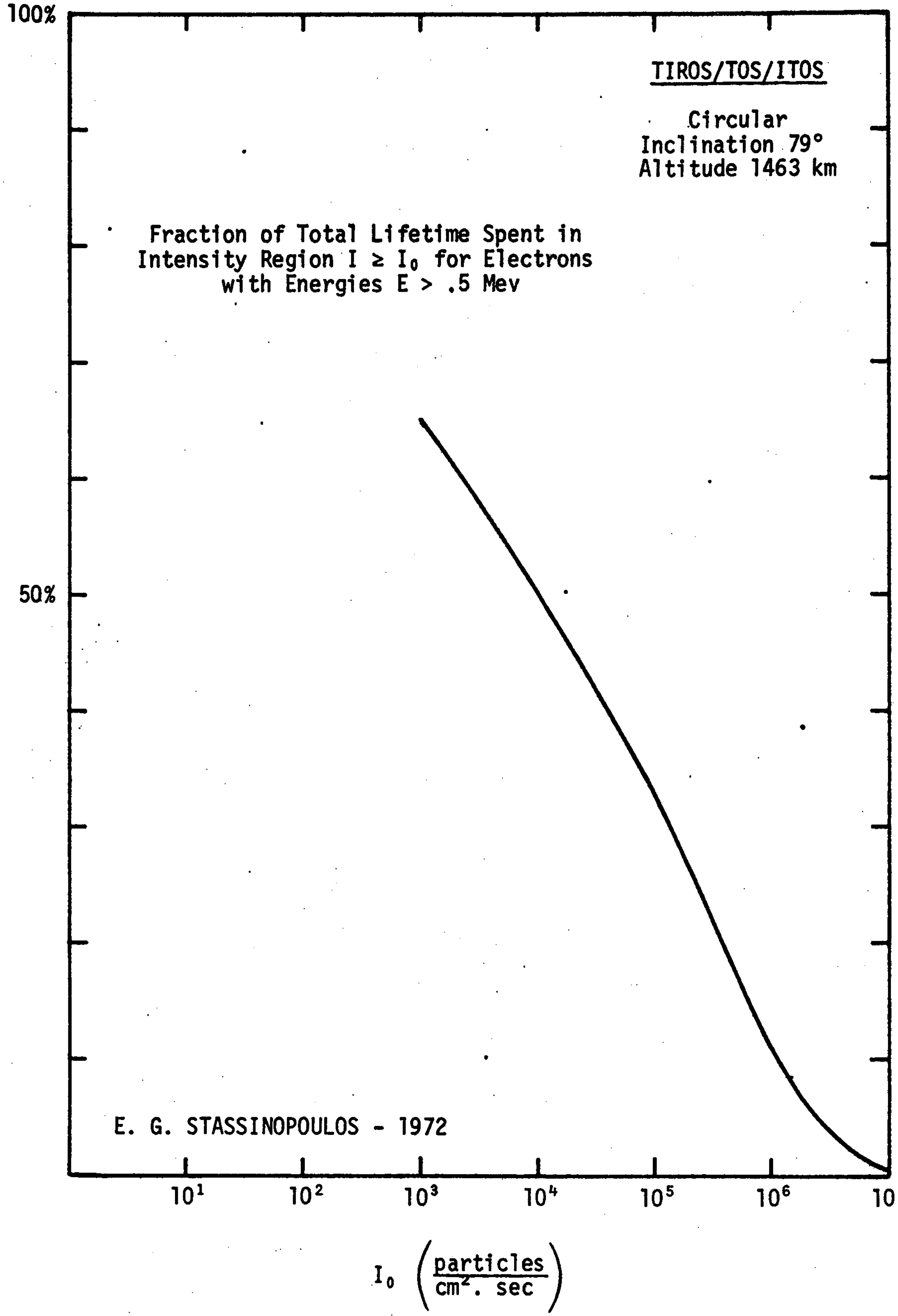
Vette, J. I., Antonio B. Lucero, and Tom A. Wright, Models of the Trapped Radiation Environment, Volume II: Inner and Outer Zone Electrons, NASA Special Publication SP-3024, 1966.

Integral Electron Intensities with E>.5 Mev
(particles per square centimeter per second)

	$\geq 10^3$	$\geq 10^4$	$\geq 10^5$	$\geq 10^6$	$\geq 10^7$
Approximate fraction of total lifetime spent in intensity region:	65%	50%	33%	11%	< 1%
Average number of passes thru intensity region per day:	25*	25*	25*	18	3-4
Average number of passes per day as to exposure rating**:					
over-exposed	6-8	4-6	4-6	5	-
in-between	12-14	14-18	6-10	1-2	3-4
under-exposed	4-6	4-6	6-10	5	-
Approximate duration of exposure during above passes (in minutes):					
over-exposed	80-100	80-110	48-52	9-16	-
in-between	70-76	50-70	40-46	6	3-4
under-exposed	60-65	6-36	25-35	1-3	-

*All orbits, all passes. Since period is about 1.9 hrs. there are approximately 12.6 orbits per day or approximately 2x12.6 = 25 passes through the belts per day.

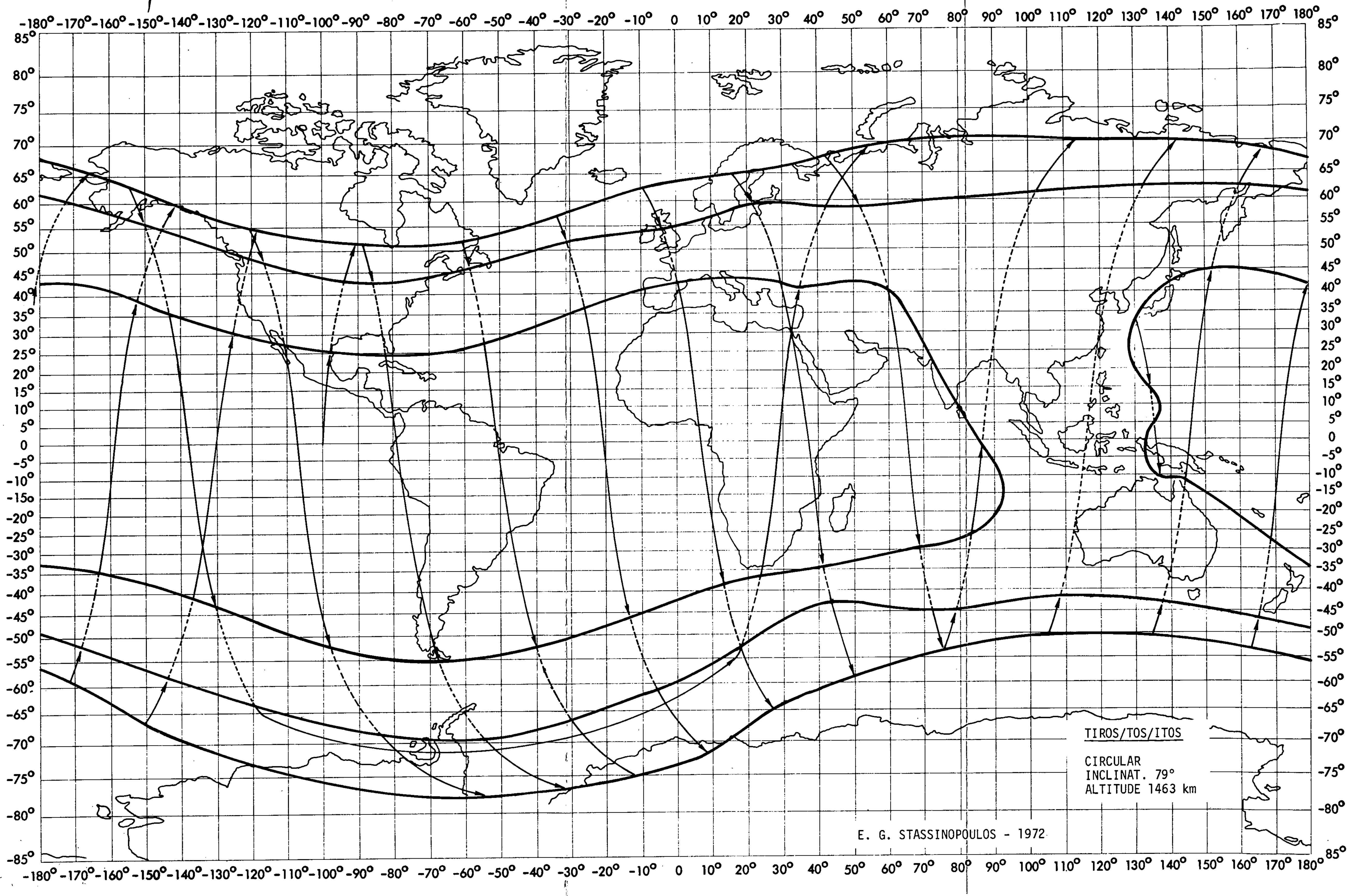
**Classification is arbitrary. It is based on a comparison of relative exposure times.


100%
50%
TIROS/TOS/ITOS
Circular
Inclination 79°
Altitude 1463 km
Fraction of Total Lifetime Spent in
Intensity Region $I \geq I_0$ for Electrons
with Energies $E > .5$ Mev
E. G. STASSINOPOULOS - 1972
10^1
10^2
10^3
10^4
10^5
10^6
10^7
$I_0 \left(\frac{\text{particles}}{\text{cm}^2 \cdot \text{sec}}\right)$

FOLDOUT FRAME 1

FOLDOUT FRAME 2

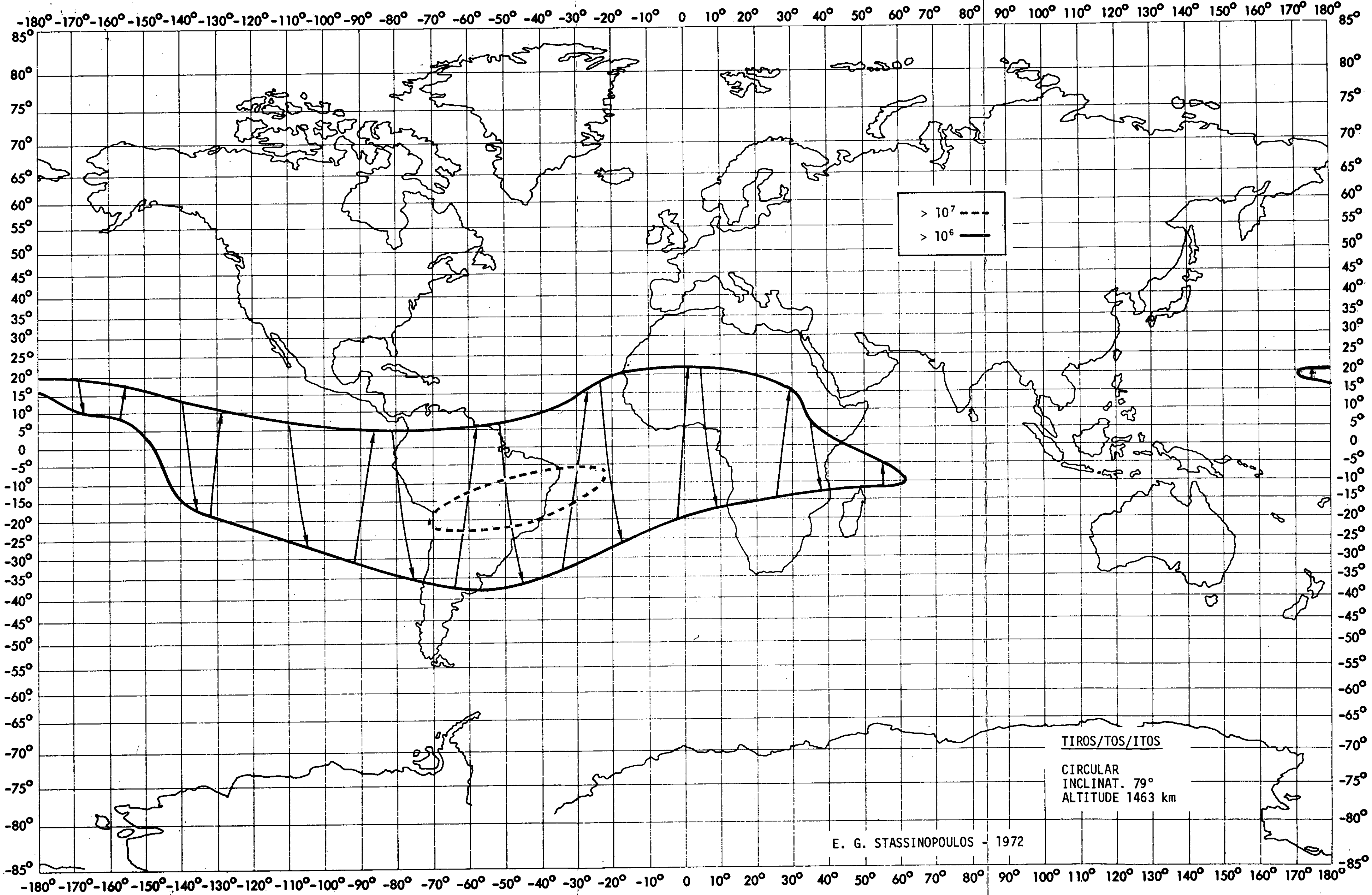
Electrons: F_e (E>.5 Mev) > 10^4 $\frac{\text{particles}}{\text{cm}^2\text{. sec}}$



FOLDOUT FRAME 1

FOLDOUT FRAME 2

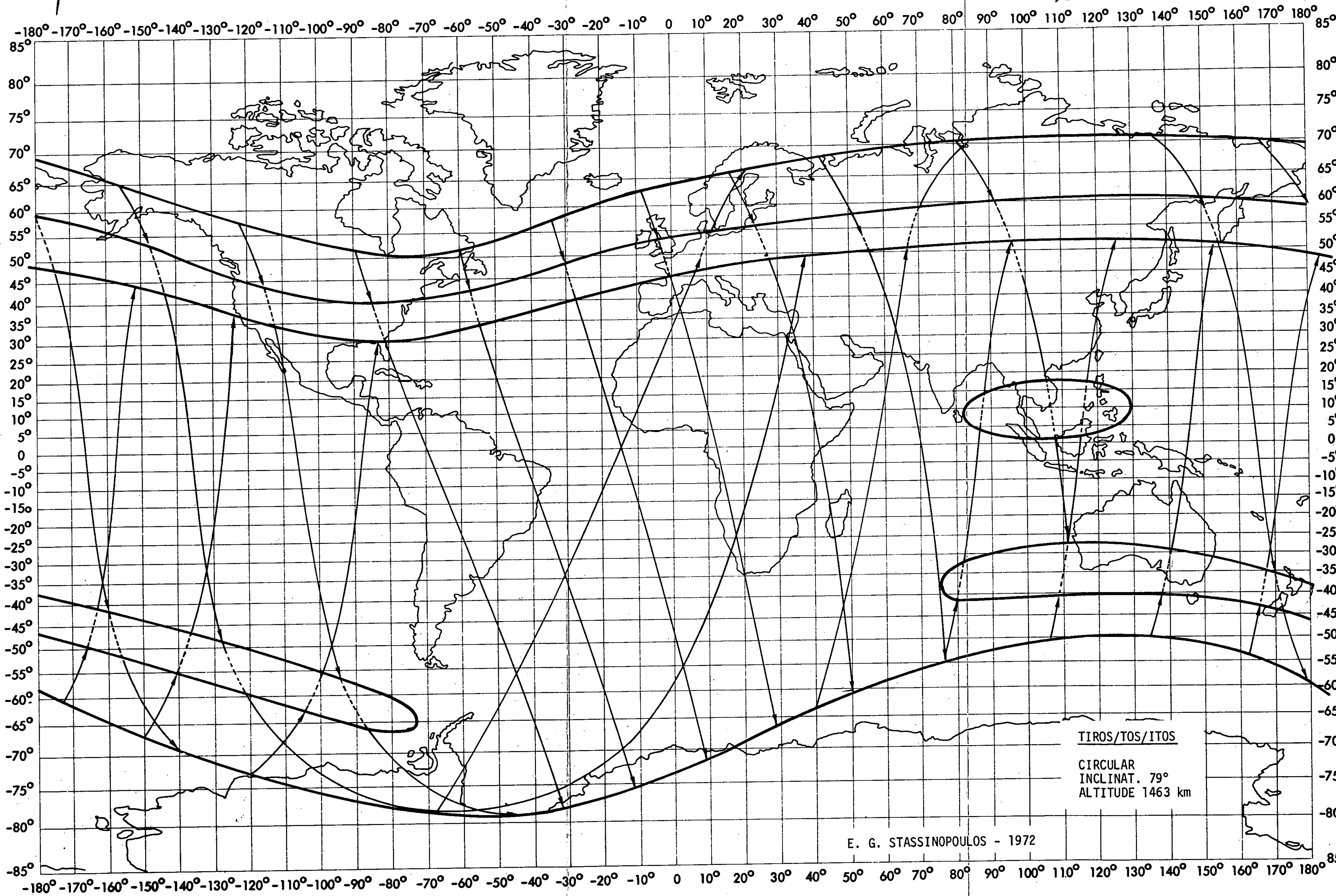
Electrons: F_e (E>.5 Mev) $\left.\begin{matrix} > 10^7 \\ > 10^6 \end{matrix}\right\}$ $\frac{\text{particles}}{\text{cm}^2 \cdot \text{sec}}$



FOLDOUT FRAME 1

FOLDOUT FRAME 2

Electrons: F_e (E>.5 Mev) > 10^3 $\frac{\text{particles}}{\text{cm}^2 \cdot \text{sec}}$



FOLDOUT FRAME 1

FOLDOUT FRAME 2

Electrons: F_e (E>.5 Mev) > 10^5 $\frac{\text{particles}}{\text{cm}^2 \cdot \text{sec}}$