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NOAA Data Report ERL SEL-3

# AN ATLAS OF POLAR CAP ENERGETIC PARTICLE OBSERVATIONS
## VOLUME I. TIROS-N: 1 JANUARY 1979 TO 28 FEBRUARY 1981

Space Environment Laboratory
Boulder, Colorado
August 1984

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / Environmental Research Laboratories

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Herbert H. Sauer

Space Environment Laboratory
Boulder, Colorado
August 1984

UNITED STATES
DEPARTMENT OF COMMERCE

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Secretary

NATIONAL OCEANIC AND
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# National Oceanic and Atmospheric Administration
# TIROS Satellites and Satellite Meteorology

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# AN ATLAS OF POLAR CAP ENERGETIC PARTICLE OBSERVATIONS

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An Atlas of Polar Cap Energetic Particle Observations:

Volume I. TIROS-N: 1 January 1979 to 28 February 1981

## I. Introduction

The Space Environment Laboratory of the National Oceanic and Atmospheric Administration maintains Energetic Particle Sensors (EPS) aboard the NOAA-TIROS series of satellites. The instruments constituting the EPS measure the flux of protons (ions) and electrons mirroring above, and precipitating into, the top of the polar atmosphere. Beyond contributing to the Laboratory mission of providing continual monitoring of the geophysical environment, these data provide a continuous archive data base available to support both Laboratory research directed toward improvement of its services, and the needs of the community of users, both public and private, to whom knowledge of the geophysical environment is important.

This series presents graphical displays of the polar cap (herein defined as geomagnetic latitudes greater than $70^{\circ}$) averages of the proton and electron fluxes precipitating into the polar atmosphere, over the energy range of 30 keV to greater than 80 MeV for protons and greater than 300 keV for electrons. Volume I presents data over the operational lifetime of the TIROS-N spacecraft from 1 January 1979 to 28 February 28 1981. Subsequent volumes using data from the NOAA-6, -7 and -8 satellites will extend the data presentations through 1983.

No elaborate data analysis procedures have been used in the processing of these data other than the conversion to physical units, the restriction in geomagnetic latitude, and the removal of demonstrably bad data points. This decision has been dictated by economic constraints as well as consideration of the intended use of these data. For example, the adopted definition of the polar cap ($\geq 70^{\circ}$ geomagnetic) is arbitrary: energetic particles arising from

auroral or magnetospheric processes are known to precipitate into the atmosphere at latitudes above 70° geomagnetic.

## II. The NOAA-TIROS Spacecraft

The NOAA-TIROS spacecraft are low-altitude, polar-orbiting, sun-synchronous satellites, including to date TIROS-N, NOAA-6, NOAA-7, and NOAA-8. Nominal characteristics of their respective orbits and associated data availability are given in Table 1.

TABLE I

Nominal Satellite Characteristics

| Satellite Designation | Altitude (km) | Period (min) | Local Time Plane (hours) | EPS Data Acquisition (dates) |
|---|---|---|---|---|
| TIROS-N | 853.5 | 102 | 0330, 1530 | 1/1/79 - 2/28/81 |
| NOAA-6 | 815.5 | 102 | 0730, 1930 | 6/26/79- 5/10/83 |
| NOAA-7 | 849.2 | 102 | 0330, 1500 | 7/11/81- 4/1/82 |
| NOAA-8 | 815.5 | 102 | 0730, 1930 | 4/11/83-Current |

The spacecraft are in retrogade 98° inclination orbits as required for sun-synchronism. Because of the tilt of the earth's rotation axis with respect to the celestial pole, and the tilt of the dipole axis with respect to the rotation axis of the earth, the time spent within the polar cap during each orbit varies both diurnally and seasonally. The range is from zero to a maximum of about 12 minutes. This behavior produces apparent noisiness of some of the traces, with a diurnal variation that is quite evident in the data displays. The Energetic Particle Sensors (EPS) aboard the NOAA-TIROS series of spacecraft are nominally identical.

## III. The Medium Energy Proton and Electron Detector

Each Medium Energy Proton and Electron Detector (MEPED) consists of two sensor subassemblies: the Telescope Sensors, and the Dome Detectors.

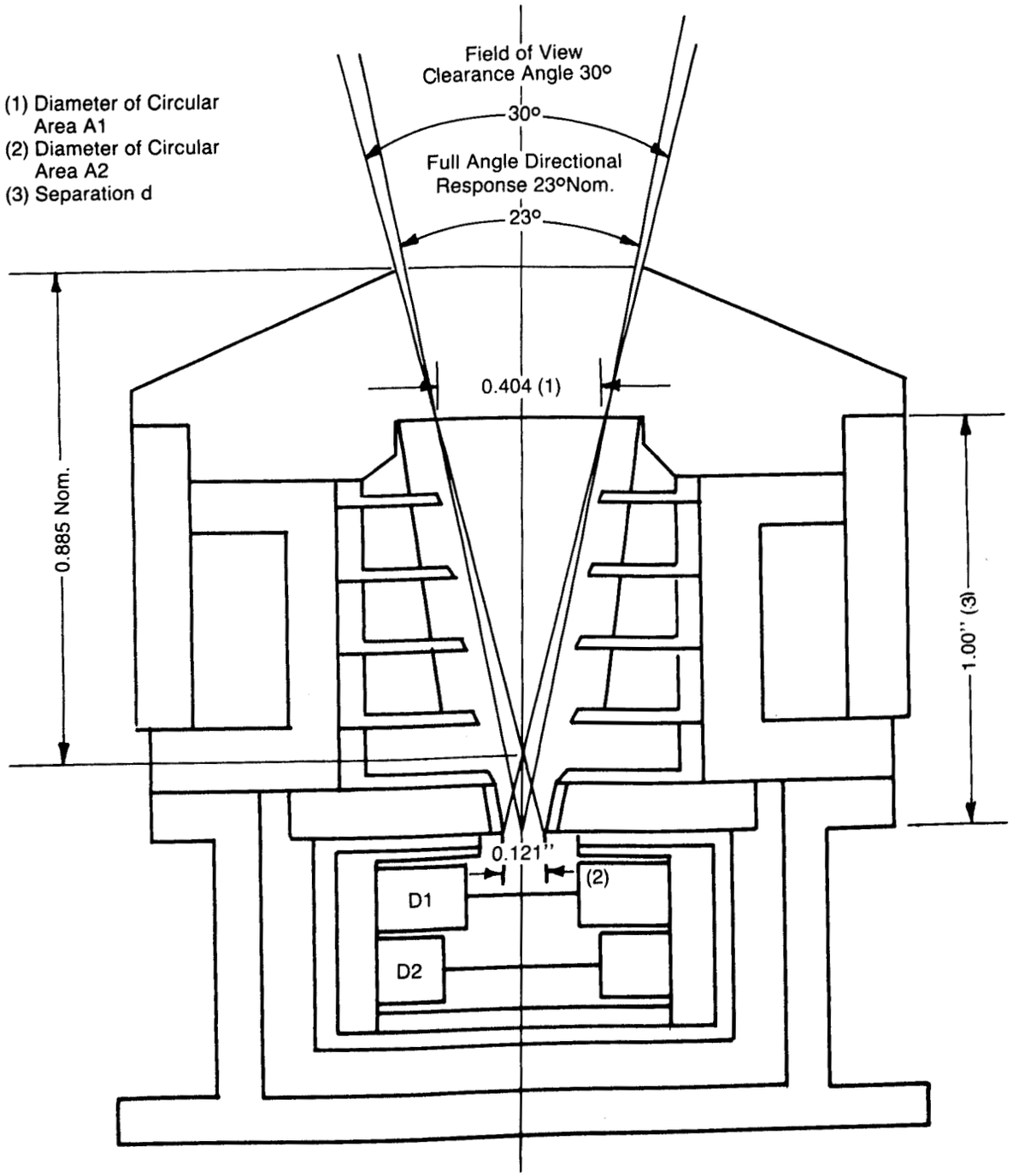
### III.1 The Telescope Sensors:

The Telescope Sensors consist of four sensor systems, a pair of which view the local zenith (precipitating particles), and a pair that "look" at approximately $90^{o}$ to the zenith (locally mirroring or trapped particles). Each pair consists of a proton telescope and an electron detector.

The proton telescope (Figure 1) has a geometric factor of $9.5 \times 10^{-3}$ cm-ster. Electrons are eliminated with a 2.5 kilogauss (minimum field strength) Alnico VIII Magnet. No particle with a magnetic rigidity of less than 6200 gauss-cm can strike the detector unless it scatters. This threshold corresponds to 1.5 MeV for electrons and 2 keV for protons. The proton threshold for the telescope is $\simeq$ 30 keV. These ions have a radius of curvature greater than 40 cm in the field of the magnet, and should therefore be virtually unaffected by the presence of the magnetic field. The telescope consists of two 200 micron thick silicon surface barrier detectors. The front detector (D1) has an effective area of 25 $mm^2$, and the other (D2) has an effective area of 50 $mm^2$.

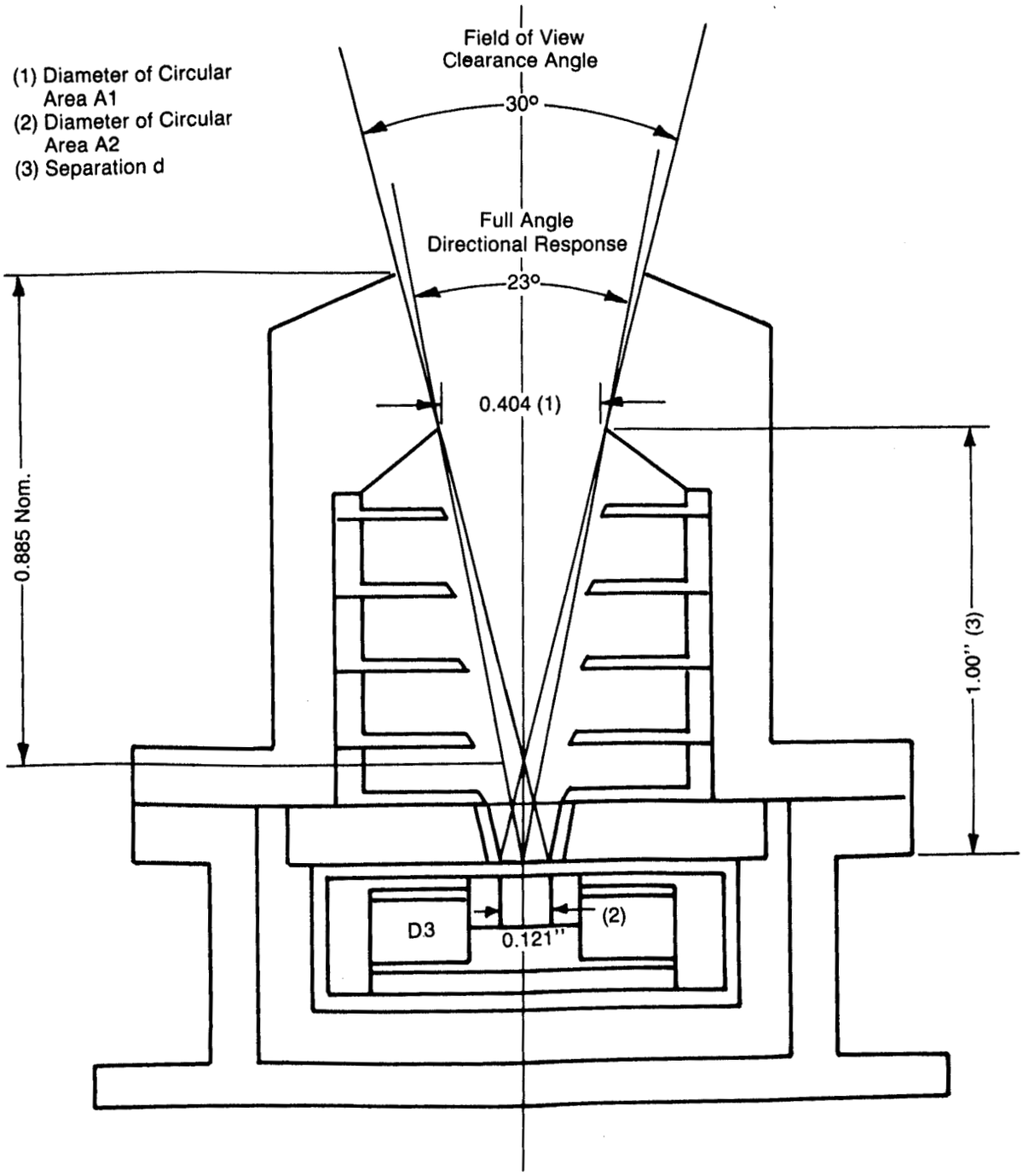
Each proton telescope measures ions in five energy passbands over the range of 30 keV to greater than 2.5 MeV through the application of selective logic on the detector discrimination levels.

The electron detector (Figure 2), has the same geometric factor as the proton telescope, $9.5 \times 10^{-3}$ $cm^2$-ster. The detector is a 1700 um thick, 25 $mm^2$ silicon surface barrier. A thin nickel foil in front of the detector aperture reduces the proton contribution to the detector count rate. The foil is approximately 20 um thick, and removes any sensitivity to protons below 175




PROTON TELESCOPE

Figure 1



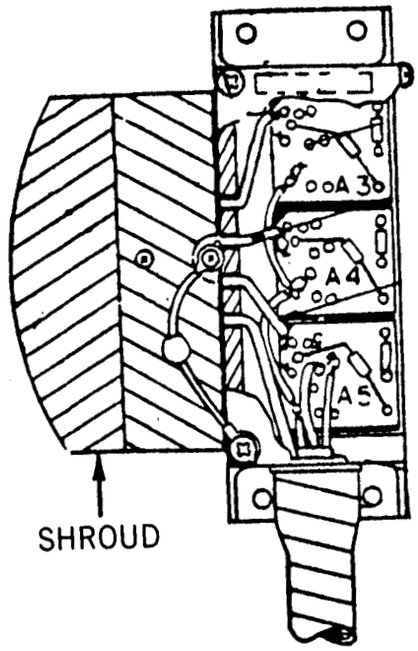

ELECTRON DETECTOR

Figure 2

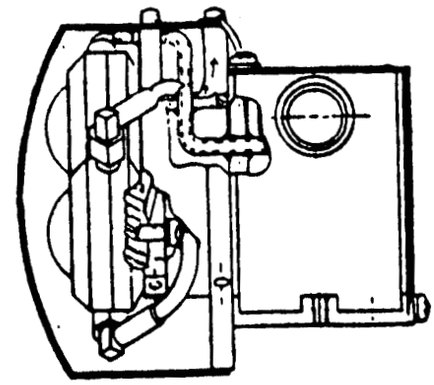
keV. Anti-coincidence logic effectively removes any proton sensitivity above 1.1 MeV from the electron detector.

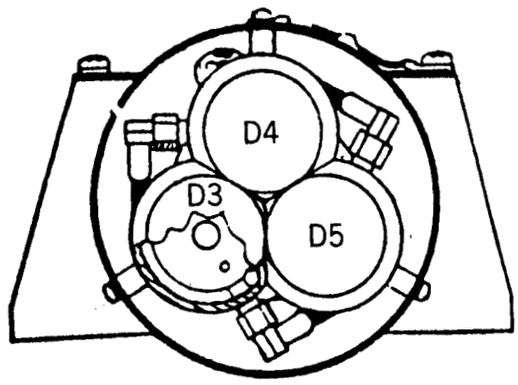
### III.2 The Dome Detector

The Dome or omnidirectional sensors consist of three nominally identical Kevex, lithium-drifted, silicon solid-state detectors of 50 $cm^2$ area, and 3 mm thickness. They are independently mounted under spherical shell moderators to provide sensitivity in three integral data channels. Each detector has a full opening angle of $120^o$ in the zenithal direction as mounted on the spacecraft. The overall out-of-aperture shielding of each detector is an identical 80 MeV, in order that the principal spurious response may be eliminated through simple subtraction of the appropriate detector count rates. Figure 3 is a schematic view of the Dome detectors.




**SIDE VIEWS**






"KEVEX"
Si (Li)
DETECTOR 3 PLACES

D3 = ALUMINUM DOME
D4 = COPPER DOME
D5 = TUNGSTEN DOME

DOME DETECTORS

Figure 3

### III.3 MEPED Characteristics

The pertinent characteristics of the MEPED detectors appropriate to this report are given in Table 2.

TABLE 2. MEPED CHARACTERISTICS

| Ion | Channel Designation | Energy | Geometric Factor ($cm^2$ ster) | Accumulation Time (s) |
|---|---|---|---|---|
| Proton | P1 | 30-80 keV | $9.4 \times 10^{-3}$ | 1 |
| Proton | P2 | 80-250 keV | $9.4 \times 10^{-3}$ | 1 |
| Proton | P3 | 250-800 keV | $9.4 \times 10^{-3}$ | 1 |
| Proton | P4 | 800-2500 keV | $9.4 \times 10^{-3}$ | 1 |
| Proton | P5 | >2.5 MeV | $9.4 \times 10^{-3}$ | 1 |
| Proton | P6 | 16-80 MeV<br>80-215 MeV | 1.57<br>5.4 | 2 |
| Proton | P7 | 36-80 MeV<br>80-215 MeV | 1.57<br>5.4 | 2 |
| Proton | P8 | 80-215 MeV | 5.4 | 2 |
| Electron | E1 | >30 keV | $9.5 \times 10^{-3}$ | 1 |
| Electron | E2 | >100 keV | $9.5 \times 10^{-3}$ | 1 |
| Electron | E3 | >300 keV | $9.5 \times 10^{-3}$ | 1 |

The equality of the secondary energy response of channels P6 and P7 is an indication of the design decision to have the out of aperture response of the three Dome detectors equal. This allows correction through subtraction of the P8 channel output from the primary channel response from P6 and P7.

## IV. The Data Presentation

The figures in the Appendix display the observed fluxes of the indicated particles and their energy ranges, time-averaged over that portion of each orbit lying above $70^{o}$ geomagnetic latitude. The display format is identical throughout.

### IV.1 The Display Format

- Each page displays data for a period of up to 11 days (3 pages per month).
- The lower left panel identifies the particle type, i.e., electrons or protons (ions), and the corresponding energy range for each data channel displayed.
- The legend at the upper right inside each data frame gives the order of presentation of the channels and identifies the scale factor applied to each channel. For example, P1 · E05 denotes a scale factor of $10^5$ on channel P1.
- The ordinates are in day of the year (Day 1 = January 1).
- The abscissae are in differential flux units for the lower energy proton channels P1 through P4 displayed in the upper left panel. Integral flux units are used for the higher energy proton channels P5 through P8 and the electron channels E1 through E3 displayed on the right panels of each page.
- The calendar date corresponding to the start day of the year for the data displayed is given at the bottom of each page. (Note: A table of conversions from calendar date to day of year is given in the Appendix.)

## IV.2 Display Data Interpretation

No analysis of the data has been done beyond that necessary to provide an intended level of information including the following:

- Identification of solar cosmic ray events.
- Identification of entry of enhanced fluxes of particles from other sources (for example, those possibly associated with an approaching shock).
- Identification of periods of interest within the archive data base.
- Establishment of an event chronology.
- Intercomparison with equivalent sensors on other platforms.

The information goal has been achieved; however certain things should be borne in mind in interpreting the data displayed.

- Invalid data points have not been entirely removed. This should not be a severe problem - isolated spikes are usually identifiable.
- Particle injections resulting from auroral and magnetospheric processes often intrude to latitudes above $70^{\circ}$ geomagnetic. This is the cause of the increasing spikiness in the data as the energy decreases. The lower envelope of these curves, however, well represent the fluxes arriving at the top of the atmosphere along "open" field lines from the interplanetary medium.
- The use of the amplitude of the spikiness referred to, as some "measure" of geophysical activity is compromised by aliasing, owing to the limited local time coverage of the NOAA-TIROS satellite. This situation improves somewhat if the data from simultaneous observations on spacecraft at different local times, i.e., TIROS-N and NOAA-6, are compared.

- The spikiness of channel P6 ($E_p$ > 16 MeV) is not due to anomalous 16 MeV protons; it is apparently due to frequent occurrences of large fluxes of trapped energetic electrons just equatorward of the auroral regions.

In sum, the lower envelope of the display traces gives a reliable measure of energetic particle fluxes of interplanetary orgin, such as solar cosmic rays. Small or short-duration events at lower energies (<1 MeV) may be distinguished from fluctuations in the aurorally produced "noise" with some experience, because of the characteristic, apparent diurnal variation of that noise.

## V. Data Availability

The choice of data periods covered in each plot was dictated by the period of time covered by the associated archive data tape; i.e., there is a one-to-one correspondence between display plots and source tape. For information concerning the NOAA-TIROS archive data, and its availability, contact:

National Geophysical Data Center, E/GC2
ATTN: Dan Wilkinson
National Oceanic and Atmospheric Administration
325 Broadway
Boulder, Colorado 80303

For information concerning the data contained in this report, contact:

Dr. Herbert H. Sauer R/E/SE
NOAA Space Environment Laboratory
325 Broadway
Boulder, Colorado 80303

## VI. Acknowledgment

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Appendix: Tables A-1 and A-2 may be used to convert between calendar date and day of the year. Data Plots of observed polar cap average fluxes are given in terms of numerical day of the year with day 1 = January 1.

TABLE A-1

## DAY OF THE YEAR CALENDAR

(FOR NON LEAP YEARS)

| DAY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 001 | 032 | 060 | 091 | 121 | 152 | 182 | 213 | 244 | 274 | 305 | 335 | 1 |
| 2 | 002 | 033 | 061 | 092 | 122 | 153 | 183 | 214 | 245 | 275 | 306 | 336 | 2 |
| 3 | 003 | 034 | 062 | 093 | 123 | 154 | 184 | 215 | 246 | 276 | 307 | 337 | 3 |
| 4 | 004 | 035 | 063 | 094 | 124 | 155 | 185 | 216 | 247 | 277 | 308 | 338 | 4 |
| 5 | 005 | 036 | 064 | 095 | 125 | 156 | 186 | 217 | 248 | 278 | 309 | 339 | 5 |
| 6 | 006 | 037 | 065 | 096 | 126 | 157 | 187 | 218 | 249 | 279 | 310 | 340 | 6 |
| 7 | 007 | 038 | 066 | 097 | 127 | 158 | 188 | 219 | 250 | 280 | 311 | 341 | 7 |
| 8 | 008 | 039 | 067 | 098 | 128 | 159 | 189 | 220 | 251 | 281 | 312 | 342 | 8 |
| 9 | 009 | 040 | 068 | 099 | 129 | 160 | 190 | 221 | 252 | 282 | 313 | 343 | 9 |
| 10 | 010 | 041 | 069 | 100 | 130 | 161 | 191 | 222 | 253 | 283 | 314 | 344 | 10 |
| 11 | 011 | 042 | 070 | 101 | 131 | 162 | 192 | 223 | 254 | 284 | 315 | 345 | 11 |
| 12 | 012 | 043 | 071 | 102 | 132 | 163 | 193 | 224 | 255 | 285 | 316 | 346 | 12 |
| 13 | 013 | 044 | 072 | 103 | 133 | 164 | 194 | 225 | 256 | 286 | 317 | 347 | 13 |
| 14 | 014 | 045 | 073 | 104 | 134 | 165 | 195 | 226 | 257 | 287 | 318 | 348 | 14 |
| 15 | 015 | 046 | 074 | 105 | 135 | 166 | 196 | 227 | 258 | 288 | 319 | 349 | 15 |
| 16 | 016 | 047 | 075 | 106 | 136 | 167 | 197 | 228 | 259 | 289 | 320 | 350 | 16 |
| 17 | 017 | 048 | 076 | 107 | 137 | 168 | 198 | 229 | 260 | 290 | 321 | 351 | 17 |
| 18 | 018 | 049 | 077 | 108 | 138 | 169 | 199 | 230 | 261 | 291 | 322 | 352 | 18 |
| 19 | 019 | 050 | 078 | 109 | 139 | 170 | 200 | 231 | 262 | 292 | 323 | 353 | 19 |
| 20 | 020 | 051 | 079 | 110 | 140 | 171 | 201 | 232 | 263 | 293 | 324 | 354 | 20 |
| 21 | 021 | 052 | 080 | 111 | 141 | 172 | 202 | 233 | 264 | 294 | 325 | 355 | 21 |
| 22 | 022 | 053 | 081 | 112 | 142 | 173 | 203 | 234 | 265 | 295 | 326 | 356 | 22 |
| 23 | 023 | 054 | 082 | 113 | 143 | 174 | 204 | 235 | 266 | 296 | 327 | 357 | 23 |
| 24 | 024 | 055 | 083 | 114 | 144 | 175 | 205 | 236 | 267 | 297 | 328 | 358 | 24 |
| 25 | 025 | 056 | 084 | 115 | 145 | 176 | 206 | 237 | 268 | 298 | 329 | 359 | 25 |
| 26 | 026 | 057 | 085 | 116 | 146 | 177 | 207 | 238 | 269 | 299 | 330 | 360 | 26 |
| 27 | 027 | 058 | 086 | 117 | 147 | 178 | 208 | 239 | 270 | 300 | 331 | 361 | 27 |
| 28 | 028 | 059 | 087 | 118 | 148 | 179 | 209 | 240 | 271 | 301 | 332 | 362 | 28 |
| 29 | 029 | | 088 | 119 | 149 | 180 | 210 | 241 | 272 | 302 | 333 | 363 | 29 |
| 30 | 030 | | 089 | 120 | 150 | 181 | 211 | 242 | 273 | 303 | 334 | 364 | 30 |
| 31 | 031 | | 090 | | 151 | | 212 | 243 | | 304 | | 365 | 31 |
| DAY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | DAY |

(FOR NON LEAP YEARS)

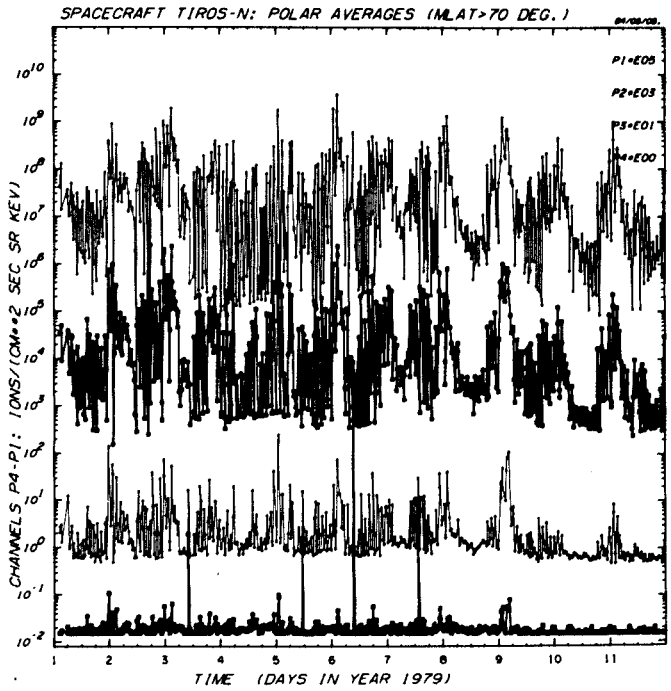
TABLE A-2

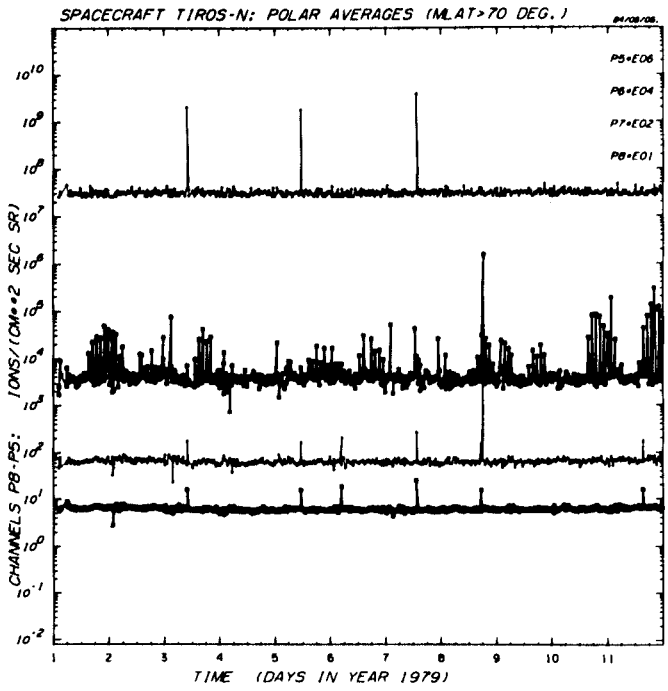
**DAY OF THE YEAR CALENDAR**

**(FOR LEAP YEARS)**

| DAY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 001 | 032 | 061 | 092 | 122 | 153 | 183 | 214 | 245 | 275 | 306 | 336 | 1 |
| 2 | 002 | 033 | 062 | 093 | 123 | 154 | 184 | 215 | 246 | 276 | 307 | 337 | 2 |
| 3 | 003 | 034 | 063 | 094 | 124 | 155 | 185 | 216 | 247 | 277 | 308 | 338 | 3 |
| 4 | 004 | 035 | 064 | 095 | 125 | 156 | 186 | 217 | 248 | 278 | 309 | 339 | 4 |
| 5 | 005 | 036 | 065 | 096 | 126 | 157 | 187 | 218 | 249 | 279 | 310 | 340 | 5 |
| 6 | 006 | 037 | 066 | 097 | 127 | 158 | 188 | 219 | 250 | 280 | 311 | 341 | 6 |
| 7 | 007 | 038 | 067 | 098 | 128 | 159 | 189 | 220 | 251 | 281 | 312 | 342 | 7 |
| 8 | 008 | 039 | 068 | 099 | 129 | 160 | 190 | 221 | 252 | 282 | 313 | 343 | 8 |
| 9 | 009 | 040 | 069 | 100 | 130 | 161 | 191 | 222 | 253 | 283 | 314 | 344 | 9 |
| 10 | 010 | 041 | 070 | 101 | 131 | 162 | 192 | 223 | 254 | 284 | 315 | 345 | 10 |
| 11 | 011 | 042 | 071 | 102 | 132 | 163 | 193 | 224 | 255 | 285 | 316 | 346 | 11 |
| 12 | 012 | 043 | 072 | 103 | 133 | 164 | 194 | 225 | 256 | 286 | 317 | 347 | 12 |
| 13 | 013 | 044 | 073 | 104 | 134 | 165 | 195 | 226 | 257 | 287 | 318 | 348 | 13 |
| 14 | 014 | 045 | 074 | 105 | 135 | 166 | 196 | 227 | 258 | 288 | 319 | 349 | 14 |
| 15 | 015 | 046 | 075 | 106 | 136 | 167 | 197 | 228 | 259 | 289 | 320 | 350 | 15 |
| 16 | 016 | 047 | 076 | 107 | 137 | 168 | 198 | 229 | 260 | 290 | 321 | 351 | 16 |
| 17 | 017 | 048 | 077 | 108 | 138 | 169 | 199 | 230 | 261 | 291 | 322 | 352 | 17 |
| 18 | 018 | 049 | 078 | 109 | 139 | 170 | 200 | 231 | 262 | 292 | 323 | 353 | 18 |
| 19 | 019 | 050 | 079 | 110 | 140 | 171 | 201 | 232 | 263 | 293 | 324 | 354 | 19 |
| 20 | 020 | 051 | 080 | 111 | 141 | 172 | 202 | 233 | 264 | 294 | 325 | 355 | 20 |
| 21 | 021 | 052 | 081 | 112 | 142 | 173 | 203 | 234 | 265 | 295 | 326 | 356 | 21 |
| 22 | 022 | 053 | 082 | 113 | 143 | 174 | 204 | 235 | 266 | 296 | 327 | 357 | 22 |
| 23 | 023 | 054 | 083 | 114 | 144 | 175 | 205 | 236 | 267 | 297 | 328 | 358 | 23 |
| 24 | 024 | 055 | 084 | 115 | 145 | 176 | 206 | 237 | 268 | 298 | 329 | 359 | 24 |
| 25 | 025 | 056 | 085 | 116 | 146 | 177 | 207 | 238 | 269 | 299 | 330 | 360 | 25 |
| 26 | 026 | 057 | 086 | 117 | 147 | 178 | 208 | 239 | 270 | 300 | 331 | 361 | 26 |
| 27 | 027 | 058 | 087 | 118 | 148 | 179 | 209 | 240 | 271 | 301 | 332 | 362 | 27 |
| 28 | 028 | 059 | 088 | 119 | 149 | 180 | 210 | 241 | 272 | 302 | 333 | 363 | 28 |
| 29 | 029 | 060 | 089 | 120 | 150 | 181 | 211 | 242 | 273 | 303 | 334 | 364 | 29 |
| 30 | 030 | | 090 | 121 | 151 | 182 | 212 | 243 | 274 | 304 | 335 | 365 | 30 |
| 31 | 031 | | 091 | | 152 | | 213 | 244 | | 305 | | 366 | 31 |
| DAY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | DAY |

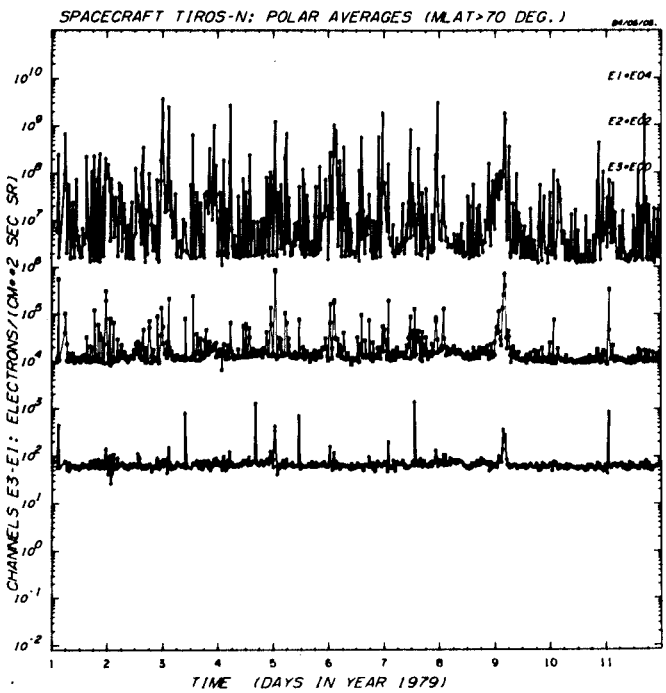
**(FOR LEAP YEARS)**



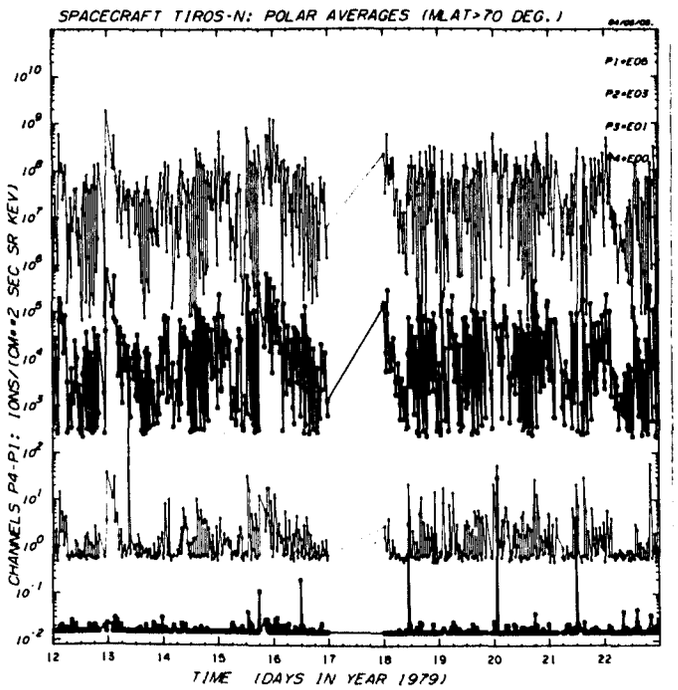



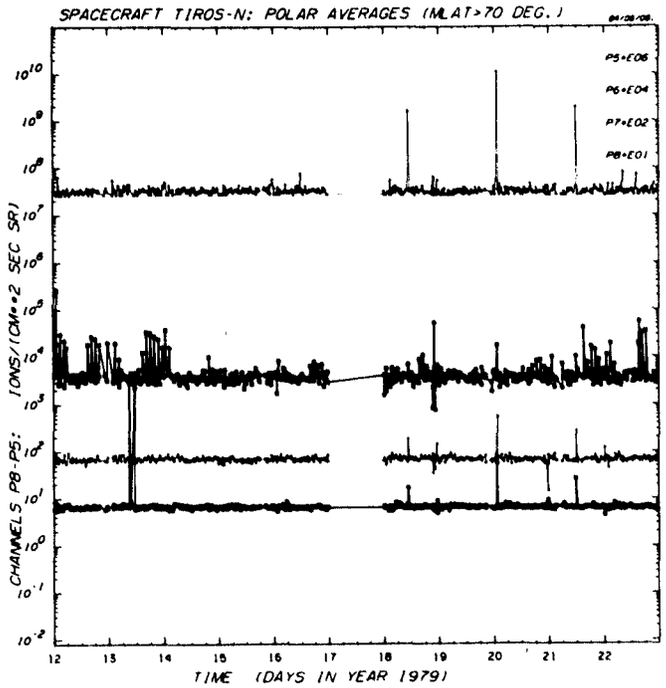

*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV



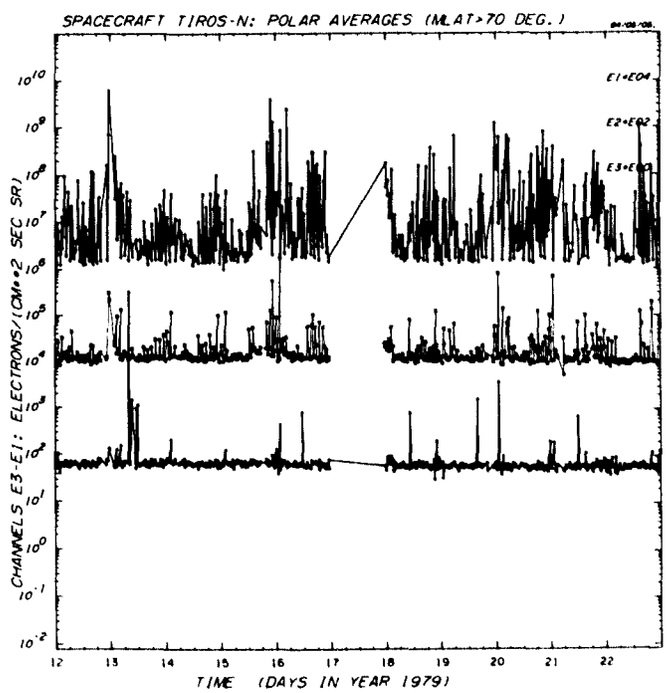

**January 1, 1979**



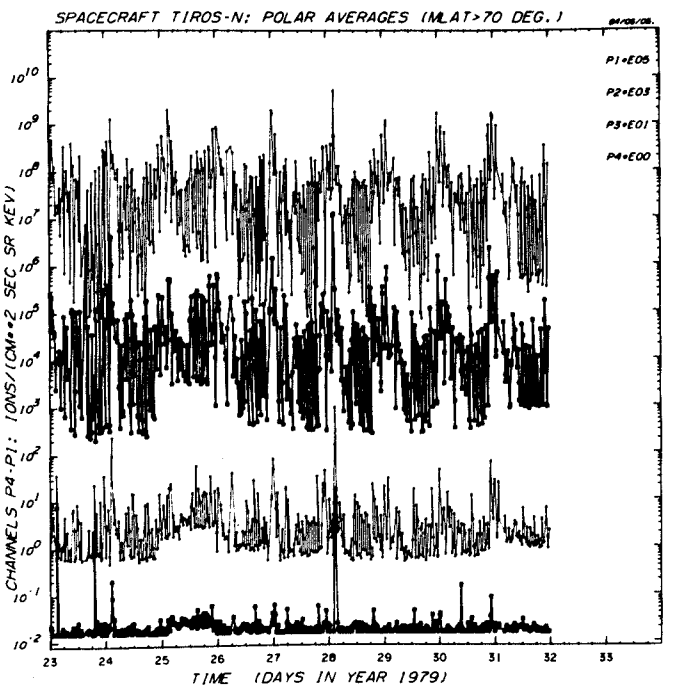



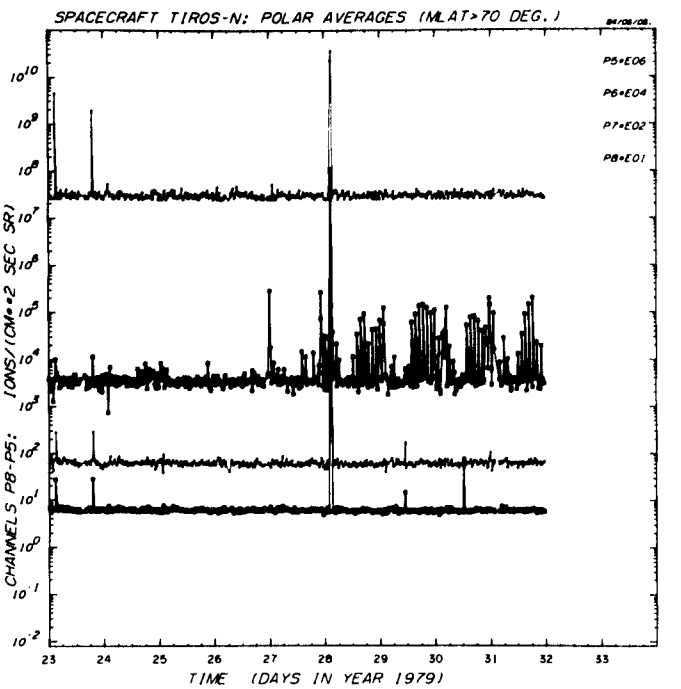

*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV



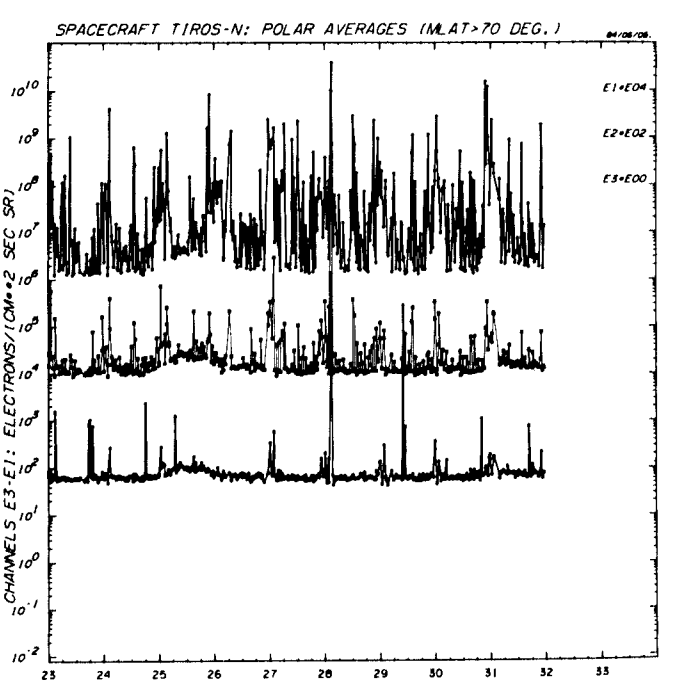

**January 12, 1979**



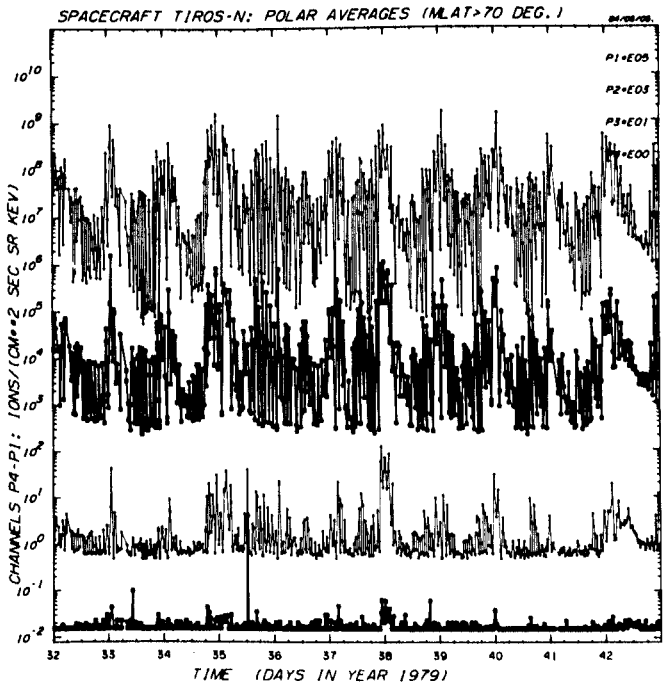



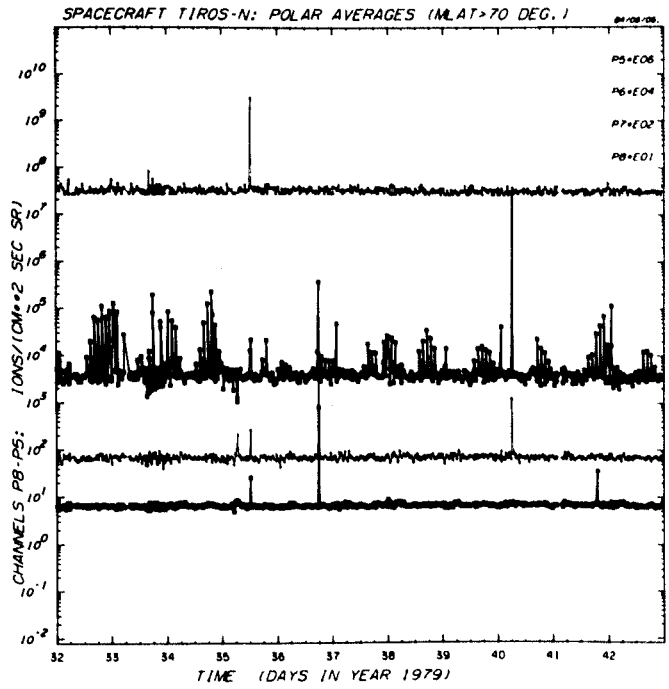

ENERGY CHANNELS:

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV



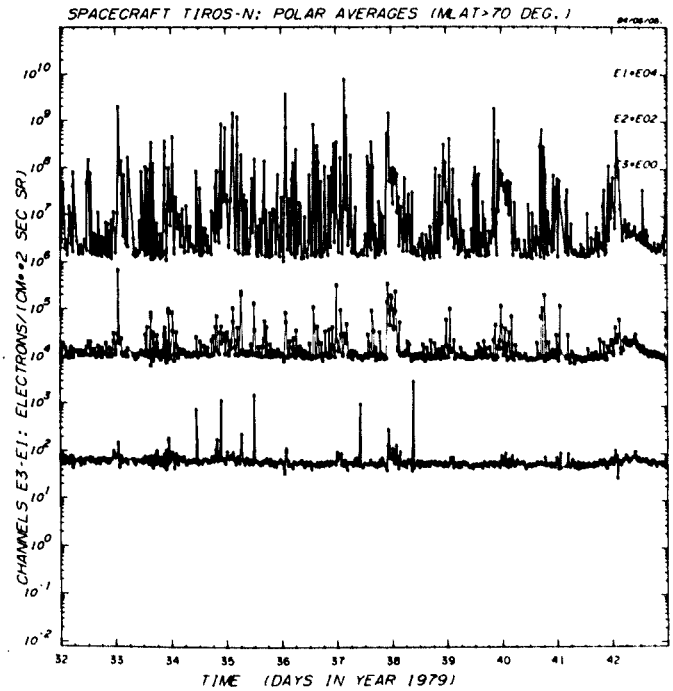

**January 23, 1979**



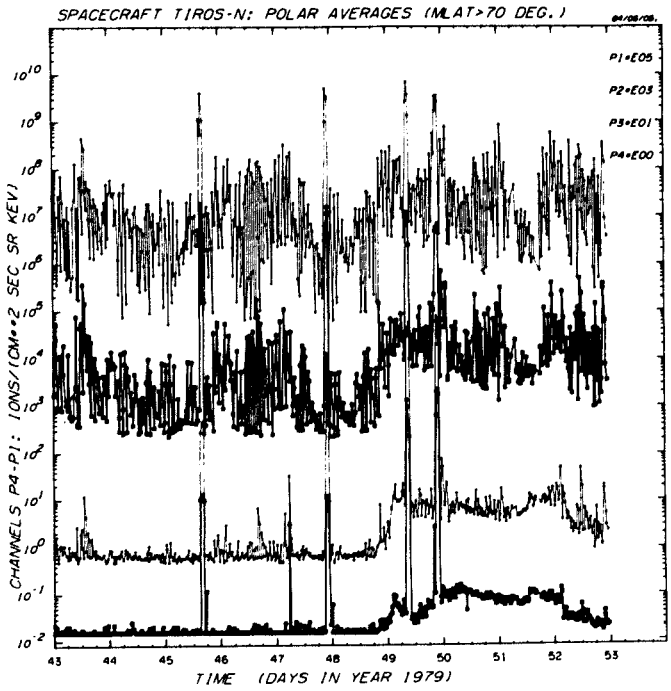



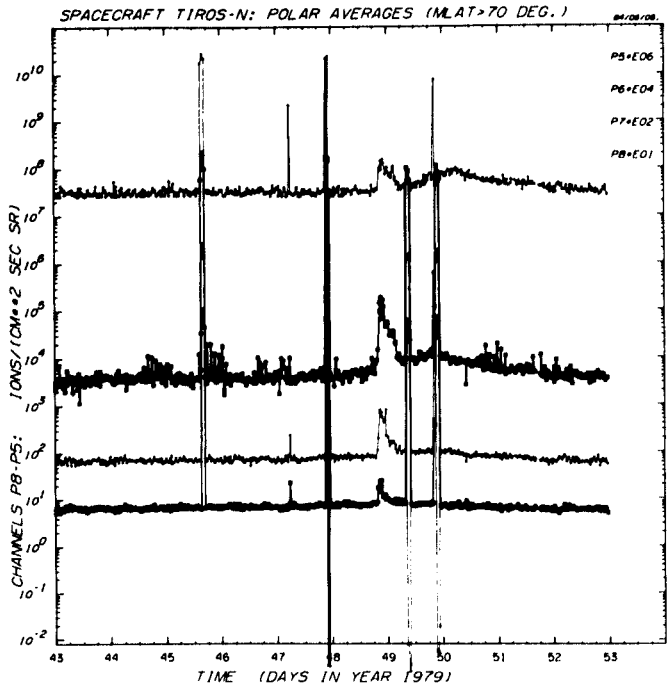

ENERGY CHANNELS:

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV



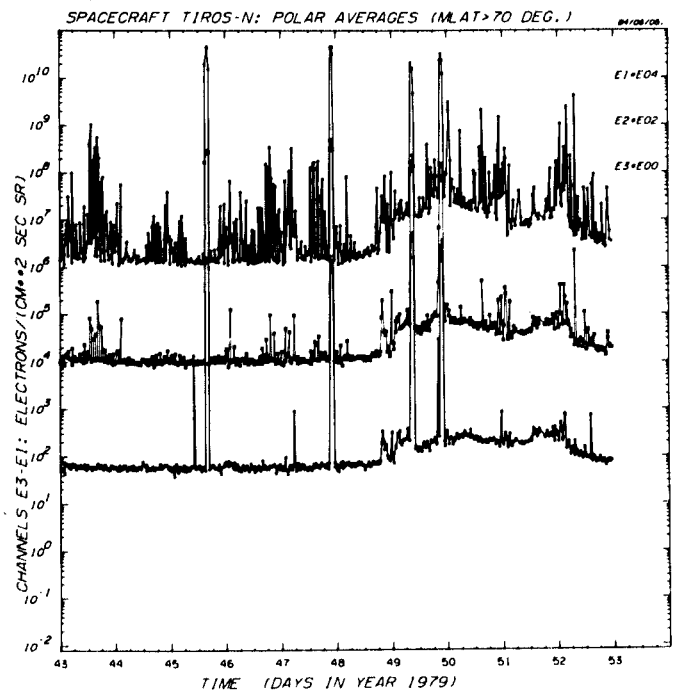

**February 1, 1979**



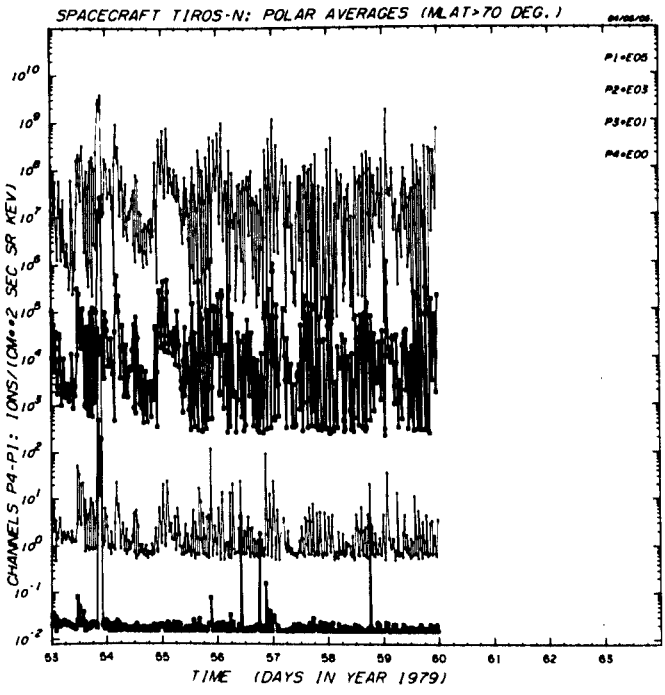



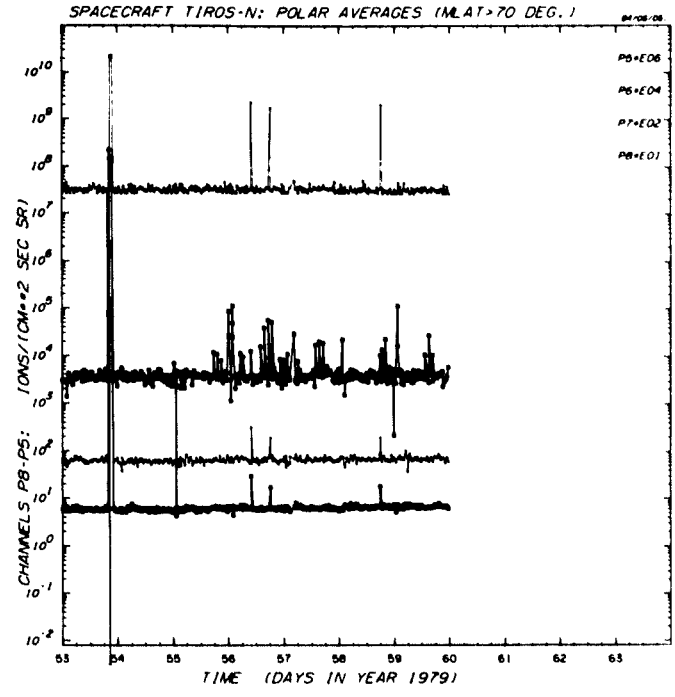

*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV



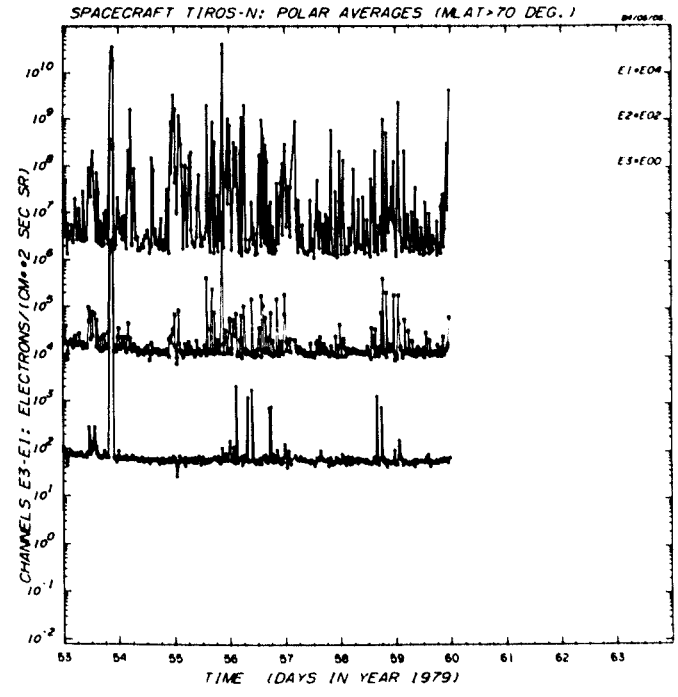

**February 12, 1979**



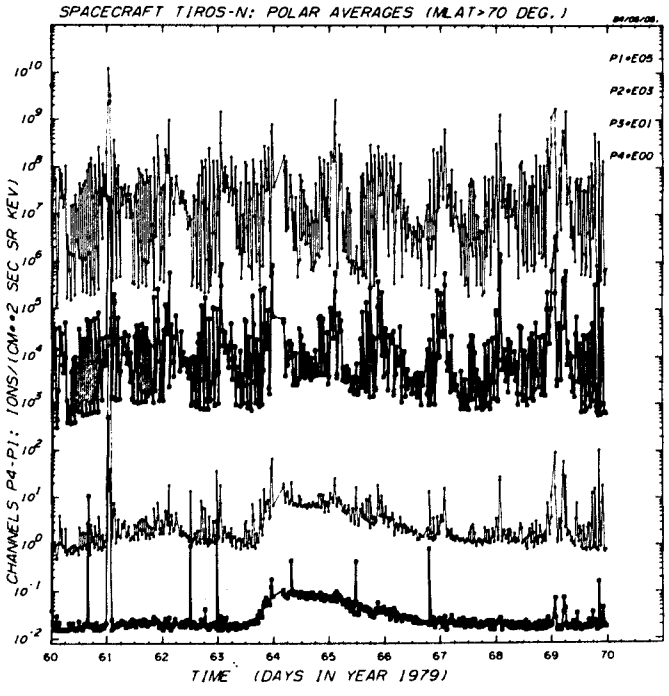



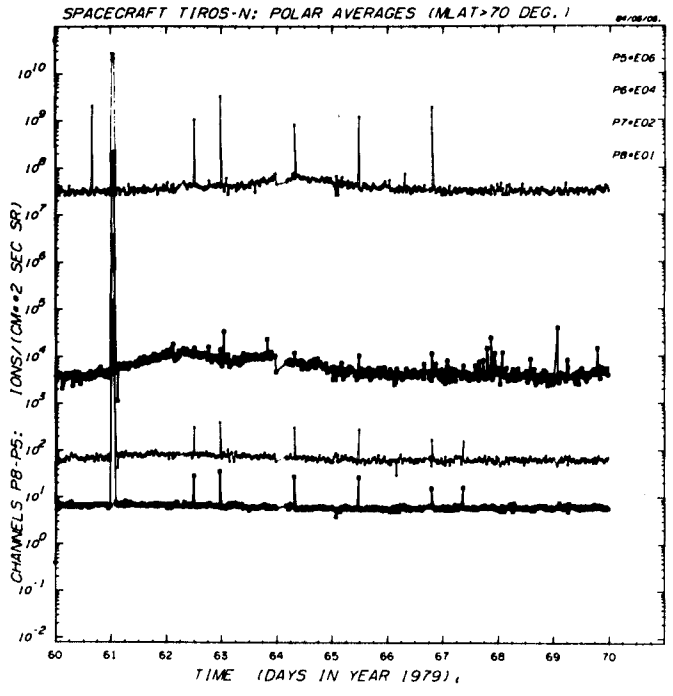

*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV




**February 22, 1979**




*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
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P4: E= 800 -2500 KEV
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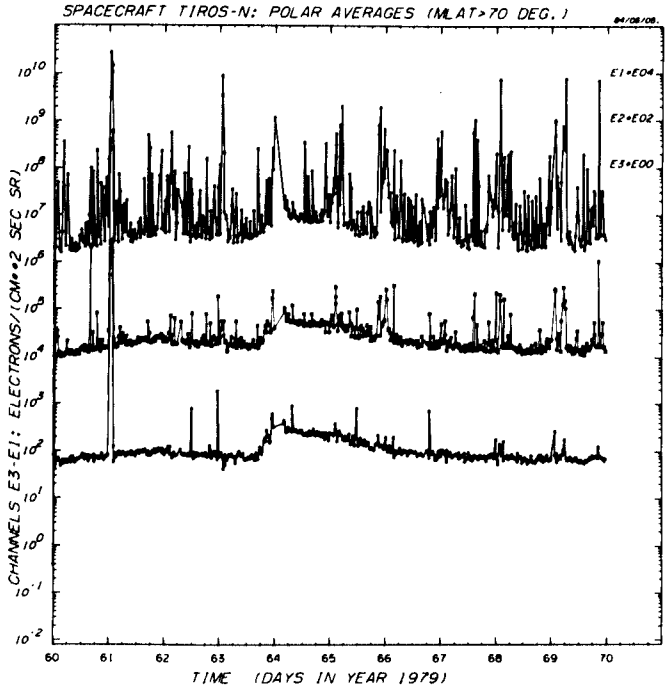
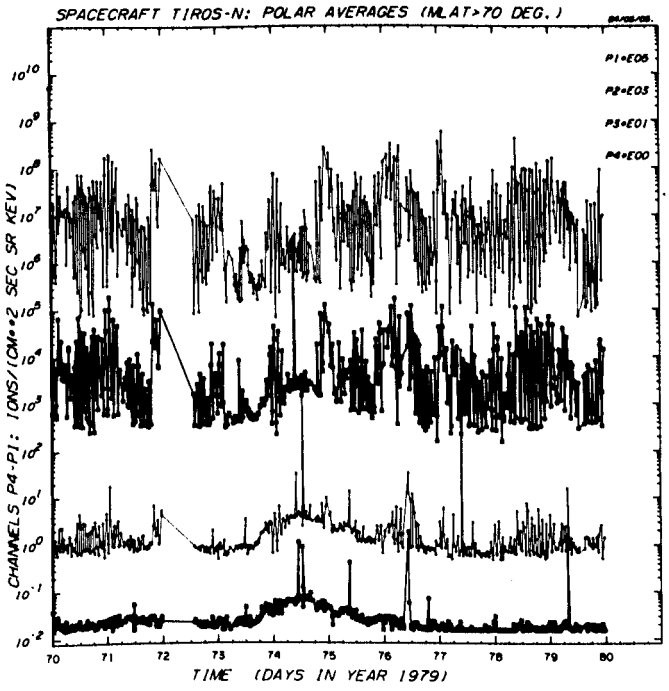
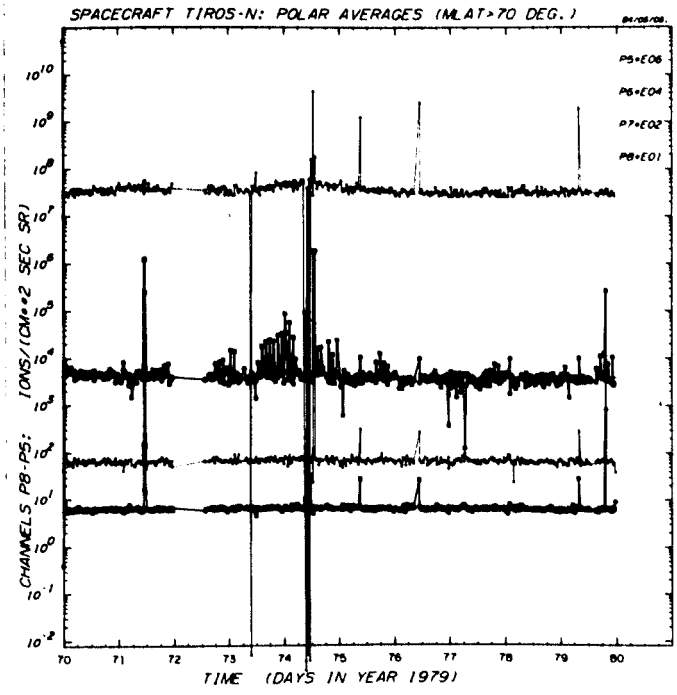
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV




**March 1, 1979**




ENERGY CHANNELS:

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
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P5: E > 2500 KEV
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P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
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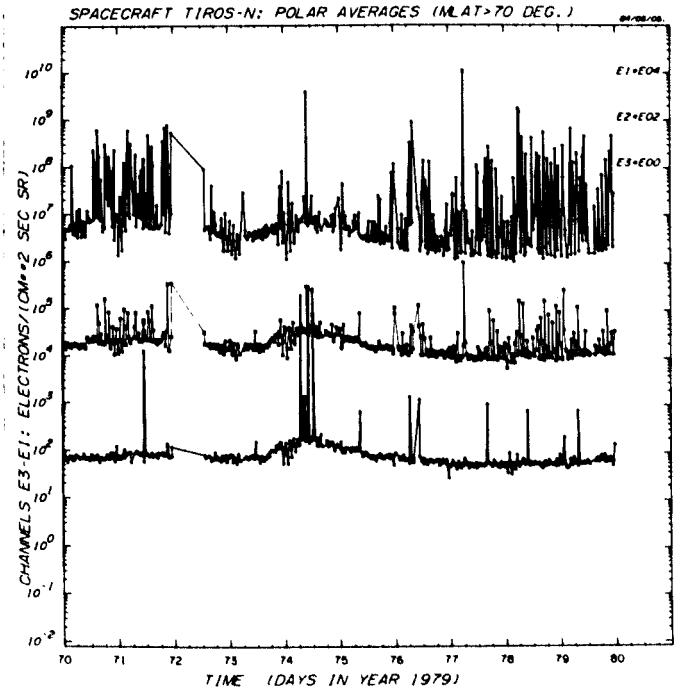
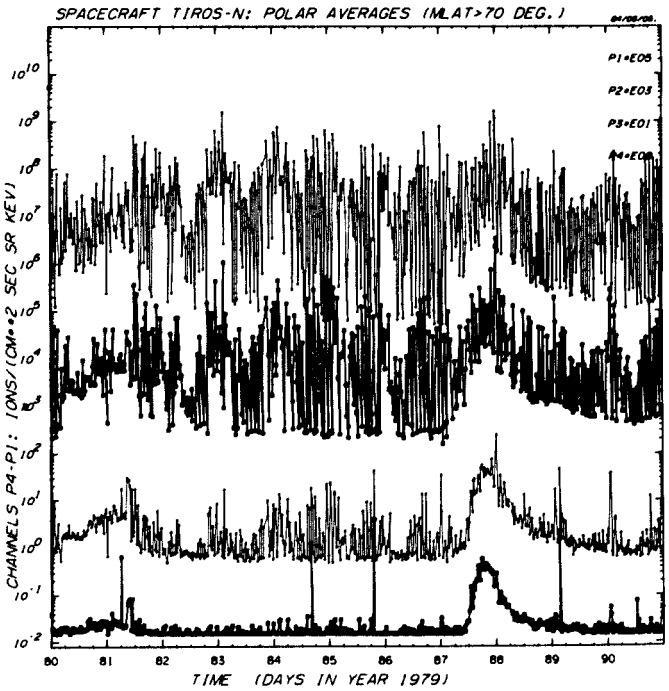
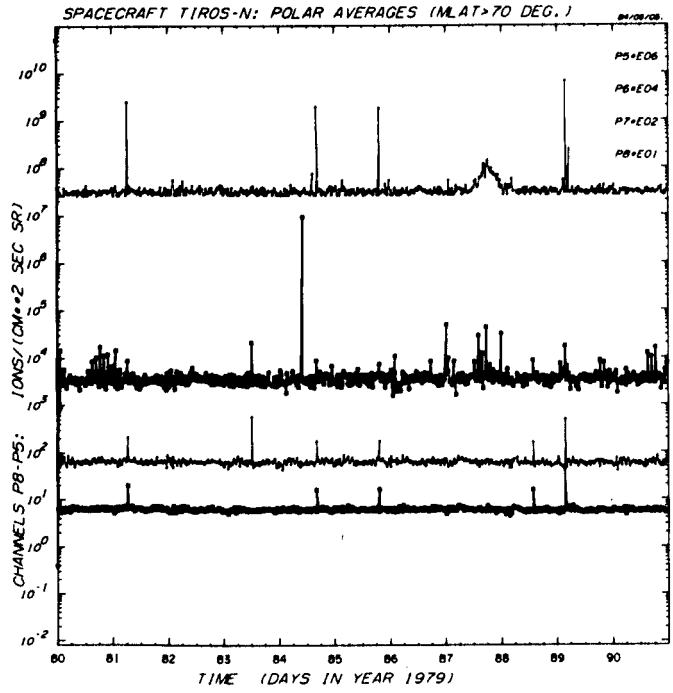



**March 11, 1979**




*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
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E1: E > 30 KEV
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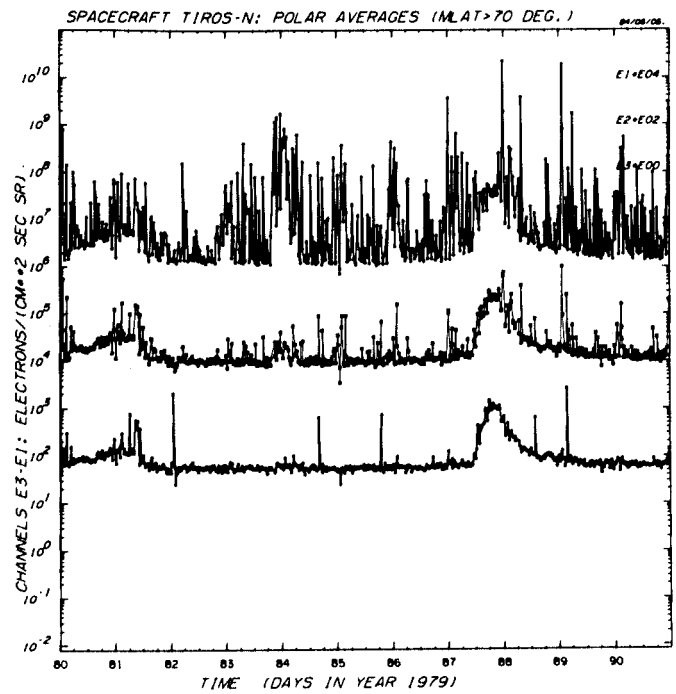
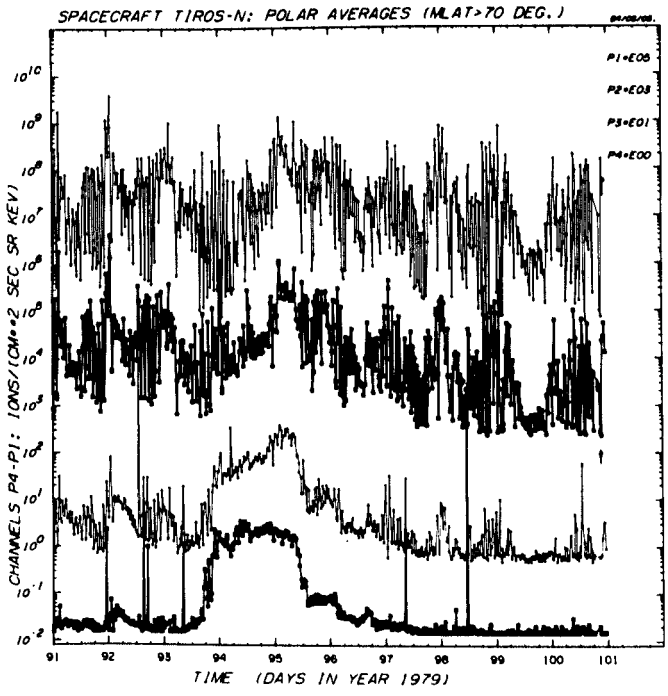
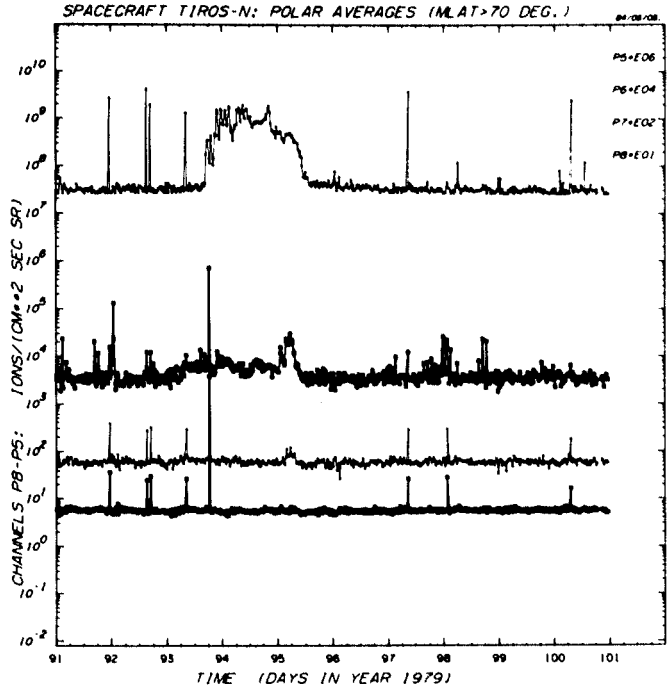



**March 21, 1979**

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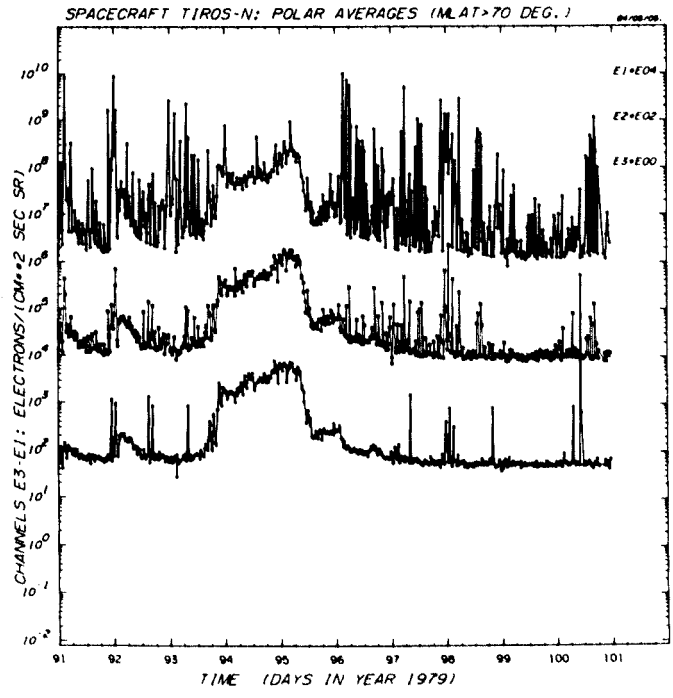
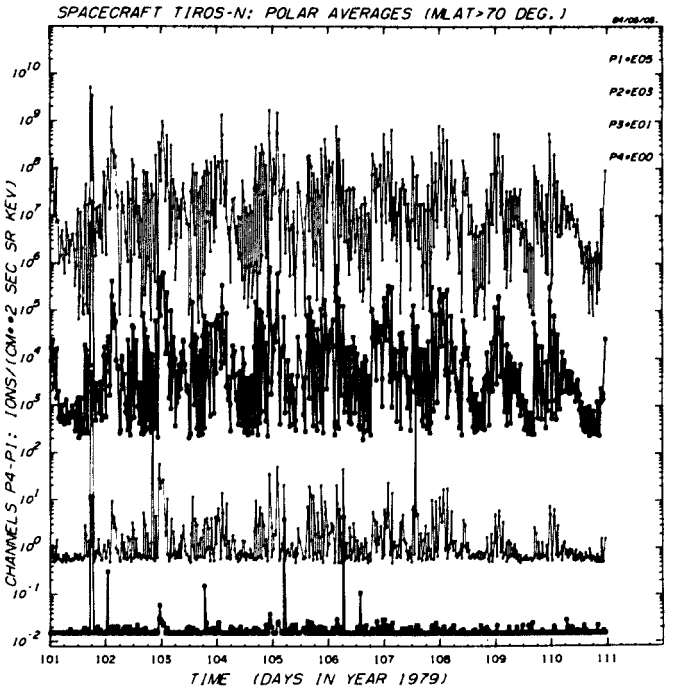
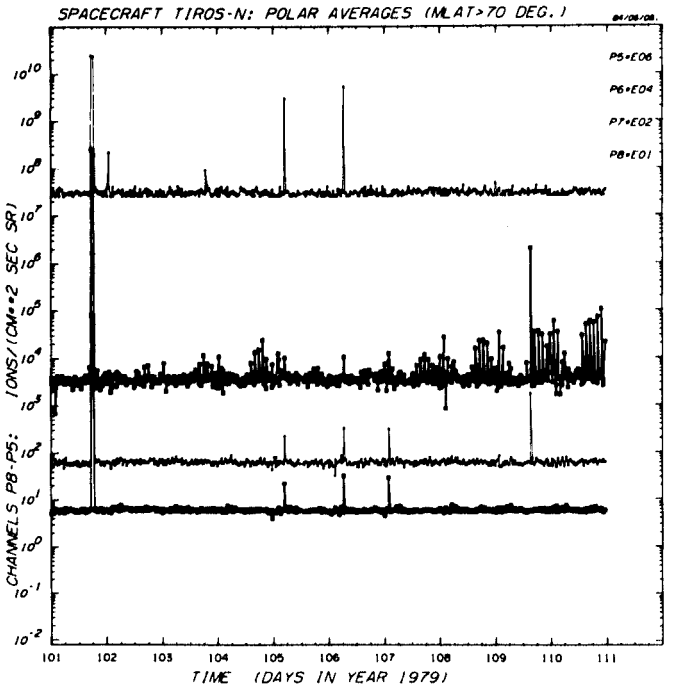



**April 1, 1979**




ENERGY CHANNELS:

P1: E= 30 - 80 KEV
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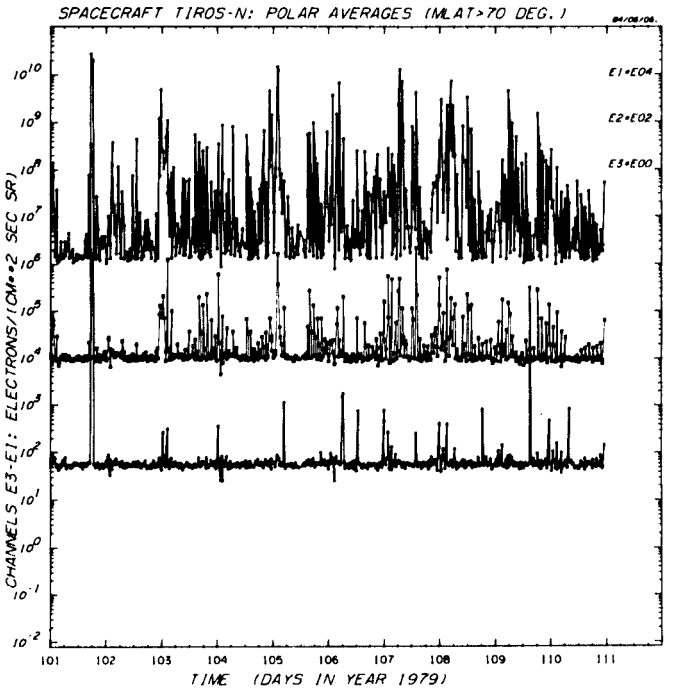
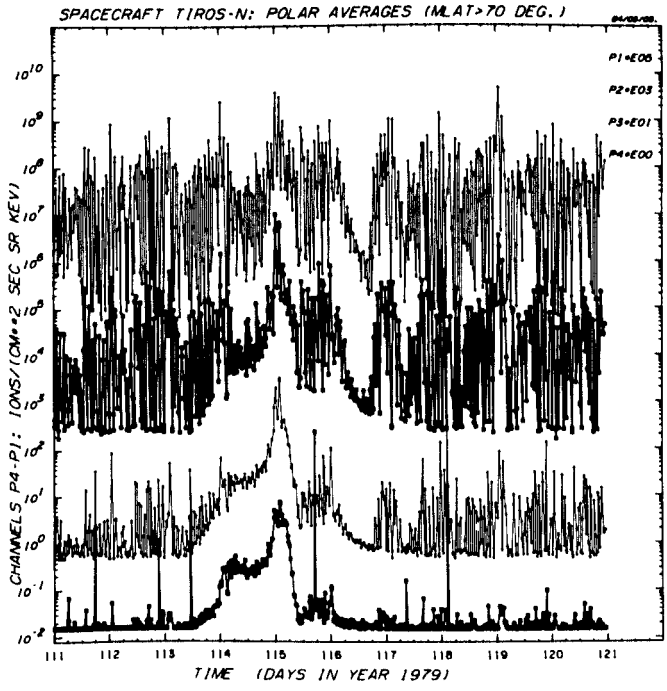
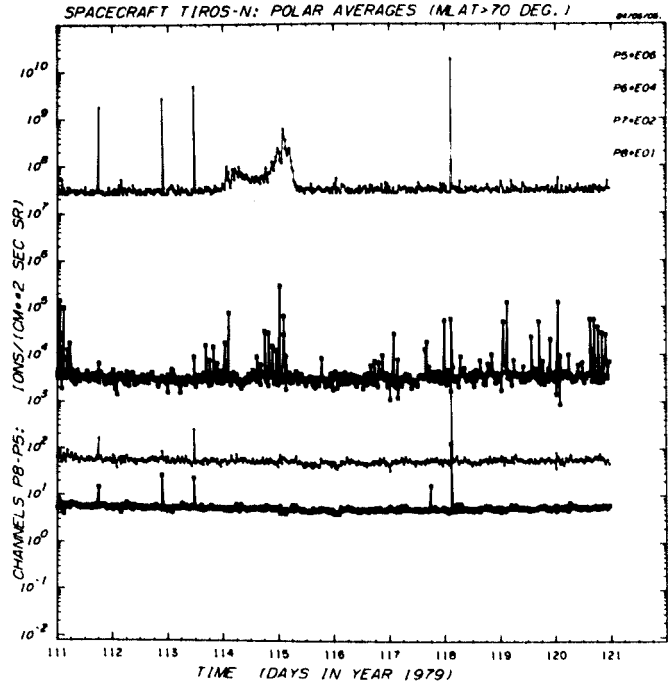



**April 11, 1979**

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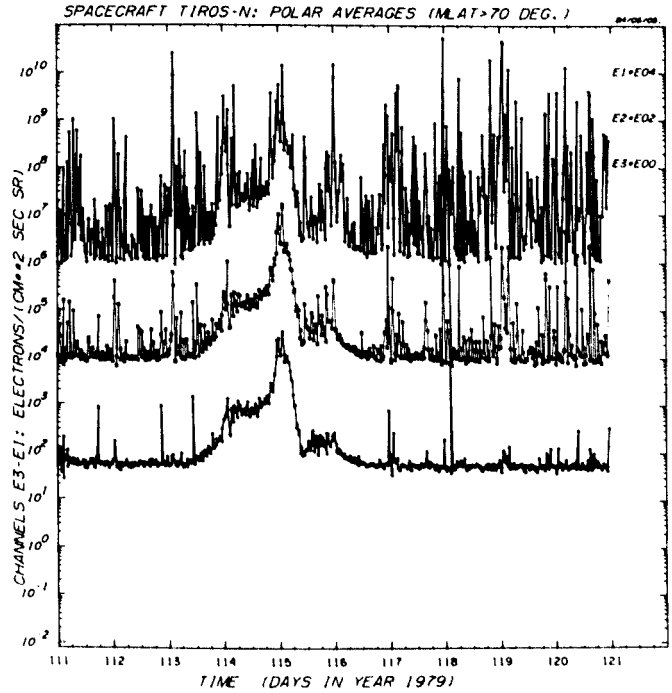
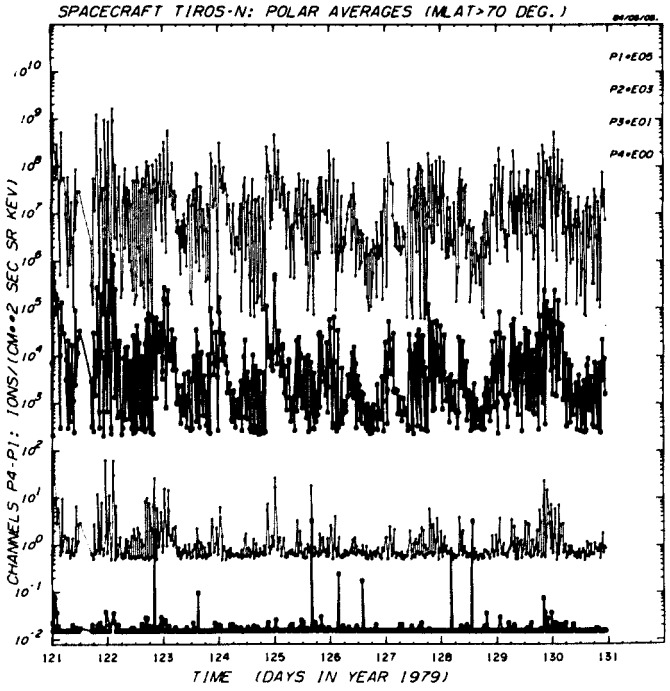
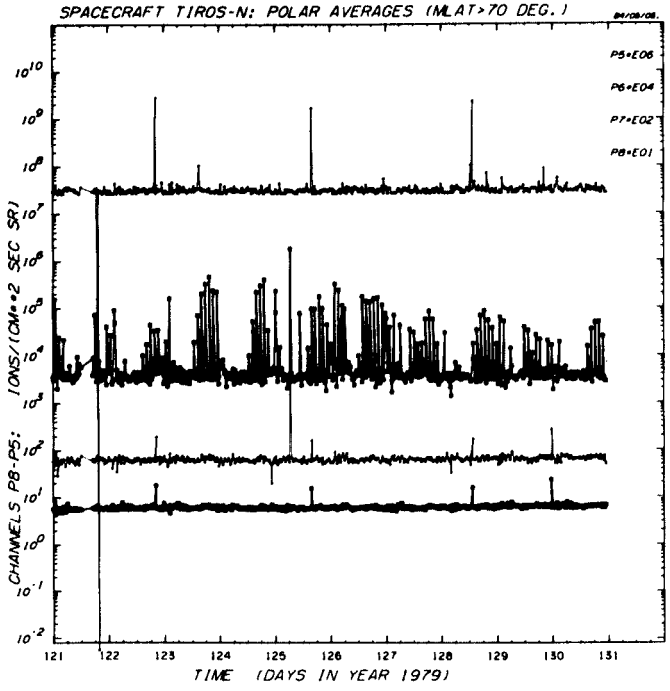



**April 21, 1979**

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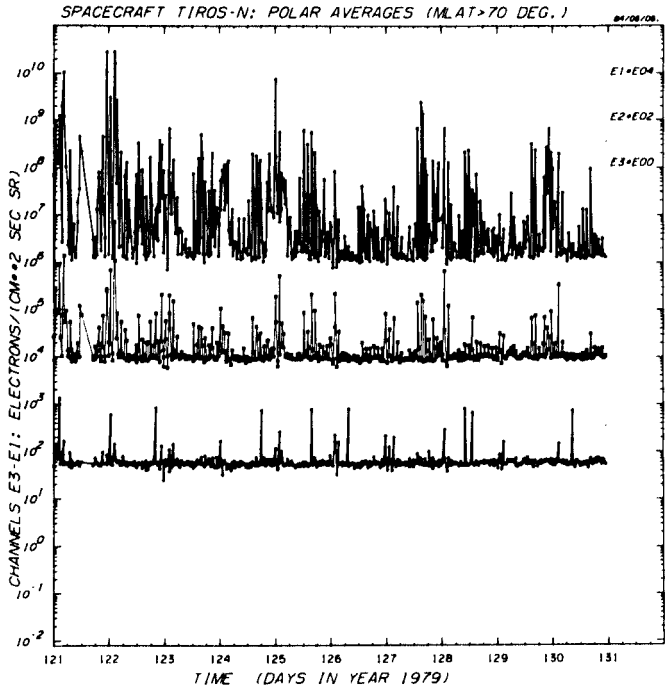
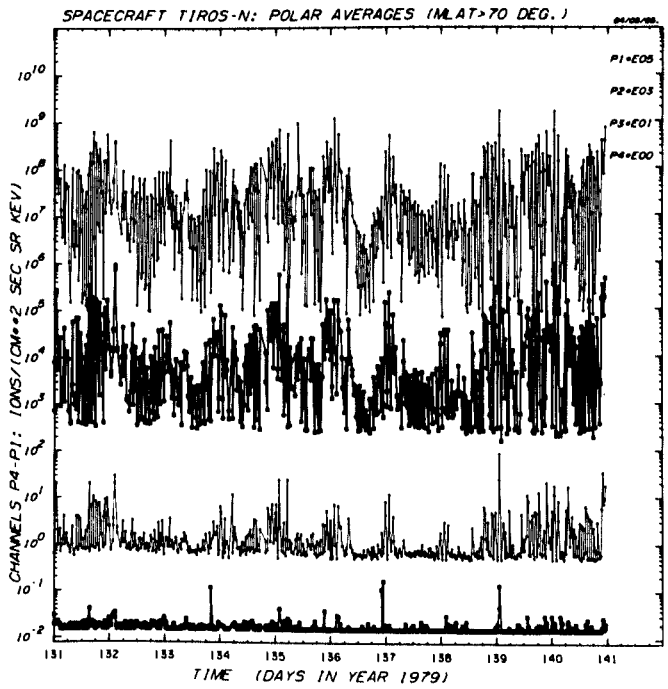
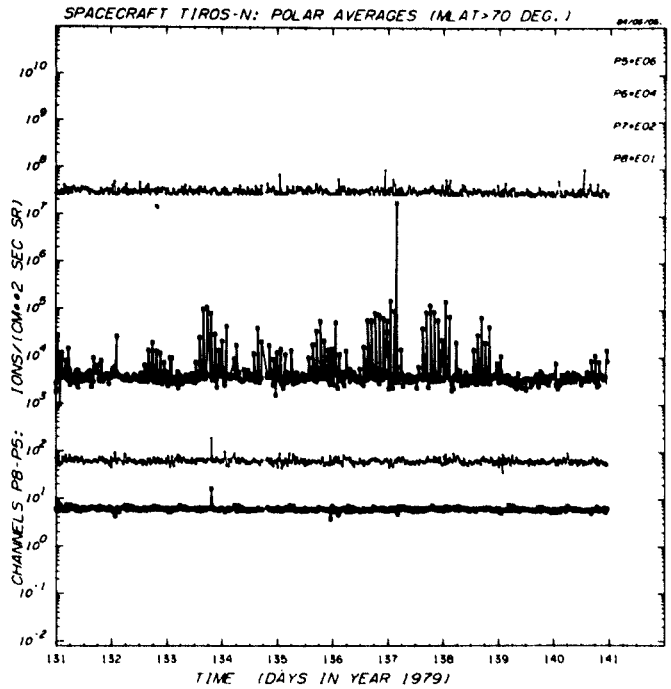



**May 1, 1979**




ENERGY CHANNELS:

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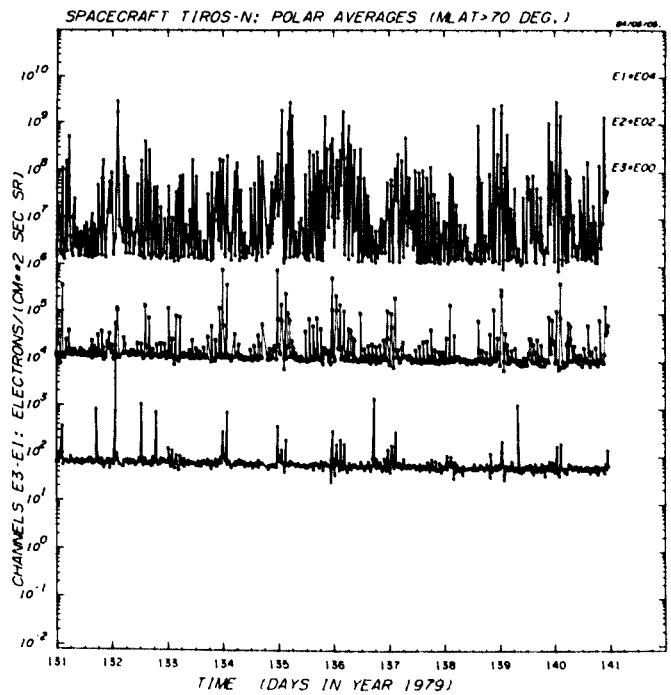
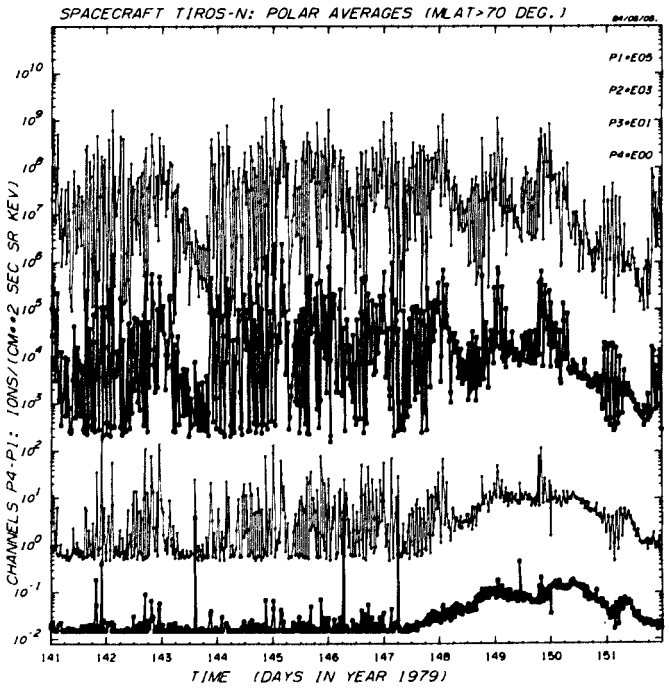
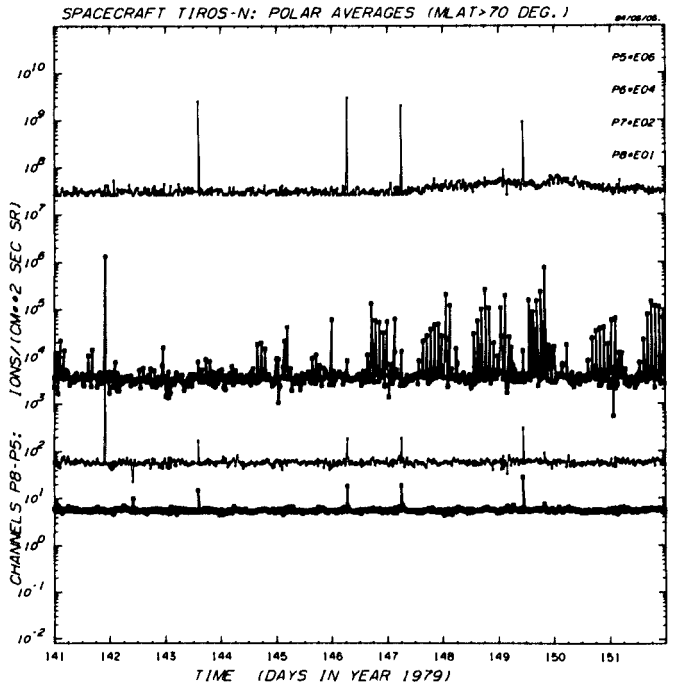



**May 11, 1979**




ENERGY CHANNELS:

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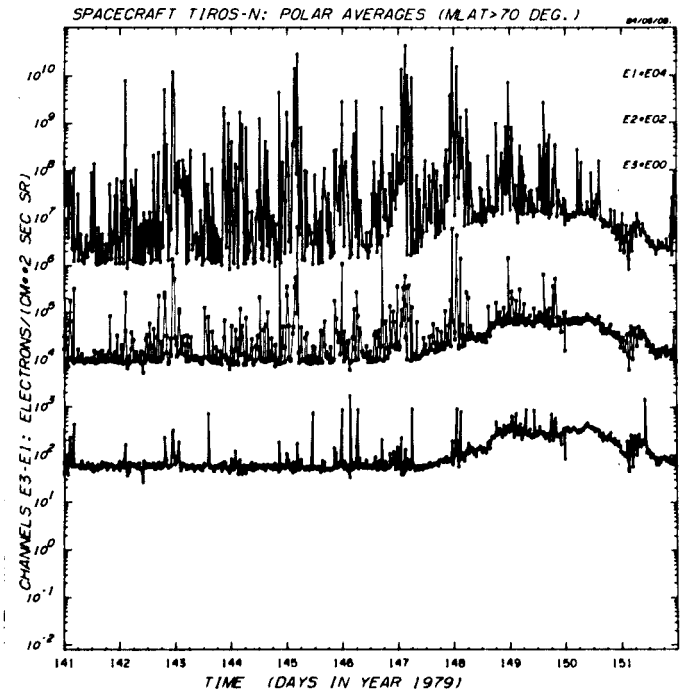
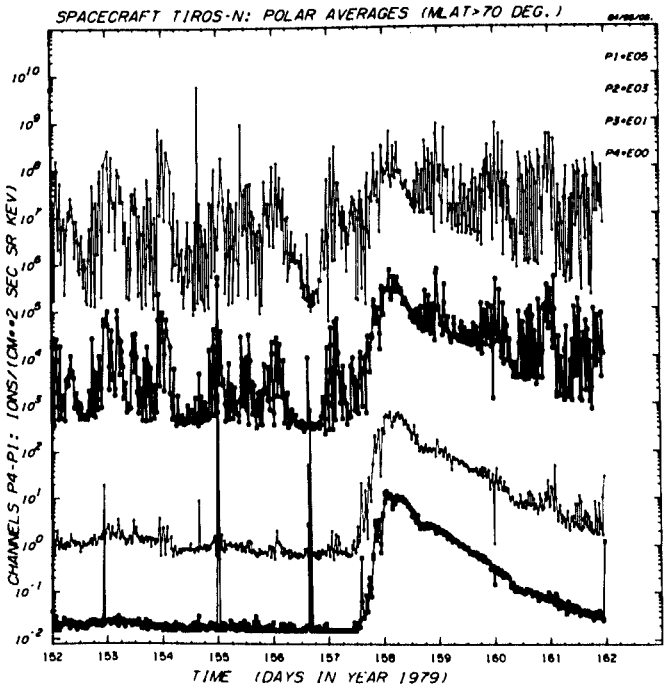
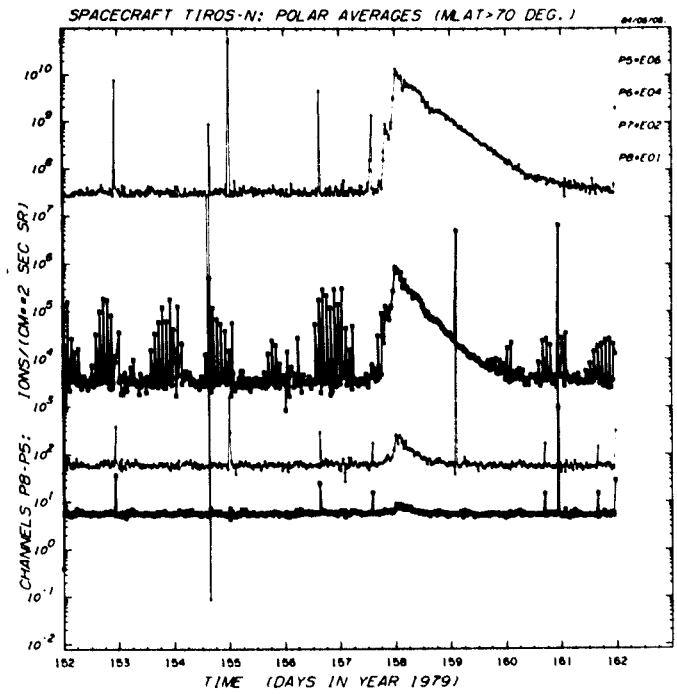



**May 21, 1979**




ENERGY CHANNELS:

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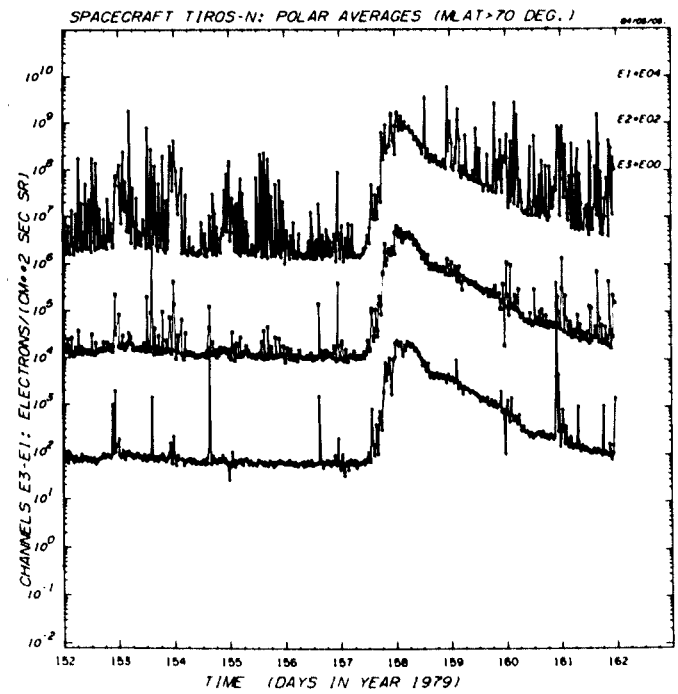
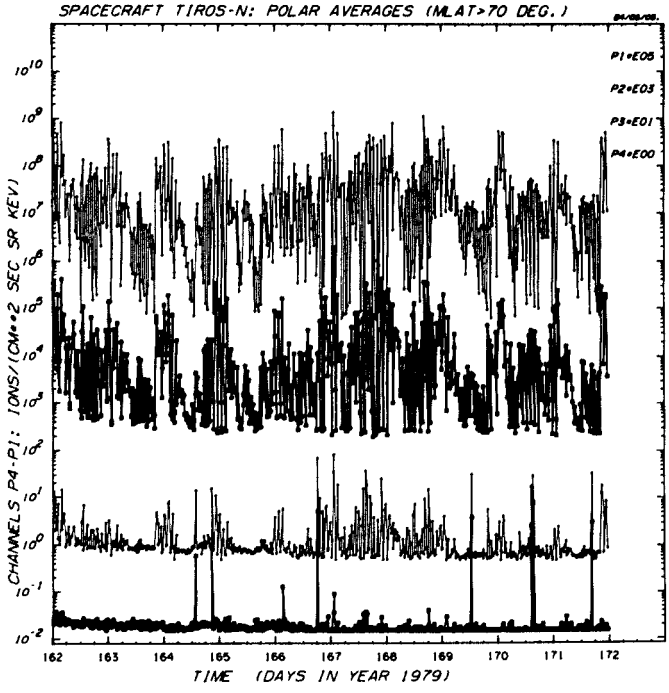
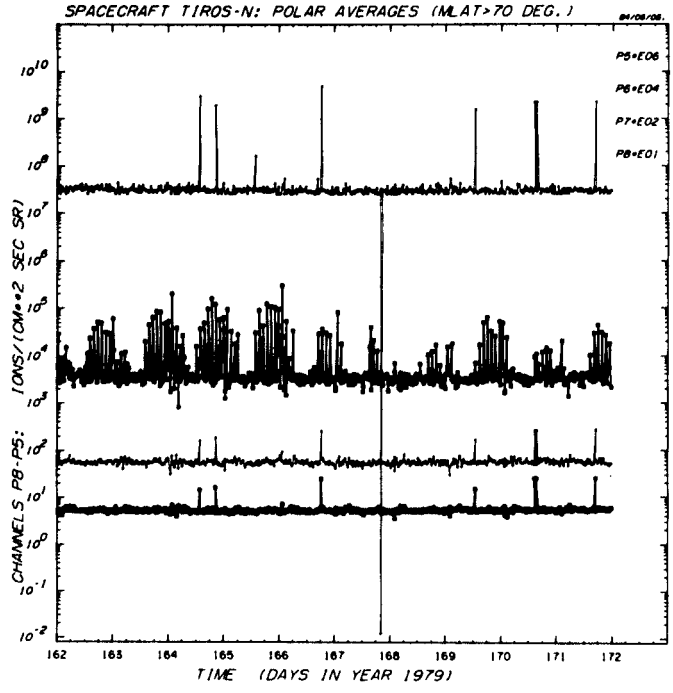



**June 1, 1979**

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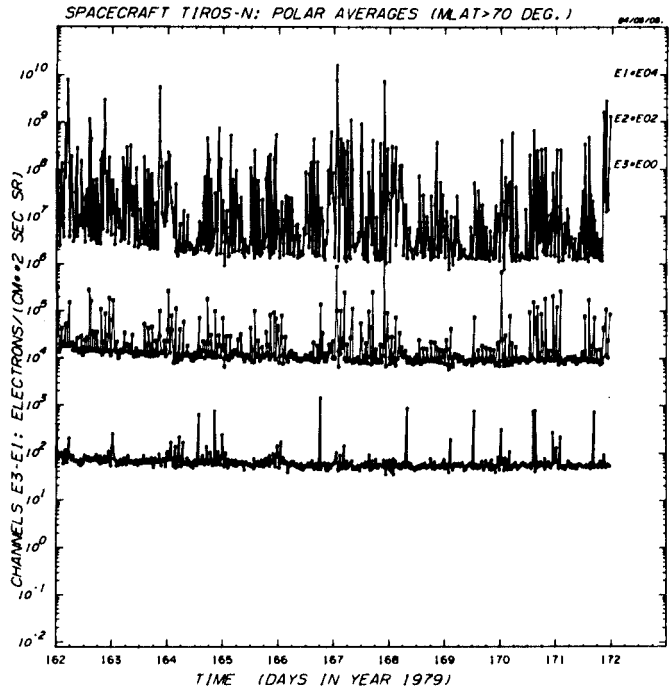
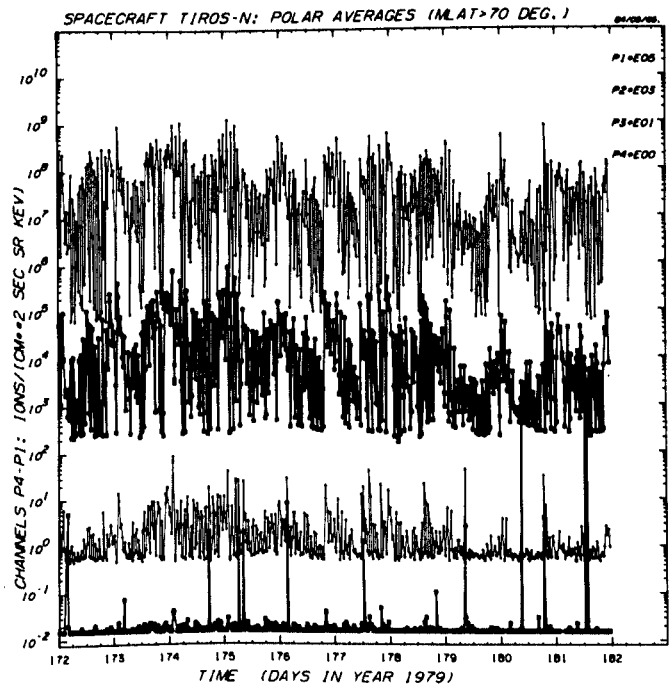
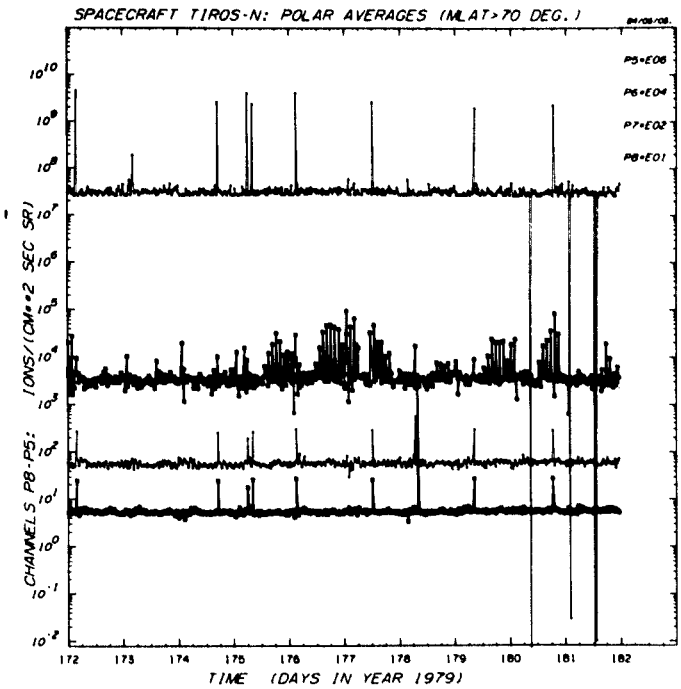



**June 11, 1979**

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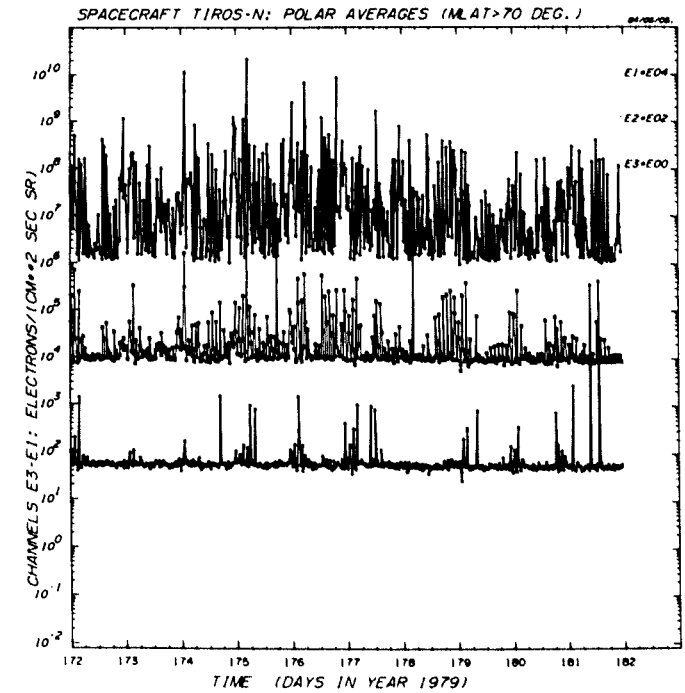
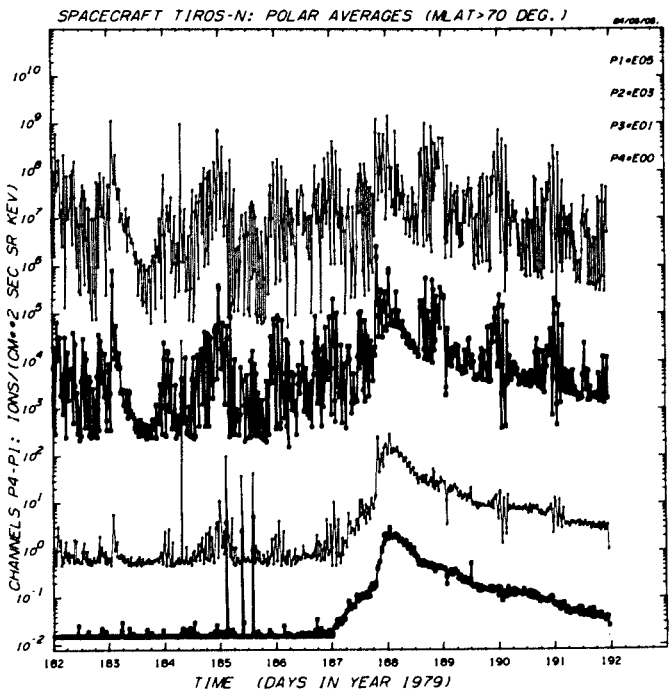
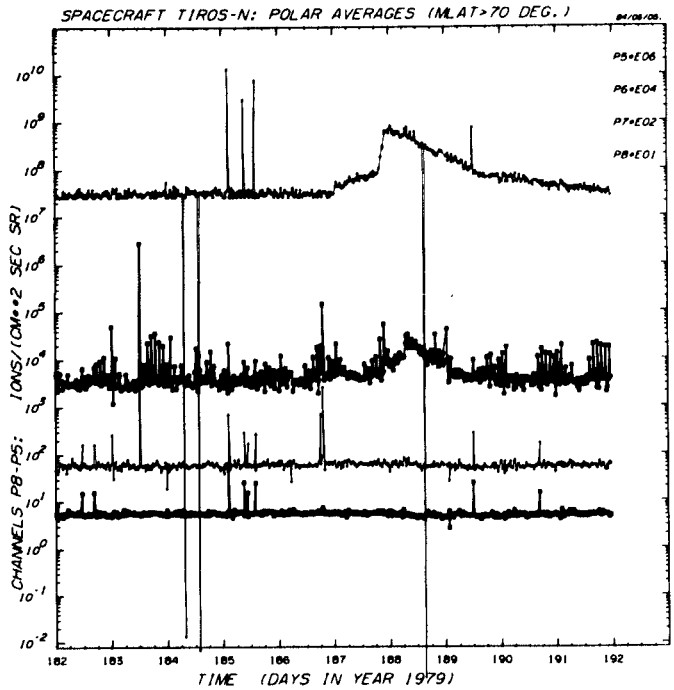


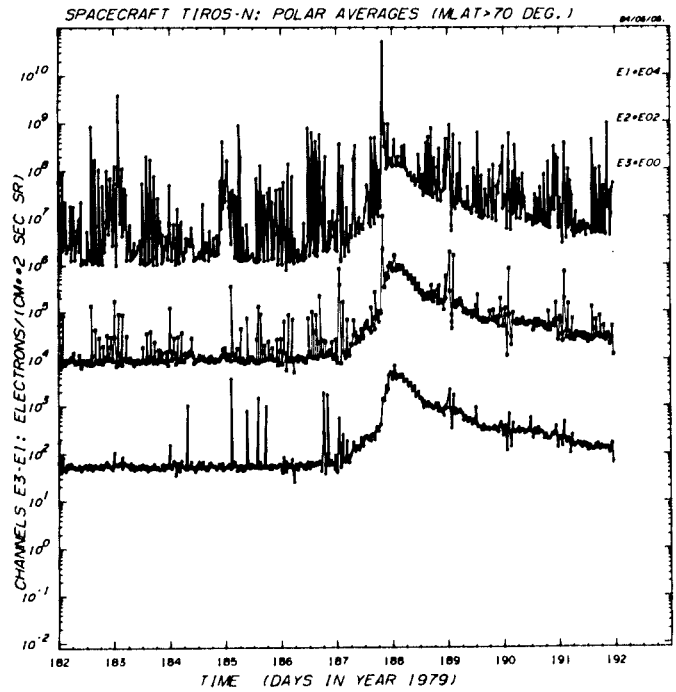

**June 21, 1979**



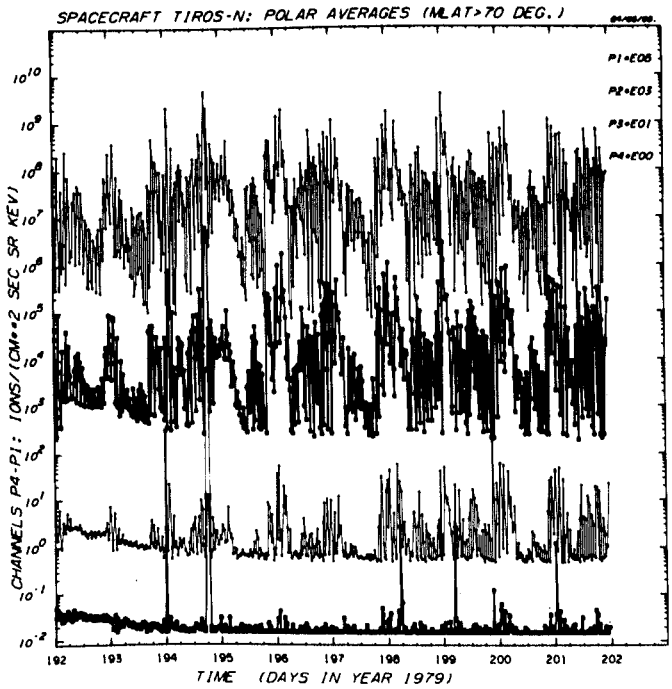



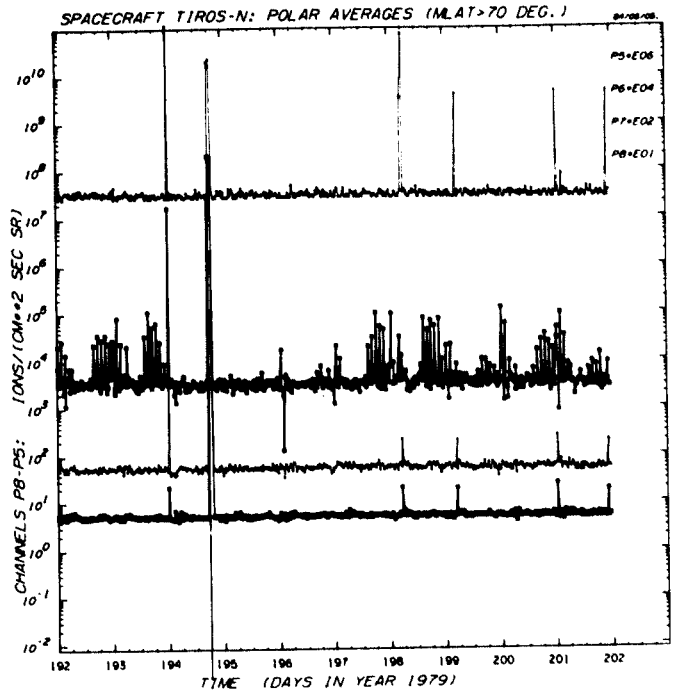

ENERGY CHANNELS:

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV




**July 1, 1979**

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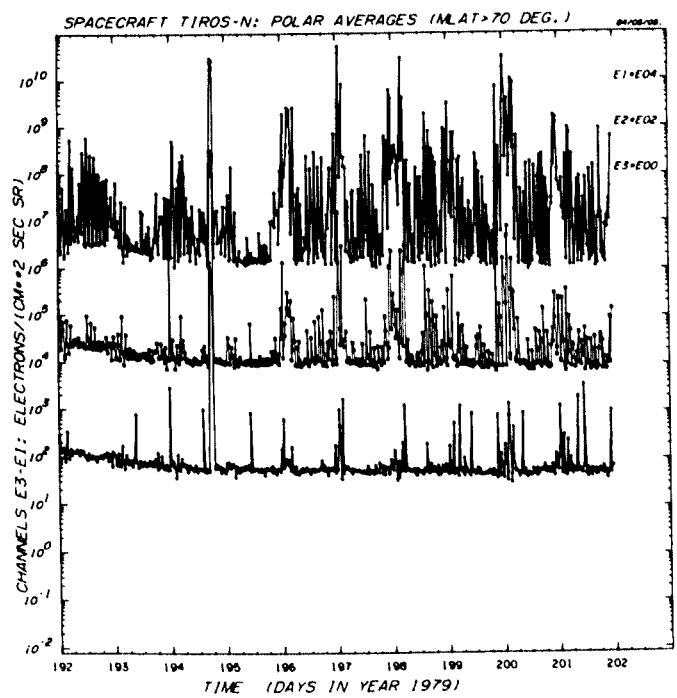
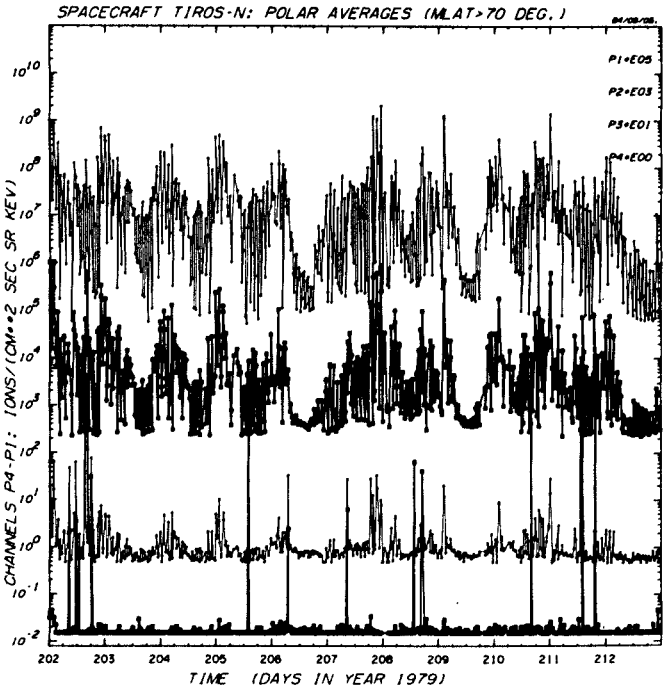
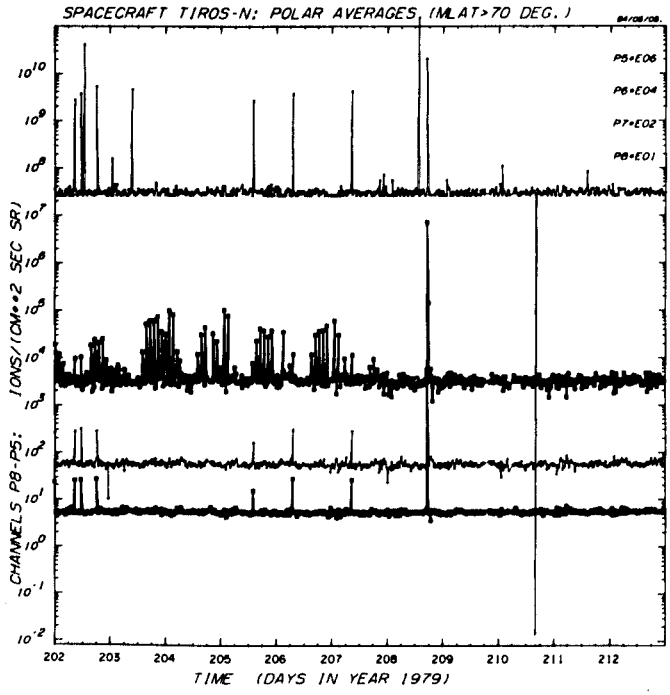



**July 11, 1979**

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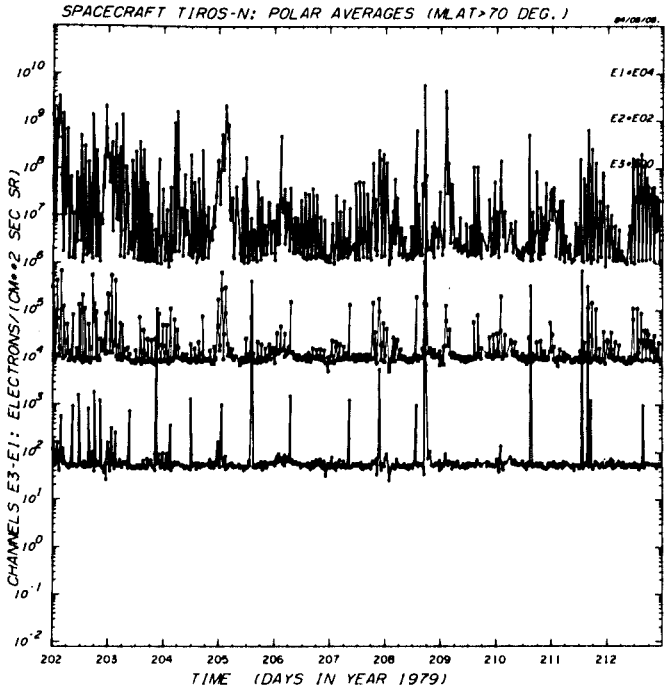
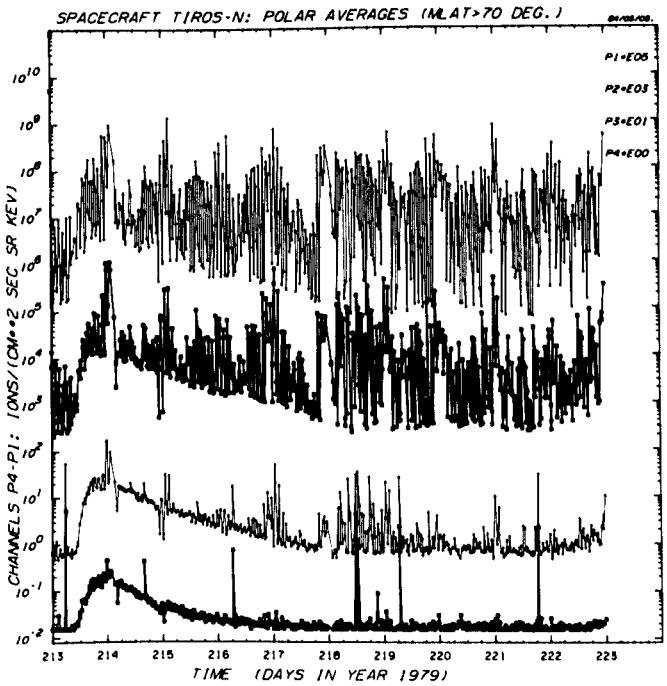
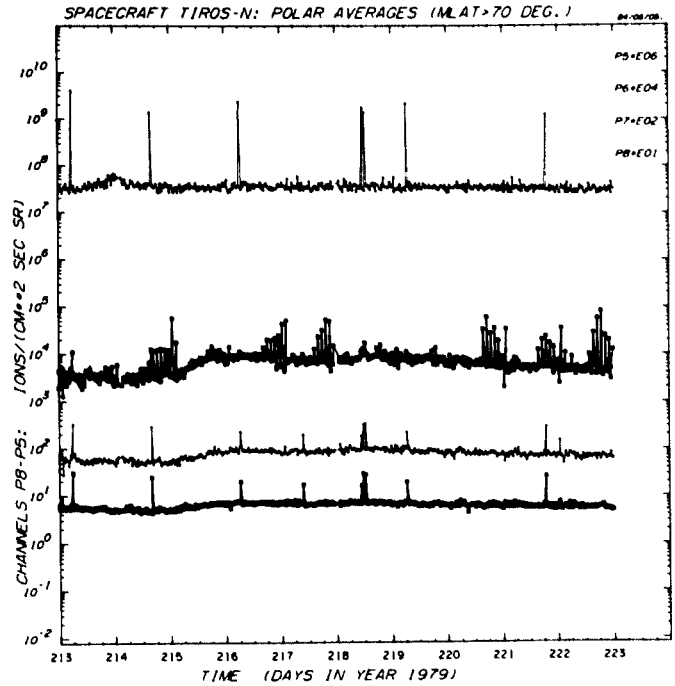



**July 21, 1979**

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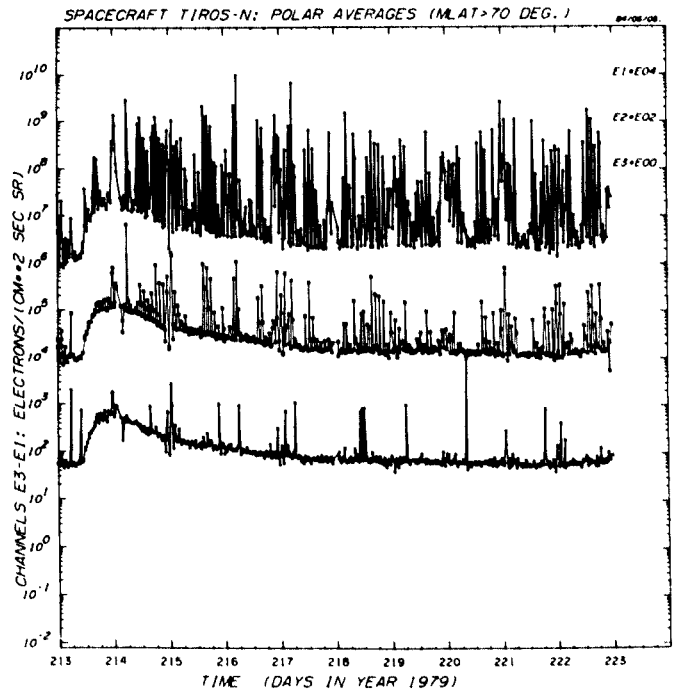
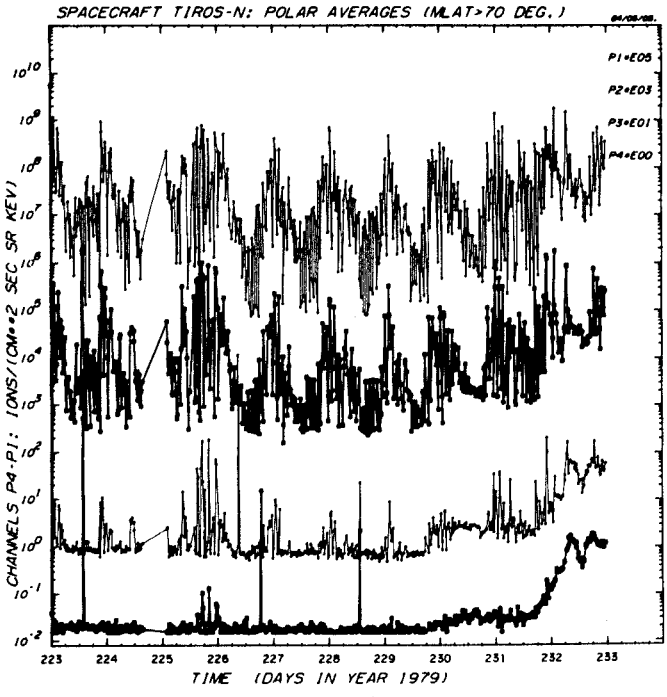
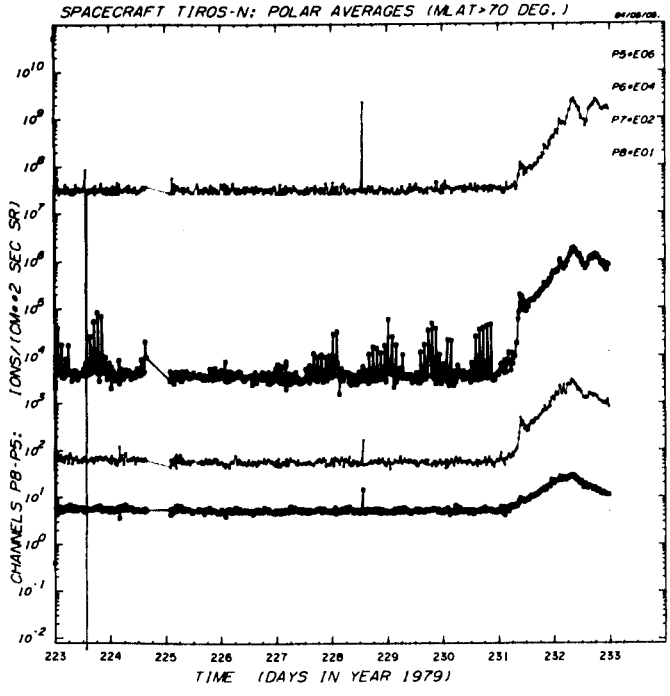



**August 1, 1979**

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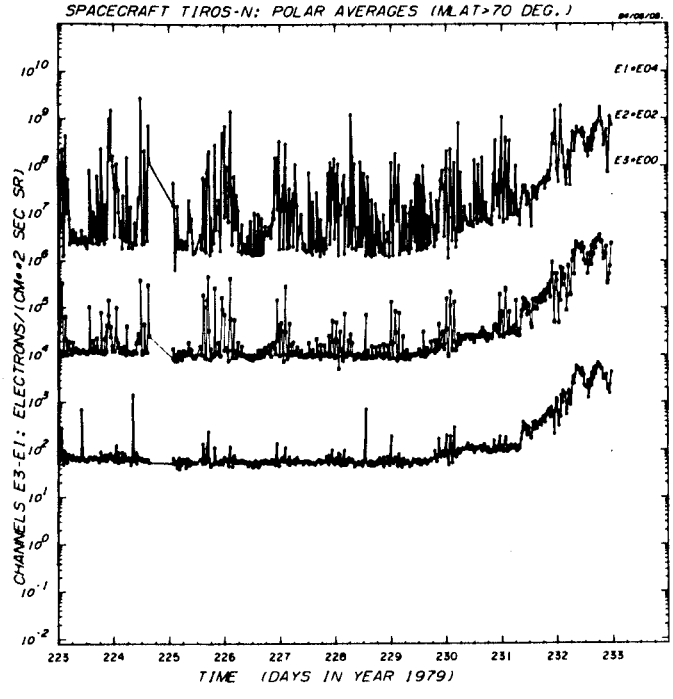


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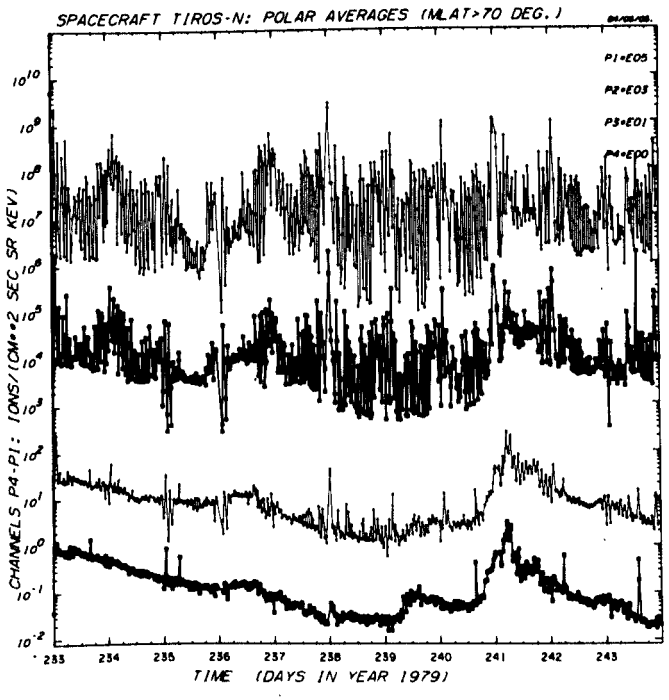


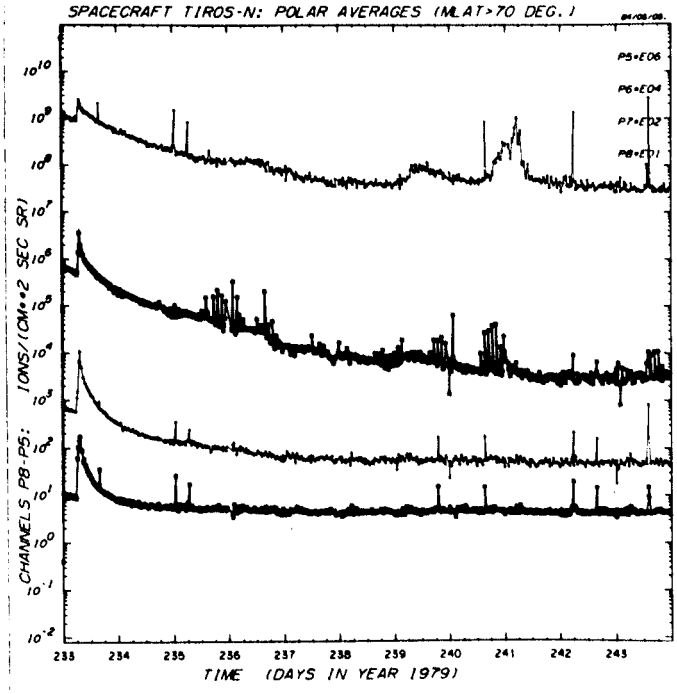


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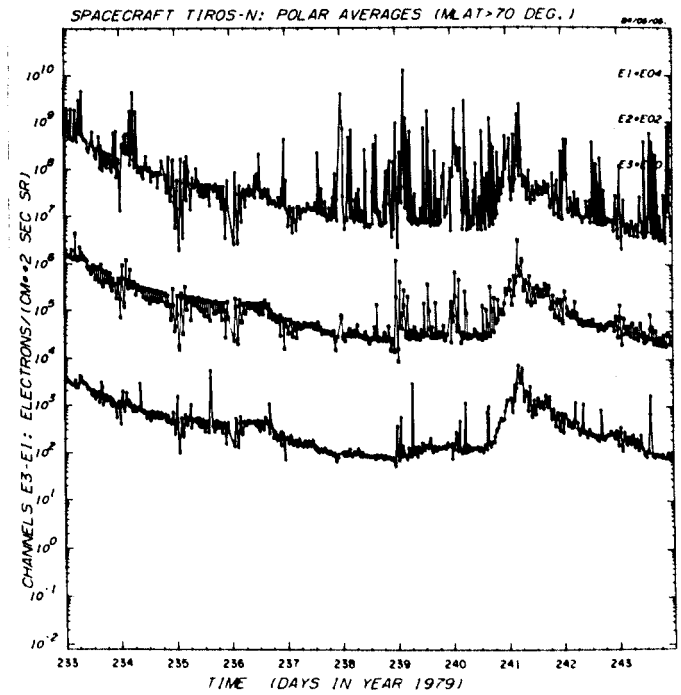


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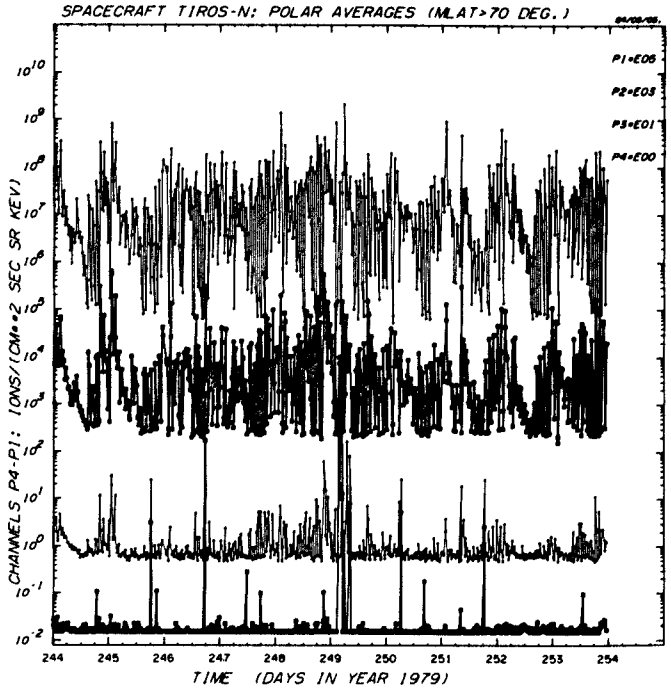


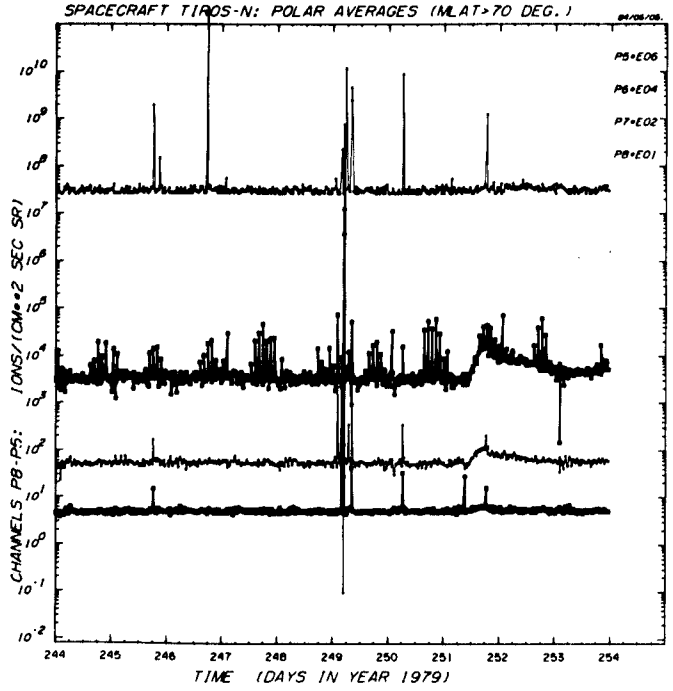


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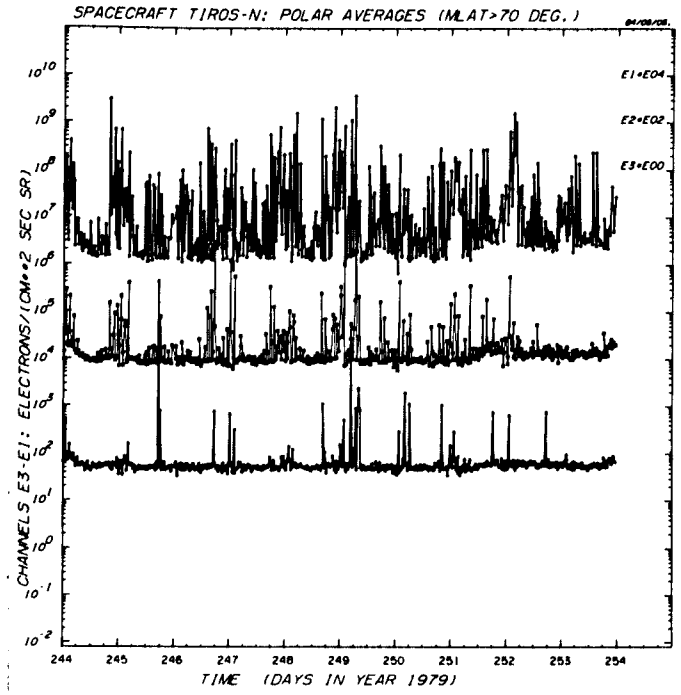
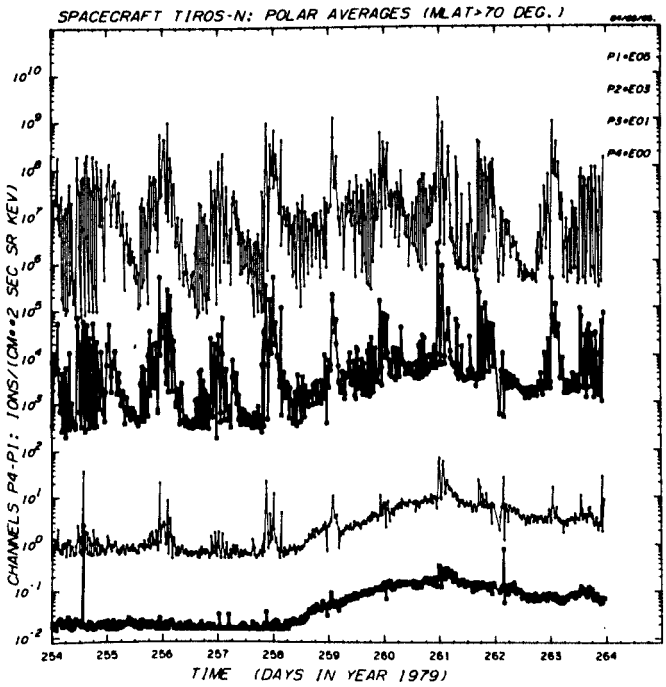
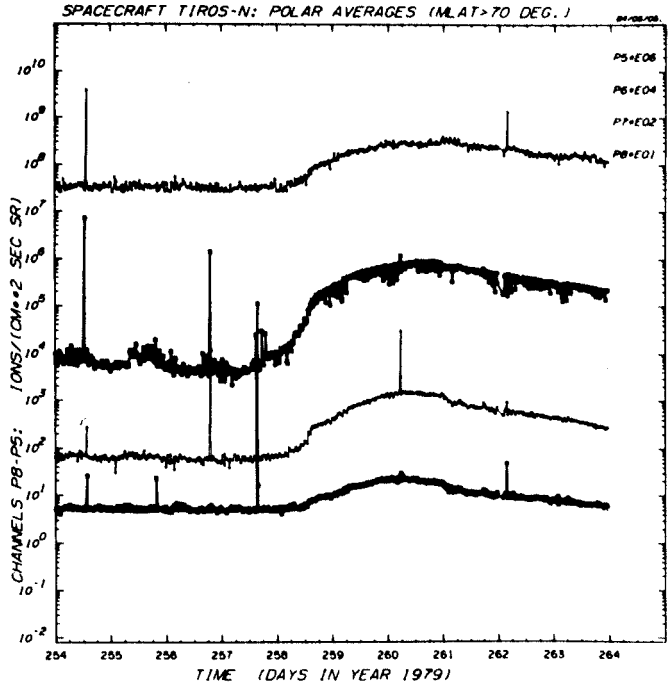



**September 1, 1979**

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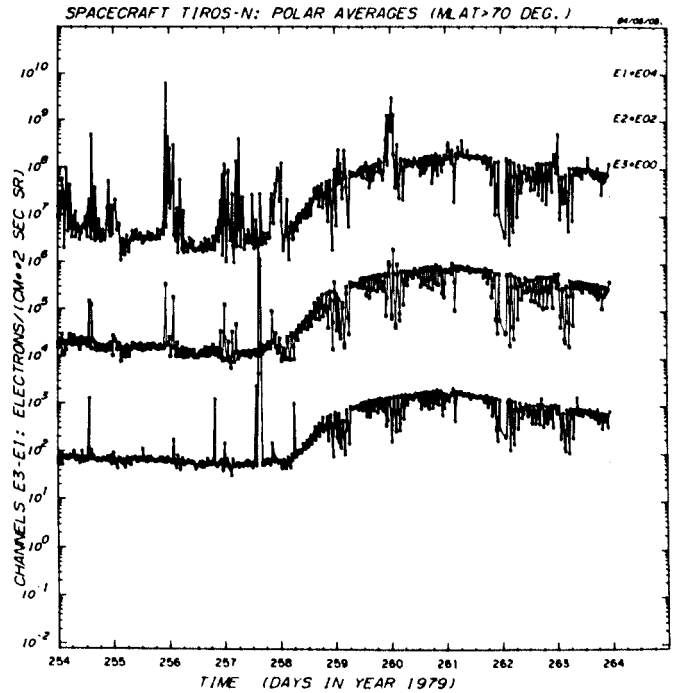


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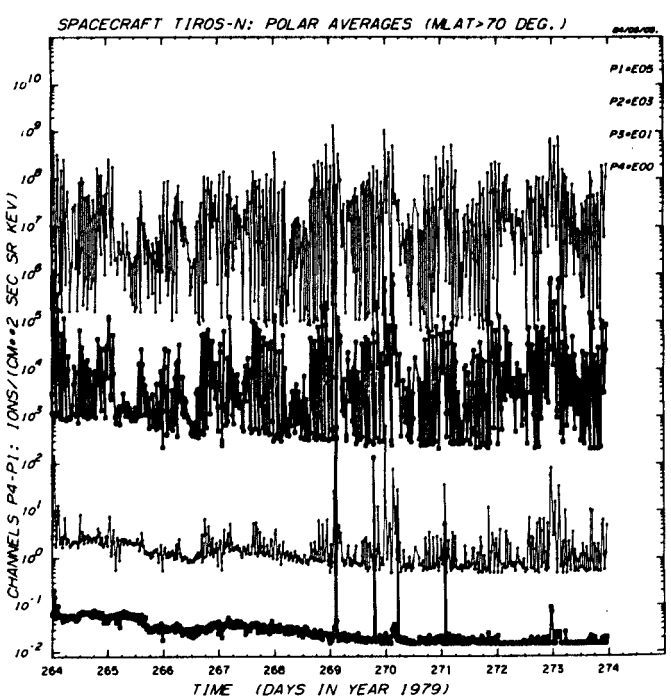


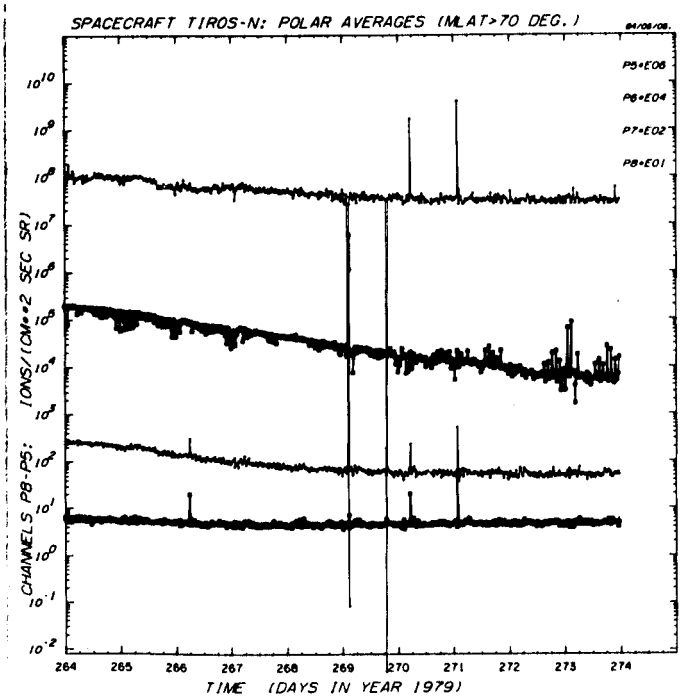


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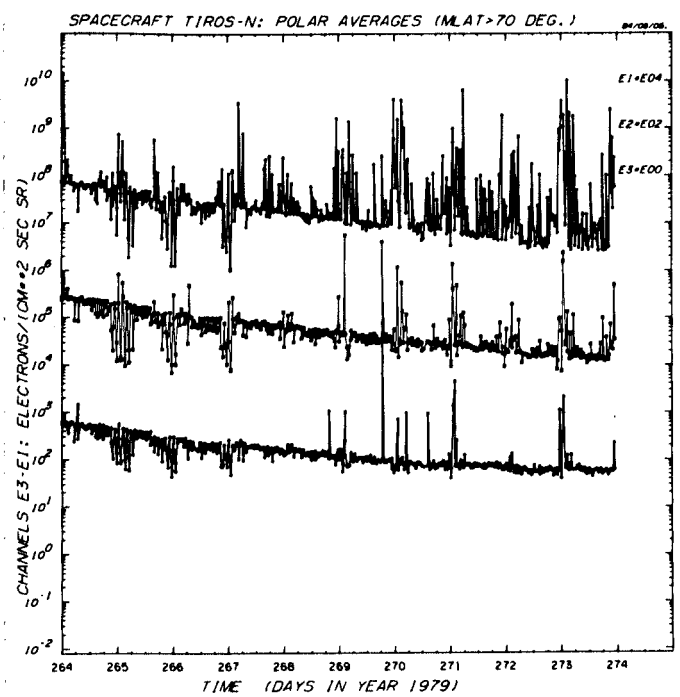


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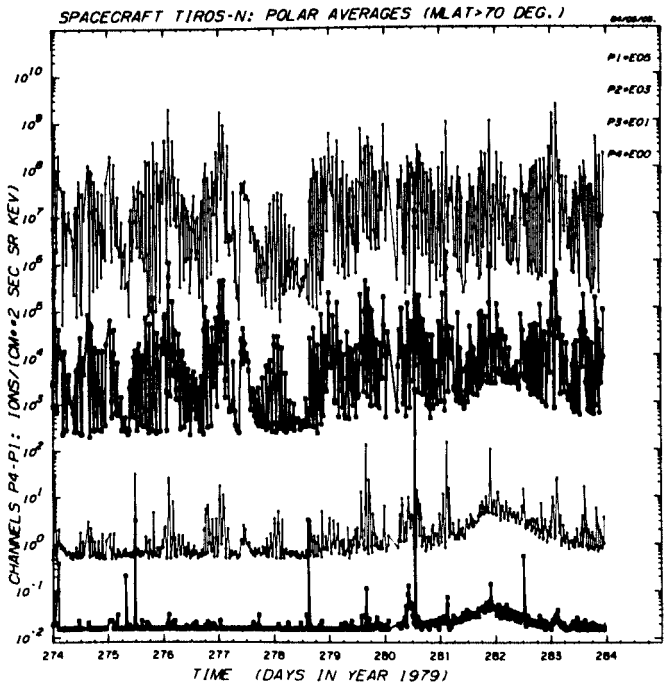


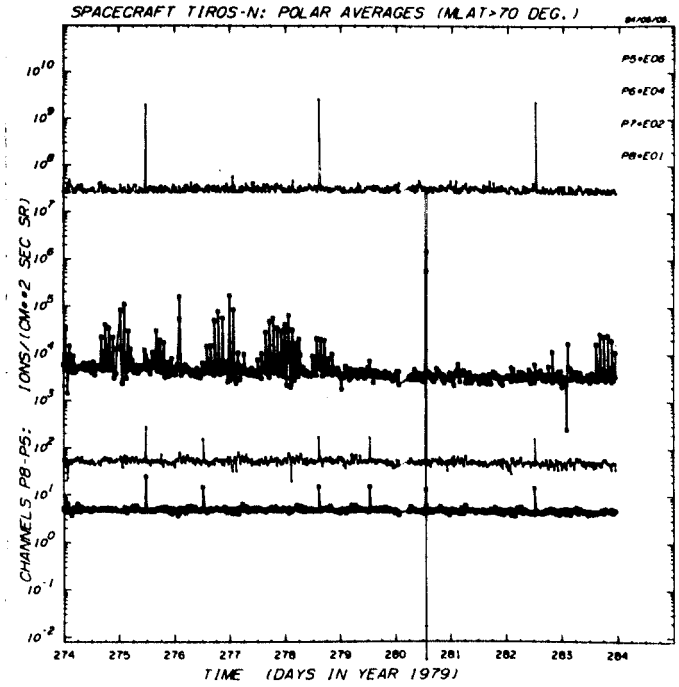


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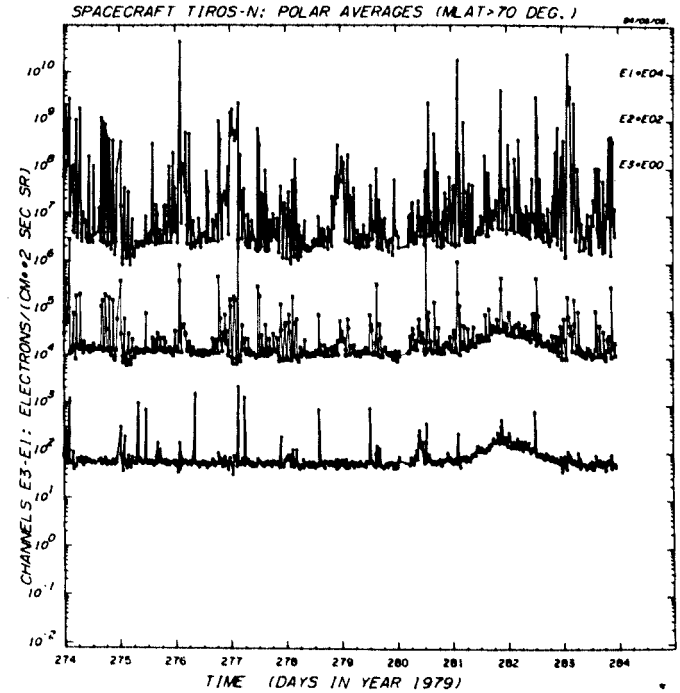
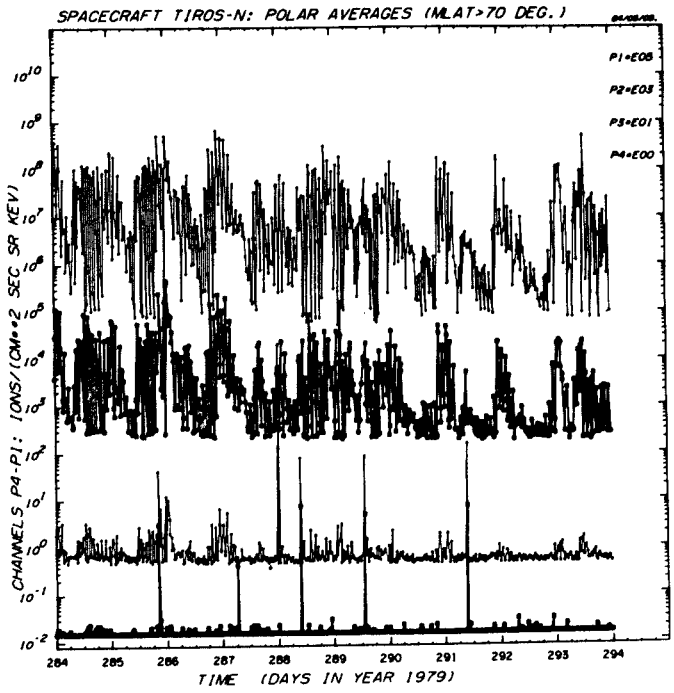
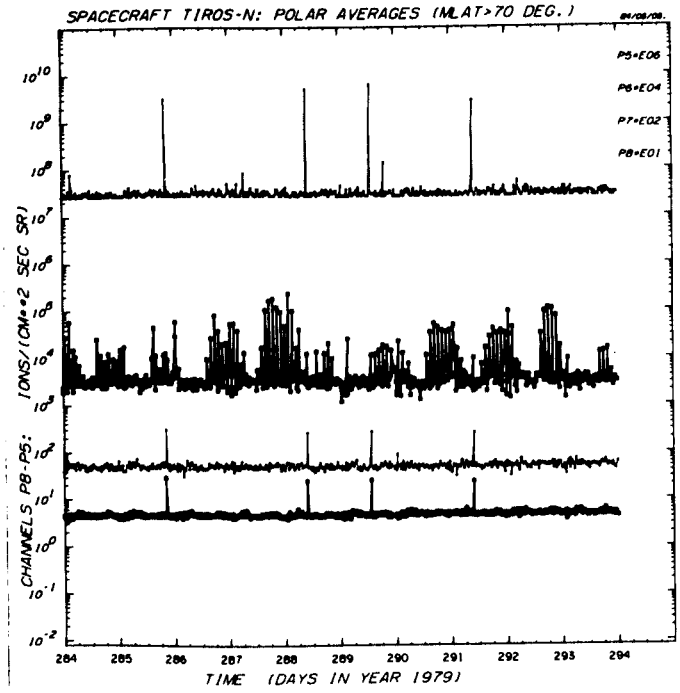



**October 1, 1979**

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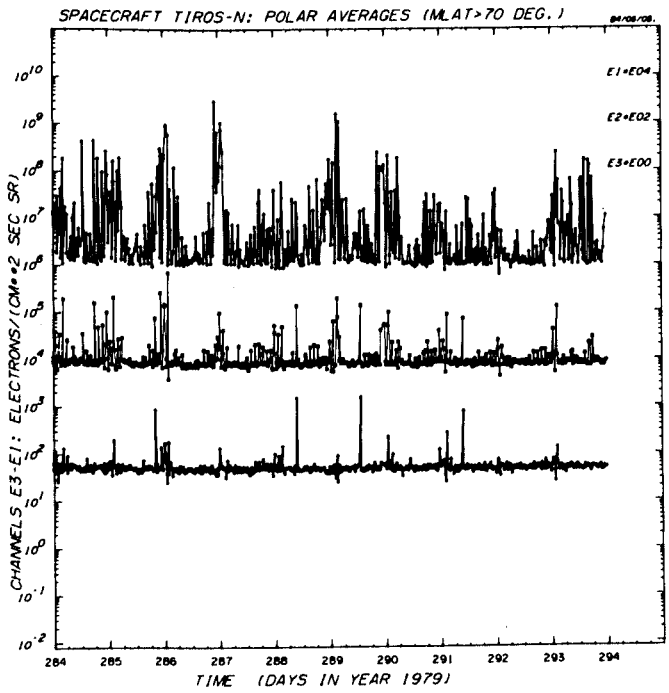


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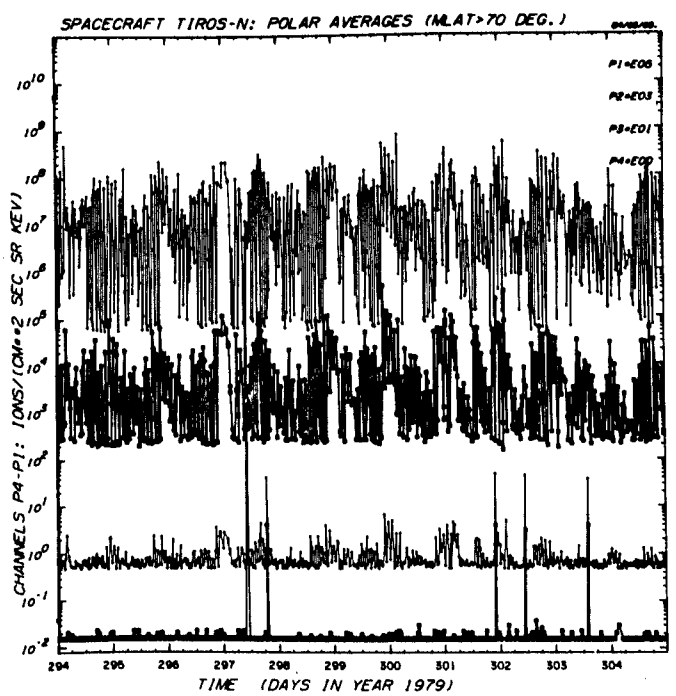


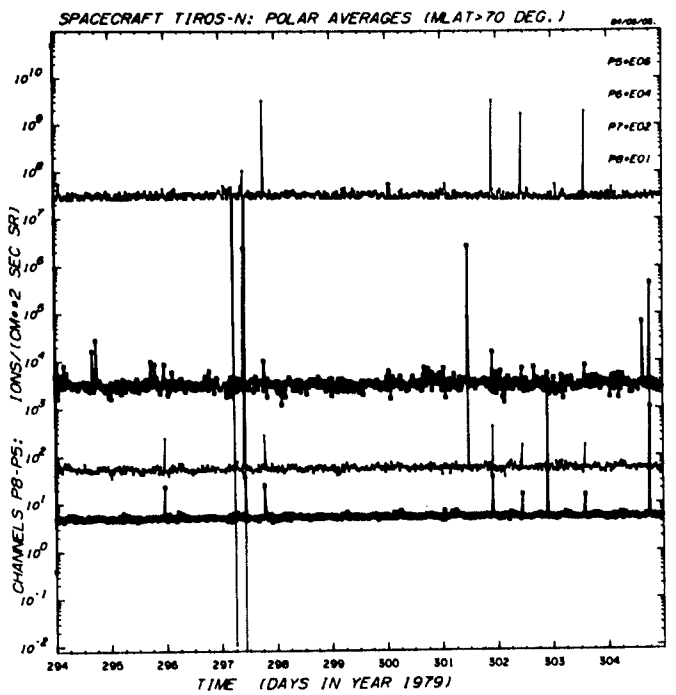


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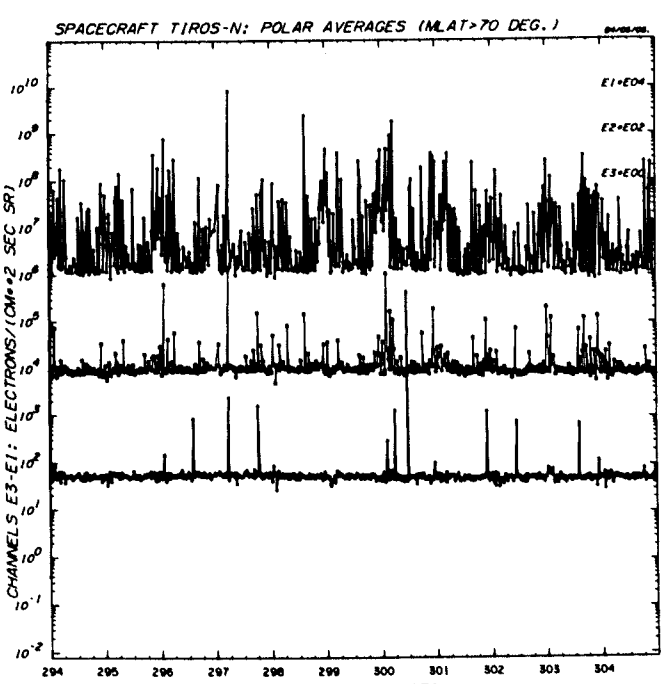


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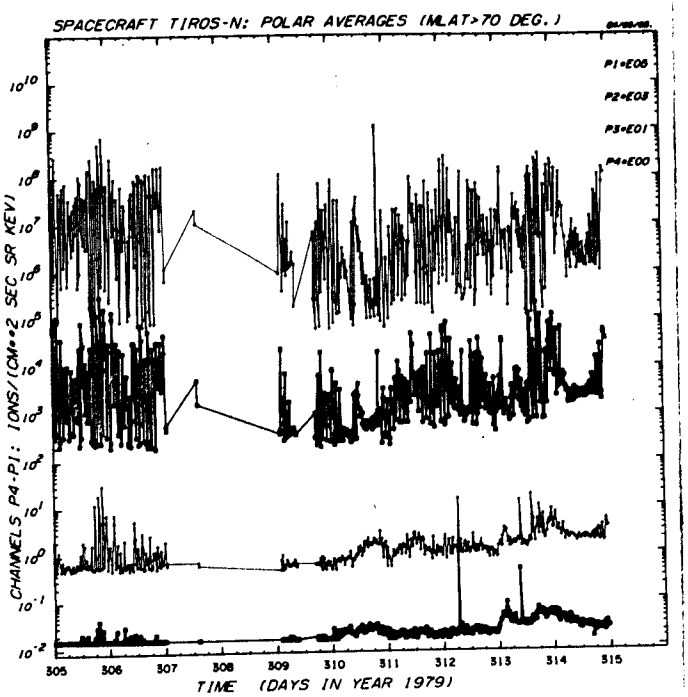


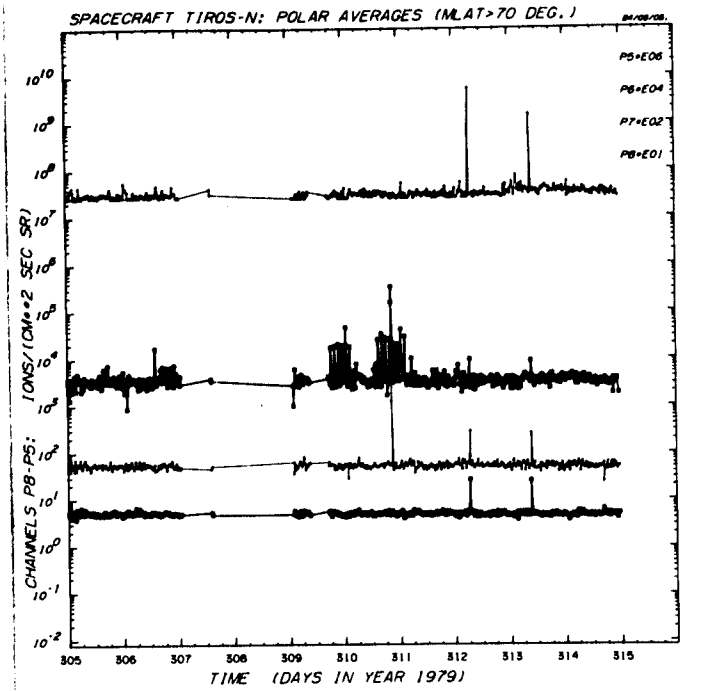


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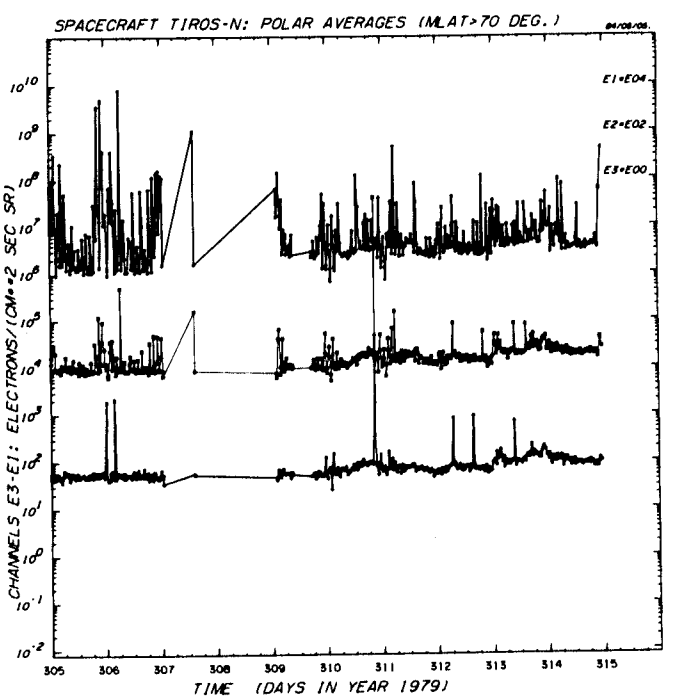
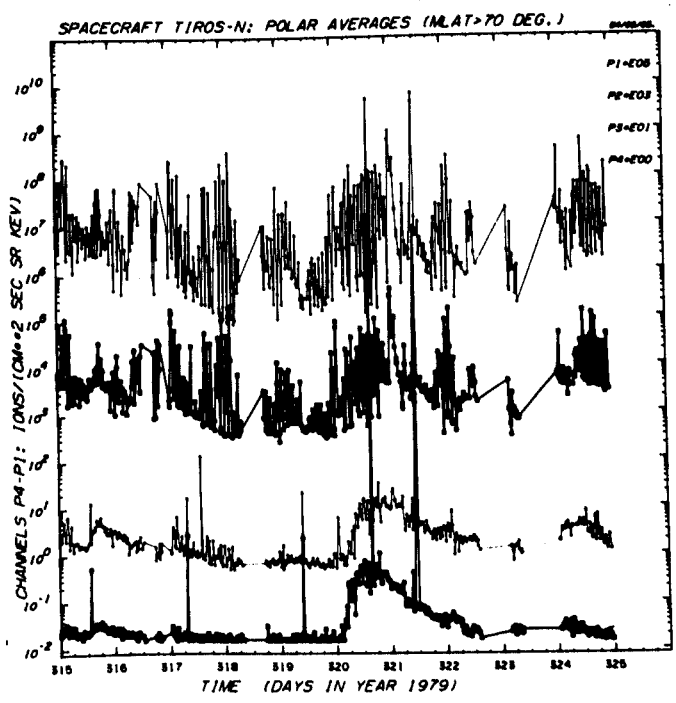
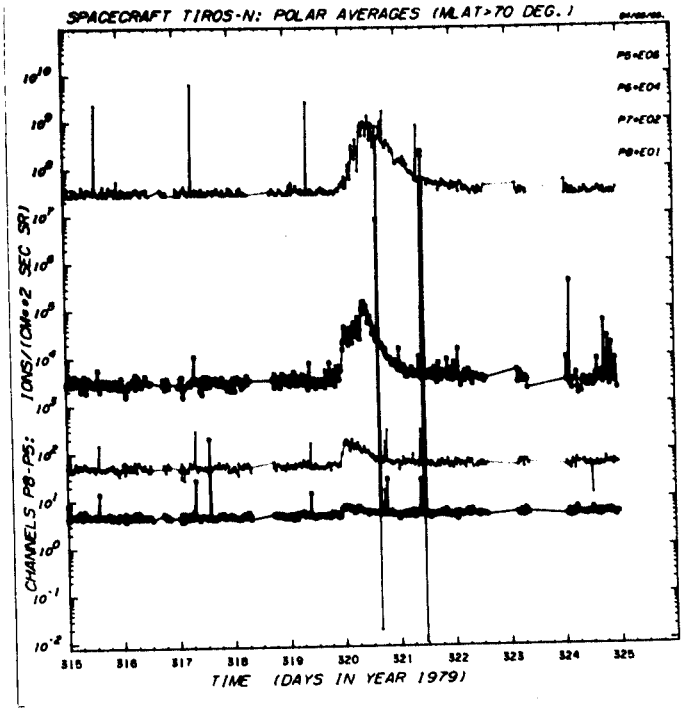



**November 1, 1979**

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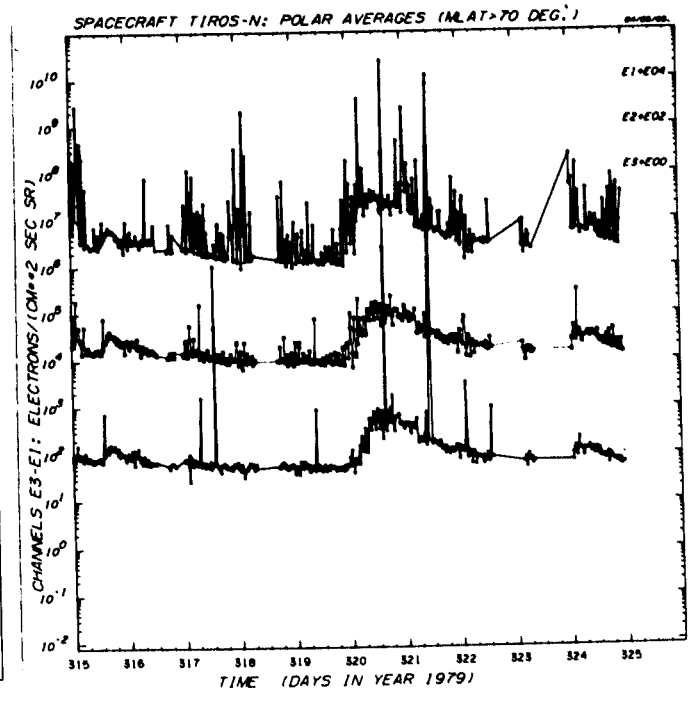


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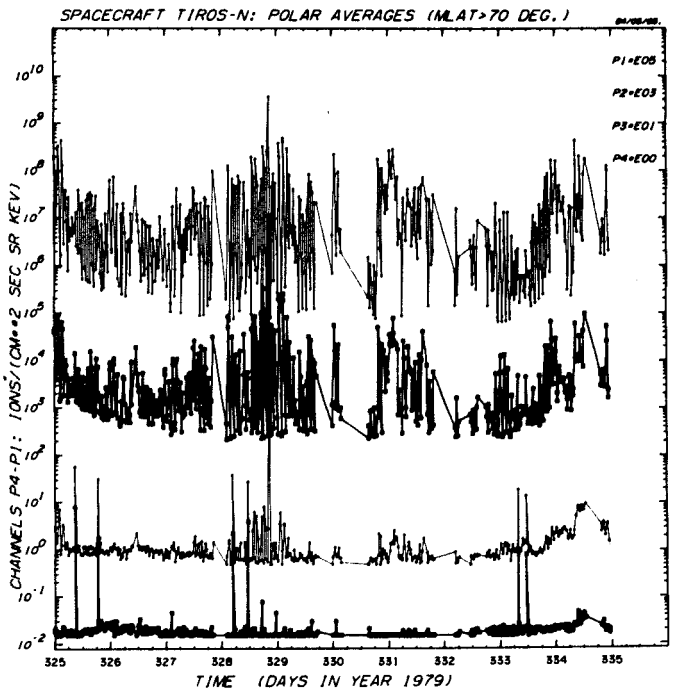


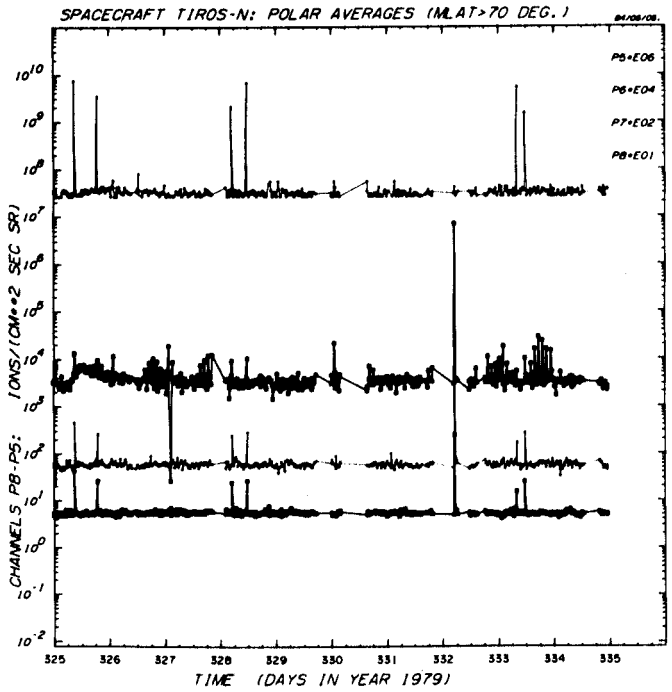


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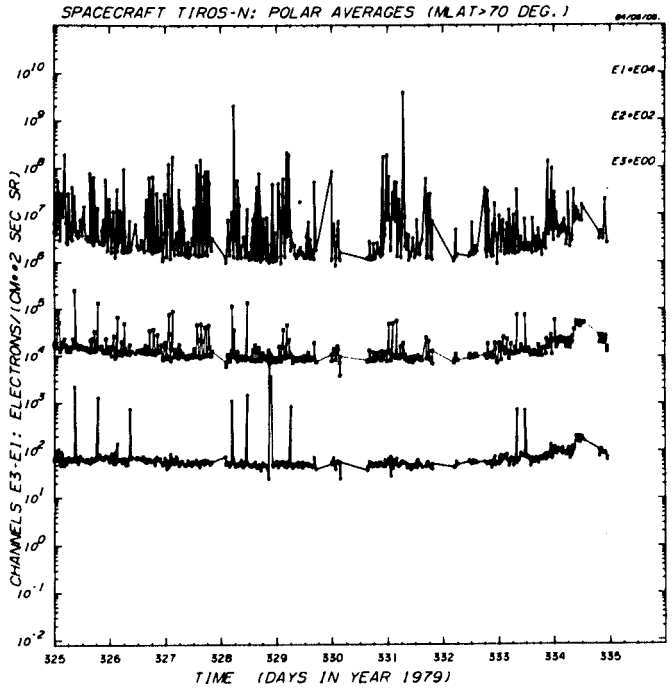


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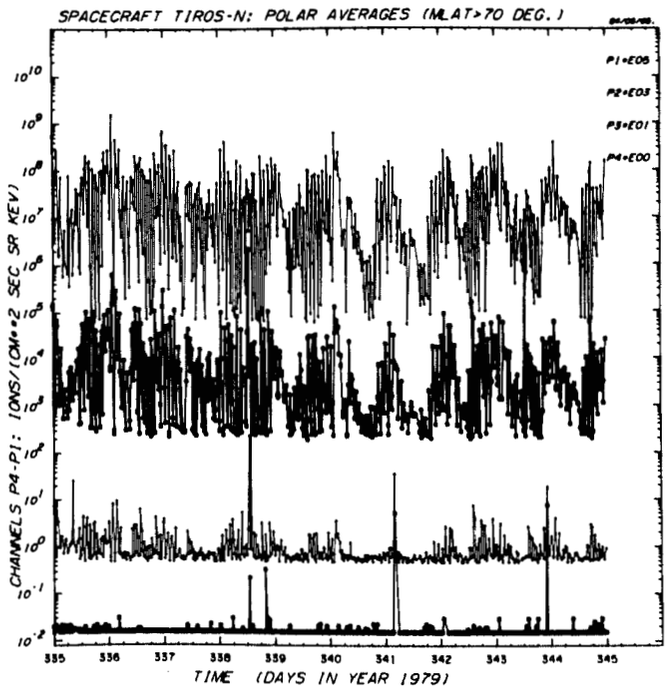


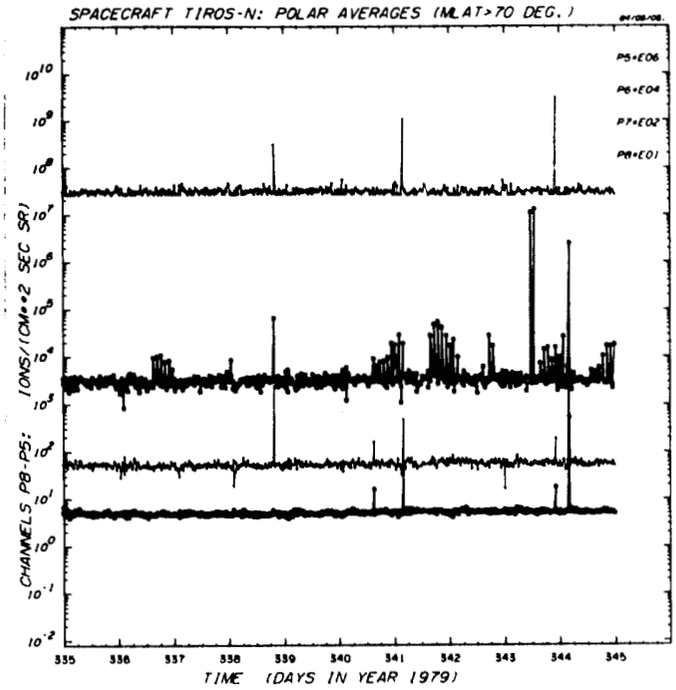


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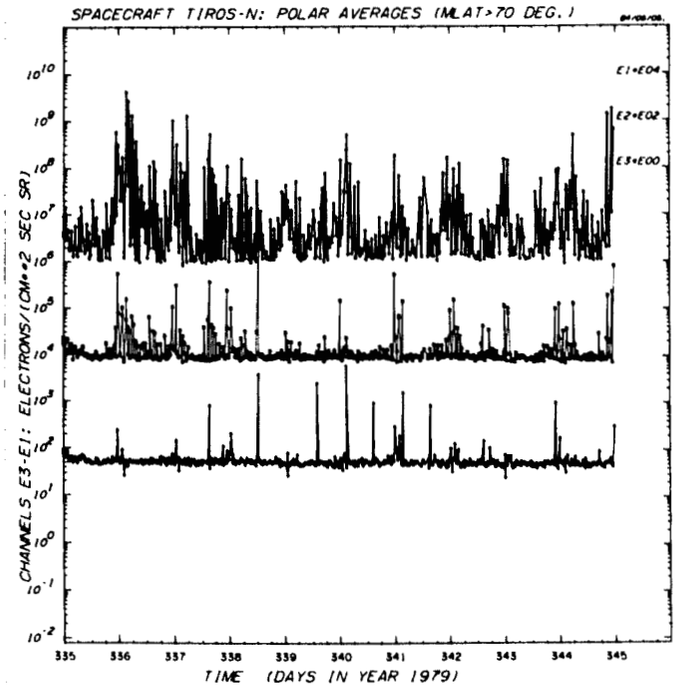
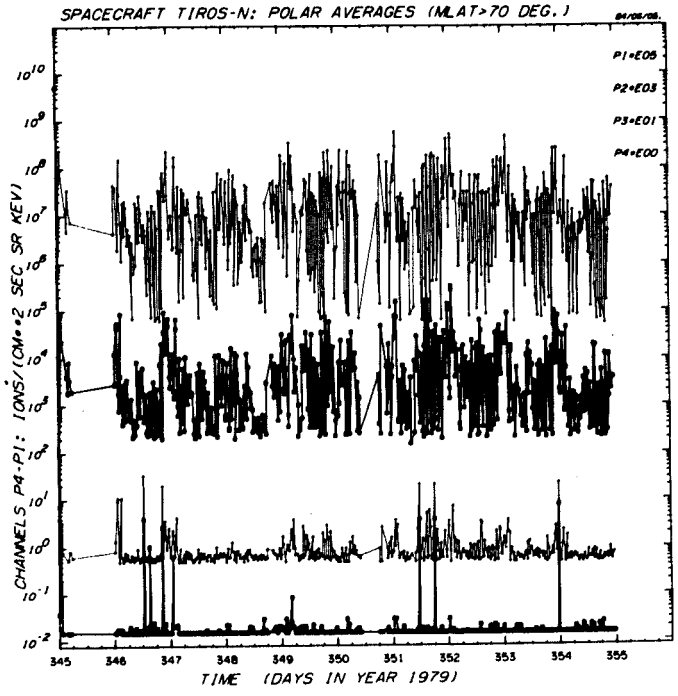
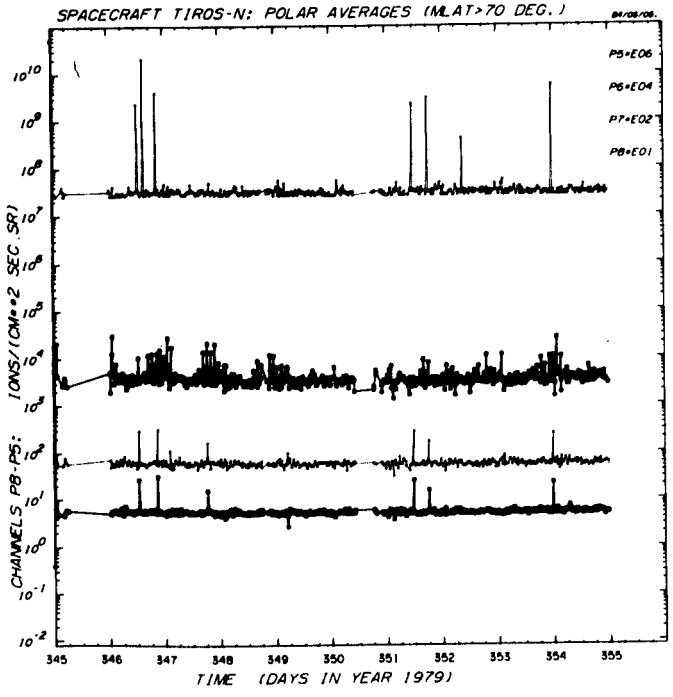
P4: E- 800 -2500 KEV
P5: E > 2500 KEV
P6: E > 16000 KEV
P7: E > 36000 KEV
P8: E > 80000 KEV
E1: E > 30 KEV
E2: E > 100 KEV
E3: E > 300 KEV




**December 1, 1979**




ENERGY CHANNELS:

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
P3: E= 250 - 800 KEV
P4: E= 800 -2500 KEV
P5: E > 2500 KEV
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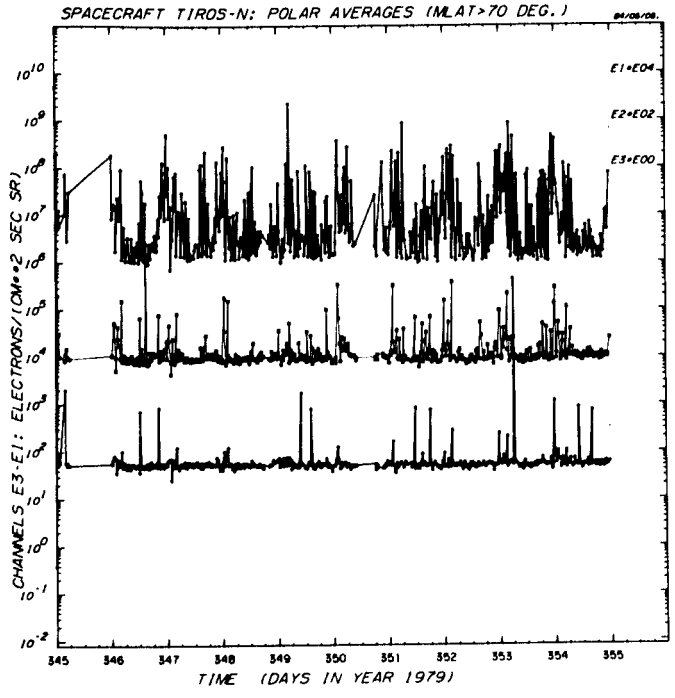
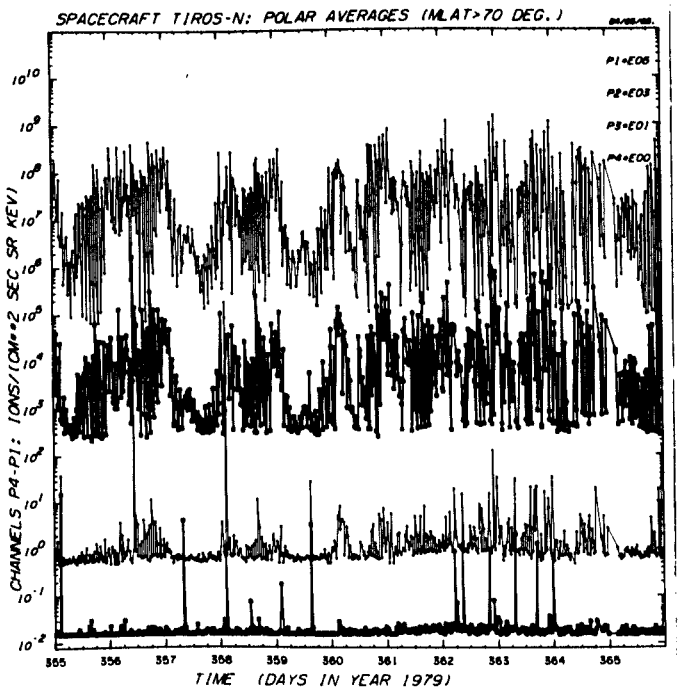
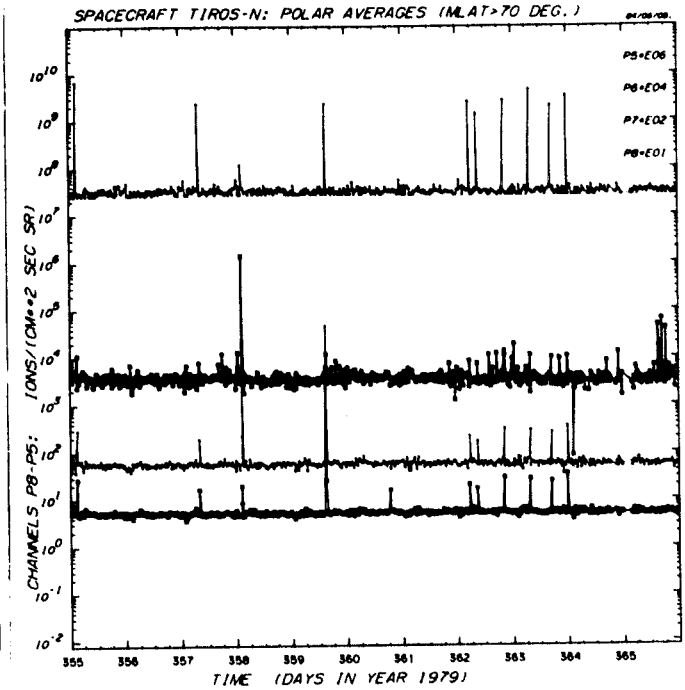



**December 11, 1979**

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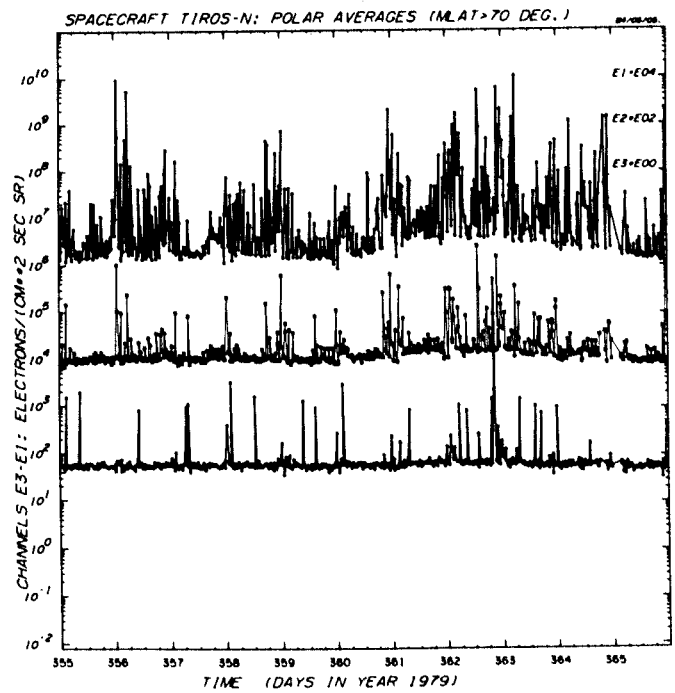


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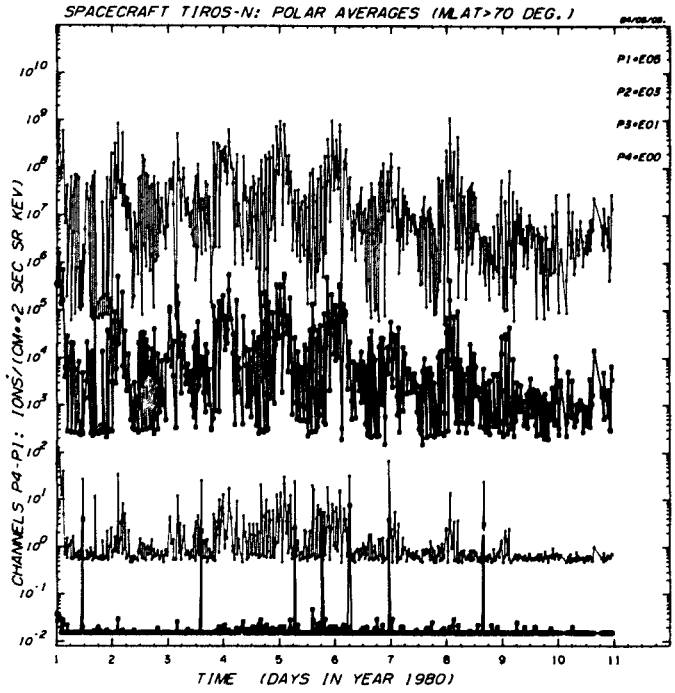


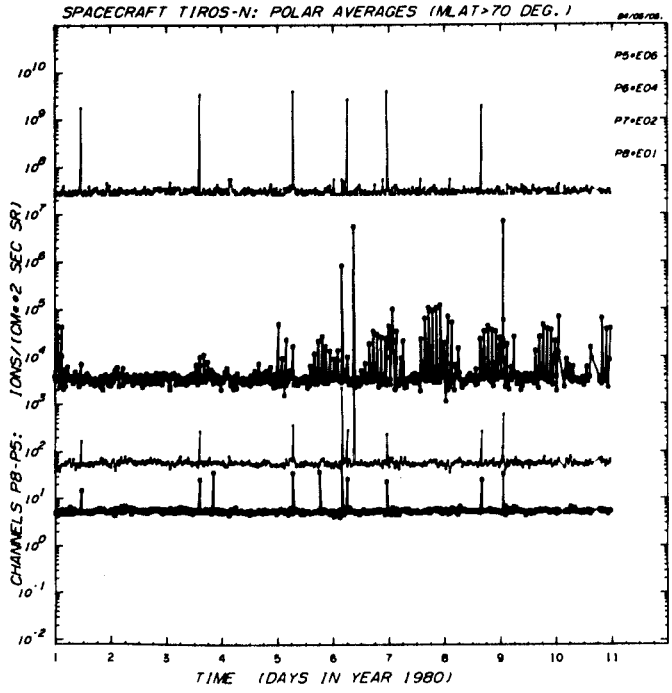


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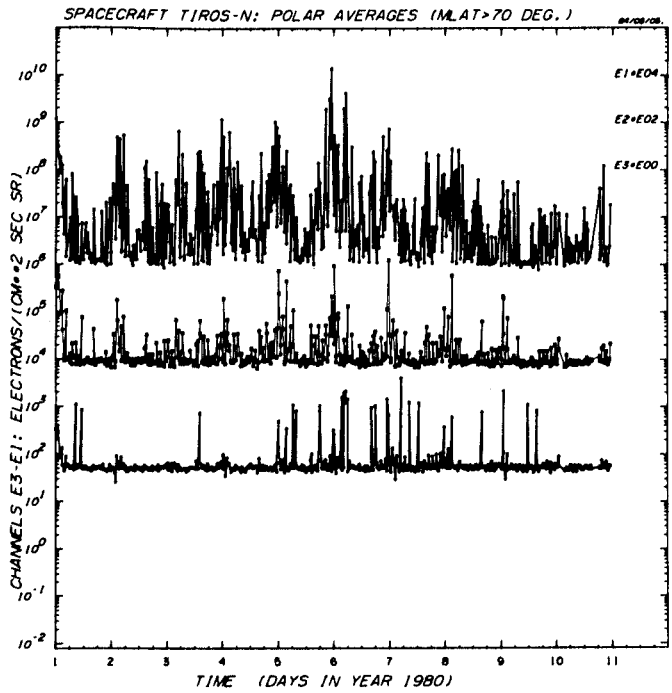


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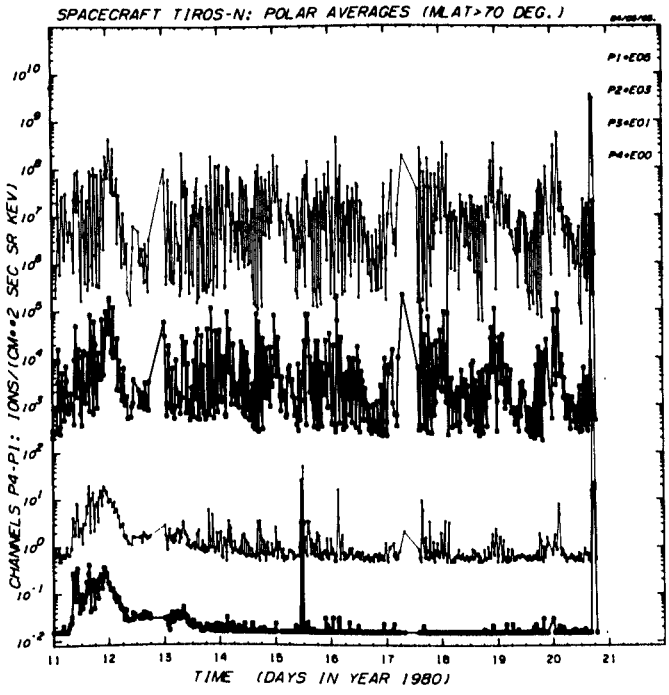


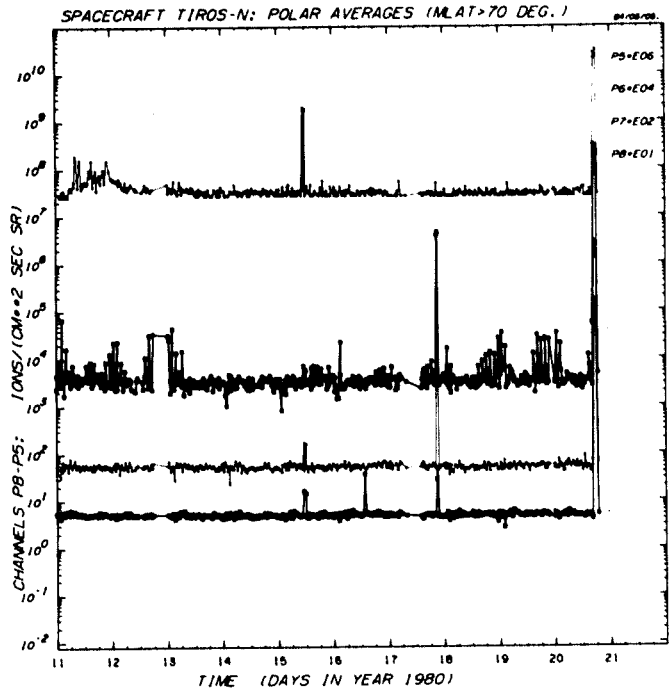


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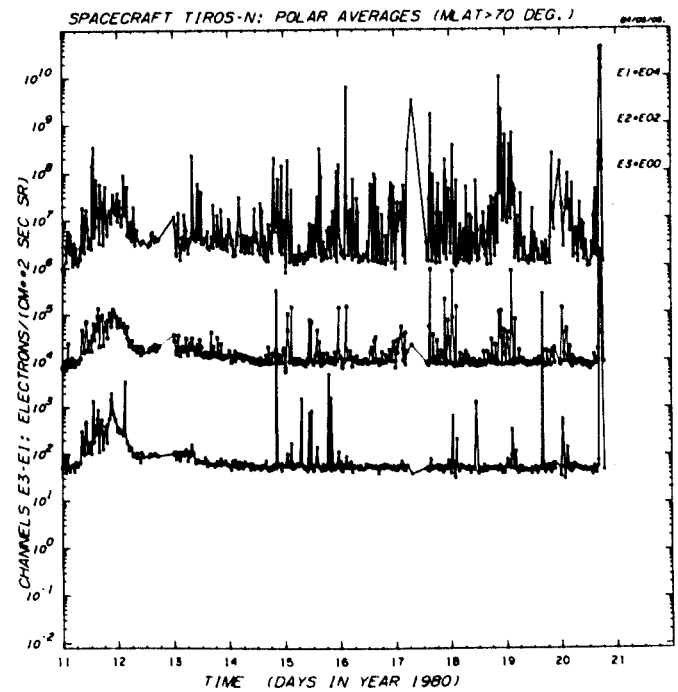


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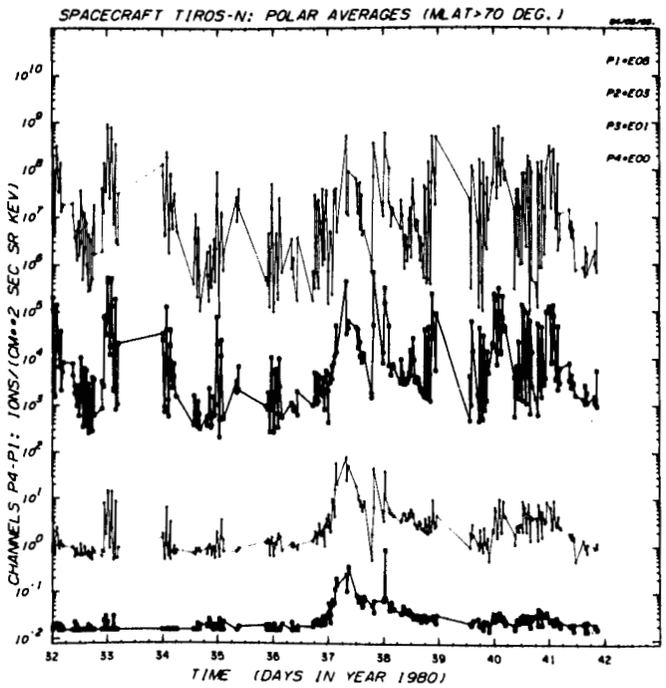


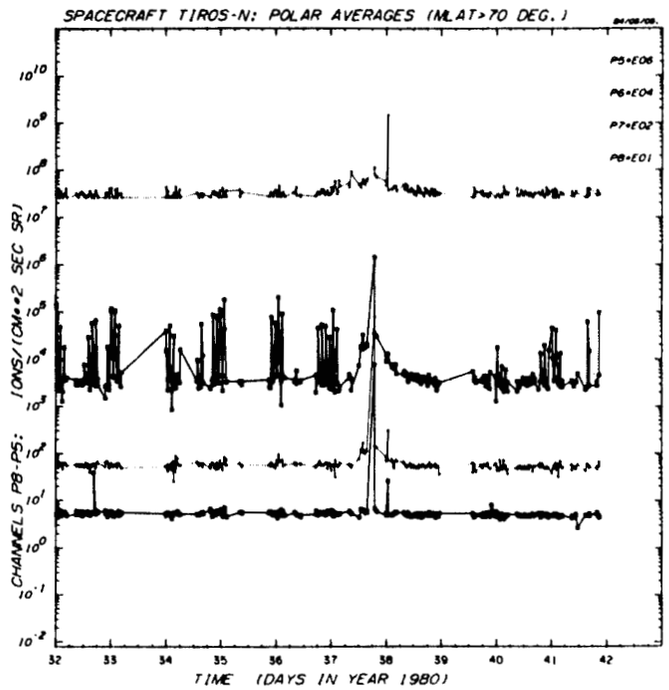


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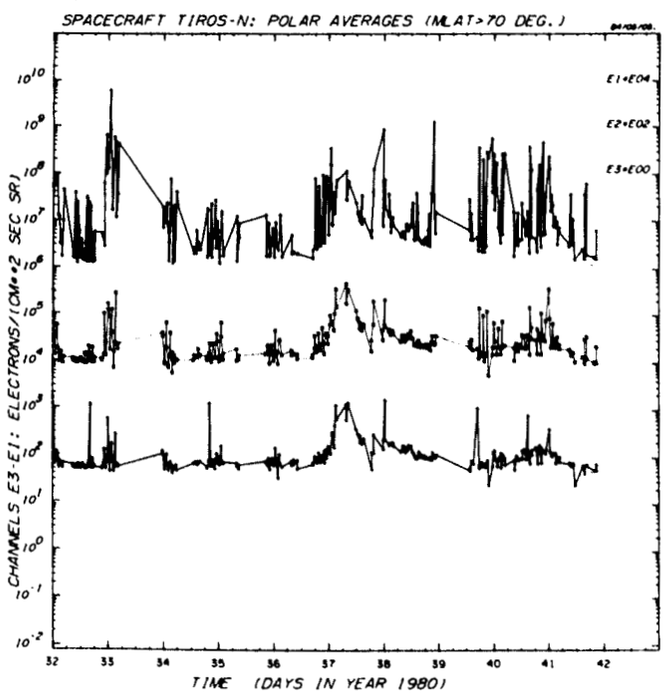


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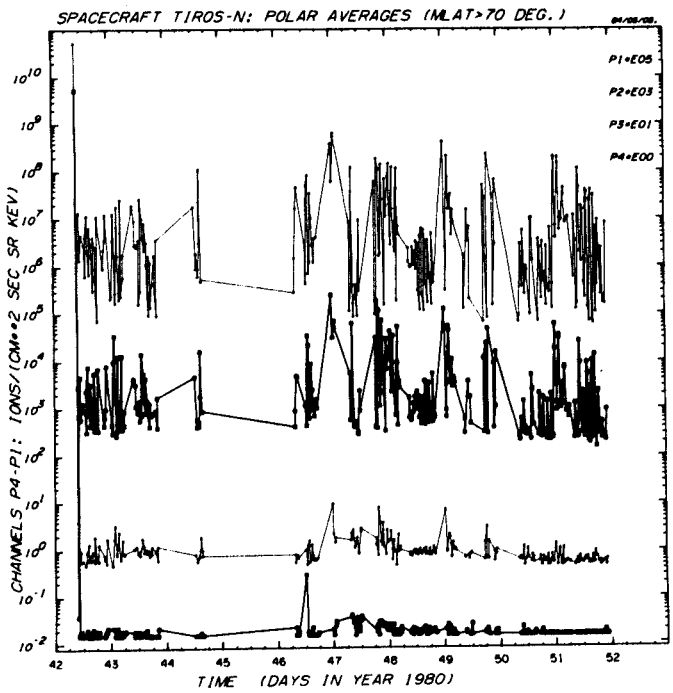


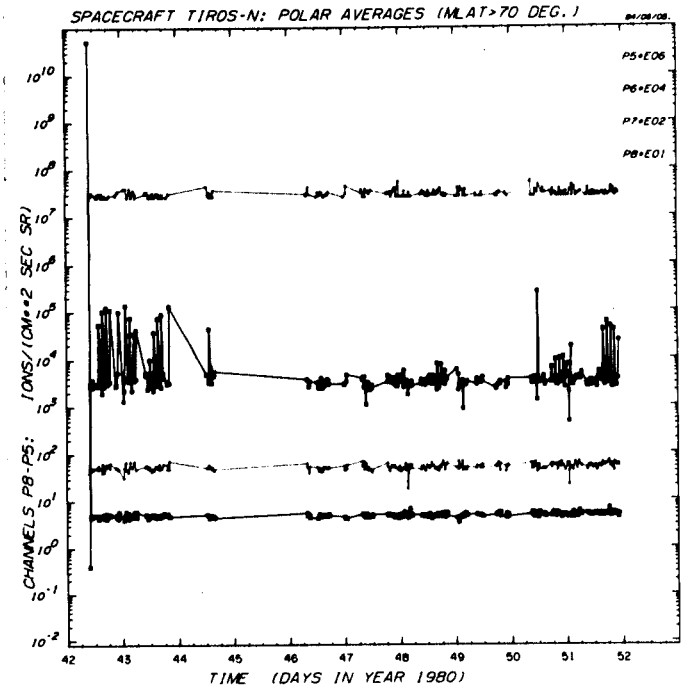


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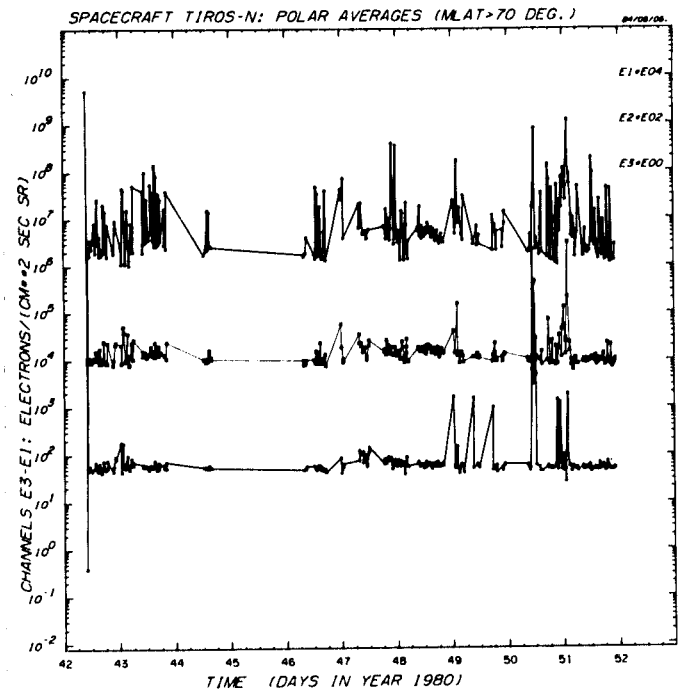


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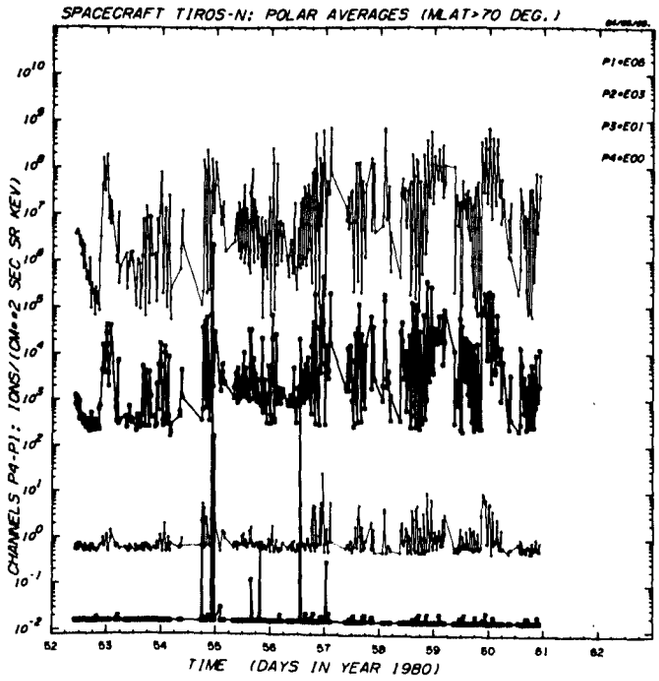


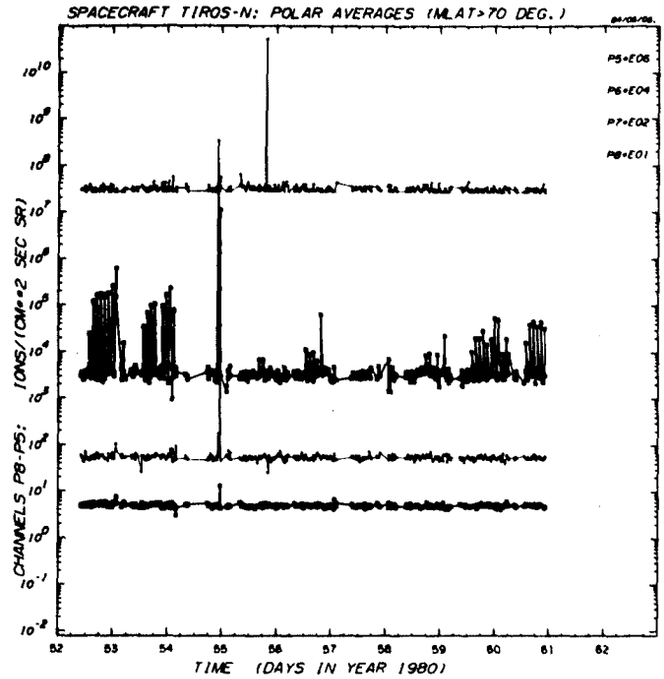


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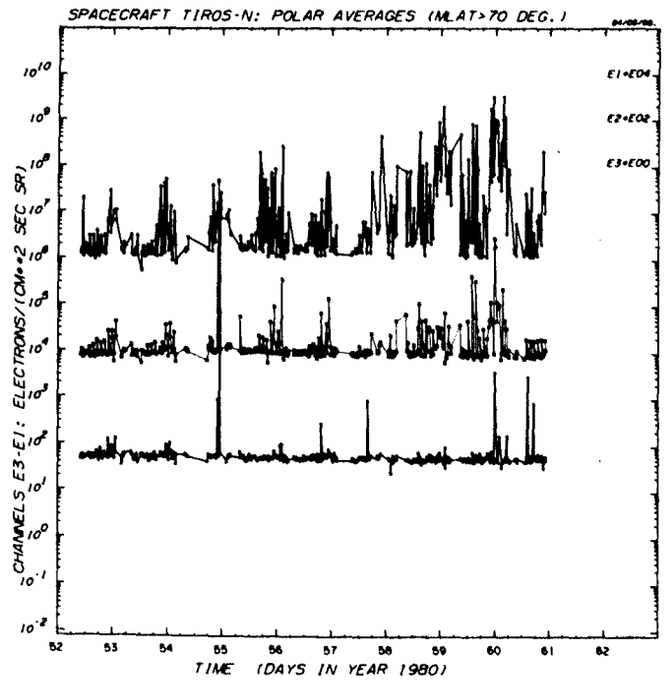
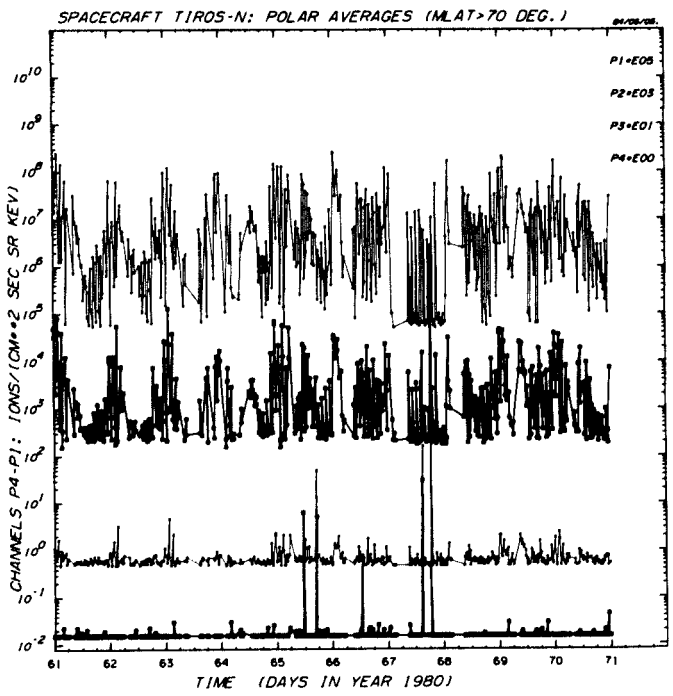
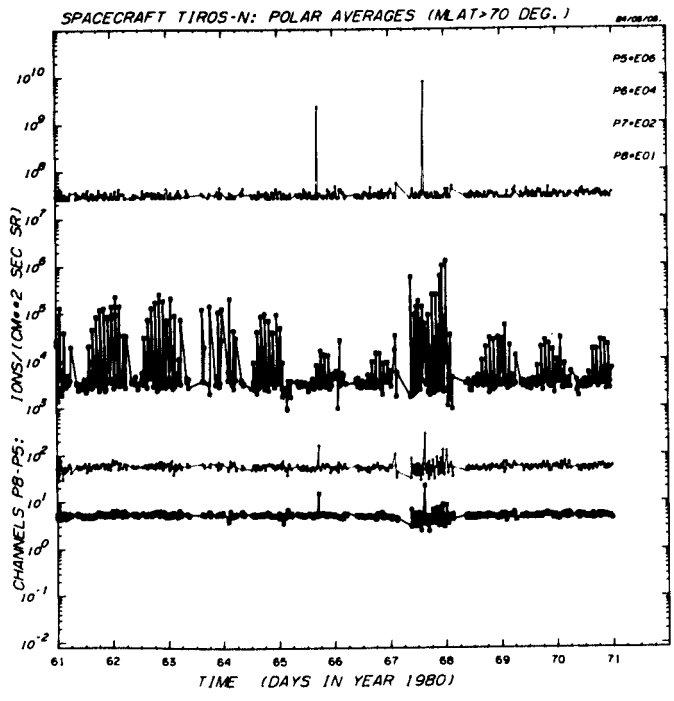



**February 21, 1980**

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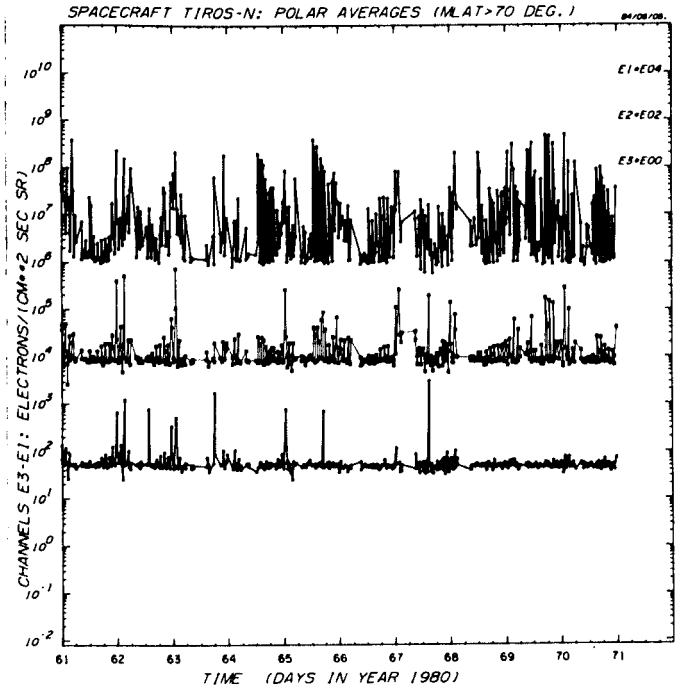
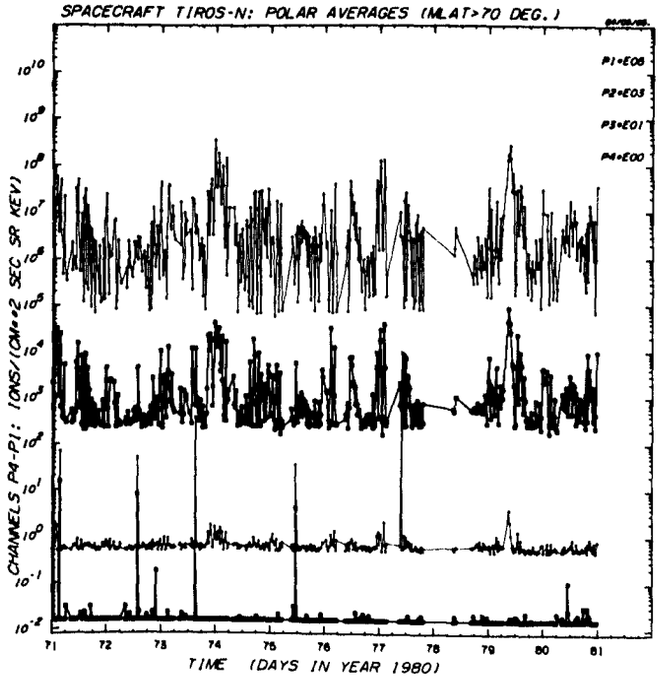
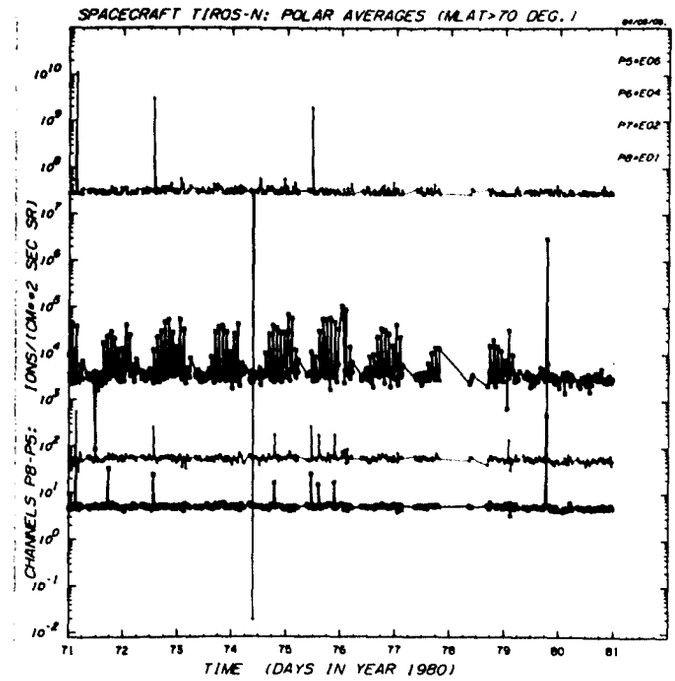



**March 1, 1980**

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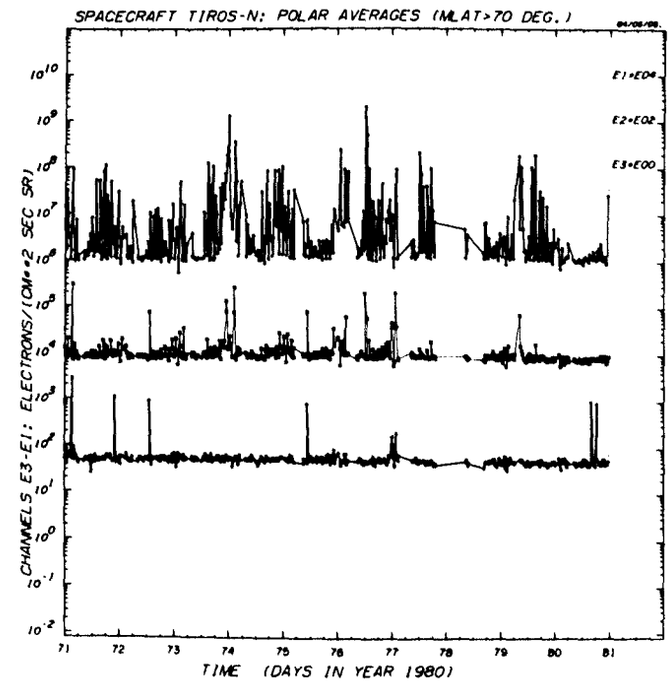


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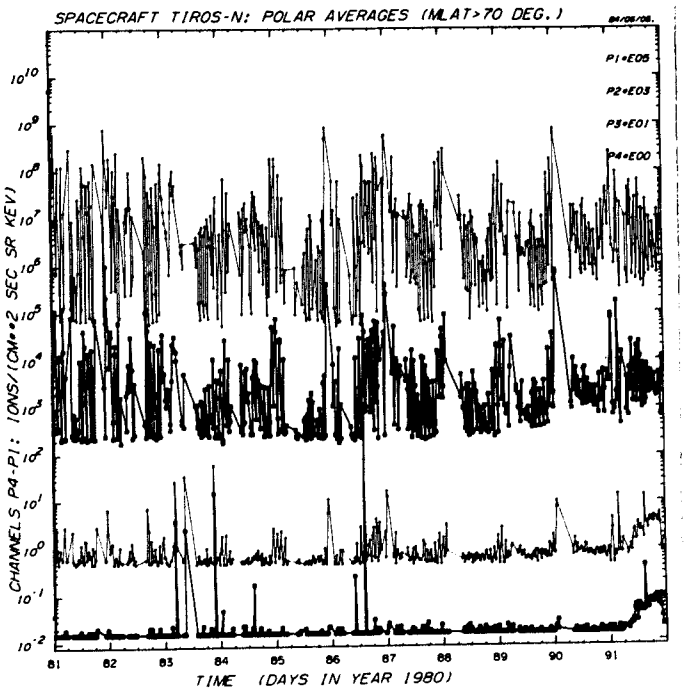


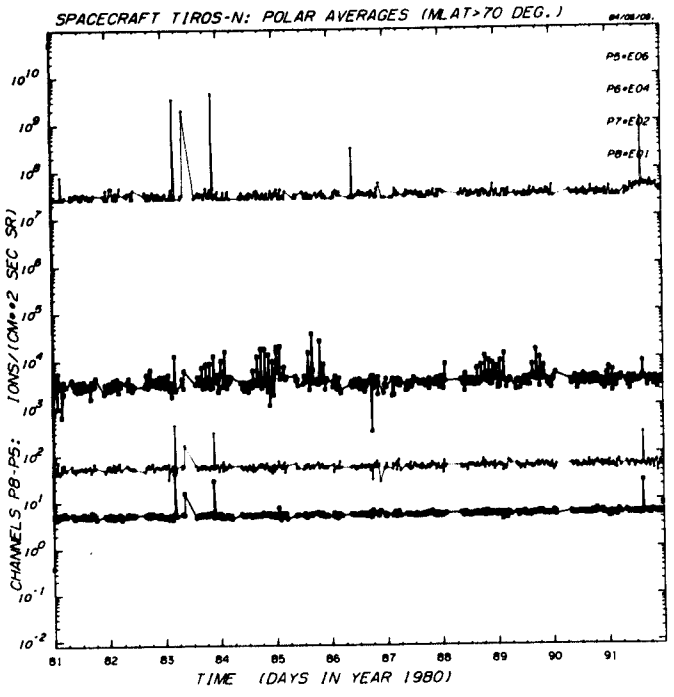


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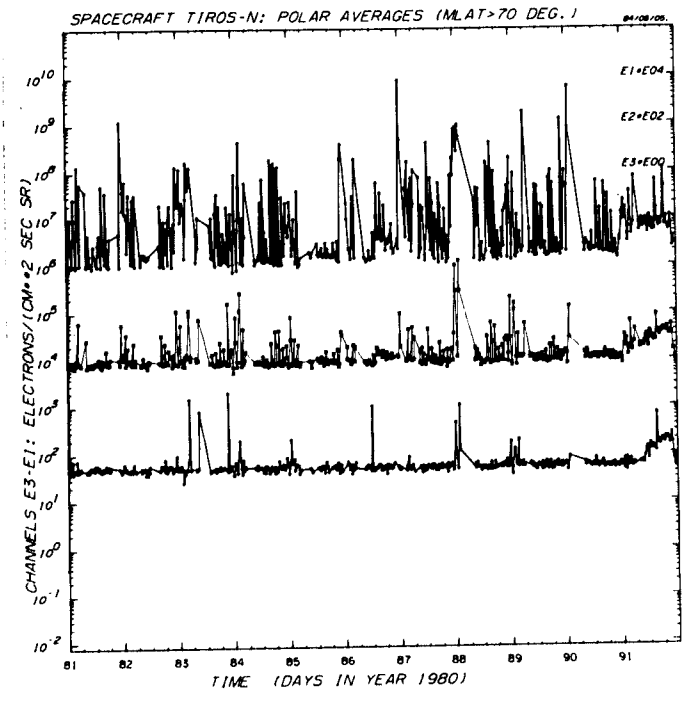


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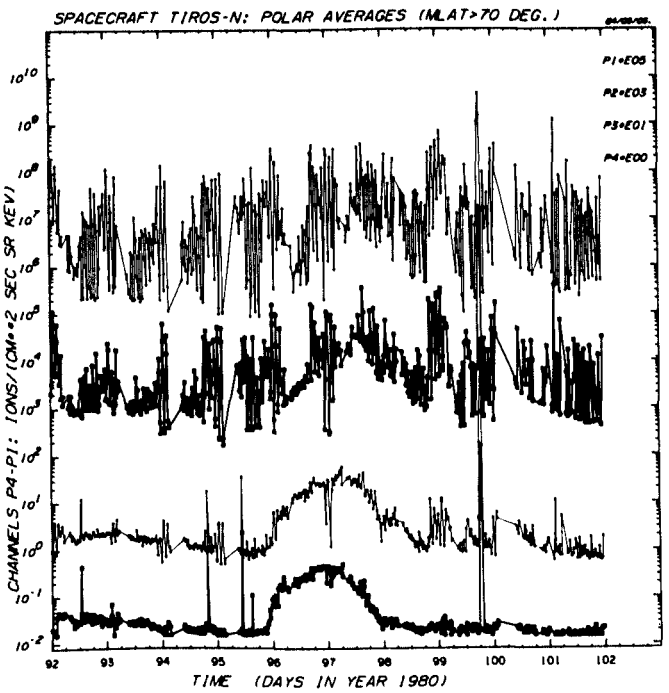


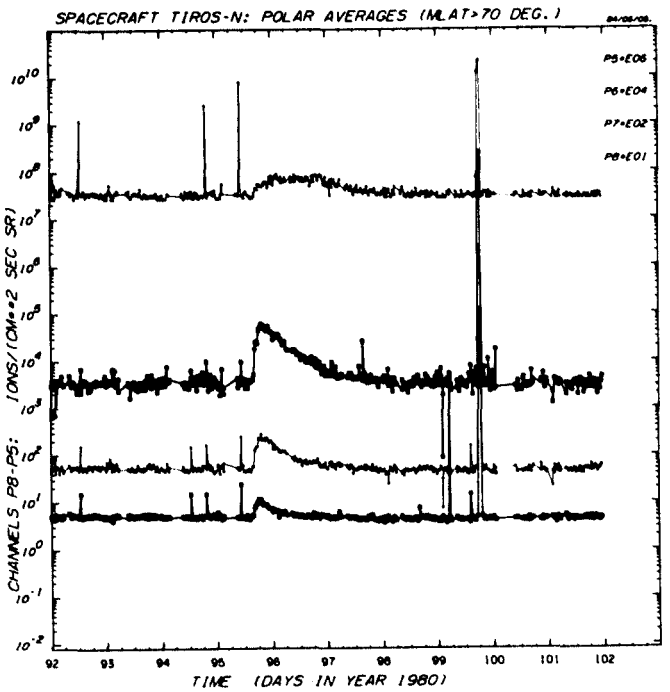


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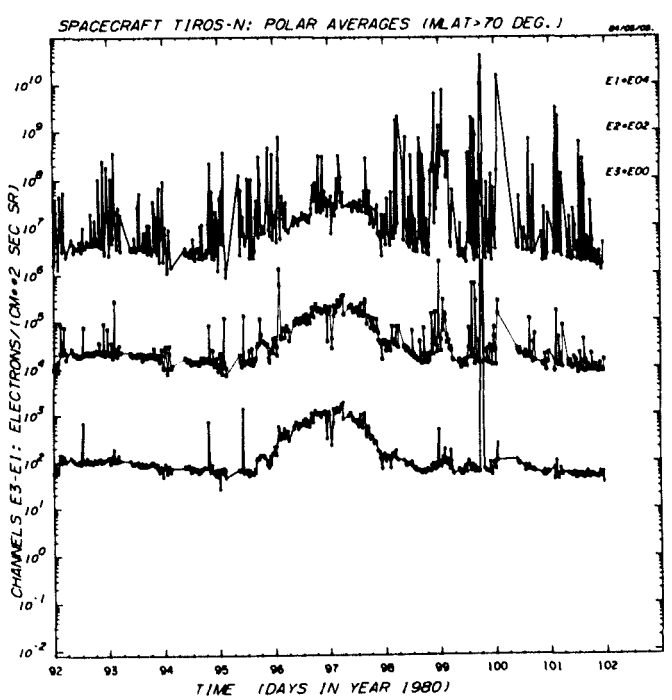
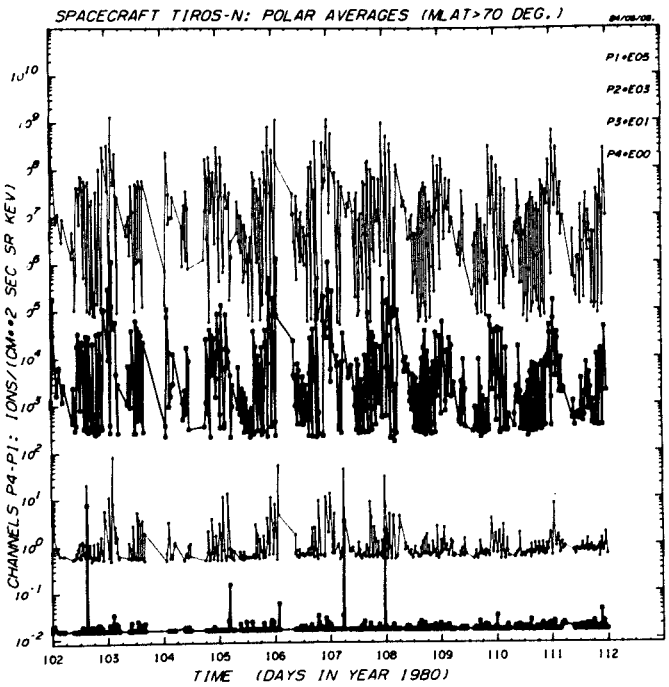
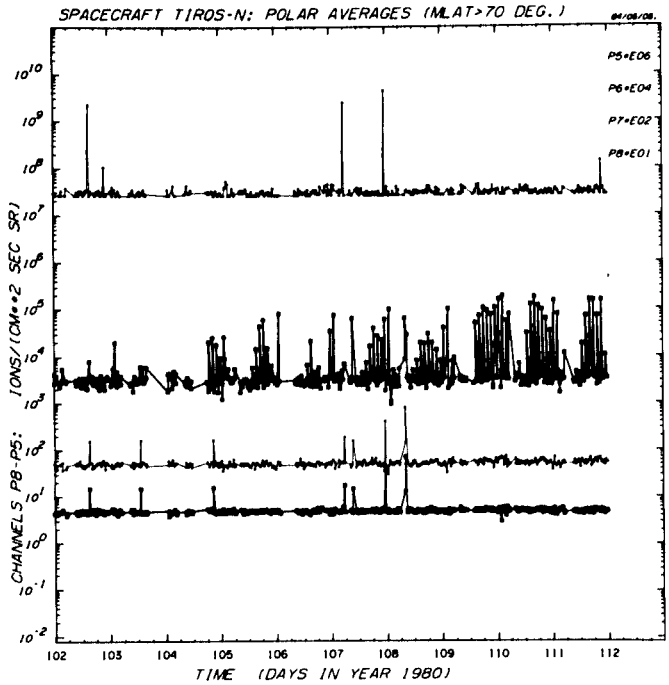



**April 1, 1980**

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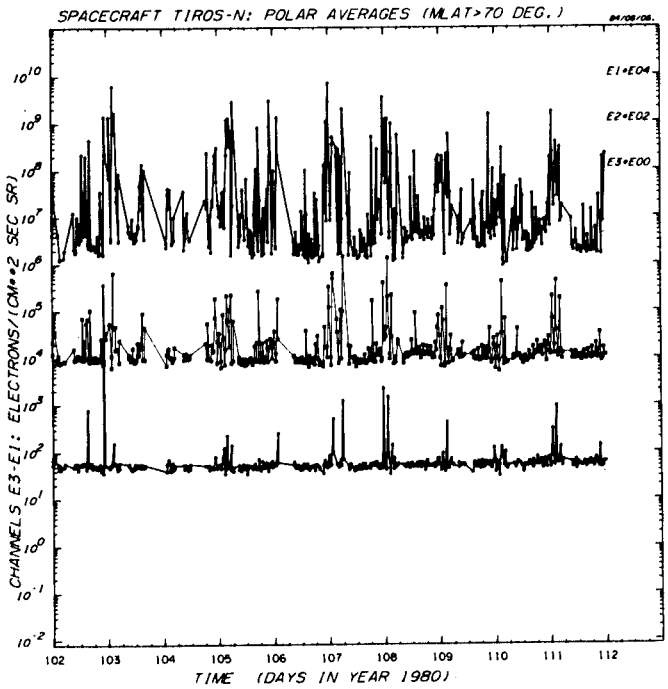


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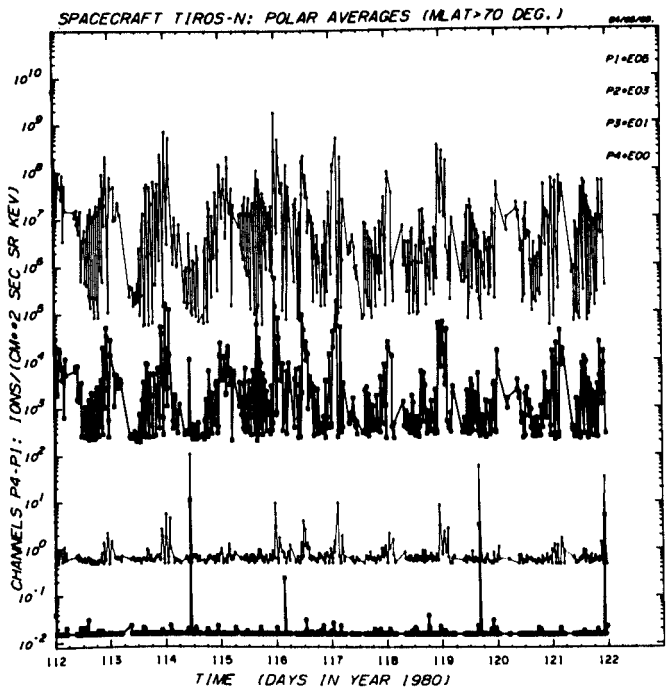


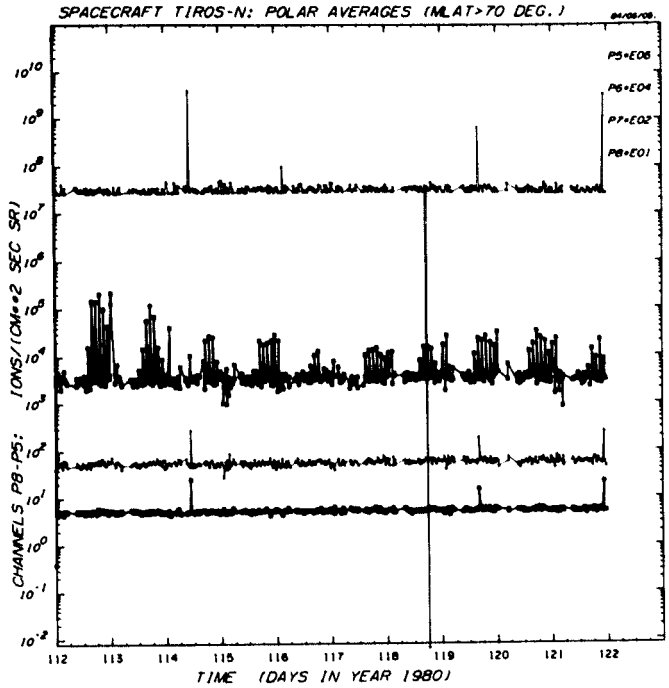


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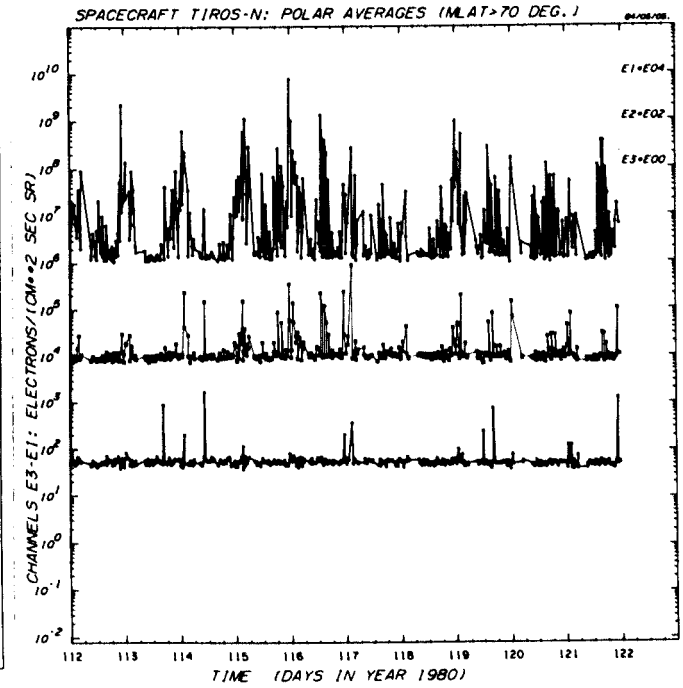


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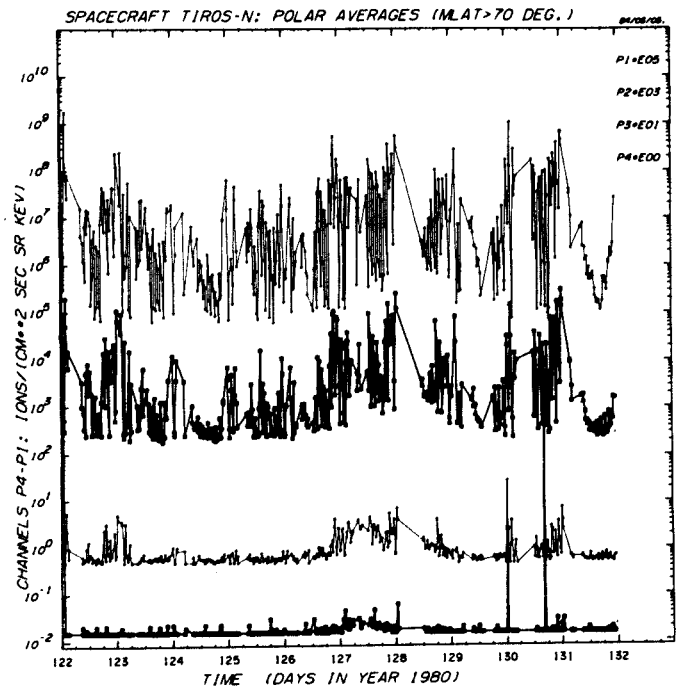


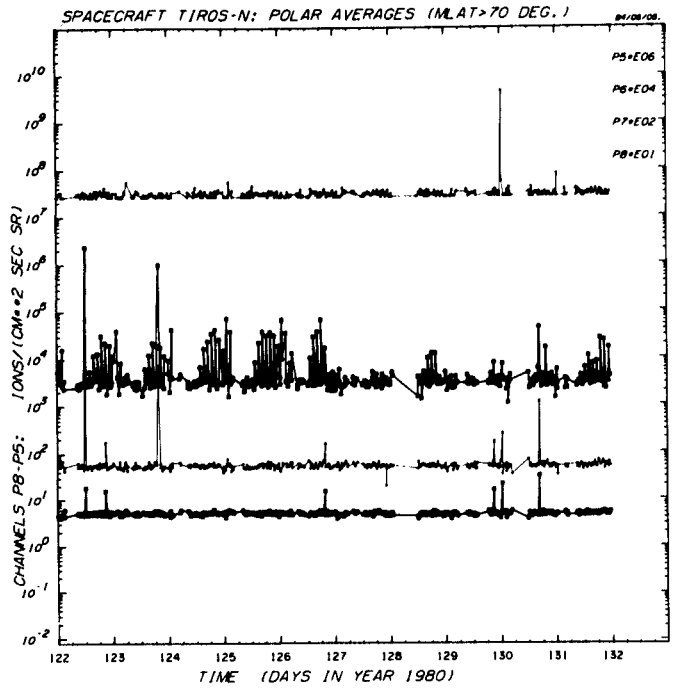


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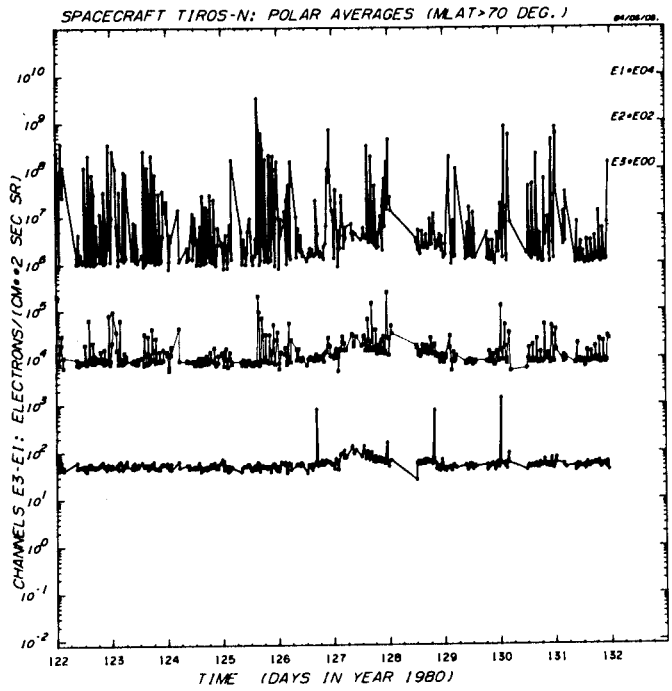
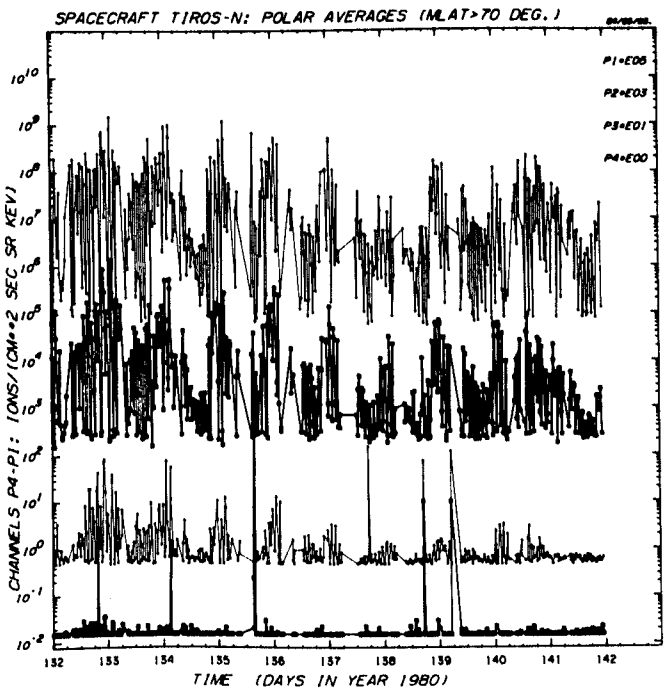
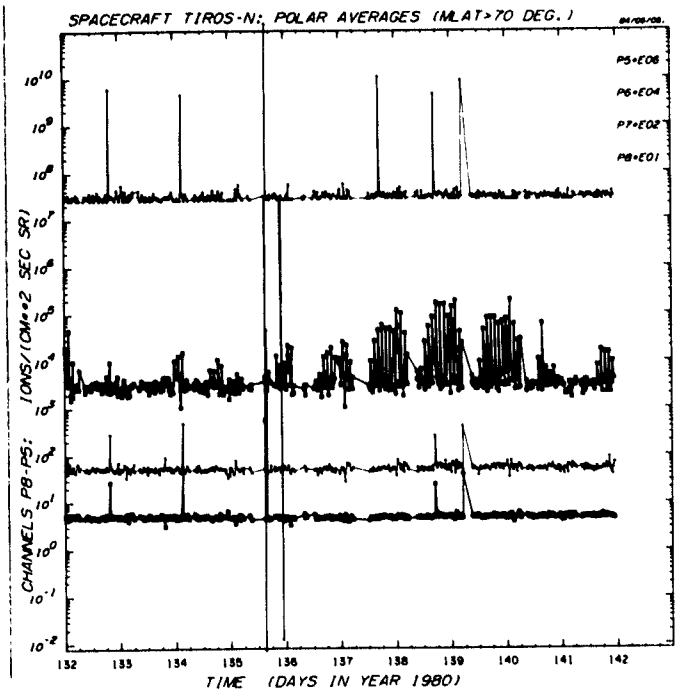



**May 1, 1980**

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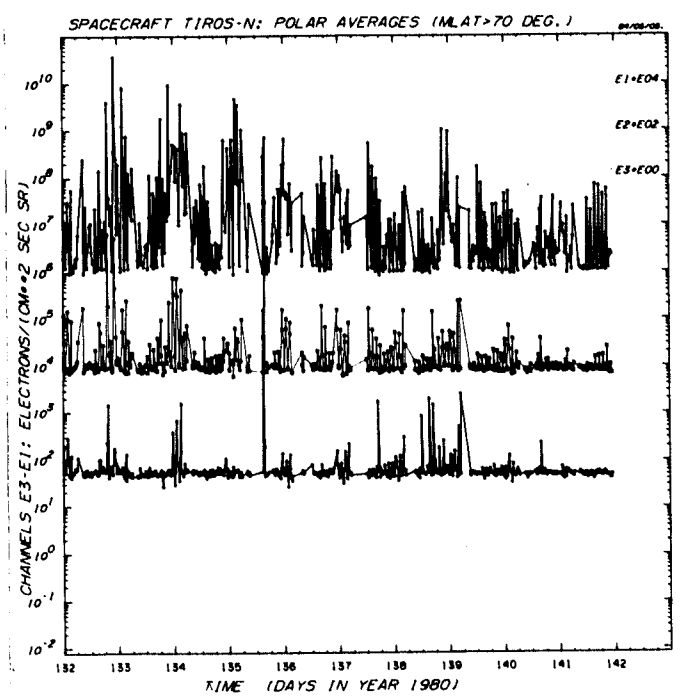
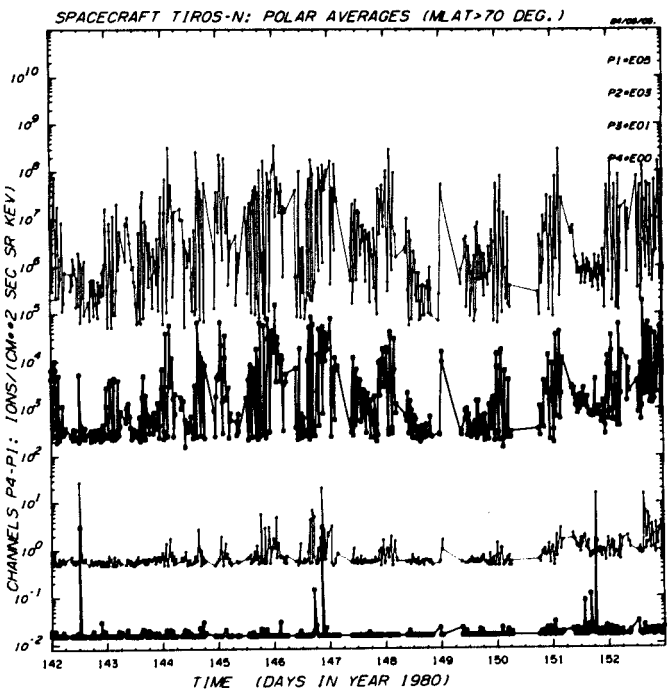
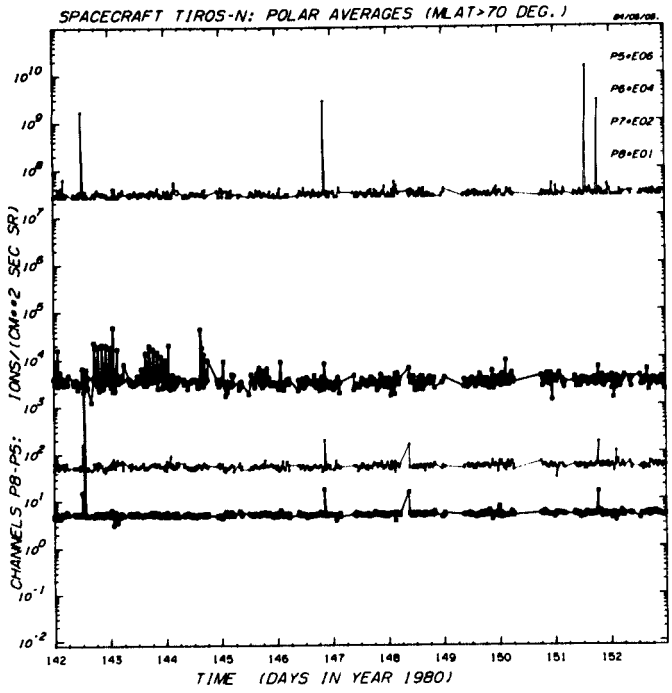



**May 11, 1980**




*ENERGY CHANNELS:*

P1: E= 30 - 80 KEV
P2: E= 80 - 250 KEV
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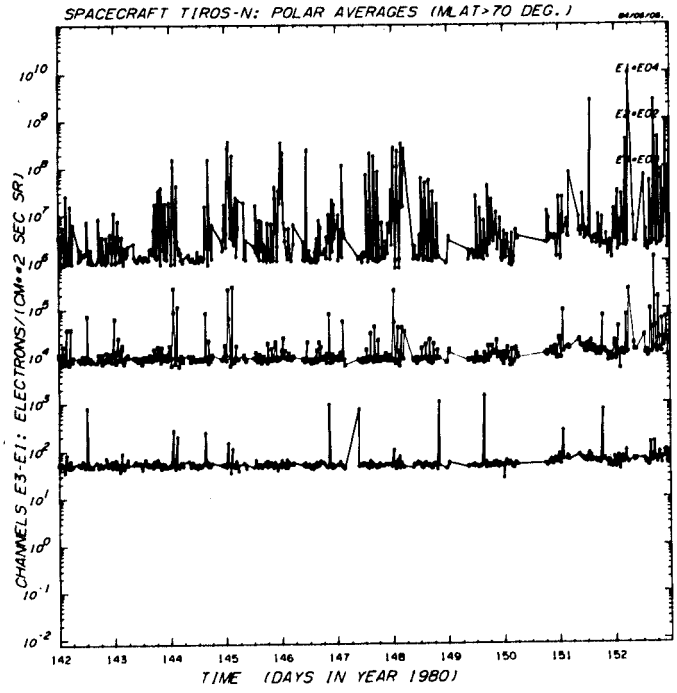
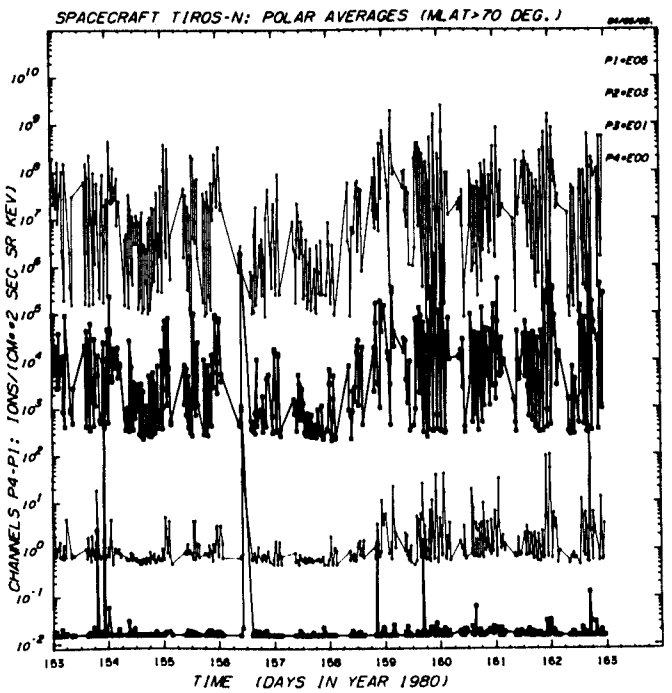
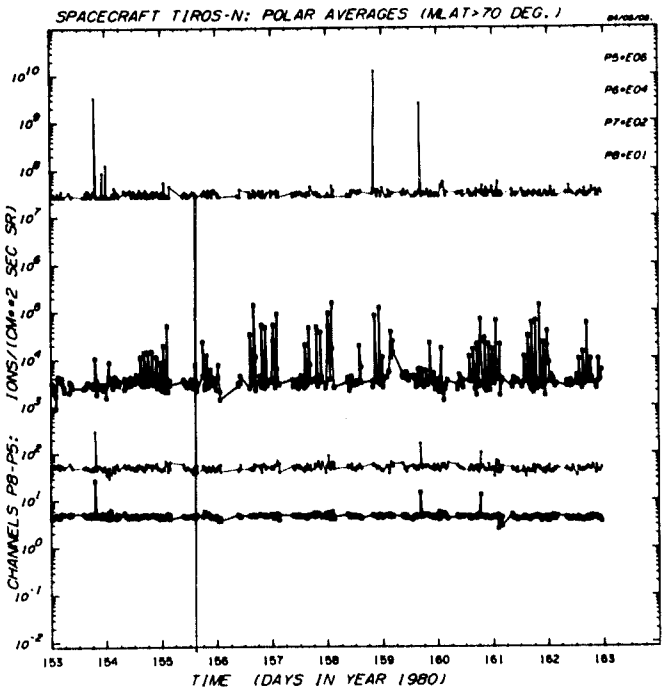



**May 21, 1980**

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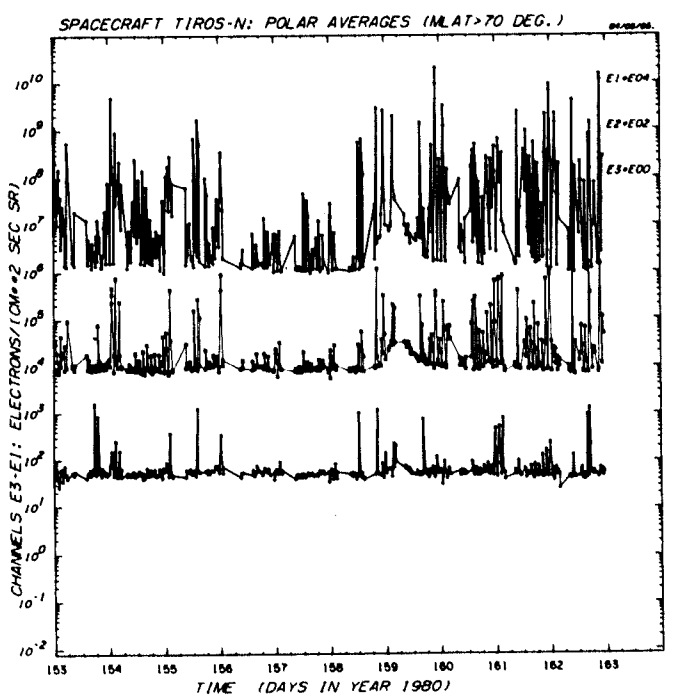
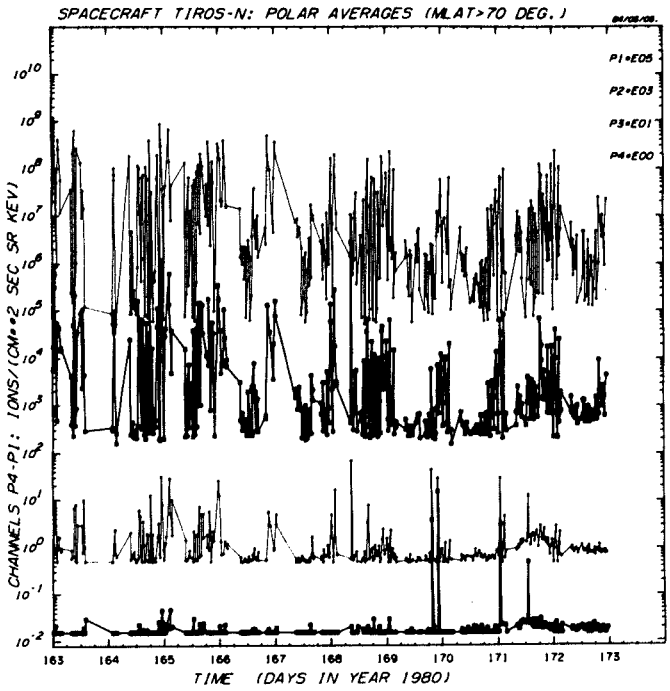
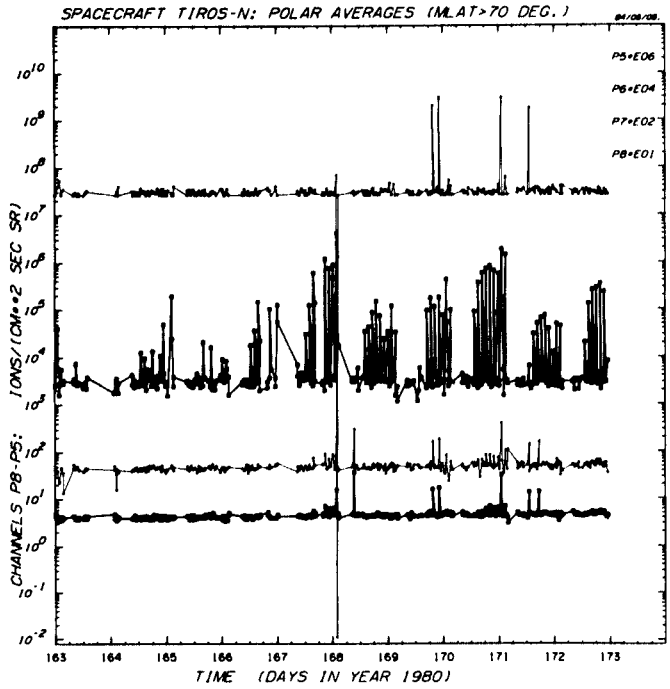



**June 1, 1980**

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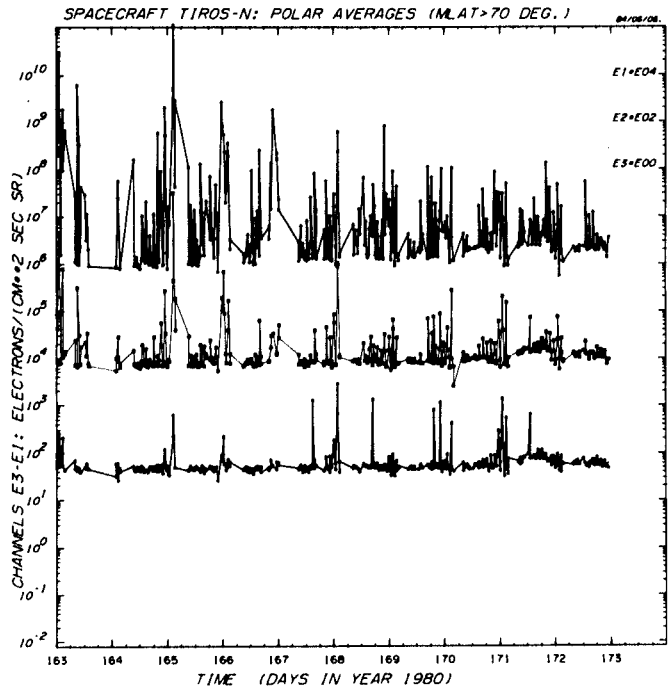


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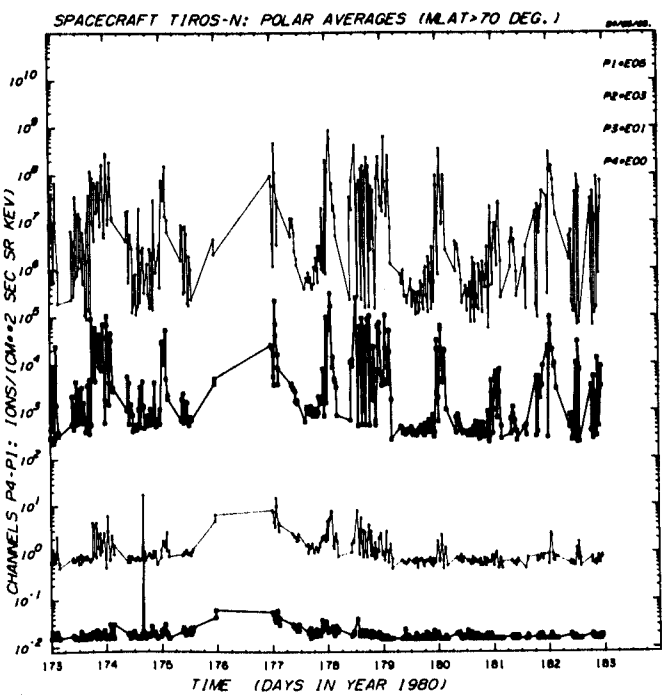


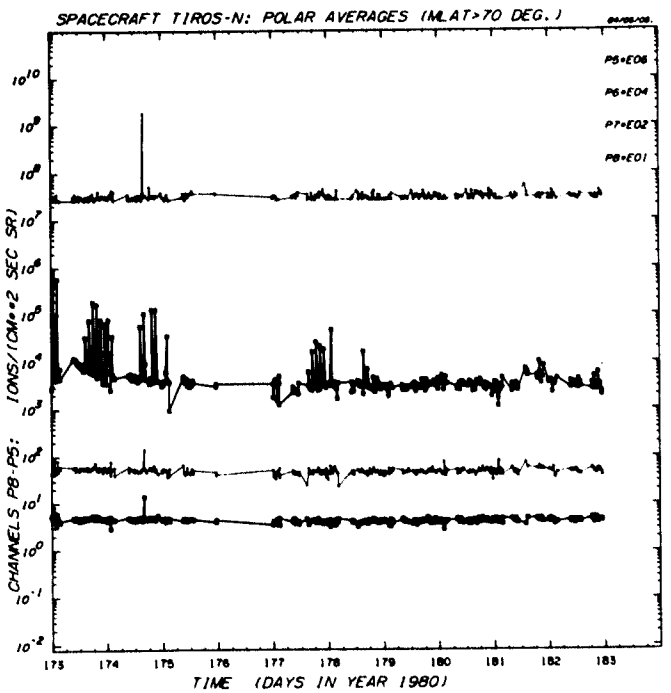


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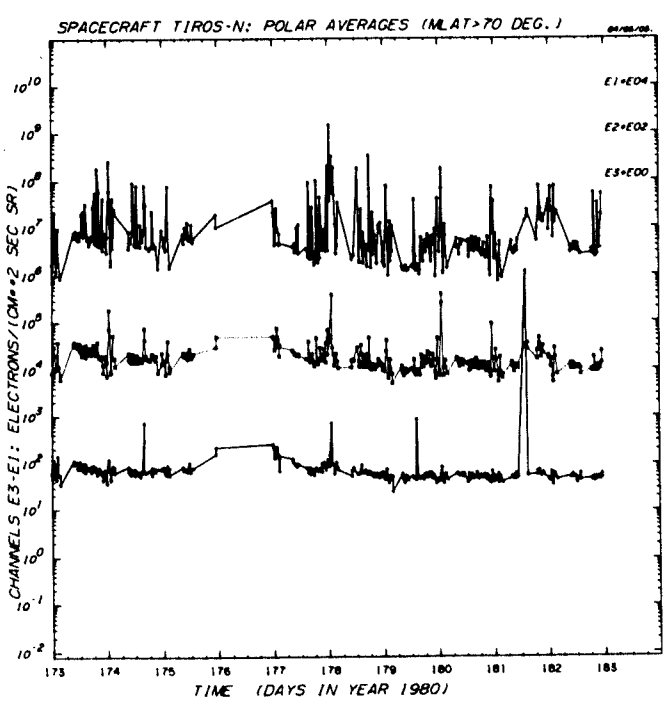


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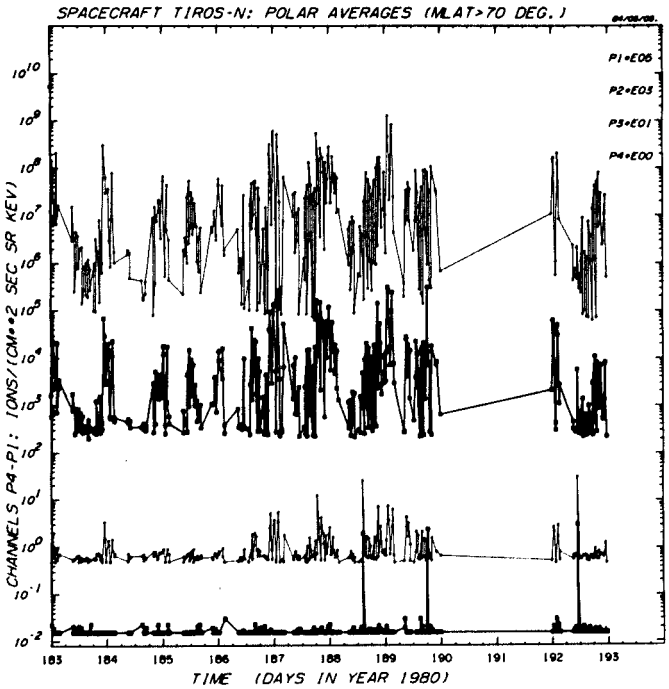


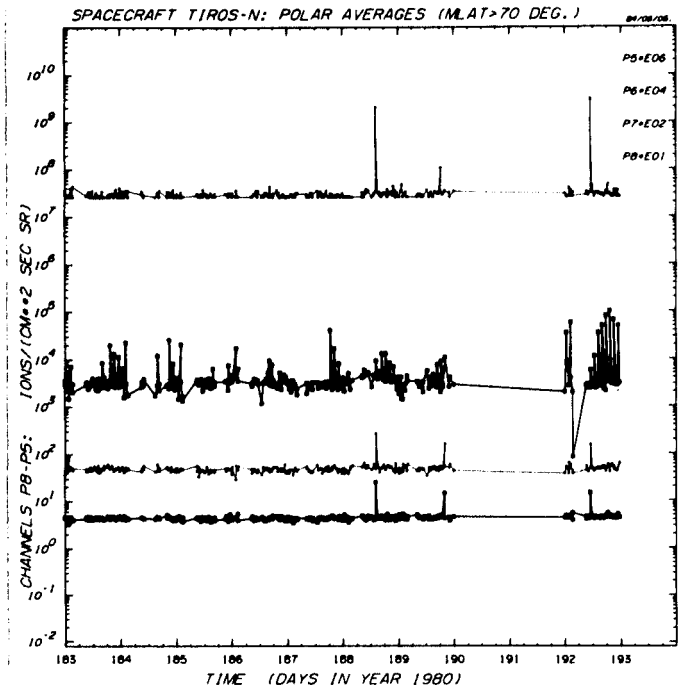


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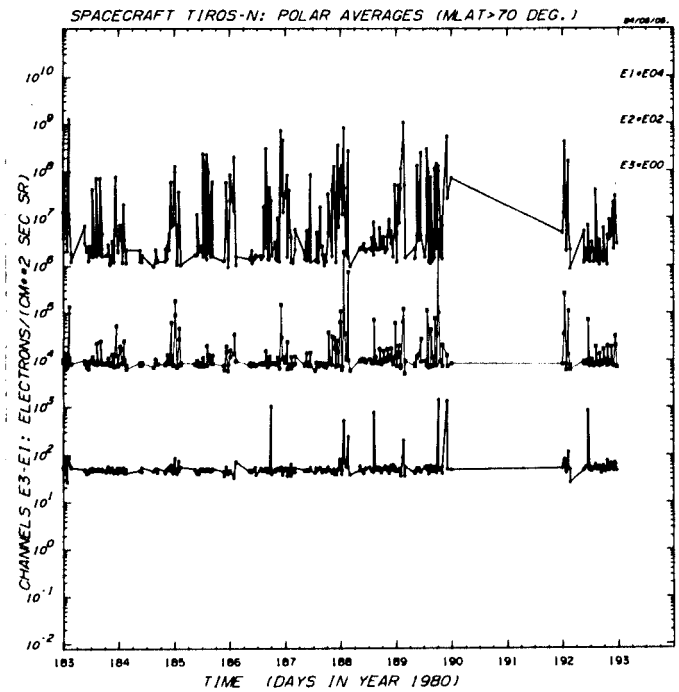
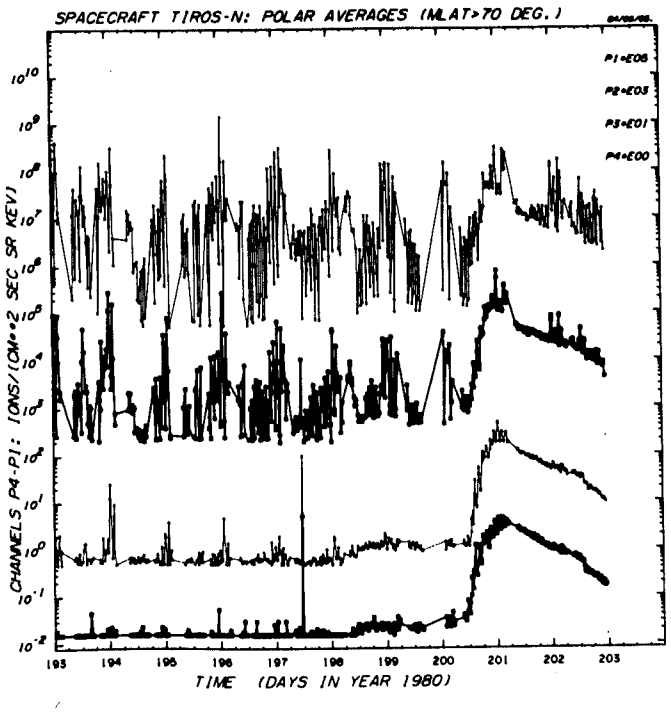
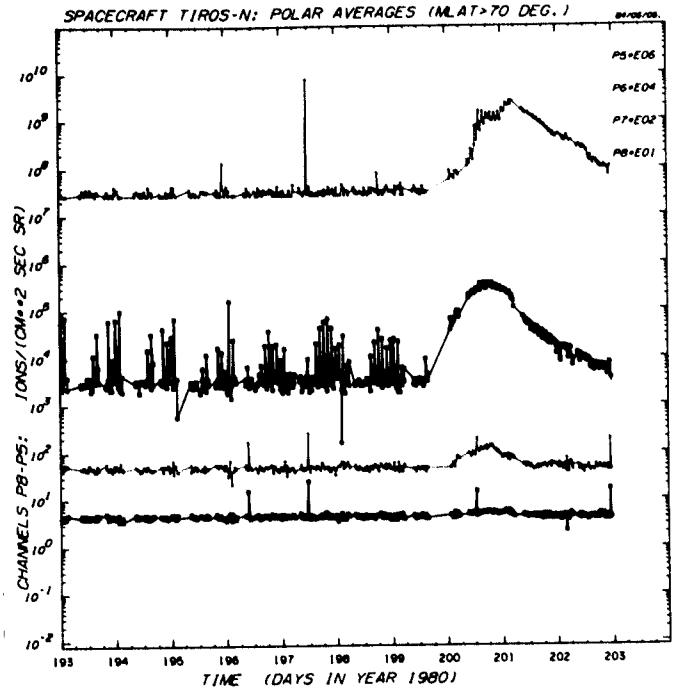



**July 1, 1980**

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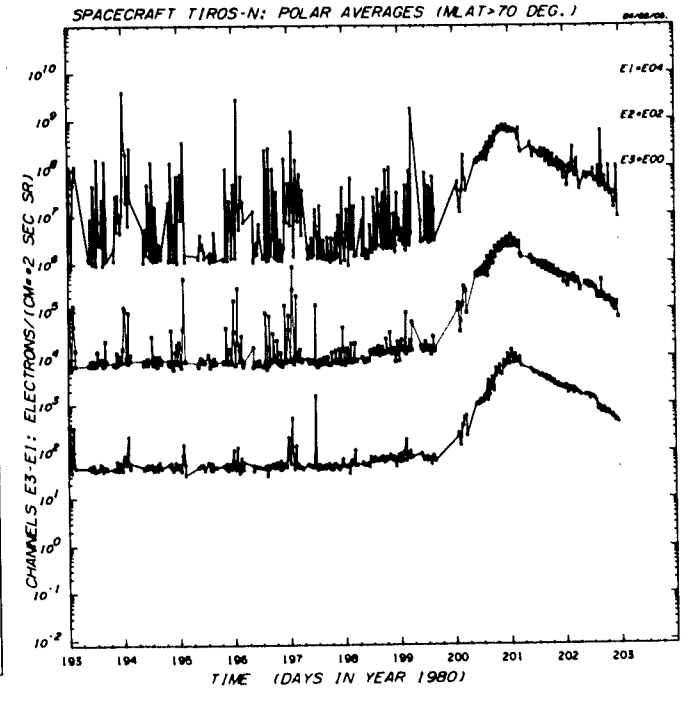
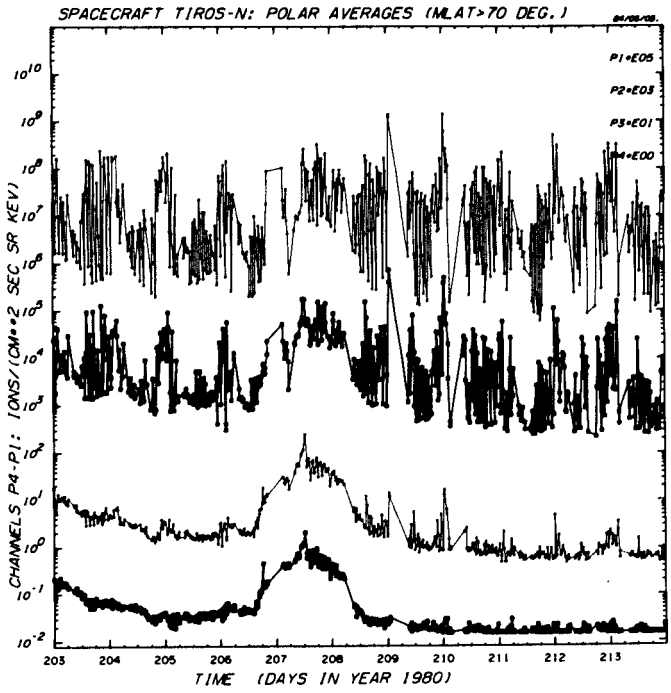
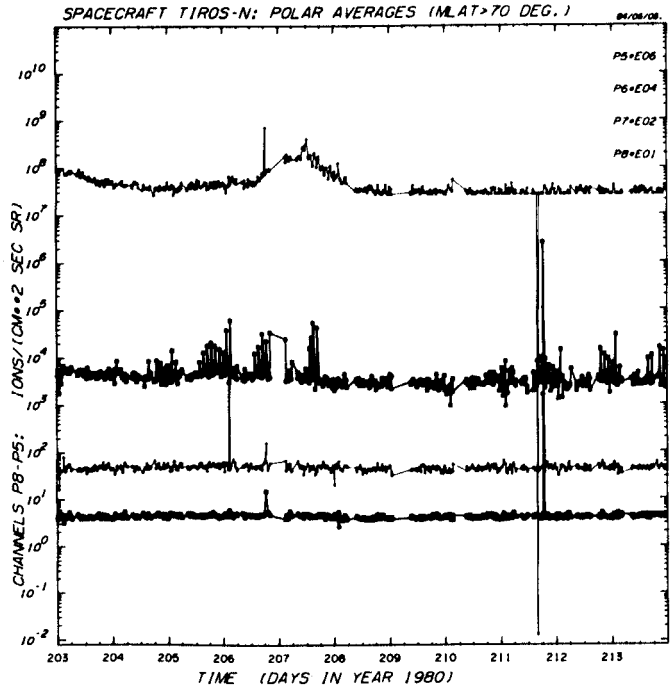



**July 11, 1980**

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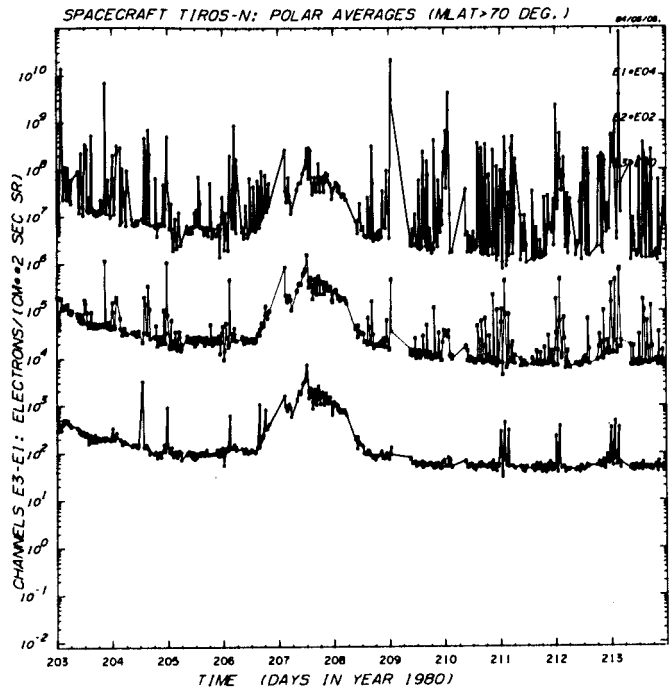
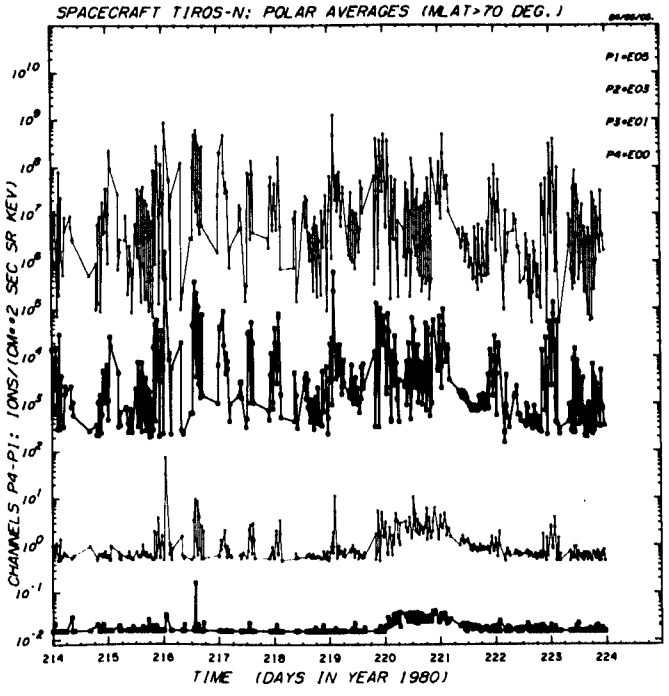
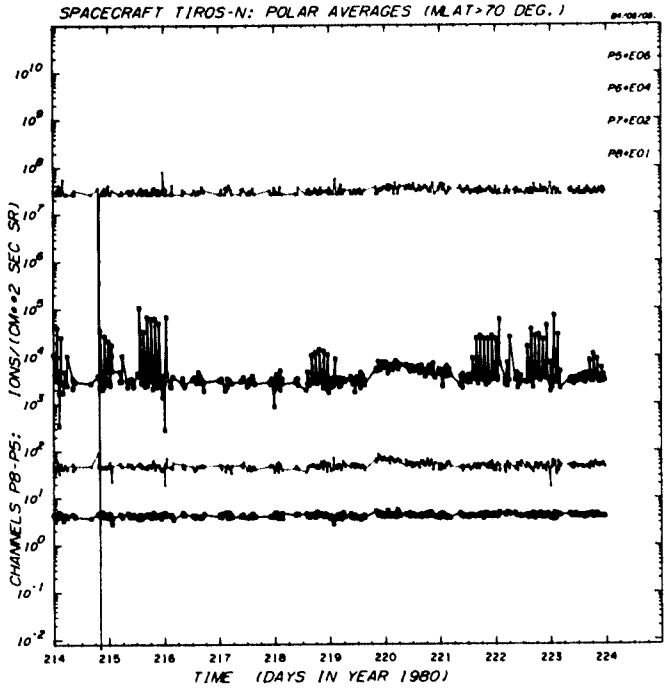



**July 21, 1980**

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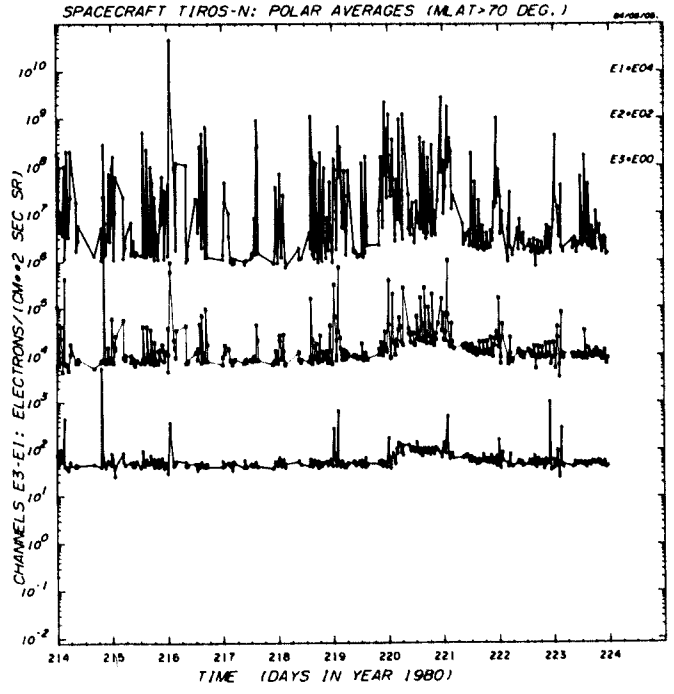
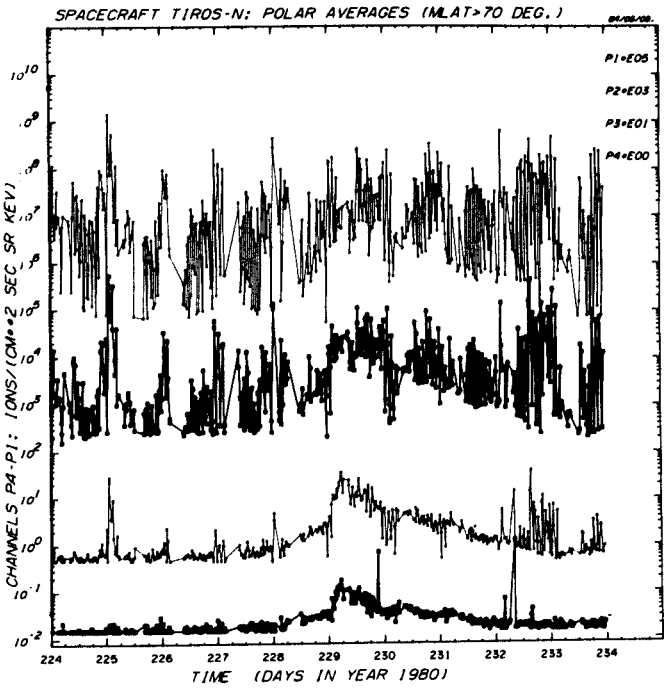
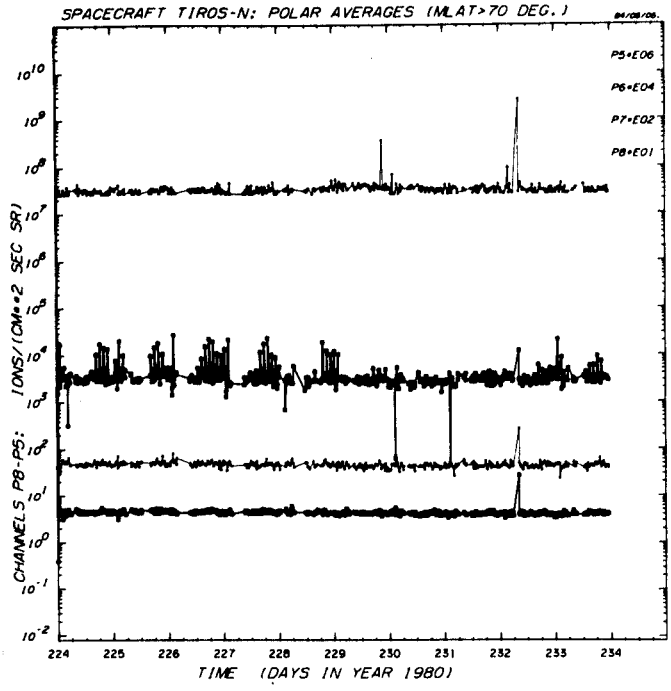



**August 1, 1980**

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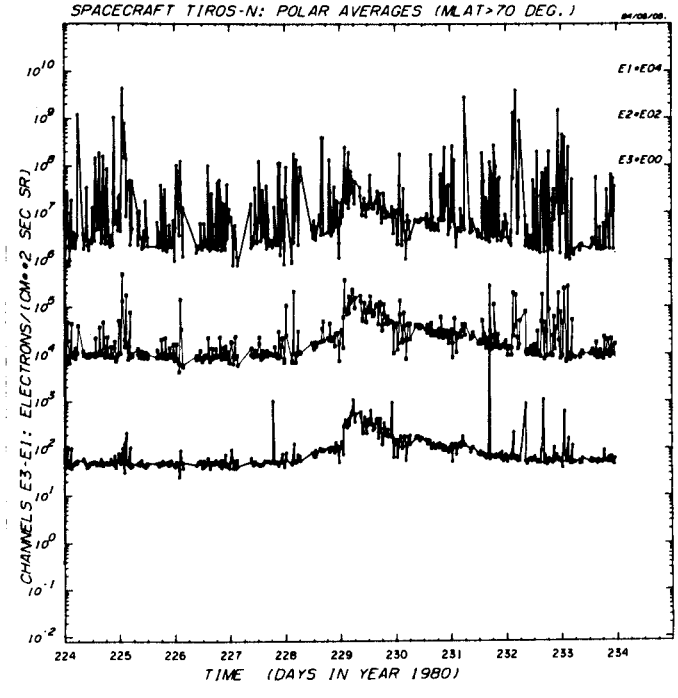


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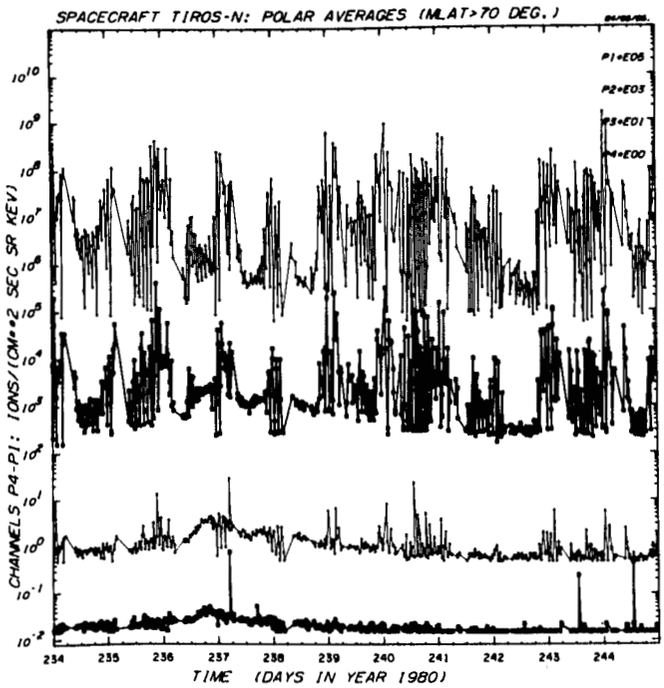


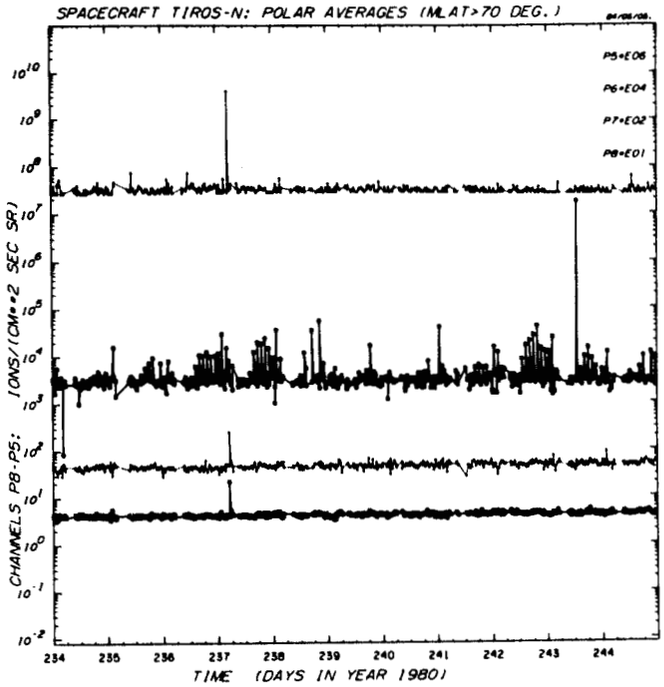


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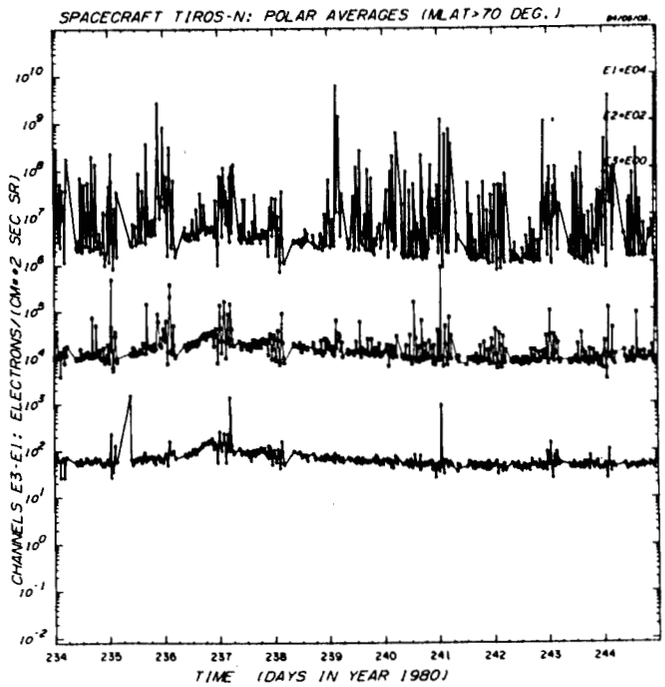


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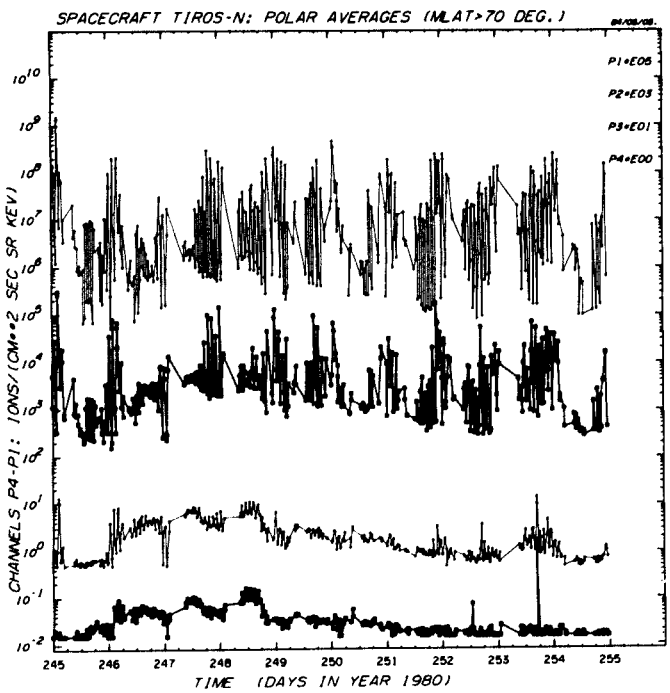


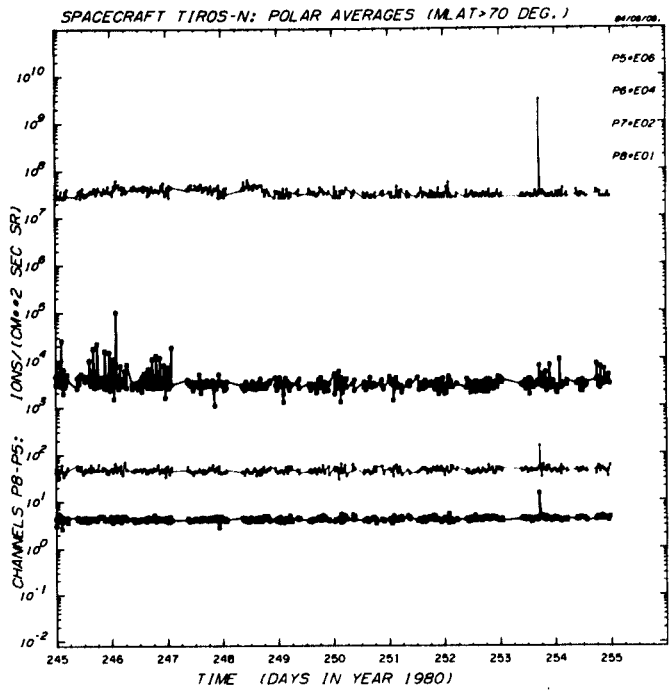


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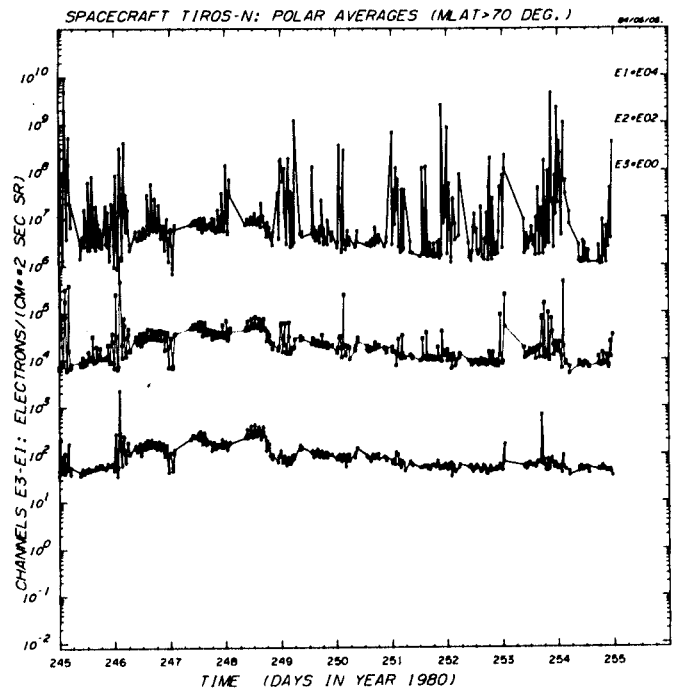
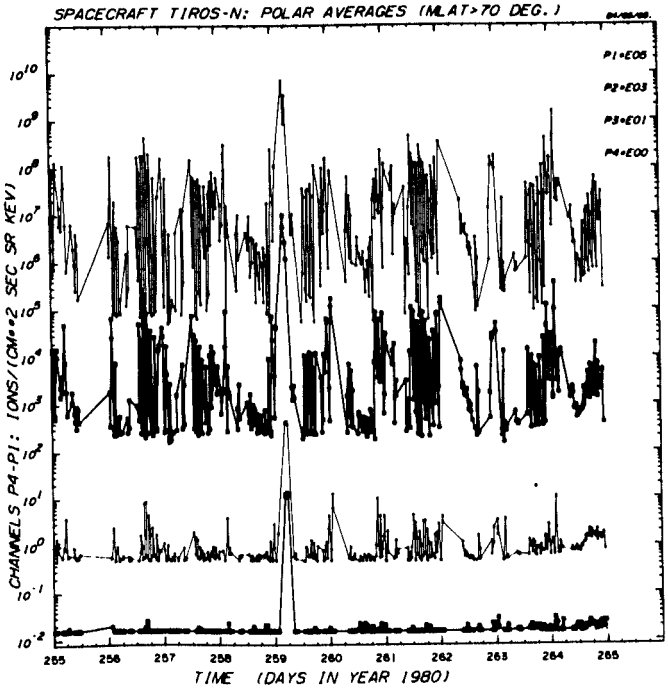
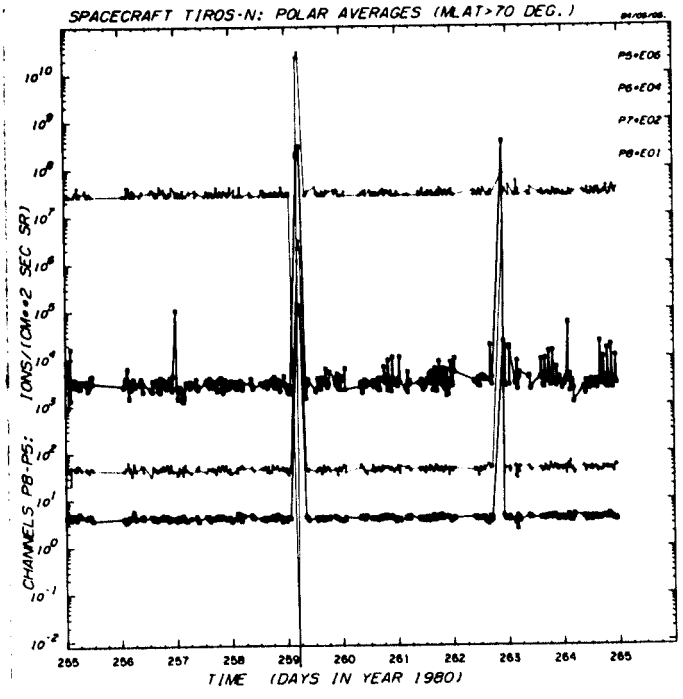



**September 1, 1980**

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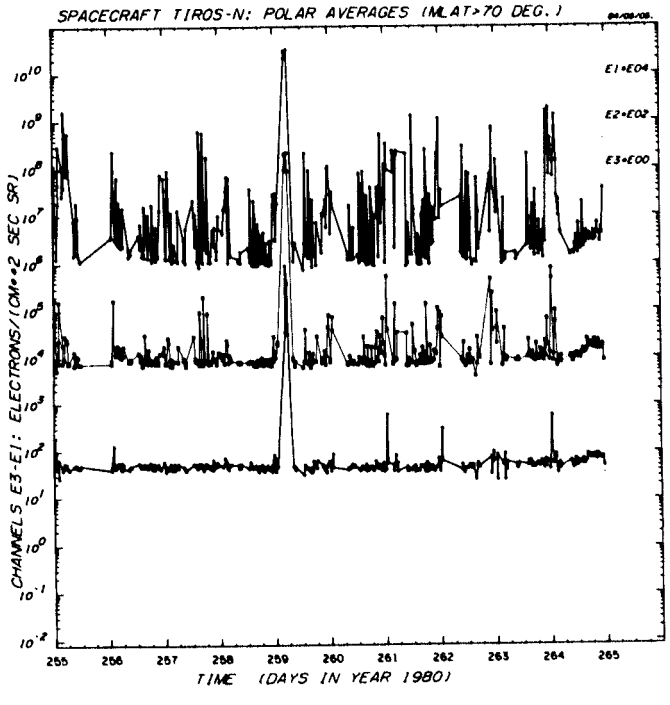


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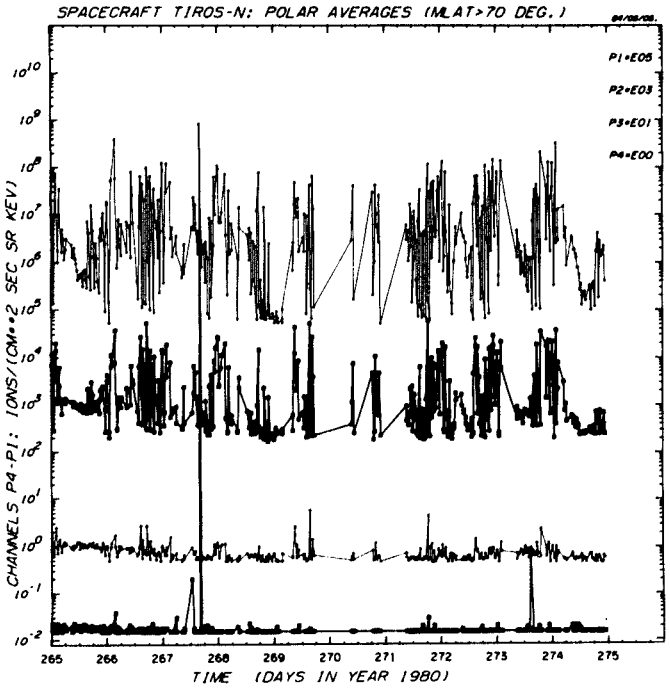


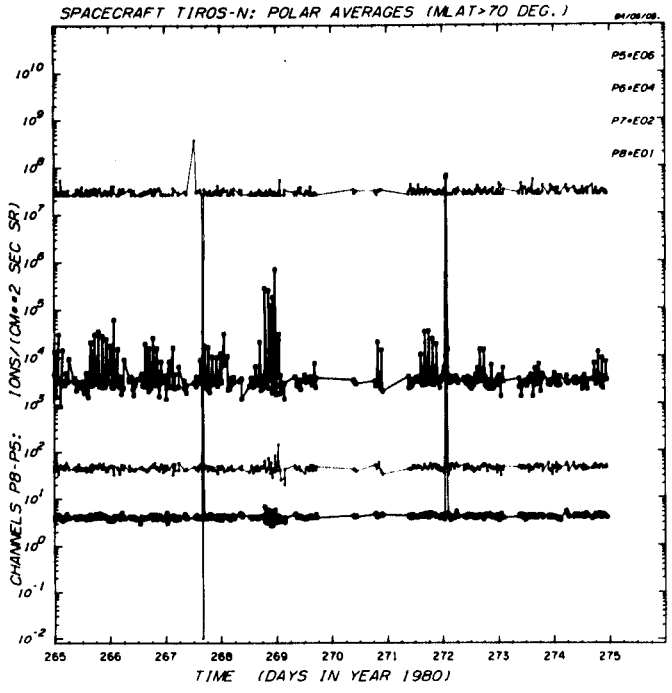


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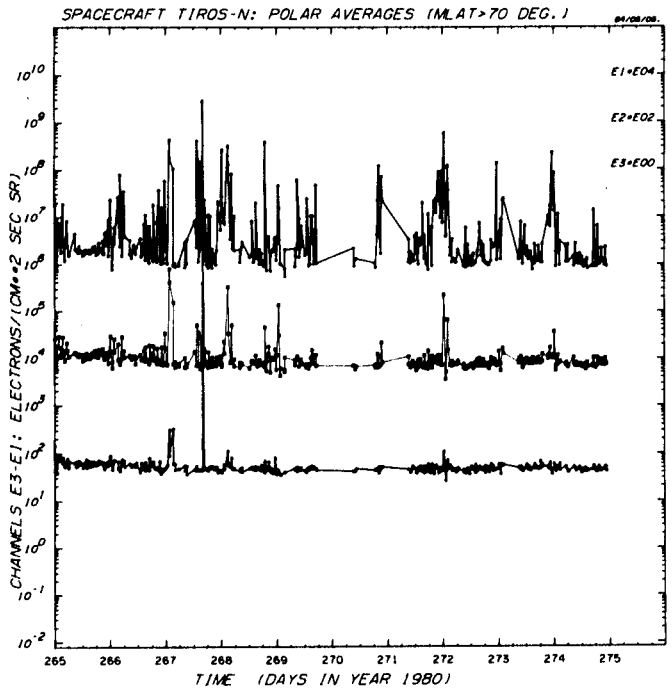


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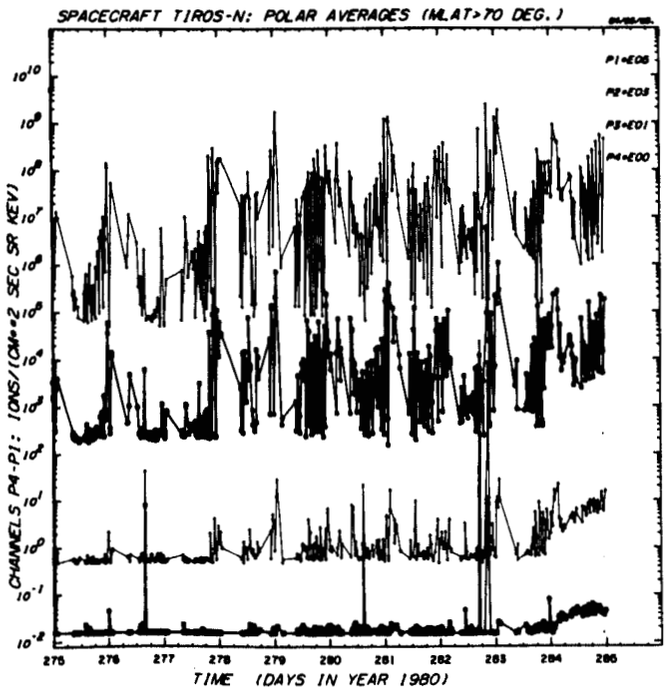


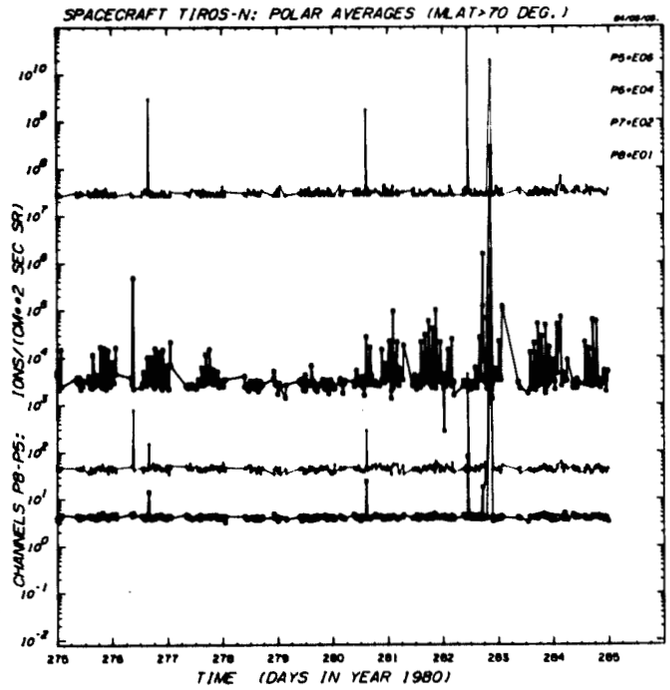


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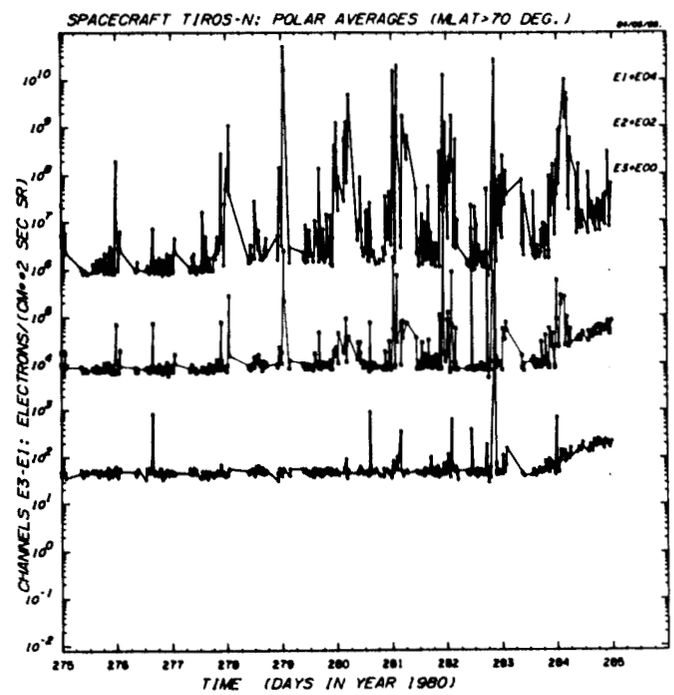

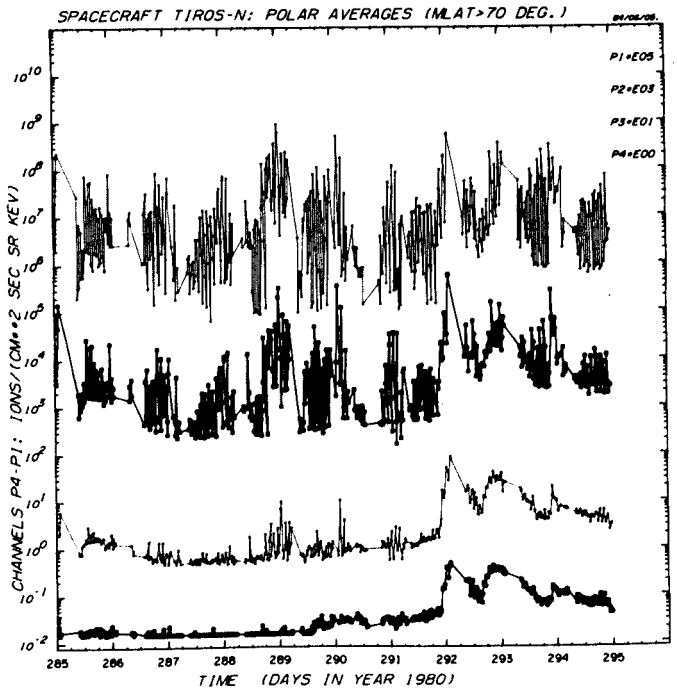


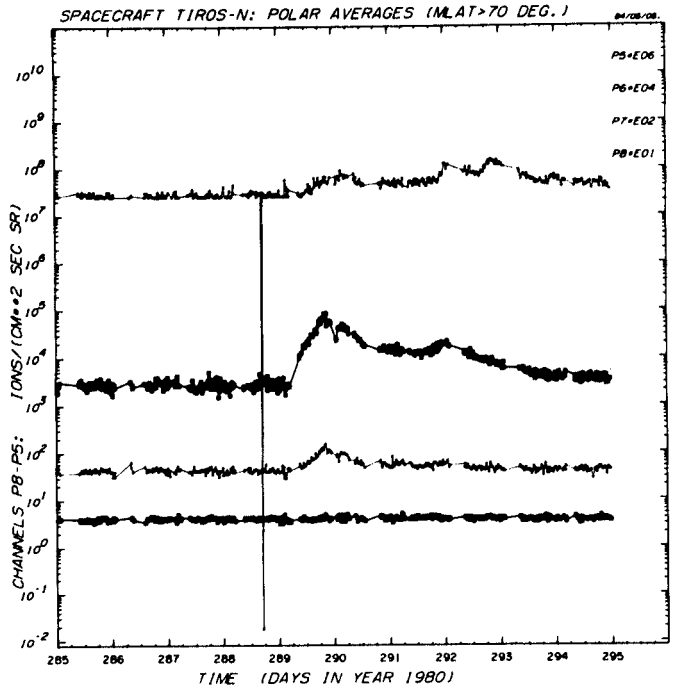


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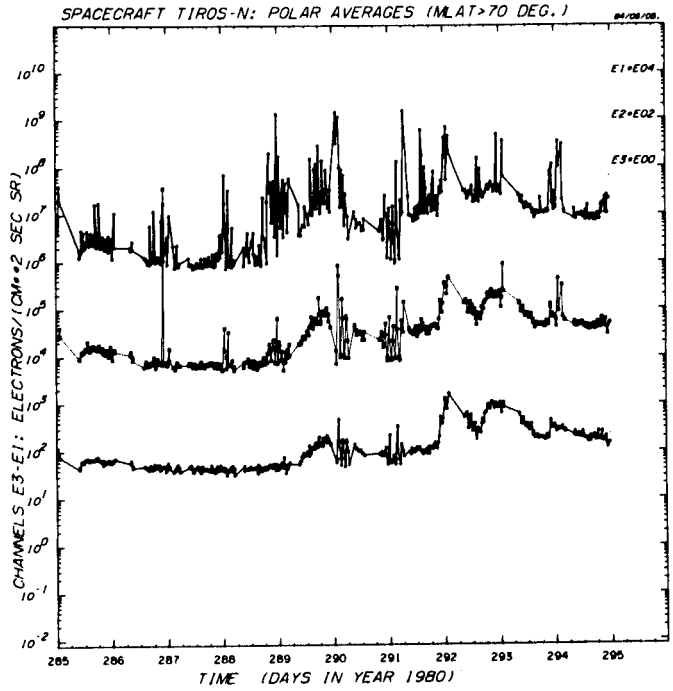
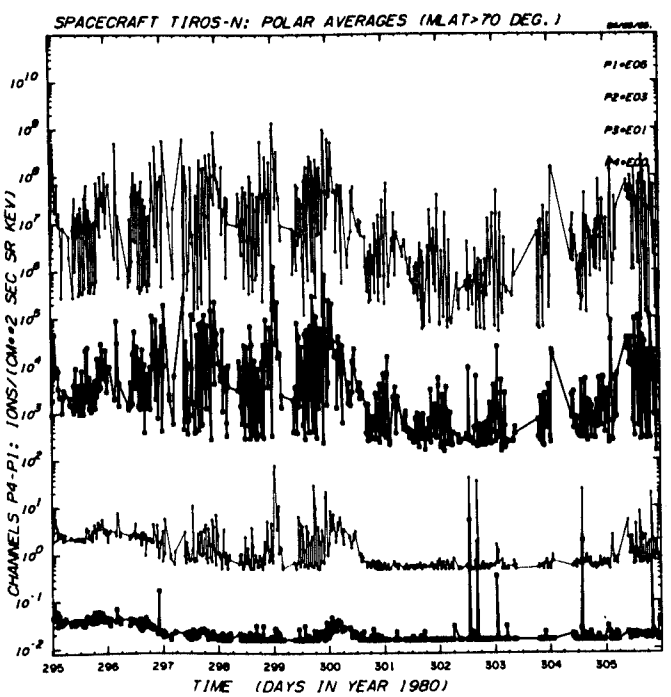
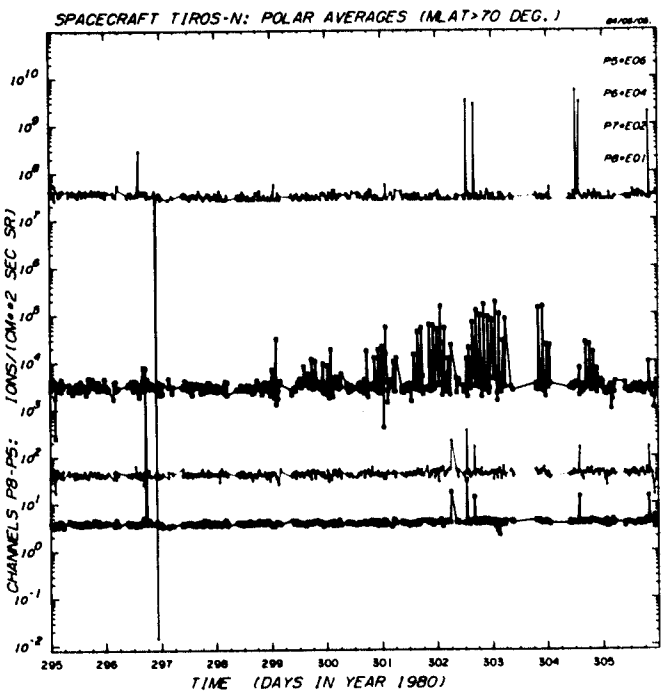



**October 11, 1980**

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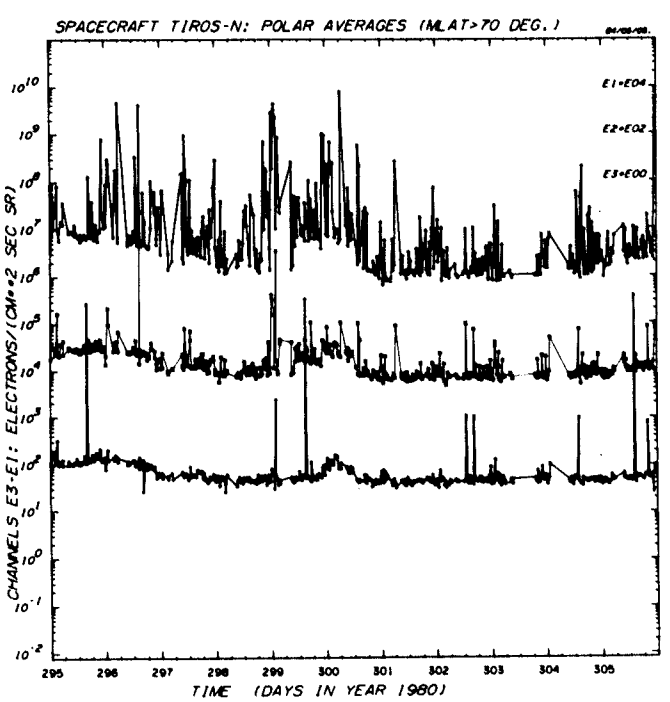
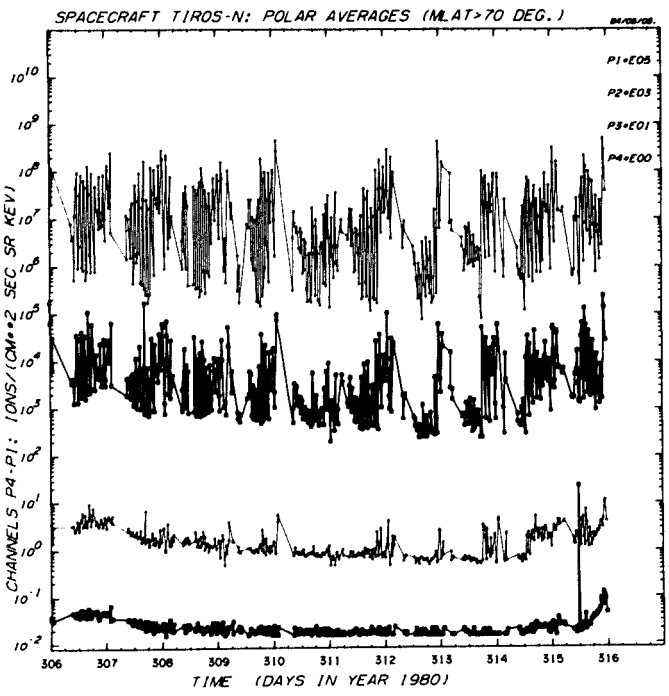
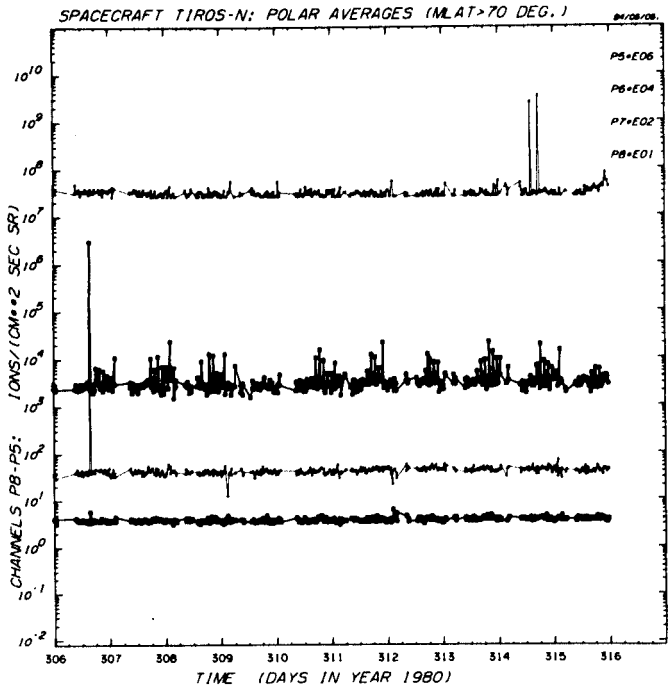



**October 21, 1980**

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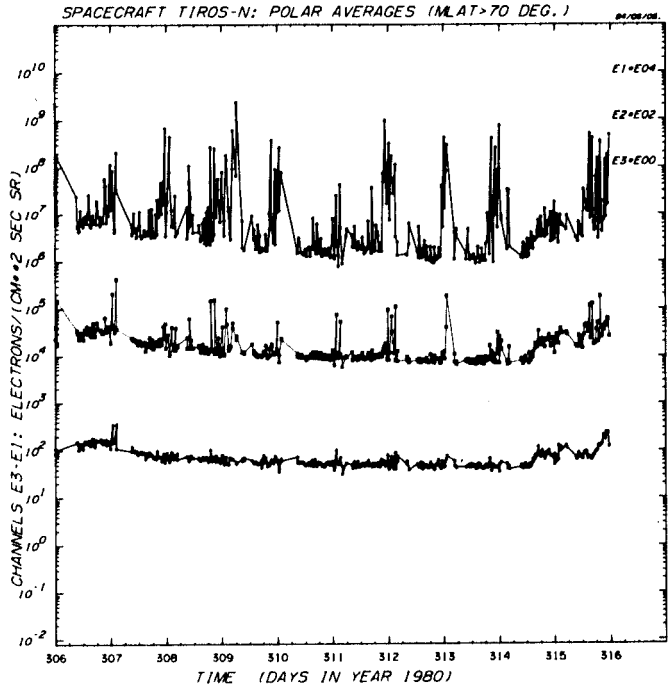
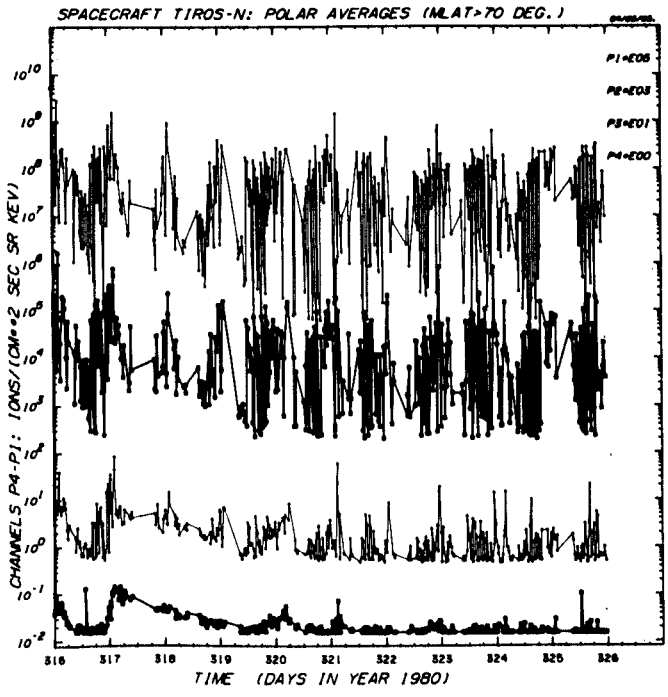
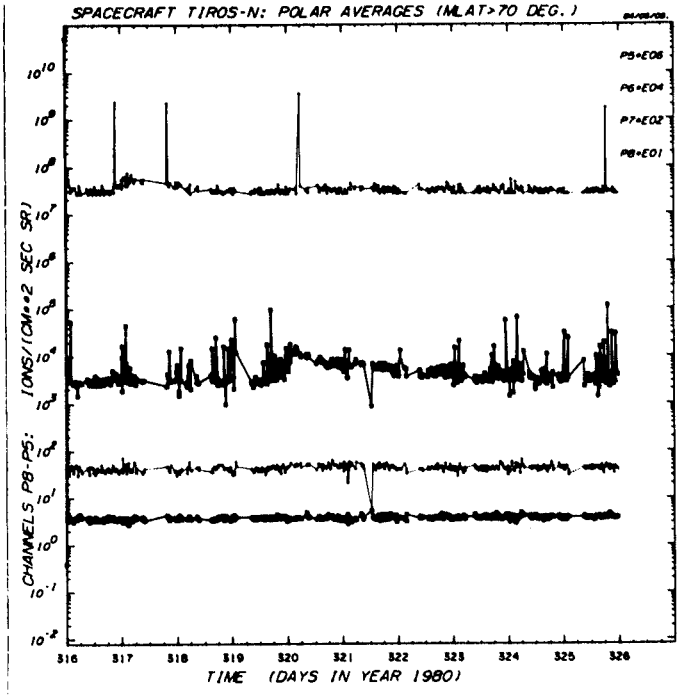



**November 1, 1980**

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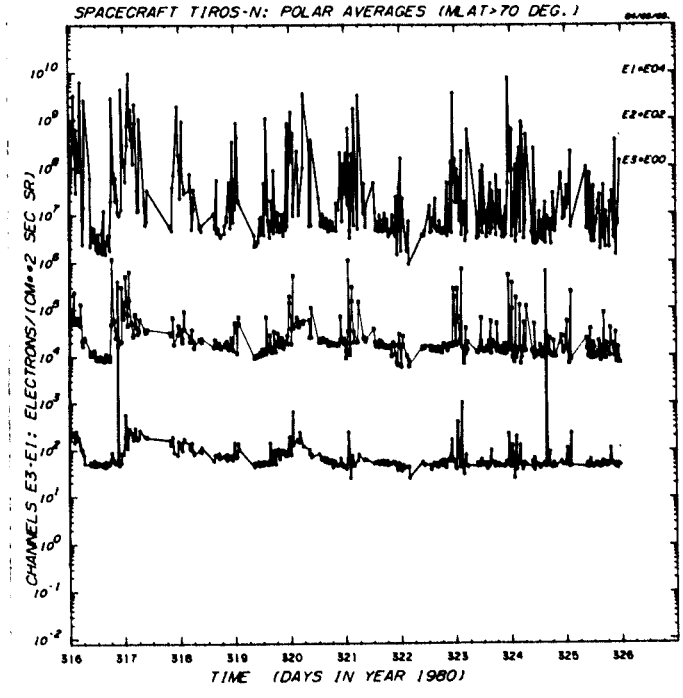


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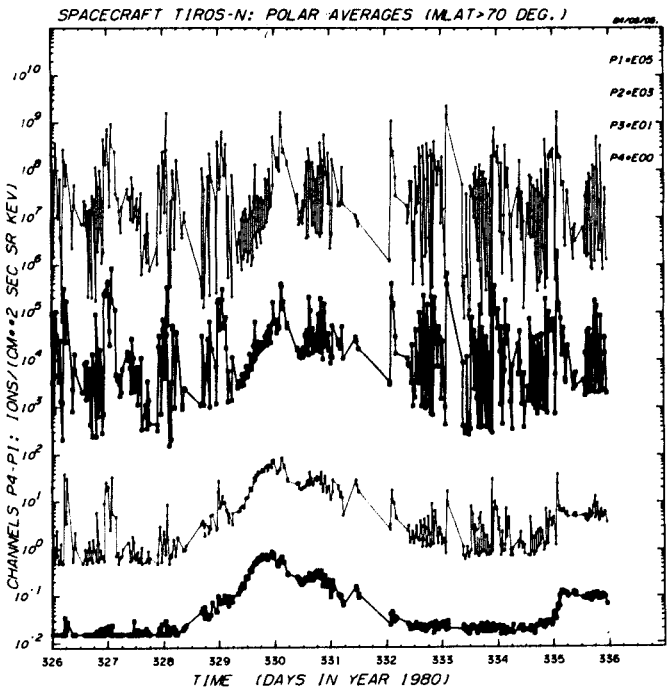


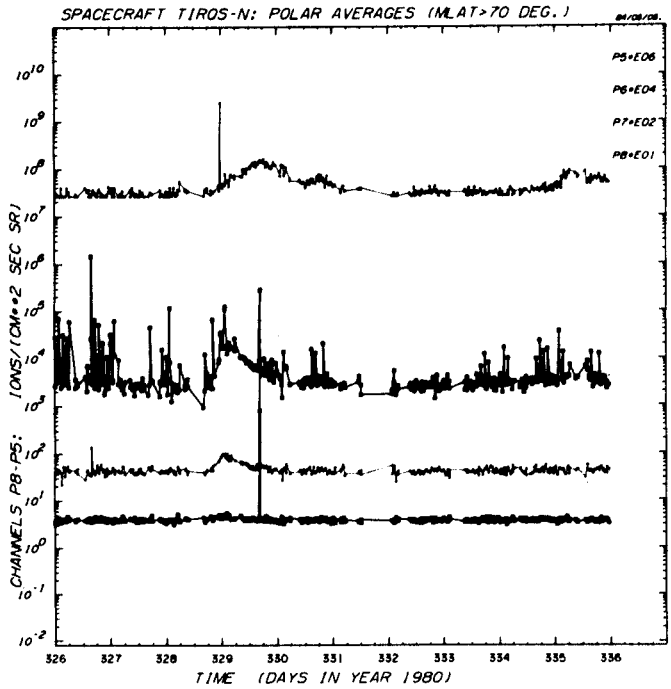


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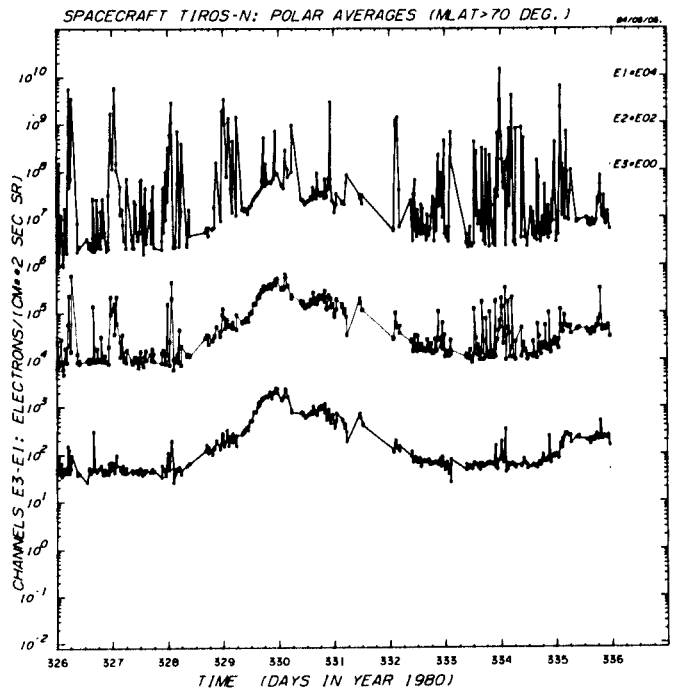
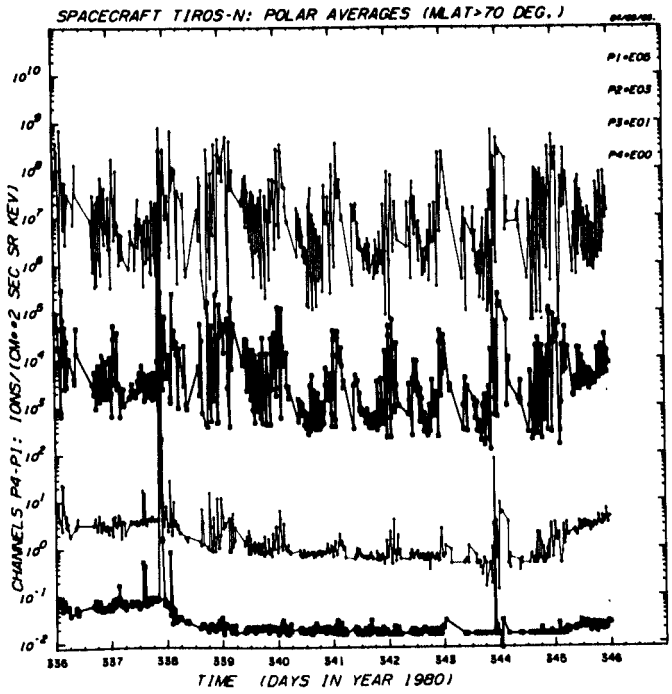
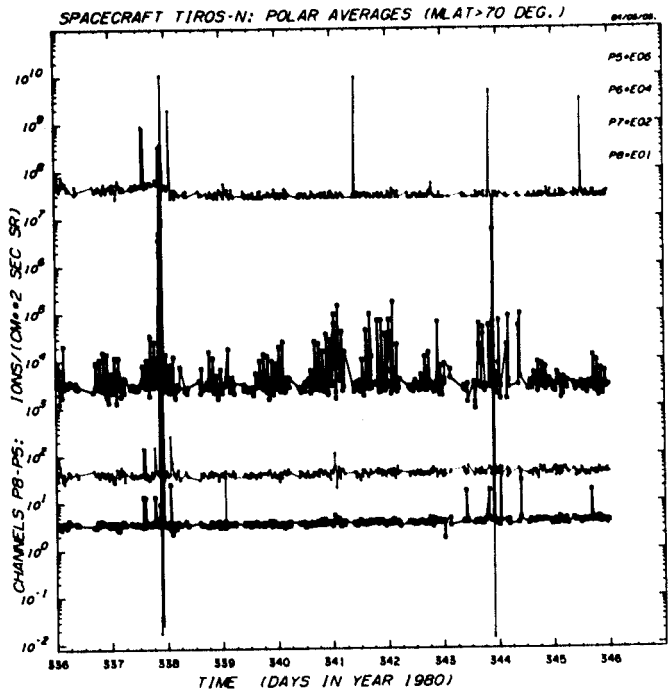



**November 21, 1980**

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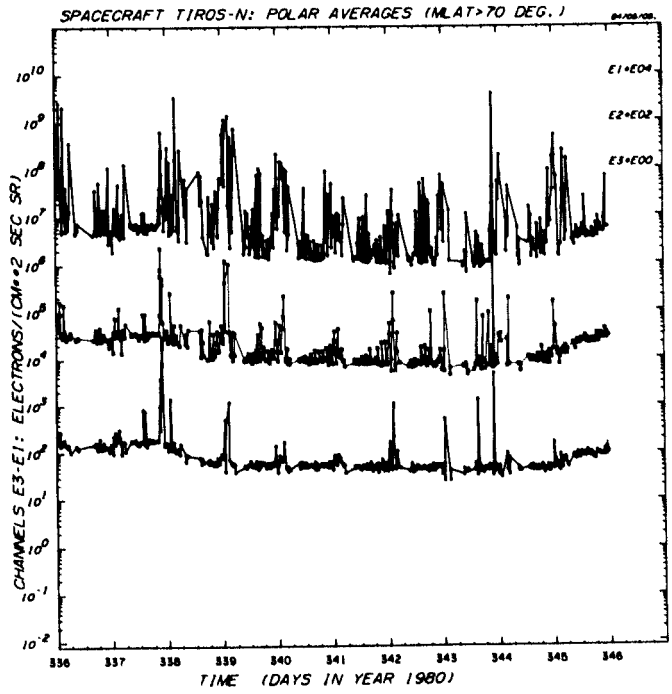

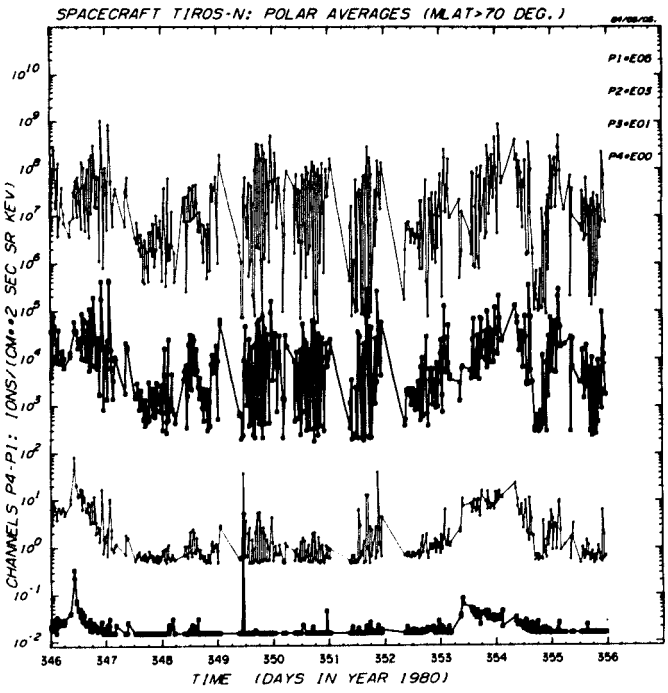


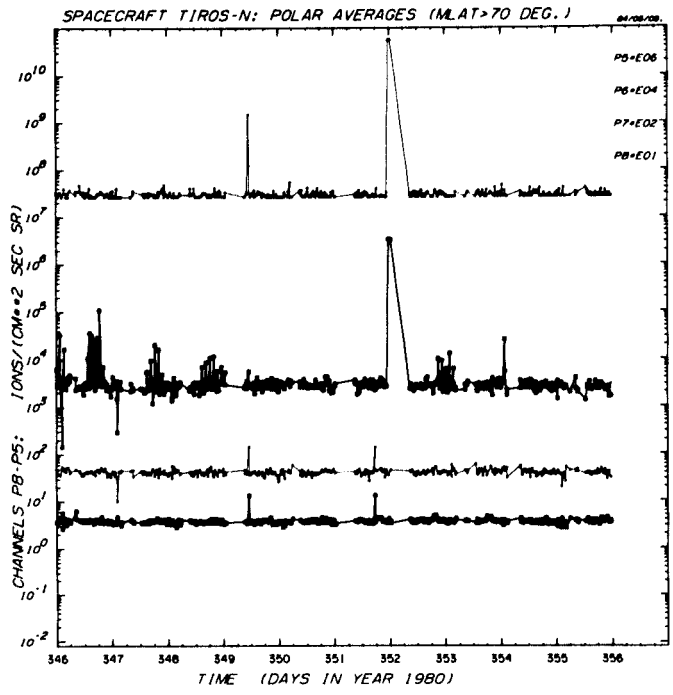


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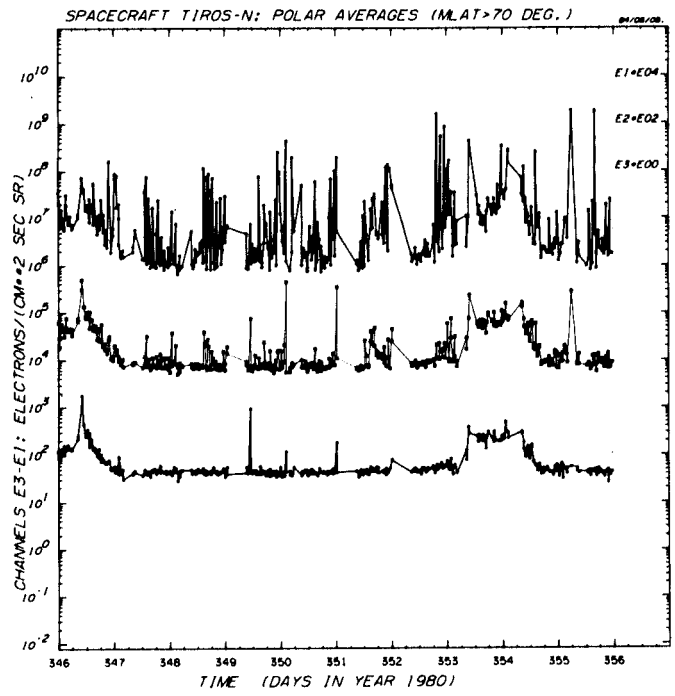
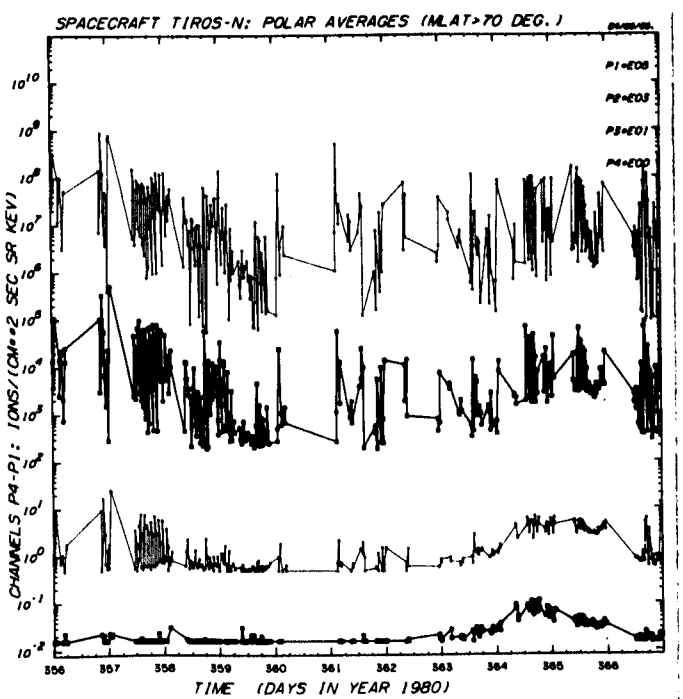
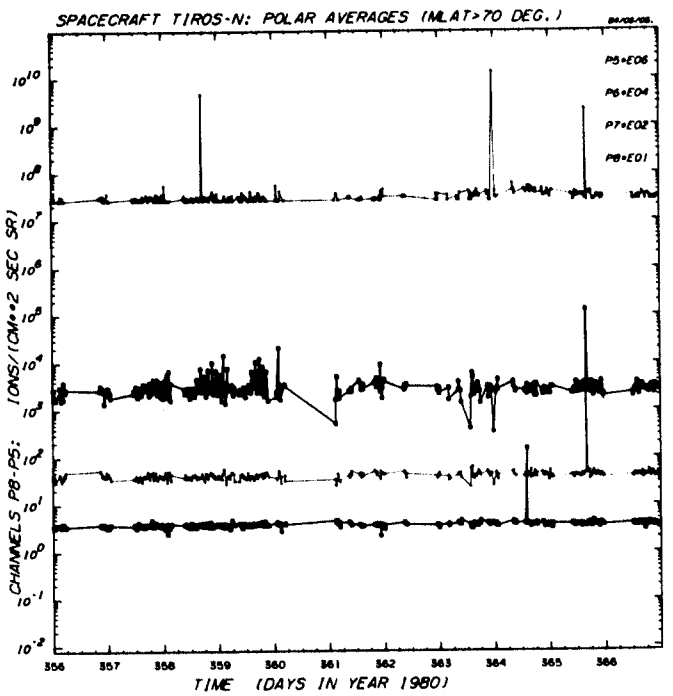



**December 11, 1980**

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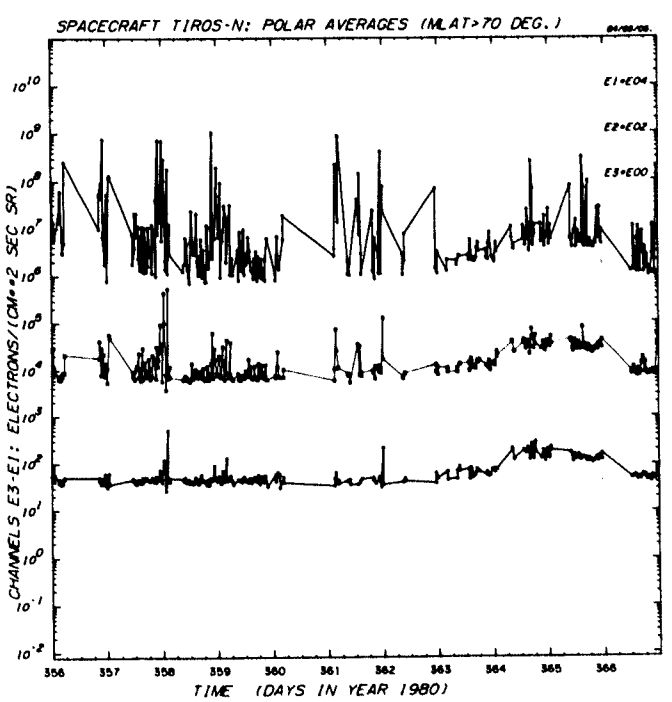


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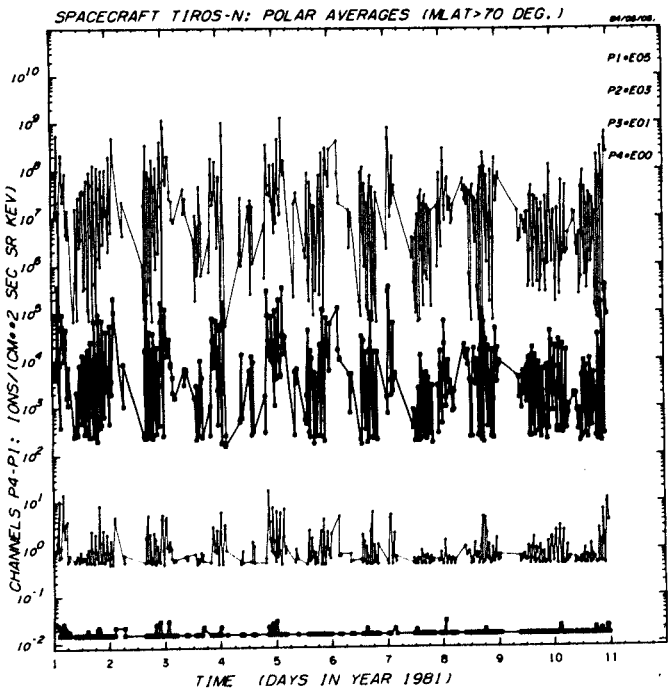


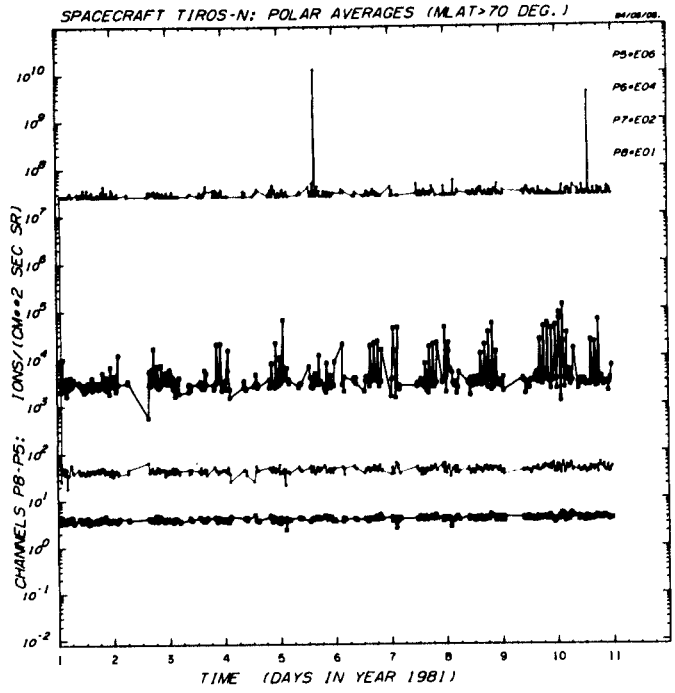


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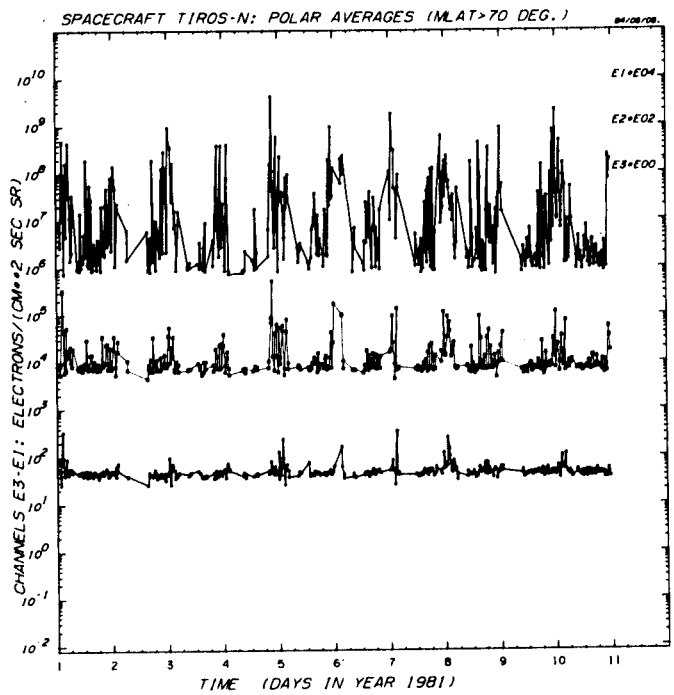
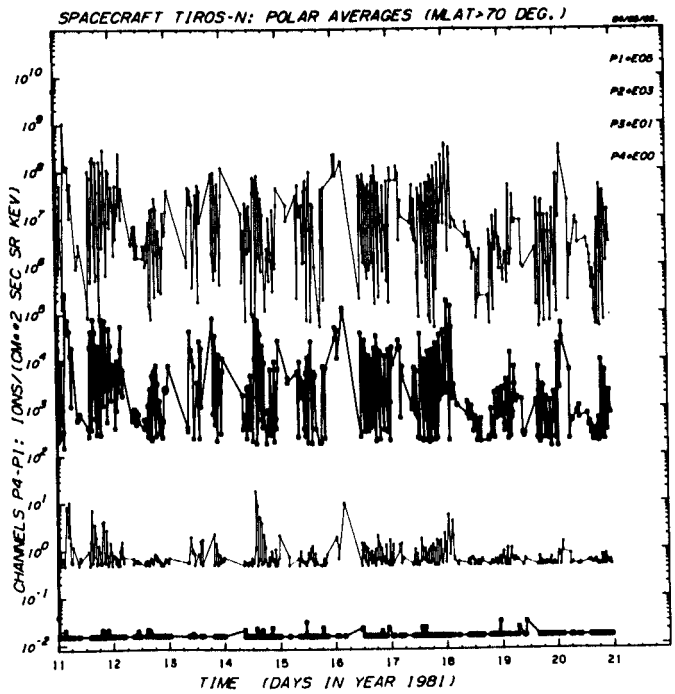
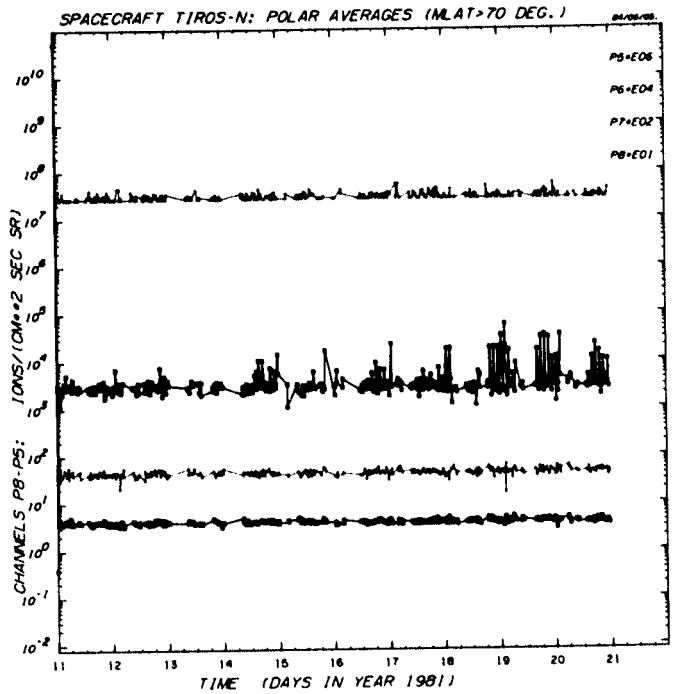



**January 1, 1981**

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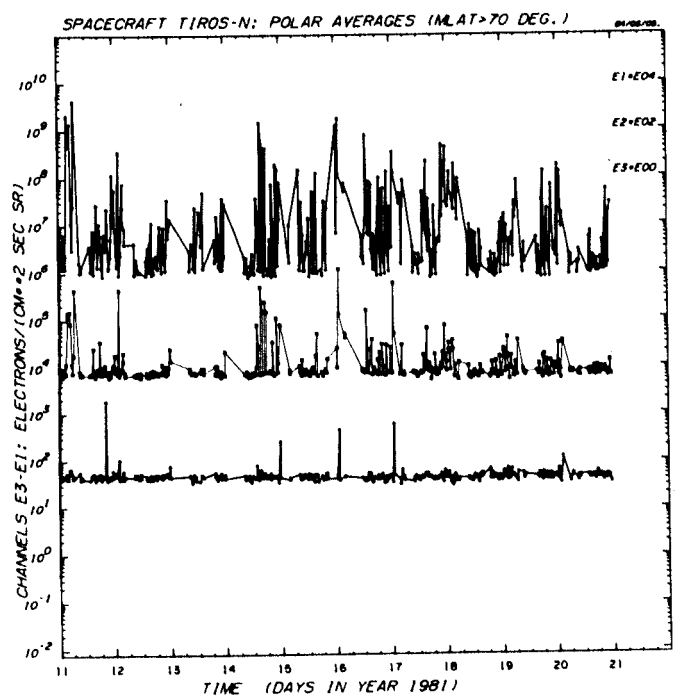


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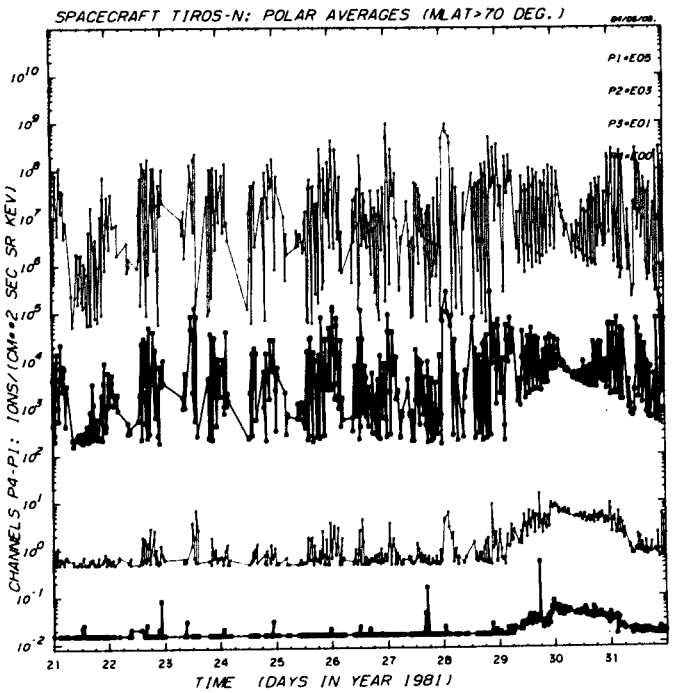


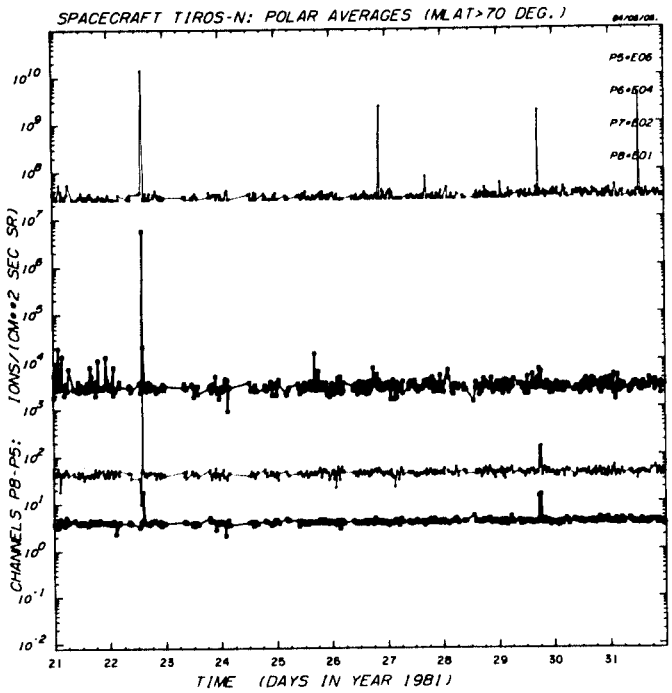


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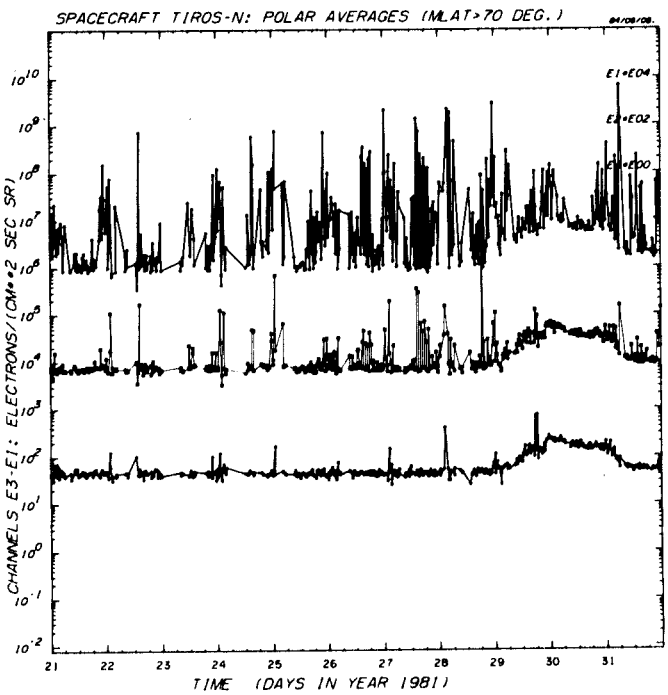


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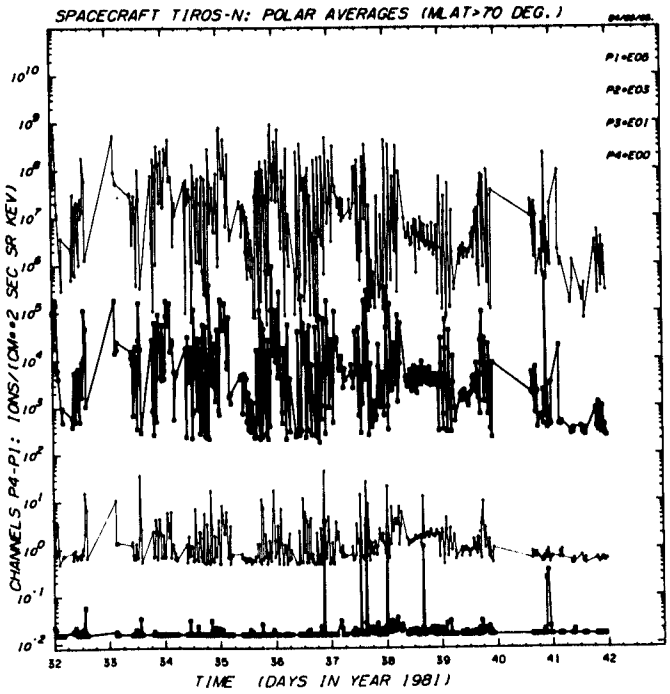


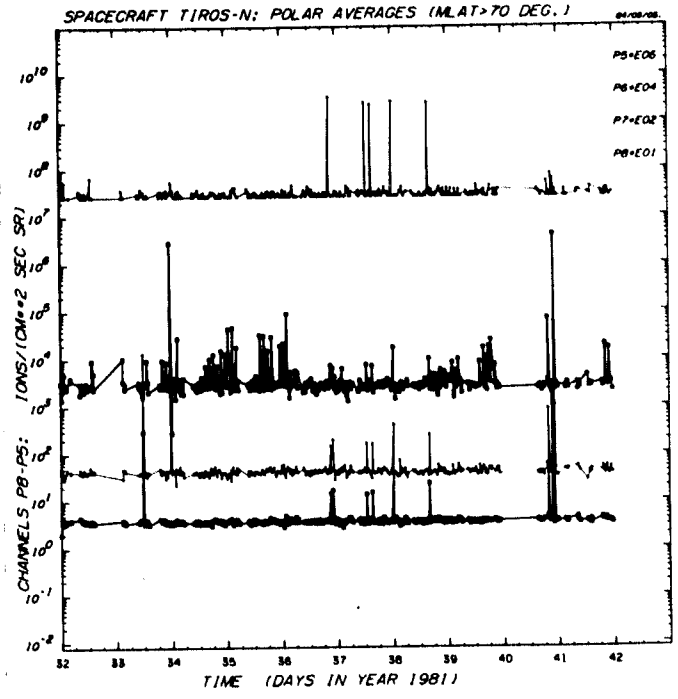


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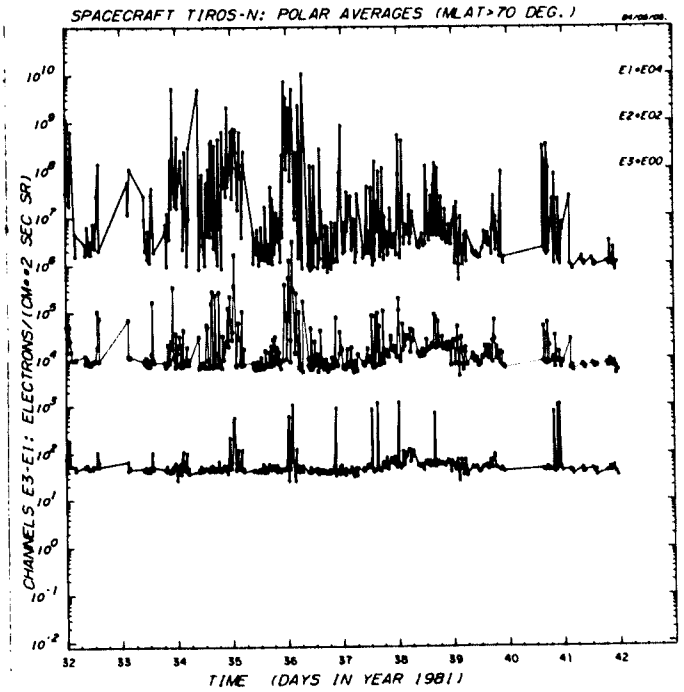


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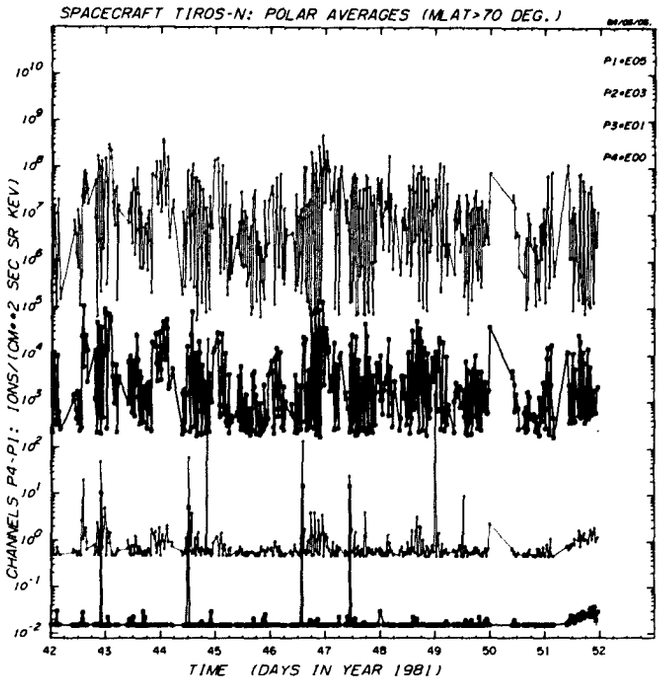


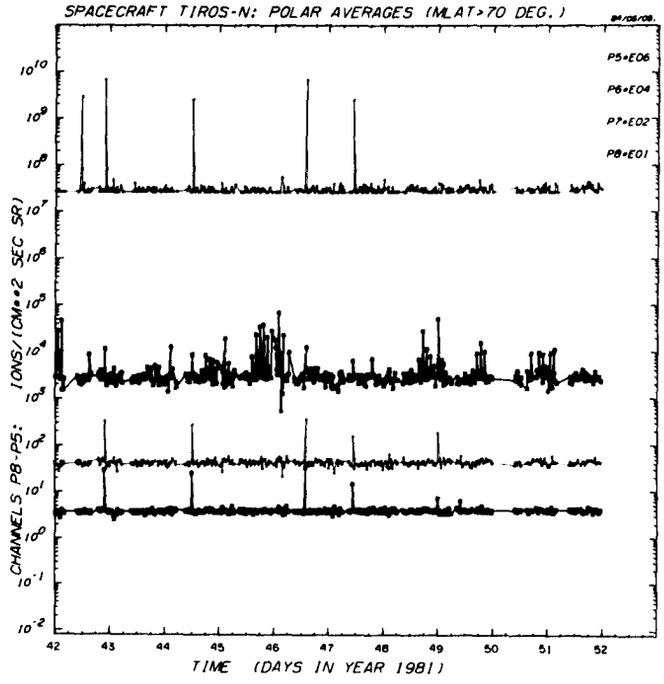


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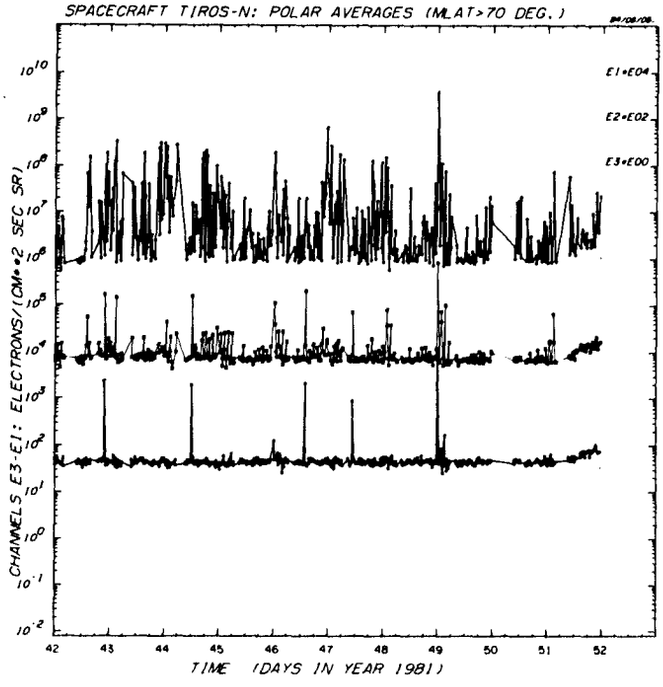


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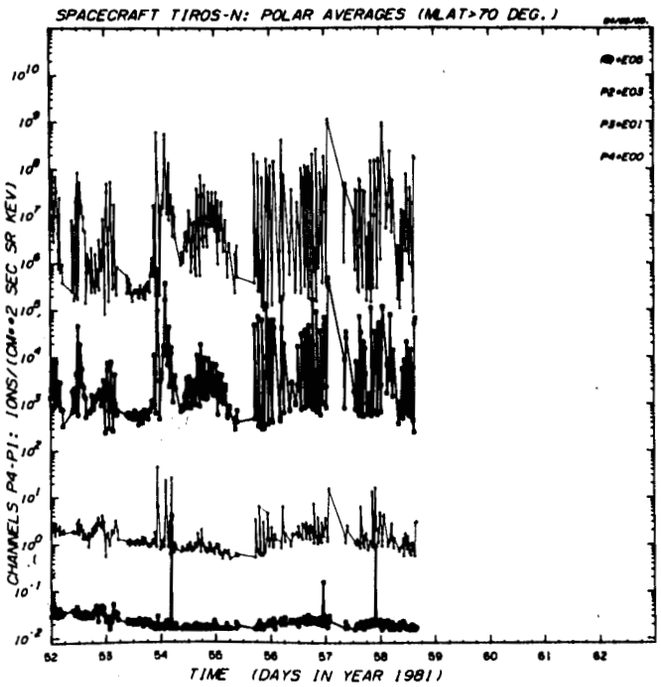


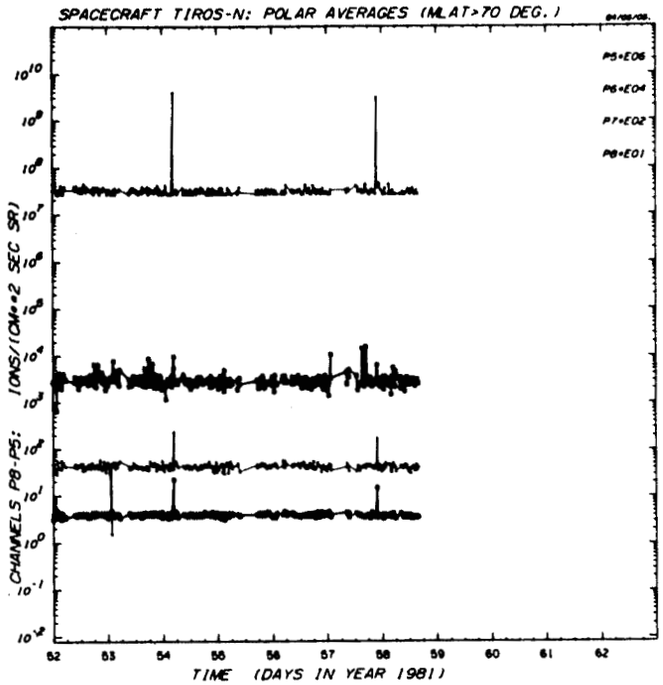


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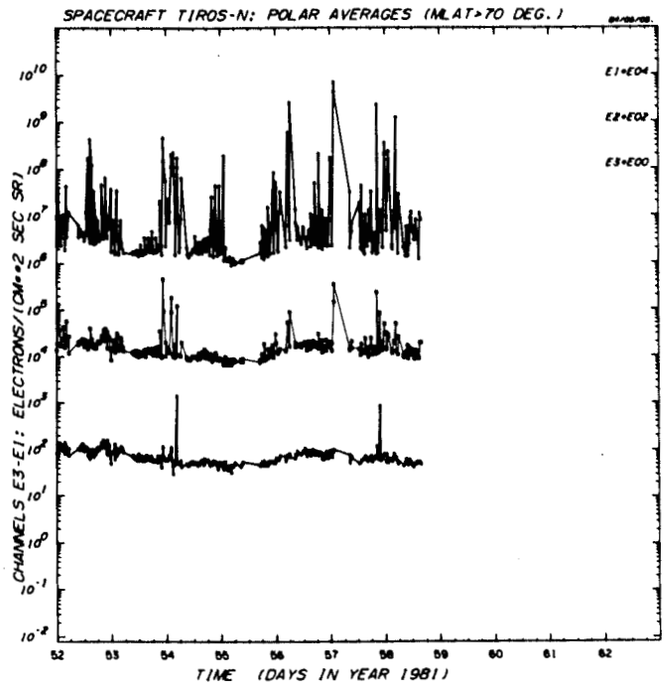


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