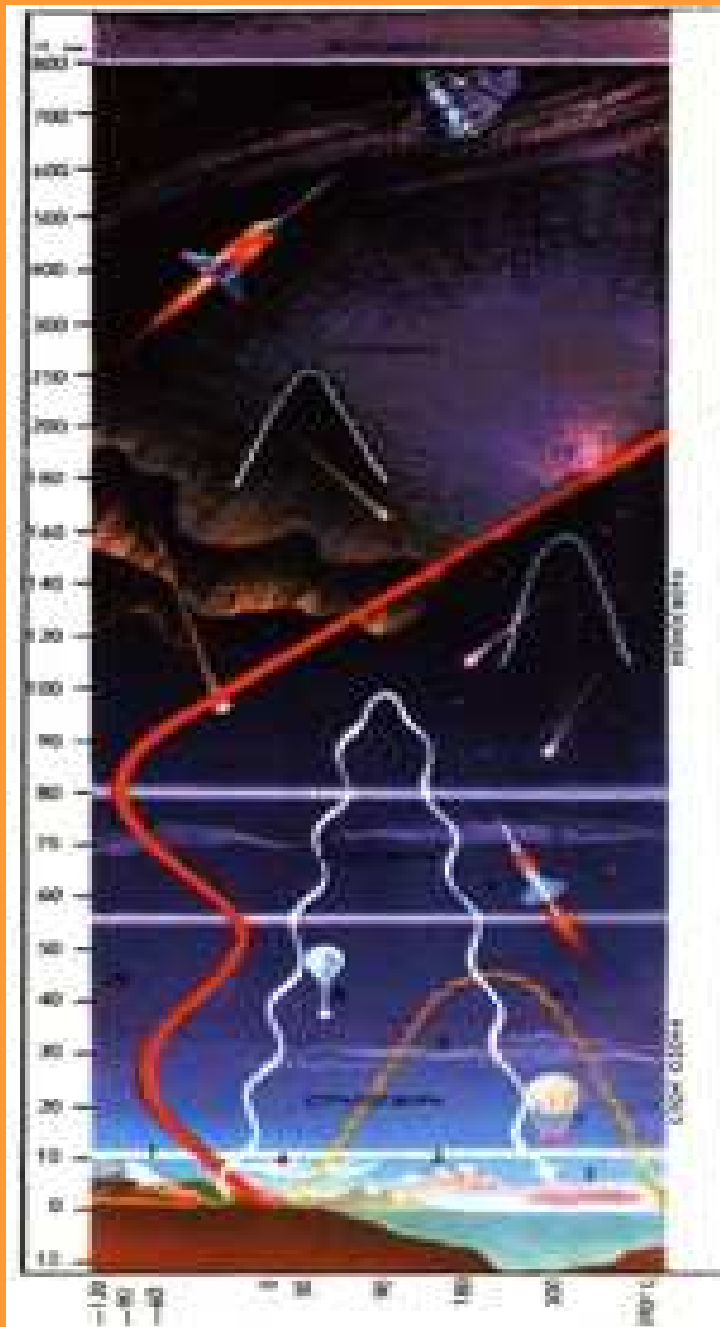


Ванина-Дарт Л.Б.
Северно-южная
асимметрия нижней
ионосферы

(ИКИ РАН)

Москва, 2011

**«СОВРЕМЕННЫЕ ПРОБЛЕМЫ
ДИСТАНЦИОННОГО
ЗОНДИРОВАНИЯ ЗЕМЛИ ИЗ
КОСМОСА»**



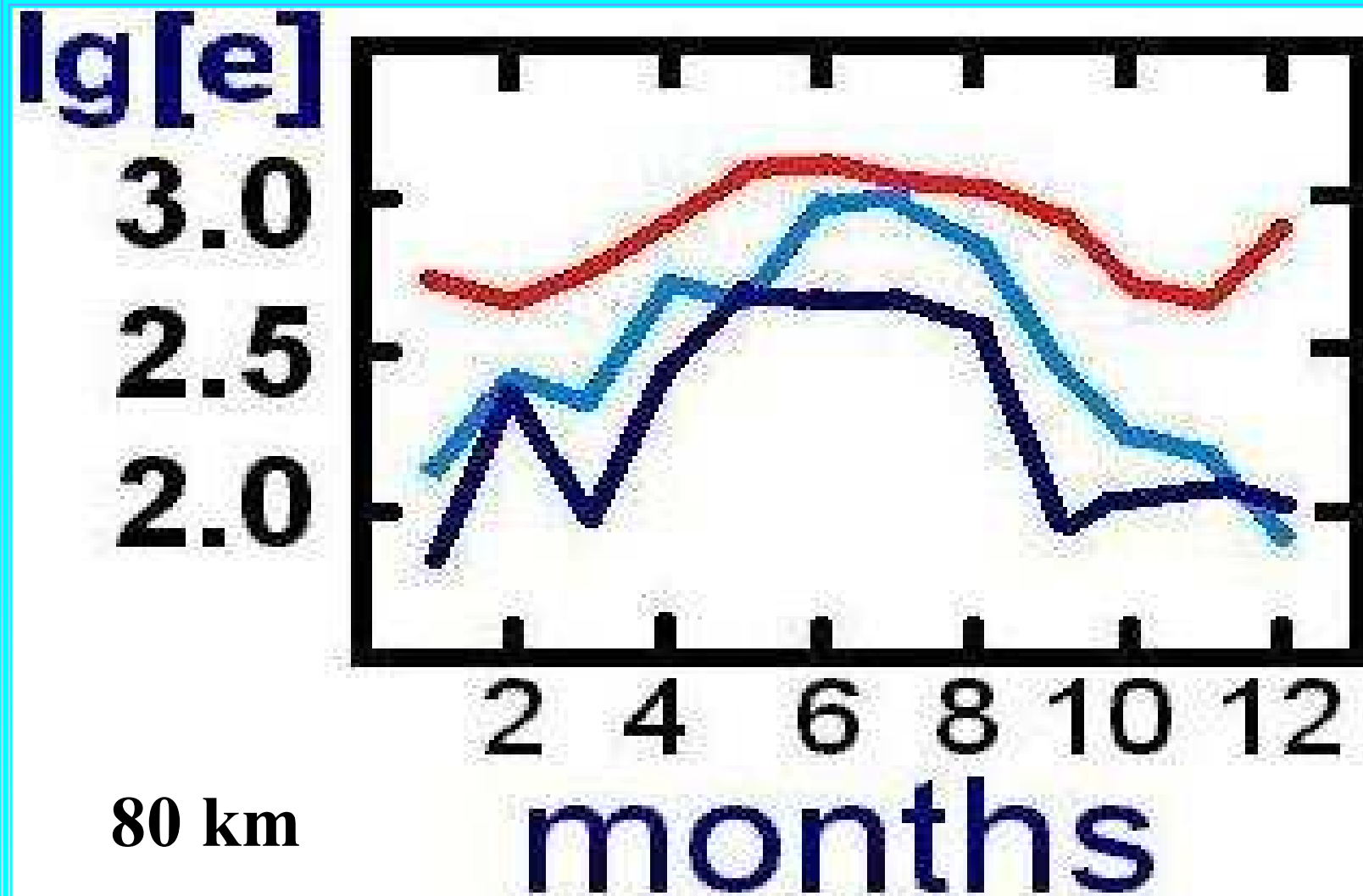
Результатом поступления солнечного ветра в плазменную мантию при пересоединении межпланетного и геомагнитного полей являются полярные электроны. Зависимость интенсивности полярных электронов от ориентации межпланетного магнитного поля (ММП) проявляется в северно-южной асимметрии потоков электронов в магнитном хвосте. Для солнечных протонов также типична асимметрия, связанная с ориентацией ММП. Асимметрия интенсивности падающих заряженных частиц должна проявляться в нижней ионосфере.

Целью данной работы является обобщение выявленных ранее различий практически одновременного высотного распределения электронной концентрации высокоширотной ионосферной области D обоих полушарий в магнито-сопряженных пунктах в период равноденствия, когда сезонные различия должны быть минимальными. Основой анализа являются данные ракетного зондирования на ст. Молодежная и о. Хейса. Также привлекались данные наземных ионосферных станций обоих полушарий.

The behaviour of the polar D-region in the Arctic and Antarctic is studied on the basis of the database of the electron concentration measurements onboard the M-100B meteorological rockets launched at the Heiss Island and Molodezhnaya sites. All the measurements have been conducted by the same method.

- **Molodezhnaya**
- *geographical coordinates*
67,7° S and 45,9° E.
- *revised geomagnetic coordinates*
69,2° S and 81,4° E

- **Heiss Island**
- *geographical coordinates*
80,5° N and 58,0° E
- *revised geomagnetic coordinates*
74,3° N and 144,1° E



Averaged over a month values of $[e]$ (in \lg) at Molodezhnaya (**red line**) and Heiss Island (**blue** for the auroral oval and **dark blue** for the polar cap)

6/09/89

F=288, Ap=12,

$\Sigma Kp=21, Fe=-3\%$

Xray – M3

15.05 UT

$\chi=88^\circ, le=2$

$I_p=50\text{cm}^{-2}\text{c}^{-1}$

14.07 UT

$\chi=91^\circ, le=2$

$I_{P(E>5\text{M}\text{\AA})} =$
 $50\text{cm}^{-2}\text{c}^{-1}$

20/09/89

F=173, Ap=6,

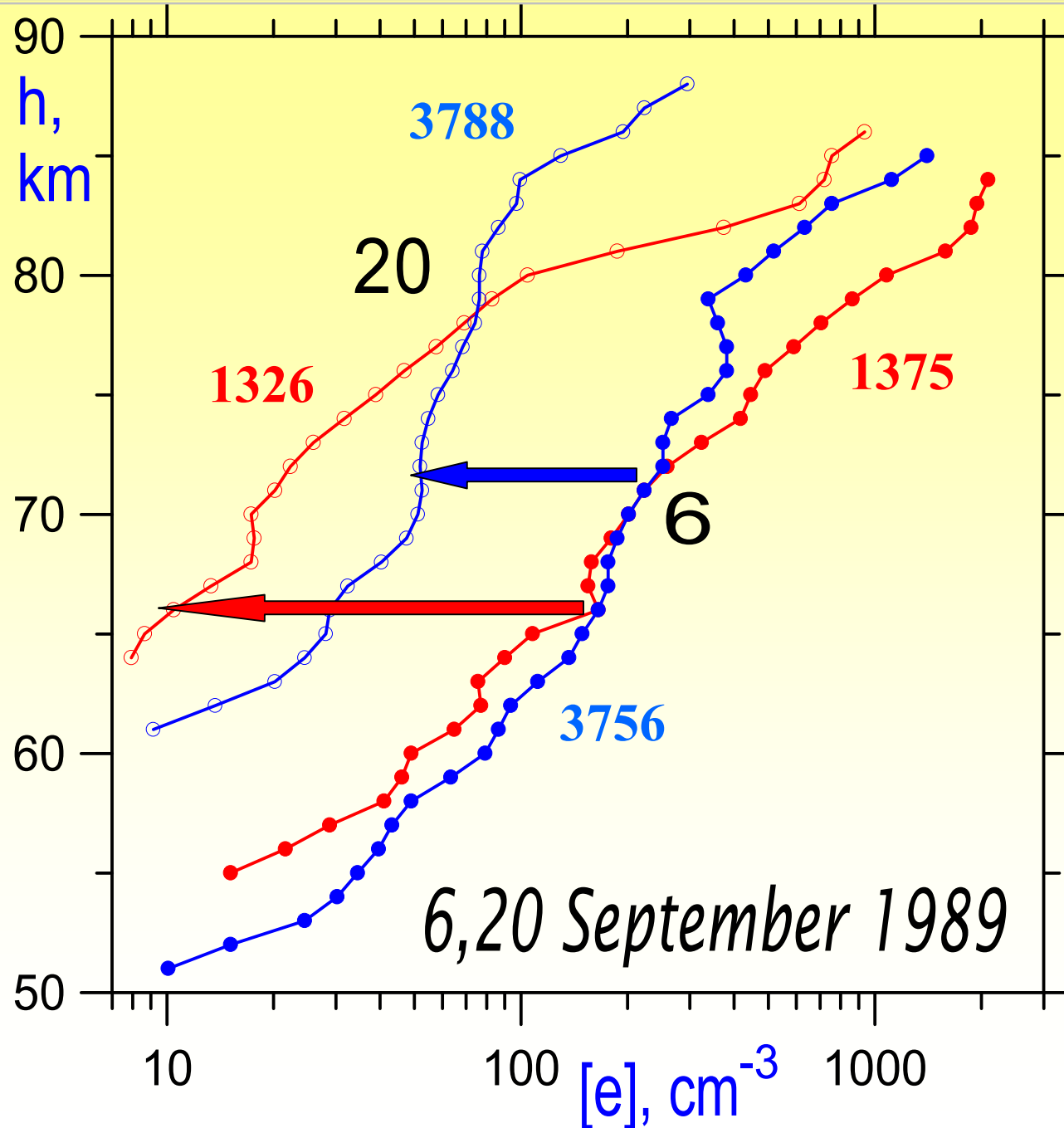
$\Sigma Kp=12, Fe=-6\%$

15.05 UT

$\chi=92^\circ, le=2$

14.07 UT

$\chi=88^\circ, le=2$



THULE

о.Хейса



SANAE

Молодежная

TERRE ADELIE

7/09/88

F=145, Ap=5,

$\Sigma Kp=9$

14.05 UT

$\chi=84^\circ$, $le=2$

14.20 UT

$\chi=95^\circ$, $le=2$

14/09/88

F=130, Ap=11,

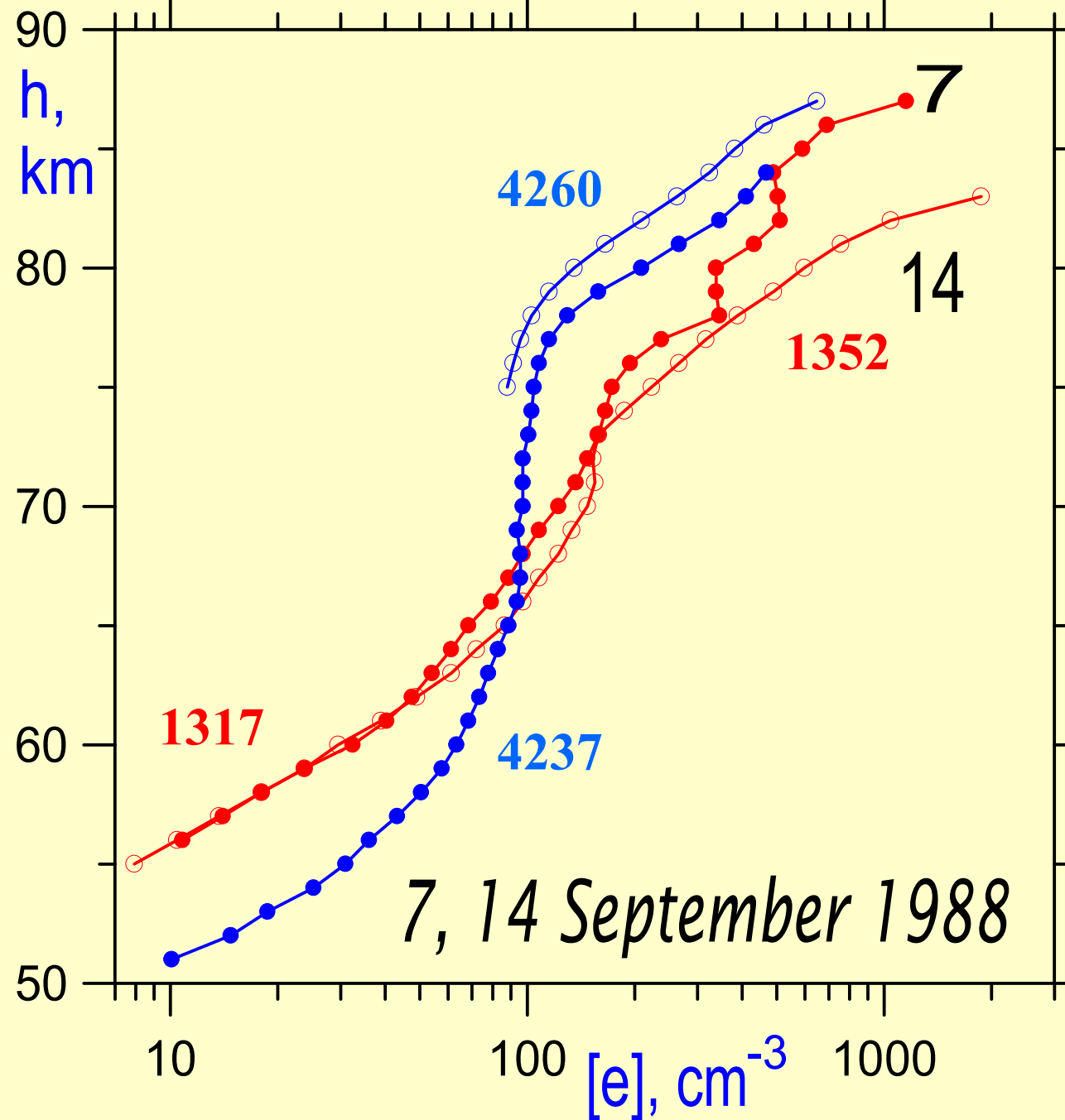
$\Sigma Kp=20, Fe=2\%$

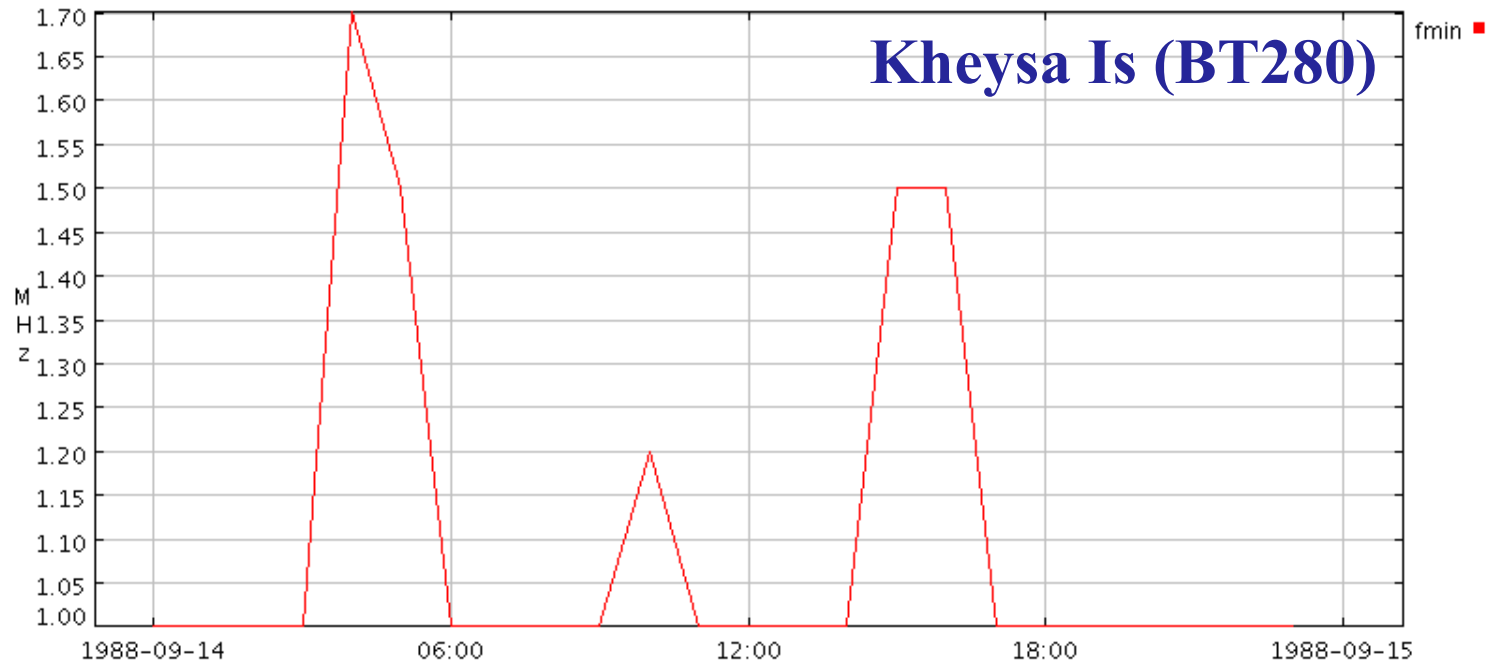
15.05 UT

$\chi=87^\circ$, $le=2$

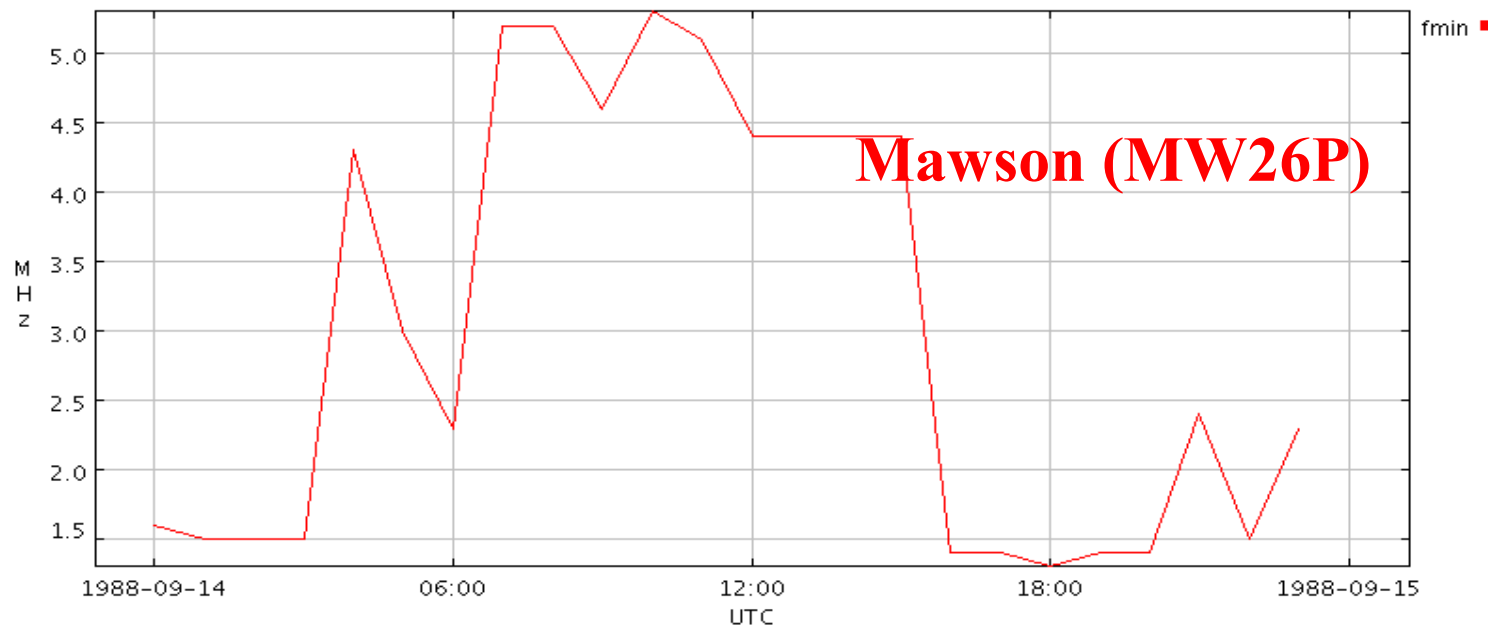
14.07 UT

$\chi=89^\circ$, $le=2$

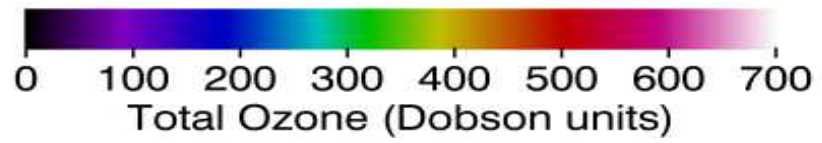




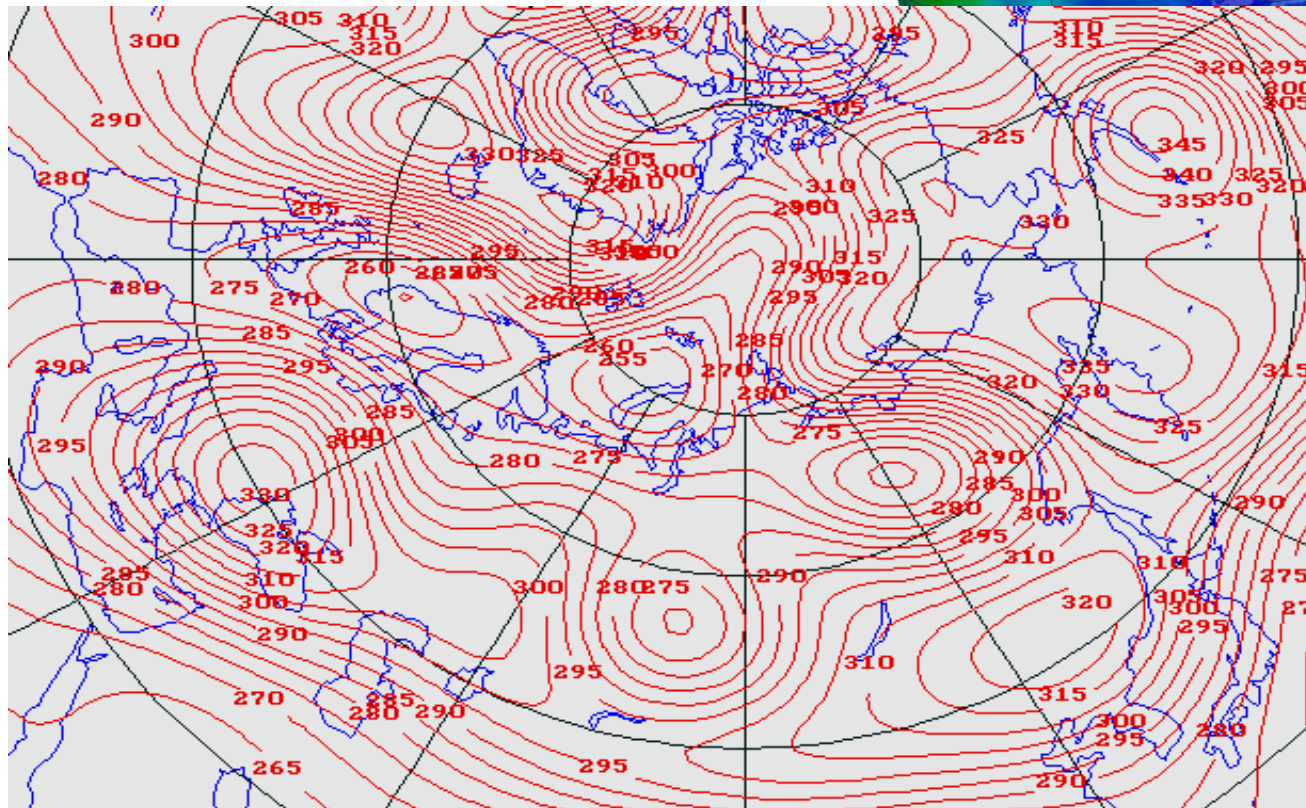
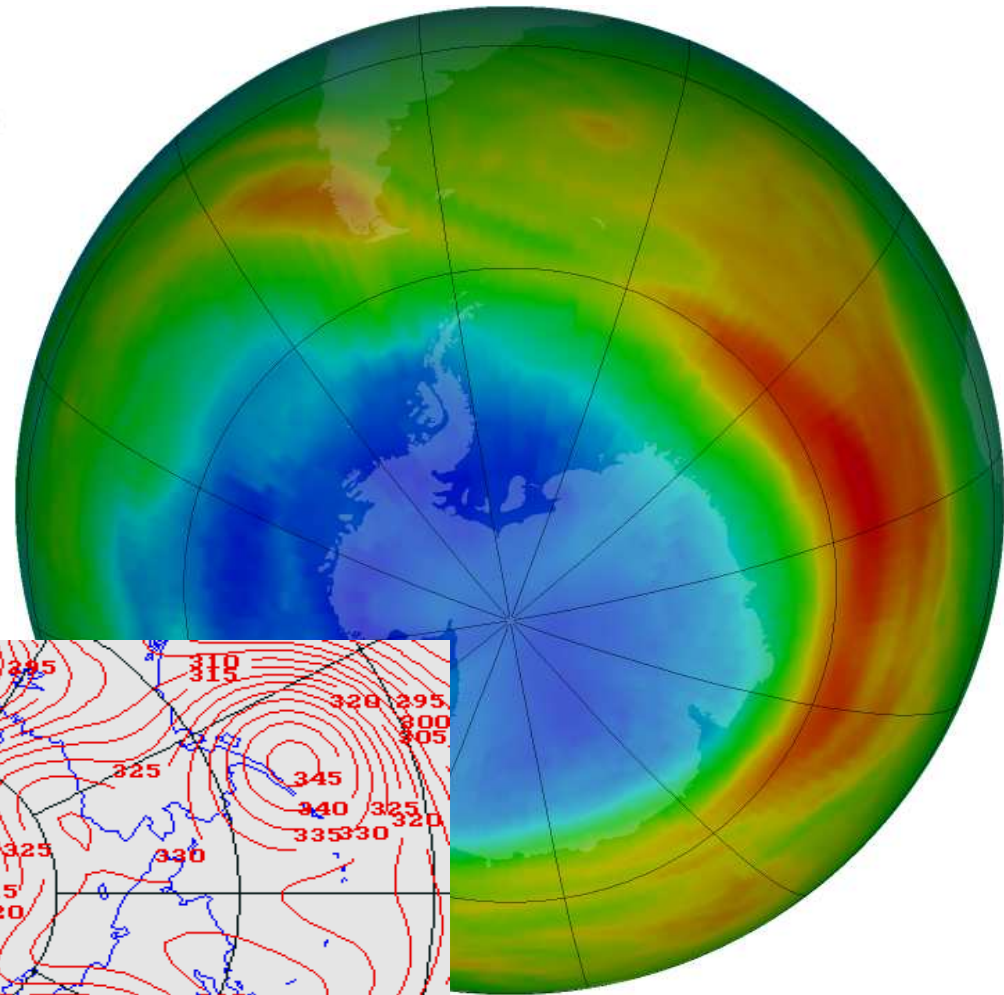
14/09/88



**-67.6 /
62.9**



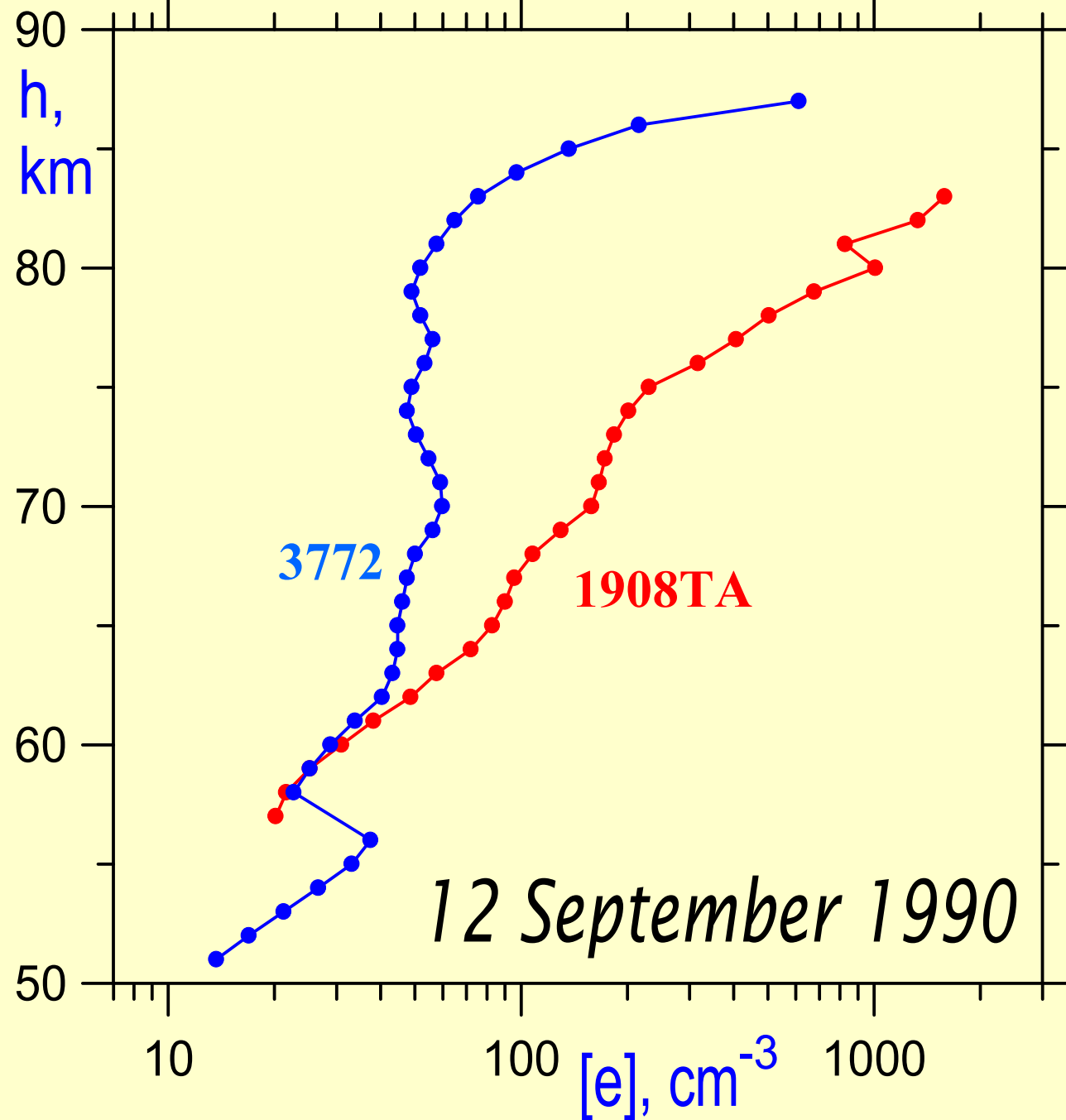
07 September 1988

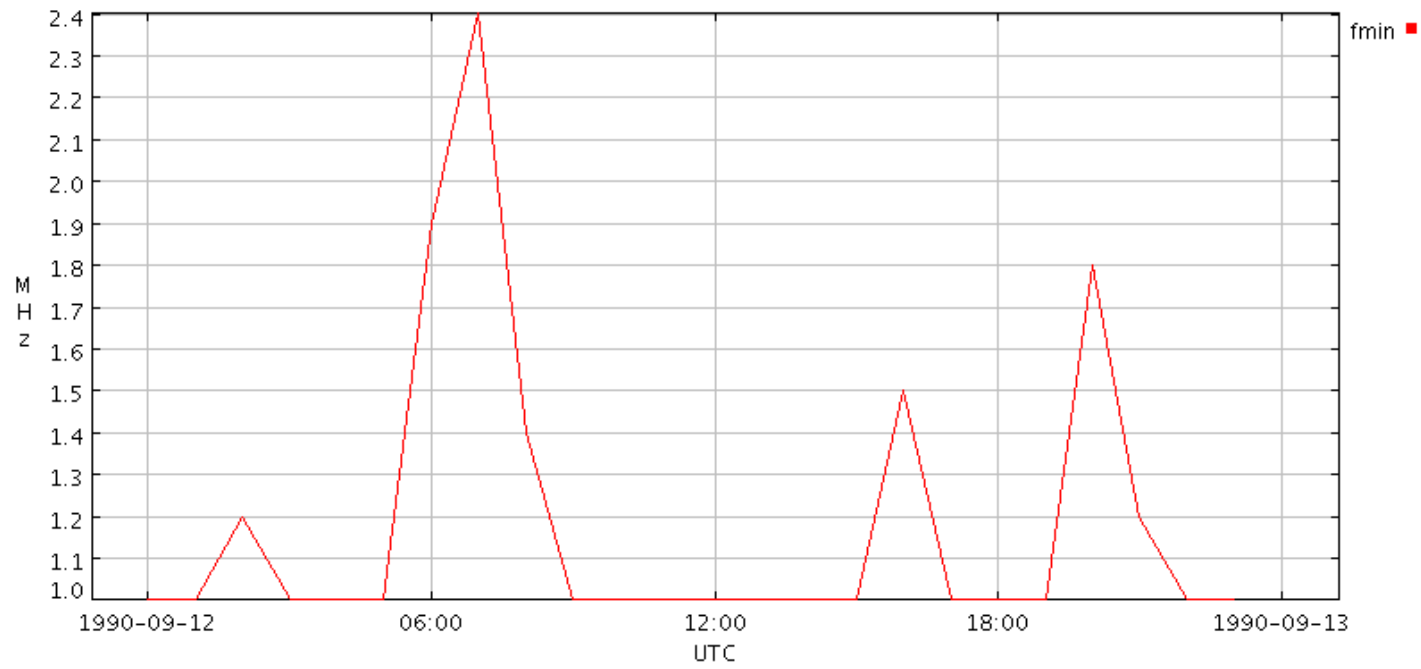


**F=193,
Ap=19,
ΣKp=27
Xray – M1**

**15.05 UT
 $\chi=89^\circ$,
le=2**

**14.07 UT
 $\chi=90^\circ$,
le=2**





Kheysa Is (BT280)

11/09/89
F=299, Ap=3,
 $\Sigma Kp=6, Fe=-2\%$

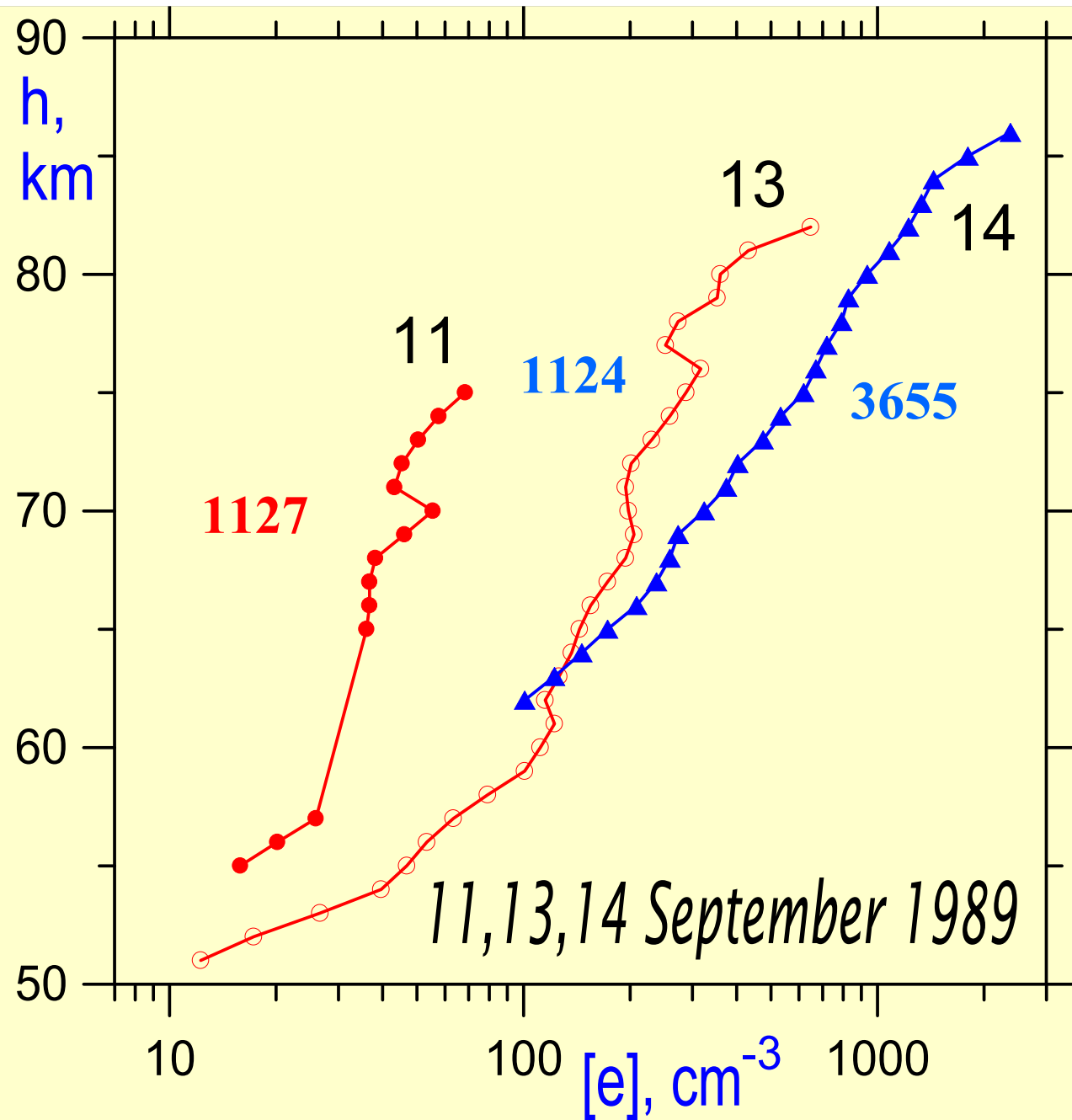
14.07 UT
 $\chi=90^\circ, I_e=2$

13/09/89
F=249, Ap=9,
 $\Sigma Kp=18, Fe=-2\%$

Xray – M4
14.07 UT
 $\chi=90^\circ, I_e=2,$
 $I_p=400 \text{ cm}^{-2} \text{ c}^{-1}$

14/09/89
F=245, Ap=7,
 $\Sigma Kp=14, Fe=-1\%$

Xray – M2
16.05 UT
 $\chi=92^\circ, I_e=3,$
 $I_p=100 \text{ cm}^{-2} \text{ c}^{-1}$



F=156,
Ap=71,
 $\Sigma Kp=45$

15.05
UT

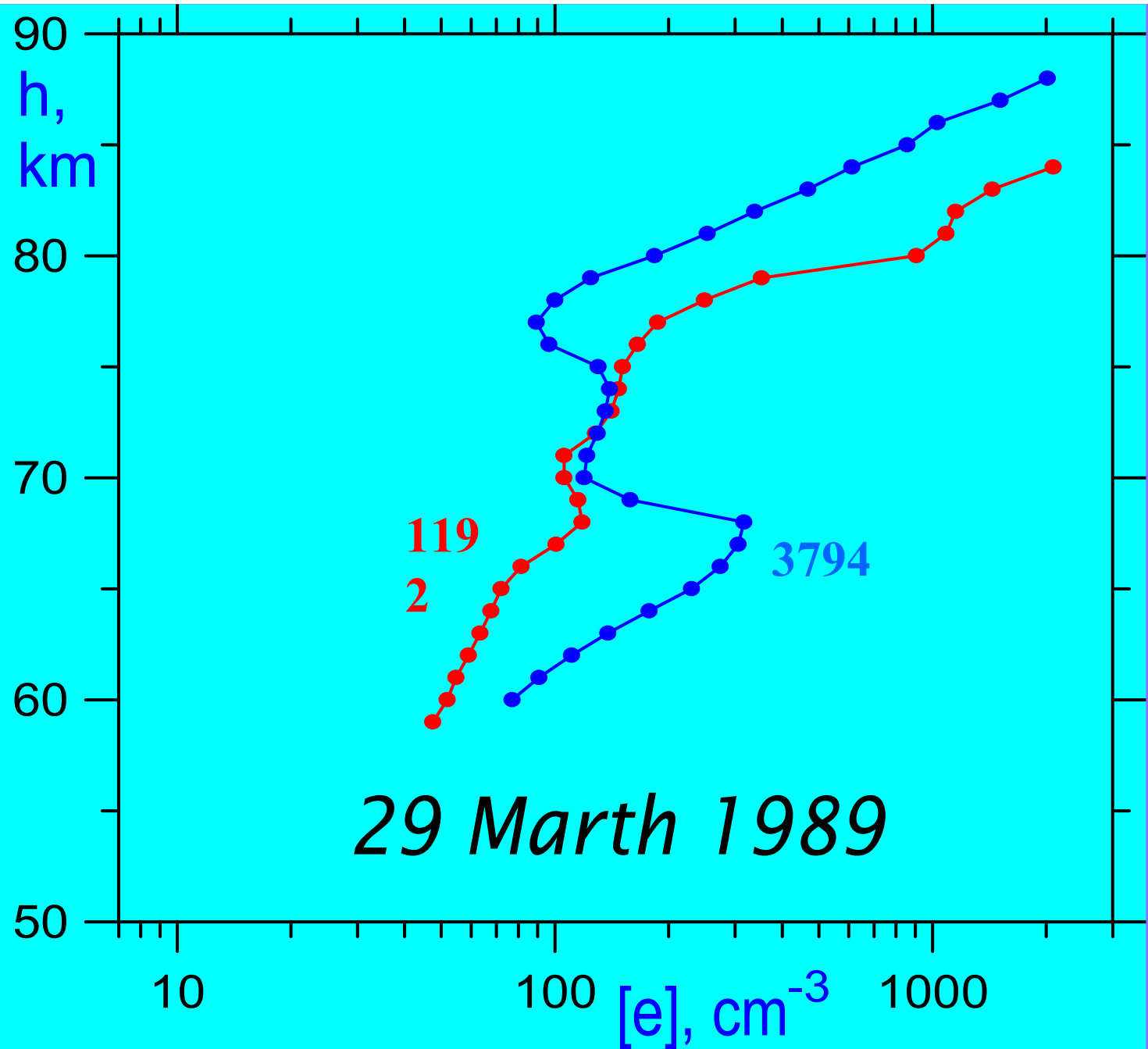
$\chi=89^\circ$,
le=3

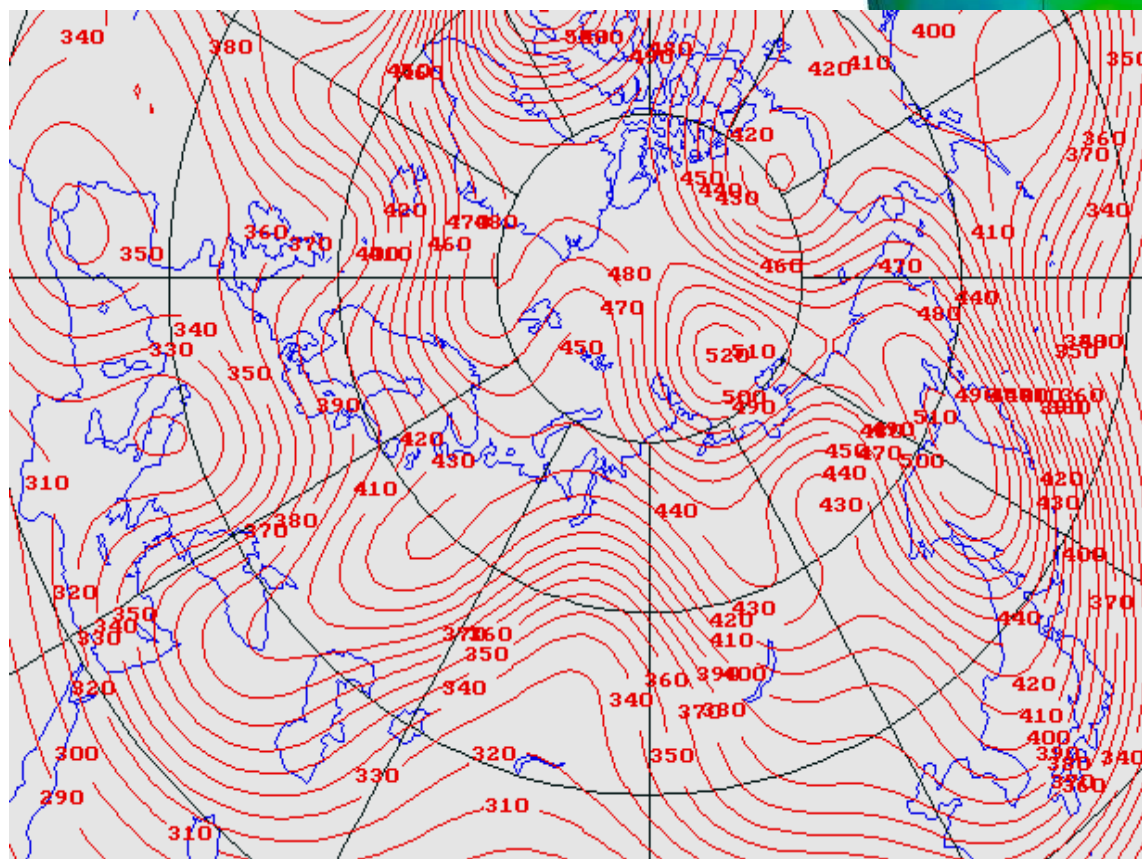
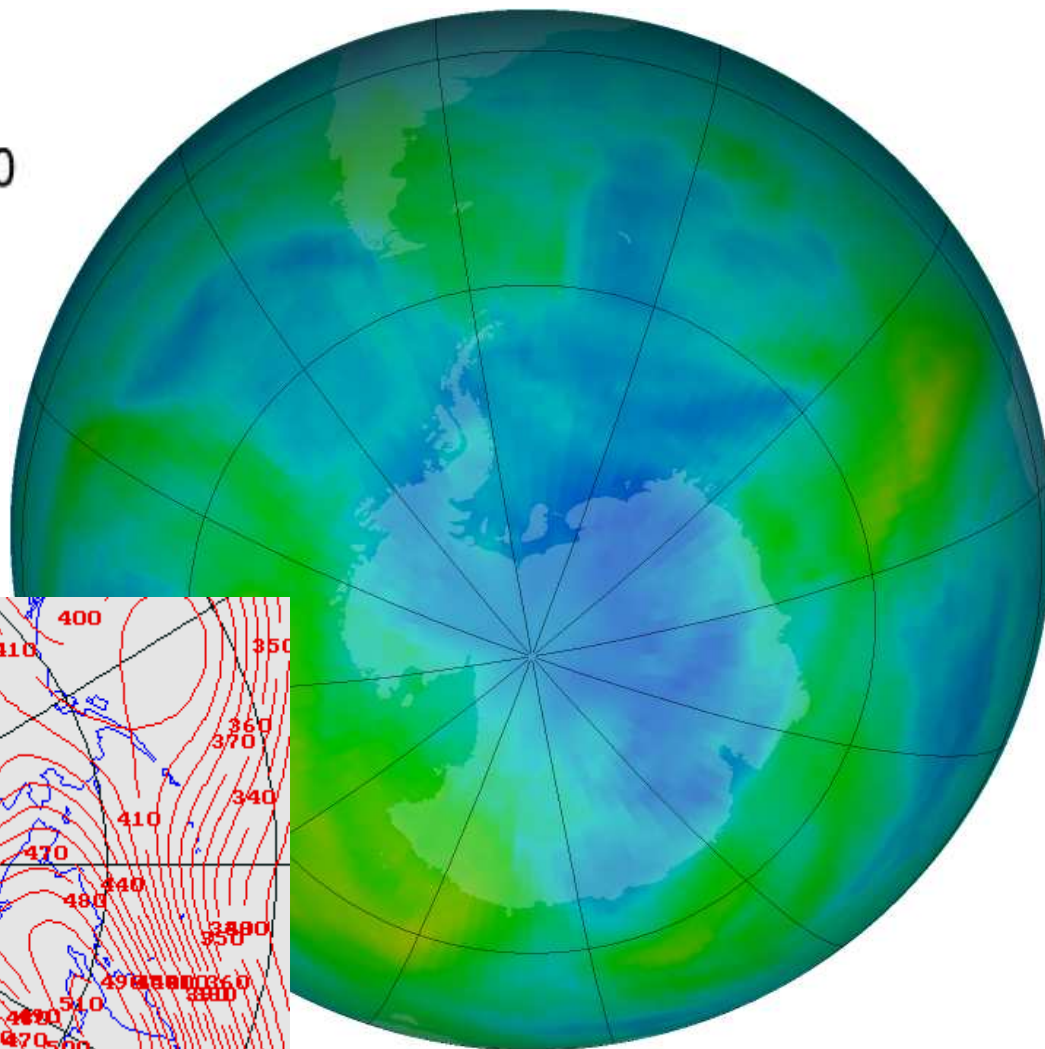
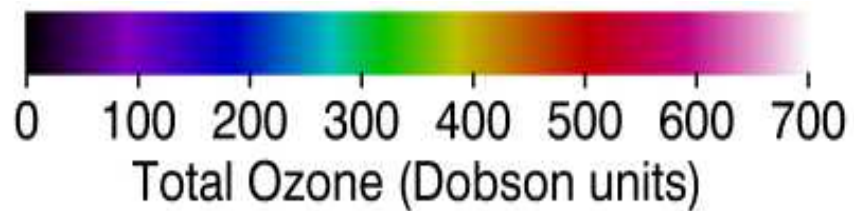
$I_p=10c$
 $m^{-2}c^{-1}$

14.07
UT

$\chi=88^\circ$,
le=3

$I_p=32$
 $cm^{-2}c^{-1}$





29 March 1989

6/03/91
F=207, Ap=24,
 $\Sigma Kp=29, Fe=-2\%$
Xray – M4

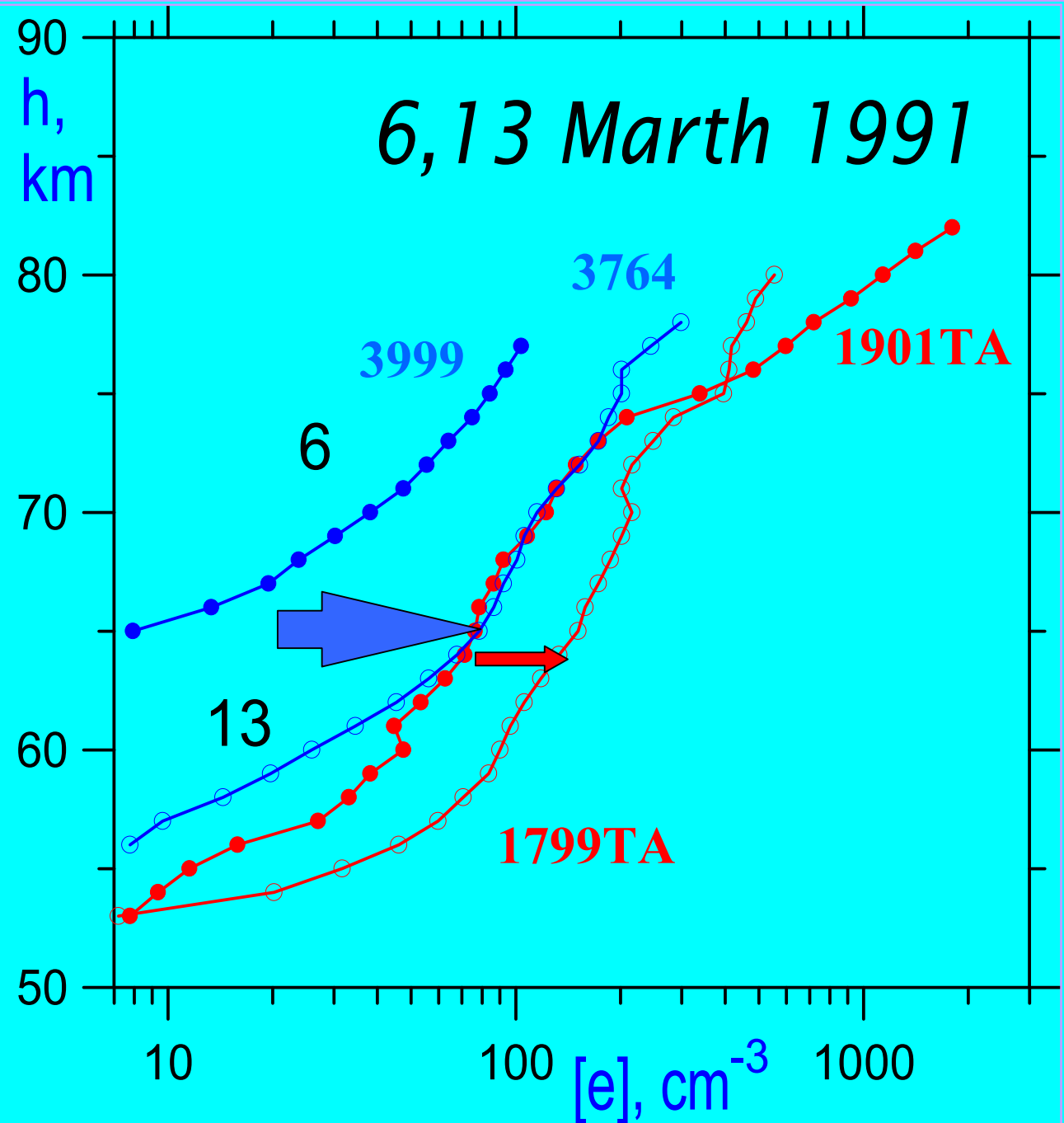
15.05 UT
 $\chi=97^\circ, le=1$
 $I_p=5\text{cm}^{-2}\text{c}^{-1}$

14.07 UT
 $\chi=78^\circ, le=1$
 $I_p=8\text{cm}^{-2}\text{c}^{-1}$

13/03/91
F=173, Ap=6,
 $\Sigma Kp=12, Fe=4\%$
Xray – M3

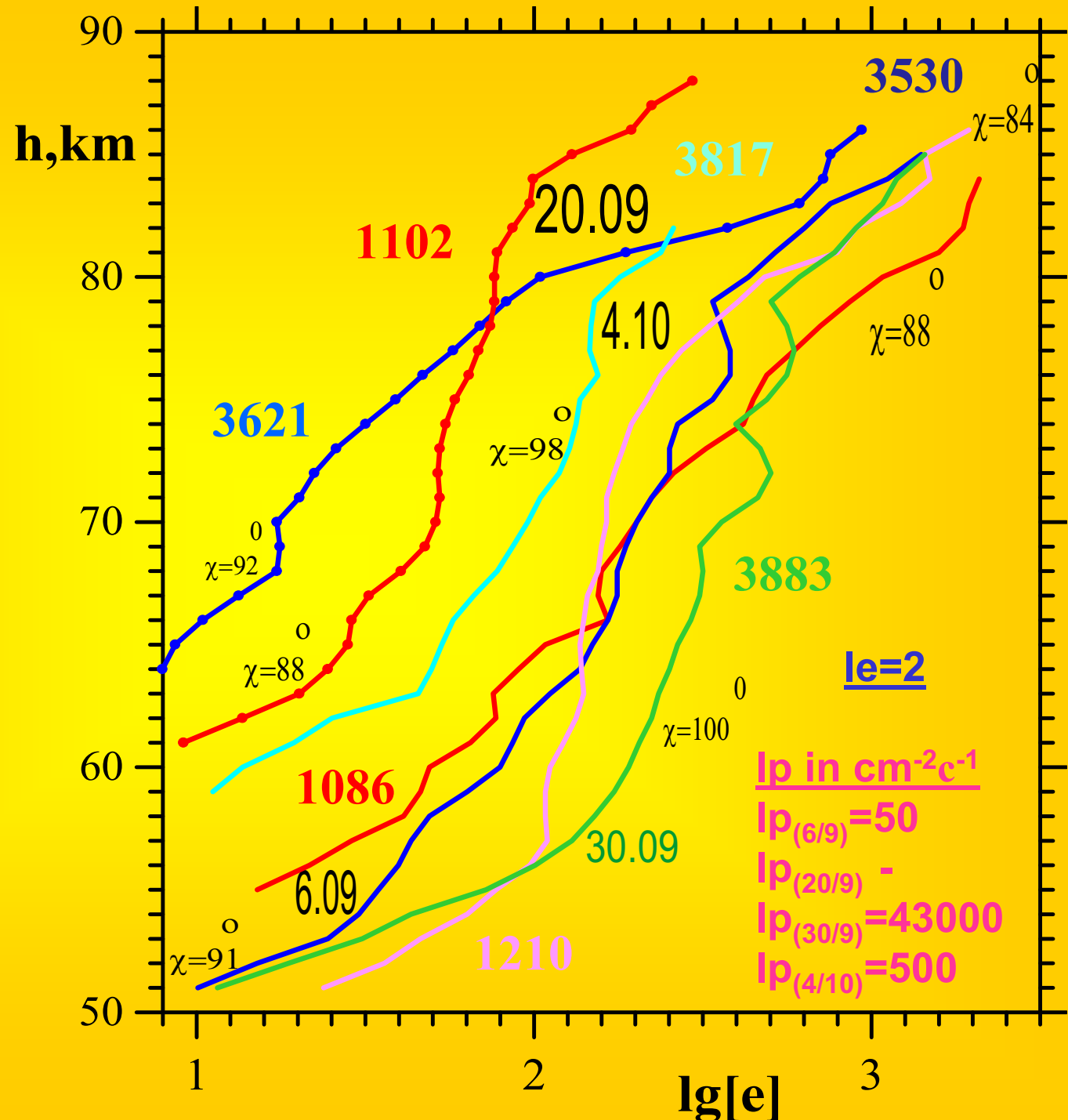
15.05 UT
 $\chi=94^\circ, le=2$
 $I_p=40\text{cm}^{-2}\text{c}^{-1}$

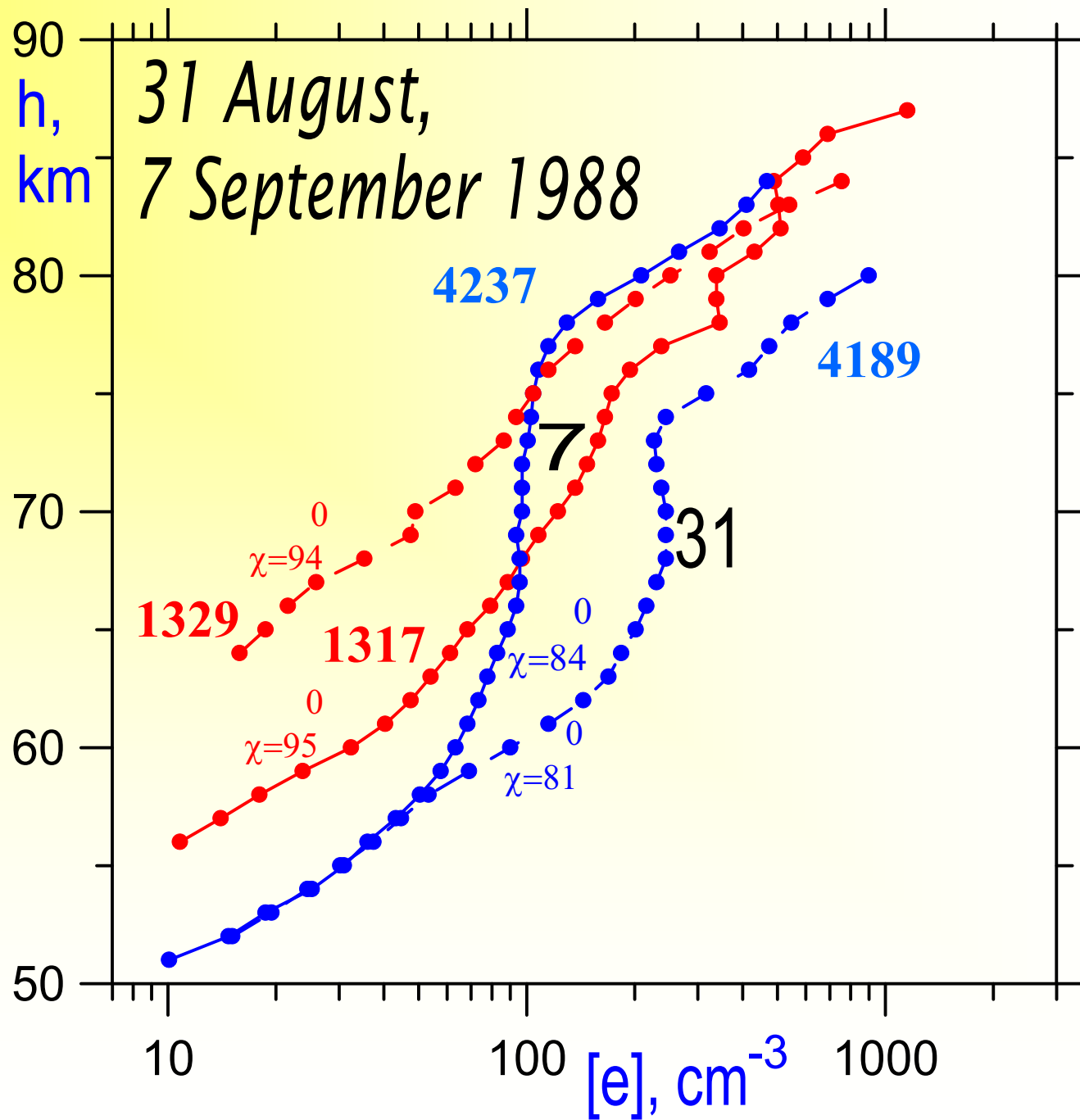
14.07 UT
 $\chi=81^\circ, le=2$
 $I_p=50\text{cm}^{-2}\text{c}^{-1}$

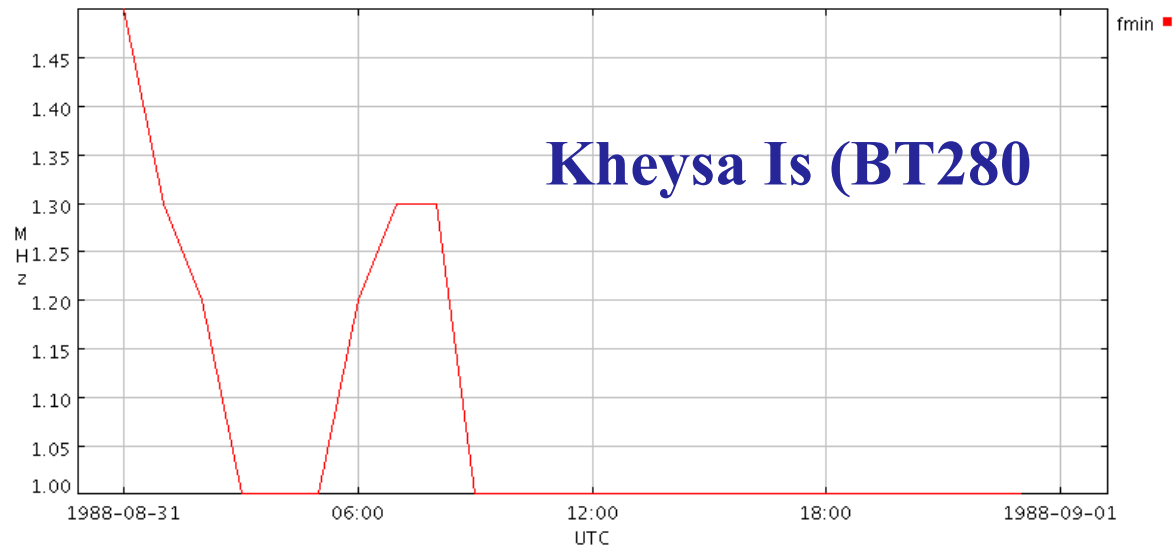


Sun flashes

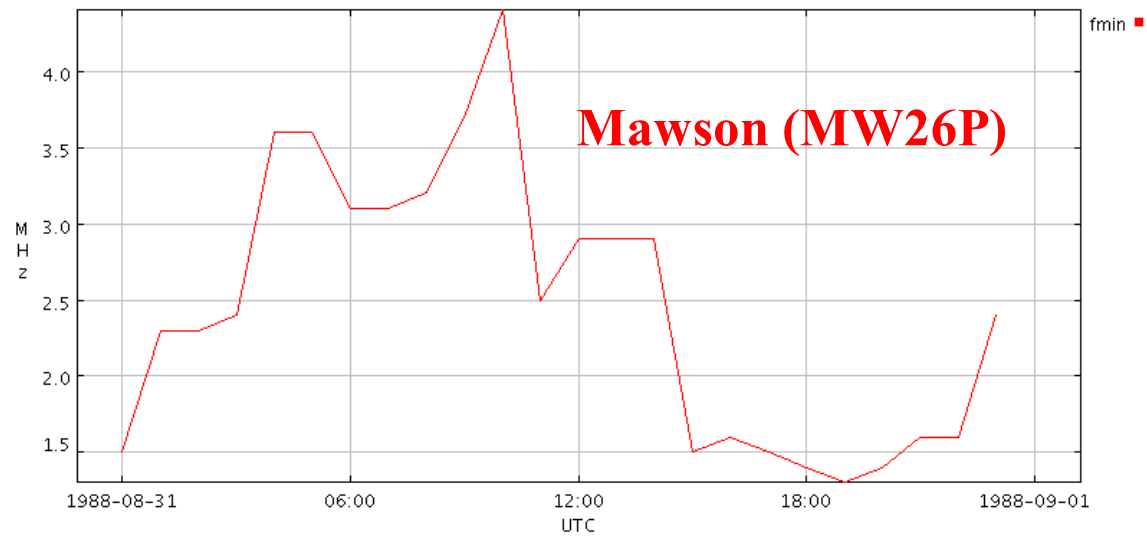
2B – 2.09.89
in 11.36 UT;
2B – 4.09.89
in 08.58UT;
2B – 5.09.89
in 21.38 UT;
2B – 9.09.89
in 09.10 UT;
2B – 12.09.89
in 10.09 UT;
3B – 30.09.89
in 02.41 UT;
1B – 4.10.89
in 08.34 UT.

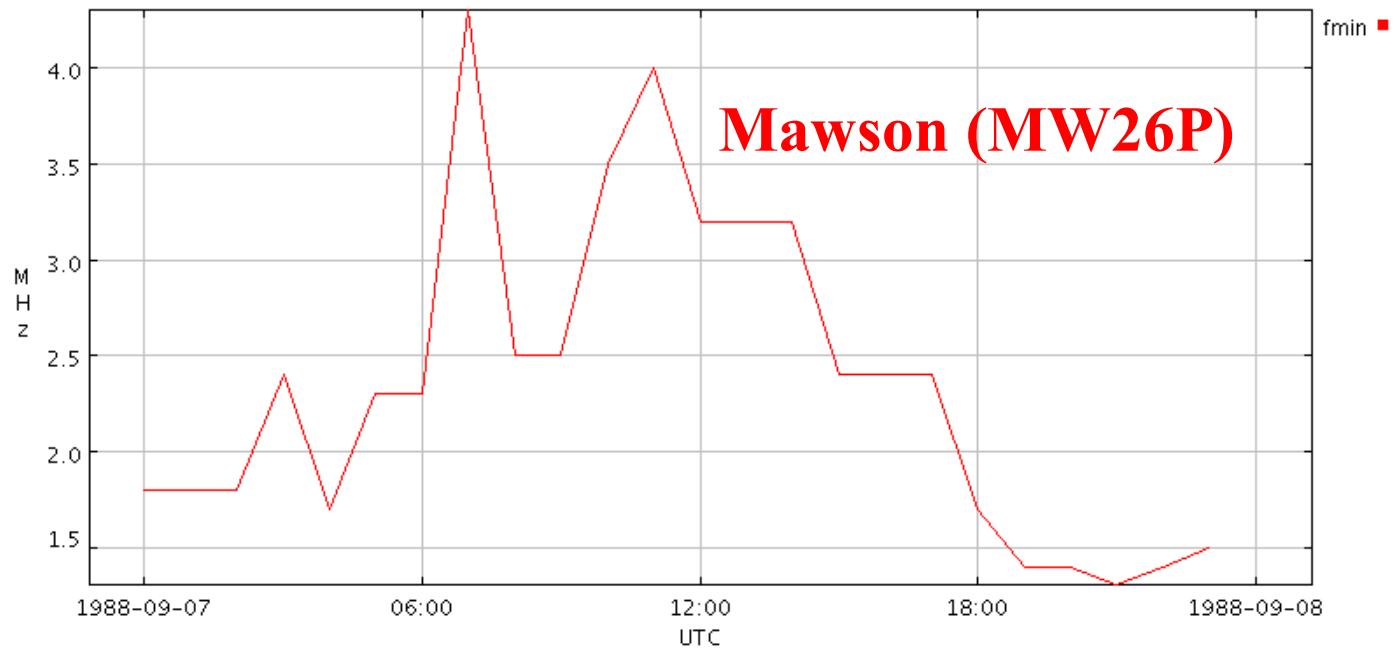


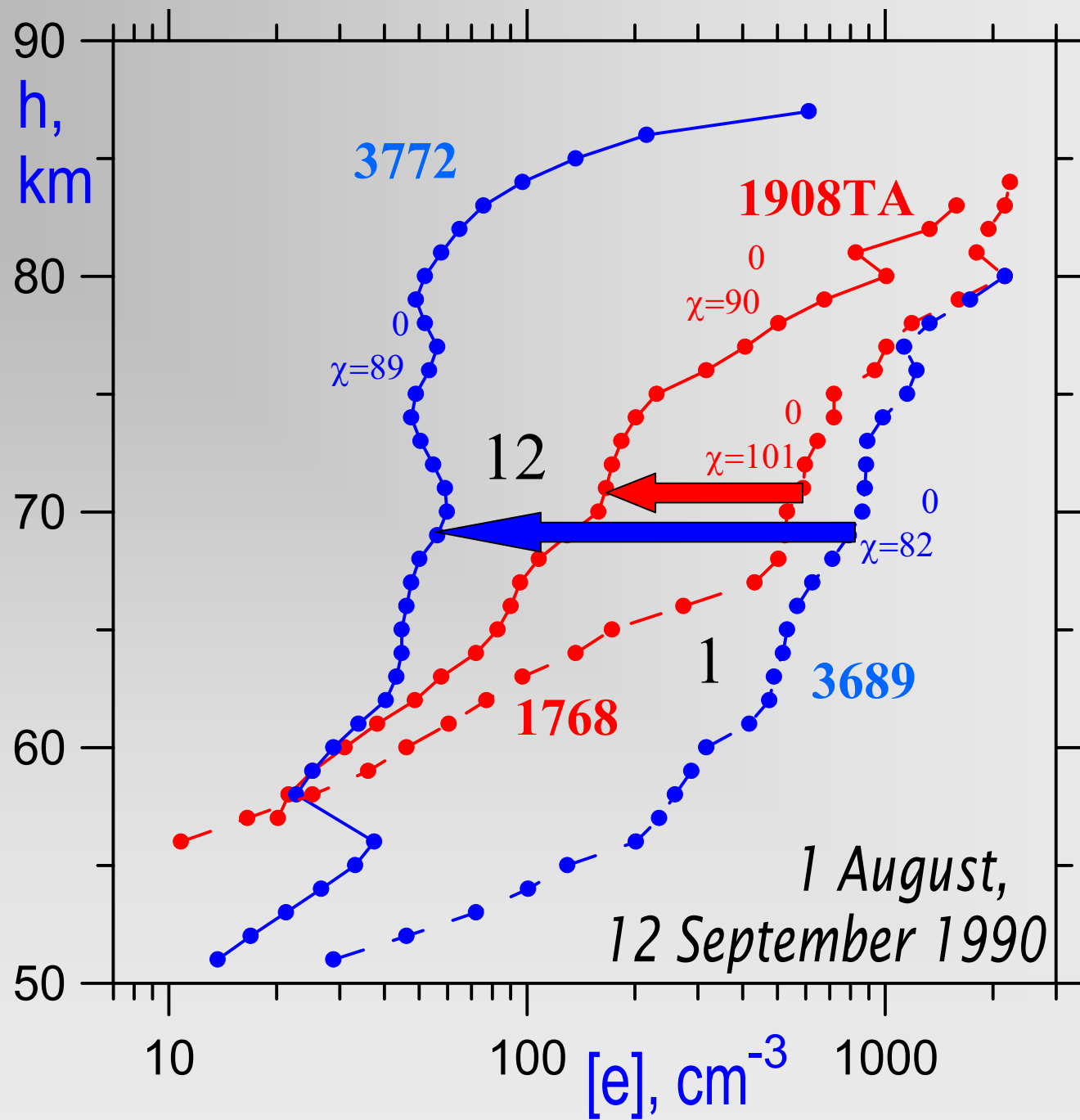




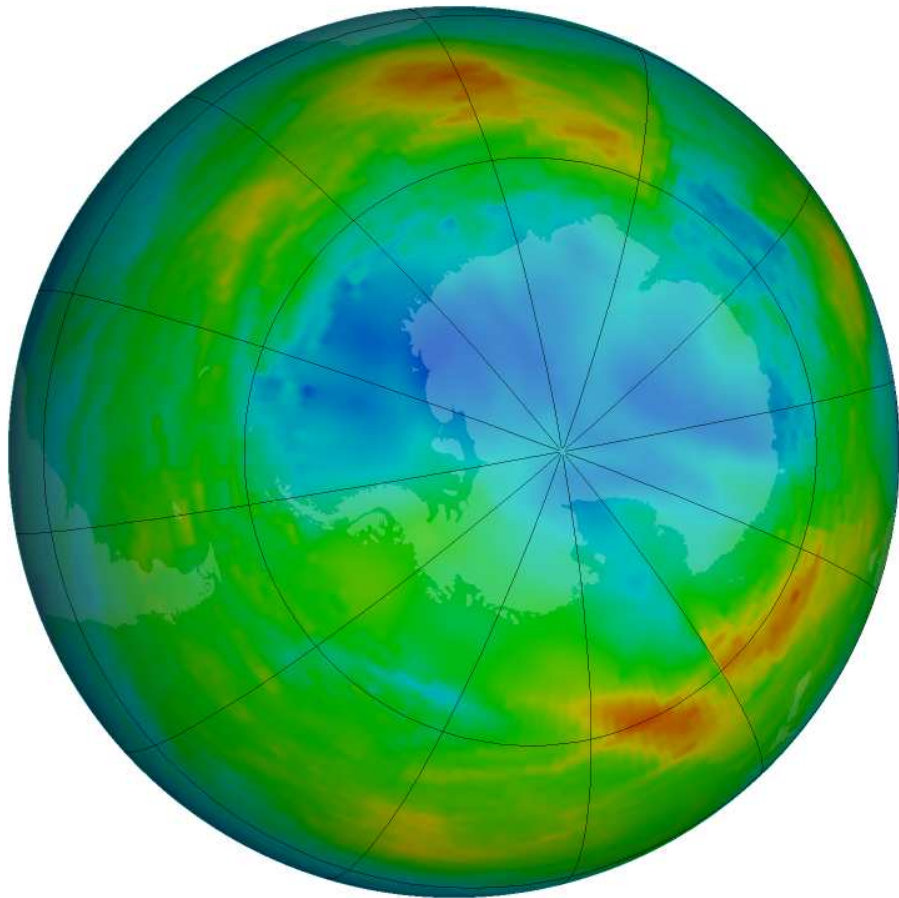
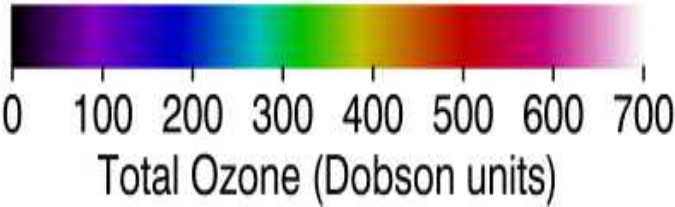
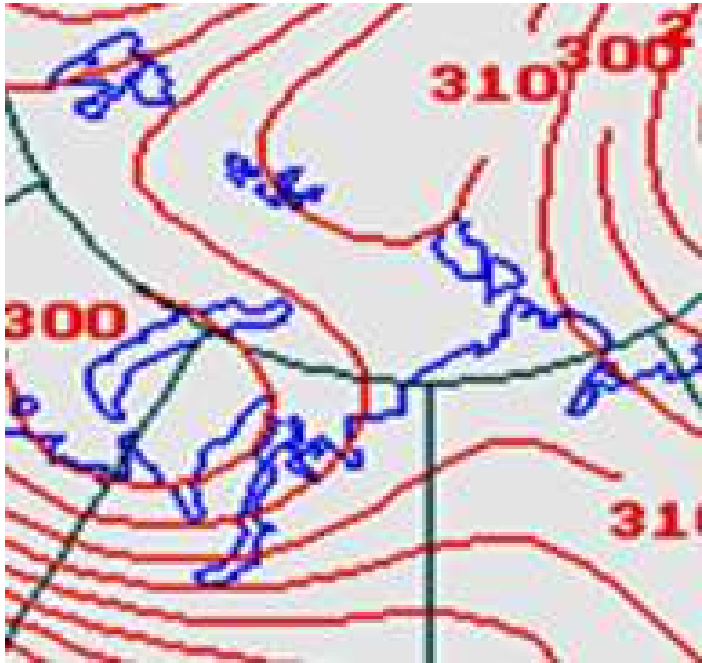
31.08.1988



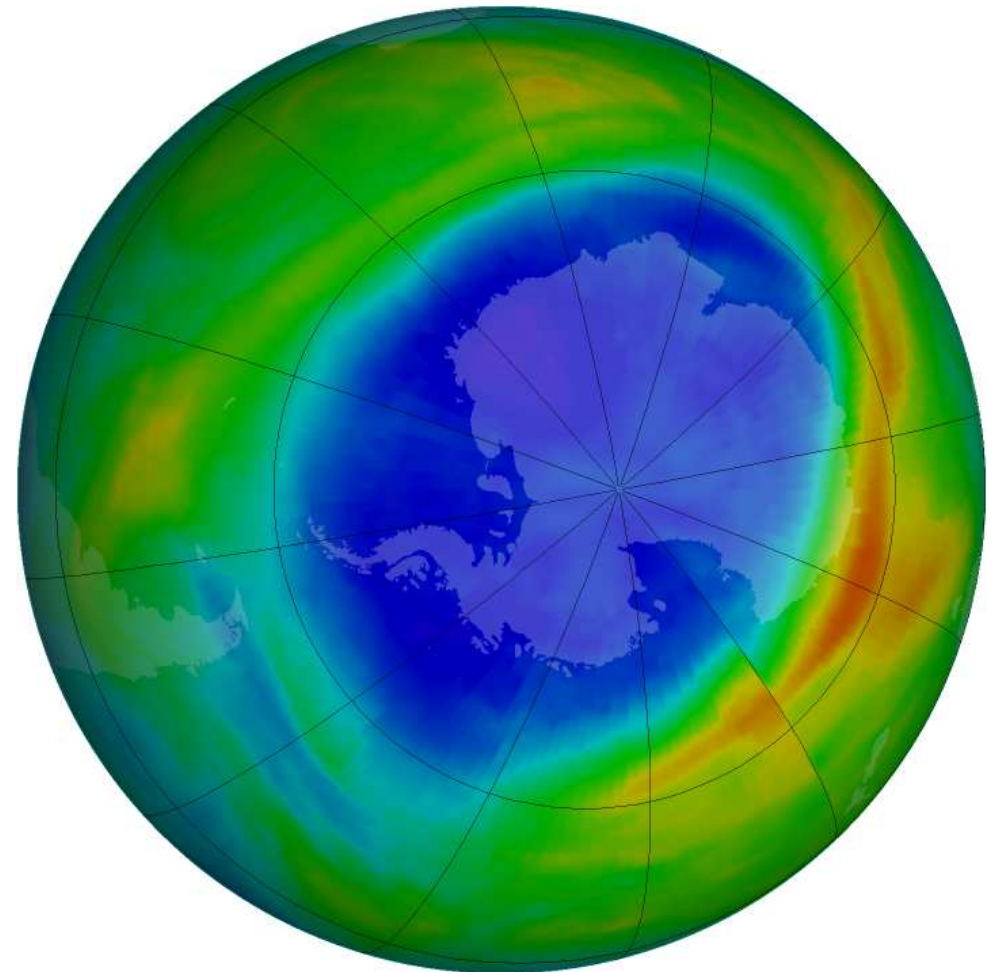
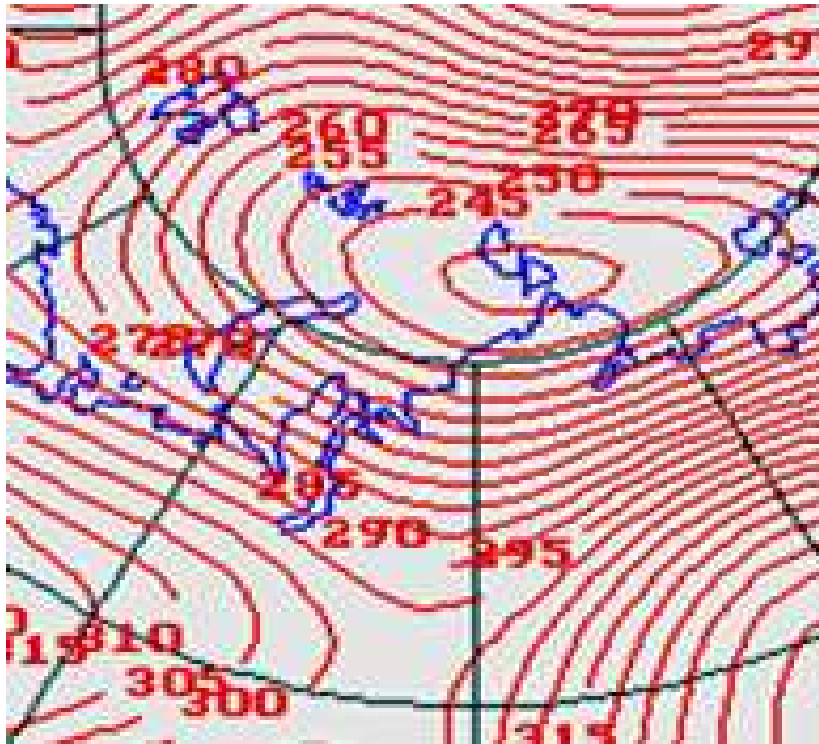
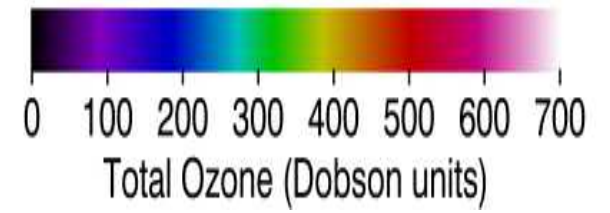


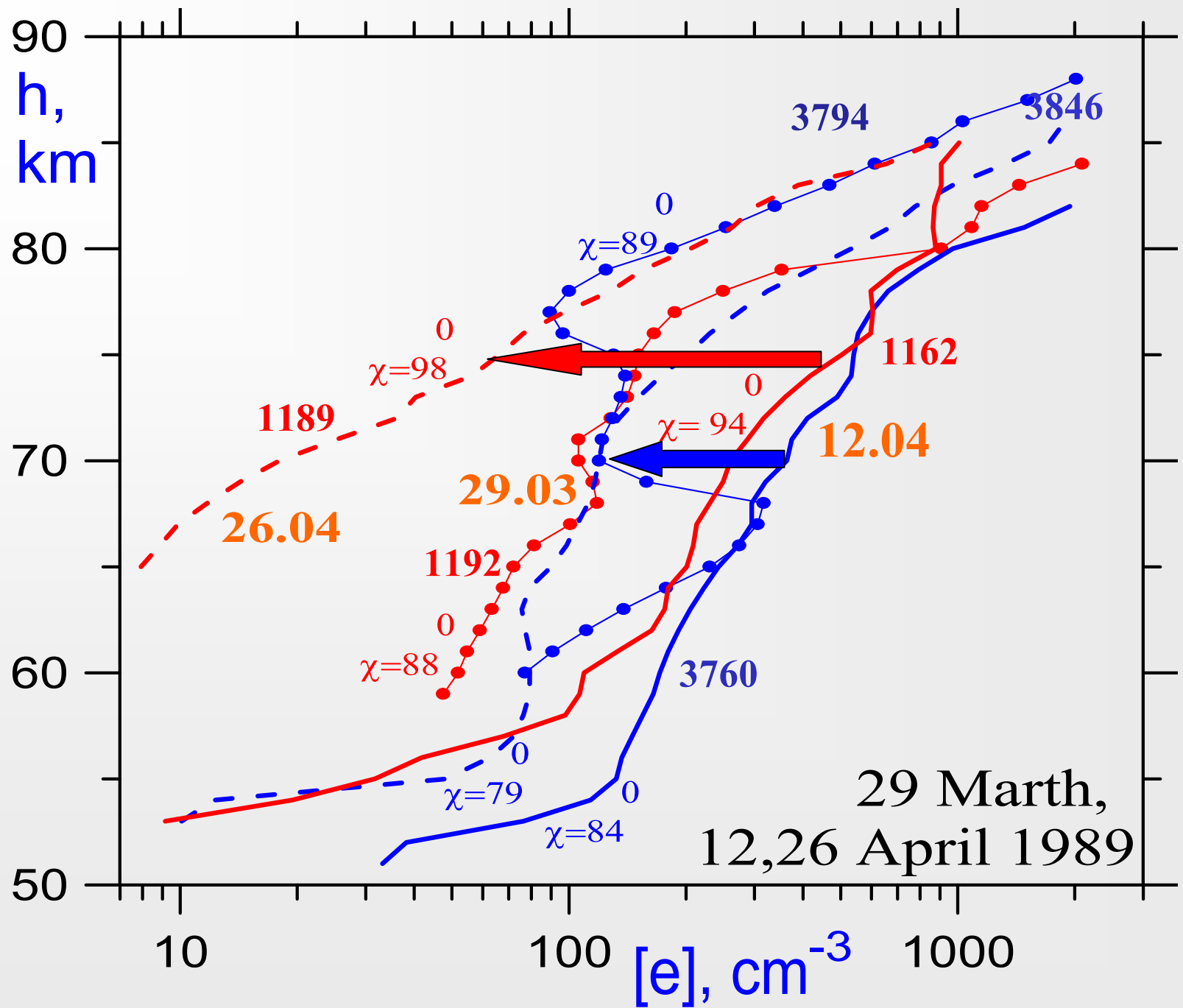


01 August 1990



12 September 1990





1. GOES DAILY PROTON FLUENCE >1,10,100 MEV

Proton fluences are provided for the >1, >10, and the >100 MeV protons. The units are **protons/cm**2-day-sr**.

2. GOES >2MeV Daily Electron fluence Data

Please note that the electron detector on GOES responds significantly to protons above the 32 MeV energy level; therefore, the electron data are contaminated when a proton event is in progress. An arbitrary cut off for dropping the electron fluence was set at the 3.0E+05 protons at the >10 MeV fluence level with these days indicated by '-999'. The units are **electrons/cm**2-day-sr**

	$I_{e>2MeV}$		$I_{p>1MeV}$		$I_{p>10 MeV}$		$I_{p>100MeV}$		
h,km	Correlation coefficients R(Lg[e],lg[Ie,p])								
60	-58	34	53	79	68	60	70	23	
65	29	53	37	78	44	65	-12	27	
70	30	39	42	85	46	76	-25	26	
75	11	8	50	89	49	77	-25	34	
80	25	0	41	78	23	69	-21	21	
	<i>M</i>	<i>H</i>	<i>M</i>	<i>H</i>	<i>M</i>	<i>H</i>	<i>M</i>	<i>H</i>	

$$\text{Lg}[e]_{60H} = \underline{0.74} + 0.193 * \text{lgIp}10 \quad (11p)$$

$$\text{Lg}[e]_{65H} = \underline{-0.49} + 0.359 * \text{lgIp}10 \quad (14p)$$

$$\text{Lg}[e]_{70H} = \underline{-0.01} + 0.314 * \text{lgIp}1 \quad (14p)$$

$$\text{Lg}[e]_{75H} = \underline{-0.50} + 0.401 * \text{lgIp}1 \quad (16p)$$

$$\text{Lg}[e]_{80H} = \underline{0.30} + 0.519 * \text{lgIp}1 \quad (14p)$$

$$\text{Lg}[e]_{60M} = 1.825 + 0.252 * \text{lgIp}100 - 0.144 * \text{Ie} \quad (12p)$$

$$\text{Lg}[e]_{65M} = 2.782 + 0.309 * \text{lgIp}1 - \underline{0.034} * \chi \quad (16p)$$

$$\text{Lg}[e]_{70M} = 2.373 + 0.271 * \text{lgIp}1 - \underline{0.024} * \chi \quad (16p)$$

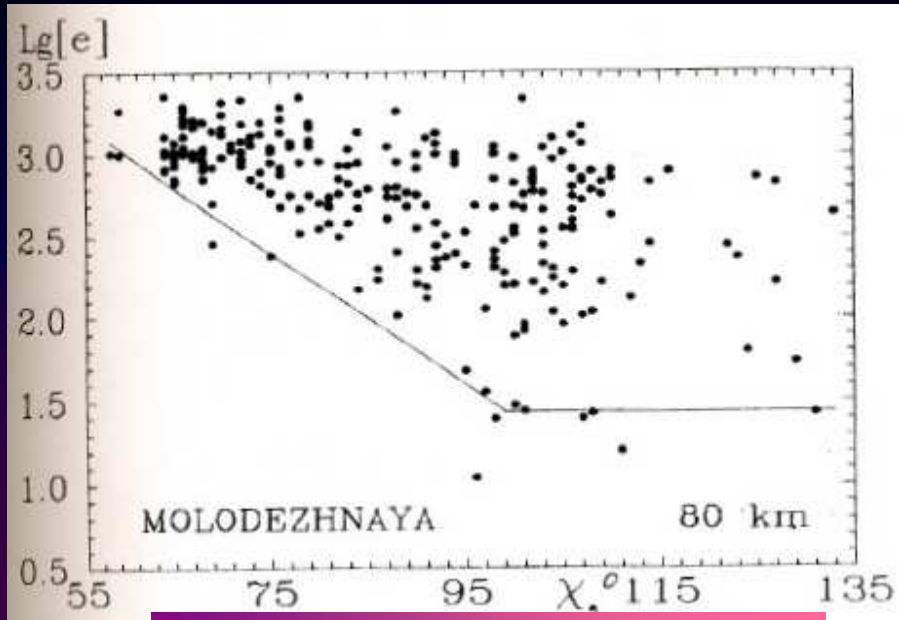
$$\text{Lg}[e]_{75M} = 2.424 + 0.272 * \text{lgIp}1 - 0.022 * \chi \quad (16p)$$

*Simultaneous reaction of lower high-latitude
D-region of both poles to proton flashes*

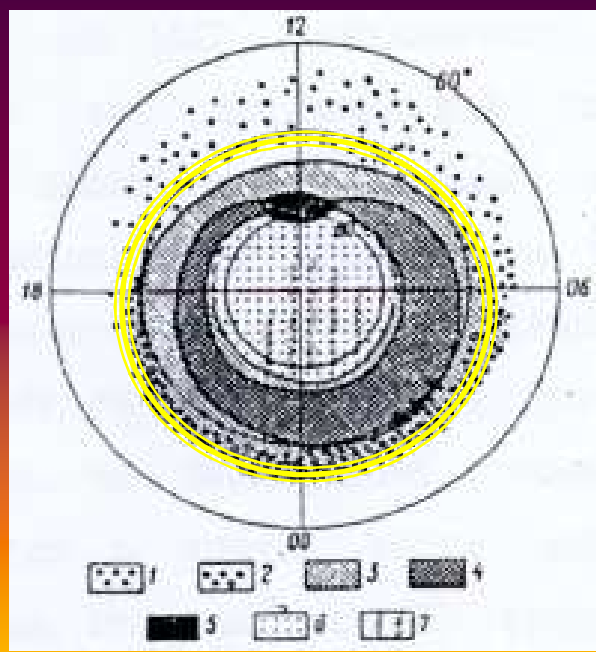
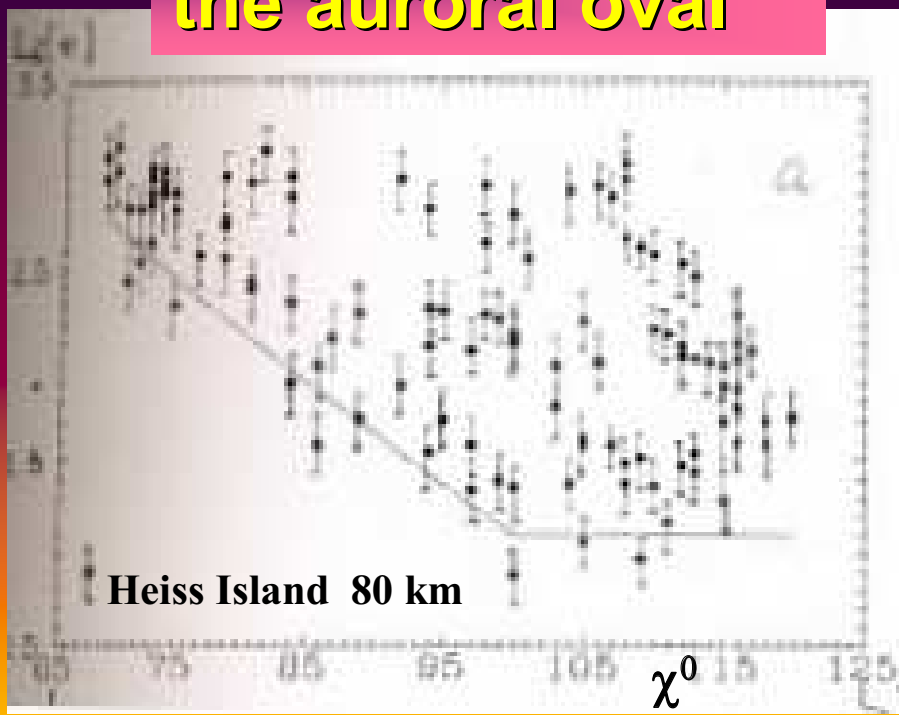
H, km	Correlation coefficients R(Lg[e],lg[Ie,p]) (6p)			
	Ip>1 MeV	Ip>10 MeV	Ip>1 MeV	Ip>10 MeV
65	89	71	20	88
70	84	86	54	88
75	73	83	24	51

$$\mathbf{Lg[e]_{70H} = -0.41 + 0.46 * lgIp10}$$

$$\mathbf{Lg[e]_{70m} = 0.83 + 0.26 * lgIp10}$$



the auroral oval



- 1. $E_e > 20 \text{ keV}$
- 2. $E_p > 20 \text{ keV}$
- 3. Zone of the auroral particles diffusion Eruption
- 4. Zone of the discrete eruption (auroral oval)
- 6. $E_p < 100 \text{ eV}$
- 7. $E_e < 1 \text{ keV}$



H,km	$[\bar{e}]_h$	$Lg[\bar{e}]_h$	$[\bar{e}]_m$	$Lg[\bar{e}]_m$	$[\bar{e}]_h/[\bar{e}]_m$
60	103	2.01	62	1.79	1.66
65	156	2.19	90	1.95	1.73
70	218	2.34	154	2.19	1.42
75	283	2.45	256	2.41	1.11
80	532	2.73	691	2.84	0.77

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Conclusions

On the average, the comparison of almost simultaneous measurements of $[e]$ in Arctic and Antarctic stations has shown, that there is no significant asymmetry. It is necessary to note, that on Heiss island the dependence between $[e]$ and protons is expressed more strongly. This dependence is height – related and depends on height (that it was not observed for Molodezhnaya). Apparently, the differences of $[e]$ average value in the lower D-region is connected not only with ionising corpuscular asymmetry, but with differences of the atmospheric composition in both poles.