

**Effects of Space Weather Manifestations as  
a Result of Solar and Geomagnetic Activity,  
Solar and Lunar Eclipses and Tidal  
Phenomena in the Ionosphere – research  
databases (radio telescope URAN-4).**

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Institute, National Academy of Sciences,  
Odessa, Ukraine,***



**Место УРАН среди других инструментов декаметрового диапазона**

# UKRAINIAN RADIO INTERFEROMETER OF THE ACADEMY OF SCIENCES /URAN/

## KHARKOV

INSTITUTE OF RADIO ASTRONOMY OF THE ACADEMY OF SCIENCES OF THE UKRAINE  
4, KRASNOZNAMENNAYA STR., KHARKOV, 310002, UKRAINE

## GRAKOVO

ARRAY: 2040 HORIZONTAL DIPOLES  
49° 38' 40" N; 36° 56' 30" E



## LVOV

INSTITUTE OF PHYSICS  
AND MECHANICS.  
ARRAY: 256 CROSSED DIPOLES  
51° 28' 31.5" N; 23° 49' 32.6" E

## ODESSA

ARRAY: 128 CROSSED DIPOLES  
46° 23' 50.5" N; 30° 16' 24" E

## POLTAVA

GRAVIMETRIC OBSERVATORY.  
ARRAY: 512 CROSSED DIPOLES  
49° 37' 57" N; 34° 49' 15" E

## ZMIEV

ARRAY: 96 CROSSED DIPOLES  
49° 39' 50" N; 36° 21' 20" E

# Radio-telescope UTR-2(W-E)



# Radio-telescope UTR-2(N-S)



# Radio-telescope URAN-2( Poltava)



# Radio-telescope URAN-3 (Lviv)

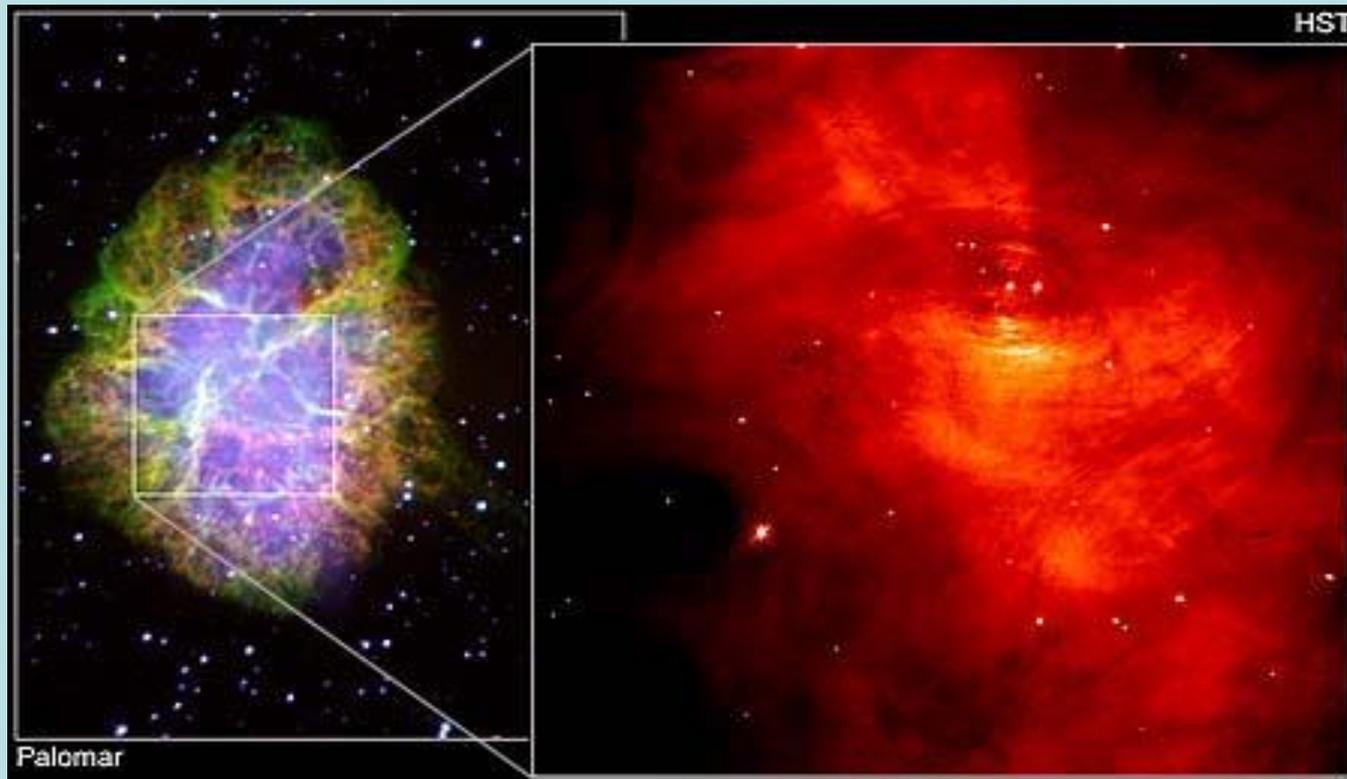


# Radio-telescope URAN-4 (Odessa)

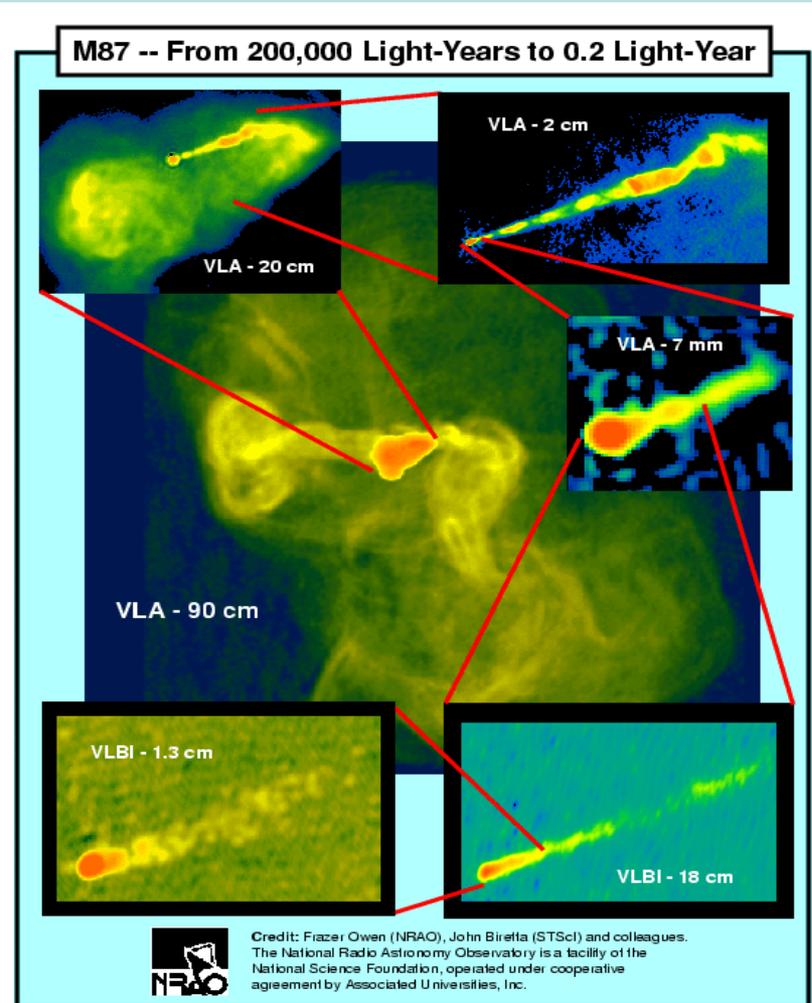
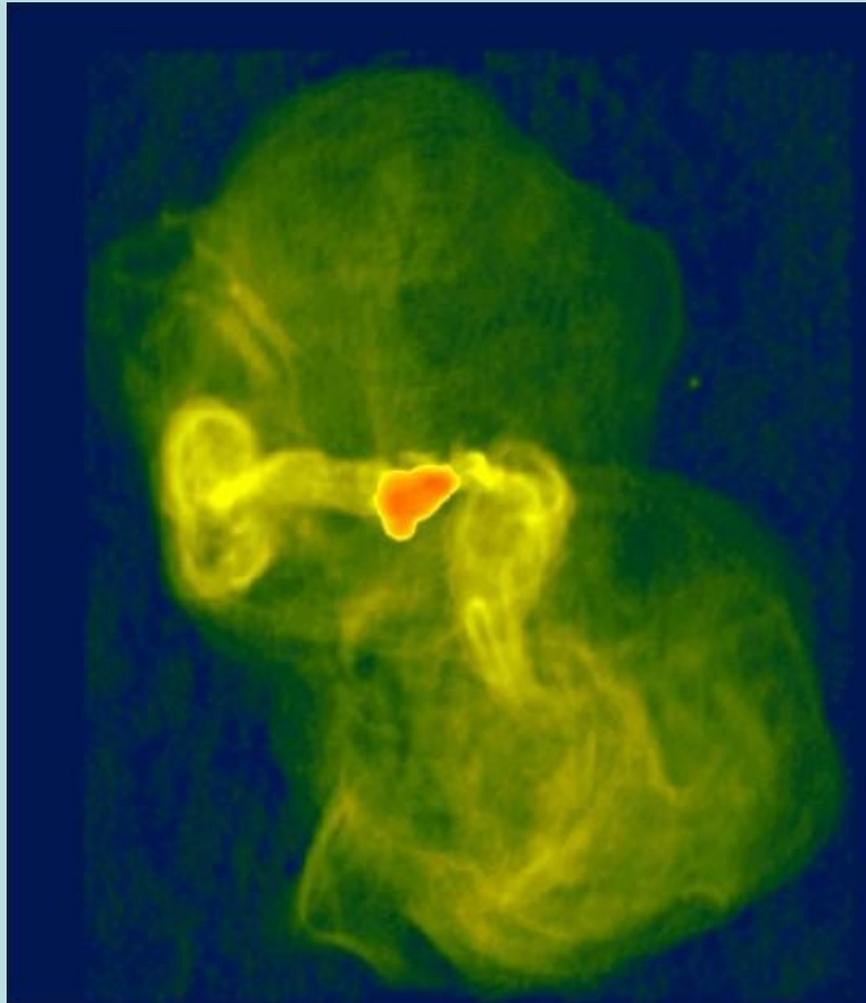


From 1987 on the RT “URAN-4” realized continuous monitoring of powerful space radio-sources.

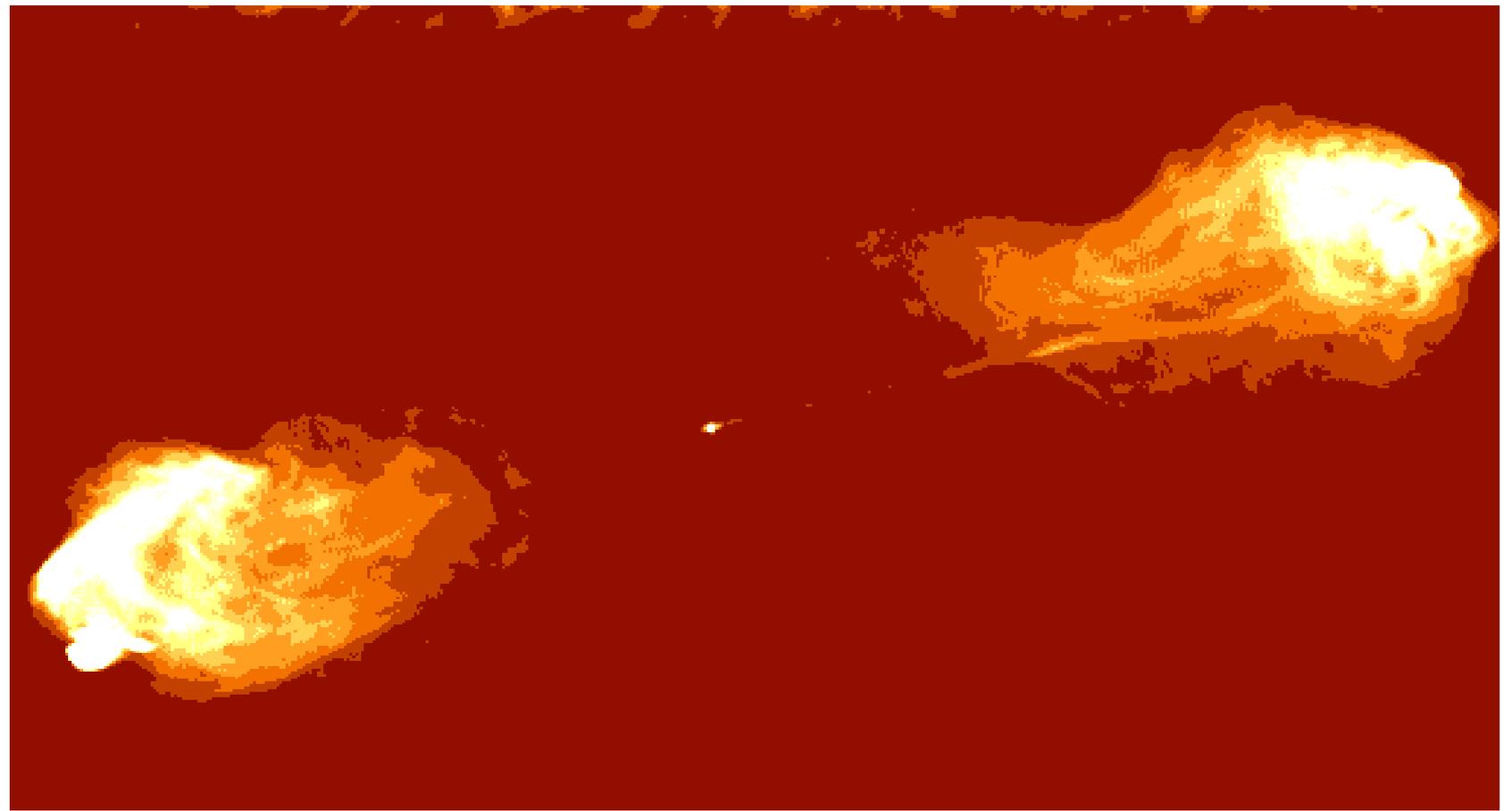
- 3C144 (Crab Nebula – SNR)



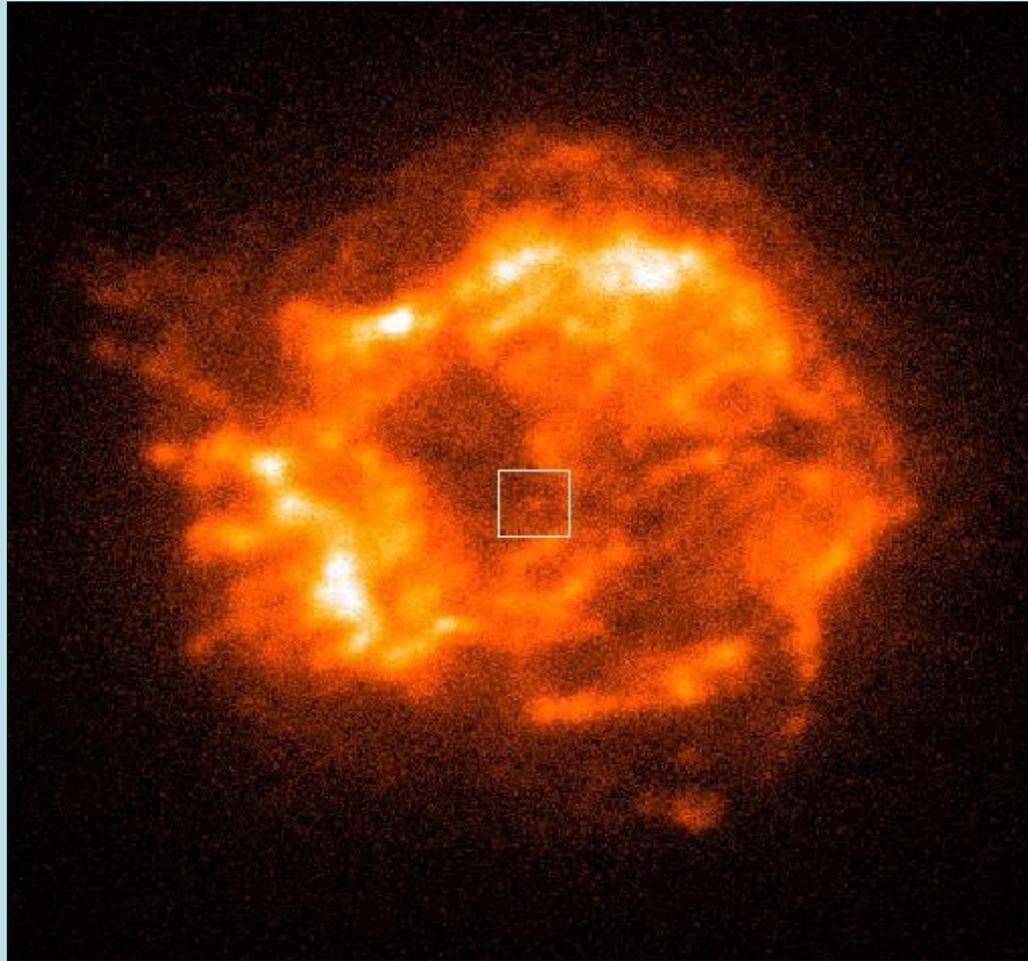
# 3C274 – VirgoA- Radiogalaxy



# 3C405-CygA-Radiogalaxy



# 3C461 – CasA- SNR



# The program of monitoring

- **3C144**
- $\alpha = 05^{\text{h}} 31^{\text{m}} 30^{\text{s}}$   $\delta = 21^{\circ} 39^{\text{m}}$
- **3C274**
- $\alpha = 12^{\text{h}} 28^{\text{m}} 18^{\text{s}}$   $\delta = 12^{\circ} 40^{\text{m}}$
- **3C405**
- $\alpha = 19^{\text{h}} 57^{\text{m}} 47^{\text{s}}$   $\delta = 40^{\circ} 36^{\text{m}}$
- **3C461**
- $\alpha = 23^{\text{h}} 21^{\text{m}} 07^{\text{s}}$   $\delta = 58^{\circ} 34^{\text{m}}$
-

# Interval time of observations

**3C144**

-120m до + 120m ,  $\Delta T = 40m$  , 7 scans.

**3C274**

- 120m до + 120m ,  $\Delta T = 40m$  , 7 scans.

**3C405**

- 120m до + 80 m ,  $\Delta T = 40m$  , 6 scans.

-

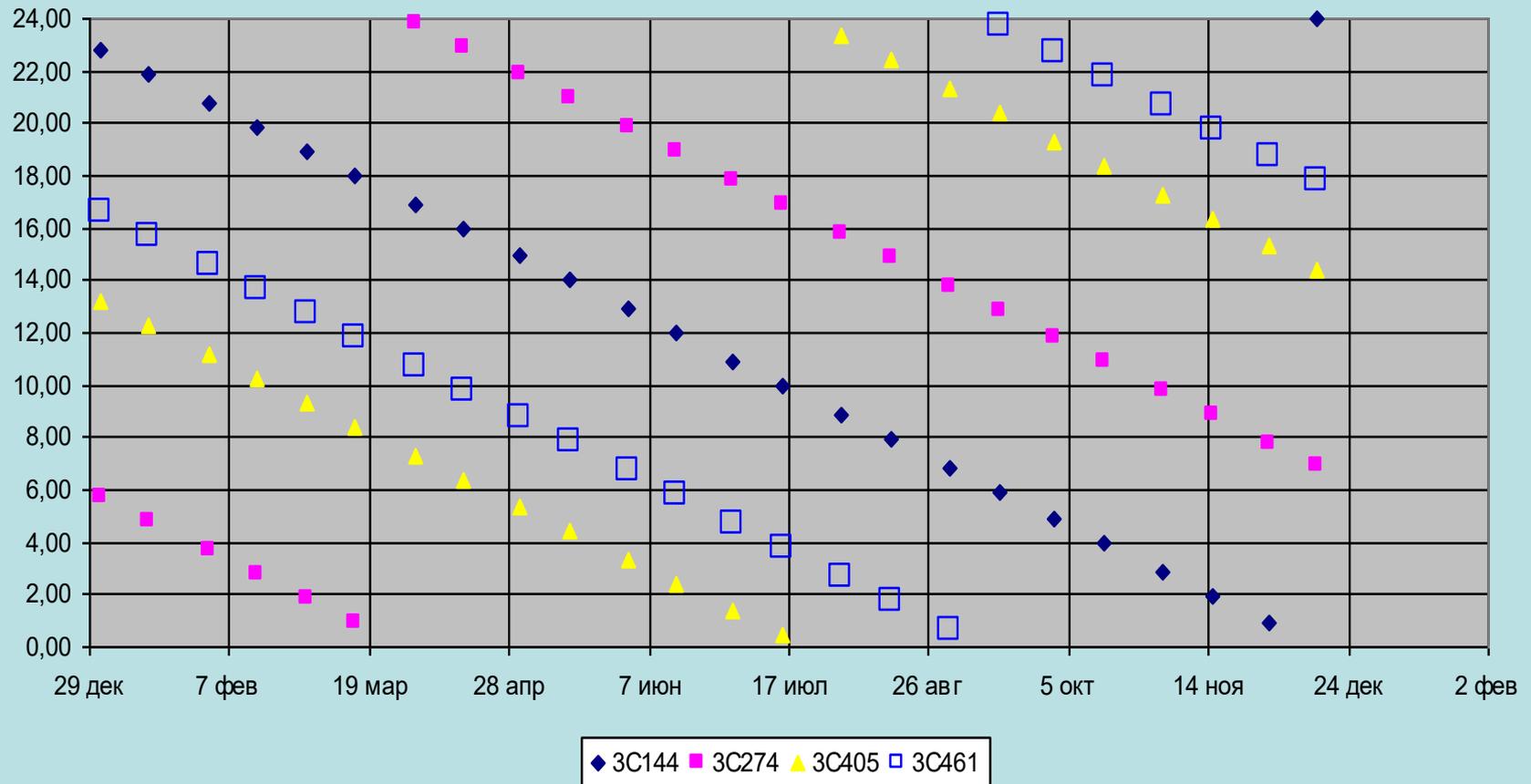
**3C461**

- 60 m до + 120 m ,  $\Delta T = 60m$  , 4 scans

- In total for a day - **13 hours 20 minutes.**

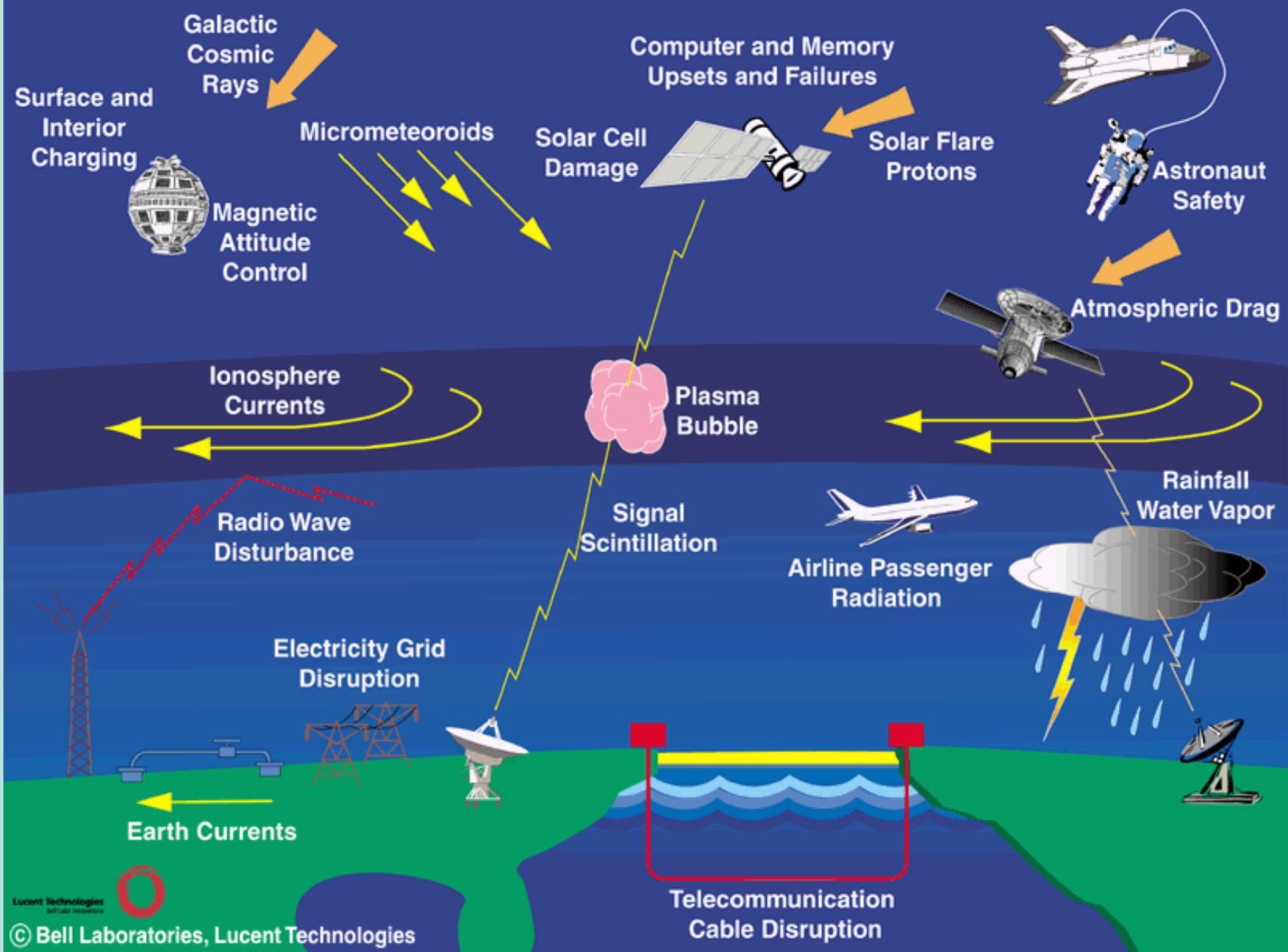
# Time observation radiosources

Time observation radiosources



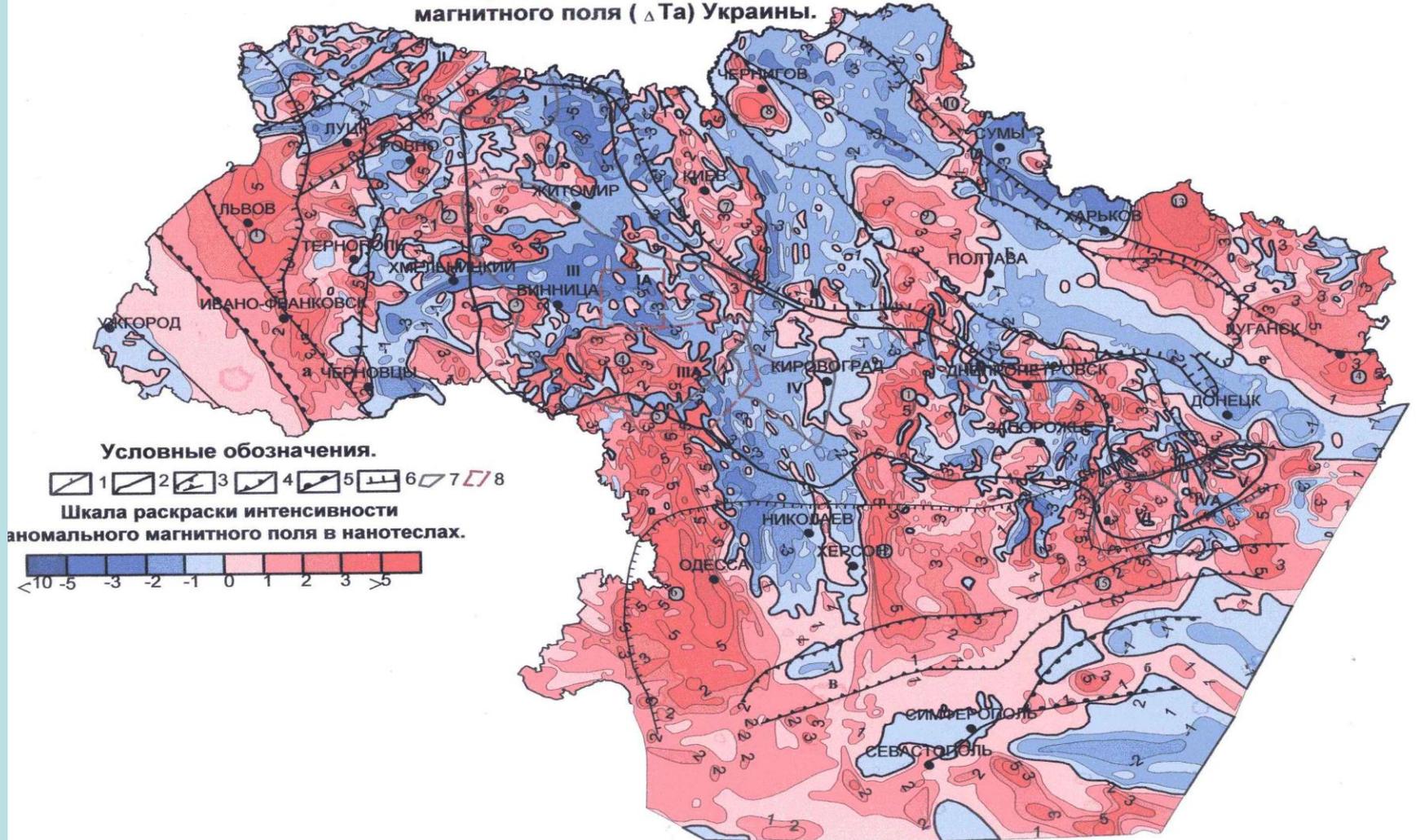
# **Space weather and its influence on an atmosphere of the Earth in a north-west part of Black Sea.**

- **The upper ionized layer of the Earth's atmosphere - ionosphere responds most sensitatively to the state of space.**
- **The ionosphere is "conductor" and active participant of all space and geophysical effects on biological systems.**
- **Radiotelescope YPAH-4 is located in a zone of magnetic anomaly.**
- **This zone promotes formation of the raised reaction to change conditions of space weather.**

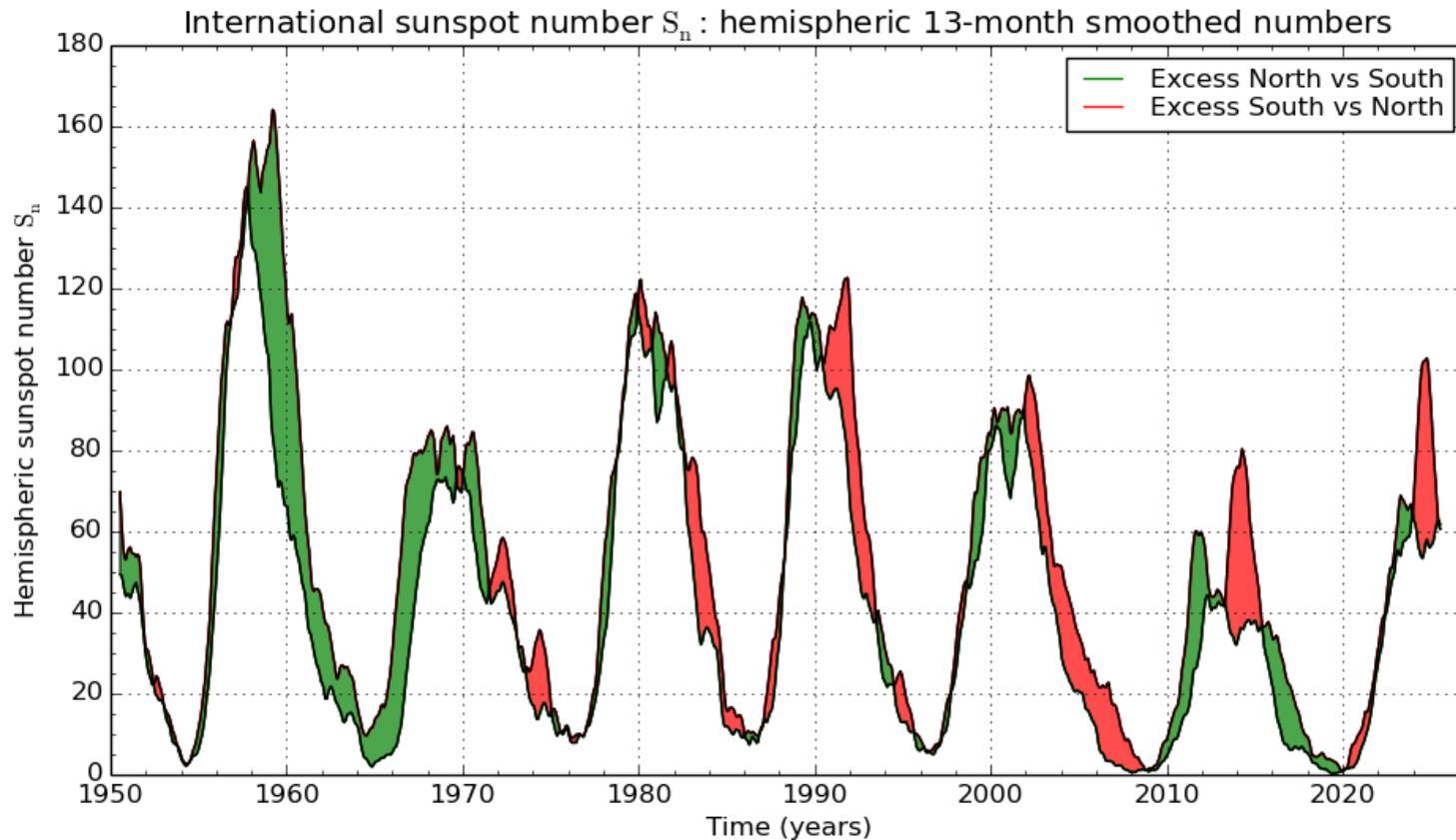


# Magnetic anomaly zone around of Odessa

Карта аномального магнитного поля ( $\Delta T_a$ ) Украины.

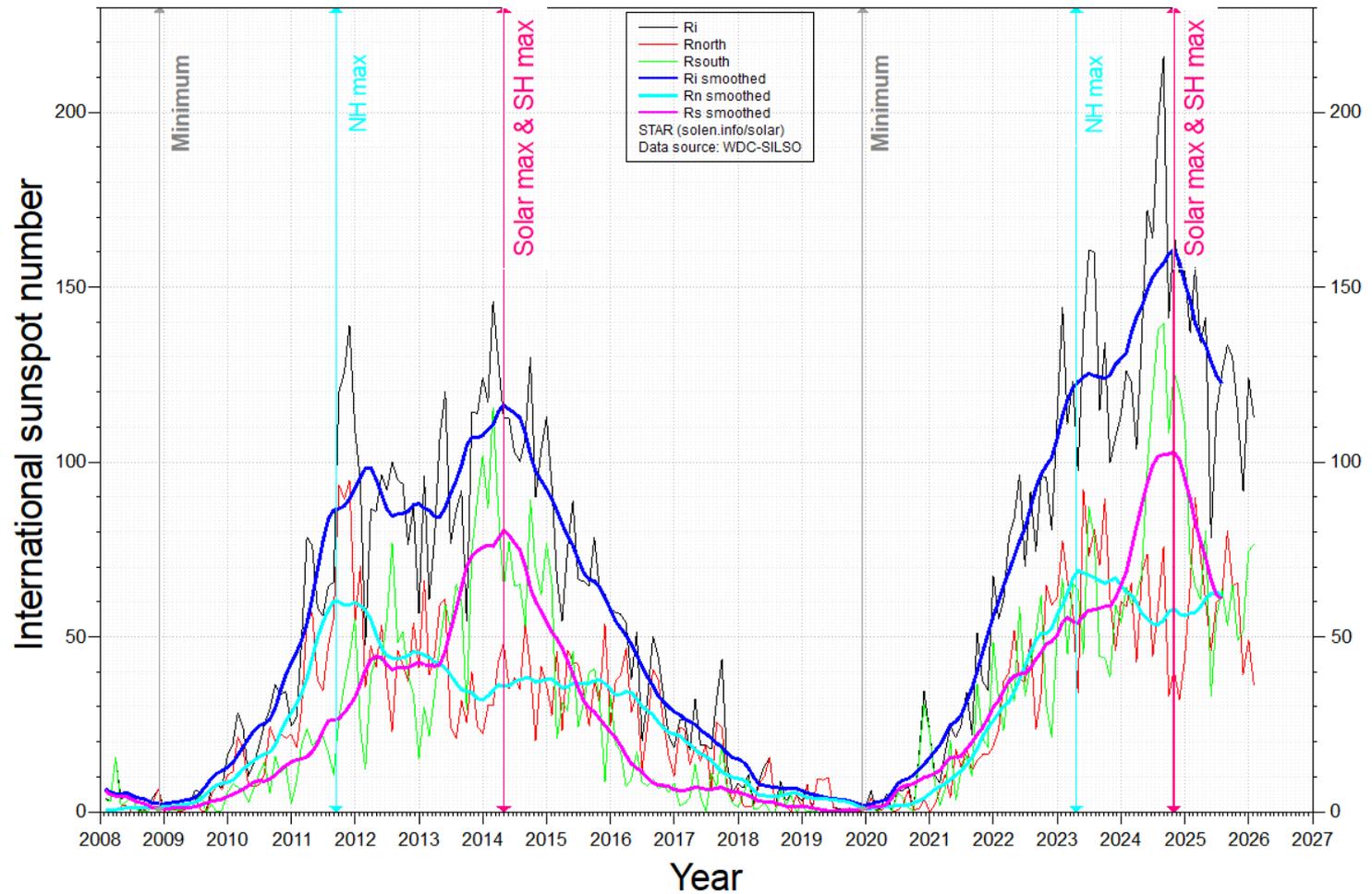


# Solar cycles in period monitoring



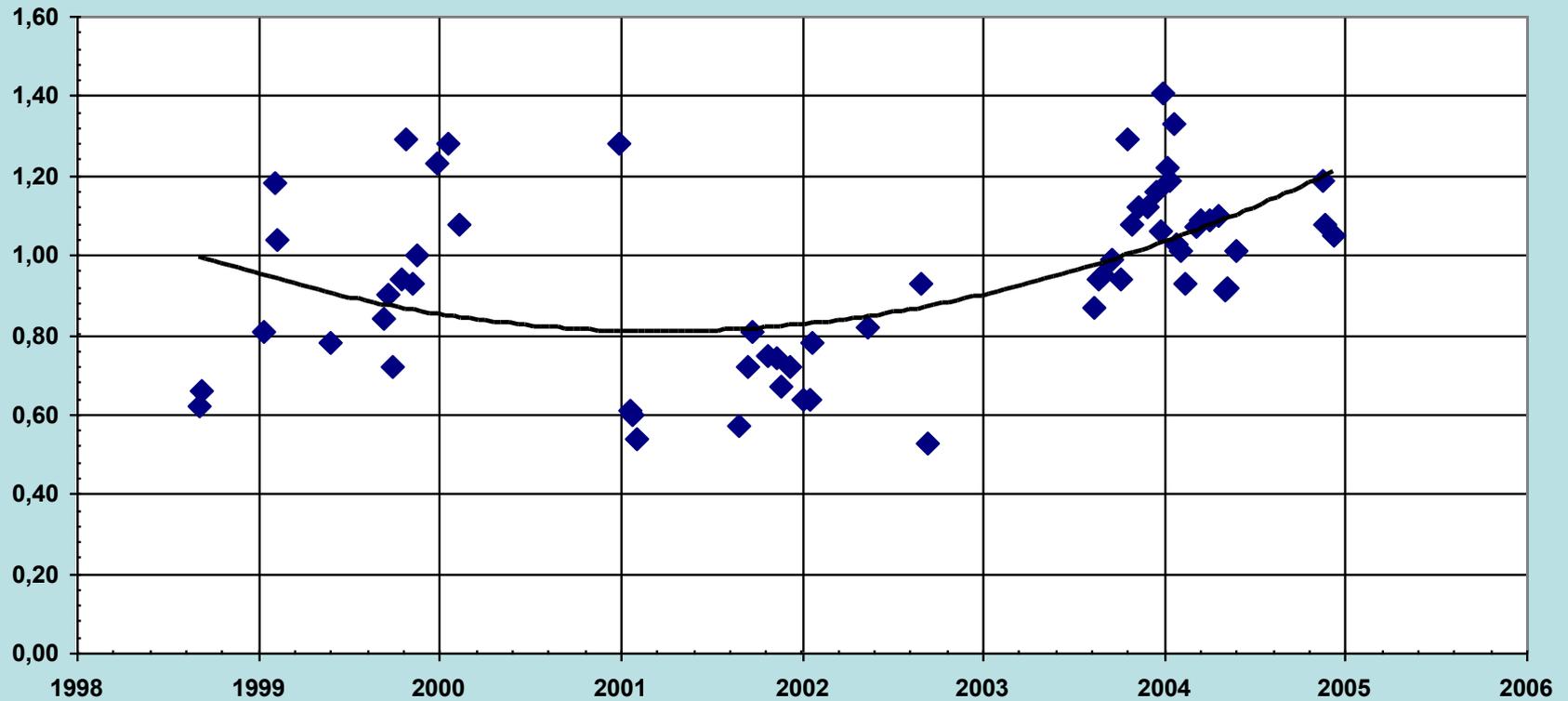
# 24-25 solar cycle,

Solar cycles 24-25 progress



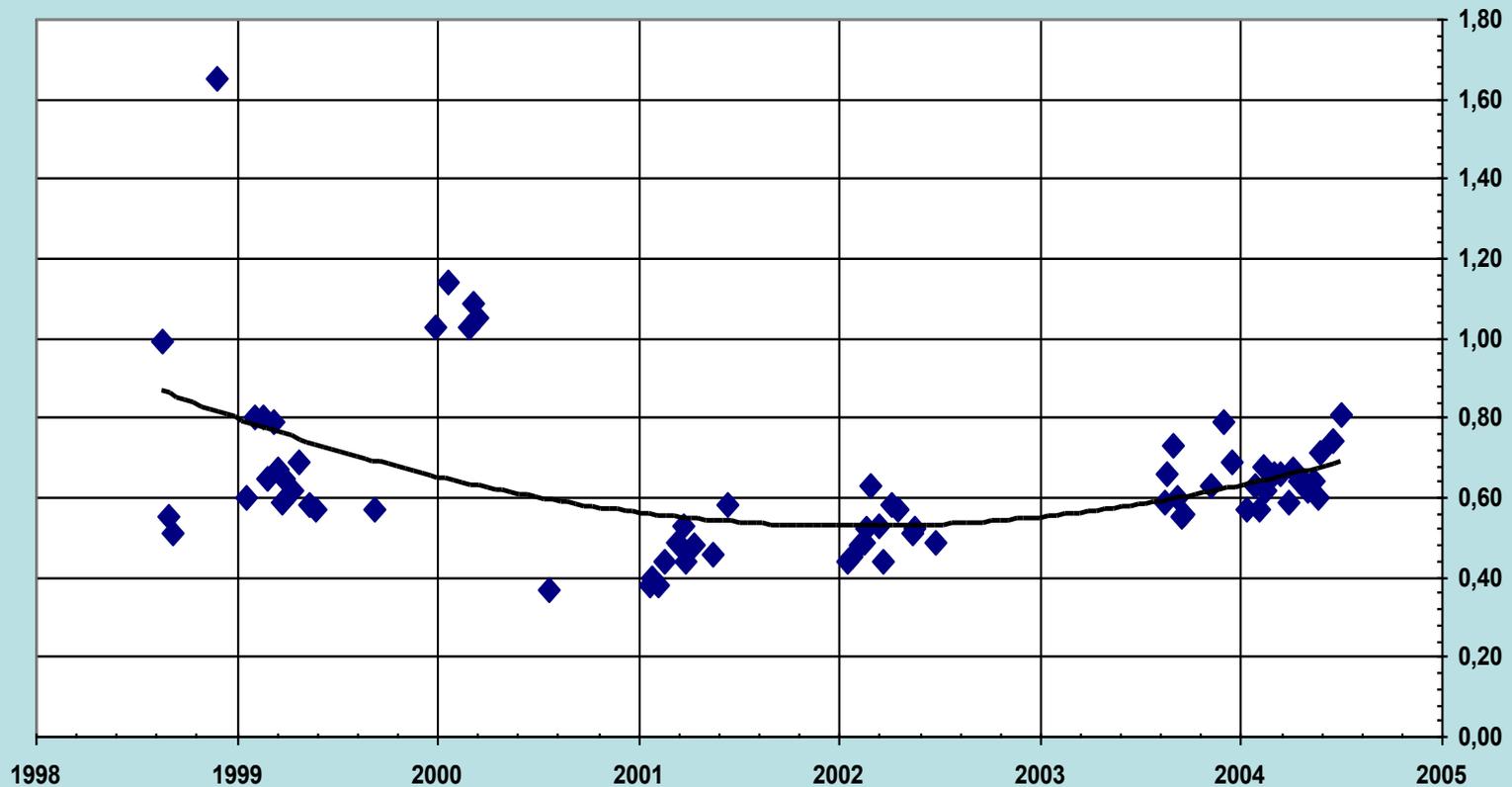
# Flux variations 3C144 – Tau A in 23 solar cycle

3C144A25-Mean for period



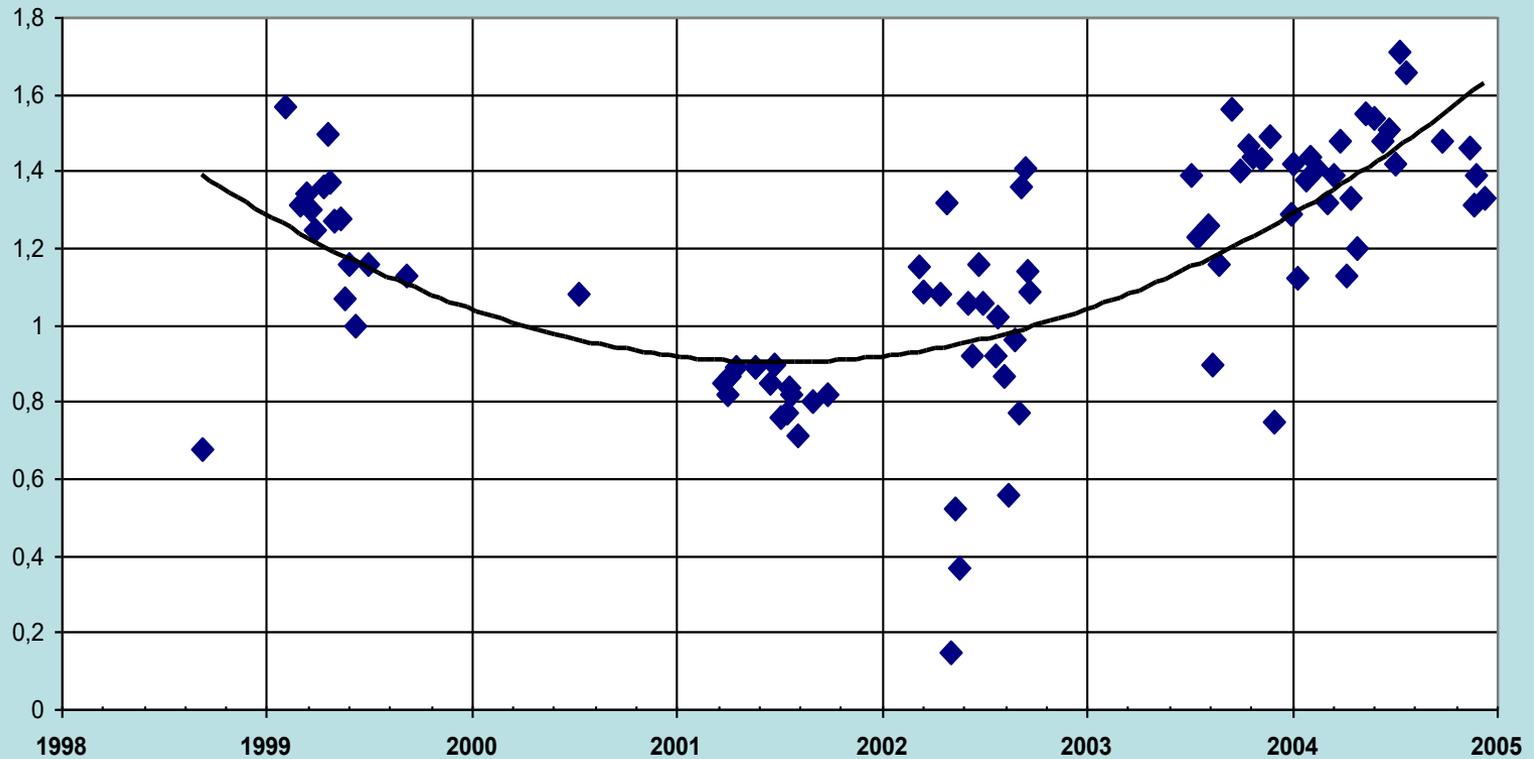
# Flux variations 3C 274 – Vir A in 23 solar cycle

3C274A25Cor



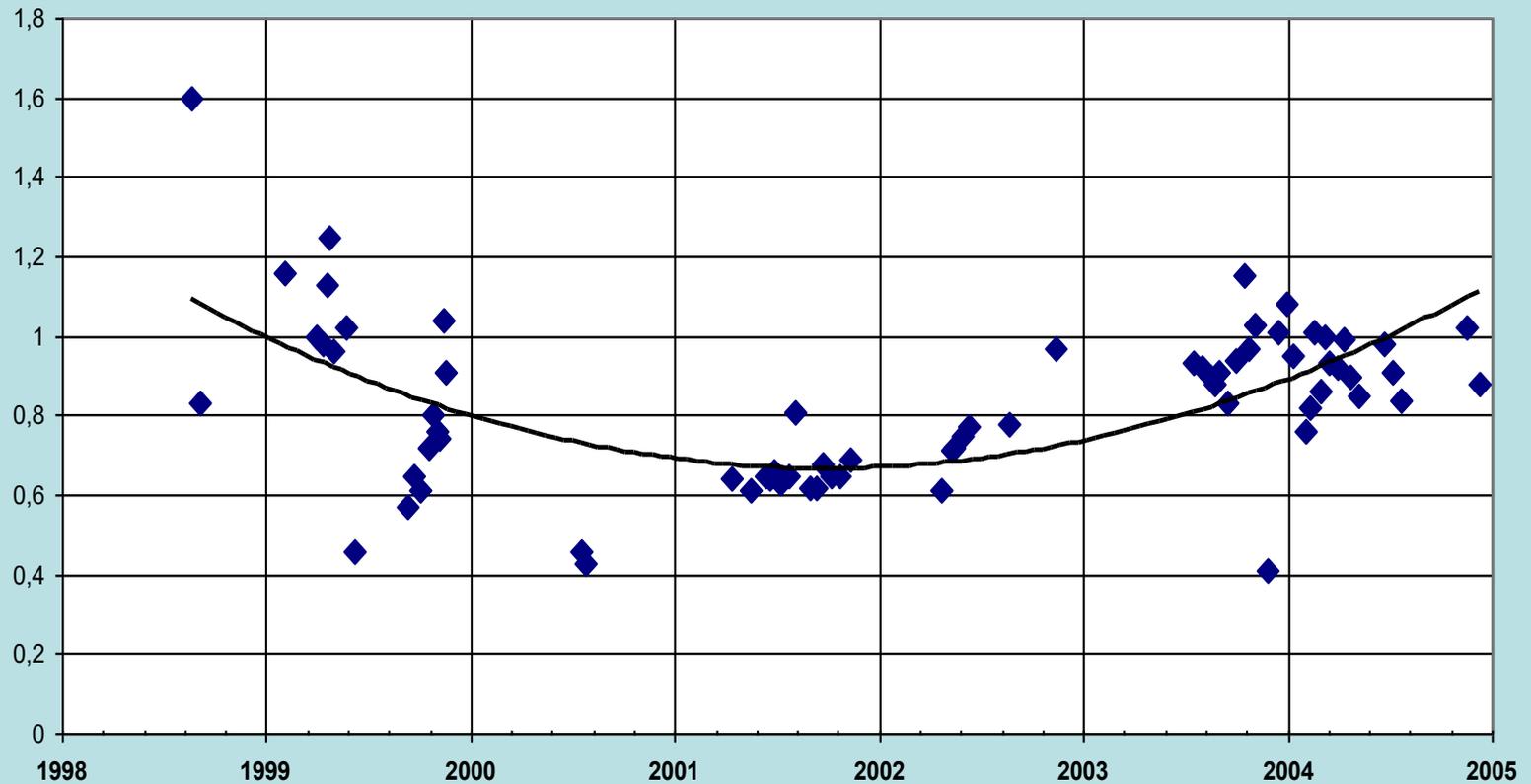
# Flux variations 3C 405 – Cyg A in 23 solar cycle

3C405A25



# Flux variations 3C 461 – Cas A in 23 solar cycle

3C461CorrA25



# Space weather on the Earth – what is it?

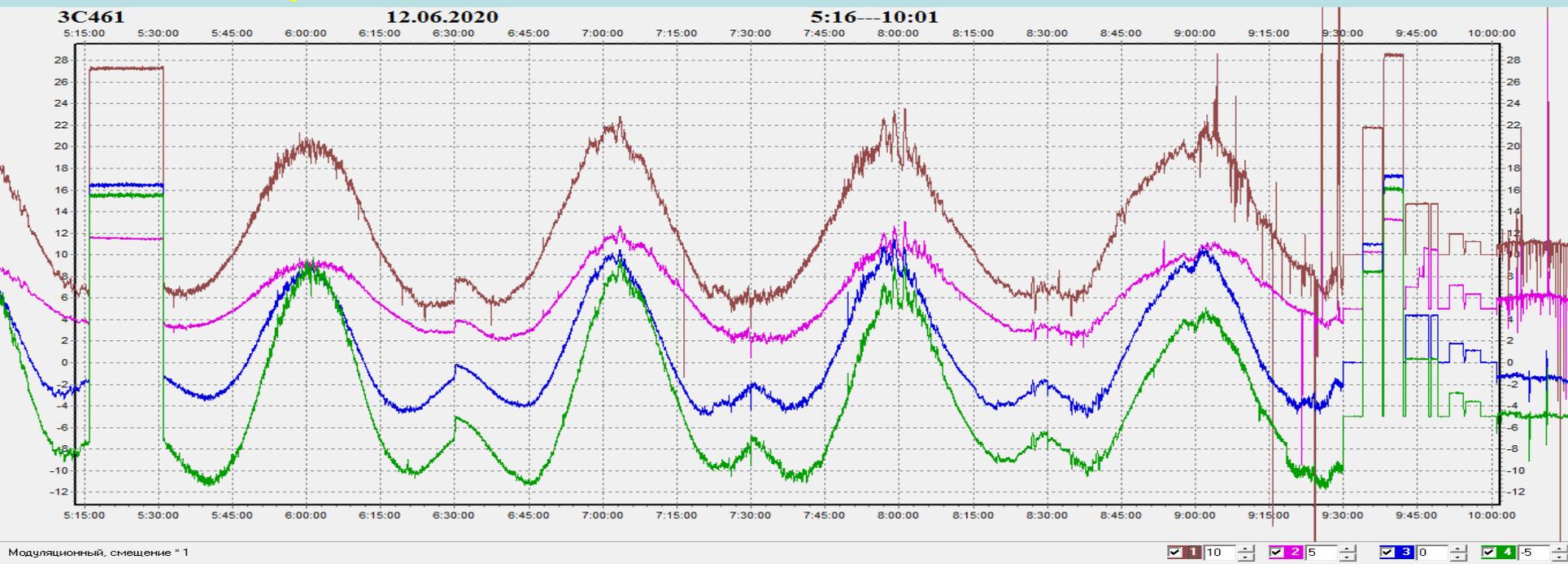
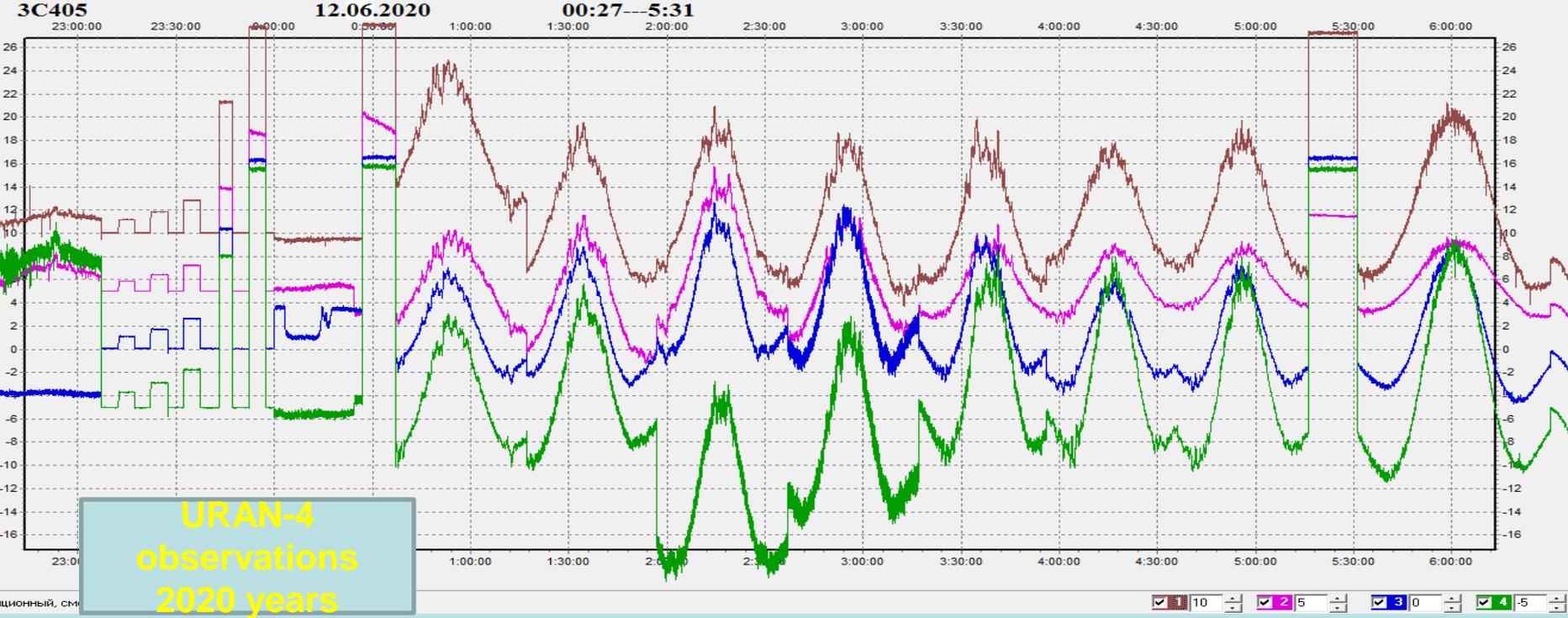
- Interaction of the Sun, the Moon and Earth form conditions of “space weather” on the Earth.
- **Structure of system:** Solar activity- Solar wind- Moon tides- Solar tides- Solar and Moon eclipse- Magnetosphere- Ionosphere- Atmosphere- Litosphere.

# Ionosphere and Extreme events of solar activity

- Odessa observatory “URAN-4” of Radio-astronomical Institutes of Ukrainian National Academy Sciences **39 years** on a radio-telescope «Uran- 4” conducts monitoring a condition Earth ionosphere using method supervision by its radiation powerful galactic and extragalactic of radiosources on frequencies **20 and 25 MHz** with application of methods of the forecast and analysis of condition of solar geomagnetic activity.

# RT URAN-4 Monitoring Data Structure

- In the period 1987 - 1993, observations were recorded in analog mode. Currently, these records are being digitized (details in the report of D. Zabora).
- From 2000 year to the present, recordings are made in digital form.
- Starting from 2025 year, modern broadband radiometers are used.



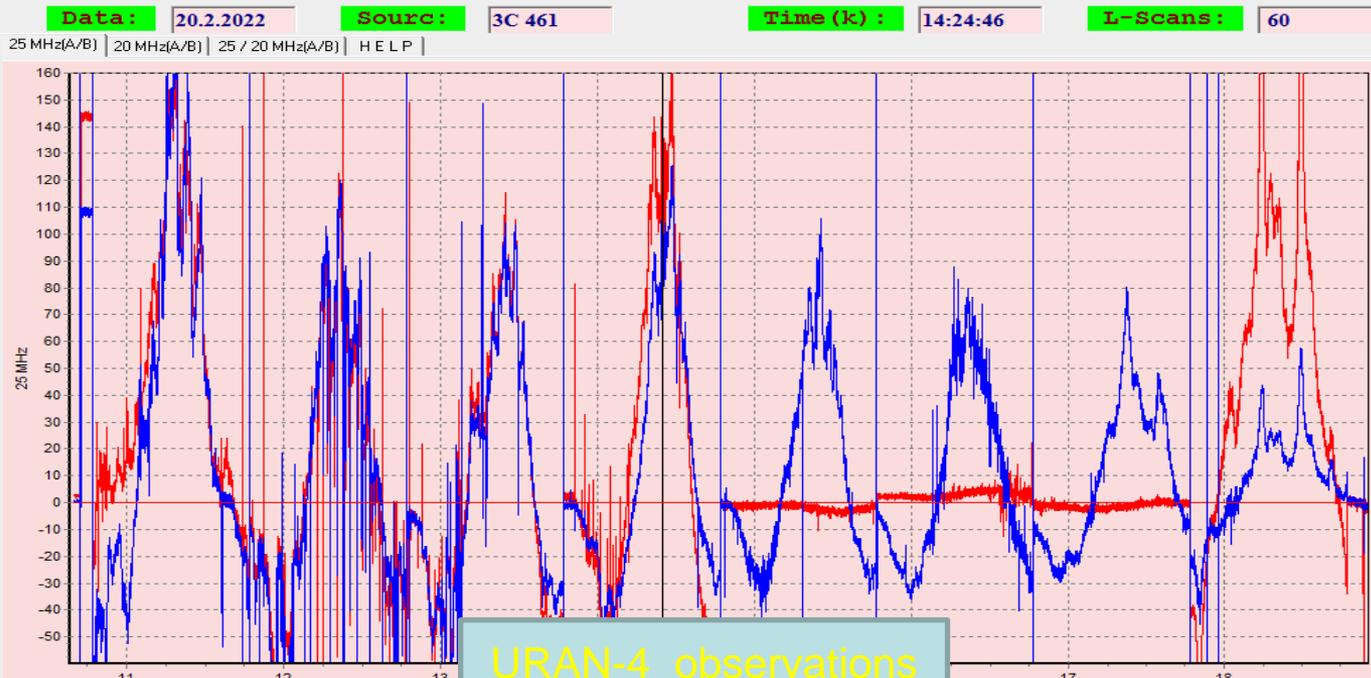
\*\*\*

Filename : 20Feb0901.ru4  
 Data : 20.2.2022  
 Data (MJD) : 2459631  
 Sourc : 3C 461  
 Time (k) : 14:24:46  
 Time (h) : 10:40:10  
 ScanB : -180  
 ScanE : 240  
 LScan : 60  
 N/B\_Scans : 10  
 Diskret. : 40  
 Modul. : 20  
 Faza Mod. : 1  
 Attenu (dB) Ap. : 8  
 Attenu (dB) K1 : 22  
 Freq. 1 (MHz) A/B : 24.600  
 Freq. 2 (MHz) A/B : 19.600  
 Faza [1]  Faza [0]

Type

Gr. Out  Gr.[1-2] / Gr.[3]

Normal.  
 Sum. /2  
 Puzitiv.  
 Negativ.  
 Modul.



URAN-4 observations  
Feb 2022 years

\*\*\*

Filename : 22Feb0902.ru4  
 Data : 22.2.2022  
 Data (MJD) : 2459633  
 Sourc : 3C 461  
 Time (k) : 14:16:54  
 Time (h) : 10:32:20  
 ScanB : -180  
 ScanE : 240  
 LScan : 60  
 N/B\_Scans : 10  
 Diskret. : 40  
 Modul. : 20  
 Faza Mod. : 1  
 Attenu (dB) Ap. : 8  
 Attenu (dB) K1 : 22  
 Freq. 1 (MHz) A/B : 24.600  
 Freq. 2 (MHz) A/B : 19.600  
 Faza [1]  Faza [0]

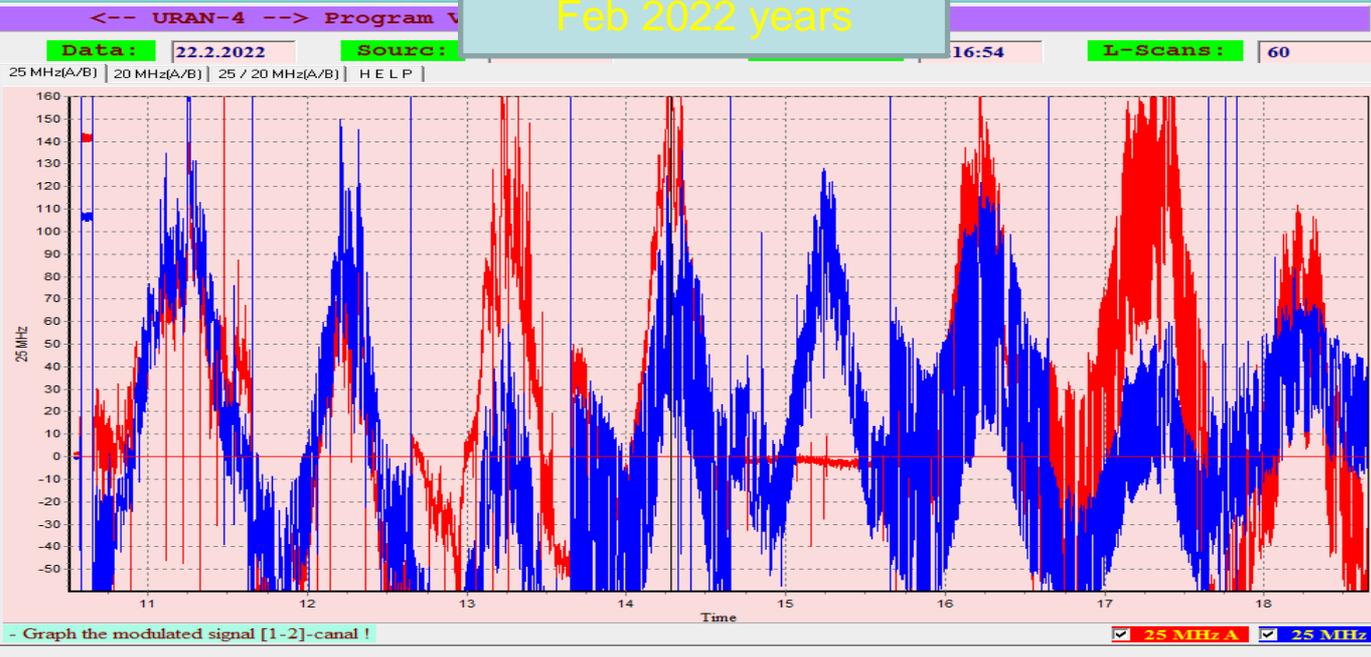
Type

Gr. Out  Gr.[1-2] / Gr.[3]

Normal.  
 Sum. /2  
 Puzitiv.  
 Negativ.  
 Modul.

V  X  O  K  I

Step: 0

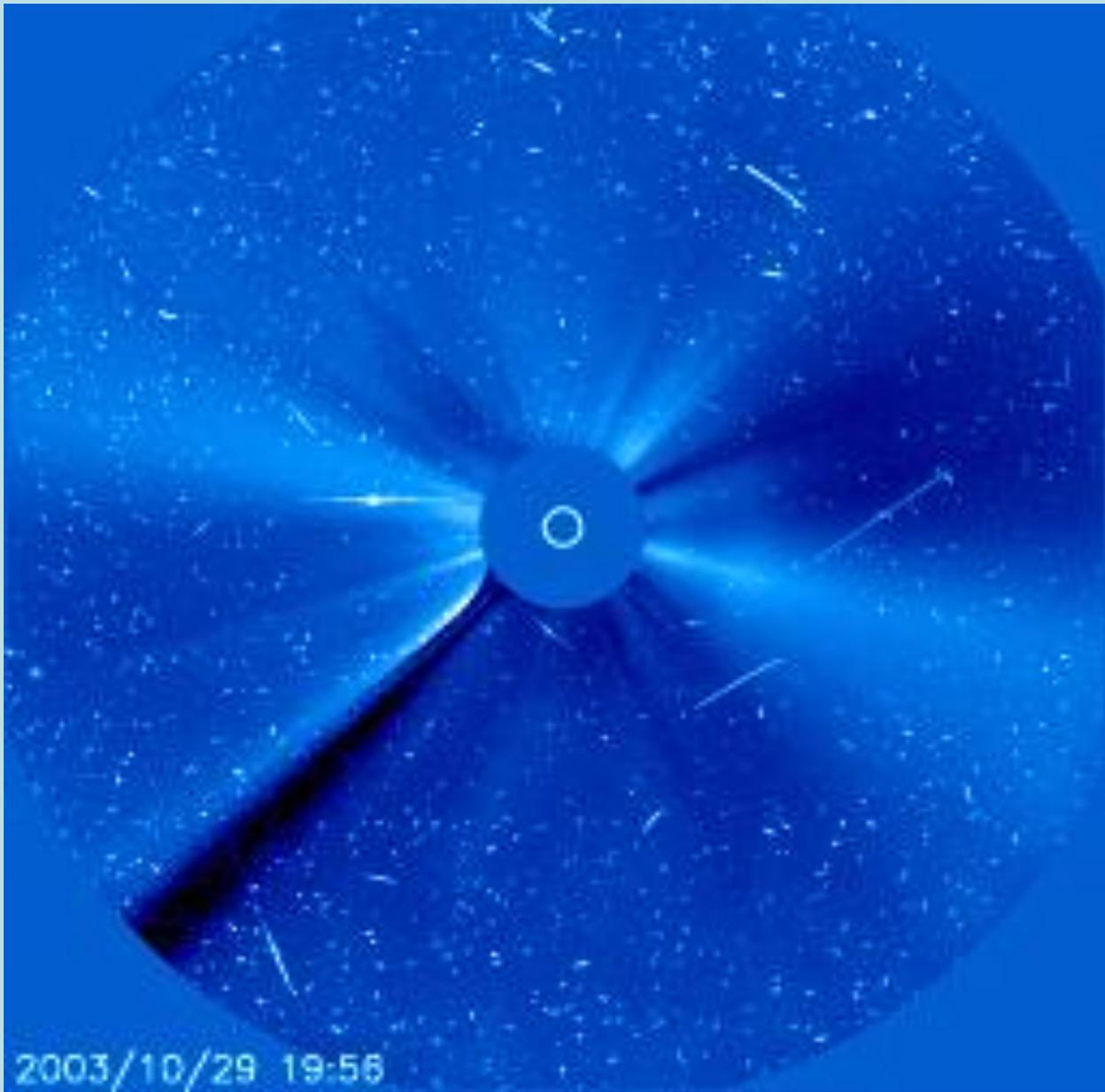


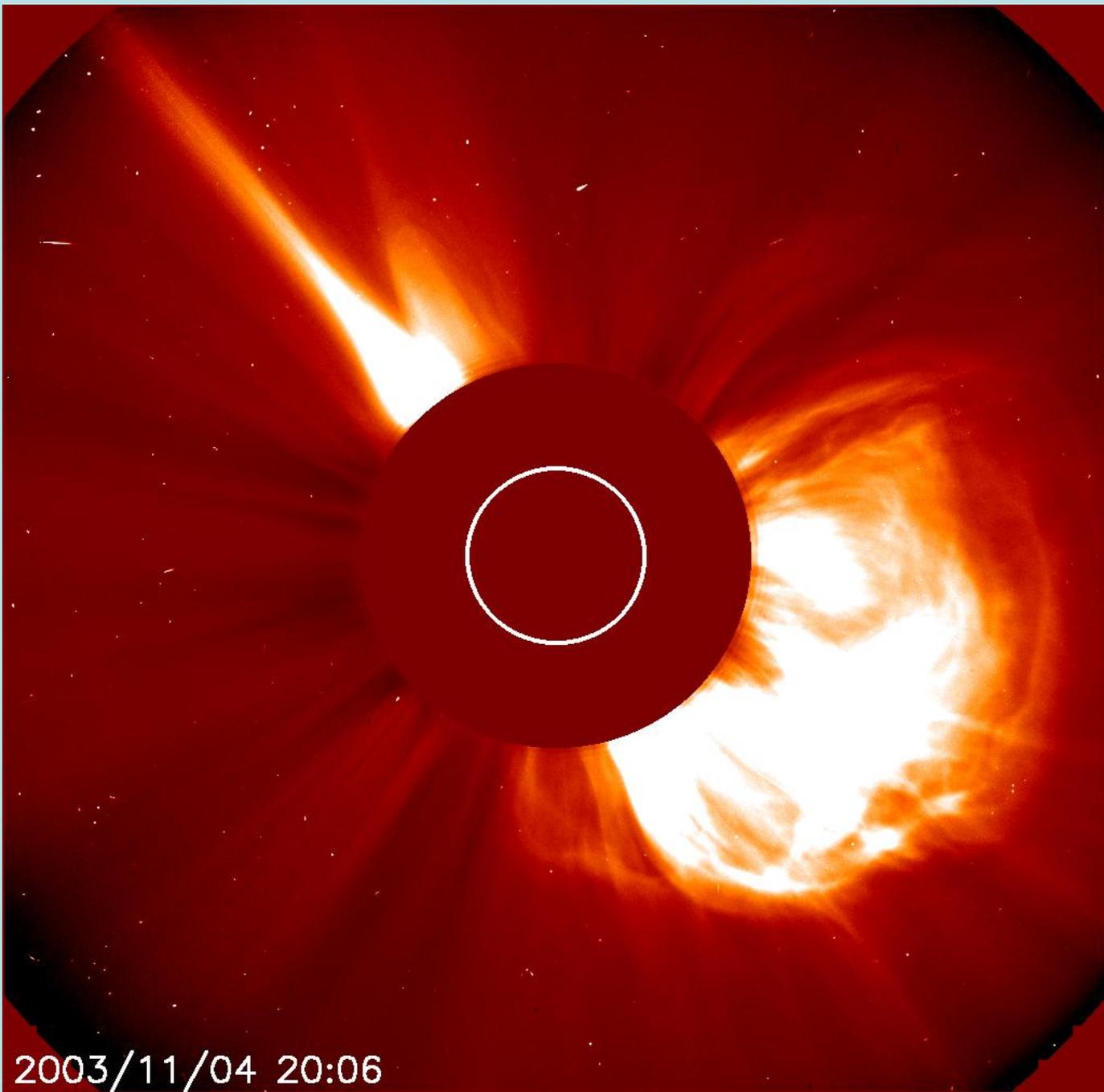
# Recording Space Weather Events on RT URAN-4

- 1. Manifestation of the effects of powerful solar flares and radio blackouts
- 2. Effects of magnetic storms in the ionosphere.
- 3. Effects of solar and lunar eclipses.
- 4. Passage of the forward and reverse lunar tidal wave in the ionosphere.
- 5. In cooperation with the Institute of Geophysics of the NASU, monitoring of the disturbance of the geomagnetic field in the zone of the Odessa magnetic anomaly is carried out.

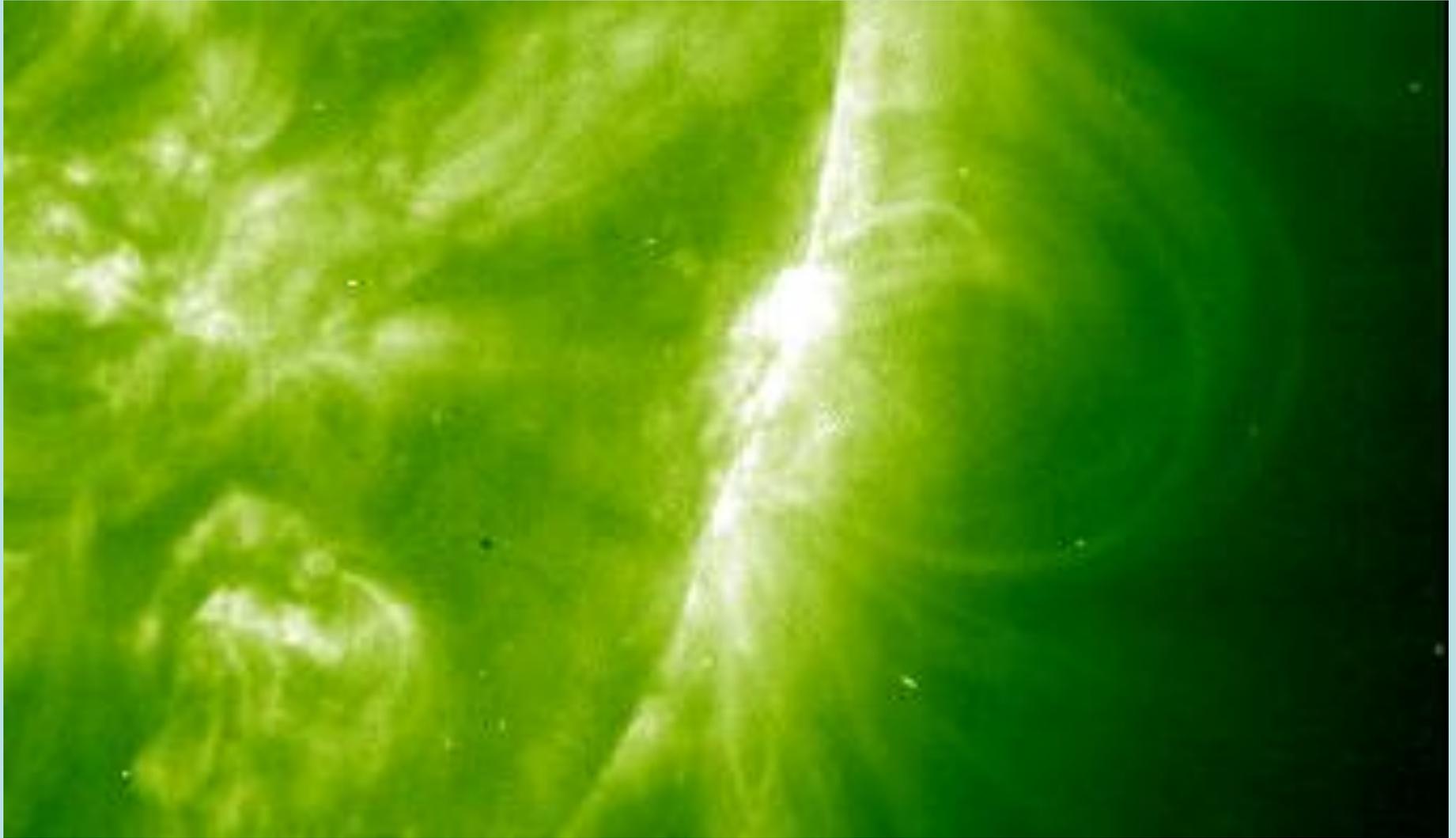
**October – December 2003**

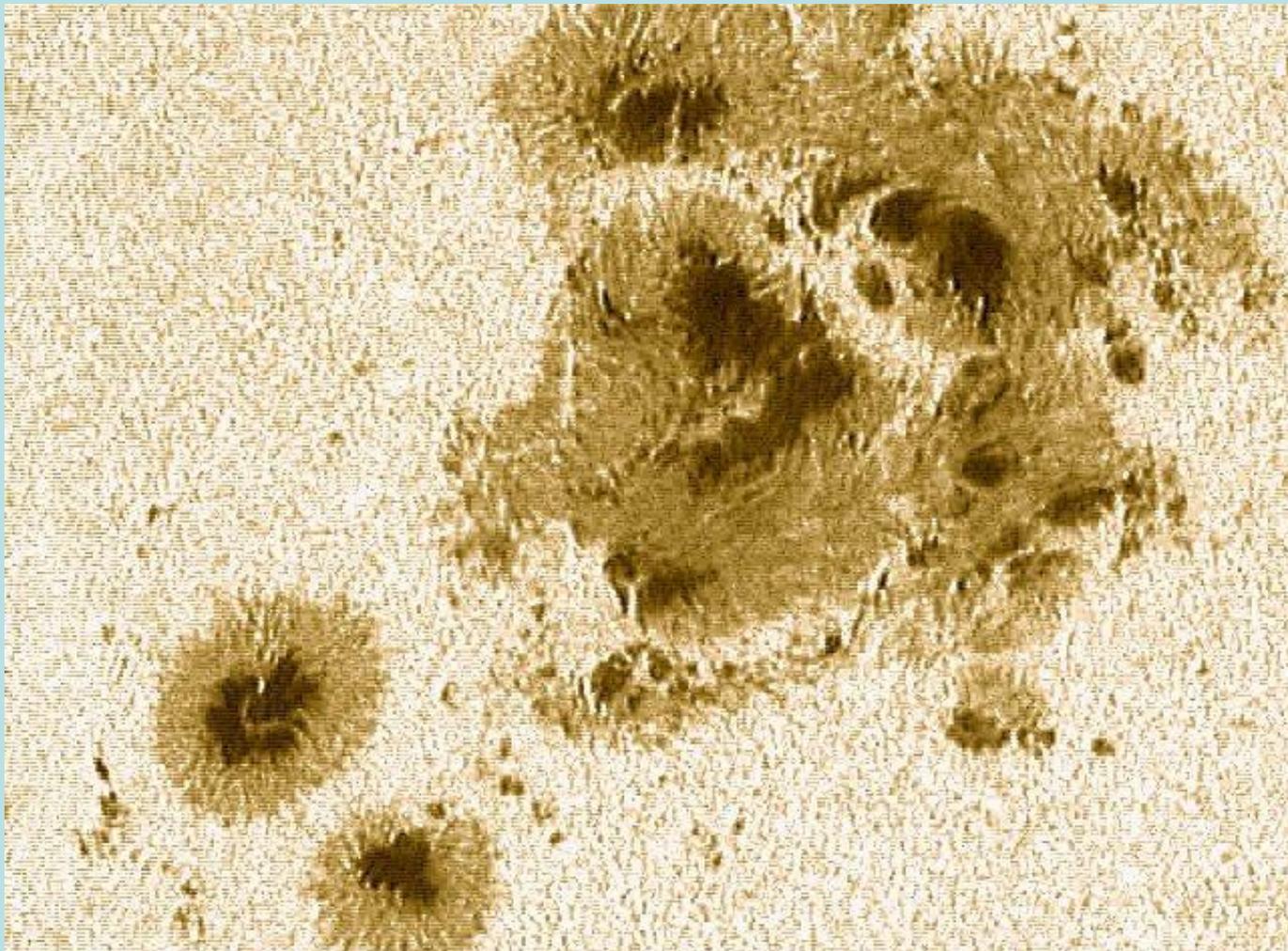
**Extreme Solar and  
geophysical events**





2003/11/04 20:06





**Sunspot Group 10486 29 October, 2003 18:20 UT**

Donald C. Parker, Coral Gables, FL  
10-in Mewlon @f-12, ToUCam Pro Single Frame  
1/2500 sec., Baader Filter



Earth



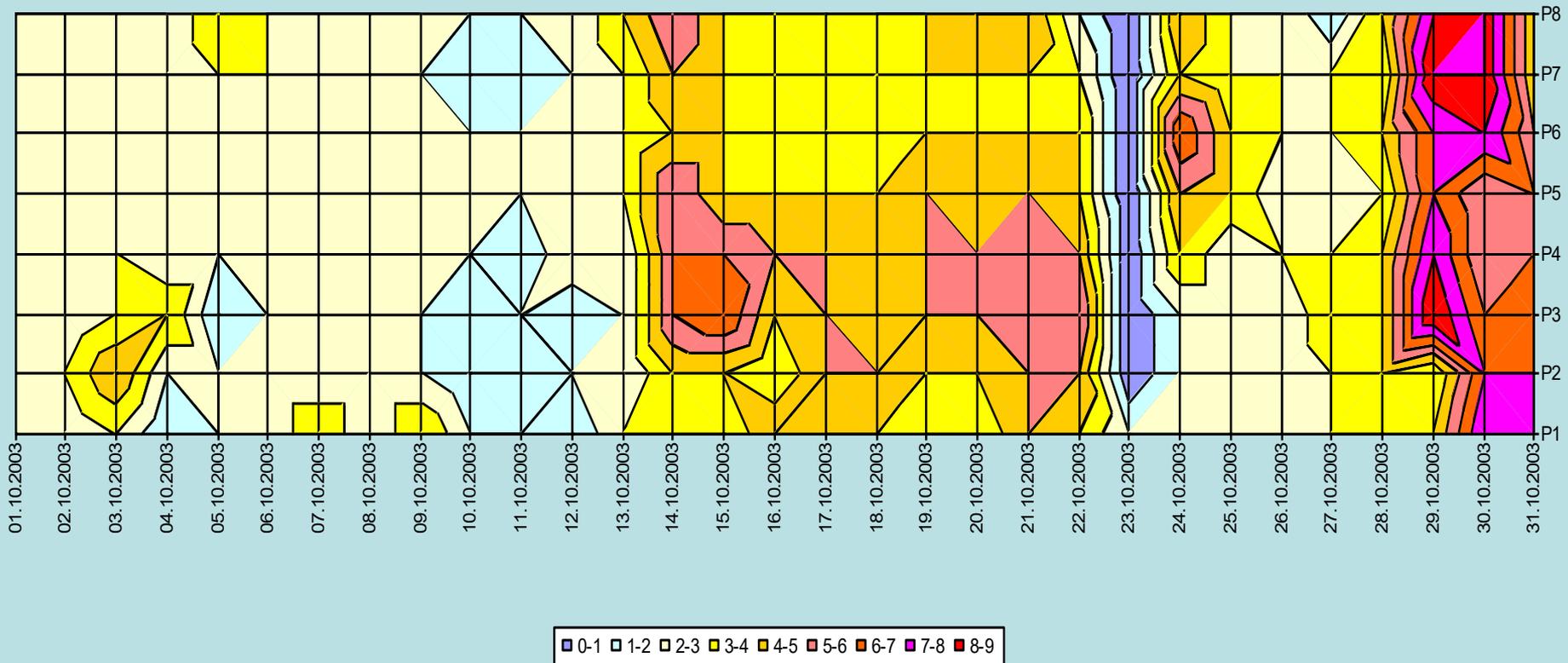
# Solar flare and magnetic Storms.

Дата	Начало UT	Длит. мин	Координаты φ λ	Балл	$I_{RB}$	Pr (p.f.u.) $I_{Pr}$	Магнитные бури; $I_{ms}$
19.10.03	1629	79	N06E58	X1.1/1N	R3		
22.10.03	1945	>41	S20E90	M9.9	R2		
23.10.03	0817	64	S21E88	X5.4/1B	R3		
23.10.03	1950	38	S17E84	X1.1/1N	R3		
24.10.03	0222	66	S19E72	M7.6/1N	R2		
26.10.03	0517	213	S17E38	X1.2/3B	R3	323 S2	M 28.10 G1
26.10.03	1717	179	N02W38	X1.2/1N	R3	466 S2	M 28.10 G1
26.10.03	2126	60	N01W38	M7.6/2N	R2		
27.10.03	0921	23	S16E26	M5.0/1F	R2		
27.10.03	1227	37	S17E25	M6.7/1F	R2		
28.10.03	0951	>269	S16E08	X17.2/4B	R5	29500 S4	ОБ 29-30.10 G5
29.10.03	2037	136	S15W02	X10.0/2B	R4	330 S2	ОБ 31.10 G4
02.11.03	1703	171	S14W56	X8.3/2B	R3	1540 S3	M 04.11 G2
03.11.03	0106	91	N10W83	X2.7/2B	R3		
03.11.03	0943	>36	N08W77	X3.9/2F	R3		
04.11.03	1929	80	S19W83	X28/3B	R5	353 S2	
05.11.03	1046	>12	S16W90	M5.3/SF	R2		
18.11.03	0716	159	N00E18	2N/M3.2/M3.9	R1		ОБ 20-21.11 G5
20.11.03	0735	61	N01W08	M9.6/2B	R2	10 S1	22.11 G1
20.11.03	2342	.16	N00W17	M5.8/2N	R2		

# Magnetic Storms

## October 2003

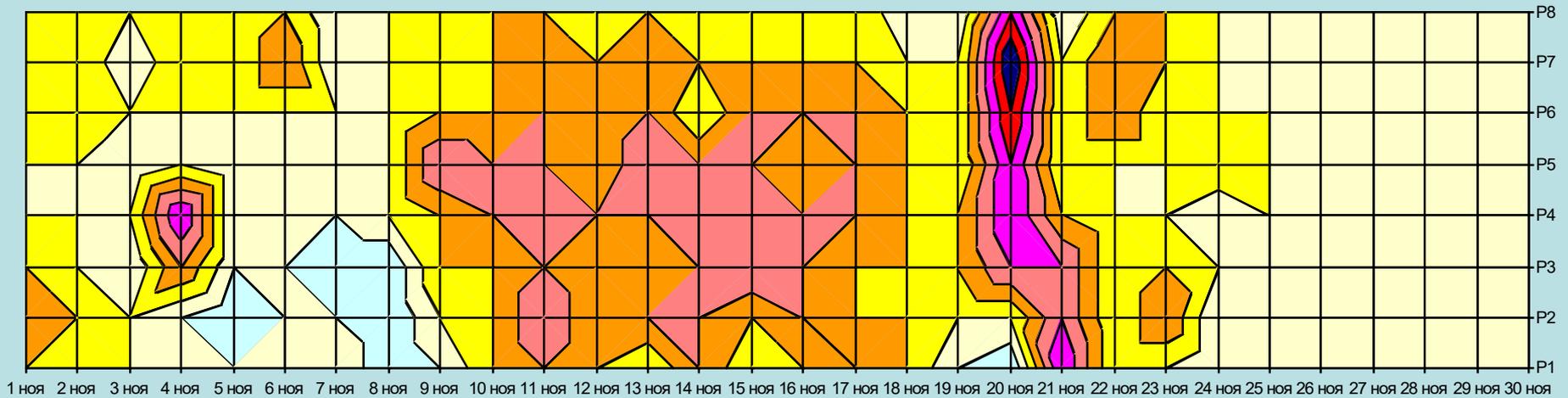
Oct03Plan



# Magnetic Storms

November 2003

Nov03PI

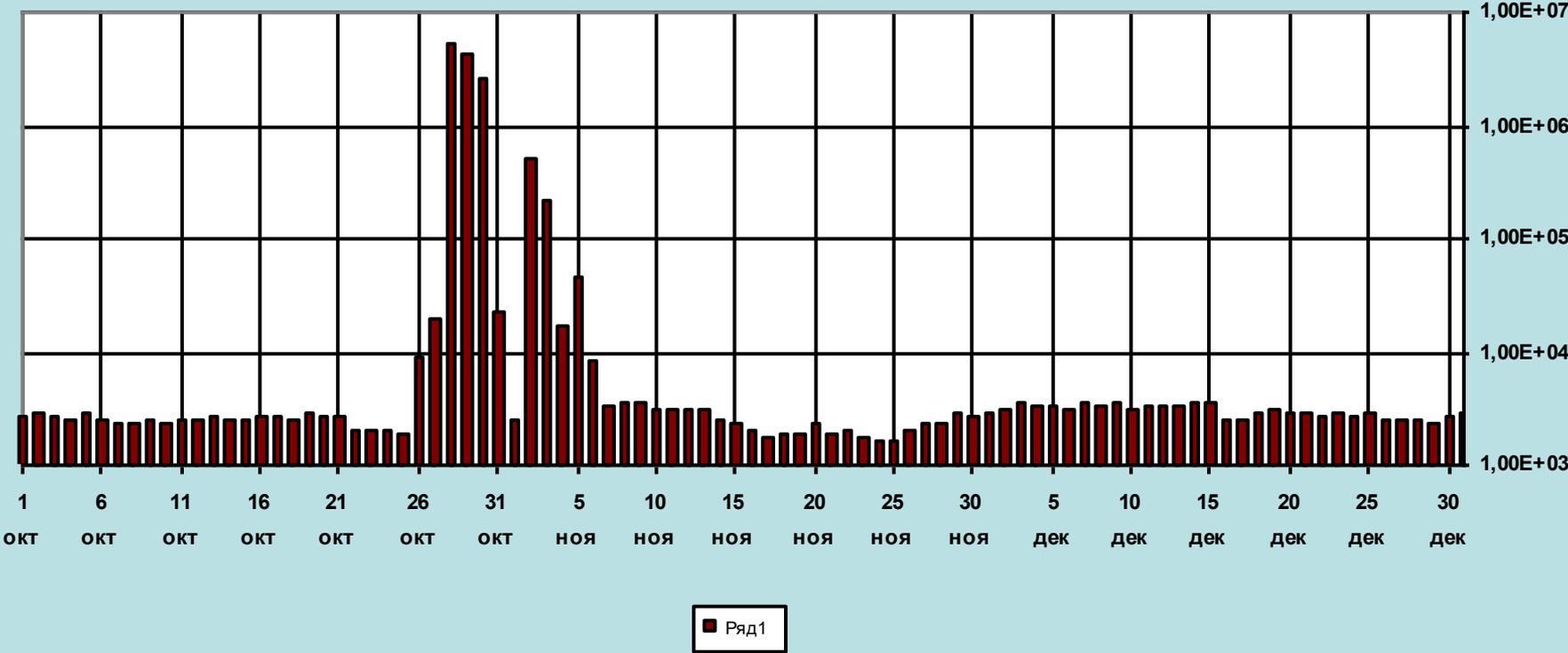


0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9

# Protons

## 100 Mev

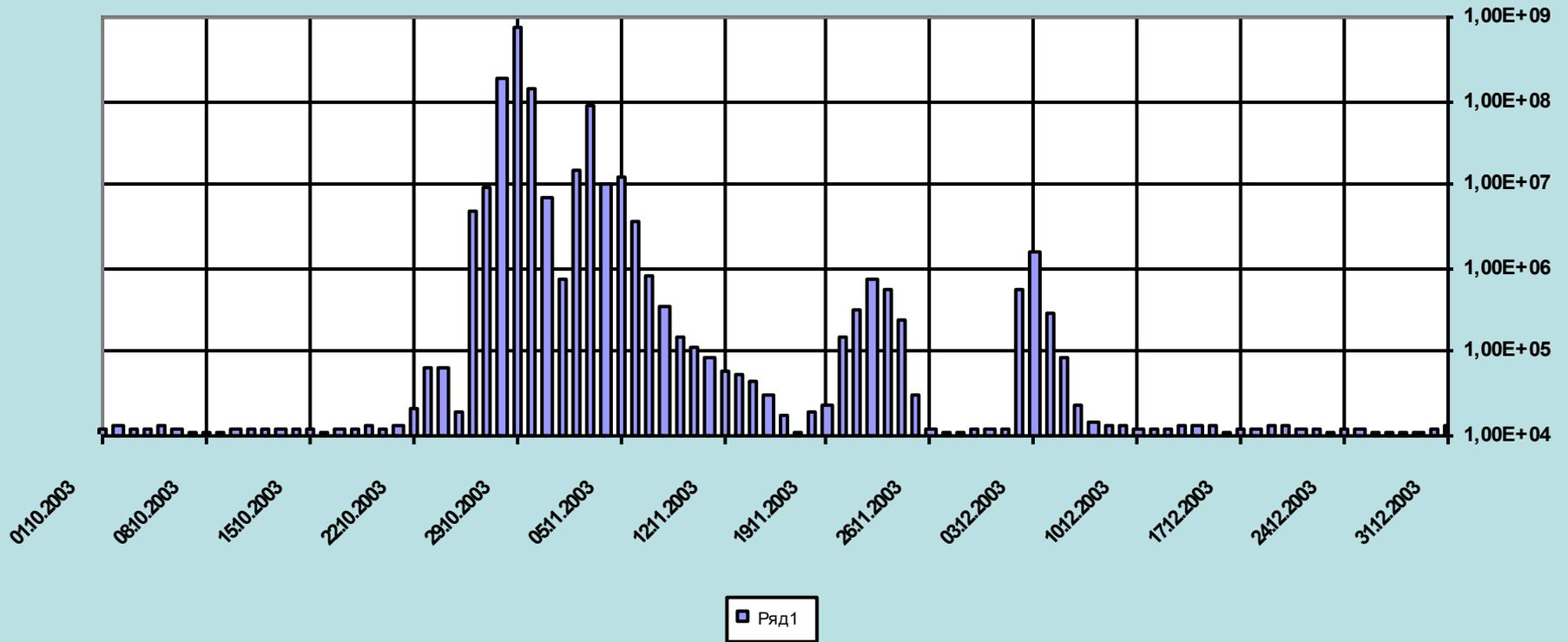
100MevProt



# Protons

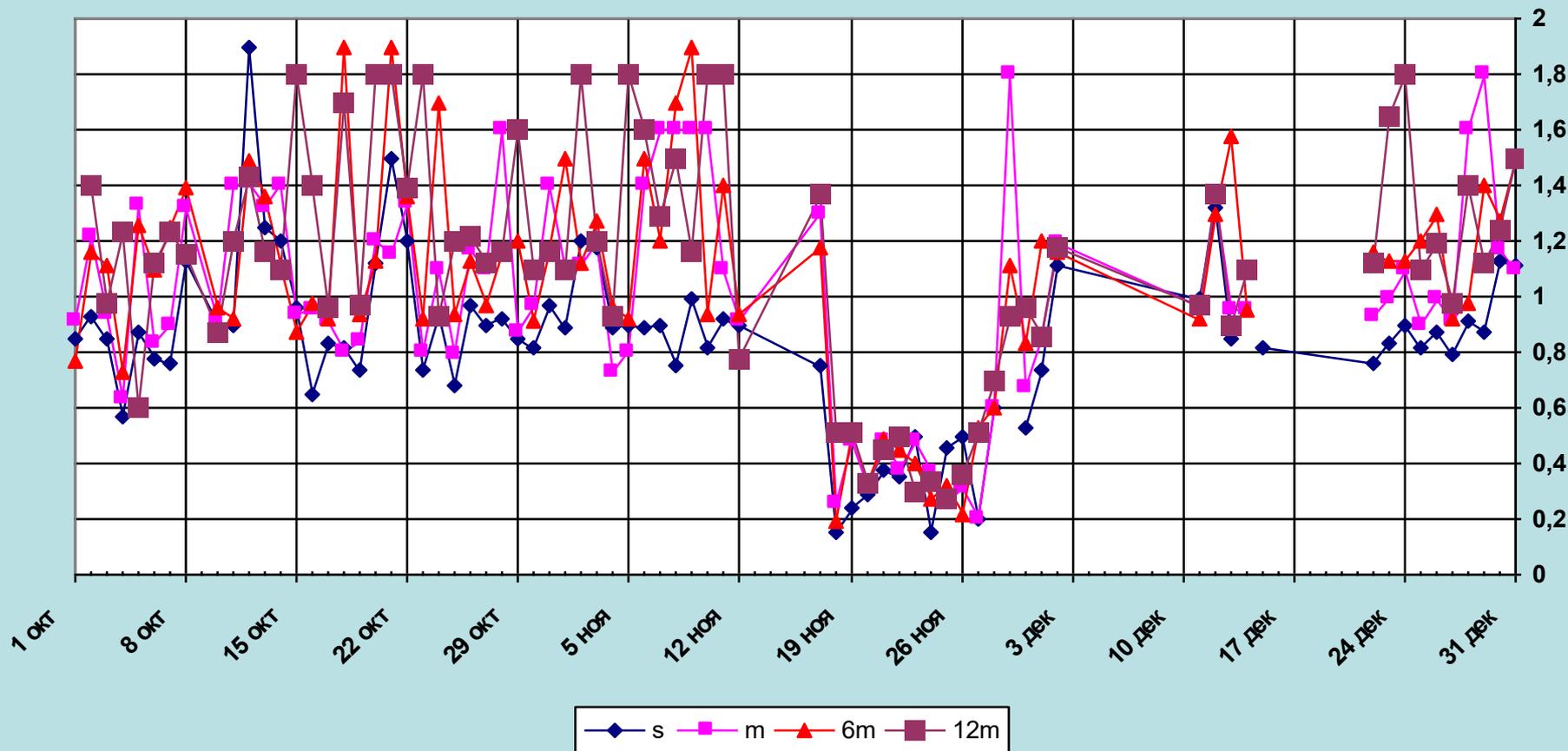
## 10 Mev

Prot10 Mev



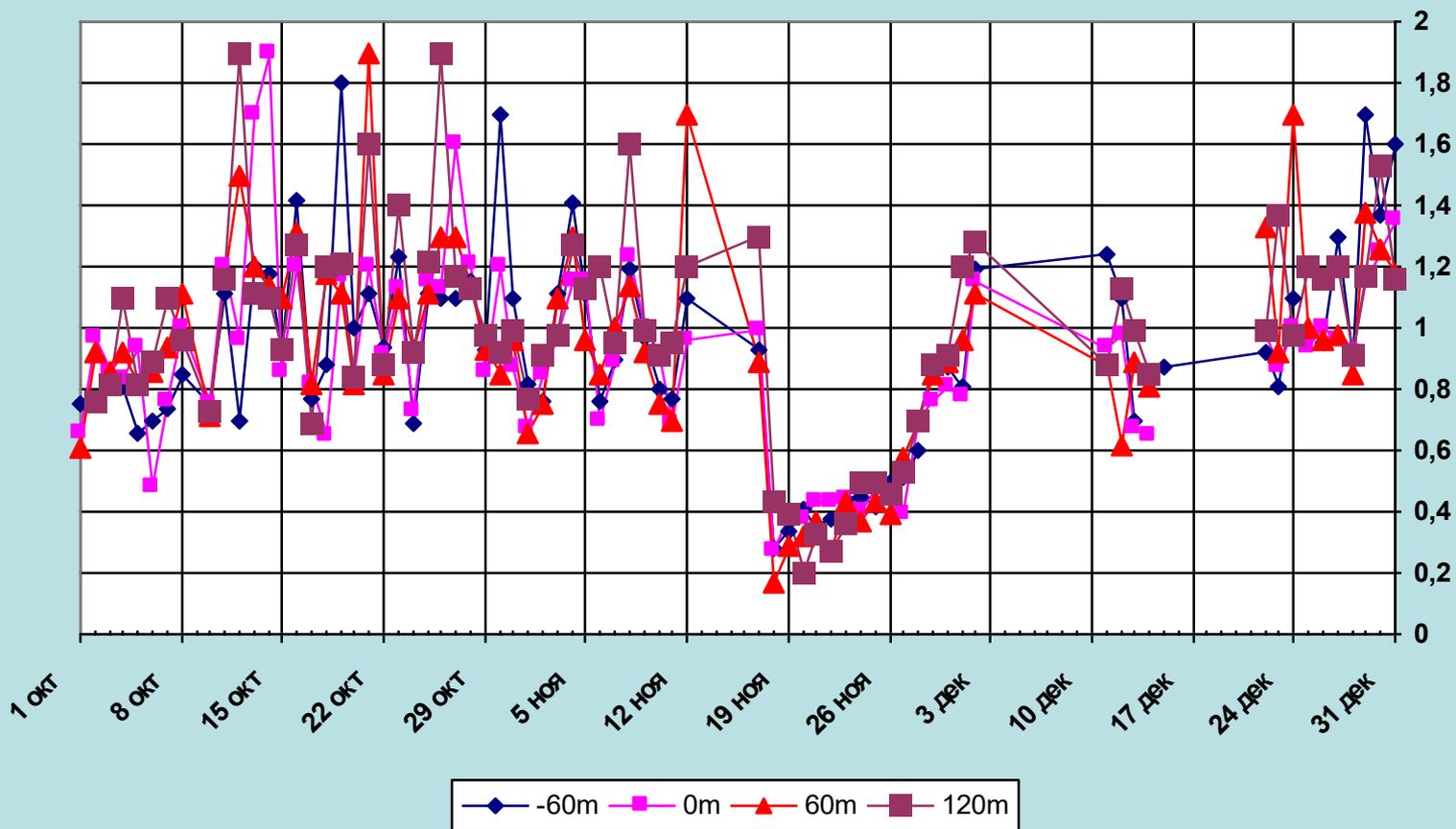
# Flux variations 3C461 (25 MHz)

3C461a103

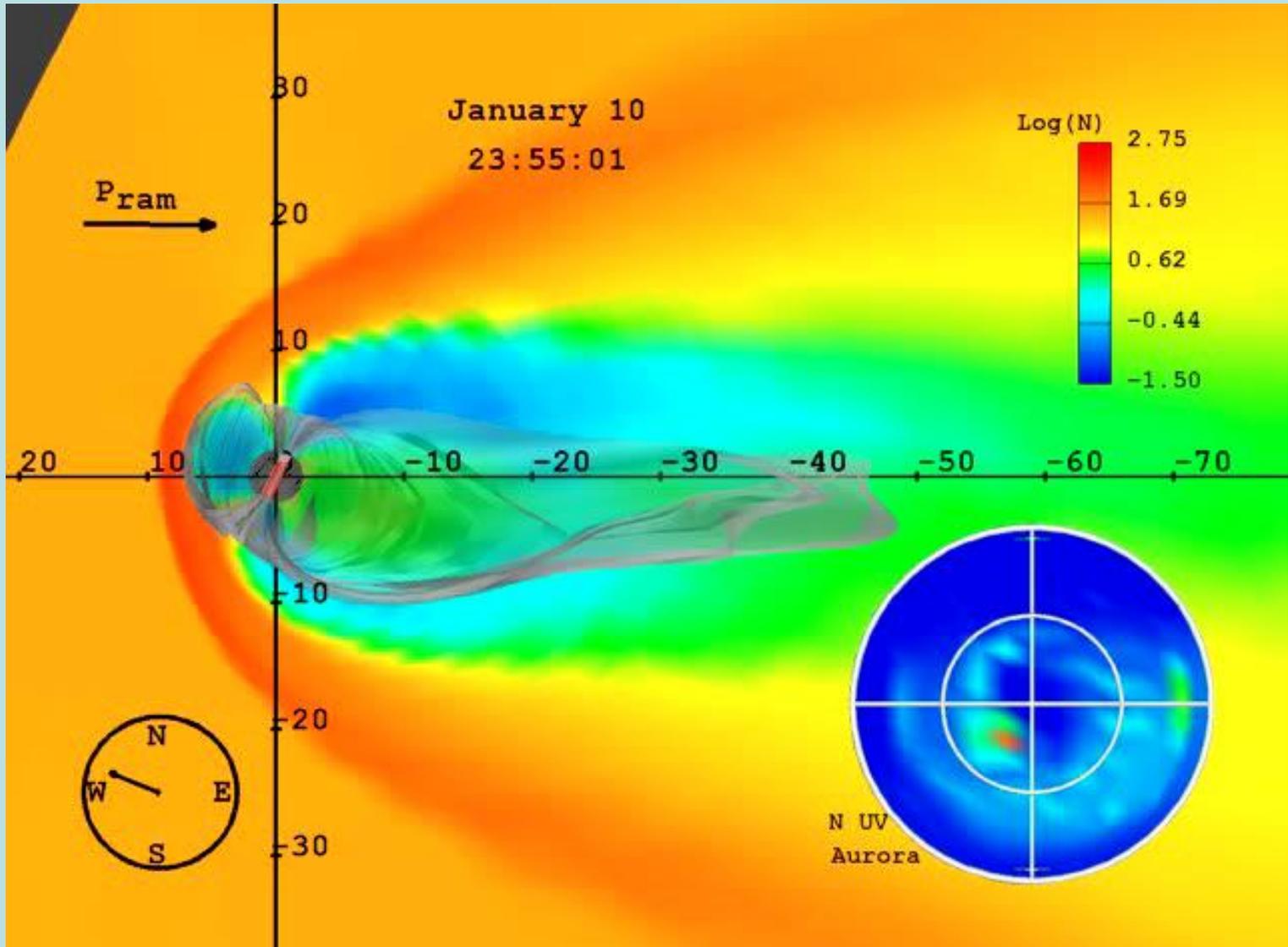


# Flux variations 3C461 (20 MHz)

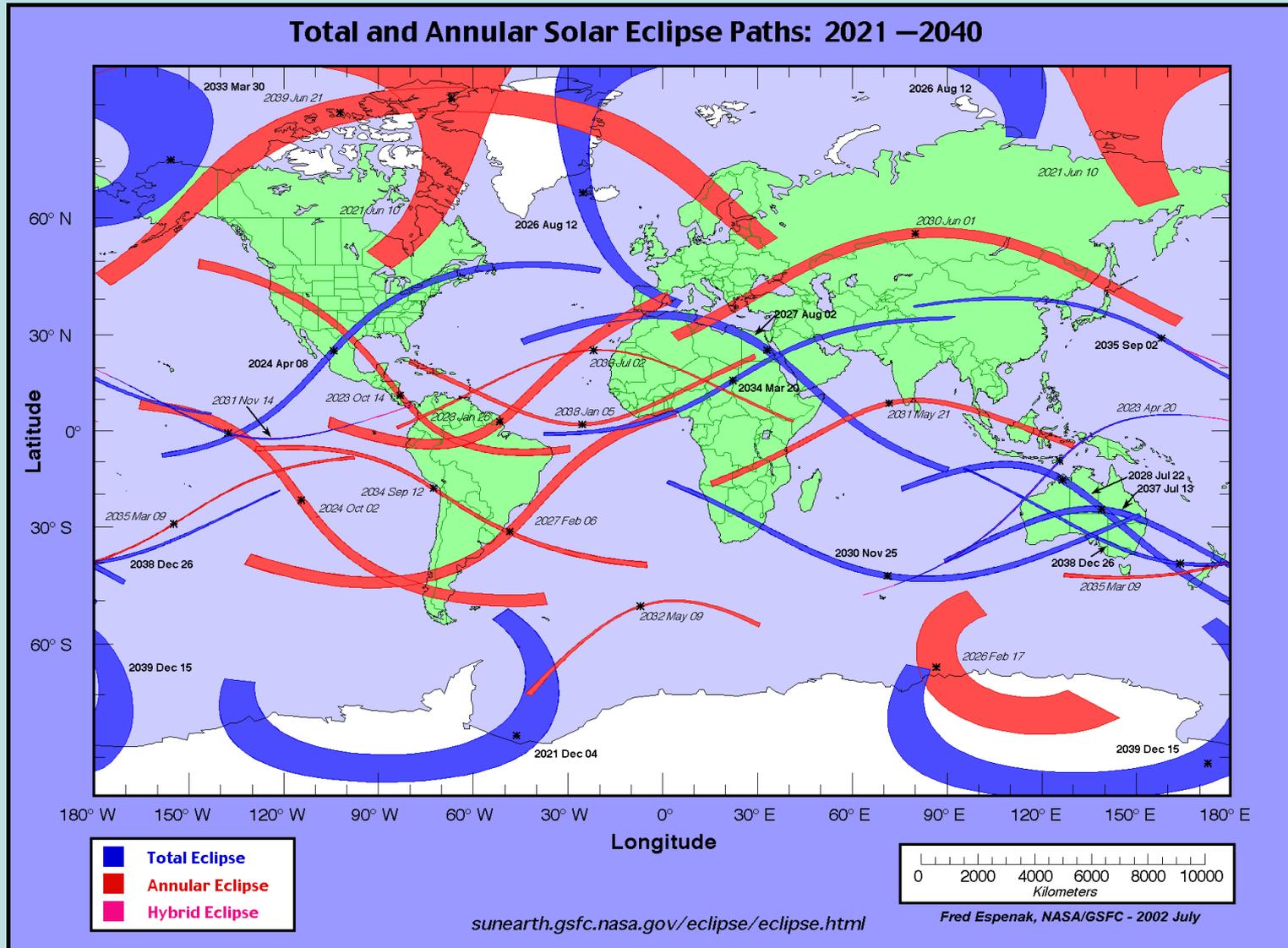
3C461a203



# Magnetic storm

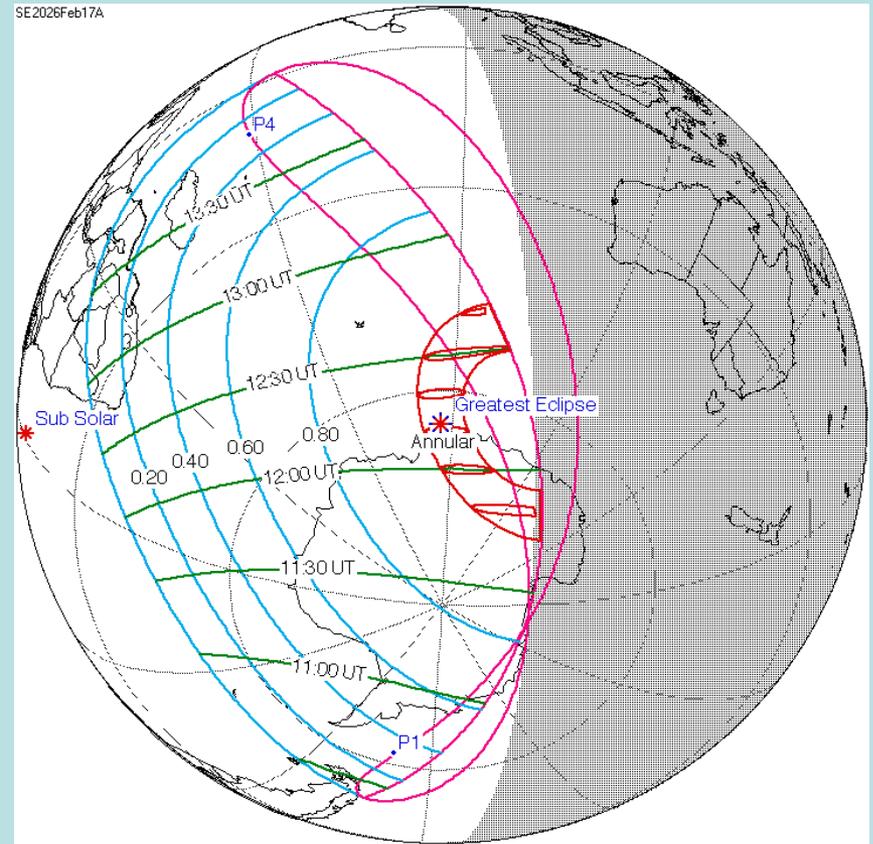
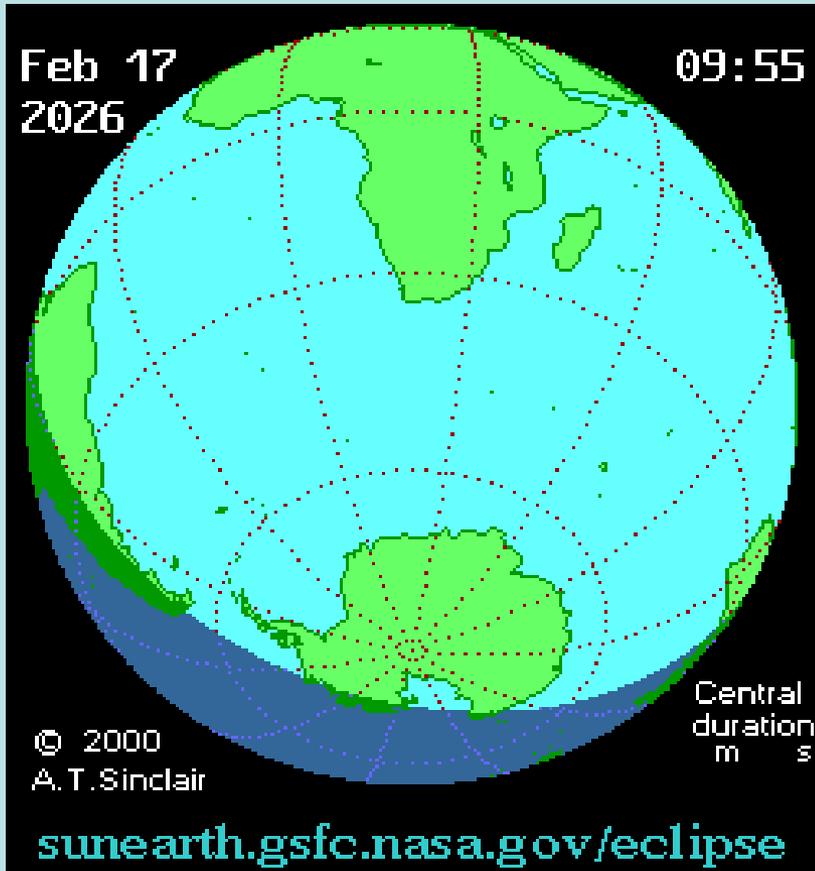


# Ionosphere and Solar Eclipse

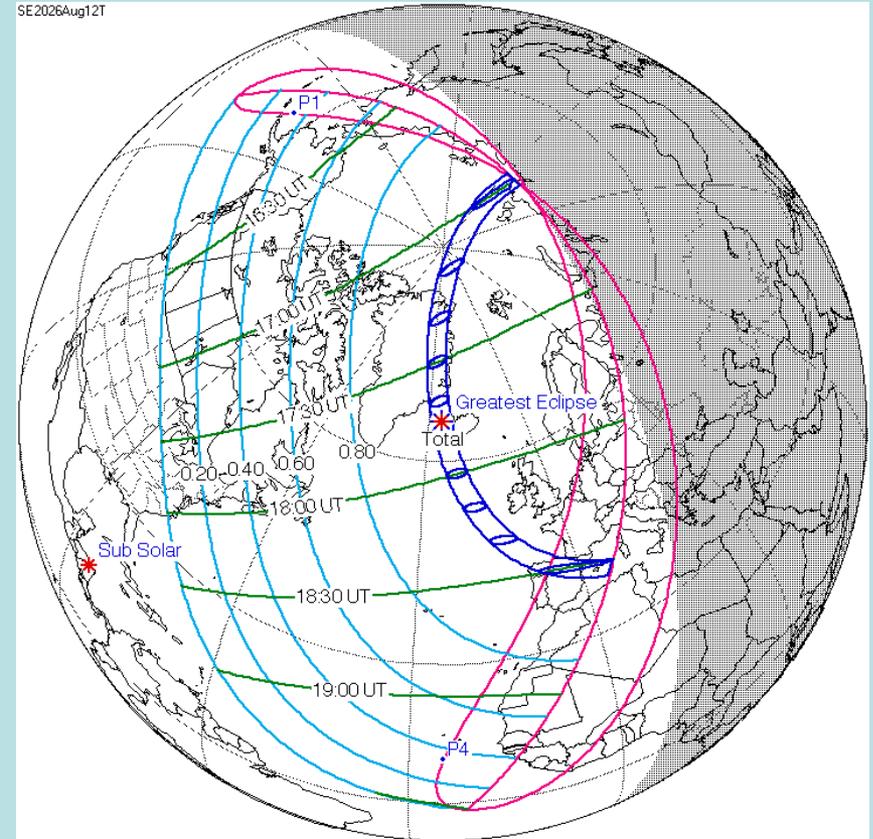
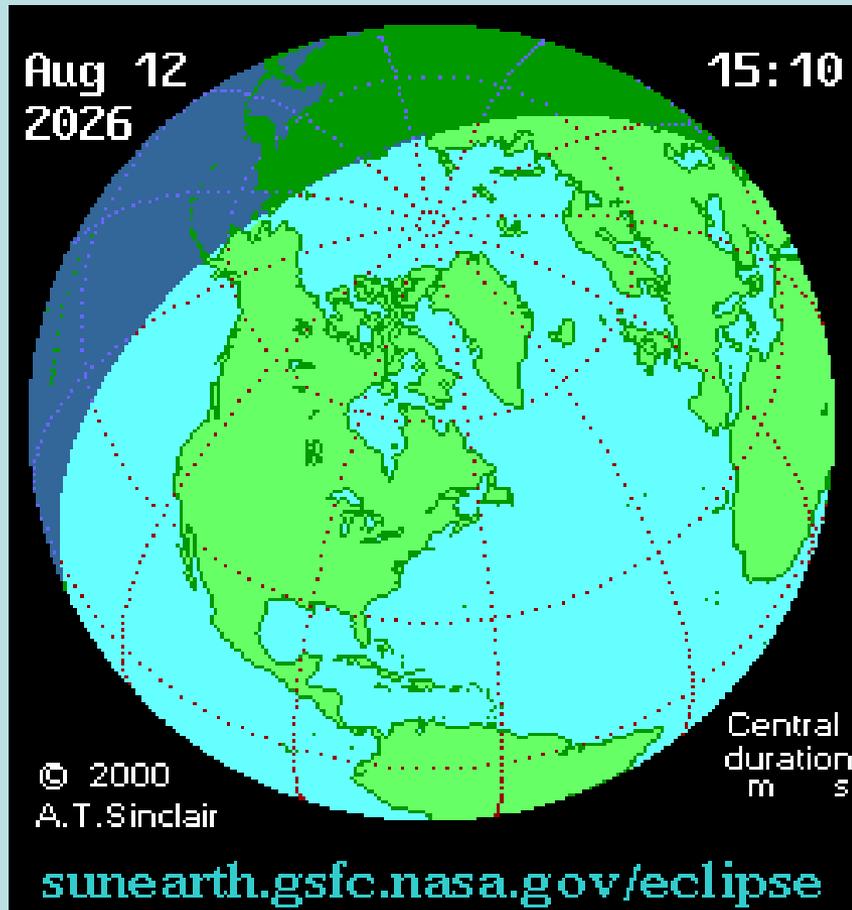


# Solar eclipse

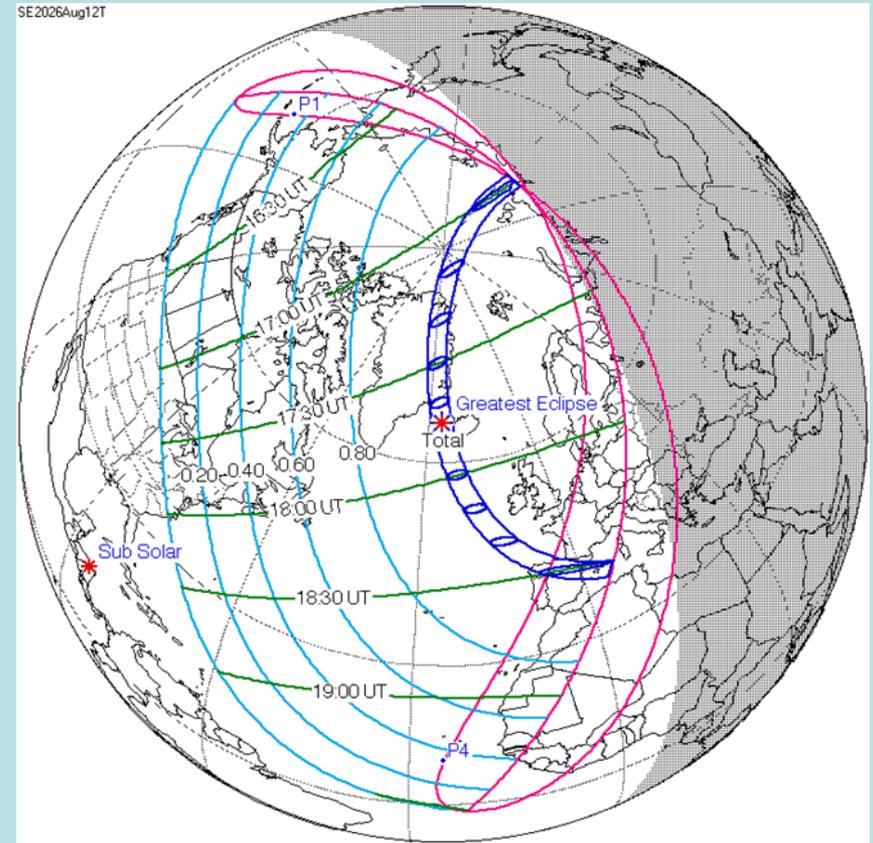
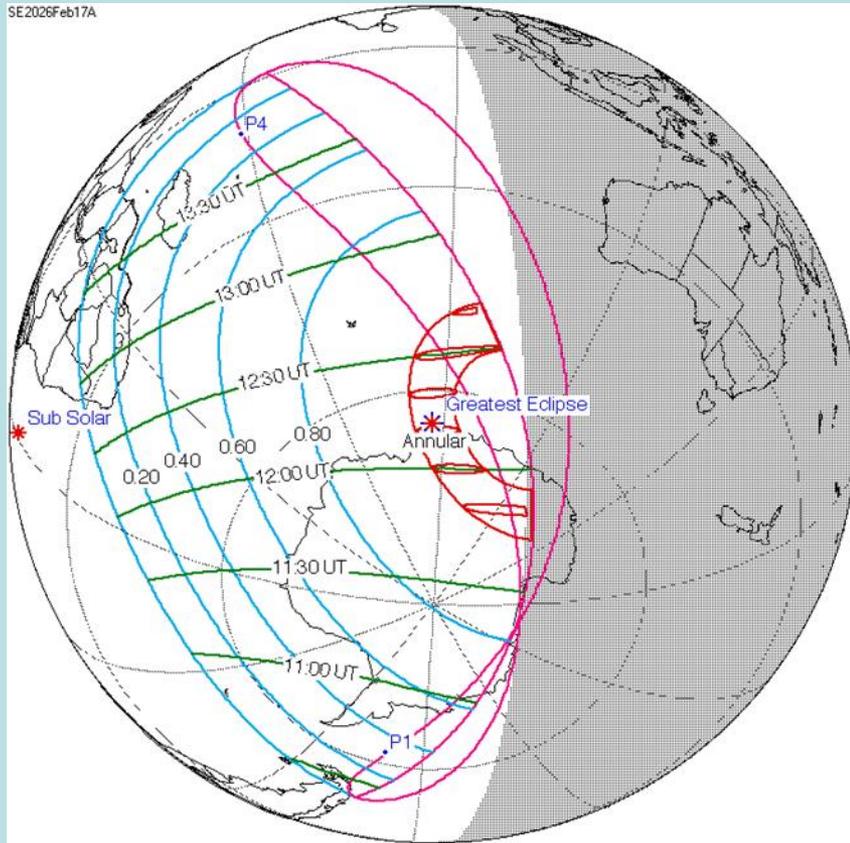
## February 17, 2026



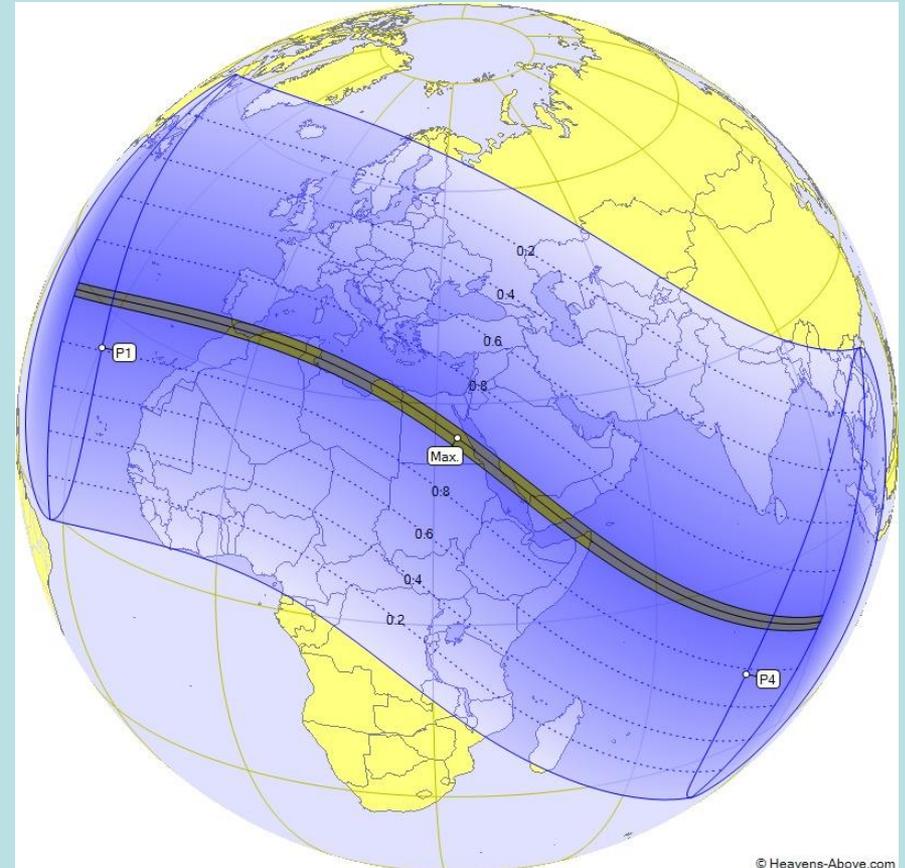
# Solar eclipse on August 12, 2026



# Solar eclipse in 2026 year ( 17 February and 12 August)



# Perspective total eclipse August 2, 2027 in Egypt



# March 14, 2025 – lunar eclipse on Earth and solar eclipse on the Moon.

## Total Lunar Eclipse of March 14 2025



From Earth

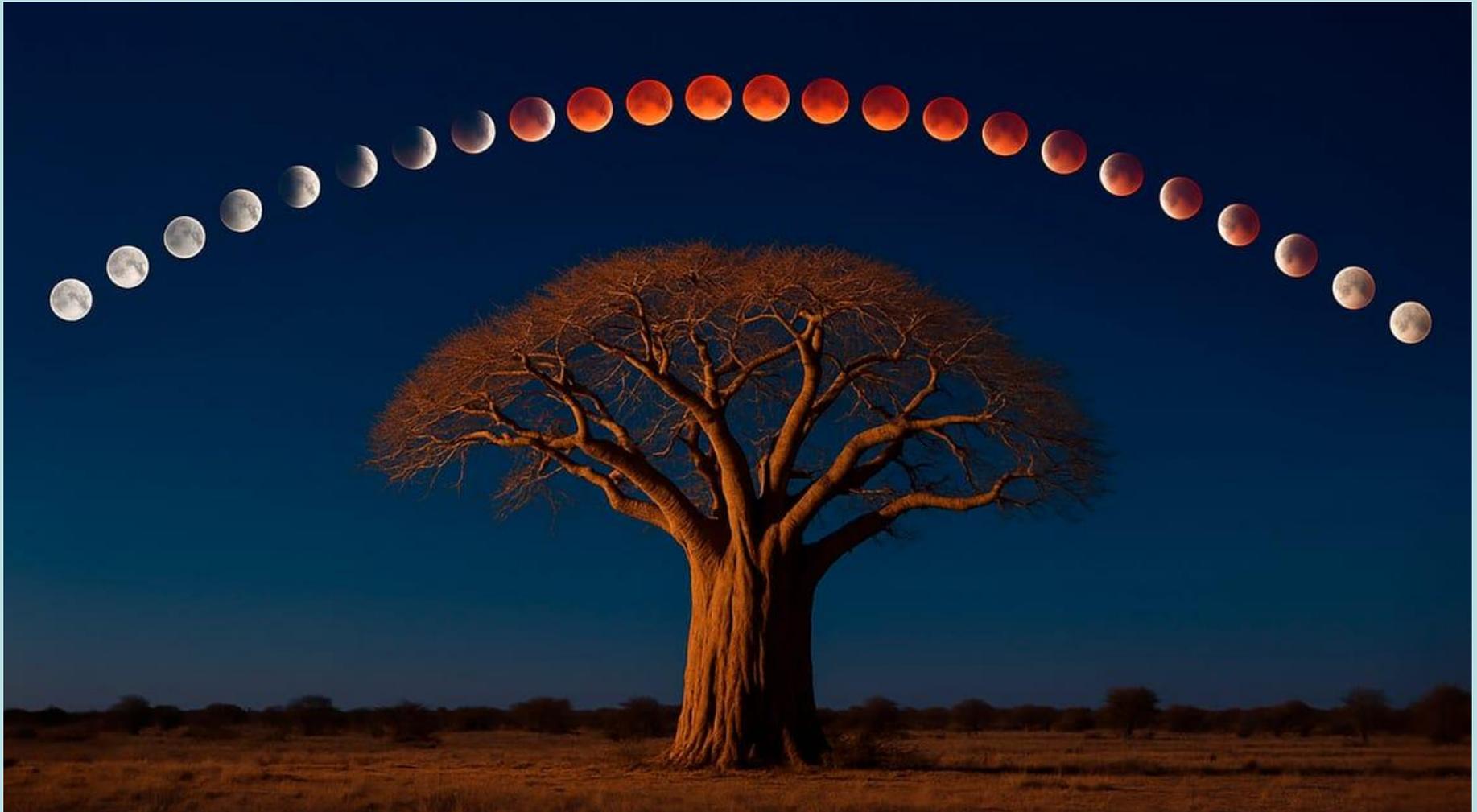
Credits: Eric Allen



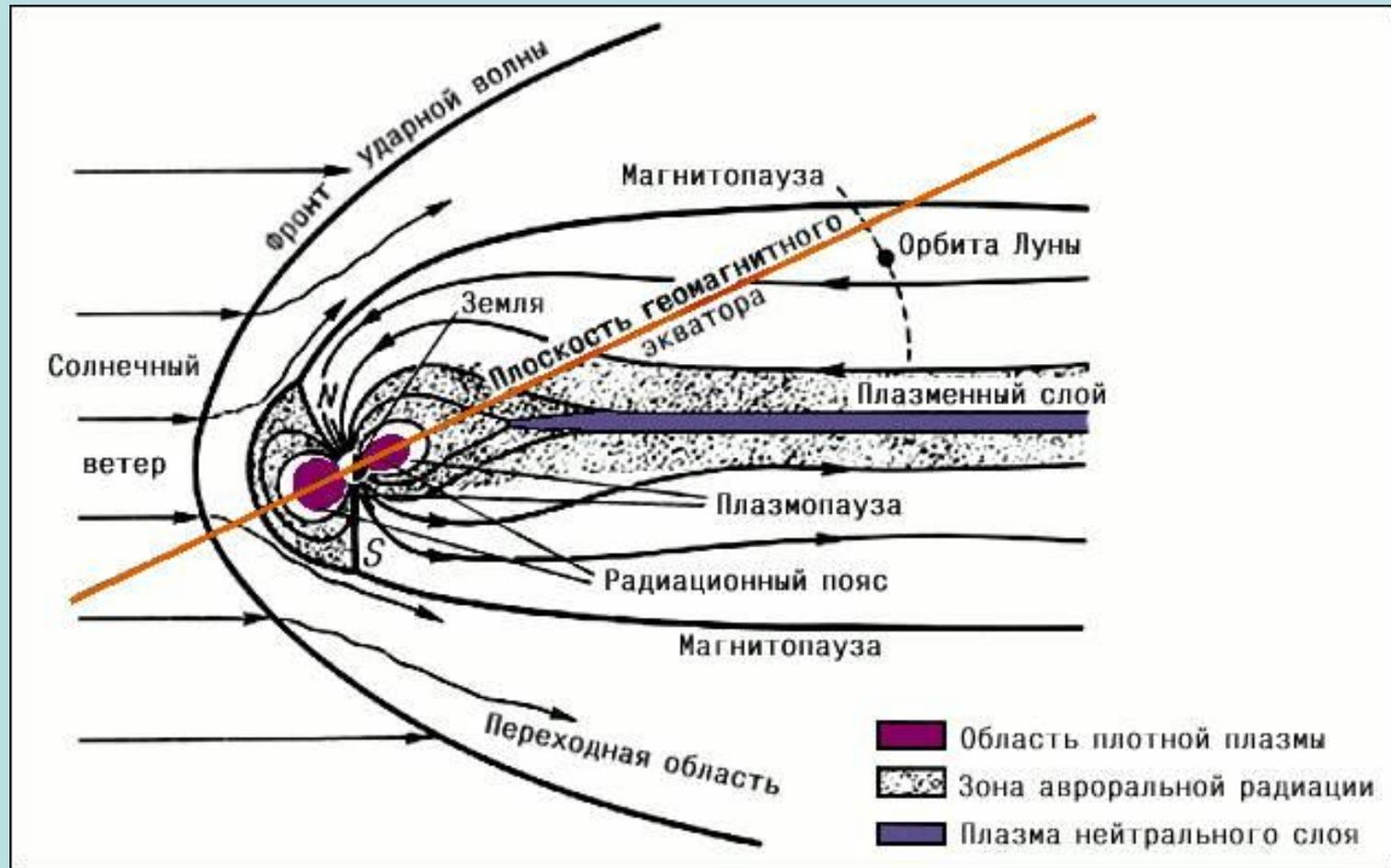
From the Moon

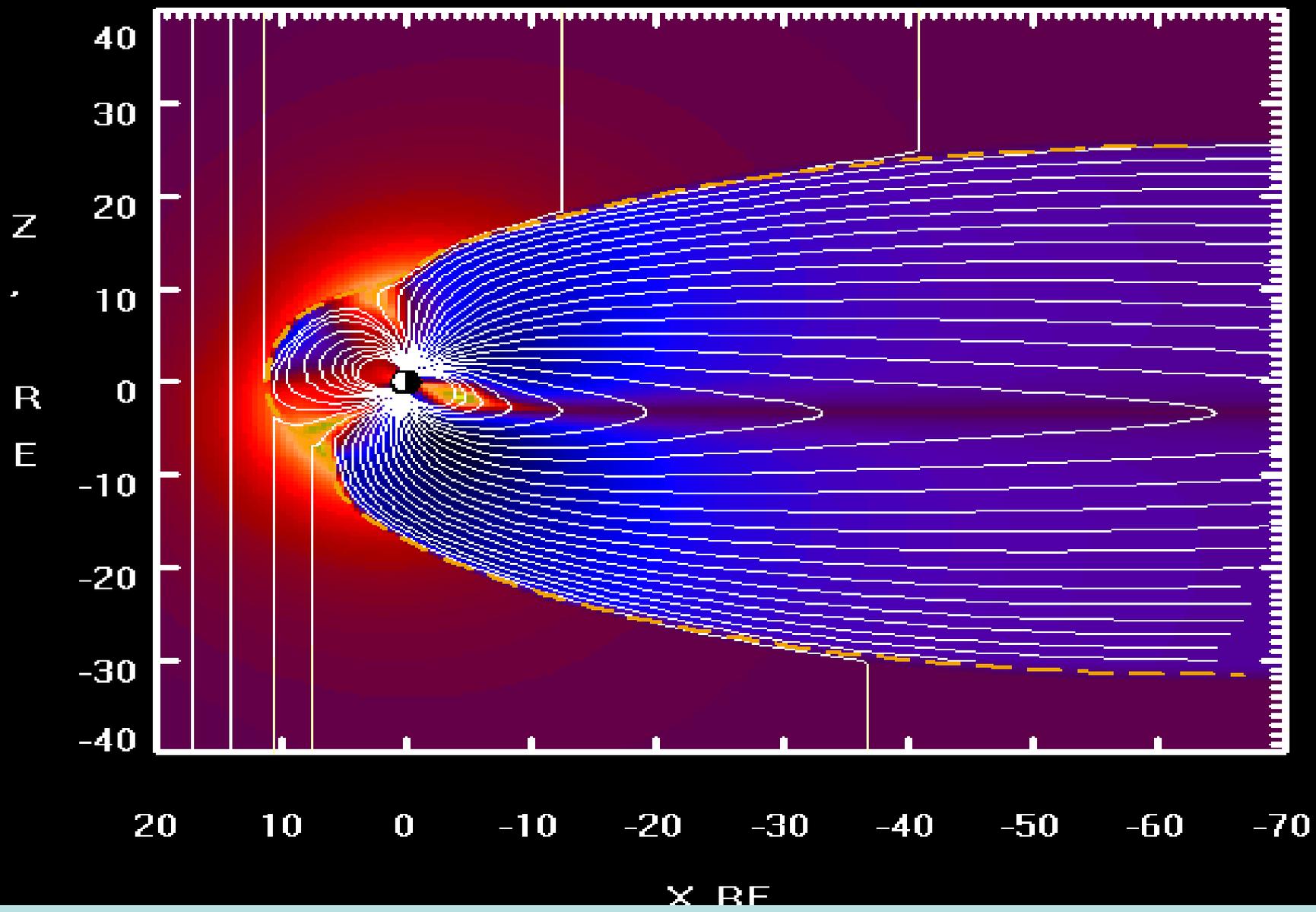
Credits: Firefly Acrospace

# Total Shadow Lunar Eclipse on September 7, 2025



# During a lunar eclipse, the Moon plunges into the Earth's magnetosphere



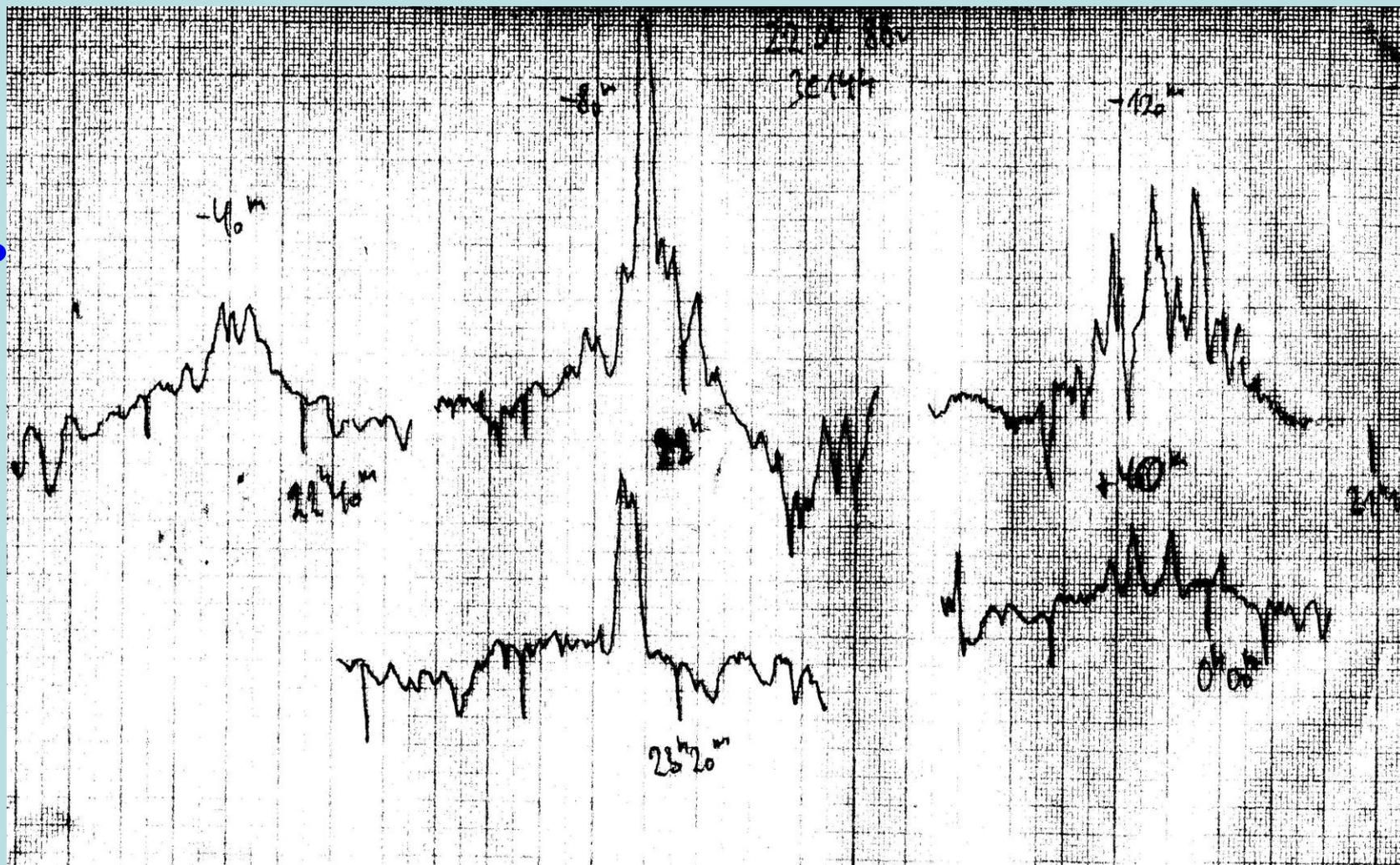


# Moon tidal phenomena in Ionosphere

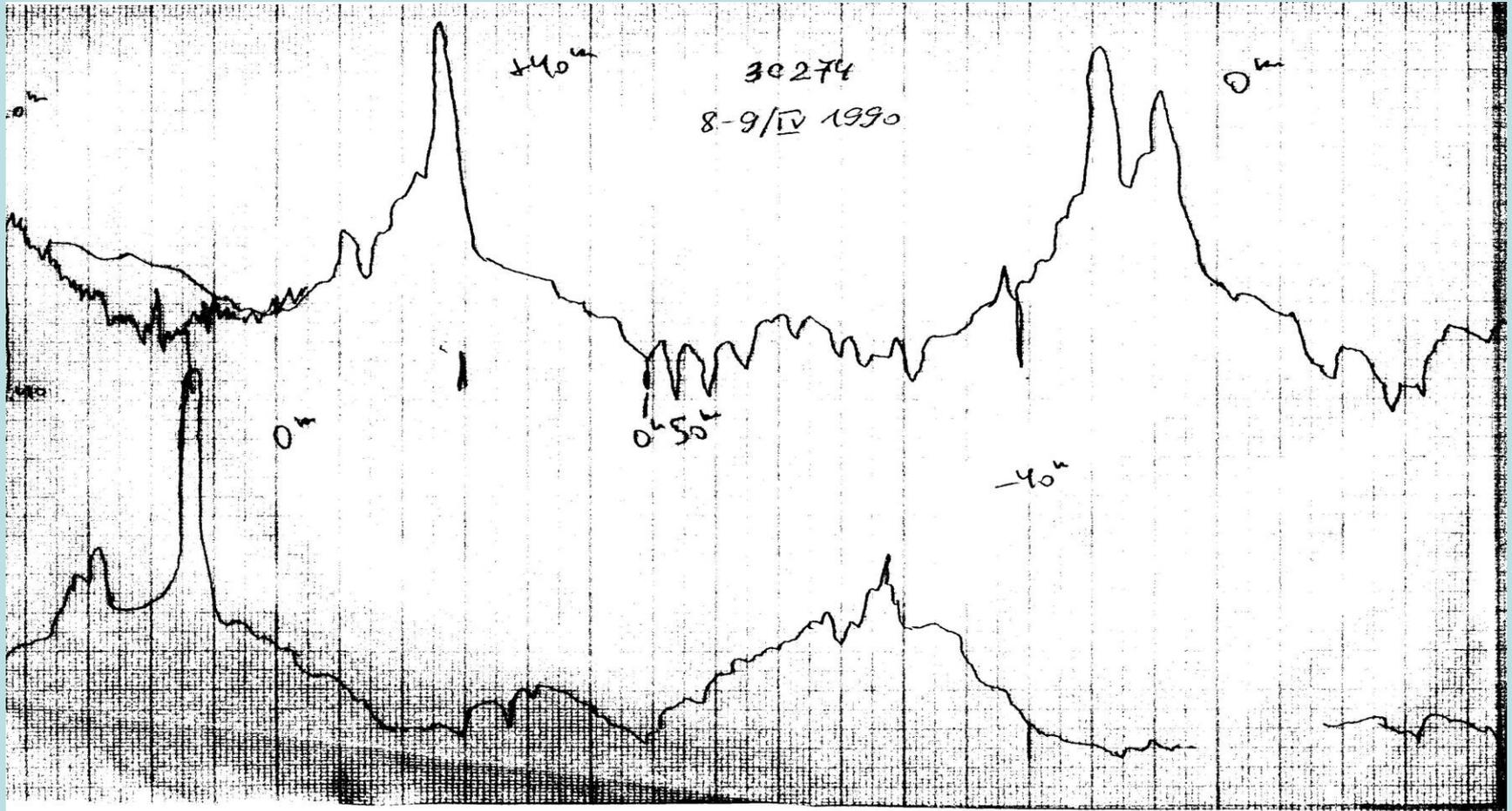
- Data monitoring flux densities of powerful radio-sources on the Radio-telescope

“URAN-4” for research of effects “plasma lensing” of lunar tides in Ionosphere.

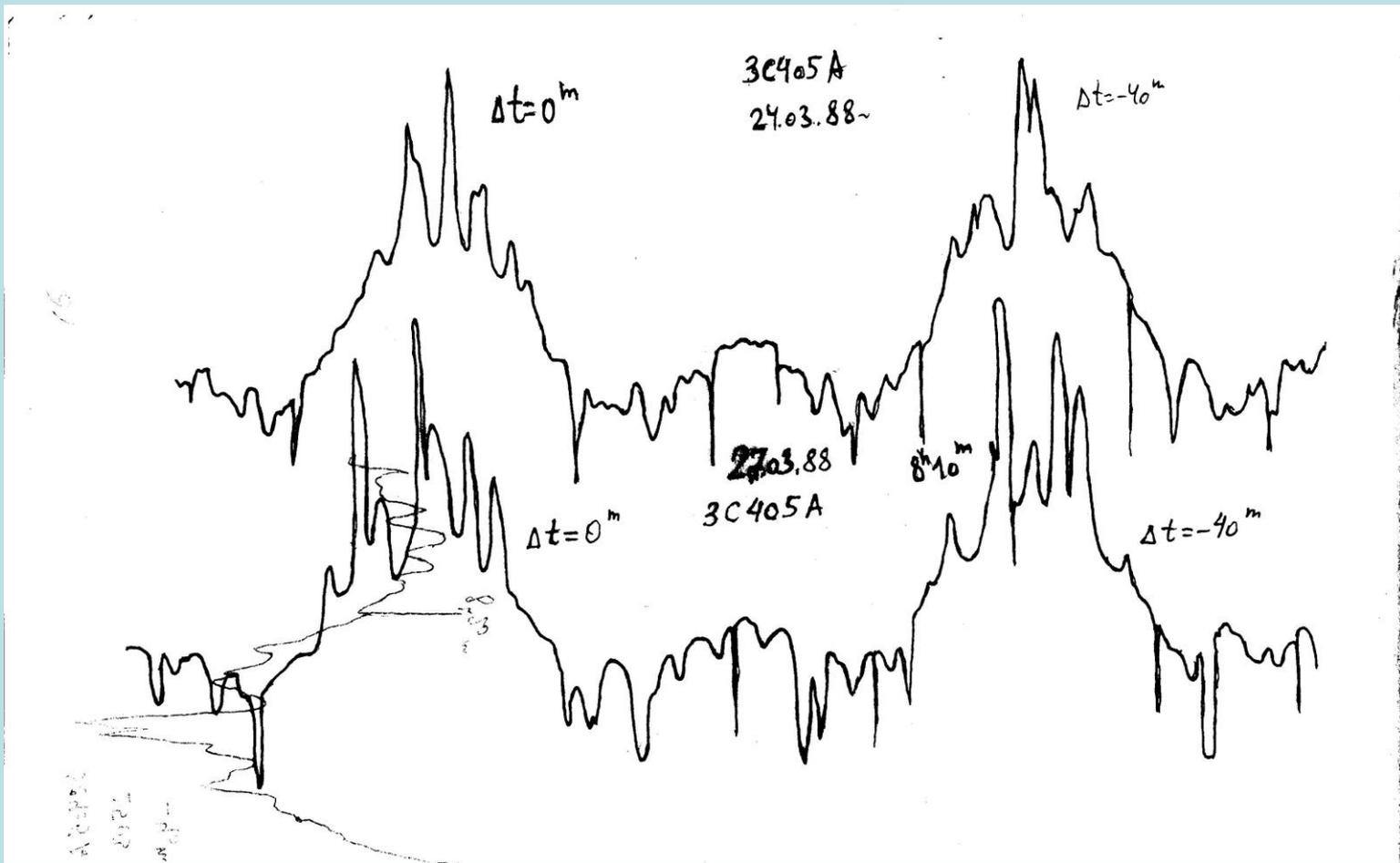
# Unusual scans of 3C144



# Unusual scans of 3C274

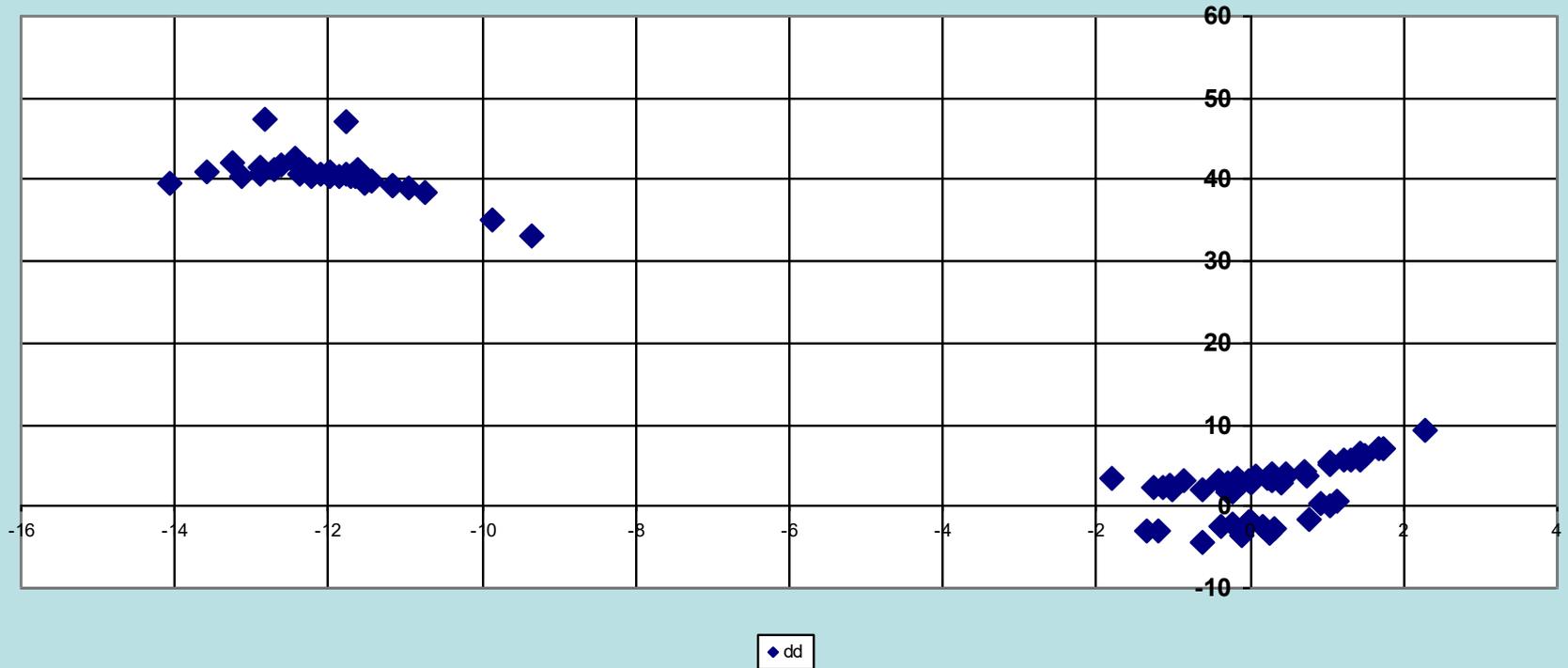


# Unusual scans of 3C405

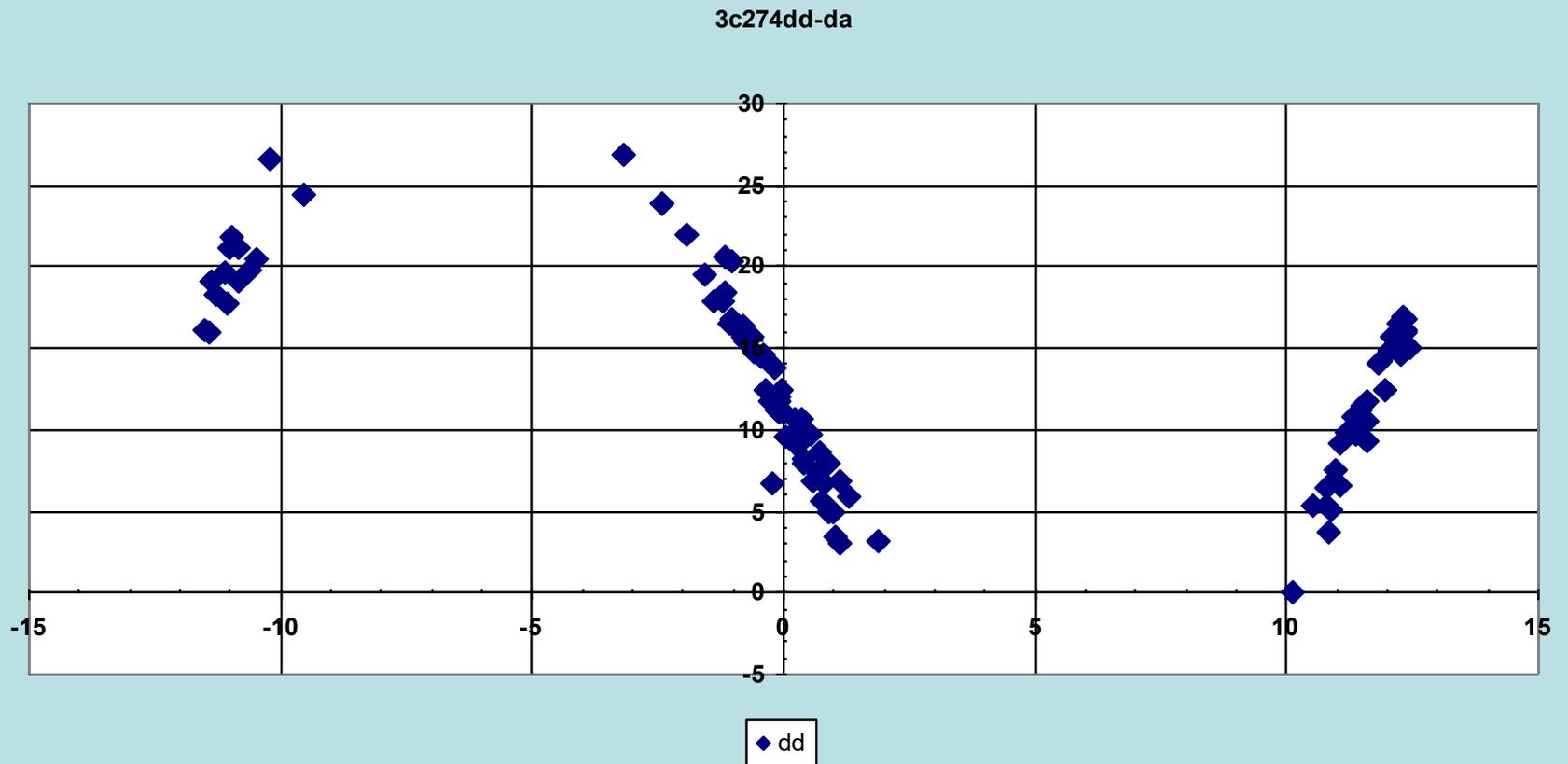


# 3C144 – moon tides

3C144dd-da

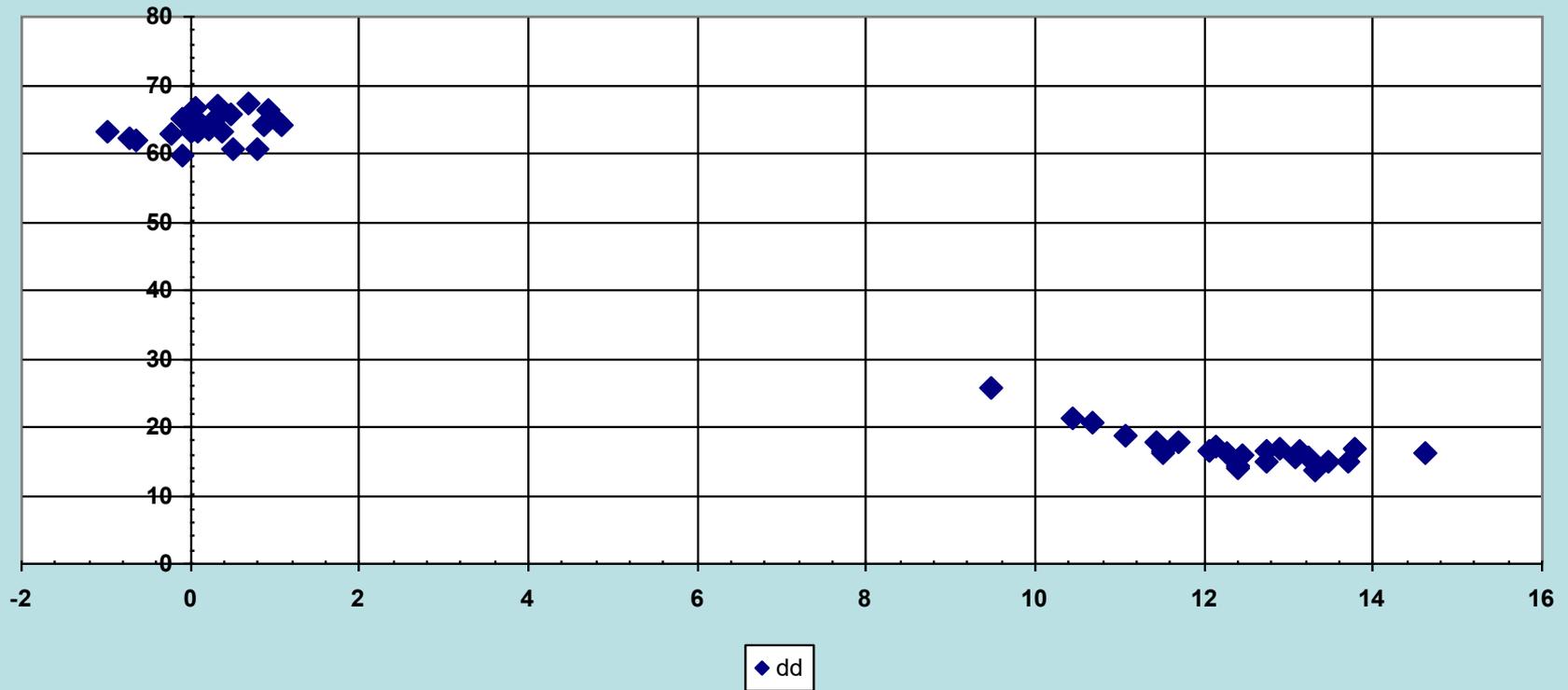


# 3C274 – moon tides



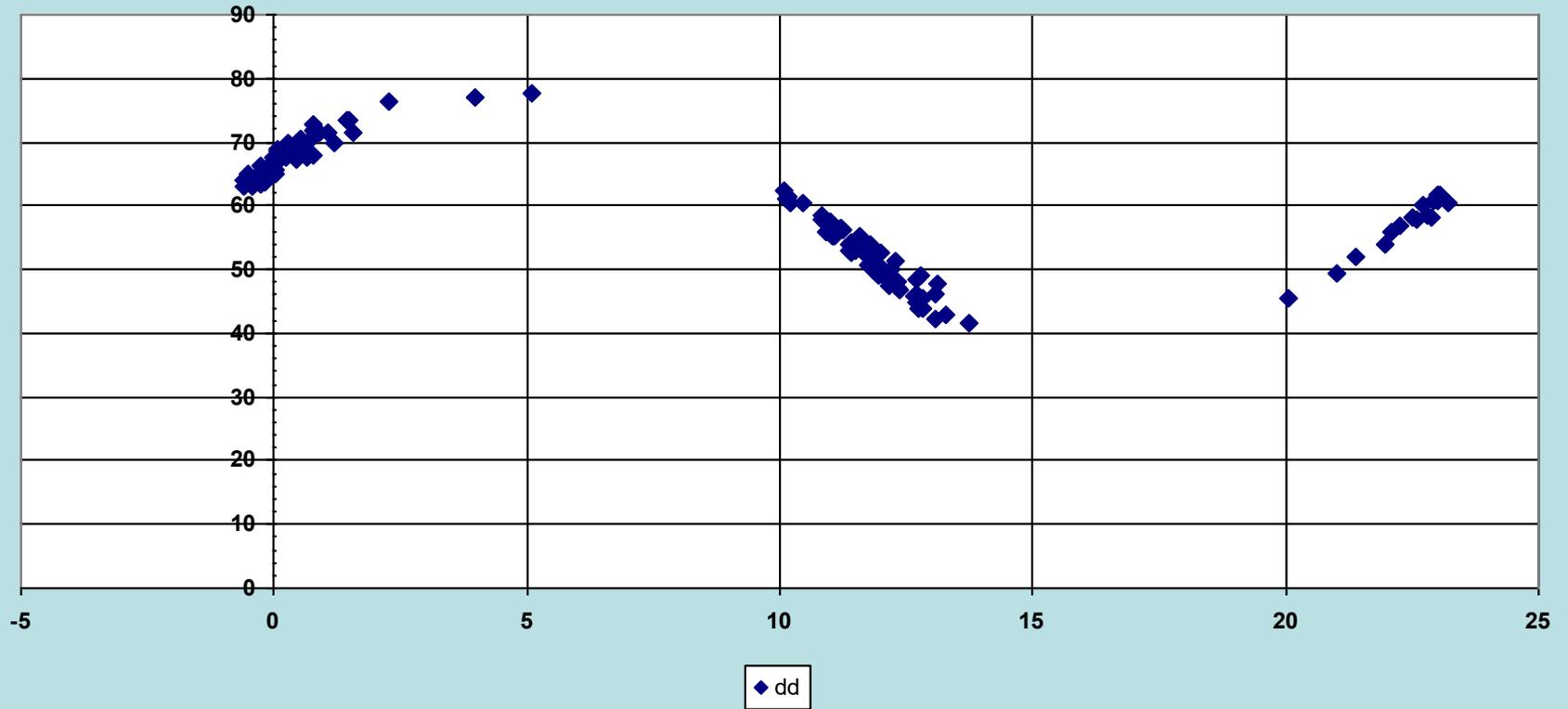
# 3C405 – moon tides

3c405dd-da



# 3C461 – moon tides

3c461dd-da



# Prospects for the study of unusual manifestations of activity in the 25th cycle.

- In the 25th cycle, the following were noted:
- 1. Powerful sudden magnetic storms
- 2. Prolonged magnetic storms with the effects of coronal ejection cannibalism.
- 3. Numerous manifestations of radiation storms and blackouts.
- The most interesting of these events will be the subject of research under the grant program.

# A unique event of solar activity in February 2026



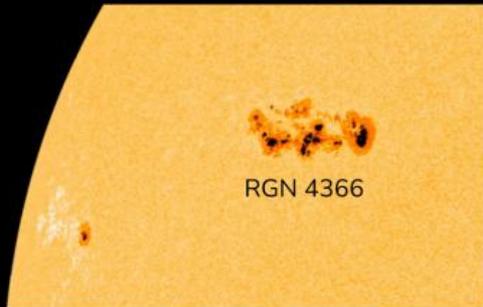
## Space Weather Story of the Week (1 - 7 Feb)

Up  
Sun, 1 Feb  
11:36am

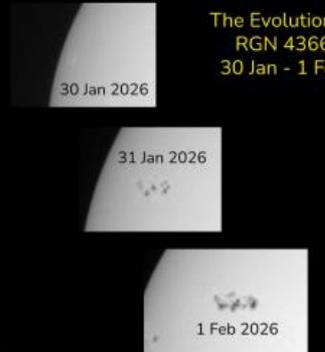
WHAT: Sunspot Groups Remain Capable of More Solar Flares Throughout the Week



RGN 4366



RGN 4366



The Evolution  
RGN 4366  
30 Jan - 1 Feb

30 Jan 2026

31 Jan 2026

1 Feb 2026

### Space Weather Activity Has Become Elevated.

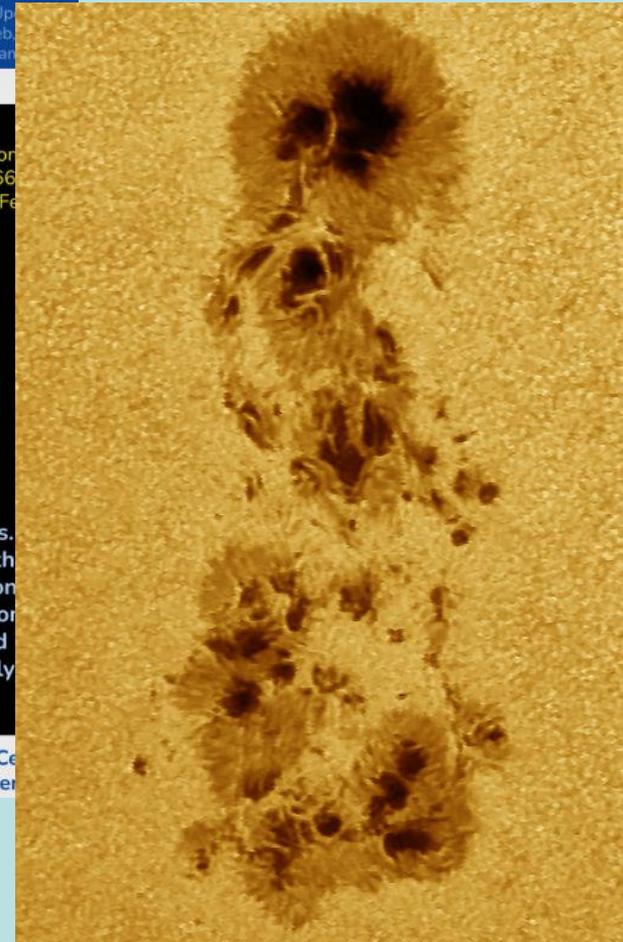
A large cluster of sunspots in the northeast quadrant has emerged and grown notably over the past few days. RGN 4366 has increased in size and magnetic complexity; and has been the source of a number of solar flares that began reaching M-class levels (R1-R2; Minor-Moderate) on February 1st. This includes an X1.0 (R3-Strong) on Feb 1st at 7:33am EST (1233 UTC). The region is in the early stages of its Earth-facing journey as it rotates from east to west (left to right) throughout the week. If this spot group continues to evolve, remains complex, and erupts with any powerful solar flares; there could be increased chances of energetic particle events & possibly even coronal mass ejections (CME) to watch for. Stay informed at [spaceweather.gov](http://spaceweather.gov)



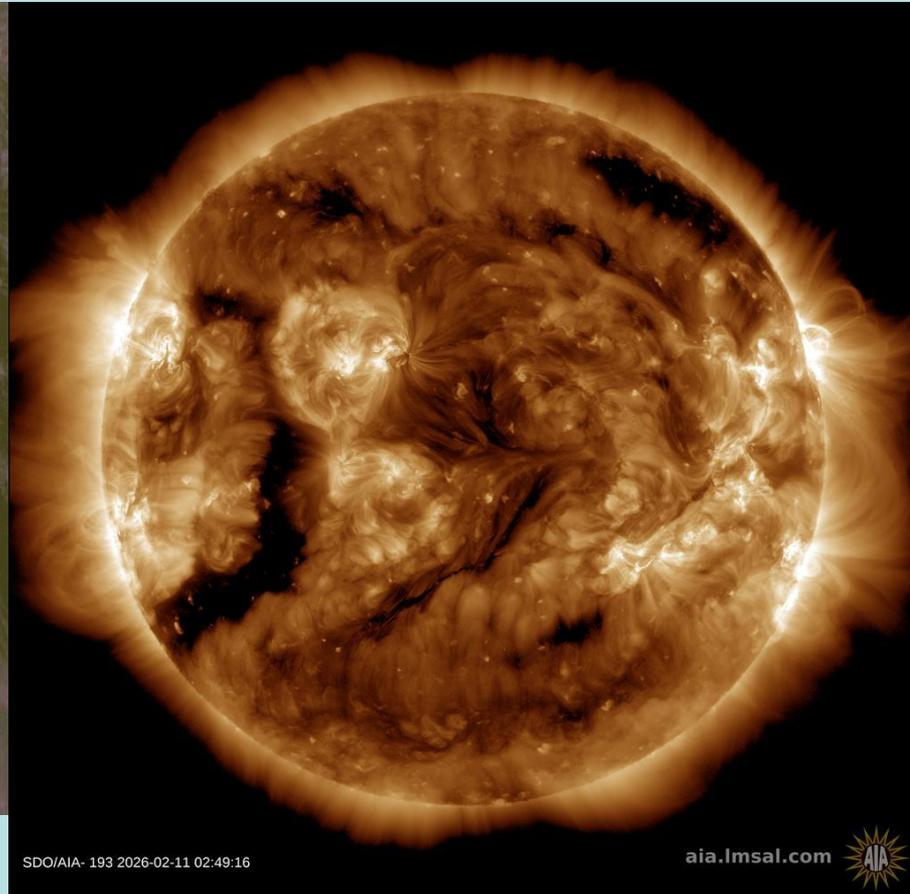
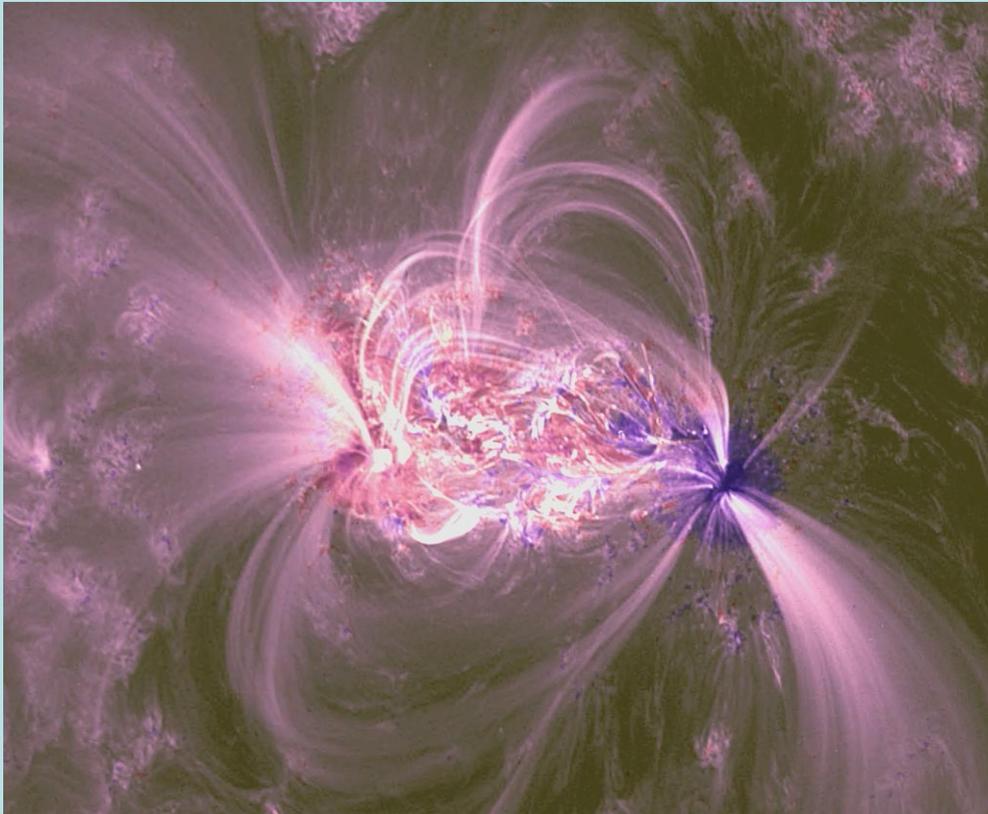
National Oceanic and  
Atmospheric Administration  
U.S. Department of Commerce

Safeguarding Society with Actionable Space Weather Information

Space Weather Prediction Center  
Boulder



# Strong flare in February 2026 in the activity complex



SDO/AIA- 193 2026-02-11 02:49:16

[aia.lmsal.com](http://aia.lmsal.com)



# The Mystery of the Activity

## Complex in February 2026 year

- 63 powerful flares occurred in active area 4366. This is the second indicator in the 21st century.
- Another record is the absence of strong manifestations of geomagnetic activity.
- In first place with 64 flares is group 3664, (May 2024) responsible for the strongest magnetic storm of the last 20 years, (May 11-12, 2024).

# Conclusions

Use of a radiotelescope “URAN- 4” allows to realize a radioastronomical method of supervision having tidal phenomena in the ionosphere of the Earth by a method registration focusing and defocusing radiosources in decameter waves.

The size of a zone having tidal waves reaches 60 angular degrees.

Effects of solar and geomagnetic activity, solar and moon eclipse , lunar tidal waves determine a condition of space weather and create rhythms of ability to live on the Earth.

# Upcoming Interesting Event



## Annual Space Weather Workshop Registration is Now Open

Updated:  
Mon, 9 Feb, 2026  
10:32 MT

WHAT: The Space Weather Workshop to be Held in Boulder, CO April 27th - May 1st, 2026



**Space Weather  
Workshop**  
April 27 - May 1, 2026  
Boulder, CO



National Oceanic and  
Atmospheric Administration  
U.S. Department of Commerce

*Safeguarding Society with Actionable Space Weather Information*

Space Weather Prediction Center  
Boulder, CO

June 2-6, 2025  
PRIMORSKO, BULGARIA

workshop

# INITIATIVE FOR SPACE WEATHER INVESTIGATIONS

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Odesa I.I. Mechnikov  
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**VENTSPILS AUGSTSKOLA**



**Thanks you for your attention  
!**

# International Gamow Conference (Odessa, 17-21 August)

Gamow Conference - Cosmolog x +

gamow.odessa.ua

Импортированны... Astrobiology Journal of Astrono... Library News Organizations Science news Расширения

## Gamow International Conference

18–22 August, 2025, Odessa, Ukraine

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**XXV Gamow International Astronomical Conference**