# FEATURES OF A SOLAR FLARE EXCESS IN MAY-JUNE 2024

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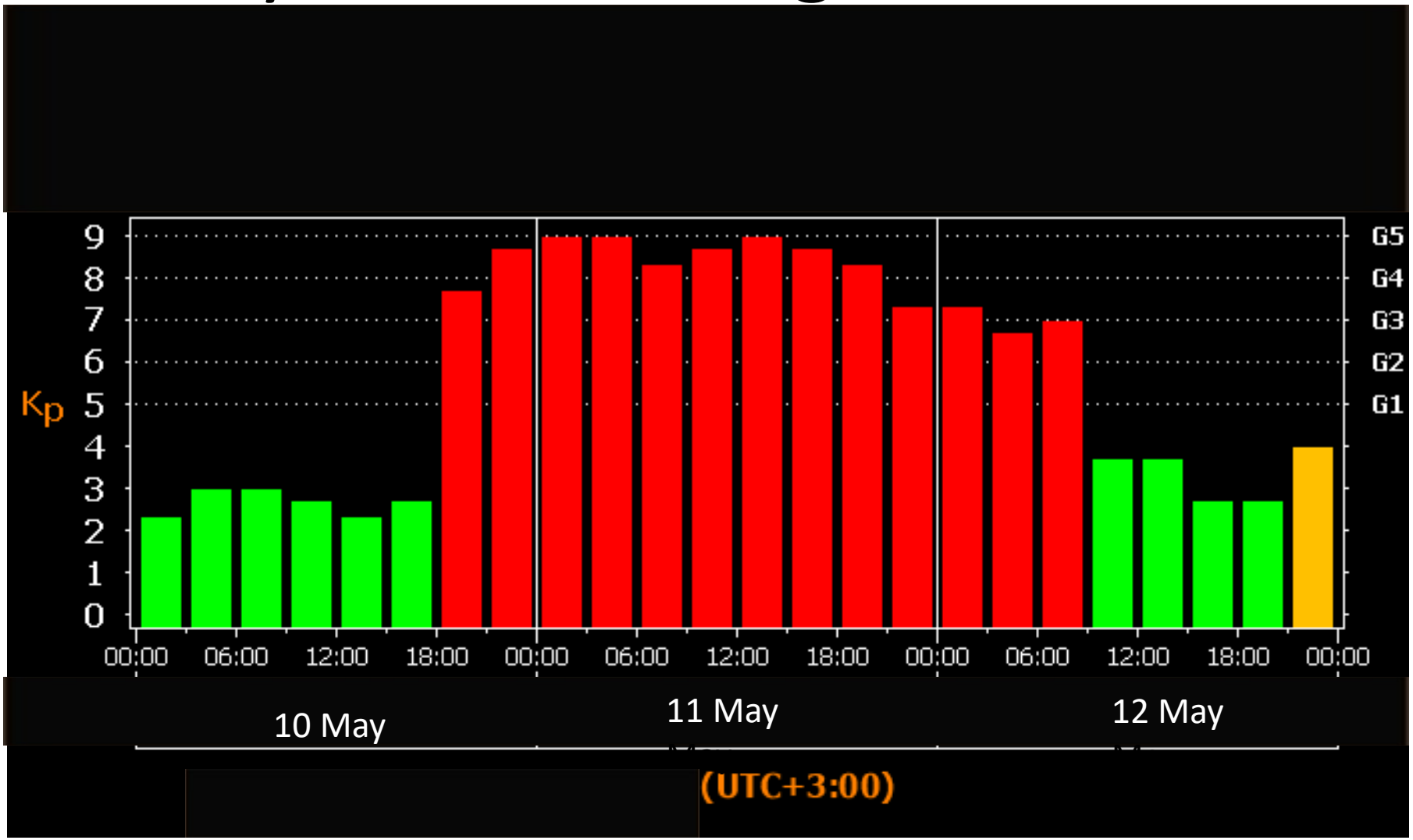
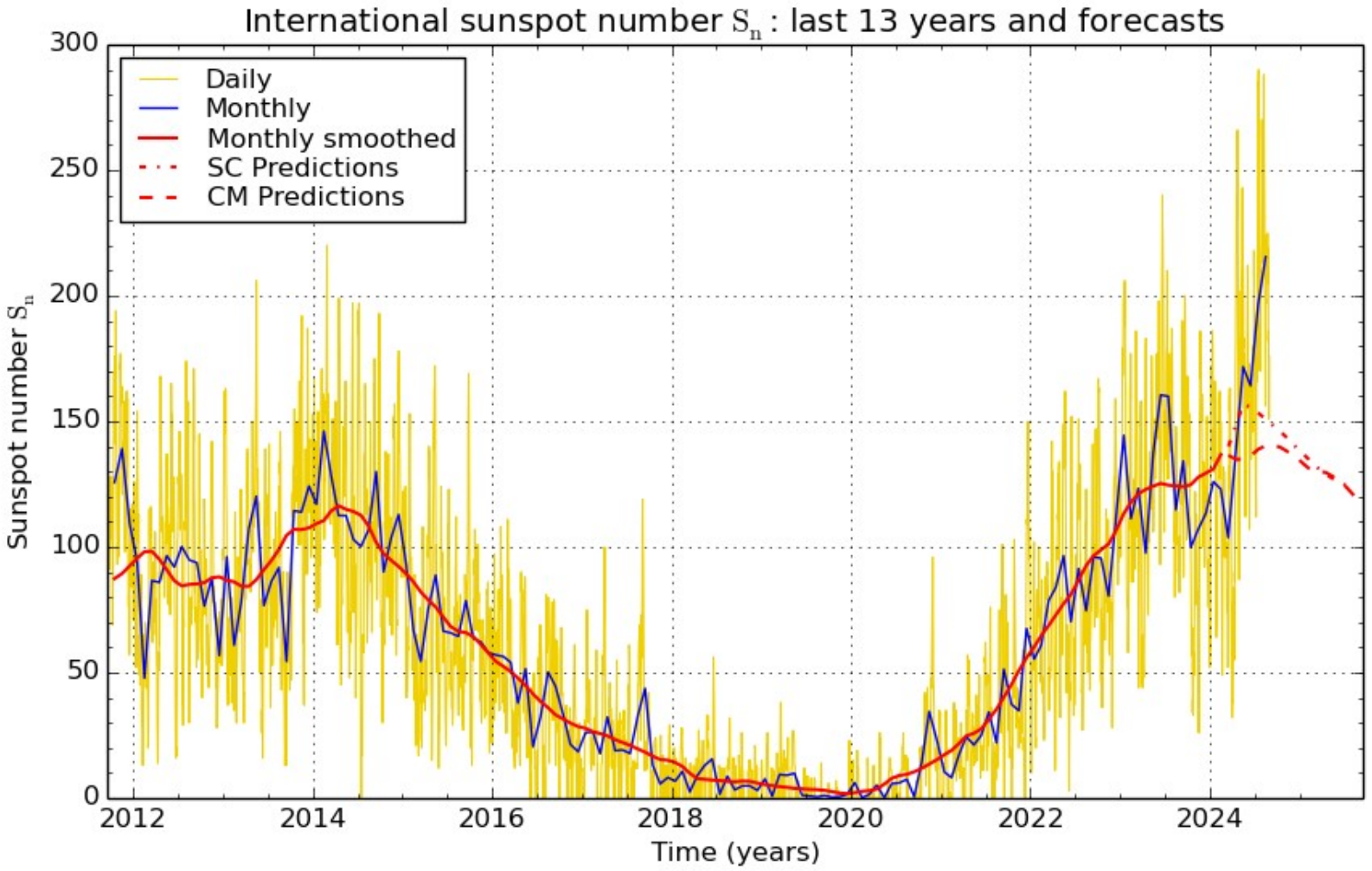
# May 2024 Geomagnetic Storm



# 11.05.2024, NEAR IRKUTSK

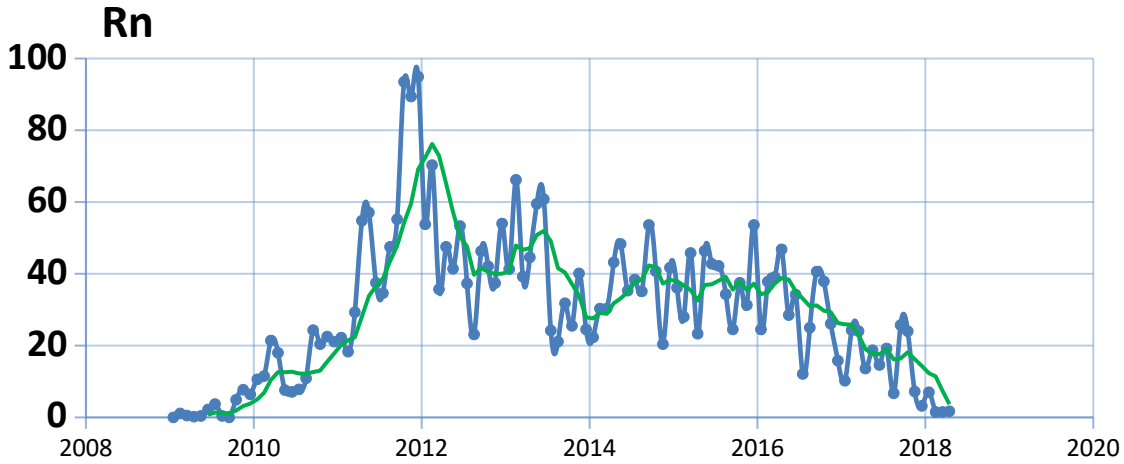
# 24 and 25 Cycles of Solar Activity



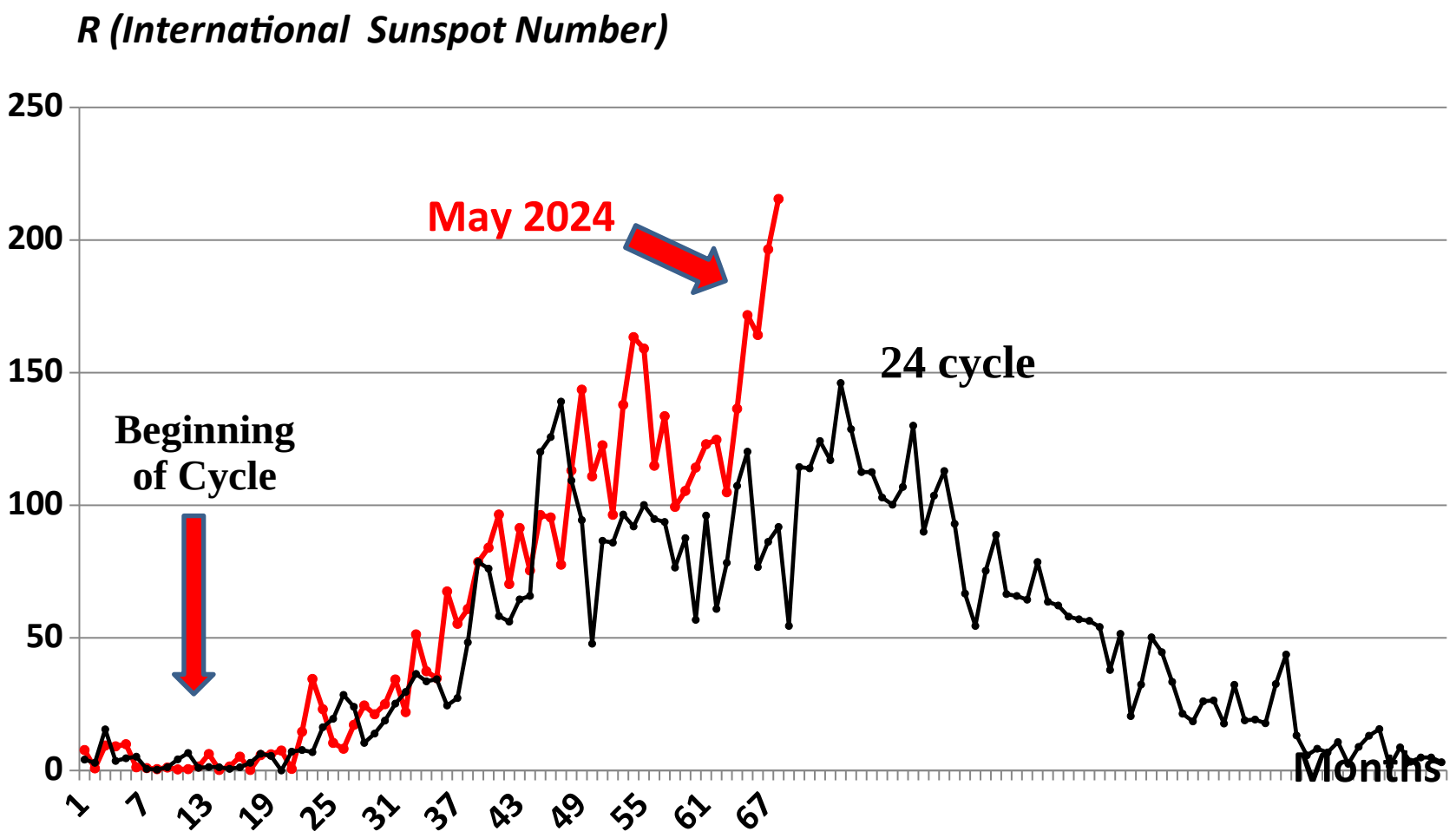
# 24 Cycle

## R – International Sunspots Number

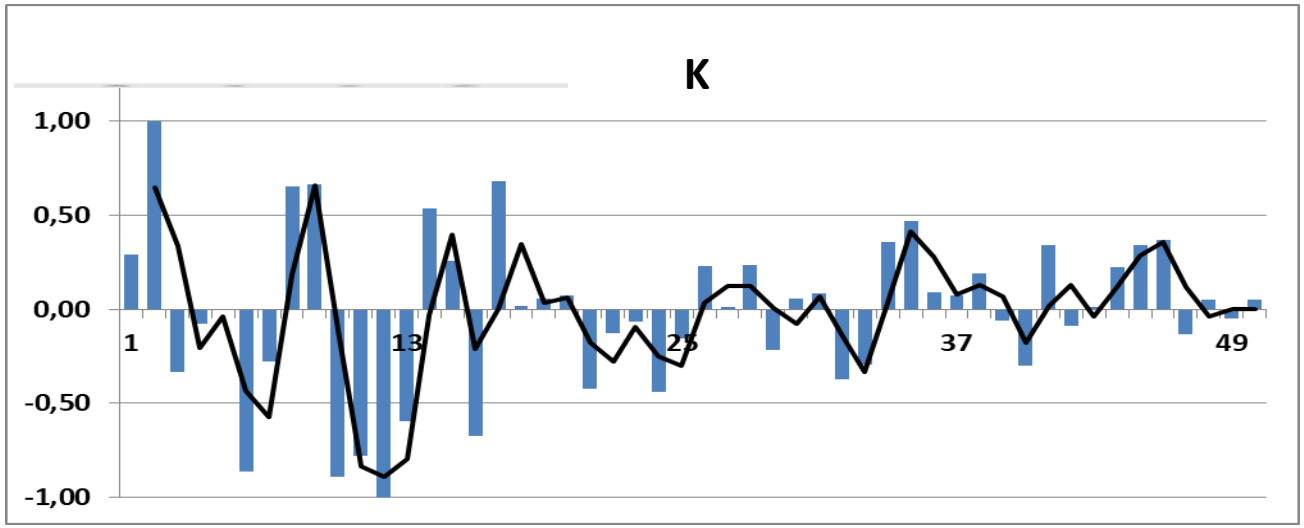
## Rn – Northern Hemisphere, Rs – Southern Hemisphere

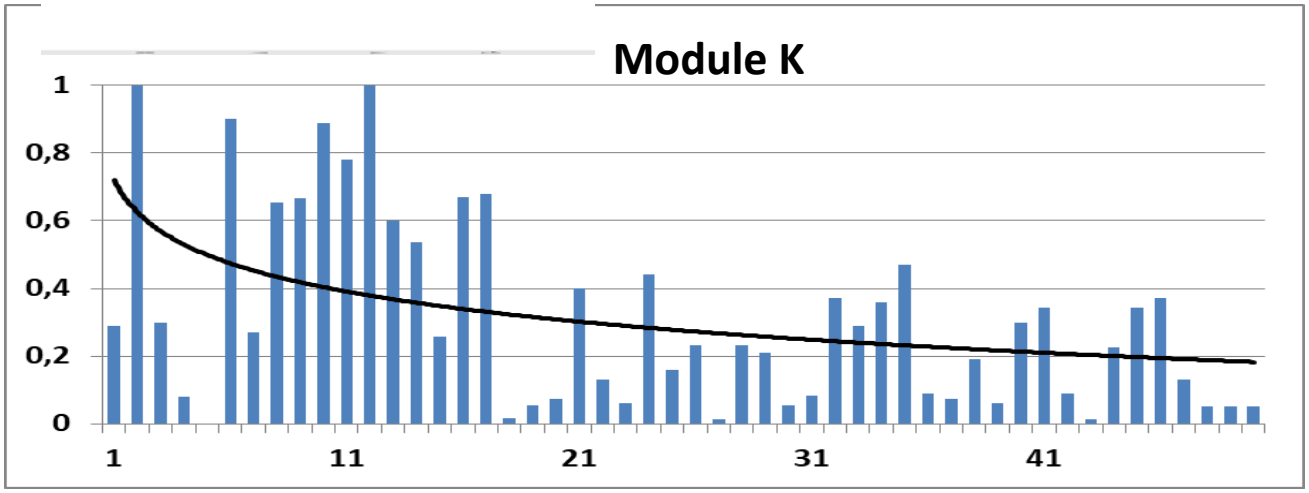



# 24 and 25 Cycles



# North-South Asymmetry Coefficient
# for first 4 years of 25 cycle
## *K = (Nn – Ns) / (Nn + Ns)*

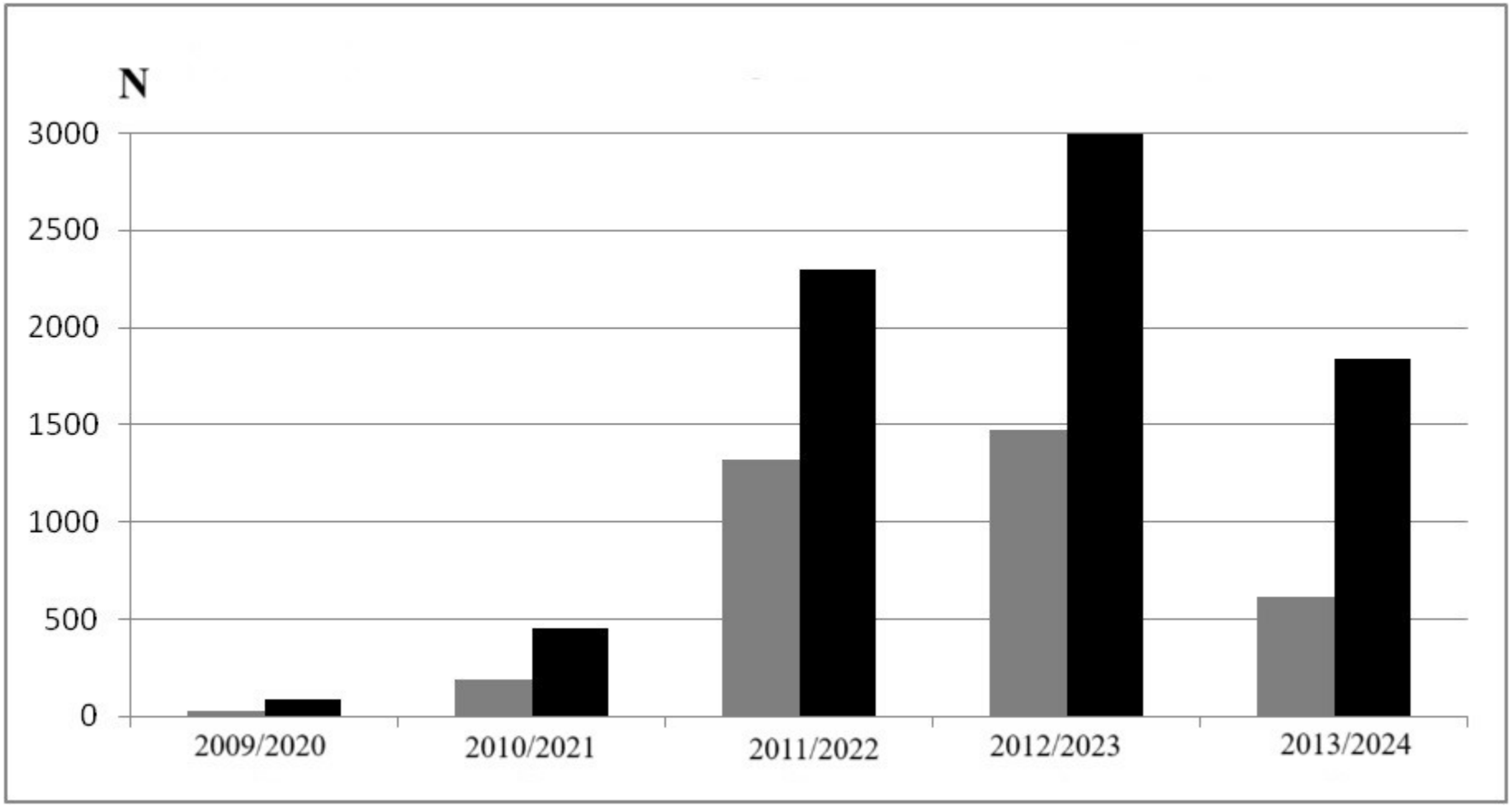


# Flares in 24 and 25 cycles before Flare Excess

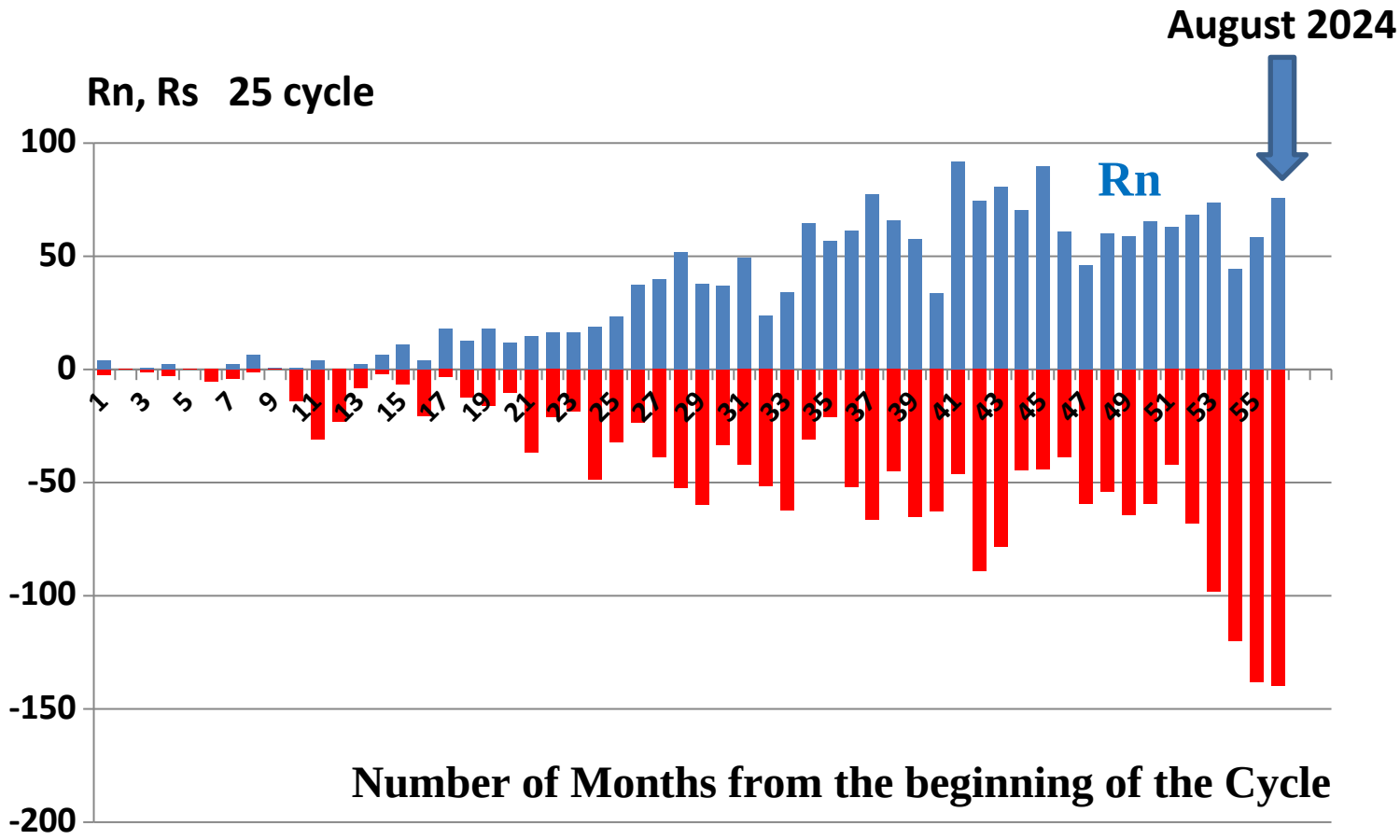
| | 24 cycle | 25 cycle |
|---|---|---|
| **Total number of flares (C + M + X)** | **3194** | **6917** |
| **Flares in the Northern Hemisphere** | **1585 (50%)** | **3092 (45%)** |
| **Flares in the Southern Hemisphere** | **1121 (35%)** | **2912 (42%)** |
| **Flares with unidentified location** | **488 (15%)** | **913 (13%)** |
| **Total flare index (C + M + X)** | **172** | **410** |
| **Flare index in the Northern Hemisphere** | **100 (58%)** | **203 (49,5%)** |
| **Flare index in the Northern Hemisphere** | **60 (35%)** | **172 (42%)** |
| **Flare index of flares with unidentified location** | **12 (7%)** | **35 (8,5%)** |

(1 – 9) $\times 10^{-6}$ Вт/м$^2$ – C-flares
(1 – 9)$\times 10^{-5}$ Вт/м$^2$ – M-flares
(1 – n)$\times 10^{-4}$ Вт/м$^2$ – X -flares




N = year number C+M+X flares

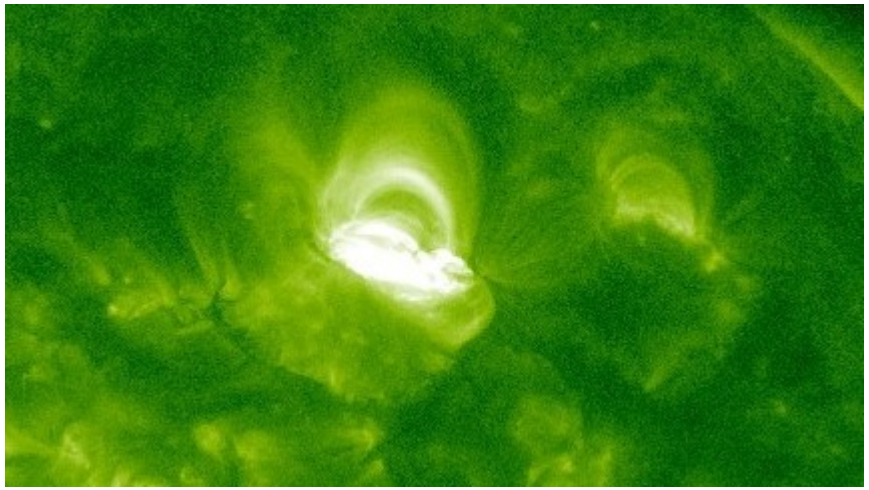
# Rn – Northern Hemisphere, Rs – Southern Hemisphere (56 Months from the beginning of the Cycle)

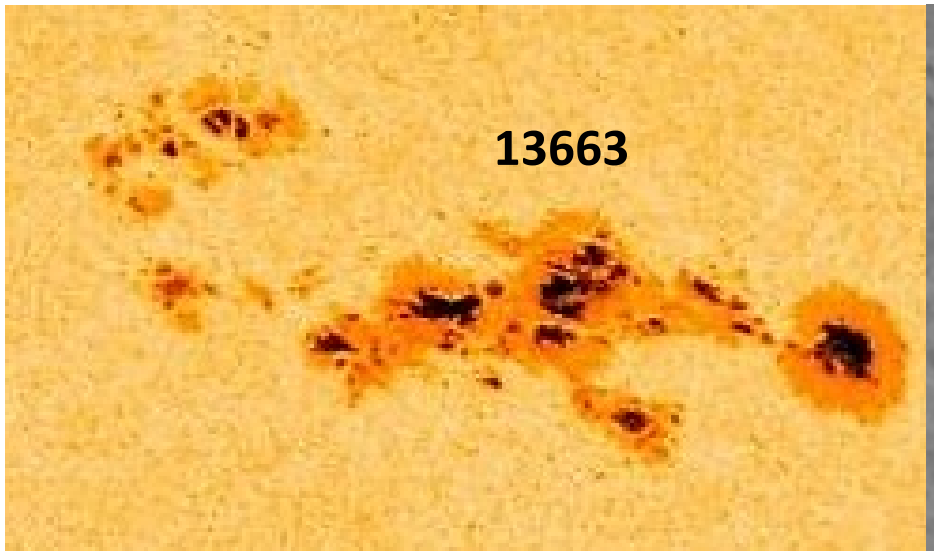


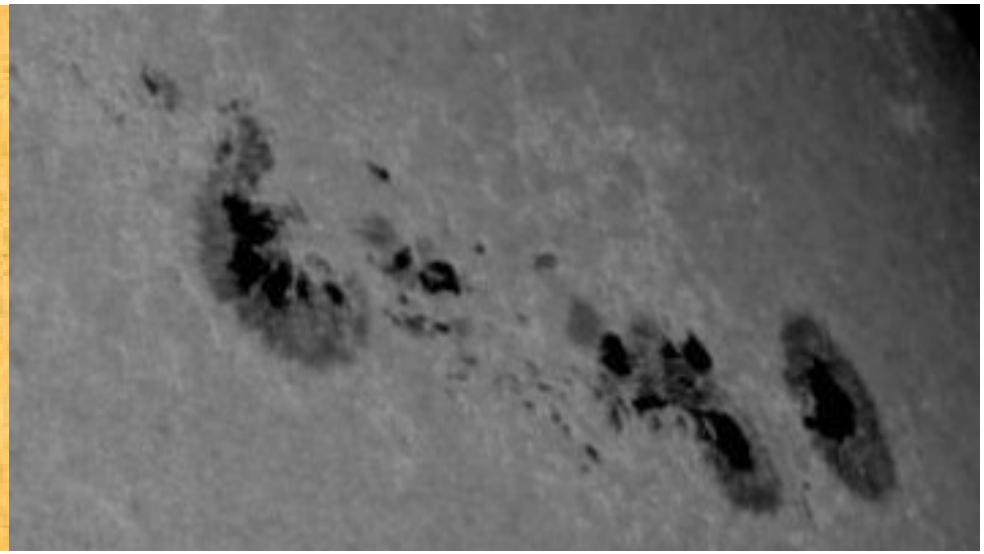
# May-June 2024 Flare Excess

# May-June 2024 Flare Excess

- AR 13663 (30.04 – 11.05)
- Flares number C39 M35 X5
- Max area -- 600 millionths of a hemisphere

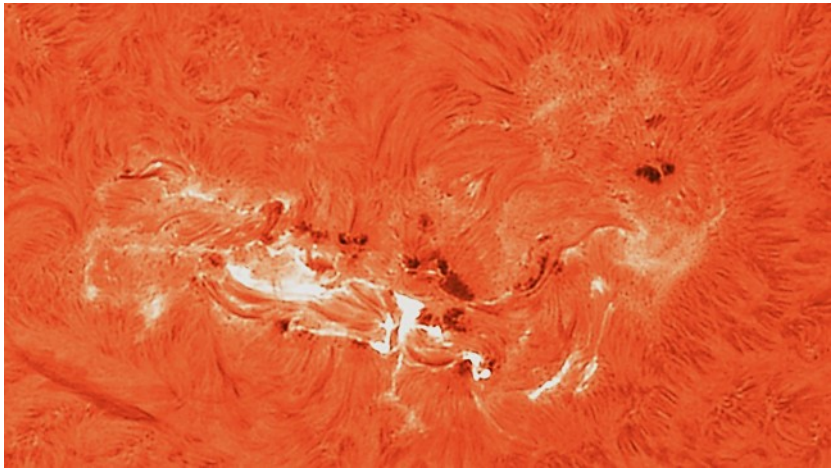


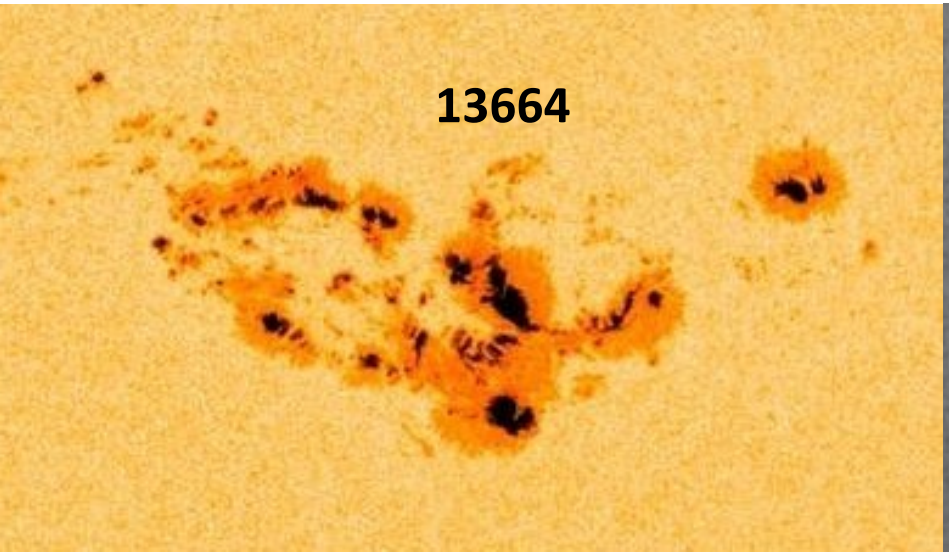


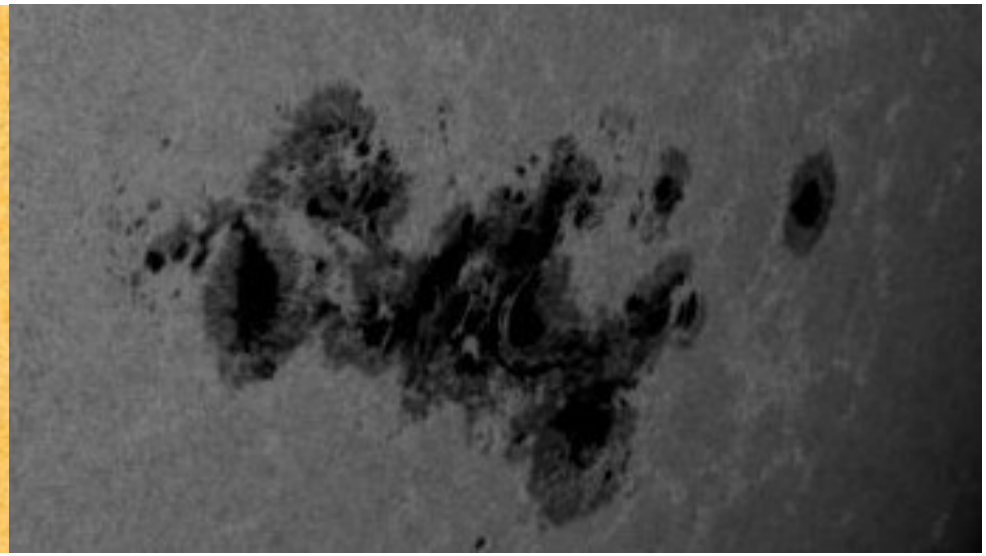



# May-June 2024 Flare Excess

- **AR 13664 (01.05 – 14.05)**
- **Flares number C39 M61 X11**
  **Max area -- 2400 millionths**
  **of a hemisphere**

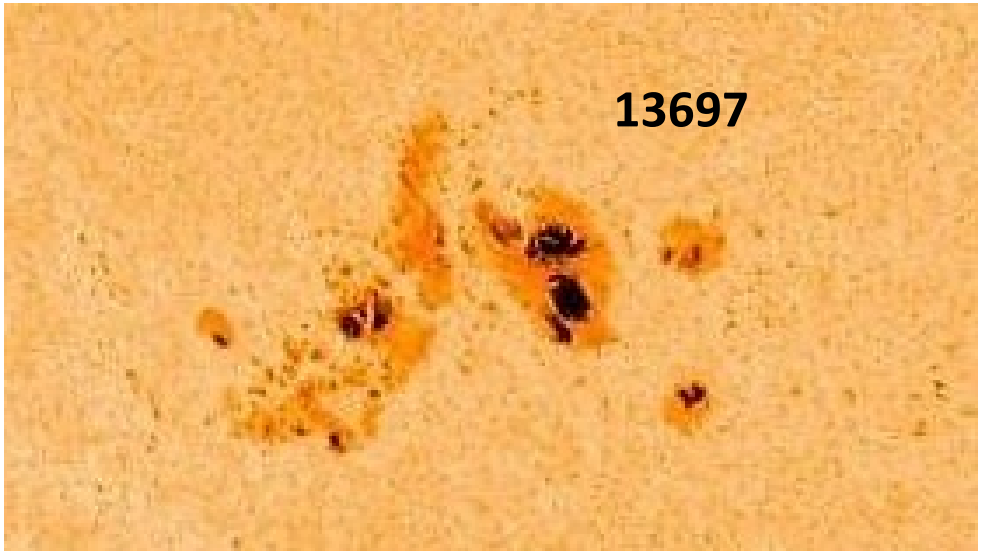


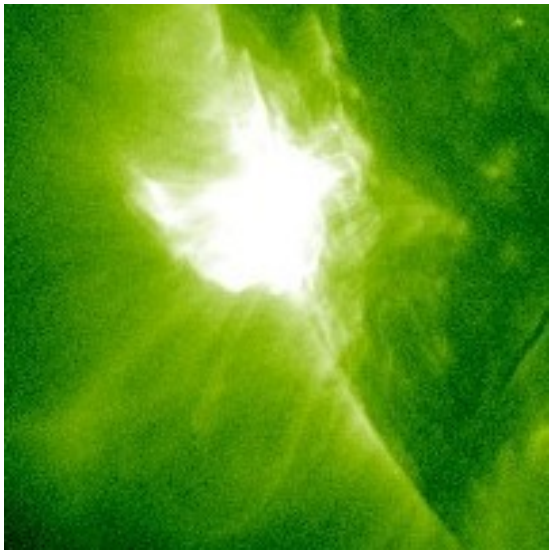


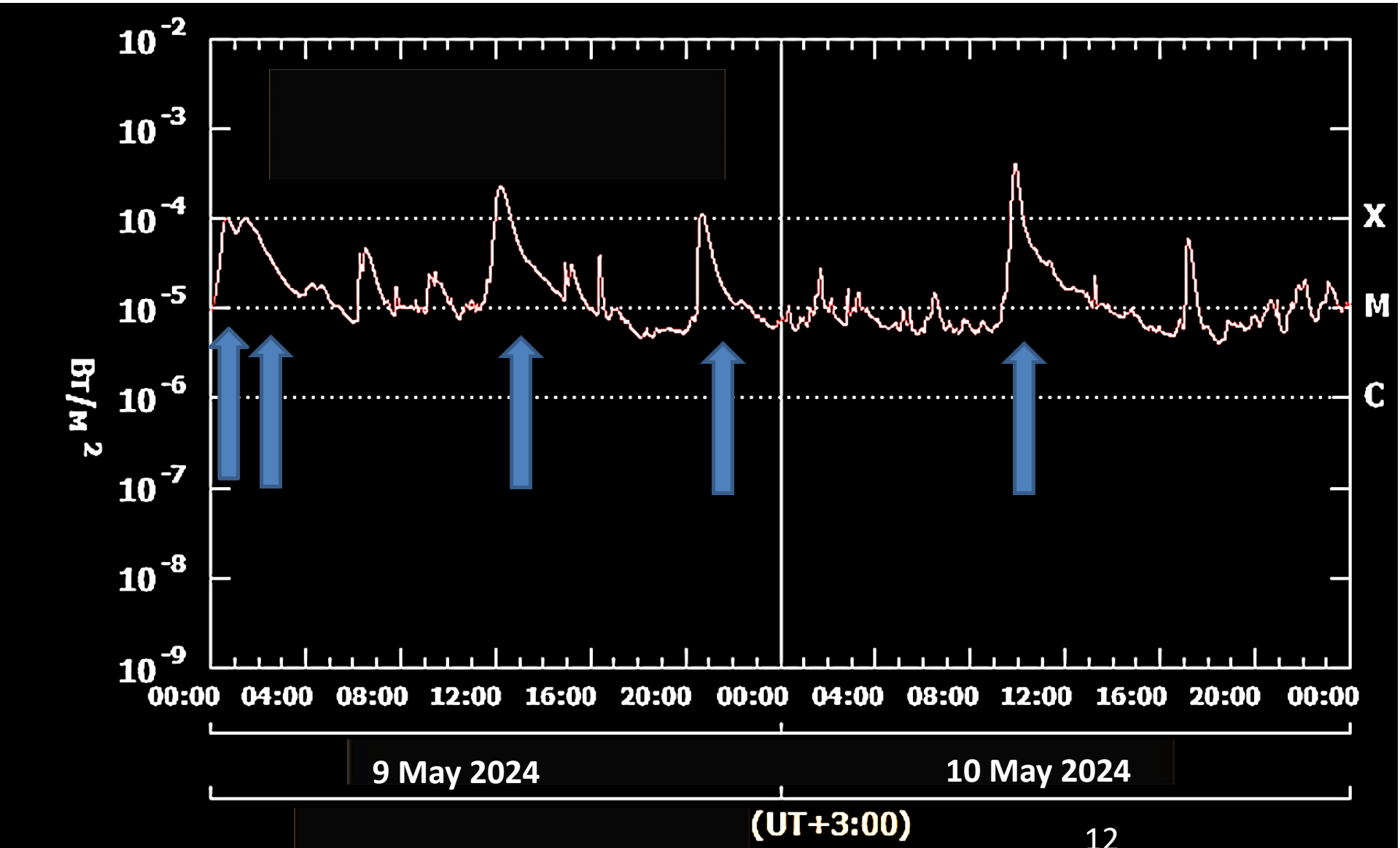
# May-June 2024 Flare Excess

- **AR 13697 (28.05 – 11.06)**
- **Flares number C88 M27 X6**
  **Max area -- 410 millionths**
  **of a hemisphere**



# 5 X-flares in 1.5 days!



**In total**

**from 2024 May 01 to June 10**

**there were**

**311 flares,**

**Including**

**25 X-flares**

**(46% of all X-flares in cycle 25)**

**+ 5 M9-flares**

**in ARs 13663, 13664, 13697**


FLARE EXCESS

**Are there any analogues to this flare excess?**

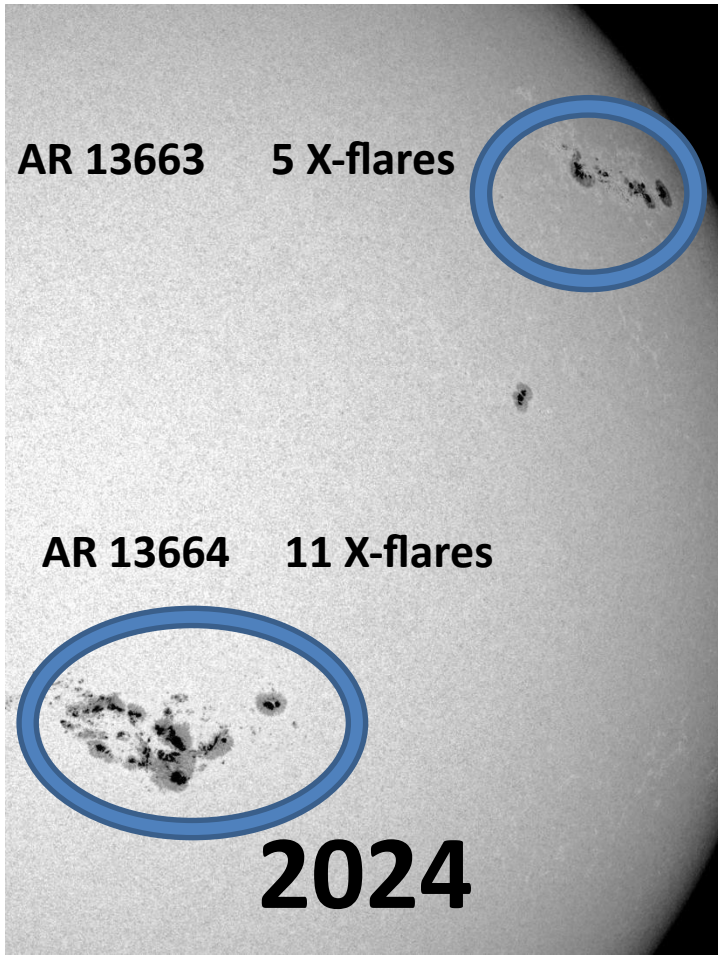
## MOST POWERFUL FLARE ACTIVE REGIONS

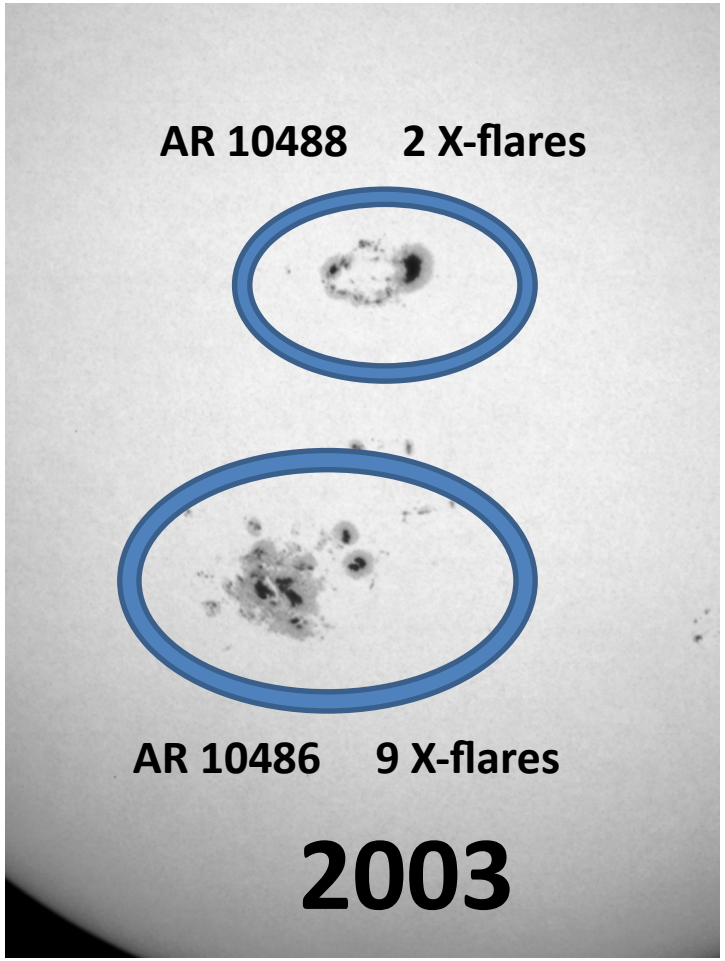
| № | Year | Active Region | Flares | Area |
|---|---|---|---|---|
| 1 | 2003 | 10486 | C10 M23 X9 | 2600 |
| 2 | 2024 | 13664 | C39 M61 X11 | 2400 |
| 3 | 2005 | 10808 | C43 M26 X11 | 1430 |
| 4 | 2014 | 12192 | C53 M42 X8 | 2750 |
| 5 | 2017 | 12673 | C42 M29 X6 | 1060 |
| 6 | 2024 | 13697 | C88 M27 X6 | 420 |
| 7 | 2001 | 9415 | C16 M8 X6 | 880 |
| 8 | 1998 | 8307 | C11 M4 X6 | 570 |
| 9 | 2024 | 13663 | C39 M35 X5 | 600 |
| 10 | 2001 | 9393 | C18 M34 X4 | 2440 |
| 11 | 2011 | 11302 | C29 M21 X4 | 1070 |
| 12 | 2013 | 11748 | C18 M7 X4 | 310 |

## ARs where the number of X-flares is greater than one

| | | | | |
|---|---|---|---|---|
| 13 | 2006 | 10930 | C56 M6 X4 | 680 |
| 14 | 2004 | 10652 | C63 M18 X3 | 2010 |
| 15 | 2003 | 10484 | C29 M18 X3 | 1750 |
| 16 | 2000 | 9077 | C15 M12 X3 | 1010 |
| 17 | 2013 | 11890 | C40 M9 X3 | 950 |
| 18 | 2013 | 12087 | C26 M9 X3 | 220 |
| 19 | 2002 | 10069 | C48 M24 X2 | 1990 |
| 20 | 2013 | 11875 | C54 M14 X2 | 720 |
| 21 | 2013 | 11882 | C7 M13 X2 | 360 |
| 22 | 2003 | 10488 | C12 M12 X2 | 1750 |
| 23 | 2001 | 9733 | C17 M7 X2 | 560 |

# Flare excess ARs 2024 & 2003



- **The flare ARs 13664 and 10486 – components of activity complexes (ACs).**

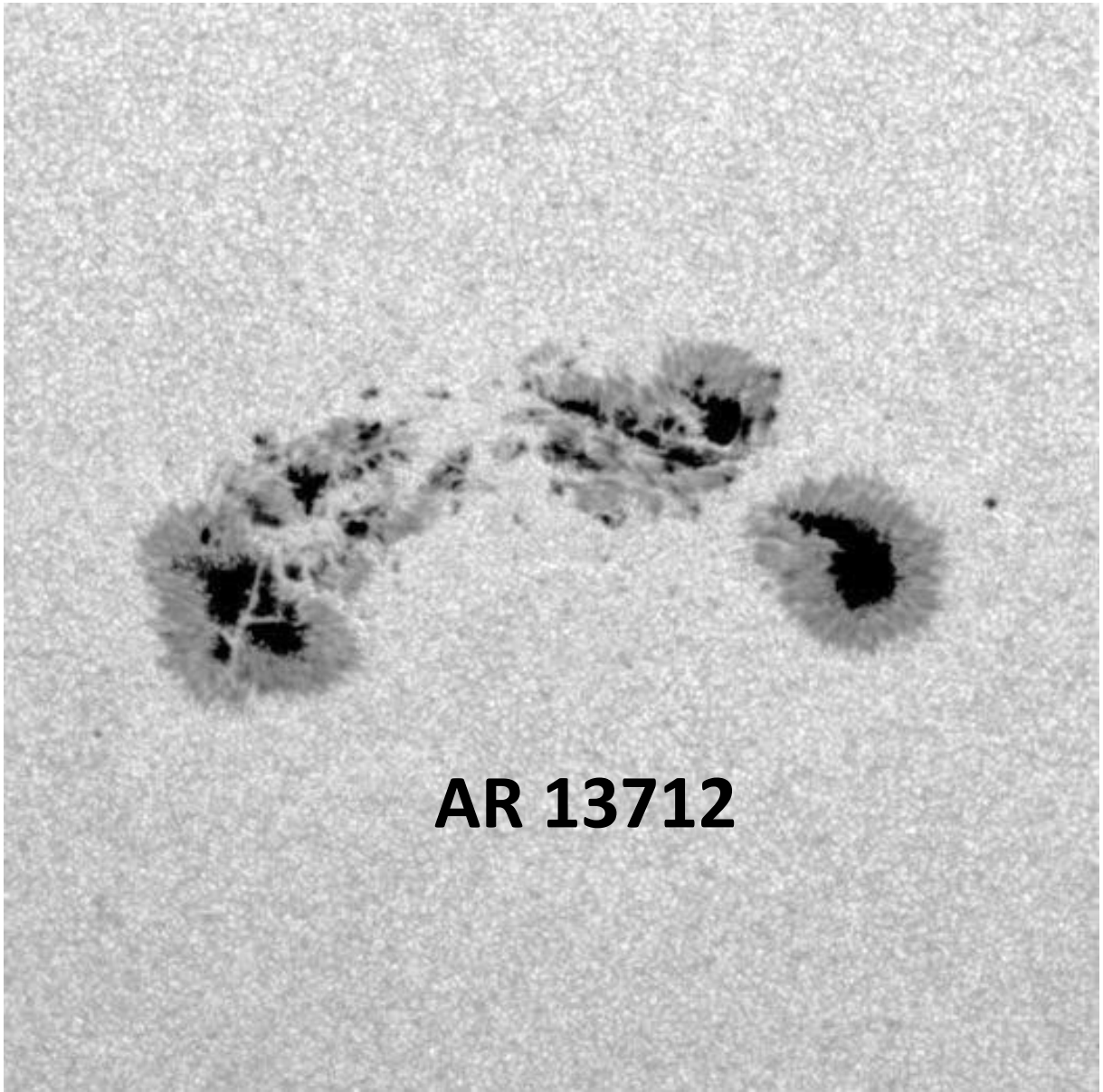
- **ACs -- long-lived magnetic formations in which ARs appear successively on the same Carrington coordinates for several months.**

**Yazev S.A. Activity Complexes on the Sun in Solar Cycle 24 //**
**Astronomy Reports.– 2015, vol. 59, No. 3, PP. 228-237.**

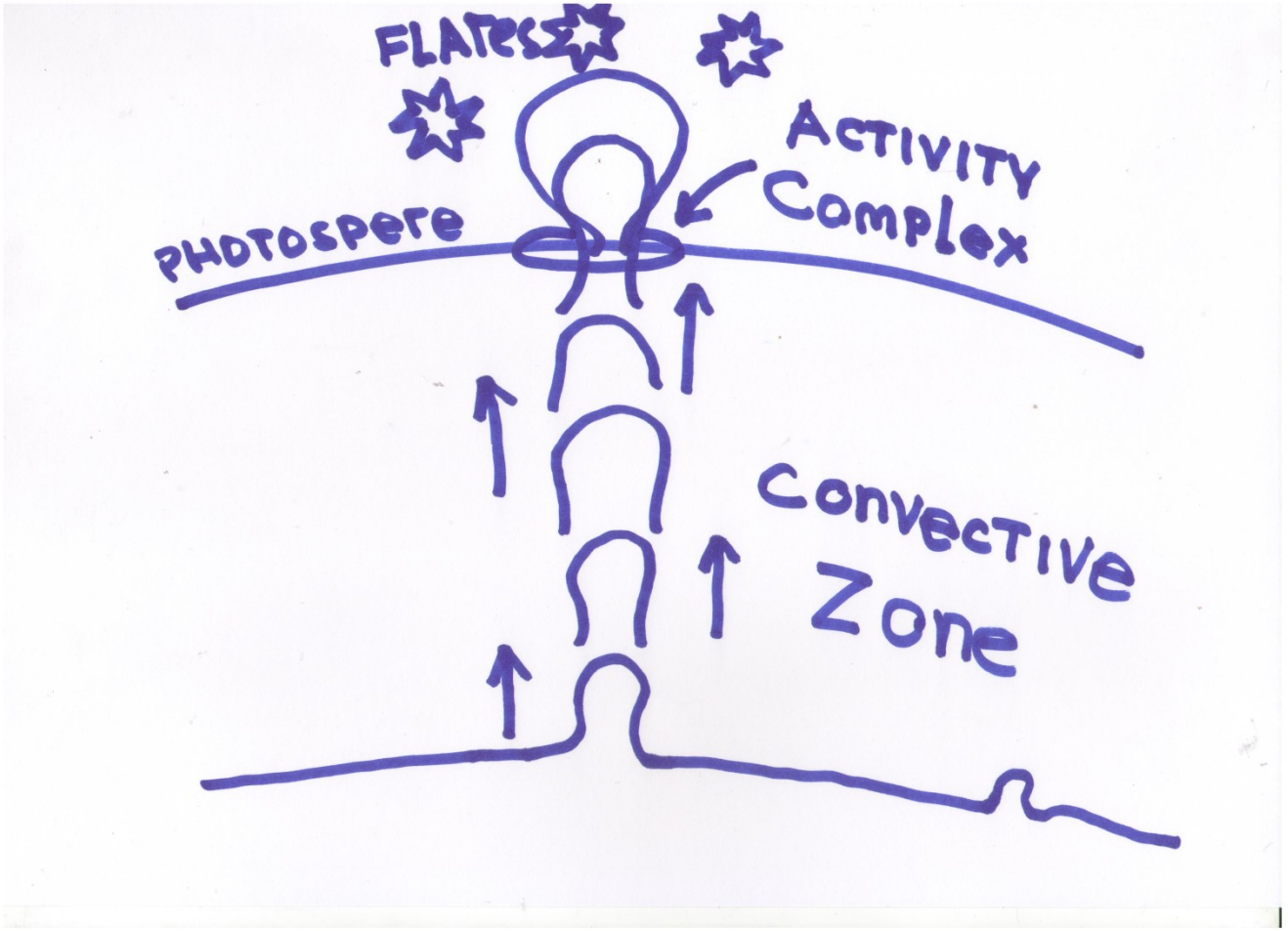
- **Up to 80% of strong flares in 21 – 24 cycles occur in ARs in the ACs.**

**Isaeva E.S., Tomozov V.T., Yazev S.A. Proton Flares in Solar Activity Complexes: Possible Origins and Consequences /**
**Astronomy Reports, 2018, Vol. 62, No. 3, pp. 243–250.**

# WHY ARE THERE NO STRONG FLARES?



# PROPOSED SCHEME OF FLARE ACTIVITY COMPLEX



# RESULTS

- **a comparative analysis of the development of the 24th and 25th solar activity cycles at the corresponding stages of the cycle development was performed;**

- **statistics of solar flare activity are provided, including the period of flare excess in May-June 2024;**

- **it is shown that during the flare excess, the north-south symmetry of solar activity was violated;**

- **a hypothesis is put forward that increased flare activity is associated with the formation of a deep complex of activity, in which repeated surfacing of new portions of the magnetic field flux occurred.**

- **THANK YOU FOR ATTENTION!**