

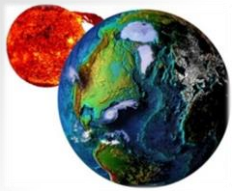
# *Extreme SWx Events*

**18 Dec 2014**

**AGU-2014**



**W. Denig, Chief**  
Solar & Terrestrial Physics Division  
NOAA/NESDIS/NGDC  
[william.denig@noaa.gov](mailto:william.denig@noaa.gov)



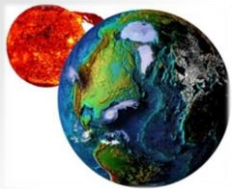
# Extreme SWx Events

## Classification per the Ap\*

Rank	Ap*	Start Date	Time	End Date	Time	SC (EBRO)
1	312	17 Sep 1941	09:00	20 Sep 1941	18:00	04:12 (18 Sep)
2	293	11 Nov 1960	21:00	15 Nov 1960	00:00	18:42 (12 Nov)
3	285	12 Mar 1989	06:00	16 Mar 1989	00:00	01:27 (13 Mar)
4	277	23 Mar 1940	00:00	27 Mar 1940	03:00	15:36 (24 Mar)
5	258	05 Oct 1960	06:00	08 Oct 1960	18:00	02:36 (06 Oct)
6	252	14 Jul 1959	09:00	17 Jul 1959	00:00	08:00 (15 Jul)
7	252	28 Oct 2003	09:00	29 Oct 2003	12:00	06:10 (29 Oct)
8	251	30 Mar 1960	12:00	04 Apr 1960	06:00	23:12 (02 Apr)
9	241	24 May 1967	15:00	27 May 1967	09:00	12:36 (25 May)
10	229	11 Jul 1982	18:00	15 Jul 1982	21:00	16:18 (13 Jul)

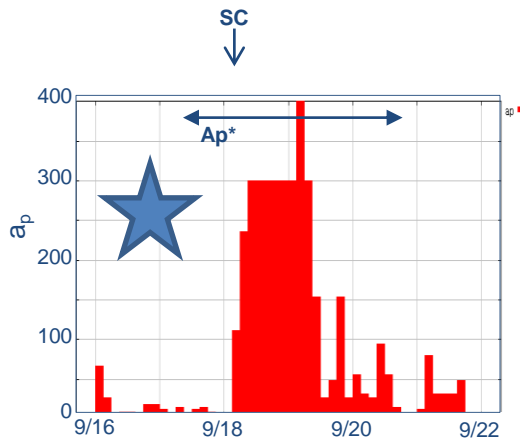
AP-Star (NGDC): <http://www.ngdc.noaa.gov/stp/spaceweather.html>

Sudden Commencement (EBRO): <http://www.obsebre.es/en/>

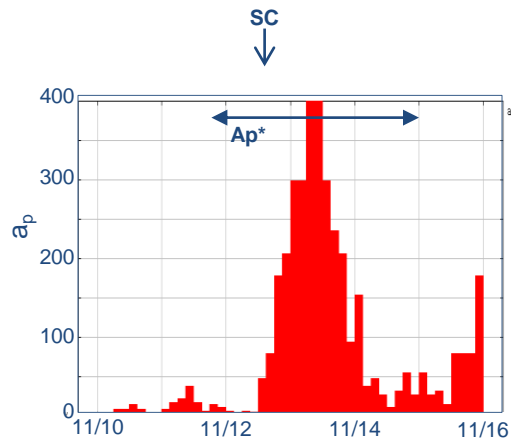


# Extreme SWx Events

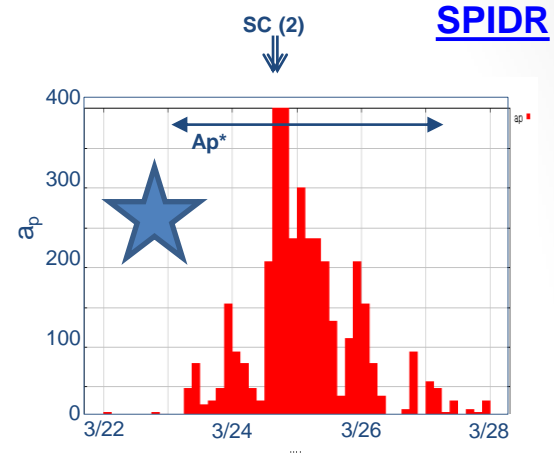
## 3-hour $a_p$ Index



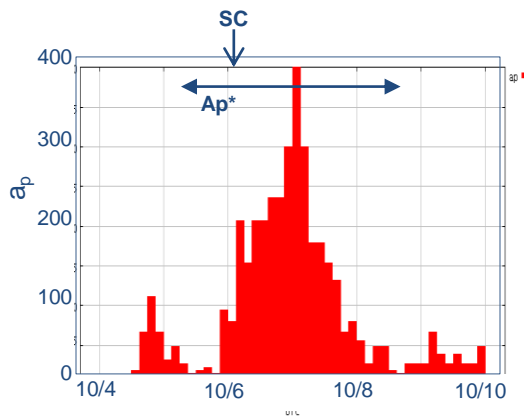
**#1 – September 1941**



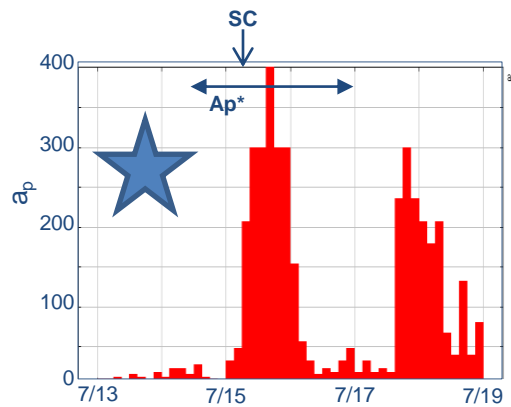
**#2 – November 1960**



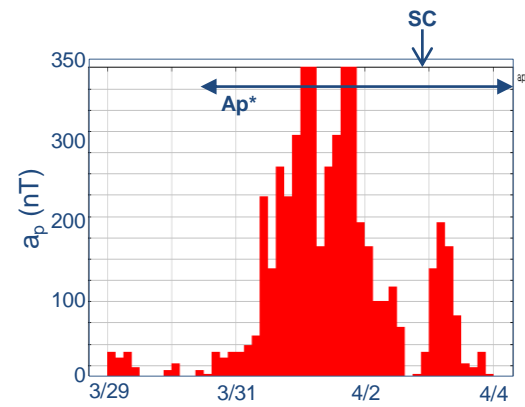
**#4 – March 1940**



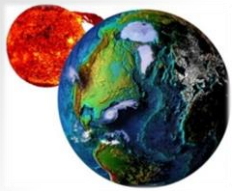
**#5 – October 1960**



**#6 – July 1959**



**#8 – March 1960**



# #4 – 23-27 March 1940

## Springfield Republican (25 Mar)

# Telegraph and Radio Upset By Magnetic Storm Caused By 'Enormous' Spot On Sun

Disruption Over Large  
Area Declared Worst in  
30 Years — Europe-New  
York Communications  
Crippled for Hours

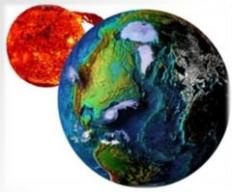
New York, March 24—(AP)—A huge spot on the sun played hob with communication today.

Disruption of telegraph and short wave radio service was the worst in 30 years, some experts said. The American Telephone and Telegraph company, largest land-line owner in the country, said it was the worst case of traffic impairment its engineers could recall.



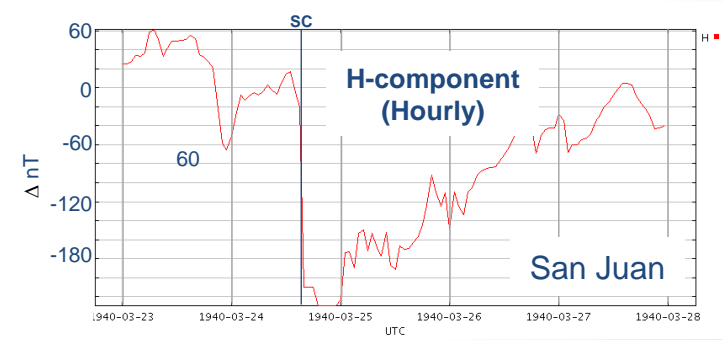
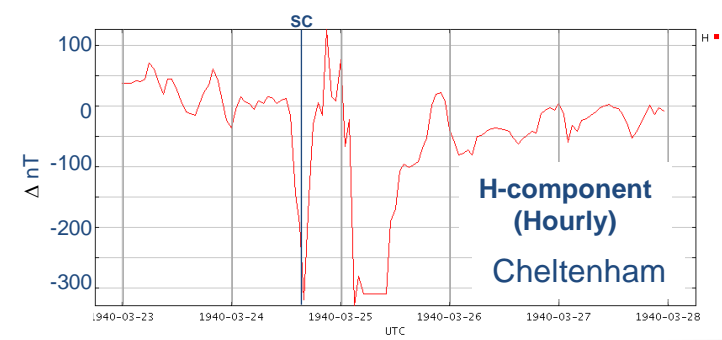
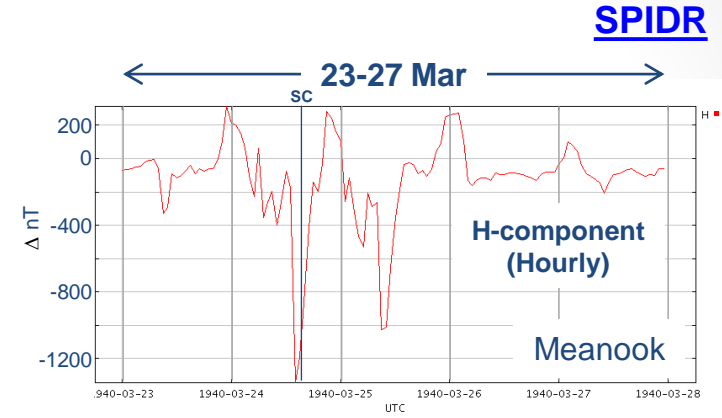
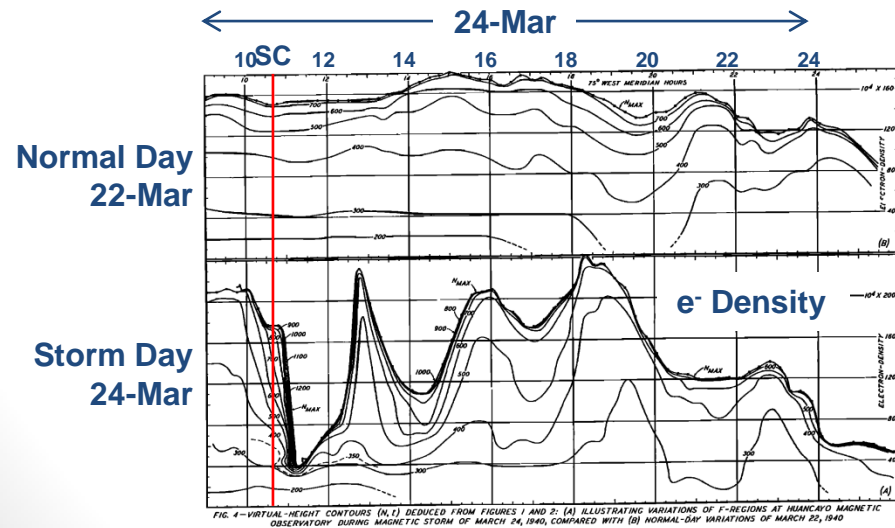
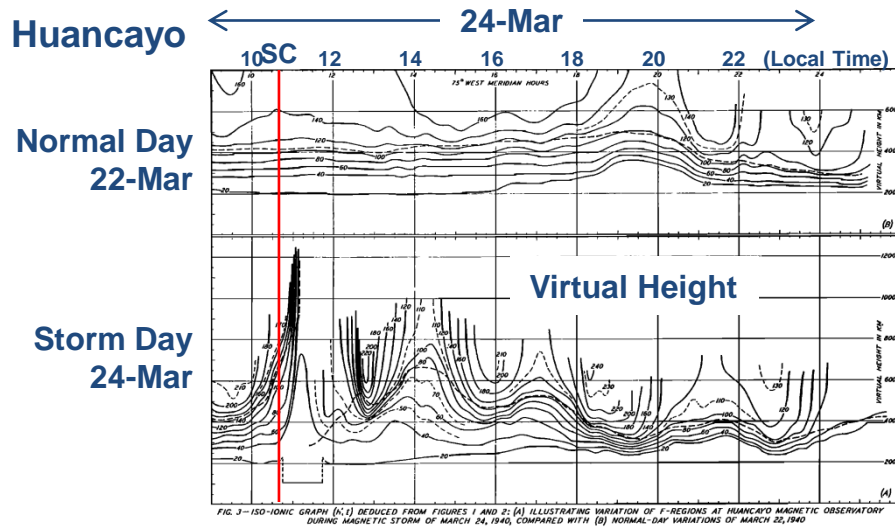
Canberra  
News  
27 Mar 40





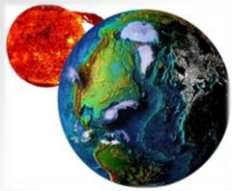
# #4 – 23-27 March 1940

## Ionospheric Response – 24 Mar 1940



AGU-2014 SH41D-06 (Extreme SWx Events)

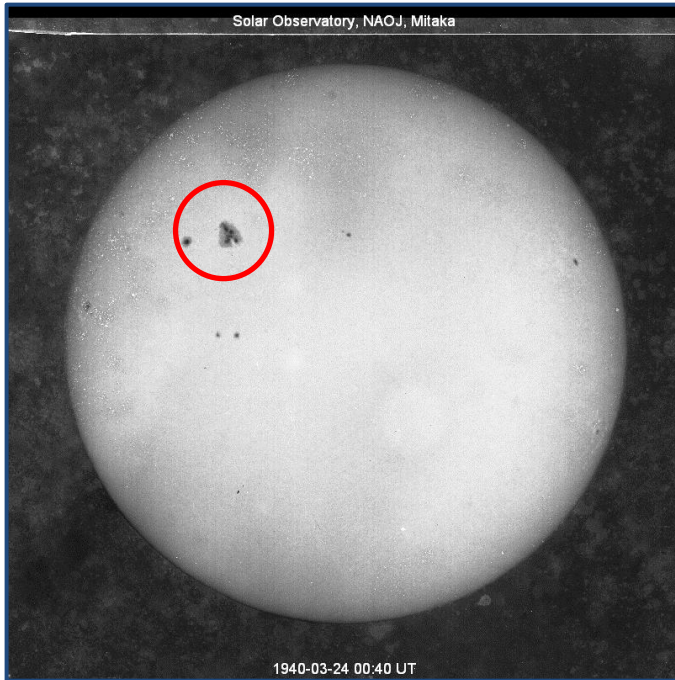
Berkner, L.V. and S.L.Seaton (1940), Ionospheric Changes Associated with the Magnetic Storm of March 24, 1940, *Terr. Mag. Atmos. Electr.*, 45, pp. 393-418.



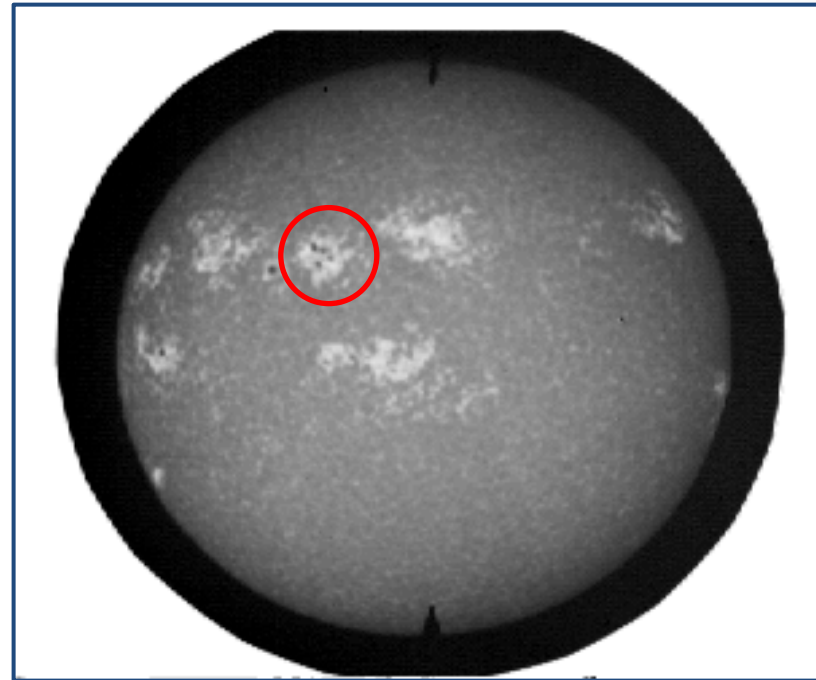
# #4 – 23-27 March 1940

## Summary

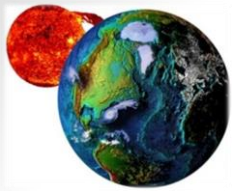
White Light ([NAOJ](#))



Ca-II ([Mt Wilson](#))



Observed	Time	Location	Characteristics	Reference
Group - 13555 MTW: 6783	23-Mar-1940	N12 E34	Umbræ: 135// Whole spots: 1017	<a href="#">Greenwich (NGDC)</a>
Optical Flare	23-Mar-1940 12:20	N12 E37	Importance: 3	<a href="#">Optical flares (NGDC)</a>
Sudden Comm	24-Mar-1940 15:36	n/a	AT = 310 nT	<a href="#">EBRE (IAGA)</a>
Max Kp / ap	24-Mar-1941 19:30	n/a	9 / 400 nT	<a href="#">WDC Geomagnetism (Kyoto)</a>



# #1 – 17-20 September 1941

## Springfield (MA) Republican (19 Sep)

### And Now Northern Lights Bring Questions On National Defense

#### Aurora Borealis Is Spectacular—Plays Hob With Radio and Telegraph Service

New York, Sept. 18—(AP)—A spectacular display of the aurora borealis swept the northwestern skies tonight in a heavenly show which led many an individual to believe it had something to do with national defense.

"Is the army testing a new searchlight?" or "Is the air force practicing a new type of night tactics?" were samples of some of the thousands of telephone calls which swamped newspaper offices.

The Hayden planetarium in New York answered calls at the rate of more than 100 an hour; city dwellers mounted to roof tops while the peo-

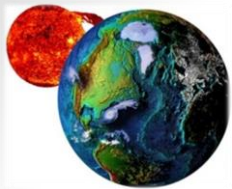
ple who deal in communications just moaned.

For the capricious flickerings in the firmament played hob with wireless and cable connections practically around the globe and disrupted radio and telegraph service throughout much of the United States.

Teletypewriters in newspaper offices showed a disconcerting volume of garbled copy which looked something like this—XHRPNSYPWM.

Spasmodically, the 300,000-mile leased wire network of the Associated Press was down—at one time for as long as two minutes—and the 10,000-

(Continued on Sixth Page)

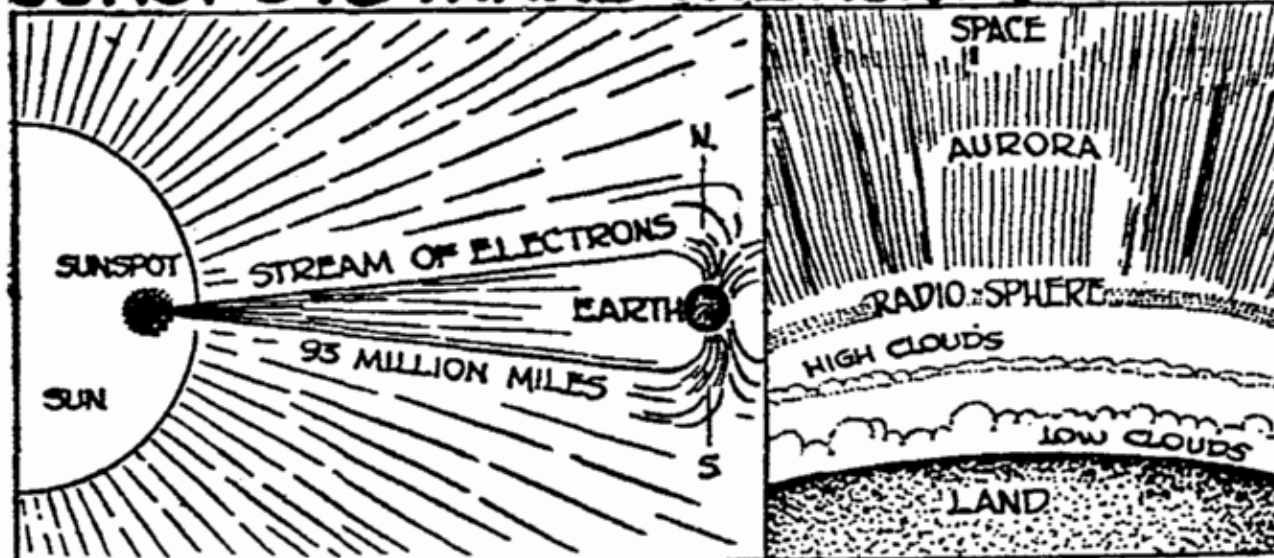


# #1 – 17-20 September 1941

## Trenton Times-Adviser

### THIS WEEK'S WEATHER

#### SUNSPOTS MAKE THE AURORA GLEAM

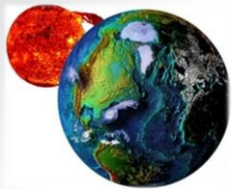


ELECTRONS FROM SUNSPOTS, DRAWN TO THE MAGNETIC POLES, MAKE THE UPPER AIR SHINE.

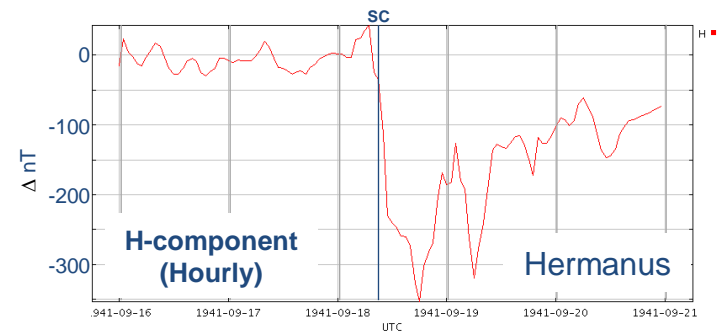
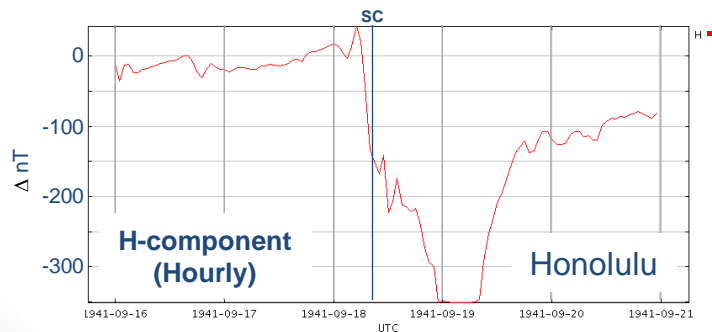
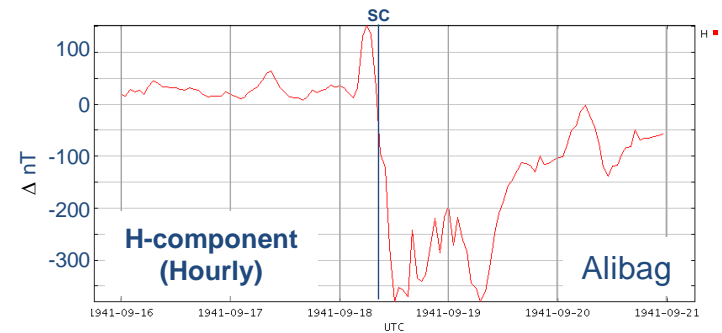
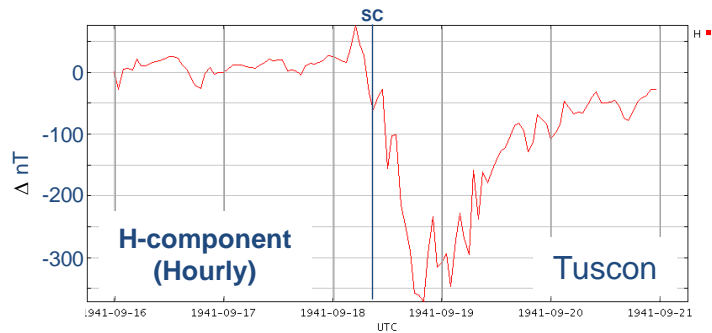
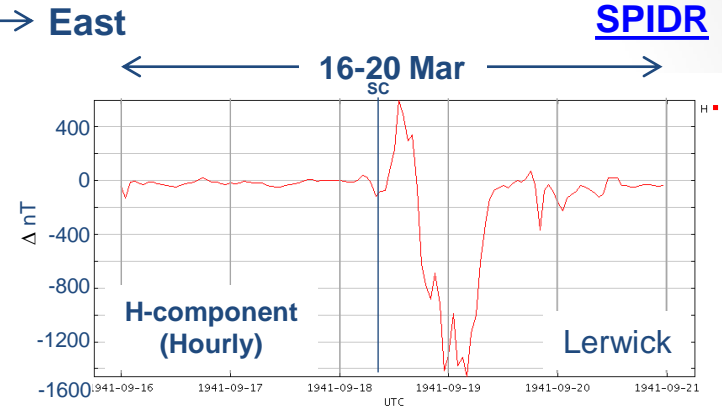
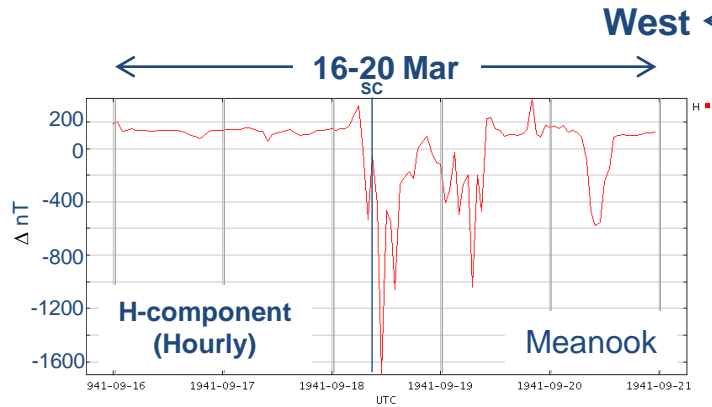
Explanation of the Northern Lights

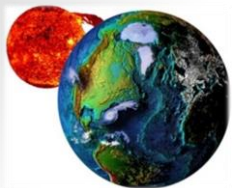






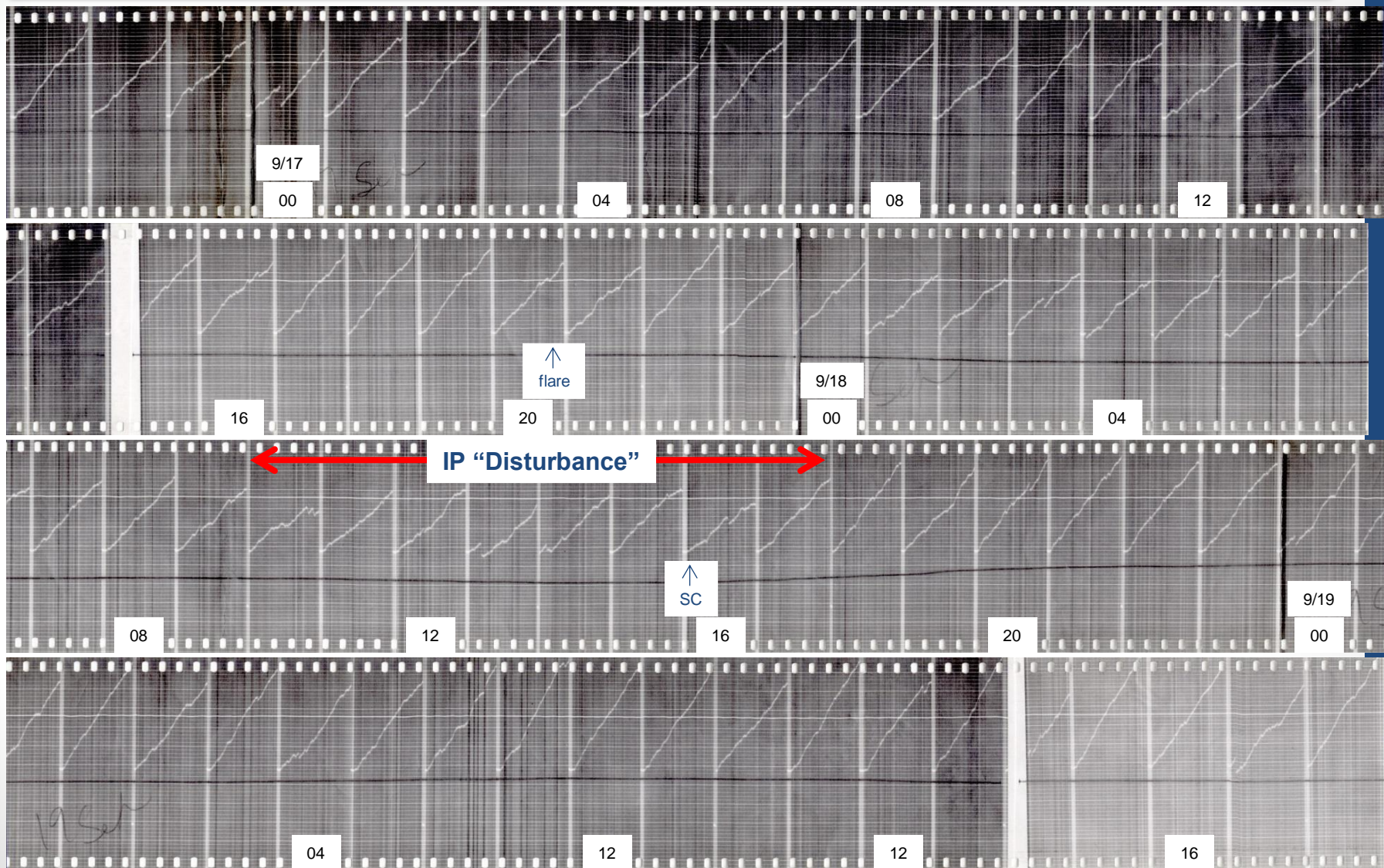
# #1 – 17-20 September 1941 Geomagnetic Response



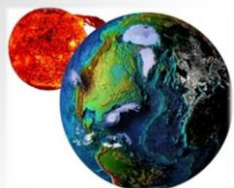


# #1 – 17-20 September 1941 Forbush Records - Christchurch

AGU-2014 SH41D-06 (Extreme SWx Events)



Times are in station local time. Christchurch (NZST) = UTC + 12 hours (or NZDT add 1 hour?)



## #6 – 14-15 July 1959

World Herald (Omaha) – 16 Jul (Thurs)

# *Sunspots Block Radio to Europe*

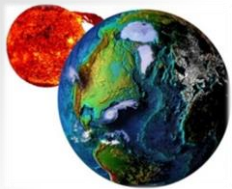
New York (AP)—Sunspots, kicking up a storm in the upper atmosphere, Wednesday virtually blacked out radio communication with Europe.

Also indirectly affected were cable communications, including those of the Associated Press.

With radio routes intermittently failing throughout the day, communica-

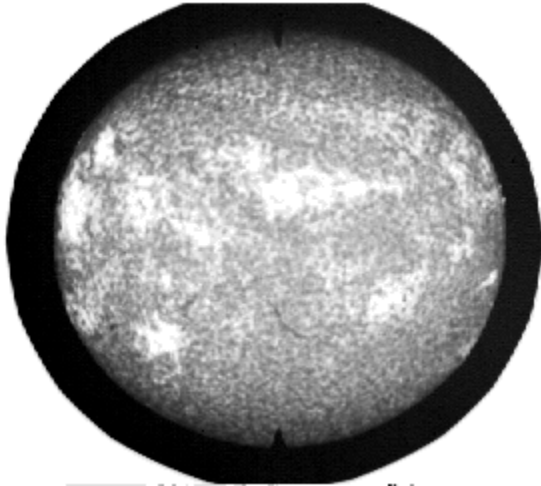
tions that would normally go by radio were switched to the cables, causing jams and delays in cable transmission.

The mysterious spots or huge flares on the sun's surface create magnetic storms in the ionosphere, the earth's upper atmosphere. These storms cause radio reception to be erratic because radio waves from the earth are bounced back from the ionosphere.

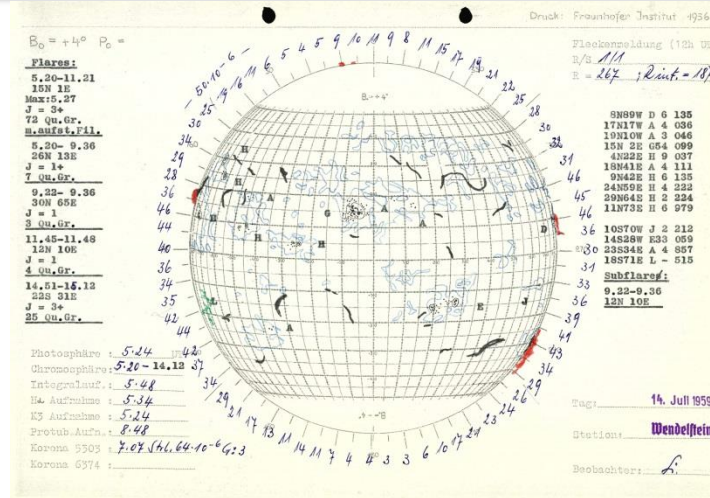


# #6 – 14-15 July 1959

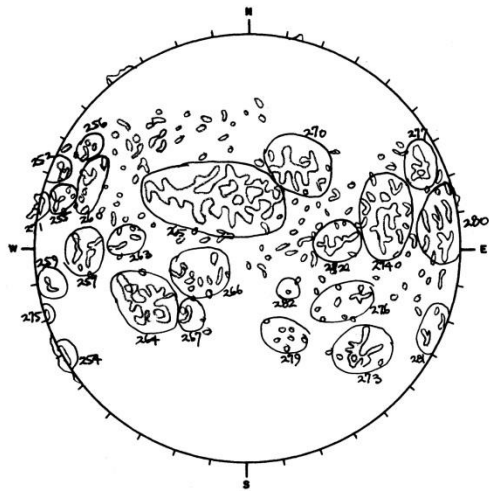
## Solar Images – 14 Jul



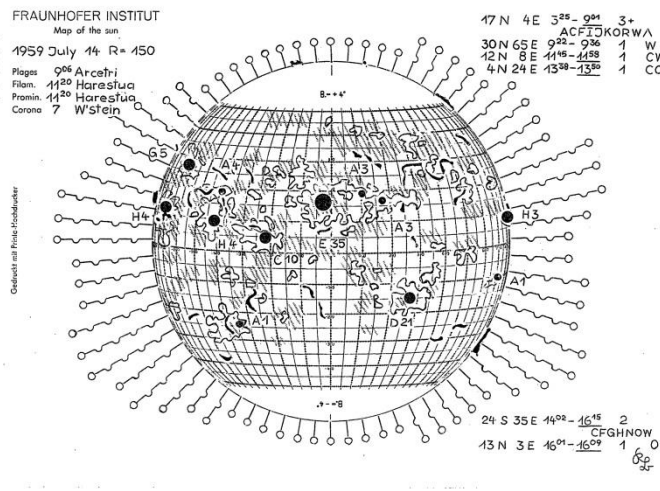
Mt Wilson – Ca-II (14 Jul)



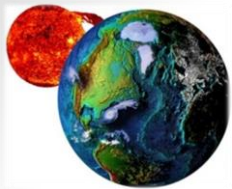
Wendelstein – Solar Composite (14 Jul)



McMath – Sunspot Drawing – (14 Jul)



Fraunhofer – Solar Composite (14 Jul)

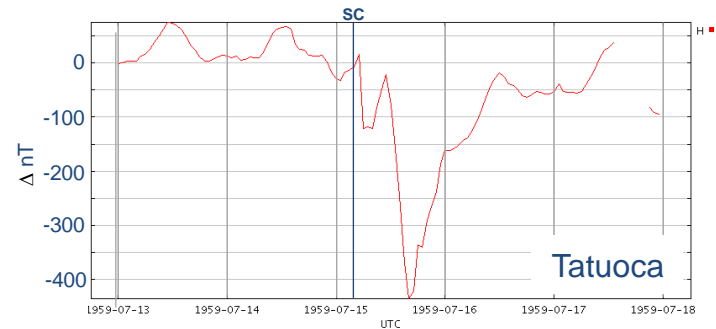
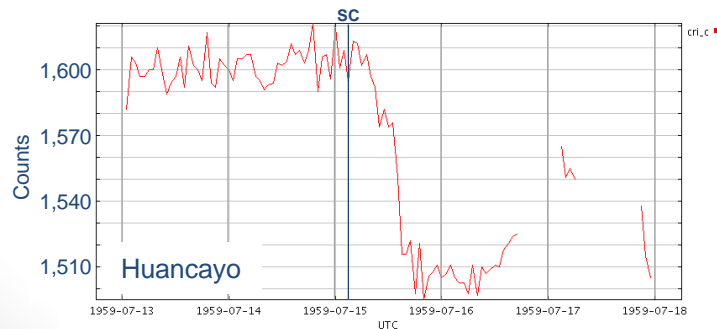
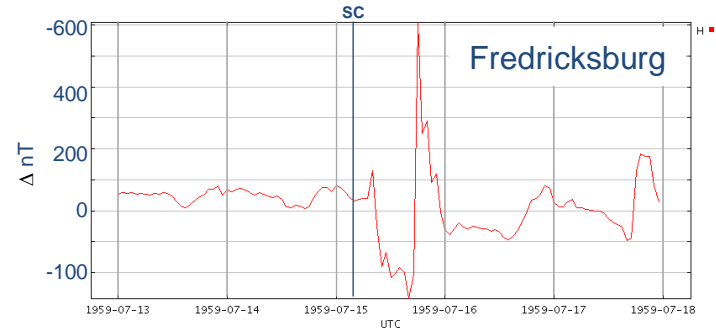
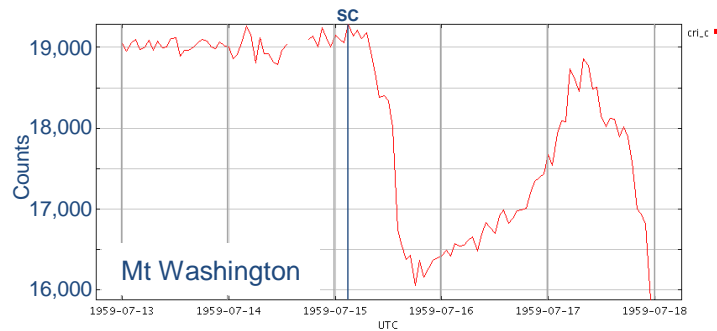
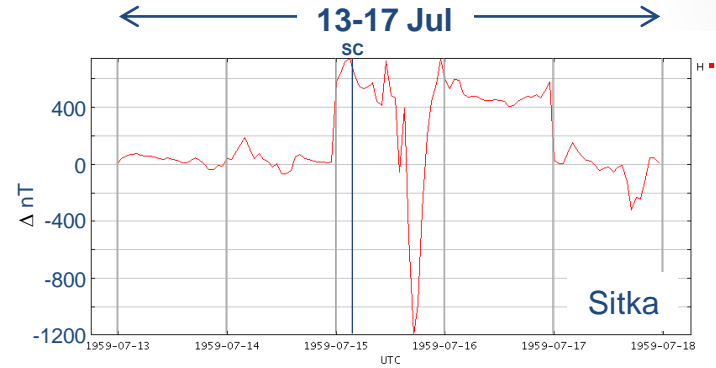
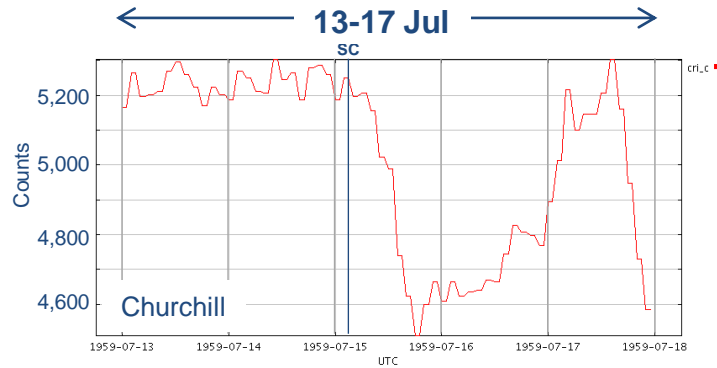


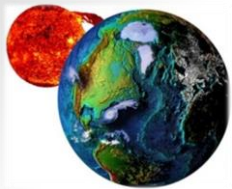
# #6 – 14-15 July 1959 Local Response

Cosmic Rays ←

→ Magnetic H-component

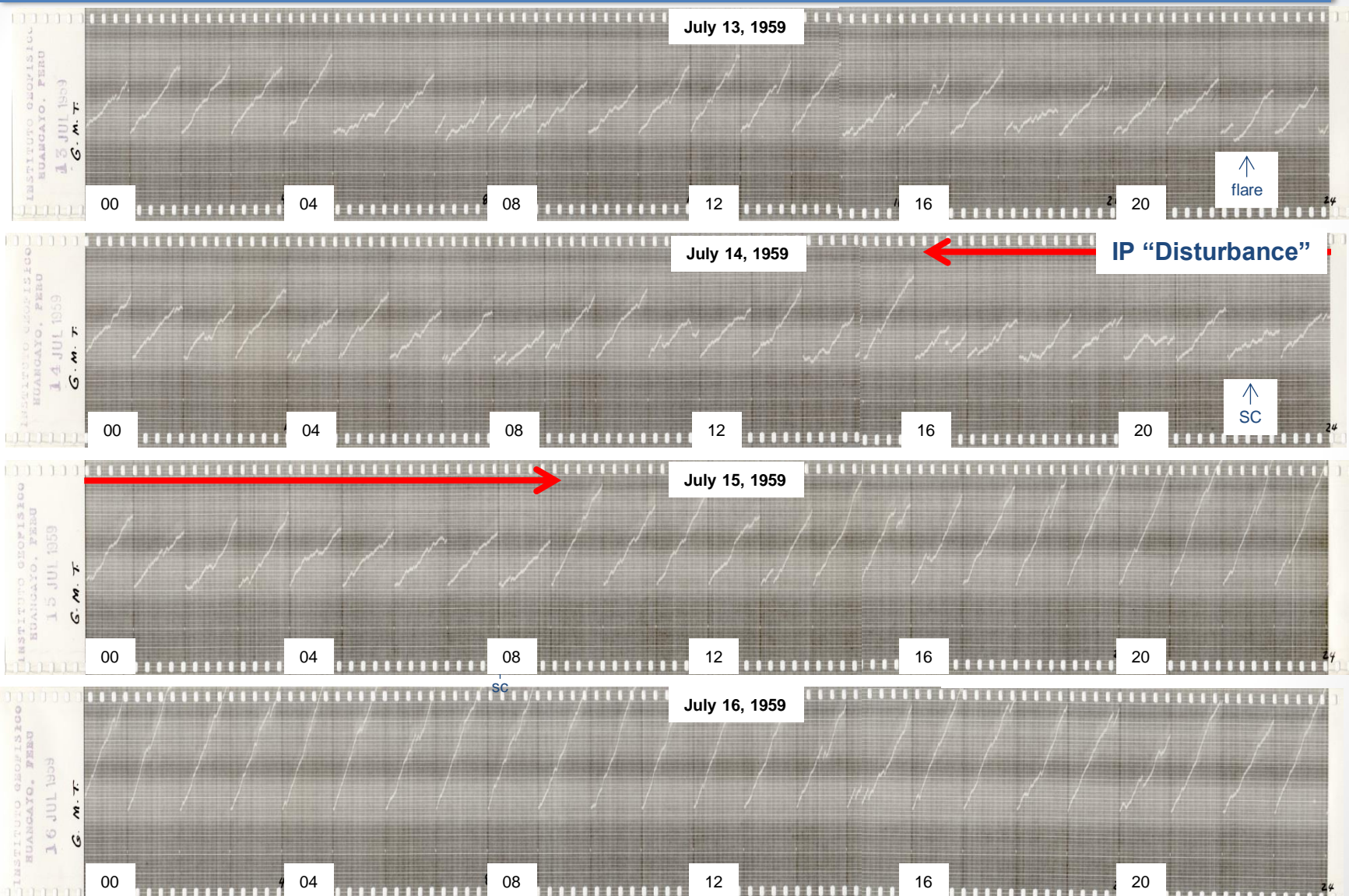
SPIDR



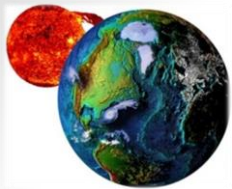


# #6 – 14-15 July 1959

## Forbush Records - Huancayo



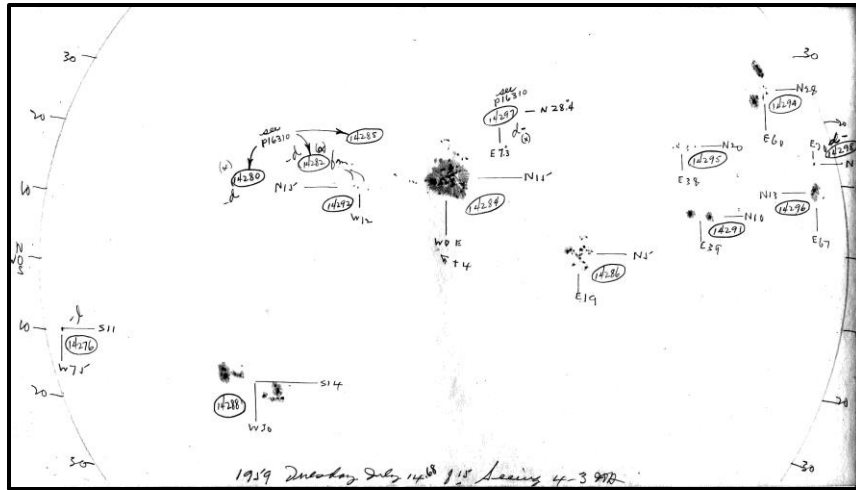
Times are in station local time. Huancayo (PET) = UTC - 5 hours



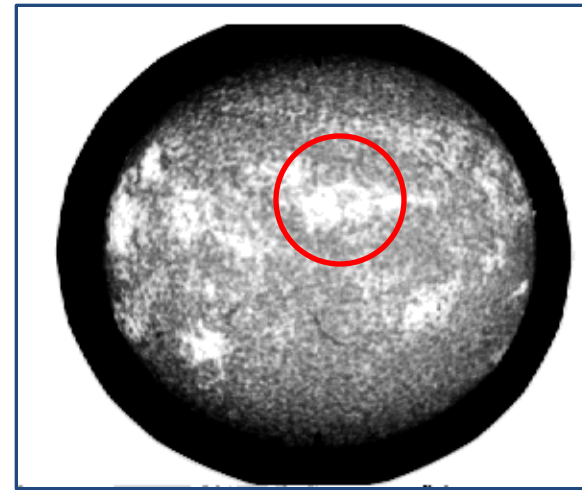
# #6 – 14-15 July 1959

## Summary

Mt Wilson (Sunspot Drawing)

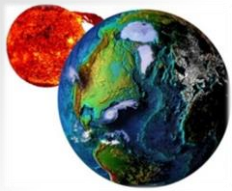


Mt Wilson (Ca-II)



Observed	Time	Location	Characteristics	Reference
Group – 19448 MTW: 14284	14-Jul-59 08:11	N16 E05	Umbra: 337 // Whole spots: 1314	<a href="#">Greenwich (NGDC)</a>
Optical Flare	14-Jul-59 03:25	N17 E07	Importance: 3	<a href="#">Optical flares (NGDC)</a>
SID	14-Jul-59 03:28	Wide Spread Index: 5	Importance: 3+ S-SWF	<a href="#">SID Report (SGD)</a>
SC	15-Jul-59 03:28	n/a	AT = 79 nT	<a href="#">Ebre (IAGA)</a>
GLE	16-Jul-59 22:00	n/a	Annotated: -1	<a href="#">GLE Report (NGDC)</a>
Max Kp / ap UT	15-Jul-59 16:30 UT	n/a	9 / 400 nT	<a href="#">WDC Geomagnetism (Kyoto)</a>





# Interesting News Item - 1959

## Trenton Evening Times (15 Oct)

# Bursts Of Cosmic Rays Imperil Space Travelers

**BERKELEY, Calif. (AP)—An other potentially deadly radiation hazard for space travelers was reported today by researchers who sampled the upper air of the arctic region with instrument-carrying balloons.**

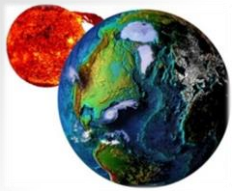
**During periods of solar flares the investigators found that the top of the earth's atmosphere near the polar region was showered with stupendous bursts of cosmic rays.**

**This radiation was 10,000 to 100,000 times above normal, said Dr.**

**Robert A. Brown, physicist, and Ray D'Arroy, graduate student, of the University of California.**

**Dr. Brown made his report after returning here from College, Alaska, where the balloon flights were made. Cosmic rays are more intense in the polar areas because they encounter less interference there from the earth's magnetic field.**

**The experimenters put up a balloon immediately after the University of Alaska detected a solar flare. A solar flare is a sudden brightening of the sun's surface in the vicinity of a sunspot.**



# Extreme SWx Events

## Summary

- **Dealing with “old” data is not for the faint of heart**
  - Most data consist of digitized analog records
  - UTC versus LT needs to be unraveled (or not)
  - Measurement techniques were crude by current standards
  - Classification schemas need to be understood
- **Dealing with “old” data is nonetheless rewarding**
  - Understanding the foundations for space weather
  - Putting one’s self in the mindset of early physicists
  - Assembling data from disparate sources now available
- **“New” physics unlikely, historical trends aside**
  - Fidelity of the datasets drives uncertainty
  - Experimental procedures lack detail and authenticity