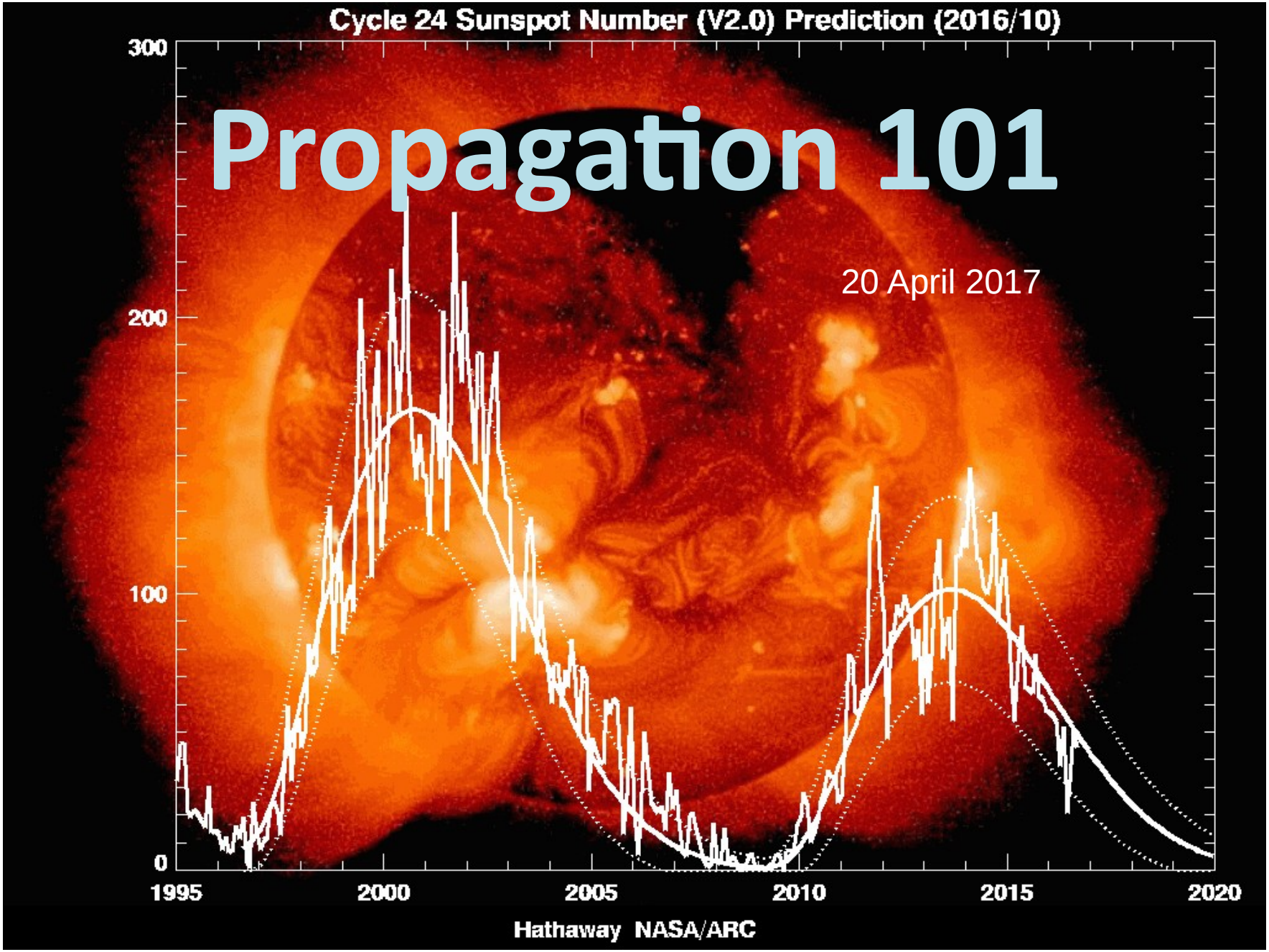
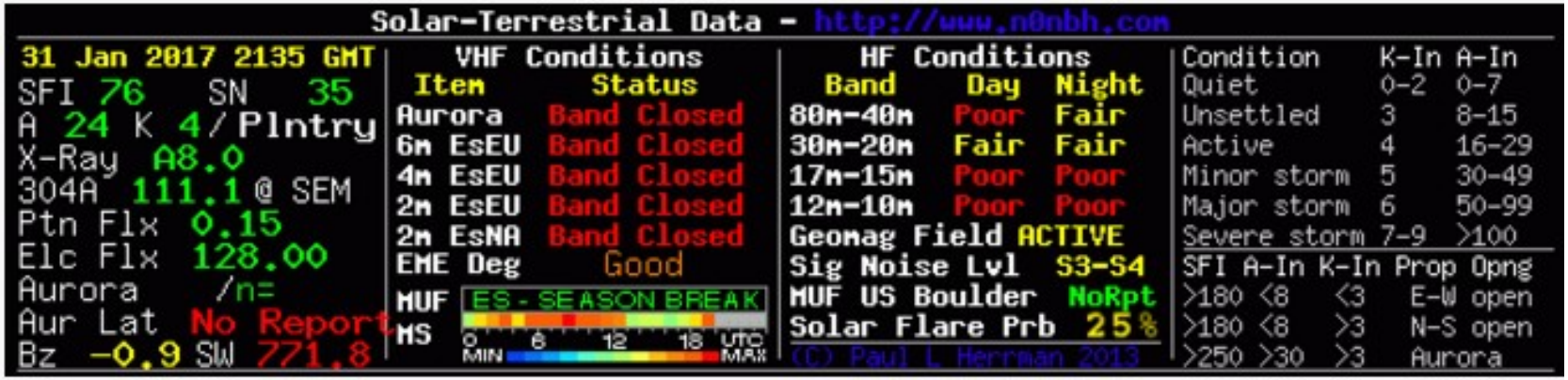
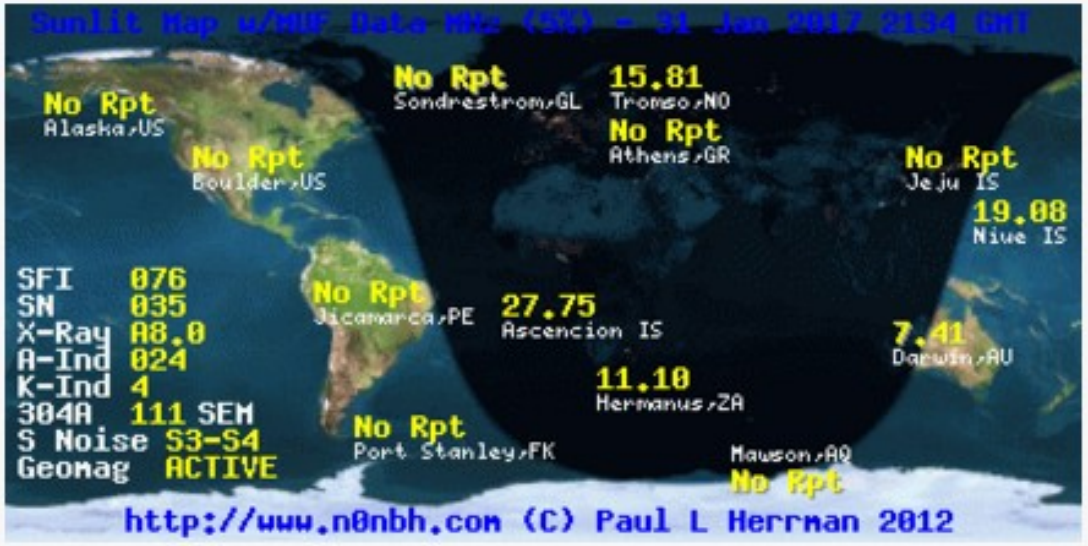


Propagation 101

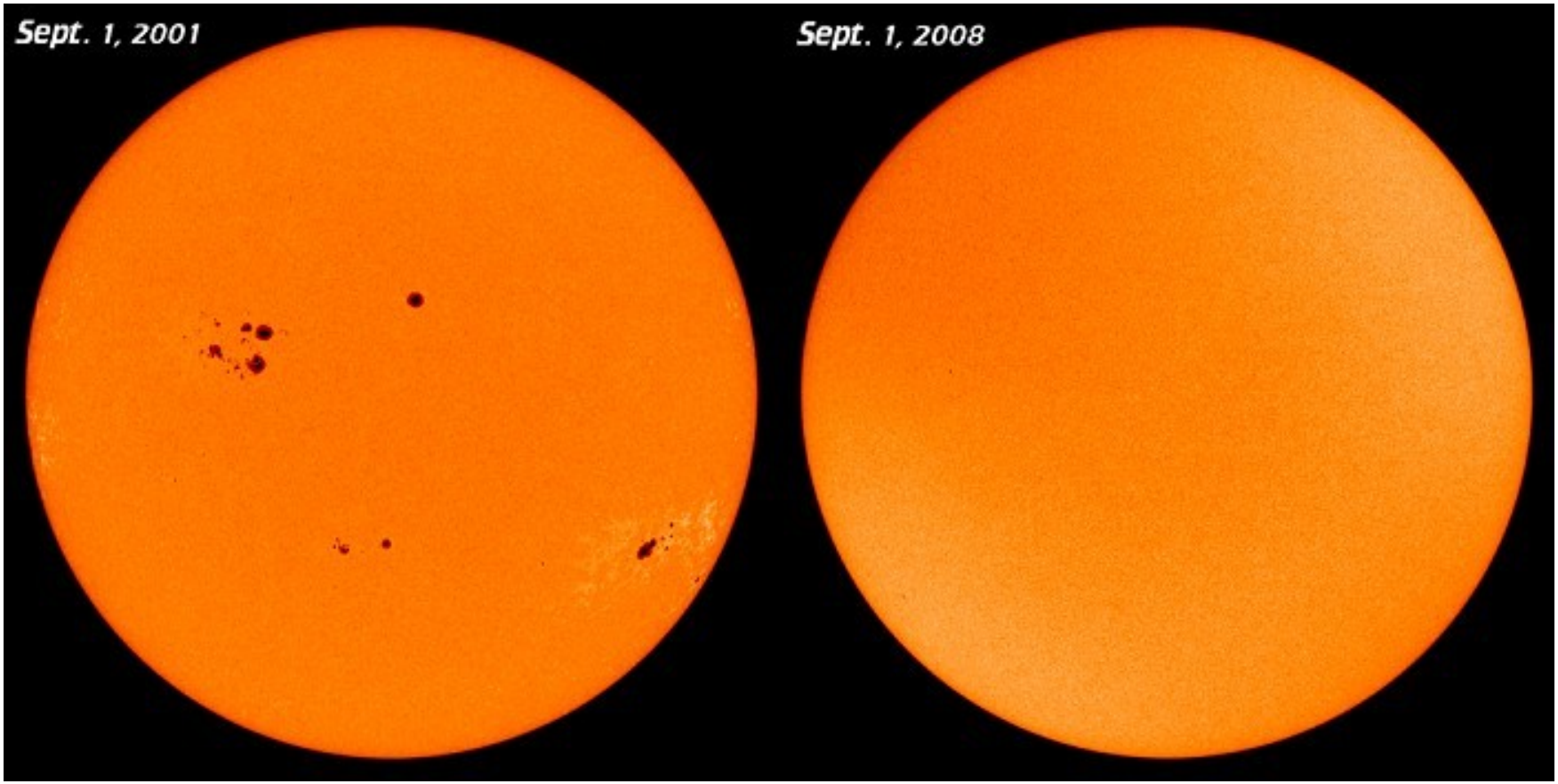
20 April 2017

What These Numbers Mean And How To Use Them?



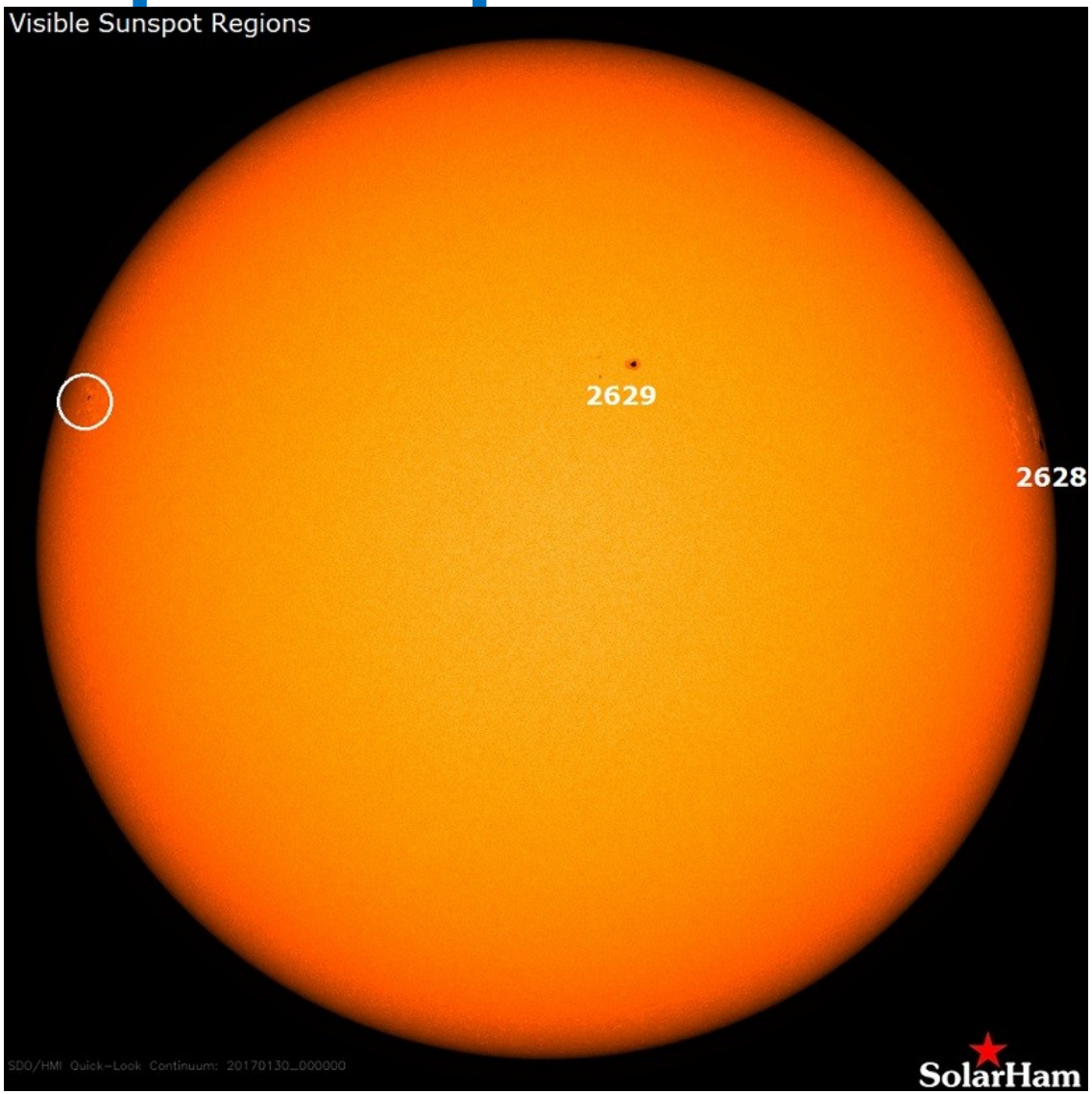


Sunspot Cycle 23

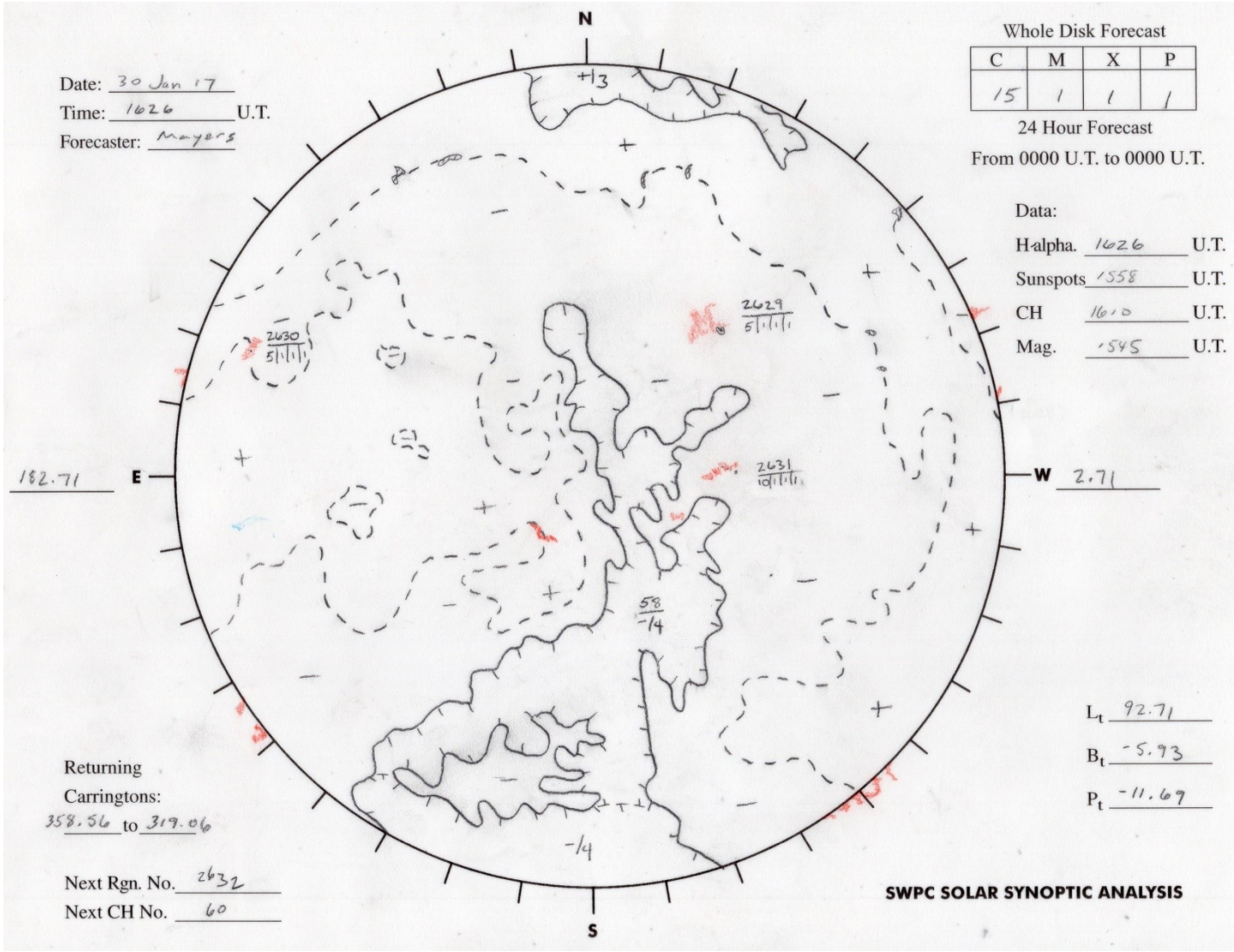


http://www.astronomy.org/StarWatch/August/index-8-09.html

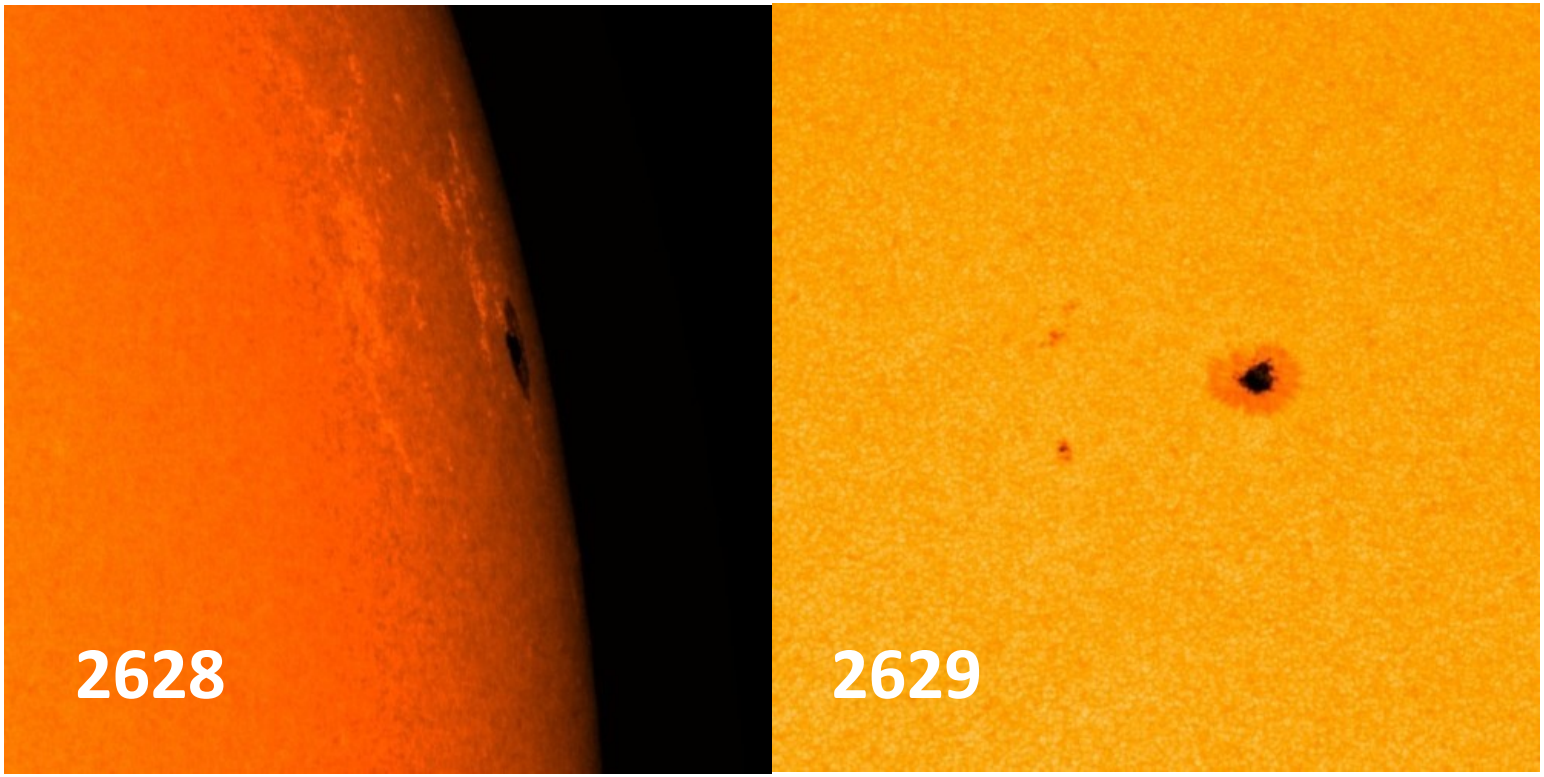
Sunspot Map – 30 Jan 2017



Synoptic Map – 30 Jan 2017



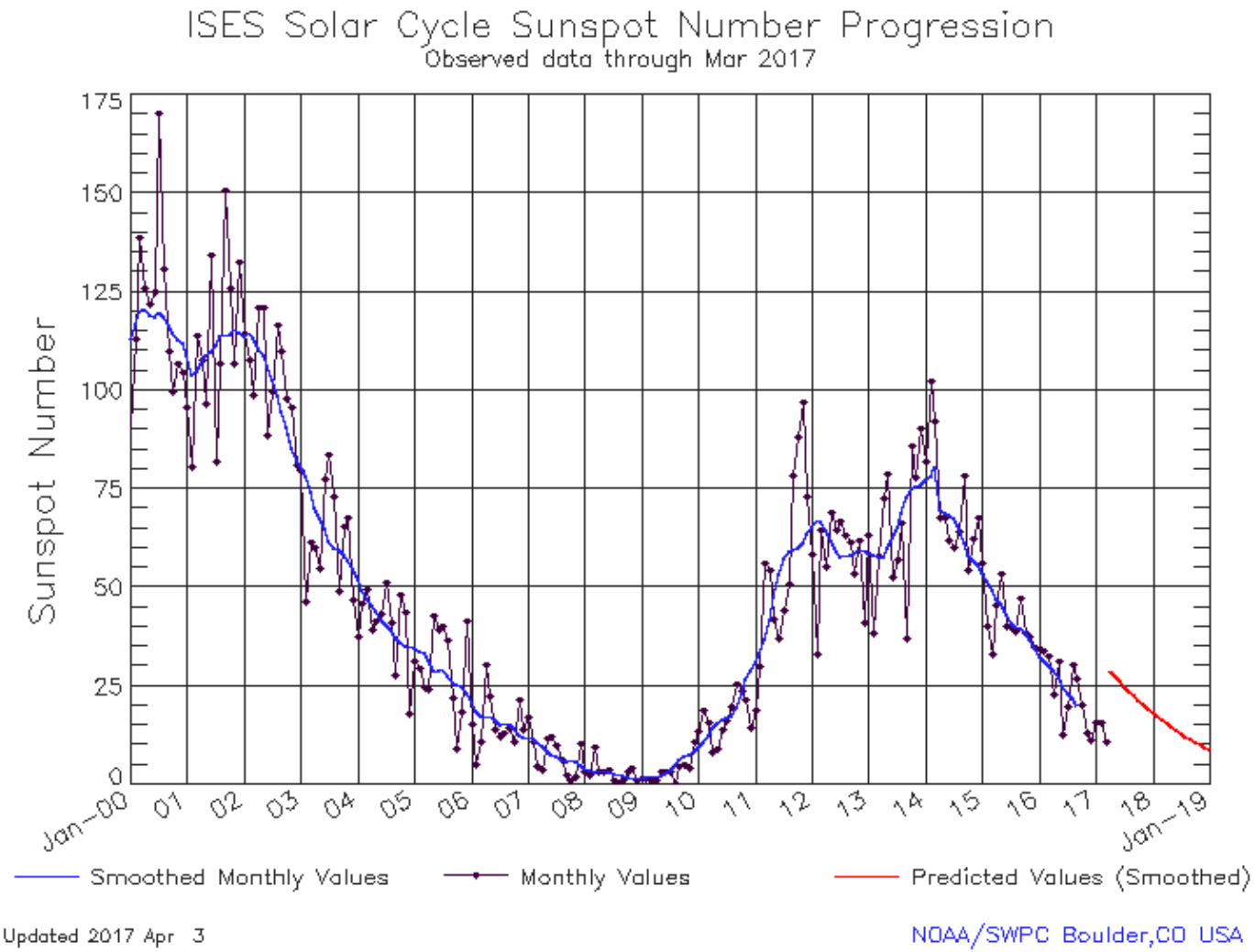
Sunspot Number = 24 - 29 Jan 2017



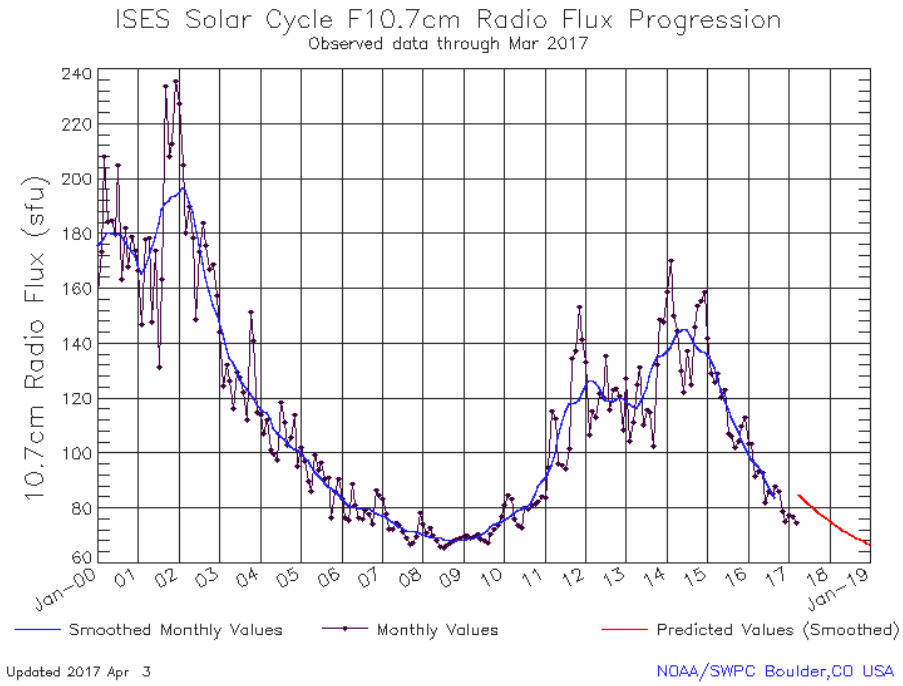
:Solar_Region_Summary: 2017 Jan 29

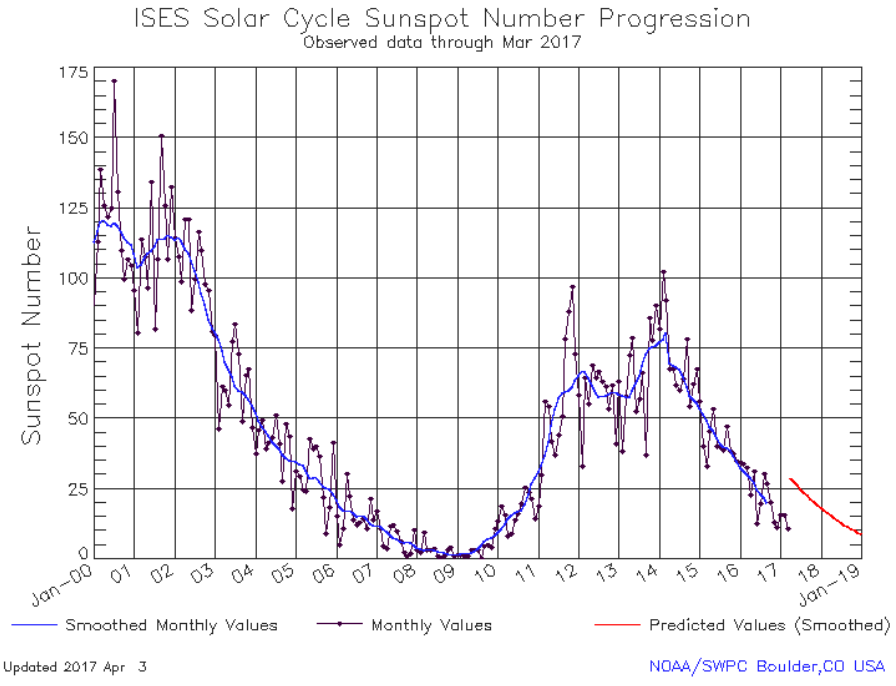
# Region	Location		Sunspot Characteristics					
# Helio							Spot	Spot Mag.
# Num	Lat.,CMD	Long.	Area	Extent	class	count	class	
2628	N11	W79	181	110	2	HSX	**1**	A
2629	N15	W10	112	120	6	CSO	**3**	B

Solar Cycle Sunspot Progression



Solar Flux Versus Sunspots

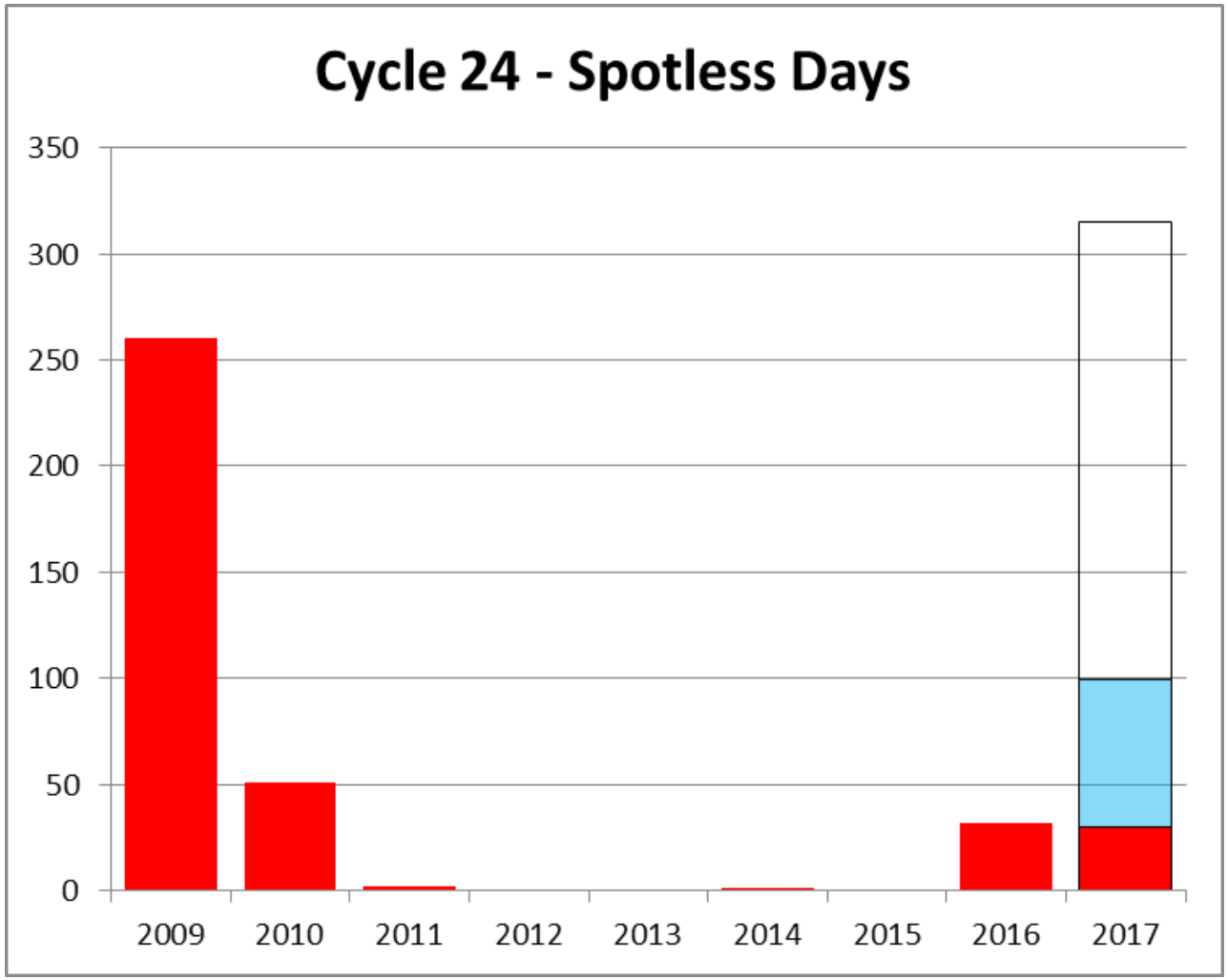




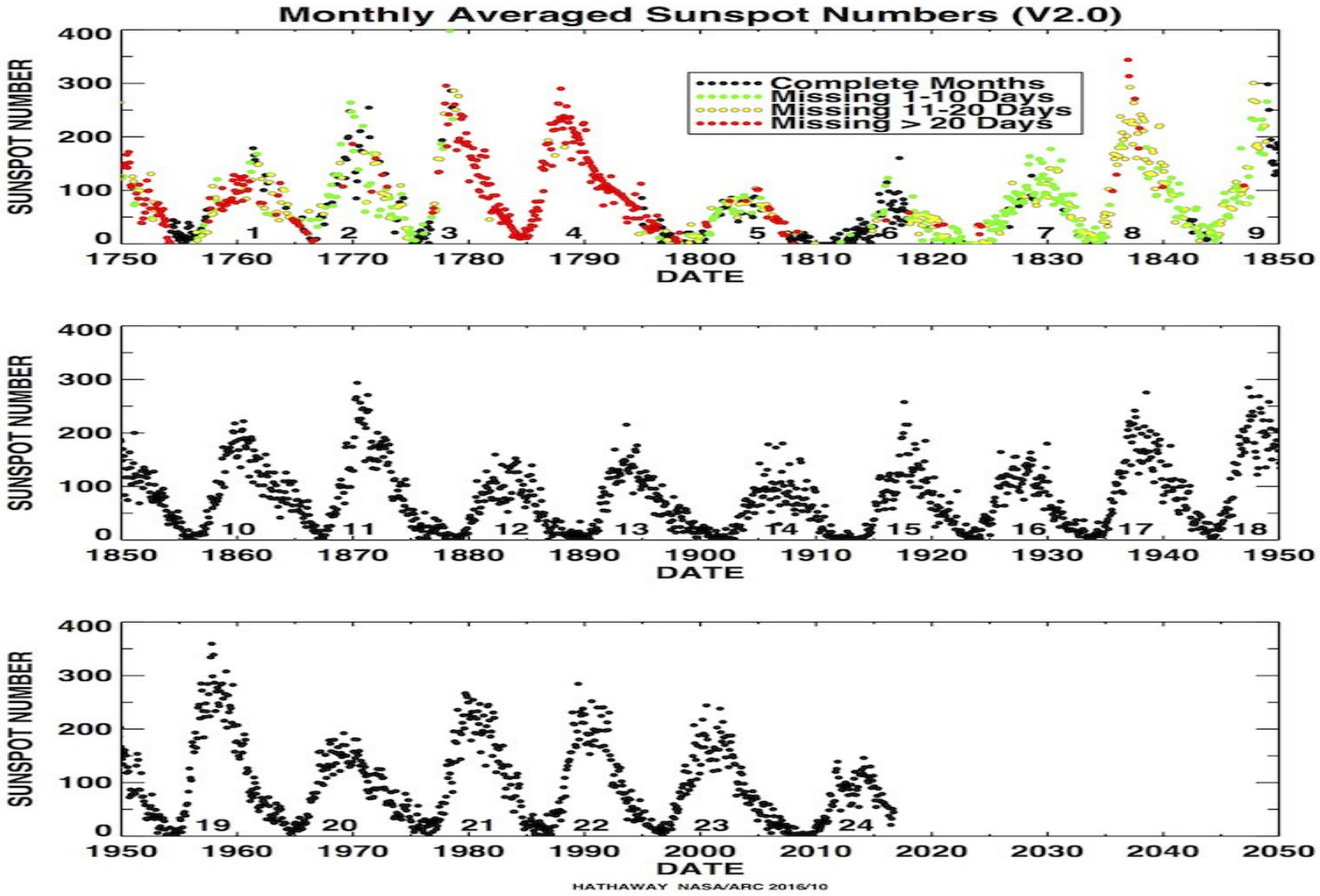
$$SF = 73.4 + 0.62\ R$$

$$SF = 63.7 + 0.73\ R + 0.0009\ R^2$$

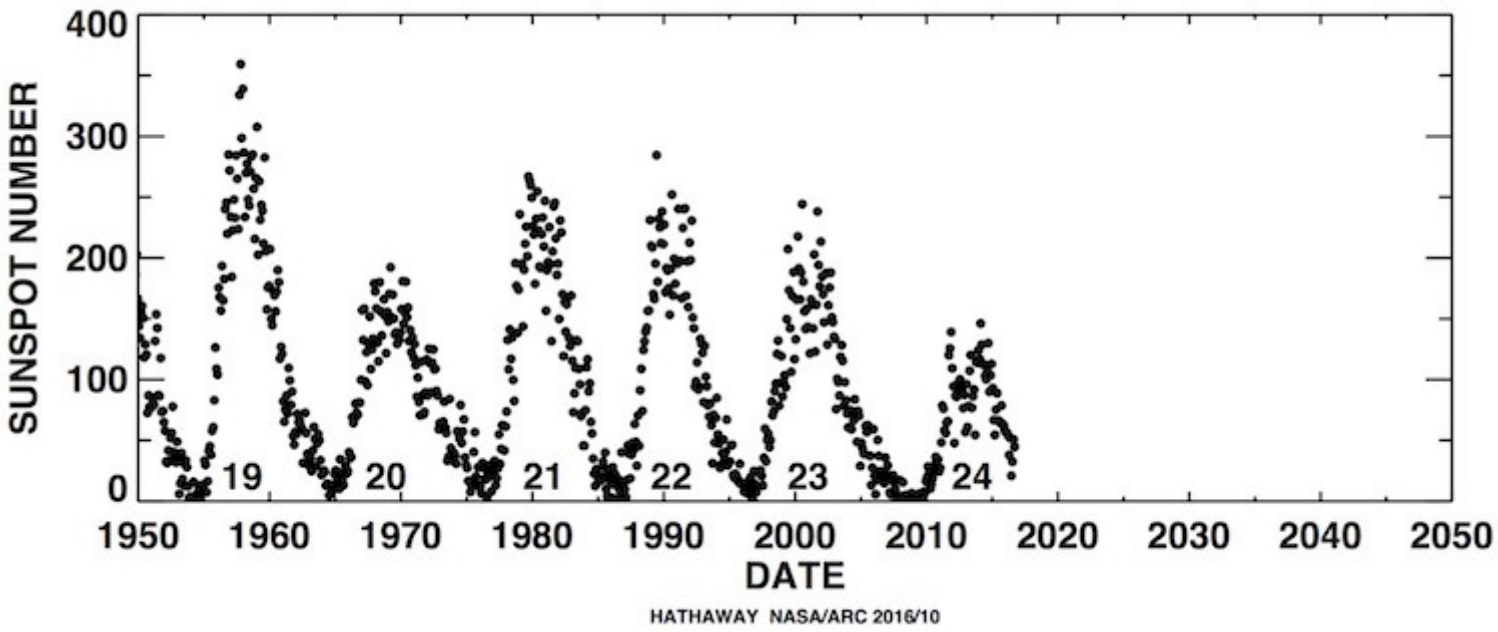
Spotless Days In Cycle 24



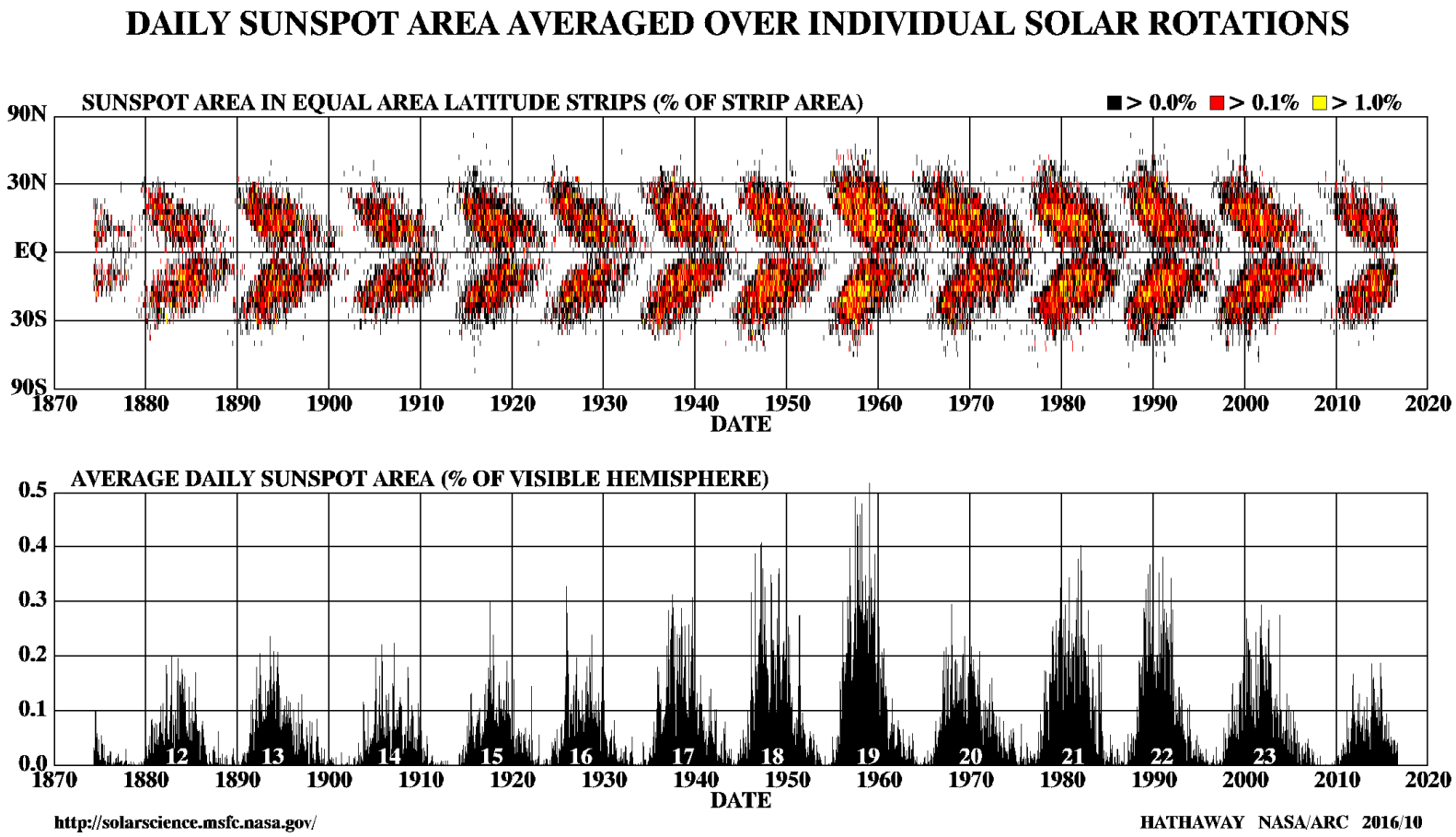
Long Term Sunspot Numbers



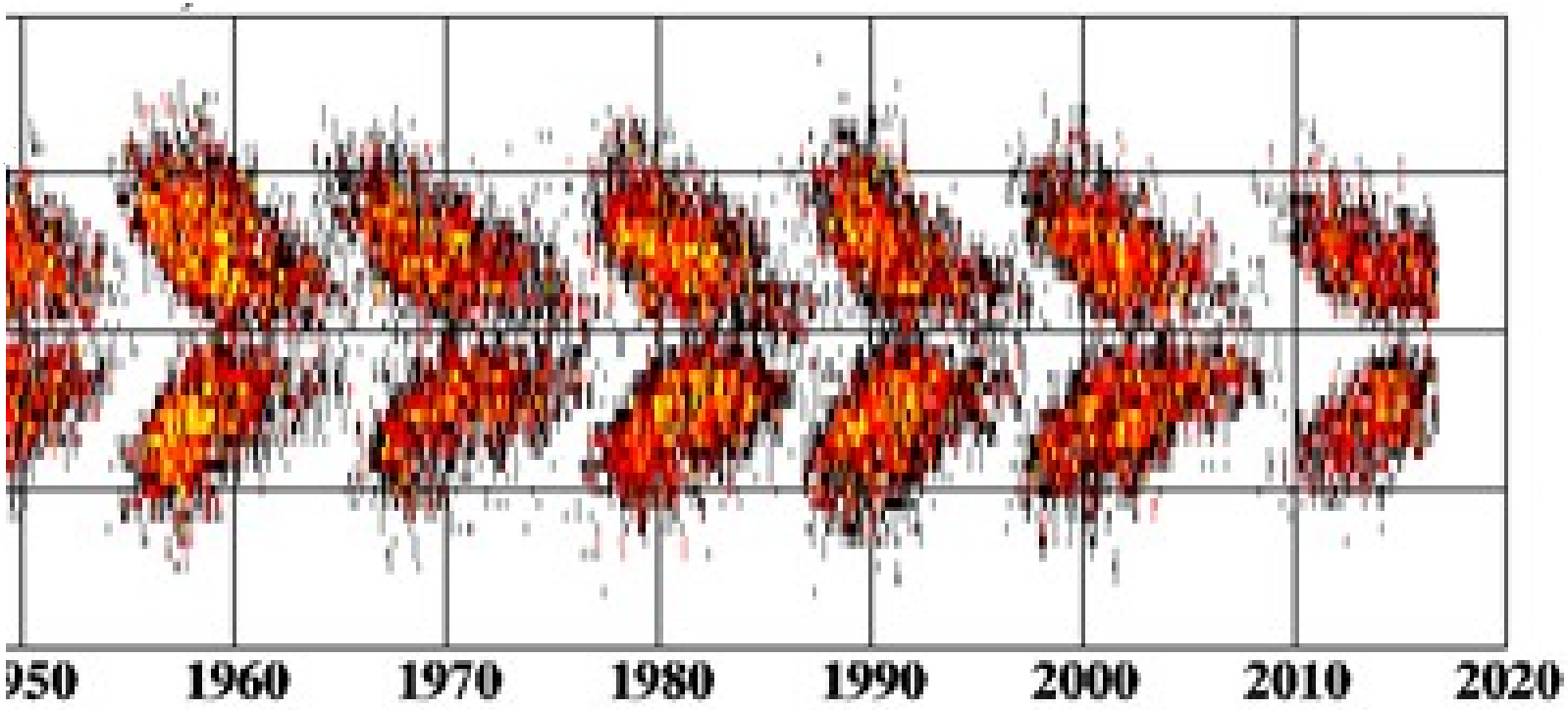
Sunspot Cycle 19 - 24



Butterfly Diagram

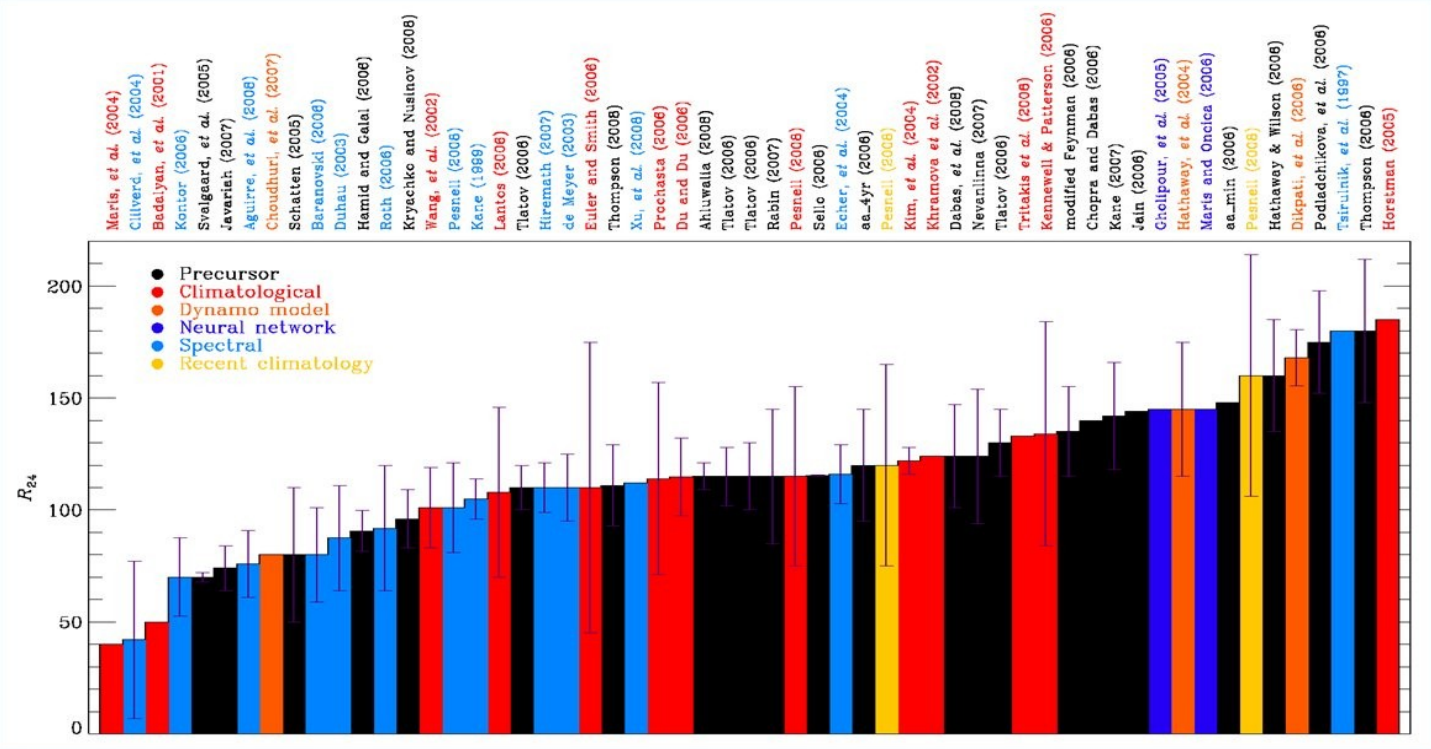


Sunspot Cycle 19 -24



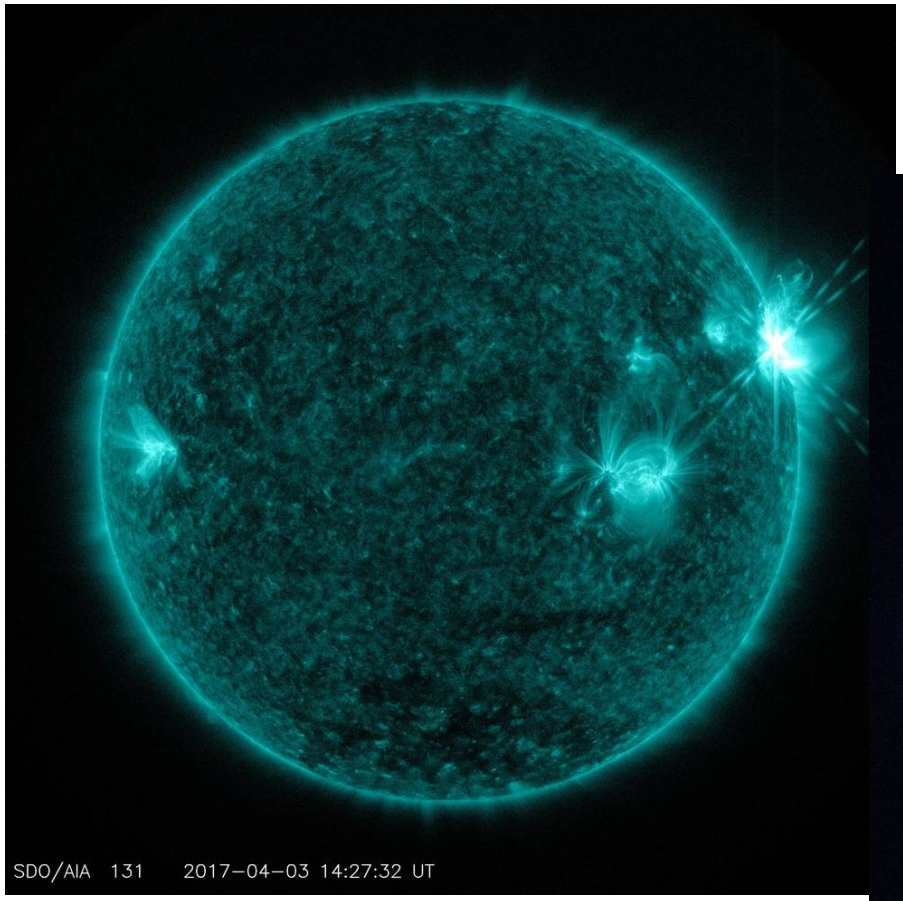
Which Predictions Get The Press

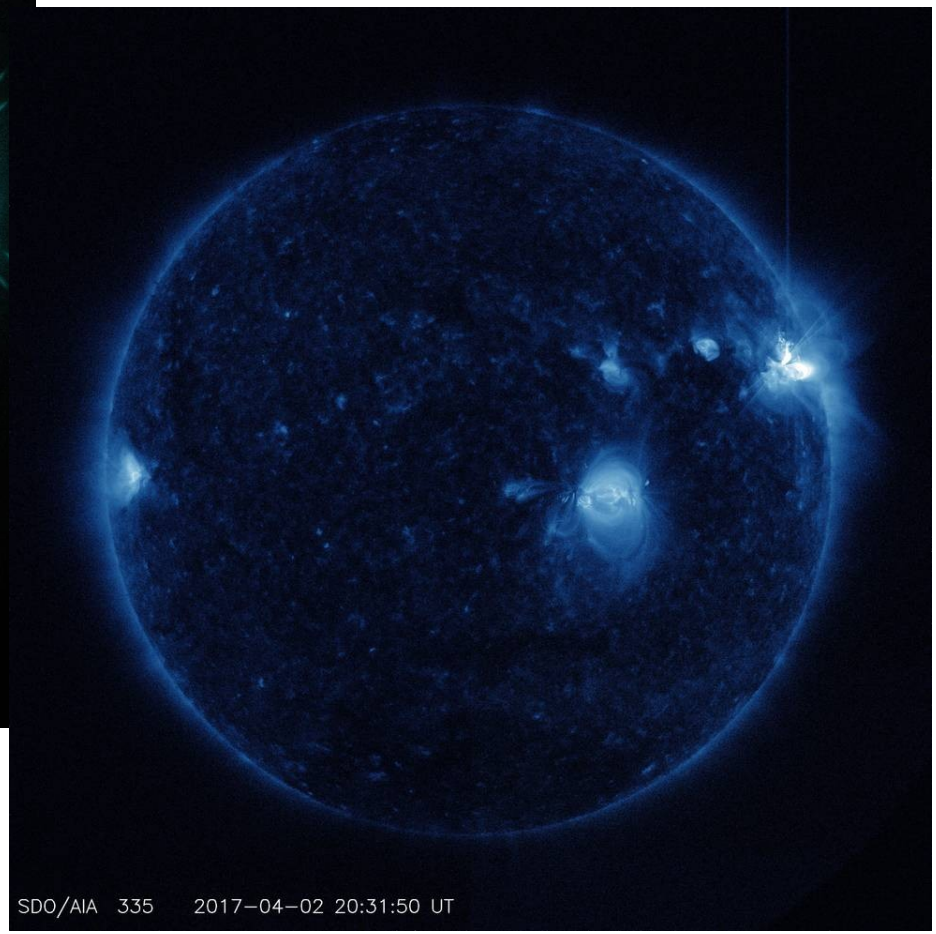
There Are Many Predictions of the Amplitude of SC24



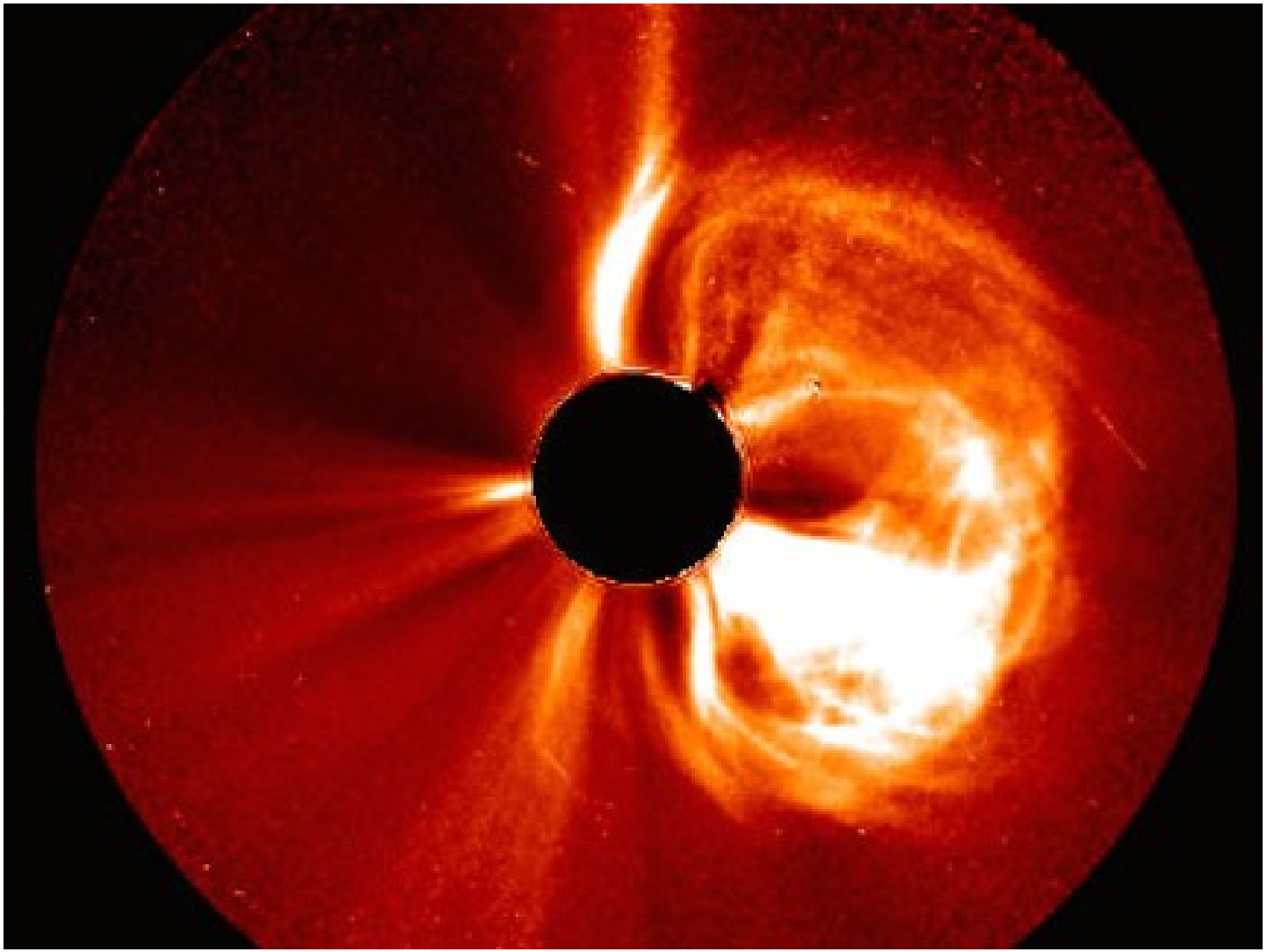
Most of these predictions cannot look more than one cycle ahead.

Solar Flares

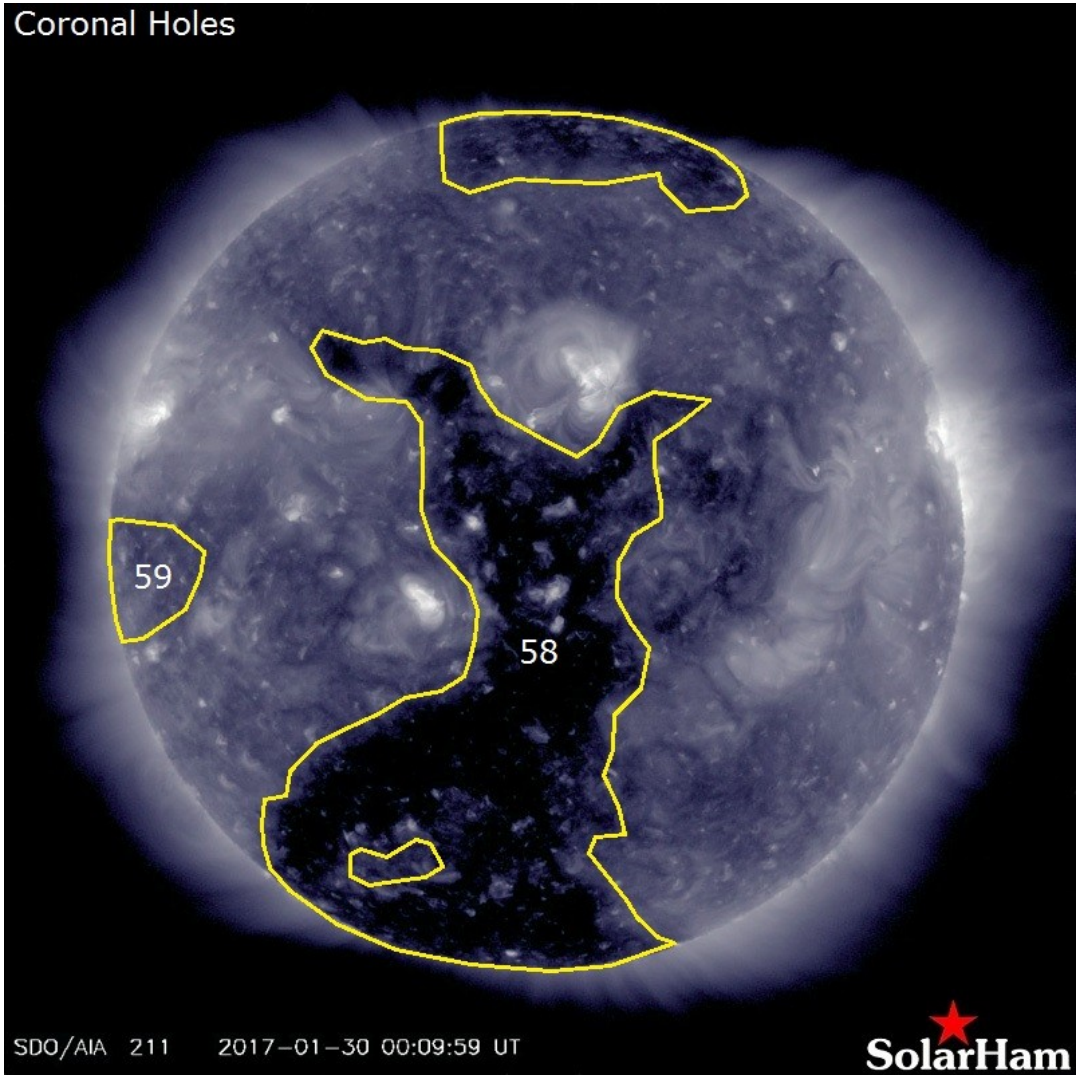




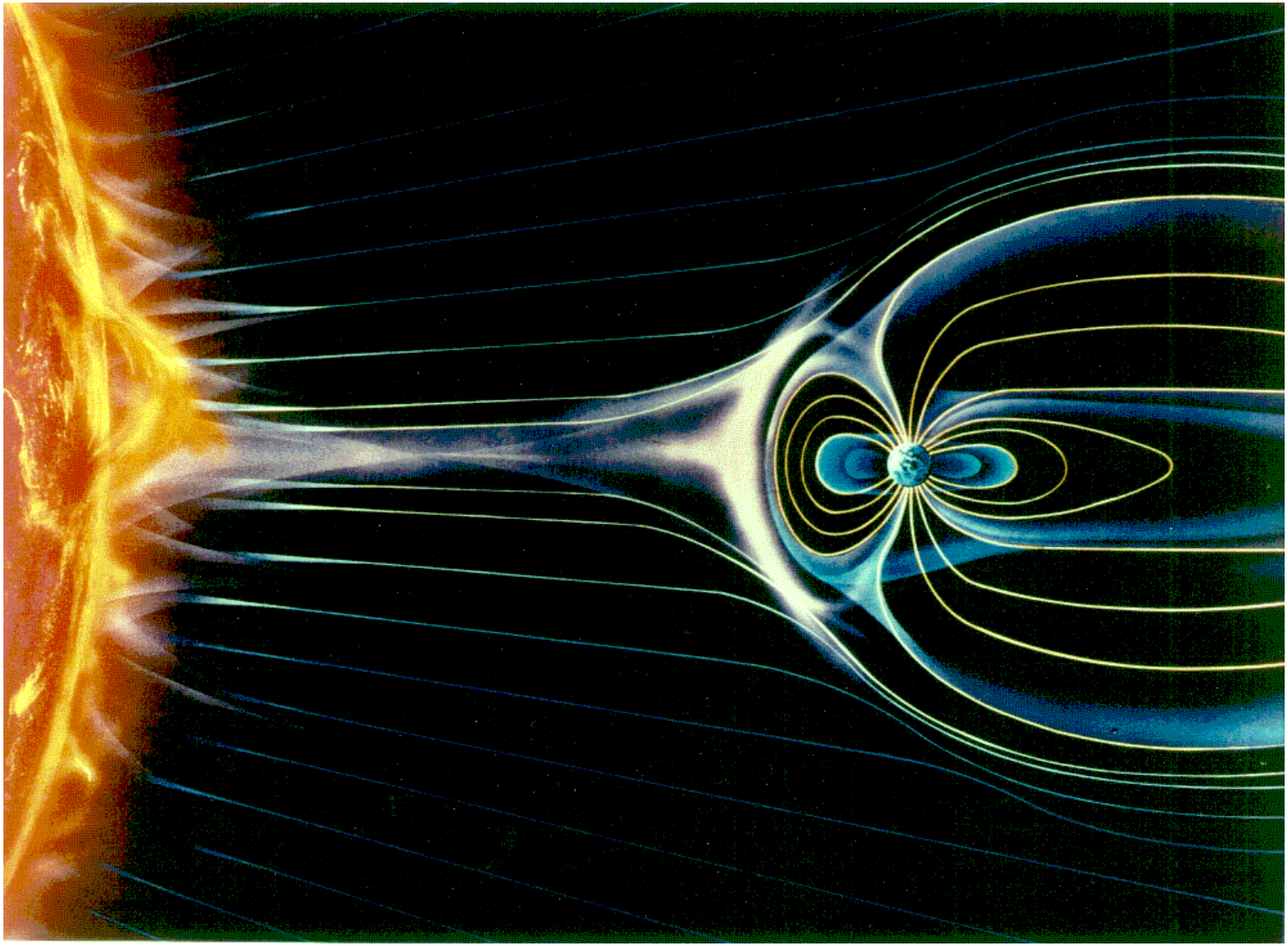
Coronal Mass Ejections (CME)



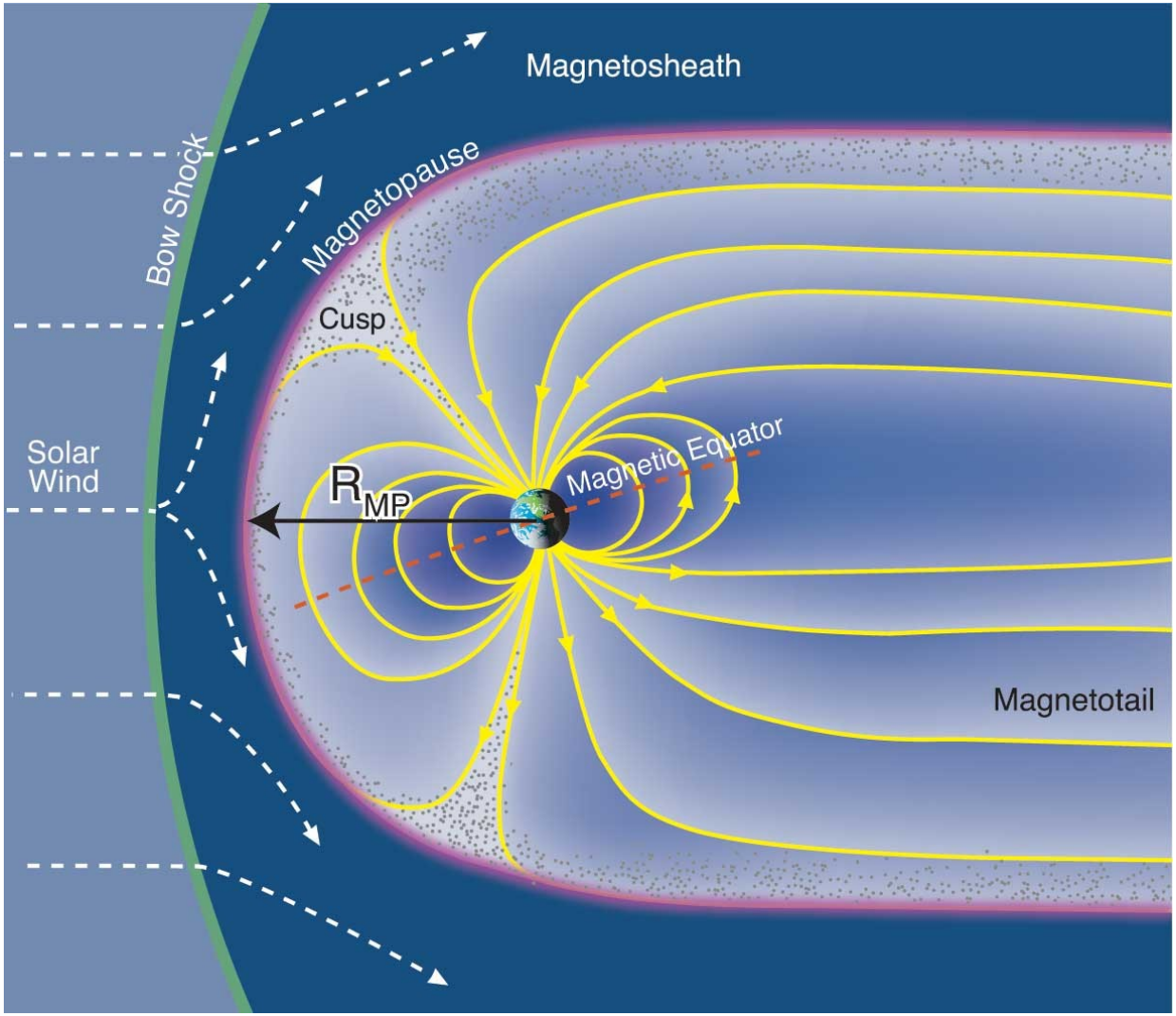
Coronal Hole – 30 Jan 2017



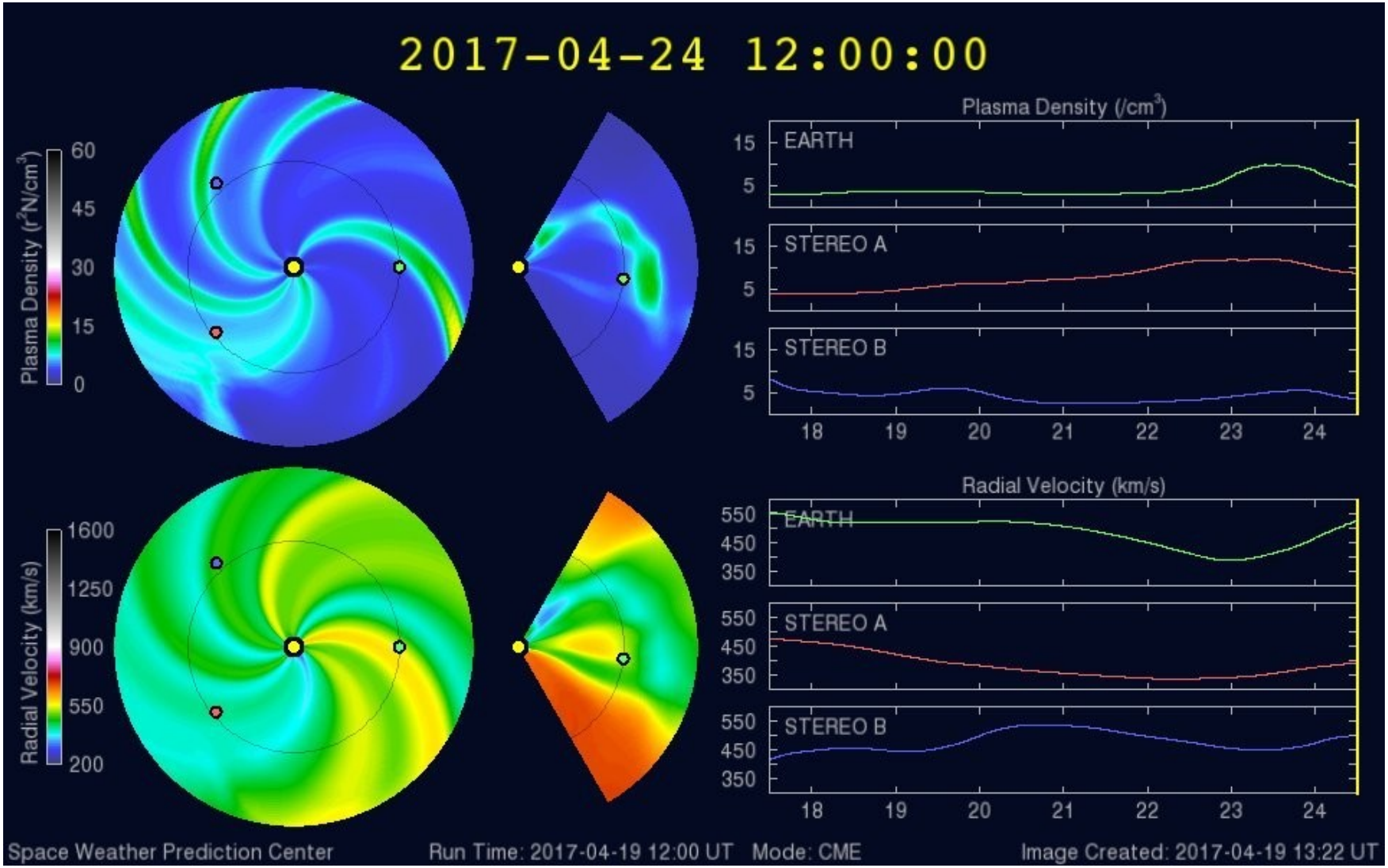
Solar Wind



Solar Wind

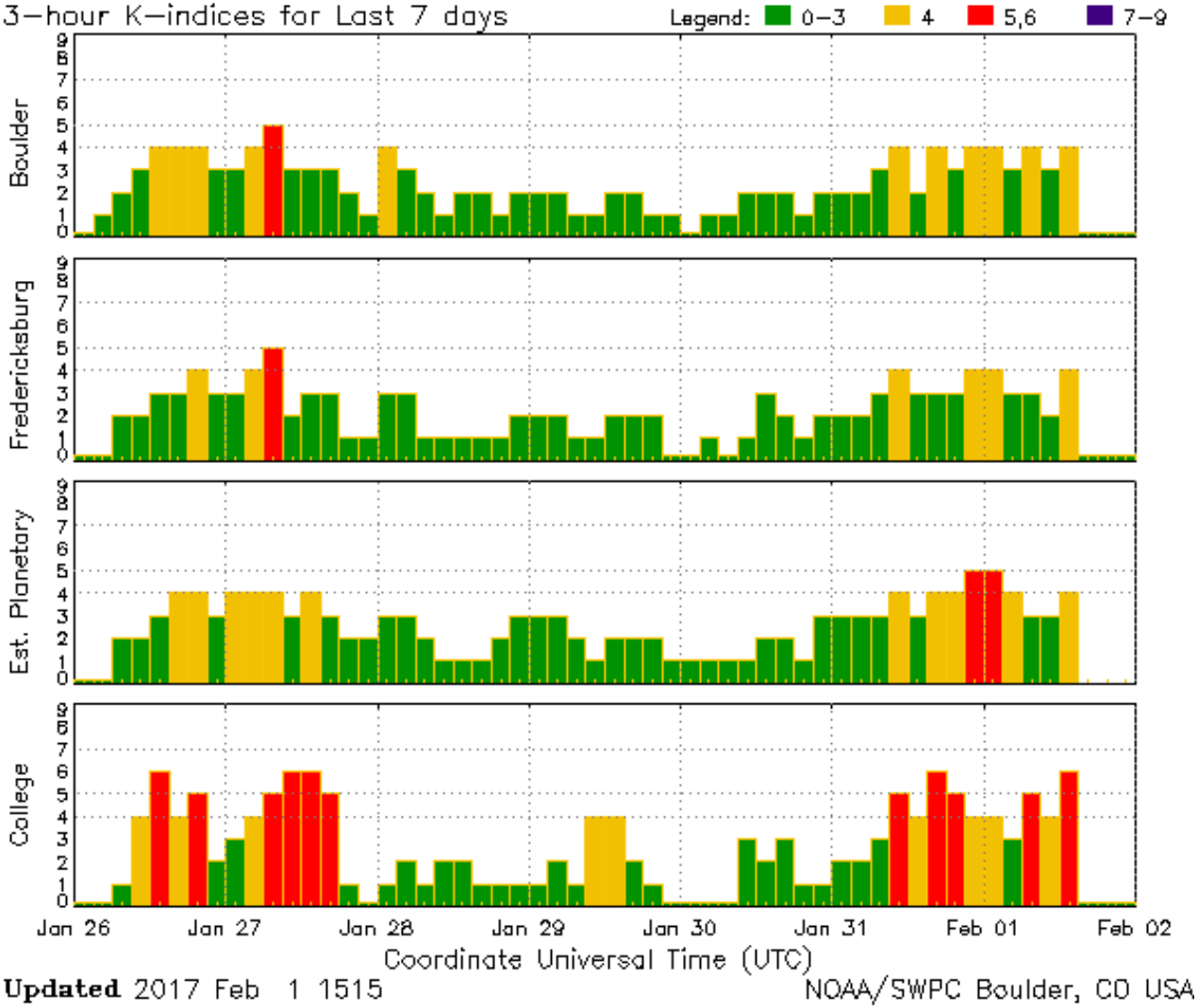

Magnetosheath
Bow Shock
Magnetopause
Cusp
Solar
Wind
R_{MP}
Magnetic Equator
Magnetotail

Solar Wind Prediction

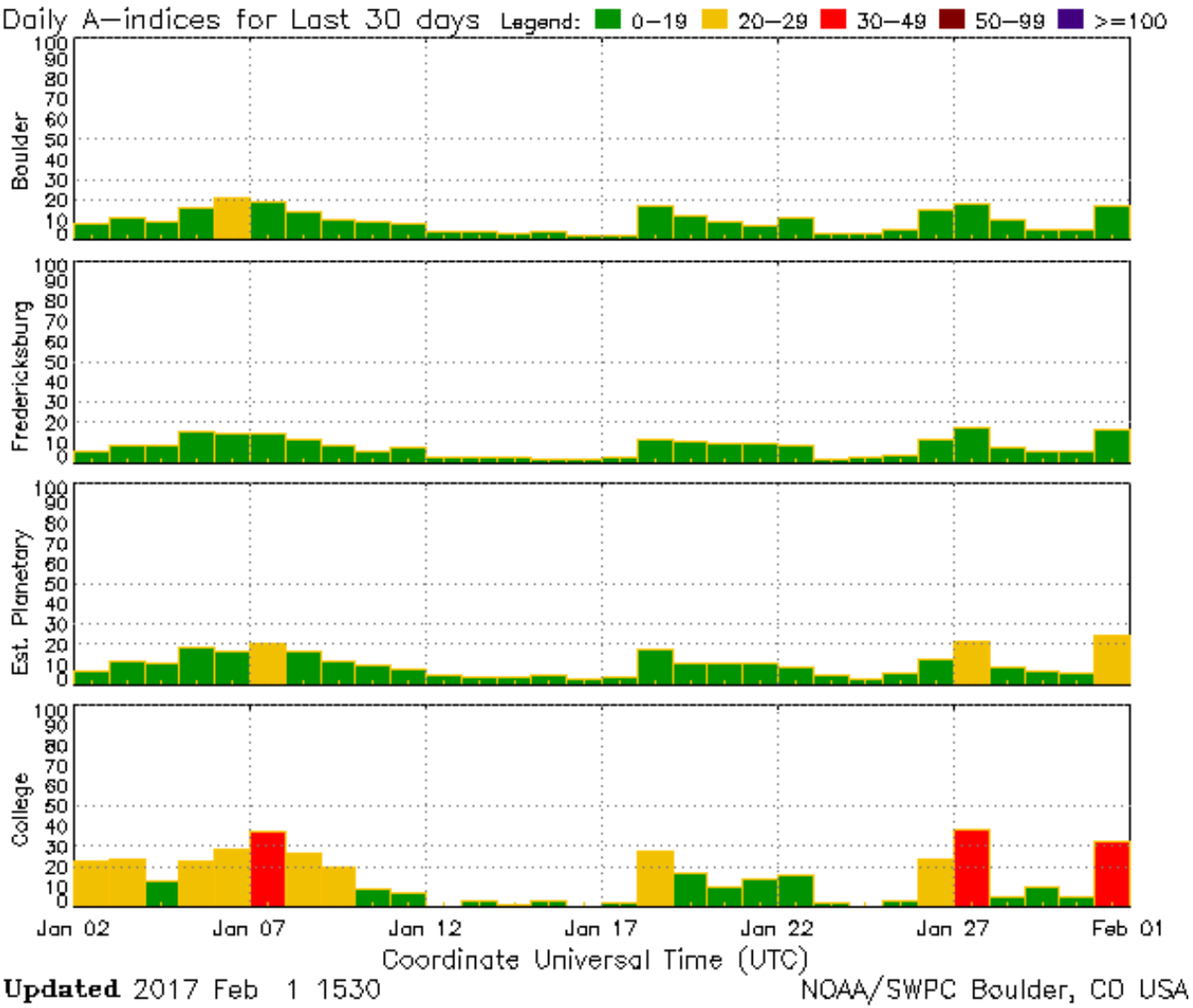


K-Index

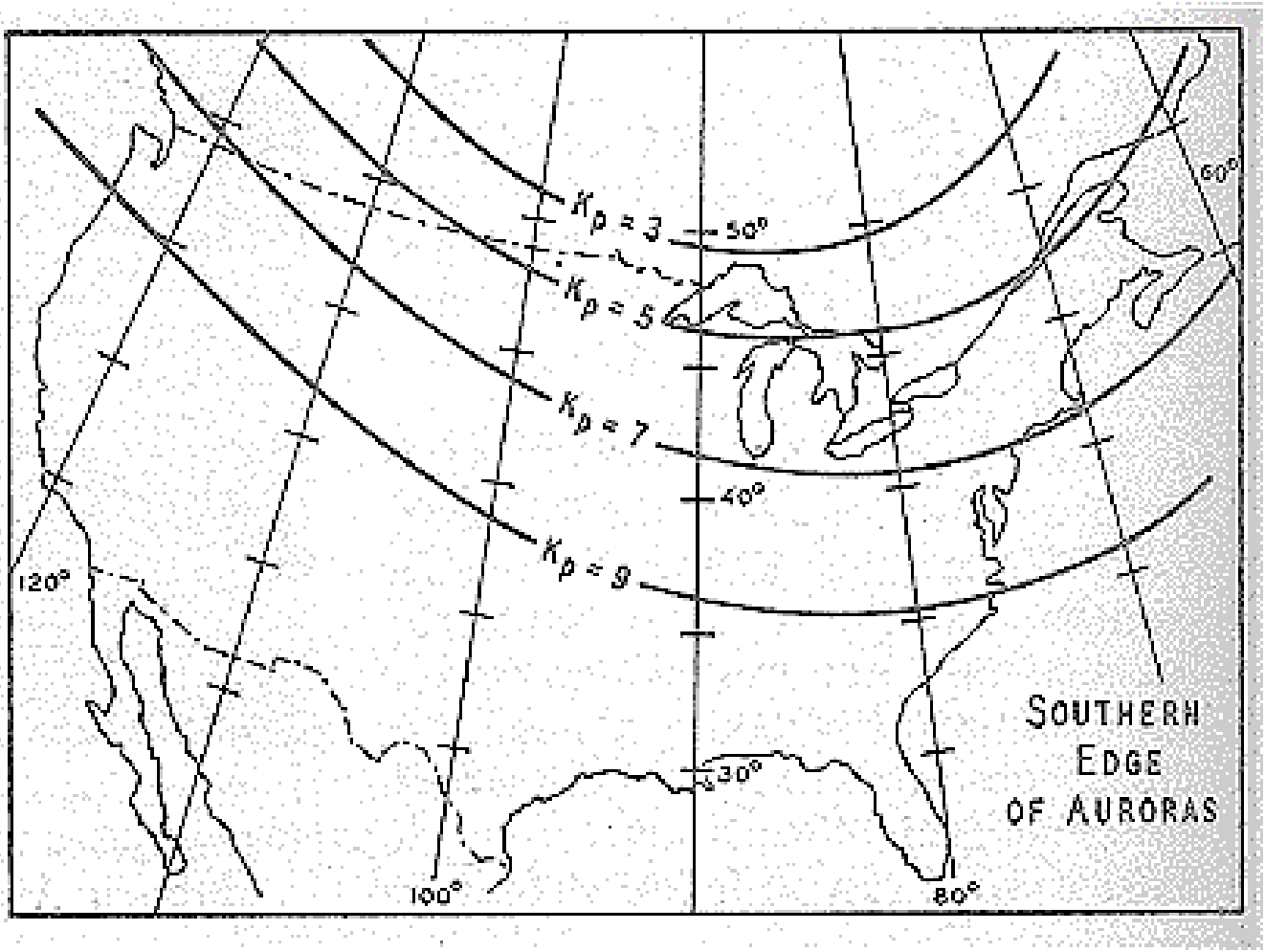
Effect of the Solar Wind on the Earth's Magnetic Field



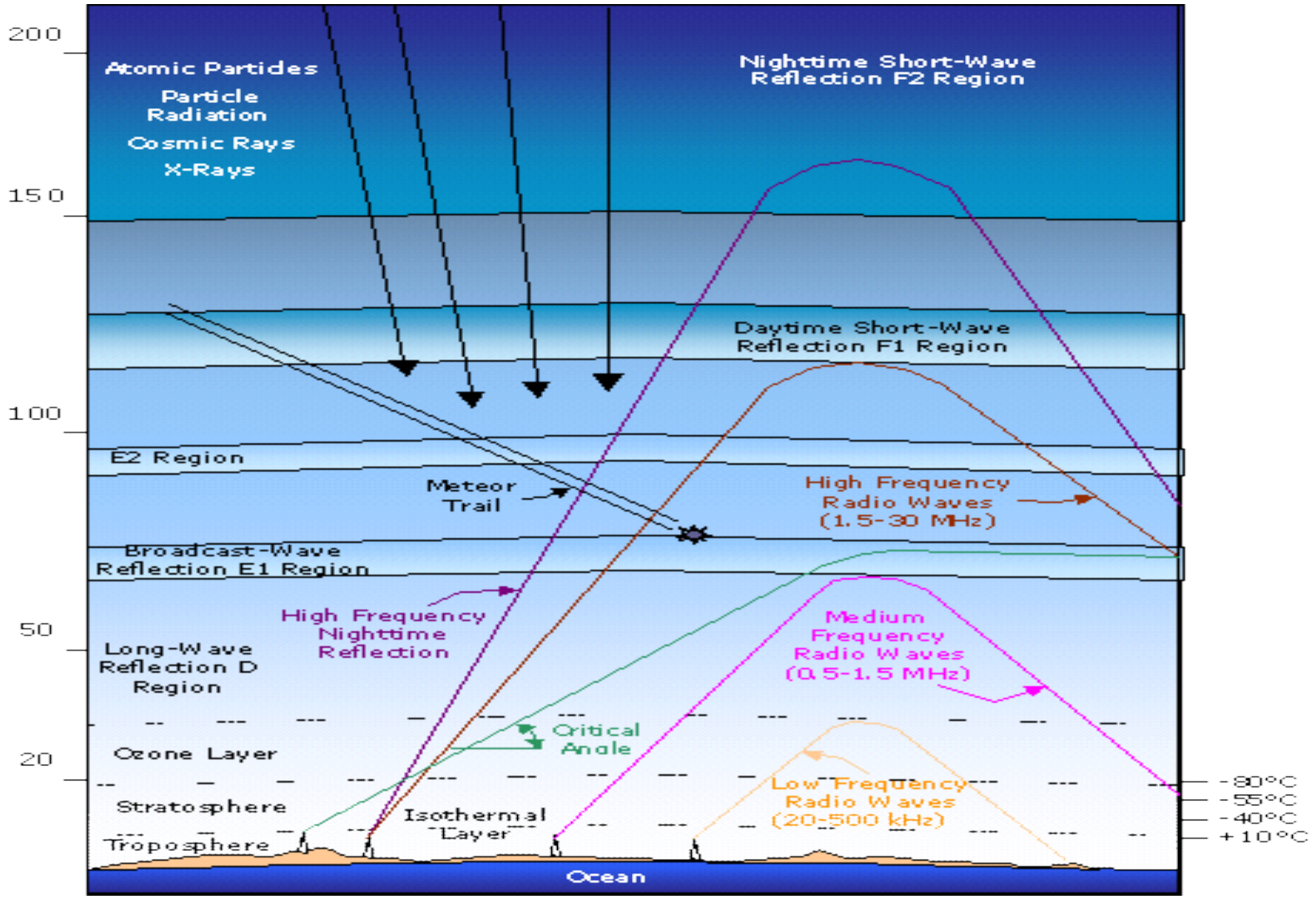
A-Index


Daily A-indices for Last 30 days
Legend: 0-19 20-29 30-49 50-99 >=100
Boulder
Fredericksburg
Est. Planetary
College
0 10 20 30 40 50 60 70 80 90 100
Jan 02
Jan 07
Jan 12
Jan 17
Jan 22
Jan 27
Feb 01
Coordinate Universal Time (UTC)
Updated 2017 Feb 1 1530
NOAA/SWPC Boulder, CO USA

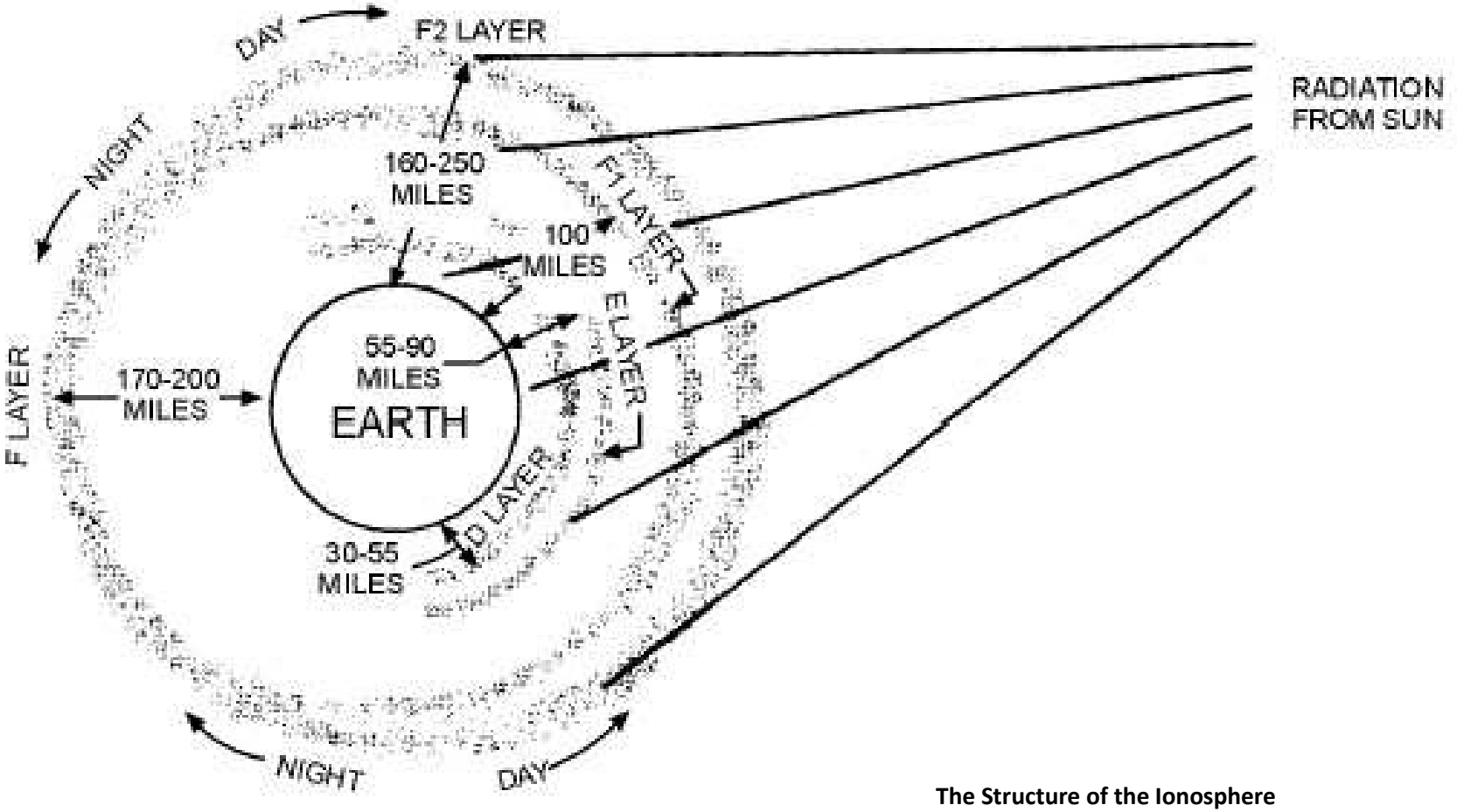
Relationship of Kp & Aurora



Earth's Atmosphere

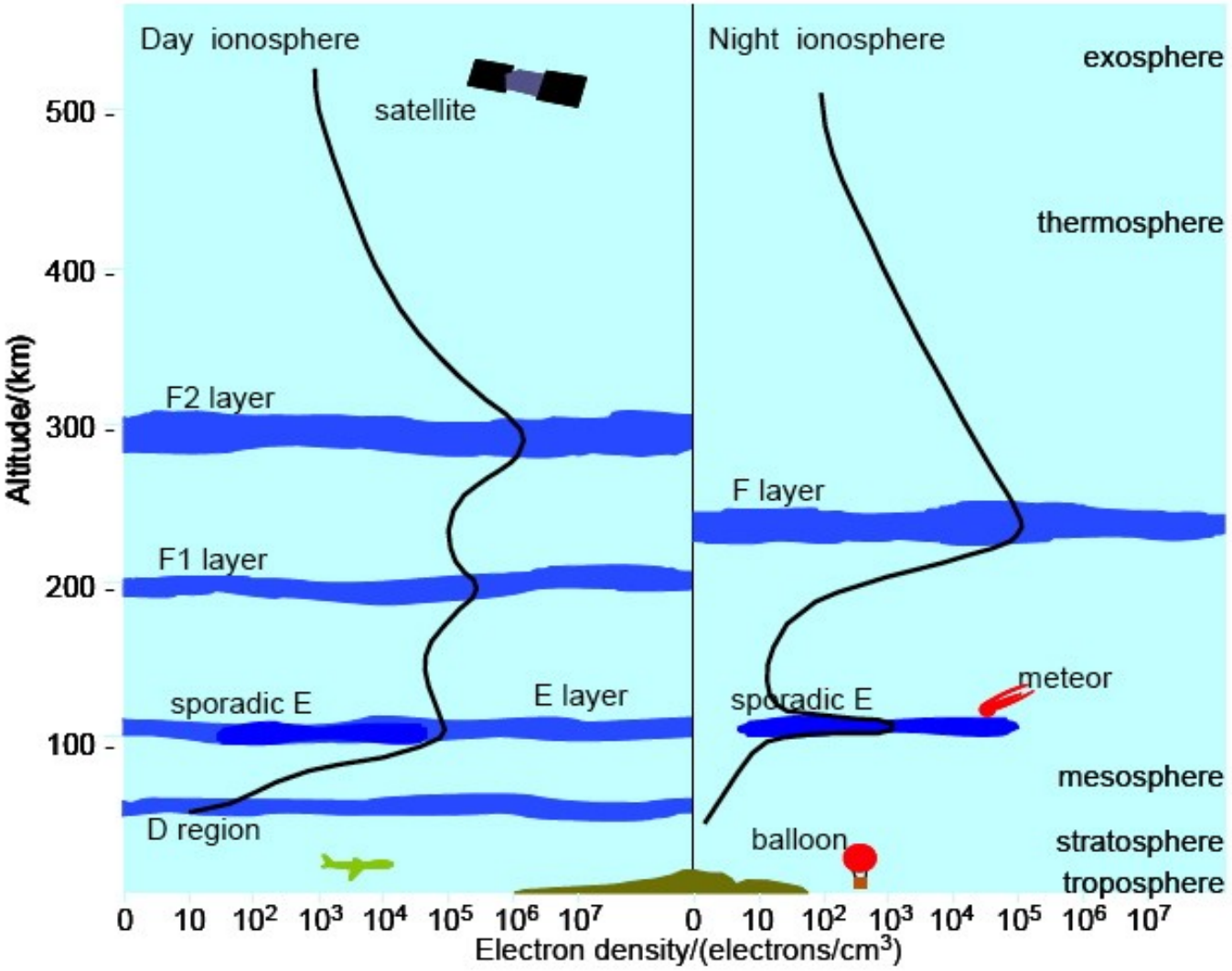


Structure Of The Ionosphere

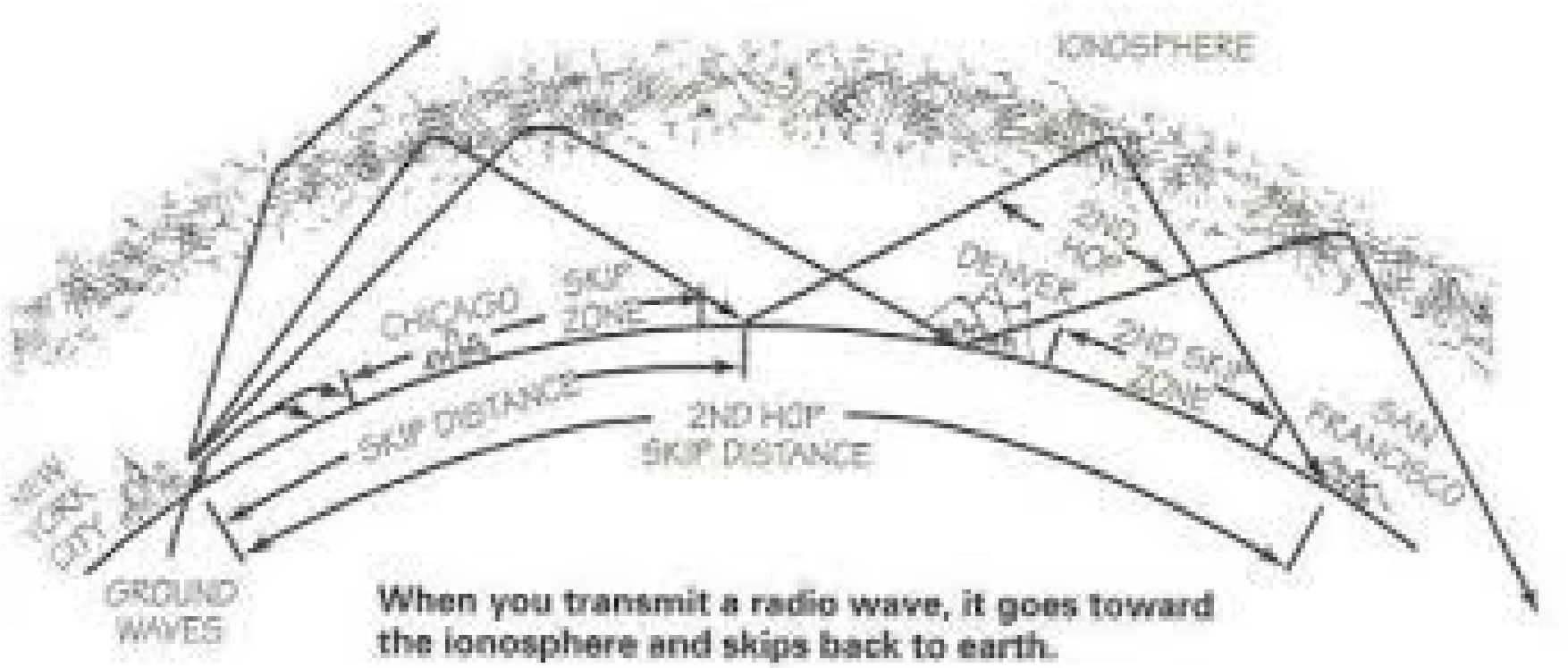


The Structure of the Ionosphere
Carl Luetzelschwab K9LA
DX University, Propagation, Visalia 2012

Day & Night

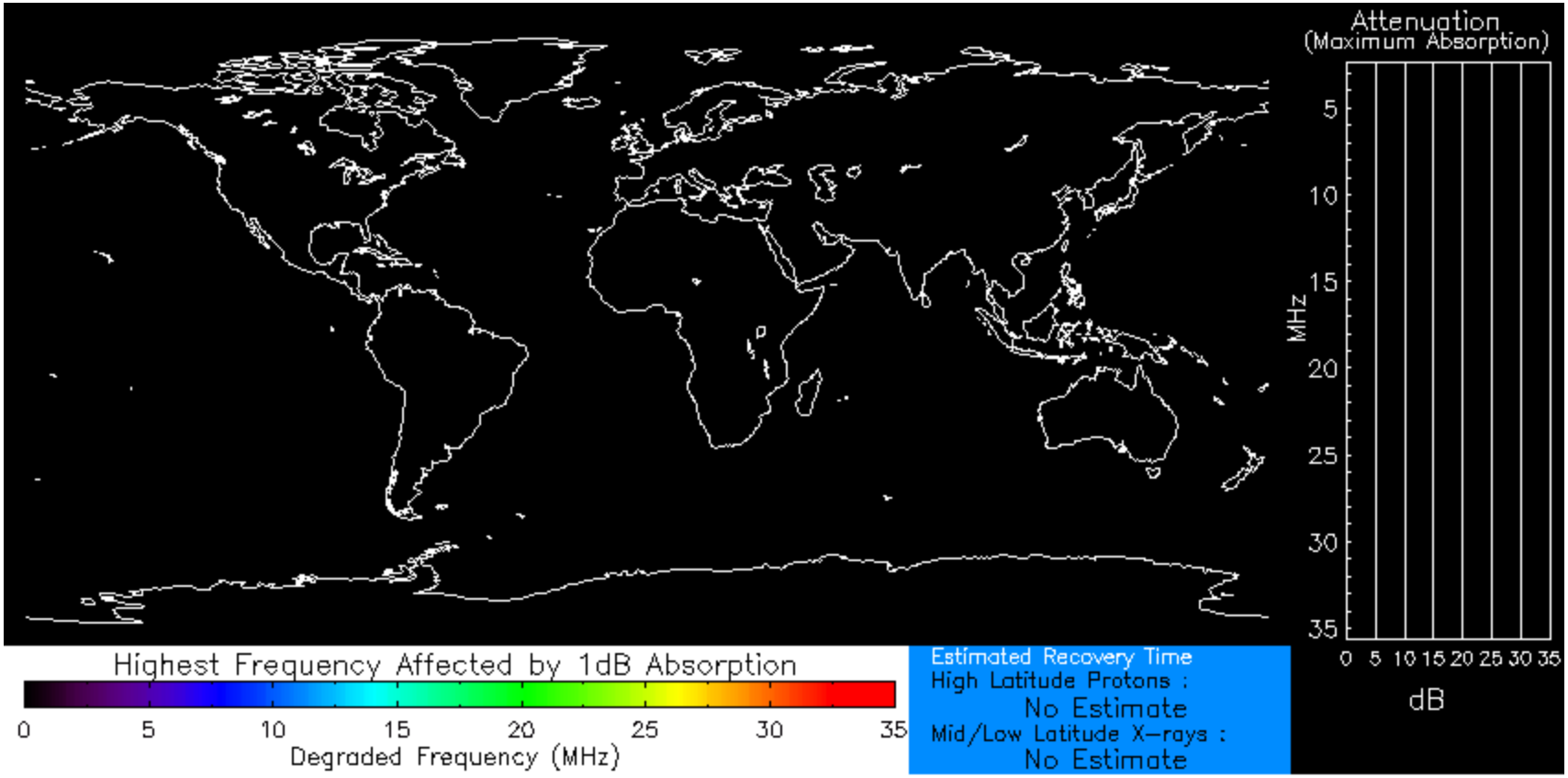

Day ionosphere
Night ionosphere
exosphere
satellite
thermosphere
500
400
300
200
100
Altitude/(km)
F2 layer
F layer
F1 layer
sporadic E
E layer
meteor
sporadic E
mesosphere
balloon
stratosphere
troposphere
D region
0 10 10² 10³ 10⁴ 10⁵ 10⁶ 10⁷
0 10 10² 10³ 10⁴ 10⁵ 10⁶ 10⁷
Electron density/(electrons/cm³)

Hop & Skip



When you transmit a radio wave, it goes toward the ionosphere and skips back to earth.

D-RAP

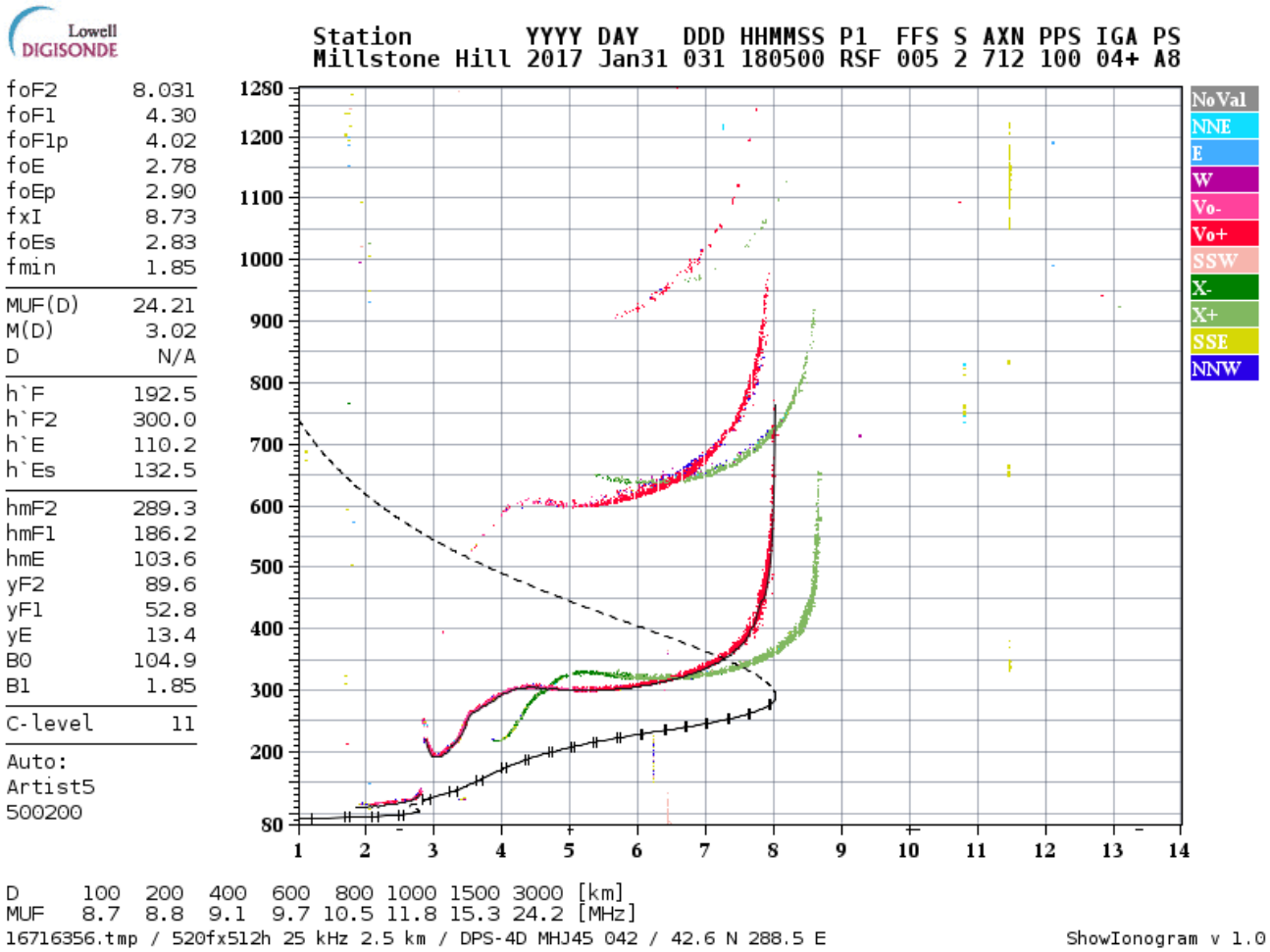


Normal X-ray Background
Product Valid At : 2017-02-14 19:03 UTC

Normal Proton Background
NOAA/SWPC Boulder, CO USA

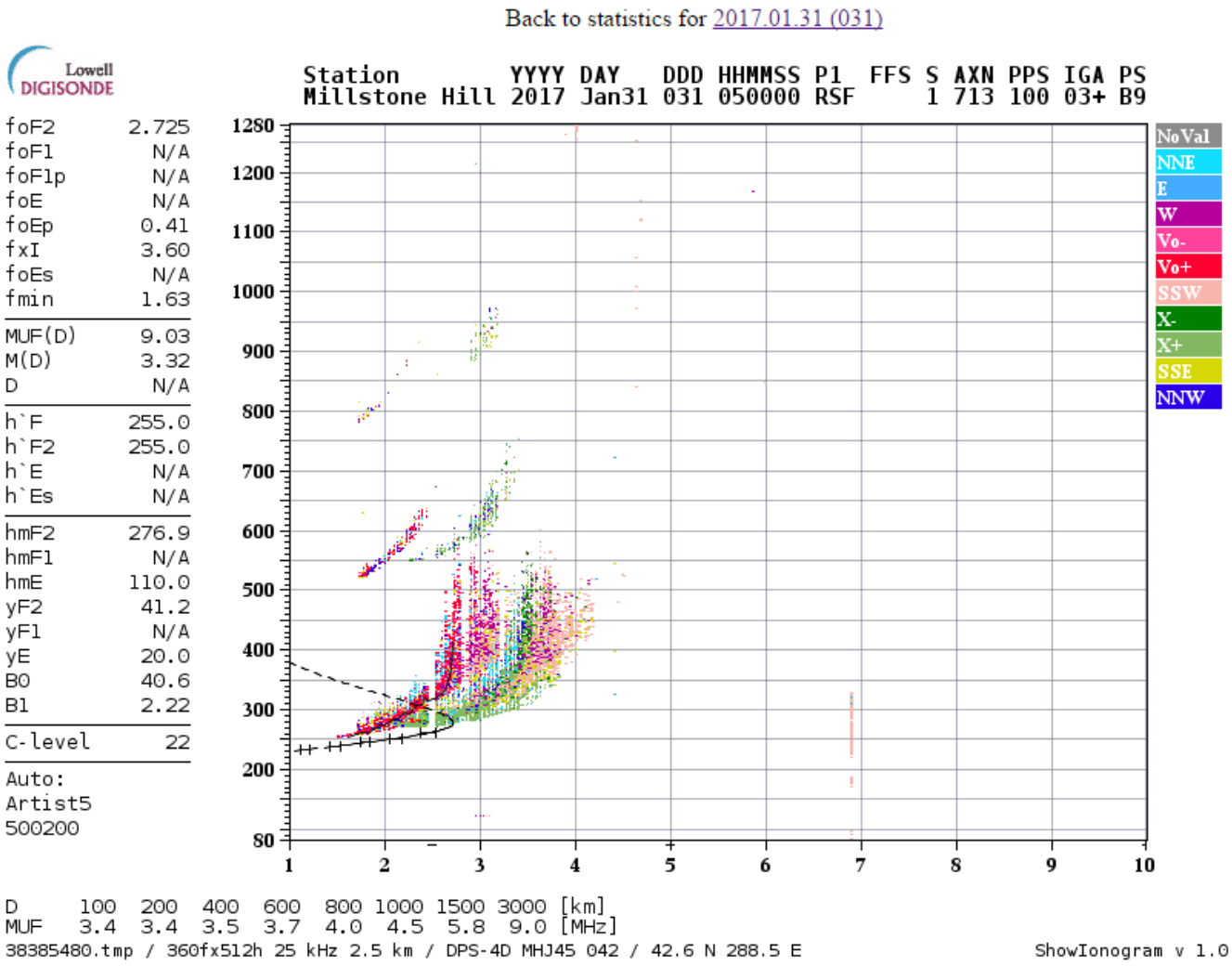
IONOGRAM

Back to statistics for 2017.01.31 (031)



http://umlcar.uml.edu/DIDBase/

IONOGRAM



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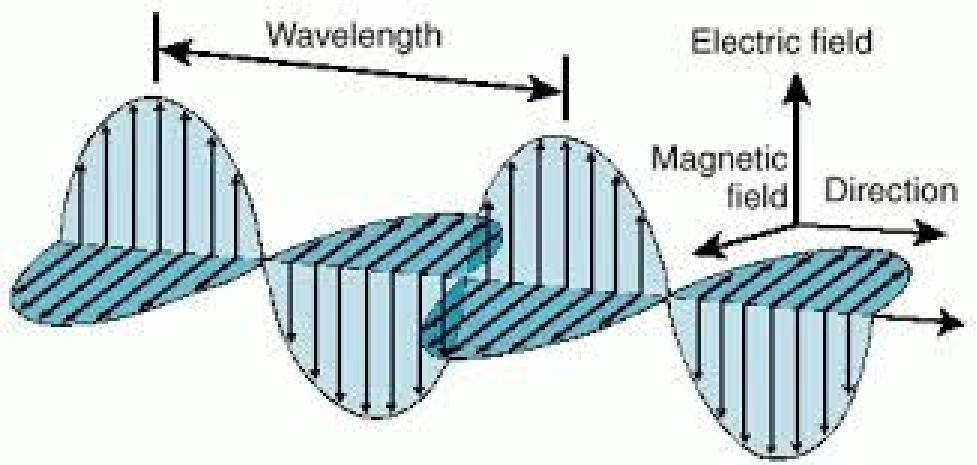
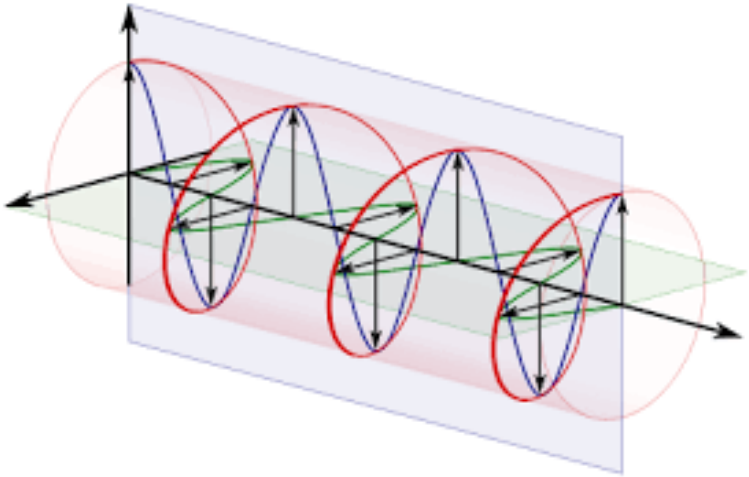
Electromagnetic Wave

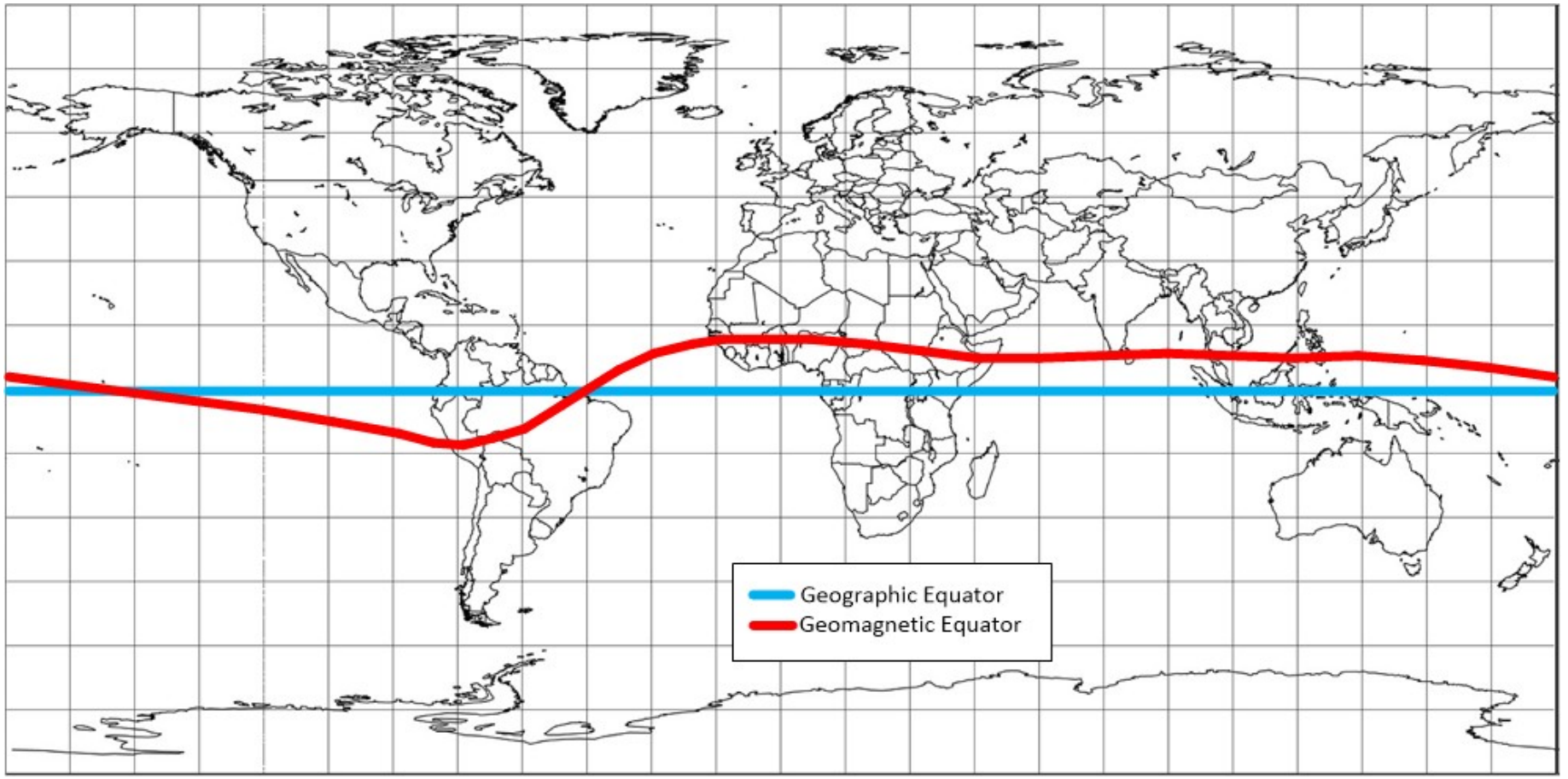


Vertical Polarization

Circular Polarization



Geomagnetic vs Geographic Equator



Trans-Equatorial Propagation

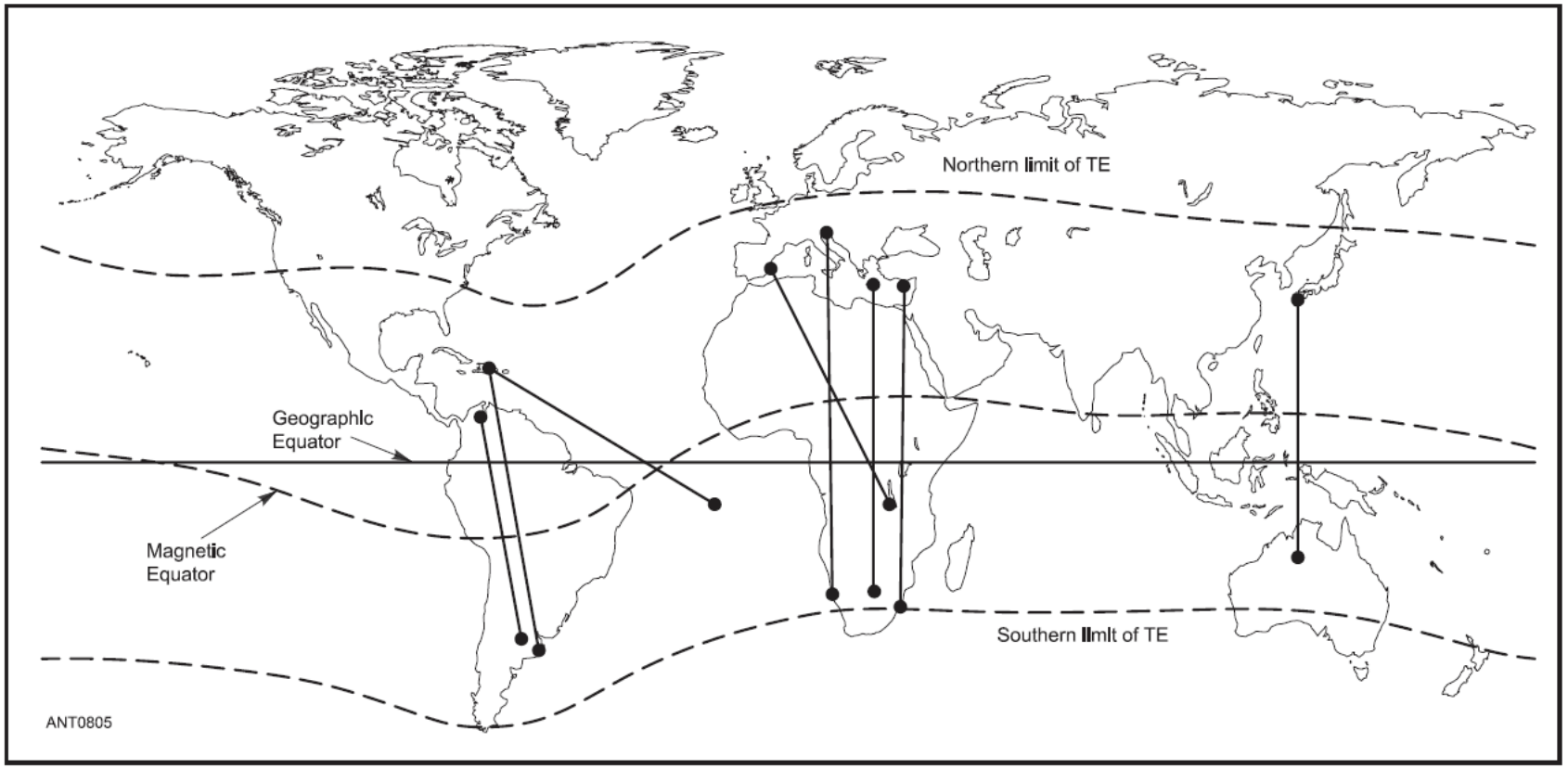
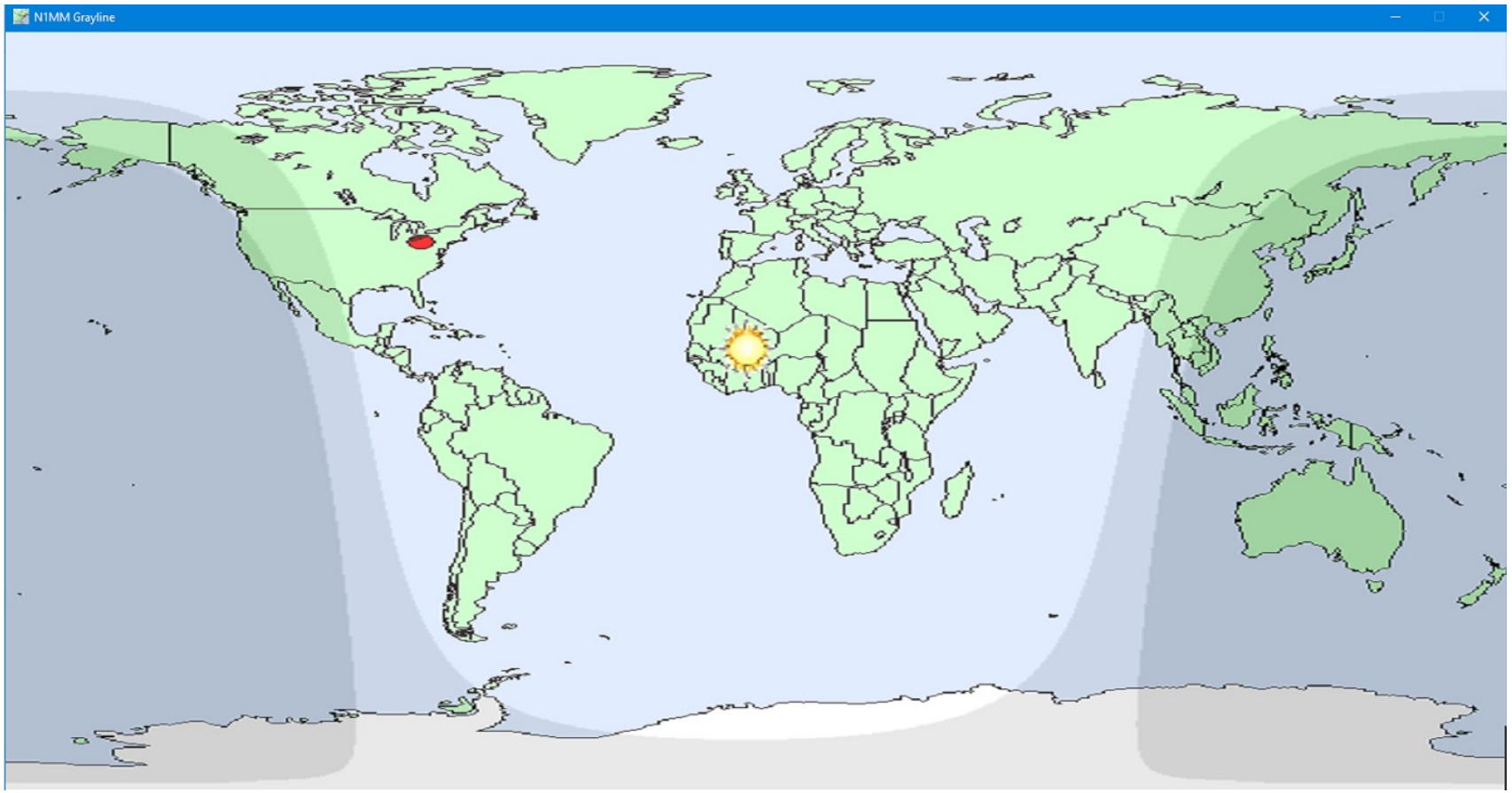


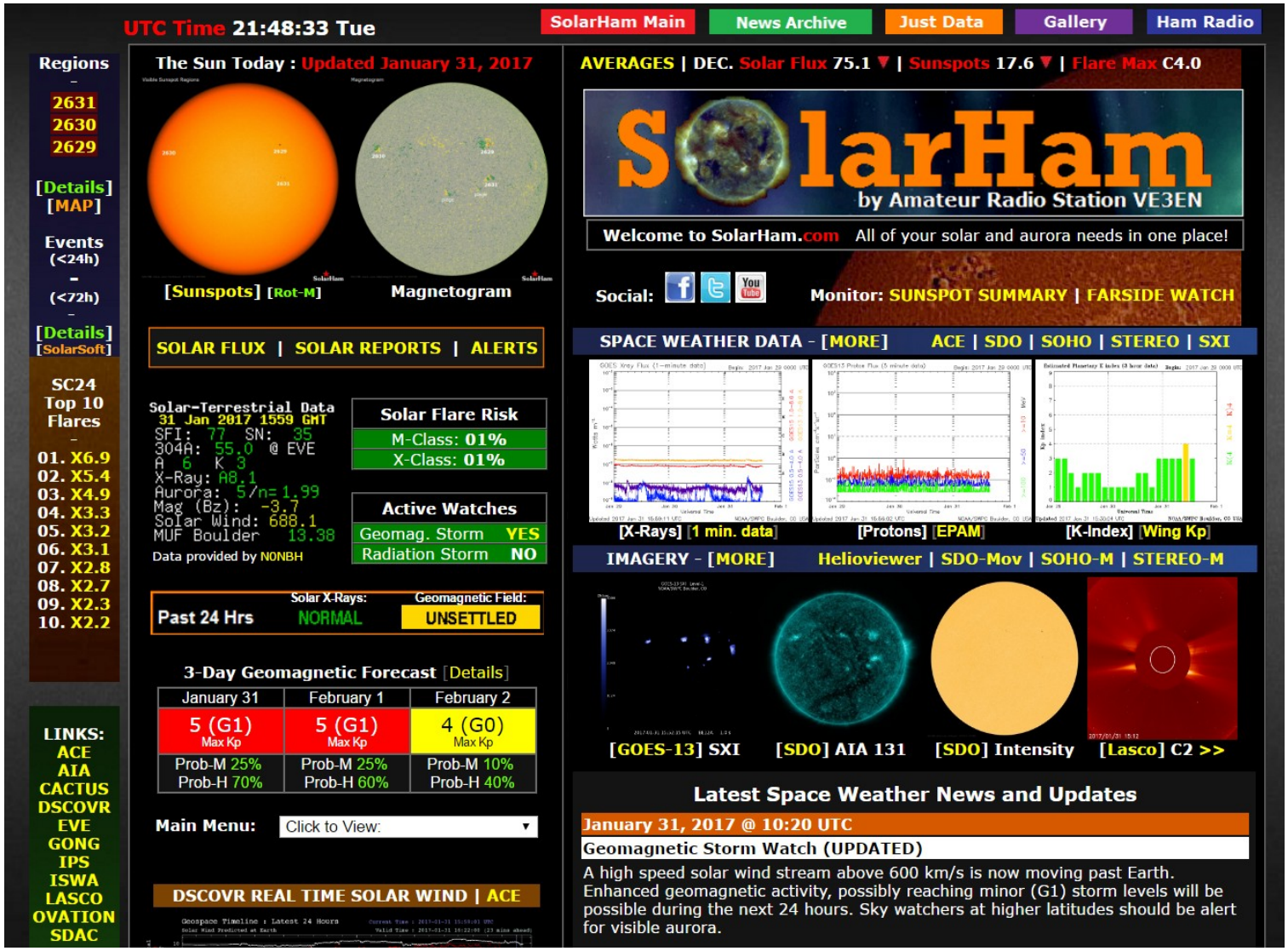
Figure 4.6 — Trans-equatorial propagation takes place between stations approximately equidistant across the geomagnetic equator. Distances up to 8000 km (5000 miles) are possible on 28 through 432 MHz. Note that the geomagnetic equator is considerably south of the geographic equator in the Western Hemisphere.

Grayline Propagation

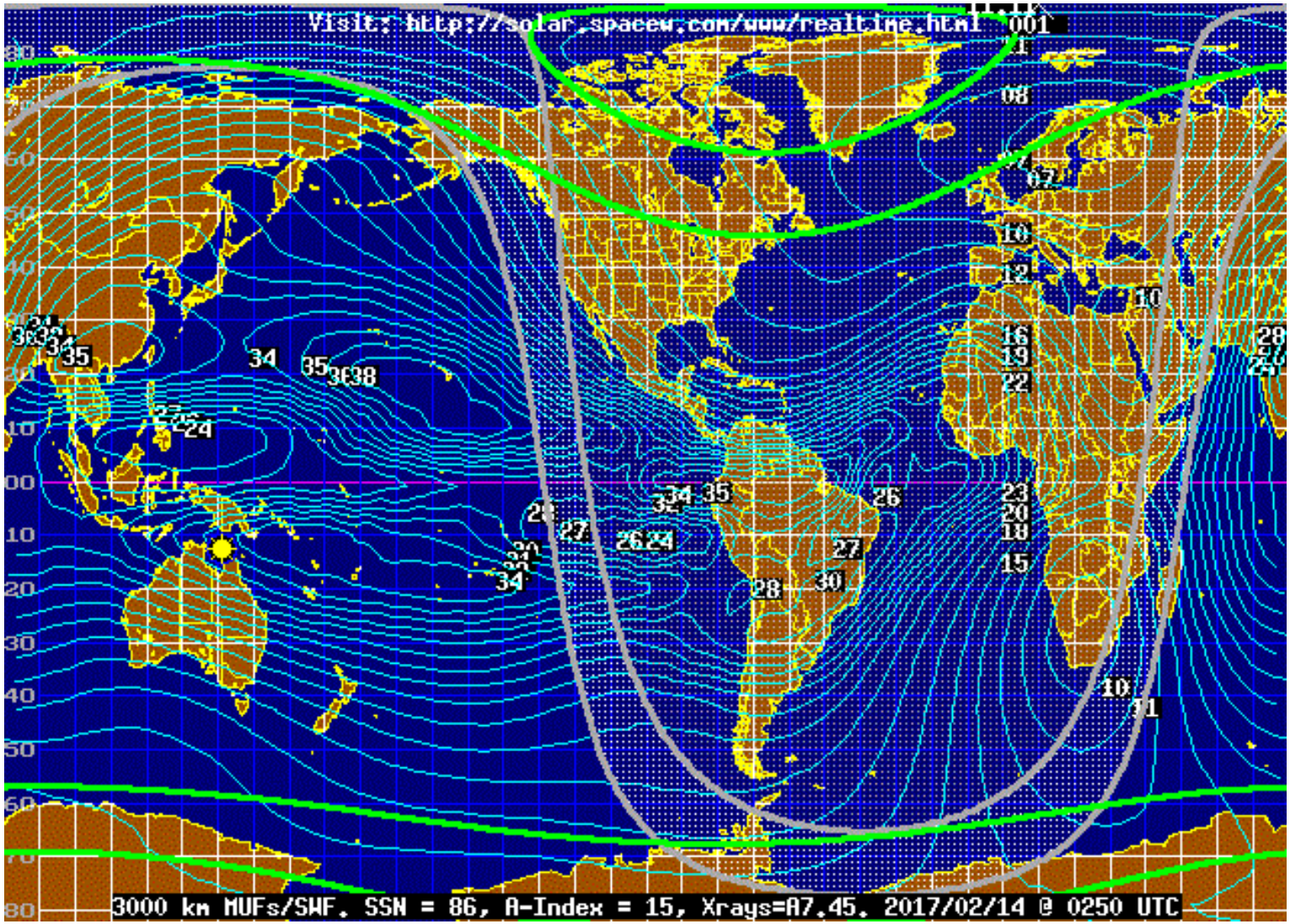


Sun Rise ⇔ Sun Set Only

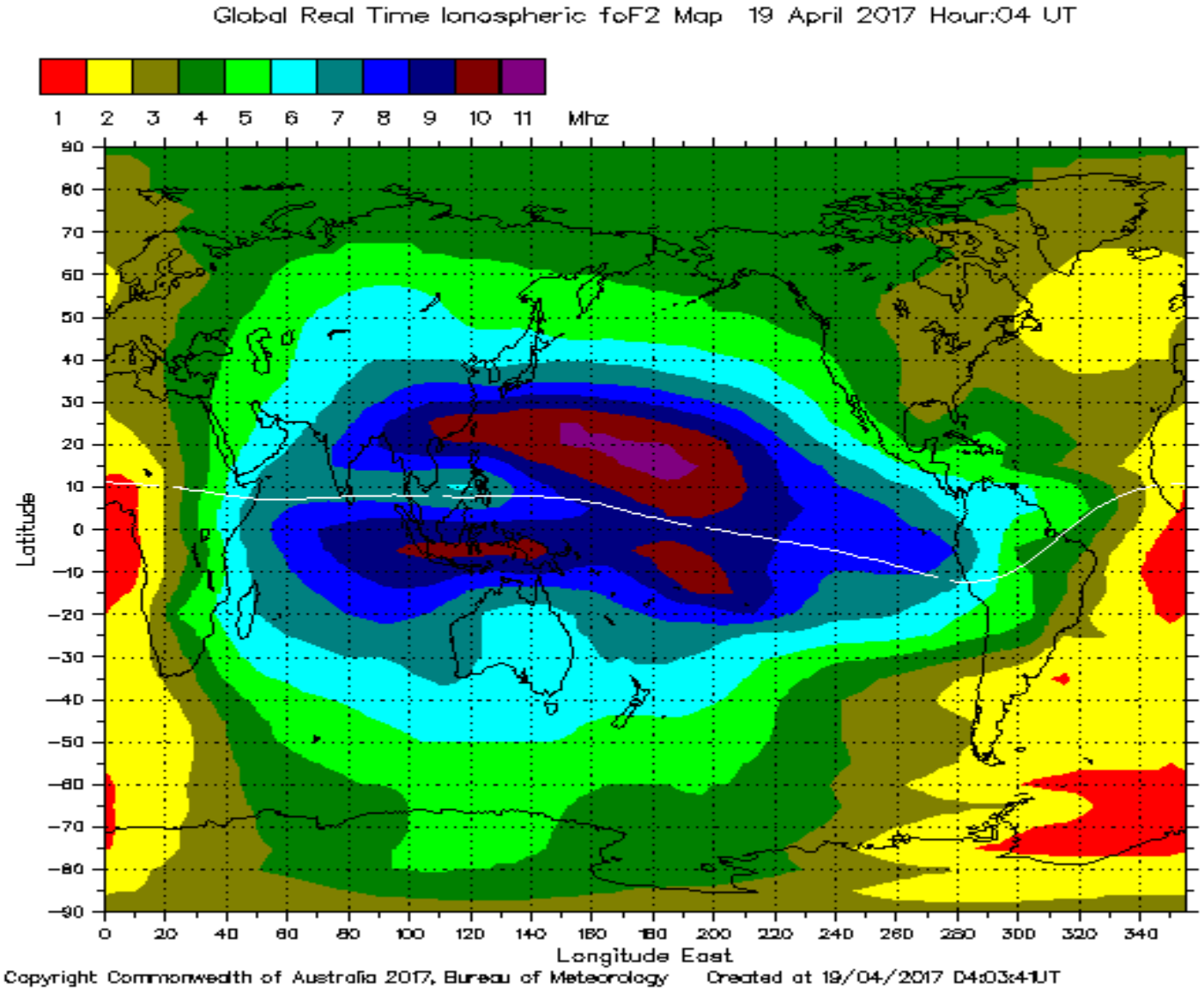
SolarHam.net



MUFs For 3,000 Kilometer Paths



Global MUF Map

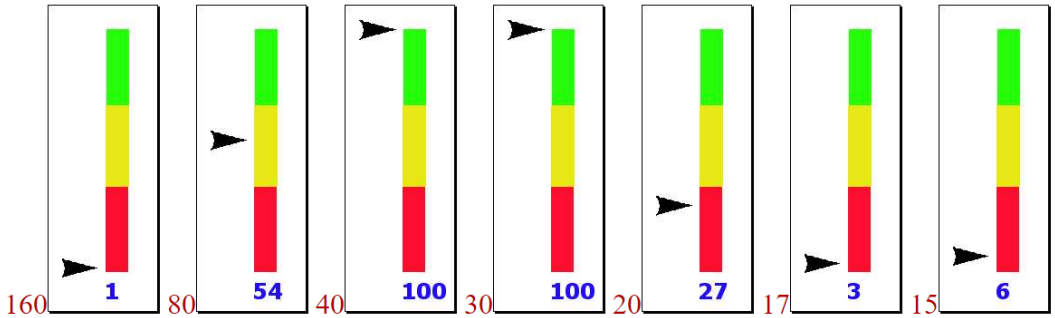


CONUS HF BAND CONDITIONS

CONUS HF BAND CONDX

1/31/17 --- 16:30:30 GMT --- REPORT # 1981

CURRENT PROPAGATION CONDITIONS.: Solar-terrestrial indices for 30 January follow. Solar flux 77 and estimated planetary A-index 6. The estimated planetary K-index at 1500 UTC on 31 January was 3. No space weather storms were observed for the past 24 hours. Space weather for the next 24 hours is predicted to be minor. Geomagnetic storms reaching the G1 level are expected.



BAND STABILITY LAST : 10 MINS HOUR 24 HRS

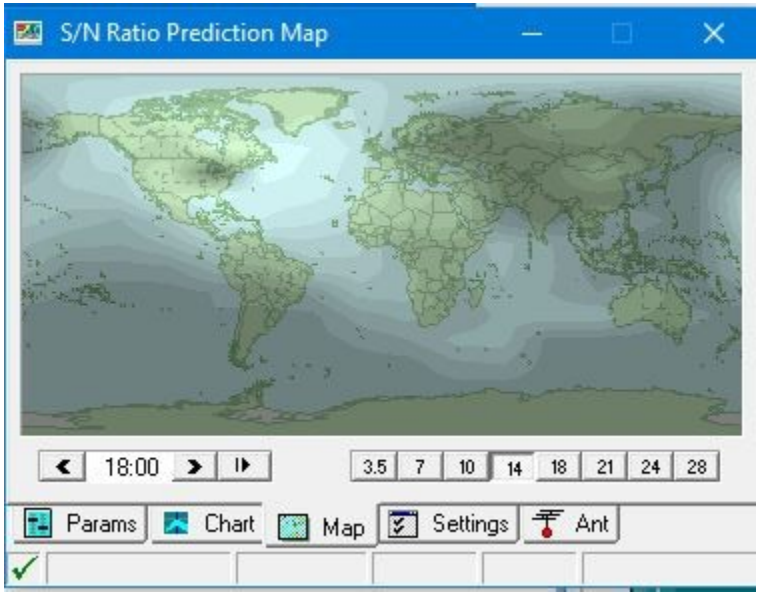
YESTERDAYS BANDCONDX :160 80 40 30 20 17 15 UPDATED @ 00:00:00 GMT

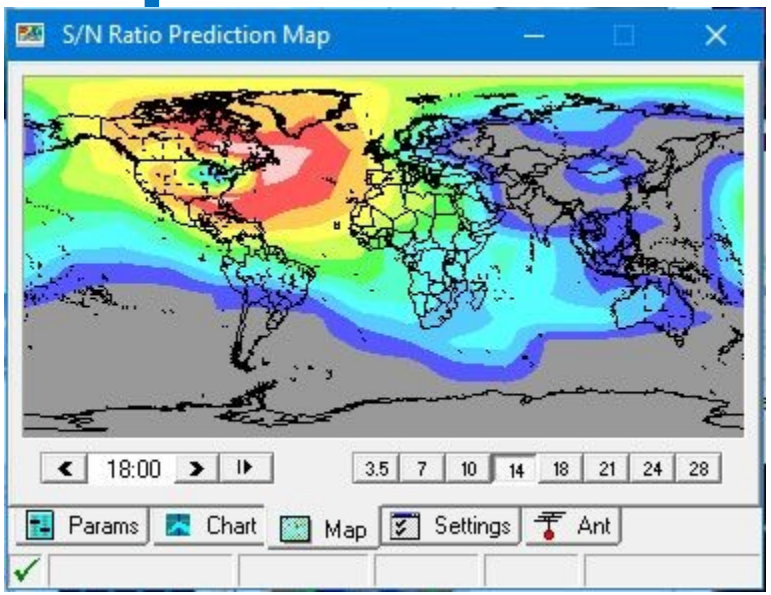
INSTRUCTIONS NEWS F/K/A HOURLY F/K/A MONTHLY CURR/PROP FAQ YAHOO GROUP

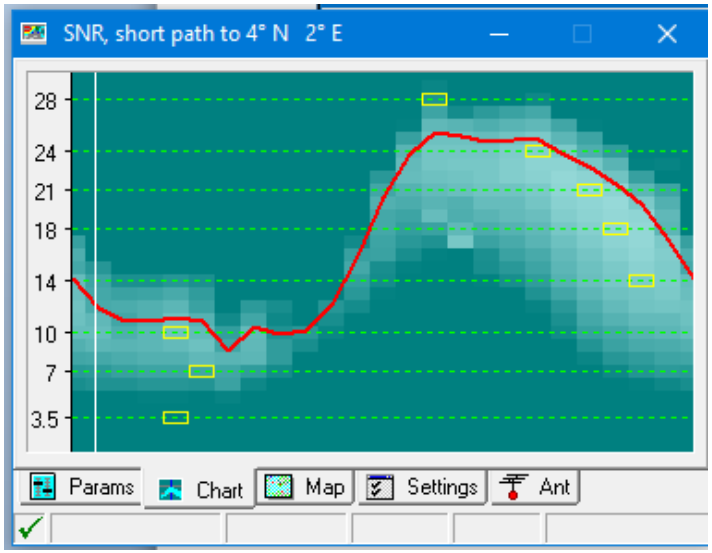
AZORES BERMUDA CHINA HAWAII IRAQ ITALY JAPAN RUSSIA SPAIN UK

http://www.cleanairwithultraviolet.com/bandconditions/

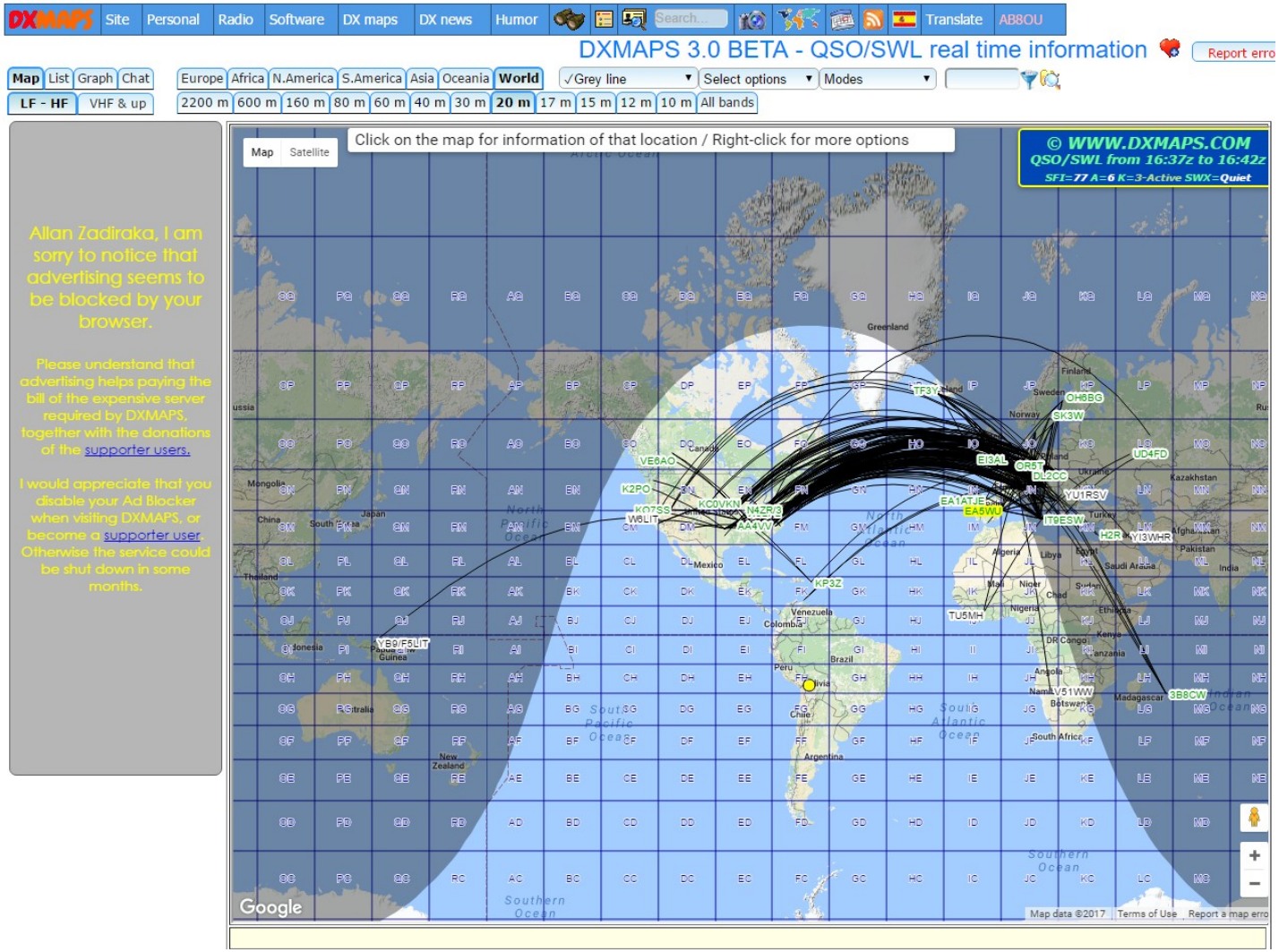
HAM Cap


S/N Ratio Prediction Map
18:00
3.5 7 10 14 18 21 24 28
Params Chart Map Settings Ant


S/N Ratio Prediction Map
18:00
3.5 7 10 14 18 21 24 28
Params Chart Map Settings Ant

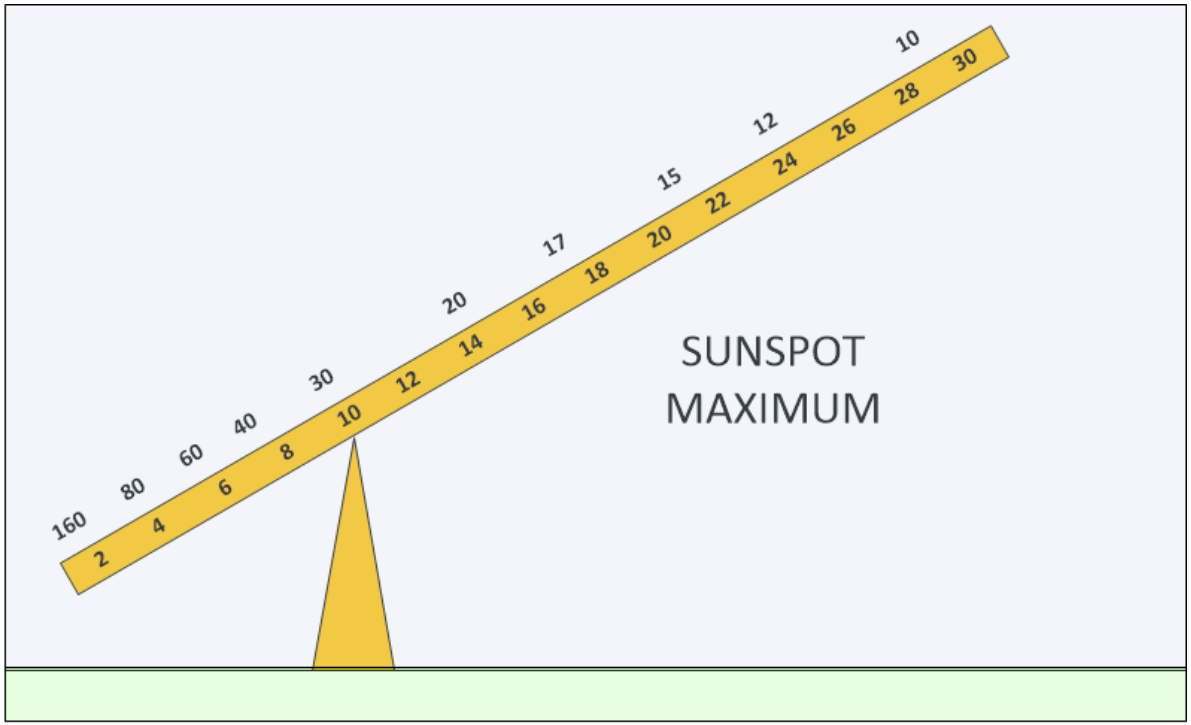

SNR, short path to 4° N 2° E
28
24
21
18
14
10
7
3.5
Params Chart Map Settings Ant

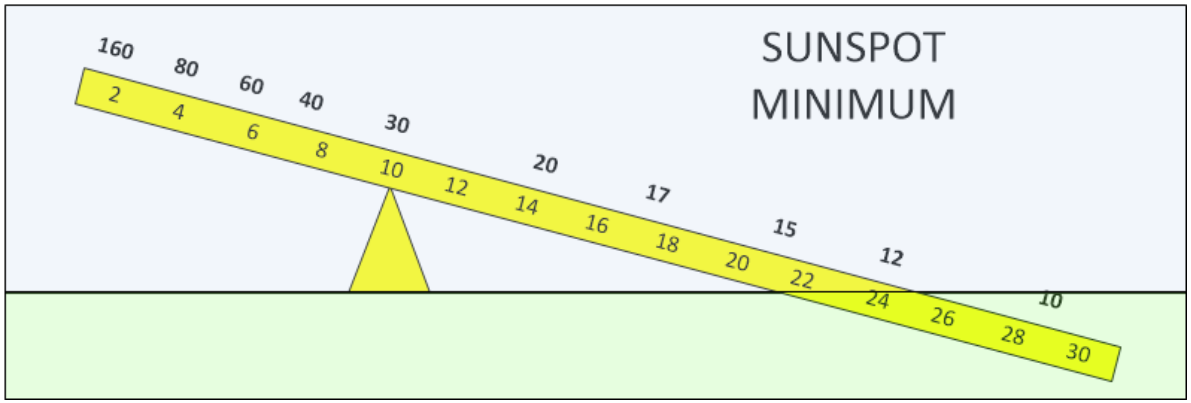
DXMAPS

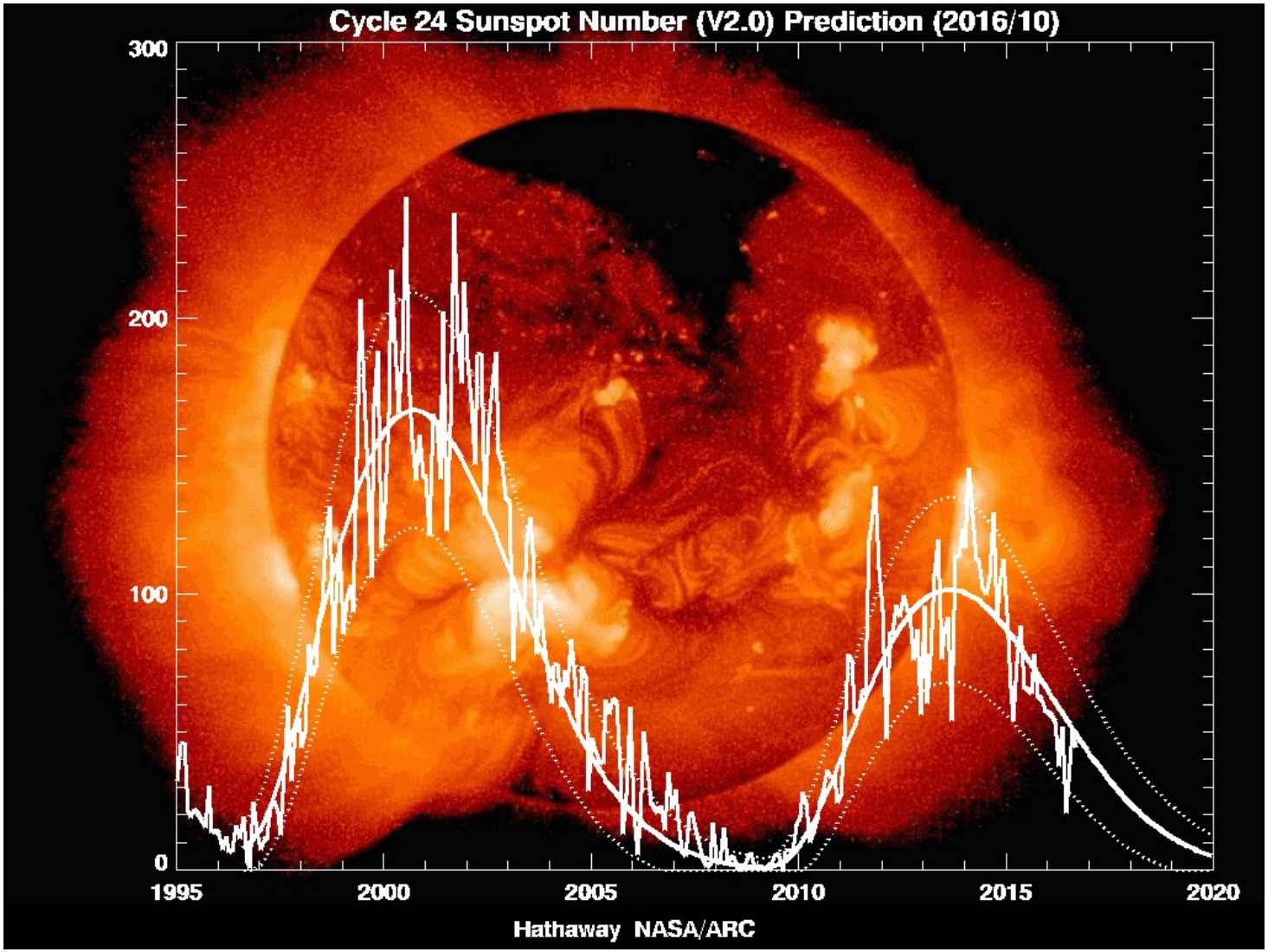


http://www.dxmaps.com/spots/mapg.php?Lan=E

What To Do


160 80 60 40 30 20 17 15 12 10
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
SUNSPOT
MAXIMUM


160 80 60 40 30 20 17 15 12 10
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
SUNSPOT
MINIMUM

Propagation 101

Questions?