



PNT Product Progress and Space Weather Approaching Solar Minimum

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Outline

Solar activity of September 06-08 2017

A couple of PNT Product Updates

Acknowledgements:

- George Millward
- Patricia Doherty
- Mihail Codrescu

The summer was generally uneventful until...

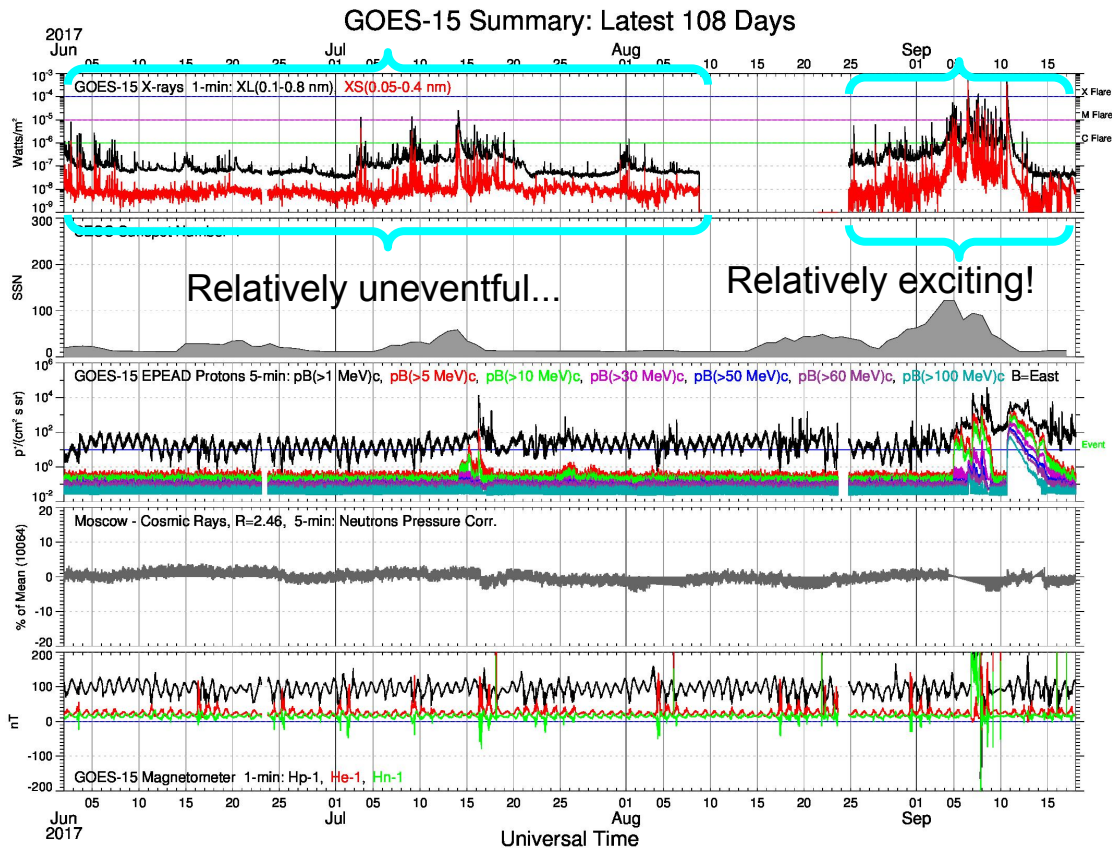
X-rays (@ Geo)

Sunspots

Particles (@ Geo)

Cosmic Rays

Magnetometer (@ Geo)

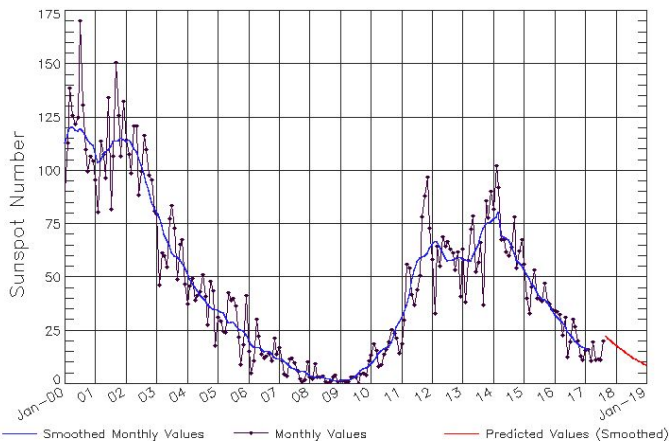


Cycle vs Watches, Warnings and Alerts Timeline 01 Sep - 16 Sep 2017



ISES Solar Cycle Sunspot Number Progression

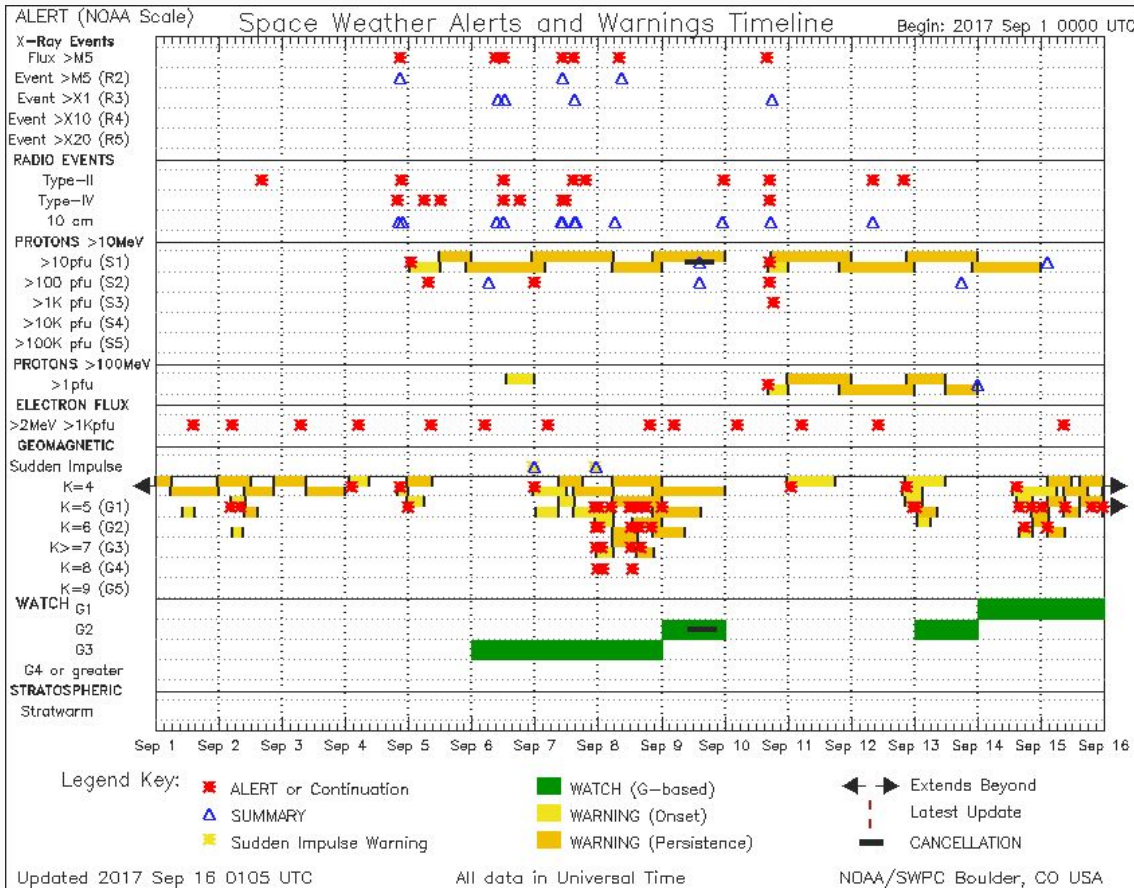
Observed data through Aug 2017

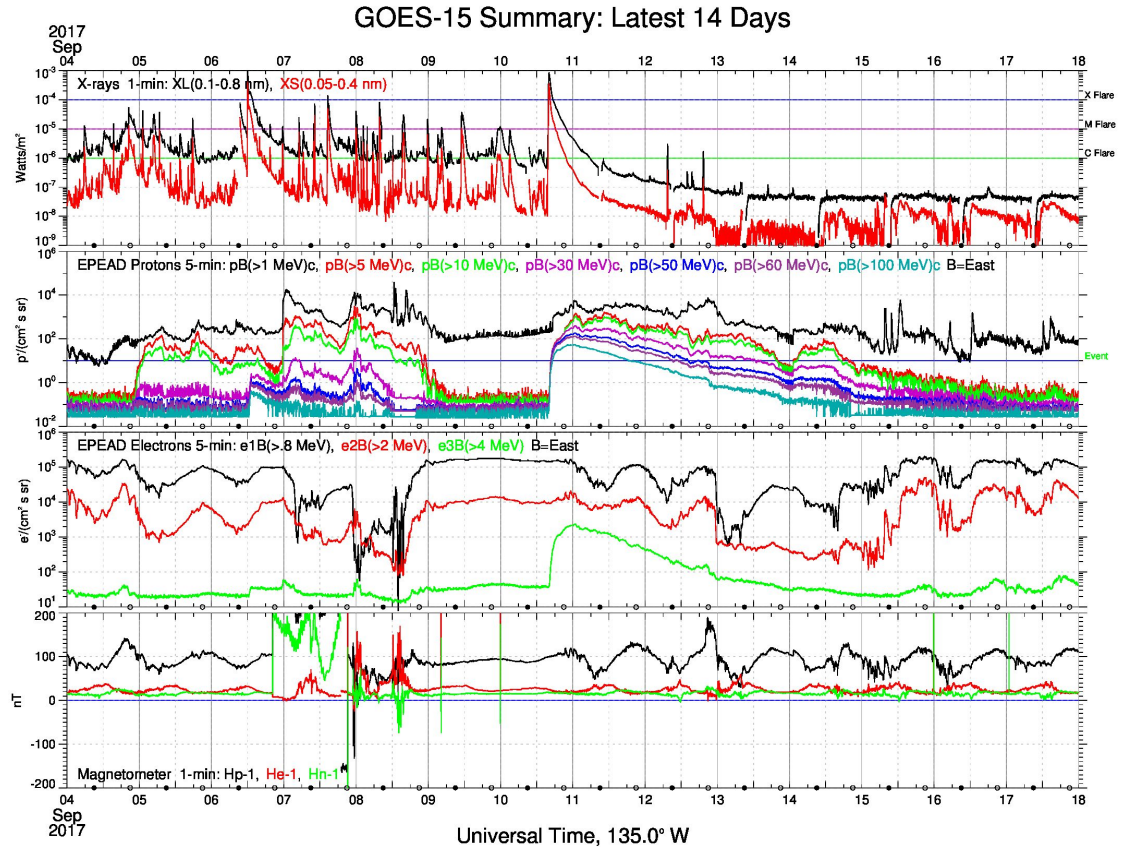
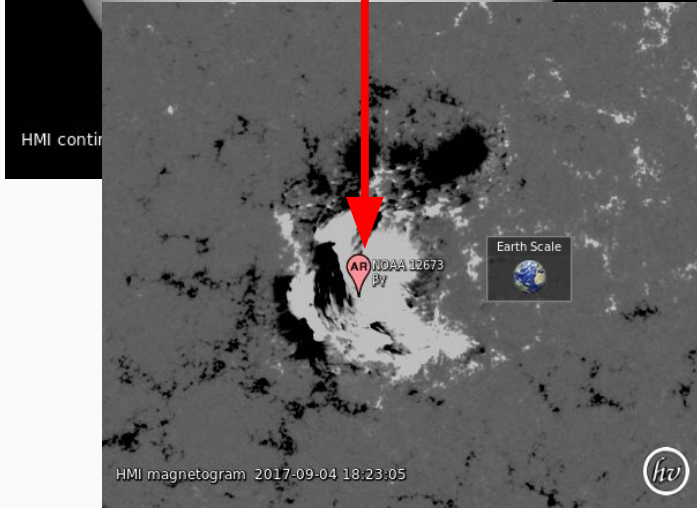
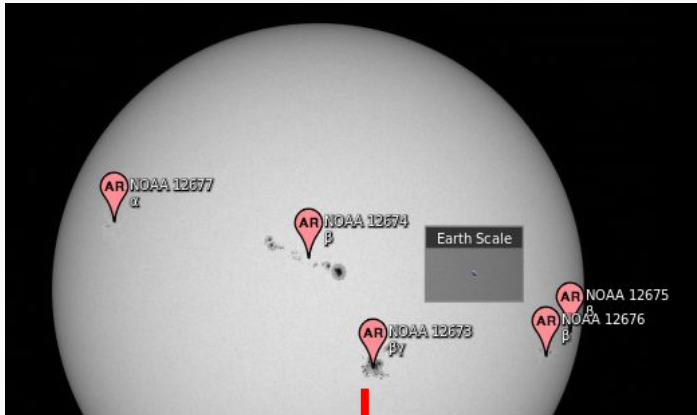


Updated 2017 Sep 4

NOAA/SWPC Boulder, CO USA

04 Sep 1200 UTC - 11 Sept 1200 UTC
123 Alert, Watch Warning and
 Summary Products issued. This was 5
 more than issued the *entire month*
 before.





Solar Activity gets interesting in September!

The X9.3 flare on Sep 6 at 1202 UTC was the largest of the solar cycle, and the largest since Sep 7, 2005 (an X17) + S3

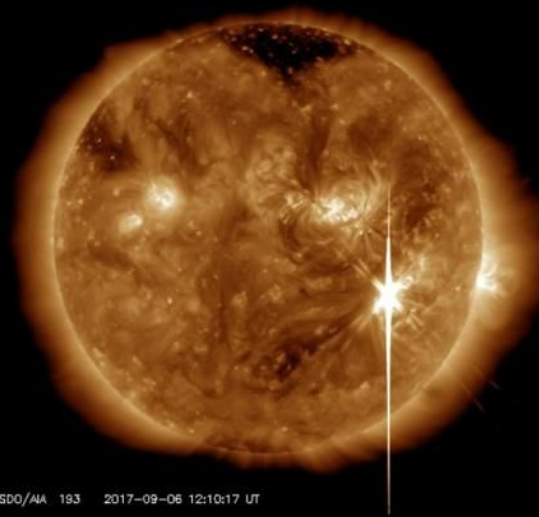
An X2.2 preceded the X9.3 flare on Sep 06 at 0910 UTC

An X1.3 event followed on Sep 07 at 1436 UTC

An X8.2 event followed on Sep 10 at 1606 UTC + S3

Strong Radio Blackout on 6 September at 1202 UTC

R3



SDO/AIA 193 2017-09-06 12:10:17 UT

PRIMARY AREA of IMPACTS
Large portions of sunlit side of Earth

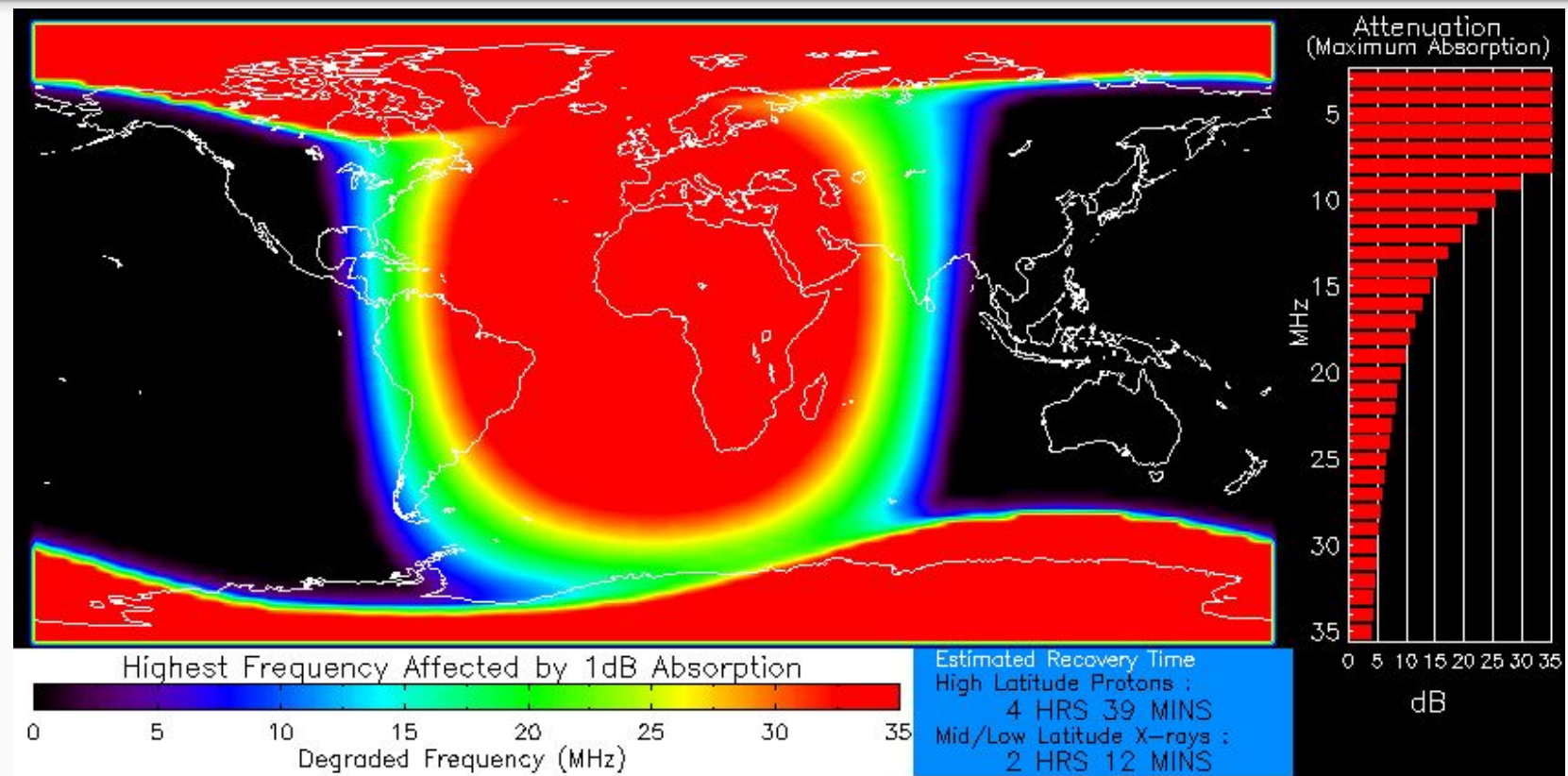
POSSIBLE EFFECTS

HF Radio: Wide area of blackouts; loss of contact for up to an hour over sunlit side of Earth

Navigation: Low frequency communication degraded for about an hour

<https://twitter.com/i/videos/tweet/905496088513269763?>

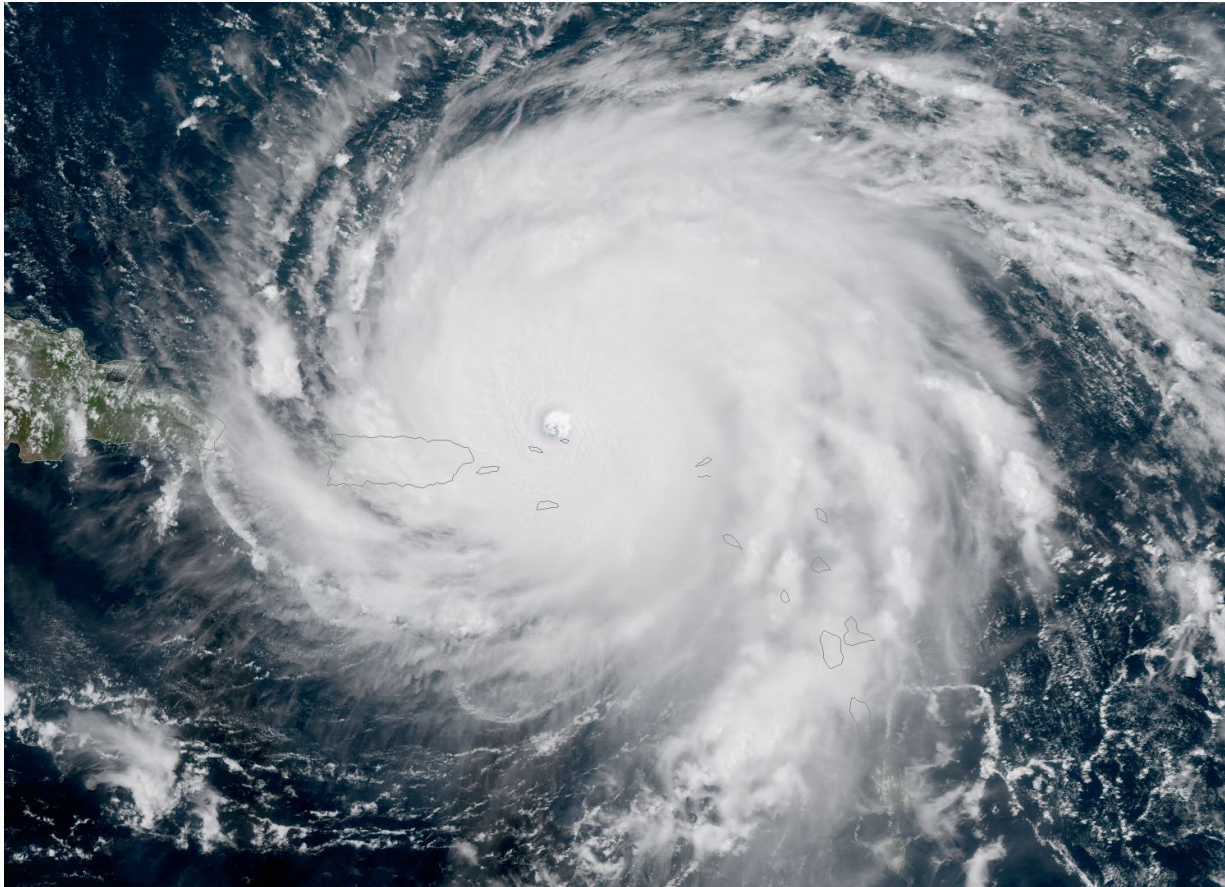
D-Region Absorption 06 Sep 2017



Strong X-ray flux
Product Valid At : 2017-09-06 12:00 UTC

Minor Proton Flux
NOAA/SWPC Boulder, CO USA

Hurricane + Solar Flare = ?



“...I’m not sure how long this blackout will last, but, **these flares could not happen at a worse time. We are looking at 3 hurricane threatening land and we cannot make contact with anyone on the 20 meter or 40 meter amateur bands...**”

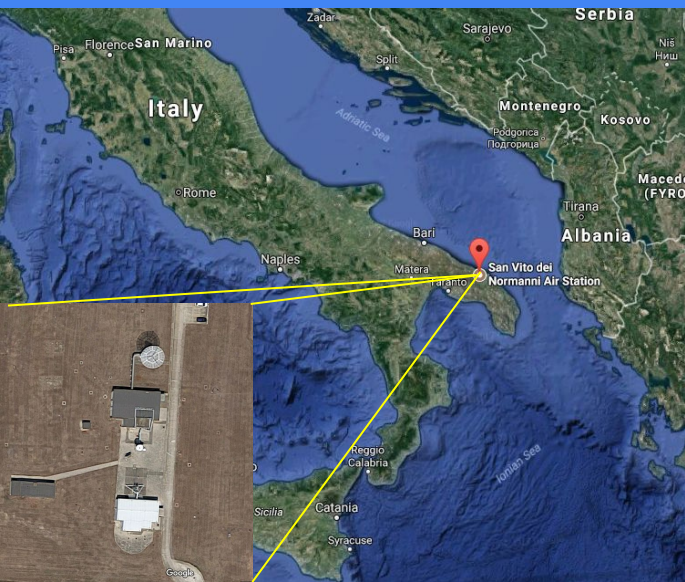
Mother Nature is not playing well.



Solar Radio Burst Activity

06 Sep 2017

Solar Radio Burst reported by USAF optical/radio observatory at San Vito, Italy.

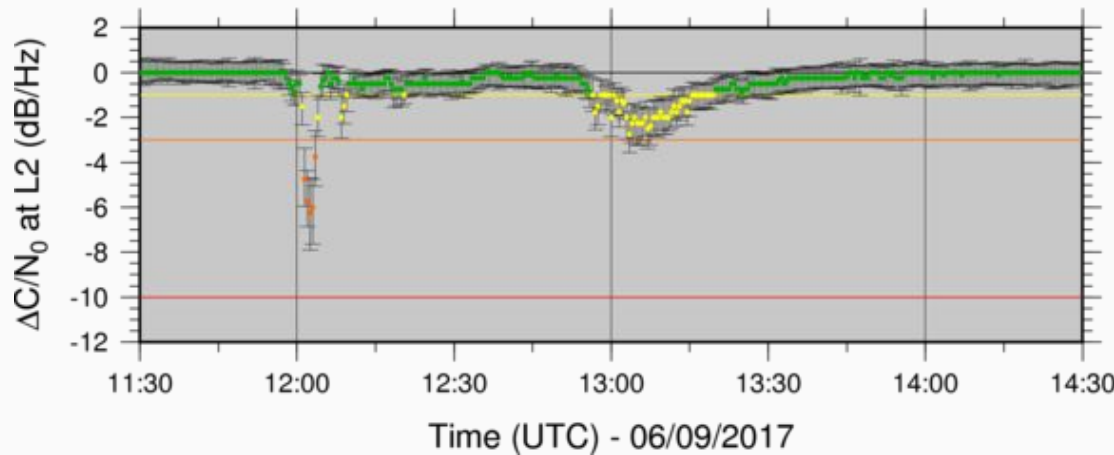
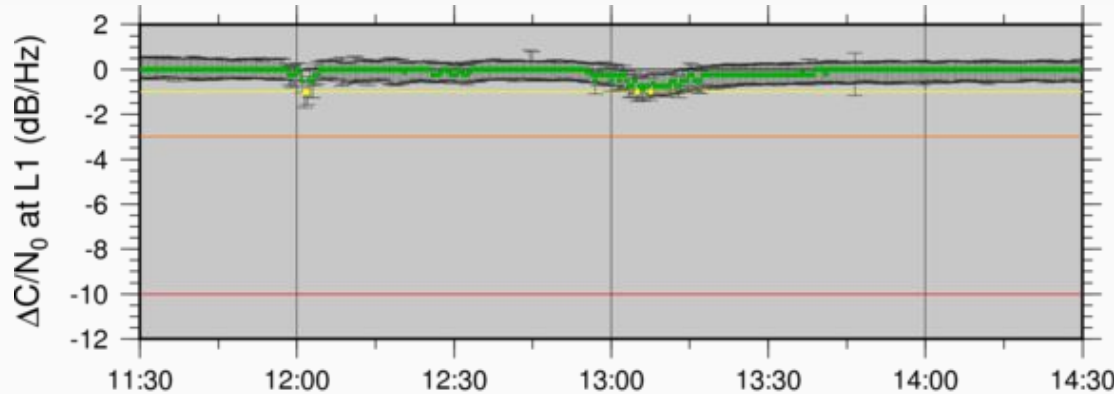


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:Product: 20170906events.txt
:Created: 2017 Sep 09 0357 UT
:Date: 2017 09 06
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction Center
# Please send comments and suggestions to SWPC.Webmaster@noaa.gov
#
# Missing data: ////
# Updated every 5 minutes.
#
# Edited Events for 2017 Sep 06
#
#Event      Begin      Max      End Obs  Q  Type  Loc/Frq  Particulars      Reg#
#-----
7160      0000      ////      0433  PAL  C    RSP    025-180  VI/1
7340 +    1153    1202      1210  G15  5    XRA  1-8A      X9.3  5.7E-01  2673
7340 +    1154    1156      1432  SVI  G    RBR  2695      14000  CastelliU 2673
7340 +    1154    1156      1351  SVI  G    RBR  15400     8100  CastelliU 2673
7340 +    1155    1202      1232  SAG  G    RBR  410       6300  CastelliU 2673
7340 +    1155    1156      1356  SVI  G    RBR  8800     6500  CastelliU 2673
7340 +    1156    1157      1405  SVI  G    RBR  4995     5900  CastelliU 2673
7340 +    1156    1202      1424  SVI  G    RBR  1415     19000  CastelliU 2673
7340 +    1157    ////      1202  SVI  C    RSP  025-170  III/2  2673
7340 +    1158    1202      1232  SAG  G    RBR  610      9400  CastelliU 2673
7340 +    1201    ////      1515  SVI  C    RSP  025-180  IV/2   2673
7340 +    1202    1203      1411  SVI  G    RBR  245      3200  CastelliU 2673
7340      1202    ////      1208  SAG  C    RSP  025-061  VI/1   2673
7340      1202    ////      1221  SVI  C    RSP  025-081  II/2   1765  2673

7790      B1224    ////      A1630  SOH  4    CME  XUV, EUV, UV227-226/FS1429  2673
  
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Summary of Radio Burst Impact to GPS - 06 September from ROB



Royal Observatory of
Belgium
GNSS Research Group

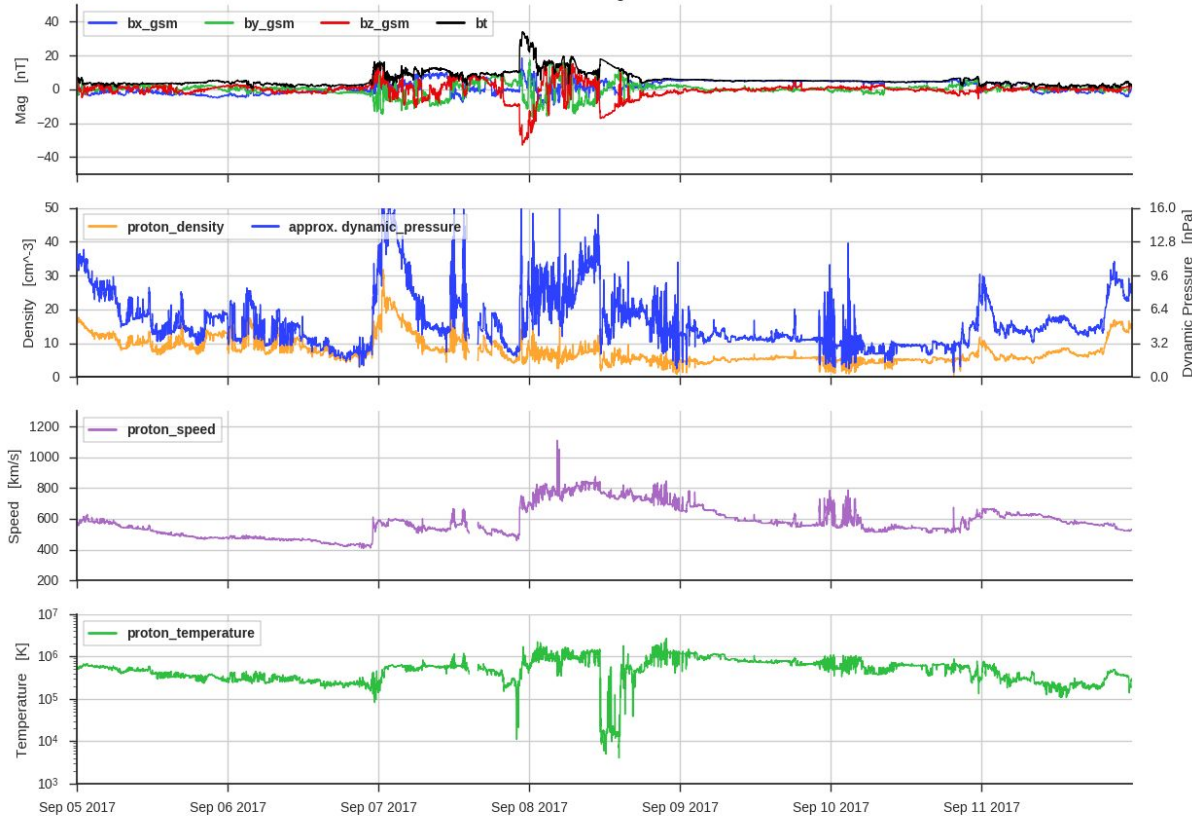
IMPACT OF THE EVENT:

- On L1, two fades above 1dB/Hz were detected at 12h01 and 12h05.
- On L2, a first fade above 3dB/Hz which could potentially affect the GNSS application, occurred for 3 min with a maximum of -6.25 ± 1.6 dB/Hz at 12h02.
- It was followed by a second lower fade above 1dB/Hz at 13h03.

Solar Wind Environment 05-11 September, 2017

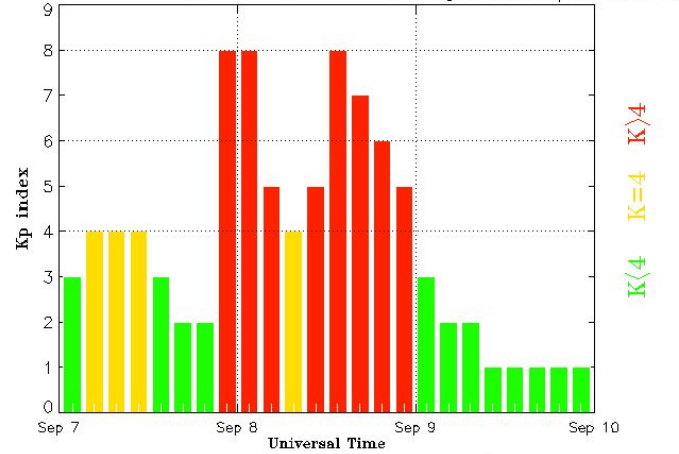


DSCOVR 7day summary
2017-09-05 00:00:00 through 2017-09-11 23:59:59



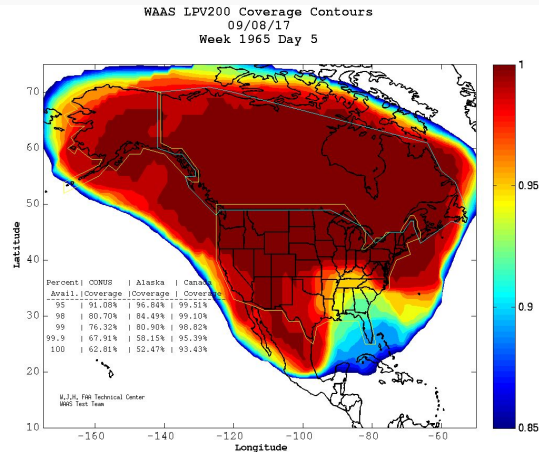
Courtesy of NCEI, CO - ngdc.noaa.gov/dscovr

Estimated Planetary K index (3 hour data) Begin: 2017 Sep 07 0000 UTC



Updated 2017 Sep 10 00:30:03 UTC NOAA/SWPC Boulder, CO USA

Localizer Performance with Vertical Guidance coverage 08 September 2017

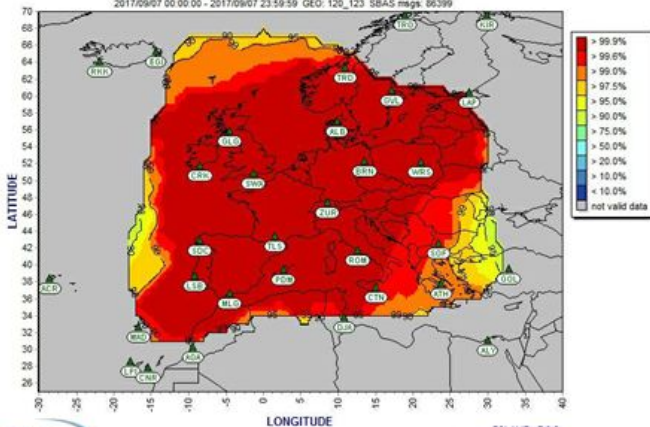


European Geostationary Navigation Overlay Service (EGNOS) performance



HPL vs HAL and VPL vs VAL for Signal in Space with Commitment Area

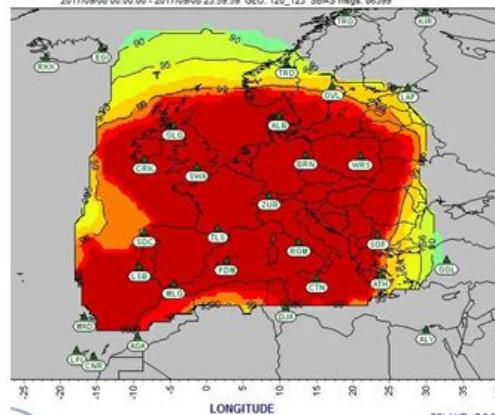
2017/09/07 00:00:00 - 2017/09/07 23:59:59 GEO: 120_123 SBAS maps: 86399



ECLAYR v7.0.8
Produced by ESSP SAS

HPL vs HAL and VPL vs VAL for Signal in Space with Commitment Area

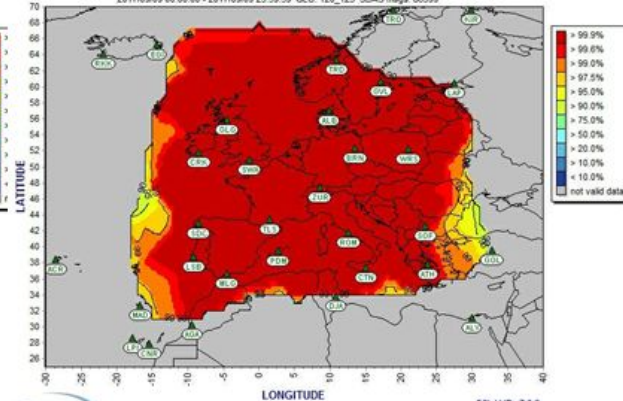
2017/09/08 00:00:00 - 2017/09/08 23:59:59 GEO: 120_123 SBAS maps: 86399



ECLAYR v7.0.8
Produced by ESSP SAS

HPL vs HAL and VPL vs VAL for Signal in Space with Commitment Area

2017/09/09 00:00:00 - 2017/09/09 23:59:59 GEO: 120_123 SBAS maps: 86399



ECLAYR v7.0.8
Produced by ESSP SAS



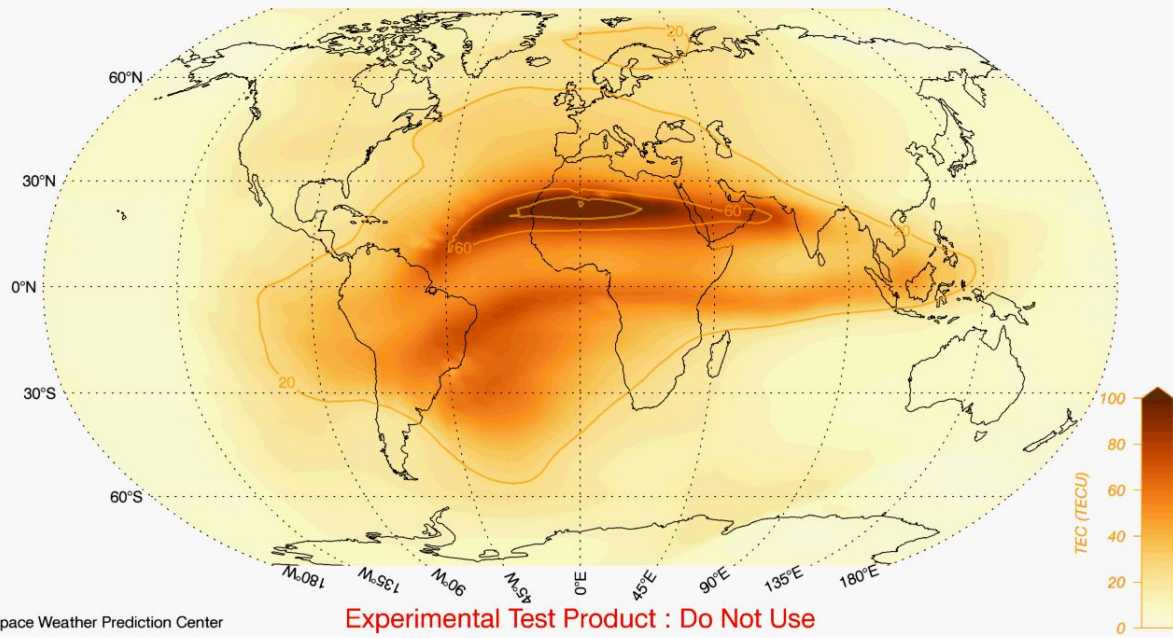


PNT Product Progress

WAM-IPE (IDEA) Progress

- New forecast products and services for GPS/GNSS, HF radio communication, and satellite orbit prediction customers.
- WAM-IPE running in realtime in an operational mode on the Weather and Climate Operational Supercomputing System (WCOSS)

WAM-IPE, Ionospheric TEC : 2017-09-19 15:00 UTC



Space Weather Prediction Center

Experimental Test Product : Do Not Use



8.3 TOPIC: Environmental Observations: Data Science Advancements

8.3.1 SUBTOPIC: **Position Error Maps for GPS/GNSS**

Customers are requesting improved products for assessing positioning errors for satellite navigation systems such as the Global Positioning Satellite (GPS) system

FIRM: **Space Environment Technologies**

PRINCIPAL INVESTIGATOR: **Dr. W. Kent Tobiska**

TITLE OF PROJECT: **Space weather-based position error maps for TEC - OnLine (SpoT-On)**

FIRM: **Atmospheric & Space Technology Research Associates, LLC (ASTRA)**

PRINCIPAL INVESTIGATOR: **Geoffrey Crowley**

TITLE OF PROJECT: **Position Error Maps for GPS/GNSS**



Questions for the GNSS Community

- Do you use NATEC/USTEC? If so, how?
- Have you used the new CTIPe product?
- Is there interest in an ionosphere disturbance index derived from the comparison of position errors obtained from dual and single frequency PPP algorithms at reference stations?
- How useful is a 3-6 hour forecast of an ionosphere disturbance?