

HamSCI and the 2017 Total Solar Eclipse

Nathaniel A. Frissell, W2NAF¹

Bill Engelke, AB4EJ²

Joshua D. Katz, KD2JAO¹

Spencer W. Gunning, K2AEM¹

Joshua S. Vega, WB2JSV¹

¹New Jersey Institute of Technology, K2MFF

²University of Alabama, W4UAL

Outline

- I. What is HamSCI?**
- II. HamSCI Database**
- III. Eclipse Experiments**
- IV. Summary**

HamSci

The Ham radio Science Citizen Investigation is:



hamsci.org/dayton2017

An organization that allows university researchers to collaborate with the amateur radio community in scientific investigations.

Objectives:

1. **Advance** scientific research and understanding through amateur radio activities.
2. **Encourage** the development of new technologies to support this research.
3. **Provide** educational opportunities for the amateur community and the general public.



KD2JAO & WB2JSV in the SEQP

HamSCI Membership

Lead HamSCI Organizer:

Dr. Nathaniel A. Frissell, W2NAF

*New Jersey Institute of Technology
Center for Solar-Terrestrial Research*



HamSCI at the 2016
American Geophysical Union Meeting

Members from:

- New Jersey Institute of Technology
- Virginia Tech
- American Radio Relay League
- Afreet Software
- Bob Jones University
- Dartmouth College
- Instituto de Telecomunicações /Universidade de Aveiro
- Johns Hopkins University APL
- MIT Haystack Observatory
- Montclair State University
- Reverse Beacon Network
- The Radio Club of America
- Rice University
- Royal Military College of Canada
- SciVision, Inc.
- SRI International
- University of Alabama
- University of Calgary
- University of Michigan
- The Amateur Radio Community

Total Solar Eclipse

21 August 2017

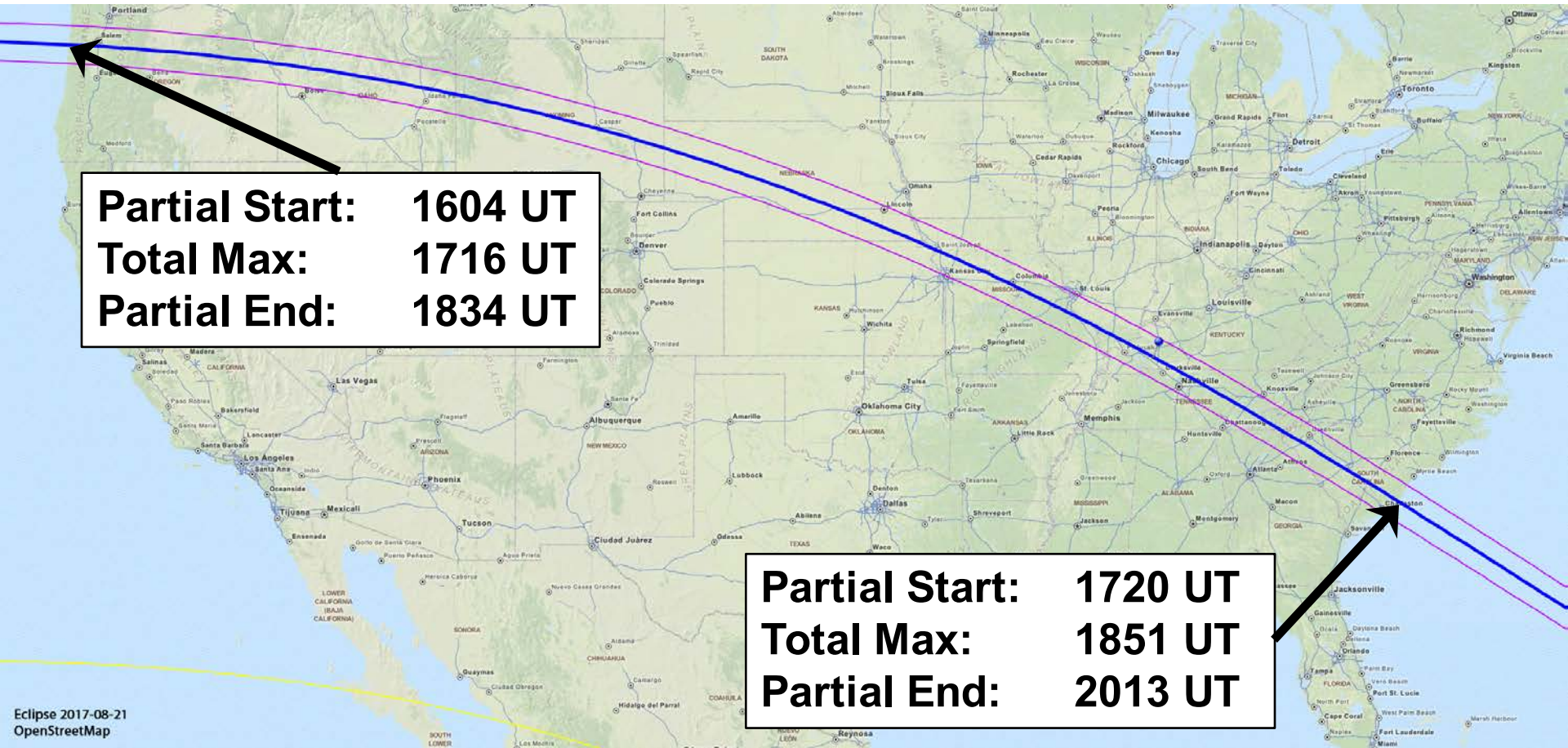


Figure: W. Strickling, Wikipedia

HamSCI Eclipse Research Questions

- What are the temporal and spatial scales of eclipse-induced ionospheric effects?
- Can we observe TIDs in the ionosphere caused by the eclipse?
- How does the eclipse affect HF propagation?



HamSCI Eclipse Experiments

- **Solar Eclipse QSO Party (SEQP)**
 - Ham Radio Contest-Like Event
 - Generate a quasi-random dataset
 - Data from RBN, PSKReporter, WSPRNet, Logs
- **HF Wideband Recording**
 - Use SDRs to record large amounts of HF Spectrum
- **HF Frequency Measurement Experiment**
 - Measure changes in WWV, CHU frequency due to eclipse



HamSCI-Related Experiments

- Sky & Telescope AM Broadcast Experiment
- EclipseMob VLF Experiments
- Professional Measurements
 - MIT Haystack Incoherent Scatter Radar
 - GPS-TEC
 - Ionosondes
 - SuperDARN
 - Virginia Tech Field Ionosondes



VT Field Ionosonde at Shaw AFB

Data Collection

hamsci.org <ul style="list-style-type: none">• SEQP Log Files	<ul style="list-style-type: none">• 571 Parsed Logs• 28,694 QSOs
zenodo.org HamSCI Community <ul style="list-style-type: none">• Wideband Recording• Frequency Measurements	<ul style="list-style-type: none">• 50 Submissions
Reverse Beacon Network	<ul style="list-style-type: none">• 625,000 Spots
PSKReporter	<ul style="list-style-type: none">• Still counting...
WSPRNet	<ul style="list-style-type: none">• 642,586 Spots

Solar Eclipse QSO Party

- 571 submitted logs
- 28,694 QSOs
- 5,201 unique callsigns
- 4,371 unique grid squares
- 864 foreign callsigns

(from logs submitted to hamsci.org)

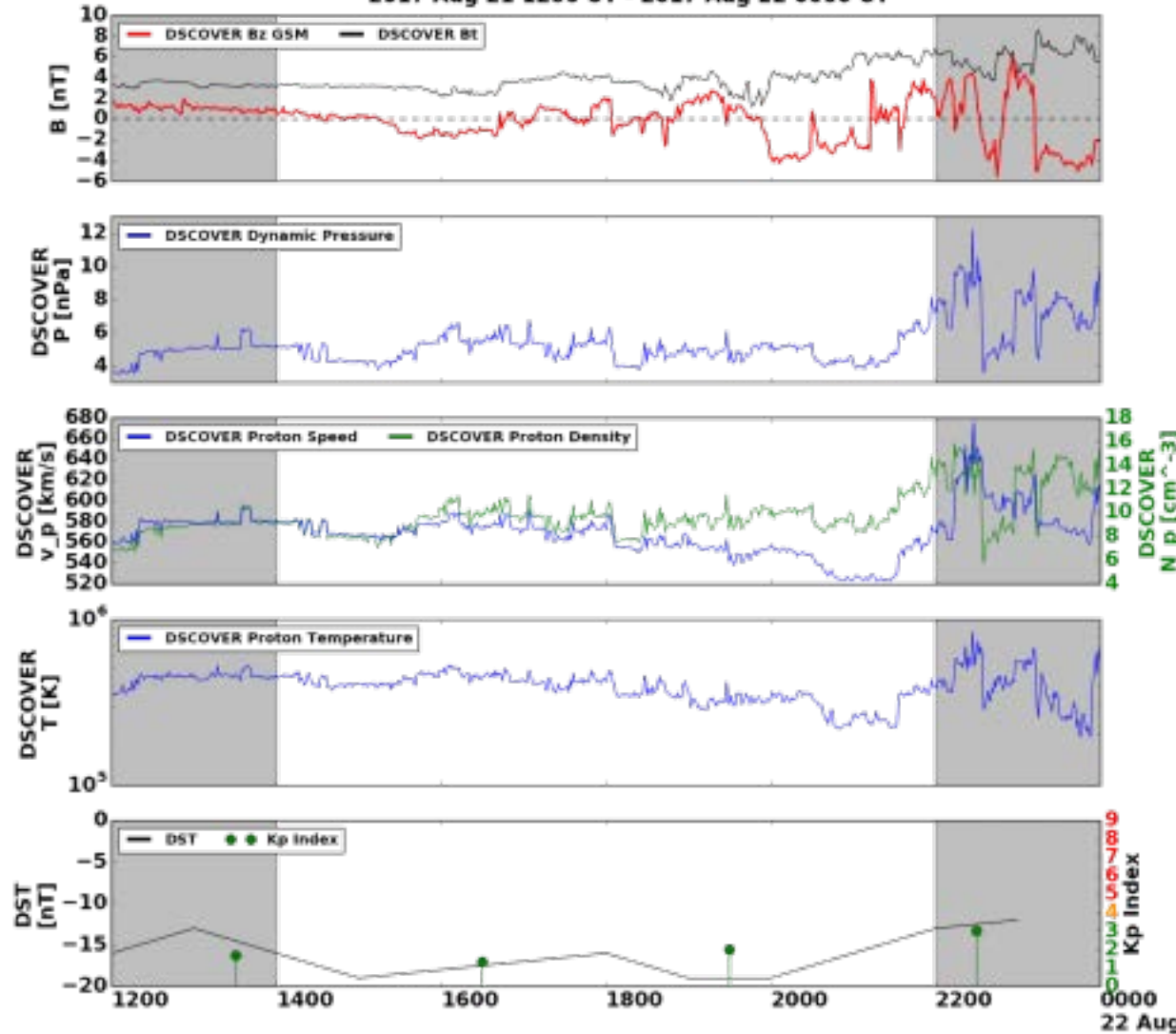


GMAG & SW Conditions

Boulder Sunspot Nr: 44
F10.7: 83 sfu

Geomagnetic Environment Summary
2017 Aug 21 1200 UT - 2017 Aug 22 0000 UT

Nominal/Quiet Values



B_T	7 nT
B_z	+ for Quiet

P_{dyn}	1–6 nPa
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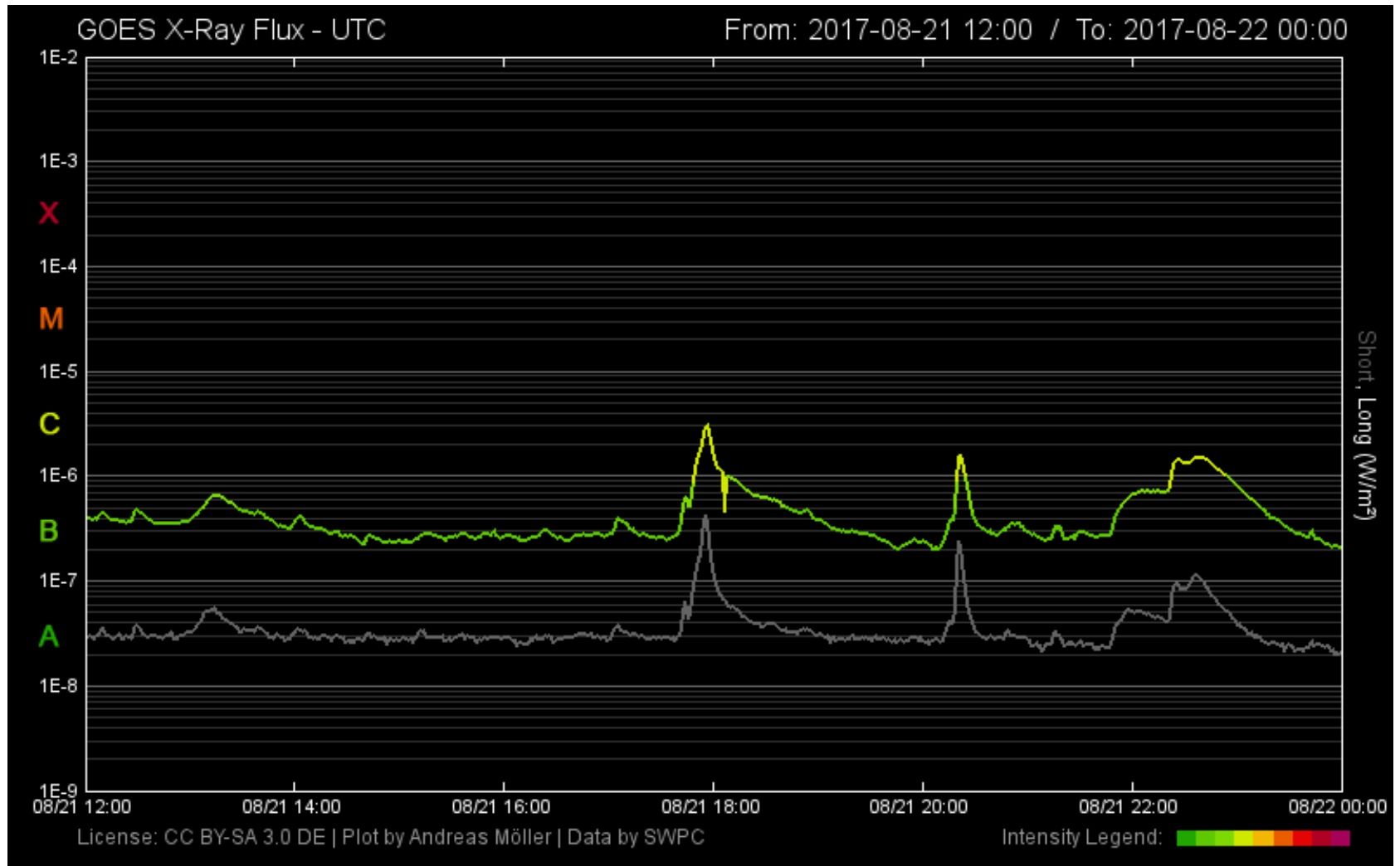
v_p	450 km s ⁻¹
n_p	6 cm ⁻³

T	1.2x10 ⁵ K
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D_{st}	> -50 nT
K_p	≤ 3

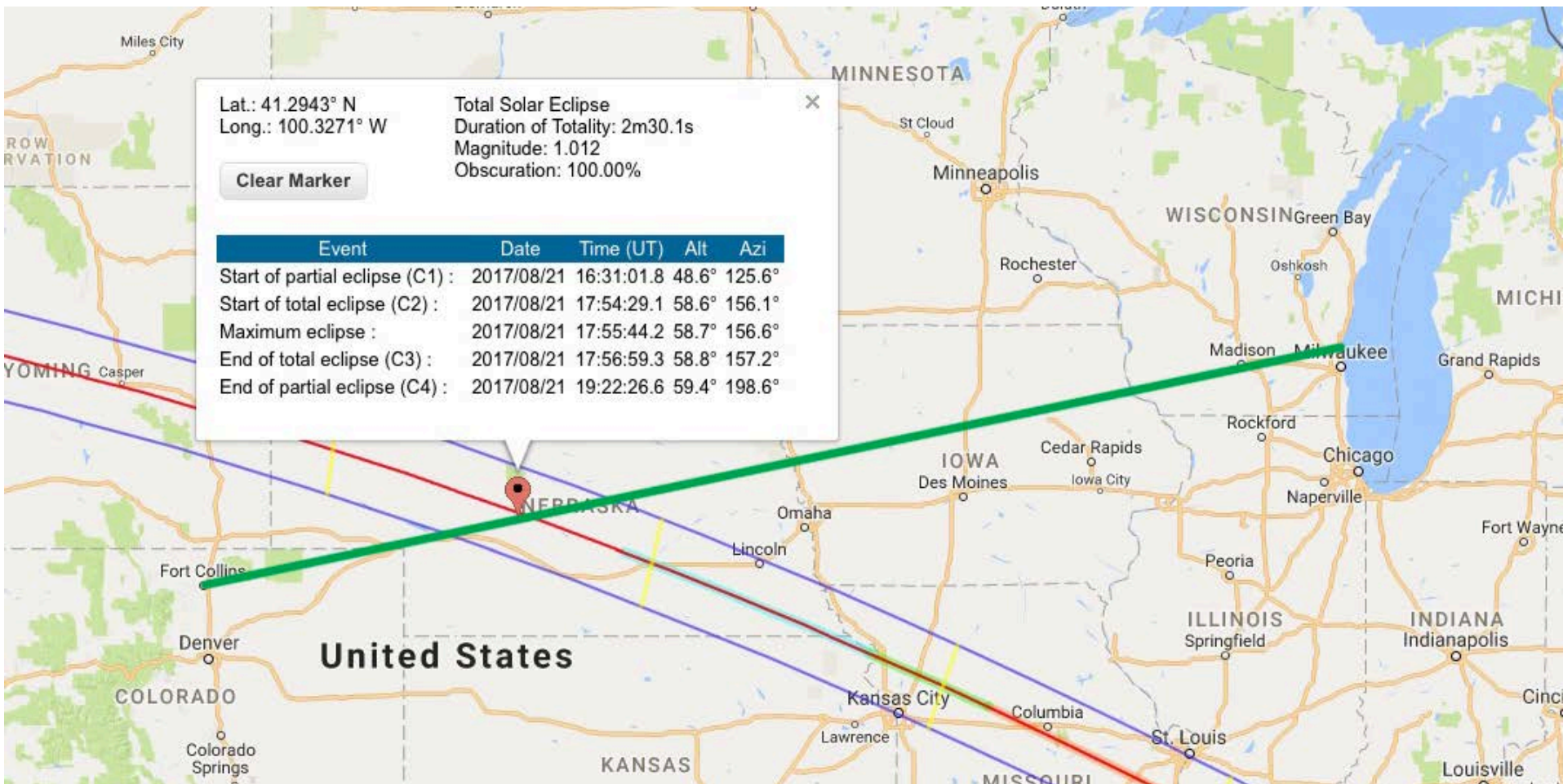
Sources: NOAA & Kyoto WDC

GOES X-Ray Flux



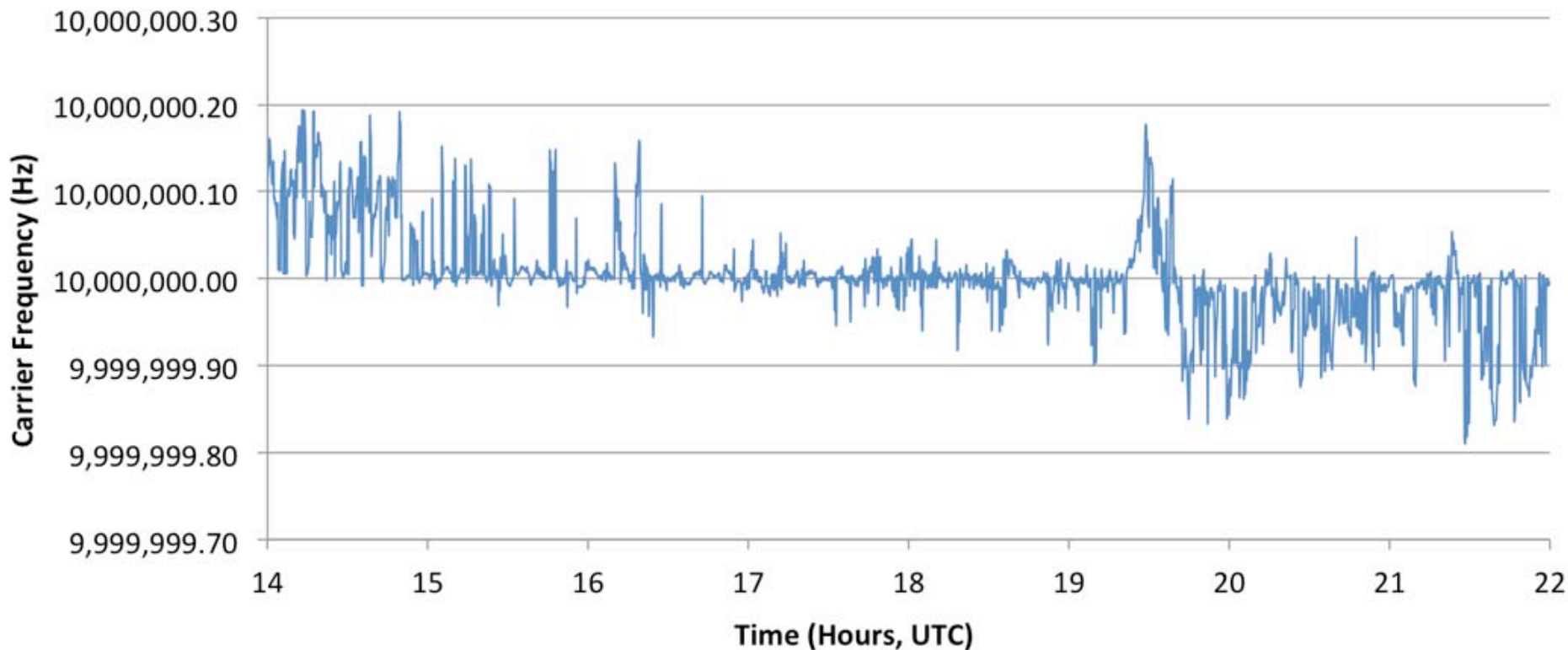
http://www.polarlicht-vorhersage.de/goes_archive

WA9VNJ 10MHz WWV Observations

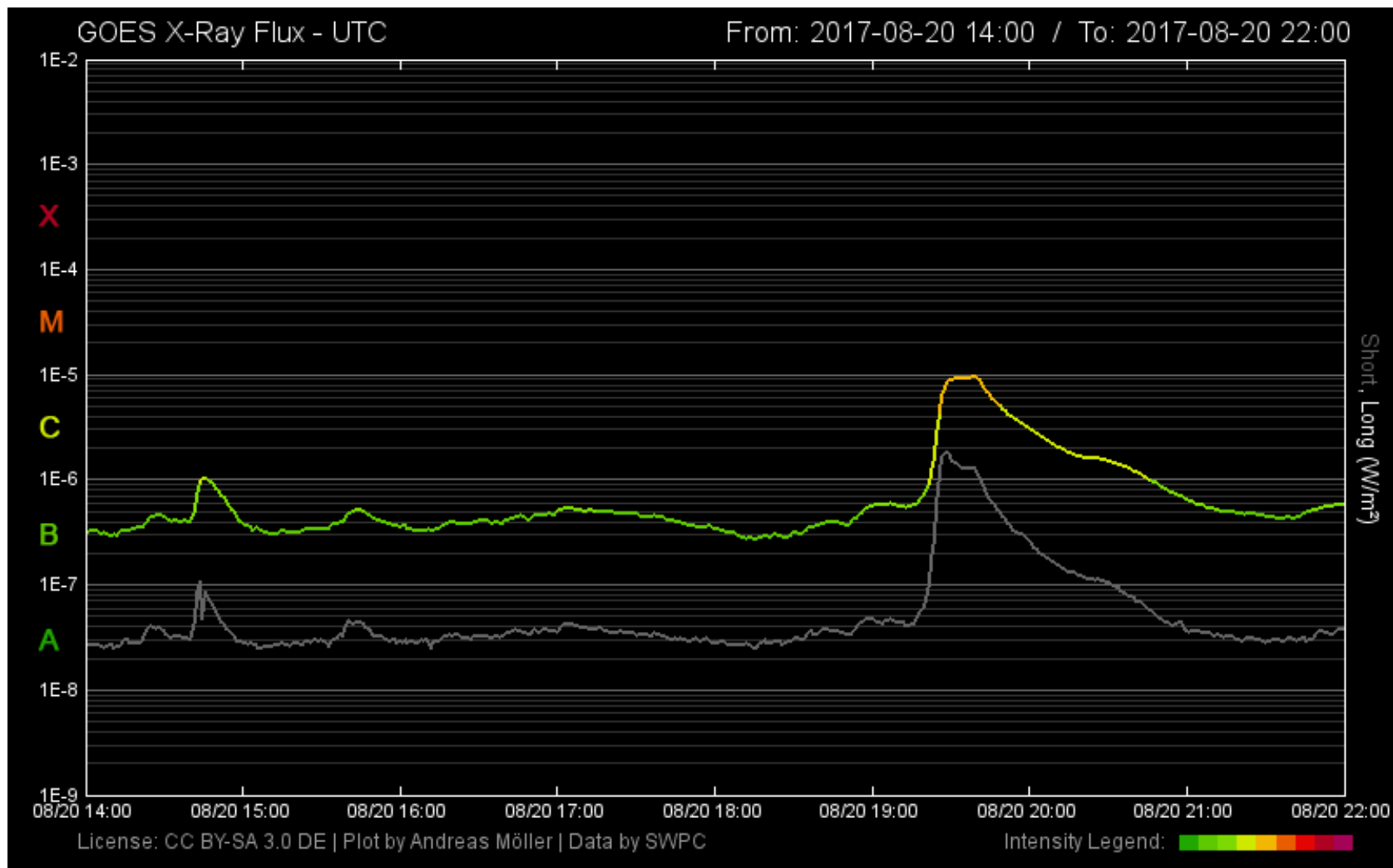


WA9VNJ 10MHz WWV Observations

WWV 10 MHz Carrier Frequency, 8/20/17 (Control Day)
Received Near Milwaukee, WI. Mean=10,000,000.0022 Hz



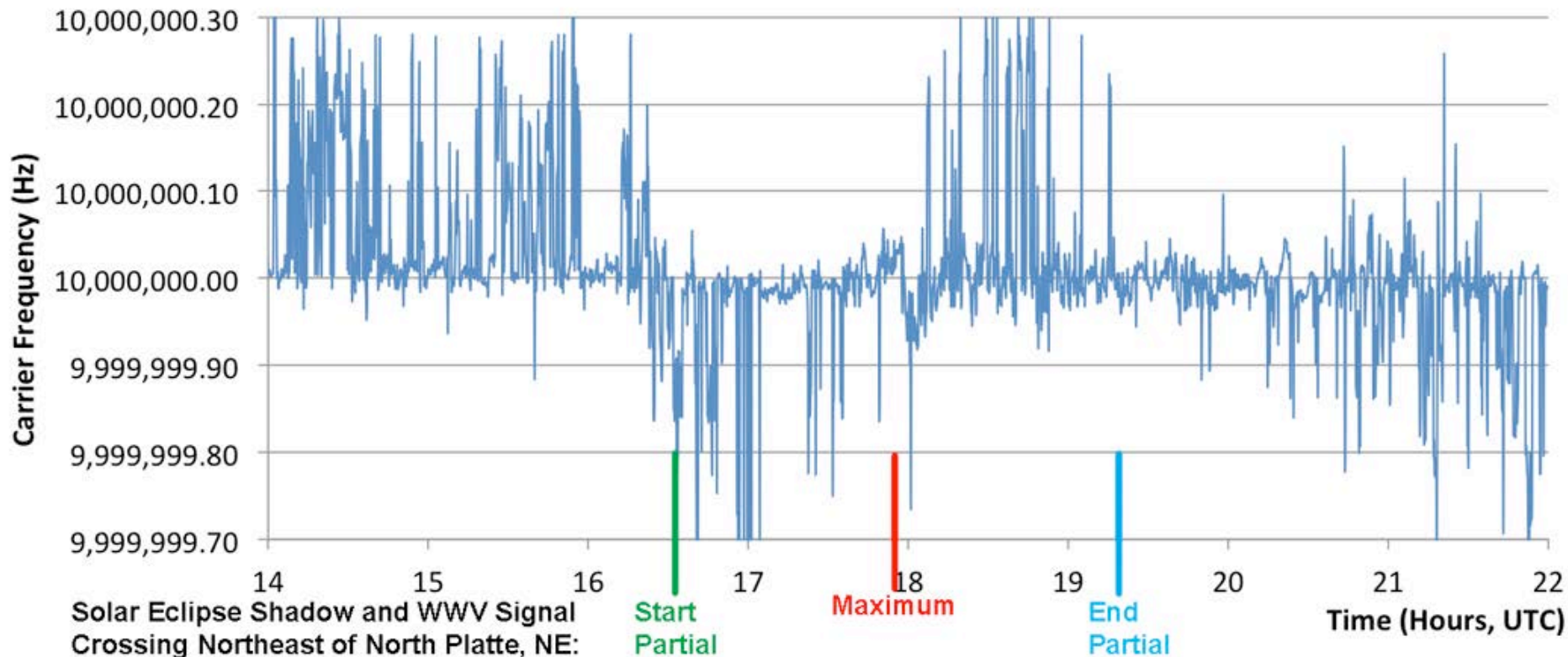
GOES X-Ray Flux – Control Day



http://www.polarlicht-vorhersage.de/goes_archive

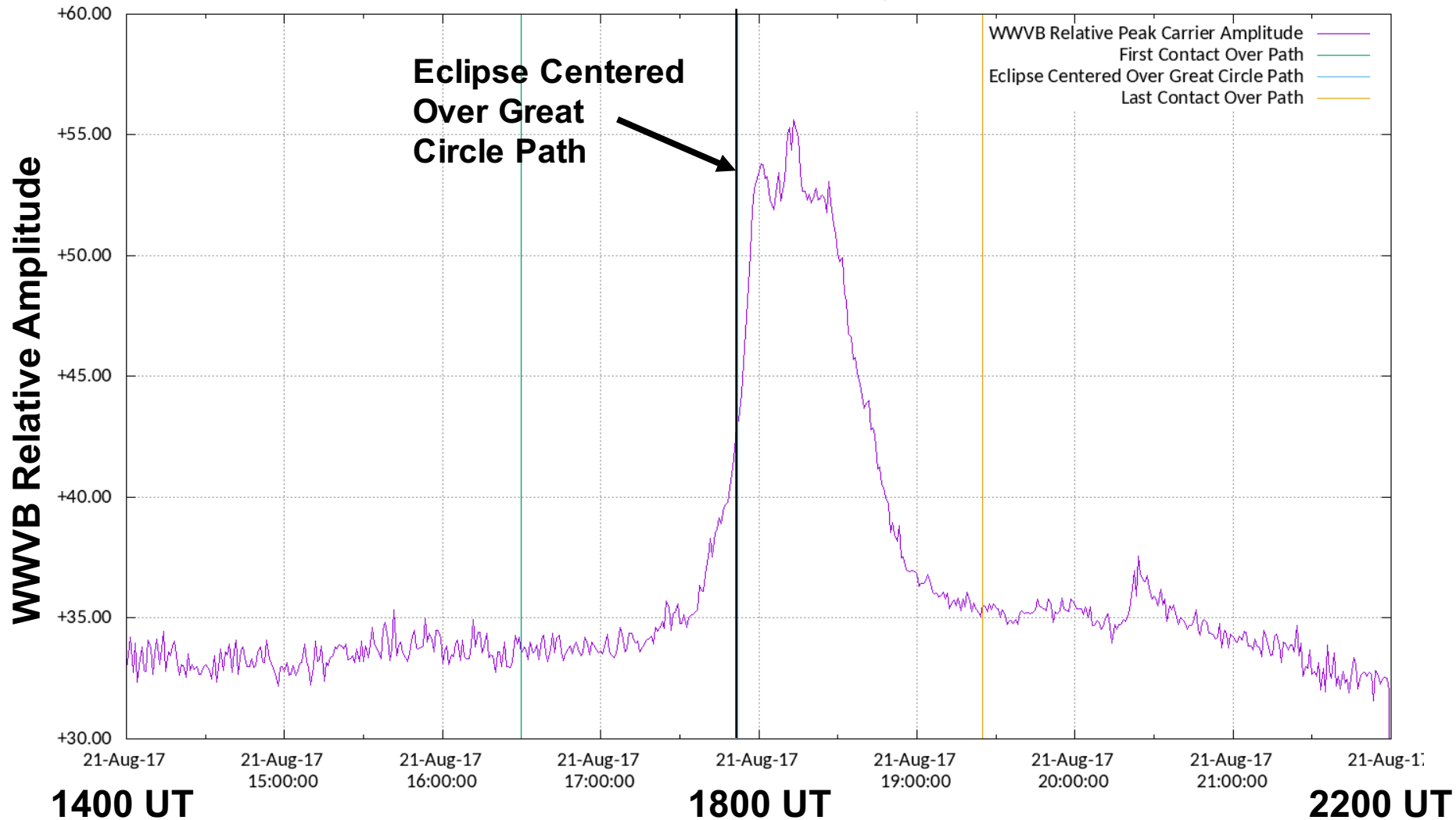
WA9VNJ 10MHz WWV Observations

WWV 10 MHz Carrier Frequency, 8/21/17 (Eclipse Day)
Received Near Milwaukee, WI. Mean=10,000,000.0096 Hz



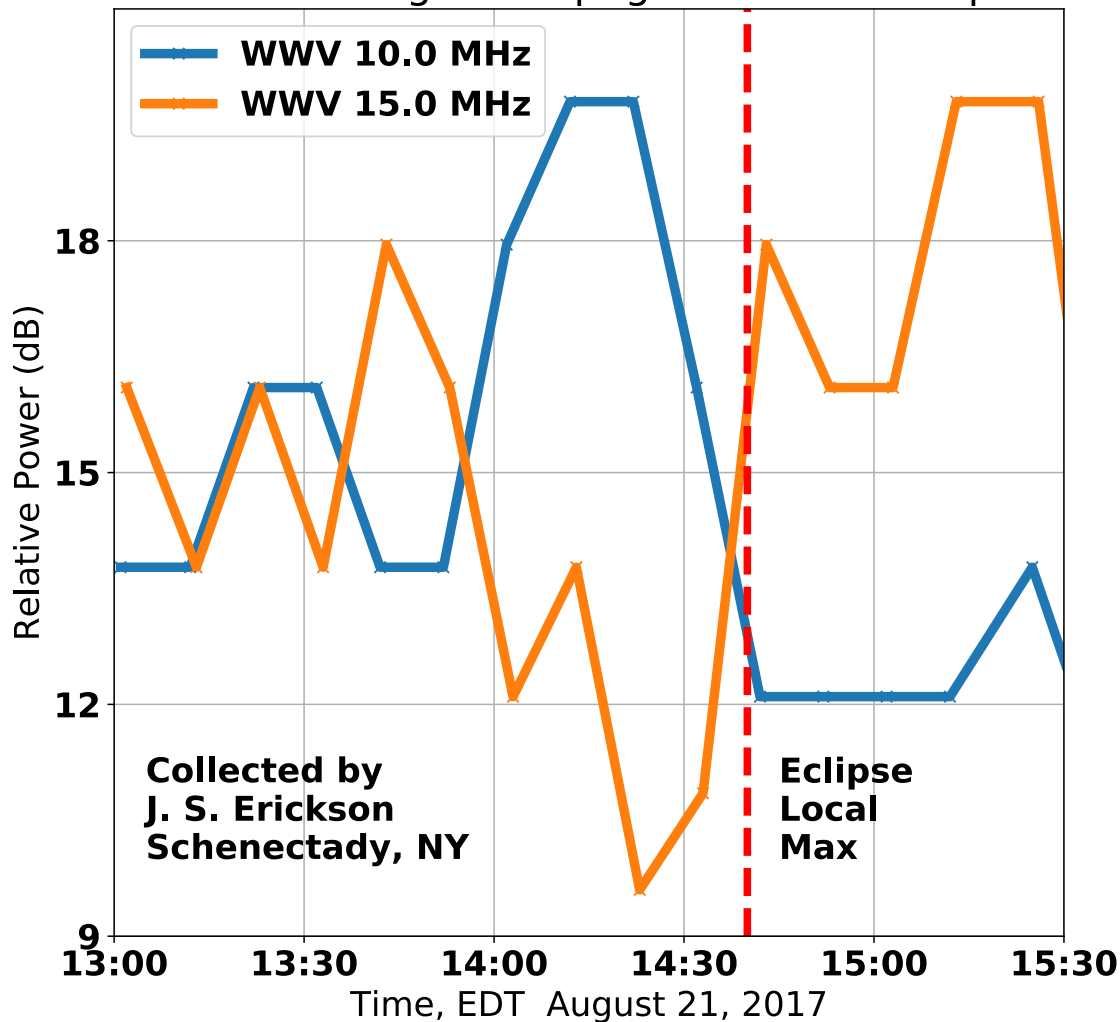
WWVB 60 kHz KD2BD Measurements

WWVB RX in Sea Girt, NJ by KD2DB



10 & 15 MHz WWV (Schenectady, NY)

Shortwave Signal Propagation 2017 Eclipse



Even shortwave listeners got into the act. Using the S meter on his Panasonic RF-4900 shortwave receiver, 88 year old John S. Erickson of Schenectady, NY (father of Extra class licensee and professional ionospheric researcher Phil Erickson W1PJE) recorded the signal strength he heard from time signals WWV at 10 and 15 MHz every 10 minutes during eclipse passage.

Solar Eclipse QSO Party (SEQP)

- **August 21, 2017 from 1400 – 2200 UT**
- **Contest-like**
 - 2 Points CW or Digital
 - 1 Point for Phone
 - Multiply Score by # of Grids
- **Exchange**
 - RST + 6 Character Grid Square
- **Data sources**
 - Reverse Beacon Network
 - PSKReporter
 - WSPRNet
 - Participant-submitted logs



<http://hamsci.org/seqp>

SEQP Log Submission

SEQP Log Submission | HamSci X Guest

hamsci.org/submit-logs

HamSci About Projects Get Involved People Resources Publications

SEQP Log Submission

SEQP Logs must be submitted by **Saturday, September 30, 2017 at 2359 UTC.**
Rules for the SEQP can be found [here](#).

Personal Information

Please select one: Single-operator Multi-operator

First Name
Appears on Certificate

Last Name
Appears on Certificate

Station Callsign
Appears on Certificate

E-Mail Address

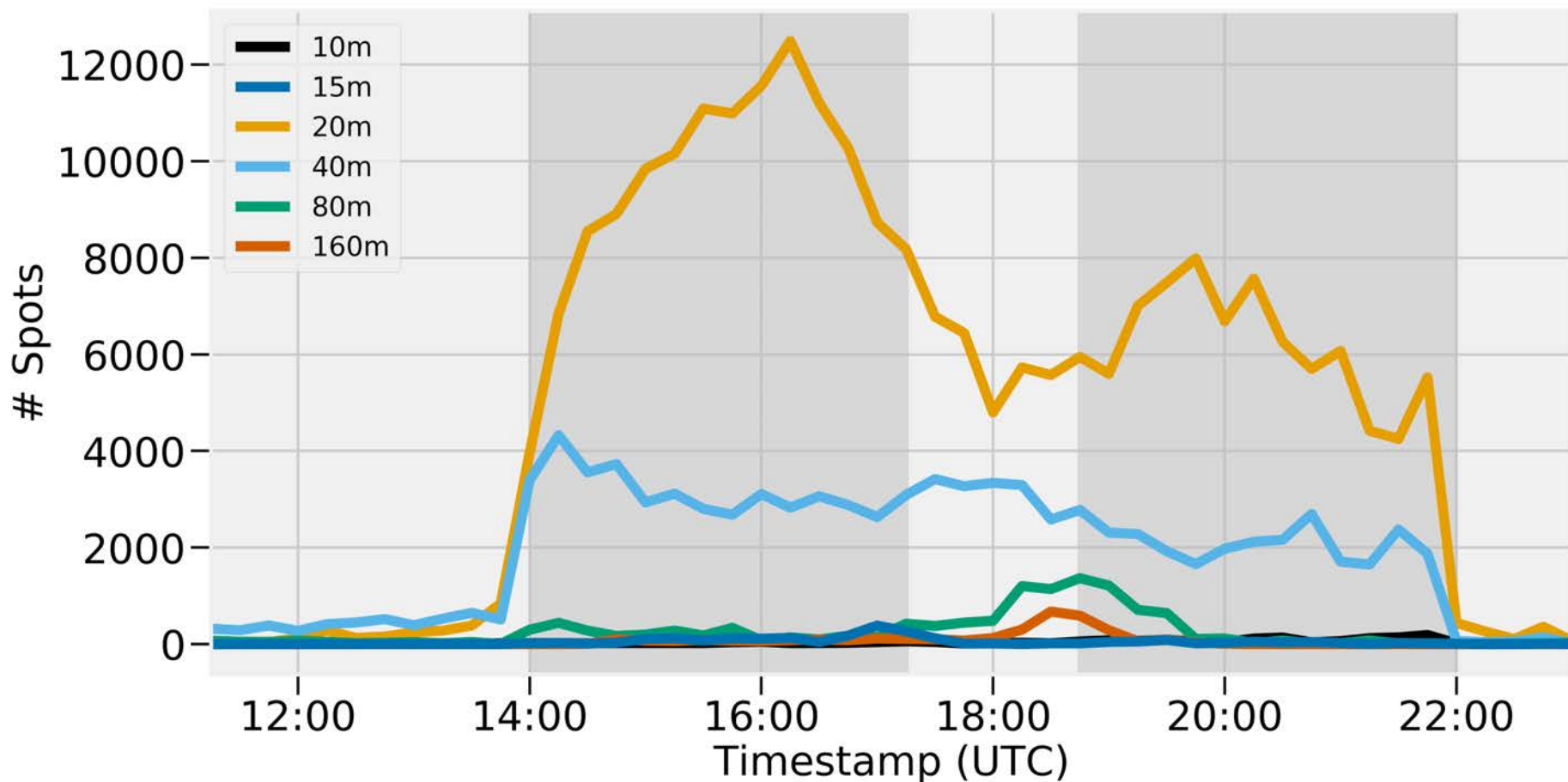
Station Grid Square
[Grid square calculator](#)

Primary TX Model

TX Power (W)

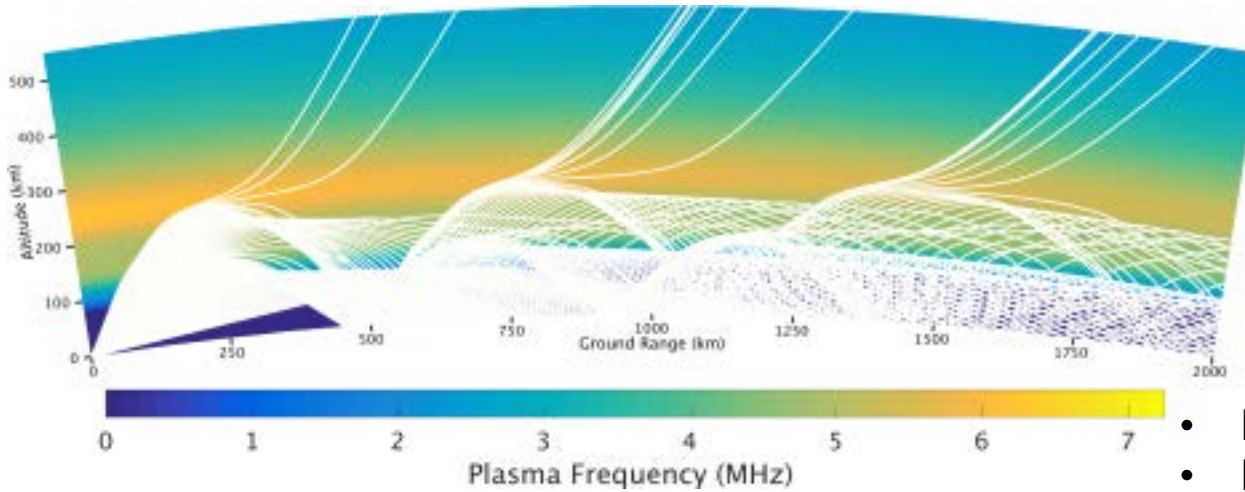
SEQP RBN Spots

RBN SEQP Spots by Band (Contiguous US TX and RX Only)



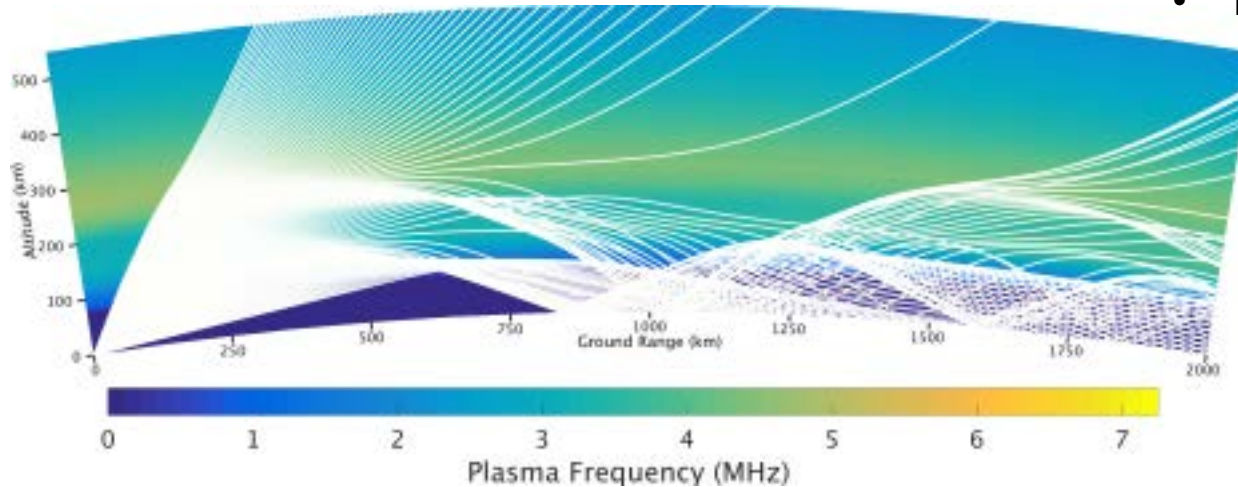
SEQP Raytrace Simulation

Non-Eclipsed



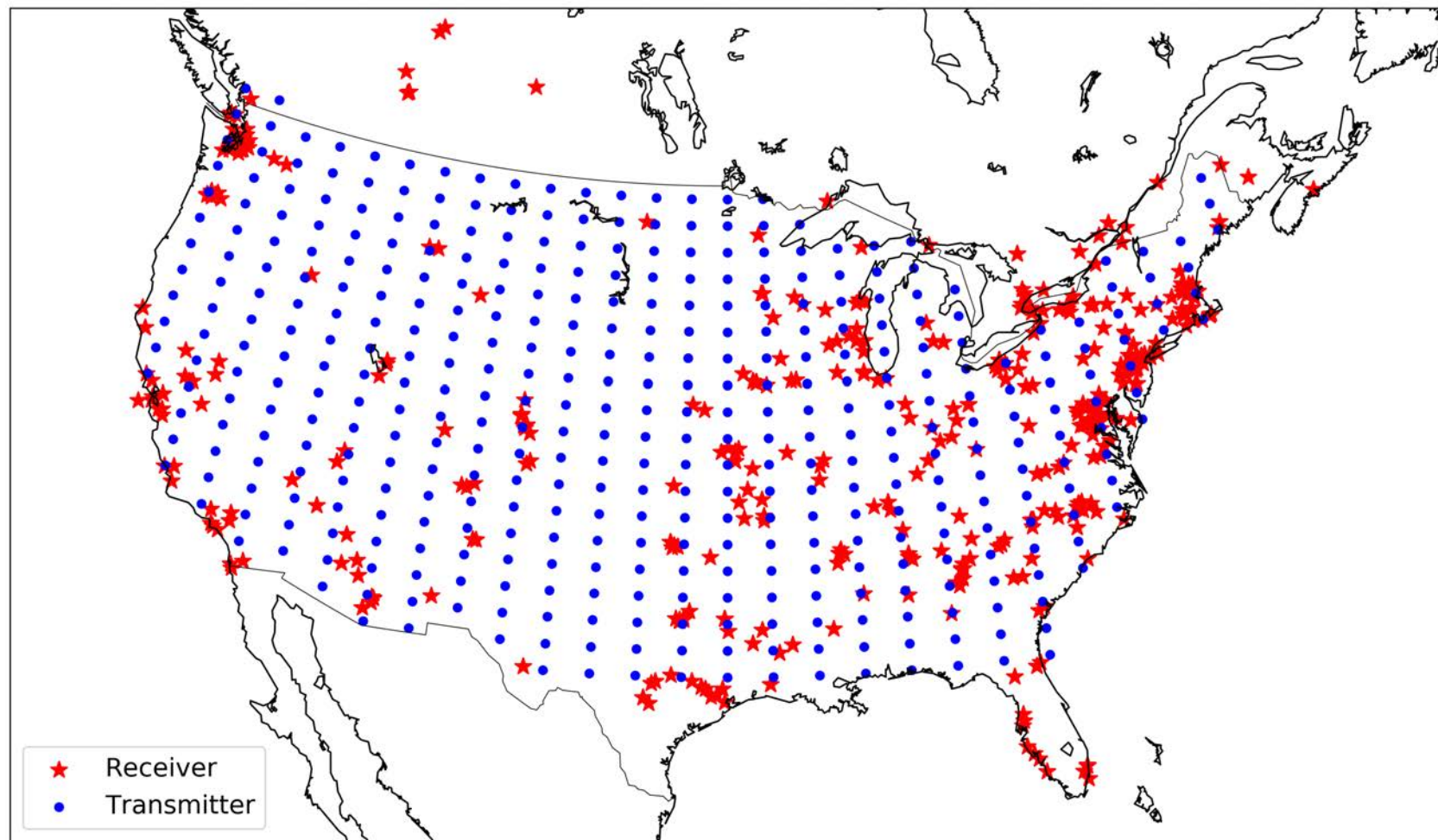
- NRL SAMI3 Ionosphere
- PHaRLAP Raytrace Toolbox
- 7 MHz
- TX: AC4PA, Georgia
- RX: WE9V, Wisconsin

Eclipsed



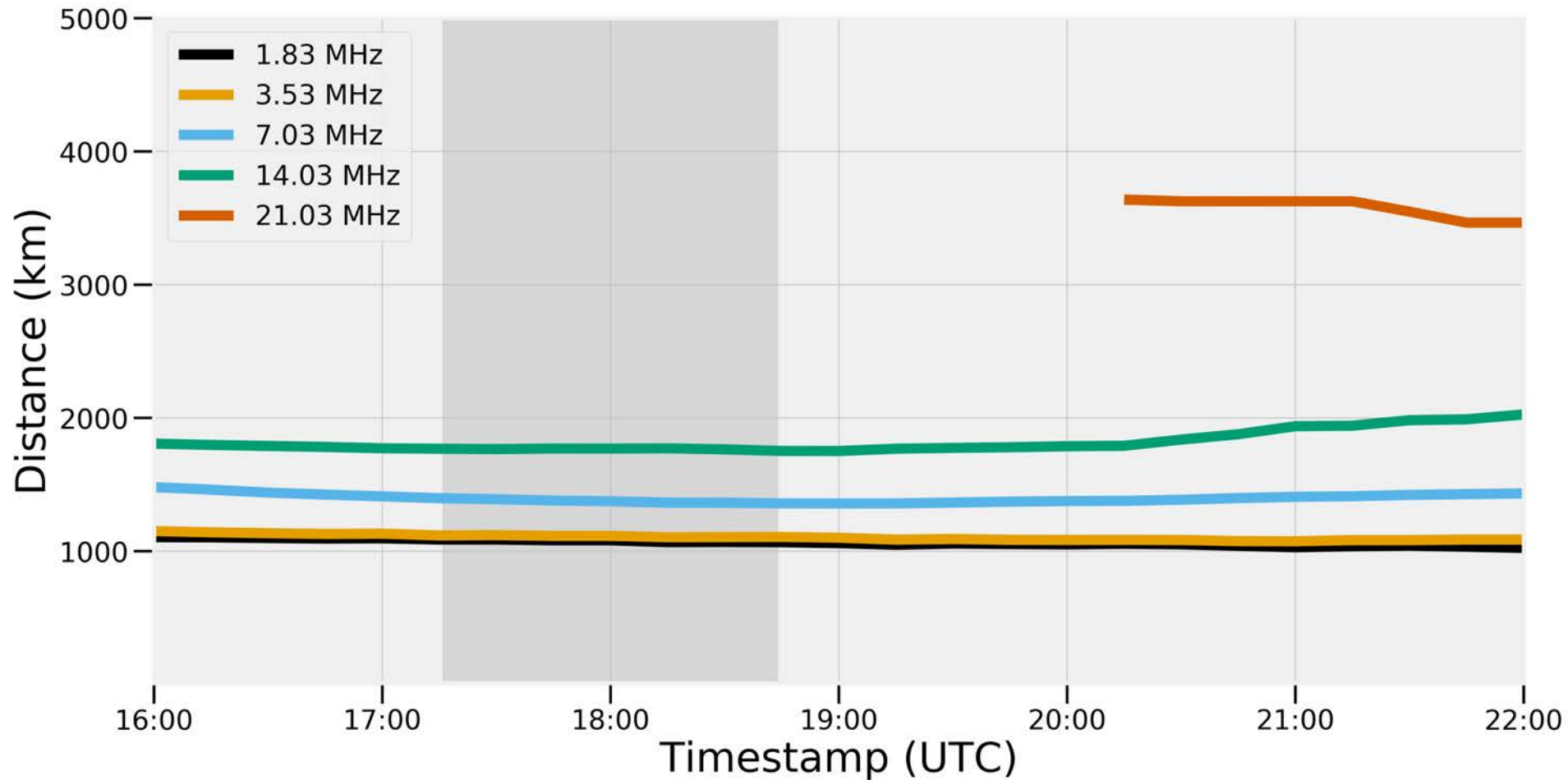
SEQP Raytrace Simulation

Location of Simulated Stations



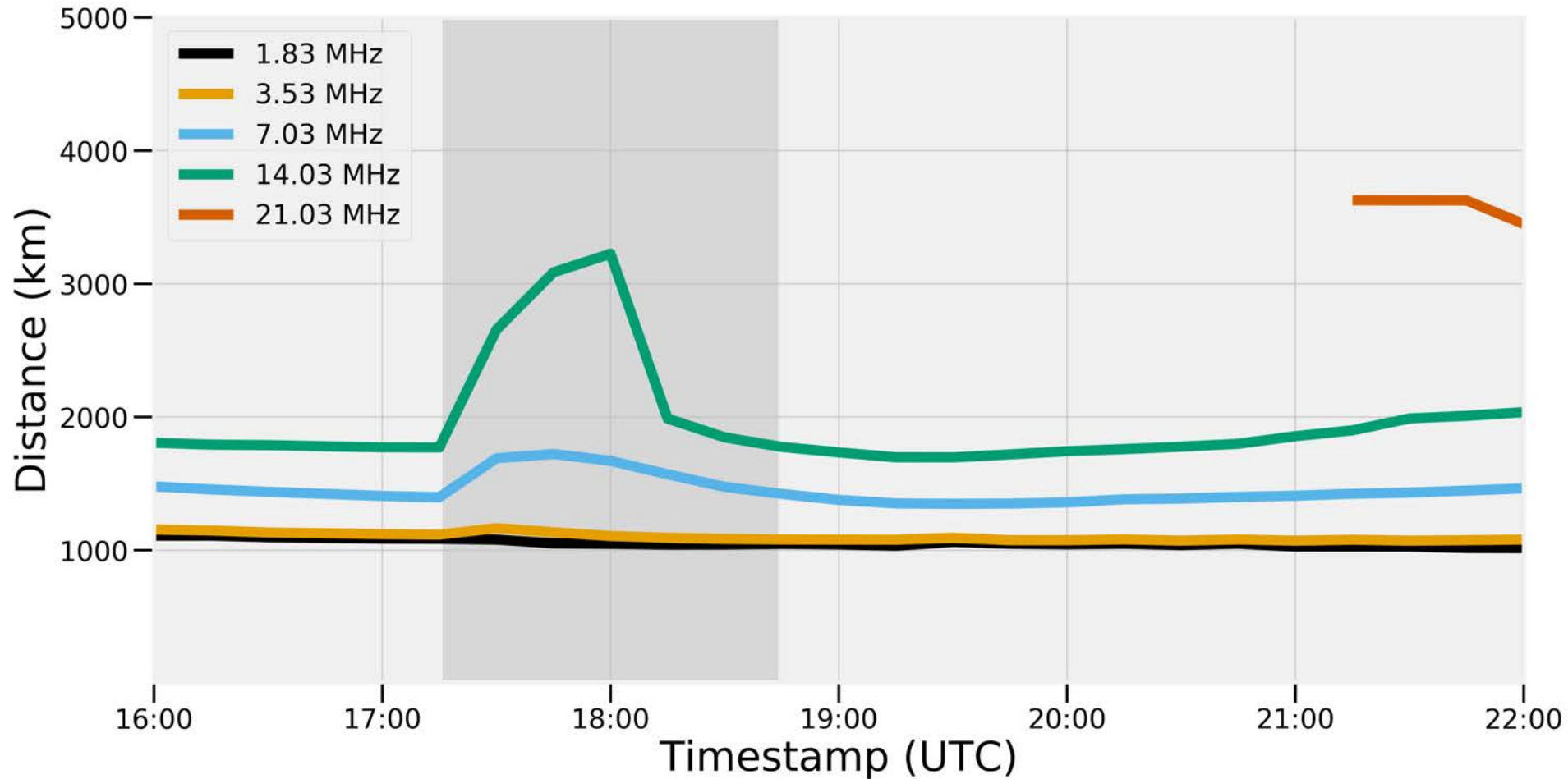
Non-Eclipse Simulated Skip Distance

Simulated Median "Hop" Ground Distance (Base)



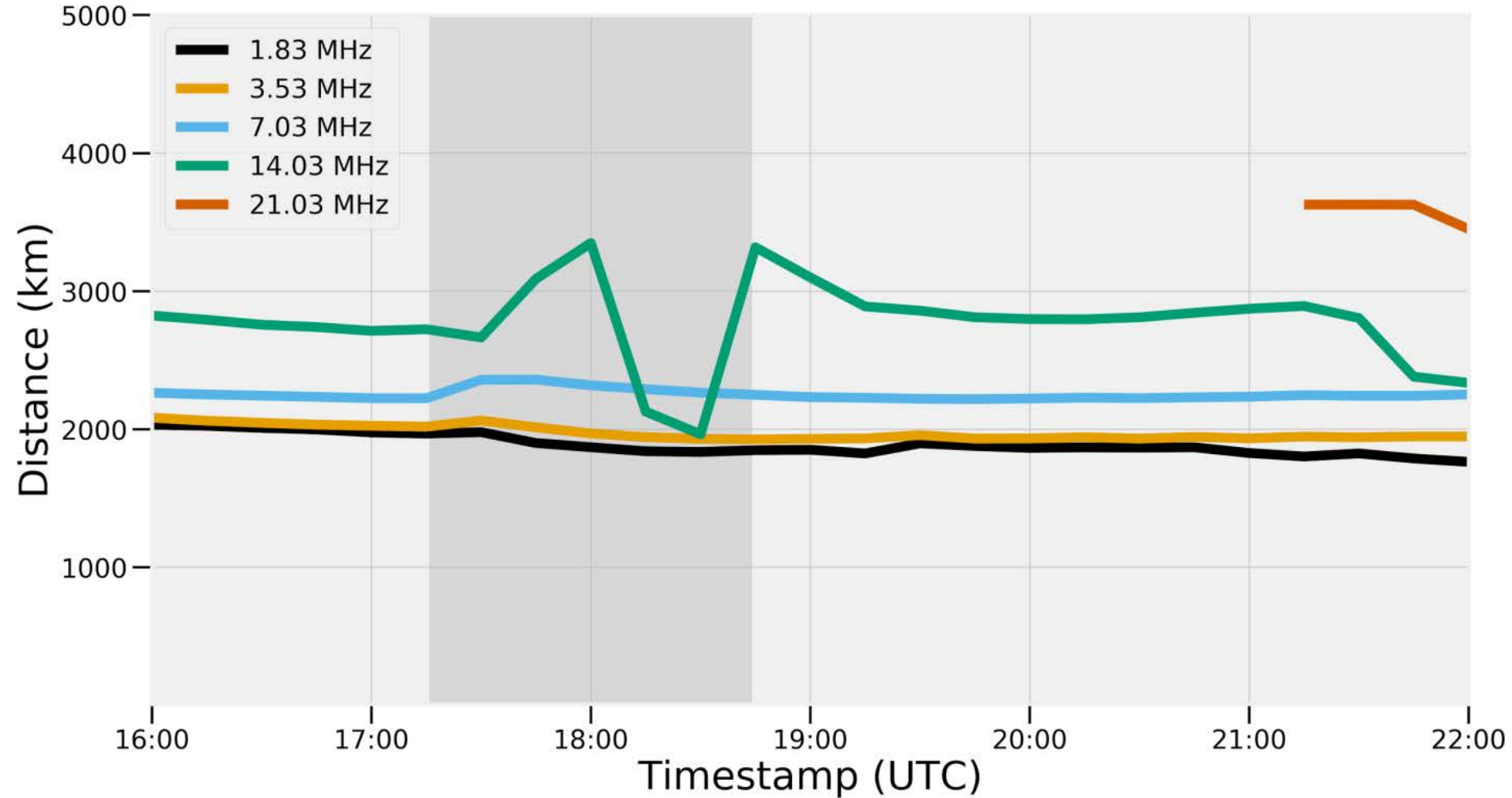
Eclipse Simulated Skip Distance

Simulated Median "Hop" Ground Distance (Eclipse)



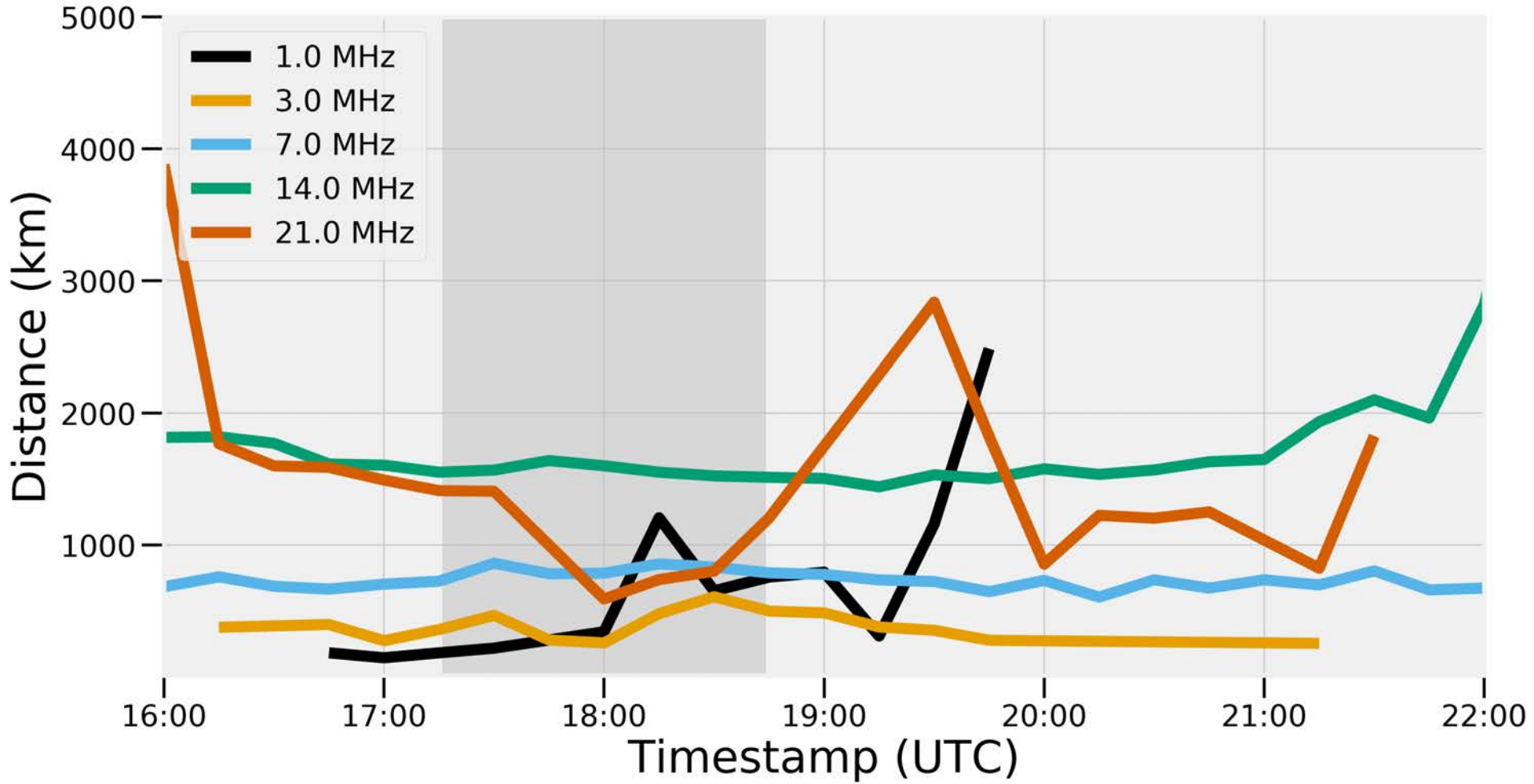
Eclipse Simulated QSO Distance

Simulated Median QSO Distance (Eclipse)



SEQP Observed Median QSO Distance

SEQP Median QSO Distance



Summary

- **Ham Radio Science Citizen Investigation**

- An organization that allows university researchers to collaborate with the amateur radio community in scientific investigations.

- **2017 Total Solar Eclipse**

- Shadow of eclipse stops ion production in ionosphere
- Amateurs observed Doppler Shifts, Phase Shifts, and Amplitude changes in WWV, WWVB, and AM radio station reception.
- SEQP observations suggest raising of the F layer and depletion of the D layer.

Special Thanks

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- Ethan Miller, K8GU
- Magda Moses, KM4EGE
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References and Acknowledgments

Huba, J.D. and D. Drob, “SAMI3 prediction of the impact of the 21 August 2017 total solar eclipse on the ionosphere/plasmasphere system,” *Geophysical Research Letters*, vol. 44, 2017.

The results published in this paper were obtained using the HF propagation toolbox, PHaRLAP, created by Dr Manuel Cervera, Defence Science and Technology Group, Australia
(manuel.cervera@dsto.defence.gov.au). This toolbox is available by request from its author.

K2MFF – The NJIT Amateur Radio Club



HamSCI Workshop at NJIT

Friday, Feb. 23 – Saturday, Feb. 24, 2018

New Jersey Institute of Technology

Newark, NJ

HamSCI



We welcome papers and presentations on
2017 Eclipse Ionospheric Effects using
Amateur Radio and related data.

Watch hamsci.org and ARRL news for details.

Thank you!
