NJIT New Jersey Institute of Technology

HamSCI

HamSCI and the 2017 Total Solar Eclipse

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Outline

I. What is Ham Radio & HamSCI?

II. Eclipse Experiments
   I. 2017 Total Solar Eclipse & The Ionosphere
   II. Ham Radio Data Sources
   III. Observations

III. Summary & Conclusions

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Amateur/Ham Radio

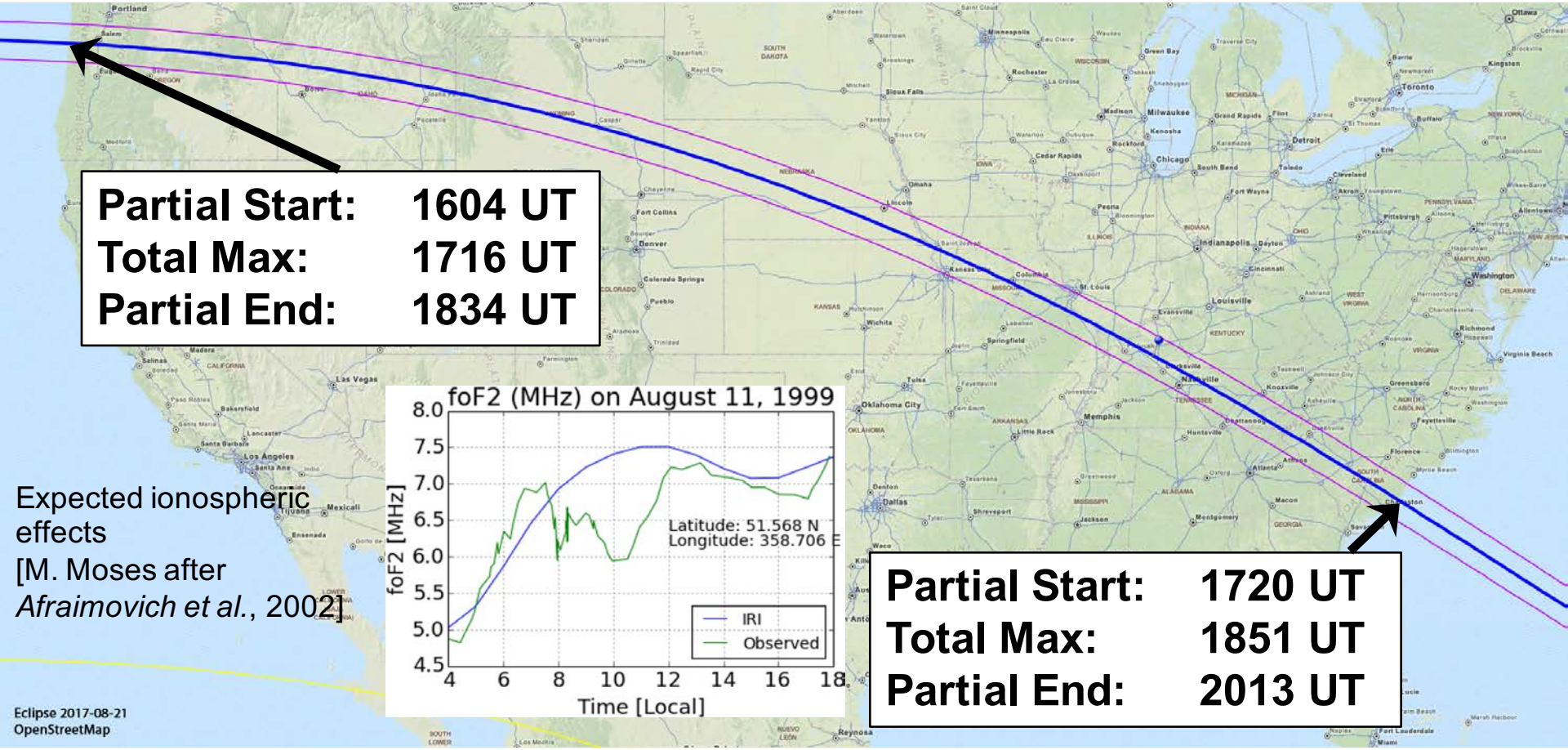
- Hobby for Radio Enthusiasts
  - Communicators • Builders • Experimenters
- Wide-reaching Demographic, Technically Able
  - All ages & walks of life
  - Over 730,000 US hams [http://www.arrl.org/arrl-fact-sheet]
  - ~3 million World Wide

- Hobbyists routinely use HF-VHF transionospheric links.
- Often ~100 W into dipole antennas.

Frequency	Wavelength
1.8 MHz	160 m
3.5 MHz	80 m
7 MHz	40 m
10 MHz	30 m
14 MHz	20 m
18 MHz	17 m
21 MHz	15 m
24 MHz	12 m
28 MHz	10 m
50 MHz	6 m

Total Solar Eclipse

21 August 2017



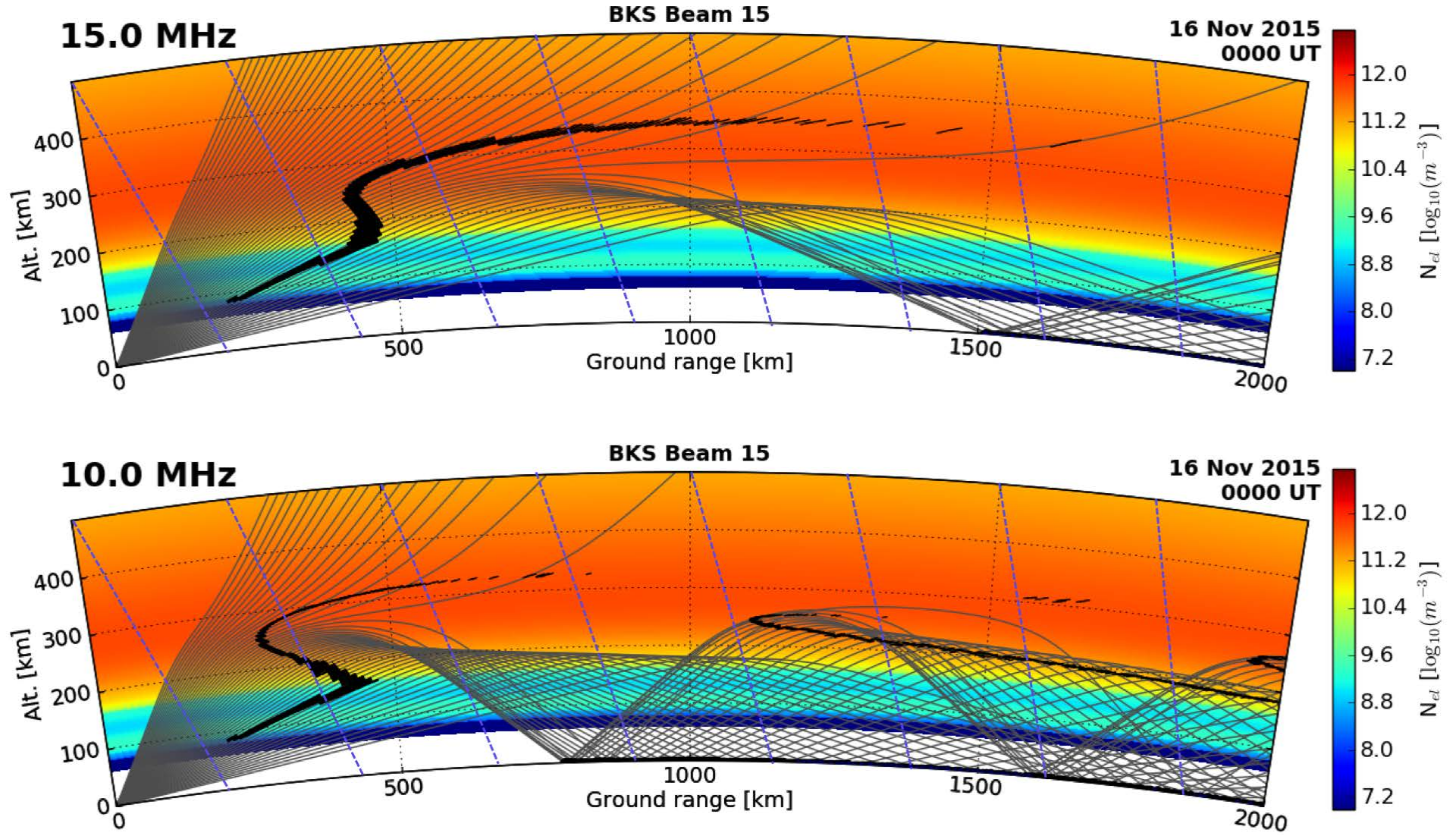
Expected ionospheric effects
[M. Moses after *Afraimovich et al.*, 2002]

Figure: W. Strickling, Wikipedia

HamSCI Eclipse Research Questions

- What are the temporal and spatial scales of eclipse-induced ionospheric effects?
- How does the eclipse affect HF propagation?

HF Propagation & The Ionosphere

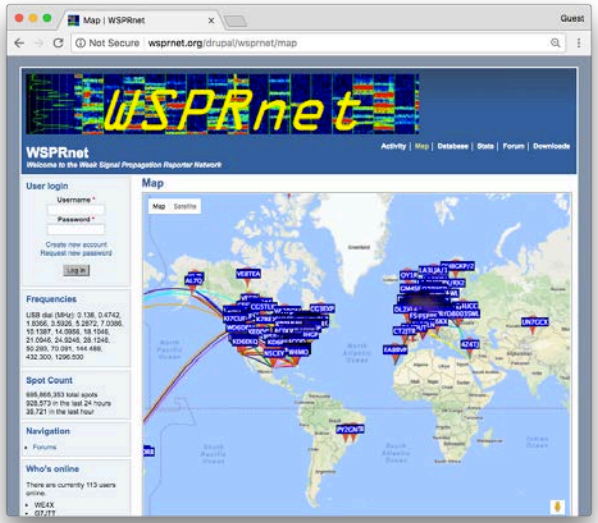


Solar Eclipse QSO Party (SEQP)

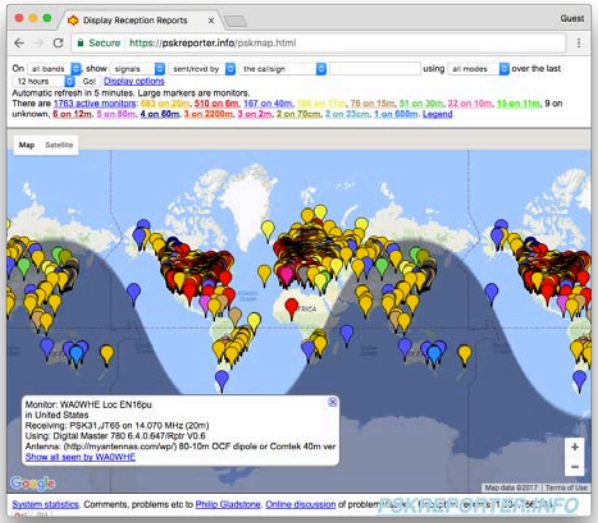
- Ham Radio Contest-Like Event
- Generate a quasi-random dataset
- Point-to-point contact (QSO) data from *automatic* [RBN, PSKReporter, WSPRNet] and *manual* sources [Logs]

SEQP Observations

RBN
reversebeacon.net



WSPRNet
wsprnet.org



PSKReporter
pskreporter.info

Observations from 21 August 2017 1400 – 2200 UT

Network	# Spots / QSOs
RBN	618,623
WSPRNet	630,132
PSKReporter	1,287,855
Participant Logs	31,151

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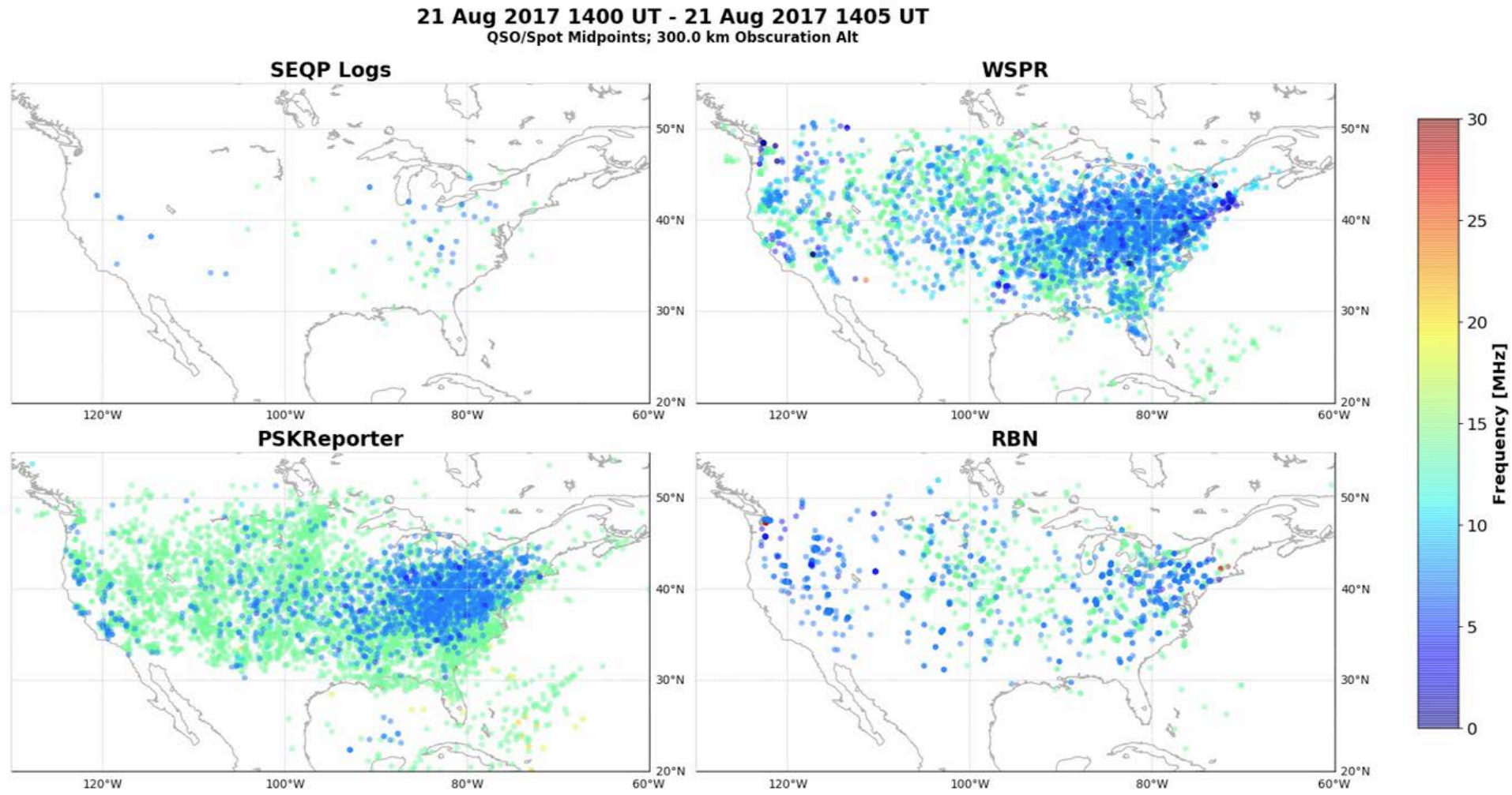
Solar Eclipse QSO Party

- 593 parsed logs
- 31,151 QSOs
- 5,045 unique callsigns
- 656 4-char grid squares
- 81 DX Entities

(from logs submitted to hamsci.org)

Ham Radio Eclipse Data



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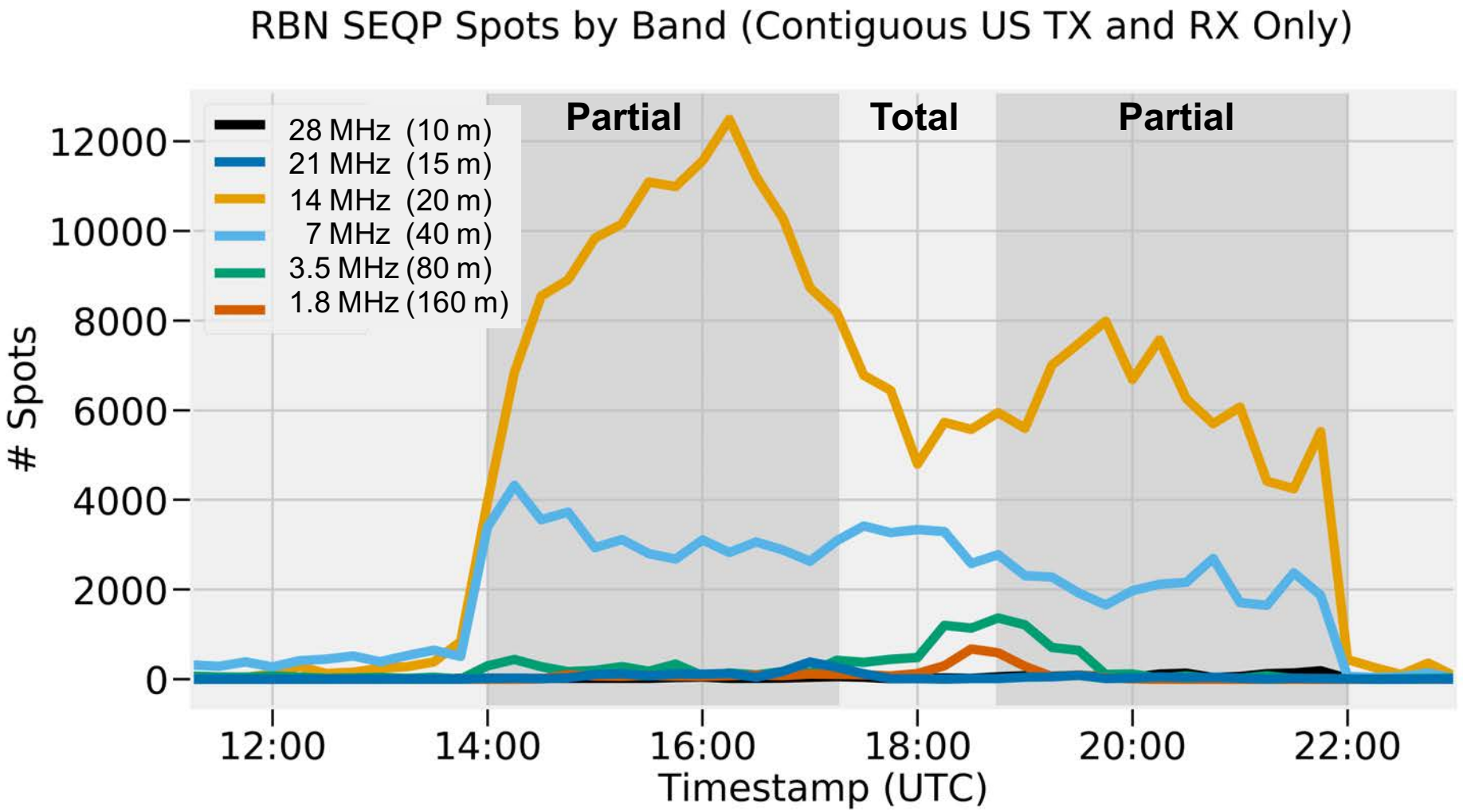
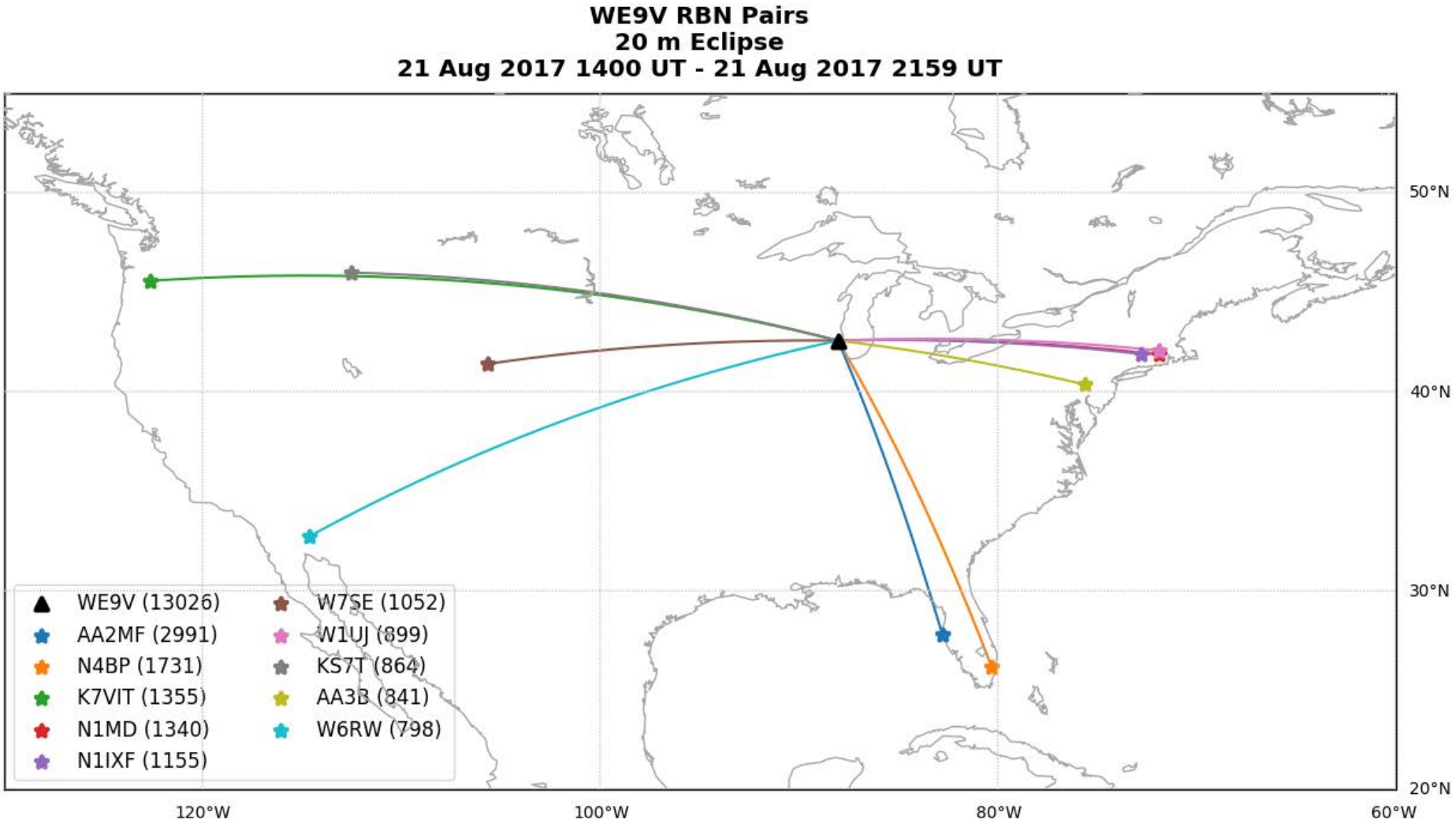
SEQP RBN Spots



WE9V 14 MHz RBN Rx, Wisconsin

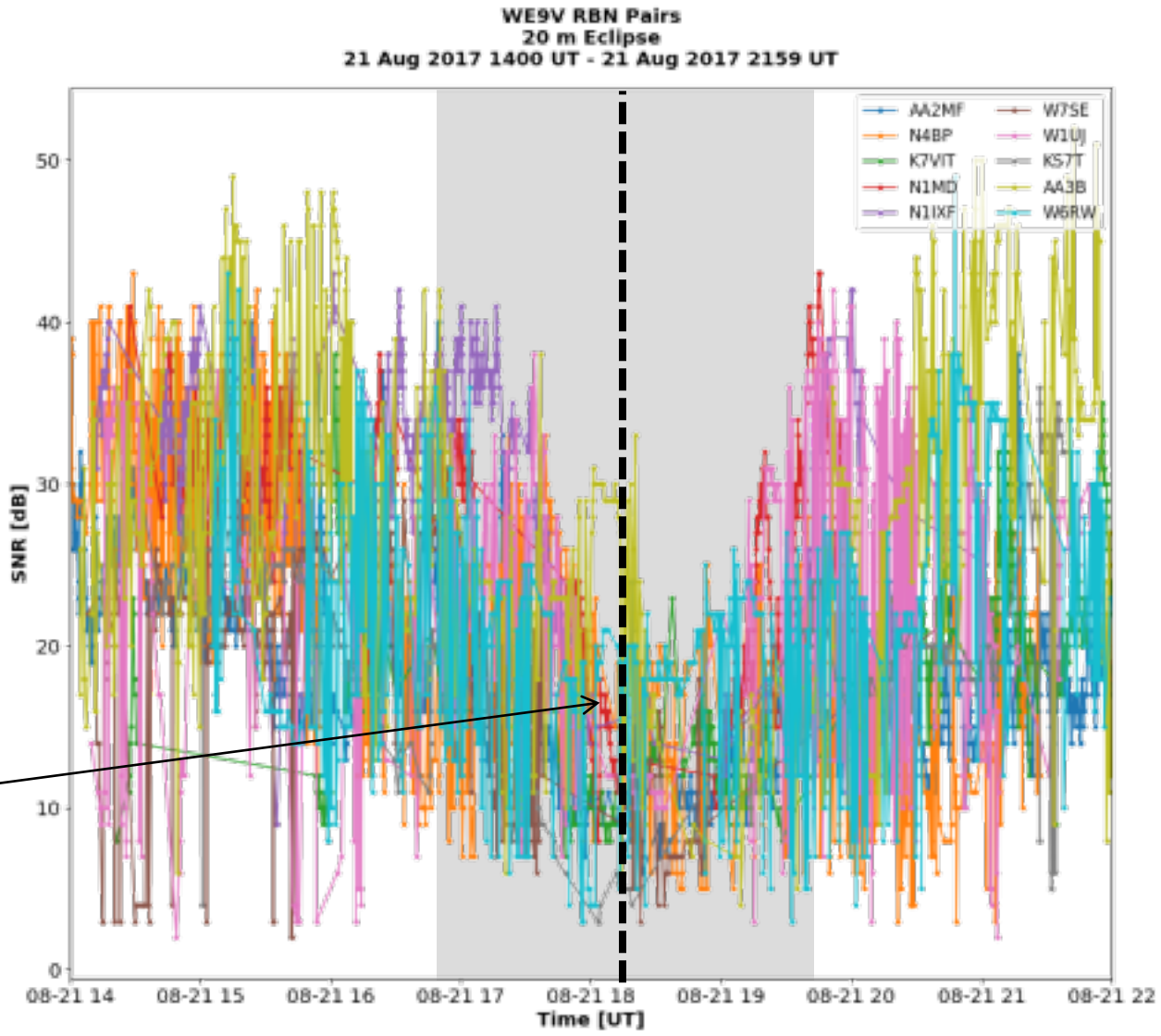


WE9V 14 MHz RBN Rx, Wisconsin

Ground Eclipse Times
Bristol, WI:

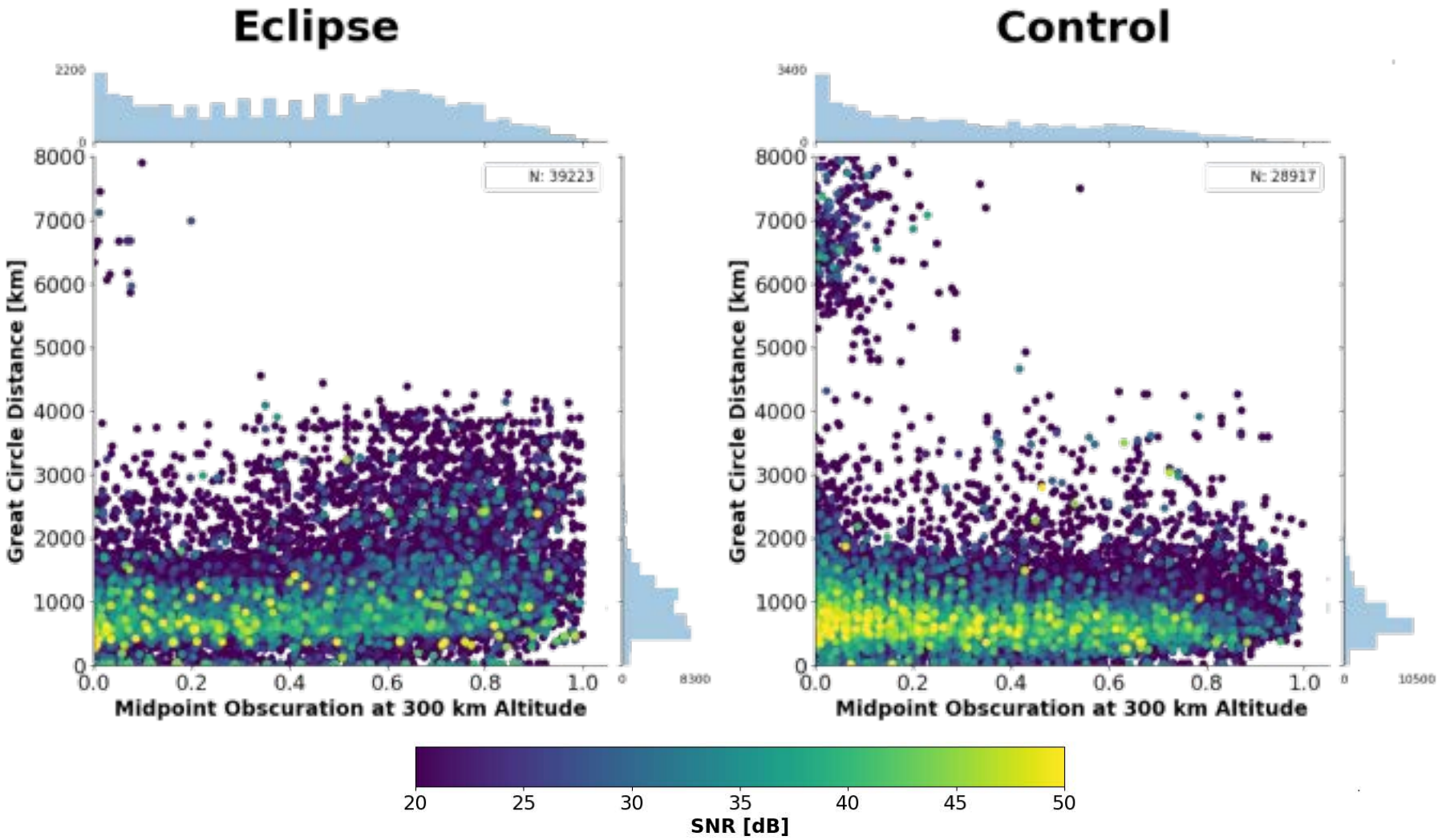
- Start partial: 1653 UT
- Max: 1818 UT
- End partial: 1940 UT

Clear drop in 20 meter propagation during temporary 'nighttime' conditions



7 MHz RBN:
Great-Circle Range vs Obscuration

7 MHz



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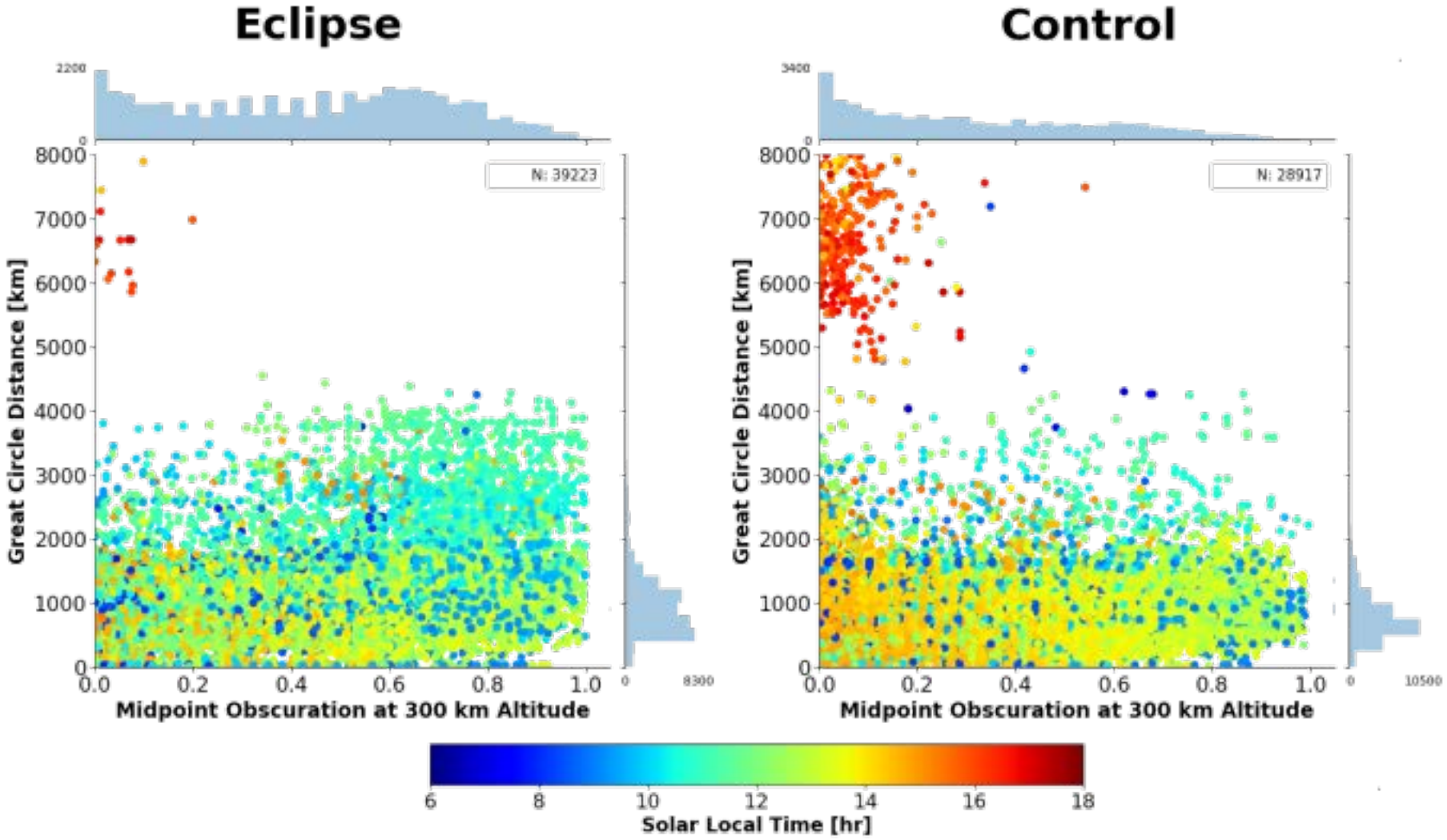
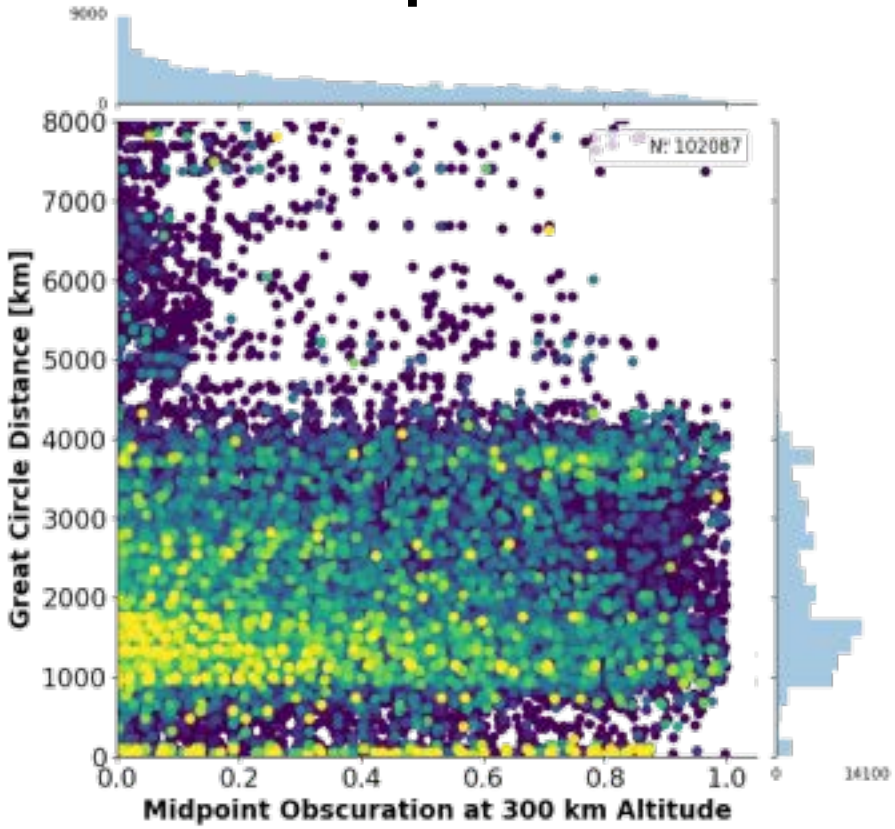


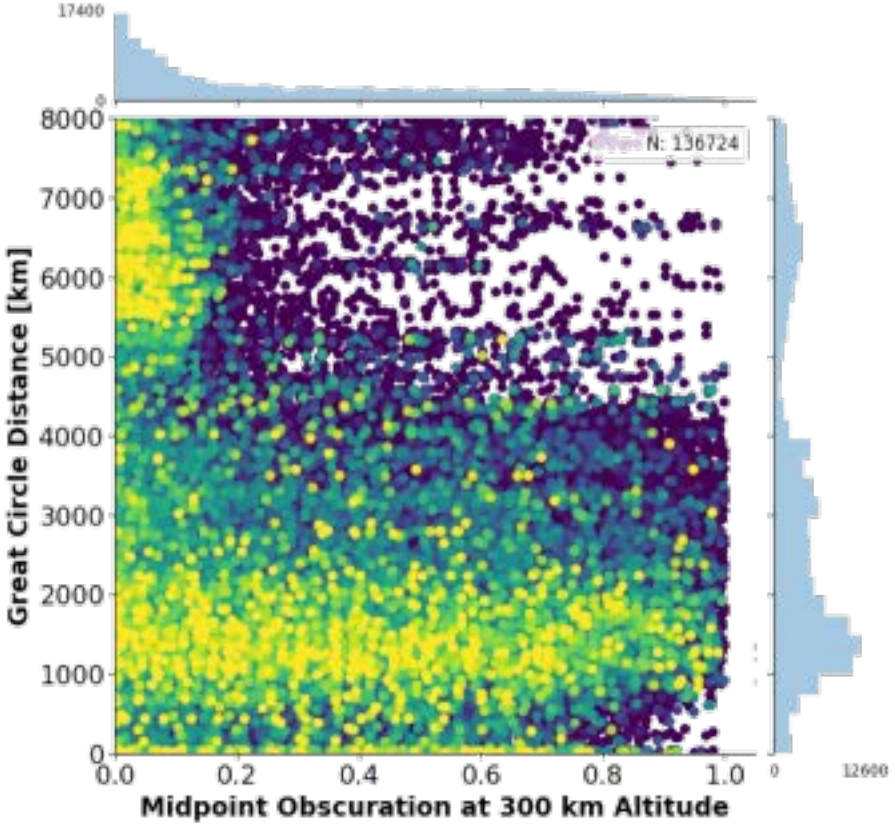
14 MHz RBN:
Great-Circle Range vs Obscuration

14 MHz

Eclipse



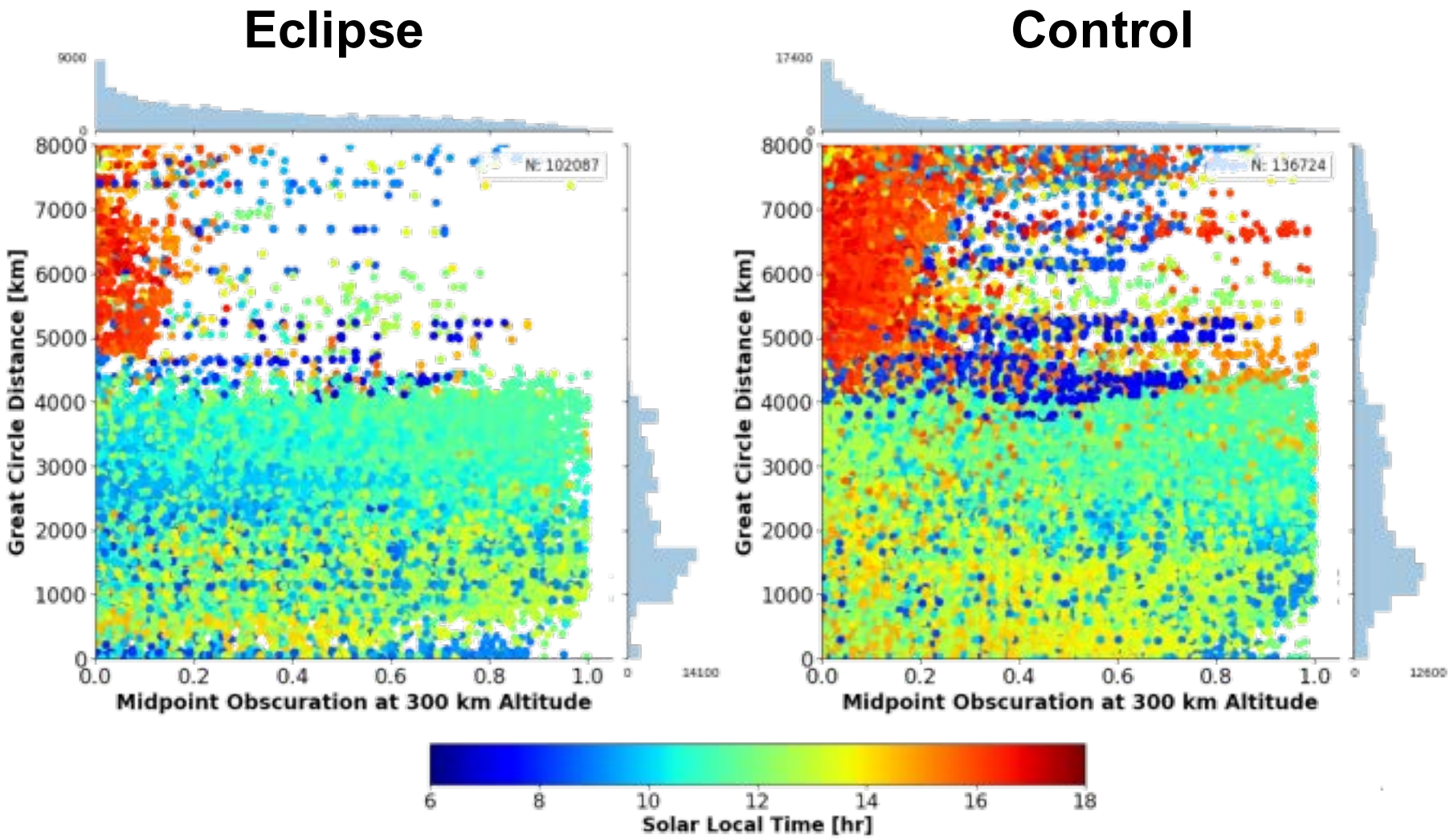
Control



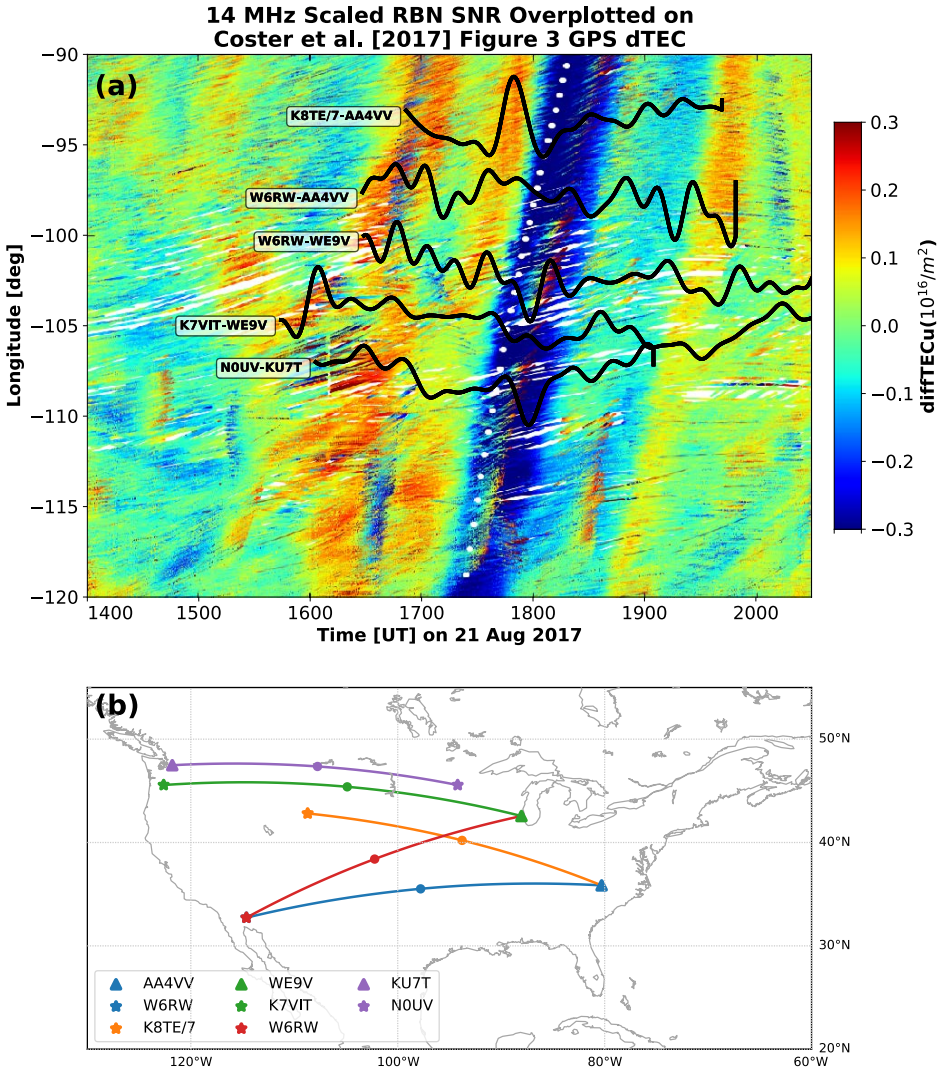
SNR [dB]

14 MHz RBN:
Great-Circle Range vs Obscuration

14 MHz



RBN SNR and GPS TEC Waves



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Summary & Conclusions

- **Ham Radio Science Citizen Investigation**
  - An organization that allows university researchers to collaborate with the amateur radio community in scientific investigations.
- **2017 Solar Eclipse QSO Party**
  - Number of HF Spots During Eclipse
    - Increases on 1.8 to 7 MHz.
    - Decreases on 14 MHz
  - With increasing obscuration
    - 7 MHz path length increases
    - 14 MHz SNR decreases; second-hop propagation goes away.
  - This shows temporary “night-like” propagation conditions of the ionosphere.

Thank you!

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References

Afraimovich, E.L., E.A. Kosogorov, O.S. Lesyuta (2002), Effects of the August 11, 1999 total solar eclipse as deduced from total electron content measurements at the GPS network, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 64, Issue 18, Pages 1933-1941, ISSN 1364-6826, http://dx.doi.org/10.1016/S1364-6826(02)00221-3.

Bamford, R. (2000), Radio and the 1999 UK Total Solar Eclipse, Rutherford Appleton Laboratory, Chilton, Didcot, UK.