VLF/LF and the 2017 Total Solar Eclipse

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I. Historical Overview

II. Collection Effort

III. Conclusions
Historical Perspective

• Spatial and temporal effects of solar eclipses on radio wave propagation continue to be of interest almost 100 years after the first reported study.

- During the eclipse on April 17, 1912, William Henry Eccles (1875 – 1968), a prominent British electrical engineer and scientist, recorded discharges – clicks – strays.

- Wavelength 5,500 meters (frequency approximately 54.545 kHz)

- Published in Nature\(^2\), 1912


Marconi Transatlantic Station located at Clifden

Rough time integral of the intensity and duration of strays

"Even the Lord's Justices temporarily adjourned their sittings at the Law Courts in order to witness the unusual event."
Other 1912 Solar Eclipse Studies

- The 1912 solar eclipse was also studied in France and Denmark, using the transmitter at the Eiffel Tower in Paris. The transmitter had a frequency of 115 kHz (wavelength approximately 2,608 meters). The UK study was done at 54.545 kHz and the French and Danish studies were done at 115 kHz, difficult for data comparison.

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101. Wireless Telegraphy Measurements at Marburg and Graz during the Recent Eclipse of the Sun. E. Takie and M. Vos. (Deutsch. Phys. Gesell., Vorb. 14. 11. pp. 697-949, Sept. 30, 1912)—During the recent eclipse of the sun on April 17, the authors independently measured the strength of the received currents at Marburg and at Graz, respectively 800 km. and 1000 km. from Paris. The measurements at Marburg were effected by means of a galena detector and a moving-coil galvanometer having a sensitiveness of $4 \times 10^{-9}$ amp, and a periodic time of 4 secs. The Eiffel Tower station sent out groups of six dashes lasting 10 secs. and divided by 10-sec. intervals. Between each dash the galvanometer was rapidly brought to rest by a short-circuiting key. The arithmetic mean of the six readings was taken, and the results are embossed in a curve in the original article. The eclipse attained its maximum in Paris at 1.10 p.m., and in Marburg at 1.21 p.m., and at the latter place was nearly total. The max. received current was recorded at the middle point between the times given above. During the eclipse no atmospheric disturbances took place. At Graz an aperiodic moving-coil vol. xvi.—b.—1918.

Galena and Galvanometer detector
Wolverhampton Grammar School

France Info - 711 kHz

Time is local time and amplitude is in S units$.^5$.
BCB during the 1999 eclipse

Plot of the variation in the received CW radio signal as recorded in the Birmingham RA Regional Office in the UK of the 1440 kHz (±1.4 kHz) carrier emanating from Radio Luxembourg at Marnach (a) for the morning of the total solar eclipse and (b) the morning after the eclipse.
75 kHz reception 1999 solar eclipse
Eclipse Mob Consortium

• The 2017 Total Solar Eclipse will provide an excellent opportunity to observe propagation interaction with the ionosphere across the continental U.S.
  • A crowd-source collection of signals across a number of different short, medium and long-paths.
  • Signals will be collected before, during and after the total eclipse.
  • Amplitude changes reported at each location.
  • Goal: Disseminate large data collection across the scientific community.

Tools for collection are available at <http://eclipsemob.org>
DIY Eclipse Mob Kits and Instructions

Antenna design with step-by-step instructions

Available receiver kits
100 kits distributed, more ordered ▼ Integration

Basic designed based on [8]
Colorado WWVB Transmitter

US Government Time and Frequency Transmitter at 60 kHz

Images from NIST.gov
Coverage Plots

• WWVB Coverage Plots during day and night

Image Nist.gov
Conclusions

In the past, many studies investigated radio wave and solar eclipse interactions.

A number of tools and methodologies exist today to perform improved studies.

This presentation outlined the EclipseMob effort to be undertaken during the August 21, 2017 solar eclipse.

We welcome participation!

EclipseMob.org
Notes and references

[1] Fellow of the Royal Society, President of the Physics Society, President of the Institute of Electrical Engineers and President of the Radio Society of Great Britain


[3] Images from de.wikipedia.org


