Crowdsourced Lessons Learned from the 2017 Solar Eclipse LF Exercise

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What is the EclipseMob project?

Crowdsourced effort to conduct a large-scale LF radio wave propagation experiment during 2017 solar eclipse.

Why? Crowdsourcing affords a large enough dataset for meaningful analysis.
Colorado WWVB Transmitter

US Government Time and Frequency Transmitter

Operates at 60 kHz

Always Transmitting!

The WWVB antenna is here.
WWVB Coverage*

Daylight Coverage Area

Nighttime Coverage Area

* This depicts coverage as “heard” by a tiny clock antenna.
Radio Luxembourg (1440kHz) recorded at Birmingham

Dawn

The eclipse

Radio Luxembourg (1440kHz) recorded at Birmingham

Dawn

Normal day
Project activities

**Designing** receiver systems/software (require little previous knowledge or tools) and **providing** kits

**Creating** web portal (resources, forum, collect data): EclipseMob.org

**Designing and sharing** K-12 lesson plans

Educational Webinars (with the Geological Society of America)

Public engagement events (libraries, museums, etc.) to **recruit & support** others to build/test
Project reach

- **150** kits delivered
- Additional participants designed/built their own receiver systems
- **80+** people follow the EclipseMob Facebook page
- Over **100** views on EclipseMob forum posts
- Over **7000** hits on EclipseMob.org
DIY Eclipse Mob Kits & Instructions

Antenna design with step-by-step instructions

Available receiver kits (Free!)

Integration
ANTENNA WITH/WITHOUT CAPACITOR

Movie courtesy of George Lemaster
**Files Formats**

**JSON Files**

```json
{
    "createdAt": "Aug 21, 2017 2:35:39 PM",
    "duration": 572.859,
    "id": "e98110fe-d70e-4735-a70a-4e00471fd328",
    "latitude": 26.xxxxxxx,
    "longitude": -80.xxxxxxx,
    "size": 50520064
}
```

**Date File**

- wav format mono with sampling rate
Spectrum Showing 18.2 kHz Signal
Design challenges:

- Student design group participation unreliable; required additional expertise
- Receiver designs didn’t meet usability needs or failed testing; including post release
- Problem with the app-receiver interface, extracting the signal has proven to be a challenging signal processing problem.

Key takeaways:

- Be prepared to seek outside help if needed
- Test, retest, retest equipment before releasing
Recruitment/Participation Challenges:

- Recruitment timeline primarily dependent on resource material availability
- Eclipse date limited # of potential class participants
- Participant data collection dependent on having kits/materials, help testing, and app to test before eclipse event
- Participants needed more on site support than we had capacity to provide before/day of experiment

Key takeaways:

- Have a working system and apps available BEFORE recruiting
- Don’t estimate release dates
- Maintain frequent and ongoing communications via email, social media, and Q&A events

Remote & on site Q&A Event at GMU Mix Space (Aug. 2017)
Data challenges:

• Due to a problem with the app-receiver interface, the WWVB signal strength is lower than we anticipated, so detecting and extracting the signal has proven to be a challenging signal processing problem.

• If data issue is unresolvable, how do you communicate experiment failure to citizen scientist participants in a way that minimizes negative attitudes towards STEM and the scientific community?

Key takeaways:

• Test, retest, retest before running experiment

• Be prepared to explain the value of work and contributions—designate a public relations person
Questions?
EclipseMob.org

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