Evaluation of CODAR Tsunami Software

Isa Judd [1], Luis A. Rodriguez-Mendoza [1], Hugh Roarty [2]
Rutgers University [1]; RU COOL [2]

Abstract

Tsunamis are a leading cause of death and destruction among natural hazards. High Frequency (HF) radars are a key technology to save lives from nature's threats such as tsunamis by providing early detection of any oncoming waves. Our research aims to improve the algorithms that have been developed by CODAR Ocean Sensors, a private company based in Mountain View, California for the detection of tsunami waves with High Frequency Radar. Rutgers has worked with CODAR by retrieving and analyzing data from four HF radar stations in New Jersey that collect sea state information. The statistics from the tsunami detection data were compared with electromagnetic noise data, water level and nearby wind measurements for correlation. We have noticed some recurring patterns in the data, one of which was that the occurrences for high q-factor values increased with the noise floor measurements of the radar. This will require that the algorithm or radar hardware will need to be adjusted in order to detect a weak tsunami like the one that struck New Jersey in 2013.

Background

Starting in July 2016 Rutgers began collaborating with CODAR Ocean Sensors, Ltd. to refine the SeaSonde HF radar (See above) outputs that will provide useful warnings of approaching tsunamis off U.S. coasts. CODAR has over 500 stations collecting real-time ocean wave data.

Methods

(All data collection was repeated for stations: Bradley Beach, Brant Beach, Brigantine, Loveladies)

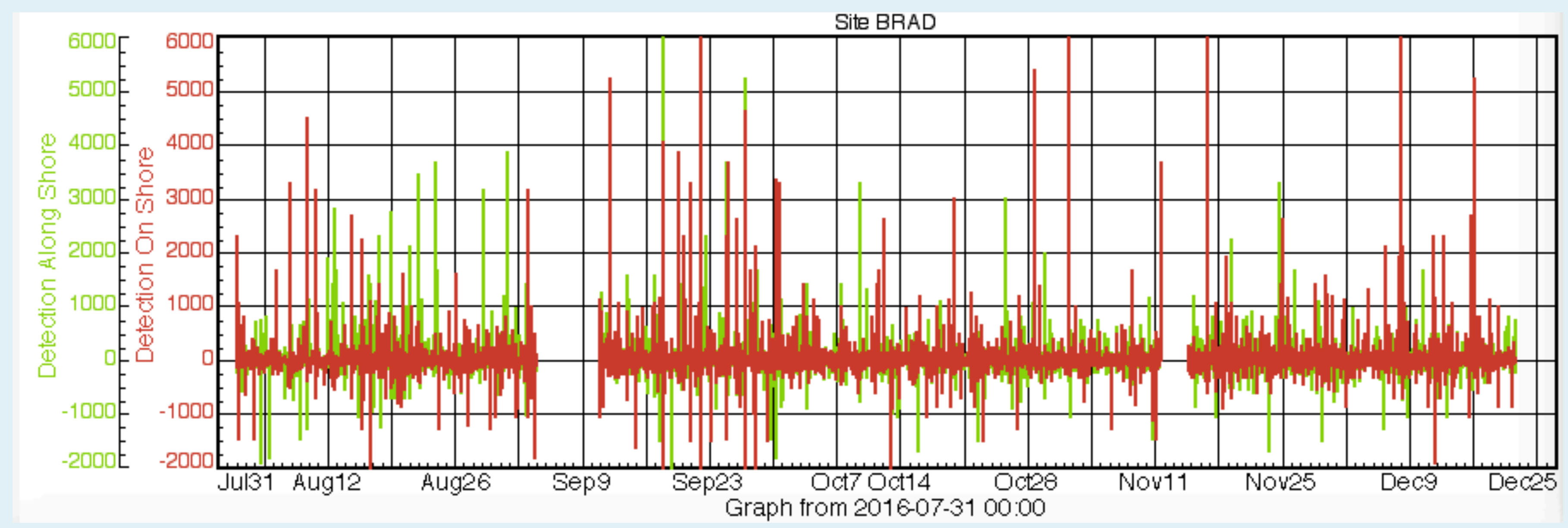

FIG 1: Time series graph of onshore (red) and alongshore (green) Q-Factor values from HF radar station in Bradley Beach, NJ. Time ranges from June 2016 to December 2016.

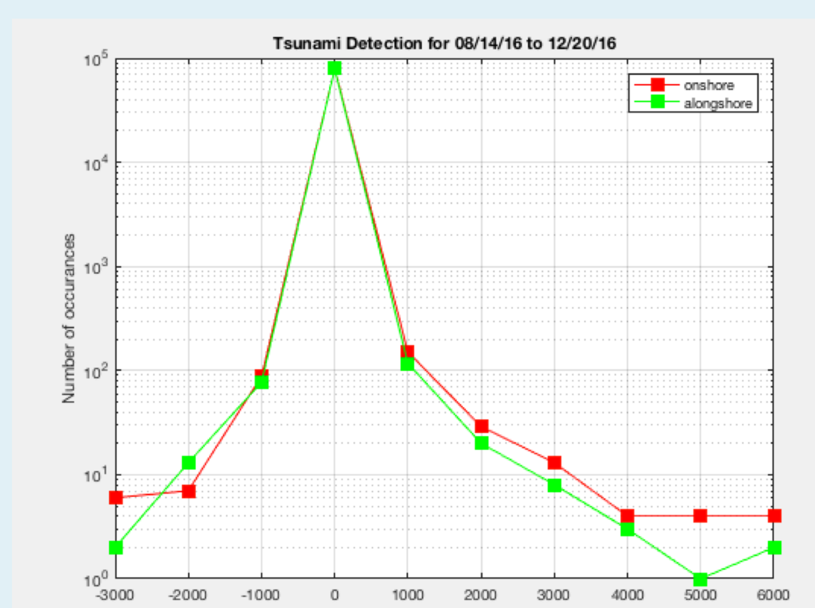

FIG 2: Histogram for Q-factor data from Bradley Beach, NJ from Figure 1. The number of occurrences are plotted on a logarithmic scale.

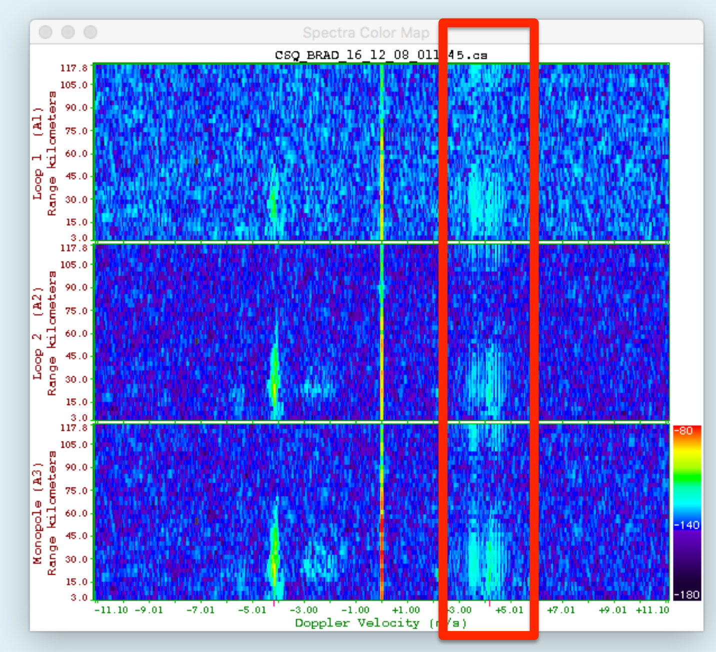

FIG 3: Spectra map of data from Bradley Beach, NJ to check if there were any sources of interference that correlated with spikes in Q-factor values.

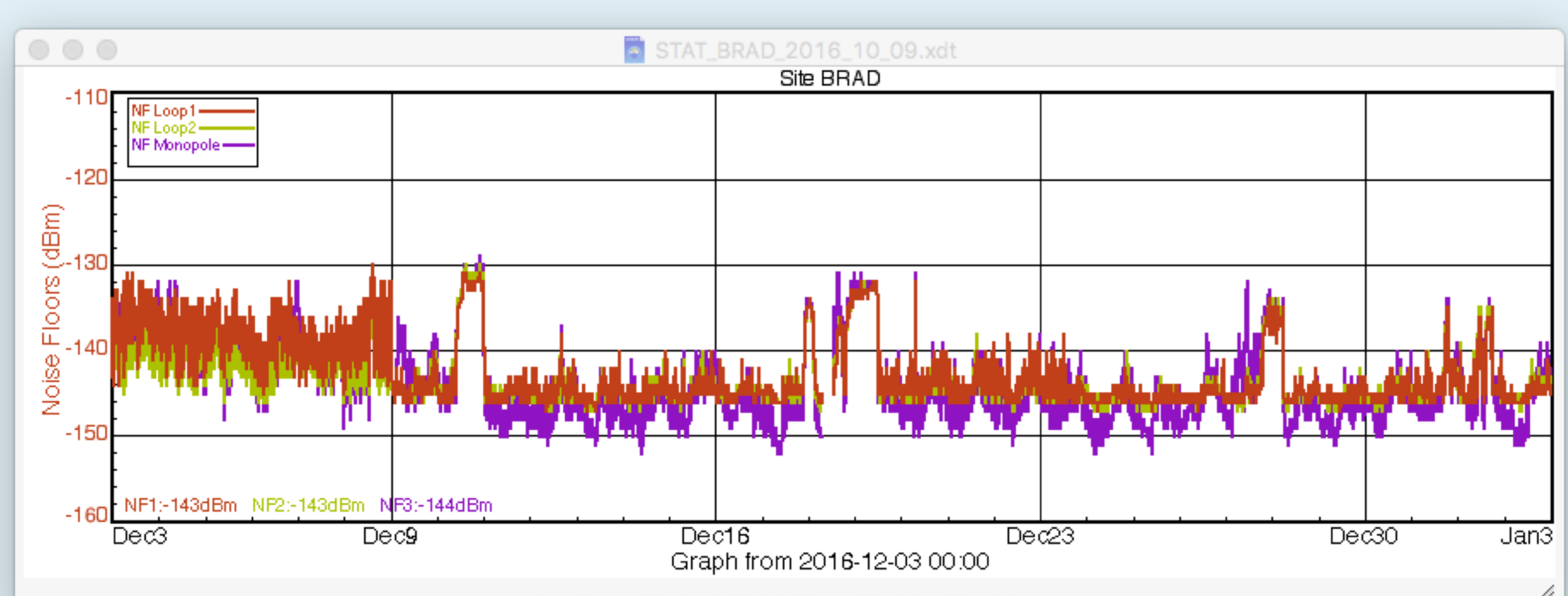

FIG 4: Time series plot of the noise floor data from station Bradley Beach. This was performed in order to analyze the frequency of noise floor jumps that were signified by interference as shown in *FIG 3.*

2013 Meteotsunami

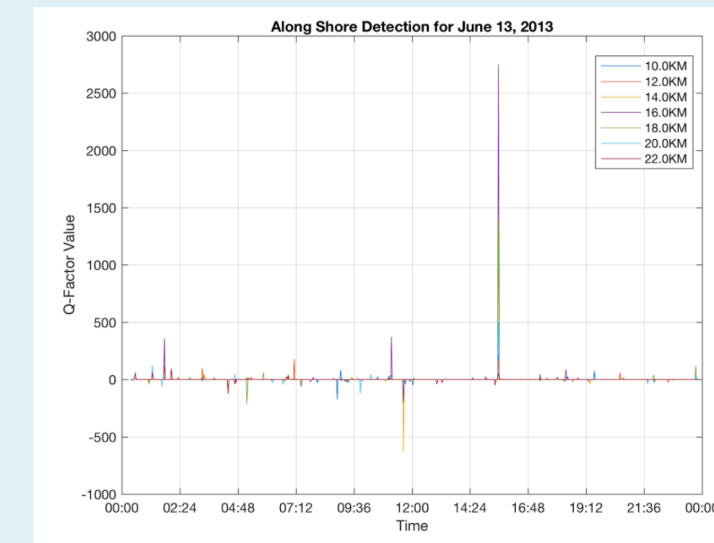

FIG 5: Q-factor values from Brant Beach for June 13, 2013. The spike of 2,750 around 15:00 GMT corresponded with the meteotsunami.

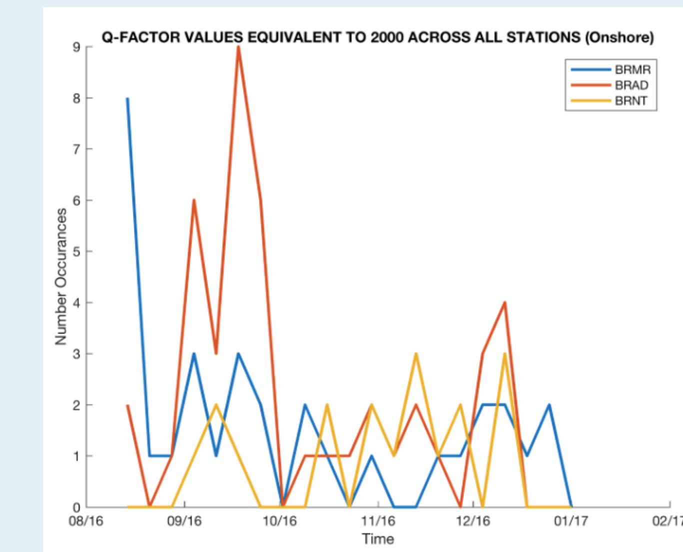

FIG 6: Number of weekly Q-Factor values >2,000 from August 2016 to February 2017 for three of the radar stations.

Results

- **"Q-factors"**
  - Values greater than 6000 were considered false alarms
  - No established threshold to accuracy detect tsunamis
  - On average, 2 values per week similar to 2013 meteotsunami
- **Spectra Map**
  - Any activity on noise floor was a direct result of multiple factor, ranging from: Thunderstorms, passing objects, or outside radio signals.

Future Directions

We will continue to record Q-factor values and compare the measurements to the 2013 meteotsunami. In addition, we will analyze if the false alarms are triggered across all radar stations or are they isolated to individual stations. Then we will be better able to determine a suitable Q-factor threshold for tsunami detection.

Acknowledgement

We would like to thank:
- Hugh Roarty for providing this research opportunity and support throughout project
- CODAR Ocean Sensors