Wind Speed and Seismic Motion Data Analysis

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Introduction

The Laser Interferometer Gravitational Wave Observatory (LIGO) was developed to exploit Einstein's prediction of gravitational waves to develop a new way to study the universe. Gravitational waves are detected by observing changes less than 1/10000 of the diameter of a proton in the distances between hanging mirrors that are four kilometers apart within two perpendicular evacuated tubes. These changes in distances between mirrors are produced by gravitational waves from large masses in space, such as colliding black holes. Many factors affect the sensitivity of the interferometer. LIGO's Physical Environment Monitoring subsystem (PEM) is one method of both eliminating noise and assisting in identifying false indications of gravitational wave detection.

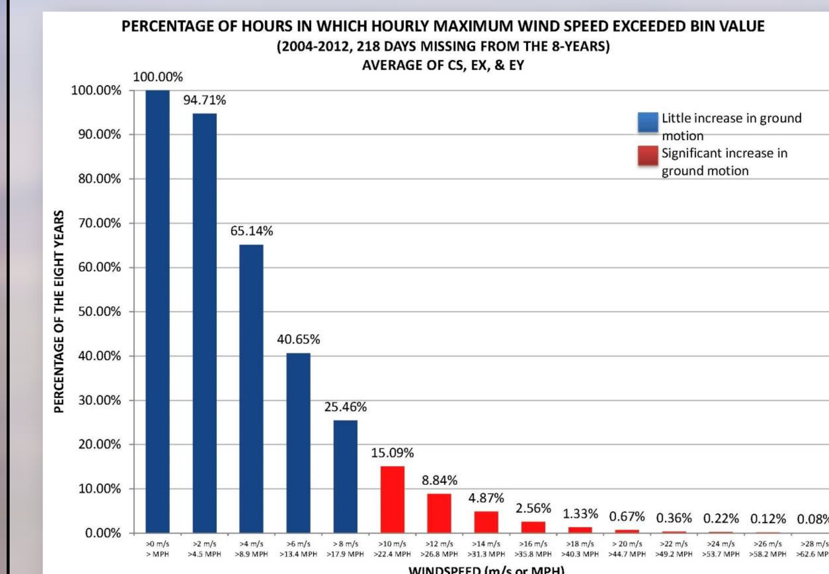
Objectives

1) Investigate the statistics of wind at LIGO Hanford's three building locations
2) Develop understanding of the statistics of ground motion in relationship to the interferometer performance,
3) Study the correlation between wind and ground motion.

Methods

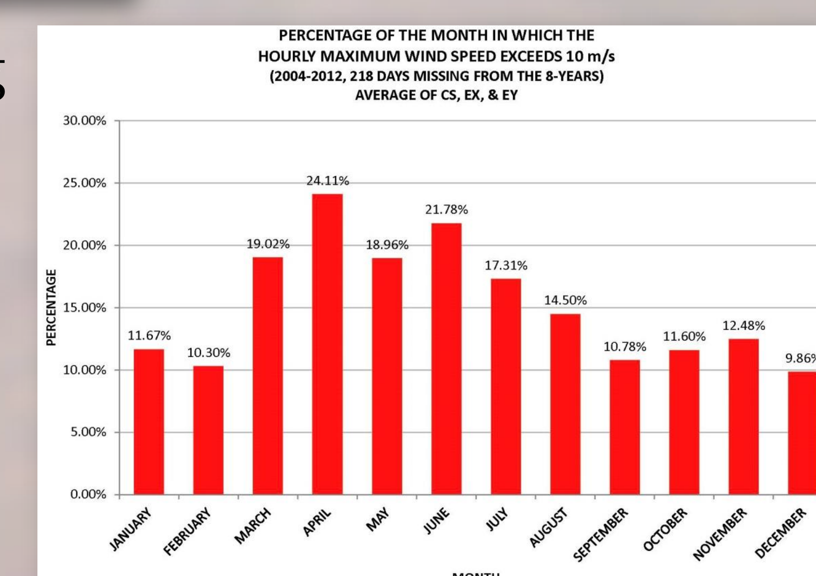
Excel was used to analyze eight years of data (2004-2012) and to represent the wind patterns and seismic motion throughout each year and across the series.

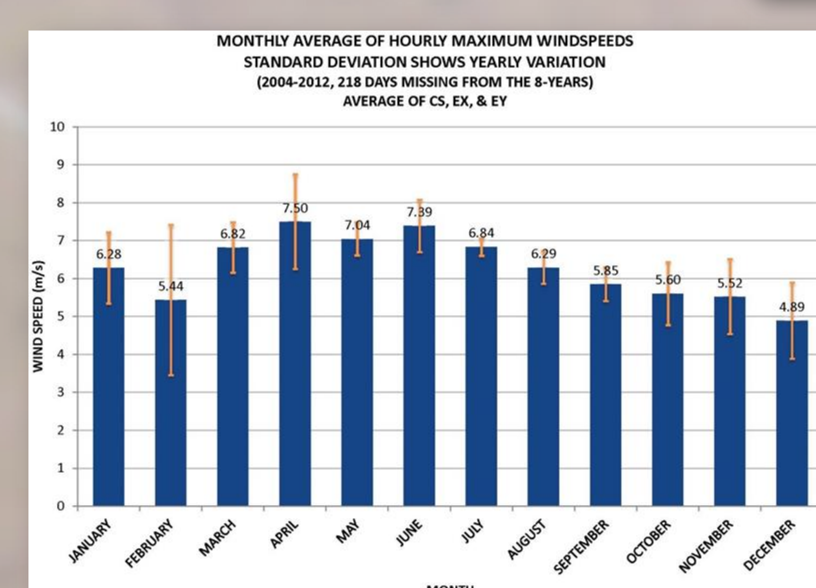
Results



15% of hours in the 8 years of wind data analyzed exceeded 10 m/s, which increases ground motion.

During each of the spring months, the wind was greater than 10 m/s in more than 15% of the hours, with a peak in April at 24%.

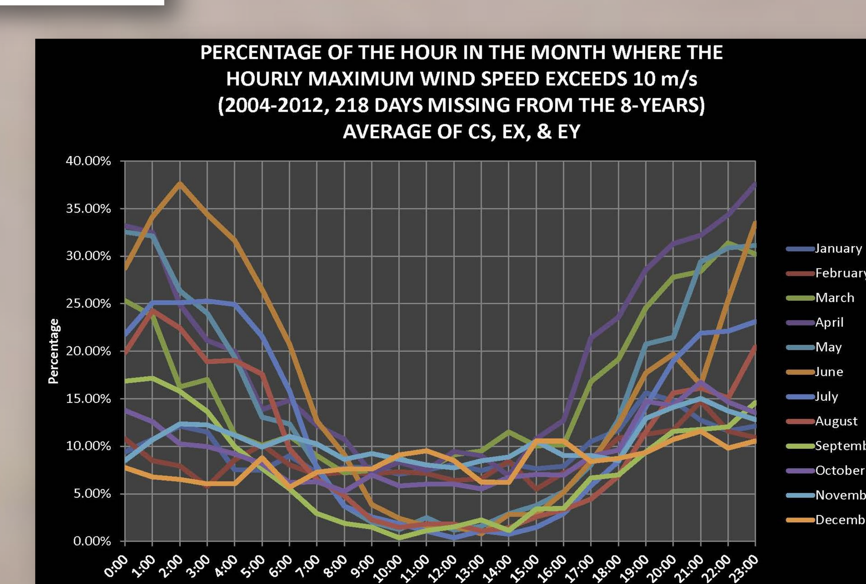




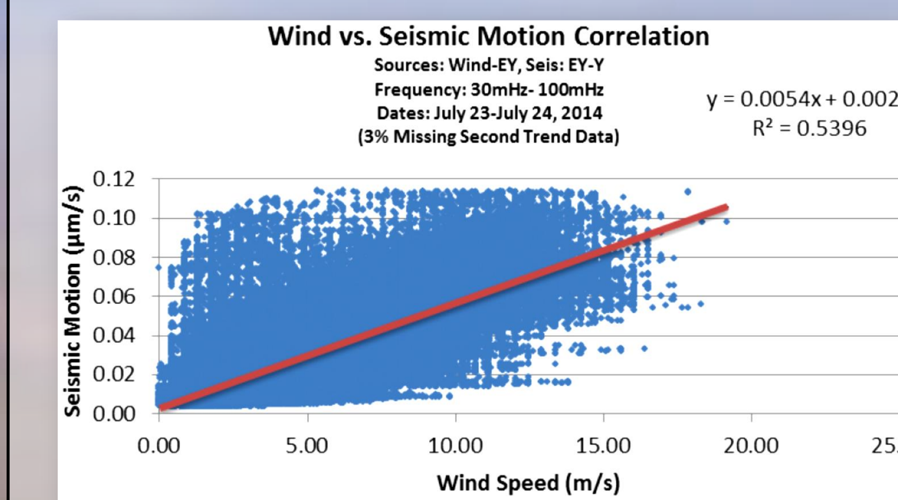
Average hourly maximum wind speed varied the most from year-to-year in the month of February.

Wind speeds exceed 10 m/s thirty eight percent of the hours in June at 2 AM and April at 11 PM.

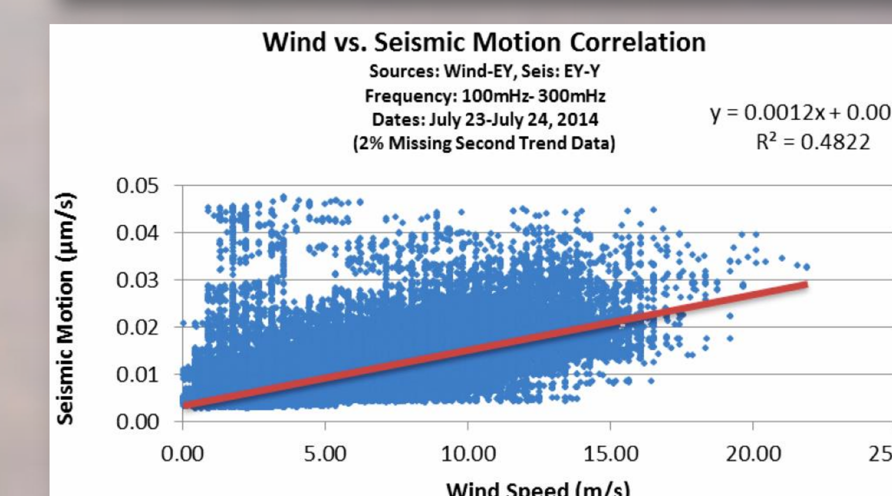
December shows a consistent percentage (between 8%-10%) of hours where wind speeds are over 10 m/s across all times of the day.



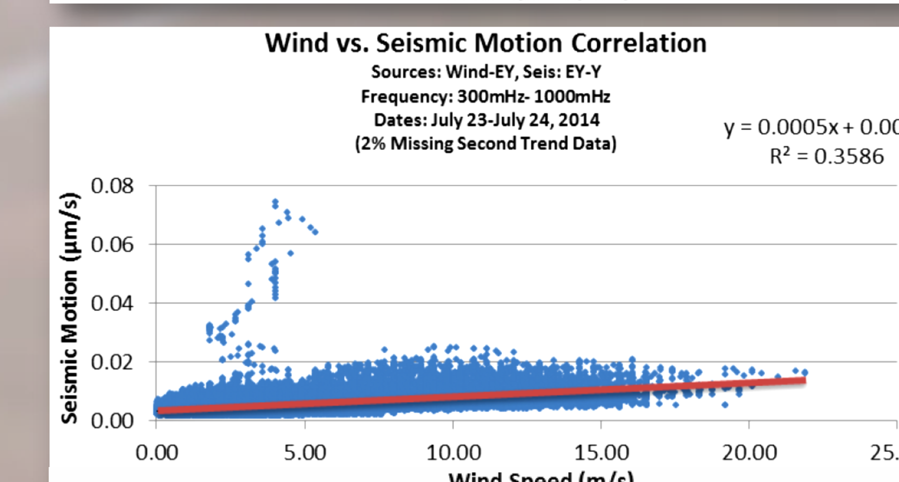
Results (continued)



A moderate correlation between wind and seismic motion can be seen in these frequency bandwidths (left).



As wind speed approaches 10 m/s, seismic motion remains constant near it's lowest bound.



As wind speed exceeds 10 m/s, seismic motion increases significantly.

Future Research

Future research includes developing systems to adapt to wind speeds over 10 m/s.

Acknowledgements

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