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Possible Precursor Events to Earthquakes and the Resulting Effects on Organic Material in the Surrounding Water Bodies

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Possible Precursor Events to Earthquakes and the Resulting Effects on Organic Material in the Surrounding Water Bodies



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Introduction

Earthquakes can cause severe damage to the infrastructure of the area surrounding the epicenter of the event. Unlike a lot of other events there are currently no reliable methods of predicting the time, magnitude, and location of the next event. In order to be better prepared for the next earthquake a more accurate warning system and precursor needs to be found. Radon and metallic aerosols monitoring over the seismo-active regions could be used for strong earthquake prediction [Pulinets et al, 1997]. Three earthquakes, one occurring off the west coast and two off the east coast of Japan, were studied to see if latent heat and gas release could be detected as precursor events using satellite data. Then hydrologic satellite data was studied to see if the earthquakes resulted in any change in chlorophyll a and color dissolved organic matter content. These parameters were used to analyze the health of the ocean before and after the earthquake. To obtain these data sets the Moderate Resolution Imaging Spectrometer (MODIS) aqua and terra were used. MODIS terra is a morning mission where as MODIS aqua is an evening mission. MODIS terra daily data was used to find all atmospheric data and MODIS aqua 4km monthly data as well as MODIS aqua 4 km Standard 8 day data were used to find the hydrologic data.

As a result of the tidal action and tectonic plate shifts both two of the earthquakes resulted in nuclear power plant malfunctions at varying degrees. These factors were taken into consideration when analyzing how the hydrologic systems in the surrounding areas responded after the earthquakes. Other factors were taken into consideration, like wind currents blowing from the west and the other anthropogenic material it could have contributed to the area of study. A large majority of these atmospheric pollutants originate in China, which can skew the data especially if taken during peak spring and summer months.

The three earthquakes are the Miyagi August 16, 2005, Chuetsu July 16, 2007, and Tohoku March 11, 2011. Chuetsu is on the west coast of Japan in central Honshu, the main island, while Miyagi and Tohoku are located on the east coast of Honshu with Tohoku more north and Miyagi more central. All three of the epicenters were located off the coast in relatively shallow waters resulting in abnormal tidal action in the near by areas. Since Japan is located on the Ring of Fire, a very seismically active area following the countries along the edge of the Pacific Ocean, it and all of the countries located on this ring are prone to seismic events at a higher frequency and magnitude. For this reason it is a good place to study earthquakes because there is more data from this area and more incentive to find precursor events that could potentially give people living in this dangerous region more time to get to a safe place and survive.

Research Questions

Is latent heat and radon be studied as a precursor through satellite data and how does the earthquake effect the aquatic systems around the earthquake area.

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Study Site and Methods

Site:

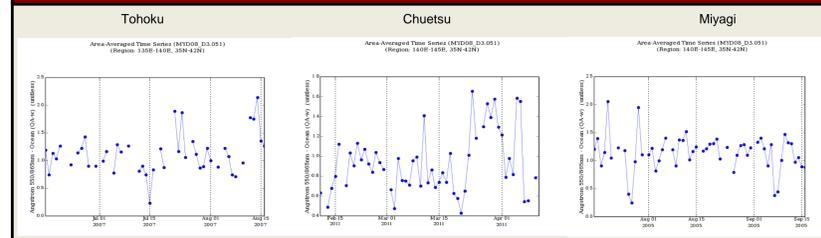
- Japan is located on the ring of fire
- One of the most active seismic areas in the world
- Tohoku and Miyagi on the east coast and Chuetsu on the west

Methods:

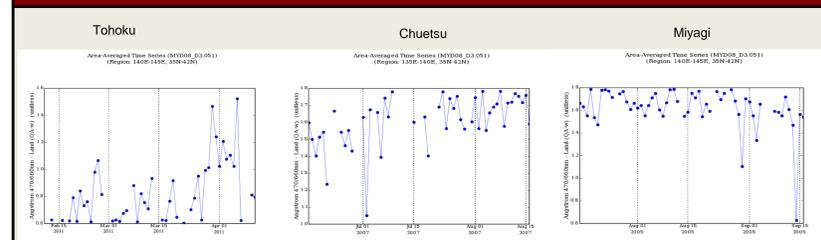
To analyze if the atmospheric parameters changed before and after the earthquakes indicating the release of latent heat and gas from fault lines Angstrom land and ocean coefficients as well as aerosol optical depth were analyzed. This data was obtained from MODIS terra daily. The Angstrom coefficient is an exponent that expresses the spectral dependence of aerosol optical thickness (τ) with the wavelength of incident light (λ), according to NASA. In layman's terms it is the measure of the amount of particulate matter in the atmosphere.



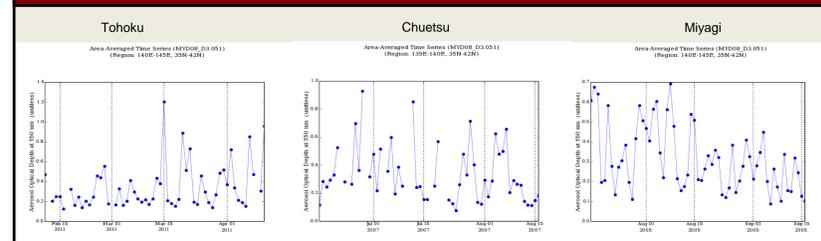
Angstrom Ocean Coefficient



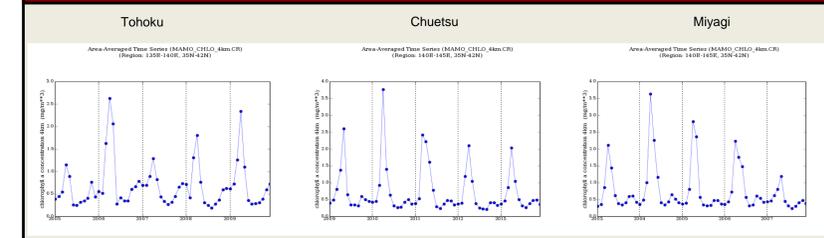
Angstrom Land Coefficient



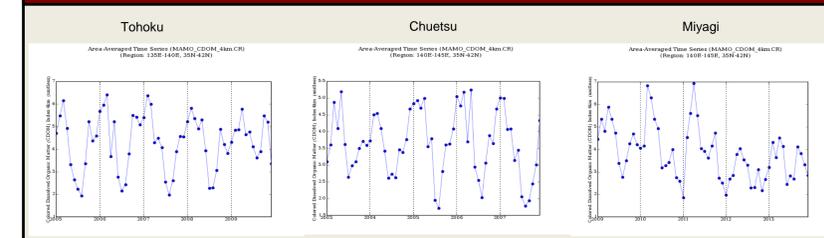
Aerosol Optical Depth



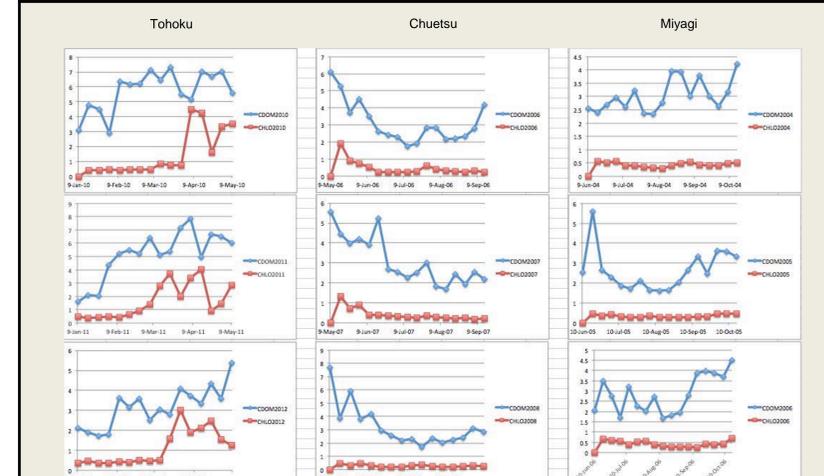
Chlorophyll A Concentration



Color Dissolved Organic Matter (CDOM)



Chlorophyll compared to CDOM



Conclusions

Overall it can be assumed that with the current satellite technology and my understanding of the data interpretation methods that it was difficult to find any result indicating the release of excess gas into the atmosphere before the event occurred. The lack of available data on radon content in the ocean hindered my ability to find results. Although I don't think radon may be a good indicator, with current technology, for oceanic earthquakes I believe it can be used for land earthquakes with ground water near by. As studies have shown positive results with this type of study. With faults that are close to the surface, like the San Andreas, satellites may be able to observe release of radon in the future. As for hydrologic data earthquakes that release a lot of debris into the surrounding water bodies effect the area for that seasonal year. However, with nuclear reactor failures as large as Fukushima the affects can be seen for years to come just because the particles been transported to head waters of rivers and snowmelts so they will continue to release material into the ocean below for years to come.