CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
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Project Number
34758

Project Title
A Study of the Effects of Solar Flares on the Magnetosphere of the Sun and the Propagation of Solar Pressure Waves

Abstract

Objectives/Goals
Solar events known as Coronal Mass Ejections (CMEs) regularly cause serious problems for electrical systems on our home planet, where the fluctuations of the solar magnetosphere eject billions of tons of particles into space and cause Earth's magnetic field to change unpredictably. While the association of solar flares with CMEs is currently "not clear" (NASA), it is hypothesized that a relationship between the two may exist. Such verification could potentially open undiscovered avenues in solar studies and revolutionize our conceptions of key heliacal activities.
This project is the first in the field to holistically explore the vast datasets available from SOHO and NOAA to assess cosmic activities and the solar magnetosphere. Furthermore, it is the only one that integrates the impact of high energy protons and electrons as well as the magnitude of specific solar flares when making predictions and confirmations of results.

Methods/Materials
In order to attain data from SOHO and NOAA, web scrapers were written to download datasets and convert the FITS (Flexible Image Transport System) files into CSV values. To test the significance of solar flares and high energy protons on the solar magnetosphere and CMEs, statistical analyses were conducted in the FATHOM Dynamic Data Analysis Software.
After extracting data from FITS files, an objective model was developed that accurately determined the relationship between energy release in conjunction with the size of solar flares on the ejection of coronal mass and fluctuation of the solar magnetosphere. The model then categorized both variations based on whether a strong solar flare existed on that specific day. Variance analyses were finally conducted on this refined set of data to obtain conclusive results.

Results
Correlations of 84.86% and 70.68% were calculated based on the analysis of variance between the magnetosphere fluctuation and flare magnitude as well as the magnetosphere fluctuation and electron flux.

Conclusions/Discussion
This analysis concluded that solar flares and high energy proton release result in massive fluctuations of the solar magnetosphere. These results allow for further understanding of the underlying mechanism of wave propagation and provide insight regarding the impacts of flares on CMEs. The great magnetosphere fluctuation induced by flares result in mass disturbance of the Earth's magnetic field and impacts our daily lives.

Summary Statement
This project analyzed data and developed an objective model that accurately determined the relationship between energy release and the magnitude of solar flares on the ejection of coronal mass and fluctuation of the solar magnetosphere.

Help Received
Parents helped with the board assembly. Science teacher and mentor Mr. Chris Spenner helped with FATHOM analysis software for large datasets.