



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

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Project Title Lost at the Solar Maximum? The Effect of Solar Flares on GPS	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this experiment was to study the impact solar flares can have on GPS receivers and determine the importance of WAAS in correcting errors made by GPS receivers. It was hypothesized that a geomagnetic storm resulting in a Kp-index of 6 would cause GPS receivers to have a significant error of 20 meters.</p> <p>Methods/Materials Two GlobalSat BU-353 WAAS GPS receivers were placed on a metal ground plane on the roof of a house. A cable was used to attach the receivers to a laptop. Using SiRFDemo.exe, WAAS, a second set of signals, was disabled on one of the two receivers. NMEA.exe, a data logger, was then used to record one data point per second of information gathered by the receivers. Microsoft Excel 2010 was used to process the data and find the difference in altitudes between the two receivers. The altitude differences were then graphed versus time.</p> <p>Results The control data (Kp-0) had an average error of 2.338 meters and an error range of about 18 meters. Data from when the geomagnetic field was disturbed (Kp-4) had an average error of 1.053 meters and an error range of 16 meters. Data from a geomagnetic storm caused by a solar flare (Kp-6) had the least average error of 0.409 meters as well as the smallest error range of about 11 meters.</p> <p>Conclusions/Discussion Surprisingly, the control data had the greatest amount of error, while the Kp-6 data had the least. This indicates that solar flares and other forms of solar activity do not have a strong impact on GPS receivers. There may also have been many other error sources interfering with the GPS receivers' calculations. Therefore, it was concluded that there must be an exceptionally powerful solar flare to significantly impact a GPS receiver's accuracy and cause the user of a GPS receiver without WAAS to become disoriented.</p>	
Summary Statement This experiment compared altitude measurements between a GPS receiver with WAAS and a receiver without WAAS to determine how strongly solar flares and other forms of solar activity impact GPS receivers.	
Help Received My father helped gather materials, made suggestions about the procedures, and assisted in my understanding of GPS receivers. Dr. Demoz Gebre also helped increase my understanding regarding GPS satellites, WAAS, and receivers.	