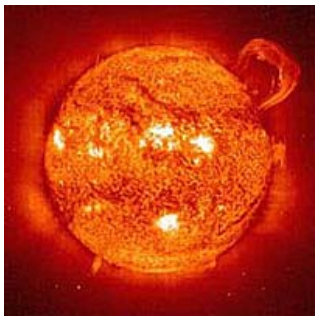
Latitude Variation of Solar-related Geomagnetic & Cosmic Ray Activity

Pittsford-Mendon High School Regents Physics Honors Period 6

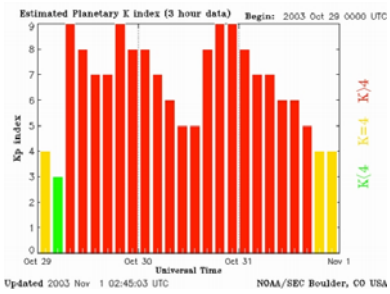
ABSTRACT



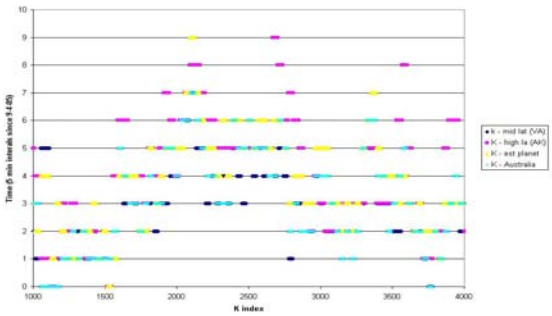
Early in the school year, our class began to study data provided online about a solar storm that occurred in September of 2005. The object of our investigation was to compare the relationship of muon rate and k-index of the geomagnetic activity with respect to latitude.

INTRODUCTION

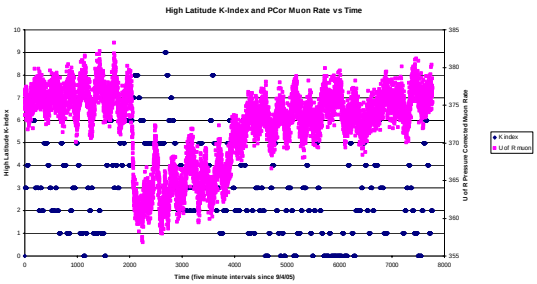
The k-index is an integer scale that is used to rate the amount of change of the earth's magnetic field per given time. As muons enter the earth's atmosphere, they pass through the earth's magnetic field. The relationship between average muon rate and the k-index proves to be a strong inverse correlation. This means that a high rate of change of the earth's magnetic field (k-index) could quite possibly be responsible for the deflection of cosmic rays and/or muons or their slowing down, causing them to lose energy and therefore decay before reaching the surface of the earth.



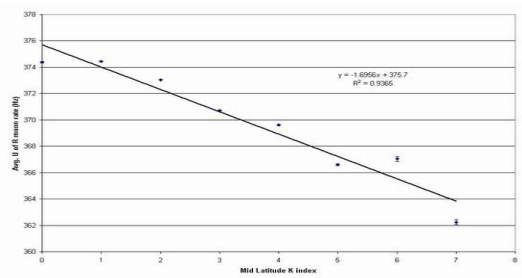
METHODS



First, geomagnetic activity at various latitudes was compared by analyzing NOAA K index data during the period following the solar storm in September 2005. The graph above shows the trends for the K index from stations in Virginia, Alaska, Australia, plus an estimated global average (Kp). Although it seems that geomagnetic activity may have been more severe at higher latitudes, overall, the trend seems fairly consistent at all locations. Next, the U of R muon rate was graphed with the K



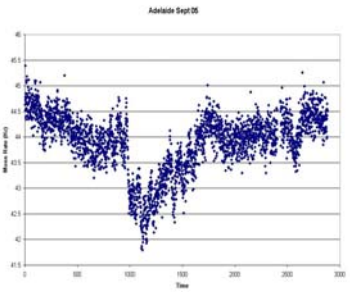
Next, the U of R muon rate was graphed with the K index as a function of time. It seems clear that there is an anticorrelation between geomagnetic activity (as represented by the K index) and cosmic ray muon rate. This is even more apparent when muon rate is compared directly to the K index, as shown in the graph below.



DISCUSSION

K-Index is an integer scale that is used to rate the amount of change of the earth's magnetic field per given time. As muons are entering the earth's atmosphere, they must pass through the earth's magnetic field. The relationship between average muon rate and k-index proves to be a strong inverse correlation as shown in the previous graphs. This means that a high rate of change of the earth's magnetic field will perhaps deflect cosmic rays and/or muons, or slow them down, causing them to lose energy and decay before reaching the surface.

Finally, the Forbush decrease as measured by the U of R detector was compared to University of Adelaide muon data from the same period (see graph below). It seems clear that the decrease was of similar magnitude (3-5%) and duration.



CONCLUSION

The geomagnetic storm cause by the solar flares during September 2005 seemed to have a significant impact on cosmic ray muon rates. The severity of this activity and the consequent effect on muon rates, however, seemed to be similar at all geographic latititudes.

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