PROJECT IN FYS-3610 SPACE PHYSICS, AUTUMN 2006

Objective:

- Learn how to operate UiO's ground based instruments at Andøya Rocket Range and gather data for further analysis
- Learn to identify and analyze interesting periods with significant magnetic activity and bright auroras
- Use Matlab to process and plot data

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Requirements of the report:

- Front page with title and candidate number(s). List of content. Introduction. Instrument description. Data presentation. Discussion. Summary. List of references. Figures and Tables, should be uniquely numbered + a small text describing the content. Equations should also be numbered. The report can be written in Norwegian or English.
- Team work (two-and-two) is recommended

Time line:

- Submission deadline is November 24th. The report has to submitted in paper form in the expedition office of the institute of physics (look for the FYS3610 box). Do not write your name on the report, but you candidate number.

Recommendation:

- When you choose collaboration partner ensure that you have about the same ambition level, and please avoid a free ride!

The objective of this project work is to identify an active period (ca. 2-3 hours) with good local data coverage and analyse it by means of several instruments. In case of bad weather conditions, old data are used.

The following instruments have to be checked in order to identify an active period:

1) Solar wind conditions
Check for example the level two MAG and SWEPAM data from the satellite ACE, found at http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/

2) Geomagnetic conditions
Data can be found at http://www.tgo.uit.no/geomag.html (local), choose "latest geomagnetic data", http://www.rocketrange.no/arr/index.html (local) or http://www.geo.fmi.fi/image (data from the IMAGE chain).

3) UiO All-sky Imager records from Andøya (Saura)
Data will be gathered at Andøya or given in case of bad weather conditions

SUGGESTED TASKS TO BE COVERED

TASK 1:

Describe briefly the available instruments and what they measure for the chosen time period.

TASK 2:

Write a short matlab program to calculate the approximate IMF conditions for the active period. See lecture notes for more details. Is it in general possible to predict a substorm event by means of ACE data? Give an estimate of the accuracy of the average delay.

TASK 3:

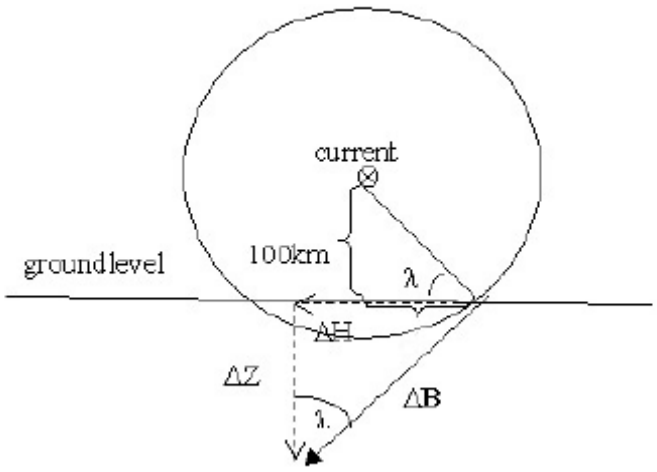
a) Identify a substorm in the active period by means of the All-sky images. Describe the data and identify the different substorm phases.

b) Analyze the plots you generated for the IMF and relate them to the substorm event. Does the calculated time delay fit with the substorm timing? Explain the delay from ACE until the substorm onset.

c) Use magnetometer data (both H, D and Z component) from the IMAGE chain to describe how the electrojet moves north/south and describe its direction. Assume line current. By direction we mean east or westward, and if it has a north-south turn. With movement, the movement of the entire system is meant. Local magnetometer data can be found at http://www.rocketrange.no/arr/index.html
Data from the IMAGE chain are available at http://www.geo.fmi.fi/image

c) How is the connection between the electrojet and the auroral arcs?

d) Starting with Biot-Savarts law for a line current, show that the Z component is affected more by currents far away than the H component. As shown in the figure: If h is the height, l the length and we let $l>>h$, we have that



$B_H/B_0 = 1/l^2$ $B_Z/B_0 \sim 1/l$, where B_0 is the strength of the magnetic field right underneath the line current (l=0). Hint: Calculate first the perturbation in the magnetic field from a line current at a distance r, substitute r by h to find B_0. Then calculate ΔB by equating r with $(l^2+h^2)^{1/2}$.

d) From the expression $J = 1/\mu_0(\nabla \times B)$ show that $B(r) = 200\ I/r$ [nT] and calculate the amperage by assuming a line current and using the magnetometer data from several stations.

e) Discuss error sources associated with the line current assumption.