# Project for FYS3600/4600 Fall 2018

Due date: 12.11.2018 11:59:59 am **(Norwegian time)**. No report will be accepted after the deadline.

## Objective

Study ionospheric and auroral dynamics in response to changes in solar wind conditions. Reconnection is the dominant mechanism, giving rise enhancements in large-scale ionospheric flows, changes in the polar cap size, and auroral activity.

## Data sources

### *Indices*

*AU, AL, AE (and other) indices are available at http://wdc.kugi.kyoto-u.ac.jp/aedir/ . Choose the Provisional AE index [1996 - ], and the date of interest*

### *ACE*

ACE data are available at http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/. Choose ACE, then highest resolution (1 second) level 2 data from the magnetic field instrument (Bartol Research Institute), and SWEPAM instrument 64-seconds level-2 (SWRI), and then the date of interest.

### *Ground-based magnetometer*

Magnetometer data are available at http://space.fmi.fi/image/beta/?page=home. Click "Data", then "user-defined magnetograms". Choose stations, time period and scaling for the components.

### *SuperDARN*

SuperDARN data are available at http://vt.superdarn.org/. Under "Qucik browse" click "Convection Maps", and select the date of interest.

### *All-Sky Camera*

ASI keogram data are available at http://tid.uio.no/plasma/aurora/. Click on the date of interest and select the station and wavelength.

## Dates

Two possible dates:

- 04 January 2011, 0000-2400 UT
- 06 January 2011, 0000-2400 UT

## Approach

### Part 1) Finding the date/interval of interest

Inspect the indices from the *http://wdc.kugi.kyoto-u.ac.jp/aedir/ webpage*, the quick look database of keograms, at http://tid.uio.no/plasma/aurora/, and the ground-based magnetometer data at http://space.fmi.fi/image/beta/?page=home.

Based on this, select one of the two days above, and a particular time interval of interest during that day (Remember to write why you choose that particular day/time interval in the final report).

### Part 2) Data "analysis"

-Familiarize yourself with ACE data and create plots of key parameters relevant to the day/interval you selected, taking into account the travel time of the solar wind from the ACE position to Earth.

-Investigate auroral data associated with your event (note that not all auroral data are good data due to poor weather conditions (clouds)). Look for large-scale movement of the auroral features in the latitudinal direction or sudden brightenings., etc.

-Widen the scope by adding information about ionospheric currents (magnetometer), and large-scale ionospheric flows (SuperDARN).

### Part 3) Writing

Describe what large-scale dynamics you would expect during your event and what is observed. Do you see signatures of Solar wind-Magnetosphere-Ionosphere coupling in your data? What are the signatures in all the datasets? Discuss!

## Requirements of the report

The report should tell the story of how a change in the solar wind conditions (as observed by the ACE satellite) propagated to Earth and affected the large-scale configuration of the magnetosphere/ionosphere (as observed by SuperDARN, ground-based magnetometers, and ASI).

**Objective: Demonstrate that you understood the underlying physics by describing what dynamics you would expect from a change in the solar wind conditions, and support your expectations with data.**

The report must include

- A front page with title and candidate numbers.
- A main part subdivided into sections of your choice. It must however include:
    - In Introductory part (introduction and theoretical background): *Counts for 25% of the project.*
    - A very brief description of the instruments (what they are, what they measure etc.): *Counts for 10% of the project.*
    - A precise description of your observations: *Counts for 25% of the project.*
    - A discussion and conclusion (discuss your results with respect to your observations): *Counts for 30% of the project.*
- Numbered figures with captions, numbered equations, list of references, numbered pages and acknowledgement. *(The form counts for 10% of the project).*

The report should be written in English (Norwegian is also OK). It should amount to 10-15 pages, contain around 3000 words, and be written by a team of two. You will receive comments and questions regarding your report and your contribution during the oral examination.

## Supporting literature

Cowley, S. W. H. (2000) Magnetosphere-Ionosphere Interactions: A Tutorial Review, in Magnetospheric Current Systems (eds S.-I. Ohtani, R. Fujii, M. Hesse and R. L. Lysak), American Geophysical Union, Washington, D. C.. doi: 10.1029/GM118p0091

Cowley, S. W. H. And M. Lockwood, (1992) Excitation and decay of solar wind-driven flows in the magnetosphere-ionosphere system, Ann. Geophysicae, 10, 103-105

Kievelson and Russel, Introduction to Space Physics, Chapters 9, 13, and 14, available in the UiO library

Sandholt, P.E., C.J. Farrugia, J. Moen, Ø. Noraberg, B. Lybekk, T. Sten, and T.L. Hansen, A classification of dayside auroral forms and activities as a function of IMF orientation, J. Geophys. Res.,103, 23,325-23,345, 1998.

Ruohoniemi, J. M., R. A. Greenwald, Dependencies of high-latitude plasma convection: Consideration of interplanetary magnetic field, seasonal and universal time factors in statistical patterns, J. Geophys. Res., 110, A09204, doi:10.1029/2004JA010815, 2005.

Newell, P. T., J. M. Ruohoniemi, and C.–I. Meng, Maps of precipitation by source region, binned by IMF, with inertial convection streamlines, J. Geophys. Res., 109, A10206, doi:10.1029/2004JA010499, 2004.