Short Course: "From Solar Eruption to Power Grids and Pipelines"

Abstract

The course will provide the information and raise the awareness on the sources and impacts of space weather on technology infrastructure. The following are the topics to be explained: the chain of multiple phenomena starting from different types of solar disturbances; their propagation through the interplanetary media, their interaction with Magnetosphere, Ionosphere and Earth's magnetic field. It will discuss the impacts of space weather on multiple technological infrastructures such as: 1) satellites (briefly); 2) radio communication and GNSS (briefly); 3) power grids and pipelines (in depth). The questions of data gaps, knowledge gaps, observational needs and forecasting possibilities will also be outlined. If time permits (and if the room is equipped with laptops and Internet connection) short exercise can be also offered to the attendees.

Outline

Part 1

1. Introduction: Historical evidences of the Sun-Earth connections and impacts
2. Solar and galactic sources of the variability in the near-Earth space environment
3. Propagation of solar disturbances through the interplanetary media: observations and modelling
4. Natural electromagnetic environment of Earth: Geomagnetic field, Magnetosphere, Ionosphere
5. Impacts of the solar disturbances on the natural Earth environment: response of the geomagnetic field and ionosphere

Part 2

6. Radiation belts and impacts on satellites at different Earth's orbits.
7. Impacts of solar transients on the ionosphere and radio communication at different latitudes.
8. Geomagnetic variations at different latitudes and geomagnetic storms
9. Effects of geomagnetic variations on the power lines and pipelines, examples
10. Influence of geophysical parameters and network topology on the technology response
11. Mitigation: Situational awareness, Solar-terrestrial predictions, other matters
12. Gap analysis

Hands-on exercise: use the on-line service for pipeline operations provided by NRCan space weather group and built "your own pipeline". Run quiet vs storm time periods and identify the differences.