Masterproject: The contribution of magnetosheath jets to solar wind–magnetosphere–ionosphere coupling

We offer a master project in the space plasma group at Umeå University to investigate the influence of magnetosheath jets on the magnetospheric wave activity observed by ground-based magnetometers!

1 Background

The solar wind is a supersonic plasma flow originating from the Sun carrying the interplanetary magnetic field (IMF). The Earth's magnetic field acts as an obstacle to the solar wind flow. Close to Earth, the solar wind is therefore slowed down and a region called the magnetosheath (dark blue region in Figure 1) is formed. The magnetopause is the boundary separating solar wind plasma in the magnetosheath from plasma controlled by the Earth magnetic field. Magnetosheath jets are dynamic pressure enhancements in the magnetosheath, their formation mechanism is related to the orientation of the IMF and jets can disturb the magnetopause. After impacting the magnetopause, jets can launch waves in the magnetosphere and therefore play a role in the solar wind–magnetosphere–ionosphere coupling. These waves travel along magnetic field lines and can be detected with ground-based magnetometers, see Figure 1.

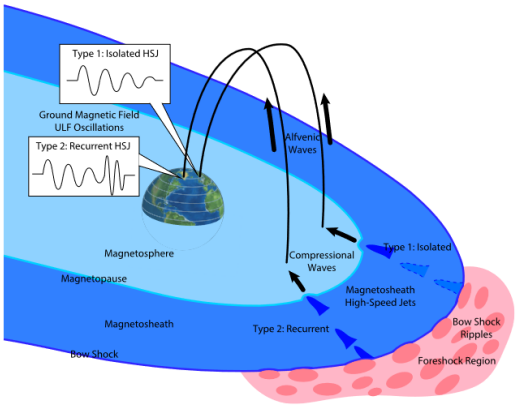

Figure 1: Disturbances caused by magnetosheath jets.[1]

The aim of the project is to investigate the role of jets in the solar wind–magnetosphere–ionosphere coupling. Jets have been suggested to be a significant driver for dayside waves in the magnetosphere. Therefore, we want to investigate the correlation between IMF orientation favorable for jet formation and wave activity observed by ground-based magnetometers.

2 Methodology and Tasks

You will be working with NASA's OMNI data base for the IMF data. In addition, you will make use of SuperMAG data which is a collection of data from ground-based magnetometer that are positioned across the world. You will learn how to handle, process, and visualize large data sets. The first task will be to identify periods with stable IMF. The next step is then to quantify the dayside magnetometer response using fourier transforms depending on the IMF orientation. Finally, the significance of different IMF orientations and solar wind parameters will be investigated.

3 Requirements

This project involves data analysis and data visualization, therefore basic programming skills, preferably in Matlab or Python, are required. However, no background in space physics is needed. We will go through the knowledge that is needed during the project.

4 Contact information

Are you interested in the project or do you have any questions? Feel free to contact Eva Krämer (eva.kramer@umu.se) or Maria Hamrin (maria.hamrin@space.umu.se).

[1] Figure from B. Wang et al. "Investigating the Role of Magnetosheath High-Speed Jets in Triggering Dayside Ground Magnetic Ultra-Low Frequency Waves". In: *Geophysical Research Letters* (2022)