Masters Project: Waves in the ionosphere detected using the Polar Research Ionospheric Doppler Experiment (PRIDE)

Overall Research Project: INTPART project: Magnetic Pulsations and transients: the Sun-Earth connection and impact on the high latitude ionosphere (Research Council of Norway) (WorkPackage4)

Timeline: 1 year (60ECTS)

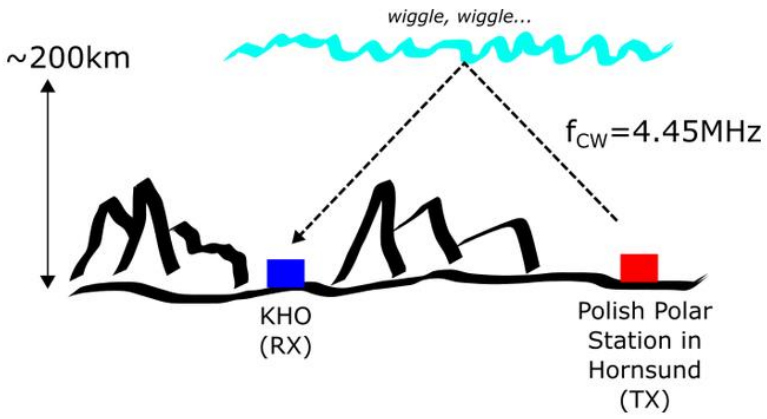
Main supervisor: Assoc. Prof. Lisa Baddeley (UNIS)

Head Engineer on the Project: Dr. Mikko Syrjäsuo (UNIS)

Funding: Some funding assistance for travel and accommodation on Svalbard is available for the duration of the project.

Project Description

A new instrument was installed during the summer 2020 to study the wave structures in the ionosphere. A system of this kind has not been successfully deployed on Svalbard before so this will be a new and exciting dataset. The *Polar Research Ionospheric Doppler Experiment* (PRIDE) transmits a CW signal at a fixed frequency from the Polish Polar Base in Hornsund. When (or if) the radio waves reflect from the ionosphere back towards the ground, the motion of plasma will cause a Doppler effect, which can then be observed in the received signal at the Kjell Henriksen Observatory (KHO). The causes of these 'wiggles' can be a multitude of things, from atmospheric gravity waves (AGWs) to Ultra Low Frequency (ULF) MHD waves.



They represent energy transfer through the ionosphere (either from the atmosphere below or the magnetosphere above). The core of the project will be a scientific investigation of the parameters and energy sources of the 'wiggles' and to compare them to previous studies at other latitudes and longitudes. Specific topics to be addressed:

- Is the PRIDE instrument detecting signals from ULF and / or AGWs?
- How do these signatures vary as a function of local time / season?

- Does the measurements from the PRIDE data corroborate observations from other in-situ instruments on Svalbard?
- What are the energy sources for the 'wiggles'?
- What are the spatial and temporal scale sizes of the signatures and how do those compare to similar structures from Doppler sounders at lower latitudes?

The project will firstly finalise the setting up of the data acquisition, processing and verification system at the KHO. Once tested the data will be made available to the scientific community through a project website (set up as part of the project).

More information about the instrument can be found here:
https://www.researchinsvalbard.no/project/9571

Scientific Conference Attendance

There is also the possibility to travel to a scientific conference to present the work, as part of the INTPART project, at the completion of the Masters thesis (also funded through the project).

Methods:

The student will familiarize themselves with the Doppler method as well as getting an overview of both ULF waves and Gravity Waves. The research work will then entail:

- Identification of doppler signatures and relate them to various ionospheric / atmospheric phenomena through comparison with complementary data sets from magnetometers, airglow imagers and ionospheric radar systems.
- Development of automated data processing codes, using spectral analysis techniques, to produce 'standard' data files from the raw data taken by the receiver system
- Setting up of the official project website for the instrument including instructions on how to access the data

Fieldwork:

The system is located at the KHO, about 25km from Longyearbyen. There will be some hands on work expected at the KHO during the initial phases of the project. The data is available online so can be worked on from an office at UNIS.

Experience:

Programming experience (matlab / python / IDL) and good knowledge of spectral analysis is essential. Background knowledge of ionospheric physics is required. Hands on experience with radar antennas is also desirable.

Further Reading:

- Baddeley, L.J., T. K. Yeoman and D. M. Wright, HF doppler sounds measurements of the ionospheric signatures of small scale ULF waves (2005), Ann. Geophys., 23, 1807-1820, 2005
- Crowley, G., and F. S. Rordigues (2012), Characteristics of traveling ionospheric disturbances observed by the TIDDBIT sounder, Radio Sci. 47, RS0L22, doi: 10.1029/2011RS004959