Project Outline:

Masters Project Title: Sporadic E-layers in the Polar Cap Ionosphere

Timeline: 1 year (60 ECTS)

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

Co-supervisor: Prof. Anasuya Aruliah (University College London)

Sporadic E layers are regions of highly dense ionospheric plasma which appear at lower E-region altitudes (~100km) which are not associated with traditional auroral particle precipitation and can last for several hours. Inside the polar cap and at auroral latitudes, due to the near vertical magnetic field lines, proposed generation mechanisms are associated with the local ionospheric electric field (e. g. MacDougall et al. 2005). However, a simple model used by Nygren et al. 2008 showed that in some cases, the neutral winds could play a more dominant role in the formation of the layer. The project will have two potential databases as a starting point: (a) a database from a previous project of sporadic E observations made by the EISCAT Svalbard radar, (b) a larger database of all ionospheric measurements from the Svalbard dynasonde which will have to be categorized to find sporadic E layers. The project plans to use observations of neutral winds made by Fabry-Perot Interferometers operated by University College London (UCL) located at the Kjell Henriksen Observatory (Griffin et al., 2009, Dhadly et al., 2019) and also the SuperDARN radar. Possible scientific questions to address will be:

1. How large a role does the ionospheric electric field play in comparison to neutral winds in the formation and dynamics of polar cap sporadic E-layers?
2. How do the statistical characteristics of the Sporadic E -layers from the larger database compare with that of a smaller statistical study done by Voiculescu et al. 2006?

The student is welcome to come up with their own suggestions regarding additional / alternative scientific questions.

Methods: The student will familiarize themselves with the previous work and characteristics of sporadic E-layers (through the reading of several scientific papers). The research work will then entail:

- the downloading, analyzing and processing of data from online databases (for instrumentation listed above).
- A visit to the EISCAT Svalbard radar where the student will be part of a team running an experiment to monitor the E-region ionosphere (subject to application approval)
- Preparation and writing of thesis manuscript.

Fieldwork: The student will be instructed how to use the EISCAT Svalbard Radar on site.

Experience: Programming experience essential – preferably with matlab (python and IDL are also acceptable). Background knowledge of ionospheric / magnetospheric physics is also required.

References:

- MacDougal, J.W. and P.T. Jayachandran, Sporadic E at cusp latitudes, J. Atmosph. and Solar. Terr. Phys., 67, 1419-1426, 2005.
- Voiculescu et al. IMF effect on sporadic-E layers at two northern polar cap sites: Part I – statistical study, Ann. Geophys., 24, 887,2006
- Nygren, T., M.Voiculescu, A.T.Aikio, The role of electric field and neutral wind in the generation of polar cap sporadic E, Ann. Geophys, 26, 3753-3763, 2008
- Dhadly, M. S., Emmert, J. T.,Drob, D. P., Conde, M. G., Aruliah, A.,Doornbos, E. et al. (2019). HL-TWiM empirical model of high-latitude upper thermospheric winds. Journal of Geophysical Research: SpacePhysics,124. https://doi.org/10.1029/2019JA027188
- Griffin, E. M., A. L. Aruliah, I. McWhirter, H.-C. I. Yiu, and A. Charalambous, Upper thermospheric ion-neutral coupling from combined optical and radar experiments over Svalbard, Ann. Geophys., 27, 4293-4303, 2009