From optical emissions to auroral acceleration using a combination of different models

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One of the outstanding questions in auroral physics is how precipitating particles obtain their energies. The highly structured and dynamic nature of the aurora makes the problem complicated, with the distinct possibility that there are several processes at work above the ionosphere, resulting in different optical signatures, such as splitting of arcs, flickering, curls and folds, and sharp boundaries. Optical emissions have long been used to give information about the energy and flux of the precipitation, but these measurements require ionospheric modelling in order to maximise their value. Spectrographic measurements fitted to synthetic molecular spectra are used for accurate subtraction of contaminating emissions in the zenith region of images captured with different filters. Measuring off the magnetic zenith creates more problems which can be addressed with a simple geometric model combined with those above. A key parameter needed for theoretical modelling of auroral acceleration is the ionospheric electric field. Optical measurements from metastable O+ ions combined with all of the above models can be used to estimate electric fields in dynamic auroral conditions.