Determination of precipitating electron fluxes from inversion of coordinated ALIS/EISCAT observations.

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Abstract

In March 2008, discrete stable auroral arcs were investigated during a coordinated observational campaign between the European Incoherent Scatter Radar (EISCAT) and the Auroral Large Imaging System (ALIS). The two sets of data are inverted to retrieve fluxes of precipitating electrons. Both results are matching in energy and shape with a typical average precipitation energy of a few keV. Finally, by using the average energy spectrum of electrons deduced from ALIS data as input for the TRANS4 kinetic/fluid electron transport 1D model, computed auroral emissions are compared to ALIS observations and electron density profiles are compared to EISCAT profiles.

1 Inversion of ALIS and EISCAT data

The ALIS network consists of five ground-based stations equipped with optical cameras that observe simultaneously the same volume of sky at altitudes above 90 km. From optical observations with ALIS, the three-dimensional (3D) volume emission rates of the N_2^+(427.8nm), OI(557.7nm) and OI(630.0nm) lines are reconstructed with tomography-like inversion techniques. The 2D energy spectra of precipitating electrons is subsequently retrieved using the N_2^+ line since the N_2^+ 1N(0,1) first negative band volume emission rate is directly proportional to the ionisation rate [1] and eventually to the precipitating electron flux [2]. The spatial extent and temporal evolution of the auroral arcs is also assessed using as parameters the average arc width in different wavelengths and the distribution of the electron characteristic energy along the arc.

From the EISCAT observations of electron density along magnetic zenith, the energy spectrum of precipitating electrons can also be inferred using a method similar to that of Semeter and Kalamabadi [3]. Results of both inversion are in agreement. In particular, the peak energy of the two spectra are within similar range around 2-3 KeV. The altitude peaks are also well retrieved.

2 Use of TRANS4 to check consistency

TRANS4 is a 1-D kinetic-fluid ionospheric model [4,5] based on Boltzmanns formalism. The code allows the computation of the state of the ionosphere with respect to electron and proton precipitation and many geomagnetic conditions, including the computation of the main auroral emissions in a wide range of wavelengths. The average energy spectrum of electrons deduced from ALIS data are used as input to TRANS4 and the computed auroral emissions are then compared to ALIS observations on one hand, and modelled electron density profiles to EISCAT profiles on the other hand. Predictions on the ion composition, ion chemistry and backscattered fluxes are highlighted.

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3 References

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