Estimating the field-aligned topside ionospheric anomalous electric field and resistivity at EISCAT

M. J. Kosch[1,2], H. Vickers[3], Y. Ogawa[4], A. Senior[2], N. Blagoveshchenskaya[5]

[1]*South African National Space Agency, Hermanus, South Africa.*
[2]*Lancaster University, Lancaster, UK*
[3]*University of Tromsø, Tromsø, Norway*
[4]*National Institute of Polar Research, Tachikawa, Japan.*
[5]*Arctic and Antarctic Research Institute, St. Petersburg, Russia*

e-mail: m.kosch@lancaster.ac.uk

We have developed an active ground-based technique to estimate the anomalous electric field in the topside ionosphere, up to ~600 km, using the EISCAT ionospheric modification facility, UHF incoherent scatter radar and optical observations. When pumping the ionosphere with high-power high-frequency radio waves, the F-region electron temperature is significantly raised, increasing the plasma pressure gradient in the topside ionosphere, resulting in ion up flow along the magnetic field line. Simultaneously, pump-induced suprathermal electrons produce artificial optical emissions and anomalous resistivity along the magnetic field line. Using the modified ion-momentum equation and MSIS model the field-aligned anomalous electric field is estimated, from the optical data the suprathermal electron flux is estimated, and from the ion velocity the thermal electron flux is estimated. From an experiment on 23 October 2013, we find the anomalous electric field points downward with a typical strength of ~1 □V/m, becoming weaker at higher altitudes, and the anomalous resistivity is significantly greater than the estimated collisional resistivity.