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Unique local results from a polar cap event with an extremely strong electric field of long duration.

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On 12 September 2014 the IMF turned very strongly northward for a prolonged period of time, reaching up to 28 nT at some point. Clauer et al (JGR, Space Physics, 121, 5422, 2016) showed from RISR-N Incoherent Scatter Radar (ISR) data at Resolute Bay that the convection on the sunward side of the polar cap was very strong and sunward during this exceptional event, with a convection electric field exceeding 150 mV/m at the peak of the event. The very strong electric fields were sustained for so long that we could determine from the ISR observations the anisotropy of the ion temperature in the F region. In particular, the perpendicular to parallel (to the geomagnetic field) temperature ratio for O+ ions undergoing resonant charge exchange with atomic oxygen could be derived. Preliminary results at the time of abstract submission indicate that this ratio was actually larger than expected from theoretical calculations involving published cross sections, with important implications for transport calculations involving collisions between ions and neutrals. The unique data set from the event also produced several large E region electron temperature (Te) measurements reaching up to almost 4000K through plasma wave heating. This temperature is one order of magnitude greater than found for electric fields weaker than 40 mV/m. Foster and Erikson (GRL, 27, 3177, 2000) have suggested that Te could be used to infer the electric field strength, based on rare electric field observations going up to 125 mV/m. The Sept 2014 data set allowed us to (1) make an alternate determination of the electric field from simultaneous E and F region ion drift measurements on nearby magnetic field lines to confirm the validity of other electric field determinations and (2) to make a substantial addition to the number of observations of Te as a function of electric field strength under very strongly disturbed conditions. We have found no evidence for a limit in the wave-induced electron heating, with an electron temperature that increased basically linearly with electric field strength all the way to 150 mV/m.

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