The modelled occurrence of non-thermal plasma in the ionospheric F-region and the possible consequences for ion outflows into the magnetosphere

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CORRECTION TO "THE MODELLED OCCURRENCE OF NON-THERMAL PLASMA IN THE IONOSPHERIC F-REGION AND THE POSSIBLE CONSEQUENCES FOR ION OUTFLOWS INTO THE MAGNETOSPHERE"

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Figures 1(d) and 2 of the paper by Lockwood and Fuller-Rowell (1987) contained the wrong contour plots of D' for the conditions stated in the text. This error has some bearing on certain statements made in that paper and here we present the correct plots along with some necessary qualifications to the discussion. The general form of the maps of D' remains the same but values are generally lower for steady-state, when the winds have attained equilibrium in a diurnal sense. The higher values of D' apply to non-steady state conditions following an increase in polar cap potential. As a result of the lower D', the incidence of non-thermal ion velocity distributions depends on the ion species and season for the steady-state conditions, with Kp near 3, used by Lockwood and Fuller-Rowell.

Figure 1 shows the maps of D' for NO^+ ions at an altitude of 200km., in the same format as used by Lockwood and Fuller-Rowell. Parts (a) and (b) are for the steady-state conditions at December solstice with a cross-cap potential of 76 kV and are for the northern and southern (winter and summer) hemispheres respectively (hence they should replace figures 1(d) and 2 in the paper by Lockwood and Fuller-Rowell). The general form of the plots is the same with peaks of D' in the throat region and in the dawn auroral oval.

As discussed qualitatively by Lockwood and Fuller-Rowell, the values of D' will be increased following an increase in the cross-cap potential. Polar cap expansions corresponding to increases in cross-cap potential of 140 kV and 200 kV have recently been reported from the EISCAT and Sondre incoherent scatter radar data (Lockwood et al., 1986a;b). In parts (c) and (d) of Figure 1, the cross-cap potential has been increased by a more modest 76kV (i.e. doubled) and the maps of D' are for immediately after such an increase.

From the arguments given by Lockwood and Fuller-Rowell, non-Maxwellian ion velocity distributions are expected when D' exceeds 1 to 1.5, depending on the importance of polarization collisions. The values of D'shown in figure 1 show that non-thermal plasma will not always be present. Table 1 lists the peak values of D' (almost invariably from the cusp region) for the

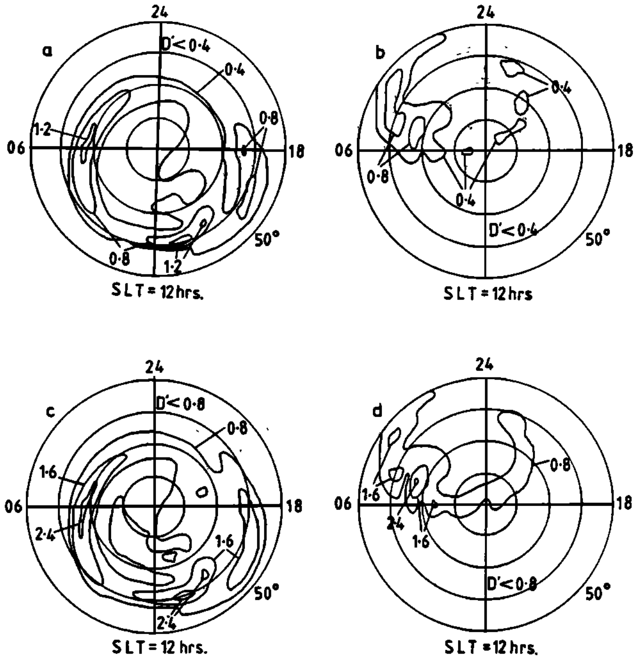

Fig. 1. Model values of D' for NO^+ ions at 200 km for 18UT and December solstice with F10.7=165 and B_y <0 and shown as a function of Solar Local Time (SLT) and geographic latitude over the range 50-90°; (a) and (c) are for the northern (winter) hemisphere and (b) and (d) are for the southern (summer) hemisphere. For (a) and (b) the cross cap potential is 76 kV and Kp=3 and the ionosphere - thermosphere system has achieved steady-state: (c) and (d) show D' immediately after an increase from 76 to 152 kV under the same conditions.

TABLE 1. Peak values of D'

Season	Cross-Cap Potential	NO^+ ions at 200km	O^+ ions at 300km
summer	76 kV *	1.1	0.7
winter	76 kV *	1.4	0.9
summer	152 kV **	2.4	1.5
winter	152 kV **	2.8	1.8

* Steady-state conditions
** Time varying conditions following increase from 76 kV

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four cases shown in figure 1. Values are given for O^+ ions at 300 km and NO^+ ions at 200 km separately (the latter showing results which are very similar to those of all expected molecular ions, N_2^+, O_2^+ and NO^+). For the steady-state, 76 kV case, the molecular ions are very close to the non-thermal threshold, and should certainly be non-Maxwellian in the winter cusp. The O^+ ions, however, are only near the threshold in the winter hemisphere. In the non-steady state, 152 kV case, both species should initially be non-thermal, but would return toward equilibrium as the neutral air is accelerated, in the manner discussed by Lockwood and Fuller-Rowell.

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