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Correction to "Comparison of empirical field models and global MHD simulations: the near-tail currents" by T.I.Pulkkinen, D.N. Baker, R.J. Walker, J. Raeder, and M. Ashour-Abdalla

Nikolai Tsyganenko

Hughes STX Corporation at NASA Goddard Space Flight Center, Greenbelt, Maryland.

Tuija Pulkkinen

Finnish Meteorological Institute, Helsinki, Finland.

The paper of *Pulkkinen et al.* [1995] discusses the interesting question on how an MHD simulation matches the observed field, approximated by data-based models. However, due to an error in the numerical calculations, the currents implied by the empirical model were significantly underestimated. Adding to this confusion, the quiet-time empirical model field was compared with that measured in the tail lobe during a disturbed period with unusually high solar wind pressure. Taken together, these two factors led to a gross exagerration of the inaccuracy of the T89 model.

According to the statement on Page 676 (left column, bottom paragraph), "The T89 models suggest much more rapid decay of the current intensity ..., giving only 9 mA/m at $40\,R_E$ and 5 mA/m at $50\,R_E$. The observations give about 33 mA/m at $30\,R_E$, 25 mA/m at $50\,R_E$, and a constant 15 mA/m current tailward of $120\,R_E$ [*Slavin et al.*, 1985]."

Therefore, it was actually claimed that the T89 model yields an electric current and hence a lobe field as much as five times smaller than the observed one, and it motivated us to perform a recheck of the above result. The current intensity (net current per unit length along the tail axis) was calculated by integrating $\mathbf{j} = \mu_0 \nabla \times \mathbf{B}$ across the current sheet between $Z = -5R_E$ and $Z = +5R_E$, at $X = -40R_E$ and $X = -50R_E$, for six Kp-versions of the T89 model. The results are given in Table 1 below.

As seen from the table, even for the quietest version with Kp=0,0+, the model currents at X=$-40\,R_E$ and X=$-50\,R_E$ are significantly larger (by 37% and 74%, respectively) than the values 9 mA/m and 5 mA/m, cited by *Pulkkinen et al.* [1995] on Page 676. Although it is true that the T89 model overestimates the rate of tailward decrease of the lobe field, the effect is far less dramatic than claimed in the above paper.

The observational values 33 ma/m and 25 mA/m cited by *Pulkkinen et al.* [1995] for the distances 30 and $50\,R_E$, respectively, were taken from the work of *Slavin et al.* [1985]. Their near-tail lobe field estimate was based on measurements taken during two passes of ISEE-3, on December 23-25, 1982, and April 17-19, 1983. These passes occurred during disturbed periods, with the AE-index between 200 and 500 nT on December 23, rising up to ~800-900 nT for several lobe data intervals on December 24 and 25, and varying between 100 and 500 nT on April 17-19. According to *Couzens and King* [1986], the solar wind dynamic pressure was between 6 and 10 nPa during the lobe data intervals on December 23 and 24, which is well above the average value of 2 nPa. No solar wind data exist for the second lobe data interval. Since the tail lobe field strongly correlates with the solar wind pressure [*e.g. Nakai et al.*, 1991], the near-tail values of B given by *Slavin et al.* [1985] are likely to be larger than the average lobe field. This conjecture also gains support from the recent Geotail measurements: as seen in Figure 3 of *Yamamoto et al.* [1994], most of the lobe field data points fall below the regression line of *Slavin et al.* [1985].

As discussed in *Pulkkinen et al.* [1995], the *Raeder* [1994] MHD simulation predicts relatively large – and almost constant as a function of radial distance – lobe field at large distances. Hence, even with the error in the empirical model current calculation corrected, and the above caveats on the ISEE-3 data in mind, the ordering discussed by *Pulkkinen et al.* [1995] holds: in the mid-tail region ($R = 30 - 60\,R_E$), the simulation lobe field is larger than in the empirical model, and observations indicate values closer to (but still somewhat larger than) the model ones.

In conclusion, the inaccuracies in the tail lobe field implied by the data-based models are actually much smaller than claimed. The finding of a large discrepancy between the model and data stemmed from both a miscalculation of the

Table 1. T89 tail current intensities (in mA/m) for different Kp intervals

Kp	0,0+	1−,1,1+	2−,2,2+	3−,3,3+	4−,4,4+	≥5−
J (X=−40)	12.3	13.3	15.9	17.9	21.2	23.1
J (X=−50)	8.7	9.1	11.2	12.7	15.8	17.2

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model currents, and an overestimate of the average observed field.

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N.A. Tsyganenko, Hughes STX Corp., Code 695, NASA GSFC, Greenbelt, MD 20771.

T.I.Pulkkinen, Finnish Meteorological Institute, P.O. Box 503, Helsinki, SF-00101, Finland.

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