resulting in $D_{LL} \propto L$. However, this plasma shielding of an external electric field is frequency dependent, weaker for fluctuations than for steady-state conditions. So we expect less shielding for drift frequencies [*Rash et al.*, 1986] than for static fields, and in fact, radar observations [*Gonzales et al.*, 1983; *Earle and Kelley*, 1987], show no shielding of penetrating high-latitude electric fields. The Rice convection

Table 1. Fits to Data

	Domain	Parameter		N	$\langle\chi^2\rangle/N$	$\chi^2>10$
0	all*		1	11215	42.6%	21
		D^E		6.845(-10)	± 0.084	
1	all*		4	11212	32.4%	21
		D^E		14.5(-10)	± 1.5	
		n		2.01	± 0.082	
		Ω_E		1.86	± 0.080	
		m		0.019	± 0.012	
2	all*		6	11210	12.2%	0
		D^E		0.825(-10)	± 0.12	
		n		0.731	± 0.082	
		Ω_E		1.22	± 0.19	
		m		-0.129	± 0.012	
		L_0		5.39	± 0.19	
		p		-0.66	± 0.40	
3	H^+		6	3850	4.03%	0
		D^E		1.47(-10)	± 0.57	
		n		5.6	± 1.1	
		Ω_E		1.070	±0.085	
		m		-0.088	± 0.035	
		L_0		5.31	± 0.13	
		p		-3.90	± 0.90	
4	He^+,		6	7354	11.8%	0
	He^{++}	D^E		0.287(-10)	± 0.094	
		n		-0.486	± 0.12	
		Ω_E		2.57	± 1.2	
		m		0.040	± 0.018	
		L_0		6.07	± 0.31	
		p		-0.56	± 0.40	
5	all†		6	10481	6.84%	0
		D^E		0.659(-10)	± 0.11	
		n		0.798	± 0.084	
		Ω_E		1.11	± 0.21	
		m		-0.175	± 0.014	
		L_0		5.65	± 0.21	
		p		-0.85	± 0.43	
6	all†		(9)	10481	5.52%	0
		D^E		0.328(-10)	± 0.045	
		n		0.531	± 0.070	
		Ω_E		0.475	± 0.072	
		m		-0.194	± 0.017	
		L_0		5.89	± 0.22	
		p		-1.21	± 0.39	
		D^M		7.61(-14)	± 1.3	
		l		2.87	± 0.40	
		Ω_M		0.88	± 0.11	

* H^+, He^+, He^{++} excluding convection.
†Excluding He^+ at $L<4.3$.

Read 6.66(-10) as 6.66×10^{-10}.

servational support. Here we use $D_{LL} \propto L$ for externally driven diffusion, in agreement with other ring current studies [*Chen et al.*, 1993]. We note, however, that any electric field applied to the ring current should generate space charge and be shielded to some extent.

On the other hand, the quiet time magnetospheric electric field may be dominated by an internal, ionospheric source at low latitudes [*Mozer*, 1973; *Maynard et al.*, 1983]. Such an ionospheric electric field weakens at larger radial distances as the magnetic (electric equipotential) field lines diverge producing an $1/L$ dependence in the azimuthal electric field, or $E^2_{\rm int} \propto L^{-2}$ dependence in the azimuthal fluctuations. North-south ionospheric electric fields when mapped to radial electric fields in the equatorial plane weaken even more rapidly giving an $E^2_{\rm int} \propto L^{-3}$ fluctuation dependence [*Matsushita*, 1971; *Mozer*, 1970]. Plasma shielding may diminish this internal electric field as well.

Possibly more important, the latitudinal dependence of the ionospheric fluctuations may generate an equatorial radial gradient in $\Delta E_{\rm int}$. These gradients tend toward increasing fluctuation level with decreasing latitude near the equator [*Fejer et al.*, 1990a], but with the opposite gradient at high latitudes. Since both internal and external sources generally contribute, there is an L shell, L_0, at which the dominant electric field and the electric field gradient switches from internal to external [*Baumjohann et al.*, 1985; *Thayer et al.*, 1990]. Thus we will use a semiempirical functional form which is the sum of external, $\Delta E^2_{\rm ext} \propto L^{q-6}$, and internal $\Delta E^2_{\rm int} \propto L^{p-6}$, electric fluctuation contributions,

$$\frac{\sum_i \langle \Delta E_i^2 \rangle}{B_d^2} \propto L^q + A L^p = L^q[1 + (L/L_0)^{p-q}] \quad (17)$$

giving an electric diffusion coefficient,

$$D^E_{LL} = \frac{D^E L^q [1 + (L/L_0)^{p-q}]}{(\Omega_E/\Omega_1)^n} (\Omega_T/\Omega_E)^{-n\,\alpha\,m} \quad (18)$$

where we normalize the coefficient to the standard form at $\Omega_1 = \Omega_T$(E=100 keV, L=7.5), and D^E, L_0, p, q, m, n, and Ω_E remain to be determined.

4. Analysis

In Table 1 we list the values of each of χ^2 fits. For all but fit 3, a pathological case, the fits show incremental improvement in reduced χ^2. If a variable is not listed in a particular fit, it is held constant at the preceding fit value. Fit 0 is the reference fit from paper 1, which is a single parameter fit of the electric diffusion amplitude D^E but using the standard form for the electric diffusion coefficient [*Spjeldvik*, 1977] and a drift frequency, Ω, solely due to $\vec{\nabla} B$ drift. The other parameters (not all applicable to the reference fit) were held fixed at the following values: $D^M = 2.3 \times 10^{-15} R_E{}^2$/s, q=6, p=0, L_0=1, n=2, l=2, k=0.3, and Ω_M =1.

The logarithm of the ratio of this fit to the data is displayed in Figure 2, which shows deviations greater than an order of magnitude over 50% of the data set. The diffusion coefficient was found to be $6.84\times10^{-10}\pm0.08 R_E{}^2$/s with a χ^2 of 42%.