from longer to shorter scales. *Earle and Kelley* [1987] suggest ionospheric gravity waves as a possible candidate for this fluctuation power, but to be consistent with our latitudinal gradient the waves must either show such a gradient or modulate the low-latitude electric fields as is implied by *Fesen et al.* [1989]. We exclude the equatorial counter-electrojet or the disturbance dynamo [*Blanc and Richmond*, 1980] with periods of ~3 hours [*Kane*, 1981], which though driven by high-latitude activity, may still exist during quiet periods [*Hanuise et al.*, 1983], because the data set orbits were selected for times >24 hours since Kp=3. More likely it is the day-to-day variability of the dynamo fields that produces the low-frequency power.

There are large LT effects of the equatorial electrojet that contribute to the global static electric field as described by *Richmond et al.* [1980]. In addition, there is a ~30% day-to-day variation in these Sq fields. *Maclennan et al.* [1991] have presented a spectral analysis of voltages induced by the Sq currents on two parallel, California to Hawaii cables. They find a rise in the power up to a peak at 24 hours followed by a gradual rolloff at lower frequencies. If we simply assume that the electrical current in the Sq system is proportional to the electric field, then the fact that there is fluctuation power in our drift resonant frequency range comparable to the main peaks at 12 and 24 hours, suggests that a dynamo fluctuations can account for the diffusion seen during quiet times. Part of the variability arises from the various tidal modes that can couple to the ionospheric plasma [*Hanuise et al.*, 1983; *Stening*, 1989], which change daily. Attempts at modeling this coupled system are currently underway, [*Richmond et al.*, 1992].

External Electric Field Source

The transition from internal to external fluctuation dominance occurs at approximately geosynchronous altitude during quiet conditions, in general agreement with satellite observations of the static electric field [*Baumjohann et al.*, 1985]. Since geosynchronous altitude maps to subauroral latitudes, it is also consistent with the 60° high-latitude limit of applicability of the quiet time ionospheric electric field model [*Richmond et al.*, 1980]. We expect this transition point to move inward with increasing activity, though the radar work of *Earle and Kelley* [1987] suggests that the high-latitude, external fluctuation source will never completely dominate at L=1 [*Blanc*, 1983].

Ions of Hydrogen and Helium

The model fit to the H^+ distribution alone is substantially different from the coupled helium ion fits. This is partly due to the weaker dependence for H^+ on loss processes than for He^+ and He^{++}. It is the algorithm's attempt to fit the He^+ deviation that generates a smaller diffusion coefficient and an underestimated H^+ and He^{++} in fits 2 and 4. But for the most part there is good agreement between the hydrogen and helium ions in the coupled solutions implying that the major loss processes are modeled correctly. This follows

at least not below ~300 keV/e.

The major disagreement between modeling and data found in He^+ alone, between L=2.8–4.8 and μ=0.08– keV/nT of Figure 4, where the model consistently overp dicts by 1–2 orders of magnitude. This region is proble atic, since in our parameter diagram it lies at an angle the constant energy curves and does not appear to be eit instrumental or convective in character. We were unable explain this deviation with the any of the loss processes corporated in the model, nor by incorporating in the mo any of the possible gyro- or bounce-resonant waves in t region. Yet since it has many characteristics of a loss proce we tentatively suggest that this feature might be due to l by electron impact ionization of He^+, possibly produced an accelerated (10–20 eV) component of the magnetosph ic electron population, and possibly even generated by spacecraft itself. If this be the mechanism, we note that acceleration increases with decreasing altitude, which m be caused by an increased ram velocity and/or plasmasphe density interaction. This aspect warrants further investi tion.

Predicted Ionospheric E Field Fluctuation Power

We plot in Figure 7 the tentative estimated electric fi power determined from our fitted diffusion coefficient, alo with some previous measurements, using the technique [*Mozer*, 1971; *Andrews*, 1980] which assumes that the lo est spatial harmonic of the field couples to the the $\vec{\nabla} B$ d period. We cautionarily note, however, that this assumpt may not always be valid, since balloon measurements [*Ho worth and Mozer*, 1979] find an equivalent power in hig spatial harmonics. Solid lines show fitted regions, dash are linear extrapolations beyond the fitted data region. T fitted values fall within the range of previous observatio s, but they do not show the same frequency dependence more direct measurements.

The spectral exponent deviation may arise for several r sons. From *Andrew*'s [1980] data, the steep drop in pov density occurs at frequencies above an inflection point. If limited data set does not sample above this inflection po then our fits will not be sensitive to the frequency falloff. T higher drift frequencies (energies) also have less particle lo so that the diffusion coefficient is not highly constrained this region. In addition, the present derivation assumes t the lowest spatial component dominates the diffusion, whi may not be correct for the highly distorted, low-energy orb s, particularly at L=3. Finally, the lower frequencies may shielded by a ring current mechanism as suggested by *Ea and Kelley* [1987].

Magnetosphere-Ionosphere Coupling Processes

The possibility of an magnetosphere-ionosphere feedba mechanism should not be overlooked. If the ionospheric d namo fluctuations really do control the diffusion rate, th they modify the location of the ring current inner edge. T location of the ring current inner edge affects the region