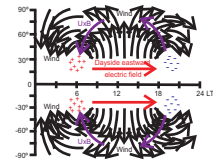


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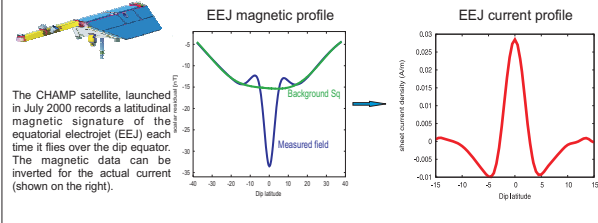
The day-side eastward electric field driving the equatorial electrojet

Diurnal tidal winds give rise to a $U \times B$ drift of ions in the E-region. This results in a buildup of charges at the dawn and dusk terminators, giving rise to a day-side eastward electric field.

This electric field drives an eastward current along the magnetic equator.

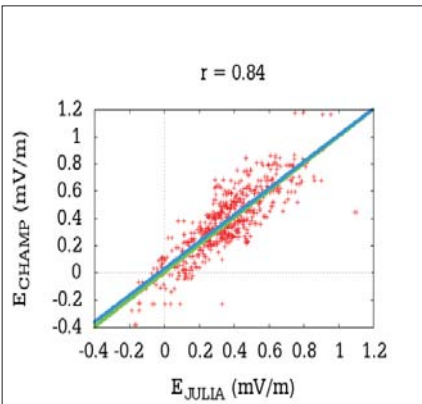


CHAMP satellite magnetic measurements



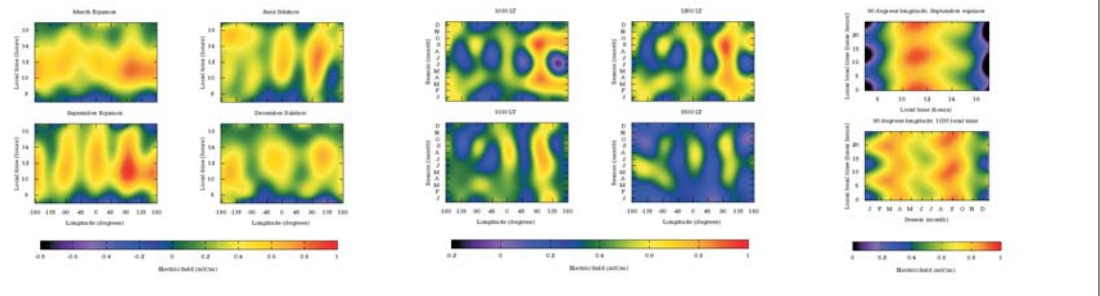
Modeling the EEJ current profiles

To try to model the CHAMP EEJ current profiles, we solve the governing equations (above). These equations can be formulated into a second order, elliptic partial differential equation for the stream function ψ . The electron, ion, and neutral temperatures and densities are provided by the International Reference Ionosphere (IRI) and NRLMSIS models. The neutral winds (meridional and zonal) are provided by HWM07. The eastward electric field input is optimized to produce the best agreement with the observed CHAMP current profile.



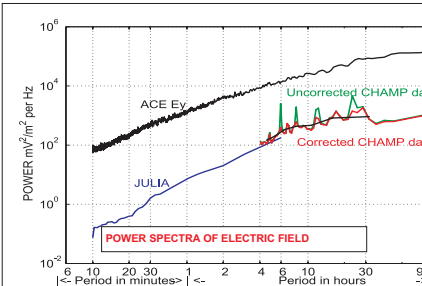
Comparison with JULIA radar measurements

When comparing our CHAMP derived electric field estimates with directly measured values from 150km ion drift echoes from the JULIA radar, we find a correlation coefficient of 0.84 and a best fit slope of 0.98. The RMS error between JULIA and our EEJ estimates is 0.13 mV/m when using all available data.



Climatological model of the EEJ

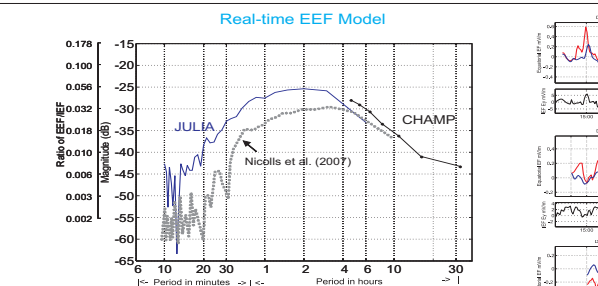
We have created a climatological model of the EEJ mean from our dataset of over 36,000 electric field estimates. The model is a function of longitude, local time, season, solar flux, and lunar local time. Plots of this model for various parameters are shown above. The left plots the electric field mean as a function of longitude and local time for four different seasons. During March and September equinox we find a wavenumber-four pattern in longitude, which is known to be due to the atmospheric eastward propagating DE3 tide coming from below the ionosphere. During solstice, we find a wavenumber-three pattern, which is also attributed to the tides. In the middle plot, we show the electric field as a function of longitude and season for different local times. We again see the wavenumber-four and wavenumber-three patterns. We also see that the electric field peaks primarily during March and September equinox. This can be attributed to the Sq current system at higher latitudes, which is known to shift equatorward during equinox, causing more current to flow at the magnetic equator. Finally, the plot on the right shows the lunar dependence of the EEJ as a function of season and local time. We see a semi-diurnal variation in the lunar local time, due to the gravitational effects of the moon, causing a lunar gravitational tide on both the near and far sides of the earth. This gravitational tide affects the winds, which in turn modulates the electric field.



Corrected CHAMP data indicates removal of climatological model described above.

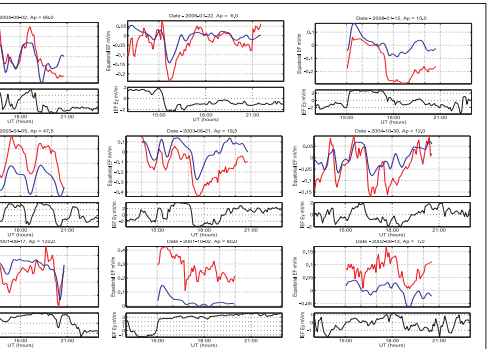
Power spectra of interplanetary and equatorial electric fields increase monotonically with period.

The equatorial electric field (EEF) spectra from CHAMP and JULIA exhibit a smooth transition. A statistically reliable, wideband spectrum of the EEF is obtained by combining JULIA and CHAMP observations.



The transfer function is the quotient of the cross-power spectral density ($P_{IEF-EEF}$) of the two data sets and the power spectral density of the input IEF ($P_{IEF-IEF}$).

A broad peak at periods of around 2 hours indicates maximum admittance of IEF fluctuations at this period.



EEF predictions using our transfer function for 9 days in 2000-2008

Orange curves show JULIA time series. Blue curves show real-time model output driven by ACE data, which is shown in the bottom panels.

- Conclusion**
- We have inverted CHAMP magnetometer data for estimates of the equatorial electric field (EEF).
 - We have developed and validated climatological and real-time models of the EEF.
 - The models are available online at: <http://www.geomag.us/models/EEF.html>.
- References**
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 - Manoj, C., S. Maus, H. Lühr, and P. Alken, Penetration characteristics of the interplanetary electric field to the daytime equatorial ionosphere, J. Geophys. Res., 113, A12310, doi:10.1029/2008JA013381, 2008
 - H. Lühr, M. Rother, K. Häusler, P. Alken and S. Maus, "The influence of non-migrating tides on the longitudinal variation of the equatorial electrojet", JGR, 113, A08313, 2008.