

Abstract

Measurements from the Defense Meteorological Satellite Program's (DMSP) F13 Satellite were used for a study of convection location in the polar regions of the earth's ionosphere. The satellite was in a sun-synchronous orbit in the dawn-dusk meridian. The data available corresponded to 4 second averages. Using a 20-second smoothing technique, the zero crossings in the ion drift velocity values were determined for each pass of the satellite. OMNI data were used to calculate the average IMF conditions for each pass from 5 minute data with a 10 minute lag to allow the IMF signal to propagate to the ionosphere. This study only considered northern hemisphere passes with a Bz southward component where the By component was three times smaller than the Bz component. These passes were archived, along with information about the location of the convection reversal boundary (zero crossing in ion drift velocity) for each pass. This survey was conducted over two years of data (1996 and July 1998-June 1999). The data were then plotted to analyze trends in boundary location dependent upon IMF conditions. We also ran the Weimer 2001 and 2005 models under the same geophysical conditions in order to compare these models with our values. Preliminary results suggest that Weimer 2005 has a better correlation to the true convection reversal boundary than Weimer 2001. Both models had higher accuracy levels on the dawn side of the earth than on the dusk side. We also found a strong tendency in both models to place the convection reversal boundary too far towards the poles. Further analysis will be needed to confirm these findings and complete the survey for all 15 years of DMSP F13 data and both hemispheres.

Comparison with Weimer Models

We ran the Weimer 2005 and 2001 models to compare the size of the convection radius as measured by DMSP with the predicted convection radius from the model given the geophysical parameters for the DMSP data

Below: plots of the Weimer models for geophysical conditions given by a single pass of DMSP data (overlaid in pink)

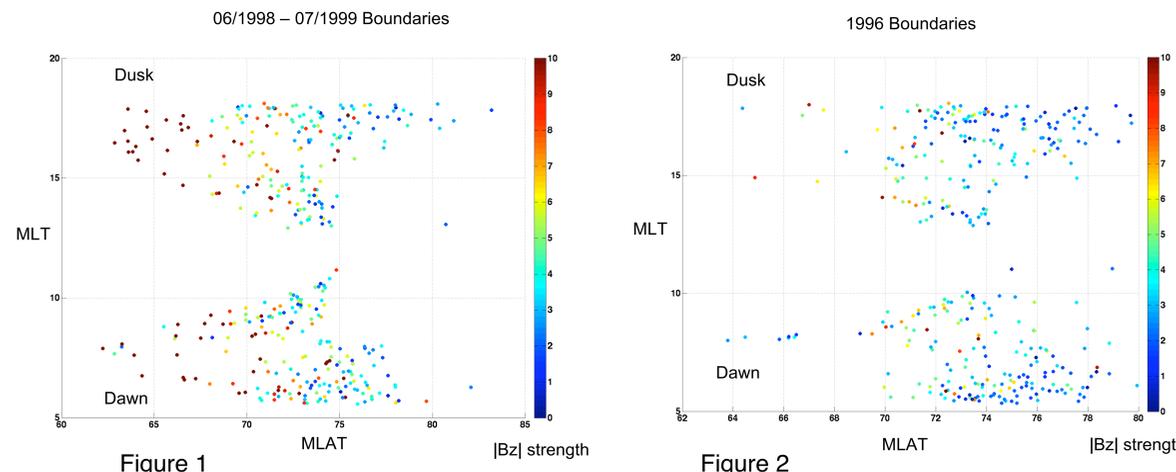
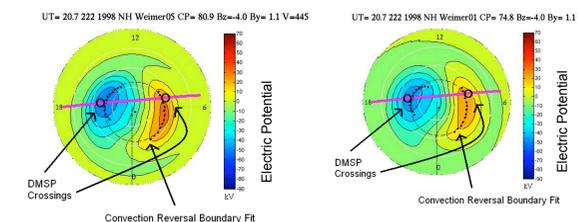


Figure 1

Figure 2

Results

Figure 1: 07/98-06/99 Boundaries plotted against MLT, MLAT and IBzI strength
 Figure 2: 1996 Boundaries plotted against MLT, MLAT and IBzI strength
 Figures 3 - 6: Crossing radius for each pair of boundaries plotted against Bz strength or electric field (Bz*VSW) with linear best fit line and cross correlation
 Figure 3: 07/98 - 06/99 Angle vs. Bz Figure 4: 07/98 - 06/99 Angle vs. Bz*VSW
 Figure 5: 1996 Angle vs. Bz Figure 6: 1996 Angle vs. Bz.*VSW

Data Analysis

Defense Meteorological Satellite Program's (DMSP) F13 Satellite
 Sun-synchronous orbit in dusk-dawn meridian from 0600-1800 LT
 Circular orbit at altitude of ~850 km
 Orbital period of 101 minutes
 Measurements taken by an ion drift meter
 Data corresponded to 4-s averages

Data Filtering:
 Northern hemisphere only
 Magnetic latitudes above 45 degrees
 IMF conditions for each pass were found using 5 minute OMNI data, averaged over the pass, allowing a 10 minute lag (to account for propagation to the ionosphere)
 IMF conditions had a strong Bz southward component and low By component
 Start and end of the pass must fall within 2 hours of dawn and dusk (in MLT)
 Smoothing with 20 second averages

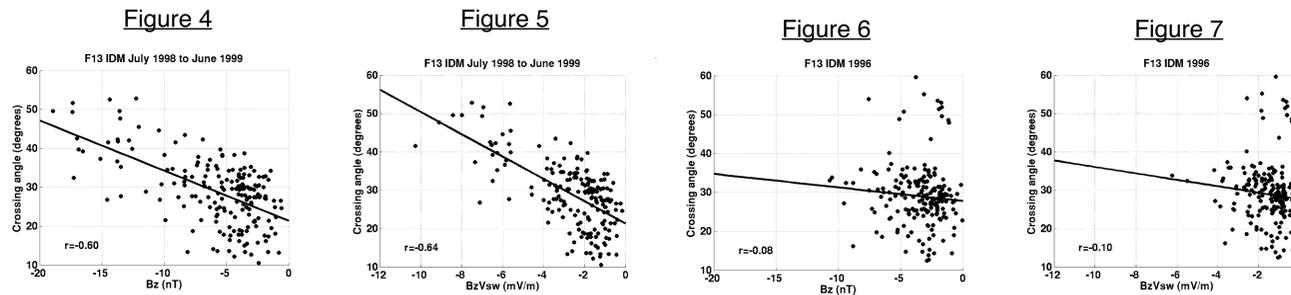


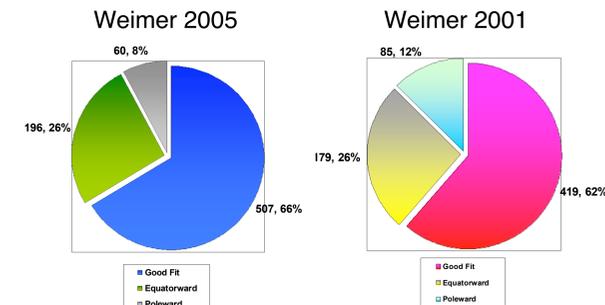
Figure 4

Figure 5

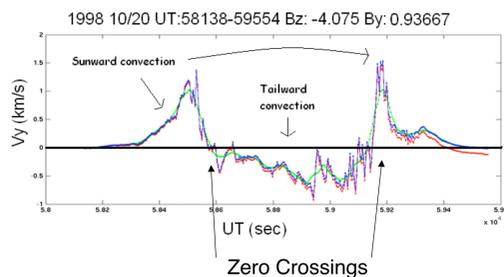
Figure 6

Figure 7

Statistical Comparisons between DMSP data and the Weimer models



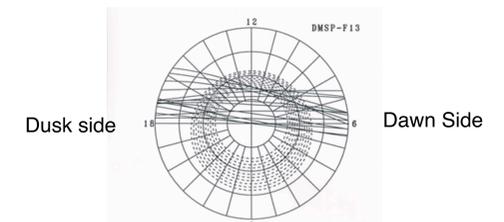
All "good fit" Weimer data falls within 2 degrees magnetic latitude of our DMSP crossing data. Poor fit data is broken into crossings that fell too far equator ward and too far pole ward



Method

Figure top left:
 Plot for a single pass of DMSP Data
 Red line - raw data
 Blue line - detrended data
 Green line - detrended and averaged data
 Black line - zero line
 Zero crossings were found and saved for each plot

Figure bottom left:
 Image showing one day of passes of DMSP F13 on the northern hemisphere

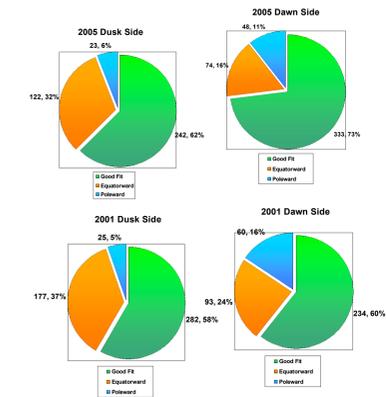


Conclusions

There is a strong correlation between Bz strength and the location of the CRBs
 Dawn side predictions of the Weimer models were more accurate than the dusk side (somewhat unexpected)
 The Weimer models often predict the convection reversal boundary to lie too far poleward
 The DMSP data has a greater range in MLAT values than the Weimer models predict
 These results warrant a full scale study covering both hemispheres and all of the DMSP F13 data (1995-2009)
 Further research will be necessary to verify these results

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More Comparisons

The left hand charts show that both the Weimer models predict the dawn side crossing much more accurately than the dusk.

The orange and the blue pie slices indicate whether the DMSP data fell further equatorward or poleward than the Weimer models predicted