

Relationship between SWPC Products and Geoelectric Fields

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Outline

- Motivation & Background
- Initial Results
- Direction for the future

E-field motivation

Electric Utilities Workshop 2011 requests

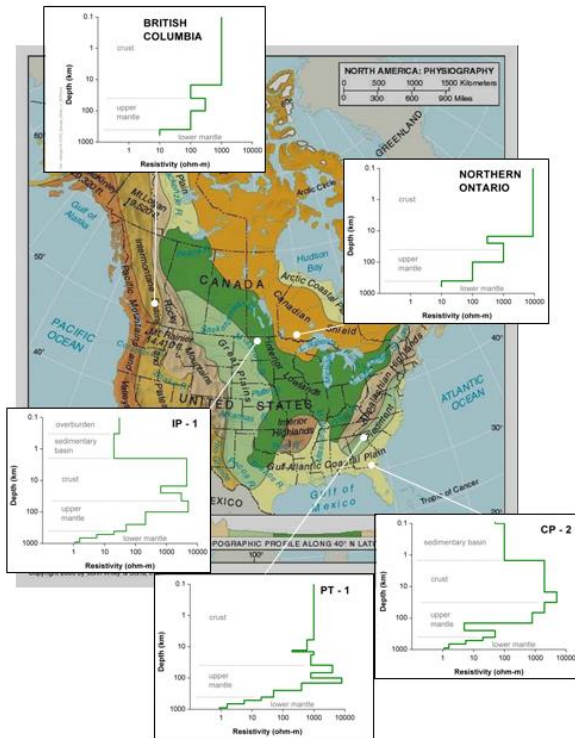
‘...real-time specification and prediction of the electric field at user operating site’

‘...due to limitations in prediction, predictive summary measures will likely be required for the near term’

‘...SWPC & partners will investigate a storm catalog to find ways to characterize the envelope of these disturbances’

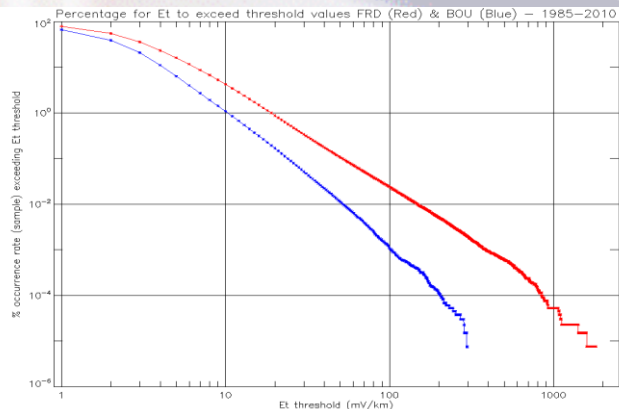
Note – current product suite uses global Kp index

Electric Field Calculation: Partnership with USGS

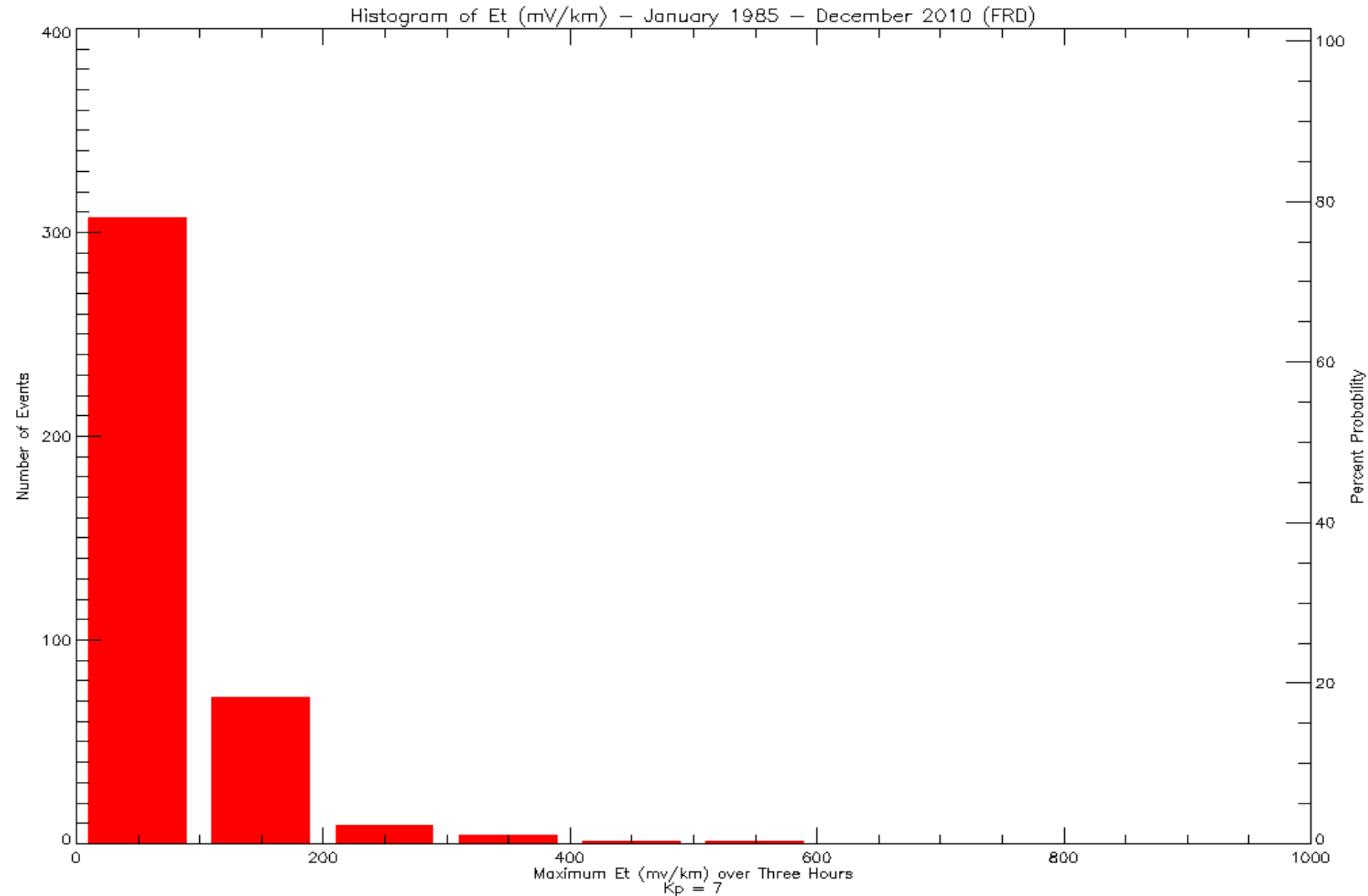


Credit: Fernberg, Gannon and Bedrosian,

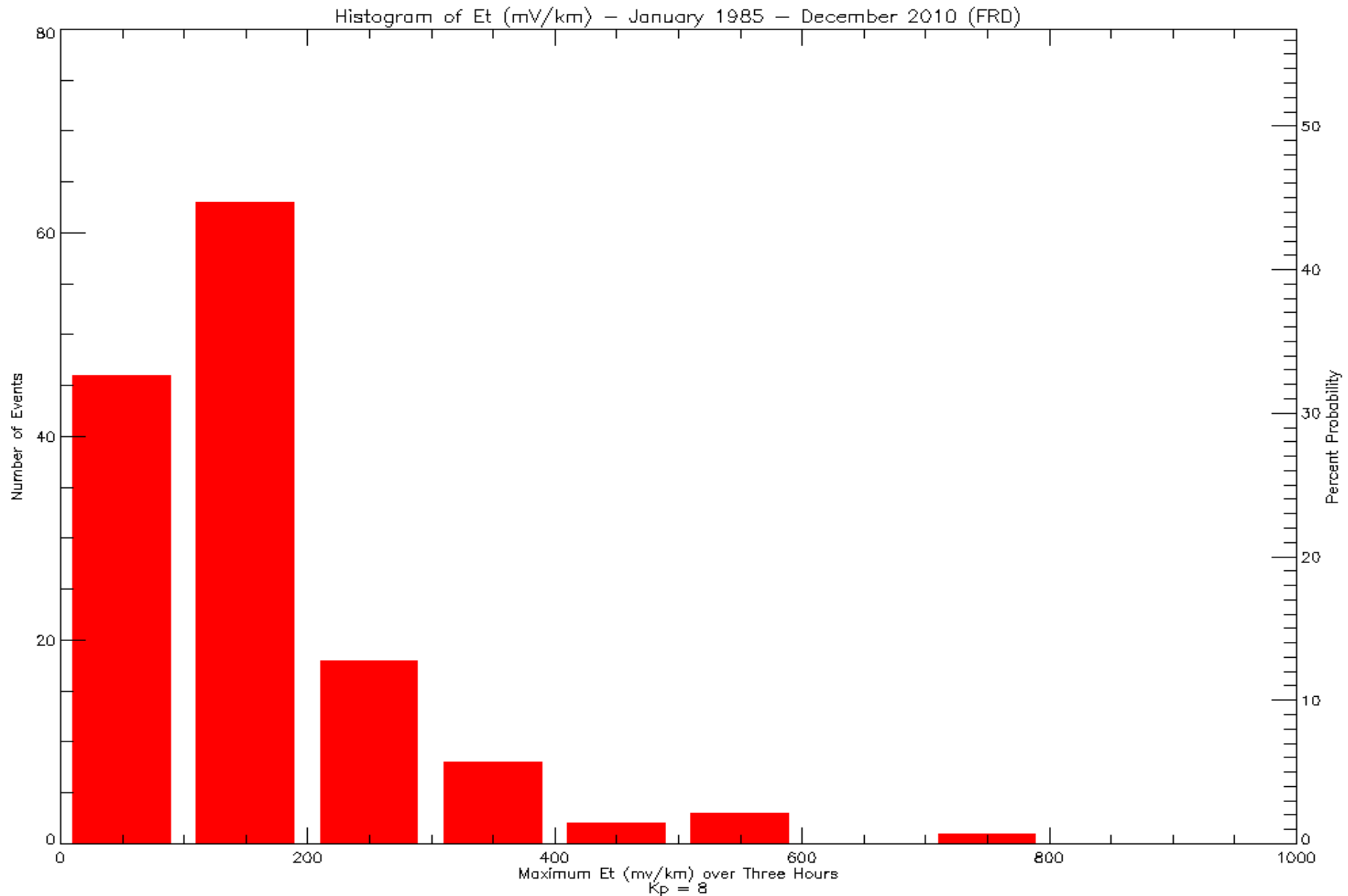
- Requires Magnetometer Data
- Requires Earth Conductivity
- Highlights GIC as a geo-hazard as well as a space wx hazard
- Calculation of historical E-field by USGS & NRCAN
(Gannon talk – this session)
- Able to specify E-field distribution as a function of Kp
- Able to look at storms from the perspective of the E-field magnitude, duration, envelope
- Points the direction for future product development



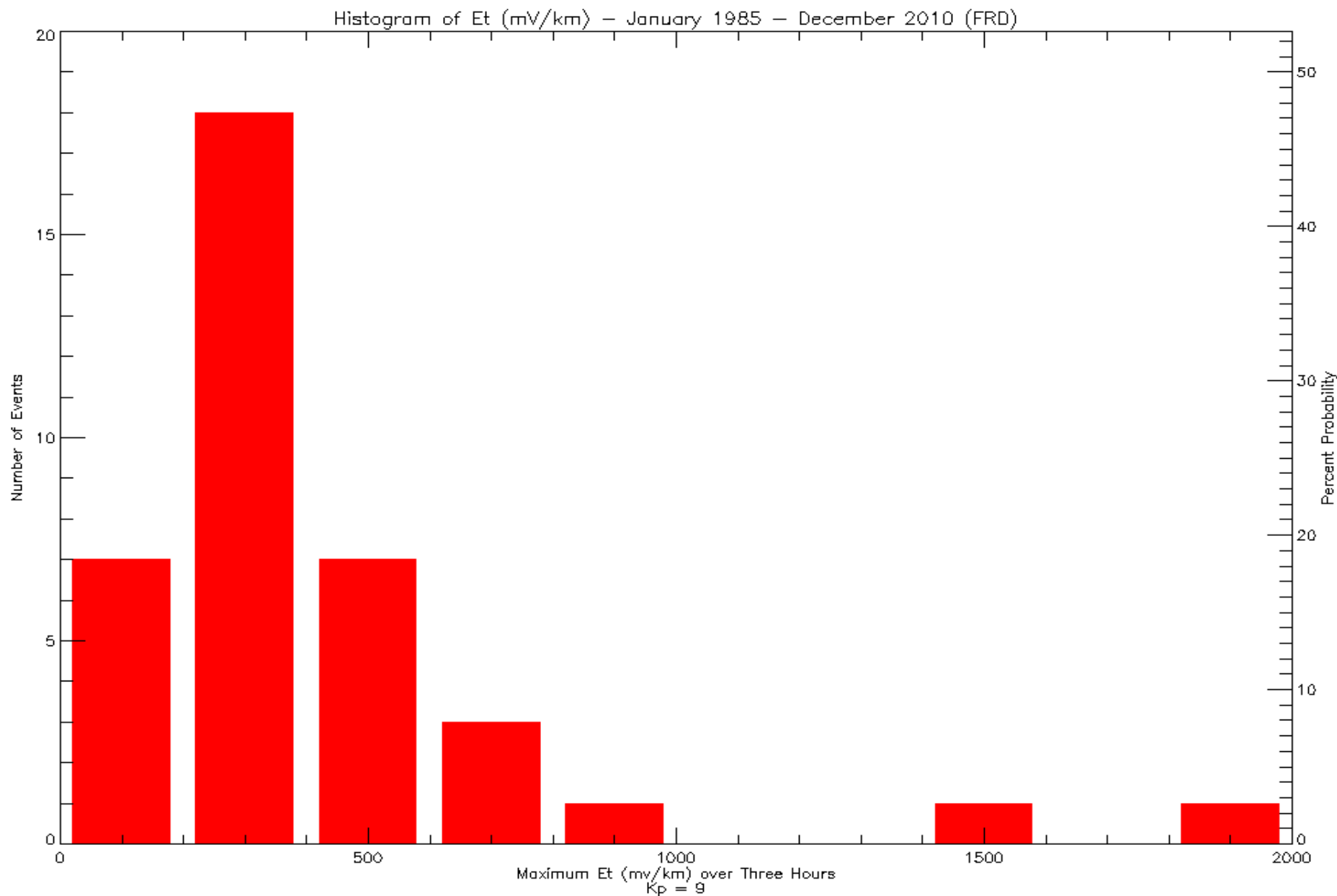
Results: Max Et for Kp=7 (FRD)



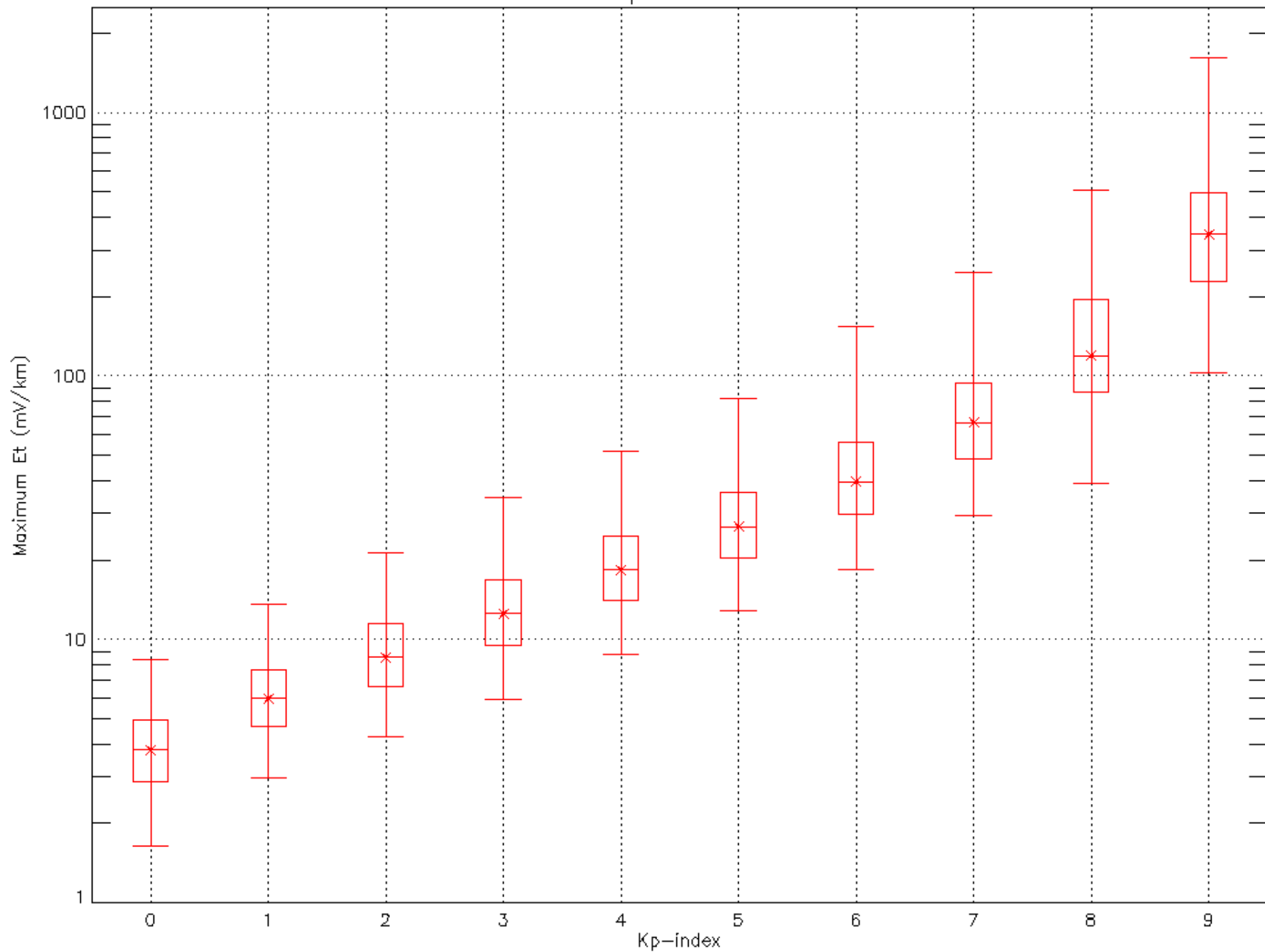
Results: Max Et for Kp=8 (FRD)



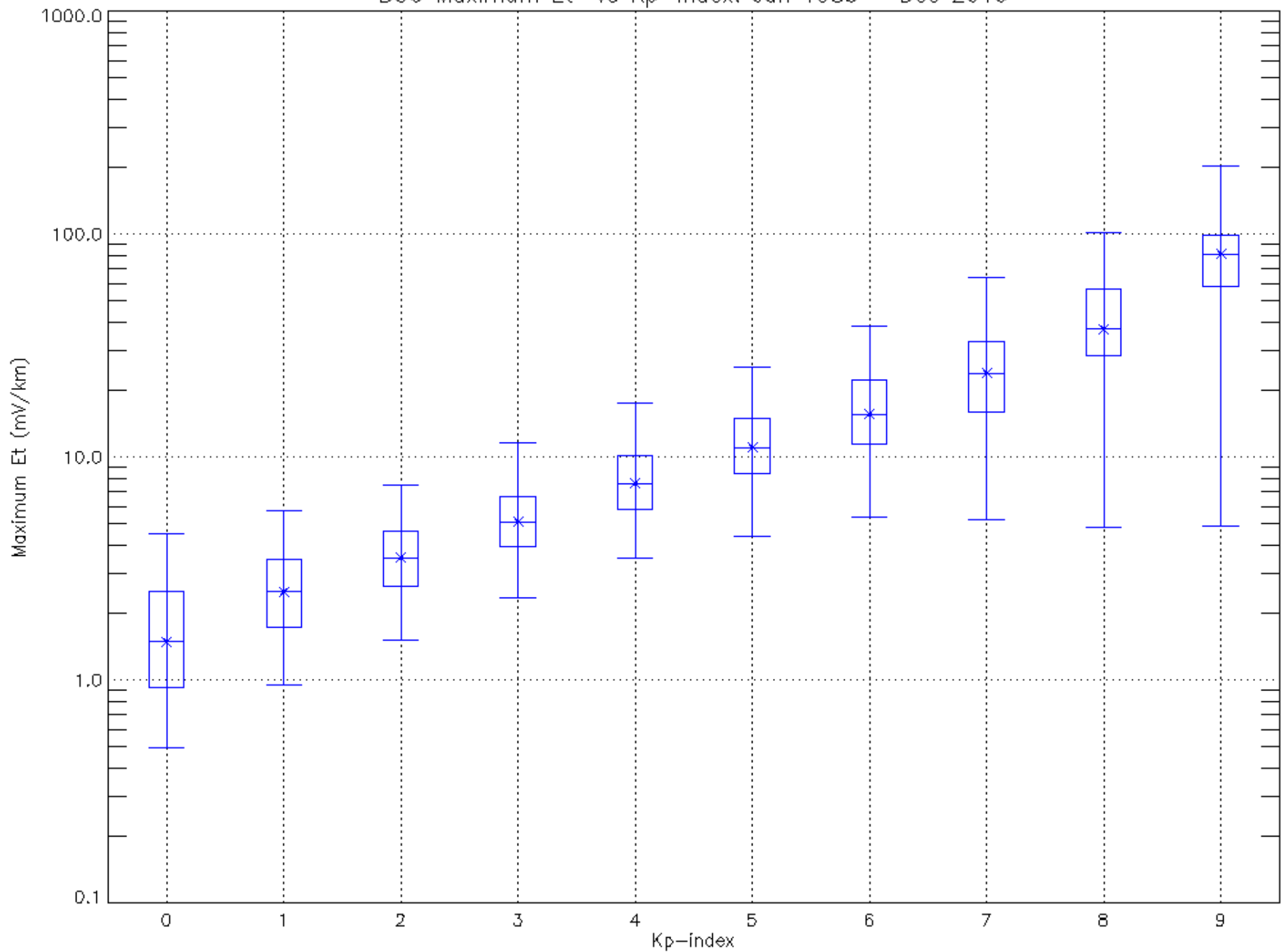
Results: Max Et for Kp=9 (FRD)



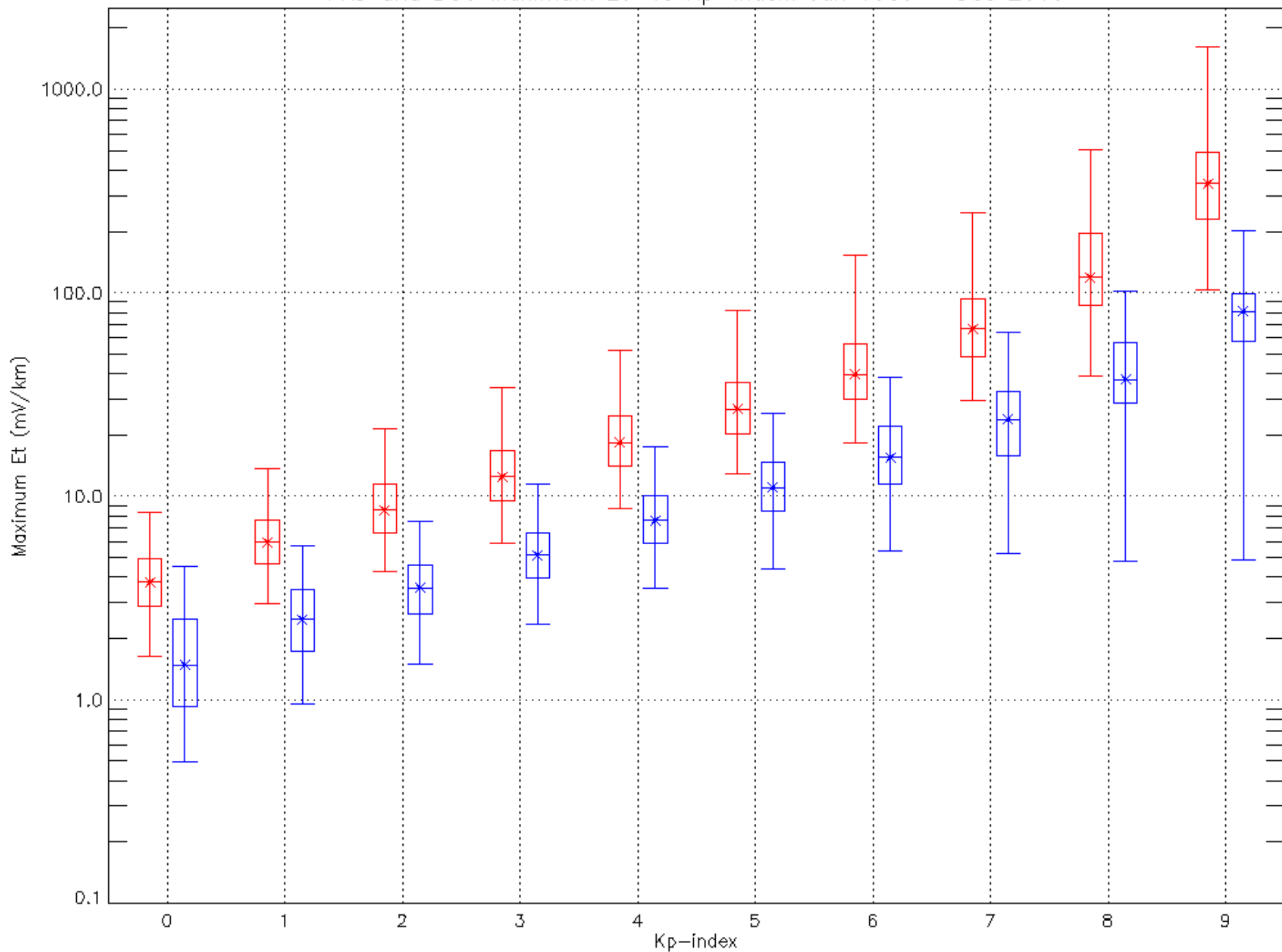
FRD Maximum Et vs Kp-index: Jan 1985 – Dec 2010



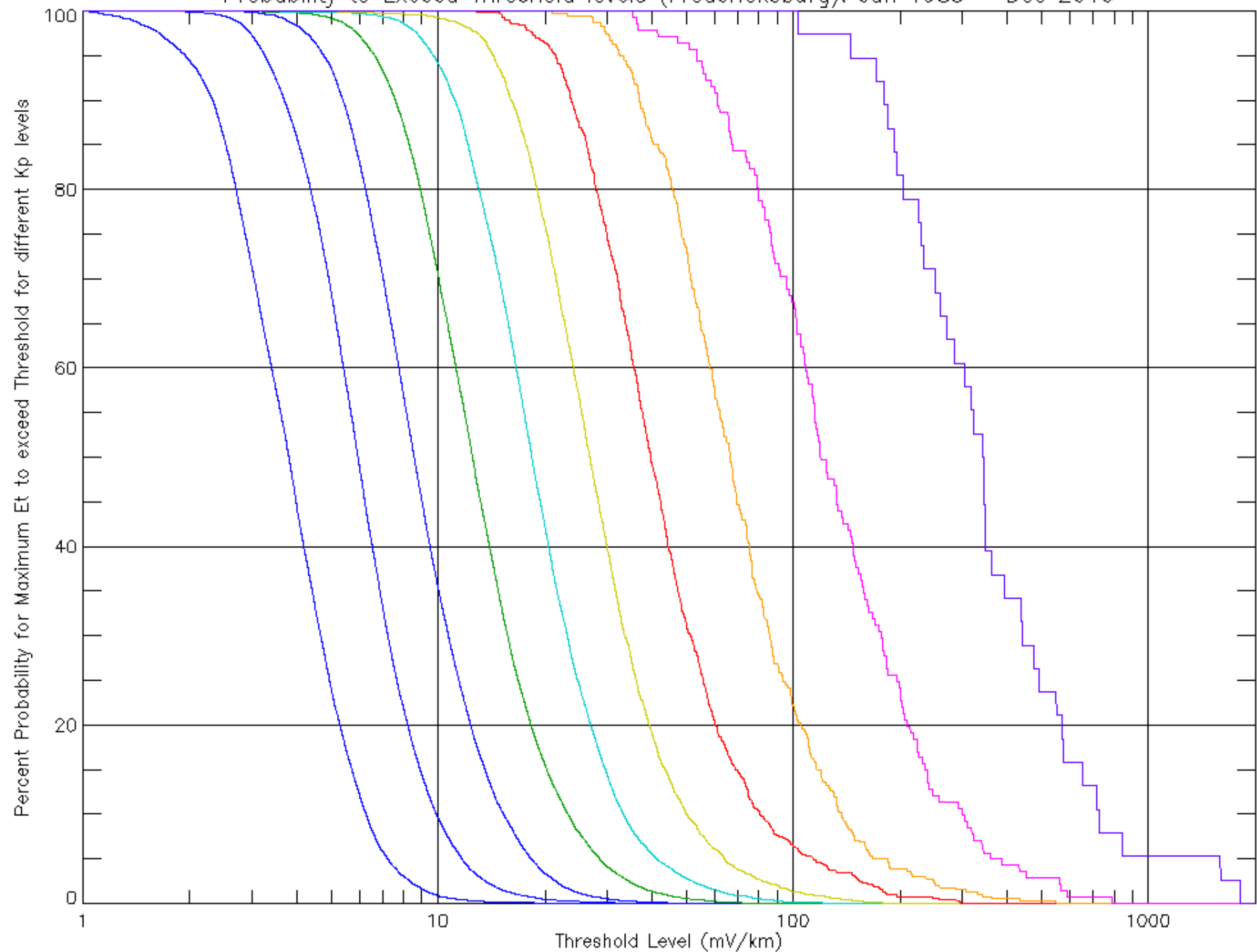
BOU Maximum Et vs Kp-index: Jan 1985 – Dec 2010



FRD and BOU Maximum Et vs Kp-index: Jan 1985 - Dec 2010



Probability to Exceed Threshold levels (Fredericksburg): Jan 1985 – Dec 2010



Probabilities to exceed Et levels

FRD probabilities

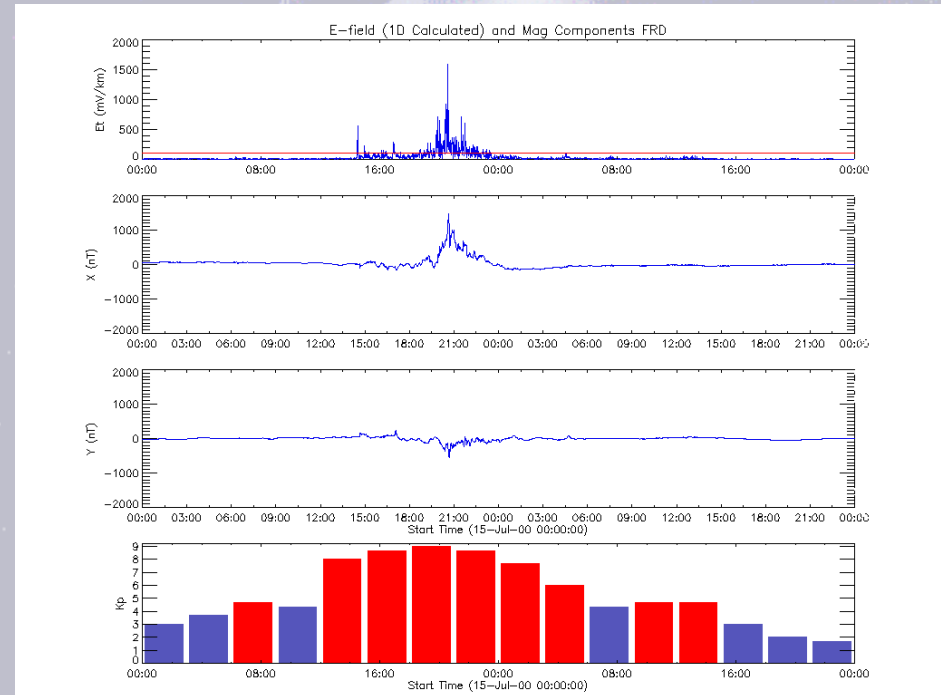
Kp	% Prob > 50 mV/km	% Prob > 100 mV/km
0	0.0	0.0
1	0.0	0.0
2	0.1	0.0
3	0.5	0.0
4	2.8	0.2
5	10.0	1.4
6	31.3	6.4
7	73.4	22.1
8	96.5	67.4
9	100.0	100.0

BOU probabilities

Kp	% Prob > 50 mV/km	% Prob > 100 mV/km
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.7	0.0
7	5.5	0.0
8	33.1	3.4
9	76.3	21.1

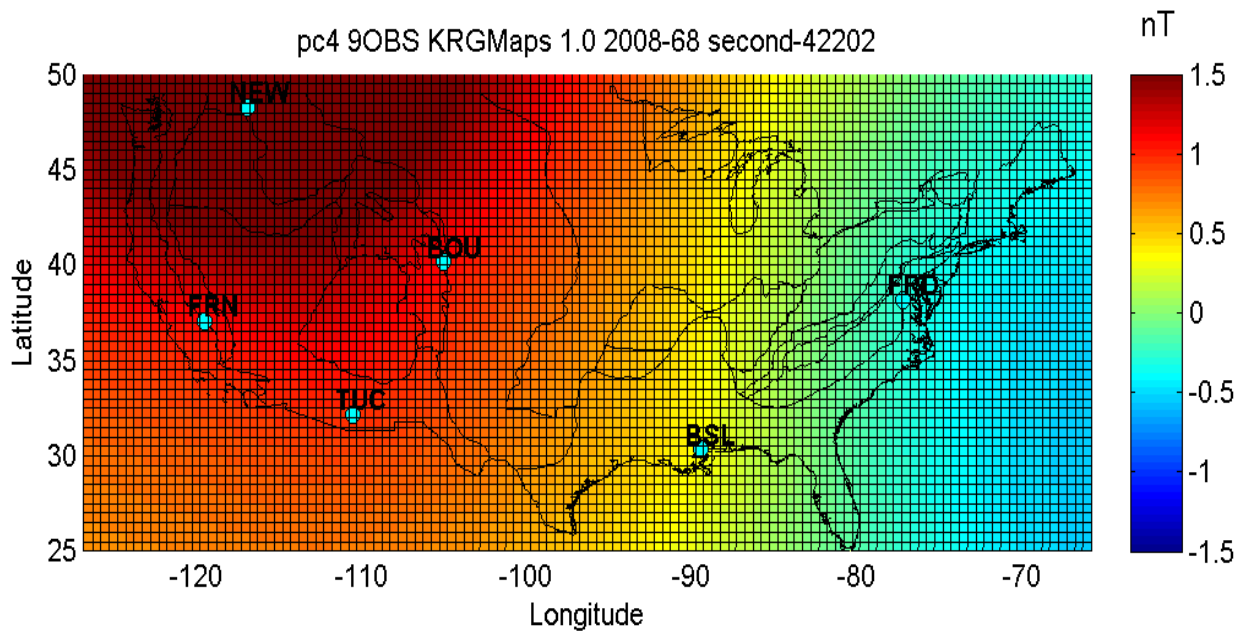
Future – storm analysis

- Characterize the Et time series
- Rank storms by electric field intensity, duration, other measures TBD
- Construct storm catalog for reference



***'Bastille Day' storm of July 2000:
Et, Bx, By, Kp***

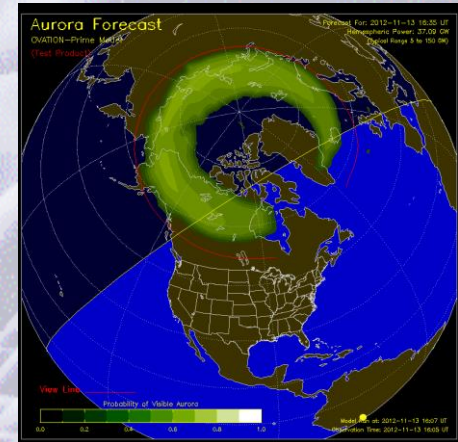
Future: USGS-NOAA Operational Local Geo-electric Field Product



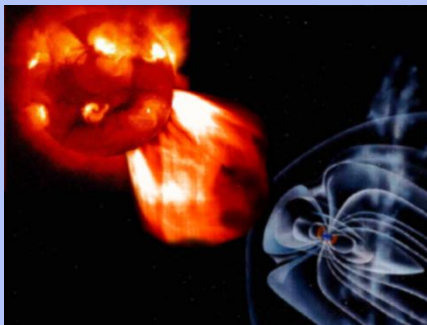
- **Driven by USGS real-time magnetometer data**
- **Electric field calculated locally using regional 1D conductivity**
- **User would be able to view calculated E-field time series anywhere on the map**

Future: E field Forecasting?

- Critical dependence on ACE solar wind data (DSCOVR)
- Efforts continue to select and transition a GEOSPACE model to support regional predictions
- Development effort will have to address limits of model time & spatial resolution



Ovation - Aurora



Solar Influences on Geospace Predicted with Geospace Models using Solar Wind Input

Summary

- **1D region conductivity models have been developed (USGS)**
- **25 years of historical E-field calculations have been completed (USGS, NRCAN)**
- **Analysis of the data is underway**
- **Comparisons between Kp & Et**
 - **Et distribution varies with Kp**
 - **Distributions are very dependent on location**
 - **Kp contains probabilistic information about Et**
- **Future Products**
 - **Storm analysis/catalog from E field perspective**
 - **Nowcast E field maps are in development**
 - **Forecast E field products are TBD**