Auroral Precipitation and HIgh Latitude Ionosphere Electrodynamics (AURORAPHILE)

(Leads: R. Robinson, Y. Zhang, B. Kosar)

- **Working Team Goals**
  To establish quantitative means to measure the accuracy and reliability of modeled properties of the auroral ionosphere, including particle precipitation, conductivities, electric fields, neutral winds, currents, and Joule heating.
- **Working Team Deliverables**
  The working team will establish a set of properties that describe the state of auroral particle precipitation and electrodynamics, and then quantify the accuracy and reliability currently achievable using a combination of data and models. Parameters that specify the auroral ionosphere will include both local and global quantities.

Auroral Precipitation and High Latitude Ionospheric Electrodynamics

Property	One-D Form	Two-D Form
Auroral Conductivities		Map
Energy Flux from Precipitating Particles	HPI	Map
Electric Fields	CPCP	Map
Currents	AE	Map
Joule Heating	JHPI	Map
Auroral Boundaries	Polar Cap Area	Boundary latitudes

HPI=Hemispheric Power Index; JHPI=Hemispherically Integrated Joule Heat; CPCP=Cross Polar Cap Potential

Metric Steps

Select Events

- 9 March 2012
- 17 March 2013
- 21-24 June 2015

Use all available data to determine the best values for

- **conductivity**
- **precipitating particle energy flux**

electric fields

- **Currents**
- **Joule heating**
- **auroral boundaries**

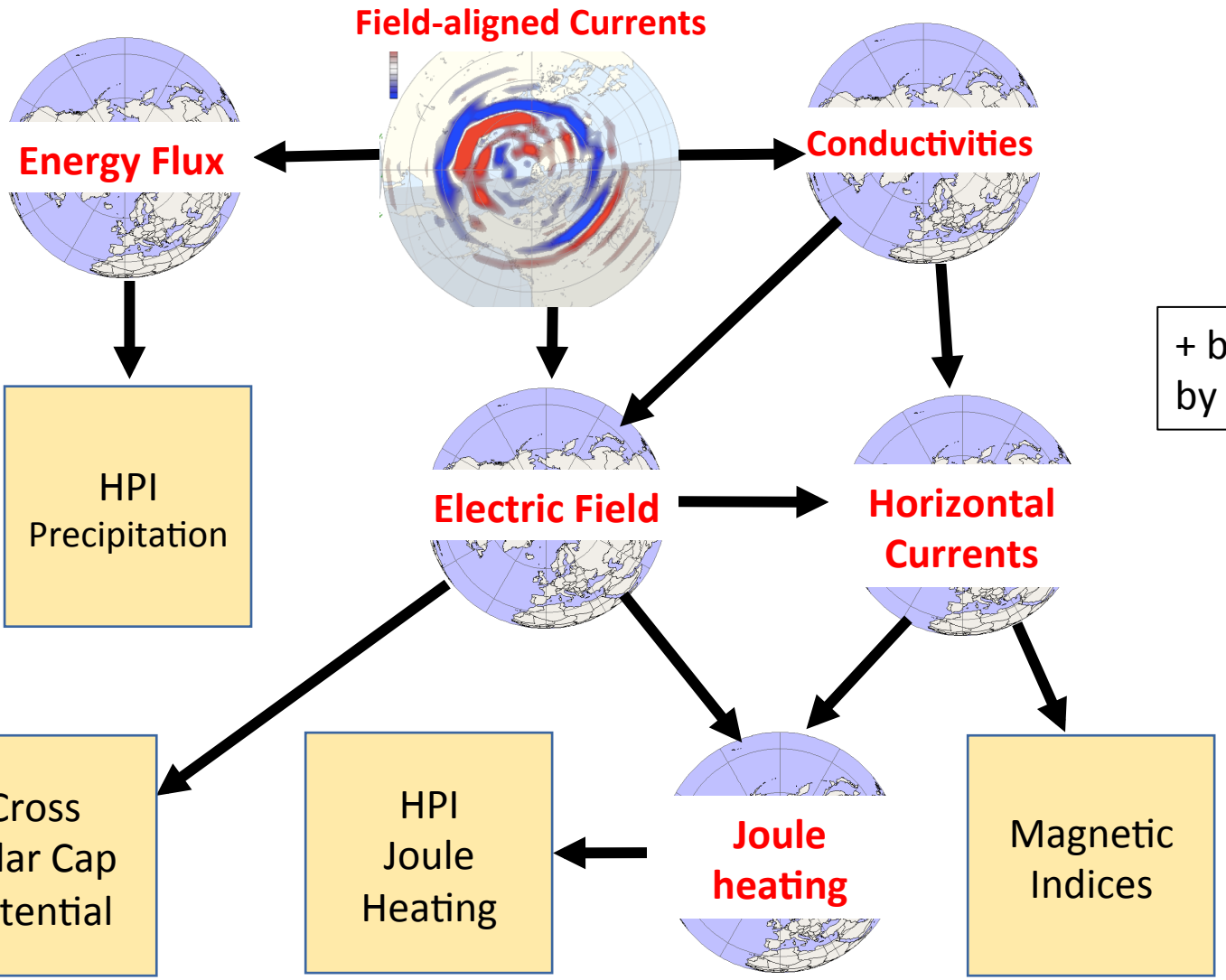
globally and over the entire day at n-minute time intervals. These data represent 'ground truth'.

Select a model. Run the model using only solar wind parameters as input.

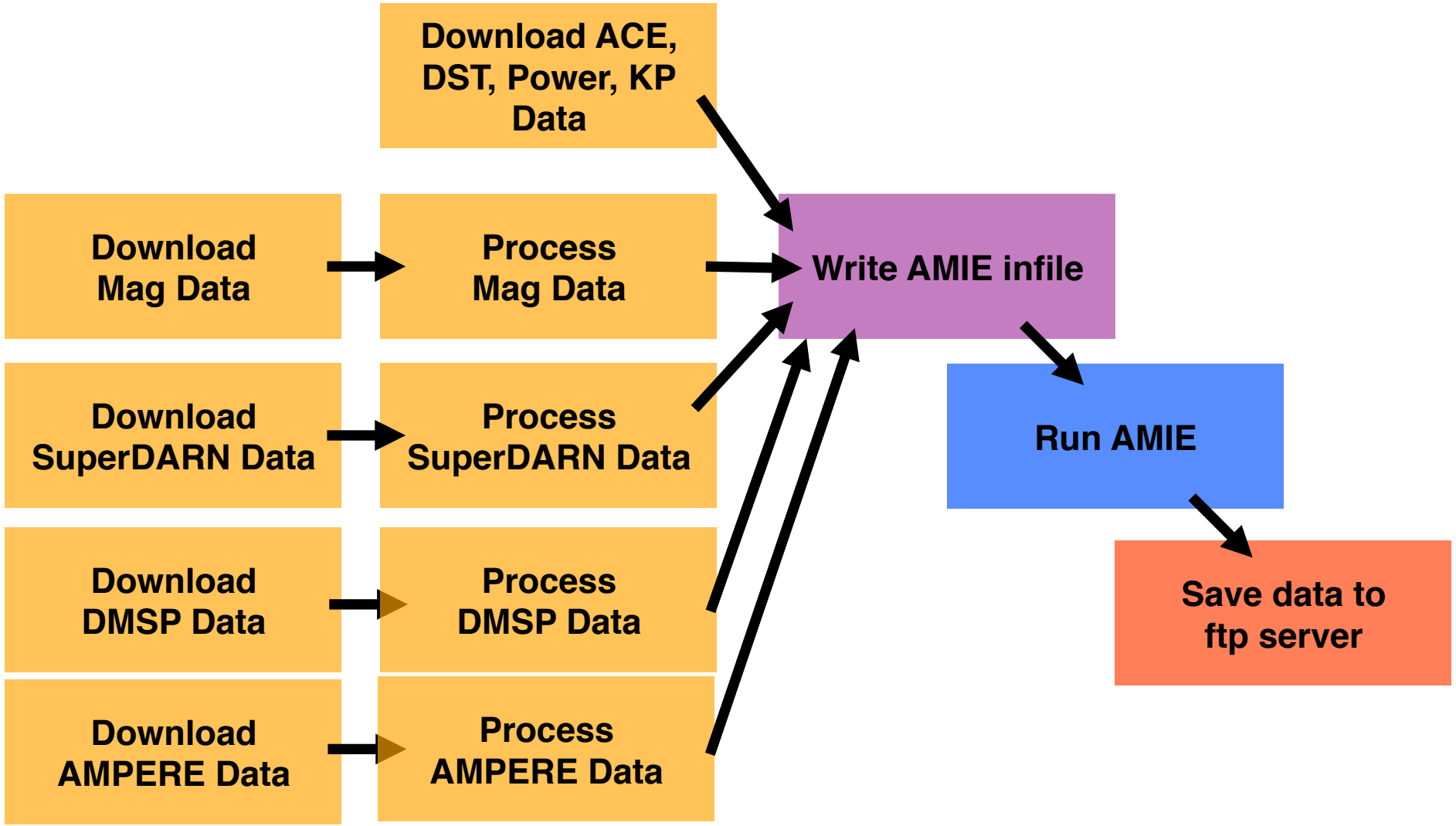
Evaluate the model's ability to determine one or more of the parameters in the ground truth database. The model will receive a single skill score for each parameter.

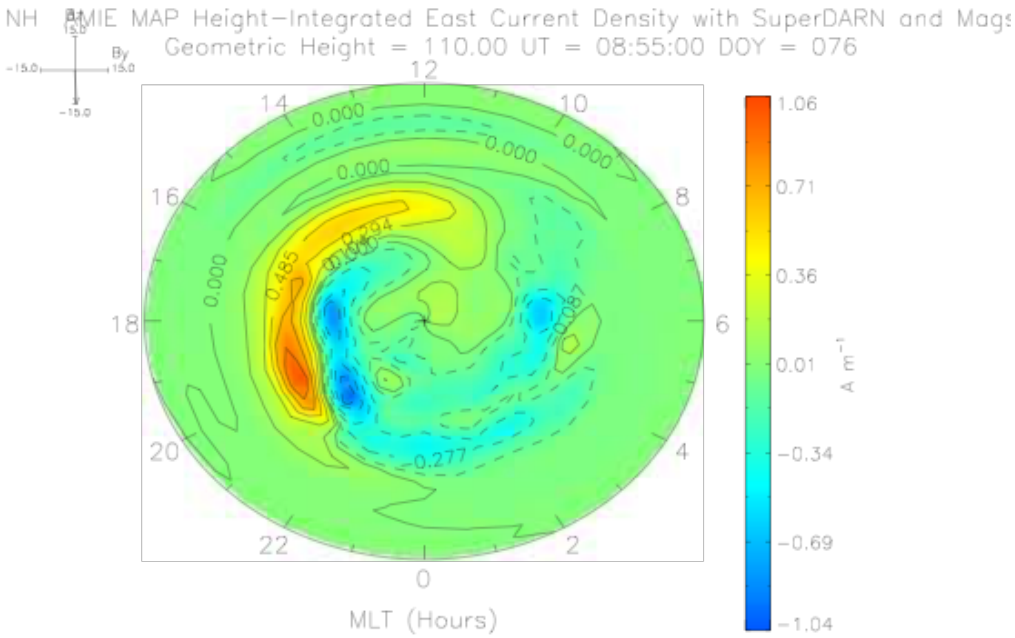
Upgrade the model and repeat.

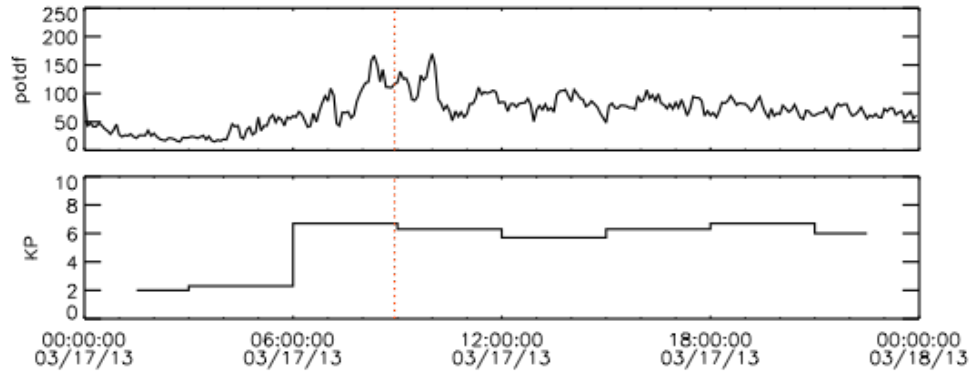
Connections Between Auroral Electrodynamic Parameters

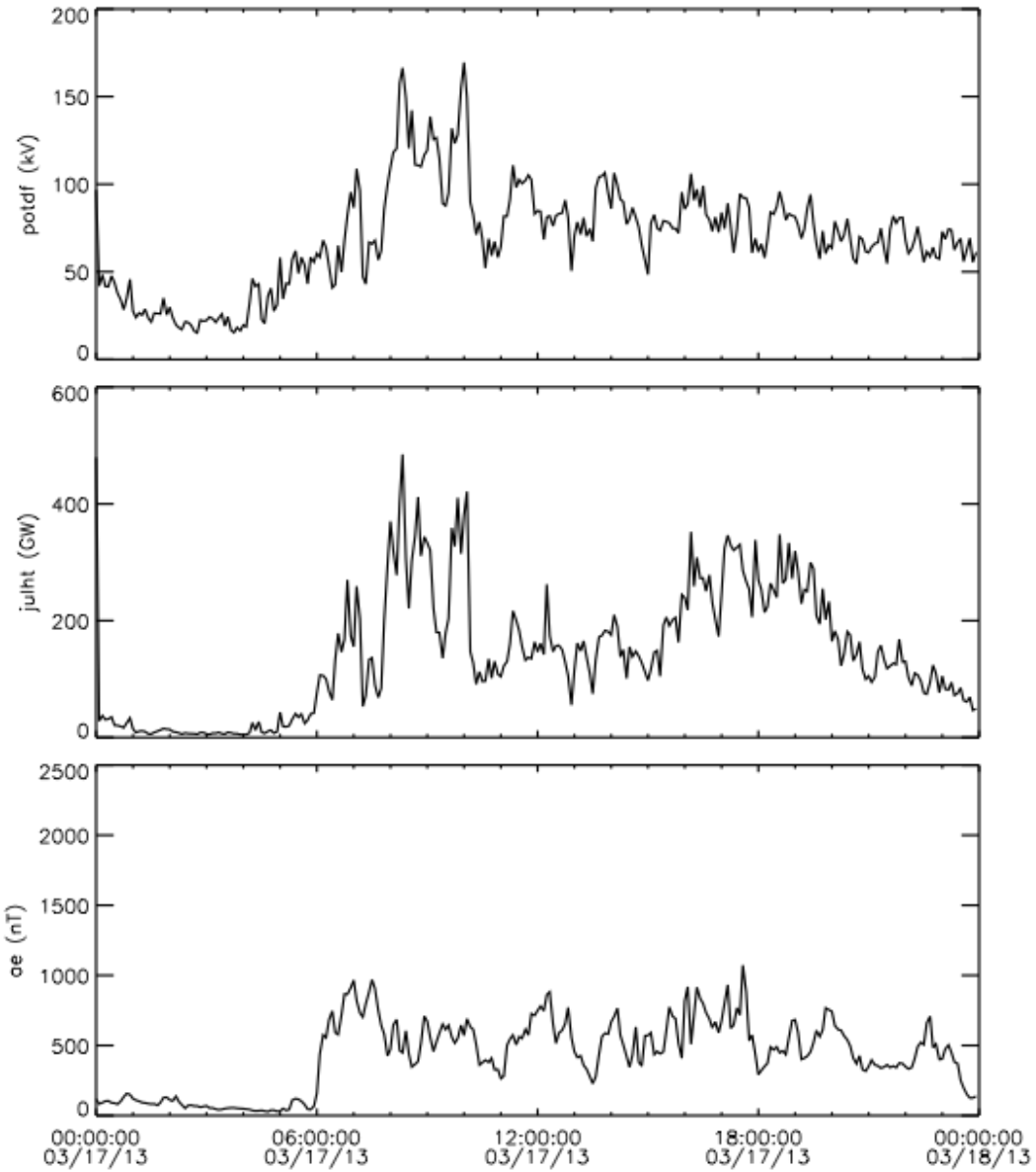


ASTRA's Automated AMIE

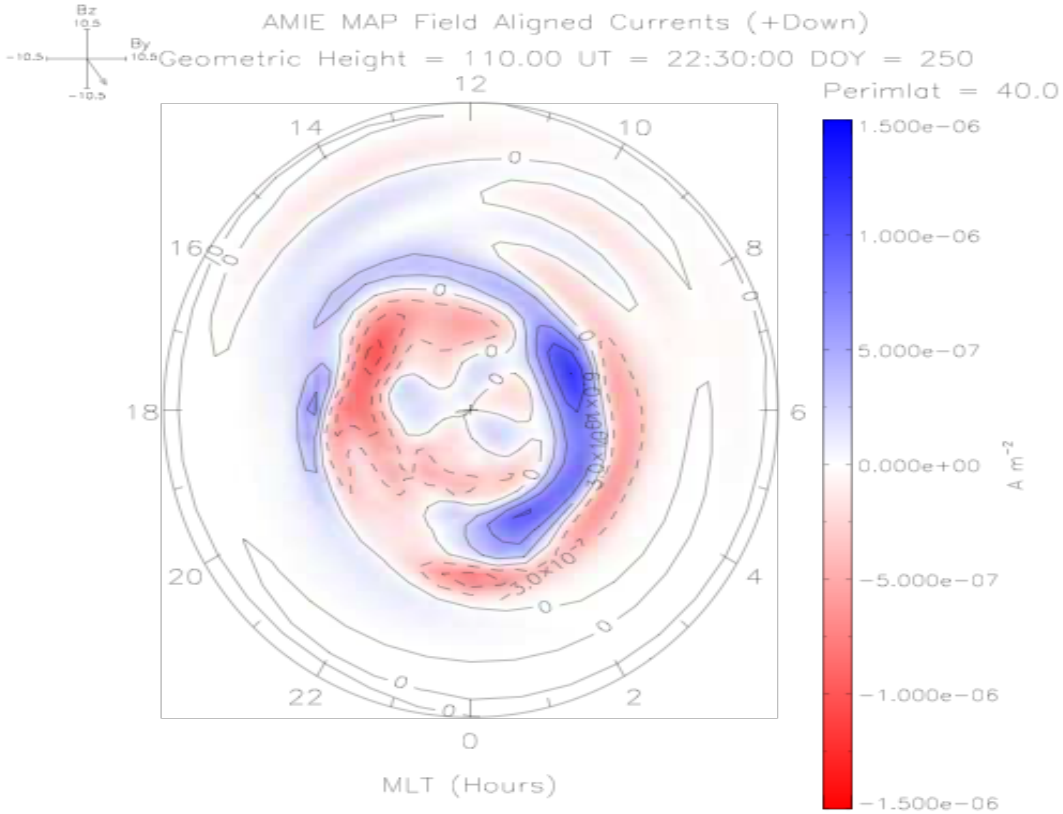


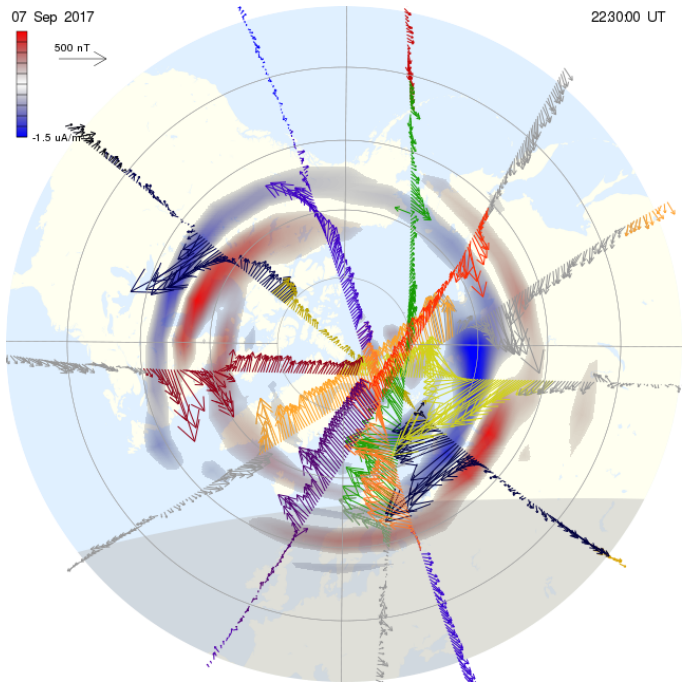

NH AMIE MAP Height−Integrated East Current Density with SuperDARN and Mags
Geometric Height = 110.00 UT = 08:55:00 DOY = 076
By
MLT (Hours)
A m⁻¹
1.06
0.71
0.36
0.01
−0.34
−0.69
−1.04


potdf
KP
00:00:00 03/17/13
06:00:00 03/17/13
12:00:00 03/17/13
18:00:00 03/17/13
00:00:00 03/18/13

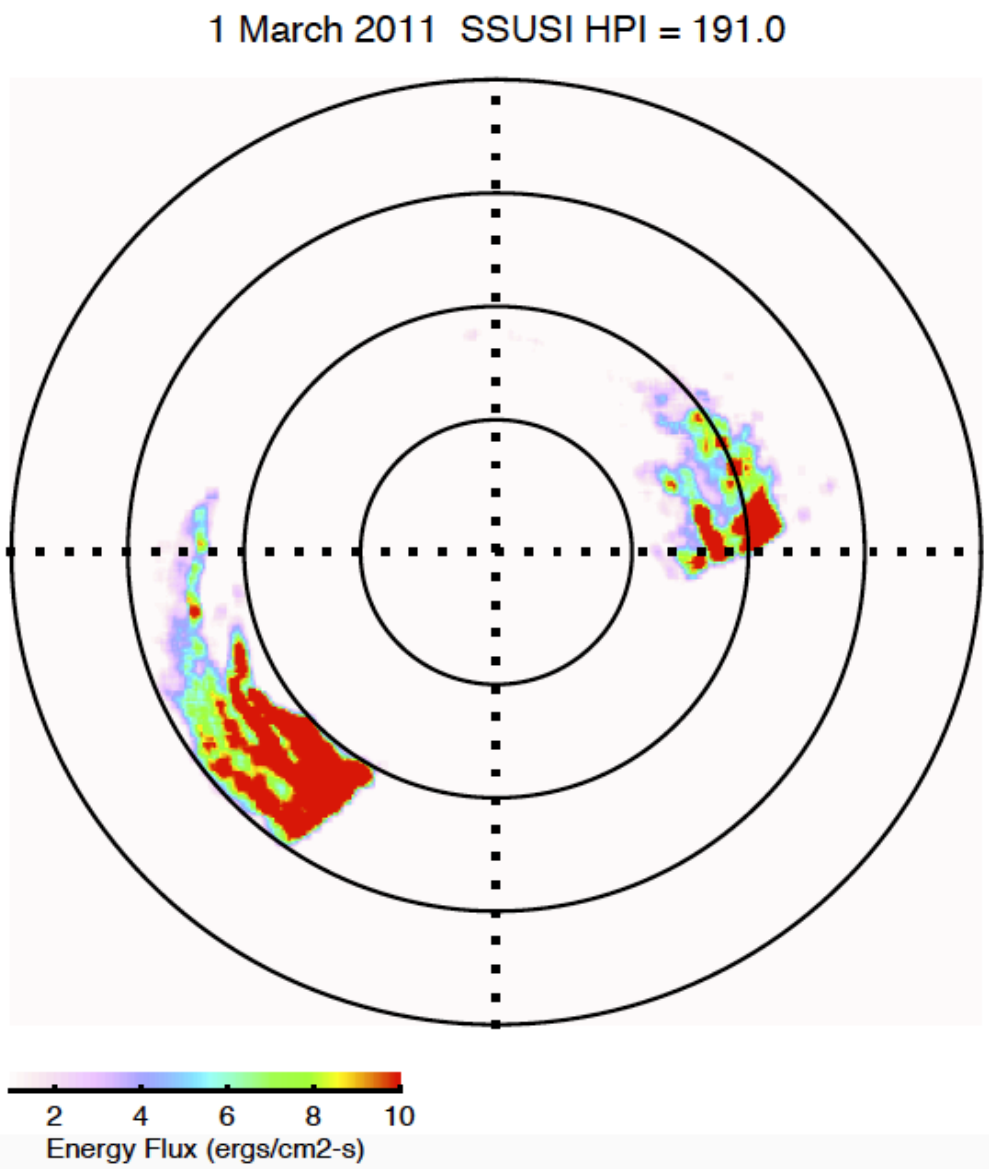

potdf (kV)
julht (GW)
ae (nT)
00:00:00 03/17/13
06:00:00 03/17/13
12:00:00 03/17/13
18:00:00 03/17/13
00:00:00 03/18/13

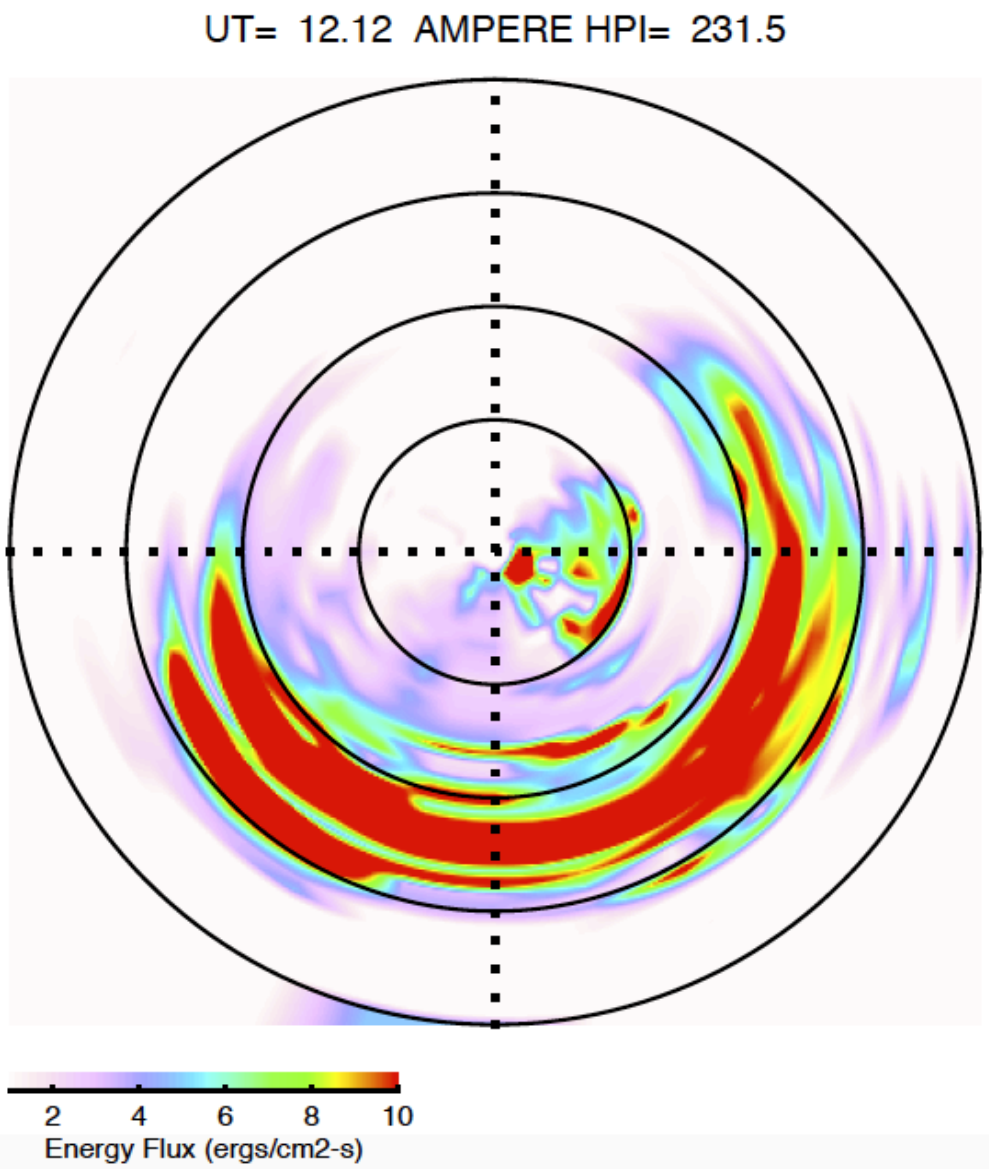
AMIE-AMPERE comparison
9/7/2017 22:30 UT



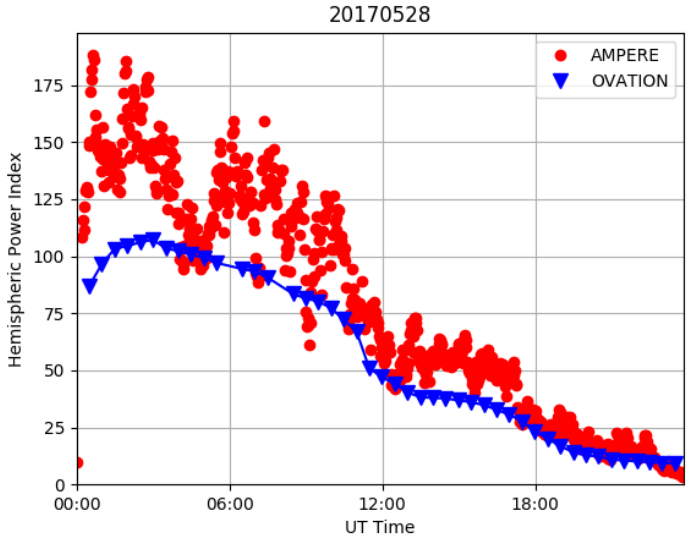


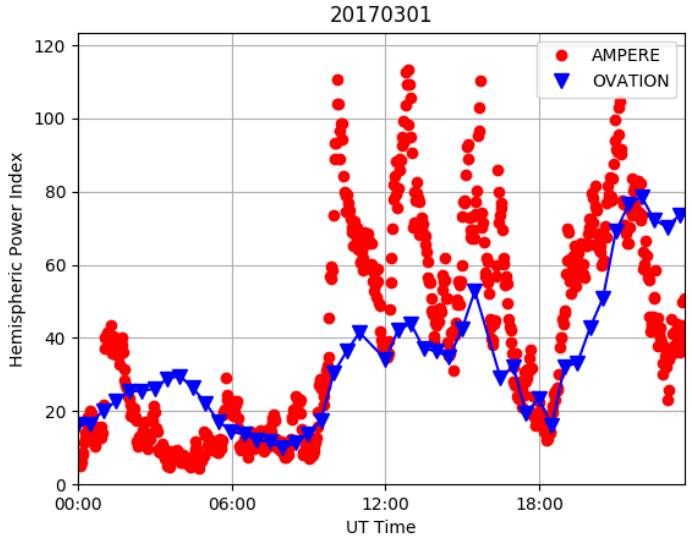
Comparison of Energy Fluxes Measured by the DMSP scanning ultraviolet imager and AMPERE

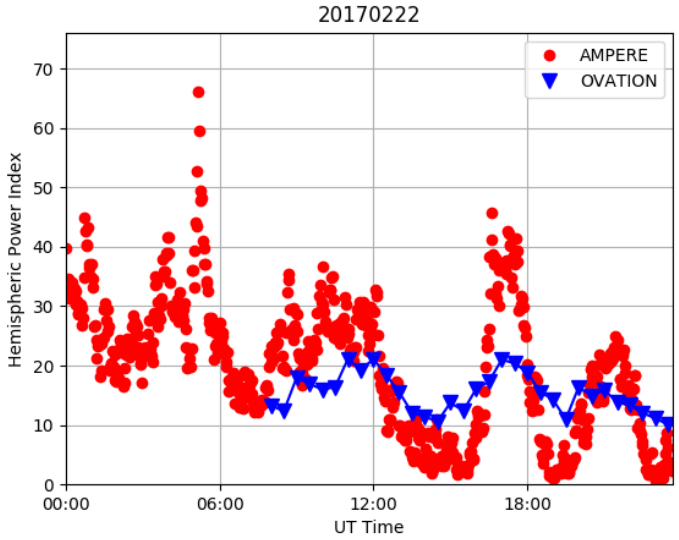


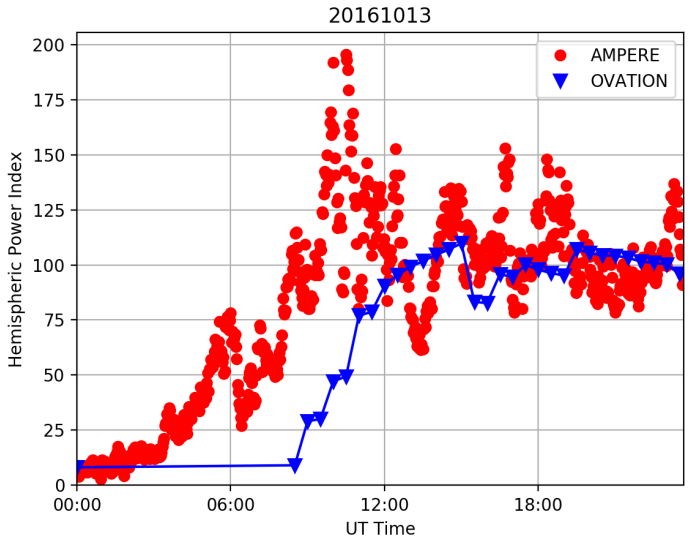


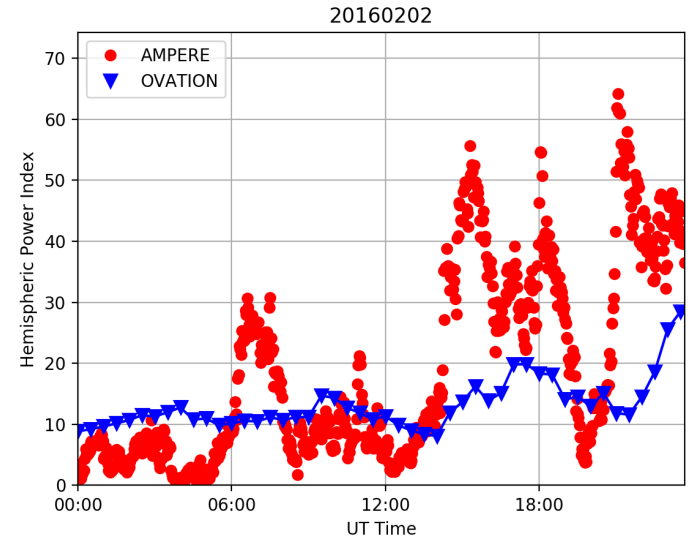
Comparison between Hemispheric Power Index from Ovation-PRIME (blue) and from AMPERE field-aligned currents (red)

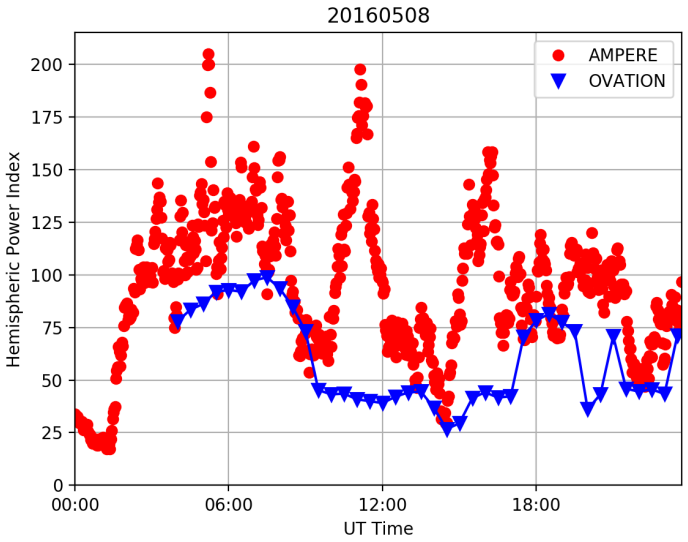


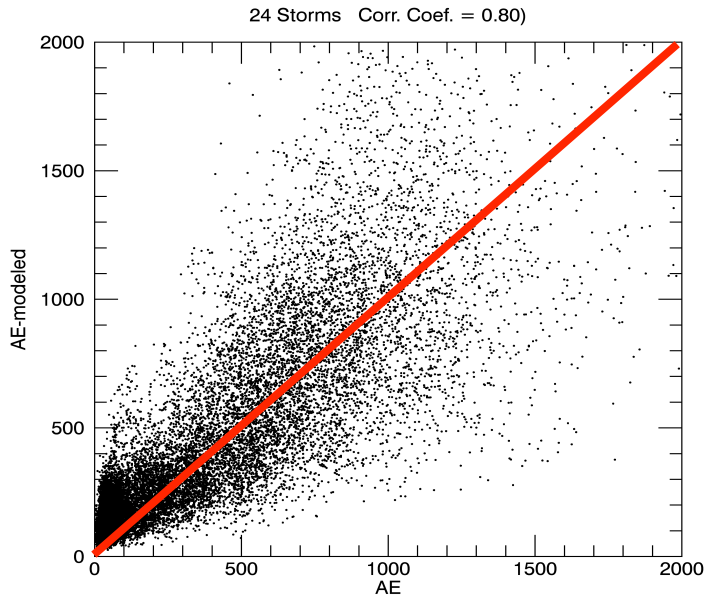


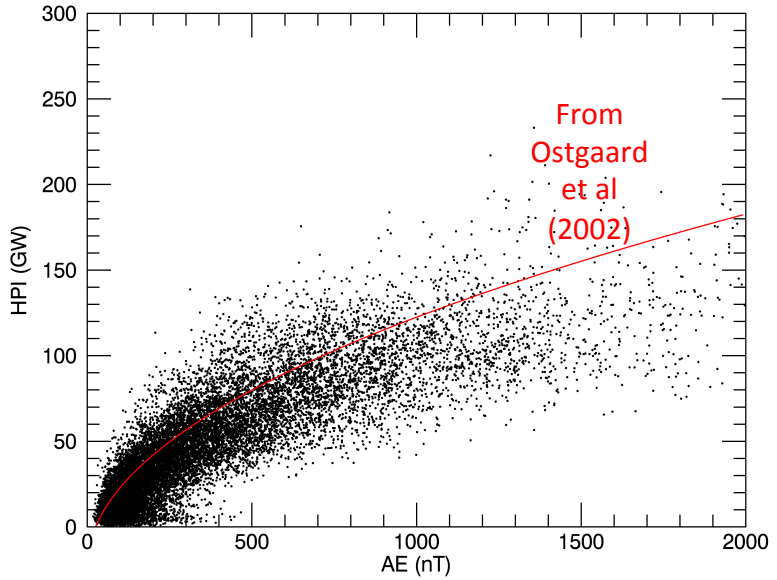


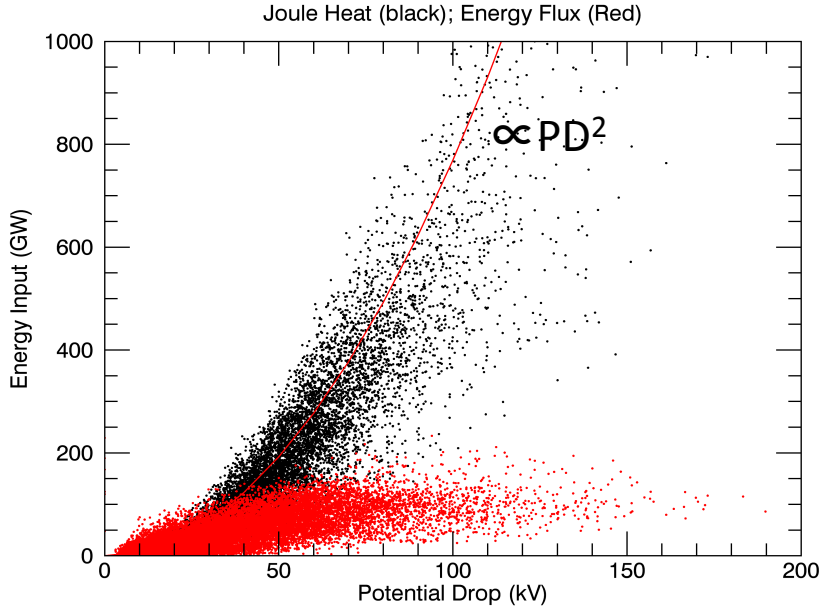




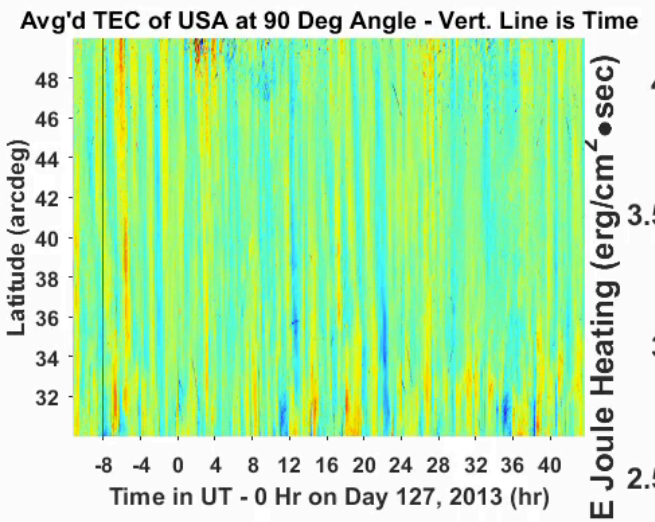


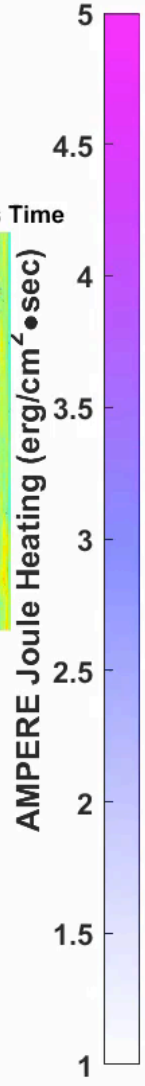

24 Storms Corr. Coef. = 0.80)
AE-modeled
AE
0
500
1000
1500
2000

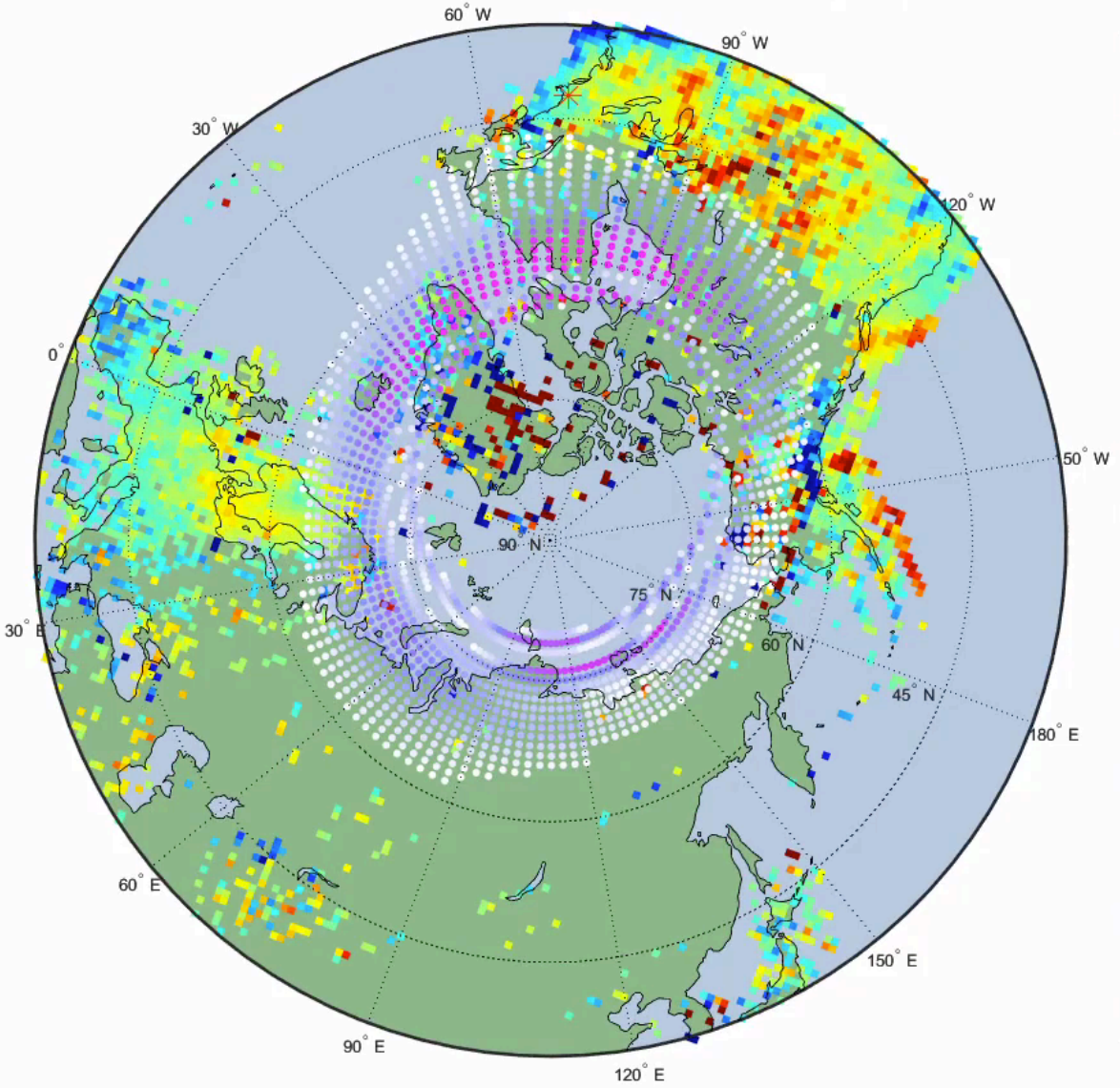

From
Ostgaard
et al
(2002)
HPI (GW)
AE (nT)
0
50
100
150
200
250
300
500
1000
1500
2000

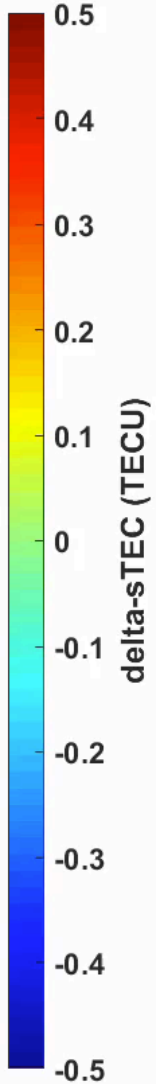

Joule Heat (black); Energy Flux (Red)
∝PD²
Energy Input (GW)
Potential Drop (kV)
0
200
400
600
800
1000
50
100
150
200

sTEC viewed over the North Pole time avg'd to every 6 min | Sun position at top of plot | Time = -8.00 hr, 0 hr on 0 UT May 7th, 2013









How quantitative assessments against ground-truth values will be done

- Calculate either one-D or two-D correlation coefficient
- Shift in time and space to account for spatial or temporal shifts
- Assessment should only be done on validated ground-truth data over the regions where the data are valid
- Or: Use OTS Pattern Recognition Software
- All groups should use the same methodology for metrics-based validation assessment

Challenges

- How to take into account end user requirements
- Distinguishing between scientific vs operations metrics
- Ambiguity of Metrics (Auroral Boundaries)
- Ground-truth—How do we know what's right
- Metrics for two-dimensional data
- Ring Current/Subauroral/REP metrics

Next Steps

- Further event selection taking into account data availability
- Select one event to test methodology for creating a ground-truth database
- Select a model for testing the test procedure
- Run the model and assess the output using standardized, quantitative comparison methodologies
- Paper for special issue of SWJ