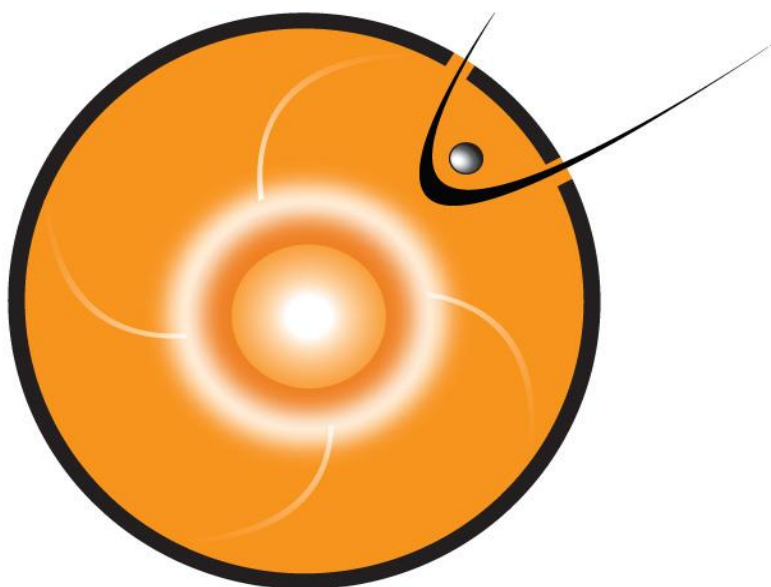


Comprehensive Assessment of Models and Events based on Library tools (CAMEL)

Lutz Rastaetter¹, Richard Mullinix¹, Chiu Wiegand¹

1 Community Coordinated Modeling Center, NASA GSFC,
Greenbelt MD , USA



CAMEL at CCMC

- GEM 2008 magnetic perturbations
- Radiation Belt Effects
 - Initial results from GEM Challenge on the Spacecraft Charging environment (uses SSPB skill)
- Solar Wind Parameters at L1
 - solar wind density and magnetic polarity
- Total Electron Content
 - observed at various ionosonde stations

<https://ccmc.gsfc.nasa.gov/camel/>



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hrm - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: frn - Fresno

Data selection:

- Events
- Models (simulation runs)
- Locations (Stations or Spacecraft)

Controls for Skill scoring:

- Phys. Parameter,
- Skill Score
- numerical parameters

Controls for Plotting:

- Select Event and Parameter

Skill Scores

Data Plots

Parameter to Score

Skillscore Type

Interpolation

Max Data Gap

Display Canvas:

Area to show tables of skill scores or time line plots.



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hrm - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: frn - Fresno

Controls for Skill scoring:

- Phys. Parameter,
- Skill Score
- numerical parameters

Skill Scores

Parameter to Score

Select... ▾

- B_NorthGeomag(nT)
- B_EastGeomag(nT)
- B_DownGeomag(nT)

Skillscore Type

- B_NorthGeomag (nT)
- B_EastGeomag (nT)
- B_DownGeomag (nT)

Data Plots

Interpolation

Select... ▾

Max Data Gap

Select... ▾



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: lqa - Iqaluit
- Polar Latitudes: hrm - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: fm - Fresno

Controls for Skill scoring:

- Phys. Parameter,
- Skill Score
- numerical parameters

Skill Scores

Parameter to Score

B_EastGeomag(nT) x ▾

Skillscore Type

- Prediction Efficiency x ▴
- Root Mean Square
- Mean Absolute Error
- Mean Error
- Correlation Coefficient
- Prediction Efficiency**

Data Plots

Interpolation

- Mean Square Error (RMSE)
- Mean Absolute Error (MAE)
- Mean Error (ME)
- Correlation Coefficient, (CC)
- Prediction Efficiency (PE)

Max Data Gap

Select... ▾



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: lqa - Iqaluit
- Polar Latitudes: hrm - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: fn - Fresno

Controls for Skill scoring:

- Phys. Parameter,
- Skill Score
- numerical parameters

Skill Scores

Parameter to Score

B_EastGeomag(nT) x

Skillscore Type

Prediction Efficiency x

Data Plots

Interpolation

- Select...
- linear
- nearest neighbor

Max Data Gap

Select

linear
nearest neighbor



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hrm - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: frn - Fresno

Controls for Skill scoring:

- Phys. Parameter,
- Skill Score
- numerical parameters

Skill Scores

Parameter to Score

B_EastGeomag(nT) x ▾

Skillscore Type

Prediction Efficiency x ▾

Interpolation

linear

Data Plots

Max Data Gap

- Select... ▾
- 1 minute
 - 2 minutes
 - 5 minutes
 - 10 minutes
 - 30 minutes

- 1 minute
- 2 minutes
- 5 minutes
- 10 minutes
- 30 minutes



Skill Scores

GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hrn - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: frm - Fresno

Tables display skill score for each Station (Location) or Event for each Model.

Skill Scores

Data Plots

Parameter to Score

B_EastGeomag(nT) x ▾

Skillscore Type

Prediction Efficiency x ▾

Interpolation

linear x ▾

Max Data Gap

5 minutes x ▾

Skills by Station

Model	All Stations	iqa	hrn	ykc
Run 9_SWMF	0.059	-0.142	0.23	0.088
Run 2_LFM-MIX	0.08	-0.294	0.386	0.148
Run 4_OPENGGCM	-0.618	-0.342	-0.285	-1.226

Skills by Event

Model	All Events	Event 1	Event 2	Event 3	Event 4
Run 9_SWMF	0.103	0.021	-0.224	0.102	0.512
Run 2_LFM-MIX	0.064	0.34	0.018	-0.5	0.398
Run 4_OPENGGCM	-0.807	0.143	-0.477	-0.389	-2.503



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: lqa - Iqaluit
- Polar Latitudes: hrn - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sankiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: frn - Fresno

Interaction:

Scores automatically update when selecting additional (or fewer) models or different stations.

The update may take a little while data are obtained and scores are compiled.

Skill Scores

Parameter to Score

B_EastGeomag(nT)

Skillscore Type

Prediction Efficiency

Interpolation

linear

Max Data Gap

2 minutes

Skills by Station

Model	All Stations	abk	pbq	mea	snk
Run 9_SWMF	-0.286	0.068	-0.427	-0.027	-0.76
Run 2_LFM-MIX	-0.241	-0.255	-0.348	-0.114	-0.246
Run 4_OPENGGCM	-1.856	-1.902	-3.108	-2.032	-0.384
Run 6_WEIMER	0.26	0.369	0.123	0.217	0.33

Skills by Event

Model	All Events	Event 1	Event 2	Event 3	Event 4	Event 7	Event 8
Run 9_SWMF	-0.188	-0.099	-0.233	-0.009	-0.22	-0.341	-0.228
Run 2_LFM-MIX	-0.228	0.109	-0.091	-0.546	-0.529	-0.254	-0.056
Run 4_OPENGGCM	-1.967	-0.165	-0.941	-2.749	-6.922	-0.497	-0.527
Run 6_WEIMER	0.247	0.323	0.084	0.426	0.166	0.136	0.344



CAMEL Data Plots

GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hrn - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: fm - Fresno

Right Tab: Rendering Plots

Data at each chosen station shown in canvas.

Colored traces for Observation and selected Model outputs.

Skill Scores

Data Plots

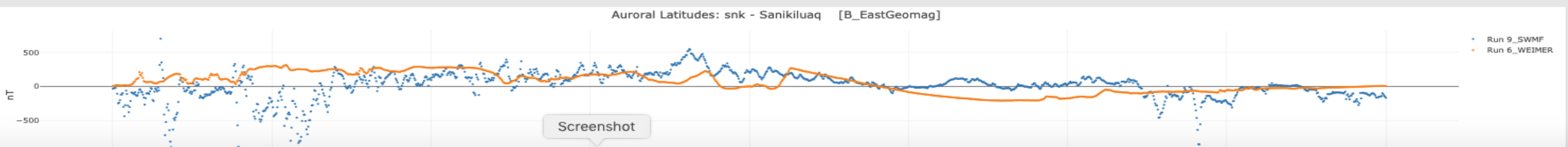
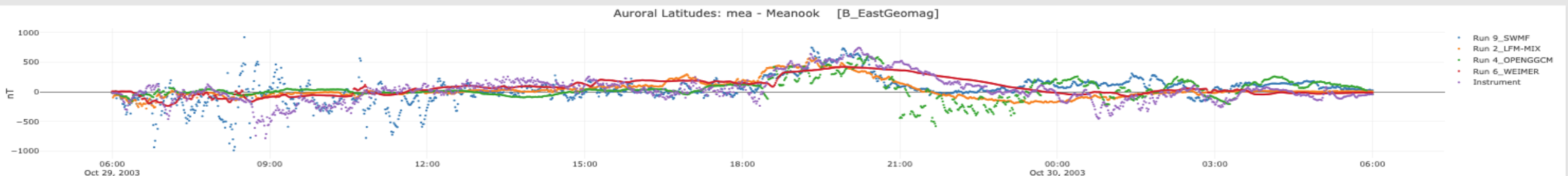
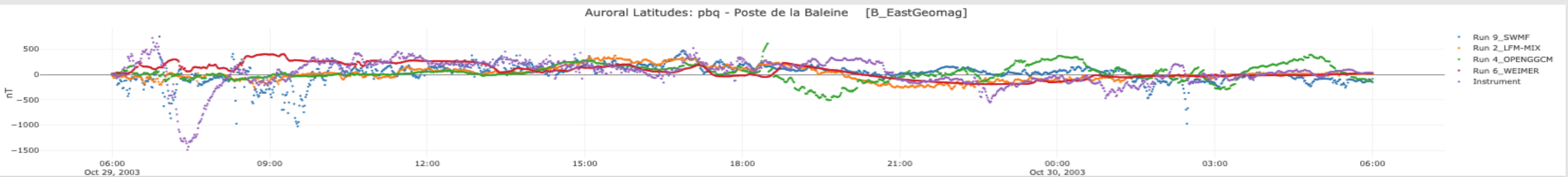
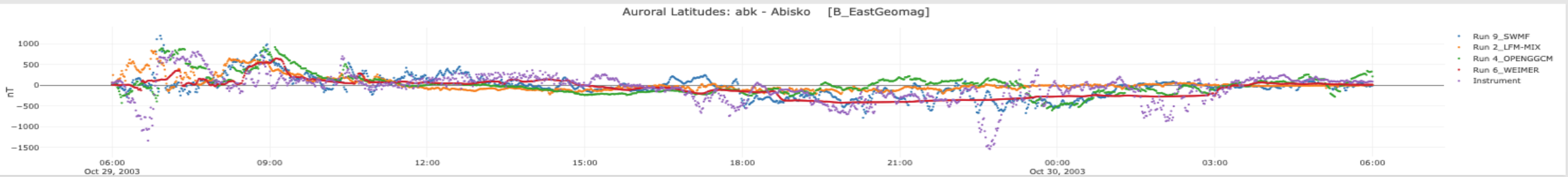
Event to Plot

Event 1 : October 29th, 2003 06:00 UT - Octob...

Parameter to Plot

B_EastGeomag(nT)

Controls for Plotting:
Select Event and Parameter



Screenshot



GEM2008 Ground Magnetic Perturbations

Events

- Event 1 : October 29th, 2003 06:00 UT - October 30th, 06:00 UT
- Event 2 : December 14, 2006 12:00 UT - December 16, 00:00 UT
- Event 3 : August 31, 2001 00:00 UT - September 1, 00:00 UT
- Event 4 : August 31, 2005 10:00 UT - September 1, 12:00 UT
- Event 5 : May 15, 2005 00:00 UT - May 16, 00:00 UT
- Event 6 : July 09, 2005 00:00 UT - July 12, 00:00 UT
- Event 7 : April 05, 2010 00:00 UT - April 6, 00:00 UT
- Event 8 : August 05, 2011 09:00 UT - August 6, 09:00 UT

Models

- Run 9_SWMF
- Run 2_LFM-MIX
- Run 4_OPENGGCM
- Run 6_WEIMER
- Run 3_WEIGEL
- Run 2_WEIGEL

Locations

- Polar Latitudes: iqa - Iqaluit
- Polar Latitudes: hmn - Hornsund
- Polar Latitudes: ykc - Yellowknife
- Auroral Latitudes: abk - Abisko
- Auroral Latitudes: pbq - Poste de la Baleine
- Auroral Latitudes: mea - Meanook
- Auroral Latitudes: snk - Sanikiluaq
- Sub-auroral Latitudes: ott - Ottawa
- Sub-auroral Latitudes: new - Newport
- Sub-auroral Latitudes: wng - Wingst
- Mid Latitudes: frd - Fredericksburg
- Mid Latitudes: fur - Furstenfeldbruck
- Mid Latitudes: fm - Fresno

Skill Scores

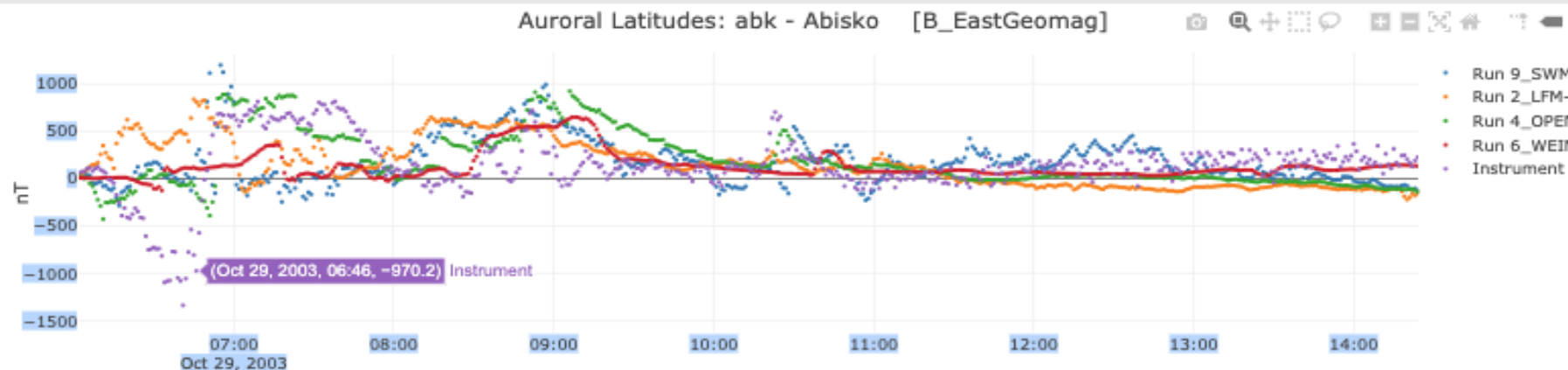
Data Plots

Event to Plot

Event 1 : October 29th, 2003 06:00 UT - Octob... X

Parameter to Plot

B_EastGeomag(nT) X



Interaction:

Zoom and study part of the time interval.

Hover over traces and see date, time, value and the data source.

TEC at various Ionosonde Stations

Events

March 1 to April 5 2013 : March 1 to April 5 2013

Models

- Model runs from IRI 2016
- Model runs from SAMI3
- Model runs from IFM
- Model runs from CTIPe v.3.2
- Model runs from GITM 2.5
- Model runs from the Upper Atmosphere Model-P
- Model runs from TIE-GCM 2.0
- Model runs from USU-GAIM 2.3

Locations

- America Northern: IN - Ionosonde Station at Idaho National Lab
- America Northern: MH - Ionosonde Station at Millstone Hill
- America Northern: BD - Ionosonde Station at Boulder
- America Northern: EL - Ionosonde Station at Eglin AFB
- America Southern: PS - Ionosonde Station at Port Stanley
- Europe/Africa Northern: CT - Ionosonde Station at Chilton
- Europe/Africa Northern: PH - Ionosonde Station at Pruhonice
- Europe/Africa Northern: ER - Ionosonde Station at Ebre
- Europe/Africa Northern: AT - Ionosonde Station at Athens
- Europe/Africa Southern: LV - Ionosonde Station at Louisvale
- Europe/Africa Southern: GS - Ionosonde Station at Grahamstown
- Europe/Africa Southern: HM - Ionosonde Station at Hermanus

Local Time

- morning
- day
- evening
- night

Local time filter options:

Morning: 3:00 - 9:00

Day: 9:00 - 15:00

Evening: 15:00 - 21:00

Night: 21:00 - 3:00

Skill Scores

Parameter to Score

TEC(TECU) x ▾

Skillscore Type

Prediction Efficiency x ▾

Interpolation

linear x ▾

Data Plots

Max Data Gap

5 minutes x ▾

Skills by Station

Model	All Stations	IN	CT	HM
Model runs from IRI 2016	0.841	0.815	0.814	0.893
Model runs from SAMI3	0.745	0.73	0.589	0.917
Model runs from IFM	0.747	0.763	0.821	0.657
Model runs from CTIPe v.3.2	0.169	0.542	-0.138	0.104
Model runs from GITM 2.5	-0.127	-0.003	-0.171	-0.207
Model runs from the Upper Atmosphere Model-P	0.336	0.341	0.073	0.595
Model runs from TIE-GCM 2.0	0.372	0.642	0.382	0.091
Model runs from USU-GAIM 2.3	0.668	0.538	0.63	0.837

Skills by Local Time

Model	All Times	morning	day	evening	night
Model runs from IRI 2016	0.335	0.796	0.572	-0.148	0.121
Model runs from SAMI3	-0.054	0.664	0.565	-0.941	-0.506
Model runs from IFM	0.014	0.741	0.44	-0.146	-0.98
Model runs from CTIPe v.3.2	-1.561	0.17	-0.289	-0.313	-5.811
Model runs from GITM 2.5	-4.528	0.306	-2.414	-10.058	-5.944
Model runs from the Upper Atmosphere Model-P	-4.97	0.34	-1.514	-17.872	-0.834
Model runs from TIE-GCM 2.0	-1.017	0.334	-0.12	0.087	-4.369
Model runs from USU-GAIM 2.3	-3.339	0.329	0.258	-14.319	0.377

TEC at various Ionosonde Stations

Event to Plot

March 1 to April 5 2013 : March 1 to April 5 2013 x v

Parameter to Plot

TEC(TECU) x v

Local time filter options:

Morning: 3:00 - 9:00

Day: 9:00 - 15:00

Evening: 15:00 - 21:00

Night: 21:00 - 3:00

All Local Times

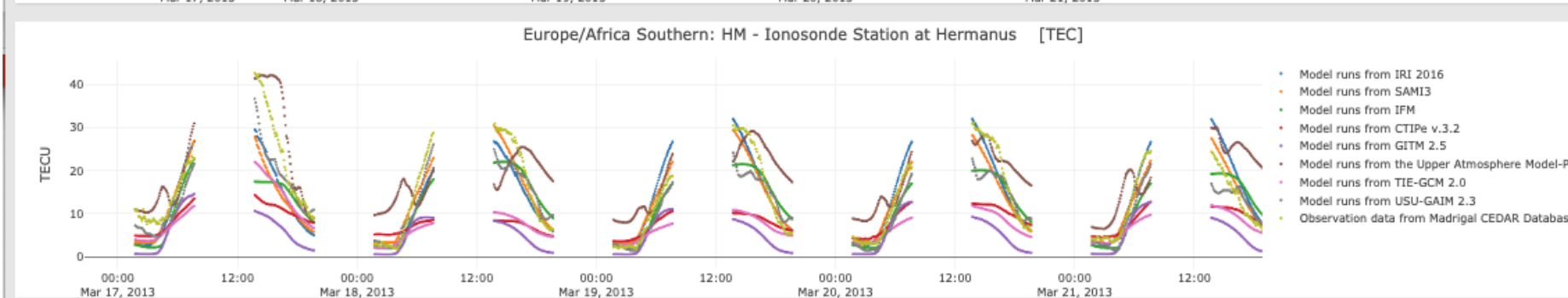
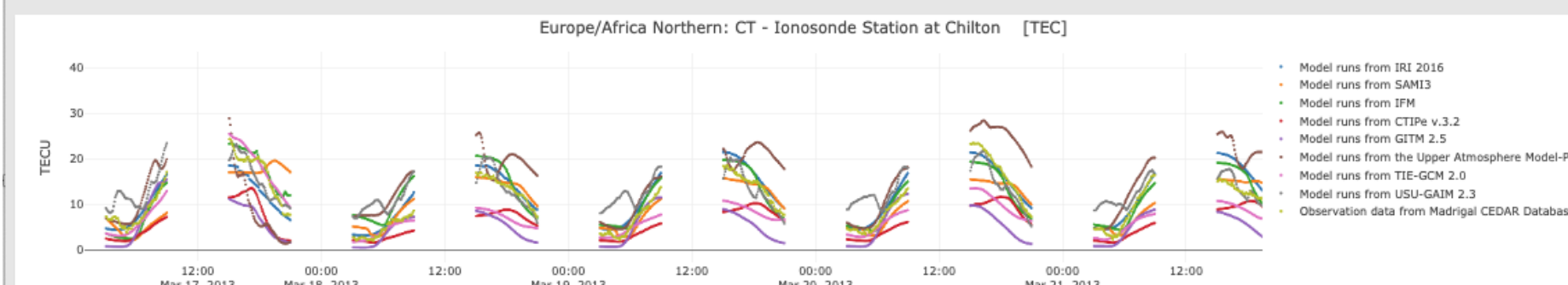
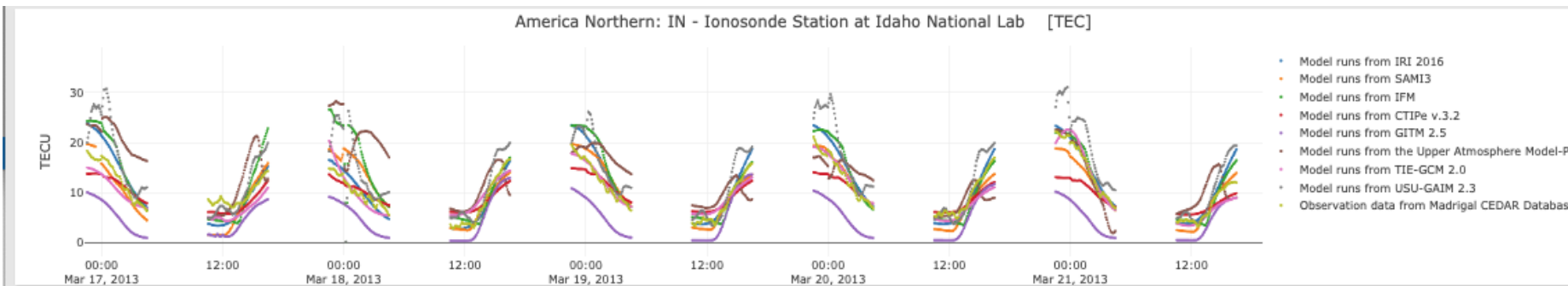
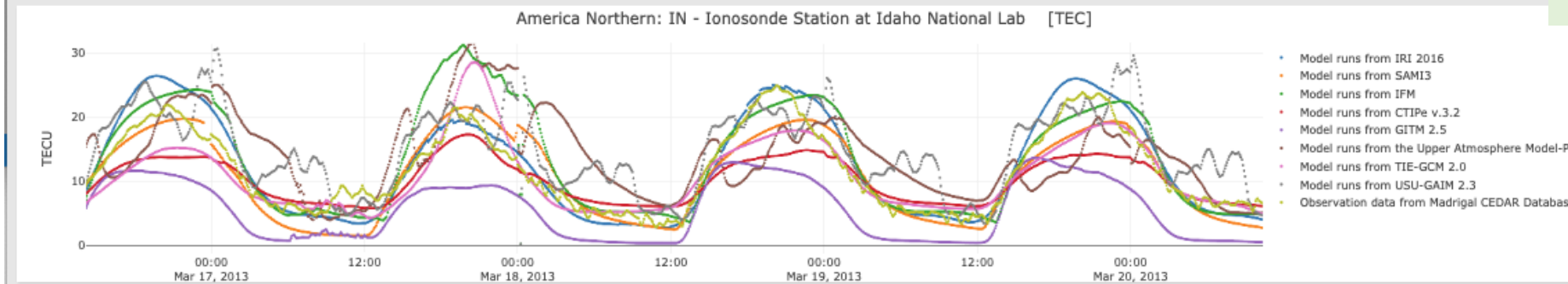
Idaho National Lab

Morning and Evening

Idaho National Lab,
43N, 113W

Chilton, 51N, 1W

Hermanus, 34S, 19E



Plans for CAMEL

- Add more data for all regions:
 - FoF2, NmF2 in ionosphere, magnetic field in magnetosphere,
 - magnetopause crossings, dB/dt from GEM and SWPC studies
- Categorical skills such as POD, POFD, HSS
 - Add user interface for threshold selection.
- Handle 2-dimensional patterns:
 - Grid to position comparison (best model match near observation)
 - Grid-to-grid comparison (number of features exceeding threshold, area, centroid location, ...)
 - Using tools available in Model Evaluation Toolkit used in Meteorology
- Open-source CAMEL
 - encourage collaboration and contributions
 - stand-alone tool run on user's own computer

<https://ccmc.gsfc.nasa.gov/camel/>

Questions / Comments?

Abstract

The CAMEL framework is being built at the Community Coordinated Modeling Center (CCMC) to facilitate model-data comparison studies.

A modern web interface allows the user to perform skill score calculations across multiple locations (e.g., spacecraft, magnetometer or ionosonde stations) or time intervals (events). Skill score analysis is applied to time series data and includes Root Mean Square, Prediction Efficiency, Correlation Coefficient and Symmetric Signed Percentage Bias (SSPB) based on the Log Accuracy Ratio. We are working towards categorical analyses with Probability of Detection, Probability of False Detection and advanced skill scores such as the Heidke Skill Score.

In the future we will employ tools available in the Model Evaluation Tools (MET) and use pattern matching techniques to track features (areas where a threshold is being exceeded) using MET's MODE matched object attributes such as centroid distance and displacement, and similarities or differences in object area and orientation.