

COMMUNITY
COORDINATED
MODELING
CENTER

Director's Report



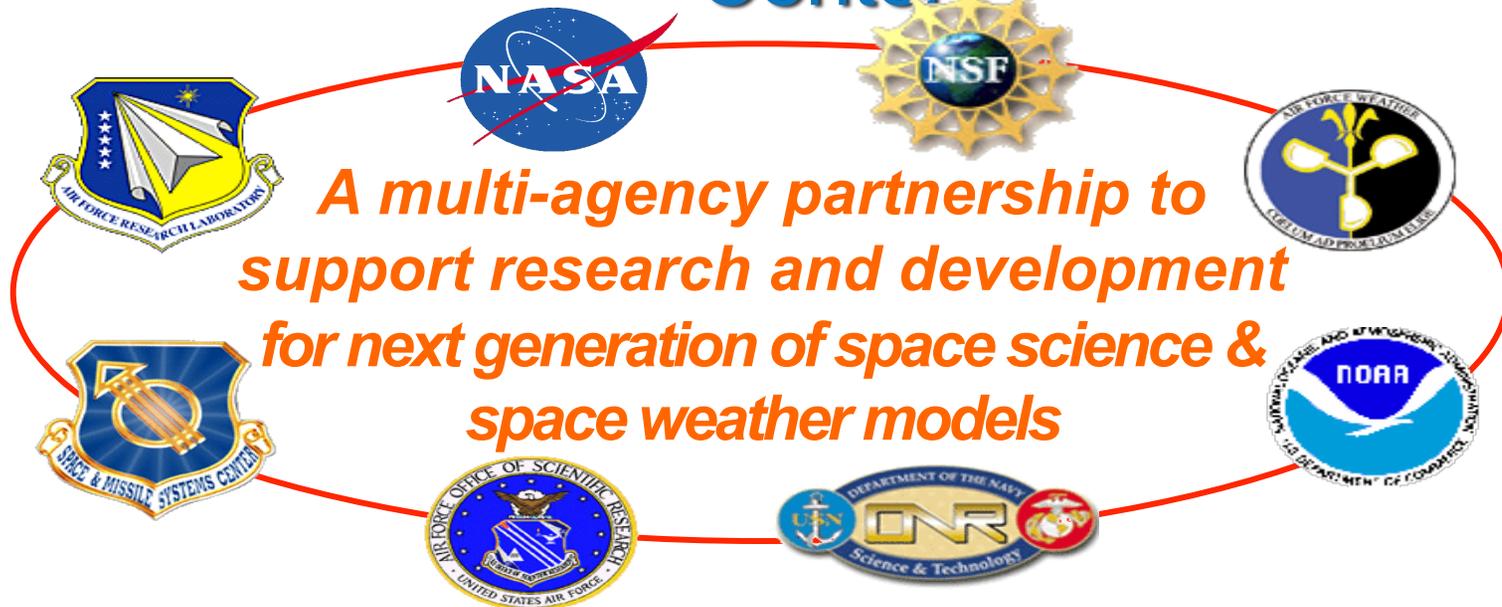
Space
Weather
Research
Center

*Masha Kuznetsova
& CCMC/SWRC team*

MODELS • DATA • TOOLS • SYSTEMS • SERVICES • INNOVATIVE SOLUTIONS



Community Coordinate Modeling Center

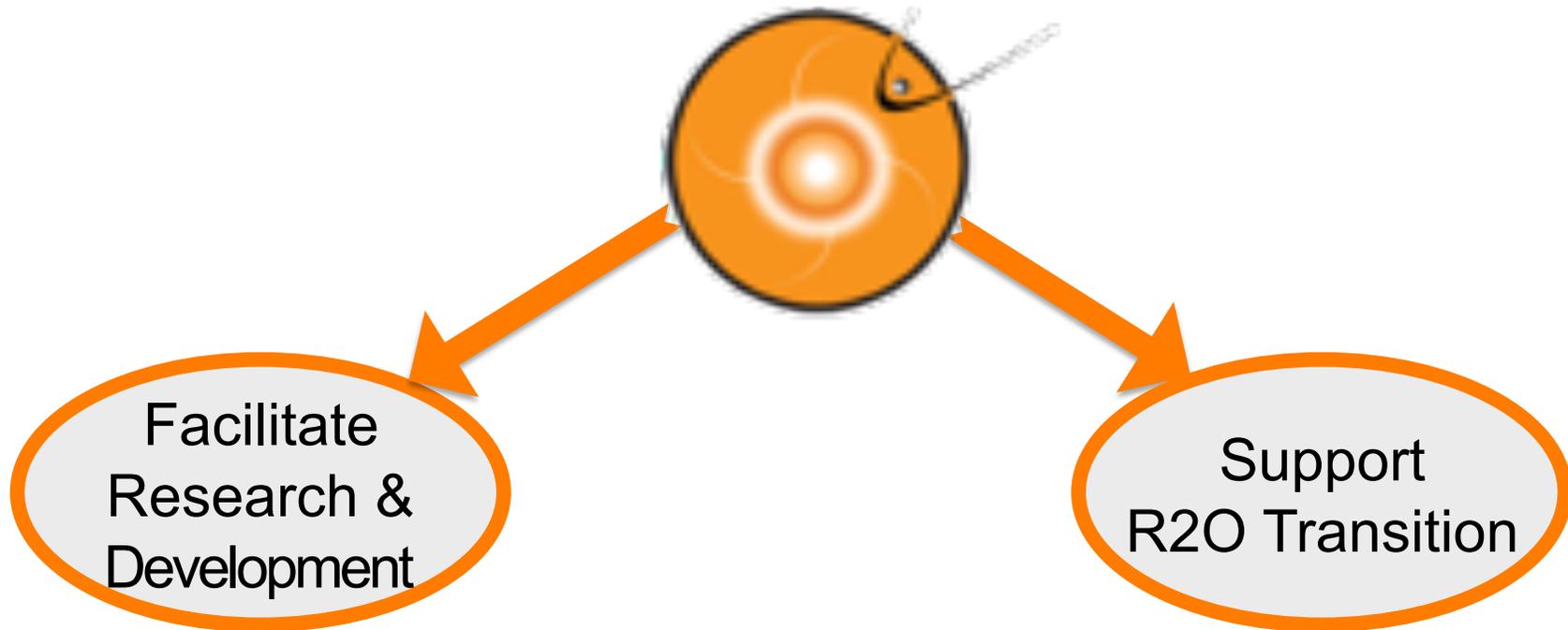


Established in 2000 as an essential element of the **National Space Weather Program**

Designed to be a **long-term & flexible** solution to the R2O problem.

Initial CCMC Goals

v. 2000



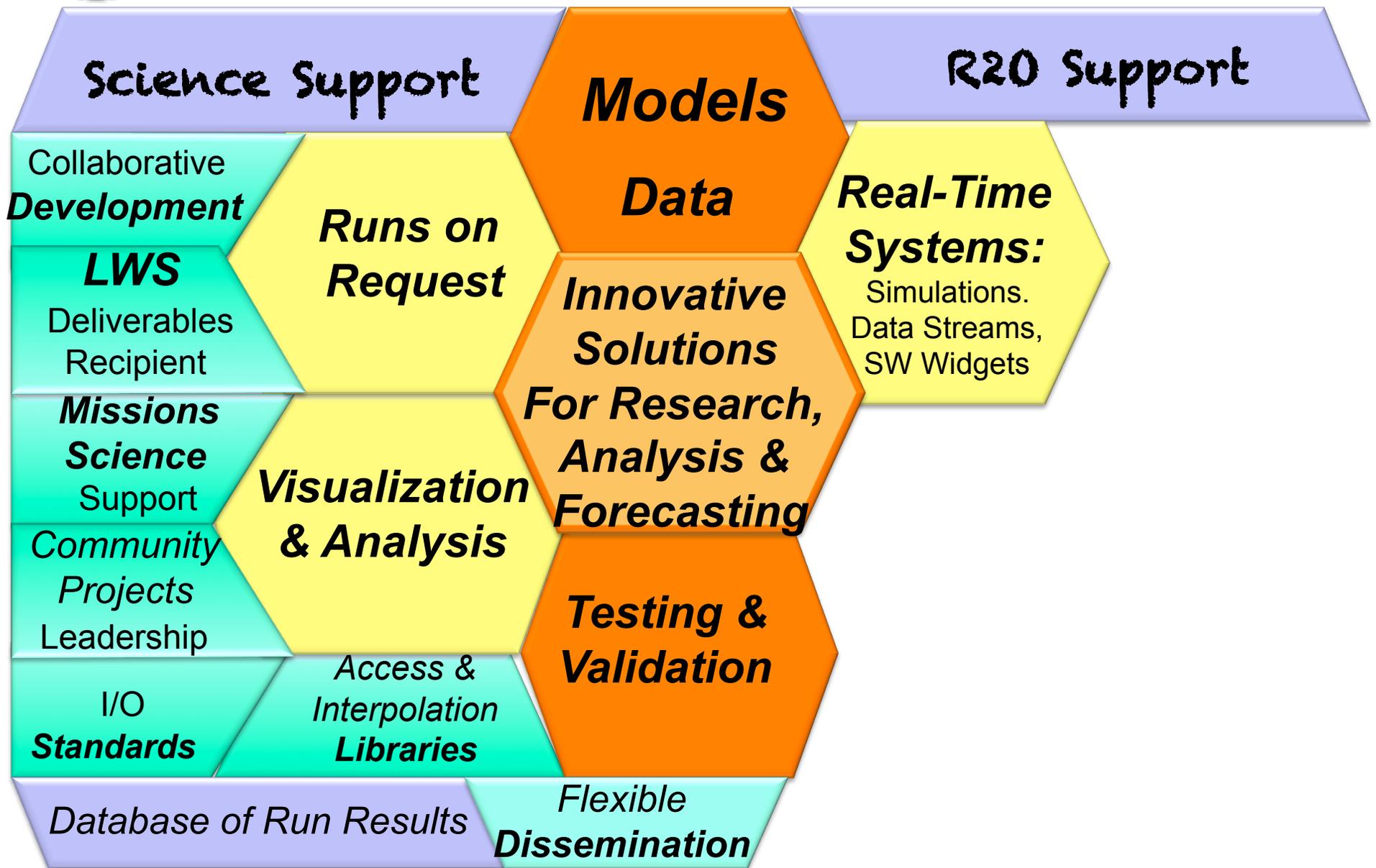
Partnership with international research community, model owners & data providers

Partnership with operational agencies & users of SW products (NOAA, DoD, DoE, DHS, FAA,..)

Goals are evolving in response to lessons learned & emerging needs.

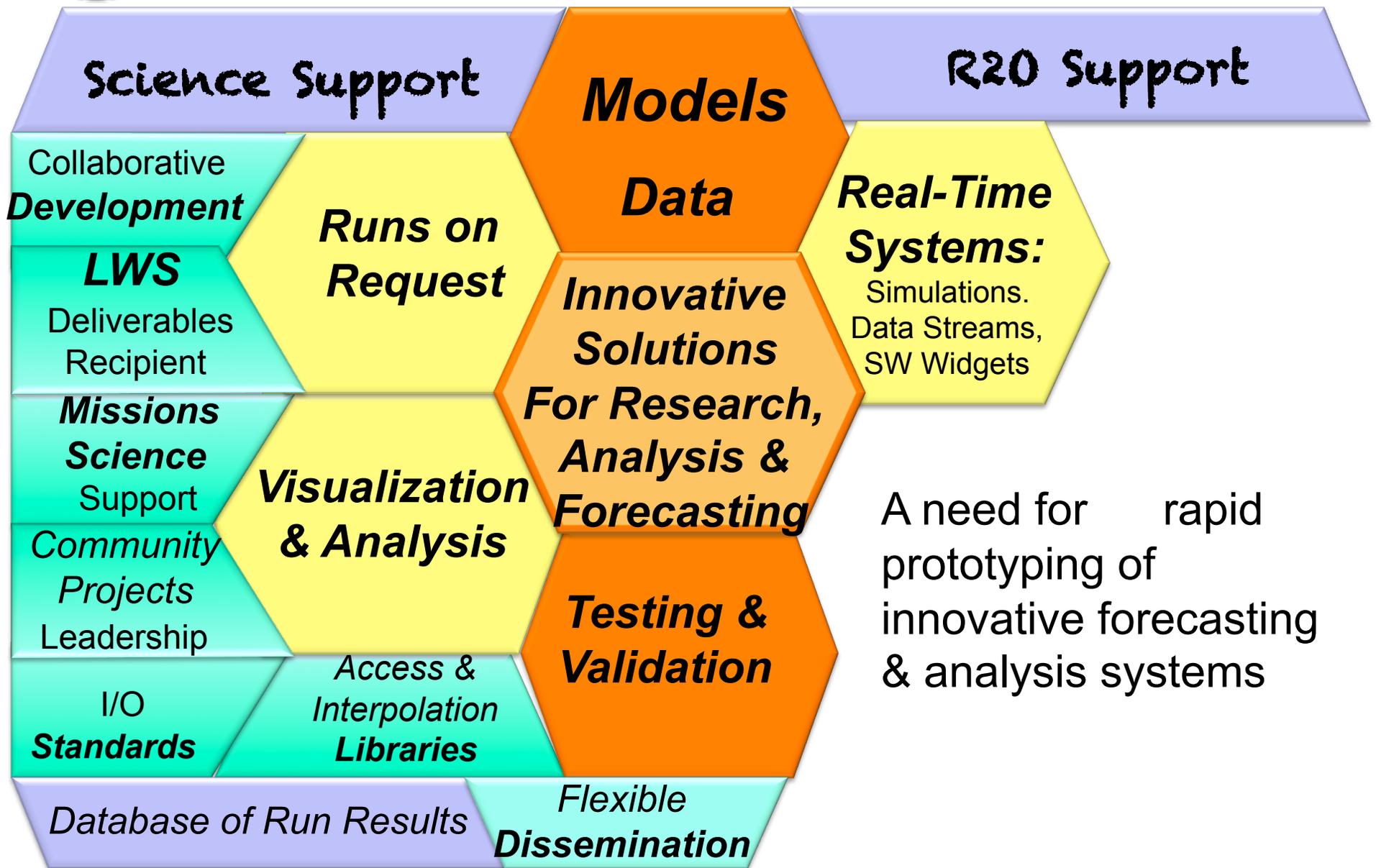


CCMC Activities at a Glance (2000 - 2010)





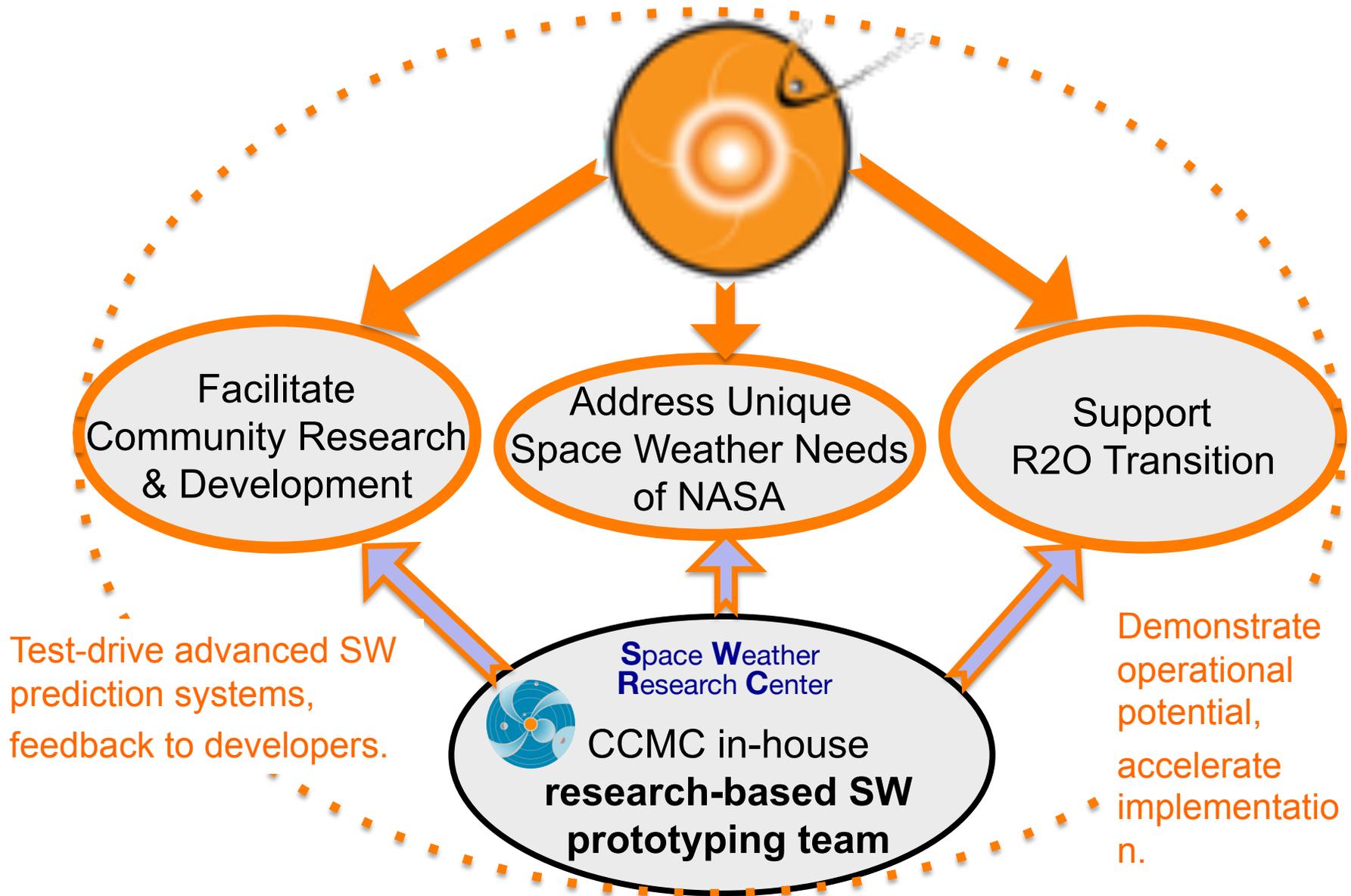
CCMC Activities at a Glance (2000 - 2010)





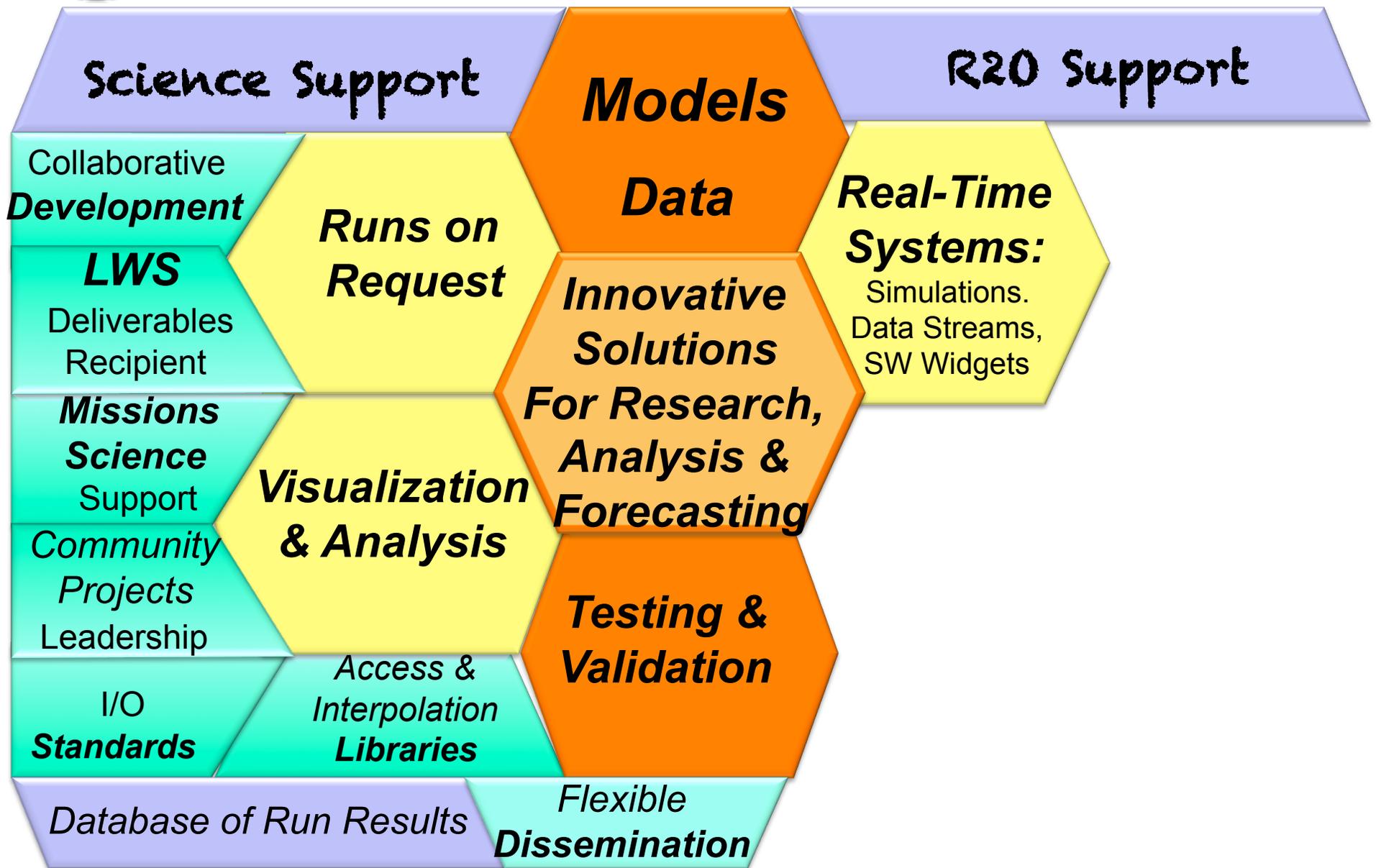
CCMC/SWRC

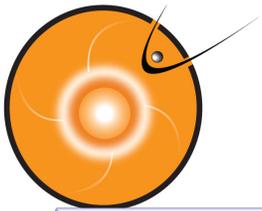
CCMC+
v. 2013





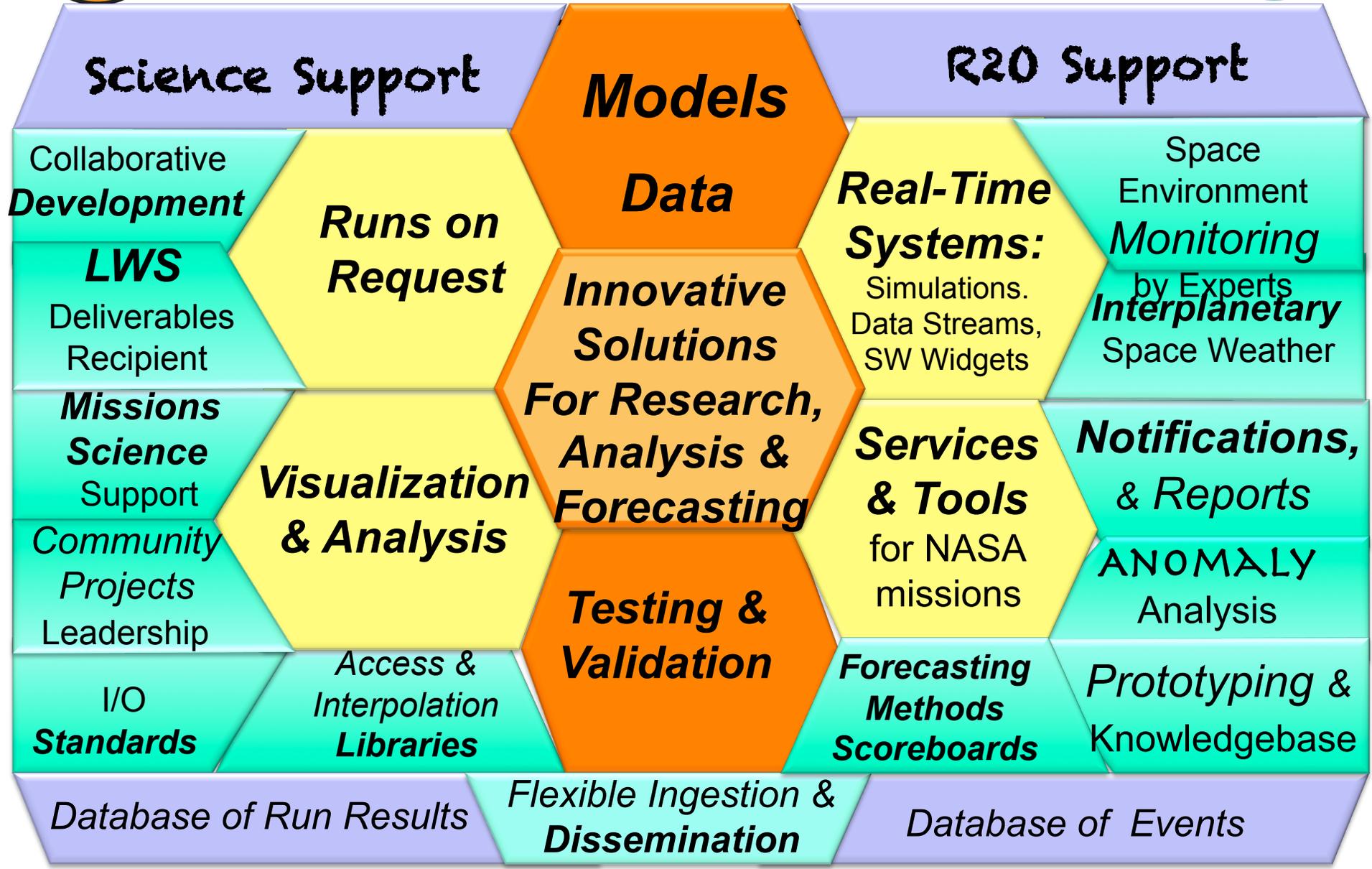
CCMC Activities at a Glance (2000 - 2010)





CCMC/SWRC v.2013

Assets & Activities at a Glance





CCMC Staff

~ 13 FTEs
NASA+NSF



S. Bakshii



Anna Chulaki



M. Kuznetsova
(Director)



Marlo Maddox
(Deputy)



P. Macneice



M. Mendoza



R. Mullinix



L. Rastaetter



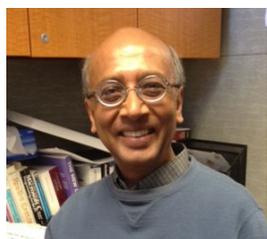
Ja Soon Shim



M. Swindell



Chiu Wiegand



Kiran Patel



A. Taktakishvili



Yihua Zheng



A. Pulkkinen **(Lead)**



Y. Collado-Vega

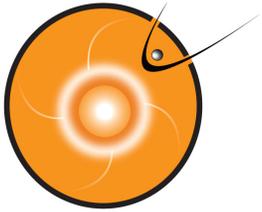


Leila Mays



Alex Glocer

SWRC Team



CCMC/SWRC Affiliates



GSFC Scientists

SW Research Analysis & Forecasting

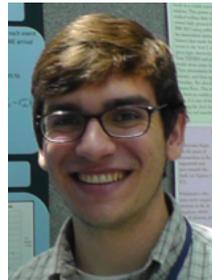


B. Thompson



K. Muglach

Space Weather Undergrad Interns



M. Romano



C. Koller



J. Bryant



Z. Titus



D. Krishnarao

Students Presentation: Wednesday, 4:20 - 5:20 pm

Postdocs



R. Evans



C. Ngwira



A. Pembroke

International Grad Students



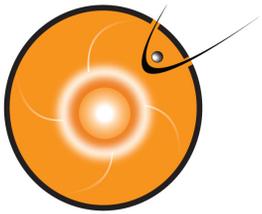
J. Strandstedt
LiU, Sweden



H-C. Helltegen



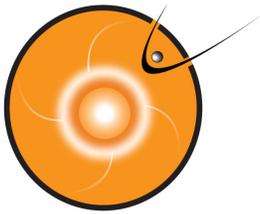
E. C. Kalafatoglu
ITU, Turkey



CCMC/SWRC Lab at GSFC Bld. 21, Rm 261



You are welcome to visit for a tour
and a demo



Computational Resources



- **Dedicated Infrastructure**
 - 17 Rack Footprint
 - 6 Beowulf Clusters (1 Scheduled for decommission)
 - 1,616 CPU Cores (240 scheduled for decommission)
 - 35 Enterprise Class Workstations
 - Virtualization / Multi Node (4) - Private Cloud
 - 0.8 Petabyte of Online Storage
 - Runs-On-Request Only SAN Storage with Mirror
 - Server Types: web, ftp, wiki, cvs, svn, file, database, web-application, meta-data controllers
- Multi-Building Setup for High Availability and Failover

Splinter mini-session: Tuesday 2:30 - 3:30 pm

*To discuss computational resource requirements
for current and future models*



Models Status, New Installations & Upgrades in 2007 – 2013

Solar Heliosphere

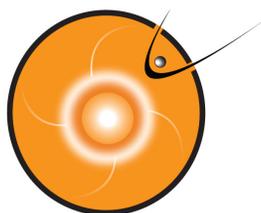
Magnetosphere

#	Model	Version	Date	Statu	#	Model	Version	Date	Status
1	WSA	2.2	04/2012	A	20	GUMICS	4.0	10/2010	A
2	PFSS_Macneice	1.0	08/2011	A		GUMICS	5.0	08/2011	EP
3	PFSS_Petrie	1.0	03/2013	E	21	LFM-TING	1.0.2	03/2009	ER
4	ANMHD	1.0.1	07/2007	A		LFM-TING	1.0.3	12/2009	ER
5	SRPM	1.0	09/2012	D		LFM-TING	1.0.4	03/2010	R
6	NLFFF_Weigelmann	1.0	05/2013	E	22	LFM-MIX	LTR-2.1.0	01/2011	ER
7	Enlil	2.5	05/2007	R		LFM-MIX	LTR-2.1.1	07/2011	R
	Enlil	2.5a	01/2008	R		LFM-MIX	LTR-2.1.4	03/2012	A
	Enlil +Enlil_Cone	2.5b	07/2009	R	23	LFM-MIX-TIEGCM	LTR-2.1.5	07/2009	A
	Enlil +Enlil_Cone	2.6	10/2009	R		LFM-MIX-TIEGCM	LTR-2.1.6	10/2009	EP
	Enlil+ Enlil_Cone	2.6b	05/2010	A	24	OpenGGCM	3.1	06/2008	A
	Enlil+ Enlil_Cone	2.7	09/2010	R		OpenGGCM	4.0	04/2011	E
	Enlil+ Enlil_Cone	2.7d	01/2012	A		OpenGGCM	4.0-updated	08/2011	A
8	CORHEL	3.4.1	06/2007	R	25	SWMF+ng+loc_res	2007-03-03	03/2007	DA
	CORHEL	3.5	12/2009	R	26	SWMF+RCM	2008-04-19	04/2008	A
	CORHEL	4.2.r45	02/2010	R	27	SWMF+RCM+deltaB	2011-01-31	01/2011	A
	CORHEL	4.6	02/2011	A		SWMF+RCM+RBE	2011-01-31	01/2011	DA
	CORHEL	4.7	01/2012	A	28	SWMF+CRCM	2013-01-29	01/2013	A
	CORHEL	5.0	05/2013	E	29	WINDMI	0.9	01/2008	R
9	Heltomo IPS	-	08/2010	R		WINDMI	1.0	02/2009	A
	Heltomo IPS	-	06/2011	R	30	RDST_calc	1.0	10/2009	EP
	Heltomo IPS	-	11/2012	A	31	RCM	-	11/2012	EP
10	Heltomo SMEI	-	06/2009	R	32	Fok_RBE	2.0	03/2010	A
	Heltomo SMEI	-	10/2011	R	33	Fok_CIMI	-	01/2013	A
	Heltomo SMEI	-	11/2012	A	34	AE-8/AP-8	8	03/2008	A
11	EXO Solar Wind	1.24	11/2010	A	35	LANLstar	-	11/2012	A
12	SWMF/SH	-	07/2007	R	36	Tsyganenko	T89	03/2008	R
	SWMF/SH		05/2008	R		Tsyganenko	T96	04/2009	R
	SWMF/SH	2009-07	07/2009	A		Tsyganenko	TS04	04/2013	A
	SWMF/SH	2013-05	05/2013	E	37	IGRF		03/2008	A
13	BRYNTRN	V1.	02/2009	R	38	Apex		03/2008	A
	BRYNTRN	V2	05/2009	R	39	AACGM		03/2008	A
14	EMMREM	v20101203	12/2010	R	40	PS_VP	1.0	04/2011	A
15	PREDICCS	-	05/2013	A	41	Ovation Prime	2010-06-17	06/2010	ER
16	Posner SEP	1.0	03/2008	A		Ovation Prime	2012-05-21	05/2012	A
17	ASAP	-	03/2010	A	42	Weimer IE	2005	05/2008	A
18	UMASEP	1.2	03/2011	A		Weimer-deltaB	-	04/2012	E
19	MAGIC	1.0	2013	D	43	Weigel-deltaB	v. dB	01/2011	E
						Weigel-deltaB	v. dB/dt	08/2012	E
					44	3DView-deltaB		12/2012	DA

A – Active
D – Collaborative
Development
E – Evaluation
P – Pending
R – Retired

Ionosphere

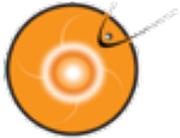
#	Model	Version	Date	Status	
45	SAMI-2	0.97	02/2007	R	
	SAMI-2	0.98	02/2008	R	
	SAMI-2	1.00	01/2011	A	
	SAMI-2	1.00	01/2011	A	
46	SAMI-3	1.00	10/2011	A	
	47	CTIPe	2.0	03/2010	R
		CTIPe	2.0-upd	03/2011	A
48	CTIPe	2.0+kml	04/2013	DE	
	TIE-GCM	1.93	09/2009	R	
	TIE-GCM	1.94	06/2011	R	
	TIE-GCM	1.94.1	07/2011	R	
	TIE-GCM	1.94.2	01/2012	A	
49	TIE-GCM	1.95+kml	06/2013	DE	
	USU-GAIM	2.4.3p1	07/2007	A	
50	SWACI TEC	-	11/2010	A	
51	ABBYNormal	V1.1	07/2007	R	
	ABBYNormal	V3.3	08/2012	A	
52	IRI	2007	03/2008	A	
	IRI	2012	02/2013	A	
53	MSISE-90	V90	03/2008	R	
	NRLMSISE-00	V2001	03/2008	A	
54	GITM	2.0	01/2012	R	
	GITM	2.1	07/2012	A	
55	PBMOD	6.0.00	09/2009	R	
	PBMOD	6.4.00	07/2011	A	
56	TRIPL-DA	2.0	04/2013	E	



Models: New Installations & Upgrades in 2012 – 2014



DOMAIN	MODEL	VERSION	DATE	STATUS
SH	WSA	2.2	04/2012	A
SH	PFSS_Petrie	1.0	03/2013	E
SH	SRPM	1.0	09/2012	D
SH	NLFFF_Weigelmann	1.0	05/2013	E
SH	Enlil+Cone Model	2.8a	03/2014	E
SH	CORHEL	5.0	05/2013	R
SH	CORHEL	5.0.1	01/2014	A
SH	Heltomo IPS		11/2012	A
SH	Heltomo SMEI		11/2012	A
SH	SWMF/SH	2013-05	05/2013	E
SH	PREDICCS		05/2013	A
SH	MAGIC	1.0	01/2013	D
GM	LFM-MIX	LTR-2.1.4	03/2012	R
GM	LFM-MIX-TIEGGCM	LTR-2.1.5	07/2012	A
GM	LFM-MIX-TIEGGCM	LTR-2.2.0	09/2013	DA
GM	SWMF+CRCM	2o13-01-29	01/2013	A
GM	RCM		11/2012	EP
GM	LANLstar	2.0	11/2012	ER
GM	LANLstar	3.0	11/2013	A
GM	Tsyganenko	TS04	04/2013	A
GM	Ovation Prime	2o12-05-21	05/2012	A
GM	Weigel-deltaB	v.dB/dt	08/2012	E
GM	3DView-deltaB	1.0	12/2012	DA
GM	3DView-deltaB	2.0	12/2012	DE
IT	SAMI-3	1.00-1	06/2013	A
IT	CTIPe	2.0kml	04/2013	DE
IT	TIE-GCM	1.95	08/2013	A
IT	ABBYNormal	V3.3	08/2012	A
IT	IRI	2o12	02/2013	A
IT	MSIS	NRLMSISE-00	05/2012	A
IT	GITM	2.1	07/2012	A
IT	TRIPL-DA	2.0	04/2013	E
IT	Weimer-deltaB		04/2012	E
IT	USSW Sheffield		12/04/2013	
IM	Plasmasphere		01/2011	A
IM	RCM	2.0	01/2012	A
IM	Fok_CIMI		01/2013	A
ISWA	MAG-4	ver 11/2013	11/2013	A
ISWA	MAG-4	ver 03/2014	03/2014	E
ISWA	UAH Probabilistic Model for SEP Fluence Spectra	v1	12/2012	E
ISWA	UAH Probabilistic Model for SEP Fluence Spectra	v2	02/2014	E

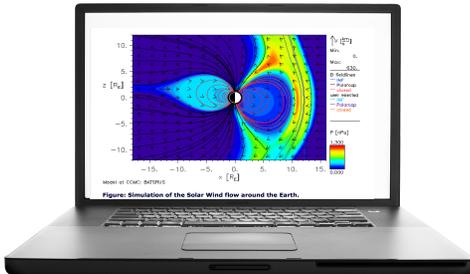


CCMC Signature Services



RoR

Runs-on-Request Service



Web-base interactive system to serve advanced models to the international research community

- User-configurable input parameters and settings.
- Comprehensive on-line visualization & downloads
- Users advising and custom simulations.

Conversion and Interpolation Library

KAMELEON

- Convert model output to platform independent standard formats and add descriptive meta-data
- Extract and interpolate data for any given variable, position, time.
- Call from any C-compatible language

iNtegrated Space Weather Analysis System

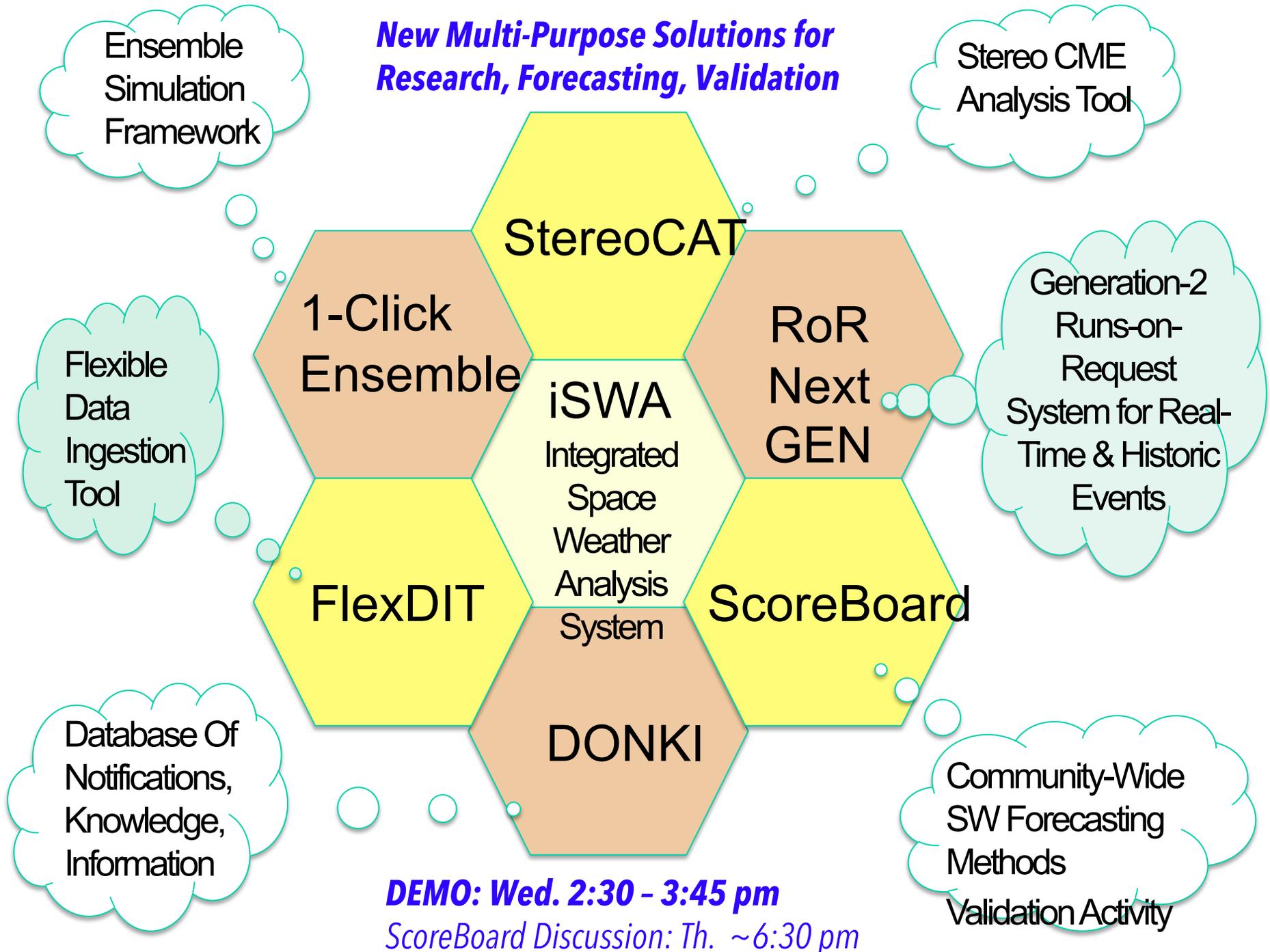
iSWA

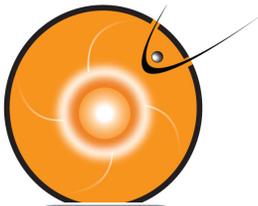


Flexible ingestion & dissemination of simulations results & observational data (**real-time** and **archives**).

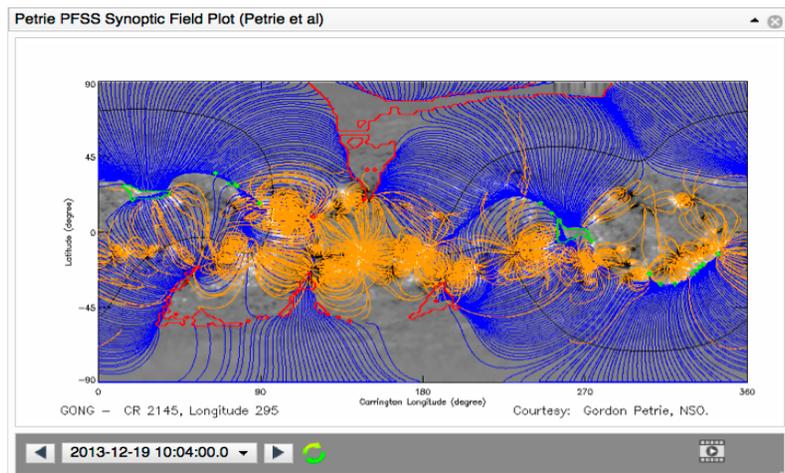
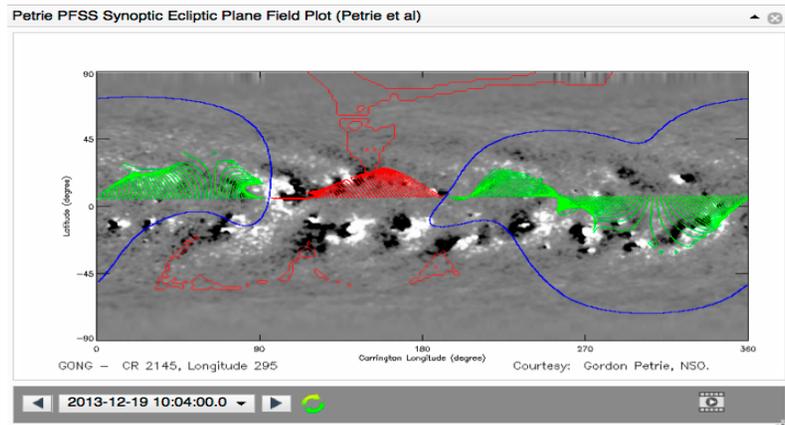
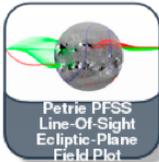
A state-of-the-art tool for real-time space environment monitoring, historical event analysis, informed decision making, system science, and education.

***New Multi-Purpose Solutions for
Research, Forecasting, Validation***

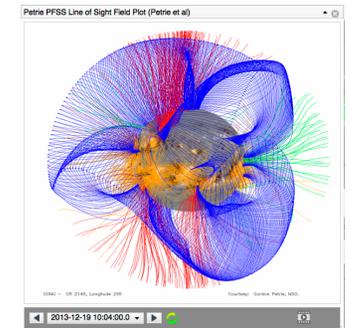
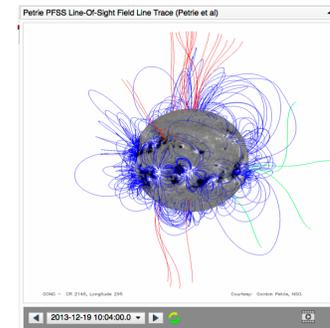
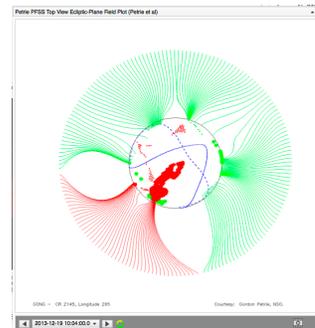




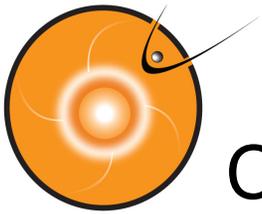
New Potential Field Source Surface Model: Petrie PFSS



- PFSS model is the simplest physical approximation for modeling the solar coronal magnetic field.
- The Petrie version provides the most **comprehensive graphics** presentation of any current PFSS model.
- It uses Solar photospheric field measurements from the GONG network.
- Status: **running in realtime**



Graphics highlight evolution of the large scale coronal field topology!



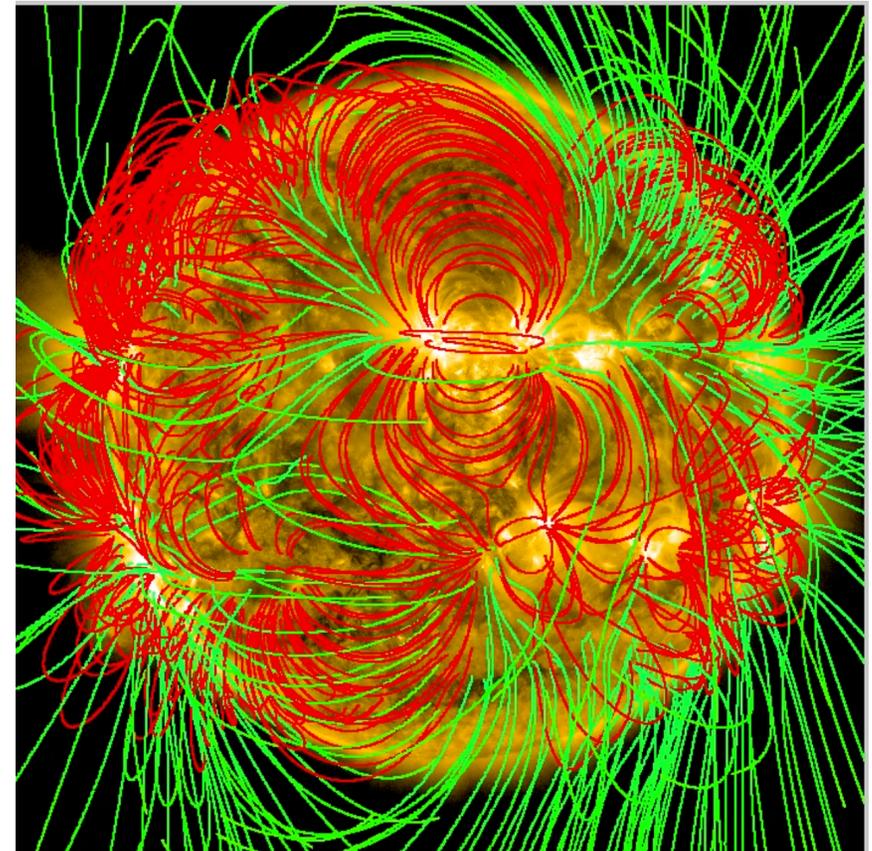
Nonlinear Force-Free 3-D Coronal Magnetic Field Reconstruction



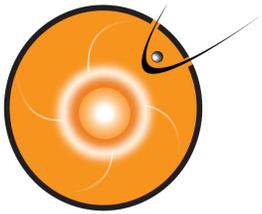
NLFFF

- Is simplest approximation capable of estimating free energy.
- Is much faster and more robust than MHD
- capable of modeling large or field-of view including active region interconnectivity.

Status: installation complete,
on-going evaluation



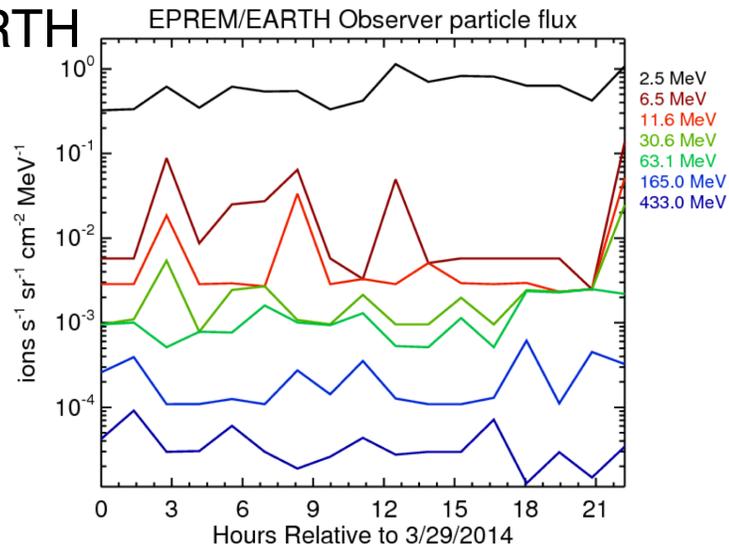
Tilaye Tadesse, T. Wiegmann
CCMC: P. MacNeice



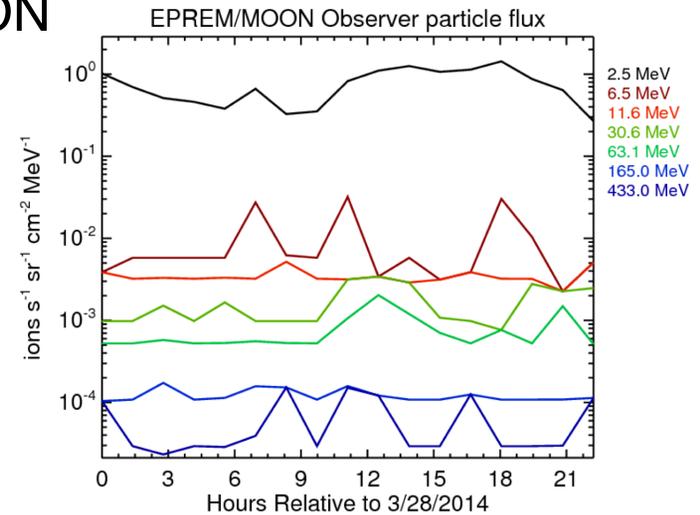
PREDICCs: Tracks SEP and Predicts Radiation Environment through the Heliosphere



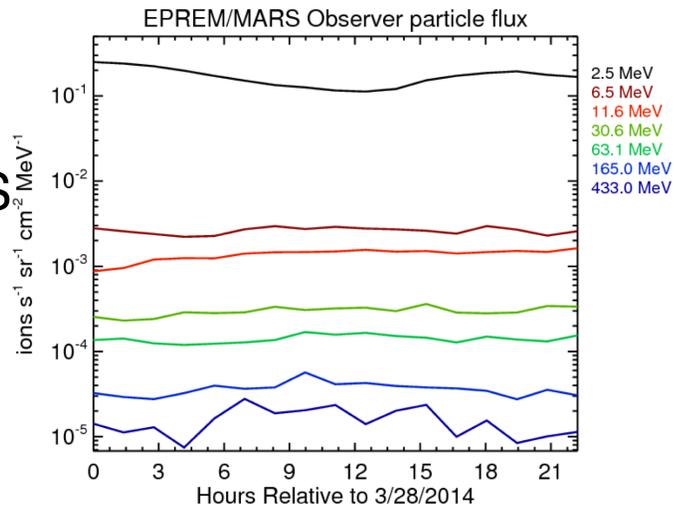
EARTH



MOON

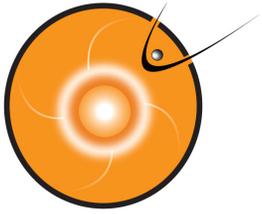


MARS

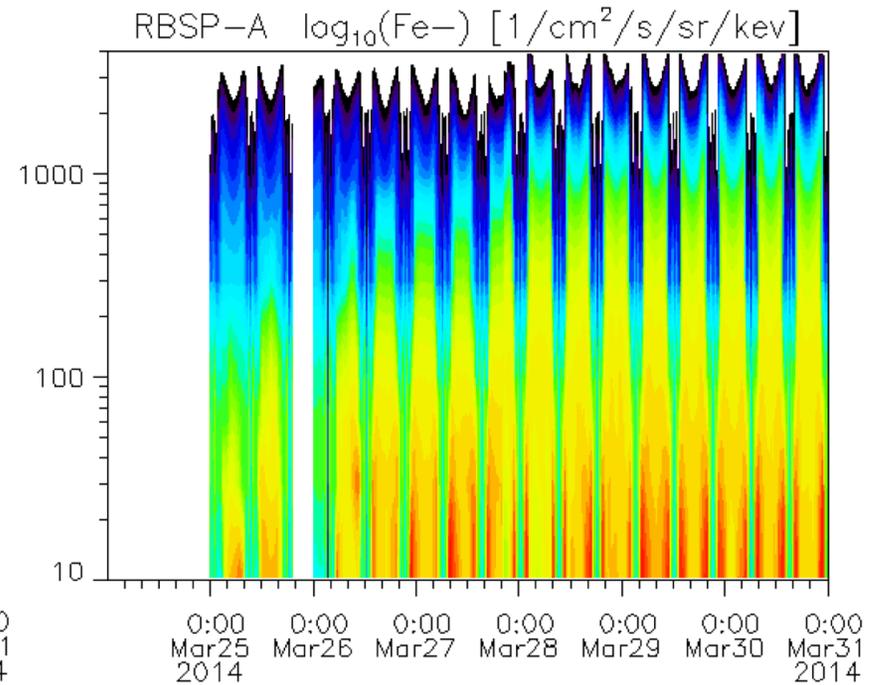
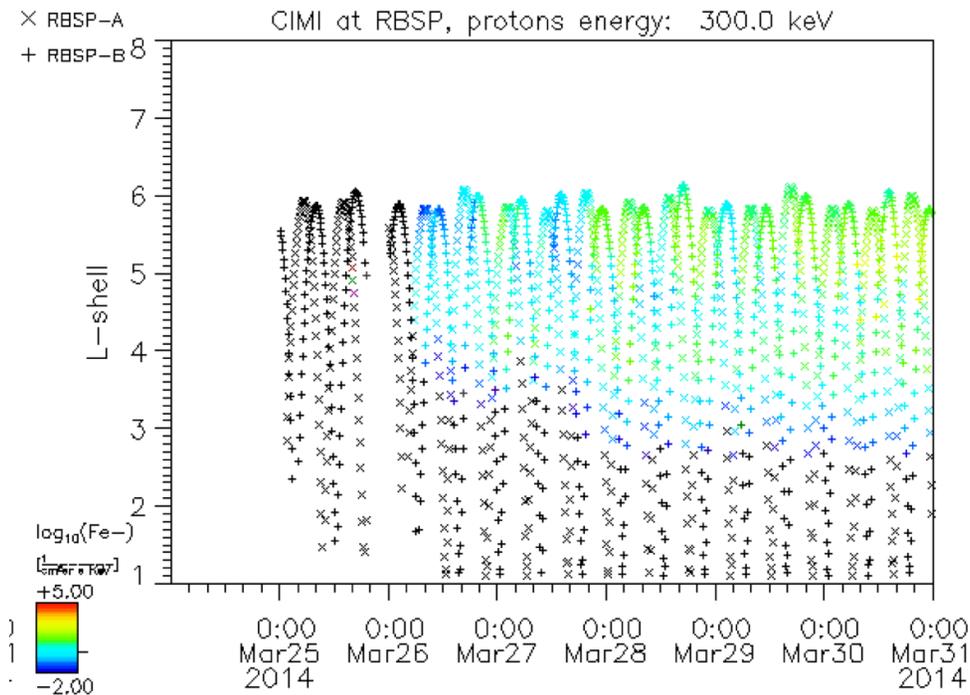


LWS deliverable
Running in realtime

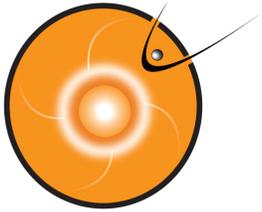
N. Schwadron, H. Spence
CCMC: L. Rastaetter.



New Inner Magnetosphere Model CIMI



M-C. Fok, N. Buzulukova, CCMC: L. Rastaetter



New Models and Updates: Magnetosphere/Ionosphere



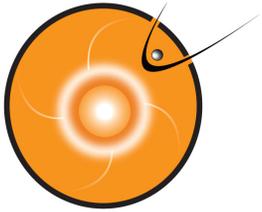
Magnetosphere

- **Tsyganenko** magnetic field models (T89, T96, T01quiet, TS05)
- **CIMI**: ring current & radiation belt (new Fok model)
- **LANL***: radiation belt drift shell modeling (Y.Yu, J Koller)
- **VERB** radiation belt (Y. Shrits) (test mode)
- **CMIT**: fully coupled LFM, MIX, TIEGCM, version 2.2.0
- **OpenGGCM** update v4.0 (with updating dipole)
- **SWMF with RCM+RBE,**
- **SWMF with CRCM**

NEW

Ionosphere

- **GITM** (stand alone component of SWMF)
- **TripleDA** – data assimilation (test mode) (T. Gaussiran, R. Calfas)
- **TIE-GCM** latest version 1.95
- **SAMI3** latest version 1.00.



Runs-on-Requests News



Global Magnetosphere:

New Post-processing options:

- Magnetosphere runs **preview movies**
- Magnetosphere runs Delta-B at magnetometer stations: output from SWMF or calculated for other models (**Rastaetter Delta-B tool**)

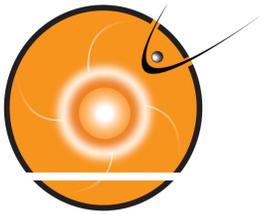
Run submission interface completely redesigned, streamlining user's experience.

Inner Magnetosphere:

Inner Magnetosphere is now a **separate, fast growing category of runs**, including RCM, Fok CIMI, Tsyganenko, IASB Plasmasphere

Solar/Heliosphere:

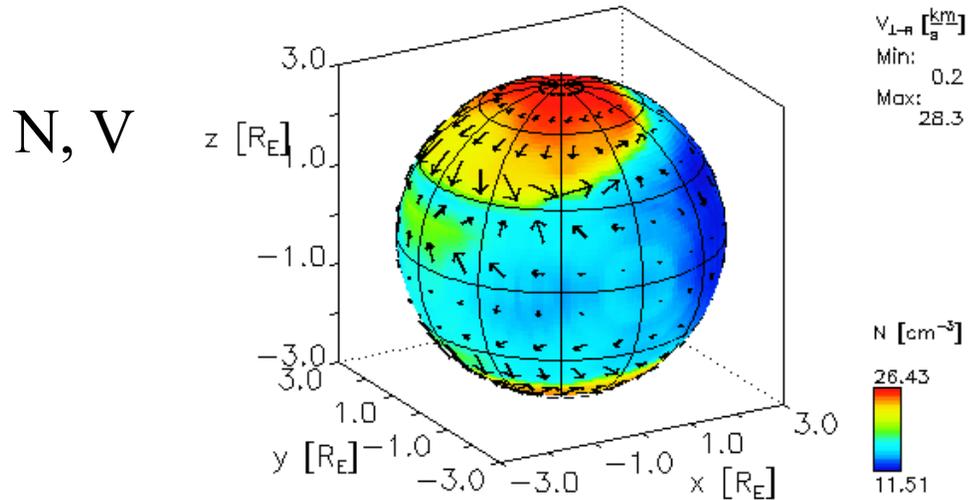
- New **Fast Track** ENLIL with Cone model ROR interface for event-based forecasting (offers opportunity to simulate current events).
- Heliospheric Tomography with IPS data now uses in situ input data from ACE, CELIAS and WIND to match the remote-sensing data near Earth.



New Visualization: Sphere Plot in Magnetosphere



Scalar quantity (N) and vector (V) on a sphere around Earth.

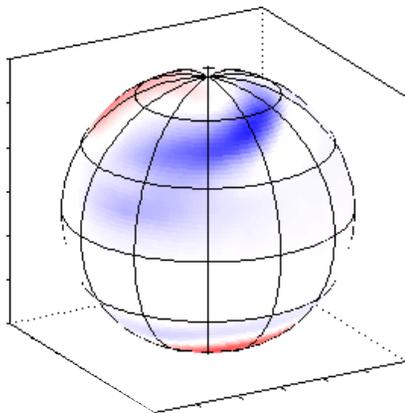


- Establish distribution of any MHD quantity at a constant radial distance in the **inner magnetosphere**.

- Velocity field can be plotted to indicate convection.

Current density (J_z) at $3 R_E$
where mapping to ionosphere occurs

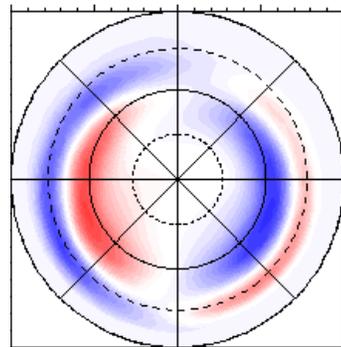
J_z



Field-aligned currents in ionosphere

J_R

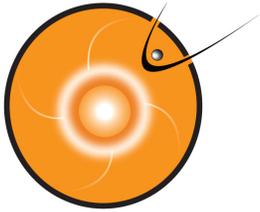
Northern Hemisphere
noon



$J_r \left[\frac{\text{A}}{\text{m}^2} \right]$
 +0.467
 -0.402

- Values plotted on sphere can be returned to user (ASCII) for further analysis.

L. Rastaetter



Runs-on-Request ChangeLog



- changes to RoR system
- upgrades to visualization
 - bug reports,
 - RoR runs: modifications applied, reruns performed.

Full log with milestones starting in 2009.

L. Rastaetter,
A. Chulaki
M. Mendoza

- **March 21, 2014**

Magnetosphere Run-on-requests: A bug was fixed in the definition of the 1.95-million cell grid offered for magnetospheric SWMF request runs. A discrepancy of about 100000 cells between some recent runs (2011 model version) and runs using the 2008 model version was eliminated.

- **March 6, 2014**

Run-on-Request visualization: A new *Plot Mode*, **ColorContour+Vector on Sphere**, was added. Components of a vector (selected as Q_2) on the sphere's surface are rendered as arrows. A bug was fixed in the **Color Contour on Sphere** plot mode that placed data values incorrectly onto the sphere and left areas around the north pole open.

- **March 4, 2014**

CTIPe real time run on iSWA: The electron density at 400 km altitude is now plotted.

ENLIL 2.8: ENLIL outputs with multiple blocks are fully supported by the visualization:

Block 0 is the full run with all CMEs entered into the model, each following block has one CME fewer until the last block without any CMEs (background steady-state run). The list of variables is automatically adjusted for the number of blocks found.

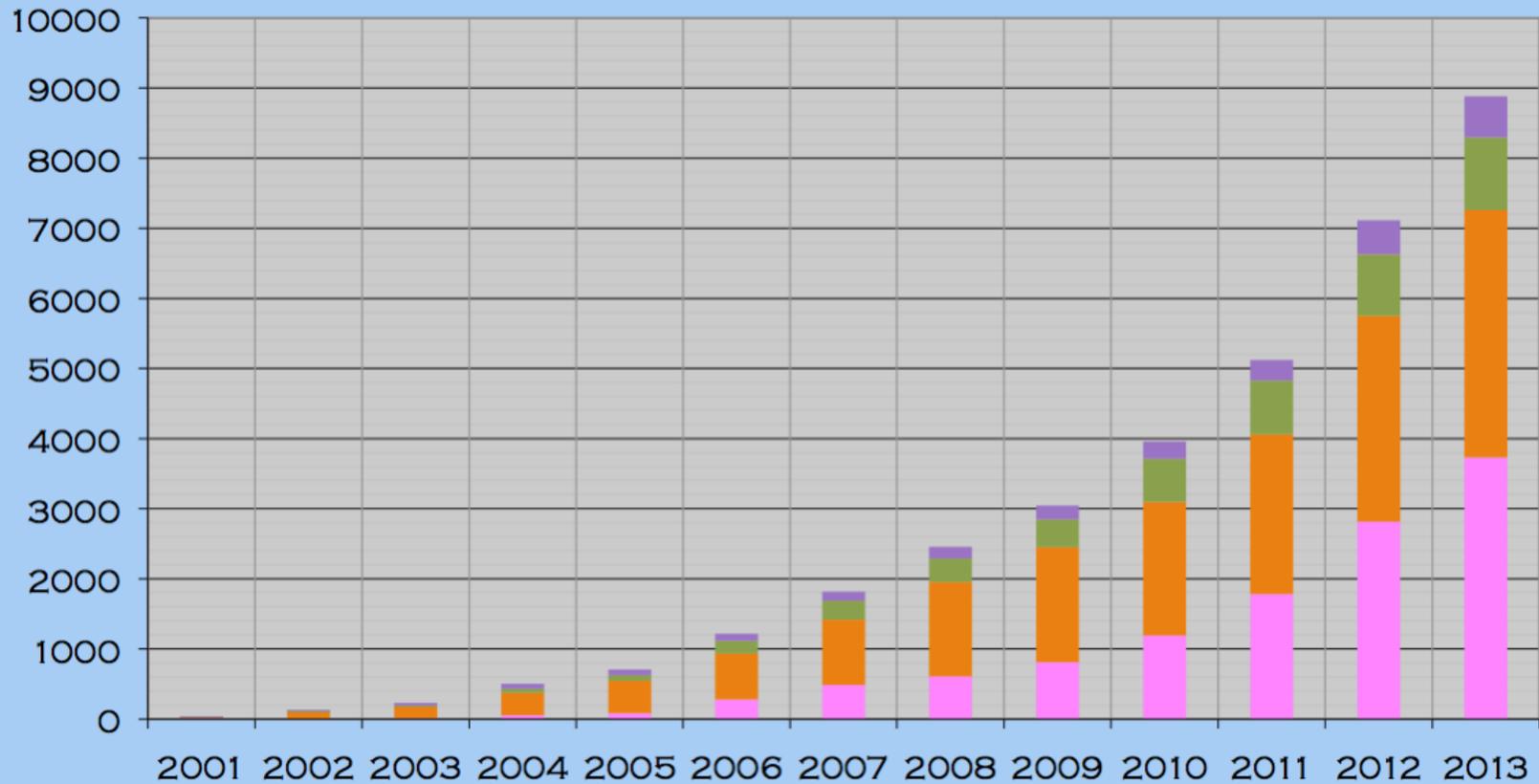
- **February 24, 2014**

SWMF coronal outputs: SWMF outputs for the solar corona in spherical coordinates are now supported. Values and positions written out in cartesian coordinates (X,Y,Z) are transferred back to spherical (R, Lon, Lat) coordinates and rendered like outputs of the MAS and ENLIL models.

- **February 12, 2014**

Run-on-Request visualization: A new *Plot Mode*, **Color Contour on Sphere** has been introduced for 3D magnetosphere model outputs. The plot mode can assist users in tracking changes near the inner boundary of a magnetosphere simulation and correlate values with corresponding patterns in the ionosphere.

RUNS ON REQUEST - CUMULATIVE GROWTH

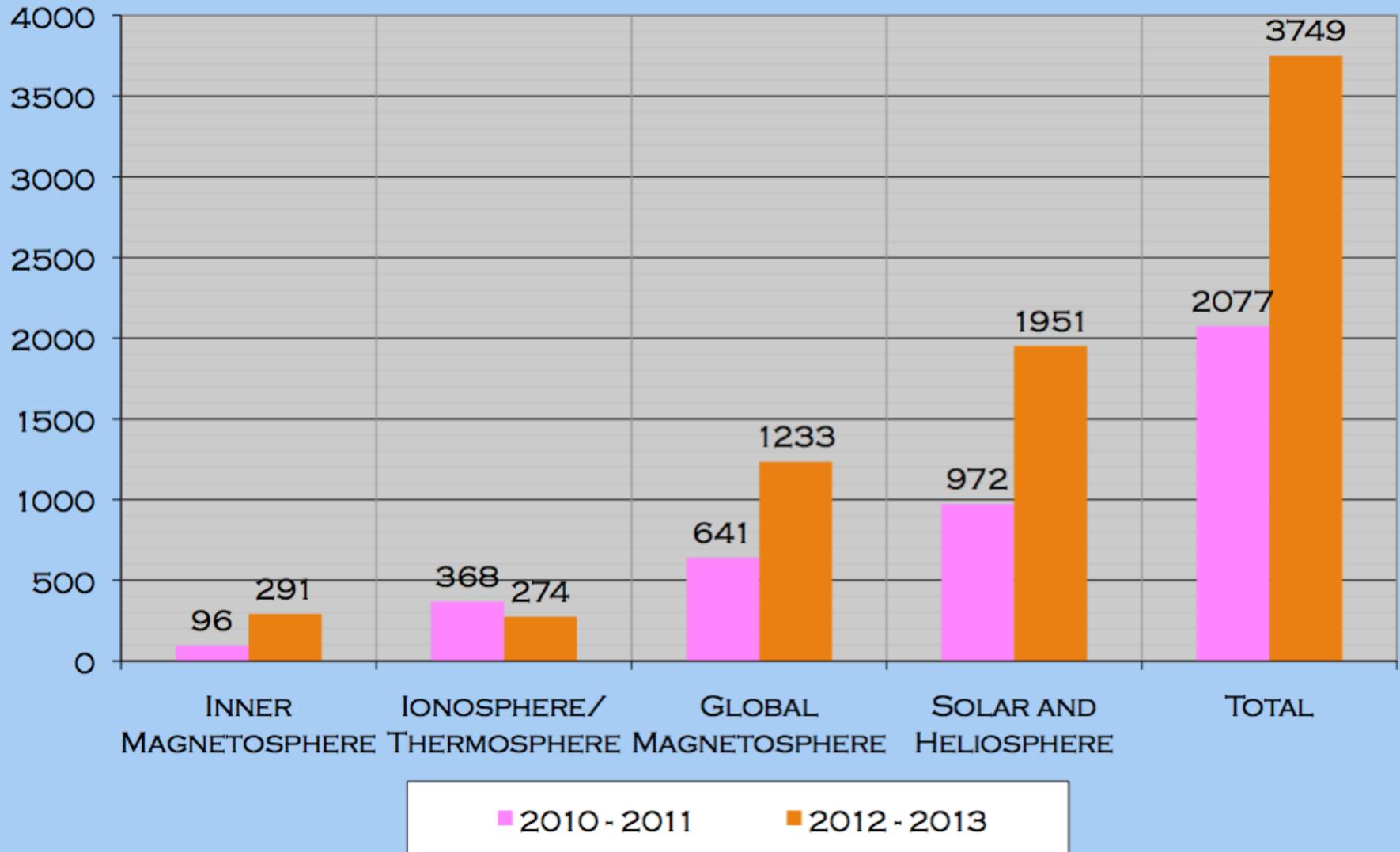


Last 3 years	SH	GM	IT	IM	Total Runs
2011	1784	2280	763	293	5120
2012	2814	2942	874	483	7113
2013	3735	3513	1037	584	8869

- SOLAR AND HELIOSPHERE
- GLOBAL MAGNETOSPHERE
- IONOSPHERE/THERMOSPHERE
- INNER MAGNETOSPHERE

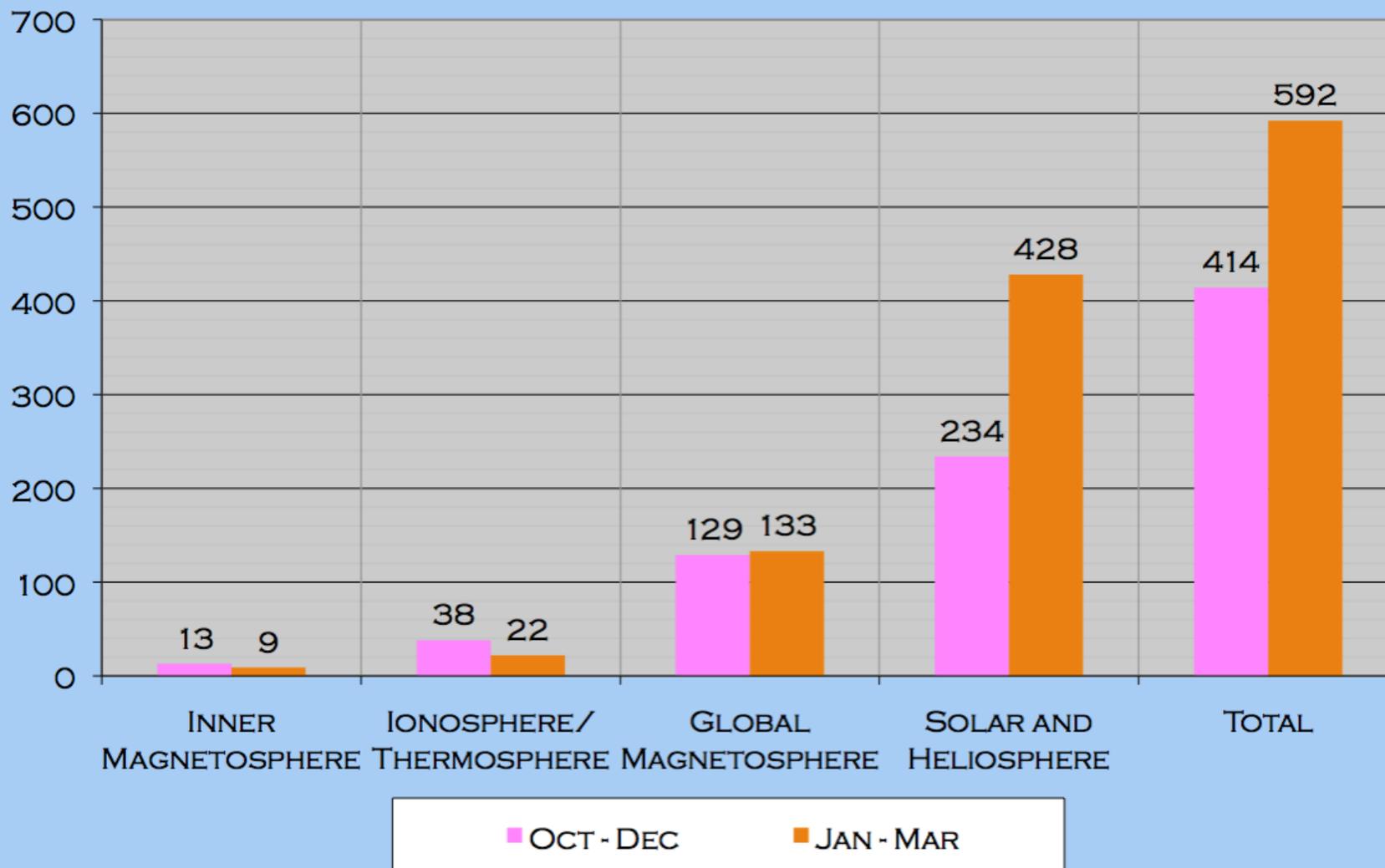
~ 9000 TOTAL RUNS

RUNS ON REQUEST - 2 YEARS COMPARATIVE

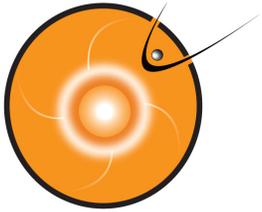


**2012-2013 NEARLY DOUBLE
THE TOTAL OF 2010-2011**

RUNS ON REQUEST - 3 MONTHS COMPARATIVE



**30% ROR INCREASE
IN 3 MONTHS**



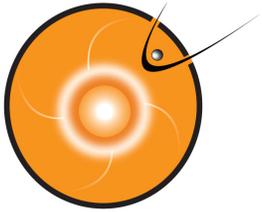
500 TOTAL UNIQUE USERS



YEAR	SH	GM	IT	IM	ALL ROR USERS
2010 - 2011	149	137	76	37	399
2012 - 2013	205	158	91	39	493

167 TOTAL PUBLICATIONS 427 TOTAL PRESENTATIONS

LAST 3 YEARS	Publications by Users	Publications by CCMC	Presentations by Users	Presentations by CCMC
2011	17	1	14	4
2012	12	4	43	51
2013	17	7	53	11
2000-2014	123	44	216	211



KAMELEON News



Current Standardized Model Output Availability

Global Magnetosphere: SWMF/BATSRUS, OpenGGCM, **LFM**

2D Ionosphere Electrodynamics: **SWMF/IE, AMIE**

Heliosphere: ENLIL, ENLIL Cone, SWMF/Heliosphere

Solar: MAS, SWMF/Solar, **MAGIC**

Science Data Format Output Options:

CDF 3.4, CDF 3.5

All Models

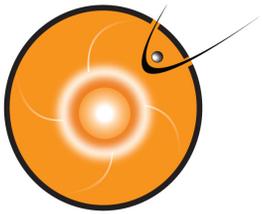
HDF5

SWMF/IE, ENLIL, ENLIL Cone, LFM
Conversion Only

NetCDF4

M. Swindell (Lead), A. Pembroke, M. Maddox,

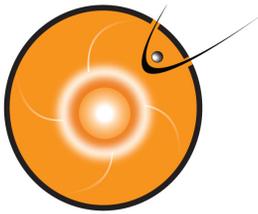
2012-2014



iSWA Usage



http:// iswa.ccmc.gsfc.nasa.gov	2008-2009 [TRL 6]	2010-2011 [TRL 7/8]	2012-2014 [TRL 7/8]
iSWA Version	1.0	1.9.8	1.15.0
Widgets/Cygnets	135	275	360
CCMC Model Feeds			272
Total Model Feeds			292
Observational Data Feeds			203
Total Feeds	171	370	495
Data Files	6 Million	27 Million	60 Million
Visits	3K	170K	380K
NASA Visits	728	10K	12K
Unique Visitors	671	70K	150K
twitter followers @NASAiSWA	0	132	1728



iSWA Solarscape Interactive Cygnet



Dynamically Generated Interactive Product with User Selectable Features From Several Sources

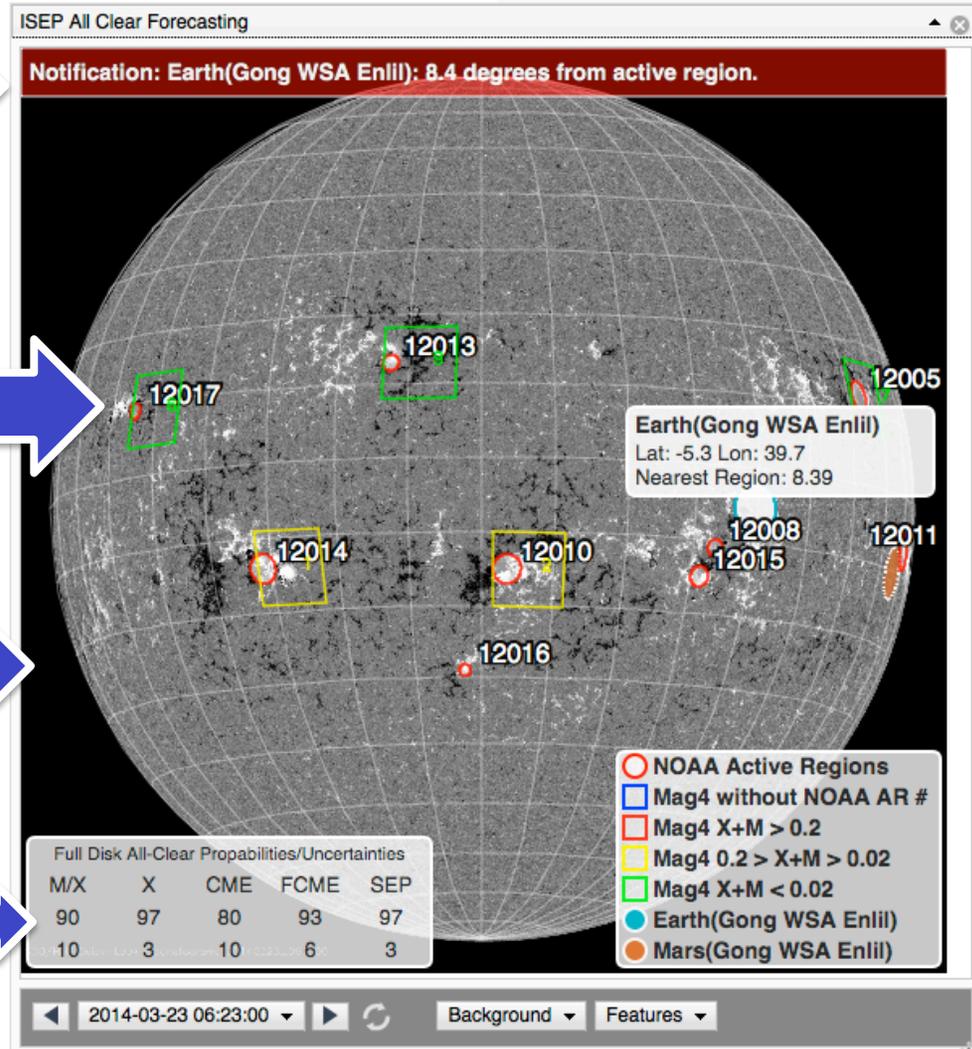
Alerts/Notifications

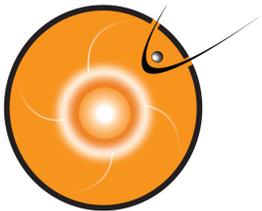
User Selectable Features

(MAG4, WSA-ENLIL Magnetic Connectivity, NOAA Active Regions)

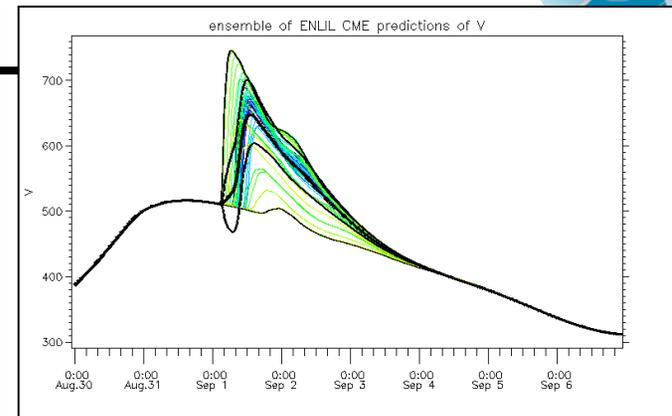
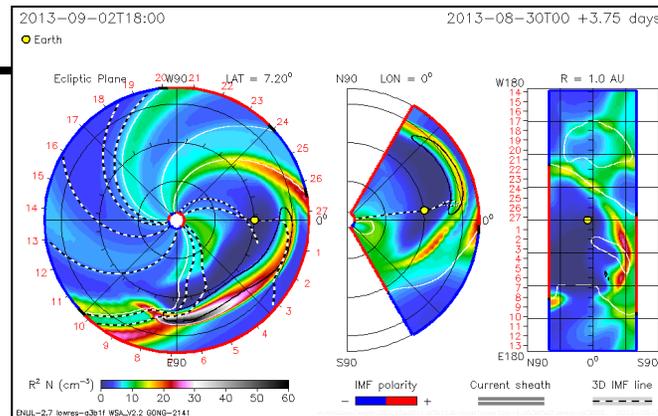
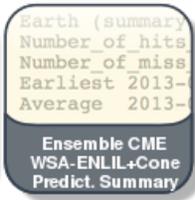
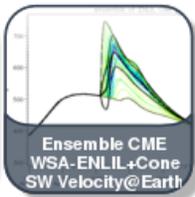
User Selectable Background

Collapsible Detailed Data Window

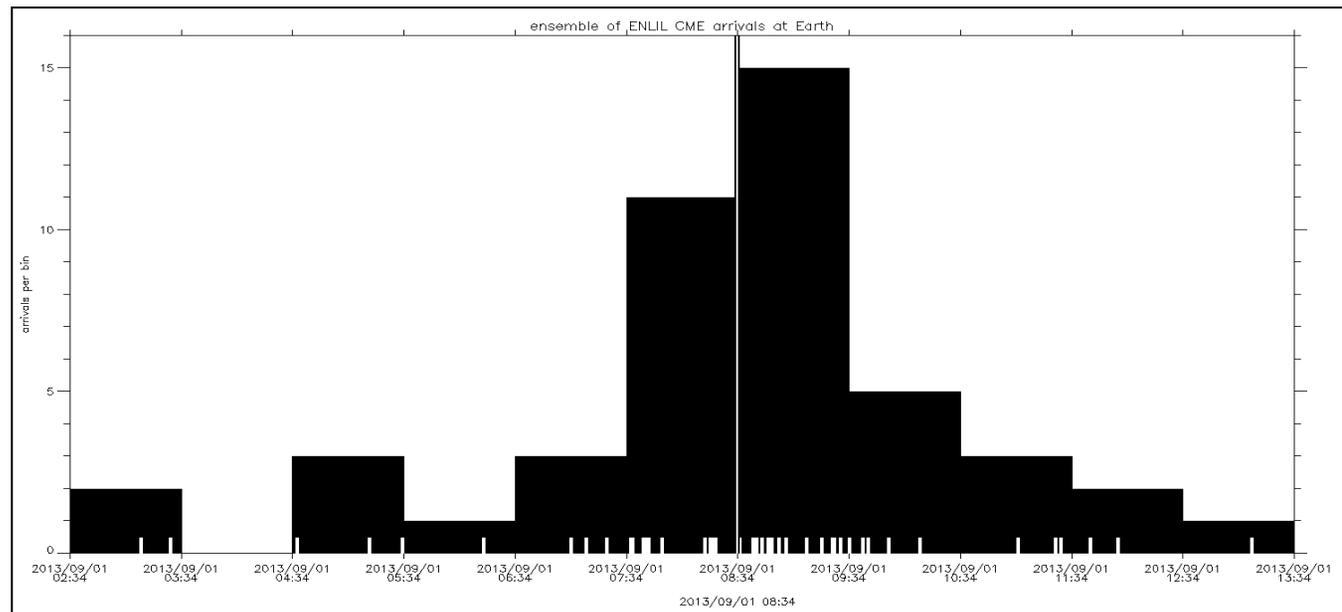




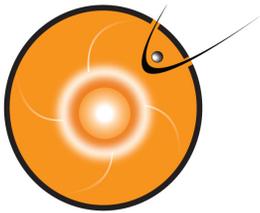
CME Ensemble Forecasting



Multiple CME Ensemble Forecast Products



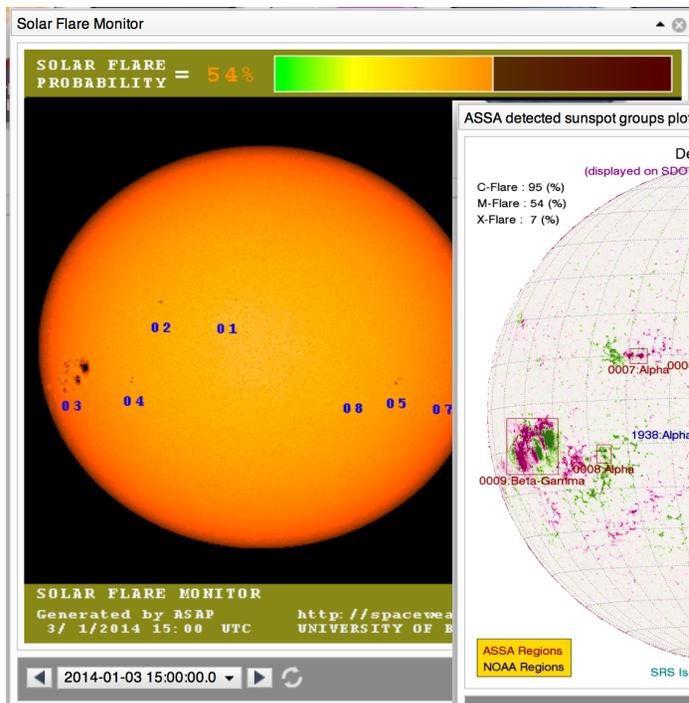
Estimate spread/uncertainty in CME arrival time predictions due to uncertainty of CME input parameters.



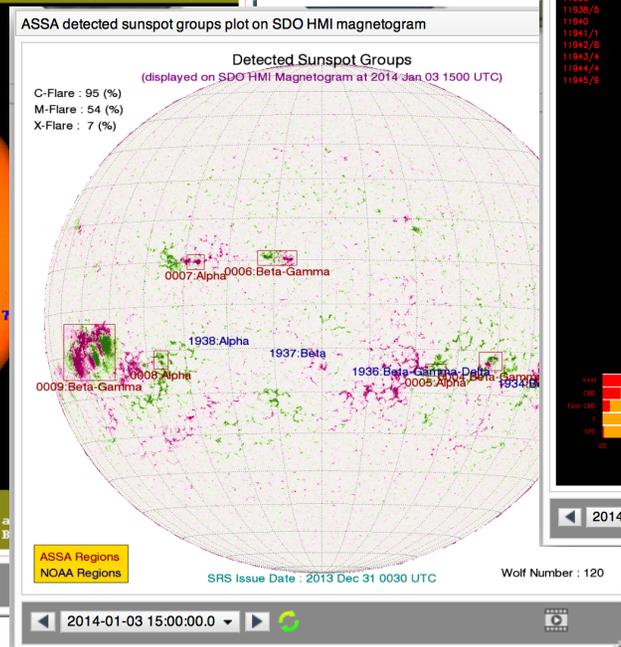
New Flare Prediction Models



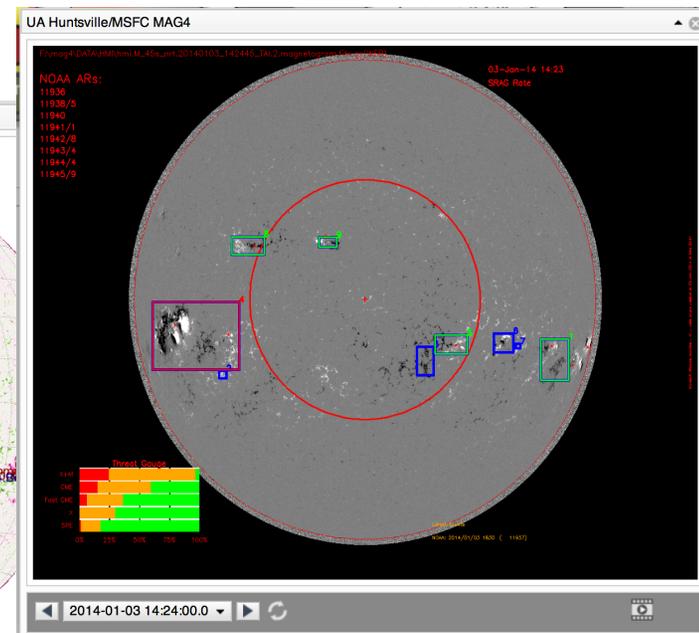
- CCMC/SWRC has now **three independent flare prediction** models implemented in iSWA. These allow, for the first time, model ensemble approach to flare prediction.



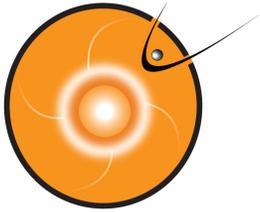
ASAP
(U. Bradford)



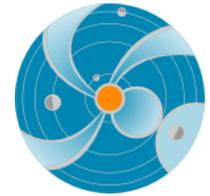
ASSA
(KSWC)



MAG4
(D. Falconer)



iSWA Cygnets: PBMOD (Ionosphere Scintillations)



Available Cygnets

Solar Heliosphere Magnetosphere Ionosphere Planetary/Spacecraft All Cygnets New Cygnets Events bETA

PBMOD Map of Total Electron Content

Retrospective PBMOD Electron Density Profile (-12 lat, 280 lon)

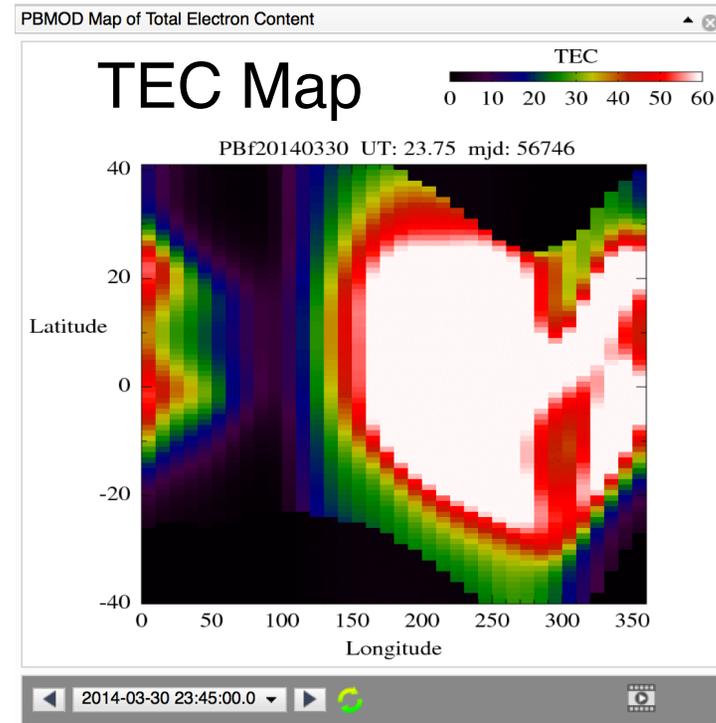
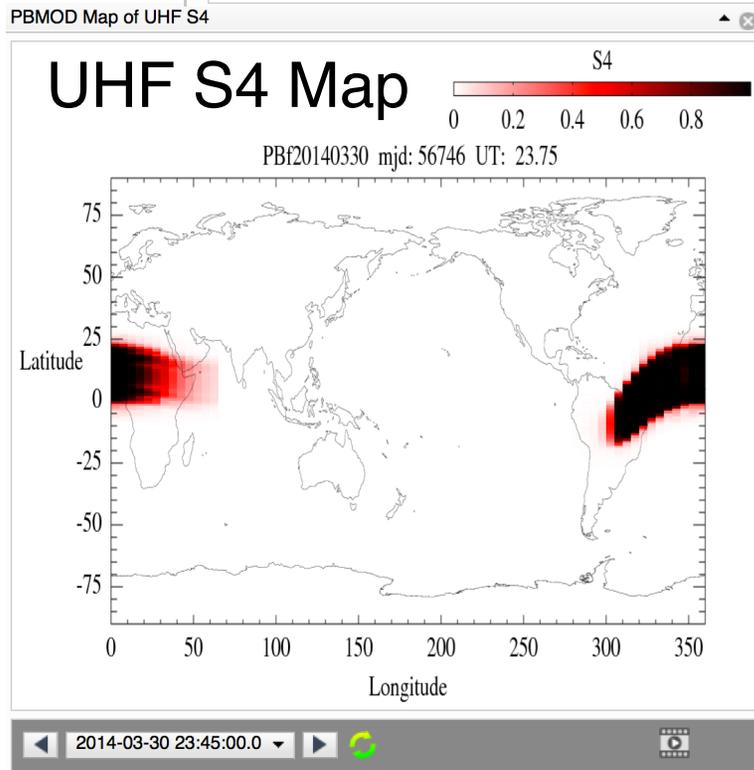
PBMOD Electron Density Profile (-12 lat, 280 lon)

PBMOD Map of UHF S4

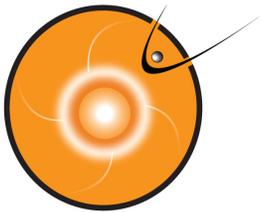
Retrospective PBMOD Map of UHF S4

PBMOD Map of L-band S4

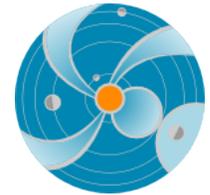
1 2 3 4 5 6 7 8 9



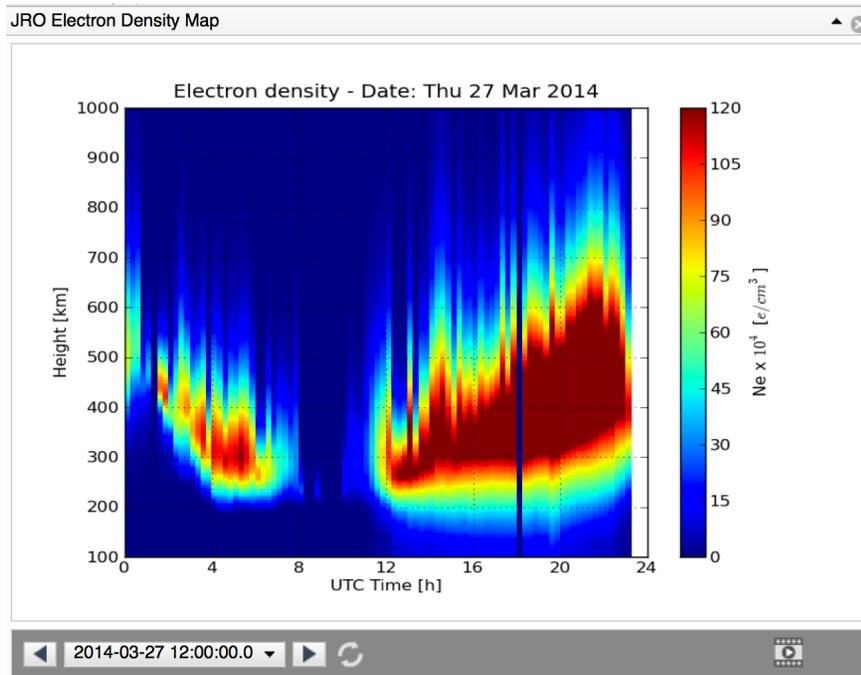
J. Retterer, CCMC: J-S. Shim



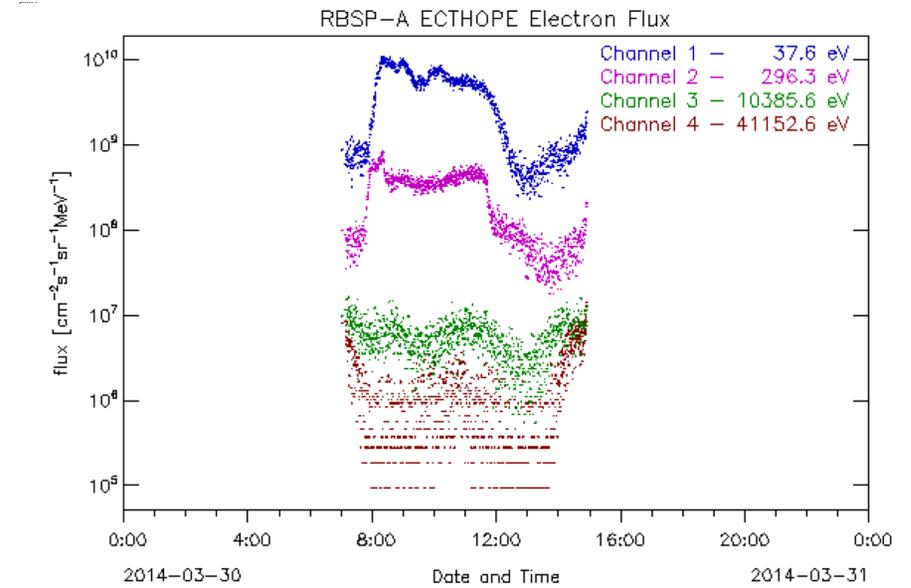
iSWA Cygnets: Realtime Observational Data

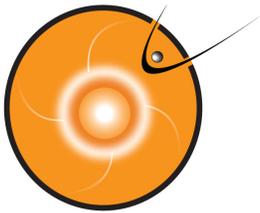


JRO Electron Density



Van Allen Electron Flux





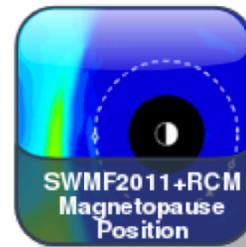
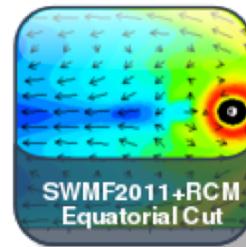
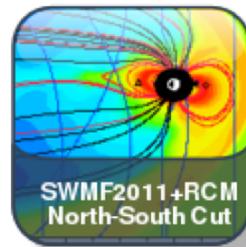
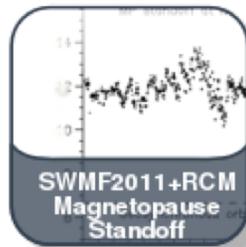
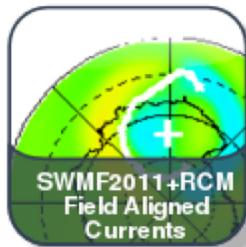
iSWA: SWMF (BATSRUS + RCM) v. 20110131 (U. Mich)



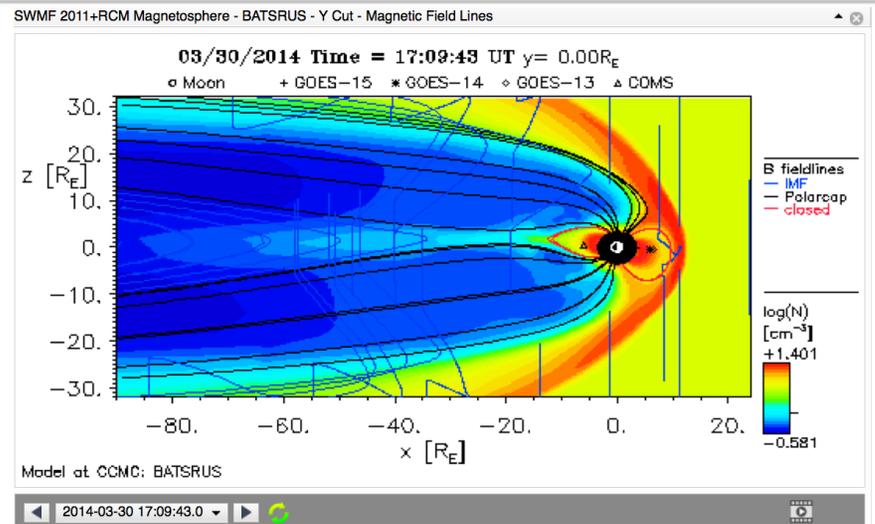
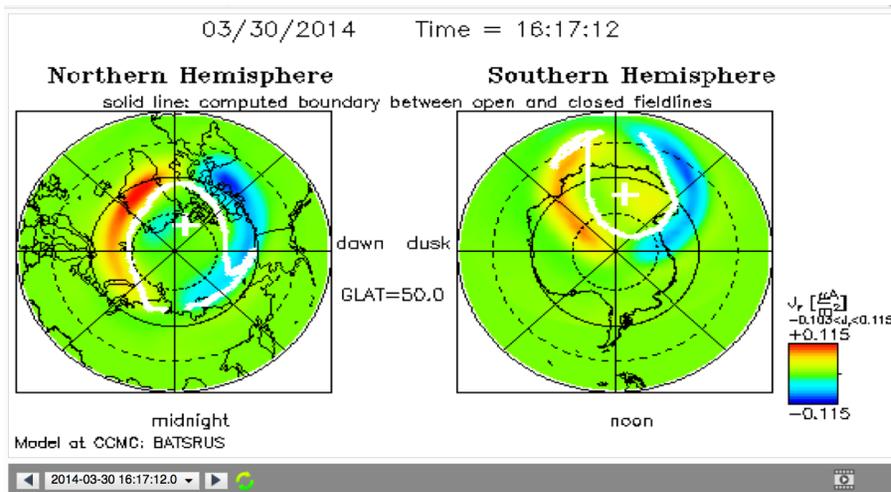
Help Save Layout Global Date/Time Clear Layout

Available Cygnets

Solar Heliosphere Magnetosphere Ionosphere Planetary/Spacecraft All Cygnets New Cygnets Events bETA



1 2 3 4 5 6 7 8 9





Advanced Visualization (based on KAMELEON libraries)

OpenSpace

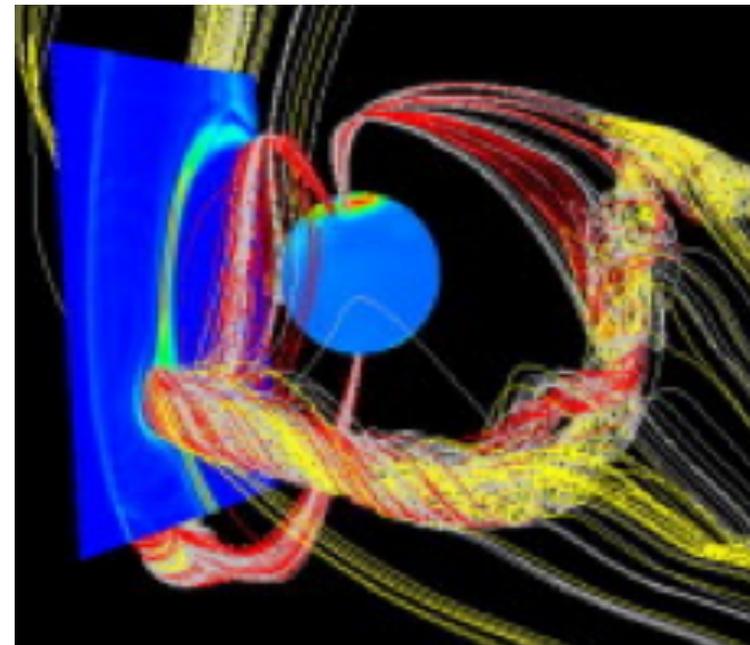
Space weather to museums
(visualization for dome projectors)
CCMC-AMNH-LiU collaboration



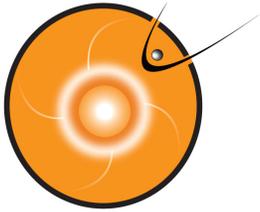
*Presentation on Wednesday Evening,
A. Bock (LiU), C. Emmart (AMNH)*

Space Weather Explorer

2 (SWX2) is a Java Web Start application for 3D visualization



R. Mullinix



Leadership in Community-Wide Model Validation Efforts



How to quantify model ability to predict space environment phenomena?
What metrics to select for specific applications?
How to estimate uncertainties in model-data comparisons?

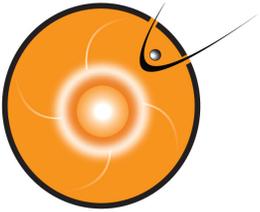
Community-wide [Modeling Model Validation Projects \(aka Challenges\)](#):
GEM, CEDAR, GEM-CEDAR, SHINE

CCMC provides support by developing [on-line interactive model validation systems](#),
maintaining databases, archive of metrics results.

Trace model performance over time.

Makes validation a seamless part of model development cycle.

Tools DEMO: Wednesday 2:30 pm (L. Rastaetter)
SHINE Challenge: Thursday 7:30 pm (P. Macneice)



Operational Geospace Model Validation Build upon GEM Challenge

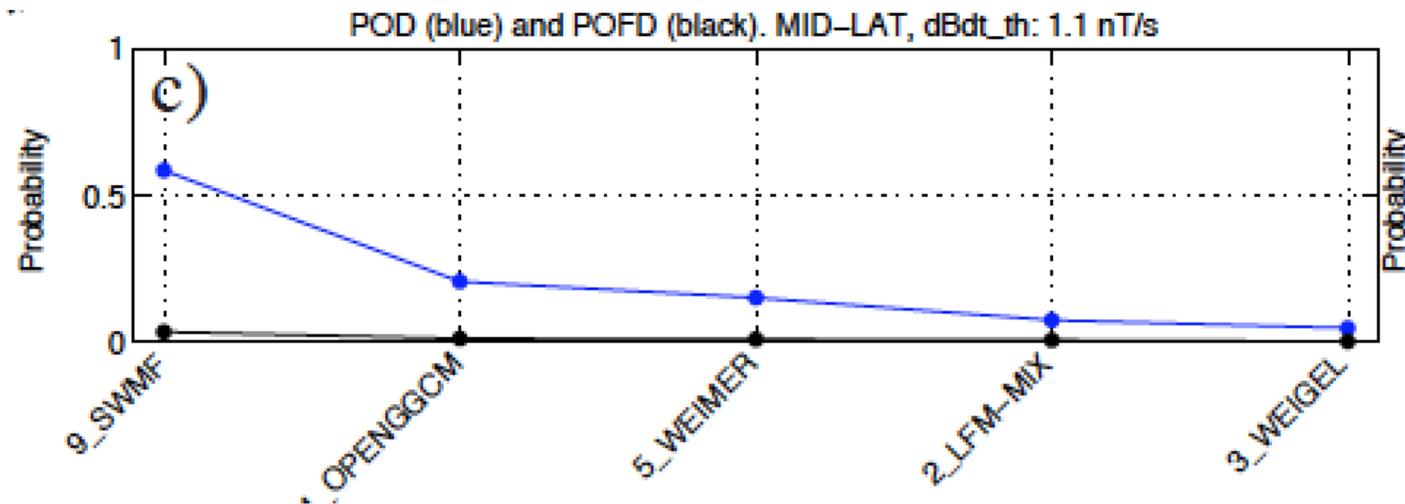


Phase I: dB/dt (Key to GICs)

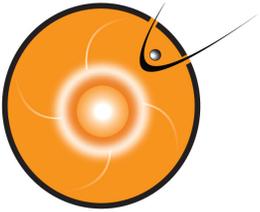
Apr. 2013: *Final Report (Phase I: dB/dt)* submitted to SWPC and NASA HQ

Jul. 2013: *dB/dt paper, Pulkkinen et al., published.*

Threshold-based metrics example
(dB/dt-threshold=1.1 nT/s, mid-latitude stations)



Model ranking depends on combination of probability of detection (POD, perfect=1) and probability of false detection (POFD, perfect=0)

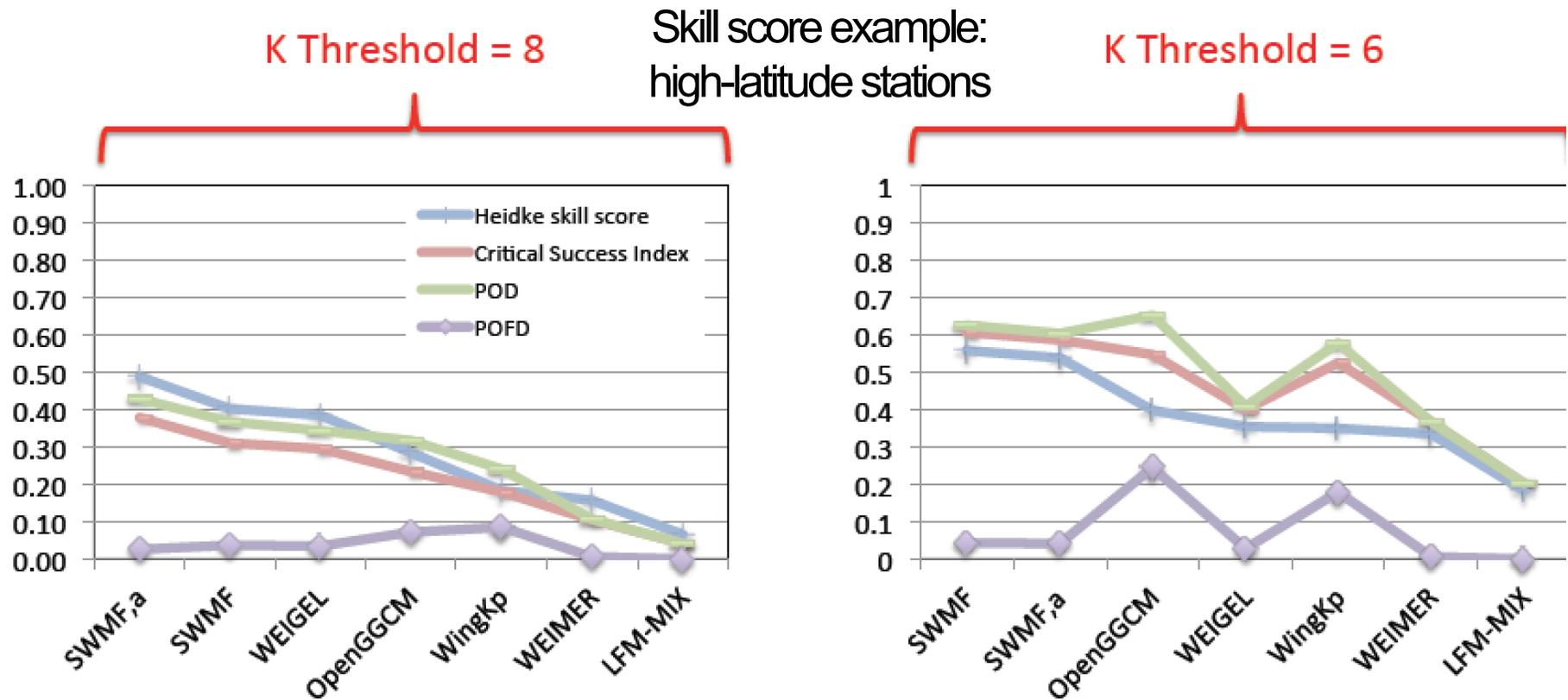


Operational Geospace Model Validation Phase II: Regional K-index



Aug. 2013: *Final Report (Phase II: dB/dt) submitted to SWPC and NASA HQ*

Paper in preparation, Glocer et al.



Models Ranked by Heidke Skill Score

How to Quantify Storm Impact on the Ionosphere

Step 1-Neutral Density Validation for Atm, Drag Studies

PURPOSE:

Quantify the storm Impact

HOW? → PROCEDURES:

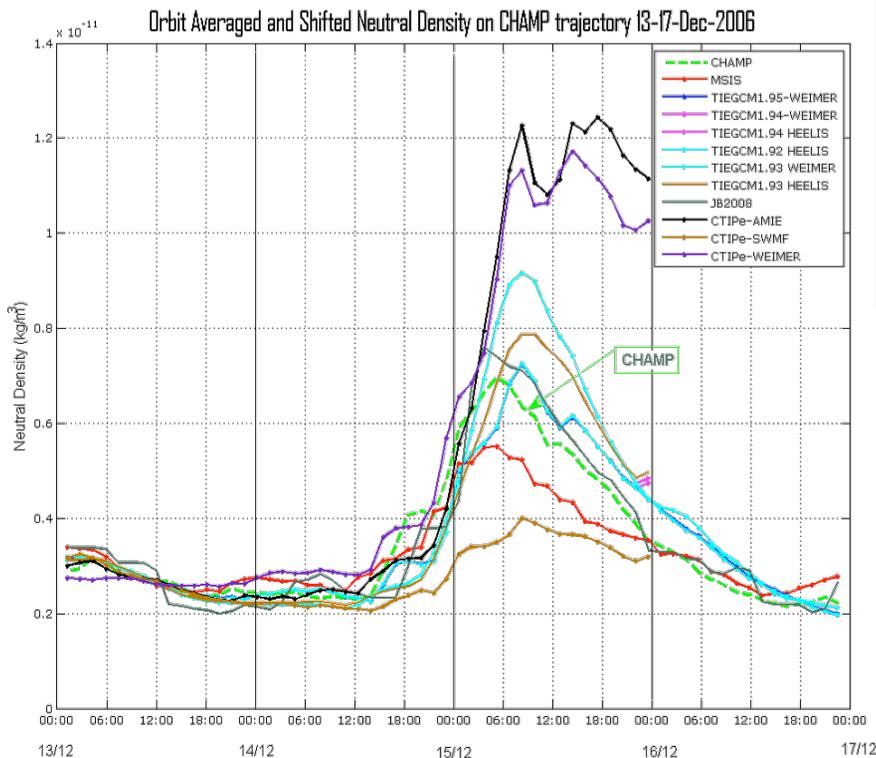
- ✓ ORBIT AVERAGING
- ✓ REMOVAL OF THE BACKGROUND VALUES TO EXTRACT THE STORM-TIME RESPONSE

HOW TO RANK THE MODELS? → SELECTED METRICS:

1. Storm-time average neutral density
2. Peak neutral density
3. Time of the neutral density peak

SHIFTED MODEL RESULTS AND CHAMP COMPARISON (DENSITIES SHIFTED TO CHAMP)

Neutral Density (10^{-12} kg/m ³)	CHAMP	MSIS	TIEGCM 1.94.2 Heelis	TIEGCM 1.94.2 Weimer	TIEGCM 1.95 with Weimer	CTIPe-Weimer	CTIPe-SWMF	CTIPe-AMIE	JB2008
stormtime density average	3.91	3.49	4.06	4.82	4.06	7.86	3.18	8.12	4.88
peak density during the storm	6.97	5.43	3.30	7.27	7.26	11.3, 11.65	4.07	12.3, 12.49	7.64
time of the peak	5:12	5:12	8:16	8:16	8:16	08:16, 14:23	8:16	08:16, 17:26	3:03

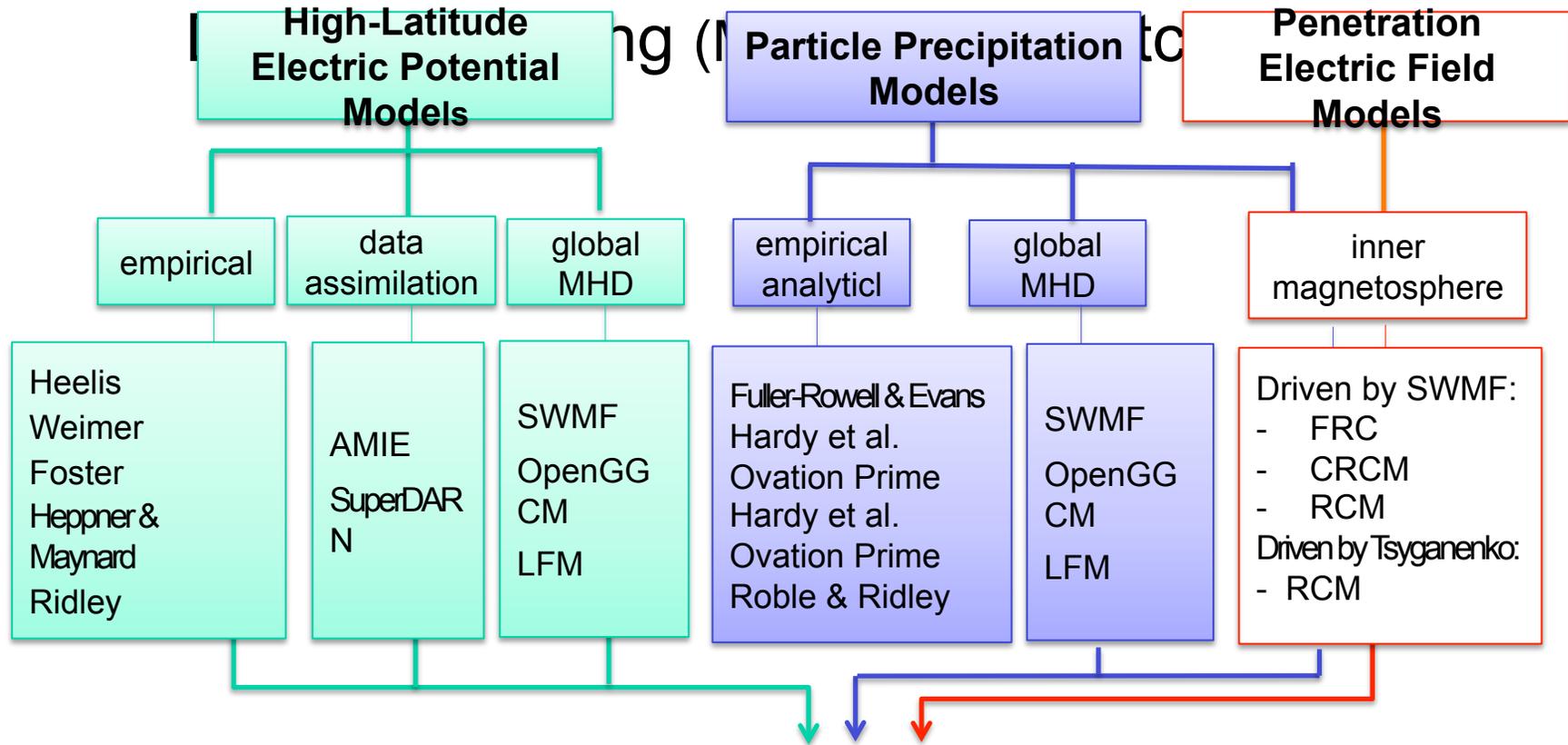


**Presentation:
Thursday: 5 pm**

E. C. Kalafatoglu Eyiguler, J-S Shim



Collaborative Development with Model Owners



All drivers are converted to a common format.
The tool is called as a KAMELEON subroutine to provide values on the grid;

call kameleon (model, time, mlts, mlats, variables, values_output)

J-S. Shim
M. Swindell

IT Models: CTIPe/TIE-GCM/GITM



Innovative Solutions to Engage World-Wide Community in Real-Time Forecasting Methods Validation



StereoCAT



A web-based interactive stereo triangulation tool.

Generates Enlil Cone Model parameters from multiple coronagraph images.

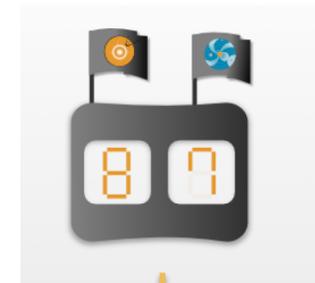
Fast-Track
WSA-Enlil

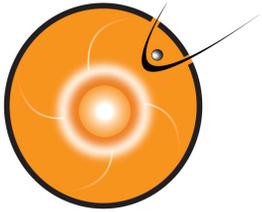


A central location for the community to:

- submit their forecast in real-time
- quickly view all forecasts at once
- compare forecasting methods when the event has arrived
- generate experimental community-wide ensemble forecasts

ScoreBoard





CCMC/SWRC–Universities Research Education & Development Initiative

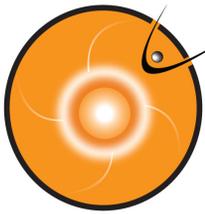


- Promote space environment awareness as an important component of the new millennium core education.
- Facilitate establishment of SW programs at universities world-wide.
- Engage students in activities that develop skills and experience beneficial for any future career pursuit.

Wednesday Evening:
Overview by Y. Zheng (Project Lead),
Impressions from students and professor



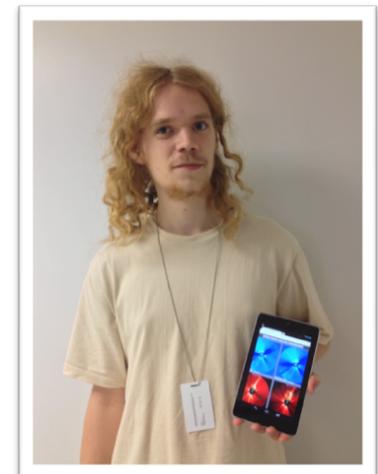
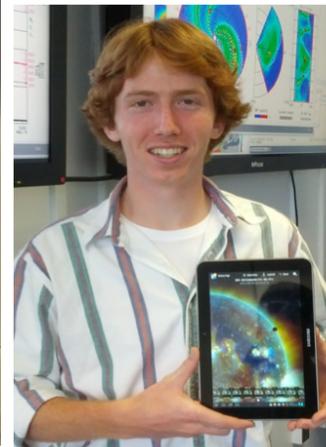
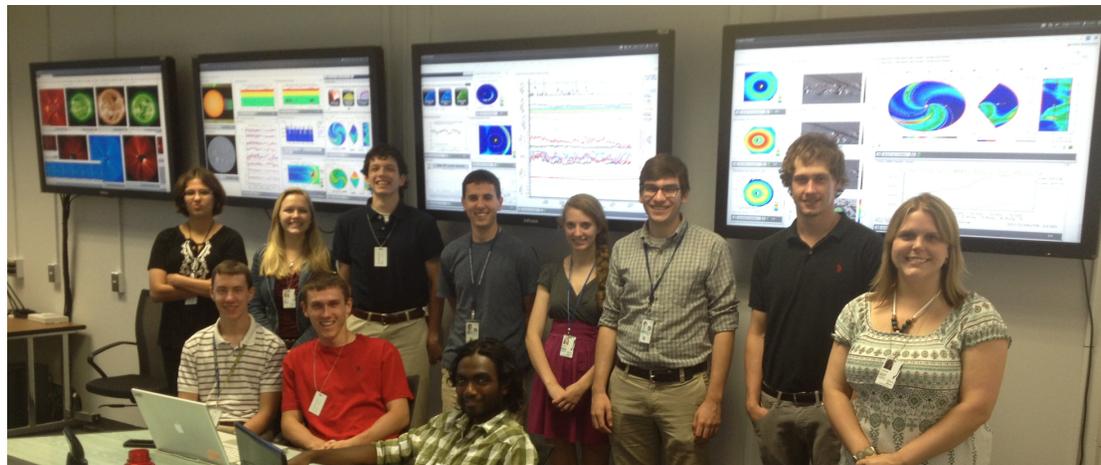
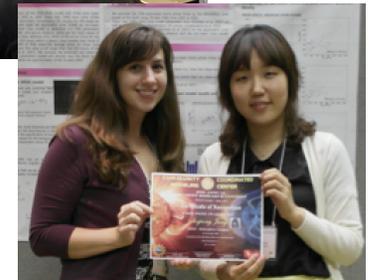
SW REDI

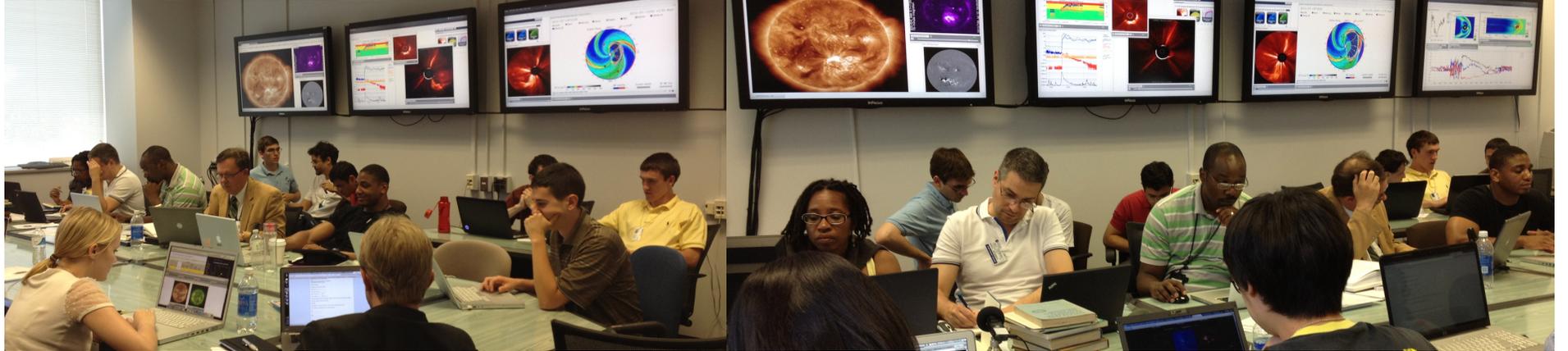


Hands-on Education Opportunities

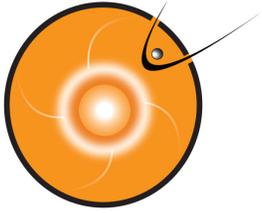


- **Research** projects using CCMC/SWRC capabilities.
 - Student Research Contests
 - Research Internships
- **Software** development projects.
- **Media** and science writing projects.
- Space weather analysis training and internships.





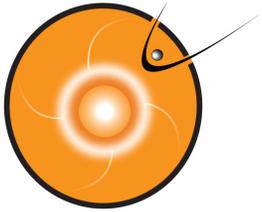
SW REDI Boot Camp. June 4-13, 2013



Outlook



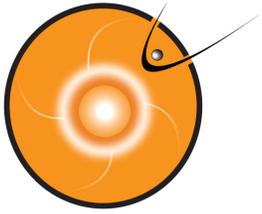
-
- Expand strong service to the research community.
 - Maintain close contact with community. User feedback as a guidance.
 - Evolve in response to lessons learned & emerging community needs.
 - Expand close collaboration with model developers. Facilitate collaborative development.
 - Engage development community into evolving of CCMC modular infrastructure.
 - Get ready to LWS Strategic Capabilities deliverables.
 - Expand education activities.
 - Expand international collaboration.



Outlook on R2O Transition Support

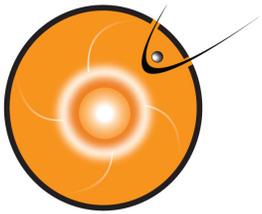


- Serve as a tool by which science progress at NASA, NSF, AFOSR, ONR feeds into Space Weather operations
- Lead and support community-wide model evaluation programs
- Prototype advanced forecasting and analysis techniques. Demonstrate operation potential and accelerate implementation.
- Continue addressing space weather needs of NASA user.
- Expand collaboration with operation agencies (NOAA, AWFA, DoD, DHS, FAA, DoE,..).
 - Support SWMF transition to NOAA/SWPC.
- Collaborate with developers of sw impact models to link space environment modeling with impact on technological systems.
- **Much more is possible – suggestions and help are invited!**



Supplementary Material





Inter-Center Partnership:



Linking CCMC space environment modeling systems with models calculating impacts on technologies & humans in space

JSC/SRAG, D. Fry et al, Space radiation analysis

JPL, H. Garret et al., Surface charging modeling

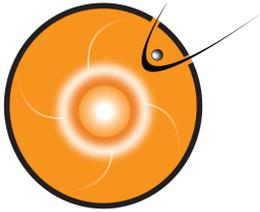
MSFC, J. Minow et al., Internal charging

GSFC, K. Label et al., SEU modeling

GSFC, L. Newman, Satellite drag & conjunction assessment

***Mini-session & discussion:
Thursday morning***

A. Pulkkinen, Y. Zheng, M. Maddox, J-S Shim



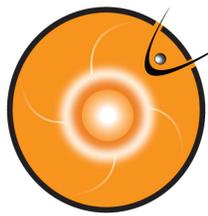
Database Of Notifications, Knowledge, Information (DONKI)



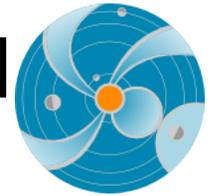
SW event catalog and knowledgebase of interpretations of models, methods, and systems performance, built in real time.

- One-stop on-line tool for dissemination and archiving of event-focused information.
- Connected to iSWA and other dissemination systems.
- Linkages, relationships, cause-and-effect among SW activities. **System science perspective.**
- Comprehensive search functionality for anomaly analysis.
- Enables broader participation: world-wide partners, modeling forecasting technique developers, students
- Fed by the SWRC team and partners.
C. Wiegand, R. Mullinix, L.Mays + SWRC team



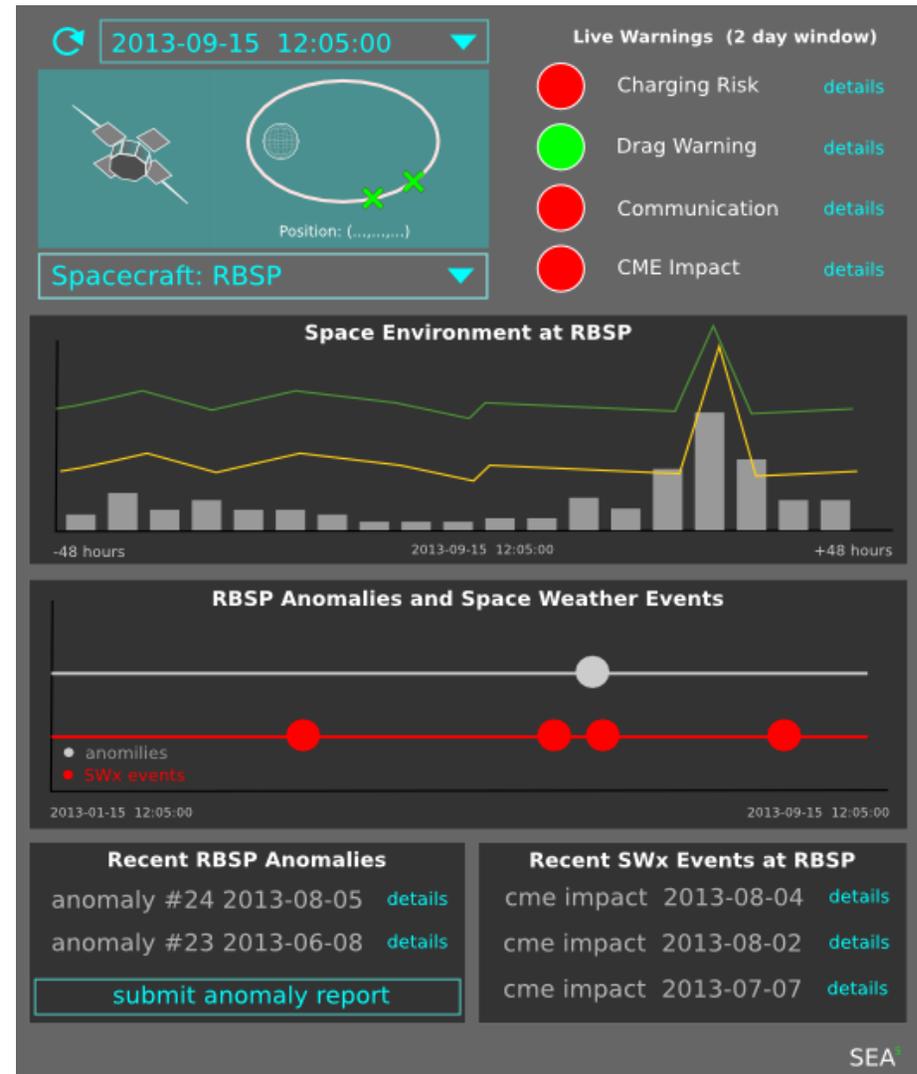
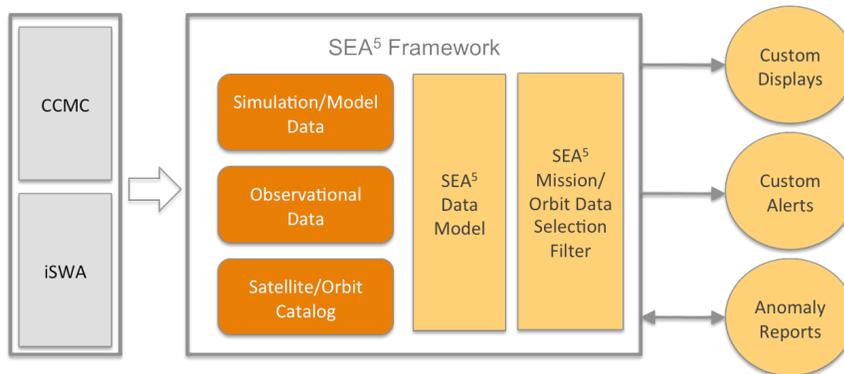


SEA⁵ : Space Environment Automated Alerts & Anomaly Analysis Assistant



An extensible software system for NASA that provides an unprecedented capability for:

- viewing space environment conditions for specific missions/orbits
- providing automated SW alerts
- assimilating and displaying spacecraft anomaly information
- displaying spacecraft/mission data

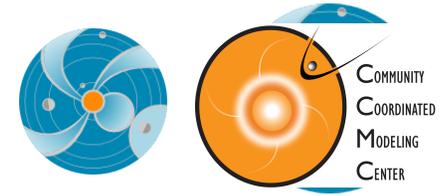


M. Maddox



Forecasting Methods Validation Research Community ScoreBoard

January 7, 2014 (Fast CME, X1.2 flare)



CME: 2014-01-07T18:24:00-CME-001

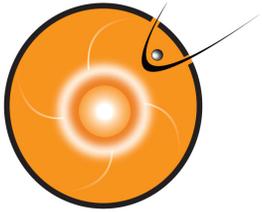
Actual Shock Arrival Time: 2014-01-09T19:32Z

Observed Geomagnetic Storm Parameters:

<http://kauai.ccmc.gsfc.nasa.gov/SWScoreBoard>

Predicted Shock Arrival Time	Difference (hrs)	Submitted On	Lead Time (hrs)	Predicted Geomagnetic Storm Parameter(s)	Method	Submitted By	
2014-01-09T19:26Z (-10.0h, +10.0h)	-0.10	2014-01-07T21:00Z	46.53	----	STOA	Leila Mays (GSFC)	Detail
2014-01-09T13:00Z (-7.0h, +7.0h)	-6.53	2014-01-08T23:17Z	20.25	Max Kp Range: 6.0 - 8.0	WSA-ENLIL + Cone	Duty Forecaster (ASFC)	Detail
2014-01-09T12:00Z (-7.0h, +7.0h)	-7.53	2014-01-08T06:32Z	37.00	----	WSA-ENLIL + Cone	RWC Jeju (KSWC)	Detail
2014-01-09T11:22Z (-11.7h, +9.1h)	-8.17	2014-01-09T18:57Z	0.58	Max Kp Range: 3.0 - 5.0	Ensemble WSA-ENLIL + Cone (GSFC SWRC)	Leila Mays (GSFC)	Detail
2014-01-10T04:04Z (-16.0h, +36.0h)	8.53	2014-01-08T14:56Z	28.60	Max Kp Range: 8.0 - 8.0 Dst min. in nT: -300	COMESSEP	Andy Devos (SIDC)	Detail
2014-01-09T08:02Z	-11.50	2014-01-08T16:37Z	26.92	----	Expansion Speed Prediction Model	Alisson Dallago (INPE)	Detail
2014-01-09T08:00Z	-11.53	2014-01-08T01:31Z	42.02	Max Kp Range: 6.0 - 7.0	WSA-ENLIL + Cone (NOAA/SWPC)	Leila Mays (GSFC)	Detail
2014-01-09T04:30Z (-2.5h, +2.5h)	-15.03	2014-01-08T05:02Z	38.50	Max Kp Range: 5.0 - 8.0	Other (SIDC)	Leila Mays (GSFC)	Detail
2014-01-09T04:00Z (-6.0h, +6.0h)	-15.53	2014-01-08T09:42Z	33.83	----	DBM	Manuela Temmer (UNIGRAZ)	Detail
2014-01-09T02:00Z	-17.53	2014-01-08T17:53Z	25.65	Max Kp Range: 8.0 - 9.0	BHV	Volker Bothmer (UGOE)	Detail
2014-01-09T01:00Z	-18.53	2014-01-08T23:00Z	20.53	Dst min. in nT: -142 Dst min. time: 2014-01-09T12:00Z	Anemomilos	WKent Tobiska (SET SWD)	Detail
2014-01-09T00:38Z (-7.0h, +7.0h)	-18.90	2014-01-08T00:41Z	42.85	Max Kp Range: 6.0 - 8.0	WSA-ENLIL + Cone (GSFC SWRC)	Leila Mays (GSFC)	Detail
2014-01-09T00:17Z (-6.9h, +9.2h)	-19.25	2014-01-08T04:11Z	39.35	Max Kp Range: 6.0 - 8.0	Ensemble WSA-ENLIL + Cone (GSFC SWRC)	Leila Mays (GSFC)	Detail
2014-01-08T22:00Z	-21.53	2014-01-08T03:17Z	40.25	Dst min. in nT: -146 Dst min. time: 2014-01-09T11:00Z	Anemomilos	WKent Tobiska (SET SWD)	Detail
2014-01-08T12:30Z	-31.03	2014-01-08T05:58Z	37.57	----	ESA	Leila Mays (GSFC)	Detail

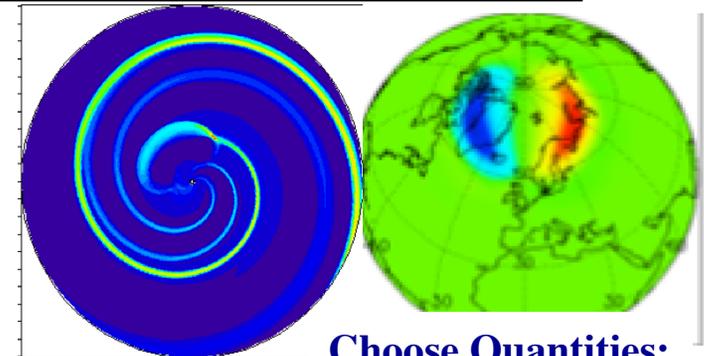
Increasing number of participants. Everyone guessed too high Kp,
Almost everyone predicted an impact that was too early.
Understanding this event is a challenge to the research community.



Interactive On-line Visualization & Analysis (3DView)



- ✓ Basic model output and derived quantities.
- ✓ User-ordered custom variables (*email the formula to Lutz and it will be tested & added.*)
- ✓ Automated movie & time series generation.
- ✓ Time series plotter & analyzer.
- ✓ 2D slices (color contours, vectors, magnetic topology), Line plots.
- ✓ 3D flow lines. Magnetic mapping.
- ✓ ASCII lists.
- ✓ Interfaces with Virtual Observatories.
- ✓ Change-Log on CCMC web page.



Choose Quantities:

Choose Plot Mode:

ColorContour (2D)

3D-Surface

Line (1D)

Contour (2D)

Vector (2D)

ColorContour (2D)

Color+Vector

Contour+Vector

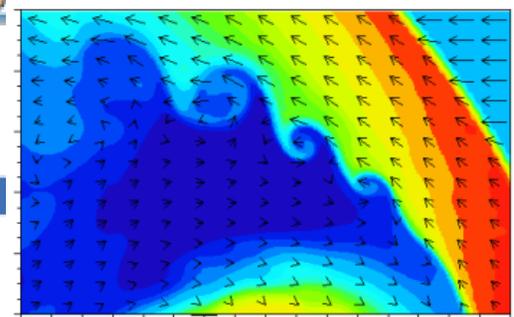
Color+Contour

Color+Vector+Contour

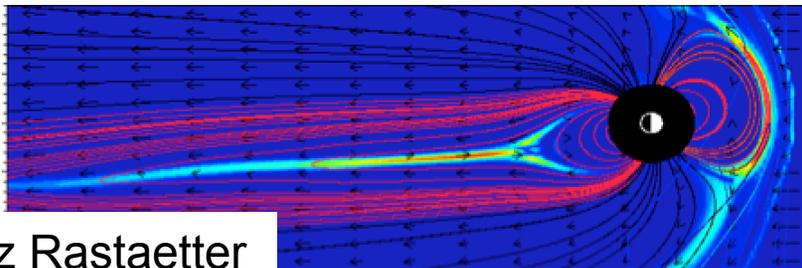
Color+Vector+Flowlines

3D Flowlines

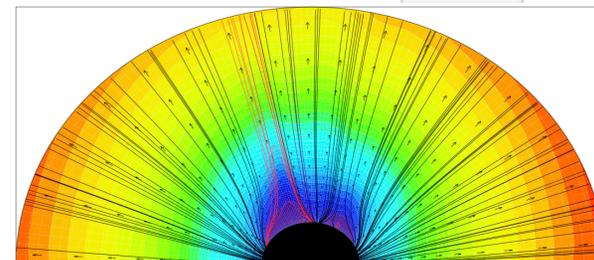
Q 1: J

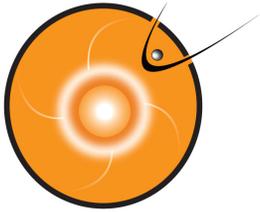


B1_y
B1_z
En.
J_x
J_y
J_z
B
beta
V
J
B1



Lutz Rastaetter





SHINE Model Validation Project



- Goal – To create an efficient automated system for SCIENTIFIC validation of models of the corona and inner heliosphere.
- Design – web based
 - Developers post ‘data cube’
 - Generated as natural part of their model development cycle
 - Automated CCMC system polls for new submissions, processes them and creates diagnostic graphics
 - Same graphics design for all comparable models enables clearest comparisons
- Status – Active as of Dec 6, 2013.
 - 9 models participating to date
 - More than 600 diagnostics generated to date

