The GEMstone

Volume 21, Issue 1 November 2011

Notes from NSF Program Director

Kile Baker

By now most of you know that I am in the process of retiring from NSF. I am currently working only half-time and for the next six months my emphasis will be on dealing with the GEM proposals that were submitted in October. I hope to have the review of the GEM proposals completed and decisions about funding made before I leave NSF for good.

NSF is actively looking for someone to take over as the Program Director for the Magnetospheric Physics program. NSF's decision may also be impacted by budget issues and organizational issues that have considerable associated uncertainties at this time. Despite the uncertainties I am sure that the Geospace Environment Modeling program will remain an important part of the Magnetospheric Physics Program and that NSF will find an excellent scientist to take my place.

Of course, one of the biggest unknowns for

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the next few years will be the funding that will be available. All program officers in the Division of Atmospheric and Geospace Sciences have been asked to come up with plans for what they would do if their budgets were cut by 5% and by 10%. My priority is very clear. I believe that GEM is such a critical part of magnetospheric research that the GEM program must be kept at a healthy level of funding. If the Magnetospheric Physics program budget is severely cut my intention is to have those cuts fall mainly on the unsolicited proposals received by the core program. No doubt some cuts would have to be made to GEM as well – particularly for the 10% cut scenario – but I hope to keep the negative impact on GEM to a minimum.

The annual GEM summer workshop is still the most important meeting I attend every year. It has been a great honor and pleasure for me to have had a role in the GEM community almost since its inception. Over the past 13 years (yes, it really has been that long) my role has been more as a program officer than as an active researcher but that is about to change. When I leave NSF I expect to get back to doing some research in an academic setting. I expect that my future research activities will sometimes have connections to GEM and sometimes not. This is, of course, due to the very structure of the GEM program, with its concept of limited duration focus groups. I sincerely hope that some of my research will be GEM relevant so that I will continue to have a good reason for attending the annual GEM workshops, seeing all my old friends and colleagues and making new friends. I want to extend my heartfelt thanks to all the members of the GEM community who have participated in the GEM steering committee meetings – and in particular thanks to the chairs of the committee, both past and present.

So here I am, a government bureaucrat caterpillar hoping to metamorphose into research scientist butterfly. Wish me luck.

Kile Baker

Venue of 2011 CEDAR-GEM Workshop

The GEMstone Newsletter is edited by Peter Chi (pchi@igpp.ucla.edu) and Marjorie Sowmendran (margie@igpp.ucla.edu).

Notes from Incoming GEM Chair

David Sibeck

Another productive GEM meeting concluded, this time held in Santa Fe in conjunction with CEDAR. One of the unforgettable memories for many was Mike Mendillo's description of his harrowing experiences in Japan during and after the tsunami, and the stoic yet kindly response of the Japanese people that he encountered.

It is again time to consider where the GEM community stands and where it is headed. As ever, things are changing. Kile Baker announced his retirement from the NSF. We have a lot to thank him for. He presided over a long period during which the number of topics tackled by the GEM community, and the annual attendance at the GEM meeting grew steadily. Although we look forward to working with his yet-to-be-announced successor, his continual encouragement and positive attitude will be sorely missed. Along similar lines, we should also thank Mike Liemohn, the outgoing GEM chair, who presided over a period during which the organization of GEM changed radically, but smoothly, to one in which all research areas participate in every GEM meeting. Both Kile and Mike have promised to participate in future GEM meetings. For those marking their calendars, GEM will return to Snowmass, Colorado from June 17-22, 2012.

Within the GEM steering committee there are some new faces. With the formal transfer of the historic 'call-to-order' GEM handbell at the banquet, I assumed the formidable task of chairing GEM steering committee meetings. Please join me in welcoming Eric Donovan as chair-elect (he will assume the chairmanship in 2013), Jacob Bortnik as a voting member of the steering committee, Robert Rankin as Liaison to Canada, Joe Borovsky as Liaison to SHINE, and Josh Semetar as Liaison to CEDAR. Nathaniel Frissell will work with Jennifer Kissinger as student representatives.

It will soon be time to think about proposing new GEM focus groups. Two dealing with Magnetic Mapping (Donovan) and the Ionospheric Sources of Magnetospheric Plasma (Schunk) have just been initiated, while that concerning Metrics and Validation has been given a new lease on life. On the other hand, those addressing the Space Radiation Climatology of the radiation belt, Plasma Entry and Transport, and Diffuse Aurora Precipitation have now come to an end. We will be issuing a call for proposals with new topics soon. Proposers will make short presentations at the GEM meeting on the day before the Fall AGU, after which the new focus groups will be selected. Please consider taking the lead in this enjoyable activity. Before proposing, you should consult with the Research Area Coordinators (whose names are listed on the GEM Wiki site at http://aten.igpp.ucla.edu/gemwiki). They are tasked with connecting researchers with similar ideas and encouraging cross-disciplinary activities. They can also help explain both the process and the duties of a focus group leader.

Finally, the GEM steering committee noted many excellent student poster presentations and expressed an interest in recognizing the effort that goes into preparing and presenting them. Emma Spanswick kindly volunteered to serve as GEM student poster evaluator. If she calls on you to help evaluate, please assist her.

See you at the 1-day GEM meeting at the Fall AGU in December…

David Sibeck

Notes from Outgoing GEM Chair

Michael Liemohn

GEM survived the Liemohn years! Woohoo!

I feel very honored to have been able to serve as the GEM Steering Committee Chair for the last two years. I would like to thank all of you that served on the Steering Committee with me, all of you that served as Focus Group leaders over the past two years, all of you that organized/convened sessions and challenges for GEM, all of you that presented results at a GEM Workshop, all of you that participated in a GEM-organized challenge or research effort, and anyone else not included above who ever participated in or attended a GEM function. There were good and bad moments, but overall I had a fantastic time serving the community in this role and feel privileged to have been given the chance. Thanks for sharing the journey with me!

The new GEM-SC chair, David Sibeck, is already running full speed ahead with the duties of this position. I have full confidence in him to lead GEM both wisely and effectively for the next 2 years. I wish him the best of luck in whatever new endeavors and directions he leads us.

I would also like to extend my sincerest thanks and appreciation to our NSF Magnetospheric Physics program manager, Kile Baker. He has been a GEM supporter, advocate, and leader since its inception nearly 25 years ago. He has seen it morph through various organization incarnations and leadership personnel changes, providing a consistent voice of guidance throughout GEM's history. I greatly admire his restraint in not dictating GEM's scientific direction or micromanaging GEM's governance, but rather taking a gentle-hand approach to allow the program and structure to adapt to the desires of the magnetospheric physics community. Kile, I am sad to see you retire from NSF and I will greatly miss you as the GEM program manager. You leave big shoes to fill.

After a bit of time away from GEM leadership, I fully intend and hope to return to it in some form in the future. One of the great things about GEM is that it is a grassroots program, allowing everyone the opportunity to participate in its organization and leadership. As a parting word of advice to everyone in the GEM community: get involved! GEM thrives because individuals step forward to serve in leadership roles. There are many ways to participate, and I encourage each of you to think about how you can make GEM better in the years ahead.

Cheers,
Mike Liemohn

2011 GEM Mini-workshop
December 4, 2011
Westin San Francisco
Market Street
50 Third Street
San Francisco, CA

GGCM Research Area Report

Coordinators: Stan Sazykin and Slava Merkin

Outflow MMM Focus Group

Co-chairs: Bob Schunk, Rick Chappell, and Dan Welling

The Ionospheric Source of Magnetospheric Plasma: Measuring, Modeling, and Merging into the GGCM focus group (or more simply, Outflow MMM), held four two-hour joint sessions at the GEM/CEDAR joint workshop. The first three were dedicated to the "three Ms" of the focus group (Measuring, Modeling, and Merging) while the fourth served as a planning session to organize future plans for the new group. The major goals of these sessions were to review the past and present state of outflow research, discuss outstanding problems and unknowns in the field, and clarify the future path of the focus group.

Session 1 – Measuring: This session was dedicated to observations of measurements at various locations and under various conditions. The greater portion of the session was spent on three invited talks that summarized the current state of our knowledge of outflow in terms of observations. The main highlight of the session was the emphasis of the complexity of outflow in terms of variations in the spatial distribution of outflow, the main ion species and the intensity of outflow fluxes as tied to solar wind and magnetospheric conditions. Generalized Jean's escape, which highlights how little energy an ion may require to escape into the magnetosphere, was also a topic of interest.

Session 2 – Modeling: Realistic modeling of outflows and comparisons to observations will be a hallmark of this focus group. Representatives from several modeling groups presented results from their codes in this session to help bring the community up to speed on the status of outflow simulations. Much of the discussion centered on which altitude acceleration occurs and what is the proper altitude for coupling these models to global MHD codes.

Session 3 – Merging: The last of the three Ms focused on merging models of outflow to GGCMs. Results from adding outflow to the LFM MHD model using both constant and causally-driven outflow were shown as well as results from coupling the BATS-R-US code to the Polar Wind Outflow Model (PWOM). The importance of outflow in the global magnetosphere was demonstrated through impacts on tail dynamics, cross polar cap potential, and other magnetospheric processes. Concerns over the proper method and altitude for such merging were expressed.

Session 4 – Planning: The final session was an open forum to help define the future of the focus group. Issues in current research were discussed and key questions were raised, especially in terms of how to properly merge outflow models and MHD models. It was decided that an email list and website will be created to help organize activities and inform interested parties. An announcement for both will be sent through the GEM messenger soon. Additionally, a GEM mini-workshop session is being planned while a future workshop dedicated to this focus group is garnering growing interest.

CEDAR-GEM Modeling Challenge Workshop

Conveners: *Masha Kuznetsova, Ja Soon Shim, Barbara Emery, Aaron Ridley, Delores Knipp, Naomi Maruyama, Tim Fuller-Rowell, Tim Guild, Jan Sojka, Geoff Crowley*

The GEM Metrics and Validation Focus Group, together with the CEDAR modeling community, organized the Joint CEDAR-GEM Modeling Challenge Workshop. The CEDAR-GEM Challenge is built upon GEM GGCM and CEDAR ETI Challenges. During the Workshop the GEM and CEDAR communities shared the experience and lessons learned from the first rounds of Challenges, addressed topics of common interest, and initiated joint model validation projects focusing on effects of geospace model coupling on metrics results. The Joint CEDAR-GEM Challenge Workshop was well attended by modelers, data providers and users of space weather models.

Both CEDAR and GEM communities have recognized that due to the maturity and increasing complexity of state-of-the-art space weather models, there is a great need for a systematic and quantitative evaluation of different modeling approaches. During the last two years, both GEM and CEDAR communities addressed this need by organizing and implementing comprehensive, community-wide efforts to test model predictions against observations. In the summer of 2008 the GEM GGCM Metrics and Validation Focus Group initiated a series of metrics studies (aka GEM 2008 Modeling Challenge) focusing on the inner magnetospheric dynamics and ground magnetic field perturbations. A year later the CEDAR community initiated the IT modeling challenge called CEDAR Electrodynamics Thermosphere Ionosphere (ETI) Challenge. The goal of the two Challenges is to evaluate the current state of the space physics modeling capability, to facilitate interaction between research and operation communities in developing metrics for space weather models, to address challenges of model-data comparison, to track model improvements over time, to facilitate collaboration among modelers, data providers and research communities, and to provide feedback for further model improvement. The Community Coordinating Modeling Center (CCMC) is supporting GEM, CEDAR and Joint Challenges and maintaining a web site with interactive access to model output archive and observational data used for metrics studies.

The Workshop had three breakout sessions. One session (2 hours Tuesday, June 28 1:30-3:30 PM) focused on climatology projects (time periods longer that 3 months). The first hour was dedicated to presentations from CEDAR community that has been performing climatological validation of ionosphere thermosphere models for years. Presentations during the second hour demonstrated that GEM community is getting increasingly interested in performing climatological validation of component GGCM models.

Katie Garcia from Boston University talked about her 2007 paper of using a long MHD model run with real solar wind inputs to statistically characterize the magnetopause standoff distance in the MHD model over a variety of solar wind conditions. Mike Liemohn and Roxanne Katus (University of Michigan) presented initial results of very long (several years) continuous HEIDI simulations of the ring current. Lutz Rastaetter and Hyesook Lee (CCMC) demonstrated model output archive from CCMC real-time simulations and presented examples of how this archive can be used for climatology projects. CCMC also demonstrated the newly developed interactive analysis tool applicable to analysis of long time series. The decision has been made to arrange a session on climatology projects during the 2012 GEM Summer Workshop. The session will be organized by Tim Guild and Lutz Rastaetter.

Two sessions (4 hours Thursday June 30, 10:00 am -noon, 1:30-3:30 PM) focused on the following events of less than 3 days duration:

- E.2006.348: 2006/12/14 (doy 348) 12:00 UT

- 12/16 00:00 UT
- E.2001.243: 2001/08/31 (doy 243) 00:00 UT - 09/01 00:00 UT
- E.2005.243: 2005/08/31 (doy 243) 10:00 UT - 09/01 12:00 UT
- E.2005.135: 2005/05/15 (doy 135) 00:00 UT - 05/16 00:00 UT
- E.2005.190: 2005/07/09 (doy 190) 00:00 UT - 07/12 00:00 UT
- E.2003.302: 2003/10/29 (doy 302) 06:00 UT - 10/30 06:00 UT (optional)

List of physical parameters to be used for metrics studies:

Ionosphere/Thermosphere models or coupled model components:

- Vertical and horizontal drifts at Jicamarca
- Neutral density at CHAMP orbit (Nden)
- Electron density at CHAMP orbit (Eden)
- NmF2 from LEO satellites (CHAMP and COSMIC) and Incoherent Scatter Radars (ISRs)
- HmF2 from LEO satellites (CHAMP and COSMIC) and ISRs
- Temperature Tn and neutral winds obtained by Fabry-Perot Interferometer at 250 km (Arrival Heights, Antarctica; Resolute Bay, Canada)
- Ne, Te, Ti at 300 km (Millstone Hill, Sondrestrom, EISCAT, Svalbard ISRs).
- Ion vertical velocity at Sondrestrom ISR

Geospace models or coupled model components:

- Magnetic field at geosynchronous orbit
- Ground magnetic perturbations
- Dst index
- Auroral oval position (high latitude boundary)
- Auroral oval position (low latitude boundary)

Parameters along DMSP tracks:

- Poynting flux (Joule heating) into ionosphere along DMSP tracks
- Plasma Velocity (Vx - along track, Vy cross track, Vz - vertical)

Additional time series in support of simulation results analysis:

- Cross polar cap potential (northern and southern hemisphere)
- Joule heating (or Poynting flux) integrated over each hemisphere in GW.

Antti Pulkkinen and Ja Soon Shim presented reviews of the first round of GEM and CEDAR Challenges results. Antti demonstrated the progress in ground magnetic perturbation Challenge from the first GEM metrics study to the operational geospace model selection. The first round of GEM GGCM Modeling Challenge has so far resulted in three publications (with all Challenge participants as co-authors). This ground magnetic perturbation metrics study is being used as a foundation for the independent model validation activity conducted by CCMC in support of NOAA SWPC operational geospace model selection. The presentation triggered a lively discussion on operational model selection process. Howard Singer representing NOAA SWPC expressed interest in community feedback on the selection process of an operational model. Modelers and model users are encouraged to send their comments and ideas on model selection processes to CCMC no later than October 1st, 2011. Ja Soon Shim presented a summary of the first CEDAR metrics studies. It was demonstrated that model performance varies from event to event. None of the model ranks at the top for all used metrics. Empirical models ranked high on the average or during the quite times, while physics based models better represent dynamics. The community agreed that there is sufficient material for two papers to be submitted to the Space Weather Journal before the Fall AGU. Ja Soon will prepare paper drafts and send them to all co-authors by October 1st, 2011. Results of the first round of Challenges will be used as a baseline for future studies.

Dan Welling and Lutz Rastaetter summarized the results of the Dst index challenge (joint effort of Metrics and Validation and Inner Magnetosphere Focus Groups with CEDAR community

participation). Interest to the Dst challenge was demonstrated by a broad participation with more than 30 model submissions (including global magnetosphere models, ring current models, statistical models, and real-time data analysis). Lutz presented a demo of the updated CCMC interface that instantly calculates skill scores for selected model settings and different metrics types (prediction yield, cross-correlation and timing error). Metrics results are presented by two-dimensional diagrams that combine correlation with prediction efficiency or prediction yield with timing error. Statistical specifications were shown to perform better than most physics-based models. Among physics-based models the best results are produced by models with self-consistent global MHD - ring current coupling. Inconsistency in USGS and Kyoto Dst (8 nT offset) for some of the events was found. USGC participant (Jennifer Gannon) is requested to clarify the issue. Lutz Rastaetter will prepare a paper draft by October 1st with the goal to submit it to the Space Weather Journal before the end of 2011.

Delores Knipp introduced a new metrics study that involves comparison of DMSP measurements of Poynting flux into ionosphere with ionosphere Joule heating that can be produced by geospace and ionosphere models. Poynting Flux/Joule Heating Challenge involves both GEM and CEDAR communities. Lutz Rastaetter showed very preliminary analysis of the first model result submissions. First comparisons of half-orbit integrated time series look promising. The discussion will be continued at the mini-workshop in San Francisco. More modelers expressed interest in participating in the Challenge. To be included in summary reports planned for the mini-workshop and Fall AGU, modelers should submit their results (Joule heating along DMSP orbits) prior to November 1st, 2011.

Aaron Ridley led the discussion on IT/geospace model coupling. For the first project it was suggested to study the role of drivers on ionosphere model results. Examples of drivers that provide ionosphere potential pattern include: Weimer, AMIE, Hardy, MHD output, RCM output. Aaron offered to share the Fortran-90 library that allowed him to easily switch between different drivers. The library takes solar wind data, Hemispheric Power, Kp, time, magnetic latitude and magnetic local time and return potential, average energy or energy flux. To proceed with the project Aaron agreed to make libraries, instructions on how to use them and necessary data files available for download via CCMC Web site. CCMC will work on converting ionosphere electrodynamics model outputs to platform independent and self-descriptive formats (cdf, netcdf, hdf5) that allow direct access to both the model data as well as the embedded metadata using CCMC Kameleon access and interpolation library. All tools should be available prior to October 1, 2011 so modelers can run simulations with different drivers (Weimer 2005 and AMIE as a first priority) and submit results before November 1, 2011. Events to begin with are: E.2006.348 (observations for maximum ionosphere parameters are available) and E.2005.243 (priority event for the Poynting Flux/Joule heating study). The experience will be discussed at the mini-workshop.

The last hour of the workshop was dedicated to challenges of model-data comparison studies and how to address them. Robert Schunk discussed problems with physics-based models that can lead to uncertainties in model output. Issues include simplified math formulation, uncertain input parameters, incomplete or approximate coupling, insufficient spatial and temporal resolution and missing physics. One suggested solution is to conduct two simulations - one with lower end and one with upper end of uncertainties. Spread in output provides an estimate of the uncertainty. Uncertainty parameters should be identified for each model participating in the metrics studies. Current CCMC model results submission interface and model results archive allowing multiple submissions for the same model with different model settings facilitate the uncertainty analysis. It was agreed that the uncertainty analysis and different approaches to ensemble modeling is an important topic that should be addressed at future workshops.

Yihua Zheng introduced a new auroral oval boundaries metrics study that is of special interest to a number of space weather model users (including US Air Force). Yihua addressed the challenging issues in auroral oval metrics studies: How to define the equatorward boundary of the auroral oval from simulations? How to do model-data comparison and measure the model performance? Several methods based on threshold in particle precipitation fluxes were introduced. Ionosphere Joule heating pattern can also be used for models that do not include ring currents. Modelers are requested to submit poleward and equatorward boundaries locations with 1 hour local time resolution (24 points for each boundary for each time step). The first priority event is E.2005.243. Results will be discussed at the mini-workshop. Model output submission deadline is November 1st 2011.

Barbara Emery, Larisa Goncharenko and Anthea Coster addressed challenges of metrics studies for global time dependent observational data sets (Total Electron Content used as an example). Examples presented by Larisa Goncharenko demonstrated that longitude slices can capture many storm features. To make the TEC study manageable, it was agreed to choose up to 5 longitude slices (5 degrees in glon and 5 degrees in glat with 15 - 36 lat bins) that corresponds to about 75 stations. Larisa and Anthea will provide TEC data files to CCMC for the E.2006.348 priori to September 15th, 2011. CCMC will post model output format description and add TEC to the submission interface by October 1st, 2011. Modelers will submit model output in required format by November 1st, 2011. The first results will be presented at the Fall AGU.

The CEDAR community expressed interest in continuing to work with GEM on joint model validation projects. To facilitate the continuation of GEM-CEDAR collaboration, members of both communities expressed interest in arranging a GEM-CEDAR modeling session during the GEM mini-workshop in San Francisco.

Presentations from the workshop, CCMC metrics tools, instructions on how to participate, and action plan summary with deadlines can be found at the Challenge Website: http://ccmc.gsfc.nasa.gov/challenges/GEM-CEDAR/

Dayside Research Area Report

Coordinators: Jean Berchem and Karlheinz Trattner

The Magnetosheath Focus Group

Co-Chairs: Katariina Nykyri and Steve Petrinec

The Magnetosheath Focus Group held two sessions at the 2011 Joint CEDAR-GEM Workshop. Eleven presentations were given, covering all three main topics of the Focus Group: 1) Large Scale Structure of the Magnetosheath, 2) *In situ* Magnetosheath Physics and 3) Magnetosheath Impact on the Magnetosphere. In addition, a Magnetosheath Challenge has been devised, and will soon be officially issued.

Summary of presentations:
The first presentations of the focus group used the THEMIS data sets to explore a variety of foreshock and magnetosheath phenomena, and compared these observations with recent numerical models. Hui Zhang presented THEMIS observations of a structure which starts as a foreshock cavity and finally evolves into a hot flow anomaly (HFA). Foreshock cavities may be the early stages of HFAs. Examples of two types of structures at the foreshock were also shown. Some are foreshock cavities consistent with Schwartz et al. [2006], and some are Foreshock Compressional Boundaries (FCB) consistent with Omidi et al. [2009].

Global hybrid simulations [Omidi et al., JGR 2010] have also predicted a new type of event (foreshock bubbles) that forms in Earth's foreshock and can affect the magnetosheath and magnetosphere. It forms as IMF discontinuities sweep up the ion foreshock region upstream of the bow shock, convect with the solar wind, and efficiently accelerate energetic particles. Drew Turner presented the first clear evidence of these events using THEMIS data. The distinguishing features between foreshock bubbles and HFAs and their effects on the magnetosheath were discussed, including global expansion of the bow shock and magnetopause followed by a sudden compression and the introduction of very energetic ions and electrons to the system.

Chih-Ping Wang showed statistical magnetosheath ion and electron temperature profiles from 3 years of THEMIS observations. Ion and electron temperature, as well as ion to electron temperature ratios, are directly correlated with solar wind speed. While ion and electron temperature decreases with downtail distance, the temperature ratio remains almost constant. Katariina Nykyri also showed used this data set to show there is no clear dawn-dusk asymmetry of magetosheath temperatures for Parker-spiral or ortho-Parker-spiral orientation. More heating at the dayside magnetosheath is observed for plasma $\beta < 1$ than for $\beta < 0.1$. The magnetosheath is hotter for larger solar wind speeds and Alfvén Mach number.

It has been shown that the total pressure at the subsolar magnetopause differs from the solar wind dynamic pressure and these changes depend on IMF orientation. Andrey Samsonov stressed that for a radial IMF orientation, the magnetosheath thermal pressure is anisotropic and the parallel pressure may exceed the perpendicular pressure in the subsolar region. This anisotropy may explain the unusual magnetopause shape observed during such times. Ted Fritz showed ISEE energetic ion observations for a magnetosheath interval, indicating that such ions do not travel sunward.

Nick Omidi demonstrated that despite the presence of ULF waves and kinetic processes in hybrid simulations, reasonable comparisons between hybrid and MHD simulations are

possible during southward IMF. Jean Berchem showed that simulation results compare fairly well with gas-dynamic predictions (*Spreiter et al.*, 1966), but significant differences are found near the shock and the magnetopause; are worse in the noon-midnight meridian plane. As expected, cusps and FTEs significantly affect the magnetosheath flow around the magnetopause.

Yongli Wang showed the results of 3D modeling efforts of the magnetopause using spacecraft crossings from multiple missions, and employing the Support Vector Regression technique.

Mike Schulz described a new coordinate system that shows promise for constructing analytical streamline (Euler-potential) models of the magnetosheath surrounding a magnetopause of rather general prescribed shape. By specifying distance from the magnetopause along an outward normal of calculable direction, the new system also shows promise for organizing *in situ* magnetosheath data obtained from spacecraft.

Steve Petrinec showed that the dayside magnetosheath can be remotely imaged with energetic neutral atoms (IBEX). Although the time integrations are long, during steady conditions these observations could be used to place constraints on plasma properties (e.g., the polytropic index). This technique could be exploited in future missions to provide global, dynamic images of the magnetosheath region.

Magnetosheath Challenge

The devised Magnetosheath Challenge is comprised two main tasks:

1) To run global hybrid and MHD models for a set of fixed, steady solar wind conditions, and

2) To identify similar 'steady' intervals from *in situ* observations within specified, constrained parameter ranges.

Magnetosheath parameter comparisons between models and observations include: Plasma moments; temperature and pressure anisotropies; electron/ion temperature ratios; wave power and wave mode spectra in B, v, density, and pressure fluctuations; specific entropy; and others. This challenge will be officially issued once appropriate, rigorous metrics have been determined.

Dayside Field Aligned Currents and Energy Deposition (FED) Focus Group

Co-Chairs: Delores Knipp, Stephan Eriksson, and Herb Carlson

The Dayside Field Aligned Currents and Energy Deposition Focus Group held two 2-hr sessions. Fifteen presentations and one student demo were given; the attendance for the first session was about 50 and for the second session about 25.

Summary of presentations:

Stefan Eriksson described Alfvén Mach number and IMF clock angle dependencies of sunward directed E x B flow channels and their embedded Joule heating rates in the ionosphere. He showed a BATSRUS run from CCMC for May 15, 2005, highlighting field aligned currents and flow channels. He suggested further model runs and statistics check of the dependencies in the DMSP F-15 data

Wenhui Li described results from a JGR paper entitled: The Relation between Dayside Local Poynting Flux Enhancement and Cusp Reconnection. The paper reports OPENGCM simulations for several events in late 2004 and in 2005. The paper concludes that flank merging is a source of field-aligned currents, E x B flow channels and intense Poynting flux to the cusp.

Aaron Ridley investigated Effects of concentrated dayside energy deposition on the global and

regional thermosphere using a BATSRUS Idealized simulation for May 15, 2005. He found neutral density enhancements associated with IMF By and appropriately placed particle deposition.

Yue Deng showed the significance of different heating mechanisms to the cusp neutral density enhancement using the GITM non-hydrostatic model. She compared effectiveness of Poynting flux and soft particle precipitation in producing neutral density enhancements near the cusp. Soft particle deposition into the upper F regions is a very efficient heat source. She concluded that the altitudinal distribution of energy input is important to neutral upwelling and TEC distribution. *Comment by Bob Strangeway*: From FAST observations, you always get high soft electron precipitation when there is large Poynting flux. How do you separate the two?

Delores Knipp discussed a GRL manuscript entitled: Extreme Poynting Flux in the Dayside Thermosphere: Examples and Statistics. The paper reports results of sorting DMSP F-15 Poynting flux by IMF and solar wind type. During intervals of large IMF By the Poynting flux deposition peaks in dayside with the Pre/Post noon maximum in Poynting flux depending on IMF By sign. During some events the Poynting flux exceeds 100mW/m^2. The locations of these extreme events are consistent with the dayside flows channels discussed in Li et al. (2011). She also reported a 9-day periodicity in the 2005 DMSP orbit integrated Poynting flux. *Comment by Aaron Ridley*: Use Robinson formula to get Pedersen conductance from electron JE flux and number flux. Then compare Poynting versus Sigma P*E^2.

Chin Lin showed polar cap neutral density enhancements observed by the CHAMP accelerometer. He surveyed CHAMP neutral density data and searched for density perturbations that were two sigma or more above the previous 24-hour orbit average. He found a tendency for long lasting perturbations on dayside and near dawn. The tendency appears to have strong IMF By modulation. Further the high-latitude density peaks occur in summer hemisphere in 2001-2005.

Lasse Clausen showed global Poynting flux derived from SuperDARN and AMPERE measurements. He used SuperDARN and AMPERE to get 2-min average Poynting flux. He showed example from December 20, 2010. The AMPERE coverage may miss confined reverse convection at high latitude. *Comment by Shin Ohtani*: AMPERE needs 10 min to replace one satellite with another one along the same orbit plane. Questioning the 2 min resolution approach.

Slava Merkin used AMPERE, SuperDARN, and LFM to deduce ionospheric electrodynamics. He reconstructed the potential distribution from AMPERE and compared this with SuperDARN. AMPERE and SuperDARN can help confirm conductances by rotations of flow vectors. The AMPERE data show NBZ system during August 3-4, 2010 in the sunlit hemisphere. Using LFM, he mapped a Poynting flux patch in northern hemisphere to reconnection site in opposite hemisphere.

Jiannan Tu discussed the time scales of dynamic Magnetosphere-Ionosphere-Thermosphere coupling. He characterized:

- Short time scale= Alfven wave travel time
- Intermediate time scale = 10-20 min for quasi steady state
- Long time scale > 1 hr for steady state of entire MIT system

And found most energy deposition is during intermediate time scales. The implication is that transient stages are prolonged periods with the time scales longer or comparable to those of many important ionospheric-thermospheric processes. The inductive-dynamic (inductive electric field and non-zero time derivatives of momentum equations) approach is required to properly describe the ionosphere/thermosphere during the transient periods.

Gang Lu showed distributions of FACs and Poynting Flux under northward and southward IMF. She compared the individual satellite measurements with the global maps of Poynting flux derived from AMIE for Nov 2004 storm, and showed that even with 2 concurrent DMSP satellites (DMSP F-15 and F-16), they are not adequate to describe the global energy deposition. She also showed dayside energy deposition during northward IMF and large East-West IMF.

Art Richmond discussed statistical Poynting flux patterns from DE -2 derived from 18 months of data. The derived patterns show net Earth-directed Poynting flux. He showed that dayside energy deposition dominates for all IMF clock angles

Rick Wilder discussed the effect of Magnetospheric field Line topology on dayside FACs and Energy Deposition for a December 5, 2004 event. He showed a case where strong northward IMF drives reverse convection in both hemispheres; stronger in summer hemisphere; Theta aurora in summer hemisphere and concluded that the winter hemisphere supported reverse convection on closed field lines. He also discussed an August 24, 2005 event with an expanded polar cap and Joule heating on open field lines. That event showed evidence of > 10 keV ions.

Juan Rodriguez discussed auroral forms that extend equatorward from the persistent midday aurora during geomagnetically quiet periods. He showed data from a 630 nm all sky imager near the cusp. The auroral forms appeared equatorward of cusp near noon with east-west extent of 1000 km. These are possible flux transfer events. He also showed additional events called "crew cuts" events with no known physical association.

Herb Carlson discussed dates/times seeking satellite over flights to compare ground based with satellite signatures of: magnetic reconnection, down going energy, and ion outflows. He showed data from EISCAT 2 min resolution since 2000, that should contain FTEs. The FTE's should pull solar-produced plasma into polar cap and create patches that give rise to polar cap scintillation. He suggested that polarward moving forms with signatures of particle flash are indicators of FTEs and asked what other signatures are associated with FTEs? He is looking for high altitude data above DMSP.

Eric Lund showed sounding rocket measurements of electron heating in association with field-aligned currents and soft precipitation from the SCIFER rocket launch on 18 Jan 2008 over Svalbard. The rocket had an apogee of 1468 km. He noted a series of poleward moving auroral forms. He showed measured electron temperature. He argued that energy to transfer to electrons required about 100 sec.

Liam Kilcommons demonstrated the DMSP Poynting flux database.

General discussion:

Local versus global density enhancements needs to be defined (Strangeway).

Soft electron precipitation dependent on FAC sense, thus dependent on IMF By and side of noon. Asymmetry expected (Strangeway). Importance of IMF By to Poynting flux now demonstrated.

Hardy formula only good for summer; how was this data set generated? (Lotko)
Plasma connectivity (M-I coupling) missing from all MHD codes (Lotko, Ridley agrees).
Does Hardy model have two particles populations, including a narrow 1 keV population poleward of current sheet from prior reconnection?

Overarching questions for FED to consider

For the currents and current loops essential to linking the M-I system, to what extent and under what conditions it is most useful to view the magnetosphere as: mostly capacitive and/or inductive

given a current and a voltage source? What is the source population for the major current carriers for the key current loops in the key regions?

For the EM energy flow ultimately tracing back to being driven by the solar wind, relatively directly near the cusp and indirectly on the night side: how significant is reconnection driven Poynting flux on the dayside and on the nightside? What parameters modulate the impact of this energy deposition on the thermosphere? How do we best characterize the "sea-saw" imbalance between dayside and nightside reconnection rates, as that imbalance modulates polar boundary locations, area, potential drop, and energy deposition?

How do we model and validate theory for the time-dependent current loops where discrete changes (and shears) in plasma flow must self-consistently lead to corresponding inter-dependent changes in currents, precipitating particles, conductivity, and a nonlinear energy deposition response?

Given importance of the "cusp location" to the question of Poynting flux dependence on IMF, to what extent can we improve our understanding of current system variability around the cusp?

Snapshots of 2011 CEDAR-GEM Workshop
(by courtesy of Barbara Emery)

Tail Research Area Report

Coordinators: Mike Hendersen and Larry Kepko

Plasma Entry and Transport (PET) within the Magnetosphere Focus Group

Co-chairs: Simon Wing, Jay Johnson, and Antonius Otto

PET FG had two sessions on Monday Jun 27, 2011: (1) Summary and (2) Future planning. PET FG ended this summer. The summary session summarizes the accomplishments and progresses made in the plasma entry and transport in the plasma sheet during life of PET FG. The future planning session discusses what the community would like to do in the future. We would like to especially thank two of our speakers, Joachim Birn and Joe Borovsky, who adhered to their commitments to give talks in our session despite the call for mandatory evacuation of their homes that came in the middle of our first session.

1. Summary

- **Jay Johnson, Antonius Otto, and Simon** Wing highlighted the major accomplishments during the life of the FG. Although it was not possible to list all accomplishments and progresses during the lifetime of the focus group, a more detailed and complete description will be released in our report to GEM in the fall of 2011. Among other accomplishments have been: a special session on entropy at the 2008 Fall AGU Meeting, a special section of JGR on entropy published in 2009-2010, and the PET2009 workshop held in Fairbanks, AK.

- **Joachim Birn** summarized his work on MHD simulation of plasma bubbles in the magnetotail. When the bubbles reached the near Earth region, field-aligned currents are launched.

- **Larry Lyons** summarized the accomplishments of his group during the life of PET FG. He showed the interplay of the large and mesoscale structures of the electrodynamic M-I coupling. Large scale PBI and streamers lead to a mesoscale flow channel that swings around the Harang discontinuity, which can lead to substorms or equtorial arcs.

- **Joe Borovsky** examined the specific entropy, s, in the radiation belt. He derived a formula for s for relativistic case. Energetic electrons in the radiation belt have roughly the same adiabats as those in the magnetotail. He suggested that the radiation belt electrons leak out to the magnetotail.

- **Chih-Ping Wang** summarized his work that shows that Vy fluctuations give rise to the diffusion of the solar wind origin cold particles from the flanks to the center of the plasma sheet. He also showed some statistical properties of Ti/Te ratio for cold and hot population. Ti/Te ratio for cold population is higher (~10) than that of hot population (~4) and Ti/Te ratio of the cold population is similar to that of the magnetosheath.

- **Vahe Peroomian** summarized his work with LSK simulation on three events. In a CME storm event of 28 Oct 2001, LSK density agrees well with that observed by LANL satellite. In another CME storm event on 17 Apr 2002, LSK density again agrees well with that of IMAGE HENA observations. During IMF Bz northward turning, the magnetosheath ions have direct access to the dawnside inner magnetosphere. During storms, magnetospheric ions can move earthward and either exit the magnetosphere or populate the ring current.

- **Jimmy Raeder** presented his work with open GGGCM MHD simulation during northward IMF. MHD density agrees well with that observed by THEMIS satellite. Poleward of the cusp reconnection occurs leading to formation of a thick cold, dense, plasma layer inside the dayside magnetopause. Moreover, reconnection does not occur simultaneously in both hemispheres, leading to asymmetry in flows at the magnetopause. During southward IMF, the cold dense layer is not found.

- **Kyung Joo Hwang** examined KHI and KH waves during various IMF confiurations. Southward IMF should suppress KH waves while dawnward IMF leads to KH waves at high-latitudes. Sunward IMF leads to FTE at the boundary layer.

- **Mark Engebretson** presented observations of PC1 waves in the high altitude mantle/ lobe region, which can be associated with streaming O+ in the tail. IMF Bz was southward and By was large during this event. However, similar O+ distribution was observed in the tail without the presence of the waves. This leads to the question of what role PC1 plays in the transport of O+ from ionosphere to the plasma sheet.

- **Wendy Mata** summarized her modeling work on the evolutions of hot ions during a prolonged period of northward IMF. Her model traces ions in Tsyganenko magnetic field model and uses statistical Geotail ion distribution at the model boundary. She found a qualitative agreement with Wing et al. [2005] observations.

- **Jian Yang** examined bubble injection in the RCM-E simulation. In the simulation, bubbles push the the inner edge of the plasma sheet earthward leading to a condition that resembles dipolarization. Bubbles can create finger like structure due to interchange instability, which leads to small field-aligned current strucures in the ionosphere. Wide bubbles would break up into small pieces at the inner edge of the plasma sheet and bubbles play a role in particle acceleration.

- **Ying Zou** summarized her work with NORSTAR high resolution observations of electron and proton aurora. She used 6300 A for electron aurora. During quiet time, the equatorward boundaries of the electron and proton aurorae almost coincide. During active time, the separation of the two boundaries widen. There are local time variations.

2. Future Planning

- **Antonius Otto** led a discussion on what the community would like to do in the future. Antonius Otto, Jay Johnson, and Simon Wing proposed an FG that focuses on the invariant in the processes along the path from solar wind to plasma sheet. The invariant includes entropy, but is not limited to entropy alone. The attendees gave some suggestions on how to improve the FG. A poll was taken and a large majority support the creation of such focus group.

Near-Earth Magnetosphere: Plasma, Fields, and Coupling Focus Group

Co-Chairs: Sorin Zaharia, Stan Sazykin, and Benoit Lavraud

This focus group seeks to improve physical knowledge and modeling capabilities of the near-Earth magnetosphere (NEM, the region that spans the inner magnetosphere and the inner plasma sheet in the tail, within roughly 10 R_E from Earth) and its coupling with the outer magnetosphere. The focus group now enters its final year. At the 2011 summer workshop, the NEM focus group held two sessions. The great majority of the 16 presentations were modeling studies, with most using data for assessing how well different models reproduce the physics of the inner magneto-

sphere. This, perhaps, serves to indicate that a lot of this focus group's work has been converging on coming up with inner magnetosphere modules, crucial components of a future GGCM.

The 16 presentations focused on one or more of the following common topics:

1. **Role of magnetic field computed self-consistently with the particle pressure distribution in inner magnetospheric models.** Work with the RAM-SCB (V. Jordanova, Y. Yu), RCM-E (C. Lemon, M. Gkioulidou, C.P. Wang, and M. Chen), and the IMPTAM (N. Ganushkina) first-principles codes shows that when self-consistent magnetic fields are included (typically in force balance with particle pressure), the resulting injection of plasma sheet material into the stormtime ring current is weaker, as compared to simulations with non-self-consistent magnetic fields.
2. **Mechanisms of particle injection into the ring current during magnetic storms.** There was a vigorous debate on the exact mechanism of particle injection into the ring current. While all models are able to reproduce ring current particle flux increases during storms through particle adiabatic energization/transport, the effect of "magnetic shielding" (see topic 1 above) may require additional physics, such as assumed strong localized inductive electric fields associated with plasma "bubbles" (J. Yang). There is presently no general agreement and work is under way in this area.
3. **Data-based prescription of the plasma sheet source for ring current models on the outer boundary.** Specifying the boundary conditions on plasma sheet fluxes for ring current models is crucial to understanding the physics of storms and substorms. A number of approaches were presented, such as specifying plasma moments based on THEMIS data (C.P. Wang, M. Gkioulidou, J. Yang), inferred from TWINS ENA images (M. Chen), based on LANL MPA fluxes (V. Jordanova, Y. Yu), or using statistical data-based plasma sheet models (S. Sazykin).
4. **Ability to reproduce the measured Dst index, ENA images, charged particle fluxes, and magnetic field perturbations during storms with modern inner magnetospheric models.** This is one of the central aspects of the focus group, and a number of speakers (N. Ganushkina, M. Chen, C. Lemon, C.P. Wang, S. Sazykin, V. Jordanova, J. Yang, A. Glocer, M. Liemohn, J.C. Zhang, R. Ilie, Y. Yu) presented their latest results and challenges.
5. **Inclusion of the physics of the inner magnetosphere in global magnetospheric (MHD-based) models.** When ring current models such as RCM, CRCM, or RAM are coupled to global MHD-based codes, the physics of the inner magnetosphere (such as large particle pressure increases during storms and electric field shielding of low latitudes by the region-2 Birkeland currents) affects the outer magnetosphere and its interaction with the solar wind. Three talks in the session addressed how these inner magnetospheric effects influence the polar cap potential saturation (D. Welling) and ring current injection during storms (A. Glocer and M. Liemohn). A heated discussion following talks by R. Strangeway and S. Zaharia raised the more general issue of the possibility of reconciling fluid and kinetic formalisms in the inner magnetosphere.

At the coming mini-GEM workshop in December 2011, the focus group will continue to discuss ways to productively wrap up the group in 2012, namely, through a modeling challenge using the participating models and data-based results, and ways to document inner magnetospheric modules with the current status of their development.

Modes of Magnetospheric Response Focus Group

Co-chairs: Bob McPherron and Larry Kepko

The goal of the Modes of Magnetospheric Response Focus Group is the improvement of knowledge of the physical mechanisms that provide different dynamical modes of response of the magnetosphere to the solar wind. These include substorms, steady magnetospheric convection, sawtooth injection events, pseudo breakups, and poleward boundary intensifications. Due to the increased number of concurrent sessions driven by the joint workshop with CEDAR, the Modes FG held only one breakout session. It was well-attended, with good audience participation. Of the nine speakers, 5 were women, and the overwhelming majority of speakers were either students or young scientists.

As usual for this focus group, there were a number of talks on SMCs and sawtooth events. Anna DeJong described a method to identify SMCs, using the AE indices. Her new algorithm identified 45 of 51 events found with satellite images, and identified a total of 2314 SMCs from 1997-2008. Jenni Kissinger presented statistical results of fast flows and flux transport during SMCs. Flows very rarely penetrate inside 15 Re during SMC. The results showed a diversion of fast flows during SMCs instead of the impact and pile-up at midnight as seen during substorms. Xia Cai reported on the relationship between sawtooth events and magnetic storms. She finds that most sawtooth events occur in a magnetic storm primarily in the main phase or at its peak development. She did identify a few events that seem to occur during very weak and steady Dst depression. Jian Yang described RCM-E simulations of SMC events. He reminded us of the pressure inconsistency problem and how it is necessary for a flux tube to have low entropy to penetrate to the inner magnetosphere after reconnection. He found that the best simulation of SMC had Bz in the tail larger than during substorms and the plasma sheet was thicker. Oliver Brambles described the effects of ion outflow on the magnetosphere convection mode using the MFLFM model, incorporating the Strangeway outflow formula. In general MHD simulations quickly converge on the SMC state when driven by steady solar wind. However, if oxygen outflow during the simulation exceeds some critical value the solution becomes periodic substorms. Delores Knipp compared the Poynting flux response during Steady Magnetospheric Convection and Sawtooth Oscillation Events, and identified significant (and unexpected) differences. The data appeared to agree with the Brambles result.

Leila Mays described the geomagnetic response to solar wind structures during the recent solar minimum. She used Dst to define different strength storms and then related these to solar wind structures that caused them. She found that CMES are highly variable and that different parts of the CME may be responsible for the largest response in different CMES. Frederick Wilder suggested that in the electrojets there is a maximum current that can be carried, which can lead to a current driven (Farley-Buneman) instability. This could then be an ionospheric mechanism for polar cap saturation. Lasse Clausen described how changes in open magnetic flux can be tracked using the AMPERE constellation of Iridium satellites. Magnetic perturbations seen by the spacecraft define the location of region 1 and 2 field-aligned currents. Circles are fit to these and the magnetic flux within the circle calculated as a function of time. Loading and unloading of flux associated with substorms is extremely obvious. Additional work is required to establish precisely the location of the open-closed field line boundary relative to the Region 1 circle, but this technique promises to be a valuable resource in the future.

Substorm Expansion Onset: The First 10 minutes Focus Group

Co-chairs: Vassilis Angelopoulos, Andrei Runov, Shin Ohtani and Kazuo Shiokawa

Overall FG objectives:

Observations during recent and coming years are redefining the questions related to substorm phenomena allowing us to revisit the timing, location, onset mechanism and effects of the global substorm instability. The primary work of the focus group is observational. It relies on the abundance of new data from THEMIS, Cluster, ground based radars and other concurrent satellite platforms to study the details of the first few minutes before and after substorm onset, with the goal of identifying the physical process responsible for the avalanche of energy release during substorms and the roles and physical connections between the relevant processes at different parts of the magnetosphere. For example, is throttling of the magnetotail reconnection rate at the distant magnetotail related to pulsations or periodic injections in the inner magnetosphere? Detailed event studies, using the unprecedented spatial coverage in the magnetotail and magnetosphere along with high temporal resolution from ground measurements of aurora and magnetic field constitute the primary means of addressing such questions.

Granted, however, that global MHD and localized simulations are rapidly increasing their ability to realistically model expansion phase phenomena, results of the detailed data analysis at multiple critical locations within the magnetosphere provide important testable constraints against which the models can be judged. The inner magnetospheric observations also constrain models and simulations of inner magnetospheric instabilities (such as ballooning mode, current disruption). The accurate timing and spatial information about auroral arcs and currents would constrain models of M-I coupling. Finally, the combination of accurate timing of onset phenomena (flows, dipolarization, arc brightening, injection, etc.), multipoint measurements, and excellent knowledge of ionospheric currents and aurora would enable challenges to the global MHD groups. Thus naturally the Substorm Expansion Onset Focus Group interacts closely with a number of existing focus groups (GGCM Modules and Methods, Metrics and Validation; Near Earth Magnetosphere: Plasma, Fields, and Coupling; Diffuse Aurora, Inner magnetosphere).

Status:

The FG has been operational since 2008 and has had three Summer GEM (and 3 pre-AGU mini-GEM) sessions. There are two more years remaining. A number of significant accomplishments can be recounted: A substorm database has been assembled and studied from various observational perspectives. These have resulted in a revised picture of the substorm onset process, whereby the phenomena at 20-40Re are closely linked to the inner magnetosphere and can, in many cases (perhaps all) trigger the avalanche of substorm energy, via the arrival of flow bursts. Notably, two aspects of the mid- to distant-tail phenomena have received new (perhaps renewed) attention: First, in the magnetotail dipolarization fronts have been measured to propagate Earthward before they collapse into the inner magnetosphere. Second, north-south arcs have been observed to emanate from (or close to) the polar cap boundary and propagate equatorward just prior to substorm onset. The two phenomena are likely manifestations of the same global process. Current research is focusing on the question of whether the phenomena observed in the near-Earth (at the dipole-like) region and near the equatorward-most arc at onset is the result of energy from the magnetotail or the

manifestation of a new, local instability of an unstable pre-onset equilibrium.

Organization:

The FG has traditionally divided its observational reports into four general questions. These provide artificial boundaries but help organize the talks and manage our forums efficiently. They are:

1. *Onset timing*: observations/theory/simulations pertaining to where/when onset starts
2. *Propagation*: How do mid-tail onset signatures propagate to near Earth and to the ground?
3. *Mapping:* How do physical processes map, can we improve our understanding of coupling?
4. *Transition region between stretched and dipole field lines*: processes and evolution.

This organization was successful over the first 2 years as the questions related to onset-timing, propagation direction and mapping were naturally addressed by the unique configuration of THEMIS tail-alignments. In 2011, thanks to a shift in community interests towards questions related to the interaction of fast flows with the inner magnetosphere and the nature of the inner magnetospheric instability, the following seemed a more natural organization of the questions at hand:

1. *Pre-onset signatures/conditions/PBIs:* Observations of free energy and instability drivers
2. *Relative timing/mapping/propagation*: High-resolution observations of onset phenomena
3. *Transport mechanisms and relations to ionosphere:* Drivers of transport and coupling

Deliberations in 2011:

1. *Pre-onset signatures/conditions/PBIs:* Observations of free energy and instability drivers

- Larry Lyons reported on observations (RISR-N, RANK polarDARN radar, and THEMIS ASI) of the poleward boundary intensifications being triggered by polar cap enhanced ionospheric flow phenomena in grouind radars. It is unclear what drives the flows to begin with – but prior reports of these phenomena by Moen and Lorentzen do exist. Lyons things that these polar cap flows are evidence of driven reconnection.

- Ping Zhu reported on resistive 2D (X-Z) MHD/OpenGGCM simulations of a ky=0 mode. This is an axial mode, no structure in y-direction, and can cause initial loss of equilibrium on closed field lines at onset in the near-Earth tail, leading to subsequent tearing/reconnection. MHD modeling of PBI and N-S arc (Feb. 29, 2008 event) equatorward and westward motion are reproduced. But the onset is well equatorward of the open-closed boundary. A local minimum of PV^gamma is developed and observed to cause interchange instability.

- Nishimura/Lyons presented new Champ-THEMIS array observations of the R1 and R2 current systems. They showed that the pre-existing arc is at the poleward edge of the R2 system, but inside the R2 system – arguing that this is evidence that the pre-existing arc is driven by the pressure gradient at the inner magnetosphere, and thus this is evidence of destabilization of the pressure system by a new substorm instability.

- Kazuo Shiokawa (for Ryuho Kataoka) presented evidence that the pre-onset arc shows fine structures ranging from about 3-4 km (3-min before breakup) to more than 10 km scale (1-min before breakup). This is again interpreted as evidence of possible destabilization of the arc by local pressure gradient or other local instability in the near-Earth plasma sheet.

2.*Relative timing/mapping/propagation*: High-resolution observations of onset phenomena

- Jim LaBelle presented evidence that Z-mode converted waves are a tell-tale signature of onset. The waves arise from precipitation of 0.1-5keV electrons. This is proposed as a good T=0 observable of onset from afar (from poleward of the active aurora).
- Michael Shay presented strong evidence that the energy release during reconnection in kinetic simulations is able to provide sufficient kinetic Alfven wave Poynting flux to power auroral acceleration via electron acceleration along the field lines.
- Joachim Birn presented evidence that driven reconnection can result in bubble penetration to the inner magnetosphere. Through 3D MHD simulation of mid tail reconnection. He presented initial onset of reconnection followed within several min by onset of fast reconnection and entropy loss, which in turn was followed after ~2min by onset of SCW and penetration of low entropy to near tail, braking and diversion of flow.
- Larry Lyons presented evidence that dipolarization fronts and associated flow bursts are associated with auroral streamers for 5 events in total of 6 events. Azimuthal separation of spacecraft may create apparent time difference of timing.
- Russell Cosgrove showed a global correlation analysis among data of 24 magnetometers. The first disturbance has a broadband correlation signature, but later the pulsations coalesce to a few discrete frequencies. Correlation steeply increases and ceases, while power slowly grows, suggesting transition from linear to non-linear global instability as a whole magnetosphere-ionosphere system.

3. *Transport mechanisms and relations to ionosphere:* Drivers of transport and coupling

- Xing, Xiaoyan showed THEMIS ion spectra which indicates that the ion injection at the dipolarization front causes enhancement of azimuthal pressure gradient a few min before the onset, and causes enhanced upward FAC and intensification of thin onset arc.
- Hwang, Joo showed evidence of particle energization associated with dipolarization front (DF/BBFs). Fermi-acceleration makes bi-directional electrons. Then the electron beam causes whistler mode waves that energize particles at and around the DF.
- Jiang Yang modelled the substorm injection boundary and related bubbles using 3D simulation. He showed that there is a two step flux enhancement: 1) high PV5/3 plasma ahead of bubble, and then 2) inside the bubble.
- Yasong Ge discussed ion and electron features at the dipolarization front. In one case the ESA shows earthward flow, while the SST does not. In another case, both ESA/SST see the earthward flow. The dipolarization front can energize and reflect plasma sheet ions in field-aligned direction and cause proton aurora in the ionosphere. This is being simulated by Xuzhi Zhou.
- Michael Shay (for Penny Wu) investigated how do the reconnection properties change by lobe density. Dipolarization front amplitude and reconnetion rate increase linearly with increasing Nps/Nlobe. Reconnection occurs faster for lower lobe density.

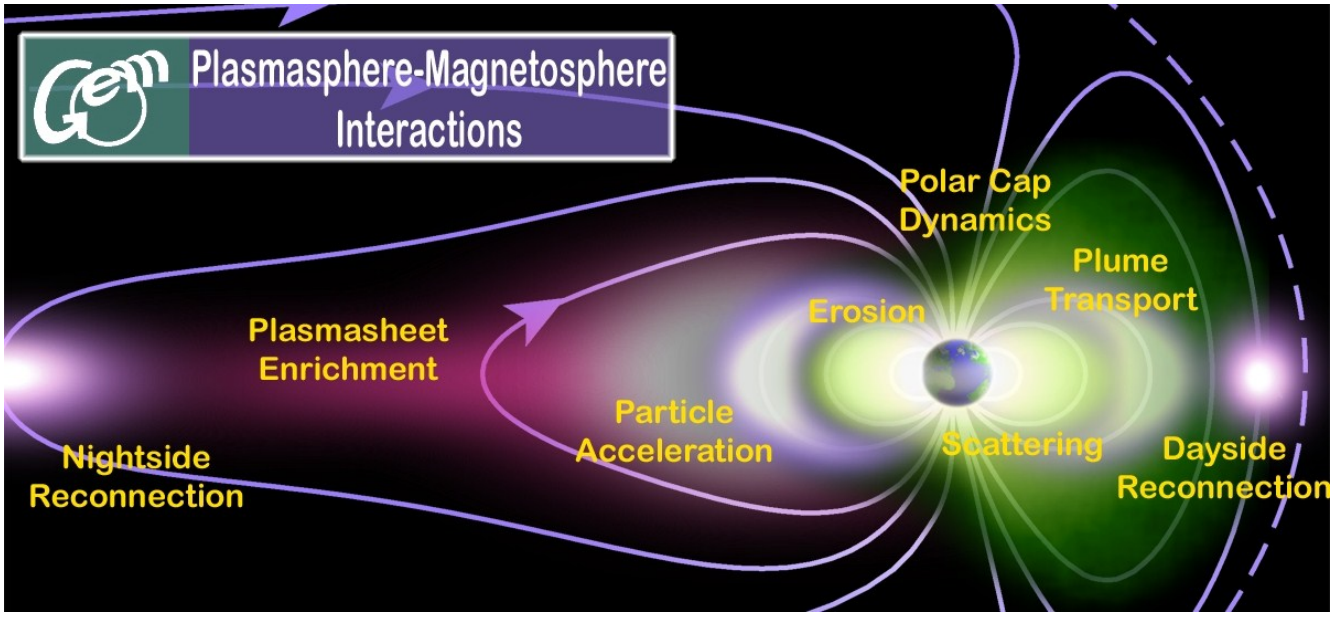
- Feifei Jiang presented observations of the preexisting arc by THEMIS, FAST, and ground ASIs. She showed that the preexisting arc just before onset is located at the boundary between the dusk Region 1 and 2 current region, at the poleward part of the energetic ion precipitation and corresponding to the inverted-V region.
- James Weygand showed reconstruction of equivalent ionospheric currents and of vertical current systems (in/out) from ground magnetometer arrays. The current systems were compared with Harang and pre-onset aurora locations for several events. They showed that the pre-onset aurora is equatorward of the Harang reversal and poleward of the peak in the R2 current system. This is consistent with the Nishimura results.
- Vassilis Angelopoulos showed Artemis data that indicate tailward moving plasmoids correlating well with the onset of substorms. New information on timing can be obtained from the tail at lunar distances. Specifically the plasmoids seem localized in Y and their release is very closely related to the first few minutes of substorm expansion. They seem to be a critical part of the expansion onset process, not just its aftermath.
- Stefan Kiehas showed Artemis plasmoid observations during substorms. By modeling individual flux-ropes/plasmoids/TCRs as observed by two spacecraft, and timing their propagation speed in comparison with the measured flow speed, they showed that the plasmoids are twisted, possibly by magnetic forces acting upon them during/after the release process.

Summary, 2011:

The Substorm FG questions have evolved considerably over the last year. Rather than asking where things start, the group is addressing now more the coupling of mid-tail reconnection (or high latitude/polar cap boundary activations) to possible precursors of these activations (in the solar wind and/or polar cap) and to possible consequences near-Earth. In the inner magnetosphere questions are related to the destabilization of an already marginally unstable (perhaps preconditioned by growth phase currents or pre-onset flow bursts) inner magnetosphere. In the magnetotail questions are related to what determines the generation of low entropy flux tubes that are most geoeffective (since they propagate closest to Earth): is it a driven or a spontaneous process. Finally Artemis data being so close to the mid-tail region where these phenomena originate (albeit mostly on the tailward side) may be able to provide critical constraints on these questions, especially since the ejecta (plasmoids, flows) are not modified by Earth's strong field and pressure forces. Studies such as that by Yasong Ge (UNH), Jun Liang (U Calgary), Jiang Yang (Rice) and Xuzhi Zhou (UCLA) who are looking at the proton aurora intensification at onset from ground, space, MHD and particle kinetic modeling, have arisen through GEM and epitomize GEM's spirit. The rapid pace of discovery in many aspects of the substorm problem bespeak of a very dynamic field of study with an expectation of many more successes in the remaining 2 years.

IMS Research Area Report

Coordinators: Reiner Friedel and Anthony Chan



Plasmasphere Magnetosphere Interactions (PMI) Focus Group

How Are Magnetospheric Processes Regulated By Plasmaspheric Dynamics (and Vice Versa)?

Co-chairs: Jerry Goldstein, Maria Spasojevic, Joe Borovsky

Wiki: http://aten.igpp.ucla.edu/gemwiki/index.php/FG11._Plasmasphere-Magnetosphere_Interactions
ABRIDGED LINK: http://tinyurl.com/pmiFGwiki

Purpose of This Document

This is a report of activities of the Plasmasphere-Magnetosphere Interactions (PMI) Focus Group (FG) at the 2011 Geospace Environment Modeling (GEM) Workshop in Snowmass, Colorado. This report presents a broad overview of the physical ideas discussed rather than a detailed summary of each and every presentation. The report is posted online at the GEM PMI Wiki page: http://tinyurl.com/pmiFGwiki.

Format of the 2010 GEM PMI Sessions

Presenters were encouraged (both in advance and at the sessions) to keep their presentations brief and informal, leaving time for questions and discussions, fostering an atmosphere of active exchange of ideas among all attendees and speakers.

PMI Breakout Sessions

To address the PMI FG's central question, "*How Are Magnetospheric Processes Regulated By Plasmaspheric Dynamics (and Vice Versa)?*" we hosted three (3) Breakout sessions at the 2011 GEM Summer Workshop:

- PMI-1: Plasmaspheric Density Structure and Dynamics (~30 people attending);
- PMI-2: Wave-Particle Interactions (~50 people attending);
- PMI-3 (Joint w. CEDAR): M-I Coupling in the Plasmaspheric Boundary Layer (~30 people attending).

The detailed schedule (GEM_PMI11_final.pdf) is posted on the PMI Wiki. These PMI

Breakout sessions were quite well-attended (on average, ~36 people per session), and there was generally a great deal of animated discussion. Directly below, each PMI Breakout Session is listed with its Topic, followed by a brief summary of what was discussed and accomplished at the session.

Monday, 27 June 2010

PMI Breakout 1: 16:00-18:00.

Topic: "Plasmaspheric Density Structure and Dynamics".

This session featured seven (7) scheduled presentations by Moldwin (INVITED), Chappell, R. Denton, Brandt, Goldstein, Ozhogin, and Foster. Modeling of the formation, evolution, and morphology of plasmaspheric density was discussed in a historical context, and it was agreed that the next generation of models must incorporate sub-global structure, and account for dynamics on longer time scales, especially during and after the recovery phase. Significant discussion dealt with possible formative mechanisms of the plasmaspheric "armpit", i.e., global density depletion inside and west of the base of an afternoon-sector plume, with a likely candidate being a combination of the natural corotation of plasma plus a sub-global duskside eddy flow whose existence is merely postulated (as it would be consistent with EUV-observed eddy-like motions of cold plasma in this region). Plume shredding was also discussed, motivating the conclusion that modelers need to think about how to put more structure into the plume. Refilling rates were modeled, and cross-comparison between active radio sounding by RPI and geostationary observations (in the literature) was performed. Field aligned density profiles were also extracted from RPI radio sounding measurements, and some MLT and/or longitudinal effects were identified for further investigation. Similarly, from TEC observations (which are believed to be roughly 50% from the plasmasphere and 50% from the ionosphere) some clear UT and longitudinal effects were identified for investigation and explanation, with the SMA being a possible candidate. At the end of this session, an eigth (8th) impromptu presentation by Shepherd highlighted the capabilities of the NSF-funded SuperDARN radars, and the new MSI stations coming online.

Tuesday, 28 June 2010

PMI Breakout 2: 10:00-12:00.

Topic: "Wave-Particle Interactions".

This session featured eight (8) scheduled presentations by Bortnik (INVITED), R. Denton, Blum, Chen, Jordanova, Lio, Zhang, and Foster. Ray tracing modeling of hiss and chorus was presented, showing fairly good agreement with observed wave dynamic spectra, and suggesting the conclusion that cold plasma can exert significant control on wave power, and on the resonance condition with energetic particles. A broad plume may stop chorus from getting in, while the normal narrowing (with time) of the plume can gradually "open the gate". The group consensus was that 3D simulations with nonmonotonic density are a high priority for future progress. Simulations show that EMIC waves grow, propagate along field lines (becoming more oblique as they do), and then are damped in the ionosphere. The generation of waves makes ions more isotropic, thus relieving the anisotropy that generated the waves. Observations of a detached proton arc on 31 July 2001 were presented and compared with in situ plasma proxies for EMIC wave growth. Epoch time analysis was suggested for anything linked to plume dynamics, such as the possible link between EMIC wave growth and plume density. A simulation of EMIC waves indicates that structure within plumes (on spatial scales from meso- to fine-scale) can strongly modulate wave growth, and therefore this internal structure must be considered/included in future models. Chorus excitation by anisotropic ring current electrons was modeled, showing strong pitch angle scattering by chorus (outside) and hiss (inside) regions of cold plasma density. Motivated by in situ observations, three imperative questions were identified: (1) What are the conditions that drive waves? (2) What are the effects of these waves? (3) How do measured plasma

conditions compare to linear theory?

PMI Breakout 3: 13:30 - 15:30pm.
Topic: (Joint with CEDAR) "M-I Coupling in the Plasmaspheric Boundary Layer".

Seven (7) scheduled presentations were given in this session, by Erickson, Brandt, Zhang, Ruohoniemi, Goldstein, Chappel (INVITED), and Foster. The role of oxygen ions in SAR arc formation was discussed (mechanism: ring current heating of cold plasmaspheric ions), highlighting once again (as in previous discussions) the urgent need for better understanding and modeling of composition. The inner magnetospheric electric field was discussed at length in this session, including variability in the PBL, and general electrodynamics initiated by region-2 M-I coupling. A superposed epoch analysis of Cluster electric fields was shown to produce dynamic features of the inner magnetospheric fied, keyed to storm phase, and statistical characterization of SAPS was presented. The capabilities of the MSI/SuperDARN radars (just coming online) were discussed. It was decided that a coordinated campaign using all available midlatitude radars should be initiated in the coming years.

Science and Programmatic Imperatives for the Community

At the three PMI Breakout Sessions this year, the group discussions identified several urgent science and programmatic imperatives that are required to advance PMI science:

• Ion Composition: Observations and models of inner magnetospheric ion composition are urgently needed to close the loop on several PMI science topics, including wave growth and wave-particle interactions, global MHD, and the possible role of oxygen enrichment in modulating dayside reconnection and substorms.

• Plume Structure: Modelers need to get more meso- to fine-scale structure into their simulated plumes, in order to match the observed cross-scale structure.

• UT and Longitudinal Effect: For several years various case studies have hinted that there may be a longitudinal (and/or UT) modulation of the strength of storms and the density of plumes. This effect must be quantified and understood.

• Wave Growth, Propagation, and Resonance: Simulations need to use 3D, realistic density for their plasmaspheres (e.g., cross-scale spatial structure both in and out of plumes, nonmonotonic density profiles, and profiles constrained by measurements). We need to know the conditions that drive waves, and we need to know the effects of both those conditions and of the waves. We also must gauge how well measured plasma conditions agree with the linear theory that is widely used.

• Epoch Time Analysis: For anything linked to plume dynamics (density, waves, etc.), a superposed epoch analysis is recommended because standard (purely indicial) statistical analysis may obscure physical processes that are initiated or terminated at particular storm phases.

• Community Activities: The PMI Modeling Challenge (see below) will foster broader community involvement in PMI science, and will document the state of the art of plasmaspheric modeling. A handful of new data sources have come to the fore, and the community should act on this new availability/prominence in the next year(s): (a) Use the existing and extensions to SuperDARN MSI radar stations; (b) Conduct a coordinated campaign between MSI and Millstone Hill radars, and possibly including others (e.g., Balloon and/or TEC data); (c) Use the full TEC capabilities, i.e., full tomographic inversions and ionospheric measurements; and (d) Encourage close coordination/ collaboration with the efforts of the NASA LWS TR&T /FST on the Plasmasphere, in the next year or so.

PMI Modeling Challenge: 2011 – 2012.

The main coordinated activity for the next year of the PMI Focus Group is to initiate and conduct the PMI Modeling Challenge. For this Challenge, two events were selected:

(A) DISTURBANCE interval: 8-11 June 2001 (days 159-162).

(B) QUIET interval: 2-5 February 2001 (days 33-36).

Participants in the PMI Modeling Challenge will provide data and modeling/ simulation results, under the guidance of Maria Spasojevic, who has agreed to lead/ coordinate the effort. A full list of data and modeling-result providers can be found at http://tinyurl.com/gempmi. The results of the

GEM PMI Modeling Challenge will be presented at the GEM 2012 Summer Workshop, and published in a coordinated, linked series of papers, most likely in Journal of Geophysical Research.

In addition to the PMI Modeling Challenge, there are numerous ongoing studies by researchers participating in the PMI FG. Coordination of these various studies will continue to be via the PMI Wiki page (http://tinyurl.com/pmiFGwiki) and via the PMI Mailer List, which includes 71 people as of the writing of this report (with several joining after this year's workshop). The goal is to promote synthesis of the various studies into a system-level conceptual framework; PMI is by its very nature a system-level FG.

Radiation Belt and Waves (RBW) Focus Group

Co-chairs: Yuri Shprits, Scot Elkington, Jacob Bortnik, and Craig Kletzing

The GEM Radiation Belt and Waves (RBW) focus group held a series of productive discussions and presentations at the June 26 - July 1 2011 joint GEM/CEDAR Workshop in Santa Fe, New Mexico. Topics covered wave-particle interactions and the dynamical evolution of the radiation belts, remote sensing, and global modeling of radiation belt dynamics.

The RBW focus group held a session on Monday, June 26, to discuss and finish formulating a global radiation belt modeling challenge. The intent of the challenge is to better understand the relative strengths of available physical and analytical models in capturing global radiation belt dynamics, defining necessary data inputs and model requirements, and working towards defining appropriate comparative metrics in evaluating the various models. The period selected for the challenge encompasses February 1, 1991 to July 31, 1991, with a prior 'training period' for analytic models. UCLA, Aerospace Corp, AFRL and others information about the RBW global radiation belt challenge is available at http://virbo.org/rbw.

A session was devoted to new results and understanding in the dynamical evolution of the radiation belts. Among the findings discussed in this session was new observational evidence that outward radial transport and losses to the magnetopause play and important role in the dynamics of the radiation belts. Adiabatic effects at low altitudes, whereby variations in the particle mirror point in response to changes in the global field configuration, were also considered in the context of flux dropouts observed at LEO. Discussions were held on the occurrence of ELF, magnetosonic, and whistler-mode VLF waves, and their effect on particle diffusion rates.

A joint session with CEDAR was organized to discuss remote sensing of the radiation belts, and how these techniques could further our understanding of relevant physical processes in these regions. The session focused on ULF and VLF ground measurements, TEC reconstructions, and balloon and riometer measurements of energetic particle precipitation.

The RBW group focused on wave-particle interactions in a Thursday session, and included topics in EMIC wave measurement, computation of diffusion coefficients using qusilinear theory and particle simulations, and properties of magnetospheric plasma waves. There was general agreement on the need to combine multiple satellite measurements to obtain detailed statistical maps of wave occurrence in the magnetosphere.

The RBW sessions wrapped up on Friday with a discussion of simulations and observations of chorus and hiss waves. THEMIS observations show that rising chorus elements are predominantly field-aligned while falling tones are oblique and weaker, each associated with different MLT and latitudinal distributions suggesting different mechanisms generation mechanisms for rising and falling tones. We also discussed PIC and ray tracing simulations of magnetospheric chorus waves,

and how these techniques could augment our understanding of radiation belt dynamics.

Participation in the RBW sessions at GEM was high, and underscored the level of scientific activity in this field of research. We look forward to continued advancements in our understanding of radiation belt and wave dynamics under the auspices of the GEM program during the upcoming era of the NASA RBSP mission.

Space Radiation Climatology Focus Group

Co-chairs: Paul O'Brien and Geoff Reeves

At the summer 2011 GEM workshop, the Space Radiation Climatology focus group held 2 sessions on Wednesday, June 29th. A detailed agenda, many of the talks, and links to data and models can be found at http://www.virbo.org/GEM_FG9_2011.

In our first session, our first scheduled talk, a summary of progress over the life of the focus group, was cancelled because the speaker, Reiner Friedel was occupied with the fire in Los Alamos. We heard from Xinlin Li about the behaviors of MeV electrons at geosynchronous orbit during different phases of the solar cycle, and, in particular, about several major climatological features of the radiation belts that are reproduced fairly well by his solar-wind driven model. Natalia Ganushkina present results of a survey of the locations of the inner and outer boundaries of the inner and outer radiations belts, and how they have evolved over multi-year timescales. Interestingly, this study was the result of examining the backgrounds in plasma instruments on Cluster and Double Star. Richard Denton announced the posting on-line of his mass density database for geostationary orbit for 1980-1991. Yuri Shprits gave us an update on the progress of the UCLA/VERB code. Geoff Reeves wrapped up our first session with a discussion, motivated by the results of his recent paper revisiting the most famous radiation belt climatology result: Paulikas and Blake's correlation of average electron flux at GEO with solar wind speed. From these talks, we learned that the climatology of the radiation belts is richer than most had assumed, and we are just beginning to determine which of those climatological features we can reproduce and sometimes explain with our models.

In our second session, we focused a bit more on the nitty gritty of doing radiation belt science. Dave Byers provided an overview of the NRO's project to develop AE9/AP9 radiation belt climatology models. Dmitri Kondrashov discussed some performance improvements one can obtain by splitting the diffusion operators. This procedure offered significant speed gains, and worked well in the context of data assimilation, even though it required some simplification of the physics (e.g., no off-diagonal terms in the diffusion tensor). Steve Morley valiantly presented several topics on behalf of his missing LANL colleagues. Included in his presentation were some validation results from comparing different L* (third invariant) calculations with different software libraries, a discussion of the ring current module in LANL's DREAM model (for those who recall the MSM and RCM, this presentation brought back many old memories). Also, Steve described SpacePy, an open-source Python tool set for space scientists. Paul O'Brien described a related set of tools that are part of the "extras" in the open-source IRBEM library at sourceforge. We concluded with an advertisement for Geoff Reeves' Radiation Belt Science Blog http://web.me.com/greeves/rbsci/Whats_New/Whats_New.html, where he posts updates on NASA's RBSP mission, GEM Focus groups, and everything else.

This was the final year of the Space Radiation Climatology focus group. While we did not achieve all of our objectives, we made good progress on many fronts.

MIC Research Area Report

Coordinators: Robert Lysak, David Murr, and Bill Lotko

Diffuse Auroral Precipitation Focus Group

Co-chairs: Richard Thorne and Joe Borovsky

At the 2011 GEM Summer workshop, there were two separate breakout sessions dealing with new observation and theoretical modeling of the diffuse aurora, followed by a wrap up session chaired by Eric Donovan and Richard Thorne, which summarized the major new results during the five-year focus group. It has been show that the most intense diffuse auroral precipitation is mainly caused by scattering of plasma sheet electrons by whistler mode chorus [Thorne et al., *Nature*, 467, 943, 2010], although electrostatic electron cyclotron harmonic waves can be important for the precipitation from L > 10. The diffuse aurora has interesting spatial structure and can pulsate over intervals of 5-20 sec. While the relationship between diffuse and pulsating aurora is not entirely resolved, many reports have been published stating that pulsating aurora appears to emerge from within regions of diffuse aurora (although not every region of diffuse aurora necessarily leads to pulsating aurora). New results are contributing to significant progress in understanding pulsating aurora. Nishimura et al. [*Science*, 330, 6000, 81-84, 2010] show conclusively that pulsating aurora can be driven by lower band chorus waves, answering a question that was asked decades ago. Jones et al. [JGR, 116, A3, 2011] show that the spatial extent of pulsating aurora events averages 7.3 in MLT and that the most probable duration of events observed by a single camera is roughly 1.5 hours (although there are examples where events last several hours, up to 8 or more). They also note that the source region of pulsating aurora drifts or expands eastward, away from magnetic midnight.

Below is a summary of the 2011 summer workshop activities.

Session 1: Observations and Origin of Pulsating Aurora, Chaired by Wen Li and Sarah Jones

At the GEM 2011 meeting, presentations were made that addressed a wide range of pulsating aurora topics:

Marc Lessard presented an overview of pulsating auroral observations and then showed two new observations. The first of these is the presence of "worms" of black aurora, embedded within pulsating patches. These features are typically aligned in the east-west direction, having an average width of 3 km and length of more than 50 km. Their durations range from 8 seconds to 2.5 minutes (based on a study of 26 events). He also showed a movie (using cameras from the THEMIS array) showing pulsating simultaneously over Canada and Alaska for nearly 8 hours and persisting through the occurrence of 2 or 3 substorms. The implication is that the substorms may provide the seed population for pulsating aurora.

Sarah Jones and Allison Jaynes showed images from a field study that was conducted from March 12-16, 2002 (courtesy of Dave Knudsen). The images were taken using Trond Trondsen's narrow-field intensified CCD camera that was installed at Churchill, Manitoba. The camera was oriented along the local magnetic zenith where small-scale black auroral forms are often visible within a region of pulsating aurora. The observations show black forms with irregular shape and non-uniform drift with respect to the relatively stationary pulsating patches. The pul-

sating patches occur within a diffuse auroral background as a modulation of the auroral brightness in a localized region. The images show a decrease in the brightness of the diffuse background in the region of the pulsating patch at the beginning of the 'off' phase of the modulation--an effect that was affectionately called "Knudsen's diffuse aurora eraser". Throughout the off phase the brightness of the diffuse aurora gradually increases back to the average intensity.

Allison Jaynes presented results from work being done at the University of New Hampshire, in collaboration with NOAA, showing GOES 13 particle fluctuations relation to pulsating aurora. Data from the GOES 13 MAGnetospheric Electron Detector mapped to the THEMIS ASI at The Pas, Manitoba for a pulsating aurora event on March 15, 2008. Fluctuations in the electron fluxes measured by the MAGED were cross correlated with the brightness fluctuations for each pixel in the all-sky images to identify regions of highest correlation, for 30 minute and 1 minute correlations. In this way, the patch that is magnetically conjugate to GOES 13 is identified. The GOES analysis (by Juan Rodriguez) used in-situ magnetometer data to confirm that precipitating electrons were field-aligned.

Robert Michell presented slides showing high-resolution all-sky imager observations of "fast pulsations". He and Marilia Samara are currently exploring the connection between enhanced wave power in situ, as measured by THEMIS, and active fast pulsating to enable identification of the wave modes responsible for pitch-angle scattering electrons into the loss cone.

Yoshizumi Miyoshi reported on a time-of-flight analysis of precipitating electrons associated with pulsating aurora observed by the REIMEI satellite and suggested that the modulation region of the pitch angle scattering is near the magnetic equator. Their estimated parameters, such as wave-frequency and latitudinal distribution of the modulation region, are consistent with previous statistical studies of whistler waves in the magnetosphere.

Toshi Nishimura and Jacob Bortnik described a multi-event study performed using conjugate measurements of the THEMIS spacecraft and an all-sky imager during periods of intense lower-band chorus waves. The thirteen identified cases support their previous finding that the intensity modulation of lower-band chorus near the magnetic equator is remarkably well correlated with quasi-periodic pulsating auroral emissions near the spacecraft magnetic footprint, indicating that lower-band chorus is the driver of the pulsating aurora.

Wen Li discussed the origin of the pulsating aurora due to modulation of whistler-mode chorus waves and their coherent size. Using coordinated in-situ spacecraft and ground-based all-sky imager observation from the THEMIS mission, she showed that the luminosity of pulsating aurora over a single auroral patch is closely related to the modulation of the chorus wave intensity. Furthermore, a one-to-one correlation exists between depletions in total plasma density and increases in chorus wave intensity, thus suggesting that density variations may play an important role in modulating chorus wave intensity and thus controlling the luminosity of the pulsating aurora. Using simultaneous observations by multiple THEMIS spacecraft, she estimated the transverse coherent size of chorus waves in the equatorial magnetosphere to be a couple of thousands km.

Yoshi Miyoshi presented the spatial distribution of plasma sheet electrons statistically using the THEMIS/ESA data. The electron phase space density decreases monotonically along the electron drift path. The electron life times estimated from the radial profile of the electron phase space density are consistent with the theoretical life times due to chorus-wave particle interactions. The results suggest that the main loss mechanisms of plasma sheet electrons at dawn side are the pitch angle scattering with

chorus waves.

Remaining outstanding problems related to pulsating aurora include:

1. What is the relationship between pulsating aurora and substorms? Do substorms provide the seed populations of energetic electrons as originally suggested by S. Akasofu?
2. What is the total energy involved in pulsating aurora events? How does this compare to substorm expansion phases?
3. What is the spatial extent of occurrences of pulsating aurora? Does it occur throughout the dayside?
4. What is the role of the ionosphere? How do the patches remain so incredibly persistent in terms of their shape and location during an event?
5. Do "worms" represent black aurora (i.e., does it represent a signature of current closure)? How do currents close in individual patches?

Session II: Scattering Mechamisms for Diffuse Auroral Precipitation, Chaired by Binbin Ni and Xin Tao

Xin Tao presented the temporal evolution of the phase space density of plasma sheet electrons injected into the nightside during disturbed times using a quasi-linear diffusion simulation. Scattering in energy and pitch angle during interactions with both whistler mode chorus waves and electron cyclotron harmonic waves are included using a wave model recently obtained using CRRES spacecraft data. The results demonstrate that the formation of the electron pitch angle distributions is consistent with pitch angle scattering by upper and lower band chorus waves.

Jun Liang reported multi-instrumental observations of fast earthward flows, ECH waves, and diffuse auroras, during 8-9 UT on February 5, 2009. Following the fast earthward flows observed on mid-tail probe THEMIS-C and subsequent magnetic dipolarization in the near-Earth plasma sheet, strong ECH waves were observed by THEMIS A/D/E at L~11 in the equatorial plasma sheet. Concurrently, ground optical instruments detected diffuse auroral intensifications around the THEMIS footprints. He established an observationally confirmative conjunction between the observed ECH waves and diffuse auroras. He also found that the ECH wave and diffuse auroral intensification was triggered by the fast flow activity from the mid-tail. Possible mechanisms linking the fast flow and its associated magnetic dipolarization to the intensification of ECH wave and diffuse aurora in the outer magnetosphere were discussed.

Based on the simultaneous observations from THEMIS spacecraft and NORSTAR optical instruments during 8 – 9 UT on February 5, 2009, **Binbin Ni** presented an example where electrostatic electron cyclotron harmonic (ECH) waves are the main contributor to the diffuse auroral precipitation. Using the electron differential energy flux inside the loss cone estimated based upon the energy-dependent efficiency of ECH wave scattering, both the auroral electron transport model developed by Lummerzheim [1987] and Maxwellian fitting produced an intensity of ~ 2.3 kR for the green-line diffuse aurora, in good agreement with the ~2.4 kR green-line auroral intensity observed simultaneously at the magnetic footpoint. The presented results support the scenario that enhanced ECH emissions in the central plasma sheet (CPS) can be an important or even dominant driver of diffuse auroral precipitation in the outer magnetosphere.

Mike Schulz introduced a fourth adiabatic invariant, which is essentially a phase-space volume, i.e., the product of a momentum-space volume and a flux-tube volume, and conserved in the limit of strong pitch-angle diffusion to pursue better understanding of the dynamics of magnetospheric particles. He presented some analytical formula that connects radial diffusion coefficients with pitch angle diffusion coefficients, enabling to

evaluate the consequences of pitch-angle diffusion and to estimate the maximum radial diffusion coefficient.

Scientific Magnetic Mapping and Techniques Focus Group

Co-chairs: Eric Donovan, Robyn Millan, and Elizabeth MacDonald

The new GEM focus group on Magnetic Mapping held three sessions at the recent workshop. Strong participation from attendees underscored the critical importance of understanding the magnetic mapping between different geospace regions to many of the GEM science challenges. Considerable time was reserved for traditional GEM style discussions and there were a few invited talks to highlight mapping technique examples (E. Zesta, T. Nishimura) and generate discussion of MHD-related issues (V. Merkin). There were also seven contributed talks (Y. Shi, R. Strangeway, S. Zaharia, R. Denton, J. Yang, A. Pembroke, J. Baker) and an introduction to the focus group by E. Donovan. Sessions were chaired by R. Millan and M. Henderson, E. Donovan and A. Pembroke, and M. Thomsen and E. MacDonald.

Present observational programs produce simultaneous observations from disparate geospace regions that cannot be properly interpreted without addressing the mapping issue. Global models and simulations imply mappings that need to be correct in order for the models to be as useful as possible for science and prediction. Techniques for such mappings include empirical and event-based models, simulations, utilizing auroral boundaries and phenomena, magnetoseismology, and multipoint in situ particle observations.

Talks in the first two sessions focused on these elements. Emerging themes included resolving mapping from different perspectives (e.g. the ground, FAST altitudes, and magnetotail regions), and ways to assess the metrics of various techniques. Universal questions were brought up; e.g. given observation A, where is point B, how did one get there, and given B, can one get back to A uniquely?

The third session was devoted to gathering community input to focus group planning. Planning discussions revolved around how to take stock of these techniques, assess their weaknesses and add to their strengths, and determine how global simulations compare with reality in terms of mapping.

Results of this session were to plan the next steps for the mini-GEM workshop. We would like to collect a detailed list of magnetic mapping techniques, workers, and results. This list will help guide the focus group's efforts and inform cross-pollination and best practices of mapping techniques. It can also be used as a basis for a review of mapping techniques and their efficacy. It can further be used to begin identifying the relevant science questions that most rely on accurate mapping.

Discussion was held with A. Runov regarding improved scheduling to reduce overlap with the substorm focus group and allow syncing of discussion topics.
An email communication list was established with nearly 90 members already and will be used for collecting and distributing the information. More information including archived talks can be found on the GEM wiki: http://aten.igpp.ucla.edu/gemwiki/index.php/FG:_Scientific_Magnetic_Mapping_%26_Techniques

GEM Steering Committee Report

Bob Clauer

GEM Steering Committee Minutes

Friday July 1, 2011

The meeting began at 1:45pm over lunch
Did not get a list of attendance

Discussion of meeting.

1. It would be good to have some type of information about breakout sessions after plenary. E-mail descriptions? Probably too much to print and hand out.
2. Earlier deadline for students, ask for the information that we need, involve the student reps, Should make a form for the required student information. (More of this discussion later in meeting)
3. General discussion of GEM focus groups VS CEDAR move toward 'system science' . There should be some way that system science ideas can be part of GEM

Future meetings

1. 2012 GEM at Snowmass June 17 – 22, tentative reservation in place
   complimentary ice cream break, airport shuttle, wireless, help with student accommodations.
2. 2012 CEDAR in Sante Fe June 23-29
3. 2013 and beyond – want to have one year at Norfolk or Portsmouth—Need to have tourism information assembled and distributed. Need to start negotiations earlier since we are not so familiar with this area.
4. Student support discussion: We typically have budget for 60 students and can support all requests. This year over 85 students applied so we had to assign priority. These decisions were not, in some cases, made well due to lack of information. We need to request information to make these decision. We should require student to fill out a form to provide necessary information about year in school, degree sought, previous GEM support, etc. We are also modifying our support policy based somewhat on CEDAR – we will provide transportation, and room, and reduced registration. Students will be responsible for meals and $100 registration fee. If oversubscribed we need to assign priority and also balance among schools. We will have an earlier deadline and will collect information on a form. Suggestions: agree with deadline – but earlier so that students get information earlier. Need to make airline travel and want to take advantage of early booking. Send student list to Student Reps. Students need a 'point of contact' in order to resolve issues. Ask for expected transportation cost information --

   Can we reduce registration to $300 from $375 but want to have a nice GEM? Student breakfast at Santa Fe was not good. Audit issues?

- CEDAR total attendance 317; Students 147
- GEM total attendance 253; Students fully supported 64; Total students73

5. Ruohoniemi rotation off of CEDAR-GEM liason, Josh Semeter taking his place.
6. CEDAR in Boulder 2013. Maybe GEM should be in Snowmass to coordinate.
7. David Sibeck will become next chair
8. Eric Donovan elected as chair elect
9. Jacob Bortnik elected as new at-large member of steering committee replacing Nick Omide. Other at large members: Emma Spanswick, Liz McDonald and Mike Wiltberger

Liaison Reports

1. NSF – Kile departs at end of September
2. NASA – Dick Fisher resigned – have a

short list, RBSP launch maybe 2012, Jim Slavin departs in August to Michigan

3. NOAA – Wang Sheely Arge model is running, next will be to select a geo-space model. GOES data being transitioned to NESDIS and NGDC – Bill Denig. Janet Green and moved from SWPC to work with Bill Denig. Solar cycle has jumped up in the last couple of months to joint prediction curve. Next space weather workshop April 24 – 27, 2012. World Meteorological Org is integrating space weather into activities. UK Met and US SWPC beginning international cooperation on space weather. Solar Wind monitoring – replacement for ACE could be Discover. Discover is in 2012 budget. SWPC may be able to advertise a NRC postdoc position (Howard is hopeful).
4. CCMC: Running metrics challenges, all results available on web servers for all to see. SWMF is able to run on request with ring current. Runs on request service is extensively used. Able to do many more model – data comparisons for event studies.
5. SHINE: Sunspot number plot shown – still some very unusual behavior (who is Shine rep.?)
6. CANADA: EPOP will be launched maybe 2012, ESA SWARM 2012 – E-field PI is Calgary Dave Knutson. Should provide excellent Poynting flux. Two satellites at 90 deg inclination, third is inclined and different altitude. Resolute radar face delivered in August -- maybe come online this Fall (November?). Also, new POLAR DARN will be coming on-line. They are planning Polar communications and weather satellites – envisioned to do GOES type measurements in polar regions and weather imaging in polar regions. UV imaging is in competition with other payloads. Particles and fields at 6-7 RE is a competing payload.
7. SHINE rep ? , Europe rep—maybe ask Richard Thorne ,
8. Canada rep: ask Robert Rankin, Katherine McWilliams, Martin Conners, Konstine Kabin, Ian Mann and David Knutson, To proceed -- up to Dave Sibeck.
9. Europe: ESA report is included in this newsletter.
10. Japan: ISAS Akebono and geotail both working. 20 years of geotail operation – a special symposium is being planned.

Student Comments

1. Liked the cedar idea of a poster competition – Should we do this. CEDAR has a committee – view posters prior to session, and then again and interview students. GEM students would like something but less than CEDAR. Given list of posters – can we have list of posters to distribute to a student awards GEM person. Student registration asks for abstract and if you are part of the competition. Is there a volunteer????
2. Housing students together is very important. Kitchens are good so they can prepare and share meals. Integrating new students into community. Having adequate food at tutorials is important. Food not adequate at Sante Fe.

Peter Chi GEM Comnications report:

Important point: Aug 15 is deadline – wants to get GEMSTONE out around end of September. Research Area Coordinators be on top of closeout reports. Wants to have a GEMSTONE from this meeting and then another with the closeout reports. The three ending reports due September 3.

Research Area Coordinator reports
Written reports will be supplied to GEMSTONE

Open Discussion: General discussion on focus groups and Research Area Coordinators. For development of Summer Workshop schedule: RAC request sessions for workshops working with the focus group leaders. Therefore, Focus Groups required to submit requests to area coordinators first.

New focus group proposals will be considered at the fall workshop. Need to have solicitation. What to do about system science proposal that Siscoe and Lotko proposed. Will follow up with e-mail discussion among steering committee.

Meeting adjourned.

Student Representative Report

Jenni Kissinger

The students of GEM had a great week in Santa Fe this year. In keeping with the spirit of the joint conference, we held a joint GEM and CEDAR tutorial session on Sunday before the meeting. More than 200 students attended! The tutorials were designed to be of interest to both groups, and we received many compliments from both GEM and CEDAR students on the format, topics, and speakers. Even with the larger room, there were many questions and good discussion. Most of the tutorials are available online for people to view and learn from at: http://aten.igpp.ucla.edu/gemwiki/index.php/GEM_Student_Forum.

After observing the success of CEDAR's poster awards, we asked the steering committee if a similar recognition could be held for GEM student posters. We're very grateful that Emma Spanswick has agreed to oversee the implementation of student poster evaluations, and encourage the community to assist her in this valuable project. Finally, we are excited to welcome Nathaniel Frissell from Virginia Tech as the new student representative for 2012.

SHINE Liaison Report

Joseph Borovsky

I very much look forward to serving as the GEM-SHINE Coordinator. Consider me as your resource. I will work to develop solar-wind/magnetosphere connections within the GEM and SHINE research communities, to inform both communities and the GEM and SHINE Steering Committees, and to helping with meetings. My active research is on the structure of the solar wind, the driving of the Earth's magnetosphere by the solar wind, and on the dynamics of the magnetosphere and its plasmas.

CEDAR Liaison Report

Mike Ruohoniemi

The CEDAR and GEM meetings were conducted as a single Joint Meeting at Santa Fe, New Mexico, June 26 – July 1, 2011. The last joint meeting was held in 2005, also in Santa Fe. This time the two scientific programs were strongly integrated through the activities of a CEDAR-GEM Taskforce that was charged with promoting meaningful interaction and collaboration in areas of common interest. The joint activities included the student workshop, meeting banquet, one of the two poster sessions, and the bulk of the plenary sessions. A total of 18 workshops were conducted jointly, that is, with both GEM and CEDAR conveners and merged scientific plans. The easy mixing of people and ideas was facilitated further by the device of distributing hotel bookings and session rooms uniformly between the two groups. The main venue for the meeting was the new Santa Fe Convention Center, which is located within easy walking distance of the meeting hotels. Additional meeting space was provided by the Eldorado hotel. The joint banquet, held at the Convention Center on Monday

night, featured music by the HooDoos and concluded with a poignant after-dinner talk during which M. Mendillo (Boston U.) recalled his personal experience of the tragic earthquake and tsunami events that struck Japan earlier this year ('A Remembrance of Sendai, Japan, March 2011').

The Joint Taskforce consisted of the CEDAR and GEM chairs (J. Foster and M. Liemohn), the CEDAR-GEM liason (M. Ruohoniemi, also chair of the Joint Taskforce), and volunteers from the GEM and CEDAR communities; Bob Clauer, Bill Lotko, Bob Strangeway, David Murr, Barb Emery, Tim Fuller-Rowell, and Josh Semeter. Over the last year subsets of the Taskforce met in person when convenient and several teleconferences were held with all available hands to draft and implement a plan of organization for the meeting. This included invitations to joint plenary speakers to discuss shared science imperatives (J. Forbes and M. Thomson) and to present contrasting views on themes of common interest (Outflow and Mass flow, B. Schunk and B. Lotko; Inner Magnetosphere – Ionosphere coupling, M. Moldwin and P. Brandt). It was notable that M. Thomson was unable to present her talk because of an evacuation of Los Alamos due to a major outbreak of wildfires, which generated amazing scenes of smoke and fire for meeting attendees. Michelle's presentation was given by M. Liemohn. On Wednesday a joint plenary session on Systems Science was conducted by Taskforce members and their invitees (D. Hysell, T. Immel, M. Liemohn, J. Semester, B. Lotko). The joint plenary activities concluded with a student tutorial by A. Coster on GPS/TEC, presentations on RBSP (D. Sibeck) and the future of space weather (S. Solomon), and the presentation of student awards. The joint workshops seemed particularly well attended and lively, as researchers that might sometimes feel themselves near the boundaries of their disciplines discovered connections to the other side. The overall sentiments of the two steering committees and of meeting attendees generally indicated satisfaction with the way the two meetings were merged and this experience perhaps provides a template for the planning of future joint meetings.

New Strategic Plan for CEDAR

Another significant development at this year's meeting on the CEDAR side was the release of a document detailing a new strategic vision: 'CEDAR: The New Dimension'. This emphasizes the development of an 'integrated, multi-scale picture of geospace processes' and will likely orient CEDAR-supported science in a direction that emphasizes systems perspectives and more integration with GEM research. The document, which was compiled by J. Thayer (U. Colorado), is available on-line at http://cedarweb.hao.ucar.edu/wiki/images/1/1e/CEDAR_Plan_June_2011_online.pdf.

CEDAR 2012 Workshop and Changes in CEDAR SSC Personnel

The 2012 CEDAR workshop will be held in Santa Fe, New Mexico, June 24-29, at the Eldorado Hotel. The student workshop will be held on Sunday (June 24).

The new chair-elect of CEDAR is D. Hysell (Cornell U.) The current chair, J. Foster, will finish his term by the summer of 2012.

In addition to new CEDAR Science Steering Committee members, there is a turnover in the position of CEDAR-GEM liaison. The current liaison, M. Ruohoniemi, is replaced by J. Semester (Boston U.) who begins a 3-year term.

It has been my pleasure to have served as the CEDAR-GEM liaison. I would especially like to thank the members of the Joint Taskforce and the Steering Committee chairs, M. Liemohn and J. Foster, for their work in bringing about the 2011 Joint Meeting.

The new CEDAR-GEM liaison, Josh Semeter, can be reached at jls@bu.edu.

ISAS/JAXA Liaison Report

Hedi Kawano, Masaki Fujimoto, and Iku Shinohara

(1) Currently-running space-physics satellites of ISAS are Akebono, GEOTAIL, and REIMEI.

(2) Akebono is a monitor of the inner magnetosphere. Akebono is planned to continue until the rise of the next solar max is firmly confirmed so that full two solar cycles will be covered. The issue will be subject to review by the science steering committee of ISAS every year.

Requests of Akebono data are to be sent to Dr. Matsuoka (Project Manager): matsuoka@stp.isas.jaxa.jp

(3) It is for sure that GEOTAIL will continue until the end of 2012. In addition, in this coming autumn, the GEOTAIL group plans to submit to ISAS a proposal to continue GEOTAIL until the end of 2015 or 2016.

(4) The year 2012 marks the 20th year from the launch of GEOTAIL on July 24, 1992. Thus, an international symposium is planned around July 24, 2012 to celebrate its 20th anniversary. Details will be announced as soon as they are available.

(5) NASA is continuously supporting GEOTAIL (tracking by DSN (Deep Space Network), and making level-1 data), and THEMIS-GEOTAIL conjunctions are a reason; thus, when you analyze THEMIS data, please also use simultaneous GEOTAIL data.

To help it, ISAS has been making efforts to further facilitate access to GEOTAIL data, such as making it possible that the THEMIS TDAS software will directly read GEOTAIL data.

(6) At the same time, you can easily browse data plots of both GEOTAIL and THEMIS at a website called CEF (Conjunction Event Finder): http://darts.isas.jaxa.jp/stp/cef/cef.cgi

At CEF, GEOTAIL data can be browsed about two weeks after the acquisition of the data. (To be more specific, magnetic field data, electric field data, and low-energy plasma data, can be browsed.)

(7) GEOTAIL digital data are open to public at a website called DARTS at http://darts.isas.jaxa.jp/stp/index.html.

When you have used the GEOTAIL data in your paper, please tell that to ISAS, for the record. The DARTS website shows where to contact.

Requests of GEOTAIL digital data that are not found at DARTS are to be sent to both Prof. Fujimoto (Project Scientist): fujimoto@stp.isas.jaxa.jp and Dr. Shinohara (Project Manager): iku@stp.isas.jaxa.jp .

(8) REIMEI is at 600km height and provides high-resolution data on auroral dynamics. High cadence electron and imagery data are available until 2007. Only imagery data are available after 2008.

Since the REIMEI camera zooms-in to a 100km × 100km region possibly embedded in the THEMIS GBO field of view, there is a chance of performing cross-scale coupling science in the context of auroral physics.

Science operation of REIMEI will be terminated soon.

The Point of Contact for REIMEI is Dr. Asamura at ISAS, JAXA: asamura@stp.isas.jaxa.jp

(9) SCOPE is a mission for simultaneous multi-scale observations of space plasma. It consists of multi satellites, and international collaborations are in its vision.

The mission proposal of SCOPE was submitted to ISAS in September 2008, and it has passed the mission definition review (MDR). Collaborative study with Canadian CSA is in progress to pass the joint system requirement review (SRR) expected in fall-winter of 2011.

The planned launch year of SCOPE is 2019.

While the original plan of collaborating with

European Cross-Scale was terminated, there still is a strong interest from both sides in collaborating via one shape or another.

Strong interest from the US community is acknowledged, and even stronger interest would be appreciated.

(10) ERG is a satellite to explore the inner magnetosphere. It is the second mission in the line of "small scientific satellite program" at ISAS.

The planned launch year of ERG is 2014.

Collaborations with RBSP and RESONANCE are in its vision.

(11) ISAS has the vision to perform the above-stated Earth-orbiting missions and its Mercury mission (MMO [Mercury Magnetospheric Orbiter] for BepiColombo, Launch in 2014) in a unified framework: This everything-linked-together style is the strength of the Japanese community. Indeed, recent exciting plasma measurement results from the lunar orbiter Kaguya are elevating the mood of the MMO team.

ESA Liaison Report

Benoit Lavraud

This report concerns 2011 news regarding space plasma missions in Europe.

1- Current missions

- The four-spacecraft Cluster mission (launched in 2000), is still in operation after an extension up to 2014 (subject to mid-term review in 2012).
- The CHAMP (Germany) mission ended on September 19 2010, after ten years of operation.
- Farther out, Venus and Mars Express are still running (extended to 2014 with mid-term review in 2012).
- Rosetta is in cruise and is still planned to get to comet 67 P/Churyumov- Gerasimenko in 2013.
- There is also continuing support from ESA and its member states on Cassini-Huygens (Saturn).

2- Upcoming mission

- The ESA SWARM mission is now planned for launch in 2012. It consists of a constellation of three satellites in three different low altitude polar orbits. Although not its prime objective, SWARM will also study magnetosphere-ionosphere coupling.
- The TARANIS mission (France) is now in conception phase. In addition to the atmospheric-sprite phenomena targets, it will permit interesting magnetosphere-ionosphere coupling studies.
- Farther out, Bepi-Colombo (Mercury) is still under development and weight issues seem to have been more or less solved. It is planned for launch in 2014.

3- Medium-size call M2 selection

- Cross-scale was not selected last year in this call.
- The Solar Orbiter mission has been selected this October 2011 for implementation in the context of the ESA M2 Cosmic Vision call. It was selected together with the astrophysics Euclid mission.

4- Medium-size call M3 proposals

- ESA has issued a new M-class call last year, giving the possibility to propose full M-class missions as well as missions-of-opportunity. None of the magnetospheric missions in competition were selected for the next phase (cf. last year's report).
- The EidoSCOPE proposal, being a mission of opportunity (one spacecraft to fly with the JAXA/CSA multi-satellite SCOPE mission), was put on a specific shelf and its future now essentially depends on SCOPE's fate at JAXA.
- The other non-selected magnetospheric missions are still being discussed in the community, but will not be done in the sole context of a full ESA M-class mission.

GEM Steering Committee

NSF Program Manager
- Kile Baker

Steering Committee Regular Members (Voting Members)
- David Sibeck (Chair, 2011 - 2013)
- Eric Donovan (Chair-elect, 2013 - 2015)
- Jacob Bortnik (2012 - 2014)
- Liz MacDonald (2011 - 2013)
- Emma Spanswick (2011 - 2013)
- Mike Wiltberger (2009 - 2012)
- Research Area Coordinators (see below)
- Meeting Organizer (see below)

Steering Committee Liaison Members
- Xochitl Blanco-Cano (Liaison to Mexico)
- Joe Borovsky (Liaison to SHINE)
- Brian Fraser (Liaison to Australia)
- Michael Hesse (Liaison to CCMC)
- Hedi Kawano (Liaison to Japan)
- Mona Kessel (Liaison to NASA)
- Benoit Lavraud (Liaison to Europe)
- Teresa Moretto (Liaison to NSF)
- Robert Rankin (Liaison to Canada)
- Josh Semeter (Liaison to CEDAR)
- Howard Singer (Liaison to NOAA)

Meeting Organizer
- Bob Clauer (2007 -)

Student Represenatives
- Jenni Kissinger (2010 - 2012)
- Nathaniel Frissell (2011 - 2013)

Research Area Coordinators
- ◊ Dayside, including boundary layers and plasma/energy entry (Dayside)
  - Jean Berchem (2009 - 2012)
  - Karl-Heinz Trattner (2009 - 2015)
- ◊ Inner magnetosphere and storms (IMS)
  - Reiner Friedel (2006 - 2012)
  - Anthony Chan (2009 - 2015)
- ◊ Tail, including plasma sheet and sub-storms (Tail)
  - Mike Henderson (2006 - 2012)
  - Larry Kepko (2009 - 2015)
- ◊ Magnetosphere - ionosphere coupling, aurora (MIC)
  - Bob Lysak (2006 - 2011)
  - David Murr (2006 - 2012)
  - Bill Lotko (2011 -)
- ◊ GGCM
  - Stan Sazykin (2006 - 2012)
  - Slava Merkin (2009 - 2015)

Communications Coordinator
- Peter Chi (2009 - 2014)

GEM on the Internet

GemWiki:
http://aten.igpp.ucla.edu/gemwiki/

GEM Workshop Website:
http://www.cpe.vt.edu/gem/

GEM Messenger (Electronic Newsletter):
To subscribe GEM Messenger, send an e-mail to majordomo@igpp.ucla.edu with "subscribe gem" (without quote) in the body of your message.

List of Focus Groups

Focus Group	Duration	Co-Chairs	Association with Research Areas				
			Day-side	IMS	Tail	MIC	GGCM
Dayside FACs and Energy Deposition	2010-2012	D. Knipp G. Crowley S. Erikson R. Lopez	•			•	
The Magnetosheath	2010-2014	S. Petrinec K. Nykyri	•				
Space Radiation Climatology	2006-2011	P. O'Brien G. Reeves		•			
Diffuse Auroral Precipitation	2006-2011	R. Thorne J. Borovsky		•		•	
Near Earth Magnetosphere	2007-2012	S. Zaharia S. Sazykin B. Levraud		•	•		
Plasmasphere-magnetosphere Interactions	2008-2013	J. Goldstein M. Spasojevic J. Borovsky		•			
Radiation Belts and Wave Modeling	2010-2014	Y. Shprits S. Elkington J. Bortnik C. Kletzing		•			
Plasma Entry and Transport into and within the Magneto-tail	2006-2011	S. Wing J. Johnson A. Otto			•		
Substorm Expansion Onset	2008-2013	V. Angelopoulos S. Ohtani K. Shiokawa A. Runov			•		
Modes of Magnetospheric Response	2008-2013	R. McPherron L. Kepko			•		
The Ionospheric Source of Magnetospheric Plasma	2011-2015	R. Schunk R. Chappell D. Welling				•	•
Scientific Magnetic Mapping & Techniques	2011-2015	E. Donovan E. MacDonald R. Millan				•	
Metrics and Validation	2011-2015	M. Kuznetsova A. Ridley T. Guild L. Rastaetter					•

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