Group III: Geospace Impact

A. Primary Science Questions

Science questions as they currently stand:
1. **How well can we characterize and predict SEPs and their impact on near-Earth space and the atmosphere?**
2. **What is the relationship between SEPs and the energetic particles in the magnetosphere?**
3. **How is SEP access to the inner magnetosphere determined during the transient phase?**
4. **How are SEPs trapped and subsequently lost in the inner magnetosphere?**
5. **What correlations are there between definable SEP parameters and corresponding effects on the atmosphere, geospace, technological systems?**

There is a proposal to restate our science questions as follows (not prioritized):
1. **What is the relationship between SEPs and the energetic particles in the magnetosphere?**
2. **How is SEP access to the inner magnetosphere determined during the transient phase?**
3. **How are SEPs trapped and subsequently lost in the inner magnetosphere?**
4. **What correlations are there between definable SEP parameters and corresponding effects on the atmosphere and is there a predictive capability?**
5. **What correlations are there between definable SEP parameters and corresponding effects on technological systems/human flight?**

We believe the former question #1, is an overarching question relevant to all the groups. The first part of the question being better assigned to Groups I and II and the second part of the question embodied in the re-stated Group III questions 1, 4 and 5.

Please send in your comments regarding this proposal so we can go into the workshop with a good understanding of our goal. To those of you present when we discussed this re-statement of the questions, please check that I represented our conclusions correctly.

B. Known Participation, in no particular order:

Because many of us haven't worked together before, the purpose here is to give everyone an idea of who each member is and what their interests during the workshop are. Please send in additions and corrections to what I have here.

Mary K. Hudson and Paul Haines/ Dartmouth College (mary.hudson@dartmouth.edu and paul.m.haines@dartmouth.edu) – formation of new ion belts through radial diffusion, simulation of events including **SEP proton (and Fe) trapping simulations** using MHD fields

Joseph E. Mazur, Penny Slocum, and Kirsten Lorentzen (not attending)/ The Aerospace Corporation (joseph.mazur@aero.org and penny.l.slocum@aero.org) – **Impulsive injection of SEP ions at low L**: Observations of MeV ion injections connected with several solar energetic particle events in 1997, 1998 and 2000, Polar and Sampex observations of new MeV ion radiation belts connected with several solar energetic particle events in 1998 and 2000, and **Variability of SEP access in the polar caps.**

Barbara Giles / NASA GSFC (barbara.giles@gsfc.nasa.gov) **Connection between SEP events and storms**, looking at the global magnetosphere state for clues to the differences between events, characterization of seed populations and wave activity.

Matthew Deland/ SSAI (matt_deland@sesda.com) – SEP impact on the atmosphere

Janet Barth/NASA GSFC (janet.l.barth@gsfc.nasa.gov) – The transition of science research and models to applications

Ron Turner / ANSER (ron.turner@anser.org) - SEPs and humans in space

Allan Tylka / NRL (allan.tylka@nrl.navy.mil) – World-wide grids of geomagnetic cutoffs for range of disturbance levels; Allan is also an organizer for Group II: SEP Physics

Michael Xapsos / NASA GSFC (mxapsos@pop500.gsfc.nasa.gov) – Statistical distribution of energy spectra of solar particle event ions, geomagnetic cutoff of ions, statistical distribution of trapped proton energy spectra.

TBD Participation:
Martin Birch/ Centre for Astrophysics, University of Central Lancashire (mjbirch@uclan.ac.uk)
David Sibeck / NASA GSFC (david.sibeck@gsfc.nasa.gov)

C. Known data activities, at workshop or immediately available:
HEO & Polar protons versus L-shell (Mazur, Slocum and Lorentzen)
SAMPEX ion composition versus L (Mazur, Slocum and Lorentzen)
SAMPEX and ACE Energy spectra (Mazur, Slocum and Lorentzen)
SAMPEX ion rates & Fluxes for Polar cap access study (Mazur, Slocum and Lorentzen)
Polar, Geotail, and IMAGE information on Global magnetosphere state (Giles)
SBUV/2 upper stratospheric ozone data for 7-day window bracketing each event (Deland)
Linear energy spectrum for 2001/11/04 event (Xapsos)
Database of spacecraft anomalies (Barth: Chris Balch/NOAA)
UARS HALOE ozone, NO, NO2 data (Deland)

D. Known modeling resources to be brought along:
Aerospace software that traces particles trajectories in model fields (Mazur et al)
Dartmouth SEP proton and FE trapping simulations using MHD fields (Hudson et al)
Perhaps, Lemaire's extension of Stoermer's calculation that includes IMF (Hudson)
Stuart Huston's trapped proton model (Barth and Xapsos)
Rob Decker and C. Paranicas web tools for a predictive cutoff latitude model (Barth and Xapsos)
Results of the Shea, Smart, Boberg model for geomagnetic cutoffs (Tylka)
Code for the propagation of solar wind properties to a nominal magnetopause (Giles)

E. Proposed Plans of Attack:

It appears that few, if any, of the Group III participants have ever participated in a CDAW before. That means, then, that we have "fresh eyes" and can be completely creative regarding what we do and how we go about it.

Following are some of the ideas that have been discussed thus far. The ideas appear to fall into three broad categories that I've named "Focus on the Interfaces", Statistical Studies and Event Studies. Please contribute more, we'll get them circulated, and we'll all have a chance to think about the suggestions before arriving. One of our first tasks will be to discuss the approaches and formulate a more structured plan that we all understand and can agree to work to.

Focus on the Interfaces: We'd like to keep the cross-disciplinary aspect of LWS and of our particular group at the forefront of our plans. Although each of us will be working in our particular area of expertise, one of our goals should be to produce results and data products that will be of use to the other group members. For example, what do the atmospheric impact folks need from the radiation belt/magnetosphere folks in order to make progress on model development? Do they need observational and/or modeled maps of particle precipitation for specific events? Can the radiation belt/magnetosphere folks do that while investigating the detailed processes underlying the trapping and loss of energetic protons? Identifying these types of cross-fertilization activities will be a priority task. Please come prepared with requests and offers in this direction.

Statistical Studies: Next, our science questions 1, 4 and 5 (new numbering system) suggest that statistical methods be applied to all 48 CDAW events. Currently I'm including what might be called "model validation" studies in this category. Regardless, we'll want to be efficient in gathering those data parameters that allow these statistical studies to be done without our getting too bogged down in data analysis issues. Each group member should consider, from their science perspective, what data parameters will be needed. Those that need to come from CDAW groups I and II should be identified immediately so that we can present our requirements early in the workshop. Statistical studies identified so far are:

a. Define a set of large-scale parameters that uniquely characterize each solar energetic particle event and are relevant for atmospheric responses.

b. Quantify relationships between SEP parameters and atmospheric response (e.g. linear dependence, exponential dependence, minimum threshold and/or saturation level if any).

Event Studies: Science questions 2 and 3 (new numbering system) appear ripe for more detailed event studies. We'll want to take care to chose events, from the CDAW 48, that will bring the most benefit across the range of problems to be studied. For example, there are certain events associated with important space asset failures, events associated with the formation of ion belts in the slot region, and events associated with strong variations in the ozone levels. In our first organizational session, we'll need to list the favored events and why, identify those with the potential to benefit all parties, and produce a priority list on which to expend our greatest efforts. If you can, please send in a prioritized list of those events you already know are important to your science issues (see below for what we have so far). Some event studies identified so far are:

a. Compare SAMPEX proton energy spectra to Huston trapped proton model

b: impulsive injection of SEP ions at low L

c: variability of SEP access in the polar caps

Event List A: important from the technology side:	Event List B:	List C:
2001/11/04		
2001/09/24		
2000/07/14		
2000/11/08		
2001/03/29		
2001/04/15		

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