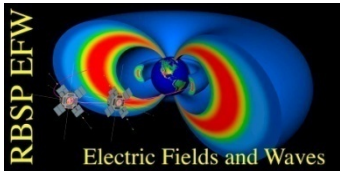


Van Allen Probes

GEM Workshop 2014
NASA Van Allen Probes
Electric Fields and Waves Instrument (EFW)
Data Access Outreach

John Bonnell
UCB SSL
jbonnell@ssl.berkeley.edu

Outline:

- **Science – Great Stuff Out of EFW (check out Wygant et al. poster, this session1**
- **Data Products – New/Improved products since GEM-2103, MiniGEM/AGU 2013.**
- **Data Access – SPEDAS/TDAS and example cribs.**

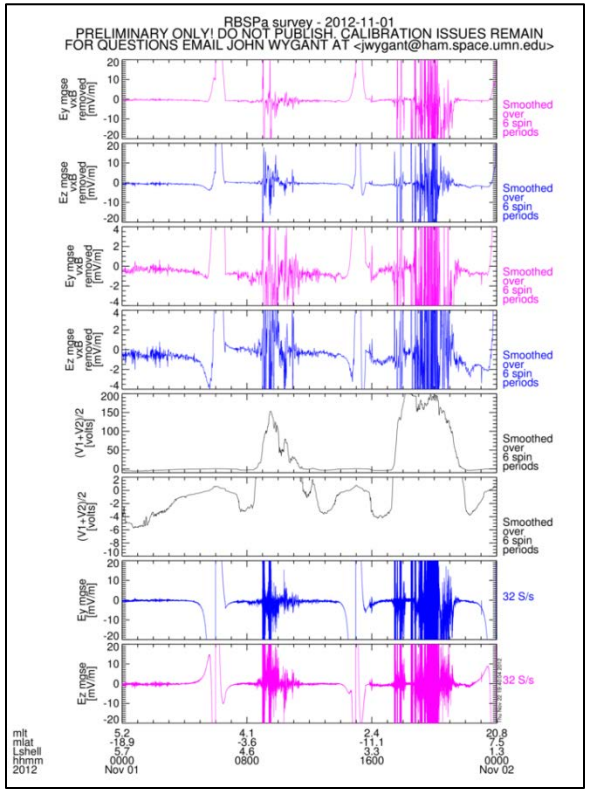
Acknowledgements:

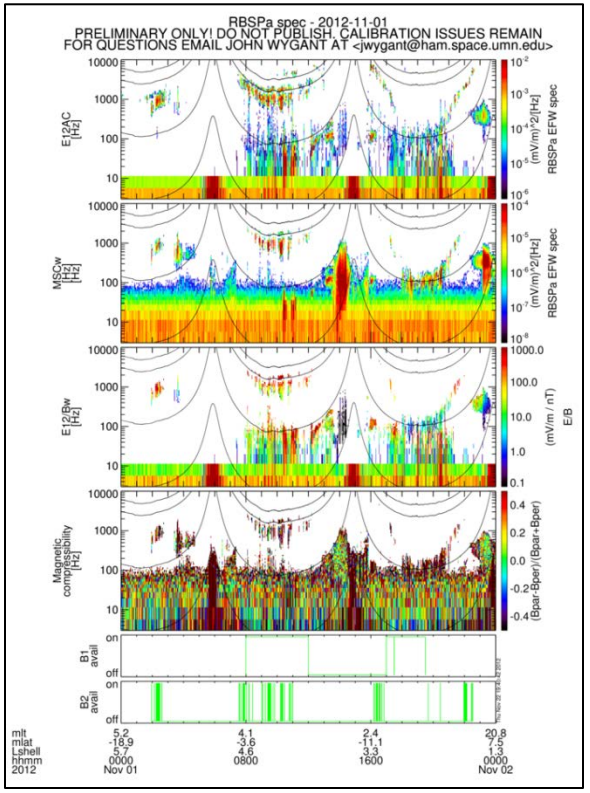
- **Will Rachelson, Aaron Breneman, Kris Kersten, Dai Lei, Jianbao Tao, John Wygant, Forrest Mozer, Jack Vernetti, Peter Schroeder, Jim McTiernan.**
- **TDAS/SPEDAS development Team:**
  - **UCB: D King (ret), J Lewis, J McTiernan, B Sadeghi.**
  - **UCLA: P. Cruce, C. Russell, A. Flores, L. Philpott, V Angelopoulos.**

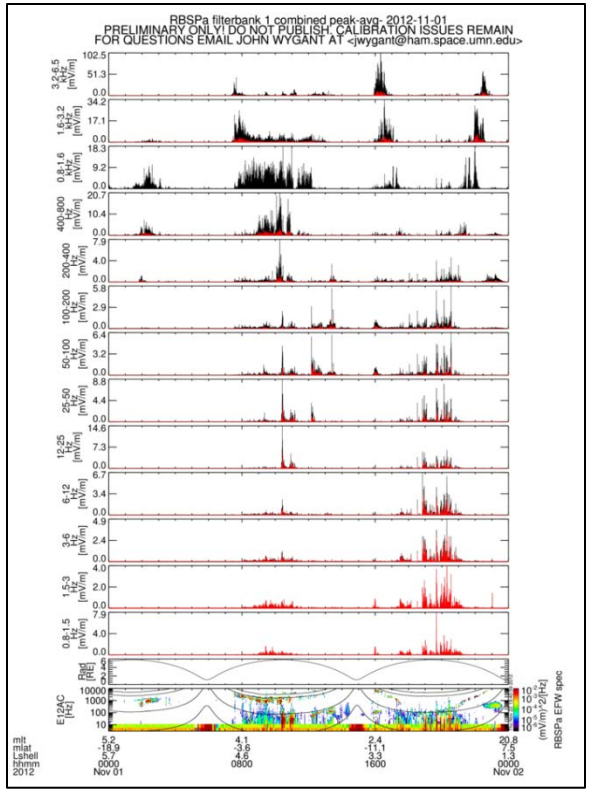
EFW Data Access
L2 Summary Plots and CDFs

- **Daily QuickLook Summary plots and ISTP-Compliant L2 CDFs of EFW data available via UMN and CDAWeb:**
  - http://www.space.umn.edu/missions/rbspefw-home-university-of-minnesota/
  - http://www.space.umn.edu/rbspefw-data/
- **Summary Plots include:**
  - Waveforms (E, Vsc)
  - Spectra (FFT Spectra, High-Rate FilterBanks)
  - Supporting Data (Position, Kyoto Dst, etc.)
- **L2 CDFs include:**
  - 2D Spinfit (~11-s) and despun (32 samp/s) E-field in M-GSE (corotation frame!).
  - Sensor potentials and Vsc (16 samp/s).
  - Peak and Avg Filter Bank (8 samp/s, 2 channels).
  - FFT Power Spectra (1/8 s, 4 channels).
- **"Caveats and Helpful Hints" for working with the EFW data and team can be found here:**
  - http://www.space.umn.edu/rbspefw-data-policy-the-rules-of-the-road/
- **Data is processed from L0->L1->L2 within 1-2 days of acquisition for survey waveform and spectral data.**
- **QL Summary Plots (quasi-L2) processed using predicted attitude and ephemerides (STATE) and polished up over time (1-2 weeks) with definitive STATE as well as L3 EMF-MAG (VxB subtraction).**
- **Full access to L1->L2 processing for general use (IDL/SPEDAS, SDT) is dependent upon public attitude and ephemerides data, which comes available about 1 week after data acquisition.**

EFW QuickLook Summary Plots Examples







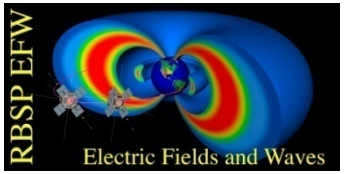
EFW QuickLook Summary Plots Access

- **EFW QuickLook (QL) Summary Plots available via the following URL:**
  - http://rbsp.space.umn.edu/survey/

- **Caveats:**
  - The QL Summary plots represent PRELIMINARY L2 data products.
  - The data depicted in the plots may contain known and unknown systematic errors which include: saturation during charging events or eclipse; inappropriate sensor bias; spin phase errors during or around eclipse; offsets and scale factor errors due to variations in plasma conditions from nominal; etc.

- **Suggested Rules of the Road for use of EFW QL Summary Plots:**
  - They should not be used in publications.
  - They should not be used in talks or other presentations until vetted by the EFW PI (John Wygant, jwygant@fields.space.umn.edu) or his designate.
  - It is suggested that one contact the EFW PI prior to starting any significant analysis utilizing the QL Summary Plots so that the data can be vetted, and one can collaborate with any members of the EFW team that are working along the same or similar lines of investigation.
  - It is also suggested that one acknowledge of the EFW PI (Wygant) in any talk or presentation that utilizes the QL Summary plots.

EFW via SPEDAS (TDAS)
Acquiring and Setting Up SPEDAS



- **Eventually, the EFW routines will be part of the normal SPEDAS distribution available via this URL: http://themis.ssl.berkeley.edu/software.shtml.**
- **Now, the most rescent and up to date EFW package is available via the latest "bleeding edge" SPEDAS software release via this URL: http://themis/ssl.berkeley.edu/socware/bleeding_edge/thmsw_latest.zip.**
- **CAVEAT: Bleeding edge is a nightly build, and has not been fully QA tested. There will be bugs and feature changes over time.**

- **SPEDAS is a package built to run in IDL; it is tested against IDL 6.4-8.x, and makes extensive use of the TPLOT libraries in IDL developed and refined over many past missions (WIND, FAST, STEREO, Cluster, THEMIS/ARTEMIS, etc.).**

- **To support the SPEDAS and EFW packages, patches a/o supporting libraries (dlm/dll or .so) for CDF, SPICE and GEOPACK are required:**
  - http://cdf.gsfc.nasa.gov/
  - http://naif.jpl.nasa.gov/naif/toolkit_IDL.html
  - http://dysprosium.jhuapl.edu/idl_geopack/ or http://themis.ssl.berkeley.edu/beta/software.shtml.

- **The process required to add the SPICE and GEOPACK support is described in README.txt files in the "external/IDL_GEOPACK" and "external/IDL_ICY" directories of the SPEDAS distribution.**

- **Initial contact points for issues/questions:**
  - TDAS: Lewis (jwl@ssl.berkeley.edu).
  - EFW TDAS: Bonnell (jbonnell@ssl.berkeley.edu), Schroeder (peters@ssl.berkeley.edu).

EFW via SPEDAS (TDAS)
Acquiring and Setting Up SPEDAS (2)

- **GEM-2014 Outreach distribution (./EFW on memory stick):**
  - This file in PDF format (RBSP-EFW-2014-06-GEM-VAP Data Outreach-revA.pdf).
  - Recent (04 Jun 2014) SPEDAS bleeding edge release.
  - CDF, ICY, and GEOPACK distributions.
  - Supporting EFW and MOC Data Products for short introductory tutorial.

- **Copy ./EFW/data to C:/data (or equivalent for unix/mac platforms).**
- **Copy ./EFW/SPEDAS to your IDL home folder.**
- **Open and install the CDF package (minimum needed for demo).**
- **Open and install the ICY and GEOPACK packages at your leisure.**
- **Try the “mini-gem” demo crib, cutting and pasting from it into your IDL command line.**

- **Stop at the comment line showing STOP – beyond this point various SPICE attitude and ephemerides files will be needed which are not included in the supporting data distribution.**

EFW Data Products

Data Product	Notes	Coverage	Analogous THEMIS Data Product (and coverage)
E_SVY	32 samp/s; EDC12, EDC34, EDC56 (U,V, W)	Continuous	EFF (<50%)
V_SVY	16 samp/s; V1..V6.	Continuous	VAF (<50%)
MAG_SVY	64 samp/s; MAG U, V, W (disabled).	Contingency for EMFISIS-MAG	FGM
FBK	Filter Bank; 1 channel, 13 bins, pk and avg, 1/8-s cadence; E12DC (U).	Continuous	FBK
SPEC	FFT Power Spec; 7 channels, 8-s cadence; 10% df/f (64 bins); E12AC (U), E56AC (U), SCM U,V,W	Continuous.	FFT
XSPEC	FFT Cross Spec; 2 channels, 8-s cadence.	Continuous.	None.
E, B Spin Fit	10.9-s (spin period) cadence; E12DC (U), MAGU.	Continuous.	EFS, BFS
Burst1	512 samp/s: EDC, V1..V6, SCM.	7.5% (~1.8 hr/day, or 40 min/orbit)	PBurst - EFP, VAP, SCP.
Burst2	16384 samp/s: V1AC..V6AC.	0.1% (~80 s/day, or ~30 s/orbit).	Wburst – EFW, VAW, SCW.
Housekeeping	Various rates; Instrument SOH, Burst Memory Parameters, etc.	Continuous	HSK

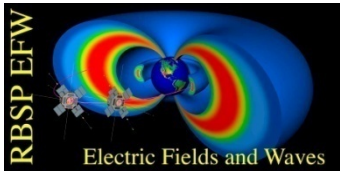
EFW TDAS Data Access

Access Routine	Quantities Accessed	Analogous THEMIS Access Routine
RBSP_EFW_LOAD_WAVEFORM	E_SVY, V_SVY, MAG_SVY; EB1, VB1, MSCB1; EB2, VB2, MSCB2.	THM_LOAD_EFI
RBSP_EFW_LOAD_FBK	FBK.	THM_LOAD_FBK
RBSP_EFW_LOAD_SPEC	SPEC.	THM_LOAD_FFT
RBSP_EFW_LOAD_XSPEC	XSPEC.	n/a.
RBSP_EFW_LOAD_FIT	E, B Spin Fit.	THM_LOAD_FIT.
RBSP_EFW_LOAD_HSK	Housekeeping.	THM_LOAD_HSK (EFI only).
RBSP_LOAD_EMFISIS	EMFISIS L2 MAG, WFR, and HFR data products.	THM_LOAD_FGM
RBSP_LOAD_{other instruments}	Public L2 data from other instruments (RBSPICE, HOPE, MagEIS, REPT, RPS) (not yet implemented)	

EFW via TDAS
Running TDAS

- **Live Demo Here using the batch file:**
  {SPEDAS_HOME}/idl/general/missions/rbsp/efw/examples/mini_gem_crib.pro
- **The relevant ISTP-Compliant CDFs are fetched from remote sites or from local directories (this demo uses pre-loaded data).**
- **The contents are converted to TPLOT variables, which can then be plotted on a common time axis, various plotting options manipulated, the time series waveforms or spectra extracted, manipulated, combined, and new TPLOT variables generated (this is how the preliminary L1->L2 processing is done for the QL Summary Plots, for example).**
- **Further example cribs can be found in *{SPEDAS_HOME}/idl/general/missions/rbsp/efw/examples*:**
  - Waveform (load, VxB subtraction, E dot B = 0, transform to B-field aligned coordinates.)
  - Spectral data (FilterBank, FBK; FFT auto- and cross-spectra)
  - Burst data management.

- **Note: {SPEDAS_HOME} stands for: {IDL_HOME}/SPEDAS/spdsw_latest/spdsw_r15307_2014-06-04, where {IDL_HOME} is the folder into which you copied the SPEDAS package earlier.**



Backup Slides

Mission Overview – Instruments Data Products

ISTP-Compliant CDFs Accessed via IDL/TDAS

Data Level	ECT	EFW	EMFISIS	RBSPICE	RPS
L0	Raw Telemetry (Raw de-commutated telemetry received from MOC)	Raw Telemetry (Raw de-commutated telemetry received from MOC)	Raw Telemetry (Raw de-commutated telemetry received from MOC)	Raw Telemetry (Raw de-commutated telemetry received from MOC)	Raw Telemetry (Raw de-commutated telemetry received from MOC)
L1	Count Rates (Sorted time tagged instrument separated counts per second)	Time Tagged Raw waveform and spectral data (Expressed in spinning spacecraft coordinate system)	Time series and spectra (relative amplitudes); burst data Calibrated Magnetic Field values (Calibrated and corrected physical units)	Count Rates (Sorted time tagged instrument separated counts per second)	Energy/Photon deposits, singles and coincidence rates (Time tagged in UTC, magnetic field vector, minimal magnetic coordinates)
L2	Calibrated Flux (Calibrated and corrected physical units)	Calibrated Waveform and Spectral Data (In despun spacecraft coordinate system and other relevant geophysical Systems)	Spectral Quantities (Calibrated and corrected physical units); Includes low frequency spectra from MAG	Calibrated Flux (Calibrated and corrected physical units)	Flux versus Energy Spectrum
L3	Pitch Angle and Moments (Pitch angle distributions and moments of the plasma distribution)	Calibrated Waveform and Spectral Data (with VxB subtraction for DC E-field estimate)	Magnetic wave parameters	Pitch Angle and Moments (Pitch angle distributions and moments of the plasma distribution)	Energy-pitch angle spectrum and magnetic coordinates
L4	Phase Space Density (PSD units in adiabatic coordinate space)	Global Electric Field Pattern	Wave propagation parameters (Spectral matrices, WNA, polarization, Poynting flux, etc) Electron densities	Phase Space Density (PSD units in adiabatic coordinate space) (PSD will be calculated for specific ring current relevant observations)	Global Maps (flux vs E/K/Phi and PSD versus M/K/Phi)

Table 4.2. Mission Level Data Products

QuickLook Summary Plots ISTP-Compliant CDFs

From RBSP SDMP, p.38.

EFW Access via SDT

The EFW waveform data products and supporting data can also be accessed and analysed via the legacy analysis package Science Data Tool (SDT).

SDT can be installed from the website:

http://sprg.ssl.berkeley.edu/~sdt/SdtReleases.html

Five platforms are currently supported:

Solaris/SPARC
Linux, 32-bit
Linux, 64-bit)
MacOSX, 32-bit (Leopard or above)
MacOSX, 64-bit (Lion or above)

Corresponding to each platform is an "INSTRUCTIONS" guide on the webpage, which indicate how to install SDT and set up for various supported projects: FAST, POLAR-EFI, CLUSTER-EFW, THEMIS-EFI, RBSP-EFW. Once installed, instructions on how to get started using SDT are in the text document:

sdt_installation_directory/docs/SdtUse

Jack Vernetti (jackv@ssl.berkeley.edu) and Forrest Mozer (fmozer@ssl.berkeley.edu) are the primary points of contact for questions of SDT support and applications.