COMBINED RELEASE AND RADIATION EFFECTS SATELLITE (CRRES) EXPERIMENTS DATA COLLECTION, ANALYSIS, AND PUBLICATION

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CONTRACTOR REPORT

COMBINED RELEASE AND RADIATION EFFECTS SATELLITE (CRRES) EXPERIMENTS DATA COLLECTION, ANALYSIS, AND PUBLICATION

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16. ABSTRACT

Combined Release and Radiation Effects Satellite (CRRES) program experiments data collection, analysis, and publication activities are described. These activities were associated with both the satellite chemical releases and a planned Puerto Rico sounding rocket campaign. To coordinate these activities, a working group meeting was organized and conducted.

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TABLE OF CONTENTS

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ACKNOWLEDGEMENTS

The authors gratefully acknowledge the cooperation encountered in collecting, analyzing, and publishing data. These data were provided by all Principal Investigators associated with the CRRES program. Presentation of summary data in this report should not imply any claims on origination of the data.

The services provided by Mr. Morgan McCook are also gratefully acknowledged. His consulting services were critical to successful performance of this effort. In addition, conversations with MSFC personnel at various points in time during this investigation were both helpful and quite insightful.

PREFACE

This technical report was prepared by the University of Alabama in Huntsville Research Institute. This is the final report of technical work performed under contract number NAS8-~~36955~~ 38609, Delivery Order Number 11.

The principal investigator was Terry N. Long, Associate Director of the UAH Research Institute. Most of the technical work was performed by Melanie O. Alzmann of the UAH Research Institute and Mr. Morgan McCook acting as an independent consultant. Mr. Clarence Gearhart of the Institutional Control Branch, Assistant Director for Management Office, Science and Engineering Directorate, Marshall Space Flight Center, NASA was the technical coordinator.

The views, opinions and/or findings contained in this report are those of the authors and should not be construed as an official MSFC position, policy, or finding unless so specified by other MSFC/NASA documentation.

Except as may be otherwise authorized, this report and its findings require MSFC approval before release to third parties.

Approval: ______________________

INTRODUCTION

The University of Alabama in Huntsville Research Institute has participated in the CRRES Program since May 1989 with various data management, scheduling, configuration management, and working group coordination and participation functions. Investigator working group meetings have been conducted at the many strategic locations, planned and arranged by the Research Institute. The CRRES satellite assembly, launch, and chemical releases have been documented on film and video tape. The CRRES sounding rockets have been filmed and video taped during their development and testing. Additionally, the Research Institute has worked closely with the CREES project office by keeping it continuously aware of schedules and achievements and by assisting in both information gathering and research data collection.

This delivery order concentrated on experiments data collection, analysis, and publication activities. These activities were associated with both the satellite chemical releases and a planned Puerto Rico sounding rocket campaign. To coordinate these activities, a working group meeting was organized and conducted.

SUMMARY

Contact with the satellite was lost on 12 October 1991. Ball's summary description of the event is provided in Appendix A. For completeness, a summary of CRRES chemical releases information is provided in Appendix B. This includes a summary table and detailed parameters in three additional tables. The first detailed parameter table is the time and location of each release. The second detailed parameter table gives the chemical makeup of each canister. And the third set of tables is a listing of the orbital elements associated with each release.

An Investigators Working Group meeting was conducted 27-29 October 1991 at Goddard Space Flight Center in Greenbelt, MD. Documentation of the meeting activities was accomplished and distributed to the CRRES project office. An agenda of the meeting is included in Appendix C along with an attendees list. To support this meeting, several preparatory meetings were required in Washington, D.C.

Most of the data gathered during this effort was gathered in conjunction with the 27-29 October 1991 Working Group meeting. The format of CRRES Release Experiment Summaries and a sample summary are provided in Appendix D. A listing of the packages of data acquired and being held by the University of Alabama in Huntsville is provided in this report's bibliography.

Working sessions were performed at Wallops Flight Facility with mechanical technicians and payload managers to develop requirements for a sounding rocket campaign to be held by the CRRES program in the spring of 1992. A list of sounding rocket campaign requirements developed during these sessions follows:

Science Requirements Topics For A Sounding Rocket Program

Payload Requirements:	Pointing (simple & complex) Deployments (booms) Separations (ejectables) Chemical Releases Data Rates Recoverable Payloads Up-link Commands Real-Time Decision Points
Supporting Services:	Parts Modelling Testing Trajectories Logistics
Special Requirements:	In-situ Measurements vs. Remote Sensing Students Launch Windows Launch Criteria Coordinator With Satellite Instrument Development Quick Response to the Unanticipated

Working sessions were also held at Wallops Flight Facility with the sounding rocket campaign manager and electrical technicians to develop a schedule of windows for the CRRES sounding rocket campaign. A draft schedule was derived and provided to the CRRES Project Scientist. This prelimary schedule is included in Appendix E.

CONCLUSIONS AND RECOMMENDATIONS

The CRRES Program completion will be an exciting achievement for both NASA and the University of Alabama in Huntsville. Plans are underway for The Sounding Rocket Campaign in Puerto Rico. It is recommended that any additional scopes of work that may be developed for future phases of the CRRES program be directed to the UAH Chemistry Department with George Miller designated as the Principal Investigator. To support this, the Research Institute's Senior Research Project Coordinator familiar with the CRRES program will be transferred to the Chemistry Department to provide continuity with any future delivery orders.

An excellent opportunity for student involvement exists to aid in the collection of research data from the CRRES chemical releases. Additionally, student involvement is encouraged in future documentation of CRRES achievements and execution of working group meetings.

The planned sounding rocket launches in Puerto Rico have renewed the need for close coordination between Principal Investigators, NASA staff, and the CRRES Project Office. Hopefully, the University of Alabama in Huntsville will be given the opportunity to provide a key role in the renewed CRRES program.

BIBLIOGRAPHY

1. Reference of Initial Results of Research in Coordination with the CRRES Project, Geoffry Maugham, Science Applications International Corporation, Oct. 1991.
2. CRRES/LASS II/QIMS Ion Composition Measurements from the Caribbean Release Campaign, Donald E. Hunston, USAF Phillips Laboratory, Oct. 1991.
3. A Space Data Analysis and Visualization System, E. P. Szuszczewicz, Science Applications International Corporation, Oct. 1991.
4. Observations of Waves Generated by the Low-Altitude CRRES Chemical Releases, H. C. Koons and J. L. Roeder, The Aerospace Corporation, Oct. 1991.
5. LASSII Pulsed Plasma Probe, Paul Rodriguez and Mark M. Baumback, NRL, Oct. 1991.
6. CRRES Release Information Summaries, W. K. Peterson, Lockheed, Oct. 1991.
7. CRRES Release Information Summaries, Gerherd Haerendel and Dr. Arnoldo Valenzuela, MPE, Oct. 1991.
8. CRRES Release Information Summaries, Eugene M. Wescott, University of Alaska, Oct. 1991.
9. CRRES SFR/SA and MCA Data, Roger R. Anderson, University of Iowa, Oct. 1991.
10. Summary of CRRES Release Data Summaries, Mary Miller, GSFC, Oct. 1991.
11. The Irregularity Structure in the CRRES G2 Barium Release, P. A. Bernhardt and J. D. Huba, Naval Research Laboratory, Oct. 1991.
12. CRRES Satellite Status, John Kierein, Ball, Oct. 1991.

APPENDICES

Appendix A

Ball's Satellite Status Report Summary

CRRES STATUS

LAST GOOD CONTACT WITH CRRES WAS OCTOBER 12, 1991 AT 1010-1025 GMT.

NO RESPONSE AT 1200-1250 GMT.

SHORT (2-3 MINUTE) TRANSMITTER SIGNALS WERE HEARD ON OCTOBER 16 AND 17.

NO RESPONSE SINCE.

PROBABLE CAUSE IS A BATTERY SHORT.

IF SPACECRAFT IS UNDERVOLTAGE IT IS PROBABLY VERY COLD, BUT IT SHOULD WARM UP BY MID-NOVEMBER TO EARLY DECEMBER.

ATTEMPTS TO CONTACT ARE CONTINUING.

Appendix B

CRRES Release Information Summaries

CRRES SATELLITE CHEMICAL RELEASE EXPERIMENTS

EXPERIMENT	Release Number	HOLE #	RELEASE CMD#	CANISTER TYPE and CHEMICAL	CHEM. WT (LBS)	EJECT ** WT. (LBS)	RELEASE LOCATION	RELEASE TIMER	RELEASE PERIOD	OBSERVATIONAL SUPPORT
High-Altitude Magnetospheric										
Diamagnetic Cavity, Plasma Coupling	G-2	37	6	Small Ba,2% Sr	7.54	19.29	North America, 1.8 Re	25 MIN	N. Hemisphere Winter,90-91 moon down, releases in sunlight ground in darkness	Northern Canada-NASA DC-8 and AFGL KC-135 South America-Argentine 707 Ground sites in both Northern and Southern Hemispheres
	G-3	16	11	Small Ba,2% Sr	7.51	19.27	North America, 3.5 Re	25 MIN		
	G-4	13	3	Small Ba,2% Sr	7.47	19.22	North America, 5.5 Re	25 MIN		
Stimulated Electron Precipitation/ Aurora Prod.	G-5	17 41	18	Large Li,3% Eu Large Li,3% Eu	20.33 20.33	45.09 45.09	North America, >6.0 Re	25 MIN 25 MIN	N. Hemisphere Winter,90-91 moon down 0000-0200 LT	Same as G-2,-3,-4 with addition of Millstone radar(foot of field)
Stimulated Ion-Cyclotron Waves and Ion Precipitation	G-6	24 48	8	Large Li,3% Eu Large Li,3% Eu	20.33 20.30	45.09 45.02	North America, >6.0 Re	25 MIN 25 MIN	N. Hemisphere Winter,90-91 moon down 2200-2400 LT	Same as G-2,-3,-4 with addition of Millstone radar(foot of field)
Ion Tracing and Acceleration	G-7	22 46	22	Large Li,3% Eu Large Li,3% Eu	20.28 20.39	45.09 45.11	North America, >6.0 Re	25 MIN 25 MIN	N. Hemisphere Winter,90-91 moon down 2000-0200 LT	Same as G-2,-3,-4 with addition of Millstone radar(foot of field)
Stimulating Magnetospheric Substorm	G-10	21 45	2	Large Ba,2% Sr Large Ba,2% Sr	27.77 26.76	51.53 51.57	North America, >6.0 Re	25 MIN 25 MIN+5sec	N. Hemisphere Winter,90-91 moon down 0000-0200LT	Same as G-2,-3,-4
Caribbean Perigee										
Gravitational Instability, Field Equipotentiality	G-8	*19 *43	19	Large Ba,2% Sr Large Ba	26.79 26.77	51.60 51.53	Field line pass thru Jicamarca,Peru (Grand Cayman Is.) 450-800 km	25 MIN 25 MIN	N. Hemisphere Summer,91 moon down,dawn	NASA DC-8 and Argentine 707 ground sites in Ecuador, Dom. Rep. Jicamara radar,
Field Line Tracing and Equipotentiality, Momentum Coupling	G-9	*23 *47	23	Large Ba,4% Li Large Ba,4% Li	27.69 26.77	52.50 51.53	Caribbean latitudes 450-800 km	25 MIN 25 MIN	N. Hemisphere Summer,91 two successive moon down periods	NASA DC-8 and AFGL KC-135 in Caribbean, Argentine 707 in South America, Arecibo radar and VHF radar and ground optical sites in Caribbean and South America
	G-11A	14	4	Small Ba,2%	7.47	19.22	Caribbean latitudes 450-800 km	25 MIN		
	G-11B	38	20	Small Ba,2%	7.47	19.22	Caribbean latitudes 450-800 km	25 MIN+5 SEC		
	G-12A	15	25	Small Ba,2%	7.51	19.27	Caribbean latitudes 450-800 km	25 MIN		
	G-12B	39	24	Small Ba,2%	7.47	19.22	Caribbean latitudes 450-800 km	25 MIN+5 SEC		
Diamagnetic Cavity, Plasma Coupling	G-1	40	21	Small Ba,2% Sr	7.51	19.27	Caribbean latitudes aprox. 1900 km	25 MIN	N. Hemisphere Summer,91 moon down	
Critical Velocitiy										
Critical Velocity Ionization	G-13	20 44	1	Large Ba Large Sr	26.74 22.12	51.46 46.84	S. Pacific(American Samoa) 450-600 km	25 MIN+2.5 SEC 25 MIN	Aug. 1990 moon down,dusk	Learjet and DC-8 and ground sites in Samoa and Fiji
	G-14	42 18	14	Large Ba Large Ca	26.74 21.03	51.64 45.84	S. Pacific(American Samoa) 450-600 km	25 MIN+2.5 SEC 25 MIN	Aug. 1990 moon down,dusk	
				TOTALS	441.09	930.51				

*THESE HOLES HAVE RCU BATTERY TEMPERTURE MONITORS.
**EJECT WEIGHT INCLUDES CHEMICAL, CANISTER AND RCU, (ALL RCUs WEIGH 2.89 LB.).

Rev. 6 2/22/90

2-2757-0-55

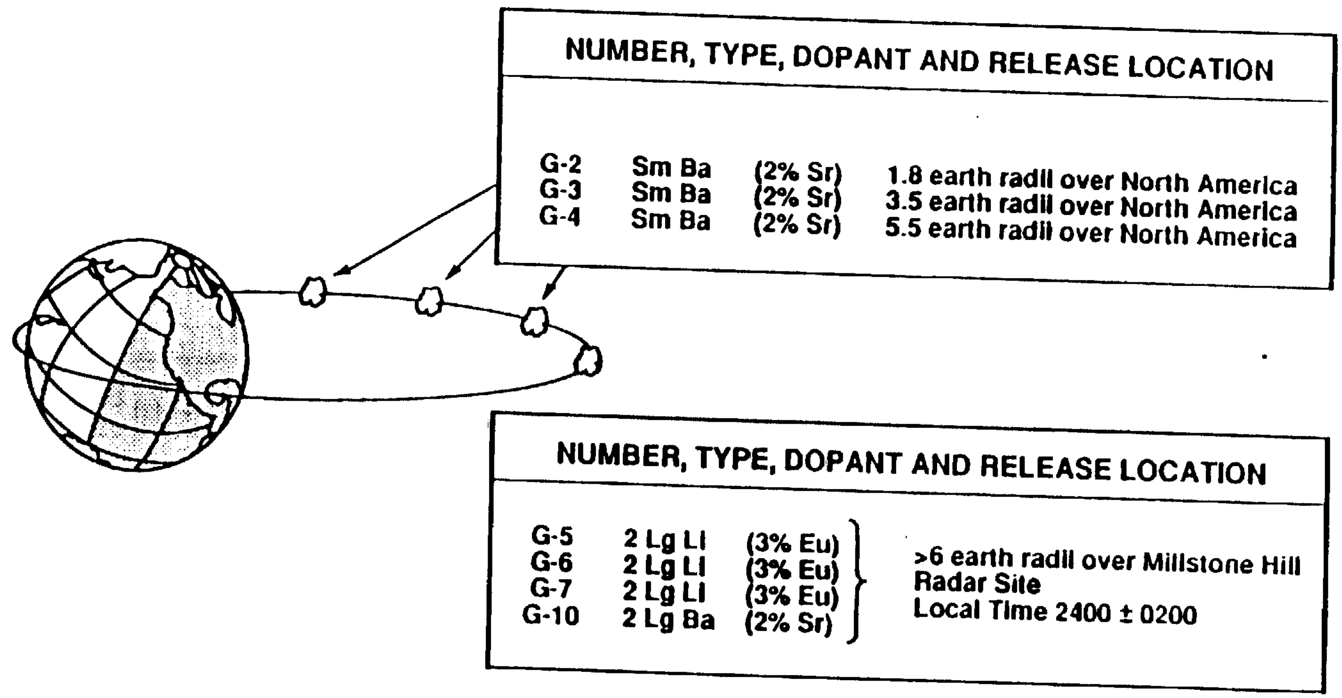

FIGURE 1-1 CRRES/GTO HIGH-ALTITUDE RELEASES

August 13, 1991 Revised 10/25/91

The following tables give the parameters of the CRRES releases.

The first table is the time and location of each release done to date. The release is identified by its "G" number, and these numbers correspond to the experiment descriptions in the science definition document.

The second table gives the chemical makeup of each canister. All chemical weights are in grams. The titanium and boron are the thermite components. We assume 100 percent vaporization efficiency of the metals, although that is still under study. Normally the canisters are ignited 24 minutes 58 seconds after ejection from the CRRES satellite. Some canisters have an additional small delay time, and this is shown in the column "DELAY."

The last set of tables is a listing of the orbital elements which are appropriate for each release. The orbital elements are Osculating Keplerian and in most cases the epoch time is very close to the time of the release. Thus they can be used to compute the satellite position and velocity at times spanning the release time with high accuracy. However, no drag terms are included and hence these elements are not useful for determining the satellite position at other times. The Mean Motion is calculated on the basis of the period between perigees before and after the element epoch time. The epoch time is Day of Year.Decimal Day format, with Day 1 = January 1.

RELEASE	DATE	TIME	LATITUDE	LONGITUDE	ALTITUDE
G-13	09/10/90	06:10:25	17.5 S	198.9 E	517
G-14	09/14/90	08:47:10	18.1 S	161.6 E	593
G-02	01/13/91	02:17:03	16.9 N	103.1 W	6180
G-07	01/13/91	07:05:00	8.0 N	86.7 W	33403
G-03	01/15/91	04:11:00	17.9 N	97.5 W	15053
G-04	01/16/91	06:25:00	0.7 S	53.8 W	23977
G-05	01/18/91	05:20:00	6.6 N	62.8 W	33337
G-10	01/20/91	05:30:00	8.9 N	75.6 W	33179
G-06	02/12/91	04:15:00	4.9 N	76.1 W	32249
G-08	02/17/91	03:30:00	0.4 N	58.1 W	33553
G-01	07/13/91	08:35:25	17.8 N	62.9 W	495
G-09	07/19/91	08:37:07	17.4 N	62.8 W	441
G-11a	07/22/91	08:38:24	16.8 N	60.3 W	411
G-11b	07/25/91	08:37:11	17.3 N	69.5 W	478
G-12	08/12/91	09:31:20	9.1 N	63.5 W	507

CANISTER	TI (GMS)	B (GMS)	BA (GMS)	SR (GMS)	LI (GMS)	EU (GMS)	CA (GMS)	DELAY (SEC)
G-1	1269	572	1468	19				NONE
G-2	1269	572	1468	19				NONE
G-3	1270	574	1471	19				NONE
G-4	1271	574	1471	19				NONE
G-5A	5770	2605			457	299		NONE
G-5B	5770	2605			457	299		NONE
G-6A	5770	2604			457	299		NONE
G-6B	5767	2603			457	299		NONE
G-7A	5768	2603			457	299		NONE
G-7B	5768	2603			457	299		NONE
G-8A	4556	2056	5410					NONE
G-8B	4282	2068	5304	67				NONE
G-9A	4692	2118	5202		11			NONE
G-9B	4693	2118	5203		11			NONE
G-10A	4584	2069	5306	67				NONE
G-10B	4583	2069	5305	67				5.0
G-11A	1270	573	1371	19				NONE
G-11B	1270	573	1471	19				5.0
G-12A	1271	573	1471	19				NONE
G-12B	1271	574	1471	19				5.0
G-13A	4254	1920		3784				NONE
G-13B	4554	2055	5408					2.5
G-14A	5214	2353					1891	NONE
G-14B	4554	2056	5409					2.5

The following are the sets of orbital elements for each release.

G-13 ;	the satellite name string
EPOCH 9/09/90: 9/10/90 RELEASE;	element set description
1990;	the epoch year (YYYY)
253.25763888;	the epoch day (DDD.dddd)
18.2296 ;	orbital inclination (degrees)
28.2984 ;	right ascension (degrees)
.7114725 ;	eccentricity
234.8666 ;	argument of perigee (degrees)
0. ;	mean motion (orbits/day)
2.5610 ;	mean anomaly (degrees)
23396.02031 ;	semi-major axis (km)
0. ;	decay (ndot2 orbits/day**2)
0;	decay flag (0=no, 1=yes)
0. ;	beacon frequency (MHz)
113 ;	orbit number at epoch
0;	orbit base (0=perigee, 1=equator)
0. ;	nddot6 or Bahn latitude
0. ;	drag or Bahn longitude
0;	0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-14 ;	the satellite name string
EPOCH 9/14/90: 9/14/90 RELEASE;	element set description
1990;	the epoch year (YYYY)
257.36597222;	the epoch day (DDD.dddd)
18.2378 ;	orbital inclination (degrees)
26.6383 ;	right ascension (degrees)
.7114072 ;	eccentricity
237.9930 ;	argument of perigee (degrees)
0. ;	mean motion (orbits/day)
2.5989 ;	mean anomaly (degrees)
23395.94276 ;	semi-major axis (km)
0. ;	decay (ndot2 orbits/day**2)
0;	decay flag (0=no, 1=yes)
0. ;	beacon frequency (MHz)
123 ;	orbit number at epoch
0;	orbit base (0=perigee, 1=equator)
0. ;	nddot6 or Bahn latitude
0. ;	drag or Bahn longitude
0;	0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-02;	the satellite name string
CSTC PRED. ELEM. FOR 01/13/90 ;	element set description
1991;	the epoch year (YYYY)
13.000000000;	the epoch day (DDD.dddd)
18.22298 ;	orbital inclination (degrees)
337.06439 ;	right ascension (degrees)
.713171 ;	eccentricity
330.15473 ;	argument of perigee (degrees)
2.437421186 ;	mean motion (orbits/day)
295.01142 ;	mean anomaly (degrees)
23323.882194;	semi-major axis (km)
.000044028 ;	decay (ndot2 orbits/day**2)
1;	decay flag (0=no, 1=yes)
0. ;	beacon frequency (MHz)
417 ;	orbit number at epoch
0;	orbit base (0=perigee, 1=equator)
0. ;	nddot6 or Bahn latitude
0. ;	drag or Bahn longitude
2;	0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

```
G-03;                                the satellite name string
CSTC PRED ELEM 01/15/90         ;    element set description
1991;                                the epoch year (YYYY)
15.000000000;                        the epoch day (DDD.dddd)
18.21785    ;                        orbital inclination (degrees)
336.21157   ;                        right ascension (degrees)
.713304     ;                        eccentricity
331.75120   ;                        argument of perigee (degrees)
2.437483073 ;                        mean motion (orbits/day)
249.921792  ;                        mean anomaly (degrees)
23322.839359;                        semi-major axis (km)
.000047351  ;                        decay (ndot2 orbits/day**2)
1;                                   decay flag (0=no, 1=yes)
0.          ;                        beacon frequency (MHz)
422         ;                        orbit number at epoch
0;                                   orbit base (0=perigee, 1=equator)
0.          ;                        nddot6 or Bahn latitude
0.          ;                        drag or Bahn longitude
2;                                   0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-04;                                the satellite name string
CSTC PRED ELEM 01/16/90         ;    element set description
1991;                                the epoch year (YYYY)
16.000000000;                        the epoch day (DDD.dddd)
18.21381    ;                        orbital inclination (degrees)
335.70565   ;                        right ascension (degrees)
.713385     ;                        eccentricity
332.70777   ;                        argument of perigee (degrees)
2.437542213 ;                        mean motion (orbits/day)
47.39631    ;                        mean anomaly (degrees)
23323.228115;                        semi-major axis (km)
.000047874  ;                        decay (ndot2 orbits/day**2)
1;                                   decay flag (0=no, 1=yes)
0.          ;                        beacon frequency (MHz)
425         ;                        orbit number at epoch
0;                                   orbit base (0=perigee, 1=equator)
0.          ;                        nddot6 or Bahn latitude
0.          ;                        drag or Bahn longitude
2;                                   0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-05;                                the satellite name string
CSTC PRED. ELEM. FOR 01/18/91 ;      element set description
1991;                                the epoch year (YYYY)
18.0000000  ;                        the epoch day (DDD.dddd)
18.21815    ;                        orbital inclination (degrees)
334.905454  ;                        right ascension (degrees)
.714466     ;                        eccentricity
334.21920   ;                        argument of perigee (degrees)
2.437608232 ;                        mean motion (orbits/day)
2.416104    ;                        mean anomaly (degrees)
23395.485674;                        semi-major axis (km)
.000047693  ;                        decay (ndot2 orbits/day**2)
1;                                   decay flag (0=no, 1=yes)
0.          ;                        beacon frequency (MHz)
429         ;                        orbit number at epoch
0;                                   orbit base (0=perigee, 1=equator)
0.          ;                        nddot6 or Bahn latitude
0.          ;                        drag or Bahn longitude
2;                                   0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4
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G-10;                                     the satellite name string
CSTC PRED. ELEM. 01/20/91          ;      element set description
1991;                                     the epoch year (YYYY)
20.000000000;                             the epoch day (DDD.dddd)
18.20432     ;                            orbital inclination (degrees)
334.16006    ;                            right ascension (degrees)
.713371      ;                            eccentricity
335.59970    ;                            argument of perigee (degrees)
2.437681133 ;                             mean motion (orbits/day)
317.53183    ;                            mean anomaly (degrees)
23323.026156;                             semi-major axis (km)
.000047580  ;                             decay (ndot2 orbits/day**2)
1;                                        decay flag (0=no, 1=yes)
0.           ;                            beacon frequency (MHz)
434          ;                            orbit number at epoch
0;                                        orbit base (0=perigee, 1=equator)
0.           ;                            nddot6 or Bahn latitude
0.           ;                            drag or Bahn longitude
2;                                        0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-06;                                     the satellite name string
CSTC PRED. ELEM. 02/12/91          ;      element set description
1991;                                     the epoch year (YYYY)
43.00000     ;                            the epoch day (DDD.dddd)
18.129867    ;                            orbital inclination (degrees)
324.52561    ;                            right ascension (degrees)
.7136606     ;                            eccentricity
353.53687    ;                            argument of perigee (degrees)
2.438681554 ;                             mean motion (orbits/day)
345.56194    ;                            mean anomaly (degrees)
23327.493889;                             semi-major axis (km)
0.           ;                            decay (ndot2 orbits/day**2)
0;                                        decay flag (0=no, 1=yes)
0.           ;                            beacon frequency (MHz)
490          ;                            orbit number at epoch
0;                                        orbit base (0=perigee, 1=equator)
0.           ;                            nddot6 or Bahn latitude
0.           ;                            drag or Bahn longitude
2;                                        0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-08;                                     the satellite name string
CSTC PRED. ELEM. 02/17/91          ;      element set description
1991;                                     the epoch year (YYYY)
48.000       ;                            the epoch day (DDD.dddd)
18.117679    ;                            orbital inclination (degrees)
322.31765    ;                            right ascension (degrees)
.7133986     ;                            eccentricity
357.70721    ;                            argument of perigee (degrees)
2.438912855 ;                             mean motion (orbits/day)
55.377321    ;                            mean anomaly (degrees)
23313.951970;                             semi-major axis (km)
0.           ;                            decay (ndot2 orbits/day**2)
0;                                        decay flag (0=no, 1=yes)
0.           ;                            beacon frequency (MHz)
503          ;                            orbit number at epoch
0;                                        orbit base (0=perigee, 1=equator)
0.           ;                            nddot6 or Bahn latitude
0.           ;                            drag or Bahn longitude
2;                                        0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4
```

```
G-01;                                          the satellite name string
CSTC PRED. ELEM. 07/13/91        ;             element set description
1991;                                          the epoch year (YYYY)
194.35694444;                                  the epoch day (DDD.dddd)
17.803591    ;                                 orbital inclination (degrees)
261.46339    ;                                 right ascension (degrees)
.71856939    ;                                 eccentricity
109.97586    ;                                 argument of perigee (degrees)
2.333100923 ;                                  mean motion (orbits/day)
357.443896  ;                                  mean anomaly (degrees)
24066.143279;                                  semi-major axis (km)
0.           ;                                 decay (ndot2 orbits/day**2)
0;                                             decay flag (0=no, 1=yes)
0.           ;                                 beacon frequency (MHz)
857          ;                                 orbit number at epoch
0;                                             orbit base (0=perigee, 1=equator)
0.           ;                                 nddot6 or Bahn latitude
0.           ;                                 drag or Bahn longitude
0;                                             0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4
```

```
G-09;                                          the satellite name string
CSTC PRED. ELEM. 07/19/91        ;             element set description
1991;                                          the epoch year (YYYY)
200.35833333;                                  the epoch day (DDD.dddd)
17.81960     ;                                 orbital inclination (degrees)
259.03056    ;                                 right ascension (degrees)
.718913      ;                                 eccentricity
114.44400    ;                                 argument of perigee (degrees)
2.3331336850;                                  mean motion (orbits/day)
358.090177  ;                                  mean anomaly (degrees)
24068.134381;                                  semi-major axis (km)
0.           ;                                 decay (ndot2 orbits/day**2)
0;                                             decay flag (0=no, 1=yes)
0.           ;                                 beacon frequency (MHz)
871          ;                                 orbit number at epoch
0;                                             orbit base (0=perigee, 1=equator)
0.           ;                                 nddot6 or Bahn latitude
0.           ;                                 drag or Bahn longitude
0;                                             0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4
```

```
G-11a;                                         the satellite name string
CSTC PRED. ELEM. 07/22/91        ;             element set description
1991;                                          the epoch year (YYYY)
203.35902777;                                  the epoch day (DDD.dddd)
17.81660     ;                                 orbital inclination (degrees)
257.84897    ;                                 right ascension (degrees)
.71878       ;                                 eccentricity
116.63078    ;                                 argument of perigee (degrees)
2.3331727480;                                  mean motion (orbits/day)
358.44416761;                                  mean anomaly (degrees)
24069.868944;                                  semi-major axis (km)
0.           ;                                 decay (ndot2 orbits/day**2)
0;                                             decay flag (0=no, 1=yes)
0.           ;                                 beacon frequency (MHz)
878          ;                                 orbit number at epoch
0;                                             orbit base (0=perigee, 1=equator)
0.           ;                                 nddot6 or Bahn latitude
0.           ;                                 drag or Bahn longitude
0;                                             0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4
```

G-11b;	the satellite name string
CSTC PRED. ELEM. 07/25/91 ;	element set description
1991;	the epoch year (YYYY)
206.35833333;	the epoch day (DDD.dddd)
17.81109 ;	orbital inclination (degrees)
256.69219 ;	right ascension (degrees)
.718627 ;	eccentricity
118.76170 ;	argument of perigee (degrees)
2.333208031 ;	mean motion (orbits/day)
357.72630408;	mean anomaly (degrees)
24067.266292;	semi-major axis (km)
0. ;	decay (ndot2 orbits/day**2)
0;	decay flag (0=no, 1=yes)
0. ;	beacon frequency (MHz)
885 ;	orbit number at epoch
0;	orbit base (0=perigee, 1=equator)
0. ;	nddot6 or Bahn latitude
0. ;	drag or Bahn longitude
0;	0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

G-12 ;	the satellite name string
CSTC PRED. ELEM. 08/12/91 ;	element set description
1991;	the epoch year (YYYY)
224.39444444;	the epoch day (DDD.dddd)
17.82237 ;	orbital inclination (degrees)
249.44847 ;	right ascension (degrees)
.719741 ;	eccentricity
132.01506 ;	argument of perigee (degrees)
2.328208401 ;	mean motion (orbits/day)
.00164346566;	mean anomaly (degrees)
24115.815561;	semi-major axis (km)
0. ;	decay (ndot2 orbits/day**2)
0;	decay flag (0=no, 1=yes)
0. ;	beacon frequency (MHz)
927 ;	orbit number at epoch
0;	orbit base (0=perigee, 1=equator)
0. ;	nddot6 or Bahn latitude
0. ;	drag or Bahn longitude
0;	0=SSI, 1=Bahn, 2=SGP, 3=SGP4/SDP4

Appendix C

28-29 October 1991
CRRES Data Exchange Meeting
Agenda and Attendees List

AGENDA

CRRES DATA EXCHANGE MEETING

OCTOBER 28-29, 1991

MONDAY, OCTOBER 28, 1991

0900	INTRODUCTIONS AND WELCOME	ALL
0915	STATUS OF CRRES	J. KIEREIN
0930	PROGRAMMATICS FOR FY 1992	R. HOWARD
0945	CRRES SOUNDING ROCKETS	R. HOWARD
1000	COORDINATED DATA ANALYSIS CAMPAIGNS	D. REASONER
1030	ARCHIVING DATA FOR THE NSSDC	D. REASONER
1045	BREAK	
1100	REPORT FROM IZMIRAN AND HYDROMET	
1200	LUNCH	
1300	HIGH ALTITUDE CAMPAIGNS	ALL
1700	ADJOURN (WE HAVE TO OUT OF 183A BY 1730)	

TUESDAY, OCTOBER 29

0900	RECONVENE
0945	CARIBBEAN CAMPAIGNS

I WOULD ANTICIPATE THAT THINGS WILL BE CONDUCTED IN AN INFORMAL WORKSHOP FORMAT. I HAVE HEARD FROM TWO INVESTIGATORS SPECIFICALLY REQUESTING TIME FOR PRESENTATIONS.

NAME	INSTITUTION	TELEPHONE
Anderson, Roger R.	Univ. of Iowa	(319) 335-1924
Baumback, Mark	NRL	(310) 336-6519
Bernhardt, Paul A.	Naval Research Lab	(202) 767-0196
Blanchard, Paul	SAIC	(703) 556-7108
Eastwood, Charles	NASA HQ/SS	(202) 453-1514
Fritz, Ted	Los Alamos Nat. Lab	(505) 667-9234
Greene, Emily	Hughes STX	(301) 286-1085
Heppner, Jim	STX	(301) 794-5188
Hoffman, Bob	GSFC	(301) 286-7386
Howard, Lt. Tim	USAF	(213) 363-6756
Huba, Joe	NRL	(202) 767-3630
Hunton, Donald E.	USAF Phillips Lab	(415) 424-3287
Johnson, Judy	GSFC	(202) 767-2248
Kierein, John	Ball Space Systems Div	(303) 939-4702
Koons, Harry	The Aerospace Corp.	(617) 377-4057
Livi, Stefano	MPAe - Lindau	49-5551-401-429
McCook, Morgan	self	(602) 431-1814
Mende, Steve	Lockheed	(415) 424-3269
Mendillo, Michael	Boston University	(617) 353-2629
Miller, Mary L.	GSFC	(301) 286-4888
Murphy, William J.	Franklin Res. Center	(215) 666-3073
Nielsen, Hans C.	Univ. of Alaska	(907) 474-7414
Owen, Storey	GSFC	(301) 286-2864
Papadopoulos, Dennis	SAIC	(703) 734-5804
Peterson, Bill	Lockheed	(703) 734-5516
Pongratz, Morrie	Los Alamos Nat. Lab	(505) 667-4740
Rairden, Rick	Lockheed	(415) 424-3282
Reasoner, David L.	NASA Headquarters/SS	(202) 453-1514
Rieger, Erich	MPE-Garching	49-89-3299-3511
Rodriquez, Paul	NRL	(202) 767-3329
Shiner, Linda	Air & Space / Smithsonian	(602) 431-1814
Singer, Howard J.	USAF Phillips Lab	(617) 377-2431
Slater, Donald	Pacific NW Lab	(509) 376-8923
Stokes, Charles S.	Franklin Res. Center	(215) 666-3020
Szuszczewicz, Ed	SAIC/LASS	(202) 287-3725
Valenzuela, Arnoldo	MPE	49-89-3299-3513
Walker, David	NRL	(202) 767-2467
Wescott, Gene	Univ. of Alaska	(907) 474-7576
Wilken, Berend	MPAe - Lindau	49-5551-401-431

Appendix D

Format and Sample of CRRES Release Experiment Summaries

CRRES RELEASE INFORMATION SUMMARY

EXPERIMENT ID (G1 ... G14) AND DATE:

STATION NAME AND LOCATION (GEOGRAPHIC COORDINATES):

PRINCIPAL POINT OF CONTACT (Experimenter's Name (PI), Tel. Number, FAX Number, SPAN or INTERNET address):

EXPERIMENT OBJECTIVES:

EXPERIMENT ELEMENTS (release materials, size and number of canisters, altitude and coordinates of the release, prevailing conditions):

TYPE AND FORM OF DATA ACQUIRED (FILM, VIDEO, FORMATS, ETC):

FIELD(S) OF VIEW OF THE INSTRUMENTS:

TIME PERIODS OF THE DATA, SAMPLING RATES, FRAME RATES:

YOUR ASSESSMENT OF THE QUALITY OF THE DATA (CLOUD COVER PROBLEMS, LIGHT CONTAMINATION):

INITIAL FINDINGS:

MAJOR ISSUES TO BE ADDRESSED BY MORE COMPLETE ANALYSIS OF RESULTS:

(With thanks to Mary Miller and Ed Szuszczewicz)

Experiment ID: G-13

Date: 9/10/90

Principal point of Contact-

Name (PI): Eugene M. Wescott

Tel. Number: (907) 474-7576

FAX: (907) 474-7290

Span: BARNEY::ROCKET

Experiment Objectives: Critical Ionization Velocity (CIV I)

Experiment Elements-

Release Materials: Ba, Sr

Size/# of canisters: 1 large each (Ba 5408g, Sr 3784g)

Release location-
Altitude: 517 km

Latitude: 17.5 N

Longitude: 198.9 E

Release time - 06:10:25 UT

Site location- Air Force C-135 and Aeromet Inc Learjet
Altitude: C-135 10km, Learjet 12km

Latitude(at release): C-135 21.5 S, Learjet 19.3 S

Longitude(at release): C-135 160.5 W, Learjet 164.9 W

Type and Form of Data Acquired: Each plane equipped with: 1) IPD filtered at 4554A (30 A width) saved as both digital integrated data, and video record of integration; 2) Intensified CCD that was run either in straight video mode - unfiltered - or integrated video, filtered at 4078 (30 A width). The C-135 also had a white light intensified camera (ISIT) to record the burst.

Field(s) of View of Instruments: IPDs 20 degrees circular, ICCDs 11x14 degrees

Time Periods of Data: video - 6:00 to 6:30
digital - 6:10 to 6:30

CRRES Release

Sampling Rates: integrated data stored every 5 to 15 seconds, varies with conditions

Frame Rates: video at 30fps, but IPD image updated every 1s

Assessment of Data Quality: Very good for Ba. Ba was seen rising above the terminator from both planes. Fair for Sr - The Sr cloud was very dim, only seen in a few integrated frames on ICCD.

Initial Findings: See Wescott et al. 1992 (JGR to be published)

Additional Research: In progress

Appendix E

Preliminary Puerto Rico
Sounding Rocket Campaign Schedule

ROCKET #	PRINCIPAL INVESTIGATOR	WINDOW	PAYLOAD MANAGER
18224	DUNCAN	MAY 17 - MAY 29	FLORES
36064	SZUSZCZEWICZ	JUNE 1 - JUNE 13	FLORES
36065	BERNHARDT	MAY 26 - JUNE 6	EBERSPEAKER
36071	KELLEY	JUNE 8 - JUNE 28	DETWILER
21105	PFAFF	JUNE 15- JUNE 28	DETWILER
36081	DJUTH	JUNE 30- JULY 13	SCOTT
36082	CARLSON	JUNE 30- JULY 6	SCOTT
36083	CARLSON	JULY 6 - JULY 13	SCOTT

THE ABOVE REPRESENTS A TENTATIVE PUERTO RICO SOUNDING ROCKET CAMPAIGN SCHEDULE. THIS SCHEDULE WAS DERIVED BY MELANIE ALZMANN, AND SHOULD NOT BE CONSIDERED FINAL. I DERIVED THIS SCHEDULE BY COMPILING INFORMATION FROM THREE SOURCES AND DETERMINED IT TO BE THE MOST COMPLETE AND ACCURATE SCHEDULE AS OF JANUARY 8, 1992. IF CHANGES OCCUR, I WILL ADVISE AS SOON AS AWARE.

Melanie A. Alzmann
1/16/92