Errata for:

Polar Orbiting Environmental Satellite Space Environment Monitor-2

In Appendix C. TED Sensor Data Grouped by Unit Serial Number

For TED S/N 009 Electron Detector System,
Column headed: 0º electron sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 11, 2.003×10^{-4} REPLACES 2.033×10^{-4}

Column headed: 30º electron sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 5, 1.365×10^{-5} REPLACES 1.365×10^{-6}

For TED S/N 010 Electron Detector System on NOAA-16
Column headed: 30º electron sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 4, 9.243×10^{-6} REPLACES 9.234×10^{-6}

Column headed: 0º electron sensor to convert counts to
particles m^{-2} sec^{-1} eV^{-1} $ster^{-1}$
Energy band 6, 1.726×10^{6} REPLACES 1.193×10^{6}

For TED S/N 010 Proton Detector System on NOAA-16
Column headed: 30º proton sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 16, 6.452×10^{-4} REPLACES 7.452×10^{-4}

For TED S/N 014 Electron Detector
Column headed: 0º electron sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 1, 2.500×10^{-6} REPLACES 2.400×10^{-6}

Column headed: 30º proton sensor to convert counts to mW m^{-2} $ster^{-1}$
Energy band 6, 9.539×10^{-6} REPLACES 9.529×10^{-6}

In the main body of the text, Table 2.5.3 (page 14)
For TED S/N 011 Electron Detector System on NOAA-15
Column headed: 30º electron sensor to convert counts to
particles m^{-2} sec^{-1} eV^{-1} $ster^{-1}$
Energy band 2, 5.842×10^{6} REPLACES 5.824×10^{6}

On page 21 in the main body of the text the thickness of the Nickel foil is mistakenly given as 76 microns. The correct value is 0.76 microns. The mass thickness of 678 μg cm^{-2} is correct.

On pages 45 and 45, in the description of the archive file variables cSum and cSumFlag. Additional text has been inserted in the interest of clarification.

The material in Appendix C has been extended to include data for TED Serial Numbers 015 and 016 that are scheduled for flight on future satellites.

Appendix G has been amended to include the launch of NOAA-17.

Several misspellings and typographical errors have been corrected.

An additional errata:

In Appendix F, equation F.7 should be $CR_8=5.504(J_8+J_9)$
In keeping with the notation adopted in the discussion of Case 1, the following corrections should be made
In Appendix F, equation F.16 should be $N_3 = 0.033\,\pi\,J_9$
In Appendix F, equation F.17 should be $N_2=.752\pi(0.067+0.467)J_9$

In the final paragraph of Appendix F the word bounds should be boards.

Further errata, June 2006. This is done with the intention of issuing a revision 1 to the full archive document:

In the main archive.doc file:

The exponents in table 2.2.2, (sensitivities for TED Serial Number 011) have now been made superscript.

In the second paragraph of section 2.3 reference is made to a pitch angle at the satellite. This reference should be to α_{sat}, but the alpha is missing and sat should be subscripted.

In equations 2.3.1 and 2.3.2 the exponent 2 in the expression for sin should be removed as these two equations are incorrect. The two equations should read:

Equation 2.3.1 $$sin(\alpha_{sat}) \leq \sqrt{(B_{sat}/B_{120})} = sin(\alpha_{mir})$$

Equation 2.3.2 $$sin(\alpha_{120}) = sin(\alpha_{sat})\sqrt{(B_{120}/B_{sat})}$$

In Appendix C

All entries for TED serial number 0013, manifested on NOAA-18, have been corrected.

In Appendix D

An error in the unpack2.c routine in Appendix D was corrected in August, 2005 and a corrected version of Appendix D exists.

In Appendix F

The equation numbering has been corrected and made consecutive

In Appendix G

Appendix G has been updated with new information concerning SEM-2 instruments on all NOAA satellites.

Further errata as of 15 October, 2003

In the archive document main text, Section 4.5, the material dealing with the cSumFlag should be updated to read:

cSumFlag=0,	telemetered and calculated check sums agree, no bit errors present,
cSumFlag=1,	telemetered and calculated check sums agree, bit errors likely,
cSumFlag=2,	a comparison could not be made because the necessary telemetered check sum had a missing data flag. The data in this 32-second record may be valid but should be treated with caution.
cSumFlag=3,	a comparison could not be made because a subsequent data gap meant the necessary telemetered check sum was not available. The data in this 32-second record may be valid but should be treated with caution.

It has been brought to our attention that the POES altitude (Table 4.2.1, element 5 in array ihd) occasionally has a zero value. In the course of SOCC processing of POES data there are instances when the satellite position cannot be located with normal precision. In those cases SOCC sets a geo-location quality flag and also sets the sub-satellite latitude, sub-satellite longitude, and satellite altitude above Earth to zero. In the course of processing to create the POES archive, those instances of zero sub-satellite latitudes and longitudes are interpolated to values that are correct to within 0.01 degree by a cubic fit to the nearby valid latitude and longitude entries. However, this fitting routine was not applied to the satellite altitude values and a zero entry was carried into the final archive record. Because the POES satellite orbits are near-circular and the satellite altitude changes slowly during an orbit, users who are require the satellite altitude in these cases may obtain a valid altitude by linear interpolation using adjacent non-zero satellite altitude entries.

It has also been brought to our attention that there is a thermal cover over the four omni-directional (dome) detectors that are described in Section 3.4. This cover is Al and approximately 0.13 mm thick and so will have little impact on the proton energy required to reach the solid state detector. However, to compensate for that additional mass, the thickness of the four energy absorbing shells has been reduced by an equivalent mass so that the actual dimensions are slightly smaller than those given in Figures 3.4.1 and 3.4.2.

Further errata as of January 6, 2004

A minor error in the archive data processing was uncovered in early January, 2004 that had impacted 4 entries in the array status of the archive file for all SEM-2 instruments. This error was introduced beginning on November, 25, 2002 and was corrected in SEM-2 archive data beginning on Jan 6, 2004.

The error interchanged element 5 with element 6 and interchanged element 7 with element 8 in the status array.

Element 5 in array status is supposed to be the TED electron discriminator level (see Table 4.1.1), but during the time the error existed, element 5 was the TED proton discriminator level.

Element 6 in array status is supposed to be the TED proton discriminator level (see Table 4.1.1), but during the time the error existed, element 6 was the TED electron discriminator level.

The discriminator level setting on all SEM-2 TED discriminators has been at level 0 since launch, and so, fortuitously, this error has had no impact on the content of the archive files.

Element 7 in array status is supposed to be the TED electron channeltron bias level setting (see Table 4.1.1), but during the time the error existed, element 7 was the TED proton channeltron bias level setting.

Element 8 in array status is supposed to be the TED proton channeltron bias level setting (see Table 4.1.1), but during the time the error existed, element 8 was the TED electron channeltron bias level setting.

Further errata and update as of January 6, 2005

During the quality checking of SEM-2 data collected during calendar year 2004 an anomaly was exposed in the geographic location of the 'foot-of-the-field-line' (fofl) that occasionally occurred when the POES satellite approached and crossed the magnetic dip equator. An investigation of the anomaly showed that it was due to an error in constructing the yearly, satellite specific, look up table that contains fofl geographic locations computed for a grid of sub-satellite latitude and longitude locations. That table, together with the instantaneous sub-satellite latitude-longitude location, is used in the archive processing to calculate the appropriate fofl location by means of an interpolation routine.

The error in constructing the look up table can result in errors fofl locations within certain longitude ranges when the POES satellite is within about 4 degrees in latitude of the geomagnetic dip equator (4 degrees of satellite motion corresponds to about 2 32-second archive records.) An error in the geographic location of the fofl will also impact the values of the dipole magnetic latitude, the corrected magnetic latitude, and McIlwain L-value in those archive records.

This error has existed since the launch of the SEM-2 instruments in mid-1998. The error has been corrected and all SEM-2 archive data beginning on January 4, 2005 has correct fofl locations for sub-satellite locations near the geomagnetic dip equator.

It should be emphasized that the error in the geographic fofl location (and associated magnetic coordinates) existed only for restricted longitude intervals and only when the POES satellite was approaching and crossing the magnetic dip equator.

Because the historical SEM-2 archive data will not be reprocessed to correct for this error, we provide an example of a transit of the NOAA-16 satellite across the dip equator when the fofl locations were miscalculated to illustrate the nature and impact of the problem. We also provide an example of an almost identical transit (in geographic terms) of the NOAA-16 satellite across the magnetic equator after the error had been corrected. These examples will permit a user of POES data in the vicinity of the geomagnetic equator to identify those instances when fofl locations are incorrect and, also, provide a first-order estimate of the magnitude of potential errors.

The first example, below, is the archive data file for a NOAA-16 transit on December 18, 2004 (day 353) where the fofl location error is evident.

The orbital data points are every 8-seconds (about 0.5º of satellite motion.) As the satellite approaches and departs the magnetic equator, the fofl latitudes change only slowly because the satellite is moving nearly parallel to the magnetic flux tube. However, near the equator (times between 62763 and 62827 seconds) the fofl latitude displays very large, and clearly incorrect, variations. It is the large changes in fofl latitude near the magnetic equator that is the symptom of incorrect fofl location determinations. A user of POES SEM data near the magnetic equator may wish to test for the variation in fofl latitudes to identify invalid locations.

Table 1

An example of an incorrect calculation of fofl location

		Sub-satellite		fofl		L-	
Day	second	lat	long	lat	long	value	
353	62667	17.50	139.44	28.13	139.10	1.096	
353	62675	17.03	139.33	27.93	138.99	1.093	
353	62683	16.56	139.22	27.73	138.89	1.090	
353	62691	16.09	139.10	27.54	138.78	1.087	
353	62699	15.63	138.99	27.36	138.68	1.084	
353	62707	15.16	138.88	27.18	138.58	1.081	
353	62715	14.69	138.76	27.02	138.47	1.079	
353	62723	14.22	138.65	26.87	138.37	1.076	
353	62731	13.75	138.54	26.72	138.27	1.074	
353	62739	13.29	138.43	26.59	138.17	1.072	
353	62747	12.82	138.32	26.46	138.07	1.070	
353	62755	12.35	138.21	26.34	137.97	1.068	
353	62763	11.88	138.10	24.69	137.81	1.046	
353	62771	11.41	137.99	18.32	137.52	.983	
353	62779	10.94	137.88	11.71	137.22	.950	
353	62787	10.48	137.77	4.88	136.91	.947	
353	62795	10.01	137.66	-2.19	136.60	.980	
353	62803	9.54	137.55	-9.48	136.28		1.055
353	62811	9.07	137.44	-17.00	135.95	1.194	
353	62819	8.60	137.33	-24.74	135.62	1.438	
353	62827	8.13	137.22	-32.72	135.28	1.875	
353	62835	7.66	137.11	-9.12	136.20	1.050	
353	62843	7.20	137.01	-9.26	136.11	1.051	
353	62851	6.73	136.90	-9.39	136.02	1.053	
353	62859	6.26	136.79	-9.53	135.93	1.055	
353	62867	5.79	136.68	-9.67	135.83	1.057	
353	62875	5.32	136.57	-9.81	135.74	1.059	
353	62883	4.85	136.47	-9.95	135.65	1.061	
353	62891	4.38	136.36	-10.08	135.56	1.063	
353	62899	3.92	136.25	-10.21	135.46	1.065	
353	62907	3.45	136.14	-10.32	135.37	1.066	
353	62915	2.98	136.04	-10.44	135.28	1.068	
353	62923	2.51	135.93	-10.56	135.18	1.070	
353	62931	2.04	135.82	-10.70	135.09	1.071	
353	62939	1.57	135.72	-10.84	135.00	1.074	

The second example, below, is from the archive file for a nearly identical NOAA-16 transit on January 5, 2005 after the error has been corrected. It should be noted that the fofl latitude varies smoothly except when the satellite crosses the magnetic equator and the fofl location changes hemispheres. It is the monotonic variation in fofl latitude with the single discrete change between hemispheres that is the signature of correct fofl locations in the SEM-2 archive.

Table 2

An example of a correct calculation of fofl location

		Sub-satellite		fofl		L-
Day	second	lat	long	lat	long	value
005	62339	17.46	141.12	28.20	140.82	1.098
005	62347	16.99	141.00	28.00	140.72	1.095
005	62355	16.52	140.89	27.80	140.61	1.091
005	62363	16.05	140.77	27.61	140.51	1.088
005	62371	15.59	140.66	27.43	140.41	1.086
005	62379	15.12	140.55	27.26	140.30	1.083
005	62387	14.65	140.44	27.10	140.20	1.080
005	62395	14.18	140.32	26.95	140.10	1.078
005	62403	13.71	140.21	26.80	140.00	1.076
005	62411	13.24	140.10	26.67	139.90	1.074
005	62419	12.77	139.99	26.54	139.80	1.072
005	62427	12.31	139.88	26.43	139.70	1.070
005	62435	11.84	139.77	26.30	139.60	1.068
005	62443	11.37	139.66	26.16	139.49	1.066
005	62451	10.90	139.55	26.01	139.39	1.064
005	62459	10.43	139.44	25.87	139.29	1.062
005	62467	9.96	139.33	25.73	139.19	1.060
005	62475	9.49	139.22	25.58	139.09	1.058
005	62483	9.02	139.11	25.44	138.99	1.056
005	62491	8.56	139.00	25.29	138.89	1.054
005	62499	8.09	138.89	25.15	138.79	1.052
005	62507	7.62	138.79	-9.86	137.79	1.063
005	62515	7.15	138.68	-9.91	137.71	1.063
005	62523	6.68	138.57	-9.96	137.62	1.064
005	62531	6.21	138.46	-10.01	137.53	1.064
005	62539	5.74	138.35	-10.05	137.44	1.065
005	62547	5.27	138.25	-10.10	137.35	1.066
005	62555	4.81	138.14	-10.15	137.26	1.066
005	62563	4.34	138.03	-10.19	137.17	1.067
005	62571	3.87	137.92	-10.25	137.08	1.068
005	62579	3.40	137.82	-10.36	136.99	1.069
005	62587	2.93	137.71	-10.48	136.90	1.071
005	62595	2.46	137.60	-10.60	136.81	1.073
005	62603	1.99	137.49	-10.74	136.71	1.074
005	62611	1.52	137.39	-10.88	136.62	1.077
005	62619	1.05	137.28	-11.03	136.53	1.079

Also, during 2004, it was brought to our attention that the P6 energy channel in the 0º and 90º proton telescope detectors (designed to respond to >6900 keV protons) may have significant sensitivity to electrons of energies greater than 500 keV. This is because the magnetic field across the aperture in these telescopes is less efficient in preventing energetic electrons from reaching the solid-state detector (because of their larger radius of curvature.) An energetic electron that gains access to the solid-state detector pair in these telescopes can deposit more than 30 keV energy in the front detector, pass through that detector, and deposit more than 60 keV energy in the back detector. That combination will cause an event to be registered in the P6 energy channel. The efficiency of this process as a function of electron energy is not known, but is suspected to be fairly high.

Finally, the NOAA-18 satellite is currently scheduled for launch near March 10, 2005. The orbit is 1400 LTAN which will be similar to the NOAA-16 orbit. The SEM-2 instrument manifested on NOAA-N (becoming NOAA-18 after launch) includes MEPED unit S/N 013 and TED unit S/N 013.