LPM 2009

Field performance summary

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V1.0

CONTENTS

1. Introduction

This report gives an analysis of the 2009 performance of the eleven BAS LPMs operating on the plateau. Also mentioned but analysed in less detail are the performance of the system at Rothera, the three systems operated by the Japanese National Antarctic Institute for Polar Research, and the four systems operated by the Polar Institute of China, and a system operated by the Italian Istituto Nazionale di Geofisica e Vulcanologia.

The site positions, names and deployment dates are given in appendix 1.

Recommendations and comments about future work are given in section 6.

2.1 Performance summary

The twelve BAS systems (11 deep field + Rothera) operated 3347 days from a possible of 4894, which is 68.4% - the major loss being due to data card failures, GPS failures and the unknown failure of M85/096. These figures include data from 2008 that was not recovered until 2009, as some systems missed a service visit in the 08/09 season.

A figure that gives a good indication of the success (or otherwise) of the year is the percentage of data at 1s resolution compared to that possible if all the systems worked without problems and continuously at 1s sampling – for BAS this figure was 62% in 2009, compared with 59% in 2008, 90% in 2007, 17% in 2006, 91% in 2005, 83% in 2004, 100% in 2003 and 51% in 2002.

There were more oddities and unexplained features in the operations this year than normal. These are examined in the body of the report.

As some systems missed a service visit in the 08/09 season they had an opportunity to run for much longer without interruption and M88/316 set a new record of 769 days without a restart or reboot.

2.2 Basic Performance details

M67/292 – Nursie (Rothera)

Operated from 22/1/09 until unplugged 7/10/09
Then from 28/12/10 until 30/12/10.
5 restarts
259/342 days.
1557 GPS fixes all successful.
All data at 1s sample.
Z and Y are +ve rather than –ve and wrong value
All channels noisy.

M78/337 - Dr Leech

Operated from 22/1/09 until pickup16/12/09
328/328 days.
No restarts.
0 missed GPS fixes out of 1966 possible.
All @1s resolution.

M79/336 – Bob

Operated from 23/1/09 until pickup 10/12/09.
321/321 days.
No restarts.
113 missed GPS fixes out of 1874 possible.
All data at 1s resolution.

M81/338 - A80 – Edmund

Operated from 25/1/09 until pickup 7/12/09.
321/321 days.
No restarts.
11 missed GPS fixes out of 1893 possible.
All data at 1s resolution.

M82/003 - A81 - Mrs Miggins

Operated from 27/1/09 until pickup 9/12/09
316/316 days.
No restarts.
0 missed GPS fixes out of 1900 possible.
All data at 1s resolution.

M83/347 – Baldrick

Operated from 27/1/09 until pickup 9/12/09
No data from 8/9/09 until 14/10/09 inclusive
276/316 days.
No restarts.
1671 GPS fixes all successful.
All data at 1s resolution.

M84/336 - Baron Richthoven

Deployed 26/1/09, picked up 9/12/09.
No data due to memory card failure.
0/317days.

M85/002 - Lord Melchett

Operated from 26/1/09 until pickup 9/12/09.
317/317 days.
No restarts.
256 missed GPS fixes out of 1876 possible.
25617600 samples @1s resolution.
177120 samples @10s resolution.
Noisy data in August and Sept.

M85/096 - Baby Eating Bishop

Partially operated from 18/12/08 to pickup 30/1/2010.
Very limited data
6/408 day possible
5 restarts.
2 missed GPS fixes out of 52 possible.
259200 samples at 1s resolution.
7200 samples at 10s resolution.
21460 samples at 60s resolution.

M87/028 - Flash Heart

Partially operated 19/12/2007 until pickup 30/1/2010
Very Limited data
96/733 days
3 restarts
0 missed GPS fixes out of 577 possible
8208000 samples at 1s resolution
8640 samples at 10s
740 samples at 60s

M87/068 - Speckled Jim

Operated from 20/12/08 until pickup 30/1/10.
NB noisy data April to Oct
338/406 days possible.
No restarts.
189 missed GPS fixes out of 2127 possible.
4896000 samples at 1s resolution.
2041920 samples at 10s.
65860 samples at 60s.

M88/316 - Lord Whiteadder

Operated from 16/12/07 until pickup 23/1/10.
769/769 days possible.
No restarts.
265 missed GPS fixes out of 4482 possible.
66052800 samples at 1s resolution.
34560 samples at 10s.

Systems operated by Japanese National Institute of Polar Research.

M70/044 - Mizuho

No data due to faulty memory card

M74/043 – MD364

Data from 29/11/2007 until 17/2/2008 then errors.
3 restarts
All 486 GPS fixes successful
All data at 1s sampling resolution.

M77/040 – Dome F

Data from 10/12/2007 until 23/10/2009
597/683 days
38 restarts
620 missed GPS fixes out of 3599 possible
All data at 1s sampling.

Systems operated by Polar Research Institute of China.

M72/078 - LT892

Data from 20/2/09 to 22/12/09
304/304 days
1 restarts.
0 missed GPS fixes out of 1822 possible.
2620800 samples at 1s resolution.
1480 samples at 10s.

M75/077 – DT154

Only a small amount of data between 17/2/09 and 19/2/09
Data not consistent with IGRF model, ACII data removed from database.
Card errors.
0 reboots
1 missed GPS fix out of 8 possible.
100800 samples at 1s resolution.
2880 samples at 10s resolution.

M77/077 – DT299

Data only between 8/2/09 and 15/3/09
Card errors and poor GPS coverage
1 reboots
14 missed GPS fix out of 229 possible.
3340800 samples at 1s resolution.

M80/077 – Dome A

Data from 13/1/09 to 20/1/10
301/373 days
System affected by cold and lack of power.
Data card had corruption problems.
22 restarts (some may have been counted twice)
325 missed GPS fixes out of 2592 possible (some may have been counted twice)
All data at 1s.

Systems operated by the Italian Istituto Nazionale di Geofisica e Vulcanologia.

M73/159.

No data due to card error.

2.3 Podule positions

Table 1 contains the podule serial number at each of the BAS sites.

Site	2008	2009
M78/337	L22/01	L38/02
M79/336	L01/00	L32/02
M81/338	L43/03	L29/01
M82/003	L06/00	L21/01
M83/347[1]	L05/00	L42/03
M84/336	L04/00	L35/03
M85/002	L07/00	L33/02
M85/096	L23/01	L34/02
M87/028	L02/00	Same
M87/069	L03/00	L36/02
M88/316	L37/02	Same
Rothera	L44/04	L44/04

Site	2001	2002	2003	2004	2005	2006	2007
M78/337	L01	L03	L39/02	L03/00	L38/02	L23/01	L35/02
M79/336	L02	L04	L40/02	L06/00	Iridium	L06/00	L39/02
M81/338	L04	L06	L37/02	L22/01	L39/02	L22/01	L33/02
M82/003	L06	L07	L38/02	L01/00	L33/02	L44/04	L34/02
M83/347[1]	L07	L01	L41/02	L23/01	L34/02	L35/02	L42/03
M84/336	L03	L05	L36/02	L04/00	L40/02	L37/02	L36/02
M85/002	L05	L02	L35/02	L05/00	L41/02	L04/00	L38/02
M85/096	NA	L22	L32/02	L07/00	L36/02	L05/00	L24/01
M87/028	NA	L21	L31/02	L02/00	L31/02	L03/00	L41/02
M87/069	NA	L23	L33/02	L21/01	L32/02	L01/00	L31/02
M88/316	NA	L24	L34/02	L42/03	L24/01	L02/00	L32/02
Rothera	NA	NA	L03/00	L43/03	L44/04	L21/01	L21/01

Table 1: Podule locations.

Notes 1: M83/348 was replaced in the 2004/5 season with M83/347, for the purpose of this and many other tables both sites have been treated as single one, however in the database they are listed as separate sites.

2.4 Enclosure Heights.

Table 2 shows the height of the bottom of the enclosure off the snow surface(m).

Site	2008/9	2009/10	Estimate Accumulation	Predict 10/11	Predict 11/12
M78/337	1.78	1.60	0.21	1.39	1.18
M79/336	1.47	1.34	0.26	1.08	0.81
M81/338	0.94	0.72	0.30	0.42	0.12
M82/003	1.20	1.12	0.10	1.02	0.93
M83/347	1.63	1.50	0.07	1.42	1.36
M84/336	1.67	1.74	0.0	1.74	1.74
M85/002	1.46	1.44	0.04[3]	1.40	1.37
M85/096	1.1	0.94	0.18	0.76	0.58
M87/028	Not visited	1.12	0.03[3]	1.09	1.06
M87/069	1.2	1.03	0.16	0.87	0.71
M88/316	Not visited	0.92	0.14	0.78	0.63
Rothera	N/A		N/A	N/A	N/A

Table 2a: Recent Enclosure Heights
Accumulation estimate is the median of the annual accumulations x 1.2

Site	2003/4	2004/5	2005/6	2006/7	2007/8
M78/337	1.30	1.13	0.89	0.73	0.61[1]/2.04[2]
M79/336	1.07	0.91	0.63[1]/1.68[2]	1.29	1.13[1]/1.88[2]
M81/338	0.91	0.79	0.51/1.71[2]	1.38	1.1
M82/003	1.67	1.58	1.61	1.24	1.16
M83/347 NEW		1.74	1.68	1.66	1.60
M83/348 OLD	0.72	0.58			
M84/336	1.75	missed	1.77	1.68	1.68
M85/002	1.60	missed	0.62/1.72[2]	1.48	1.45
M85/096	1.17	1.10	0.92	0.78	0.75/1.52[2]
M87/028	1.60[1]	missed	1.56	1.60	1.57
M87/069	1.20	1.03	0.97	0.87	0.77/1.56[2]
M88/316	0.92	missed	0.67/1.62[2]	1.50	1.44
Rothera	N/A	N/A	N/A	N/A	N/A

Table 2b Historic Enclosure Heights

Note 1: Estimated.
Note 2: Raised this season.
Note 3: High variability

M79/336 has been raised twice and a complete excavation and redeployment should be considered next time.

The predictions suggest that M81/338 should be raised, M85-096 and M88-316 will need raising in the next couple of years. M87-069 will need raising in the next couple of years but some of this can be achieved by sliding the enclosure up the poles.

2.5 Wind generator Heights.

Table 3 contains what data we have for the height of the bottom wind generators off the snow surface, due to the limited data the estimated accumulation is taken from the enclosure height information presented in table 2.

Site	2007/8	2008/9	2009/10	Estimated Accumulation	Predict 10/11	Predict 11/12
M78/337		2.80[1]	2.56	0.25	2.31	2.06
M79/336		2.30[1]	2.12	0.24	1.88	1.64
M81/338		0.99	0.72	0.31	0.41	0.10
M82/003		1.40	1.37	0.07	1.30	1.24
M83/347		1.80	1.80	0.04	1.76	1.73
M84/336		1.73	1.74	-0.01	1.75	1.76
M85/002	1.48	1.48	1.45	0.04	1.41	1.38
M85/096	1.38	0.90	0.82	0.18	0.64	0.46
M87/028	1.17	Not visited	0.50	0.22	0.28	0.06
M87/069	1.53	1.30	1.07	0.28	0.79	0.52
M88/316	1.47	Not visited	1.01	0.21	0.80	0.59
Rothera	N/A	N/A				

Table 3: Wind generator heights.
Note 1. Raised this season.
Estimated accumulation is the median of the accumulations (including the estimate of the accumulation from the enclosures as one value) x 1.2

M81-338 and M87-028 should have a wind generator raise this season, M85-096, M87-069 and M88-316 will probably need raising next season.

3. Magnetometer data.

The data processing programs (the Degum suite) contain many consistency and quality control checks, some of the values from these checks are tracked from year to year. These are: the average values of the GPS position fixes, the rotation angle of the xyz coordinate frame to get it into hdz coordinate frame (this is calculated from the quietest 24hr period of XYZ, values and their variances tracked), the average H, D and Z values, and their variances. These are all presented in the accompanying LPM_data_processing_results_V09.XLS spreadsheet

Any average or quite period values that are inconsistent with previous years and the IGRF model are highlighted in red in the spreadsheet. Data from these periods has been examined and has been replaced with the erroneous data value 9999.9 and marked with bit 5 of the status byte (One or more components have been replaced post-processing).

In 2009 (and continuing into 2010) M67-292 had a un-diagnosed fault that resulted in the Y and Z channels being the wrong sign and possibly the wrong value. It has been marked as erroneous from day 22 2009 until day 298 2010, however this data is still available and may be useful for some studies.

To date, the following data contains replaced or quality flagged samples:

Station	Year	Replaced Data
M67-292	2004	All Z samples and H, D samples from 04/11/04 onwards
M67-292	2005	All H, D and Z samples
M88-316	2005	All H and D samples

Table 4a. Replaced erroneous data

Station	Year	Issue
M85-002	2008	352/2007 to 26/2009 – non standard calibration
M67-292	2009	Z wrong orientation and value, Y wrong orientation.
M67-292	2010	Z wrong orientation and value, Y wrong orientation.

Table 4b. Data flagged as having significant quality issues – use with caution.

M67-292 system had a faulty sensor or sensor cable (as the fault was multi-year) ,these were replaced in the 2006/7 season.

M88-316 in 2005 had a faulty logger, L24/01, which it was believed was repaired during the normal annual maintenance.

In addition to the automatic quality control checks in the degum suite, one of BAS's data browsing tools that contains the LPM data allows easy overview of the whole years data

as well as facilities for zooming into events. See http://psddb.nerc-bas.ac.uk .The following problems were spotted by examining the data.

In 2008 data from M85-002 was recorded using a non standard analogue card and its calibration is uncertain – it has been marked as erroneous from day 352 2007 to day 26 2009, however this data is still available and may still be useful for qualitative studies. Potentially it could be used for quantitative studies after further verification.

Dec 22 2008 – M67/292 had a significant change in Z and H, did the sensor get moved?

M87/068 L03/00 – Very noisy data from 27/8/08 to 21/10/08.

3.1 Noise floors

One set of values presented in the accompanying LPM_data_processing_results_V09.XLS spreadsheet are those of the variances of the H,D,Z components during the quietest 24 hour period – the period that is used to calculate the rotation angle. In general the variances show some consistency at each site from year to year, suggesting that the noise characteristics of each individual logger is not the major contribution – as the loggers move around from year to year. To investigate this 24 hours of data from each site has been highpass filtered with a TC of 60 seconds to remove the diurnal variation and the majority of any geophysical activity and then assessed for its standard deviation. The 24 hour segments chosen were in each case the calendar day that contained the majority of the year's quietest 24 hour period.

The standard deviation of this 24hour segment of highpass filtered value is then considered representative of the noise floor of that system. In general these noise values are more consistent for a particular channel at a particular site than they are for the loggers that move from site to site. For example table 5 shows the standard deviations of the D component for M85-002 (one of the sites that shows high noise values) compared with the average of standard deviations of the same logger measured at other sites.

Std_dev D nT	Year/Logger	Ave other Std_dev D nT For that Logger	Notes
3.9	2002/L02	2.45	Logger ave include 1 other high noise site
8.6	2003/L35	0.64	
6.6	2004/L05	0.80	
5.4	2005/L41	0.77	
7.0	2007/L38	3.69	Logger ave include 1 other high noise site
11.8	2008/L07	1.30	
6.3	2009/L33	2.32	Logger ave include 1 other high noise site

Figure 5. M85-002 noise value (standard deviation of 60s high pass filtered 24hour sample from a geomagnetically quiet period) compared to average noise values for the same logger – in all cases D channel.

Table 6 shows the average noise value for each component from each site. In general if a site has a high value in one channel then it is more likely to have a high value in its others. However there is no particular geographic or geomagnetic pattern.

Site	Noise value H	Noise value D	Noise value Z	Notes
M78/337	0.83	0.83	0.72	
M79/336	0.76	0.95	1.09	
M81/338	0.74	0.71	0.69	
M82/003	6.46	3.60	2.56	
M83/347	2.60	0.97	1.58	
M84/336	1.09	1.21	1.26	
M85/002	10.40	7.09	5.14	
M85/096	1.86	1.72	1.92	
M87/028	3.23	1.43	2.84	
M87/069	1.42	1.25	1.25	
M88/316	3.43	2.70	0.84	

Table 6: Average noise values from each site (2002-2009) . Highlighted values are greater than 2.0

This suggests that the noise floor is a function of the site rather than the loggers and is presumably due to the characteristics of the sensor or its cabling. The overall picture has not changed with the additional data from 2009.

4.0 Housekeeping data.

Since 2005 the loggers have recorded housekeeping every 4 hours, compared with every 6 hours in 2004, 12 hours in 2003 and every hour in 2002. This is also the interval between GPS fixes.

Housekeeping data consists of battery voltage, solar panel voltage, wind generator voltage and a variety of temperatures from around the system and the environment.

4.1 Temperature data

Temperature data recorded are:

a/ Outside temperature – measured behind solar panel (subject to solar warming).
b/ Enclosure temperature – in most instances identical to outside temperature.
c/ Logger temperature.
d/ 1m depth snow temperature – useful as an indication of magnetometer temperature.
e/ First battery box temperature.

Table 7 is a summary of the temperature information from each site.

The Logger Min is the minimum temperature recorded in the logger electronics, M85-096 has the coldest operational temperature so far at –78.8°C which it reached in both 2003 and 2005. The intention is to put a meteorological grade temperature sensor on this site and M87-069.

'Ave Delta' is the difference between the average logger temperature and the average outside temperature, a positive temperature indicates the logger is warmer than the outside.

The battery minimum and maximum show the extreme of temperatures measured within the first battery box. The battery Delta max shows the maximum warming inside the battery box due to charging.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	-23.6	-25.5	+21.3	+1.6	void	void	void	1
M78-337	-55.3	-57.8	+6.2	+2.2	-34.3	-8.0	+39.1	2,3
M79-336	-55.3	-56.3	+5.2	+1.8	-32.4	-8.0	+22.5	2,3
M81-388	-56.3	-58.7	+2.3	+2.5	-37.2	-11.4	+22.0	2
M82-003	-67.0	-71.0	-9.4	+3.5	-50.0	+19.9	+61.0	3
M83-348	-58.7	-61.7	-2.1	+2.5	-49.5	+20.0	void	4
M84-336								5
M85-002	-70.5	-71.9	-21.6	+4.6	-60.2	+28.2	+60.0	
M85-096								5
M87-028								5
M87-069	-73.8	-72.4	-7.9	+0.8	-58.0	+16.0	+59.1	6
M88-316	-64.6	-67.0	+3.8	+3.4	-52.9	+22.0	+65.0	

Table 7a. **2009** temperature information summary.
Note 1, Rothera system on PSU not batteries.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.
Note 4, Warmest ever battery temperature.
Note 5. Not enough data recorded.
Note 6. Partial data.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	-21.1	-25.1	+25.2	+2.1	Void	void	void	1
M78-337	-41.7	-43.6	-0.6	+1.5	-30.9	-1.6	+23.9	2
M79-336	-52.4	-55.3	+6.7	+3.1	-31.9	-6.5	+19.5	2,3
M81-388	void	void	void	void	void	void	void	5
M82-003	-68.5	-71.9	+6.1	+3.2	-49.5	+33.5	+69.3	3,4
M83-348	-62.2	-64.6	-5.5	+2.5	-51.9	+17.9	void	3
M84-336	void	void	void	void	void	void	void	5
M85-002	-68.5	-71.4	-4.1	3.1	-57.8	+32.1	+70.3	
M85-096	-55.3	-54.4	-4.1	void	void	void	void	5
M87-028								No visit
M87-069	-72.9	-74.4	-3.1	2.8	void	void	void	
M88-316								No visit

Table 7b. **2008** temperature information summary.
Note 1, Rothera system on PSU not batteries.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.

Note 4, Warmest ever battery temperature.
Note 5. No data recorded.
Note 6. Partial data.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	-21.1	-25.1	+24.8	+2.4	Void	void	void	1
M78-337	-50.4	-53.9	+12.5	+2.7	-33.8	-4.1	+22.5	2
M79-336	-43.6	-48.0	+11.1	+3.5	-31.4	-4.1	+21.5	2
M81-388	-53.4	-59.7	+4.7	+4.8	-36.3	-8.0	+21.0	2
M82-003	-62.2	-65.1	-10.4	+2.6	-49.5	+33.4	+77.8	4
M83-348	void	void	void	void	void	void	void	5
M84-336	-56.3	-58.7	-13.4	3.2	-48.5	+19.4	+51.3	
M85-002	-69.0	-71.9	-9.9	3.1	-58.7	+29.1	+64.9	
M85-096	-76.3	-77.8	-9.0	3.1	-61.2	-3.5	+40.5	
M87-028	-64.6	-67.5	-0.7	3.6	-53.9	-6.5	+29.8	
M87-069	-75.8	-77.8	-11.4	2.7	-62.7	+9.1	+60.5	
M88-316	-66.1	-68.5	-7.4	2.9	-54.4	+17.9	+62.0	1

Table 7c. **2007** temperature information summary.
Note 1, Rothera system on PSU not batteries.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.
Note 4, Warmest ever battery temperature.
Note 5. No data recorded.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	void	void	void	void	void	void	void	1,2
M78-337	void	void	void	void	void	void	void	1,2
M79-336	void	void	void	void	void	void	void	1,2
M81-388	void	void	void	void	void	void	void	1,2
M82-003	void	void	void	void	void	void	void	1
M83-348	-60.2	-63.6	+1.3	3.14	-53.4	12.1	void	
M84-336	-62.2	-65.1	-2.1	4.03	-54.4	+33.1	+62.0	3,4
M85-002	void	void	void	void	void	void	void	1
M85-096	void	void	void	void	void	void	void	1
M87-028	void	void	void	void	void	void	void	1
M87-069	void	void	void	void	void	void	void	1
M88-316	void	void	void	void	void	void	void	1

Table 7d. **2006** temperature information summary.

Note 1, No data.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.
Note 4, Warmest ever battery temperature.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	-31.4	-34.8	+8.1	2.32	-18.7	+16.4	26.9	2
M78-337	-52.4	-54.4	+9.6	2.48	-43.1	-6.0	21.0	2
M79-336	-44.6	-48.0	+10.1	5.35	-34.3	-2.1	22.9	2
M81-388	-56.3	-60.7	+9.6	4.05	-36.3	-4.5	25.3	2
M82-003	-64.1	-68.5	-4.1	4.37	-52.9	+15.0	54.7	
M83-348	-58.7	-60.7	-5.0	2.91	-50.9	+8.6	VOID	
M84-336	-56.8	-59.2	-8.0	3.01	-50.9	+30.1	60.5	
M85-002	-72.9	-75.8	-8.0	3.66	-60.7	+30.6	68.4	3,4
M85-096	-77.3	-78.8	-6.5	2.89	-63.1	-3.6	42.5	
M87-028	-51.9	-53.9	-9.9	4.46	-40.7	-2.1	28.8	
M87-069	-75.3	-76.8	-1.6	2.54	-62.2	+8.6	54.7	
M88-316	-66.6	-69.5	-9.9	2.97	-53.8	+11.1	54.7	

Table 7e. **2005** temperature information summary.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.
Note 4, Warmest ever battery temperature.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M68-292	-23.6	-25.0	+11.6	1.78	-14.8	+10.6	14.2	1,2
M78-337	-50.4	-52.4	+8.6	2.96	-37.8	-5.5	18.6	2
M79-336	-47.5	-50.4	+14.0	2.91	-36.8	-3.6	24.4	2
M81-388	-57.8	-60.2	+9.1	2.63	-38.7	-6.0	19.0	2
M82-003	-63.1	-67.0	-2.1	3.99	-53.3	+12.1	50.3	
M83-348	-60.7	-64.1	+5.7	4.46	-47.5	+9.6	48.3	3
M84-336	-59.7	-63.1	-15.3	4.29	-52.9	+22.3	46.8	3
M85-002	-70.0	-72.9	-2.6	3.60	-61.7	+19.8	59.0	3
M85-096	-73.4	-76.8	-10.9	3.55	-62.7	0.0	45.9	
M87-028	-67.5	-71.4	-1.1	4.34	-57.7	+4.2	35.2	3
M87-069	-74.9	-77.8	-5.0	3.95	-61.7	+7.6	54.2	
M88-316	-67.5	-70.5	-3.1	3.17	-55.8	+11.1	52.7	3

Table 7f. **2004** temperature information summary.
Note 1, No previous values.

Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.

LPM	Logger Min	Outside Min	Outside Max	Ave Delta	Batt Min	Batt Max	Batt Delta Max	Notes
M78-337	-50.9	-54.8	-2.2	3.27	-38.7	-2.1	20.0	2, 3
M79-336	-50.4	-52.8	+9.6	1.53	-37.3	-1.6	22.0	2
M81-388	-57.8	-61.2	+6.7	3.06	-40.2	-4.5	21.0	2
M82-003	-68.0	-70.9	-8.45	2.57	-52.9	6.2	43.9	3
M83-348	-60.2	-63.1	-11.9	3.12	-45.1	8.1	44.4	3
M84-336	-55.3	-58.7	-13.3	1.57	-48.0	14.0	44.9	
M85-002	-67.5	-70.5	-19.2	3.69	-60.2	14.0	55.2	3
M85-096	-76.3	-78.8	-22.1	2.88	-68.0	-3.5	47.9	1,3,4
M87-028	-65.6	-69.0	-13.8	3.13	-57.8	2.8	43.9	1,3
M87-069	-74.4	-78.3	-17.2	4.28	-64.1	4.2	50.7	1,3
M88-316	-65.1	-66.5	-8.0	2.67	-57.3	7.2	49.8	1,3

Table 7g. **2003** temperature information summary.
Note 1, No previous outside min temps.
Note 2, Cellyte rather than Sunlyte batteries.
Note 3, New outside coldest record for this site.
Note 4, New absolute outside coldest recorded for any site to 2003.

System M83-347 has had a non-working 1m temperature measurement since 2005. At a low priority a new sensor could be fitted.

System M87-068 has had a non working temperature sensor in the outer enclosure since 2005. At low priority a new sensor could be fitted. The battery and depth temperature sensors have spikes on the data for unknown reasons.

M84-336, M85-002, M82-003 have all shown high battery temperature maximums since 2005. In all three systems many periods can be seen when the dump box operates (solar voltage pulled down to about 5v). The high maximum temperatures may be due to deeper than normal discharging due to a software problem (fixed in 2010 onwards) and the relatively poor wind generator coverage (discussed in the next section).

4.2 Battery voltage data

Battery voltage is important as it indicates the charge state of the batteries. If the batteries are too deeply discharged then they will have a shortened life (which could be as short as one discharge in the severe case). As the method of retaining battery charge is to slow down the sampling rate of the magnetometer, too conservative estimation of battery voltage will result in reduced high resolution data coverage.

Voltage is not important for correct operation of the instrument itself as all power supplies are derived from DC-DC converters that are specified down to 8v.

Of chief importance is the state of charge of the batteries. At room temperature, 13V would indicate 100% available, and 12V 20% available. It is therefore possible to calculate how much battery power has been used during periods of no charge and compare this with the calculated usage. Since 2005 with 1s sampling and a 10minute GPS fix every 4 hours the calculated power consumption is 458mW (118mW at 10s and 85mW at 60s sampling). The ratio of calculated use to measured use is presented in table 8 – a value below 1 indicates poor battery performance. Not too much significance on these numbers for a particular system for a particular year but over several years they do reveal the general trend of battery performance.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337	1.43	1s	12.29	12.40	-31.4	3
M79-336	1.90	1s	12.30	12.51	-28.0	3
M81-388	0.82	1s	12.07	12.30	-33.4	3,2
M82-003	1.15	1s	11.43	11.77	-43.6	4
M83-347	1.19	1s	11.76	11.88	-44.1	
M84-336						2
M85-002	0.41	1s	8.96	11.52	-50.9	4
M85-096						2
M87-028						2
M87-069	0.18	1s	8.65	9.92	-52.4	4
M88-316	0.85	1s	9.92	11.66	-48.0	4

Table 8a. Battery data in **2009**
Note 2, Not enough data to report.
Note 3, Cellyte rather than Sunlyte batteries.
Note 4, Battery knee evident.

In 2008 site M87-068 showed some anomalous battery voltage behaviour (see figure 1).

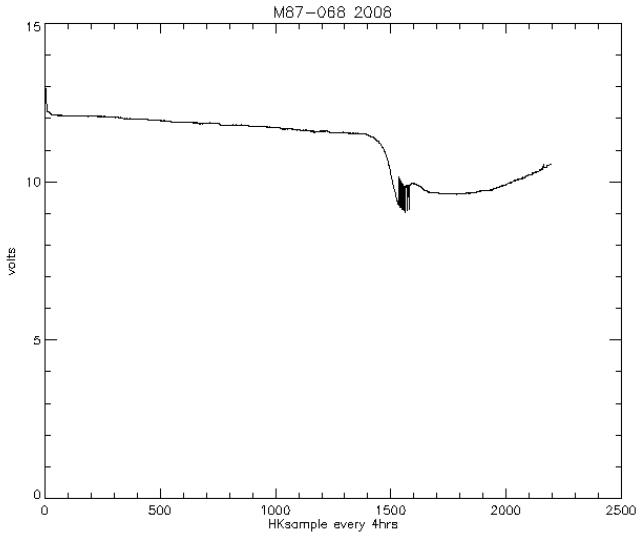

Figure 1 The battery voltage from M87-068 in 2008, there is no evidence of charging.

In 2009 (figure 2) , there is still no evidence of charging until the spring (at around sample 1500) when charging starts to take place. The decline in the battery voltage over the period of spring 2008 to Spring 2009 is consistent with the power usage at 10s sampling. As the logger changed between these years, the problem is one with the site, although it looks like it maybe intermittent.

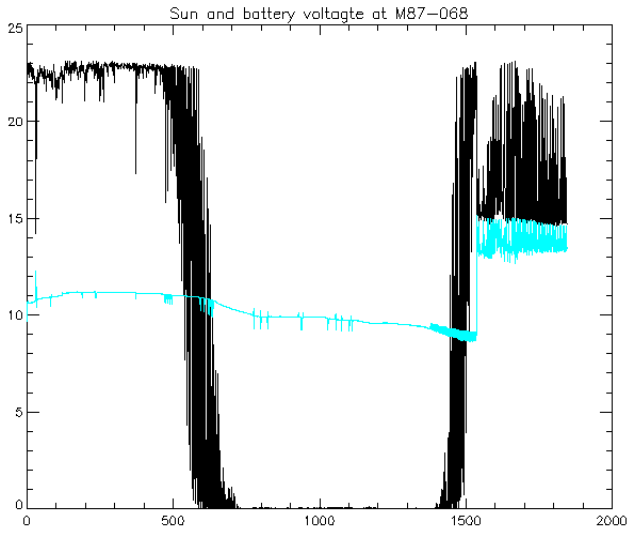

Figure 2. The battery and solar panel voltage from M87-068 in 2009. Black is solar panel voltage, blue is battery voltage.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337			8.7			3,2
M79-336	0.82	1s	12.29	12.44	-29.9	3
M81-388						3,2
M82-003	0.87	1s	11.46	11.80	-44.1	
M83-347	1.36		11.82	11.93	-51.4	
M84-336						2
M85-002	0.68	1s	11.37	11.76	-56.3	
M85-096						2
M87-028						No visit
M87-069	0.95	1s	9.04			4
M88-316						No visit

Table 8b. Battery data in **2008**
Note 2, Not enough data to report.
Note 3, Cellyte rather than Sunlyte batteries.
Note 4, Battery knee evident.

In 2007 it was noticed that M85-002 failed to slow down its sampling rate when the battery voltage was low, there was no obvious reason for this as the software has not changed since this feature was working and there is no hardware fault evident that would cause this behaviour. Subsequently Dome A was seen to show the same behaviour. As a consequence of staying at 1s sampling the batteries at both these sites did get deeply discharged to the point of the battery discharge knee being evident – see figure 3. It has been found out that there is a software bug that manifests during very cold temperatures, this has been rectified in version 4.2 of the logging program which has been fitted to loggers that were deployed in the 2009/10 season. Interestingly the batteries at M85-002 showed no ill effects in 2008 from their deep discharge in 2007 although the battery voltage in 2009 does show the deep discharge knee earlier in winter (figure 4).

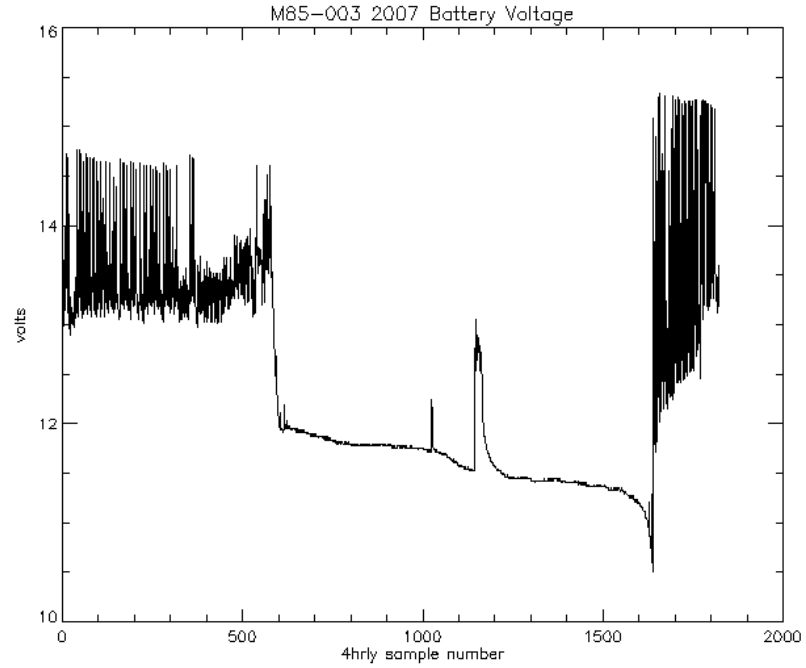

Figure 3. M85-002 Battery voltage in 2007, showing deep discharge ‘knee’

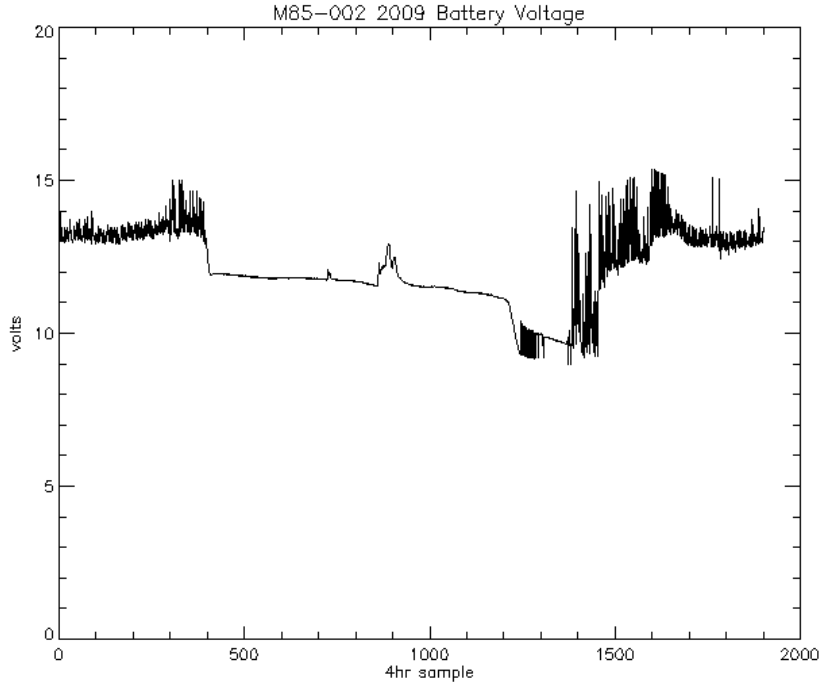

Figure 4. M85-002 Battery voltage in 2007, showing deep discharge ‘knee’

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337	1.23	1s	12.23	12.29	-32.4	3
M79-336	0.75	1s	12.29	12.44	-29.5	3
M81-388	0.90	1s	12.11	12.34	-34.8	3
M82-003	0.96	1s	11.43	11.74	-45.1	
M83-347						2
M84-336	0.87	1s	11.66	11.74	-45.6	
M85-002	0.61	1s	10.51	11.76	-52.9	4
M85-096	1.83	1s	11.62	11.76	-55.8	
M87-028	1.36	1s	11.45	11.79	-49.0	
M87-069	1.47	1s	11.31	11.68	-57.3	
M88-316	1.06	1s	11.60	11.88	-48.0	

Table 8c. Battery data in **2007**
Note 1. Wind generator coverage makes * invalid.
Note 2, Not enough data to report.
Note 3, Cellyte rather than Sunlyte batteries.
Note 4, Battery knee evident.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337						2,3
M79-336						2,3
M81-388						2,3
M82-003						2
M83-347	1.08	1s	11.73	11.95	-47.0	
M84-336	1.32	1s	11.74	*	*	1
M85-002						2
M85-096						2
M87-028						2
M87-069						2
M88-316						2

Table 8d. Battery data in **2006**
Note 1. Wind generator coverage makes * invalid.
Note 2, Not enough data to report.
Note 3, Cellyte rather than Sunlyte batteries.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337	0.91	1s	12.22	*	*	1,2,3
M79-336	0.71	1s	12.15	*	*	1,2,3
M81-388	*	*	12.40	*	*	1,3
M82-003	1.06	1s	11.52	11.74	-48.0	
M83-347	1.32	1s	11.78	11.89	-48.0	
M84-336	*	*	11.77	*	*	1
M85-002	0.85	1s	11.33	11.66	-54.4	
M85-096	1.04	1s	11.50	11.67	-57.8	
M87-028	N/A	N/A	N/A	N/A	N/A	4
M87-069	1.04	1s	11.50	11.76	-54.8	
M88-316	1.08	1s	11.68	11.80	-50.9	

Table 8e. Battery data in **2005**
Note 1. Wind generator coverage makes * invalid.
Note 2, Usage calculation during pause in wind generation
Note 3, Cellyte rather than Sunlyte batteries.
Note 4, Short period of operation.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M68-292	0.13	10s	11.91			
M78-337	0.85	1	12.11	12.36	-34.3	3
M79-336	0.80	1	11.99	12.29	-32.9	3
M81-388	0.68	1	11.95	12.29	-35.8	3
M82-003	0.94	1	11.68	11.86	-49.5	
M83-347	*	*	11.86	*	*	1
M84-336	*	*	11.88	*	*	1
M85-002	0.68	1	11.43	11.72	-56.3	2
M85-096	0.73	1	11.60	11.68	-62.2	2
M87-028	1.23	1	11.64	11.76	-61.2	2
M87-069	0.93	1	11.58	11.68	-65.6	2
M88-316	1.04	1	11.76	11.86	-56.3	2

Table 8f. Battery data in **2004**
Note 1. Wind generator coverage makes * invalid.
Note 2, Usage calculation during pause in wind generation
Note 3, Cellyte rather than Sunlyte batteries.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337	0.56	1	12.09	12.34	-34.3	3
M79-336	0.62	1	12.03	12.25	-33.8	3
M81-388	0.62	1	12.01	12.27	-36.3	3
M82-003	1.13	1	11.52	11.64	-49.5	
M83-348	*	*	11.97	*	*	1
M84-336	*	*	12.36	*	*	1
M85-002	1.01	1	11.45	11.54	-57.8	2
M85-096	1.51	1	11.25	11.39	-64.6	2
M87-028	1.69	1	11.48	11.60	-56.3	2
M87-069	1.93	1	11.36	11.48	-60.7	2
M88-316	1.23	1	11.64	11.76	-55.3	2

Table 8g. Battery data in **2003**

Note 1. Wind generator coverage makes * invalid.

Note 2, Usage calculation during pause in wind generation

Note 3, Cellyte rather than Sunlyte batteries.

LPM	Use Ratio	Use calc@ sample rate	Min Volts	mid V	mid T	Notes
M78-337	1.02	1	12.13	12.40	-32.9	3
M79-336	0.97	1	12.13	12.48	-31.4	3
M81-388	1.13	1	12.13	12.25	-34.8	3
M82-003	0.41	3	11.98	11.99	-43.1	1
M83-348	0.54	3	11.91	12.03	-42.1	
M84-336	1.05	3	11.91	12.05	-42.1	
M85-002			12.13			1
M85-096	0.50	3	11.64	11.91	-58	2
M87-028	0.40	3	11.86	11.95	-50	2
M87-069	1.12	60	11.74	11.91	-47	2
M88-316						1

Table 8g. Battery data in **2002**

Note 1, Not a whole year.

Note 2, Mid T is Logger Temperature

Note 3, Cellyte rather than Sunlyte batteries.

The use ratio (calculated use/measured use) has to be interpreted with some caution, the batteries' voltage changes are actually quite small and this figure cannot be considered accurate. However tentative conclusions can be drawn by looking at the long term averages. The long term average use ratio of the Sunlyte batteries is 1.07 (from 39 samples) – which indicates that we get close to the rated AHrs from the batteries. The very low discharge currents compensating for the low temperatures. The long term average use ratio for the Cellytes is 0.93 (from 18 samples) – this may indicate that they have slightly poorer performance.

Battery type	To 2003	2004	2005	2006	2007	2008	2009
Cellytes	0.82	0.78	0.81	No data	0.96	0.82[2]	1.38
Sunlytes	1.04	0.93	1.07	1.20[1]	1.17	0.97	1.17

Table 9. Average use ratio of the battery types.
Note 1. Just 2 sites.
Note 2. Just 1 site.
Note 3. Excludes M87-069, M85-002, M88-316, sites where the deep discharge knee is evident. Only 2 sites in average.

4.3 Wind generators.

The wind generators fitted in the 2002/3 season were rated to –40°C, and did not spin continuously at the cold sites. Whether a wind generator spins or not is a function of both the windspeed (which we don't have a record of) and temperature, but in general the –40°C rated generators seemed to work down to about –50°C. In the 2004/5 season Wind generators with –60°C rated were deployed at the colder sites (see table 10), but there is little evidence that the –60°C generators work any better in the extreme temperatures than the –40°C rated units.

Site	2003	2004	2005-2009
M68-292	Not fitted	Not fitted	Not fitted
M78-337	Not fitted	Not fitted	WG12/04-40C
M79-336	Not fitted	Not fitted	WG13/04-40C
M81-388	Not fitted	Not fitted	WG20/04-40C
M82-003	Not fitted	Not fitted	WG19/04-60C
M83-347/8	WG07/02-40C	WG07/02-40C	WG15/04-60C
M84-336	WG??/02-40C	WG??/02-40C	WG21/04-60C
M85-002	WG??/02-40C	WG??/02-40C	WG17/04-60C
M85-096	WG02/02-40C	WG02/02-40C	WG18/04-60C
M87-028	WG04/02-40C	WG04/02-40C	WG14/04-60C
M87-069	WG03/02-40C	WG03/02-40C	WG24/04-60C
M88-316	WG01/02-40C	WG01/02-40C	WG16/04-60C

Table 10: Wind generator serial number at each site.

It is possible to estimate what the wind generator is delivering **when it is operating** by examining the way battery voltage has changed between periods of wind generator non-operation. Table 11 summarises wind generator performance and gives an estimate of the power from the wind generator (when spinning). Although winter performance is pretty dire, the wind generators do add charge in the important pre-winter period.

LPM	Rating	Winter Performance	Wind Operating temperatures	Estimated Average Power	Notes
M78-337	-40C	some	>-30C	1W	
M79-336	-40C	some	>-30C	1W	
M81-388	-60C	some early	>-30C	0.5W	
M82-003	-60C	none			
M83-347	-60C	none			
M84-336	-60C				1
M85-002	-60C	some	>-50C	0.4W	
M85-096	-60C				1
M87-028	-60C				1
M87-069	-60C				1
M88-316	-60C	none	>40C		

Table 11a. Wind generator performance in **2009**
None < practically none < some < reasonable < lots
Note 1, Not enough data to report.

LPM	Rating	Winter Performance	Wind Operating temperatures	Estimated Average Power	Notes
M78-337	-40C				1
M79-336	-40C	Practically none	>-30C	0	1
M81-388	-60C				1
M82-003	-60C	None		0	
M83-347	-60C	None	>-40°C	0	
M84-336	-60C				1
M85-002	-60C	Some	>-50°C	0.5W	1
M85-096	-60C				1
M87-028	-60C				Not visited
M87-069	-60C	None			1
M88-316	-60C				Not visited

Table 11b. Wind generator performance in **2008**
None < practically none < some < reasonable < lots
Note 1, Not enough data to report.

LPM	Rating	Winter Performance	Wind Operating temperatures	Estimated Average Power	Notes
M78-337	-40C	some	>-30C	0.5W	
M79-336	-40C	some	>-30C	0.5W	
M81-388	-60C	None		0	
M82-003	-60C	None		0	
M83-347	-60C	reasonable early	>-40°C	0.6W	
M84-336	-60C	Practically none			1
M85-002	-60C	Practically none			1
M85-096	-60C	None			1
M87-028	-60C	None			1
M87-069	-60C	None			1
M88-316	-60C	None			1

Table 11c. Wind generator performance in **2007**
None < practically none < some < reasonable < lots
Note 1, Not enough data.

LPM	Rating	Winter Performance	Wind Operating temperatures	Estimated Average	Notes
M78-337	-40C				1
M79-336	-40C				1
M81-388	-60C				1
M82-003	-60C				1
M83-347	-60C	reasonable early	>-50°C	0.90W	
M84-336	-60C	reasonable	>-55°C	0.46W	
M85-002	-60C				1
M85-096	-60C				1
M87-028	-60C				1
M87-069	-60C				1
M88-316	-60C				1

Table 11d. Wind generator performance in **2006**.
None < practically none < some < reasonable < lots
Note 1, Not enough data.

LPM	Rating	Winter Performance	Wind Operating temperatures	Estimated Average Power	Notes
M78-337	-40C	Some	>-40°C	0.83W	
M79-336	-40C	Some	>-35°C	1.23W	
M81-388	-40C	Reasonable	>-50°C	*	1
M82-003	-60C	None	>-40°C	*	1
M83-347	-60C	Some early	>-55°C	*	1
M84-336	-60C	Lots	>-60°C	*	1
M85-002	-60C	None	>-45°C	*	1
M85-096	-60C	Practically None	>-55°C	*	1
M87-028	-60C	N/A	N/A	N/A	2
M87-069	-60C	None	>-45°C	*	1
M88-316	-60C	None	>-45°C	*	1

Table 11e. Wind generator performance in 2005.
None < practically none < some < reasonable < lots
Note 1, Wind generator coverage (high or low) makes * invalid.
Note 2, Short period of operation.

5.0 Site work performed the in 2009/10 season.

1. All podules replaced as normal, with logger program v4.2 to overcome temperature/sampling rate bug.

2. Wind generators at M78/337 and M79/336 were raised this season.

5.1 Summary of investigations highlighted in earlier annual reports.

Investigate why M68-292 magnetic values changed on 22/12/08 – looks like broken sensor due replacement in 10/11 season.

Investigate why M78/337 in 2008 spent so much time not working, and why its sampling rate was slow – no obvious reason, all ok in 2009.

Confirm that M81/338's logger (L43/03) that got VTG rather than ZDA messages was due to incorrect setup – confirmed.

Investigate why M84/336's GPS failed (L04/00) – Failure of DCDC converter on power card.

Remove non standard analogue card from M85/002 (L07/00) – done

Investigate why M85/096 (L23/01) had limited coverage and why did its temperature readings go awry – no obvious reason, very poor in 2009 too.

Investigate why M87/068 (L03/00) – had noisy data from 27/8/08 to 21/10/08 – seems related to very low power due to no charging.

6.0 Summary of work planned for 2010/11 season.

Replace magnetometer sensor at M68-292.

Prepare for complete excavation and redeployment of M79/336 at next raise (it has already been raised twice).

M81/338 should be raised if its enclosure height is less than 0.8m.

M85/002 should be raised if its enclosure height is less than 0.9m.

Raise the wind generators on M81-338, M85-096 and M87-028 if their heights are less than 0.8m.

Consider putting a meteorological grade temperature sensor on M85-002, M85-096 and M87-069.

System M83-347 has had a non-working 1m temperature measurement since 2005. At a low priority a new sensor could be fitted.

System M87-068 has had a non working temperature sensor in the outer enclosure since 2005. At low priority a new sensor could be fitted. Investigate the battery and depth temperature sensors and why they have spikes on the data.

Investigate why there is no evidence of charging at M87-068.

APPENDIX 1

LPM Positions

BAS Low Power Magnetometer Sites

Site	Name	1st Deployed	Latitude	Longitude	Elevation ft	IGRF Declination	IGRF H in nT	IGRF Z in nT
M68/292	Nursie (Rothera)	18/03/03	67°34’11”S	68°07’00”W	50	+20°46	21396	36279
M78/337	Dr Leech	04/01/01	77°30'40"S	23°25'31"W	5200	-3°12'	19590	40978
M79/336	Bob	03/02/00	79°04'36"S	24°07'11"W	4000	-2°34'	19490	42566
M81/338	Edmund	07/01/01	80°53'18"S	22°15'50"W	3860	-3°59'	19251	44348
M82/003	Mrs Miggins	21/01/01	81°29'33"S	02°58'23"E	7900	-24°21'	18974	45079
M83/348	Baldrick	23/01/01- 16/01/05	82°53'57"S	12°14'39"W	6900	-12°21'	18837	49960
M83/347[1]	Baldrick	16/01/05	82°46'30"S	13°03'07"W	6900	-12°21'	18837	49960
M84/336	Baron Richthoven	15/01/01	84°21'14"S	23°51'30"W	6700	-2°58'	18519	47860
M85/002	Lord Melchett	23/01/01	85°21'26"S	02°03'47"E	8800	-25°57'	18139	48909
M85/096	Baby Eating Bishop	22/01/02	85°21'23"S	95°58'32"E	10500	-118°12'	15752	54672
M87/028	Flash Heart	19/01/02	86°59’58"S	28°24'37"E	9330	-51°09'	17495	50792
M87/068	Speckled Jim	22/01/02	86°30'53"S	68°10'19"E	10650	-90°51'	16678	52773
M88/316	Lord Whiteadder	19/01/02	88°01'30"S	43°52'02"W	8370	+16°08'	17276	51644

Positions are from a single GPS fix from the logger in Jan 2003.
Note 1. M83/348 was removed on the 16/01/05, and replaced with M83/347
Elevations are those given by the airunit (estimated for Rothera).
IGRF values are those quoted 31/01/2000.
Rothera is included from the date it became a standard LPM.

BAS Low Power Magnetometer Sites
Site name cross reference

Site	LPM Name	Operation's Site name	Other name
M68/292	Nursie	Rothera	
M78/337	Dr Leech	Buzzard	A77
M79/336	Bob	Condor	
M81/338	Edmund	Eagle	A80
M82/003	Mrs Miggins	Falcon	A81
M83/347	Baldrick	Hawk	
M84/336	Baron Richthoven	Kite	A84
M85/002	Lord Melchett	Kestrel	
M85/096	Baby Eating Bishop	Merlin	
M87/028	Flash Heart	Osprey	
M87/068	Speckled Jim	Raptor	
M88/316	Lord Whiteadder	Vulture	

AFI/BAS Low Power Magnetometer Sites

These are 0.1nT/5s variants of the normal LPMs.

Site	Name	1st Deployed	Latitude	Longitude	Elevation ft	IGRF Declination	IGRF H in nT	IGRF Z in nT
Lockroy	Percy	29/11/00	64°49’28”S	63°29’20”W	10	+16°08’	21223	33010
Trump Island	Queenie	01/12/00	66°01’57”S	65°58’12”W	10	+18°27’	21366	34544
Rothera	Nursie	12/12/00	67°29’18”S	68°09’47”W	50	+20°46	21396	36279

Positions are those given by the deployment teams.
Elevations are estimated.
IGRF values are those quoted 31/01/2000.

JAPANESE NIPR/BAS Low Power Magnetometer Sites

Site	Name	1st Deployed	Latitude	Longitude	Elevation ft	IGRF Declination	IGRF H in nT	IGRF Z in nT
J70/039[1]	Skallen	15/01/03	69°40’23”S	39°24’06”E	30	-48°41”	19206	39127
J68/041[1]	Omega	31/01/03	68°34’39”S	41°04’53”E	140	-49°39”	19171	38842
J69/041[1]	H100	01/01/03	69°17’44”S	41°19’15”E	4260	-50°05”	19198	39375
J77/035[1]	DomeF	06/02/03	77°19’02”S	39°42’33”E	12340	-52°48”	18969	44686
J70/044[2]	Mizuho	18/10/04	70°42’07”S	44°17’02”E	70	-53°22”	19162	41072
J74/043[2]	MD364	29/10/09	74°00’36”S	42°59’31”E	50	-53°55”	19084	42925

Note: These sites have not operated continuously but single LPM systems have been moved around.

Note 1. Positions are from a single GPS fix from the logger in Jan/Feb 2003.
Elevations are estimated from a single GPS fix from the logger in Jan/Feb 2003.
IGRF values are those quoted 01/02/2003.

Note 2. Position is average of 2005. Elevation from single fix when logger first started. IGRF from 1/1/2005.

CHINESE PRIC/BAS Low Power Magnetometer Sites

Site	Name	1st Deployed	Latitude	Longitude	Elevation ft	IGRF Declination	IGRF H in nT	IGRF Z in nT
M80/077[1]	Dome A	17/01/08	80°25'08"S	77°05'24"E	13428	-91°45"	16667	-52475
M77/077[2]	DT299	8/02/09	77°10'34"S	76°57'34"E				
M75/077[2]	DT154	17/02/09	74°35'04"S	77°01'11"E				
M72/078[2]	LT892	20/02/09	71°40'27"S	77°45'55"E				

Note 1. Position is average of 2008. Elevation is generally accepted value. IGRF from 1/1/2008.

ITALIAN IGNV/BAS Low Power Magnetometer Sites

Site	Name	1st Deployed	Latitude	Longitude	Elevation ft	IGRF Declination	IGRF H in nT	IGRF Z in nT
M73/159[1]		15/01/08	72°46’05”S	159°01’52”E	7766	-91°45”	6629	-64483

Note 1. Position is average of 2008. Elevation is from first spot GPS reading. IGRF from 1/1/2008.

APPENDIX 2

Document History

V1.0 31/1/11 1st Public version