Imperial College London

MAG Data Release Report 2203

28 May 2024 (report covers data release for 1-31 Mar 2022)

Report Version	2	L2 ground processing software version:	V2.26.1
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Data Summary

V2 updates 2024:
After an investigation by ESA, Airbus and Imperial, the unexplained spacecraft interference has been confirmed not to impact the science quality of the OBS data. Cleaning of data around thruster firings requires use of the contaminated IBS data so users should beware of data during these periods, which can be identified by the thruster flag. These now re-released periods have also been quality flagged to level 2, due to the effect on the IBS data, as IBS-OBS is also an important tool in offset determination. This SC interference had historically resulted in the data not being released for these periods. The MAG team is now working to re-release these previously retracted periods, please see the Appendix for the periods now released.

V1:
MAG was on throughout March 2022.

On the 14th of March there are several gaps for a total of 2 hours missing data. This data was lost due to bad weather at the ground station Cebreros. The ESA ops and MAG teams are working on filling the gaps.

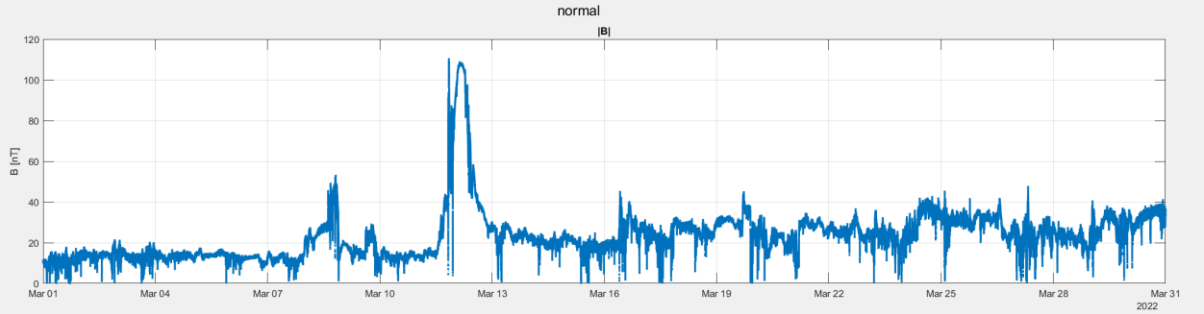
Approaching the Sun, the magnetic field measured by MAG became stronger and more variable, as expected. This high variability did not allow us to fully characterize and remove the **MAG heater signal** around perihelion using the usual algorithm. The heater signal is still partially visible in our quality check comparison of the field measured at the outboard and inboard sensors. The remnant heater signal (<0.7nT pkpk variation, primarily in the sensor y axis/B_T in RTN coordinates on a ~15 minute timescale) is very small compared to the magnitude of the natural field (20+nT), so we are releasing the data to be exploited for scientific research with no limitations.

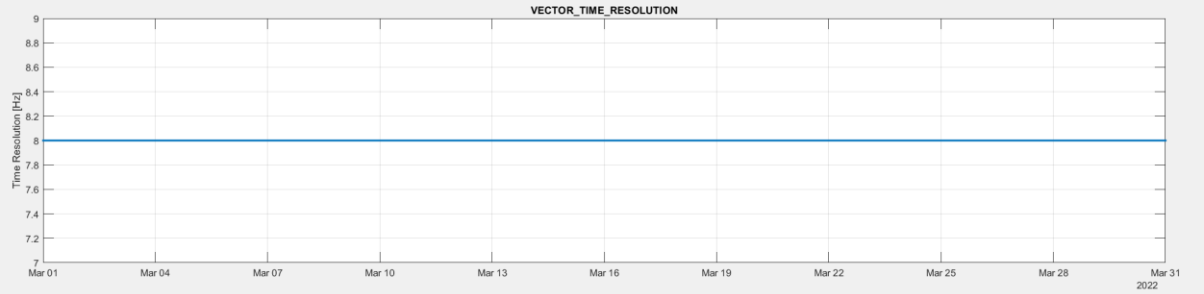
Spacecraft noise was observed for several periods (there was significant noise for a total of 69 hours in the period 1-31 Mar 2022). This noise is very clear in IBS, the source has not been identified. We can see evidence for it being there in OBS as well and have not got algorithms to clean this from the data. The magnetic field data have been converted to NaNs when the noise in the data was particularly high. The full period of missing data is listed in the appendix of this report. If you have particular need for any data during these periods, please contact the MAG team and we see if the data maybe suitable for release for certain applications.

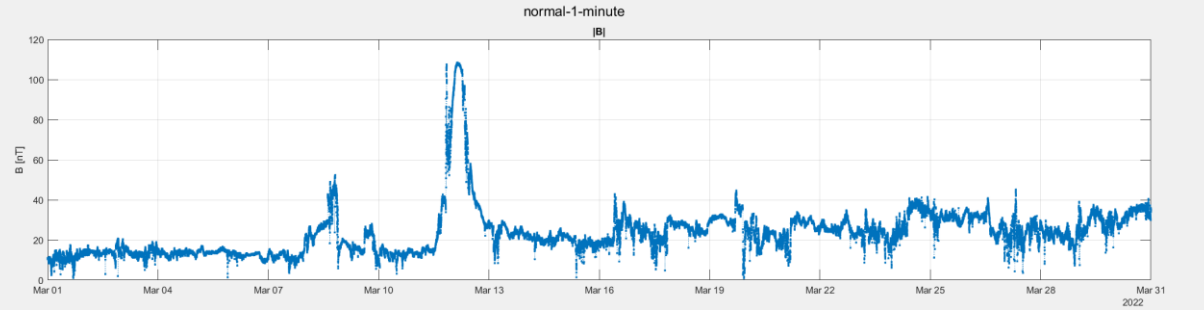
The 13th of March 2022 cannot be released because spacecraft generated interference was high for the entire day.

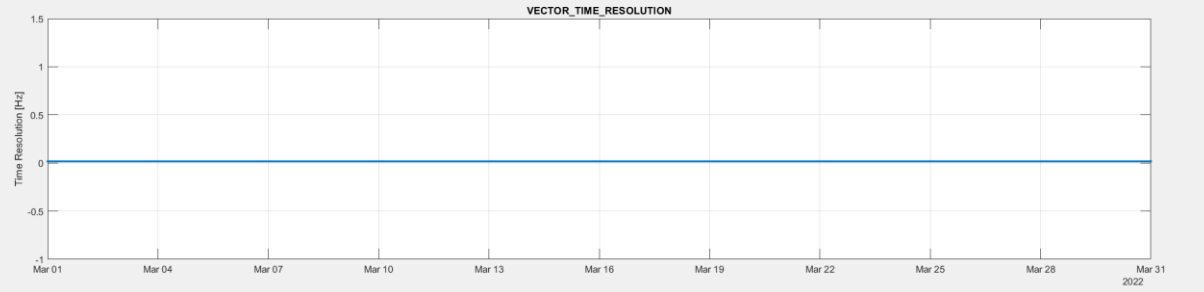
The spacecraft started the month at 0.57AU, went through a perihelion pass at 0.32AU on 26 March and ended the month (31 March) at 0.34AU from the Sun.

Normal Mode







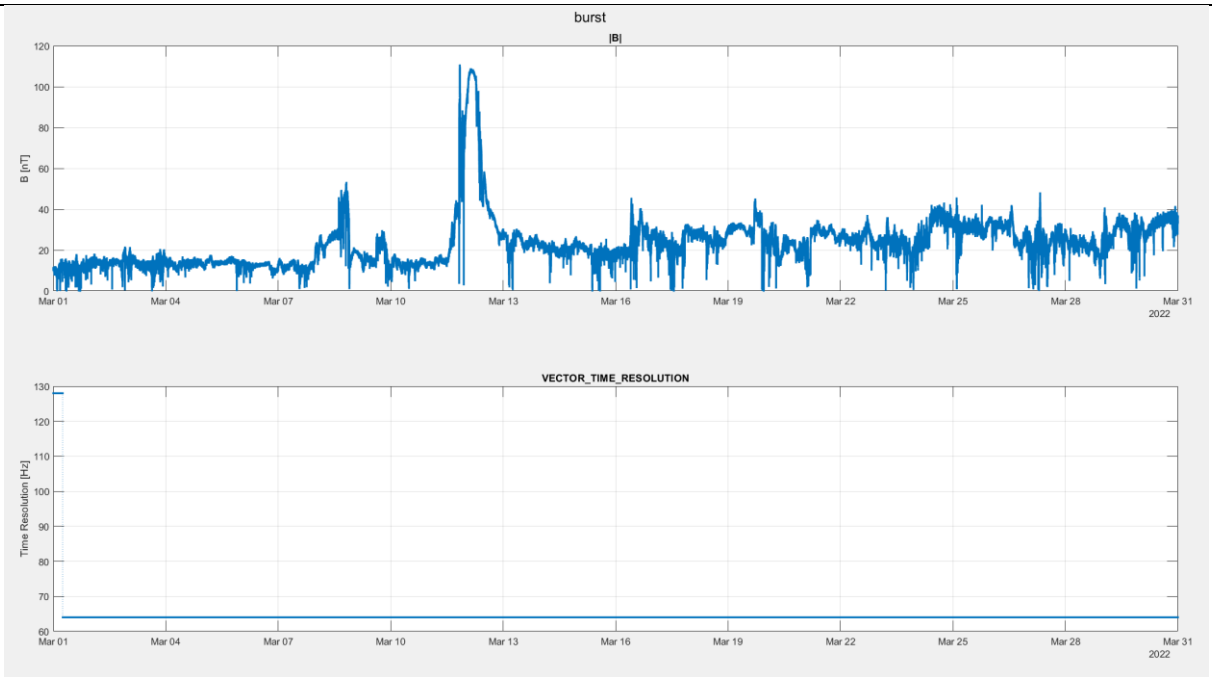


MAG was on with 8Hz cadence normal mode data returned, for exceptions see below.

Operations	1-31 March	Science phase throughout period, normal data returned
Operational Events of Note	Perihelion (0.327AU) on the 26/03/2022 at 11:50.	

Data Gaps greater than one minute:
There are several gaps on the 14th of March due to lost packets.
NaNs have been introduced during the noisiest periods because the data was highly disturbed. See Appendix for details.

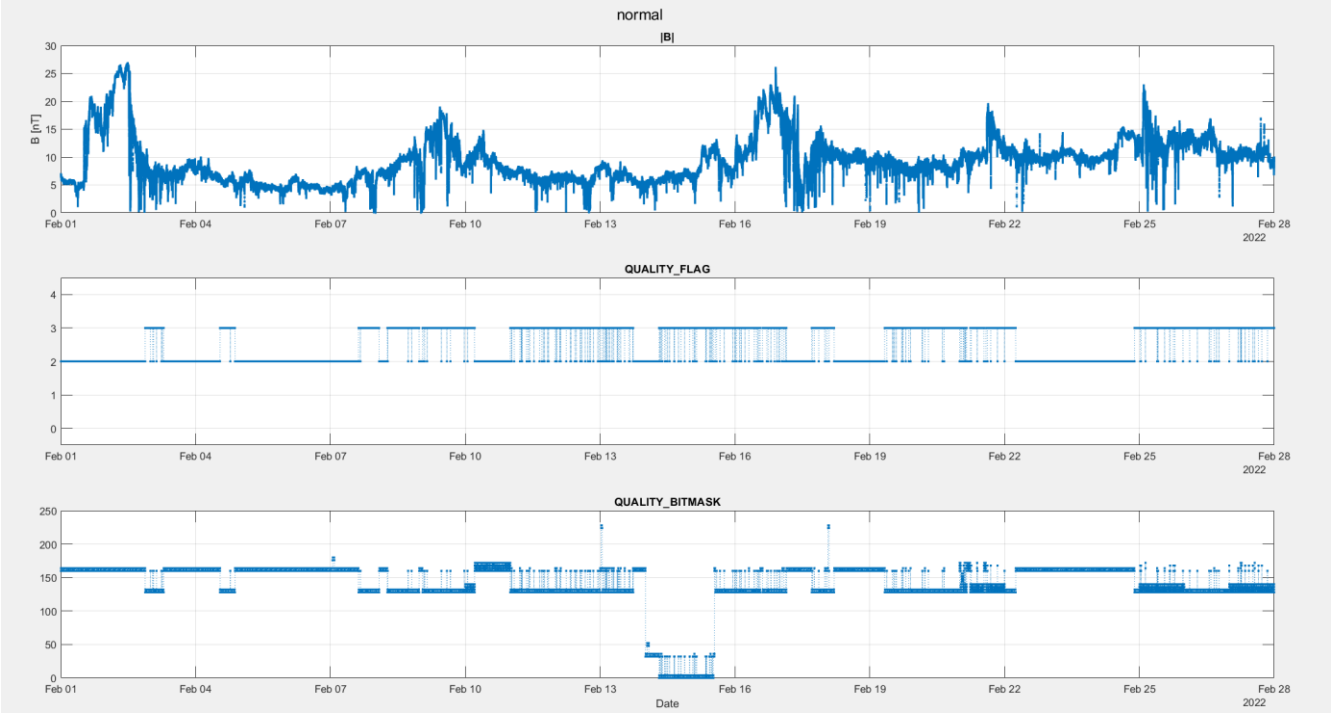
Burst Mode



Coverage is continuous, except the data gaps due to bad weather at the ground station on the 13th and 14th of March.

Coverage	From	To	Coverage
	01/03	01/03 06:00	24 hours per day 128 Hz
	01/03 06:00	31/03	24 hours per day 64 Hz

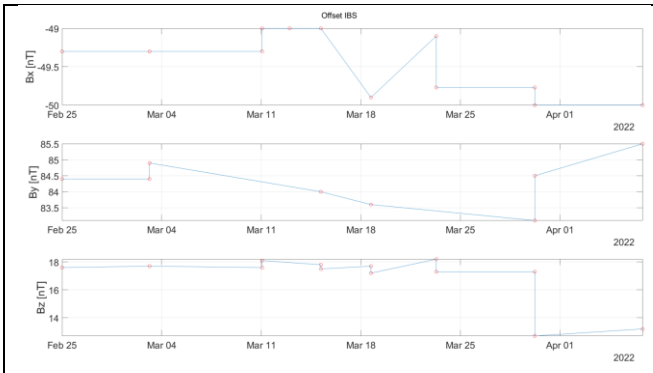
Quality bitmask

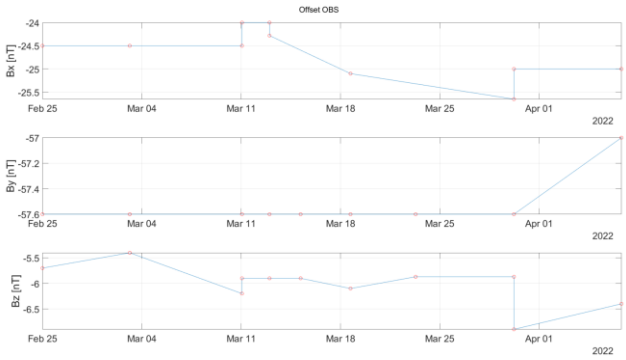


Quality bit mask events	
SC events which disturb the field	1. Thruster firings 2. Solar array lubrications (solar array is moved 15 degrees, then returned to original position) 3. Solar array movements (solar array angle is changed, and then remains at new angle due to sun-SC distance thermal constraints) 4. High gain antenna movements
SC related issues	

Time	Reason
03/03/2022 03:32	Solar Array movement from 60 to 70 deg
11/03/2022 01:24	Solar Array movement from 70 to 73 deg
15/03/2022 00:04	Solar Array battery top up event
15/03/2022 04:32	Solar Array movement from 73 to 77 deg
23/03/2022 07:08	Solar Array movement from 77 to 79 deg
29/03/2022 16:36	Solar Array movement from 79 to 77 deg

Offset





1-31 March:
IBS and OBS offsets were affected by the solar arrays events and movements listed in the previous sections. These offsets have been quantified and removed from the L2 data.

Offset	Date	OBSX	OBSY	OBSZ	IBSX	IBSY	IBSZ	Comment
20220303	22/02/2022 18:37	-24.5	-57.95	-5.7	-49.5	84.24	17.44	Post SA current event
20220303	25/02/2022 00:00	-24.5	-57.6	-5.7	-49.3	84.4	17.6	End linear trend after SA current even
20220303	03/03/2022 03:32	-24.5	-57.6	-5.4	-49.3	84.4	17.7	Pre SA movement from 60 to 70 deg
20220303	03/03/2022 03:34	-24.5	-57.6	-5.4	-49.3	84.9	17.7	Post SA movement from 60 to 70 deg
20220304	11/03/2022 01:24	-24.5	-57.6	-6.2	-49.3		17.6	Pre SA movement from 70 to 73 deg
20220305	11/03/2022 01:25	-24	-57.6	-5.9	-49		18.1	Post SA movement from 70 to 73 deg
20220313	13/03/2022 00:00	-24	-57.6	-5.9	-49			Offset correction for data set up to 12 March
20220338	13/03/2022 00:00	-24.28	-57.6	-5.9	-49			Offset correction for data from 14 March
20220314	15/03/2022 04:32		-57.6	-5.9	-49	84	17.8	Pre SA movement from 73 to 77 deg
20220315	15/03/2022 04:33		-57.6				17.5	Post SA movement from 73 to 77 deg
20220316	18/03/2022 17:00	-25.1	-57.6	-6.1	-49.9	83.6	17.7	Unknown event visible as step in IBS-OBS
20220317	18/03/2022 17:00	-25.1	-57.6		-49.9		17.2	Unknown event visible as step in IBS-OBS
20220318	23/03/2022 07:08		-57.6	-5.87	-49.1		18.2	Pre SA movement from 77 to 79 deg
20220319	23/03/2022 07:08		-57.6	-5.87	-49.77		17.3	Post SA movement from 77 to 79 deg
20220320	30/03/2022 05:21	-25.65	-57.6	-5.87	-49.77	83.1	17.3	Pre SA current event
20220321	30/03/2022 05:21	-25		-6.9	-50	84.5	12.7	Post SA current event
20220322	06/04/2022 19:11	-25	-57	-6.4	-50	85.5	13.2	Pre SA movement from 77 to 73 deg

SC Interference Re-Release

After an investigation by ESA, Airbus and Imperial, the unexplained spacecraft interference (SC interference) has been confirmed not to impact the science quality of the OBS data, so this is no longer being removed from these periods. Cleaning of data around thruster firings requires use of the contaminated IBS data so users should beware of data during these periods, which can be identified by the thruster flag. These now re-released periods have also been quality flagged to level 2, due to the effect on the IBS data, as IBS-OBS is also an important tool in offset determination.

Appendix

Appendix – Periods now released

StartTime	EndTime	Comment
03/03/2022 03:32	03/03/2022 03:34	SA movement from 60 to 70 deg
04/03/2022 18:45	04/03/2022 21:00	SC interference
05/03/2022 05:42	05/03/2022 05:46	SC interference
05/03/2022 10:10	05/03/2022 13:00	SC interference
06/03/2022 10:30	06/03/2022 11:40	SC interference
06/03/2022 12:00	06/03/2022 12:05	SC interference
06/03/2022 12:15	06/03/2022 12:32	SC interference
06/03/2022 12:43	06/03/2022 12:46	SA movement
06/03/2022 14:32	06/03/2022 14:39	SA movement
11/03/2022 01:24	11/03/2022 01:25	SA movement from 70 to 73 deg
11/03/2022 03:15	11/03/2022 07:15	SC interference
12/03/2022 02:30	12/03/2022 06:30	SC interference
12/03/2022 18:30	14/03/2022 00:00	SC interference
15/03/2022 04:32	15/03/2022 04:34	SA movement from 73 to 77 deg
17/03/2022 07:19	17/03/2022 07:49	SC interference
17/03/2022 11:24	18/03/2022 00:23	SC interference
19/03/2022 01:25	19/03/2022 01:28	SC interference
19/03/2022 01:42	19/03/2022 05:30	SC interference
19/03/2022 10:00	19/03/2022 10:30	SC interference
22/03/2022 02:00	22/03/2022 08:00	SC interference
22/03/2022 09:20	22/03/2022 09:37	SC interference
23/03/2022 07:07	23/03/2022 07:09	SA movement from 77 to 79 deg
29/03/2022 16:36	29/03/2022 16:37	SA movement from 79 to 77 deg

Appendix B: Files within this release

Filename	**Date release**
solo_L2_mag-rtn-burst_20220301_V01.cdf	19/08/2022
solo_L2_mag-rtn-burst_20220301_V01.cdf	19/08/2022
solo_L2_mag-rtn-burst_20220302_V01.cdf	19/08/2022
solo_L2_mag-rtn-burst_20220303_V01.cdf	19/08/2022
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solo_L2_mag-rtn-burst_20220308_V01.cdf	19/08/2022

solo_L2_mag-rtn-burst_20220309_V01.cdf	19/08/2022
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solo_L2_mag-srf-normal_20220316_V01.cdf	20/09/2022
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solo_L2_mag-srf-normal_20220318_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220319_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220320_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220321_V01.cdf	20/09/2022

solo_L2_mag-srf-normal_20220322_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220323_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220324_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220325_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220326_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220327_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220328_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220329_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220330_V01.cdf	20/09/2022
solo_L2_mag-srf-normal_20220331_V01.cdf	20/09/2022