Imperial College London

MAG Data Release Report 2101

17 Jan 2024 (report covers data release for 1-17 and 21-31 Jan)

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 for the period 1-17 and 20-31 January, in burst mode throughout.

MAG was turned off on 17 January for CSW update and was switched on again on 20 January. This release covers **1-17 and 21-31 January**. 20 January will not be released due to interference after reboot.

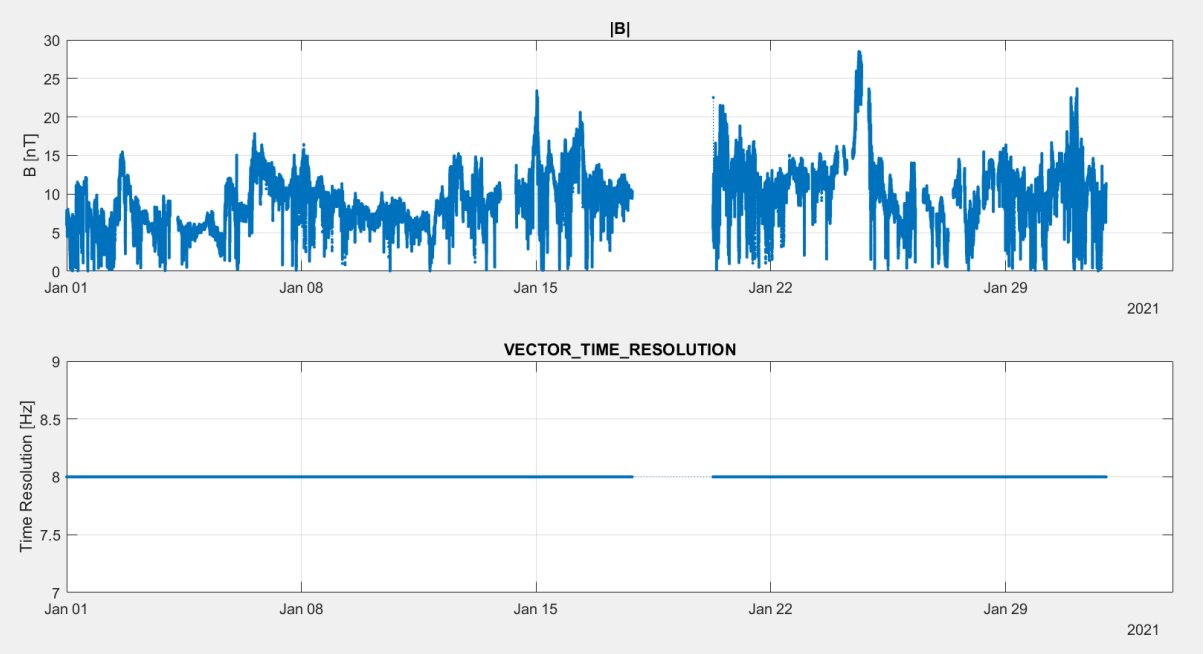
In January there were events such as the solar arrays and high gain antenna movements, which generated **offset changes** in the inboard and outboard sensors.

On **10, 17 and 24 January**, there were three solar array current events which are not yet fully understood, but which caused a large step change in offset at the inboard sensor (more than 1nT in all components) and a smaller change in the outboard sensor. The MAG team has characterised and removed this step.

Higher frequency (2-15Hz) interference from the MAG heater is observable in burst mode data throughout January: please, see the last section of this report for further details.

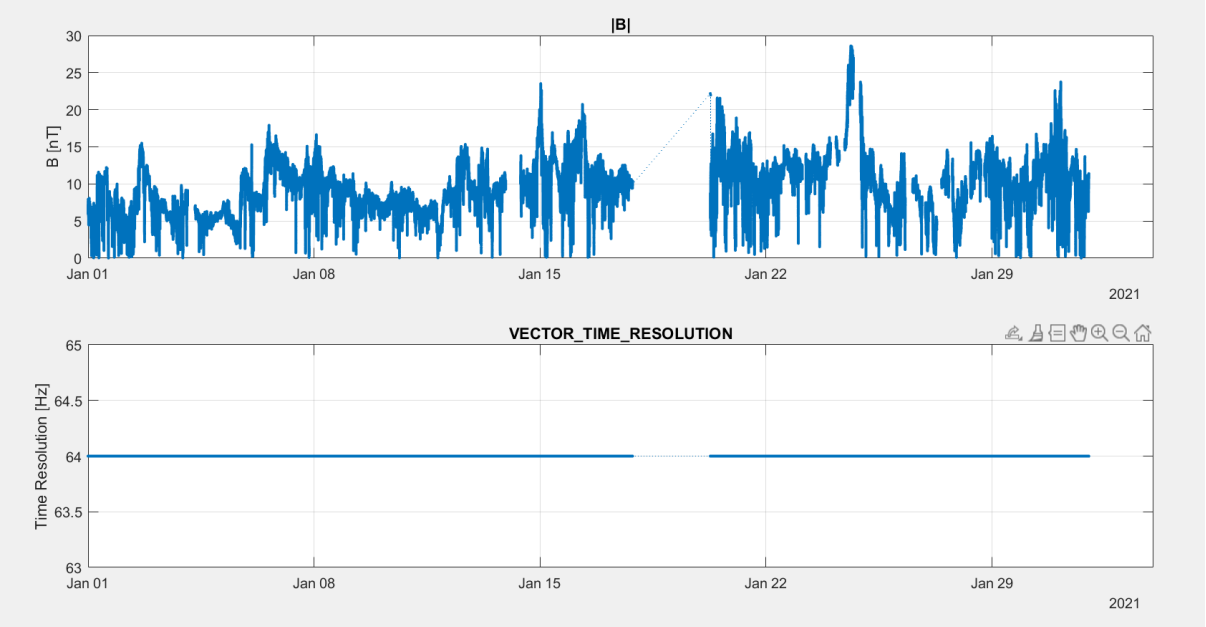
The spacecraft started the month at 0.69AU and ended it at 0.51AU.

Normal Mode



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

Operations	1-31 Jan	Cruise phase throughout period
Operational Events of Note	On 17th Jan 2020 at 20:51 MAG has been switched off for CSW update. It was switched on again on 20th Jan 2020 at 06:00.	

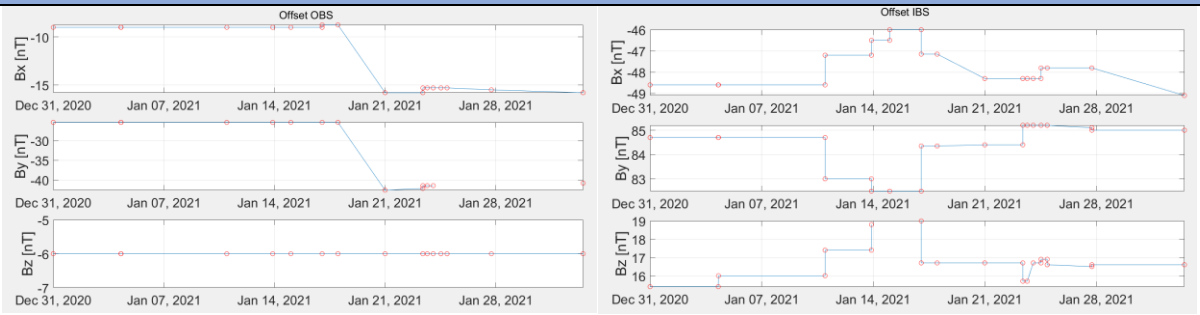
Burst Mode


Coverage continuous. Data at 64 Hz cadence.			
	From	To	Coverage
Coverage	1/01	31/01	24 hours 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	- High gain antenna movement on 02/01/2021 at 03:42-11:15. This period has been flagged to quality level 2 because it was impossible to determine an accurate offset. Another HGA movement happened on 04/01/2021 at 06:45. - Solar array current event at 23:33 on 10/01/2021, on 17/01/2021 at 00:19 and on 24/01/2021 at 22:00. The period between the SA current event and MAG power off has been flagged to quality level 2 because it was impossible to determine an accurate offset. - Solar arrays movement at 09:20 on 23/01/2021. - Two unknown events affecting IBS offset: 13/01/2021 at 21:17 and 27/01/2021 at 17:20

Offset



1-31 Jan:
Both IBS and OBS offsets have been modified by the solar array current events and movements and IBS Offset has been modified by the high gain antenna movements and changes in IBS range. Two changes unrelated to any known SC events have been detected on the 13th and 27th January. These offsets have been quantified and removed from the L2 data.

Offset	Date	OBSX	OBSY	OBSZ	IBSX	IBSY	IBSZ	
119	31/12/2020 00:00	-9	-25.37	-6	-48.6	84.7	15.4	End of Dec 2020
119	04/01/2021 06:44	-9	-25.37	-6	-48.6	84.7	15.4	Pre HGA movement
120	04/01/2021 07:01	-9	-25.37	-6	-48.6	84.7	16	Post HGA movement
120	10/01/2021 23:33	-9	-25.37	-6	-48.6	84.7	16	Pre SA current event
121	10/01/2021 23:33	-9	-25.37	-6	-47.2	83	17.4	Pre SA current event
121	13/01/2021 21:17	-9	-25.37	-6	-47.2	83	17.4	Start unknown event affecting IBS
122	13/01/2021 21:17	-9	-25.37	-6	-46.5	82.5	18.8	End unknown event affecting IBS
123	15/01/2021 00:51	-9	-25.37	-6	-46.5	82.5		Pre IBS range change from 2 to 3
124	15/01/2021 00:51	-9	-25.37	-6	-46	82.5		Post IBS range change from 2 to 3
125	17/01/2021 00:19	-9	-25.37	-6	-46	82.5	19	Pre SA current event
126	17/01/2021 00:19	-8.75	-25.37	-6	-47.15	84.35	16.7	Pre SA current event
126	18/01/2021 00:20	-8.75	-25.37	-6	-47.15	84.35	16.7	MAG off
109	20/01/2021 23:59	-15.8	-42.6	-6	-48.3	84.4	16.7	MAG on
110	23/01/2021 09:18	-15.8	-42.15	-6	-48.3	84.4	16.7	Pre SA from 60 to 70 deg
111	23/01/2021 09:20	-15.3	-41.45	-6	-48.3	85.2	15.7	Post SA from 60 to 70 deg
111	23/01/2021 16:00	-15.3	-41.45	-6	-48.3	85.2	15.7	Start linear trend IBS Z

111	24/01/2021 01:00	-15.3	-41.45	-6	-48.3	85.2	16.7	End linear trend IBS Z, start linear trend OBS Y
127	24/01/2021 12:45	-15.3		-6	-48.3	85.2	16.7	IBS range 2
128	24/01/2021 12:45	-15.3		-6	-47.8	85.2	16.9	IBS range 3
129	24/01/2021 22:00	-15.3		-6	-47.8	85.2	16.9	Start SA current event
130	24/01/2021 22:00	-15.3		-6	-47.8	85.2	16.6	End SA current event
131	27/01/2021 17:20	-15.5		-6	-47.8	85.1	16.5	Pre unknown event affecting IBS
132	27/01/2021 17:20	-15.5		-6	-47.8	85	16.6	Post unknown event affecting IBS
133	02/02/2021 12:39	-15.8	-40.8	-6	-49.1	85	16.6	Pre unknown event affecting By. End linear trend OBS Y

MAG Heater 3-15Hz interference

An interference signal is generated by the MAG heater. This is routinely modelled and removed from the time series. However, during December and January, there was higher frequency noise (usually around 10Hz but at times in the range from 3 to 15Hz) associated with the times when the heater is operational. This is not cleaned from the burst mode data using the current technique. It has been filtered out of the NM data by the instrument low pass filters.

This interference is present throughout January: it always starts when the MAG heater is switched on and it stops when it is switched off. The heater is on for one minute, thus the observable signal lasts exactly one minute. The frequency characterising the signal is not fixed and such high variability has not been explained yet. The components of the field mostly affected by this signal is Bz (URF).

The flag called “MAGHEATERONFLAG” highlights the times at which the MAG heater was on, so it can be used to identify the periods in which the interference caused by the heater can be present.

The following spectrograms show the periodic signal as lighter vertical features emerging from the blue background. The duration of each single feature is one minute.

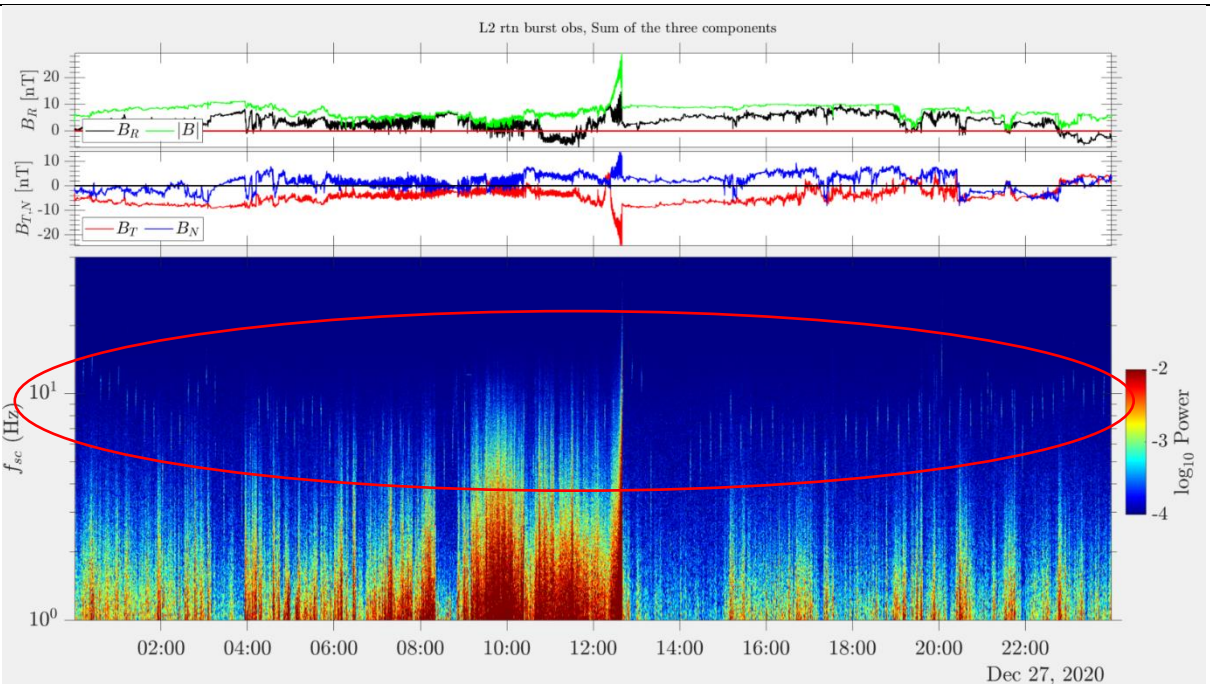


Figure 1: Spectrogram of OBS burst mode data (27th Dec 2020)

This signal is clearly correlated with the MAG heater, whose activations are represented in Figure 2 by red vertical lines. It is an artificial signal.

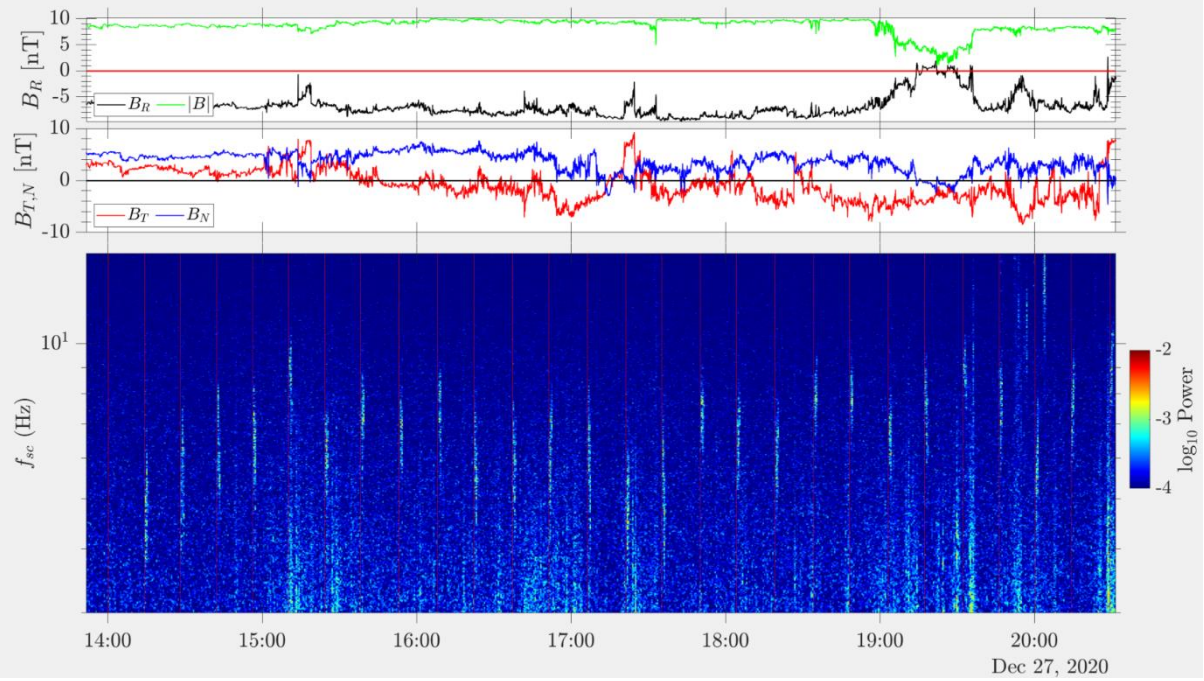


Figure 2: Spectrogram of OBS burst mode data (27th Dec 2020: from ~14:00 to ~20:30). The red vertical lines show the exact time at which the MAG heater was switched on.

Figure 3 shows the PSD of a period when the heater was on: Bz is the component of the field which is affected the most by the MAG heater interference.

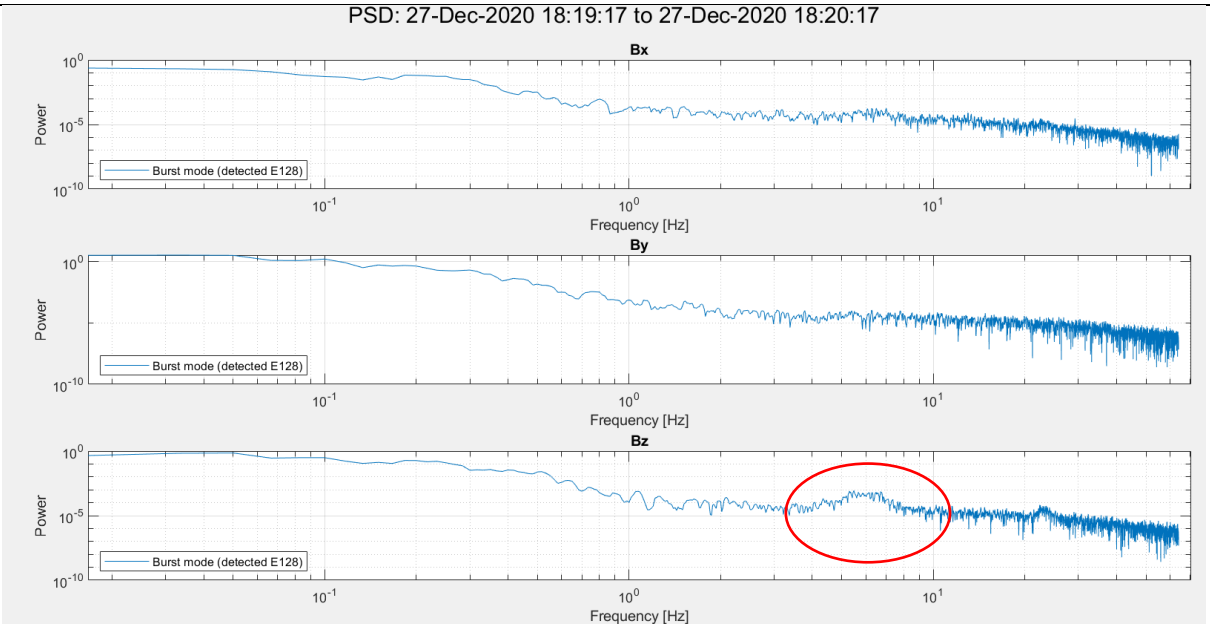


Figure 3: Power Spectral Density starting when the heater was switched on and ending when it was switched off. It represents OBS Bx By Bz in Sensor Reference Frame (URF). The PSD of the 3rd component shows a bump corresponding to the signal in the spectrogram.

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 – Periods now released.

StartTime	EndTime
04/01/2021 02:00	04/01/2021 07:30
04/01/2021 12:00	04/01/2021 12:30
04/01/2021 16:45	04/01/2021 18:00
04/01/2021 20:00	04/01/2021 20:30
04/01/2021 22:00	04/01/2021 22:20
05/01/2021 01:25	05/01/2021 02:00
12/01/2021 19:50	12/01/2021 20:20
13/01/2021 22:30	14/01/2021 09:30
15/01/2021 00:45	15/01/2021 01:00
21/01/2021 13:00	21/01/2021 14:30
21/01/2021 18:00	21/01/2021 19:00
22/01/2021 08:30	22/01/2021 09:00
22/01/2021 04:00	22/01/2021 05:00
23/01/2021 03:00	23/01/2021 05:35
24/01/2021 00:00	24/01/2021 04:00
24/01/2021 06:30	24/01/2021 10:30
24/01/2021 17:00	24/01/2021 22:00
26/01/2021 07:30	26/01/2021 13:00
26/01/2021 20:00	26/01/2021 22:30
27/01/2021 07:00	27/01/2021 10:30
27/01/2021 16:00	27/01/2021 18:30
28/01/2021 05:15	28/01/2021 08:00
28/01/2021 15:45	28/01/2021 18:30
28/01/2021 20:30	28/01/2021 22:00

Appendix – Files Released

Filename
solo_L2_mag-rtn-burst_20210101_V06.cdf
solo_L2_mag-rtn-burst_20210102_V06.cdf
solo_L2_mag-rtn-burst_20210103_V06.cdf

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