

We thank both reviewers for their suggestions and the time spent reviewing this article. Here we address their comments and describe how we have revised the manuscript in response. Please note that all line numbers quoted in our response refer to the tracked changes version of the manuscript.

- Adrian LaMoury, on behalf of the co-authors

### **Reviewer 1**

The paper presents some initial results from the J-MAG experiment during the JUICE Earth Flyby.

What is shown is mainly that a J-MAG measurements are largely in-line with expectations during the passage through the generally well-understood terrestrial magnetosphere - no new understanding is developed beyond this, with the exception of some initial indications as to the instrument behavior. This is to be seen within context of the other papers of this LEGA special issue. The bigger loss is the lack of deep-tail measurements that would otherwise have been possible given the JUICE trajectory, but were not operationally feasible, as such measurements are very rare and could have lead to genuinely new science.

The discussion regarding discrepancies between the constituent sensors is cursory, reflecting the early stage of the analysis. However, data quality should not be judged in this paper, as the data are not yet subject to conclusive calibration. The analysis shown demonstrates the performance of the instrument tentatively, without the data having undergone "the final calibration process" (whatever that may mean in practice - we are not told). The text makes this point consistently.

*The reviewer is correct that the data presented here are not the final calibrated data product and will be updated following further tests and operation periods. To clarify the current calibration status, we have added the new Section 'Calibration Summary' (line 125), which outlines the procedures performed on the data presented in the paper and those yet to be introduced or refined. Please note that this is a summary and not an extensive report on calibration parameters, as this is planned for a future work following refinement and more data.*

Annales Geo. publication policy is clear that the data comprising the figures should also be available. The JUICE project presented a possible repository for such un-calibrated data; others also exist. The current statement given in the paper is however not compatible with Annales' policy as it stands in my interpretation.

*A J-MAG LEGA data set has been deposited in an ESA Planetary Science Archive Guest Storage Facility repository specific to this special issue. This has been referenced in the Data Availability section (note that at time of writing, the repository is not yet publicly available, but when it is published it will be accessible by the doi included here).*

More detail would be interesting surrounding the discrepancies seen between the IBS and OBS sensor:

It is stated that "These axes were determined to be roughly perpendicular to the axis of the magnetometer boom during this period. It is therefore believed that a current source along the boom harness may be responsible for the signal seen by IBS, which would also explain why it was not seen by OBS, which is mounted further along the boom."

"Roughly perpendicular" could presumably be easily quantified? Because, what would be the

alternative? A current through the plasma would presumably be insignificant and not manifest in this way in the J-MAG sensors, and larger currents flowing elsewhere on the S/C bus would also not have such an appearance?

*We have clarified that when viewed in sensor frame, the disturbance is only seen in the two axes that are, by definition, perpendicular to the boom. We have also added detail on the other instruments on the boom with harness running past IBS to clarify why IBS has a greater risk than OBS of electrical disturbance, and made a back of the envelope calculation of the current required to generate such a disturbance in order to assess its plausibility. This updated discussion can be seen around line 270.*

Many readers will not be familiar with the scalar magnetometer technique. A brief elaboration would be a courtesy to the reader.

*We have added some additional details on the physical principles behind the scalar sensor (and references for further information) to the introduction at line 30.*

Line 143: "By performing a minimisation, we determined that a small rotation of less than  $1^\circ$  in each axis can reduce the maximum difference between the measured and modelled field at any point to 20 nT, which we consider very good agreement in this high field environment."

In my reading, this is ambiguous when stated so. Have the data shown in the figure (and subsequently) had this rotation applied or not?

*The data shown in the manuscript have had the rotation applied in Figures 4, 7, and 8. We have clarified this in the manuscript in the Calibration Summary section and when discussing Figure 4 (line 210).*

A potential temperature sensitivity is mentioned, but without reference to any similar effects known to affect previous missions in the same environment. Is there something here specific to JUICE/J-MAG in terms of susceptibility to this in this design?

*We discuss the temperature-dependent effects as part of the calibration summary, pointing towards a recent discussion on calibration drift of the Cluster magnetometers to highlight that this is not a unique issue for J-MAG, while also noting that the specific response of J-MAG to temperature variation is yet to be fully characterised.*

OMNI data are used, but a statement is made that "No timing adjustments have been made to either dataset". OMNI data are as a matter of routine, time shifted to make them relevant to the sub-solar bow shock. This is the "algorithmic propagation" referred to earlier. It would also be very easy, for example, to calculate and display the GSE-x displacement of JUICE relative to this point. One could also argue that, for the specific purpose of comparing individual instruments and sensors, it might be relevant to know which of the OMNI spacecraft are being used at this specific time in order to produce their B-field product.

*We thank the reviewer for pointing this out. We have edited the manuscript to note that the OMNI data for the LEGA period originate from the Wind spacecraft and added details of the relevant instruments at line 70. Alongside the OMNI data in Figure 2, we describe the movement of the bow shock position for which the OMNI data correspond (line 75).*

*When discussing Figure 8 (line 325), we have clarified the statement about timing adjustments, and expanded this point with calculations of Juice, Wind, and bow shock positions to confirm and caveat the validity of the comparison with OMNI.*

Around Line 240, the usefulness of these data for space weather are discussed. This is a little far fetched, given the data are not calibrated often (as in exactly this case). The bigger loss, however, is that the relevant instruments including most importantly J-MAG were not operated continuously during the long passage through the Earth's magnetotail, which is a very poorly explored region of the magnetosphere, particularly at large distances, and on such quasi-radial trajectories. This argument could also be made.

*We have expanded and clarified this discussion in the manuscript to indicate we mean both the use of low-latency (and minimally calibrated) data for advance warning, and for post-event analysis elsewhere in the heliosphere. This discussion is at line 350.*

*We very much agree about the unfortunate loss of deep magnetotail science, however this was beyond the control of the J-MAG team. We hope that this opportunity may arise in a future flyby, and have added this sentiment to the conclusion.*

## **Reviewer 2**

This manuscript presents the first in-flight assessment of the JUICE magnetometer (J-MAG) during the Lunar–Earth Gravity Assist (LEGA). The text is well written, clearly organised, and offers an overview of the instrument's performance at this early mission stage. The successful operation of both the fluxgate and scalar magnetometers is demonstrated. Comparisons with geomagnetic field models, ARTEMIS measurements, and OMNI solar wind observations provide evidence that the instrument is already performing at a high level, despite only preliminary in-flight calibration.

A strength of the manuscript is the clear presentation of the work as an early performance assessment rather than a final calibration study. This approach is appropriate for a first-results publication. However, since the terms "preliminary" and "final calibration" are referenced, it would be beneficial to briefly outline the planned calibration roadmap. Providing this context would clarify for readers which aspects of the current data are expected to improve as calibration progresses.

*Please see response to the first comment by Reviewer 1, and the new 'Calibration Summary' section of the manuscript.*

The discussion of the alignment calibration should be further clarified. The manuscript reports that a rotation of less than 1° provides the best agreement between the measured and modelled magnetic field, but this should probably be interpreted as an effective alignment correction rather than only as the magnetometer sensor misalignment. Such a rotation is likely to include contributions from the sensor mounting, boom alignment, spacecraft reference frame, star tracker attitude knowledge, as well as uncertainties in the geomagnetic field models. A short discussion of these contributions, particularly the role of the spacecraft attitude determination system, would help put the reported 1° correction into context.

*We have expanded the discussion of Figure 4 to acknowledge this point and discuss possible sources of uncertainty. We note that future flybys and JACS usage will help to constrain this*

*calibration parameter, while sensitivity analysis to the Earth field modelling will provide uncertainty estimates. These additions can be found around line 215.*

It would be helpful to add a short comparison between the in-flight measurements and the pre-launch magnetic cleanliness predictions or requirements. This would help put the results in context and more clearly demonstrate how well the spacecraft's magnetic cleanliness programme has performed.

*We have made reference to the J-MAG EMC requirements when discussing the discrepancies seen during the lunar pass and note that the disturbances we see here sit well within the requirements, indicating very good cleanliness (line 285).*