Dear Mr. Velimsky, thank you for your time and willingness to review this manuscript and for the encouraging words. Please see the detailed answers to your questions below.

General:

The paper compares the numerical predictions of magnetic fields tidally induced in the Earth's oceans at the satellite altitude suitable for Swarm observations. In particular, it concentrates on the differences in the magnetic field calculated for M2 tides for five different state-of-the-art tidal models: purely physical baroclinic models OMCT and STORMTIDE, and three assimilative barotropic models: HAMTIDE, TPXO8-atlas, and FES2014. The EM fields were calculated using the integral-equation approach (X3DG) at 1x1 degree resolution with a quasi-realistic 2-D distribution of electrical conductivity in the oceans and continents. While the relative differences between the physical models reach up to 100% of amplitude, the predictions of assimilative models are more tightly clustered with relative differences of about 30%.

I find this study useful for future reinterpretation of satellite-observed tidal magnetic signals in terms of ocean or lithosphere/astenosphere conductivity, and possible evaluation of individual ocean models based on the match of the predicted and observed magnetic fields.

I have two major points that the authors should address to improve the manuscript.

Q: All tidal flow models were regridded to 1x1 degree resolution prior the calculation of the magnetic field. Most of the ocean models provide the tidal flows at higher resolution, and from my experience, this can have significant effect on the predicted magnetic field, since we are dealing with the global source term internal to the computational domain, and interacting with electromagnetically strongly heterogeneous background (the lateral conductivity contrast being three orders of magnitude or more). I'd suggest to recalculate the induced fields at a higher resolution (0.5 degree should be still manageable by X3DG) and check the consistency of the conclusions.

A: This is a good point. It is true that the modelling of the induction process can be sensitive to the resolution of the sources. However, this is not specific to tides or oceanic signals in general. It is a general problem of induction modelling. As Mr. Tyler pointed out, there are many other uncertainties involved. Beginning with the choice of the induction solver, the uncertainties in ocean/sediment/mantle conductivity, core field, secular variation, galvanic coupling, magnetization and so on (see Reviewer #2). However, to determine/compare how to correctly model tidal magnetic fields is somewhat out of the scope of our paper. The paper claims not to present all errors in EM tidal modeling but studies only the influence of the range of existing ocean tide models on a given/robust induction set-up. We choose to study only a fraction of all the possible uncertainties, the errors due to the tidal sources. These errors would still show up even in a perfect induction set-up (even without any regridding). We did choose the manuscript's title to reflect exactly that. As Mr. Tyler points out this is a reasonable start.

However, we now stress this point more detailed in the introduction. We mention resolution and other possible sources of errors and how this study is focused only on a subset of the errors. We now mention the resolution issue also in the model section where the regridding is first mentioned. We state that regridding does not influence our results. Please compare the figures

below (fig. 4 bases on 1° data, fig. 5 bases on 0.5° data):

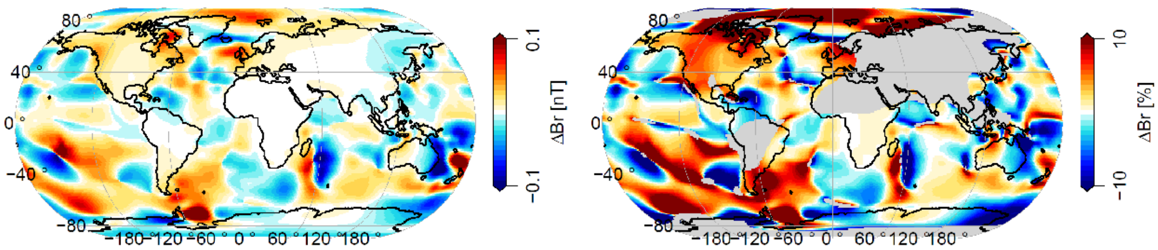

Figure 4. Differences of radial tidal magnetic field at satellite height. FES2014 minus HAMTIDE amplitudes, i.e., the assimilative models. Left: Absolute differences. Right: Relative differences (regions of tidal signal strength below 0.1 nT are grayed out).

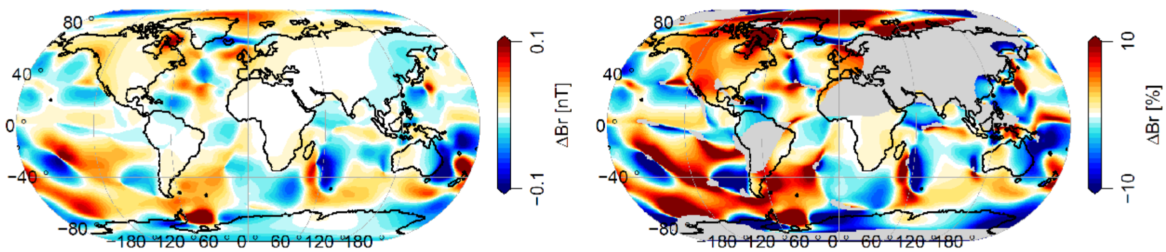

Figure 5. Differences of radial tidal magnetic field at satellite height based on higher resolved tidal data. FES2014 minus HAMTIDE amplitudes, i.e., the assimilative models. Left: Absolute differences. Right: Relative differences (regions of tidal signal strength below 0.1 nT are grayed out).

On request Fig. 5 could be included in the manuscript. But since it is barely discernible from Fig. 4 we did not include it.

In summary we think the resolution issues should be thoroughly dealt with (together with the model issues) in another study and should not be stressed here by including additional pictures. Given the insensitivity of our results to the resolution, mentioning the issues in several places of the revised manuscript should be sufficient.

Q: The OMCT and STORMTIDE models include the wind-driven global ocean circulation that can bias the prediction of M2 tides obtained by fitting selected frequency into data. Could you provide a direct comparison of OMCT predictions for a purely tidal run, forced by ephemerides only? This would provide a direct insight at the importance of the bias.

A: Yes, this issue is already stated in the manuscript. Calculating the exact bias is a good idea and very tempting. However, the used ocean model configuration (including the spin-up) is not stable in a tide-only mode where other forces are simply switched off. The ensuing spin-down would invalidate the claim that the ensuing differences between tide-only OMCT and tide+circ OMCT originate from the tides only. To fix this, forcing, relaxation, and spin-up would have to be adjusted from the beginning. A meaningful comparison would have to be redesigned from scratch. Tide-only OMCT and tide+circ OMCT have to be stable with the same configuration that differs only in the forcing. We think that the expected amount of work is to much for a

remark in this manuscript and should be done separately. However, estimates of these "second order" coupling effects between tides and global circulation are already published. These publication are now referenced in the manuscript. For example, Müller et al. (2012, 2014) state that M2 amplitudes can vary due to the oceanic annual cycle by 5-10%. Thomas et al. (2001) report approximately the same numbers for the opposite direction (influence of tides on the oceanic circulation's angular momentum budged).

Thank you again for your help.

Sincerely, on behalf of all authors,

Jan Saynisch