Response to the reviewer comments for the manuscript "Post-processing scheme for modeling the lithospheric magnetic field" Lesur et al., submitted for publication in SE.

We would like to thank the reviewers for their constructive comments that helped us in improving the manuscript. We address all remarks and comments for each reviewer below, where the original reviewer comments are partly reported in **bold** fonts, the reply is following in normal format.

Although the reviewers did not require this, we have added an appendix describing how the variances of the random variable χ_m^k can be analytically derived. We hope that this is acceptable.

Reply to reviewer~2 comments:

In his general comments the reviewer points out the math are rather difficult to follow and that the discussion on the method limitations should be extended.

We tried to reply to the remarks from the first reviewer without adding equations. We hope that the general equation flow is now easier to understand. We have also extended our discussion about the technique limitations in the conclusion. The method we are proposing probably performs better than the well known "along track filtering", but that has to be tested on a case-by-case basis.

Replies to specific comments are given below.

1- **You make the assumption of a constant radius of the orbit,….**
This is a rather strong approximation (e.g. in the case of CHAMP the satellite went from 480 km altitude to 250 km. Nonetheless the mean and median altitudes are around 380 km, with relatively few data at lower altitudes). There is always the possibility to build several noise models, one for each of a series of altitude ranges. In the present application we used only one model with the radius chosen at 300 km. The results appear to be satisfying.

   The conclusion has been modified.

2- **The choice of applying a scaling parameter for each revolution….**
The whole parameterization has been setup to mimic what is observed in real data. The noise is correlated in time and it results in apparent offsets between adjacent tracks. The reviewer is perfectly right in saying that it is the offsets between adjacent tracks that control the geometry of the noise model.

   One of the benefits in using a constant scaling per half-orbit is the possibility to derive the solution of equation~4 analytically. Using a scaling factor varying along orbits would preclude the separation of the latitude and longitude summations in equation 9. We would then end-up with random variables χ depending not only on m and k, but also on l and n. We have not studied further this possibility, but in our view it is unlikely to lead to tractable problems.

   Although this issue may be of interest to scientists wanting to apply and develop further the technique, it is probably too specialized to be presented fully in the manuscript. Therefore we have simply added a remark after equation 9.

3- **Not only the radial case is applicable to gravity data ….**

We thank the reviewer for this interesting remark. This has been added to the text in the conclusion.

4- **You mention that you performed tests to assess the possibility of removing part of the …..**
We have performed further tests that indicate that the separation of the noise model and the true lithospheric field model is more difficult than we expected. This point is therefore discussed in more details in the conclusion.

5- **Appendix A is quite hard to read….**
We can only agree with the reviewer and that is precisely why we put these developments in appendix. Unfortunately we did not find a more elegant way to solve the equations.

Technical corrections: All implemented