Review of the manuscript: Post-processing scheme for modeling the lithospheric magnetic field, by Lesur et al.

General comments

This manuscript presents a post-processing method aimed at minimizing the noise in the lithospheric field models from satellite magnetic field data. The principle is to build a harmonic perturbation model, accounting for physical error sources that may leak into the lithospheric field estimates, to apply a scaling factor per revolution of the satellite, and to compute the projection of this modelled noise on the searched lithospheric field. The co-estimation of the noise model (perturbation + scaling) and the lithospheric field requires to solve a non-linear inverse problem, for which an iterative approach is proposed. The method is applied to the CHAMP data and shows promising results – the discussion on the possible distortions in the obtained model could however be extended.

The manuscript is clear and well written (a little bit dense as far as the maths are concerned). To my knowledge, the proposed approach, mixing a deterministic and a statistical modelling of the noise, is highly innovative. It has the advantage of relying on a physical model for the correlated noise in satellite data, and avoids the problem of handling large covariance matrices as well as empirical trend fitting. This mixed modelling is a very interesting idea. The discussion in the Conclusions section, on the possibility to remove part of the lithospheric field in the process, would however deserve more emphasis, since it adresses an important point related to the method validation and possible risks of distortion. In any case, the study already brings new elements to understand how an unmodelled perturbation may leak into a lithospheric field estimate. Thus I think this work deserves publication in eEarth, provided a few comments are taken into account.

Specific comments

- You make the assumption of a constant radius of the orbit, in order to simplify scalar products computation, if my understanding is correct. How strong is this approximation ?

- The choice of applying a scaling parameter for each revolution, treated as a random variable, seems to have an important impact on the geometry of the noise model, almost dominating that of the physical perturbation field. Can you comment on the choice of keeping the scaling constant for one revolution : would the noise geometry be much affected with a scaling constant for half a revolution, two revolutions ? Is there a trade-off between the « memory length » along the orbit controlled by the scaling parameter and the physical model geometry ?

- Not only the radial case is applicable to gravity data, but also the 3D case (case of vector gravimetry or gradiometry).

- You mention that you performed tests to assess the possibility of removing part of the lithospheric field signal in the process, in the Conclusions section. Could you discuss this point in more depth (see general comments), as it contributes to the validation and assessment of your results on CHAMP data ?

- Appendix A is quite hard to read...

Technical corrections

p 1355, line 14 : « ... to obtain A realistic noise model. »

p 1357, line 10 : « ... such that the lithospheric field model looks acceptable » → please rephrase in order to avoid the subjective judgement « acceptable ».

g_l^m : signal ou bruit

p 1360, line 2 : « number of unknownS » (S missing)

p 1362, line 4 : straightfoRward (R missing)

p 1362, line 6 : conSequences instead of « concequences »

p 1362, line 9 : please change « tries » into « trial »

p 1362, line 13 : Please replace « : » with « . » at the end of the sentence : « It is however an approach worth studying ».

p 1362, line 17 : « ... the noise leaking in A lithospheric magnetic model »