We thank the anonymous reviewer for the valuable suggestions.

Concerning the specific comments:

- *"At least the figures should be improved and enforced with some numbers, e.g., the performance of the approaches are indistinguishable over the ocean . . . ."*

  We have added Table 1 at the end of Section 3 that includes the root mean square error (rms) of all presented approximations, together with some further explanation within the main text. The root mean square error is indicated separately for oceans and continents.

- *". . . the paper would improve greatly if the authors could demonstrate the main purpose of their physical trial-functions: to separate between oceanic contributions and artifacts from land. The authors claim several times that their method could be used to remove undesired terrestrial contributions. I would recommend to add such contributions to their observations ($\mathbf{B}_{oc}^{CM5}$, $\mathbf{B}_{oc}^{X3DG}$) and (re)apply their method to prove that claim.."*

  An additional example (Figures 8,9,10) has been added at the end of Section 3 that addresses these issues. There, we compare the approximations of a M2 tidal magnetic field model with and without artificial 'noise' over the continents.

Concerning the technical corrections:

- *"Since this is a physical journal it would help to point out mathematical defined terms that are not so common in this community"*

  Mathematical terms that are not clear to a larger audience have been reformulated or explained:

  - p.2, l.14: "... serves as a foundation for the approximation ..." has been reformulated to "... is suitable for the approximation ..."
  - The term "greedy-type algorithm" has been deleted as it does not have any particular importance for the paper.
  - The terms "dictionary" and "trial functions" are explained after their first appearance on p.2, l.30 and p.3, l.8.

- *"Signals on the continents should be clearly distinguishable from oceanic contributions: Please add visible coastal lines to all plots and unify the plotted range where applicable."*

  Coastlines have already been included in the original images, but they have been made clearer in the new versions of Figures 5,6,7.

- *"Fig. 6-7: It would make sense to plot also the differences of the residuals. For example, keep the D1 residuals and plot the D2-D1 and D3-D1 residuals. The influence of the dictionaries on the oceanic residuals is not visible in the plots! At least give numbers (rms) for the residuals from all dictionaries and discuss them in the text. It would be a good idea to calculate separate rms for land and ocean."*

  We decided not to include further differences of residuals D3-D1 and D2-D1 for Figures 6,7. In particular, the residuals for the different dictionaries are of different orders of magnitude (in Figure 6, e.g., the residual for spherical harmonics has a maximum of

0.04 while the residual for the physics-based trial functions has a maximum of 0.3), so that the differences would not yield any visible additional information. However, we adjusted the scales in Figure 6 to improve the representation of the spatial distribution of the residuals.

Additionally, for the new example with artificial 'noise' over the continents, we have added a figure indicating the differences between the approximation of a signal with and without continental 'noise' (cf. Figure 10). We hope that this way the influence of the dictionaries on the oceanic and continental residuals becomes clearer.

- *"Please, unify the scales(!)"*

  We now have used unified scales within sets of pictures containing the same information. An exception where we kept non-unified scales are the residuals in Figure 6. There, the goal was to highlight the spatial distribution of the differences rather than their amplitudes. This, we think, is better achieved by non-unified scales.

- *"page 7: remove eq. 9 page 7"*

  Equation (9) has been removed.

- *"line 16: how is best localized determined? Based on the eigenvalues proximity to 1?"*

  "best localized" in terms of Slepian functions means an energy ratio (i.e., the eigenvalue of a Slepian function) that is close to one, as indicated by the reviewer. This we now have mentioned explicitly after the first appearance of "best localized" before equation (8).

- *"page 8, line 17: add reference for TPXO"*

  A proper reference for TPXO has been added.