

Interactive comment on “Geopotential field anomalies and regional tectonic features – two case studies: southern Africa and Germany” by Monika Korte and Mioara Manda

Anonymous Referee #3

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This manuscript discusses observations of potential field measurements across multiple scales with focus on two case studies in Germany and the southern African region that represent two different geological settings. Anomaly maps based on magnetic data from surface repeat stations, airborne and satellite measurements are presented and compared for different components and different wavelengths. It includes a comprehensive discussion about the procedures of obtaining these different datasets and their correlation, including non-standard correction for the long-term non-periodic secular variations and its clear impact on the data. The presented magnetic anomaly plots are further compared with gravity anomaly maps and known tectonic boundaries over the respective regions, allowing implications about crustal-scale structures to be made.

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The manuscript is comprehensive, well-written and well-structured and suited for the scope of the journal.

The manuscript could be published as is with a few minor text edits (in addition to the comments of reviewer 1). Please find a list at the end of this review. Although I am fine with the paper as is, I have a few minor questions/remarks on things that are slightly unclear to me or not discussed in the paper, and that may at least be given some thought.

1) As I am not familiar with the studied regions, including a general map of the respective regions would make the manuscript easier for me to follow. Many of the places referred to in the text are not labelled in figures 8 or 9. Even though the locations of most places are mentioned or hinted in the text, I felt I had to use other sources to figure out where some of the anomalies are located and how they are related to each other. Figures 8 and 9 are quite small and would soon be too crowded if more units, places and structures were labeled, but another option would be to add general geological or tectonic maps as part of figure 3. In section 3.3 for example, Witwatersrand terrane, Kimberly terrane, Colesburg lineament, Tugela terrane, Mzumbe terrane, Margate terrane and Kibaran Orogen are mentioned in the text but not labeled in any maps. I assume that the Cape mobile belt (line 358) is the Cape fold belt as labeled in Fig. 8? For the German region, the extent of Caledonian and Variscan basement and the location of the Bohemian Forest, the Black Forest, Vosges and the Rhenian massif are not entirely clear.

2) A personal reflection that struck me when looking at the geometry of the anomaly pattern in the northeastern German region, especially clear in the long wavelength north components of Fig. 9, and that I did not see mentioned in the text, are two features that may or may not be related to the observed anomalies. I do not know what kind of signature they would have, if any, and perhaps they are too small or too close to the border of your region to have any influence or be resolved and thus may be irrelevant to the current study, but I'm a bit curious if you have any thoughts about

this. (1) The maximum extent of the ice sheets of the last glacial period as well as the associated post-glacial crustal deformation and still active isostatic adjustment due to the removal of the differential load appears to me to coincide geometrically with the WNW-ESE anomalies clear in the north component in Fig. 9. (2) The Törnquist Zone comes in from Denmark along the northeastern coast in your map and is associated with crustal/lithospheric thickening towards the northeast.

3) In the discussion of section 3.1, comparing long and short wavelengths, you state several observations of differences between the anomaly maps, but give no explanations as to why (unless I miss it). On 255-257 you point out that there is a clear disagreement between the regional and global high resolution anomaly maps in the Namibian region; is there a reason for this? On lines 278-285 you make three observations: (1) SW-NE oriented anomalies in southern Germany seen in short but not long wavelength maps; (2) in central to northern Germany short wavelength anomalies are oriented SSW-NNE while long wavelength anomalies are oriented SSE-NNW; (3) a general division on the X component with positive in N and negative in S. I don't see any direct speculations as to why, unless I skip forward to the conclusions where insufficient resolution of the weak large-scale anomalies is mentioned. Furthermore, this SSE-NNW trending long wavelength anomalies in point (2) also appear in the dXX gravity anomaly map (and perhaps also in the dZZ with overprint of WSW-ENE anomalies) but I don't see this mentioned either.

List of minor suggested corrections of text and figures

Line 5: please correct "Focussing" to "Focusing".

Line 135: please consider adding a comma; "In this case, the. . .".

Line 136: please correct "lies in" to "lies on". I may be mistaken but I believe things are "on the order" or "in the range".

Line 136: please consider changing "among" to "between".

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Line 148: please consider adding a comma; “For 42 of the 44 stations, robust. . .”.

Line 149: please consider removing the comma; “. . .two to five (on average four) individual. . .”.

Line 156: please consider adding a comma; “. . .two regions, located in. . .”.

Line 159: The sentence “. . ., as expected from sources which are dominated by, but not purely, a ring- current in large distance from the Earth.” reads a bit strange with the subclause and the dominated-purely-relationship. Perhaps consider something like “. . ., as expected when the dominant (but not only) source is a ring-current at large distance from the Earth.”

Line 160: please correct “in large distance” to “at large distance”.

Line 170: please consider “In most cases, the influence of the fast external variations has likely been. . .”.

Line 174: You write “some gaps”, but do you have an estimate for how significant these gaps are, perhaps a percentage of the areal coverage?

Line 224: please correct “A unsystematic” to “An unsystematic”.

Line 243: please consider “shallow sources” or “sources closer to the surface” as an alternative to “sources near the surface”. You could perhaps also be a bit more specific and add a parenthesis with an approximate depth range? To me, near surface implies depths on the order of 10’s - 100’s of m (a few km at the most) which are feasible for exploration, i.e. at least an order of magnitude lower than the Curie depths.

Line 273: please correct “lie in” to “lie on”.

Line 277: please correct “lies in” to “lies on”.

Line 293: please consider removing “with a few exceptions”. It is not necessary if you have “most” and it disrupts the flow of the sentence.

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Line 303: please consider “. . .anomalies, the amplitudes of the F and Z field anomalies at the ground stations are once more generally higher. . .”

Line 315: please consider changing “the later ones” to “the latter”.

Section 3: I would have liked to see some more figure references in the text, especially in section 3.3, to avoid confusion of looking at Figs. 8 and 9 vs. Figs. 4 and 5.

Line 356: please correct “orogenes” to “orogen”

Line 366: please consider adding a comma; “To explain this anomaly, some models. . .”.

Line 367: please correct “granulite-faces” to “granulite-facies”.

Line 378: please correct “in then north” to “in the north”.

Line 389: does “there” refer to Fig. 5? Then consider writing “. . .2003) is in Fig. 5 characterized. . .”

Line 391: please consider adding a comma; “. . .2003), is characterized. . .)

Line 392: please consider modifying “. . ., which clearly reflects in. . .” to “. . ., which is clearly reflected in. . .”

Line 393 -396: Perhaps it is just me, but I find the sentence a bit unclear and strangely formulated. Please consider something like for example (unless I misunderstood the sentence) “However, there is no obvious agreement between the proposed tectonic units and the weak long-wavelength magnetic anomaly patterns shown in Fig. 9, possibly because their sizes are comparable to the wavelength of the studied magnetic anomalies.”

Line 401: please consider “. . .where an up to 4 km thick sedimentary cover overlies the Variscan basement. . .”

Line 403: please consider “The mountain areas of the Bohemian Forest in the Czech Republic, the Black Forest and Vosges (France) around the southern Rhine graben,

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and the Rhenian massif on the west side of the Rheno-hercynian belt, all show positive dZZ and negative dYY anomalies.”

Line 408: please consider “vertical component are in this case hard to interpret”.

Line 408-410: please consider “The only area well within the studied region that shows a somewhat significant positive correlation, is a patch in the south-eastern part of Germany that cannot be linked to any known tectonic structure.”

Line 417: please add “in” and “the”; “. . . differences in lithospheric thickness. . .” and “. . . estimated the lithospheric thickness”.

Line 418: please correct “in the order” to “on the order”.

Line 420: please consider changing “lower” to “less” and perhaps add a reference here about the lithospheric thickness below Germany.

Line 429: I wouldn’t say that “the European value” of 55 km is “in broad agreement” with 22 to 45 km, perhaps “comparable” or something similar.

Line 434-436: please consider “In particular for the magnetic field, the present ESA Swarm satellite constellation⁶, which comprises two parallel-flying satellites at low altitude, will provide new data and lead to improved long-wavelength lithospheric magnetic field models.”

Line 474: please consider adding a comma; “Overall, our. . .”

Figure 1, Table 3: please add “southern African region” at some point so that a reader does not have to search the text to be sure.

Table 4: please add “German region” for same reason as above.

Figure 4: is the total field high resolution grid (lower left) the same as the plot in Fig. 3 but scaled differently?

Figs. 4, 5, 6, 7, 8, 9: inconsistent naming of the subfigures where you write for example

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“north (X)” in Figs 4-7 and “X (top)” for the magnetics in Figs. 8-9 and “north (top)” for the gravity in Figs 8-9. I would suggest to change the caption of Figs 8-9 to have “north (X)” for the magnetics and “north (dYY)” for the gravity, thus being consistent within the caption and also to previous figures.

Note on the authors response to the first reviewers comments. In addition to the missing space in “smallerand” pointed out by the first reviewer, there is a similar missing space in “Niemegk observatory recordings forall stations” in the 10 line of page C2.

Interactive comment on Solid Earth Discuss., doi:10.5194/se-2015-132, 2016.

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