

Interactive comment on “The European Alps as an interrupter of the Earth’s conductivity structures” by D. Al-Halbouni

Anonymous Referee #1

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The paper by D. Al-Halbouni presents a large scale conductivity model for the Alps based on MT and GDS data. As the crustal and mantle structure of his region has not been explored much by these methods, this study can potentially make an important contribution. However, in its current form I fear that the results are not robust enough to warrant the level of interpretation given by the author. I was a reviewer for a previous version of the manuscript and I am happy to see that my suggestion of performing a study to test the requirement of certain structures has been taken into consideration. Unfortunately this sensitivity study partially confirms my suspicion that certain features are not required by the data. In other cases they do not test the aspects of the features that form the basis of the interpretation. Thus a major revision is needed before this paper can be published. I outline my concerns in more detail below.

C403

The study is based on a sparse dataset. Only 7 measurement sites are distributed along a nearly 400km long profile. From these sites the MT data at only 4 sites shows any usable data and at 2 of these sites the long period data does not contain much information. Additional GDS measurements provide some constraints, but overall there is poor data coverage. I am not aware of any deep MT/GDS studies in this region, so despite the sparse data there is scope for important contributions. However, the 3D model presented by the author contains many complex features in the upper 20~km and according to the manuscript the upper 25km are the focus of this study. Given site spacings of 50-100km or more and low quality long period data at most stations there is very little overlap in sensitivities between different sites and large parts of the model most likely are not sensed at all (particularly the eastern part).

To test the significance of some of the features in Figure 4 (the 2D slice) which forms the basis of further interpretation, the author performs some sensitivity tests. However, I do not think these test what is actually needed. For example, the author tests in how far a model without feature C1 (a mid crustal conductor in the northern part) can explain the data. From increased data misfit for the GDS data he concludes that its existence is required and I partially agree with this conclusion. However, for the further discussion it is essential that this conductor is interrupted to the South and this hypothesis is not tested by simply removing it. The author should test different extents of the conductor to the south, in how far it is possible to connect C1 and C2, how big the gap between C1 and C2 has to be, and if it is possible to continue C2 further to the south.

The general existence of the mantle conductor seems to be confirmed by the MT data (figure 8), but again the important feature in the discussion (deeper mantle under the alps) is not tested. Different depths should be tested and a range of permissible depths should be given. Given the level of discrepancy between observations and synthetic data I consider the other sensitivity tests to demonstrate that the tested features (Molasses) are not required by the data. Still, the author bases some of his conclusions on this.

C404

In light of this I suggest a thorough simplification of the model, testing the aspects (extent, depth) of the main features relevant to the discussion and reconsidering the interpretation. Given the sparse data, this interpretation will most likely be relatively limited, but much more valuable than the current version which I have reservations about.

More minor points:

- The quality of the language varies throughout the manuscript. It is generally good, but in parts impedes understanding (e.g. top of page 1042, top of page 1046, I do not understand what the author wants to say there). Other minor grammatical mistakes should also be corrected.

- Section 2.1 needs some work, the description is brief with some irrelevant information (Kramers-Kroenig relationship) and appears somewhat disjoint. Also, I commented on an earlier version that in 3D concentrating on the MT phase does not avoid static distortion problems. This passage still exists in the manuscript.

- page 1042 line 25, I doubt that with this data quality there is any sensitivity to conductivity at 400 km depth

- page 1043, line 20 "... the model gives a finally insufficient fit which could be improved by relocating the station." I doubt that the author wants to suggest that the station needs to be moved to improve the model fit, but to reduce data errors. Should be rewritten.

- page 1045, line 10 "... is necessarily performed to explain the data". I do not understand this statement.

- Figures of apparent resistivity should have a logarithmic scale (B1b) and apparent resistivity should be plotted instead of $|Z|$ (C1-C4). In the current version it is impossible to make a meaningful assessment of the data in these plots. If this causes problems because of large error bars, the author could clip them.

- Similarly powerspectra (A1 B1a) should be plotted on a log-log scale, the current

C405

versions do not allow a meaningful assessment.

- Figure C4, are these the data after RP and RR or without. If after they do not contain any information, if without, the best quality data should be plotted instead.

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