

Dear Reviewer#1

We sincerely thank you for accepting the revised manuscript. Your constructive comments during the review process were highly valuable in improving both the methodological presentation and the interpretation of the synthetic and field-data results. We greatly appreciate the valuable comments and constructive suggestions provided during the first review round, which helped us improve the clarity, structure, and scientific quality of the manuscript.

Dear Lorenzo Schmitt,

We sincerely thank you for your positive evaluation of the revised manuscript and for acknowledging the substantial improvements made during the revision process. We also appreciate your recognition that the revised sections, newly added sensitivity analyses, improved figures, and expanded conclusions have enhanced the readability and scientific understanding of the manuscript. Your constructive comments during the review process were highly valuable in improving both the methodological presentation and the interpretation of the synthetic and field-data results.

We are grateful that the manuscript has been recommended for acceptance after minor revision. We used blue colors in the revised manuscript to indicate where we made changes to comply with your comments. In the revised version, we have carefully addressed the remaining minor comments and technical corrections, as detailed in our point-by-point responses below.

Specific comments and questions:

MT:

Line 223-226: The description of the MT method remains somewhat misleading, as it suggests that only a time-varying electric field induces a time-varying magnetic field, which is technically correct. In MT, however, we must consider both fields simultaneously. Therefore, I would reverse the order of these two sentences and insert the following: “Time-varying external electromagnetic fields interact with the conductive Earth and induce secondary currents, whose resulting electric and magnetic fields can be measured at the surface. The Earth acts as a transfer function that defines the ratio of orthogonal horizontal electric and magnetic field pairs (Cagniard, 1953).” Reference: Cagniard, L. (1953). Basic theory of the magneto-telluric method of geophysical prospecting. *Geophysics*, 18(3), 605-635.

**R:** We thank you for this helpful clarification. We agree that the previous wording could be misleading regarding the simultaneous treatment of electric and magnetic fields in MT. Accordingly, we revised Lines 224-227 following your suggestion and added the reference to Cagniard (1953).

Line 237: Use a better formulation: apparent resistivity is frequency-dependent

**R:** We thank you for this correction. We revised Line 239 by replacing “period-dependent” with “frequency-dependent” to provide a more appropriate formulation of apparent resistivity in the MT context.

General:

Line 144: Here, the model vector should be written in bold for all elements of the objective space, since the argument remains a vector for each individual iteration of the objective space.

**R:** We thank you for this correction. We agree that the model argument should be consistently written as a vector in the objective space. Accordingly, we revised Line 145 and used the bold notation  $m$  for all relevant elements of the objective functions.

Line 244: It might be worth mentioning here that the effective impedance is used not only for the synthetic data but also for the field data.

**R:** We thank you for this useful suggestion. We added a clarification to state that the effective impedance formulation was used not only for the synthetic examples but also for the field-data inversions. In Lines 247-248.

Line 267 & 302: The logarithm has still to be changed to “ $\log_{10}(\rho) [\Omega]$ ” and “ $\log_{10}[1, 5] \Omega$ ”.

**R:** We thank you for this correction. We revised Line 272 and Lines 305-307 to clarify the parameter bounds and their units.

Line 690: Use the word “phases” instead of “phase angles”.

**R:** We thank you for this suggestion. We revised the terminology by replacing “phase angles” with “phases” in Line 694 and throughout the relevant text.

Technical corrections:

Line 240:  $\omega$  is the angular frequency as  $\omega = 2\pi f$

**R:** We thank you for this clarification. We revised the relevant sentence by explicitly defining the angular frequency as  $\omega = 2\pi f$ , where  $f$  is the frequency in Line 241.

Line 272-273: Missing references to equations.

**R:** We thank you for pointing this out. We added the missing references to the relevant equations in Line 276.

Equation 3: The argument  $\omega$  in the parentheses should not be written in the form of a subscript, since the apparent resistivity and the impedance depend on it.

**R:** We thank you for this correction. We revised the notation in Equation 3 by writing  $\omega$  as a functional argument, e.g.,  $\rho_a(\omega)$  and  $Z(\omega)$ , rather than as a subscript, since both apparent resistivity and impedance depend on angular frequency.

Equation 4: First, the impedance is also frequency-dependent. The argument omega should be added. Second, either write out “imag” and “real”, or explain them in the text as “Im = imaginary” and “Re = real” part.

**R:** We thank you for this clarification. We revised the notation in Equation 4 by adding the angular-frequency argument to the impedance,  $Z(\omega)$ , to explicitly indicate its frequency dependence. We also defined Re and Im in the text as the real and imaginary parts of the impedance in Lines 240-241.

Figure 3: The apparent resistivity labels for the smaller ticks are missing. Alternatively, use one more major tick label, such as the x-axis tick labels in Figure 7 or 8.

**R:** We thank you for this helpful suggestion. We revised the apparent resistivity axes in the synthetic-data figures, specifically Figures 3, 4, and 5, by adding the missing intermediate major tick labels, including to improve the readability of the logarithmic scale. In the figures presenting the joint modeling results, the tick-label spacing was kept relatively sparse to preserve visual clarity and avoid overcrowding of the panels, while maintaining consistency in the logarithmic scale. We believe that this revision improves the readability of the synthetic-data figures while preserving the visual clarity of the modeling-result panels.

Figure 14: The labels a), b), etc. from the caption are not included in the figure itself.

**R:** We thank you for pointing this out. We revised the Figure 14 by adding the subfigure labels, such as (a), (b), etc., directly within the figure panels to ensure consistency with the figure captions.