

Interactive comment on “Hydrogeological conceptual model of andesitic watersheds revealed by high-resolution geophysics” by Benoit Vittecoq et al.

Benoit Vittecoq et al.

b.vittecoq@brgm.fr

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We thank the referee #2 for reviewing our manuscript for publication in Hydrology and Earth System Sciences. Her comments will help to improve and clarify the manuscript.

Responses to comments:

C1: “Since the clearance is derived from the DEM model and the DGPS altitude, why is it needed to invert for the altitude of the transmitter?”

R1: Over rugged terrain, the DEM model allows obtaining a more consistent altitude than the one derived from laser altimeter. However, DGPS may suffer from inaccuracy

C1

cies mainly on the z-axis and the resolution of the DEM may not suit to the measurement at some places. Thus, we decided to invert for the altitude even if the use of the DEM allows inverting for the altitude after more iterations than what is done commonly.

C2: “The principle and the function of the SVD filter method must be explained, even succinctly. Indeed, SVD is a very general concept used in many other contexts”

R2: Of course, SVD is used in many other contexts. The way we use the SVD is fully described in Reninger et al., 2011 (cited in the manuscript). We will add some information on the procedure in the text (page 7, line 18): The SVD allows explaining a dataset with only few components, each data being a linear combination of these components. Thanks to this decomposition we are able to identify and remove several types of noise, making the processing less time consuming and subjective.

C3: “Similarly, some details should be provided to explain why a trapezoidal filter is used to filter the TDEM data (e.g., because of increasing lateral footprint with time windows etc.).”

R3: a sentence will be added about the trapezoid stacking: (page 7, line 19): The trapezoid shape is consistent with the increasing of the footprint of the EM method with time.

C4: “How important is the trapezoidal lateral filter in practice? Does it smooth only the noise or also some 2D/3D effects in the data? Or, are local 2D/3D effects considered as noise in this study?”

R4: The trapezoid stacking is adapted to the noise level at each measurement, un-noisy windows are not stacked in order to unalter the lateral resolution. The detailed methodology is presented in Reninger et al., 2018 (cf. reference in the manuscript). A new sentence will be added to clarify in the text (page 7, line 19): Thanks to this filter we try to retrieve the noisy windows, which are unusable otherwise.

C5: “Is it worth and safe (with the price and risk of minimizing an optimum function

C2

involving a large number of non-correlated data) to use an expensive SCI algorithm to invert profiles, which barely overlap each other (400 m is a large distance with respect to the TDEM lateral footprint for most of the time windows channels, making the data set/maps highly under-sampled in the crossline direction)?”

R5: The SCI algorithm used in the Aarhus workbench proved its robustness in many published studies, even when flightlines are acquired mainly in one direction, and is become a standard. As shown in Figures, The SCi also allowed making good use the intersections between lines. Moreover, the inversion was set with weak lateral constrains. A sentence will be added in the text (page 7, line 25): weak constrains were applied for this study in order to limit the smoothing of the inversion procedure.

C6: “A lateral (trapezoidal) smoothing filter is applied to the data before inversion. In addition, lateral smoothness constraints are applied in the inversion. It must also be recalled that, by definition, the 1D forward modelling algorithm used for the data inversion assumes a layered earth (with no lateral variations and a flat ground surface).”

R6: Trapezoid stacking is applied on noisy windows only in order to retrieve windows, which are unusable otherwise. Unnoisy windows are not stacked, the lateral resolution is therefore unaltered. Moreover, weak lateral constrains were applied. Our processing tried to keep as much lateral resolution as possible (Reninger et al, 2018), this will be added to the text (page 7, line 28): The aim of the applied processing was to keep as much resolution as possible (Reninger et al, 2018). Concerning 1D model, they are described page 7, line 22-23.

R7: Given the number of data used and the size of the study area, we think that it is rather fair to use the words "high-resolution". Moreover, as it is noticed by the reviewer, it is not possible to obtain results of better resolution at this time. Nevertheless, the title of the paper may be modified in this way: “Hydrogeological conceptual model of andesitic watersheds revealed by helicopter-borne electromagnetic geophysics”.

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