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

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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 inaccura-
cies mainly on the z-axis and the resolution of the DEM may not suit to the measure-
ment 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
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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