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Hydrology and Earth System Sciences
Discussions

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

Anonymous Referee #2

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This manuscript presents a multidisciplinary study including geological, hydrological and geophysical data for characterizing andesitic watersheds located in Martinique Island, in the Lesser Antilles Archipelago. As motivated by the authors, such specific hydrogeological setting has taken less attention in the literature than, e.g., in basaltic islands. For this aspect, I think this study can be published in the journal HESS.

The manuscript is clear and well organized. However, because the geophysical helicopter-borne TDEM method is presented as a new key element for constraining the hydrogeological model, I think the authors should provide few more details about their data processing workflow. Please consider the following comments:

1- 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?

2- 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.

3- 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..).

4- 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?

5- 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)?

6- 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).

These three layers of constraints/assumptions basically force flatness in the results, at the scale of the TDEM lateral footprints. This approach could erroneously give the impression of flatness even if it is not the case in the reality, at a local scale. According to this study, it seems actually sufficient to properly characterize formations at the watershed scale. However, I think it is fair to recall that such a workflow inherently loses a substantial part of lateral details, which is present in the recorded TDEM data. To sum up, according to basic signal processing criterions, the overall acquisition + filter-

ing + inversion approach presented in this study does not fully exploit the potential of the helicopter-borne TDEM method in term of lateral resolution. This makes the term "high-resolution" in the title maybe not appropriate for the presented approach; from the geophysical perspective. This is not really a criticism as the acquisition of TDEM data is difficult in practice, in such a mountainous area, and because 2D/3D imaging algorithms are still hardly available for processing such large data sets. However, I think it is important to highlight these limitations anyway, as we must expect further developments concerning the TDEM method, with a spatial coverage reaching the Nyquist's sampling theorem condition and more robust processing approaches.

Best regards

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