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Hydrology and Earth System Sciences
Discussions
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Interactive comment on "Assessing the dynamics of soil salinity with time-lapse inversion of electromagnetic data guided by hydrological modelling" *by* Mohammad Farzamian et al.

Mohammad Farzamian et al.

angelo.basile@cnr.it

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Dear Referee #2,

We sincerely appreciate and thank you for your constructive comments on our manuscript. We will revise the manuscript according to your suggestions and comments. Our answers are placed below each of your comments.

Sincerely,

Angelo Basile on behalf of all authors

Anonymous Referee #2

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In this study, the authors carried out a time-lapse EMI survey over four experimental plots irrigated with water at four different salinity levels for three months. They examined how well the time-lapse EMI measurements and a time-lapse inversion algorithm can be used to monitor soil salinity variability in space and time through performing simulation experiments and inversion processes. The proposed methods are up to date, innovative, and a new addition to agriculture geophysics. It could be used in the field of precision agriculture. The manuscript is well written. I would recommend publishing the paper after “minor revision”.

- We would like to thank Anonymous Referee #2 for evaluating our manuscript. We highly appreciate the overall positive comments.

I have a few comments:

1- Interpretation of the results should be more quantitative rather than qualitative

- We agree with the Referee #2. We will revise the manuscript adding some quantitative evaluation of the results. Specifically, because the key point of the manuscript is the aid of a synthetic test to the inversion procedure we will present field ECa data and also discuss the inversion results with more details.

2- Although the manuscript is well written, it is lengthy and has many details that should be omitted.

- We agree with the Referee comment. We will revise and shorten the manuscript significantly. Please, you could refer to the detailed answers to the same issues given to the Referee # 1.

3- Why not to use the real field EMI measurements instead of synthetic data.

- Dear Referee #2, as your question is the same one asked by Referee #1, please read the detailed answer we gave Referee# 1 to her/his comment #4 and L346-381.

4- I am wondering if you could do a correction for EM data before using it. I would

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recommend reading Beamish (2011) paper to correct the FDEM data that is measured under LIN-condition highly conductive geomaterials such as soil saturated with saltwater, which is your case.

- Although in most cases EMI sensors use the LIN approximation to convert quadrature component (Q) to field ECa measurements (which is only valid at low EC values), the GF Instruments including CMD-mini explorer that we used in this study use a manufacturer calibration at sites of known subsurface EC (e.g. McLachlan et al. 2020) for conversion of Q to ECa. The manufacturer calibration aims to obtain a more representative ECa value in the field to overcome the use of LIN approximation. We also measured all data manually in the field at ground level to maintain the manufacturer calibration which was acquired at ground level and to avoid the impact of the sensor height in both ECa measurements and inversion results. It is also worth mentioning that although the top-soil is conductive due to irrigation as the Referee pointed out, the soil (conductive layer) is very shallow and the presence of shallow resistive bedrock contribute significantly to the cumulative EMI response and as results the field ECa values are not very high (always below 100 mS/m) even for the transect irrigated with water at 12 dS/m. This was also expected from the synthetic data shown in Figure 7. Therefore, the obtained Eca values are still within the range that the relationship between Q and EC is monotonic and inversion of only ECa data will yield reliable results.

McLachlan, P., Blanchy, G., & Binley, A. (2020). EMagPy: Open-source standalone software for processing, forward modeling and inversion of electromagnetic induction data. Computers & Geosciences. https://doi.org/10.1016/j.cageo.2020.104561

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