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Interactive comment on "Comparison of soil characteristics from geophysical and geochemical techniques along a climate and ecological gradient, Chilean Coastal Cordillera (26° to 38° S)" *by* Mirjam Schaller et al.

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Response to review of manuscript soil-2020-3 by RC1

Preface to the response to reviews by the authors: We would like to thank Colin Pain for his constructive comments to improve the manuscript. The regolith terminology has been adjusted to World Reference Base for Soil Resources (WRB). This adjustment should clarify some of the confusion created. Furthermore, all of the following changes we've made to the manuscript have been implemented in the manuscript text file.

Note: The reviewer's comments are in italic text, our response is in bold text.

Thank you for your time, M. Schaller on behalf of all co-authors. **********

General comments This paper reports on correlations between GPR profile data and physical and chemical soil properties. The soil properties come from work that has previously been published, while the GPR data are new. The correlations are discussed and demonstrate that GPR can be used to infer soil thicknesses and to a lesser extent soil properties. The paper is well written and is a very useful contribution to our knowledge of the value of using geophysical methods to study soil properties and distribution. I suggest a change to the title: "Comparison of regolith physical and chemical characteristics with geophysical data along a climate and ecological gradient, Chilean Coastal Cordillera (26âÚę to 38âÚę S)"..

Line 1-3: The title has been changed as suggested by the referee. Only soil has been replaced by regolith to be consistent with the rest of the manuscript and reviewer comments.

Specific comments There is some confusion in soil/regolith terminology. Regosol, cambisol, and umbrisol are World Reference Base for Soil Resources (WRB) classes. I think it would be useful to mention this, and to briefly discuss the soil classification. Part of the confusion is the distinction between soil and saprolite – the saprolite is the C horizon and is therefore part of the soil. While there is clearly a difference between the mobile zone (A and B horizons) and the underlying saprolite zone (C horizon), both are parts of the soil profile. (The mobile zone may be transported by creep or surface wash, or it may simply be re-sorted, as by termites or earthworms, or it may be a combination of both, so it is a very general term.) For this reason, I disagree with Riebe and Granger (2013) when they restrict the term "soil" to the mobile zone.

The terminology of used in this manuscript has been adjusted to "World Reference Base for Soil Resources".

I would find photos of the soil/saprolite profiles useful. Perhaps you could include photos and soil profile descriptions in the supplementary file? Or refer to Figure 2 in Bernhard et al (2018) – perhaps even reproduce it. It is a very useful figure and should be easily available to readers of this paper.

We thank the reviewer for this suggestion. We prefer not to republish figures from other figures, but to accommodate this suggestion we have add reference in the main text (section 2.2) and the figure caption for our Figure 3 to say: (for complete characterization and interpretation of the pedons see Fig. 2 in Bernhard et al. (2018) and Figs 3 to 6 in Oeser et al. (2018))..

Lines 162 and 163. "In Pan de Azúcar, the soil is part of a regosol and consists of a 20 to 25 cm thick A and B horizon." A regosol is a soil, so how can the soil be part of it? I suggest rewording: "In Pan de Azúcar, the soil, a regosol, consists of A and B horizons with a combined thickness of 20 to 25 cm and an underlying saprolite zone (the C horizon), which is coarse-grained and jointed (Oeser et al., 2018). The total organic carbon content of the A and B horizons is <0.1% (Bernhard et la., 2018). Angular fragments in the soil increase in size (> 1 mm) with depth."

Sentences have been reworded as suggested: "In Pan de Azúcar, the regolith, a regosol, consists of A and B horizons with a combined thickness of 20 to 25 cm and an underlying saprolith (the C horizon), which is coarse-grained and jointed (Oeser et al., 2018). The total organic carbon content of the A and B horizons is <0.1% (Bernhard et la., 2018). Angular fragments in the pedolith increase in size (> 1 mm) with depth."

I also suggest rewording soil descriptions for the other areas in the same section. Soil descriptions have been adjusted in all sections to terminology used in first section.

Section 2.2. For La Campana and Nahuelbuta there is no mention of the characteristics of the saprolite.

For Santa Gracia, La Campana, and Nahuelbuta the saprolith is now mentioned and

shortly described in section 2.2.

Technical corrections Line 88. What do you mean by "sub-surface"?

"sub-surface" has been changed to "regolith" where not used in connection with GPR analysis.

Figure 3 caption – what do the colours in the pedons represent?

A legend for the colors used in this figure has been added to the figure.

Line 254, also 278 "In this way, the move-outs of linear events" – I/m not sure what this means – what are "move-outs"?

The sentence with the term "move-outs" has been replaces by: "Using this type of survey, we can distinguish between signals that increase linearly in traveltime with increasing receiver-transmitter distance (e.g., air wave and ground wave) and signals that increase hyperbolically in traveltime with increasing receiver-transmitter distance (e.g., subsurface reflections). In this analysis, we assume that internal reflection horizons are not dipping.

Check figures for text size. In some (e.g. Figure 4, Figure 6, some of the text is too small. I attach a file with suggested edits.

Figure 4, 6, 8, and 10: Font sizes have been enlarged where possible. The same changes have been applied on the supplementary figures in question.

Additional comments This is not a comment on your paper, but a general comment on the research. Have you considered using ground-based electromagnetic sensing? This measures conductivity and might supplement GPR as a way of mapping sub-surface soil units. See, for example: Ahmed, M.F., Odeh, I.O.A. and Triantafilis, J. 2002. Application of a mobile electromagnetic sensing system (MESS) to assess cause and management of soil salinization in an irrigated cotton- growing field. Soil Use and Management 18, 330-339. Triantafilis, J. and Buchanan, S.M. 2009. Identi-

fying common near-surface and subsurface stratigraphic units using EM34 signal data and fuzzy k-means analysis in the Darling River valley. Australian Journal of Earth Sciences 56, 535-558. Amezketa, E. 2007. Use of an electromagnetic technique to determine sodicity in saline - sodic soils. Soil Use and Management 23, 278-285.

Unfortunately, electromagnetic induction EMI was applied, but did not produce reliable results. Therefore, EMI analyses were not included in Dal Bo et al. (2019) and did not get measured in the second field campaign performed for this manuscript. Thank you for this suggestion and the references addressing this kind of investigations.

Supplement comments Please also note the supplement to this comment: https://soil.copernicus.org/preprints/soil-2020-33/soil-2020-33-RC1-supplement.pdf

All suggested changes have been taken into account in the manuscript.

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