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Interactive comment on "Soil physical quality changes under different management systems after 10 years in Argentinian Humid Pampa" *by* J. L. Costa et al.

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Author Comments Title: "Soil physical quality changes under different management systems after 10 years in Argentinian Humid Pampa" by J. L. Costa et al. General appreciation of the authors, The study's authors want to express our thanks to thematic editor and reviewers for each suggestion and question. Answering the suggestions made, we have improved our article trying to make a better contribution to the knowledge on soil.

Structure of the response of the authors to the reviewers: (1) Comments from Referees, (2) Author's response, (3) Author's changes in manuscript (see yellow highlighted text

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in manuscript).

Anonymous Referee #1 Received and published: 2 September 2014

GENERAL COMMENTS: this paper evaluated the evolution of the soil physical parameters in three management systems: moldboard plow, chisel plow and no-till. The manuscript represent an interesting paper and I consider the paper merits publication in Solid Earth (after moderate/major revisions). The scientific approach and applied methods are valid. The paper is well structured and the length of the paper is adequate. However, the results and conclusions weren't presented in a clear, concise and well-structured way. So, I considered that the results discussed should be re-worked and sometimes the text should re-write, because it is really difficult to understand some discussions. The authors of this paper thank the reviewer for their dedication and suggestions in reviewing this article. The responses to each suggestion were explained as clearly as possible and we look forward to your comments.

SPECIFIC COMMENTS The title clearly reflects the contents of the paper.

Abstract I suggest to simplify and clarify the abstract. It is confused. We have made an effort to make more pleasant the discussion of results.

Introduction. 1. In my opinion, the objectives of the manuscript should be clarify. We aimed to evaluate- i.-bulk density, the change in weighted average diameter, the hydraulic conductivity and organic carbon content on wheat / maize / sunflower crop sequence in three management systems; ii.- that pore size is affecting the differences in bulk density observed in three management systems and its relation to the hydraulic conductivity of the soil and iii.- yields the crop sequence over 10 years. 2. The hypotheses should be indicated in the introduction section. We hypothesize that the increase in bulk density in NT mainly affects the mesopores.

Material and methods 1. I suggest changing the order of the first and second paragraphs. First, you should introduce the area and then you present the climate char-

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acteristics. We accept the suggestions of the reviewer and reverse the order of paragraphs for a clearer description of the study area and climate. 2. Page 2619 (lines 7-18). I suggest to move it to a new sub-section (experiment design). We accept the suggestions of the reviewer 3. In my opinion it is not clear the study period. You indicate in the tittle and in the text that the experimental period is 10 years (1997-2007); however, you analyzed two samples in two years. Could you explain it in the text? why? We accept the challenge to the reviewer and we have incorporated in sub-section 2.2, two sentences:" The experiment was installed in 1997, in soils managed with chisel plow (CP) " and " The crop sequence analyzed was wheat - corn – sunflower; during the experimental period three crop sequences were performed and ended with wheat ." Moreover, in sub-section 2.3 Physical and chemical in soil determinations, we added: The soil physical parameters, except maximum δb, were determined after wheat harvests in two years (2004 and 2007) during the experimental period of 10 years (1997-2007). In the wheat harvest of the year 2004 the first determination of physical parameters was performed to begin after two complete cycles of the wheat-corn-sunflower sequence under three soil management systems. This decision was made because we consider necessary to allow a period of stabilization of the NT since it has been suggested that between 3 and 4 years is required for soils with tillage reduced succeed in developing a favorable porosity in the first centimeters deep (Voorhees and Lindstrom , 1984) at the end of the third cycle of the crop sequence determinations of the physical parameters were again carried out during the wheat harvests in the year 2007 to analyze trends between the two periods. The methodology used was as follows: 4. Page 2621 (line 1). Check the text because there are some mistakes in the formula explanation. We have corrected the errors in the explanation of equation 1. We thank the reviewer this correction. 5. Section 2.3 Crop yield. I suggest a better explanation of the method or include some references. In the new version of the work, the section on crop yield is 2.4. We have included a clearer explanation on the method of estimating crop yields, with bibliographic citations. The paragraph included is as follows: Crop production was determined by manual harvest of three sub-samples of each treatment

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and crop, representing 10 m2 for corn, sunflower and corn (Noellemeyer et al., 2013) and by mechanical harvest, using an experimental harvester similar to use to Velazco et al., (2012), representing 20 m2 for wheat.

Results and Discussion The explanations are not clear and sometimes they are confused. Please try to simplify the result discussions. We have tried to improve the discussion of the results to clarify them. Changes are shaded yellow. The details about Figure 2 should be improved (also Figure 2 should be clarified) We have removed Figure 2 and present the data in a table bulk density (Table 2) Results about SOC should be improved. Some Figure or Table should be added. We have incorporated Figure 4 Figure 1 should be improved. Some coordinates can be added in the Figure, north, legend. I also suggest to include some Pictures of the study area. We have removed the suggestion Figure 1 reviewer 2. Unfortunately we do not have clear pictures of field experiments to incorporate in the text. Figure 2. It should be improved. I suggest to split up the Figure in different figures with more information about bulk density. I suggest to make 4 figures (3-8 cm, 13-18 cm, 2004 and 2007). Similar to Figure 3. We have removed Figure 2 and present the data in a table bulk density (Table 2). References. It should be interesting to include new references related to worldwide studies. Many of the references in the manuscript are related to Argentina systems, and maybe it would be better to include wide literature. We have included new references, however over 65% of the references are international.

TECHNICAL CORRECTIONS References: 1. Check references. Check agreement between names in the text and in the reference list. We have checked the references. 2. Please homogenize references and make sure that the referencing style follows that currently in use in the Solid Earth. The study should be checked and it would be necessary to change different points in relation with the forms (See PDF). So, I consider that the paper merits its publication, and I think that it has to be accepted for publication with moderate/major revisions. We check the references standards of publication of SE and correct whatever was wrong. We thank the reviewer who believes that our work can be

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published in SE. Please also note the supplement to this comment: http://www.solid-earth-discuss.net/6/C849/2014/sed-6-C849-2014-supplement.pdf We review the suggestions and corrections given by the reviewer in the pdf and have accepted and fixed absolutely everything. ———————————————————————————————-

Interactive comment on "Soil physical quality changes under different management systems after 10 years in Argentinian Humid Pampa" by J. L. Costa et al. Anonymous Referee #2 Received and published: 2 September 2014

The study compares the effect of different tillage system on soil physical properties along 10 years. In general, the study is well conducted and provide good results conclusion to be applied on soil management with local interest. However, it could be improved before the publication on S&E.

Introduction I could not see a clear proposal distinction on this manuscript compared to others cited on the introduction and discussion. What it is the novelty or innovation of the manuscript? The novelty of our work is to try to make a contribution to a discussion that is underdeveloped in the international and national literature. This is to provide data that allow us to check in NT, which is affecting pore size increased soil bulk density. This outline emerges that, in a review from Alvarez and Steinbach (2009), a number of experiments have confirmed the improvements in soil aggregation and infiltration achieved by NT in dry land farming areas associated with increases of δb under NT. An increase to δb implies a reduction of the macro and meso porosity which is in contradiction with the increased infiltration which occurs at macro and meso-pores. We hypothesize that the increase in bulk density in NT mainly affects the mesopores. On the other hand, averaging out soil SOC differences in various experiments under NT showed an increase of 2.1 Mg C ha$-$1 over MP and the steady state was reached after 25–30 years (Alvarez, 2005). When enough nutrients were applied, there was no difference in yields between tillage. With this scenario and the tendency to increase the surface under NT in the southeast of the Humid Pampa, we aimed to evaluate- i.- bulk density, the change in weighted average diameter, the hydraulic conductivity and

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organic carbon content on wheat / maize / sunflower crop sequence in three management systems; ii.- that pore size is affecting the differences in bulk density observed in three management systems and its relation to the hydraulic conductivity of the soil and iii.- yields the crop sequence over 10 years.

Material and Methods Explain the experimental procedure: The CMWD increased between 2004 and 2007 as the management system became more intensive (MP >CP> NT). Won't be the change on physical properties assessed for 10 years. I did not see clearly the initial conditions of the experiment. I was expecting to see the change of the soil through the time (i.e., 10 years). Keep just MWD instead of CMWD. In addition, authors could explain briefly the methodology applied to assesses this parameter (see reference). For example, the soil is richer on sand. It was sand corrected from the final MWD. Thanks to your suggestions, we have modified the text with the intention of clarifying it. Structural stability was measured by the De Leenheer and De Boodt (1959) method. The De Leenheer and De Boodt instability index is determined as the measured area between the two curves corresponding to the aggregate size distributions found before and after wet sieving water-moistened aggregates with diameters between 2 and 8 mm. The authors determined the index graphically, but it is numerically equivalent to change in mean weight diameter (CMWD) between the dry aggregate distribution and the water stable aggregate size distribution. The larger the value of CMWD, the more unstable the aggregates (Diaz Zorita et al., 2002). Castro Filho et al. (2002) use the MWD because they analyze the increase in that parameter as a function of increasing large aggregates retained on the sieves, while we compare the distribution curves of aggregates sieved dry and wet to analyze the exchange area between two curves, this is the reason why we express it as CMWD. The soil physical parameters, except maximum δb, were determined after wheat harvests in two years (2004 and 2007) during the experimental period of 10 years (1997-2007). In the wheat harvest of the year 2004 the first determination of physical parameters was performed to begin after two complete cycles of the wheat-corn-sunflower sequence under three soil management systems. This decision was made because we consider

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necessary to allow a period of stabilization of the NT since it has been suggested that between 3 and 4 years is required for soils with tillage reduced succeed in developing a favorable porosity in the first centimeters deep (Voorhees and Lindstrom , 1984) at the end of the third cycle of the crop sequence determinations of the physical parameters were again carried out during the wheat harvests in the year 2007 to analyze trends between the two periods. Initially all experiments started from a soil management with MP and are not rich sandy soils (see Table 1) Equation 1. Why it as used 2.65 on particle density. Is it reliable for this soil? In this equation it is considered, for the mineral soil, a density of 2.56 and a density of the organic part of 1.3. The actual density of the soil was corrected for the content of soil organic carbon (SOC. Statistical analyses. Provide the name of the statistical test and not the statistical package. Also, what was the post-hoc test to compare average (Dunnet - to compare the initial conditions - control) or Tukey. We clarify that: Analyses of variance were performed using mixed linear models(SAS Institute, Inc. 2002). The data at different years were analyzed as repeated measurement. The random effect was block and the fixed effects were N rates and soil management. The different levels of a fixed factor, such as the treatments were tested using the post-hoc test pairwise comparison of the least square mean (LSMeans). Please separated the results from the discussion. The text is so heavy that became difficult to follow the discussion. We decided not to follow the suggestion of the reviewer because we are more comfortable with this way of presenting the work. However, we have made an effort to make more pleasant the discussion of results. 3.2 Replace Structural stability to Mean Weight Diameter. Since the first, involve other parameters. We modify the title of the sub-section as suggested by the reviewer but keep the word change. p. 2624 l. 20. Overall, structural stability is usually associated with the increase in the SOC content (Tisdall and Oades, 1982). Should the authors take carefully on this argument, because we have different OC phase on the soil, different turnover ratio. And, micro and macro aggregate have different behavior according to type of organic matter, clay, oxide etc. It is a general statement. Also the gramineous crops (wheat and corn), especially, roots could

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be more important to macro aggregate stability than stubble over the ground. For rainplash, it is ok. We understand the reasoning of the reviewer and have removed the phrase: Overall, structural stability is usually associated with the increase in the SOC content (Tisdall and Oades, 1982) 3.3 Near-saturated hydraulic conductivity (K(h). Such a long experiment could have different soil moisture conditions during soil infiltration measurement. How the authors deal with it? We incorporate the following paragraph: The Kh measurement method using a disc infiltrometer is performed once the equilibrium (steady-state flow) was achieved with this tension. The time required to reach steady-state in unconfined infiltration measurements depends on initial soil water content and on hydraulic properties of a given soil. In general, drier soil and lower hydraulic conductivity result in the need for a longer infiltration period in order to reach steady-state infiltration. Table 3 the authors use R for radius and in the text is used r. Keep the same. (Álvarez, Steinbach, 2009) and (Álvarez and Steinbach, 2009) keep a consistent form throughout the text. We accept the suggestions of the reviewer Conclusions (ii) the CMWD values showed a decrease in the structural stability of the soil due to the agricultural activities. The CMWD increased more between 2004 and 2007 as the management system became intensive (MP>CP >NT) Should not the MWD suffered a decrease? No, with a larger value of CMWD, the more unstable the aggregates (Diaz Zorita et al., 2002). All the crop system displayed a MWD bigger than 2004. And conventional was equal to NT. See a paper than can help on this discussion and methodology to MWD as well. Castro Filho C, Lourenço A, de F. Guimarães M, Fonseca ICB. 2002. Aggregate stability under different soil management systems in a red latosol in the state of Parana, Brazil. Soil and Tillage Research, 65: 45-51. DOI: 10.1016/s0167-1987(01)00275-6. We have incorporated in the discussion the results provided by Castro Filho et al (2002) Table 1. Initial soil characteristics of the experiments. Where is the other soil characteristics such as infiltration, bulk density, MWD? The data presented in Table 1 correspond to the time of installation of the experiment. In the wheat harvest of the year 2004 the first determination of physical parameters was performed to begin after two complete

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cycles of the wheat-corn-sunflower sequence under three soil management systems. Table 1 displays different units Replace: P (ppm) to mg or g / kg-1, Texture% to kg kg-1, Soil carbon stock will not be better in kg kg-1 and related to soil bulk density. Bulk density affect directly the soil carbon content. We accept the suggestions of the reviewer and We have incorporated in materials and methods the units of SOC (% for concentration and g m-2 for stock). Table 2. Maximum soil density (_bmax) Mg m-1 or Mg m-3? Different letters meaning significantly different. It is obvious, just in case, replace to Different letters in the columns meaning significantly different. We corrected the maximum soil density units and we have noted that the letters indicate differences between values in the same column. Also, all the data should be followed by standard deviation etc.. We accept the suggestions. Table 3. Effective porosity calculated. No statistical comparison was done on these parameters. Avoid to use * as a note in order to not cause confusion with * ($p < 0.05$) We accept the suggestions. Figure 1. Experiment geographic location. Definitely, figure 1 is awful. We removed the figure.

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/6/C1163/2014/sed-6-C1163-2014-supplement.pdf

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Interactive comment on Solid Earth Discuss., 6, 2615, 2014.

Table 2. Effect of time: years 2004 and 2007, depth: from 3 to 8 cm and from 13 to 18 cm and treatments: mouldboard plow (MP), chisel plow (CP) and no till (NT) on soil bulk density.

Effect		Bulk density	
		Mg m^3	
Time	2004	1.20	a*
	2007	1.18	b
Soil depth	3-8 cm	1.21	a
	13-18 cm	1.18	b
Tillage system	NT	1.22	a
	MP	1.19	b
	CP	1.17	b

*Different letters indicate significant differences (LSMEANS, p<0.05).

Fig. 1.

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Figure 4. Soil organic carbon (SOC, %) in the principal axes and soil organic carbon stock (SOC, g m^{-2}) in the secondary axes of the treatments: moldboard plow (MP), chisel plow (CP) and no till (NT). Different letters indicate significant differences among treatments ($p < 0.05$).

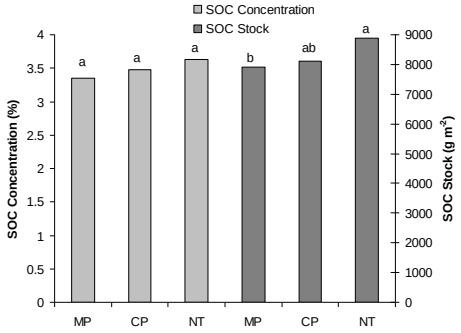

Figure 4.

Fig. 2.

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