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Interactive comment on "Evaluating management-induced soil salinization in golf courses in semi-arid landscapes" *by* J. Young et al.

J. Young et al.

theo.udeigwe@ttu.edu

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Response to Reviewer's Comments

P. Sarah (Referee)

***General comment The paper aims to examine the potential management-induced alteration in soil salinity indicators in golf course facilities and to develop predictive relationships for a more rapid soil salinity examination within urban landscape soils using findings from portable x-ray fluorescence (PXRF) spectrometer. The authors give attention to the risk of salinization because of irrigation in golf courses which are major users of irrigation water per unit area.They provide evidences on the alteration of soil

characteristics because of land management. Their findings are of great importance for the urban system.

The description of the “study sites” and” materials and methods” needs more information and more clarified information. I recommend to separate “Results and discussion” into “results” and “discussion”. The” Introduction” and “Materials and methods” should be improved by more citations and information, respectively. This is the basis for analysis of the data and for comparison with other studies.

The authors would wish to remain with combined results and discussion since the manuscript has already been written in that format. I think the style may be field-specific. A number of final revised papers on Solid Earth particularly in the field of soil science, have a combined results and discussion. Please see final papers in SE published with combined “Results and Discussion” below:

Scale effect on runoff and soil loss control using rice straw mulch under laboratory conditions S. H. R. Sadeghi, L. Gholami, E. Sharifi, A. Khaledi Darvishan, and M. Homaee Solid Earth, 6, 1-8, 2015 Soil organic carbon along an altitudinal gradient in the Despeñaperros Natural Park, southern Spain L. Parras-Alcántara, B. Lozano-García, and A. Galán-Espejo Solid Earth, 6, 125-134, 2015 Impact of the addition of different plant residues on nitrogen mineralization–immobilization turnover and carbon content of a soil incubated under laboratory conditions M. Kaleeem Abbasi, M. Mahmood Tahir, N. Sabir, and M. Khurshid Solid Earth, 6, 197-205, 2015 Kinetics of potassium release in sweet potato cropped soils: a case study in the highlands of Papua New Guinea B. K. Rajashekhar Rao Solid Earth, 6, 217-225, 2015 Factors driving the carbon mineralization priming effect in a sandy loam soil amended with different types of biochar P. Cely, A. M. Tarquis, J. Paz-Ferreiro, A. Méndez, and G. Gascó Page(s) 585-594 Conventional tillage versus organic farming in relation to soil organic carbon stock in olive groves in Mediterranean rangelands (southern Spain) L. Parras-Alcántara and B. Lozano-García Page(s) 299-311

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***Specific comments Additional references related to the introduction (such as Soil sodium and potassium adsorption ratio along a Mediterranean-arid transect. J. Arid Environments 59(4), 731-741; Soluble salts dynamics in the soil under different climatic regions. Catena 43(4), 307-321) should be given.

We appreciate the suggestion. The following reference(s) has been added to strengthen the introduction: Pariente, S. (2001). Soluble salts dynamics in the soil under different climatic conditions. Catena, 43(4), 307-321. (line 71 and 395-396)

***P 3 L 15: Add values of "relatively higher level of soluble salts". Higher than what?

This sentence has been modified to read "Given the chemical properties of soils in the semi-arid and arid regions, which are typified by high pH (>7.0) and limited leaching of soluble salts (IUSS Working Group, 2006), poor management practices could lead to soil salinization (line 66-68)

***A detail description of the study sites might support the discussion. Information on climate rainfall amount and distribution, temperature, relative humidity), lithology, topography and history (date of construction) should be completed.

The requested information has been added as shown below: (line 121-125)

This area is characterized by semi-arid climatic conditions. Mean weather parameters recorded in year 2013 when soil sampling was conducted were 320 mm (for precipitation), 61°F (ambient air temperature), 53% (relative humidity), and 18.2 mph (wind speed) (NOAA, 2015). Geological materials are composed mainly of Quaternary aeolian sand and loess (Nordstrom and Hotta, 2004).

Supporting references added: NOAA: NOAA Online Weather Data (Lubbock Area), available: http://www.weather.gov/ climate/xmacis.php?wfo=lub, accessed Feb. 22, 2015.

Nordstrom, K. F., and Hotta, S.: Wind erosion from cropland in the USA: a review of problems, solutions and prospects, Geoderma, 121(3), 157-167, 2004.

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***P 5 L 15: “seven golf course facilities spread all over the city were selected”. Selected in random? Are they similar in their structure (organization), topography, history? What is the area of each facility? All of these might explain the range of the results in these areas (and added to the discussion too).

Almost all the golf courses in the city selected for this purpose, so not random. They are located all over the city. The golf courses are similar in topography but varies size and age (all > 12 years old). The average golf course fairway contains 10 to 12 hectares of irrigated fairways (line 121).

But it is important to note that our goal was not to compare golf courses (we are not accounting for differences among golf courses) but rather to examine the differences between the managed and non-managed zones at each golf course. Information of the history (age) of the golf courses have been added (line 127).

***P 5 L22: “. . . non-managed areas were composed of poorly managed grass cover, native vegetation, or bare soil.” Assessment of the cover percentage of each type of cover should be added. The root system of different types of veg. might affect soil depth characteristics including leaching, upwards movement of salts. It might give an additional explanation to the differences between the managed and non-managed treatments. The species (full names) are also indicative for treatment type.

The non-managed sites were more like zones adjacent to the fairways that are not receiving irrigation, fertilization, and other management practices. They were sparsely covered by vegetation so the % cover of the native vegetation was not taken into account. We agree that the root system of the different types of vegetation could affect soil depth characteristics but in this instance, there are not many different types of vegetation. We don’t think this is of interest to this study since we are mainly examining changes in chemical properties which will be influenced more by management (irrigation and possibility fertilization) and minimally by the grass species.

***In the summary you mentioned that the research area is characterized by wind ero-

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sion. Don't you think that the difference between the treatments in soil salinity can be attributed, in addition to irrigation etc', to the roughness of the land, i.e., differences in the potential of vegetation cover and type to trap dust? (Soluble salts dynamics in the soil under different climatic regions. Catena 43(4), 307-321)

This is a very good question. However, we do not think the differences in vegetation and possible dust trapping will be sensitive enough to cause differences in soluble salt dynamics within almost the same geological and geographical boundaries and climate as the case in this study.

***P 6. . .L 1: How many samples? In what season the samples were taken? More details/description on the biomass of the sites is needed. Such details can improve the discussion (For example: P 8 L 21).

The number of samples has been added. Likewise the season of sampling has also been added. More supporting information has also been added (line 138, 141-144).

***P 10 L 26: "Besides irrigation, this shift toward salinization is further supported by the semi-arid condition of the study site, characterized by low rainfall and less leaching of the soluble salts, leading to their build up in the top soil." Salts in the soil represent . . ...Can you relate to the hydraulic conductivity of each soil layer? Is it similar/not similar in both the managed and no-managed? The HD in depth can affect the EC in the upper soil layers.

Good suggestion! However, our focus was more on the chemical properties. The physical properties are also important but not the focus of this study and may be covered in any upcoming study at some of these facilities. We also believe that differences in hydraulic conductivity (if existing) could also factor into the resultant effect of management practices as well.

***P 13 L 10-11: "This is an area characterized by semi-arid climatic conditions, typified by drought, wind erosion, salinization, etc." What other characteristics are included in

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“etc”

The “etc” has been removed and the sentence modified to:

“This is an area characterized by semi-arid climatic conditions, typified by drought, wind erosion, and potential for soil salinization” (line 321-323).

***One of your findings was “Irrigation tended to increase the salinity and sodicity properties of the soils. . .” . Based on the values of soil EC, ESP and SAR that you have found, do you think that there is a risk for salinization of the golf areas.

With the evidence gathered from this study and the increasing dependence on the Ogallala Aquifer which is declining in both quantity and quality, coupled with the unique management practices at these facilities, there could be a possibility of soil salinization over time (years). Na is already an issue at some of these facilities.

Interactive comment on Solid Earth Discuss., 7, 91, 2015.