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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatial variations of deep soil moisture and the influencing factors in the Loess Plateau, China" *by* X. N. Fang et al.

Anonymous Referee #2

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This study examines the soil moisture in deep soil profiles (up to 5 m) in a 1000 Km2 catchment of the Loess Plateau of China. The main motivation of the study is to assess the impact of different types of land management on soil water content. Three land management types are examined: i) native grasses; ii) deep root vegetation introduced as part of a large afforestation plan known as Grain for Green project; iii) cropped lands.

The number of soil profiles explored within each type of land management ranges from 10 to 25, for a total of 151 profiles. Soil samples were collected along 5 m profiles with 20 cm increments in summer 2014. Gravimetric soil water content was assessed by oven drying. Standard statistical methods have been employed to assess to what extent the deep soil moisture profiles are influenced by land vegetation types as well as other environmental factors (soil properties, terrain attributes, climate etc.).

Main comments

The title of the manuscript is misleading. The paper does not explore the spatial variability of the soil moisture, it rather analyses how locally observed soil moisture values are related with both natural and human induced local factors.

The manuscript is too long, it provides several details that are not relevant for the key messages of the paper. Some data could be provided as supplementary material attached to paper.

Since the main scope of the paper is to assess the effect of the vegetation on soil moisture profile, a description of the root architecture of the different vegetation species in the examined sites would facilitate the analysis of the results. At lines 15-17, page 19, the authors state that "despite the deep root system of the apple orchard. . .the soil moisture in the apple orchard was higher than in native grasses". But how deep is the "effective" rooting system of the apple trees? Is it really deeper than native grasses? And what about the other species? It is well known that the soil moisture profile in the inter-storm periods is influenced by the vertical distribution of the active roots. Previous studies (e.g. Laio et al., Geophysical Research Letters, 2006) showed that the vertical root distribution in water controlled ecosystems is the result on an equilibrium condition affected by the local climate and soil properties. The data provided in the paper do not prove an unbalance "between soil availability and water utilization by plants". The observed soil moisture profiles could be representative of a stationary equilibrium condition.

Other comments

Line 5-7 page 2 and Figure 2: it is not clear if the meteorological data collected during the sampling period have been exploited for the soil moisture data analyses. Apparently not. Therefore the sentence (lines 5-7) and Figure 2 can be removed. The authors should clarify to what extent the soil moisture observed in top layers could have been influenced by the rainfall events during the same sampling period.

Equations 1 and 2 can be removed. They describe simple metrics (depth-average soil moisture values) but are quite confusing . The same symbol SMC is used with different subscripts to describe different metrics in a way that does not appear to be consistent. From Equation 2 and the corresponding description, is not clear that SMCs represents the average soil moisture within the same type of land management at a given layer depth.

Table 2 provides details (such as Kurtosis, Skweness, K-S normality test) that are not commented in the manuscript.

Lines 10-22, page 15. The classification of the different layers is rather subjective and not supported by experimental evidences. The first layer should be influenced by both evaporation and transpiration. Not clear while the second layer is a “rainfall infiltration layer”: transpiration could be significant in this layer in case of deep rooted vegetation.

Section 3.3 could be removed. It does not add information relevant for the main outcomes of the paper.

Line 15-18, page 20. It is not clear how the correlation of the soil moisture with the average annual rainfall has been computed. No data about rainfall height at the different sampling sites have been provided. The result is rather surprising. Since surface soil moisture is highly variable in time, due to evapotranspiration and rainfall events, what is the motivation of this “significant correlation”? Despite what is stated in the manuscript, Table 4 does not highlight the correlation value as “significant” (I do not see it in bold or underlined).

From pages 9-10, it seems that soil properties (particle size distribution, bulk density, porosity) have been measured only from soils cores collected from the surface. Are these properties expected to be uniform along the soil profile? Soil moisture values are significantly influenced by soil texture and organic carbon content. Do the correlations presented in Tables 4-6 refer to surface soil properties?

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