Postprint: Spatiotemporal Distribution Characteristics of Soil Moisture on Slopes with Different Vegetation Types in the Dry-Hot Valley of the Jinsha River

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Abstract

During the dry and rainy seasons from July to December 2016 and April 2017, soil water content in the 0–100 cm layer was collected and measured using grid and soil auger methods for Leucaena Benth forest land, Dodonaea angustifolia shrubland, and Heteropogon cantortus grassland in the Juna small watershed of the dry-hot valley of the Jinsha River. Classical statistical and geostatistical methods were applied to analyze the dynamic variation characteristics of hillslope soil moisture under different forest and grass vegetation types in this region. The results showed that: (1) Soil water content in the study area was generally low, being significantly higher in the rainy season than in the dry season. In both dry and rainy seasons, the trend was shrubland > grassland > forest land, showing moderate to strong variation (ranging from 0.07 to 0.28). (2) Soil moisture under different forest and grass vegetation types exhibited similar spatial autocorrelation in both dry and rainy seasons, with autocorrelation coefficients transitioning from positive to negative. However, the lag distance for this transition differed, being greater in the rainy season than in the dry season, and showing moderate or strong spatial autocorrelation. (3) The spatial structure of soil moisture differed among different forest and grass vegetation types, with the spherical model being the best-fitting model for both dry and rainy seasons in forest land, shrubland, and grassland. Under the same vegetation type, the spatial distribution characteristics of soil moisture in each soil layer were similar between dry and rainy seasons, but the difference in distribution patterns was more pronounced in the dry season. Under different forest and grass vegetation types, the distribution of deep soil moisture was more complex than that of surface soil moisture, with soil moisture showing obvious patchy or banded distribution, and the locations of high and low water content zones were not fixed. In summary, different forest and grass vegetation types alter the

spatial distribution of soil moisture at local sites, and rainfall strengthens this trend of difference, but soil moisture still maintains a certain degree of spatial continuity.

Full Text

Preamble

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Title: Effects of Typical Forest and Grass Vegetation on Slope Soil Moisture Variation in Dry-Hot Valleys

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1 Study Area Overview

1.1 Location and Natural Environment

The study area is located in the dry-hot valley of the Jinsha River, Yunnan Province, southwestern China, with geographic coordinates ranging from 25°34 to 25°38 N and 101°52 to 101°54 E. The elevation is approximately 634 m above sea level. The region is characterized by a dry-hot valley climate with annual precipitation exceeding 1,500 mm, relative humidity of 80–90%, and maximum temperatures reaching above 40°C.

The dominant vegetation types in the study area include: - **Forest land:** Leucaena Benthamii plantation - **Shrubland:** Dodonaea angustifolia shrubland - **Grassland:** Heteropogon contortus grassland

Associated species include Eulaliopsis binata, Eupatorium heterophyllum, Bothriochloa pertusa, Dodonaea viscosa, Phyllanthus emblica, Ziziphus mauritiana, Eucalyptus robusta, and Abrus precatorius.

1.2 Research Methods

1.2.1 Sample Plot Design A grid sampling method was employed to establish sample plots within three representative vegetation types: Leucaena forest land, Dodonaea shrubland, and Heteropogon grassland. Each sample plot covered an area of 100 m × 100 m, with sampling points arranged at 10 m intervals, resulting in 100 sampling points per plot.

Soil moisture content was measured using a soil auger at each sampling point. Samples were collected from the 0–100 cm soil profile. The study was conducted during two distinct seasons: the dry season from July to December 2016 and the rainy season in April 2017. Soil moisture dynamics were analyzed using geostatistical methods to characterize spatial and temporal variability patterns.

Abstract: In order to explore the influence of typical forest grass vegetation on soil moisture change on sloping land in dry-hot valley area, the soil moisture content (within the depth of 0 to 100 cm) were collected and measured using the grid sampling method and soil auger method in the drought season in July to December 2016 and rainy season in April 2017, taking the Leucaena Bentham forest land, Dodonaea angustifolia shrubland and Heteropogon contortus grassland as the research objects at dry-hot valley of Juna small watershed in Jinsha River, Yunnan Province, China. The dynamic characteristics of soil moisture under typical forest vegetation in the slope area were analyzed with geostatistics method. The soil moisture content in the dry-hot valley of Jinsha River was low (which were 7.44% in the dry season and 9.88% in the rainy season for the forest land; 10.25% and 10.31% respectively for the shrubland; and 5.03% and 10.60% respectively for the grassland), the soil moisture in the rainy season was higher than that in the dry season, and the soil moisture content in the shrubland was bigger than that in the grassland which was bigger than that in the forest land regardless of the dry season or the rainy season, showing a moderate to strong variation (between 0.07 to 0.28). The soil moisture in the hot valley of Jinsha has significant spatial structure and spatial continuity, and the soil moisture had similar spatial autocorrelation regardless of the season (drought season or rainy season) and the land cover (forest or shrub or grass vegetation). All the autocorrelation coefficients went from positive to negative but with a different lagging distance in the transformation and it was bigger in the rainy season than that in the dry season, demonstrating a moderate to strong spatial autocorrelation. The spatial structure of soil moisture was different depending on the types of land cover and this difference was remarkable in the dry season. The moisture distribution in the deep soil was more complex than that in the surface layer, displaying an obvious patched or stripped distribution with unset high water content areas and low water content areas. The best fitting model was the spherical model for the forest land, shrub and grassland. Under the same land cover, the spatial structure of the water content was similar regardless of dry season or rainy season. In short, different type of land cover will change the spatial distribution of soil moisture in the areas and the rainfall will amplify this difference, but soil moisture still has some spatial continuity. Therefore, diverse strategies in the utilization of water resources should be adopted during ecological restoration and vegetation reconstruction in dry-hot valley.

Keywords: dry-hot valley; soil moisture; spatial and temporal variability; vegetation; geostatistics

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References

[1] LI Meng, DUAN Wenbiao, CHEN Lixin, et al. Geostatistical analysis on spatiotemporal distribution pattern of soil water content of forest gap in Pinus koraiensis dominated broadleaved mixed forest [J]. Chinese Journal of Ecology, 2014, 33(3): 716-722.

[2] YUN Lei, BI Huaxing, TIAN Xiaoling, et al. Research progress on spatial heterogeneity of soil moisture in slope scale and its relationship with topographic factors [J]. Chinese Journal of Ecology, 2012, 32(5): 1396-1402.

[15] ZHAO Leilei, ZHU Qingke, NIE Lishui, et al. Soil moisture variation patterns of steep slope in the loess region in northern Shaanxi Province [J]. Ecology and Environmental Sciences, 2013, 21(5): 590-597.

[20] WU Weizhen. Spatial heterogeneity of soil moisture in slope scale and its relationship with topographic factors [D]. Lanzhou: Lanzhou University, 2014: 14-16.

[21] YANG Quan, ZHAO Chengzhan, SHI Lili, et al. Spatial autocorrelation analysis on soil moisture of Melica przewalskyi patch in a degraded alpine grassland of Qilian Mountains, Northwest China [J]. Chinese Journal of Ecology, 2014, 33(3): 716-722.

[22] YU Lei, BI Huaxing, TIAN Xiaoling, et al. Research on spatial heterogeneity of soil moisture in slope scale and its relationship with topographic factors [J]. Acta Ecologica Sinica, 2012, 32(5): 1396-1402.

[29] FEI Xiliang, ZHANG Xinmin, JING Lingyun, et al. Vertical variability of soil moisture content in semi-arid loess region: A case study of Sunjiacha Basin of Lanzhou in Gansu Province [J]. Acta Pedologica Sinica, 2013, 50(4): 652-656.

[30] YAO Xueling, FU Bojie, LYU Yihe. Spatial patterns of soil moisture at transect scale in the Loess Plateau of China [J]. Acta Ecologica Sinica, 2012, 32(16): 4961-4968.

[31] ZONG Luping, JIAO Yuanmei, LI Shihua, et al. Spatial and temporal variability of soil moisture in water source region of Hani terrace landscape [J]. Chinese Journal of Ecology, 2015, 34(6): 1650-1659.

[32] XU Huifang, SONG Tongqing, HUANG Guoqin, et al. Spatiotemporal variation of soil moisture under different land use types in typical karst hill region [J]. Acta Ecologica Sinica, 2014, 34(18): 5311-5319.

Note: Figure translations are in progress. See original paper for figures.