DISTRIBUTION OF WINTER FROZEN SOIL DEPTH IN QILIAN MOUNTAIN AND ITS RESPONSE TO TEMPERATURE CHANGE

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ABSTRACT: Generally speaking, the soil moisture of the high altitude region will freeze during winter season when the soil temperature drops below 0^{o}C. There are two types of frozen soil, the seasonal frozen soil when soil freezes during the cold days in winter, and defreeze as soon as the temperature rises in the following spring. The other type of frozen soil is the permafrost soil, which remains consecutively frozen below 0^{o}C for at least three years. Qilian Mountain is located in the northeast of the Tibet Plateau. And it is known as the natural water reservoir for the arid Hexi Corridor, Northwest China. Water from melted snow and ice, and seasonal frozen soil on Qilian Mountain merges together to form the surface runoff, which provides the major water resource to Hexi Corridor.

Global warming and human activities have caused tremendous alteration on the glacier, snow cover, and depth of frozen soil. The substantial changes could endanger the water reservoir. It is therefore necessary to clarify the status of water resources in Qilian Mountain in order to use them appropriately. Studies on permafrost soil have also made significant progress [1]. The seasonal frozen soil is close to ground level, should respond more sensitively [2], and experience the most significant impact from climate change. In Tibet Plateau, Inna Mongolia, and Xinjiang, studies in the related area indicate that as the global warming proceeds, the depth of the frozen soil is getting shallower and shallower [3-7]. However, there are not much research activities targeting to the seasonal frozen soil in Qilian Mountain.

This paper reports the distribution characteristics and response to air temperature of the seasonal frozen soil depth in Qilian Mountain, which will provide further understanding about the surface flow of the water melted from the seasonal frozen soil in this region. The data for the analysis include the maximum depth of winter frozen soil and air temperature collected at 13 meteorological stations on Qilian Mountain, during the 45 year time period of 1960～2004.

The statistics analysis was performed using trend coefficient, linear retrogression, correlation test, and F test. The trend coefficient represents the extent of variation of the factors. Correlation test estimates the degree of correlation between two variables. F test determines the significant

effect of the retrogression equation. When the F value is larger or equal to the F threshold, the retrogression equation becomes reliable.

The results show that the spatial distribution of frozen soil depth was obviously influenced by altitude; the maximum average depth was found in Yeniugou station which had the highest elevation. The variation of maximum frozen depth was relatively smoother, while the average frozen depth fluctuated more dramatically across different years. Winter temperature and frozen soil depth changed oppositely. The relationship is shown in the regression equation $Y = 51.13 - 8.73X$, where: Y is the average frozen soil depth, and X is the average temperature. For every 1℃ increase in winter temperature, the frozen soil would become 8.37cm shallower. The response of frozen soil depth to temperature warming was stronger in middle and east parts, but milder in the west part of Qilian Mountains.

KEY WORDS: Qilian Mountain; frozen soil depth; spatial-temporal variation; climate warming; response

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