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# 半干旱地区草地生态系统的潜水依赖性模拟

# Simulation and analysis of grassland ecosystem dependence on phreatic water in semi-arid areas

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中文摘要：

针对半干旱地区复杂的水分条件，从水循环整体的角度出发，通过水循环模拟与植物生长模拟，探索地表植被与潜水的关系。以通辽市平原区的主要植被类型草地为研究对象，选取草地干物质产量作为反映草地植被生长状况的指标，通过分析该指标对降水和地下水变化的响应，阐明地表生态系统对地下水的依赖性。结果表明，枯水年草地生态系统稳定的适宜地下水埋深应在2.0～2.2 m之间；平水年草地干物质产量比枯水年增加13.0%～47.8%，说明降水是影响半干旱地区生态系统稳定的重要因素；无潜水支持条件下，枯水年的草地干物质产量比多年平均值减产11.0%～14.7%，而平水年仅减产3.8%～5.9%，可见降水的丰枯变化影响着草地的潜水依赖程度。

英文摘要：

Abstract: In semi-arid areas, human activity is more frequent than in arid areas, which makes groundwater exploitation more severe, while there is more precipitation relative to dry areas, which increases the complexity of the moisture conditions. For the complex water conditions in the semi-arid regions, the relationship between vegetation and phreatic water was explored by water cycle simulation and plant growth simulation from the perspective of the whole water cycle. The grassland, the main land use/cover types in Tongliao plain areas, and the grass dry matter yield (DMY), an indicator reflecting grassland vegetation growth situation, were selected for this study.Grassland plays an important role in the water cycle and regulates runoff, infiltration, evapotranspiration, groundwater recharge and discharge and so on in this region. In this paper, the water cycle is simulated by the MODCYCLE model, which is a distributed hydrological model with physical mechanism. The model also contains plant growth module, and couples with groundwater numerical simulation model, which makes the model become a set of powerful integrated hydrological model. Calibration and validation of the model were conducted in terms of groundwater and grass DMY. Simulated values and measured values of the groundwater level were compared in the end of simulation period by the way of groundwater contour map, and found both good fit. The analog values of grass DMYs were compared with the measured values from several literatures, and were proved that the results are reasonable.By analyzing the response of the DMY per unit area to the changes of precipitation and groundwater, the dependence of surface ecosystems on the groundwater was understood. Firstly, the response relationship between the analog values of the grass DMYs and the precipitation is analyzed and it is not a linear relationship. However, the grass DMYs are roughly in line with the movement trends of the precipitation. Precipitation is a factor affecting the growth of grass in dry years, but not all factors. Secondly, based on the statistical analysis of the grass DMYs at different intervals of phreatic water evaporation volume, relation curve between evaporation and grassland vegetation dry matter yield is established. As the evaporation increases, the DMYs of the high and medium coverage grasslands also increase. However, when the amount of evaporation increases to a certain extent, the grass DMYs are stabilized. The results show that the range of 2.0-2.2 m is the suitable groundwater depth for the stability of grassland ecosystems in dry years. Thirdly, the grass DMYs in normal precipitation years were also simulated for comparison with those in dry years. The results of statistical analysis show that the grass DMYs in normal precipitation years increase by 13.0%-47.8% to those in dry years, which explains that precipitation is an important factor affecting the stability of ecosystems in semi-arid areas. Finally, no support from phreatic water, the grass DMYs cut 11.0%-14.7% of the average for 10 years in dry years, and cut 3.8%-5.9% of the average for 10 years in normal precipitation years, showing that changes in precipitation affect the dependence on groundwater for grassland.

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