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黄河上游参考作物蒸散量变化特征及其对气候变化的响应

Variation characteristics of reference crop evapotranspiration and its responses to climate change in upstream areas of Yellow River basin

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中文摘要:

研究参考作物蒸散量对气候变化的响应对于辨析气候要素对蒸散发的影响具有重要意义。该文在验证FAO推荐的Penman-Monteith（P-M）方法在黄河上游地区适用性的基础上，分析了10个气象站点近50 a来参考作物蒸散量的变化特征，计算了参考作物蒸散量对4种气候要素的敏感系数及其对气候变化的响应。结果表明：FAO P-M方法在研究区域具有较强的适用性；参考作物蒸散量随海拔升高而减少，主要集中在生长季的3－10月。高海拔站点参考作物蒸散量年值多呈显著增加趋势，低海拔则明显减少，且变化过程不同。气温和风速敏感系数的年内变化分别呈显著的波峰型和波谷型，日照时数的变化不明显，相对湿度的敏感性呈生长季略有增加趋势；年际变化方面，气温的敏感系数呈显著增加趋势，低海拔地区相对湿度的敏感系数呈显著增加趋势。气温、日照时数的增加和相对湿度的降低导致了高海拔站点参考作物蒸散量的增加，高海拔地区的蒸散发主要受气温、日照时数等能量制约；低海拔站点参考作物蒸散量的减少主要受日照时数和风速减小、相对湿度提高的影响，水分条件的限制更显著。该研究对于结合未来气候变化趋势开展黄河上游地区生态管理，促进生态系统的良性发展，具有重要的科学意义和应用价值。

英文摘要:

It is practically significant for identification of different impacts of meteorological factors to study the response of reference crop evapotranspiration (ET0) to climate change. Based on the daily data of ten weather stations across a large climatic gradient in upstream areas of the Yellow River basin, China for recent 50 years, ET0 was estimated with the FAO56 Penman-Monteith (P-M) method. The P-M results and pan evaporation data were compared and the trends and response to climate change for reference crop evapotranspiration were calculated. The results show that the P-M method is suitable for study area. ET0 occurs mainly from March to October in growing season, and decreases with the increase of altitude. Significant increasing ET0 can be observed in most stations, where elevation is higher than 3000 m, and most stations in low elevation (<3 000 m) show obvious decreasing ET0. There are different change processes of ET0 in high altitude and low elevation area. Daily sensitivity coefficients to air temperature, wind speed and relative humidity exhibit large fluctuations during the year, while small fluctuations for sunshine hours. ET0 is insensitive to air temperature in winter and early spring, and the sensitivity gradually increases and achieves its maximum value in summer while opposite patterns were found for weed speed. Relatively strong negative sensitivity coefficients were obtained for relative humidity, and ET0 is more sensitive to relative humidity in growing season. The long-term trend analyses of sensitivity coefficients show that the sensitivity coefficients to air temperature increased, while decreased for relative humidity in low elevation stations. Increased air temperature, sunshine hours and reduced relative humidity led to increasing ET0 in high altitude area, whereas decreased ET0 is dominated by reduced sunshine hours, wind speed and increased relative humidity in low elevation area. So the high altitude area in upstream areas of of the Yellow River basin is taken as the 'energy-limited' system and the low elevation area as the 'water-limited' system.