全球暖化程度 2°C 對臺灣降雨與流量年際變化之衝擊分析－以中部重要水庫集水區為例

Interannual Variation of Rainfall and Runoff Under Global Warming Level of 2°C – A Case Study for the Reservoir Catchments in Central Taiwan

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摘　要

本研究使用「臺灣氣候變遷推估資訊與調適知識平台」(Taiwan Climate Change Projection Information and Adaptation Knowledge Platform, TCCIP)根據聯合國政府間氣候變遷專門委員會(Intergovernmental Panel on Climate Change, IPCC)於 2021 年發布之第六次評估報告(IPCC Sixth Assessment Report, AR6)結果產製之空間降尺度產品，進行中部德基水庫與集集攔河堰於全球暖化程度(Global Warming Level, GWL) 2°C 之降雨與流量年際變化之衝擊分析，以瞭解未來氣候變遷情境下對於水資源可用水量可能帶來之衝擊。本研究取得 GWL 2°C 之 99 組 Shared Socioeconomic Pathways (SSPs)情境雨量，每組有 20 年日雨量資料，針對各組情境雨量分別計算每年豐、枯水期雨量相較於基期(1995–2014)模擬雨量平均值之衝擊比率，以其瞭解各組情境雨量於豐、枯水期之年際變化。再藉由取得 86 組 SSP 情境溫度資料後，輸入 SSP 情境雨量與溫度資料至修正型 HBV 水文模式，產製 86 組 SSP 情境流量資料(每組有 20 年日流量資料)，針對各組情境流量分別計算每年豐、枯水期流量相較於基期模擬流量平均值之衝擊比率，以其瞭解各組情境流量於豐、枯水期之年際變化。分析結果顯示：GWL 2°C 所有 SSP 情境雨量與流量模擬結果於豐水期的平均值大於基期觀測平均值，而枯水期的平均值略小於基期觀測平均值。但值得關注的是年際變化(年與年之間的變化)，無論是在豐、枯水期，超過半數的 SSP 情境雨量與流量支持過半數年份的雨量與流量會低於基期平均值(稱為枯水年)。換言之，就平均情況而言，未來臺灣中部的豐水期雨量與流量可能增加，但豐、枯水年之雨量與流量差異將更為懸殊，且枯水年發生機會「大於」豐水年發生機會，較大雨量與流量發生主要集中在少數的豐水年。

關鍵詞：氣候變遷情境，年際變化，HBV 水文模式，雨量與流量衝擊分析

Abstract

This study utilizes the downscaled projection products from the "Taiwan Climate Change Projection Information and Adaptation Knowledge Platform" (TCCIP), which are based on the results of the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) released in 2021. The aim is to analyze the interannual variation of rainfall and runoff at the Deji Reservoir and Jiji Weir under the Global Warming Level (GWL) of 2°C, in order to comprehend the potential impact on water resource availability under future climate change scenarios. The study acquired 99 sets of Shared Socioeconomic Pathways (SSPs) rainfall scenarios for GWL 2°C, each set comprising 20 years of daily rainfall data. For each SSP scenario, the ratios of projected rainfalls during the wet and dry seasons, respectively, for each year relative to the simulated rainfall average during the baseline period (1995-2014) were calculated to understand the interannual variations in rainfall for the wet and dry seasons.

After collecting 86 sets of SSP temperature data, the SSP rainfall and temperature data were entered into the modified HBV hydrological model to generate 86 sets of SSP runoff data, each set comprising 20 years of daily runoff data. The ratios of simulated runoffs during the wet and dry seasons for each year, in comparison to the simulated runoff average during the baseline period, were also computed to analyze the yearly variations in runoff for the wet and dry seasons. The findings indicate that all SSP rainfall and runoff simulations under GWL 2°C exhibit an average value for the wet season higher than the baseline observed average, while the dry season average is slightly lower than the baseline observed average. Notably, the interannual variation in both the wet and dry seasons suggests that more than half of the SSP rainfall and flow scenarios indicate that rainfall and flow in over half of the years will be below the baseline average (referred to as dry years). In essence, the analysis suggests that, on average, rainfall and flow in the wet season in central Taiwan may increase in the future. However, the disparities in rainfall and flow between wet and dry years are expected to be more significant, with a higher likelihood of dry years occurring than wet years. The occurrence of intense rainfall and flow events is primarily concentrated in a few wet years.

Keywords: climate change, interannual variation, HBV hydrological model, impact analysis of rainfall and runoff