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Seasonal Prediction of Taiwan's Streamflow Using Teleconnection Patterns

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Seasonal streamflow as an integrated response to complex hydro-climatic processes can be subject to activity of prevailing weather systems potentially modulated by large-scale climate oscillations (e.g., El Niño-Southern Oscillation, ENSO). To develop a seamless seasonal forecasting system in Taiwan, this study assesses how significant Taiwan's precipitation and streamflow in different seasons correlate with selected teleconnection patterns. Long-term precipitation and streamflow data in three major precipitation seasons, namely the spring rains (February to April), Mei-Yu (May and June), and typhoon (July to September) seasons, are derived at 28 upstream and 13 downstream catchments in Taiwan. The three seasons depict a complete wet period of Taiwan as well as many regions bearing similar climatic conditions in East Asia. Lagged correlation analysis is then performed to investigate how the precipitation and streamflow data correlate with predominant teleconnection indices at varied lead times. Teleconnection indices are selected only if they show certain linkage with weather systems and activity in the three seasons based on previous literature. For instance, the ENSO and Quasi-Biennial Oscillation, proven to influence East Asian climate across seasons and summer typhoon activity, respectively, are included in the list of climate indices for correlation analysis. Significant correlations found between Taiwan's precipitation and streamflow and teleconnection indices are further examined by a climate regime shift (CRS) test to identify any abrupt changes in the correlations. The understanding of existing CRS is useful for informing the forecasting system of the changes in the predictor-predictand relationship. To evaluate prediction skill in the three seasons and skill differences between precipitation and streamflow, hindcasting experiments of precipitation and streamflow are conducted using stepwise linear regression models. Discussion and suggestions for coping with extreme events in empirical seasonal predictions are also carried out. Findings from this work will contribute to the development of an integrated water resources planning and management system.