

## **Trend analysis of major hydroclimatic variables in the Langat River basin, Malaysia**

### **ABSTRACT**

Trend analyses of monthly, seasonal and annual rainfall, air temperature, and streamflow were performed using Mann-Kendall test within the Langat River basin to identify gradual trends and abrupt shifts for 1980 – 2010. Annual rainfall showed an increasing trend in upstream flow, a combination of decreasing and increasing trends in middle stream flow, and a decreasing trend in downstream flow. Monthly rainfall in most months displayed an insignificant increasing trend upstream. Stations with significant increasing trends showed larger trends in summer than those of other seasons. However, they were similar to the trends observed in annual rainfall. Annual minimum air temperature showed a significant decreasing trend upstream and significant increasing trends in the middle stream and downstream areas. Annual maximum air temperature portrayed increasing trends in both upstream and middle stream areas, and a decreasing trend for the downstream area. Both monthly and seasonal maximum air temperatures exhibited an increasing trend midstream, whereas they demonstrated trends of both decreasing and/or increasing temperatures at upstream and downstream areas. Annual streamflow in upper, middle and lower catchment areas exhibited significant increasing trend at the rates of 0.036, 0.023 and  $0.001 \times 10^3 \text{ m}^3/\text{y}$  at  $\alpha = 0.01$ , respectively. Seasonal streamflow in the upstream, midstream and downstream areas displayed an increasing trend for spring (0.55, 0.33 and  $0.013 \text{ m}^3/\text{y}$  respectively) and summer (0.51, 0.37,  $0.018 \text{ m}^3/\text{y}$  respectively). The greatest magnitude of increased streamflow occurred in the spring ( $0.54 \text{ m}^3/\text{y}$ ). Significant increasing trends of monthly streamflow were noticed in January and August, but insignificant trends were found in May, September and November at all stations. Annual streamflow records at the outlet of the basin were positively correlated with the annual rainfall variable. This study concludes that the climate of the Langat River basin has been getting wetter and warmer during 1980-2010.