

Trends in intensity and frequency of precipitation extremes in Malaysia from 1951 to 2009

Jeong Yik Diong[†]; Subramaniam Moten; Munirah Ariffin; Siva Shangari Govindan

[†] Malaysian Meteorological Department, Malaysia

Leading author: diong@met.gov.my

Based on hourly and daily precipitation dataset, 21 stations with a minimum of 30 years of record and robust trend detection techniques, trends in annual, seasonal total precipitation and in extreme daily and hourly precipitation defined as those greater than its 95th percentile for the year, winter and summer monsoon seasons have been examined for the period 1951 to 2009. Indices and their trends are performed using the RClimDex software developed by the Climate Research Branch of Meteorological Services of Canada. Statistical significance at various confidence levels for the trends are based on the Kendall's tau statistic. Cumulative hourly totals for 1, 2 and 3 hours are examined to study the frequency and intensity trends at convective time scale. Possible links between the changes in the seasonal precipitation and extreme events during the two main monsoon seasons have also been explored. A total of 11 indices for each precipitation event and regionally averaged indices to examine regional characteristics for Peninsular Malaysia and East Malaysia respectively are carried out. The results indicate that the maximum hourly precipitation events at the convective time scales around 60% of the stations show increasing trend, of which 10% being statistically significant, while the remaining 40% showing decreasing trend. Three quarters of the country shows an upward trend in the frequency and intensity of extreme convective precipitation. The summer (June-July-August) and winter (November-December-January) monsoons greatly influence the rainfall over Malaysia, with the summer monsoon season being drier and the winter monsoon season being wetter. The regionally averaged indices indicate that over Malaysia during the summer monsoon there is generally an upward trend in the seasonal precipitation due to increasing number of days with intense precipitation even though there is an overall decrease in the number of consecutive wet days. During the winter monsoon season the maximum cumulative precipitation summed over different number of days to capture the monsoon surges shows a downward trend in Peninsular Malaysia, however the extreme precipitation shows an increasing trend. In East Malaysia an increasing trend is observed for all indices except for the number of consecutive dry days. For the trends at the annual time scale, the maximum 1-day, 5-day, heavy precipitation day (>20mm) and number of extreme rainfall days, most stations in Malaysia generally show an increasing trend but they are not statistically significant. All stations in East Malaysia show an upward trend in the annual total precipitation, with Sibul station having a significant positive trend of 18.9mm per decade. However in Peninsular Malaysia the annual total rainfall shows a slightly decreasing trend, which could be mainly due to the number of rain days exceeding 10mm, is on the downtrend. This study shows that in general the intensity and frequency of extreme precipitation events are on the rise. The summer monsoon season is becoming wetter but at the same time prolonged dry spells are more frequent. During the winter monsoon the extreme precipitation events associated with monsoon surges and other synoptic features are on the rise. Notable increasing trend in the annual precipitation is observed in East Malaysia with both the monsoon seasons possibly contributing to this trend.