

# Determination of Start and End of Rainy Season in the South-western Region of Sri Lanka

upul sonnadara (✉ [upul@phys.cmb.ac.lk](mailto:upul@phys.cmb.ac.lk))

Department of Physics, University of Colombo, Colombo 3, Sri Lanka <https://orcid.org/0000-0001-7862-2537>

---

## Research Article

**Keywords:** Start of rainy season, end of rainy season, cumulative rainfall, Yala season, Maha season

**Posted Date:** May 10th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-485195/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Determination of start and end of rainy season in the south-western region of Sri Lanka

Upul Sonnadara

Department of Physics, University of Colombo, Colombo 3, Sri Lanka

Daily rainfall records for 50 years (1961 to 2010) were used to determine the start and end of rainy seasons in the south western region of Sri Lanka. The study was based on data records obtained from two weather stations in Colombo and Galle situated in the western and southern coastal belts of Sri Lanka respectively, that have two growing seasons Yala and Maha. The start and end dates were determined by using a method that is based on cumulative rainfall measured during a season. Substantial interannual variability is seen in start and end of rainy seasons in this study.

For the Yala season, the mean start and end dates are in the standard weeks  $12.0 \pm 2.3$  and  $24.1 \pm 2.0$  (March 24<sup>th</sup> to June 20<sup>th</sup>) respectively. For the Maha season the mean start and end dates are in the standard weeks  $35.4 \pm 2.0$  and  $49.6 \pm 2.0$  (September 5<sup>th</sup> to December 15<sup>th</sup>) respectively. The mean duration of the rainy season for Yala and Maha are  $12.1 \pm 2.6$  weeks and  $14.2 \pm 2.3$  weeks respectively. The start date and the duration of the rainy season for both Yala and Maha are correlated, leading to early start dates resulting in longer rainy seasons. It can be concluded from this study that it is possible to use daily rainfall records to determine the mean start and end dates of rainy seasons in the south-western region of Sri Lanka.

**Keywords:** Start of rainy season; end of rainy season; cumulative rainfall; Yala season; Maha season

---

Corresponding author: **Prof. D.U.J. Sonnadara**

Department of Physics, University of Colombo, Colombo 3

Tel/Fax: 011-2584777, Mobile: 071-4406251

Email: [upul@phys.cmb.ac.lk](mailto:upul@phys.cmb.ac.lk)

## 1. INTRODUCTION

Sri Lanka is an island located south of the Indian subcontinent close to the equator. Agriculture, particularly paddy is heavily dependent on the variability and the distribution of amount of rainfall received duration of the growing season (Domroes, 1993). The major paddy producing seasons in Sri Lanka are named as Yala (April - September) and Maha (October – March). Depending on the mean annual rainfall it receives, the country is divided into two regions, the wet zone and the dry zone. The wet zone which contains the central highlands and extends to the low land coastal regions of the southwest sector of Sri Lanka, receives rainfall predominantly from two monsoons; the southwest monsoon and the northeast monsoon. The mean start and end of the southwest monsoon are defined traditionally as being the months of May and September respectively while for the northeast monsoon they are defined as being the months of December and February of the following year, respectively. The dry zone which covers about 60% of the total land area of Sri Lanka, consists of low altitude areas of the coastal belt. The dry zone receives rainfall mainly from the northeast monsoons. The rainy season in this area which commences in October and ends in January is short and hence rainfed cultivation is possible only for about 4 months. The natural vegetation in the dry zone has adopted to seasonal changes where crop growth is dependent on the availability of water.

The start, end and duration of growing season depends on the geographical location under consideration (Benoit, 1977; Stern et. al., 1982; Holland, 1986; Sivakumar, 1988; Stewart, 1988). By using long term daily rainfall data for many locations in the southern Sahelian and Sudanian climatic zones of West Africa, Sivakumar (1988) has shown that a significant relationship exists between the date of start of rains and the duration of the rainy season. The early start of rain produces a longer growing season. Stewart (1988) carried out a study using rainfall data from number of countries in Africa Asia, the Near East and North America. The study suggests that using the correlation between the start and end of rain, there is a possibility of using the rainy season potential. Although present, the correlation is weak between the start and rainfall amount. A study carried out in the Sudan Savanna of Northern Nigeria (Ati, 2002) has concluded that traditional methods of determining the start dates are unreliable and new methods which would reduce false starts are required. A Nigerian study (Odekunle, 2006) to assess the relative efficiency of using rainfall amounts and the number of rainy days has shown that both are effective in determining the mean rainfall start and end dates. The study suggests that rainy days should be used to determine start and end dates for Nigeria when individual years are considered.

Studies analysing the connectivity between the start of rain and seasonal characteristics are somewhat limited in the literature on Sri Lanka. Punyawardene et. al. (2002) used **stochastic rainfall generator/model** and simulated weekly rainfall data to determine whether there is a relationship between the date of start of the seasonal rains and seasonal characteristics in the north central part of the country, located in the dry zone. They conclude that there is no strong evidence to suggest that the start of rain impacts the

amount of rainfall or the duration of the season. Sonnadara (2015) in a recent study carried out using daily rainfall data has shown that for the northeast region of Sri Lanka, start dates and duration of growing season is weakly correlated with early starts leading to a longer growing season. The present study is a sequel to the previous work but focused on the southwest region of Sri Lanka.

This study focuses on studying daily rainfall data observed at two coastal stations in the wet zone that receive rainfall predominantly from the southwest and northeast monsoons to (1) determine dates of the mean start and end of rain for the two growing seasons, namely Yala and Maha (2) study the interannual variations of the start and end dates and (3) find a link between the start date and the duration of the rainy season in the south western region of Sri Lanka, if such a link exists. The early identification of the potential of the season using events such as temporal patterns of the wet and dry spells leading to the start of the rainy season is not considered in the present work.

## 2. METHODOLOGY AND IMPLEMENTATION

The meteorological observations in Sri Lanka have a long history dating back to as far as 1850. The data for this study were obtained from the Department of Meteorology in Sri Lanka which is one of the oldest government departments in the country and responsible for collection maintenance and monitoring of metrological and climatological parameters. Two first order stations Colombo and Galle in the coastal area of the wet zone were selected for the present study. One reason for selecting two stations is to verify the robustness of the results against each other. The selected stations receive rainfall during the southwest and northeast monsoons and display a clear bimodal rainy season. Daily rainfall measurements during the 50-year period from 1961 to 2010 were utilized. The coordinates of these two stations together, the annual mean rainfall and the estimated percentage of missing data during the period under consideration are provided in Table 1. The geographical locations of these two stations as well as the locations of other first order stations in the coastal belt are provided in Figure 1.

Table 1: Summary of the rainfall stations selected for the study

<b>Station</b>	<b>Latitude N°</b>	<b>Longitude E°</b>	<b>Period considered</b>	<b>Annual Rainfall (mm)</b>	<b>Missing Data %</b>
Colombo	9.68	80.03	1961-2010	1,256	0.4
Galle	8.58	81.25	1961-2010	2,349	0.2

As shown in Table 1, the percentage of missing daily rainfall data during the 50-year period considered in this analysis varied from 0.4% to 0.2%. For the present analysis, the missing data were filled with the long term mean rainfall amounts estimated for the given day.

One can consider either rainfall amounts or rainy days to estimate the rainy season start and end dates. In one of our earlier studies on rainfall in the dry zone, we successfully used rainy days to determine start and end dates (Sonnadara 2015). Using rainfall amounts can result in false start and end dates, if isolated showers occur, which is a distinct possibility in the dry zone (Punyawardene, 2002). However, in the wet zone, the conditions are quite different, and isolated showers are less frequent. In addition, a clear separation between two rainy seasons is essential for the method adopted here. Figures 2a and 2b show the 5-day totals of rainfall amounts and rainy days for Colombo. A day with rainfall exceeding 1.0 mm was considered as a rainy day. Comparatively, there is a more marked separation between the two seasons when rainfall amounts are considered instead of rainy days. The same pattern was observed for the Galle data as well. Thus, to determine the start and end dates, cumulative distributions based on rainfall amounts was used in this study instead of rainy days.

In general, the effective period of the Yala season rainfall can be considered to be from April to September while the effective period of the Maha season rainfall can be considered to be from October to March of the following year. The effective period of the rainy season can vary especially between the wet zone and dry zone (Suppiah 1985). First, a shift of 1 month was made in the calendar year so that the effective periods of the rainy seasons appear in the middle of the two 6 months seasons (see Figure 2). Then the data set was divided into two seasons from February to July and August to January of the following year. To reduce statistical uncertainties, the rainfall amounts were computed considering 5-day intervals for each season and then the cumulative rainfall amounts were also computed considering 5-day intervals. The data from all the available years were combined and a polynomial was fitted to the data to produce a smooth curve. In an earlier study (Odekunle 2006) the point of maximum positive curvature of the curve was defined as the time of rainfall start while the point of maximum negative curvature was defined as the time of rainfall end. In this work in addition to adopting the above definition, the end date was extended by an additional 14 days from the point of maximum negative curvature since it has been shown that this is the approximate period required to match the probability of rain estimated at the start and the end dates (Sonnadara 2015). A cubic spline interpolation was first used to interpolate the fitted data for daily intervals. Then the derivatives and then the curvature of the curve at each interval were calculated. The day corresponding to the maximum positive curvature was considered as the start date and the day corresponding to the maximum negative curvature plus 14 days was considered as the end date.

Once the percentage of rainfall amounts corresponding to the mean start and end of the rainy seasons were estimated, the same percentage values were used to calculate the annual start and end dates for each station separately. This was done by computing the cumulating percentage of the rainfall amounts for individual years. The time between the start and end dates of a rainy season was considered as the duration of the rainy season.

### 3. RESULTS AND DISCUSSION

#### 3.1 Start and end of the rainy season

Figures 3a and 3b show the cumulative percentage of rainfall for Colombo calculated with 5-day total rainfall for the two rainy seasons Yala and Maha respectively. On the same graphs, the point of maximum positive curvature defined as the mean start date and the point of maximum negative curvature plus 14 days defined as the mean end date are also shown. The mean start of rains during the Yala season occurs towards the last week in March, around March 25th while the mean end of rains occurs towards the third week in June around June 22nd. The start corresponds to about 15% of the cumulative seasonal rainfall while the end corresponds to about 86% of the cumulative seasonal rainfall. The duration of the rainy season is limited to about 89 days which is approximately 3 months. For the Maha season, the mean start occurs towards the first week in September, around September 2nd, while the end of rains occurs towards the third week in December, around December 20th. The start corresponds to about 10% of the cumulative seasonal rainfall while the end corresponds to about 93% of the cumulative seasonal rainfall. The duration of the Maha season is 109 days, which is approximately 3.5 months, which is longer than the duration of the Yala season. A similar pattern is observed in Galle during the Yala season where start and end dates occur a few days earlier compared to Colombo. However, for the Maha season, while the start date is late, the end date arrives early in Galle in comparison to Colombo. Thus, the duration of the rainy season for Maha observed at Galle corresponds to a slightly shorter rainy season (roughly 15 days less) when compared with Colombo. The mean start and end dates obtained through this analysis are shown in Table 2.

Table 2: The timing of the rainy season determined from mean daily rainfall amounts

Season	Date of Start	Date of End	Duration (Days)	Cumulative % for start	Cumulative % for end
<b><i>Colombo</i></b>					
Yala	March 25	June 22	89	15%	86%
Maha	September 2	December 20	109	10%	93%
<b><i>Galle</i></b>					
Yala	March 23	June 17	86	14%	78%
Maha	September 7	December 10	94	17%	86%

### 3.2 Annual variation of start and end dates

Figures 4a and 4b show the annual start and end dates for Yala and Maha seasons estimated from cumulative rainfall amounts during the period from 1961 to 2010 for Colombo. The start and end dates for the individual years were estimated by evaluating the percentage of daily rainfall that coincided with the percentages estimated from the mean rainfall amounts for each season. For example, the start and end dates for Colombo correspond to 15% and 86% of the annual cumulative rainfall in the Yala season. Results show that although there is high variability, there are no statistically significant increasing or decreasing trends in the start and end dates of the rainy season in Colombo during the 50-year period considered in this work (from 1961 to 2010). Similar results were observed for Galle. A summary of the findings of this analysis is provided in Table 3. The average rainy season for Yala starts in the standard week  $12.0 \pm 2.3$  and ends in the standard week  $24.1 \pm 2.0$ . The average duration of the rainy season is  $12.1 \pm 2.6$  weeks. For the Maha season, the average rainy season commences in the standard week  $35.4 \pm 2.0$  and ends in the standard week  $49.6 \pm 2.0$ . The average duration of the rainy season is  $14.2 \pm 2.3$  weeks. About 95% of the observed deviations are within  $\pm 4$  weeks from the average start and end dates. The few cases having large deviations can be attributed to false start or end dates due to the simple criterion used in this work.

Table 3: Mean and standard deviation of the start, end and duration of the rainy season extracted from the annual percentage of daily rainfall data.

Station	Yala Season			Maha Season		
	Start in weeks	End in weeks	Duration in weeks	Start in weeks	End in weeks	Duration in weeks
Colombo	$12.0 \pm 2.3$	$24.4 \pm 1.9$	$12.5 \pm 2.7$	$35.1 \pm 2.0$	$50.3 \pm 2.0$	$15.2 \pm 2.6$
Galle	$12.0 \pm 2.3$	$23.8 \pm 2.1$	$11.8 \pm 2.5$	$35.8 \pm 1.9$	$48.9 \pm 1.9$	$13.1 \pm 2.0$
Wet Zone	12.0	24.1	12.1	35.4	49.6	14.2

Figures 5a and 5b show the correlation between the start and end dates for Colombo and Galle for the Yala and Maha seasons respectively. The data show that the start and end dates computed at the individual stations are linearly correlated. When there is a delay in the start/end of rainfall it affects both stations. We may infer from this that most of the variations observed in the start and end dates are not due to false starts. The false starts appear as outliers from the 45-degree line.

A study was also done with the same data to determine whether a relationship exists between the start and the duration of the rainy season. It was observed that there is a weak correlation between the start date and the duration of the rainy season (see Figure 6). For the Yala and Maha seasons, these relationships are represented by the following two equations;

$$L(Yala) = 21.1 - 0.75 \times S$$

$$L(Maha) = 40.8 - 0.75 \times S$$

where  $L$  is the duration of the rainy season in weeks and  $S$  is the date of the start in weeks. This suggests that the later the start, the shorter the duration of the rainy season. For example, in the Yala season for early start dates of week 5 the estimated duration of the rainy season would increase to 17.4 weeks (122 days) and for late start dates of week 15 the estimated duration of the rainy season would decrease to 9.9 weeks (69 days) from the average of 12.1 weeks.

#### 4. CONCLUSIONS

In this work, the start and end dates of the rainy seasons in the south western region of Sri Lanka based on rain amounts was investigated. The daily rainfall observations during the period 1961 to 2010, recorded in the Colombo and Galle meteorological stations were used in this work. Since there are two rainy seasons depicting a bimodal distribution of rain, a method adopted in an earlier study was revised by narrowing the search of the start and end dates to the two rainy seasons separately.

The results clearly show that the two rainy seasons are linked to southwest and northeast monsoon seasons. For the Yala season, the mean start of the rainy season in the south western region of Sri Lanka falls around March 25 and the mean end of the rainy season falls around June 22. The average duration of the Yala season is limited to about 3 months. For the Maha season the mean start of the rainy season falls around September 2 and the mean end of the rainy season falls around December 20. The average duration of the Maha season is slightly longer but limited to about 3.5 months.

The data show that during the 50-year period considered in this work there has been no statistically significant trend in the start and end dates of the Yala or Maha seasons. There is a weak inverse correlation between the start date and the duration of the rainy season for both Yala and Maha seasons, giving rise to shorter rainy seasons for late start dates.

#### DECLERATIONS

**Conflict of Interest – Not applicable**

**Funding Statement** - Financial assistance given by the National Research Council, Sri Lanka for the research grant number NRC 06-18 is greatly acknowledged.

**Author's Contribution – Single author (100%)**

**Availability of data and material – Purchased from the Department of Meteorology Sri Lanka (anyone can purchase this data)**

**Code availability – Custom code**

Ethics approval – Not applicable

Consent to participate – Not applicable

Consent for publication – Full consent given to the journal

## REFERENCES

1. Ati OF, Stigter CJ, & Oladipo EO (2002) A comparison of methods to determine the start of the growing season in northern Nigeria, *International Journal of Climatology*, 22: 731-742
2. Benoit P (1977) The start of the growing season in Northern Nigeria. *Agricultural Meteorology* 18: 91-99
3. Domroes ME, Ranatunge A (1993). *Statistical approach towards a regionalization of daily rainfall in Sri Lanka, International J. Climatology* 13: 741-754.
4. Holland, GJ (1986). Interannual Variability of the Australian Summer Monsoon at Darwin: 1952–82, *Monthly Weather Review*, 114 (3): 594-604.
5. Odekunle, TO (2004). Rainfall and the duration of the growing season in Nigeria, *International Journal of Climatology*, 24: 467-479.
6. Odekunle, TO (2006). Determining rainy season start and end over Nigeria from precipitation amount and number of rainy days, *Theoretical and Applied Climatology*, 83: 193-201.
7. Punyawardena BVR, Kulasiri D (2002) Identification of the potential of growing seasons by the start of seasonal rains: A study in the DL1 region of the North Central dry zone. *J. National Science Foundation* 30 (1&2): 13-21
8. Sivakumar MVK (1988). Predicting rainy season potential from the start of rains in Southern Sahelian and Sudanian climatic zones of West Africa. *Agricultural and Forest Meteorology*. 42: 295-305
9. Sonnadara DUJ (2015) The onset, retreat and the length of growing season in the north-eastern region of Sri Lanka, *International Journal of Climatology*, 35(12): 3633-3639
10. Stern RD and Coe R (1982). The use of rainfall models in agricultural planning, *Agricultural Meteorology*, 26: 5-50
11. Stewart JI (1988) *Response farming in rainfed agriculture*. The WHARF foundation press, Davis, California USA, ISBN: 0-9620274-0-5
12. Suppiah R (1985) Four types of relationships between rainfall and paddy production in Sri Lanka, *GeoJournal*, 10, 109-118

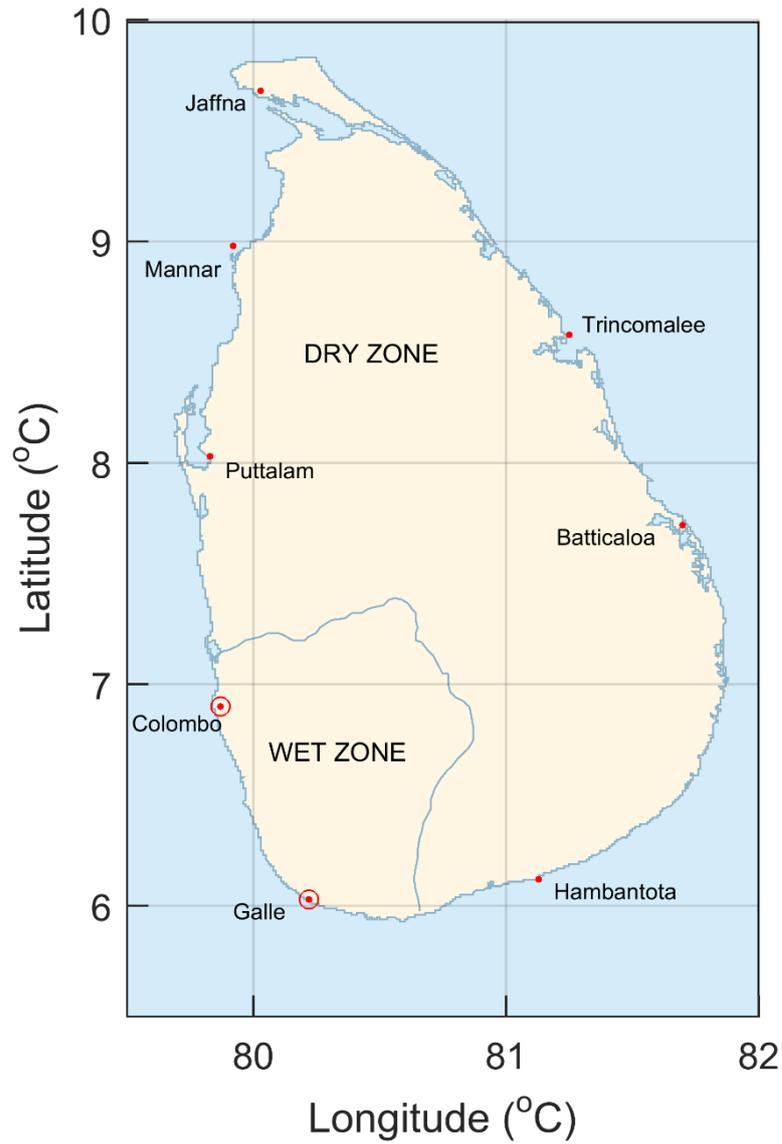


Figure 1: The geographical locations of the two selected stations; Colombo and Galle. The line indicates the demarcation of the commonly identified climate zones; the Wet zone and the Dry zone.

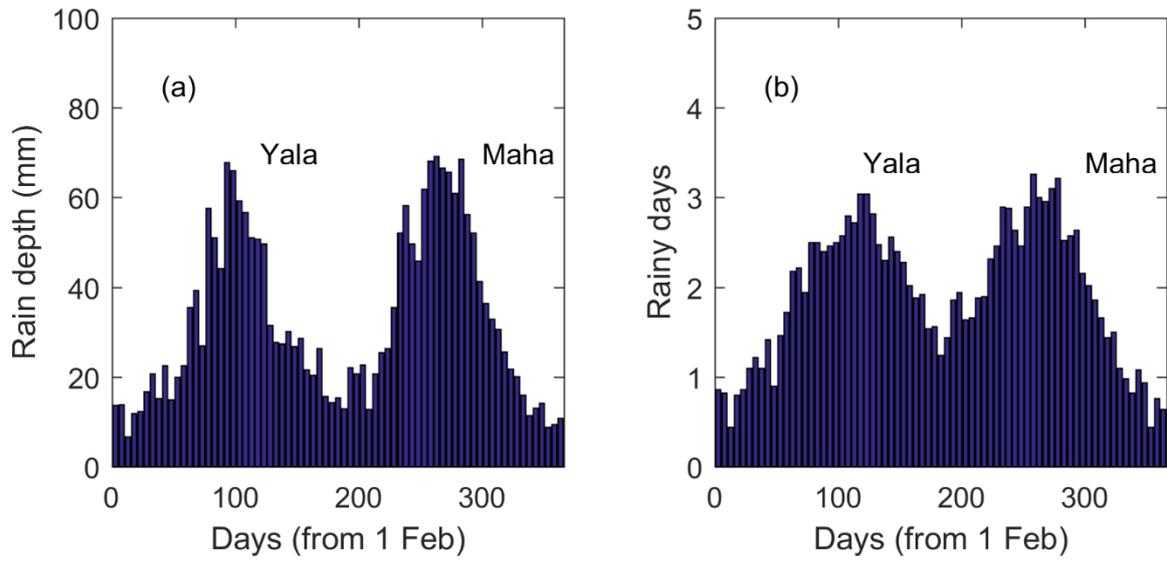


Figure 2: Distribution of rainfall observed in Colombo showing Yala and Maha rainy seasons (a) daily rainfall (b) rainy days. Days are counted from 1 February.

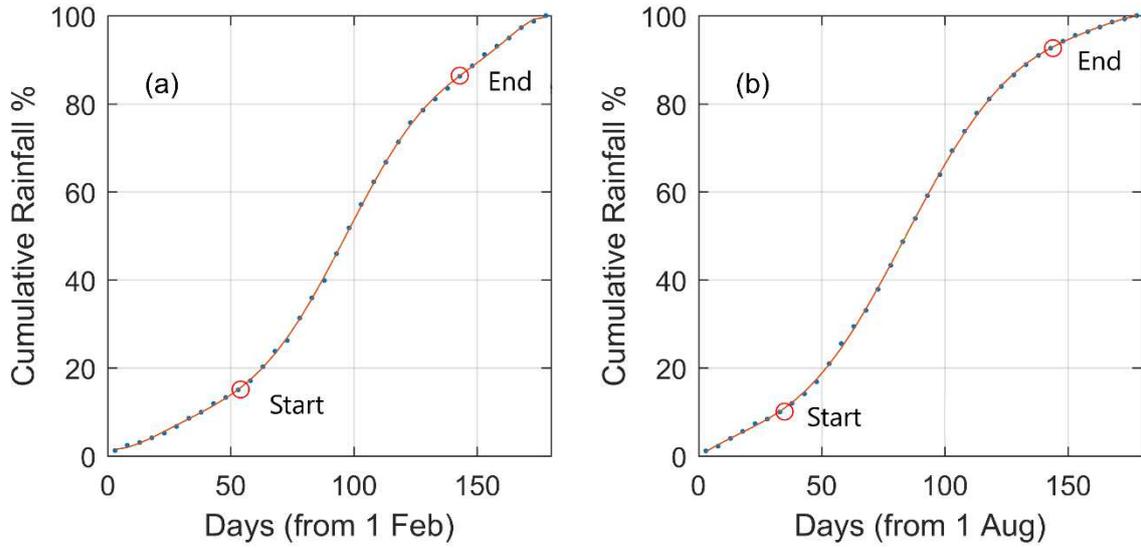


Figure 3: Mean rainfall start and end dates derived from a cumulative distribution of rainy days in Colombo for (a) Yala season and (b) Maha season. The start and end dates correspond to the maximum positive and negative curvatures. The smooth line drawn through the data points are generated by fitting an 8-degree polynomial.

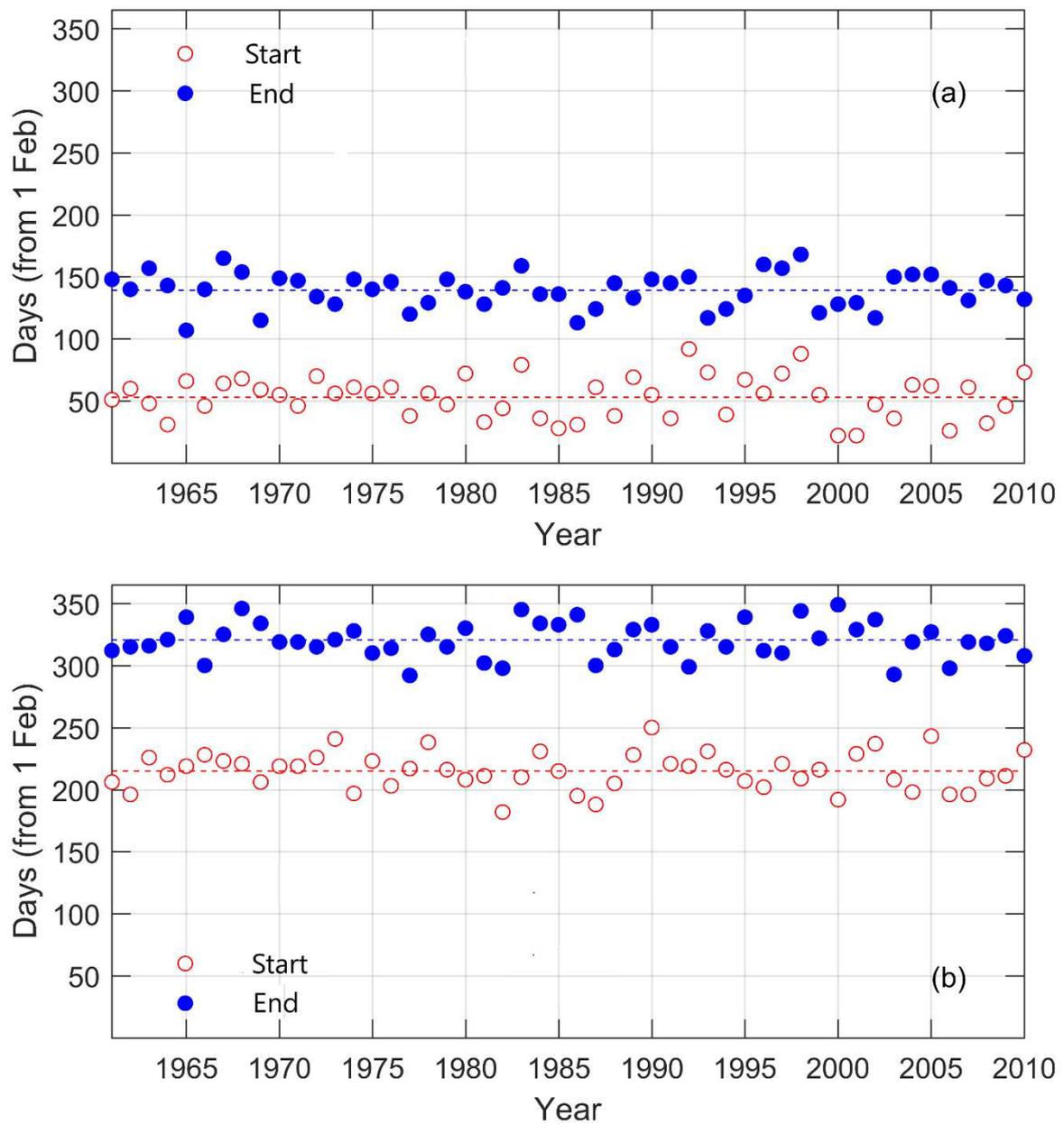


Figure 4: Interannual variability of start and end dates of the rainy season derived from the rainy days in Colombo for (a) Yala season and (b) Maha season from 1961 to 2010. The dotted lines depict the average start and end dates. Days are counted from 1 February

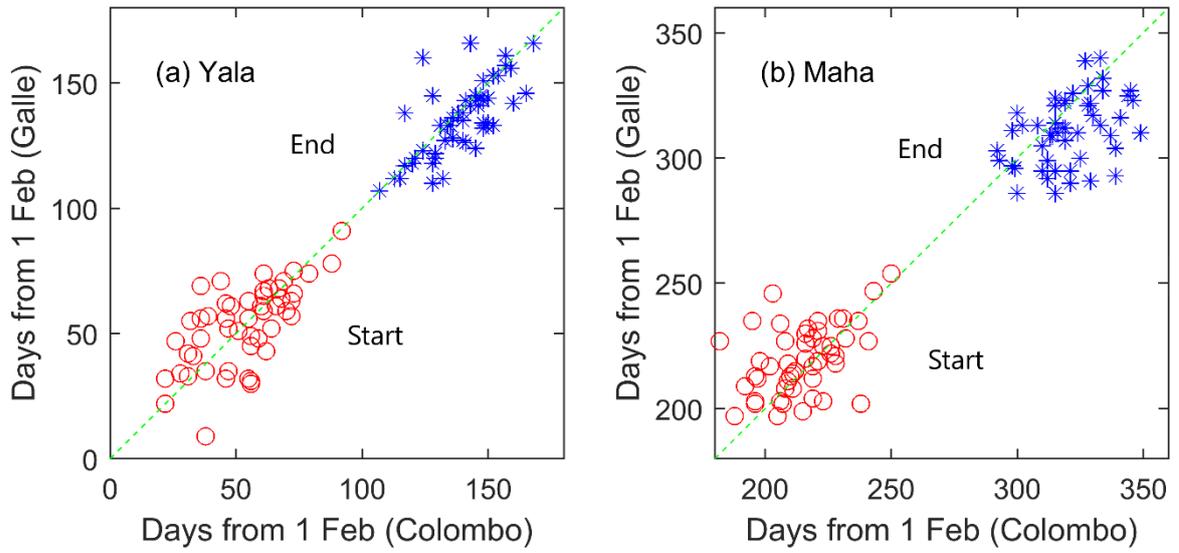


Figure 5: Correlation between the start and end dates of Colombo against Galle. Days are counted from 1 February. (a) Yala season and (b) Maha season

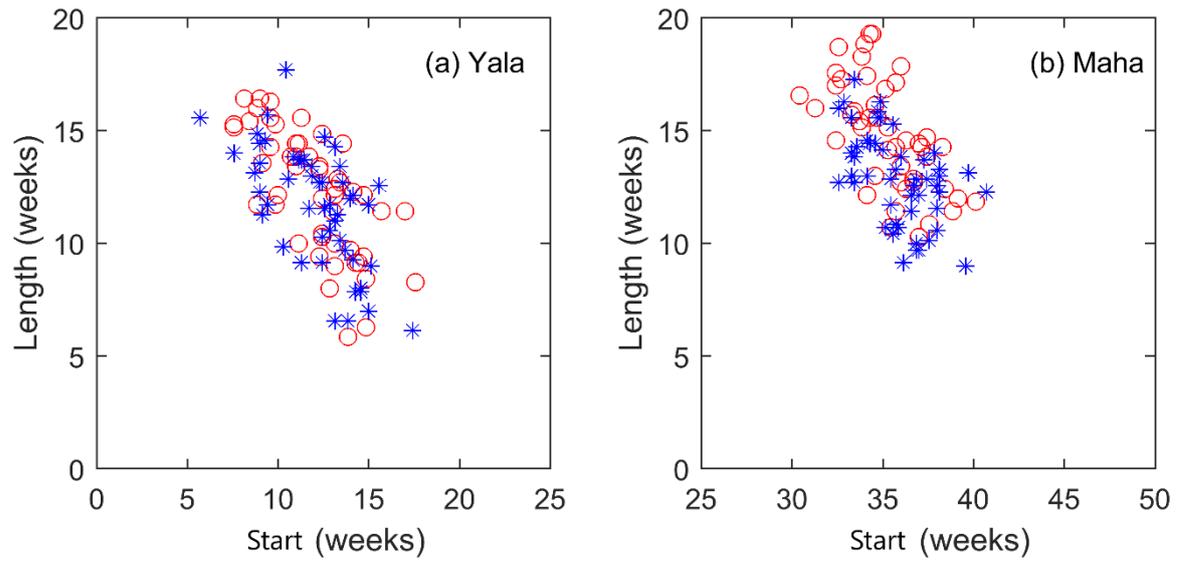
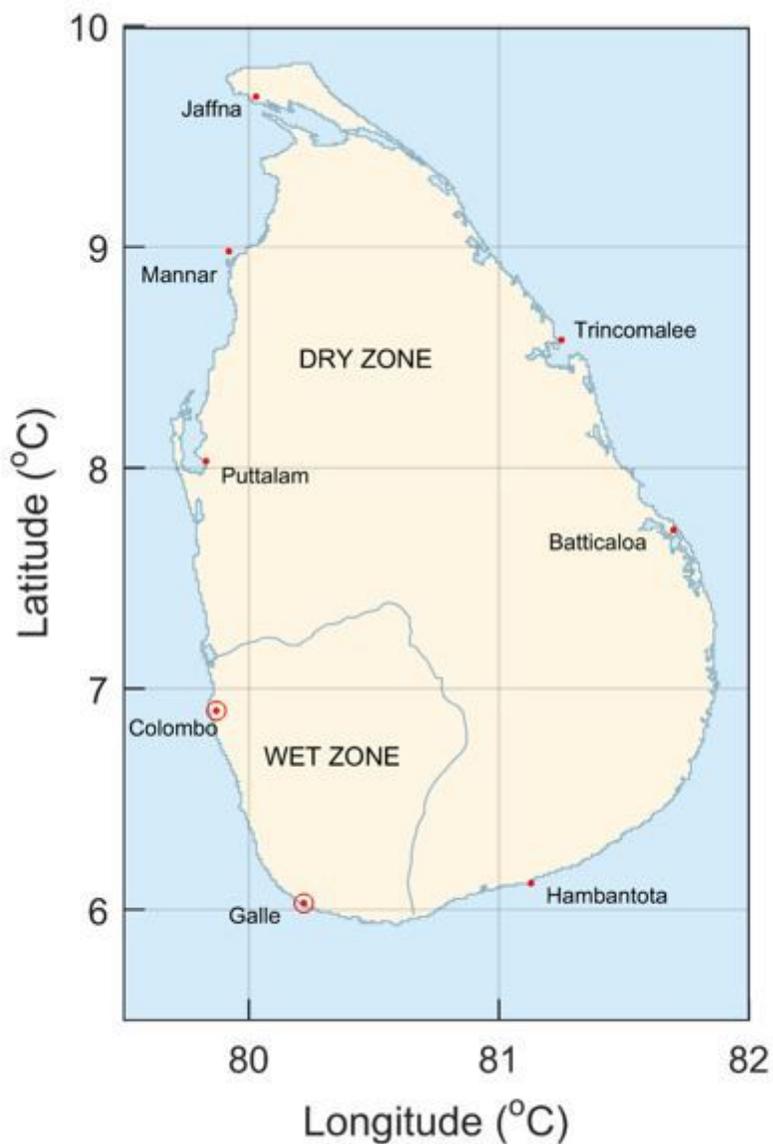


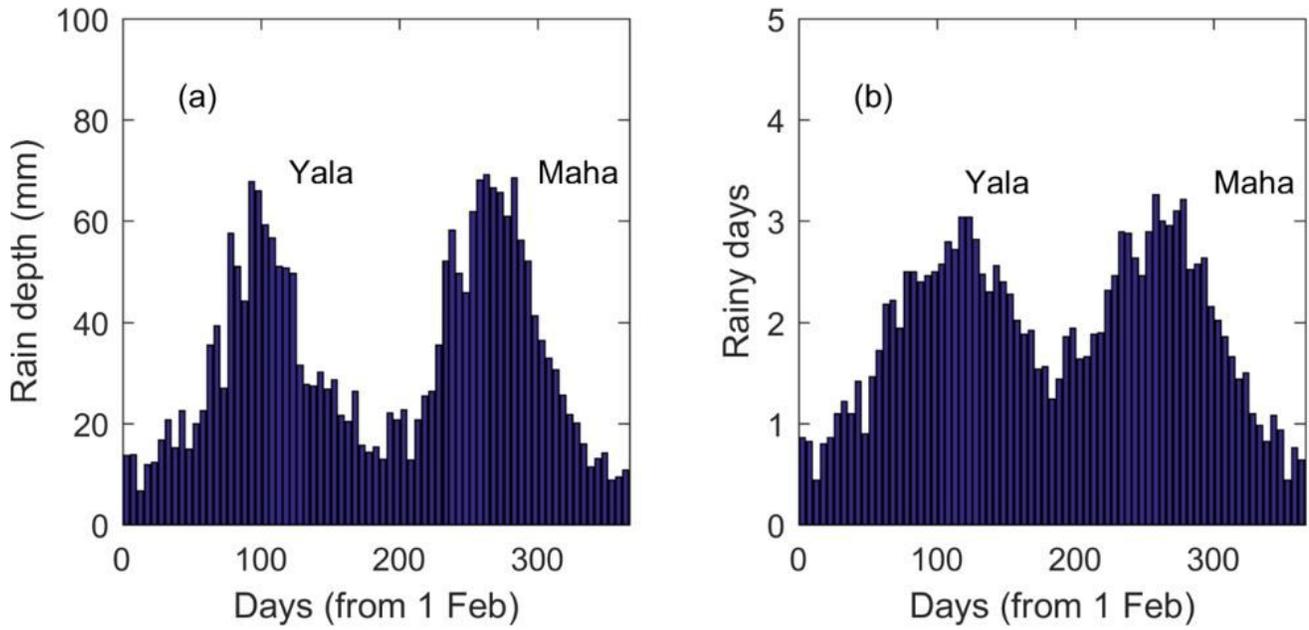
Figure 6: Correlation between start and duration of rainy season in Colombo (open circles) and Galle (asterisks). (a) Yala season and (b) Maha season

## Figures



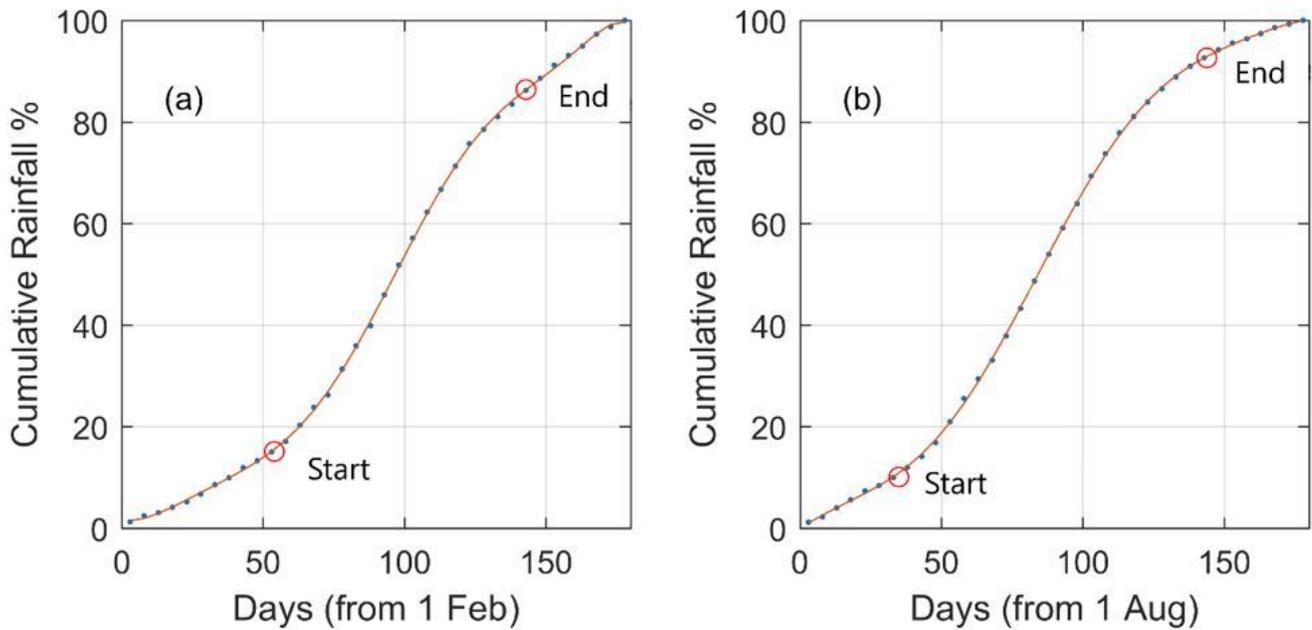
**Figure 1**

The geographical locations of the two selected stations; Colombo and Galle. The line indicates the demarcation of the commonly identified climate zones; the Wet zone and the Dry zone. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.



**Figure 2**

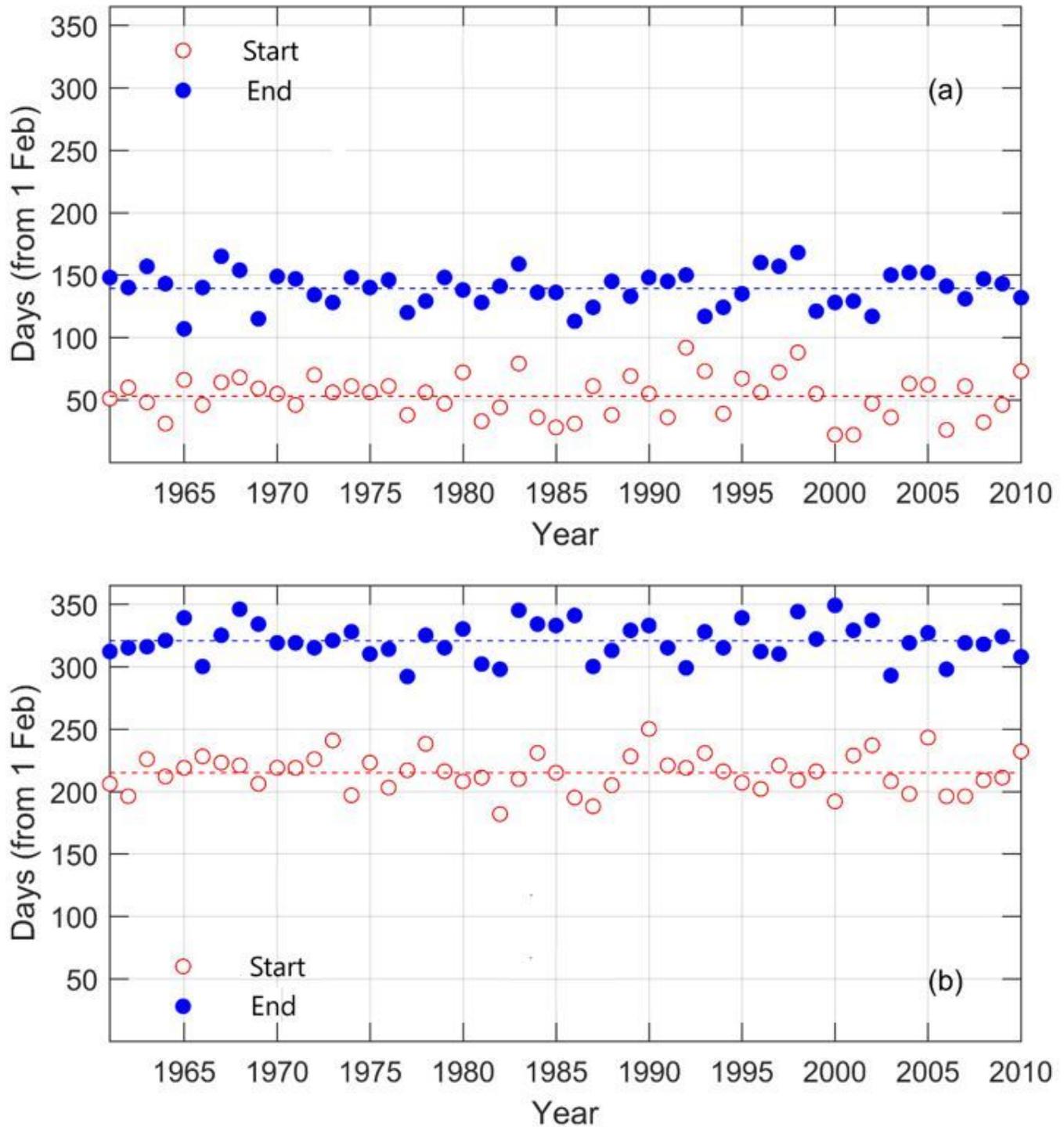
Distribution of rainfall observed in Colombo showing Yala and Maha rainy seasons (a) daily rainfall (b) rainy days. Days are counted from 1 February.



**Figure 3**

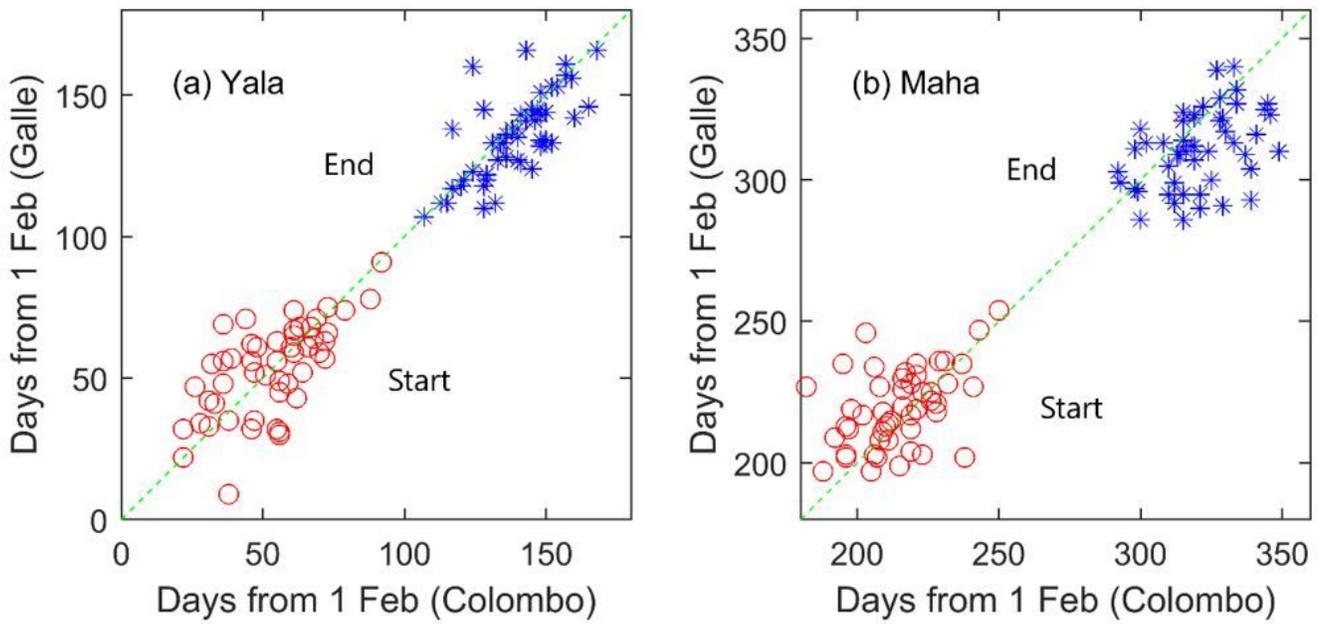
Mean rainfall start and end dates derived from a cumulative distribution of rainy days in Colombo for (a) Yala season and (b) Maha season. The start and end dates correspond to the maximum positive and

negative curvatures. The smooth line drawn through the data points are generated by fitting an 8-degree polynomial.



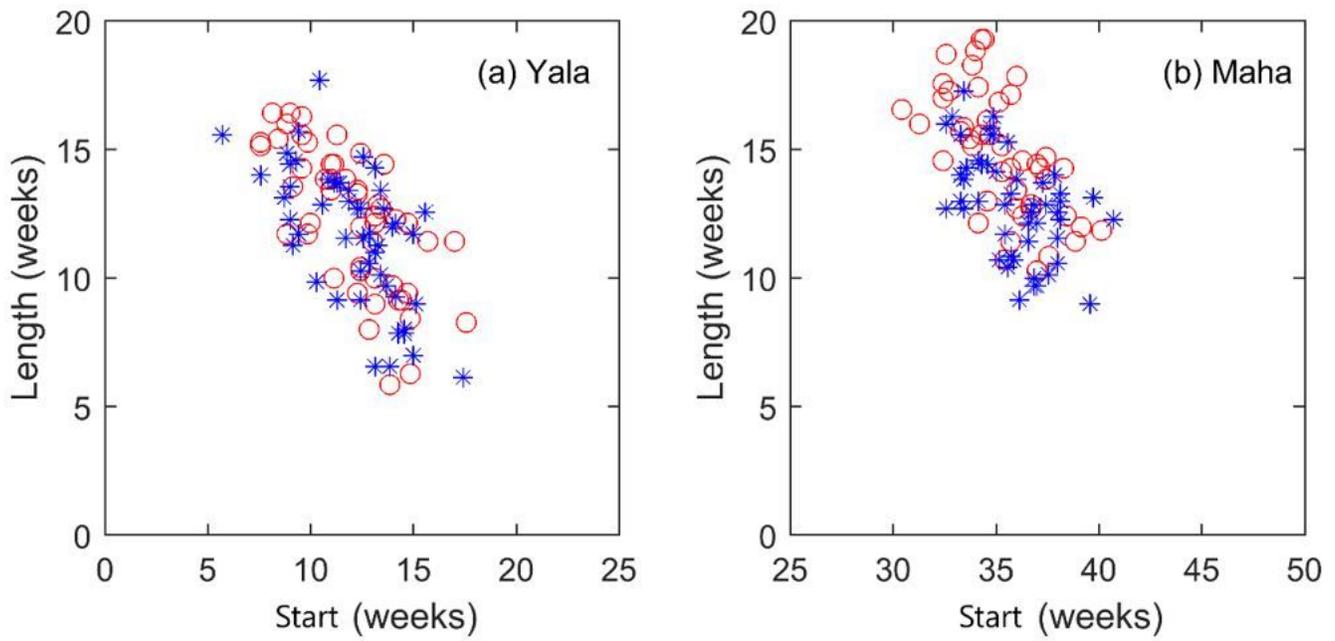
**Figure 4**

Interannual variability of start and end dates of the rainy season derived from the rainy days in Colombo for (a) Yala season and (b) Maha season from 1961 to 2010. The dotted lines depict the average start and end dates. Days are counted from 1 February



**Figure 5**

Correlation between the start and end dates of Colombo against Galle. Days are counted from 1 February.  
 (a) Yala season and (b) Maha season



**Figure 6**

Correlation between start and duration of rainy season in Colombo (open circles) and Galle (asterisks).  
(a) Yala season and (b) Maha season