

**THE IMPACTS, VARIABILITY, AND UNCERTAINTY OF  
PRECIPITATION IN SRI LANKA  
ASSOCIATED WITH SEASONAL MONSOONS**

S. C. Herath

Meteorologist

Department of Meteorology

Sri Lanka

## **Introduction**

Sri Lanka is an island located in the Indian Ocean, southeast of the Indian subcontinent. Its terrain is mostly low, flat to rolling plain, with mountains in the south-central interior. The highest point is Pidurutalagala at 2,524.13 m.

In Sri Lanka all the rivers rise in the Central Highlands and flow in a radial pattern toward the sea. Once they reach the plain, the rivers slow down and the waters meander across flood plains and deltas. Human intervention has altered the flows of some rivers in order to create hydroelectric, irrigation, and transportation projects. In the north, east, and southeast, the rivers feed numerous artificial lakes or reservoirs (tanks) that store water during the dry season. During the 1970s and 1980s, large-scale projects dammed the Mahaweli Ganga and neighboring streams to create large lakes along their courses. Several hundred kilometers of canals, most of which were built by the Dutch in the 18th century, link inland waterways in the southwestern part of Sri Lanka. The upper reaches of the rivers are wild and usually have steep slopes and the lower reaches are prone to seasonal flooding.

An increase in average rainfall coupled with heavier rainfall events has resulted in recurrent flooding and related damages to human life, infrastructure, utility supply and the urban economy. And vice versa (Decreasing in average rainfall also causes to human life, infrastructure, utility supply and the urban economy).

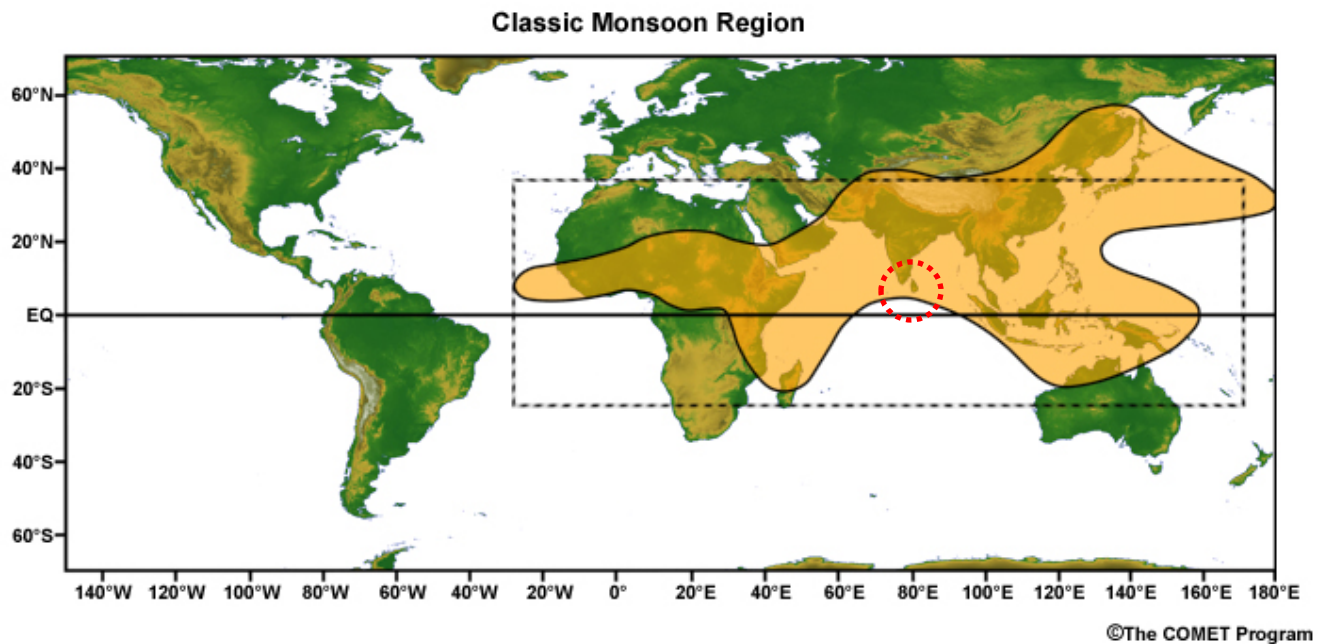
Being a tropical island weather forecasting for the country is more challengeable due to high amount of energy and vast oceanic area. Sri Lanka's climate includes tropical monsoons: the southwest monsoon (May to September), and the northeast monsoon (December to February).

To reduce damages from flood and drought events, it is very important to study impacts, variability, and uncertainty regarding precipitation in Sri Lanka associated with climate cycles such as seasonal monsoons. And also study trends and future projections.

## Discussion

Sri Lanka is an island located in the Indian Ocean, and is in the Asian Monsoon region (*Fig1: The monsoon regions as defined by Ramage (1971).*). Sri Lanka's climate can be described as tropical, and quite hot. Its position between 5 and 10 north latitude endows the country with year-round warm weather, moderated by ocean winds and considerable moisture.

The word monsoon comes from the Arabian word 'mausim' meaning 'season' and was first used to refer to seasonal reversal of the prevailing surfaces winds over southern Asia and the Indian Ocean.



*Fig1: The monsoon regions as defined by Ramage (1971).*

(*Ref: Introduction to Tropical Meteorology 2nd Edition, Chapter 3: Global Circulation, 3.5.1 Defining the Monsoon, Produced by The COMET® Program*)

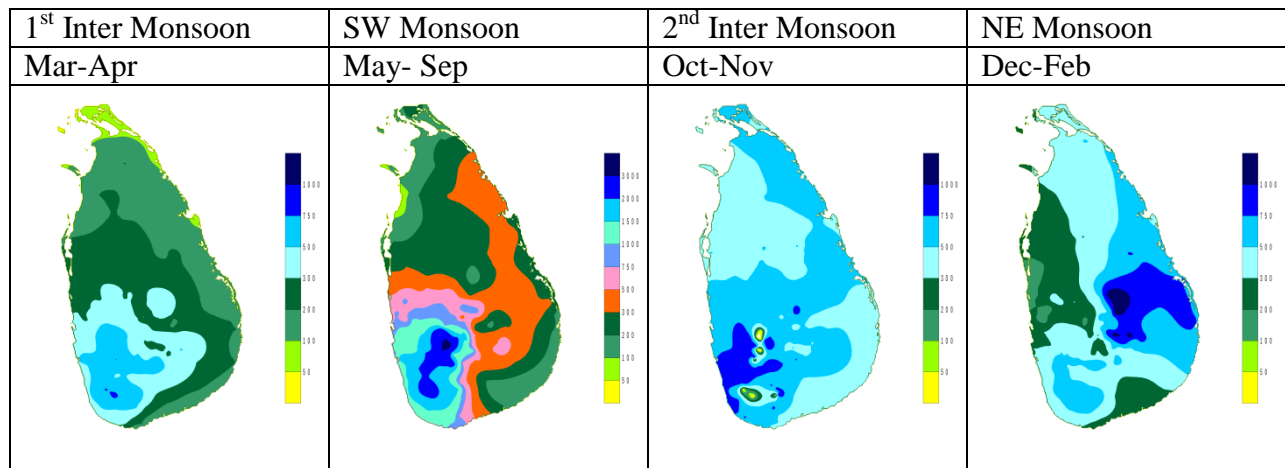
The weather that Sri Lanka experiences could be broadly divided into monsoonal and inter monsoonal. The rainfall pattern is influenced by the monsoon winds of the Indian Ocean and Bay of Bengal and is marked by four seasons (*Fig2: The monsoon seasons in Sri Lanka*).

The first inter-monsoon is from March to April, with light, variable winds and evening thundershowers.

The summer monsoon or southwest monsoon is from May to September, when winds originate in the southwest, bringing moisture from the Indian Ocean. When these winds encounter the slopes of the Central Highlands, they unload heavy rains on the mountain slopes and the southwestern sector of the island. Some of the windward slopes receive up to 2,500 mm (98.4 in) of rain per month, but the leeward slopes in the east and northeast receive little rain.

During the third season (2<sup>nd</sup> inter monsoon) October and November months is also experience with light, variable winds and evening thundershowers. During this season, periodic squalls occur and sometimes tropical cyclones bring overcast skies and rains to the southwest, northeast, and eastern parts of the island.

The winter monsoon or northeast monsoon is experience over the island during December to February. Monsoonal winds come from the northeast, bringing moisture from the Bay of Bengal. The northeastern slopes of the mountains may be inundated with up to 1,250 mm (49.2 in) of rain during these months.



*Fig2: The monsoon seasons in Sri Lanka*

However, out of these two monsoons, southwest monsoon is more effective in Sri Lanka since it gives more rain over large parts of the Island and is experienced nearly a half of the year. The farmers in the western and southern parts in the country mostly depend on southwest monsoon rainfall for their agriculture. Also the amount of rainfall which Sri Lanka receives during the southwest monsoon period, contribute much to the generation of hydro-power electricity in the country.

The area at where the air from northern hemisphere and southern hemisphere meet. ITCZ is a narrow zonal band of intense deep convection. As a result it gives torrential rain causing flood. This zonal band moves North and Southwards according to the Sun's apparent movement. During the third week of April and the Month of October (that is in inter-monsoonal seasons) ITCZ comes over Sri Lanka enhancing the afternoon thunder activity.

So on a hot afternoon, especially in the tropical country like Sri Lanka where the air is moist, surface heating is intense and condensation is abundant. It may experience towering anvil-topped clouds. Often 10 or more kilometers high, these thunderstorms may generate intense rainfall causing flash flood.

The highest average annual precipitation amounts occur:

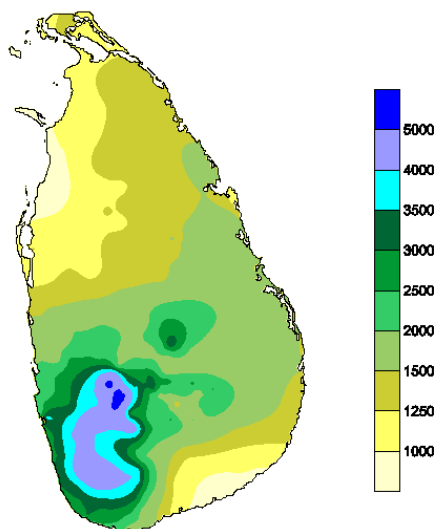
- Near oceans
- Where onshore winds are prevalent
- On the windward side of tropical mountains

The lowest average annual precipitation amounts occur:

- Inland, away from moisture sources
- On the leeward side of mountains

*(Ref: Introduction to Tropical Meteorology 2nd Edition, Chapter 5: Focus Areas » Focus 1: Extremes of Tropical Precipitation, Distribution of Moisture and Precipitation, Produced by The COMET® Program)*

In Sri Lanka the annual average rainfall varies from below 900mm in the driest zones in the northwest and southeast of the island to over 5000mm in some areas on the western slopes of the central highlands.



*Fig3: The average annual rainfall in Sri Lanka*

At the beginning of the monsoon, rain can be expected particular along the coastal areas. Then these showers will penetrate inland areas .with the strong wind flow the facing side of the central hills experiences occasional showers. If the two wind flows meet each other (Confluence) heavy showers can be expected causing floods.

Out of these flood situations due to monsoonal rain, there was an exceptionally heavy rainfall in Colombo on 4<sup>th</sup> June 1992 and hence most parts of the Colombo city were flooded. The 24-hour rainfall of this event was 493.7 mm and it was the highest rainfall recorded at Colombo since observations commenced in 1869. The heavy rains occurred on 17<sup>th</sup> May 2003 over Ratnapura and Deniyaya areas and on the 17<sup>th</sup> May 2010 over Colombo area were due to the confluence of wind flow.

As mention above there is a strong variability, and uncertainty of precipitation in Sri Lanka associated with seasonal monsoons. Being a tropical island weather forecasting for the country is more challengeable due to high amount of energy and vast oceanic area. Difficulties in weather prediction purely based on synoptic scale are largely due to local orography, diurnal and seasonal effects in tropics with the former dominating over our small island. In here mainly focused on the area of impact, variability and uncertainty of precipitation in Sri Lanka due to seasonal monsoons.

In Sri Lanka all the rivers rise in the Central Highlands and flow in a radial pattern toward the sea. Once they reach the plain, the rivers slow down and the waters meander across flood plains and deltas. Human intervention has altered the flows of some rivers in order to create hydroelectric, irrigation, and transportation projects. In the north, east, and southeast, the rivers feed numerous artificial lakes or reservoirs (tanks) that store water during the dry season. During the 1970s and 1980s, large-scale projects dammed the Mahaweli Ganga and neighboring streams to create large lakes along their courses. Several hundred kilometers of canals, most of which were built by the Dutch in the 18th century, link inland waterways in the southwestern part of Sri Lanka. The upper reaches of the rivers are wild and usually have steep slopes and the lower reaches are prone to seasonal flooding.



Fig 4: Rivers in Sri Lanka

An increase in average rainfall coupled with heavier rainfall events has resulted in recurrent flooding and related damages to human life, infrastructure, utility supply and the urban economy. And decreasing in average rainfall resulted drought and also causes to mainly in agricultural sector and drinking water. Therefore it is directly impact to human life, infrastructure, utility supply and the urban economy.

Therefore it is very important to study both hydrological and meteorological impacts, variability, and uncertainty regarding precipitation in Sri Lanka associated with climate cycles such as seasonal monsoons.

Within past few years Sri Lanka has been experienced many circumstances that causes damages in to human life, infrastructure, utility supply and the economy due to extreme weather conditions such as drought and heavy rainfall with flood & landslides. Damages increases with the urbanization, inappropriate land usage, land filling, changing the natural irrigation system and not having good irrigation management system according to expected weather conditions. There for it is important to study trends and implement future projection in both meteorological and hydrological scenarios. And also it is very important to consider climate change and how it can be affected to seasonal monsoon and annual precipitation and precipitation extreme events.

To improve management of irrigation and to reduce damage cause from extreme events it will be helpful to use General Circulation Models, Climate Projections and other future prediction tools associate with seasonal monsoonal system.

General Circulation Models, or GCMs, are often referred to as a climate models. They are designed to represent the interrelated processes of the land, oceans, and atmosphere, and provide guidance about temperature, precipitation, and other climate variables. Although GCMs provide details of individual short-term weather events in the distant future, these are not used directly. These representations can include information such as average temperature, mean annual precipitation, number of 1-day precipitation events per year that are greater than 25 mm, and number of consecutive dry days per month. As a first step for simulating future climates, GCMs are often used to simulate past climate. When a GMC does a reliable job of simulating the complex interacting processes of past climates, it has greater confidence in their ability to simulate future climates.

Climate Projections A climate projection simulates a possible climate future in terms of temperature, precipitation, and other climate variables. Each projection is the combination of a GCM, an RCP (Representative Concentration Pathway), and a set of initial conditions that are input to the GCM.

There for it is very important to study climate variability according to regional monsoons, their conceptual models, seasonal evolution, and variability to make better Water Resources Management. And flood or drought forecasts to issue advance warning about water level or discharge large enough that threatens safety of structures and flood/drought plain activities. An advance warning of this nature help authorities adopt a series of measures to contain adverse impacts of flood or drought.

## **Summary**

Sri Lanka is an island located in the Indian Ocean, and is in the Asian Monsoon region. The weather that Sri Lanka experiences could be broadly divided into monsoonal and inter monsoonal. The rainfall pattern is influenced by the monsoon winds of the Indian Ocean and Bay of Bengal and is marked by four seasons. The first inter-monsoon is from March to April, the southwest monsoon May to September, Second inter monsoon October and November and the northeast monsoon December to February.

The annual average rainfall of Sri Lanka varies from below 900mm in the driest zones in the northwest and southeast of the island to over 5000mm in some areas on the western slopes of the central highlands.

An increase in average rainfall coupled with heavier rainfall events has resulted in recurrent flooding and related damages to human life, infrastructure, utility supply and the urban economy. And vice versa (Decreasing in average rainfall also causes to human life, infrastructure, utility supply and the urban economy).

Therefore it is very important to study both hydrological and meteorological impacts, variability, and uncertainty regarding precipitation in Sri Lanka associated with climate cycles such as seasonal monsoons and implement trends and future predictions.