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Climate of Yangon City, Myanmar

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Climate Change

The consequences of climate change can already be seen in worldwide. Temperatures are rising, rainfall patterns are shifting, glaciers are melting, sea levels are getting higher and hazards such as floods and droughts are becoming more common.

These changes pose a serious threat to human lives, to economic development and to the natural world.

Society needs to take measures to adapt to these impacts.

Global temperature (from 1900 to 2000)

©IPCC 2007: WG1-AR4
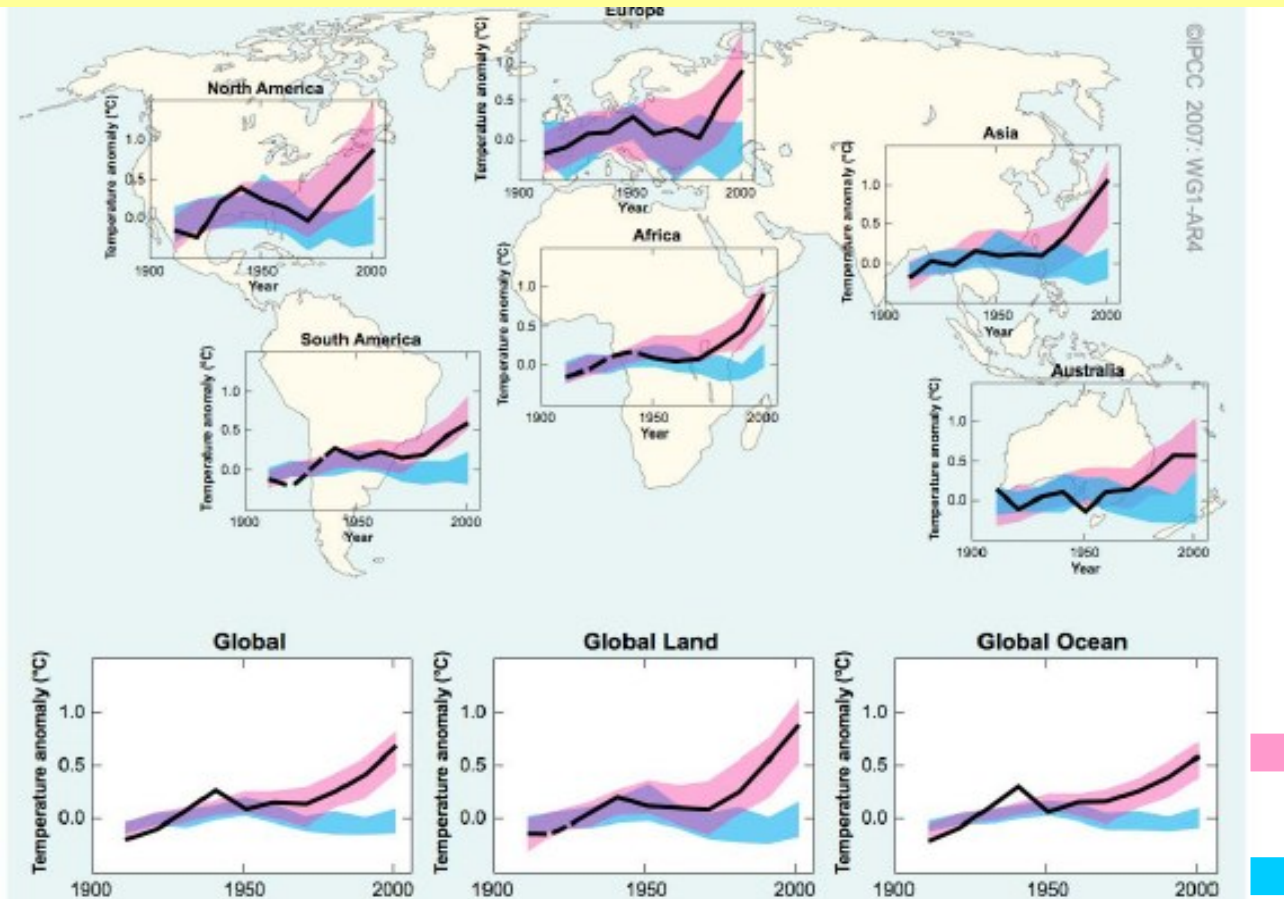
The trend can clearly be seen that global temperature has risen since 1940s and after 1960s more significant rise has occurred.

Model using both natural and anthropogenic forcing

Model using only natural forcing

The average surface temperature of the Earth rose 0.6 to 0.9 degrees Celsius (1.08°F to 1.62°F) between 1906 and 2006, and the rate of temperature increase nearly doubled in the last 50 years.
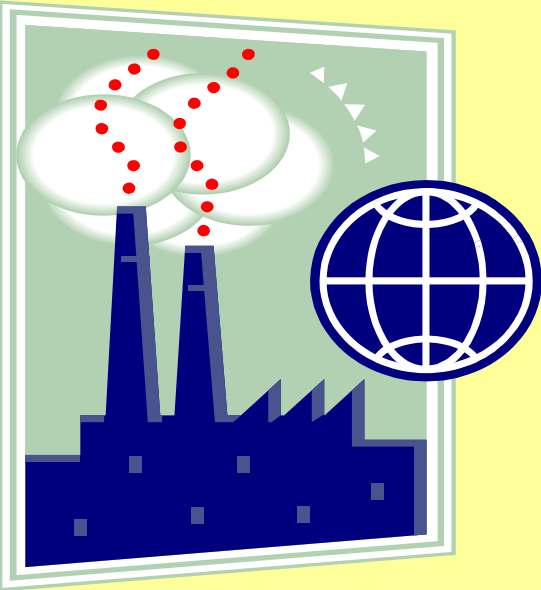
Global warming is rising global average temperature by increasing in both day and night time temperature.

- Global warming has already changed the world climate and changes in global climate become more and more significant with each passing decade.

- Changes in climatic elements vary regionally and even locally.

- To reduce impacts and vulnerability and to conduct adaptation strategies, from global, regional to local scale understanding and assessments on climate change are the most importance.
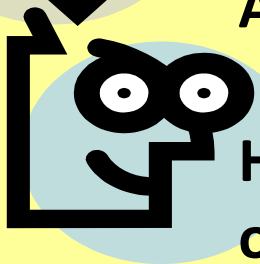
Aims

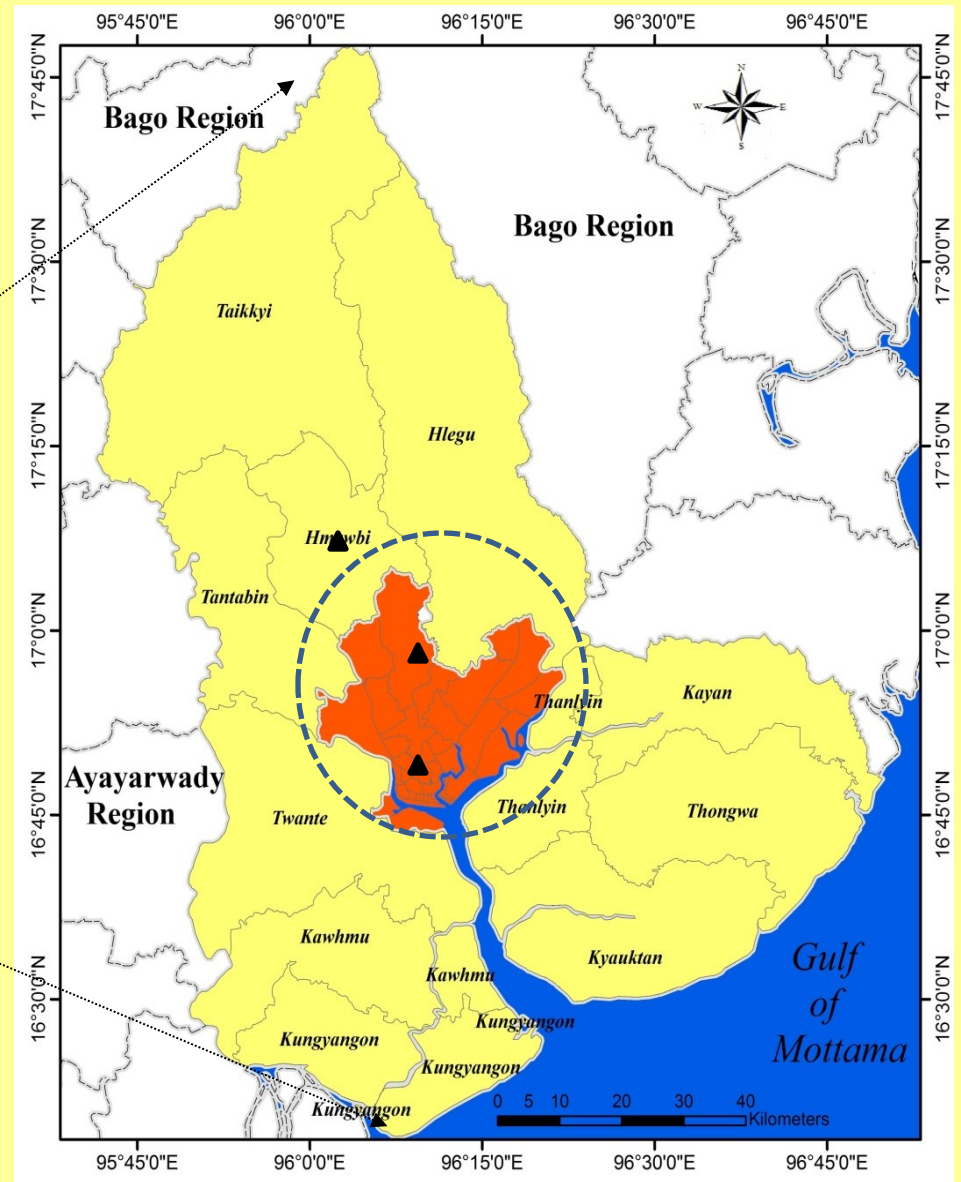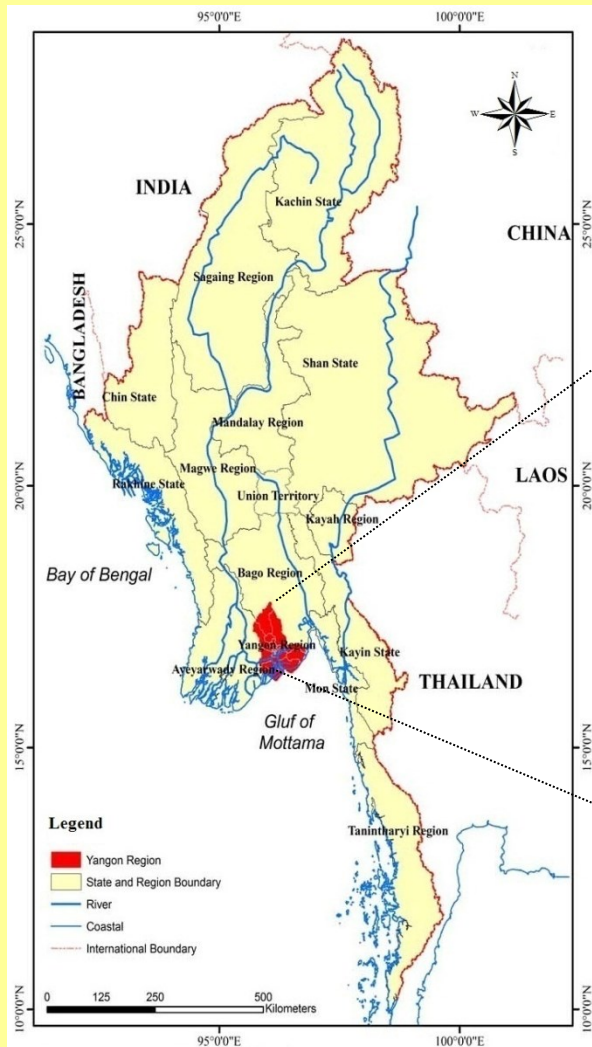to evaluate the climate of Yangon City in context with global warming.

How changes are recognized in climate of Yangon City in context with global warming?

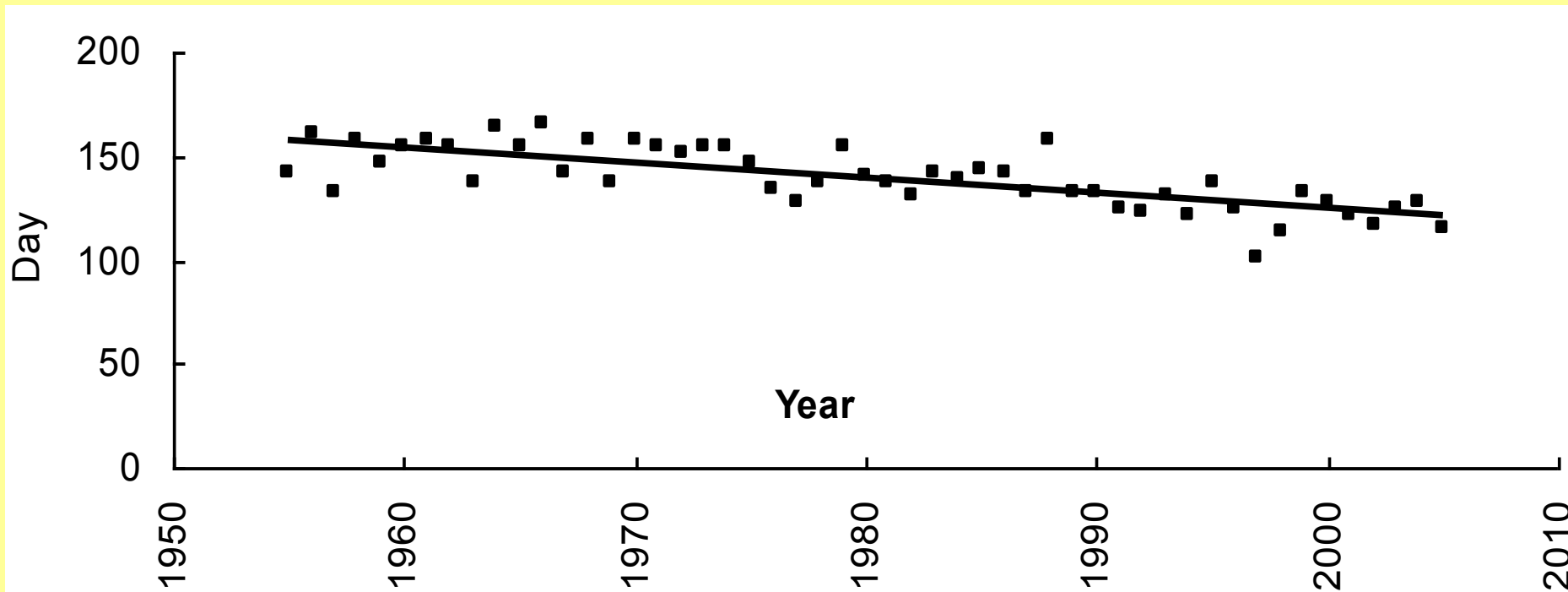Are these changes apparent?

How about the future trend of change in climate condition of Yangon City?

Climate of Yangon City

Regression line showing decreasing rainy days from 1960 to 2005

The shorter duration of rainy season has experienced since 1970s in Yangon City due to the continual late onset and early withdrawal of monsoon over delta area of Myanmar.

Average, Standard deviation and coefficient of variability for rainfall of Yangon

| Station	Period	Average annual total (mm)	SD (mm)	COV
Hmawbi	1961-2002 (42 years)	2507	301.4	12%
Mingaladon	1955-2007 (53 years)	2603	338.4	13%
Kaba-Aye	1950-2002 (53 years)	2710	328.1	12%
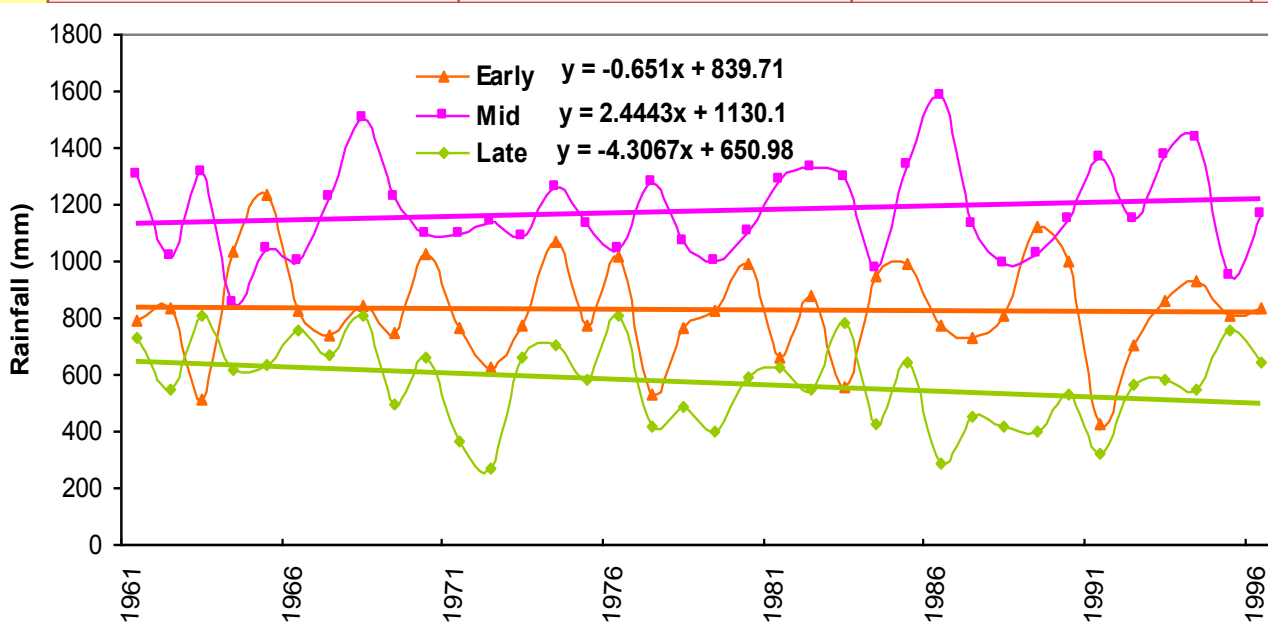
Peak-monsoon rainfall slightly increases but early and late monsoon rainfall decreases.

Early- 21st May to June 30th

Peak- June to August

Late- September to October

Early $y = -0.651x + 839.71$
Mid $y = 2.4443x + 1130.1$
Late $y = -4.3067x + 650.98$
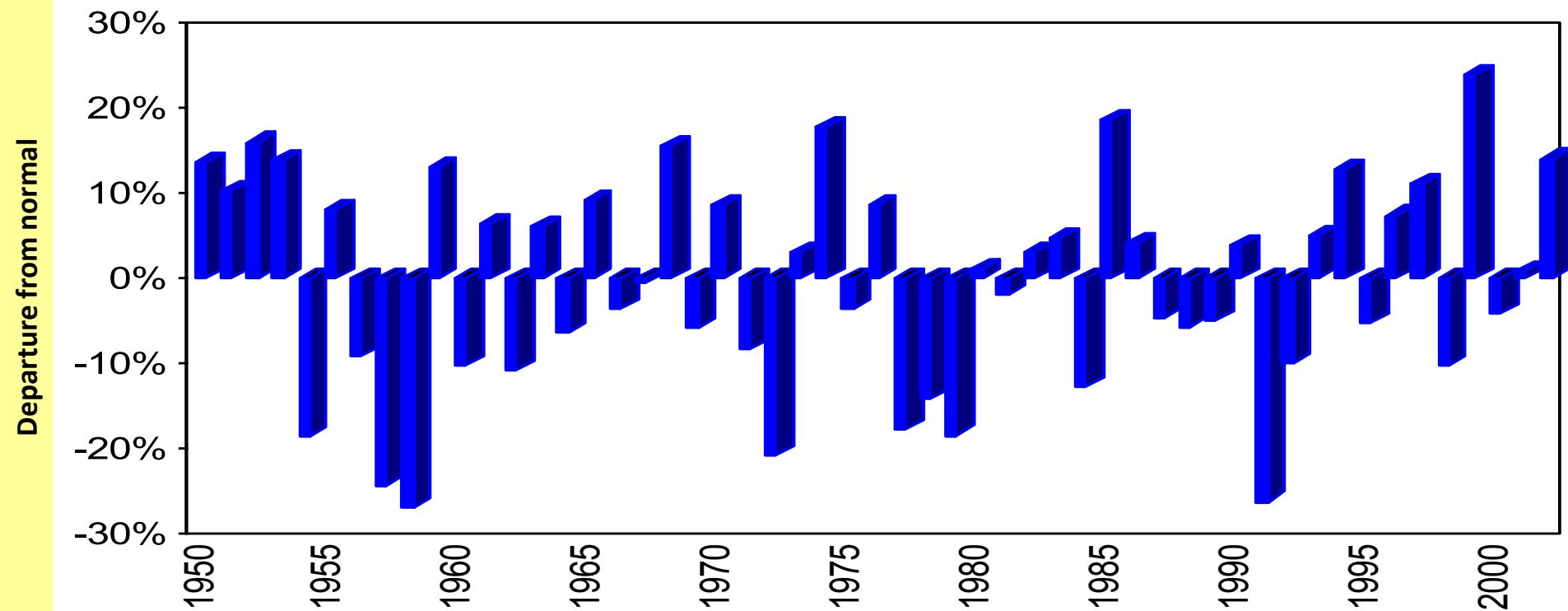
Fluctuations and trends of early, peak, and late monsoon rainfall in Yangon City
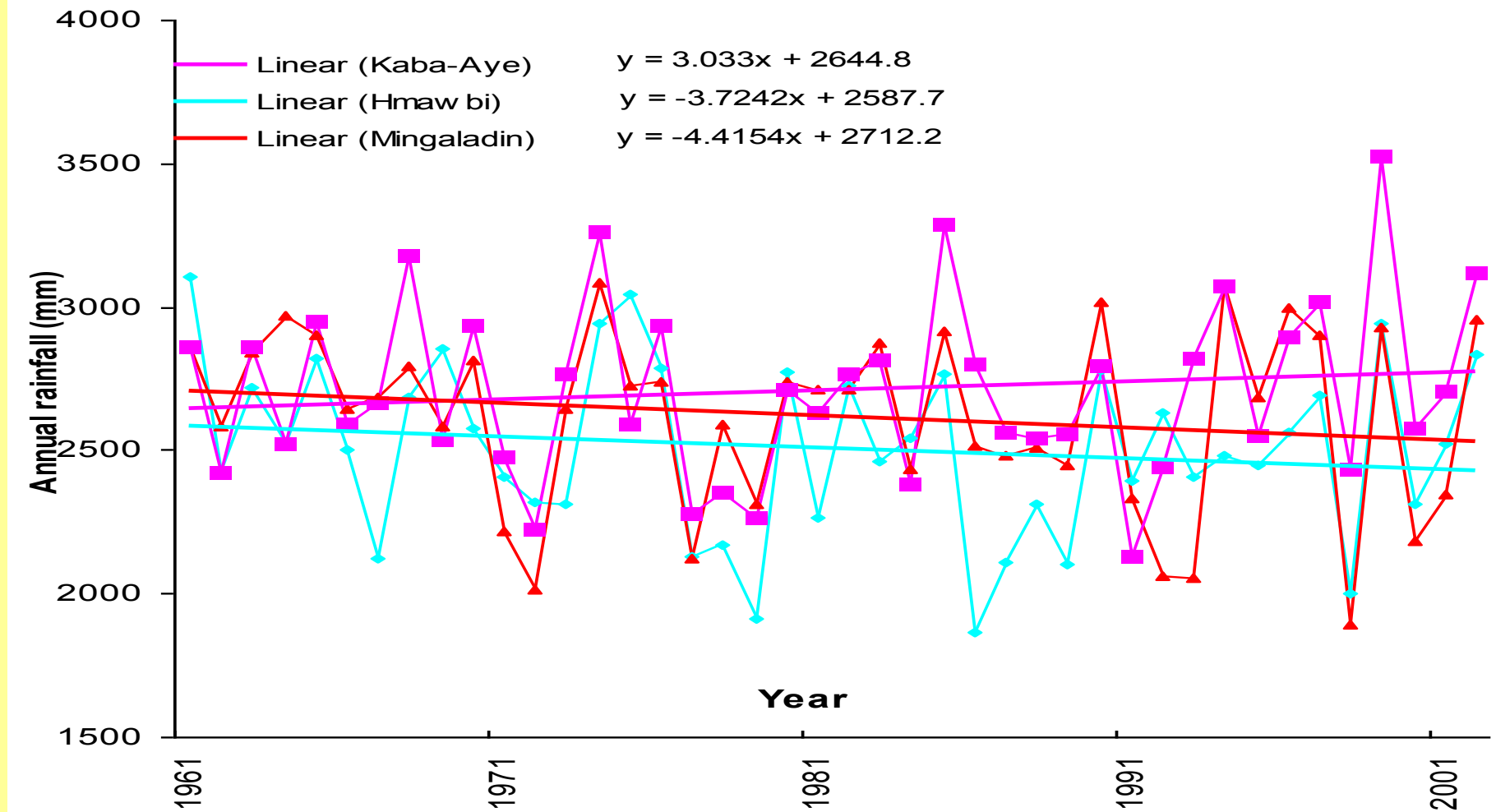
**Fluctuations and trends of average annual rainfall in Yangon**

Over the period of 42 years, the annual total rainfall increases slightly at Kaba-Aye and the other two stations show slight decreasing trends.

Percentage departure from normal rainfall in Kaba-Aye, Yangon

To examine the extreme rainfall condition in Yangon City, DFN is calculated for the years from 1950 to 2002. The extreme rainfall occurs when DFN is outside the range of ($\pm$) 20% during the particular period (DMH, Myanmar).

- Temperature, the major climatic element, globally increases.

- Global continental change is significant from 1950s to present.

- To analyze the changes in temperature of Yangon City, simple graphs and trend lines, and decadal temperature data of 6 decades (1951 to 2010) are used.

- To avoid the effect of cloudy sky and precipitation, maximum and minimum temperatures of December and January are analyzed.
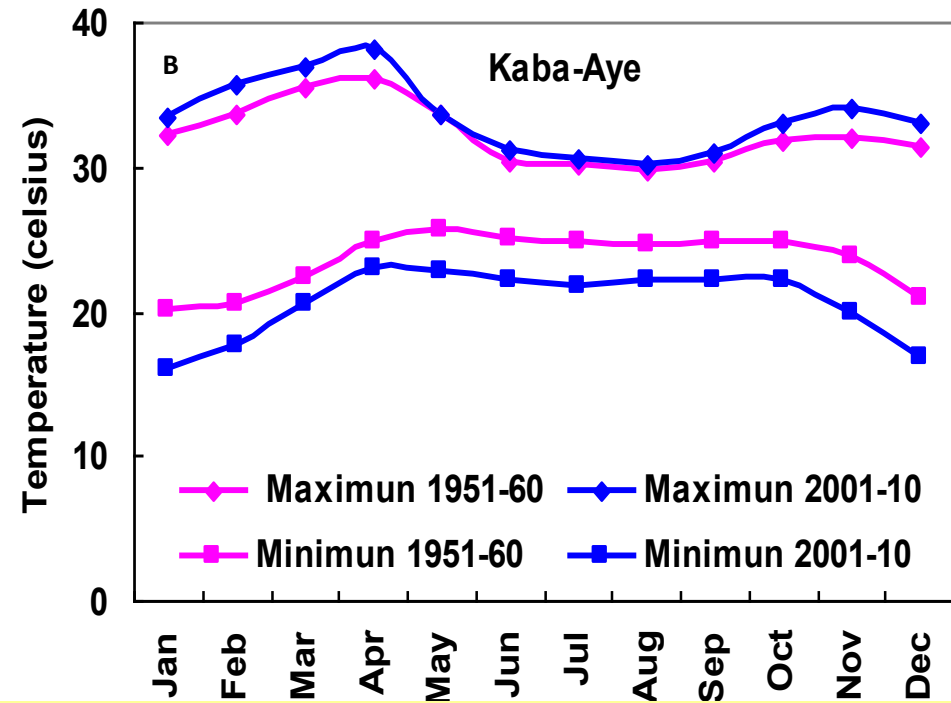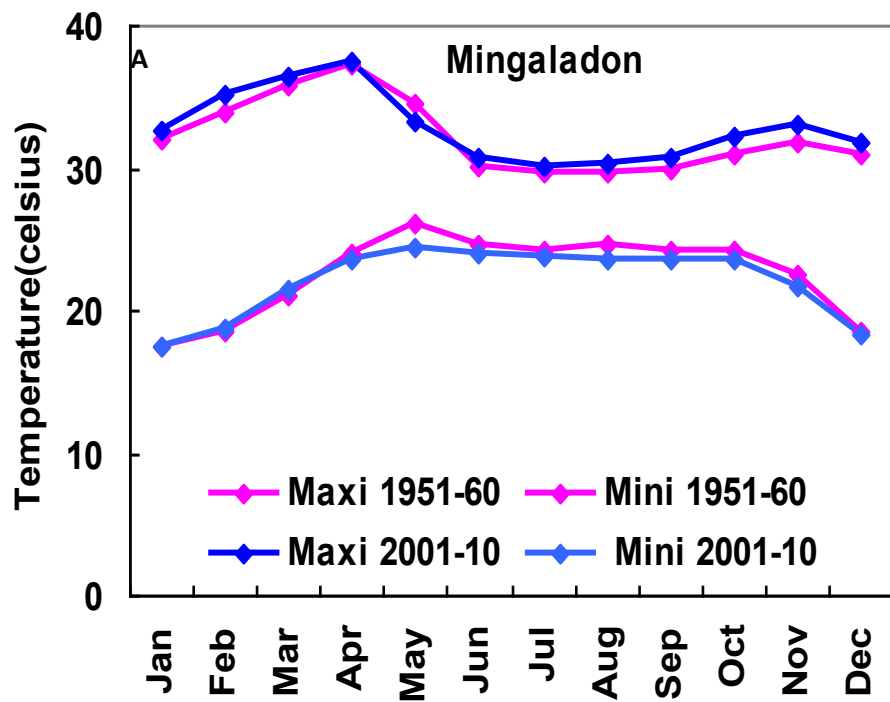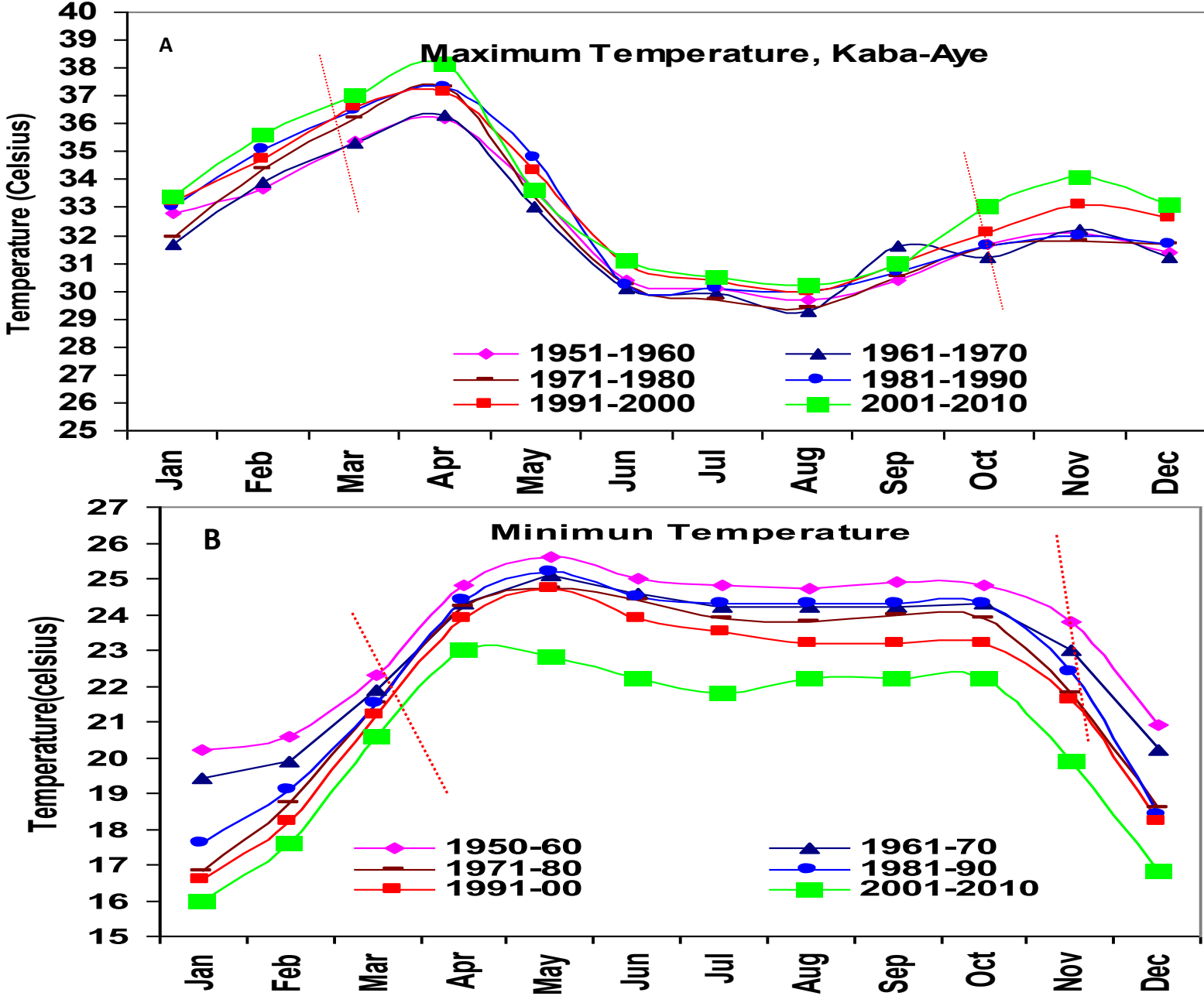
Average maximum and minimum temperature differences in Yangon

temperatures of first decade (1950s) vary apparently that of last decade (2010s)

Decadal daily maximum and minimum temperature of Kaba-Aye

Month	1951-1960 Maximum (Celsius)	2001-2010 Maximum (Celsius)	1951-60 Minimum (Celsius)	2001-2010 Minimum (Celsius)
Jan	32.8	33.4	20.2	16.0
Feb	33.7	35.6	20.6	17.6
Mar	35.4	37.0	22.3	20.6
Apr	36.2	38.1	24.8	23.0
May	33.6	33.6	25.6	22.8
Jun	30.4	31.1	25.0	22.2
Jul	30.1	30.5	24.8	21.8
Aug	29.7	30.2	24.7	22.2
Sep	30.4	31.0	24.9	22.2
Oct	31.7	33.0	24.8	22.2
Nov	32.1	34.1	23.8	19.9
Dec	31.4	33.1	20.9	16.8

average daily maximum temperatures of 1950s are lower than that of 2000s. However average daily minimum temperatures of 1950s are higher than that of 2000s. Decadal daily temperatures of other two stations in Yangon are also found the same pattern. But Kaba-Aye is more pronounce which is situated at the Yangon City center.
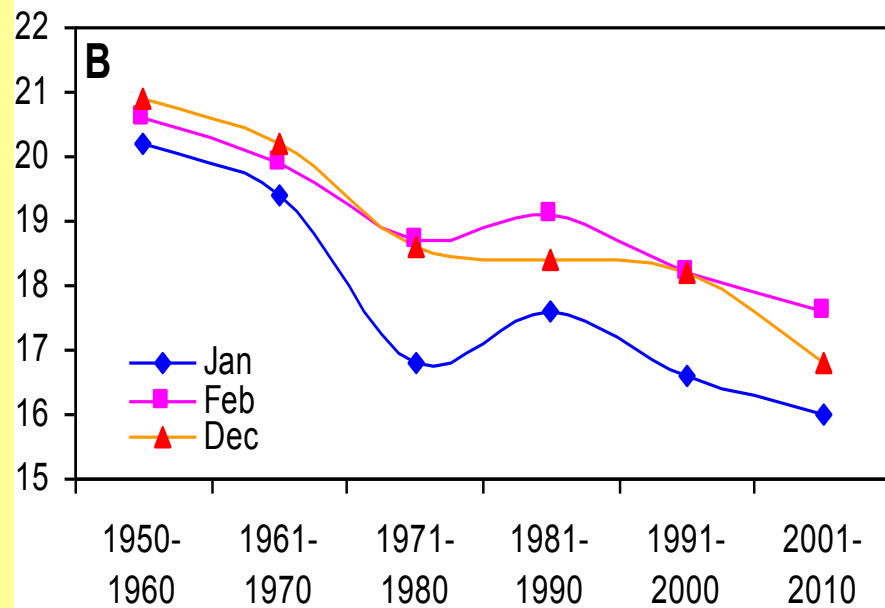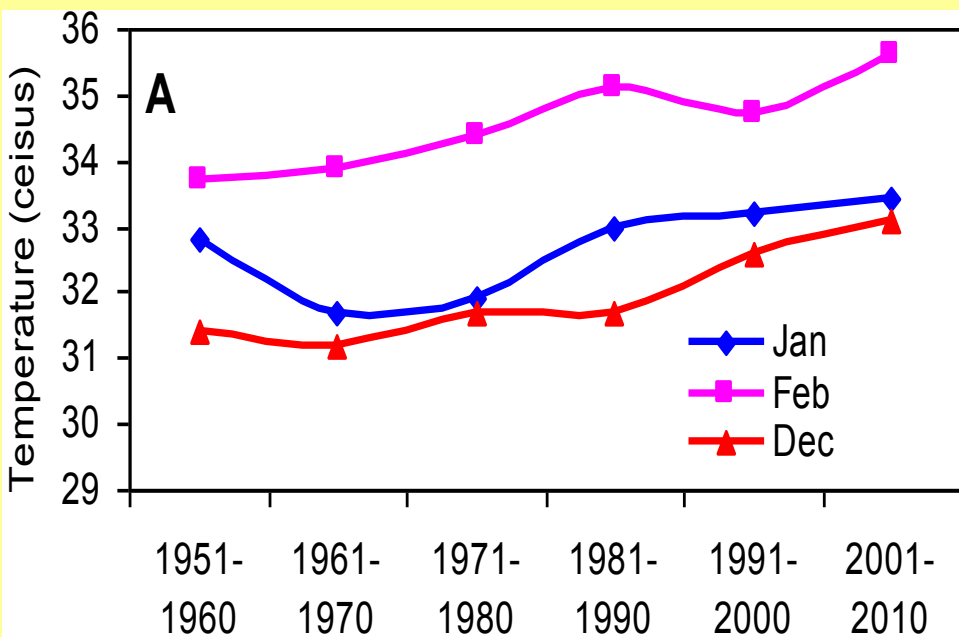
Daily maximum and minimum temperature by decade

- More cloudy sky in the months of May to September affects both monthly and daytime temperatures.

- So day time temperatures are markedly lower in the months of May to October in Yangon City

- The global average surface temperature has increased significantly since 1950.
- According to Fourth Assessment Report (AR4, 2007), the rate of global warming average over the last 50 year is 0.13 dC ± 0.03 d C per decade.
- According to time series analysis on temperature in this study, Yangon City is also warmer over decade by decade at a somewhat rate in day time.
- Although warming condition experience at day time in Yangon, night time is experiencing cooling effect. This can be expressed by figure.

Daily average maximum and minimum temperatures at December, January, February at ten-year intervals over a period of 60 years (Kaba-Aye, Yangon)

December maximum temperature

December minimum temberature
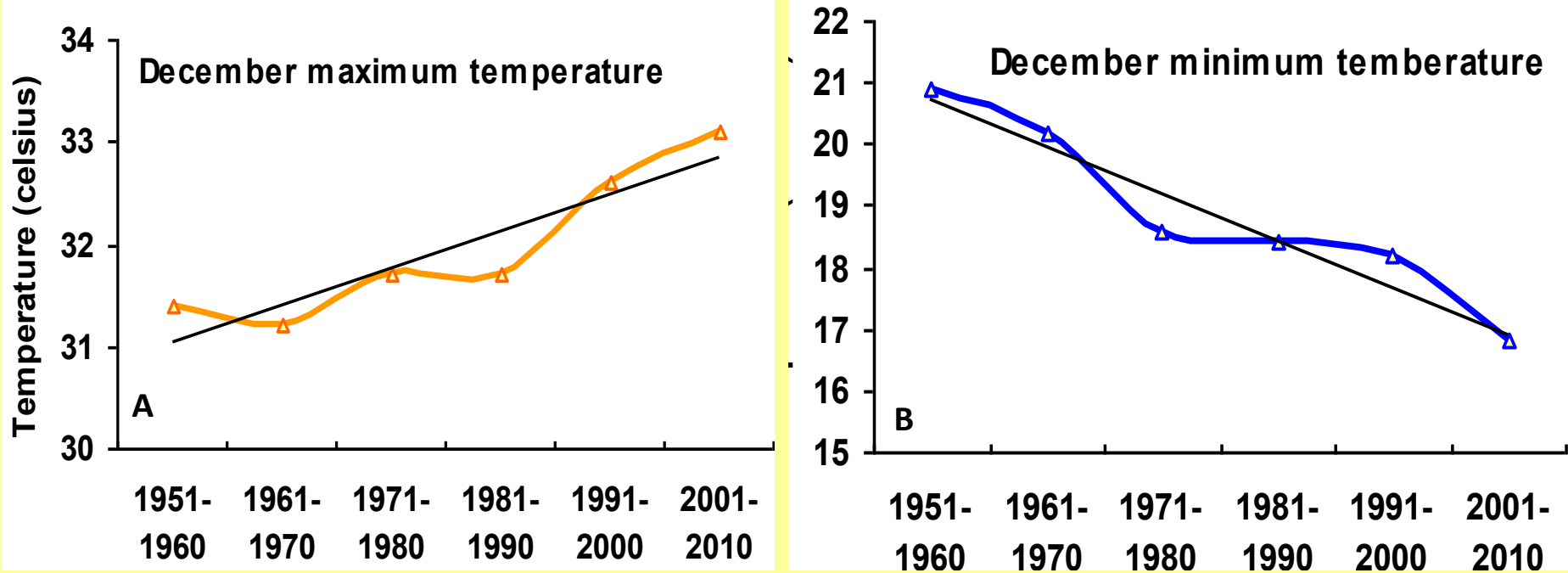
Daily average maximum and minimum temperature in December at ten-year intervals over a period of 60 years (Kaba-Aye, Yangon)

- Figure A, overall trend reflects a steady increase of day time temperature throughout 60 years period (1950-2010),
- Figure B, overall trend reflects a steady decrease of night time temperature throughout 60 years period (1950-2010).
- It shows an important condition of DTR in Yangon. Under this day and night time temperature trends, DTR of Yangon has increased as time pass through decade by decade.

Many evidences have revealed that the urban heat island affects on precipitation, cloud cover, and diurnal range of temperature (DTR) in micro climate scale.

A decrease in DTR of approximately 0.1 dC per decade for the period 1950 to 1993 was reported in Third Assessment (TAR, IPCC 2001). This is due to increase in night time temperature.

In Fourth Assessment Report (AR4, IPCC 2007), *global average DTR has not changed from 1979 to 2004 as both day and night time temperature have risen at about the same rate. Trends are highly variable from one region to another*. The rise in both day and night time temperatures contributes warming affect on globe.

★ **According to temperature analysis in Yangon City, a rise in day time temperatures and a fall in night time temperatures contribute increase in DTR and decrease in daily mean temperature per decade by decade in Yangon City.**
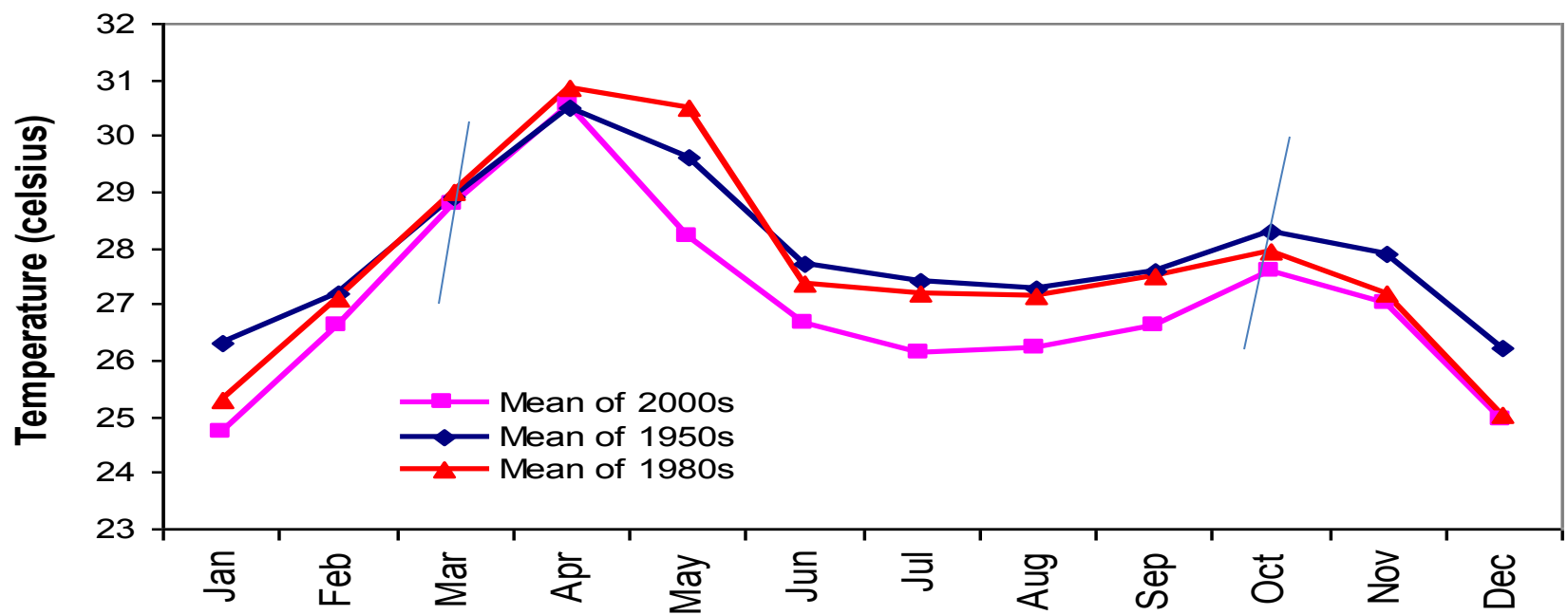
Decadal mean monthly temperature, Kaba Aye

mean temperatures decrease within 60 years in accordance with increased maximum temperature is subtracted by decreased minimum temperatures in Yangon City.

03-Feb-15

Conclusion

How changes are recognized in climate of Yangon City in context with global warming?

Are these changes apparent?

- So this study shows past and present trend of change in climate of Yangon City.

How about the future trend of change in climate condition of Yangon City?

World Climate Research Program's (WCRP)
Coupled Model Intercomparison Project Phase 5 (CMIP 5)

BCC-CSM1.1
Beijing Climate Center, China Meteorological Administration

new scenarios of RCPs (Representative concentration pathways) by IPCC in the fifth assessment report (AR 5)

▪ The localize variation is important factor for local-scale-planning. The local differences may be due to some local factors such as location of station, and environmental condition of respective station. Surrounding physical condition, environmental situation, and other socio-economic factors of an area can influent its climatic condition. So, more detail analysis should be made by using sufficient environmental and climatic observed data for the City.

If, local conditions that can generate imperceptible change in temperature or can mitigate or can be mild the extreme climatic events, it should be conserved as one of the adaptation strategies. Microclimate study of Cities should be made by using observed climatic data and combined with local environmental and social condition of that area. If there have favorable existing conditions in an area, it should be conserved.

Thank You Very Much

Methods and data used

- Time-series analysis, statistical computation, regression and trend line analysis , and graphical representations (understand changing climatic elements and variability).

- Standard deviation (SD) and coefficient of variation (COV) (examine the variability of rainfall in Yangon City).

- Percentage departure from normal (DFN) is calculated by [{(R-N)/N }*100] (where ; R- annual rainfall at given period, N- normal rainfall of 1960-1990). (analyze the extreme rainfall condition)

  - Temperature (both maximum and minimum),
  - Rainfall and Rainy days,
  - Dates of monsoon onset and withdrawal