

"Analysis and forecasting of climate variability during 37 years (1979 & 2016); and the consequences to future Agriculture in Belize (2017 to 2054)"

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## AGENDA:

- Objectives.
- Methodology.
- Results.
- Conclusion.
- Recommendations.

## **GENERAL OBJECTIVE**

Analyse the behavioral pattern of rainfall and temperature during the last 37 years and forecasting the approximate behavioral pattern for the next 37 years.

## **SPECIFIC OBJECTIVES**

Analyse the Climatic Variation (Temperature and Rainfall) in Belize during the last 37 years(1979-2016).

Forecast the Climatic Variation (Temperature and Rainfall) for the next 37 years (2017-2054).

Analyse the negative consequences of Climate Variability.

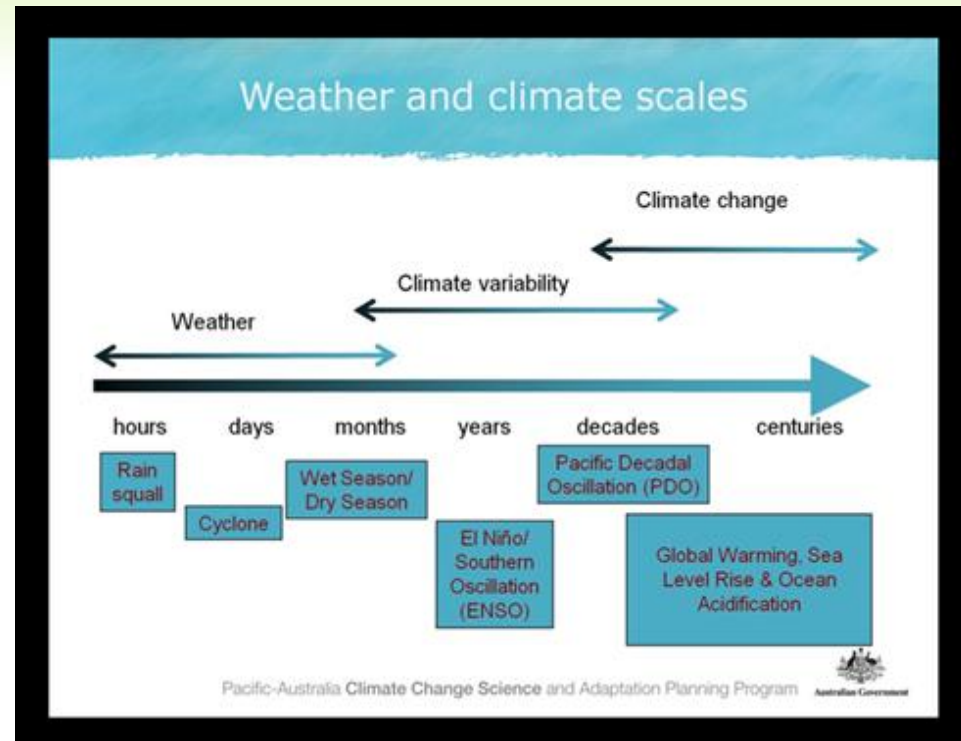
Recommend mitigation strategies to minimize the negative impact on Belizean Agriculture.

Recommend adaptation strategies to minimize the negative impact on Belizean Agriculture.

# LIT. REVIEW

## Climate Variability

It is defined as long-term averages and variations in weather measured over a period of several decades. The Earth's climate system includes the land surface, atmosphere, oceans, and ice.

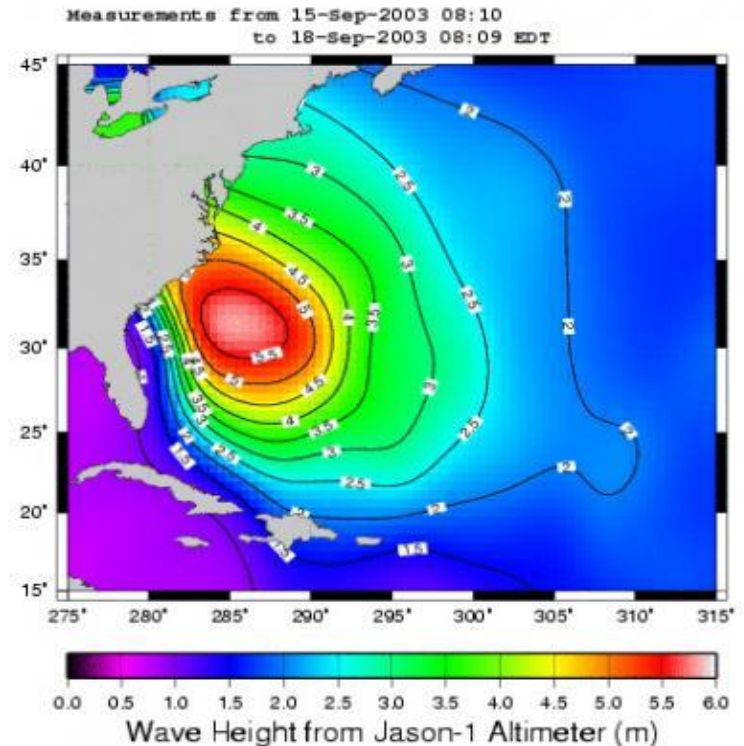


# LIT. REVIEW

## *Seasonal Variability*

The Atlantic Ocean is flanked by two large tropical continents, which host major centers of atmospheric convection. As early as 320 years ago, Halley [1686] recognized the important influence of these continents on climate in the Atlantic sector and suggested that the intense surface heating over North Africa drives the southerly winds in the Gulf of Guinea. It was not until 1970s, however, that the influence of the tropical Atlantic Ocean on continental climate variability began to come to light.

The tropical Atlantic is not isolated, but is influenced by, and may influence climate variability in other regions, in particular ENSO and the North Atlantic Oscillation (NAO). The NAO is of central importance for climate variability in the extratropical North Atlantic and Europe.



# LIT. REVIEW

## *Effects*

- ✓ The combination of these changes is causing sea levels to rise, resulting in flooding and erosion of coastal and low lying areas.
- ✓ Heavy rain and other extreme weather events are becoming more frequent. This can lead to floods and decreasing water quality, but also decreasing availability of water resources in some regions.
- ✓ Many poor developing countries are among the most affected. People living there often depend heavily on their natural environment and they have the least resources to cope with the changing climate.
- ✓ Damage to property and infrastructure and to human health imposes heavy costs on society and the economy.
- ✓ Sectors that rely strongly on certain temperatures and precipitation levels such as agriculture, forestry, energy and tourism are particularly affected.
- ✓ Many terrestrial, freshwater and marine species have already moved to new locations. Some plant and animal species will be at increased risk of extinction if global average temperatures continue to rise unchecked.

# LIT. REVIEW

## ✓ *Mitigation*

- ✓ When water warms up it expands. At the same time global warming causes polar ice sheets and glaciers to melt.
- ✓ The combination of these changes is causing sea levels to rise, resulting in flooding and erosion of coastal and low lying areas..
- ✓ Heavy rain and other extreme weather events are becoming more frequent. This can lead to floods and decreasing water quality, but also decreasing availability of water resources in some regions.
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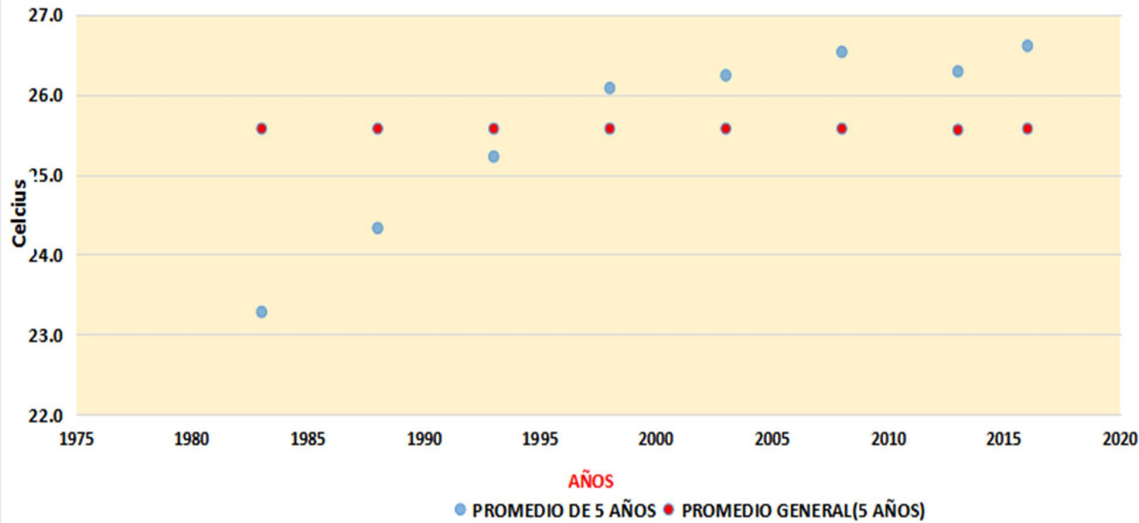
# METHODOLOGY

- Raw data of monthly Temperature ( $^{\circ}$  C) and Rainfall (mm) was collected for 37 years from the meteorological section of the Belize Weather Bureau.
- The information was analysed; weekly, monthly and yearly for each station within the country.
- The information on Temperature and Rainfall was graphed to observed to behavior(Seasonal, Tendency and Cycle) during 37 years for 5 and 10 years respectively to analyse the increase or decrease in the two phenomenon.
- Correlation analysis was performed for information of past 37 years and the coming next 37 years.
- Conclusion regarding adaptation and mitigation to climate change was done.



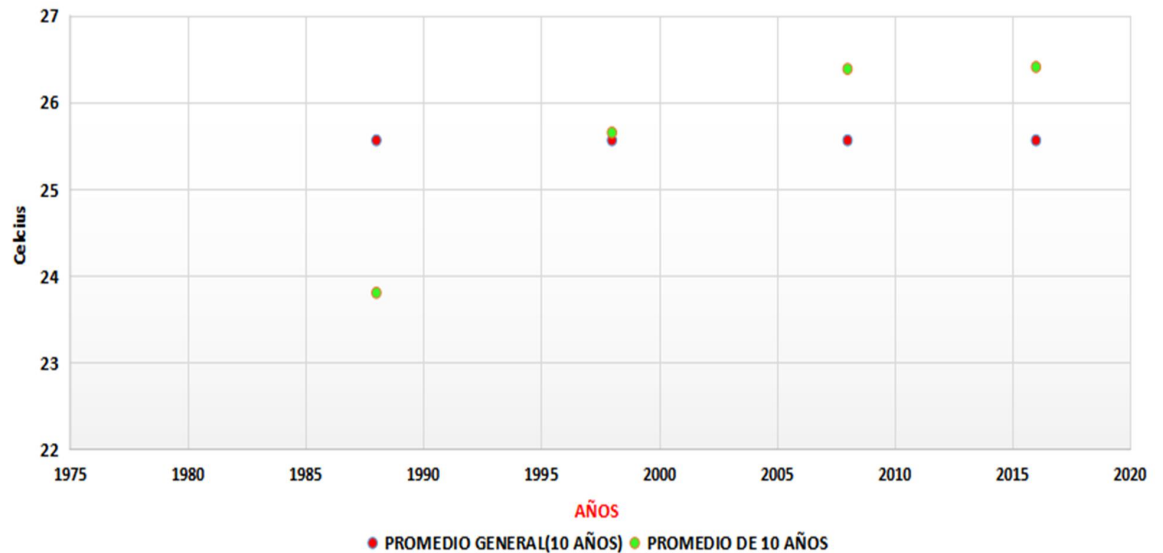
# RESULTS & DISCUSSION

Grafica No. 6; FLUCTUACION PROMEDIO DE 5 AÑOS DURANTE 37 AÑOS EN BELICE



TEMPERATURE

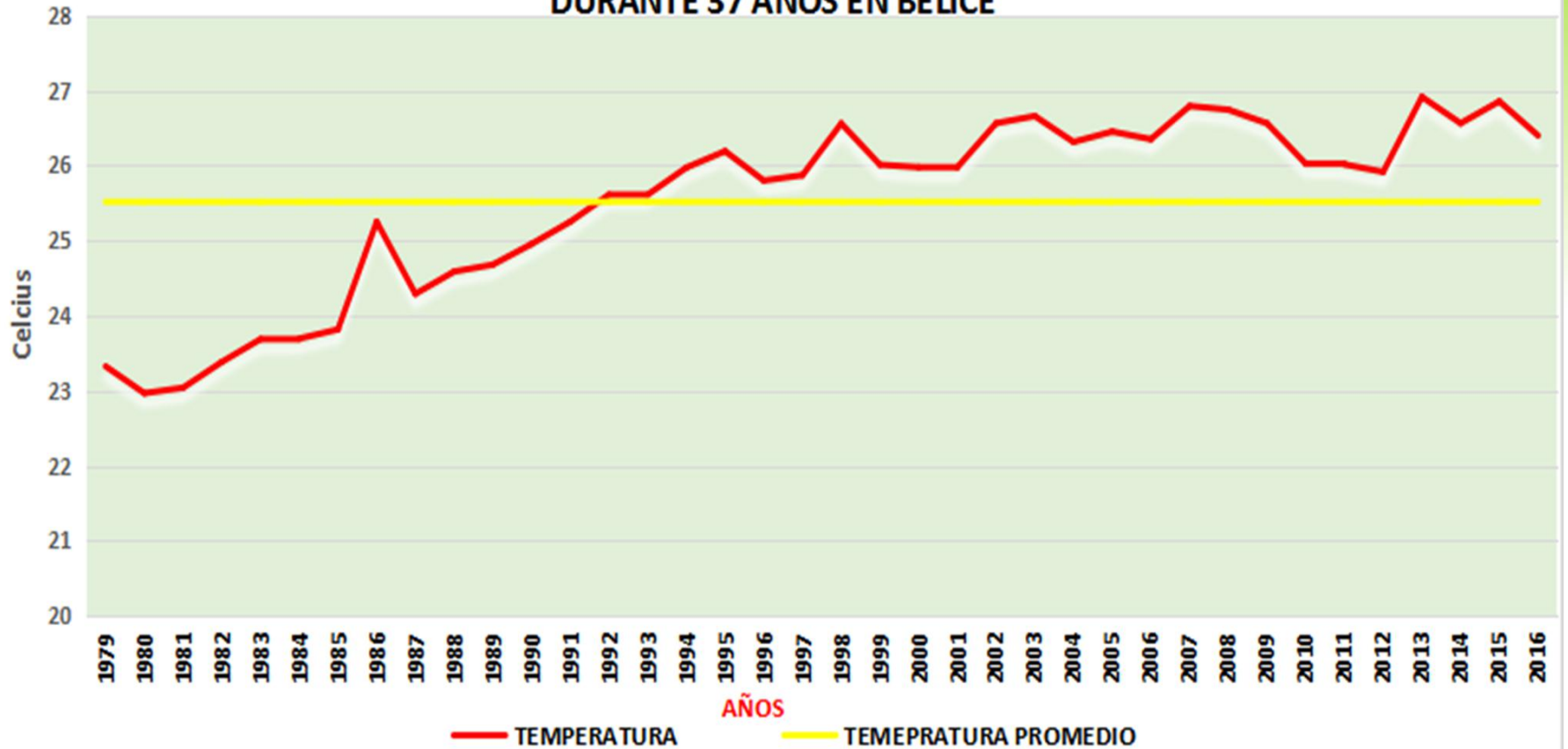
Grafica No. 7; FLUCTUACION PROMEDIO DE 10 AÑOS DE LA TEMPERATURA DURANTE 37 AÑOS EN BELICE



# RESULTS & DISCUSSION

## TEMPERATURE

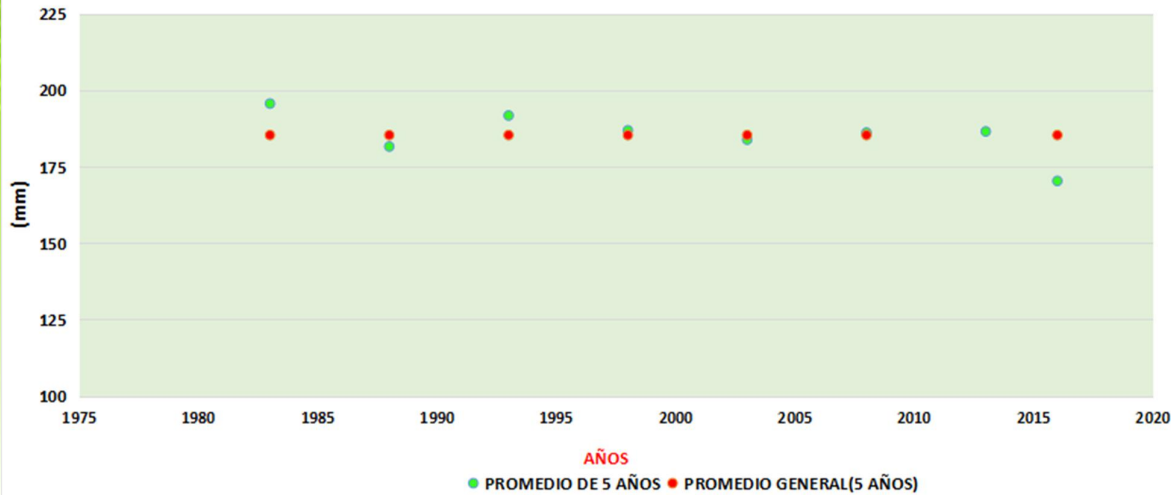
Grafica No. 5; FLUCTUACION DE LA TEMPERATURA Y LA TEMPERATURA MEDIA DURANTE 37 AÑOS EN BELICE



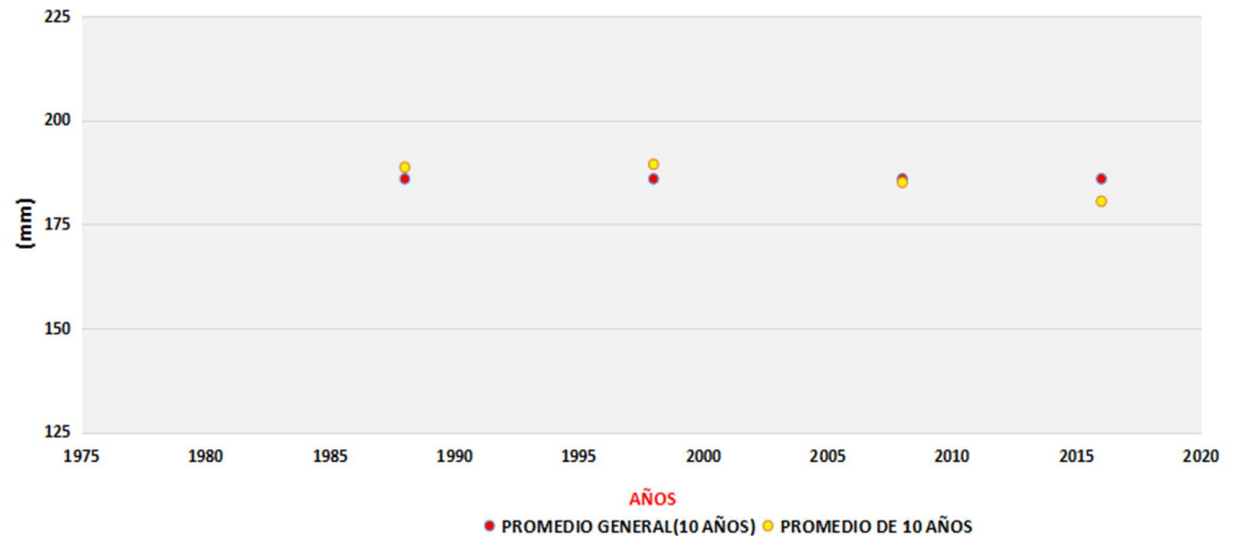
# RESULTS & DISCUSSION

RAINFALL

Grafica No. 9; FLUCTUACION DE LA PRECIPITACION MEDIA DE 5 AÑOS DURANTE 37 AÑOS EN BELICE



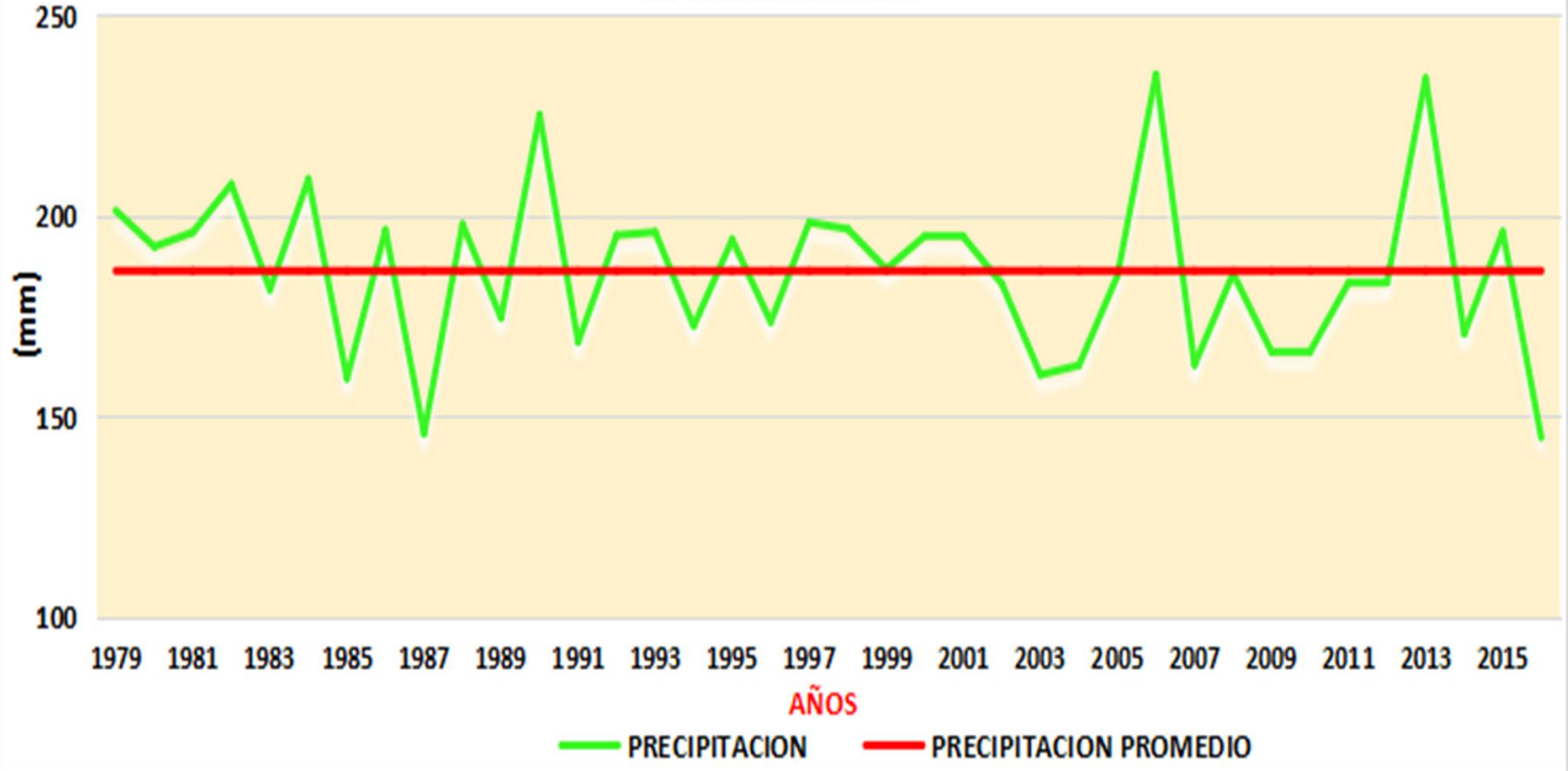
Grafica No. 10; FLUCTUACION DE LA PRECIPITACION MEDIA DE 10 AÑOS DURANTE 37 AÑOS EN BELICE



# RESULTS & DISCUSSION

## RAINFALL

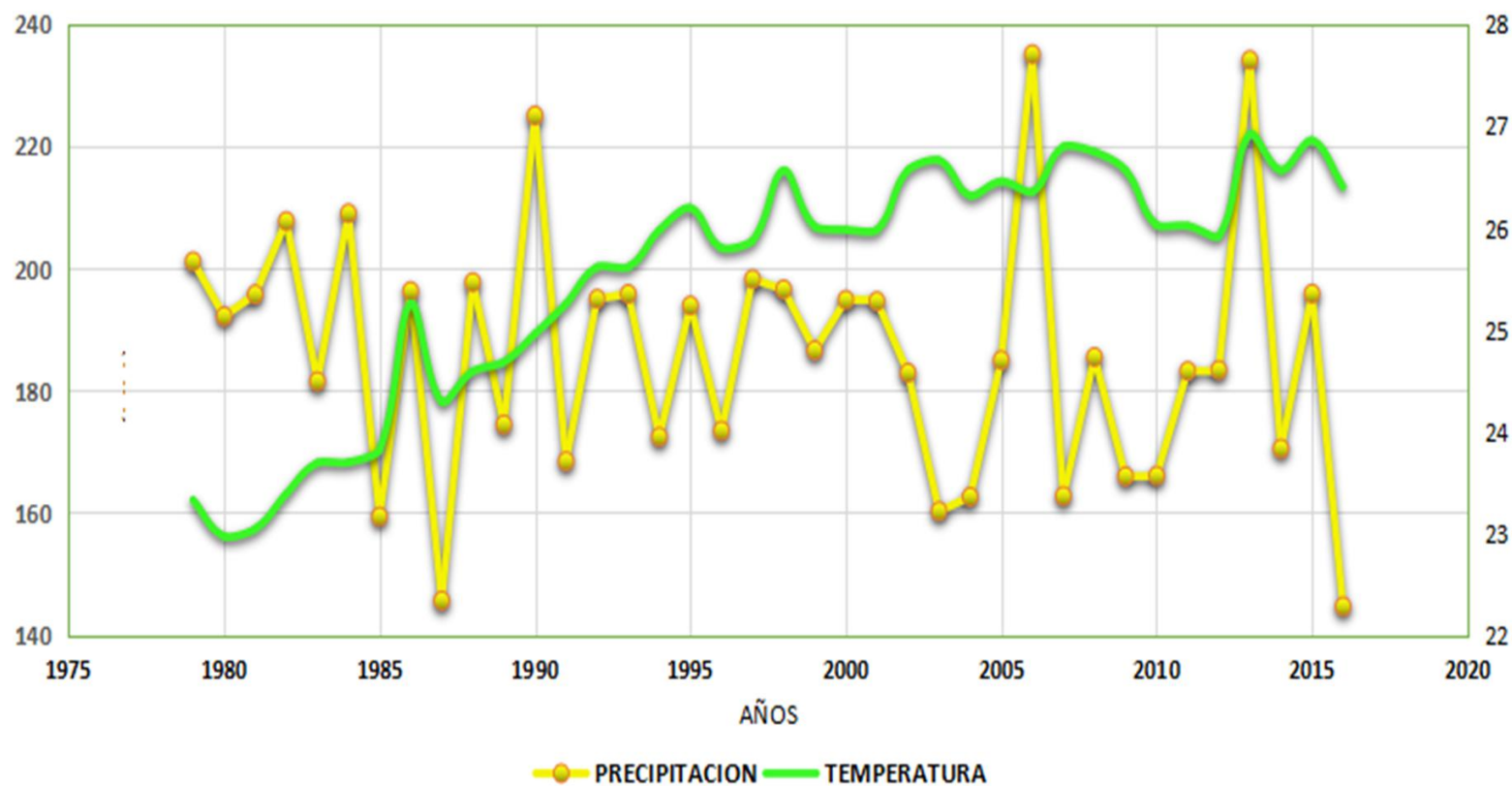
Grafica No. 8; FLUCTUACION DE LA PRECIPITACIÓN Y PRECIPITACIÓN MEDIA DURANTE 37 AÑOS EN BELICE



# RESULTS & DISCUSSION

## TEMPERATURE AND RAINFALL

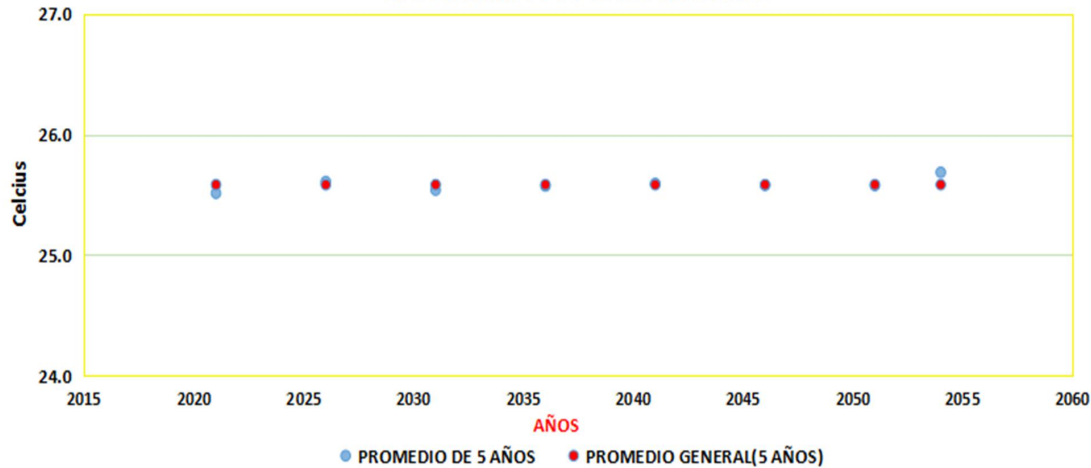
Grafica No. 11; FLUCTUACION DE LA TEMPERATURA Y LA PRECIPITACION DURANTE 37 AÑOS EN BELICE



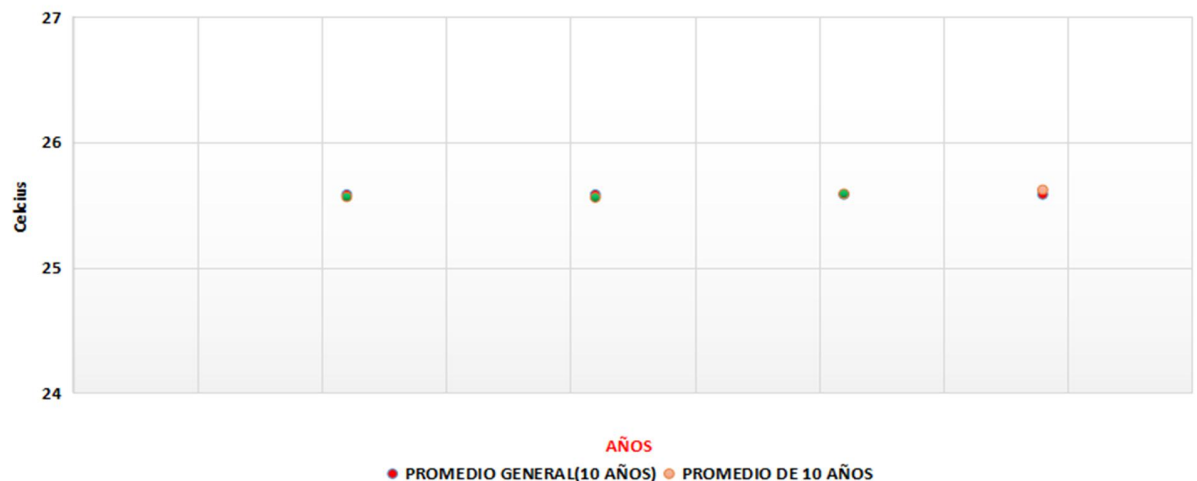
# RESULTS & DISCUSSION

## TEMPERATURE FORECAST

Grafica No. 13; TEMPERATURA MEDIA PRONOSTICADO CADA 5 AÑOS DURANTE LOS PROXIMOS 37 AÑOS EN BELICE

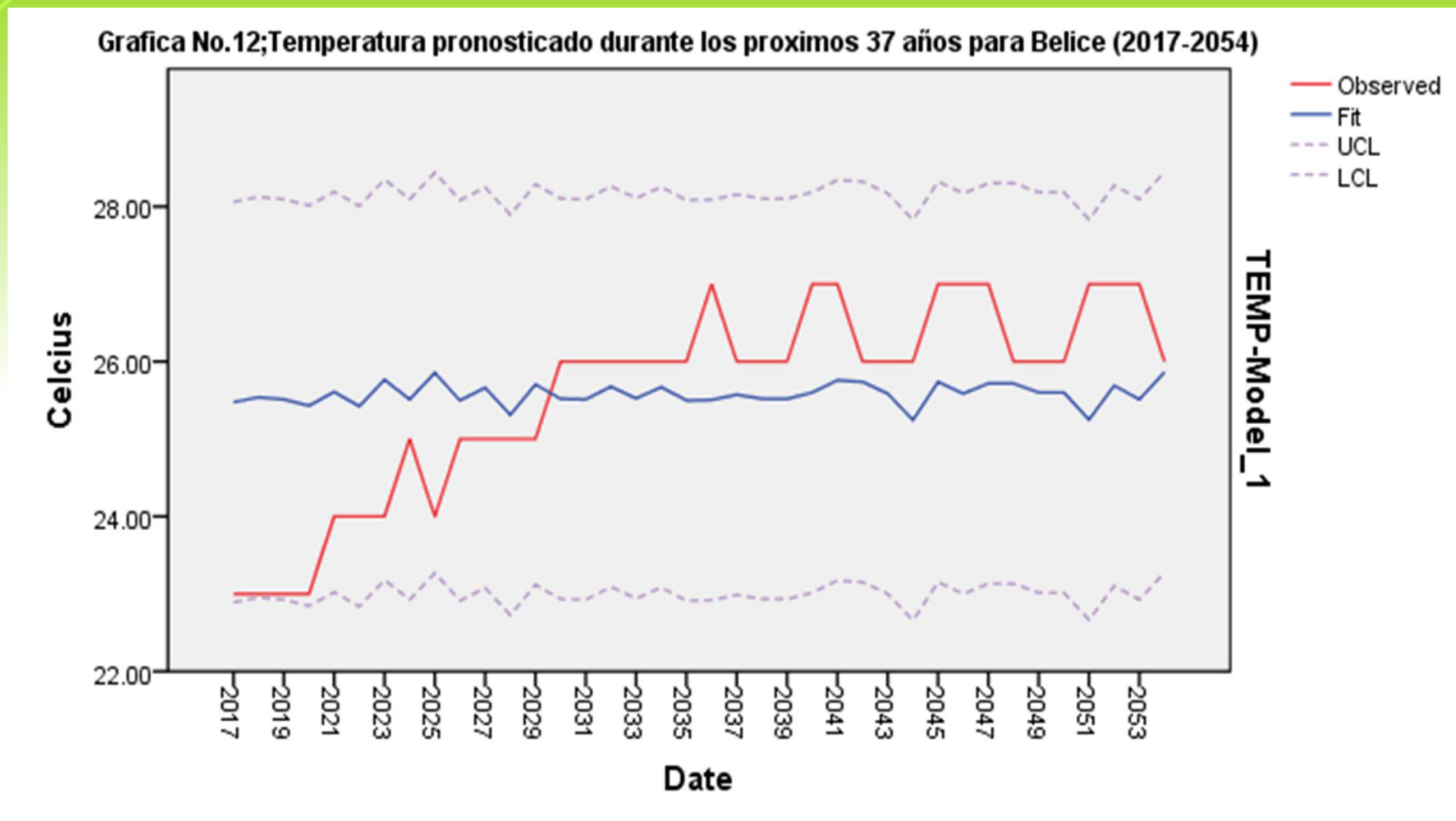


Grafica No. 14; TEMPERATURA MEDIA PRONOSTICADO DE 10 AÑOS DURANTE LOS PROXIMOS 37 AÑOS EN BELICE



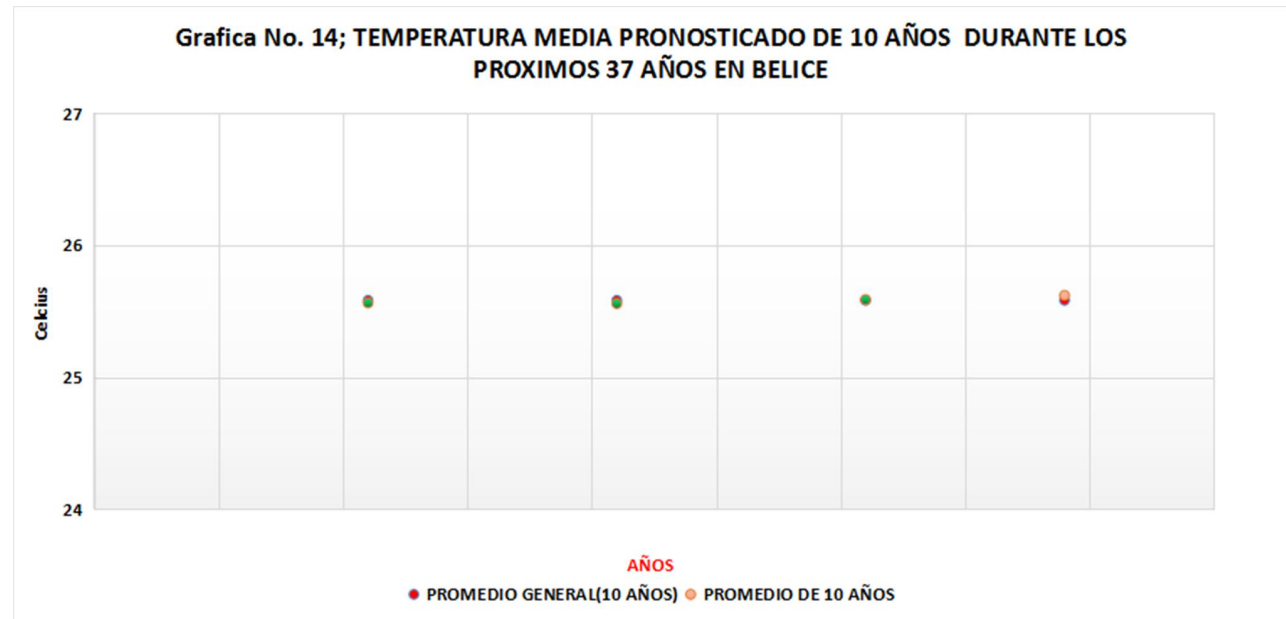
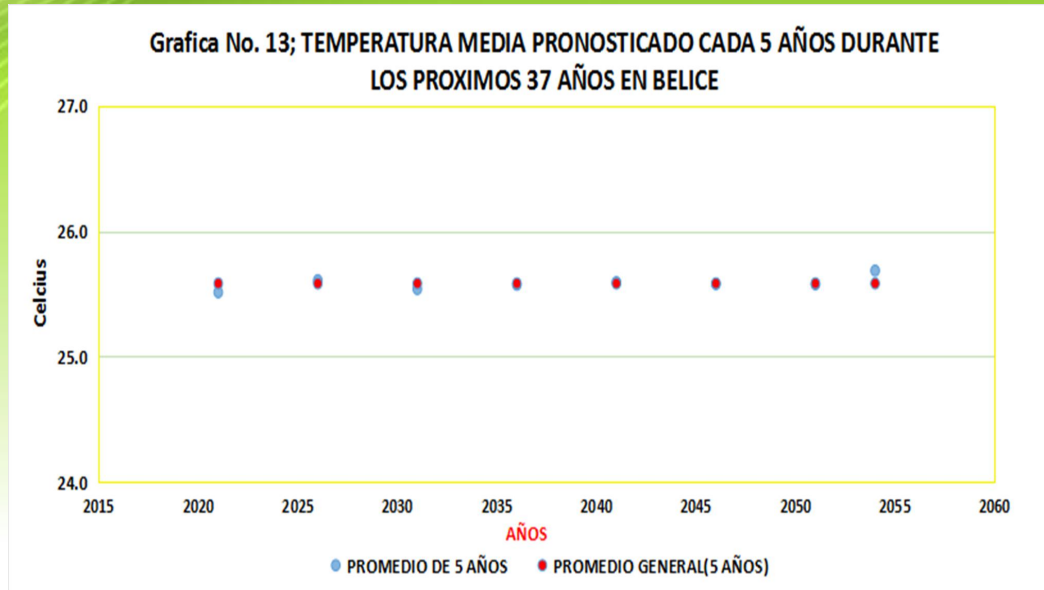
# RESULTS & DISCUSSION

## TEMPERATURE FORECAST



# RESULTS & DISCUSSION

## RAINFALL FORECAST

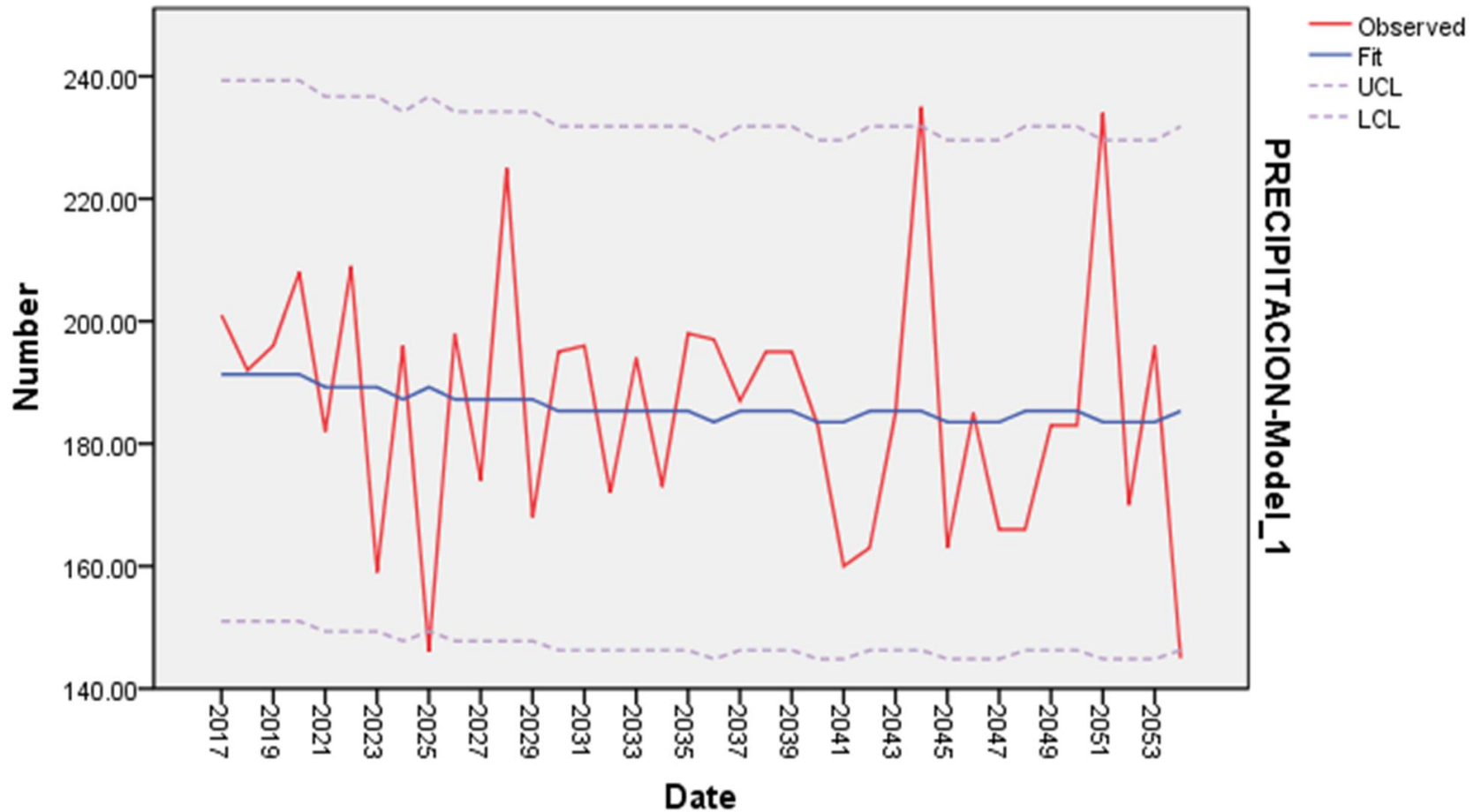




# RESULTS & DISCUSSION

## RAINFALL FORECAST

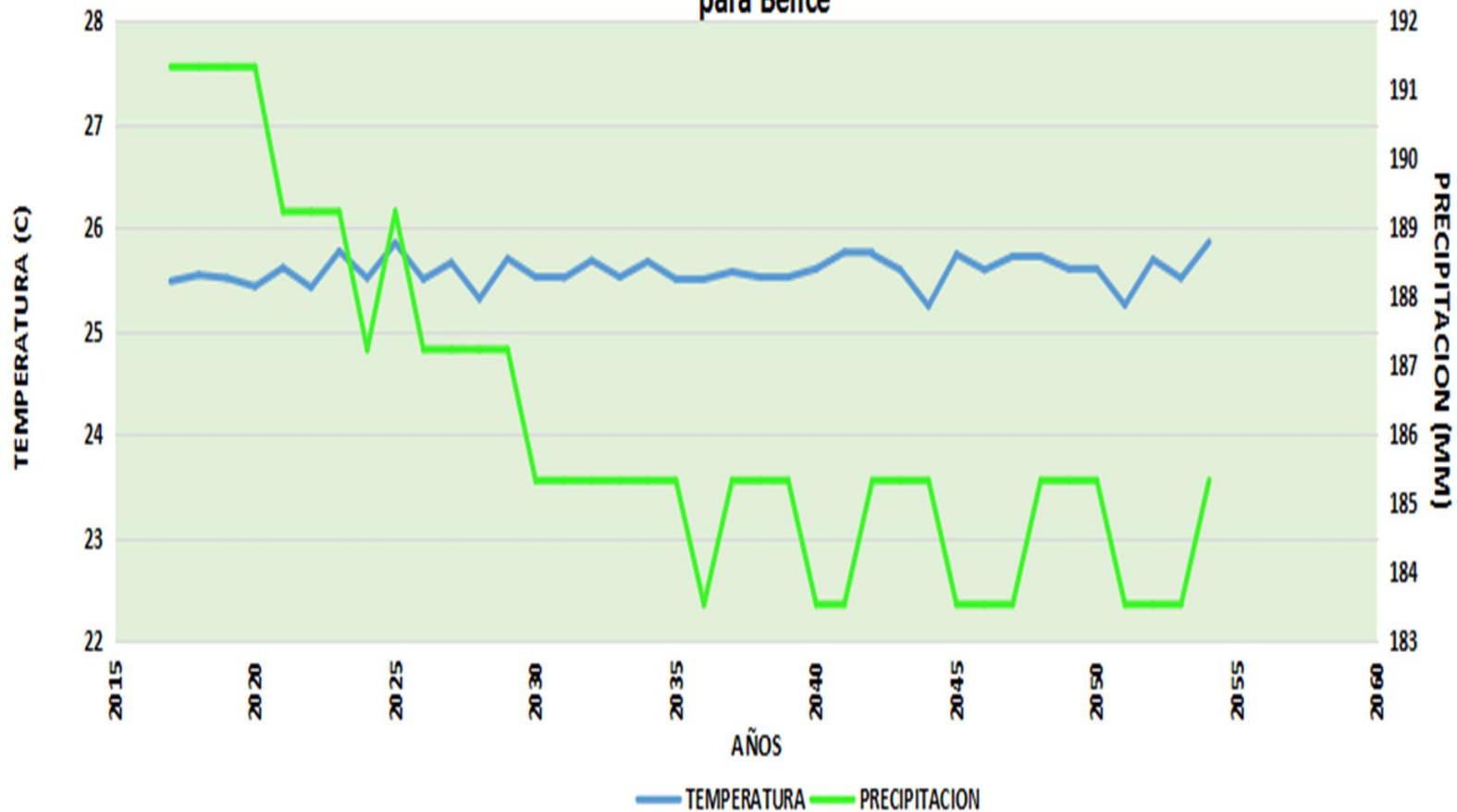
Grafica No. 15; Pronostico de Precipitación(mm) para los proximos 37 años para Belice (2017-2054)



# RESULTS & DISCUSSION

## TEMPRETURE & RAINFALL FORECAST

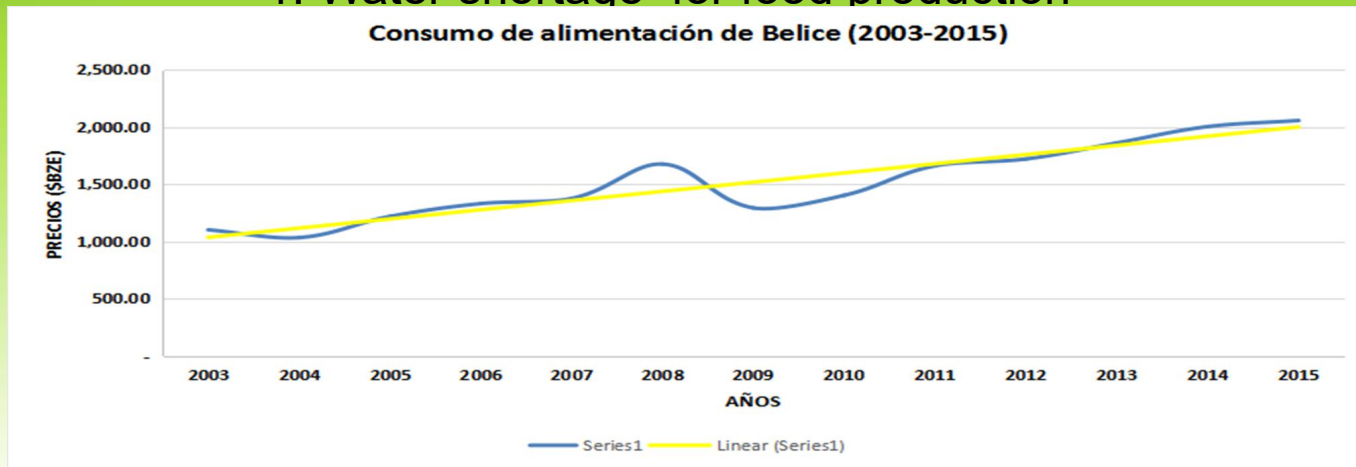
Grafica No. 18; Pronostico de la Temperatura (t) y la Precipitación (mm) durante 37 Años (2017-2054) para Belice



# RESULTS & DISCUSSION

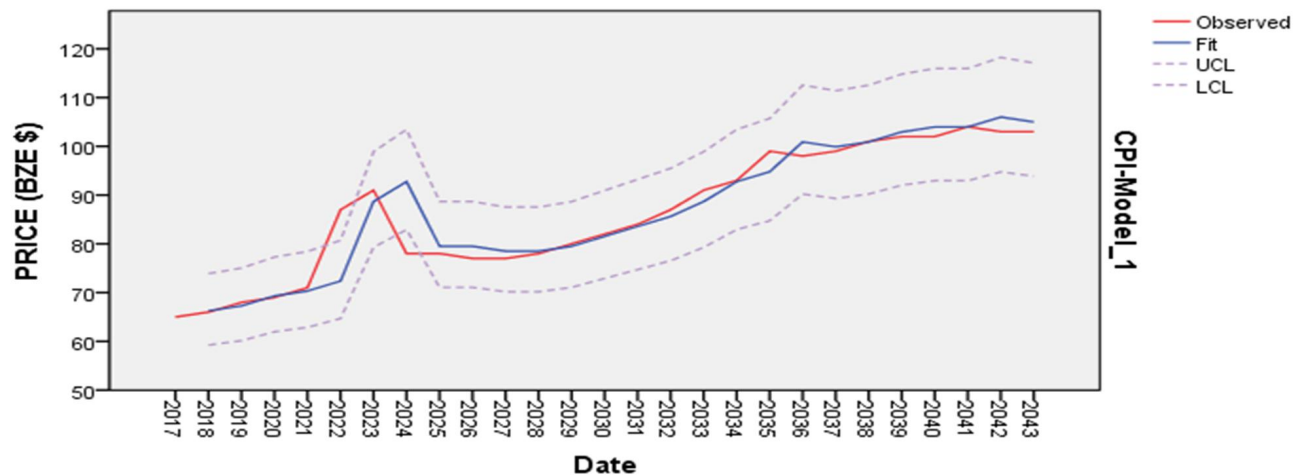
## EFFECTS ON AGRICULTURE (FOOD SECURITY)

### 1. Water shortage for food production



### 2. Increase in food demand as well as prices on food commodities.

#### Pronostico de Tasa de Precio al Conusmidor (TPC) durante los proximos 27 años



### 3. Decrease in crop yield (ton/acre) as well as the quality of food production.

# CONCLUSION

## *Analysis of Temperature & Rainfall behavior(1979-2016).*

➤The analysis indicates that the Temperature in 1979 was 23.3 ° C and 26.0 ° C in 2,016 for an average of 25.5 ° C. The analysis clearly demonstrates that the country has suffered and an increase in accumulated Temperature of 3.08° C during the last 37 years (1,979-2,016); which is equivalent to an annual variation of 0.08 ó 8.32%.

➤The analysis indicates that the rainfall in 1979 was 201 mm and 145 mm in 2016 for an average of 172.9 mm. The analysis clearly demonstrates that the country has suffered a reduction in the accumulated rainfall of 56.51 mm during 37 years (1,979-2,016); which is equivalent to an annual variation of 1.53 ó 152.7%.

# CONCLUSION CONT'

## *Temperature & Rainfall Projections (2017-2054).*

- The analysis indicates that the projected temperature will have a variation of  $0.38^{\circ}$  C in the next 37 years (2,017-2,054); this is equivalent to an annual variation of  $0.010 \text{ ó } 1.03\%$ . This calculation confirms the effort of the United Nation Program on Climate Change in order to maintain the average global temperature from  $2$  to  $1.5^{\circ}$  C.
- With regards to projected rainfall; the rainfall for 2017 will be 191.3 and 185.3 mm in 2054; for average of 188.3 mm. The analysis indicates that there will be a deficit in the rainfall 6.00 mm during the next 37 years. This is equivalent to an annual variation of  $0.162 \text{ ó } 16.22\%$ . This calculation confirms the effort of the United Nation Program to increase or maintain protected areas and to conserve forest that will contribute the rainfall.

# CONCLUSION CONT'

## *Temperature & Rainfall (1979-2016).*

The behavioral pattern of the temperature is an increase tendency; compared to the rainfall whose behavior is Cycle or inter annual. However the correlation is positive (0.084) but below Zero according to Dancey & Reidy's (2004). According to the regression Analysis; The comparasion is not statistically significant because of its F (0.6147)

## *Temperature & Rainfall Projections (1979-2054).*

➤The behavioral pattern of the projected temperature is also tendency compared to the rainfall which is cycle or inter annual. However the correlation analysis(0.846) is positive and strong according to Dancey & Reidy's (2004) Table. According to the regression analysis, the temperture is statically significant with the rainfall according to the Ljung-Box Q Value (32.7).

<i>Correlation Coefficient Value</i>	<i>Correlation Strength</i>
1.00	Perfect
0.7 – 0.90	Strong
0.40 – 0.60	Moderate
0.10 – 0.30	Weak
0	Zero

# RECOMMEDATION CONT'

## **a. Analysis of historical data**

In historical data analysis; it is important to illustrate the graphs to analysed behaivoral pattern where the statistical and correlation analysis can be done.

## **d. Variability in Agricultural Commodities**

Considering that there will be a shortage of rainfall due to the deficit (6.00 mm); it is recommendable to continue with adaptation and mitigation strategies with establishing and forestry buffer country wide during the next 37 years (2017-2054).

it is recommendable to stimulate production and consumption of Agricultural commodities; which is highly correlated to price inflations in the market.

## **e. Implement mitigation & adaptation strategy**

Implement polices and regulation that focus on clean energy usage.

Invest in research & development that can substitute products that are originated from fossils in order to reduce the carbon cycle.

**THANKS FOR YOU TIME**