Climate Service for Climate Change Impact Indexes on Food Security in Nicaragua

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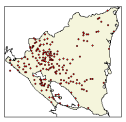
Introduction

The Central American Region is continuously affected by climatological events of negative consequences. These events have a great impact on the farm production, especially in the more vulnerable zones, which originates food insecurity and a lack of nutritional status. The different scenarios modelled for the future, according to the Intergovernamental Panel for Climatic Change (IPCC), have predicted an increase in temperature and a greater climatological variability in the region. In order to set policies for adaptation and mitigation to ensure food security in these regions, it is of great interest to establish indexes which allow to determine those weather phenomenon with a major impact on the study areas, like the *Rain Period* or the temperature extremes.

As a tool for the determination of these indexes, a method of regionalization developed by the FIC has been used to simulate daily series of temperature and precipitation from which we are able to generate the impact indexes selected.

Once the appropriate indexes have been determined, it is possible to apply the results in the future thanks to the information provided by several General Circulation Models under the assumptions of future emissions scenarios.

Data and study area



Precipitation Observatories

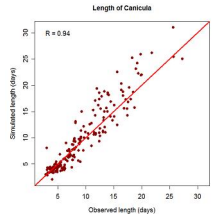
Temperature Observatories

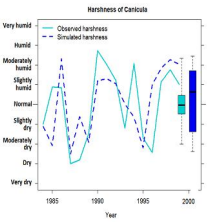
- The study was conducted on Nicaragua {lat (0-30 º N) and lon (110-70 ° W)}. For making this study we have used meteorological data from 17 temperature stations and 197 precipitation gauges within the territory of Nicaragua. These stations go through a prior control to ensure the validity of the data, and the shortest duration (2000 days with daily data) required to perform a satisfactory regionalization.
- The used reanalysis database is the NCEP, from the National Centre American Prediction (http://www.esrl.noaa.gov/). Spatial resolution: 2.5 º x 2.5 °; temporal resolution: six-hourly; period: 1951-2008.
- The used General Circulation Model (GCM) is the ECHAM5 from the Max-Plank Institute (http://www.mpimet.mpg.de/). Spatial Resolution: 1.8 ° x 1.8 °, temporal resolution: daily. Period control: 20C3M. Future climate scenario: A1B.

Verification of the Methodology

The verification process is used to study the ability of the methodology to simulate the local climate. This process involves comparing the results from the regionalization of the NCEP reanalysis against the observations of the stations of Nicaragua. As an example of the verification process, we show the results of two phenomena of great importance in the agriculture of Nicaragua: the midsummer drought, the so-called ***Canícula***, and the average, maximum and minimum temperature.

➢ Verification of the Length and the Harshness of the ***Canícula***





Harshness:

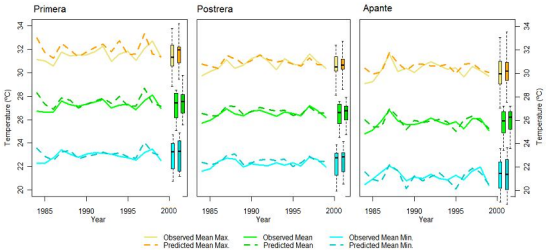
Very humid	[>40]%
Humid	[31,40]%
Moderately humid	[21,30]%
Slightly humid	[11,20]%
Normal	[-10,10]%
Slightly dry	[-20,-11]%
Moderately dry	[-30,-21]%
Dry	[-40,-31]%
Very dry	[>-40]%

The *Canícula* (from latin, the dog-days of Summer) is a period of relative drought that happens during the *Rain Season* that divides it into two periods of rain, so-called, ***Primera*** and ***Postrera***, and whose Length and Harshness are of greast interest.

As shown in the results for the Canícula, both for its Length and for its Harshness, the methodology is able to simulate both variables very satisfactorily.

The variability of the Harshness of the *Canícula* – matched with a defined normal value – is very well simulated by the methodology. The length of the *Canícula* is simulated with a correlation of 0.94.

➢ Verification of the Temperature



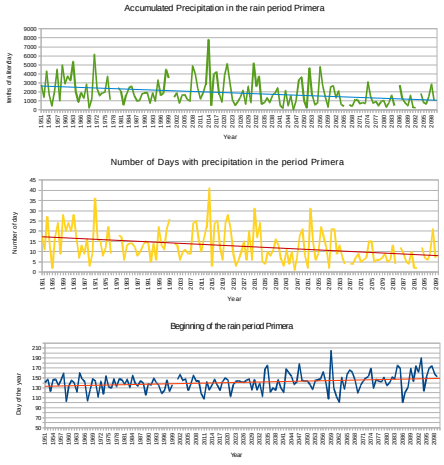
Primera: 1st May- 31th July *Postrera:* 1st August- 31th October *Apante:* 1st November- 31th December

The verification results for temperature (mean of the maximum, average and mean of the minimum) in the three periods of agricultural interest show very satisfactory results, picking up very well the variability and the value of the three variables.

Future Precipitation Indexes

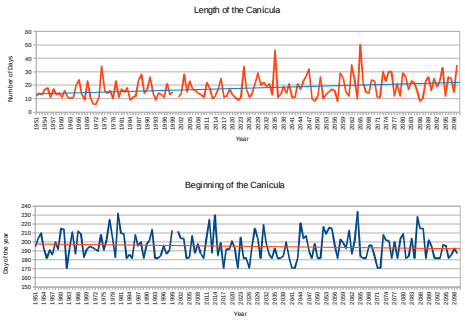
The Precipitation plays a fundamental role in the agriculture, determining the appropriate times to perform different agricultural tasks. The Rain Season goes through three stages: the first rain period called ***Primera***, a second period of relative drought, called ***Canícula***, and a third rain period, called ***Postrera***. For the generation of future climate scenarios we used the ECHAM5 Model output and the A1B emission scenario.

➢ Rain period ***Primera***

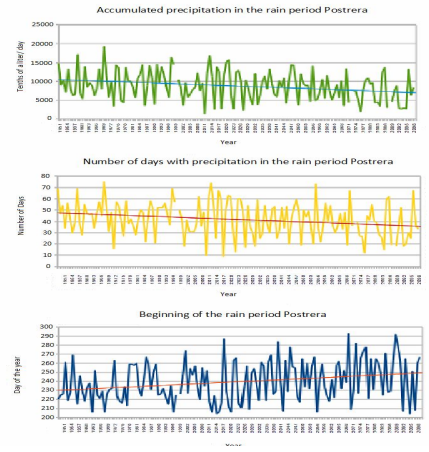


➢ Period of ***Canícula*** (Midsummer Drought)

The *Canícula* is a period of relative drought that happens between the rain periods of *Primera* and *Postrera*. Throughout the XXI century it is expected that the starting day of the year of the *Canícula* goes forward and that this phenomenon lasts more days.



➢ Rain period ***Postrera***



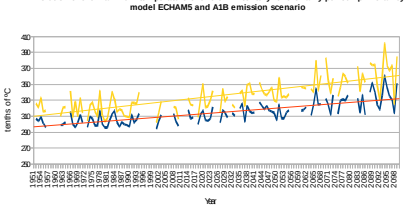
In this first period, *Primera*, it happened the first precipitations of the year, which means the beginning of the wet season. In the future, it is expected that the amount of precipitation accumulated falls gradually throughout the XXI century and that interannual variability increase, ie, the amount of accumulated precipitation vary strongly from one year to another. A similar trend is expected on the number of days. The starting day of the year for this rain period is expected to happen a little later.

The period of time when the heavy precipitations return after a period of relative drought is called *Postrera*. It is expected that during the XXI century this phenomenon begins later and its duration is less and less, which means a decrease in the amount of precipitation accumulated during the days in which this phenomenon happens. It is expected that the variability of this phenomenon will be higher in both, accumulated precipitation and lenght.

Future Temperature Indexes

The temperature is a very important meteorological variable for the planting season, and also in each period of the agricultural cycle, so the temperature variations will be of great value.

In general it is expected that the temperature, both the maxima and minimum, will progressive increase throughout the XXI century.



The results for the period of *Postrera* and for the minimum temperatures are very similar to those obtained for the maximum temperature in the period of *Primera* and therefore not shown here.

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Conclusions

- The Nicaraguan agricultural calendar is heavily influenced by the climate of the area, especially by extensive rain season. That wet season was characterized by two rain periods separated by a period of relative drought.
- The Methodology developed by the FIC has been successfully adapted to Nicaragua, as the results of verification show. These results are better for temperature than for precipitation, although in both cases are quite robust.
- The results obtained by applying the methodology FIC to the ECHAM5 model output and the A1B emission scenario expect that the periods of rain, *Primera* and *Postrera*, reduce their length and happened later and later. In addition, the results expect that the amount of precipitation accumulated during both periods decreased progresively throughout the XXI century. Along with the decrease of the length of the rain periods is expected that the *Canícula* period will be widespread and its starting day will be earlier. The results obteined in each of the periods of the wet season are consistent with each other.
- The results for the temperature expected, both maximum and minimum temperatures, to increase progressively throughout the XXI century in both period, *Primera* and *Postrera*.
- The variability of the indexes of temperature and precipitation are expected to increase. This means that the characteristics of the precipitation and the temeperature change from one year to another.