THE EFFECT OF EL NINO/LA NINA ON THE TEMPERATURE AND RAINFALL FLUCTUATION AT DOMLUANG AIRPORT

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Abstract: In this research we study the effect of El Nino/La Nina on the temperature and rainfall fluctuation at Domluang airport for a period of 60 years from 1951 to 2010. The results show that these natural cycles have an effect on temperature and rainfall amount at Domluang airport. Positive fluctuation from the average temperature are usually correlated with El Nino cycles while negative temperatures are usually correlated to La Nina cycles. The greatest fluctuation in positive temperature is nearly 4°C in the year 1957 during the El Nino cycle. The greatest fluctuation in negative temperature is more than -4°C during the 1975-1976 La Nina cycle. La Nina phases tend to have a stronger effect on temperatures and rainfall amount than the positive rainfall amount. Positive rainfall amounts are usually correlated with La Nina cycles while negative rainfall amounts are usually correlated to El Nino cycles. When we compare the effect on temperatures and rainfall amount from the present 2009-2011 El Nino/La Nina cycle with the previous three cycles (1973, 1983 and 1998), the effects from the present cycle seems to be following a similar path to the previous cycles. For the future weather forecasting, it will be better if these effects are added into the process.

Introduction: In 1891, the President of the Lima Geographical Society contributed his small article to the Bulletin of that Society, the article then appears in the southern current coming from north to south. It is obvious that the phenomenon in the name of El Nino and La Nina which have been the major cause of the global climate change. The change has been the main factor of weather variation such as the variation of rainfall, sea surface temperature rising, the increasing in frequency and intensity of extreme weather: floods, drought, tropical cyclones, hurricane, tornado and etc. [2,3]. El Nino is characterized by a positive sea surface temperature departures from normal. In contrast to a La Nina phase, the average sea surface temperature are about 1.5 degrees Celsius cooler than normal in the east-central Pacific Ocean shown in figure 1.

Methodology: 1. Collecting the hourly temperature and rainfall amount at Domluang airport for the period of 60 years (1951 - 2010).
2. Calculating the average daily and monthly temperature over the entire 60 years period.
3. Calculating the monthly temperature and rainfall fluctuation.
4. Calculating the average monthly temperature and rainfall fluctuation at Domluang airport between 1951-2010.
5. Comparing the temperature and rainfall fluctuation with the sea surface temperature anomalies monitoring along the equator at the location of the Niño 3.4 region.
6. Plotting and comparing the effect on temperature and rainfall amounts from the present 2009-2011 El Nino/La Nina cycle with the previous three cycles (1973, 1983 and 1998).

Results, Discussion and Conclusion: 1. The effect on the temperatures: The temperatures at Domluang airport are collected every hour for a total of 24 data points per day. The data are measured and recorded in a period of 60 years between 1951-2010. All of the 629,500 data are stored into the Excel spreadsheet or later analyzing. In order to observe the temperature variation due to the effect of El Nino and La Nina cycles, we calculate the average daily and monthly temperature over the entire 60 years period and then subtract from the observed temperatures to get the temperature fluctuation. These temperatures are calculated on a monthly basis. The graph between the temperature fluctuation as a function of time is shown in figure 2. Positive temperatures are usually correlated with El-Nino cycles while negative temperatures are usually correlated to La Nina cyclces. The greatest fluctuation in positive temperature is nearly 4°C in the year 1957. The temperatures are close to 3°C over the average in the years 1971, 1992, 2002 and even 2°C in the years 1972, 1982, 1992, and 1999 and 2004. The greatest fluctuation in negative temperatures are more than -4°C in the year 1997 and close to -4°C in the year 1964. The temperatures are nearly -3°C lower than the average in the years 1959, 1970, 1974, 1979, 1999 and 2008. The temperatures are much cooler during La Nina cycles than they are warmer than average during El Nino events.

2. The effect on rainfall amounts: For the rainfall data at Domluang airport, we also collected every hour for a total of 34 data points per day. The data are measured and recorded in a period of 60 years between 1951-2010. In order to observe the rainfall variation due to the effect of El Nino and La Nina cycles, we calculate the average daily and monthly rainfall over the entire 60 years period and then subtract from the observed rainfall to get the rainfall fluctuation. These rainfall data are also calculated on a daily basis. The graph between the rainfall amount as a function of time is shown in figure 4. As opposite to the temperature, positive rainfall amounts are usually correlated with La Nina cycles while negative rainfall amounts are usually correlated to El Nino cycles. When we compare the effect on rainfall amount from the present 2009-2011 El Nino/La Nina cycle with the previous three cycles (1973, 1983 and 1998), the effects from the present cycle seems to be following a similar path to the previous cycles. For the future weather forecasting, it will be better if these effects are added into the process.

3. Comparing the effect from the present cycle with the previous cycles: When we compare the effect on temperature and rainfall amounts from the present 2009-2011 El Nino/La Nina cycle with the previous three cycles (1973, 1983 and 1998), the effects from the present cycle seems to be following a similar path to the previous cycles as shown in figure 6. In this figure, the temperatures and rainfall amounts during the four El Nino/La Nina cycles (1973, 1983, 1998 and present) are plotted. Moderate to strong El Nino/La Nina conditions have been observed since 2010, closely following the onset of the 2009-2010 El Nino. The 1998 El Nino caused the highest temperature in December than the 1973, 1983 and 2010 cycles. All of the four El Nino cycles caused nearly the same temperatures in March. The temperature caused by the present La Nina is closed to the 1973 and 1979. In January 1974, the lowest temperature in December. After the La Nina phases in February, the 4 cycles followed a similar path. El Nino phases in December temperature fluctuation is nearly the same. The sea surface temperature and the ocean and the atmosphere in the tropical Pacific have the effect on the temperature and rainfall fluctuation at Domluang airport. The effect of El Nino is more widespread than that of the El Nino. If we take these effects into consideration, the future weather forecasting will be more accurate.

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Figure 1: Observed Sea Surface Temperature Anomalies Along the Niño 3.4 Region

Figure 2: The monthly temperature fluctuation at Domluang airport between 1951 and 2010. The signal itself is a time record of the temperature anomalies.

Figure 3: The monthly temperature fluctuation at Domluang airport between 1951-2010. The signal itself is a time record of the temperature anomalies.

Figure 4: The monthly rainfall fluctuation at Domluang airport between 1951-2010. The signal itself is a time record of the rainfall anomalies.

Figure 5: The sea surface temperature anomalies in the eastern equatorial Pacific Ocean (red) and the sea surface temperature anomalies in the western equatorial Pacific Ocean (green) at Domluang airport.

Figure 6: The sea surface temperature anomalies in the eastern equatorial Pacific Ocean (red) and the sea surface temperature anomalies in the western equatorial Pacific Ocean (green) at Domluang airport.

Figure 7: The sea surface temperature anomalies in the eastern equatorial Pacific Ocean (red) and the sea surface temperature anomalies in the western equatorial Pacific Ocean (green) at Domluang airport.