Madagascar rainfall and its interrelationship with the OLR

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ABSTRACT

The rainfall constitutes the element undoubtedly climatic determinant in the climatic characterization of the different regions of Madagascar.

The goals of these researches are to study the relation between the OLR (Outgoing Longwave Radiation) and the pluviométrie in Madagascar, and to specify the geographical points of it where the values of OLR are in good interrelationship those of rains. Seen the insufficiency of number of meteorological stations in Madagascar, this survey finds its utility well on the rainfall survey, on the analysis of the displacement of the ZCIT and for the climatic forecasting of the big island. .

Applying the FFT (Fast Fourier Transform) and the transformation in wavelet, we noted two types of waves which are very dominant to Madagascar then: wave of period 10 to 20 days and the one of 5 to 7 days. The first nearly dominates the different regions of the big island, except to the center that is dominated by the second wave (5 to 7 days).

While working on the filtered data, we could raise seven geographical points where the values of the OLR are in good interrelationship those of rain, as: dawned A(15° South; 50° Est) for the north region, B(25°S ;50°E) for the South, C(22,5°S,; 47,5°E) for the South is, D(17,5°S ;50°E) for the West South, E(20°S,; 47,5°E) for the Center, F(20°S ;50°E) for the Center is and G(20°S; 42,5°E) for the West center of Madagascar. It is well to note that, among the determining points, there are those that are outside of the terrestrial surface of Madagascar (on the channel of Mozambique or on the Indian Ocean).

1 - Introduction

The rainfall is the determinant element climatic in the climatic characterization of the different regions of Madagascar. The understanding of the set of the mechanisms that is at the origin of the convective phenomena and rains in Madagascar is as well important concerning the impacts on the economic development of the country.

The goals of these researches are to study the fashion of displacement of the ZCIT, to surround the convection and to study the degree of interaction between the tropical convection and the rainfall in Madagascar. Indeed, according to the tabular observations and the photos satellites received to the level of the meteorological service of Madagascar, the North part of Madagascar is a region where the convection is a phenomena frequently observed during the southern summer. These phenomena convective, if they are developed well, are at the origin of a proportion important of the precipitations received by the set of the West side of the island [2, 4, 15].

This work appears in the setting of the scientific activities to fear the convective systems generating the strong rains in Madagascar. It is dedicated to the analysis of the convection through Madagascar and especially applicable in the region of the ocean Indian and the channel of Mozambique in general. Particularly, in the southern hemisphere, very few meteorological studies treating the convection while considering the displacement of the ZCIT.

We are going to take like zone of reference for our survey the region delimited by the longitudes 42,5°E - 52,5°E and by the latitudes 10°S - 25°S. This zone will be subdivided in six regions (fig.1).

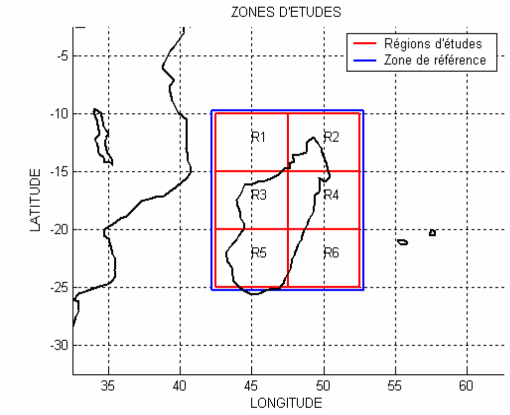


Figure.1 : the different etude's zones

Tableau I : Survey Regions

Régions	Longitudes	Latitudes
Région N°1	42,5°E - 47,5°E	10°S-15°S
Région N°2	47,5°E - 52,5°E	10°S-15°S
Région N°3	42,5°E - 47,5°E	15°S- 20°S
Région N°4	47,5°E - 52,5°E	15°S- 20°S
Région N°5	42,5°E - 47,5°E	20°S-25°S
Région N°6	47,5°E - 52,5°E	20°S-25°S

2 - Inter tropical convergence zone (ITCZ)

2.1 - definition

The inter tropical zone of convergence is a zone where the humid trade winds of the northeast in the northern hemisphere and the trade winds of the southeast in the southern hemisphere converge. It is close to the equator. The mass of air is warmed there and go back up. A low thermal pressure forms itself under the mass of hot air. During the flux of the trade winds, the mass of air warms itself and go back up. Because of the very strong humidity of air and the very high temperature, the ascending air mass entails the formation of cumulonimbus in height. These clouds are bigger and thick that the cumuli of good weather. The top of a cumulonimbus can reach a height of 12 000 meters. The formation of these cumulonimbus results in storms and strong precipitations. The position of the ITCZ depends on seasons. Fundamentally, the ITCZ moves with the zenith of the sun of 20° N to 20° S. She can move however beyond these latitudes, in part because of the circulation of the trade winds. The position of the ITCZ corresponds at the meteorological equator [1, 19, 6].

The ITCZ positions itself in the northern hemisphere lasting the boreal summer, then in the southern hemisphere lasting the southern summer. However, its oscillation is not symmetrical in relation to the equator, considering the unequal distribution of the earth and seas in every hemisphere.

These are the fluctuations of this ITCZ, associated to the precipitations, that control the climate in this zone and produce the succession of the seasons, humid (season of rains) then dry (dry season) [7, 19]. The differentiation of the climates rests as a priority on this only rainfall criteria, since the length of day as well as the incidental solar energy vary a little.

2.2 - the tropical convection

The most remarkable visual signature of the convection is the apparition of clouds to strong vertical extension as the big cumuli and the cumulonimbus. The convection can intervene to different scales; to small scales where the processes of convection will form isolated enough clouds of type cumulonimbus capable to generate spectacular phenomena as the storms and the tornados. The convection amounts then to a main ascending current [8, 9]; to scales so-called averages with the formation of cells convective and systems stormy convective as the SCME (System Convective of Méso Scale) who will have the particularity to be able to survive during several hours [9]; but also to global scales with as main example the formation of the Inter Tropical Convergence Zone of (ITCZ) who is due to a rise of the humid equatorial air to the level of the ascending branches of the cells of Hadley [6, 18].

To the meteorological sense of the term, the convection corresponds therefore to the movement and vertical transportation of the air properties having for origin a vertical gradient of instability temperature generator [9, 3].

To understand the process, let's consider the equation of the whirlwind in a model of one atmosphere to a layer without rubbing given by the expression

$$\frac{\partial \varsigma}{\partial t} + \vec{v} . \vec{\nabla} \varsigma = - \varsigma . D \qquad (1)$$

Where $\zeta = f + \xi$ is the absolute whirlwind (sum of the global whirlwind and the relative whirlwind) and $D = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}$ (2)

So in (5), one decomposes the horizontal wind field… of it adds it merely divergent part and a rotational part, one succeeds to the following writing of the equation of the whirlwind:

$$\frac{\partial \zeta}{\partial t} + \vec{v}_{\psi} . \vec{\nabla} \zeta = - \zeta . D - \vec{v}_{\chi} . \vec{\nabla} \zeta \qquad (3)$$

With $\vec{v}_{\psi} = \vec{k} \wedge \vec{\nabla} \psi$ and $\vec{v}_{\chi} = \vec{\nabla} \chi$ (4)

Where ψ the function of current and χ is the potential function. One will notice that the relative whirlwind and the divergence verify the equations of Poisson.

$$\xi = \nabla^2 \psi \text{ and } D = \nabla^2 \chi \qquad (5)$$

While making appear a source led by the divergent part of wind, the equation of the whirlwind can write itself:

$$\frac{\partial \zeta}{\partial t} + \vec{v}_{\psi} . \vec{\nabla} \zeta = - \zeta \, div \, (\vec{v}_{\chi} + \vec{v}_{\psi}) - \vec{v}_{\chi} . \vec{\nabla} \zeta \qquad (6)$$

$$\frac{\partial \zeta}{\partial t} + \vec{v}_{\psi} . \vec{\nabla} \zeta = - \zeta \, div \, \vec{v}_{\psi} + S \qquad (7)$$

with $S = - div \, (\zeta . \vec{v}_{\chi})$ (8)

One sees that in this formulation, the absolute whirlwind can have a source led by the transportation of the whirlwind by the divergent part of the wind field. Currently, the satellite observations the more used for the detection of the big scale convection in tropical region remained the radiance of big length of wave or OLR that we will present subsequently [5, 10].

2.3 - data and methods

2.3.1 - data

Before approaching the actual analysis of the results, we propose to recall the data bases that have been used in this work as well as the nature and the features of the data briefly (type of data, temporal depth of the set, spatial cover).

The satellite data used in this work essentially relate to observations on the convection and more especially the deep convection. Indeed, we used the data of flux radiatifs of big length of wave or the OLR (Outgoing Longwave Radiation; Liebmann Smith and, 1996) field by field, introverted of 1979 to 2003.

The OLR (3-100mm of wave length) represents the evaluation of the radiance given out by the earth toward the space. In the tropics, the modulation of the OLR is owed to the presence of elevated clouds mainly (Cumulus, Cumulonimbus and Cirrus). These clouds being bound to the presence of deep convection and rainfall, the modulations of these can be detected and consistent by this measure of the OLR [12, 14, 20].

These OLR data also have a spatial resolution of 2,5°x2,5° and temporal of 24 hours. They are descended of the center American Climate Diagnosis Center (CDC) that treats the data coming from the satellites of the NOAA (National Oceanic and Atmospheric Administration).

The spatial cover of the data used in this document goes from 0°E to 120°E in longitude and the equator to 60°S in latitude. The temporal cover goes from November 1st, 1979 to April 30, 2003, either 23 summers of the southern hemisphere. In every point of grid, for every meteorological element and to every level, 4350 daily values are treated thus.

The temporal sets of OLR are going to serve us to determine the seasonal migration of the ITCZ on Madagascar.

2.3.2 - methods

In order to be able to analyze the displacement of the ITCZ through Madagascar, of the domain kept for the survey is consisted between the longitudes 42,5°E - 52,5°E and of the latitudes 10°S - 25°S This zone has been subdivided in six regions of same surfaces (fig1).

With regard to the ITCZ, one can indicate that it is admitted commonly that values of OLR of the order of 180-240 Wm-2 for the tropical regions indicate the existence of the deep convection [19, 13, 16]. The OLR data are used in a first time to clear the features of the convection in every region.

One of the investigating techniques that we are going to use is the general average (composite). For that to make, one selects a coherent whole while using a criteria. One does the average of all events answering the criteria defined to get the average of this whole then. To interpret the behavior of this whole, if it is about spatial data as our case, we can represent it graphically.

Concerning the data to analyze, they are of three types: the raw data, the anomalies and the data filtered. The raw data are generally directly those exits of the observations or reanalysis. The anomalies are gaps to the average. The data filtered, to the sense of which one uses it in this document, are the gotten data while passing the raw data through a numeric filter.

In order to specify the dominant temporal fashions, we are going to construct a temporal set that corresponds to the daily continuation of the spatial averages of the OLR values of the reference zone (or of the regions) on a temporal depth of 25 years (1979-2003). The set of the OLR anomalies of every region is gotten while entrenching to every daily value of OLR of the region the average rainfall of the season which been calculated on the basis of the 23 summers of the corresponding zone.

These different methods will permit us to know the presence or no of the ITCZ on the region studied in a given moment, and also to know the evolution of its displacement movement.

2.4 – Displacement movement of the ITCZ trough Madagascar

We arrange currently only of very few specific studies on the displacement of the ITCZ to the level of Madagascar. Our survey has then as object to specify us the necessary information on the movement of the ITCZ to the level of the big island and to provide us its interdependence with the rainfall of this country.

To understand better, it would be important to define terminologies, concerning the average values, first that we are going to adopt during this survey:

- Daily value: it is the value of the OLR raised of every day

- Daily global average: it is the middle value of the OLR raised to the same date of the day and the same month (of the November to April, 181 different days ago). November 1st is the first day, and April 30 is the last day.

Example: the 50th day is in date of December 20 because the first 30 days are the month of November and the 20 following days for the month of December.

- Monthly average: it is the monthly average of every year (for the 23 summers, there is 23 x 6 months = 138 months.
- Monthly global average: It is in the same way the average of the monthly averages month (there is only 06 months)

2.4.1. Middle position of the ITCZ during the southern summer

On the faces below, the part colored in blue, that crosses the north part of Madagascar, represent the ITCZ. These different represent show us that the ITCZ crosses the country lasting the southern summer and she comes of the West North part of Madagascar. It is essentially in January and February that it testifies its biggest frequency and intensity.

To understand this displacement, we are going to study the variation of the value of the OLR in every region of our zone of study (fig1).

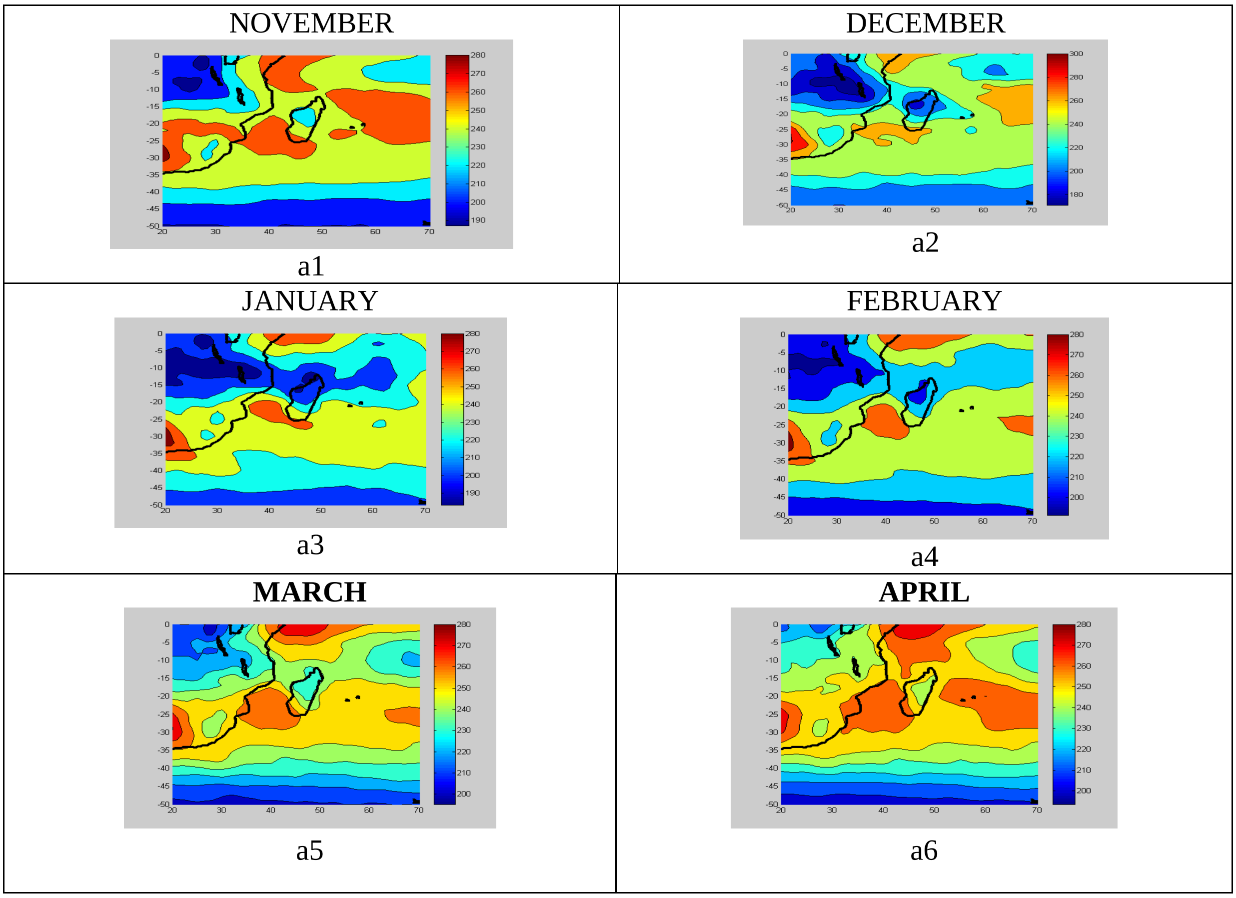


Figure.2: monthly global Average of the OLR (1979-2003)

2.4.2- global variability of the OLR of every region during the southern summer

It is about studying the daily global averages of the values of the OLR of every region during the period of southern summer (November-April), including the 24 years (1979-2003).

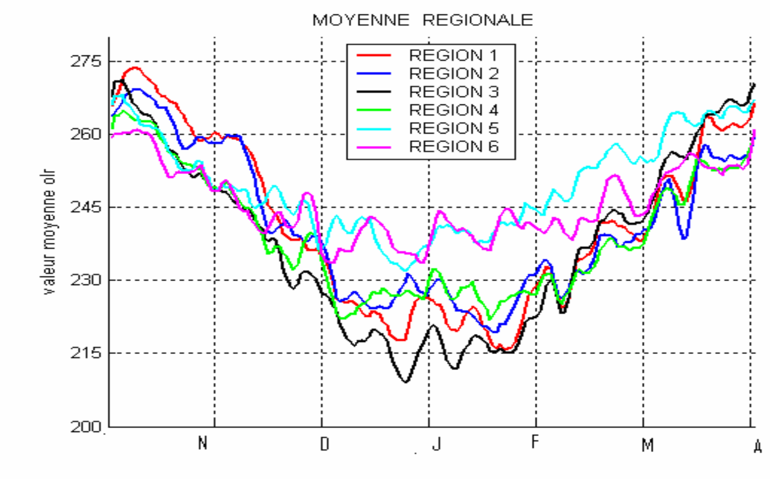


Figure.3: Comparison of the daily global averages (180 days) of the OLR of every Region for the years (1979-2003).

These different bend give us the general information on the phenomena that happen in every region lasting the southern summer.

To know the presence or the absence of the ITCZ better in a region, we are going to represent the anomalies graphically between the daily global averages and the value 240 Wm-2s (value representing the existence of the OLR) in a region during the period of southern summer [11],

Anomalie1 (Wm-2) = monthly global average of the OLR – 240 (9)

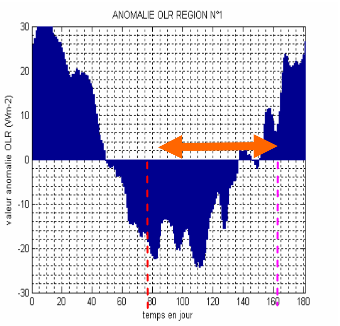
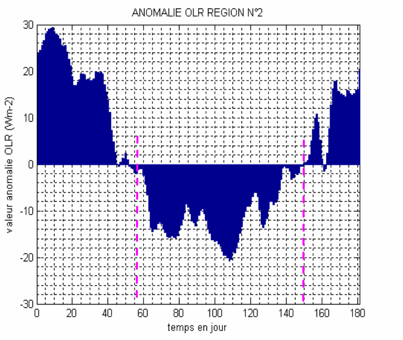
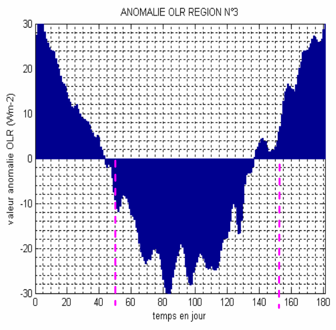
The three following cases could present themselves:

Anomalie1 <0, it means the presence of the ITCZ in the region for the corresponding day.

Anomalie1> 0, absence of the ITCZ in the zone.

Anomalie1 = 0, beginning or thin of the presence of the ITCZ in the region.

We have the different figures then below:

REGION :1	REGION: 2	REGION: 3
		

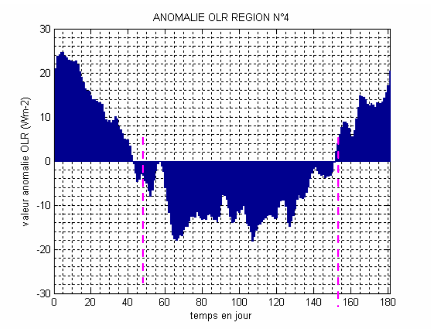
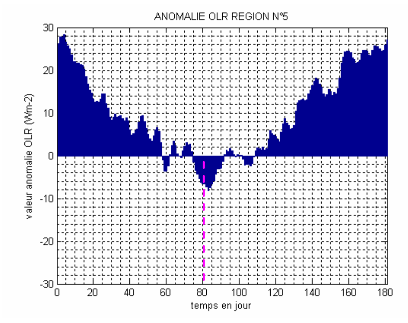
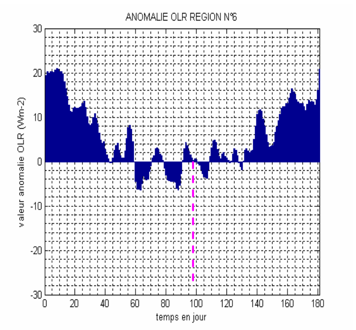
REGION :4	REGION: 5	REGION :6
		

Figure.4: Anomaly representing the presence or no of the ITCZ in the region

First of all, not to confound the days and the rank of the region, we are going to put in Roman number the regions. For example instead of writing region 5, write region V.

In general, it is on the 42nd day (either December 12) (fig.4. Region III) that the ITCZ attacks the region III, and it is at 46th that she arrives in the region I (fig.4.Région I).

The ITCZ doesn't attack the regions II and IV that the 60th day (either the beginning of the month of January) (fig.4.Région II and fig.4.Région IV).

The ITCZ rarely arrives in the V regions and VI. If it arrives in these regions, it is solely toward the 80th day (either toward January 20). (Fig.4.Région V and fig.4.Région VI).

The ITCZ leaves the regions I and III on the 138th day (either March 28) and don't leave the regions II and IV that two days after.

2.4.3 - the particularities of every year

In this part, our objective is to know the particularities of every year in every region how to be able to observe the extreme phenomena and, also, to identify if they are conjugated by the ZCIT or no.

To observe these phenomena better, we are going to study the anomalies between the monthly averages and the monthly global averages (note: Anomalie2).

Anomalie2 = monthly averages - monthly global averages (10)
(Wm-2)

We are going to combine in the same face the graphic presentation of the anomaly 2 (in shape rod of blue color) with the anomalie1 (in Stem: in the shape of structural stick of circle to the extremity).

Significance:

- If the stem heads downwards (resp. upwards), it indicates the presence (resp. the absence) of the ITCZ in the region at the moment.
- If the blue rod moves downwards (resp. upwards), it means that the value of the OLR is lower (resp. superior) to the normal value (monthly global middle value).
- If the blue rod passes one of the two red lines (it is the double of the value of the gap marks: 2), it is the presence of an extreme phenomenon. Here is an example:

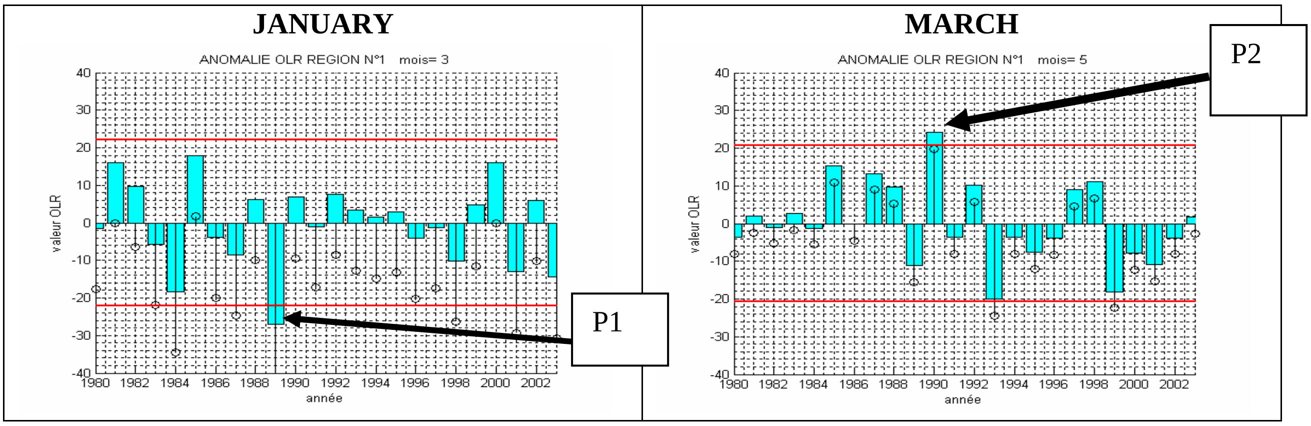


Figure.5: Extremes phenomena

On these faces, P1 and P2 are extremes phenomena because they pass the red line, with:

- P1 is an extreme phenomenon accompanied by the ITCZ (stem downwards).
- P2 is also an extreme phenomenon but without presence of the ITCZ (stem upwards).

It is well to note that the other results will be presented together with the results of rain during the survey rainfall.

We consider whereas the value lower to 240 W/m-2 of the OLR represents the presence of the ITCZ in a region. Therefore, the different figures show us that the ITCZ doesn't meet on the different regions the month of November and, in most cases, the month of April. In principle, she gets settled in the month of December and retires the month of March. For its installation, its direction doesn't come from the Southbound North, but rather of the west toward the East and it enters in the N°3 region and, in continuation it occupies largely the N°4 regions, then the N°1 and the N°2; finally, it retires Northbound.

. Sometimes, it occupies the N°5 region and N°6 during the months of January, February and March

We also noted that present themselves on some years of the extreme phenomena, as:

- The delay of the installation of the ITCZ that is planned for the month of December (years: 1987, 1992 and 2001).
- The presence of the ITCZ in some regions even in the month of April (year: 1990).
- Presence of the ITCZ in the N°5 regions and N°6: in month of March (1980, 1981, 1983, 1992, 1993, 1995 and 2001).
- Occupation of the regions 1, 2, 3, 4 and 6 in month of April (years: 1989 and 1990).

3 – The rainfall

The formation of the clouds is essentially owed to the process of convection that frequently operates itself in the atmosphere and is of fundamental importance for the vertical exchanges of heat and humidity.

Two fashions of convections are produced in the atmosphere:

- **The forced convection** where the vertical air movement is produced by the mechanical strengths resulting from wind shearing, especially to the surface.
- **The free or natural convection** for which these are the strengths of buoyancy that operate, and of which one can distinguish the dry convection of the humid convection. From the equation of the conservation of the static energy dries, the gradient of temperature dT/dz, resulting of the détentes or compressions adiabatic associated to the vertical movements of the column convective, is given by:

$$\frac{dT}{dz} = -\frac{g}{C_P}$$

Where Cp is the calorific capacity to constant pressure and g the constant of gravity.

The column of air can be steady, neutral or unsteady (to different altitudes) depending on whether its gradient is weaker, equal or stronger than the gradient adiabatic, respectively.

The humid convection results from a static instability making intervene the condensation of water. The ancestry saturated adiabatic (in the case of a column convective) gives a weaker temperature gradient then than the gradient dry adiabatic, in tie with the deposit of latent heat (L) coming from the water condensation during the rise (qs is the saturating specific humidity of water):

The control of the convection is achieved in part by the processes of food of the column convective, especially in the layer limits. If one considers an unsaturated atmosphere, one supposes whereas one raises according to the dry adiabatic a parcel of air since the surface. This parcel can become saturated to one instant of its rise while reaching its LCL (Facelift Condensation Level). This point delimits the basis of the cloud. Often, the column of air is in fact that conditionally unsteady (concept of conditional instability); in this case, if the vertical disruption applied to the parcel of air is too weak, there won't be development of deep convection. The amplitude of the vertical displacement must be sufficiently big so that the particle reaches the LFC (Level of Free Convection), first level where its virtual temperature is superior to the one of the surrounding air. The energy to provide to the particle to raise it until this level corresponds to the work of the buoyancy strengths (strength of Archimedes by unit of volume) negatives. This work is called CIN (Convective Inhibition). If the CIN is equal to zero, one has a situation of absolute instability.

After the LFC, buoyancy becomes positive (the virtual temperature of the particle being superior to the temperature of the surrounding air). The strength of buoyancy is gotten while making the balance of strengths (the raised particle is submitted to its weight and the thrust of Archimedes). A strong ascending movement occurs then with a continuous condensation of steam. The parcels of cloudy air are accelerated by the strengths of positive buoyancy. The integral of these strengths is the MANTLE (Convective Available Potential Energy). The MANTLE is the motor of the convection, because it represents the available energy for the creation and the maintenance of the saturated ancestries, while the CIN and the processes of uprising are the orders of it. This ancestry continues until the parcels of air reach the neutral buoyancy level (LNB: Level of Neutral Buoyancy), just under the tropopause or in small zones of stability of the troposphere. The LNB is the level from which, the virtual temperature of the parcel is lower to the one of air [8,9,17].

One considers in general that this point delimits the end of the cloud creates. One disregards the effects of inertia thus. This deep convection comes with the vertical development of the clouds of cumulo-nimbus type in the summit of which are present of the ice crystals (appeared by condensation of water at the time of the ancestry) that are going to hurl down (Bergeron effect). Reaching the front of fusion (toward 500 hPa), ice is going to melt and to lead to abundant precipitations inside the cloud. The fraction that didn't hurl down mixes itself thereafter to the non cloudy air. Every mixture is going to rise or to descend until its neutral buoyancy level.

3.1 - the data

We are going to approach the survey rainfall to be able to compare it with the different evoked previously phenomena.

The temporal cover of the data for this survey rainfall spreads of January 1st, 1979 until December 31, 2003. But to have a good comparison with the data of the OLR, we will only take values of rains during the periods of the 23 summers.
It agrees here of to specify the distribution of the different stations of service weather report first from where the data are provided.

Region I: We don't have rainfall data of this region.
Region II: 04 stations (Antsiranana, Sambava, Vohémar, Antsohihy)
Region III: 04 stations (Besalampy, Maevatanana,Mahajanga, Antananarivo)
Region IV: 02 stations (Mahanoro, Toamasina).
Region V: 04 stations (Taolagnaro, Morombe, Morondava, Ranohira).
Region VI: 03 stations (Farafangana, Fianarantsoa, Mananjary)

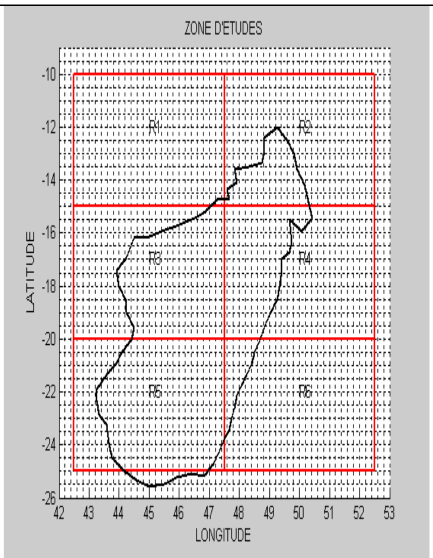


Figure.6: Etude's zones

3.2 - the rainfall characteristic of the survey region

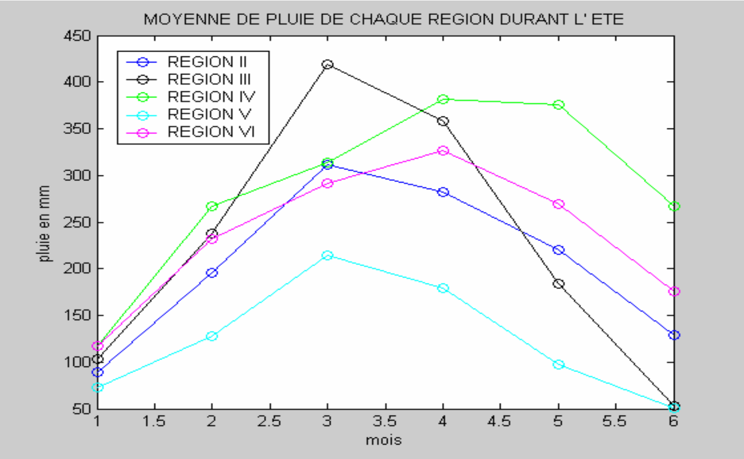


Figure.7: Average of rain of every region

In general, the island can be divided in four big rainfall zones:

- The EST zone is characterized by the presence (or absence) and the intensity of the trade wind régime. It rains practically all year round except in the northeast zone,

- The Northwest zone is governed by the presence (or absence) and the intensity of the monsoon. The Rains generally fall between the months of November and April.

- The South region is generally above safe from the two rainfall systems, this region is relatively dry.

- The high trays are submitted to the dynamic interaction of the three systems above. A big proportion of the rainfall yearly happens between January and February.

The other sources of precipitations are: the oscillations of the Inter tropical convergence zone (ITCZ) that reach the latitudes of Madagascar.

3.3 - Specters of Rain and OLR

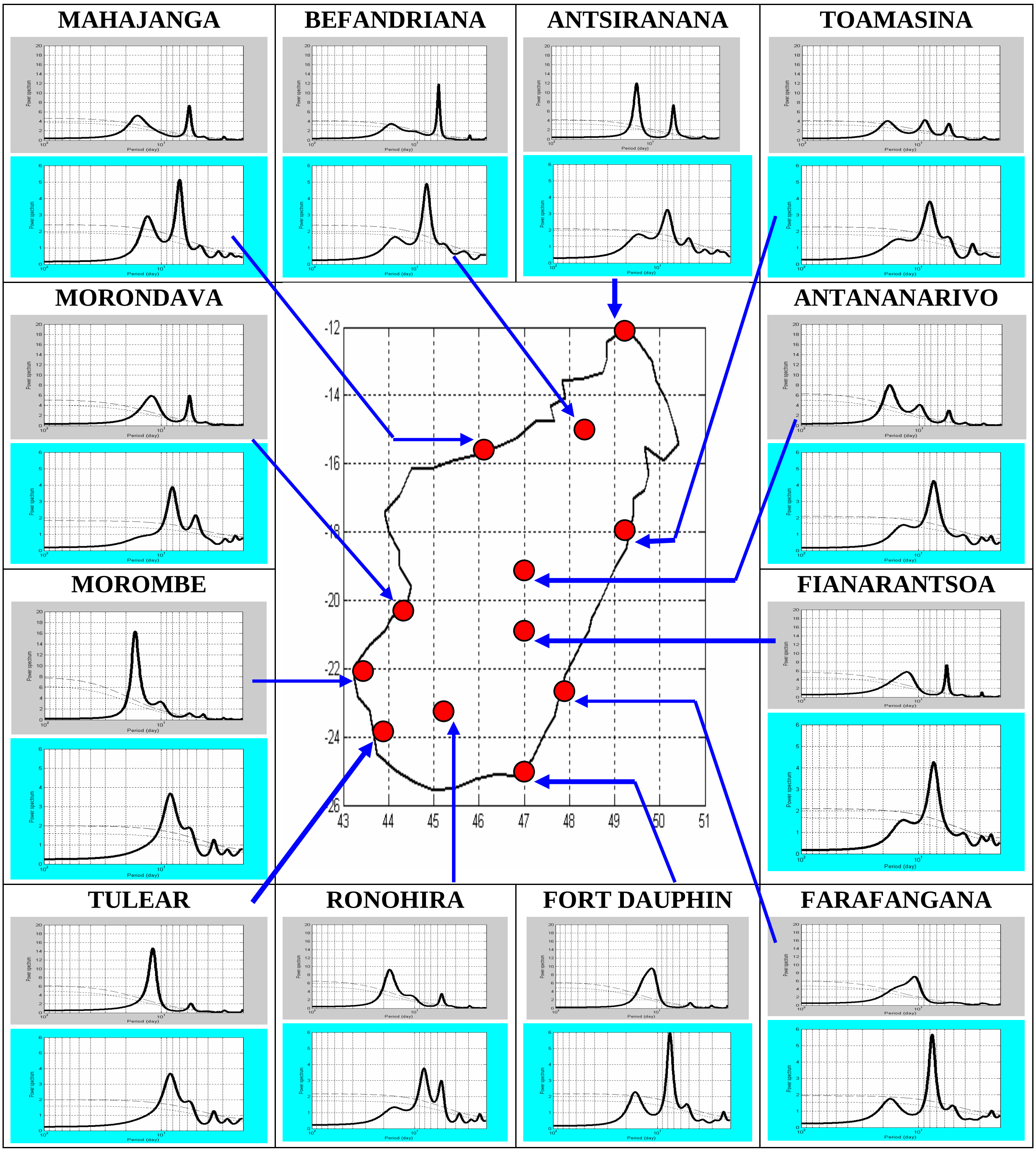


Figure.8: Specter of rain (gray) and Specter of OLR (bleu)

Interpretation:

We noticed that there are two types of period of rain in Madagascar, of which:

- The rain of frequency: 0, 15 to 0, 2 (that is to say of period 5 to 7 days)
- The rain of frequency: 0, 05 to 0, 1 (or of period 10 to 20 days)

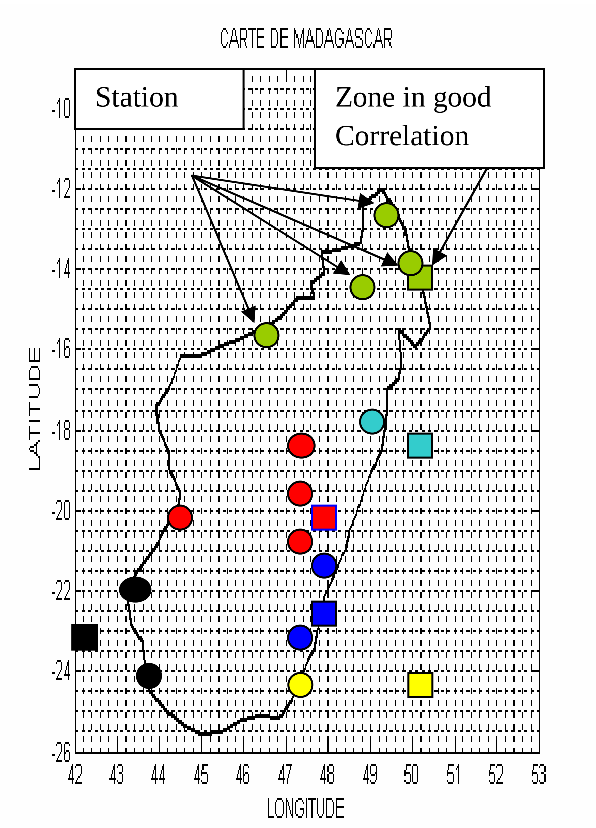
We only find the second type of rain (period 10 to 20 days) in the SOUTH, SOUTH- EST and SOUTH- WEST of Madagascar (Regions V and VI), while in the same regions; the OLR is from period of 5 to 9 days.

In the rest of the country, the two frequencies are almost present for rain. On the other hand, for the OLR, there is only the period 5 to 9 days. It is well to note that the first type of rain (period 5 to 7 days) has a strong density in the WEST- NORTH parts and in the center of the island.

We also noticed that the OLR of period de10 to 20 days is present in the channel of Mozambique to the level of the zone of ITCZ (zone 0°S to 22°S) while, for the Indian ocean, this one is in the subtropical zone (zone where the value of the latitude is superior than 22°S).

3.4 - the coefficients of interrelationship

Picture II: Coefficients of interrelationship between the filtered data (OLR and RAIN)

	RAIN			**OLR (10 to 20 days)**		**Coeff**	
N°	**Station**	**Long**	**Lat**	**Long (°E)**	**Lat (° S)**		
1	Antsiranana	49,2	12,5	50	15	+ 0,907	
2	Befandriana	48,5	15,2	50	15	- 0,751	
3	Vohémar	49,8	13,2	50	15	- 0,870	
4	Mahajanga	46,5	15,8	50	15	- 0,532	
5	Antananarivo	47	19	47,5	20	+ 0,492	
6	Antsirabe	47,1	19,7	47,5	20	+ 0,620	
7	Ambohitsilao	47,3	19,5	47,5	20	- 0.788	
8	Morondava	44,5	20,5	47,5	20	- 0,411	
9	Toamasina	47,2	18	50	17,5	- 0,661	
10	Mananjary	48,2	21	47,5	22,5	- 0,455	
11	Fianarantsoa	47	21,5	47,5	20	- 0,973	
12	Farafangana	47,6	22,8	47,5	22,5	- 0,531	
13	Morombe	43,5	21,5	42,5	20	+ 0,886	
14	Ranohira	45,5	22,5	45	22,5	+ 0,341	
15	Toliary	43,8	23,5	42,5	22,5	+ 0,808	
16	Fort-Dauphin	47	25	50	25	+ 0,649	

Coefficients of positive interrelationship: Gone South, to the center and to the north of Madagascar

The place marked in square is the place where the values of the OLR are in good interrelationship with the values of rains on the different stations marked in circle including the same color.

Due to a lack of rainfall data on the region I, we are going to start the comparison between rain and the OLR with the region II.

3.5 – Exemple: Comparison between rain and OLR in the REGION II

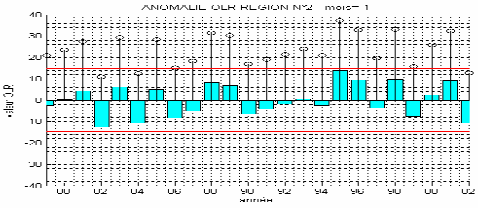
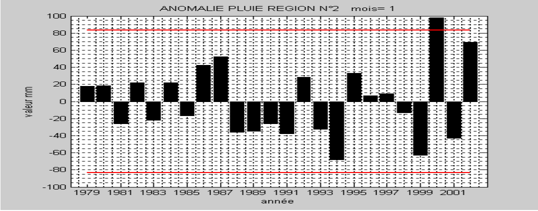
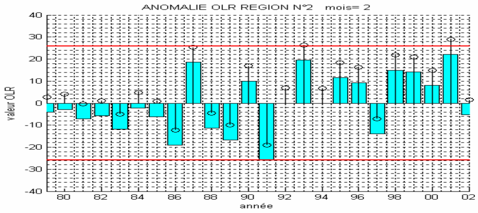
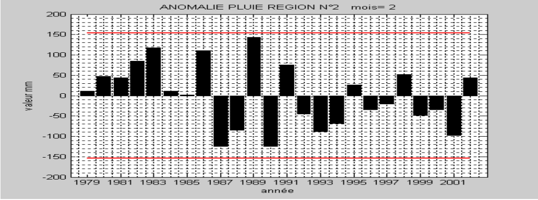
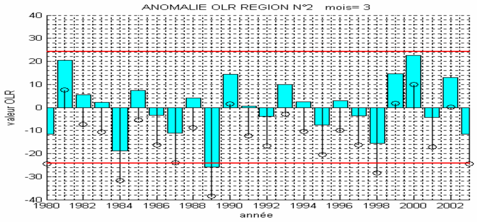
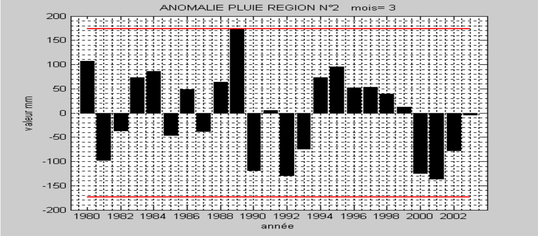
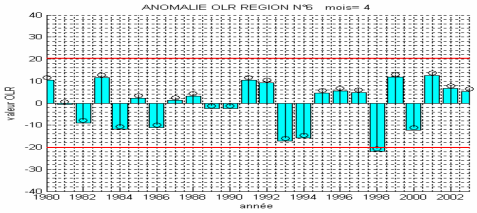
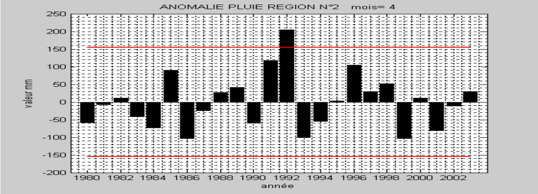
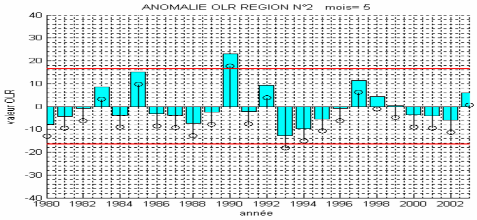
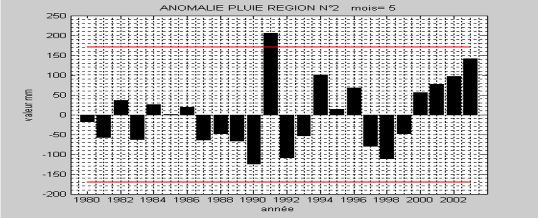
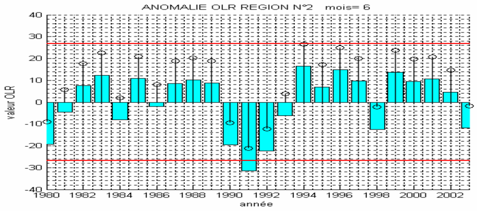
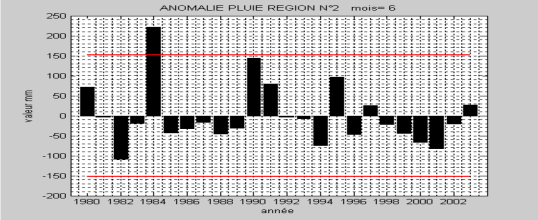
MONTH coefficient	OLR	RAIN
NOVEMBER **Cf= - 0, 229**		
DECEMBER **Cf = - 0, 664**		
JANUARY **Cf = - 0, 625**		
FEBRUARY **Cf = - 0, 497**		
MARCH **Cf = - 0, 361**		
APRIL **Cf = - 0, 582**		

Figure.9: **Comparison between rain and OLR in the REGION II**

3.4.2- Phenomena extreme comparison

Picture III : Phenomena extreme comparison (ITCZ present)

REGION	OLR	RAIN
REGION II	**January 1989**	**January 1989,**
REGION III	**February 1998**	**February 1998,**
REGION IV	**April 1991**	**April 1991**
REGION V	**March 1982,** **March 1996,**	**March 1982** **March 1996,**
REGION VI	**December 1983,** **April 1990,** **April 1991**	**December 1983,** **April 1990** **April 1991**

4 - CONCLUSION

This survey allowed us to know the relation between the OLR (Outgoing Longwave Radiation) and the rainfall in Madagascar, and to specify the geographical points of it where the values of OLR are in good interrelationship those of rains.

The analysis of the displacement of the ITCZ that crosses the country lasting the southern summer and that comes of the West North part of Madagascar, facilitate us the rainfall survey of the big island. It is essentially in month of January and February that the ITCZ reveals its biggest frequency and intensity.

While applying the FFT (Fast Fourier Transform) and the transformation in wavelet, we noted two types of waves that are very dominant to Madagascar then: wave of period 10 to 20 days and the one of 5 to 7 days. The first nearly dominates the different regions of the big island, except to the center that is dominated by the second wave (5 to 7 days).

While working on the filtered data, we could raise seven geographical points where the values of the OLR are in good interrelationship those of rain, like,: points A(15° South; 50° Est) for the north region, B(25°S ;50°E) for the South, C(22,5°S,; 47,5°E) for the Southwest, D(17,5°S ;50°E) for the West South, E(20°S,; 47,5°E) for the Center, F(20°S ;50°E) for the Center-Est. and G(20°S; 42,5°E) for the West center of Madagascar. It is well to note that, among the determining points, there are those that are outside of the terrestrial surface of Madagascar (on the channel of Mozambique or on the Indian Ocean).

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