

GFDD/FUNGLODE  
Second Conference in Climate Change:  
"Evidence of Global Warming in the Dominican Republic"

CLIMATOLOGY OF THE DOMINICAN REPUBLIC  
Relevance for a Sustainable Future

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## Introduction

We want to thank the Foundation for inviting us to participate in this Climate Change Conference follow-up event. It gives us the opportunity to discuss what should be our framework, the Dominican Republic Climate, if we want to explain the variations noticed or the expected changes in our climate, as a response to climate variability, the poor use of our natural spaces, or the Climate Change that is currently in process.

The Dominican Republic counts with the ideal climate for its development, it provides the necessary components for life. Furthermore, it puts at our service several beneficial climate resources such as radiation, precipitation, temperature, humidity and wind. It supplies the power needed for our development: hydraulic, solar and wind power.

The atmosphere provides us with abundant water, necessary for sustainable development. The only thing we are called to do is learn how to use it to achieve this goal. Water is a finite resource. If we don't use it and preserve it adequately, future generations will suffer water shortages and they will make us accountable for it.

The well managed climate constitutes the main resource to achieve the long-yearned sustainable development. Everything indicates that the warming of the earth's atmosphere will force us to think more in climatic terms. In this way, we consider that our presentation should be directed towards the definition of a starting point to begin research and the application of its results to productive sectors. It should also be applied to the necessary mitigation that will take us in the route to wellbeing.

Thus, we should talk hoping that a constructive debate on this issue will be produced. Said debate will address historic and climatic concepts, the complexity of our climate in relation to the factors that intervene in its behavior, it will specify the results accomplished and highlight the

influence of the action centers that govern world climate. Finally it should address the possible impact of global warming according to the latest report from the Intergovernmental Panel on Climate Change (IPCC).

We also want to take this brilliant opportunity to launch our dynamic climatology proposal. It allows us to better understand the reasons for our climate, its behavior and variability during established climatic periods and thermic oceanic anomalies. These are some of the considerations that we will bring to the work table.

### The first Climatic Concepts

The interest for natural phenomena, especially for climate variations has always been present since the time when the island was inhabited by Taino indigenous people. At that time, there were eleven gods. Some of



them in particular were Guabancex, with and his two companions: one as the announcer and the other one who governed the waters.

The story says that when Guabancex infuriates, the waters flow and the winds blow turning everything down and removing the trees from the earth. When this chaos reaches its highest

point and there are thunders, lightning and hail, the phenomenon is attributed to the god of storms: Hurricane.

Guatauva, one of the assistants of the Goddess of Wind, was in charge of convening all the "Cemies" (spirits) to help her produce a great amount of rain and wind. They were, without any doubt referring to conditions created by tropical cyclones. The other assistant was Coatrisquie, and he was in charge of taking water from the valleys in the mountains and then letting it flow to destroy everything on its way. This is just what happened at the Jimani avalanche, caused by the containment of Soliette River in the highest part of the Bahoruco Mountain Range.

The Tainos developed the concept of drought period when the sun went down on the horizon, which corresponded to winter. They also recognized the rainy seasons during the summer when the sun was up. In other words they had their own rainy and drought season which after six or more centuries is still valid. This continued practice of observing climatic variability throughout the years originated the cabañuelas, research that

is applied in some communities even in our days. It represents an effort to know the upcoming months' weather with anticipation and plan the agricultural activities; something we should emphasize in the current times.

After the discovery of America and the arrival of the Spaniards, major climatic events started to be registered. In other words, it was the origin of climatologic statistics. The power of hurricanes was first felt in 1502. As a result, changes are introduced in the construction processes of buildings (building norms) in order to increase the resistance to strong winds generated by tropical phenomenon never seen in Europe.

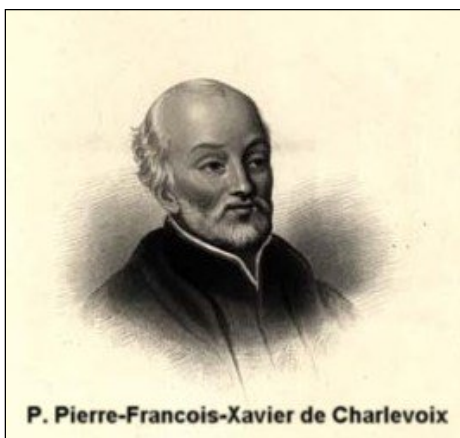
With the few experiences he had accumulated, and before the impact of this hurricane, Columbus emitted the first Early Warning known in the Americas which we tried to implement in the present. We didn't succeed and the result was the worst maritime tragedy of all times in the Caribbean region. Nowadays, the scientific community and different towns are trying by all means to establish an early warning system. Yet, we are getting the same results than in 1502. Later on, in the 1508 hurricane the wind circulation around the eye of the hurricane was described in detail. These were the first notes of tropical meteorology.

A few years later, the Ozama River established the maximum swelling limit which was near to the so called Ceiba de Colon in the western margin of the Ozama. Apparently this was taken into consideration and when the Colonial City was developed, the level designated by nature was respected. Today we occupy the flat lands with the results known.

### The First Climatology Treaty

Time passed and more experiences were accumulated. On 1730 the priest of the "Compañía de Jesus" P. Pierre-Francois-Xavier of Charlevoix wrote and published the "History of the Spanish Island or Santo Domingo". In the first volume we can find the main climate traces we observe today. We consider this publication to be the first Climatology Treaty of the Dominican Republic. In this book, the wind from the east is called Breeze as well as Alisio or "trade" from the French Word Alis which means "united". In addition, the eastern wind is felt in the coasts only at nine or ten in the morning when the solar heat expands the air. The wind increases with the sun and then decreases until dusk. During night time, it goes back to the sea, and it's called "viento de tierra" "land wind". If we observe this phenomenon in the city of Santo Domingo, we'll notice that secondary sea and land breeze circulation remains intact. This circulation is an important element of the local climate and it definitely influences the ventilation of buildings in the city.

Regarding rain, it is said that it's frequent based on the theory that rain increases in the same way that the cenit progresses. This corresponds to the summer time. It can rain in a week as much as it would rain in a year in Paris; the author mentions France because he was from French origins. About humidity he stated that it produces meat decomposition, rotten ripe fruit, molded bread, sour wines and rusty iron.



This publication highlights the differences in climate in opposite sides of the island and says that "among two neighboring cantons, one is continuously flooded due to the rain and the other has almost no rain." We know now through observation that at the end of November the southern and eastern coasts suffer a strong drought while the northern coast is irrigated by continuous rain. Yet, this depends on the roughness of winter in the northern

countries showing that not all winters are the same and that they are linked to climatic variability.

A few thunders can be heard from November to April. After the month of April, the land that hasn't received any rain throughout the winter, floods with the torrential rain and storms, unlike the north coast where five or six weeks can pass without a single drop of water. These climatic characteristics remain throughout time. Not much changes after studying the behavior of the coastal plains' precipitations in the North Atlantic.

The seasonal drought period happens regularly and it is a climatic constant in that region. This condition decreases the milk production in the cattle region which should be taken into consideration for any economic activity planned in that subsector of the economy.

We focus in the dew, fog frequency and temperature decrease in the valleys of the Mediterranean provinces. In spite of the different temperature oscillations, our ancestors didn't agree on what was considered summer or winter. Those who lived in the east and the south named winter the time of squalls or tropical cyclones which occur from April until November. However, those who live in the north coast assume that winter is the period between November and February, the months of cold fronts. Among them, there was a period of flourishing until May and a period of draught until the end of August. In other words, they were starting to include transition periods.

The publication presents the first indicators of a medical climatology. For instance, it says that due to a lack of winter people couldn't recover their strength. Likewise, when they were feeling hot, people didn't request refreshing but strong beverages. People aged fast and children from European parents couldn't develop properly and often died. However, this was accentuated by poor health care, corruption and work excesses. The natives and the Europeans, when acclimatized for more than two centuries could live up to 120 years.

Thus, in the taino period, as well as in the time of the European arrival to this lands, climate was an important aspect that had to be taken into consideration, even to explain why some events happened in these remote areas of the world. It would be interesting to analyze how much progress have we achieved since those ancient times in climate management.

Going on in time, the first pluviometric information dates from the end of the XIX century, when stations were installed by the Scottish railroad Company that went from Samana to Santiago. On 1891, the topographer Gerardo Jansen was designated by the Meteorological Service of the United States to give his observations regarding the tropical cyclones. The sequence of observations in Samana responded to the strike of Cyclone Lilis in 1894. Climatologic information started to be registered. This means that we have a data base with more than a hundred years to study climate.

#### Climatology evolution at the beginning of the XX century

At the beginning of the XX century a severe drought took a toll on the northern part of the country. However, instead of praying to Boinayel, an assistant to Guabancex, to bring the rain, they had peregrinations in honor of Virgin Mary to bring back the rain. This started due to the evangelization process. We have also seen it in some professional sectors in the beginning of the XXI century.

In 1905, climate observations become more regular and the Agricultural Magazine is published. As expected, one of the main topics is "Weather and Harvest". In fact, the April 1907 edition, exactly a century ago, emphasizes a terrible drought that also caused forest fires and cattle death. The publication quotes: "It would be hard to avoid many of the disastrous effects of the current lack of rain in fields and towns; yet we can't deny that we could remedy a lot of it if we at least counted with the

earth and climate's kindness, and in addition, with men's capacity to correct nature's defects or extreme conditions."

In subsequent editions referring to the same climatic event, they highlight that while there is a severe drought in the south and the east, in the north extreme rain is generating abundant cocoa and tobacco harvests. This was also emphasized by Charlevoix in 1730. Thus, the main climatic characteristics remained almost the same after 175 years.

Interest in climate information increased and in 1910 Mr. Viñalet took the lead in a meteorological observatory. In 1915, President of the Republic, Mr. Juan Isidro Jimenez, established the Meteorological Service and designated Capitan Francisco Catrain as its first Director. That was the beginning of today's National Meteorological Office.

By the same time, the Universidad Autonoma de Santo Domingo, included a lecture on Climatology among the study programs of Architecture. This event was fundamental to project development. However, later on, in detriment of the professionals in that area, the lecture was suppressed until today.

The evolution of meteorological services and climate information kept improving and gained strength with the impact of San Zenon Hurricane in 1930. This first process concluded with the arrival of the United Nations Mission of Technical Assistance to the country which took place in 1954 and professionalized meteorological activity in the Dominican Republic.

We consider then, that the XX century was a period to gather information through observation stations networks. Many of them were reliable at the time and now should be ready to be used in a serious and deep climate research. We'll leave the second part of the century for another occasion.

#### Factors that intervene in the Dominican Republic's Climate

In order to be able to take the greatest advantage of a country's climate, we not only have to know the average values of different variables that allow us to plan diverse activities. We also have to know the factors that intervene to obtain said results and understand the deviations of the registered values.

The climate of the Spanish Island or Santo Domingo is under the influence of the north Atlantic anticyclone and the maritime tropical air mass that it generates.

With these general characteristics and our geographical position, in general terms we can say that our climate is humid and tropical. It is also maritime tropical due to the air mass that covers the island practically all year round. For this reason, the sea temperatures and humidity content in the air will have important repercussions in the weather observed at a given moment. Furthermore, the anticyclone is also responsible for the trade winds that predominate on the east and northeast in the Dominican territory. Thus, it is necessary to learn the elements that model the Dominican Republic's climate.

In the topic, we will first define the external influences considering solar radiation, the Earth's movement around the sun and its rotation as well as the astronomic tides. Researchers can deepen their knowledge in each of these subjects as long as we obtain further results. Regarding the local influences, we contemplate the orography, convection, temperature and humidity of lake and sea waters, sea and land breezes, valley and mountain breezes and the anthropic influences.

The meteorological systems that inform about the weather forecast or analyze climatological data refer to one of the following: general circulation, trade winds, the Maritime Tropical air mass, subtropical jet streams, subtropical watercourse, cold air movements, cold temperature drops in high lands, low and high pressure in heights, polar fronts, pre-frontal watercourses, cutting wind, equatorial jet streams, tropical waves and tropical cyclones.

In a global scale, we also count with climate regulation centers, where we should mention the two most important, the North Atlantic Oscillation and the South Oscillation, the ENOS, better known as the Niño and the Niña of the equatorial Pacific. We should finally include global warming due to anthropic influences. In other words, if we really wanted to understand our climate's variability to take advantage of it, we should analyze all these influential factors.

If those didn't exist, as a small country, the climatic variables wouldn't have great differences. However, in the following chart of selected stations in different regions of the country, we can observe that the variable "average monthly precipitation" presents great differences in the same station. The same applies for the seasonal values located in different regions such as Santo Domingo and Villalpando, or Villalpando and Villa Nizao.

## Average Monthly Precipitation in Selected Stations (entire millimeters)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tamayo	7	9	16	31	64	62	24	60	61	62	31	19
Villarpando	8	9	35	60	74	57	39	60	82	86	37	10
Jinamagao	26	32	29	63	95	64	17	23	58	69	75	38
El Novillo	204	171	244	259	335	170	207	188	241	328	368	238
Los Jengibres	190	133	141	203	286	123	171	170	152	247	364	229
Villa Nizao	99	107	160	175	314	278	141	211	258	299	208	120
Puerto Plata	203	156	135	160	152	73	78	88	88	147	297	309
Las Américas	49	41	42	65	134	107	100	143	149	143	100	62
Bonao	107	108	118	204	333	139	176	204	180	252	248	146
Bayaguana	45	61	79	127	232	230	227	281	218	201	117	58
Santo Dgo.	63	57	54	72	188	140	145	177	181	187	100	84

### The influences of ocean-atmospheric patterns

Scientists have identified several anomalies in oceans' behavior that have passed to the atmosphere and have translated into climate changes in countries around the world. In this opportunity we will focus on two: The Niño, the Southern Oscillation also known as ENOS and the North Atlantic Oscillation, also known as NAO. The first one is related to temperature sea water temperature oscillations, and the second one is related to atmospheric masses' oscillations that move from north to south.

When referring to el Niño, it means that the sea waters are warmer than normal in the Eastern Equatorial Pacific. These conditions produce important weather changes in many parts of the world. It creates intense rain in South America, droughts in Africa and forest fires in Australia. The impact of such phenomena is currently under evaluation and it has been estimated that the warm event of el Niño from 1982 to 1983 produced losses of more than U.S.\$ eight billion worldwide.

We did some research about the influence of the two oscillation phases in the south in our climate. Without going very deep in our conclusions, we found out that the Dominican Republic didn't escape el Niño effects and on February 2<sup>nd</sup>, 1983 a forest fire took place. The fire happened in extreme drought conditions and affected 51,200 forest hectares in the Valle Nuevo, Constanza zone. In 2005 a prolonged drought extended from Cuba to the East, produced the greatest forest fire ever known, the Gajo del Toro Fire in the Central Mountain Range.

The relationship between ENOS and the Dominican Republic's climate is evident, especially in the coastal plains of the North Atlantic where precipitations decrease. Naturally, when precipitations go down in any part of the country, there are less clouds and a more direct radiation that

increases temperatures. For instance, using the index developed by Japan's Meteorological Agency for the ENOS, 16 climatologic stations of the Dominican Republic established minimal annual precipitation marks during the cold period in 1967. Others did the same with the 1976 and 1991 Niño.

Water availability and water flow to the reservoirs also responded to the phenomenon. The Tavera Reservoir registered the lowest average water level for a year in 1982 with 17.7 cubic meters per second. The second record was of 19.08 cubic meters per second with the warm even in 1997. On the other extreme, the highest average water level occurred in 1988 with 51.7 cubic meters per second and 51.8 cubic meters per second, both in la Niña years. These signs tell us that we should take a greater advantage of our research.

If we were really able to establish a well based relationship between ENOS and the Dominican Republic's Climate, we would be able to perform climate forecasts with more than six months of anticipation, which would allow us to plan all the nation's productive sectors' activities. We will share with you the example we presented at the III IRI meeting about Climate Change in Santo Domingo to defend our thesis: "regional forecasts didn't represented what is going to happen in our country due to the different regional climates."

**TEMPORADA FRONTAL (Nov – Abr/Decilos)**

La Niña	La Vega	Cabral	Luperón	Bayaguana	El Cercado
1950	HUMEDO	SECO	-----	SECO	SECO
1955	NORMAL	NORMAL	NORMAL	SECO	SECO
1957	SECO	SECO	NORMAL	SECO	SECO
1965	NORMAL	SECO	HUMEDO	SECO	SECO
1971	HUMEDO	SECO	HUMEDO	SECO	SECO
1974	NORMAL	SECO	HUMEDO	SECO	SECO
1976	HUMEDO	SECO	HUMEDO	NORMAL	SECO
1985	NORMAL	SECO	HUMEDO	NORMAL	SECO
1986	HUMEDO	NORMAL	HUMEDO	SECO	NORMAL

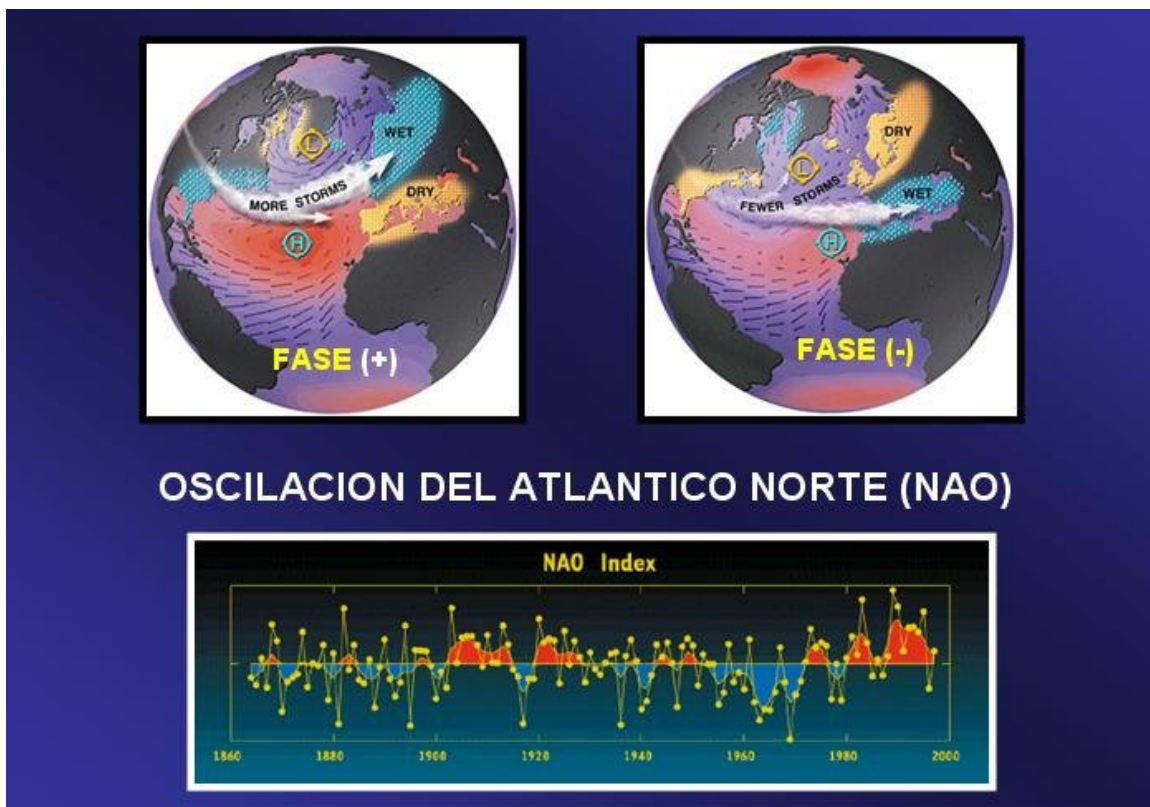
Humedo= Humid Seco=Dry Normal=Normal

As you may observe in the table, we took the years of la Niña given to us and selected five stations in different regions. We chose the period that spans from November until April and called it frontal activity due to the influence of the cold fronts. The results speak by themselves: During la Niña years we should expect higher precipitations than normal in the Luperón zone; yet in the Cabral and la Hoya del Lago Enriquillo stations,

the Bayaguana Eastern plains and the Cercado in San Juan de la Maguana Valley, we shouldn't expect rain, and this is extremely interesting.

Let's look at the second most important but least studied by us. The climate's tele-connections with the North Atlantic Oscillation, the NAO which consists in an index resulting from the difference in pressures between the low pressures at the Greenland and the higher ones associated with the anticyclone of the Azores islands. The positive phase is characterized by lower than normal pressures in high latitudes in the north Atlantic and higher pressures in the central Atlantic, the east of the U.S. and the west of Europe. On the other hand, in the negative phase, the pressure centers move to the south. Both phases are related to the north Atlantic's jet stream which is also related to the extra-tropical storms' paths.

The positive as well as the negative phase has to do with temperatures and precipitations' behaviors in the United States, Europe and Greenland.



Even though there are inter-annual variations, long positive or negative phase periods can be observed. We are currently in an extended period

of the positive phase since 1995 that coincides with the active period of hurricane season.

First we consider that this is one of the important points in its relation with the increased amount of hurricanes in the Atlantic basin. Second, we should expect a change of direction in trade wind in our island due to anticyclone movement. Third, there are chances or receiving African dust during the positive phase which influences people's sensation of warmth and well being as it has occurred in recent years.

The precipitation map in the Dominican Republic

The first observation results in an attempt to better understand and know our climate was the beginning of pluviometric maps' analyses over the distribution of annual precipitations. The map represents the first development instrument to determine de best location for a reservoir, point where we can get solar power, what we can count on to plan water usage, and among other things, to be able to organize crops among zones to take better advantage of our productive land.

Oliver Fassig, first meteorologist obtaining a doctorate in Meteorology in the Americas, published in 1929 the first isohyet map in his book A tentative chart of Annual Rainfall over the island Haiti – Santo Domingo, while working in San Juan, Puerto Rico. Here, it is possible to observe some of the main precipitation distribution features.

With more information that Fassig and acknowledging the important role that the mountains' location in wind circulation plays in precipitations' increase, in 1940 Leo Alpert developed a map with better defined maximum and minimum pluviometric centers.

In 1958, the National Meteorological Service publishes the Dominican Republic's Climate, where the monthly average precipitation and temperature maps are analyzed. They increase the Service's observation networks, the INDRHI starts working on hydro climatic information and the sugar plantations pay attention to their networks. In addition, the Central Romana, the Industrial Dominican Society, the Alcoa Exploration Company and the Vicini Group in the Peravia province near the Bani Dunes activate reliable observation networks. In other words we prepare ourselves for a better understanding of our climate and without knowing we were starting to strengthen a data base for research of a possible climate change, just like it is occurring in the present.

In the decade of the 60s and in the context of thematic maps for planning, the Organization of American States published a map of annual average precipitation, which is still used in the present by some institutions.

With great effort we tried to revise those maps since some of the concepts included didn't fit with the isohyets, resulting in inaccuracy in the maximum pluviometrics. This led us to perform research and starting from the Annual Pluviometric Map, which included all available information, adjust the lines according to crucial factors such as orography, exposure to trade wind, and vegetation. We have a publication in our website where we explain the process that brought us to these conclusions.

The areas prone to desertification are a factor we should be aware of in these maps. They are a topic of great interest in the scientific community and in the global warming process, which we should keep an eye on, in our efforts to stop this process as much as possible. Global warming is linked to the excessive use of the land and the inadequate management of the forests. The province of Pedernales in the southern part of the Barahona Peninsula, the Hoya del Lago Enriquillo, the Northern Yaque lower basin in the northeast and the highest part of the Central Mountain Range stand out.

The role of Mountains in the production of water ===

In the annual precipitations map, we can highlight the role of mountain ranges in precipitation distribution. However, there is an additional precipitation contributed by the forest which we should analyze now.

As we have seen in some climate regulating centers, in imposed drought conditions, where several localities of the Dominican Republic have faced water shortages due to extended drought periods of more than 120 days, the activity in the highest part of the mountains is different. Due to the sun's heat, the humid air ascends from the valleys, saturates and condenses every day. As a result, millions and millions of water drops are produced. They group in mountain fog and are captured by the pine peaks to produce big drops that then fall in the ground.

Those who travel to Constanza know this fog that interferes with transit in the afternoons due to the low visibility that it allows. This precipitation induced by the forest falls in the highest part of the mountain and contributes to the water deposits and springs that at the same time give origin to the main rivers in the country and allow the permanent water flow.

Let's quantify the results to better point out the importance of this process. Assuming that a pine tree extends 100 meters above the earth and that every day, due to the process we just explained, one millimeter precipitates, we can measure with a pluviometer that the pine will have produced 100 liters of water in a day. If we have a million pines, they will produce 100 million liters in a day, and if we multiply this by 365 days, the amount given would be considerable. This is how we can explain our great hydraulic potential and reveals that our forests are untouchable if we don't want to see the disappearance of more rivers and streams, as it has been the case of the Ino River a few years ago according to the Parks National Direction Office.

We should all agree that we are a privileged country, that we should give more attention to nature issues, especially our climate from which we can get unquantifiable benefits for our population at a low cost. Instead of taking advantage of it we have mistreated it for a long time. Now it is demanding a change in our conduct because we are warming the planet's atmosphere.

#### Climate Change and the IV IPCC report

Climate change is a reality but it isn't uniform for all countries in the world. Thus, each one in particular should develop its own research and apply the necessary measures to mitigate its effects. Each country should take its own decisions based on research, observation and collection of Climate data.

In the past conference we highlighted that according to the fourth IPCC Report that includes projections for small islands in the world, the Caribbean islands among them, the governments agree to sign an international treaty. The treaty is the United Nations Framework Convention on Climate Change which tries to analyze what can be done to reduce the atmosphere's warming and take measures against the rise in temperatures and its consequences.

The official United Nations document about Climate Change indicated that the earth's surface average temperature has increased more than 0,6°C since the last years of the XIX century. It also states the possibility of a further increase of about 1,4°C and 5,8°C for year 2100, which is attributed to industrialization processes and especially to oil combustion, gas and coal and tree felling, among others. The decade of the 90s has been the warmest one in the last 1000 years and 1998 was the warmest year.

Studies' results show that the sea level increased 10 to 20 centimeters in average during the XX century. By 2100, an additional elevation of 9 to 88 centimeters is estimated. This will translate into sea invasions in several populated areas of the world. If these ever happened, the expected climate change could have serious consequences in communities close to the coasts in the Dominican Republic.

The report emphasizes the urgent need to improve disaster planning. In other words, risk management independently of having or not climate change. Better information and stronger institutions are suggested. It is highlighted that new buildings should be designed and located in a way that reduces the damage that a flood or tropical hurricane could cause. On its first report to the United Nations Framework Convention on Climate Change, the Dominican Republic suggested the need of taking into consideration Disaster Mitigation, emphasizing the demographic increase that maximize risk conditions.

Considering that the changes expected will occur in the long term; even though there is an urgent need to start systematically monitoring our climate and the adaptation processes, we should take into account the past remarks and take advantage of the opportunity to better know our climate and microclimate. For instance: The hot zones generated by our big cities; Santo Domingo induces an increase of temperature of 6 to 7 degrees Celsius in some neighborhoods.

#### Climate periods and Dominican Climate dynamics

After several experiences such as the tainos, Charlevoix, the climate regulating world centers, the frequency of hydro meteorological disasters, the results of climate change and the need of sustainable development, we need a climate model that answers to all this experiences that have been accumulated throughout centuries. In addition, said model also has to respond to variations occurred in a given period of time and in the same region or in different regions due to the factors that influenced climate at the time.

We study several climate classifications including the Koppen, Thornthwaite, Holdridge among others, and found that none of them related the climatic behavior to the dynamic elements that model our climate such as the general atmosphere circulation systems, the semi permanent anticyclones, the migratory cyclones, the secondary circulations and the local influence along with all the other factors that we outlined at the beginning of this conference.

Let's consider that the Spanish island is under the influence of the North Atlantic cyclone, which regulates the trade wind and the humid tropical maritime air. When this air is disrupted by the eastern waves of the summer, it becomes accountable for a great part of total precipitations. In addition, the winter meteorological systems, called fronts and watercourses that come along with the maritime air are also responsible of important precipitation during that time of the year. Thus, we developed a classification based on climate periods where these systems prevailed. A period when the eastern winds grow strong enough to allow the intense convection and the development of powerful clouds that also generate rain, electric storms, and in some cases tornados, and another period where the waves and the tropical cyclones prevail.

Opposite to the seasonal precipitation analysis from spring to the fall, this helped us to better understand the climate's variability from one year to the next. In addition, it allows us to explain in current times the relations with the events in the equatorial Pacific.

The classification system we have agreed, takes into account the following activity periods: (i) a three month connective activity period from May to July, (ii) a tropical activity period from August to October and a (iii) frontal activity period from November to April. There are also two short transition periods: one in the second two weeks of April, from the frontal activity period to the connective activity period, going from an atmosphere with subtropical characteristics to a tropical one; the other one in the first two weeks of November where we go from the tropical activity period to the frontal, passing inversely from a tropical atmosphere to a subtropical one.

Analyzing climate this way and with our classification, we can gain a better understanding of the reason for rain in the North Atlantic coastal plains during winter and in the south during the summer, as well as why there are seasonal droughts. With this methodology we can understand the different behavior between the Tavera and Valdesia reservoirs, as well as what happens in Puerto Plata's North Atlantic coastal plains since it receives the greatest precipitations in the months of November, December and January due to the frontal systems coming from the U.S.

In the south, the station located at the International Airport of the Americas presents the greatest monthly values in the months of August, September and October. It coincides with the tropical activity period; while in the heart of the country the month with greatest precipitation is May in the connective activity period. In addition we can also plan the agricultural year in the different macro systems of production.

Some examples of monthly average precipitations in different stations of the Dominican Republic can give us a good idea of the pluviometric behavior in the three climate periods. Besides, for your information, in the annual series of precipitation at the Puerto Plata station, it rains in the frontal activity period from November to April.

#### Relevance for a Sustainable Future

Nature has blessed us with the main resource that it could offer us, a favorable climate that encourages our development with multiple possibilities. However, it also demands that we learn how to exploit it appropriately to guarantee the sustainable development needed by our nations. We can't tolerate the disappearance of our rivers or violence towards our mountains.

We have plenty of water. However, as we saw in the last conference poverty and water availability are linked. In other words, there is something that we aren't getting. Maybe that is the inadequate management of extreme climatic conditions such as meteorological droughts, so common in our country. This can be proved with the rural migrations that have taken place in the last decades.

Hence, it is clear that including Climate as a vital element in the Nation's development is the solution to obtain better results. Through a climate economy, or Econoclimatology, we can manage the economic aspects of production depending on the climate. However, to do this we would have to consider the "package" of data that the climate provides, the beneficial forces that generate wealth, as well as the harmful ones that cause destruction and death. Regarding the first ones, we should take the greatest advantage of optimal environmental conditions including, radiation, and strength of the wind, temperature and humidity, among others.

Regarding the second ones, we would lose it all if the harmful forces destroy in a few hours all what has taken us years to build; therefore, in order to undertake the road to development, it is necessary that we substantially improve our risk management skills. As a result, climatologic disasters won't ruin our plans of leaving future generations a country that can offer them the wellbeing that we were able to enjoy.

Developed countries have proceeded this way and have been economically successful. For instance, Chinese companies, tired of assuming avoidable losses, have started to take climatic factors into consideration. This attitude change is promoting the adoption of different

modalities of meteorological services. In the case of China, their businesses are adopting the international practice of taking into account the meteorological forecasts when launching their products. These trends will contribute to expand the national demand of this type of services.

A western economist states that the return for every dollar invested in climatological and meteorological information is 98 dollars. Chinese researchers assure that for every Yuan invested in this sector, Chinese businesses could earn 40 Yuan, which is profitable. Then, what are we waiting for? A great amount of information in the Dominican Republic is waiting to be analyzed and filtered through the necessary quality procedures. It can be put at the service of researchers and applied climatology to different development sectors.

The exploitation of the Dominican Republic's climate is in early stages. We should not continue building a hospital or a school without first considering the environmental climatic conditions. Engineering work such as roads in the natural environment can duplicate or triplicate its costs when they take place in rainy seasons. Likewise, houses should have the proper ventilation systems depending on the prevailing air circulation in the cities.

Following up on the recommendations of the past conference and the National Forum on Natural Threats results we should defend our proposal to create the Sub-secretary of Climatic Resources and strengthen the meteorological services bringing it to the level of an institute. This will allow the State to give the country the necessary attention to adapt to the expected climate change. In addition, it'll be able to take a greater advantage of the climatic resources that it counts with.

In order to develop all the activities that will lead us to change in attitude and mitigation tasks, we have to reorganize ourselves, rescue climatological information, apply quality control check, improve the observation stations, put the information at the public's service, stimulate research, integrate Universities in climate research, exploit our climatological resources and project our growth based on climate.

This new order will help us meet the main immediate challenges of the Dominican Republic, monitor global warming, prepare the country for World climate change impact, conserve and manage water resources adequately, assure a more efficient natural disaster management, food production according to the climate, take advantage of the energetic climatologic resources and tackle poverty reduction.

Ladies and Gentleman: We can't argue that we have the best climate of the world, but we are very close to having it. Let's take advantage of it, love it and project it and leave all the beneficial forces intact for future Dominican generations.

Thank you very much

*Bibliography*

*El Clima de la República Dominicana. 1958. Servicio Meteorológico Nacional*

*Las Regiones Climáticas de Haiti. Jean Saint-V.*

*Climate of Central and South America. 1976. Helmut Landberg*

*El Enos, El Clima Dominicano y las Sequias Meteorológicas. Antonio Cocco Quezada*

*Precipitación Media Anual de la República Dominicana. Antonio Cocco Quezada*

*Seminario sobre el Cambio Climático y su impacto en la República Dominicana y el Caribe. 20 de abril del 2006. Antonio Cocco Quezada*

*Agrometeorología de la prehistoria. Abelardo Jimenez Lambertua*

Recommendations