



MINISTRY OF
TRAFFIC, TRANSPORT & URBAN PLANNING
Meteorological Department Curaçao

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Climatological Report 2016

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Published by: The Meteorological Department Curaçao
Siegfried Francisco Building
Seru Mahuma z/n.

Telephone: 5999 839-3360 or 5999 839-3361
Fax : 5999 868-2699
E-mail: info@meteo.cw
Website: www.meteo.cw

Prepared by: Climatological & Seismological Division.

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Meteorological Department Curaçao
Seru Mahuma z/n.
Curaçao, Dutch Caribbean

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Introduction

Climate Summary 2016

Globally

The year 2016 was the warmest year on record: a remarkable 1.1 °C above the pre-industrial period (before 1750), which is 0.06 °C above the previous record set in 2015.

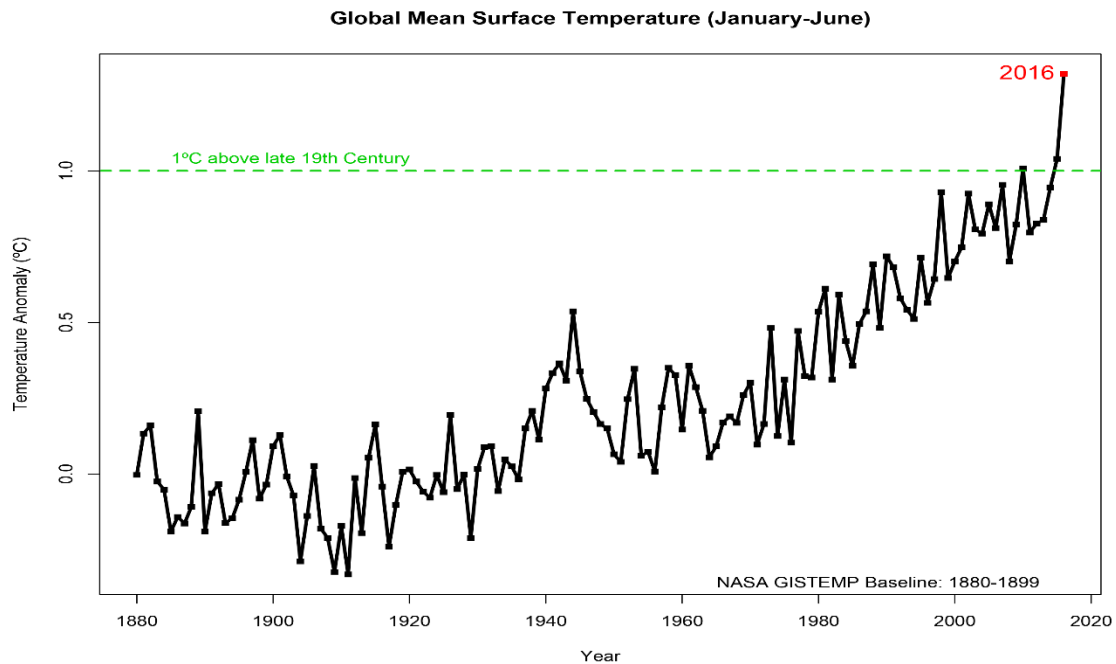
This increase in global temperature is consistent with other changes in the climate system. Globally averaged sea-surface temperatures were also the warmest on record; global sea levels continued to rise; and Arctic sea-ice extent was well below average for most of the year. The powerful 2015/2016 El Niño played an important role in the year's climate and confirmed that, when natural variability interacts with anthropogenic climate change, the impacts on human societies and the natural environment can be severe. The year was marked by severe droughts that affected agricultural production and left people exposed to food insecurity in southern and eastern Africa and Central America. Hurricane Matthew caused significant damage

in Haiti and the United States, while heavy rains and floods affected eastern and southern Asia. Coral bleaching and mortality were reported in many tropical waters, with important impacts on marine food chains, ecosystems and fisheries.

With carbon dioxide reaching a record annual average concentration of 400 parts per million (ppm) in the atmosphere, the influence of human activities on the climate system has become more and more evident.

Global sea-ice extent dropped more than 4 million km² below average – an unprecedented anomaly – in November. Global sea levels rose strongly during the 2015/2016 El Niño, with the early 2016 values making new records.

El Niño impacting the global climate



Global temperatures in 2016 were substantially influenced by the strong El Niño event of 2015/2016, especially early in the year. Temperatures in years in which strong El Niño events finish, such as 1973, 1983 and 1998, are typically 0.1 °C to 0.2 °C warmer, (as indicated by 10-year mean temperatures centered on each of those years) and temperatures in 2016 were consistent with that pattern. Conditions were especially warm from October 2015 to April 2016, when the El Niño influence on global climate was at its maximum. Global temperatures were at least 0.85 °C above the 1961–1990 average in each of those months, peaking at 1.13 °C above the 1961–1990 average in February 2016. It was somewhat less warm from May onwards as El Niño broke down, with each of the months from May to December being between 0.65 °C and 0.75 °C above average, except for August (+0.82 °C). Each month from January to August, except for June, had the highest global temperatures on record, but from September onwards, temperatures were lower than those for the corresponding month in 2015.

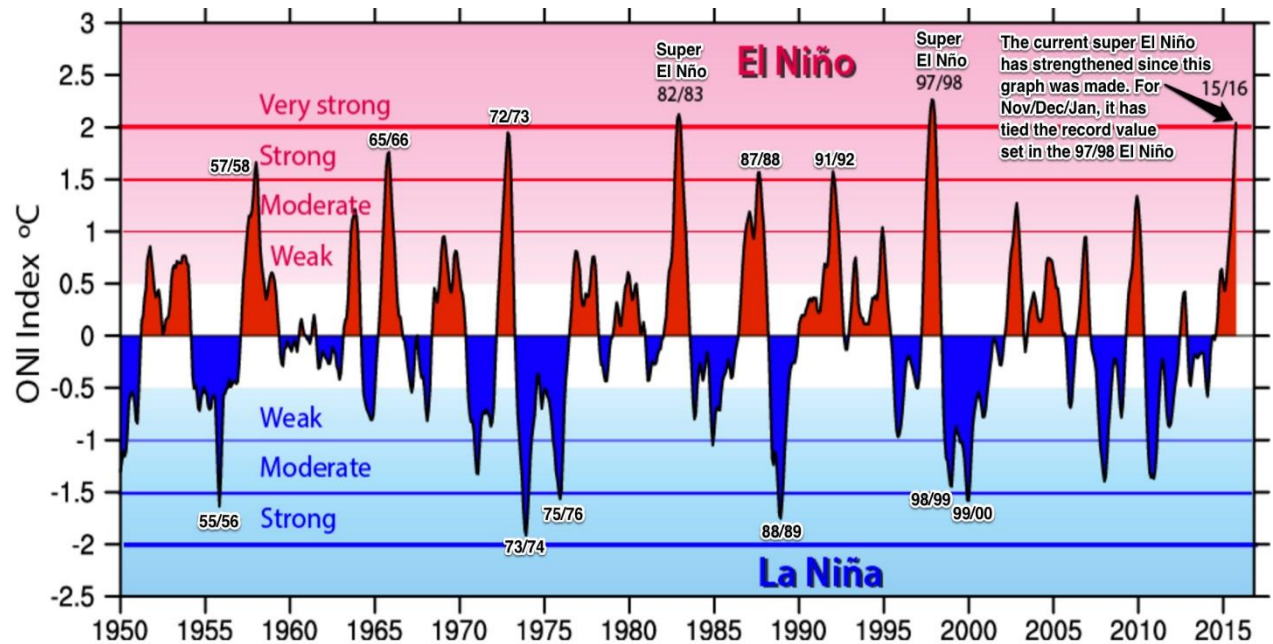
TEMPERATURES OVER LAND

Warmth extended almost worldwide in 2016. Temperatures were above the 1961–1990 average over the vast majority of the world’s land areas, the only significant exceptions being northern and central Argentina, and parts of south-western Australia. Most mid- and higher-latitude areas of the northern hemisphere were at least 1 °C above the 1961–1990 average (the main exceptions were in Quebec (Canada) and parts of the far eastern Russian Federation).

Mean annual temperatures at least 3 °C above the 1961–1990 average occurred in various high-latitude locations, particularly along the Arctic coast of the Russian Federation and in Alaska and far north-western Canada, and on islands in the Barents and Norwegian Seas.

In the high Arctic, in Norway, Svalbard Airport’s mean annual temperature of –0.1 °C was 6.5 °C above the 1961–1990 average and 1.6 °C above the previous record. Beyond the Arctic, the warmth was more notable for its consistency across the globe than for its extreme nature in individual locations.

Only a relatively small proportion of countries which reported national temperature data had their warmest year on record. On a wider scale, 2016 was featured in the five warmest years for every inhabited continent. It was the warmest year on record for North America, with the continental United States having its second warmest year, Alaska its warmest and Canada its fourth warmest. It was the second warmest for Africa and South America and third warmest for Europe. Asia had its warmest January–September on record, as did the Russian Federation, but relatively cool conditions in the last three months of the year (including Asia’s coolest November since 2000) saw Asia’s annual mean temperature anomaly drop to third highest, and the Russian Federation’s to fifth. North America had its warmest autumn on record and Africa its warmest June–August.



THE OCEANS

The rate of energy increase in the climate system – the Earth’s energy imbalance is the most fundamental metric that defines the rate of global climate change in timescales longer than about a year, the vast majority (more than 90%) of the Earth’s energy imbalance goes into heating the oceans. Thus, tracking ocean temperatures and associated changes in ocean heat content (OHC) allow us to monitor variations in the Earth’s energy imbalance over time. As the oceans warm, they expand, resulting in both global and regional sea-level rise. Increased OHC accounts for about 40% of the observed global sea-level increase over the past 60 years. Globally averaged sea-surface temperatures in 2016 were the warmest on record. As for land temperatures, the anomalies were strongest in the waters around Indonesia and northern Australia, and the Tasman Sea. Record high mean annual sea-surface temperatures occurred over most of the Maritime Continent (covering waters of Indonesia, northern Australia, the Philippines and other islands in the region) and adjacent areas of the western North Pacific, the Tasman Sea, the Caribbean Sea and parts of the western North Atlantic. Below-average sea-surface temperatures occurred in various parts of the Southern Ocean south of 45°S, most notably around, and east of, the Drake Passage between South America and the Antarctic Peninsula, as well

as in the North Atlantic south of Greenland (where the cool anomaly, however, was less pronounced than in 2015), parts of the central North Pacific and around south-western Australia.

The very warm ocean temperatures contributed to significant coral bleaching in some tropical waters. Among the areas significantly affected was the Great Barrier Reef, off the east coast of Australia, where record high sea-surface temperatures occurred in March. Coral mortality of up to 50% was reported in northern parts of the reef north of Lizard Island.

Globally, sea level has risen by 20 cm since the start of the twentieth century, due mostly to thermal expansion of the oceans and melting of glaciers and ice caps. Some regions are experiencing greater sea-level rise than others. The tropical western Pacific observed some of the highest rising sea-level rates over the period 1993–2015, which was a significant factor in the enormous devastation in parts of the Philippines when Typhoon Haiyan caused a massive storm surge in November 2013.

Global sea levels rose strongly during the 2015/2016 El Niño, rising about 15 mm between November 2014 and February 2016, well above the post-1993 trend of 3 mm–3.5 mm per year, with the early 2016 values reaching new record highs. From February to August, sea levels remained fairly stable as the influence of El Niño declined. Final 2016 sea-level data are not yet available at the time of writing.

Precipitation Globally

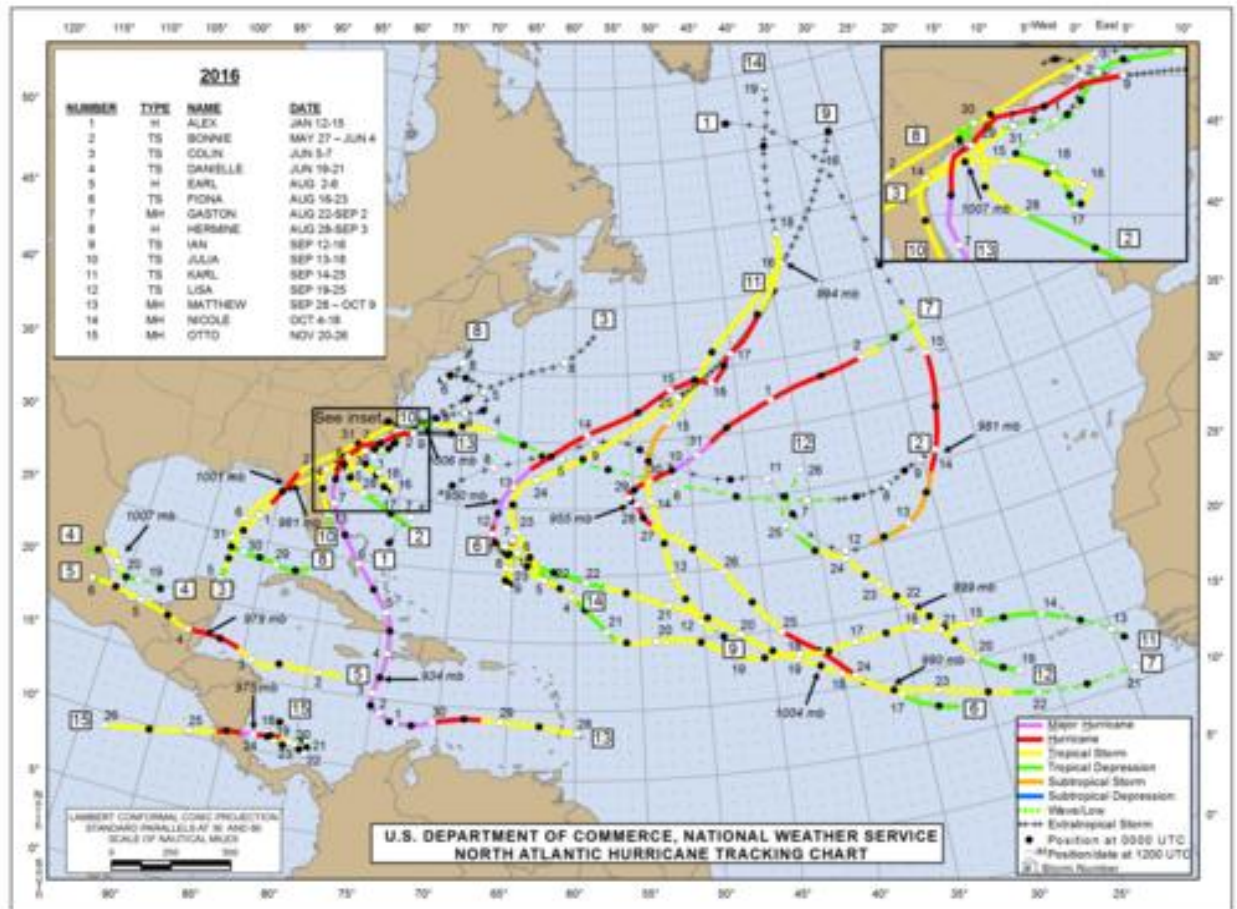
Global precipitation in 2016 was strongly influenced by the transition from El Niño conditions in the early part of the year to neutral or weak La Niña conditions in the second half. This resulted in strong seasonal contrasts but annual totals relatively close to average in many parts of the world.

This drought was also noticeable during the first part of the year for Curaçao with a meager amount of 21.5 mm. between January 1st and May 31st. The latter part of the year however, compensated for the first months of the year, which brought the total precipitation of 2016 to 543.4 mm. (30 yr. avg. 601.9 mm.) Which is still 58.5 mm. below the 30 year average.

TROPICAL CYCLONES

Global tropical cyclone activity was close to normal, with a total of 82 cyclones, slightly below the long-term average of 85. Due to the transition of El Niño to a neutral or even mild La Niña in the latter part of 2016. Activity was above average in the North Atlantic (15 cyclones, average 12). See tropical cyclone tracks (North Atlantic track chart 2016.)

Atlantic Hurricane Season 2016



2016 North Atlantic track chart

The 2016 Atlantic hurricane season featured above normal activity, with 15 tropical storms and 7 hurricanes, with 4 reaching major hurricane strength (category 3 or higher on the Saffir-Simpson Hurricane Wind Scale). (see table 2) The amount of activity was well above that seen during the 2013-2015 hurricane seasons. Most of the 2016 cyclones affected land. Numerical predictions in mid-September started to suggest the development of a tropical cyclone over the southeastern or southern Caribbean area near the end of that month. This system indeed developed and was classified on September 28 as Tropical Storm *Matthew*.

During the early afternoon of the next day it reached hurricane intensity as it was approaching the south-central Caribbean Sea. Late that evening its center passed north of Curaçao at a safe distance of about 190 kilometers. A few rain and thundershowers were observed over Curaçao on that day but the amounts of rain were not large. The next day, as *Matthew* was moving toward the west-southwest while it continued to intensify, a few strong thundershowers moved over the northwestern section of the island (Bándabou). Some locations received more than 50 mm of rainfall at that time. Parts of Aruba also received significant amounts of rain, while strong southerly winds affected the latter island during the evening of

September 30 and the early morning of October 1. During that period, *Matthew* also briefly reached category five status, while its center was located well north of the coast of the Colombian department of Guajira. This system was the first Atlantic hurricane to reach category five status since Hurricane Felix in early September 2007. It became nearly stationary that Saturday afternoon and late that evening it started to move toward the north-northwest. Although the weather improved, Curaçao continued to feel the effects of Matthew through October 4. It was then that huge swells generated by this hurricane reached especially the west facing shores of our island. Significant damage was caused by these swells in especially Boca Sami. Matthew reached Category 5 intensity south of Haiti (the first Atlantic hurricane to do so since 2007) and crossed south-western Haiti as a Category 4 system on October 4.

Matthew was the strongest, deadliest, and most destructive cyclone of the season, with its impacts reaching from the eastern Caribbean Sea across Haiti, Cuba, and the Bahamas to the southeastern United States. Earl, Hermine, and Otto also made landfall at hurricane strength, while Nicole affected Bermuda as a hurricane.



Major Hurricane Matthew over southwestern Haiti October 4, 2016

After crossing eastern Cuba and the Bahamas, Matthew then moved north just off the eastern coast of the United States with a near-parallel track to the coast and briefly making landfall in South Carolina before moving back offshore. The heaviest casualties associated with Matthew occurred in Haiti, with at least 546 deaths, reported. It also contributed to worsening existing issues of food insecurity and disease in the country, with cholera cases in the worst-affected provinces increasing by 50% from pre-hurricane levels. There were also major economic losses in the United States (mostly from flooding in North and South Carolina, Georgia and Florida), Cuba, the Bahamas and Haiti, amounting to more than US\$ 15 billion.



Aftermath passage major Hurricane Matthew 2016 over southwestern Haiti

Table 2. *Atlantic Basin Seasonal Hurricane Forecasts for 2016*

| 30 year. Average. | Forecast | Observed in 2016 |
|-------------------------------|----------|------------------|
| Named storms (12) | 15 | 15 |
| Named storm days (60) | 55 | 78¼ |
| Hurricanes (6.5) | 6 | 7 |
| Hurricane days (21.3) | 22 | 26¼ |
| Mayor Hurricanes (2.0) | 2 | 4 |
| Mayor Hurricane days (3.9) | 5 | 9 |
| A.C.E. (92) | 100 | 134 |
| N.T.C. Activity (103%) | 110 | 145 |

Table 3. 2016 Atlantic hurricane season statistics

| Storm Name | Class ^a | Dates ⁿ | Max. Winds (kt.) | Min. Pressure Hpa. | Casualties (deaths) | |
|------------|--------------------|--------------------|------------------|--------------------|---------------------|--|
| Alex | H | Jan 12 - 15 | 75 | 981 | | |
| Bonnie | TS | May 27–Jun 4 | 40 | 1006 | 1 | |
| Colin | TS | Jun 5 - 7 | 45 | 1001 | | |
| Danielle | TS | Jun 19 - 21 | 40 | 1007 | 1 | |
| Earl | H | Aug 2 - 6 | 75 | 979 | 81 | |
| Fiona | TS | Aug 16 - 23 | 45 | 1004 | | |
| Gaston | MH | Aug 22 - Sep 2 | 105 | 955 | | |
| Hermine | H | Aug 28 - Sep 3 | 70 | 981 | 1 | |
| Ian | TS | Sep 12 - 16 | 50 | 994 | | |
| Julia | TS | Sep 13 - 18 | 45 | 1007 | | |
| Karl | TS | Sep 14 - 25 | 60 | 988 | | |
| Lisa | TS | Sep 19 – 25 | 45 | 999 | | |
| Matthew | MH | Sep 28 – Oct 9 | 145 | 934 | 585 | |
| Nicole | MH | Oct 4 – 18 | 120 | 950 | | |
| Otto | MH | Nov 20 - 26 | 100 | 975 | 18 | |

^a Tropical depression (TD), maximum sustained winds 33 kt or less; tropical storm (TS), winds 34 – 36 kt; hurricane (H), winds 64 – 95 kt; major hurricane (MH), winds 96 kt or higher.

ⁿ Dates begin at 00:00 UTC and include all tropical and subtropical cyclone stages; non tropical stages are excluded.

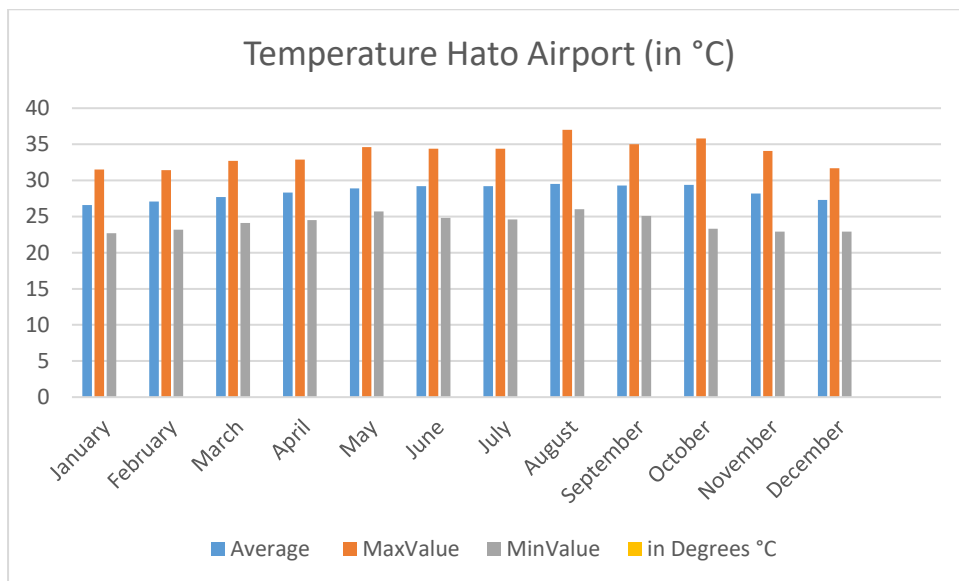
Extreme weather events in Curaçao

Eight extremely warm months with unusual drought.

The first eight months of the year were characterized by above normal temperatures and extensive drought. January through August was influenced by a well-developed strong “El Niño” event.

We can confirm this by higher monthly maximum, minimum and average temperatures and extremely low rainfall amounts for every one of those months. Total rainfall for January was 8.0 mm. this was 84% below the long term average. There was 9% more hours of sunshine for that same month.

February was also very dry only 4.3 mm was measured at Hato airport with a daily average evaporation of 8.1 mm. and an average monthly sunshine duration of 9 hours and 31 minutes 10% above normal average. March showed also the same trend with 5.0 mm. rainfall which is 65% below the monthly average and a 9.1 mm. daily average evaporation. The whole month of April had only 2.0 mm. rain this is 90% below the monthly average. As a matter of fact a new record for the April minimum average temperature was established (26.5°C) this was an increase of 0.1°C. The month May showed almost the same trend, with 2.2 mm. rainfall and an evaporation of 8.1mm. and extremely high temperatures. This was also the case for the month June with low rainfall amounts (10.2mm.) and extreme high temperatures. Although July had somewhat more rainfall (28.2 mm.) this remained still for 32% below the total long-term average. A meager 3.0 mm. rainfall total was collected during the month of August (92% below the total long-term average).

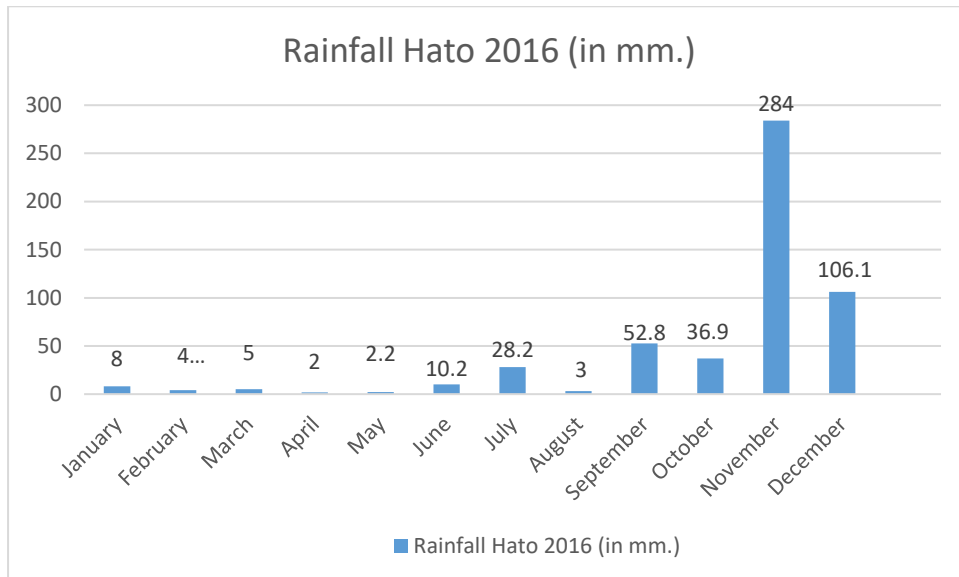


Four wet months.

As the strong El Niño weakens during the second half of the year, the month September shows an increase in the precipitation. The total rainfall for the month September at the Hato airport was 52.8 mm. this was 2% above the total/long-term average for the month. October shows again a dip in the total precipitation, however the month November shows a total precipitation of 284 mm. which is 32% above the total long-term average. The rain event of November the 8th, which measured in 24 hours 82.9 mm contributed greatly to this. An absolute minimum temperature of 22.9°C was also measured that day.



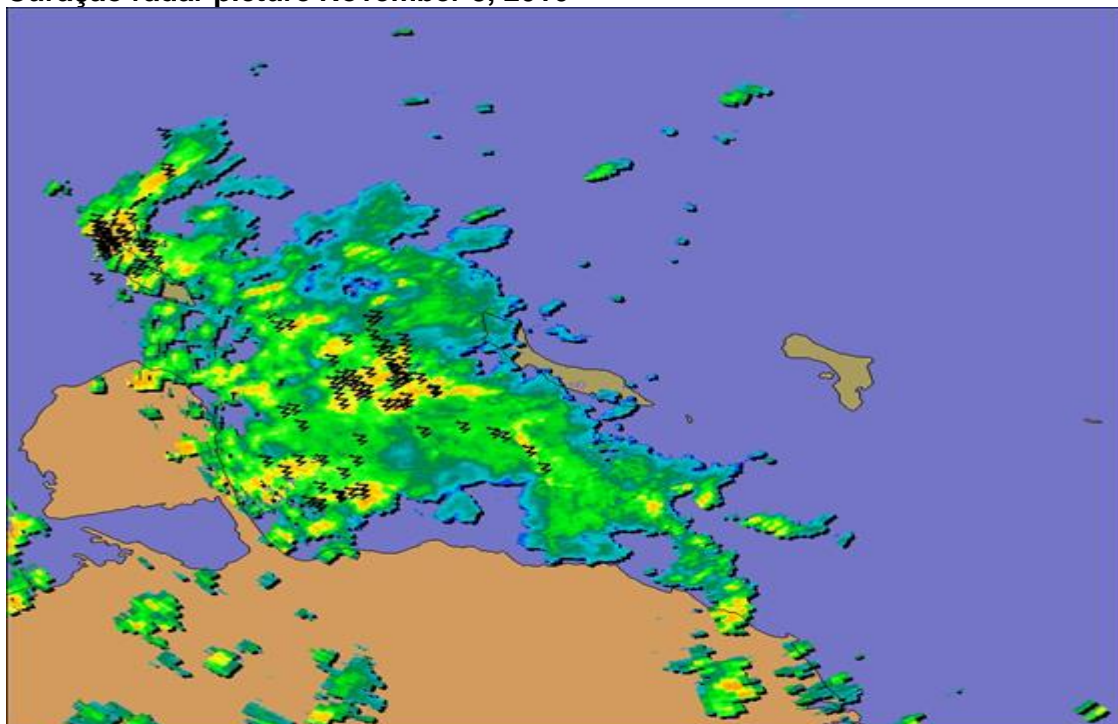
A total of 16 rain-days (equal or more than 1.0 mm) were recorded with a total of 73 hours of rain for November. The month December had also an above normal amount of total rainfall, 106.1 mm (12% above normal). The year 2016 finishes with a total year rainfall of 542.7 mm, which was just 11% below the total/long-term amount. This all was due to the rapid change from a strong El Niño to a weak La Niña during the last four months of 2016.



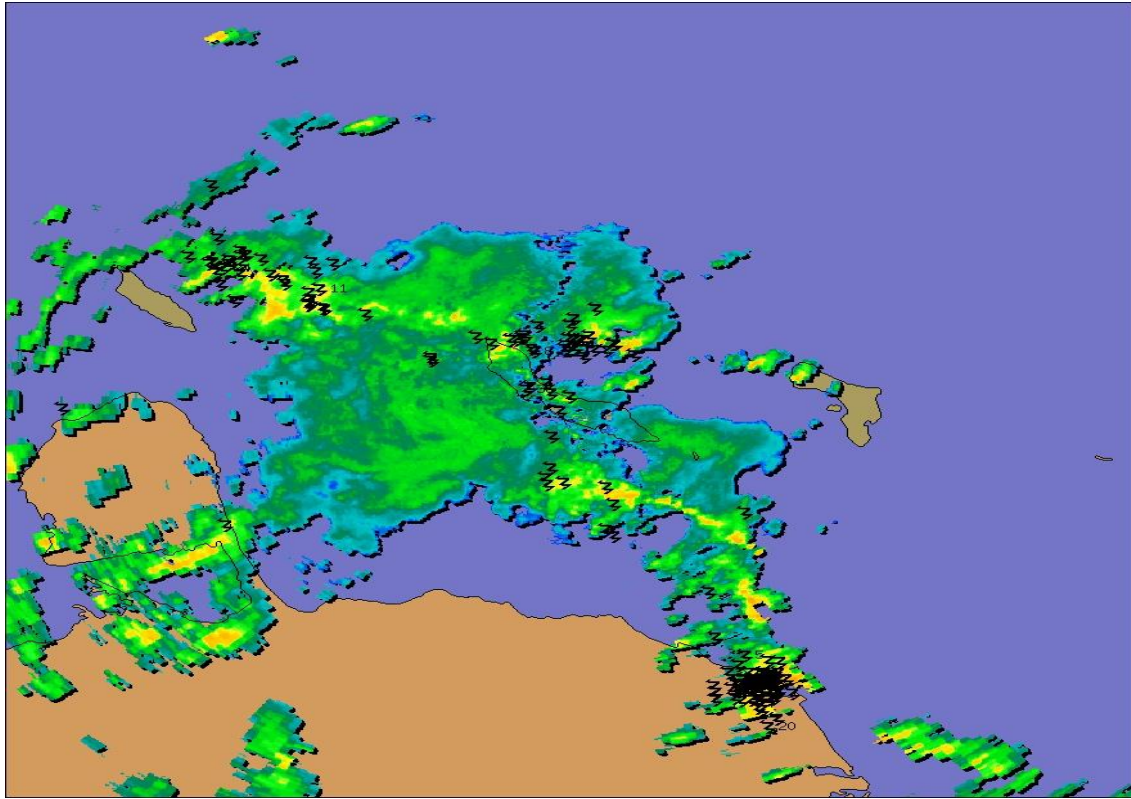
***Severe thunderstorm and intense rain event of November 8.**

During the early hours of November 8th a very active low level disturbance which had developed over the Southeastern Caribbean region a few days earlier triggered the development of a vast amount of strong thunderstorms over the local waters. Early that morning thunderstorm activity started to develop Southwest of Curaçao and the island of Aruba.

Curaçao radar picture November 8, 2016

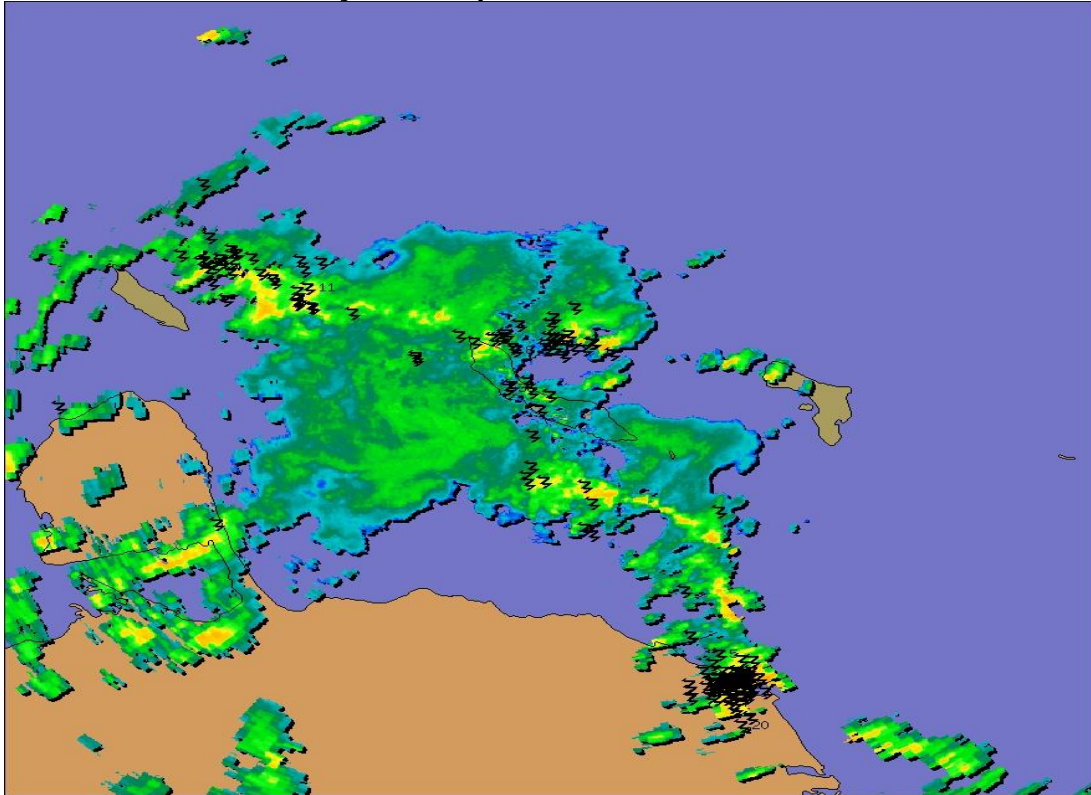


As the morning hours progressed southwest of the island large clusters with severe and frequent thunderstorm activity formed and moved in between the island of Curaçao and Aruba. As could be observed on the Curaçao weather radar, strong echoes started to develop at approximately 3:00 o'clock in the morning.



A few hours later larger areas with strong shower- and thunderstorm activity developed at first South of Bonaire and Southeast of Curaçao later during the day covered all three Dutch Caribbean islands for several hours.

Curaçao radar picture November 8, 2016



Curaçao is completely covered by rain shower echoes, black symbols are lightning discharges. (03:25 a.m.)

Because of the large amount of precipitation in a very short time flooding caused locally some inconvenience within neighborhoods and streets. The official weather station Hato measured in 24 hours 74.1 mm. The voluntary rain station at Grote berg collected 68.3 mm, Van Engelen measured 42.1 mm, Sumbu 22mm, Sunset Heights a meager 9.9 mm. The automatic weather stations at; Spaanse Water measured 29.2 mm, Steenrijk 24.6 mm, Santa Maria 14.8 mm. in a 24 hour time span.

²Special Bulletins:

During 2016, the Meteorological Department Service of Curaçao issued in September several “special bulletins” for strong thunderstorms and heavy rain events. During September 28 through the 30 “special bulletins” for rough seas and strong thunderstorm and heavy shower activity where issued due to the rapid development and close passage of Hurricane Matthew just north of Curaçao. Due to the imminent threat of possible dangerous seas at first, code yellow bulletins followed by code orange, were issued on September 28. As Matthew came closer to the island even the higher code pink was issued on September 29. During the month of November, most “special bulletins” where issued. These all where related to frequent thunderstorm and heavy shower activity, as November had extreme rain events. A total of 284 millimeters of rain was measured at Hato international for the month of November, which was extremely high. All by all more than 25 special bulletins where issued by the M.D.C. during 2016.

² Special bulletins are issued for weather events, sea conditions or geological phenomena that can cause general inconvenience or public concern and cannot adequately be described in a weather forecast. Four types of special bulletins are issued by MDC: 1. Precaution [color code yellow], 2. Watch [color code orange] 3. Advisory [color code pink] 4. Warning [color code red].

Tropical Cyclone Bulletins:

As hurricane Matthew was developing over the western Atlantic, and approaching the Caribbean basin with possibility to pass just north of the A,B,C. islands, more than nine tropical cyclone bulletins were issued during the last days of September. At first these TCB's were of the type code yellow but as Matthew was approaching the island and it continued to strengthen a watch (code orange) and thereafter a warning (code red) was issued, on September 29.

***Aerodrome Warnings:**

The National Meteorological Forecast Center of Curaçao issued in 2016 more than 40

Aerodrome warnings. Most of these warnings were issued because of strong thunderstorms and/or heavy shower activity in the month of November and December. The remaining warnings were issued because of strong gusty winds of 35 knots (65 km/hr.) or more. During most of the months of spring and early summer.

**Aerodrome warnings are issued when meteorological conditions could adversely affect safe operation of aircraft at an airport.*

****SIGMET:**

The Meteorological Watch Office (M.W.O.) of Curaçao has issued in 2016 more than 30 SIGMETs** most of these were issued in the months November and December for large areas of severe thunderstorms and heavy rain shower activity in the "Curaçao" Flight Information Region (F.I.R.).

**SIGMETs are special bulletins of possible threats that can affect flight safety and expedition. These are issued for aircraft in flight moving in a Flight Information Region (F.I.R.), for which a Meteorological Watch office is responsible. In the case of the Curaçao F.I.R. this encompasses an airspace of about 300.000 km² which MDC is responsible for. The word SIGMET stands for, a significant meteorological bulletin for aircraft in flight and is normally issued by a Meteorological Watch Office.

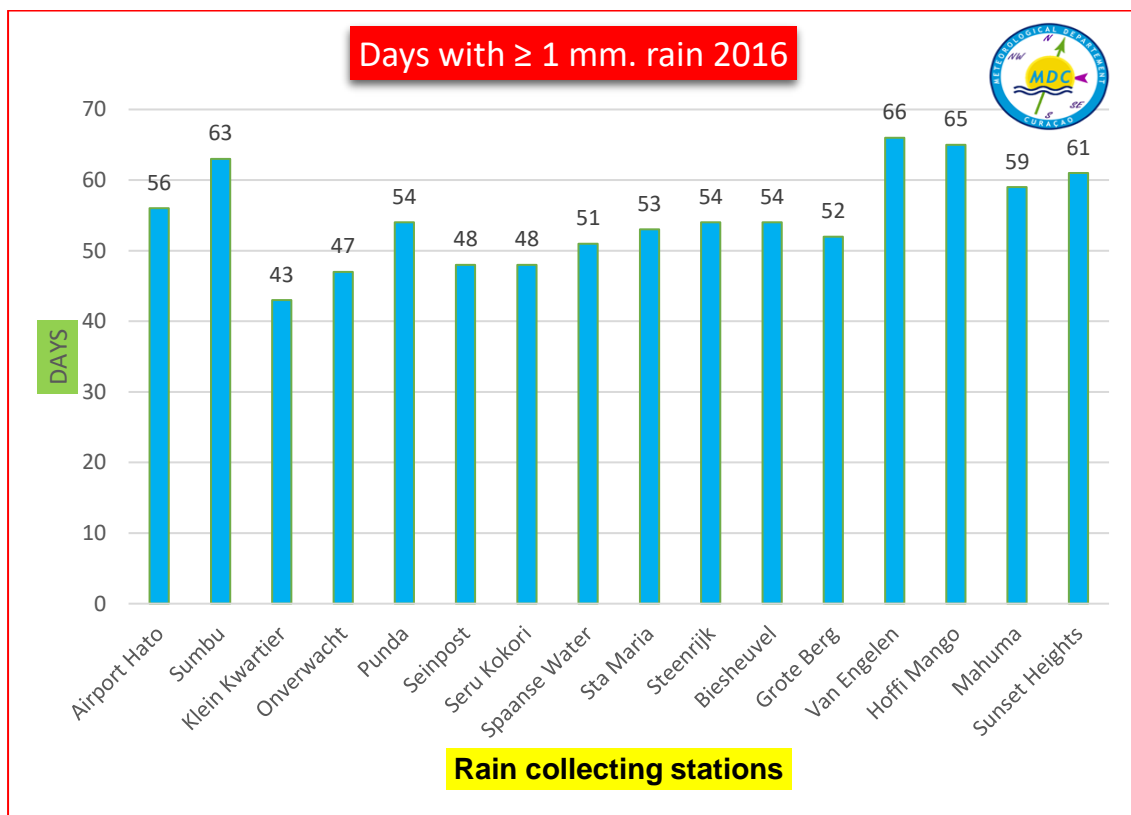
Curaçao Climate

Precipitation

The island's average total rainfall for 2016 according to eighteen rain collecting stations was **417.1 mm**.

The rainfall station with the highest year total, **770 mm**, was located in Hòfi Mango, Banda Bou.

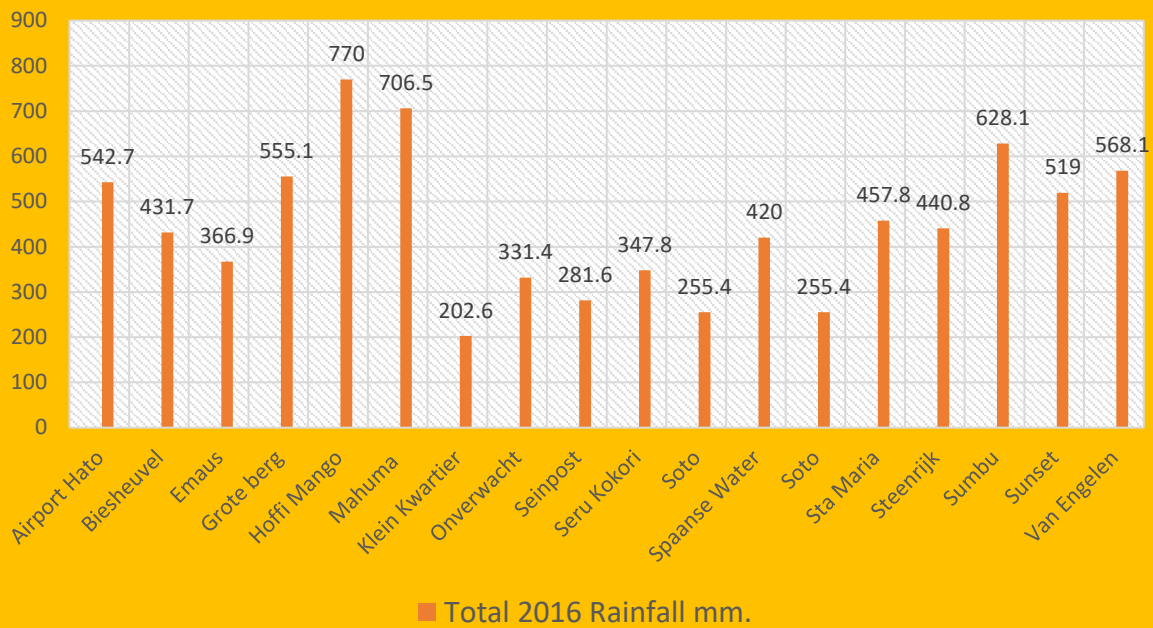
The station with the largest amount of days with rainfall ≥ 1.0 mm: **66 days** was located in Van Engelen. (Normal 76 days). Which was 10 days less than the 30 year normal.



The maximum 24-hour rainfall total for Curaçao was **155 mm** and was measured at the rainfall station at Hoffi Mango on November 26, as consequence of an area of severe weather developing and moving over mainly the western part of the island. As can be noticed 2016 was a year with rainfall below the long-year average, due to the impact of El Niño during the first half of the year. However, during the second half of the year some intense rain events, almost compensated for the island's "year" total water table.



Rain Collecting Stations Curaçao 2016

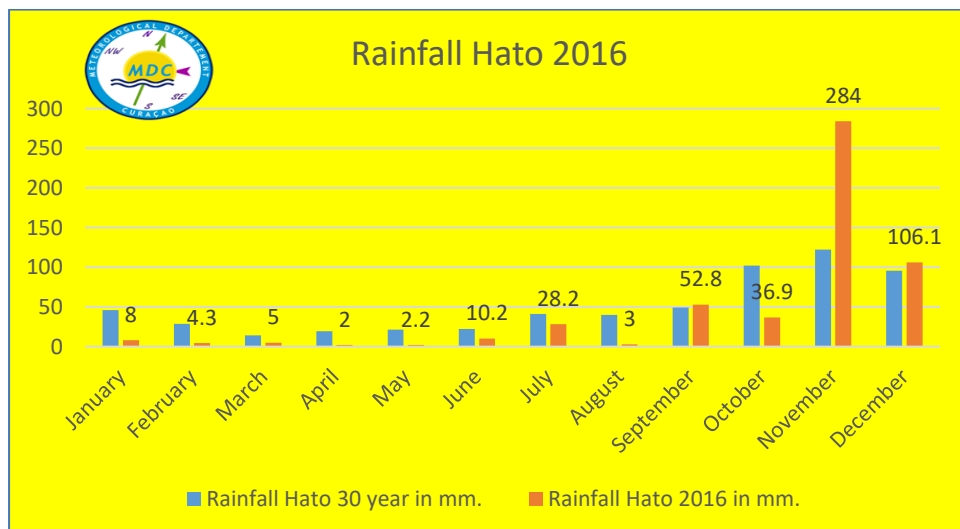


Rainfall data from Hato airport

The rainfall total recorded at the Hato International Airport for the year 2016 was **542.7 mm**. This was **9.9%** below the 30 year normal (1981-2010).

The wettest month of the year 2016 was November with a monthly total of **284.0 mm** and the driest month was April with **2.0 mm**. The months between January through May including August had less than 10 millimeters of precipitation for each of those months.

The number of hours with rainfall for 2016, recorded at Hato international Airport, was **260 hours**. (normal 481.5 hrs.). This was 54 % of hours below the 30 year normal.

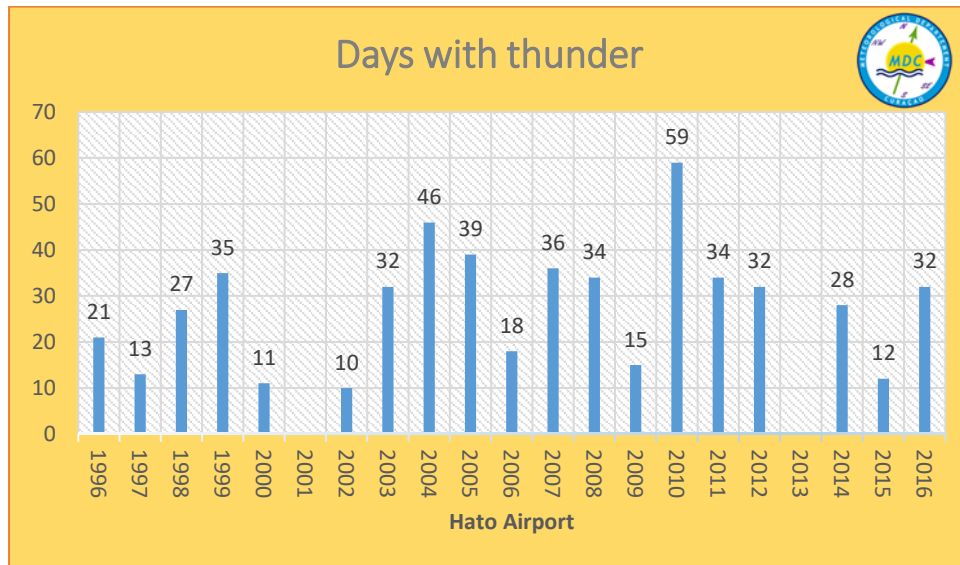


Days with rainfall and thunder

The number of days with rainfall greater or equal to 1.0 mm was **56 days** (normal 70 days). This was 20 % less rain than the 30 year average.

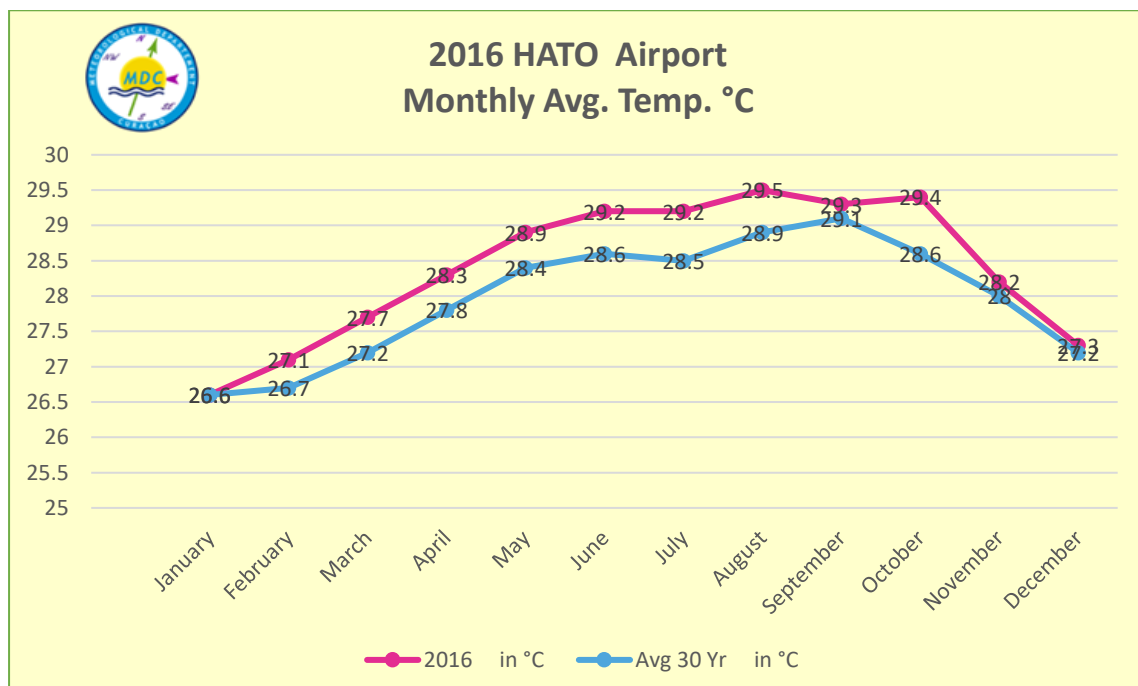
The number of days with thunder was **32 days** (normal 28 days).

November and December proved to be the wettest months with monthly totals varying from **284.0 mm** in November and **106.1 mm** in December.

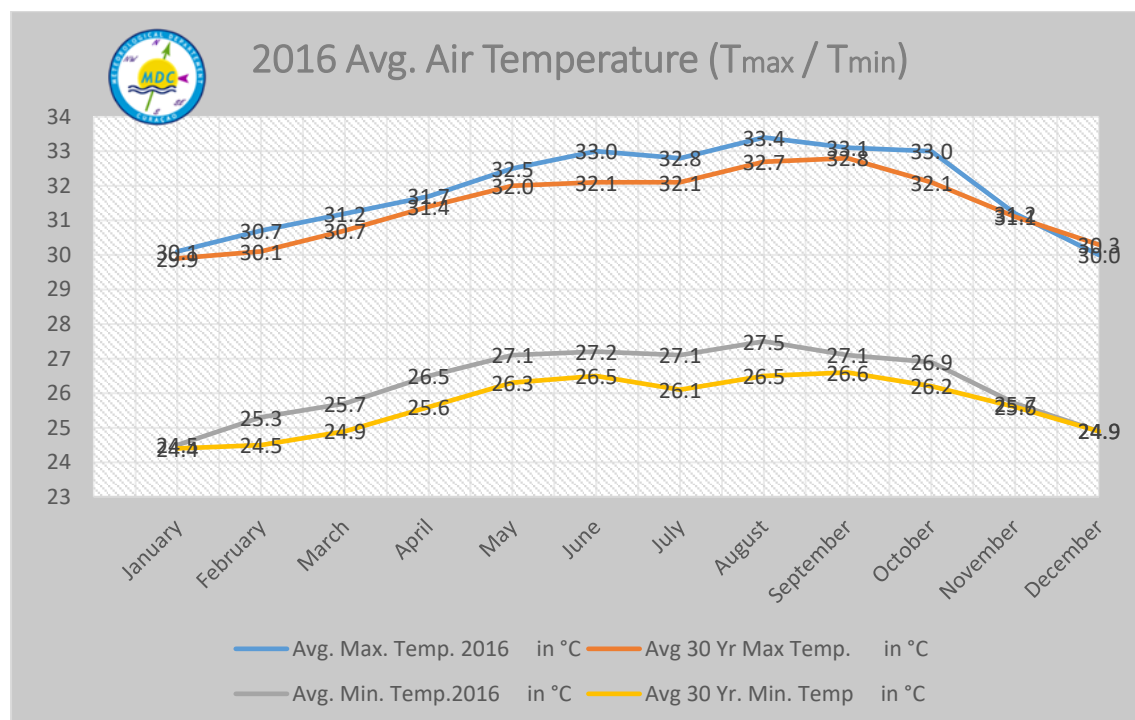


Temperature

The average air temperature as recorded at Hato International Airport over 2016 was **28.4 °C** (normal 28.0 °C).

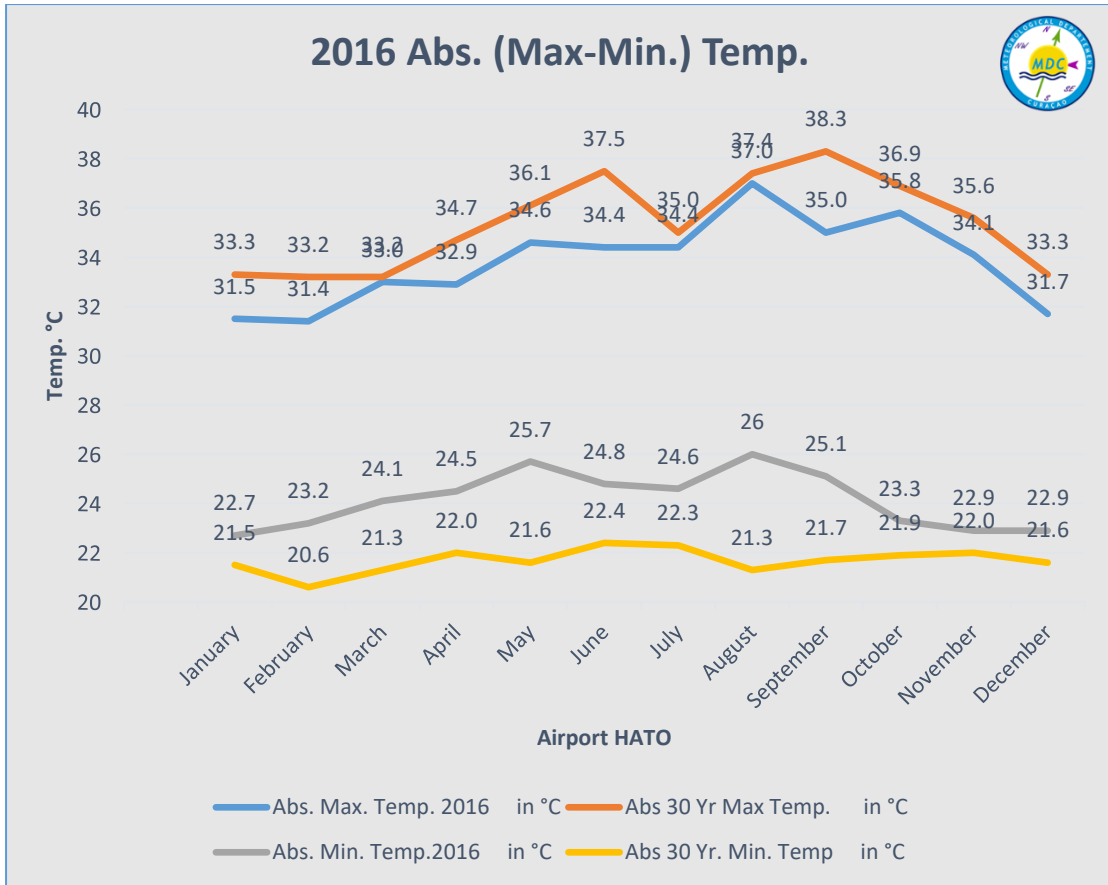


The average maximum air temperature for 2016 was **31.2 °C** (30 year normal: 31.4°C). October proved to be the warmest month of the year with a daily average temperature of **29.4 °C**. January 2016, was the coolest month with a daily average temperature of **26.6 °C**. The average minimum temperature (30 year, 25.9°C) for January was also exceeded reaching 24.5°C, which is a record.



Hato Airport 2016 Air Temperature (T_{abs max.} / T_{abs min.})

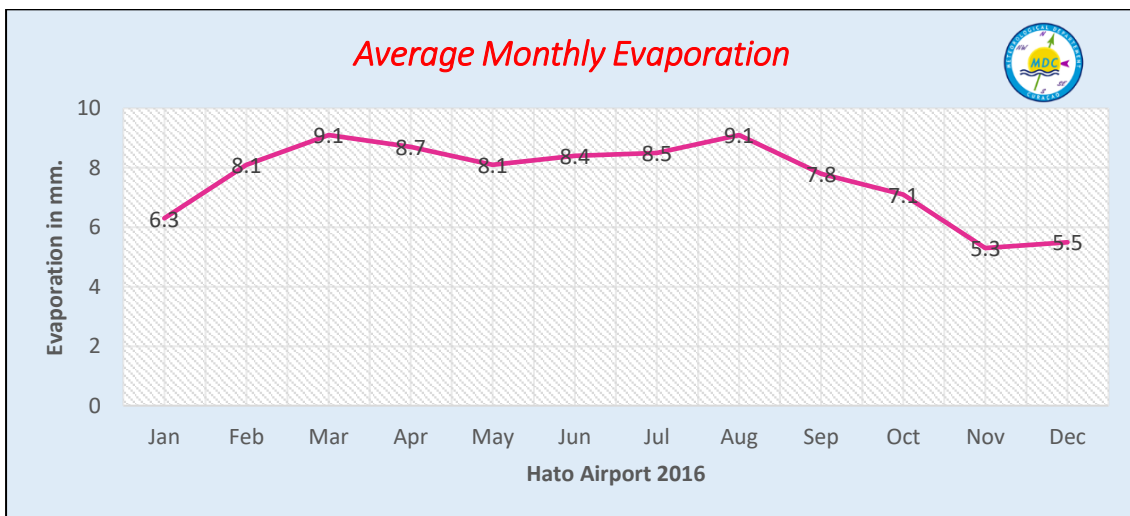
The absolute maximum air temperature for 2016 was **37.0 °C** and was recorded on August 26, at 13:22 local time. *(The all-time absolute maximum air temperature was 38.3 °C and was recorded on September 11, 1996)*
 The absolute minimum air temperature of **21.5 °C** was measured on (January 20, at 4:26 a.m. *(The all-time absolute minimum air temperature was 17.0 °C and was recorded in March 1933)*)



The warmest day in 2016 was October 3 at 13:32 l.t, with an average day temperature of **30.9 °C**. The coolest day for 2016 was January 19 with a 24-hour average temperature of **25.4 °C**.

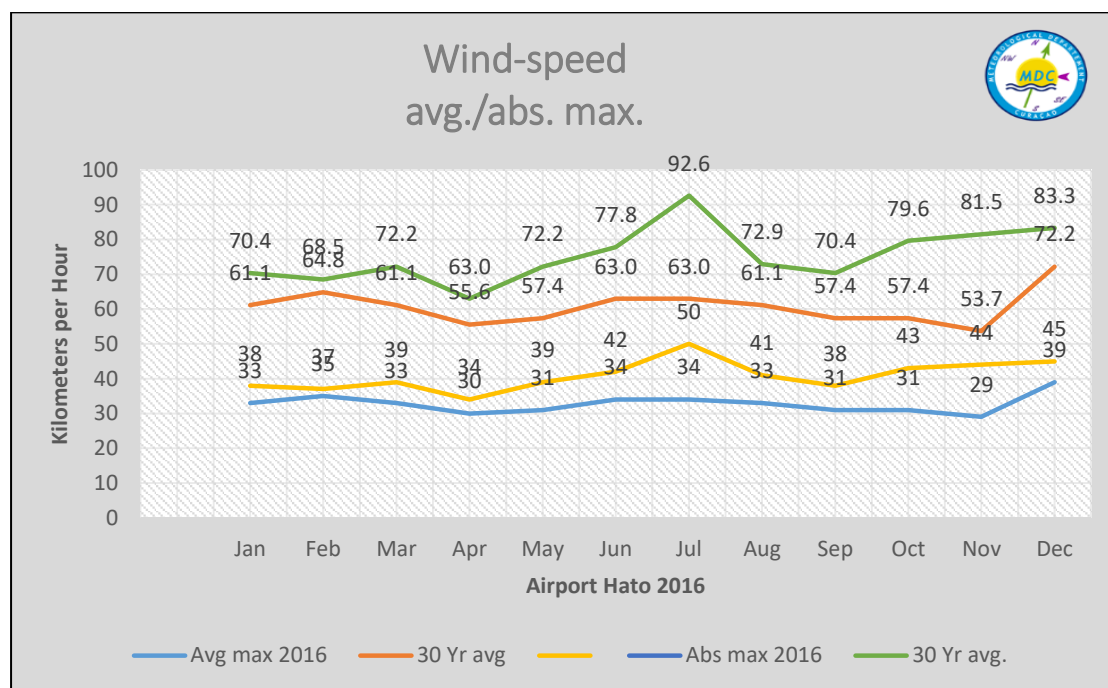
Evaporation

The site of the evaporation pan is located at the Meteorological Department at Seru Mahuma. The daily average evaporation for the year 2016 was **7.7 mm**. The highest daily average evaporation value of **17.3 mm**, was measured on August 29. The total evaporation during 2016 was **2795.0 mm**.



Wind

The average wind speed for the year 2016 was 22.2 km/hr [=6.2 m/sec.] (normal 23.8 km/hr. [=6.6 m/sec.]) at a height of 10 meters above ground level and the average wind direction was 99.0° (E). [30 year normal 88.7°]. The months of May and June 2016 had the highest monthly average wind speed of 60.7 km/hr [=16.9 m/sec.] and November 2016 had the lowest monthly average wind speed of 18.9 km/hr. [=3.6 m/sec.]. The highest wind gust was 72.2 km/hr. [=20.1 m/sec.] and was recorded on December 09 at 10:36 am. [all time record 92.2 km/hr. (=25.6 m/sec.) July 1996]. An average maximum wind speed of 44 km/hr [=12.3 m/sec.] was measured in June, which remained below the 30 year record of 51.9 km/hr [=14.4 m/sec.].



Potential Wind Energy

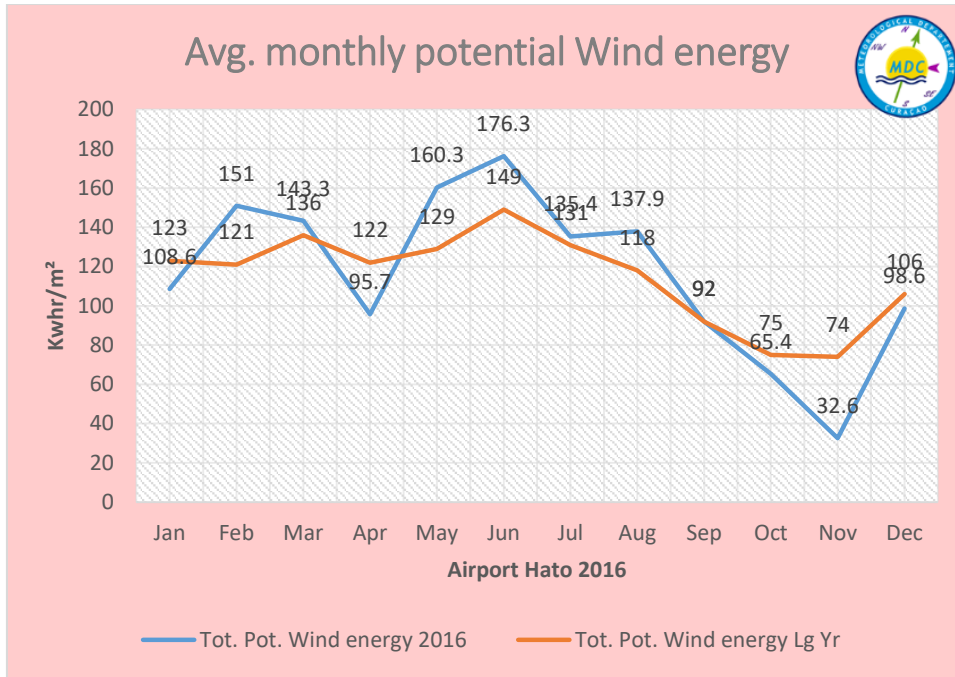
The total potential wind energy (at 10m. height and wind speeds ≥ 4 m/sec.) for the year 2016 was **1397.1 kWh/m²**.

The daily average was **45.1 kWh/m²/day**.

The maximum daily wind energy potential was **57.1 kWh/m²/day** and was recorded in June.

The minimum daily wind energy potential was **23.7 kWh/m²/day** and was recorded in September 2016, which broke the 2010 record. (long year average min. 24.4 kWh/m² September 2010.)

The minimum average monthly wind energy potential was **32.6 kWh/m²** measured in September 2016.

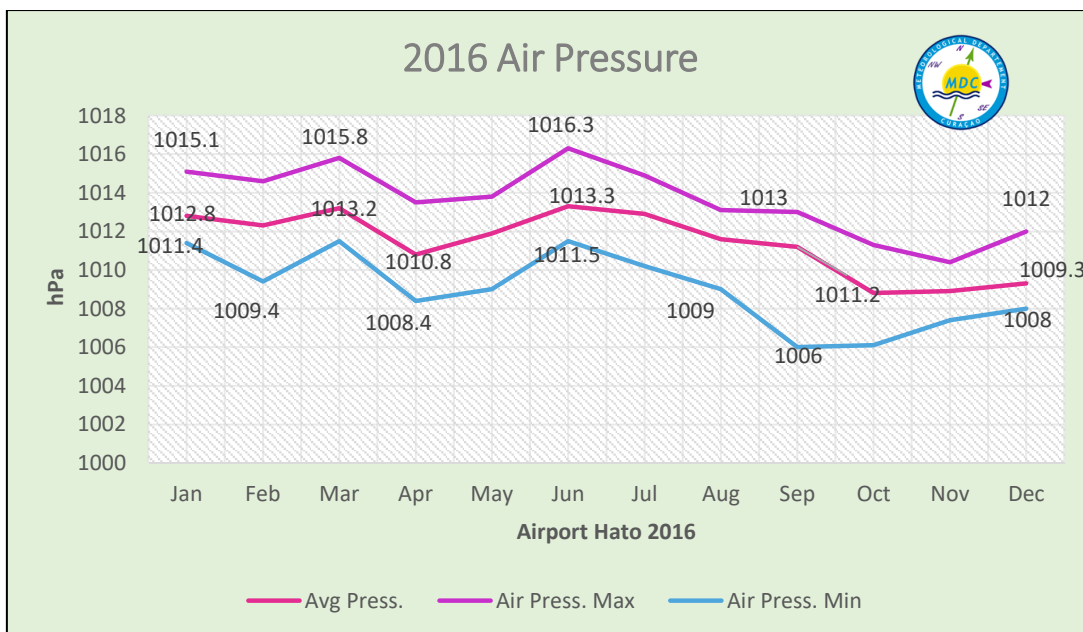


Air Pressure

The average air pressure recorded at Hato International Airport over 2016 was **1011.6 hPa**. (30 yr avg 1012.5 hPa.)

The maximum air pressure of **1017.9 hPa** was recorded on November 5 at 10:01 a.m., while the minimum air pressure of **1004.0 hPa** was observed on September 30, at 03:37 a.m.

The maximum average monthly air pressure was **1016.3 hPa** measured in June 2016. The minimum average monthly air pressure was **1006.0 hPa** measured in the month September 2016.



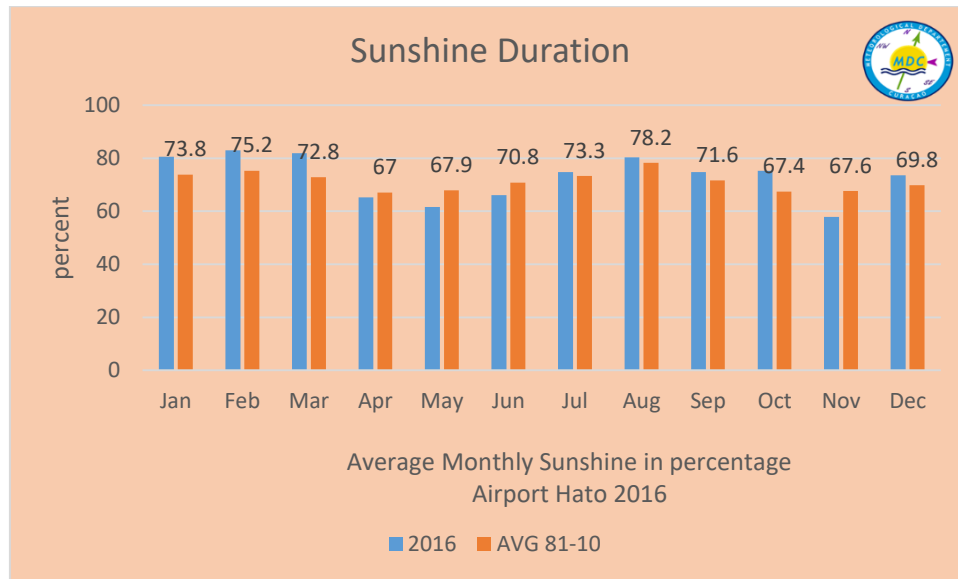
Sunshine Duration

The total sunshine duration over the year was **3223 hours**. This is **72%** of the maximum possible duration (**4428 hrs**).

The average daily sunshine duration was **8 hours** and **50 minutes**.

The warmest month was August with a daily average sunshine duration of **10 hrs.** and **13 min.**, while the coolest month was August with a daily average of **6 hrs.** and **41 minutes**.

The longest day, as far as sunshine is concerned for 2016, was on **January 16**. The duration lasted for **10 hrs.** and **42 min.** of sunshine.



2016 Sunshine Duration

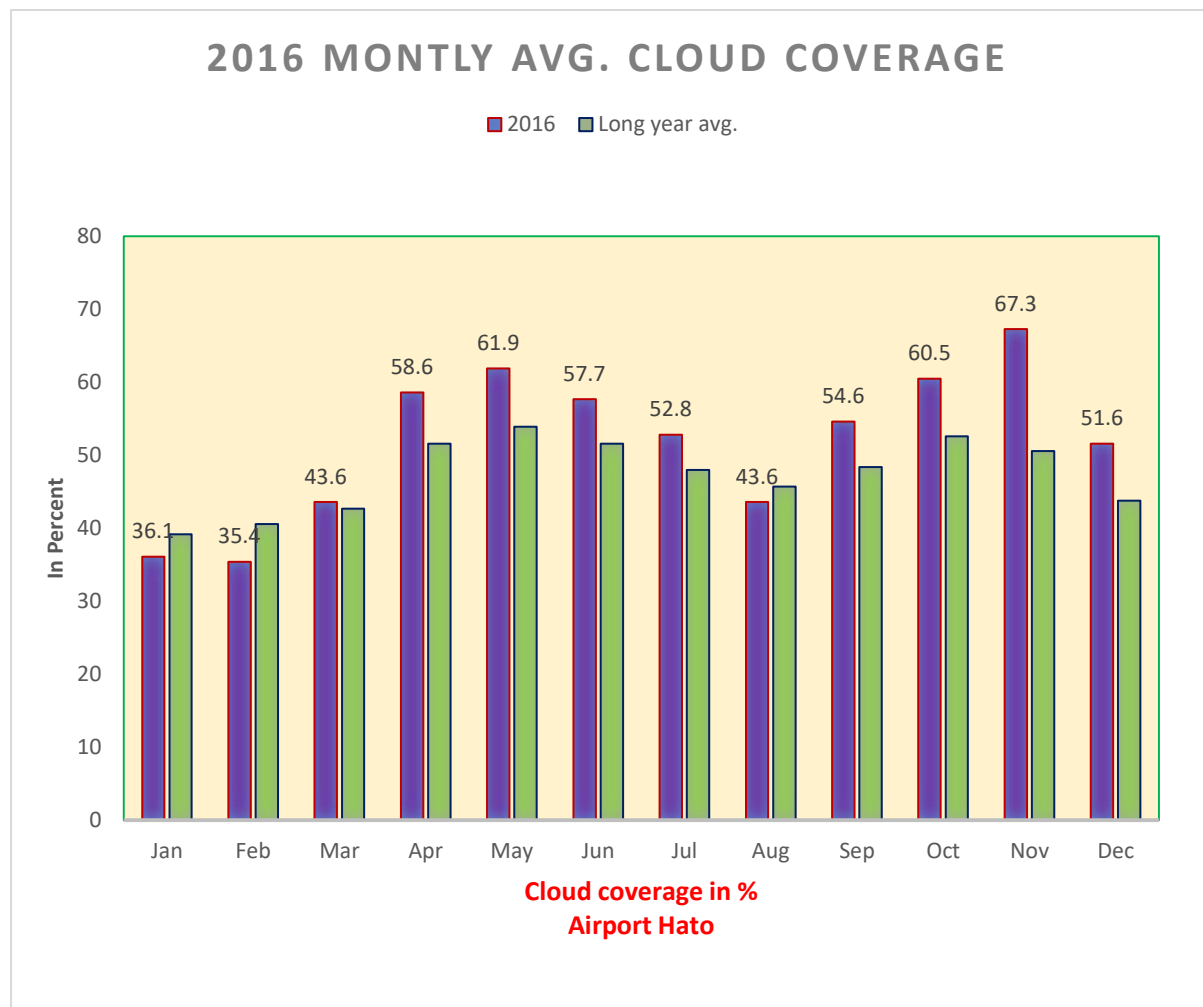
Cloud coverage

The average cloud coverage for 2016 was **51.6%**.

The highest total cloud coverage per month was **67.3 %** was observed in November.

The lowest amount was **35.4%** and was recorded in February.

Hato Airport 2016 Cloud Coverage in percentage



Conclusion

The total rainfall at the Hato International Airport for 2016 was 542.7 millimeters, which was 11.0% below the long term average. Total rainfall for nine months of the year remained below or even well below the monthly averages, except for the months of September, November and December, with a total rainfall of resp. 52.8 mm. (49.1) 284.0 mm (122.4) and 106.1 mm (95.9).

The average temperature was 28.4 °C (long year average is 27.8 °C) approximately 7.8 % above the long year average. The average minimum temperature was 26.3 °C which is 6.8 % higher compared to the long year average of 25.7 °C. Whilst the average maximum temperature was 31.9 °C, this is 1.6 % above the long year average maximum temperature which was 31.4 °C.

The average wind speed for 2016 (6.1 m/sec) was very close to the 30 year average (6.2 m/sec). The absolute maximum wind speed was 20.0 m/sec (25.7 m/sec). We can say however, that the monthly average wind speed between the months of May thru September remained above the monthly average, with an extreme windy month of June.

We can conclude that:

The year 2016 will go into the books as quite dry during the first 8 months, windy during the summer months and a partially wet November month.

« «+++++++» »





**METEOROLOGICAL DEPARTMENT CURAÇAO
CLIMATOLOGICAL DATA 2016**

| Absolute Minimum Temperature (°C) | | | | | | | | | | | | | |
|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|-------------|
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Abs. Min. |
| CURAÇAO 2016 | 22.7 | 23.2 | 24.1 | 24.5 | 25.7 | 24.8 | 24.6 | 26 | 25.1 | 23.3 | 22.9 | 22.9 | 22.7 |
| Record | 19.0 | 19.0 | 17.0 | 20.1 | 20.2 | 20.8 | 21.6 | 20.6 | 21.5 | 20.0 | 20.0 | 19.9 | 17.0 |
| Year | | | 1933 | | | | | | | | | | |
| Average Minimum Temperature (°C) | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
| CURAÇAO 2016 | 24.5 | 25.3 | 25.7 | 26.5 | 27.1 | 27.2 | 27.1 | 27.5 | 27.1 | 26.9 | 25.7 | 24.9 | 26.3 |
| Long Year Avg. | 24.4 | 24.5 | 24.9 | 25.6 | 26.3 | 26.5 | 26.1 | 26.5 | 26.6 | 26.2 | 25.6 | 24.9 | 25.7 |
| Average Temperature (°C) | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
| CURAÇAO 2016 | 26.6 | 27.1 | 27.7 | 28.3 | 28.9 | 29.2 | 29.2 | 29.5 | 29.3 | 29.4 | 28.2 | 27.3 | 28.4 |
| Long Year Avg. | 26.5 | 26.6 | 27.1 | 27.6 | 28.3 | 28.5 | 28.4 | 28.7 | 28.9 | 28.5 | 27.9 | 27.0 | 27.8 |
| Average Maximum Temperature (°C) | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
| CURAÇAO 2016 | 30.1 | 30.7 | 31.2 | 31.7 | 32.5 | 33.0 | 32.8 | 33.4 | 33.1 | 33.0 | 31.2 | 30.0 | 31.9 |
| 1981-2010 Avg. | 29.9 | 30.1 | 30.7 | 31.4 | 32.0 | 32.1 | 32.1 | 32.7 | 32.8 | 32.1 | 31.1 | 30.3 | 31.4 |
| Absolute Maximum Temperature (°C) | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Abs. Max. |
| CURAÇAO 2016 | 31.5 | 31.4 | 32.7 | 32.9 | 34.6 | 34.4 | 34.4 | 37 | 35 | 35.8 | 34.1 | 31.7 | 37.0 |
| 1981-2010 Record | 33.0 | 33.2 | 33 | 34.7 | 36.1 | 37.5 | 35.0 | 37.4 | 38.3 | 36.9 | 35.6 | 33.3 | 38.3 |
| Year | | | | | | | | | 1996 | | | | |



**METEOROLOGICAL DEPARTMENT CURAÇAO
CLIMATOLOGICAL DATA 2016**

Rainfall in mm.

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Total |
|---------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| CURAÇAO 2016 | 8.0 | 4.3 | 5.0 | 2.0 | 2.2 | 10.2 | 28.2 | 3.0 | 52.8 | 36.9 | 284.0 | 106.1 | 542.7 |
| 1981-2010 Avg. | 46.0 | 28.8 | 14.1 | 19.4 | 21.3 | 22.4 | 41.3 | 39.7 | 49.1 | 102.0 | 122.4 | 95.5 | 600.6 |

Average air pressure (Hpa.)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| CURAÇAO 2016 | 1012.8 | 1012.3 | 1013.2 | 1010.8 | 1011.9 | 1013.3 | 1012.9 | 1011.6 | 1011.2 | 1008.8 | 1008.9 | 1012.0 | 1011.6 |
| 1981-2010 Avg. | 1013.7 | 1013.8 | 1013.2 | 1012.3 | 1012.1 | 1013.2 | 1013.5 | 1012.6 | 1011.6 | 1011.1 | 1011.3 | 1012.8 | 1012.5 |

Average Wind Speed at 10 m. height (in m/sec.)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| CURAÇAO 2016 | 5.9 | 6.9 | 6.6 | 5.9 | 7.0 | 7.3 | 6.6 | 6.6 | 5.7 | 4.9 | 3.9 | 5.9 | 6.1 |
| 1981-2010 Avg. | 6.3 | 6.6 | 6.5 | 6.3 | 6.3 | 6.9 | 6.4 | 6.2 | 5.6 | 5.2 | 5.2 | 6.0 | 6.2 |

Average Wind Direction at 10 m. height (in m/sec.)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|
| CURAÇAO 2016 | 116.0 | 106.0 | 87.0 | 89.0 | 96.0 | 98.0 | 92.0 | 96.0 | 94.0 | 97.0 | 89.0 | 89.0 | 95.8 |
| 1981-2010 Avg. | 87.6 | 87.4 | 86.5 | 86.3 | 89.5 | 92.7 | 90.5 | 90.2 | 90.7 | 88.9 | 86.7 | 87.0 | 88.7 |

Absolute Maximum Wind Speed at 10 m. (in m/sec.)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Max. |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CURAÇAO 2016 | 16.9 | 18.0 | 16.9 | 15.4 | 15.9 | 17.5 | 17.5 | 17.0 | 15.9 | 15.9 | 14.9 | 20.0 | 20.0 |
| Absolute Max. | 19.5 | 19.0 | 24.9 | 19.0 | 20.0 | 21.6 | 25.7 | 21.1 | 19.0 | 22.1 | 22.6 | 23.1 | 25.7 |



METEOROLOGICAL DEPARTMENT CURAÇAO
CLIMATOLOGICAL DATA 2016

Avg. Sunshine duration in hours

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|------------|------------|------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|------------|
| CURAÇAO 2016 | 9.3 | 9.5 | 9.9 | 8.1 | 7.8 | 8.5 | 9.6 | 10.2 | 9.1 | 8.9 | 6.7 | 8.4 | 8.8 |
| 1981-2010 Avg. | 8.5 | 8.9 | 8.8 | 8.3 | 8.6 | 8.9 | 9.4 | 9.8 | 8.7 | 8.0 | 7.8 | 8.0 | 8.6 |

Cloud Coverage(in %)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CURAÇAO 2016 | 36.1 | 35.4 | 43.1 | 58.6 | 61.9 | 57.7 | 52.8 | 43.6 | 54.6 | 60.5 | 67.3 | 51.6 | 51.9 |
| 1981-2010 Avg. | 45.7 | 42.3 | 58.3 | 43.1 | 47.5 | 54.5 | 49.9 | 45.0 | 44.2 | 36.4 | 36.8 | 41.4 | 46.1 |

Avg. Evaporation (in mm/day)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| CURAÇAO 2016 | 6.3 | 8.1 | 9.1 | 8.7 | 8.1 | 8.4 | 8.5 | 9.1 | 7.8 | 7.1 | 5.3 | 5.5 | 7.7 |
| 1981-2010 Avg. | 5.6 | 6.3 | 7.2 | 7.6 | 7.8 | 8.1 | 7.8 | 8.1 | 7.7 | 6.3 | 5.2 | 5.1 | 6.9 |

Potential Wind Energy (in KWhr/m²)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Avg. |
|---------------------|--------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|--------------|
| CURAÇAO 2016 | 108.6 | 151.0 | 143.3 | 95.7 | 106.3 | 176.3 | 135.4 | 138.8 | 92.0 | 65.4 | 32.6 | 98.6 | 112.0 |
| Long Year Avg. | 121.0 | 121.9 | 134.5 | 122.3 | 129.4 | 150.1 | 132.0 | 118.5 | 92.4 | 74.6 | 74.5 | 106.4 | 114.8 |

Abs. Max = Absolute maximum

Abs. Min = Absolute minimum

Avg. = Average

Record= Long Year Record

METEOROLOGICAL DEPARTMENT CURAÇAO CLIMATOLOGICAL SUMMARY

Year 2016

Station: HATO, Airport

RAIN

| | | | | | |
|--|----------|--|-------|--------|--|
| Rainfall total | | | 542.7 | mm | |
| Rainfall percentage total / (long-term average) | | | -11% | | |
| Rainfall 24 hour's maximum date: | 8-Nov-16 | | 82.9 | mm | |
| Rainfall amount of days \geq 1.0 mm | | | 56 | day(s) | |
| Hours with rainfall | | | 260 | hrs | |
| Hours with rainfall percentage / (long-term average) | | | -46 | | |

EVAPORATION

| | | | | | |
|-----------------------------------|-----------|--|-------|----|--|
| Evaporation daily average | | | 7.70 | mm | |
| Evaporation total | | | 2795 | mm | |
| Evaporation maximum / month date: | 29-Aug-16 | | 17.30 | mm | |

SUNSHINE

| | | | | | | |
|---|-----------|--|----|-------|----------------|------|
| Sunshine duration average | | | 8 | 50 | hrs | min |
| Sunshine percentage total / normal | | | | | | % |
| Sunshine absolute max. / month date: | 16-Jan-16 | | 10 | 42 | hrs | min |
| Sunshine absolute min. / month date: | 3-Jan-16 | | 2 | 42 | hrs | min |
| Solar radiation monthly average | | | - | Whr / | m ² | /day |
| Solar radiation absolute max. / month date: | | | - | Whr / | m ² | /day |
| Solar radiation absolute min. / month date: | | | - | Whr / | m ² | /day |

TEMPERATURE

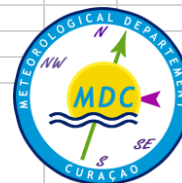
| | | | | | |
|--|-----------|-------|------|----|--|
| Temperature average | | | 28.4 | °C | |
| Temperature max. average | | | 31.9 | °C | |
| Temperature absolute max. date / time: | 26-Aug-16 | 13:22 | 37.0 | °C | |
| Temperature min. average | | | 26.3 | °C | |
| Temperature absolute min. date / time: | 20-Jan-16 | 4:26 | 22.7 | °C | |
| Relative humidity average | | | 77.6 | % | |

WIND

| | | | | | |
|---------------------------------------|----------|-------|--------|----------|---------------------|
| Wind speed average | | | 11.9 | kts | |
| Wind speed average max. | | | 23.9 | kts | |
| Wind speed absolute max. date / time: | 9-Dec-16 | 10:36 | 39 | kts | |
| Wind vector average | | | 96.0 ° | 12.0 Kts | |
| Wind energy potential total * | | | 1,397 | KWhr / | m ² |
| Wind energy average * | | | 45 | KWhr / | m ² /day |
| Wind energy potential maximum * date: | | | 57 | KWhr / | m ² /day |
| Wind energy potential minimum * date: | | | 24 | KWhr / | m ² /day |

REMARKS

| | | | | | |
|--|--|--|--|--|--|
| <p>* Wind energy at a height of 10 m for windspeeds of 4 m/s or more. ** Sunshine duration in hrs (solar time) *** Solar radiation (local time) _ Blank field - No data available</p> | | | | | |
|--|--|--|--|--|--|



2016 Preparing for the next generation

In the scope of preparing for the next generation (21st century) for the Meteorological Department of Curaçao. The department has started in the course of the last 3 years a program to upgrade its current personnel and also renewing the old dated equipment for state of the art and more precise instruments. Also the exercise of recruiting new staff for the next generation of meteorologists and observers. The International Civil Aviation Organization and the World Meteorological Organization in a joint effort introduced more strict regulations for the Civil Aviation world. These stricter regulations were implemented in December of 2016 and all members are.



Mr. Denrick R. Rombley, born in Curaçao, graduated in November of 2016 as the first forecaster at the “Agencia Estatal de la Meteorología en España” (AEMeT). During a very intensive period of approximately 2 years, Mr. Rombley followed at first, during several months an online course which contained approximately 110 subjects which consisted of dynamic meteorology, synoptic meteorology, mesoscale modelling, Climatology, Aerology and several more related topics.

For the last two months of the course Mr. Rombley had to attend in Madrid management courses, also courses on operating and maintaining observation equipment and also additional courses on forecasting and Climatology.

This all thanks to the association of M.D.C. in 2014 to “La Conferencia de Directores en Meteorología y Hydrología de los países Iberoamericanos”.

This association made it possible for the M.D.C. personnel to attend to courses of CIMHET.

During the graduation ceremony the president of the AeMeT, Mr. Don Miguel Angel López referred to the great effort that was necessary to make the course become a success. He also urged the meteorological community all around the globe to cooperate and work together as a big family, which is the only way humanity can deter natural catastrophic events.



The representative of the W.M.O. in Genève which is also chief of the department for Education and scholarships, Dr. Yinka Adebayo, urged all the new forecasters to continue to develop themselves further as real professionals. He stated that this graduation should not be the end of their carrier, but the start of their capacity development for the well being of there respective countries.

Together with Mr. Rombley participants of the following countries also received their certification: Bolivia, Chile, Colombia, Ecuador, Nicaragua, Panamá, Republic of Sto. Domingo, El Salvador and Venezuela.

Mrs. Ann Groot-Philipps, BSc. Director from the “Kas di Kòrsou” in the Netherlands, she also represented the government of Curaçao, for the European Union in Brussels, and the director of the M.D.C. Dr. Albert Martis. During her speech Mrs. Groot Philipps thanked the government of Spain and also the W.M.O. for financing the whole course. She was also very pleased to hear that Mr. Rombley was a model student during the whole course. The minister of “Transportation, Aviation and Urban development” Mrs. Camelia Römer, expert in law, who the M.D.C. resorts congratulates Mr. Denrick Rombley with his big achievement.

