

# Meteorological Service Netherlands Antilles & Aruba



Annual report 2003

Published by : THE METEOROLOGICAL SERVICE OF THE NETHERLANDS ANTILLES AND ARUBA.  
SERU MAHUMA z/n  
CURAÇAO, NETHERLANDS ANTILLES  
<http://www.meteo.an>

COVER : Dam at Muizenberg, Curaçao

## Tables of Contents

Introduction .....	3
Rainfall outlook 2004 .....	4
Hurricane season 2003 .....	5
ABC-Islands .....	11
Curaçao .....	11
PRECIPITATION .....	11
TEMPERATURE .....	12
WIND .....	13
POTENTIAL WIND ENERGY .....	13
AIR PRESSURE .....	14
SUNSHINE DURATION .....	14
CLOUD COVER .....	15
EVAPORATION .....	15
Bonaire .....	16
PRECIPITATION .....	16
TEMPERATURE .....	16
WIND .....	17
AIR PRESSURE .....	18
Aruba .....	19
PRECIPITATION .....	19
TEMPERATURE .....	19
WIND .....	20
AIR PRESSURE .....	21
SSS-Islands .....	22
St. Maarten .....	22
PRECIPITATION .....	22
TEMPERATURE .....	22
WIND .....	23
AIR PRESSURE .....	24
SUNSHINE .....	24
CLOUD COVER .....	25
EVAPORATION .....	25
St. Eustatius .....	26
PRECIPITATION .....	26
TEMPERATURE .....	26
WIND .....	27
AIR PRESSURE .....	28
Saba .....	29
PRECIPITATION .....	29
Track Map of 2003 Atlantic Tropical Cyclones .....	30
Tables of Climatological Data .....	31

## **INTRODUCTION**

### **GLOBAL TEMPERATURE IN 2003 THIRD WARMEST ON RECORD.**

The global surface temperature for 2003 was expected to be +0.45/C above the annual average. This will make 2003 the third warmest year just behind 2002 (+0.48/C). The warmest year is 1998 (+0.55/C) in the past 1000 years. The global surface temperature has increased since the beginning of the instrumental record in 1861. Over the 20<sup>th</sup> century the increase was greater than 0.6/C. The 1990's were the warmest decade.

The year 2003 began with a moderate El Niño fading to neutral conditions by the end of April. Nevertheless the atmospheric conditions, which go along with a warm event, were observed through June. In the second half of the year the SST in the equatorial Pacific Ocean slowly increased, but did not reach the criteria to be called a warm event.

The SST in the Tropical Atlantic and the Caribbean Sea were normal in the first half of the year and gradually warmed up during the last three months of year 2003.

### **NETHERLANDS ANTILLES, CLIMATE 2003**

Aruba, Bonaire, Curaçao.

The occurrence of a moderate El Niño, combined with normal Sea Surface Temperature in the Caribbean Sea and Tropical Atlantic Ocean induced rainfall deficits on the islands of Aruba, Bonaire and Curaçao in the first 9 months of 2003. A dissipating El Niño and the warming up of the SST in the Tropical Atlantic Ocean and the Caribbean Sea late 2003 increased the rainfall both in event and amount on the ABC islands. (On December 2<sup>nd</sup> at Beatrix Airport, Aruba a new 24hour rainfall maximum record of 71.8mm, was established for the month of December). Also a new absolute maximum temperature, 36.5/C, was established for Aruba.

Saba, St. Eustatius, St. Maarten

No tropical cyclones affected St. Maarten, St. Eustatius or Saba during the 2003 hurricane season.

Very heavy rainfall during the months of April and November brought the annual rainfall total to above the annual average for all the three islands. The monthly rainfall total for the remaining months was either normal or below normal. New records were established for the monthly rainfall total for April (273.8 mm) at the Juliana Airport, St. Maarten and for December (195.6mm) at the F.D. Roosevelt Airport, St. Eustatius. On December 11<sup>th</sup> a new record was established for the 24 hours maximum rainfall, 77.2mm, for St. Eustatius. These records are based on the climatological normals over the period 1971-2000.

### **SEISMOLOGY NETHERLANDS ANTILLES**

In the morning of July the 13th volcanic ash was reported on the islands of St. Maarten, St. Eustatius and Saba. The Montserrat volcano observatory has reported eruption on the Soufriere Hills early that morning. The ash plume spread out and propagated in a northwesterly direction due to a prevailing southeasterly wind in the lower atmosphere. Consequently considerable amount of ash was reported on the islands and the airports were closed for several hour. Nevertheless, there were no reports of injuries or damage.

In the afternoon of November 17th, a small earthquake was felt at different locations on Curaçao and Aruba. Information received from the seismic institution of Venezuela (FUNVISIS) confirmed that there was a small earthquake southwest of Curaçao. The epicenter of this earthquake was located at 12.03N and 69.42W, about 50 km southwest of Willemstad, Curaçao and 65 km southeast of San Nicolas, Aruba. The earthquake had a magnitude of 3.8 on the Richter scale and was located at a depth of 17.9 km.

No damage was reported in the ABC Islands.

## **Rainfall outlook for 2004**

There are several climate models that show near neutral conditions for the ENSO event through June 2004. Thereafter some of the models show a slight increase of the Sea Surface Temperature (SST) which may result in a weak El Niño. Some models do not indicate this increase in the SST thus making it difficult to make a reliable outlook for the second half of 2004.

The outlook for the SST in the Tropical Atlantic Ocean and the Caribbean Sea indicates that warm conditions will be maintained during the first part of 2004. Therefore the rainfall during this period of the year will be near to above normal for the ABC and the SSS islands. If a weak El Niño event occurs, the rainfall will be somewhat suppressed during the rainfall season on the ABC islands during the second half of 2004.

## Hurricane Season 2003

There were sixteen named tropical cyclones in the Atlantic basin in 2003. Seven of these became hurricanes. These totals compare to long-term averages of ten named tropical cyclones and six hurricanes. There have been six seasons with sixteen or more named storms in the 118 seasons since 1886. So this season ranks in the top five of seasonal number of named tropical cyclones. Seven hurricanes is close to the long-term average value of six but both *Fabian* and *Isabel* were exceptionally long-lived and intense hurricanes. *Fabian*, *Isabel* and *Kate* were major hurricanes with wind speeds of 185 km/hour or higher (category three or higher on the *Saffir-Simpson* hurricane scale). In addition, there were five tropical depressions which did not reach storm strength.

None of these 21 systems caused any direct hit for neither the SSS nor the ABC Islands. Hurricanes *Fabian* and *Isabel* both appeared to be a potential risk for the islands in the Northeastern Caribbean Area but the three to five day forecasts indicated well in advance that these systems would both miss these islands by hundreds of kilometers. Large swells generated by both these major hurricanes however were observed on the coasts of these islands. Late-season tropical storm *Odette* developed North of Colombia and was indirectly responsible for heavy rain in Aruba. It also moved over the island of Hispaniola a couple of days later and some of the associated (heavy) rain got as far East as St. Maarten.

### Very Early Start

The season started very early on Easter Sunday (April 20) when tropical storm *Ana* developed. It was also extended beyond the official end of November 30 when two late-season December tropical storms, *Odette* and *Peter*, developed. *Ana* was the first April tropical storm on record. The only other year on record with two December tropical cyclones is 1887.

*Ana* formed as a subtropical cyclone about 400 kilometers West of Bermuda on April 20 and soon became a tropical system. It moved generally toward the East across the central North Atlantic with maximum winds reaching 95 km/hour before becoming extratropical on April 24. Two deaths are attributed to *Ana* when a boat capsized at Jupiter Inlet, Florida on April 20 due to a combination of incoming swells from *Ana* and the outgoing tide.

Short-lived tropical depression *Two* developed over the tropical Atlantic on June 10. This was only the third tropical cyclone to form East of the Lesser Antilles in June since 1967. The depression moved quickly westward and degenerated into a tropical wave only one day after it developed.

### Bill Makes Landfall

Tropical storm *Bill* formed over the Southern Gulf of Mexico on June 29 from the interaction of a tropical wave with an upper-level low. It moved northward and made landfall in Southeastern Louisiana with winds to 95 km/hour late on the next day. *Bill* produced at least five tornadoes, coastal flooding and heavy rain. One tornado struck Reserve, Louisiana damaging 20 mobile homes and injuring four persons. *Bill* was absorbed by a frontal system over Virginia on July 3 after producing locally heavy rain and floods over much of the Southeastern United States. This system was responsible for four deaths and about 50 million U.S. dollars in damage.

### First Caribbean Storm

Hurricane *Claudette* developed from a tropical wave over the central Caribbean Sea on July 8. *Claudette*'s winds briefly reached 130 km/hour on July 10 before the storm made landfall and moved across the Yucatán peninsula with 95 km/hour winds on the next day. *Claudette* then moved slowly northwestward to west-northwestward across the Western Gulf of Mexico for several days before making landfall at Matagorda Island just East of Port O'Connor, Texas on July 15 as a category one hurricane with 145 km/hour winds. *Claudette* turned westward after landfall and moved across Southern Texas and Northern Mexico before dissipating over the high terrain of Northwestern Mexico on July 17. *Claudette* was responsible for one direct fatality and 180 million U.S. dollars in damage in Texas. Minor damage was reported from St. Lucia in the Windward Islands from the *pre-Claudette* tropical wave.

Hurricane **Danny** developed from a tropical wave about 1000 kilometers East of Bermuda on July 16. **Danny** moved northward and then eastward across the North Atlantic Ocean on a lengthy clockwise loop and strengthened to a minimal, 120 km/hour, hurricane on July 18 and 19. On July 21, **Danny** weakened to a non-convective remnant low that continued on the clockwise track with a smaller loop superimposed on the larger-scale track for six more days. The remnant low finally dissipated on July 27 about 2015 kilometers East of Bermuda and only 1045 miles East of where this system originated.

Tropical depression **Six** was short-lived. It formed from a tropical wave on July 19 over the central tropical Atlantic and moved quickly westward. The depression degenerated into an open tropical wave two days later while located just East of the central Lesser Antilles. A few thunderstorms accompanied the wave as it moved through the islands and the depression dissipated completely on July 23 over the central Caribbean Sea.

Tropical depression **Seven**, which formed from the same tropical wave that spawned tropical depression **Six**, developed on July 25 just East of Daytona Beach, Florida. The depression moved inland on the central Georgia coast with 50 km/hour winds on July 26 and dissipated over central Georgia on the next day. The depression produced 50 to 75 mm of rain over portions of Eastern Georgia and South Carolina.

### **Belated Hurricane**

Hurricane **Erika** was first detected as a weak surface low detached from a decaying frontal system about 1850 kilometers East of Bermuda on August 8. This low interacted with an upper-level cold low and the combined system moved across the Bahamas and South Florida before developing into a tropical cyclone in the Eastern Gulf of Mexico on August 14. **Erika** briefly strengthened to a 120 km/hour hurricane as it made landfall along the Northeastern coast of Mexico about 75 kilometers South of Brownsville, Texas on August 16. Extreme Southern Texas experienced tropical-storm force winds. **Erika** dissipated on the next day over the mountains of Northern Mexico. Two persons died in Montemorelos Mexico when their truck was swept away by flood waters as they tried to cross a partially-submerged bridge. Damage in Mexico consisted of roof and automobile damage as well as numerous highways blocked by mud slides. Interestingly **Erika** was not operationally upgraded to a hurricane but a post-storm review of Brownsville doppler radar data indicates that this system was actually a hurricane at landfall.

Tropical depression **Nine** was a short-lived tropical cyclone that developed from a fast-moving tropical wave in the Eastern Caribbean Sea on August 21. The depression moved west-northwestward and degenerated into a tropical wave South of Hispaniola on the next day.

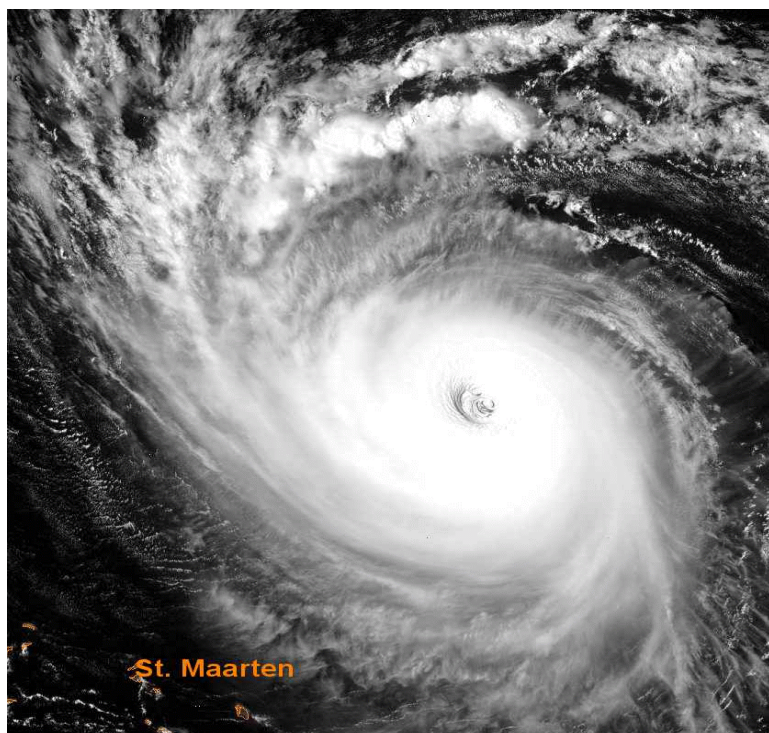
### **The First Big One**

Hurricane **Fabian** developed on August 27 from a tropical wave over the far Eastern tropical Atlantic Ocean. Its track followed a clockwise path around the Western periphery of a subtropical high pressure ridge until it became extratropical over the far North Atlantic to the East of Newfoundland on September 8. **Fabian** moved West-Northwestward across the tropical Atlantic from August 27 until September 3 while gradually strengthening to its peak sustained winds of 235 km/hour, category four intensity, on September 1. Fluctuating in strength for several days but remaining at least category three intensity, the hurricane turned northward on September 4 and hit Bermuda on the next day with winds near 185 km/hour. **Fabian** caused four deaths in Bermuda as well as extensive damage estimated near 300 million U.S. dollars. The total death toll of eight includes three fishermen who drowned near Newfoundland, Canada and a rip current drowning near Cape Hatteras, North Carolina in the United States.



Tropical storm **Grace** developed from a tropical wave. The wave became a tropical depression and then a 65 km/hour tropical storm on August 30 over the West-central Gulf of Mexico. **Grace** moved north- westward to the Texas coast near Galveston on August 31 as a disorganized and weakening tropical storm. It weakened to a depression shortly after moving inland and eventually merged with a frontal system over Arkansas on September 2. Up to 200 mm of rain fell over Eastern Texas and Southwestern Louisiana.

Tropical storm **Henri** formed from a tropical wave on September 3 over the East-central Gulf of Mexico. It moved slowly eastward and winds reached their peak value of 95 km/hour on September 5. While weakening, **Henri** accelerated northeastward across North-central Florida as a tropical depression with 30-mph winds. **Henri** dissipated on September 8 about 240 kilometers South of Cape Hatteras, North Carolina while becoming extratropical. **Henri** dumped up to 250 mms of rain over portions of West-central Florida.



*Isabel as a category five hurricane well Northeast of St. Maarten on September 12, 2003.*

## Category Five

### Isabel

**Isabel** was a long-lived Cape Verde hurricane that formed as a tropical cyclone over the Eastern tropical Atlantic Ocean on September 6. It moved in a general west-northwestward direction and strengthened to a category five hurricane by September 11 with 265 km/hour winds. **Isabel's** maximum winds remained between 240 and 260 km/hour for five days from September 11 to 15. Weakening began on September 16 as the hurricane turned north northwestward.

**Isabel** made landfall on the outer banks of North Carolina on September 18 as a category two hurricane with maximum winds of 170 km/hour and higher gusts. Portions of Eastern North

Carolina and Southeastern Virginia experienced hurricane-force winds.

Tropical-storm-force winds spread inland over a large area from Eastern North Carolina northward to the Eastern Great Lakes and Western New England. They also spread northward along the Atlantic coast to New York. Storm surge flooding along the Atlantic coast was 2 to 3 meters above normal near the point of landfall and above normal tides extended to Long Island, New York. Over three meters of surge was reported on North Carolina's Neuse River. Surge values of two to three meters were observed in the upper reaches of Chesapeake Bay and in many of the rivers that normally drain into the bay, including the Potomac and James rivers. Water levels in Washington D.C., Baltimore and Annapolis exceeded the previous record levels established by the 1933 Chesapeake-Potomac hurricane. Delaware Bay and Delaware river also had a significant storm surge flood. Rainfall was in the 100 to 175 mm range over portions of North Carolina, Virginia and Maryland. Higher amounts up to 275 mm occurred in the Shenandoah Valley (Northwestern Virginia).

**Isabel** was responsible for sixteen direct deaths, ten in Virginia and one each in Maryland, New Jersey, North Carolina, Pennsylvania, Rhode Island and Florida. The Florida and Rhode Island deaths were drowning deaths in high surf generated by **Isabel**. The total damage caused by **Isabel** until December was estimated at 3.37 billion (3.370.000.000) U.S. dollars.

Tropical depression *Fourteen* developed from a tropical wave on September 8 over the far Eastern tropical Atlantic Ocean. The depression quickly encountered unfavorable upper-level winds and dissipated on September 10 as it passed through the Western Cape Verde Islands.

### **Juan Hits Canada**

Hurricane *Juan* had a complex formation developing from the interaction of a tropical wave with a large upper-level low about 485 kilometers Southeast of Bermuda on September 25. *Juan* initially appeared to have subtropical characteristics but became fully tropical as it moved north-northwestward to northward. Continuing northward, the center passed about 360 kilometers East of Bermuda and *Juan's* winds increased to 170 km/hour on September 27. Hurricane *Juan* made landfall in Nova Scotia early on September 29 as a category two hurricane with 160 km/hour winds. The hurricane weakened some over Nova Scotia and arrived in Prince Edward Island as a 120 km/hour hurricane. Two deaths have been attributed directly to *Juan* and the Canadian Hurricane Centre reported that this hurricane was the most damaging storm in modern history for Halifax.

### **Third Major Storm**

Hurricane *Kate* developed from a tropical wave in the central tropical Atlantic Ocean on September 25. The tropical cyclone became a hurricane on September 29 and, after temporarily weakening, reached an estimated 200 km/hour wind speed, category three intensity, on October 4. *Kate's* track was rather unusual. It moved northwestward and then northeastward for several days. Then it made a sharp turn and moved westward across the central North Atlantic for five days before accelerating northeastward into the far North Atlantic Ocean. *Kate* became a powerful extratropical low pressure system, East of Newfoundland on October 8 and merged with another low pressure system near Norway on October 10.

Tropical storm *Larry* developed from a tropical wave that interacted with a frontal system. The system became a tropical storm over the Bay of Campeche on October 1. Winds reached 105 km/hour on the next day as the tropical storm drifted slowly and erratically southward. Maintaining the same intensity, *Larry* moved inland on October 5 with winds of 95 km/hour along the coast of the state of Tabasco, Mexico and dissipated inland over the state of Vera Cruz on the next day. Heavy rain affected portions of Southeastern Mexico and five deaths from fresh water floods are attributed to *Larry*.

Tropical storm *Mindy* originated from a tropical wave and became a 75-km/hour tropical storm on October 10 near the northeastern tip of the Dominican Republic. *Mindy* moved northwestward to northward for two days, gradually weakened to a depression by October 12 and then turned eastward ahead of an approaching mid-level trough. The depression dissipated on October 14 while located about 800 kilometers North of Puerto Rico. *Mindy* passed near the Turks and Caicos Islands on October 11 but heavy rain and tropical storm force winds remained to the East of these islands. *Mindy* produced periods of heavy rain over portions of Puerto Rico and Eastern Dominican Republic.

Tropical storm *Nicholas* formed from a tropical wave on October 13 over the central tropical Atlantic Ocean. *Nicholas* reached its peak intensity of 115 km/hour on October 17 while located several hundred miles East of the Lesser Antilles. *Nicholas's* track as a tropical cyclone lasted ten days and was slow and generally northwestward. The cyclone degenerated into a remnant low cloud swirl on October 23 several hundred miles northeast of the Northern Leeward Islands with the remnant low meandering erratically over the Western North Atlantic Ocean for several more days.



<b>Trop. Depr. Nr.</b>	<b>Name</b>	<b>Period</b>	<b>Lowest Air Pressure</b>	<b>Maximum sustained winds</b>
1	TS Ana	April 20 - 24	994 hPa	95 km/h
3	TS Bill	June 29 - July 3	997 hPa	95 km/h
4	Hur. Claudette	July 8 - 17	979 hPa	150 km/h
5	Hur. Danny	July 16 - 21	1000 hPa	120 km/h
8	Hur. Erika	August 14 - 16	986 hPa	120 km/h
10	Hur. Fabian	August 27 - September 8	939 hPa	230 km/h
11	TS Grace	August 30 - September 2	1007 hPa	65 km/h
12	TS Henri	September 3 - 8	997 hPa	95 km/h
13	Hur. Isabel	September 6 - 19	915 hPa	270 km/h
15	Hur. Juan	September 24 - 29	969 hPa	165 km/h
16	Hur. Kate	September 25 - October 7	952 hPa	205 km/h
17	TS Larry	October 1 - 6	993 hPa	100 km/h
18	TS Mindy	October 10 - 14	1002 hPa	75 km/h
19	TS Nicholas	October 13 - 23	990 hPa	115 km/h
20	TS Odette	December 4 - 7	993 hPa	90 km/h
21	TS Peter	December 7 - 11	990 hPa	110 km/h

## **Two December Systems**

Tropical storm *Odette* formed from an area of disturbed weather that originated along a frontal zone and then lingered over the Southwestern Caribbean Sea for several days. The disturbed weather area became a tropical depression and then a tropical storm on December 4 about 525 kilometers South Southeast of Jamaica. Winds increased to 105 km/hour by December 6 as *Odette* moved slowly northeastward. Later on the same day, after weakening slightly, it made landfall on the *Barahona* peninsula of the Dominican Republic with winds estimated at 95 km/hour. *Odette* dumped copious amounts of rainfall over portions of the Dominican Republic and Haiti. Ten fresh-water flood-related deaths have been reported from the Dominican Republic. *Odette* then moved over the Southwestern North Atlantic Ocean on December 7 and became extratropical as it merged with a frontal trough.

Tropical storm *Peter* formed from a large extratropical gale center over the far Eastern North Atlantic Ocean. Moving southward, the low gradually acquired organized convection and became subtropical storm *Peter* on December 7 while located about 1490 kilometers Northwest of the Cape Verde Islands. *Peter* completed its transition to a tropical storm and also reached its maximum intensity of 115 km/hour on December 9. At the same time, the system reversed its southward motion and moved northward ahead of a strong approaching frontal trough. *Peter* quickly weakened as it lost deep convection and moved over colder sea surface temperatures. It became extratropical on December 11 and was absorbed by a cold front soon thereafter. Satellite imagery showed a short-lived banding eye feature on December 9, suggesting that *Peter* may have briefly reached hurricane force.

## **Outlook for the 2004 Season**

Dr. William Gray, well known for his hurricane season predictions, expects another active Atlantic hurricane season in 2004. In his initial outlook issued early December 2003, he foresees the development of thirteen tropical storms of which seven should reach hurricane intensity. Three of these are forecast to become major hurricanes (maximum sustained winds of 185 km/hour or more). Cautionary statement: Dr. Gray's forecast does not specify when, where or how any particular system may affect a particular country or location.

# ABC-Islands

## General

The year 2003 began under the influence of an El Niño event that started in 2002. This moderate El Niño weakened during April and May to neutral conditions. With the exception of the month of July dry to very dry conditions were experienced on Curaçao, Bonaire and Aruba during the first 9 to 10 months of 2003. The total rainfall of 139.6mm recorded at Hato Airport for this period (January through September) is the second lowest since 1945. The normal 1970-2000 is 273.2mm. The lowest value was 120mm measured during the first 9 months of 1947.

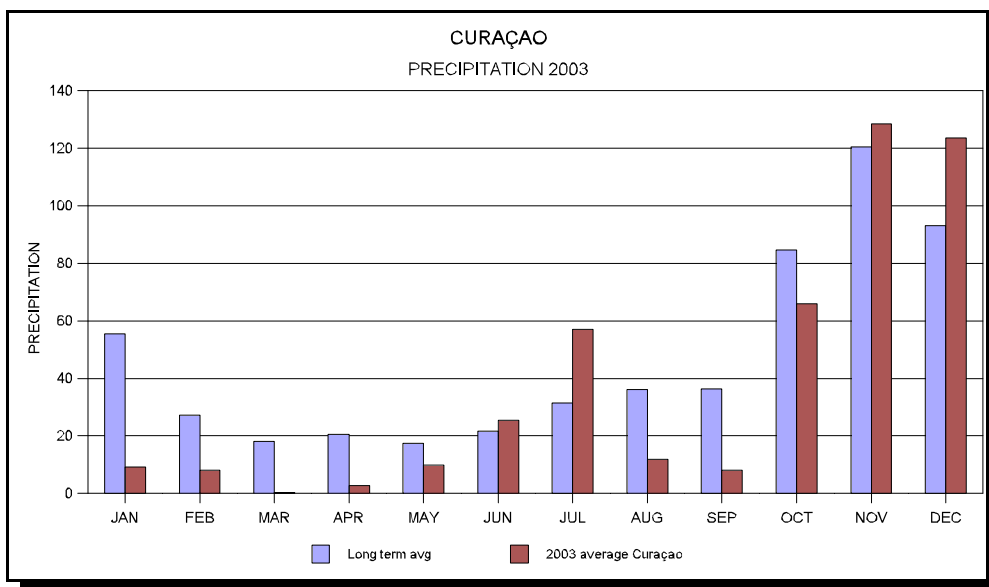
The recorded rainfall at the Flamingo Airport Bonaire for this dry period (January through October 2003) totaled 158.2mm. The normal for the same is 293.8mm

At the Queen Beatrix Airport a total of 170.2mm was recorded during January through October. The normal for the same is 265.1mm.

## Curaçao

### PRECIPITATION

The island average rainfall for 2003 was 449.8 mm. This is about 20% below the long-term average of 562.1 mm. When analyzing the individual data from the rain gauge network, the rainfall station at Mahuma recorded the highest annual total over 2003, namely 512.8 mm. The maximum 24-hour rainfall total for Curaçao was 97.5 mm measured at rainfall station San Juan on December 2. The highest monthly total of 2003 was 152.5 mm, measured in November at rainfall station Christoffel Park at Savonet. Rainfall station Van Engelen had the highest number of rain days (54 days) with rainfall greater than or equal to 1.0 mm.



### Rainfall data from Hato rainfall station

The annual rainfall total for Hato in 2003 was 507.6 mm. (The 30 year average of 1971-2000 is 553.4 mm). With 31.3% above the 30 year average (October through December) we can consider the rainfall season of 2003 to be a wet one. The total rainfall for the rainfall season of 2003 was 368 mm.

The 24 hour maximum of 77.4 mm was recorded on October 30. The one hour maximum of 57.4 mm was recorded on October 30 between 11:00 and 12:00 hours. The maximum intensity per minute for 2003 (3.6 mm) was recorded on December 2.

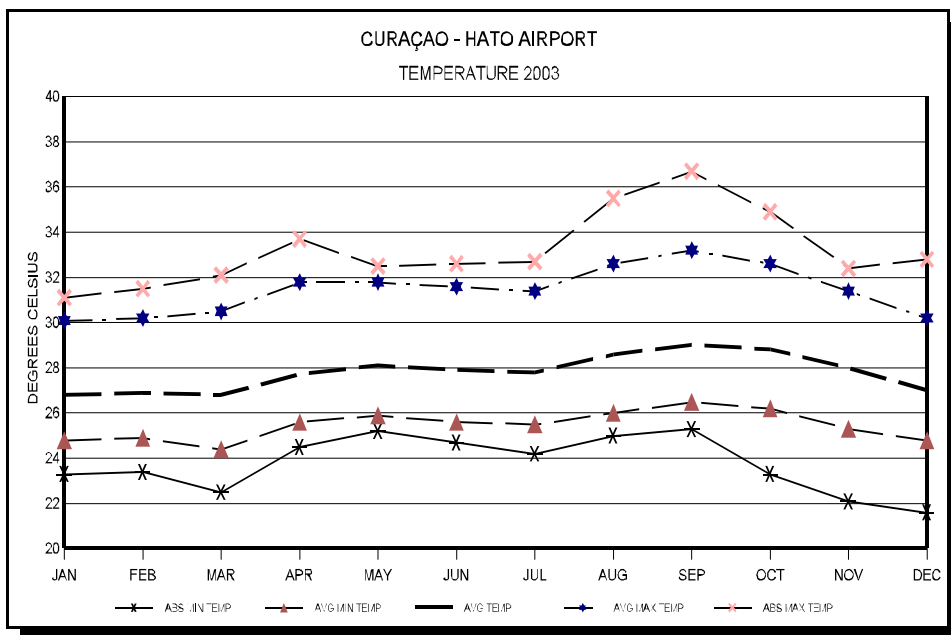
The hours with rainfall for 2003 recorded at Hato International Airport totaled 155 hours. The maximum rainfall duration (in minutes) was 102 minutes and was recorded on October 30. The number of days with thunder was 26 (normal 23 days)

### TEMPERATURE

The average air temperature as recorded at Hato International Airport over the year 2003 was 27.8/C (normal 27.8/- standard deviation 0.8). September was the warmest month with a daily average temperature of **29.0/C** (normal 28.9/C). This month also had the highest average maximum temperature of **33.2/C** (normal 31.9/C). The maximum temperature was **36.7/C** and was recorded on September 14 at 14:25 hours (Absolute maximum record of 38.3/C was established in 1996). The warmest day of 2003 was September 14 with a 24 hour average temperature of 30.5/C.

January and March were the coolest months with a daily average temperature of **26.8/C**. The month with the lowest annual average minimum temperature of **24.4/C** was March.

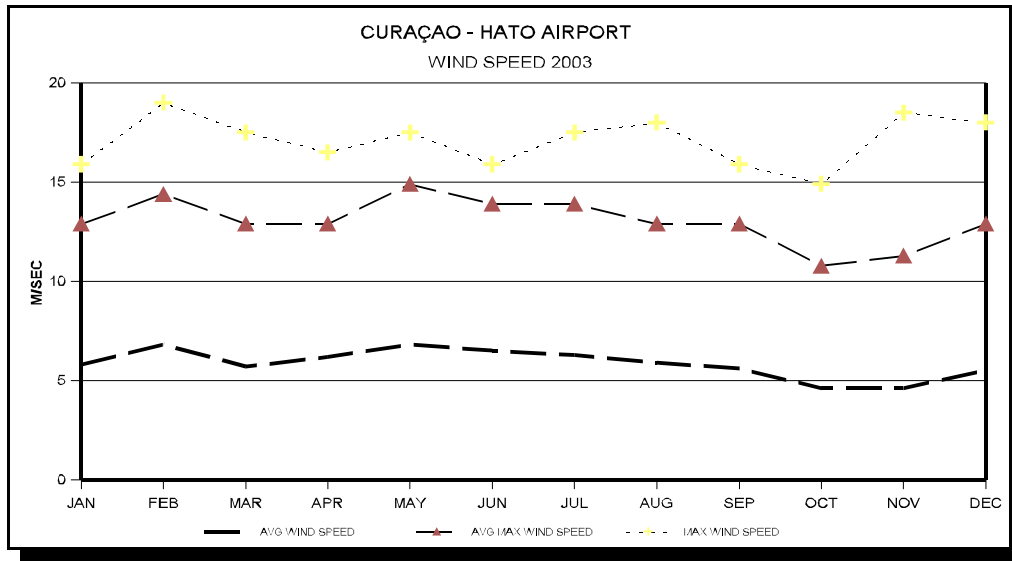
The absolute minimum temperature of 21.6/C was recorded on December 31 at 05:33 hours. The coolest day of the year was December 28 with a 24 hour average temperature of 24.5/C.



## WIND

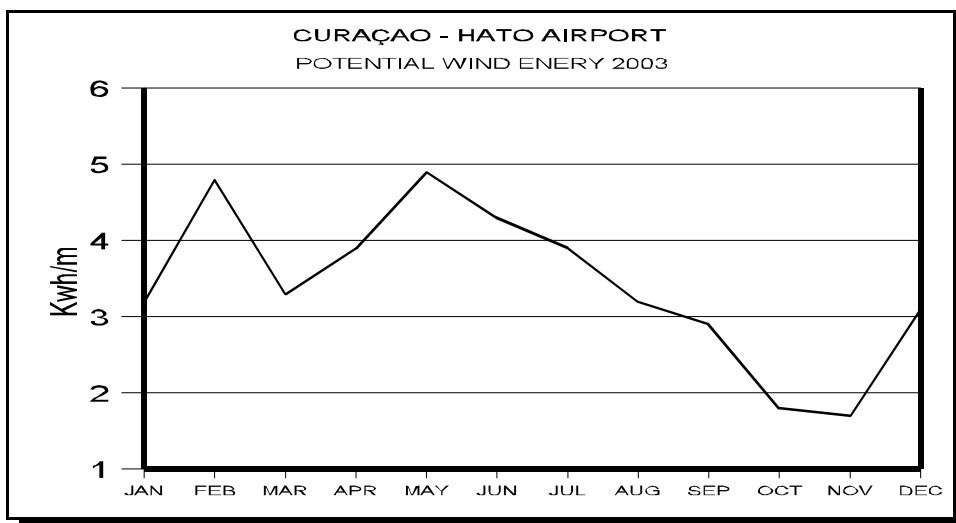
The average wind speed for the year 2003 was 5.9 m/sec (21.2 km/hr) (normal 6.6 m/sec - 23.8 km/hr) at a height of 10m and the average wind direction was 94/.

February and May were the months with the highest average wind speed of 6.8 m/sec (24.5 km/hr) and October and November were the months with the lowest average wind speed 5.5 m/sec (19.8 km/hr). The highest 24 hour average wind speed of 8.1 m/sec (29.7 km/hr) was recorded on February 22 and on July 3. The lowest 24 hour average wind speed 2.2 m/sec (8.0 km/hr) was recorded on October 29. The highest wind gust 19.0 m/sec (68.4 km/hr) was observed on February 22 at 11:01 hours.



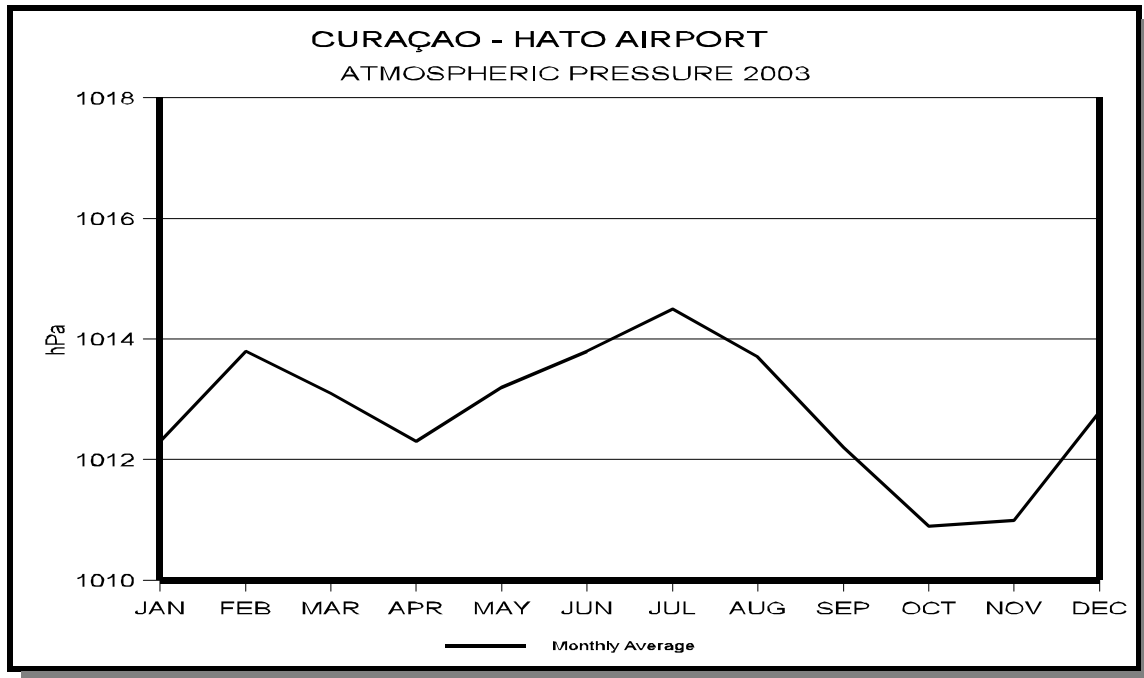
## POTENTIAL WIND ENERGY

The total potential wind energy (at 10m height and wind speeds  $\geq 4$  m/sec) for the year 2003 was 1205 kWh/m<sup>2</sup>. The daily average was 3.4 kWh/m<sup>2</sup>/day.



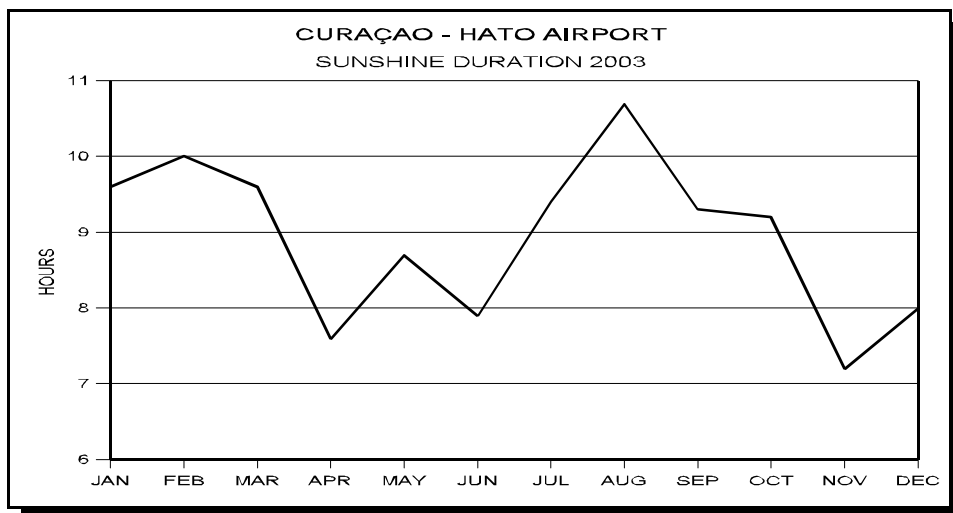
## ATMOSPHERIC PRESSURE

The average atmospheric pressure recorded at Hato Airport over the year 2003 was 1012.8 hPa. The maximum atmospheric pressure of 1018.5 hPa was recorded on December 31 while the minimum 1006.5 hPa was recorded on October 27 and November 11.



## S UNSHINE DURATION

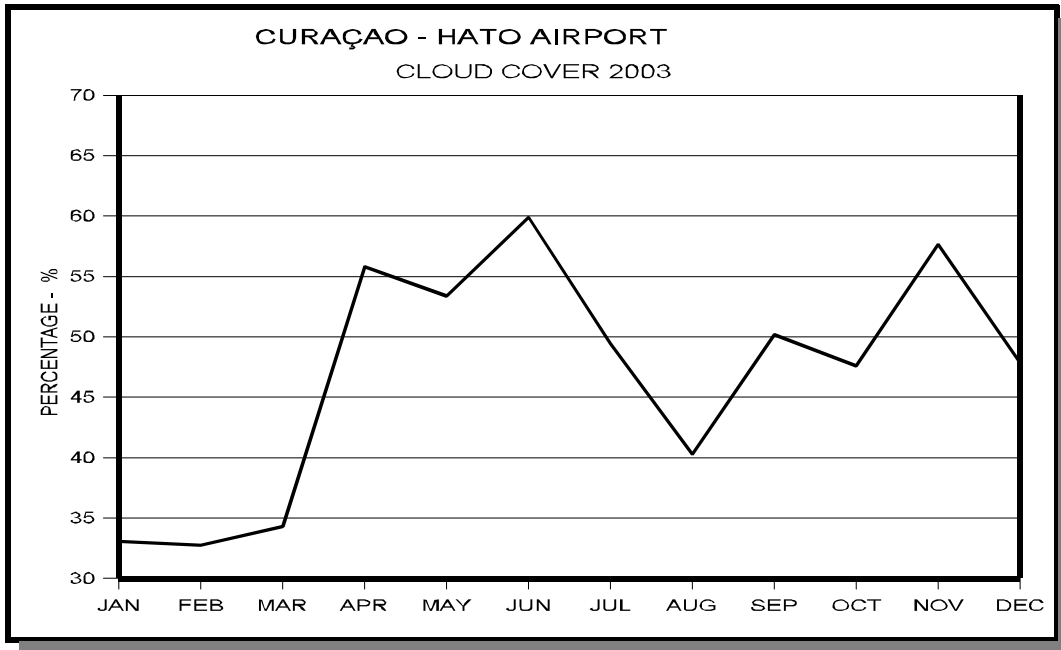
The total sunshine duration for the year 2003 was 3284.6 hours. This is 74.2 % of the maximum possible duration (4428 hrs). The average daily sunshine duration was 8 hours and 54 minutes. The sunniest month, August, had a daily average sunshine duration of 10 hours and 42 minutes while the month with the least sunshine was November, with a daily average of 7 hours and 12 minutes. The day with the maximum sunshine duration, 11 hours and 42 minutes, was August 6.





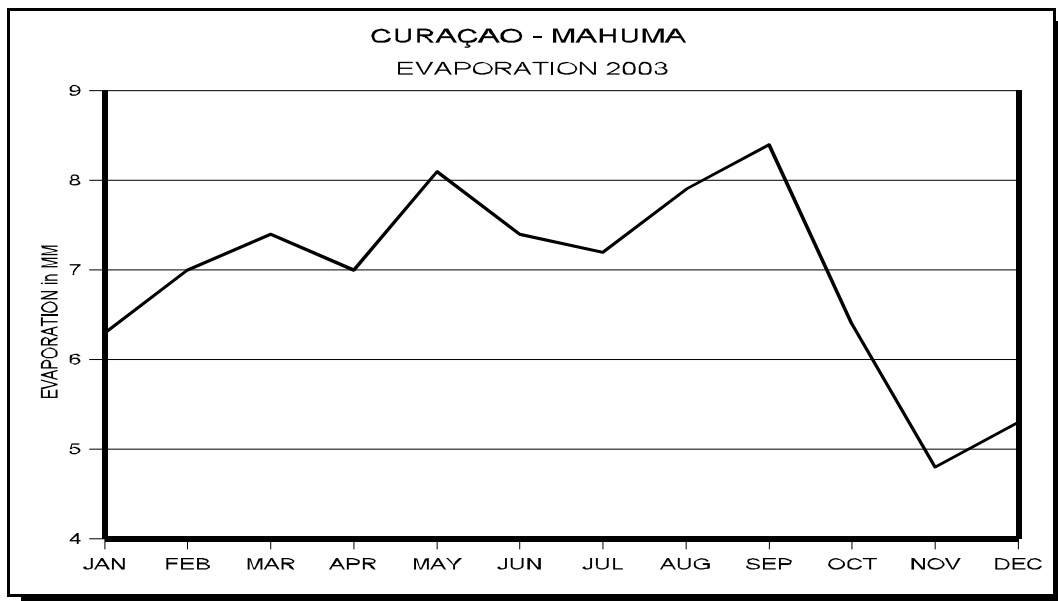
## CLOUD COVERAGE

The average cloud cover for the year 2003 was 46.9%. The highest total cloud coverage per month, 59.9% was observed in June. The lowest, 32.8% was observed in February



## EVAPORATION

The site of the evaporation pan is located at the Meteorological Service at Seru Mahuma. The daily average evaporation for the year 2003 was 6.9 mm. September had the highest daily average evaporation of 8.4 mm while November had the lowest value of 2003 with 4.8 mm.



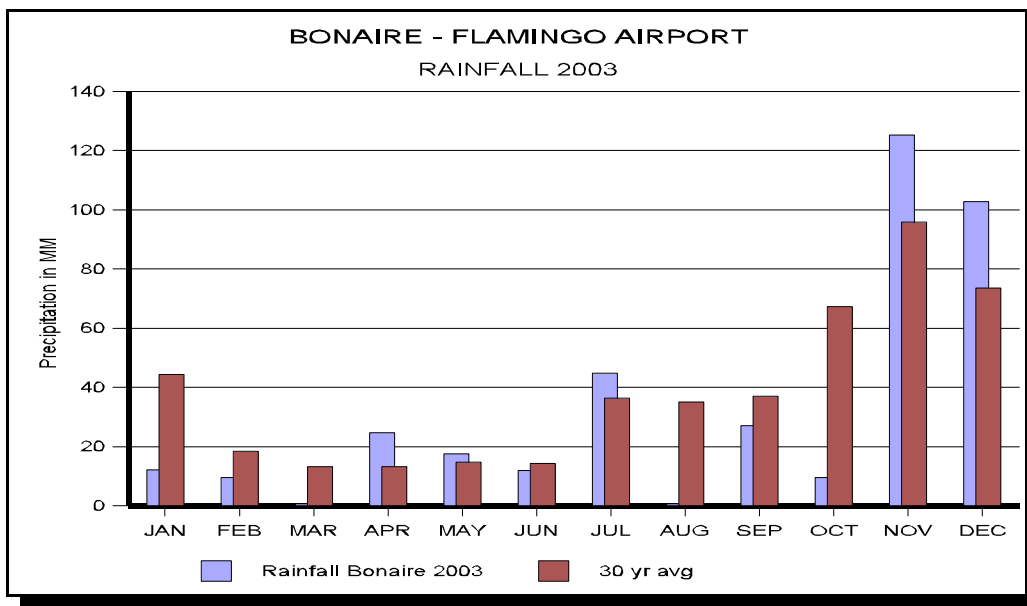
# Bonaire

## PRECIPITATION

The rainfall total, over the year 2003, as recorded at the Flamingo Airport of Bonaire was 368.2 mm. (normal 1971-2000, 463.3 mm). The rainfall total for 2003 measured at rainfall station BOPEC totaled 459.7mm considerably higher than at the Flamingo Airport.

November was the wettest month of the year with a total of 125.2 mm.

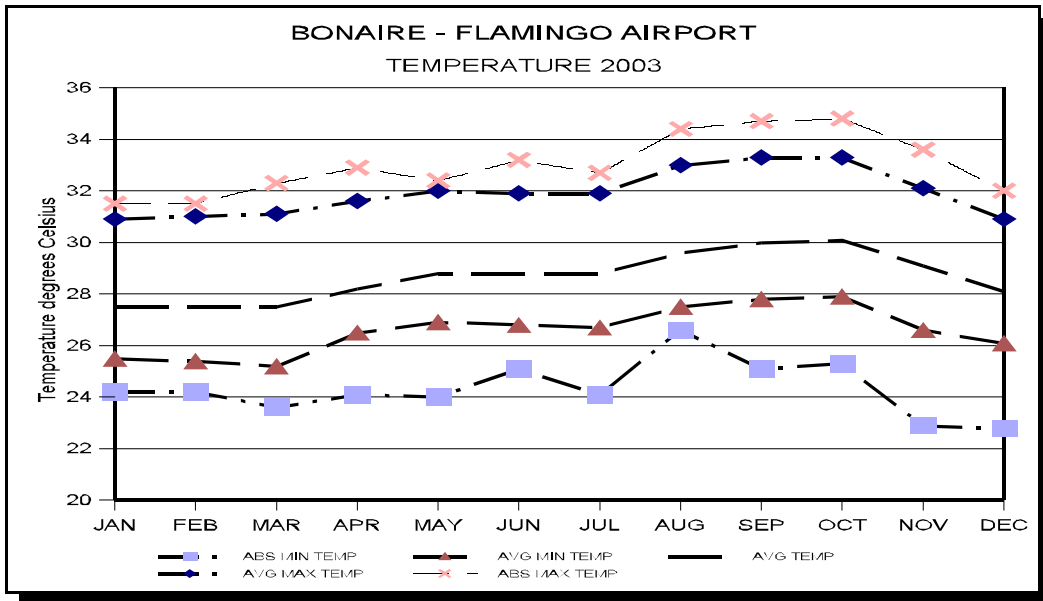
The 24-hour maximum was 76.4 mm and occurred on December 3. The number of days with precipitation greater than or equal to 1.0 mm was 36.



## TEMPERATURE

The average air temperature recorded at the Flamingo Airport of Bonaire over the year 2003 was 28.7/C (normal 28.0). The month of October was the warmest month with an average temperature of 30.1/C (normal is 28.8/C). October and September were the months with the highest average maximum temperature of 33.3/C. The absolute maximum temperature of the past year was 34.8/C. It was recorded on October 24 at 14:09 local time. The warmest day of 2003 was September 15 with a 24 hour average temperature of 30.7/C.

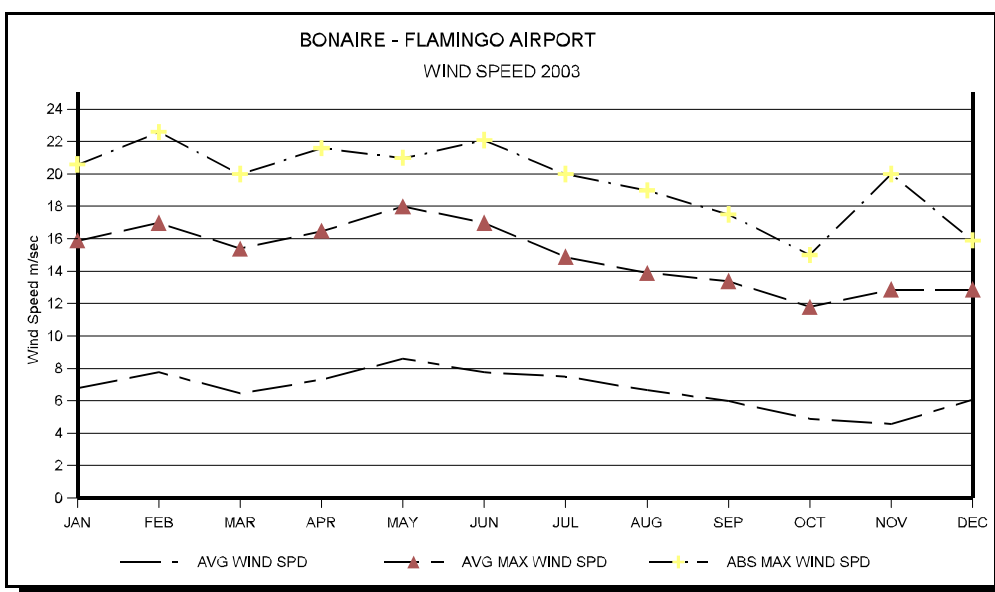
The lowest monthly average temperature for 2003 was 27.5/C and was recorded in January, February and March. March had the lowest average minimum temperature of 25.2/C for 2003, and the absolute minimum temperature of 22.8/C was recorded on December 31 at 03:04. The coolest day of 2003 was December 2 with a 24 hour average temperature of 26.0/C.



## WIND

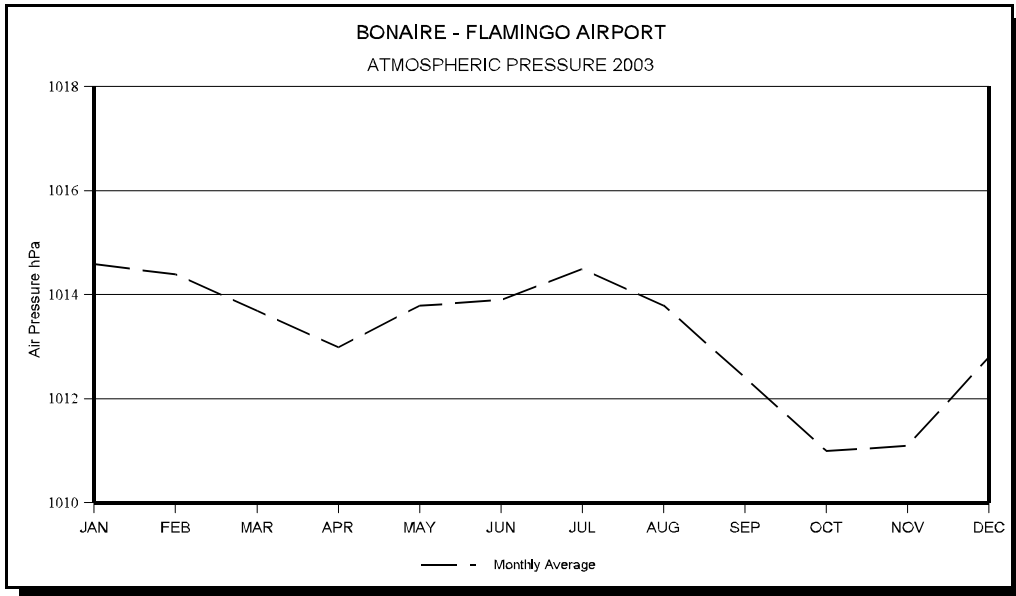
The average wind speed of 2003 recorded at the Flamingo airport was 6.7 m/sec (24.1 km/hr) at 10 m height.

May was the month with the highest average wind speed 8.6 m/sec (31 km/hr). The lowest monthly average of 4.6 m/sec (16.4 km/hr) was recorded during November. The day with the highest average wind speed 10.7 m/sec (38.5 km/hr) was recorded on February 22. The lowest 24 hour average wind speed of 2.0 m/sec (7.2 km/hr) was observed on November 3. The highest wind gust 22.6 m/sec (81.4 km/hr) was recorded on February 18 at 15:19 local time.



## ATMOSPHERIC PRESSURE

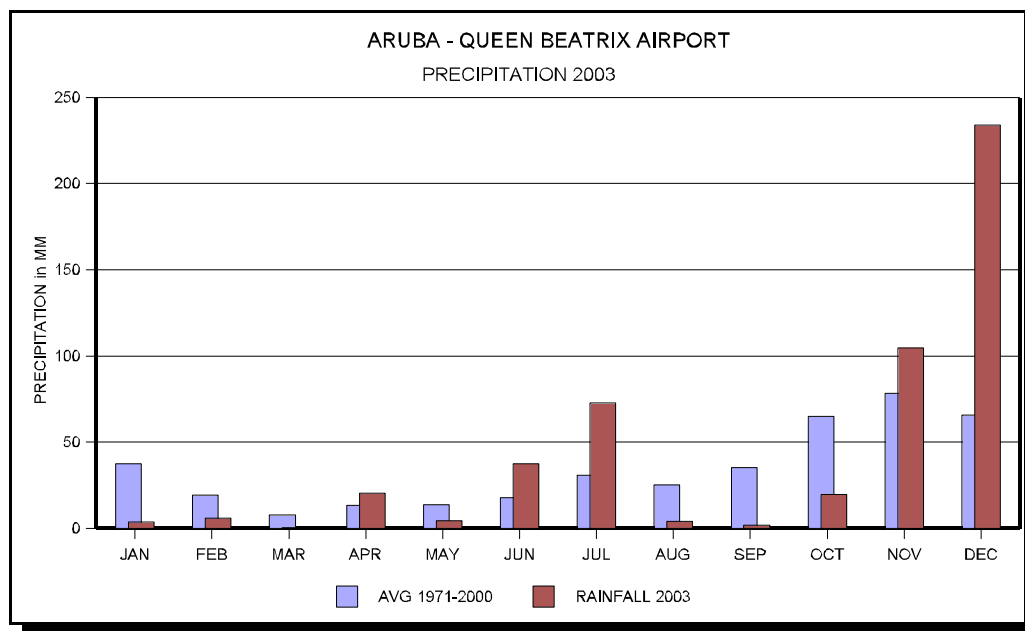
The average atmospheric pressure recorded at Flamingo Airport over the year 2003 was 1013.3 hPa. The maximum atmospheric pressure of 1019.7 hPa was observed on January 22 while the minimum atmospheric pressure of 1006.6 hPa was recorded on October 27 and November 11.



# ARUBA

## PRECIPITATION

The rainfall total, recorded at the Queen Beatrix Airport, for the year 2002 was 508.8 mm. Aruba experienced dry to very dry conditions through October. The wettest month was December with a total rainfall of 234.0mm (normal 1970-2000 is 65.7mm) making up for 46% of the total for 2003. Due to the December rainfall the annual total reached the average of 409. A new 24-hour maximum record, 71.2 mm, was established on December 2. The number of days with precipitation greater than or equal to 1.0 mm was 45.



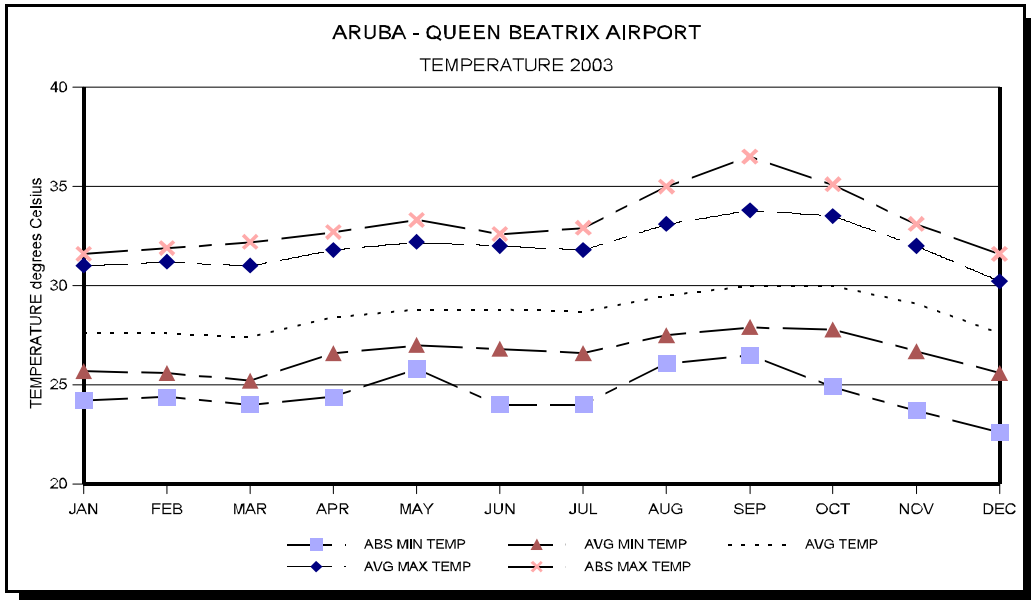
## TEMPERATURE

The average air temperature as recorded at Queen Beatrix Airport over the year 2003 was 28.6/C (normal 27.8/). September and October recorded the highest monthly average temperature of 30.0/C and September had the highest average maximum temperature of 33.8/C .

The absolute maximum temperature 36.5/C, was recorded on September 16 at 14:21 local time. This is a new record for Aruba. The old record 35.5/C was set in August 1998 on the 22<sup>nd</sup> and the 23<sup>rd</sup>.

March was the coolest month with an average temperature of 27.4/C and also the month with the lowest average minimum temperature of 25.2/C .

The absolute minimum temperature was 22.6/C and was recorded on December 31 at 01:51 local time

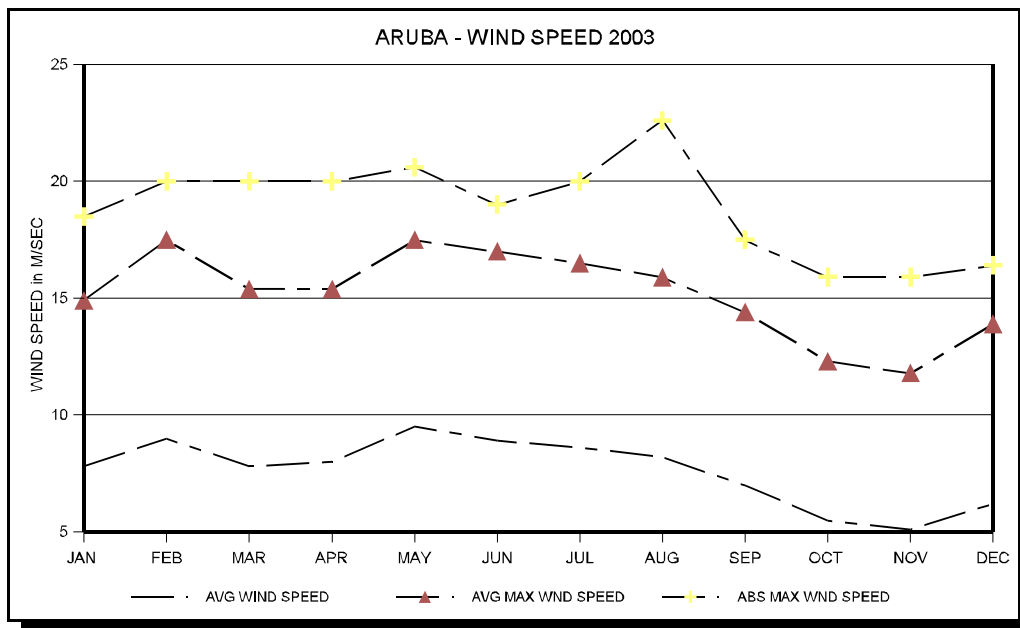


## WIND

The average wind speed, at 10 m height, for the year 2003, as recorded at Queen Beatrix Airport was 7.6 m/sec (27.4 km/hr).

May was the month with the highest average wind speed 9.5 m/sec (34.2 km/hr) and January had the lowest average wind speed 7.4 m/sec (26.6 km/hr). The highest 24 hour average wind speed 11.3 m/sec (40.7 km/hr) was recorded on July 3 and the lowest 1.5 m/sec (5.4 km/hr) was recorded on December 7.

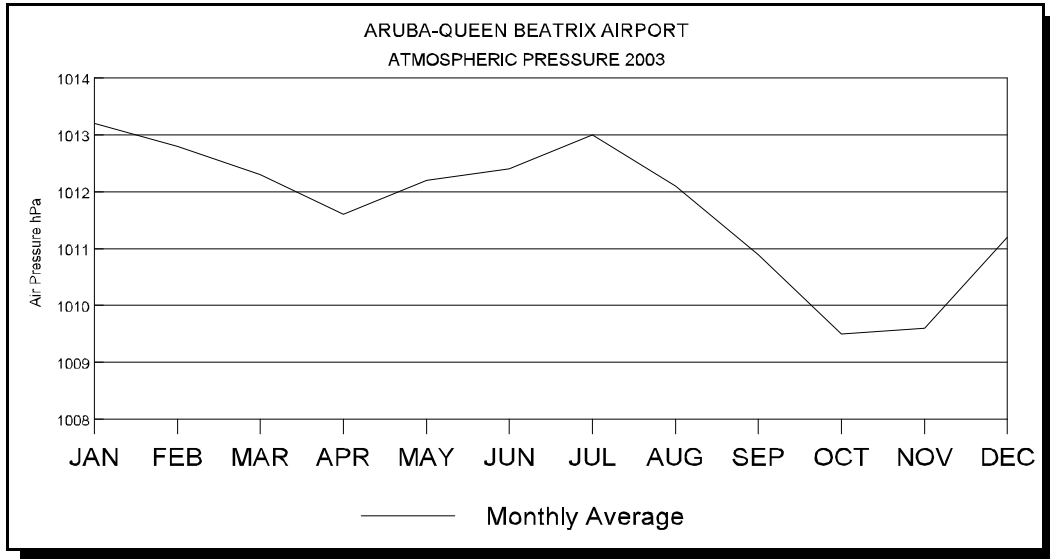
The highest wind gust 22.6 m/sec (81.4 km/hr) was recorded on August 2 at 17:26 local time.





## ATMOSPHERIC PRESSURE

The average atmospheric pressure recorded at Queen Beatrix Airport over the year 2003 was 1011.7 hPa. The maximum atmospheric pressure of 1019.0 hPa was observed on January 20 while the minimum atmospheric pressure of 1005.2 hPa was recorded on October 27.



# SSS ISLANDS

## General

No tropical cyclone affected the Leeward Islands during the hurricane season of 2003. All three islands experienced dry to very dry conditions during the hurricane season of 2003.

Exceptionally high amounts of rainfall were recorded in April and November bringing the total rainfall for 2003 to above normal for the Leeward Islands.

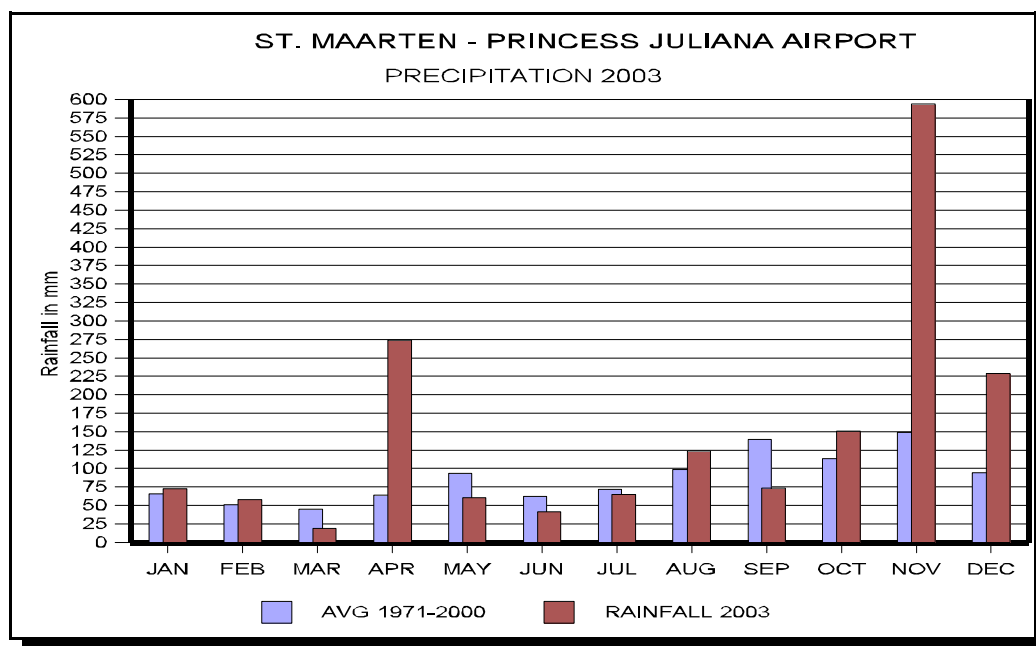
The conditions which caused this rainfall in November were because of an interaction between a low pressure area and an upper level trough from November 10 through 13 producing a large area of scattered to locally numerous heavy showers. This activity produced heavy rains during this period over the Leeward islands. For St. Maarten, the total for this period was 397.6 mm. St. Eustatius and Saba experienced the same type of conditions.

## Saint Maarten

### PRECIPITATION

The year 2003 was a wet year compared to the 30-year average. But the distribution was not spread out equally over all the months. Of the 12 months 5 were below normal. The rainfall total, recorded at the Princess Juliana Airport was 1758.2 mm (normal 1971-2000 is 1047.1 mm). The total rainfall for November was 593.4mm, about 300% above normal (149.3mm), making it the wettest month for the year 2003.

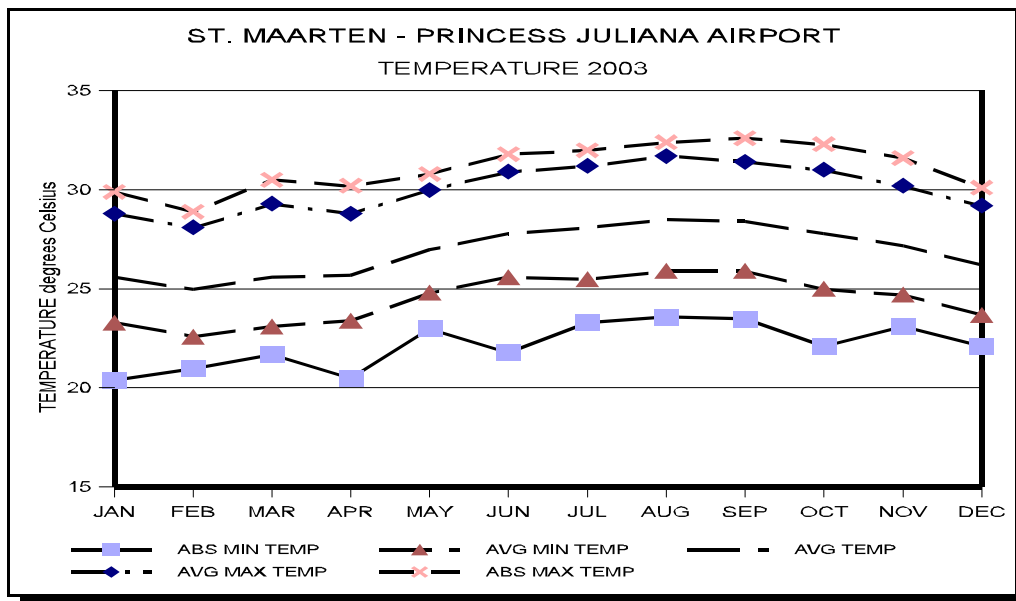
Very dry conditions were experienced during March with 18.8 mm (normal 45.2mm) The 24-hour maximum was 206.4mm and occurred on November 11. The number of days with precipitation greater than or equal to 1.0 mm was 166 days.



### TEMPERATURE

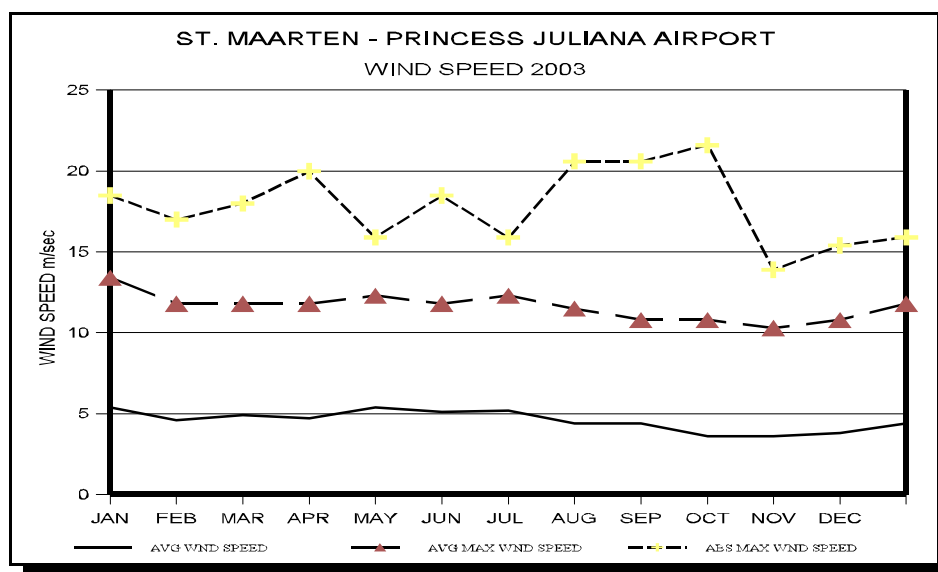
The average air temperature as recorded at Princess Juliana Airport over the year 2003 was 27.0/C (normal 27.2/). September was the warmest month with a monthly average temperature of 28.8/C and September also had the highest monthly average maximum temperature of 32.0/C of 2003. The absolute maximum temperature was 33.1/C and was recorded on September 25 at 11:37 hours local time. September 25<sup>th</sup> was the warmest day of 2003 with an average temperature of 29.5/C.

The months with the lowest monthly average temperature of 25.6/C were January and February. January and February had also the lowest average minimum temperature of 22.6/C for 2003. The absolute minimum temperature was 20.1/C and was recorded on April 17 at 22:34. The coolest day of 2003 was November 15<sup>th</sup> with an average temperature of 23.6/C



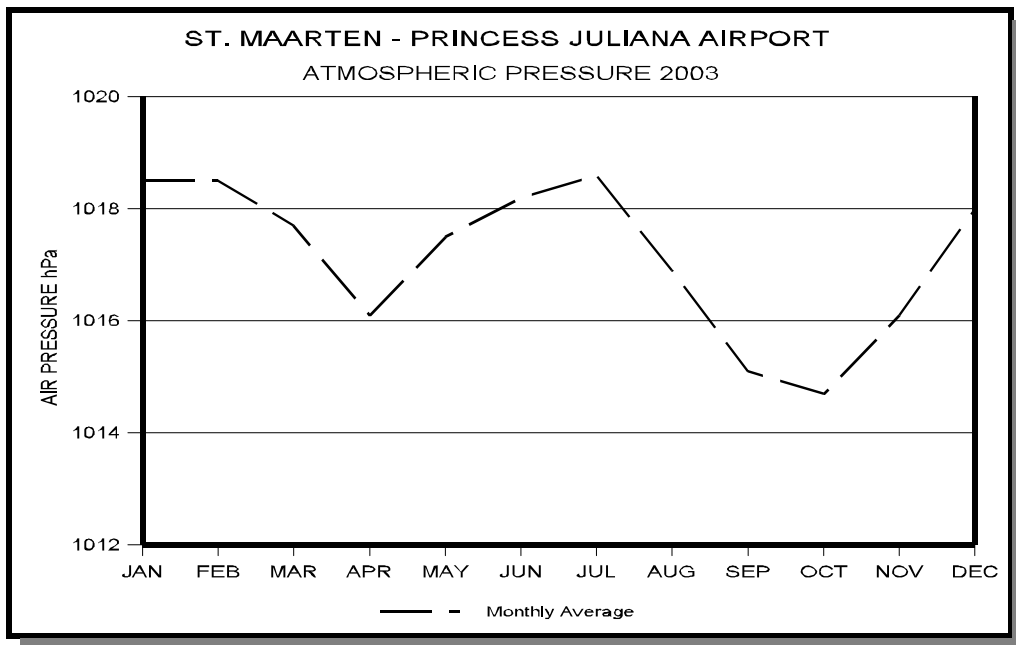
## WIND

The average wind speed of 2003 as recorded at the Princess Juliana airport, was 4.5 m/sec (16.2 km/hr) at 10m height. July had the highest average wind speed of 6.0 m/sec (21.6 km/hr) while October had the lowest average wind speed of 3.1 m/sec(11.2 km/hr). The highest daily average wind speed of 8.5 m/sec (30.6 km/hr) was recorded on July 7 and the lowest daily average wind speed of 1.1 m/sec (3.9 km/hr) was on January 8. The highest wind gust 22.1 m/sec (79.6 km/hr) was recorded on April 7 at 02:56 hours local time.



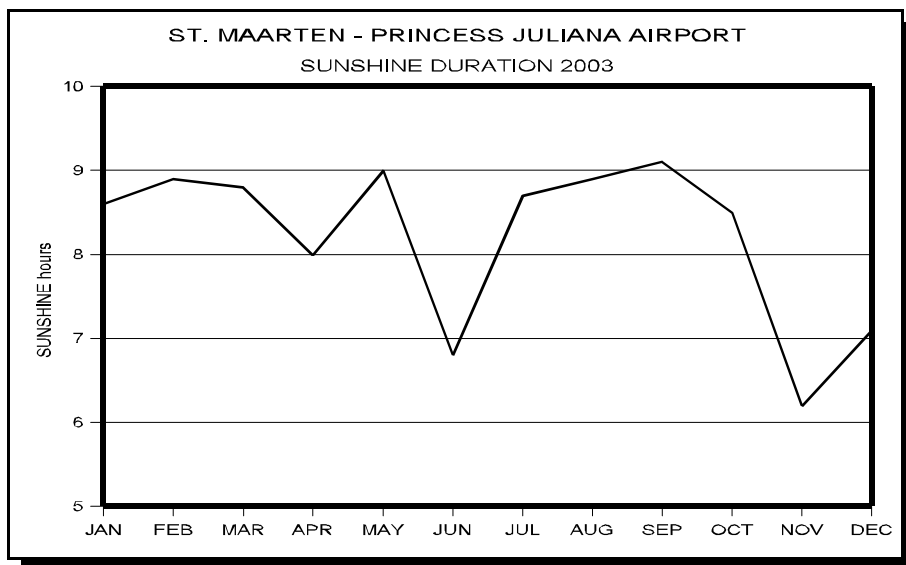
## ATMOSPHERIC PRESSURE

The average atmospheric pressure, recorded at Princess Juliana Airport, over the year 2003 was 1016.5 hPa. The maximum atmospheric pressure of 1022.9 hPa was recorded on January 17 while the minimum atmospheric pressure of 1008.4 hPa was recorded on December 28.



## SUNSHINE

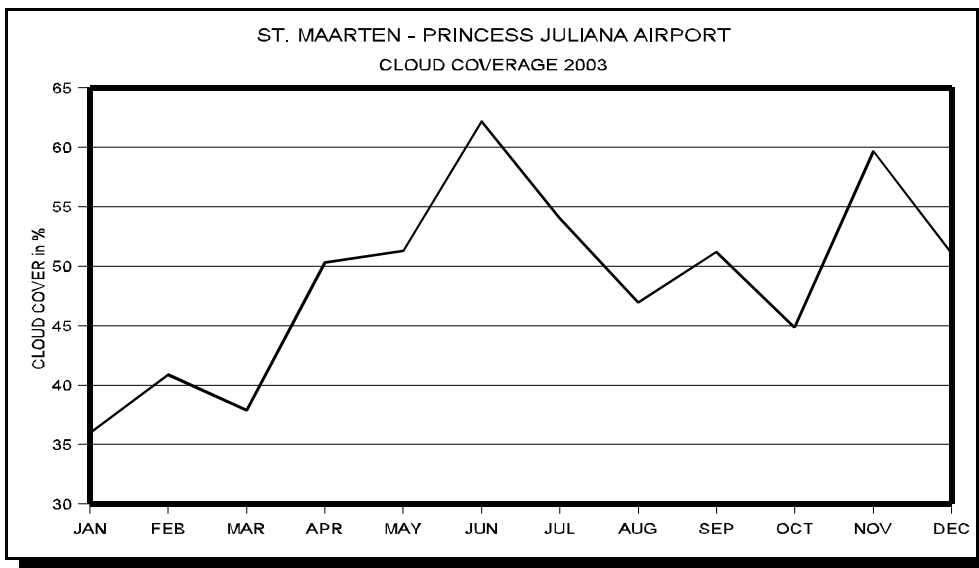
The total sunshine duration for 2003 as recorded at the Princess Juliana airport, was 3008.8 hrs. This is 67.9% of the maximum annual possible duration (4431.3 hrs). The daily average sunshine duration in 2003 was 8 hours and 12 minutes. This was just below the long-term average daily sunshine duration (8 hours and 16 minutes). The sunniest month was July with a daily average sunshine duration of 9 hours and 6 minutes. The month with least sunshine in 2003 was November with a daily average of 6 hours and 12 minutes. The maximum daily sunshine duration for the past year was 11 hours and 18 minutes recorded on April 1.



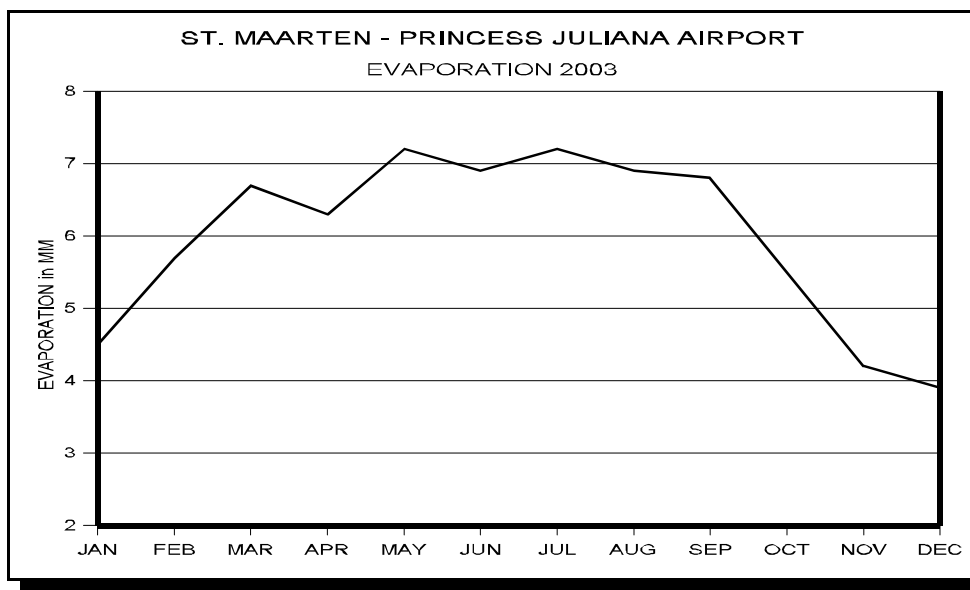
**CLOUD COVER**

The daily average cloud coverage for St. Maarten over the year 2003 as recorded at Princess Juliana Airport was 48.9%. The highest monthly average cloud cover of 62% was observed in June while January had the lowest cloud coverage value of 36%.

### EVAPORATION



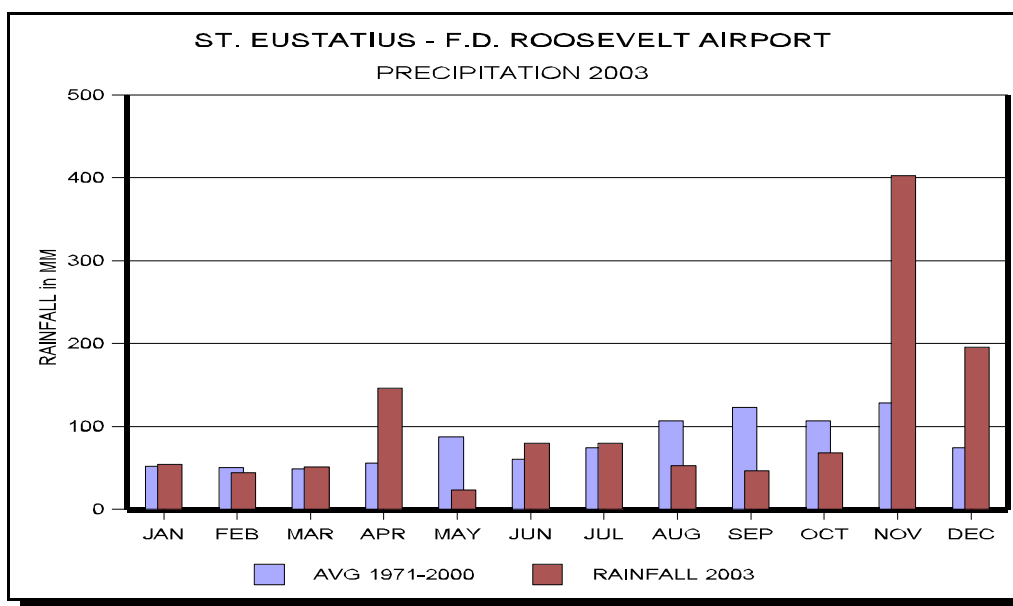
The average daily evaporation, measured at the Princess Juliana Airport, over the year 2002 was 5.9 mm. May and July both had the maximum average evaporation value for 2003 of 7.2 mm while December had the lowest value of 3.9 mm.



# Saint Eustatius

## PRECIPITATION

The total rainfall amount, recorded at the Roosevelt Airport, for 2003 was 1243.6 mm. This amount is 28.4% above the 30-year average (1971-2000) which is 968.6 mm. The 24-hour maximum rainfall, 186.8 mm, was recorded on November 11. The number of days with precipitation greater than or equal to 1.0 mm was 127 days. November was the wettest month of 2003 with a monthly total of 402.4 mm and the driest month was May with 23.4 mm.



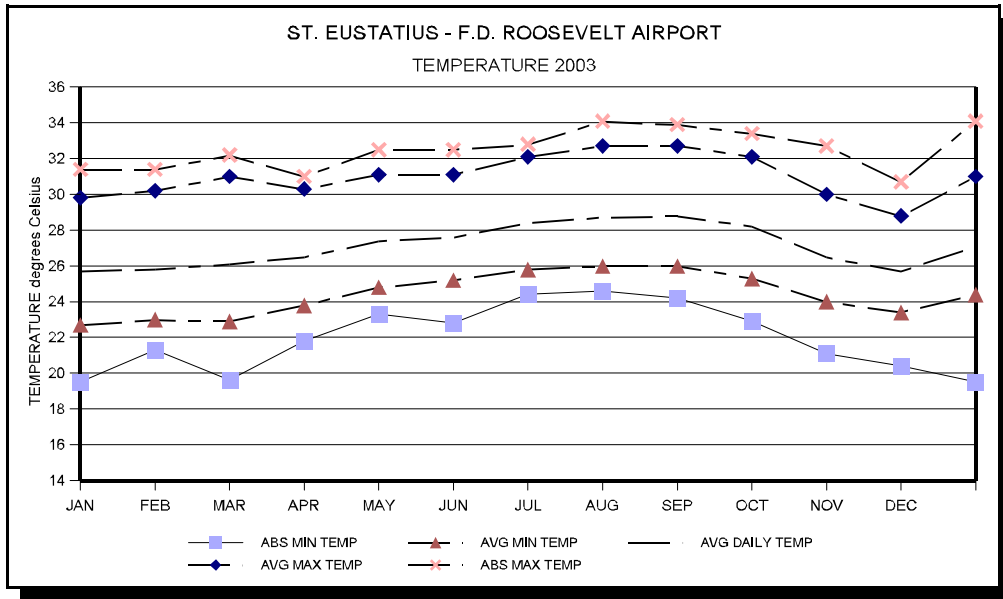
## TEMPERATURE

The average air temperature as recorded at Roosevelt Airport over the year 2003 was 27.1/C (normal 26.9/). September was the warmest month with average temperature 28.8/C. August and September shared the highest average maximum temperature of 32.3/C for 2003. The absolute maximum temperature, 34.1/C, was recorded on August 21 at 14:08 local time. This is a new record for the month of August. The warmest day of 2003 was September 5<sup>th</sup> with a 24 hour average temperature of 30.6/C.

January and December recorded the lowest monthly average with a temperature of 25.7/C and January was the month with the lowest average minimum temperature 22.7/C. The absolute minimum temperature was 19.5/C and was recorded on the 8<sup>th</sup> of January at 06:32 local time.

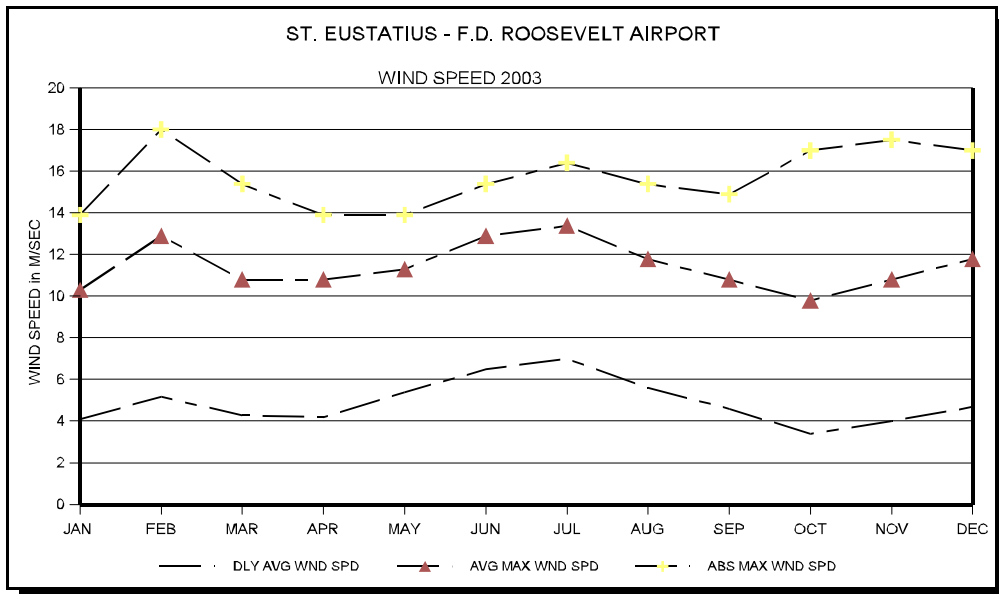
The coolest day of 2003 was November 11<sup>th</sup> with an average temperature of 23.9/C.





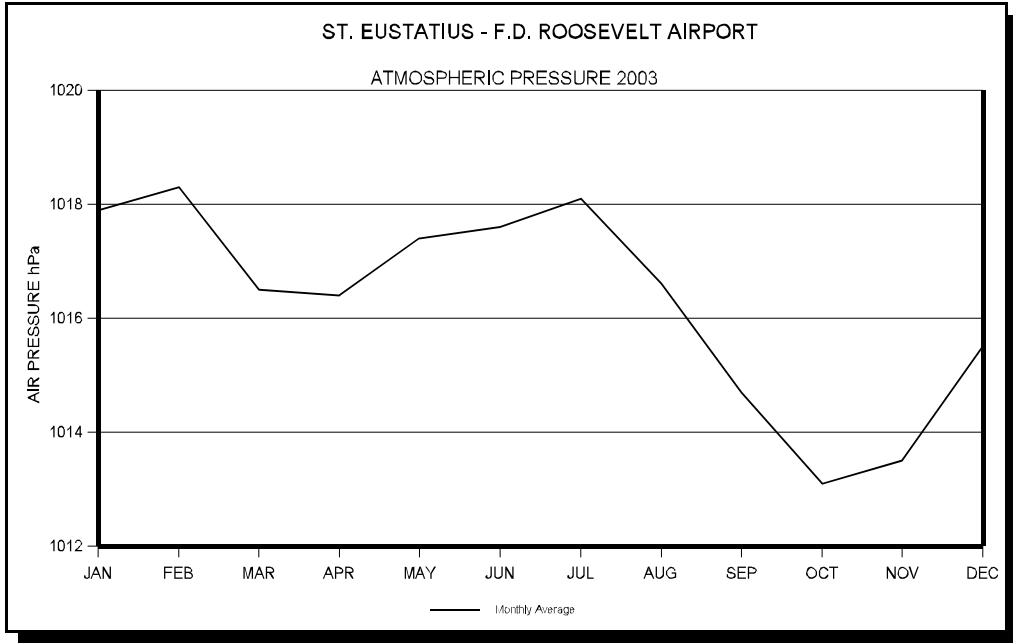
## WIND

The average wind speed, at 10 m height, as recorded at the Roosevelt airport was 4.9 m/sec (17.6 km/hr). July was the month with the highest average wind speed 7.0 m/sec (25.2 km/hr). October had the lowest average wind speed 3.4 m/sec (12.2 km/hr). The highest 24-hour average wind speed of 9.9 m/sec (35.5 km/hr) was recorded on July 7. The highest wind gust 18 m/sec (64.8 km/hr) was recorded on February 19 at 17:27 local time.



## ATMOSPHERIC PRESSURE

The average atmospheric pressure recorded at Roosevelt Airport the year 2003 was 1016.3 hPa. The maximum atmospheric pressure of 1022.4 hPa was recorded on the January 10 while the minimum atmospheric pressure of 1007.8 hPa was recorded on November 11.

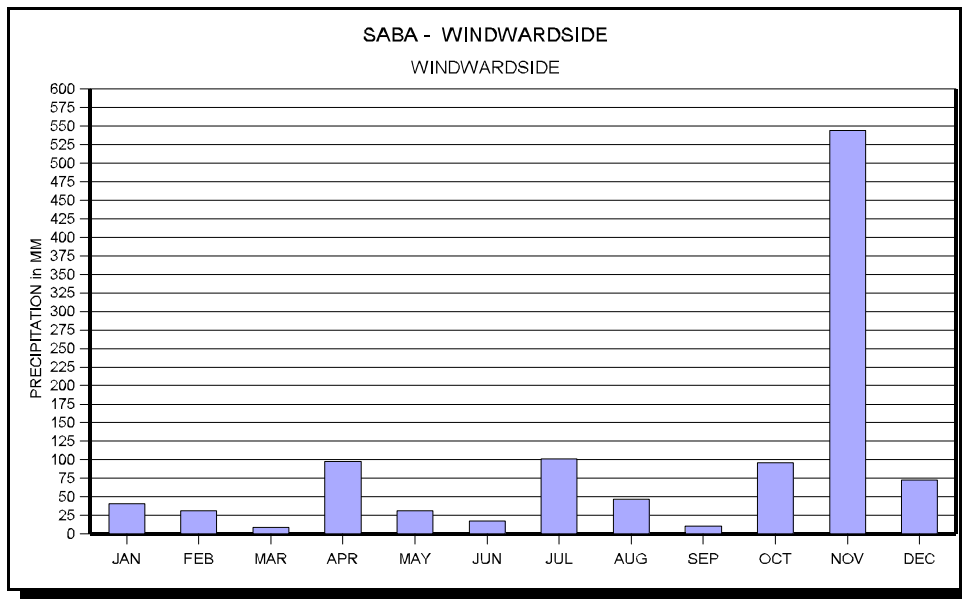


# Saba

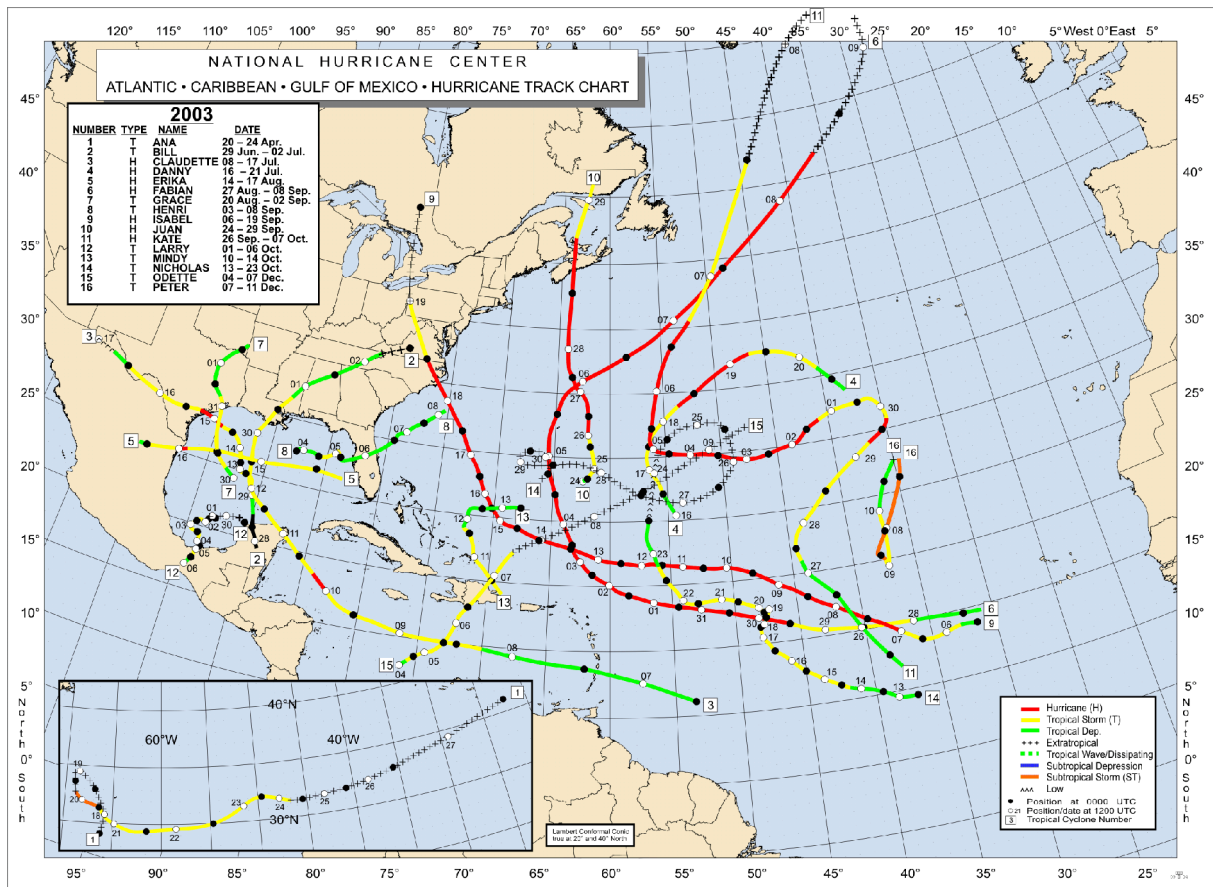
## PRECIPITATION

The rainfall total recorded at Windwardside for the year 2003 was 1099.3 mm. Just above the long term average of 1050.4mm.

November was the wettest month with a total of 543.9 mm while March was the driest month with a total of only 8.9 mm.



No data is available from the Juancho Yrausquin Airport at Saba during 2003.



Tracks of all 2003 Atlantic Tropical Cyclones

**METEOROLOGICAL SERVICE NETHERLANDS ANTILLES & ARUBA  
CLIMATOLOGICAL DATA 2003**

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Abs. Min. Temp. (°C)</b>												
<b>CURAÇAO</b>	23.3	23.4	22.5	24.5	25.2	24.7	24.2	25.0	25.3	23.3	22.1	21.6
<b>SINT MAARTEN</b>	21.3	20.8	21.1	20.1	22.6	22.4	23.2	24.4	23.4	23.1	21.5	20.6
<b>BONAIRE</b>	24.2	24.2	23.6	24.1	24	25.1	24.1	26.6	25.1	25.3	22.9	22.8
<b>SINT EUSTATIUS</b>	19.5	21.3	19.6	21.8	23.3	22.8	24.4	24.6	24.2	22.9	21.1	20.4
<b>ARUBA</b>	24.2	24.4	24.0	24.4	25.8	24.0	24.0	26.1	26.5	24.9	23.7	22.6

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Avg. Minimum Temp. (°C)</b>												
<b>CURAÇAO</b>	24.8	24.9	24.4	25.6	25.9	25.6	25.5	26.0	26.5	26.2	25.3	24.8
<b>SINT MAARTEN</b>	23.1	23.1	23.5	23.5	24.9	25.4	25.8	25.9	26.3	25.6	24.2	23.7
<b>BONAIRE</b>	25.5	25.4	25.2	26.5	26.9	26.8	26.7	27.5	27.8	27.9	26.6	26.1
<b>SINT EUSTATIUS</b>	22.7	23.0	22.9	23.8	24.8	25.2	25.8	26.0	26.0	25.3	24.0	23.4
<b>ARUBA</b>	25.7	25.6	25.2	26.6	27.0	26.8	26.6	27.5	27.9	27.8	26.7	25.6

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Average Temp. (°C)</b>												
<b>CURAÇAO</b>	26.8	26.9	26.8	27.7	28.1	27.9	27.8	28.6	29.0	28.8	28.0	27.0
<b>SINT MAARTEN</b>	25.6	25.6	26.0	26.4	27.2	27.6	28.1	28.5	28.8	28.2	26.6	25.7
<b>BONAIRE</b>	27.5	27.5	27.5	28.2	28.8	28.8	28.8	29.6	30.0	30.1	29.1	28.1
<b>SINT EUSTATIUS</b>	25.7	25.8	26.1	26.5	27.4	27.6	28.4	28.7	28.8	28.2	26.5	25.7
<b>ARUBA</b>	27.6	27.6	27.4	28.4	28.8	28.8	28.7	29.5	30.0	30.0	29.1	27.6

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Avg. Max.Temp. (°C)</b>												
<b>CURAÇAO</b>	30.1	30.2	30.5	31.8	31.8	31.6	31.4	32.6	33.2	32.6	31.4	30.2
<b>SINT MAARTEN</b>	28.9	28.8	29.3	29.4	30.2	30.6	31.3	31.7	32.0	31.4	29.2	28.6
<b>BONAIRE</b>	30.9	31.0	31.1	31.6	32.0	31.9	31.9	33.0	33.3	33.3	32.1	30.9
<b>SINT EUSTATIUS</b>	29.8	30.2	31.0	30.3	31.1	31.1	32.1	32.7	32.7	32.1	30.0	28.8
<b>ARUBA</b>	31.0	31.2	31.0	31.8	32.2	32.0	31.8	33.1	33.8	33.5	32.0	30.2

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Abs. Max.Temp. (°C)</b>												
<b>CURAÇAO</b>	31.1	31.5	32.1	33.7	32.5	32.6	32.7	35.5	36.7	34.9	32.4	32.8
<b>SINT MAARTEN</b>	30.1	30.2	30.3	30.9	31.0	31.7	32.1	32.7	33.1	32.3	31.3	30.1
<b>BONAIRE</b>	31.5	31.5	32.3	32.9	32.4	33.2	32.7	34.4	34.7	34.8	33.6	32.0
<b>SINT EUSTATIUS</b>	31.4	31.4	32.2	31.0	32.5	32.5	32.8	34.1	33.9	33.4	32.7	30.7
<b>ARUBA</b>	31.6	31.9	32.2	32.7	33.3	32.6	32.9	35.0	36.5	35.1	33.1	31.6

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>RainFall</b>												
<b>CURAÇAO</b>	16.0	4.4	0.0	2.8	1.6	43.4	54.2	9.2	8.0	130.6	128.0	109.4
<b>SINT MAARTEN</b>	72.2	58.2	18.8	273.8	60.6	41.2	64.4	123.6	73.2	150	593	228.6
<b>BONAIRE</b>	12.0	9.6	0.6	24.6	17.6	11.8	44.8	0.6	27.0	9.6	125.2	102.8
<b>SINT EUSTATIUS</b>	54.0	44.2	51.2	146.0	23.4	79.8	79.8	52.4	46.4	68.4	402.4	195.6
<b>ARUBA</b>	3.8	6.0	0.0	20.2	4.4	37.6	72.6	4.0	2.0	19.6	104.6	234.0

**METEOROLOGICAL SERVICE NETHERLANDS ANTILLES & ARUBA  
CLIMATOLOGICAL DATA 2003**

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Average Wind Speed 10m height (in m/sec)</b>												
CURAÇAO	5.8	6.8	5.7	6.2	6.8	6.5	6.3	5.9	5.6	4.6	4.6	5.5
ST. MAARTEN	3.8	5.0	4.1	4.3	4.6	5.5	6.0	4.7	4.0	3.1	3.9	4.4
BONAIRE	6.8	7.8	6.5	7.3	8.6	7.8	7.5	6.7	6.0	4.9	4.6	6.1
ST. EUSTATIUS	4.1	5.2	4.3	4.2	5.4	6.5	7.0	5.6	4.6	3.4	4.0	4.7
ARUBA	7.8	9.0	7.8	8.0	9.5	8.9	8.6	8.2	7.0	5.5	5.1	6.2

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Average Maximum Wind Speed 10m height (in m/sec)</b>												
CURAÇAO	12.9	14.4	12.9	12.9	14.9	13.9	13.9	12.9	12.9	10.8	11.3	12.9
ST. MAARTEN	10.3	12.9	10.8	11.3	11.3	12.9	14.4	12.3	10.3	9.3	11.3	11.8
BONAIRE	15.9	17.0	15.4	16.5	18.0	17.0	14.9	13.9	13.4	11.8	12.9	12.9
ST. EUSTATIUS	10.3	12.9	10.8	10.8	11.3	12.9	13.4	11.8	10.8	9.8	10.8	11.8
ARUBA	14.9	17.5	15.4	15.4	17.5	17.0	16.5	15.9	14.4	12.3	11.8	13.9

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Absolute Maximum Wind Speed (in m/sec)</b>												
CURAÇAO	15.9	19.0	17.5	16.5	17.5	15.9	17.5	18.0	15.9	14.9	18.5	18.0
ST. MAARTEN	14.9	18.5	14.9	22.1	14.4	17.5	20.0	17.5	15.4	19.0	17.5	15.9
BONAIRE	20.6	22.6	20.0	21.6	21.0	22.1	20.0	19.0	17.5	15.0	20.0	15.9
ST. EUSTATIUS	13.9	18.0	15.4	13.9	13.9	15.4	16.4	15.4	14.9	17.0	17.5	17.0
ARUBA	18.5	20.0	20.0	20.0	20.6	19.0	20.0	22.6	17.5	15.9	15.9	16.4

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Potential Wind Energy (in Kwhr/m/day)</b>												
CURAÇAO	3.2	4.8	3.3	3.9	4.9	4.3	3.9	3.2	2.9	1.8	1.7	3.1

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Sunshine Duration (in hours)</b>												
CURAÇAO	9.6	10.0	9.6	7.6	8.7	7.9	9.4	10.7	9.3	9.2	7.2	8.0
ST. MAARTEN	8.6	8.9	8.8	8.0	9.0	6.8	8.7	8.9	9.1	8.5	6.2	7.1

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Cloud Coverage (in %)</b>												
CURAÇAO	33.1	32.8	34.3	55.8	53.4	59.9	49.5	40.3	50.2	47.6	57.7	47.9
ST. MAARTEN	36.0	40.9	37.9	50.3	51.3	62.2	54.1	47.0	51.2	44.9	59.7	51.1

	JAN	FEB	MRT	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Evaporation (in mm)</b>												
CURAÇAO	6.3	7.0	7.4	7.0	8.1	7.4	7.2	7.9	8.4	6.4	4.8	5.3
ST. MAARTEN	4.5	5.7	6.7	6.3	7.2	6.9	7.2	6.9	6.8	5.5	4.2	3.9