HYM MWB 04/2005

MONTHLY WEATHER BULLETIN

Morawhanna

Wauna

Anna Regina

Capoey Compound

Mc Nabb Back

Onderneeming

Wakapoa

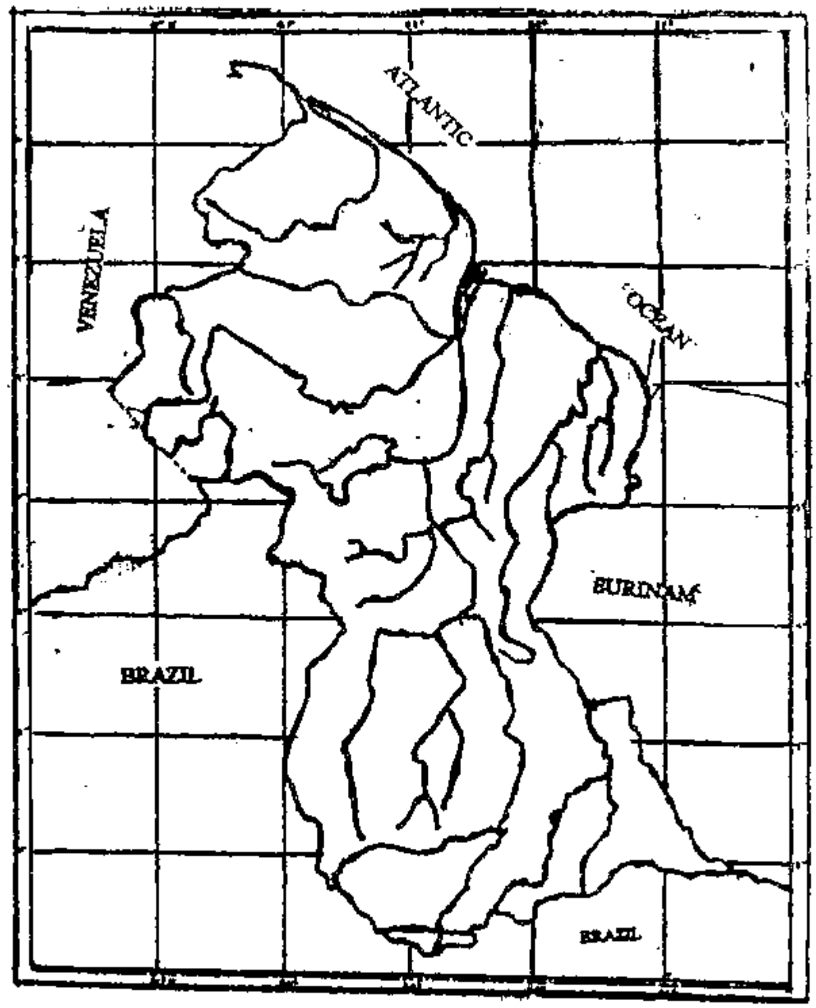
La Bagatelle

Fort Island

Hogg Island

Good Success

Cane Grove Front



Gtown Bot. Gds

Mon Repos

C B J Intl. Airport

Bath Front

Blairmont # 7

No 54 Village

No. 63 Benab

No. 73 Village

Providence Back

Providence Front

Reliance

MINISTRY OF AGRICULTURE

HYDROMETEOROLOGICAL SERVICE

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WEBSITE: http://www.guyanaclimate.org

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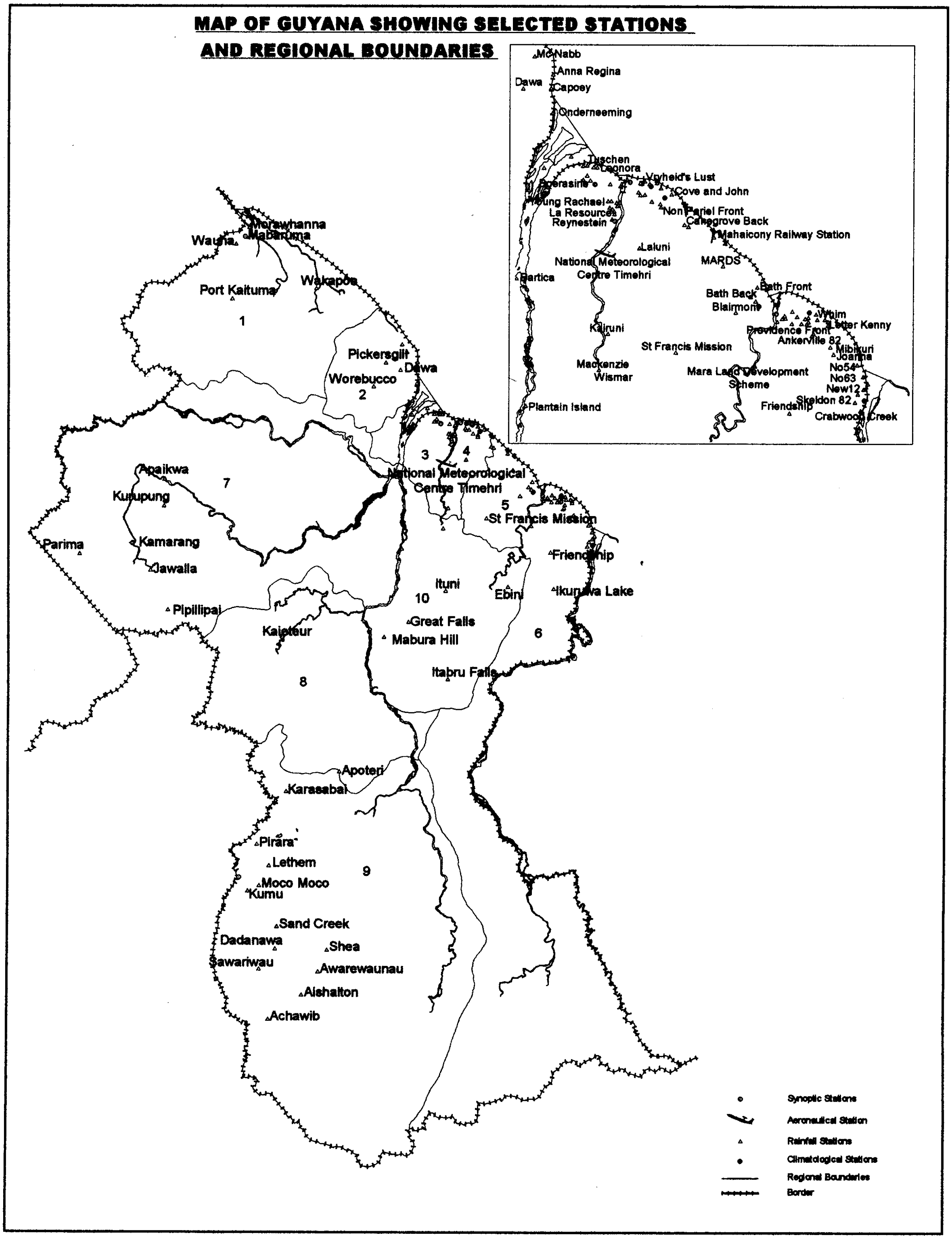


WEATHER VIEW

Flood forecasting and response: reducing flood losses while managing water more effectively

Introduction

The occurrence of floods and droughts globally has increased. In addition, the vulnerability of local communities, provinces and states, countries and regions is now greater. It is essential that National Hydrological and Meteorological Services increase their capabilities to reduce these losses and disruptions. This article describes how the growing need for improved water management and mitigation of disasters can be partially met by a coordinated team of hydrologists and meteorologists. Significant gains in technology, data acquisition and hydrometeorological modeling have resulted in increased predictive capability of both NHSs and NMSs that could be used to reduce losses from hydrological extremes and contribute to integrated water-management solutions for communities, states, countries and regions. Emerging technology and science in both fields of hydrology and meteorology promise significant improvements in forecast accuracy for the future.

Mitigating water-related disasters

Global economic losses due to weather related events (primary floods) are increasing rapidly. The recent catastrophic flooding experienced in Bangladesh, China, Europe and India demonstrates this alarming trend. At the same time that disastrous floods were devastating some parts of the world, droughts were impacting the USA and Africa. This trend in impact of hydrological extremes is caused by a number of factors, including an increasing population in the world's flood-plains, urbanization/land use changes, and a growing increase in extreme rainfall events. More than 25 per cent of the world's population lives in areas with a risk of natural disasters. Weather-related extreme events will continue to occur in the future (and in fact may increase in magnitude and frequency).

Applying structural and non-structural approaches can mitigate disasters. In general, a multiple mitigation approach must be taken by analyzing the flood management in an integrated manner. The use of structural measures such as levees, dams, flood proofing of structures and land-use controls have played an important role in flood mitigation. However, structural approaches are becoming more difficult to apply because of the high economic costs and environmental consequences. Non-structural approaches consist of floodplain zoning, flood proofing, establishing programmes that provide disincentives for living in floodplains such as flood insurance. Establishing a river and flood forecasting and response programme enhances all (structural and non-structural) flood-reduction approaches. Also, river forecasts are a critical component to the management of water resources. Countries, states and communities are recognizing that water is not limitless and that its allocation must be determined by economic, social and environmental values. Forecasts for rivers, especially transboundary rivers, provide decision-makers with information to optimize water use and minimize conflict.

There are many types of water-related disasters. Floods and flash floods, mudslides and landslides, droughts and pollution can produce huge human losses and economic disruption. Increases in water demand, coupled with dwindling water supplies and extreme climate conditions, are causing stress to our society.

Establishing flood forecasting and response system

Establishing a viable flood-forecasting and warnings system for communities at risk requires the combination of meteorological and hydrological data, forecast tools and trained forecasters. A flood-forecast system must provide sufficient lead-time for communities to respond. The greater the lead-time, the more reduction in damages and loss of life can be achieved. Forecasts must be sufficiently accurate to promote confidence so that communities and users will take effective actions when warned. Inaccurate forecasts reduce credibility and hinder response actions.

Flood-warning systems must be reliable and designed to operate under the most severe flood situations. The greatest benefits for an effective flood-warning programme occur when flooding is severe, widespread, and/or sudden, and when communities and organizations are prepared to mitigate impacts.

Experience and lessons learned have demonstrated that an end-to-end flood forecast, warning and response system consists of the following elements or steps, which must be linked to achieve reduction in losses from forecasts. These elements are: data collection and communication; hydrological forecasting and forecast product generation; disseminating forecast to users; decision-making and decision support; and actions taken by users.

The interaction of the technology components of the integrated flood-forecast system can be represented as a chain composed of many links. Each link must be fully functional and strong if benefits from the system are to be derived. Even if one link is weak or not functioning properly then the entire system breaks down. In other words, if a perfect flood forecast was generated but does not reach the population at risk, then the warning system is ineffective. Equally, should the population at risk receive the warning but does not know what actions should be taken, then the system yet again has not accomplished its purpose.

In the past 10 years there have been tremendous improvements in technology to provide more accurate river and floods forecasts. However, these tools (data systems and models) must be linked and used appropriately in the generation of forecasts and warnings. Even the poorest countries can afford many of the new technologies available to support forecast and warnings.

Source: World Meteorological Organisation Bulletin, Volume 53, No. 1 January 2004 - pages 28 & 29

HIGH TIDE OCCURRENCES FOR MAY 2005

During the month of May there will be two periods of high tides equal to or exceeding 2.74m. The highest tide of 3.03 m will occur on the morning of May 7, 2005. It is advised that precautionary measures be taken against possible flooding by residents in low-lying coastal and tidal riverain areas.

DATE	TIME	HEIGHT (m)	TIME	HEIGHT (m)
2005-05-04	01:12	2.75	13:32	2.79
2005-05-05	01:54	2.90	14:21	2.88
2005-05-06	02:32	2.99	15:07	2.92
2005-05-07	03:06	3.03	15:51	2.91
2005-05-08	03:37	3.02	16:33	2.87
2005-05-09	04:08	2.97	17:12	2.79
2005-05-10	04:37	2.90	-	-
2005-05-11	05:08	2.81	-	-
2005-05-21	02:12	2.84	-	-
2005-05-22	02:46	2.93	15:13	2.76
2005-05-23	03:23	2.99	15:59	2.80
2005-05-24	04:02	3.02	16:46	2.81
2005-05-25	04:46	3.01	17:34	2.79
2005-05-26	05:32	2.96	18:21	2.74
2005-05-27	06:24	2.87	-	-
2005-05-28	07:25	2.76	-	-

The above table contains information on high tides equal to or greater than 2.74 m in height.

MONTHLY WEATHER FORECAST UPDATE

WEATHER

PERIOD	PRECIPITATION									
	REG 1	REG 2	REG 3	REG 4	REG 5	REG 6	REG 7	REG 8	REG 9	REG 10
May 2005	W	W	W	W	W	W	VW	VW	W	W
June 2005	W	W	W	W	W	W	VW	VW	W	W
July 2005	W	W	W	W	W	W	W	W	MW	W

PROBABILITIES

MONTH	BELOW NORMAL	NORMAL	ABOVE NORMAL
May 2005	2.5	3.5	4
June 2005	2	3.5	4.5
July 2005	2	4	4

DISCHARGE AND IMPACTS

The average daily discharge at Apaikwa Falls, Mazaruni River is predicted to be $1238.9m^3s^{-1}$ during the month of May 2005 with a corresponding stage of 16.6m. The prevailing stage will allow navigation along the river.

The average daily discharge at Loo River, Soesdyke Linden Highway is predicted to be $1.9m^3s^{-1}$ with a corresponding stage of 1.15m during the month of May 2005.

FORECAST ASSESSMENT FOR RAINFALL IN RESPECTIVE REGIONS

MONTH	DEVIATION AND RATING									
	REG 1	**REG 2**	**REG 3**	**REG 4**	**REG 5**	**REG 6**	**REG 7**	**REG 8**	**REG 9**	**REG 10**
April 2004	(88.9%) GOOD	(81.5%) BAD	(79.3%) BAD	(80%) BAD	(94.4%) EX	(88.9%) GOOD	(83.3%) PA	(55.6%) BAD	(83.3%) PA	(82.2%) PA
May 2004	(88.9%) GOOD	(66.7%) BAD	(65.4%) BAD	(75.9%) BAD	(77.8%) BAD	(84.9%) PA	(77.8%) BAD	(55.6%) BAD	(72.2%) BAD	(74.1%) BAD
June 2004	(100%) EX	(85.2%) PA	(94.1%) EX	(87.5%) PA	(81.5%) BAD	(90.0%) GOOD	(77.8%) BAD	(66.7%) BAD	(88.9%) GOOD	(91.7%) GOOD
July 2004	(88.9%) GOOD	(86.7%) PA	(76.8%) BAD	(90.7%) GOOD	(87.0%) PA	(83.3%) PA	(83.3%) PA	(77.8%) BAD	(88.9%) GOOD	(77.8%) BAD
Aug 2004	(88.9%) GOOD	(83.3%) PA	(88.3%) GOOD	(92.6%) GOOD	(66.7%) BAD	(86.8%) PA	(88.9%) GOOD	(88.9%) GOOD	(88.9%) GOOD	(96.3%) EX
Sept 2004	(66.7%) BAD	(100%) EX	(84.1%) PA	(98.4%) EX	(94.4%) EX	(86.7%) PA	(77.8%) BAD	- -	(88.9%) GOOD	(83.3%) PA
Oct 2004	(66.7%) BAD	(77.8%) BAD	(80.0%) PA	(77.8%) BAD	(77.8%) BAD	(83.3%) GOOD	(77.8%) BAD	- -	- -	(77.8%) BAD
Nov 2004	(83.3%) PA	(88.9%) GOOD	(94.0%) EX	(95.2%) EX	(77.8%) BAD	(88.9%) GOOD	(77.8%) BAD	(88.9%) GOOD	(83.3%) PA	(77.8%) BAD
Dec 2004	(66.7%) BAD	(88.9%) PA	(87.6%) PA	(76.5%) BAD	(92.6%) GOOD	(89.3%) GOOD	(83.3%) PA	- -	(88.9%) PA	(100%) EX
Jan 2005	(55.6%) BAD	(37.0%) BAD	(33.3%) BAD	(35.6%) BAD	(48.1%) BAD	(53.2%) BAD	(66.7%) BAD	(66.7%) BAD	(88.9%) GOOD	(70.4%) BAD
Feb 2005	(88.9%) GOOD	(86.1%) PA	(94.4%) EX	(98.1%) EX	(79.4%) BAD	(86.9%) PA	(85.2%) PA	(88.9%) GOOD	(88.9%) GOOD	(92.6%) EX
Mar 2005	(77.8%) PA	(66.7%) BAD	(69%) BAD	(67.9%) BAD	(79.4%) PA	(88.9%) GOOD	(77.8%) PA	(88.9%) GOOD	(77.8%) PA	(88.9%) GOOD

Note *The key is found on page 32

REVIEW FOR MARCH 2005

The month of March was extremely dry. The selected stations recorded only 34.3% of the average monthly precipitation. Only two stations (Wismar and Kaieteur) recorded in excess of 100 mm for the month. There were 25 dry days, 4 moderately dry days and 2 moderately wet days recorded.

The predominant synoptic systems were low to mid level ridges along with the north easterly trades. These were largely responsible for the low level of convective activity experienced during the month.

REVIEW OF SYNOPTIC SYSTEMS

This discussion concentrates on the major synoptic systems during the month of March 2005.

1st to 12th	The first dry spell. North easterly low level flow and strong ridges at the low and mid levels dominated. Twelve consecutive dry days occurred.
13th, 14th	The presence of a low to mid level trough was responsible for one moderately dry day followed by one moderately wet day. The precipitation was heaviest along the Berbice coast on the 13th. As the trough moved westwards the bulk of the precipitations was concentrated over Regions 1,2,3,4 and 5 on the 14th.
15th to 20th	A return to dry conditions as the trough moved out of Guyana's area and the north easterly low level flow was restored. Six consecutive dry days occurred during this period.
21st to 23rd	The wettest period of the month. Another low to mid level trough moved over Guyana and produced significant precipitation. Its effect seems to have been strongest over inland and interior Guyana as the heaviest precipitation was recorded at inland and interior locations. Wismar reported 47.9 and 27.2 mm for the 21st and 22nd. Kaiteur recorded 58.4 and 11.7 mm for the two day period. One moderately wet day and two moderately dry days were experienced.
24th to 31st	The month ended as it began with dry conditions caused by the combination of low level ridges and a north easterly flow. Seven dry days and one moderately dry day occurred.

DISCHARGE AND IMPACTS

The average daily discharge at Apaikwa Falls, Mazaruni River ranged from a maximum of 710.8m^3s^{-1} to a minimum of 157.7m^3s^{-1} and averaged 271.2m^3s^{-1} which was 79.2% below the normal value and 58.2% below the predicted value. The river height was a maximum of 14.73m on March 1, 2005 and a minimum of 11.87m on March 31, 2005.

The average daily discharge at Loo River, Soesdyke Linden Highway was 3.0 m^3s^{-1}, with a corresponding gauge height of 1.38m. The river height was at a maximum of 1.42m on March 23, 2005 and a minimum of 1.37m on March 17-21, 29-30, 2005.

SYNOPTIC SYSTEM SUMMARY - MARCH 2005

SYNOPTIC SYSTEM	FREQUENCY	COMMENTS
LOW LEVEL TROUGH, MID LEVEL AND UPPER LEVEL RIDGE	3	This was associated with 3 dry days
NORTH EASTERLY FLOW	12	This was associated with 12 dry days
LOW LEVEL, MID LEVEL AND UPPER LEVEL RIDGE	13	This was associated with 10 dry days and 3 moderately dry days
LOW LEVEL, MID LEVEL AND UPPER LEVEL TROUGH	1	This was associated with 1 moderately dry day
LOW LEVEL AND MID LEVEL TROUGH WITH UPPER LEVEL RIDGE	2	This was associated with 2 moderately wet days
TOTAL	**31**	

STATIONS CATEGORISED BY PRECIPITATION VALUES

Reg	VERY DRY	DRY	MODERATELY DRY
1		Hossororo	Mabaruma
2	Anna Regina Dawa		
3	La Bagatelle Boerasirie De Kinderen Back De Kinderen Front La Resource Leonora Corner Leonora Front Potosi Uitvlugt Back Uitvlugt Front Reynestein Back	Belle Vue Front Leonora Back Vriesland Front Wales	
4	Cane Grove Back Cane Grove Front Enmore Front L.B.I. Lusignan Front Ogle Aerodrome Ogle Front Timehri	Botanic Gardens	
5	Bath Front Blairmont # 7 Blairmont Midlands MARDS Mahaicony St. Francis Mission New Amsterdam Tech. Inst.	Blairmont Front	New Spring Garden
6		Skeldon	Skeldon Front
7		Mazaruni	
8			Kaieteur
9	Lethem Karasabai		
10			Ebini Wismar

RAINFALL AND NORMAL

SELECTED STATIONS	PARAMETERS	March 2005
Region 2		
Anna Regina	Rainfall	16.6
	% of Normal	**18.8**
Onderneeming	Rainfall	26.2
	% of Normal	**16.1**
Region 3		
Boersarie	Rainfall	67.8
	% of Normal	**57.7**
De Kinderen B	Rainfall	22.2
	% of Normal	**17.5**
De Kinderen F	Rainfall	16.2
	% of Normal	**13.9**
Leonora F	Rainfall	36.3
	% of Normal	**31.2**
Uitvlugt F	Rainfall	57.4
	% of Normal	**53.7**
Wales F	Rainfall	66.3
	% of Normal	**57.0**
Young Rachael	Rainfall	115.8
	% of Normal	**89.5**
Region 4		
Cane Grove B	Rainfall	14.0
	% of Normal	**13.6**
Cane Grove F	Rainfall	10.5
	% of Normal	**10.0**
Enmore	Rainfall	24.0
	% of Normal	**23.6**
Georgetown	Rainfall	78.5
	% of Normal	**70.7**
L. B. I	Rainfall	31.4
	% of Normal	**32.4**
Mon Repos	Rainfall	123.6
	% of Normal	**89.8**
Ogle F	Rainfall	24.9
	% of Normal	**24.4**
Timehri	Rainfall	40.6
	% of Normal	**30.3**
Region 5		
Blairmont #7	Rainfall	3.4
	% of Normal	**3.6**
Blairmont F	Rainfall	34.0
	% of Normal	**31.0**
Blairmont Mid	Rainfall	1.9
	% of Normal	**1.9**

SELECTED STATIONS	PARAMETERS	March 2005
Mahaicony Rly Stn.	Rainfall	23.6
	% of Normal	**30.0**
MARDS	Rainfall	23.8
	% of Normal	**21.8**
Region 6		
Albion F	Rainfall	154.1
	% of Normal	**180.9**
New Amsterdam	Rainfall	12.8
	% of Normal	**14.6**
Rose Hall F	Rainfall	21.8
	% of Normal	**31.4**
Skeldon F	Rainfall	119.8
	% of Normal	**117.2**
Region 9		
Lethem	Rainfall	18.5
	% of Normal	**100.5**
Region 10		
Ebini	Rainfall	91.7
	% of Normal	**60.1**

MONTHLY DATA SUMMARY (CLIMATIC) FOR MARCH 2005

Station Name	Element #	Data Days	Average(A) or Total(T)					Extreme				Number of Day		
				Decade 1	Decade 2	Decade 3	Monthly	Max	Day	Min	Day	Limit 1	Limit 2	Limit 3
Hossororo	Precip	31	T	8.3	41.8	19.0	69.1	17.9	14	0.0	31*	9	5	2
Mabaruma N.W.D.	Tmpmax	31	A	32.2	32.0	32.1	32.1	33.2	30	29.8	26	30	0	0
	Tmpmin	31	A	23.3	23.0	22.8	23.0	24.5	9	20.0	15	0	0	0
	Tmpmn	31	A	27.7	27.5	27.5	27.6	28.5	14	25.2	15			
	Precip	31	T	2.5	54.0	34.4	90.9	22.5	14	0.0	27*	14	5	3
	Rhmean	31	A	77.2	76.6	79.3	77.7	91.0	26	71.0	19			
	Dsoil	31	A	23.0	22.9	22.4	22.7	24.4	4	20.0	15			
	Mnvapr	31	A	31.0	30.9	31.3	31.1	32.7	29	29.9	15			
Anna Regina	Precip	31	T	0.0	4.8	11.8	16.6	7.0	21	0.0	30*	4	1	0
Dawa	Precip	31	T	0.0	0.0	13.6	13.6	8.8	22	0.0	31*	3	1	0
La Bagatelle Leguan	Precip	31	T	21.6	0.0	4.4	26.0	12.7	8	0.0	31*	3	2	1
Belle Vue Front W B D	Precip	31	T	2.3	16.7	35.3	54.3	19.3	31	0.0	29*	11	3	1
Boerasirie W.C.D	Precip	31	T	1.7	16.9	8.6	27.2	13.7	14	0.0	29*	9	1	1
De.Kinderen Back W.C.D	Precip	31	T	1.5	12.7	8.0	22.2	7.5	14	0.0	29*	10	1	0
De Kinderen Front W.C.D	Precip	31	T	0.5	8.7	7.0	16.2	7.1	14	0.0	31*	10	1	0
La Resource W.B.D	Precip	31	T	0.5	10.9	39.7	51.1	23.1	31	0.0	28*	10	3	1
Leonora Back.W.C.D	Precip	31	T	0.3	7.7	76.1	84.1	47.6	31	0.0	29*	11	3	2
Leonora Corner W.C.D	Precip	31	T	0.3	9.3	22.4	32.0	9.2	23	0.0	30*	10	3	0
Leonora Front.W.C.D	Precip	31	T	3.1	2.5	10.1	15.7	4.8	24	0.0	29*	10	0	0
Potosi W.B.D	Precip	31	T	0.0	12.7	29.1	41.8	11.7	14	0.0	29*	7	4	2
Reynestein Front W.B.D	Precip	31	T	1.5	7.1	21.2	29.8	5.3	24*	0.0	29*	11	2	0
Uitvlugt Back.W.C.D	Precip	31	T	0.2	5.1	36.8	42.1	27.1	31	0.0	29*	8	1	1
Uitvlugt Front W C D	Precip	31	T	1.2	3.4	8.1	12.7	3.3	24	0.0	29*	11	0	0
Vriesland Front W.B.D	Precip	31	T	4.8	13.5	46.3	64.6	14.2	24	0.0	29*	8	4	4
Wales Front W.B.D	Precip	31	T	5.4	14.0	46.9	66.3	14.0	14	0.0	28*	10	6	3
Cane Grove Back E C D	Precip	31	T	0.0	3.8	10.2	14.0	10.2	23	0.0	31*	2	1	1
Cane Grove Front E.C.D	Precip	31	T	0.0	1.0	9.5	10.5	6.0	22	0.0	31*	3	1	0
Enmore Front E.C.D	Precip	31	T	0.0	10.0	14.0	24.0	6.5	14	0.0	30*	6	1	0
	Evappn	31	T	76.4	75.2	60.2	211.8	11.7	11	0.0	31*			
	Sunshn	31	A	9.4	8.7	7.9	8.6	10.7	10	4.6	14			
Georgetown Bot. Gardens	Tmpmax	31	A	30.9	30.9	31.1	31.0	31.8	19	30.2	20	31	0	0
	Tmpmin	31	A	25.5	25.5	25.2	25.4	26.2	30*	23.4	25	0	0	0
	Tmpmn	31	A	28.2	28.2	28.2	28.2	28.9	19	27.3	24			
	Precip	31	T	2.9	9.9	65.7	78.5	45.1	31	0.0	29*	8	4	1
	Rhmean	31	A	70.2	67.0	69.5	68.9	84.0	14	33.0	19			
	Evappn	31	T	62.7	62.5	66.9	192.1	10.3	13*	2.0	27			
	Mxtpan	31	A	36.6	36.4	35.3	36.1	38.5	18	26.8	23			
	Mntpan	31	A	23.4	24.0	24.1	23.9	26.0	26	21.0	10			
	Presst	23I	A	1012.3	1012.1	-	1012.5	1015.1	23	1010.3	15*			
	Pressl	23I	A	1012.7	1012.5	-	1012.9	1015.5	23	1010.7	15*			
	Wndmil	31	T	573.0	604.0	668.0	1845.0	91.0	12	40.0	4			
	Soil05	31	A	28.4	29.3	28.8	28.8	30.5	12	26.5	25			
	Soil10	31	A	28.0	29.0	28.6	28.5	30.0	20*	25.7	2			
	Soil20	31	A	29.7	30.9	30.4	30.3	31.8	12	27.8	1			

Station Name	Element #	Data Days		Average(A) or Total(T)				Extreme				Number of Day		
				Decade 1	Decade 2	Decade 3	Monthly	Max	Day	Min	Day	Limit 1	Limit 2	Limit 3
	Dsoil	31	A	23.3	24.3	24.3	24.0	25.8	29	20.8	10			
	Sunshn	31	A	9.1	9.3	9.2	9.2	10.9	7*	5.1	10			
	Prmx12	31	A	0.3	1.0	6.0	2.5	44.9	31	0.0	29*			
	Prmx6h	31	A	0.3	1.0	5.7	2.4	43.9	31	0.0	29*			
	Mnvapr	31	A	28.2	28.5	28.3	28.4	30.6	14*	25.2	2			
La Bonne Intention Front	Precip	31	T	1.4	6.4	23.6	31.4	15.8	31	0.0	28*	10	1	1
	Evappn	31	T	78.1	72.3	70.7	221.1	13.0	18	0.0	31			
	Wndmil	31	T	1374.0	1372.0	1657.0	4403.0	185.0	20	43.0	13			
	Sunshn	31	A	8.5	6.8	3.2	6.1	10.3	3	0.0	30*			
Lusignan Front E.C.D	Precip	31	T	0.0	3.6	11.2	14.8	8.8	31	0.0	30*	4	1	0
Ogle Aerodrome	Precip	31	T	0.5	7.5	32.6	40.6	11.2	31	0.0	29*	8	5	1
Ogle Front E.C.D	Precip	31	T	0.6	6.4	17.9	24.9	13.2	31	0.0	28*	10	1	1
Timehri Airport E.B.D	Tmpmax	31	A	31.5	32.2	32.3	32.0	33.4	25	29.9	10	29	0	0
	Tmpmin	31	A	21.6	22.1	21.5	21.7	23.6	18	19.8	10	0	0	0
	Tmpmn	31	A	26.6	27.1	26.9	26.9	28.0	18	24.8	10			
	Precip	31	T	0.9	10.0	29.7	40.6	9.4	23	0.0	29*	10	4	0
	Rhmean	31	A	71.7	73.1	71.2	72.0	91.0	14	64.0	25			
	Evappn	31	T	52.4	60.5	52.5	165.4	9.2	16	0.0	23*			
	Presst	31	A	1009.7	1009.5	1010.2	1009.8	1012.3	23	1007.8	15			
	Pressl	31	A	1013.2	1013.0	1013.7	1013.3	1015.8	23	1011.2	15			
	Wndmil	31	T	1500.0	1776.0	2040.0	5316.0	226.0	28*	114.0	10			
	Dsoil	31	A	19.7	20.3	20.3	20.1	23.5	22	15.5	10			
	Mnvapr	31	A	27.2	27.7	27.3	27.4	30.0	1	24.9	9			
Bath Front	Precip	31	T	3.5	5.4	15.5	24.4	10.3	24	0.0	30*	6	1	1
Blairmont #7 W.C.B	Precip	31	T	0.6	0.3	2.5	3.4	0.9	21	0.0	28*	6	0	0
Blairmont Midlands W.C.B	Precip	31	T	0.2	0.0	1.7	1.9	0.6	23	0.0	31*	6	0	0
Blairmont Front	Precip	31	T	2.5	13.0	18.5	34.0	11.5	29	0.0	30*	11	2	1
M/Cony. Abary Rice Dev.S	Tmpmax	31	A	29.7	30.0	30.1	29.9	30.5	31*	29.5	11*	6	0	0
	Tmpmin	31	A	25.1	25.6	25.4	25.4	26.0	29*	23.0	10	0	0	0
	Tmpmn	31	A	27.4	27.8	27.7	27.6	28.1	29*	26.3	10			
	Precip	31	T	6.1	3.1	14.6	23.8	8.2	30	0.0	31*	9	2	0
	Evappn	31	T	63.9	59.6	78.9	202.4	9.1	25	4.6	6			
	Mxtpan	31	A	34.2	33.7	33.5	33.8	36.0	18*	31.0	22			
	Mntpan	31	A	22.7	22.8	22.7	22.7	25.5	2	21.5	10*			
	Wndmil	31	T	1620.0	1634.0	2124.0	5378.0	269.0	1	107.0	11			
	Soil05	31	A	26.2	26.5	26.1	26.3	27.0	19*	25.6	31*			
	Soil10	31	A	26.2	26.8	26.7	26.6	28.6	19	25.2	2			
	Soil20	31	A	28.1	28.3	28.3	28.2	28.9	18	27.8	15*			
	Sunshn	31	A	8.7	8.9	8.9	8.9	11.2	11	3.9	10			
Mahaicony	Precip	31	T	0.0	4.7	18.9	23.6	13.7	23	0.0	29*	12	1	1
St Francis Mission	Precip	31	T	0.0	0.0	29.0	29.0	23.2	21	0.0	28*	5	1	1
New Amsterdam Tech. Ins	Tmpmax	31	A	31.4	31.7	31.7	31.6	32.8	27*	30.2	8	31	0	0
	Tmpmin	31	A	22.6	22.9	23.0	22.9	25.2	31	20.6	11	0	0	0
	Tmpmn	31	A	27.0	27.3	27.4	27.2	28.4	31	25.8	13			
	Precip	31	T	4.8	13.3	17.4	35.5	11.2	13	0.0	30*	10	2	1
	Rhmean	31	A	67.4	69.1	72.3	69.7	79.0	28*	64.0	18*			
	Evappn	31	T	53.3	61.1	59.2	173.6	8.0	18	2.4	5			

Station Name	Element #	Data Days	Average(A) or Total(T)					Extreme				Number of Day		
				Decade 1	Decade 2	Decade 3	Monthly	Max	Day	Min	Day	Limit 1	Limit 2	Limit 3
	Wndmil	31	T	689.0	805.0	1003.0	2497.0	116.0	22	41.0	6			
	Dsoil	31	A	21.6	22.2	21.1	21.6	24.4	22*	15.4	27			
	Sunshn	31	A	6.1	7.4	7.4	7.0	10.5	11	1.0	13			
	Mnvapr	31	A	28.2	29.0	30.3	29.2	34.6	26	26.6	9			
New Spring Garden 12	Precip	31	T	55.7	8.7	33.7	98.1	22.1	4	0.0	30*	12	7	4
Skeldon 82/B1 Berbice	Precip	31	T	49.6	9.8	23.3	82.7	28.9	5	0.0	30*	11	6	2
Skeldon Front	Tmpmax	31	A	29.8	30.3	30.4	30.2	31.1	30*	28.9	10*	11	0	0
	Tmpmin	31	A	25.8	25.6	25.5	25.6	26.7	22*	23.3	21	0	0	0
	Precip	31	T	70.3	13.9	35.6	119.8	44.8	5	0.0	30*	13	7	3
	Wndmil	29I	T	571.0	712.0	640.0	1923.0	95.0	17	34.0	25			
	Sunshn	31	A	7.4	7.5	4.3	6.3	9.2	1	2.1	31*			
Mazaruni Prison	Tmpmax	30I	A	31.5	31.1	31.0	31.2	32.0	28*	29.5	24*	-	-	-
	Tmpmin	31	A	23.1	22.4	22.3	22.6	25.0	29*	20.0	9	0	0	0
	Precip	30I	T	6.4	31.2	51.4	89.0	30.6	30	0.0	28*	-	-	-
	Wndmil	30I	T	1150.0	1367.0	1548.0	4065.0	214.0	22	83.0	24*			
	Sunshn	31	A	7.2	6.9	6.1	6.7	9.9	26	3.4	22			
Kaieteur Falls	Tmpmax	31	A	28.9	29.8	29.0	29.2	30.5	16*	26.8	31*	5	0	0
	Tmpmin	31	A	20.6	20.4	19.7	20.2	21.5	7*	19.0	29*	0	0	0
	Tmpmn	31	A	24.7	25.0	24.3	24.7	26.0	6	23.2	22			
	Precip	31	T	3.0	46.5	97.3	146.8	58.4	21	0.0	27*	19	7	5
	Rhmean	31	A	77.6	74.0	78.2	76.6	91.0	31	64.0	27			
	Evappn	31	T	31.0	52.5	47.1	130.6	7.2	17	0.0	10*			
	Wndmil	31	T	851.0	894.0	899.0	2644.0	99.0	27*	66.0	22			
	Sunshn	31	A	5.2	7.6	6.4	6.4	9.7	16	0.5	22			
	Mnvapr	31	A	25.3	25.1	24.9	25.1	28.3	1	22.0	9			
Karasabai Rrupununi	Precip	31	T	0.0	20.2	0.0	20.2	20.1	11	0.0	31*	2	1	1
Lethem Airstrip	Tmpmax	31	A	33.7	33.6	34.0	33.8	35.2	27	30.0	22	30	1	0
	Tmpmin	31	A	25.2	24.6	24.5	24.8	26.0	6*	22.6	23	0	0	0
	Tmpmn	31	A	29.5	29.1	29.2	29.3	30.4	27	27.2	22			
	Precip	31	T	0.2	14.3	4.0	18.5	8.6	12	0.0	31*	6	1	0
	Rhmean	31	A	59.8	61.4	59.3	60.1	76.0	22	52.0	29			
	Wndmil	31	T	3414.0	2891.0	3490.0	9795.0	376.0	9	236.0	12			
	Soil05	31	A	30.8	28.6	29.4	29.6	39.0	1	26.2	23*			
	Soil10	31	A	31.1	29.1	29.8	30.0	38.4	1	26.4	14			
	Soil20	31	A	32.3	31.0	31.6	31.6	34.6	1	28.2	14			
	Dsoil	31	A	25.1	24.6	24.1	24.6	26.4	4	22.5	10			
	Sunshn	31	A	3.8	6.3	8.7	6.3	10.7	26	0.1	8*			
	Mnvapr	31	A	26.0	26.4	26.0	26.2	28.0	22*	23.7	29			
Ebini Livestock Station	Tmpmax	31	A	31.5	33.0	32.2	32.2	33.6	20*	28.4	31	28	0	0
	Tmpmin	31	A	22.1	22.4	21.8	22.1	24.3	5	19.5	10	0	0	0
	Tmpmn	31	A	26.8	27.7	27.0	27.2	28.5	24	24.2	10			
	Precip	31	T	13.9	18.5	59.3	91.7	27.2	21	0.0	27*	15	6	2
	Evappn	31	T	53.6	51.9	61.1	166.6	9.5	21	0.0	31*			
	Mxtpan	31	A	35.1	36.3	31.6	34.3	39.0	2	0.0	31			
	Mntpan	31	A	22.5	22.7	21.7	22.3	24.0	2	20.0	29			
	Wndmil	31	T	304.0	384.0	494.0	1182.0	71.0	22	0.0	31			
	Soil05	31	A	28.3	28.1	28.0	28.1	29.2	28*	26.8	31			

Station Name	Element #	Data Days	Average(A) or Total(T)					Extreme				Number of Day		
				Decade 1	Decade 2	Decade 3	Monthly	Max	Day	Min	Day	Limit 1	Limit 2	Limit 3
	Soil10	31	A	28.4	28.1	28.1	28.2	29.4	5	27.2	31*			
	Soil20	31	A	29.9	29.7	29.7	29.8	30.6	6*	28.8	30			
	Sunshn	31	A	5.7	7.5	7.2	6.8	10.3	23	0.2	31			
	Prmx12	31	A	1.4	1.9	5.3	2.9	27.2	21	0.0	27*			
	Prmx6h	31	A	1.3	1.9	2.9	2.0	20.2	31	0.0	27*			
Wismar Linden	Precip	31	T	9.4	15.6	96.8	121.8	47.9	21	0.0	28*	18	6	2

Station List

Station Name	District	Latitude	Longitude
Mabaruma N.W.D.	Region I	08 12 05N	059 47 15W
Anna Regina	Region II	07 15 45N	058 28 50W
Dawa	Region II	07 12 10N	058 36 30W
Onderneeming Essequibo	Region II	07 06 05N	058 28 55W
La Bagatelle Leguan	Region III	06 54 55N	058 24 05W
Belle Vue Front W B D	Region III	06 43 05N	058 12 25W
Boerasirie W.C.D	Region III	06 49 10N	058 21 30W
De.Kinderen Back W.C.D	Region III	06 50 00N	058 19 55W
De Kinderen Front W.C.D	Region III	06 52 40N	058 20 00W
Fort Island Esseq River	Region III	06 47 00N	058 30 40W
La Resource W.B.D	Region III	06 43 30N	058 14 35W
Leonora Back.W.C.D	Region III	06 47 55N	058 17 55W
Leonora Front.W.C.D	Region III	06 52 10N	058 17 20W
Potosi W.B.D	Region III	06 40 15N	058 12 55W
Reynestein Front W.B.D	Region III	06 38 30N	058 12 45W
Uitvlugt Back.W.C.D	Region III	06 48 50N	058 19 10W
Uitvlugt Front W C D	Region III	06 52 15N	058 18 20W
Vriesland Front W.B.D	Region III	06 41 15N	058 12 35W
Vriesland Back W.B.D	Region III	06 41 30N	058 13 25W
Wales Front W.B.D	Region III	06 42 15N	058 12 10W
Young Rachael W.B.D	Region III	06 41 55N	058 14 05W
Cane Grove Back E C D	Region IV	06 37 05N	057 53 55W
Cane Grove Front E.C.D	Region IV	06 37 35N	057 55 00W
Diamond Front E.B.D	Region IV	06 43 15N	058 11 30W
Enmore Front E.C.D	Region IV	06 44 55N	057 59 25W
Georgetown Bot. Gardens	Region IV	06 48 25N	058 08 50W
La Bonne Intention Front	Region IV	06 48 00N	058 03 55W
Ogle Aerodrome	Region IV	06 48 30N	058 06 30W
Ogle Front E.C.D	Region IV	06 48 15N	058 06 15W
Timehri Airport E.B.D	Region IV	06 30 20N	058 15 10W
Blairmont Front	Region V	06 15 15N	057 32 35W
M/Cony. Abary Rice Dev.S	Region V	06 27 50N	057 45 35W
Mahaicony	Region V	06 34 25N	057 47 25W
Adelphi Berbice	Region VI	06 13 45N	057 28 55W
Albion Front	Region VI	06 15 15N	057 22 45W
Albion 33 Nigg41	Region VI	06 14 00N	057 23 05W
Albion69\ Nigg92	Region VI	06 12 30N	057 23 30W

Station Name	District	Latitude	Longitude
Ankerville.E.82	Region VI	06 09 20N	057 22 05W
Enterprise Back Berbice	Region VI	06 12 30N	057 24 50W
Enterprise Front Berbice	Region VI	06 12 30N	057 27 20E
Jubilee3 \Nigg72	Region VI	06 13 40N	057 23 55W
Jubilee 1-9	Region VI	06 13 00N	057 18 00W
Letter Kenny Berbice	Region VI	06 12 00N	057 18 00W
Lochaber Berbice	Region VI	06 13 40N	057 29 45W
Mibikuri	Region VI	06 06 30N	057 17 20W
New Amsterdam Tecn Ins	Region VI	06 14 58N	057 31 15W
Nigg 58 C\Tyne	Region VI	06 12 50N	057 23 05W
No 54 Village Berbice	Region VI	06 01 55N	057 10 25W
No 63 Benab	Region VI	05 58 55N	057 09 05W
No 73 Village	Region VI	05 55 40N	057 08 50W
Port Mourant Front	Region VI	06 14 50N	057 21 05W
Providence Back Berbice	Region VI	06 10 00N	057 30 00W
Providence Front Berbice	Region VI	06 13 00N	057 31 00W
Reliance Berbice	Region VI	06 15 35N	057 27 10W
Resource E.13\17	Region VI	06 11 05N	057 21 20W
Resource .E.33\34	Region VI	06 09 55N	057 21 40W
Rose Hall Front	Region VI	06 14 25N	057 29 10W
Resource O.G.16	Region VI	06 13 30N	057 20 45W
Skeldon Front	Region VI	05 52 45N	057 08 30W
Whim \Corentyne	Region VI	06 13 30N	057 18 50W
Jawalla Mazaruni	Region VII	05 41 00N	060 29 00W
Kamarang Mazaruni	Region VII	05 53 00N	060 37 00W
Kaieteur Falls	Region VIII	05 10 00N	059 29 00W
Karasabai Rupununi	Region IX	04 01 00N	059 27 00W
Lethem Airstrip	Region IX	03 22 15N	059 48 10W
Wismar Linden	Region X	06 00 00N	058 18 00E

Element Definition

Abbrev	Name	Units
TMPMAX	Temp daily max	DegreesC
TMPMIN	Temp Daily min	DegreesC
PRECIP	Precip daily	Millimeters
EVAPPN	Evap pan daily	Millimeters
SUNSHN	Sunshine Daily	Minutes
TMPMN	Temp daily mean	DegreesC
RHMEAN	RH daily mean	Percent
MXTPAN	Temp evap pn mx	DegreesC
MNTPAN	Temp evap pn mn	DegreesC
PRESST	Press stn avg	Hectopascals
PRESSL	Press sea lv avg	Hectopascals
WNDMIL	Wind Mile dly	Kilometers
SOIL05	Temp soil 05 dly	DegreesC

Abbrev	Name	Units
SOIL10	Temp soil 10 dly	DegreesC
SOIL20	Temp soil 20 dly	DegreesC
DSOIL	Temp soil daily	DegreesC
PRMX12	PRCP MAX 12 HR	Millimeters
PRMX6H	PRCP MAX 6 HR	Millimeters
MNVAPR	MEAN DLY VAP PRE	Hectopascals

SURFACE WATER HYDROLOGY DATA FOR MARCH 2005

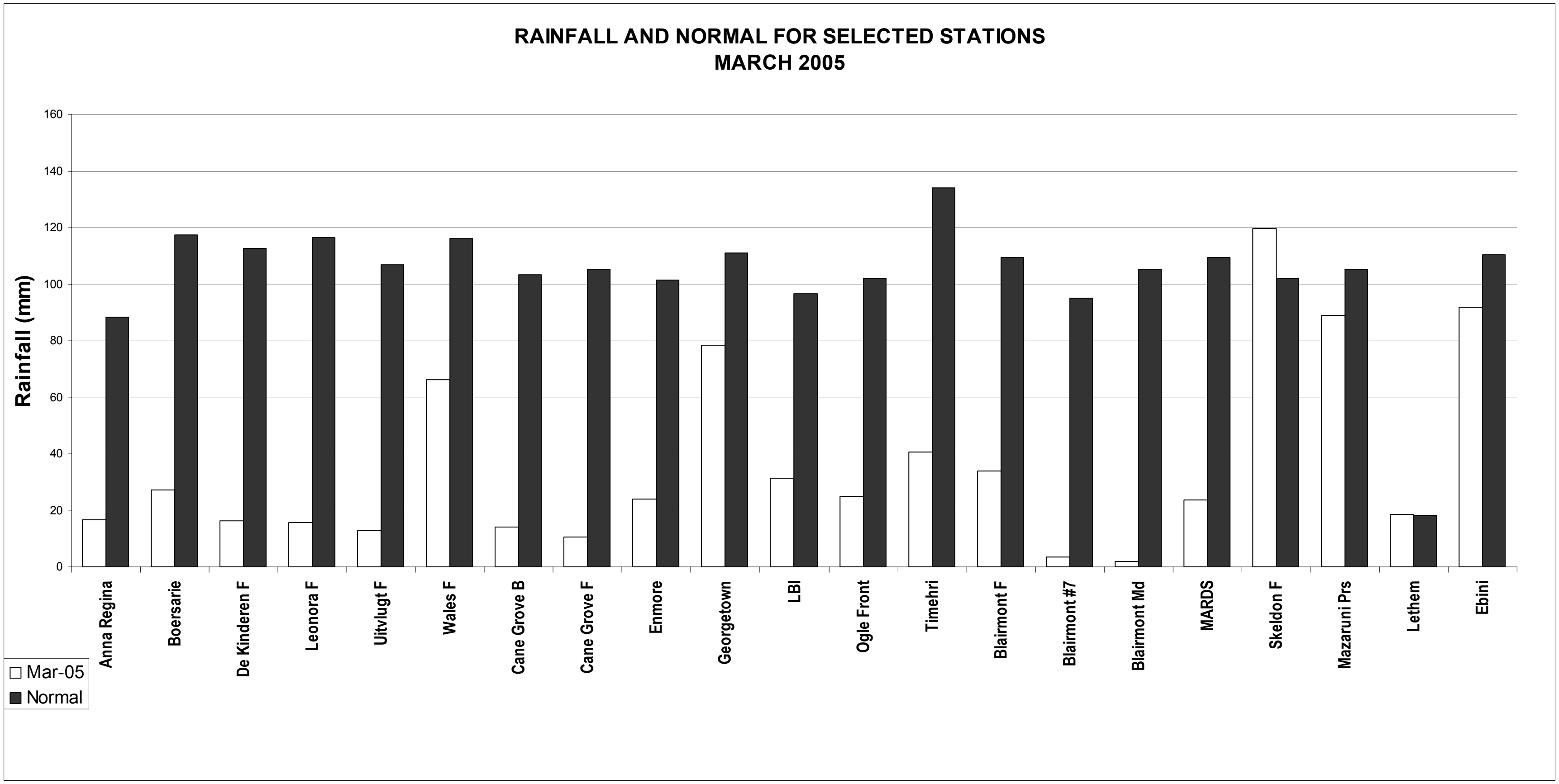
DATE	MAZARUNI RIVER AT APAIKWA FALLS		LOO RIVER AT LINDEN HIGHWAY	
	STAGE (m)	DISCHARGE (m^3s^{-1})	STAGE (m)	DISCHARGE (m^3s^{-1})
1	14.73	710.8	1.41	3.3
2	14.10	560.7	1.40	3.2
3	13.61	453.1	1.39	3.1
4	13.23	379.5	1.38	3.0
5	13.00	334.2	1.38	3.0
6	12.89	311.5	1.38	3.0
7	12.79	294.5	1.39	3.1
8	12.71	279.5	1.38	3.0
9	12.62	263.1	1.38	3.0
10	12.55	251.5	1.38	3.0
11	12.40	229.4	1.39	3.0
12	12.27	209.9	1.38	3.1
13	12.16	195.4	1.38	3.0
14	12.08	184.9	1.39	3.0
15	12.03	179.0	1.39	3.1
16	12.13	191.4	1.38	3.0
17	12.21	202.5	1.37	2.9
18	12.16	195.7	1.37	2.9
19	12.28	211.6	1.37	2.9
20	12.43	233.6	1.37	2.9
21	12.87	308.7	1.37	2.9
22	12.66	271.3	1.40	3.2
23	12.62	264.5	1.42	3.4
24	12.55	251.5	1.40	3.2
25	12.64	267.1	1.39	3.1
26	12.56	254.0	1.38	3.0
27	12.35	221.5	1.37	2.9
28	12.16	196.0	1.37	2.9
29	12.02	177.8	1.37	2.9
30	11.92	164.0	1.37	2.9
31	11.87	157.7	1.38	3.0
AVERAGE	**12.60**	**271.2**	**1.38**	**3.04**

GAUGE HEIGHT FOR SHELTER BELT FOR MARCH 2005

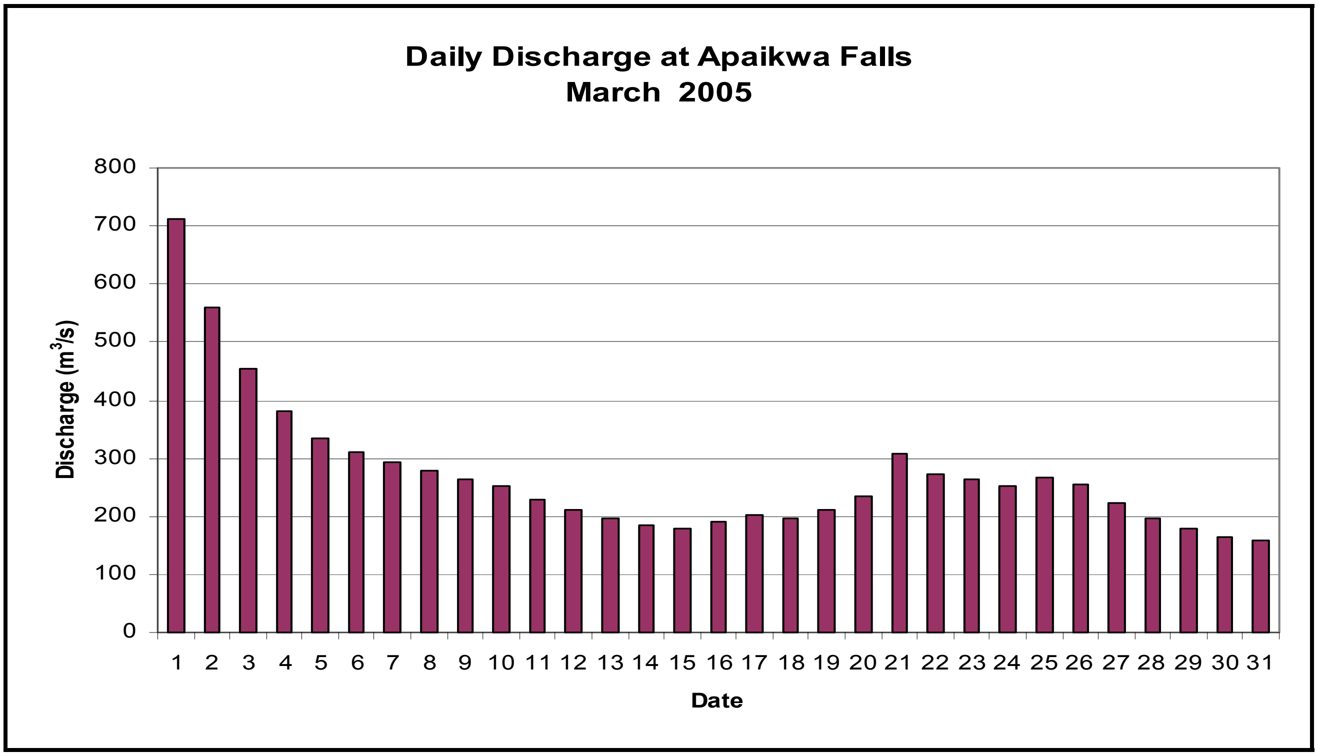
DATE	GAUGE HEIGHT (m)	DATE	GAUGE HEIGHT (m)
1	15.10	**16**	15.20
2	15.18	**17**	15.15
3	15.44	**18**	15.33
4	15.87	**19**	15.50
5	16.16	**20**	15.55
6	15.90	**21**	15.63
7	15.85	**22**	15.70
8	15.82	**23**	15.79
9	15.66	**24**	15.87
10	15.56	**25**	15.96
11	15.38	**26**	16.03
12	15.24	**27**	16.08
13	15.15	**28**	16.14
14	15.18	**29**	16.18
15	15.19	**30**	16.19
		31	16.13
AVERAGE		**15.65**	

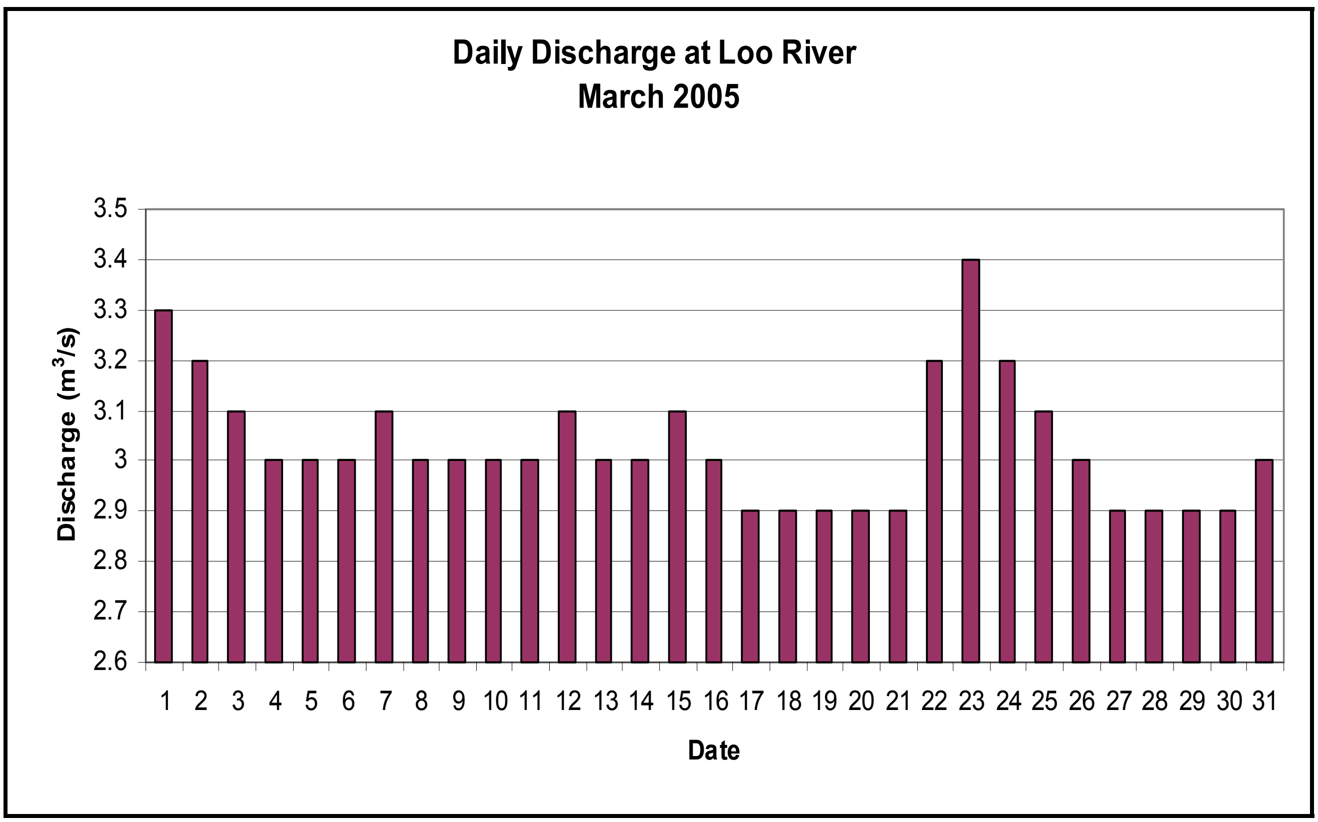
Note: Actual Water Level = Gauge height (m) - Georgetown Datum 14.02 (m)

RAINFALL GRAPHS



HYDROLOGY GRAPHS





WEATHER NOTE

Exposure of Thermometers for measuring air temperature

Continuation from last month

Stevenson Thermometer Screen

The Stevenson thermometer screen is a rectangular wooden box provided with doors at the back and front; the sides, back and front are double louvered, the roof is double and the base consists of overlapping boards separated vertically by an air space. A series of holes, of 2.54 cm. diameter with brass liners, in the inner roof helps the air circulation between the inner and outer roofs. The two sides of the louvers act in a similar manner to double walls, and at the same time allow the air to circulate freely. The screen is painted white and the top of the screen is covered with sheet zinc, which is turned down at the edges. The front door is hinged at the bottom and may be fastened by a brass turn, hasp and staple at the centre top. A suitable length of brass chain is fixed between the side posts and the door, so that the door comes to rest in an approximately horizontal position when opened to its fullest extent. The rear door is identical with the front door, except that the brass turn, hasp and staple are replaced by brass securing plates. These plates can be unscrewed when necessary if access to the rear of the screen is required. On the centre base board is mounted a short mahogany cylinder which is used as a support for the water reservoir, which feeds the wet bulb. The dimensions of the clear rectangular space inside the screen are 0.7 m by 0.4 m by 0.6 m.

The screen itself is supported on a stand consisting of four uprights of angle iron, with angle-iron cross-pieces and diagonal ties of mild-steel strip. Foot plates, 12.7 cm square, are provided at the base of each upright. The two end sets of angle-iron cross-pieces are riveted to the uprights to form two complete units, while the other members are supplied drilled, ready for assembly, together with the necessary nuts and bolts. The stand should be erected in the following manner.

Place the two end units at about the right distance apart, and attach the four cross-pieces of angle iron, the horizontal surfaces being in each case uppermost and inside; bolt holes for the attachment of these members will be seen near the top and bottom of each end. Place the diagonal strips in position and secure them by means of a bolt at each end and one passing through both diagonal pieces where they overlap. The ends of the diagonal strips should be inside the uprights and not outside. During the process of assembly the nuts should only be put on hand tight, the whole being firmly tightened up when all the members are in position.

A hole should then be dug, one foot deep and of sufficient length and breadth to take the flat ends of the feet of the uprights. This depth should ensure that the base of the screen is 1.4 m above the ground level and thus that the bulbs of the dry and wet bulb thermometers are 15.6 cm above the ground. The front of the screen should face true north in the northern hemisphere (south in the southern hemisphere to reduce to a minimum the risk of sunlight reaching the thermometer bulbs when the door is opened.

The stand should be placed in the hole, the top checked for leveling, and then the earth filled in and trodden down. The legs should be sufficiently rigid when in position to prevent shaking during gales; in very exposed situations, however, it is advisable to have the feet set in a layer of concrete. There should be no boarding beneath the base of the screen, and the earth should be compacted to bring it to the level of the surrounding ground. If grass is allowed to grow on the surrounding plot it should be kept cut short. The stand should be given two coats of white paint; this causes it to reflect a large fraction of the solar radiation falling on it, and reduces the disturbance to the temperature distribution caused by its presence. Once the stand is erected, the screen can be fitted on to the top and fixed in place by screws at each end.

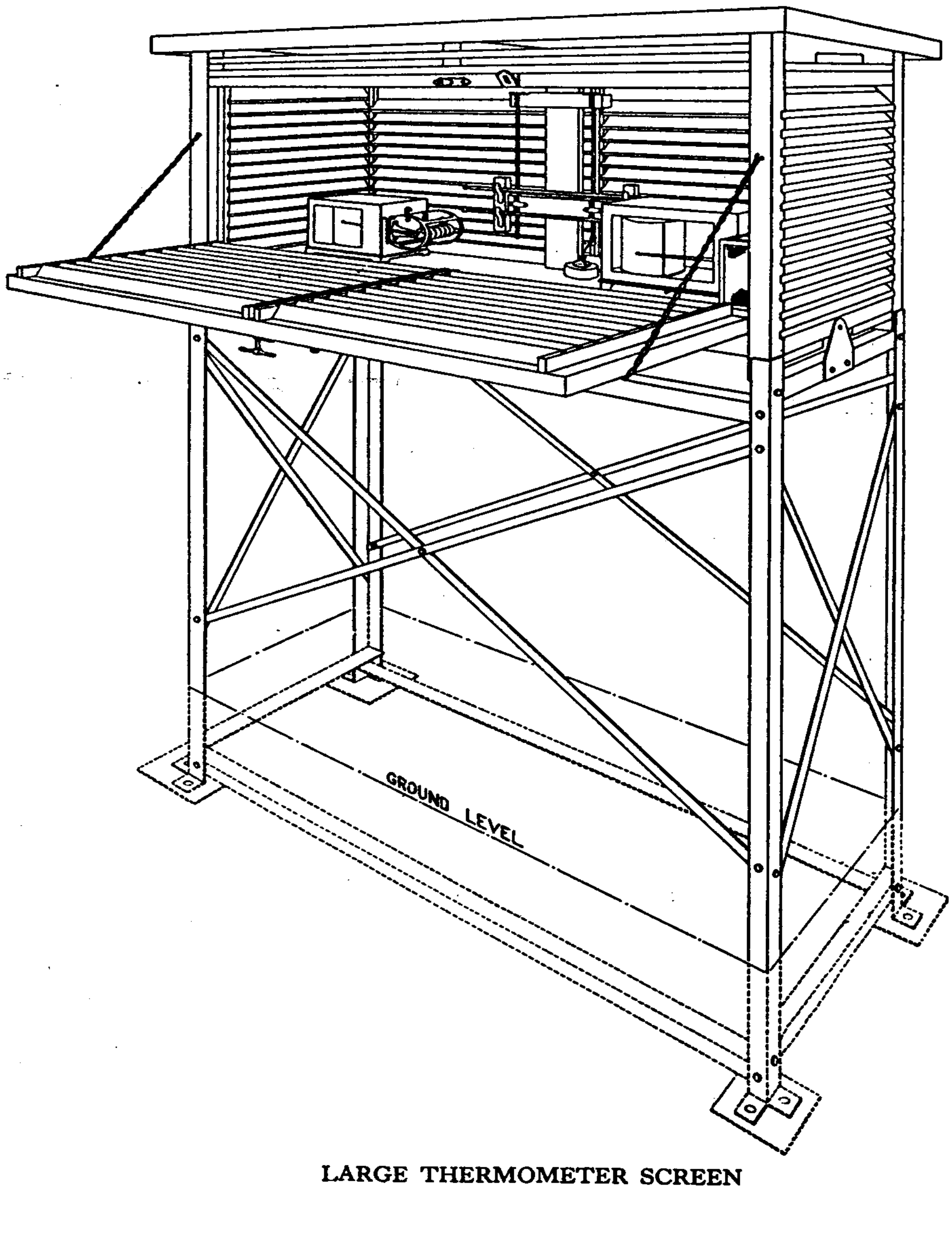
The mounting for the thermometers consists of a wooden framework firmly fixed in position inside the screen. The dry and wet bulb thermometers are suspended in a vertical position, 14.6 cm apart, with the button at the top of the thermometer resting in the supports on the upper T-piece of the mounting and being fixed in grooves in the lower T-piece by means of small brass clips. The grooves are sufficiently deep to take the sheathed thermometers but not deep enough to allow any movement, once the thermometers are in position.

The mercury in glass maximum thermometer is laid in position on the upper two metal brackets on the lower T-piece, and these are positioned so that the thermometer rests at an angle of 2^o to the horizontal. The thermometer should be placed so that the bulb is at the lower end, i.e. with the bulb on the left when facing the front of the screen. The spirit in glass minimum thermometer is laid in position on the lower two metal brackets on the lower T-piece. It also slopes at an angle of 2^o to the horizontal, and the bulb should be lower than the stem. The thermometers are held firmly in place by the elasticity of the metal.

This arrangement, with the thermometers grouped closely together, reduces to a minimum the obscuring of one thermometer scale by other thermometers, and places the maximum and minimum thermometers in a readily available position for removal for the purpose of resetting. The wet bulb is also well away from the other three bulbs, and there is a space of at least 7.5 cm between each bulb and the walls of the screen. The firm fixing of the maximum and minimum thermometers is important, as any jolting in strong winds, or when the door of the screen is opened, might otherwise lead to a displacement of the index or mercury column. The reason for the slope of the maximum thermometer is to prevent the mercury column from slipping forward when it is replaced after setting; if this were unnoticed it might give rise to a serious error in the reading. Too great a slope of the thermometer might, however, give rise to errors in the other direction, by allowing the mercury to pass back through the constriction when the temperature falls.

The paint on the screen should be kept in good condition and renewed regularly. A grey screen absorbs much more radiation than a white screen, and thus the errors introduced by the heating of the screen are larger. It is advisable to wash the screen with soap and water regularly in the intervals between painting.

<u>Note:-</u> The Hydrometeorological Service in Guyana maintains and operates eight Synoptic Stations within Regions 1, 4(2), 5, 6, 7, 8 and 9. At these locations thermometer screens are installed with thermometers for the recording of temperature values such as dry, wet, maximum and minimum temperatures.



LARGE THERMOMETER SCREEN

Source, Handbook of Meteorological Instruments - Part I, Year of publication 1956 - pages 94-97

WEATHER YIELD

SOIL AND PLANT NUTRITION (Part 2)

Continuation from last month

Potassium
Potassium (K) is absorbed by plants in larger amounts than any other mineral element except nitrogen and, in some cases, Calcium. Potassium is supplied to plants by soil minerals, organic materials, and inorganic fertilizer.

Potassium, unlike nitrogen and Phosphorus, is not found in organic combination with plant tissues. Potassium plays an essential role in the metabolic processes of plants and is required in adequate amounts in several enzymatic reactions, particularly those involving the adenosine phosphates (ATP and ADP), which are the energy carriers in the metabolic processes of both plants and animals. Potassium also is essential in carbohydrate metabolism, a process by which energy is obtained from sugar. There is evidence that K also plays a role in photosynthesis and protein synthesis.

Calcium
Calcium, an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength in the plant. It is also thought to counteract the effect of alkali salts and organic acids within a plant. Calcium exists in a delicate balance with magnesium and potassium in the plant. Too much of any one of these elements may cause insufficiencies of the other two.

Magnesium (Mg)
Soil minerals, organic material, fertilizers, and dolomitic limestone are sources of magnesium for plants. Magnesium is part of the chlorophyll in all green plants and essential for photosynthesis. It also helps activate many plant enzymes needed for growth. Magnesium is a relatively mobile element in the plant.

Sulphur
In most soils, sulphur (S) is present primarily in the organic fraction which becomes available upon decomposition of organic matter and crop residues. Sulphur may be supplied to the soil from the atmosphere in rainwater. It is also added in some fertilizers as an impurity, especially the lower grade fertilizers. The use of gypsum ($CaSO_4$) also increases soil sulphur levels.

Sulphur is taken up by plants primarily in the form of sulphate ($SO_4^{=}$) ions and reduced and assembled into organic compounds. It is a constituent of the amino acids cystine, cysteine and methione and, hence, proteins that contain these amino acids. It is found in vitamins, enzymes and coenzymes.

Sulphur is also present in glycosides which give the characteristic odors and flavors in mustard, onion and garlic plants. It is required for nodulation and fixation of legumes. As the sulfate ion, it may be responsible for activating some enzymes.

Micronutrients

Of the 16 elements known to be essential for plant growth, seven are required in such small quantities that they are referred to as "micronutrients". These are Iron, Manganese, Zinc, Copper, Boron, Molybdenum and Chlorine.

Micronutrient deficiencies are most apt to limit crop growth under the following conditions:
(1) highly leached acid sandy soil,
(2) muck soils,
(3) soils high in pH or lime content, and
(4) soils that have been intensively cropped and heavily fertilized with macronutrients.

Manganese (Mn) Manganese may substitute for Mg by activating certain phosphate-transferring enzymes, which in turn affect many metabolic processes. High Manganese concentration may induce iron deficiency in plants.

Manganese availability is closely related to the degree of soil acidity. Deficient plants are usually found on slightly acid or alkaline soils.

Iron (Fe) is a constituent of many organic compounds in plants. It is essential for the synthesis of chlorophyll. Iron deficiency is often induced by alkaline soil pH and can be induced by high levels of Manganese. High iron concentration can also cause manganese deficiency.

Copper (Cu) is essential for growth and activates many enzymes. A deficiency interferes with protein synthesis and causes a buildup of soluble nitrogen compounds. Excess quantities of copper may also induce iron deficiency.

Zinc (Zn) is essential for plant growth because it controls the synthesis of indoleacetic acid, which dramatically regulates plant growth. Zinc is also active in many enzymatic reactions.

Boron (B) primarily regulates the metabolism of carbohydrates in plants. The need varies greatly with different crops. Rates required for responsive crops may cause serious damage to B-sensitive crops. Boron deficiency may occur on both alkaline and acid soils but is more prevalent on the calcareous, alkaline soils.

Molybdenum (Mo) functions largely in the enzyme systems of nitrogen fixation and nitrate reduction. Plants which can neither fix nitrogen nor incorporate nitrate into their metabolic system because of inadequate molybdenum become nitrogen deficient. Molybdenum is required in minute amounts.

Chlorine (CI) is needed in relatively large quantities in plant nutrition. However, the abundance of chlorine from many sources in the environment means that chlorine deficiencies in plants are rare. Excess and toxicity of chlorine are more frequently occurring problems than are deficiencies.

Source: University of Florida, IFAS Website http://www.edis.ifas.ufl.edu/

WEATHER NEWS

Changing Climate, Changing World

Climate and weather affect humankind but, in order to understand these complex reciprocal relationships, it is necessary to look at how climate works, and how change may affect weather.

Anatomy of climate - challenges to well-being

If a range of weather conditions - temperature, precipitation, atmospheric pressure, duration of sunshine and wind, humidity and cloud cover are averaged for one region over a period of time, we call that climate. But the Earth's climate system is something much larger and more complex. It involves the atmosphere, oceans, land surface, the biosphere, the permanent snow and ice of the cryosphere, aerosols and incoming solar radiation in continuous interplay, a kind of global choreography.

Overall, this system is a marvel of balance. Driven by energy from the Sun, the climate keeps its energy budget in equilibrium by emitting solar energy back into space, but not all at once. Certain gases in the atmosphere, such as water vapour, carbon dioxide and methane, retain some of the energy radiated back from the planet's surface, creating the warming greenhouse effect that makes life on Earth possible. But over the last half-century, emissions from cars and industry, urbanization, agricultural practices and land clearance have boosted concentrations of greenhouse gases. The Intergovernmental Panel on Climate Change (IPCC), sponsored jointly by WMO and the United Nations Environment Programme (UNEP), has shown that concentrations of carbon dioxide are over 33 percent higher now than they were before the industrial revolution.

This being said, however, change and variability are intrinsic parts of our global climate. It is a dynamic system that shifts over decades, millennia and millions of years as a result of alterations in the Earth's orbit and tilt and solar radiation, as well as volcanic eruptions and other natural phenomena. Temperature, wind and precipitation are in constant flux, and extreme events such as droughts, blizzards and storms are natural features of its variability. What makes today's climate change different is that the rate of warming in the last century is greater than at any other time in the last few thousand years.

The effect on the global environment has been dramatic. Sea-level rose at an average rate of 2 mm a year during the 20th century. The range of many plants, insects and birds shifted to higher altitudes and latitudes. Precipitation in the mid to high latitudes of the northern hemisphere increased by up to 10 per cent, with some unusual events such as severe floods in parts of Europe, while droughts became more intense and frequent in parts of Africa and Asia. Glaciers worldwide are melting at an unprecedented rate and Arctic ice is thinning. Changes in ecosystems continue to be reported from various parts of the world.

Population growth, fossil fuel and renewable energy use, changes in industrial practice and land use will all affect future levels of greenhouse gases and hence warming rates. Sea-level could rise by between 9 and 88 cm by the end of this century.

Summers could become drier and more drought-prone in some areas. These changes could, in turn, profoundly affect progress towards sustainable development. They pose a real threat to all countries and in particular to the fragile economies of developing countries, and their fundamental needs - clean water and sanitation, food security, good health, the eradication of poverty and better protection of the environment and natural resources. Countries can find a way to address these hydrometeorological challenges. But first, the "anatomy" of extreme weather and climate events will be explored.

Natural disasters and climatic variations

We live in tempestuous times. Over the period 1992-2001, weather and climate related disasters killed about 622,000 people, affected more than two billion, left millions more homeless, devastated arable land and spread disease. Such events are increasing. Studies suggest that the number of weather-related disasters have increased three-fold over the past 30 years.

Storms, floods, storm surges, slides and avalanches

Also known as typhoons and hurricanes, tropical cyclones are born when areas of low atmospheric pressure form over warm waters in the tropics or subtropics. These can grow into giant whirling masses of air and heavy rainfall, up to hundreds of kilometers in diameter, cutting a swathe of destruction as they move inland from the sea, whipping up high seas, storm surges, floods and tornadoes.

Coastal and inland regions of the Pacific, Atlantic and Indian Oceans, the Bay of Bengal, Gulf of Mexico and even the North Sea are often exposed to storm surges. When a cyclone moves over a continental shelf, strong onshore winds and low atmospheric pressure form a monumental dome of seawater that can stretch 80 km across and reach several metres in height. If the cyclone hits a coast, the surge can form a wall of water that crushes everything in its path. Low-lying coasts are particularly vulnerable to damage from surges.

There is concern that rising sea-level could herald larger storm surges. The predicted rise in sea-surface temperatures could also lead to a change in the intensity and frequency of tropical storms.

Inland flooding can occur whenever water accumulates faster than soils can absorb it or rivers accommodate it, ranging from flash floods to massive inundations covering thousands of hectares. They can be set off by El Nino events, monsoons, melting snow or dam breaks, as well as by storms and rainfall. Floods are not always bad news - they replenish wetlands, fisheries and irrigation systems, but they are a significant threat to lives, property and livelihoods. In the last decade of the 20th century, floods affected some 1.5 billion people. An alarming factor is the growing number of people who are putting themselves in jeopardy by settling in floodplains or on adjoining slopes.

Landslides and mudflows are essentially semi-solid floods, often set off by heavy rain or rapid snowmelt. Soil degradation is a big factor as deforestation and land burnt by bush fires make soils less stable and prone to break away when saturated.

Mudflows are formidable hazards, so dense and viscous they can completely bury built-up areas. By contrast, avalanches - large masses of snow and ice that race down steep slopes, kill far fewer people a year because they occur mostly in remote, sparsely populated regions. They do, however, pose a great hazard for populations, skiers, tourists and travellers in mountain areas. However, forecasts for such events have considerably improved over the past decades.

In Guyana the low lying coastal plain which is occupied by 70% of the total population and where all the economic agriculture is carried out, is particularly vulnerable to the hydrometeorological hazards of flooding and drought. The economic losses sustained during the last flooding in January were estimated at around 93 billion Guyana dollars, there were some thirty flood related deaths due to drowning and diseases. Guyana can ill afford the losses and the social displacement accompanying these events, since it is unlikely that we can change the weather then we must step up our adaptation strategies to deal with the adverse effect of these.

Source, WMO No. 974, Water Climate and Sustainable Development - pages 4-6
ELAC flood report, Friday March 5th 2005

GLOSSARY

1. **E.N.S.O** (El Nino/La Nina and the Southern Oscillation)
This is a climate system, which influences climate worldwide. It is characterised by anomalous warming of the tropical Pacific in the warm phase (El Nino) or cooling in the cold phase (La Nina) with consequent shifts in atmospheric pressure and changes in the wind fields.

In the warm phase Guyana experiences reduced rainfall while in the cold phase the country experiences increased rainfall, usually for months.

2. **SUBTROPICAL HIGH**
Subtropical high-pressure system is a region of relatively high pressure that lies between 25^{o}N and 35^{o}N latitude. In the Northern Hemisphere, it is characterised by clockwise wind motion around the high-pressure centre, subsidence (sinking air motion from aloft). Low relative humidity and generally clear skies. An extension of high-pressure area is called a ridge and this influences fair weather.

3. **INTER-TROPICAL CONVERGENCE ZONE (I.T.C.Z)**
This is a zone of convergence between the trade wind regimes of both the Northern and Southern Hemisphere. This zone closely parallels the axis of the equatorial trough. It is characterised as a narrow east-west band of vigorous convective clouds with heavy precipitation.

The Inter-tropical Convergence Zone migrates from North to South with the sun, being in the Northern hemisphere in the Northern hemispheric summer and in the Southern hemisphere in the Southern hemispheric summer. This system migrates from its southerly position near the equator in February- March to its extreme northerly position 10^{o}N by August or September. It is mainly responsible for Guyana's two rainy seasons.

4. **TROUGHS**
Troughs are low-pressure areas extended from low-pressure centres. These low-pressure centres usually develop in the upper atmosphere and extend downwards. Troughs are usually associated with wet weather sometimes lasting for days.

5. **TROPICAL WAVES**
Tropical waves/troughs in the trade wind easterlies. The wave may reach maximum amplitude in the low or middle troposphere or may be an extension from a low-pressure system with cold air in the upper troposphere or equator-ward extension of a mid latitude trough.

The majority of tropical disturbances develop over the continent of Africa. While a few forms within the maritime portion of the ITCZ. These waves originate largely between 30^{o}E and 40^{o}E longitude over the eastern sub Sahara. They migrate westward often producing wet weather over coastal and near inland areas of Guyana between June and November.

6. SOUTHERN HEMISPHERIC FLOW

Wind circulations are opposite in the northern and southern hemispheres. An anti-clockwise circulation in the southern hemisphere will be associated with a high pressure system; the same anti-clockwise circulation in the northern hemisphere will be associated with a low pressure system.

Ridges extending from high-pressure centres in the Southern Hemisphere sometimes protrude into the Northern Hemisphere. When this occurs it produces weather similar to a northern hemispheric trough because the circulation is similar to a Northern hemispheric trough. This system normally produces cloudiness along the hinterland region, if it is intense enough then the weather will be extended along the coast.

7. SOI (Southern Oscillation Index)

The Southern Oscillation Index gives an indication of the changes in atmospheric pressure in the Western and Eastern Pacific. It is the difference in standardised pressure anomalies between Tahiti and Darwin. It is negative in the warm phase of ENSO and positive in the cold phase.

8. ANOMALY

This is a departure from the mean. A positive anomaly indicates that the value is above the mean while a negative anomaly indicates that is below the mean.

Below Normal implies that rainfall is less that 67% of normal

Near Normal implies that rainfall is between 67% and 133% of normal

FORECAST ASSESSMENT TECHNIQUE

Deviation is the departure of the actual precipitation at the stations in the Region during the month from the forecasted Regional precipitation. Accuracy is dependent on the relative number of stations that deviate and the magnitude of the deviation. E.g. if Moderately Wet conditions were forecasted and the assessed actual condition as at all of the stations in the Region fell into any of the categories listed below then the deviation, accuracy and the rating will be tabulated (refer also to the precipitation classification table on next page).

Forecast	Actual	Deviation	Accuracy	Rating
Moderately Wet	Very Wet	+2	78%	Bad
	Wet	+1	89%	Good
	Moderately Wet	0	100%	Excellent
	Moderately Dry	-1	89%	Good
	Dry	-2	78%	Bad
	Very Dry	-3	67%	Bad

% Accuracy = $\sum I = i^9 \, n_i/N[1-|D_i|/9] \times 100$

n_i = number of stations observed with precipitation values in the i th class

N = total number of stations observed

D_I = deviation of the i th class the forecasted precipitation class

DEVIATION	ACCURACY (%)	DESCRIPTION
0 – 0.5	100 – 94	Excellent (Ex)
0.6 – 1.0	93 – 89	Good (Gd)
1.1 – 1.5	88 – 83	Probably acceptable (PA)
1.6 – and more	82 and less	Bad (Bd)

Crop growth and development	Excellent	Leaching of soils	Periodic flood	Extended flood	Extended flood
Cricket	Unlikely	Impossible			

Note: precise determinations require detailed investigation as soil type, drainage capacity and anthropogenic factors may influence specific differences. Nevertheless, general contributions towards the development of this table are encouraged.

PRECIPITATION CLASSIFICATION

For further information, or answers to queries and or questions, please call

DESCRIPTION	ABBREVIATION	RAINDAYS	RAINFALL (mm)
Very Dry	VD	0 - 10	0 -59.9
		11-20	11 - 29.9
Dry	D	1 - 10	60 - 119.9
		11 - 20	30 - 89.9
		21 - 31	21 - 59.9
Moderately Dry	MD	1 - 10	120 - 179.9
		11 - 20	90 - 149.9
		21 - 31	60 - 119.9
Moderately Wet	MW	1 - 10	180 - 239.9
		11 - 20	150 - 209.9
		21 - 31	120 - 179.9
Wet	W	1 - 10	240 329.9
		11 - 20	210 - 269.9
		21 - 31	180 - 239.9
Very Wet	VW	1 - 10	330 - 449.9
		11 - 20	270 - 389.9
		21 - 31	240 - 329.9
Exceedingly wet	EeW	1 - 10	450 - 569.9
		11 - 20	390 - 509.9
		21 - 31	330 - 449.9
Excessively Wet	EsW	1 - 10	> 570
		11 - 20	510 - 629.9
		21 - 31	450 - 569.9
Extremely Wet	EtW	11 - 20	> 630
		21 - 31	> 570

Chief Hydrometeorological Officer,
Ministry of Agriculture