Verification of the 1999 Precipitation Forecasts

S. Dec. Burton, H. H. P. Burton and C. A. Depradine
Caribbean Institute for Meteorology and Hydrology

1. Introduction

The Caribbean Institute for Meteorology and Hydrology (CIMH) was given the mandate to produce three-month precipitation probability outlooks for the region at the first Caribbean Outlook Forum in 1998. The regional meteorological offices and research groups agreed to provide information to the CIMH to assist in this effort.

In 1999 six outlooks were produced and made available on the CIMH homepage. The information used in producing these outlooks was obtained from climate forecast charts published by the International Research Institute for Climate Prediction (IRI) and the European Centre for Medium-Range Weather Forecasts (ECMWF) from climatological means and expected sea surface temperature conditions. The Cuban Meteorological Service and the Physics Department of the University of the West Indies at Mona, Jamaica, also provided precipitation probabilities.

2. Forecast procedure

The procedure adopted by the CIMH for preparing the outlook starts with an examination of the three-month precipitation forecast from the three IRI models and the ECMWF model. The output from the IRI models is in the form of anomalous precipitation as a percentage of average seasonal rainfall and the ECMWF output is in the form of probabilities of above or below normal rainfall. Precipitation probabilities are then estimated based on:

- the forecast anomalous precipitation from the IRI models,
- the probabilities from the ECMWF model,
- the level of agreement between the different models, and
- a subjective confidence in the different predictions based on the current conditions and knowledge of the local climatic conditions.

In addition, the probabilities provided by the various contributors are consulted to present a consistent forecast. Figure 1 shows extracted portions from the three IRI models and the ECMWF model for the period June-July-August 1999.

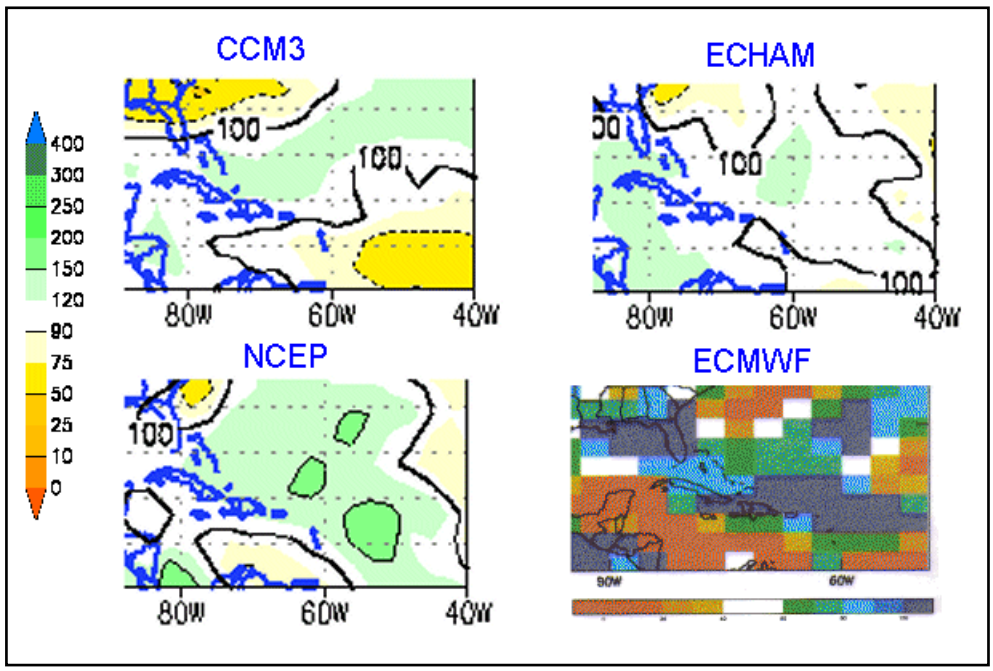

Fig. 1. Extracts of output from the CCM3, ECHAM, NCEP, and ECMWF models

The precipitation outlook is presented in the form of a tercile probability distribution indicating the likelihood of below-, near-, or above normal rainfall for the various sub-regions. For this purpose, 'normal' is defined as the climatological mean.

3. Verification

Forecast verification is essential for monitoring forecast reliability and for ensuring credibility for users. The current probabilistic format of the precipitation outlook makes it difficult to develop a meaningful quantitative measure of its performance. CIMH has adopted a simple approach to verify the probability outlooks by computing the anomalies (difference between the actual three-month average and the long-term average) to determine whether the observed rainfall fell within the near-, above-, or below normal categories as given in the projections. For verification any value falling within 10% of the

long-term average is considered normal, while larger positive (negative) anomalies are considered as above (below) normal.

Table 1 shows rainfall anomalies for some countries in the region for four forecast periods during 1999. The data not only reveals large variations in the rainfall anomalies over the region, as would be expected, but also in individual countries. An example is seen in Table 1 for the S-O-N period where at one station in Guyana the anomaly is -49% while at another it is 37%.

Figures 2 to 5 show four outlooks for 1999, the May to July consensus forecast prepared at the Forum in May 1999 and three outlooks prepared by the CIMH. Selected rainfall anomalies for the respective periods are superimposed on each forecast.

As an example of verification, Fig. 2 indicates a forecast of a greater probability of average and below average precipitation over the southern Leeward Island, the Windward Islands, and Guyana. The anomalies show that in general the observed precipitation for this period was below average, by as much as 34 percent in one case. On the other hand, over the northern Leeward Islands westward to Jamaica and Cuba the forecast was for a higher probability of normal and above normal rainfall. The anomaly figures for Antigua (26%) and Cayman Islands (22%) indicate that above average rainfall was observed. However, in Jamaica the rainfall was well below average (-24%) overall, even though a few stations recorded average rainfall. (See Table 1)

Another example is seen in the September to November outlook (Fig. 4) where the forecast for the region was generally for normal and below normal rainfall. Even though most of the anomalies fall within this range, a few ‘anomalies’ stand out. For example, 132% above normal in Antigua, due for the most part to the excessive rainfall associated with Lenny, and 93% above normal over the Cayman Islands.

Table 1. Selected Rainfall Anomalies - 1999

Country	Station Name	M-J-J	J-A-S	S-O-N	N-D
Guyana	Georgetown	-27	20	-49	-9
	Timehri	-20	24	37	22
Trinidad	Piarco	-26	-14	7	9
Tobago	Crown Point	-24	10	13	22
Grenada	Point Salines	-34	-8	-8	3
St. Vincent	E.T. Joshua	3	-10	-1	12
Barbados	CIMH	13	30	28	58
	Lears	-11	8	-11	6
	Union Hall	-16	-6	-6	33
	GAA	-25	0	15	5
	Haggatts	-4	2	-16	30
	St. Nicholas	1	8	-6	58
	BARBADOS (Avg)	-7	7	1	32
St. Lucia	Hewanorra	-17	6	-19	-42
	G.F.L. Charles	-25	2	-22	-14
	Saltibus	-32	-4	-10	-19
Dominica	Melville Hall	-15	-29	-16	-28
	Canefield	5	-30	-1	28
Antigua	V.C. Bird	26	-13	132	200
Jamaica	Hanover	-27	-11	9	-28
	Westmoreland	-40	-28	-25	6
	Manchester	-12	32	32	16
	St. Elizabeth	-8	12	19	-11
	Clarendon	-46	13	65	59
	St. Catherine	-45	15	22	-26
	Trelawny	5	19	-5	-31
	St. James	-16	-5	-13	-36
	St. Ann	-19	55	-2	-46
	St. Mary	-33	44	13	-32
	Portland	-15	-26	23	-25
	St. Thomas	-39	-15	26	-8
	Kingston/St. Andrew	-11	47	9	-44
	JAMAICA (Avg)	-24	4	14	-22
Cayman	Owen Roberts	22	29	93	130

An attempt was made to assess and compare the performances of the models by comparing the anomalies with the various model forecasts. At this point no clear signals have been established.

4. Summary and conclusions

The CIMH is mandated to produce three-month precipitation probability outlooks to the region and has been undertaking this task since 1998.

The outlooks are produced by utilising precipitation forecasts from four climate models and input from regional meteorological services and research groups. The precipitation outlook for the Caribbean is presented in the form of a tercile probability distribution indicating the likelihood of below-, near-, or above normal rainfall for the various sub-regions.

During 1999 six forecasts were prepared and distributed via the CIMH homepage. Attempts at verification of these forecasts using anomalies (difference between the actual three-month average and the long-term average) indicate that there may be some skill (subjective) in the forecasts. However, local variations in rainfall anomalies and the current method of presentation of the forecast are providing a challenge to verification. An example is seen in Table 1 for the S-O-N period where at one station in Guyana the anomaly is –49% while at another it is 37%.

It is essential that an assessment of the performance of the various models over the region be undertaken to provide some indication of the strengths and weaknesses of the various models used in preparing the outlook. This information would greatly assist in subjectively determining the tercile probabilities derived from the model output. This assessment as well as the validation of the regional precipitation forecasts cannot, however, be undertaken without the necessary observational data. It is therefore important that the various countries supply the CIMH with rainfall data on a regular and timely basis.

Some meteorological services and agencies continue to provide the CIMH with input to the precipitation outlook. It is vital that individual countries continue to contribute to the outlooks by providing the CIMH with their local outlooks and any other relevant information.

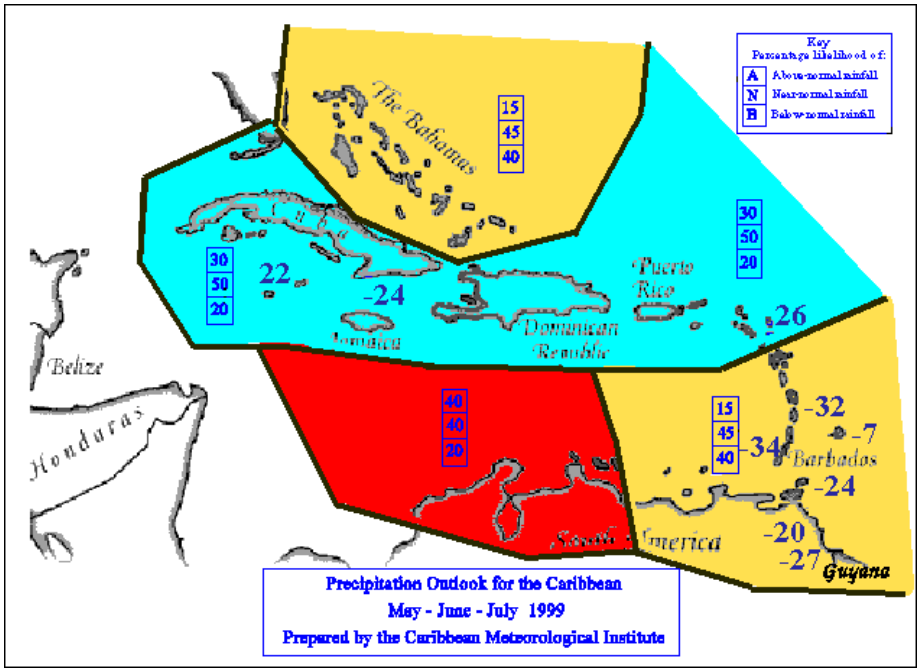

Fig. 2. Precipitation outlook for May to July 1999 with rainfall anomalies.

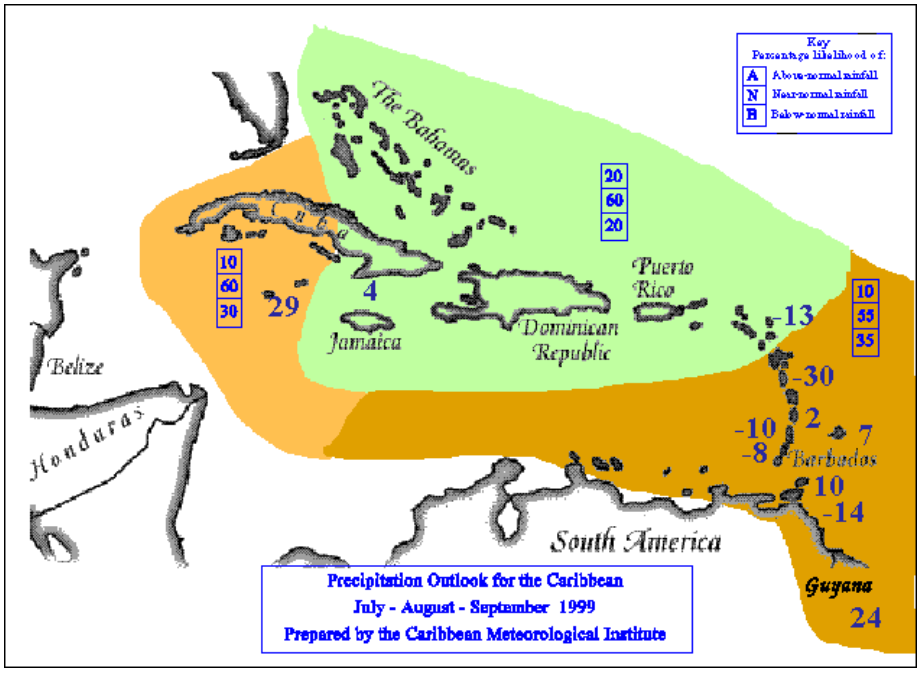

Fig. 3. Precipitation outlook for July to September 1999 with rainfall anomalies.

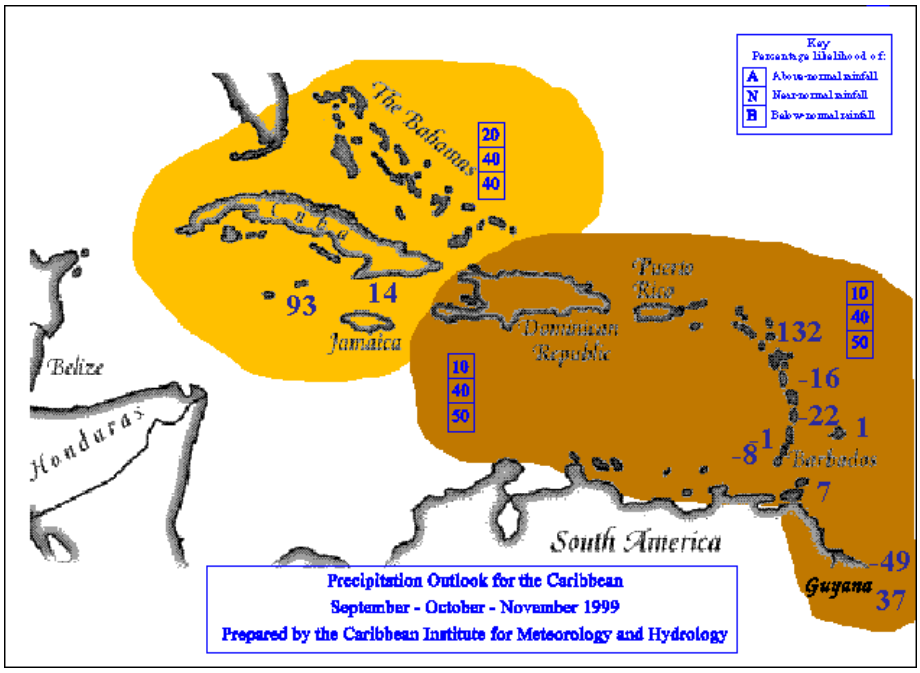

Fig. 4. Precipitation outlook for September to November 1999 with rainfall anomalies.

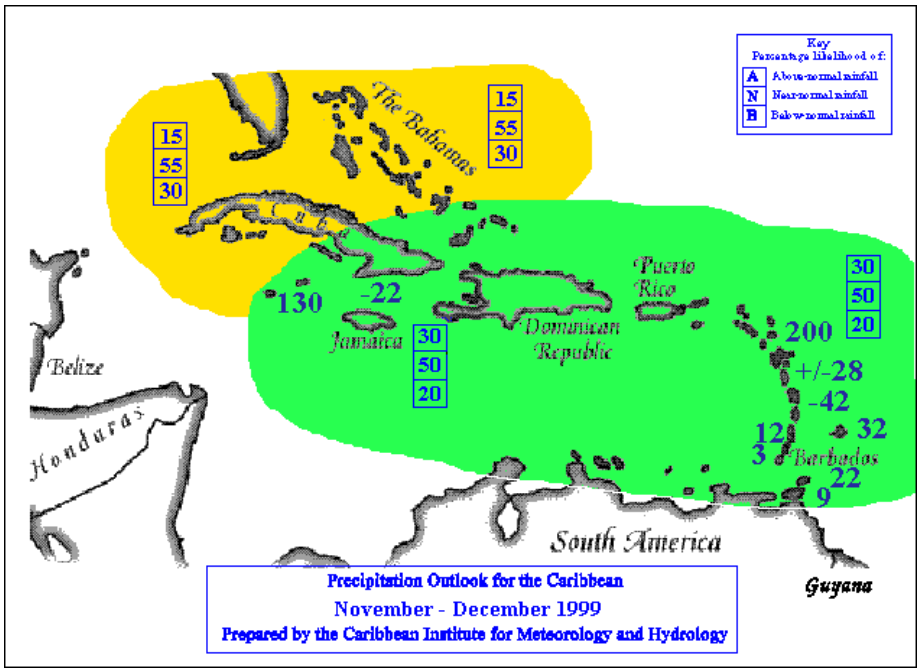

Fig. 5. Precipitation outlook for November to December 1999 with rainfall anomalies.