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THE WEATHER AFFECTING AIR OPERATIONS IN THE CARIBBEAN AREA

INTRODUCTION

This study and the accompanying tables have been prepared to determine the feasibility of carrying out low level air operations at the localities specified by the requesting agency. The Air Weather Service accepts no responsibility for any interpretation of this study or the included data made without its concurrence.

Detailed information for all the localities specified were not available. However, this lack should not reduce the value of this study greatly since the observations taken at Guatemala City give the worst conditions on the average which will be experienced in this area. In this area low ceilings and visibilities, and poor flying conditions are closely associated with the occurrence of rain. Therefore, since it is generally assumed that the duration of rainfall increases with elevation while the amount of rainfall reaches a maximum at an elevation of approximately 4500 feet, the Guatemala City observations should be representative of the poorest flying conditions. The only exception to this rule of increasing duration of rainfall occurs at stations which are shielded by high mountains in both the northeast and south quadrants. Examples of this exception are Zacapa and Iuezaltenanga, Guatemala.

DISCUSSION

Flying conditions in this area, as in all of Central America, are quite good. During the months studied, which are in the rainy season, contact weather (defined as ceiling above 950 feet and

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visibility greater than two and one-half miles) prevails more than 98 percent of the time during each month at San Jose. These conditions vary from a monthly low of 89.4 per cent of the time in September to an average monthly high of 96.0 per cent of the time in November at Guatemala City. Of these four months as a general rule contact conditions prevail most frequently in this whole area during November, since the rainfall which is associated with poor flying weather is at a minimum then. The only exception to this statement that was found in this investigation is at Puerto Barrios and the lowlands in its general locality.

The greatest hazards to flying operations in Guatemala are the tropical storms of summer and fall, winter storms from the north, and the frequent thunderstorms which form in all tropical areas.

Of these three hazards the most widespread in its effects and most spectacular by far is the tropical storm and hurricane. Even though they do not pass over a station if they come within 50 to 100 miles of the coast, they will cause widespread and intense rainfall, sometimes lasting three days or more at all stations on the windward side of the mountains, and very strong winds and turbulent seas along the coast.

The season for the formation of hurricanes and tropical storms is roughly May through November. In the Western Caribbean they occur most frequently in the months of September and October. The storms which frequently form in the southwestern Caribbean will affect all of Guatemala north of the mountains even though they do not cross the country. Those that cross the country as they have on infrequent occasions between 1924 and 1945 have had more widespread and intense effects in Northern Guatemala.

On the Pacific side the effects of tropical storms are not so great. Of the 176 storms recorded between 1910 and 1940, only 11 had their origin far enough eastward to effect the coastal waters of Guatemala. None of these 11 attained hurricane force (to be termed a hurricane the winds near the center of a tropical storm must be greater than 75 miles) while in that locality. In September, the month of greatest frequency in the Pacific, none has occurred far enough to the eastward to touch the Guatemalan coast.

The cold waves or northers that extend south past Guatemala during winter constitute the greatest hazard to flying conditions from November to May. They cause high winds along the northern coast and through mountain passes that open to the north. Other accompanying phenomena are widespread cloudiness, general rains, low ceilings, and visibilities and icing at a much lower level than the average wintertime height, which is above 12000 feet. However, these storms occur infrequently averaging less than one occurrence per month in January and February this far south and are even less frequently observed in November.

Thunderstorms, although less hazardous than the two preceding phenomena, occur much more frequently. In addition, they are the only storms dangerous to flying that can not be forecast with sufficient accuracy to allow for proper precautions in advance. While no attempt should be made to minimize the hazards associated with any thunderstorm, they are probably less severe and less turbulent than those of the Southeastern United States or of the Rocky Mountain Area. However, because of the mountainous terrain in this area, they are difficult to avoid, and often obscure the mountain peaks and even the passes through the mountains. Sometimes

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a steep slope of only 200 or 300 feet suffices to cause turbulence and local showers in this region. At Guatemala City, San Jose, and Chimax thunderstorms occur much more frequently on the average in August and September than in the next two months. At the inland stations they occur much more frequently in the afternoon. Along the coast they are most frequent in the evening and early morning hours since the more frequent night time storms forming over the water often drift in over the coast.

Generally during adverse weather conditions, one important consideration is that terminals on leeward sides of mountains likely have better ceiling, visibility, and wind conditions than terminals on the windward side. Therefore, if the enroute weather is passable a suitable alternate can usually be found within the limits of Guatemala.

Fog is not too frequently observed in this area. Those fogs which reduce visibility to less than one mile occur more frequently inland than they do at the coastal stations. At all localities they are almost exclusively early morning phenomena and can usually be expected to start to dissipate before 1000 hours.

Other weather factors which may restrict visibility at these localities are haze and heavy rainfall. Haze did not restrict visibility to less than one mile during the more than three years for which records were available at either San Jose or Guatemala City. Haze reducing visibility to less than six miles is observed more at coastal locations and will occur as often in the late morning as any other hour.

Visibility less than one mile due only to intense precipitation was observed infrequently at both stations, with the greater frequency at San Jose. Visibility less than three miles because of intense

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precipitation can be expected to attain its maximum frequency at stations which lie on open slopes at elevations of between 2000 and 4000 feet. Since precipitation is usually most intense in the afternoon and early evening, the low visibilities associated with it will occur most frequently during the same hours.

Most of the stations will experience surface winds prevailing from the northeast quadrant. A secondary maximum will prevail from the south or southwest quadrant. The only exceptions will be in deep sheltered valleys where the winds are lighter and more variable than those of San Jose and Guatemala City or in mountain passes whose main axis lies in some other direction than northeast-southwest. In the passes which are oriented at an angle to the northeast, the average wind speed will be less than that of Guatemala City in almost all cases. At the inland stations wind speeds exceeding the maximum attained at Guatemala City will occur very infrequently. Along the coast the Guatemala City maximum will be exceeded only when a hurricane passes closeby or when a cold outbreak crosses the north coast.

Along the coast or on slopes open to the sea, there is a definite diurnal pattern to the surface winds. During the day a breeze blowing onto the land from the sea will commence in the late morning and reach its maximum development during the afternoon, usually between 1500 and 1600. After sunset the wind speed will die down. This sea breeze will be most prevalent along the north coast in November since then it is strengthened by the northeast trade wind during that month.

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Sometime after 2200 the opposing wind, the land breeze, will commence blowing off the land. It reaches a maximum in the early morning shortly before sunrise. The land breeze is seldom as strong as the sea breeze. It is strongest on the middle or lower slopes on the south side of Guatemala. There is no month when it can be expected to reach its peak as is the case with the sea breeze.

No hourly surface wind data were available to this office for the inland station. Since the winds do not follow any such well-developed diurnal pattern inland, it is impossible to make any statements about their variation during the day.

#### CONCLUSIONS

Low level air operations can be carried out during all these months at these localities. However, because of the greater possibility of hurricanes, which can bring air operations to a complete halt over extended periods and because of the greater possibility of hazardous thunderstorms during the other three months, November is the best month for these operations. Since the following months are as good, if not better than November, it is by far the best month to begin any operations which may require more than one month for completion. November has the added advantage that there are usually many more hours during the day which are suitable for air operations.

Diurnally the best hours for operations during November are from 0900 through 1800. However, the last two hours of this period are not quite so good at all stations as the preceding hours. During the remaining months the best hours are normally from 0900 until 1400. If the planes are taking-off from coastal stations for

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inland terminals this period can be extended by scheduling earlier departures.

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