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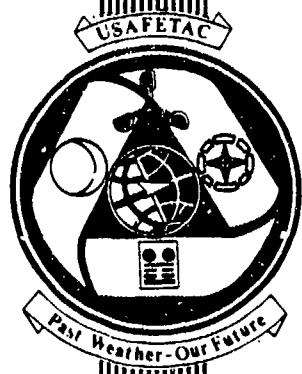


# CENTRAL AMERICAN FLYING WEATHER

By

Kenneth R. Walters

DECEMBER 1985



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*This report, which summarizes*  
19. Abstract: A summary of flying weather in Honduras, El Salvador, Nicaragua, and Costa Rica, was prepared from interviews with highly experienced civil and military pilots and meteorologists in Honduras and Costa Rica. Flying weather in defined areas is described for each of the climatological seasons--seasons that do not necessarily match calendar seasons or North American temperate zone seasons. The author drew upon pilot/forecaster interviews, USAFETAC/TN-85/002 (AD-159 989), and his own 30 years experience as an aviation meteorologist in preparing this report. Primary emphasis, however, was on the interviews. *Key words!*

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## PREFACE

This report is the result of an Air Weather Service Technical Library information scouting visit to Panama, Venezuela, Costa Rica, and Honduras in November and December 1983. During that visit, the author held extensive discussions with Costa Rican and Honduran meteorologists and pilots. He also discussed Central American flying weather with U.S. Army pilots and AWS meteorologists.

Interviews with Central American pilots and forecasters formed the basis for this report. These interviews were then combined with information from other sources, notable among which was USAFETAC/TN-85/002, Central American Climatology. However, primary emphasis was placed on the experiences of people who have either flown over, or made forecasts for, these countries routinely over a period of many years. The result is a collection of brief flying weather summaries for the countries of Honduras, El Salvador, Nicaragua, and Costa Rica.

Readers should note that while many of the comments made about Honduras and El Salvador could also apply to parts of Guatemala, there has been no effort to expand the report to include Guatemala or any other country.

The author wishes to acknowledge the patience and cooperation of the Honduran and Costa Rican pilots and meteorologists who provided the basis for the flying weather descriptions presented here. He hopes the summaries and conclusions presented here may be of help to AWS forecasters supporting Department of Defense operations in the areas described.

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# CENTRAL AMERICAN FLYING WEATHER

## AVIATION FORECASTING IN CENTRAL AMERICA

The author's discussions with Central American and USAF meteorologists produced general agreement that the key to producing a reasonably successful aviation weather forecast for any part of Central America lies in having:

- A good, basic knowledge of what happens to moist and unstable air as it is lifted over mountainous terrain.
- A thorough grounding in the basics of tropical meteorology, including streamline analysis technique.
- A good knowledge of meteorological satellite imagery interpretation.
- Ready and routine access to the following:
  - Meteorological satellite imagery of routinely high quality,
  - All available radiosonde observations, especially those upstream.

- All available surface observations in or near the area in question.
- High resolution terrain charts. The Tactical Pilotage Chart series, produced by the Defense Mapping Agency, is excellent. A suitable substitute is the Operational Navigation Chart series, issued by the same agency.

By understanding the basic causes of tropical weather (including regional and local climatology), by doing low- and high-level streamline analyses that are cross-checked against satellite imagery, and by evaluating the vertical moisture and wind fields, a meteorologist should be able to determine the basic state of the air being advected into the area of interest. By combining the results of these analyses with careful study of available surface reports and close evaluation of upstream terrain effects, it is possible to produce a reasonably accurate aviation forecast.

## METEOROLOGICAL BACKGROUND

### The Temporale

"Temporale" is the term used by Central American meteorologists and pilots to describe the relatively uncommon periods of widespread low ceilings, poor flying conditions, and almost steady precipitation lasting for 5 to 7 days. The most common occurrence of this phenomenon is in summer and early fall. Although infrequent, temporales often result in extensive flooding, widespread damage, and loss of life. Accepted meteorological causes for the temporale are:

- Tropical vortices forming or reforming just off the Pacific coast of Central America, then moving very slowly westward. This is the cause of most occurrences.
- Prolonged stagnation of a polar front or polar shear line over Honduras or northern Nicaragua.
- Slow moving easterly waves.
- Weakening Atlantic hurricanes moving onshore from the Caribbean. These decaying storms will cause strong winds in areas immediately adjacent to landfall.

Typical conditions in these stems are 8/8 stratus and nimbostratus layered to 25,000 or 35,000 feet MSL. Bases range from 300 to 1,000 feet MSL, with visibilities  $\frac{1}{2}$  to 2 miles in rain and fog. Isolated TCU and CB are embedded in these layers, but thunderstorms and high winds are rare except in weakening hurricanes. The biggest problem lies in extensive flooding resulting from heavy rains.

### Mountain Wave

Wind flow perpendicular to mountain ranges results in wave-like airflow over much of Central America during all months. But perhaps the most marked occurrences occur during the winter months in the fresh northerly-component flow following polar outbreaks. Such conditions result in strong (20-30 knot) winds at mountain crest altitude. Where terrain is favorable for a venturi effect, winds immediately downstream of ridge crests can reach 50 knots. Mountain waves are relatively common under these conditions. Although classic mountain wave forecasting techniques can generally be used, the Tegucigalpa and San Jose (Costa Rica) soundings are representative only above about



7,000 feet MSL because both sites are in valleys surrounded on all sides by mountains with tops near 7,000 feet MSL. Similar problems occur when using the San Salvador sounding below 5,000 feet MSL. The only sounding in Central America that is representative below 5,000 feet MSL is that for Managua.

### Severe Thunderstorms

Many temperate zone meteorologists are convinced that severe thunderstorms (winds equal to or greater than 50 knots, with 3/4-inch hail or larger) do not occur in the tropics. However, the experiences of Central American pilots and meteorologists would indicate that this assumption is not completely true, at least in Central America.

Although rare, severe thunderstorms apparently do occur, primarily over terrain above 3,000 feet MSL. Dr Fernandez of the University of Costa Rica has been doing research on these storms since 1981 and is convinced that the intrusion of middle level (600 to 700mb) dry air is necessary for severe thunderstorm occurrence. Dr Fernandez is conversant with Colonel Miller's AWSTR-200 (Rev), and he believes that the characteristics Col Miller postulates are at least partially valid for Central America.

The senior Honduran pilot interviewed had more than 4,000 flying hours, most of it in Central America. He said he had experienced small hail in and near CBs at altitudes well below the freezing level. He was convinced that flight at or just above the freezing level in or near the more intense CBs can result in encountering hail large enough to cause aircraft damage. Dr Fernandez said that his research indicates such hail probably has occurred. This view gains some support from fragmentary reports of hail damage to U.S. Navy fighter aircraft (F4F/F6F/F4U) in the Solomon Islands during World War II.

### Diverse Views and Theory

As stated earlier, the primary information sources for this report were the interviews with experienced Central American pilots and meteorologists. Their views on ITCZ locations, low-level flow, and frontal passages have been used here. In many cases, these ideas differ from those generally held by most meteorologists working in the United States. For example, most United States meteorologists do not normally consider the ITCZ to be onshore in Central America during late spring, summer, and fall, nor do they expect it to lie across central Honduras in the summer. Similarly, low-level southwesterly flow on the Pacific coast of the region south of the ITCZ is not indicated in any

of the climatological atlases available in the AWS Technical Library. Finally, no United States meteorological center analysis shows frontal positions south of Guatemala, even in winter.

Based on the virtually unanimous opinions expressed by the interviewees--the "experts on the ground"--the author has elected to present their views throughout this report. No attempt is made to arbitrate dissimilar theory as it pertains to Central American meteorology.

### A Note on Maps

To facilitate the discussion, each country has been divided into separate numbered areas within which the flying weather is approximately the same. Terrain, however, can result in major differences in flying weather even within these generally homogeneous areas--conditions may vary considerably, for example, from a valley to an adjacent ridge line. Since there are no black and white maps of the entire region that will allow reduction to standard page size and still show even gross terrain features, the areas in question are presented on five maps. Figures 1 and 2 show that Honduras and El Salvador have been divided into five areas. Figures 3 and 4 divide Nicaragua into four areas, and Figure 5 splits Costa Rica into three. Although these maps provide a basic visual reference to the text, readers are urged to use an aeronautical navigational chart, scale 1:500,000 or 1:1,000,000, to better understand the local terrain and get the most out of the discussion.

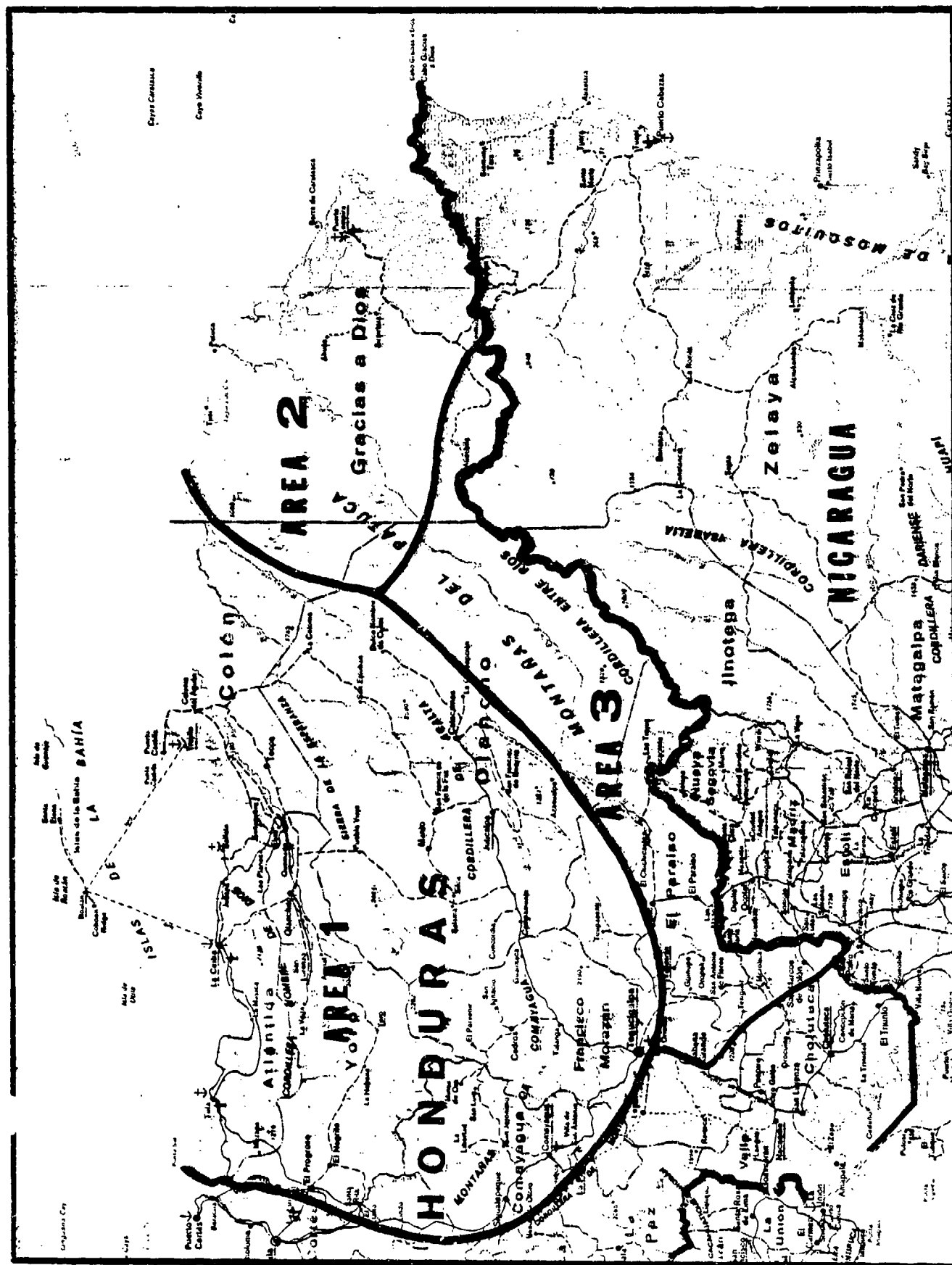


FIGURE 1. HONDURAS AND EL SALVADOR, AREAS 1, 2, AND 3.

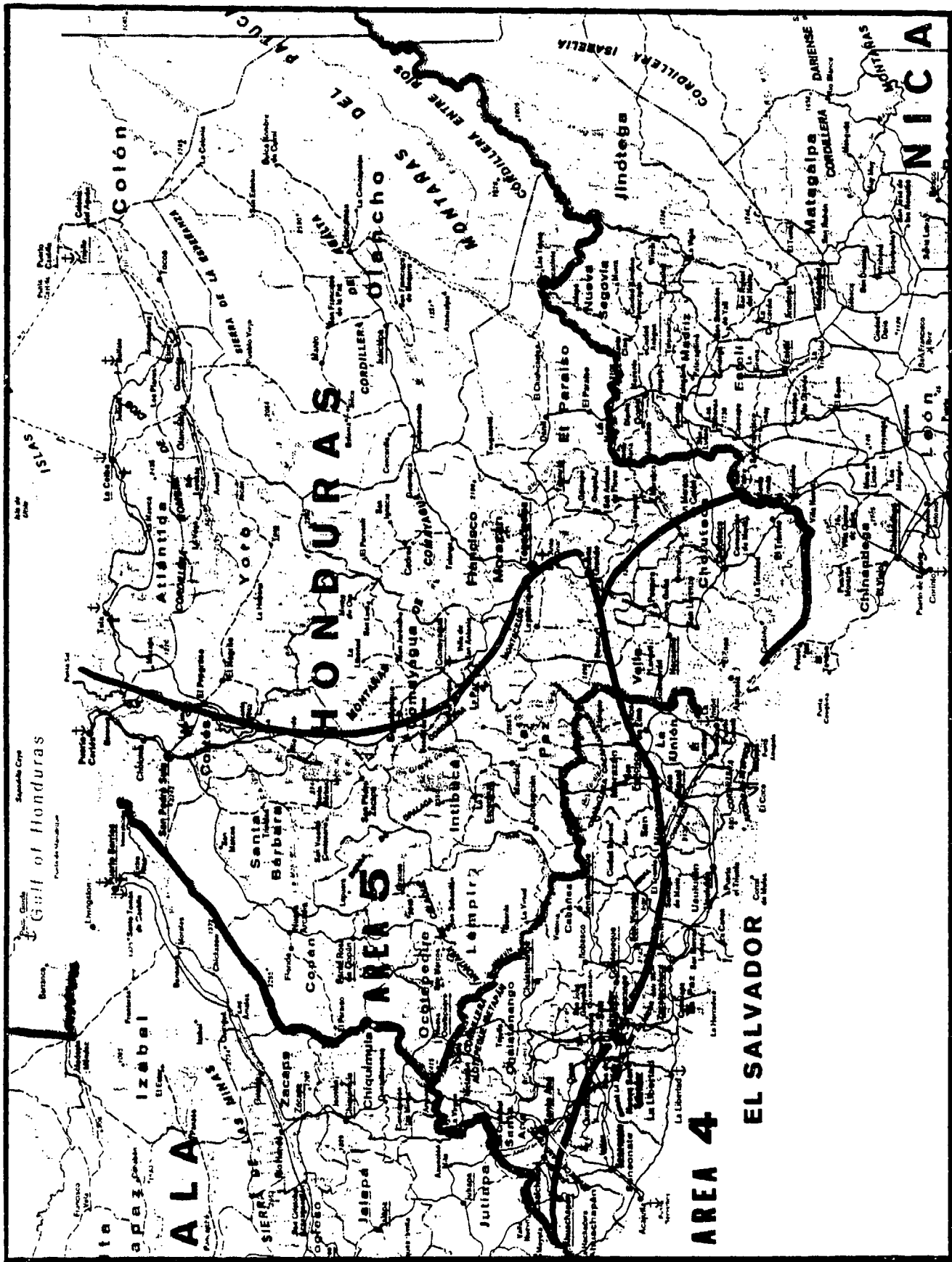


FIGURE 2. HONDURAS AND EL SALVADOR, AREAS 4 AND 5.

## FLYING WEATHER IN HONDURAS AND EL SALVADOR

To facilitate the discussion, Honduras and El Salvador are divided into the five areas (or "zones of similar climate") described below and shown in Figures 1 and 2.

Area 1 - Northern Caribbean coast and central mountains.

Area 2 - Northeastern Caribbean coast and Delta.

Area 3 - Southeastern Plains and central Nicaraguan border.

Area 4 - Gulf of Fonseca and southern mountains of Honduras, and the coastal area of El Salvador.

Area 5 - Western mountains of Honduras, and El Salvador southward to the crest of the coastal mountains.

The discussion will cover, in turn, each of four 3-month Central American "seasons" for each of the five areas specified above. These periods correspond roughly to the Northern Hemisphere's winter, spring, summer, and fall.

### Winter Flying Weather

#### Honduras and El Salvador

#### December-January-February

The primary winter synoptic feature in Honduras and El Salvador is the alternating passage of polar fronts or old polar shear lines moving south from the United States. Polar fronts in December and early January tend to stagnate or dissipate in central Honduras, but those in late January and February tend to keep moving southward. Honduran and Costa Rican meteorologists were convinced that these are true fronts, with definite air mass discontinuities. Flying weather characteristics seem to lend validity to their arguments. These fronts normally penetrate well into Honduras.

#### Area 1--Winter

In the absence of stagnating polar fronts, mornings throughout the region from 0600 to 1000L are clear, with patchy ground fog in low lying areas and along river valleys. Clouds begin forming between 1300 and 1400L as 1/8-4/8 coverage with bases from 2,000 to 3,000 feet AGL and tops from 6,000 to 8,000 feet MSL. Visibilities are good (5 to 15 miles).

Along the northern side of the mountain ridges immediately south of the coast, clouds are normally heavy CU/TCU or isolated CBs, with RW or isolated TRW. Bases of these CU/TCU

before precipitation are those of the convective condensation level (CCL), putting higher terrain in the clouds. Tops range anywhere from 12,000 to 15,000 feet MSL for TCU, and to 35,000 feet for CBs. With the passage of a polar front, overcast cloud layers extend from the coast southward well into the interior mountains. Cloud bases along the coast and in valleys open to the Caribbean will be 1,000 to 1,500 feet MSL, with 3 to 5 mile visibilities in light rain and fog. Tops of multi-layers extend to 15,000 feet MSL.

TCU and CBs are common over and near ridges, with ceilings down to 500 feet AGL and visibilities 1/2 to 2 miles in RW/TRW. Tops are anywhere from 25,000 to 40,000 feet. Moderate mixed (rime and clear) icing in TCUs and CBs is common in and near the freezing level. Moderate or severe turbulence is common in and immediately near CBs. Moderate or occasionally severe wave turbulence occurs over and downwind of mountain ridges oriented perpendicular to the mean flow following a polar outbreak.

Because December and early January see a maximum of stagnating polar fronts, this period is still considered part of the rainy season. Conditions improve rapidly to the south; Tegucigalpa usually has no more than 4/8 to 5/8 coverage, with bases 4,000 to 5,000 feet MSL, tops 8,000 to 9,000 feet MSL, and some RW. Visibilities remain good (5+ miles).

#### Area 2--Winter

Winter is the primary rainy season in this area for two reasons: the passage of polar fronts, and the post-frontal north-northeast trajectory of polar air. Mornings are overcast, with bases 2,000-3,000 feet MSL, layered to 8,000-9,000 feet MSL. Visibilities under the overcast are 5+ miles, but can go down to 2-3 miles in RW or R. Cloud cover decreases to 6/8 or 7/8 after 1200L. A considerable number of TCUs and CBs form in early afternoon; bases are as low as 500-1,000 feet with visibilities 1/2 to 2 miles in heavier showers. Turbulence and mixed icing occur frequently in and near TCUs and CBs. With northerly winds, there is light to occasionally moderate turbulence over mountain ridges.

#### Area 3--Winter

In the absence of polar fronts, skies remain virtually clear. Patchy ground fog occurs from 0600 to 1000L in river valleys. Immediately after a polar frontal passage, conditions in the extreme northeastern part of Area 3 are the same as in Area 2. However, conditions rapidly improve towards the southwest, becoming 1/8-4/8 coverage, with bases 4,000 to 5,000 feet MSL and

tops 8,000 to 9,000 feet MSL. Visibilities remain excellent. With northerly winds, there is light to occasionally moderate turbulence over mountain ridges.

#### Area 4--Winter

Winter is the dry season for the Gulf of Fonseca and surrounding areas. Skies are virtually clear. Light to occasionally moderate turbulence occurs over mountain ridges after polar frontal passage. With strong (25-30 knot) northerly flow, there is a foehn effect in and just north of the Gulf. If terrain is favorable, the foehn effect can produce 40 to 50 knot winds at certain locations.

#### Area 5--Winter

In the absence of stagnating polar fronts, mornings throughout Area 5 are clear from 0600L to 1000L, with patchy ground fog in low lying areas and along river valleys. Clouds begin forming between 1300 and 1400L as 1/8-4/8 coverage with bases 2,000 to 3,000 feet AGL and tops 6,000 to 8,000 feet MSL. Visibilities are good (5 to 15 miles). Along the windward side of mountain ridges, clouds are normally heavy CU/TCU or isolated CBs, with RW or isolated TRW. Before precipitation, the bases of these CU/TCU are close to the height of the CCL, with higher terrain in cloud. Tops range anywhere from 12,000 to 15,000 feet MSL for TCU, to 35,000 feet for CBs.

With the passage of a polar front, overcast cloud layers extend from the coast southward well into northern El Salvador. Bases along the coast and in valleys will be 1,000 to 1,500 feet MSL, with visibilities of 3-5 miles in light rain and fog. Tops of multi-layers extend to 15,000 feet MSL. TCUs and CBs are common over and near ridges, with ceilings down to 500 feet AGL and visibilities 1/2 to 2 miles in RW/TRW. Tops are anywhere from 25,000 to 35-40,000 feet. Moderate mixed (rime and clear) icing in TCUs and CBs is common in and near the freezing level. Moderate or severe turbulence is common in and immediately near CBs. Conditions improve very slowly towards the south. However, even in northern El Salvador clouds will persist over mountain ridges, with bases 2,000 to 3,000 feet MSL, tops 12,000 to 15,000 feet MSL, and RW or rain. The northern El Salvadoran mountains see afternoon CBs similar to those over the Honduran mountain ridges mentioned earlier.

## Spring Flying Weather Honduras and El Salvador March-April-May

Frontal activity decreases to virtually nil. With the ITCZ is still south of the country, skies are virtually clear.

#### Area 1--Spring

There are extensive visibility restrictions below 10,000 or 15,000 feet MSL caused by smoke from farmers burning their fields. Under extreme conditions, airfields will close. Inflight visibilities range from 1/2 to 2 miles. Improvement occurs only when a fresh surge of polar air moves into the country to temporarily clear the smoke.

#### Area 2--Spring

Field burnings result in the same visibility restrictions from smoke as in Area 1, with inflight visibilities also 1/2 to 2 miles. Tops of smoke layers are 8,000 to 9,000 feet MSL. Conditions get worse over the Delta proper.

#### Area 3--Spring

There are some visibility restrictions from smoke in valleys. Tops of the smoke layers are from 4,000 to 7,000 feet MSL. Inflight visibilities are 2 to 4 miles.

#### Area 4--Spring

Visibility restrictions from smoke offer the least problems in this area because of downslope winds blowing over the mountains and into the Gulf. Sustained downslope winds will blow smoke out into the Pacific ocean. Light to moderate turbulence occurs with the downslope winds. Visibilities without sustained downslope winds range from 2 to 3 miles; tops of the smoke layer are 4,000 to 5,000 feet MSL.

#### Area 5--Spring

Smoke is at its worst here. Visibilities in mountain valleys may go down to zero. In extreme conditions, flight is impossible as inflight visibilities drop to less than 1/2 mile. Tops of the smoke layers range from 5,000 to 9,000 feet MSL. As in Area 4, fresh surges of northwesterly air will temporarily eliminate the problem.

## Summer Flying Weather

### Honduras and El Salvador

#### June-July-August

The primary summer synoptic control is the position of the ITCZ which, by late June or early July, has moved as far north as Tegucigalpa. For Areas 1 and 2, and the southern half of Area 5, this is the primary rainy season.

#### Area 1--Summer

Mornings are clear. TCU and CBs form over the mountains between 1000 and 1100L. Bases are 2,000-3,000 feet MSL; CB tops can be up to 45,000 feet MSL. There is considerable RW activity over the mountains. Valleys see 3/8-5/8 CU/TCU coverage by 1200-1300L, with isolated RW. Conditions deteriorate to the south. Mixed icing occurs in CBs, and there is moderate-severe turbulence in or around CBs.

#### Area 2--Summer

Except for easterly waves, conditions are similar to those in Area 1. With easterly waves, conditions are similar to those of Areas 3 and 4, and the southern part of Area 5.

#### Area 3--Summer

With the northward movement of the ITCZ, Area 3 starts its primary rainy season. The rains may start anywhere from late May to early June. Mornings are overcast, with bases 2,000 - 3,000 feet MSL and tops to 8,000 - 10,000 feet MSL. Visibilities are 2-3 miles in RW and rain. By early afternoon, embedded CU/TCU/CB will have developed. Ceilings are from 1,000 to 2,000 feet MSL, with tops from 15,000 to 45,000 feet MSL. Visibilities range from near zero to 2 miles in RW/TRW. Moderate mixed icing and moderate to severe turbulence occurs in and near CBs.

#### Area 4--Summer

The ITCZ is just to the north of Area 4. Mornings have 4/8-5/8 cloud cover, with bases at 3,000 to 4,000 feet MSL, and tops to 10,000 or 15,000 feet MSL. Visibilities are 3-5 miles in light R or RW. By early afternoon, considerable heavy CU/TCU/CB activity develops. Bases are 2,000 to 3,000 feet MSL, tops from 15,000 to 45,000 feet MSL. Visibilities are 2-3 miles in RW/R. In TRW, bases are 500-1,000 feet MSL with visibilities of 1-2 miles. Mixed icing and moderate to severe turbulence occur in and near CBs.

## Area 5--Summer

Morning cloud cover averages 4/8-5/8, with bases 2,000 to 3,000 feet MSL and tops 4,000 to 6,000 feet MSL. Visibilities are 3-5 miles in light rain and/or fog. By afternoon, coverage is 6/8-8/8, with bases 3,000 feet MSL and tops 10,000-15,000 feet MSL. Numerous TCU/CBs occur at all hours; bases are 1,000 to 2,000 feet MSL and tops are 15,000 to 45,000 feet MSL. Mixed icing and moderate to severe turbulence occurs in and near TCUs/CBs.

## Fall Flying Weather

### Honduras and El Salvador

#### September-October-November

The ITCZ has started its southward retreat. By November, the first of the polar surges are reaching the north coast.

#### Area 1--Fall

Summer conditions along the Caribbean coast persist through September. But by early October, winter conditions set in and persist through November. In contrast, the southern portion of the area experiences almost clear weather in September, the "mini-dry season". As along the Caribbean coast, conditions in this area deteriorate by mid-October to those of winter.

#### Area 2--Fall

Conditions deteriorate through September. By October, the rainy season has started, with winter-like conditions.

#### Area 3--Fall

Conditions improve rapidly by mid-October to those of winter.

#### Area 4--Fall

See Area 3.

#### Area 5--Fall

With the southward movement of the ITCZ in late September, conditions improve rapidly. October has almost clear skies and good visibilities (the "mini-dry season"). In November, conditions deteriorate to those of winter.

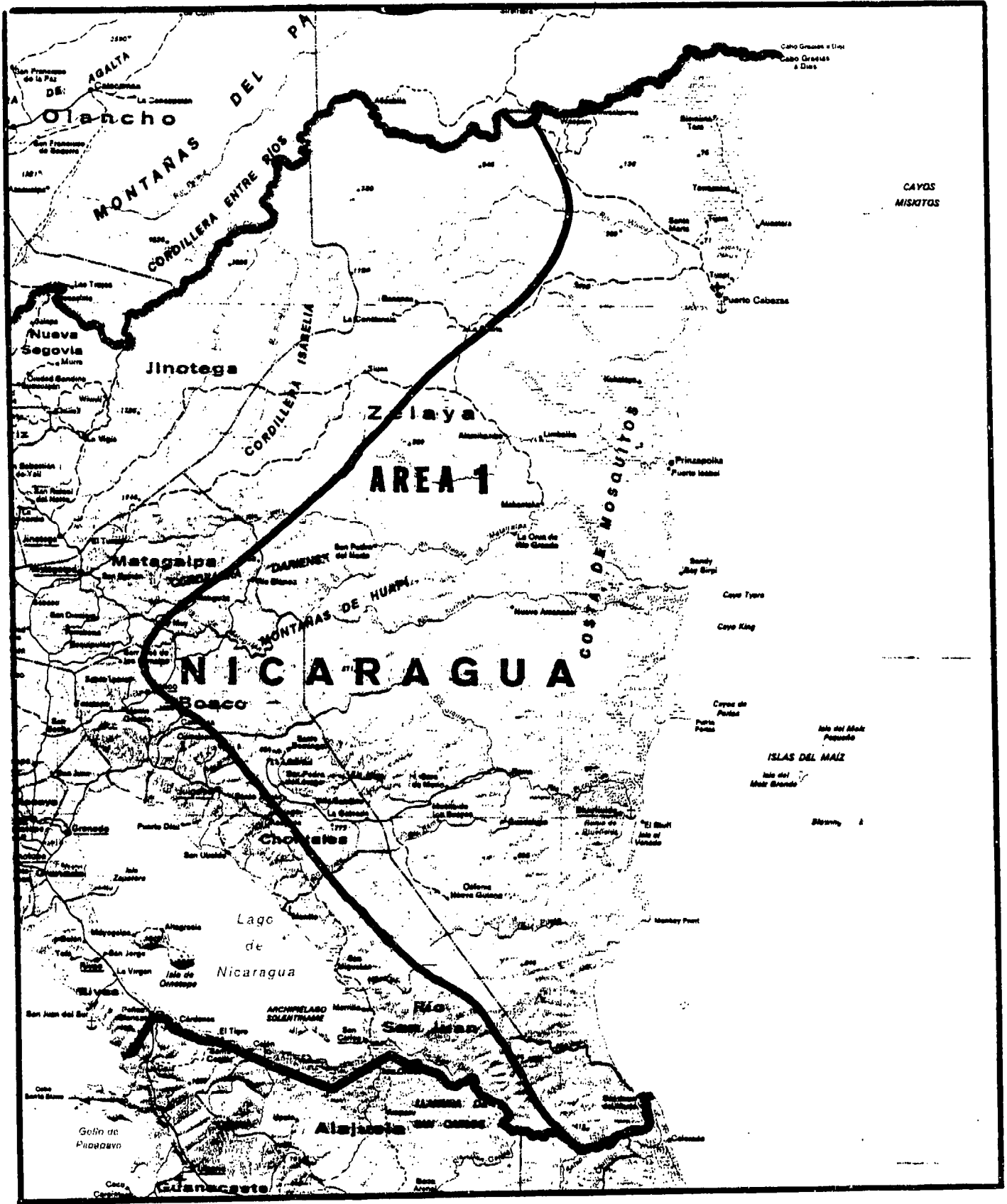


FIGURE 3. NICARAGUA, AREA 1.





## FLYING WEATHER IN NICARAGUA

For this discussion, Nicaragua is divided into the four "climate-similar" areas described below and shown in Figures 3 and 4.

Area 1: The Caribbean coast west to the central mountains.

Area 2. Lake Nicaragua - Lake Managua valley.

Area 3. Pacific Coast.

Area 4. Northern mountains.

### Winter Flying Weather

#### Nicaragua

#### December-January-February

The primary winter synoptic control is the passage of old polar fronts or polar shear lines that have moved southward from the United States. Frequency decreases from north to south. Those areas near the Honduran border will see passages from mid- to late December through the middle of March. Passages near the Costa Rican border normally occur from mid-January through early March. Both Honduran and Costa Rican meteorologists were convinced that these are true fronts, with definite air mass discontinuities across them. The flying weather characteristics would seem to lend validity to their arguments.

#### Area 1--Winter

In the absence of polar surges or shear lines, early mornings are clear, with patchy ground fog from 0500 to 1000L. Visibilities range from 1 to 3 miles in ground fog. Cumulus clouds form between 1100 and 1200L, with bases between 2,000 and 3,000 feet MSL. Tops are normally 6,000 to 10,000 feet MSL, with occasional afternoon RW. Clouds form over the crests and windward sides of mountain ranges by 0900L. Bases are at the 2,000 to 3,000 feet MSL level, with tops from 14,000 to 18,000 feet MSL. There is almost continuous drizzle and light rain, with heavier showers in the afternoons. Clouds clear rapidly after sunset.

Immediately after cold front or shear line passage, conditions worsen considerably and persist for 24 to 48 hours. Mornings are overcast, with cloud bases 2,000-3,000 feet MSL layered to 8,000-9,000 feet MSL. Visibilities beneath the clouds are 5+ miles, but go down to 2-3 miles in RW or R. Cloud cover decreases to 6/8-7/8 after 1200L. Considerable TCU and CB activity begins in early afternoon, with bases as low as 500-1,000 feet and visibilities 1/2 to

2 miles in heavier showers. There is considerable mixed icing and turbulence in and near TCUs and CBs. With northerly winds, there is light to occasionally moderate turbulence over mountain ridges.

#### Area 2--Winter

Immediately after cold front or shear line passage, skies are clear over and to the east of Lakes Nicaragua and Managua. Isolated TCU will form above 2,500 feet MSL along the eastern side of the higher mountains west of these lakes by 1100, with tops reaching 12,000 to 15,000 feet. The usual hazards associated with convective development are present. Winds through the mountain passes from the Caribbean range from 25 to 35 knots, but can be up to 50 knots on the immediate lee side of the passes because of the combination of local venturi effects and enhanced gradient winds due to polar surges. Similar conditions will occur along and westward of passes in the Pacific range.

Farmers burn their fields during this period, but downslope winds off the mountains usually dissipate any smoke by mid-morning (0900L). Moderate turbulence is common over the ridge crests and on the lee (western) side. On occasion--primarily when a strong polar surge is occurring--turbulence may be severe, with standing (mountain) waves. These waves will be dry (cloud-free). The best tool here is the Managua sounding and application of classic mountain wave forecasting techniques.

In the absence of fresh polar outbreaks, morning skies are clear. Isolated heavy J will form over the two large islands in Lake Nicaragua by mid-morning, with very isolated TCU/RW developing over the mountain ridges on both sides of the lake by early afternoon due to forced ascent of moist air resulting from the lake breeze effect. Tops are normally on the order of 12,000 to 17,000 feet MSL. Winds through the mountain passes from the Caribbean range from 25 to 35 knots. Visibilities in the cultivated fields on either side of the lake will go down to 2-4 miles in smoke when farmers burn the stubble in their fields (normally in late January and February). Smoke will be advected inland during the afternoon, then advected out over the lake in late evening or early morning with the pronounced lake breeze effect. A radiation inversion will occur that does not completely dissipate; the gradient wind level over Area II is of the order of 3,000 to 4,000 feet.

### Area 3--Winter

This is the dry season for the Pacific Coast. Skies are virtually clear. Winds across the mountains from Lake Nicaragua range from 15 to 25 knots with light to moderate turbulence. Farmers along the coastal plain burn their fields during these months; low level visibilities will be 2-4 miles before 0900. Downslope winds from the mountains and normal daytime heating will dissipate the smoke shortly after 0900L. Downslope winds can be up to 35 knots on the immediate lee side of the passes from a combination of local venturi effects and enhanced gradient winds due to polar surges. Moderate turbulence is common over the ridge crests and on the lee (western) side under these conditions. On occasion--primarily when a strong polar surge is occurring--turbulence may be severe, with standing (mountain) waves. These waves will be dry (cloud-free). The best tool here is the Managua soundings and application of classic mountain wave forecasting techniques.

### Area 4--Winter

In the absence of polar fronts, skies remain virtually clear. Patchy ground fog occurs from 0600 to 1000L in river valleys. Immediately after a polar frontal passage, conditions in the extreme northeastern part of Area 3 are the same as those in Area 2. However, conditions rapidly improve towards the southwest, becoming 1/8-4/8 coverage, with bases 4,000 to 5,000 feet MSL and tops 8,000 to 9,000 feet MSL. Visibilities remain excellent. With northerly winds, there is light to occasionally moderate turbulence over mountain ridges.

### Spring Flying Weather

#### Nicaragua

#### March-April-May

Several synoptic features influence spring flying weather in Nicaragua. The ITCZ passes northward through the western part of the country during April and early May. During this time a convergence line may be established through the Lake Nicaragua valley, with flow from both the Caribbean and the Pacific. In late May, vortices will occasionally form just offshore of the Pacific coast and slowly move westward. Again, this often results in a convergence line through the Lake Nicaragua valley or along the main mountain range east of this valley. Moderate mixed icing and moderate to severe turbulence will occur in and near TCU and CBs.

### Area 1--Spring

Deteriorating conditions spread northward as the ITCZ moves northward over Areas II and III. In March and April, northern sections are initially clear, with patchy ground fog from 0500 to 1000L. Visibilities range from 1 to 3 miles in ground fog. Cumuliform clouds form by 1100-1200L, with bases between 2,000 and 3,000 feet MSL. Tops normally are 6,000 to 10,000 feet MSL, with occasional afternoon RW. Clouds form over the crests and windward sides of the ranges by 0900L. Bases are at the 2,000 to 3,000 feet MSL level, with tops from 14,000 to 18,000 feet. There is almost continuous drizzle and light rain, with heavier showers in the afternoon. Clouds clear rapidly after sunset.

Southern sections have 4/8-6/8 cloud cover, with bases 1,500-2,000 feet MSL and tops 4,000-6,000 feet MSL. Visibilities are 5 to 7 miles. TCU/CBs form by 1100-1300L. Cloud cover averages 5/8-7/8, with bases near 2,000 feet MSL, and tops from 10,000 to (with CBs) 45,000 feet. Visibilities under clouds are 3-5 miles in RW; TRW visibilities drop to 1/2 mile or less. Ridges above the elevations mentioned, either with or without easterly waves, are in cloud. Passes are closed intermittently. By late May, these conditions have spread northward to the Honduran border.

### Area 2--Spring

As the ITCZ moves northward, there is a switch to southwesterly flow. Conditions deteriorate by early May. With the southwesterly low-level flow, mornings average 3/8-5/8 cloud coverage with bases 1,500-2,500 feet AGL, and tops 6,000-9,000 feet MSL. These conditions persist over the lake throughout the day. Heavy CU begins building over both primary mountain ranges by 1100L; afternoons average 5/8-7/8 cloud cover, with bases at 2,000-2,500 feet AGL and tops 10,000-15,000 feet MSL. There is considerable rainshower activity after 1300L; bases range from 1,000 to 1,500 feet AGL, tops from 15,000 feet MSL to, with CBs, 45,000 feet MSL. Visibilities are 1/2 mile or lower. Mountains are obscured above 5,500 to 6,000 feet MSL.

### Area 3--Spring

Conditions deteriorate rapidly from south to north beginning in early March near the Costa Rican Border and spreading all the way to the Gulf of Fonseca by late May. After this deterioration takes place, mornings see 5/8-7/8 cloud coverage with bases 1,000 to 1,500 feet MSL and tops 6,000 to 12,000 feet MSL. Visibilities average 2-4 miles in occasional light rain. By 1100L, TCU and CBs form, with tops ranging from 15,000 to 45,000 feet MSL. Multi-layers rapidly form as a result of the

convective activity, with tops between 18,000 and 25,000 feet MSL. Visibility in RW/TRW averages 1/2 to 2 miles, but may go down to zero in the heaviest TRW. Ridges above 2,000 feet MSL are normally in cloud by mid-morning, with continuous rain and heavier RW by early afternoon.

#### Area 4--Spring

Early in the period, there are some visibility restrictions from smoke in valleys. Tops of the smoke layers are from 4,000 to 7,000 feet MSL. Inflight visibilities are 2 to 4 miles. Conditions deteriorate from the south beginning in mid-May, and reach the Honduran frontier by early June. Mornings are overcast, with bases 2,000 - 3,000 feet MSL and tops to 8,000 - 10,000 feet MSL. Visibilities are 2-3 miles in RW and rain. By early afternoon, embedded CU/TCU/CB will have developed. Ceilings are from 1,000 to 2,000 feet MSL, with tops from 15,000 to 45,000 feet MSL. Visibilities range from near zero to 2 miles in RW/TRW. Moderate mixed icing and moderate to severe turbulence occurs in and near CBs.

#### Summer Flying Weather

##### Nicaragua

#### June-July-August

By late June, the ITCZ moves northward into southern Honduras. The summer season sees the first of a double precipitation maximum over Areas 2 and 3, with the first of the two peak periods occurring in June and early July. In Area 1, the double peak is less marked; the entire summer is a rainy season.

#### Area 1--Summer

Mornings are overcast, with bases 2,000--3,000 feet MSL and tops 8,000--10,000 feet MSL. Visibilities are 2-3 miles in RW and rain. By early afternoon, embedded CU/TCU/CB will have developed. Ceilings are from 1,000 to 2,000 feet MSL, with tops from 15,000 to 45,000 feet MSL. Visibilities range from near zero to 2 miles in RW/TRW, but may go down to zero in the heaviest TRW. Moderate mixed icing and moderate to severe turbulence occurs in and near CBs. Multi-layers rapidly form as a result of the convective activity, with tops between 18,000 and 25,000 feet MSL. Ridges above 2,000 feet MSL are normally in cloud by mid-morning, with continuous rain and heavier RW by early afternoon.

#### Area 2--Summer

Mornings average 3/8-5/8 cloud cover, with bases 1,500-2,500 feet AGL and tops 6,000-9,000 feet MSL. Heavy CU starts to build by 1100L; afternoons average 5/8-7/8 cloud cover with bases 2,000-2,500 feet AGL and tops 10,000-15,000 feet MSL. There is considerable rain shower activity after 1300L; bases range from 1,000 to 1,500 feet AGL and tops from 15,000 feet MSL up to, with CBs, 45,000 feet. Visibilities are 1/2 mile or lower. Mountains are obscured above 3,500 to 5,500 feet MSL; passes out of the Lake Nicaragua Valley to the Caribbean coast are often closed.

#### Area 3--Summer

Mornings see 5/8-7/8 cloud cover, with bases 1,000 to 1,500 feet MSL and tops 6,000 to 12,000 feet MSL. Visibilities average 2-4 miles in occasional light rain. By 1100L, TCU and CBs form; tops range from 15,000 to 45,000 feet MSL. Multi-layers rapidly form as a result of convective activity, with tops between 18,000 and 25,000 feet MSL. Visibilities in the RW/TRW average 1/2 to 2 miles, but may go down to zero in the heaviest TRW. Ridges above 2,000 feet MSL are normally in cloud by mid-morning, with continuous rain and heavier RW by early afternoon. Passes are often closed. Temporales will cause extensive layered clouds, low ceilings, steady rain, and poor visibilities. Mountains above 2,000 feet MSL are obscured.

#### Area 4--Summer

Area 3 begins its primary rainy season anywhere from mid-May to late June. Mornings are overcast, with bases 2,000 - 3,000 feet MSL and tops to 8,000 - 10,000 feet MSL. Visibilities are 2-3 miles in RW and rain. By early afternoon, embedded CU/TCU/CB will have developed. Ceilings are from 1,000 to 2,000 feet MSL, with tops from 15,000 to 45,000 feet MSL. Visibilities range from near zero to 2 miles in RW/TRW. Moderate mixed icing and moderate to severe turbulence occurs in and near CBs.

#### Fall Flying Weather

##### Nicaragua

#### September-October-November

The ITCZ begins to retreat southward, reaching the Costa Rican border by late November. Fall sees the second of two precipitation peaks in Areas 2 and 3. Although precipitation in Area 1 is less than its midsummer maximum, it remains substantial throughout the period.

#### Area 1--Fall

Conditions continue to resemble those of summer, with the exception of a temporary break along the extreme northern coast in mid- to late September. By late November, conditions begin to improve markedly as the rainy season draws to a close.

#### Area 2--Fall

Conditions improve rapidly by late October. By late November, conditions are the same as December's.

#### Area 3--Fall

Conditions improve to resemble December's from north to south, beginning in mid-October near the Gulf of Fonseca, and reaching the Costa Rican border by late November.

#### Area 4--Fall

Conditions improve rapidly from north to south. By late October, conditions are those of winter.

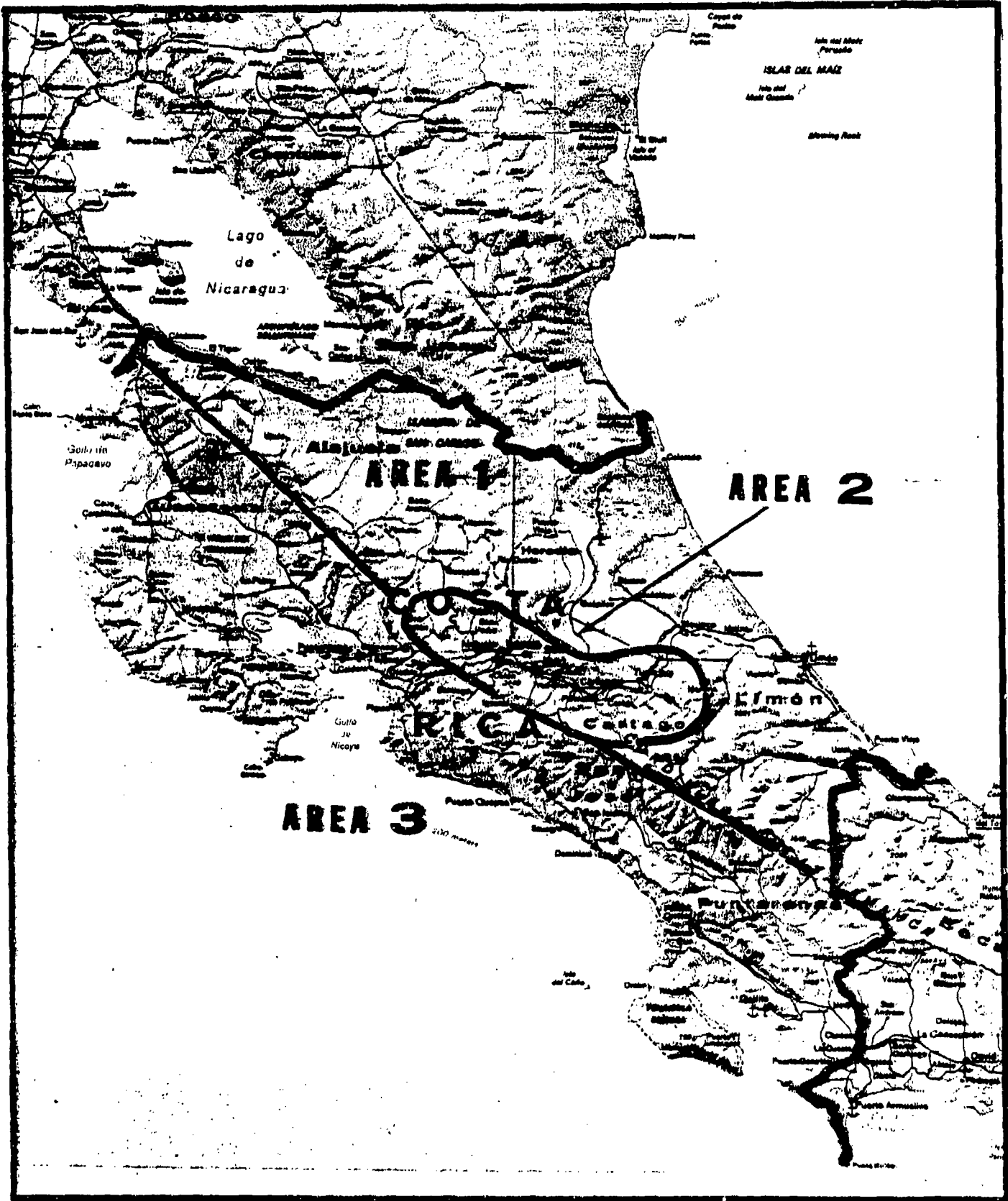


FIGURE 5. COSTA RICA.

## FLYING WEATHER IN COSTA RICA

To facilitate the discussion, Costa Rica has been divided into the three areas described below and shown in Figure 5.

**Area 1:** The Caribbean coast westward to the crests of the Cordillera de Guanacaste and Cordillera de Talamanca.

**Area 2:** The Central Valley.

**Area 3:** The Pacific coast eastward to the crests of the Cordillera de Guanacaste and Cordillera de Talamanca excluding the Central Valley.

Unlike Honduras, El Salvador, and Nicaragua, the Costa Rica discussion covers only two seasonal periods: The dry season (December, January, and February) that corresponds roughly to the Northern Hemisphere Winter, and the wet season that persists through the rest of the year.

### Dry Season Flying Weather

#### Costa Rica

December-January-February

The primary dry season synoptic control is the occasional passage of old polar fronts or polar shear lines that have progressed southward from the United States, usually reaching Costa Rica by January and February. Penetration of these surges into Costa Rica, however, is relatively infrequent, even in January and February. Drs Amador and Fernandez are convinced that these are true fronts, with a definite, although slight, air mass discontinuity across them. Flying weather seems to support their views.

### Area 1--Dry Season

Early mornings are clear with patchy ground fog from 0500 to 1000L. Visibilities range from 1 to 3 miles in the ground fog. Cumuliform clouds form between 1100 and 1200L, with bases between 2,000 and 3,000 feet MSL. Tops are normally 6,000 to 10,000 feet MSL, with occasional afternoon RW. Clouds form over the crests and windward sides of the ranges by 0900L. Bases are at the 2,000 to 3,000 feet MSL level, with tops from 14,000 to 18,000 feet MSL. There is almost continuous drizzle and light rain, with heavier showers in the afternoons. Clouds clear rapidly after sunset.

### Areas 2 and 3--Dry Season

Skies are clear. Winds through the mountain passes from the Caribbean range from 25 to 35 knots, but can be up to 50 knots on the immediate lee side of the passes from the combination of local venturi effects and enhanced gradient winds due to polar surges. Visibilities in Area 2 will go down to 2-4 miles in smoke when the farmers are burning the stubble in their fields, normally in late January and February. A radiation inversion that does not completely dissipate will occur; the gradient wind level over Area 2 is on the order of 6,000 to 7,000 feet. Strong polar surges will dissipate the inversion and the smoke. While farmers in Area 3 also burn their fields at this time, downslope winds off the mountains will usually dissipate any smoke by mid-morning (0900L). Moderate turbulence is common over the ridge crests and on the lee (Pacific) side. On occasion--primarily when a strong polar surge is occurring--turbulence may be severe, with standing (mountain) waves. These waves will be dry (cloud-free). The best tool here is the San Jose sounding and application of classic mountain wave forecasting technique.

### Wet Season Flying Weather

#### Costa Rica

March thru early December

There are several synoptic features that influence Costa Rica's wet season. During March and April, and again in November, the ITCZ passes through Costa Rica. When it does, a convergence line may be established along the main ridge crests of the Cordillera de Guanacaste and the Cordillera de Talamanca, with flow from the Caribbean and the Pacific. From late May through September (or even through October), vortices will occasionally form just off the Pacific coast and slowly move westward. Again, this often results in a convergence line along the ridge crests mentioned earlier. Easterly waves and hurricanes will affect all areas of the country. Moderate mixed icing and moderate to severe turbulence will occur in and near TCU and CBs.

### Area 1--Wet Season

Mornings have 4/8-6/8 cloud cover, with bases 1,500-2,000 feet MSL, and tops 4,000-6,000 feet MSL. Visibilities are 5 to 7 miles. TCU/CBs form between 1100-1300L. Cloud cover averages 5/8-7/8, with bases near 2,000 feet MSL and tops from 10,000 to (with CBs) 45,000 feet. Visibilities under clouds are 3-5 miles in RW; TRW visibilities drop to 1/2 mile or lower. With easterly waves, layers extend to 15,000 to 25,000 feet MSL; skies are overcast and ceilings range from 1,000 to 1,500 feet MSL. Visibilities are from 2 to 4 miles in rain. Ceilings and visibilities in numerous TCU/CBs are 500/1/2 to 1,000/1 MSL. Ridges above the elevations mentioned, either with or without easterly waves, are in cloud. Passes are closed intermittently. Hurricanes will cause extensive low cloud, precipitation, and poor visibility, as well as the usual wind shears and turbulence.

### Area 2--Wet Season

With passage of the ITCZ northward, flow in this area switches to southwesterly. Mornings average 3/8-5/8 cloud cover with bases 1,500-2,500 feet AGL, and tops 6,000-9,000 feet MSL. Heavy CU begins building by 1100L; afternoons average 5/8-7/8 cloud cover with bases 2,000-2,500 feet AGL and tops 10,000-15,000 feet MSL. There is considerable rain shower activity after 1300L; bases range from 1,000 to 1,500 feet AGL, tops from 15,000 feet MSL up to, with CBs, 45,000 feet MSL. Visibilities are 1/2 mile or lower. Mountains are obscured above 5,500 to 6,000 feet MSL. In November, there is a 3- to 4-week period of poor flying weather as the ITCZ seems to stagnate. Skies are overcast; ceilings run 500 to 1,000 feet AGL with tops layered to 15,000 to 25,000 feet MSL. Visibilities average 1/2 to 1 mile in rain and fog. Mountains above 4,500 to 5,000 feet MSL are obscured; passes out of the Central Valley to either coast are often closed.

### Area 3--Wet Season

Mornings see 5/8-7/8 cloud cover with bases 1,000 to 1,500 feet MSL; tops are 6,000 to 12,000 feet MSL. Visibilities average 2-4 miles in occasional light rain. By 1100L, TCUs and CBs form; tops range from 15,000 to 45,000 feet MSL. Multi-layers rapidly form as a result of convective activity, with tops between 18,000 and 25,000 feet MSL. Visibilities in RW/TRW average 1/2 to 2 miles; visibility may go down to zero in the heaviest TRW. Ridges above 2,000 feet MSL are normally in cloud by mid-morning, with continuous rain and heavier RW by early afternoon. Passes are intermittently closed. Temporales will cause extensive low cloud, precipitation, and poor visibility.

**SUPPLEMENTARY**

**INFORMATION**



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# ERRATA

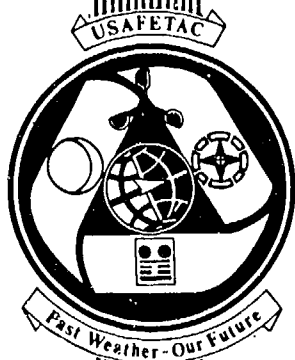


## CENTRAL AMERICAN FLYING WEATHER

by

Kenneth R. Walters

December 1985



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## PREFACE

This report is the result of an Air Weather Service Technical Library information scouting visit to Panama, Venezuela, Costa Rica, and Honduras in November and December 1983. During that visit, the author held extensive discussions with Costa Rican and Honduran meteorologists and pilots. He also discussed Central American flying weather with U.S. Army pilots and AWS meteorologists.

Interviews with Central American pilots and forecasters formed the basis for this report. These interviews were then combined with information from other sources, notable among which was USAFETAC/TN-85/002, Central American Climatology. However, primary emphasis was placed on the experiences of people who have either flown over, or made forecasts for, these countries routinely over a period of many years. The result is a collection of brief flying weather summaries for the countries of Honduras, El Salvador, Nicaragua, and Costa Rica.

Readers should note that while many of the comments made about Honduras and El Salvador could also apply to parts of Guatemala, there has been no effort to expand the report to include Guatemala or any other country.

The author wishes to acknowledge the patience and cooperation of the Honduran and Costa Rican pilots and meteorologists who provided the basis for the flying weather descriptions presented here. He hopes the summaries and conclusions presented here may be of help to AWS forecasters supporting Department of Defense operations in the areas described.



DEPARTMENT OF THE AIR FORCE  
HEADQUARTERS AIR WEATHER SERVICE  
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January 17, 1997

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