

# A SUMMARY OF FOUR, FIVE-DAY CLEAR AIR TURBULENCE REPORTING PERIODS

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## ABSTRACT

This paper summarises the results of the four ICAO five-day clear air turbulence (CAT) reporting periods covering the South Pacific region and conducted on selected days in December 1964 and March, June and September, 1965.

The incidence of CAT was greatest in March (autumn). Much of this CAT occurred over mountains. Vertical wind shear, either averaged over a 10,000 ft layer above and a 10,000 ft layer below the jet stream, or in the 10,000 ft layer below the jet stream, was the most successful parameter.

## 1. INTRODUCTION

This paper summarises the results of the ICAO short term high level turbulence reporting programme, covering the South Pacific region, which consisted of four periods each of five days duration in December 1964 and March, June and September, 1965. The results of these studies are the four preceding articles in this publication (Colquhoun and Bourke (1967 a, b) and Colquhoun (1967 a, b)). The data for flights at and above 20,000 ft were divided into (a) flights at and below 30,000 ft and (b) flights above 30,000 ft.

Two separate studies were conducted: (1) Covering all flight squares and (2) Covering flight squares bounded by latitudes  $22\frac{1}{2}^{\circ}\text{S}$  and  $40^{\circ}\text{S}$  and longitudes  $112\frac{1}{2}^{\circ}\text{E}$  and  $160^{\circ}\text{E}$ .

## 2. RESULTS OF ANALYSES

The seasonal variation of clear air turbulence (CAT) is shown in Table 1.

Table 1. Seasonal variation of CAT occurrence

Month	No. of Occurrences (Flight Squares)					Percentage of Occurrences			
	Total	None	Light	Mod.	Sev.	None	Light	Mod.	Sev.
December	2481	2346	85	40	10	94.6	3.4	1.6	0.4
March	1840	1662	115	59	4	90.3	6.3	3.2	0.2
June	2537	2343	161	33	0	92.6	6.3	1.3	0
September	1568	1445	89	34	0	92.1	5.7	2.2	0

The greatest percentage of CAT occurred in March (autumn). The greatest percentage of flights encountering CAT also occurred in this month (52 per cent).

The effect of mountain barriers on the occurrence of CAT was particularly evident in the March period when most of the CAT occurred above the Great Dividing Range of Eastern Australia and the hills of southwest Western Australia. This effect was also evident, but not as pronounced, in the December period.

In the September and March periods there were flight squares with high percentages of CAT occurrence on the route between Darwin and Singapore. Many of these occurrences were of long duration (up to 1 hour). Because of the generally light surface winds in this area it is difficult to attribute this CAT to topographical influences.

To obtain the vertical distribution of CAT, flights were divided into four layers. In the December period the highest percentage of CAT was for flight squares in the layer  $\leq 26,500$  ft but in all other periods the greatest percentage was in the layer 27,000 - 30,000 ft. In the March period 35 percent of flights through squares in this layer encountered CAT.

In each of the general studies one or both of the vertical wind shears were superior to the other parameters. It is difficult to say which of the two is the better. Horizontal wind shear gave good results in only one of the studies. Its combination with vertical wind shear was not fruitful. Generally poor results were obtained with maximum wind speed in the vertical, Richardson's number and the tropopause analysis. Mean airspeed fluctuations increased with increasing severity of CAT. Three of the studies indicated areas to the right (or cold) side of the jet as more favourable for CAT than areas to the left.

In the study over a restricted area "average" vertical wind shear gave the most consistent results. In the September period Richardson's number was the most successful parameter. Generally poor results were obtained with vorticity, vorticity advection, Endlich's turbulence index (excepting in the June period, where the parameter gave results comparable with "average" vertical wind shear) and the Colson - Panofsky turbulence index (studied in only two periods).

### 3. CONCLUSIONS

Broad scale studies such as this, based on a sparse radiosonde network and a low flight density, are unlikely to contribute to the solution of the problem of finding a parameter which reliably indicates the occurrence or non-occurrence of CAT. The dimensions of CAT, often in shallow layers, suggests that it is necessary to perform detailed investigations of air-masses. Such an analysis, coupled with non-subjective CAT data, would possibly yield better results. Spillane (1967) showed that CAT is often found in a relatively stable layer above a shallow unstable one. Evaluating parameters such as Richardson's number in 5,000 ft layers is likely to leave such layers undetected.

Kadlec (1963) gives evidence of a strong relationship between CAT and the thickness of cirrus. An evaluation of CAT incidence in cirrus was not possible in the studies because the data forms made no provision for noting cloud when CAT was not experienced.

### REFERENCES

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