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ADVERSE WEATHER CONDITIONS FOR FLYING OPERATIONS AT McMURDO SOUND AND CAPE HALLETT, ANTARCTICA

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Abstract

Climatological information relevant to flying operations at McMurdo Sound and Cape Hallett, Antarctica have been briefly reviewed. Six-hourly observations from three years have been analysed to show the frequency of occurrence of adverse weather conditions at McMurdo and the percentage of these occasions in which conditions were also adverse at Cape Hallett. From almost all points of view there is a marked deterioration in average weather conditions outside of the period November-February.

Introduction

For the advance planning of flying operations it is advantageous to know in some detail the climatological frequency of adverse weather conditions at the destination. This is especially true in Antarctica, as not only is adverse weather likely to be more severe, but the availability of alternative landing sites is likely to be more limited than in most other regions.

The U.S. Naval Air Facility at McMurdo Sound ($77^{\circ}51'S$, $166^{\circ}40'E$) is the main logistics centre for United States Antarctic ("Deepfreeze") operations, and is the main destination and departure point for flights carrying men, equipment and supplies between Antarctica and New Zealand. In recent years the Royal New Zealand Air Force has also carried out a significant and increasing number of operations between New Zealand and this Facility.

Meteorological observations have been made regularly at McMurdo from March 1956, and summaries of these, covering a number of periods and in a number of different forms, are available from various sources, (for example, U.S. Navy 1961, 1965, 1966, Weyant 1967, Schwerdtfeger 1970). In addition, observations have been made from New Zealand's Scott Base, about 2km distant (Thompson and MacDonald 1961, Thompson 1969).

Observations from Cape Hallett (72°19'S, 170°19'E) have been summarized in U.S. Navy (1965), Weyant (1967) and Schwerdtfeger (1970).

While conditions at the destination airfield are of vital importance, an equally vital consideration from an operational point of view is the likelihood of acceptable landing conditions at the alternative airfield or fields, given that conditions are not acceptable at the planned destination. In the present instance the alternative landing field for flights to McMurdo is at Hallett.

The purpose of this note is to briefly summarize some of the available information on weather conditions at McMurdo and Hallett as obtained from a study of the references cited above, and to present some new data on the simultaneous occurrence of adverse weather conditions at the two places.

Weather Conditions at McMurdo

The prevailing surface wind at McMurdo is from the east or northeast in all seasons. Typically, these east or northeast winds blow with a speed of 10-15 knots and are likely to be present about 70% of the time in summer and 50% in winter. Winds of two knots or less are relatively frequent in winter (20-30% of the time) and least frequent in February and March (7-8% of the time).

Winds of gale force and over may be expected on about 50 days each year. These gales are practically always from the south. Violent winds occur mostly in the period April-October, with peak gusts up to 87 knots having been recorded. However even in summer there have been occasions when winds gusting to 65 knots or more have been recorded. These southerly winds are often squally, with a rapid rise, often from near calm, to maximum speed within a few minutes or less. Usually this rise is followed by a gradual decrease in speed over a period of an hour or so, or until the next squall, so that in most (but not all) cases the high winds are not sustained at maximum force over a long period.

Blowing snow is important operationally because of the often complete reduction in visibility it brings about. Table 1 shows the average number of days per month that blowing snow has been reported at McMurdo. The sharp increase from March to October compared with the summer period is noteworthy. There is no sub-division of this data according to intensity so it is probable that some of the occasions included do not represent conditions severe enough to prevent flying operations.

TABLE 1

CLIMATOLOGICAL MEANS McMURDO

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Temp., °C	-3	-8	-19	-21	-24	-23	-26	-28	-24	-20	-9	-4
Days Blowing Snow	2	3	11	14	12	14	13	11	16	10	4	3
Frequency of Snow	9%	14%	12%	18%	17%	17%	16%	18%	15%	12%	11%	13%
Frequency of Fog	2%	1%	4%	3%	3%	1%	2%	3%	2%	3%	1%	2%
Freq. Visibility ≤ 2nm	3%	4%	12%	14%	13%	16%	13%	12%	17%	11%	4%	5%

Precipitation is likely at any time of the year, as shown in Table 1. Falls are usually light. An annual precipitation of 11 cm of water equivalent is quoted in the references but this is subject to some doubt as it is difficult to differentiate between falling and drifting snow. For flying operations the main hazard with snow is likely to be the reduction in ceiling and/or visibility which accompanies it. In fact, the great majority of reports show low visibility to be accompanied by precipitation.

A graphical illustration of the occurrence of low ceiling and visibility at McMurdo has been prepared by the U.S. Navy (1961). This and other diagrams and tables in the publication show clearly that the period November to February inclusive is least affected by these conditions and that there is a marked deterioration in the period March-October relative to these months. The frequency distribution of the duration of sub-VFR conditions (ceiling 600m or less and/or visibility 5nm or less) is also given for each month. Examination of these shows that on average 20% of sub-VFR conditions persist for 12 hours or more during the November-February period. During the remainder of the year the corresponding figure is 30%, showing that periods of adverse weather tend to last longer from March.

The frequencies of occurrence of various combinations of low cloud and visibility at McMurdo are of operational significance and have been obtained from the examination of three years' spring/summer season observations in the form of six-hourly synoptic reports. They are shown in Table 2. On the basis of this data, for example, one can expect to find ceiling less than 100m and/or visibility less than one nautical mile about 12% of the time during September. The marked increase in the frequency of occurrence of adverse weather outside the November-February period is also apparent in these figures.

TABLE 2

Percentage of Time with Ceiling and/or Visibility less than or equal to the Values Specified, McMurdo

	Sep	Oct	Nov	Dec	Jan	Feb	Mar
600m, 5nm	24	15	7	11	11	3½	13½
300m, 3nm	17	8½	4½	4½	3½	1	8
100m, 1nm	12	5½	2½	2	2	0	5½
Total observations	356	364	346	360	366	331	368

It is worthy of note that in the November-February period about 20% of sub-VFR conditions are also below the 1nm/100m criteria whereas in the remaining months (Sept., Oct., March) almost 45% are also below these criteria. In other words, conditions tend to be relatively more severe outside the November to February period.

Weather Conditions at Hallett

The prevailing wind at Hallett is very markedly channelled from the south or south-southeast in all seasons. Winds from other directions are not common. Calm conditions are very often experienced, on average some 35-40% of the time in March and 50-60% of the time during the remainder of the year. Southerly gales are frequent during the autumn and winter but are less so in spring and summer when the frequency of occurrence is probably comparable to that at McMurdo.

The occurrence of blowing snow is shown in Table 3. It is seen that the frequency of occurrence is roughly the same as at McMurdo during the summer, but somewhat less during the remainder of the year.

The frequency of occurrence of precipitation is also given in Table 3. There is a tendency for more frequent precipitation in the autumn, otherwise the figures are similar to those for McMurdo.

TABLE 3

CLIMATOLOGICAL MEANS, HALLETT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Temp. °C	-2	-4	-11	-18	-23	-23	-27	-28	-25	-19	-9	-3
Days Blowing Snow	2	4	6	6	5	8	7	6	7	7	1	2
Frequency of Snow	16%	24%	29%	22%	15%	20%	17%	15%	14%	18%	11%	16%
Freq. Visibility ≤ 2nm	8%	8%	12%	5%	6%	13%	10%	8%	8%	10%	2%	6%

Less comprehensive information is available on low cloud and visibility at Hallett than for McMurdo. From a study of available summaries it would appear that there is not quite the same clear-cut distinction between the November-February period and the remainder of the year. As an example, Table 3 shows the frequency of occurrence of visibilities of less than two nautical miles at Hallet. Comparison with Table 1 shows generally higher frequencies in summer and lower in winter than for McMurdo.

The U.S. Navy (1965) has published graphs giving the persistence of periods of low visibility. Taking mean values for the period November to February it is found that on average 24% of periods with visibility below 2nm last for 12 hours or more. The corresponding value for McMurdo is 12%. These figures are not directly comparable with those for sub-VFR conditions quoted for McMurdo in the previous section but they indicate a tendency for periods of adverse weather to be of significantly longer duration at Hallett.

Simultaneous Occurrence of Adverse Conditions at McMurdo and Hallett

Three successive spring/summer seasons' observations (between October 1957 and March 1960) were examined for instances of adverse weather occurring at both stations at the same time. The results are summarized in Table 4. The increase in frequency outside November-February is notable once more.

TABLE 4

Number of times the criteria of ceiling and visibility conditions at both McMurdo and Hallett are equal to or less than specified values out of total of 1391 cases

Ceiling and/or Visibility	≤ 600 m 5nm	300 m 3nm	100 m 1nm
November to February	10 (0.7%)	6 (0.4%)	5 (0.4%)
Sep., Oct., March	32 (2.3%)	25 (1.8%)	19 (1.4%)

Total Number of Observerations: 1391

The frequency of occurrence simultaneously of conditions below a specified criterion at the two stations is considerably less than for the individual stations, as might be expected. However in summer the reduction in frequency is not as great for the more severe criteria as it is for the occurrence of sub-VFR conditions. Table 5, which shows the same data expressed in terms of the occurrence of adverse conditions at McMurdo, also illustrates this. Evidently storms which give rise to the more severe conditions tend to be more widespread and provide a greater chance that both places will be affected.

TABLE 5

Percentage of occasions when adverse conditions of ceiling and visibility affecting McMurdo occur also at Hallett

Ceiling and/or Visibility	≤ 600 m 5nm	300 m 3nm	100 m 1nm
November to February	9%	12½%	20%
Sep., Oct., March	17%	22%	23%

The tables also show that if adverse weather is present at both places at the same time it is likely to be relatively severe, especially outside the November-February period.

No information is available on the expected duration of simultaneously adverse conditions. Since these are likely to be produced by widespread disturbances rather than local ones, it is possible that the average duration would be somewhat longer than for the duration of adverse conditions at the individual places.

Concluding Remarks

The information on the frequency of occurrence of adverse conditions as given above is based on a relatively limited amount of data. It is felt, however, that the addition of further observations is unlikely to have a substantial effect on the results. It should be emphasized that in general the discussions have been concerned with averages, and deviations from these in individual years or over limited periods of time must be expected.

A further point which should be mentioned is that the actual runways, which vary in position according to ice conditions, are often some appreciable distance from the site of the meteorological observations used here. Thus, average conditions at the runways may differ from those described above, but it is not expected that these differences would be major.

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