*Weather Engineering Services for Aerial Photography**

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ABSTRACT: *Intelligent use of weather advisories of the type developed by the experienced consultant weather engineer in the service of aerial photography, can only result in benefit to the client companies. Greater economy in planning and consequent lowering of costs are necessary adjuncts of operating in phase with the weather. The different facets of such a weather service are discussed and illustrated, and their development within the author's company traced from the late Thirties to the present time.*

INTRODUCTION

IT IS generally recognized that the possession of advance weather information is vital to the good conduct of every weather-sensitive industrial operation. Through the agency of press and radio certain facets of the weather engineer's work are becoming increasingly well-known. For example, "cloud seeding," "rainmaking," and "weather modification" are now household terms, and no one doubts the pilot's need of a weather-flight-forecast before take-off. But little publicity has as yet been given to the weather services that benefit the photographer, in spite of the fact that they have been available in completed form for the last ten years, and were in process of development for at least another ten prior to that time.

This paper describes a variety of weather forecasting techniques developed by the American Institute of Aerological Research, specifically for the film industry and for aerial-photographic survey crews. It suggests ways in which the client can obtain maximum advantage from the weather information with which he is provided by the consultant weather engineer.

WEATHER SERVICES APPLICABLE TO THE FILM INDUSTRY

"Industrial meteorology," or as we now prefer to call it, "weather engineering," has a total life history of only about 20 years. It was when the subject was in its early infancy that the potential of advance weather information was first recognzied by the film industry.

In this field, as in every other in which the weather engineer works, it was first of all necessary for him to learn the photographer's job, so that he could do his own efficiently. The film producer talks in terms of "shooting conditions," amounts of blue cover, degrees of "air transparency," sun angles, etc.—a very different language from that of the pilot, construction engineer, or agriculturist. This jargon, and the limiting weather conditions, implied in each term, must be completely mastered by the consultant. Armed with his client's vocabulary, he can treat and recast basic weather records to fit each client's need. While learning his client's language, the weather engineer is also making himself familiar with all of his client's weather problems. Whereas the "weather man" merely supplies weather information, the

* Paper read at the Society's Semiannual Convention and Trade Show, Statler Hotel, Los Angeles, Calif., Sept. 7–10, 1955.

weather engineer assists his clients in using it.

Weather services which have been found to be a maximum benefit to the film industry are essentially climatological studies for pre-planning purposes, long-range forecasts of shooting conditions when the operation comes within seasonal range, and detailed short-range weather advices, when the group is finally on location. These three variously-prepared types of information supply an integrated weather service to cover each phase of the producer's operational schedule.

THE PRE-OPERATIONAL SURVEY

In the pre-planning stage, the weather engineer gets most help from his library of climatic records. He needs as long a weather history as possible for the various places under review, so that he can calculate the odds on certain defined conditions occurring in any given year. He may be asked to select the best location for a given "set" from a series of possible sites, or he may have to decide the best time of year to attain a certain shot in a specified location. In either case, the decision which, in the bad old days, would have involved sending members of the film group to different locations, possibly half-way round the world to question the locals, is now made in the laboratory, with a minimum of time and expense.

In this type of survey, consultation between the weather engineer and the film producer, leads to the definition of "operational days." The records are then combed to give the producer the answer on how much operational time he can expect per month; which month will be best for specific shots when due regard is paid to sun angle, as well as sunshine; and such practical considerations as matching scenery and suitable accommodation for personnel. The film "*Scott in the Antarctic*" serves to illustrate many of these points. It was shot in Norway. Sun angles, snowfields, and glaciers, had to be found which would compare with those of the Antarctic. Accommodation for a particularly large cast in such condition was not an easy problem.

THE LONG-RANGE FORECAST

When the chosen date for location comes within "seasonal" range, the long-range forecast is prepared to sharpen the information supplied in the climatological survey, and to provide more detailed notes on the particular months in which shooting is to take place. The forecast is again given in terms of expected amounts of operational time over a three-month period. An additional feature is introduced at this stage when the over-all forecast for the first of the three months is broken down to give details on the time of best operational periods *within* the month.

Weather history repeats itself in shorter and longer rhythms. Careful cataloging of weather types over long periods of time makes it possible to extract weather sequences from past years which are similar to the ones currently being experienced. Forecasts of future weather are therefore prepared on the evidence of past trends. This, very simply, is the basis of the "Analogue Method" of long-range forecasting, employed by the author's weather-consultant group in Denver.

THE SHORT-RANGE FORECAST

When the time to go on location arrives, day-to-day advices are given on when, within each day, best outdoor shooting conditions can be expected. These forecasts cover amounts of pictorial cloud, blue cover, air transparency, and all the problems of the film producer that lie within the sphere of the weather engineer.

Integrated weather services of this type have been prepared by the author's organization for many film groups in the western United States and northwest Europe over the last 20 years.

Weather Services Applicable to Aerial Photography

Not only was experience of the type gained in the setting up of suitable services for film groups used in the cause of aerial photography but, in addition, a good deal of the author's war-time experience was brought to bear on a new problem with many facets of a variety of old ones.

As Deputy-Director of Weather Services in the European Theater of Operations, 1944–1945, the author helped in the planning of reconnaissance and bombing raids. Features of this planning are also features of an aerial photographic survey, especially on the operational side. It was in these war-time operations that the value of a central dispatch point for planes and equipment first became evident.

This method of swift and tactical de-

FIGURE 1

OPERATIONAL DAY DEFINITIONS

Operational Days have been defined according to the following criteria:

MAY, JUNE, JULY—Latitudes 50°–75° N.

Operational	10.0 hours or more bright sunshine.
Marginal	6.0–9.9 hours bright sunshine.
Non-Operational	5.9 or less hours bright sunshine.

AUGUST—Latitudes 50°–75° N.

Operational	7.0 hours or more bright sunshine.
Marginal	4.0–6.9 hours bright sunshine.
Non-Operational	3.9 hours or less bright sunshine.

SEPTEMBER—Latitudes 50°–70° N.

Operational	5.0 hours or more bright sunshine.
Marginal	3.0–4.9 hours bright sunshine.
Non-Operational	2.9 hours or less bright sunshine.

OCTOBER—Latitudes 50°–65° N.

Operational	4.0 hours or more bright sunshine.
Marginal	2.0–3.9 hours bright sunshine.
Non-Operational	1.9 hours or less bright sunshine.

ploy of forces from a strategic center forms the basis of the present recommendations made in this paper. All illustrations are taken from advices supplied to specific clients in aerial photographic businesses. They are capable of unlimited variation to suit individual client requirements, but are samples of the type of service that would represent basic requirements for most aerial-survey crews.

Figure 1 is a table of operational-day definitions—the actual working requirement of one photographic crew. These are the weather criteria from which a number of climatic studies were developed.

Figure 2 is a simple pictorial method of showing the number of hours per day, over a period of months, when sun angles for a specific location would be above certain specified values. In this case, conditions would be non-operable if sun angles were below 15 degrees.

Figure 3, based on a climatic survey of operational days, according to certain specified criteria over a period of years, shows the number which were available last year in June, and the number forecast to be available in June 1955. These forecasts were all made during March 1955.

Figure 4 demonstrates a long-range forecast technique, used for comparing the best and worst operational conditions within a given month for a variety of different target areas. By this means, photographic crews can be sure of being in the most favorable spot, weather-wise, at the most favorable time—thus avoiding an undue amount of costly waiting.

Figure 5 shows the type of long-range forecast employed to give an indication of when ice and snow cover can be expected in the fall, and when thaw will be affecting these same areas in the spring.

Figure 6 gives information to the crew concerning temperature ranges and types of precipitation that can be expected within a given month.

Summarizing, climatic studies provide the basis for over-all strategy; long-range forecasts help in planning the disposition of equipment and crews; and short-term forecasts supply guidance for immediate operations.

Purpose of the Weather Engineer

From the foregoing description of types service developed to aid personnel engaged in aerial photography, it will be realized that the weather engineer has a very practical purpose in mind. He has made it his business to see that the client company is saved large sums of money by being in possession of information that will make economic planning feasible. Reliable advice concerning the best time and place for specific operations minimizes the necessity for trained crews to sit idle, waiting for the weather.

A further example of this type of thinking is shown in Figure 7.

Scheduling in Phase with the Weather

Figure 7 shows how the "weather types" to which we have already referred in the sections dealing with long-range forecasting, can also be used for short-term crew disposal. Each sketch represents one phase of a six-day weather type. Associated with each phase, there is a well-defined good photographic area. As can be seen from the illustration, these good photo-

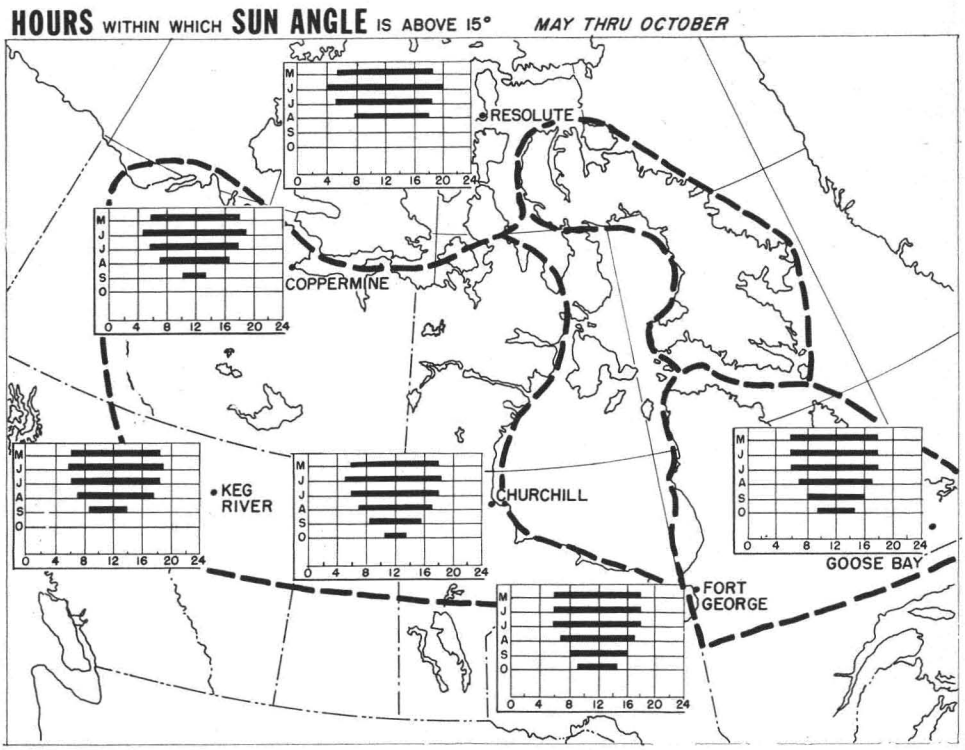
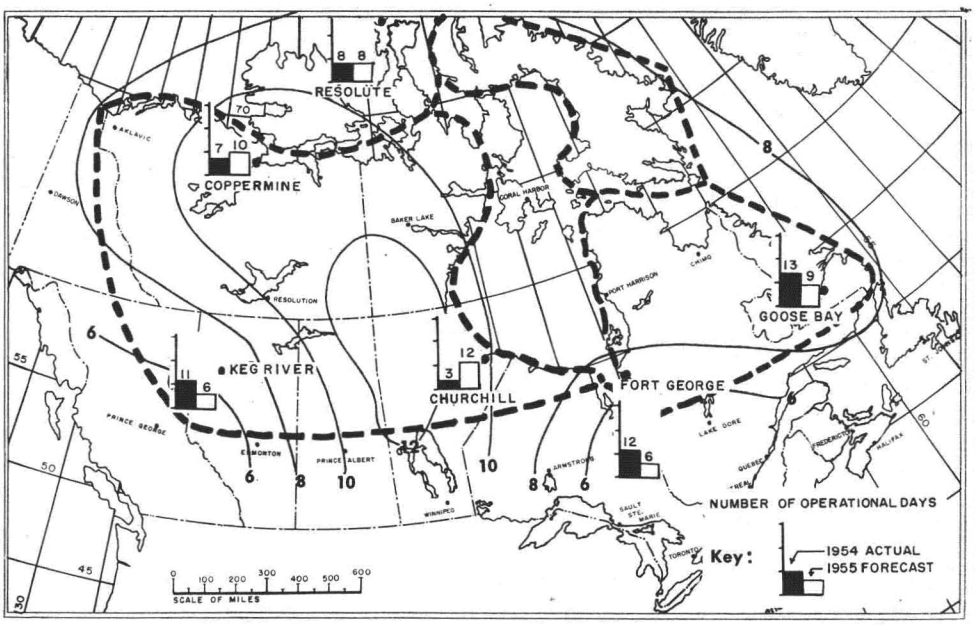
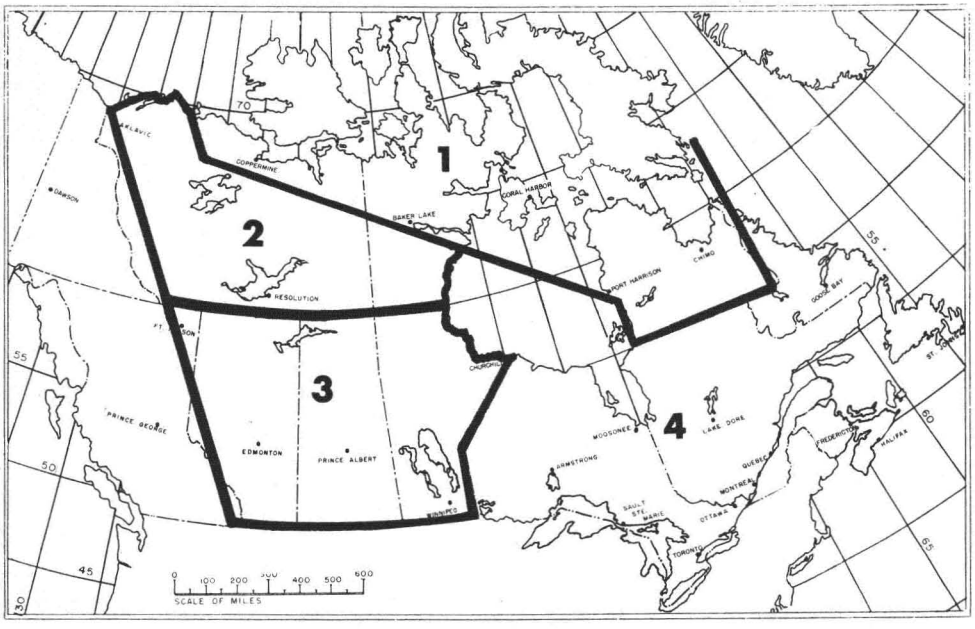


FIG. 2.



OPERATIONAL DAYS JUNE 1955

FIG. 3.



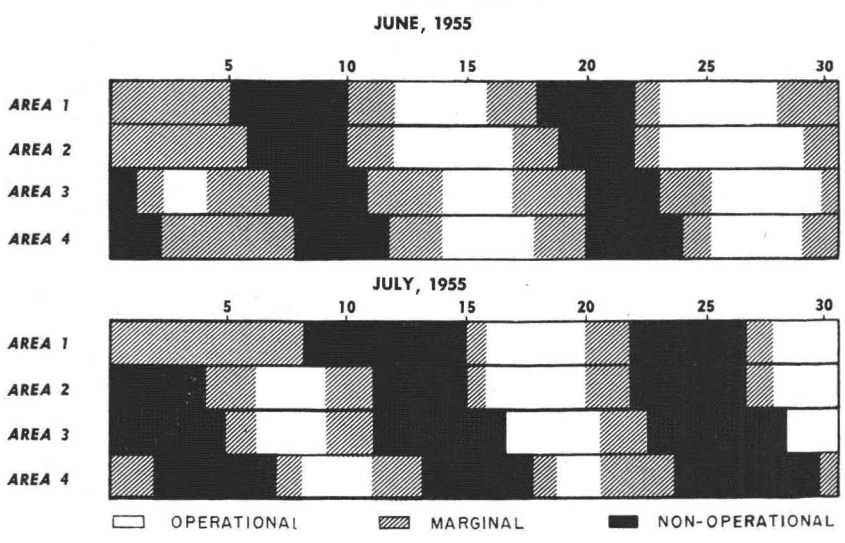


FIG. 4.

graphic areas move roughly from west to east, across the United States, with this particular Type *F*, until they finally travel out of range of the targets *A*, *B*, *C*, *D*, *E*, *F*, to the east.

It is quite evident that, armed with weather information of this kind, crews operating from a central dispatch point can do their job with a minimum waste of time, and a high degree of certainty that the conditions forecast will be experienced when they arrive on their target. Of the six targets, *D* is the only one denied favorable photographic weather during the life span of the weather type used for this illustration.

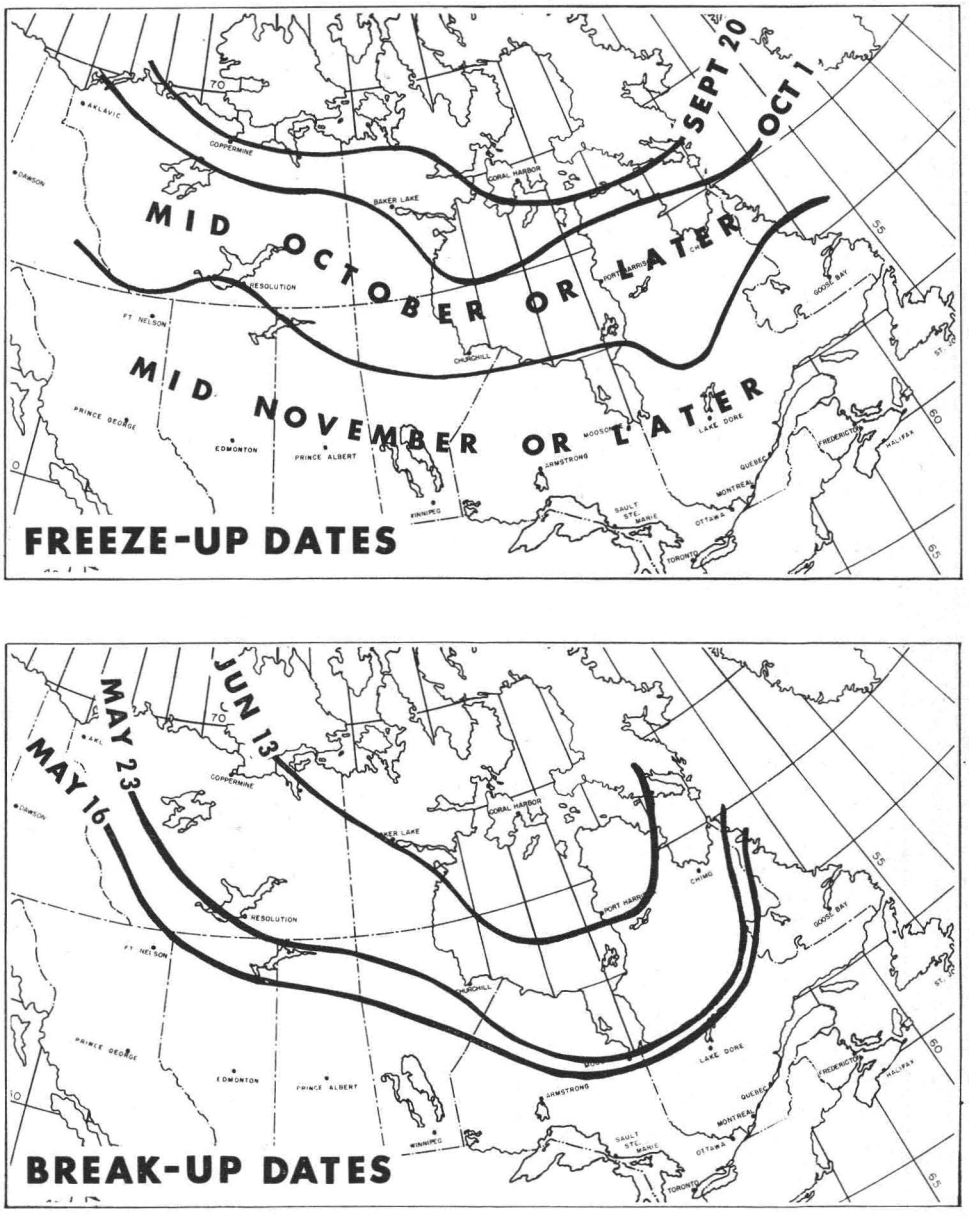


FIG. 5.

CONCLUSION

Since each weather type has a code of behavior that is known and charted, and since the area of best photographic conditions for each weather pattern is also defined, the recommendation is made that operations be set up in such a way that they be conducted in-phase-with and not in-spite-of the weather. By having a photographic operational base in close contact with the consultant weather engineer, crews can be alerted and dispatched to a particular target in time to reach it at about the time that optimum photographic conditions occur.

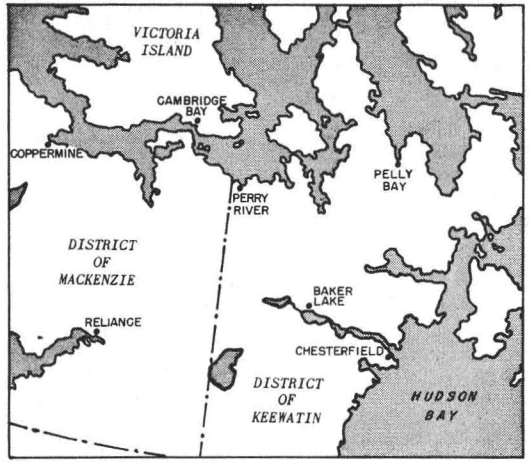
It must be stressed again that techniques developed to facilitate this type of operation are capable of unlimited flexibility.

Weather Estimates JULY, 1955

prepared for SPARTAN AIR SERVICE, Ltd.

by
WEATHER ENGINEERING CORPORATION OF CANADA, LTD.

	Mackenzie Area	Keewatin Area
PRECIPITATION	1 1/4 - 1 3/4"	3/4 - 1 1/4"
PERCENT OF NORMAL	100%	80%
AVERAGE TEMPERATURE	60°	56°
DEPARTURE FROM NORMAL	1	1



TIMING

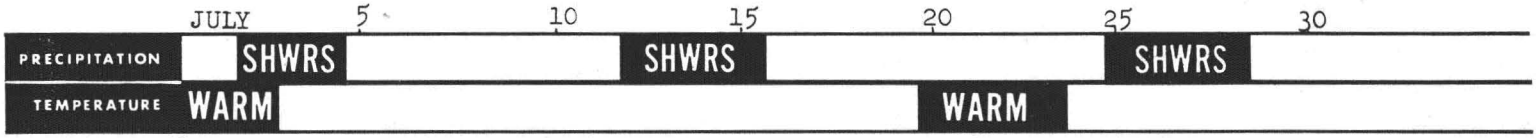


FIG. 6.—Weather estimates—July 1955. Temperatures still are expected to average slightly on the warm side this July with warmest conditions expected after mid-month. Total number of ideal photographic days will be around 8 days; marginal around 6 days. Along the coastal areas, fog and stratus will still be a problem.