THE COMPARISON OF PERIODIC AERIAL PHOTOGRAPHS IN AIR PHOTO ANALYSIS AND LAND USE PLANNING

by
L. C. Munn
Air Photo Analysis & Engineering Geology Division, P.F.R.A., Regina, Sask.

INTRODUCTION:

Air photos have long been used for map making and photogrammetric purposes. On the other hand, air photo analysis and interpretation are relatively recent developments in the use of air photos. In planning land use from air photos, it is necessary for the viewer to have an understanding of the analysis and interpretation techniques.

These techniques involve the study and recognition of air photo patterns that tell the observer something regarding the cultural or natural landscape. Climatic variations, whether they be the results of a particular geographic location or a cyclic phenomenon, result in changing air photo patterns.

Western Canada has experienced extreme climatic variations, particularly in respect to annual precipitation, and these changes are readily seen by comparing air photos taken in dry years with those taken in wet years. In some instances the conditions governing land use actually change with changes in annual precipitation. In other instances, only the air photo pattern changes and not the true significance of the characteristic.

Various parts of Western Canada have been photographed several times in the last thirty to forty years. As a result, many changes in the natural and cultural landscape are recorded.

This paper attempts to illustrate some of the changes that occur in air photo patterns and particularly those that are related to characteristics governing land use in Western Canada.

AIR PHOTO ANALYSIS AND INTERPRETATION:

Only a brief mention of the air photo analysis and interpretation techniques can be made in this paper. There is a difference in the two terms. Analysis refers to the examination of air photo patterns to determine something about the natural or cultural landscape. Air photo interpretation refers to relating the results of air photo analysis to a particular problem. In this case, the results of air photo analysis are being interpreted in the light of agricultural land use.

The pattern is composed of several elements, each of which must be examined individualy. The elements that made up the air photo patterns include photo tone, topography, erosion, land use, vegetation and drainage. Analyzing and weighing the significance of each element tells the observer something about the landscape. However, many elements change with climatic changes. Therefore, an element that might be important in identifying an outwash plain under one set of climatic conditions may not be as important under different climatic conditions.

The comparison method then becomes valuable in air photo analysis and interpretation as some air photo patterns are more readily identified under one set of climatic conditions than another. Although the experienced air photo analyst is able to recognize the air photo patterns under all conditions, nevertheless, the job can be made easy or difficult depending upon the climatic setting.

AIR PHOTOS IN LAND USE SURVEYS AND PLANNING:

Air Photos have been used in both Canada and the United States in land use planning and land use inventories. Potential land use maps have been prepared for Ceylon and Pakistan using air photo interpretation.

In planning land use, many land characteristics must be considered. These characteristics must be recognized in the air photos and properly evaluated by the air photo interpreter. Conservationists and agrologists require a good deal of information to make proper recommendations concerning land use, management and conservation. Some of the information desired is as follows:

(a) Topography or slope of the land.

(b) Soil texture.

(c) Drainage characteristics, internal and external.

(d) Erosion, amount and type (wind or water).

(e) Location of rocks or gravel that may interfere with farm operations.

(f) Concentrations of toxic salts.

(g) Location and amount of ponded water.

(h) Location of suitable sites for dams, dugouts and wells.

(i) Presence of springs and their dependability.

(j) Location of suitable construction materials.

(k) Amount and type of native vegetation.

Fortunately, this information is recorded in the air photos and available to the air photo interpreter.

THE AIR PHOTO COMPARISON METHOD IN WESTERN CANADA:

Since land use characteristics vary with climatic changes, the semi-arid climate of Western Canada and its variable annual precipitation is especially adapted to the comparison of air photos. Precipitation is very low compared to Eastern Canada, averaging somewhere between ten and twenty inches. Wide variations in amounts of precipitation occur from year to year, and lows and highs of approximately seven and twenty-five inches respectively have been recorded.

For the comparison method to be used, an area must be photographed at least twice. Fortunately Western Canada has been photographed many times since the nineteen-twenties. A fairly good record is available showing changes in the natural and cultural landscape. Many changes have been observed when comparing photographs of 1928, 1938, 1948, 1955 and 1958 vintage. Some of these air photos represent dry years, particularly those of the nineteen-thirties, and others represent wet years.

CHARACTERISTICS GOVERNING LAND USE THAT CHANGE WITH ANNUAL VARIATION IN PRECIPITATION:

1. Surface Drainage:

Information regarding the hydrology of an area is necessary in planning agricultural land use. Information such as drainage areas, amount and location of standing water, and reliability of sloughs is of value in planning dams, dugouts, small irrigation schemes, reclamation schemes, stock-water supplies and management zones. Often a particular drainage area is generally thought of as being fairly constant. To understand how drainage areas vary from year to year, a brief description of the drainage characteristics of the glaciated prairies is necessary.

Following the last glacial epoch, Western Canada was left with a variable depth of glacial drift. The landscape is characterized by many shallow depressions or sloughs resulting from the irregular placement of the glacial materials. In general, drainage is in a very young stage of development and many of the depressions or sloughs are undrained except at very high water stages. These sloughs or pot-holes are filled by spring snow melt and precipitation. Under normal precipitation some sloughs are connected to definite drainage channels only in the spring; others are connected only by above-normal precipitation. During the summer the ponded water enters the ground water table or is lost to evaporation. In years of above-normal precipitation the water level of each slough is higher, and many more become connected and the drainage basin will then be expanded. This changing drainage area results in difficulties in estimating runoff when planning dams for stock-watering or domestic water supplies, small irrigation schemes and general management.

Analyzing and comparing aerial photographs of wet and dry years gives the viewer a better picture of this drainage characteristic and helps in planning land use. The difference in drainage area is readily seen in Figure 1. The relative merits of each slough and drainage course can be better assessed when viewed under both wet and dry conditions. Plans can be made to meet the requirements of dry years.

2. Ponded Areas:

Ponded areas or sloughs are looked upon with mixed affections by agricultural workers. In good grain producing areas, especially in years of normal or above-normal precipitation, they are frowned upon and very often drained to increase the cultivated acreage. Some farmers look upon them as a blessing helping to maintain groundwater levels, and in

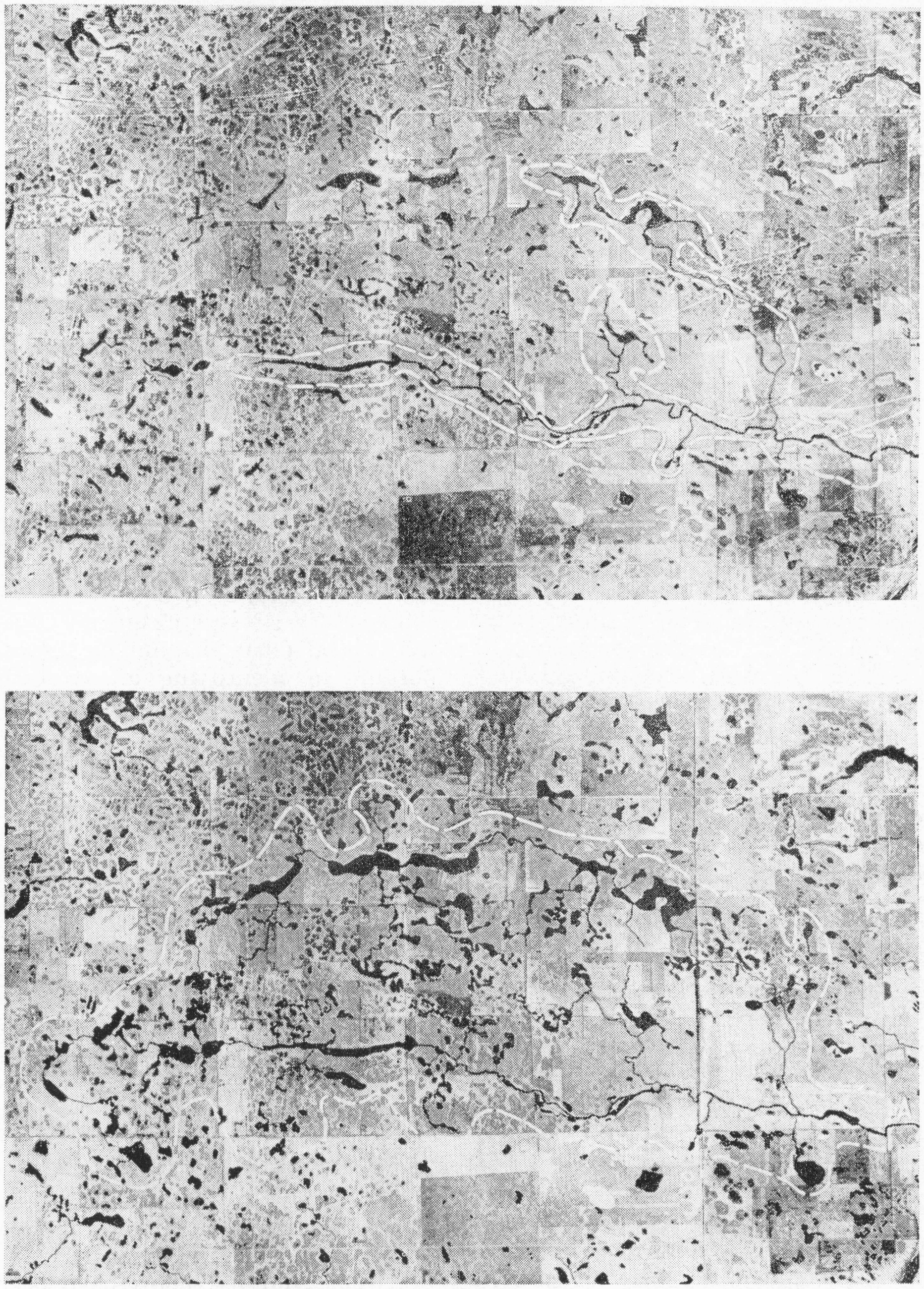

Figure 1. The upper mosaic shows a typical drainage basin in a dry year while the lower mosaic indicates the drainage basin in a wet year.

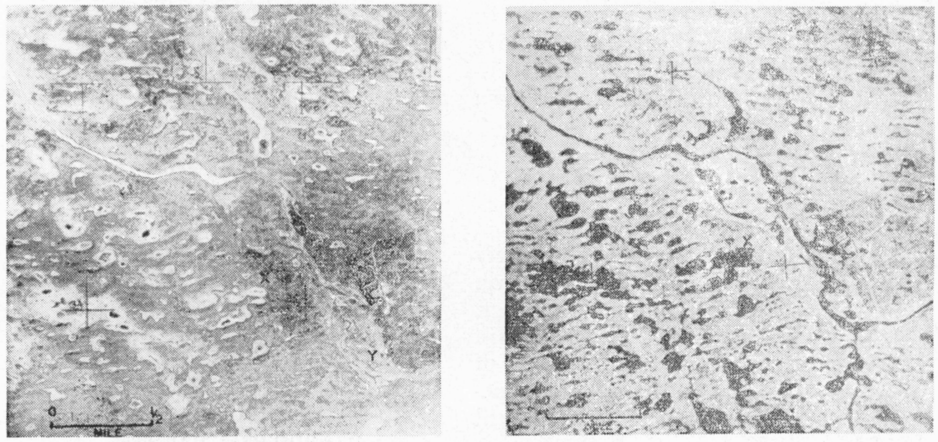

Figure 2. The photo on the left shows the air photo pattern of an area in a dry year, while the photo on the right was taken in a wet year. In the left photo most of the sloughs are dry. In the photo on the right all are filled with water. The same locations in each photograph are shown at X and Y.

periods of drought their best producing areas.

In ranching circles sloughs are possible stock-watering facilities, and in drier years they are a source of hay. Sometimes they are drained to produce hay in the wet years, then in dry years they are of little value.

Figure 2 indicates the difference that occurs, from year to year, in the amount of ponded water.

3. Springs:

The fact that springs are recognizable in air photos gives the comparison method further value by allowing the conservationist to see the spring under both drought and moist conditions. Some springs are seasonal, while others are more reliable and flow at all times. The reliability of a spring in dry years is important in planning management and land use.

4. Sulphate Concentrations:

The acumulation of salt is favored by semi-arid climates, where evaporation exceeds precipitation. Alkali salts are recognizable in aerial photographs as white flecks or sometimes as large white blotches. Mollard, (3) in 1954, recognized varying degrees of alkali concentrations in air photos.

In dry years when precipitation is low, evaporation results in salt accumulations at the surface of the soil; while in wet years better moisture conditions result in the salts being taken further down in the soil profile. Salt concentration has a bearing on the type of crop and variety and on the life of concrete structures that may complement a land use program. An illustration showing the variations in salt accumulations in different years is shown in Figure 3.

5. Erosion:

An erosible soil is always susceptible to erosion; and this characteristic does not change. However, the air photo pattern and the degree of erosion does change. The changes are mainly brought about by changes in natural vegetation resulting from variations in annual precipitation.

Figure 4 shows the changes that can occur in the degree of wind erosion as a result of climatic variations. Severe erosion is evident by the large white areas of actively blowing sand in 1938. In 1958 the area is hardly recognizable.

CHANGES IN LAND USE AND CONSERVATION PRACTICES:

The use of air photos in land use surveys and inventories is not new. Recently, Dill (1), used the comparison method to determine changes in agricultural land use in the United States.

In Western Canada, the dry years resulted in conservation practices aimed at conserving all available moisture and preventing wind erosion. However, with adequate moisture many of the conservation methods employed were soon abandoned. For example, areas susceptible to wind erosion, that were strip-farmed in dry years, are now farmed in larger blocks. In some instances areas that had been left in native range to prevent erosion have been broken and cultivated.

Changes in forest cover due to management practices are readily evident from a comparison of periodic air photos. The comparison method permits forest inventories to be made at frequent intervals if necessary.

CONCLUSION:

Climatic changes bring about many variations in air photo patterns. Changes in characteristics governing land use also result. To help in air photo analysis and in land use planning, the comparison of periodic air photos is a useful technique for the agricultural worker. The comparison method gives the conservationist a view of the soil and water characteristics under various climatic conditions. Thus he is able to make better recommendations regarding land use, conservation practices and management.

The comparison method also permits surveys showing changes in land use and changes in the natural landscape resulting from land use.

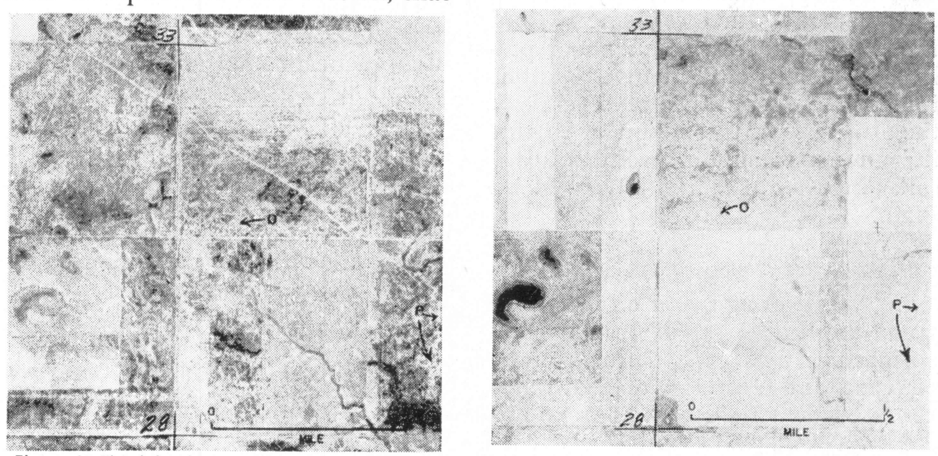

Figure 3. The left photograph was taken in a dry period and the right in a wet year. Salt concentrations are readily observed in A at O and P (white specks), in dry year, but not so readily in the wet year.

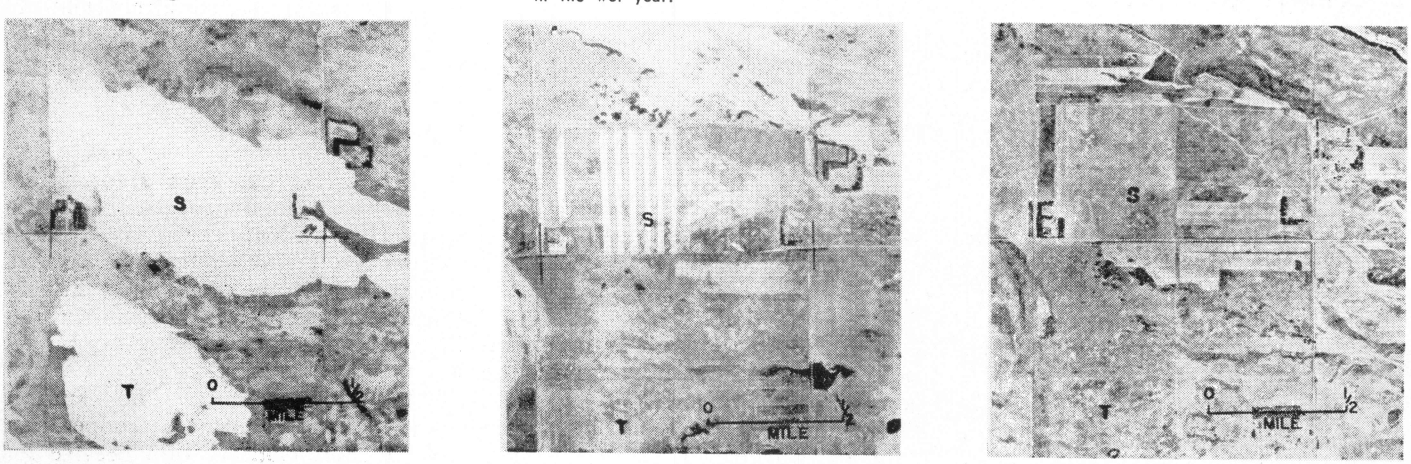

Figure 4. Vertical air photos of the same area taken in 1938, 1949 and 1958, from left to right. The actively moving sand areas are indicated at S and T in each air photo. Note the moving sand in 1938, and the attempt at strip-farming in 1949. The droughty characteristic and erosion hazard is much more evident in the 1938 photograph than in 1958.

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niques have been developed to photograph high frequency strain signals with an oscilloscope camera operating on the Polaroid Land principle.

Selection of strain gage amplifying and recording equipment require the consideration of the following factors:

1.—The type of strain to be measured (static or dynamic) and therefore the frequency response required. For the potentiometer type the full scale balancing time is important; the shorter the better.

2.—The sensitivity of the instrument in mv. per chart line and the measurement range.

3.—The number of chart speeds available and the type of marking whether ink or inkless.

4.—Single or multiple channel.

5—Input and output impedance so that components may be electrically compatible.

6.—The availability of the equipment and its cost.

Most of these factors are included in the instruments specifications.

SUMMARY

Transducer applications of the SR-4 bonded electrical resistance strain gage have become an important tool in machinery design and testing. The Wheatstone bridge is the basic circuit used for static and dynamic strain measurement. An analysis is made of the unbalanced Wheatstone bridge circuit as applied to an SR-4 strain gage drawbar dynamometer. Instrumentation for dynamic measurement is discussed briefly.

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