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Placement of Surface Lows Using Satellite Imagery I

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FOREWORD

This project was initiated while working on project in the ODIT unit at the Pacific Weather Center.

INTRODUCTION

Often the analyst at the Pacific Weather Center has no ship reports in the vicinity of a fairly well developed low pressure system. Mostly, he will simply extrapolate the past motion of the low pressure center. In this event, his analysis is actually a forecast. Then he is faced with the unenviable task of forecasting the future motion of a low pressure center from a position that is already uncertain.

An important source of qualitative information is the satellite imagery currently received at the Pacific Weather Center. An attempt will be made to develop guidelines (if possible) for the analyst to use for placing centers and determining the shape of the ambient surface isobaric patterns when his main source of information is the satellite imagery.

EXAMPLE

Figure 1 shows a representative satellite picture series showing a closed circulation in the cloud formations about coordinates 48N 147W at time of picture b. Drawing streamlines about the lines of low clouds, the analyst can determine (approximately) the inflow point of the vortex at the cloud top level. The visual picture(a) shows the vortex in the eastern Pacific. The visual picture (b) has the inferred streamlines coinciding with lines of low clouds. Picture (c) is an infrared. These are not as useful for the stated purpose because of the enhancement of the high cloud and the smoothing of the low cloud. Unfortunately for the receipents of these notes, the zeroxed copies of the pictures have predictablely less quality than the originals.(Let us hope that the next era of national prosperity will bring with it the recognized need for better copying devices for these satellite pictures)

GENERAL CATEGORIES OF VORTICES

Category A Stationary Vertical Vortices.

In this case, the streamline inflow point at the cloud top level will coincide with the coordinates of the pressure low at the surface. Understandably, the images of these vortices are the easiest to use for analysis purposes.

Category B Slowly Moving Slightly Tilted Vortices

If the cloud lines used as tracers are low level convective cumulus or stratocumulus clouds (as is often the case), the position of the surface pressure low will approximate the coordinates of the inflow point at cloud top levels.

Category C Moving Tilted Vortices

1 With these type of vortices, the inflow point at cloud top levels may deviate appreciable from the surface isobaric low center. The reasons for this effect are discussed below.

2 Suppose a surface low is originally stationary. The streamlines at the surface will have a cross isobaric component (frictionally induced) but the inflow point (where V=0) and the lowest pressure will be coincident.

3 Now if the same low begins to move eastward at a constant speed C, then the wind at any point would have an additional westerly component C.

4 If C is not too large, then there will be a point at right angles and on the left hand side to direction of motion where the wind will equal zero. At the same time the wind at the center of the low pressure will now be equal to C in an easterly direction. Thus the new inflow point has moved to the north. The distance separating the new inflow point from the surface isobaric low center will be a function of system speed and the system intensity.

5 If C is large enough, there may be no circulation center evident in the streamlines although a closed isobaric center can exist.

6 When we use the satellite imagery, the situation is even more complicated. What we can sense is the inflow point at cloud top level and what we would like to deduce is the isobaric low center at the surface. The horizontal distance between the two will now also be a function of the tilt of the system.

7 As mentioned in 5, an isobaric center may exist at the surface, however when the system speeds are great no closed circulation will exist. Therefore satellite imagery cannot show a closed circulation in the cloud formations.

PURPOSE OF THIS STUDY

1 The above outlines some of the problems with using satellite imagery for placing surface isobaric lows.

2 It is hoped that this study will result in reasonable and useful guidelines for the analyst to decide
   (a) if and when satellite imagery may help with the positioning of the category C type vortices.
   (b) if satellite imagery may help decide the shape of the pressure system.

3 A note on the results of this study will be issued after completion (sometime before summer 1979).

4 Any suggestions about how to approach the above task will be appreciated.

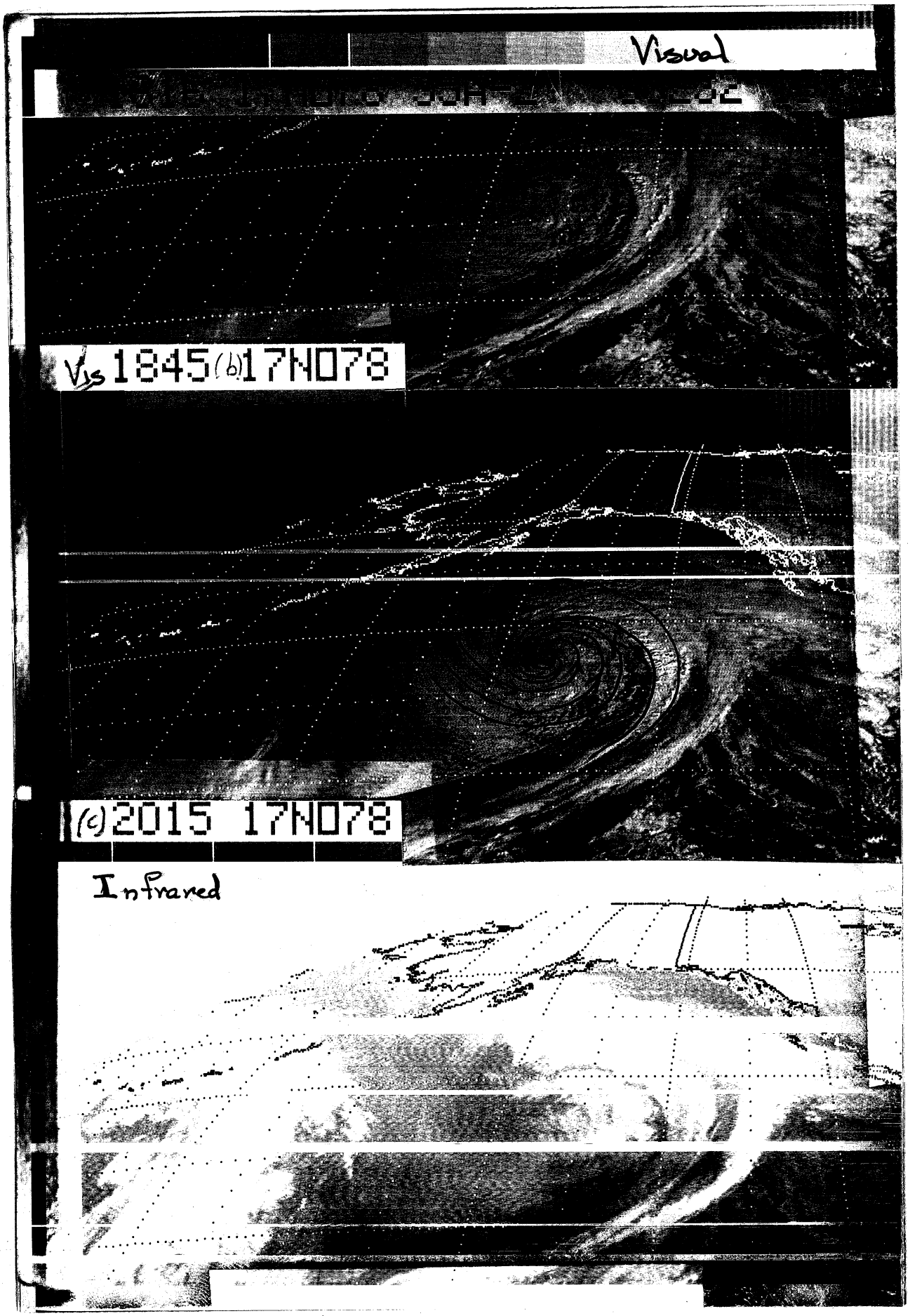

Figure 1.