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A MIDPACIFIC SQUALL LINE

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Introduction

Narrow bands of cloud consisting of a line of convective cells are often observed in satellite imagery over the Pacific ocean. These cloud lines are normally associated with well marked cold fronts moving eastwards across the open ocean and have been labeled " Rope Clouds ". Previous studies have concluded that Rope Clouds are aligned parallel to the surface winds with strong horizontal wind shear across the line indicating that cyclonic vorticity plays an important part in their formation and propagation. Low level inflow, (confluence), is observed in the formation of these clouds which have been observed to be orographically produced, (Cochran and Thomas, 1969), as well as being associated with active cold fronts. After two years of observation, (SHaughnessy and Wann, 1973), it was concluded that " Frontal Ropes " are convective rainshowers with cloud tops of 12 to 15 thousand feet, and that, " cumulonimbus activity is rarely, if ever, associated with a Frontal Rope in the central Pacific ". They argue further that if significant cumulonimbus activity were present, the cirrus shield would completely obscure the line on the satellite image.

This type of cumulonimbus activity is observed over the continental U.S.A. ahead of active cold fronts and the cloud line is generally refered to as a " Squall Line ". They occur less frequently as non-frontal " Dry Line Convection ", (J.A. Miller, 1976), but in both cases they are observed to be cumulonimbus clouds with frequently associated tornados. As with Rope Clouds, low level convergence, dynamically or orographically induced, is found to be a major factor in their generation.

In December of 1978, an extensive and intense line of clouds, similiar to those observed by the author in the American mid-west, formed in the central Pacific and then dissipated rapidly into a line of much smaller convective cells.

The Case

On December 7, 1978, during a period of rapid transition from a meridional circulation pattern to a strong zonal flow across the Pacific, a pre-frontal cloud line formed, intensified rapidly, and then dissipated in the matter of only a few hours. Since this dramatic change in the general circulation is the subject of another Technical Note, only the cloud line will be discussed here.

Before proceeding further, it must be pointed out that the identification of this phenomenon as a line of cumulonimbus clouds is based solely on the interpretation of satellite imagery comprised of the limited selection of images received at the Pacific Weather Centre. During its short life there were a limited number of images received and no surface observations which could be used to substantiate this interpretation of the cloud line as a Squall Line.

The area of generation of this cloud line was located between two frontal systems as shown in figure 1. This IR (infrared) image at 1515Z December 7th shows an area of cirrus (labeled A) between the two fronts indicated. From this image and the Enhanced IR image, figure 2, (both 2 mile resolution), it is impossible to determine whether or not this cirrus is associated with deep convective activity. During the next 8 hours no images of this area of interest were received at the PWC.

When this area of the Pacific was observed again at 2345Z, figure 3, the line of clouds extended over 10 degrees of latitude and had a definite convective appearance with apparent cirrus anvils streaming eastwards from the brightest cells. Figures 4 and 5, IR and Enhanced IR images, show these cloud tops to be as cold as the jet stream cirrus clouds of the two frontal systems with temperatures of -50 C to -60 C. These images show warmer (lower) clouds at this time to the south of 35 deg. N . This indicates that the system was already dissipating and figure 6, (0215Z), shows a marked decrease in the extent of the coldest cloud tops. An hour later, figure 7, most of the cloud line is a much lower cloud form and the line appears to be connected to the leading frontal system. The appearance is not that of the classical Frontal Rope cloud. The dissipation continued and by 0945Z, figure 8, only fragments of cirrus remained.

With the images showing a steady decrease in intensity after 2345z, it is highly probable that the most intense stage of development was completely missed during the period that no images of the area of interest were received at the PWC. The presence of an interactive satellite receiving station at the PWC would enable meteorologists to examine such phenomenon in detail making their interpretation scientifically plausable in the absence of surface observations.

Conclusion

Even without surface observations as evidence of its true nature, it is obvious from satellite imagery that an extensive Squall Line did exist in the central Pacific for a few hours on December 7, 1978. It's appearance during dissipation and the linking of this cloud line with the cloud system of the leading frontal system indicate that the commonly observed Rope Clouds originate in some cases in the cold air behind a frontal system. They may be the transversly sheared remnants of frequently observed Comma Clouds which often overtake and merge with slower moving frontal systems. This may indeed be the exception rather than the rule with the final explanation of this and other occurances being made as much more extensive investigations become technically feasible.

Figure 1

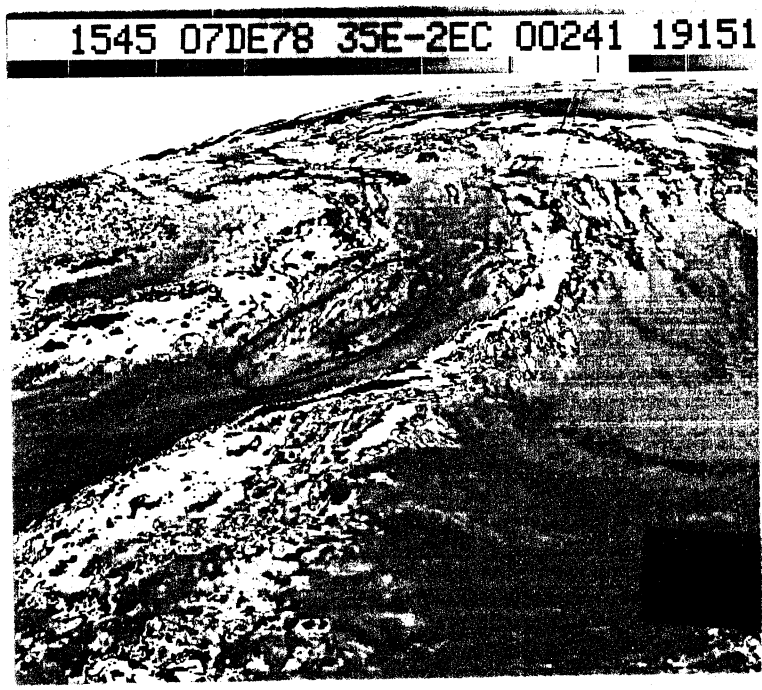

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

BIBLIOGRAPHY

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