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OC 3570

Clearing of 19 July (0800Z to 1000Z) and Catalina Eddy Development

1. Introduction

The first night of the Summer 2002, OC 3570 Oceanography Cruise, Leg 2, the R/V Pt Sur sailed into a clear region during its transit through the waters dividing mainland California and the Channel Islands (Fig 1). This clearing was of interest because it lasted only a few hours, from 0800Z to 1000Z 19 July 2002 (0000 to 0200 18 July local time). This period stood out since most all other time periods of the cruise had marine stratus. The clearing was also seen on the satellite image, received the next morning, as an eddy (Fig 2). Upon further investigation into this event, an eddy did not yet exist during this period.

2. Purpose

The purpose of this project was to examine data collected during the time period of observed clearing to determine if the clearing we observed had any connection to the clear eddy seen on the satellite picture the next morning.

3. Data

In researching this event, the SAIL data from the R/V Pt Sur, fog images, quick observations, surface wind analyses and profiler images were used. Plots were generated using the ship's SAIL data in Matlab for the period of 0400-1200Z 19 July.[1] The ship collected no vertical data during that time, i.e. no rawinsonde data available, so the Goleta, CA profiler (located at the Santa Barbara Airport) was used to obtain this information.

4. Dynamics

Eddies are characterized by a cyclonic circulation pattern in the marine stratus. Summer time eddies are related to the response of the flow to coastal topography. The initiating mechanism for development of the Catalina Eddy, which develops in this region, appears to be related to the coastal mountains near Santa Barbara.

It has been seen through previous studies that the winds along the Southern California coast are important to defining an eddy versus non-eddy day. When the winds in San Diego are from the south, an eddy seems to be present, in contrast, eddies are not present when the breeze is from the west (Nuss, 65).

The subtropical high is also believed to play a role in the formation of an eddy. The 850-millibar (mb) high tends to amplify and move closer to the coast during active eddy periods.

There needs to be Northerlies, around the 850mb level, across the mountains during the early stages of development. This establishes the lee

[1] First light was at 1245Z.

troughing needed to reverse the along-shore pressure gradients forcing southerly winds. These along-shore southerlies and offshore northerlies generate the eddy (Nuss, 65).

5.Analysis

The long wave radiation plots, from the R/V Pt Sur SAIL data, and quick observation log were compared to determine the exact time that the ship experienced clear skies. There was a two-hour difference between the two methods. As seen in figure 3, the long wave radiation data shows a decrease at 0700Z with an increase again at about 0915Z, reaching its initial level again at 1000Z. There is a small spike around 0800Z, which is thought to be a bad data point because the satellite imagery for that time does not show the ship in marine stratus. The quick observation log shows the clearing beginning at 0800Z, which agrees with the long wave radiation data. The log shows that it was clear until 1200Z and then at 1245Z, which was first light, the sky was completely obscured. The log is less reliable during this time because it was night and it is difficult to determine cloud cover when it is dark. The conclusion was drawn that the clear sky event occurred from 0800 until 1000Z.

The rest of the SAIL data was analyzed for the time period of transit through the channel (0700-1200Z). As the R/V Pt Sur exited the marine stratus (0700Z), the pressure dropped 1.5mb; the temperature and dew point temperature increased, while relative humidity decreased; and the wind speed decreased 7 m/s (Fig 4-7).

Next, the data was analyzed using the dynamics of eddy formation as a guide. Using the Goleta profiler, it was seen that the winds above 700m had a northerly component from 1600Z 18 July and continued until 0500Z 19 July (Fig 8-9). This northerly across the mountains in this region established a lee trough just off the coast. The characteristics of a lee trough were evident during our transit through the area. The pressure was slightly lower and due to subsidence in the area the air was warmer and drier (Fig 4-7).

The surface wind analysis showed the winds along the Southern California coast through out the time period. At 0700Z the winds began to have a southerly component near San Diego. This southerly continued northward along the coast, where it was sustained north of Los Angeles (Fig 10). Another important factor that the surface wind analyses showed was the strong northwest winds offshore and the southeast winds along the coast (Fig 10). This wind shear has been found necessary for Catalina eddy development. These analyses also showed a weak cyclonic circulation in the area of the developing eddy, further supporting signs of the lee though (Fig 10).

6.Conclusion

The clearing that the R/V Pt Sur experienced from 0800Z to 1000Z on 19 July was the precursor to the Catalina Eddy, which developed two hours after leaving the area. If the ship were in the waters north of the Channel Islands longer, the eddy would have been observed first hand. The data collected while transiting toward the Channel Islands was valuable in helping to determine the causes of the eddy. In this case, the eddy developed how theory suggests it should, with the predominate forcing from the influence of the mountains to the north.

7. Figures

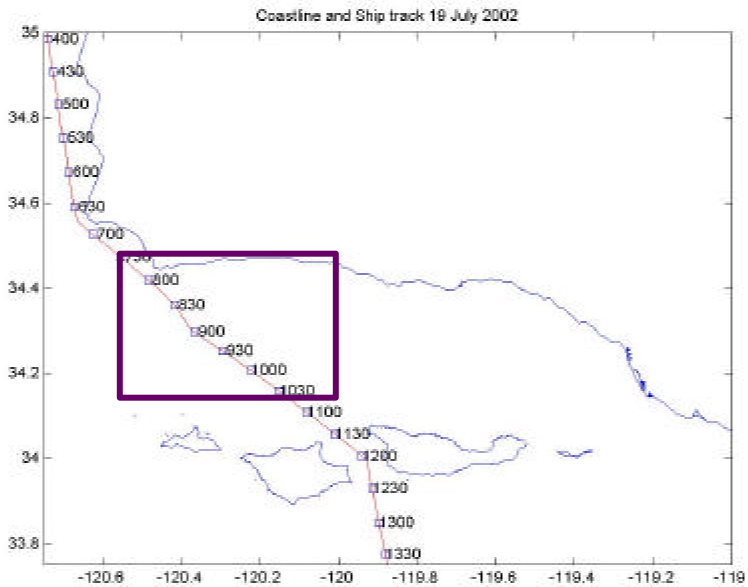

Figure 1: Coastline and Ship's track.

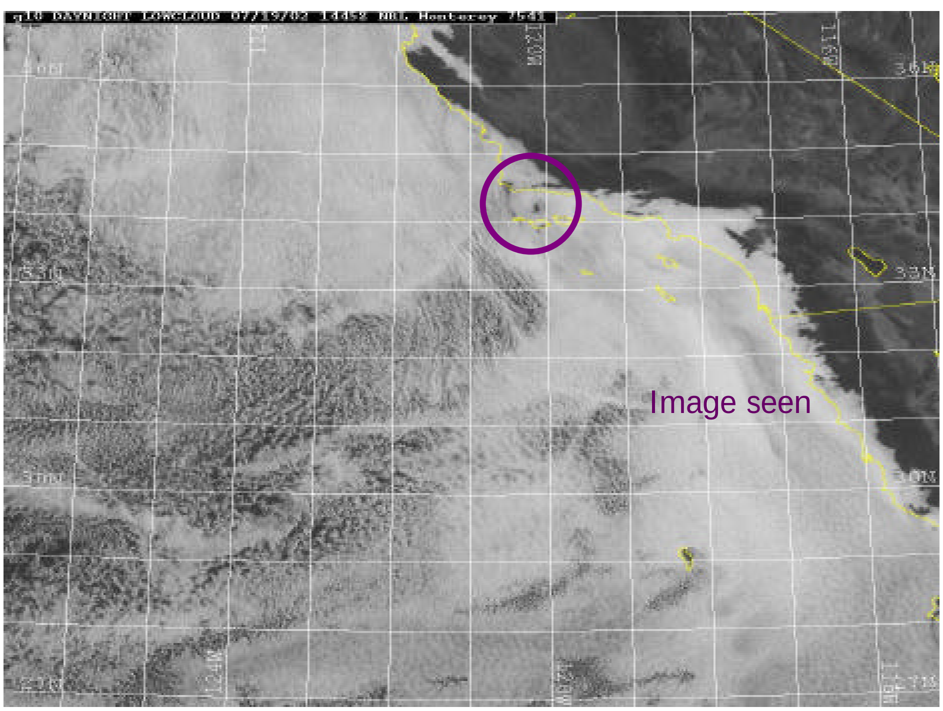

Figure 2: Eddy seen the following morning.

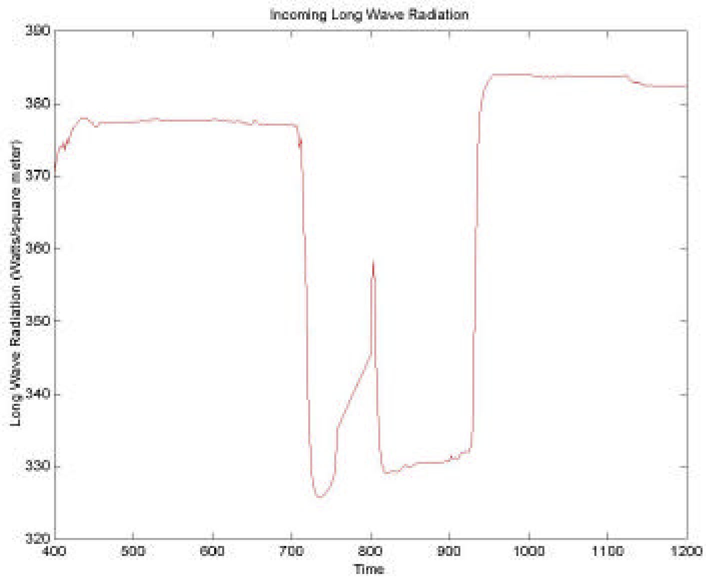

Figure 3: Incoming Long wave radiation shows clear periods.

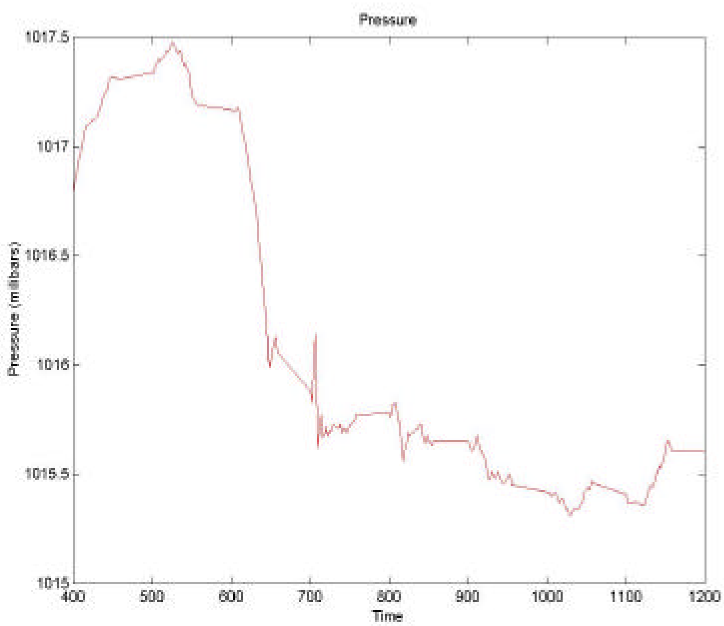

Figure 4: Note drop around 0630

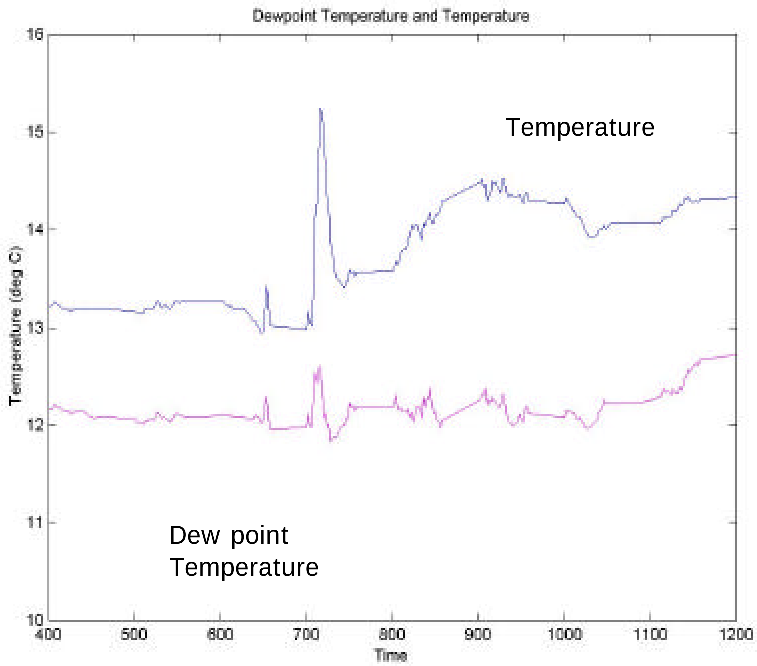

Figure 5: Note increases beginning at 0630

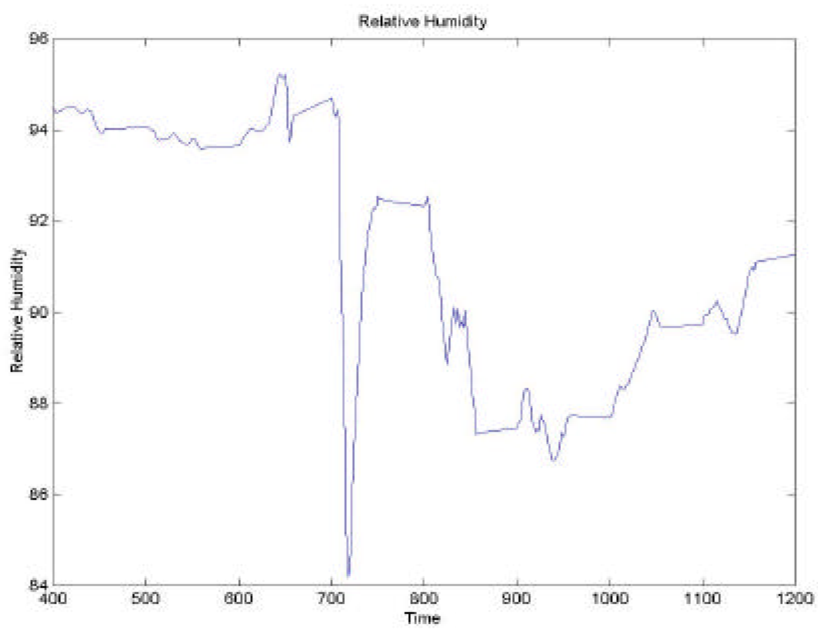

Figure 6: Note decrease around 0700

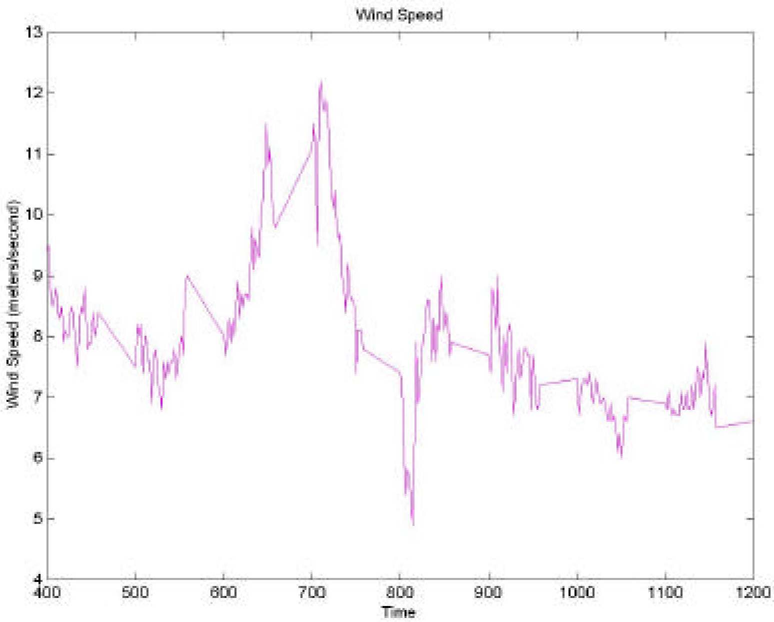

Figure 7: Note decrease around 0700

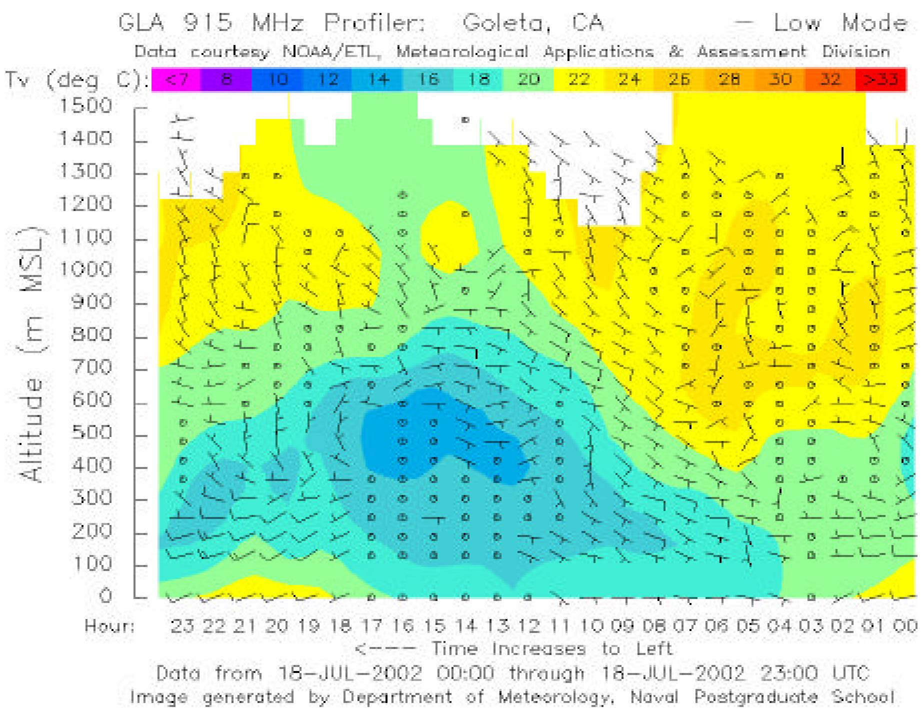

Figure 8: North breeze beginning at 1600

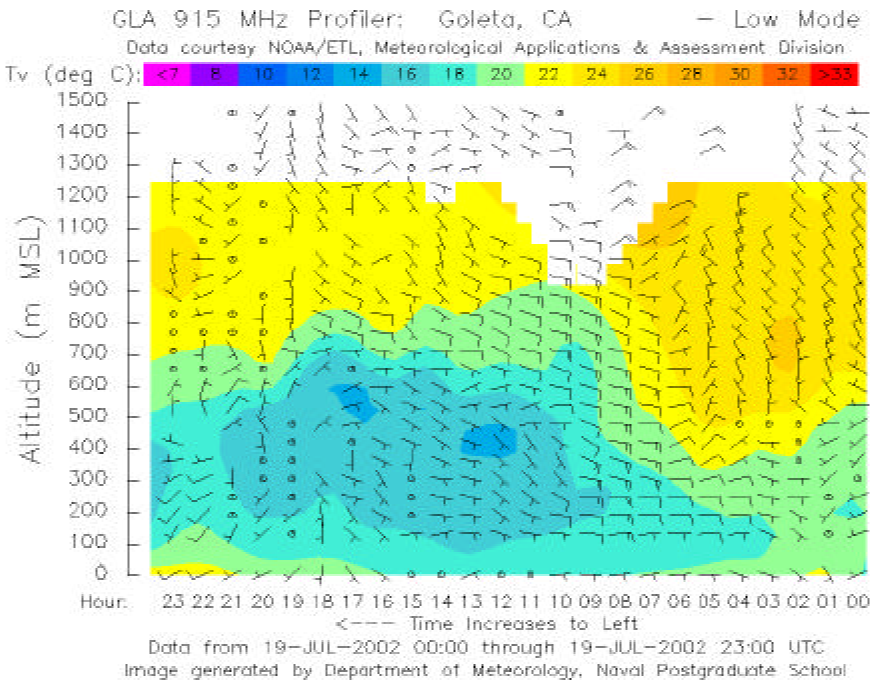

Figure 9: North breeze ends around 0500

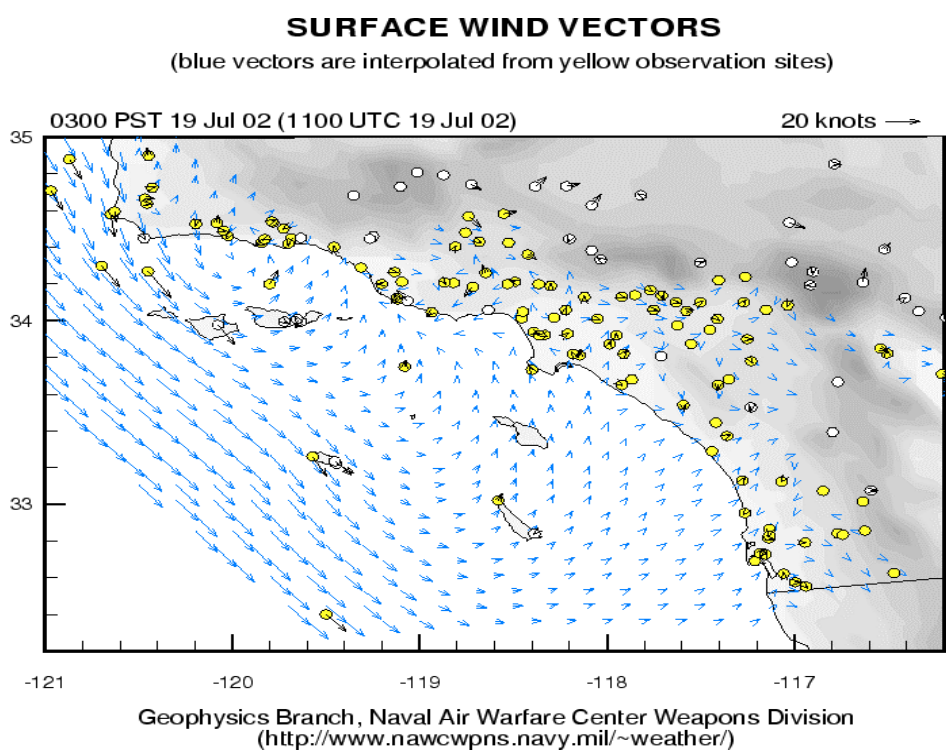

Figure 10: Strong NW offshore with S along coast and cyclonic circulation near Santa Barbara.

8. Reference

Nuss, W.A., Coastal Meteorology Class Notes for MR4240, pg. 64-66.