Spring 2018 Clouds 2

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1 Introduction

This was the second clouds visualization assignment. I took pictures of clouds on a March 17 at 7 pm. I chose to shoot at the time because I noticed that mountain wave clouds had formed a cool pattern that looked like a bird. I thought it was interesting that this cloud was composed of two orthogonal streaks. The image I turned in is shown in Figure 1.

Figure 1: Final cloud image. The cloud of interest is composed of two orthogonal streaks and resembles a bird. Other clouds are shown to compliment the bird-shaped cloud.

2 Circumstances

The picture was taken March 17 2018 at 7 pm. The camera was facing the Westward direction with approximately 20 degrees tilt from the horizontal. The cloud was quite low in the sky; I estimate its elevation was around 1,000 meters. According to the skew-T diagram from Denver airport that evening, the atmosphere was stable (Figure 2) at the time of taking the picture.

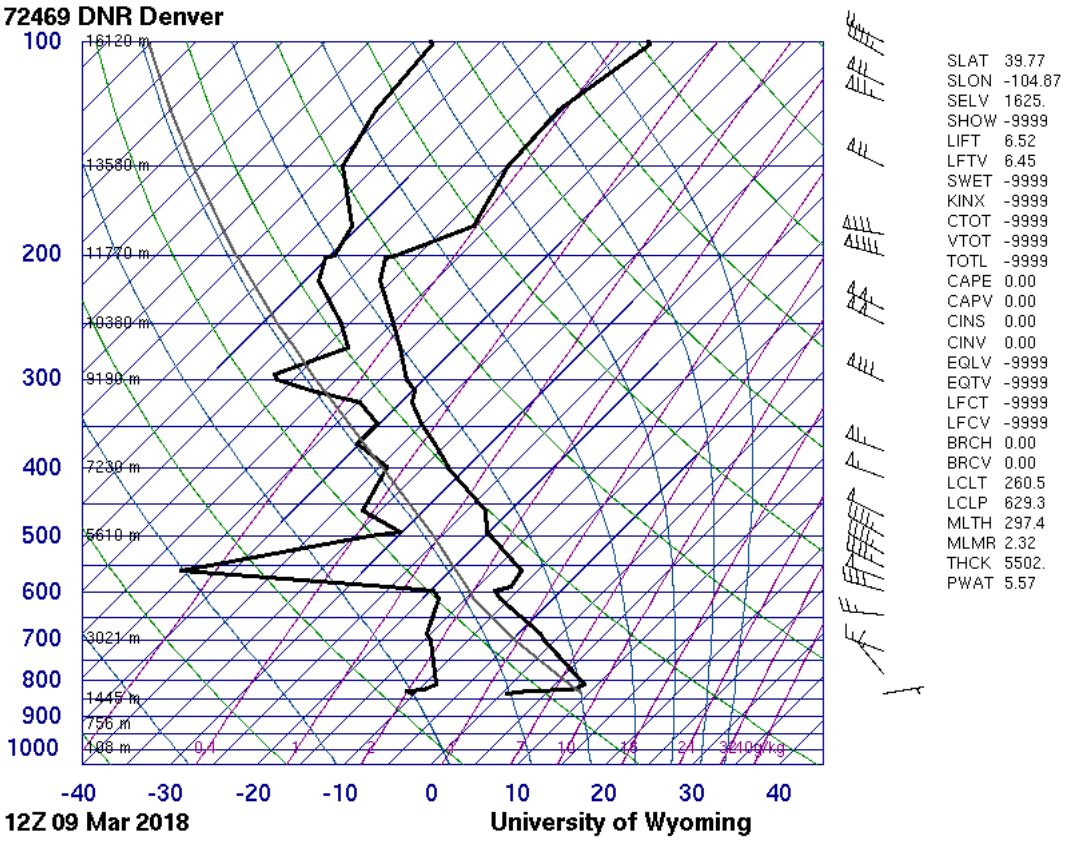

Figure 2: Skew-T diagram corresponding to the evening the picture was taken. The position of the thick black lines relative to the blue lines indicate that, for the relatively low elevation of the clouds in the picture, the atmosphere was stable at typical cloud elevations. The claim that this atmosphere was stable is further substantiated by the cape being zero. This was provided by the University of Wyoming.

3 Photographic Technique

The camera settings I used to capture the image are shown in Figure 3. At first, I used a high ISO. This resulted in grainy pictures. I used an ISO of 100 to avoid distortion from too much light absorption.

Dimensions:	3456 × 2304
Device make:	Canon
Device model:	Canon EOS DIGITAL REBEL XT
Color space:	RGB
Color profile:	sRGB IEC61966-2.1
Focal length:	39
Alpha channel:	No
Red eye:	No
F number:	5
Exposure program:	3
Exposure time:	1/1,250

Figure 3: Camera settings used to capture the image.

4 What the Image Reveals

I took the picture from Table Mesa Road facing West. I think that this cloud formation was caused by a mountain wave catching the end of the cloud (Figure 4). Researchers from the National Center for Atmospheric Research have measured mountain waves; Figures 8 and 13 in [1] and Figures 4 and 10 in [2] and are illustrative of the phenomena. Kaplan and Thompson offer stunning photos of the mountain wave phenomenom [3]. To me, this image reveals the exciting physics happening in our atmosphere. These streaks were created by a mountain wave, creating an interesting-looking streaking effect, that looks somewhat like a bird. This was a rare phenomena; I have not noticed clouds like this before or after taking the picture. This tells a rich story about the atmospheric dynamics and looks like an elegant bird.

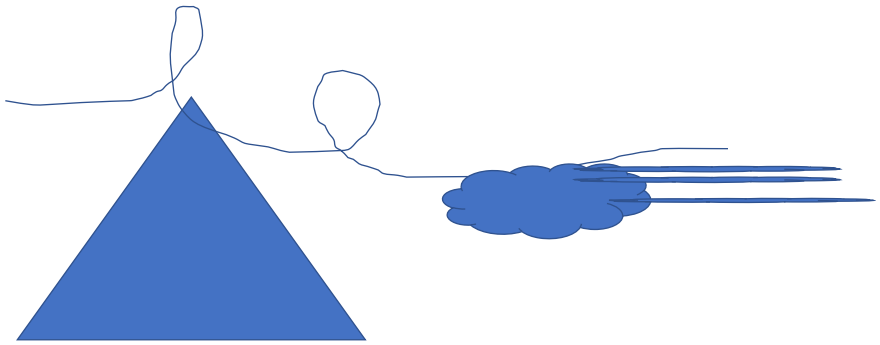

Figure 4: Artistic rendition of the physics captured. A wave of wind is excited by the westward mountains, causing oscillations to occur in the wind velocity. The downwind side of the cloud was caught by the excited wind, causing the streaked effect.

References

[1] Lukas Strauss, Stefano Serafin, Samuel Haimov, and Vanda Grubišić. Turbulence in breaking mountain waves and atmospheric rotors estimated from airborne in situ and doppler radar measurements. *Quarterly Journal of the Royal Meteorological Society. Royal Meteorological Society (Great Britain)*, 141(693):3207–3225, 10 2015.

[2] Robert A. Houze. Orographic effects on precipitating clouds. *Reviews of Geophysics*, 50(1), January 2012.

[3] Curt Kaplan and Rich Thompson. The palmdale wave: An example of mountain wave activity on the lee side of the san gabriel mountains curt kaplan and rich thompson, wfo los angeles,oxnard, ca, 2009.