11/28/2007

MCEN 4228 FLOW VISUALIZATION

CLOUDS 2

Cumulus Fractus in a Mountain Wave | Joseph M. Graham

Introduction

Over the past three years I've made the daily trip through Broomfield and Lafayette to arrive at the precipice of my favorite mountain range, The Rocky Mountains, headlined by our very own Flatirons. As I make my commute I have the opportunity to pass overlooks and open plain vistas that would make any other American jealous. Today was fortunately, another one of these days when the crisp and bitter cold afternoon was tempered by a fabulous view. Looking east from the mountains I could see the door to The Great Plains open wide and with a quiet 'click, click, click', captured this moment forever.

I'm depressed to think that I may only have 5 months left to enjoy these sights, sounds, and panoramic opportunities before I transition to my next duty station, Pensacola, Florida. I'm so thankful now that I made the decision to enroll in a course where I could capture some of my favorite views, while earning credit for the effort.

Image Background

This panoramic image was pieced together from an overlook on the US 42 near the Coal Creek Trail Head on November 28th, 2007 at approximately 1:35 p.m. After standing for a few minutes I could easily see the mountain wave that was directly over me as the wind from the west provided the common, cumulus fractus formation. The prediction for the high temperature of the day was 23 degrees Fahrenheit, and the SkewT [2] plot (Figure 1) shows that the ground temperature is just slightly over 0 degrees Celsius.

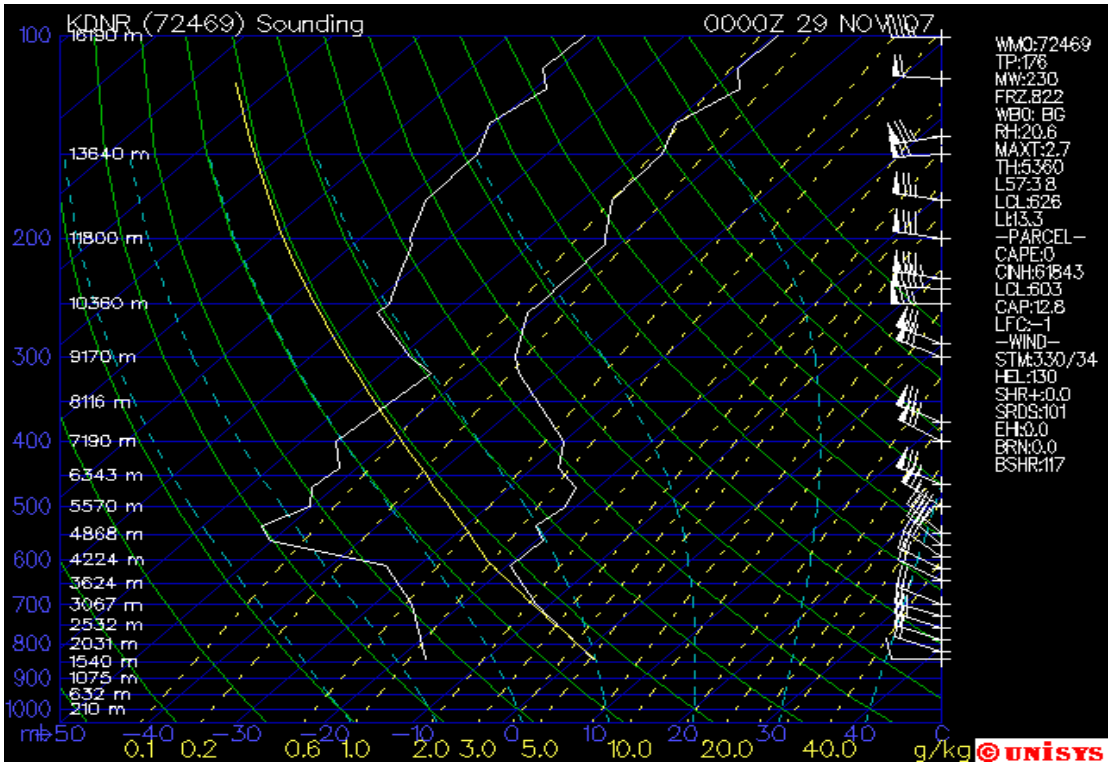

Figure 1 - SkewT 0000Z - 5:00 M.S.T.

Cloud Analysis

The formation of the mountain wave is due to high winds out of the west, usually 25 knots or greater, which, while passing over the mountains, decreases in temperature as the streamlines gain altitude. The water within the air at the higher altitudes condenses, forming clouds that would roll over the mountains. The normal formation is an arrangement of an atmosphere similar to a strong coil sandwiched between two weaker atmospheric springs, simulating a stable layer sandwiched between areas of lesser stability. Figure 2 shows a visual representation of the spring like condition of the atmosphere. As the air ascends, it cools and condenses out moisture, and after descending it regains some of its moisture and increases in temperature, at which point the cloud disappears. The warmer air now rises into the lower temperature region and again condenses, repeating this pattern for a distance from the mountain relative to the wind speed.

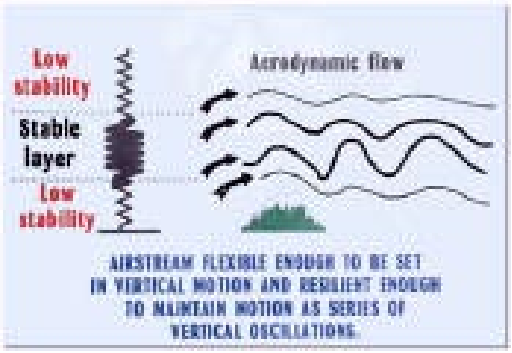

Figure 2 - Mountain Wave Spring Image

As can be seen from the SkewT plot, the winds are very strong from the west with a stable range capable of supporting this formation between 3000 m to 4000 m (3500 to 6800 ft A.G.L.).

Photographic Technique

The camera that used was a digital SLR Nikon D40. The camera was manually focused to infinity for best view of the scene. The appropriate settings used are listed below:

- Compressed RAW (12-bit)
- Image Size: Large (10307 x 2170)
- Lens: 18-55mm F/3.5-5.6 G
- Focal Length: 18mm
- Exposure Mode: Manual
- Metering Mode: Multi-Pattern
- Exposure Specs:

    - Shutter Speed - 1/2000 sec
    - Aperture - F/4.5
- Sensitivity: ISO 200
- White Balance: Auto

Since the field of view is from the extreme southern to northern sky, the distance covered is several 100s of miles. The distance from the lens to the clouds is too far to approximate, but is comparable to the range of the field of view. In order to prepare the image, 10 separate photos were automatically photo merged in Adobe Photoshop CS3. There were no other adjustments made to the RAW files, except for an un-sharpen mask that was applied after the merging.

Conclusion

Now that I am looking at my final fall and winter in Boulder I'm trying to bask in my two favorite seasons of the year. Getting out and taking pictures of the clouds and the surrounding terrain is the best way for me to capture memories, and savor my home one last time. I'm very satisfied with this image for the simple fact that it is panoramic, a Photoshop tool which I never knew how to use before others in the class showed me. Now I have another tool that I can use to make fantastic pictures of the outdoors. I've always been completely skyward intrigued, being a Pilot at heart, but using that same fascination and applying it to the beauty of cloud dynamics, gives me even more reason to keep looking up!

References

1. Mountain Waves; http://www.mountainflying.com/mountain_wave1.htm
2. Denver Skew T; http://weather.unisys.com/upper_air/skew/skew_KDNR.html