CLOUDS I

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Introduction

The image shown was created for MCEN 5151-Flow Visualization as the for the Clouds 1 assignment. The intent of the assignment was to observe clouds formations and document the unique beauty and flow visuals that they can illustrate. The formation shown is a radiation fog, a specific type of stratus cloud formation, that often forms during cool fall/winter nights and appears in the early mornings (NOAA). The following report will detail the experimental setup and photographic techniques used to capture this unique cloud formation as well as the fluid mechanics driving the effect illustrated in the image.

Fluid Physics

The image illustrates a clear example of a radiation fog, a specific type of stratus cloud formation, that occurs after a cool night when humidity is high enough and the temperature is low enough to condense local, moist air into clouds at low elevations. As the heat radiate from the ground overnight, the thermal energy leaves in the moist air nearest to the ground via conduction (Apollo Lsc). This effect continues until the sun rises and begins to heat ground and the air at the lower elevations. Thus radiation fog is the densest right before sunrise, when the ground is the coldest. This effect is often perpetuated in valleys, forming a specific type of radiation fog, known as valley fog. This is because the air in local valleys is coldest and thus seeds the formation of clouds sooner. This closely matches the fog shown in the image since the entire South Park Valley is a flat area surrounded by mountains and is saturated with cool, moist air from the surrounding bodies of water, perfect for valley fog formation.

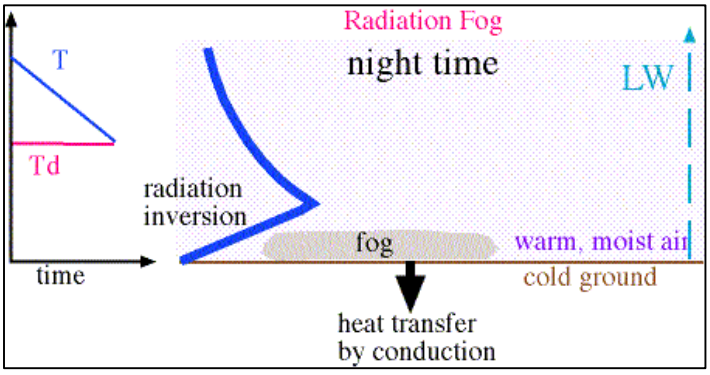

Figure 1: Formation of Radiation Fog

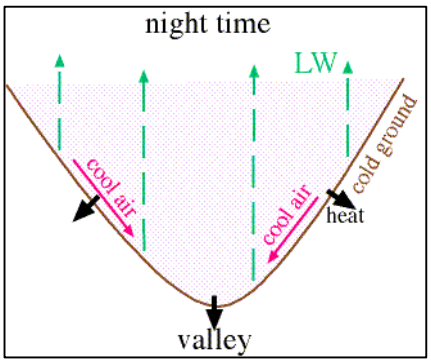

Figure 2: Formation of Valley Fog

Shown below is the Skew-T plot for Saturday, October 1st at 00Z, which corresponds to approximately 6:00AM MST. The sounding data is gathered by a via a weather balloon launched from Denver, CO and while this data is not ideal for identifying weather patterns in the mountains, it was the closest stations that day. Based on the information present in the Skew-T diagram, a CAPE value of 67 and sharply varying dew point around 7500m, the local atmosphere would be classified as unstable. However, since the radiation fog effect occurs at very low elevations (<500m) is driven much more by local temperature and topography, I doubt the Skew-T data has much of a bearing on the mechanics driving the radiation fog effect illustrated in the image.

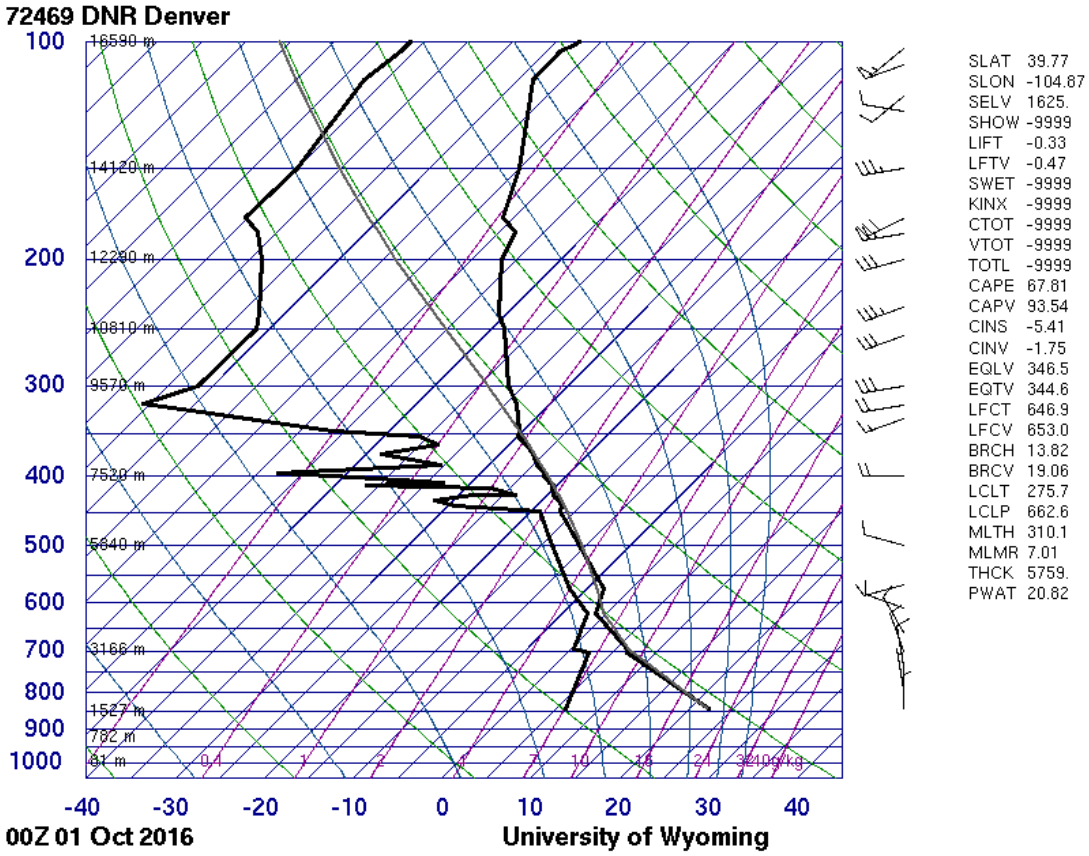

Figure 2: Skew-T Diagram for October 1st

Experimental Setup

The image was created on purely though coincidence, good fortune and keeping an eye peeled for unique cloud physics. I had originally intended to use an image that of a cloud formation hat I had captured weeks earlier and had edited and was ready for submission. After a night of camping during a chilly, fall weekend, I awoke to this amazing fog that had settled against the foothills of the mountain range as I was exiting the campsite. Luckily, I had my camera with me, from shooting scenery the previous day.

I tried to capture the formation prior to heading downhill, but the forest was too thick to capture the macro-scale aesthetic of the formation shown. Thus I elected to head downhill and stopped at a few locations during the descent to snap photos as the hills opened up and the clouds became more visible. The final stop yielded the best photographic results and most clearly illustrates the radiation fog effect, due to favorable topography in the scene captured and marginally more light as the sun continued to rise above just the horizon.

Photographic Technique

The image was shot on October 1st, 2016 in the South Park valley near Terryall, Colorado, using a Canon Rebel XTI digital DSLR camera. The following equipment and parameters were used to capture the image:

- Lens: 18-55mm Macroscopic Lens
- Shutter Speed: 1/160 Second
- Exposure Settings: ISO 400, F/9.0
- Image Resolution: Original- 3888 × 2592 pixels, Edited- 3521 × 1808 pixels
- Editing: Photoshop CS6 was utilized for post processing the image

A medium-fast shutter speed was utilized to capture the clouds shown in the image. While the clouds were stationary, the shutter speed helped to eliminate the presence of any motion blur due to unsteady hands during the shot. An aperture of f/9.0 was selected in order to capture the depth of the individual cloud formations creeping up the hills. The field of view in the original image is difficult to estimate, due to the scale, but is likely miles across.

Photoshop CS6 was used to post process the image. The resolution of the initial image was 3888 × 2592 pixels and was cropped down to 3521 × 1808 pixels to remove any distracting elements from the photo and focus on the cloud formation being illustrated. The color balance was adjusted the bring out the depth of the individual “fingers” off fog that seem to be creeping up the hills. The produced a rather blue hue to the image, thus the vibrance was reduced to bring the color spectrum back toward the grey scale. The original and post-processed images are shown below.

Original Image

Figure 3: Original Image, Unedited

Edited Image

Figure 4: Final Image, After Post Processing

Commentary

Overall I am very pleased with how this image turned out, it was a last minute substitution for a prior image, as it's aesthetic was too good to pass up. I have always found clouds very appealing; they seem to convey emotions and attitudes of their own. While some are happy, carefree others can convey a sense of sadness, anger or powerful might. The cooler tones between the clouds and the mountain topography make this image seem peaceful but also rather ominous.

Citations

1. NOAA. "NWS Fog Safety in Radiation Fog." Nation Weather Service. Accessed October 17, 2016. http://www.nws.noaa.gov/om/fog/radiation.shtml.
2. "Formation of Radiation Fog." Formation of Radiation Fog. Accessed October 17, 2016. http://apollo.lsc.vsc.edu/classes/met130/notes/chapter5/radiation_fog2.html.