Fog Density Versus Visibility

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The image below, in *Figure 1*, is a submission for the Clouds 2 assignment in the Flow Visualization course at the University of Colorado Boulder. The intent of the image was to visually display the effects that fog has on visibility. The image in *Figure 1* displays the effects of fog on visibility well due to the partially seen landscape.

Figure 1: Fog impacts on visibility

The trees in front are visible, but the ridges of the mountains behind the trees on the right can barely be seen and the whole mountain face cannot be seen. In otherwise clear conditions the mountain is fully visible, but not in the fog. Fog is a low-lying cloud, which means that fog and clouds are made of the same thing; water particles and ice crystals. These particles make it hard to see any great length of distance because of the amount of particles in the air, otherwise known as the fog's density. As the density of the fog increases, the viewer's visibility decreases.

The image in *Figure 1* was taken on the 29th of March 2013 at 7:47AM in the morning on a drive to Winter Park, Colorado. It was taken on highway 40 towards Winter Park near the top of the pass with an elevation of 10,224 ft [1]. The approximate latitude and longitude coordinates of where the image was taken are: 39.837° N, -105.761° E [2]. During the capturing of the image, the camera was facing NNE and had little to no tilt with respect to the ground.

As previously stated, fog is just a low-lying cloud. It is actually a type of stratus cloud. Stratus clouds are uniform gray clouds that usually cover a large area [3]. The sky was gray all morning and later that day, about 2 hours later, the fog broke up and there were blue skies with no breeze. The next few days were breezy with winds in the 15-20 mph range from the West. In *Figure 2*, the skew-T diagram can be seen for the date the image was taken, but nearly two hours earlier at 6:00AM. Keeping in mind that Denver, Colorado is about 50 miles from Winter Park, Colorado, this particular skew-T plot won't be a very accurate depiction of the

atmospheric conditions in Winter Park, Colorado. The convective available potential energy (CAPE) number displayed in *Figure 2* indicates whether the atmosphere is stable. On the day the image was taken, the CAPE was 0.00 which indicative of a stable atmosphere.

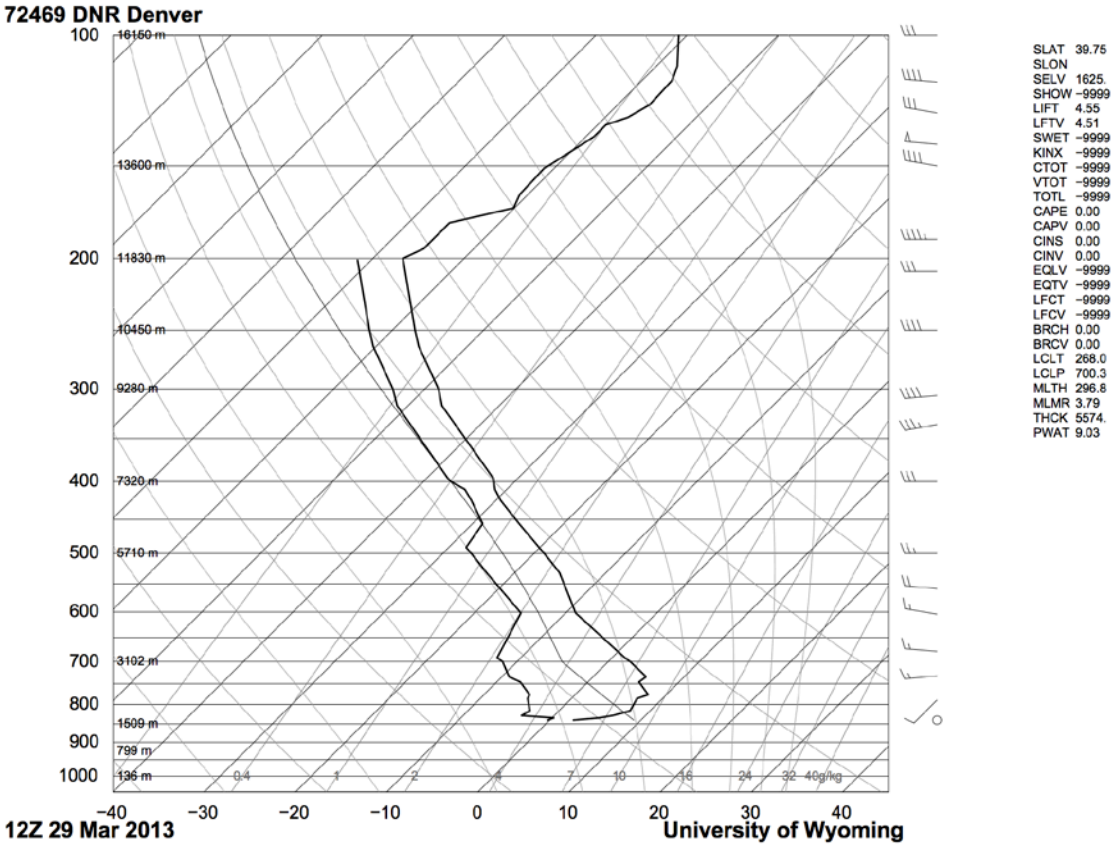

Figure 2: Skew-T diagram for 6:00AM on March 29th, 2013 [4]

Photographic Technique

The following are the parameters used in the creation of this image.

- Type of camera: Nikon COOLPIX S4300
- Focal length: 4.6 mm
- Aperture: f/3.5
- Shutter speed: 1/1250s
- ISO: 80
- Final image size: 3127 x 1139 pixels
- Original image size: 4608 x 3456 pixels
- Field of view: 50 ft x 20 feet (w.r.t. the trees)
- Distance from object to lens: ~ 40 ft (w.r.t. the trees)

The focal length, aperture and shutter speed are automatic on the Nikon COOLPIX S4300 and not user controlled. However, the ISO can be controlled. Since the fog

was a light grayish color there was a lot of light available for the camera. Because of this, a low ISO was chosen to ultimately reduce noise/graininess of the image and to create a smoother image. The original image can be seen to right. The field of view and distance to object is hard to quantify in the case of this image. The visibility makes it hard to judge how far the mountain ridges are from the camera lens and the distance of the mountains in the background, so the image's field of view and object distance is with respect to the trees near the bottom of the image. To obtain the final image seen in *Figure 1*, some post processing of the image was done. The original image can be viewed in *Figure 3*. The brightness of the image was enhanced to make the gray lighter and give the image a lighter tone. The final image is a cropped version of the original. Cropping was done to the image to give it a better composition, which the tall tree on the left balances nicely with the faded mountain ridges on the right.

Figure 3: Original Image

The image reveals the effects of fog on visibility. I like the composition of the image and the monotone colors in it. I dislike the resolution on the image, I feel like a camera that can choose the aperture can be set to have it be smaller so as to allow a greater depth of field in the image. The fluid physics are well displayed in the image. I would like to expand this idea into mathematical terms and define visibility in terms of percentage able to be seen clearly at specified distances and relate that to

the density of the fog. With this topic of fog, there's a lot of ways to get creative and expand on this idea in trying to capture fog. A city block with fog would be a nice way to capture this effect so it can be displayed. Also, taking a picture from above a city with fog upon it would be another way to display the effect well, especially if tall city buildings are poking up out of the fog.

Sources:

[1] Google Maps. "Daft Logic." *Google Maps Find Altitude*. Draft Logic, n.d. Web. <http://www.daftlogic.com/sandbox-google-maps-find-altitude.htm>.

[2] ITouchMap. "Latitude and Longitude of a Point." *ITouchMap*. Google, n.d. Web. <http://itouchmap.com/latlong.html>

[3] Web Weather. "Stratus Clouds." *Stratus Clouds*. Cloud Science, n.d. Web. <http://eo.ucar.edu/webweather/stratus.html>.

[4] University of Wyoming. "Department of Atmospheric Science." *Weather*. College of Engineering, n.d. Web. <http://weather.uwyo.edu/cgibin/sounding?region =naconf>.