

# Clouds First Image Assignment

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Flow Visualization - Professor Jean Hertzberg

10/19/2016

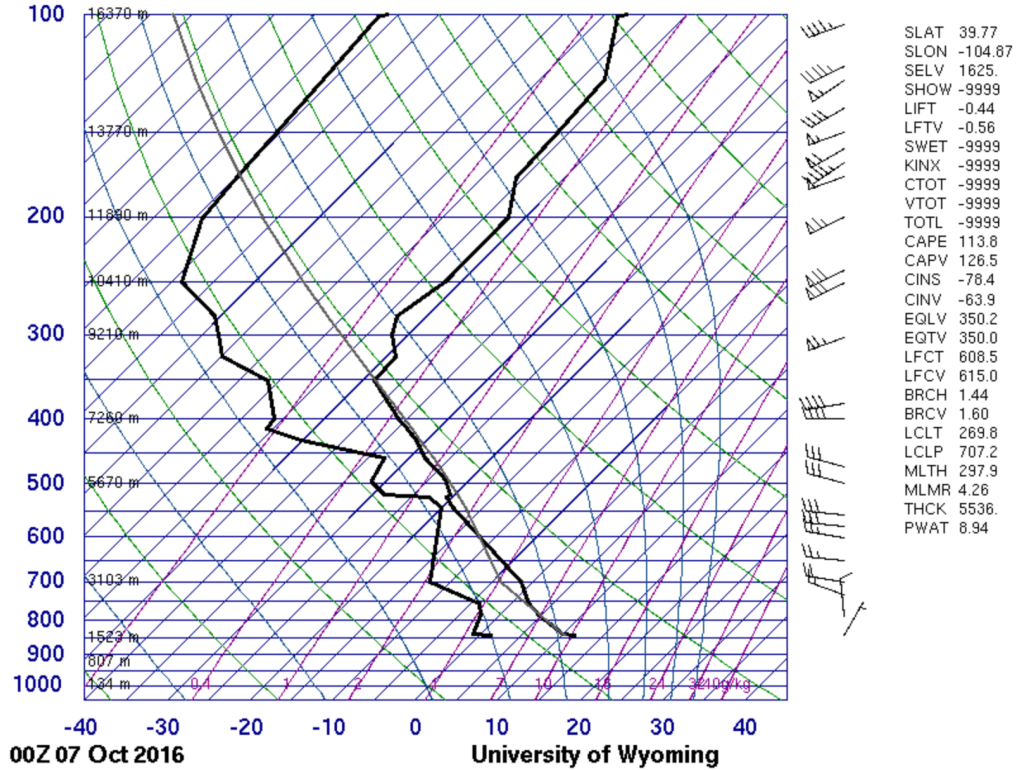


The storm depicted above represents a the result of an unstable atmosphere on the evening of October 7th, 2016. The image was taken for the Cloud Image First Report, and the purpose was to capture unusual phenomenon in cloud appearance and identify the physics that governs it. Shown above is a cumulonimbus cloud that spans an altitude of roughly 50,000 feet. Though the storm was not active at the moment, rain was apparent within the hour. The intent was to get a beautiful cumulonimbus cloud that reaches maximum height in the atmosphere.

The image was shot at 6:30 p.m. at an altitude of 6,000 ft facing directly East from the Sanitas Trail in Boulder, CO. The camera was approximately angled down at 10 degrees from horizontal.

The Clouds seen in the image are mostly cumulonimbus, accompanied by smaller cumulus clouds at lower elevation. The classic anvil shape hidden behind the cumulus clouds suggests this is a cumulonimbus capillatus cloud. These types of clouds can produce lightning and hail. The weather data supports this hypothesis because the the Skew-T diagram from Denver International Airport recorded a cape of 113.8 (shown below), which is a measure of instability in the atmosphere. The number suggests that the atmosphere was trying to stabilize its weather patterns, creating this chaotic, cumulonimbus cloud. The front was moving away from the viewer (from West to East), but since it was later in the evening, the storm was at an inactive state and in the process of breaking down. The clouds were similar the day before, but also mostly inactive for the duration of the evening. Light winds also accompanied the storm from West to East as the front moved through the city.

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The field of view in the image was approximately 270,000 ft wide by 180,000 ft tall. The height of the Cumulonimbus clouds reached about 50,000 ft. The image was shot using a Canon EOS Digital Rebel XS at f/9 and ISO of 200. It was shot at 1/125 second with a 45mm lens. The original resolution was 4272 x 2848, but it was cropped to 4137 x 2758 pixels after post-processing. The before and after images are shown below.



Post-processing includes bringing up the exposure and contrast within Adobe Lightroom, and increasing shadows and clarity in Adobe Photoshop. Color was further enhanced by increasing the vibrance levels.

The physics in the image is well represented by the cumulonimbus clouds. The instability shows the powerful change in weather and the effects of cooler air from the Rocky Mountains mixing with warmer, moist air from the East. It is interesting to see the soft, consistent clouds at the maximum height in the atmosphere. They begin to level off at a certain height due to the stability of the air once densities start to equal out. This effect is simply represented by buoyancy forces in the atmosphere. I believe this image is particularly interesting because it shows the entire span of a cumulonimbus cloud within every layer of the atmosphere.

## **Cited Sources**

"Cloud Types." UCAR Center for Science Education. UCAR, 2012. Web. 16 Oct. 2016.

"Google Maps Find Altitude." Daft Logic. N.p., n.d. Web. 16 Oct. 2016.